

NITROGEN, PHOSPHORUS, AND SUSPENDED-SEDIMENT LOADS AND TRENDS

Long- (1985-2022) + Short-term (2013-2022)

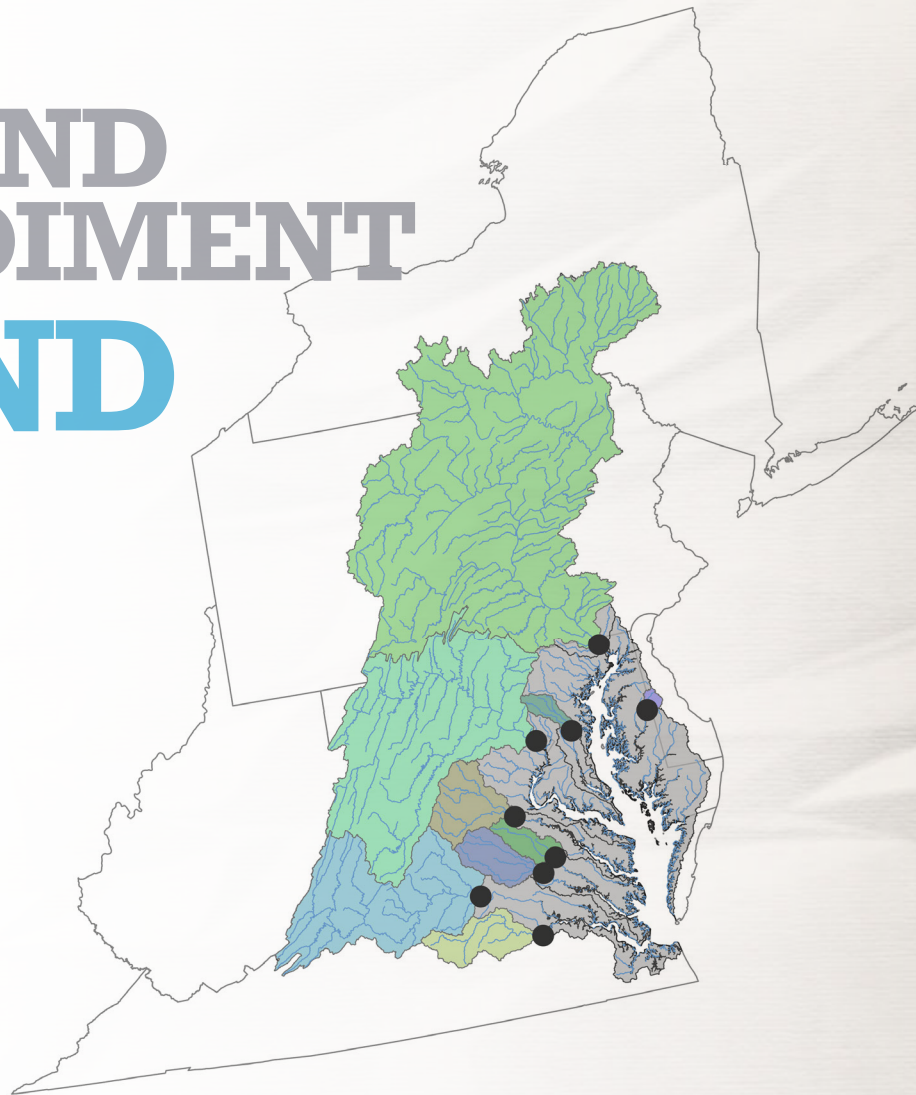
Measured at the River Input Monitoring Stations

NTNWG 10/18/2023

Chris Mason | camason@usgs.gov

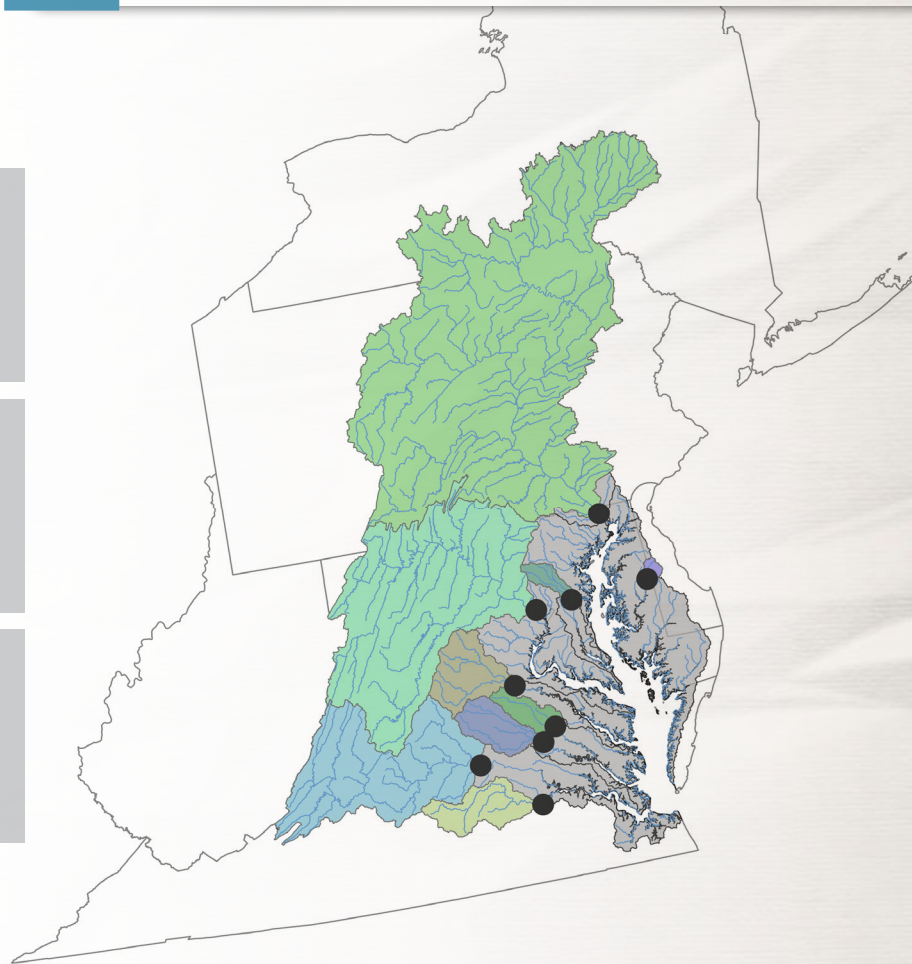
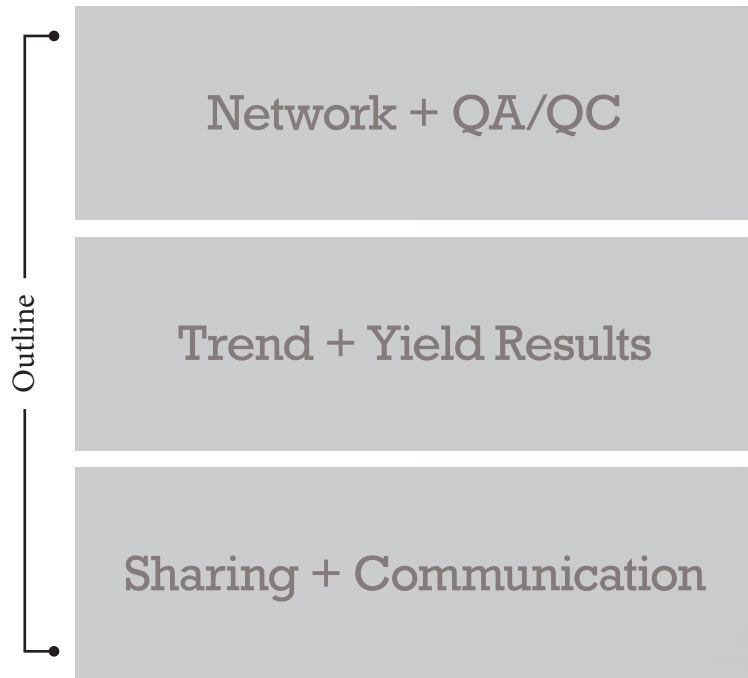
United States Geological Survey

Virginia-West Virginia Water Science Center



OBJECTIVE

Summarize results of updated long- and short-term RIM monitoring data that describe how nutrient and sediment loads, and trends in loads, have changed over time



The Chesapeake Bay Nontidal Network (NTN) and River Input Monitoring (RIM) Network

Computing loads and trends of total nitrogen (TN), total phosphorus (TP), and suspended sediment (SS) in nontidal rivers of the Chesapeake Bay watershed (CBW).

EXPLANATION

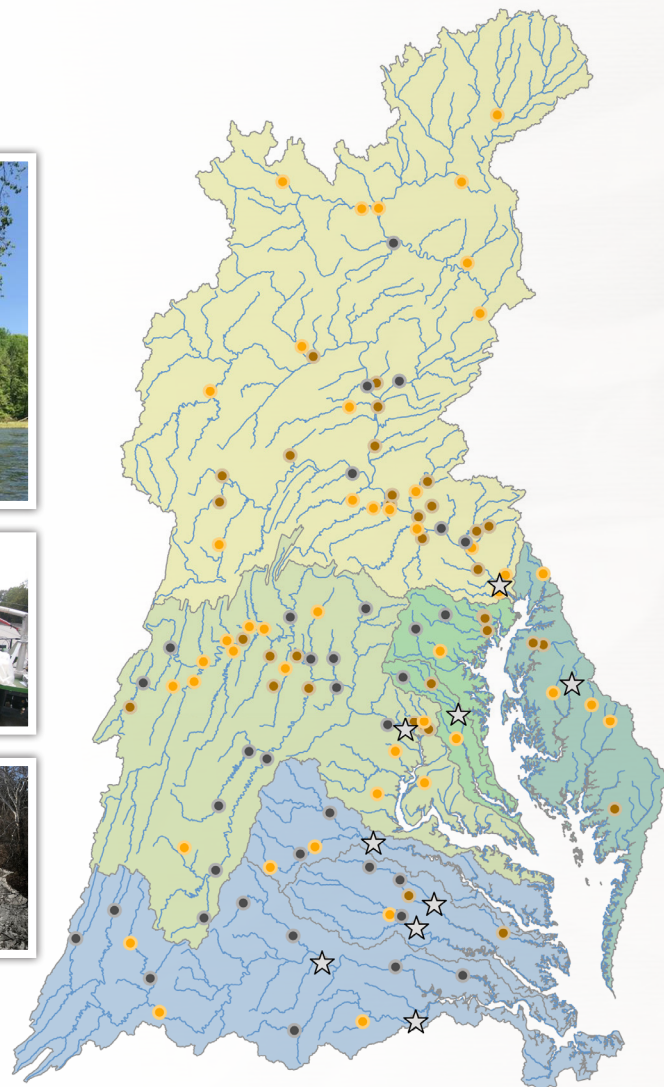
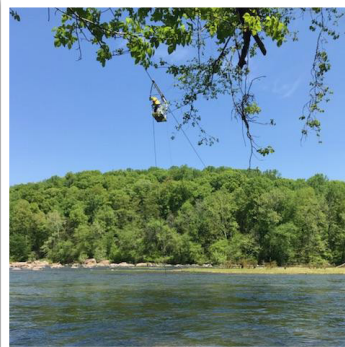
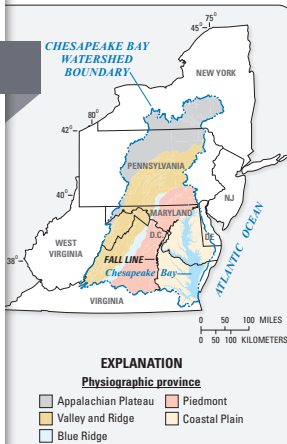
NTN status through water year 2020

- ☆ RIM site
- Long-term site
- Short-term site
- Load-only site
- Streams

Major Basins

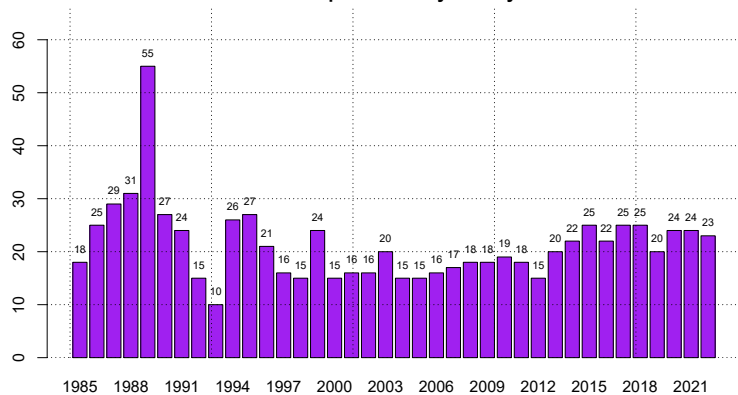
- Eastern Shore
- Potomac
- Susquehanna
- Virginia
- Western Shore

Load is the amount of nutrients or sediment in a river during a period of time (≥ 5 years of data needed). Trend is the change in load over multiple years (≥ 10 years of data needed).

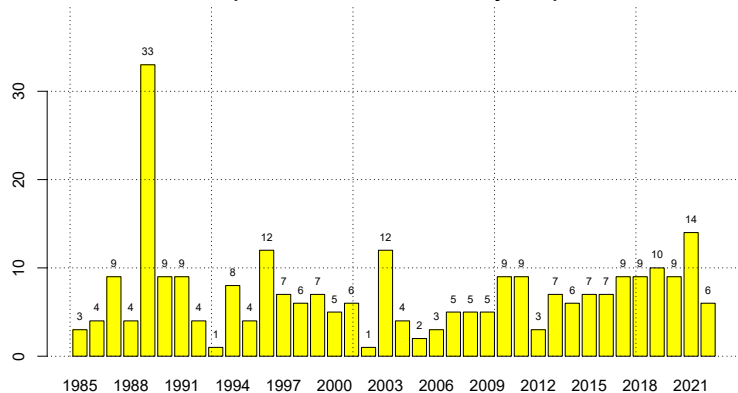


Example of Discrete Sampling Summaries

Total sample counts by water year

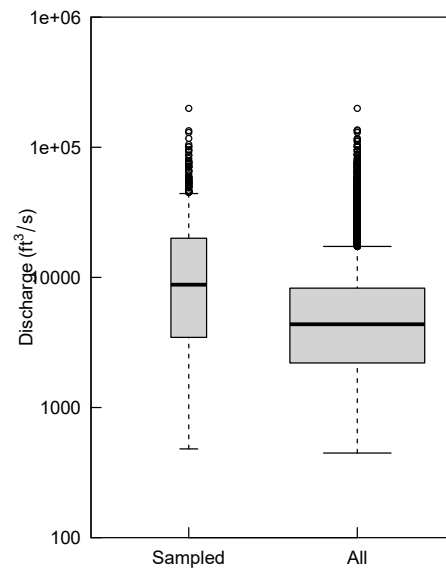
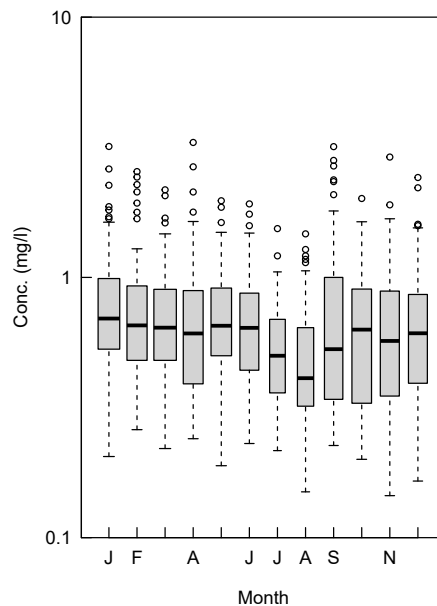


Total samples collected above 85th daily flow percentile



WRTDS uses observed data: over 180 water quality samples are collected throughout the RIM network each year.

The RIM network is a collaborative effort between the USGS, EPA, and agencies in Chesapeake Bay states (MD DNR, VA DEQ, and more).



Load and trend results have been computed through 2022 to provide timely information available for decision making

Load is a measure of

the total amount of nutrients or sediment that is mobilized in a given time period (monthly, annually, ...). Important for understanding receiving water response

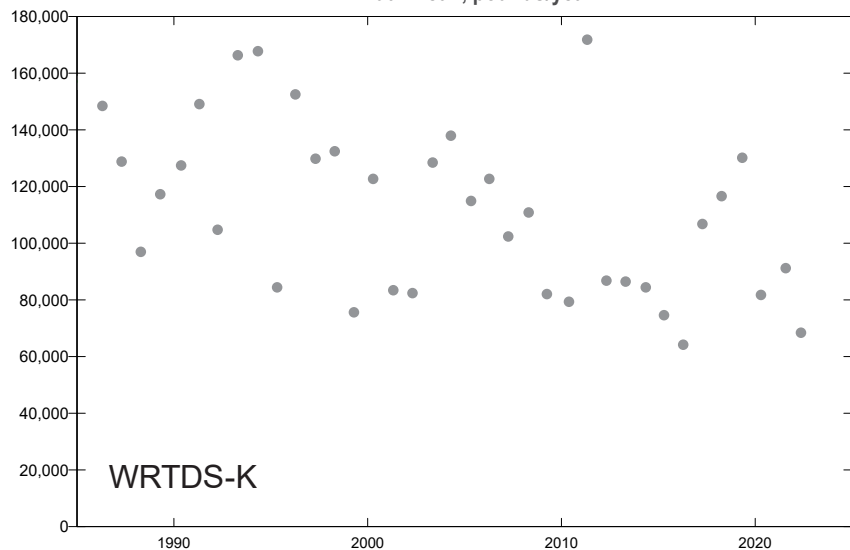
Flow-normalized (FN) loads remove

most of the hydrologic variability associated with loads. Important for understanding water-quality responses to watershed changes

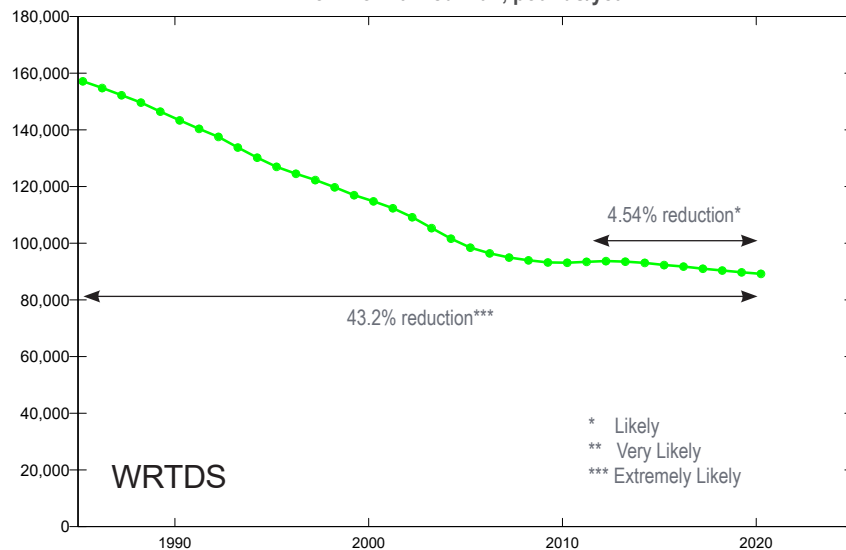
A trend is reported when

the likelihood estimate of a trend existing is greater than 0.67 after at most 100 bootstrap re-samples and a 90% confidence interval

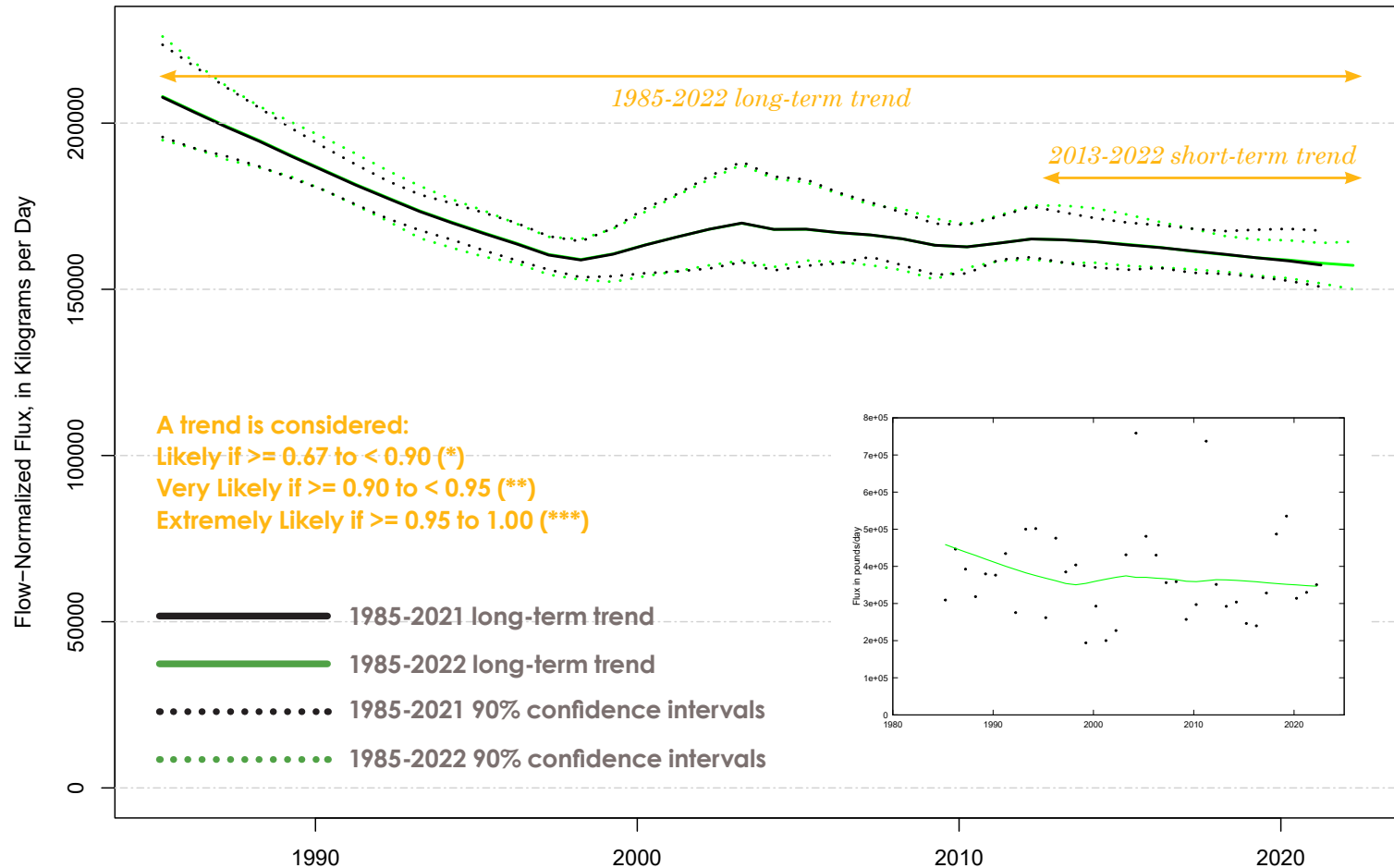
RIM River Example, Total Nitrogen
Annual mean, pounds/year



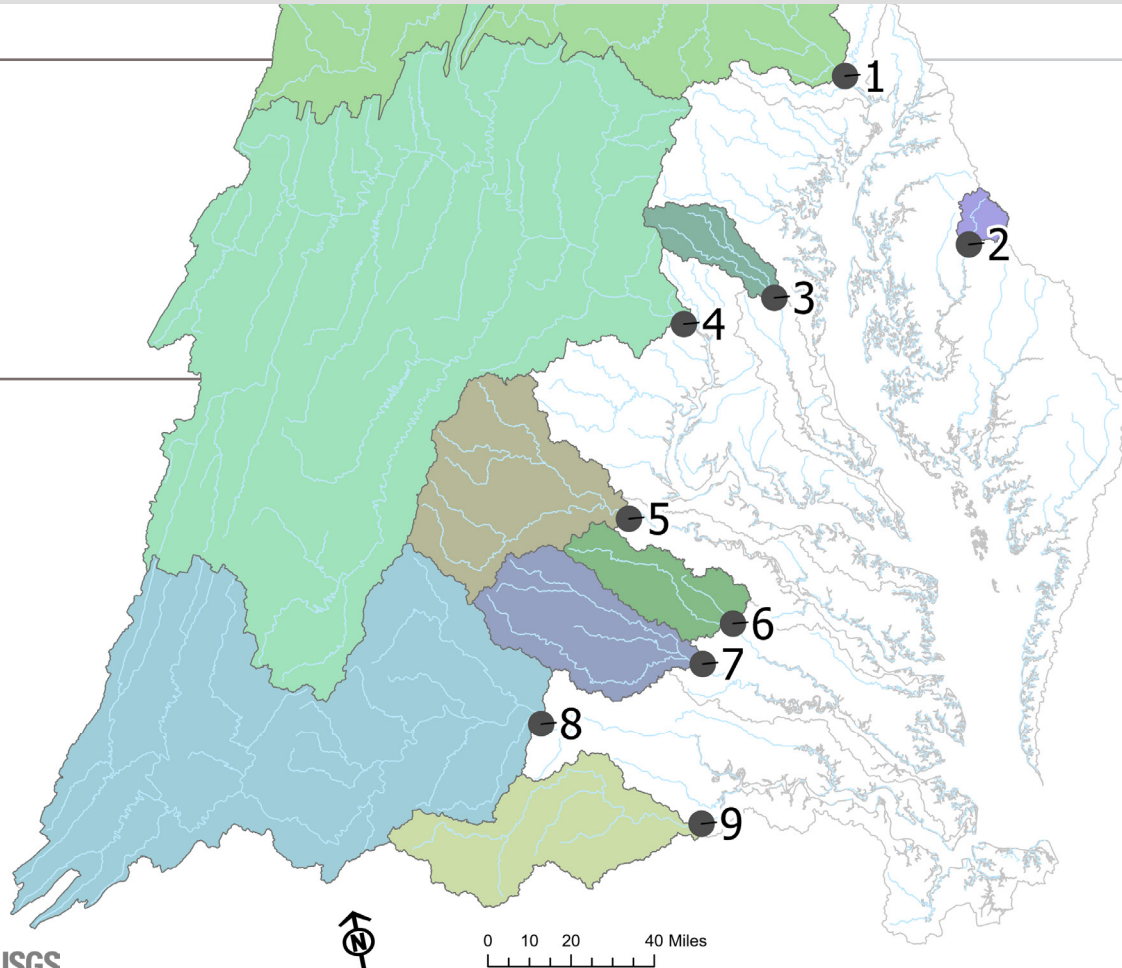
RIM River Example, Total Nitrogen
Flow-normalized Flux, pounds/year



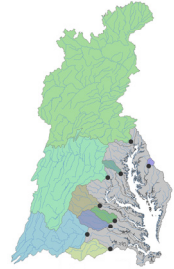
WRTDS Methods + QA/QC



RIM Network Basins + Stations

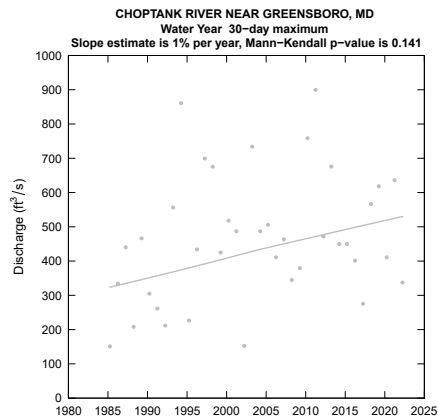
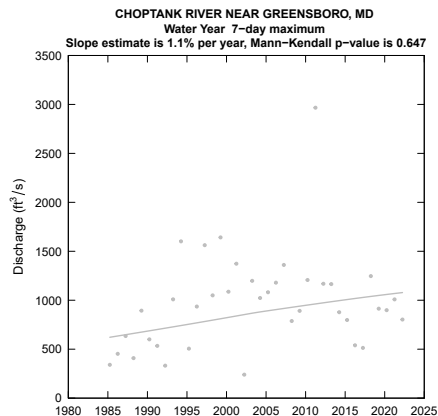
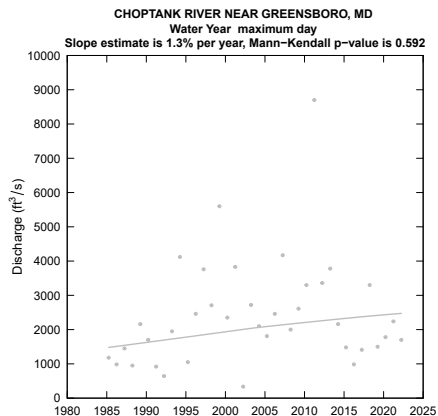
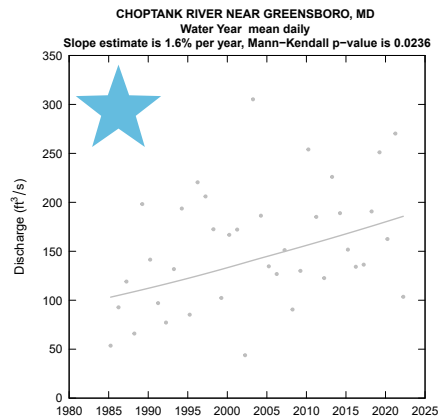
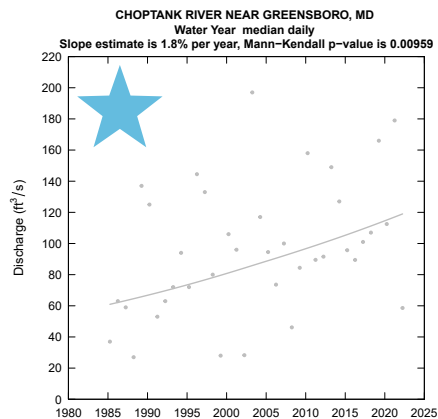
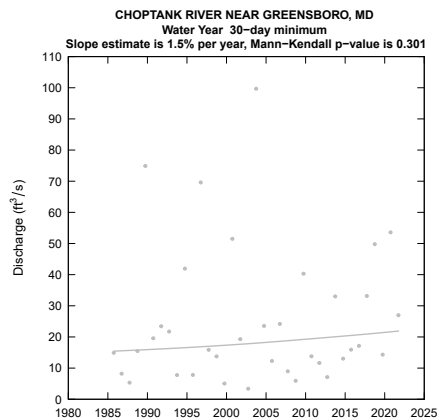
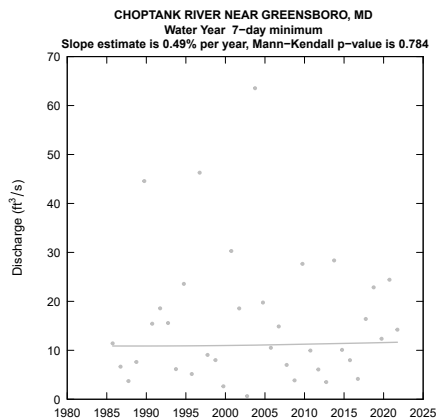
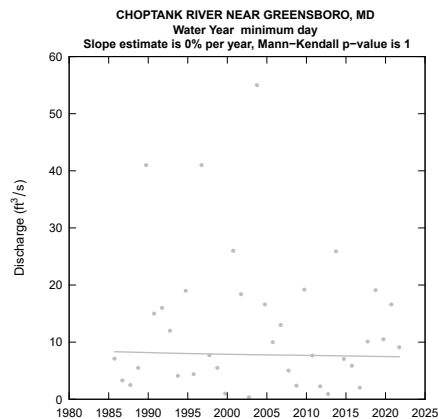


~78%
of CBW



1. Susquehanna River at Conowingo, MD {701,620 km²}
2. Choptank River near Greensboro, MD {292 km²}
3. Patuxent River near Bowie, MD {906 km²}
4. Potomac River at Chain Bridge, DC {29,973 km²}
5. Rappahannock River near Fredericksburg, VA {4,131 km²}
6. Mattaponi River near Beulahville, VA {1,554 km²}
7. Pamunkey River near Hanover, VA {2,796 km²}
8. James River at Cartersville, VA {16,207 km²}
9. Appomattox River at Matoaca, VA {3,482 km²}

Do any sites have significant Q trends?



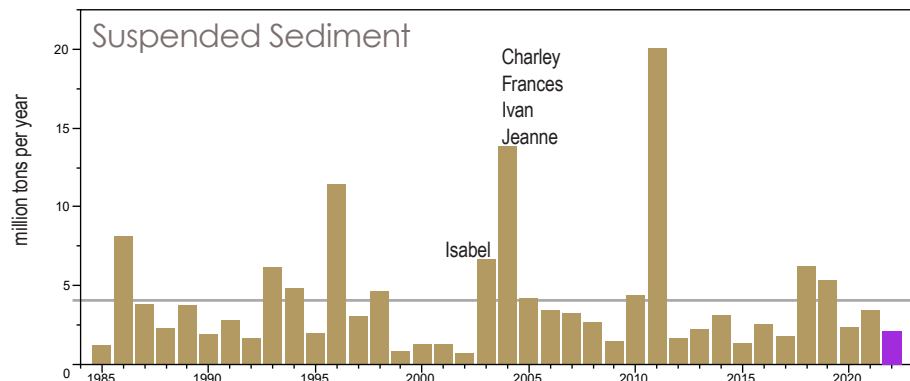
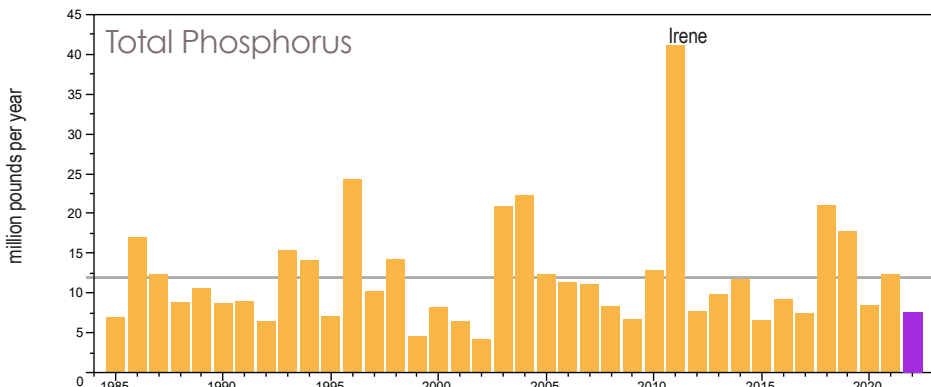
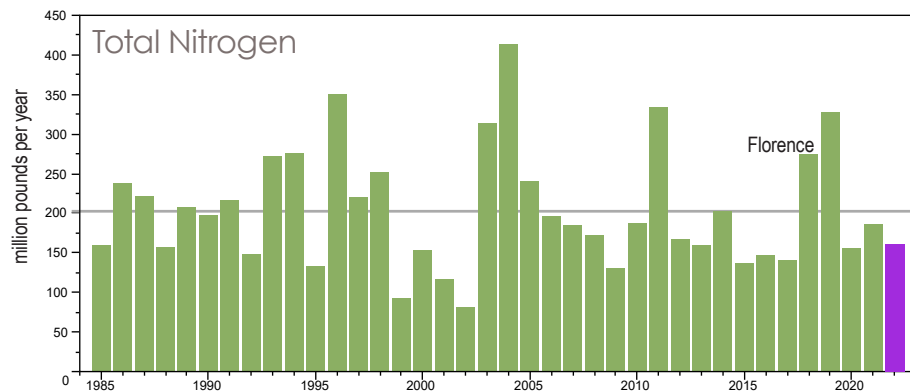
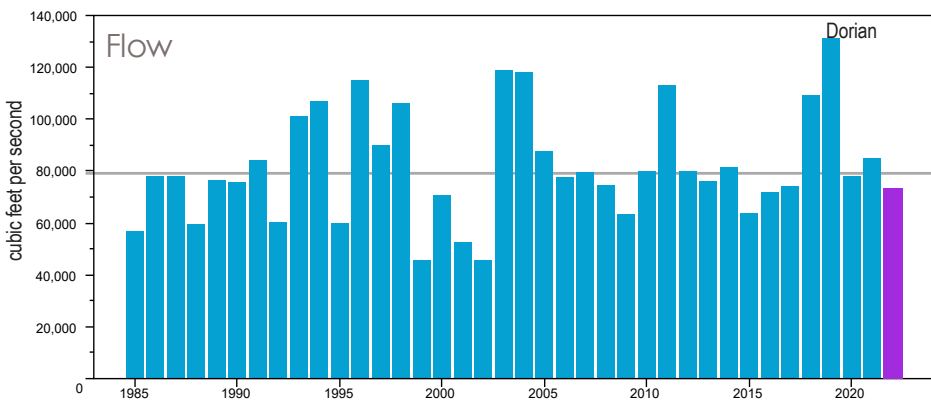
2022 delivery of freshwater flow and loads

An average flow year to the bay since 1985, 10% below long-term mean of 81,470 cubic feet per second

Total Nitrogen load for 2022 was 43 million pounds less than the long-term mean of 203

Total Phosphorus load for 2022 was 4.4 million pounds less than the long-term mean of 11.9

Total Suspended-Sediment load for 2022 was 2 million tons less than the long-term mean of 4



2022 summary of long- and short-term trends

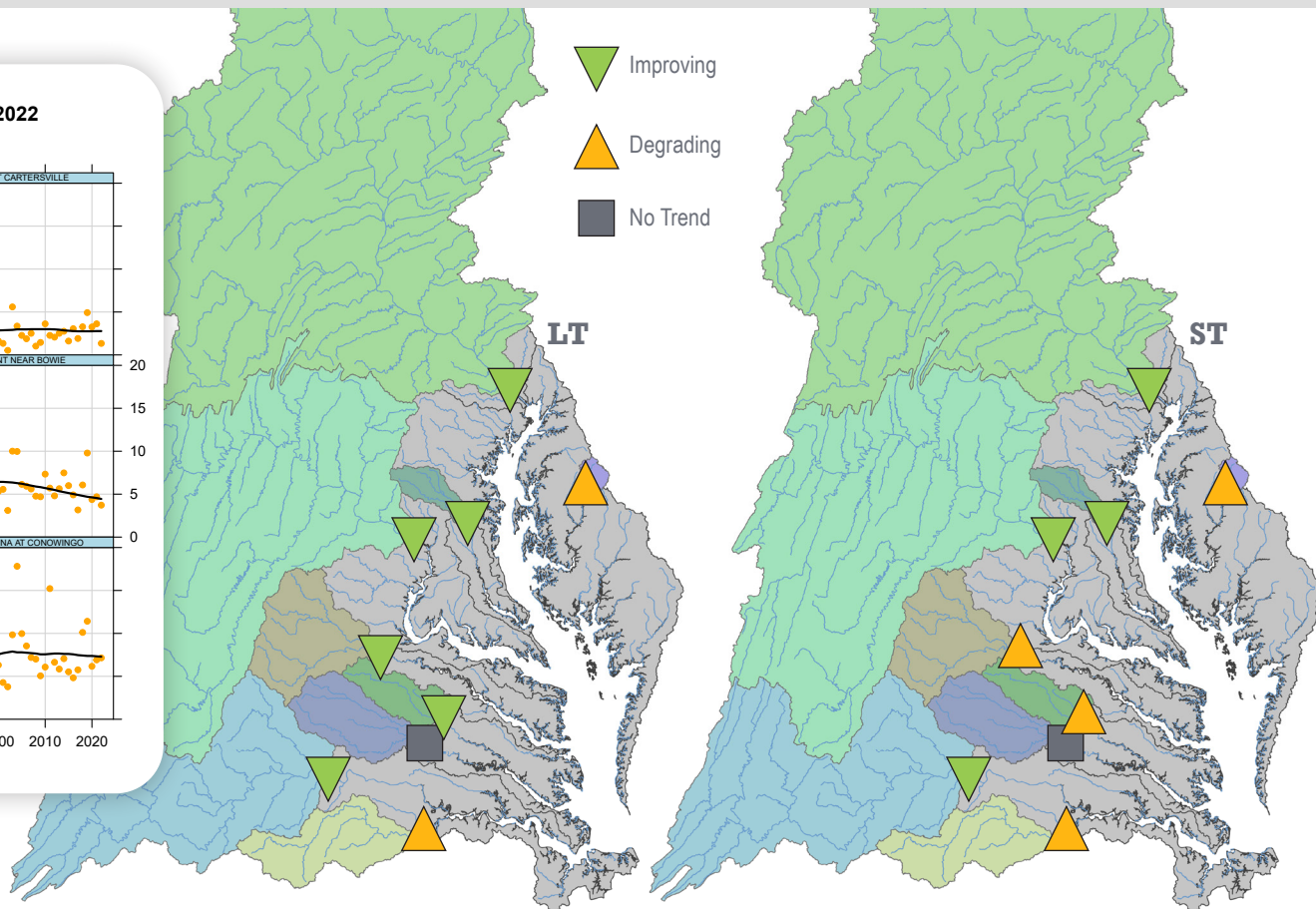
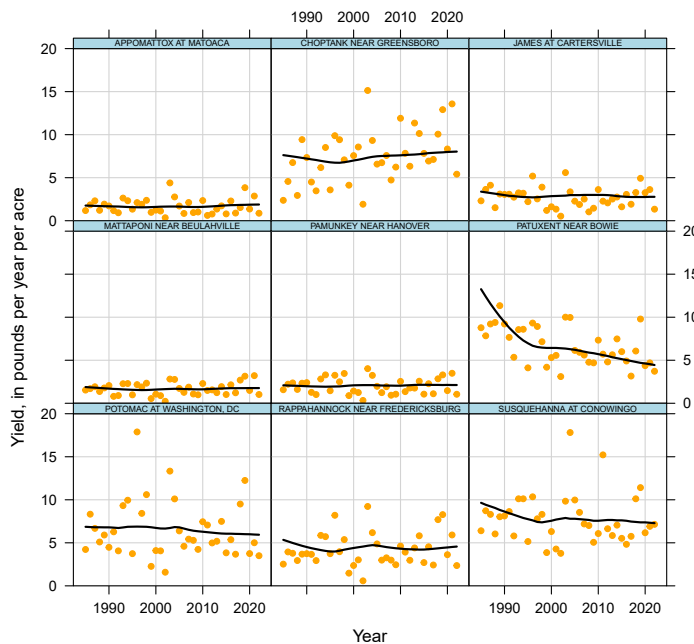
RIVER INPUT MONITORING STATION <i>Summary of long-term (1985-2022) and short-term (2013-2022) trends in nitrogen, phosphorus, and suspended- sediment loads for the River Input Monitoring stations. Improving or degrading trends classified as likelihood estimates greater than or equal to 67 percent.</i>	TOTAL NITROGEN LOAD		TOTAL PHOSPHORUS LOAD		SUSPENDED- SEDIMENT LOAD	
	Long-term	Short-term	Long-term	Short-term	Long-term	Short-term
<i>SUSQUEHANNA RIVER AT CONOWINGO, MD</i>	Improving	Improving	No Trend	Improving	Degrading	Improving
<i>POTOMAC RIVER AT CHAIN BRIDGE, MD</i>	Improving	Improving	Improving	Improving	Improving	No Trend
<i>JAMES RIVER AT CARTERSVILLE, VA</i>	Improving	Improving	Improving	No Trend•	No Trend	No Trend•
<i>RAPPAHANNOCK RIVER NEAR FREDERICKSBURG, VA</i>	Improving	Degrading	Degrading	Degrading••	Degrading	Degrading••
<i>APPOMATTOX RIVER AT MATOACA, VA</i>	Degrading	Degrading	Degrading	Degrading	Degrading	Degrading
<i>PAMUNKEY RIVER NEAR HANOVER, VA</i>	No Trend	No Trend	Degrading	No Trend•	Degrading	Improving
<i>MATTAPONI RIVER NEAR BEULAHVILLE, VA</i>	Improving	Degrading	No Trend	No Trend•	Degrading••	Degrading
<i>PATUXENT RIVER AT BOWIE, MD</i>	Improving	Improving	Improving	Improving	Improving	Improving
<i>CHOPTANK RIVER NEAR GREENSBORO, MD</i>	Degrading	Degrading	Degrading	Degrading	Improving	Degrading

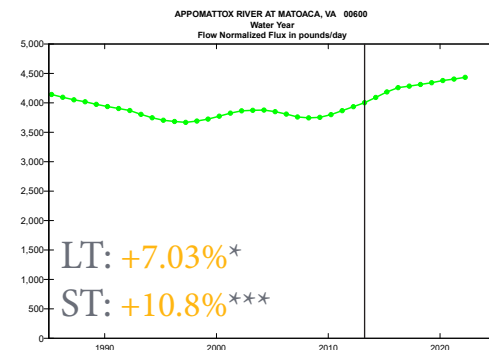
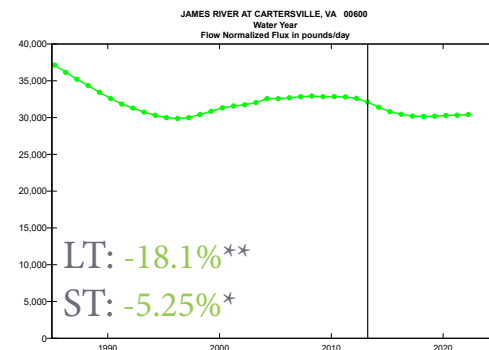
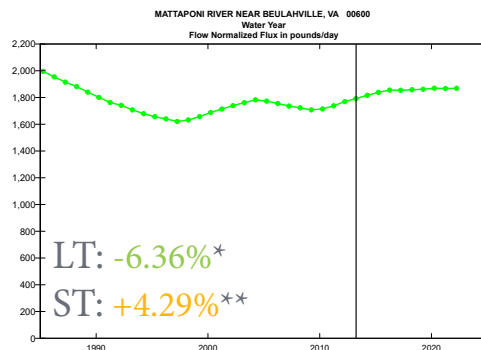
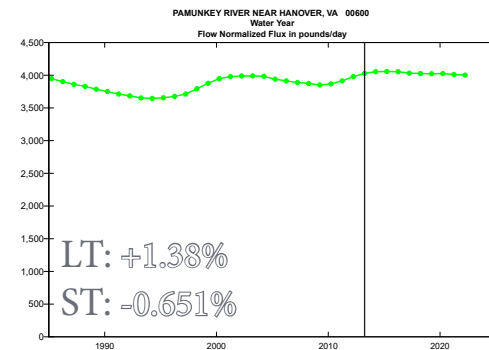
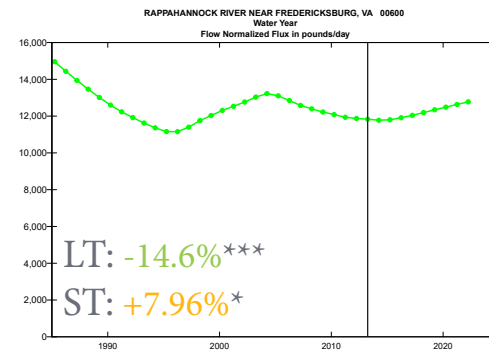
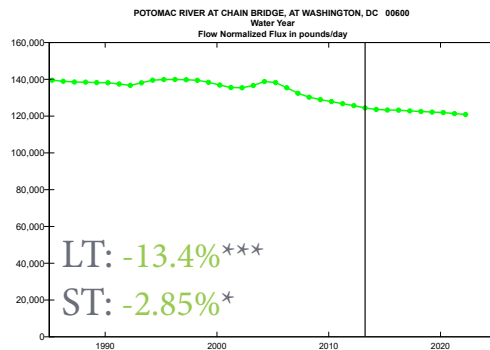
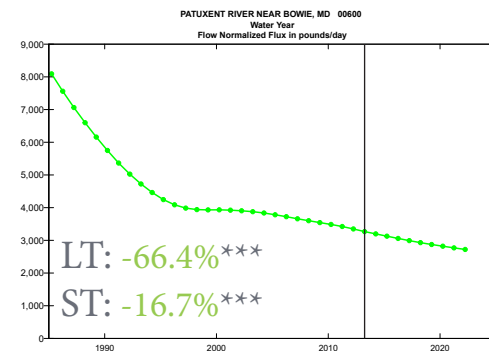
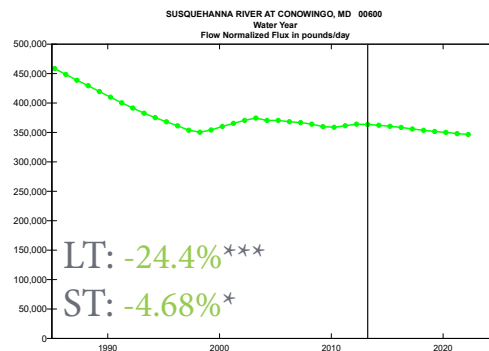
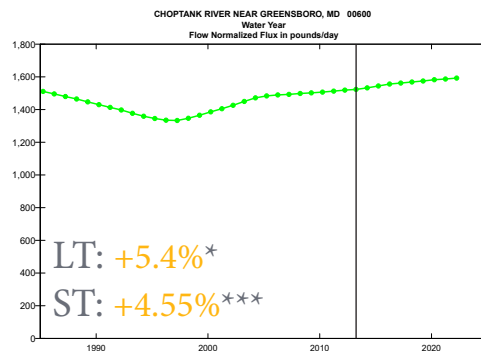


Additional markers denote change between 2021 and 2022 long-term (1985-2021 vs. 1985-2022) and 2021 and 2022 short-term (2012-2021 vs. 2013-2022) trend estimation results. A "•" marker indicates a downward/degrading shift from either (1) Improving to No Trend [•] or, (2) No Trend to Degrading [••].

Total Nitrogen Loads and Trends (1985-2022, 2013-2022)

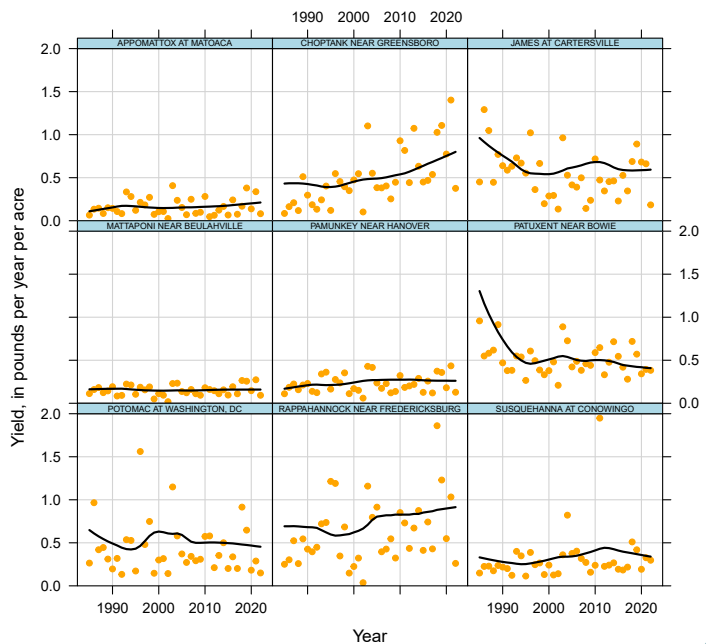
Total Nitrogen Yields at the RIM sites
Black Line is Flow-Normalized Yield, 1985-2022





Total Phosphorus Loads and Trends (1985-2022, 2013-2022)

Total Phosphorus Yields at the RIM sites
Black Line is Flow-Normalized Yield, 1985–2022



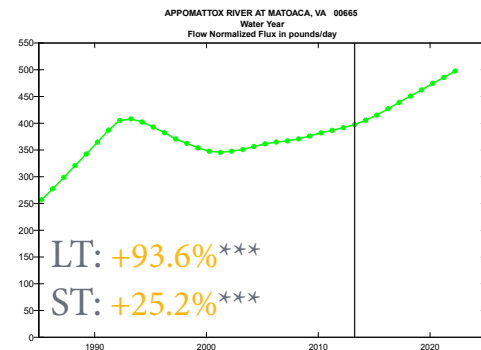
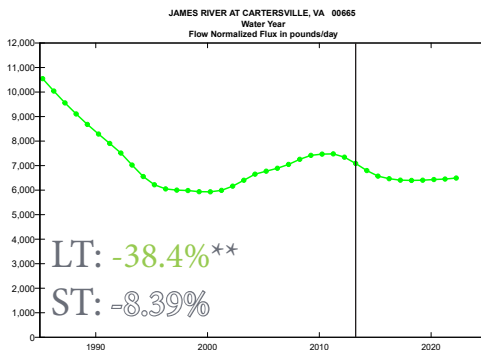
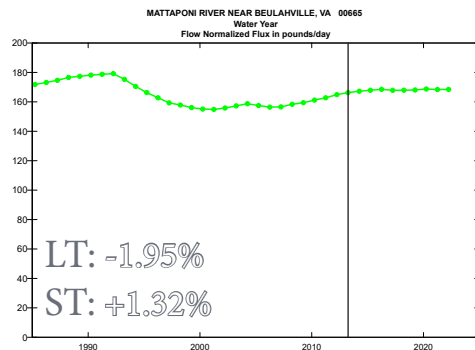
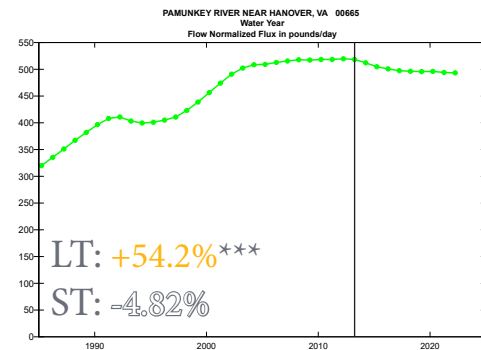
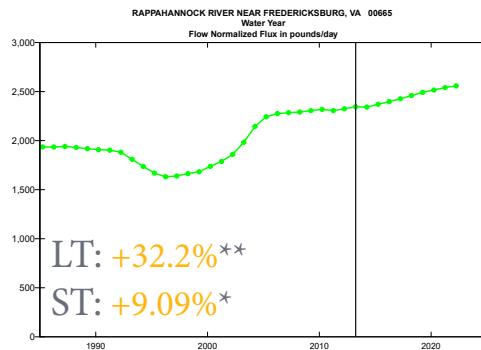
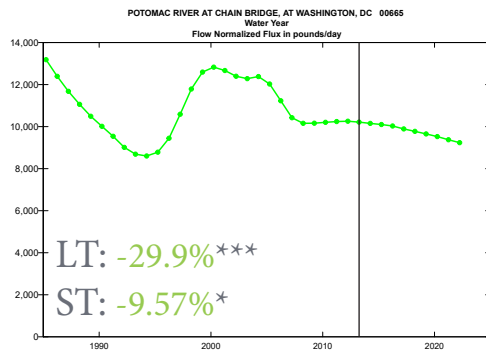
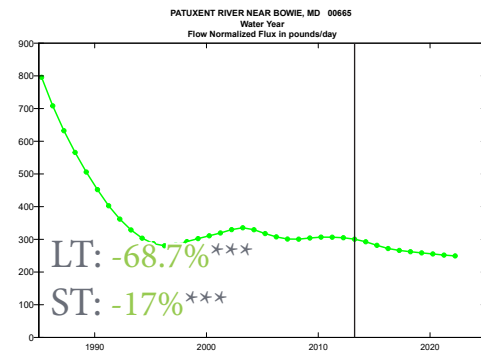
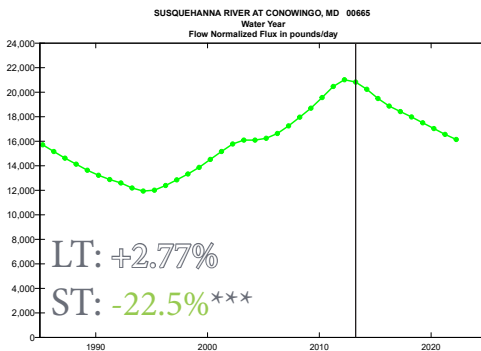
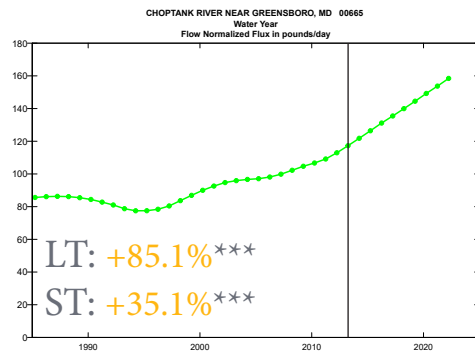
Improving

Degrading

No Trend

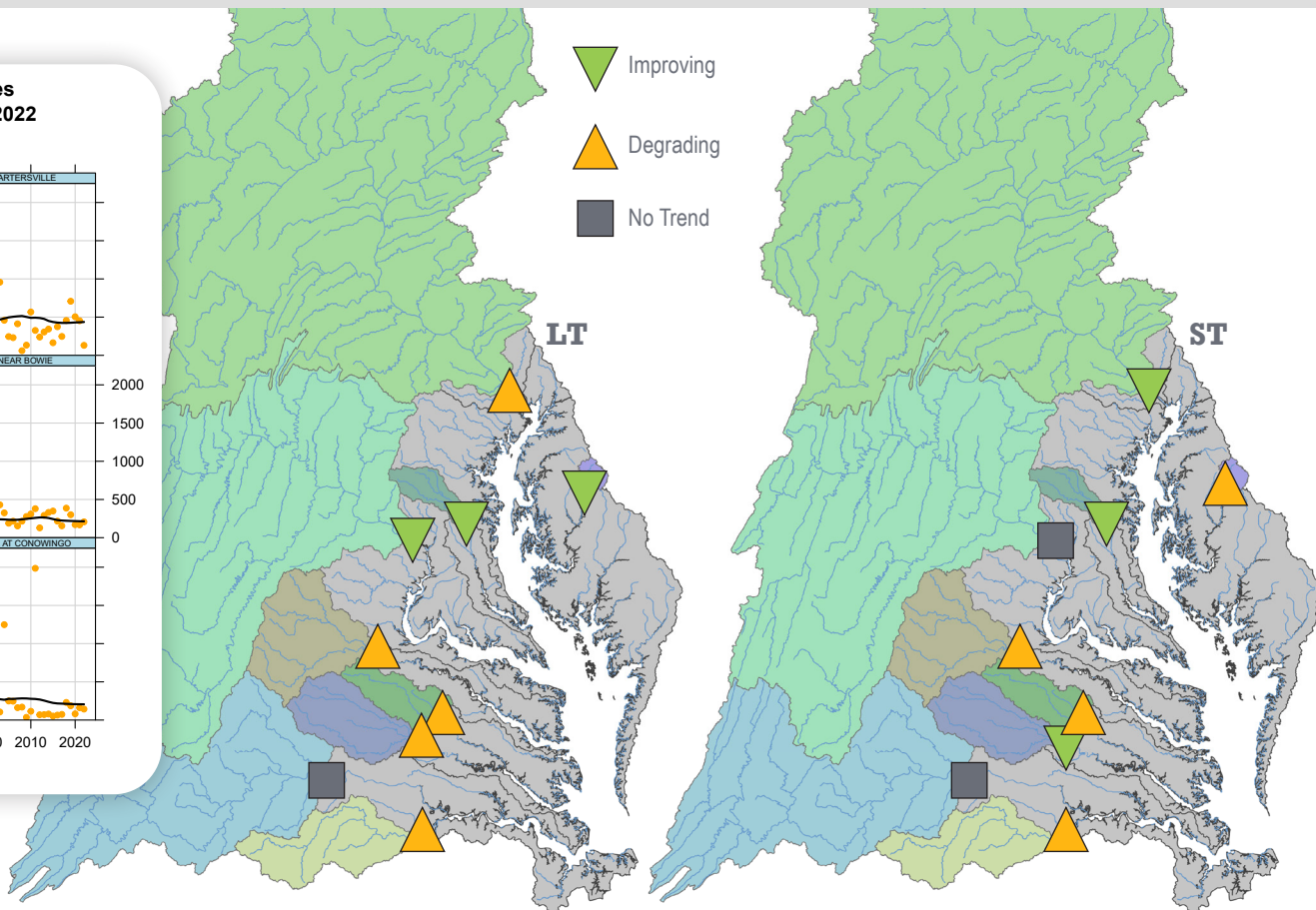
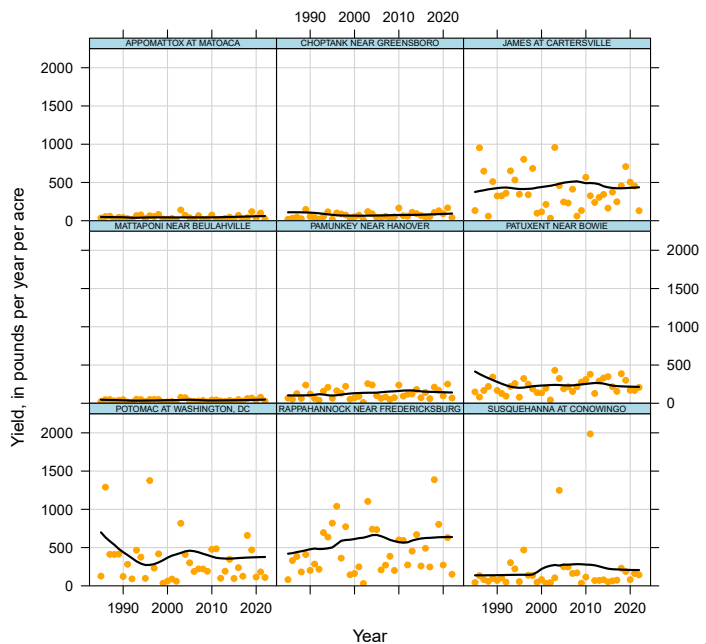
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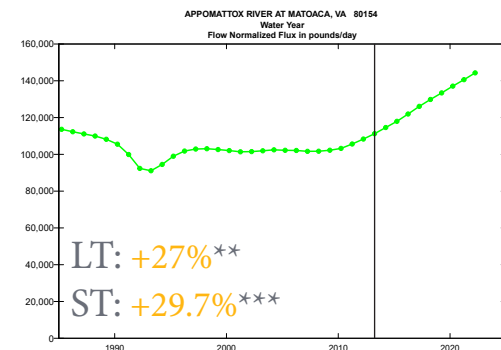
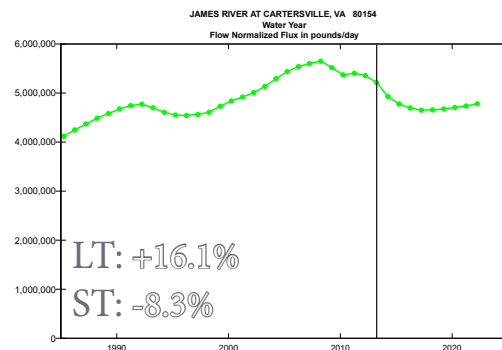
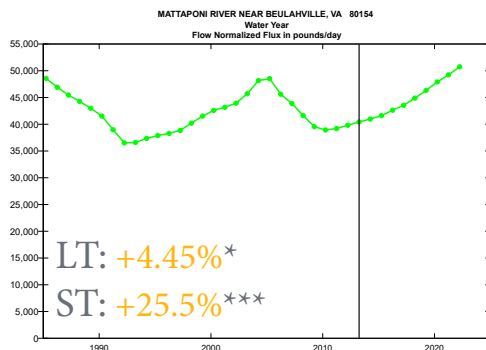
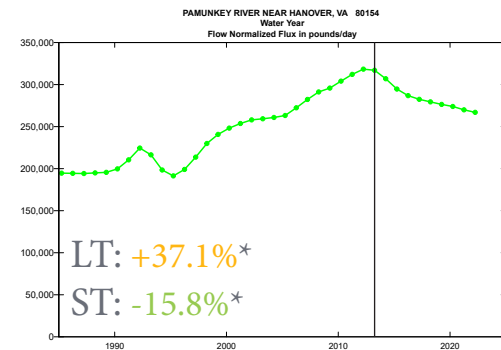
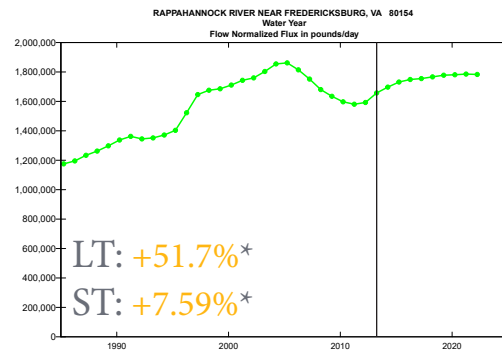
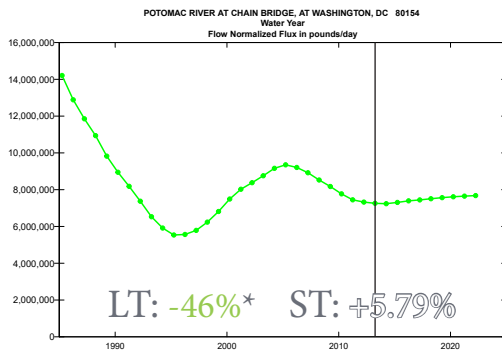
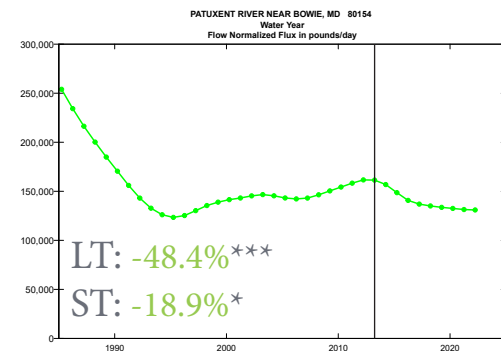
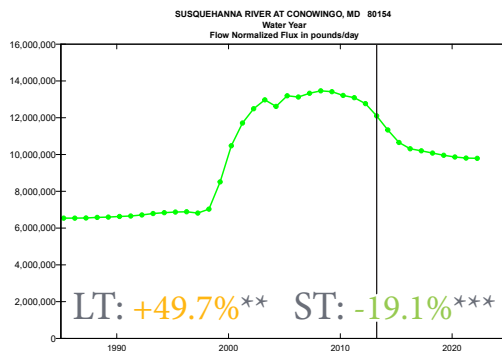
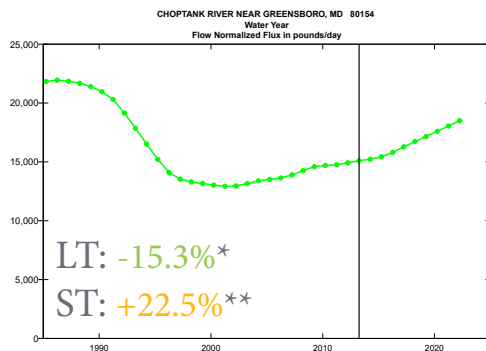
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Suspended Sediment Loads and Trends (1985-2022, 2013-2022)

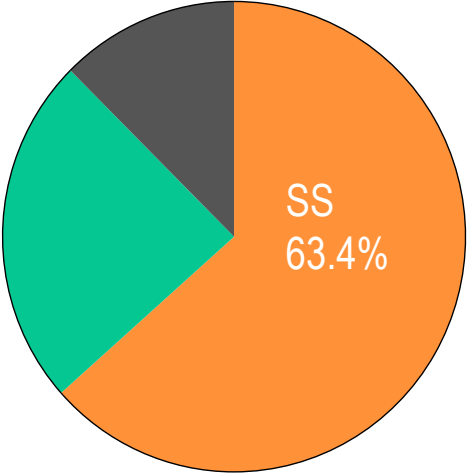
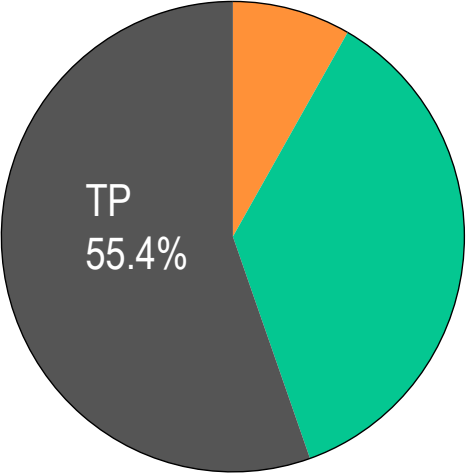
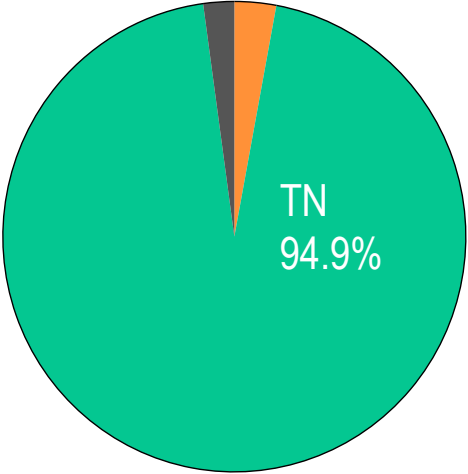
Suspended Sediment Yields at the RIM sites
Black Line is Flow-Normalized Yield, 1985–2022



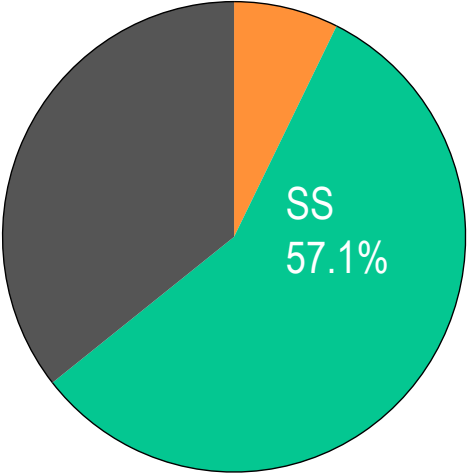
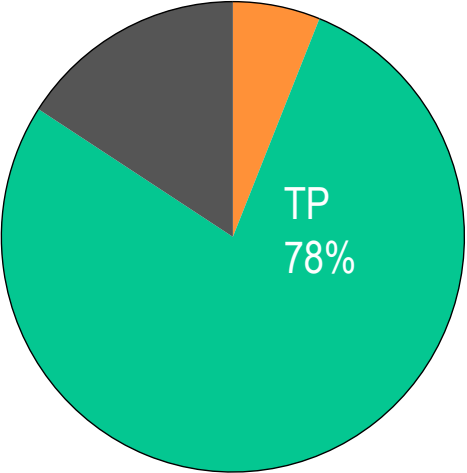
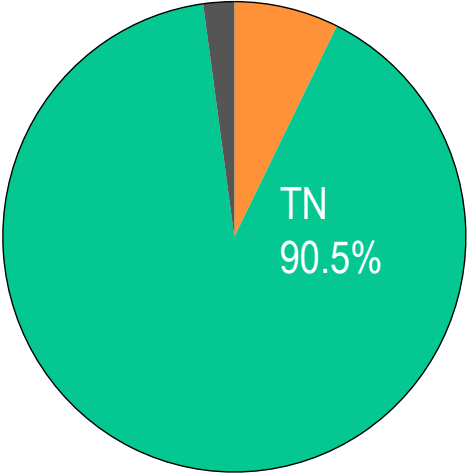


Dominant trend direction by percent of total RIM watershed

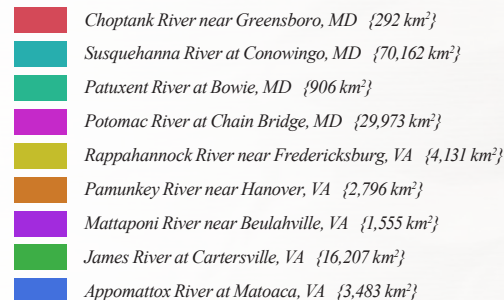
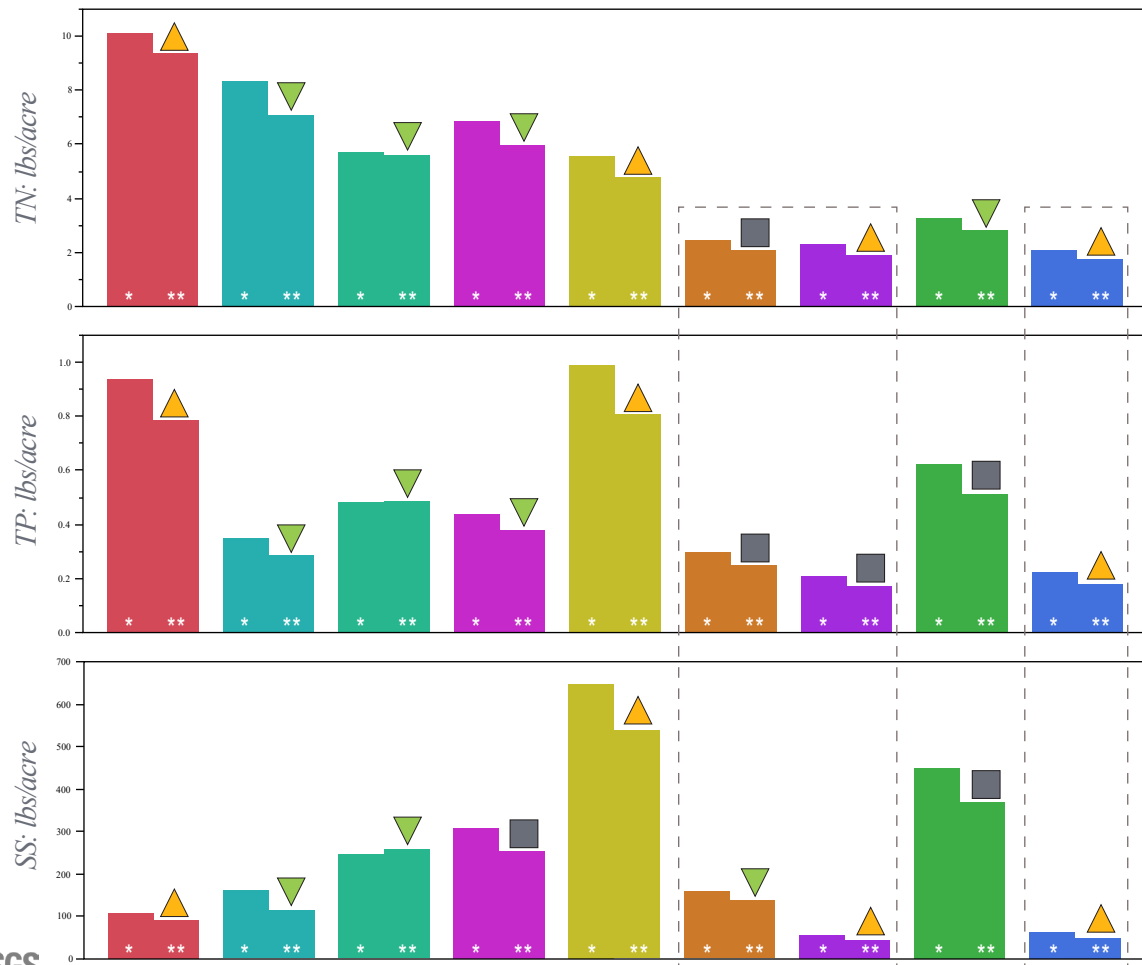
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ST



5- and 10-year Yields (2018-2022, 2013-2022)



SUMMARY

- Choptank, while the smallest drainage area (DA), has the largest TN yield and second largest TP yield
- Rappahannock, 4th largest DA, has the largest TP and SS yields
- Susquehanna, largest DA, 2nd largest TN yields
- Mattaponi (TP and SS) and Appomattox (TN) had the lowest 5- and 10-year yields with 7th and 5th largest DAs, respectively
- All sites' 5-year yields were larger than their 10-year yields, except for the Patuxent's TP and SS
- 5-year RIM network yield means: TN 5.2, TP 0.5, SS 244
- 10-year RIM network yield means: TN 4.6, TP 0.4, SS 206

* 5-year mean yield (lbs/acre) ** 10-year mean yield (lbs/acre)

ScienceBase Catalog → USGS Data Release Products → Nitrogen, phosphorus, and s...

Nitrogen, phosphorus, and suspended-sediment loads and trends measured at the Chesapeake Bay River Input Monitoring stations: Water years 1985-2022

View

Dates

Publication Date : 2023-06-13
Start Date : 1984-10-01
End Date : 2022-09-30

Citation

Mason, C.A., and Soroka, A.M., 2023. Nitrogen, phosphorus, and suspended-sediment loads and trends measured at the Chesapeake Bay River Input Monitoring stations: Water years 1985-2022: U.S. Geological Survey data release, <https://doi.org/10.5066/P97IFYES>.

Summary

Nitrogen, phosphorus, and suspended-sediment loads, and changes in loads, in major rivers across the Chesapeake Bay watershed have been calculated using monitoring data from the Chesapeake Bay River Input Monitoring (RIM) Network stations for the period 1985 through 2022. Nutrient and suspended-sediment loads and changes in loads were determined by applying a weighted regression approach called WRTDS (Weighted Regression on Time, Discharge, and Season). The load results represent the total mass of nitrogen, phosphorus, and suspended sediment that was exported from each of the RIM watersheds and were estimated using the WRTDS method with Kalman filtering. To determine the trend in loads, the annual load results are flow normalized to integrate out the year-to-year variability in river discharge. The trend in load is derived from the flow-normalized load timeseries and represents the change in load resulting from changes in sources, delays associated with storage or transport of historical inputs, and/or implemented management actions. Four data tables are provided that describe nitrogen, phosphorus, and suspended-sediment conditions across the RIM: (1) Annual Loads, (2) Monthly Loads, (3) Trends in Annual Loads, and (4) Average Yield (mass per unit area). Additionally, essential WRTDS input and output files are provided.


Child Items (6)

- Chesapeake Bay River Input Monitoring Network 1985-2022: Annual loads
- Chesapeake Bay River Input Monitoring Network 1985-2022: Average annual yields
- Chesapeake Bay River Input Monitoring Network 1985-2022: Monthly loads
- Chesapeake Bay River Input Monitoring Network 1985-2022: Short- and long-term trends
- Chesapeake Bay River Input Monitoring Network 1985-2022: WRTDS input data
- Chesapeake Bay River Input Monitoring Network 1985-2022: WRTDS output data

Contacts

Point of Contact : Christopher A. Mason
Originator : Christopher A. Mason, Alexander M. Soroka

Map



Spatial Services

ScienceBase WMS : <https://www.sciencebase.gov/catalog>

Communities

- USGS Data Release Products

Tags

Harvest Set : USGS Science Data Catalog (SDC)
Theme : Kalman filtering, WRTDS, WRTDS-K, load analysis, nitrogen, nutrients, phosphorus, rivers, suspended sediment, trends, water quality, weighted regression
Place : Chesapeake Bay Watershed, Delaware, Maryland, New York, Pennsylvania, United States, Virginia, Washington DC, West Virginia
USGS Scientific Topic Keyword : Hydrology, Water Quality, Water Resources
Types : Map Service, OGC WFS Layer, OGC WMS Layer, OGC WMS Service

Provenance

USGS data release

doi.org/10.5066/P97IFYES

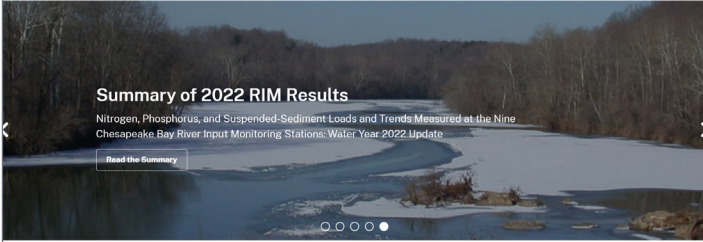
Mason, C.A. and Soroka, A.M., 2023, Nitrogen, Phosphorus, and suspended-sediment loads and trends measured at the Chesapeake Bay River Input Monitoring stations: Water years 1985-2022: U.S. Geological Survey data release, doi.org/10.5066/P97IFYES.

CHESAPEAKE BAY ACTIVITIES SCIENCE

Chesapeake Bay Water-Quality Loads and Trends

ACTIVE

By Chesapeake Bay Activities January 1, 2016



Summary of 2022 RIM Results

Nitrogen, Phosphorus, and Suspended-Sediment Loads and Trends Measured at the Nine Chesapeake Bay River Input Monitoring Stations: Water Year 2022 Update

Read the Summary


Overview Data Maps Partners

Access the most recent data gathered from the Chesapeake Bay Nontidal Monitoring Network, learn about the techniques used to collect this data, and read about the history of the Chesapeake Bay Nontidal Monitoring Program.

Nontidal Network (NTN) data refers to data from the 123 monitoring stations where nutrients and sediment are collected monthly and during storms.

River Input Monitoring (RIM) data refers to data from nine stations within the NTN network. This data is used to estimate the total amount of nutrient and sediment delivered

Study Area



USGS monitoring website

usgs.gov/CB-wq-loads-trends