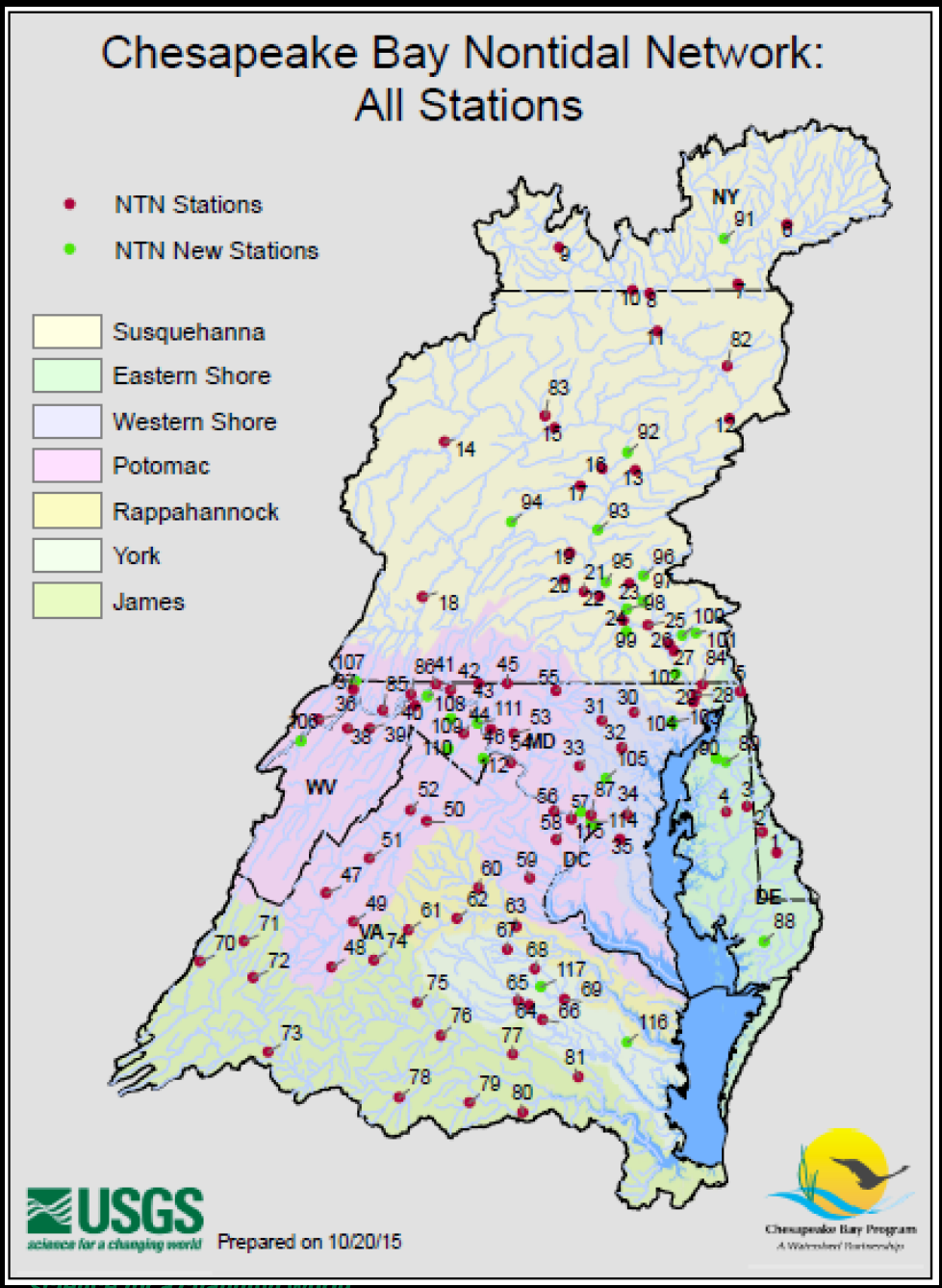
# Non-Tidal Network

## Topic: Comparison of Hydrograph and Sampling Times

Integrated Monitoring Networks Workgroup
5/18/2016

Doug Moyer, Joel Blomquist, & Mindy Ehrich

# Chesapeake Bay Nontidal Monitoring Network




## Purpose

- Collect water-quality samples using consistent methodology
- Collect water-quality samples across the full range of hydrologic conditions
- Quantify *loads* of nutrients and sediment in the nontidal rivers of the Chesapeake Bay watershed
- Estimate *trends* (changes over time) in loads to detect effects of changes in land management effects on water quality

## Monitoring Stations

- 117 monitoring stations
  - 30 with records > 30 yrs
  - 81 with records > 10 yrs
  - 6 with records 5-10 yrs
  - 30 (green on map) with records < 5 years
- Drainage areas range from 1 to 27,100 $mi^2$

# Data Collection

Discrete water quality samples, typically 12 “routine” and 8 “storm” are collected annually at or near streamflow gaging stations.

Samples are analyzed for total N, $NO_{23}$, total P, ortho-P and suspended sediment

Total samples collected across NTN = 2,340 Annually

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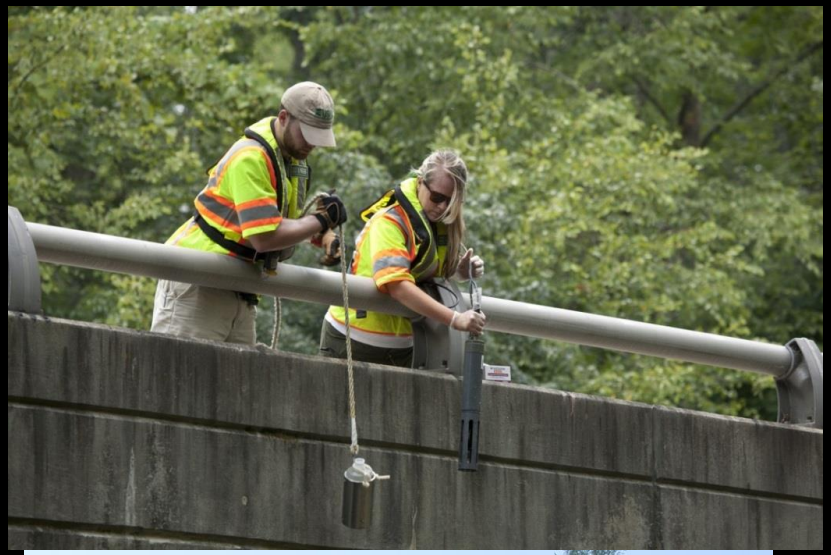
# Weighted Bottle Sampler



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## DH-81

Designed for wading isokinetic or nonisokinetic sampling *(velocity = 1.5-7.6 ft/s)*

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# DH-95

Designed for isokinetic sampling up to 15 feet

*(velocity 2.0 to 6.7 ft/s)*


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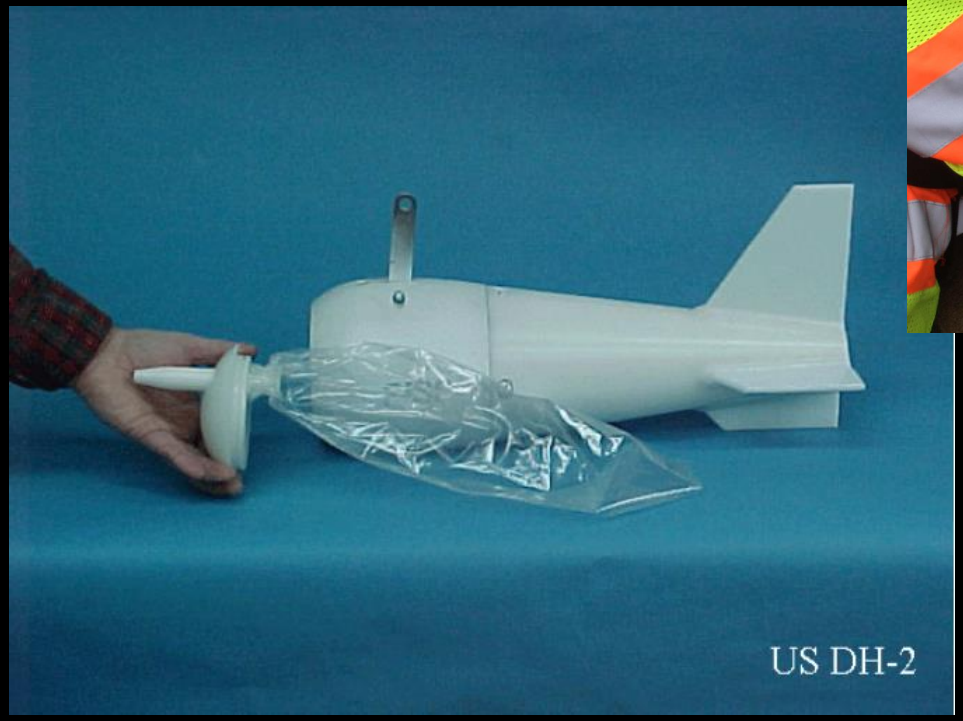
# DH-2

Designed for isokinetic sampling at depths greater than 16 feet
*(velocity 2.0 to 6.0 ft/s)*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# D-96

Designed for isokinetic sampling at depths up to 100 ft

*(velocity 1.5 to 6.0 ft/s)*

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# Sample Processing



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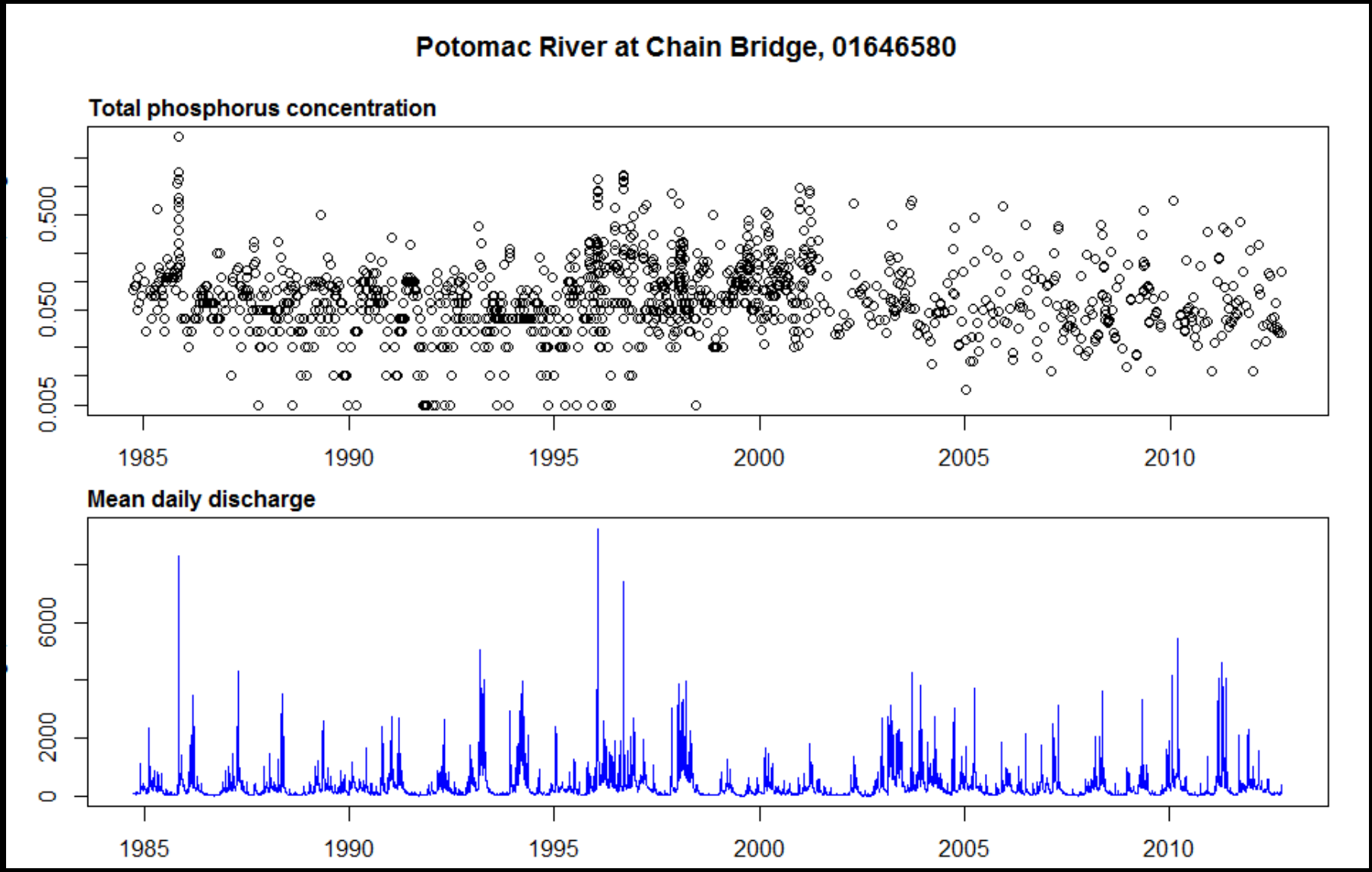
# WRTDS and flow-normalization

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# Load and Trend Estimation

Daily Load = Daily Concentration * Mean Daily Discharge

Weighted Regression on Time, Discharge, and Season (WRTDS)

*(Hirsch and others, 2010)*

Primary Load Computation Model 2012-2015

$$\ln(c) = \hat{\beta}_0 + \hat{\beta}_1 t + \hat{\beta}_2 \ln(q) + \hat{\beta}_3 \sin(2\pi t) + \hat{\beta}_4 \cos(2\pi t) + \varepsilon$$

Time Discharge Season

- Unique regression model for each point at which a concentration estimate is required
- Models weight observations based on “proximity”, in *time, discharge, and season*, to conditions at the time each estimate is required

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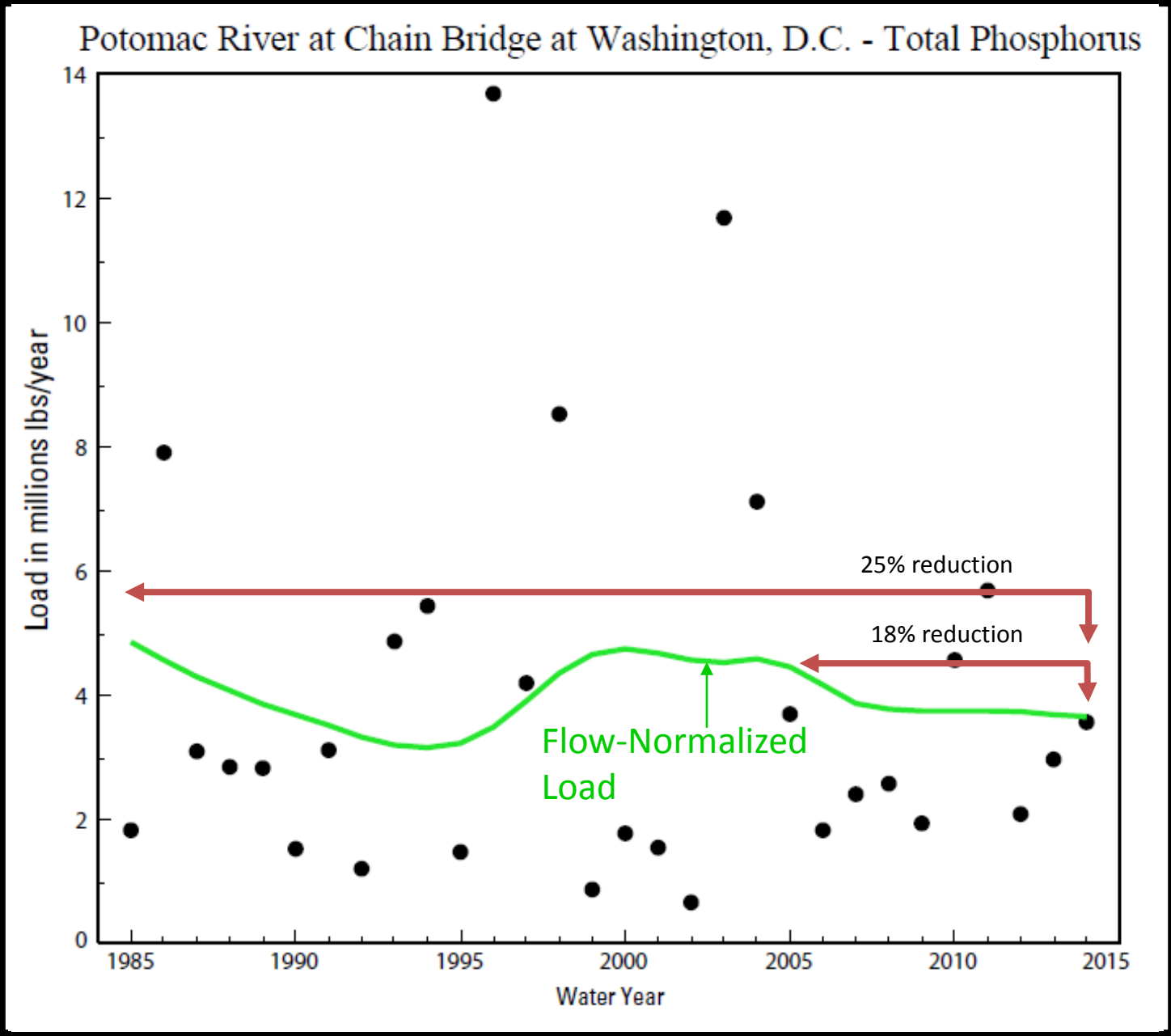
# WRTDS Load and Trend Example: Potomac River Total Phosphorus

Total reduction in RIM total nitrogen:
1985 to 2014 = -25%
2005 to 2014 = -18%

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# Total Nitrogen per Acre Loads and Trends: 2005-2014

Improving Trends = 44 of 81 (54%)
Degrading Trends = 22 of 81 (27%)
No Trend = 15 of 81 (19%)

Of the 14 stations with the highest per acre loads for Total Nitrogen:

- 6 have improving trends
- 3 have degrading trends
- 4 have no trends
- 1 has insufficient data for trend analysis

Results by major basins

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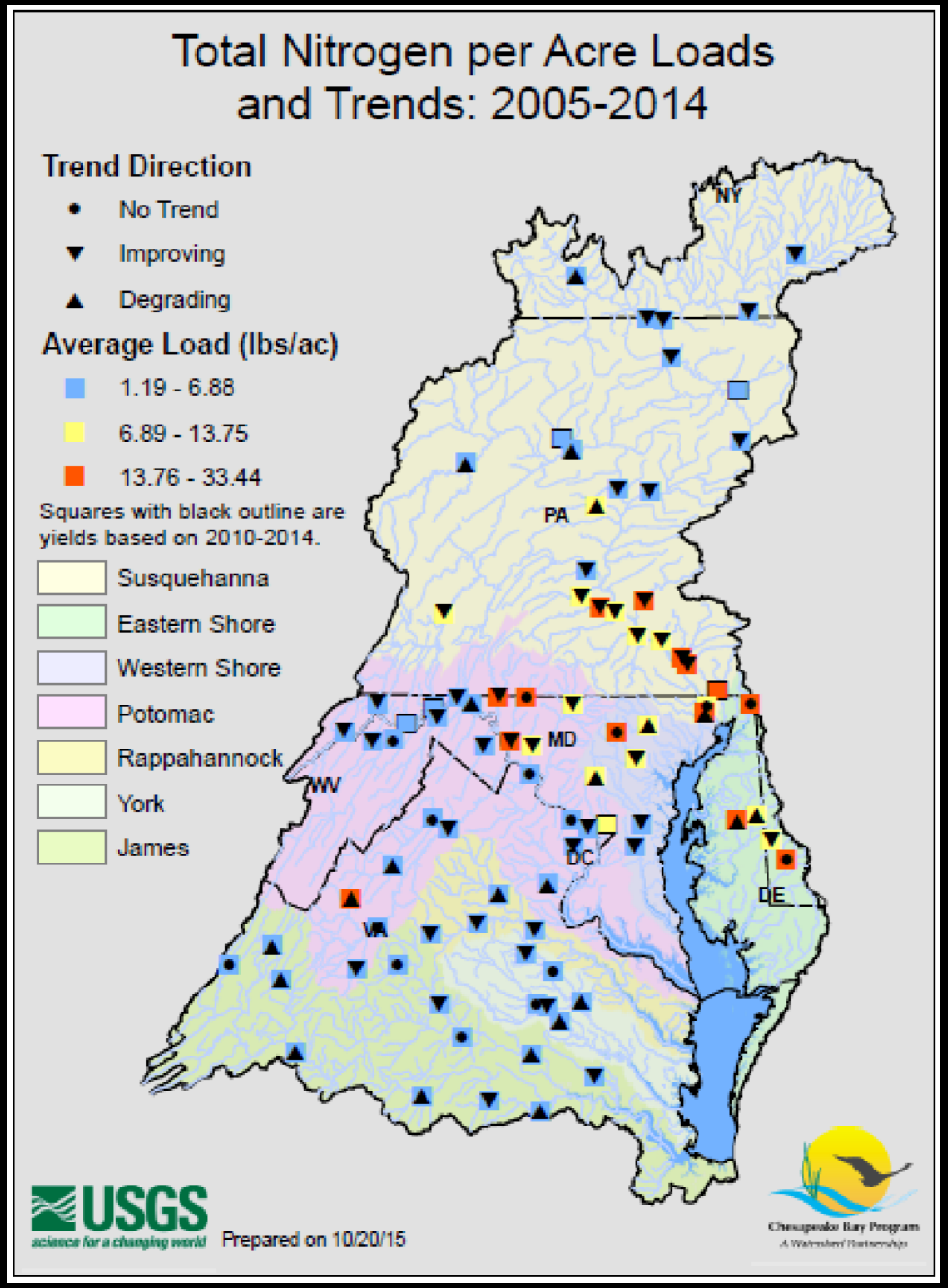
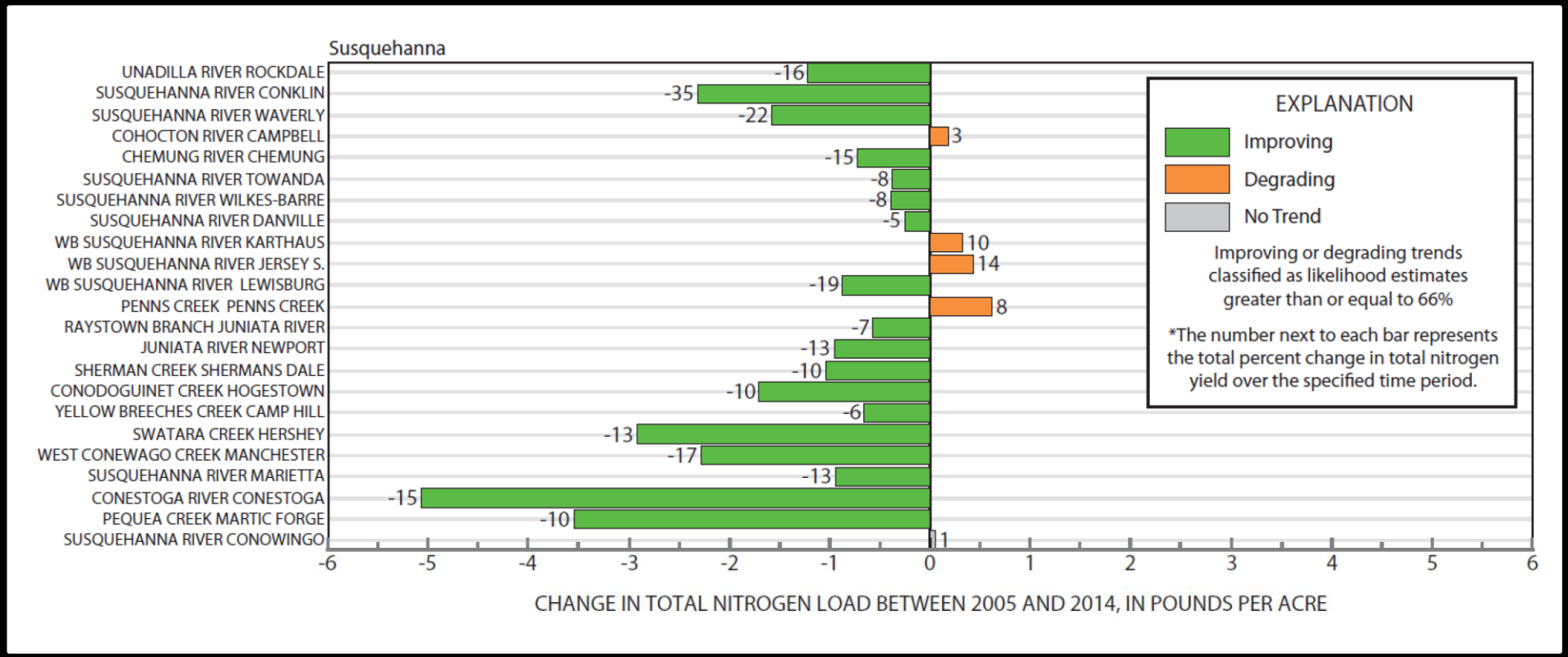


# Changes in Nitrogen per Acre Loads: 2005-2014

## *Example from the Susquehanna Watershed*

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# Changes in Nitrogen per Acre Loads: 2005-2014

Trend in load network is the first of its kind

Improving Stations

*Range = -0.10 to -5.07 lbs/ac*

*Median = -0.68 lbs/ac (-10.0%)*

Degrading Stations

*Range = 0.04 to 1.21 lbs/ac*

*Median = 0.33 lbs/ac (7.84%)*

Download figure:
http://cbrim.er.usgs.gov/maps.html

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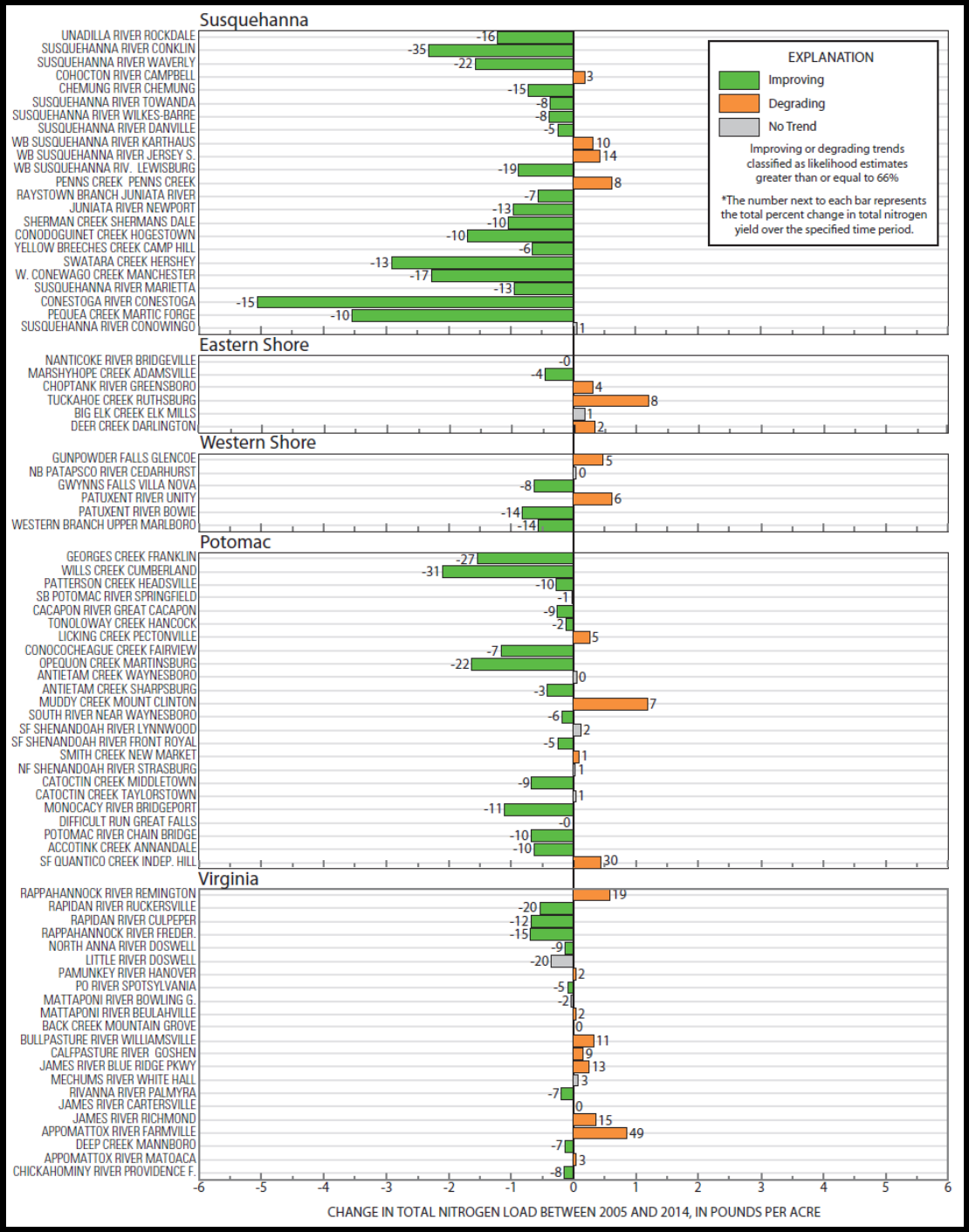

# USGS Nontidal Web Page

## http://cbrim.er.usgs.gov/

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Intranet Home
Find A Person
Search Intranet

**Water-Quality Loads and Trends at Nontidal Monitoring Stations in the Chesapeake Bay Watershed**

**Navigate Menu**

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Methods
Glossary
Bibliography

**Results and Maps**

Load and Trend Summary
Interactive Map
Tables and Figures

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Model Input Data
Load Table
Yield Table
Trend Results Table

**Contacts**

Partners
USGS Chesapeake Activities
Technical Contacts
Web Administrator

### Welcome

This web site is dedicated to providing water-quality load and trend results for the nontidal rivers of the Chesapeake Bay watershed.

### What are the Objectives of the Chesapeake Bay Nontidal Monitoring Program?

- Quantify nutrient and sediment loads in the nontidal rivers of the Chesapeake Bay watershed. These loads are defined as the mass of nutrient or sediment passing a monitored location per unit time.
- Estimate changes over time (trends) in sediment and nutrient loads, in a manner that compensates for any concurrent trend in stream discharge. Trends estimated in this manner can indicate changes in the watershed, such as the effects of best management practices that cannot be attributed primarily to climatic fluctuation.

### How the Program Works

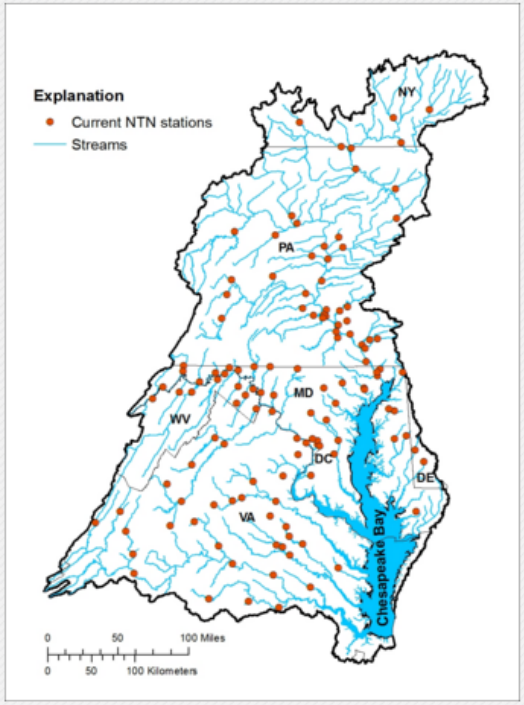
- Monitoring data are collected by numerous agencies through the nontidal monitoring partnership.
- Results are updated on even-numbered water years for the network of water-quality monitoring stations distributed throughout the Chesapeake Bay watershed.

### What Data and Related Information Are Available?

Methods, data, results, and interpretations are available for

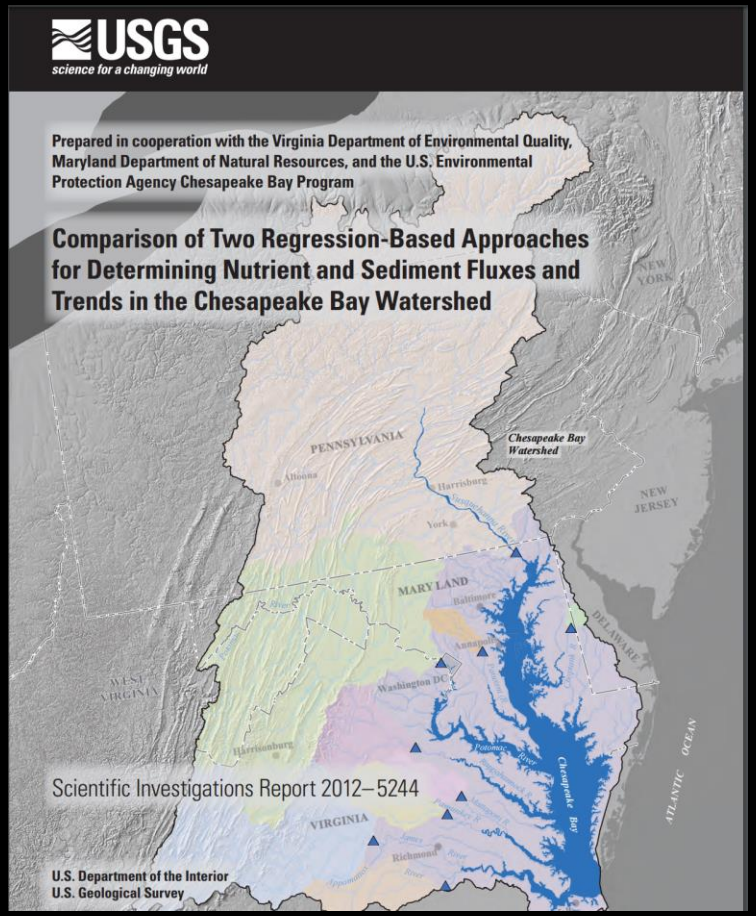
- Nutrient and sediment loads and yields (per-acre loads)
- Trends in nutrient and sediment loads

Load and trend results are available from the Chesapeake Bay nontidal monitoring network through the 2014 water year.



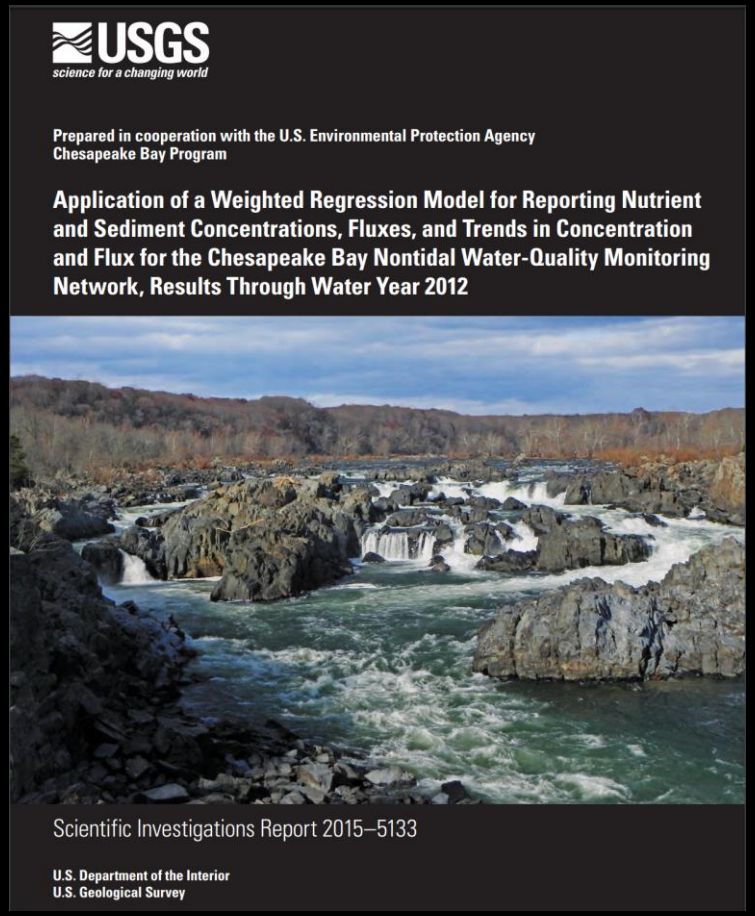

Click on the image above to access the interactive map

# Recent Publications




Moyer and others 2012

https://pubs.er.usgs.gov/publication/sir20125244




Chanat and others 2015

https://pubs.er.usgs.gov/publication/sir20155133

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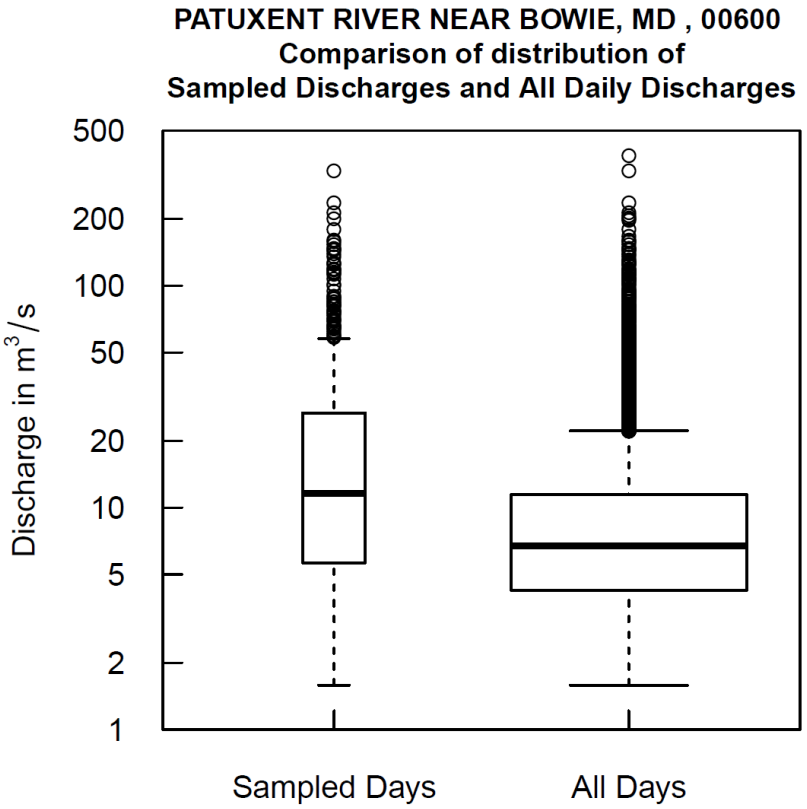
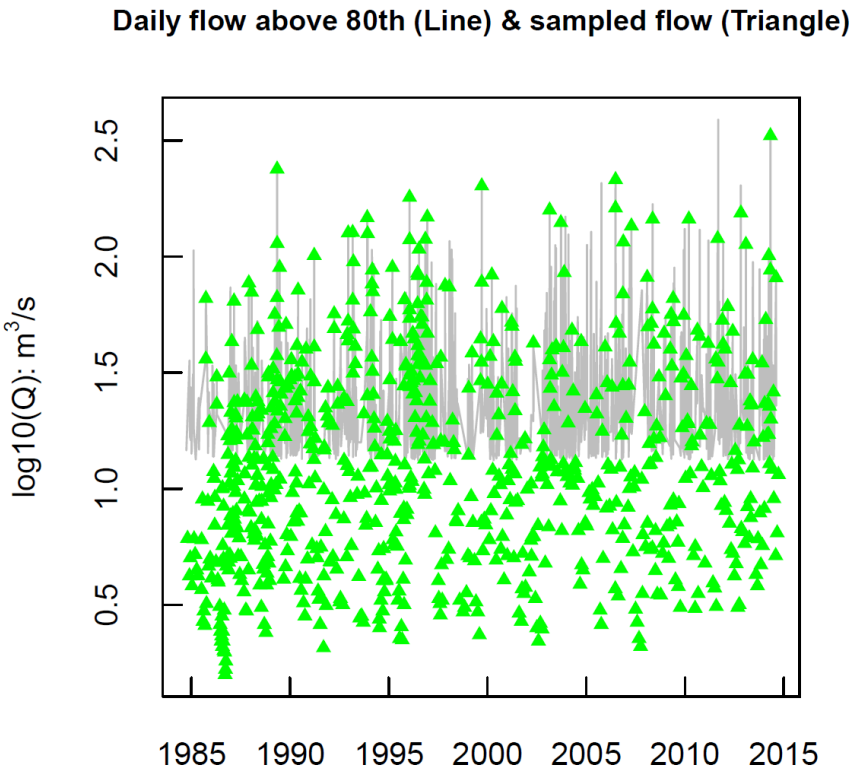
# Example of Good Storm Coverage

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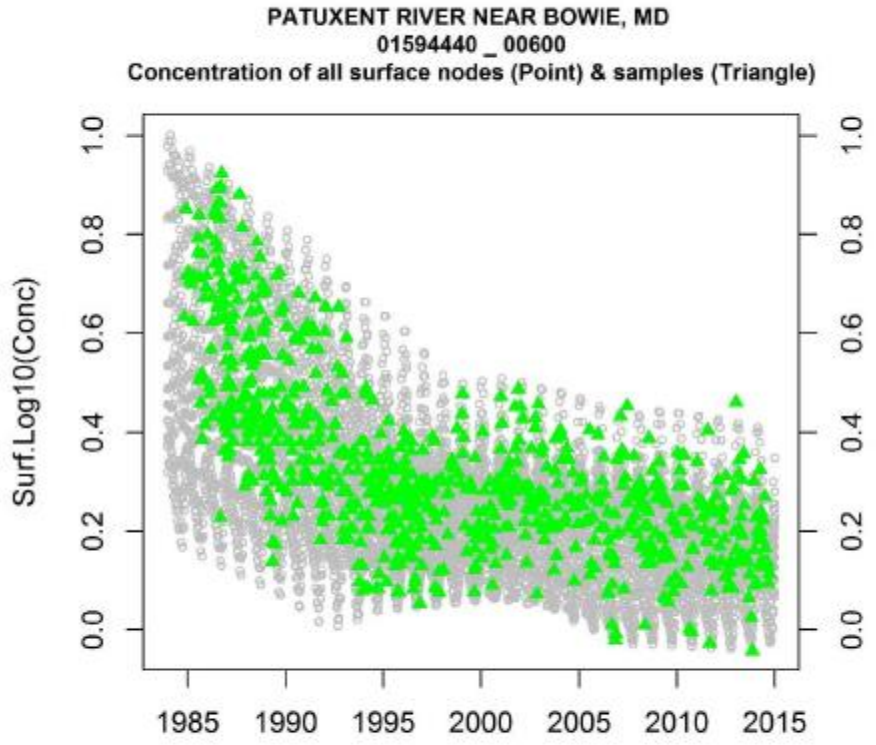


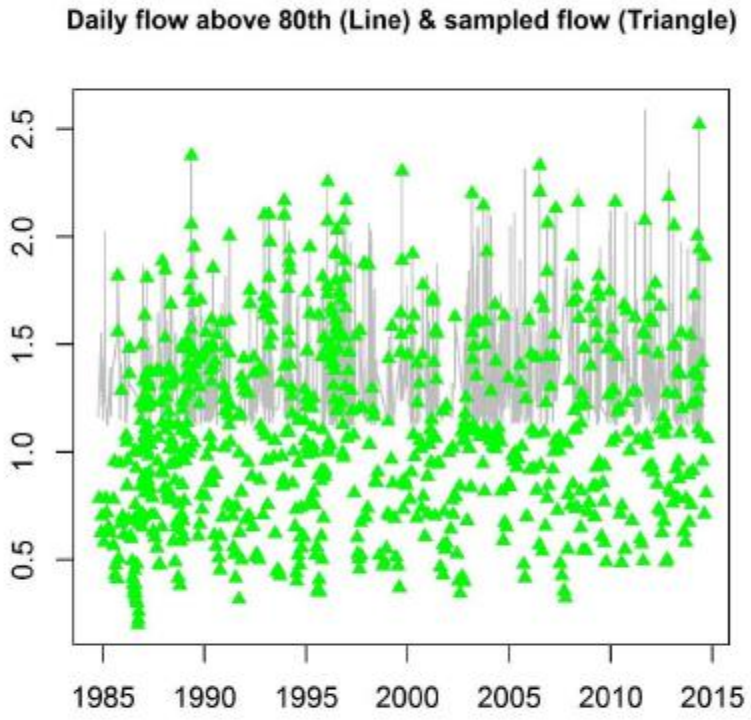


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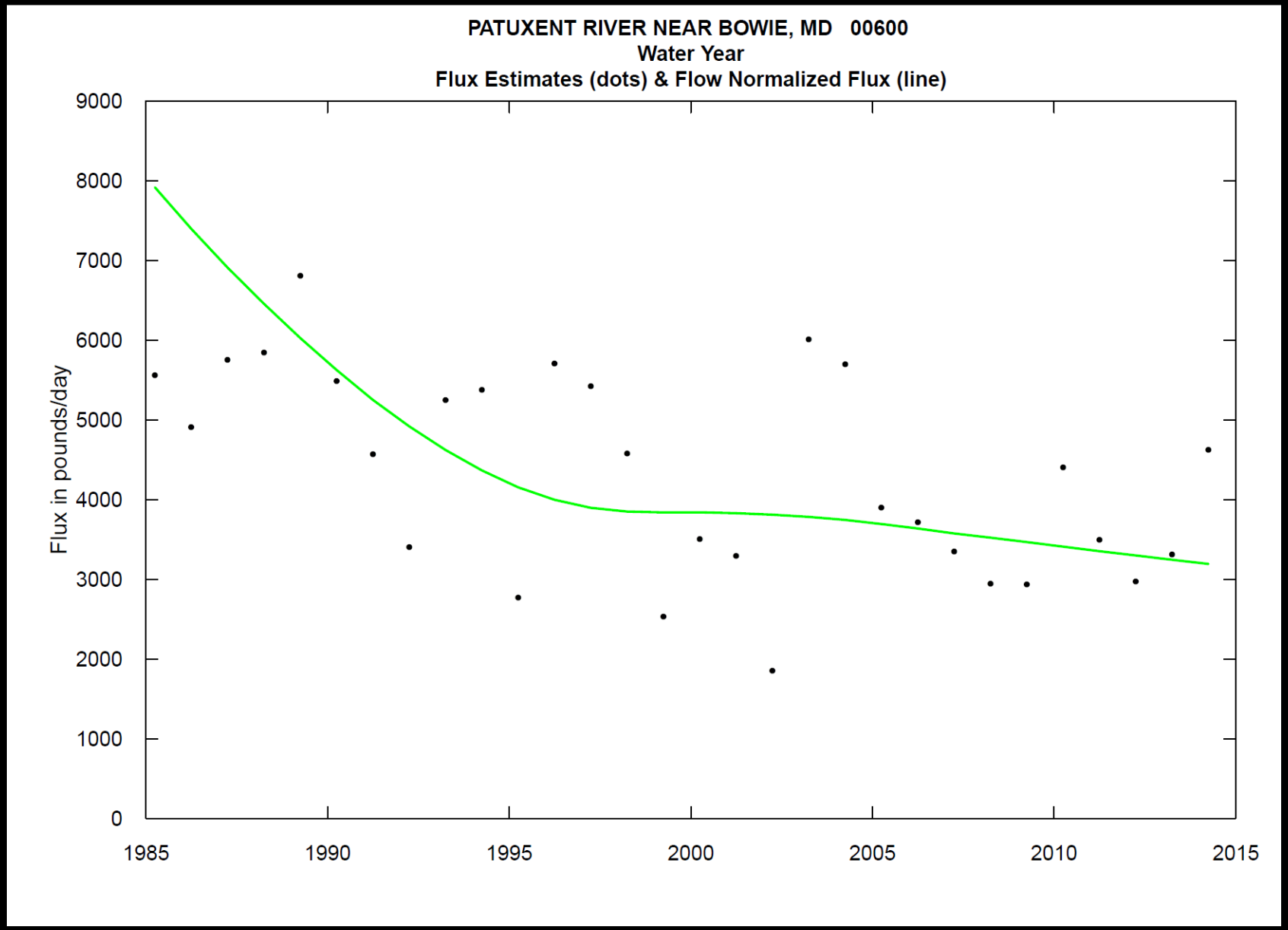


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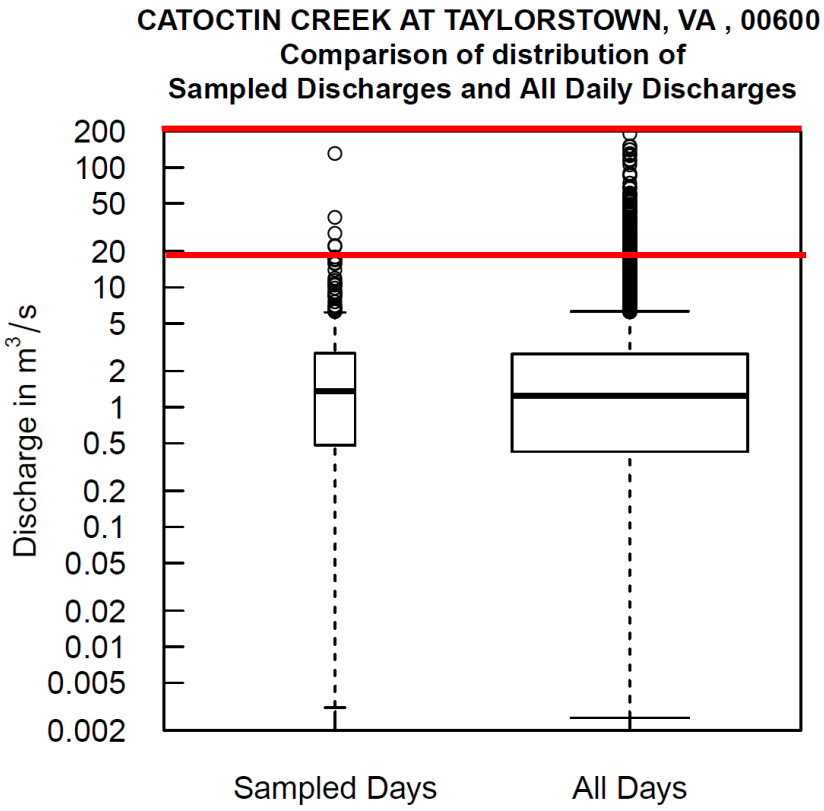
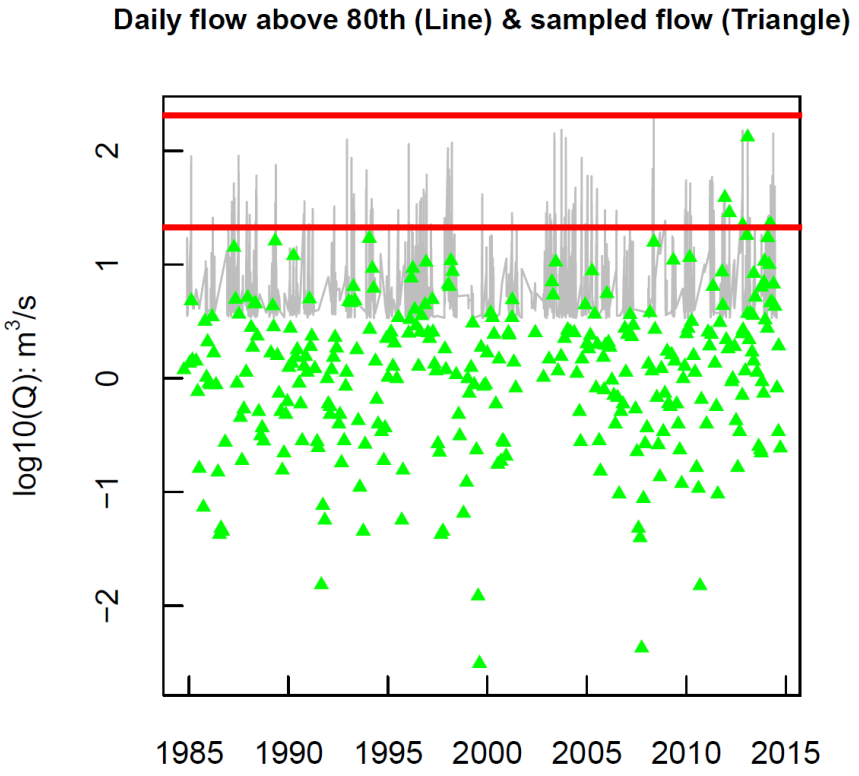
# Example of station that transitioned from no storms to targeted storm samples

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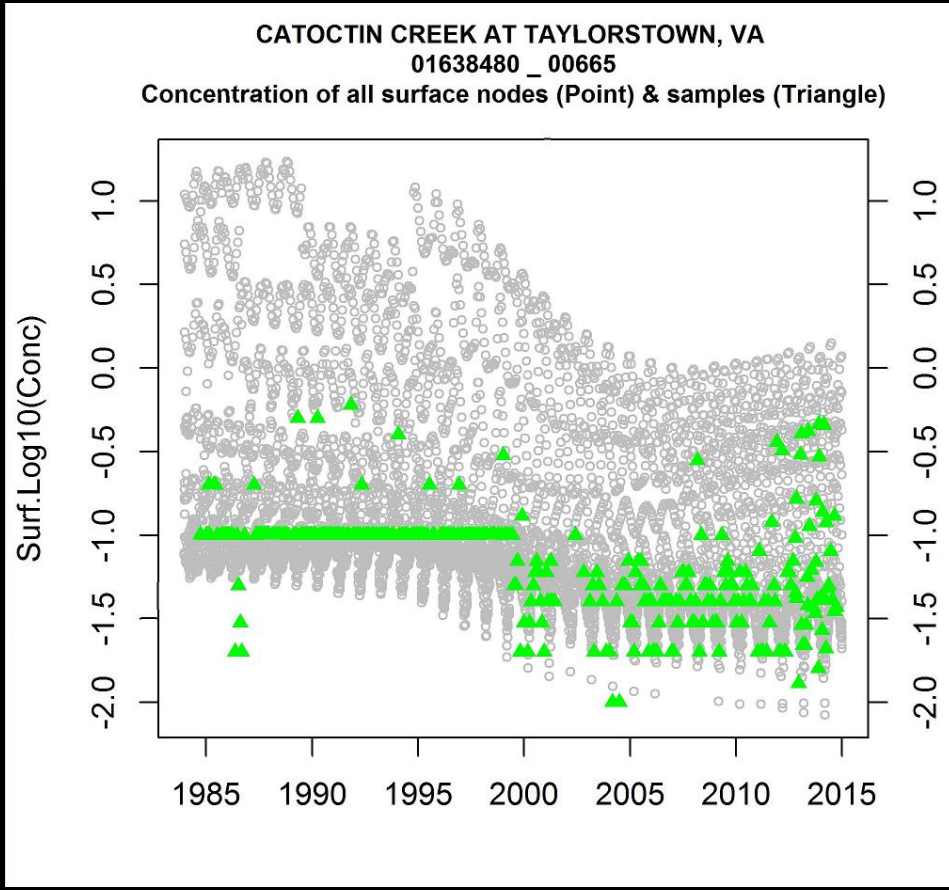
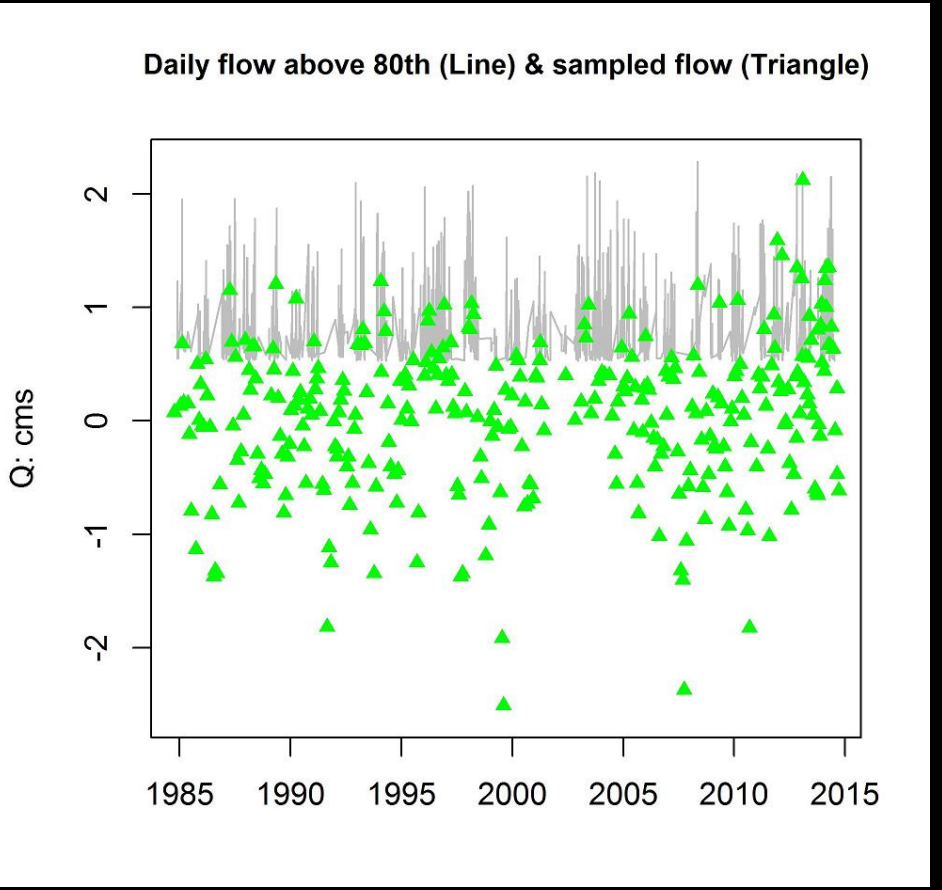
# Example of Poor Storm Coverage

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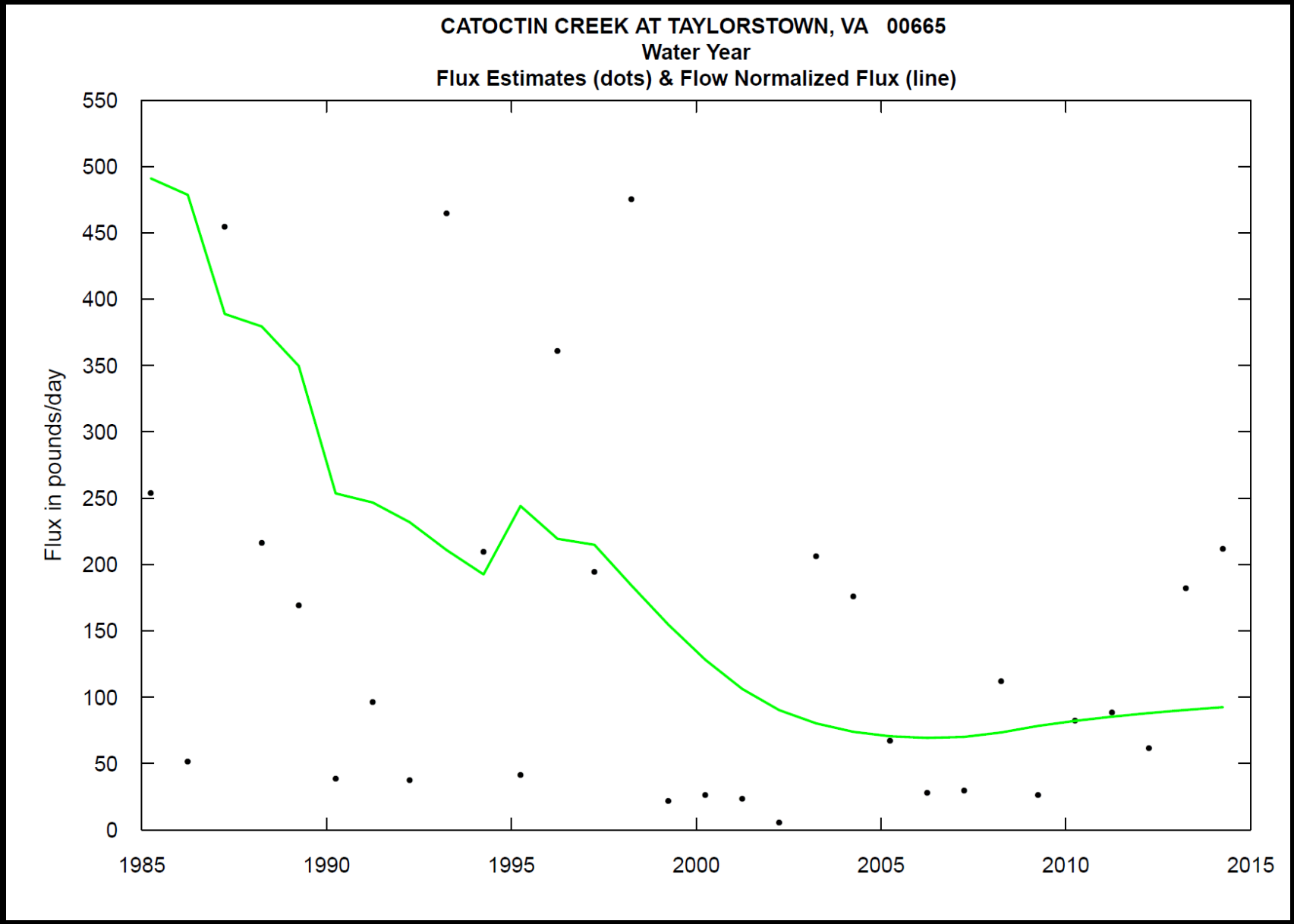


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# Graphs of Hydrograph vs. Sampling Time

PDFs for each of the following samplers:

- DEDNREC
- USGSWV
- USGSPA
- PADEP
- SRBC
- USGSVA
- VADEQ
- USGSMD
- MDDNR

TWO types of graphs shown

- Older station figures from D. Moyer / USGS
- New station figures assembled by M. Ehrich

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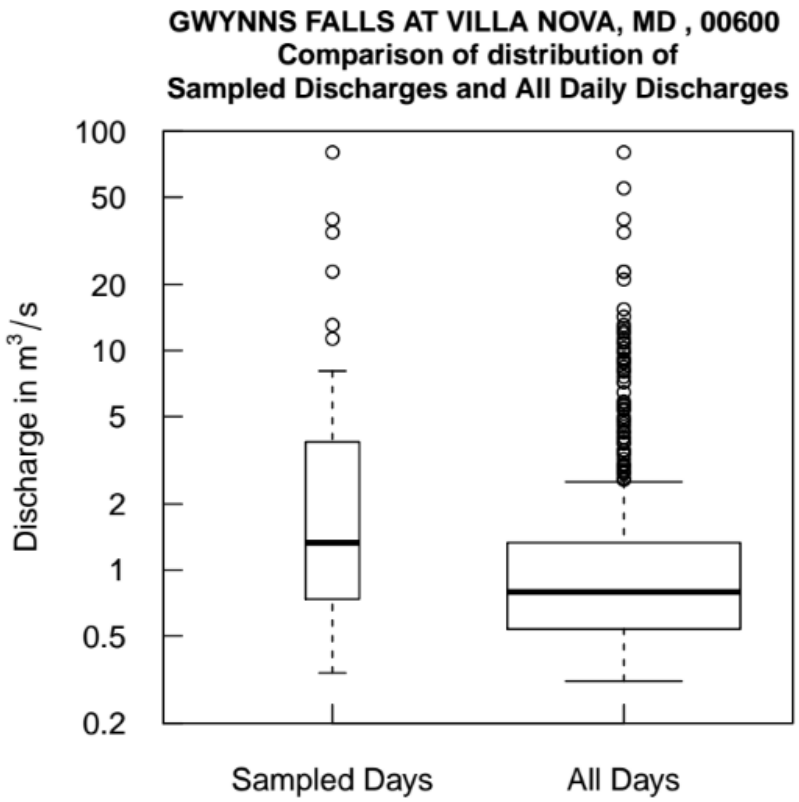
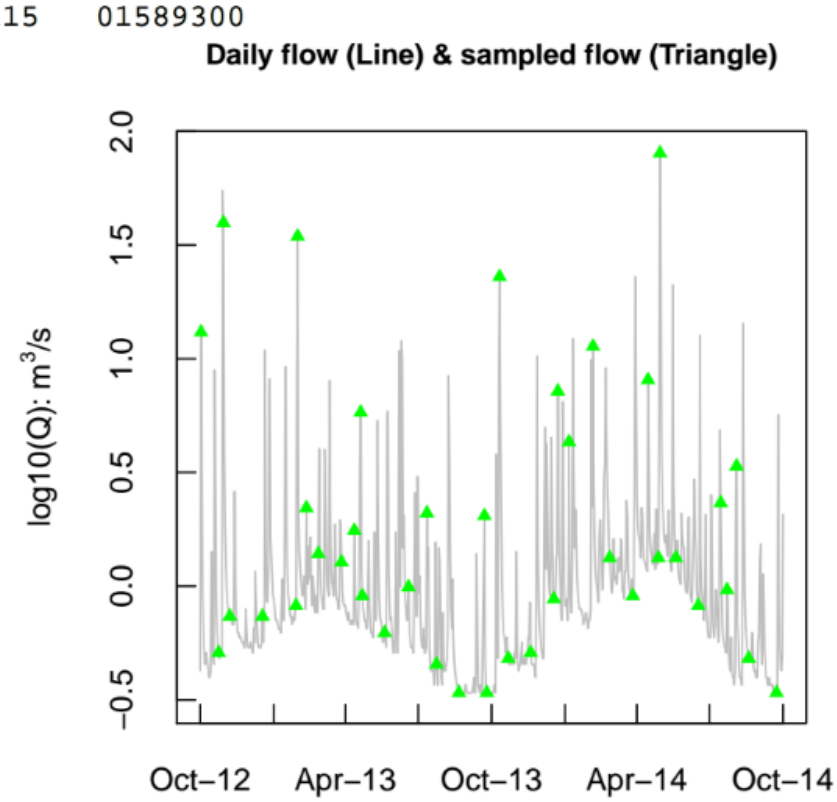
# Example of Good Storm Representation

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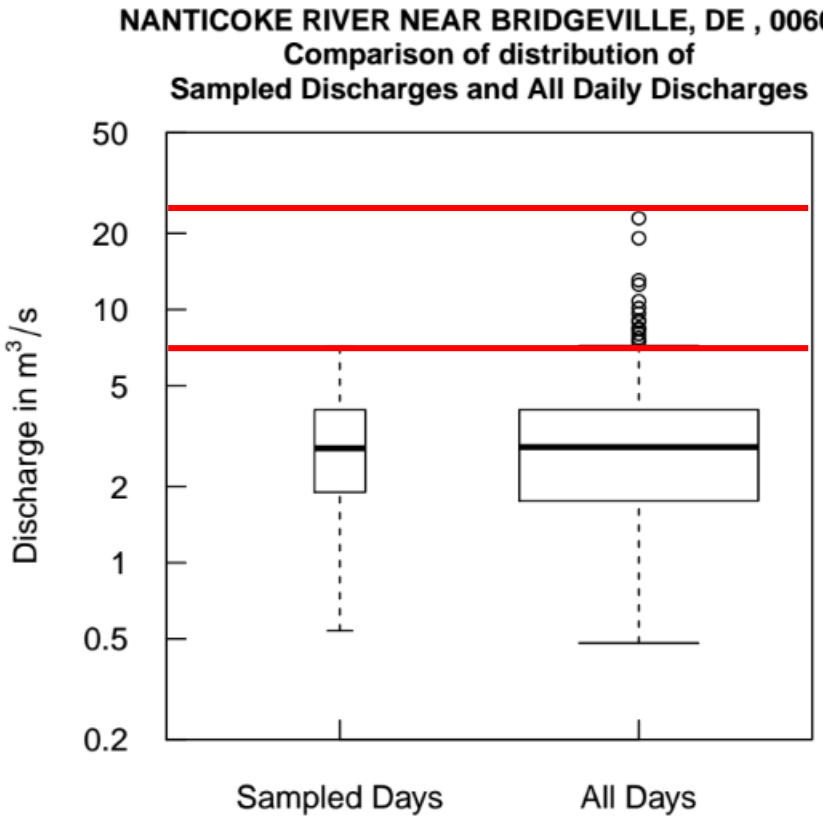
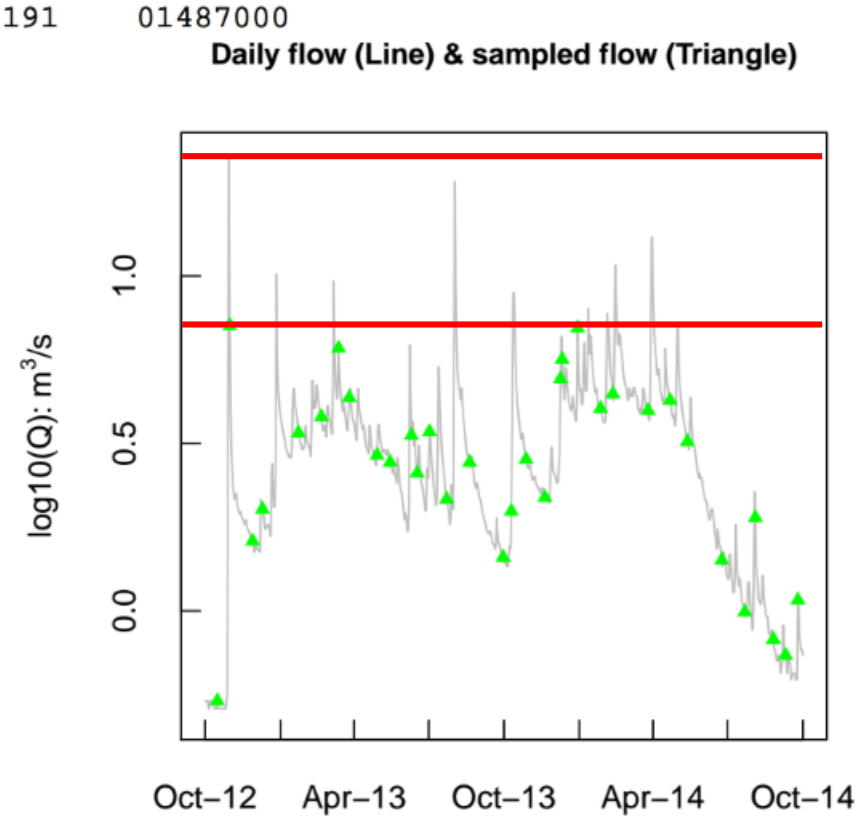
# Example of station where targeting larger storms would considerably improve load and trend estimates.

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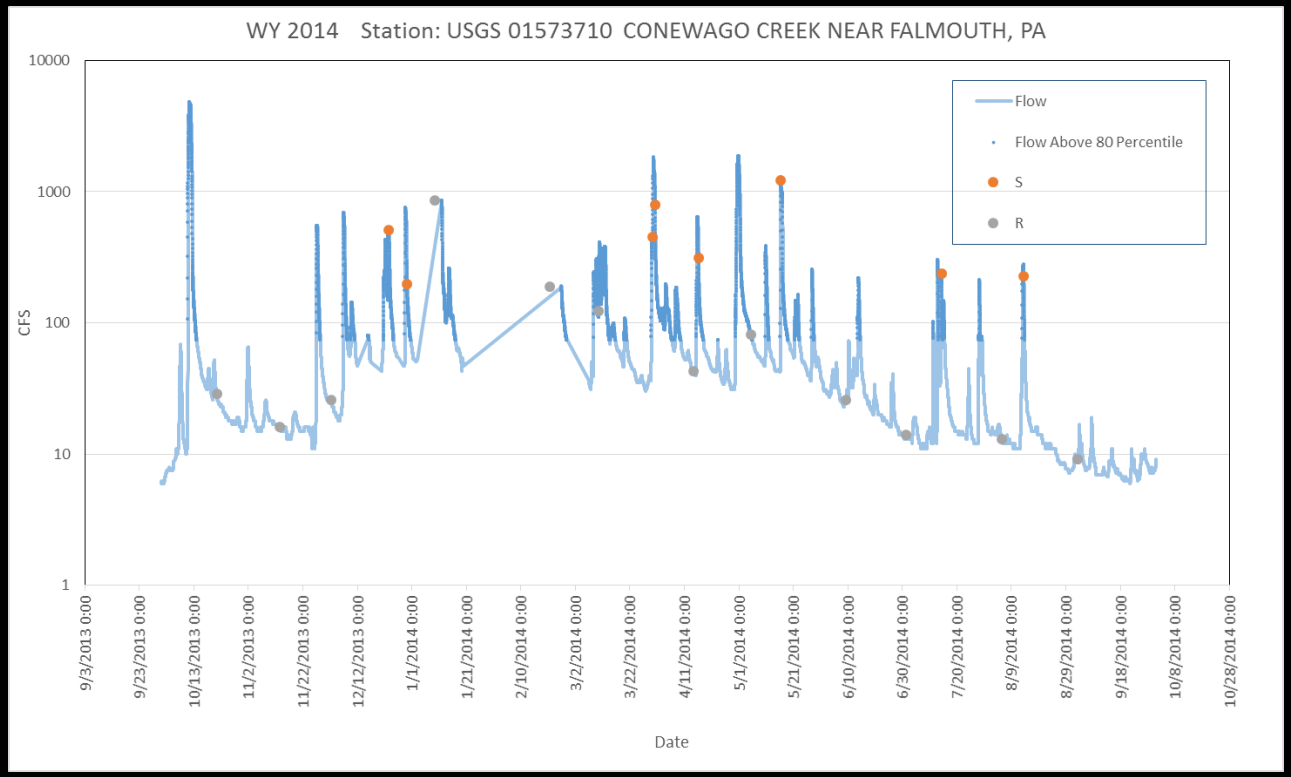
# Newer Station Figures Info




- WY 2014
- Cubic ft /sec

- Blue – flow
- Dark blue – flows above 80$^{th}$ Percentile
- Orange – Storm samples (S)
- Grey – Regular samples (R)
- Yellow – Regular, but counted as a storm (RSI)

- If dots are not on the hydrograph line, no flow was recorded at the sample time (using the # of the closest flow recording)

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