5 New Small Watershed Continuous Water Quality Monitoring Sites

- Funding for equipment to support 5 new small watershed sites was transmitted in the FY23 EPA/USGS NTN budget
- USGS is in the process of ordering QW equipment (reporting 4-to-6-month lead times right now)
- EPA has indicated O&M support for the 5 sites in outyear budgets
- Ideally, we’d like approximately 4 months lead time on site selections in order to reconnoiter, get permissions, and build out site.

EPA/NRCS/USGS White Paper

Coordinating water-quality monitoring, interpretation, and funding to assess the impacts of agricultural conservation practices on water quality in the Chesapeake Bay Watershed

Description of Recommendations.

Objective 1: Identify watersheds with the greatest needs and opportunities for monitoring the impacts of conservation work on local streams and rivers.

Recommendation: Develop criteria to identify watersheds that can show water quality response to conservation practices.

Criteria should be developed for identifying watersheds that have adequate information to show impacts of agricultural conservation practices on water quality. Based on previous efforts, the criteria may include: adequate existing or past water quality monitoring data that can serve as a baseline; a high density of voluntary conservation practices that aim to reduce nutrient and sediment loads; watersheds where there is a concerted focus by NRCS, States, and other conservation partners to accelerate implementation of priority conservation practices; ***watersheds that are dominated by agricultural land use or forested land use (i.e. control watersheds); and small watersheds draining 1st to 4th order streams*.**

The criteria should also consider the design for optimal monitoring to detect water quality response to conservation practices. One established design is paired watershed studies, having a "treatment" watershed (with increased conservation practices) and having "control" watershed (without an increase in implementation) to compare water quality responses. Another important design consideration is scale-nested (e.g. farm-watershed scale; see Fig. 1) watershed studies, which can facilitate the isolation and quantification of water quality impacts from agricultural land use practices (Hubbart et al, 2019). Other watershed monitoring designs should be explored for developing criteria.

Finally, the criteria could include additional benefits from conservation efforts, such as improvements to stream condition and habitat. However, these additional benefits were not a focus of this report.

Thoughts from EPA/NRCS/USGS White Paper

Coordinating water-quality monitoring, interpretation, and funding to assess the impacts of agricultural conservation practices on water quality in the Chesapeake Bay Watershed

Chesapeake Bay Monitoring Programs – Scale, Objective, and Quality

STUDY SCALE	MONIOTING PROGRAM	OBJECTIVE	QUALITY OF CURRENT NETWORK
Large Rivers (4th order and larger)	1) Nontidal Monitoring Network 2) State Monitoring Networks	1) Integrated trends in water quality across the Chesapeake watersheds 2) Identify impairments of water quality standards	1) Good (100+ station long-term monitoring network) 2) Good (Extensive statewide networks exist)
Streams (2-3rd order)	1) NRCS-USGS Showcase Watershed monitoring	1) Integrated changes of water quality in ag watersheds with substantial ag conservation practice implementation	1) Fair (Relatively few monitoring sites exist)
Small streams (zero-1st order)	1) None identified	1) Evaluate the effects of ag conservation practice implementation and other landscape change	1) Poor (lack of monitoring)
Edge-of-field studies	1) USDA/NRCS Studies 2) University Research	1) Evaluating the efficacies of individual ag conservation practices	1) Fair (because none currently ongoing) 2) Fair (based on historical efforts)

The current monitoring in the Chesapeake Bay watershed does not focus on smaller order streams where changes from agricultural conservation practices are most likely to be detected. For example, lower order streams (i.e. 1st to 4th order) comprise approximately 97% of total stream length in the U.S. (Poff et al., 2006), but are rarely directly monitored by federal and state programs, which are often focused on larger riverine systems.

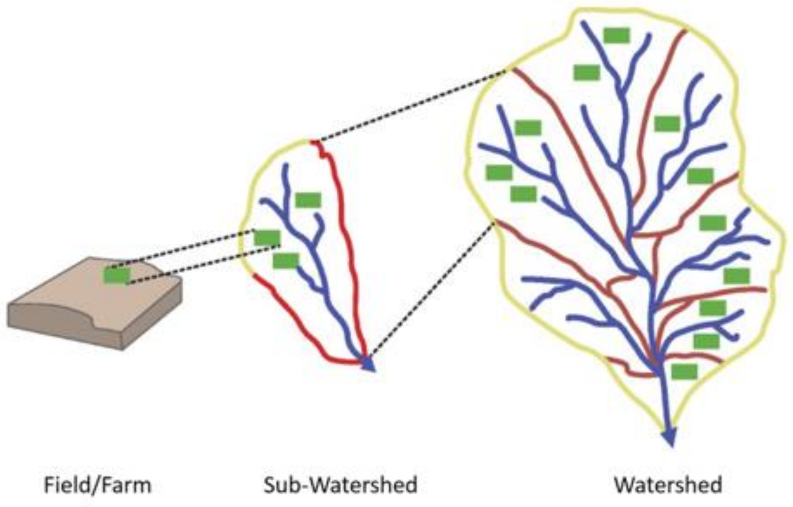
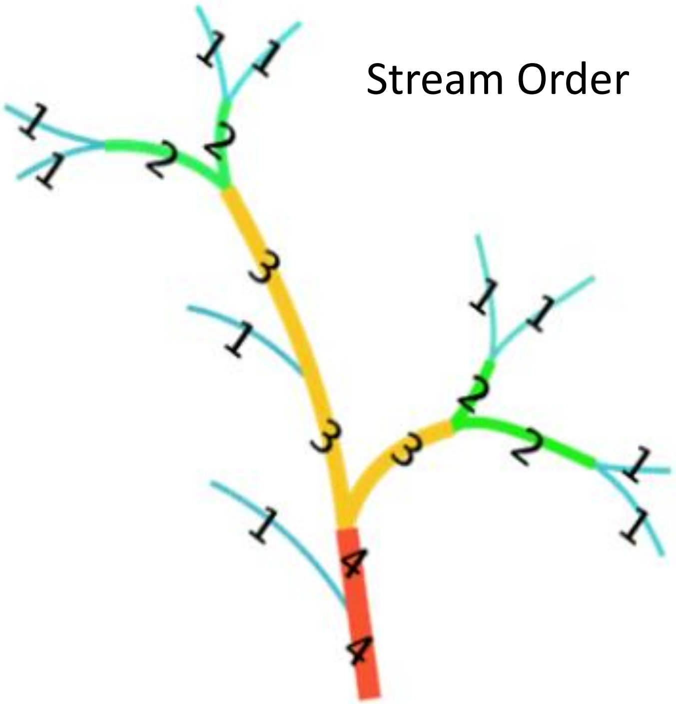


Figure 1. Diagram illustrating relevant scales for water quality monitoring (adapted from Golden and Hoghooghi, 2018).

Small Watershed – How to Define



Stream Order

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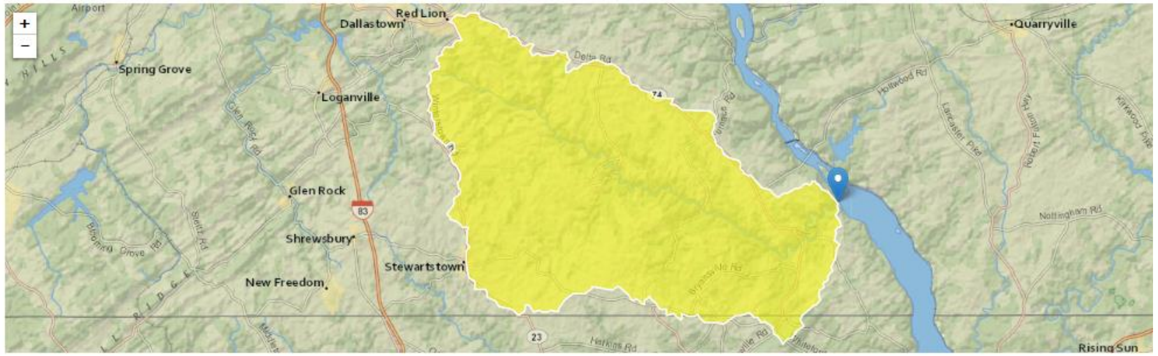

Catchment size

› Peak-Flow Statistics

Peak-Flow Statistics Parameters [Peak Flow Region 4 SIR 2019 5094]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	138	square miles	1.2	512
CARBON	Percent Carbonate	0.32	percent	0	68.5

Peak-Flow Statistics Flow Report [Peak Flow Region 4 SIR 2019 5094]

PII: Prediction Interval-Lower, Plu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
50-percent AEP flood	6640	ft^3/s	40.4
20-percent AEP flood	10300	ft^3/s	33.1
10-percent AEP flood	13200	ft^3/s	30.9
4-percent AEP flood	17300	ft^3/s	29.8
2-percent AEP flood	20700	ft^3/s	30.4

Flow metrics

Statistic	Value	Unit	SE	ASEp
Mean Annual Flow	177	ft^3/s	12	12

Annual Flow Statistics Citations

Stuckey, M.H.,2006, Low-flow, base-flow, and mean-flow regression equations for Pennsylvania streams: U.S. Geological Survey Scientific Investigations Report 2006-5130, 84 p.

Very Small Watersheds – Flow Estimates

Region ID: PA
Workspace ID: PA20221018185547228000
Clicked Point (Latitude, Longitude): 39.84153, -76.51308
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Collapse All

› Peak-Flow Statistics

Peak-Flow Statistics Parameters [Peak Flow Region 4 SIR 2019 5094]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.26	square miles	1.2	512
CARBON	Percent Carbonate	0	percent	0	68.5

Peak-Flow Statistics Disclaimers [Peak Flow Region 4 SIR 2019 5094]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Peak-Flow Statistics Flow Report [Peak Flow Region 4 SIR 2019 5094]

Statistic	Value	Unit
50-percent AEP flood	89.2	ft^3/s
20-percent AEP flood	164	ft^3/s
10-percent AEP flood	229	ft^3/s
4-percent AEP flood	327	ft^3/s
2-percent AEP flood	409	ft^3/s
1-percent AEP flood	501	ft^3/s
0.5-percent AEP flood	601	ft^3/s
0.2-percent AEP flood	750	ft^3/s

Region ID: PA
Workspace ID: PA20221018185547228000
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Time: 2022-10-18 14:56:09 -0400

Collapse All

⌄ Peak-Flow Statistics

› Low-Flow Statistics

Low-Flow Statistics Parameters [Low Flow Region 1]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.26	square miles	4.78	1150

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
BSLOPD	Mean Basin Slope degrees	3.7681	degrees	1.7	6.4
ROCKDEP	Depth to Rock	5	feet	4.13	5.21
URBAN	Percent Urban	0.0151	percent	0	89

Low-Flow Statistics Disclaimers [Low Flow Region 1]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Low-Flow Statistics Flow Report [Low Flow Region 1]

Statistic	Value	Unit
7 Day 2 Year Low Flow	0.0479	ft^3/s
30 Day 2 Year Low Flow	0.0648	ft^3/s
7 Day 10 Year Low Flow	0.0183	ft^3/s
30 Day 10 Year Low Flow	0.0263	ft^3/s
90 Day 10 Year Low Flow	0.0464	ft^3/s

Annual Flow Statistics Flow Report [Statewide Mean and Base Flow]

Statistic	Value	Unit
Mean Annual Flow	0.281	ft^3/s

Annual Flow Statistics Citations

Stuckey, M.H.,2006, Low-flow, base-flow, and mean-flow regression equations for Pennsylvania streams: U.S. Geological Survey Scientific Investigations Report 2006-5130, 84 p.

Does there come a time when there's not enough consistent flow to support meaningful monitoring?

Watershed Selection Criteria: Monitoring the Effectiveness of Conservation Practices

Criteria	Considerations	Importance
Land cover, use and watershed characteristics ?	Dominant Ag - land cover should be >50 % ag and less than 5% urban (Dubrovsky et al., 2007). Watersheds with that are completely ag should be avoided as they may not be able to show a water response.	Will help ensure water-quality monitoring is detecting ag land use and practices.
	Land use and Operations - consider focusing on small watersheds where specific types of land-use operations (dairy, poultry, or cropping systems_ can be isolated to monitor BMP effects	Could help assess how specific types of ag operations are responding to BMPs.
	Atypical land-use Features – avoid areas that may have a particular feature that unrepresentative of the ag land use of interest (nursery, point sources, quarries, gas well pads, etc.)	Atypical land uses are not representative of Baywide conditions. Such features like point source reductions mask water-quality response to other drivers
	Change - avoid areas that have past, current or future changes in land use (except BMP installation)	Changes in agricultural activities could confound our ability to identify conservation practice effects
	Growing season - site selection should span the varying latitude, elevation and temperature ranges of the Bay watershed	Nutrient uptake and transport vary based on climatic conditions
	Geology - watersheds should be selected representing various physiographic/geologic setting in the watershed with a range of residence time	The fate and transport of nutrients and sediment vary based on watershed characteristics in different physiographic provinces. Fate and transport of nutrients differ in carbonate vs noncarbonate settings. Will increase our ability to link watershed changes with water-quality response on management-relevant timescales.
	Flowpaths - sampling design should consider monitoring slow flow (groundwater), fastflow (runoff) and drainflow (tile drains, etc.)	Monitoring these flowpaths within a watershed or choosing representative watersheds dominated by such flowpaths.
	Specific Issues – special consideration should be given to issues such as legacy sediment	Regions that have specific issues affecting the Bay
Existing monitoring	Long Term/High Frequency – the nested design should include long term monitoring (>7 years) across multiple hydrologic conditions with (or has) capabilities for continuous water quality monitoring (nitrate sensor, etc.)	Typically, at least 5-years of data are needed for load analysis and 10 years for trend analysis. Continuous monitoring provides better resolution of water-quality change to land practices.
	Scale and Nested design – Need to have watersheds at a scale to allow for a Nested design. Such as large watershed (NTN, gaged)-> small watershed (combination of practices, showcase) -> headwaters (less practices/types of operation) -> field studies (individual practices, LTAR/CEAP).	Nested design will better detect changes of practices. We are lacking information at smaller scale, which would represent "watershed-wide" conservation practice effects. Important to be related this up to the larger watershed. If possible, a control site/monitoring location (upper watershed) in the nested design would be a benefit.
	SW/GW - includes both surface and groundwater monitoring	Nitrogen moves through groundwater so some wells are needed to help understand BMP response
	Fixed/Synoptic Sampling - watersheds that can accommodate both fixed monitoring for temporal and synoptic sampling for spatial/characterization of water quality	Important to understand the temporal changes as fixed sites and spatial component of water quality to better understanding differences in loadings within a watershed
BMP Implementation	Implementation - watersheds should have a high amount of implementation (25-30%) in order to see a water quality response. Conservation practices can be existing or planned.	Need information on the amount of implementation to understand water-quality response.
	Placement - the high amount of implementation needs to be coupled ideally with targeting high yield areas and important flowpaths	More strategic BMP planning and prioritization would likely show improvements in water quality sooner
	Verification - places would be ideally in areas with farmers maintaining practices	Areas where verification/tracking exists to know if farmers are maintaining/following practices would better strengthen results
	BMP Data - useful to have a watershed with a good amount of federal/state bmp data for comparison with water quality results	More reliable BMP data over time will help with water quality analysis
	WQ BMPs - contain a majority of BMPs designed to reduce nitrogen, phosphorus, and sediment. Improvements in water quality would mostly likely in occur in watersheds with BMPs that target reducing manure/fertilizer inputs and set-aside land for conservation (CREP, etc.).	These type of practices are expected to result in nitrogen, phosphorus, and sediment reductions.
Watershed characteristics	Geology - watersheds should be selected representing various physiographic/geologic setting in the watershed with a range of residence time	The fate and transport of nutrients and sediment vary based on watershed characteristics in different physiographic provinces. Fate and transport of nutrients differ in carbonate vs noncarbonate settings. Will increase our ability to link watershed changes with water-quality response on management-relevant timescales.
	Flowpaths - sampling design should consider monitoring slow flow (groundwater), fastflow (runoff) and drainflow (tile drains, etc.)	Monitoring these flowpaths within a watershed or choosing representative watersheds dominated by such flowpaths.
Cooperation	Funding - watersheds should be selected with dedicated funding for monitoring and BMP work.	Such monitoring may take a long time to see a water quality response and areas with dedicated funding would help site selection
	Multiple Agencies - benefit from areas that leverage multiple agency efforts (NRCS, USGS, ARS, etc.)	Several existing long running multi-agency efforts could be leveraged (Choptank, Manhantango, Conewago, Smith Creek, Spring Creek, etc.)
	Stakeholder - watersheds with an existing framework of stakeholders	Would reduce the long time it takes to establish the relations and trust in the community.
	Farmer Support - watersheds should have farmers/landowners willing to commit to long term bmp implementation and monitoring efforts	Strong landowner partnerships increase the ability to identify and implement conservation practice opportunities