SPOTLIGHT
ON
NORTH FORK CATOCTIN CREEK

A Watershed Management Plan to Restore Water Quality

Virginia Department of Environmental Quality

October 2019

Overview

The Virginia Department of Environmental Quality (DEQ) has studied the North Fork Catoctin Creek **watershed** and identified a portion of the aquatic environment of the stream as unhealthy, largely due to excessive sediment (generally from eroded land, streambanks and soils). While sediment occurs naturally in the environment, larger amounts are ending up in streams due to human activities. To rehabilitate the health of this waterway, DEQ developed a watershed management plan entitled "A TMDL and Watershed Management Plan to address Sediment in the North Fork Catoctin Creek Located in Loudoun County, Virginia" dated October 2019 to reduce pollutant sources of sediment. This work was done with technical support from the Virginia Tech-Biological Systems Engineering (VT-BSE) and local insight from members of the Technical Advisory Committee (TAC).

Watershed: An area of land that drains to a common point or body of water.

Protecting Water Quality

DEQ monitors Virginia's waterways to determine if they meet the water quality goals of being fishable, swimmable, and supportive of a healthy aquatic environment. Those rivers and streams monitored and evaluated by DEQ to be exceeding water quality standards (WQS) are identified as **impaired.** These impaired waters are then listed on Virginia's impaired waters list, which is reported by DEQ to the U.S. Environmental Protection Agency (USEPA) every 2 years. According to Section 303(d) of the Clean Water Act (CWA), total maximum daily loads (TMDLs) must be developed for all waterbodies on the impaired waters list.

Impaired Water: A section of a waterway that does not meet water quality standards based upon monitoring data.

Total Maximum Daily Load

A TMDL is a budget for pollutants in a stream, which determines the maximum amount of a pollutant that a stream can receive, while still allowing the stream to maintain water quality standards. Developing the TMDL is the first step in the process to rehabilitating the health and cleaning up a waterway. A TMDL study includes analysis of sources of pollutants and development of the TMDL budget.

The TMDL program consists of a three-step path to attain WQS for impaired waters. The first step in the process is to develop a TMDL that identifies how much pollutant discharges must be reduced to meet water quality standards. The second step is to develop a TMDL implementation plan, which identifies best management practices that can achieve those **pollutant** reduction goals for unpermitted, nonpoint sources through voluntary actions. Watershed stakeholders provide input to DEQ and participate in the development of TMDLs

Pollutant: A substance introduced into the environment by human activity that has an undesirable effect.

and TMDL implementation plans, in addition to other cooperating agencies, such as Soil and Water Conservation Districts, Counties, Virginia Department of Forestry and Virginia Department of Conservation and Recreation, to name just a few. The final step is to implement the TMDL through 1) issuing permits for point sources subject to permit requirements and 2) implementing recommendations outlined in the TMDL implementation plan, for unpermitted, nonpoint sources. DEQ and its partners conduct follow-up monitoring of the water quality and biology of the stream to determine if water quality standards are being attained. The plan entitled "A TMDL and Watershed Management Plan to address Sediment in the North Fork Catoctin Creek Located in Loudoun County, Virginia" dated October 2019, encompasses the first two steps identified above, development of a TMDL and development of a TMDL implementation plan.

More information on WQS and the associated regulatory requirements can be found in the plan under Section 1.

Watershed Characteristics

The North Fork Catoctin Creek watershed is located in Loudoun County. Almost half of the watershed (49%) is forested land, with the other half comprised of 38% agricultural and 12% residential lands. The creek flows east and discharges into the larger Catoctin Creek, which then flows into the Potomac River and ultimately, the Chesapeake Bay. Additional information on the characteristics of the watershed is provided under Section 2 of the plan.

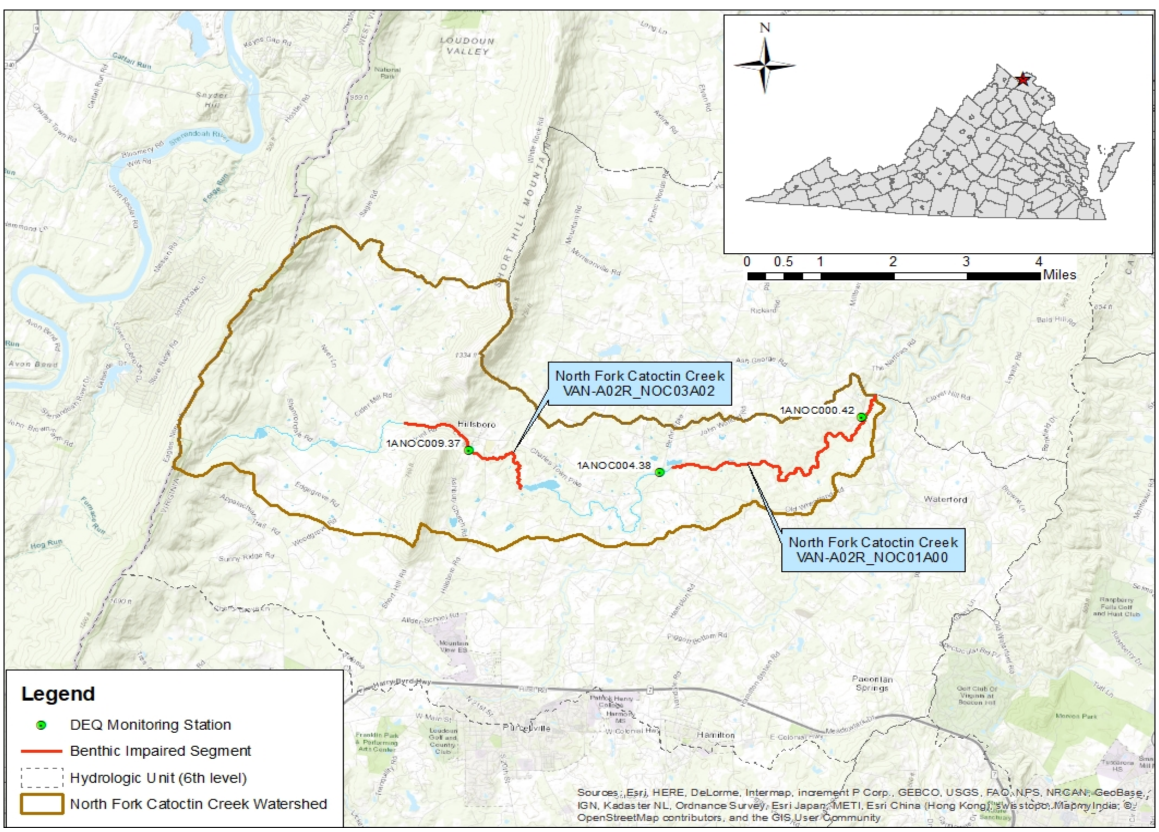

Figure 1. Impaired segments and DEQ monitoring stations in the North Fork Catoctin Creek watershed

An Impaired Stream

One indicator of an impairment of aquatic life is an unhealthy **benthic macroinvertebrate** community. Samples of benthic macroinvertebrates were collected at three locations in the North Fork Catoctin Creek watershed. DEQ biologists evaluated those samples to understand the health of the "bugs" that live in the bottom (benthos) of the stream. They found there is not a healthy and diverse community in the upper and lower sections of the creek, while the middle section of the creek supports a healthy benthic community. As a result of the biological sampling, two sections of North Fork Catoctin Creek, the upper and downstream sections, are identified as impaired for aquatic life on Virginia's impaired waters list (formally known as the Section 305(b)/303(d) Water Quality Assessment Integrated Report).

Benthic Macroinvertebrates: Bugs that are large enough to be seen with the naked eye, do not have a backbone, and live on the bottom (benthos) of the stream.

Table 1. Summary of Stream Segments with a benthic impairment in North Fork Catoctin Creek watershed (based on the 2018 305(b)/303(d) Water Quality Assessment Integrated Report).

Impaired Stream Name	305(b)/303(d) Assessment Unit ID	Initial Listing Year	DEQ Listing Station	Impairment Size	Impairment Length Description
North Fork Catoctin Creek	VAN-A02R_NOC01A00	2008	1ANOC000.42	4.42 miles	Confluence with an unnamed tributary to North Fork Catoctin Creek, approximately 0.15 river miles downstream from the Route 287 bridge to the confluence with Catoctin Creek
North Fork Catoctin Creek	VAN-A02R_NOC03A02	2014	1ANOC009.37	2.54 miles	Confluence with an unnamed tributary to North Fork Catoctin Creek, approximately 0.75 river miles upstream from Route 719 near Hillsboro, and continues downstream 2.45 river miles to an unnamed impoundment

Because a benthic impairment is based on a biological inventory of the "bugs" collected through sampling, rather than from physical or chemical water quality sampling, a stressor analysis study is conducted to understand the most likely causes of the unhealthy benthic macroinvertebrate community (called "stressors"). The analysis conducted for North Fork Catoctin Creek found the upper section of the creek is primarily impacted by low-flow conditions (a non-pollutant), which means there is not enough water in the stream to support a healthy benthic community. For the lower section, the stressor analysis concluded it is primarily impacted by excessive sediment, which is a CWA pollutant warranting development of a TMDL.

Figure 2. Types of Benthic Macroinvertebrates (Left to Right: Dragonfly larva, Stonefly nymph, Caddisfly larvae, Flathead mayfly larva, and Oligochaeta worm)

When too much sediment makes its way into our waterways, it settles out onto the bottom of the stream, changing the habitat and harming the aquatic environment. Many benthic macroinvertebrates make their home in the spaces between rocks and gravel on the bottom of the stream. When there is too much sediment, spaces between the rocks are filled in, removing their safe home and making it difficult to travel and find food. Below is an illustration of a healthy stream bed versus one with too much sediment.

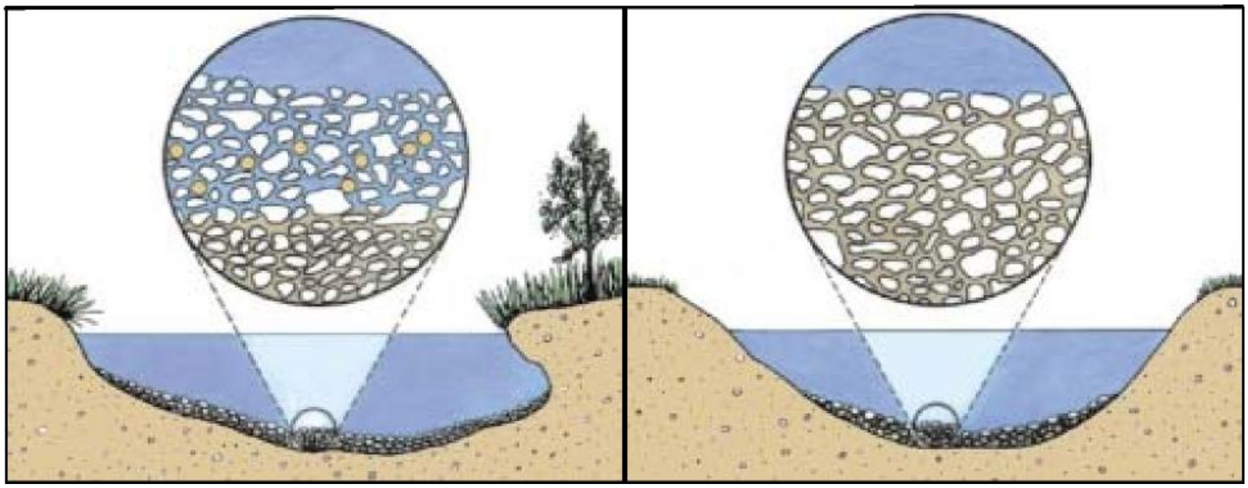

Figure 3. Example of a healthy stream bottom (left) and a stream bottom with too much sediment (right).

Once a pollutant is identified, in this case sediment, a TMDL is developed as the first step toward taking action to restore water quality. A TMDL may only be developed for a pollutant based upon the way the CWA is written. Therefore, this TMDL addresses the impairment in the lower section caused by sediment. However, due to the manner in which the TMDL is modeled because the impairment is located at the bottom of the watershed, the TMDL encompasses the entire North Fork Catoctin Creek watershed. More information on monitoring data may be found under Section 3 of the plan, while information on the stressor analysis is under Section 4 and Appendix B.

Addressing Land Use Changes in the Watershed

The North Fork Catoctin Creek watershed is experiencing residential growth and development. As a result, the use of the land is changing from agriculture and forested to more residential, which changes the nature of the nonpoint sources contributing sediment to the stream. Understanding the nature of this growth was accomplished by reviewing Loudoun County's "Existing and Potential Development Mapping Tool" (EPD) that identifies build-out scenarios based on current zoning. From that information and stakeholder input, future land use was estimated.

The Technical Advisory Committee (TAC) recommended future land use estimates, and not existing loads, be considered in the development of the TMDL to account for increased sediment load from transitional (land under construction) and developed land uses. The TAC preferred this approach to provide more opportunity for urban best practices (such as stream restoration) in light of their knowledge of the potential for residential development to occur in the watershed.

Additionally, this acknowledges their concerns of higher sedimentation rates during land disturbance.

Visit Section 6.2.3 of the report for more information on future growth.

Developing the TMDL

A TMDL is based the equation shown and described below:

$$TMDL = WLA + LA + MOS$$

Where:

WLA = waste load allocation (point source permitted contributions, including future growth);
LA = load allocation (nonpoint source contributions); and
MOS = margin of safety.

In other words, the TMDL is based on the Waste Load Allocation (WLA), plus the Load Allocation (LA), plus the Margin of Safety (MOS). The WLA is the part of the TMDL equation reserved for point source (such as from a pipe) discharges that are required to be permitted to govern releases of pollutants into waterbodies. The LA is the part of the TMDL equation reserved for non-point source (dispersed, such as runoff from a field or parking lot) discharges that DEQ does not have authority to regulate with a permit. This latter source of pollution is commonly referred to as “nonpoint source pollution,” is typically addressed through voluntary actions supported by DEQ and other partners through grants and other incentives. The MOS is a cushion added to the TMDL equation to account for uncertainties in the other two values such as changes in stream flows or other variables inherent in these studies.

A **modeling approach** is used to develop a TMDL to 1) identify the current condition of the watershed in terms of the existing sources and loads of the pollutant, 2) estimate the unimpaired condition, meaning how much of the pollutant the waterbody can handle and still meet WQS and finally 3) determine how much the pollutant needs to be reduced from the current condition to achieve the unimpaired condition. From there, allocations are identified for each source of the pollutant, in the form of a WLA or LA.

Modeling Approach: A simplification of a real-world system (i.e. watershed) to help predict and manage water resources.

For this TMDL, the Generalized Watershed Loading Functions (GWLF) model was used to simulate **sediment loads** in the North Fork Catoctin Creek. The GWLF model uses a variety of data to simulate the watershed, including weather and erosion estimates. Sources of sediment were analyzed, including both permitted point sources and unpermitted nonpoint sources. For more information on the modeling approach used, see Sections 5 and 6 and Appendices C, D and E of the plan.

Sediment Load: The amount of sediment carried in a waterbody (i.e. stream run-off or discharge)

Permitted point sources were identified for the North Fork Catoctin Creek watershed by searching DEQ's permitting program records, which document all permitted discharges to state waters. There are five domestic sewage discharge general permits for single-family homes in the North Fork Catoctin Creek watershed (Table 2). As of January 2018, there was one active construction stormwater general permit (Table 3) with a total area of 344 acres; it is within both the North Fork Catoctin Creek and South Fork Catoctin Creek watersheds. The WLA of the TMDL is comprised of these permitted sediment sources and also considers future growth of point sources by 2%, to account for potential expanding or additional permitted sources.

Table 2. General permit discharges into North Fork Catoctin Creek.

Permit Number	Facility Name	Design Daily Flow (MGD)*	Permitted Average TSS Concentration (mg/L)	Permitted Annual TSS Load (tons/yr)
VAG406086	Domestic Sewage	0.001	30	0.04
VAG406103	Domestic Sewage	0.001	30	0.04
VAG406477	Domestic Sewage	0.001	30	0.04
VAG406539	Domestic Sewage	0.001	30	0.04
VAG406175	Domestic Sewage	0.001	30	0.04

* MGD – million gallons per day

Table 3. Construction stormwater general permit permitted discharges into North Fork Catoctin Creek.

			Total Area		North Fork Catoctin Creek Watershed		
Permit Number	Operator Name	Construction Activity Location Name	Total Area of Development (acres)	Estimated Area to be Disturbed (acres)	Estimated Area of Development (acres)	Estimated Area to be Disturbed (acres)	Annual Disturbed Area (acres/yr)
VAR10D141	Carrington Builders at Wheatland LCC	Old Wheatland Estates	344	181.9	165	87.2	21.8

The TMDL equation includes a 10% MOS, which accounts for uncertainty based on best professional judgement and input from the TAC. The final part, the LA, is the amount remaining, the TMDL minus the sum of WLA and MOS. Table 4 below summarizes the annual sediment TMDL for the North Fork Catoctin Creek watershed.

Table 4. Sediment TMDL and components (tons/yr) for North Fork Catoctin Creek.

Impairment	TMDL	WLA		LA	MOS
	(tons/yr)				
Cause Group Code A02R-02-BEN					
North Fork Catoctin Creek VAN-A02R_NOC01A00	2,936.6	99.1		2,543.8	293.7
		VAG406086	0.04		
		VAG406103	0.04		
		VAG406175	0.04		
		VAG406477	0.04		
		VAG406539	0.04		
		Construction	40.18		
		Future Growth WLA	58.73		

Visit Section 7 of the plan for more information on development of the TMDL.

Approaches to Implement the TMDL

The second step in the overall TMDL process consists of implementing the TMDL. The WLA part of the TMDL equation, which addresses permitted, point sources, is implemented through DEQ's permitting programs. The Virginia Pollution Discharge Elimination System (VPDES) program and Virginia Stormwater Management Program (VSMP) permits set conditions and limits on the allowable releases of pollutants that are consistent with the assumptions and requirements of the TMDL. Permits are assigned these limits, or WLAs, during issuance (for new permits) or reissuance (for existing permits).

The LA portion of the TMDL equation, which focuses on nonpoint sources, is addressed through voluntary actions guided by an **Implementation Plan.** This type of plan consists of strategies or ways to reduce sources of sediment so less sediment makes its way to the stream. It identifies nonpoint sources of sediment and actions and best practices recommended to reduce the pollutant loads they convey to the stream. It also outlines a timeline for full implementation of the identified best practices, which typically is over a 10 or 15 year horizon. The selected best practices are intended to be both realistic for the watershed and also cost-effective. This process involves seeking out and incorporating input from local stakeholders from agricultural, business, governmental sectors, and other interested parties. The public participation process helps to identify feasible and achievable steps needed to meet the goals set in this TMDL.

Implementation Plan: Identifies specific, voluntary steps to meet pollutant reduction goals for nonpoint sources.

For more information on the approaches to implement the TMDL, visit Section 8 of the plan.

Identifying Sediment Allocations for Nonpoint Sources

Identifying all nonpoint sources of the pollutant is the starting point of Implementation Plan development. Those sources comprise the Load Allocation (LA) portion of the TMDL equation. Once the type of nonpoint sources contributing the pollutant are known, actions and best practices can be chosen that are best suited to target those sources.

Due to the residential growth and development occurring and anticipated to continue in the North Fork Catoctin Creek watershed, the TMDL equation is based upon projected future growth. However, due to uncertainty inherent in predicting future growth, two distributions of the LA over the sources of sediment were developed, one based upon future land use and one on existing land use. The first LA distribution, identified as "Strategy 1," is based upon future conditions and focuses on increased sediment loads from developed and transitional (land under construction) land uses, as well as increased channel erosion, that will accompany projected residential and urban build-out in the watershed.. For Strategy 1, the overall reduction in estimated future sediment loads needed to achieve the TMDL's LA is 30.3% (Table 5).

The second LA distribution scenario, identified as "Strategy 2" (Table 6), focuses on existing conditions and sediment loads from agricultural land use types. Strategy 2 focuses solely on additional best management practices for pasture land use type to meet the sediment load allocation as an alternative in case the anticipated growth does not occur, or occurs more slowly, than projected. If future growth does not occur, Strategy 2 will require a 33.4% overall sediment reduction.

More information on the distribution of the LA can be obtained from Section 8.3.4 of the plan.

Table 5. North Fork Catoctin Creek sediment TMDL load allocation (LA), Strategy 1.

Land Use/Source Group	Future Land Area (acres)	Future Sediment Load (tons/yr)	Strategy 1	
			% Reduction	Load (tons/yr)
Row Crops	904.7	585.9	37.5%	366.2
Pasture / Hay	3,577.3	1,905.9*	27.4%	1384.6
Forest	6,013.3	178.5	0.0%	178.5
Developed, impervious	201.5	45.0	37.5%	28.1
Developed, pervious	3,996.1	514.3	37.5%	321.5
Transitional, non-regulated	52.9	373.4	37.5%	233.4
Channel Erosion		46.2	37.5%	28.9
Total Load		**3,649.2**		**2,541.1**
LA =	(tons/yr)	**2,543.8**		
Needed Reduction = (tons/yr)		1,105.4		
% Reduction Needed = (%)		30.3%		

*Includes adjustment for existing BMPs

Table 6. North Fork Catoctin Creek sediment TMDL load allocation (LA), Strategy 2.

Land Use/Source Group	Existing Land Area (acres)	Existing Sediment Load (tons/yr)	Strategy 2	
			% Reduction	Load (tons/yr)
Row Crops	1,154.7	747.6	40.1%	447.8
Pasture / Hay	4,565.7	2,517.5*	32.7%	1693.3
Forest	7,252.0	215.2	0.0%	215.2
Developed, impervious	84.8	18.9	33.3%	12.6
Developed, pervious	1,679.1	216.1	33.3%	144.1
Transitional, non-regulated	9.6	68.2	74.0%	17.7
Channel Erosion		36.8	70.5%	10.9
Total Load		**3,820.3**		**2,541.6**
LA =	(tons/yr)	**2,543.8**		
Needed Reduction = (tons/yr)		1,276.5		
% Reduction Needed = (%)		33.4%		

*Includes adjustment for existing BMPs

Selecting Practices to Minimize Sediment from Nonpoint Sources

Once the nonpoint sources of sediment are identified and the sediment loads are allocated among the various land use types, one can then identify the specific best practices aimed at reducing sediment. The type and quantity identified for each of the best practices in the plan are those necessary to achieve water quality goals for the watershed. DEQ anticipates the effort to reduce sediment in the watershed will take time and that meeting WQS is a long-term goal. Therefore, the plan recommends prioritizing best practices based upon those that address the largest source of sediment. For North Fork Catoctin Creek, streamside fencing for cattle and improved pasture management are practices to prioritize as those address sediment that comes from pasture lands, which are the largest source of sediment loads.

As mentioned above, two distributions of sediment allocations for the Load Allocation (LA) (Strategies 1 and 2) were developed, with Strategy 2 serving as a conservative measure should future growth not occur as anticipated. To carry this conservative measure forward, best practices are grouped into two stages (Stages 1 and 2), providing an order for which best practices are to be pursued first and then second. Stage 1, to be implemented first, focuses on addressing sediment from land disturbance activities (identified as pervious/impervious developed, transitional/non-regulated and channel erosion land use types). Stage 1 practices are those necessary to meet the sediment reduction goals identified for "Strategy 1" (future conditions).

Stage 2 identifies additional best practices necessary to achieve sediment reduction goals identified for "Strategy 2" (existing conditions) should planned development not occur as expected. Therefore, best practices identified for Stage 2 focus on sediment sources from agricultural land uses, specifically pasture. Stage 2 is intended to be implemented second, in addition to the practices identified for Stage 1, if planned development is found to occur more slowly than anticipated.

Visit Sections 10.1 and 10.2 of the plan for information on selecting implementation practices.

Agricultural Best Practices

Specific best practices for agricultural land uses were identified. These practices are categorized as livestock exclusion best practices and land based agricultural best practices for pasture and cropland. Restricting cattle access to streams reduces stream bank erosion and pasture/cropland improvements reduce sediment transport to streams via stormwater runoff. The agricultural best practices identified for Stage 1 include livestock exclusion and land based agricultural practices. Only land based agricultural best practices are needed for Stage 2. The necessary practices to achieve water quality goals for each strategy are summarized in Tables 7 and 8 below. Potential locations for livestock exclusion fencing are shown in Figure 4.

Table 7. Livestock exclusion needed to achieve reduction of pasture sediment load.
Assumes one exclusion system averages 1,800 linear feet of fencing.

Fencing needed	LE-1T/SL-6/SL-6AT (35 foot buffer): 95%		LE-2T (10 foot buffer): 5%	
feet	feet	systems	feet	systems
4,512	4,286	3	226	1

Table 8. Land based agricultural best practices needed to achieve reduction of pasture and cropland sediment load.

Land Use	BMP	Acres	
		Stage 1	Stage 2
Pasture	Riparian buffers included with livestock exclusion practices	4	-
	Woodland filter buffers	18	-
	Grass riparian buffers	2	-
	Improved pasture management (beef)	939	582
	Improved pasture management (equine)	235	146
	Afforestation of highly erodible pasture	14	-
	Critical area stabilization	1	-
Cropland	Cover crops (annual acreage)	771	137
	Long term vegetative cover on cropland	97	210

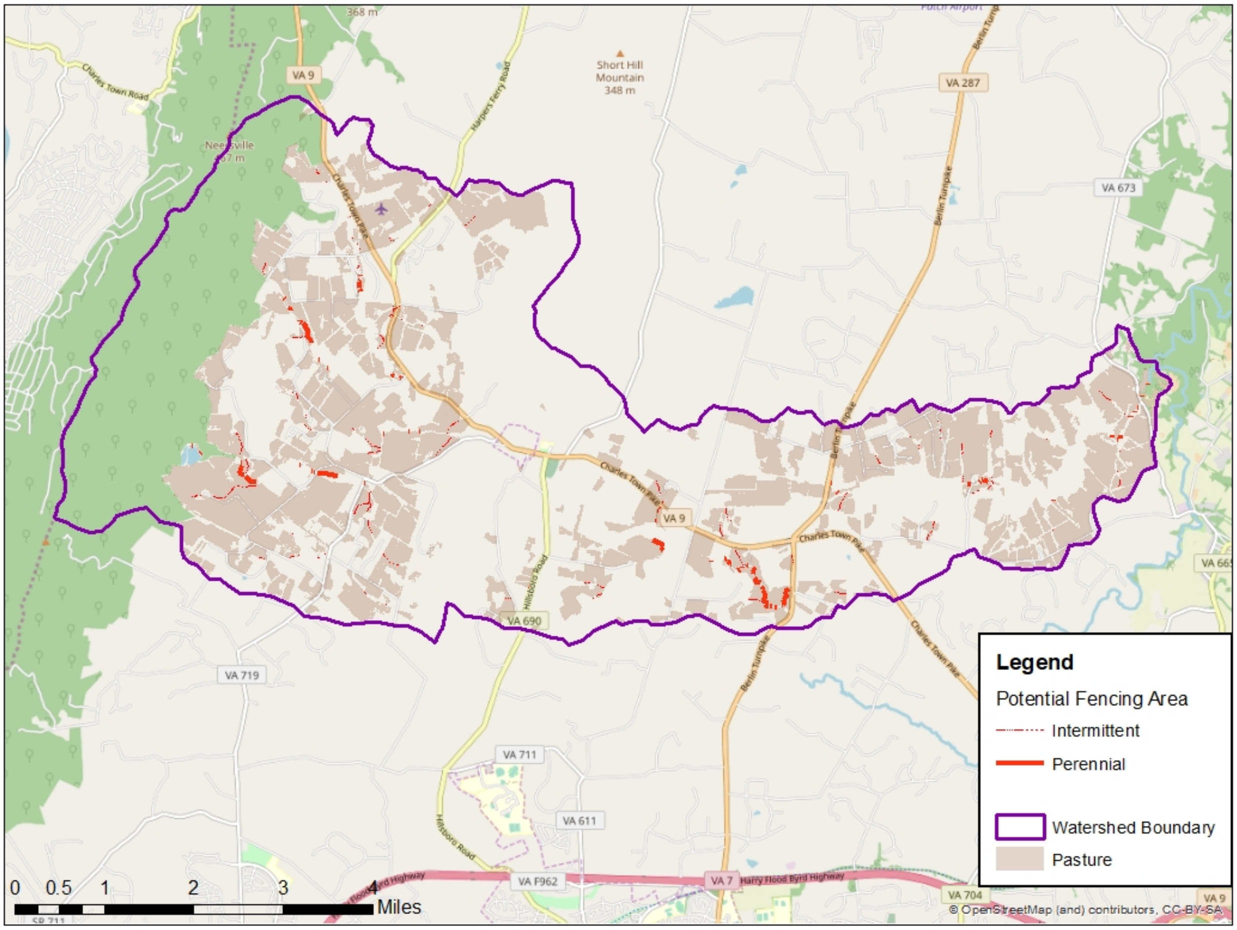

Figure 4. Potential livestock stream exclusion fencing areas (highlighted in red) in North Fork Catoctin Creek watershed. NOTE: Existing livestock exclusion practices are included.

Additional information on agricultural best practices can be found under Section 10.2.1 of the plan.

Streambank and Channel Restoration Best Practices

Efforts to stabilize stream banks or restore the stream are recommended in this plan based upon input from the TAC that this is a realistic practice for this watershed. By stabilizing banks or restoring degraded streams, sediment losses during high flow events will be significantly reduced. These practices are based upon planned development and will be implemented in Stage 1 (which represents the sediment loads based upon future growth). The practices identified as necessary to achieve water quality goals are summarized in Table 9 below.

Table 9. Streambank and channel restoration needed to achieve reduction of instream sediment load.

Streambank stabilization	Stream channel restoration
linear feet	linear feet
291	500

Additional information on streambank and channel restoration best practices can be found under Section 10.2.2 of the plan.

Residential and Urban Best Practices

Best practices identified to address sources of sediment from residential and developed land use types are based upon the future growth anticipated to occur in the North Fork Catoctin Creek watershed. Therefore, these practices are based upon planned development and will be implemented in Stage 1 (which represents the sediment loads based upon future growth). The practices identified as necessary to achieve water quality goals are summarized in Table 10 below, all of which serve to reduce the amount of sediment transported by stormwater from developed land to streams.

Table 10. Land based residential and urban best practices needed to achieve reduction of transitional and residential sediment load.

BMP	Units	Extent
Erosion and sediment controls	Acres treated	53
Bioretention	Acres treated	89
Rain gardens	Acres treated	0.1
Riparian buffers – grassed	Acres treated	469
Riparian buffers – trees	Acres treated	156
Urban infiltration	Acres treated	104

Additional information on residential and urban best practices can be found under Section 10.2.3 of the plan.

Conservation Easements

The plan recommends efforts to restore water quality of this watershed to include strengthening older **conservation easements** to improve their water quality protections. It encourages pursuing new easements to increase the percentage of land under easement in the watershed, which will establish protections where none currently exist. Conservation easements preserve land in a largely undeveloped state, which can reduce sediment losses. The first step to pursuing this effort is to identify the percentage of land under easement and the extent of those existing protections, as it pertains to water quality protections.

Conservation Easement: A voluntary agreement between a landowner and a qualified conservation organization or public entity that excludes certain activities on private land to protect and conserve its values permanently.

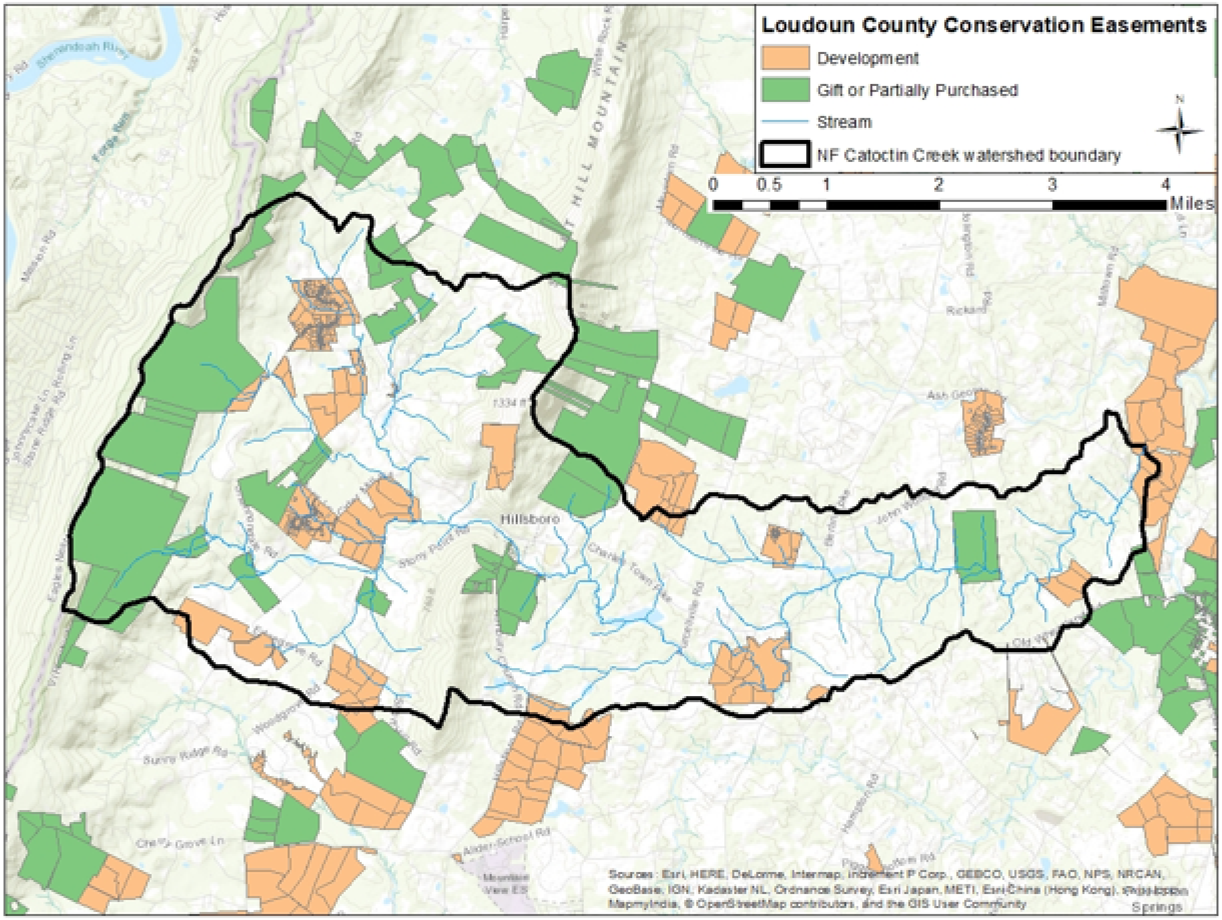

Figure 5. Conservation easements in the North Fork Catoctin Creek watershed

Additional information on conservation easements in the watershed can be found under Section 10.3 of the plan.

Costs and Funding Needs to Support Voluntary Implementation

When selecting best practices to address pollutant sources from unpermitted nonpoint sources, the costs for those are considered as well as the benefits to be gained. This is necessary to ensure the best practices proposed are potentially viable from an economic standpoint for the watershed, while understanding the gains that can be realized if those in the watershed are willing to incur the upfront costs. Because these best practices are voluntary to implement, this part of the plan also reviews possible funding opportunities to help support nonpoint source implementation efforts with incentives for landowners' participation.

Costs and Benefits of Best Practices

The costs identified for each of the best practices were estimated based upon existing data for those practices and input from the TAC. The majority of the recommended agricultural practices are included in state and federal cost share programs. These programs offer financial assistance and other incentives to the landowner to encourage voluntary participation. The total costs per each category of best practices is provided in Tables 11-13 below. Table 14 provides the overall total costs for plan.

Table 11. Agricultural BMP implementation costs by stage.

Practice	Cost share code	Units	Unit cost	Cost by Stage		
				Stage 1	Stage 2	TOTAL
Livestock exclusion with riparian buffers	LE-1T, SL-6, SL-6AT	system	$30,000	$90,000	-	$90,000
Livestock exclusion with reduced setback	LE-2T	system	$25,000	$23,000	-	$23,000
Exclusion fence maintenance (10 yrs)	N/A	feet	$3.50	$790	$789	$1,579
Woodland filter buffers	FR-3	acres	$1,500	$27,000	-	$27,000
Grass riparian buffers	WQ-1	acres	$150	$300	-	$300
Improved pasture management (beef)	SL-10T, EQIP 528	acres	$100	$93,900	$58,200	$152,100
Improved pasture management (equine)	SL-6AT	acres	$1,000	$235,000	$146,000	$381,000
Afforestation of erodible pasture/cropland	FR-1	acres	$560	$7,840	-	$7,840
Critical area stabilization	SL-11	acres	$2,550	$2,550	-	$2,550
Small grain cover crops	SL-8B	acres	$55	$42,405	--	$42,405
Long term vegetative cover on cropland	SL-1	acres	$60	$5,820	$12,600	$18,420
TOTAL ESTIMATED COST				$528,605	$217,589	**$746,194**

Table 12. Residential BMP implementation costs by stage.

Practice	Cost share code	Units	Unit cost	Cost by Stage		
				Stage 1	Stage 2	TOTAL
Erosion and sediment control	N/A	acres treated	$500	$26,500	-	$26,500
Bioretention	N/A	acres treated	$15,000	$1,335,000	-	$1,335,000
Rain gardens	N/A	acres treated	$15,000	$1,500	-	$1,500
Riparian buffers - grassed	N/A	acres treated	$500	$234,500	-	$234,500
Riparian buffers - trees	N/A	acres treated	$1,000	$156,000	-	$156,000
Urban infiltration	N/A	acres treated	$11,000	$1,144,000	-	$1,144,000
TOTAL ESTIMATED COST				$2,897,500	-	**$2,897,500**

Table 13. Streambank and channel restoration BMP implementation costs by stage.

Practice	Cost share code	Units	Unit cost	Cost by Stage		
				Stage 1	Stage 2	TOTAL
Streambank stabilization	WP-2A	feet	$300	$87,300	-	$87,300
Stream restoration	N/A	feet	$1,000	$500,000	-	$500,000
TOTAL ESTIMATED COST				$587,300	-	**$587,300**

Table 14. Total BMP implementation costs by stage.

BMP Application	Cost by Stage		
	Stage 1	Stage 2	TOTAL
Agricultural	$528,605	$217,589	**$746,194**
Stream bank and channel	$587,300	-	**$587,300**
Residential/urban	$2,897,500	-	**$2,897,500**
TOTAL ESTIMATED COST	$4,013,405	$217,589	**$4,230,994**

Additional information on costs associated with the best practices can be found under Section 11.1 of the plan.

A qualitative assessment was conducted to understand the benefits that can be realized if the upfront costs are incurred. While the main benefit is cleaner water in North Fork Catoctin Creek, there are other benefits of implementing those practices, such as clean water supply that reduces livestock illnesses when cattle are restricted access to the stream. This assessment looked at benefits gained from agricultural practices, residential and urban stormwater management practices and watershed health. Information on the cost benefits analysis is provided under Section 11.3 of the plan.

Staffing Needs to Assist with Implementation

In addition to understanding the cost to implement voluntary best practices, the plan also considers costs associated with staff needed to manage grants to fund implementation and assist in efforts to find opportunities and work with interested landowners to install best practices. For this plan, it was anticipated one full time position at a cost of $60,000 per year will be needed. Over the course of the 10 year horizon for the plan, the total “technical assistance” cost comes to about $600,000. For more information on technical assistance costs, visit Section 11.2 of the plan.

Funding Opportunities

There are a variety of funding opportunities available to support implementation of the plan in the North Fork Catoctin Creek watershed. The types of funding that commonly support implementation projects once an Implementation Plan is approved by DEQ and USEPA are USEPA 319(h) funding, Virginia Agricultural Best Management Practices Cost-Share Program, Virginia Conservation Assistance Program (VCAP), and USDA’s Conservation Reserve Enhancement Program (CREP). A description of these programs as well as a complete summary of possible funding opportunities recommended for this watershed are provided under Section 14 of the plan.

Identifying Results of Voluntary Efforts to Address Nonpoint Sources

The timeframe Implementation Plans identify over which the best practices that address nonpoint sources should be implemented to reach water quality goals is typically 10 or 15 years. The first period identified pertains to the time it will take to install all best practices identified by the plan, which is known as "full implementation." The second period typically discussed is the time to reach the water quality goal, resulting in a **delisting** of the impaired section of waterbody due to its water quality being restored.

> **Delisting**: Removal of a waterbody from the impaired waters list based upon new data that shows WQS are met for that waterbody.

Goals and Milestones

For this plan, a 10 year horizon was agreed to by the TAC for full implementation of best practices. Within those 10 years, implementation will occur in two stages, identified as Stage 1 (years 1-10) and if needed, Stage 2 (years 6-10). The sediment reduction goals for Stage 1 are identified by the load allocation (LA) distribution scenario for the future condition known as "Strategy 1" (Table 5). The second stage, Stage 2, will only be initiated if it is observed during implementation of the plan that projected future growth is either not occurring or occurring more slowly than anticipated. In that situation, in Year 6, efforts will shift to include implementation of best practices identified for Stage 2, in addition to those practices identified for Stage 1. Under Stage 2, additional agricultural management practices would be implemented to address the larger amount of agricultural lands in the watershed than assumed in the future growth condition ("Strategy 1"). In this case, the sediment reduction goals will change to the LA distribution scenario for the existing condition known as "Strategy 2" (Table 6).

Then, once practices are installed, an additional 5 years was identified to meet the goal of restored water quality in the impaired section of stream. The additional 5 years acknowledges the time needed between when best practices finish being installed and when improvements in water quality and biological samples should be evident. More information on the goals and milestones for this plan can be found under Section 12.1.

Monitoring Water Quality

Water quality and biological monitoring is a key component to understanding the effects the implementation of best practices has on the watershed's water quality. Monitoring efforts are conducted by DEQ as well as citizens and organizations active in the watershed. The monitoring activities conducted by DEQ are part of the Agency's overall water quality monitoring program for Virginia. Additional monitoring conducted by citizens and other organizations helps to improve understanding of the water quality conditions of the waterbody. Timing of monitoring events takes into consideration when best practices were installed, due to the time lag in seeing changes in water quality and the biological community. Visit Section 12.2 of the plan for information on recommended monitoring.

Involving the Public and Stakeholders

The public participation component of TMDL and Implementation Plan development serves to inform the public of the effort and encourage their participation. Their input and local knowledge helps to ensure the TMDL and Implementation Plan will be suitable for the watershed.

The stressor analysis conducted to identify the most probable stressor to the benthic community comprised of 1 public meeting and 2 Technical Advisory Committee (TAC) meetings. For development of this plan, which comprises development of the TMDL and Implementation Plan, 2 public meetings and 4 TAC meetings were held. Local citizens and representatives from the Catoctin Creek Scenic River Advisory Committee, Loudoun County, Loudoun Soil and Water Conservation District, Piedmont Environmental Council, Town of Purcellville, Virginia Cooperative Extension and Virginia Department of Forestry contributed their knowledge and insights during the TAC meetings. Information on those meetings is provided under Section 9 of the report.

Implementation of best practices that address nonpoint sources is dependent on stakeholder participation and strong leadership by the community and local conservation organizations. DEQ helps to support implementation of voluntary best practices through its grant programs and work with local partners, such as the Soil and Water Conservation Districts. More information on stakeholders and their roles in implementation can be found under Section 13.1 of the plan.

Complementary Water Quality Improvement Efforts

Efforts to address the benthic impairment in this watershed will benefit and complement other ongoing work to improve the water quality in watersheds that are downstream. This means that the best practices installed to improve the water quality in the North Fork Catoctin Creek watershed will help to improve the water quality of Catoctin Creek, the Potomac River and ultimately the Chesapeake Bay. Similarly, efforts conducted to support restoration of the water quality of those larger watersheds that take place in North Fork Catoctin Creek's watershed will benefit this local watershed. For example, an Implementation Plan developed to implement a TMDL addressing a bacteria impairment in the Catoctin Creek watershed resulted in implementation of best practices from 2005 to 2010 to reduce bacteria loadings. Many of the best practices placed in the North Fork Catoctin Creek watershed to reduce bacteria also help to reduce sediment loads. For more information on similar links to on-going restoration efforts, visit Sections 8.3.5 and 13.2 of the plan.