Albemarle County

Local TMDL Action Plan:

Sediment TMDLs for Moores Creek, Lodge Creek, Meadow Creek, and Schenks Branch

For Special Condition (Part II.B) of the
2018-2023
VPDES General Permit for
Small Municipal Separate Storm Sewer Systems
VAR040074

prepared by:
Albemarle County
Environmental Services Division
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April 30, 2021

Table of Contents

List of Acronyms

BMP – Best Management Practice

DEQ – Virginia Department of Environmental Quality

GIS – Geographic Information Systems

MS4 – Municipal Separate Storm Sewer System

POC – Pollutant of Concern

RCA – Rivanna Conservation Alliance

RSEP – Rivanna Stormwater Education Partnership

TMDL – Total Maximum Daily Load

UVA – University of Virginia

WLA – Waste Load Allocation

Introduction

Albemarle County has prepared this Local Total Maximum Daily Load (TMDL) Action Plan to address Sediment TMDLS for Moores Creek, Lodge Creek, Meadow Creek, and Schenks Branch. Specifically, this report fulfills the "Local TMDL Special Condition" portion of the MS4 General Permit (Part II.B). The specific contents included in this Action Plan, as required by the MS4 Permit Part II.B.3, are listed below and addressed in respective sections of this Action Plan:

a. The TMDL project name;
b. The EPA approval date of the TMDL;
c. The wasteload allocated to the permittee (individually or in aggregate), and the corresponding percent reduction, if applicable;
d. Identification of the significant sources of the pollutants of concern discharging to the permittee's MS4 and that are not covered under a separate VPDES permit. For the purposes of this requirement, a significant source of pollutants means a discharge where the expected pollutant loading is greater than the average pollutant loading for the land use identified in the TMDL;
e. The BMPs designed to reduce the pollutants of concern in accordance with Parts II B 4, B 5, and B 6;
f. Any calculations required in accordance with Part II B 4, B 5, or B 6;
g. For action plans developed in accordance with Part II B 4 and B 5, an outreach strategy to enhance the public's education (including employees) on methods to eliminate and reduce discharges of the pollutants; and
h. A schedule of anticipated actions planned for implementation during this permit term.

Albemarle County collaborated with the University of Virginia and the City of Charlottesville in preparation of this Action Plan. However, each entity has produced its own Action Plan.

The County intends to implement this Action Plan through multiple permit cycles using an adaptive, iterative approach as progress is demonstrated toward achieving reductions necessary to meet the waste load allocations (WLAs). While this Action Plan presents current and future practices intended to mitigate sediment impairments described in this report, the County reserves the right to substitute/modify other projects and practices for the ones described in this report.

1. TMDL Project Name and EPA Approval Dates (*Parts II.B.3.a,b*)

The report titled *Sediment TMDLs for Moores Creek, Lodge Creek, Meadow Creek, and Schenks Branch prepared by the Virginia Department of Environmental Quality (DEQ)* establishes sediment TMDLs for Albemarle County. A revised report was published on January 20, 2016, and was approved by the EPA on July 26, 2016. This report is henceforth referred to as the "Sediment TMDL Report." (Additional sediment and bacteria TMDLs of relevance to Albemarle County are addressed by the County's existing combined local TMDL Action Plan.)

2. Pollutants Causing the Impairments

In 2006 and 2008, four stream segments, respectively located on Moores Creek, Lodge Creek, Meadow Creek, and Schenks Branch, were added to Virginia's 303(d) List of Impaired Waters for exceedance of water quality standards necessary to support aquatic life. The Sediment TMDL Report identified sedimentation as the most probable stressor in Moores Creek, whereas sediment and hydrologic modification were identified as most probable stressors in Meadow Creek, Schenks Branch, and Lodge Creek. To address these impairments, a plan to reduced sediment discharges to these stream segments is presented in the Sediment TMDL Report.

The impaired reaches applicable to this TMDL report are summarized below in Table 2.1. This table was taken directly from Table ES. 1. in the Sediment TMDL Report. Corresponding watersheds are shown in Figure 2.1.

Table 2.1 – Summary of impaired reaches addressed by this TMDL Action Plan.

Impaired Segment	Size	305(b) Segment ID	Initial Listing Year	Impairment Type
Moores Creek (VAV-H28R_MSC01A00)	6.37 miles	VAV-H28R_MSC01A00	2008	Benthic
Lodge Creek (VAV-H28R_XRC01A04)	1.57 miles	VAV-H28R_XRC01A04	2006	Benthic
Meadow Creek (VAV-H28R_MWC01A00)	4.0 miles	VAV-H28R_MWC01A00	2006	Benthic
Schenks Branch (VAV-H28R_SNK01A02)	1.13 miles	VAV-H28R_SNK01A02	2008	Benthic

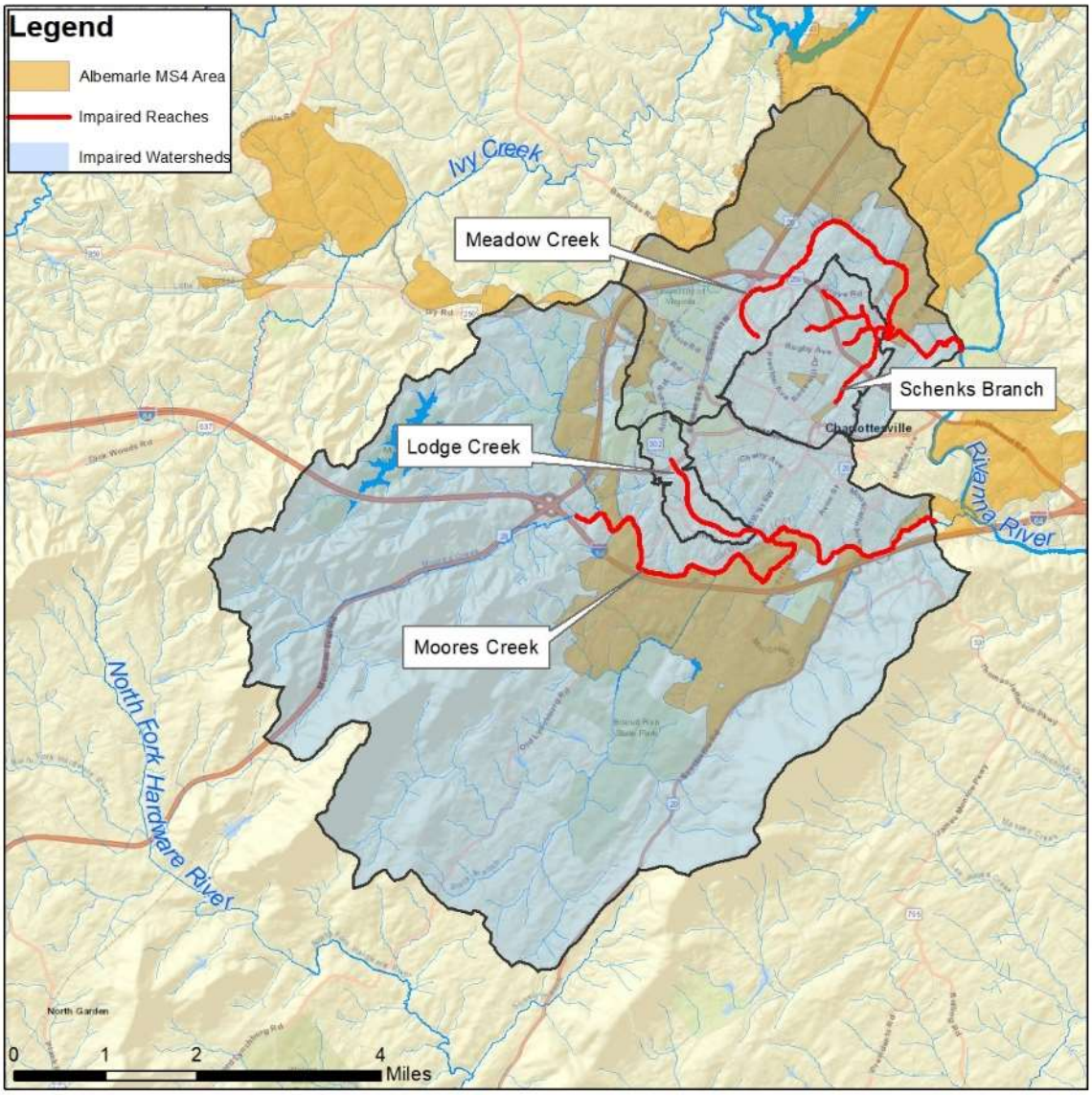

Figure 2.1. Sediment-Impaired Reaches and Watersheds Addressed in this Local TMDL Action Plan

3. Wasteload Allocations and Corresponding Percent Reductions (*Part II.B.3.c*)

The Sediment TMDL Report summarizes estimated existing sediment loads from each jurisdiction's MS4-regulated area into each impaired stream, and it provides an aggregate WLA and percent reduction requirement for each impaired waterbody (Sediment TMDL Report, tables 6-4 through 6-7). The existing and allocated aggregate loads (for all MS4 jurisdictions combined) assigned in the Sediment TMDL Report are summarized below in Table 3.1.

Table 3.1. Aggregate percent load reduction required, WLA, and summary of aggregate existing loads. (summary of TMDL Report Figures 6-4 through 6-7)

		Lodge Creek	Moores Creek	Meadow Creek	Schenks Branch
Aggregate Required Reduction		**50.1%**	**14.6%**	**50.7%**	**57.1%**
Aggregate WLA (tons/yr)		**45.6**	**713.8**	**442.6**	**126.7**
Pasture	Existing Loads (tons/yr)	0	10.3	0	0
Hay		0	25.5	14.4	0
Forest		1.06	36.9	17.7	1.3
Impervious developed		48.6	376.7	478.4	162.4
Pervious developed		36.24	292.6	304.7	110.7
Transitional		4.8	40.7	34.3	13.3
Channel Erosion		0.64	52.8	49	2.6
Total existing aggregate load		**91.3**	**835.5**	**898.5**	**290.4**

4. Significant Sources of Pollutants of Concern Discharging to the MS4 (*Part II.B.3.d*)

The General Permit (Part II.B.3.d) requires this Action Plan to include:

> *Identification of the significant sources of the pollutants of concern (POCs) discharging to the permittee's MS4 and that are not covered under a separate VPDES permit. For the purposes of this requirement, a significant source of pollutants means a discharge where the expected pollutant loading is greater than the average pollutant loading for the land use identified in the TMDL.*

The Sediment TMDL Report identifies that instream erosion contributes approximately 20% of sediment loads from MS4 areas to the impaired stream reaches. However; some sections of streams are known to experience greater erosion rates and will contribute above-average pollutant loadings. Through a program to assess and improve drainage infrastructure throughout the County's urban areas, and an additional ongoing effort to identify stream restoration needs and opportunities within the Biscuit Run Park in the Moore's Creek Watershed, Albemarle County is working toward identifying and prioritizing individual stream and channel reaches where instream erosion contributes loads that are significantly greater than average.

Because much of the County's urban area was developed prior to stringent stormwater quality and quantity control requirements, runoff from many developed areas in the County receives no stormwater treatment. Concentrated impervious and turf areas that are not treated by BMPs are expected to contribute greater than average sediment loading rates. These untreated areas contribute sediment in two primary ways; watersheds not served by water *quality* BMPs will contribute higher land-based sediment loads, and watersheds not served any runoff that is not detained by water *quantity* BMPs (such as traditional detention basins) will contribute greater stormflow energy into the downstream channel and therefore cause greater channel erosion.

5. BMPs Designed to Reduce Pollutants of Concern *(Part II.B.3.e - h)*

This section of the Action Plan describes County BMPs to reduce sediment pollution in line with General Permit Part II.B.3.e (BMPs designed to reduce the pollutants of concern) and Part II.B.5 (local sediment, phosphorus, and nitrogen TMDLs). This section also provides sediment reduction calculations, outreach strategies, and a schedule of anticipated milestones, as respectively required by General Permit Part II.B.3.f through h.

5.1 BMPs Designed to Reduce Sediment *(Parts II.B.5)*

Albemarle County has utilized and intends to utilize BMPs approved by the Chesapeake Bay Program in addition to other measures to reduce sediment loads into the sediment-impaired reaches of Moores Creek, Meadow Creek, Lodge Creek, and Schenks Branch (General Permit Part II.B.5.a). This section summarizes installed and planned BMPs to reduce sediment loads, presents calculations for sediment load removal (General Permit Part II.B.5.c), and presents a schedule of anticipated actions planned (General Permit Part II.B.3.h).

5.1.1 Lower Land Disturbance Thresholds *(Part II.B.5.a.3)*

In addition to structural BMPs, Albemarle County reduces sediment loads by utilizing a lower land disturbance threshold than required under Virginia Stormwater Management and Erosion and Sediment Control Regulations. Chapter 17 of the County Code – known as the Water Protection Ordinance (WPO) – is the primary legal mechanism through which the County regulates land disturbing activities, land development, illicit discharges, and impacts to riparian areas and other natural resources. Among many measures designed to reduce erosion and sediment pollution, the WPO includes a disturbance threshold for small construction activities of 10,000 square feet, as opposed to 1 acre required by Virginia's regulatory requirements.

5.1.2 Completed and Proposed Structural BMPs and Stream Restorations *(Part II.B.5.a.2)*

Since 2011 Albemarle County has constructed two stormwater facility retrofits and two stream restoration projects within the drainage areas of the sediment-impaired reaches of the Moores Creek, Meadow Creek, and Schenks Branch watersheds. The location of these BMPs relative to impaired reaches and watersheds is depicted in Figure 5.1.2. These BMPs are described in greater detail in the County's Phase II Chesapeake Bay TMDL Action Plan, but load removal calculations pertinent to this Action Plan are also provided in Section 5.2 of this Action Plan. In addition to already-completed BMPs, Albemarle County intends to construct additional Chesapeake Bay Program approved stormwater retrofits and stream restorations in order to reduce sediment loads into the locally-impaired reaches and the Chesapeake Bay.

As previously mentioned, the County is also currently in the process of assessing impaired streams within the Biscuit Run Park property, within the Moores Creek and Rivanna River watersheds. This project is expected to ultimately result in the construction of at least one stream restoration project. Please note that, while the County anticipates funding to be available based on current economic conditions, the County cannot guarantee the availability of future funding to construct these projects per the anticipated schedule provided below in Table 5.2.2. In addition, the County reserves the right to modify the projects proposed in Table 5.2.2 or substitute them for other projects and/or practices.

The City of Charlottesville, County of Albemarle, and UVA have agreed to take responsibility for the sediment loads generated within their MS4 regulated area boundaries regardless of sheet flow draining to or from another jurisdiction. Sediment reduction credit for BMPs installed on any lands with inter-jurisdictional sheet flow will be received by the permittee that installs and maintains the BMP. However, each entity reserves the right to enter into agreements in which TMDL credit is shared with adjacent permittees for any projects which treat drainage from their own and/or multiple permittees' lands.

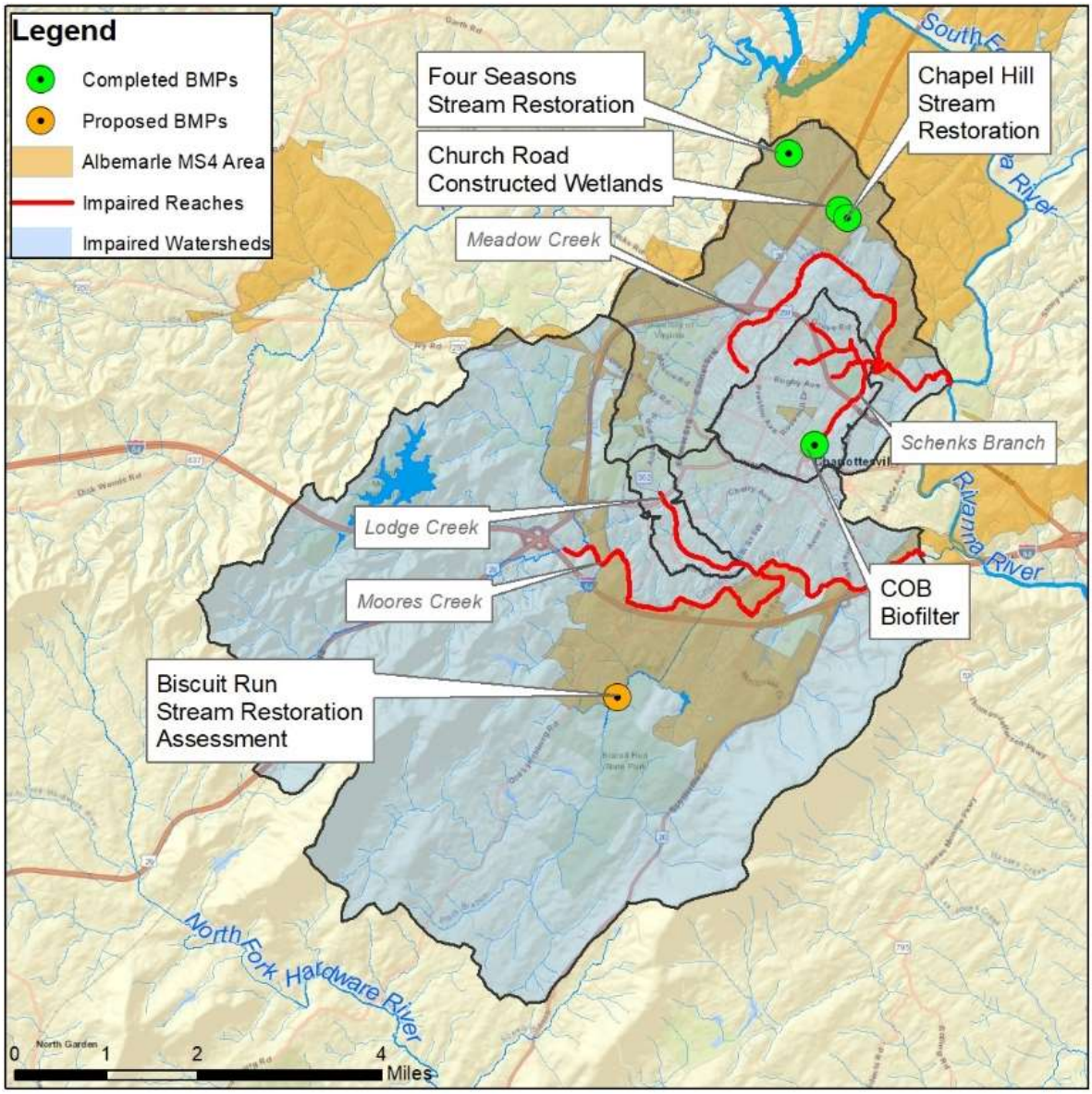

Figure 5.1.2. Completed and Proposed Structural BMPs for Sediment Removal

5.2 Sediment Load Reduction Calculations *(Part II.B.3.f)* and Schedule of Anticipated Actions *(Part II.B.3.h)*

The County has calculated sediment load reductions achieved through stream restoration projects and structural BMPs prior to this report in addition to anticipated reductions. Load reductions were calculated utilizing the Chesapeake Bay TMDL Action Plan Guidance Documents published by DEQ (Guidance Memos No. 15-2005 and 20-2003), with the exception of the land-based sediment loading rates. DEQ staff have indicated that it is not appropriate to use the edge of stream sediment loading rates provided in the Chesapeake Bay TMDL Action Plan Guidance Document Table 2a, as these loading rates reflect average sediment delivery into the Chesapeake Bay (not the Rivanna River) as a function of land use type.

As a result, County staff are utilizing loading rates for existing sediment discharges derived from Tables 6-4 through 6-7 in the Sediment TMDL report in order to calculate sediment loads removed by stormwater facilities. These loading rates, and the information from which they were derived, are summarized below in Table 5.2.1. Albemarle County staff intend to refer to existing total regulated sediment loads, as presented and disaggregated by MS4-permittee in Appendix F in the Sediment TMDL report, in order to estimate anticipated end-dates by which permittees will meet each WLA for sediment (General Permit Part II.B.5.d).

Table 5.2.1. Calculated Existing Sediment Load Rates for MS4-regulated Land Uses

Regulated Landuse Type	Lodge Creek - Table 6-4			Moores Creek - Table 6-5			Meadow Creek - Table 6-6			Schenks Branch - Table 6-7		
	Regulated Area (acres)	Existing sediment load (tons/yr)	**Calculated Loading Rate (lbs/ac/yr)**	Regulated Area (acres)	Existing sediment load (tons/yr)	**Calculated Loading Rate (lbs/ac/yr)**	Regulated Area (acres)	Existing sediment load (tons/yr)	**Calculated Loading Rate (lbs/ac/yr)**	Regulated Area (acres)	Existing sediment load (tons/yr)	**Calculated Loading Rate (lbs/ac/yr)**
Pasture				16.01	10.3	**1286.7**						
Hay				93.86	25.5	**543.4**	35.81	14.4	**804.2**			
Forest	50.04	1.06	**42.4**	1189.06	36.9	**62.1**	598.09	17.7	**59.2**	44.48	1.3	**58.5**
Impervious developed	156.81	48.6	**619.9**	1180.17	376.7	**638.4**	1337.67	478.4	**715.3**	475.54	162.4	**683.0**
Pervious developed	252.66	36.24	**286.9**	2759.24	292.6	**212.1**	2249.84	304.7	**270.9**	770.51	110.7	**287.3**
Transitional	1.12	4.8	**8571.4**	13.91	40.7	**5851.9**	9.96	34.3	**6887.6**	3.07	13.3	**8664.5**
Channel Erosion		0.64			52.8		0	49		0	2.6	
Totals	460.63	90.28		5252.25	762.8		4231.37	866.4		1293.6	289	

Calculations for sediment load reductions from the stream restoration and structural BMP projects described in section 5.1 are presented below in Tables 5.2.2 and 5.2.3, respectively.

Table 5.2.2. Sediment load reduction calculations for completed and proposed stream restorations

Project Name	Year Installed / anticipated	Lat	Long	Acres Treated	Length (LF)	Sediment removed (lb/yr)
Chapel Hills Stream Restoration	2019	38.072	-78.475	73.0	1,278	57,357*
Four Seasons Stream Restoration	2015	38.082	-78.487	12.6	360	92,000**
Biscuit Run Stream Restoration (*Proposed*)	Phased Project – Assumed design Commencing: in 2022	37.9954	-78.5221	7,680	1,000 (assumed for planning purposes)	44,880*

*Stream restoration sediment removal calculations utilize Interim Removal Rate Per Linear Foot of 44.88 lbs/day[1]
**Stream restoration sediment removal calculations provided in Appendix.

Calculations for the removal of sediment from structural BMPs are presented below in Table 5.2.2. Sediment load reduction was modeled pursuant to the Chesapeake Bay TMDL Action Plan Guidance Document, with the exception that watershed and land use-based loading rates presented in Table 5.2.1 of this report, as calculated from Tables 6-4 through 6-7 in the sediment TMDL report, were used to calculate sediment loads entering these facilities. Removal rates for the County Office Building Biofilter were calculated using the stormwater treatment / runoff reduction curves presented in the Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects[3]. Removal rates for the Church Road Constructed Wetlands were calculated using Chesapeake Bay Program Established Efficiencies[4]. Additional details regarding the sediment removal efficiencies of these BMPs are provided in Albemarle County's Chesapeake Bay TMDL Action Plan, which was submitted in October of 2019.

[1] Berg et al., 2014. Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects. Tom Schueler and Bill Stack, Chesapeake Stormwater Network.

[3] Bahr et al., 2012. Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects. Prepared by Tom Schueler and Cecilia Lane, Chesapeake Stormwater Network.

[4] Chesapeake Bay TMDL Action Plan Guidance Document published by DEQ (Guidance Memo No. 15-2005), Appendix V.C.

Table 5.2.3. Sediment load reduction calculations for completed and proposed sediment-reduction BMPs						
Project Name	**Year Installed**	**Imperv. Acres Treated**	**Pervious Acres Treated**	**Total Sediment Load (lb/yr)**	**Sediment Removal Rate (%)**	**Sediment Removal (lbs/yr)**
Church Road Constructed Wetlands	2015	39.1	26	35,001	51.0%	17,851
County Office Building (COB) Biofilter	2011	1.28	0.83	1,115	73.0%	813.7

5.3 Outreach Strategy *(Part II.B.3.g)*

This section of the Action Plan addresses strategies to enhance outreach and education for the public and County employees on methods to eliminate and reduce discharges of sediment. Albemarle County is a sponsor and active participant of the Rivanna Stormwater Education Partnership (www.rivanna-stormwater.org, RSEP), which is a collaboration between local MS4 permittees to promote education and outreach regarding local stormwater issues, including sediment-impaired waterbodies. As a group, RSEP developed an education and outreach plan for the 2018-2023 MS4 permit cycle. Table 5.3.1. lists all the activities in that plan that are relevant to sediment pollution, along with the anticipated frequency of each.

Table 5.3.1. Outreach & Education Strategies for the Public			
Strategy *Examples*	**Time Frame *Anticipated Frequency***	**Anticipated Relevant Message(s)**	**Relevant POC(s)**
Media Materials *Charlottesville Public Access Station PSAs*	Winter *Once during permit cycle*	We all prefer healthy streams and lakes…but most of our local waters are somewhat polluted. When it rains, pollution is carried directly into streams by runoff from parking lots, streets, and lawns. Here's what YOU can do to reduce pollution: (one) pick up after your pet, (two) don't over-fertilize your lawn, and (three) capture the water from your rooftop in a rain barrel...or in a rain garden. Do your part to keep our streams clean and healthy. Visit Rivanna-stormwater.org.	Sediment
Alternative Materials *Stickers*	Spring *Once during permit cycle*	Hand out stickers with stormwater focused messaging at Earth Week or other tabling events	Sediment
Media Materials *Social Media Promotion*	Twice Yearly *Annually*	Provide stormwater focused social media content to existing local Facebook pages or other social media outlets. Share stormwater video online.	Sediment

Applicable County employees undergo periodic training – either internally or externally – related to various MS4 functions. Some of the training topics relate to sediment reduction. Table 5.6.2 below largely reflects the employee training plan from the County's 2018 – 2023 MS4 Program Plan, with the addition of stream restoration maintenance which is related to sediment reduction. The frequency of these trainings is also included in the table.

Table 5.6.2. Outreach for County Employees

Department Receiving Training	Targeted Staff	Good Housekeeping / Pollution Prevention	Enhanced Training (for applicable staff)		
			Stream Restoration Maintenance	Spill Response	VA ESC
Frequency:	*biennial*	*To maintain certification*	*As needed*	*To maintain certification*	*To maintain certification*
Public Schools Building Services	• building maintenance • grounds management • custodians • mechanics • bus drivers • other field staff	x		x	
Community Development	• E&S control inspectors • building inspectors • zoning inspectors	x			x
Community Emergency Response Team	• all staff	x		x	
Emergency Communications Center	• all staff	x			
Fire & Rescue	• all staff	x		x	
Facilities and Environmental Services	• building maintenance • grounds management • custodians • project managers	x	x	x	
Parks and Recreation	• all staff	x		x	
Police	• all staff	x			
Purchasing	• all staff	x			
Social Services	• field staff	x			

6. Public Comment

On April 15, 2021, Albemarle County made a draft of this Action Plan available for public review and comment, as required by Part II.B.7 in the General Permit. As of the completion of this Action Plan, the County has not received any public comments.

7. Appendix: Supporting Documents

7.1 Four Seasons Stream Restoration Sediment Load Reduction Accounting

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

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April 15, 2014

Greg Harper
County of Albemarle
Water Resources Manager
401 McIntire Road, Room 224
Charlottesville, Virginia 22902-4596

VIA EMAIL: gharper@albemarle.org

Re: Defining Pollutant Reductions by Four Season Drive Channel Improvements
Albemarle County, Virginia

Dear Mr. Harper:

Timmons Group was contracted to analyze the applicability of three of the four (Protocols 1-3) *Recommended Protocols for Defining Pollutant Reductions Achieved by Individual Stream Restoration Projects*[1]. The following is a summary of our analysis.

Protocol 1: Credit for Prevented Sediment during Storm Flow

"This protocol provides an annual mass nutrient and sediment reduction credit for qualifying stream restoration practices that prevent channel or bank erosion that would otherwise be delivered downstream from an actively enlarging or incising urban stream," (Schueler and Stack 2013). Timmons Group followed the outlined three step process to compute a mass reduction credit for prevented sediment, as follows:

Step 1. The stream sediment erosion rates and annual sediment loadings were estimated utilizing the Bank and Nonpoint Source Consequences of Sediment (BANCS) Method developed by Rosgen (2001). On January 17, 2014, Timmons Group assessed the existing channel by performing a series of field data collection exercises including the Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS) assessments for each stream bank within the restoration reach. This assessment summary can be found on the enclosed Worksheet 3-13. Summary form of annual stream bank erosion estimates for various study reaches. Sample reaches were then assigned one of four (4) corresponding erosion rate categories ranging from "Low" to "Extreme," as illustrated on the enclosed BANCS Assessment Map. Based on this analysis, the existing channel can be classified as having an extremely high erosion rate (calculated unit erosion rate = 0.17 tons/yr/ft). Extrapolated along the existing restoration length, the overall sediment load is predicted to be 92 ton/yr.

Step 2. The erosion rates calculated using the BANCS method were converted to nitrogen and phosphorus loadings. Based on the published values presented in the guidance document for both phosphorus and nitrogen concentrations in stream bank sediments (1.05 pounds P/ton of sediment and 2.28 pounds N/ton of sediment), the predicted nutrient load resulting from erosion of the stream banks within the project limits is 97 lb/yr of phosphorus and 210 lb/yr of nitrogen.

[1] Provided as Section 5 in *Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects* prepared by Tom Schueler, Chesapeake Stormwater Network and Bill Stack, Center for Watershed Protection. The Water Quality Goal Implementation Team issued their final approval of this document on May 13, 2013.

Step 3. The protocol calls for a 50% effective reduction in the nutrient loading unless there is a representative "natural" condition from which the low BEHI and NBS scores can be estimated from, however the 50% effective reduction was used in this analysis. The following sediment and nutrient credits were determined for Protocol 1:

Sediment = 46 ton/yr
Total Phosphorus = 49 lb/yr
Total Nitrogen = 105 lb/yr

Protocol 2: Credit for In-stream and Riparian Nutrient Processing during Base Flow

"This protocol provides an annual mass nitrogen reduction credit for qualifying projects that include design features to promote denitrification during base flow," (Schueler and Stack 2013). To qualify for credit under Protocol 2, the bank height ratio is required to be 1.0 or less in order to promote hyporheic exchange between the stream channel and the floodplain rooting zone. The hyporheic box is calculated as the width of the channel plus five feet on either side of the stream bank, extending to a maximum depth of five feet, excluding areas of bedrock outcropping or confining clay layers. The box extends the length of the restored channel.

As a result of the project 360 linear feet of stream will be reconnected to the hyporheic zone. The area of the proposed hyporheic box is 98 ft^2, resulting in an estimated 2,205 tons of soil nutrient processing.

Protocol 2 limits the amount of reduction based on 40% of the contributing watersheds nitrogen load. The project will provide 64 lb/yr of nitrogen reduction.

Protocol 3: Credit for Floodplain Reconnection Volume

"This protocol provides an annual mass sediment and nutrient reduction credit for qualifying projects that reconnect stream channels to their floodplain over a wide range of storm events… A wetland-like treatment is used to compute the load reduction attributable to floodplain deposition, plant uptake, denitrification and other biological and physical processes," (Schueler and Stack 2013).

It appears the intent of Protocol 3 is to provide increased sediment and nutrient credit for restoration projects that include the design of wetlands within the project floodplain that are actively engaged during smaller storm events, specifically those less than the 1.5 year storm event. The result is a reduction in sediment and nutrient concentrations of the stormwater runoff from the contributing watershed by means of hydraulic detention and nutrient processing occurring in the floodplain wetlands. Therefore, the project should result in a minimum watershed to floodplain ratio of one percent to ensure adequate hydraulic detention time for flows in the floodplain. Further, the floodplains should be specifically designed to act as wetlands, and designers are afforded more credit for designs that engage the floodplain during smaller storm events (e.g., 0.25 or 0.5 inches).

The goal of this stream restoration project was to reduce erosion of the existing stream banks utilizing natural stream channel techniques. The proposed design primarily utilizes a Priority 3 restoration approach - widening the floodplain at the existing bankfull elevation. This is accomplished by creating a floodplain bench on one or both sides of the existing stream channel at the elevation of the existing bankfull stage (1- to 2-year storm event). A minimal floodplain bench is proposed, corresponding to 0.2 acres of the 13-acre project watershed, or only 0.83%. As this project does not meet the minimum floodplain to watershed ratio, nor include specifically designed wetland areas to be engaged in small storm events, Protocol 3 is not applicable.

Summary

Sediment and nutrient credits were computed for the Hoehns Lake Stream Restoration project, as follows:

Protocol	Phosphorous Credit (lbs/yr)	Nitrogen Credit (lbs/yr)	Sediment Removal Credit (ton/yr)
1	49	105	46
2	N/A	64	N/A
3	N/A	N/A	N/A
Total	49	169	46

Timmons Group thanks you for the opportunity to work on this project and assess the potential sediment and nutrient reduction credits associated with compliance with the Chesapeake Bay TMDL. We would be happy to meet with you to review our findings and to discuss our assumptions, the guidance documents, and the Protocols in-depth, as related to this and future projects for Albemarle County. Please contact us at your convenience to discuss the subject further.

Sincerely,

Timmons Group

Rebecca Napier, PE
Environmental Project Manager

Enclosures:

- Worksheet 3-13. Summary form of annual streambank erosion estimates for various study reaches.
- BANCS Assessment Map

7.2 RiverRun Stream Restoration Sediment Load Reduction Accounting

ECOSYSTEM SERVICES

POLLUTANT REDUCTION MEMO: RIVER RUN

1739A Allied St.
Charlottesville, VA 22903
540.239.1428
www.ecosystemservices.us
info@ecosystemservices.us

September 25, 2019

TO: Stavros Calos
Albemarle County Water Resource Program
401 McIntire Road
Charlottesville, VA 22902
434-296-5816 80 |scalos@albemarle.org

SUBJECT: As-Built Pollution Reduction Report – River Run

Summary:
The pollutant reductions reported in table 1 associated with Protocol 1 below are 2.3% higher than those reported in the memo dated December 19th, 2017 to reflect new erosion rate curves released with the Phase 6 Chesapeake Bay Model. Otherwise, the methodology is identical to that reported on December 19th, 2017. Edge of stream loading and reduction rates have been removed since the Phase 6 model now calculates delivery loads based on the project's location. Protocol 2, nitrogen reductions due to floodplain connection, have been added. Protocol 3 was assessed, but due to limited riparian area and volume under 1' of depth, removal efficiencies were less than 1% and would yield less than 1 lb TP/yr.

Table 1: As-built pollutant reduction achievements

Method	TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)
Protocol 1	101.18	106.24	230.70
Protocol 2	0	0	64.63
Total	**101.18**	**106.24**	**295.33**

1.1. Methodology: Protocol 1

1. Perform a geomorphic survey of the project reach
2. Conduct Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS) assessments in accordance with standards set forth by the Chesapeake Bay Field Office (USFWS A, 2004) & (USFWS B, 2004)
3. Estimate bankfull height based on field identified bankfull indicators and hydraulic geometry
4. Conduct bulk density testing
5. Estimate erosion rates using the Bank Assessment for Non-point-source Consequences of Sediment (BANCS) model with the erosion rate curves provided by the Chesapeake Bay Program in the documentation for the Chesapeake Assessment Scenario Tool
6. Calculate edge of field sediment loading rates by multiplying the volumetric erosion rate by the field-measured bulk density
7. Calculate edge of field nitrogen and phosphorous loading rates by multiplying the sediment

loading rate by nitrogen and phosphorous concentrations supplied by the Expert Panel.

8. Calculate the edge of field pollutant reduction rate by applying a restoration efficiency to the edge of field loading rates supplied by the Expert Panel.
9. **Validate:** Conduct post-construction BEHI on representative cross-section to ensure that BEHI is rated as moderate or less to receive credit.

1.2. Methodology: Protocol 2

Section 5 of the Expert Panel Guidance outlines the methodology for calculating nitrogen reductions from increased hyporheic exchange between the stream channel and the floodplain rooting zone. Since the floodplain rooting zone depth is limited, credit is only available for reaches in which the bank height ratio (low bank height to bankfull depth) is less than 1.0. In this case, 570.53 linear feet of the restored stream has a bank height ratio of less than 1 foot. The downstream section of the restored reach drops in elevation to tie to the existing stream, and as such, has a slightly higher BHR. The reduction rates achievable along these stretches are largely based on in-situ denitrification studies conducted on restored streams in the Baltimore metropolitan area by Kaushal et al., 2008 and Striz and Mayer, 2008.

For credit calculations, the hyporheic zone is modeled as a rectangular tunnel with a width that stretches 5 feet on either side of the median base flow width, a depth of 5 feet, and a length equal to the qualified stream length (the entire reach in this case). It is within this volume of soil that denitrification occurs at a rate of 1.06×10^{-4} pounds/day/ton of soil (Kaushal et al., 2008). The accounting process for Protocol 2 credit calculations are as follows:

1. Estimate the median base flow width
2. Calculate the volume of hyporheic exchange tunnel and weight of soil contained therein using bulk densities from Protocol 1
3. Apply the denitrification rate to yield the nitrogen reductions due to hyporheic exchange

The median baseflow width was estimated using measured base flow during asbuilt conditions.

1.3. Nutrient & Sediment Loading Estimate

Sediment loading was calculated by performing a BANCS assessment to estimate erosion rates. Then the associated nutrient loading was calculated based on nutrient concentrations determined by Walter et al. (2007), consistent with the Expert Panel Guidance and shown in table 3. Inputs of the BANCS model include: bank erosion hazard index (BEHI) parameters, near bank stress (NBS) parameters, bank length, bank height, bulk density, and bankfull depth. Changes in BEHI parameters were geolocated using a survey grade GPS along the left and right bank and were combined with reconnaissance level 1 near bank stress (NBS) ratings to calculate erosion rates in feet per year. The area of bank subject to erosion was taken to be the area between the top and toe of the banks which were geolocated using a total station

during the geomorphic survey conducted in October 2017. Bank height was calculated for sections between each change in NBS or BEHI parameter which follows the assumption that variations in bank height will correspond to a break in at least 1 BANCS parameter. Bankfull height was estimated using bankfull indicators and regional hydraulic geometry curves. Bulk density testing of stream bank sediments was performed using a modified USDA-NRCS methodology, the results of which are shown in table 2. With these inputs, a volumetric erosion rate could be calculated and multiplied by the bulk density to determine the edge of field (EoF) sediment loading rate shown in table 4. EoF nutrient loading rates were calculated by multiplying the EoF sediment loading rate by the nutrient concentrations shown in table 3.

Table 2: Bulk density results

Bank Length (ft)	Bulk Density (lbs/cf)
574.88	73.20
379.07	76.30

Table 3: Nutrient concentrations

Associated Pollutant	lbs/ton of soil
TP	1.05
TN	2.28

Table 4: Pre-restoration pollutant loading rates

Loading Region	TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)
Edge of Field	202.36	212.483	461.392

Watershed loading rates using TMDL Action Plan guidance can be found in Table 5 below. The methodology for Protocol 2 requires that reductions cannot exceed the loading produced by the watershed. The reductions achieved by Protocol 2 are verified as less than the loading produced by the watershed.

Table 5: Watershed Pollutant Loading

TP=	21.10	lb/yr
TN=	322.64	lb/yr
TSS=	13432.17	lb/yr

1.4. Restoration Efficiency

The Expert Panel conservatively assumed a 50% restoration efficiency for calculating pollutant reductions for Protocol 1. The Panel also decided that if monitoring proves an efficiency greater than 50%, a revised efficiency may be applied to all previous and subsequent credit releases. This efficiency is applied to the EoF pollutant loads from table 4 to determine the EoF reductions found in table 1 at the top of this document.