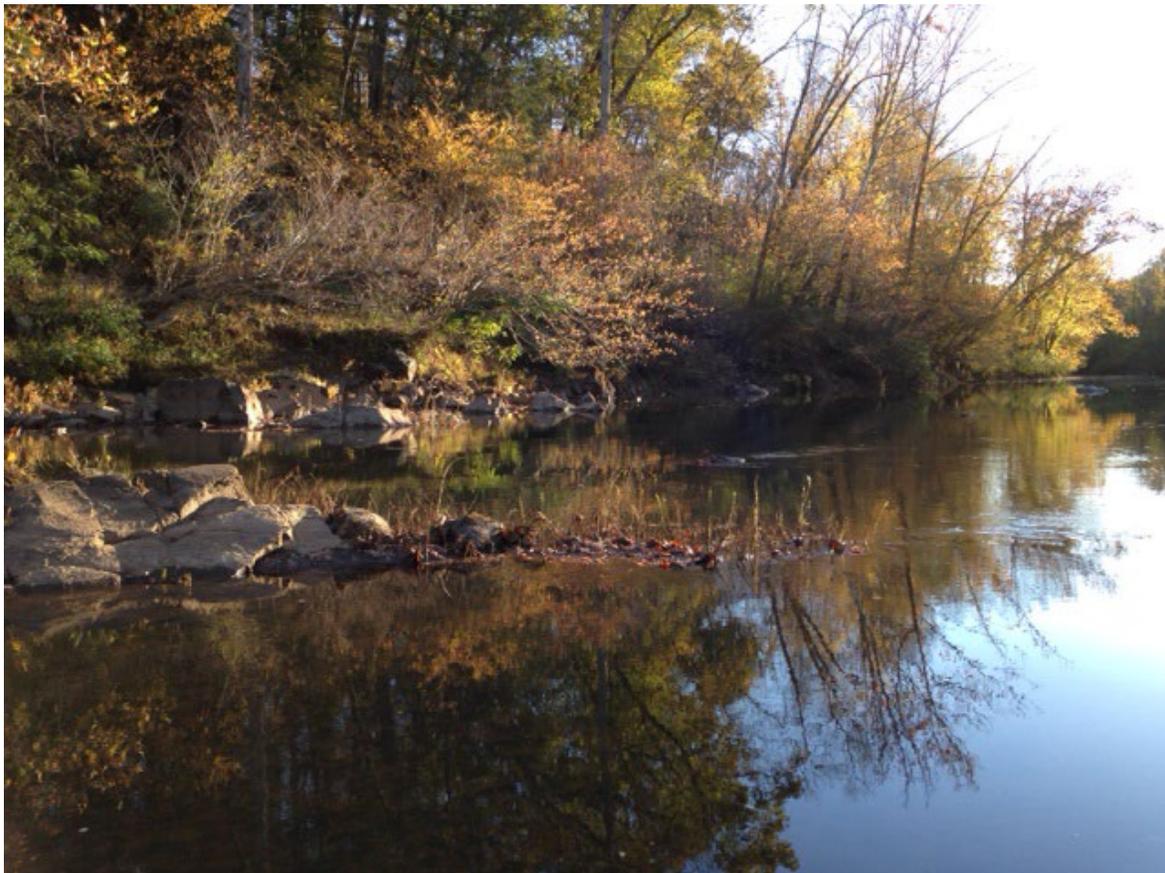




City of Charlottesville, Virginia

Combined Benthic and Bacteria Total Maximum Daily Load (TMDL) Action Plan for the Rivanna River



*MS4 General Permit Registration Number VAR040051
April 2025*

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Background

The City of Charlottesville, Virginia's corporate limits and population of just over 48,000 people are located within the 750 square mile Rivanna River watershed. The Rivanna River watershed is part of the larger James River watershed, the largest watershed in Virginia; the James River is a major tributary of the Chesapeake Bay. Originating from springs in the foothills of the Blue Ridge Mountains, the Rivanna River flows along the eastern portion of Charlottesville and forms a boundary with neighboring Albemarle County. The Rivanna River and its urban tributaries provide important ecological, recreational, and cultural value to the city.

The city's 10.2 square miles contain approximately thirty-five miles of open waterways, with approximately thirteen additional miles of waterways that flow inside of the stormwater infrastructure system. Charlottesville consists of three main drainage areas. Along the eastern portions of the city, approximately 1.3 square miles of land drain through tributaries of or directly into the Rivanna River. The Meadow Creek and Moores Creek watersheds are the two largest drainage areas within the city and both drain into the Rivanna River. The Meadow Creek watershed spans the northern portion of the city and has a highly urbanized drainage area of approximately eight square miles, about 70 percent of which is located within the city limits. Moores Creek, which has its headwaters in Albemarle County, forms the southern boundary of the city; approximately 3.8 square miles of the city drain into the creek. The thirty-five square mile Moores Creek watershed encompasses diverse land uses including highly urbanized areas, suburban and rural, agricultural, as well as open space within Charlottesville and Albemarle County.

The City has a municipal separate storm sewer system (MS4), meaning there are two separate conveyance systems for stormwater and sewage, with wastewater from residents and businesses flowing to the wastewater treatment plant, and stormwater draining untreated directly into local surface waters. As a result of stormwater runoff's impacts to water quality, stormwater discharges from MS4s are regulated by the United States Environmental Protection Agency (EPA) under the Clean Water Act and by the Commonwealth of Virginia under the Virginia Stormwater Management Act. The regulations governing MS4s were developed and implemented in two phases. The first phase began in the early 1990s, requiring operators of MS4s serving populations of greater than 100,000 people to apply for and obtain a permit to discharge stormwater collected by their systems into waterways. The second phase of MS4 regulations became effective March 23, 2003, and requires that operators of small MS4s (less than 100,000 people) in "urbanized areas" obtain permit coverage for stormwater discharges. Small MS4s include stormwater systems operated by cities such as Charlottesville, as well as counties, towns, community colleges, and public universities.

In Virginia, discharges from small MS4s are regulated by the Department of Environmental Quality (DEQ), under the *General Permit for Discharges of Stormwater from Small Municipal Separate Storm Sewer Systems* (MS4 General Permit). Under that permit, small MS4s must develop, implement, and enforce a stormwater management program that addresses six "minimum control measures (MCMs)" to control the discharge of pollutants from the MS4 to "the maximum extent practicable" through the development and implementation of best management practices (BMP).

As required by the EPA and Commonwealth of Virginia, the City of Charlottesville operates and enforces a stormwater management program. The City was originally issued a stormwater discharge permit from DEQ on March 4, 2003 (Permit No. VAR040051). Subsequently, regulatory authority and program

oversight was transferred to the Virginia Department of Conservation and Recreation (DCR) in January 2005, and the permit expired on December 9, 2007. This permit was administratively extended while new permit requirements were being finalized. The City's second MS4 General Permit was issued by DCR on July 9, 2008 and remained in effect until July 1, 2013. Regulatory authority and program oversight was transferred back to DEQ in 2013, and the City's third MS4 General Permit was issued on July 1, 2013 and the permit expired on October 31, 2018. This permit was administratively extended while new permit requirements were being finalized. The City's fourth MS4 General Permit was issued by DEQ on November 1, 2018 and remained in effect until it expired on October 31, 2023. The City's fifth, and current, MS4 General Permit was issued on November 1, 2023 and will remain in effect until it expires on October 31, 2028.

The City has prepared this local TMDL Action Plan to address Part II.B of the City's MS4 General Permit, *Local TMDL Special Condition*. This included an evaluation of the results achieved by the previous version of the Action Plan. While the benthic and bacteria impairments remain in place for the Rivanna River, the actions documented in the Action Plan were completed in accordance with the MS4 General Permit and have contributed to the reduction of sediment and bacteria inputs to the Rivanna River. The City coordinated with the County of Albemarle (the County) and the University of Virginia (UVA) in the development of this Action Plan. The City posted this Action Plan for public comment in accordance with Part II.B.9 of the MS4 General Permit. No public comments were received.

The requirements of this Action Plan, as presented in Part II.B of the MS4 General Permit, are below:
B. Local TMDL special condition.

2. Permittees previously covered under the General VPDES Permit for Discharges of Stormwater from MS4 effective November 1, 2018, shall develop and maintain a local TMDL action plan designed to reduce loadings for pollutants of concern if the permittee discharges the pollutants of concern to an impaired water for which a TMDL has been approved by the U.S. Environmental Protection Agency (EPA) as described in Part II B 2 a and 2 b:

a. For TMDLs approved by EPA prior to July 1, 2018, and in which an individual or aggregate wasteload has been allocated to the permittee, the permittee shall develop and initiate or update as applicable the local TMDL action plans to meet the conditions of Part II B 4, B 6, B 7, and B 8, as applicable, no later than 18 months after the permit effective date and continue implementation of the action plan. Updated action plans shall include:

- (1) An evaluation of the results achieved by the previous action plan; and
- (2) Any adaptive management strategies incorporated into updated action plans based on action plan evaluation.

b. For TMDLs approved by EPA on or after July 1, 2018, and prior to October 31, 2023, and in which an individual or aggregate wasteload has been allocated to the permittee, the permittee shall develop and initiate implementation of action plans to meet the conditions of Part II B 4, B 5, B 6, B 7, and B 8, as applicable no later than 30 months after the permit effective date.

3. The permittee shall complete implementation of the TMDL action plans as determined by the schedule. TMDL action plans may be implemented in multiple phases over more than one permit cycle using the adaptive iterative approach provided adequate progress is achieved in the implementation of BMPs designed to reduce pollutant discharges in a manner that is consistent with the assumptions and requirements of the applicable TMDL.

4. Each local TMDL action plan developed by the permittee shall include the following:
 - 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 that are not covered under a separate VPDES permit. For the purposes of this requirement, a significant source of pollutants of concern 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 5, B 6, B 7, and B 8;
 - f. Any calculations required in accordance with Part II B 5, B 6, B 7, and B 8;
 - g. For action plans developed in accordance with Part II B 5, B 6, and B 8, 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.

The City intends to implement this Action Plan through multiple MS4 General Permit cycles using an adaptive iterative approach, making progress to reduce pollutant discharge in a manner consistent with the assumptions and requirements of the applicable TMDL WLAs. While this Action Plan presents current and future practices intended to mitigate sediment and bacteria impairments described in this report, the City reserves the right to make modifications to the Action Plan as new opportunities become available or proposed projects and strategies are deemed infeasible or ineffective.

TMDL Action Plan

1. The TMDL project name; (General Permit Part II.B.4.a)

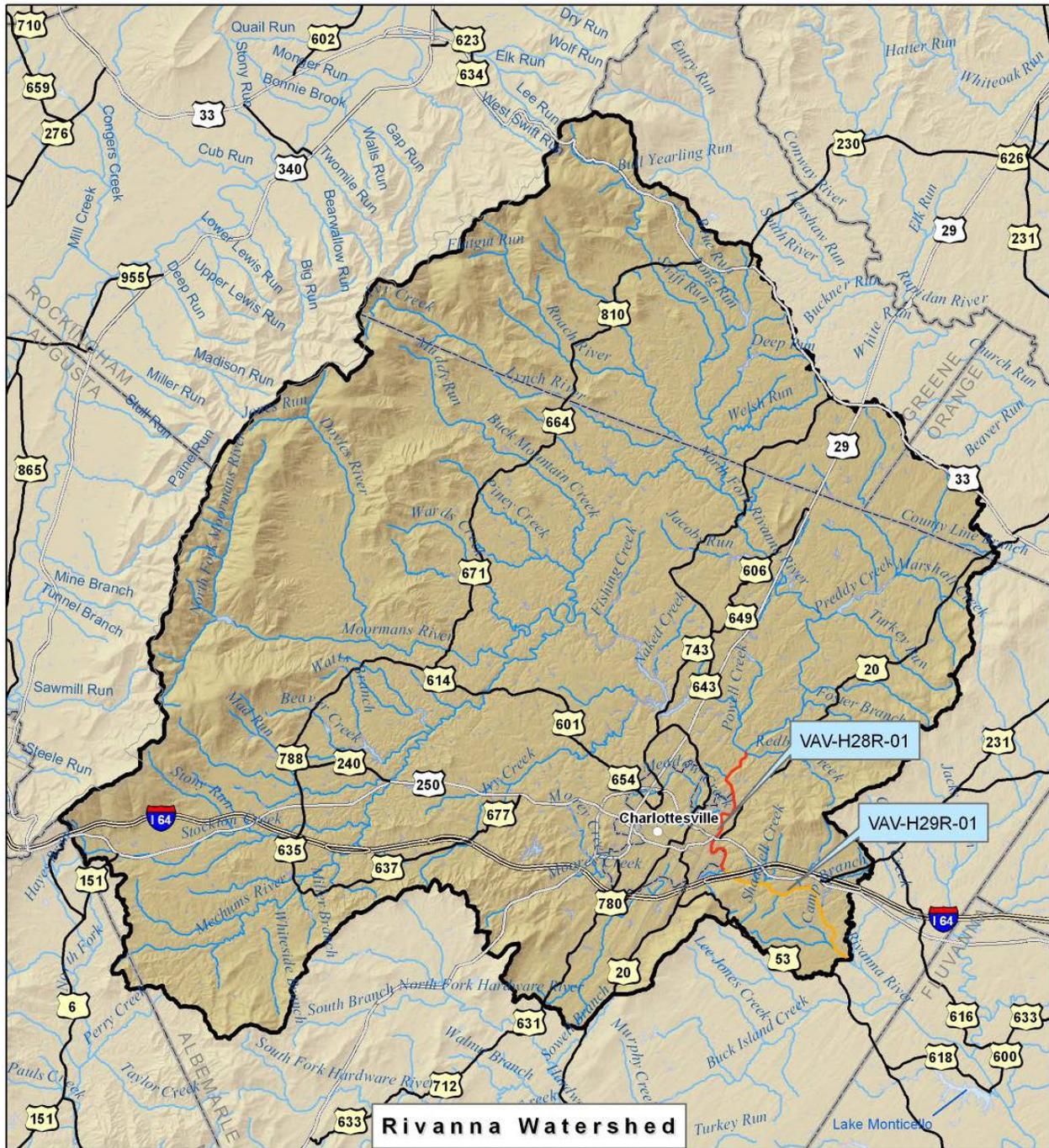
Benthic TMDL

- *Benthic TMDL Development for the Rivanna River Watershed, Final Report (dated March 2008)*

The Benthic TMDL Report noted above identified two separate stream segments with benthic impairments for the main stem of the Rivanna River; segment VAV-H28R-01 and segment VAV-H29R-01. These segments are included in Virginia's 303(d) List of Impaired Waters. An analysis of the candidate stressors indicated that sedimentation is the most probable cause of the impairment and is the basis of the TMDL.

As required by Section 303(d) of the Clean Water Act and current EPA regulations, states are required to develop Total Maximum Daily Loads (TMDLs) for waterbodies that exceed water quality standards. One segment of the Rivanna River mainstem was first included on Virginia's 1996 Section 303(d) List of Impaired Waters, and was subsequently included on Virginia's 303(d) Lists of Impaired Waters and Water Quality Assessment 305(b)/303(d) Integrated Reports because of violations of the General Standard (benthic impairment). During the 2006 303(d) assessment, DEQ concluded that a second segment was also biologically impaired (DEQ, 2006).

Below is Figure 1-1 from the Benthic TMDL Report: Rivanna River Benthic Impaired Segments and Delineated Watershed.



Legend		 Sources: USGS - National Hydrography Dataset, VADEQ - Watersheds, Municipalities ESRI - Roads 	MAP INDEX
○ Populated Places — Streams □ County Boundary 303 (d) Impaired Segments — VAV-H28R-01 — VAV-H29R-01	Major Roads === Interstate — US Hwy — State Hwy — Other		

Bacteria TMDL

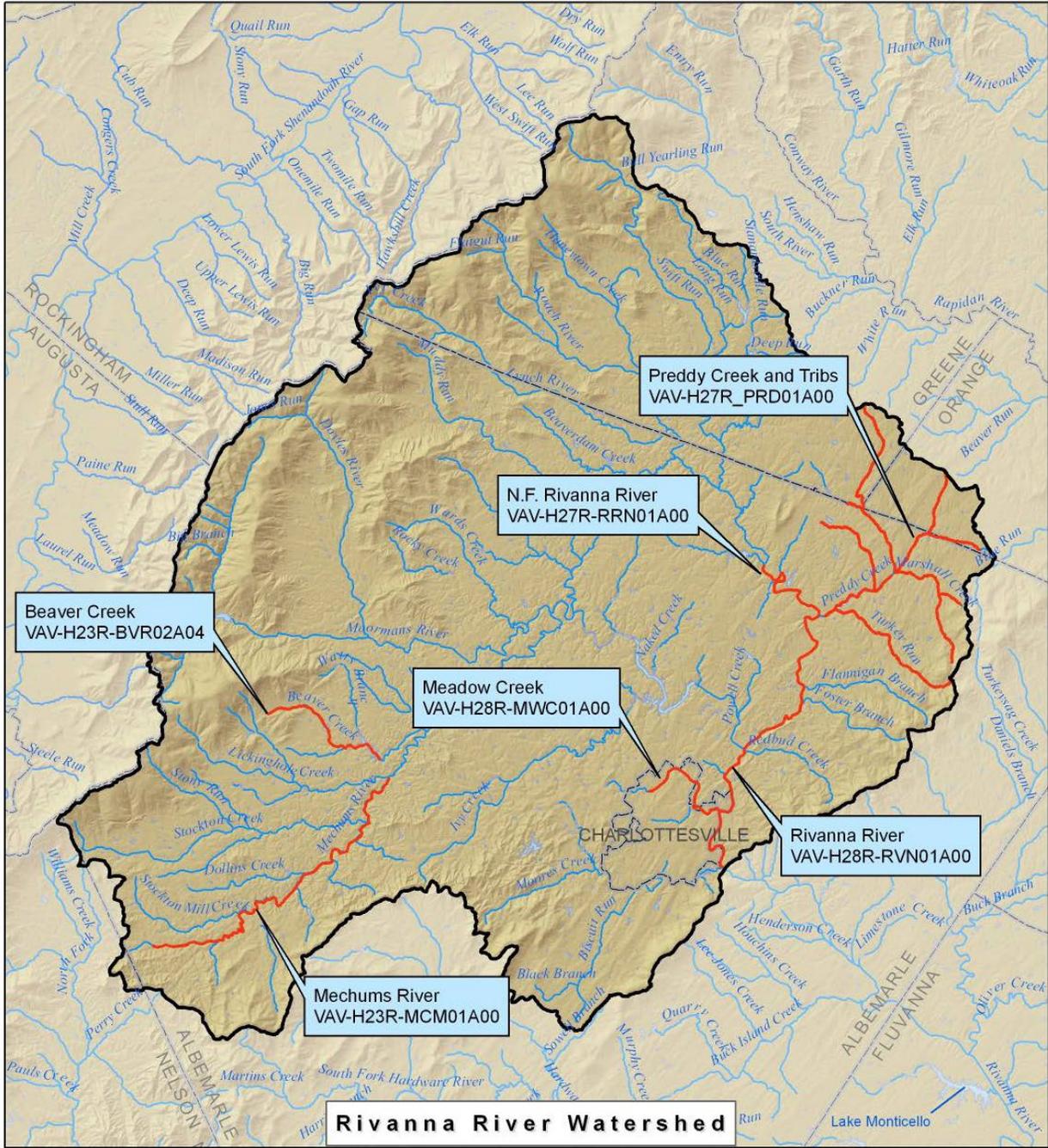
- *Bacteria TMDL Development for the Rivanna River Mainstem, North Fork Rivanna River, Preddy Creek and Tributaries, Meadow Creek, Mechums River, and Beaver Creek Watersheds (dated March 2008)*

As stated in the Bacteria TMDL Report, bacteria TMDLs have been established for the Rivanna River main stem (VAV-H28R-RVN01A00), the North Fork Rivanna River (VAV-H27R-RRN01A00), Preddy Creek and tributaries (VAV-H27R-PRD01A00), Meadow Creek (VAV-H28R-MWC01A00), Mechums River (VAV-H23R-MCM01A00), and Beaver Creek (VAV-H23R-BVR02A04) watersheds. The watersheds that are pertinent to the City include the Rivanna River main stem and Meadow Creek, as the City's MS4 discharges to these water bodies. These water bodies were added to Virginia's 303(d) List of Impaired waters between 2002 and 2006 for exceedances of the state's water quality standards for *E. coli* and for fecal coliform bacteria. When these water bodies were first listed as impaired, the water quality standard was expressed in units of fecal coliform bacteria. The bacteria water quality standard is now expressed in units of *E. coli*.

The impaired segment of the Rivanna River main stem (VAV-H28R-RVN01A00) extends 5.28 miles from the confluence of the North Fork Rivanna River to Moores Creek. This segment of the Rivanna River was first listed in the 2006 305(b)/303(d) Water Quality Assessment Integrated Report for exceedances of the *E. coli* standard. During the 2006 assessment period (January 2000 through December 2004), 2 out of 9 samples (22%) collected at listing station 2-RVN037.54 exceeded the *E. coli* criterion of 235 cfu/100 ml.

The impaired segment of Meadow Creek (VAV-H28R-MWC01A00) extends 4.01 miles from its headwaters to the confluence of the Rivanna River. This segment of Meadow Creek was first listed on the 2002 303(d) Water Quality Assessment Integrated Report for exceedances of the fecal coliform standard. During the 2002 assessment period (January 1996 through December 2000), 4 out of 23 fecal coliform samples (17%) collected at listing station 2-MWC000.60 exceeded the fecal coliform instantaneous standard of 400 cfu/100 ml.

Below is Figure 1-1 from the Bacteria TMDL Report: Location of Bacteria Impaired Segments of the Rivanna River main stem, North Fork Rivanna River, Preddy Creek and tributaries, Meadow Creek, Mechums River, and Beaver Creek Watersheds.



Legend

- 303d Listed Segment
- Stream
- Waterbodies
- County Boundary



Sources: USGS - National Hydrography Dataset, VADEQ - Watersheds, Municipalities ESRI - Roads



MAP INDEX



2. The EPA approval date of the TMDL; (General Permit Part II.B.4.b)

The Benthic TMDL was approved by EPA on June 11, 2008.

The Bacteria TMDL was approved by EPA on January 1, 2009.

3. The wasteload allocated to the permittee (individually or in aggregate), and the corresponding percent reduction, if applicable; (General Permit Part II.B.4.c)

The following wasteload allocations (WLA) and corresponding percent reductions were assigned to the City in the Benthic and Bacteria TMDL Reports:

Benthic TMDL

The Benthic TMDL Report assigns a WLA of 776 pounds/day and a 59.3% reduction of sediment to the City's MS4.

Table 7-2: Wasteload Allocation by MS4 Location # Within the Rivanna River Benthic Impaired Watershed						
Permit Number	MS4 Permit Holder	Land-Based Loads (lbs/day)	Instream Erosion (lbs/day)	Existing Total Load (lbs/day)	Allocated Load (lbs/day)	Percent Reduction*
VAR040051	City of Charlottesville	477	1,406	1,883	776	59.3

Bacteria TMDL

The Bacteria TMDL Report assigns an aggregated WLA of 3.27E+10 cfu/day and a 95% reduction of *E. coli* to the MS4s in the Rivanna River watershed, including the City.

Table 5-4: Rivanna River Distribution of Annual Average <i>E. coli</i> Load under Existing Conditions and TMDL Allocation				
Land Use/Source	Average <i>E. coli</i> Loads (cfu/yr)		Allocation (cfu/day)	Percent Reduction (%)
	Existing	Allocation		
Forest	5.74E+12	5.74E+12	5.74E+10	0%
Cropland	1.33E+13	6.65E+11	6.65E+09	95%
Pasture	3.86E+14	1.93E+13	1.93E+11	95%
Urban Residential	7.49E+13	3.75E+12	3.75E+10	95%
Water/Wetland	4.85E+07	4.85E+07	4.85E+05	0%
Cattle - direct deposition	1.91E+13	0.00E+00	0.00E+00	100%
Wildlife - direct deposition	4.84E+13	1.16E+13	1.16E+11	76%
Failed Septic - direct deposition	1.43E+11	0.00E+00	0.00E+00	100%

Point Source	8.29E+11	1.66E+12	4.54E+09	0%
MS4s	6.54E+13	3.27E+12	3.27E+10	95%
Total loads /Overall reduction	6.14E+14	4.60E+13	4.48E+11	92%

The Bacteria TMDL Report assigns an aggregated WLA of 4.06E+10 cfu/day and a 95% reduction of *E. coli* to the MS4s in the Meadow Creek watershed, including the City.

Table 5-18: Meadow Creek Distribution of Annual Average <i>E. coli</i> Load under Existing Conditions and TMDL Allocation				
Land Use/Source	Annual Average <i>E. coli</i> Loads (cfu/yr)		Allocation (cfu/day)	Percent Reduction (%)
	Existing	Allocation		
Forest	1.15E+10	1.15E+10	1.22E+08	0%
Cropland	0.00E+00	0.00E+00	0.00E+00	0%
Pasture	2.40E+08	1.20E+07	1.27E+05	95%
Urban Residential	3.12E+13	1.56E+12	1.65E+10	95%
Water/Wetland	2.85E+06	2.85E+06	3.02E+04	0%
Cattle - direct deposition	3.35E+10	0.00E+00	0.00E+00	100%
Wildlife - direct deposition	1.27E+12	6.59E+11	6.99E+09	48%
Failed Septic - direct deposition	3.94E+09	0.00E+00	0.00E+00	100%
Point Source*	0.00E+00	6.06E+10	1.66E+08	0%
MS4s	7.66E+13	3.83E+12	4.06E+10	95%
Total loads /Overall reduction	1.09E+14	6.12E+12	6.44E+10	94%

* There are no permitted facilities; the point source allocation includes 1 percent of the total NPS allocations to account for future growth

4. 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 of concern means a discharge where the expected pollutant loading is greater than the average pollutant loading for the land use identified in the TMDL; (General Permit Part II.B.4.d)

Benthic TMDL

The City notes that average pollutant loading rates as a function of land use are not provided in the TMDL, and they cannot be directly inferred from the Benthic TMDL Report; the Benthic TMDL Report utilized the Universal Soil Loss Equation to estimate land-based sediment loads into the impaired reaches of the Rivanna (Sediment TMDL Report Page 6-4). Noting that streambank erosion was also a significant source of erosion, the Benthic TMDL Report estimated instream erosion using a spatial model developed by Evans et al. (2003). This model estimates streambank erosion as a function of estimated monthly stream flow, fraction of developed land, animal density, curve numbers, K factors, and mean field slope (Benthic TMDL Report Page 6-7 to 6-8).

However, based on Section 4 of the Benthic TMDL Report, the City assumes that the following are significant sources of sediment discharging to the City's MS4: impervious surfaces, increased runoff, and urban erosion (construction sites, street dust, and litter accumulation). The City also assumes that

segments of waterways with severely eroding banks and/or beds that discharge to the City's MS4 are significant sources of sediment.

Bacteria TMDL

Based on Section 3 of the Bacteria TMDL Report, significant sources of bacteria include wildlife and pets.

5. The BMPs designed to reduce the pollutants of concern in accordance with Parts II B 5, B 6, B 7, and B 8; (General Permit Part II.B.4.e)

Bacteria TMDL

Part II.B.5 of the MS4 General Permit states:

4. Bacterial TMDLs.

- a. Traditional permittees shall select and implement at least three of the strategies listed in Table 5 designed to reduce the load of bacteria to the MS4. Selection of the strategies shall correspond to sources identified in Part II B 4 d.
- b. Nontraditional permittees shall select at least one strategy listed in Table 5 designed to reduce the load of bacteria to the MS4 relevant to sources of bacteria applicable within the MS4 regulated service area. Selection of the strategies shall correspond to sources identified in Part II B 4 d.

Table 5 Strategies for Bacteria Reduction Stormwater Control/Management Strategy	
Source	Strategies (provided as an example and not meant to be all inclusive or limiting)
Domestic pets (dogs and cats)	<p>Provide signage to pick up dog waste, providing pet waste bags and disposal containers.</p> <p>Adopt and enforce pet waste ordinances or policies, or leash laws or policies.</p> <p>Place dog parks away from environmentally sensitive areas.</p> <p>Maintain dog parks by removing disposed of pet waste bags and cleaning up other sources of bacteria.</p> <p>Protect riparian buffers and provide unmanicured vegetative buffers along streams to dissuade stream access.</p>
Urban wildlife	<p>Educate the public on how to reduce food sources accessible to urban wildlife (e.g., manage restaurant dumpsters and grease traps, residential garbage, feed pets indoors).</p> <p>Install storm drain inlet or outlet controls.</p> <p>Clean out storm drains to remove waste from wildlife.</p> <p>Implement and enforce urban trash management practices.</p> <p>Implement rooftop disconnection programs or site designs that minimize connections to reduce bacteria from rooftops</p> <p>Implement a program for removing animal carcasses from roadways and properly disposing of the same (either through proper storage or through transport to a licensed facility).</p>

Illicit connections or illicit discharges to the MS4	<p>Implement an enhanced dry weather screening and illicit discharge, detection, and elimination program beyond the requirements of Part I E 3 to identify and remove illicit connections and identify leaking sanitary sewer lines infiltrating to the MS4 and implement repairs.</p> <p>Implement a program to identify potentially failing septic systems.</p> <p>Educate the public on how to determine whether their septic system is failing.</p> <p>Implement septic tank inspection and maintenance program.</p> <p>Implement an educational program beyond any requirements in Part I E 1 though E 6 to explain to citizens why they should not dump materials into the MS4.</p>
Dry weather urban flows (irrigations, carwashing,	<p>Implement public education programs to reduce dry weather flows from storm sewers related to lawn and park irrigation practices, carwashing, powerwashing and other nonstormwater flows.</p> <p>Provide irrigation controller rebates.</p>
powerwashing,	<p>Implement and enforce ordinances or policies related to outdoor (etc.) water waste.</p> <p>Inspect commercial trash areas, grease traps, washdown practices, and enforce corresponding ordinances or policies.</p>
Birds (Canadian geese, gulls, pigeons, etc.)	<p>Identify areas with high bird populations and evaluate deterrents, population controls, habitat modifications and other measures that may reduce bird-associated bacteria loading.</p> <p>Prohibit feeding of birds.</p>
Other sources	<p>Enhance maintenance of stormwater management facilities owned or operated by the permittee.</p> <p>Enhance requirements for third parties to maintain stormwater management facilities.</p> <p>Develop BMPs for locating, transporting, and maintaining portable toilets used on permittee-owned sites. Educate third parties that use portable toilets on BMPs for use.</p> <p>Provide public education on appropriate recreational vehicle dumping practices.</p>

The City is a traditional permittee. The City selects the sources and strategies highlighted in yellow in Table 5 above to address the discharge of bacteria to the Rivanna River and Meadow Creek. The strategies correspond to the identified significant sources – wildlife and pets.

Benthic TMDL

Part II.B.6 of the MS4 General Permit states:

5. Local sediment, phosphorus, and nitrogen TMDLs.

a. The permittee shall reduce the loads associated with sediment, phosphorus, or nitrogen through implementation of one or more of the following:

- (1) One or more of the BMPs from the Virginia Stormwater BMP Clearinghouse listed in 9VAC25-870-65 or other approved BMPs found on the Virginia Stormwater BMP Clearinghouse website;

(2) One or more BMPs approved by the Chesapeake Bay Program. Pollutant load reductions generated by annual practices, such as street and storm drain cleaning, shall only be applied to the compliance year in which the annual practice was implemented; or

(3) Land disturbance thresholds lower than Virginia's regulatory requirements for erosion and sediment control and post development stormwater management.

b. The permittee may meet the local TMDL requirements for sediment, phosphorus, or nitrogen through BMPs implemented or sediment, phosphorus, or nitrogen credits acquired. BMPs implemented and nutrient and sediment credits acquired to meet the requirements of the Chesapeake Bay TMDL in Part II A may also be utilized to meet local TMDL requirements as long as the BMPs are implemented or the credits are generated in the watershed for which local water quality is impaired.

c. The permittee shall calculate the anticipated load reduction achieved from each BMP and include the calculations in the action plan required in Part II B 4 f.

d. No later than 36 months after the effective date of this permit, the permittee shall submit to the department an update on the progress made toward achieving local TMDL action plan goals and the anticipated end dates by which the permittee will meet each wasteload allocation for sediment, phosphorus, or nitrogen. The proposed end date may be developed in accordance with Part II B 3.

The following best management practices (BMP) have been employed to reduce sediment discharges to the Rivanna River:

Stream Restoration

Project Name	Year Completed	Linear Feet Restored	Sediment Reduction (pounds/year)*	Lat/Long
Meadowcreek Golf Course	2010	170	7,629.6	38.05582/-78.44941
Meadow Creek	2013	7,372	320,496.9	38.06384/-78.47599
Rock Creek – Phase I and II	2017	264.5	11,870.8	38.02317/-78.50182
Schenks Branch Tributary	2024	880	234,600	38.04906/-78.47322

Street Sweeping

For local TMDL accounting purposes, the City commits to sweeping 2,000 lane miles annually. This results in a reduction of 5,773 pounds of sediment annually*.

* See Appendix B for full calculations of sediment reductions.

Programmatic BMPs

The City's MS4 Program Plan also includes a variety of programmatic BMPs that aim to reduce pollutants of concern, including sediment and bacteria. The following section provides an explanation of how the identified BMPs are applicable to reducing the sediment and bacteria impairments.

MCM 1 – Public Education and Outreach on Stormwater Impacts

The City's public education and outreach program is an effective way of making citizens and businesses aware of ways to reduce the stormwater impact of their everyday activities, as well as raising public

awareness about what they see others doing on a day-to-day basis. Efforts to educate the community and promote low impact development practices such as rain gardens and rainwater harvesting, proper management of pet waste, and to identify and report illicit discharges through a diverse array of media has the effect of reducing the discharge of bacteria and sediment into impaired waters.

MCM 2 – Public Involvement / Participation

Involving the public in activities such as stream clean-ups, tree plantings, workshops, and community events not only educates the public on things they can do to reduce their stormwater impacts, but also promotes a connection to local waters and watershed issues while fostering a sense of shared responsibility for stewardship of these community resources. This ultimately leads to a reduction in the amount of pollutants entering local impaired waters through behavior change. Additionally, projects such as tree planting in riparian areas increases their pollution reduction capacity through greater filtration and absorption of stormwater. Continuing to foster community partnerships, such as the ones the City has cultivated with the University of Virginia, the County of Albemarle, the Rivanna Conservation Alliance, and the Thomas Jefferson Soil and Water Conservation District advances the state of stormwater management in the City, ultimately resulting in reduced pollutant discharge.

MCM 3 – Illicit Discharge Detection and Elimination

The City's illicit discharge detection and elimination (IDDE) program provides the mechanism to identify and directly eliminate pollutants entering impaired waters through dry weather screening of stormwater outfalls and response to water pollution reports. IDDE education of residents and businesses also raises awareness of the stormwater drainage system's direct connection to local waterways and illicit discharges, while providing avenues for reporting of illegal activities so that the City can take the appropriate actions. GIS mapping of the stormwater drainage system, including portions of the system that convey streams, allows for faster and targeted responses to incidents, reducing the impacts to waterways. Training of City staff also puts more "eyes on the street" to identify potential and actual situations that lead to stormwater pollution, while reducing impacts from City operations.

MCM 4 – Construction Site Stormwater Runoff Control

The City's Erosion and Sediment Control Program aims to minimize sediment leaving active construction sites in the city. The City has voluntarily reduced the land disturbance threshold which triggers the requirement for an E&S control plan and permit to 6,000 square feet, making this program even more effective at preventing sediment from leaving construction sites. Properly trained and certified staff ensures that program administration, plan review, and site inspection most effectively and efficiently reduce sedimentation from the development process.

MCM 5 – Post Construction Stormwater Management in New Development and Redevelopment

The City's post-construction stormwater management program aims to ensure appropriate measures are employed such that post-development water quantity does not increase and water quality does not decrease when compared to the pre-development conditions of land in the City. The City has voluntarily reduced the land disturbance threshold which triggers post-construction stormwater management requirements to 6,000 square feet, making this program even more effective at reducing stormwater volumes and protecting water quality. The City encourages green stormwater infrastructure in new development and redevelopment that reduces stormwater volume and improves stormwater quality, thereby reducing high flows that cause in-stream erosion and sedimentation and reducing bacteria pollution in the runoff that does enter streams. The City also implements green stormwater infrastructure on public lands in new development, redevelopment, and retrofit situations that reduce stormwater volume, thereby reducing high flows that cause in-stream erosion and sedimentation and

reducing bacteria pollution in the runoff that does enter streams. The structural stormwater management facility (SMF) inspection program ensures that existing public and private SMFs are being maintained properly, thereby maximizing their effectiveness in addressing sediment and bacteria pollution. Protecting and improving the City's urban forest, particularly in riparian areas, allows these areas to serve as natural pollution filtration devices, keeping sediment and bacteria in surface runoff from ever entering impaired waters.

MCM 6 – Pollution Prevention / Good Housekeeping for Municipal Operations

The City's street sweeping and stormwater infrastructure flushing and cleaning programs are effective at capturing sediment and bacteria pollution that would otherwise be conveyed into impaired waters. Pollution prevention training also raises public employee awareness of how they can reduce the stormwater impact of their everyday work activities. The green public lands management strategies employed by the City reduce sediment and bacteria pollution by acquiring and preserving green space and reducing pet waste. Development and implementation of stormwater pollution prevention plans and nutrient management plans for certain City facilities and lands will decrease the amount of pollutants leaving these sites.

6. Any calculations required in accordance with Part II B 5, B 6, B 7, or B8; (General Permit Part II.B.4.f)

All calculations of sediment reductions presented in Section 5 above for stream restoration projects and street sweeping were completed in accordance with DEQ Guidance Memos No. 15-2002, *Chesapeake Bay TMDL Special Condition* (dated May 18, 2015) and No. 20-2003, *Chesapeake Bay TMDL Special Condition Guidance* (dated February 6, 2021).

The guidance memos state, "This document may also be used as a reference to meet the Chesapeake Bay TMDL load allocation for unregulated urban entities as well as local TMDL waste load allocations for nutrients and sediment."

See Appendix B for the detailed calculations.

7. For action plans developed in accordance with Part II B 5, B 6, and B8, an outreach strategy to enhance the public's education (including employees) on methods to eliminate and reduce discharges of the pollutants; (General Permit Part II.B.4.g)

Public Education and Outreach Program

The City's public education and outreach programs have been enhanced to promote methods to eliminate and reduce discharges of sediment and bacteria. See Appendix A, the City's Public Education and Outreach Plan, developed in conjunction with the Rivanna Stormwater Education Partnership (RSEP), for details on these enhancements. In addition to the education program described in Appendix A, City staff worked to enhance education and outreach through designing and conducting a stormwater management facility maintenance workshop, which educated BMP owners and maintenance staff on their responsibilities for maintenance and how best to fulfill them. The workshop was conducted in June 2016 and addressed both sediment and bacteria pollution. Also in collaboration with RSEP, the City completed a GIS-based Story Map website in 2020, which provides interactive information on the Rivanna River and its watershed, local stream health, community water quality monitoring programs, projects and programs the MS4 permit holders are undertaking, and things residents can do at home

and work to improve stream health and water quality. The Story Map can be found here: tinyurl.com/RivannaStoryMap. The RSEP has also launched and sustained the [Love Your Watershed](#) campaign, which is a social media and online campaign designed to motivate residents of the greater Charlottesville area to reduce their impact on waterways and ultimately improve local water quality.

Training Program

The City conducts training for applicable employees in accordance with the MS4 General Permit. The goal of the training program is to reduce the impact of municipal operations on stormwater runoff. This program builds on stormwater general awareness and pollution prevention (P2) training that is routinely provided to City operations and maintenance employees from the Departments of Public Works, Utilities, and Parks and Recreation. Training materials include stormwater pollution prevention plans, standard operating procedures, illicit discharge detection and elimination procedures, training videos and other presentations.

The following table provides an overview of the training plan and its basic elements:

Training Category (and Frequency)	Department of Utilities	Department of Public Works	Department of Parks and Recreation	Neighborhood Development Services	Fire Department
Recognition & Reporting of Illicit Discharges for Field Personnel (once per 24 months)	X	X (Public Service, Engineering, and Facilities Maintenance)	X	X (Property Maintenance and Building Inspectors)	X
Good Housekeeping & P2 Practices for Road, Street, and Parking Lot Maintenance (once per 24 months)		X (Public Service)	X		
Good Housekeeping & P2 Practices for Maintenance and Public Works Facilities (once per 24 months)	X	X (Public Service and Facilities Maintenance)	X (Parks and Golf)		X
Good Housekeeping and P2 Practices for Recreational Facilities (once per 24 months)			X (Parks, Aquatics and Rec Center staff, maintenance staff)		
Pesticide and Herbicide Applicators certification per VA Pesticide Control Act (as required)			X (Horticulture Crew)		
VA E&S Control Law and Regulations - DEQ certifications (as required)		X Plan Reviewers, Inspectors, VSMP Administrator			
Stormwater Management Law and Regulations - DEQ/VSMP certifications (as required)		X Plan Reviewers, Inspectors, VSMP Administrator			
Basic Spill Response (once every 24 months)	X	X	X		X
Hazardous Materials Operations and Technicians (annually)					X
Procedures for Operations and Maintenance Activities (once every 24 months)	X	X	X		

**8. A schedule of anticipated actions planned for implementation during this permit term.
(General Permit Part II.B.4.h)**

As permitted in Part II.B.3 of the MS4 General Permit, the City is proposing to implement this Action Plan in multiple phases over more than one permit cycle using an adaptive iterative approach to ensure that adequate progress continues to be made toward reducing the discharge of sediment and bacteria to the Rivanna River.

The following schedule is proposed for implementation of the BMPs included in this Action Plan for the current permit cycle ending on October 31, 2028:

BMP	Description	Schedule
BMP 1.1	Rivanna Stormwater Education Partnership (RSEP)	Ongoing/Annual
BMP 1.2	City Environmental Webpages	Ongoing/Annual
BMP 1.3	Youth Stormwater Education	Ongoing/Annual
BMP 1.4	Illicit Discharge and Pollution Prevention Education Program	Ongoing/Annual
BMP 1.5	Public Education and Outreach Plan	Ongoing/Annual
BMP 2.1	Volunteer Stream Clean-Ups	Ongoing/Annual
BMP 2.2	Adopt-A-Stream Program	Ongoing/Annual
BMP 2.3	Tree Planting Program	Ongoing/Annual
BMP 2.4	Watershed and Water Quality Activities	Ongoing/Annual
BMP 2.5	Public Involvement	Ongoing/Annual
BMP 3.1	IDDE Program	Ongoing/Annual
BMP 3.2	Maintenance of GIS Data, MS4 Map, and Information Table	Ongoing/Annual
BMP 3.4	Online Reporting of Environmental Concerns and Illicit Discharges	Ongoing/Annual
BMP 4.1	Erosion and Sediment Control Program	Ongoing/Annual
BMP 4.2	General Permit for Discharges from Construction Activities	Ongoing/Annual
BMP 5.1	Stormwater Management Materials	Ongoing/Annual
BMP 5.2	Development Plan Review	Ongoing/Annual
BMP 5.3	Structural Stormwater Management Facility and Best Management Practice Reporting	Ongoing/Annual
BMP 5.4	Structural Stormwater Management Facility Inspection and Maintenance Program	Ongoing/Annual
BMP 5.5	Urban Forest Management	Ongoing/Annual
BMP 5.6	Investigate Green Stormwater Infrastructure Retrofit Opportunities	Ongoing/Annual
BMP 6.1	Street Sweeping Program	Ongoing/Annual
BMP 6.2	Stormwater Infrastructure Flushing and Cleaning	Ongoing/Annual
BMP 6.3	Training for Appropriate Personnel	Ongoing/Annual
BMP 6.4	Written Procedures for Operations and Maintenance Activities	Ongoing/Annual
BMP 6.5	Stormwater Pollution Prevention Plans for Municipal Facilities	Ongoing/Annual
BMP 6.6	Turf and Landscape Nutrient Management Plans	Ongoing/Annual
BMP 6.7	Green Public Lands Management Strategies	Ongoing/Annual
Table 5 – Domestic Pets (dogs and cats)	Provide signage to pick up dog waste, providing pet waste bags and disposal containers.	Ongoing/Annual

Table 5 – Domestic Pets (dogs and cats)	Adopt and enforce pet waste ordinances or policies, or leash laws or policies.	Ongoing/Annual
Table 5 – Domestic Pets (dogs and cats)	Maintain dog parks by removing disposed of pet waste bags and cleaning up other sources of bacteria.	Ongoing/Annual
Table 5 – Domestic Pets (dogs and cats)	Protect riparian buffers and provide unmanicured vegetative buffers along streams to dissuade stream access.	Ongoing/Annual
Table 5 – Urban Wildlife	Clean out storm drains to remove waste from wildlife.	Ongoing/Annual
Table 5 – Urban Wildlife	Implement and enforce urban trash management practices.	Ongoing/Annual
Table 5 – Urban Wildlife	Implement a program for removing animal carcasses from roadways and properly disposing of the same (either through proper storage or through transport to a licensed facility).	Ongoing/Annual

Additionally, the City anticipates completing the following projects during the current permit cycle ending on October 31, 2028:

Project Name	Type of BMP	Location (Lat, Long)	% POC Removal Efficiency	POC Reductions (lbs/year)	Preliminary Implementation Schedule
Street Sweeping Program	Street Sweeping (SCP-1 and SCP-2)	Across the city	TN: 3-4% TP: 8-10% TSS: 16-21%	TN: 15.1 TP: 7.28 TSS: 5,772	Annually
Biscuit Run Stream Restoration*	Stream Restoration	37.999529, -78.515791	N/A	TN: 1288 TP: 0 TSS: 0	Winter 2025
Riverview Park Restoration	Stream and Outfall Restoration	38.023329, -78.453971	N/A	TN: 161 TP: 145 TSS: 17,1930	Spring 2026

* Albemarle County and the City of Charlottesville have entered into a Memorandum of Understanding to share Chesapeake Bay TMDL pollutants of concern reductions generated by the Phase I Biscuit Run stream restoration project, a County-led project to restore approximately 6,200 linear feet of Biscuit Run and tributaries. This project lies entirely in the County but discharges into Moores Creek, an impaired stream which lies along the City/County border. As documented in the *Biscuit Run Stream Restoration Phase 1 Pollutant Reduction Report* (dated 9/9/2022) this project is estimated to reduce 1,717 lbs/yr of total nitrogen (TN), 987 lbs/yr of total phosphorus (TP), and 1,483,346 lbs/yr of total suspended sediment (TSS). As part of this agreement, the City will claim 75% of the final total nitrogen reductions (estimated 1,288 lbs/yr) generated by the project, and the County will claim the remainder of the pollutant reductions that are applicable to the Chesapeake Bay TMDL (estimated 429 lbs/yr TN, 987 lbs/yr TP and 1,483,346 lbs/yr TSS). Final pollutant reduction values will be calculated based on an as-built survey when the project is complete. All pollutant reductions generated by the Phase I Biscuit Run stream restoration project will be claimed and reported by the two permittees in a manner that ensures pollutant reduction totals are not double counted.

The City intends to demonstrate its progress on implementation of this Action Plan by tracking and reporting on BMP implementation in its MS4 Annual Report that is submitted to DEQ on or before October 1st of each permit year. In accordance with the adaptive iterative approach adopted by the City

and referenced in this Action Plan, the City may modify/replace BMPs, as necessary, to achieve the most effective plan for reducing the discharge of sediment and bacteria from the City's MS4 and meeting the assigned TMDL WLAs.

Appendix A

Public Education and Outreach Plan

**Public Education and Outreach Plan
and
Public Involvement and Participation Program
Small MS4 MCM1 and MCM2**

November 28, 2023



Prepared By:

Rivanna Stormwater Education Partnership

Albemarle County
Albemarle County Public Schools
Albemarle County Service Authority
City of Charlottesville
Rivanna Conservation Alliance
Rivanna Water and Sewer Authority
Thomas Jefferson Planning District Commission
Thomas Jefferson Soil and Water Conservation District
University of Virginia

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1.0 Rivanna Stormwater Education Partnership (RSEP)

Founded in March 2003, the Rivanna Stormwater Education Partnership (RSEP) meets a minimum of six times a year to plan and implement stormwater education initiatives and share information about each partner's stormwater programs. Education initiatives are undertaken by RSEP to help make citizens aware of stormwater issues, while also equipping them with practical knowledge and actions to help improve local water quality. RSEP utilizes a multi-faceted approach to educate and provide outreach across targeted urban areas (Figure 1). Past campaign materials, including print ads, movie theater ads, posters on public transit buses, magnets, radio spots, and utility bill inserts are written in simple, easy to understand language and often utilize simple pictures or drawings to help the message come across to all generations and all education levels. RSEP also provides some campaigns in Spanish. Education and outreach materials are available at www.rivanna-stormwater.org. Each partner pays an annual membership fee to help fund RSEP projects. In addition, the RSEP has successfully applied for and partnered on grants to supplement education efforts.

1.1 Members

RSEP was initially created as a collaborative effort among local public entities in the City of Charlottesville and the surrounding County of Albemarle that hold small Municipal Separate Storm Sewer (MS4) permits under the National Pollutant Discharge Elimination System program. RSEP has since expanded to also include non-MS4 members in the region who have interests related to education, outreach, and public participation in stormwater management. While the core premise of RSEP still remains focused on helping MS4 members achieve permit compliance with Minimum Control Measures (MCM) 1 and 2, the inclusion of non-MS4 members allows RSEP to look beyond compliance and reach a broader audience.

The MS4 permit holders that comprise RSEP are Albemarle County, the City of Charlottesville, and the University of Virginia. Other members of RSEP are Albemarle County Public Schools, the Albemarle County Service Authority, the Rivanna Water and Sewer Authority, the Rivanna Conservation Alliance, the Thomas Jefferson Planning District Commission, and the Thomas Jefferson Soil and Water Conservation District. The Thomas Jefferson Soil and Water Conservation District (TJSWCD) provides support to RSEP and serves as its coordinating body.

1.2 Collaboration Benefits

This program plan has been developed with the intent to increase public's knowledge on how to reduce stormwater pollution, increase the public's knowledge of hazards associated with illegal discharges and improper disposal of waste, and has been developed as a diverse program with strategies that are targeted toward individuals or groups likely to have significant stormwater impacts. RSEP has produced effective and far-reaching education programs that have benefited from the variety of expertise and resources each partner offers. Planning and implementing education initiatives through RSEP has resulted in Rivanna River watershed-focused projects and

has avoided the over-exposure and redundancy that might result if each partner were carrying out projects on their own.



Figure 1. Urban areas targeted by RSEP Education and Outreach (US Census-designated urban areas, 2020)

2.0 High Priority Water Quality Issues

RSEP members collaborated to determine the high priority water quality issues for the region, which will be the focus of the education and outreach campaigns for the current MS4 permit cycle. During the 2013-2018 permit cycle, RSEP chose local and regional water quality impairments, bacteria, sediment, and nutrients (nitrogen and phosphorus), as their high priority

issues. Campaigns conducted during this time frame were considered successful. However, RSEP found the chosen issues somewhat limited the extent of outreach efforts that the group could undertake. For the 2018-2023 permit cycle, RSEP members chose to address broader categories of water quality issues, namely runoff volume reduction, potential runoff pollutants, and TMDL impairments as the high priority issues. By grouping regional water quality impairments as one high priority issue, RSEP was able to address this highly important topic, while allowing the group to also address other issues that also have the potential to impact water quality in the region. Due to the success of this approach, RSEP has decided to continue with these same high priority water quality issues for the 2023-2028 permit cycle.

2.1 Runoff Volume Reductions

One of the biggest challenges facing urban waterways is the sheer volume of runoff being transported from impervious surfaces to the streams. In developed areas, rainwater falls on impervious surfaces, such as buildings, parking lots, and driveways which prevent water from infiltrating into the ground and recharging local aquifers. This rainwater flows rapidly across impervious surfaces and into storm sewers, which direct the water to local streams. As a result of this rapid transport to local streams, stream flow volumes and velocities are significantly higher than would be observed under natural conditions. These high, rapid flows can cause stream bank erosion and changes in stream ecosystem habitats. In addition, flooding has become an increasing issue due to the severity and intensity of rainstorms in recent years, combined with concerns about other climate change impacts. Best management practices (BMPs) can be installed to mitigate the impacts of development by slowing down the transport of water from impervious surfaces to local streams.

While localities and developers are required to install BMPs for certain construction projects, maintenance of these BMPs is not always taken into account during their installation. In addition, there are many BMPs homeowners can implement or install to reduce the runoff volume and velocity from their properties and contribute to healthier streams. RSEP intends to provide education and outreach to both homeowners as well as new and existing BMP owners during the permit period. The goal of this education program will be to educate recipients on the negative impacts of increased stormwater volume and velocity and also provide ideas for ways they can reduce, mitigate, or treat runoff from their property. Example messaging may include information about rain barrel installations, downspout disconnections, or information about local flood resilience planning.

2.2 Potential Runoff Pollutants

As stormwater flows across roadways, parking lots, and driveways, it picks up pollutants such as sediment, oil, nutrients, bacteria, and trash that are lying on the surface. Sources of these pollutants can be as varied as the pollutants themselves, ranging from pet waste left by a local resident to a diesel fuel spill on a local industrial site to cigarette butts tossed on the ground by

passing smokers. Additionally, emerging contaminants that do not yet fall under TMDLs, such as chlorides and PCBs, could be covered in this category if local conditions warrant such coverage.

There are two primary ways to handle potential runoff pollutants. The first is to prevent the potential pollutant from becoming a water quality issue. Educational messaging for this approach may range from reminding restaurants how to properly handle their used cooking oil to information on excess salt usage during the winter to reminding residents to obtain a soil test before applying fertilizer on their lawns. The second way to handle potential runoff pollutants is to try to capture them after they are out in the environment. While this approach is not ideal, it is a necessary component of a comprehensive outreach program. In addition to reducing runoff as previously discussed, certain BMPs can also help trap or absorb these pollutants in the environment and prevent them from reaching local waterways. In addition, the illicit discharge and elimination (IDDE) programs run by the various MS4 permit holders will help to identify and eliminate possible illicit discharges resulting from human activity in the watershed. IDDE outreach and education efforts provided by RSEP have and will continue to warn against storm drain dumping and encourage use of the RSEP Water Pollution Hot Line to report suspected illegal discharges.

2.3 TMDL Impairments – Bacteria, Sediment, Nitrogen, Phosphorus

The Chesapeake Bay TMDL requires pollution reductions in sources of phosphorus, nitrogen, and sediment loads across the Bay watershed and sets pollution limits need to achieve desired water quality standards. These TMDL impairments have significant impacts in the local area. Sediment source reductions are also required locally by the Rivanna River Benthic TMDL. TMDLs for many local streams also touch on sediment as a pollutant source, with bacteria as an added pollutant of concern in many of these local streams.

TMDL impairments are logical topics for MS4 outreach and education programs, as most of the streams with TMDLs in the local areas are urban streams and MS4s are concentrated in the urban areas. Of the stream miles assessed within the targeted urban areas, almost 30% have an impaired benthic macro-invertebrate community, as a result of too much sediment in our waterways¹. The *Final Report of the Benthic TMDL Development for the Rivanna River Watershed* submitted to VA DEQ (2008) identifies an existing sediment load from land-based and in-stream erosion from the MS4 point source. Over a quarter (26%) of streams assessed within the targeted urban areas are considered impaired by excessive amounts of bacteria². Bacteria impairments in these streams can be caused by a variety of sources in urban stormwater including pet waste, leaking sewer pipes, wildlife excrement, and agricultural uses. As for nitrogen and phosphorus, the MS4 general permit requires permittees to utilize turf and landscape management plans to minimize nutrient usages, while also prohibiting the usage of deicers containing urea, nitrogen, or phosphorus. Similar messaging is also relevant to local residents and business owners.

¹ *Final 2012 305(b)/303(d) Water Quality Assessment Integrated Report*, VA DEQ, 2014

² *Final 2012 305(b)/303(d) Water Quality Assessment Integrated Report*, VA DEQ, 2014

The goal of outreach and education campaigns focusing on TMDL impairments will include a variety of approaches, strategies, and target audiences. Licensed dog owners in the City and County could be targeted to pick up pet waste to reduce bacteria. Strategies utilized to address reductions in runoff volume could be used to target sediment. While homeowners, gardeners, and landscape maintenance professionals could be targeted to address fertilizer usage.

3.0 Public Education and Outreach Opportunities

The public education and outreach opportunities that RSEP plans to provide during the 2023-2028 permit cycle are included in Table 1. These strategies will be used to communicate the high priority water quality issues to the target audiences. At minimum, two strategies will be used per year to communicate to the target audience regarding the high priority stormwater issues.

4.0 Public Involvement and Participation Opportunities

This Outreach and Education Plan will be posted on the [RSEP website](#), [the City of Charlottesville's website](#), [Albemarle County's website](#), and [UVA's website](#) and will remain available for the duration of the 2023-2028 MS4 Permit Cycle. At any time during the permit cycle, the public can visit any of these websites to report potential illicit discharges, improper disposal or spills to the MS4, complaints regarding land disturbing activities, or other potential stormwater pollution concerns. In addition, the public can also utilize these websites to provide input on any of the RSEP partners MS4 program plans, including this Outreach and Education Plan.

The public involvement and participation opportunities that RSEP plans to provide during the 2023-2028 permit cycle are included in Table 1. No fewer than four activities per year from a minimum of two or more of the activity categories will be conducted to provide an opportunity for public involvement to improve water quality and support local restoration and clean-up projects.

5.0 Adjusting Target Audiences and Messaging

As necessary, RSEP will adjust target audiences and messages to address any observed weaknesses or shortcomings in the public education and outreach program. Educational materials may be developed, modified, or improved to address changing needs. In addition, the messaging or activities described in Table 1 may be altered to appeal to different target audiences or to address different high priority issues than the ones listed. Other methods beyond those currently described in Table 1 are likely to be employed as well.

Table 1. Planned Public Education and Outreach and Public Involvement and Participation Opportunities

Time Frame - Frequency	Strategy or Activity Description	High Priority Water Quality Issue Addressed			Target Audience / Metric to Determine if Activity is Beneficial to Water Quality	MCM 1	MCM 2
		Runoff Volume	Runoff Pollutants	TMDL Pollutants			
Spring - once during permit cycle	Written Materials - <i>Utility Bill Inserts</i>	✓	✓	✓	Homeowners and residents – number of inserts delivered	✓	
Spring - once during permit cycle	Written Materials – <i>Electronic Utility Bill Inserts</i>	✓	✓	✓	Homeowners and residents – number of electronic recipients	✓	
Fall - Once during permit cycle	Written Materials - <i>Charlotteville Area Transit Bus Ad</i>		✓	✓	Homeowners and residents – number of bus riders during ad period	✓	
Winter Once during permit cycle	Media Materials - <i>Charlotteville Public Access Station PSAs</i>	✓	✓	✓	Homeowners and residents – there is no metric to determine viewership or number of times the ad is shown, however it is still a worthwhile effort that may catch viewers not reached via other methods	✓	
Fall or Spring - 2-3x during permit cycle	Media Materials - <i>Cville Weekly Ads</i>		✓	✓	Homeowners and residents – estimated distribution	✓	
Winter and Summer - Annually	Media Materials - <i>Social Media Promotion</i>	✓	✓	✓	Homeowners and residents – estimated number of followers	✓	
Ongoing	Media Materials – <i>GIS StoryMap</i>	✓	✓	✓	Homeowners and residents – no tracking available, but information is linked from RSEP	✓	

Appendix B
Detailed Calculations

Name: Meadowcreek Golf Course
 Linear Feet of Restoration: 170

POC Reductions		
TN	TP	TSS
12.75	11.56	7629.6

Acres Draining Stream Restoration Project					
	Urban Impervious Acres	Urban Pervious Acres	Total Urban Acres	Forested Acres	
Regulated Land*	15.61	28.43	44.04	22.21	
Unregulated Land	0	0	0	0	Total
		Total	44.04	22.21	66.25

*Based on Regulated_Landcover2 and Albemarle County landcover

Total Reductions for Regulated and Unregulated Urban Lands				
	Ratios	TN Credit	TP Credit	TSS Credit
Regulated Acres	0.6648	8.48	7.68	5071.81
Unregulated Acres	0.0000	0.00	0.00	0.00
Forested Acres	0.3352	4.27	3.88	2557.79

Total Baseline Unregulated Land Reductions Adjustment						
		Loading rate (Table 3a)	x 20	x Unregulated Acres	Total Reduction	Subtract from Credit
Regulated Urban Impervious	TN	0.042255	0.8451	0	0	0.00
Regulated Urban Pervious		0.02097	0.4194	0		
Regulated Urban Impervious	TP	0.01408	0.2816	0	0	0.00
Regulated Urban Pervious		0.0018125	0.03625	0		
Regulated Urban Impervious	TSS	6.7694	135.388	0	0	0.00
Regulated Urban Pervious		0.442225	8.8445	0		

TN Credit	12.75
TP Credit	11.56
TSS Credit	7629.60

Name: Meadow Creek
 Linear Feet of Restoration: 7372

POC Reductions		
TN	TP	TSS
552.9	501.296	330855.36

Acres Draining Stream Restoration Project					
	Urban Impervious Acres	Urban Pervious Acres	Total Urban Acres	Forested Acres	
Regulated Land*	1280.53	1400.61	2681.14	998.28	
Unregulated Land	21.40	57.16	78.56	19.57	Total
		Total	2759.7	1017.85	3777.55

*Based on Regulated_Landcover2, Albemarle County and UVA landcover

Total Reductions for Regulated and Unregulated Urban Lands				
	Ratios	TN Credit	TP Credit	TSS Credit
Regulated Acres	0.7098	392.42	355.80	234826.68
Unregulated Acres	0.0208	11.50	10.43	6880.65
Forested Acres	0.2694	148.98	135.07	89148.03

Total Baseline Unregulated Land Reductions Adjustment						
		Loading rate (Table 3a)	x 20	x Unregulated Acres	Total Reduction	Subtract from Credit
Regulated Urban Impervious	TN	0.042255	0.8451	18.08514	42.058044	0.00
Regulated Urban Pervious		0.02097	0.4194	23.972904		
Regulated Urban Impervious	TP	0.01408	0.2816	6.02624	8.09829	2.33
Regulated Urban Pervious		0.0018125	0.03625	2.07205		
Regulated Urban Impervious	TSS	6.7694	135.388	2897.3032	3402.85482	3477.79
Regulated Urban Pervious		0.442225	8.8445	505.55162		

TN Credit	541.40
TP Credit	488.54
TSS Credit	320496.92

Name: Rock Creek
 Linear Feet of Restoration: 264.5

529 184 Added to total for Phase II

POC Reductions		
TN	TP	TSS
19.8375	17.986	11870.76

Acres Draining Stream Restoration Project					
	Urban Impervious Acres	Urban Pervious Acres	Total Urban Acres	Forested Acres	
Regulated Land*	71.29	131.18	202.47	26.74	
Unregulated Land	0	0	0	1.69	Total
		Total	202.47	28.43	230.9

*Based on Regulated_Landcover2 - Includes UVA MS4 areas within watershed

Total Reductions for Regulated and Unregulated Urban Lands				
	Ratios	TN Credit	TP Credit	TSS Credit
Regulated Acres	0.8769	17.39	15.77	10409.15
Unregulated Acres	0.0000	0.00	0.00	0.00
Forested Acres	0.1231	2.44	2.21	1461.61

Total Baseline Unregulated Land Reductions Adjustment						
		Loading rate (Table 3a)	x 20	x Unregulated Acres	Total Reduction	Subtract from Credit
Regulated Urban Impervious	TN	0.042255	0.8451	0	0	0.00
Regulated Urban Pervious		0.02097	0.4194	0		
Regulated Urban Impervious	TP	0.01408	0.2816	0	0	0.00
Regulated Urban Pervious		0.0018125	0.03625	0		
Regulated Urban Impervious	TSS	6.7694	135.388	0	0	0.00
Regulated Urban Pervious		0.442225	8.8445	0		

TN Credit	19.84
TP Credit	17.99
TSS Credit	11870.76

July 25, 2024

Dan Frisbee
Water Resources Specialist
City of Charlottesville, Department of Public Utilities
305 4th Street NW
Charlottesville, VA 22903

Re: Post-Construction Nutrient Credits for Schenks Branch Tributary Stream Restoration Project

via email: frisbee@charlottesville.gov

Dear Mr. Frisbee:

This letter serves as documentation to support the increase of nutrient credits following the construction of the Schenks Branch Tributary Stream Restoration project in Charlottesville, Virginia. This increase in credits is a result of Field Modification 1 and 2 (Dated 12/12/2023 and 12/13/2023, respectively) which entailed:

- expanding the bankfull bench at Riffle Grade Control 6 / Cross Vane 3 and Riffle Grade Control 7 / J-Hook 4 to account for instream bedrock while
- extending the proposed left bank grading approximately 65 linear feet, tying into the edge of the limits of disturbance where the streambank slope flattens.

Refer to Attachment 1 which documents the redlines for Field Modification 1. For Field Modification 2 the Contractor used the same left bank grading scheme as dictated in the construction drawings, as shown in XS 200+12.77 on drawing C13. The representative cross-section information to compare existing conditions to the proposed grading scheme is shown in **Figure 1** and **Figure 2**. Pre-construction conditions were representative of BEHI ID 18L (BEHI: Extreme, NBS: Low; **Attachment 2**), and therefore 65 linear feet were added to the original 70 linear feet for a total of 135 feet of restoration.

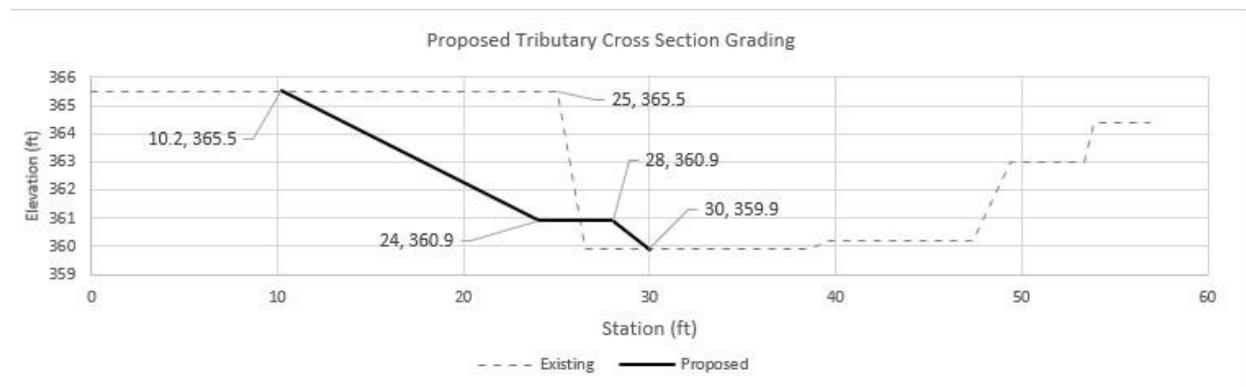


Figure 1: Representative Cross-Sections for Field Modification 2



Figure 2: Photo documentation of Existing Conditions to support Field Modification 2

Table 1, Table 2, Figure 3, and Figure 4 document this post-construction change. **Attachments 3 and 4** provide the updated nutrient credits calculations associated with Protocols 1 and 2, respectively. The original SLAF grant application estimated an annual Total Phosphorous removal of 70 lbs/r. As seen in the **Table 2** below, the restoration exceeds the preliminary estimate by 12.1 lbs/yr.

Table 1: Updated Schenks Branch Tributary BANCS Assessment and Pollutant Loading Summary

Criteria	Unit	Left Bank	Right Bank	Total
BANCS Assessment Length	ft	679	323	1002
Streambank Erosion	tons/yr	148.5	86.0	234.5
Total Phosphorous Loading	lbs/yr	103.9	60.2	164.2
Total Nitrogen Loading	lbs/yr	89.1	51.6	140.7

Table 2: Updated Schenks Branch Tributary Pollutant Loading Credit Summary

Pollutant of Concern	Unit	Protocol 1	Protocol 2	Total
Sediment Loading	tons/yr	117.3	--	117.3
Total Phosphorous Loading	lbs/yr	82.1	--	82.1
Total Nitrogen Loading	lbs/yr	70.4	42.8	113.2



Figure 3: Photo documentation of Post-Construction Conditions to support Field Modification 1



Figure 4: Photo documentation of Post-Construction Conditions to support Field Modification 2

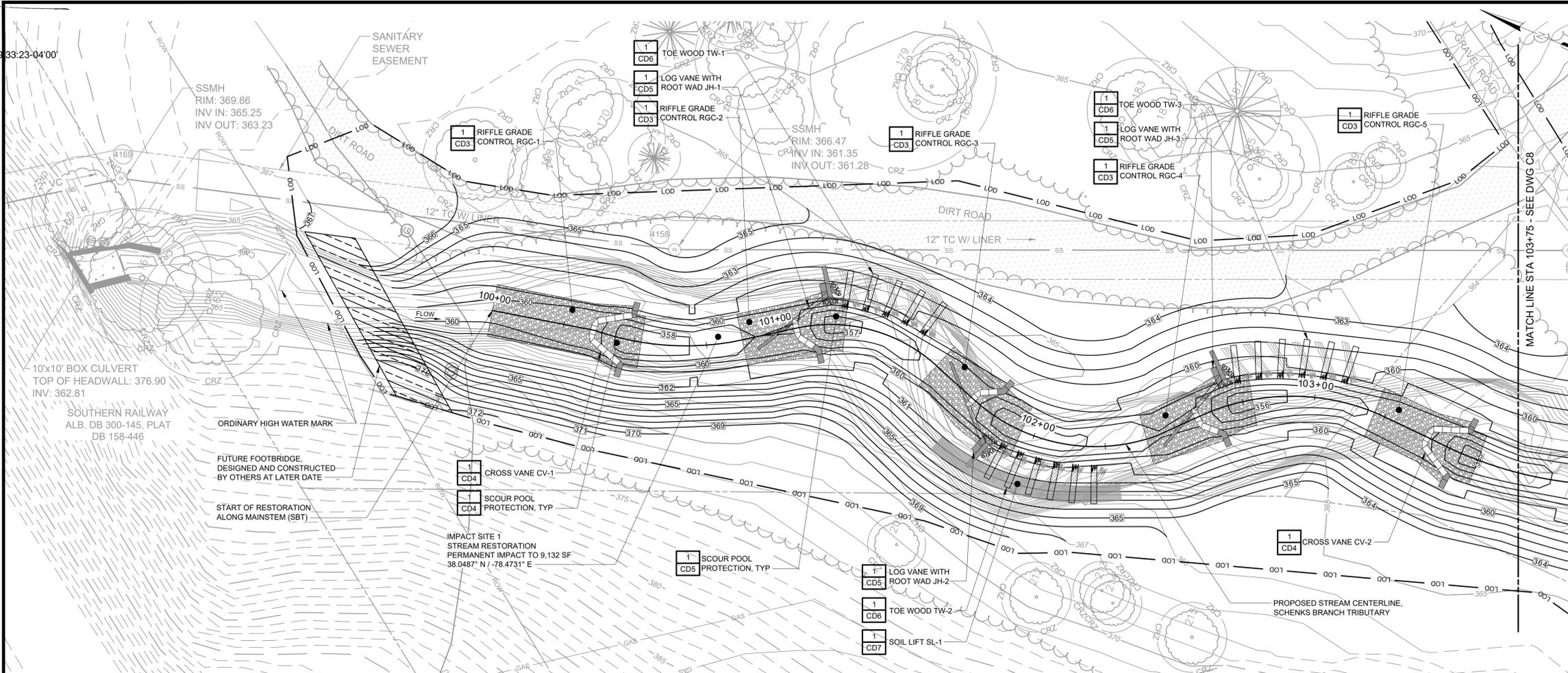
Be well,

Ty Smith, PE
Associate

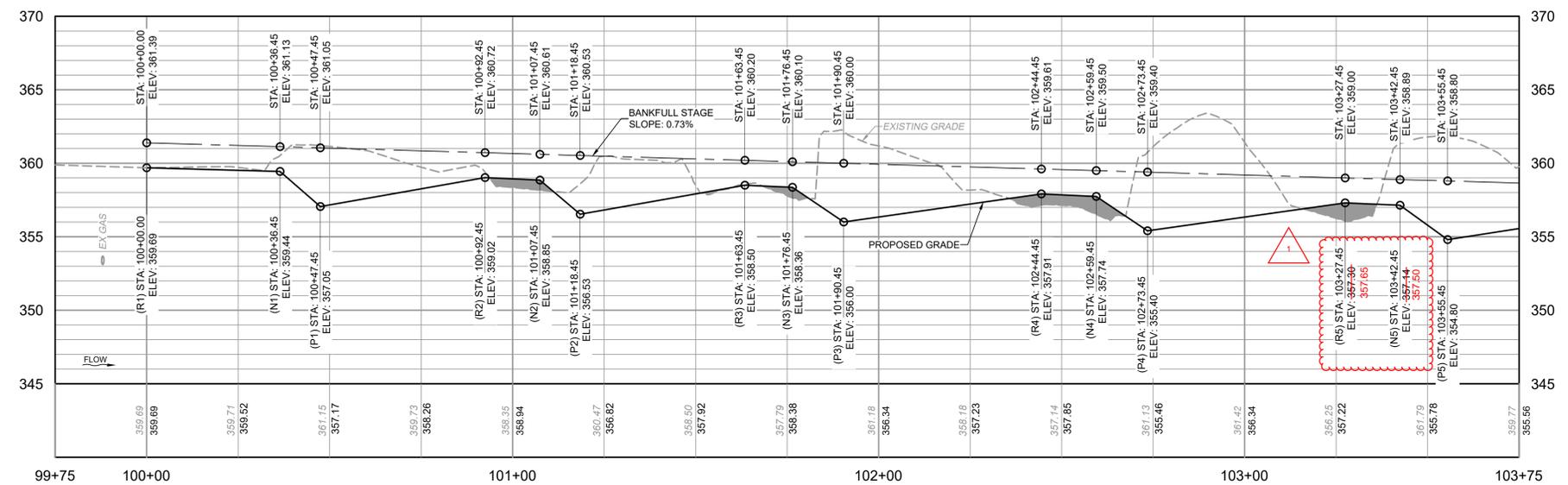
Attachments: 1 Field Modification 1 Documentation
 2 Updated Existing Conditions BANCS Assessment
 3 Updated CBP Protocol 1 Calculations
 4 Updated CBP Protocol 2 Calculations

cc: Chris Tabor, Matt Wimmer, Brandon Kwa, Ben Felton

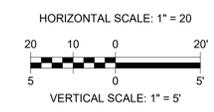
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PLAN VIEW FOR SCHENKS BRANCH TRIBUTARY (SBT)
SCALE: 1" = 20'



PROFILE
H: 1" = 20' - V: 1" = 5'



- NOTES:**
- SEE STREAM PROFILE AND STRUCTURES TABLE ON C10 FOR PROPOSED STREAM STRUCTURES, ALIGNMENT, AND PROFILE.
 - R = RIFFLE STATION, N = RUN STATION, P = POOL STATION.
 - SIZE STRUCTURES AS SPECIFIED IN CD SERIES.
 - CHANNEL GRADING DEFINED PER TYPICAL STREAM CHANNEL CROSS SECTIONS IN CD SERIES.
 - BOULDER DIMENSIONS SHOWN ARE APPROXIMATE. REFER TO CD SERIES FOR MINIMUM BOULDER DIMENSIONS.
 - SEE CD SERIES FOR IN-STREAM STRUCTURE FOOT EXCAVATION ELEVATIONS.
 - FIELD RUN TOPOGRAPHIC SURVEY WAS SUPPLEMENTED WITH CITY-PROVIDED GIS CONTOURS. MINOR GRADING MODIFICATIONS DURING CONSTRUCTION CAN BE EXPECTED.
 - SCHENKS BRANCH TRIBUTARY WIDTH:
EXISTING = 12-15 FEET; PROPOSED = 18-22 FEET.

FILE: 012071-00032071-001010-01.DWG - BRANCH/UCT7 - Sheet by SKANE - Revs: 04/2022 8:52 AM
 PLOT DATE: 4/26/2022 10:51 AM BY: SKANE

PROJECT ENGINEER:	C. TABOR
DESIGNED BY:	T. SMITH
DRAWN BY:	S. KANE
CHECKED BY:	T. SCHUELER
1 BEDROCK MODIFICATIONS	12/11/2023 TWS
ISSUED FOR	DATE BY

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Hazen

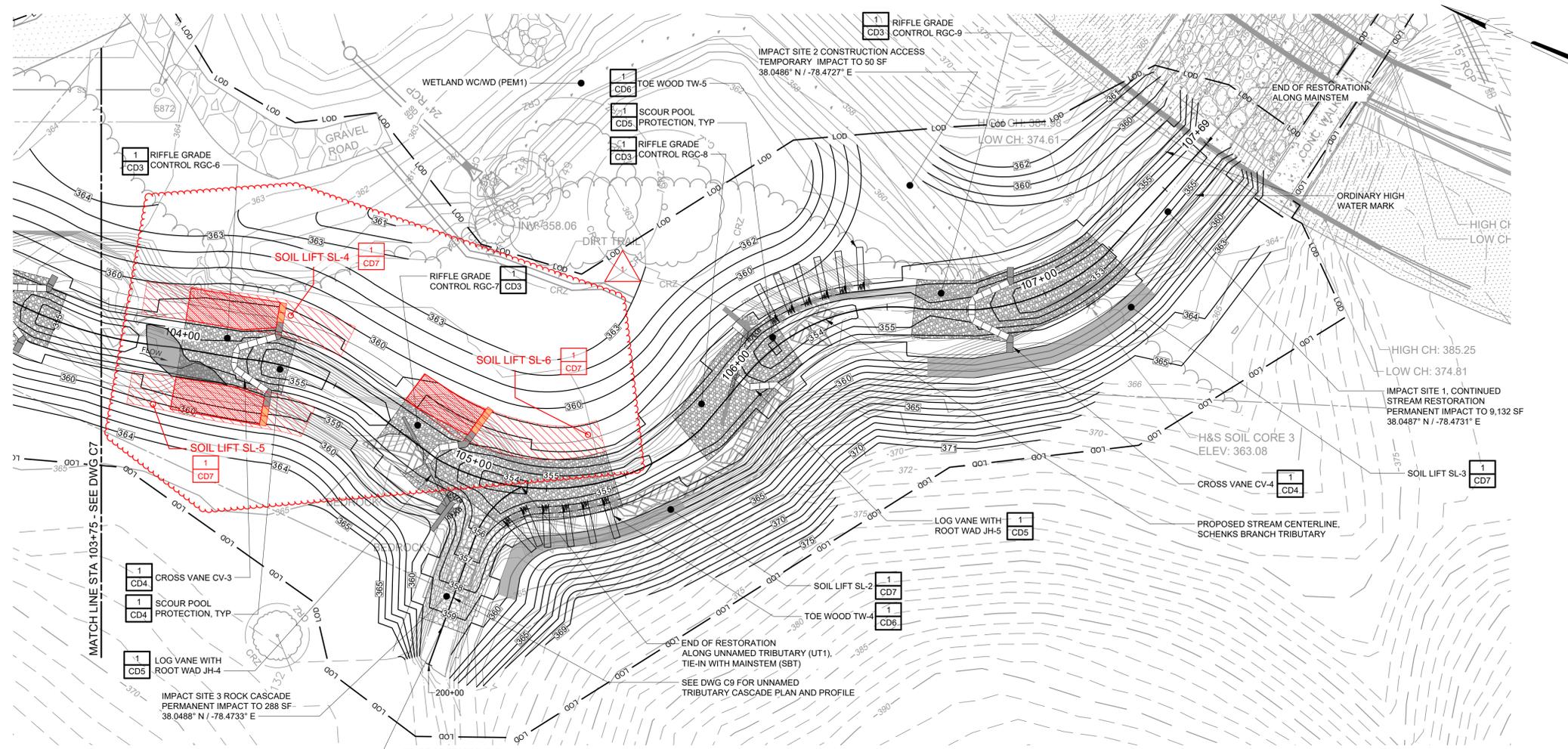
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1555 ROSENEATH ROAD
RICHMOND, VA, 23230

CITY OF CHARLOTTESVILLE
CHARLOTTESVILLE, VIRGINIA

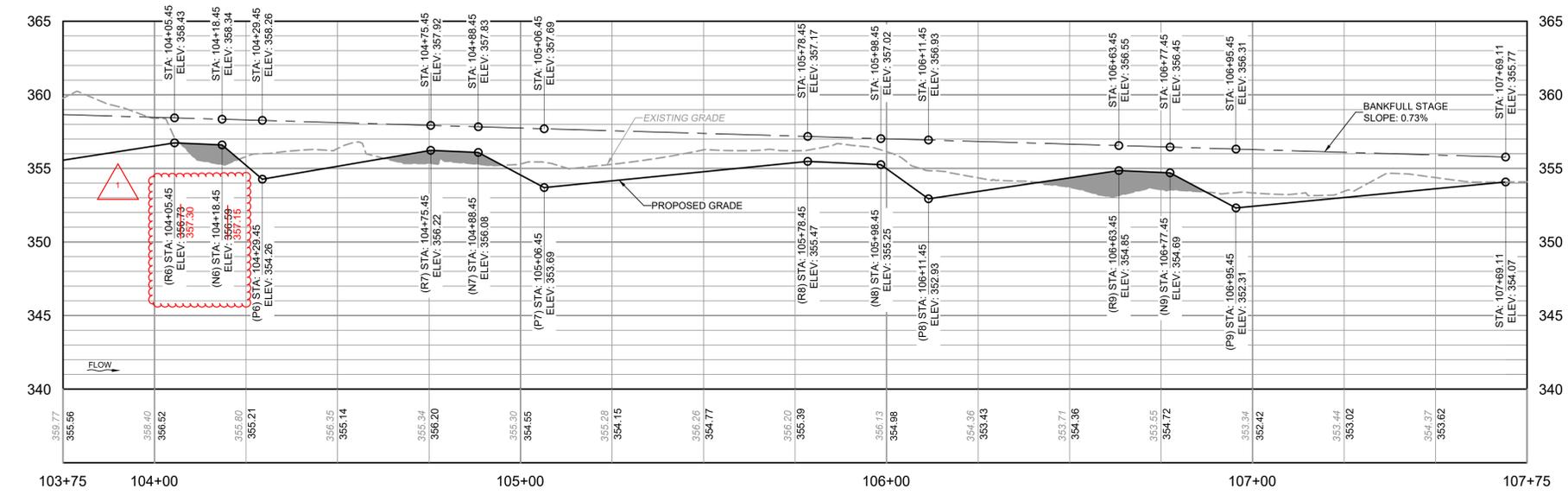
SCHENKS BRANCH TRIBUTARY STREAM
RESTORATION PROJECT

CIVIL
SCHENKS BRANCH TRIBUTARY STREAM
RESTORATION PLAN AND PROFILE - 1 OF 2

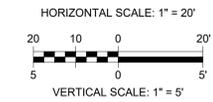
DATE:	APRIL 2022
HAZEN NO.:	32571-003
HAZEN CONTRACT NO.:	202827
DRAWING NUMBER:	C7



PLAN VIEW FOR SCHENKS BRANCH TRIBUTARY (SBT)
SCALE: 1" = 20'



PROFILE
H: 1" = 20' - V: 1" = 5'



NOTES:

- SEE STREAM PROFILE AND STRUCTURES TABLE ON C10 FOR PROPOSED STREAM STRUCTURES, ALIGNMENT, AND PROFILE.
- R = RIFFLE STATION, N = RUN STATION, P = POOL STATION.
- SIZE STRUCTURES AS SPECIFIED IN CD SERIES.
- CHANNEL GRADING DEFINED PER TYPICAL STREAM CHANNEL CROSS SECTIONS IN CD SERIES.
- BOULDER DIMENSIONS SHOWN ARE APPROXIMATE. REFER TO CD SERIES FOR MINIMUM BOULDER DIMENSIONS.
- SEE CD SERIES FOR IN-STREAM STRUCTURE FOOT EXCAVATION ELEVATIONS.
- FIELD RUN TOPOGRAPHIC SURVEY WAS SUPPLEMENTED WITH CITY-PROVIDED GIS CONTOURS. MINOR GRADING MODIFICATIONS DURING CONSTRUCTION CAN BE EXPECTED.
- SCHENKS BRANCH TRIBUTARY WIDTH:
EXISTING = 12-15 FEET; PROPOSED = 18-22 FEET.
- UNNAMED TRIBUTARY TO SCHENKS BRANCH TRIBUTARY (UT1) WIDTH:
EXISTING = 15 FEET; PROPOSED = 16-20 FEET.

FILE: 010371-100032571-001000 - BMAP01010213 - Sheet 05 of 05 - 4/8/2022 8:53 AM
 PLOT DATE: 4/26/2022 10:31 AM BY: WSKANE

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DESIGNED BY:	T. SMITH
DRAWN BY:	S. KANE
CHECKED BY:	T. SCHUELER
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1 BEDROCK MODIFICATIONS	12/11/2023 TWS
REV	ISSUED FOR

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CITY OF CHARLOTTESVILLE
CHARLOTTESVILLE, VIRGINIA

SCHENKS BRANCH TRIBUTARY STREAM
RESTORATION PROJECT

CIVIL
SCHENKS BRANCH TRIBUTARY STREAM
RESTORATION PLAN AND PROFILE - 2 OF 2

DATE:	APRIL 2022
HAZEN NO.:	32571-003
HAZEN CONTRACT NO.:	202827
DRAWING NUMBER:	C8

SCHENKS BRANCH TRIBUTARY PROFILE & STRUCTURE TABLE								
REACH	STATION	PROFILE FEATURE	THALWEG ELEVATION	BANKFULL ELEVATION	CROSS SECTION TYPE	STRUCTURE NAME	STRUCTURE TYPE	STRUCTURE DETAIL DRAWING
SCHENKS BRANCH TRIBUTARY	100+00.00	R1	359.69	361.39	RIFFLE	RGC-1	RIFFLE GRADE CONTROL	CD3
	100+36.45	N1	359.44	361.13	RUN	CV-1	CROSS VANE	CD4
	100+47.45	P1	357.05	361.05	CENTER POOL			
	100+92.45	R2	359.02	360.72	RIFFLE	RGC-2	RIFFLE GRADE CONTROL	CD3
	101+07.45	N2	358.85	360.61	RUN	JH-1	J-HOOK VANE	CD5
	101+18.45	P2	356.53	360.53	LEFT SKEWED POOL			
	101+63.45	R3	358.50	360.20	RIFFLE	RGC-3	RIFFLE GRADE CONTROL	CD3
	101+76.45	N3	358.36	360.10	RUN	JH-2	J-HOOK VANE	CD5
	101+90.45	P3	356.00	360.00	RIGHT SKEWED POOL			
	102+44.45	R4	357.91	359.61	RIFFLE	RGC-4	RIFFLE GRADE CONTROL	CD3
	102+59.45	N4	357.74	359.50	RUN	JH-3	J-HOOK VANE	CD5
	102+73.45	P4	355.40	359.40	LEFT SKEWED POOL			
	103+27.45	R5	357.90	359.00	RIFFLE	RGC-5	RIFFLE GRADE CONTROL	CD3
	103+42.45	N5	357.44	358.89	RUN	CV-2	CROSS VANE	CD4
	103+55.45	P5	354.80	358.80	CENTER POOL			
	104+05.45	R6	356.79	358.43	RIFFLE	RGC-6	RIFFLE GRADE CONTROL	CD3
	104+18.45	N6	356.69	358.34	RUN	CV-3	CROSS VANE	CD4
	104+29.45	P6	354.26	358.26	CENTER POOL			
	104+75.45	R7	356.22	357.92	RIFFLE	RGC-7	RIFFLE GRADE CONTROL	CD3
	104+88.45	N7	356.08	357.83	RUN	JH-4	J-HOOK VANE	CD5
105+06.45	P7	353.69	357.69	RIGHT SKEWED POOL				
105+78.45	R8	355.47	357.17	RIFFLE	RGC-8	RIFFLE GRADE CONTROL	CD3	
105+98.45	N8	355.25	357.02	RUN	JH-5	J-HOOK VANE	CD5	
106+11.45	P8	352.93	356.93	LEFT SKEWED POOL				
106+63.45	R9	354.85	356.55	RIFFLE	RGC-9	RIFFLE GRADE CONTROL	CD3	
106+77.45	N9	354.69	356.45	RUN	CV-4	CROSS VANE	CD4	
106+95.45	P9	352.31	356.31	CENTER POOL				
107+69.11	R10	354.07	355.77	RIFFLE				

THALWEG ELEVATION MODIFICATION
357.65
357.50
357.30
357.15

1 SCHENKS BRANCH TRIBUTARY (SBT) PROFILE AND STRUCTURE TABLE

UNNAMED TRIBUTARY PROFILE & STRUCTURE TABLE								
REACH	STATION	PROFILE FEATURE	THALWEG ELEVATION	BANKFULL ELEVATION	CROSS SECTION TYPE	STRUCTURE NAME	STRUCTURE TYPE	STRUCTURE DETAIL DRAWING
UNNAMED TRIBUTARY	200+12.77	C1	359.41	360.41	RUN	C-1	ROCK CASCADE	CD8
	200+62.00	P10	354.03	357.63	CENTER POOL			

2 UNNAMED TRIBUTARY (UT1) PROFILE AND STRUCTURE TABLE



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PROJECT ENGINEER:	C. TABOR		
DESIGNED BY:	T. SMITH		
DRAWN BY:	S. KANE		
CHECKED BY:	T. SCHUELER		
1	BEDROCK MODIFICATIONS	12/11/2023	TWS
REV	ISSUED FOR	DATE	BY

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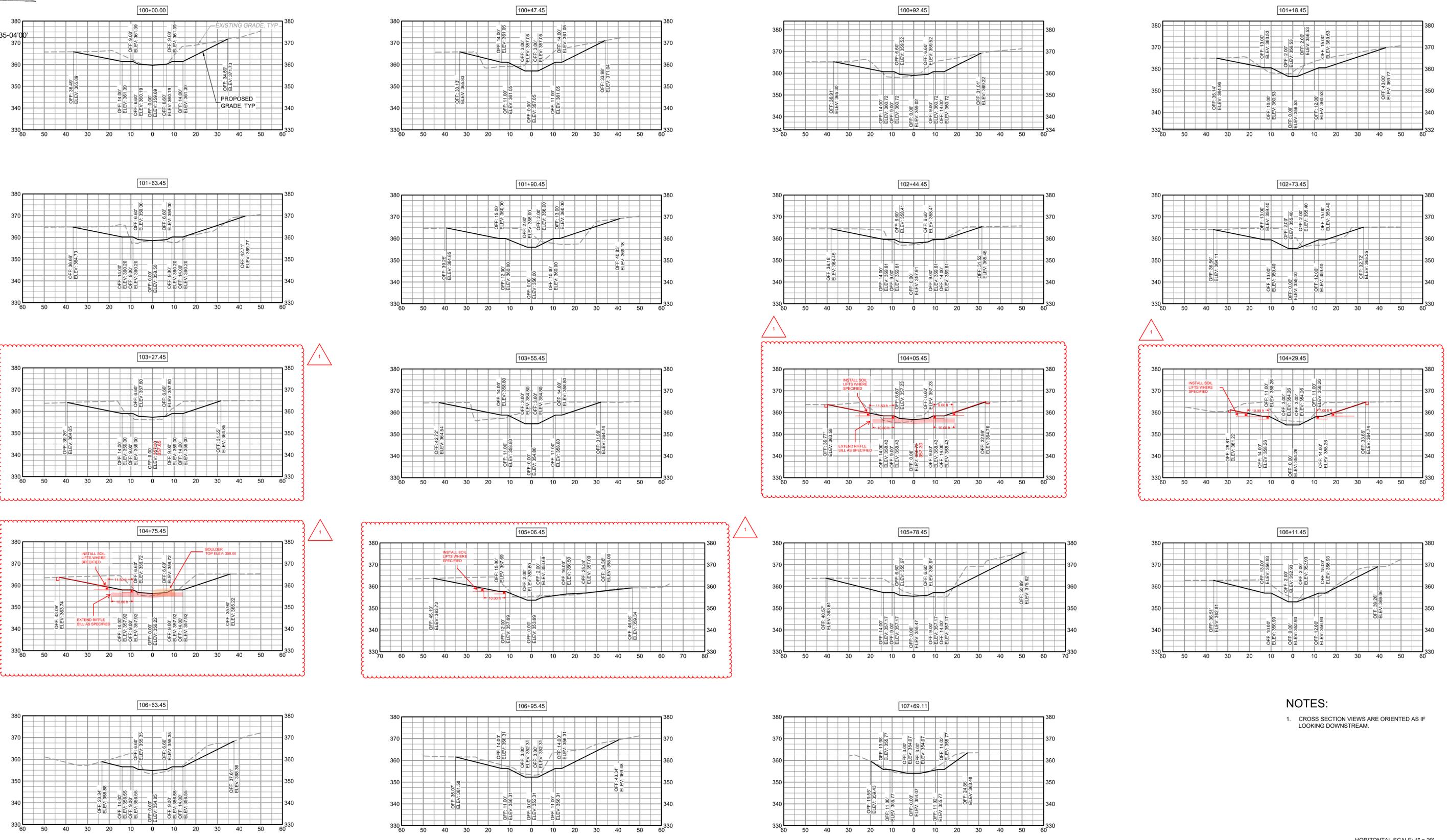
CITY OF CHARLOTTESVILLE
 CHARLOTTESVILLE, VIRGINIA

SCHENKS BRANCH TRIBUTARY STREAM
 RESTORATION PROJECT

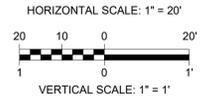
CIVIL
 STREAM PROFILE AND STRUCTURE TABLE

DATE:	APRIL 2022
HAZEN NO.:	32571-003
HAZEN CONTRACT NO.:	202827
DRAWING NUMBER:	C10

2022.05.02 09:33:35-04'00"



CROSS SECTION
H: 1" = 20' - V: 1" = 1'



NOTES:
1. CROSS SECTION VIEWS ARE ORIENTED AS IF LOOKING DOWNSTREAM.

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 PLOT DATE: 4/20/22 2:54 PM BY: SKANE

PROJECT ENGINEER:	C. TABOR
DESIGNED BY:	T. SMITH
DRAWN BY:	S. KANE
CHECKED BY:	T. SCHUELER
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE	

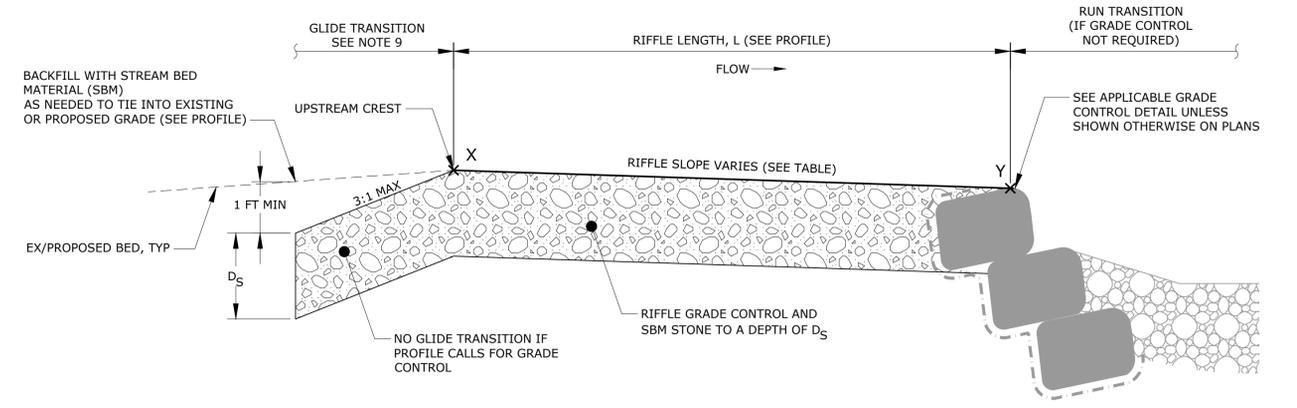
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RICHMOND, VA, 23230

CITY OF CHARLOTTESVILLE
CHARLOTTESVILLE, VIRGINIA

SCHENKS BRANCH TRIBUTARY STREAM RESTORATION PROJECT

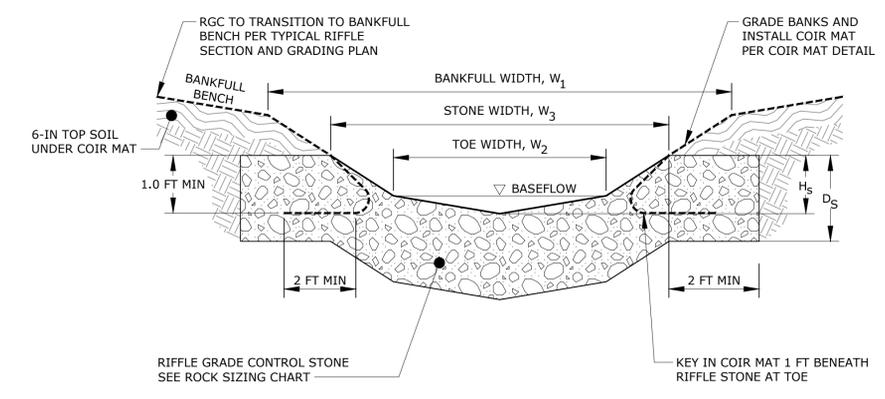
DATE:	APRIL 2022
HAZEN NO.:	32571-003
HAZEN CONTRACT NO.:	202827
DRAWING NUMBER:	C12



NOTES:

- IF EXISTING OR PROPOSED UTILITY OCCURS WITHIN THE RGC, COMPLETE PIPE INSTALLATION, REHABILITATION, OR REPLACEMENT WORK AND INSTALL PIPE PROTECTION (IF REQUIRED) PER SEPARATE UTILITY AND PIPE PROTECTION DETAILS PRIOR TO COMPLETING RGC WORK.
- CONSTRUCT UPSTREAM AND DOWNSTREAM GRADE CONTROLS (IF REQUIRED) PER SEPARATE DETAILS PRIOR TO INSTALLING THE RGC.
- CROSS-SECTIONAL DIMENSIONS AND LONGITUDINAL SPACING OF FEATURES VARY. SEE STRUCTURE TABLES, TYPICAL SECTIONS, DETAILED CROSS SECTIONS, AND PROFILES FOR DIMENSIONS OF EACH INDIVIDUAL STRUCTURE.
- RIFFLE GRADE CONTROL STONE SHALL BE PLACED SO THAT IT SHINGLES IN A DOWNSTREAM DIRECTION. SMALL AND LARGE STONES SHALL BE MIXED PRIOR TO IN-STREAM PLACEMENT TO MINIMIZE VOID SPACES. STONES MUST BE PLACED IN A MANNER TO PROMOTE INTERLOCKING. DUMPING OF RIPRAP SHALL NOT BE PERMITTED.
- CHINK ALL RGC VOIDS WITH SBM PER ROCK SIZING TABLE.
- THERE MAY BE NO GLIDE OR RUN TRANSITION WHERE THE UPSTREAM OR DOWNSTREAM RIFFLE LIMITS ARE SET BY GRADE CONTROLS.
- THALWEG MAY BE MODIFIED IN FIELD PER THE ENGINEER.
- SEE TYPICAL RIFFLE FOR RIFFLE CROSS SECTION DIMENSIONS, DWG CD1.
- CONTRACTOR, TO PROVIDE 5' OF GLIDE TRANSITION, UPSTREAM OF UPSTREAM CREST.

A PROFILE VIEW



B SECTION VIEW

1 RIFFLE GRADE CONTROL (RGC) DETAIL
NTS

STRUCTURE #	UPSTREAM STA	DOWNSTREAM STA	STREAMBED ELEV X (MSL)	STREAMBED ELEV Y (MSL)	LENGTH L (FT)	RIFFLE SLOPE (%)	BANKFULL WIDTH W1 (FT)	TOE WIDTH W2 (FT)	STONE WIDTH W3 (FT)	STONE HEIGHT HS (FT)	RGC STONE DEPTH DS (FT)
RGC-1	100+00.00	100+36.45	359.69	359.44	36.45	0.7%	18	13.2	17	1.1	2
RGC-2	100+92.45	101+07.45	359.02	358.85	15	1.1%	18	13.2	17	1.1	2
RGC-3	101+63.45	101+76.45	358.5	358.36	13	1.1%	18	13.2	17	1.1	2
RGC-4	102+44.45	102+59.45	357.91	357.74	15	1.1%	18	13.2	17	1.1	2
RGC-5	103+27.45	103+42.45	357.3 357.65	357.14 357.50	15	4.4% 1.0%	18	13.2	17	1.1	2
RGC-6	104+05.45	104+18.45	356.79 357.30	356.59 357.15	13	4.4% 1.2%	18	13.2	17	1.1	2
RGC-7	104+75.45	104+88.45	356.22	356.08	13	1.1%	18	13.2	17	1.1	2
RGC-8	105+78.45	105+98.45	355.47	355.25	20	1.1%	18	13.2	17	1.1	2
RGC-9	106+63.45	106+77.45	354.85	354.69	14	1.1%	18	13.2	17	1.1	2

2 SCHENKS BRANCH TRIBUTARY PROJECT, RIFFLE GRADE CONTROL (RGC) SCHEDULE

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 PLOT DATE: 4/20/22 10:51 AM BY: SKANE

PROJECT ENGINEER:	C. TABOR		
DESIGNED BY:	T. SMITH		
DRAWN BY:	S. KANE		
CHECKED BY:	T. SCHUELER		
REV	ISSUED FOR	DATE	BY
1	BEDROCK MODIFICATIONS	12/11/2023	TWS

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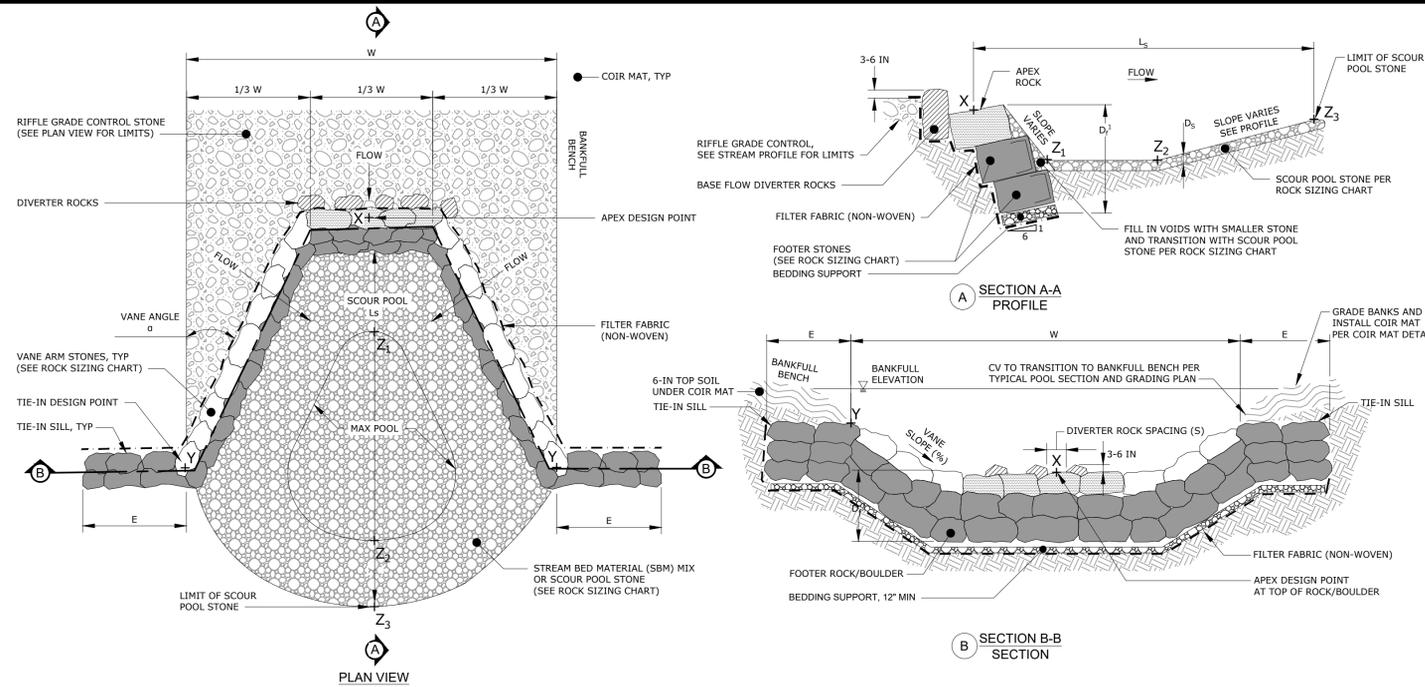
HAZEN AND SAWYER
1555 ROSENEATH ROAD
RICHMOND, VA, 23230

CITY OF CHARLOTTESVILLE
CHARLOTTESVILLE, VIRGINIA

SCHENKS BRANCH TRIBUTARY STREAM
RESTORATION PROJECT

DETAILS
RIFFLE GRADE CONTROL STRUCTURE

DATE:	APRIL 2022
HAZEN NO.:	32571-003
HAZEN CONTRACT NO.:	202827
DRAWING NUMBER:	CD3



1 CROSS VANE (CV) DETAIL

- NOTES:
- NUMBER OF STACKED FOOTER ROCKS REQUIRED TO ACCOMPLISH DESIGN FOOTER DEPTH MAY VARY. SEE DETAIL TABLE AND ROCK SIZING CHART FOR STONE DIMENSIONS AND MIN FOOTER DEPTHS (D_i).
 - ALL DIMENSIONS/ELEVATIONS TO BE FIELD ADJUSTED TO ENSURE STABLE INSTALLATION, FISH PASSAGE, AND TIE-IN TO BANKS.
 - VANE STONES SHALL BE BOULDERS WITH RECTANGULAR BLOCK SHAPE AND MINIMUM D50 DIMENSION OF 18 INCHES IN ANY DIRECTION UNLESS NOTED OTHERWISE (SEE ROCK SIZING CHART).
 - ROCKS/BOULDERS SHALL BE TIGHT FITTING WITH NO VOIDS/GAPS LARGER THAN 1 INCH. VOIDS ALONG APEX AND VANE ARMS SHALL BE CHINKED-IN WITH SMALLER NON-WEATHERING STONE TO ESTABLISH SURFACE FLOW AND INTERCONNECTION OF ROCKS.
 - ROCKS/BOULDERS ALONG APEX AND VANE ARMS SHALL BE FLUSH WITH THE TOP SURFACES OF ADJACENT STONES.
 - TOP ROCKS SHALL BE SUPPORTED BY A FOOTER ROCK AND SHINGLED UPSTREAM.
 - STONE PLACEMENT SHALL BE FIELD ADJUSTED TO ENSURE STONE WILL REMAIN IN PLACE OVER FULL RANGE OF FLOW CONDITIONS.
 - REPLACEMENT OF ROCKS/BOULDERS MAY BE REQUIRED BASED UPON INSPECTION OF COMPLETED INSTALLATION TO MEET DESIGN INTENT AND PERMIT REQUIREMENTS.
 - SPACING BETWEEN DIVERTER ROCKS SHALL BE 1/3 TO 1/2 THE LENGTH OF THE APEX STONE LENGTH UNLESS NOTED OTHERWISE (SEE DETAIL TABLE). DIVERTER STONES SHALL BE PLACED SO THAT THE TOP SURFACE IS 3 TO 6 INCHES ABOVE THE APEX ROCK ELEVATION.
 - TIE-IN SILLS SHALL BE EMBEDDED 4 FT (MIN) INTO STABLE CHANNEL BANK UNLESS NOTED OTHERWISE (SEE DETAIL TABLE).
 - ANGLE OF VANE ARM SHALL BE BETWEEN 20 (MIN) AND 30 (MAX) DEGREES UNLESS NOTED OTHERWISE (SEE DETAIL TABLE).
 - SLOPE OF VANE ARM SHALL BE BETWEEN 2% (MIN) AND 7% (MAX) UNLESS NOTED OTHERWISE (SEE DETAIL TABLE). ARM SLOPE IS MEASURED FROM APEX POINT X TO BANK TIE-IN POINT Y.
 - PLACE FILTER FABRIC (NON-WOVEN) ON UPSTREAM FACE OF ROCKS FOR THE ENTIRE STRUCTURE INCLUDING APEX, VANE AND TIE-IN SILLS. FABRIC SHALL EXTEND BENEATH THE FOOTER ROCKS.
 - WHERE EXISTING BED MATERIAL IN SCOUR POOLS MATCHES SIZE AND MATERIAL OF STREAM BED MATERIAL (SBM) MIX, SCOUR POOL STONE LINING IS NOT REQUIRED UNLESS NOTED OTHERWISE. WHERE SCOUR POOL LIES IN CLAY OR OTHER SUBSTRATE FINER THAN THE SBM MIX, THE CONTRACTOR SHALL OVER EXCAVATE BY 6 INCHES (MIN.) UNLESS NOTED OTHERWISE (SEE DETAIL TABLE) AND PLACE SBM MIX TO PROPOSED GRADE OR AS DIRECTED BY THE ENGINEER.
 - STREAM BED MATERIAL SHALL COME FROM SALVAGED SOURCE FIRST AND THEN FURNISHED AS NECESSARY. OFFSITE STREAMBED MATERIAL SHALL BE USED TO CHOKE BOTTOM LAYERS OF ROCK WITH SALVAGED MATERIAL SAVED FOR TOP.
 - ROCKS (APEX, ARM, AND FOOTERS) ARE PLACED AT 6:1 CAMBER WITH HORIZONTAL.
 - SEE ROCK SIZING CHART FOR STONE SIZES.

STRUCTURE #	APEX X	STONE TIE-IN AT BANK Y		MAX POOL Z1	MAX POOL Z2	SCOUR POOL STONE Z3	VANE SLOPE (%)	VANE ANGLE a (DEGREES)	SILL EMBEDMENT LENGTH E (FT)	SCOUR POOL STONE LENGTH LS (FT)	BANKFULL WIDTH W (FT)	ROCK DIVERTER SPACING S (FT)	FOOTER DEPTH DF (FT)	SCOUR POOL STONE DEPTH DS (FT)					
		LEFT	RIGHT																
CV-1	STA	100+36.45	100+48.45	100+48.45	100+47.45	-	100+52.45	(L) 3.7%	(R) 3.7%	(L) 25%	(R) 25%	(L) 5	(R) 5	16	18	0.2	4.4	1.3	
	OFFSET	-	12	12	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ELEV	359.44	359.884	359.884	357.05	-	357.27	-	-	-	-	-	-	-	-	-	-	-	-
CV-2	STA	103+42.45	103+54.45	103+54.45	103+55.45	-	103+60.45	(L) 3.0%	(R) 3.0%	(L) 25%	(R) 25%	(L) 5	(R) 5	18	18	0.2	4.4	1.3	
	OFFSET	-	12	12	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ELEV	357.50	357.86	357.86	354.8	-	354.99	-	-	-	-	-	-	-	-	-	-	-	-
CV-3	STA	104+18.45	104+30.45	104+30.45	104+29.45	-	104+34.45	(L) 3.0%	(R) 3.0%	(L) 25%	(R) 25%	(L) 6	(R) 10	16	18	0.2	4.4	1.3	
	OFFSET	-	12	12	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ELEV	357.15	357.51	357.51	354.26	-	354.47	-	-	-	-	-	-	-	-	-	-	-	-
CV-4	STA	106+77.45	106+89.45	106+89.45	106+95.45	-	107+24.45	(L) 3.7%	(R) 3.7%	(L) 25%	(R) 25%	(L) 5	(R) 5	47	18	0.2	4.4	1.3	
	OFFSET	-	12	12	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ELEV	354.69	355.134	355.134	352.31	-	352.43	-	-	-	-	-	-	-	-	-	-	-	-

2 CROSS VANE (CV) SCHEDULE

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 PLOT DATE: 4/20/22 10:51 AM BY: SKANE

PROJECT ENGINEER:	C. TABOR		
DESIGNED BY:	T. SMITH		
DRAWN BY:	S. KANE		
CHECKED BY:	T. SCHUELER		
REV	ISSUED FOR	DATE	BY
1	BEDROCK MODIFICATIONS	12/11/2023	TWS

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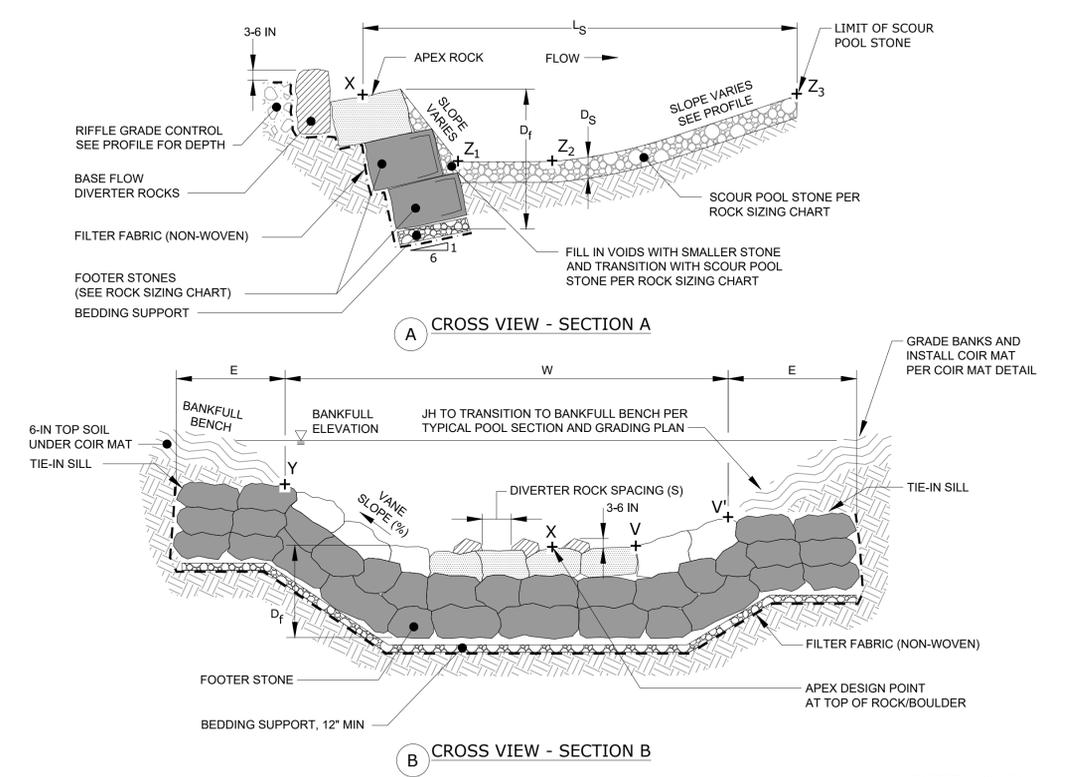
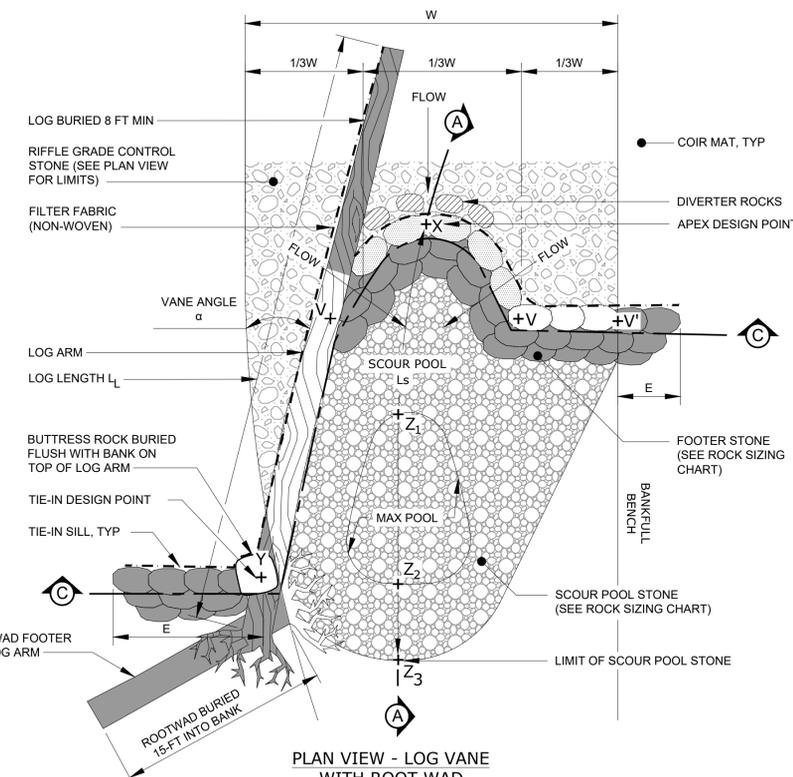
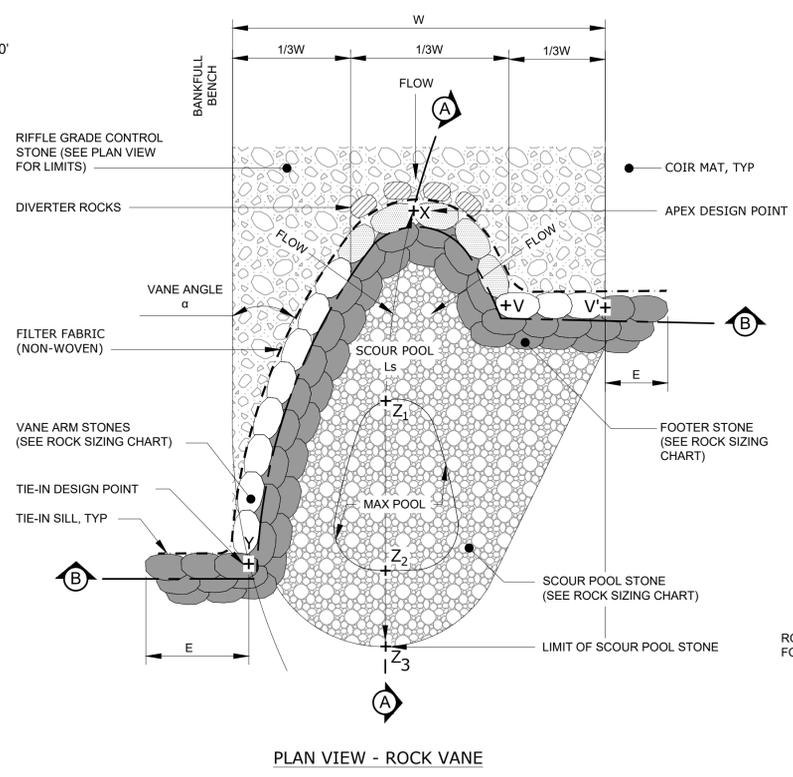
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HAZEN AND SAWYER
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CITY OF CHARLOTTESVILLE
CHARLOTTESVILLE, VIRGINIA

SCHENKS BRANCH TRIBUTARY STREAM
RESTORATION PROJECT

DETAILS
CROSS VANE

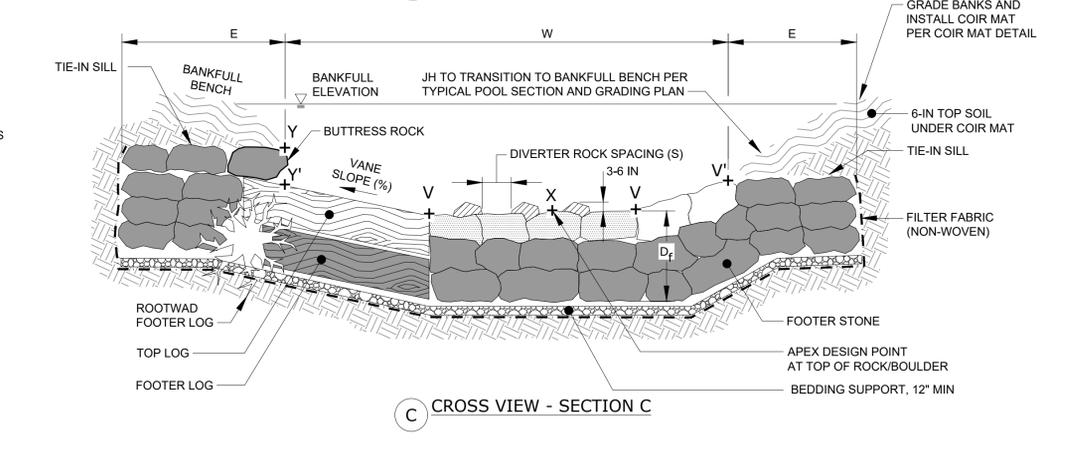
DATE:	APRIL 2022
HAZEN NO.:	32571-003
HAZEN CONTRACT NO.:	202827
DRAWING NUMBER:	CD4



J-HOOK VANE NOTES:

- NUMBER OF STACKED FOOTER ROCKS REQUIRED TO ACCOMPLISH DESIGN FOOTER DEPTH MAY VARY. SEE DETAIL TABLE AND ROCK SIZING CHART FOR STONE DIMENSIONS AND MIN FOOTER DEPTHS (D_f).
- ALL DIMENSIONS/ELEVATIONS MAY BE FIELD ADJUSTED BY DESIGN ENGINEER TO ENSURE STABLE INSTALLATION, FISH PASSAGE, AND TIE-IN TO BANKS.
- VANE STONES SHALL BE BLOCK-LIKE BOULDERS WITH TWO ROUGHLY PARALLEL OPPOSITE SIDES SUITABLE FOR STACKING AND MINIMUM DIMENSION AS SPECIFIED IN THE ROCK SIZING TABLE, UNLESS NOTED OTHERWISE.
- ROCKS/BOULDERS SHALL BE TIGHT FITTING WITH NO VOIDS/GAPS LARGER THAN 1 INCH. VOIDS ALONG APEX AND VANE ARMS SHALL BE CHINKED-IN WITH SMALLER NON-WEATHERING STONE TO ESTABLISH SURFACE FLOW AND INTERCONNECTION OF ROCKS.
- ROCKS/BOULDERS ALONG APEX AND VANE ARMS SHALL BE FLUSH WITH THE TOP SURFACES OF ADJACENT STONES.
- TOP ROCKS SHALL BE SUPPORTED BY A FOOTER ROCK AND SHINGLED UPSTREAM.
- STONE PLACEMENT SHALL BE FIELD ADJUSTED TO ENSURE STONE WILL REMAIN IN PLACE OVER FULL RANGE OF FLOW CONDITIONS.
- SPACING BETWEEN DIVERTER ROCKS SHALL BE 1/3 TO 1/2 THE LENGTH OF THE APEX STONE LENGTH UNLESS NOTED OTHERWISE (SEE DETAIL SCHEDULE). DIVERTER STONES SHALL BE PLACED SO THAT THE TOP SURFACE IS 3 TO 6 INCHES ABOVE THE APEX ROCK ELEVATION.
- TIE-IN SILLS SHALL EXTEND 4 FT (MIN) INTO STABLE CHANNEL BANK UNLESS NOTED OTHERWISE (SEE DETAIL SCHEDULE).
- ANGLE OF VANE ARM SHALL BE BETWEEN 20 (MIN) AND 30 (MAX) DEGREES UNLESS NOTED OTHERWISE (SEE DETAIL SCHEDULE).
- SLOPE OF VANE ARM SHALL BE BETWEEN 2% (MIN) AND 7% (MAX) UNLESS NOTED OTHERWISE (SEE DETAIL SCHEDULE). ARM SLOPE IS MEASURED FROM APEX POINT X TO BANK TIE-IN POINT Y FOR ROCK VANES. FOR LOG VANES, ARM VANES MEASURED FROM APEX POINT X TO TO BANK TIE-IN POINT Y'.
- LOG VANES SHALL TIE INTO BANK AT A LOWER ELEV THAN ROCK VANES IN ORDER TO BURY THE ROOTBALL IN THE BANK (SEE DETAIL SCHEDULE).
- PLACE FILTER FABRIC (NON-WOVEN) ON UPSTREAM FACE OF ENTIRE STRUCTURE, INCLUDING APEX, VANE ROCKS, LOG VANES AND TIE-IN SILLS. FABRIC SHALL EXTEND BENEATH THE FOOTER ROCKS AND FOOTER LOGS.
- WHERE EXISTING BED MATERIAL IN SCOUR POOLS MATCHES SIZE AND MATERIAL OF SPECIFIED SCOUR POOL STONE, SCOUR POOL STONE LINING IS NOT REQUIRED UNLESS NOTED OTHERWISE. WHERE SCOUR POOL LIES IN CLAY OR OTHER SUBSTRATE FINER THAN THE SPECIFIED SCOUR POOL STONE, THE CONTRACTOR SHALL OVER EXCAVATE BY 6 INCHES (MIN.) UNLESS NOTED OTHERWISE (SEE DETAIL SCHEDULE) AND PLACE STONE TO PROPOSED GRADE OR AS DIRECTED BY THE ENGINEER.
- SCOUR POOL STONE SHALL COME FROM SALVAGED SOURCE FIRST AND THEN FURNISHED AS NECESSARY. OFFSITE SCOUR POOL STONE SHALL BE USED TO CONSTRUCT BOTTOM LAYERS OF POOL WITH SALVAGED MATERIAL SAVED FOR TOP.
- ALL ROCKS ARE TO BE PLACED AT 6:1 CAMBER WITH HORIZONTAL.
- SEE ROCK SIZING CHART FOR STONE SIZES.
- DUCKBILL ANCHORS SHALL NOT BE INSTALLED.

1 J-HOOK (JH) VANE DETAILS
NTS

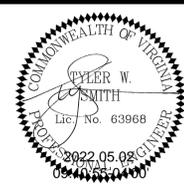


STRUCTURE #	TYPE	APEX X	HOOK SILL/LOG V	SILL AT BANK V'	STONE AT BANK Y	LOG AT BANK Y'	MAX POOL Z1	MAX POOL Z2	SCOUR POOL STONE Z3	VANE SLOPE (%)	VANE ANGLE a (DEGREES)	LOG LENGTH LL (FT)	SCOUR POOL STONE LENGTH LS (FT)	BANKFULL WIDTH W (FT)	ROCK DIVERTER SPACING S (FT)	FOOTER DEPTH DF (FT)	SCOUR POOL STONE DEPTH DS (FT)	SILL EMBEDMENT LENGTH E (FT)
JH-1	STA	101+07.45	101+13.45	101+13.45	101+19.45	101+19.45	101+18.45	-	101+23.45	3.7	25	20	16	18	0.2	4.4	1.3	5
	OFFSET	-	6	6	12	12	11	-	-									
	ELEV	358.85	358.97	358.97	359.29	359.29	356.53	-	356.75									
JH-2	STA	101+76.45	101+82.45	101+82.45	101+88.45	101+88.45	101+90.45	-	101+95.45	3.7	25	20	19	18	0.2	4.4	1.3	5
	OFFSET	-	6	6	12	12	14	-	-									
	ELEV	358.36	358.48	358.48	358.80	358.80	356.00	-	356.18									
JH-3	STA	102+59.45	102+65.45	102+65.45	102+71.45	102+71.45	102+73.45	-	102+78.45	3.7	25	20	19	18	0.2	4.4	1.3	5
	OFFSET	-	6	6	12	12	14	-	-									
	ELEV	357.74	357.86	357.86	358.18	358.18	355.40	-	355.58									
JH-4	STA	104+88.45	104+94.45	104+94.45	105+00.45	105+00.45	105+06.45	-	105+46.45	3.7	25	20	58	18	0.2	4.4	1.3	6 10
	OFFSET	-	6	6	12	12	18	-	-									
	ELEV	356.08	356.20	356.20	356.52	356.52	353.69	-	354.68									
JH-5	STA	105+98.45	106+04.45	106+04.45	106+10.45	106+10.45	106+11.45	-	106+16.45	3.7	25	20	18	18	0.2	4.4	1.3	5
	OFFSET	-	6	6	12	12	13	-	-									
	ELEV	355.25	355.37	355.37	355.69	355.69	352.93	-	353.11									

2 J-HOOK (JH) SCHEDULE

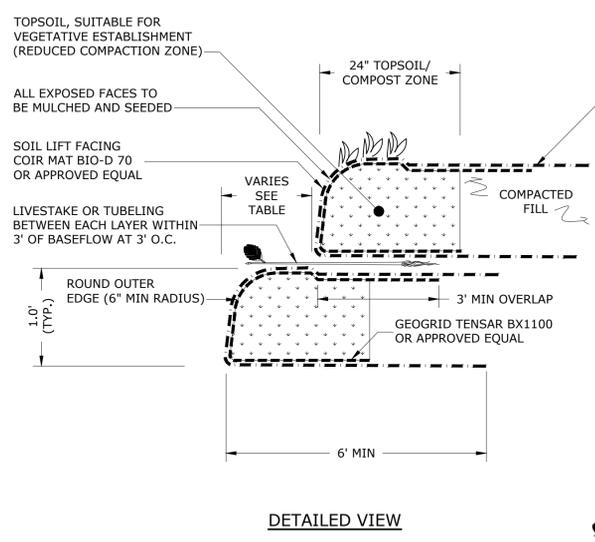
PROJECT ENGINEER:	C. TABOR
DESIGNED BY:	T. SMITH
DRAWN BY:	S. KANE
CHECKED BY:	T. SCHUELER

100% DESIGN - ISSUED FOR CONSTRUCTION

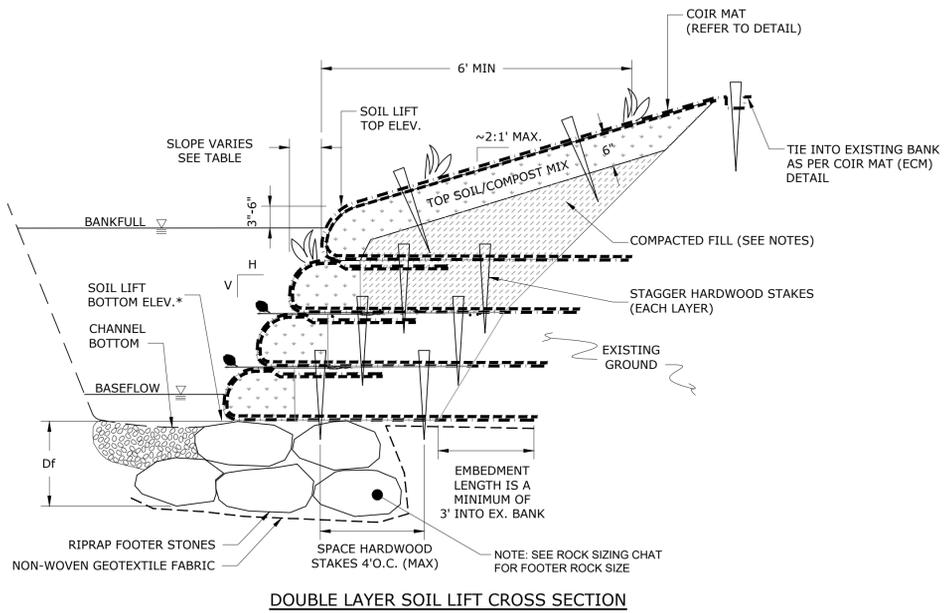


CITY OF CHARLOTTESVILLE
CHARLOTTESVILLE, VIRGINIA
SCHENKS BRANCH TRIBUTARY STREAM
RESTORATION PROJECT

DATE: APRIL 2022
HAZEN NO.: 32571-003
HAZEN CONTRACT NO.: 202827
DRAWING NUMBER: CD5



- LEGEND**
- INNER LAYER BIAXIAL GEOGRID
 - OUTER LAYER COIR FIBER MAT
 - GEOTEXTILE FABRIC
 - TOP SOIL/COMPOST MIX
 - ▨ COMPACTED FILL
 - 🌱 PLANTS
 - LIVESTAKES/TUBELINGS



- NOTES:**
- DOUBLE SOIL LIFT SHALL CONSIST OF TWO LAYERS OF MATTING OF DIFFERENT MATERIALS. THE INNER MAT LAYER IS TO CONSIST OF A BIAXIAL GEOGRID (TENSAR BX1100 OR APPROVED EQUAL). THE OUTER MAT IS TO CONSIST OF A COCONUT FIBER COIR MAT (ROLANKA BIO-D 70 OR APPROVED EQUAL. ROLANKA BIO-D BLOCK 12-300 IS AN ACCEPTABLE SUBSTITUTE.
 - THE SOIL LIFTS ARE TO BE FILLED WITH TOPSOIL AND SEED MIX.
 - THE SOIL LIFTS ARE TO BE 12-INCHES HIGH, PER LIFT.
 - MATting TO BE STRETCHED TIGHT AND WRINKLE FREE AROUND LIFT.
 - 6" TOPSOIL/COMPOST MIX SURFACE TO BE FREE OF STICKS, DEBRIS, AND TWIGS TO PREVENT CAVITATION.
 - SATISFACTORY SOIL TYPES INCLUDE ASTM D 2487 SOIL CLASSIFICATION GROUPS GW, GP, GM, SW, SP AND SM OR A COMBINATION OF THESE SOIL GROUPS. SOIL SHALL BE FREE OF ROCK OR GRAVEL LARGER THAN 2 INCHES IN ANY DIMENSION DEBRIS, WASTE, FROZEN MATERIALS, VEGETATION AND OTHER DELETERIOUS MATTER.
 - SOIL LIFTS TO BE SEEDED AND PLANTED AS DESCRIBED ON PLANTING DETAIL PLANS.
 - PLAIN WOODEN STAKES SHALL CONSIST OF ROUGH SAWN HARDWOOD, TRIANGULAR IN SHAPE, 2-INCH BY 4-INCHES IN CROSS SECTION AND 24-INCHES IN LENGTH.
 - ONCE PLACED, SOIL LIFTS SHALL NOT BE DRIVEN OVER WITH HEAVY EQUIPMENT.

1 DOUBLE LAYER SOIL LIFT NTS

BANK	UPSTREAM STATION	DOWNSTREAM STATION	TYPE	LENGTH	WALL SLOPE	NUMBER OF LIFTS	TOP ELEVATION TIE IN	NOTES
RIGHT	101+63.45	102+23.45	WITH COIR BLOCK	60	3H:1V	2	363	NO TOE ROCK REQUIRED
RIGHT	200+28.00	105+45.45	WITH COIR BLOCK	41	2H:1V	2	361	NO TOE ROCK REQUIRED
RIGHT	106+63.45	107+26.45	WITH COIR BLOCK	62	2H:1V	3	360	NO TOE ROCK REQUIRED
LEFT	103+86.45	104+48.45	WITH COIR BLOCK	62	----	2	SEE DWG C12	NO TOE ROCK REQUIRED
RIGHT	103+86.45	104+48.45	WITH COIR BLOCK	62	----	2	SEE DWG C12	NO TOE ROCK REQUIRED
LEFT	104+70.45	105+46.45	WITH COIR BLOCK	76	----	2	SEE DWG C12	NO TOE ROCK REQUIRED

2 SOIL LIFT SCHEDULE

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 PLOT DATE: 4/20/22 10:51 AM BY: SKANE

PROJECT ENGINEER:	C. TABOR		
DESIGNED BY:	T. SMITH		
DRAWN BY:	S. KANE		
CHECKED BY:	T. SCHUELER		
REV	ISSUED FOR	DATE	BY
1	BEDROCK MODIFICATIONS	12/11/2023	TWS

100% DESIGN - ISSUED FOR CONSTRUCTION

2022.05.02 09:34:03-04'00'

HAZEN AND SAWYER
1555 ROSENEATH ROAD
RICHMOND, VA, 23230

CITY OF CHARLOTTESVILLE
CHARLOTTESVILLE, VIRGINIA

SCHENKS BRANCH TRIBUTARY STREAM
RESTORATION PROJECT

DATE: APRIL 2022

HAZEN NO.: 32571-003

HAZEN CONTRACT NO.: 202827

DRAWING NUMBER: CD7

DETAILS
SOIL LIFT

Stream: Schenks Branch Tributary		Location: Mainstem														
Graph: USFWS Hickey Run Bank Erosion Rate Curve		Total Stream Length (ft): 1100										Date: _____				
Observers: TS/PL																
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
BEHI ID	BEHI Score	BEHI rating	NBS Score	NBS rating	Bank Erosion Rate (ft/yr)	Length of bank (ft)	Study bank height (ft)	Erosion subtotal [(4)×(5)×(6)] (ft ³ /yr)	Soil Bulk Density (g/cm ³)	Total Annual Load (TSS tons/yr)	Sediment Delivery Ratio	Erosion subtotal (tons/yr)	Phosphorous Concentration(lb per ton of sediment)	Phosphorous Loading (lbs/yr)	Nitrogen Concentration(lb per ton of sediment)	Nitrogen Loading (lbs/yr)
2L	32.50	high	1.08	low	0.40	106	6.40	271.36	1.23	10.42	1	10.42	0.70	7.29	0.60	6.25
3L	36.20	high	2.00	high	1.00	88	7.10	624.80	1.23	23.99	1	23.99	0.70	16.79	0.60	14.39
5L	41.40	very high	2.00	high	1.00	80	8.30	664.00	1.23	25.49	1	25.49	0.70	17.85	0.60	15.30
7L	35.20	high	1.11	low	0.40	39	7.10	110.76	1.23	4.25	1	4.25	0.70	2.98	0.60	2.55
9L	34.60	high	1.08	low	0.40	14	7.50	42.00	1.23	1.61	1	1.61	0.70	1.13	0.60	0.97
10L	47.50	extreme	1.25	low	1.25	60	8.20	615.00	1.23	23.61	1	23.61	0.70	16.53	0.60	14.17
12L	37.90	high	1.29	low	0.40	60	7.90	189.60	1.23	7.28	1	7.28	0.70	5.10	0.60	4.37
13L	43.70	very high	1.19	low	0.40	32	8.60	110.08	1.23	4.23	1	4.23	0.70	2.96	0.60	2.54
15L	44.00	very high	1.15	low	0.40	65	8.10	210.60	1.23	8.09	1	8.09	0.70	5.66	0.60	4.85
18L	50.20	extreme	1.14	low	1.25	135	6.10	1029.38	1.23	39.52	1	39.52	0.70	27.66	0.60	23.71
LEFT BANK TOTALS						679		3867.58				148.5		103.9		89.1
1R	33.50	high	1.12	low	0.40	57	8.40	191.52	1.23	7.35	1	7.35	0.70	5.15	0.60	4.41
4R	27.40	moderate	2.00	high	0.80	15	3.70	44.40	1.23	1.70	1	1.70	0.70	1.19	0.60	1.02
6R	40.10	very high	2.00	high	1.00	75	10.00	750.00	1.23	28.79	1	28.79	0.70	20.16	0.60	17.28
8R	40.30	very high	1.14	low	0.40	35	7.60	106.40	1.23	4.09	1	4.09	0.70	2.86	0.60	2.45
11R	45.00	extreme	1.35	low	1.25	55	8.00	550.00	1.23	21.12	1	21.12	0.70	14.78	0.60	12.67
14R	40.00	very high	1.08	low	0.40	60	12.20	292.80	1.23	11.24	1	11.24	0.70	7.87	0.60	6.74
16R	46.20	extreme	1.13	low	1.25	26	9.40	305.50	1.23	11.73	1	11.73	0.70	8.21	0.60	7.04
RIGHT BANK TOTALS						323		2240.62				86.0		60.2		51.6
GRAND TOTALS						1002		6108.20				234.5		164.2		140.7



Project: Schenks Branch Tributary Stream Restoration
 Location: Charlottesville, VA
 Client: City of Charlottesville
 Hazen Project No. 32571-004
 Subject: **Nutrient Removal Protocol for Stream Restoration Work [PROTOCOL 1]**
 Design Phase: Post-Construction
 Design Date: 7/25/2024
 Designer: BK Version: 1.0 (5/17/2021)
 Reviewer: BF Date: 7/25/2024
 Review Date:
 Source: Reference file locations or pertinent design spreadsheets that the entered values are based on.
 Template Version:

Subject: Estimate of Stream Sediment and Nutrient Loading and Removal
Methodology: Calculate mass reduction credit for prevented sediment using **Protocol 1** per guidelines set by the *Expert Panel to Define Removal Rates for Individual Stream Restoration Projects* (dated 09/08/14) and *Consensus Recommendations for Improving the Application of the Prevented Sediment Protocol for Urban Stream Restoration Projects for Pollutant Removal Credit* (revised 2/27/20). Blue cells require user input. Green cells are result cells.

Step 1. Estimate stream sediment erosion rate and sediment load

Bulk density of soil ¹, c = 1.23 gm/cc
 77.01 lb/cf

Method Used: 2 (Enter 1 or 2)

Method #1:
 Eroding bank area, A = sf
 Bank erosion rate, R = ft/yr

Sediment load ², S = tn/yr
 lb/yr

Method #2:
 Predicted Erosion ³ = 235 cy/yr

Sediment load ², S = 234.5 tn/yr
 469,000 lb/yr

¹ **Site specific bulk density values are now required for Protocol 1 use:** NRCS General guide for Est. Moist Bulk Density can be used as an initial guide. Document source of bulk density values: For this example, average silty clay values were used from soil boring data to the right

Document source of method #1 data, if used, in this cell.

² $S = \frac{\sum(c * A * R)}{2,000 \text{ lb/tn}}$

³ From RiverMorph field work BEHI data below: Document specific location/date of collected data, if used, in this cell.

Step 2. Convert stream bank erosion to nutrient loading

Phosphorous concentration ⁴ = 0.7 lb P/tn sediment
 Nitrogen concentration ⁵ = 0.6 lb N/tn sediment

Therefore, the nutrient loading for this site prior to restoration is:

Phosphorous Loading = 164.2 lb P/yr
 Nitrogen Loading = 140.7 lb N/yr

⁴ Expert panel recommended value for Phosphorous unless field measured
⁵ Expert panel recommended values for Nitrogen unless field measured
 Document specific field measurement data, if used, in this cell.

Nutrient Loading = Sediment Load * Concentration

Step 3. Estimate stream restoration efficiency

Amount of sediment, Phosphorous, Nitrogen loading reduced through restoration:

Sediment Removed ⁶ = 234,500 lb sediment/yr
 Phosphorous Removed ⁶ = 82.1 lb P/yr
 Nitrogen Removed ⁶ = 70.4 lb N/yr

⁶ For stream restoration practices, the Expert panel recommends a 50% efficiency in reducing sediment and nutrients from the stream reach.

Project: *Schenks Branch Tributary Stream Restoration*
 Location: *Charlottesville, VA*
 Client: *City of Charlottesville*
 Hazen Project No. *32571-004*
 Subject: **Nutrient Removal Protocol for Stream Restoration Work [PROTOCOL 2]**
 Design Phase: *Post-Construction*
 Design Date: *7/25/2024*
 Designer: *BK* Version: *1.0 (5/17/2021)*
 Reviewer: *BF* Date: *7/25/2024*
 Review Date:
 Source: Reference file locations or pertinent design spreadsheets that the entered values are based on.
 Template Version:

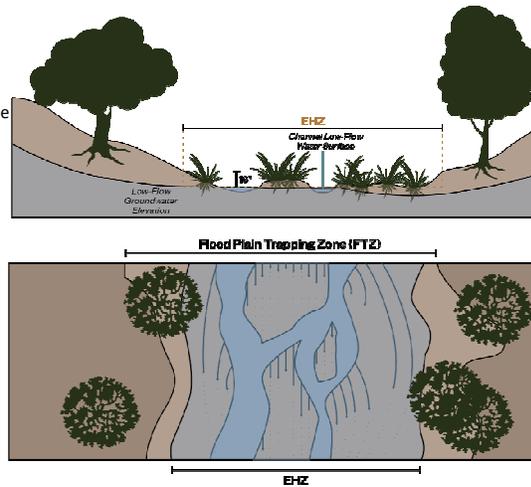
Subject: Estimate of Stream Sediment and Nutrient Loading and Removal

Methodology: Calculate mass reduction credit for prevented sediment using **Protocol 2** per guidelines set by the *Expert Panel to Define Removal Rates for Individual Stream Restoration Projects* (dated 09/08/14) and *Consensus Recommendations to Improve Protocols 2 and 3 for Defining Stream Restoration Pollutant Removal Credits* (revised 10/26/20). Blue cells require user input. Green cells are result cells.

Step 1. Establish limits of effective hyporheic zone (EHZ), as follows:

The lateral limits of the EHZ are defined by locations where the *restored* floodplain elevation are less than 18 inches above the low flow water elevations and confirmed through on-site soil/groundwater investigation. See Figure 1 for representation of EHZ; see Ref 2-EHZ and FTZ information for more information on onsite investigation.

Est. total width EHZ:	26.50	ft
Est. channel width:	18	ft
Est. length EHZ:	883	ft
Est. floodplain area:	7505.5	ft ²
Est. Channel Area:	15894	ft ²



Step 2. Apply the denitrification rate to the EHZ:

The denitrification rate has been standardized to 0.00269 lbs/sf/year.

Est. floodplain denitrification:	20.2	lbs NO ₃ /yr
Est. Channel denitrification:	42.8	lbs NO ₃ /yr

Figure 1: Representation of EHZ and FTZ boundaries

Step 3. Apply site specific discount factors:

Determine discount factors for baseflow (Bf), floodplain height factor (Hf) and aquifer conductivity reduction factor (Af) per Table 10 of the *Consensus Recommendations*.

Floodplain only:

Baseflow reduction factor (Bf):	1
Floodplain height red. factor (Hf):	0
Aquifer cond. red. Factor (Af):	1

Channel only:

Baseflow reduction factor (Bf):	1
Floodplain height red. factor (Hf):	1
Aquifer cond. red. Factor (Af):	1

Denitrification rate established in Step 2 affected by factors:

Final rate = base rate * Bf * Hf * Af

Est. floodplain denitrification:	0.0	lbs NO ₃ /yr
Est. Channel denitrification:	42.8	lbs NO ₃ /yr
Total denitrification:	42.8	lbs NO ₃ /yr

Table 10: Site Specific Discount Factors for Adjusting the Denitrification Rate (Parola et al, 2019)				
Effective Hyporheic Zone N credit = (Base Rate) (EHZ) (B) (H) (A)				
Baseflow Reduction Factor (B)	Floodplain Height Factor ¹ (H)	Aquifer Conductivity Reduction Factor ² (A)		
Perennial baseflow	1.0	0-0.75 ft	1.0	cobbly gravel, gravel, gravely sand, sand and peat
Baseflow in all but late summer/fall	0.75	0.76 ft – 1.00 ft	0.75	gravely silt, silty sand, or loamy sand, sandy loam, and organic silt with no coarse material layer connected to the streambed
Baseflow in winter/spring	0.50	1.01 ft – 1.25 ft	0.50	clayey gravel, sandy silt, or sandy clay loam, loam, silt loam, and silt with no coarse material layer connected to the streambed
Baseflow only during wet seasons	0.25	1.26 ft – 1.50 ft	0.10	sandy clay, clay loam, silty clay loam, organic clay with no coarse material layer connected to the streambed
Flow only during runoff events	0.10	>1.50 ft	0.00	silty clay and clay with no coarse material layer connected to the streambed

¹The floodplain height factor is determined by the restored floodplain height (H) above the streambed riffle elevations or low flow water surface elevations. Additional streambed feature elevations, like those at a run in sand bed channels or streambeds comprised of silty clay, also may be used to determine the restored floodplain height. Low base-flow (lowest 10% of flows) could also be used as a suitable alternative.

²This refers to an aquifer capacity factor based on the dominant materials within the streambed and below the floodplain soil of the EHZ (Figure 4). Where coarse grain aquifer layers are not directly connected to the channel, the factor should be determined based on the soil texture at the elevation of the streambed using NRCS standard texture classifications (Schoeneberger, et al., 2012).

³“Base Rate” is the mean areal floodplain denitrification rate (lbs/sq foot/yr), as recommended by Group 4.

**Street Sweeping Calculations
SCP-1 and SC- 2**

James River Basin SCP - 1				
Subsource	Pollutant	Curb Lane Miles Swept (1 curb lane mile swept = 1 acre)	2009 EOS Loading rate (lbs/acre/yr) James River Basin	Estimated Total POC Load Based on 2009 Progress Run (lbs/yr)
Regulated Urban Impervious	Nitrogen	14.40	9.39	135.22
Regulated Urban Impervious	Phosphorus	14.40	1.76	25.34
Regulated Urban Impervious	Total Suspended Solids	14.40	676.94	9,747.94
Subsource	Pollutant	Curb Lane Miles Swept (1 curb lane mile swept = 1 acre)	Removal Rate	Total Reduction Credit (lbs/yr)
Regulated Urban Impervious	Nitrogen	135.22	0.04	5.41
Regulated Urban Impervious	Phosphorus	25.34	0.10	2.53
Regulated Urban Impervious	Total Suspended Solids	9,747.94	0.21	2,047.07

James River Basin SCP - 2				
Subsource	Pollutant	Curb Lane Miles Swept (1 curb lane mile swept = 1 acre)	2009 EOS Loading rate (lbs/acre/yr) James River Basin	Estimated Total POC Load Based on 2009 Progress Run (lbs/yr)
Regulated Urban Impervious	Nitrogen	34.40	9.39	323.02
Regulated Urban Impervious	Phosphorus	34.40	1.76	60.54
Regulated Urban Impervious	Total Suspended Solids	34.40	676.94	23,286.74
Subsource	Pollutant	Estimated Total POC Load Based on 2009 Progress Run (lbs/yr)	Removal Rate	Total Reduction Credit (lbs/yr)
Regulated Urban Impervious	Nitrogen	323.02	0.03	9.69
Regulated Urban Impervious	Phosphorus	60.54	0.08	4.84
Regulated Urban Impervious	Total Suspended Solids	23,286.74	0.16	3,725.88