



XVI.

Agenda Item

**County of Hanover  
Board Meeting: May 13, 2015**

**Subject:** Public Hearing – Department of Public Works – TMDL Action Plan - General Permit for Small Municipal Separate Storm Sewer Systems (MS-4)

**Summary of  
Agenda Item:**

In accordance with applicable state and federal rules, Hanover County must comply with the Virginia Stormwater Management Program (VSMP) for Small Municipal Separate Storm Sewer Systems (MS4). To meet these requirements, Hanover County is eligible to file a registration statement for coverage under a general permit. The general permit includes State stormwater management requirements mandated by Section 402 of the Federal Clean Water Act. One of the general permit special conditions requires Hanover County to establish a Chesapeake Bay Total Daily Maximum Load (TMDL) action plan by July 1, 2015.

The Commonwealth in its Phase I and Phase II Chesapeake Bay TMDL Watershed Implementation Plans (WIP) committed to a phased approach for MS4s, affording MS4 operators up to three full five-year permit cycles to implement necessary reductions. This plan in accordance with the general permit is consistent with the Chesapeake Bay TMDL and the Virginia Phase I and II WIPs to meet the first permit cycle 5.0% reduction requirement for existing developed lands. Conditions of future plans will be consistent with the TMDL or WIP conditions in place at the time of permit issuance.

Hanover County's Chesapeake Bay TMDL Action Plan was formatted in accordance with Part VI of The Department of Environmental Quality's Action Plan Guidance (draft rev. 3/19/2015).

The hearing allows the public to comment on the County's proposed TMDL Action Plan. In addition to the hearing, the public may submit comments on the proposed TMDL Action plan to the Department of Public Works until close of business June 15, 2015.

**County  
Administrator's  
Recommended  
Board Motion:** N/A

**PUBLIC HEARING NOTICE  
HANOVER COUNTY BOARD OF SUPERVISORS**

The Hanover County Board of Supervisors will hold a public hearing on **Wednesday, May 13, 2015 at 7:00 p.m.** in the Board meeting room at the Hanover County Administration Building, 7516 County Complex Road, at Hanover Courthouse, Hanover, Virginia, on the following plan:

**HANOVER COUNTY  
DRAFT CHESAPEAKE BAY TMDL ACTION PLAN  
JUNE 30, 2015**

**SECTION 25-890 OF TITLE 9 OF THE VIRGINIA ADMINISTRATIVE  
CODE REGARDING GENERAL VPDES PERMITS FOR DISCHARGES  
OF STORMWATER FROM SMALL MUNICIPAL SEPARATE STORM  
SEWER SYSTEMS (MS4S) REQUIRES HANOVER COUNTY TO  
ESTABLISH A CHESAPEAKE BAY TOTAL DAILY MAXIMUM LOAD  
(TMDL) ACTION PLAN BY JULY 1, 2015.**

A complete copy of the proposed plan and related information is available at the office of the County Administrator any regular working day between 8:30 a.m. and 5:00 p.m.

All persons wishing to comment on the proposal may appear at the stated time and place.

  
Cecil R. Harris, Jr., County Administrator

Publish: April 30, 2015 and May 7, 2015

# **Chesapeake Bay Total Maximum Daily Load (TMDL) Action Plan**

## **Hanover County, Virginia**

### **Permit No. VAR040012**

Prepared by:  
Department of Public Works  
7516 County Complex Road  
Hanover, VA 23069  
(804) 365-6181

**DRAFT**  
**May 13, 2015**



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## Introduction

Virginia Regulation 9VAC-25-890 et. seq. regard General VPDES permit for Discharges of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4s) requires Hanover County to establish a Total Daily Maximum Load (TMDL) Action Plan by July 1, 2015. This action plan must address the permit special condition for the Chesapeake Bay TMDL. The Commonwealth in its Phase I and Phase II Chesapeake Bay TMDL Watershed Implementation Plans (WIP) committed to a phased approach for MS4s, affording MS4 operators up to three full five-year permit cycles to implement necessary reductions. This plan in accordance with the general permit is consistent with the Chesapeake Bay TMDL and the Virginia Phase I and II WIPs to meet the Level 2 (L2) scoping run for existing developed lands as it represents an implementation of 5.0% of L2 as specified in the 2010 Phase I WIP. Conditions of future plans will be consistent with the TMDL or WIP conditions in place at the time of permit issuance.

Hanover County's Chesapeake Bay TMDL Action Plan was formatted in accordance with Part VI of The Department of Environmental Quality's Action Plan Guidance (draft rev. 3/19/2015).

### **1. Current Program and Existing Legal Authority** (*General Permit Section I.C.2.a.(1)*)

*A review of the current MS4 program implemented as a requirement of this state permit including a review of the existing legal authorities and the operator's ability to ensure compliance with this special condition;*

Hanover County Municipal Separate Storm Sewer System (MS4) Permit (VAR040012)

#### Hanover County Ordinances

##### Chapter 10 – Environmental Management

- Article I – Erosion and Sediment Control
- Article II – Chesapeake Bay Preservation
- Article IV – Municipal Separate Storm Sewer System (MS4) Management Program
- Article V – Stormwater Management

##### Chapter 12 - Flood Plain and Drainage Control

**2. New or Modified Legal Authority (General Permit Section I.C.2.a.(2))**

*The identification of any new or modified legal authorities such as ordinances, state and other permits, orders, specific contract language, and interjurisdictional agreements implemented or needing to be implemented to meet the requirements of this special condition;*

Hanover Ordinances have been modified to meet the new requirements of the requirements to adopt a stormwater program consistent with the requirements of 9VAC-25-870-150, including the most recent provisions related to the implementation of the Chesapeake Bay TMDL:

**Ordinance 13-09 – Erosion and Sediment Control**

An ordinance amending Chapter 10, ARTICLE I, of the Hanover County Code pursuant to Title 62.1, Chapter 3.1, Article 2.4 (§ 62.1-44.15:51 et seq.) of the Code of Virginia to conform to state law and new regulatory requirements

**Ordinance 13-10 – Chesapeake Bay Preservation**

An ordinance amending Chapter 10, ARTICLE II, of the Hanover County Code pursuant to Title 62.1, Chapter 3.1, Article 2.5 (§ 62.1-44.15:67 et seq.) of the Code of Virginia to conform to state law and new regulatory requirements

**Ordinance 13-12 – Stormwater Management**

An ordinance adopting ARTICLE V of Chapter 10 of the Hanover County Code pursuant to Title 62.1, Chapter 3.1, Article 2.3 (§ 62.1-44.15:24 et seq.) of the Code of Virginia to conform to changes in state law and new regulatory requirements

Hanover County received VSMP program approval from DEQ on December 22, 2014.

**3. Means and Methods to Address Discharges from New Sources** (*General Permit Section I.C.2.a.(3)*)

*The means and methods that will be utilized to address discharges into the MS4 from new sources;*

As part of the ordinances above, Hanover Ordinance Chapter 10 Article V Sec. 10-85 requires new projects to address the technical criteria under the provision of 9 VAC 25-870-62 Part IIB.

**4. Estimated Existing Source Loads and Calculated Total Pollutant of Concern (POC) Required Reductions** (*General Permit Section I.C.2.a.(4)*) and (*General Permit Section I.C.2.a.(5)*)

*An estimate of the annual POC loads discharged from the existing sources as of June 30, 2009, based on the 2009 progress run. The operator shall utilize the applicable [Table/Tables] in this section based on the river basin to which the MS4 discharges by multiplying the total existing acres served by the MS4 on June 30, 2009, and the 2009 Edge of Stream (EOS) loading rate;*

Pervious and impervious surfaces were estimated using a GIS based land cover dataset prepared at a one meter resolution by WorldView Solutions Inc, from 2009-2011 land cover imagery. This data was then used to generate acreage estimates for applicable land uses. (See Appendix A for a categorization of land uses) These land uses were analyzed to determine the percentage of pervious and impervious area for each land use category. This data was further processed to generate urban pervious and impervious, forest / open space and other estimated areas in the county applicable to determining the necessary POC loadings and required reductions.

Publically owned or operated drainage areas (PDAs) to each of 794 outfalls in the MS4 area (2000 urbanized area) were obtained by mapping watershed and drainage areas to each outfall. 591 of these outfalls are owned or operated by Hanover County. The total area of PDAs owned by Hanover County is 4,683 acres. Drainage to privately owned systems or owned by VDOT were excluded for pervious and impervious area estimates for the calculated reductions for the MS4. These public drainage areas are divided between regulated urban pervious, and impervious areas for the James River and York River Basins. A summary of these areas and the estimate of the POC load as required under the MS4 regulations are provided below.

<b>Table 2a – Calculation Sheet for Estimating Existing Source Loads for the James River Basin</b>				
<b>(* Based on Chesapeake Bay Program Watershed Model Phase 5.3.2)</b>				
<b>Subsource</b>	<b>Pollutant</b>	<b>Total Existing Acres Served by MS4 (06/30/09)</b>	<b>2009 EOS Loading Rate (lbs/acre/yr)</b>	<b>Estimated POC Load Based on 2009 Progress Run (lbs/yr)</b>
Regulated Urban Impervious	Nitrogen	1,092	9.39	10,254
Regulated Urban Pervious		2,073	6.99	14,490
Regulated Urban Impervious	Phosphorus	1,092	1.76	1,922
Regulated Urban Pervious		2,073	0.5	1,032
Regulated Urban Impervious	Sediment	1,092	676.94	739,218
Regulated Urban Pervious		2,073	101.08	209,539

<b>Table 2d – Calculation Sheet for Estimating Existing Source Loads for the York River Basin</b>				
<b>(* Based on Chesapeake Bay Program Watershed Model Phase 5.3.2)</b>				
<b>Subsource</b>	<b>Pollutant</b>	<b>Total Existing Acres Served by MS4 (06/30/09)</b>	<b>2009 EOS Loading Rate (lbs/acre/yr)</b>	<b>Estimated POC Load Based on 2009 Progress Run (lbs/yr)</b>
Regulated Urban Impervious	Nitrogen	482	7.31	3,523
Regulated Urban Pervious		1,036	7.65	7,925
Regulated Urban Impervious	Phosphorus	482	1.51	728
Regulated Urban Pervious		1,036	0.51	528
Regulated Urban Impervious	Sediment	482	456.68	220,120
Regulated Urban Pervious		1,036	72.78	75,400

<b>Table 3a – Calculation Sheet for Determining Total POC Reductions Required During this Permit Cycle for the James River Basin</b> (* Based on Chesapeake Bay Program Watershed Model Phase 5.3.2)				
<b>Subsource</b>	<b>Pollutant</b>	<b>Total Existing Acres Served by MS4 (06/30/09)</b>	<b>First Permit Cycle Required Reduction in Loading Rate (lbs/acre/yr)</b>	<b>Total Reduction Required First Permit Cycle (lbs/yr)</b>
Regulated Urban Impervious	Nitrogen	1,092	0.04	43.68
Regulated Urban Pervious		2,073	0.02	41.46
Regulated Urban Impervious	Phosphorus	1,092	0.01	10.92
Regulated Urban Pervious		2,073	0.002	4.15
Regulated Urban Impervious	Sediment	1,092	6.67	7,284
Regulated Urban Pervious		2,073	0.44	912

<b>Table 3d – Calculation Sheet for Determining Total POC Reductions Required During this Permit Cycle for the York River Basin</b> (* Based on Chesapeake Bay Program Watershed Model Phase 5.3.2)				
<b>Subsource</b>	<b>Pollutant</b>	<b>Total Existing Acres Served by MS4 (06/30/09)</b>	<b>First Permit Cycle Required Reduction in Loading Rate (lbs/acre/yr)</b>	<b>Total Reduction Required First Permit Cycle (lbs/yr)</b>
Regulated Urban Impervious	Nitrogen	482	0.03	14.46
Regulated Urban Pervious		1,036	0.02	20.72
Regulated Urban Impervious	Phosphorus	482	0.01	4.82
Regulated Urban Pervious		1,036	0.002	2.07
Regulated Urban Impervious	Sediment	482	4.60	2217
Regulated Urban Pervious		1,036	0.32	332

**5. Means and Methods to Meet the Required Reductions and Schedule (General Permit Section I.C.2.a.(6))**

*The means and methods, such as management practices and retrofit programs that will be utilized to meet the required reductions included in subdivision 2 a (5) of this subsection, and a schedule to achieve those reductions. The schedule should include annual benchmarks to demonstrate the ongoing progress in meeting those reductions;*

**Means and Methods (Proposed Projects to meet required TMDL load reductions)**

Within regulated drainage areas, Hanover County receives the full reduction credit. Within unregulated drainage areas, Hanover County receives the full reduction credit minus the required baseline reduction.

Within VDOT drainage areas (outfall lies within VDOT right-of-way), Hanover County receives the full reduction credit minus the required baseline reduction.

For sections of drainage areas that are within the VDOT right-of-way, Hanover County receives the full reduction credit minus the required baseline reduction. VDOT receives credit for the baseline reduction.

Hanover County receives the full reduction credit for all forested acres treated.

**(See Appendices B-E for project specific computations in accordance with DEQ TMDL Action Plan Guidance dated April 2015, including baseline subtractions)**

**James River Basin**

Project	Type	Location	Treatment Area (ac)	Length (ft)	TP Removal (lbs/yr)	TN Removal (lbs/yr)	TSS Removal (lbs/yr)
Church of the Creator <sup>4*</sup>	Stream Restoration	37.609, -77.346	28.7	650	42.7	222.6	507,207
Laurel Meadows ES <sup>1*</sup>	Wet Pond Level 2	37.627, -77.335	16.9		11.6 <sub>2</sub>	38.2 <sub>2</sub>	3,722 <sub>3</sub>
<b>TOTAL</b>					<b>54.3</b>	<b>260.8</b>	<b>510,929</b>
<b>5% Req.</b>					15.07	85.14	8,196
<b>40% Req.</b>					120.56	681.12	65,568
<b>100% Req.</b>					301.4	1,702.8	163,920

1. Not classified as a retrofit, original design does not address water quality

2. BMP Clearinghouse Efficiency

3. Retrofit Curve Efficiency

4. BANCs Method

\* located in coastal plain terrain (based on USGS mapping)

**York River Basin**

Project	Type	Location	Treatment Area (ac)	Length (ft)	TP Removal (lbs/yr)	TN Removal (lbs/yr)	TSS Removal (lbs/yr)
Henderson Hall	Stream Restoration	37.687, -77.422	62	700	45.6	45.1	30,572
Opossum Creek*	Stream Restoration	37.653, -77.392	1,161	4,029	230.1	182.4	43,581
<b>TOTAL</b>					<b>275.7</b>	<b>227.5</b>	<b>74,153</b>
<b>5% Req.</b>					6.89	35.18	2,549
<b>40% Req.</b>					55.12	281.44	20,392
<b>100% Req.</b>					137.8	703.6	50,980

*\* located in coastal plain terrain (based on USGS mapping)*

**Accounting for Unregulated Baseline Removal and VDOT Credits**

Project	ROW in Regulated Area (ac)	Unregulated Area (ac)	Unreg. Baseline (lbs/yr)			VDOT Drainage Area (ac)		VDOT Removal (lbs/yr)		
			TP	TN	TSS	Hanover	ROW	TP	TN	TSS
Church of the Creator	8.49	1.96	0.18	1.04	96.99	0.0	0.0	1.1	5.4	697
Laurel Meadows ES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Henderson Hall	11.44	2.76	0.32	1.37	131.51	0.0	0.0	1.7	6.1	713
Opossum Creek	69.3	210.88	20.67	54.9	7,895	82.15	24.85	13.9	43.5	5,716
<b>TOTAL</b>								<b>16.7</b>	<b>55.0</b>	<b>7,126</b>

**Proposed Schedule**

The proposed schedule includes when new management practices will be initiated, BMP construction will begin, permits have been or need to be obtained, and when BMP installation is expected to be completed. Annual benchmarks for the estimates will be included as part of this schedule.

<i>Schedule item</i>	<b>Laurel Meadows ES</b>	<b>Church of the Creator</b>	<b>Henderson Hall</b>
Notice to proceed on design	June 2014	May 2014	March 2015
Completion of plans and specification	February 2015	March 2015	January 2016
Plans and specs approved	January 2015	March 2015	February 2016
Advertise for bids	April 2015	April 2015	February 2016
Bid opening	April 2015	April 2015	March 2016
Award contract	May 2015	April 2015	April 2016
Construction time	July 2015-September 2015	June 2015-August 2015	May 2016- July 2016
<b>TOTAL</b>	1 Year 4 Month	1 Year 4 Months	1 Year 5 Months

**6. Means and methods to offset increased loads from new sources initiating construction between July 1, 2009 and June 30, 2014 (General Permit Section I.C.2.a.(7))**

*The means and methods to offset the increased loads from new sources initiating construction between July 1, 2009, and June 30, 2014, that disturb one acre or greater as a result of the utilization of an average land cover condition greater than 16% impervious cover for the design of post-development stormwater management facilities. The operator shall utilize the Table 4 in this section to develop the equivalent pollutant load for nitrogen and total suspended solids. The operator shall offset 5.0% of the calculated increased load from these new sources during the permit cycle.*

Hanover County adopted an average land cover condition of 16% impervious in the implementation of the stormwater program; therefore consistent with this section, no increased load offset is required.

All projects with and acreage over 16% impervious were required to treat impervious acreage consistent with the stormwater nutrient reduction requirements in place at that time, or purchase credit under the County’s approved prorata share program.

**7. Means and methods to offset increased loads from grandfathered projects that begin construction after July 1, 2014** (*General Permit Section I.C.2.a.(8)*)

*The means and methods to offset the increased loads from projects as grandfathered in accordance with 9VAC25-870-48, that disturb one acre or greater that begin construction after July 1, 2014, where the project utilizes an average land cover condition greater than 16% impervious cover in the design of post-development stormwater management facilities. The operator shall utilize Table 4 in this section to develop the equivalent pollutant load for nitrogen and total suspended solids.*

Hanover County adopted an average land cover condition of 16% impervious in the implementation of the stormwater program; therefore consistent with this section, no increased load offset is required.

All projects with and acreage over 16% impervious were required to treat impervious acreage consistent with the stormwater nutrient reduction requirements in place at that time, or purchase credit under the County’s approved prorata share program.

**8. A list of future projects, and associated acreage that qualify as grandfathered** (*General Permit Section I.C.2.a.(10)*)

*A list of future projects and associated acreage that qualify as grandfathered in accordance with 9VAC25-870-48*

**Grandfathered Projects**

<b>Project Name</b>	<b>Permit Number</b>	<b>Acreage</b>	<b>Permit Date</b>	<b>SPR</b>	<b>Plan Approval Date</b>
<b>Blue Bell Creameries</b>	VAR10G454	2.44	2/13/15	20-14	1/21/15
<b>Hanover County New Courts Building</b>	VAR10G573	13.14	2/12/15	29-83 Am. 9-14	10/15/14

**9. An estimate of the expected cost to implement the necessary reductions**  
(General Permit Section I.C.2.a.(11))

*An estimate of the expected costs to implement the requirements of this special condition during the state permit cycle;*

Project	Type	Cost/lb Phosphorous	Total Cost (SLAF Grant)	County Cost (50%)	TP Removal (lbs/yr)
Church of the Creator	Stream Restoration	\$17,253	\$736,720	\$368,360	42.7
Laurel Meadows ES	Wet Pond 2	\$8,343	\$96,780	\$48,390	11.6
Henderson Hall	Stream Restoration	\$17,893	\$815,936	\$407,968	45.6
<b>TOTAL</b>			<b>\$1,649,436</b>	<b>\$824,718</b>	<b>99.9</b>
5% Req.					21.96

**Potential Future Projects** - The following are a list of projects being considered to meet the requirements of the Chesapeake Bay TMDL. An estimated phosphorous removal of **440 lbs/yr** by Hanover County will be necessary to meet required reductions over the course of the next three permit cycles. This reduction was calculated using the 2000 U.S. Census Bureau urbanized MS4 drainage areas.

These are some of the projects that Hanover County will consider to meet these reduction requirements in the future:

Hanover County, Virginia  
Chesapeake Bay TMDL Action Plan

Project	Type	Treatment Area (ac)	River Basin	Cost/lb Phosphorous	Total Cost	Total lbs Phosphorous
<b>Washington Henry ES</b>	Bioretention A	0.94	York	\$13,841	\$62,837	4.54
	Bioretention B	1.80				
<b>Pearson's Corner ES</b>	Modified Wet Swale	2.00	York	\$17,107	\$88,785	0.56
	Stormfilter	0.87				0.47
	Vegetated Filter Strip	0.73				0.63
	Vegetated Filter Strip	9.25				2.16
	Vegetated Filter Strip	1.83				1.37
<b>Cold Harbor ES</b>	Bioretention	2.20	James	\$19,421	\$175,373	3.26
	Bioretention	1.29				2.21
	Bioretention	1.53				0.92
	Bioretention	4.65				2.64
<b>Rural Point ES</b>	Bioretention	6.94	York	\$20,039	\$199,195	4.98
	Bioretention	1.84				3.59
	Filter Strip	1.99				1.37
<b>Mechanicsville ES</b>	Bioretention	4.02	James	\$20,323	\$178,436	3.72
	Bioretention	1.42				1.95
	Bioretention	1.73				3.11
<b>Lee Davis/ Stonewall Jackson</b>	Bioretention	3.77	James	\$22,342	\$90,488	4.05
<b>Green Ridge</b>	Stream restoration	63.0	James	\$4,311	\$741,555	172.00
<b>Hunters Ridge</b>	Stream restoration	71.0	James	\$8,170	\$514,689	63.00
<b>Windy Hills</b>	Stream restoration	21.0	James	\$21,431	\$728,674	34.00
<b>Summerwalk Regional Pond Restoration</b>	Pond upgrade	133.0	James	\$9,563	\$98,500	10.3
<b>Cherrydale Regional Pond Restoration</b>	Pond upgrade	2233.0	James	\$2,028	\$290,000	143.00
<b>TOTAL</b>					\$3,016,910	463.83

Please note that some projects will require funds for cost of land acquisition, plats, easement negotiations, contingencies and other factors necessary to complete the project. These prices are for planning purposes and reflect the costs of Engineering and construction and plan approval only.

**10. Public Comments on Draft Action Plan** (*General Permit Section I.C.2.a.(12)*)

*An opportunity for receipt and consideration of public comment regarding the draft Chesapeake Bay TMDL Action Plan.*

The Hanover County Department of Public Works presented on the Chesapeake Bay TMDL Action Plan at the May 15, 2015 Hanover County Board of Supervisors Meeting. This allowed the opportunity for the public to comment. The Board of Supervisors Meeting was advertised on the Hanover County website. Comments received will be addressed in updates of the Action Plan.

## **APPENDICES**

Appendix A – Hanover County MS4 Land Cover

Appendix B – Church of the Creator Stream Restoration Project

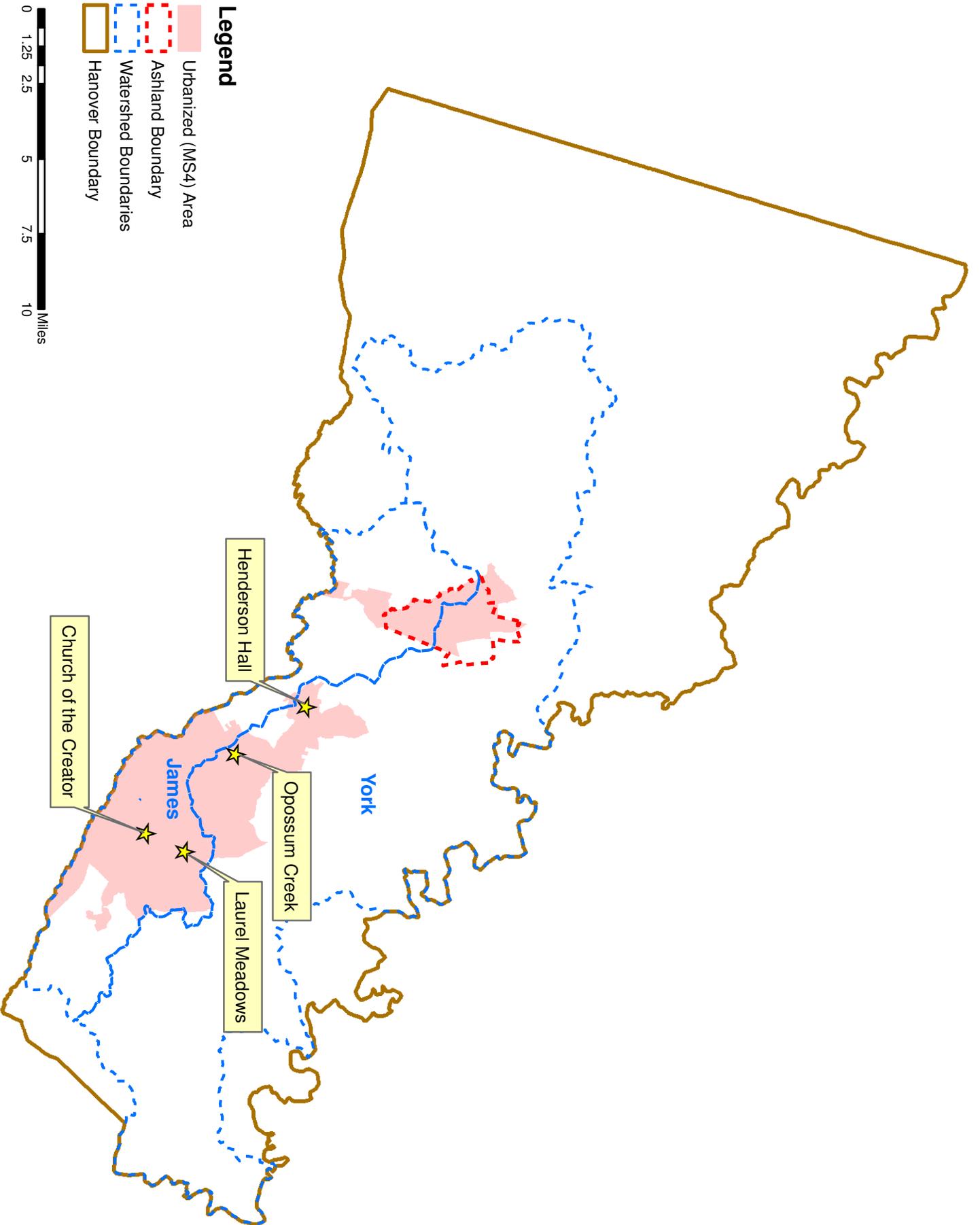
Appendix C – Henderson Hall Stream Restoration Project

Appendix D – Laurel Meadows Elementary School Pond Enhancement Project

Appendix E – Opossum Creek Stream Restoration Project

Appendix A – Hanover County MS4 Land Cover

# Hanover County MS4

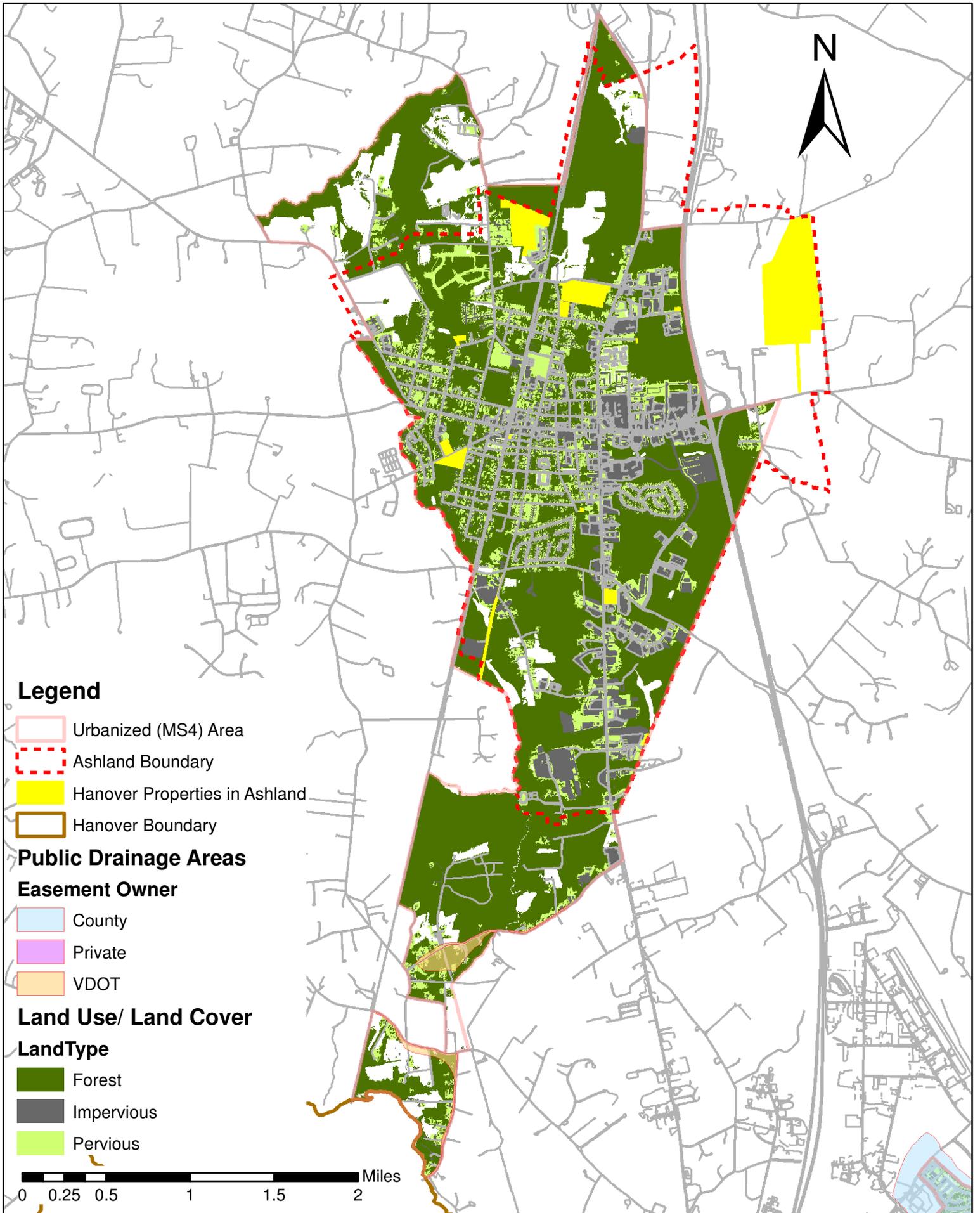


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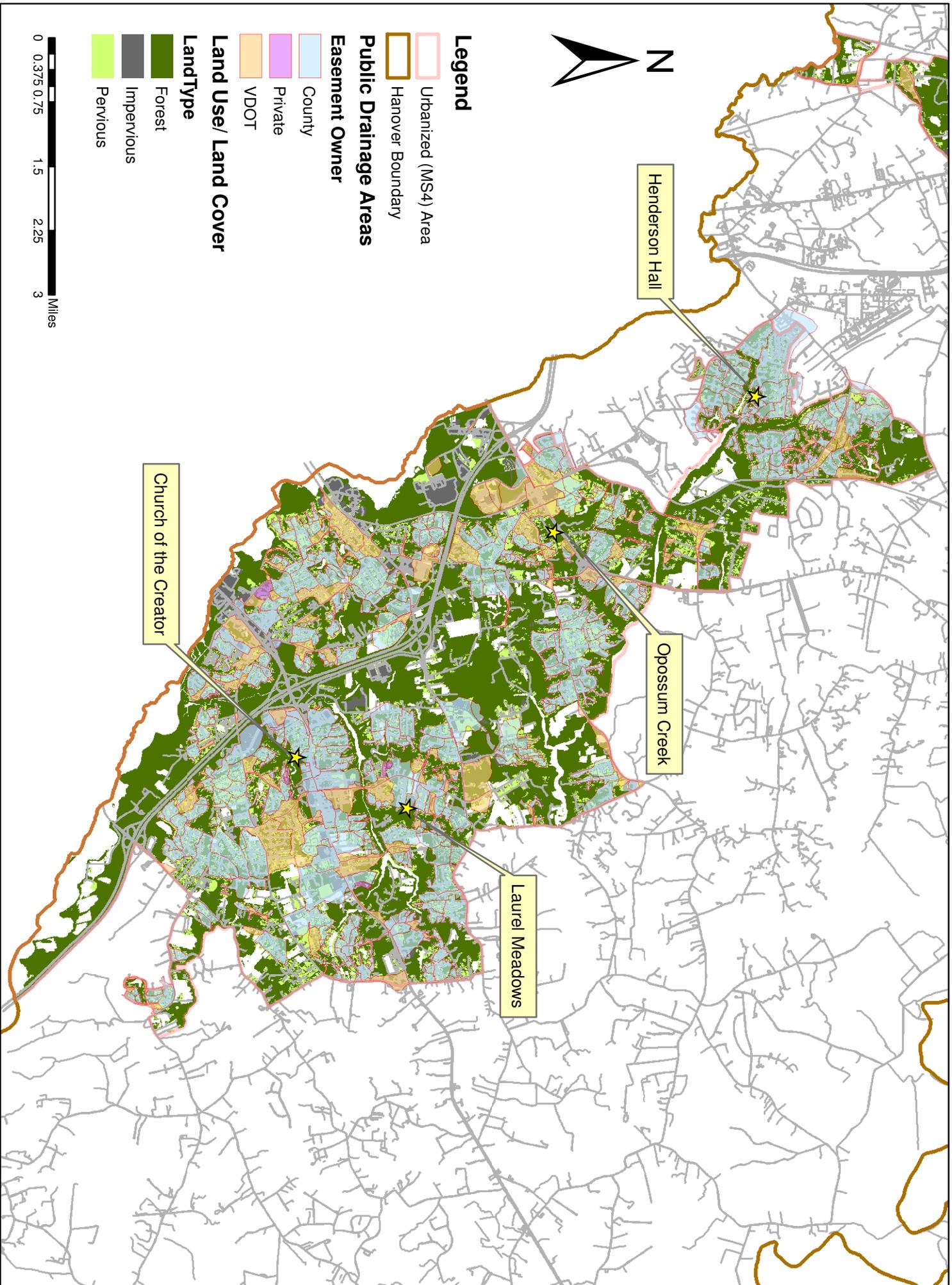
- Urbanized (MS4) Area
- Ashland Boundary
- Watershed Boundaries
- Hanover Boundary



# Hanover County MS4 (North)



Hanover County MS4 (South)



**Legend**

- Urbanized (MS4) Area
- Hanover Boundary
- Public Drainage Areas
- Easement Owner
  - County
  - Private
  - VDOT
- Land Use/ Land Cover
  - Forest
  - Impervious
  - Pervious



## Summary of Land Use Codes within Hanover County

The table below shows land use acreage totals for the entire county and regulated public drainage areas (PDA) within the 2000 urbanized MS4 service area. The MS4 area is further split between the James River and York River Watersheds as required for permit Tables 2 & 3.

Entire County	MS4 PDA	James MS4 PDA	York MS4 PDA
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### Land Use Code

Low Density (Rural) Residential Structures (1)	1143	25	15	10
Medium Density (Subdivisions) Residential Structures (2)	857	482	320	162
High Density Residential Structures (3)	60	22	15	7
Commercial Structures (4)	410	111	98	13
Industrial Structures (5)	359	2	2	
Church Structures (6)	33	6	5	1
School Structures (7)	77	15	11	4
Government Structures (8)	20	2	1	1
Other Structures (9)	10			
Managed Turf (11)	20055	3109	2073	1036
Grassland (12)	10521	259	204	55
Agriculture (13)	58380	220	173	47
Bare Earth (14)	880			
Parks (15)				
Deciduous Forest (21)	124408	1779	1092	687
Coniferous Forest (22)	56104	857	631	226
Forest Harvest (23)	9470	0		
Water (30)	10116	2	2	
Impervious Surface (40) Total				
Impervious Surface (40) Public ROW	3898	861	562	299
Impervious Surface (40) Private Total				
Impervious Surface (40) Commercial Zoning (COR)	739	338	275	63
Impervious Surface (40) Industrial Zoning (COR)	1320	42	6	36
Impervious Surface (40) Government (Town)	9			0
Impervious Surface (40) Government (County)	142	5	5	0
Impervious Surface (40) Public Schools	103	24	18	6
Impervious Surface (40) Residential Zoning (COR) & Other	4713	500	321	179
Total	303827	8661	5829	2832
Developed Impervious	9995	1574	1092	482
Developed Pervious	20055	3109	2073	1036
Developed Total	30050	4683	3165	1518

**\*\*All numbers are in Acres**

## Summary Table of Land Use Code Groupings

The tables below show how the land use codes were grouped to account for Impervious, Pervious, and Forested cover.

### Land Use Code Groupings

Low Density (Rural) Residential Structures (1) Medium Density (Subdivisions) Residential Structures (2) High Density Residential Structures (3) Commercial Structures (4) Industrial Structures (5) Church Structures (6) School Structures (7) Government Structures (8) Other Structures (9) Impervious Surface (40)	<b>Impervious</b>
Managed Turf (11)	<b>Pervious</b>
Grassland (12) Deciduous Forest (21) Coniferous Forest (22) Forest Harvest (23)	<b>Forest</b>

	Entire County	% of Entire County	MS4 PDA	James MS4 PDA	York MS4 PDA
SF Residential	6713	2.2%	1007	656	351
Comm., Ind., Multi-Fam., Church, Other	2931	1.0%	521	401	120
Schools, Govt.	351	0.1%	46	35	11
Public ROW	3898	1.3%	861	562	299
Managed Turf	20055	6.6%	3109	2073	1036
Agricultural	58380	19.2%	220	173	47
Forrest, Grassland	200503	66.0%	2895	1927	968
Bare Earth	880	0.3%	0	0	0
Water	10116	3.3%	2	2	0
TOTAL	303827	100%	8661	5829	2832
Developed Impervious	9995	3.3%	1574	1092	482
ROW Impervious	3898	1.3%	861	562	299
Developed Pervious	20055	6.6%	3109	2073	1036
Developed Total	33948	11.2%	5544	3727	1817
ROW % of Total Imp		28.1%	35.4%	34.0%	38.3%

## Appendix B – Church of the Creator Stream Restoration Project

### **Overview**

The Church of the Creator Stream Restoration Project is located in Mechanicsville, VA. The restoration limits begin at the southeast corner of The Church of the Creator (7159 Mechanicsville Turnpike) parking lot and continue downstream to Brandy Branch.

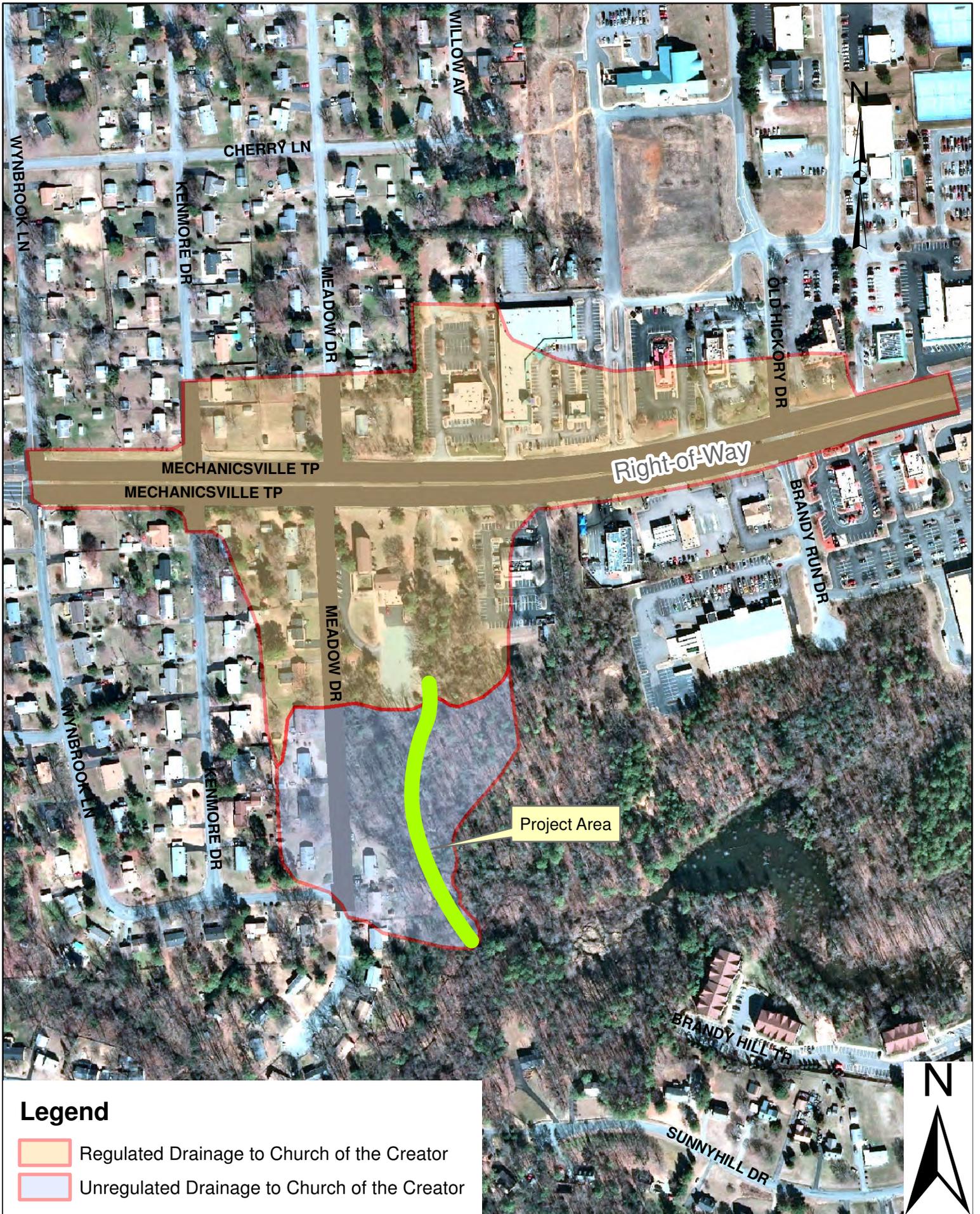
The project will restore 650 linear feet of stream channel which collects a 28.7 acre watershed. The land use within the county regulated portion of the drainage area contains a mixture of commercial development, roadways, and residential lots with landscaping. The land use within the unregulated portion of the drainage area consists of several residential lots with landscaping and undeveloped land.

The stream corridor is entirely wooded and the soil is composed of sand and sandy loams. Due to increased flow and frequency of flow caused by development, the channel has experienced significant down cutting. The stream receives concentrated flow from two points at the upstream end of the channel. The channel has degraded to the point that the upstream portion of the project area is characterized by 10-15 foot deep scoured banks. The 10-15 foot cut extends downstream 450 feet where it transitions to a 5-7 foot deep channel until it outfalls into Brandy Branch.

### Project Removal Credit Summary

	<b>Phosphorus (lbs/yr)</b>	<b>Nitrogen (lbs/yr)</b>	<b>Sediment (lbs/yr)</b>
<b>Hanover</b>	42.7	222.6	507,207
<b>VDOT</b>	1.1	5.4	697

# Church of the Creator Project Map





Looking Upstream



Looking Downstream

**CHURCH OF THE CREATOR STREAM RESTORATION PROJECT - JAMES RIVER BASIN**

Input Value
Calculated Value

Developed from Chesapeake Bay Action Plan Guidance - Appendix V.1

**STEP 1: PROJECT REDUCTIONS**

Stream Length Restored (ft)	-	TN (lbs/in ft)	TP (lbs/in ft)	TSS (lbs/in ft)
Default Removal Rate	-	-	-	-
Project Reductions (lbs)	229.00	44.00	508,000.00	

\* Computed Loads from Sampling Results

**STEP 2: ACRES DRAINING TO THE PROJECT**

Drainage Area Type	Owner	Urban Impervious Acres	Urban Pervious Acres	Total Urban Acres	Forested Acres	Total
Regulated	Hanover County	5.77	3.93	9.70	4.35	
	VDOT ROW	4.99	3.50	8.49	0.00	
	Hanover County	0.32	1.01	1.33	4.19	
Unregulated	VDOT ROW	0.32	0.31	0.63	0.00	
				20.15	8.54	28.7

**STEP 3: REGULATED PROJECT CREDIT**

Max. Regulated Reduction	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Hanover County Portion	145.19	27.90	322,081.56
VDOT Portion (Baseline)	139.80	26.76	321,385.10
	5.39	1.14	696.47

Land Type Ratios	Regulated	Unregulated	Forested
	0.63	0.07	0.30

**STEP 4: FORESTED PROJECT CREDIT**

Max. Forested Reduction	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Hanover County Portion	68.17	13.10	151,213.66
VDOT Portion (No Credit)	68.17	13.10	151,213.66
	0.00	0.00	0.00

**100% REQUIRED REDUCTION RATES (BASELINE)**

	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS (lbs/ac/yr)
Urban Impervious	0.80	0.20	133.40
Urban Pervious	0.40	0.04	8.80

**STEP 5: UNREGULATED PROJECT CREDIT**

Max. Unregulated Reduction	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Unregulated Baseline Reduction	15.64	3.01	34,704.78
Hanover County Portion	1.04	0.18	96.99
	14.60	2.83	34,607.78

= (Project Reduction \* Unregulated Land Ratio)

= (Unregulated Project Reduction - Unregulated Baseline)

Note: Baseline Reduction > Project Reduction then Project Credit = 0

**STEP 6: FINAL CREDIT PROJECT REDUCTIONS**

Hanover Reductions	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
	222.6	42.7	507,206.5
VDOT Reductions	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
	5.4	1.1	696.5

## Sediment Nutrient Testing Summary

Sediment Samples							Computed Loads		
Sample ID	Inorganic Nitrogen (ppm)	Kjeldahl Nitrogen (ppm)	Total Nitrogen (ppm)	Total Phosphorus (ppm)	Total Nitrogen lb/ton	Total Phosphorus (lb/ton)	Tons of Sed (ton)	N (lb)	P (lb)
<b>Church of Creator</b>									
1	214	210	424	77	0.848	0.154			
2	241	240	481	123	0.962	0.246			
4	226	220	446	60	0.892	0.12			
Average	227	223	450	87	0.90	0.17			
						*50%:	508	458	88
							254	229	44
							(508,000 lb)		

\* Chesapeake Bay Expert Panel for Stream Restoration, Protocol 1

Sediment determined using BANCs Method



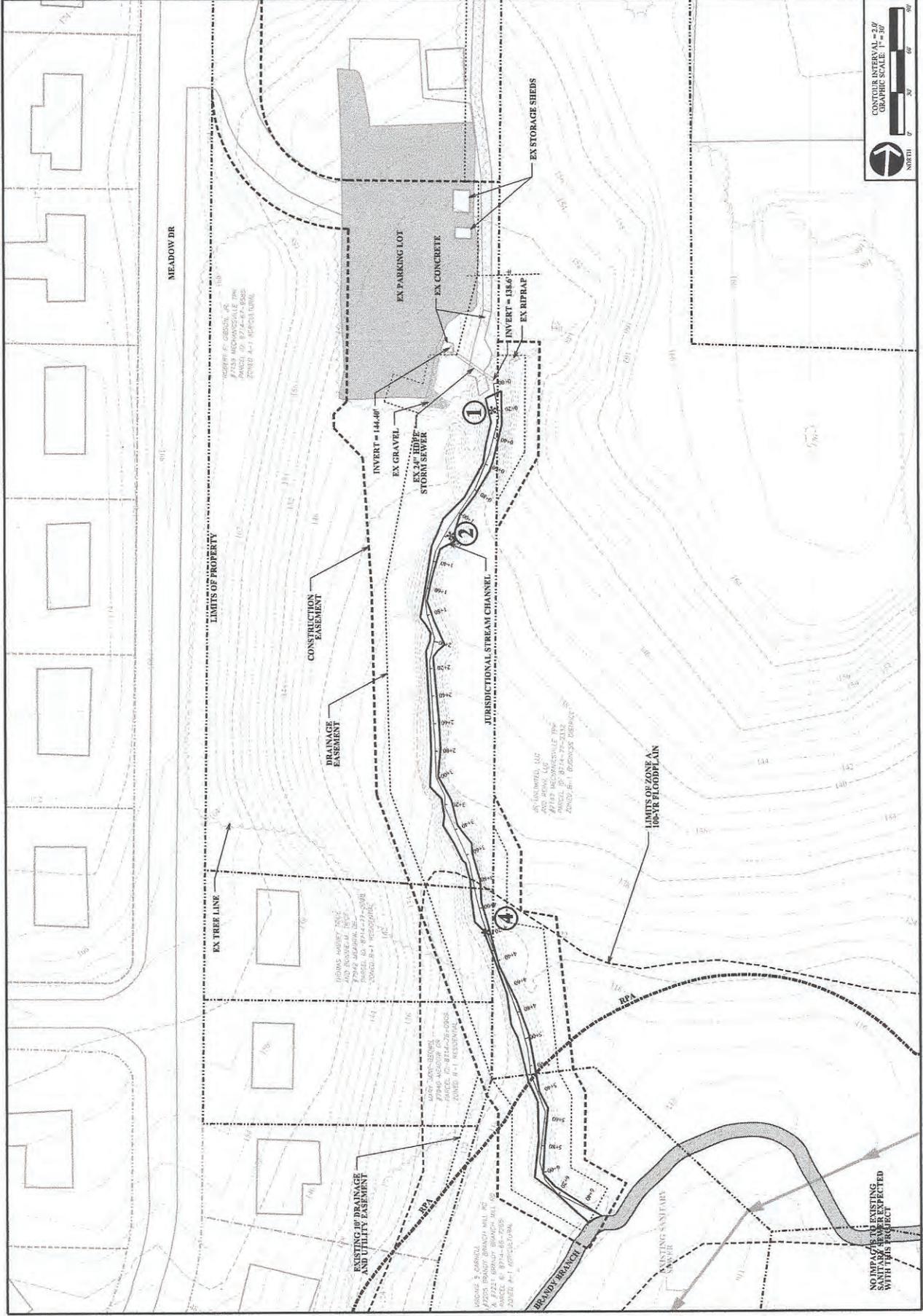
**WATERSHED CONSULTING, PLLC.**  
 P.O. Box 2718  
 Richmond, VA 23221  
 (804) 310-4659  
 www.watershedconsulting.com

**SOIL SAMPLE LOCATIONS**  
 HANOVER COUNTY, VIRGINIA

CHURCH OF THE CREATOR



PROJECT MANAGER:	EA
DRAWN:	EA
SCALE:	AS SHOWN
DATE:	11/20/13
PROJECT:	CHURCH OF THE CREATOR
LOCATION:	114201 - HYUNDRISTON
DATE:	11/20/13
PROJECT:	CHURCH OF THE CREATOR
LOCATION:	114201 - HYUNDRISTON
DATE:	11/20/13



CONCEPT INTERVAL - 5.0'  
 GRAPHIC SCALE: 1" = 30'

North ↑

0 30 60 90

Report Number  
15-023-0503  
Account Number  
07353

Page: 1 of 2

Send To : WATERSHED CONSULTING, PLLC  
ERIK ALLEN  
15 N THOMPSON ST  
RICHMOND , VA 23221

Client : HENDERSON HALL  
CHURCH OF CREATOR

Submitted By : ERIK ALLEN  
Purchase Order :  
Report Date : 2/2/2015  
Date Received : 1/23/2015



www.aleastern.com

**A&L Eastern Laboratories, Inc.**

7521 Whitepine Road Richmond, Virginia 23237 (804) 743-9401 Fax (804) 271-6446

### REPORT OF ANALYSIS

Nitrogen, Total (Inorganic + CALCULATION	Total Kjeldahl Nitrogen SM-4500-NH3C-TKN	Total Phosphorus SW 6010C
214	210	77.0
241	240	123
71	70.0	25.0
226	220	60.0

Lab No	Sample ID Sample Date and Time	ppm
09115	1	210
09116	2	240
09117	2A	70.0
09118	4	220

*Paucic McGeary*

Paucic McGeary

## Appendix C – Henderson Hall Stream Restoration Project

### **Overview**

The Henderson Hall Stream Restoration Project is located in Mechanicsville, VA within the Kings Charter Subdivision. The restoration limits are located to the east of Henderson Hall Road between Kings Charter Drive and Finger Lake.

The project will restore 700 linear feet of stream channel which collects a 62.3 acre watershed. The land use within the county regulated portion of the drainage area contains a mixture of roadways, residential lots with landscaping, and undeveloped land. The land use within the unregulated portion of the drainage area consists of residential lots with landscaping, and undeveloped land.

The stream corridor is maintained in various manners on each of the residential properties. All properties are partially wooded which provides some visual screening between lots. The corridor is mowed/heavily maintained to the stream bank on many of the lots and various types of fences and pedestrian bridges have been installed within and adjacent to the stream channel.

The upper portion of the soil profile is composed of silt loams. Due to increased flow and frequency of flow caused by development, the channel has experienced significant down cutting. Degradation has been exacerbated by residential maintenance activities within the corridor including construction of fences, bridges, removal of native trees and shrubs, mowing and landscaping.

In general, the stream is incised due to historical down-cutting. The upper portion of the stream channel is characterized by vertical banks averaging 3 feet in height with the worst erosion occurring in the middle section which has been down-cut to create 6 foot deep scoured banks.

### Project Removal Credit Summary

	<b>Phosphorus (lbs/yr)</b>	<b>Nitrogen (lbs/yr)</b>	<b>Sediment (lbs/yr)</b>
<b>Hanover</b>	45.6	45.1	30,572
<b>VDOT</b>	1.7	6.1	713

# Henderson Hall Project Map

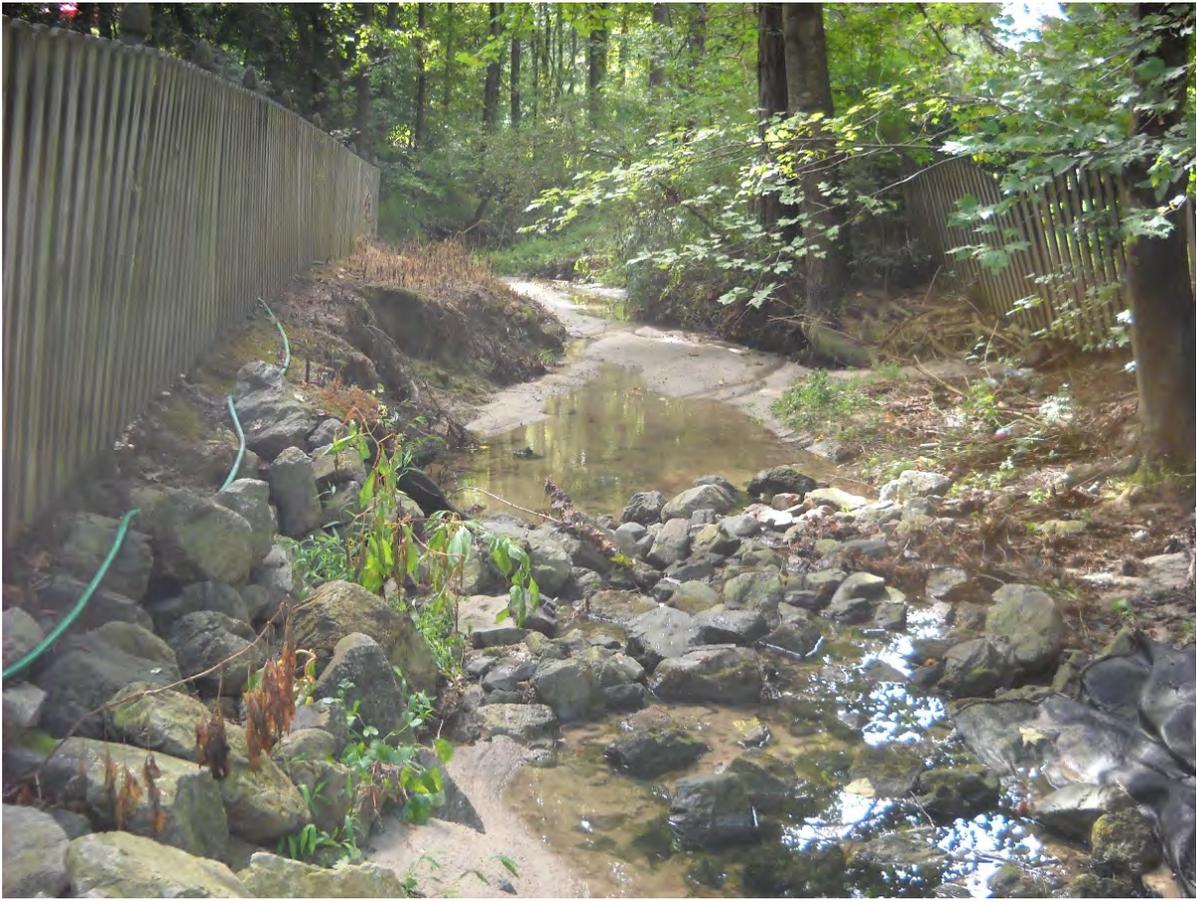




Looking Downstream



Looking Upstream



Downstream Section

**HENDERSON HALL STREAM RESTORATION PROJECT - YORK RIVER BASIN**

Input Value
Calculated Value

Developed from Chesapeake Bay Action Plan Guidance - Appendix V.1

**STEP 1: PROJECT REDUCTIONS**

Stream Length Restored (ft)	700.00	TP (lbs/in ft)	TSS (lbs/in ft)
Default Removal Rate	0.075	0.068	44.88
Project Reductions (lbs)	52.50	47.60	31,416.00

\*15.13 for coastal plain

**STEP 2: ACRES DRAINING TO THE PROJECT**

Drainage Area Type	Owner	Urban Impervious Acres	Urban Pervious Acres	Total Urban Acres	Forested Acres	Total
Regulated	Hanover County	6.73	14.30	21.03	22.65	Total
	VDOT ROW	7.47	3.97	11.44	0.00	
	Hanover County	1.33	1.43	2.76	4.40	
Unregulated	Hanover County	0.00	0.00	0.00	0.00	Total
	VDOT ROW	0.00	0.00	0.00	0.00	
					Total	62.3

**STEP 3: REGULATED PROJECT CREDIT**

Max. Regulated Reduction	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Hanover County Portion	27.37	24.82	16,378.89
VDOT Portion (Baseline)	21.30	23.16	15,666.25
	6.07	1.65	712.65

Land Type Ratios	Regulated	Unregulated	Forested
	0.52	0.04	0.43

**100% REQUIRED REDUCTION RATES (BASELINE)**

	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS (lbs/ac/yr)
Urban Impervious	0.60	0.20	92.00
Urban Pervious	0.40	0.04	6.40

**STEP 4: FORESTED PROJECT CREDIT**

Max. Forested Reduction	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Hanover County Portion	22.80	20.67	13,644.87
VDOT Portion (No Credit)	22.80	20.67	13,644.87
	0.00	0.00	0.00

**STEP 5: UNREGULATED PROJECT CREDIT**

Max. Unregulated Reduction	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Unregulated Baseline Reduction	2.33	2.11	1,392.23
Hanover County Portion	1.37	0.32	131.51
	0.96	1.79	1,260.72

= (Project Reduction \* Unregulated Land Ratio)

= (Unregulated Project Reduction - Unregulated Baseline)

Note: Baseline Reduction > Project Reduction then Project Credit = 0

**STEP 6: FINAL CREDIT PROJECT REDUCTIONS**

Hanover Reductions	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
VDOT Reductions	6.1	1.7	712.6

## Appendix D – Laurel Meadows Elementary School Pond Enhancement

### **Overview**

The Laurel Meadows Elementary School Pond Enhancement Project is located at 8248 Lee Davis Road in Mechanicsville, VA. The pond is located at the eastern rear of the property.

The project will convert an existing Dry Pond to a Wet Pond #2, which collects a 16.9 acre watershed. This entire drainage area is county regulated that consists of 6.26 acres of impervious cover and 10.68 acres of managed turf.

The property contains a large school facility with associated parking, sidewalks, bus loops, maintenance access lots, and turf grass fields. The developed area is located on the highest portion of the property and drains via stormsewer into the existing detention facility. Parking lots drain primarily by curb and gutter directly into curb inlets. Some roof tops are collected directly into underground pipe networks and others outfall onto the ground surface. The stormsewer has two main outfall points into the existing basin.

The original pond design did not account for any water quality benefits, therefore full credit will be taken for the conversion.

### Project Removal Credit Summary

	<b>Phosphorus (lbs/yr)</b>	<b>Nitrogen (lbs/yr)</b>	<b>Sediment (lbs/yr)</b>
<b>Hanover</b>	11.6	38.2	3,722
<b>VDOT</b>	0.0	0.0	0.0

# Laurel Meadows Project Map





Looking North



Looking South

## Nitrogen and Phosphorus Removal (Runoff Reduction Method)

### Site Data Summary

Total Rainfall = 43 inches

#### Site Land Cover Summary

	A Soils	B Soils	C Soils	D Soils	Total	% of Total
Forest (acres)	0.00	0.00	0.00	0.00	0.00	0.00
Turf (acres)	6.11	3.56	0.56	0.45	10.68	63.05
Impervious (acres)	5.50	0.45	0.07	0.24	6.26	36.95
					16.94	100.00

Site Rv	0.46
Post Development Treatment Volume (ft <sup>3</sup> )	28355
Post Development TP Load (lb/yr)	17.82
Post Development TN Load (lb/yr)	127.45
Total TP Load Reduction Required (lb/yr)	10.87

Total Runoff Volume Reduction (ft <sup>3</sup> )	0
Total TP Load Reduction Achieved (lb/yr)	12
Total TN Load Reduction Achieved (lb/yr)	38.19
Adjusted Post Development TP Load (lb/yr)	6.25
Remaining Phosphorous Load Reduction (Lb/yr) Required	0.00

#### Drainage Area Summary

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	Total
Forest (acres)	0.00	0.00	0.00	0.00	0.00	0.00
Turf (acres)	10.68	0.00	0.00	0.00	0.00	10.68
Impervious (acres)	6.26	0.00	0.00	0.00	0.00	6.26
						16.94

#### Drainage Area Compliance Summary

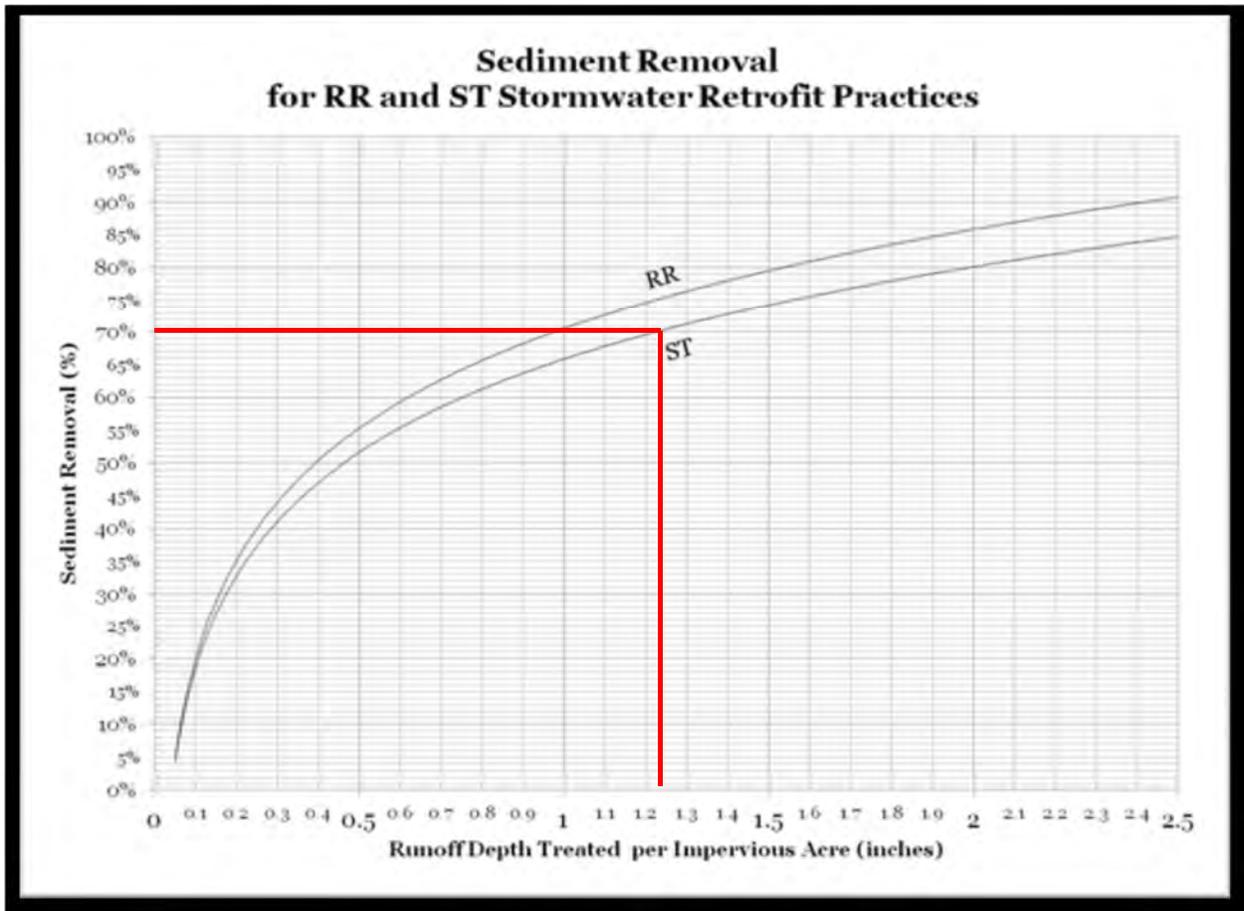
	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	Total
TP Load Red. (lb/yr)	11.57	0.00	0.00	0.00	0.00	11.57
TN Load Red. (lb/yr)	38.19	0.00	0.00	0.00	0.00	38.19

**Sediment Removal (Appendix V.B – Chesapeake Bay Program, Retrofit Curves)**

$$RD = \frac{(RS)(12)}{IA} = \frac{(.65)(12)}{6.26} = 1.25 \text{ in}$$

Where

- RD = Runoff Depth Treated (inches)
- RS = Runoff Storage (acre-feet)
- IA = Impervious Area (acres)



Sediment Reduction for Impervious Area:

$$6.26 \text{ acres} * 676.94 \text{ TSS/ac/yr} = 4237.6 \text{ lbs TSS/yr} * 70\% = 2966.4 \text{ lbs TSS/yr}$$

Sediment Reduction for Pervious Area:

$$10.68 \text{ acres} * 101.08 \text{ TSS/ac/yr} = 1079.5 \text{ lbs TSS/yr} * 70\% = 755.7 \text{ lbs TSS/yr}$$

Total Sediment Removal:

$$2966.4 \text{ lbs TSS/yr} + 755.7 \text{ lbs TSS/yr} = 3722.1 \text{ lbs TSS/yr}$$

## Appendix E – Opossum Creek Stream Restoration Project

### **Overview**

The Opossum Creek Stream Restoration Project is located in Mechanicsville, VA. The restoration limits extend east of Shady Grove Road and terminate downstream just beyond Elder Trail. Two tributaries at Wyattwood Road were included in the restoration limits as well. This project was completed in 2009?

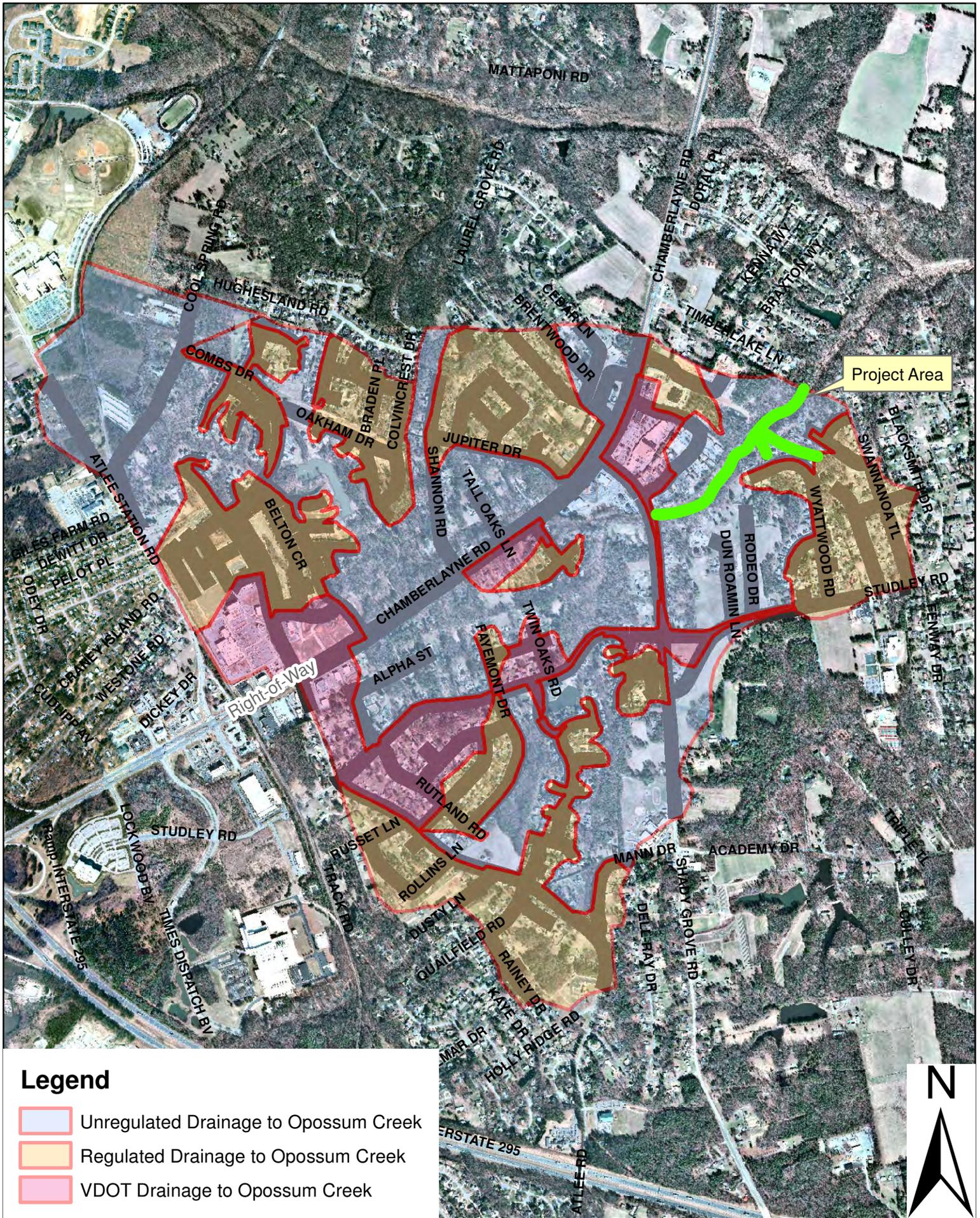
The project restored 4,029 linear feet of stream channel which collects a 1,205 acre watershed (1,161 acres considered for land use analysis). The land use within the county regulated portion of the drainage area contains a mixture of commercial development, landscaping, roadways, residential lots, undeveloped land. The land use within the unregulated (includes VDOT-interconnected) portion of the drainage area consists of commercial development, landscaping, roadways, residential lots, undeveloped land.

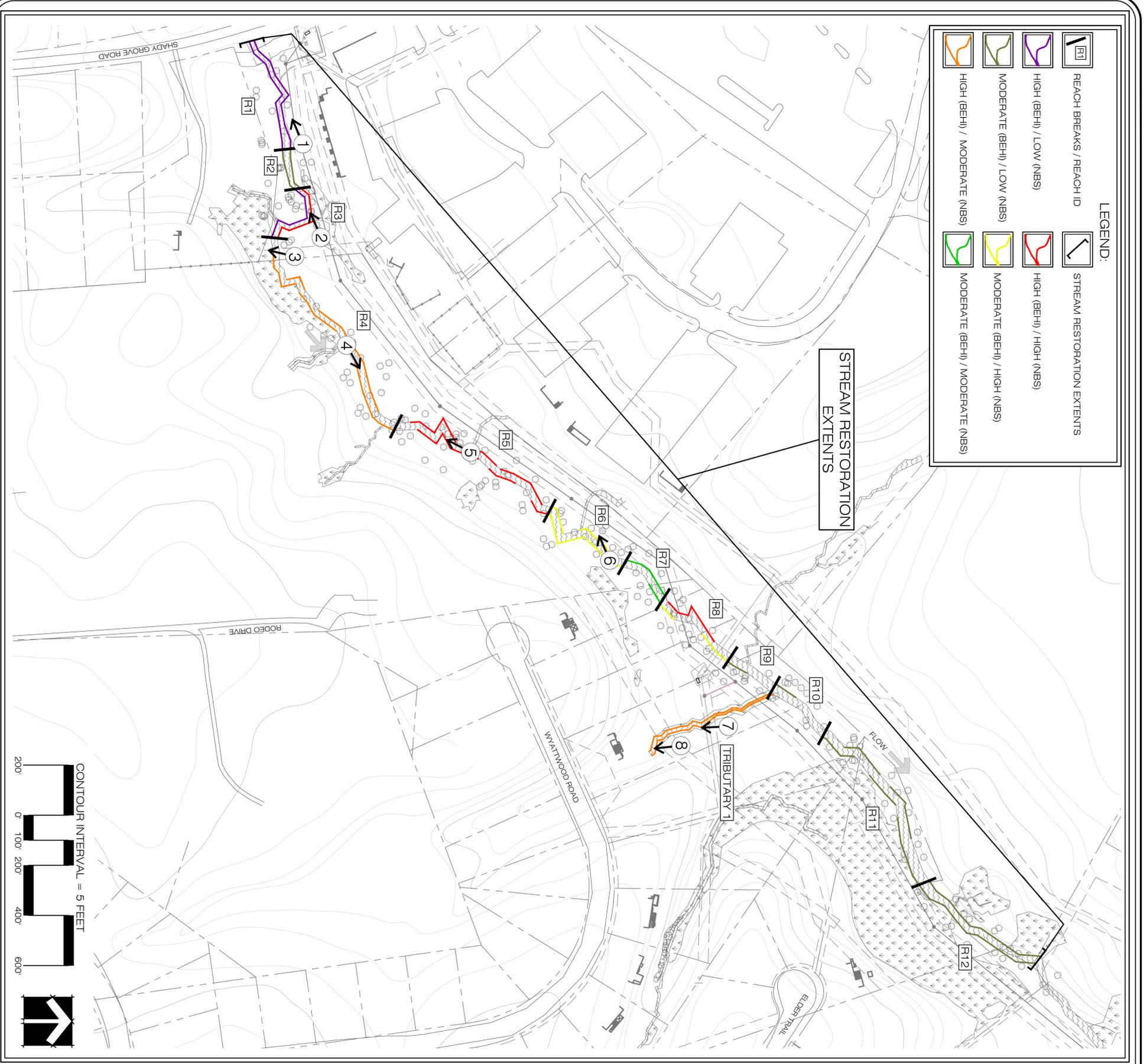
The pre-restoration conditions of Opossum Creek were characterized by extensive bank erosion and scour as well as tortuous, unstable meander patterns. The channel had been incised and disconnected from the floodplain. The banks were frequently vertical with insufficient rooting depth and lack of surface protection.

### Project Removal Credit Summary

	<b>Phosphorus (lbs/yr)</b>	<b>Nitrogen (lbs/yr)</b>	<b>Sediment (lbs/yr)</b>
<b>Hanover</b>	230.1	182.4	43,581
<b>VDOT</b>	13.9	43.5	5,716

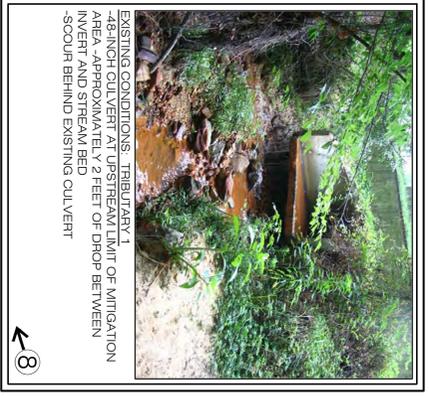
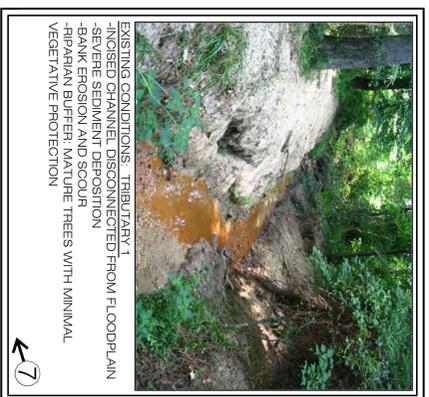
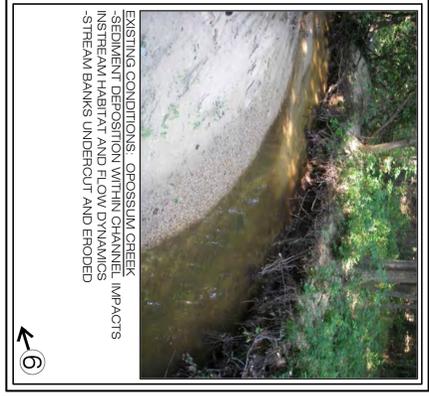
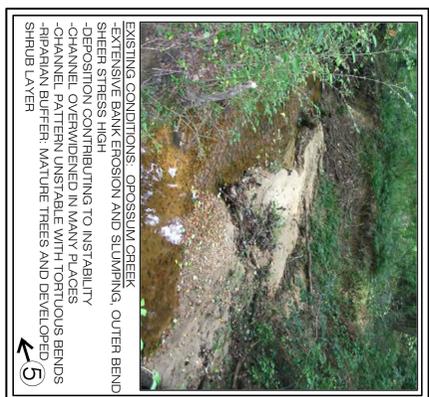
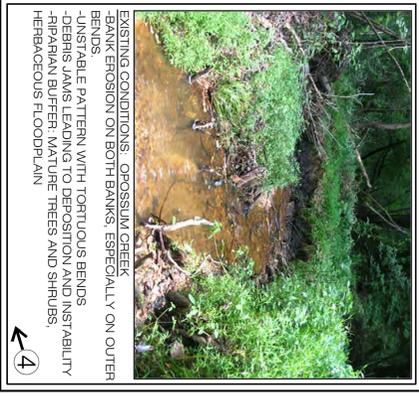
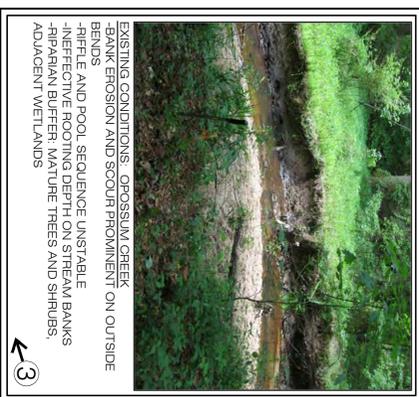
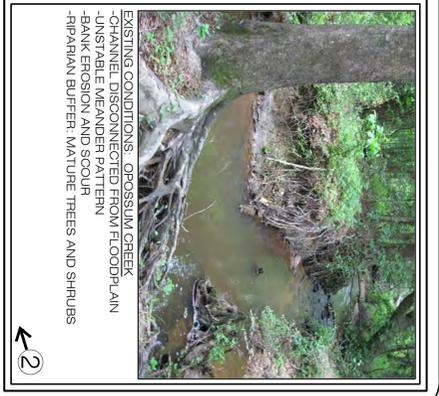
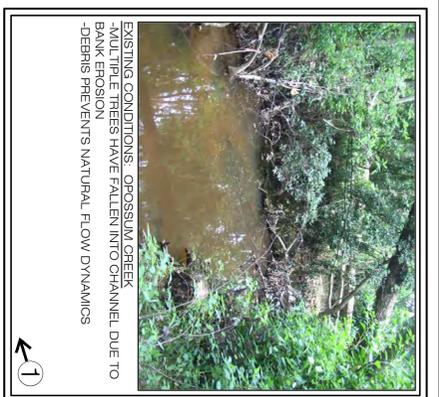
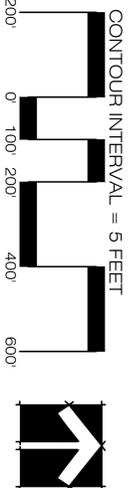
# Opossum Creek Project Map





**LEGEND:**

	REACH BREAKS / REACH ID		STREAM RESTORATION EXTENTS
	HIGH (BEHI) / LOW (NBS)		HIGH (BEHI) / HIGH (NBS)
	MODERATE (BEHI) / LOW (NBS)		MODERATE (BEHI) / HIGH (NBS)
	HIGH (BEHI) / MODERATE (NBS)		MODERATE (BEHI) / MODERATE (NBS)



**BEHI / NBS ASSESSMENT MAP  
HANOVER NUTRIENT  
REDUCTIONS  
HANOVER COUNTY, VIRGINIA**

DATE: MAY 2014  
JOB NUMBER: 203400233  
SCALE: 1 INCH = 100 FEET

5209 Center Street  
Williamsburg, Virginia 23188  
(757) 220-6869

1011 Boulder Springs Drive, Suite 225  
Richmond, Virginia 23225  
(804) 267-3474

150 Riverside Parkway, Suite 301  
Fredericksburg, Virginia 22406  
(540) 785-5544

Environmental Consultants

**OPOSSUM CREEK STREAM RESTORATION PROJECT - YORK RIVER BASIN**

Input Value  
Calculated Value

Developed from Chesapeake Bay Action Plan Guidance - Appendix V.1

**STEP 1: PROJECT REDUCTIONS**

Stream Length Restored (ft)	4,029.00	TP (lbs/in ft)	TSS (lbs/in ft)
Default Removal Rate	0.075	0.068	15.13
Project Reductions (lbs)	302.18	273.97	60,958.77

\*15.13 for coastal plain

**STEP 2: ACRES DRAINING TO THE PROJECT**

Drainage Area Type	Owner	Urban Impervious Acres	Urban Pervious Acres	Total Urban Acres	Forested Acres	Total
Regulated	Hanover County	52.90	179.12	232.02	109.26	
	VDOT ROW	46.35	22.95	69.30	11.67	
Unregulated	Hanover County	56.64	127.75	184.39	368.03	
	VDOT ROW	19.82	6.66	26.48	16.15	
	Hanover County	37.86	44.29	82.15	31.19	
	VDOT ROW	16.68	8.17	24.85	5.09	
						Total
				619.19	541.39	1,160.6

**STEP 3: REGULATED PROJECT CREDIT**

Max. Regulated Reduction	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Hanover County Portion	78.45	71.13	15,826.65
VDOT Portion (Baseline)	41.46	60.94	11,415.57
	36.99	10.19	4,411.08

**STEP 4: FORESTED PROJECT CREDIT**

Max. Forested Reduction	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Hanover County Portion	140.96	127.80	28,436.19
VDOT Portion (No Credit)	140.96	127.80	28,436.19
	0.00	0.00	0.00

**STEP 5: UNREGULATED PROJECT CREDIT**

Max. Unregulated Reduction	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Unregulated Baseline Reduction	54.90	49.78	11,075.82
Hanover County Portion	99.64	20.67	7,894.54
VDOT Portion (No Credit)	0.00	29.11	3,181.28

**STEP 6: VDOT D.A. PROJECT CREDIT**

Max. VDOT Reduction	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Max. outside ROW	27.86	25.26	5,620.11
Baseline (VDOT) outside ROW	21.39	19.39	4,314.88
Max. inside ROW	21.39	9.34	3,766.58
VDOT Portion (Baseline)	6.47	5.87	1,305.23
Hanover County Portion	6.47	3.66	1,305.23
	0.00	12.25	548.30

Note: Baseline Reduction > Project Reduction then Project Credit = 0

**STEP 7: FINAL CREDIT PROJECT REDUCTIONS**

Hanover Reductions	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
	182.4	230.1	43,581.3
VDOT Reductions	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
	43.5	13.9	5,716.3

Land Type Ratios	Regulated	Unregulated	Forested	VDOT
	0.26	0.18	0.47	0.09

**100% REQUIRED REDUCTION RATES (BASELINE)**

	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS (lbs/ac/yr)
Urban Impervious	0.60	0.20	92.00
Urban Pervious	0.40	0.04	6.40

= (Project Reduction \* Unregulated Land Ratio)

= (Unregulated Project Reduction - Unregulated Baseline)

Note: Baseline Reduction > Project Reduction then Project Credit = 0