Chesapeake Bay Total Maximum Daily Load (TMDL) Action Plan

Second Phase

Hanover County, Virginia

Permit No. VAR040012

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Introduction

Virginia Regulation 9VAC-25-890 et. seq. regarding the General VPDES permit for Discharges of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4s) required Hanover County to establish a Total Daily Maximum Load (TMDL) Action Plan by July 1, 2015. This action plan addresses 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 is in compliance with the general permit and 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 an additional 35.0% of L2 as specified in the 2010 Phase I and Phase II WIPs. In combination with the 5.0% reduction of L2 that has already been achieved, a total reduction at the end of this permit term of 40% of L2 will be achieved. Conditions of future plans will be consistent with the TMDL or WIP conditions in place at the time of permit issuance.

A second phase Chesapeake Bay TMDL Action Plan is required under 9VAC25-890. This plan was developed in accordance with 9VAC25-890-40 and the Department of Environmental Quality's Action Plan Guidance dated 5/18/2015.

1. Current Program and Existing Legal Authority *(General Permit Part II.A.11.a)*

Any new or modified legal authorities, such as ordinances, permits, policy, specific contract language, orders, and interjurisdictional agreements, implemented or needing to be implemented to meet the requirements of Part II A 3, A 4, and A 5.

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

<u>Hanover County Ordinances</u>

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

Hanover Ordinances meet the requirements to adopt a stormwater program consistent with the requirements of 9VAC-25-870-150, including the 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.

Hanover County received first phase Chesapeake Bay TMDL Action Plan approval from DEQ on February 29, 2016.

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.

2. Estimated Existing Source Loads and Calculated Total Pollutant of Concern (POC) Required Reductions *(General Permit Part II.A.11.b)*

The load and cumulative reduction calculations for each river basin calculated in accordance with Part II A 3, A 4, and A 5.

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, and other estimated areas in the county applicable to determining the necessary POC loadings and required reductions.

Publically owned or operated drainage areas (PDAs) were obtained by mapping watershed and drainage areas to outfalls from existing developed lands served by the MS4 area as of June 30, 2009. Within the 2000 census urbanized area, the total area of pervious and impervious land cover of PDAs owned by Hanover County is 4,942 acres. Within the 2010 census urbanized area, the total area of pervious and impervious land cover of PDAs owned by Hanover County is 5,240 acres. Drainage to privately owned systems or systems owned by VDOT were excluded from 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.

The second phase reduction of an additional 35% of the L2 Scoping Run based on lands within the 2000 census urbanized areas is required by June 30, 2023, and the reduction of at least 40% of the L2 Scoping Run based on lands within the 2010 expanded census urbanized areas is required by June 30, 2023.

No offset of increased loads from new sources initiating construction between July 1, 2009 and June 30, 2019, and designed in accordance with 9VAC25-870 Part IIC is necessary. No offset of increased loads from projects grandfathered in accordance with 9VAC25-870-48 is necessary. Hanover County adopted an average land cover condition of 16% impervious in the implementation of the stormwater program; therefore no increased load offset is required.

All projects with an 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.

James River Basin - Loading and Cumulative Reductions based on the 2000 U.S. Census Bureau urbanized MS4 area

Table 3a: Calculation Sheet for Estimating Existing Source Loads and Reduction Requirements for the **James River**, Lynnhaven, and Little Creek Basins

Pollutant	Subsource	A. Loading Rate (lbs/ac/yr) [1]	B. Existing Developed Lands as of 6/30/09 served by the MS4 within the 2000 CUA (acres)[2]	C. Loading (lbs/yr) [3]	D. MS4 Required Chesapeake Bay Total L2 Loading Rate Reduction	E. Percentage of L2 Required Reduction by 6/30/2023	F. 40% Cumulative Reduction Required by 6/30/2023 (lbs/yr) [4]	G. Sum of 40% Cumulative Reduction (lb/yr) [5]
Nitrogen	Regulated Urban Impervious	9.39	1,092	10,254	9%	40%	369	751
	Regulated Urban Pervious	6.99	2,277	15,916	6%	40%	382	
Phosphorus	Regulated Urban Impervious	1.76	1,092	1,922	16%	40%	123	156
	Regulated Urban Pervious	0.5	2,277	1,139	7.25%	40%	33	
Total Suspended Solids	Regulated Urban Impervious	676.94	1,092	739,218	20%	40%	59,137	67,193
	Regulated Urban Pervious	101.08	2,277	230,159	8.75%	40%	8,056	

[1] Edge of Stream Loading rate based on the Chesapeake Bay Watershed Model Progress Run 5.3.2

[2] To determine the existing developed acres required in Column B, the permittee should first determine the extent of their regulated service area based on the 2000 Census Urbanized Area (CUA). Next, permittees will need to delineate the lands within the 2000 CUA served by the MS4 as pervious or impervious as of the baseline date of June 30, 2009.

[3] Column C = Column A x Column B

[4] Column F = Column C x (Column D ÷ 100) x (Column E ÷ 100)

[5] Column G = The sum of the Subsource Cumulative Reduction Required by 6/30/23 (lbs/yr) as calculated in Column F.

James River Basin - Loading and Cumulative Reductions based on the 2010 U.S. Census Bureau urbanized MS4 area

Table 3a: Calculation Sheet for Estimating Existing Source Loads and Reduction Requirements for the **James River**, Lynnhaven, and Little Creek Basins

Pollutant	Subsource	A. Loading Rate (lbs/ac/yr) [1]	B. Existing Developed Lands as of 6/30/09 served by the MS4 within the 2010 CUA (acres)[2]	C. Loading (lbs/yr) [3]	D. MS4 Required Chesapeake Bay Total L2 Loading Rate Reduction	E. Percentage of L2 Required Reduction by 6/30/2023	F. 40% Cumulative Reduction Required by 6/30/2023 (lbs/yr) [4]	G. Sum of 40% Cumulative Reduction (lb/yr) [5]
Nitrogen	Regulated Urban Impervious	9.39	1,389	13,043	9%	40%	470	848
	Regulated Urban Pervious	6.99	2,254	15,755	6%	40%	378	
Phosphorus	Regulated Urban Impervious	1.76	1,389	2,445	16%	40%	156	189
	Regulated Urban Pervious	0.5	2,254	1,127	7.25%	40%	33	
Total Suspended Solids	Regulated Urban Impervious	676.94	1,389	940,270	20%	40%	75,222	83,196
	Regulated Urban Pervious	101.08	2,254	227,834	8.75%	40%	7,974	

[1] Edge of Stream Loading rate based on the Chesapeake Bay Watershed Model Progress Run 5.3.2

[2] To determine the existing developed acres required in Column B, the permittee should first determine the extent of their regulated service area based on the 2010 Census Urbanized Area (CUA). Next, permittees will need to delineate the lands within the 2010 CUA served by the MS4 as pervious or impervious as of the baseline date of June 30, 2009.

[3] Column C = Column A x Column B

[4] Column F = Column C x (Column D ÷ 100) x (Column E ÷ 100)

[5] Column G = The sum of the Subsource Cumulative Reduction Required by 6/30/23 (lbs/yr) as calculated in Column F.

York River Basin - Loading and Cumulative Reductions based on the 2000 U.S. Census Bureau urbanized MS4 area

Table 3d: Calculation Sheet for Estimating Existing Source Loads and Reduction Requirements for the **York River** and Poquoson Coastal Basin

Pollutant	Subsource	A. Loading Rate (lbs/ac/yr) [1]	B. Existing Developed Lands as of 6/30/09 served by the MS4 within the 2000 CUA (acres)[2]	C. Loading (lbs/ac/yr) [3]	D. MS4 Required Chesapeake Bay Total L2 Loading Rate Reduction	E. Percentage of L2 Required Reduction by 6/30/2023	F. 40 % Cumulative Reduction Required by 6/30/2023 (lbs/yr) [4]	G. Sum of 40% Cumulative Reduction (lb/yr) [5]
Nitrogen	Regulated Urban Impervious	7.31	482	3,523	9%	40%	127	327
	Regulated Urban Pervious	7.65	1,091	8,346	6%	40%	200	
Phosphorus	Regulated Urban Impervious	1.51	482	728	16%	40%	47	63
	Regulated Urban Pervious	0.51	1,091	556	7.25%	40%	16	
Total Suspended Solids	Regulated Urban Impervious	456.68	482	220,120	20%	40%	17,610	20,389
	Regulated Urban Pervious	72.78	1,091	79,403	8.75%	40%	2,779	

[1] Edge of Stream Loading rate based on the Chesapeake Bay Watershed Model Progress Run 5.3.2

[2] To determine the existing developed acres required in Column B, the permittee should first determine the extent of their regulated service area based on the 2000 Census Urbanized Area (CUA). Next, permittees will need to delineate the lands within the 2000 CUA served by the MS4 as pervious or impervious as of the baseline date of June 30, 2009.

[3] Column C = Column A x Column B

[4] Column F = Column C x (Column D ÷ 100) x (Column E ÷ 100)

[5] Column G = The sum of the Subsource Cumulative Reduction Required by 6/30/23 (lbs/yr) as calculated in Column F.

York River Basin - Loading and Cumulative Reductions based on the 2010 U.S. Census Bureau urbanized MS4 area

Table 3d: Calculation Sheet for Estimating Existing Source Loads and Reduction Requirements for the **York River** and Poquoson Coastal Basin

Pollutant	Subsource	A. Loading Rate (lbs/ac/yr) [1]	B. Existing Developed Lands as of 6/30/09 served by the MS4 within the 2010 CUA (acres)[2]	C. Loading (lbs/ac/yr) [3]	D. MS4 Required Chesapeake Bay Total L2 Loading Rate Reduction	E. Percentage of L2 Required Reduction by 6/30/2023	F. 40 % Cumulative Reduction Required by 6/30/2023 (lbs/yr) [4]	G. Sum of 40% Cumulative Reduction (lb/yr) [5]
Nitrogen	Regulated Urban Impervious	7.31	511	3,735	9%	40%	134	334
	Regulated Urban Pervious	7.65	1,086	8,308	6%	40%	199	
Phosphorus	Regulated Urban Impervious	1.51	511	772	16%	40%	49	65
	Regulated Urban Pervious	0.51	1,086	554	7.25%	40%	16	
Total Suspended Solids	Regulated Urban Impervious	456.68	511	233,363	20%	40%	18,669	21,435
	Regulated Urban Pervious	72.78	1,086	79,039	8.75%	40%	2,766	

[1] Edge of Stream Loading rate based on the Chesapeake Bay Watershed Model Progress Run 5.3.2

[2] To determine the existing developed acres required in Column B, the permittee should first determine the extent of their regulated service area based on the 2010 Census Urbanized Area (CUA). Next, permittees will need to delineate the lands within the 2010 CUA served by the MS4 as pervious or impervious as of the baseline date of June 30, 2009.

[3] Column C = Column A x Column B

[4] Column F = Column C x (Column D ÷ 100) x (Column E ÷ 100)

[5] Column G = The sum of the Subsource Cumulative Reduction Required by 6/30/23 (lbs/yr) as calculated in Column F.

3. Means and Methods to Meet the Required Reductions and Schedule *(General Permit Part II.A.11.c&d)*

The total reductions achieved as of July 1, 2018, for each pollutant of concern in each river basin; A list of BMPs implemented prior to July 1, 2018, to achieve reductions associated with the Chesapeake Bay TMDL including:

(1) The date of implementation; and

(2) The reductions achieved.

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 treated baseline reduction.

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

(See Appendices B-H for project specific computations in accordance with DEQ TMDL Action Plan Guidance dated May 18, 2015, including baseline subtractions)

James River Basin

Project	Type	Location	Date of Implementation	TP Removal (lbs/yr)	TN Removal (lbs/yr)	TSS Removal (lbs/yr)
Church of the Creator	Stream Restoration	37.609, -77.346	2015	43	223	507,207
Laurel Meadows ES	Wet Pond Level 2	37.627, -77.335	2015	11	40	3,722
L-5 Pond	Pond Enhancement	37.700, -77.445	2017	25	181	8,157
Liberty Hall Hills Pond	Pond Enhancement	37.616, -77.315	2017	17	129	7,027
TOTAL				**96**	**573**	**526,113**
5% Req. (2000)				20	94	8,399
5% Req. (2010)				24	106	10,399
40% Req. (2000)				156	751	67,193
40% Req. (2010)				189	848	83,196
100% Req. (2000)				390	1,878	167,983
100% Req. (2010)				473	2,120	207,990

**Reduction met as of July 1, 2018*

York River Basin

Project	Type	Location	Date of Implementation	TP Removal (lbs/yr)	TN Removal (lbs/yr)	TSS Removal (lbs/yr)
Henderson Hall	Stream Restoration	37.687, -77.422	2017	54	55	36,167
Opossum Creek	Stream Restoration	37.653, -77.392	2011	228	165	43,109
Eagles Point	Stream Restoration	37.738, -77.400	2017	27	28	17,825
TOTAL				**309**	**248**	**97,101**
5% Req. (2000)				7.88	41	2,549
5% Req. (2010)				8.18	42	2,679
40% Req. (2000)				63	327	20,389
40% Req. (2010)				65	334	21,435
100% Req. (2000)				158	818	50,972
100% Req. (2010)				164	835	53,589

**Reduction met as of July 1, 2018*

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	97	0.0	0.0	1.14	5.39	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	10.20	3.00	0.34	1.48	139	0.0	0.0	1.46	5.40	630
Opossum Creek	71.52	272.23	23	71	8,287	82.74	26.02	14	45	5,792
Eagles Point	0.0	13.98	0.34	1.74	127	0.0	0.0	0.0	0.0	0.0
L-5 Pond	10.37	39.37	5.27	23	3,385	0.0	0.0	0.22	1.11	142
Liberty Hall Hills Pond	5.32	5.22	0.10	0.71	48	0.0	0.0	0.16	0.66	115
High Point Farms	9.17	3.86	0.20	1.41	84	0.0	0.0	0.46	1.13	347
Locust Hill	10.72	3.12	0.09	0.81	25	0.0	0.0	0.51	1.20	386
TOTAL								**18**	**60**	**8,109**

**The BMPs included in this Action Plan that result in reductions in excess of the required 40% will be guaranteed at the efficiencies available at the time this Action Plan is submitted and credited toward future permit cycle reductions; Per DEQ Chesapeake Bay TMDL Action Plan Guidance dated 05/18/2015.*

4. Future Projects *(General Permit Part II.A.11.e)*

The BMPs to be implemented by the permittee prior to the expiration of this permit to meet the cumulative reductions calculated in Part II A 3, A 4, and A 5, including as applicable:

(1) Type of BMP;

(2) Project name;

(3) Location;

(4) Percent removal efficiency for each pollutant of concern; and

(5) Calculation of the reduction expected to be achieved by the BMP calculated and reported in accordance with the methodologies established in Part II A 8 for each pollutant of concern.

Below are a list of projects being considered by Hanover County to meet the requirements of the Chesapeake Bay TMDL. In the James River basin, a removal of ***93 lbs/yr*** of TP and ***275 lbs/yr*** of TN will need to be achieved prior to the expiration of this permit to reach the required 40% cumulative reduction. In the York River basin, ***86 lbs/yr*** of TN removal will need to be achieved prior to the expiration of this permit to reach the required 40% cumulative reduction.

In total, ***377 lbs/yr*** of TP and ***2,134 lbs/yr*** of TN will need to be removed by Hanover County to meet the required 100% cumulative reduction over the course of the next two permit cycles. These reductions were calculated using the 2010 U.S. Census Bureau regulated MS4 drainage areas.

The potential projects listed in this Action Plan are all subject to change at the discretion of Hanover County and will continue to evolve based on community expectations and cost effectiveness. Alternative methods may be employed to achieve the required reductions; such as Pollutant Trading referenced in *General Permit Part II.A.10*. Any changes to the listed pollutant reduction methods would be included in future Action Plan updates as required by the permit.

Listed below are projects that Hanover County will consider in order to meet reduction requirements.

Project	Type	Location	River Basin	Removal Efficiency (%) TP/TN/TSS*	TP Removal (lbs/yr)	TN Removal (lbs/yr)	TSS Removal (lbs/yr)
High Point Farms	Wetland Lvl.1	37.591, -77.332	James	40/20/50	16	72	5,937
Locust Hill	Wetland Lvl.1	37.599, -77.332	James	40/20/50	17	78	6,851
Covenant Woods (B-10)	Pond Enhancement	37.622, -77.348	James	23/22/26	44	444	15,477
Rose Hill (B-5)	Pond Enhancement	37.617, -77.373	James	26/23/31	34	301	12,212
Cherrydale Lake	Wet Pond Level 2	37.624, -77.325	James	30/20/16	269	1,705	28,331
	Nutrient Credit Trading		York			86	
Total Project Removal Available			**James**		380	2,600	68,808
			York		0.0	86	0.0
Amount needed to meet 40% Reduction			**James**		93	275	0.0
			York		0.0	86	0.0

*Uplift efficiency shown for retrofit projects

5. Public Comments on Action Plan *(General Permit Part II.A.11.f)*

A summary of any comments received as a result of public participation required in Part II A 12, the permittee's response, identification of any public meetings to address public concerns, and any revisions made to Chesapeake Bay TMDL action plan as a result of public participation.

The Hanover County Department of Public Works presented on the Chesapeake Bay TMDL Action Plan at the April 25, 2018 Hanover County Board of Supervisors Meeting. This allowed the opportunity for public comment through May 10, 2018. The Board of Supervisors Meeting was advertised through the Hanover County website and the Herald Progress. A copy of the advertisement and agenda summary can be found in Appendix I.

No comments were received during the advertised public comment period. Any comments received in the future will be addressed (if appropriate) in updates of this Action Plan.

APPENDICES

Appendix A – Hanover County MS4 Land Cover (2010 census urbanized area)

Appendix B – Church of the Creator Stream Restoration Project

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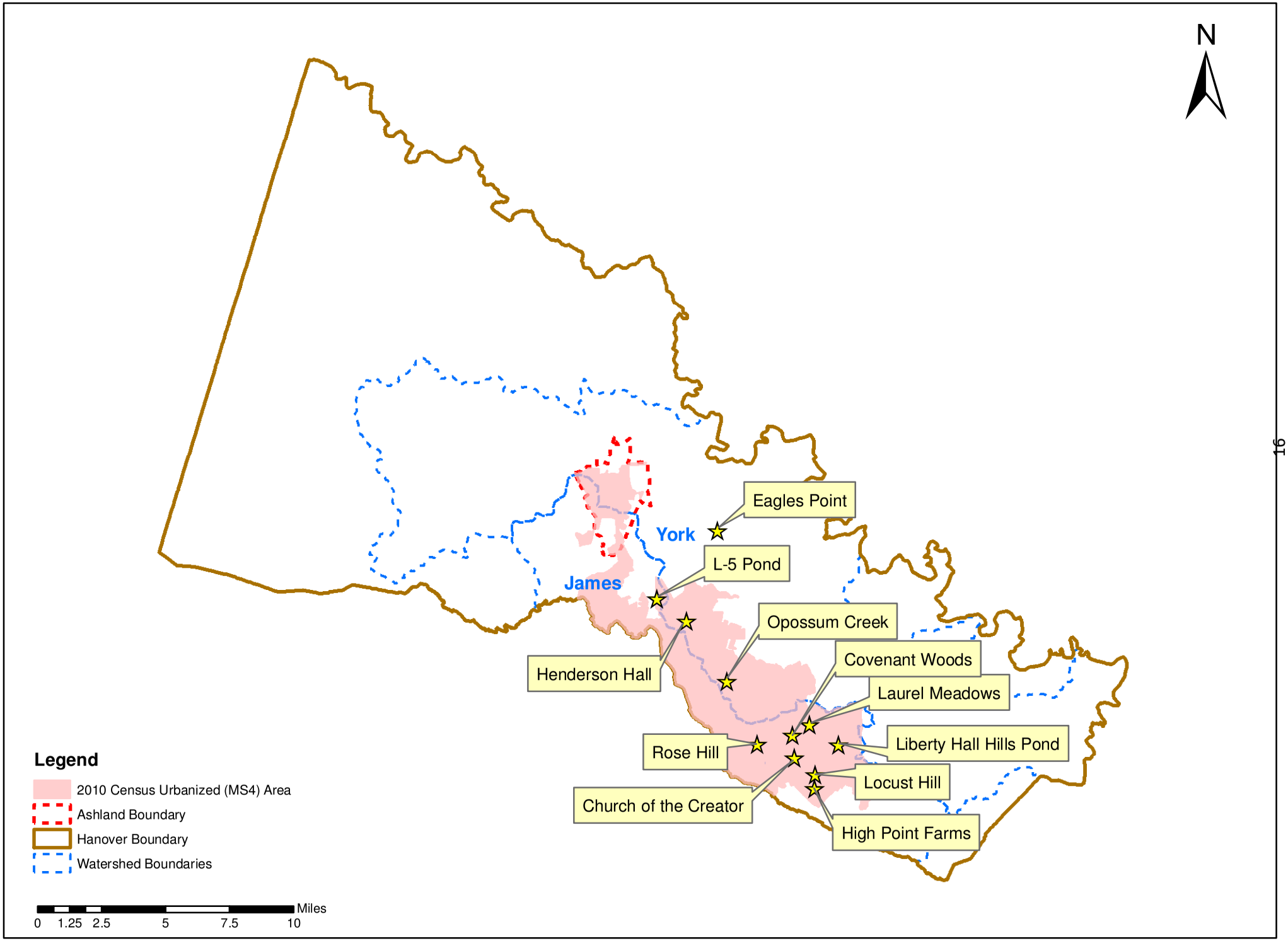
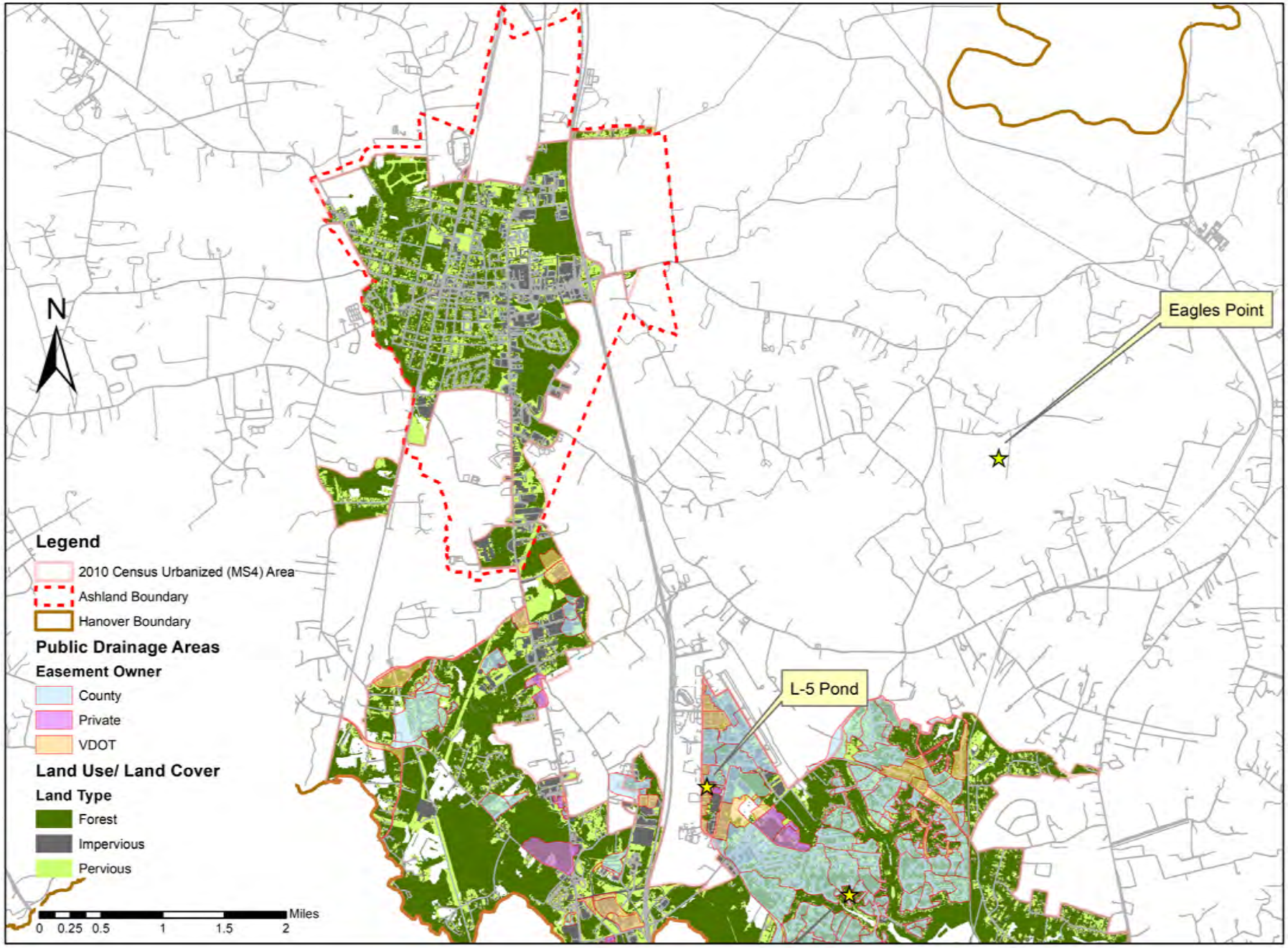
Appendix A – Hanover County MS4 Land Cover

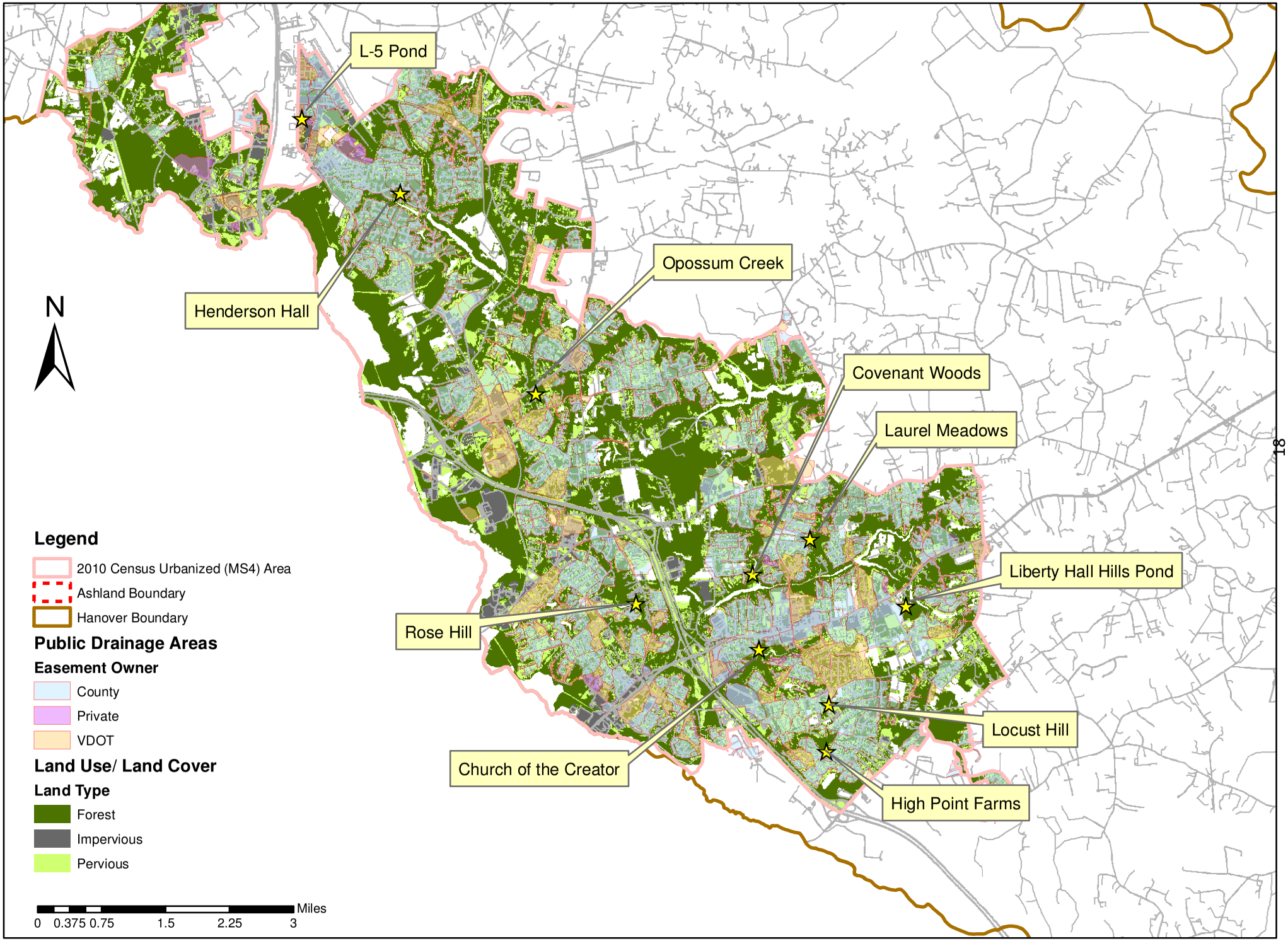
Hanover County MS4



Hanover County MS4 (North)



Hanover County MS4 (South)



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 2010 urbanized MS4 service area. The MS4 area is further split between the James River and York River Watersheds as required for permit Table 3. Land use acreage totals within the 2000 urbanized MS4 service area are available in Appendix A of Hanover County's first phase Chesapeake Bay TMDL Action Plan.

Land Use Code	Entire County	MS4 PDA	James MS4 PDA	York MS4 PDA
Low Density (Rural) Residential Structures (1)	1138	27	17	10
Medium Density (Subdivisions) Residential Structures (2)	844	521	348	173
High Density Residential Structures (3)	34	18	13	5
Commercial Structures (4)	423	144	118	26
Industrial Structures (5)	237	57	50	7
Church Structures (6)	50	8	6	2
School Structures (7)	76	24	13	11
Government Structures (8)	21	2	1	1
Other Structures (9)	4	-	-	-
Managed Turf (11)	19323	3085	2054	1031
Managed Turf in ROW	732	427	282	145
Grassland (12)	9789	255	200	55
Grassland in ROW	732	45	28	17
Agriculture (13)	58209	251	199	52
Agriculture in ROW	171	6	4	2
Bare Earth (14)	880	-	-	-
Deciduous Forest (21)	123566	1794	1098	696
Deciduous Forest in ROW	843	143	89	54
Coniferous Forest (22)	55826	954	640	314
Coniferous Forest in ROW	279	56	38	18
Forest Harvest (23)	9459	64	54	10
Forest Harvest in ROW	13	2	1	1
Water (30)	10094	12	12	-
Water in ROW	22	-	-	-
Apartments (51)	24	5	3	2
Agricultural Buildings (52)	122	-	-	-
Impervious Surface (40) Total	10866	2076	1464	611
Impervious Surface (40) Public ROW	2700	982	644	338
Impervious Surface (40) Private Total	8165	1094	820	274
ROW "Other"	2792	679	442	237
Total	303777	9975	6732	3243
Developed Impervious	11138	1900	1389	511
Developed Pervious	29112	3340	2254	1086
Developed Total	40250	5240	3643	1597

**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)	**Impervious**
Managed Turf (11) Grassland (12)	**Pervious**
Deciduous Forest (21) Coniferous Forest (22) Forest Harvest (23)	**Forest**

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

	Phosphorus (lbs/yr)	**Nitrogen (lbs/yr)**	**Sediment (lbs/yr)**
Hanover	43	223	507,207
VDOT	1.14	5.39	697

Church of the Creator Project Map

Pre-construction - Looking Upstream

Pre-construction - Looking Downstream

Post-construction

CHURCH OF THE CREATOR STREAM RESTORATION PROJECT - JAMES RIVER BASIN

	Input Value
	Calculated Value

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

STEP 1: PROJECT REDUCTIONS

Stream Length Restored (ft)	-		
	TN (lbs/ln ft)	TP (lbs/ln ft)	TSS (lbs/ln 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	
Regulated	Hanover County	5.77	4.19	9.96	4.09	
	VDOT ROW	4.99	3.50	8.49	0.00	
Unregulated	Hanover County	0.32	1.01	1.33	4.19	
	VDOT ROW	0.32	0.31	0.63	0.00	Total
			Total	20.41	8.28	28.7

* Forest and Pervious Acreage Revised Feb 2016

STEP 3: REGULATED PROJECT CREDIT

	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Max. Regulated Reduction	147.27	28.30	326,685.26
Hanover County Portion	141.87	27.16	325,988.79
VDOT Portion (Baseline)	5.39	1.14	696.47

	Regulated	Unregulated	Forested
Land Type Ratios	0.64	0.07	0.29

STEP 4: FORESTED PROJECT CREDIT

	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Max. Forested Reduction	66.09	12.70	146,609.97
Hanover County Portion	66.09	12.70	146,609.97
VDOT Portion (No Credit)	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

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

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

STEP 6: FINAL CREDIT PROJECT REDUCTIONS

	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Hanover Reductions	222.57	42.68	507,206.54

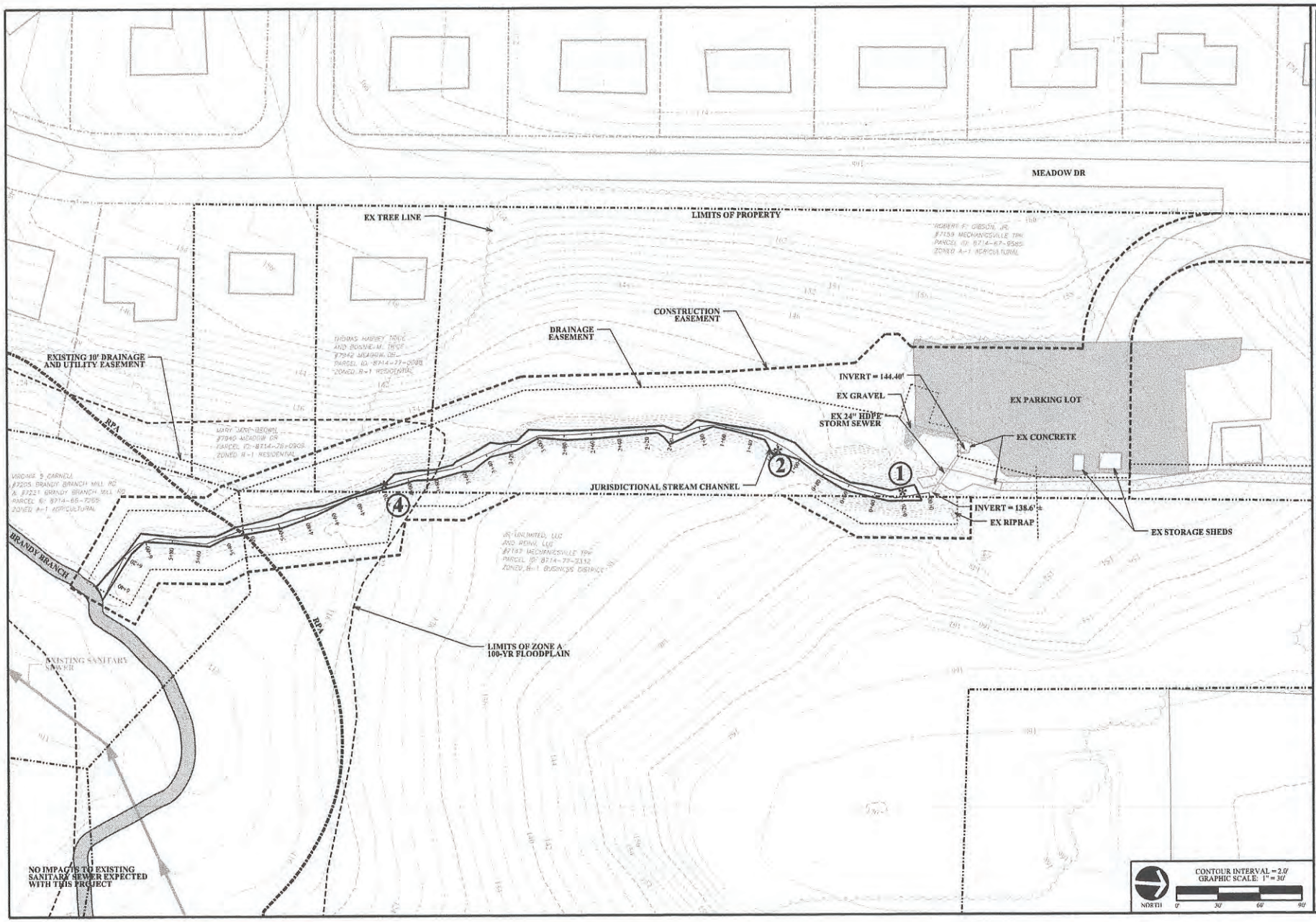
	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
VDOT Reductions	5.39	1.14	696.47

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)
Church of Creator									
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	508	458	88
						*50%:	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 7216
Richmond, VA 23221
(804) 304-4659
www.watershedva.com

CHURCH OF THE CREATOR

SOIL SAMPLE LOCATIONS

HANOVER COUNTY, VIRGINIA

COMMONWEALTH OF VIRGINIA
Erik Leon Allen
Lic. No. 024783
1/16/2015
PROFESSIONAL ENGINEER

PROJECT MANAGER:	EA
DESIGNED:	EA
DRAWN:	SC
DESIGN FILE:	
DATE:	7/10/2014

REVISIONS:

1/14/2015 - REVISED STONE SPECS

10/22/2014 - REVISED PER COUNTY COMMENTS

10/8/2014 - REVISED PER COUNTY COMMENTS

Report Number
15-023-0503 **Page:** 1 of 2

Account Number
07353

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

Client : HENDERSON HALL
CHURCH OF CREATOR

A&L Eastern Laboratories, Inc.

7621 Whitepine Road Richmond, Virginia 23237 (804) 743-9401 Fax (804) 271-6446

www.aleastern.com

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

REPORT OF ANALYSIS

Lab No	Sample ID Sample Date and Time	Nitrogen, Total (Inorganic + Organic) CALCULATION	Total Kjeldahl Nitrogen SM-4500-NH3C-TKN	Total Phosphorus SW 6010C
			ppm	
09115	1	214	210	77.0
09116	2	241	240	123
09117	2A	71	70.0	25.0
09118	4	226	220	60.0

Pauric McGroary

Pauric McGroary

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 823 linear feet of stream channel which collects a 59.5 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

	Phosphorus (lbs/yr)	**Nitrogen (lbs/yr)**	**Sediment (lbs/yr)**
Hanover	54	55	36,167
VDOT	1.46	5.40	630

Henderson Hall Project Map

Pre-construction - Looking Downstream

Pre-construction - Looking Upstream

Pre-construction - Downstream Section

Post-construction

HENDERSON HALL STREAM RESTORATION PROJECT - YORK RIVER BASIN

	Input Value
	Calculated Value

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

STEP 1: PROJECT REDUCTIONS

Stream Length Restored (ft)	823.00			
	TN (lbs/ln ft)	TP (lbs/ln ft)	TSS (lbs/ln ft)	
Default Removal Rate	0.075	0.068	44.88	*15.13 for coastal plain
Project Reductions (lbs)	61.73	55.96	36,936.24	

STEP 2: ACRES DRAINING TO THE PROJECT

Drainage Area Type	Owner	Urban Impervious Acres	Urban Pervious Acres	Total Urban Acres	Forested Acres	
Regulated	Hanover County	6.50	13.70	20.20	21.70	
	VDOT ROW	6.60	3.60	10.20	0.00	
Unregulated	Hanover County	1.40	1.60	3.00	4.40	
	VDOT ROW	0.00	0.00	0.00	0.00	Total
			Total	33.40	26.10	59.5

STEP 3: REGULATED PROJECT CREDIT

	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Max. Regulated Reduction	31.54	28.59	18,871.63
Hanover County Portion	26.14	27.13	18,241.39
VDOT Portion (Baseline)	5.40	1.46	630.24

	Regulated	Unregulated	Forested
Land Type Ratios	0.51	0.05	0.44

STEP 4: FORESTED PROJECT CREDIT

	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Max. Forested Reduction	27.08	24.55	16,202.28
Hanover County Portion	27.08	24.55	16,202.28
VDOT Portion (No Credit)	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	0.60	0.20	92.00
Urban Pervious	0.40	0.04	6.40

STEP 5: UNREGULATED PROJECT CREDIT

	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)	
Max. Unregulated Reduction	3.11	2.82	1,862.33	= (Project Reduction * Unregulated Land Ratio)
Unregulated Baseline Reduction	1.48	0.34	139.04	
Hanover County Portion	1.63	2.48	1,723.29	= (Unregulated Project Reduction - Unregulated Baseline)

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

STEP 6: FINAL CREDIT PROJECT REDUCTIONS

	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Hanover Reductions	54.85	54.16	36,166.96

	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
VDOT Reductions	5.40	1.46	630.24

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

	Phosphorus (lbs/yr)	**Nitrogen (lbs/yr)**	**Sediment (lbs/yr)**
Hanover	11	40	3,722
VDOT	0.0	0.0	0.0

Laurel Meadows Project Map

Pre-construction - Looking North

Pre-construction - Looking South

Post-construction

Laurel Meadows Pond Enhancement

		Total Acres	Regulated (Hanover)	Regulated (VDOT ROW)	Unregulated (Hanover)	Unregulated (VDOT ROW)	VDOT (Hanover)	VDOT (ROW)	Total Regulated Load	Baseline in ROW (VDOT)	Total Unregulated Load	Unregulated Baseline	Total VDOT Load	Baseline outside ROW	Baseline in ROW (VDOT)	
Nitrogen	Urban Imp Acres	6.26	6.26	0.00	0.00	0.00	0.00	0.00	58.78	0.00	0.00	0.00	0.00	0.00	0.00	
	Urban Perv Acres	10.68	10.68	0.00	0.00	0.00	0.00	0.00	74.65	0.00	0.00	0.00	0.00	0.00	0.00	
	Forest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	-	0.00	-	-	
		16.94							133.43	0.00	0.00	0.00	0.00	0.00	0.00	Totals
Phophorus	Urban Imp	6.26	6.26	0	0	0	0	0	11.02	0.00	0.00	0.00	0.00	0.00	0.00	
	Urban Perv	10.68	10.68	0	0	0	0	0	5.34	0.00	0.00	0.00	0.00	0.00	0.00	
	Forest	0	0	0	0	0	0	0	0.00	-	0.00	-	0.00	-	-	
									16.36	0.00	0.00	0.00	0.00	0.00	0.00	Totals
Sediment	Urban Imp	6.26	6.26	0	0	0	0	0	4237.64	0.00	0.00	0.00	0.00	0.00	0.00	
	Urban Perv	10.68	10.68	0	0	0	0	0	1079.53	0.00	0.00	0.00	0.00	0.00	0.00	
	Forest	0	0	0	0	0	0	0	0.00	-	0.00	-	0.00	-	-	
									5317.18	0.00	0.00	0.00	0.00	0.00	0.00	Totals

LOADING RATES - JAMES BASIN

	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS (lbs/ac/yr)
Urban Impervious	9.39	1.76	676.94
Urban Pervious	6.99	0.50	101.08
Forest	2.36	0.13	77.38

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

Downward Modification		TP	TN	TSS
Existing	0%	0%	0%	0%
Proposed	0%	65%	30%	70%
	Difference (Uplift)	65%	30%	70%

Clearinghouse Wet Pond 2	
TP	65%
TN	30%
TSS	70%

*Coastal Plain Efficiencies used for TP & TN

Max. Eff.	Existing	Proposed
TP	0%	65%
TN	0%	30%
TSS	0%	70%

*Ches. Bay Retrofit Curve Eff.

Phosphorus

	Hanover	VDOT
Regulated Credit =	10.63	0.00
Unregulated Credit (incld. Baseline reduction) =	0.00	-
VDOT D.A. Credit =	0.00	0.00
Project Credit =	10.63	0.00

Nitrogen

	Hanover	VDOT
Regulated Credit =	40.03	0.00
Unregulated Credit (incld. Baseline reduction) =	0.00	-
VDOT D.A. Credit =	0.00	0.00
Project Credit =	40.03	0.00

Sediment

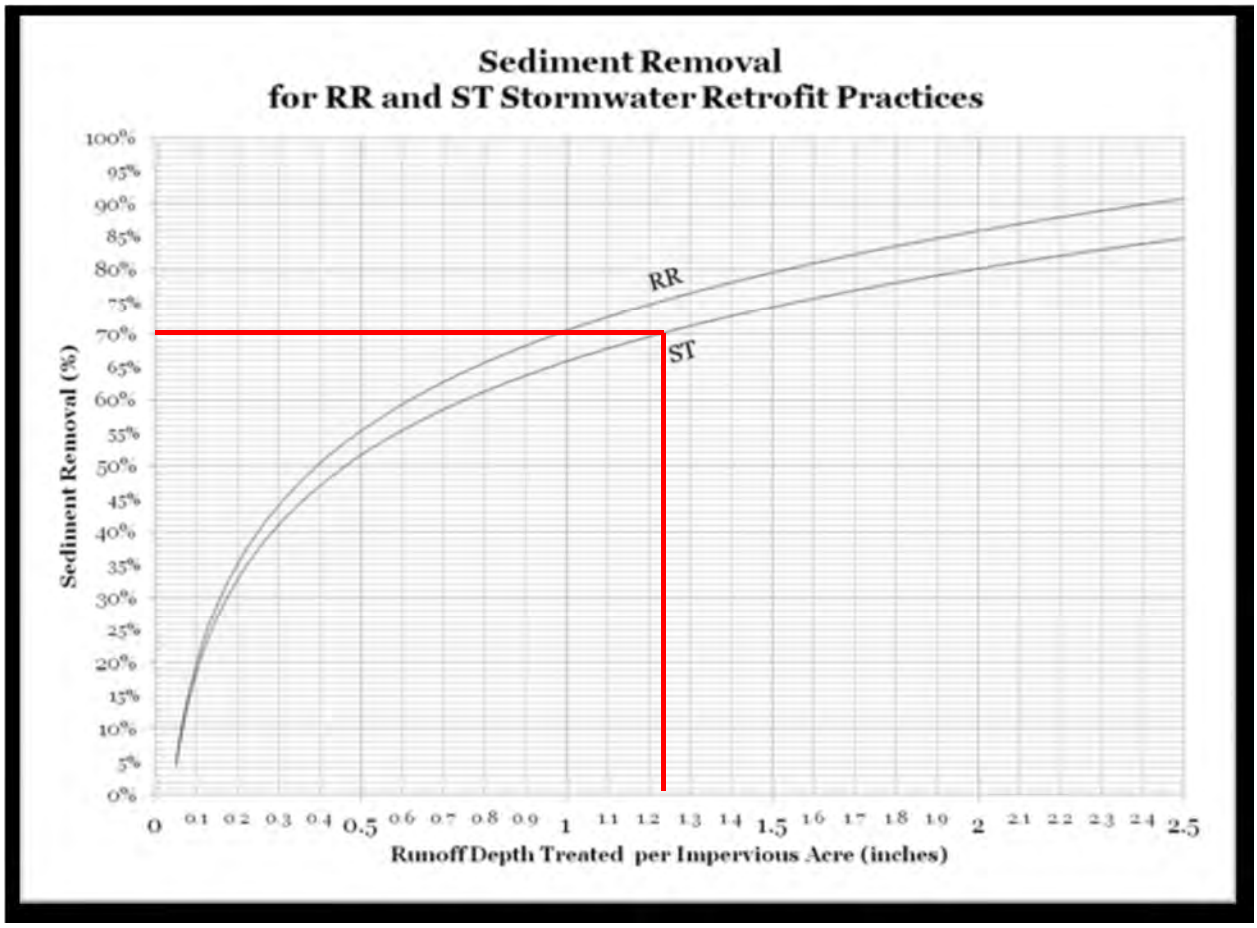
	Hanover	VDOT
Regulated Credit =	3722.03	0.00
Unregulated Credit (incld. Baseline reduction) =	0.00	-
VDOT D.A. Credit =	0.00	0.00
Project Credit =	3722.03	0.00

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 Removal Efficiency = 70%

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. The bond for this was project was released 7/19/2011.

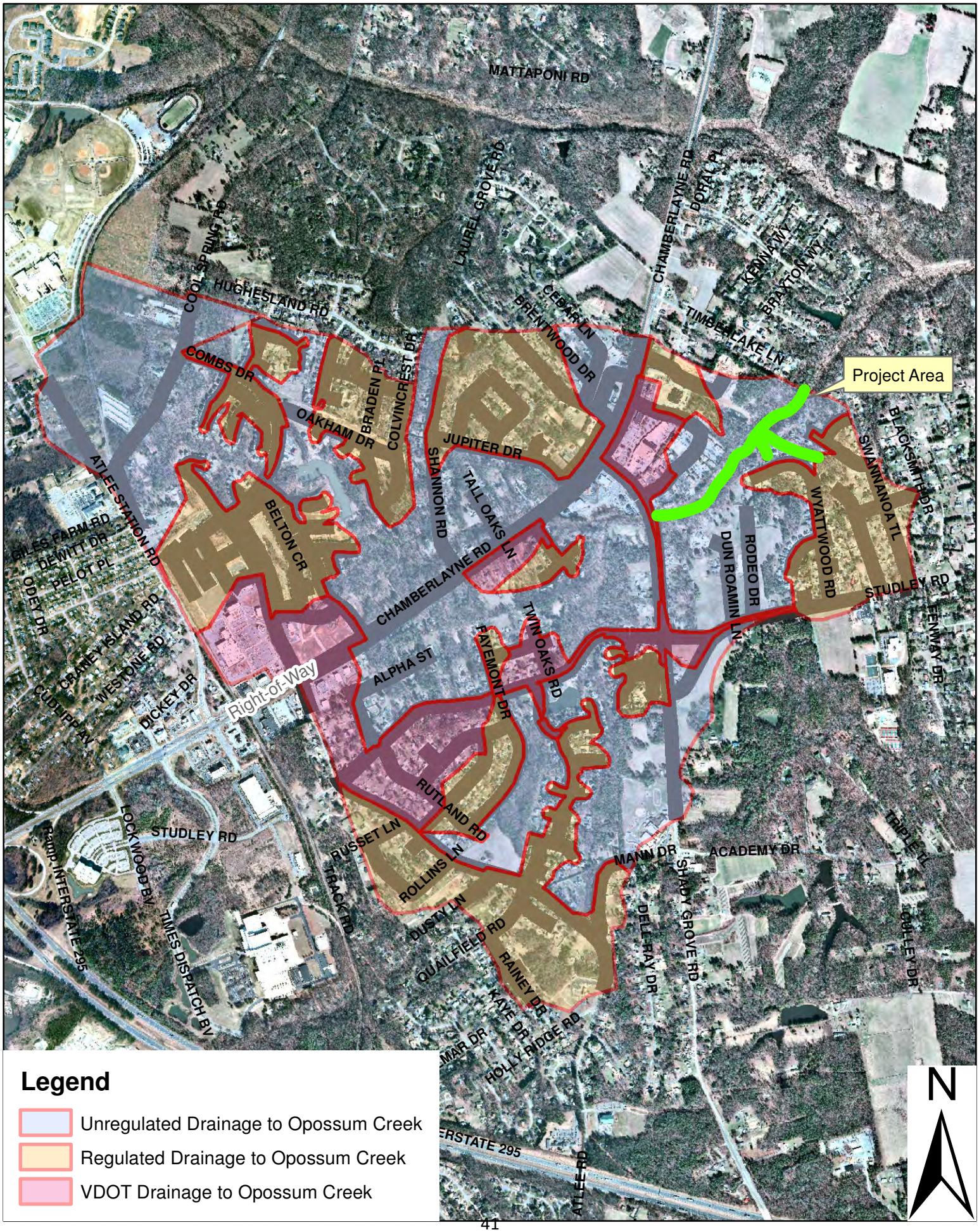
The project restored 4,029 linear feet of stream channel which collects a 1,205 acre watershed (1,161 acres considered for land use analysis). The land use within the county regulated portion of the drainage area contains a mixture of commercial development, landscaping, roadways, residential lots, undeveloped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

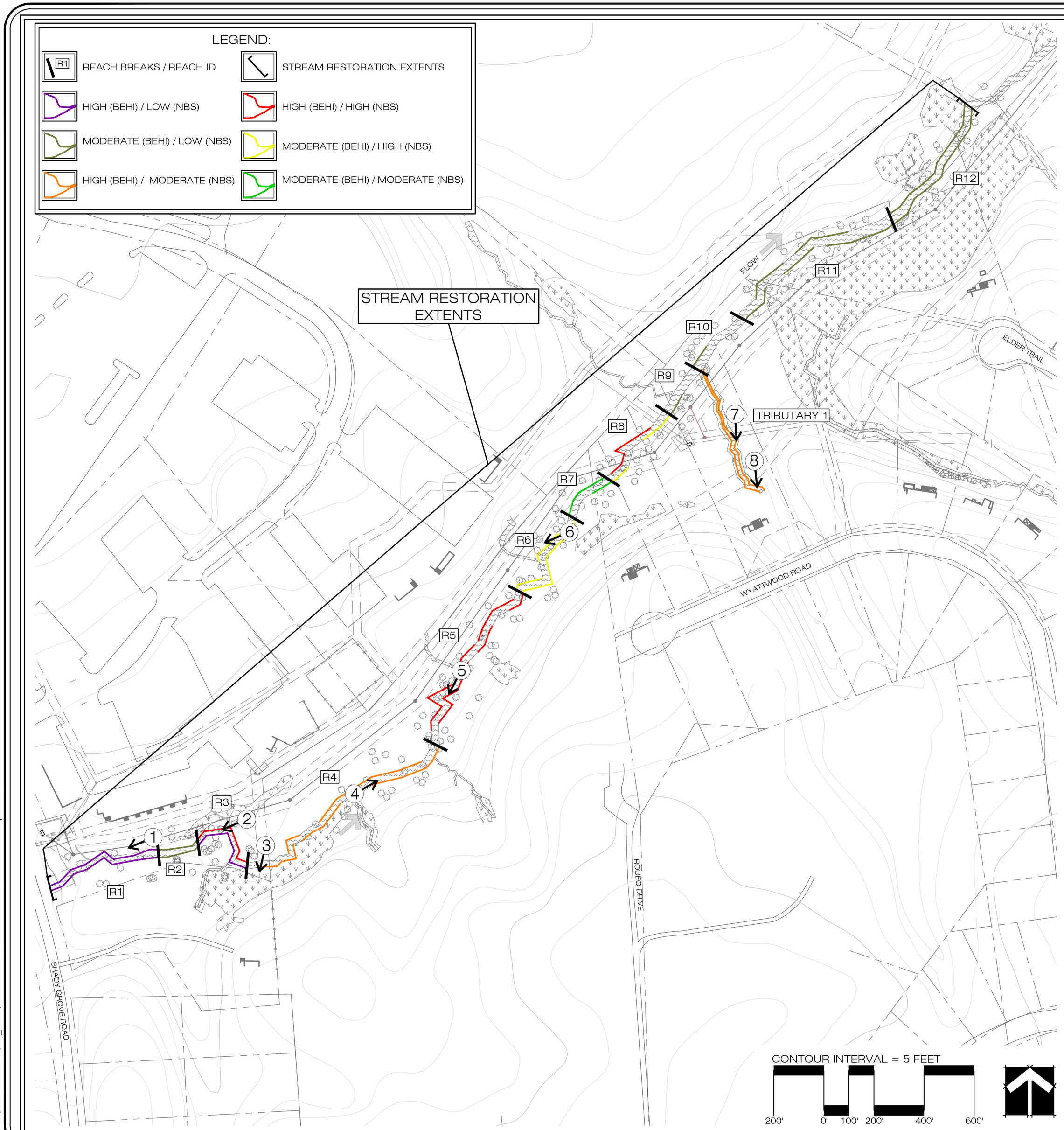
	Phosphorus (lbs/yr)	**Nitrogen (lbs/yr)**	**Sediment (lbs/yr)**
Hanover	228	165	43,109
VDOT	14	45	5,792

Opossum Creek Project Map



Legend

- Unregulated Drainage to Opossum Creek
- Regulated Drainage to Opossum Creek
- VDOT Drainage to Opossum Creek



EXISTING CONDITIONS: OPOSSUM CREEK
-MULTIPLE TREES HAVE FALLEN INTO CHANNEL DUE TO BANK EROSION
-DEBRIS PREVENTS NATURAL FLOW DYNAMICS
1

EXISTING CONDITIONS: OPOSSUM CREEK
-CHANNEL DISCONNECTED FROM FLOODPLAIN
-UNSTABLE MEANDER PATTERN
-BANK EROSION AND SCOUR
-RIPARIAN BUFFER: MATURE TREES AND SHRUBS
2

EXISTING CONDITIONS: OPOSSUM CREEK
-BANK EROSION AND SCOUR PROMINENT ON OUTSIDE BENDS
-RIFFLE AND POOL SEQUENCE UNSTABLE
-INEFFECTIVE ROOTING DEPTH ON STREAM BANKS
-RIPARIAN BUFFER: MATURE TREES AND SHRUBS, ADJACENT WETLANDS
3

EXISTING CONDITIONS: OPOSSUM CREEK
-BANK EROSION ON BOTH BANKS, ESPECIALLY ON OUTER BENDS.
-UNSTABLE PATTERN WITH TORTUOUS BENDS
-DEBRIS JAMS LEADING TO DEPOSITION AND INSTABILITY
-RIPARIAN BUFFER: MATURE TREES AND SHRUBS, HERBACEOUS FLOODPLAIN
4

EXISTING CONDITIONS: OPOSSUM CREEK
-EXTENSIVE BANK EROSION AND SLUMPING, OUTER BEND SHEER STRESS HIGH
-DEPOSITION CONTRIBUTING TO INSTABILITY
-CHANNEL OVERWIDENED IN MANY PLACES
-CHANNEL PATTERN UNSTABLE WITH TORTUOUS BENDS
-RIPARIAN BUFFER: MATURE TREES AND DEVELOPED SHRUB LAYER
5

EXISTING CONDITIONS: OPOSSUM CREEK
-SEDIMENT DEPOSITION WITHIN CHANNEL IMPACTS INSTREAM HABITAT AND FLOW DYNAMICS
-STREAM BANKS UNDERCUT AND ERODED
6

EXISTING CONDITIONS: TRIBUTARY 1
-INCISED CHANNEL DISCONNECTED FROM FLOODPLAIN
-SEVERE SEDIMENT DEPOSITION
-BANK EROSION AND SCOUR
-RIPARIAN BUFFER: MATURE TREES WITH MINIMAL VEGETATIVE PROTECTION
7

EXISTING CONDITIONS: TRIBUTARY 1
-48-INCH CULVERT AT UPSTREAM LIMIT OF MITIGATION AREA -APPROXIMATELY 2 FEET OF DROP BETWEEN INVERT AND STREAM BED
-SCOUR BEHIND EXISTING CULVERT
8

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Fredericksburg, Virginia 22406
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WILLIAMSBURG ENVIRONMENTAL GROUP INC.
Environmental Consultants

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

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

U:\203400233\07_cad\203400233 - BEHI Assessment Map.DWG

OPOSSUM CREEK STREAM RESTORATION PROJECT - YORK RIVER BASIN

	Input Value
	Calculated Value

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

STEP 1: PROJECT REDUCTIONS

Stream Length Restored (ft)	4,029.00			
	TN (lbs/ln ft)	TP (lbs/ln ft)	TSS (lbs/ln ft)	
Default Removal Rate	0.075	0.068	15.13	*15.13 for coastal plain
Project Reductions (lbs)	302.18	273.97	60,958.77	

STEP 2: ACRES DRAINING TO THE PROJECT

Drainage Area Type	Owner	Urban Impervious Acres	Urban Pervious Acres	Total Urban Acres	Forested Acres	
Regulated	Hanover County	52.90	183.78	236.68	104.60	* Forest and Pervious Acreage Revised Feb 2016
	VDOT ROW	46.35	25.17	71.52	9.45	
Unregulated	Hanover County	56.64	180.02	236.66	315.76	
	VDOT ROW	19.82	15.75	35.57	7.06	
VDOT	Hanover County	37.86	44.88	82.74	30.60	
	VDOT ROW	16.68	9.34	26.02	3.92	Total
			Total	689.19	471.39	1,160.6

STEP 3: REGULATED PROJECT CREDIT

	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Max. Regulated Reduction	80.24	72.76	16,188.02
Hanover County Portion	42.37	62.48	11,762.73
VDOT Portion (Baseline)	37.88	10.28	4,425.29

	Regulated	Unregulated	Forested	VDOT
Land Type Ratios	0.27	0.23	0.41	0.09

STEP 4: FORESTED PROJECT CREDIT

	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Max. Forested Reduction	122.73	111.28	24,759.48
Hanover County Portion	122.73	111.28	24,759.48
VDOT Portion (No Credit)	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	0.60	0.20	92.00
Urban Pervious	0.40	0.04	6.40

STEP 5: UNREGULATED PROJECT CREDIT

	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)	
Max. Unregulated Reduction	70.88	64.26	14,298.72	= (Project Reduction * Unregulated Land Ratio)
Unregulated Baseline Reduction	124.18	23.12	8,287.25	
Hanover County Portion	0.00	41.14	6,011.47	= (Unregulated Project Reduction - Unregulated Baseline)

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

STEP 6: VDOT D.A. PROJECT CREDIT

	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)	
Max. VDOT Reduction	28.32	25.67	5,712.55	
Max. outside ROW	21.54	19.53	4,345.87	
Baseline (VDOT) outside ROW	21.54	9.37	3,770.35	
Max. inside ROW	6.77	6.14	1,366.68	
VDOT Portion (Baseline)	6.77	3.71	1,366.68	
Hanover County Portion	0.00	12.60	575.52	Note: Baseline Reduction > Project Reduction then Project Credit = 0

STEP 7: FINAL CREDIT PROJECT REDUCTIONS

	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Hanover Reductions	165.10	227.50	43,109.20

	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
VDOT Reductions	44.65	13.99	5,791.97

Appendix F – Eagles Point Stream Restoration Project

Overview

This project involves the restoration of 400 linear feet of eroded and incised stream channel which receives runoff via a paved ditch. The project is located in the Courthouse Ridge, a large-lot rural subdivision in Hanover County, and drains to Mechumps Creek as part of the Pamunkey River watershed. The project is located outside the MS4 urbanized area and collects 14 acres of unregulated drainage area.

The purpose of the project is to prevent further head-cutting and severe erosion in this stream corridor, protect upstream threatened properties, and reduce/eliminate further erosion of the corridor that would result in impacts to downstream properties and tributaries of Mechumps Creek.

The existing channel has experienced very high to severe erosion with channel incision ranging from 5-9 feet in depth. The banks are near vertical, extremely incised, and lack roots and cover vegetation. Sloughing has resulted in many downed trees. The channel corridor is entirely wooded with soils consisting of sands and sandy loams with clay.

Project Removal Credit Summary

	Phosphorus (lbs/yr)	**Nitrogen (lbs/yr)**	**Sediment (lbs/yr)**
Hanover	27	28	17,825
VDOT	0.0	0.0	0.0

1.0 GENERAL MAPPING AND ASSESSMENT REQUIREMENTS

The proposed project includes restoration of a degraded stream located in a residential area of Hanover County, Virginia. The Eagles Point Lane stream channel branches from Eagles Point Lane roadside ditch running east, parallel to the Mautte and Goebel Living Trust parcel line. The project area defined by Hanover County is located completely within this lot, approximately 10.2-acre in size.

The stream corridor resides primarily in unmaintained, forested areas. The corridor is not mowed or heavily maintained.

Ecosystem Services, Inc. conducted a delineation of wetlands and other waters of the United States located within the project limits in December 2015. Jurisdictional waters within the project limits include a significantly degraded stream channel which is proposed for restoration. No jurisdictional wetlands are located within the project limits.

Ecosystem Services also conducted a perennial stream assessment and concluded that the majority of the stream is intermittent in nature. The stream becomes perineal approximately 500-ft downstream from the beginning of the stream restoration project. Thus a 100-foot RPA buffer is associated with this portion of the stream channel.

2.0 Proposed Project

Stream improvements include the implementation of natural stream design techniques with an emphasis on techniques needed to stabilize urban high gradient streams. A priority has been placed on minimizing land disturbance within the stream corridor. The proposed stream design incorporates a combination of improvements focusing primarily on 1) elevating the existing channel by filling the channel with earth fill and lining the channel with clayey fill, 2) restoring the channel floodplain to provide more stable stream geometry, and 3) providing drop structures and pools to center flow and dissipate energy. Areas will be revegetated with native trees and shrubs.

These improvements are intended to increase stream stability and promote the stream's access to its floodplain bench. The stream channel will also be widened to increase its flow carrying capacity at lower flood depths. Geometry has been defined using a combination of appropriate reference streams, modeling, and or published empirical relationships.

3.0 HYDROGEOLOGICAL ELEMENT

The existing topography, soils, and hydrology of the site and immediately adjacent land were evaluated based on site visits as well as published information and maps. The topography within the project limits is relatively steep with slopes ranging from 5%-25% and elevations ranging from 130 to 192-ft msl. Adjacent lands are characterized by gently rolling hills bisected by drainageways, which is typical of the eastern sections of the Piedmont Physiographic Province.

Based on review of the USDA online soil mapper, the construction site is underlain by Kempsville-Bourne fine sandy loam, Orangeburg-Faceville fine sandy loam, and Utults Ochrepts complex. Soil characteristics are summarized as follows:

Soil Name	K Value	Slopes
Kempsville-Bourne	0.28	2-7%
Orangeburg-Faceville	0.32	2-7%
Udults Ochrepts	0.24	2-7%

The drainage patterns found within and around the site are characteristic of the typical western Piedmont dendritic drainage systems. Adjacent properties to the north, south and west are characterized as forested rural land.

No disruptions or reductions in the supply of water or hydrology will occur to other wetlands, streams, lakes or rivers as a result of this project.

No disruptions to existing hydrology, including wetland stream circulation patterns will occur as a result of this project.

No increase in offsite flood elevations will result from this project.

No increase in impervious surface or turf is proposed. Thus no onsite BMPs are needed for Chesapeake Bay water quality compliance. The stream restoration project will provide significant water quality improvements.

The project results in no change in land use conditions and no increase in runoff.

No impacts to jurisdictional wetlands are needed to accommodate this project. The project will temporarily impact 475 linear feet of stream channel. A nationwide 27 permit will be required from the U.S. Army Corps of Engineers.

A land disturbance permit is required by Hanover County and a VSMP construction permit is required by the Department of Environmental Quality.

Project construction is planned during the summer of 2016.

The project results in 0.09-acre of land disturbance in the Resource Protection Area. This disturbed area will be reforested with container shrubs at rates provided on Sheet 8 of the plans. There remaining 1.02-acre is located within the Resource Management Area.

4.0 WASTEWATER ELEMENT

No wastewater is associated with the proposed improvements

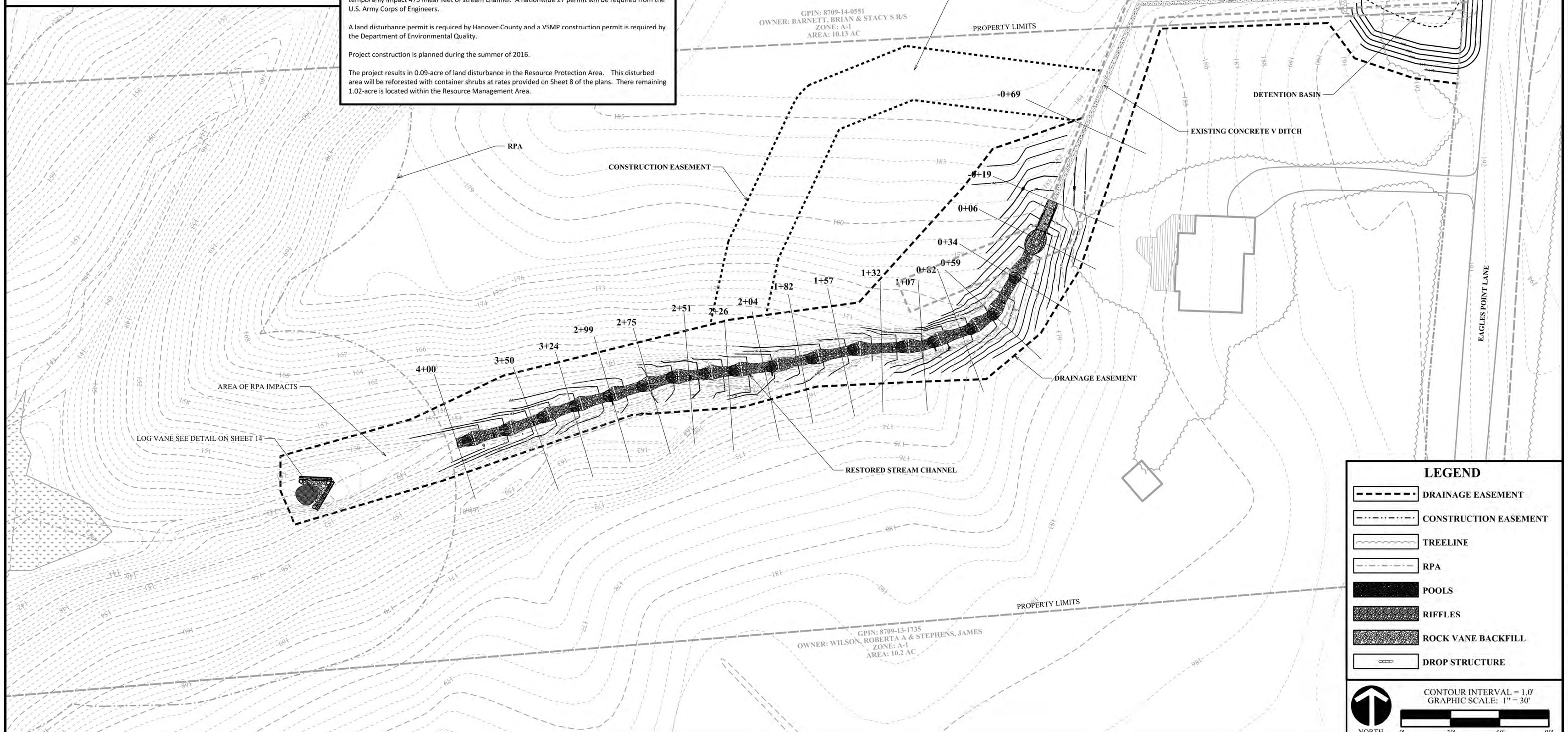
5.0 LANDSCAPE ELEMENT

The project will require the clearing of several mature trees. The floodplain bench will be reforested with container trees at a rate of 800 trees per acre and the slopes with 400 shrubs per acre. A landscape plan is provided on Sheet 8 of the Eagles Point Lane Stream Restoration Construction Plan.

6.0 Summary

In summary, project impacts are minimal. The project is a stream restoration project which will be self mitigating.

Project Area/Limits of Environmental Studies	1.11 acre
Limits of Disturbance/Construction Easement	1.11-acre
Total Area of Grading in RPA	0.09-acre (3965 sq ft)
New Impervious Cover	0.00 acre
Wetland Impacts	0.00 acre
Permanent Stream Impacts	0 lf
Restored Stream Length	400-lf



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EAGLES POINT LANE

DEVELOPMENT PLAN

HANOVER COUNTY, VIRGINIA

COMMONWEALTH OF VIRGINIA
Erik Leon Allen
Lic. No. 024783
1/11/2017
PROFESSIONAL ENGINEER

PROJECT MANAGER:	EA
DESIGNED:	EA
DRAWN:	BF
DESIGN FILE:	Eagles_Point_Lane_7_16_2015.dgn
DATE:	2/16/2016

REVISIONS:
3/22/2016 Revised per county comments
5/2/2016 Revised per county comments
1/11/2017 Revised per county comments

SHEET 4

Pre-construction - Looking Upstream

Pre-construction - Looking Downstream

Post-construction

EAGLE POINT STREAM RESTORATION PROJECT - YORK RIVER BASIN

	Input Value
	Calculated Value

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

STEP 1: PROJECT REDUCTIONS

Stream Length Restored (ft)	400.00		
	TN (lbs/ln ft)	TP (lbs/ln ft)	TSS (lbs/ln ft)
Default Removal Rate	0.075	0.068	44.88
Project Reductions (lbs)	30.00	27.20	17,952.00

STEP 2: ACRES DRAINING TO THE PROJECT

Drainage Area Type	Owner	Urban Impervious Acres	Urban Pervious Acres	Total Urban Acres	Forested Acres	
Regulated	Hanover County	0.00	0.00	0.00	0.00	
	VDOT ROW	0.00	0.00	0.00	0.00	
Unregulated	Hanover County	0.60	2.08	2.68	9.81	
	VDOT ROW	0.60	0.46	1.06	0.43	Total
			Total	3.74	10.24	14.0

STEP 3: REGULATED PROJECT CREDIT

	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Max. Regulated Reduction	0.00	0.00	0.00
Hanover County Portion	0.00	0.00	0.00
VDOT Portion (Baseline)	0.00	0.00	0.00

	Regulated	Unregulated	Forested
Land Type Ratios	0.00	0.27	0.73

STEP 4: FORESTED PROJECT CREDIT

	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Max. Forested Reduction	21.97	19.92	13,149.39
Hanover County Portion	21.97	19.92	13,149.39
VDOT Portion (No Credit)	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	0.60	0.20	92.00
Urban Pervious	0.40	0.04	6.40

STEP 5: UNREGULATED PROJECT CREDIT

	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)	
Max. Unregulated Reduction	8.03	7.28	4,802.61	= (Project Reduction * Unregulated Land Ratio)
Unregulated Baseline Reduction	1.74	0.34	126.66	
Hanover County Portion	6.29	6.94	4,675.95	= (Unregulated Project Reduction - Unregulated Baseline)

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

STEP 6: FINAL CREDIT PROJECT REDUCTIONS

	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Hanover Reductions	28.26	26.86	17,825.34

	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
VDOT Reductions	0.0	0.0	0.0

Appendix G – L-5 & Liberty Hall Hills Pond Enhancements

Overview

The L-5 Pond Enhancement Project is intended to retrofit an existing wet pond in Hanover County. The pond collects runoff from a 160 acre drainage area which consists of commercial properties located in the Hanover County Airpark. The pond discharges to a Trib. to Stony Run and ultimately the Chickahominy River. The enhancement includes the addition of aeration and installation of wetlands on 10% of the pond area.

The Liberty Hall Hills Pond Enhancement Project is intended to retrofit an existing wet pond in Hanover County. The pond collects runoff from a 100 acre drainage area which consists of a mixture of commercial and residential areas. The pond discharges to a Trib. to Beaverdam Creek and ultimately the Chickahominy River. The enhancement includes the addition of aeration and installation of wetlands on 10% of the pond area.

The pollution reduction calculation for these projects was done in accordance with Appendix V.D of the Chesapeake Bay TMDL Action Plan Guidance.

Project Removal Credit Summary (L-5 Pond)

	Phosphorus (lbs/yr)	**Nitrogen (lbs/yr)**	**Sediment (lbs/yr)**
Hanover	25	181	8,157
VDOT	0.22	1.11	142

Project Removal Credit Summary (Liberty Hall Hills Pond)

	Phosphorus (lbs/yr)	**Nitrogen (lbs/yr)**	**Sediment (lbs/yr)**
Hanover	17	129	7,027
VDOT	0.16	0.66	115

L-5 Pond

Liberty Hall Hills Pond

L-5 Pond BMP Enhancement

Project Summary

The L-5 Pond Enhancement Project is intended to retrofit an existing wet pond in Hanover County. The pond collects runoff from a 160 acre drainage area which consists of commercial properties located in the Hanover County Airpark. The pond discharges to a Trib. to Stony Run and ultimately the Chickahominy River, which are both impaired waterways in Hanover County. The project addresses both the Chesapeake Bay TMDL and Chickahominy Bacterial TMDL Action Plans in an effort to restore, protect, and prevent pollution to State waters.

The enhancement includes the addition of aeration and installation of wetlands on 10% of the pond area. The pollution reduction calculation for this project was done in accordance with Attachment A of the SLAF Program Guidelines and Appendix V.D of the Chesapeake Bay TMDL Action Plan Guidance.

Existing and Proposed BMP Efficiencies

The existing pond was not built to meet VA Stormwater BMP Clearinghouse specifications, so the accepted Bay Program efficiencies were chosen as a starting point. For Wet Ponds the accepted Bay Program removal efficiencies are:

TN	TP	TSS
20%	45%	60%

**A downward modification was applied to these initial efficiencies, as described below.*

For the proposed Wet Pond enhancement, the Bay Program Adjuster Curve efficiencies were chosen. The Bay Program Curves were chosen because the enhanced pond cannot meet all of the Clearinghouse standards for the Wet Pond Level 2. Using the process described in *Appendix V.B* (see below), the enhanced Wet Pond will be able to capture a runoff depth of 0.84" per impervious acre. Wet Ponds are a ST practice, therefore the ST adjuster curves were used to estimate the pollutant removal rates:

TN	TP	TSS
33%	52%	65%

Appendix V.B Calculation for the Chesapeake Bay Program Retrofit Curves

The estimated existing normal lake volume is 7.0 acre-ft.

$$RD = \frac{(RS)(12)}{IA} = \frac{(7.0)(12)}{99.53} = 0.84 \text{ in}$$

Where

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

The storage volume allows the pond to capture a runoff depth of 0.84" per impervious acre.

Existing BMP Efficiency Modification

The existing L-5 Pond is missing major design elements, so the BMP efficiency was modified in order to calculate the incremental rate. A downward modification of 10% was applied for each missing design criteria.

L-5 Pond Modification Table

BMP Type	BMP Location	Modification Type	Downward Modification Applied (%)
Wet Pond	37.6999, -77.4451	Missing Aquatic Bench	10
		Missing Forebay	10
		Total	20

The initial efficiencies of the Wet Pond (20%, 45%, and 60% for TN, TP, and TSS) were modified 20% downward which resulted in initial efficiencies of 16%, 36% and 48%. These downwardly modified efficiencies were used to calculate the incremental efficiencies applied to their POC loads.

Final Uplift Efficiencies

Taking the difference between the proposed Bay Program Adjuster Curve efficiencies and downwardly modified Bay Program efficiencies, uplift efficiencies for TN, TP, and TSS were determined for the project. The uplift efficiencies are as follows:

TN = 33% - 16% = 17%
TP = 52% - 36% = 16%
TSS = 65% - 48% = 17%

The attached L-5 Pond Enhancement spreadsheet shows how these efficiencies are applied to the pond's overall loading to determine the pollutants removed by this project.

L-5 Pond Enhancement

*Using GIS mapping Parcel Layer was using to determine ROW

		Total Acres	Regulated (Hanover)	Regulated (VDOT ROW)	Unregulated (Hanover)	Unregulated (VDOT ROW)	VDOT (Hanover)	VDOT (ROW)	Total Regulated Load	Baseline in ROW (VDOT)	Total Unregulated Load	Unregulated Baseline	Total VDOT Load	Baseline outside ROW	Baseline in ROW (VDOT)	
Nitrogen	Urban Imp Acres	99.52	68.64	5.98	23.41	1.49	0.00	0.00	700.68	4.78	233.81	19.92	0.00	0.00	0.00	
	Urban Perv Acres	35.42	23.82	4.39	6.48	0.73	0.00	0.00	197.19	1.76	50.40	2.88	0.00	0.00	0.00	
	Forest	24.12	16.86	0.00	7.26	0.00	0.00	0.00	39.79	-	17.13	-	0.00	-	-	
		159.06							937.66	6.54	301.34	22.80	0.00	0.00	0.00	Totals
Phophorus	Urban Imp	99.52	68.64	5.98	23.41	1.49	0	0	131.33	1.20	43.82	4.98	0.00	0.00	0.00	
	Urban Perv	35.42	23.82	4.39	6.48	0.73	0	0	14.11	0.18	3.61	0.29	0.00	0.00	0.00	
	Forest	24.12	16.86	0	7.26	0	0	0	2.19	-	0.94	-	0.00	-	-	
									147.63	1.37	48.37	5.27	0.00	0.00	0.00	Totals
Sediment	Urban Imp	99.52	68.64	5.98	23.41	1.49	0	0	50513.26	797.73	16855.81	3321.66	0.00	0.00	0.00	
	Urban Perv	35.42	23.82	4.39	6.48	0.73	0	0	2851.47	38.63	728.79	63.45	0.00	0.00	0.00	
	Forest	24.12	16.86	0	7.26	0	0	0	1304.63	-	561.78	-	0.00	-	-	
									54669.36	836.36	18146.37	3385.11	0.00	0.00	0.00	Totals

LOADING RATES - JAMES BASIN

	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS (lbs/ac/yr)
Urban Impervious	9.39	1.76	676.94
Urban Pervious	6.99	0.50	101.08
Forest	2.36	0.13	77.38

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

Downward Modification		TP	TN	TSS
Existing	20%	36%	16%	48%
Proposed	0%	52%	33%	65%
Difference (Uplift)		16%	17%	17%

* Missing forebay and wetlands

Adjuster Curve Eff.	
TP	52%
TN	33%
TSS	65%

Max. Eff.	Existing	Proposed
TP	45%	52%
TN	20%	33%
TSS	60%	65%

Ches. Bay Wet Pond	
TP	45%
TN	20%
TSS	60%

L-5 Plans

Imp. Area=	165 ac x 63
IA=	103.95
RS=	7
RD=	0.808081

Phosphorus

	Hanover	VDOT
Regulated Credit =	22.25	0.22
Unregulated Credit (incld. Baseline reduction) =	2.47	-
VDOT D.A. Credit =	0.00	0.00
Project Credit =	24.72	0.22

Nitrogen

	Hanover	VDOT
Regulated Credit =	152.86	1.11
Unregulated Credit (incld. Baseline reduction) =	28.42	-
VDOT D.A. Credit =	0.00	0.00
Project Credit =	181.29	1.11

Sediment

	Hanover	VDOT
Regulated Credit =	8457.43	142.18
Unregulated Credit (incld. Baseline reduction) =	0.00	-
VDOT D.A. Credit =	0.00	0.00
Project Credit =	8457.43	142.18

Liberty Hall Hills Pond BMP Enhancement

Project Summary

The Liberty Hall Hills Pond Enhancement Project is intended to retrofit an existing wet pond in Hanover County. The pond collects runoff from a 100 acre drainage area which consists of a mixture of commercial and residential areas. The pond discharges to a Trib. to Beaverdam Creek and ultimately the Chickahominy River, which are both impaired waterways in Hanover County. The project addresses both the Chesapeake Bay TMDL and Chickahominy Bacterial TMDL Action Plans in an effort to restore, protect, and prevent pollution to State waters.

The enhancement includes the addition of aeration and installation of wetlands on 10% of the pond area. The pollution reduction calculation for this project was done in accordance with Attachment A of the SLAF Program Guidelines and Appendix V.D of the Chesapeake Bay TMDL Action Plan Guidance.

Existing and Proposed BMP Efficiencies

The existing pond was not built to meet VA Stormwater BMP Clearinghouse specifications, so the accepted Bay Program efficiencies were chosen as a starting point. For Wet Ponds the accepted Bay Program removal efficiencies are:

TN	TP	TSS
20%	45%	60%

**A downward modification was applied to these initial efficiencies, as described below.*

For the proposed Wet Pond enhancement, the Bay Program Adjuster Curve efficiencies were chosen. The Bay Program Curves were chosen because the enhanced pond cannot meet all of the Clearinghouse standards for the Wet Pond Level 2. Using the process described in *Appendix V.B* (see below), the enhanced Wet Pond will be able to capture a runoff depth of 1.72" per impervious acre. Wet Ponds are a ST practice, therefore the ST adjuster curves were used to estimate the pollutant removal rates:

TN	TP	TSS
39%	61%	78%

Appendix V.B Calculation for the Chesapeake Bay Program Retrofit Curves

The estimated existing normal lake volume is 3.9 acre-ft.

$$RD = \frac{(RS)(12)}{IA} = \frac{(3.9)(12)}{27.22} = 1.72 \text{ in}$$

Where

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

The storage volume allows the pond to capture a runoff depth of 1.72" per impervious acre.

Existing BMP Efficiency Modification

The existing Liberty Hall Hills Pond is missing major design elements, so the BMP efficiency was modified in order to calculate the incremental rate. A downward modification of 10% was applied for each missing design criteria.

Liberty Hall Hills Pond Modification Table

BMP Type	BMP Location	Modification Type	Downward Modification Applied (%)
Wet Pond	37.6158, -77.3147	Missing Aquatic Bench	10
		Missing Forebay	10
		Total	20

The initial efficiencies of the Wet Pond (20%, 45%, and 60% for TN, TP, and TSS) were modified 20% downward which resulted in initial efficiencies of 16%, 36% and 48%. These downwardly modified efficiencies were used to calculate the incremental efficiencies applied to their POC loads.

Final Uplift Efficiencies

Taking the difference between the proposed Bay Program Adjuster Curve efficiencies and downwardly modified Bay Program efficiencies, uplift efficiencies for TN, TP, and TSS were determined for the project. The uplift efficiencies are as follows:

TN = 39% - 16% = 23%
TP = 61% - 36% = 25%
TSS = 78% - 48% = 30%

The attached Liberty Hall Hills Pond Enhancement spreadsheet shows how these efficiencies are applied to the pond's overall loading to determine the pollutants removed by this project.

Liberty Hall B-15AA Pond Enhancement

*Using GIS mapping Parcel Layer was using to determine ROW

		Total Acres	Regulated (Hanover)	Regulated (VDOT ROW)	Unregulated (Hanover)	Unregulated (VDOT ROW)	VDOT (Hanover)	VDOT (ROW)	Total Regulated Load	Baseline in ROW (VDOT)	Total Unregulated Load	Unregulated Baseline	Total VDOT Load	Baseline outside ROW	Baseline in ROW (VDOT)	
Nitrogen	Urban Imp Acres	27.22	24.18	2.76	0.28	0.00	0.00	0.00	252.97	2.21	2.63	0.22	0.00	0.00	0.00	
	Urban Perv Acres	32.22	29.31	1.70	1.21	0.00	0.00	0.00	216.76	0.68	8.46	0.48	0.00	0.00	0.00	
	Forest	41.08	36.41	0.86	3.81	0.00	0.00	0.00	87.96	-	8.99	-	0.00	-	-	
		100.52							557.68	2.89	20.08	0.71	0.00	0.00	0.00	Totals
Phophorus	Urban Imp	27.22	24.18	2.76	0.28	0	0	0	47.41	0.55	0.49	0.06	0.00	0.00	0.00	
	Urban Perv	32.22	29.31	1.7	1.21	0	0	0	15.51	0.07	0.61	0.05	0.00	0.00	0.00	
	Forest	41.08	36.41	0.86	3.81	0	0	0	4.85	-	0.50	-	0.00	-	-	
									67.76	0.62	1.59	0.10	0.00	0.00	0.00	Totals
Sediment	Urban Imp	27.22	24.18	2.76	0.28	0	0	0	18236.76	368.18	189.54	37.35	0.00	0.00	0.00	
	Urban Perv	32.22	29.31	1.7	1.21	0	0	0	3134.49	14.96	122.31	10.65	0.00	0.00	0.00	
	Forest	41.08	36.41	0.86	3.81	0	0	0	2883.95	-	294.82	-	0.00	-	-	
									24255.21	383.14	606.67	48.00	0.00	0.00	0.00	Totals

LOADING RATES - JAMES BASIN

	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS (lbs/ac/yr)
Urban Impervious	9.39	1.76	676.94
Urban Pervious	6.99	0.50	101.08
Forest	2.36	0.13	77.38

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

Downward Modification		TP	TN	TSS
Existing	20%	36%	16%	48%
Proposed	0%	61%	39%	78%
Difference (Uplift)		25%	23%	30%

Adjuster Curve Eff.	
TP	61%
TN	39%
TSS	78%

Max. Eff.	Existing	Proposed
TP	45%	61%
TN	20%	39%
TSS	60%	78%

Ches. Bay Wet Pond	
TP	45%
TN	20%
TSS	60%

Phosphorus

	Hanover	VDOT
Regulated Credit =	16.32	0.16
Unregulated Credit (incld. Baseline reduction) =	0.29	-
VDOT D.A. Credit =	0.00	0.00
Project Credit =	16.62	0.16

Nitrogen

	Hanover	VDOT
Regulated Credit =	125.38	0.66
Unregulated Credit (incld. Baseline reduction) =	3.91	-
VDOT D.A. Credit =	0.00	0.00
Project Credit =	129.29	0.66

Sediment

	Hanover	VDOT
Regulated Credit =	6893.42	114.94
Unregulated Credit (incld. Baseline reduction) =	134.00	-
VDOT D.A. Credit =	0.00	0.00
Project Credit =	7027.42	114.94

Appendix H – High Point Farms & Locust Hill Constructed Wetlands

Overview

The High Point Farms Constructed Wetland Project converted an existing dry detention basin into a Constructed Wetland Level 1. This project is located in a residential subdivision in Hanover County's High Point Farms Subdivision. The pond collects runoff from a 59.4 acre drainage area. The wetland ultimately discharges to Beaverdam Creek and the Chickahominy River, which are both impaired waterways in Hanover County. The conversion included installation of all design elements necessary to achievement a level 1 constructed wetland per the VA BMP Clearinghouse.

The Locust Hill Constructed Wetland Project converted an existing dry detention basin into a Constructed Wetland Level 1. This project is located in a residential subdivision in Hanover County's Locust Hill Subdivision. The pond collects runoff from a 78.5 acre drainage area. The wetland ultimately discharges to Beaverdam Creek and the Chickahominy River, which are both impaired waterways in Hanover County. The conversion included installation of all design elements necessary to achievement a level 1 constructed wetland per the VA BMP Clearinghouse.

The pollution reduction calculation for these projects was done in accordance with Appendix V.D of the Chesapeake Bay TMDL Action Plan Guidance.

Existing and Proposed BMP Efficiencies

The existing basins were not built to meet VA Stormwater BMP Clearinghouse specifications, so the accepted Bay Program established efficiencies were chosen as a starting point. For Dry Detention the accepted Bay Program removal efficiencies are:

TN	TP	TSS
5%	10%	10%

For the proposed Level 1 wetland enhancement, the VA Stormwater BMP Clearinghouse established efficiencies were used for TN and TP. The Bay Program established efficiency for TSS was chosen to estimate the pollutant removal rates:

TN	TP	TSS
25%	50%	60%

Final Uplift Efficiencies

Taking the difference between the existing and proposed efficiencies, the uplift efficiencies for TN, TP, and TSS were determined for the projects. The uplift efficiencies are as follows:

TN = 25% - 5% = 20%

TP = 50% - 10% = 40%

TSS = 60% - 10% = 50%

Project Removal Credit Summary (High Point Farms)

	Phosphorus (lbs/yr)	**Nitrogen (lbs/yr)**	**Sediment (lbs/yr)**
Hanover	16	72	5,937
VDOT	0.46	1.13	347

Project Removal Credit Summary (Locust Hill)

	Phosphorus (lbs/yr)	**Nitrogen (lbs/yr)**	**Sediment (lbs/yr)**
Hanover	17	78	6,851
VDOT	0.51	1.20	386

High Point Farms

Locust Hill

Level 1 Treatment Wetland Design

1. Required Treatment Volume		
DA	**59.4**	acre
Rv	**0.33**	
Tv=	71,155	cu-ft
Required Volume	71,155	cu-ft
2. Proposed Open Water Volume		
Fraction Wet Vol	0.3	
Open Water volume	21,346.58	
Wet Depth	3	
Wet Surface Area	7,116	sf
Forbay	4,269	sf
3. High Marsh Volume Estimate		
Volume	49,809	cf
ED Depth	0.75	ft
High Marsh Depth (Wet)	0.50	ft
Total Depth	1.25	ft
Wet Surface Area	39,847	sf

Hydrology Summary

Drainage Area	63 acre
Curve Number	65
Time of Concentration	30 min

	Flow			Elevation		
	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)	2-yr	10-yr	100-yr
Runoff	23.8	89.8	166.3			
Existing Routed	21.2	62	102.5	155.5	158.25	160.5
Proposed Routed	8.1	59	102	156.7	158.37	160.57

Parameter	Goal	Requirement	Provided	Comments
Treatment Volume 1" (cu-ft)	1"	71,155	75,881	
Single Cell w Forebay		Yes	Yes	
forebay Volume (cu-ft)	>15%	10,673	17,975	
Extended Detention max (in)	12"	<=12"	12"	
Length to width	>2:1	>2:1	2.1 +/-	Lt=332 w=160
Shortest flow Path	0.5	0.5	0.86	Lt=332 Ls= 287
Forebay max depth (ft)	4	4	3.5	
Deep Pools	at least 3	3	3	
Deep Pools (cuft)	Approximately 25%	17,789	22873 (30%)	
High Marsh (sf)	Approximately 70%	23,418	23147 (70%)	
Microtoprgraphy	Required for Level 2	NA	NA	
2-yr Outflow (cfs)	Existing Rate	21.2	8.1	
10-yr Outflow (cfs)	Existing Rate	62	59	
10-yr Elevation	Existing Elevation	158.25	158.37	
100-yr Elevation	Existing Elevation	160.5	160.57	

Lt=total length with berms
w= average width
Ls= shortest length for concentrated flow

The contractor shall exercise extreme care when working around and overtop of the sewer main to prevent damage. Add an additional note requiring the contractor to provide a minimum 2 weeks prior notice to any construction activity over the sewer main to allow Hanover County DPU sufficient time to perform a pre-construction CCTV inspection of the sewer main. DPU will also perform a post-construction CCTV inspection of the sewer main, and any damage resulting from this construction will be the contractor's responsibility to repair. Further, DPU requests that we be invited and present at the pre-construction conference for this project to discuss work around the sewer main.

WATERSHED CONSULTING, PLLC.
P.O. Box 7216
Richmond, VA 23221
(804) 304-4659
www.watershedva.com

HIGH POINT FARMS

BMP PLAN

HANOVER COUNTY, VIRGINIA

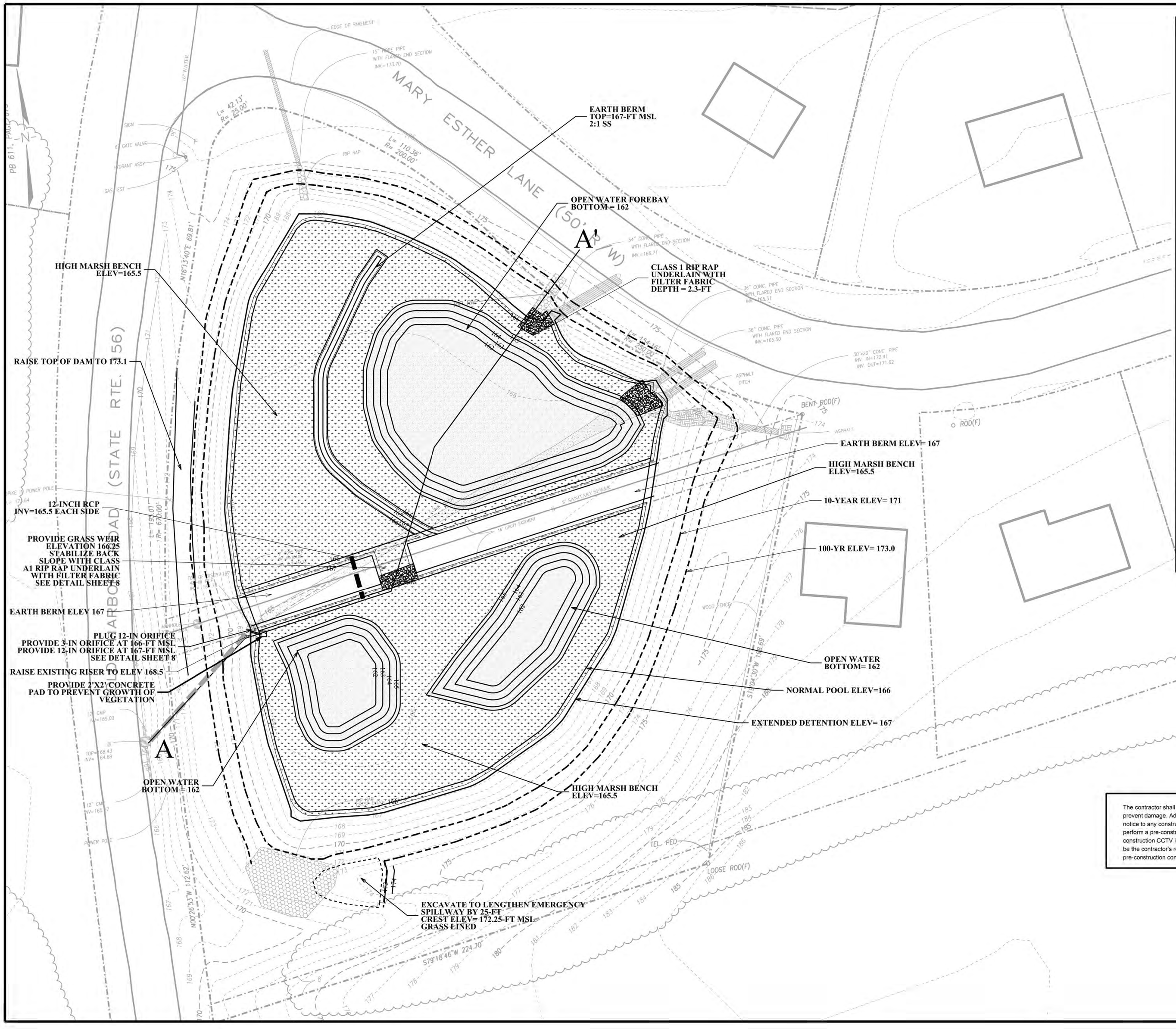
COMMONWEALTH OF VIRGINIA
Erik Leon Allen
Lic. No. 024783
12/6/17
PROFESSIONAL ENGINEER

PROJECT MANAGER:	EA
DESIGNED:	EA
DRAWN:	BF
DESIGN FILE:	file name
DATE:	9/18/17

REVISIONS:
11/10/17 PER COUNTY COMMENTS
12/6/17 PER COUNTY COMMENTS

E&S PLAN 5369
BP#17-09900050

SHEET 4



Level 1 Treatment Wetland Design

1. Required Treatment Volume		
DA	**78.5**	acre
Rv	**0.27**	
Tv=	76,938	cu-ft
Required Volume	76,938	cu-ft
2. Proposed Wet Volume		
Fraction Wet Vol	0.3	
Wet volume	23,081.36	
Wet Depth	3	
Wet Surface Area	7,694	sf
Forbay	4,616	sf
3. High Marsh Volume Estimate		
Volume	53,856	cf
ED Depth	1.00	ft
High Marsh Depth	0.50	ft
Total Depth	1.50	ft
Wet Surface Area	35,904	sf

Hydrology Summary

Drainage Area	78	acre
Curve Number	65	
Time of Concentration	62	min

	Flow			Elevation		
	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)	2-yr	10-yr	100-yr
Runoff	19	73	137			
Existing Routed	5.2	33.1	103	167.72	170.68	173.21
Proposed Routed	4.0	34	112	168.41	170.96	173.01

Parameter	Goal	Goal	Provided	Comment
Treatment Volume 1" (cuft)	1"	76,983	77,116	
Single Cell w Forebay	Single w forebay	Single w forebay	Single w forebay	
forebay Volume (cu-ft)	>15% total Volume	11,567	20,000	
Extended Detention max (in)	</=12"	</=12"	12"	
Length to width	>2:1	>2:1	2 to 1	L1= 406 W= 195
Shortest flow Path	0.5	0.5	0.64	L1=406 Lo=260
Forebay max depth (ft)	4	4	3.5	
Deep Pools	at least 3	3	3	
Deep Pools (cuft)	Approximately 25%	19,279	30,847 (40%)	
High Marsh (sf)	Approximately 70%	22,400	19,558 (61%)	
Microtoprgraphy	Required for Level 2	NA	NA	
2-yr Outflow (cfs)	Q2	5.2	4.0	
10-yr Outflow (cfs)	Q10	33.1	34.0	
	10-yr Elev	170.68	170.96	
100-yr Elevation	100-yr Elev	173.21	173.01	

L= flow path with berms
W= average width of basin
Lo= shortest flow plath from an outlet

The proposed project results in a decrease in 1-year and 2-year peak discharge rates. A 1-cfs increase in in the 10-year and a 9-cfs increase in the 100-year peak flow rates are required to provide attenuation of the smaller storms and prevent overtopping of the dam. These increases in peak flow rates are considered insignificant.

The contractor shall exercise extreme care when working around and overtop of the sewer main to prevent damage. Add an additional note requiring the contractor to provide a minimum 2 weeks prior notice to any construction activity over the sewer main to allow Hanover County DPU sufficient time to perform a pre-construction CCTV inspection of the sewer main. DPU will also perform a post-construction CCTV inspection of the sewer main, and any damage resulting from this construction will be the contractor's responsibility to repair. Further, DPU requests that we be invited and present at the pre-construction conference for this project to discuss work around the sewer main.

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LOCUST HILL BASIN

BMP PLAN

HANOVER COUNTY, VIRGINIA

COMMONWEALTH OF VIRGINIA
Erik Leon Allen
Lic. No. 024783
12/6/17
PROFESSIONAL ENGINEER

PROJECT MANAGER:	EA
DESIGNED:	EA
DRAWN:	BF
DESIGN FILE:	file name
DATE:	#/#/#

REVISIONS:
11/10/17 COUNTY COMMENTS
12/6/17 COUNTY COMMENTS

E&S PLAN #5370
HTE#18-09900051

SHEET 4

High Point Farms Constructed Wetland Level 1

*Using GIS mapping Parcel Layer was using to determine ROW

		Total Acres	Regulated (Hanover)	Regulated (VDOT ROW)	Unregulated (Hanover)	Unregulated (VDOT ROW)	VDOT (Hanover)	VDOT (ROW)	Total Regulated Load	Baseline in ROW (VDOT)	Total Unregulated Load	Unregulated Baseline	Total VDOT Load	Baseline outside ROW	Baseline in ROW (VDOT)	
Nitrogen	Urban Imp Acres	13.34	7.96	4.92	0.46	0.00	0.00	0.00	120.94	3.94	4.32	0.37	0.00	0.00	0.00	
	Urban Perv Acres	35.21	28.36	4.25	2.60	0.00	0.00	0.00	227.94	1.70	18.17	1.04	0.00	0.00	0.00	
	Forest	10.85	10.05	0.00	0.80	0.00	0.00	0.00	23.72	-	1.89	-	0.00	-	-	
		59.40							372.61	5.64	24.38	1.41	0.00	0.00	0.00	Totals
Phophorus	Urban Imp	13.34	7.96	4.92	0.46	0	0	0	22.67	0.98	0.81	0.09	0.00	0.00	0.00	
	Urban Perv	35.21	28.36	4.25	2.6	0	0	0	16.31	0.17	1.30	0.10	0.00	0.00	0.00	
	Forest	10.85	10.05	0	0.8	0	0	0	1.31	-	0.10	-	0.00	-	-	
									40.28	1.15	2.21	0.20	0.00	0.00	0.00	Totals
Sediment	Urban Imp	13.34	7.96	4.92	0.46	0	0	0	8718.99	656.33	311.39	61.36	0.00	0.00	0.00	
	Urban Perv	35.21	28.36	4.25	2.6	0	0	0	3296.22	37.40	262.81	22.88	0.00	0.00	0.00	
	Forest	10.85	10.05	0	0.8	0	0	0	777.67	-	61.90	-	0.00	-	-	
									12792.88	693.73	636.10	84.24	0.00	0.00	0.00	Totals

LOADING RATES - JAMES BASIN

	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS (lbs/ac/yr)
Urban Impervious	9.39	1.76	676.94
Urban Pervious	6.99	0.50	101.08
Forest	2.36	0.13	77.38

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

Downward Modification		TP	TN	TSS
Existing	0%	10%	5%	10%
Proposed	0%	50%	25%	60%
Difference (Uplift)		40%	20%	50%

Wetland Level 1	
TP	50%
TN	25%
TSS	60%

Max. Eff.	Existing	Proposed
TP	10%	50%
TN	5%	25%
TSS	10%	60%

Ches. Bay Dry Detention	
TP	10%
TN	5%
TSS	10%

Phosphorus

	Hanover	VDOT
Regulated Credit =	14.96	0.46
Unregulated Credit (incld. Baseline reduction) =	0.69	-
VDOT D.A. Credit =	0.00	0.00
Project Credit =	15.65	0.46

Nitrogen

	Hanover	VDOT
Regulated Credit =	68.89	1.13
Unregulated Credit (incld. Baseline reduction) =	3.47	-
VDOT D.A. Credit =	0.00	0.00
Project Credit =	72.35	1.13

Sediment

	Hanover	VDOT
Regulated Credit =	5702.71	346.86
Unregulated Credit (incld. Baseline reduction) =	233.81	-
VDOT D.A. Credit =	0.00	0.00
Project Credit =	5936.52	346.86

Locust Hill Constructed Wetland Level 1

*Using GIS mapping Parcel Layer was using to determine ROW

		Total Acres	Regulated (Hanover)	Regulated (VDOT ROW)	Unregulated (Hanover)	Unregulated (VDOT ROW)	VDOT (Hanover)	VDOT (ROW)	Total Regulated Load	Baseline in ROW (VDOT)	Total Unregulated Load	Unregulated Baseline	Total VDOT Load	Baseline outside ROW	Baseline in ROW (VDOT)	
Nitrogen	Urban Imp Acres	14.85	9.27	5.52	0.06	0.00	0.00	0.00	138.88	4.42	0.56	0.05	0.00	0.00	0.00	
	Urban Perv Acres	32.23	26.34	3.98	1.91	0.00	0.00	0.00	211.94	1.59	13.35	0.76	0.00	0.00	0.00	
	Forest	25.63	23.26	1.22	1.15	0.00	0.00	0.00	57.77	-	2.71	-	0.00	-	-	
		72.71							408.59	6.01	16.63	0.81	0.00	0.00	0.00	Totals
Phophorus	Urban Imp	14.85	9.27	5.52	0.06	0	0	0	26.03	1.10	0.11	0.01	0.00	0.00	0.00	
	Urban Perv	32.23	26.34	3.98	1.91	0	0	0	15.16	0.16	0.96	0.08	0.00	0.00	0.00	
	Forest	25.63	23.26	1.22	1.15	0	0	0	3.18	-	0.15	-	0.00	-	-	
									44.37	1.26	1.21	0.09	0.00	0.00	0.00	Totals
Sediment	Urban Imp	14.85	9.27	5.52	0.06	0	0	0	10011.94	736.37	40.62	8.00	0.00	0.00	0.00	
	Urban Perv	32.23	26.34	3.98	1.91	0	0	0	3064.75	35.02	193.06	16.81	0.00	0.00	0.00	
	Forest	25.63	23.26	1.22	1.15	0	0	0	1894.26	-	88.99	-	0.00	-	-	
									14970.95	771.39	322.67	24.81	0.00	0.00	0.00	Totals

LOADING RATES - JAMES BASIN

	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS (lbs/ac/yr)
Urban Impervious	9.39	1.76	676.94
Urban Pervious	6.99	0.50	101.08
Forest	2.36	0.13	77.38

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

Downward Modification		TP	TN	TSS
Existing	0%	10%	5%	10%
Proposed	0%	50%	25%	60%
Difference (Uplift)		40%	20%	50%

Wetland Level 1	
TP	50%
TN	25%
TSS	60%

Max. Eff.	Existing	Proposed
TP	10%	50%
TN	5%	25%
TSS	10%	60%

Ches. Bay Dry Detention	
TP	10%
TN	5%
TSS	10%

Phosphorus

	Hanover	VDOT
Regulated Credit =	16.49	0.51
Unregulated Credit (incld. Baseline reduction) =	0.40	-
VDOT D.A. Credit =	0.00	0.00
Project Credit =	16.88	0.51

Nitrogen

	Hanover	VDOT
Regulated Credit =	75.71	1.20
Unregulated Credit (incld. Baseline reduction) =	2.51	-
VDOT D.A. Credit =	0.00	0.00
Project Credit =	78.22	1.20

Sediment

	Hanover	VDOT
Regulated Credit =	6714.08	385.70
Unregulated Credit (incld. Baseline reduction) =	136.52	-
VDOT D.A. Credit =	0.00	0.00
Project Credit =	6850.60	385.70

Appendix I – Public Hearing Documents

X.

Agenda Item

County of Hanover
Board Meeting: April 25, 2018

Subject: Public Hearing – Department of Public Works, Virginia Stormwater Management Program – General Permit Registration Statement 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 (MS-4). To meet these requirements, Hanover County is eligible to file a registration statement for coverage under a general permit by June 2018. The general permit registration statement will include State stormwater management requirements mandated by Section 402 of the Federal Clean Water Act (without state or federal funding). This requirement is intended to reduce to the "maximum extent practical" sources of pollution runoff from land use such as residential and commercial developments, vehicles, equipment and urban nonpoint sources of pollution. Since Hanover owns and operates a number of stormwater systems throughout the county we are required to develop, implement, and enforce a stormwater management program designed to reduce the discharge of pollutants from the storm system to the maximum extent practicable, to protect water quality, and to satisfy the water quality requirement of the Clean Water Act and associated State Law. The VSMP regulations require Hanover to develop programs and fully implement the measures covering 6 primary areas. These six areas pertain to minimum control measures for: (1) Public education and outreach on stormwater impacts; (2) Public notice requirements; (3) Illicit discharge detection and elimination; (4) Construction site stormwater runoff control; (5) Post-construction stormwater management in new development and redevelopment; (6) Pollution prevention / good housekeeping for municipal operations. This is the forth, 5 year permit for Hanover County. As drafted, the new regulation governing this permit has substantial requirements which include increased record keeping and planning requirements and mandates to address Total Maximum Daily Loads (TMDLs) particularly special provisions for the Chesapeake Bay. The Staff will present a general permit registration statement that covers the MS-4 Area and addresses the 6 major areas. A summary of the major new requirements is attached. The hearing allows the public to comment on the County's proposed general permit registration statement.

County Administrator's Recommended Board Motion: Motion to authorize the County Administrator to take all actions necessary to file the Virginia Stormwater Management Program renewal registration statement regarding MS-4 Phase II General Permit.