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OLD DOMINION UNIVERSITY

IDEA FUSION

CHESAPEAKE BAY TMDL ACTION PLAN

June 30, 2018

vhb

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Acknowledgements

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Old Dominion University

Doug Alexander – Director of Environmental Health and Safety

Dale J. Feltes – Director of Design & Construction

David W. Robichaud – Assistant Director of Design & Construction

Jean Kennedy-Sleeman – Design & Construction

Virginia Department of Environmental Quality

Jeffery Selengut – Environmental Specialist II

Planning Team

Vanasse Hangen Brustlin, Inc.
Two Columbus Center
4500 Main Street, Suite 400
Virginia Beach VA 23462
www.vhb.com

John M. Stronach, P.E. – Principal,
ODU Class of 1993 & 1999

John D. Hines, P.E. – Project Manager,
ODU Class of 2000

Erika M. Walsh, PE. – Senior Project Engineer,
ODU Class of 2015

Evan N, Waagen, PE. – Site/Civil Designer,
ODU Class of 2013 & 2017

Noel O'Neil – Lead Designer/Graphics

Karen Bagnell – Site/Civil Designer,
ODU Class of 2016

Tom Luehman – Site/Civil Designer,
ODU Class of 2017

List of Abbreviations

Title	Abbreviation
Bureau of Capital Outlay Management	BCOM
Best Management Practice	BMP
Chesapeake Bay Local Assistance Department	CBLAD
Chesapeake Bay Preservation Act	CBPA
Capital Improvement Project	CIP
Virginia Department of Conservation and Recreation	DCR
Virginia Department of Environmental Quality	DEQ
Department of General Services	DGS
Edge of Stream	EOS
Environmental Protection Agency	EPA
Intensely Developed Area	IDA
Leadership in Energy and Environmental Design	LEED
Low Impact Design	LID
Minimum Control Measure	MCM
Minimum Standard	MS
Municipal Separate Storm Sewer Systems	MS4
National Pollution Discharge Elimination System	NPDES
Norfolk Stormwater Master Plan	NSWMP
Old Dominion University	ODU
Pollutant of Concern	POC
Resource Protection Area	RPA
Stormwater Improvement Project	SIP
Stormwater Management	SWM
Stormwater Management Masterplan	SWMP
Stormwater Pollution Prevention Plan	SWPPP
Total Maximum Daily Load	TMDL
Total Nitrogen	TN
Total Phosphorus	TP
Total Suspended Solids	TSS
Vanasse Hangen Brustlin	VHB
Virginia Erosion and Sediment Control Program	VESCP
Virginia Pollution Discharge Elimination System	VPDES
Virginia Stormwater Management Handbook	VSMH
Virginia Stormwater Management Program	VSMP
Watershed Implementation Plan	WIP

1. Introduction

Purpose

This Chesapeake Bay Total Maximum Daily Load (TMDL) Action Plan was written to describe the means and methods by which Old Dominion University (ODU) intends to meet the Special Condition for the Chesapeake Bay TMDL. This Special Condition is located in the General Permit for Discharges of Stormwater from Small Municipal Separate Storm Sewer Systems which was effective as of July 1, 2013, and states that Small Municipal Separate Storm Sewer Systems (MS4) must create a TMDL Action Plan and submit the plan to the Virginia Department of Environmental Quality (DEQ).

The University's MS4 permit (VAR040078) requires action plans to be implemented for the impaired bodies of water to which ODU discharges stormwater runoff. The ultimate discharge point for ODU is the Chesapeake Bay. Approximately half of the campus drains to the Elizabeth River, the other half drains to the Lafayette River. A TMDL is assigned to determine a waste load allocation to the University that establishes the maximum amount of pollutant that can enter an impaired water without violating water quality standards.

The TMDL for the Chesapeake Bay was established by the EPA in 2010 and targets specific Pollutants of Concern (POCs). POCs included in the TMDL are total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS). Virginia developed a Chesapeake Bay TMDL Watershed Implementation Plan (WIP) that implements an outline for meeting the Chesapeake Bay TMDL. The WIP requires a phased approach over three five-year permit cycles for meeting required POC reductions in order to meet the final TMDL target goal. The reductions include:

- 5% first permit cycle reduction, which will be met at the end of the first permit cycle (June 30, 2018)
- 35% second permit cycle reduction, which will need to be accomplished by the end of the second permit cycle (June 30, 2023)
- 60% third permit cycle reduction which will need to be accomplished by the end of the third permit cycle (June 30, 2028). The total reduction thus is 100% of the TMDL requirement.

Reductions are applied to 2009 Edge of Stream (EOS) loading rates for each POC as defined by the Chesapeake Bay Program Watershed Model Phase 5.3.2 for the James River Basin. A target reduction percent in the 2009 EOS loading rates must be met in order meet the TMDL target goal at the end of the third permit cycle. The reduction target percent is defined for each POC by the Chesapeake Bay WIP. Target reduction percentages are further broken into two categories for impervious and pervious cover. Impervious areas must show a reduction of 9.0% for nitrogen loads, 16% for phosphorous loads, and 20% for total sediment loads. Pervious areas must show a reduction of 6.0% for nitrogen, 7.25% for phosphorous, and 8.75% for total sediment loads.

This plan establishes how ODU intends to meet the 35% and 60% reduction requirements by the end of the second and third permit cycles to stay in compliance with their MS4 Permit and the Chesapeake Bay TMDL Special Condition Guidance developed by DEQ. This report follows the order specified in Guidance Memo No. 15-2005 set forth by DEQ and dated May 18, 2015.
The following elements are included within this Action Plan:

1. Current Program and Existing Legal Authority
2. New or Modified Legal Authority
3. Means and Methods to Address Discharges from New Sources
4. Estimated Existing Source Loads and Calculated Total Pollutant of Concern Required Reductions
5. Means and Methods to Meet the Required Reductions and Schedule
6. Means and Methods to Offset Increased Loads From New Sources Initiating Construction Between July 1, 2009 and June 30, 2014
7. Means and Methods to Offset Increased Loads from Grandfathered Projects that Begin Construction After July 1, 2014
8. List of Future Projects and Associated Acreage that Qualify as Grandfathered
9. An Estimate of the Expected Cost to Implement the Necessary Reductions
10. Public Comments on Draft Action Plan

MS4 Permit Compliance

Table 1 of this report provides the requirements of ODU's MS4 permit and the specific section of this report where the requirement is met by ODU's MS4 Program Plan. Additionally, *Table 1* also describes actions ODU has taken to meet the requirements specified by the MS4 permit.

Table 1: MS4 Permit Compliance

ODU TDML Action Plan Section	Element from DEQ TMDL Special Condition Guidance	MS4 General Permit Section	MS4 Permit Requirement
2	Part VI.1 - Current Program and Existing Legal Authority	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
2	Part VI.2 - New or Modified Legal Authority	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

3	Part VI.3 - Means and Methods to Address Discharges from New Sources	I.C.2.a(3)	The means and methods that will be utilized to address discharges into the MS4 from new sources
4	Part VI.4 - Estimated Existing Source Loads and Calculated Total Pollutants of Concern (POC) Required Reductions	I.C.2.a(4) and 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 versions of Tables 2 a-d 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. A determination of the total pollutant load reductions necessary to reduce the annual POC loads from existing sources utilizing the applicable versions of Tables 3 a-d in this section based on the river basin to which the MS4 discharges. This shall be calculated by multiplying the total existing acres served by the MS4 by the corresponding permit cycle required reduction in loading rate. For the purposes of this determination, the operator shall utilize those existing acres identified by the 2000 U.S. Census Bureau urbanized area and served by the MS4
5	Part VI.5 - Means and Methods to Meet the Required Reductions and Schedule	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

6	Part VI.6 - Means and Methods to Offset Increased Loads from New Sources Initiating Construction between July 1, 2009 and June 30, 2014	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 Table 4 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.
7	Part VI.7 - Means and Methods to Offset Increased Loads from Grandfathered Projects that Begin Construction after July 1, 2014	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 to develop the equivalent pollutant load for nitrogen and total suspended solids
8	Part VI.8 - List of Future Projects and Associated Acreage that Qualify as Grandathered	I.C.2.a(10)	A list of future projects and associated acreage that qualify as grandfathered in accordance with 9VAC25-870-48;
9	Part VI.9 - Estimated Expected Cost to Implement Necessary Reductions	I.C.2.a(11)	An estimate of the expected costs to implement the requirements of this special condition during the state permit cycle
10	Part VI.10.a&b - Public Comments on Draft Action Plan	I.C.2.a(12)	An opportunity for receipt and consideration of public comment regarding the draft Chesapeake Bay TMDL Action Plan.

Summary

In accordance with the MS4 Permit, the University must calculate required permit cycle reductions and offsets for the following:

- Existing sources as of June 30, 2009
- Sources beginning construction between July 1, 2009 and June 30, 2014,
- Grandfathered sources beginning construction after July 1, 2014

Existing best management practices (BMPs) that were constructed simultaneously with pollutant sources provide offset for the required first permit cycle reductions. BMPs that are outlined in the 2018 ODU Stormwater Master Plan, if implemented, will provide pollutant offset for the required second and third permit cycle reductions. Total POC Load Reductions required by the permit cycles and associated offsets can be found in *Table 2A* through *Table 2C* of this report. Calculations to determine load reductions can be found in *Table 3A* through *Table 3C* of this report. A breakdown of total phosphorus removal provided by the existing BMPs can be found in *Appendix B*.

Table 2A: Summary of Required and Achieved Reductions – First Permit Cycle

Pollutant of Concern	2009 POC Load (lbs/yr)	MS4 Target POC Load (lbs/yr)	First Permit Cycle Required Reduction in Loading Rate (lbs/acre/yr)	Total POC Load Reduction Required by First Permit Cycle (lbs/yr)	First Permit Cycle POC Load Reduction Achieved (lbs/yr)	First Permit Cycle POC Load Surplus (lbs/yr)
Nitrogen	1462.61	1345.52	0.063	**5.85**	**6.47**	**0.62**
Phosphorus	217.92	186.09	0.016	**1.59**	**4.35**	**2.76**
Total Suspended Solids	77484.40	62776.71	7.212	**735.38**	**750.90**	**15.52**

Table 2B: Summary of Required and Achieved Reductions – Second Permit Cycle*

Pollutant of Concern	2009 POC Load (lbs/yr)	MS4 Target POC Load (lbs/yr)	Second Permit Cycle Required Reduction in Loading Rate (lbs/acre/yr)	Total POC Load Reduction Required by Second Permit Cycle (lbs/yr)	Second Permit Cycle POC Load Reduction Achieved (lbs/yr)	First Permit Cycle POC Load Surplus (lbs/yr)	Second Permit Cycle POC Load Surplus (lbs/yr)
Nitrogen	1462.61	1345.52	0.443	**40.97**	**174.23**	**0.62**	**133.88**
Phosphorus	217.92	186.09	0.111	**11.14**	**60.61**	**2.76**	**52.24**
Total Suspended Solids	77484.40	62776.71	50.481	**5147.69**	**202707.98**	**15.52**	**197575.81**

Table 2C: Summary of Required and Achieved Reductions – Third Permit Cycle*

Pollutant of Concern	2009 POC Load (lbs/yr)	MS4 Target POC Load (lbs/yr)	Third Permit Cycle Required Reduction in Loading Rate (lbs/acre/yr)	Total POC Load Reduction Required by Third Permit Cycle (lbs/yr)	Third Permit Cycle POC Load Reduction Achieved (lbs/yr)	Second Permit Cycle POC Load Surplus (lbs/yr)	Third Permit Cycle POC Load Surplus (lbs/yr)
Nitrogen	1462.61	1345.52	0.759	**70.24**	**0.00**	**133.88**	**63.64**
Phosphorus	217.92	186.09	0.191	**19.09**	**0.00**	**52.24**	**33.15**
Total Suspended Solids	77484.40	62776.71	86.540	**8824.61**	**0.00**	**197575.81**	**188751.20**

*Note: Second and Third permit cycles are based upon the assumption that all BMPs listed are constructed or offset nutrient credits are purchased. 2028 permit cycle load reductions are met with surplus POC reductions from the 2018 and 2023 permit cycles or additional nutrient credits must be purchased.

2. Current Program and Legal Authority

Current Program and Existing Legal Authority

As an operator of an MS4, Old Dominion University must develop, implement, and enforce an MS4 Program Plan as stated in Phase II MS4 regulations. ODU has created an MS4 Program Plan that is continually updated and monitored to ensure ODU meets MS4 regulations. This MS4 Program Plan ensures the ODU is acting in the most effective manner to reduce pollutant discharge, protect water quality, and ensure compliance with water quality standards. Additionally, the MS4 Program Plan ensures that ODU is adhering to the Clean Water Act, the MS4 permit regulations, and other associated regulations.

The ODU MS4 Program Plan is managed by the Environmental Health and Safety Office and includes updating the MS4 Program Plan and the MS4 General Permit Annual Report. Six minimum control measures (MCMs) are outlined in the Phase II MS4 General Permit:

- Public Education and Outreach on Stormwater Impacts
- Public Involvement and Participation
- Illicit Discharge Detection and Elimination
- Construction Site Stormwater Runoff Control
- Post Construction Stormwater Management
- Pollution Prevention and Good Housekeeping for Municipal Operations

Best Management Practices have been integrated into these six MCMs to assist in protecting the water quality within the regulated acreage that ultimately discharges

into the Chesapeake Bay. The University's MS4 Program Plan lists each of the six MCMs and activities that ODU is pursuing to meet them.

Stormwater policies have been implemented by ODU within the MS4 Program Plan to administer the Program and comply with the MCMs. These policies can be found on the ODU's Stormwater Management Webpage.

- Stormwater Management Master Plan, July 2015
- Illicit Discharge Detection and Elimination Program, May 2008
- Nutrient Management Plan, October 2015
- Spill Prevention Control and Countermeasure Plan, June 2012
- Annual Standards and Specifications For Erosion and Sediment Control and Stormwater Management, June 2017

New or Modified Legal Authority

New or modified legal authorities are not required for compliance with the Special Condition for the Chesapeake Bay TMDL. ODU possesses the authorities necessary to meet pollution reduction goals.

ODU and neighboring MS4 jurisdictions are responsible for the drainage area within their boundaries. In the event that an agreement is made with a neighboring MS4 operator, such as the City of Norfolk, that provides more easily managed compliance, this TMDL Action Plan will be updated.

3. Means and Methods to Address Discharges from New Sources

The University must introduce and implement means and methods to offset pollutant loads from new sources. To offset pollutant loads, provisions of the Virginia Stormwater Management Handbook (VSMH), as of the 2014 revisions, require that if a redevelopment project site is less than 1 acre, phosphorus loadings from that site be reduced by 10% as compared to the existing developed conditions. Phosphorous loadings must be reduced by 20% when the project area is greater than 1 acre. Virginia Stormwater Management Program (VSMP) Regulations identify phosphorus loading as the "keystone" indicator of runoff water quality. As phosphorus is present in stormwater runoff in both particulate and soluble form, its concentration in stormwater runoff is considered indicative of the presence of other pollutants (nitrogen, TSS) that exist in either form. VSMP regulations requires all new developments to remove 0.41 pounds of phosphorus per acre per year. The VSMH evaluates BMP pollutant removal performance in terms of percentage of Total Phosphorus (TP) removed. Total phosphorus removal loads are used to determine TN and TSS removal loads through use of pollutant loading ratios found in *Table 4* of the MS4 General Permit regulations and *Table 3A* through *Table 3C* of this report.

For the plan approval and application process, refer to ODU Annual Standards and Specifications. The construction documents are developed by a design team hired by

ODU which includes surveyors, engineers, and landscape architects. Plans are designed to the Virginia Standards and to comply with the MS4 General Permit regulations.

Following plan approval, general contractors are responsible for obtaining the necessary land disturbance permits and attending preconstruction meetings with ODU officials. The purpose of the preconstruction meeting is to review all erosion and sediment controls once they are in place on site and to confirm that they comply with the approved plans before the start of construction. The contractor is also responsible for maintaining the latest approved set of plans and the SWPPP on-site for each project during the extent of construction. A certified inspector is responsible for making sure each inspection is completed for the site.

Following construction, permanent stormwater facilities are inspected for conformance with plans, specifications, and standards. Annual inspection of stormwater facilities will be conducted with maintenance being performed as required by the contractor, or ODU Facilities Management staff.

In addition to measures discussed within this TMDL Action Plan, ODU has submitted an updated Stormwater Master Plan to the Virginia DEQ. This Master Plan outlines several Stormwater Improvement and Capital Improvement projects that can be implemented on campus to meet future Permit Cycle pollutant reduction goals. Campus wide Stormwater Pollution Prevention Plans are to be submitted as part of the University's MS4 Program Plan to assist in facilitating the measures for maintaining current and future best management practices.

4. Estimated Existing Source Loads and Calculated Total Pollutant of Concern 313111(POC) Required Reductions

MS4 Area Delineation

In order to estimate the existing source loads within ODU's regulated area, an MS4 boundary for the campus must be outlined. The MS4 area delineation as well as areas of pervious and impervious regulated land were determined based on data from the 2015 Stormwater Master Plan (SWMP) submitted to DEQ in July of 2015. Area delineation was calculated in the SWMP using GIS data and survey for the ODU campus that was generated from an aerial flown in 2013. GIS data was supplemented by various record drawings of completed projects on the ODU campus. If ODU expands or reduces its current campus area, the MS4 area delineation will need to be revised. A map of ODU's MS4 boundary can be found in *Appendix A*.

In accordance with DEQ's Chesapeake Bay TMDL Special Guidance, the University may exclude from its MS4 service area land regulated under any general VPDES permit that addresses industrial stormwater or forested land one half contiguous acre or more that meets specific criteria. The University has not identified any property with a VPDES industrial stormwater permit or forested area within its MS4 boundary. In the event that a property within the ODU campus obtains an industrial stormwater

permit, further analysis would be necessary to determine if this property meets specific criteria to be excluded from the MS4 service area delineation.

Existing Source Loads

Existing source loads for phosphorus, nitrogen, and total suspended solids were calculated using 2009 Edge of Stream (EOS) loading rates specified in the MS4 General Permit. Since the ODU campus is the James River watershed, 2009 EOS rates were taken from *Table 2* of the MS4 General Permit. Loading rates were applied to impervious and pervious cover and summed in order to determine total existing source loads. See *Table 3A* through *Table 3C* of this report for existing source load calculations.

Total POC Reduction Requirements

Total pollutant of concern (POC) reduction requirements were calculated using 2009 EOS loading rates that were reduced to meet the final TMDL target goals as required by the Chesapeake Bay Watershed Implementation Plan (WIP). Loading rates for the James River watershed can be found in *Table 2* of the MS4 Permit. The loading rate reduction percentage is defined by the Chesapeake Bay WIP for each specific POC and land cover type. MS4 Impervious areas must show a reduction of 9.0% for nitrogen loads, 16% for phosphorous loads, and 20% for total sediment loads. MS4 Pervious areas must show a reduction of 6.0% for nitrogen, 7.25% for phosphorous, and 8.75% for total sediment loads. Reduced loading rates were then used to determine reduced final POC loads required at the end of the third permit cycle.

After determining the total net reduction required to meet TMDL target goals, the percent reduction for each POC for each permit cycle was calculated. Reduction required for pervious and impervious cover were summed to determine a total reduction required for each POC for each permit cycle. *Table 3A* through *3C* of this report summarize POC reduction requirements.

Table 3A: Summary of Existing Source Loads and POC Reduction Required

			1	2	3	4	5	6	7
Pollutant of Concern	**Impervious Area Served by MS4 (acre)**	**Pervious Area Served by MS4 (acre)**	**2009 EOS Loading Rate (lbs/acre/yr)**	**2009 POC Load (lbs/yr)**	**MS4 Required Loading Rate Reduction (%)**	**Final MS4 Target Loading Rate (lbs/acre/yr)**	**MS4 Target POC Load (lbs/yr)**	**First Permit Cycle Required Reduction in Loading Rate (lbs/acre/yr)**	**Total POC Load Reduction Required by First Permit Cycle (lbs/yr)**
Nitrogen	104.1		9.39	977.50	9.00	8.54	889.52	0.042	4.40
		69.4	6.99	485.11	6.00	6.57	456.00	0.021	1.45
			Total:	1462.61			1345.52	0.063	**5.85**
								First Permit Cycle Total Reduction Achieved:	**6.47**
Phosphorus	104.1		1.76	183.22	16.00	1.48	153.90	0.014	1.46
		69.4	0.5	34.70	7.25	0.46	32.18	0.002	0.13
			Total:	217.92			186.09	0.016	**1.59**
								First Permit Cycle Total Reduction Achieved:	**4.35**
Total Suspended Solids	104.1		676.94	70469.45	20.00	541.55	56375.56	6.769	704.69
		69.4	101.08	7014.95	8.75	92.24	6401.14	0.442	30.69
			Total:	77484.40			62776.71	7.212	**735.38**
								First Permit Cycle Total Reduction Achieved:	**750.90**

Table 3B: Summary of Existing Source Loads and POC Reduction Required

			1	2	3	4	5	6	7
Pollutant of Concern	**Impervious Area Served by MS4 (acre)**	**Pervious Area Served by MS4 (acre)**	**2009 EOS Loading Rate (lbs/acre/yr)**	**2009 POC Load (lbs/yr)**	**MS4 Required Loading Rate Reduction (%)**	**Final MS4 Target Loading Rate (lbs/acre/yr)**	**MS4 Target POC Load (lbs/yr)**	**Second Permit Cycle Required Reduction in Loading Rate (lbs/acre/yr)**	**Total POC Load Reduction Required by First Permit Cycle (lbs/yr)**
Nitrogen	104.1		9.39	977.50	9.00	8.54	889.52	0.296	30.79
		69.4	6.99	485.11	6.00	6.57	456.00	0.147	10.18
			Total:	1462.61			1345.52	0.443	**40.97**
								Second Permit Cycle Total Reduction Achieved:	**174.23**
								Excess First Permit Cycle Reduction Achieved:	**0.62**
								Total Reduction Achieved:	**174.85**
Phosphorus	104.1		1.76	183.22	16.00	1.48	153.90	0.099	10.26
		69.4	0.5	34.70	7.25	0.46	32.18	0.013	0.88
			Total:	217.92			186.09	0.111	**11.14**
								Second Permit Cycle Total Reduction Achieved:	**60.61**
								Excess First Permit Cycle Reduction Achieved:	**2.76**
								Total Reduction Achieved:	**63.38**
Total Suspended Solids	104.1		676.94	70469.45	20.00	541.55	56375.56	47.386	4932.86
		69.4	101.08	7014.95	8.75	92.24	6401.14	3.096	214.83
			Total:	77484.40			62776.71	50.481	**5147.69**
								Second Permit Cycle Total Reduction Achieved:	**202707.98**
								Excess First Permit Cycle Reduction Achieved:	**15.52**
								Total Reduction Achieved:	**202723.50**

Table 3C: Summary of Existing Source Loads and POC Reduction Required

			1	2	3	4	5	6	7
Pollutant of Concern	**Impervious Area Served by MS4 (acre)**	**Pervious Area Served by MS4 (acre)**	**2009 EOS Loading Rate (lbs/acre/yr)**	**2009 POC Load (lbs/yr)**	**MS4 Required Loading Rate Reduction (%)**	**Final MS4 Target Loading Rate (lbs/acre/yr)**	**MS4 Target POC Load (lbs/yr)**	**Third Permit Cycle Required Reduction in Loading Rate (lbs/acre/yr)**	**Total POC Load Reduction Required by Third Permit Cycle (lbs/yr)**
Nitrogen	104.1		9.39	977.50	9.00	8.54	889.52	0.507	52.78
		69.4	6.99	485.11	6.00	6.57	456.00	0.252	17.46
			Total:	1462.61			1345.52	0.759	**70.24**
								Third Permit Cycle Total Reduction Achieved:	**0.00**
								Excess Second Permit Cycle Reduction Achieved:	**133.88**
								Total Reduction Achieved:	**133.88**
Phosphorus	104.1		1.76	183.22	16.00	1.48	153.90	0.169	17.58
		69.4	0.5	34.70	7.25	0.46	32.18	0.022	1.51
			Total:	217.92			186.09	0.191	**19.09**
								Third Permit Cycle Total Reduction Achieved:	**0.00**
								Excess Second Permit Cycle Reduction Achieved:	**52.24**
								Total Reduction Achieved:	**52.24**
Total Suspended Solids	104.1		676.94	70469.45	20.00	541.55	56375.56	81.233	8456.33
		69.4	101.08	7014.95	8.75	92.24	6401.14	5.307	368.28
			Total:	77484.40			62776.71	86.540	**8824.61**
								Third Permit Cycle Total Reduction Achieved:	**0.00**
								Excess Second Permit Cycle Reduction Achieved:	**197575.81**
								Total Reduction Achieved:	**197575.81**

1. 2009 EOS Loading Rates from Chesapeake Bay Program Watershed Model Phase 5.3.2 for the James River Basin.
2. 2009 POC Load is determined by applying the 2009 EOS Loading Rate for impervious and pervious areas to areas within the ODU Campus MS4 Area. [POC Load] = [MS4 Area] * [2009 EOS Loading Rate].
3. MS4 Required Loading Rate Reduction is defined by the Phase II Chesapeake Bay TMDL Watershed Implementation Plan.
4. Final MS4 Target Loading Rate is the 2009 EOS Loading Rate after the required loading rate reduction has been applied. [Final MS4 Target Loading Rate] = [2009 EOS Loading Rate] - [MS4 Required Loading Rate Reduction]/100 * [2009 EOS Loading Rate].
5. MS4 Target POC Load is determined by applying the Final MS4 Target Loading Rate for impervious and pervious areas to areas within the ODU campus MS4 area. [MS4 Target POC Load] = [MS4 Area] * [Final MS4 Loading Rate].
6. A 5% Reduction in the POC Loading Rate is required by the Phase II Chesapeake Bay TMDL Watershed Implementation Plan for the First Permit Cycle. [First Permit Cycle Reduction in Loading Rate] = [2009 EOS Loading Rate] - [Final MS4 Target Loading Rate] * 5%.
7. Total POC Load Reduction Required by First Permit Cycle is 5% of the total load reduction required by the Phase II Chesapeake Bay TMDL Watershed Implementation Plan for the First Permit Cycle. [Total POC Load Reduction Required by First Permit Cycle] = [2009 EOS POC Load - [Final MS4 Target POC Load] * 5%.

Based on all land uses 2009 Progress Run. Ratio of Phosphorus to Other POCs	**Phosphorus Loading Rate, lbs/ac**	**Nitrogen Loading Rate, lbs./ac**	**Total Suspended Solids Loading Rate, lbs./ac**
James River Basin	1.0	5.2	420.9
Potomac River Basin	1.0	6.9	469.2
Rappahannock River Basin	1.0	6.7	320.9
York River Basin	1.0	9.5	531.6

5. Means and Methods to Meet the Required Reductions and Schedules

Best Management Practices

Best Management Practices (BMP) are used extensively by ODU to offset sources of pollutant loads. The University presently has a total of 24 BMPs to meet these offsets. It is a common ODU practice to construct BMPs as part of Capital Improvement Projects located on the University campus. These BMPs are intended to provide water quality treatment and to offset increases in pollutant loads that are associated with new developments. Additionally, these BMPs provide surplus treatment that can be used to offset permit cycle reduction requirements. The sum offset provided by existing condition BMPs provides enough pollutant removal credit to meet the 5% first permit cycle reduction requirements. In addition, existing BMPs provide surplus pollutant removal credits that can be applied to the second and third permit cycles. BMPs that are planned to be constructed with future CIPs and SIPs will provide additional credit towards the second and third permit cycle reduction requirements. Since phosphorus is considered a "keystone" pollutant, reduction calculations were performed to target solely phosphorus. Pollutant loading ratios found in *Table 4* of the MS4 General Permit regulations were used to calculate required TN and TSS reductions. See *Table 4A* through *Table 4C* of this report for a summary of the BMPs and associated pollutant offsets.

Table 4A: Summary of POC Offsets Provided by Existing BMPs

										POC Removal Achieved		
					1	2	3	4	5	6	7	8
Permit Cycle	CBPA BMP Number	ODU BMP Number	Name/Description	Reduction Means/Methods	TP Removal Required (lb/yr)	Scaled TN Removal Required (lb/yr)	Scaled TSS Removal Required (lb/yr)	TP Removal Achieved (lb/yr)	TN Removal Efficiency	TSS Removal Efficiency	TP	TN	TSS
2018	BMP 2	E-1	Lot 23	Dry Detention Basin	0.67	3.47	281.01	0.84	0.05	0.1	0.17	0.04	5.77
2018	BMP 6	E-2	Computational Sciences Building	Bioretention Basin	0.21	1.07	86.98	0.26	0.64	0.55	0.05	0.14	9.82
2018	BMP 3	E-3	Lot 42	Hydrodynamic Separator	0.68	3.55	287.70	0.86	0.05	0.1	0.18	0.04	5.90
2018	BMP 7	E-4	43rd Street Parking Garage	Hydrodynamic Separator	0.56	2.89	234.18	0.7	0.05	0.1	0.14	0.03	4.81
2018	BMP 1	E-5	Oceanograpy and Physical Sciences Building	Wet Pond	6.08	31.62	2559.20	7.65	0.2	0.6	1.57	1.30	315.07
2018	BMP 8	E-6	Wresting Addition	Infiltration Basin	0.00	0.00	0.00	0	0.8	0.95	0.00	0.00	0.00
2018	BMP 9	E-7	Tennis Center	Bioretention Basin	1.76	9.18	742.67	2.22	0.64	0.55	0.46	1.20	83.81
2018	BMP 10	E-8	Physical Sciences Building	Filterra System	0.19	0.99	80.29	0.24	0.64	0.8	0.05	0.13	13.18
2018	BMP 11	E-9	Student Recreation Center	Bioretention Basin	0.64	3.35	270.97	0.81	0.64	0.55	0.17	0.44	30.58
2018	BMP 13	E-10	Student Recreation Center	Filterra System	0.25	1.32	107.05	0.32	0.64	0.8	0.07	0.17	17.57
2018	BMP 12	E-10	Student Recreation Center	Hydrodynamic Separator	0.31	1.61	130.47	0.39	0.05	0.1	0.08	0.02	2.68
2018	BMP 18	E-11	Quad Student Housing	Cistern	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00
2018	BMP 5	L-1	Gornto Teletechnet Building	Wet Pond	1.24	6.45	521.88	1.56	0.2	0.6	0.32	0.26	64.25
2018	BMP 4	L-2	Constant Hall	Hydrodynamic Separator	0.30	1.57	127.12	0.38	0.05	0.1	0.08	0.02	2.61
2018	BMP 17	L-4	Garage E	Cistern	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00
2018	BMP 15	L-5	Student Success Center	Bioretention Basin	0.25	1.32	107.05	0.32	0.64	0.55	0.07	0.17	12.08
2018	BMP 14	L-6	Dragas Hall	Bioretention Basin	0.68	3.55	287.70	0.86	0.64	0.55	0.18	0.47	32.47
2018	BMP 19	L-7	Diehn Fine and Performing Arts	Bioretention Planter	0.50	2.60	210.76	0.63	0.64	0.55	0.13	0.34	23.78
2018	BMP 21	L-8	New Art Building	Filterra System	0.11	0.58	46.84	0.14	0.64	0.8	0.03	0.08	7.69
2018	BMP 20	L-9	Systems Research and Academics Building	Bioretention Basin	0.86	4.46	361.30	1.08	0.64	0.55	0.22	0.59	40.77
2018	BMP 22	L-10	New Art Studio Building	Filterra System	0.17	0.91	73.60	0.22	0.64	0.8	0.05	0.12	12.08
2018	BMP 23	L-11	College of Education	Bioretention Basin	1.07	5.54	448.28	1.34	0.64	0.55	0.27	0.73	50.59
2018	BMP 24	L-12	College of Education	Pervious Pavers	0.30	1.57	127.12	0.38	0.59	0.59	0.08	0.19	15.39
				SUM	16.85	87.62	7092.17	21.2			4.35	6.47	750.90
								2018 Permit Cycle POC Required Reduction			**1.59**	**5.85**	**735.38**
								2018 Surplus POC Reduction			**2.76**	**0.62**	**15.52**

Table 4B: Summary of POC Offsets Provided by BMPs

											POC Removal Achieved		
					1	2	3	4	5		6	7	8
Permit Cycle	**CBPA BMP Number**	**ODU BMP Number**	**Name/Description**	**Reduction Means/Methods**	**TP Removal Required (lb/yr)**	**Scaled TN Removal Required (lb/yr)**	**Scaled TSS Removal Required (lb/yr)**	**TP Removal Achieved (lb/yr)**	**TN Removal Efficiency**	**TSS Removal Efficiency**	**TP**	**TN**	**TSS**
2023	BMP 26*	L-13	Child Studies	Bioretention Basin	0.36	1.87	151.52	0.36	0.64	0.55	0.00	0.00	0.00
2023	BMP 25*	L-14	Child Studies	Nutrient Credit Purchase	0.29	1.51	122.06	0.29	0.05	0.1	0.00	0.00	0.00
2023	BMP 26*	-	Football Stadium	Pervious Pavers	2.43	12.64	1022.79	0.76	0.59	0.59	0.00	0.00	0.00
2023	BMP 27*	-	Owens	Bioretention	1.47	7.64	618.72	0.13	0.64	0.55	0.00	0.00	0.00
2023	BMP 28*	-	Chemistry Building	Pervious Pavers	1.80	9.36	757.62	1.28	0.59	0.59	0.00	0.00	0.00
2023	BMP 29	-	Art Museum	Bioretention	0.13	0.68	54.72	0.2	0.64	0.55	0.07	0.15	10.53
2023	BMP 30	-	Art Museum	Wet Pond	0.24	1.25	101.02	0.35	0.2	0.6	0.11	0.08	19.05
2023	BMP33		Ireland House	Bioretention	0.15	0.78	63.14	0.43	0.59	0.59	0.28	0.30	24.26
2023	BMP31	-	Lafayette River Outfall	Constructed Wetlands	0.00	0.00	0.00	6.08	0.00	0.00	7.17	115.27	9437.34
2023	BMP32	-	Elizabeth River Outfall	Stream Restoration	0.00	0.00	0.00	52.98	0.00	0.00	52.98	58.43	193216.80
				SUM	**6.87**	**35.72**	**2891.58**	**62.86**			**60.61**	**174.23**	**202707.98**
								2018 Permit Cycle Surplus			**2.76**	**0.62**	**15.52**
								2023 Permit Cycle Removal W/2018 Surplus			**63.38**	**174.85**	**202723.50**
								2023 Permit Cycle Removal Requirement			**11.14**	**40.97**	**5147.69**
								Excess POC Removal			**52.24**	**133.88**	**197575.81**

Table 4C: Summary of POC Offsets Provided by BMPs

											POC Removal Achieved		
					1	2	3	4	5		6	7	8
Permit Cycle	CBPA BMP Number	ODU BMP Number	Name/Description	Reduction Means/Methods	TP Removal Required (lb/yr)	Scaled TN Removal Required (lb/yr)	Scaled TSS Removal Required (lb/yr)	TP Removal Achieved (lb/yr)	TN Removal Efficiency	TSS Removal Efficiency	TP	TN	TSS
2028*	-		-	-	-	-	-	-	-	-	0	0.00	0.00
				SUM	-	-	-	-			**0.00**	**0.00**	**0.00**
						2023 POC Removal Surplus					**52.24**	**133.88**	**197575.81**
						2028 Permit Cycle Removal W/2023 Surplus					**52.24**	**133.88**	**197575.81**
						2028 Permit Cycle Removal Requirement					**19.09**	**70.24**	**8824.61**
						Excess POC Removal					**33.15**	**63.64**	**188751.20**

1. Total Phosphorus Removal as Required by VSMP Regulations. Refer to Appendix B for calculations.
2. Scaled Total Nitrogen Removal. Calculated using Loading Ratios from Table 4 of Virginia Administration Code Section 9VAC25-890-40
3. Scaled Total Suspended Solids Removal. Calculated using Loading Ratios from Table 4 of Virginia Administration Code Section 9VAC25-890-40
4. Total Phosphorus Removed for VSMP Regulations using CPBA Spreadsheet. Refer to Appendix B for calculations.
5. POC Removal Efficiencies from DEQ Guidance Memo 15-2005, Tables V.A.1 and Tables V.C.1. A TN and TSS Removal Effciency is not availible in these two tables for a Filterra Bioretention System.
   A Filterra System and bioretention basin operate in a similar manner. As a result, the TN and TSS Removal Effciencies for listed for a Bioretention Basin 1 in Table V.A.1 and V.C.1 were applied
   to Filterra Bioretention Systems.
6. Excess TP Removal Achieved using CBPA Method. Refer to Appendix B for calculations. [TP] = [TP Removal Achieved] - [TP Removal Required]
7. TN Removal Achieved Using Methods outlined in DEQ Guidance Memo 15-2005 for Meeting Special Condition 7 Requirements.
   [TN] = [Excess TP Removal Achieved / TP Removal Achieved] * [Scaled TN Removal] * [TN Removal Efficiency]
8. TSS Removal Achieved Using Methods outlined in DEQ Guidance Memo 15-2005 for Meeting Special Condition 7 Requirements.
   [TSS] = [Excess TP Removal Achieved / TP Removal Achieved] * [Scaled TSS Removal] * [TSS Removal Efficiency]

* No BMPs required for 2028 if offset nutrient credits are purchased or BMPs 31 and 32 are constructed in 2023.

2015 Old Dominion University Master Plan

The 2015 ODU Stormwater Master Plan (SWMP) was submitted to DEQ in July 2015. One of the goals of the SWMP was provide a "menu" of Capital Improvement Projects, and Stormwater Improvement Projects that could be implemented to meet TMDL reduction goals through the use of a variety of BMPs. Of these projects, ODU is considering Stream Restoration of the Elizabeth River Tributary and Constructed Wetlands located at the Outfall to the Lafayette River. These projects provide enough pollutant offset to meet University TMDL goals and will be used towards meeting second and third permit cycle goals.

Stream Restoration of Elizabeth River Tributary is located on the west boundary of the ODU campus. Restoring the stream will provide significant pollutant reduction while also reestablishing heavily eroded stream banks. The restored stream channel will improve sediment and biological processes within the stream as well as the receiving Elizabeth River.

The Constructed Wetlands at the outfall to the Lafayette River are located at the northeast corner of the ODU campus. Constructing a tidal wetland at this location provides an opportunity to enhance phosphorus reduction, provide denitrification, and capture sediment from stormwater discharge.

Table 5 of this report summarize the means and methods to meet the required reductions.

Table 5: Means and Methods to Offset Increased Loads

Permit Cycle	Removal	POC Removal		
		TP	TN	TSS
2018	Removal Achieved	4.35	6.47	750.90
2018	Removal Required	1.59	5.85	735.38
	Difference	2.76	0.62	15.52
2023 w/ BMP 31 & 32	Removal Achieved	60.61	174.23	202707.98
2023 w/ BMP 31 & 32	Surplus from 2018	2.76	0.62	15.52
2023 w/ BMP 31 & 32	Removal Required	11.14	40.97	5147.69
	Difference	52.24	133.88	197575.81
2028 w/ BMP 31 & 32	Removal Achieved	0.00	0.00	0.00
2028 w/ BMP 31 & 32	Surplus from 2023	52.24	133.88	197575.81
2028 w/ BMP 31 & 32	Removal Required	19.09	70.24	8824.61
	Difference	33.15	63.64	188751.20
Removal Shortage				
2018 Shortage		0.00	0.00	0.00
2023 w/ BMP 31 & 32 Shortage		0.00	0.00	0.00
2028 w/ BMP 31 & 32 Shortage		0.00	0.00	0.00
Total		**0.00**	**0.00**	**0.00**

Offsite Nutrient Credit Purchases

ODU has the option to purchase nutrient credits to meet TMDL goals. To meet the requirements of the 2023 permit cycle, the University will need to either purchase credits or complete the design and construction of BMPs 31 and 32 (Constructed Wetlands and Stream Restoration) as listed in *Table 4B*.

2028 TMDL goals can also be met with the construction of BMP 31 and 32 or with a nutrient credit purchase. As both options will likely be pursued during the 2023 permit cycle, 2028 TMDL goals can be met during the 2023 permit cycle or additional credits must be purchased.

6. Means and Methods to Offset Increase Loads from New Sources Initiating Construction between July 1, 2009 and June 30, 2014

Between July 1, 2009 and June 30, 2014, a number of projects have been constructed on the ODU campus. Increased pollutant loads were typically offset on a project by project basis through the use of BMPs. The sum offset provided by existing condition BMPs provided enough offset to meet the entire 5% first permit cycle reduction requirements. All excess reductions from the first permit cycle will be applied towards

the second and third permit cycles. Since phosphorus is considered a "keystone" pollutant, reduction calculations were performed to target solely phosphorus. Pollutant loading ratios found in *Table 4* of the MS4 General Permit regulations were used to calculate required nitrogen and TSS reductions. See *Table 3A* through *Table 3C* of this report for a summary of permit cycle reduction requirements and total reductions achieved by existing/proposed BMPs. See *Appendix C* for pollutant offset calculations.

7. Means and Methods to Offset Increased Loads from Grandfathered Projects Beginning Construction after July 1, 2014

Grandfathered Projects Beginning Construction after July 1, 2014

ODU does not have any projects that qualify for grandfathering under 9VAC25-870-48.

Future Projects Beginning Construction after July 1, 2014

ODU is expecting to begin construction projects after July 1, 2014 as part of the Campus Master Plan. In order to offset pollutant loads, provisions of the Virginia Stormwater Management Handbook (VSMH), as of the 2014 revisions, require that if a redevelopment project site is less than 1 acre, phosphorus loadings from that site be reduced by 10% as compared to the existing developed conditions. Phosphorous loadings must be reduced by 20% when the project area is greater than 1 acre. Virginia Stormwater Management Program (VSMP) Regulations identify phosphorus loading as the "keystone" indicator of runoff water quality. As phosphorus is present in stormwater runoff in both particulate and soluble form, its concentration in stormwater runoff is considered indicative of the presence of other pollutants (nitrogen, TSS) that exist in either form. VSMP regulations requires all new developments to remove 0.41 pounds of phosphorus per acre per year. The VSMH evaluates BMP pollutant removal performance in terms of percentage of Total Phosphorus (TP) removed.

Pollutant removal required by the VSMH will be used as pollutant offsets towards second and third permit cycle TMDL goals. Removal is typically achieved through the use of BMPs.

8. List of Future Projects Qualifying as Grandfathered

ODU has not identified any projects that qualify to be grandfathered under 9VAC25-870-48

9. Estimated Cost of Compliance

Since existing BMPs provided first permit cycle pollutant offsets, estimated costs include only operation and maintenance that are required to keep existing BMPs functioning. These costs are summarized in *Table 6* of this report.

Table 6: Costs of Compliance (Operations and Maintenance)

BMP Type	Typical Cycle (years)	Cycle Cost ($)		Qty	Total Cost ($/year)
Hydrodynamic Structure	1	500	per structure	4	$ 2,000
Bioretention Basin	1	1000	per basin	12	$ 12,000
Detention Basins	1	750	per basin	1	$ 750
Wet Pond	1	750	per basin	3	$ 2,250
Stream Restoration	1	5	per LF	1000	$ 5,000
Constructed Wetland	1	2000	per acre	2.55	$ 5,100
Permeable Pavers	1	1500	per acre	1.02	$ 1,530
Cistern	1	1500	per structure	2	$ 3,000
Total BMP's				27	
Yearly Cost					$ 29,630

Projects including the construction of stream restoration, and constructed wetlands are expected to provide pollutant offsets in the second and third permit cycles. Estimated construction costs are summarized in *Table 7* of this report. Cost breakdowns of the Lafayette River Outfall Constructed Wetlands and Elizabeth River Outfall Stream Restoration can be found in *Appendix C*.

Table 7: Costs of Compliance (New Projects)

Name/Description	Reduction Means/Methods	Estimated Total Cost ($)	Phosphorus Removed (lbs)	Estimated Cost per Pound of Phosphorus Removed ($/lb)
Lafayette River Outfall	Constructed Wetlands	$258,750	7.17	$36,075
Elizabeth River Outfall	Stream Restoration	$1,780,200	52.98	$33,601

10. Public Comment

Part of the University's MS4 program includes Public Education and Outreach to students, faculty and staff. As part of this program, this TMDL Action Plan will be available on the University's Stormwater Management webpage. A two week public comment period will take place before October 1st 2018 which will provide an opportunity the ODU community to provide feedback. Public comments and feedback will be considered and incorporated into this Action Plan before final completion.

OLD DOMINION UNIVERSITY

IDEA FUSION

CHESAPEAKE BAY TMDL ACTION PLAN

APPENDICES

vhb

Appendix A: Figures

Campus Study Area =
±173.50 AC

Stormwater Management Master Plan

Figure 1 Applicable Area

0 125 250 Feet

OLD DOMINION UNIVERSITY
IDEA FUSION

Appendix B:
First Permit Cycle Pollutant Offsets

ODU Overall 2012 CBPA Worksheet with Current Best Management Practices

Performance Based Water Quality Calculations Appendix 5D - VSMH

Worksheet 3 : Situation 3

PRJ #33535.00 Date : December 6, 2013

Summary of values from Worksheet #1: Sheet: 2 of 3

Total Applicable Area (A) = 172.10 acres
Applicable Area I_{post} = *58.22* %
Applicable Area $I_{watershed}$ = *53.00* %
Applicable Area $I_{existing}$ = *60.00* %

Determine the relative pre-development load(L_{pre}):

Based on existing Impervious cover:

$L_{pre(existing)}$ = 231.51 lbs/year

Based on average land cover condition:

$L_{pre(watershed)}$ = 206.79 lbs/year

Determine the relative post-development load(L_{post}):

$L_{(post)}$ = 225.21 lbs/year

Determine the relative pollutant removal requirement(RR):

RR = $L_{post} - L_{pre(watershed)}$
RR = 18.42 lbs/year

OR

RR = $L_{post} - (0.9 * L_{pre(existing)})$
RR = 16.85 lbs/year

Use the lesser of the two values:

RR = **16.85** lbs/year

Indentify best management practice(BMP) for the site:

A. Determine the required pollutant removal efficiency for the site:

EFF = (RR/Lpost)*100
EFF = *7.48* %

B. Select BMP from Table 5-15 and give location on site:

BMP 1:	**E-5: Wet Retention Basin - OCNPS**	A_{bmp1}= 6.71	EFF_{bmp1}= 0.65	I_{bmp1}= 79.88
BMP 2:	**E-1: Dry Detention Basin - Lot 23 (Elkhorn Avenue**	A_{bmp2}= 1.66	EFF_{bmp2}= 0.30	I_{bmp2}= 77.00
BMP 3:	**E-3: Vortechnics - Lot 42 (Whitehurst Hall)**	A_{bmp3}= 2.10	EFF_{bmp3}= 0.20	I_{bmp3}= 93.95
BMP 4:	**L-2: Vortechnics - Constant Hall**	A_{bmp4}= 1.27	EFF_{bmp4}= 0.20	I_{bmp4}= 66.51
BMP 5:	**L-1: Wet Retention Basin - Gornto Teletechnet**	A_{bmp5}= 2.96	EFF_{bmp5}= 0.50	I_{bmp5}= 45.78
BMP 6:	**E-2: Bioretention - Computational Sciences**	A_{bmp6}= 0.31	EFF_{bmp6}= 0.65	I_{bmp6}= 58.01
BMP 7:	**E-4: Vortechnics© - 43rd Street Parking Garage**	A_{bmp7}= 2.20	EFF_{bmp7}= 0.20	I_{bmp7}= 72.50
BMP 8:	**E-6: Infiltration Trench - Wrestling Addition**	A_{bmp8}= 0.00	EFF_{bmp8}= 0.00	I_{bmp8}= 0.00
BMP 9:	**E-7: Bioretention - Indoor Tennis Center**	A_{bmp9}= 2.23	EFF_{bmp9}= 0.65	I_{bmp9}= 69.24
BMP 10:	**E-8: Filterra© - Physical Sciences Building**	A_{bmp10}= 0.25	EFF_{bmp10}= 0.65	I_{bmp10}= 67.31
BMP 11:	**E-9: Bioretention - Student Recreation Center**	A_{bmp11}= 3.57	EFF_{bmp11}= 0.35	I_{bmp11}= 26.02
BMP 12:	**E-10: Vortechnics© - Student Recreation Center**	A_{bmp12}= 1.90	EFF_{bmp12}= 0.15	I_{bmp12}= 61.30
BMP 13:	**E-10: Filterra© - Student Recreation Center**	A_{bmp13}= 0.25	EFF_{bmp13}= 0.65	I_{bmp13}= 90.00
BMP 14:	**L-6: Bioretention - Dragas Hall**	A_{bmp14}= 0.77	EFF_{bmp14}= 0.65	I_{bmp14}= 77.92
BMP 15:	**L-5: Bioretention - Student Success/ University College**	A_{bmp15}= 0.34	EFF_{bmp15}= 0.50	I_{bmp15}= 87.00
BMP 16:	**L-3: Green Roof - Batten Arts and Letters**	A_{bmp16}= 0.00	EFF_{bmp16}= 0.00	I_{bmp16}= 100.00
BMP 17:	**L-4: Cistern - Garage E (Game Day Bldg)**	A_{bmp17}= 0.99	EFF_{bmp17}= 0.00	I_{bmp17}= 100.00
BMP 18:	**E-11: Cistern - Quad Housing**	A_{bmp18}= 0.19	EFF_{bmp18}= 0.00	I_{bmp18}= 100.00
BMP 19:	**L-7: Bioretention - Diehn II Addition**	A_{bmp19}= 0.57	EFF_{bmp19}= 0.65	I_{bmp19}= 77.19
BMP 20:	**L-9: Bioretention - Systems Research**	A_{bmp20}= 1.20	EFF_{bmp20}= 0.65	I_{bmp20}= 61.67
BMP 21:	**L-8: Filterra Roof Drain© - New Art Building**	A_{bmp21}= 0.10	EFF_{bmp21}= 0.65	I_{bmp21}= 100.00
BMP 22:	**L-10: Filterra Roof Drain© - New Art Studio Buildi**	A_{bmp22}= 0.21	EFF_{bmp22}= 0.50	I_{bmp22}= 95.24
BMP 23:	**L-11: Bioretention-College of Education Building**	A_{bmp23}= 1.33	EFF_{bmp23}= 0.65	I_{bmp23}= 69.92
BMP 24:	**L-12: Pervious Paver-College of Education Buildi**	A_{bmp24}= 0.49	EFF_{bmp24}= 0.45	I_{bmp24}= 77.55

A_{bmp} = Drainage area of proposed BMP(acres)
EFF_{bmp} = Pollutant removal efficiency of BMP(decimal form)
I_{bmp} = impervious percentage of A_{bmp} (expressed as a whole number)

ODU Overall 2012 CBPA Worksheet with Current Best Management Practices

Performance Based Water Quality Calculations Appendix 5D - VSMH

Worksheet 3 : Situation 3

PRJ #33535.00 Date : December 6, 2013

Sheet: 3 of 3

C. Determine the pollutant load entering the proposed BMP(s), L_{bmp}:

$$L_{bmp} = (0.05+(0.009*I_{bmp}))*A_{bmp}*2.28$$

L_{bmp1} =	11.76	lbs/year
L_{bmp2} =	2.81	lbs/year
L_{bmp3} =	4.29	lbs/year
L_{bmp4} =	1.88	lbs/year
L_{bmp5} =	3.12	lbs/year
L_{bmp6} =	0.40	lbs/year
L_{bmp7} =	3.52	lbs/year
L_{bmp8} =	0.00	lbs/year
L_{bmp9} =	3.42	lbs/year
L_{bmp10} =	0.37	lbs/year
L_{bmp11} =	2.31	lbs/year
L_{bmp12} =	2.61	lbs/year
L_{bmp13} =	0.49	lbs/year
L_{bmp14} =	1.32	lbs/year
L_{bmp15} =	0.65	lbs/year
L_{bmp16} =	0.00	lbs/year
L_{bmp17} =	2.14	lbs/year
L_{bmp18} =	0.41	lbs/year
L_{bmp19} =	0.97	lbs/year
L_{bmp20} =	1.66	lbs/year
L_{bmp21} =	0.22	lbs/year
L_{bmp22} =	0.43	lbs/year
L_{bmp23} =	2.06	lbs/year
L_{bmp24} =	0.84	lbs/year

D. Calculate the pollutant load removed by the proposed BMP(s):

$$L_{removed} = EFF_{bmp} * L_{bmp}$$

$L_{removed/bmp1}$ =	7.65	lbs/year
$L_{removed/bmp2}$ =	0.84	lbs/year
$L_{removed/bmp3}$ =	0.86	lbs/year
$L_{removed/bmp4}$ =	0.38	lbs/year
$L_{removed/bmp5}$ =	1.56	lbs/year
$L_{removed/bmp6}$ =	0.26	lbs/year
$L_{removed/bmp7}$ =	0.70	lbs/year
$L_{removed/bmp8}$ =	0.00	lbs/year
$L_{removed/bmp9}$ =	2.22	lbs/year
$L_{removed/bmp10}$ =	0.24	lbs/year
$L_{removed/bmp11}$ =	0.81	lbs/year
$L_{removed/bmp12}$ =	0.39	lbs/year
$L_{removed/bmp13}$ =	0.32	lbs/year
$L_{removed/bmp14}$ =	0.86	lbs/year
$L_{removed/bmp15}$ =	0.32	lbs/year
$L_{removed/bmp16}$ =	0.00	lbs/year
$L_{removed/bmp17}$ =	0.00	lbs/year
$L_{removed/bmp18}$ =	0.00	lbs/year
$L_{removed/bmp19}$ =	0.63	lbs/year
$L_{removed/bmp20}$ =	1.08	lbs/year
$L_{removed/bmp21}$ =	0.14	lbs/year
$L_{removed/bmp22}$ =	0.22	lbs/year
$L_{removed/bmp23}$ =	1.34	lbs/year
$L_{removed/bmp24}$ =	0.38	lbs/year

E. Calculate the **total** pollutant load removed by the BMP(s):

$L_{removed/total}$ =	**21.19**	lbs/year

F. Verify Compliance:

$L_{removed/total}$	≥	**RR**	
21.19	≥	**16.85**	**COMPLIANCE**
Net Loading	=	**4.34**	

Comparison of L_{post} versus $L_{pre(watershed)}$

$L_{pre(watershed)}$	≥	L_{post} - $L_{removed\ total}$	
206.79	≥	**204.01**	**COMPLIANCE**
Net Loading	=	**2.77**	

Appendix C: References

Cost Estimates

VHB - Stormwater Group

2015 ODU Stormwater Master Plan Construction Cost Opinion	DATE PREPARED : May 08, 2015
PROJECT/PROJECT # : 31331.64	BASIS FOR ESTIMATE: X STUDY PRELIMINARY DESIGN FINAL DESIGN
LOCATION : Norfolk, VA	
CLIENT: Old Dominion University	FILE NAME: \\vhb\proj\VaBeach\31311.64 ODU Stormwater Regs\tech\Drainage\Cost Estimates\[Cost Opinion SIP.xls]Elizabeth River

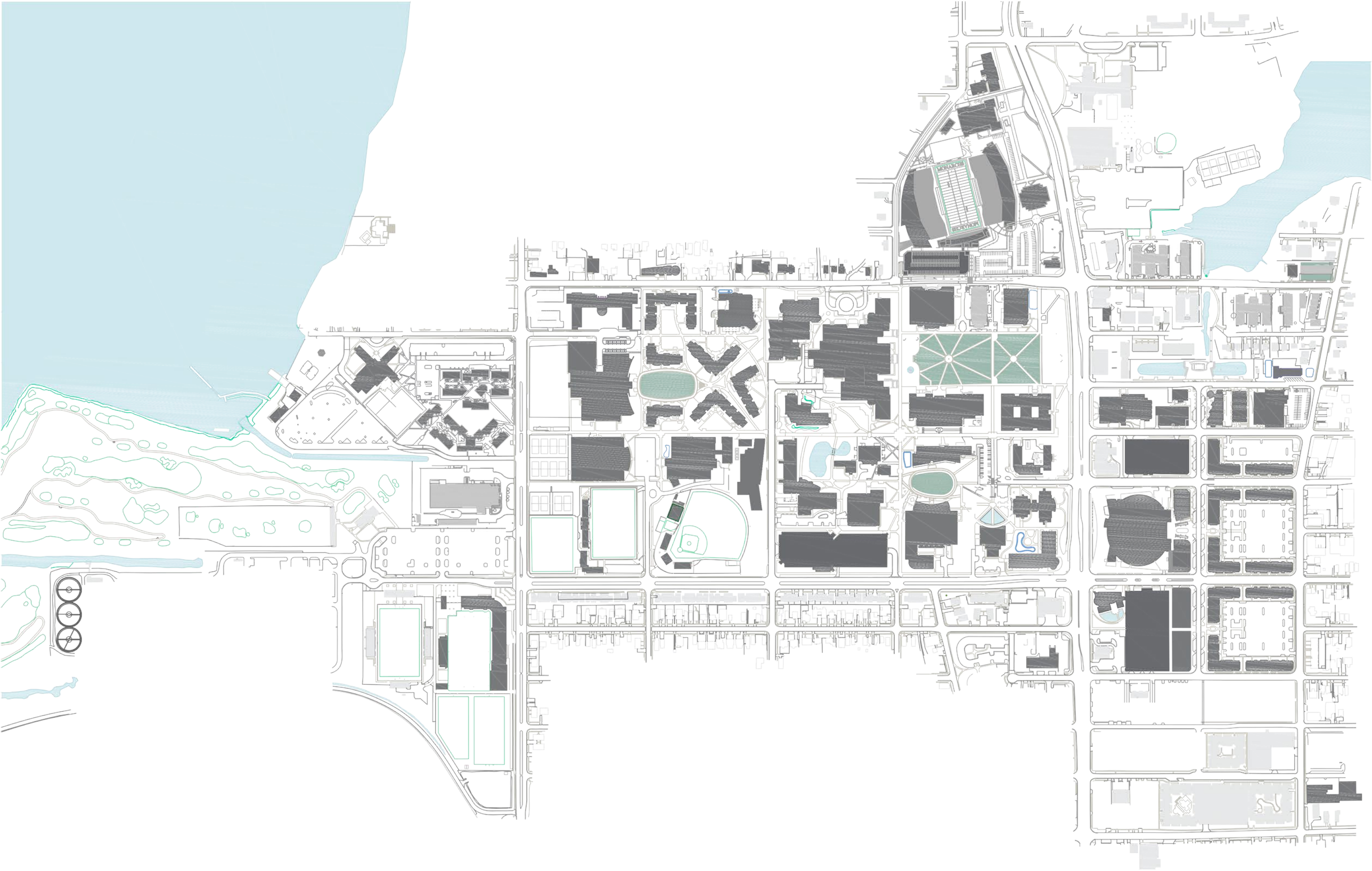
ITEM NO	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST	COMMENTS
	ELIZABETH RIVER OUTFALL - Stream Restoration					
1	MOBILIZATION	1	LS	$20,000	$20,000	
2	DEMOLITION	1	LS	$15,000	$15,000	
3	UTILITY ADJUSTMENTS	1	LS	$5,000	$5,000	
4	STREAM RESTORATION (MATERIALS & INSTALLATION)	1000	LF	$1,250	$1,250,000	
						Pounds Phosphorus Removed
						52.98
						Initial Cost per Pound of Phosphorus Removed
						$33,601
				TOTAL	**$1,290,000**	
				15% Design Contingency	$193,500	
				8% General Conditions	$103,200	
				15% Construction Contingency	$193,500	
				TOTAL	**$1,780,200**	

VHB - Stormwater Group

2015 ODU Stormwater Master Plan Construction Cost Opinion	DATE PREPARED : May 08, 2015
PROJECT/PROJECT # : 31331.64	BASIS FOR ESTIMATE: X STUDY PRELIMINARY DESIGN FINAL DESIGN
LOCATION : Norfolk, VA	
CLIENT: Old Dominion University	FILE NAME: \\vhb\proj\VaBeach\31311.64 ODU Stormwater Regs\tech\Drainage\Cost Estimates\[Cost Opinion SIP.xls]Lafayette River

ITEM NO	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST	COMMENTS
	LAFAYETTE RIVER OUTFALL - Constructed Wetlands					
1	MOBILIZATION	1	LS	$20,000	$20,000	
2	DEMOLITION	1	LS	$15,000	$15,000	
3	UTILITY ADJUSTMENTS	1	LS	$25,000	$25,000	
4	CONSTRUCTED WETLANDS (MATERIALS & INSTALLATION)	2.6	AC	$50,000	$127,500	
						Pounds Phosphorus Removed
						6.08
						Initial Cost per Pound of Phosphorus Removed
						$42,558
				TOTAL	**$187,500**	
				15% Design Contingency	$28,125	
				8% General Conditions	$15,000	
				15% Construction Contingency	$28,125	
				TOTAL	**$258,750**	

Campus Map

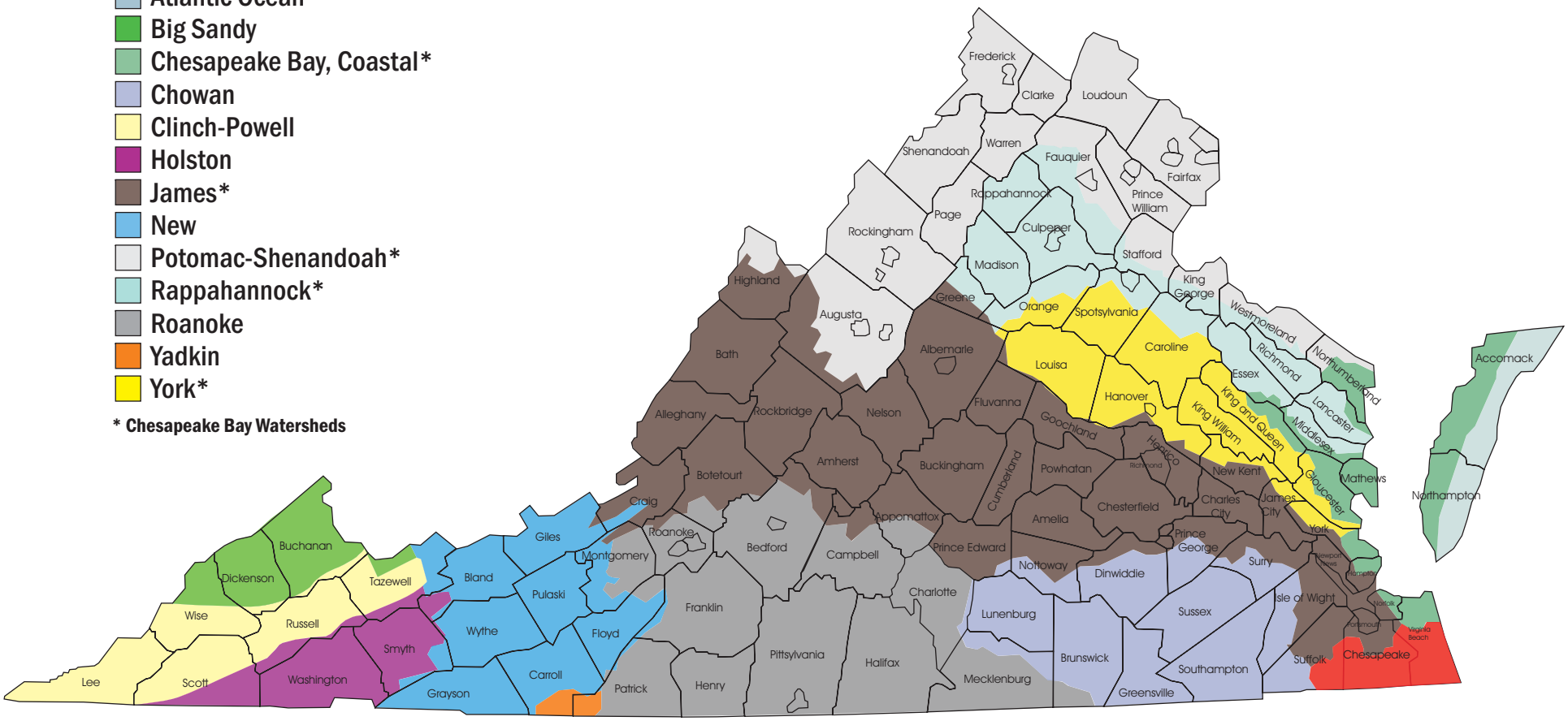


Virginia's Major Watersheds

Virginia's Major Watersheds

- Albemarle Sound, Coastal
- Atlantic Ocean
- Big Sandy
- Chesapeake Bay, Coastal*
- Chowan
- Clinch-Powell
- Holston
- James*
- New
- Potomac-Shenandoah*
- Rappahannock*
- Roanoke
- Yadkin
- York*

* Chesapeake Bay Watersheds



Virginia Department of Conservation and Recreation

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