VIRGINIA PENINSULA
COMMUNITY COLLEGE

Preliminary Engineering Report for Chesapeake Bay TMDL Action Plan Phase II - Compliance Reassessment

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Note: References to previous Virginia Peninsula Community College (VPCC) Action Plans = Thomas Nelson Community College (TNCC) Action Plans as a result of the recent name change for the college.

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Executive Summary

Virginia Peninsula Community College (VPCC) is permitted to discharge stormwater from the college's municipal separate storm sewer systems (MS4s) by maintaining coverage under the General Virginia Pollutant Discharge Elimination System (VPDES) Permit for Discharges of Stormwater from Small MS4s (MS4 General Permit). In part, the MS4 General Permit requires the college meet special conditions for the Chesapeake Bay Total Maximum Daily Load (TMDL). Included as a special condition is the development of the VPCC Chesapeake Bay TMDL Action Plan (Action Plan), with Phase II previously developed and dated November 1, 2019. The Action Plan includes the description of past progress and proposed practices to achieve pollutant reductions required to be achieved during the previous, current and subsequent permit cycles. VPCC successfully achieved the pollutant reductions required during the last MS4 General Permit cycle that spanned from 2013 – 2018, representing a minimum of 5% of the total reductions that are to be achieved by 2028. Reductions for the previous permit cycle were achieved with annual street sweeping at the Hampton campus and a regional stormwater management (SWM) facility at the Historic Triangle campus. The regional SWM facility provides the entirety (100%) of the required reductions for the Historic Triangle campus and thus no further practices are required at this campus.

The current MS4 General Permit requires reduction of an additional 35% of the total required pollutant reductions (40% cumulative) be achieved prior to the conclusion of the current permit cycle that expiries on October 31, 2023. VPCC's Phase II Action Plan proposes to achieve the 2023 reductions at the Hampton campus with continued implementation of a street sweeping program. The Phase II Action Plan describes quantification of pollutant reductions supported with continued compilation of data from swept material chemical analyses in context to past studies. Since the development of the Phase II Action Plan, quantification of reductions and sample analyses has been refined to only determine the pollutant concentrations in the fraction of swept particles characterized that could be expected to enter surface waters as total suspended solids (TSS), with only the TSS-associated particles and associated pollutants quantified as reductions, herein referred to as the Refined Sampling Method.

Quantification of pollutant reductions achieved the past two reporting years from street sweeping finds the current level of sweeping does not achieve the required annual reductions

necessary for this permit cycle. Further, although the Refined Sampling Method is based on a published study and continued sampling, it is not yet known if the Department of Environmental Quality (DEQ) will continue to accept this quantification method. Alternatively, DEQ issued guidance for quantifying pollutant reductions from street sweeping in DEQ Guidance Memo No. 20-2003 (DEQ Guidance), dated November 11, 2020. Although guidance and not regulation, DEQ may require the guidance be used for quantifying pollutant reductions. The DEQ Guidance method is based on data from street solids information and uses a model to determine street sweeping credit. However, the determinations are not based on calibrated sampling information in surface waters and the results are suspect, dramatically reducing the pollutant reduction credits quantified by previous DEQ Guidance and those quantified using the Refined Sampling Method. If the DEQ Guidance quantification method is required, street sweeping alone is not a viable practice towards achieving the required reductions for the current permit cycle.

The purpose of this Preliminary Engineering Report (PER) was to reassess the ability of the Phase II Action Plan to result in pollutant reduction compliance in context to the new DEQ Guidance. All potential alternative practices were considered towards achieving the compliance targets, with limited options identified as applicable or feasible. Due to uncertainty regarding compliance based on pollutant reduction quantification from street sweeping and the feasibility constraints for implementing structural stormwater practices, the following concurrent steps are recommended to ensure compliance:

1. As soon as possible, VPCC is recommended to purchase nutrient credits for the full reductions required by 2023 (equivalent to 4.15 lbs of TP with an estimated cost of $74,700); and
2. (***Optional***) VPCC is recommended to continue street sweeping to a level that ensures compliance with the 2023 pollutant reductions based on the Refined Sampling Method (sweep approximately 20 - 33 tons per year, depending on when sweeping occurs in context to rainfall), including continued sampling and chemical testing. It is recommended the Refined Sampling Method continue to be used for annual reporting. This approach allows for:
    - *Potential* credit from sweeping at a level quantified by the Refined Sampling Method in the case of continued acceptance by DEQ through the annual reporting process. In this

case, the credits purchased in Step 1 can be applied to future reductions required in the subsequent permit cycle beginning after October 2023.

- In the case the Refined Sampling Method is no longer accepted by DEQ, the credits from Step 1 can be used to ensure compliance.

If VPCC decides not to continue street sweeping as described in Step 2, Step 1 would be sufficient to ensure compliance, with purchase ideally occurring prior to the end of this calendar year to ensure they can be applied prior to the pollutant reduction deadline. It is further recommended that VPCC consider purchase of credits to achieve 100% of the pollutant reductions that will ultimately be required by 2028. To obtain the entirety of the pollutant reductions required by 2028, 10.38 lbs. of TP could be purchased at a cost of approximately $186,640.

1.0 Introduction

VPCC has developed, implements and enforces a municipal separate storm sewer system (MS4) program designed to reduce the discharge of pollutants from the college's municipal separate storm sewer systems (MS4s) to the maximum extent practicable (MEP) in accordance with the General Virginia Pollutant Discharge Elimination System (VPDES) Permit for Discharges of Stormwater from Small MS4s (MS4 General Permit). The purpose of the program is to protect water quality and to satisfy the appropriate water quality requirements of the State Water Control Law and its attendant regulations. VPCC utilizes the legal authority provided by the laws and regulations of the Commonwealth of Virginia to control discharges to and from the college MS4s through the MS4 General Permit, college policies and specific contract language, as applicable.

Compliance with the MS4 General Permit is dependent on the implementation of best management practices (BMPs) to address minimum control measures described in the permit and Special Condition requirements associated with applicable total maximum daily loads (TMDLs). The VPCC MS4 program plan describes the BMPs to address each permit requirement, including reference to the previously developed VPCC Phase II Chesapeake Bay TMDL Action Plan (Action Plan), dated November 1, 2019. The Action Plan serves as the second phase of an anticipated three-phase plan to ultimately achieve 100% of assigned pollutant reductions by 2028. The current permit requires 40% of the reductions be achieved by October 2023. The Action Plan, as required by the MS4 General Permit, includes:

1. Loading and cumulative reduction calculations, as specified by the permit;
2. Total pollutant reductions achieved during the last permit cycle that concluded in 2018, along with the BMPs implemented and reductions achieved by each;
3. A description of the BMPs to be implemented to achieve the reductions required prior to the expiration of the current permit; and
4. A description of legal authorities necessary to implement the BMP to be employed to achieve the pollutant reductions required by the permit.

For context, this PER also includes Items 1, 2 and 3 listed above, with modifications to Item 3 as part of a reassessment of the Action Plan to ensure compliance with pollutant reduction targets for this permit cycle.

2.0 MS4 Pollutant Discharge Characterization

Pollutant load and cumulative reduction calculations are provided in this Section for the two Chesapeake Bay river basins within which VPCC MS4 systems discharge. The loading and required reduction calculations are determined using tables provided within the MS4 General Permit and are dependent on the regulated impervious and pervious area draining to the college's MS4s, as summarized in **Table 2.1** and as shown in the Action plan mapping. VPCC has two regulated campuses within the Chesapeake Bay watershed, including the:

- ✓ Hampton campus in the York River Basin and the
- ✓ Historic Triangle campus in the James River Basin.

Table 2.1 Summary of regulated impervious and pervious area for the VPCC campuses.

VPCC Campus	MS4 Regulated Area (acres)	
	Impervious	Pervious
Hampton campus	38.64	28.06
Historic Triangle campus	10.23	8.06

2.1 Pollutant Loadings

Pollutant loading are computed for each campus using the calculation sheets provided in the MS4 General Permit for the respective basin within which each campus resides. The calculation sheets provide the loading rates, as pounds (lbs) per acre (ac) per year (yr), as reflected in **Table 2.2** and **Table 2.3** for computing loads from the Hampton and Historic Triangle campuses, respectively.

Table 2.2 Hampton campus loadings based on the York River Basin calculation sheet provided in the MS4 General Permit.

Pollutant	Subsource	Loading Rate (lbs/ac/yr)	Area (acres)[1]	Load (lbs/yr)	Total Load (lbs/yr)
TN	Impervious	7.31	38.64	282	497
	Pervious	7.65	28.06	215	
TP	Impervious	1.51	38.64	58	73
	Pervious	0.51	28.06	14	
TSS	Impervious	456.68	38.64	17,646	19,688
	Pervious	72.78	28.06	2,042	

[1] Area served by the Hampton campus MS4 within the 2010 Census Urbanized Area.

Table 2.3 Historic Triangle campus loadings based on the James River Basin calculation sheet provided in the MS4 General Permit.

Pollutant	Subsource	Loading Rate (lbs/ac/yr)	Area (acres)[1]	Load (lbs/yr)	Total Load (lbs/yr)
TN	Impervious	9.39	10.23	96	152
	Pervious	6.99	8.06	56	
TP	Impervious	1.76	10.23	18	22
	Pervious	0.50	8.06	4	
TSS	Impervious	676.94	10.23	6,925	7,740
	Pervious	101.08	8.06	815	

[1] Area served by the Historic Triangle campus MS4 within the 2010 Census Urbanized Area.

2.2 Required Pollutant Reductions

The required cumulative pollutant reductions at each campus are computed for each campus using the calculation sheets provided in the MS4 General Permit for the respective basin within which each campus resides. The calculation sheets provide the total percentage of the loadings required for the L2 Scoping Run of the Chesapeake Bay Model, as reflected in **Table 2.4** and **Table 2.5**, for computing required reductions from the Hampton and Historic Triangles campuses, respectively. Additional pollutant reductions as a result of: (1) new sources initiating construction between July 1, 2009, through June 30, 2019 with total phosphorus loadings exceeding 0.45 lbs/acre/yr, or (2) grandfathered projects initiating construction after July 1, 2014, with total phosphorus loadings exceeding 0.45 lbs/acre/yr are not necessary since neither occurred at either regulated campus.

Table 2.4 Hampton campus required load reductions based on the York River Basin calculation sheet provided in the MS4 General Permit.

Pollutant	Subsource	Load (lbs/yr) [1]	Total Load Reduction (%) [2]	Required Reduction by 2023 (lbs/yr) [3]	Total Load Reduction by 2023 (lbs/yr) [3]
TN	Impervious	282	9	10	15.32
	Pervious	215	6	5.15	
TP	Impervious	58	16	3.73	4.15
	Pervious	14	7.25	0.42	
TSS	Impervious	17,646	20	1412	1,483
	Pervious	2,042	8.75	71.48	

[1] From Table 2.2.
[2] Percentage of total load reduction per the L2 Scoping Run of the Chesapeake Bay Model.
[3] Represents 40% of the total load reduction, as required for the current permit cycle.

Table 2.5 Historic Triangle campus required load reductions based on the James River Basin calculation sheet provided in the MS4 General Permit.

Pollutant	Subsource	Load (lbs/yr) [1]	Total Load Reduction (%) [2]	Required Reduction by 2023 (lbs/yr) [3]	Total Load Reduction by 2023 (lbs/yr) [3]
TN	Impervious	96	9	3	4.81
	Pervious	56	6	1.35	
TP	Impervious	18	16	1.15	1.27
	Pervious	4	7.25	0.12	
TSS	Impervious	6,925	20	554	583
	Pervious	815	8.75	28.51	

[1] From Table 2.3.

[2] Percentage of total load reduction per the L2 Scoping Run of the Chesapeake Bay Model.

[3] Represents 40% of the total load reduction, as required for the current permit cycle.

3.0 Pollutant Reduction – Phase I Milestones

VPCC's Phase I Chesapeake Bay TMDL Action Plan, dated June 30, 2015, identified the means and methods to achieve 5% of the total required reductions by July 1, 2018, as follows:

- ✓ **Hampton campus:** pollutant load reductions achieved with implementation, verification of effectiveness and documentation of street sweeping efforts.
- ✓ **Historic Triangle campus:** pollutant load reductions achieved with historical water quality BMP that treats the entirety of the campus.

The following subsections present the total reductions achieved by July 1, 2018, at each campus and describe the BMPs implemented to achieve reductions.

3.1 Hampton Campus

VPCC implemented street sweeping during the previous permit cycle to achieve at least 5% of the total required reductions, as was required during the permit cycle that expired in 2018. VPCC's Phase I Action Plan specified the total annual mass of material that would be required to be annually collected to achieve the 5% target based on the Mass Loading Approach (MLA), as described in the Virginia Department of Environmental Quality (DEQ) Chesapeake Bay Action Plan Guidance Memo (VDEQ 2015). The MLA method is based on sampling of street particulate matter by Law et al. (2008). Using the MLA computation methods, VPCC's 2017-2018 MS4 annual report demonstrated that street sweeping far exceeded the 5% target of the total reduction requirement based on a total of 19.7 tons of material collected for the reporting year, as reflected in **Table 3.1**.

Table 3.1 Hampton campus Phase I Chesapeake Bay TMDL Action Plan compliance summary.

Pollutant	Reduction Required for the Phase I Action Plan (5% of total)	Reduction Provided by street sweeping in 2017-2018 [1]
TN	1.75	69.02
TP	0.53	27.61
TSS	191.97	8,282.82

[1] Based on total material swept of 19.7 tons using the Mass Loading Approach (VDEQ 2015) and as provided in 2017-2018 annual reporting.

Note: A new DEQ Guidance Memo (No. 20-2003), dated November 11, 2020, has been issued and no longer allows the use of the MLA for quantifying pollutant reductions. The guidance memo presents a new quantification method based on sweeper type, area swept and sweeping frequency. The new DEQ Guidance quantification method significantly reduces the pollutant reductions attributed to street sweeping. However, as discussed in the VPCC Phase II Action plan and in later sections of this PER, VPCC participates in a study that bases quantification off of chemical analyses of swept samples (Refined Sampling Method). With the removal of the MLA for quantification, both the new DEQ Guidance and Refined Sampling Method are evaluated in Section 4 to assess compliance options moving forward.

3.2 Historic Triangle Campus

The VPCC Phase I Chesapeake Bay TMDL Action Plan demonstrates that 5% of the total required reductions were achieved with application of credit from a historic water quality BMP that was:

- Initially installed on or after January 1, 2006 and prior to July 1, 2009, and
- Constructed to address water quality within the permittee's regulated service area.

The Phase I Action Plan provides detailed information and computations for the historic water quality BMP to determine the available pollutant reduction credit to VPCC's Historic Triangle campus towards achieving reductions for addressing the Chesapeake Bay TMDL. The available reductions from the historic water quality BMP, a regional stormwater pond known as the Warhill Pond, are provided in **Table 3.2**. As noted, the available pollutant reduction credit from the historic water quality BMP not only achieve the required reductions described in the Phase I Action Plan, but also 100% of the required reductions through 2028. As a result, no other practices are required for this campus for the current and subsequent permit cycles.

Table 3.2 Historic Triangle campus Phase I Action Plan compliance summary.

Pollutant	Reductions Required for the Phase I Action Plan (5% of total) (lb./yr)	Total Reductions Required by 2028 (100% of total) (lb./yr)	Reduction Provided by the Warhill Pond to VPCC to address the Chesapeake Bay TMDL [1] (lb./yr)
TN	0.56	12.03	22.89
TP	0.15	3.18	13.22
TSS	67.93	1,458	5,565

[1] Exceeds 100% of required reductions. Computations provided in the Phase I Action Plan.

4.0 Phase II Pollutant Reduction Practices

VPCC has implemented a street sweeping program since 2019 intended to obtain the required reductions to achieve the cumulative 40% of the total reductions by the 2023 expiration date of the current MS4 General Permit. Quantifications of reductions in **Table 4.1** have been based on the Refined Sampling Method, stemming from a study described in VPCC's Phase II Action Plan that utilizes an ongoing dataset with results of chemical analysis on the fraction of swept materials associated with total suspended solids (TSS). Note from the Table that targets have not been achieved the past two years with the current level of sweeping. Current dataset values for the Refined Sampling Method for quantification of pollutant reductions from total mass of swept material are provided in **Table 4.2**.

Table 4.1 Summary of reductions achieved by street sweeping the past two reporting periods using the current values from the Refined Sampling Method. **Red** indicates targets not achieved.

Pollutant	Remaining Annual Load Reduction Req'd by 2023 [1] (lbs/yr)	Reduction Achieved in 2019-2020 (lbs/yr) ***(13.0 tons swept)***	Reduction Achieved in 2020-2021 (lbs/yr) ***(2.96 tons swept)***
TN	15.32	**11.36**	**2.59**
TP	4.15	**2.75**	**0.63**
TSS	1,483	17,004	3,871

[1] From Table 2.4.

Table 4.2 Estimate of pollutant reduction to surface waters per ton of swept materials, revised values based on refined sampling and current dataset added to each year with continued sampling performed by several VCCS colleges. Values provided are median values within dataset.

Days Since Rain	TP (lbs/ton)[1]	TN (lbs/ton)[1]	TSS (≤ 841 µm) (lbs/ton)[2]
≤ 2	0.044	1.188	794 (39.7%)
> 2	0.324	1.336	1,308 (65.4%)

[1] Values applied to material swept < 841 µm (computed with last column).

[2] Adjusted using a moisture content of 2.2% to compute dry weight, the median value measured in samples presented by Hixon and Dymond (2019).

In review of **Table 4.1**, it is noted that the 2020-2021 sweeping efforts were minimal, resulting in reductions well below the targets. Although results from 2019-2020 indicate potential for sweeping to achieve the required reductions, an increase in sweeping efforts would be necessary. However, there is additional uncertainty regarding the ability for sweeping to achieve the pollutant reduction targets since the values in **Table 4.1** are based on the Refined Sampling Method that finds higher pollutant reductions than the method presented in the new DEQ guidance. Although guidance, and not regulation, DEQ may *require* the guidance be used for quantifying pollutant reductions. Further assessment of the two quantification methods is provided in the following Section.

4.1 Street Sweeping for Achieving 2023 Reduction Targets

This Section provides an assessment of the potential for street sweeping to achieve the required 2023 pollutant reductions based on both the Refined Sampling Method and the new DEQ Guidance method, the latter based on frequency of sweeping and sweeper type. Note the assessment of both methods is based on sweeping being performed with a regenerative-air or vacuum type sweeper.

4.1.1 Street Sweeping - Refined Sampling Method Quantification

To estimate the annual sweeping effort necessary to achieve the reduction targets, the refined values for quantifying pollutant reductions from **Table 4.2** are applied as:

$$Required\ Mass\ Swept\ (tons) = \frac{TN\ or\ TP\ Mass\ Removed\ (lb)}{(\%\ as\ TSS \times Concentration\ of\ TP\ or\ TN\ in\ lb/ton)} \quad (1)$$

Use of Equation 1 solves for required tonnage necessary as the values provided in **Table 4.3**. Based on quantification of reductions with the Refined Sampling Method, 33 tons of material would be required to be swept annually if sweeping occurs within 2 days since rainfall. If sweeping occurs when more than 2 days has passed since rainfall, 20 tons would need to be swept annually. It is noted these amounts may fluctuate over time as the values in the dataset are further refined with continued swept material sampling and analysis. A review of **Table 4.1** finds the 2019-2020 level of sweeping, which collected 13 tons, would annually need to be

increased 54% to 154% to achieve all of the required pollutant reductions, depending on if sweeping occurs after two days since rainfall, or before, respectively.

Table 4.3 Estimate of required tonnage of swept material to achieve the 2023 required reductions using the Refined Sampling Method for reduction quantification. Note: this pollutant reduction quantification method may not be accepted by DEQ.

Days Since Rain when Sweeping	TN	TP	TSS
	Material Swept (tons)	Material Swept (tons)	Material Swept (tons)
≤ 2	29	**33**	2
> 2	18	**20**	2
Target Achieved →	15.32 lbs/yr	4.15 lbs/yr	1,483 lbs/yr

4.1.2 Street Sweeping - New DEQ Guidance Quantification

The DEQ Guidance provides pollutant reduction credit based on the frequency a specified area is swept. The credit values are provided as a percentage of removal from the annual pollutant load generated from the swept area using the loading rates in **Table 2.2** for impervious cover. The values in the Guidance are based on data from street solids information and a model to determine street sweeping credit. However, these values are not based on calibrated sampling information in surface waters and the results are suspect. In contrast, the Refined Sampling Method is based on years of continuing sampling data that provides an actual measure of the portion of swept material and associated pollutants that would be transported from the swept surface ultimately to surface waters. The DEQ Guidance values dramatically reduce the pollutant reduction credits provided by previous DEQ Guidance and are significantly lower than reductions quantified with the Refined Sampling Method.

An analysis of campus mapping for VPCC's Hampton campus finds a total available area of approximately 26.5 acres for sweeping, including parking lots and campus-interior streets. Potential reductions based on various sweeping frequency over the 26.5 acres are provided in **Table 4.4**. Results in the Table show that pollutant reductions from sweeping based on the DEQ Guidance quantification methods do not provide the opportunity to achieve the required reductions with sweeping alone. However, sweeping may serve as a supplemental practice in the case the DEQ Guidance is required to be used in combination with other practices.

Table 4.4 Potential reductions from street sweeping at VPCC using the DEQ Guidance pollutant reduction quantification method (GM20-2003). Equivalent curb lane miles available = 26.5 acres.

Pollutant	Loading Rate (lbs/ac/yr)	Load (lbs/yr)	Total Load Reduction Credit (lbs/yr) *			
			Every 2 Months	Every Month	Every 2 Weeks	Every Week
TN	7.31	193.72	1.36 (9%)	1.93 (13%)	3.87 (25%)	5.82 (38%)
TP	1.51	40.02	0.80 (19%)	1.20 (29%)	2.00 (48%)	3.2 (77%)
TSS	456.68	12,102.02	484 (33%)	726 (49%)	1,331 (90%)	1,936 (131%)

* Within parenthesis are the percentage of total reductions achieved of those required by 2023.

4.2 Alternative Options for Achieving 2023 Reduction Targets

In the case the Refined Sampling Method is accepted by DEQ, sweeping efforts with the increases in efforts described in Section 4.1.1 would be adequate for achieving the 2023 reduction targets (20 – 33 tons annually). In the case the Refined Sampling Method is not accepted by DEQ and the DEQ Guidance must be used, additional BMPs to achieve reductions will be necessary. For the latter scenario, of the available means and methods available for achieving reductions, the following were identified to have the potential ability to supplement sweeping for VPCC: (1) structural SWM facilities, specifically underground proprietary filter systems, and (2) the purchase of nutrient credits.

4.2.1 Structural BMP(s)

Assessment of the installation of structural BMPs towards achieving the required 2023 pollutant reduction targets is based on the computation of area that would need to be treated to achieve the targets, both alone, and in combination with street sweeping. The assessment also depends on available locations on the college campus to install BMP(s) that can treat the computed drainage areas and also the type of BMP that could feasibly be installed. A summary of consideration of BMP types is provided in **Table 4.5**. The summary identifies only underground proprietary filtering devices as the BMP type to have the potential to achieve reductions towards achieving the 2023 targets. Depending on the sweeping scenario, 4.6 – 5.3 acres of impervious area would need to be treated (see **Table 4.6**). A review of the campus

layout and storm sewer system indicates 3 – 5 underground filter systems would be necessary to achieve the reductions.

Table 4.5 Summary of feasibility considerations for various types of structural BMP options.

Practice Type	Feasibility Considerations	Feasible?
Vegetated Roofs	Not feasible for existing buildings and could not provide significant reductions towards target reductions.	No
Rooftop Disconnection	Insufficient area of rooftop and very limited due to constructability (surface discharge of interior drains).	No
Permeable Pavement	Would require majority of all parking spaces on campus not draining to existing constructed wetlands be converted to porous pavement with sweeping still needed. Additional constructability constraints regarding grades and underdrains.	No
Grass channel	Insufficient opportunity and low reduction efficiency could not achieve target reductions.	No
Dry swale	Insufficient opportunity to capture significant impervious cover.	No
Bioretention	Insufficient opportunity to capture significant impervious cover due to depth of storm sewer. Also concern with ground water.	No
Infiltration	Insufficient opportunity to capture significant impervious cover due to depth of storm sewer and poor soils for infiltration.	No
Extended Detention Pond	Low reduction efficiency could not provide significant reductions towards target reductions.	No
Sheet Flow to Open Space	Insufficient opportunities and could not provide significant reductions towards target reductions. Lack of available space.	No
Wet swale	Insufficient opportunities and low reduction efficiency could not provide significant reductions towards target reductions.	No
Filtering Practices	Could achieve reductions. Would require underground proprietary systems at multiple locations placed in line with existing storm sewer. Groundwater could cause function issues.	Possible
Constructed wetlands or wet pond	Potential location south of Thomas Nelson Drive. However, appears to be insufficient area for anticipated footprint based on size of drainage area. Detailed survey and preliminary design could be considered for reductions required next permit cycle. Not feasible for installation this cycle if found physically feasible.	Potential, but not this permit cycle.

[1] Other means and methods allowable in the DEW Guidance to obtain reductions found not to be applicable to the campus or to provide only very small reductions.

Table 4.6 Required impervious aera needed for treatment by filtering practice BMPs with various sweeping scenarios. Values based on Chesapeake Bay Program established removal efficiencies for filters: TN = 40%, TP = 60% and TSS = 80%.

Structural BMP Scenario [1]	Required Acreage Needed for treatment by Filtering Device		
	TN	TP	TSS
No Sweeping	**5.30**	4.60	4.10
Every 2 Months	**4.70**	3.70	3.00
Once Monthly	**4.60**	3.30	2.10

[1] Sweeping more frequent than month assumed not practical.

4.2.2 Purchase of Perpetual Nutrient and TSS Credits

In accordance with § 62.1-44.19:21 of the Code of Virginia, "an MS4 permittee may acquire, use, and transfer nutrient credits for purposes of compliance with any waste load allocations established as effluent limitations in an MS4 permit …." This applies to phosphorous, nitrogen, and sediment. with purchase of sediment reduction credits signed into law by the Governor on March 1, 2016. Purchase of credits must be consistent with the following:

- ✓ The perpetual credits are generated and applied for purposes of compliance for the same calendar year;
- ✓ Credits are acquired no later than a date following the calendar year in which the credits are applied as specified by the Department consistent with VPCC MS4 permit annual report deadline under such permit;
- ✓ The credits are generated in the same locality or tributary; and
- ✓ The credits either are point source nitrogen or point source phosphorus credits generated by point sources covered by the general permit issued pursuant to § 62.1-44.19:14, or are certified pursuant to § 62.1-44.19:20.

With the development of this PER, it was confirmed that credits for the required 2023 reductions are currently available within the watershed; but these credits cannot be reserved or guaranteed at a future date. Specifically, available credit would be purchased per pound of TP with the following ratios: 1 lb. TP = 7.208 lb.TN = 492.85 lb. TSS. As a result, purchase of the required 2023 TP reductions would provide 195% and 138% of the required TN and TSS reductions, respectfully.

5.0 Phase II Compliance Practices

Findings in this PER identify limited means and methods for addressing the 2023 pollutant reduction targets with the potential of the new DEQ Guidance being required for quantifying street sweeping pollutant reductions. However, in the case of continued acceptance of the Refined Sampling Method, street sweeping does have the potential to address the required 2023 reductions with a dedicated annual sweeping program. In summary, the following scenarios have been identified as having potential to provide compliance with the required 2023 reductions:

- **Scenario 1 (Conditional on DEQ Acceptance)**: In the case of continued DEQ acceptance of the Refined Sampling Method, VPCC can achieve the 2023 pollutant reductions with annual sweeping of 20 – 33 tons of material collected and continued sampling and analyses as a measure of effectiveness; or
- **Scenario 2**: In the case that DEQ requires pollutant reduction quantification for street sweeping using the DEQ Guidance, proprietary underground filtering BMPs would be necessary to treat 4.6 – 5.3 acres, depending on the level of sweeping that would occur as part of this scenario (refer to Table 4.4); or
- **Scenario 3:** Purchase of TP, TN and TSS credits for the full reductions, or for partial reductions to supplement a selected sweeping frequency (refer to **Table 4.4**).

5.1 Scenario 1 Considerations

This requires DEQ acceptance of the Refined sampling method, and thus does not guarantee compliance with the required 2023 pollutant reductions. The DEQ Guidance states it "… does not mandate any particular method nor does it prohibit any alternative method." The Guidance also states, "If alternative proposals are made, such proposals should be reviewed and accepted or denied based on their technical adequacy and compliance with appropriate laws and regulations." Therefore, the continued acceptance of the sampling methods utilized by VPCC and other Virginia Community College System (VCCS) colleges over the current permit cycle are dependent on DEQ review and acceptance for future compliance, which is not likely to be immediately forthcoming. The Refined Sampling Method is suggested to have technical compliance based on the following:

- ✓ Quantification is only based on the portion of collected material that would be expected to be transported in runoff to downstream receiving waters.
- ✓ TN and TP concentrations are estimated based on chemical analysis at a certified laboratory for the sieved portion of material associated with the particles expected to be transported in runoff to downstream receiving waters.
- ✓ Participating colleges take multiple samples each year of swept material as a measure of effectiveness, with results included in a database to continue tightening the statical significance of the data. Quantification values are revised, as necessary, for annual reporting.

This scenario has the smallest impact on the college regarding cost and resources, but the quantification method is not guaranteed to be accepted by DEQ and requires annual implementation to a compliant level, which has not been consistency implemented over the past couple of years. However, there is potential the Refined Sampling Method will continue to be accepted by DEQ and is therefore recommended to be implemented and reported in combination with Scenario 3, as a fail-safe (see Section 5.3). *Note: this scenario is not recommended without purchase of nutrient credits as a fail-safe for compliance.*

5.2 Scenario 2 Considerations

Scenario 2, based on the case the DEQ Guidance quantification is required, has a significant impact whereas multiple proprietary underground filters would be necessary to achieve the required reductions, even with implementation of a street sweeping program (see **Table 5.1**). Further, due to the time necessary for budgeting, planning, design and construction, the option of including underground proprietary filters at this scale is not feasible to achieve the pollutant reductions required by the October 2023 deadline. See also the cost considerations in Section 6.0. This scenario, in part, may want to be reconsidered in the next permit cycle, depending on the level of reductions achieved at that time.

Table 5.1 Estimate of required underground proprietary filtering BMPs dependent on combined sweeping program scenarios.

Sweeping Frequency	Remaining Reduction			Estimated Area Needing Treatment (acres)	Associated # of Underground Filtering BMPs [2]
	TN [1]	TP	TSS		
Every 2 Months	13.76	3.35	999	4.7	3 to 5
Monthly	13.19	2.95	757	4.6	3 to 5
Every 2 Weeks	11.25	2.15	152	3.9	3 to 4
Weekly	9.3	0.95	-453	3.2	2 to 3

[1] TN is limiting pollutant with filtering BMPs.
[2] See also Section 6.0 for cost considerations.

5.3 Scenario 3 Considerations (Recommended Scenario)

Due to uncertainty regarding compliance with Scenario 1 and the feasibility constraints of Scenario 2, this Scenario is recommended for implementation to achieve the 2023 pollutant reduction targets. The implementation of Scenario 3 is proposed with the following concurrent steps:

1. As soon as possible, VPCC is recommended to purchase nutrient credits for the full reductions required by 2023 (equivalent to 4.15 lbs of TP); and
2. (***Optional***) VPCC is recommended to continue street sweeping to a level that ensures compliance with the 2023 pollutant reductions based on the Refined Sampling Method, including continued sampling. It is recommended that this method continue to be used for annual reporting. This approach allows for:
    - *Potential* credit from sweeping at a level quantified by the Refined Sampling Method in the case of continued acceptance by DEQ through the annual reporting process. In this case, the credits purchased in Step 1 can be applied to future reductions required in the subsequent permit cycle beginning after October 2023. The credits would also be available if sweeping efforts resulted in less mass swept than necessary for compliance in any given year.
    - In the case the Refined Sampling Method is no longer accepted by DEQ, the credits from Step 1 can be used to ensure compliance.

If VPCC decides not to continue street sweeping, Step 1 would be sufficient to ensure compliance and the necessary credits should be purchased as soon as possible, ideally prior to the end of the calendar year to ensure they can be applied prior to the pollutant reduction deadline.

6.0 Cost Considerations

As demonstrated in this PER, opportunities to achieve the required pollutant reductions by 2023 for the Chesapeake Bay TMDL are limited to scenarios involving street sweeping or purchase of nutrient credits, or a combination of the two. In the case that sweeping is paired with sweeping and anticipating that the DEQ Guidance for pollutant reduction quantification has to be used, the required amount of credit that would need to be purchased is associated with the remaining TP reductions in **Table 5.1**. For example, if street sweeping is not employed as a practice, 4.15 lbs. of TP would need to be purchased; but if sweeping occurred monthly, 2.95 lbs. would need to be purchased. A summary of associated costs for the Scenarios described in Section 5 are provided in **Table 6.1**. Purchase of nutrient credits is by far the most cost-effective option for VPCC. Scenario 2 not feasible within timeframe, but provided for comparison.

Table 6.1 Cost estimates based on identified scenarios for achieving compliance of the required 2023 Chesapeake Bay TMDL pollutant reductions.

Scenario	Implementation Description	Implementation Cost ($)	Notes
1	Sweep 30 tons/year quantify using Refined Sampling Method. Not guaranteed for acceptance by DEQ at this time. Requires implementation of Scenario 3, as fail-safe.	See notes	Recommended college use past sweeping cost for estimate. Recommend cost for 2019 sweeping with a multiplier of 3.
2	Underground filters with no sweeping or sweeping every 2 months, 3 to 5 BMPs required.	$680,000 to $1,105,000 + Cost associated with Scenario 1 for sweeping	Cost range for filters - estimated cost for survey, design, construction and construction administration + sweeping costs. Not feasible within timeframe.
	Underground filters with sweeping every 2 weeks, 3 to 5 BMPs required.	$680,000 to $895,000 + plus sweeper cost $280,000 [1]	
	Underground filters with weekly sweeping, 3 to 5 BMPs required.	$470,000 to $680,000 + plus sweeper cost $280,000 [1]	
3	Purchase of full nutrient credits to achieve the 2023 reduction targets.	$74,700 + Cost associated with Scenario 1 for sweeping (sweeping optional) [2]	Cost based on purchase of 4.15 lbs. TP at $18,000/lb.

[1] Assumes sweeping frequency necessitates purchase of sweeper.
[2] Sweeping optional, but allows for opportunity to receive credit using the Refined Sampling Method that could be applied to required future reductions.