



# CHESAPEAKE BAY TMDL ACTION PLAN

VSMP MS4 Permit No. VA0088650

*Prepared for:*

City of Norfolk, Department of Public Works  
Division of Environmental Management  
2233 McKann Avenue  
Norfolk, Virginia 23509

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WRA Project No. 019512.008

**June 2018**





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## ABBREVIATIONS

BMP	Best Management Practice
CDA	Contributing Drainage Area
City	City of Norfolk
CWA	Clean Water Act
FY	Fiscal Year
HRPDC	Hampton Roads Planning District Commission
HRSD	Hampton Roads Sanitation District
HUC	Hydrologic Unit Code
LA	Load Allocation
LIDAR	Light Detection and Ranging
MLA	Mass Loading Approach
MOS	Margin of Safety
MOU	Memorandum of Understanding
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
PARS	Permit Administration and Review System
POC	Pollutant of Concern
QSLM	Qualifying Street Lanes Method
SWIFT	Sustainable Water Initiative for Tomorrow
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
VDEQ	Virginia Department of Environmental Quality
VDOT	Virginia Department of Transportation
VSMP	Virginia Stormwater Management Program
VPDES	Virginia Pollutant Discharge Elimination System
WLA	Waste Load Allocation



## **1.0 INTRODUCTION AND BACKGROUND**

### **1.1 Purpose**

With a continued commitment to water quality improvement, the City of Norfolk (City) has developed this Action Plan to address the Chesapeake Bay Total Maximum Daily Load (TMDL) reduction requirements as outlined in the Municipal Separate Storm Sewer Permit (MS4) No. VA0088650. The City is pleased to have this opportunity to provide specific information including local baseline data and potential implementation strategies specific to Norfolk's unique environment. Due to the Chesapeake Bay's proximity to the City, it provides direct economic benefits through increased tourism, diverse fisheries, and an enhanced quality of life for residents; therefore, the City is devoted to seeing the Bay clean-up efforts succeed.

This report provides area-specific baseline data collection of best management practices implemented by the City. Additionally, the report outlines proposed strategies to meet established waste load allocations (WLA) for total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS). The City understands our role and responsibilities in the implementation of relevant local strategies to support Virginia's demonstration of reasonable assurance of TMDL compliance. The City is dedicated to improving the quality of the Chesapeake Bay, thereby also guaranteeing improved local water quality.

The Clean Water Act (CWA) requires States to designate their waters with appropriate uses (e.g. swimming, drinking, shellfish harvesting, etc.) and to adopt water quality standards protective of those designated uses. When waters do not meet these standards, the CWA requires the development of a Total Maximum Daily Load (TMDL), or the maximum amount of pollutant that a waterbody can receive without exceeding the water quality standard.

The City is authorized to discharge stormwater from all existing and new municipal separate stormwater point source discharges to surface waters under its MS4 permit. Parts 1.A.6 and I.D of the permit require the City to maintain an updated MS4 Program Plan that includes TMDL Action Plans for pollutants for which waste loads have been allocated to the MS4 in approved TMDL studies.

The City's MS4 Permit and this TMDL Action Plan serve as the regulatory mechanisms for addressing the load reductions described in the Chesapeake Bay TMDL and assigned to the City in the MS4 permit. The Virginia Department of Environmental Quality (VDEQ) requires MS4 operators to address the required waste loads through the implementation of best management practices (BMPs), legal authorities, and other programs implemented to address the pollutants of concern (POC). This TMDL Action Plan addresses reductions of POCs to the Chesapeake Bay, specifically TN, TP and TSS.

### **1.2 Total Maximum Daily Loads and Waste Load Allocations**

A TMDL is defined as the total maximum daily load, or the maximum amount of pollutant, that a waterbody can receive without exceeding the water quality standard for that pollutant. TMDLs are calculated by summing up the following three components, which together equal the TMDL assigned to a specific waterbody:

- Waste Load Allocations (WLA) for point source contributions are discharges from identifiable sources at specific locations. The City's MS4 outfalls are defined as point source discharges and therefore fall under this category.
- Load Allocations (LA) for non-point source contributions that are from unidentifiable sources or locations and originate over a relatively large area.
- Margin of Safety (MOS) is a required component that accounts for the modeling uncertainty and other unknown factors.

The City's MS4 permit presents the applicable TMDLs as WLAs and they are the major component of the required pollutant reductions needed to meet water quality standards.

### **1.3 Public Notification and Comment**

This TMDL Action Plan has been subjected to public notification and review. The Action Plan was published on the City of Norfolk website between May 4 and June 4, 2018 for public comment. Email notifications of the comment period were sent to contacts lists for Keep Norfolk Beautiful, Bay Star Homes, and Civic League Presidents. A copy of the comments received and any action taken as a result of the comments is provided in **Appendix C**.

## 2.0 CURRENT MS4 PROGRAM AND OTHER LEGAL AUTHORITIES

Norfolk has developed an MS4 Program Plan in accordance with Virginia Stormwater Management Law, Virginia Stormwater Management Regulations, and MS4 Permit requirements. The Program Plan was most recently revised and submitted to VDEQ in June 2017.

Part 1.D.1.b)1)(a) of the City’s MS4 permit requires the City to include “... a review of the current MS4 Program Plan including existing legal authorities and the permittee’s ability to ensure compliance with this special condition.”

A review of City Codes and Ordinances was conducted during development of this TMDL Action Plan. During the course of its review, the City has determined that it currently possesses all required legal authority to ensure compliance with the Chesapeake Bay Special Conditions specified in the City’s MS4 permit. **Table 2-1** identifies the existing legal authority permitting Norfolk to execute its MS4 Program Plan and this TMDL Action Plan.

**Table 2-1. Legal Authority**

Item	Date
Norfolk City Code, Chapter 14.5: Environmental Offenses	April 13, 1999
Norfolk City Code, Chapter 15: Erosion and Sediment Control	July 1, 2014
Norfolk City Code, Chapter 41.1: Stormwater Management	July 1, 2014
Norfolk City Code, Chapter 41.2: Virginia Stormwater Management Program	July 1, 2014
Norfolk City Code, Chapter 42.5: Subdivisions	July 22, 2014
Norfolk City Code, Chapter 45: Trees and Other Vegetation	February 28, 2012
Norfolk City Code, Chapter 49: Wetlands and Coastal Primary Sand Dunes	July 1, 2016
Norfolk City Code, Appendix A, Zoning Ordinance, Article 3.9.6: CBPA-O: Chesapeake Bay Preservation Area Overlay	March 1, 2018
Norfolk City Code, Appendix A, Zoning Ordinance, Article 5: Development Standards	March 1, 2018

A full copy of the City of Norfolk Stormwater Management Ordinances can be found on the City’s Municode system located online at [https://library.municode.com/va/norfolk/codes/code\\_of\\_ordinances](https://library.municode.com/va/norfolk/codes/code_of_ordinances).

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### **3.0 NEW OR MODIFIED LEGAL AUTHORITIES**

Part 1.D.1.b)1)(b) of the MS4 Permit requires the City to include "... any new or modified legal authorities, such as ordinances, permits, orders, contracts and inter-jurisdictional agreements, implemented or needing to be implemented to meet the requirements of this special condition."

No new or modified legal authorities are currently planned or necessary to meet the Special Condition requirements.

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#### **4.0 MEANS AND METHODS TO ADDRESS DISCHARGES FROM NEW SOURCES**

Part 1.D.1.b)1)(c) of MS4 Permit No. VA 0088650 requires the City to include “...the means and methods utilized to address discharges into the MS4 from new sources.”

New sources are defined by VDEQ as urban land uses served by the MS4 on or after July 1, 2009 which are modified through development or redevelopment. To address the compliance requirements of the Virginia Stormwater Management Regulations, the City of Norfolk has adopted the Norfolk Stormwater Design and Construction Manual into its local ordinance (Ord. No. 45,534, § 1, 5-13-14, eff. 7-1-14). All development and redevelopment projects undergoing site plan review must comply with the requirements of the manual. Additionally, all land disturbance activities exceeding 2,500 square feet must have an approved stormwater management plan and erosion and sediment control plan.

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## 5.0 ESTIMATE OF THE ANNUAL POC LOADS

Part 1.D.1.b)1)(d) of MS4 Permit No. VA 0088650 requires the City to include “... an estimate of the annual POC loads discharged from the existing sources as of June 30, 2009 based on the 2009 progress run.”

The MS4 Permit requires Norfolk to estimate existing POC source loads utilizing the POC unit loading rates provided in Tables 1.a and Table 1.b of its MS4 permit for the James River Basin and the Little Creek Watershed, respectively. The City previously delineated the MS4 service area and used the results of the land use analysis to estimate the annual pollutant loads of TP, TN, and TSS discharged from the regulated MS4 service area. **Figure 5-1** illustrates the regulated MS4 service area, while Sections 5.1 and 5.2 provide an analysis of the annual POC loadings.

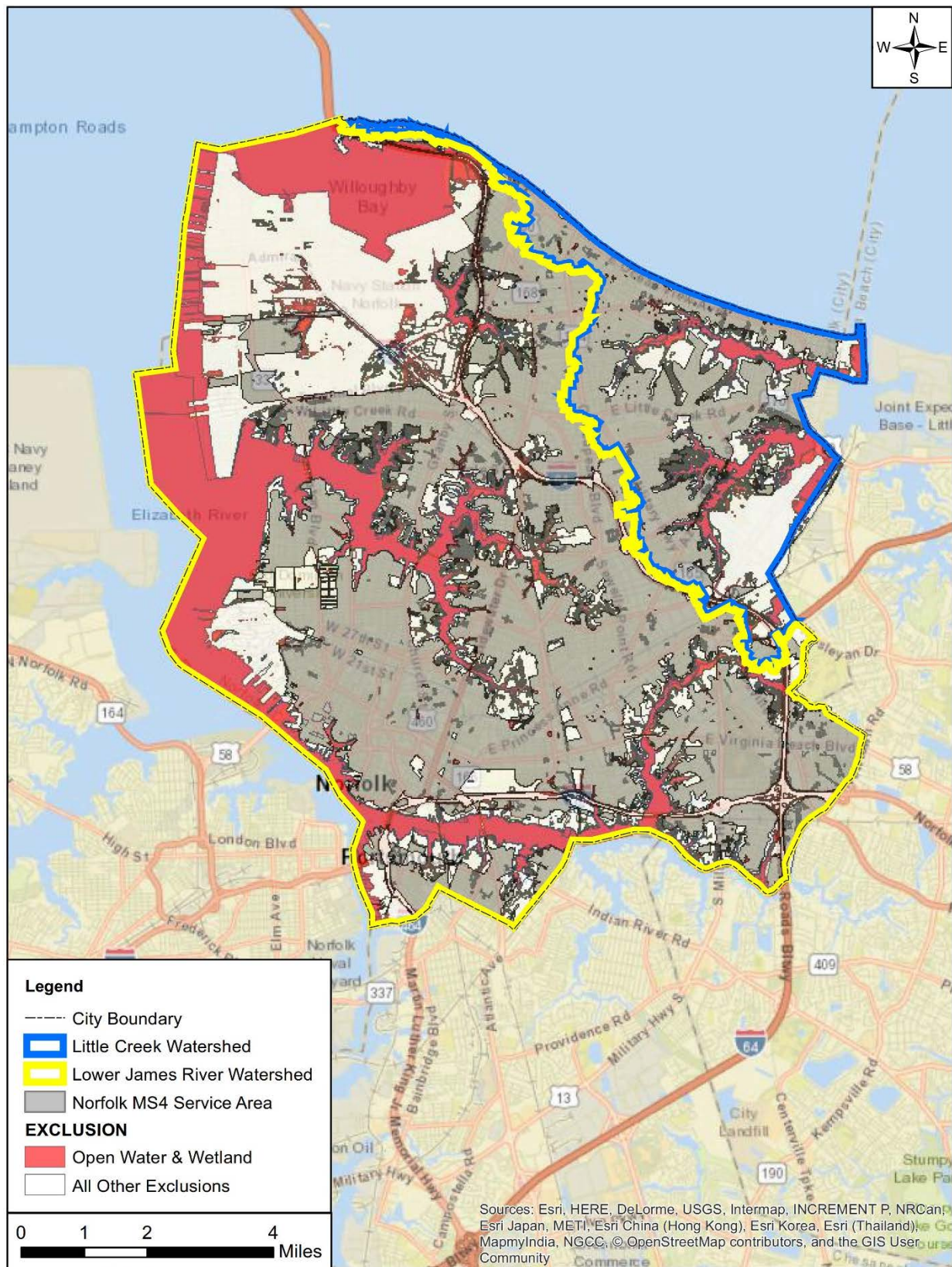
### 5.1 MS4 Service Area and Exclusions

The MS4 service area defines lands which drain to a City-owned/maintained storm sewer system. From a regulatory perspective, pollutants generated from these lands are the responsibility of the City. Delineating the MS4 service area is a critical step in the TMDL action planning process. It determines both the annual pollutant loads to the Chesapeake Bay from the regulated MS4 as well as the required nutrient reductions required by the City. These issues are addressed in Sections 5.2 and 6.0 through 6.3, respectively. Norfolk’s Department of Public Works Division of Environmental Stormwater Management previously delineated the City’s MS4 service area utilizing older maps which were recently digitalized, GIS shapefiles of the City’s stormwater network, field verifications, available aerial photography, and LIDAR elevation data. The effort excluded the following lands within the MS4 service area:

- other Phase II MS4 service areas;
- property within the Virginia Department of Transportation (VDOT) right-of-way;
- sites with individual Virginia Pollutant Discharge Elimination System (VPDES) permits;
- contiguous forested areas greater than 900 m<sup>2</sup> (0.22 acres);
- wetlands and open water; and,
- lands draining directly to natural waterways not entering the regulated storm sewer system.

As seen in **Table 5-1**, of the approximate 43,000 acres within the Norfolk city boundary, roughly 20,100 acres are defined as the City’s responsibility, comprised of approximately 11,300 acres of regulated urban impervious lands and 8,800 acres of regulated pervious lands.

**Figure 5-1. MS4 Service Area**



**Table 5-1. Summary of Regulated and Excluded Land Uses**

Regulated and Excluded Land Uses	HUC6 Watershed		Total
	Little Creek	Lower James River	
<b>Exclusions</b>			
Open Water	856.5	7466.8	8,323.3
Wetlands	111.5	567.4	678.9
Direct Drainage	1,203.4	2971.2	4,174.7
Forested Lands	487.9	1,303.2	1,791.1
Other MS4 Operator	0.0	377.3	377.3
VDOT MS4	76.0	913.8	989.8
VPDES Stormwater Permittee	863.7	5,618.9	6,482.6
<b>Total Exclusions</b>	<b>3,599.0</b>	<b>19,218.6</b>	<b>22,817.6</b>
<b>Regulated MS4 Service Area</b>			
Regulated Urban, Impervious	2,060.6	9,249.9	11,310.5
Regulated Urban, Pervious	1,929.2	6,892.0	8,821.2
<b>Total Regulated MS4</b>	<b>3,989.8</b>	<b>16,141.9</b>	<b>20,131.7</b>
<b>TOTAL, CITY OF NORFOLK</b>	<b>7,588.8</b>	<b>35,360.5</b>	<b>42,949.3</b>

**5.2 Nutrient and Sediment Loadings**

The regulated urban land use acreages discussed above were further defined by HUC6 watershed to apply the appropriate POC unit loading rates. The regulated MS4 service area was found to be 20,131.7 acres (11,310.5 acres of regulated impervious area and 8,821.2 acres of regulated pervious area). 16,141.9 acres (9,249.9 acres of regulated impervious area and 6,892.0 acres of regulated pervious area) of the regulated MS4 are located in the James River Basin while 3,989.8 acres (2,060.6 acres of regulated impervious area and 1,929.2 acres of regulated pervious area) are located in the Little Creek Watershed.

The POC unit loading rates, provided as Tables 1a and 1b of MS4 Permit No. VA0088650, are multiplied by the urban regulated impervious and pervious land uses served by the MS4 to obtain annual TN, TP, and TSS loadings to the Chesapeake Bay. **Table 5-2** and **Table 5-3** present a summary of the existing POC source loads to the Chesapeake Bay from the James River and Little Creek watersheds, respectively.

**Table 5-2. Existing POC Source Loads - James River Basin**

Pollutant of Concern	Subsource	Total Existing Acres Served by MS4 (6/30/09)	2009 EOS Loading Rate (lbs/ac/yr)	Estimated Total POC Load Based on 2009 Progress Run (lb/yr)
Nitrogen	Regulated Urban Impervious	9,249.9	9.574666034	88,565
	Regulated Urban Pervious	6,892.0	6.843763814	47,167
	<b>Total</b>			<b>135,732</b>
Phosphorus	Regulated Urban Impervious	9,249.9	1.786015931	16,520
	Regulated Urban Pervious	6,892.0	0.496330705	3,421
	<b>Total</b>			<b>19,941</b>
Total Suspended Solids	Regulated Urban Impervious	9,249.9	703.4240675	6,506,602
	Regulated Urban Pervious	6,892.0	103.763636	715,139
	<b>Total</b>			<b>7,221,741</b>

**Table 5-3. Existing POC Source Loads – Little Creek Watershed**

Pollutant of Concern	Subsource	Total Existing Acres Served by MS4 (6/30/09)	2009 EOS Loading Rate (lbs/ac/yr)	Estimated Total POC Load Based on 2009 Progress Run (lb/yr)
Nitrogen	Regulated Urban Impervious	2,060.6	8.711137964	17,950
	Regulated Urban Pervious	1,929.2	8.474634338	16,349
	<b>Total</b>			<b>34,299</b>
Phosphorus	Regulated Urban Impervious	2,060.6	1.548900585	3,192
	Regulated Urban Pervious	1,929.2	0.553383655	1,068
	<b>Total</b>			<b>4,260</b>
Total Suspended Solids	Regulated Urban Impervious	2,060.6	518.2273806	1,067,859
	Regulated Urban Pervious	1,929.2	78.9393873	152,290
	<b>Total</b>			<b>1,220,149</b>

## 6.0 DETERMINATION OF THE TOTAL POLLUTANT LOAD REDUCTIONS

Part 1.D.1.b)1)(e) of the MS4 permit requires the City to include “... a determination of the total pollutant load reductions necessary to reduce the annual POC existing loads.”

The City’s MS4 permit requires Norfolk to reduce pollutant loadings to the Chesapeake Bay, with the nutrient and sediment reduction requirement split over three permit cycles. The first (current) permit cycle required reduction is 5% of the total requirement, with the second and third permit phases requiring additional POC reductions of 35% and 60%, respectively.

### 6.1 First (Current) Permit Cycle Required POC Load Reductions – Baseline

Tables 2a and 2b of MS4 Permit No. VA0088650 provide the unit loading rates for required POC reductions for the first (current) permit cycle. These loading rates are multiplied by the regulated urban impervious and pervious acres in each applicable watershed to obtain the City’s baseline POC reduction requirement for the current permit cycle. **Table 6-1** and **Table 6-2** present a summary of the City’s required POC source load reductions for the first (current) permit cycle from the James River and Little Creek watersheds, respectively. Based on the information provided in Tables 6-1 and 6-2, Norfolk has a combined annual first permit cycle baseline reduction requirement from all regulated lands of 669.8 pounds of TN, 174.0 pounds of TP, and 79,540 pounds of TSS.

**Table 6-1. Baseline POC Reductions Required – James River Basin**

Pollutant of Concern	Subsource	Total Existing Acres Served by MS4 (6/30/09)	First Permit Cycle Required Reduction in Loading Rate (lbs/ac/yr)	Baseline Reduction Required During First Permit Cycle (lbs/yr)
Nitrogen	Regulated Urban Impervious	9,249.9	0.043085997	398.5
	Regulated Urban Pervious	6,892.0	0.020531291	141.5
	<b>Total</b>			<b>540.0</b>
Phosphorus	Regulated Urban Impervious	9,249.9	0.014288127	132.2
	Regulated Urban Pervious	6,892.0	0.001799199	12.4
	<b>Total</b>			<b>144.6</b>
Total Suspended Solids	Regulated Urban Impervious	9,249.9	7.034240675	65,066
	Regulated Urban Pervious	6,892.0	0.453965907	3,129
	<b>Total</b>			<b>68,195</b>

**Table 6-2. Baseline POC Reductions Required – Little Creek Watershed**

Pollutant of Concern	Subsource	Total Existing Acres Served by MS4 (6/30/09)	First Permit Cycle Required Reduction in Loading Rate (lbs/ac/yr)	Baseline Reduction Required During First Permit Cycle (lbs/yr)
Nitrogen	Regulated Urban Impervious	2,060.6	0.039200076	80.8
	Regulated Urban Pervious	1,929.2	0.025423903	49.0
	<b>Total</b>			<b>129.8</b>
Phosphorus	Regulated Urban Impervious	2,060.6	0.012391205	25.5
	Regulated Urban Pervious	1,929.2	0.002006016	3.9
	<b>Total</b>			<b>29.4</b>
Total Suspended Solids	Regulated Urban Impervious	2,060.6	5.182279806	10,679
	Regulated Urban Pervious	1,929.2	0.345361794	666
	<b>Total</b>			<b>11,345</b>

**6.2 First (Current) Permit Cycle Required POC Load Reductions – Additional 15%**

Part 1.D.1.b)1)(g) of the MS4 permit requires the City to include “... the means and methods to reduce 15% of total pollutant load reduction calculated in (e) to offset increased loads from new sources initiating construction between July 1, 2009 and June 30, 2014 and grandfathered projects in accordance with 9VAC25-870-48 ...”

Grandfathered projects are stormwater management practices built after June 30, 2014 which utilized the Virginia Stormwater Management Handbook design guidelines and which disturb one acre or greater of land with an average impervious land cover greater than 16% for the design of post development stormwater management facilities. To satisfy this requirement, the City has agreed to reduce its POC loadings by an additional 15% during the first permit cycle for a total first permit cycle reduction requirement of 5.75% (1.15 x 5%).

**6.3 First (Current) Permit Cycle Required POC Load Reductions – Total**

**Table 6-3** provides a summary of the City’s baseline, additional 15%, and total POC reduction requirements for the first (current) permit cycle. Norfolk’s total annual required POC loading reductions to the Chesapeake Bay over the first permit cycle (July 1, 2016 through June 30, 2021), including the additional 15% reduction, are 770.3 pounds of TN, 200.1 pounds of TP, and 91,471 pounds of TSS.

Section 7.0 identifies the means and methods being implemented by the City of Norfolk during the first permit cycle to meet its nutrient reduction requirements. These projects also serve as the means and methods to reduce pollutant loads by the additional 15%.

**Table 6-3. Total Required POC Load Reductions – First Permit Cycle**

Pollutant of Concern	Baseline Reduction Requirement (5.00%) (lb/yr)	Additional 15% Reduction Requirement (0.75%) (lb/yr)	Total Reduction Requirement (5.75%) (lb/yr)
Nitrogen (TN)	669.8	100.5	770.3
Phosphorous (TP)	174.0	26.1	200.1
Total Suspended Solids (TSS)	79,540	11,931	91,471

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## 7.0 MEANS AND METHODS TO MEET THE REQUIRED REDUCTIONS AND SCHEDULE

Part 1.D.1.b)1)(f) of the MS4 permit requires the City to include “... the means and methods, such as management practices and retrofit programs, that will be utilized to meet the required reductions identified in Part 1.D.1.b)1)(e) and a schedule to achieve those reductions.” The projects identified in this section satisfy this permit requirement as well as the requirement presented in Part 1.D.1.b)1)(g) of the permit which requires the City to include “... the means and methods to reduce 15% of total pollutant load reduction calculated in (e) to offset increased loads from new sources initiating construction between July 1, 2009 and June 30, 2014 and grandfathered projects in accordance with 9VAC25-870-48.” The projects employed to address the MS4 permit requirements stated above are presented in this section collectively rather than separately.

The following sections provide the means and methods used by Norfolk to satisfy its TMDL POC first (current) cycle POC load reduction requirements.

### 7.1 Methodology for Estimating POC Removals

Sections 7.2 through 7.5 describe POC reduction credits available to the City through active, planned and under construction BMPs located throughout the City. Because TP is the keystone pollutant, typically projects only track the TP reductions achieved, and not TN or TSS. Additionally, phosphorus reduction credits for several of the project types discussed in the subsections below must account for a baseline phosphorus reduction for land disturbance activities, and any phosphorus reductions achieved above that baseline are creditable. State code 9VAC25-870-47 defines this baseline reduction for land disturbing activities based on the date the land disturbance permit was issued. Permits issued before July 1, 2014 are subject to Part II C technical criteria and permits issued on or after July 1, 2014 are subject to Part II B technical criteria. These technical criteria were established “to protect the quality of state waters and to control the discharge of stormwater pollutants.” There are no baseline reduction requirements for nitrogen or total suspended solids loads.

**Table 7-1**, included as Table 3 in the MS4 permit, provides conversion ratios for equivalent TN and TSS pollutant loads based on a known TP load. These equivalent loads can then be multiplied by removal efficiencies for the respective BMP to obtain nitrogen and total suspended solids reductions. When available, POC reductions were obtained from design documents. Table 7-1 was utilized in this Action Plan when only phosphorus reduction data was available.

**Table 7-1. Ratio of TP Loading Rate to TN and TSS Loading Rates**

Ratio of TP to Other POCs (Based on All Land Uses 2009 Progress Run)	TP Loading Rate (lb/ac/yr)	TN Loading Rate (lb/ac/yr)	TSS Loading Rate (lb/ac/yr)
James River Basin	1.0	5.1	423.5
Little Creek Watershed	1.0	9.2	266.0

Part II C technical criteria requires the total phosphorus load discharging from new development projects to not exceed 0.45 pounds of phosphorus per acre per year. Part II B is more stringent than

earlier technical criteria and requires the total phosphorus load leaving the site to be less than 0.41 pounds of phosphorus per acre per year. All of the projects analyzed in this effort were the result of redevelopment activities with no baseline removal requirement.

In 2007, an electronic tracking mechanism called PARS (Permit Administration and Review System) was developed to track structural BMPs as well as additional site specific information. Through the 2007-2008 inspection year, the Environmental Specialist, in coordination with the annual structural BMP inspections, continuously confirmed and revised data captured as compared to paper files on record, including approved site plan sheets, post-construction water quality/quantity worksheets, and project narratives. By 2008, the data captured in PARS contained all information currently on file for all structural BMPs. The PARS data served as the primary data source for completing this TMDL Action Plan.

The process for developing pollutant loads and pollutant removals during the development of this TMDL Action Plan is described below and illustrated graphically in **Figure 7-1**.

Step 1: Obtain Site and BMP Data from the PARS System - Data on all BMPs in Norfolk, both public and private, were obtained from the City's HRPDC Permit Administration and Review System (PARS) account. PARS tracks and stores information regarding all active BMPs located throughout the City. Applicable data for this analysis included hydrologic unit code (HUC), BMP type, date online, contributing drainage area (CDA), total site area, site impervious area and TP reduction achieved. GIS was employed to determine whether or not a BMP is in the MS4 service area, i.e., regulated or unregulated land.

Step 2: Remove Non-Creditable BMPs – Using the date online, status, and comment fields, non-qualifying BMPs were removed from further consideration. These included:

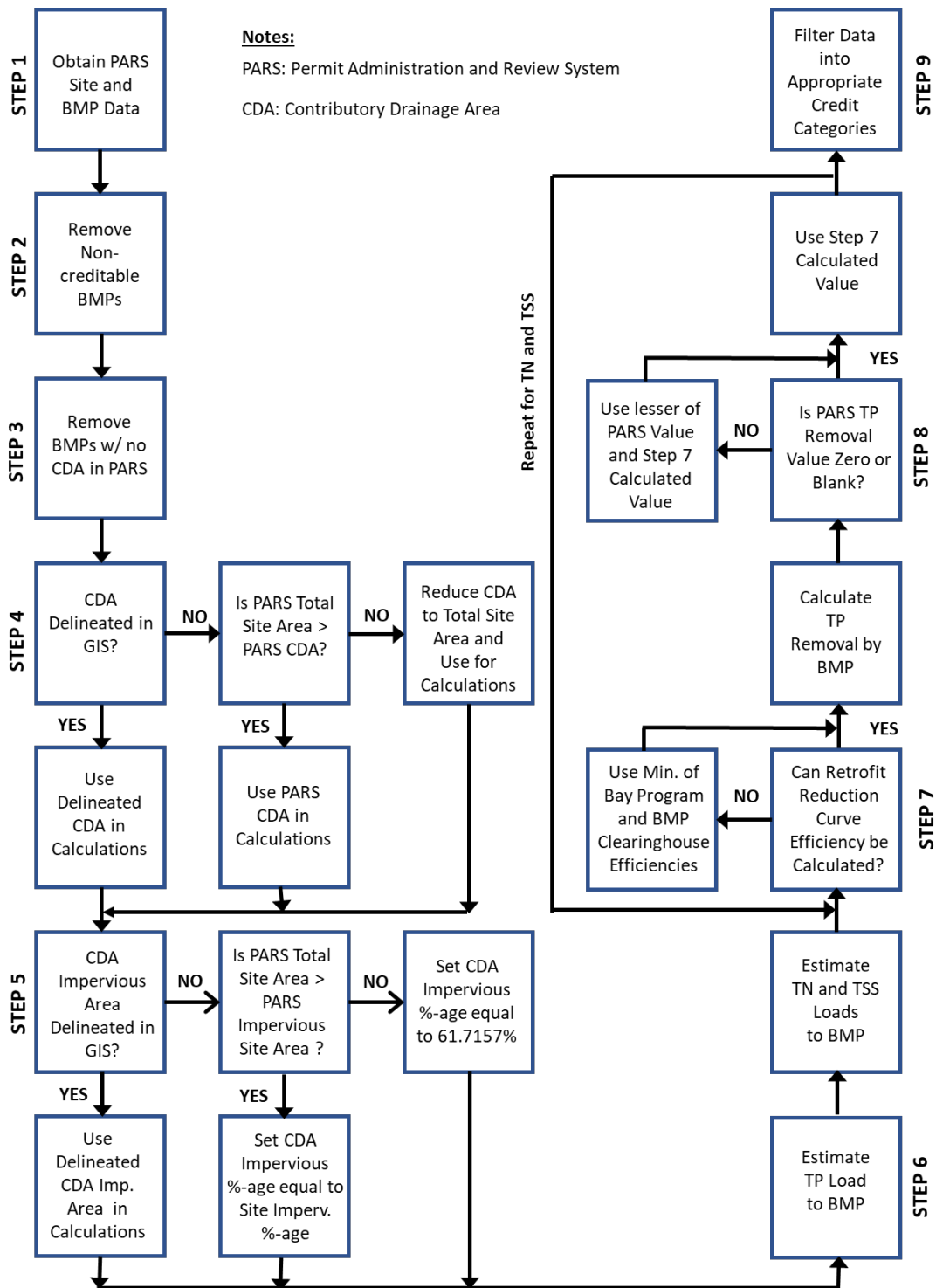
- BMPs implemented to address only water quantity;
- BMPs constructed prior to January 1, 2006; and,
- BMPs which had been archived and were no longer active.

Step 3: Remove BMPs with no contributory drainage area (CDA) contained in PARS – Pollutant loads were incapable of being estimated for BMPs without a CDA.

Step 4: Select Appropriate/Conservative CDA Value for Calculations – If the CDA for a BMP was based on an actual delineation present in the GIS, that CDA was used for calculations. If no CDA was available in GIS and the PARS Total Site Area was greater than the PARS CDA, the PARS CDA was used for calculations. If no CDA was available in GIS and the PARS Total Site Area was less than the PARS CDA, the PARS CDA was reduced to the PARS Total Site Area.

Step 5: Estimate CDA Impervious Area - If the CDA impervious area for a BMP was based on an actual delineation present in the GIS, that CDA impervious area was used for calculations. If no CDA impervious area was available in GIS and the PARS Total Site Area was greater than the PARS Site Impervious Area, the CDA impervious area was established as at the same level of imperviousness of the site. If no CDA impervious area was available in GIS and no PARS Site Impervious Area was available, the CDA imperviousness was set at 61.7157 % based on an analysis of previously delineated BMPs (r-squared > 0.90).

**Figure 7-1. Methodology for Estimating BMP POC Removals**



Step 6: Estimate POC Loads to BMP – POC Loads to each BMP were developed using the CDA impervious area selected in Step 5. TP was estimated using the equation

$$\text{TP Load to BMP} = [0.05 + (0.009 * (\text{CDA Impervious Area}))] * 2.28$$

TN and TSS POC loads to the BMP were estimated from the TP load to the BMP and the conversion factors presented in Table 7-1.

Step 7: Estimate POC Load Reductions by BMP – As a matter of consistency, all POC removals were estimated using the 5<sup>th</sup>-order polynomial equations for the applicable retrofit reduction curves for the type of BMP under consideration, i.e. runoff reduction (RR) or stormwater treatment (ST). Where a value was not calculable, the minimum value of the Chesapeake Bay Program BMP efficiencies and the BMP Clearinghouse efficiencies were selected for calculations.

Step 8: Select POC Reduction Credit – If the value for the POC removal in PARS was zero or blank, the POC removal estimated using the methodology described above was selected for credit. If a non-zero value for the POC removal was available in PARS, the lesser of the PARS entry and the value estimated using the described methodology was selected for credit.

Step 9: Filter Data into Appropriate Credit Categories – Following all calculations, the data was filtered to sort each BMP into the appropriate category corresponding to Sections 7.2 through 7.5 of this TMDL Action Plan.

## 7.2 Credit for BMPs Implemented on Unregulated Lands

Part 1.D.1.b)2)(a) of the MS4 permit allows credit for “... implementation of BMPs on unregulated lands provided the baseline reduction is subtracted from the total reduction prior to application of the reduction towards meeting the required reductions.” Following the exclusion of non-qualifying BMPs as discussed in Section 7.1, the City identified BMPs which meet the reporting criteria for credit on unregulated lands. All of these BMPs are the result of redevelopment. **Table 7-2** provides a summary of the POC reductions achieved by applicable watershed. A comprehensive list of qualifying BMPs installed on unregulated lands is included as **Table A.1** and **Table A.2** in Appendix A.

**Table 7-2. Credit for BMPs Implemented on Unregulated Lands**

HUC 6 Watershed	Reference Table	POC Reductions (lbs/yr)		
		TN	TP	TSS
James River Basin	A.1	289	51	38,955
Little Creek Watershed	A.2	1,003	158	54,491
	Total	1,292	209	93,446

## 7.3 Credit for BMPs Installed to Meet Development/Redevelopment Requirements

Part III, Section 3 of *Guidance Memo No. 15-2005, Chesapeake Bay TMDL Special Condition Guidance, May 18, 2015*, allows permittees to receive POC reduction credits for BMPs installed to meet development/redevelopment provided any necessary baseline reductions are not included. Following the exclusion of non-qualifying BMPs as discussed in Section 7.1, the City identified BMPs

which meet the reporting criteria for credit, including baseline pollutant removal requirements. **Table 7-3** provides a summary of the POC reductions achieved by applicable watershed. A comprehensive list of qualifying BMPs installed on unregulated lands is included as **Table A.3** and **Table A.4** in Appendix A. All of the BMPs are the result of redevelopment.

**Table 7-3. Credit for BMPs Installed to Meet Development/Redevelopment Requirements**

HUC 6 Watershed	Reference Table	POC Reductions (lbs/yr)		
		TN	TP	TSS
James River Basin	A.3	591	142	92,391
Little Creek Watershed	A.4	170	23	9,254
	Total	761	165	101,645

**7.4 Credit for BMPs and Impoundments Installed Prior to July 1, 2009**

Part IV, Section 2 of *Guidance Memo No. 15-2005, Chesapeake Bay TMDL Special Condition Guidance, May 18, 2015*, prepared by the VDEQ allows permittees to receive full POC reduction credits for previously unreported BMPs. To receive this credit, permittees must have submitted data on historical BMPs to VDEQ by the September 1, 2015 deadline. This deadline was established to ensure that previously unreported BMPs were included in the Phase 6 Chesapeake Bay Model. The creditable BMPs must have been constructed between January 1, 2006 and July 1, 2009 AND constructed to address water quality within the MS4 service area. To receive this credit, the City must provide an affirmative statement in its TMDL Action Plan indicating, to the maximum extent practicable, the City has submitted a complete list of historical BMPs before the deadline date. The City has complied with the above requirements, agrees with the noted provision, and is requesting allowable POC reduction credits for completing the historical data collection effort. The following statement is provided as required.

*“The City has completed and submitted its historical data for BMPs installed prior to June 30, 2013. This data was submitted to VDEQ on August 31, 2015, before the September 1, 2015 deadline.”*

As a result of the BMP historical data collection effort, the City identified BMPs which fall within the historical data reporting criteria. Non-qualifying BMPs were excluded as discussed in Section 7.1. **Table 7-4** provides a summary of the POC reductions achieved, broken down by applicable watershed. A comprehensive list of qualifying historic data BMPs is included as **Tables A.5** and **Table A.6** in Appendix A.

**Table 7-4. Credit for BMPs and Impoundments Installed Prior to July 1, 2009**

HUC 6 Watershed	Reference Table	POC Reductions (lbs/yr)		
		TN	TP	TSS
James River Basin	A.5	325	82	46,146
Little Creek Watershed	A.6	216	23	8,607
	Total	541	105	54,753

### 7.5 Credit for BMPS Retrofitting Prior Developed Lands

Part 1.B.2.b) of the City’s MS4 permit requires the City to complete “... no less than five (5) projects no later than the expiration date of this state permit.” The permit also stipulates that projects implemented to meet the Chesapeake Bay Special Conditions, Part 1.D. of the MS4 permit “...may be used to meet the requirements of this special condition.”

The City’s Fiscal Year 2017 Phase I MS4 Annual Report identifies numerous projects in both the James River Basin and the Little Creek Watershed being implemented during the first permit term aimed at satisfying the requirements of MS4 permit Part 1.B.2.b). These projects qualify for creditable POC reductions and receive total annual removals of 3,278 pounds of TN, 776 pounds of TP, and 366,872 pounds of TSS. The estimated cost to implement these projects is \$12,205,293. **Table 7-5** provides a summary of the POC reductions achieved by applicable watershed. The comprehensive list of BMPs retrofitting prior developed lands are provided as **Table A.7** and **Table A.8** in Appendix A.

**Table 7-5. Credit for BMPs Retrofitting Prior Developed Lands**

HUC 6 Watershed	Reference Table	POC Reductions (lbs/yr)		
		TN	TP	TSS
James River Basin	A.7	3,086	712	362,472
Little Creek Watershed	A.8	195	64	4,400
	Total	3,278	776	366,872

### 7.6 Credit for MOU BMPs with other MS4 Permittees

Part 1.D.1.b)2)(c) of the MS4 permit allows credit for “...establishment of a memorandum of understanding (MOU) with other MS4 permittees that discharge to the same or adjacent eight-digit hydrologic unit within the same basin to implement BMPs collectively. The MOU shall include a mechanism for dividing the POC reductions created by BMP implementation between the cooperative MS4s.”

No MOUs for joint BMP implementation exist between the City and any other MS4 permittee.

### 7.7 Credit for POC Reductions by Street Sweeping

The Virginia Department of Environmental Quality currently allows MS4 Permittees to claim street sweeping nutrient and sediment reduction credits towards attaining their TMDL load reduction requirements. Appendix V.G of VDEQ *Guidance Memo No. 15-2005* outlines the two current VDEQ approved methods to calculate creditable street sweeping reductions available to MS4 Permittees. These two methods include the “Mass Loading Approach” (MLA) and the “Qualifying Street Lanes Method”, (QSLM) both of which were based on the 2011 recommendations provided by an Expert Panel convened by the Chesapeake Bay Program.

In the 2011 Expert Panel document, the MLA was recommended as the “preferred method” as it provides permittees with the simplest way to track, calculate and verify POC reduction credits since the permittee need only track the pounds of sweeping waste collected and calculations for this

method do not differ based on the type of sweeper used. The Expert Panel has since re-evaluated their recommendations to eliminate the MLA method and has suggested using the more comprehensive QSLM moving forward to generate nutrient and sediment reduction credits. This Action Plan reports reduction credits utilizing the MLA approach for the first (current) permit cycle.

The MLA allows permittees to track the pounds of material collected annually and to generate POC reduction credits by applying factors to the mass collected; the first factor converts the material collected to dry weight and the second factor delineates annual reduction rates for the POCs. For each ton of wet material collected (2,000 pounds wet weight) the MLA approach allows permittees annual POC reductions of 3.5 lbs TN, 1.4 lbs TP, and 420 lbs TSS. As the mass collected through street sweeping from fiscal year (FY) 2004 to FY 2013 was tracked yet variable, an average weight collected between fiscal FY 2014 and FY 2016, when the program operated consistently from year to year, was applied to the mass loading approach unit reduction factors. The average annual pounds collected between FY 2014 and FY 2016 was determined to be 7,764 tons wet weight. This equates to annual POC reductions of 27,175 pounds of TN, 10,870 pounds of TP and 3,260,880 pounds of TSS.

To distribute reduction credits to the targeted watersheds, a simple ratio of watershed area to the total city area was applied to these values. Approximately 18% of the City of Norfolk drains to the Little Creek Watershed and 82% of the City drains to the James River Basin. **Table 7-6** and **Table 7-7** provide a summary of the POC reductions attributable to street sweeping by watershed.

**Table 7-6. Credit for POC Reductions by Street Sweeping – James River Basin**

	TN	TP	TSS
Wet Weight Collected (tons)	7,764	7,764	7,764
Wet Weight Collected (lbs)	15,528,000	15,528,000	15,528,000
Conversion Factor from Wet to Dry Weight	0.7	0.7	0.7
Dry Weight Collected (lbs)	10,869,600	10,869,000	10,869,600
Percent of Total Weight attributable to Watershed	82	82	82
Dry Weight Collected in Watershed (lbs)	8,913,072	8,913,072	8,913,072
Unit Loading Factor (lbs/lb)	0.001	0.0025	0.3
<b>POC Removal (lbs)</b>	<b>8,913</b>	<b>22,283</b>	<b>2,673,922</b>

**Table 7-7. Credit for POC Reductions by Street Sweeping – Little Creek Watershed**

	TN	TP	TSS
Wet Weight Collected (tons)	7,764	7,764	7,764
Wet Weight Collected (lbs)	15,528,000	15,528,000	15,528,000
Conversion Factor from Wet to Dry Weight	0.7	0.7	0.7
Dry Weight Collected (lbs)	10,869,600	10,869,000	10,869,600
Percent of Total Weight attributable to Watershed	18	18	18
Dry Weight Collected in Watershed (lbs)	1,956,528	1,956,528	1,956,528
Unit Loading Factor (lbs/lb)	0.001	0.0025	0.3
<b>POC Removal (lbs)</b>	<b>1,957</b>	<b>4,892</b>	<b>586,958</b>

## 7.8 Credit for POC Reductions through Nutrient Trading

Pursuant with Part 1.D.1.b)2)(d) of the MS4 permit, Norfolk may obtain POC reduction credits through “... any pollutant trading or offset program in accordance with §62.1-44.19:20 through 62.1-44.19:23 et seq. of the Code of Virginia governing trading and offsetting.”

The City is participating with the Hampton Roads Sanitation District (HRSD) in a nutrient trading opportunity which qualifies for POC reduction credits. The HRSD Sustainable Water Initiative for Tomorrow (SWIFT) Project presents a nutrient trading opportunity whereby treated wastewater will be purified through additional rounds of treatment to meet drinking water standards and subsequently injected into the Potomac aquifer. The SWIFT Project will significantly reduce the total volume of HRSD discharge to the Chesapeake Bay watershed, consequently reducing TN, TP, and TSS discharges to the Bay. The City has signed an agreement with HRSD to accept credits to meet its TMDL requirements should they be required. A copy of the agreement is provided in Appendix B.

## 7.9 Plan Summary

Sections 7.2 through 7.8 document numerous nutrient and sediment reduction opportunities which the City intends to claim for credit towards meeting its TMDL load reduction requirements. **Table 7-8** and **Table 7-9** provide a plan summary for the James River and Little Creek watersheds, respectively. Examination of Table 7-7 and Table 7-8 reveal that the City exceeds its POC reduction requirements for the first (current) permit cycle.

It is worth noting that the City also implements several other programs and activities which provide water quality benefits for the POCs of interest. These programs include, but are not limited to, the following:

- Connecting homeowner septic systems to the public sanitary sewer system- Norfolk’s Department of Utilities regularly assess opportunities to expand sanitary sewer systems towards remaining clusters of septic systems. Once sanitary sewer is available adjacent to a property, the owner is advised that they must connect within five years.
- Providing homeowner BMP installation assistance- Through its Bay Star Homes program and a variety of community partnerships, the City provides residential BMPs such as rain barrels at reduced cost to interested homeowners. The City anticipates availability of improved tracking software for residential BMPs during the current MS4 permit cycle.
- Urban tree planting- The City routinely replaces dead or aging trees on public property and encourages private property owners to do so on their own property through tree adoption events several times per year. Larger grant funded initiatives target overall increase in city tree canopy.
- Constructing oyster reefs- Over the past decade, the City and a variety of governmental and community partners have restored many acres of sub- and inter-tidal oyster reef in local



waterways. It is anticipated that crediting protocols for these restoration activities will be approved during the current MS4 permit cycle.

- Performing illicit discharge detection and elimination- The City routinely investigates reported illicit discharges and industries that are at high-risk for discharges. Any identified discharges are inspected until the discharge is eliminated.
- Catch basin and drainage system sediment removal- The City operates three Vactor-style pump trucks, dedicated to clearing blockages and pumping pollutants from the pipes, catch basins, and other structures within the City's MS4 drainage network.
- Conducting numerous public education and involvement activities- Through direct programming and partnerships with the Hampton Roads Planning District Commission and community partners, the City operates an extensive public education program for residents and business.

The City anticipates expanding potential credit reporting activities in the future and reserves the right to report any additional creditable activities from 2009 forward as better data management capabilities and crediting guidance is made available by regulatory agencies, including VDEQ.

**Table 7-8. TMDL Action Plan Summary - James River Basin**

Description	Reference Table/Section	Pollutant of Concern (POC) (lb/yr)		
		TN	TP	TSS
<u>Required POC Reductions:</u>				
Baseline Requirement	Table 6-1	540.0	144.6	68,195
Additional 15% Requirement	Section 6.2	81.0	21.7	10,229
<b>Total Reduction Requirement</b>		<b>621.0</b>	<b>166.3</b>	<b>78,424</b>
<u>Reduction Credits:</u>				
BMPs Installed on Unregulated Lands	Table 7-2	289	51	38,955
BMPs Installed to Meet Redevelopment Requirements	Table 7-3	591	142	92,391
BMPs Installed Prior to July 1, 2009	Table 7-4	325	82	46,146
BMPs Retrofitting Prior Developed Lands	Table 7-5	3,086	712	362,472
MOU BMPs with Other MS4 Permittees	Section 7.6	---	---	---
POC Reductions by Street Sweeping	Table 7-6	22,283	8,913	2,673,922
POC Reductions through Nutrient Trading	Section 7.8		As Required	
<b>Total Reduction Credits</b>		<b>26,574</b>	<b>9,900</b>	<b>3,213,886</b>

**Table 7-9. TMDL Action Plan Summary – Little Creek Watershed**

Description	Reference Table/Section	Pollutant of Concern (POC) (lb/yr)		
		TN	TP	TSS
<u>Required POC Reductions:</u>				
Baseline Requirement	Table 6-2	129.8	29.4	11,345
Additional 15% Requirement	Section 6.2	19.5	4.4	1,702
<b>Total Reduction Requirement</b>		<b>149.3</b>	<b>33.8</b>	<b>13,047</b>
<u>Reduction Credits:</u>				
BMPs Installed on Unregulated Lands	Table 7-2	216	23	8,607
BMPs Installed to Meet Redevelopment Requirements	Table 7-3	195	64	4,400
BMPs Installed Prior to July 1, 2009	Table 7-4	1,003	158	54,491
BMPs Retrofitting Prior Developed Lands	Table 7-5	170	23	9,254
MOU BMPs with Other MS4 Permittees	Section 7.6	---	---	---
POC Reductions by Street Sweeping	Table 7-6	4,892	1,957	586,958
POC Reductions through Nutrient Trading	Section 7.8		As Required	
<b>Total Reduction Credits</b>		<b>6,476</b>	<b>2,225</b>	<b>663,710</b>

## **8.0 ESTIMATE OF EXPECTED COSTS**

Part 1.D.1.b)1)(h) of the City's MS4 permit requires the City to include "... an estimate of the expected cost to implement the necessary reductions during the permit cycle."

Section 7.3 provides a summary of the expected costs necessary to implement the planned water quality improvement projects related to retrofitting on prior developed lands during the first (current) permit cycle. The estimated cost to implement the identified projects is \$12,205,293.

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## **APPENDIX A**

### **CREDITABLE BEST MANAGEMENT PRACTICES (BMP)**

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**APPENDIX B**  
**HRSD SWIFT AGREEMENT**

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## **APPENDIX C**

### **PUBLIC COMMENTS AND RESPONSES ON TMDL ACTION PLAN**

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**Comment No. 1:**

Comment:

No amount of pollution in our waterways is acceptable.

Response:

As demonstrated by this TMDL Action Plan, the City regards itself as a steward of the environment, has undertaken numerous programs and activities to protect local water resources, and will be commencing additional initiatives as outlined in this TMDL Action Plan to further improve water quality to the benefit of the environment and local residents.

Action Taken:

No changes to the TMDL Action Plan were made as a result of this comment.

**Comment No. 2:**

Comment:

Good morning,

I am very much in favor of all TMDL requirements for the Chesapeake Bay including the Elizabeth River. I would encourage the City of Norfolk to do everything possible to meet or exceed these goals.

Response:

As demonstrated by this TMDL Action Plan, the City regards itself as a steward of the environment, has undertaken numerous programs and activities to protect local water resources, and will be commencing additional initiatives as outlined in this TMDL Action Plan to further improve water quality to the benefit of the environment and local residents.

Action Taken:

No changes to the TMDL Action Plan were made as a result of this comment.

**Comment No. 3:**

Comment:

Our concern with storm water in the Bay is the street runoff (which contains oil, gasoline, garbage etc) - is this filtered in some way before it goes through those pipes on the beach and into the Bay?

Response:

As previously described in Section 7 of this TMDL Action Plan, over time, both the City and private concerns have implemented well over 1,000 structural best management practices (BMPs) providing direct water quality benefits to the Chesapeake Bay. Collectively, these BMPs treat more than 7,500 acres (11.8 square miles) of land area and provide significant treatment of stormwater runoff.

Action Taken:

No changes to the TMDL Action Plan were made as a result of this comment.

**Comment No. 4:**

Comment:

Please have professional landscapers stop blowing grass clippings in the street, create some type of fine to stop this. I live in Larchmont and my street floods even in a light rain sometime, I know we need more storm drains, but I also know they cost time and money for the city, but continue to focus on the storm drains.

Response:

The City addresses illicit discharges to the stormwater system in accordance with Sections I.B.2.e)5) and I.B.2.l)1) of its MS4 permit with the goal of detecting the presence of potential illicit connections and unauthorized discharges by conducting dry weather screening. In 2017, the City expanded its IDDE program to a more strategic approach in order to meet both environmental regulatory screening and preventative maintenance inspection goals. Field staff aim to visually inspect the City's approximately 28,000 stormwater structures on a routine basis. The Department of Public Works also conducts environmental investigations on a complaint driven basis. If a resident reports a suspicious complaint, it is investigated to ensure there is not an illicit discharge.

Action Taken:

No changes to the TMDL Action Plan were made as a result of this comment.

**Comment No. 5:**

Comment:

It is simple. More water equals less pollution suspended in the in the water column. It also enhances the flushing of tidal estuaries by tidal activity we get for free every day. We can counteract sea level rise and obviously subsidence as well as visual appeal with effective ecologically responsible dredging. There is likely even sand under that crude, nasty, ruminating silt. Let's just remove some of the rotting decaying muck that fouls and poisons nature by its natural fermentation that. It naturally represents. We should put it where the grass can grow and

use the cocktail of nutrients that now choke the life out of water grass on the muck exposed twice daily by low tide, deprived of the sandy water in which they need to live.

We are here now. The rivers were more navigated in colonial times. Roads and parking lots and roofs and piers have provided silt and a comparatively small amount of additional or unnatural nutrients to the mix. We should, where we can, replace the runoff, silt and rotten muck with good clean water. We can restore flood prone areas with the spoils and derive nature's bounty from the natural compost we find (once rain has rinsed it).

All we do and all we are is rinsed into the rivers and it settles to the bottom containment and setting ponds have no effect on what is already there. We have to go back and get it and find a better place for it first. The protection will be a less perfect example of our "closing the gate after the horses have already escaped".

Response:

In-stream treatment, such as dredging, are not creditable practices under State TMDL Guidance; however, due to its many co-benefits, opportunities for dredging will continue to be assessed as funding allows.

Action Taken:

No changes to the TMDL Action Plan were made as a result of this comment.

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