City of Chesapeake Southern Rivers TMDL Action Plan

Prepared for
City of Chesapeake,
Virginia
July 24, 2018

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City of Chesapeake, Virginia

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List of Abbreviations

ac	acre(s)
BC	Brown and Caldwell
BMP	best management practice
BST	bacteria source tracking
CCTV	closed-circuit television
CEIC	Chesapeake Environmental Improvement Council
cfu	colony-forming unit(s)
Chesapeake Bay Guidance	*Chesapeake Bay TMDL Special Condition Guidance*
CIP	Capital Improvement Program
City	City of Chesapeake
Council	Urban Water Resources Research Council
DEQ	(Virginia) Department of Environmental Quality
DO	dissolved oxygen
EPA	U.S. Environmental Protection Agency
FEPAP	Fentress Encroachment Protection Acquisition Program
FIB	fecal indicator bacteria
FOG	fats, oils, and grease
FY	fiscal year
GIS	geographic information system
Implementation Guidance Manual	*Guidance Manual for TMDL Implementation Plans*
HRPDC	Hampton Roads Planning District Commission
HRSD	Hampton Roads Sanitation District
HSPF	Hydrologic Simulation Program-Fortran
I/I	infiltration and inflow
kg	kilogram(s)
L	liter(s)
lb	pound(s)
LF	linear foot/feet
Local Guidance	*TMDL Action Planning for Local TMDLs as Required in the Small MS4 General Permit (VAR04) Effective July 1, 2013, and MS4 Individual Permits*
m^2	square meter(s)
mg	milligram(s)
MRLC	Multi-Resolution Land Characteristics Consortium
MS4	municipal separate storm sewer system
MYA	Multi-Year Agreement
N/A	not applicable
NALF	Naval Auxiliary Landing Field
NLCD	National Land Cover Dataset

NWI	National Wetlands Inventory
OSAP	Open Space and Agriculture Preservation
PAR	perimeter-to-area ratio
Plan	TMDL Action Plan
POC	pollutant of concern
REPI	Readiness and Environmental Protection Initiative
SSO	sanitary sewer overflow
SSURGO	Soil Survey Geographic Database
SWCB	State Water Control Board
SWMF	stormwater management facility
SWPPP	stormwater pollution prevention plan
TBD	to be determined
TMDL	total maximum daily load
TN	total nitrogen
TP	total phosphorus
UAL	unit area load
USGS	United States Geological Survey
VAHU6	Virginia Hydrologic Unit
VDOT	Virginia Department of Transportation
VGIN	Virginia Geographic Information Network
VPDES	Virginia Pollutant Discharge Elimination System
WLA	wasteload allocation
yr	year(s)

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Section 1

Introduction

To comply with the requirements of the Phase I Municipal Separate Storm Sewer System (MS4) Permit (VA0088625) issued by the Virginia Department of Environmental Quality (DEQ), the City of Chesapeake (City) is required to develop a local total maximum daily load (TMDL) Action Plan (Plan) for TMDLs in which a wasteload has been allocated for a pollutant of concern (POC) within the city. Two watersheds in the southern portion of Chesapeake have local bacteria TMDLs, and four watersheds have local total phosphorus (TP) TMDLs. The southern portion of the city is known as the Southern Rivers. The following two watersheds in the Southern Rivers area have bacteria TMDLs:

- North Landing River, Middle
- Pocaty River

The following four watersheds in the Southern Rivers area have TP TMDLs:

- Albemarle Canal
- North Landing River, Middle
- Northwest River
- Pocaty River

For the purposes of this Plan, the Virginia Hydrologic Unit (VAHU6) boundaries were used to delineate the boundaries of the TMDL watersheds. Table 1-1 summarizes the relationship between the TMDL watersheds and VAHU6 boundaries. Figure 1-1 shows the watershed boundaries.

Table 1-1. Southern Rivers TMDL and VAHU6 Watersheds

TMDL Watershed	VAHU6 Watersheds
North Landing River, Middle (bacteria)	AS12, AS13
North Landing River, Middle (TP)	AS13
Albemarle Canal	AS12
Pocaty River	AS15
Northwest River	AS07, AS09, AS10

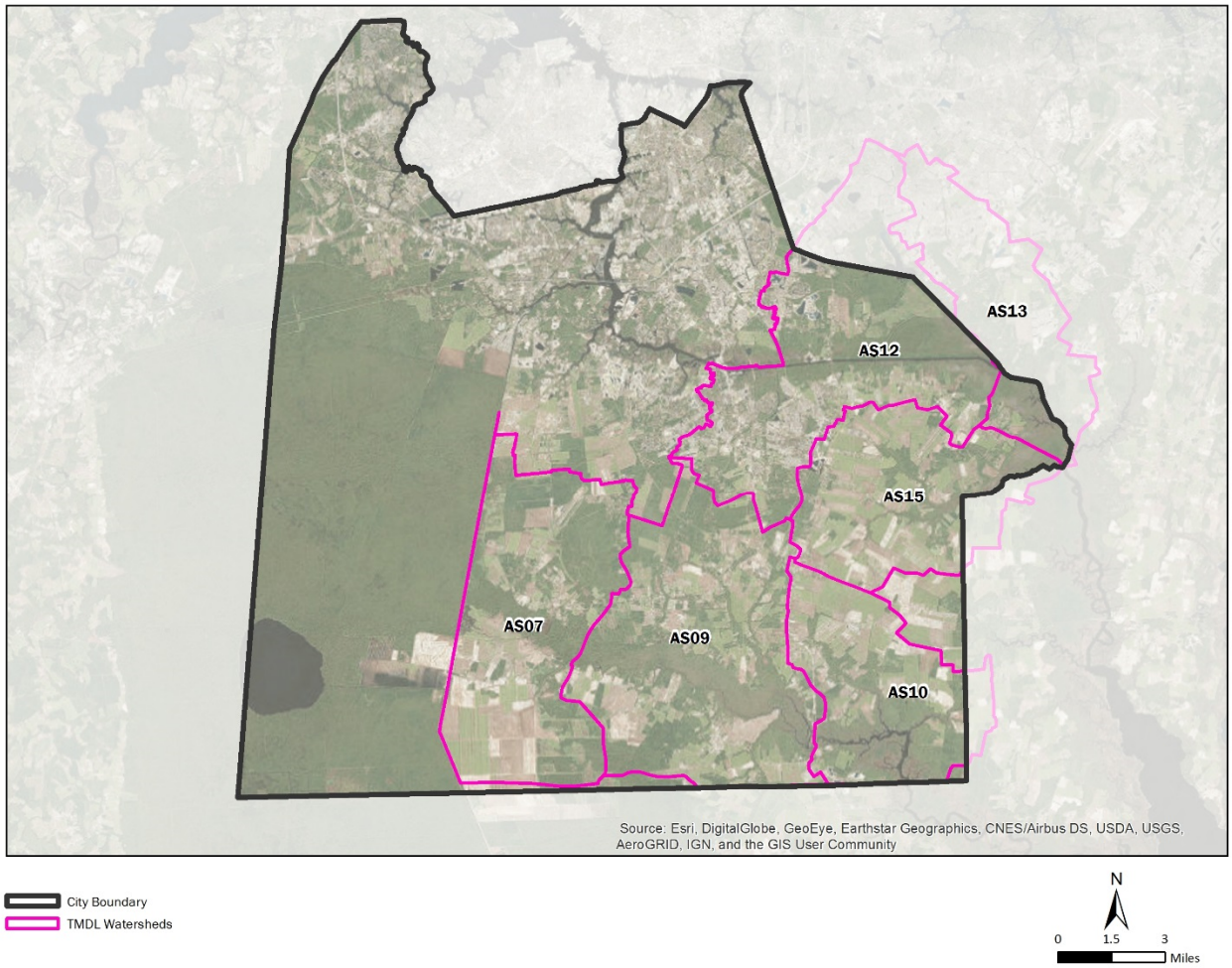

Figure 1-1. Southern Rivers TMDL watersheds in the city of Chesapeake

The targets for the pollutants are specified in the wasteload allocations (WLAs) published in each TMDL report. The DEQ Guidance Memorandum GM-162006, *TMDL Action Planning for Local TMDLs as Required in the Small MS4 General Permit (VAR04) Effective July 1, 2013, and MS4 Individual Permits* dated November 21, 2016 (Local Guidance) and the TMDL reports provide examples of acceptable assessment methods and implementation strategies for local TMDL action plans (DEQ 2016a).

This Plan outlines the City's MS4 service area delineation, approved TMDLs, monitoring procedures and methods used by DEQ to develop the TP and bacteria loadings and required reductions, calculations used to estimate TP and bacteria loads for each impaired watershed that contains City MS4 service area, projects and programs that the City will implement, identified facilities of concern, and legal authority required for Plan implementation. The City developed this Plan to address the impairments described within the Phase I MS4 permit. The required elements within the permit are included in Table 1-2, along with the section of this Plan where they are addressed.

The City also has WLAs assigned through the Chesapeake Bay TMDL. A separate action plan is being developed for the portions of the city covered by the Chesapeake Bay TMDL.

Table 1-2. Overview of Non-Chesapeake Bay Plan Permit Requirements

Plan Section	Permit Section	MS4 Permit Section Requirement	Page Number(s)
12	Part I.D.2(b)1	Develop and maintain a list of its legal authorities such as ordinances, permits, order, specific contract language, and inter-jurisdictional agreements applicable to reducing the pollutant identified in a WLA.	12-1
7.1 8.1	Part I.D.2(b)2	Identify and maintain an updated list of all additional management practices, control techniques, and system design and engineering methods, beyond those identified in Part I.B of this state permit, that have been implemented as part of the MS4 Program Plan that are applicable to reducing the pollutant identified in the WLA.	7-1 8-1
7.2	Part I.D.2(b)3	Enhance the public education and outreach and employee training programs to also promote methods to eliminate and reduce discharges of the pollutants identified in the WLA.	7-7
6	Part I.D.2(b)4	Assess all significant sources of pollutant(s) from facilities of concern owned or operated by the MS4 operator that are not covered under a separate VPDES industrial stormwater permit and identify all municipal facilities that may be a significant source of the identified pollutant. For the purpose of this assessment, a significant source of pollutant(s) from a facility of concern means a discharge where the expected pollutant loading is greater than the average pollutant loading for the land use identified in the TMDL. (For example, a significant source of pollutant from a facility of concern for a bacterial TMDL would be expected to be greater at a dog park than at other recreational facilities where dogs are prohibited).	6-1
7.4 10.1 10.2	Part I.D.2(b)5)	Develop and implement a method to assess TMDL Action Plans for their effectiveness in reducing the pollutants identified in the WLAs. The evaluation shall use any newly available information, representative and adequate water quality monitoring results, or modeling tools to estimate pollutant reductions for the pollutant(s) of concern from implementation of the MS4 Program Plan. Monitoring may include BMP, outfall, or in-stream monitoring, as appropriate, to estimate pollutant reductions. The permittee may conduct monitoring, utilize existing data, establish partnerships, or collaborate with other MS4 permittees or other third parties, as appropriate. This evaluation shall include assessment of the facilities identified in Part I.D.2(b)4. The methodology used for assessment shall be described in the TMDL Action Plan.	7-9 10-1
13	Part I.D.2(b)6)	Solicit public input on the draft TMDL Action Plan and consider public comments in development of the final TMDL Action Plan that is submitted to the Department for review and approval.	13-1
7.6 8.3 11	Part 1.D.2.g	The permittee shall identify the best management practices and other steps that will be implemented during the next permit term as part of the permittee's reapplication for coverage as required under Part II.M. The permittee shall also evaluate and modify the estimated end date for achieving the applicable wasteload based on information acquired during the permit cycle.	7-12 8-3 11-1
9	Part I.D.2.a	These TMDL Action Plans shall identify the best management practices and other interim milestone activities to be implemented during the remaining term of this state permit.	9-1
14	Part I.D.2.a	The plan shall include an estimated end date for achieving the applicable wasteload allocations.	14-1

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Section 2

MS4 Service Area, Impaired Watersheds, and POC Background

This section describes the development of the City's MS4 service area, approved TMDL reports for the City, and TP and bacteria TMDL development in the Southern Rivers.

2.1 MS4 Service Area Development

The City is responsible for managing the MS4 service area per its MS4 permit. The MS4 service area is suburban and urban land including all land draining to the MS4, except for land covered by a separate Virginia Pollutant Discharge Elimination System (VPDES) permit.

The Southern Rivers MS4 service area was delineated in the ArcMap geographic information system (GIS) based on the guidelines set forth in the *Chesapeake Bay TMDL Special Condition Guidance* (Chesapeake Bay Guidance) and the procedure used by the City to delineate the Chesapeake Bay MS4 service area (DEQ 2015). The procedure used for the Chesapeake Bay TMDL was referenced in the Southern Rivers area for consistency across the city.

According to the Chesapeake Bay Guidance, permittees may exclude the following areas:

- Lands regulated under a General VPDES permit that addresses industrial stormwater
- Lands regulated under an Individual VPDES permit for industrial stormwater discharges
- Forested lands
- Agricultural lands
- Wetlands
- Open waters
- Lands with surface runoff into a natural water body or another MS4 system

The forested, agricultural lands, and open-water data were developed from the 2016 Virginia Geographic Information Network (VGIN) 1-meter land use data. The wetland areas were delineated using data from the National Wetlands Inventory (NWI).

Per the Chesapeake Bay Guidance, forested lands that may be excluded are contiguous areas larger than 900 square meters (m^2) that meet the tree density requirements specified by DEQ (DEQ 2015). The forest and tree land cover classes were extracted from the VGIN data, and polygons smaller than 900 m^2 were removed. Because tree density information was not available, the City determined the perimeter-to-area ratio (PAR) of each polygon of forested land to be larger than 900 m^2. The data set was divided in quartiles by size, and these data were visually inspected to determine the maximum PAR in each quartile that would distinguish between tracts resembling forested land versus those of tree-lined streets and other urban tree canopy. The forested lands with a PAR greater than the PAR ceiling were removed from the forested lands exclusion area, producing a more conservative estimate of forested land in the Southern Rivers watersheds.

To finalize the MS4 service area, the VGIN land cover information was reviewed with recent aerial imagery to identify and modify tracts with significant changes in land cover. The final MS4 service

area within each watershed was developed by spatially intersecting the draft MS4 service area with the Southern Rivers TMDL watershed boundaries.

The boundaries of the TMDL watersheds were defined spatially in GIS. During development of the MS4 service area in the Chesapeake Bay watershed, the City revised the boundaries of four VAHU6 watersheds based on the results of detailed hydraulic modeling. The modifications were approved by DEQ and used to develop the Chesapeake Bay MS4 service area.

Table 2-1 summarizes the areas identified and calculated during the MS4 service area delineation. Figure 2-1 and A-2 show the final MS4 service area and TMDL watersheds, respectively. Figures A-3 through A-8 in Appendix A show the exclusion areas.

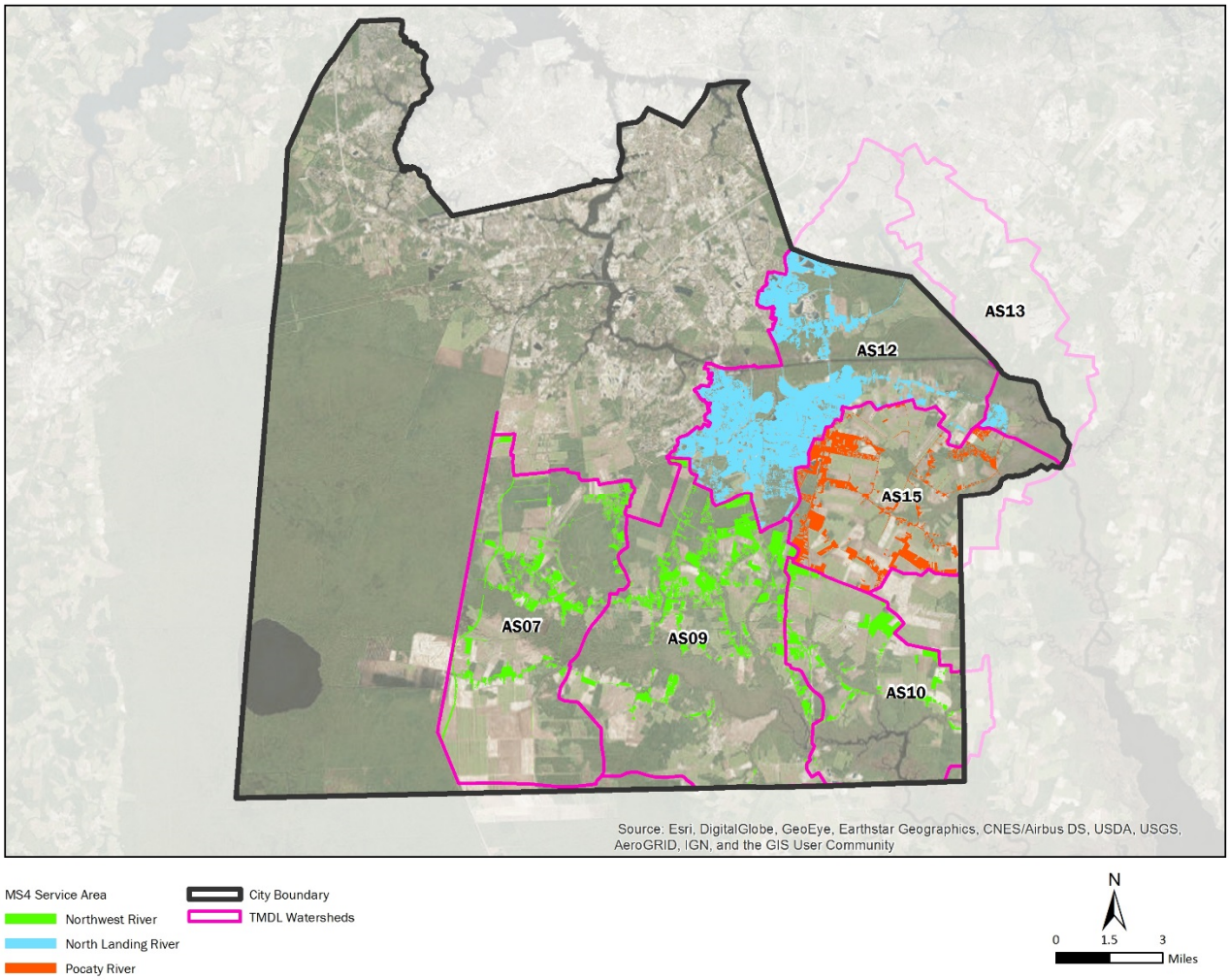

Figure 2-1. MS4 service area in the Southern Rivers TMDL watersheds

Table 2-1. Southern Rivers MS4 Area and Exclusion Areas	
Area Category	TMDL Watershed Area (ac)
Area of impaired watersheds (VAHU6) in the Southern Rivers	123,940
Preliminary MS4 service area in TMDL watersheds	60,847
Exclusion areas	
Forested lands	8,842
Wetlands	12,462
Open water	390
Cropland	22,004
Total exclusion area (non-overlapping) [a]	43,635
Southern Rivers MS4 service area	17,212

The total exclusion area is less than the sum of the individual exclusion areas because some of the individual exclusion areas overlap.

There are several differences between the City's current MS4 service area and the MS4 service area as defined in the TMDL reports. The TMDL MS4 service area:

- Includes only the impervious portion of the developed, barren, and open-space land
- Reflects the land cover at the time of TMDL development
- Includes land from other permitted entities, such as the Virginia Department of Transportation (VDOT), as those lands were not distinguished in the TMDL reports

The MS4 service area delineated through this Plan:

- Represents present-day land cover (2017)
- Includes both the impervious and pervious urban land cover
- Removes other permitted entities within the municipal boundary

2.2 Approved TMDLs Within the City

The following reference reports are the three approved TMDL documents for watersheds within the city:

- *Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds* prepared by MapTech, Inc., originally submitted in October 2013 and updated in May 2014 (MapTech, Inc. 2014)
- *Total Maximum Daily Load Development for the Northwest River Watershed* prepared by MapTech, Inc. and dated March 2011 (MapTech, Inc. 2011)
- *Total Maximum Daily Load Development for the Albemarle Canal/North Landing River* prepared by MapTech, Inc. and dated April 2010 (MapTech, Inc. 2010)

Table 2-2 lists the approval dates and impairment listings for each watershed by report. In the Southern Rivers watersheds, the POC is dissolved oxygen (DO); however, the WLA has been assigned for TP. WLAs are assigned for TP because it is assumed that the TP reduction will address the response variable—in this case, the DO impairment.

Table 2-2. Watershed TMDL Overview

Report	Watershed	EPA Approval Date	SWCB Approval Date	Impairment Listing [a]	POC [a]
MapTech, Inc. (2014)	North Landing River, Middle	6/26/2014	12/11/2014	Primary contact	*E. coli*
	Pocaty River	6/26/2014	12/11/2014	Primary contact	*E. coli* / DO
MapTech, Inc. (2010)	Albemarle Canal	1/13/2011	6/25/2012	Primary contact	DO
	North Landing River, Middle	1/13/2011	6/25/2012	Primary contact	DO
MapTech, Inc. (2011)	Northwest River	4/26/2011	6/25/2012	Primary contact	DO

a. *Information was sourced from the DEQ Draft 2014 Water Quality Assessment Any Use Map Service (DEQ 2016b).*

EPA = U.S. Environmental Protection Agency, SWCB = State Water Control Board.

2.3 Determination of Total Phosphorus TMDLs

The TP TMDLs in the Southern Rivers watersheds are the result of DO impairments. Low DO is a response indicator; in other words, DO is not causing the impairment but is responding based on the cause. In the case of the DO impairments for the Southern Rivers, the presumption in the TMDL reports is that low DO is due to an excess of TP.

In the Pocaty River and Northwest River watersheds, DEQ performed an assessment of natural conditions to determine if the observations of low DO concentrations were the result of natural conditions or anthropogenic impacts. The results of the assessment are part of the appendices of the TMDL reports for the respective watersheds.

The procedure to determine if natural conditions are the cause of low pH and/or low DO levels is outlined by DEQ in the *Procedure for Natural Condition Assessment of Low pH and Low DO in Virginia Streams*, and includes consideration of the following (DEQ 2004):

- Characterization of the slope and velocity flow of streams or stream segments in the watershed
- Evaluation of nutrient levels
- Analysis of seasonal fluctuation of DO concentrations
- Determination of anthropogenic impacts or sources

If the velocity or slope of waterways is low, if wetlands are present along the stream reach, if nutrient levels do not exceed expected background standards defined by the United States Geological Survey (USGS), if there are no point sources with more than minimal impact on DO, and if seasonal fluctuation is normal, then the waterway may be classified as impaired because of natural conditions. A waterway must meet all five criteria listed above to meet this standard.

In the Pocaty River, DEQ collected 78 samples at two monitoring stations between January 2000 and March 2011 and found that DO levels did not meet the minimum water quality standard of 4.0 milligrams per liter (mg/L). In addition, an assessment of natural conditions in the Pocaty River determined that low DO concentrations are the result of anthropogenic impacts, not natural conditions.

Though wetlands are present in the watershed and the seasonal variation of DO concentrations did not suggest anthropogenic impacts, the concentrations of total nitrogen (TN) and TP exceeded the expected background concentrations estimated for those pollutants. In addition, TP concentrations

are higher than those of an undeveloped reference watershed, the Feeder Ditch to Dismal Swamp. This observation, combined with occasional increases in organic matter, led to the conclusion that a TP TMDL was needed for the Pocaty River.

In the Northwest River, 32.75 percent (150 of 458 data points collected between 1972 and 2010) of samples had DO concentrations less than the 4.0 mg/L standard. Though the watershed includes large areas of swamps and wetland, exhibits natural seasonal DO fluctuation, and lacks significant anthropogenic sources, nutrient concentrations exceed the expected background concentrations. Therefore, a TP TMDL was developed for the watershed.

In the Albemarle Canal/North Landing River watershed, only one monitoring station had more than one data point during the TMDL monitoring period. At that station (5BNLR013.61), 19 of 88 samples (21.59 percent) collected between 1998 and 2009 did not meet the minimum DO concentration of 4.0 mg/L. Though there are significant wetlands in the watershed, the TP concentrations in the North Landing River exceed those of a similar, undeveloped reference watershed; therefore, a TP TMDL was developed.

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Section 3

Approach

Because bacteria and phosphorus are very different types of pollutants, the City's approach to reducing each pollutant is different. This section outlines the approach for bacteria and phosphorus.

3.1 Bacteria

The approach for reducing bacteria presented in this Plan focuses on source control. Source controls for fecal indicator bacteria (FIB) are the first strategies that should be pursued when FIB impairments are identified (Council 2014).

Potential sources of bacteria discharging to the impaired water bodies include:

- Domestic animals
- Humans
- Livestock
- Wildlife

The TMDL reports address individual loadings from these sources. The reports generally call for a high reduction of loadings of bacteria from human sources, and similar bacteria reductions from pets and livestock with a lower expectation for reduction of wildlife bacteria loadings. Because controlling wildlife is difficult and generally undesirable, and because livestock are typically not present in the MS4 area, focusing on human and pet sources is the most reasonable approach for the City.

The City's efforts will focus on reducing sources of bacteria from the City's MS4 service area, which includes residential, commercial, and open-space urban land areas. Controlling bacteria from non-urban land uses and other sources outside the City's jurisdictional control are not included in this Plan; however, some programs (e.g., public education efforts) can be expected to have some impact or influence outside the MS4 service area.

The City's Phase I MS4 permit does not currently require milestones or a schedule to meet the final bacteria WLA, but instead focuses on actions during the remainder of the current permit term. Presently, a prescribed methodology for calculating bacteria load reductions for projects and programs does not exist, and available research does not support a purely quantitative approach to bacteria reduction. This is due to unknown factors and limited research into bacteria reduction capability. According to *Pathogens in Urban Stormwater Systems:*

> There are significant limitations associated with use of currently available models to accurately predict FIB loading and reductions associated with various management measures. These limitations are due to multiple factors such as limited understanding of fate and transport mechanisms in the natural environment, scale-related issues, limited datasets for model calibration and verification, and variable performance of stormwater control practices (Council 2014).

Because of these limitations, a semi-quantitative approach to bacteria reduction tracking and reporting is presented. The quantitative elements relate primarily to the degree of implementation of various practices, rather than the bacteria load reduced. Therefore, each bacteria project or program is discussed in terms of its potential for bacteria reduction and measurable metrics, indicating level

of implementation within the city. Numeric bacteria reductions are not calculated for the City's best management practices (BMPs).

3.2 Total Phosphorus

The approach for reducing TP within the city is much more prescriptive. The City is required to develop this Plan per the City's MS4 permit and the Chesapeake Bay Guidance. This Plan will include means and methods intended to achieve required reductions for TN, total suspended solids, and TP in the Chesapeake Bay watersheds. To maintain consistency between the TMDL action plans in the Chesapeake Bay and Southern Rivers watersheds, the City will use the documented BMP efficiencies from the Chesapeake Bay Guidance to quantitatively estimate the reduction from projects in the Southern Rivers (DEQ 2015). This approach is supported by the Local Guidance, which states that permittees may use the Chesapeake Bay Guidance and BMP efficiencies to estimate the reductions achieved by BMPs toward nutrient and sediment TMDLs outside the Chesapeake Bay (DEQ 2015, 2016a). Similar to the approach for bacteria reduction, the actions outlined in this Plan address loads from urban sources in the MS4 service area, and do not address potential fluxes in nutrient loads due to natural conditions or events.

The crediting procedure for TP TMDLs in the Southern Rivers watersheds will be based on the following:

- Identifying programs and projects to be incorporated in the Plan
- Estimating progress achieved by those projects through calculations referenced in the Chesapeake Bay Guidance
- Assessing the level of effort needed to achieve the TMDL WLA beyond the previously identified projects
- Implementing the selected projects and programs

Section 4

Bacteria Wasteload Allocations

This section defines the methodology used to recalculate the WLAs and percent reductions for the MS4 within each TMDL watershed. For consistency with the approved TMDL reports, the data used to recalculate the WLAs are referenced from the TMDL reports.

The WLAs published in the TMDL reports differ from the WLAs recalculated in this Plan for the following two primary reasons:

- Developing TMDLs uses complex models such as Hydrologic Simulation Program-Fortran (HSPF) to calculate the existing loading, percent reductions, and WLAs, whereas this task used a unit area load (UAL) calculated from the TMDL results
- The current MS4 service area (as of December 2017) is different from the MS4 service area used during TMDL development

4.1 Overall Approach

The TMDL reports include loading values from various permit sources, direct sources, and land use sources—both urban and rural. The City is responsible only for the loading from its MS4 service area. Per the Local Guidance, WLAs may be recalculated by multiplying the regulated land use area by its representative UAL (DEQ 2016a). The following sub-sections describe how data from the TMDL reports were used to recalculate the WLAs for the City's MS4 service area.

4.1.1 Urban Land Use

As described in Section 2, the current MS4 service area was delineated using the most recently available data, and finalized using present-day land cover conditions (most recent aerial photography and development data). Therefore, the MS4 service area represents the present-day regulated area and is a compilation of the current urban land in each watershed.

4.1.2 Urban Unit Area Loads

Urban UALs were calculated using available data in the TMDL reports; each TMDL report contained varying load data. Some TMDLs include total loads per land use category while others include total loads per watershed. Therefore, the approach used to calculate the urban UALs varies. Each approach is described in the sub-section for the TMDL.

4.1.3 Calculation Steps

The steps used to recalculate the WLAs vary based on the data available in each TMDL report. The steps are generally as follows:

1. Calculate the urban UAL for each regulated pervious and impervious surface
2. Determine the regulated pervious and impervious surface in the MS4 service area
3. Apply urban UALs to regulated pervious and impervious surfaces
4. Sum the regulated pervious and impervious WLAs to obtain the MS4 service area WLA for each watershed

The steps used to recalculate the percent reductions also vary based on the information available in each TMDL report. The steps are generally as follows:

1. Reference the percent reduction for each regulated pervious and impervious surface
2. Apply percent reductions to the already-determined regulated pervious and impervious surfaces
3. Recalculate the weighted MS4 service area percent reduction based on area of each regulated and impervious surface

The following sections describe the available data and how they were used to recalculate the WLAs and percent reductions.

4.2 North Landing River

The WLA in the North Landing River TMDL report was calculated with a land-cover-based approach from the 2006 Multi-Resolution Land Characteristics (MRLC) National Land Cover Database (NLCD) data set (MapTech, Inc. 2014). Because the existing and allocated loads from the MS4 areas are reported separately as a direct source in addition to the land-based loads, it is assumed that the land-based loads represent only the contribution of pervious surfaces within the land use category, and that the loads from impervious surfaces are associated with the load from the MS4. However, the MS4 service area developed in this Plan includes urban pervious and impervious surfaces, as described in the Local Guidance (DEQ 2016a). Therefore, the WLA calculated in this section accounts for loads from pervious and impervious surfaces.

The report defines the bacteria loads at the outlet of a sub-watershed of the North Landing River. Based on the documentation provided in the report and the location of the sub-watersheds, it is assumed that the outlet of the reported sub-watershed is the outlet of the entire North Landing River watershed, and that the existing and allocated loads account for the sources and land use in sub-watersheds upstream of the outlet (MapTech, Inc. 2014).

The report defines land use in 10 categories: (1) residential, (2) cropland, (3) forest, (4) pasture/hay, (5) commercial, (6) livestock access, (7) open space, (8) wetlands, (9) barren, and (10) water. The City is responsible only for the pollutant load from its MS4 service area, which comprises urban land uses. The urban land uses in the TMDL report are residential, commercial, open space, and barren land; therefore, only these land uses were considered in the WLA calculation (MapTech, Inc. 2014).

The first step in calculating the WLA is to determine the urban impervious and pervious area within the MS4 service area. The ratios of impervious surfaces for each land use type were determined from Table B.9 in Appendix B of the *Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds* report (MapTech, Inc. 2014). The percent pervious and impervious for each land use was multiplied by the area of that land use at the time of TMDL development to determine the acreage of each urban impervious and pervious fraction. Table 4-1 shows the land use area, percent impervious and pervious, and resulting acreages for the impervious and pervious fractions of the urban land uses.

Table 4-1. TMDL Pervious and Impervious Areas North Landing River Watershed				
Urban Land Cover	Total Area in TMDL Watershed (ac) [a]	Percent Impervious (percent) [b]	Impervious Area in Watershed (ac)	Pervious Area in Watershed (ac)
Residential	9,586	35	3,355	6,231
Commercial	211	70	148	63
Open space	7,132	8	571	6,562
Barren	129	7	9	120
Total			4,083	

a. *Source: Table B.3, Appendix B, page 10,* Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds *(MapTech, Inc. 2014).*

b. *Source: Table B.2, Appendix B, page B-8,* Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds *(MapTech, Inc. 2014).*

The next step is to determine the UAL for each urban impervious and pervious land cover. The total existing load provided in the TMDL report was divided by the area in Table 4-1 above to calculate the UAL for each land cover class (MapTech, Inc. 2014). Table 4-2 includes the urban pervious and impervious area, total existing load, and UAL.

Table 4-2. Bacteria (*E. coli*) TMDL UALs North Landing River Watershed			
Urban Land Cover	Area in TMDL Watershed (ac)	TMDL Existing Load (cfu/yr) [a]	UAL (cfu/ac/yr)
Pervious areas			
Residential	6,231	1.22E+15	1.96E+11
Commercial	63	2.28E+12	3.60E+10
Open space	6,562	8.65E+13	1.32E+10
Barren	120	1.26E+12	1.05E+10
MS4 area/impervious area [b]	4,083	7.43E+13	1.82E+10

a. *Source: Table 5.2 (, page 5-8,* Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds *(MapTech, Inc. 2014).*

b. *Source: Appendix B, page B-19 of* Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds *states that MS4 loads were calculated as the loads coming from the impervious surfaces within the MS4 permit boundaries (MapTech, Inc. 2014).*

cfu = colony-forming units.

The most recent NLCD land use data were released in 2011. To remain consistent with the land use categories defined in the TMDL report, the 2011 NLCD land cover data were clipped to the extents of the MS4 service area and separated by TMDL watershed. Some land use changes may have occurred in the MS4 service area since the development of the 2011 data set; therefore, the MS4 service area may include some non-urban land use categories. However, these land uses are not present in the current MS4 service area based on the delineation procedure described in Section 2; therefore, the non-urban land uses were redistributed to the urban land use categories based on each category's proportion of the urban land uses.

Following the redistribution, the percent impervious and pervious were applied to the redistributed land use areas to determine the present-day urban pervious and impervious land use acres (ac) (see Table 4-3).

Table 4-3. MS4 Service Area Pervious and Impervious Areas North Landing River Watershed

Urban Land Cover	Total Area in MS4 Service Area (ac)	Percent Impervious (percent) [a]	Impervious Area in Watershed (ac)	Pervious Area in Watershed (ac)
Residential	4,269	35	1,494	2,775
Commercial	99	70	70	30
Open space	3,726	8	298	3,428
Barren	7	7	1	7
Total	8,101		1,862	

a. *Source: Table B.2, Appendix B, page B-8,* Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds *(MapTech, Inc. 2014).*

Then the urban UAL for each land use fraction was multiplied by the area in Table 4-3 above to determine the total existing load for each land cover category, as shown in Table 4-4.

Table 4-4. Bacteria (*E. coli*) Total Existing Load per MS4 Service Area Land Use North Landing River Watershed

Urban Land Cover	Land Use Area in MS4 Service Area (ac) [a]	MS4 Service Area Existing Load (cfu/yr)
Pervious areas		
Residential	2,775	5.43E+14
Commercial	30	1.07E+12
Open space	3,428	4.52E+13
Barren	7	7.24E+10
Impervious area	1,862	3.39E+13
Total	8,101	6.24E+14

a. *Existing land cover referenced from 2011 NLCD data set. Where existing land use was developed since creation of the 2011 data set, an urban land use was assumed based on a proration of the 2011 land use distribution.*

As shown in Table 4-5, the WLA for each land use fraction was calculated with the existing loads in Table 4-4 above and the percent reductions documented in the TMDL report (MapTech, Inc. 2014). The WLA for the MS4 service area is the sum of the WLAs for the land use fractions. An area-weighted percent reduction was calculated to determine the percent reduction for the MS4 service area. Table 4-6 shows the final WLA and percent reduction for the MS4 service area.

Table 4-5. MS4 Service Area Land Use WLA and Percent Reduction for Bacteria (*E. coli*) North Landing River Watershed		
Urban Land Cover	Percent Reduction (percent) [a]	WLA (cfu/yr)
Pervious areas		
Residential	99	5.43E+12
Commercial	50	5.37E+11
Open space	50	2.26E+13
Barren	50	3.62E+10
Impervious area	94	2.03E+12

a. *Source: Table 5.2, page 5-8,* Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds *(MapTech, Inc. 2014)*.

Table 4-6. WLA and Percent Reduction for Bacteria (*E. coli*) North Landing River Watershed	
Weighted percent reduction based on area of each land use	77
MS4 service area WLA (cfu/yr)	3.06E+13

4.3 Pocaty River

The methodology described for the North Landing River watershed was also applied for the Pocaty River watershed. Table 4-7 shows the area by land use category, percent impervious and pervious for urban land uses, and pervious and impervious area within each land use category.

Table 4-7. TMDL Pervious and Impervious Areas Pocaty River Watershed				
Urban Land Cover	Total Area in TMDL Watershed (ac) [a]	Percent Impervious (percent) [b]	Impervious Area in Watershed (ac)	Pervious Area in Watershed (ac)
Residential	225	35	79	146
Commercial	9	70	6	3
Open space	1,073	8	86	987
Barren	37	7	3	34
Total	1,343		173	

a. *Source: Table B.3, Appendix B, page 10,* Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds *(MapTech, Inc. 2014)*.

b. *Source: Table B.2, Appendix B, page B-8,* Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds *(MapTech, Inc. 2014)*.

Table 4-8 includes the area, total existing load, and UAL for each pervious and impervious land use fraction.

Table 4-8. Bacteria (*E. coli*) TMDL UALs Pocaty River Watershed			
Urban Land Cover	Area in TMDL Watershed (ac)	TMDL Existing Load (cfu/yr) [a]	Urban UAL (cfu/ac/yr)
Pervious areas			
Residential	146	1.22E+15	8.36E+12
Commercial	3	2.28E+12	8.55E+11
Open space	987	8.65E+13	8.77E+10
Barren	34	1.26E+12	3.66E+10
MS4 area/impervious area [b]	173	7.43E+13	4.29E+11

a. *Source: Table 5.6page 5-14,* Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds *(MapTech, Inc. 2014).*

b. *Source: Appendix B, page B-19 of* Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds *states that MS4 loads were calculated as the loads coming from the impervious surfaces within the MS4 permit boundaries (MapTech, Inc. 2014).*

The 2011 NLCD data were clipped to the extent of the MS4 service area in the Pocaty River watershed and redistributed among the urban land use categories. Table 4-9 shows the impervious, pervious, and total land use areas in the MS4 service area.

Table 4-9. MS4 Service Area Pervious and Impervious Areas Pocaty River Watershed				
Urban Land Cover	Total Area in MS4 Service Area (ac)	Percent Impervious (percent) [a]	Impervious Area in Watershed (ac)	Pervious Area in Watershed (ac)
Residential	850	35	297	552
Commercial	34	70	24	10
Open space	1,588	8	127	1,461
Barren	25	7	2	23
Total	2,496		450	

a. *Source: Table B.2, Appendix B, page B-8,* Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds *(MapTech, Inc. 2014).*

Table 4-10 includes the existing load for each urban pervious and impervious land cover based on the UAL calculated in Table 4-8 above.

Table 4-10. Bacteria (*E. coli*) Total Existing Load per MS4 Service Area Land Use Pocaty River Watershed		
Urban Land Cover	Land Use Area in MS4 Service Area (ac) [a]	MS4 Service Area Existing Load (cfu/yr)
Pervious areas		
Residential	552	4.62E+15
Commercial	10	8.63E+12
Open space	1,461	1.28E+14
Barren	23	8.51E+11
Impervious area	450	1.93E+14
Total	2,496	4.95E+15

a. *Existing land cover referenced from 2011 NLCD data set. Where existing land use was developed since creation of the 2011 data set, an urban land use was assumed based on a proration of the 2011 land use distribution.*

Table 4-11 shows the percent reduction and WLA for each land cover fraction; Table 4-12 shows the total WLA for the Pocaty River watershed and an area-weighted percent reduction.

Table 4-11. MS4 Service Area Land Use WLA and Percent Reduction for Bacteria (*E. coli*) Pocaty River Watershed		
Urban Land Cover	Percent Reduction (percent)	WLA (cfu/yr)
Pervious areas		
Residential	99	4.62E+13
Commercial	50	4.32E+12
Open space	50	6.40E+13
Barren	50	4.25E+11
Impervious area	94	1.16E+13

Table 4-12. WLA and Percent Reduction for Bacteria (*E. coli*) Pocaty River Watershed	
Weighted percent reduction based on area of each land use	69
MS4 service area WLA (cfu/yr)	1.27E+14

4.4 Summary of Bacteria WLAs

Sections 4.1 through 4.3 above describe the methodology used to recalculate the city's existing loads, percent reductions, and WLAs for each bacteria TMDL watershed. Table 4-13 provides a summary of the existing loads, percent reductions, and WLAs as documented in the TMDL report and in this Plan (MapTech, Inc. 2014).

Table 4-13. Bacteria TMDL Watershed Published and Recalculated Values

TMDL Watershed	Published Values			Recalculated Values		
	MS4 Service Area (ac)	WLA (cfu/yr)	Percent Reduction	MS4 Service Area (ac)	WLA (cfu/yr)	Percent Reduction
Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds						
North Landing River	4,083	3.57E+13	94	8,101	3.06E+13	77
Pocaty River	173	2.06E+11	87	2,496	1.27E+14	69

Because of change in land cover and the definition of the MS4 service area between the development of the TMDL and present, the sizes of the MS4 service area and the WLA have changed. Because the MS4 service area now includes both pervious and impervious surfaces and development has occurred since TMDL development, the acreage of the MS4 service area and the WLA have generally increased.

The TMDL reports call for high bacteria loading reductions. Efforts to attain these aggressive reduction targets are complicated by the following factors:

- Some bacteria in surface waters are naturally occurring (e.g., contributions from native wildlife)
- Large proportions of some watersheds are outside the service area that is regulated under the City's MS4 permit
- Some land uses within the MS4 service area are exempted (e.g., agriculture and forested areas)

This means that the City's success in reducing its bacteria loadings cannot necessarily be assessed by recognizing attainment of the reduction targets above. If monitoring data were to show that a watershed comes into compliance with applicable bacteria criteria, it can indicate that efforts by the City contributed to the improvement. Conversely, the City might implement enough programs and structural BMPs in a watershed to attain the reduction listed for its MS4 service area, but contributions from unregulated sources might still result in bacteria levels exceeding water quality criteria.

Section 5

Phosphorus Wasteload Allocations

An approach similar to that for the bacteria calculations was used to calculate the TP existing loads, WLAs, and percent reductions. The difference is that the bacteria calculations used a percent impervious, whereas the TP calculations used the actual impervious area. This is because the bacteria TMDL reports included percent impervious, but the TP TMDL reports included actual impervious area. This section describes the calculations and assumptions.

5.1 Pocaty River

Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds outlines the WLAs for TP in the Pocaty River watershed (VAHU6 AS-15) (MapTech, Inc. 2014). Tables 5-1 and 5-2 present the developed land uses incorporated in the developed UAL and the revised existing load and WLA from the current MS4 service area.

Table 5-1 also shows the area, existing load, and calculated UAL for each urban land use category, as documented in the TMDL report (MapTech, Inc. 2014).

Table 5-1. TP TMDL UALs Pocaty River Watershed

Urban Land Cover	Area in TMDL Watershed (ac) [a]	TMDL Existing Load (kg/yr) [b]	UAL (kg/ac/yr)	UAL (lb/ac/yr)
Pervious areas				
Residential	148	2	0.01	0.03
Commercial	1.78	0.01	0.01	0.01
Open space	987	36	0.04	0.08
Barren	34	7	0.20	0.44
Developed	0	0	N/A	N/A
MS4 area/impervious area [a]	172	150	0.87	1.92

a. *Source: Table D.1, Appendix D, page D-5,* Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds *(MapTech, Inc. 2014).*

b. *Source: Table 8.1, page 8-3,* Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds *(MapTech, Inc. 2014).*

kg = kilogram(s), N/A = not applicable.

The 2011 NLCD data were clipped to the MS4 service area, and the non-urban land uses were proportionately distributed among the urban land uses. The resulting land use areas were then divided into the pervious and impervious fractions based on the ratio of impervious surfaces documented in the TMDL report, as shown in Table 5-2.

Table 5-2. MS4 Service Area Pervious and Impervious Areas Pocaty River Watershed				
Urban Land Cover	Total Area in MS4 Service Area (ac) [a]	Percent Impervious (percent) [b]	Impervious Area in Watershed (ac)	Pervious Area in Watershed (ac)
Residential	850	35	297	552
Commercial	34	70	24	10
Open space	1,588	8	127	1,461
Barren	25	7	2	23
Total	2,496		450	

a. *Existing land cover referenced from 2011 NLCD data set. Where existing land use was developed since creation of the 2011 data set, an urban land use was assumed based on a proration of the 2011 land use distribution.*

b. *Source: Table B.2, Appendix B, page B-8,* Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds *(MapTech, Inc. 2014).*

The existing loads from the current MS4 service area were then calculated from the UAL values in Table 5-1 above. Table 5-3 shows the existing loads.

Table 5-3. TP Total Existing Load per MS4 Service Area Land Use Pocaty River Watershed			
Urban Land Cover	Land Use Area in MS4 Service Area (ac)	MS4 Service Area Existing Load (kg/yr)	MS4 Service Area Existing Load (lb/yr)
Pervious areas			
Residential	552	7.01	15.45
Commercial	10	0.06	0.13
Open space	1,461	53.27	117.44
Barren	23	4.59	10.12
Impervious area	450	391.67	863.48
Total	2,496	456.59	1,006.61

Finally, the percent reductions documented in the TMDL report for each land use category were applied to the existing loads in Table 5-3 above to determine the WLA for each land use category (Table 5-4). The total WLA for the Pocaty River watershed is the sum of the WLA by land use; in addition, an area-weighted percent reduction was calculated for the MS4 service area. The final WLA and percent reduction are summarized in Table 5-5.

Table 5-4. MS4 Service Area Land Use WLA and Percent Reduction for TP Pocaty River Watershed			
Urban Land Cover	Percent Reduction (percent) [a]	WLA (kg/yr)	WLA (lb/yr)
Pervious areas			
Residential	64	2.52	5.56
Commercial	0	0.06	0.13
Open space	0	53.27	117.44
Barren	64	1.65	3.64
Impervious area	64	141.00	310.85

a. *Source: Table 8.1, page 8-3,* Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds *(MapTech, Inc. 2014)*.

Table 5-5. WLA and Percent Reduction for TP Pocaty River Watershed	
Weighted percent reduction based on area of each land use	26
MS4 service area WLA (kg/yr)	198.50
MS4 service area WLA (lb/yr)	437.62

5.2 Albemarle Canal/North Landing River

The report *Total Maximum Daily Load Development for the Albemarle Canal/North Landing River* was reviewed to identify the WLAs for the City's MS4 service area within the Albemarle Canal/North Landing River watersheds (MapTech, Inc. 2010). The TMDL load allocations in the report were determined based on land use and direct loads to the stream in the target watershed and those values in an undeveloped reference watershed. The MS4 service area used in this Plan includes pervious and impervious surfaces within the permit area, and the load allocation and required reduction developed in this section account for loading rates from both pervious and impervious lands.

Table 5-6 shows the area, existing load, and calculated UAL for each urban land use category, as documented in the TMDL report (MapTech, Inc. 2010). In the Albemarle Canal/North Landing River watershed, the urban land uses are commercial, barren land, and developed.

Table 5-6. TP TMDL UALs Albemarle Canal/North Landing River Watershed				
Urban Land Cover	Area in TMDL Watershed (ac)	TMDL Existing Load (kg/yr) [a]	UAL (kg/ac/yr)	UAL (lb/ac/yr)
Pervious areas				
Commercial	79	0.4	0.01	0.01
Barren	339	62.1	0.18	0.40
Developed	9,813	125.3	0.01	0.03
MS4 area/impervious area [b]	4,359	1,479	0.34	0.75

a. *Source: Table 5.1, page 5-3,* Total Maximum Daily Load Development for the Albemarle Canal/North Landing River *(Map Tech, Inc. 2010).*

b. *Source: Table 4.6, page 4-13,* Total Maximum Daily Load Development for the Albemarle Canal/North Landing River *(Map Tech, Inc. 2010).*

The 2011 NLCD data were clipped to the MS4 service area in the Albemarle Canal/North Landing River watershed, and the non-urban land uses were proportionately distributed among the urban land uses. The resulting land use areas were then divided into the pervious and impervious fractions based on the ratio of impervious surfaces documented in the TMDL report, as shown in Table 5-7 (MapTech, Inc. 2010).

Table 5-7. MS4 Service Area Pervious and Impervious Areas Albemarle Canal/North Landing River Watershed				
Urban Land Cover	Total Area in MS4 Service Area (ac) [a]	Percent Impervious (percent) [b]	Impervious Area in Watershed (ac)	Pervious Area in Watershed (ac)
Commercial	99	70	70	30
Barren	7	7	1	7
Developed	7,995	30	2,398	5,596
Total	8,101		2,469	

a. *Existing land cover referenced from 2011 NLCD data set. Where existing land use was developed since creation of the 2011 data set, an urban land use was assumed based on a proration of the 2011 land use distribution.*

b. *Source: Table B.2, Appendix B, page B-8,* Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds *(MapTech, Inc. 2014).*

The existing loads from the current MS4 service area were then calculated from the UAL values in Table 5-6 above. Table 5-8 shows the existing loads.

Table 5-8. TP Total Existing Load per MS4 Service Area Land Use Albemarle Canal/North Landing River Watershed			
Urban Land Cover	Land Use Area in MS4 Service Area (ac)	MS4 Service Area Existing Load (kg/yr)	MS4 Service Area Existing Load (lb/yr)
Pervious areas			
Commercial	30	0.15	0.33
Barren	7	1.26	2.78
Developed	5,596	71.48	157.59
Impervious area	2,469	837.35	1,846.04
Total	8,101	910.25	2,006.76

Finally, the percent reductions documented in the TMDL report for each land use category were applied to the existing loads in Table 5-8 above to determine the WLA for each land use category (Table 5-9) (MapTech, Inc. 2010). The total WLA for the Albemarle Canal/North Landing River watershed is the sum of the WLA by land use; in addition, an area-weighted percent reduction was calculated for the MS4 service area. The final WLA and percent reduction are summarized in Table 5-10.

Table 5-9. MS4 Service Area Land Use WLA and Percent Reduction for TP Albemarle Canal/North Landing River Watershed			
Urban Land Cover	Percent Reduction (percent) [a]	WLA (kg/yr)	WLA (lb/yr)
Pervious areas			
Commercial	39	0.09	0.20
Barren	0	1.26	2.78
Developed	39	43.85	96.67
Impervious area	39	513.71	1,132.54

a. *Source: Table 5.1, page 5-3,* Total Maximum Daily Load Development for the Albemarle Canal/North Landing River *(Map Tech, Inc. 2010).*

Table 5-10. WLA and Percent Reduction for TP Albemarle Canal/North Landing River Watershed	
Weighted percent reduction based on area of each land use	12
MS4 service area WLA (kg/yr)	558.92
MS4 service area WLA (lb/yr)	1,232.21

5.3 Northwest River

The report *Total Maximum Daily Load Development for the Northwest River Watershed* was reviewed to identify the WLAs for the City's MS4 service area within the Northwest River watershed (MapTech, Inc. 2011). The TMDL load allocations in the report were determined based on land use and direct

loads to the stream in the target watershed compared to those in an undeveloped reference watershed.

Land uses in the target and reference watersheds were determined with 2001 NLCD data. The MS4 service area is located in three VAHU6 watersheds associated with the Northwest River: (1) AS09 (Northwest River-U.S. Naval Reservation), (2) AS07 (Northwest River-Twelve Foot Ditch), and (3) AS10 (Northwest River-Indian Creek). The urban land uses defined in the TMDL report for the Northwest River are commercial land, barren land, developed land, and residential grassland (MapTech, Inc. 2011). The MS4 service area used in this Plan includes pervious and impervious surfaces within the permit area, and the load allocation and required reduction developed in this section account for loading rates from both pervious and impervious lands.

Table 5-11 shows the area, existing load, and calculated UAL for each urban land use category, as documented in the TMDL report (MapTech, Inc. 2011).

Table 5-11. TP TMDL UALs Northwest River Watershed

Urban Land Cover	Area in TMDL Watershed (ac)	TMDL Existing Load (kg/yr) [a]	UAL (kg/ac/yr)	UAL (lb/ac/yr)
Pervious areas				
Commercial	0	0.0	-	-
Barren	1	0.1	0.13	0.28
Developed	2,854	28.2	0.01	0.02
Residential grassland	4,162	92.6	0.02	0.05
MS4 area/impervious area [b]	1,276	428	0.34	0.74

a. *Source: Table 4.7, page 4-15,* Total Maximum Daily Load Development for the Northwest River Watershed *(MapTech, Inc. 2011).*

b. *Source: Table 4.1, page 4-3,* Total Maximum Daily Load Development for the Northwest River Watershed *(MapTech, Inc. 2011).*

The 2011 NLCD data were clipped to the MS4 service area in the Northwest River watershed, and the non-urban land uses were proportionately distributed among the urban land uses (barren, developed, and residential grassland). The resulting land use areas were then divided into the pervious and impervious fractions based on the ratio of impervious surfaces documented in the TMDL report, as shown in Table 5-12 (MapTech, Inc. 2011). The residential grassland was assumed to be 100 percent pervious.

Table 5-12. MS4 Service Area Pervious and Impervious Areas Northwest River Watershed				
Urban Land Cover	Total Area in MS4 Service Area (ac) [a]	Percent Impervious (percent) [b]	Impervious Area in Watershed (ac)	Pervious Area in Watershed (ac)
Commercial	0	70	0	0
Barren	41	7	3	39
Developed	4,208	30	1,262	2,946
Residential grassland	3,143	0	0	3,143
Total	7,392		1,265	

a. *Existing land cover referenced from 2011 NLCD data set. Where existing land use was developed since creation of the 2011 data set, an urban land use was assumed based on a proration of the 2011 land use distribution.*

b. *Source: Table B.2, Appendix B, page B-8,* Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds *(MapTech, Inc. 2014).*

The existing loads from the current MS4 service area were then calculated from the UAL values in Table 5-11 above. Table 5-13 shows the existing loads.

Table 5-13. TP Total Existing Load per MS4 Service Area Land Use Northwest River Watershed			
Urban Land Cover	Land Use Area in MS4 Service Area (ac)	MS4 Service Area Existing Load (kg/yr)	MS4 Service Area Existing Load (lb/yr)
Pervious areas			
Commercial	0	-	-
Barren	39	4.82	10.63
Developed	2,946	29.13	64.22
Residential grassland	3,143	69.93	154.17
Impervious area	1,265	989.13	2,180.66
Total	7,392	1,093.00	2,409.65

Finally, the percent reductions documented in the TMDL report for each land use category were applied to the existing loads in Table 5-8 above to determine the WLA for each land use category (Table 5-14) (MapTech, Inc. 2011). The total WLA for the Northwest River watershed is the sum of the WLA by land use; in addition, an area-weighted percent reduction was calculated for the MS4 service area. The final WLA and percent reduction are summarized in Table 5-15.

Table 5-14. MS4 Service Area Land Use WLA and Percent Reduction for TP Northwest River Watershed			
Land Cover	Percent Reduction (percent) [a]	WLA (kg/yr)	WLA (lb/yr)
Pervious areas			
Commercial	0	-	-
Barren	0	4.82	10.63
Developed	58	12.18	26.85
Residential grassland	58	29.25	64.49
Impervious area	58	413.75	912.16

a. *Source: Table 5.1, page 5-3,* Total Maximum Daily Load Development for the Northwest River Watershed *(MapTech, Inc.).*

Table 5-15. WLA and Percent Reduction for TP Northwest River Watershed	
Weighted percent reduction based on area of each land use	58
MS4 service area WLA (kg/yr)	460.00
MS4 service area WLA (lb/yr)	1,014.13

5.4 Summary of Total Phosphorus WLAs

Sections 5.1 through 5.3 above describe the methodology used to recalculate the City's existing loads, percent reductions, and WLAs for each TP TMDL watershed. Table 5-16 summarizes the existing loads, percent reductions, and WLAs as documented in the TMDL report and in this Plan (MapTech, Inc. 2011).

Table 5-16. TP TMDL Watershed Published and Recalculated Values						
TMDL Watershed	Published Values			Recalculated Values		
	MS4 Service Area (ac)	WLA (kg/yr)	Percent Reduction (percent)	MS4 Service Area (ac)	WLA (kg/yr)	Percent Reduction (percent)
Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds						
Pocaty River	173	146.69	64	2,496	198.50	26
Total Maximum Daily Load Development for the Albemarle Canal/North Landing River						
Albemarle Canal/ North Landing River	4,359	568.90	39	8,101	558.92	39
Total Maximum Daily Load Development for the Northwest River Watershed						
Northwest River	1,276	428.31	58	6,279	460.00	58

Because of a change in land cover and the definition of the MS4 service area between the development of the TMDL and present, the sizes of the MS4 service area and the WLA have changed. Because the MS4 service area now includes both pervious and impervious surfaces, the acreage of the MS4 service area and the WLA have generally increased.

The *Total Maximum Daily Load Development for the Back Bay, North Landing River, and Pocaty River Watersheds* report includes a discrepancy in the size of the MS4 service area defined for the bacteria and TP TMDL in the Pocaty River basin (MapTech, Inc. 2014). Based on the land cover information and the definition of the MS4 service area provided in the report, the MS4 service area, which is the sum of the impervious land in the watershed, is 205 acres for the bacteria TMDL and 172 acres for the TP TMDL.

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Section 6

Facilities of Concern

This section discusses facilities of concern for both bacteria and phosphorus. Facilities of concern are areas that will have a higher pollutant loading than expected for their land use. Examples of such facilities include pump/vacuum stations, municipal parks where dogs are allowed, and non-agricultural land with fertilizer addition (e.g., golf courses).

6.1 Bacteria Facilities of Concern

The City evaluated its MS4 service area for inclusion of bacteria facilities of concern. Facilities that were considered include:

- **Municipal parks:** dogs are allowed and may be walked through these locations
- **Dog parks:** potential high bacteria load from dog waste
- **Equestrian facilities:** potential high bacteria load from horse waste
- **Sewer pump stations:** potential higher risk of human source bacteria
- **Sanitary sewer infrastructure:** potential risk of sewer overflow with human source bacteria

The City identified 56 facilities within its MS4 service area within a bacteria TMDL watershed: 10 parks, 43 sewer pump stations, and 3 municipal facilities (see Table 6-1 and Figure 6-1). There were no equestrian facilities or dog parks.

Table 6-1. Facilities of Concern Within MS4 Service Area per Bacteria TMDL Watershed

Watershed	Municipal Parks [a]	Municipal-Owned Sewer Pump Stations [b]	Municipal Facilities [c]
North Landing River, Middle	7	42	2
Pocaty River	3	1	1
Total	10	43	3

a. *Data obtained from City website March 2017 (City 2017b).*

b. *GIS data downloaded from City March 2017 (City 2017a).*

c. *GIS data file dated August 2016 (City 2016b).*

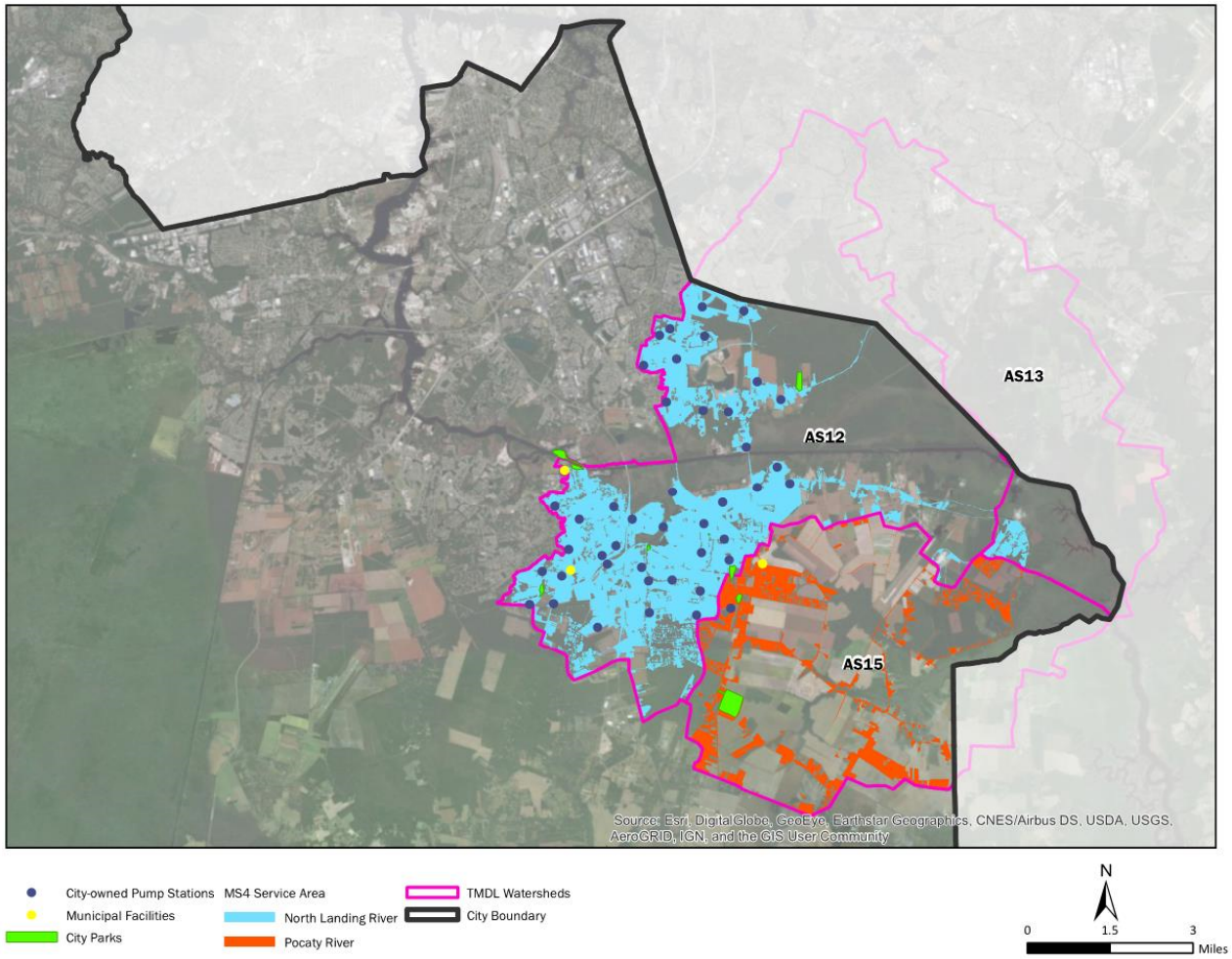

Figure 6-1. Potential facilities of concern for bacteria in the MS4 service area

6.2 Phosphorus Facilities of Concern

In some cases, facilities of concern for bacteria may also qualify as facilities of concern for phosphorus. Major sources of phosphorus include landscape fertilizers, soil erosion, sanitary sewer systems, and animal waste; therefore, facilities of concern include the following:

- **Municipal parks:** dogs are allowed and may be walked through these locations; if fertilizer is applied, the potential for higher phosphorus loads is present
- **Dog parks:** potential phosphorus loads from dog waste
- **Equestrian facilities:** potential phosphorus loads from horse waste
- **Sewer pump stations:** potential higher risk of phosphorus from human waste
- **High-priority municipal facilities:** municipal facilities identified by the City that include activities designated by the MS4 permit

In the watersheds with a TP TMDL are 17 municipal parks, 46 City-owned sewer pump stations, 9 municipal facilities including two high-priority facilities identified in the *City of Chesapeake, Virginia, MS4 Program Plan*, and two equestrian facilities (see Table 6-2 and Figure 6-2) (City 2017c).

Table 6-2. Facilities of Concern Within MS4 Service Area per TP Southern Rivers TMDL Watershed

Watershed	Municipal Parks [a]	Municipal-Owned Sewer Pump Stations [b]	Municipal Facilities [c]	High-Priority Municipal Facilities	Facilities with Equestrian Access
Albemarle Canal/North Landing River	7	42	2	1	0
Pocaty River	3	1	1	0	0
Northwest River	7	3	6	1	2
Total	17	46	9	2	2

a. *Data obtained from City website March 2017 (City 2017b).*
b. *GIS data downloaded from City March 2017(City 2017a).*
c. *GIS data file dated August 2016 (City 2016b).*

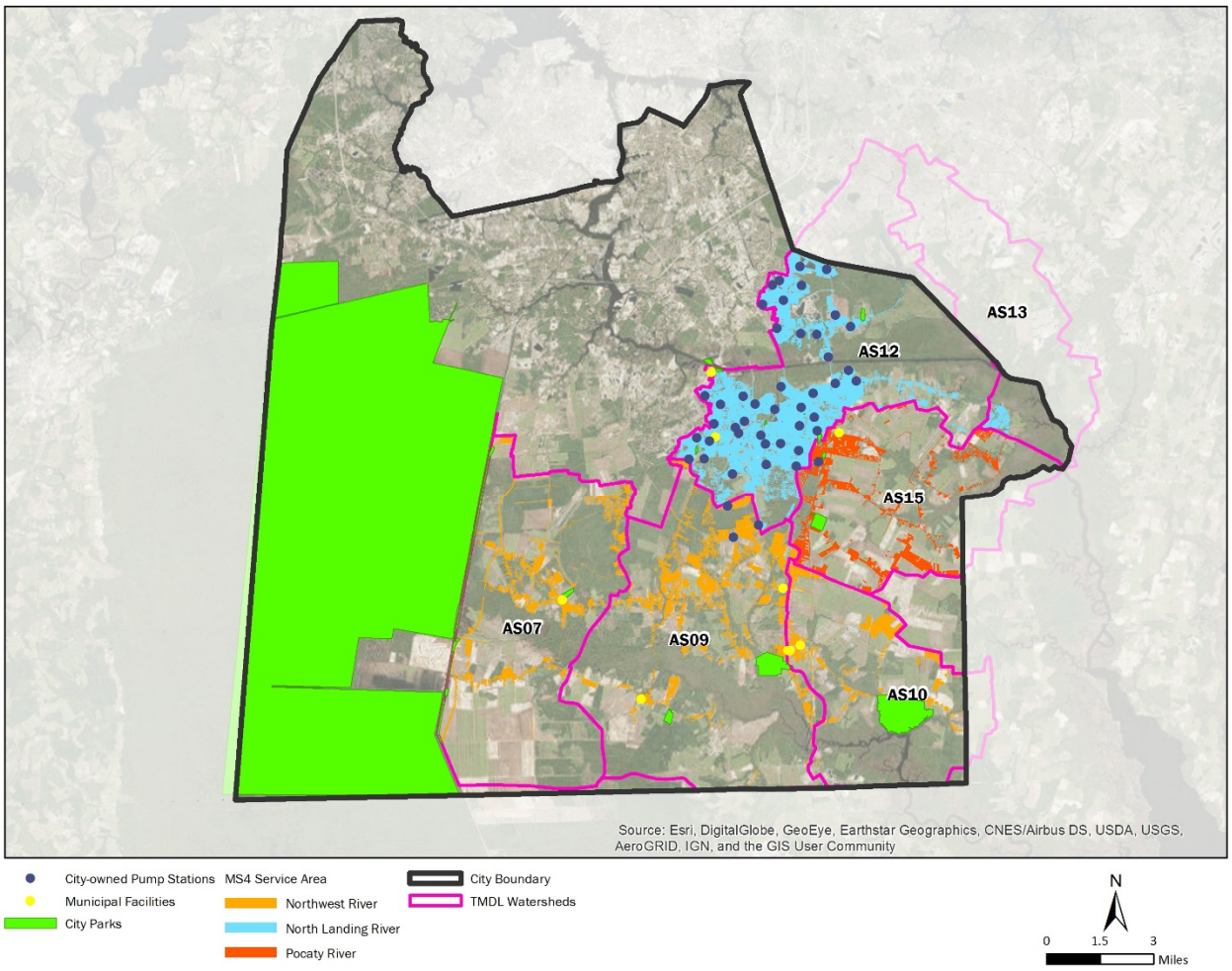

Figure 6-2. Potential facilities of concern for TP in the Southern Rivers MS4 service area

Section 7

Strategies to Reduce Bacteria

This section includes a list of current and future projects and programs designed to reduce bacteria. Projects and programs in this Plan are selected from the *City of Chesapeake, Virginia, MS4 Program Plan*, regional and local public outreach campaigns, land conservation programs, and other relevant documents (City 2017c). Also in this section is a description of the measure of effectiveness for bacteria reduction by structural practices and programs.

7.1 Current Projects and Programs from the MS4 Program Plan

Projects, programs, and structural BMPs that the City currently implements are included in this section. Each project and program is discussed in terms of its potential to help reduce bacteria.

Each bacteria TMDL report used bacteria water quality monitoring data as inputs to model the total existing load in the watershed of concern. Because the load and WLAs developed in the reports represent a snapshot of the existing conditions based on sampling data, efforts from the City since that date are assumed to have an impact on local water quality. This section summarizes the programs and structural BMPs that have been put into place since the modeling to develop the respective TMDL was completed. Table 7-1 summarizes the TMDL reports and modeling dates.

Table 7-1. Date Range of Monitoring Data in TMDL Reports

POC	TMDL Watershed	Start Year	End Year
E. coli	North Landing River	2002	2013
	Pocaty River	2002	2013
TP and DO	North Landing River/Albemarle Canal	2000	2011
	Pocaty River	2000	2011
	Northwest River	1990	2010

7.1.1 Stormwater Infrastructure Management

Per *Pathogens in Urban Stormwater Systems*, the dominant passive removal mechanisms for FIB include natural inactivation (affected by sunlight, water temperature, and exposure to air), predation, inert filtration and sedimentation, and sorption and chemical inactivation (Council 2014). Based on the treatment processes provided in retention (i.e., wet) ponds, media filters, and bioretention practices, FIB reductions would be expected by those structural BMPs. This list is not exhaustive of all BMPs that may remove bacteria, and represents only a few that, based on limited research, exhibit an ability to reduce bacteria.

Though some studies are available, geographical variation and limited replication of field studies provide no reliable record of bacteria removal efficiencies for structural BMPs in the city of Chesapeake that are sufficient to quantitatively estimate the resulting load reductions. Though DEQ has defined the bacteria removal efficiency for a subset of common stormwater BMPs, more studies and representative data are needed for all BMP types to increase the confidence in performance estimates regarding FIB (Council 2014).

7.1.1.1 Current Implementation of Structural BMPs

Hundreds of structural BMPs have been installed throughout the city. The ability to reduce bacteria varies by the type of BMP, its location, and ambient conditions. Because research is limited on removal rates for specific BMP types and because results can be highly variable based on the factors mentioned above, the City will track the number and type of BMPs implemented and the drainage area treated by the BMPs.

Table 7-2 lists the BMPs and subsequent drainage areas that can be credited toward meeting the WLAs. These BMPs include all publicly owned BMPs or private BMPs with a BMP maintenance agreement that are in the TMDL watersheds and were installed after January 1, 2006. All BMPs that were implemented before that date were in place during the monitoring of bacteria concentrations and accounted for in modeling scenarios and the baseline TMDL bacteria load calculations. In total, 40 BMPs were identified where credit can be taken; a full list of the creditable BMPs and all active BMPs in the Southern Rivers watersheds are provided in Appendix B.

Most BMPs installed since 2006 in the Southern Rivers are retention (wet) ponds (31 BMPs) with some detention basins (3), manufactured BMPs (3), dry swales (2), and a shallow swale (1).

Table 7-2. BMP Counts

TMDL Basin	MS4 Service Area (ac)	VAHU6 Watershed	BMPs	Total by TMDL Basin	Drainage Area (ac)
Northwest River	6,279	AS07	0	14	391
		AS09	14		
		AS10	0		
North Landing River	8,101	AS12	26	26	262
Pocaty River	2,496	AS15	0	0	0

7.1.1.2 Inspection, Maintenance, and Verification for Structural BMPs

Inspecting and maintaining BMPs is essential to maintain their ability to remove POCs (including bacteria) at the documented efficiencies. The City is required to inspect all public stormwater management facilities (SWMFs) owned or operated by the City annually, and privately maintained BMPs must be inspected at least every 5 years. In fiscal year (FY) 2017, the City inspected 438 private and 144 public facilities across the city.

As required by its MS4 permit, the City developed a strategy to encourage maintenance of BMPs treating stormwater runoff solely from individual residential lots. The strategy includes periodic inspections, homeowner outreach and education, and other methods to promote long-term maintenance. The City distributes informational materials to homeowners in support of this program.

In addition, the City is required to inspect a minimum of 15,000 storm sewer structures and 685 miles of the storm sewer system, including pipes and ditches, during the duration of the 5-year MS4 permit. For FY2017, the City cleaned/serviced 119 structures; cleaned and cleared 251.4 miles of blocked ditches; and cleaned, cleared, and re-graded 222.6 miles of roadside ditches. Approximately 379,300 gallons and 21,416 tons of sediment and debris were removed from gutter pans and roads. One ton of debris was removed from stormwater BMPs.

7.1.1.3 Capital Improvement Program

The City's approved Capital Improvement Program (CIP) for FY2018 to FY2022 includes 38 stormwater projects, including $1.5 million for BMP renovation and rehabilitation between FY2018 and FY2022 (project 73-120). The CIP also includes six projects occurring exclusively in the Southern Rivers watersheds. Table 7-3 summarizes those projects. A full list of the FY2018 to FY2022 stormwater projects is included in Appendix C.

Table 7-3. FY2018–22 Stormwater Projects

Project Name	Location	Project Number	Estimated Completion Date	Total Expense
Master Drainage Improvements II	Cooper's Ditch Watershed Southern Chesapeake	40-210	6/30/2018	$1,908,000
Shillelagh Road Drainage Outfall Improvements	Shillelagh Road	77-120	12/1/2018	$3,100,000
Whittamore Road Outfall Improvements	Whittamore Road	20-200	N/A	$300,000
Cooper's Ditch Dredging	Cooper's Ditch Watershed	04-100	12/1/2016	$2,000,000
Prince Edward Drive Outfall Improvements	Prince Edward Drive	09-130	11/1/2016	$600,000
Royce Drive Drainage Outfall Improvements	East/West Royce Drive	10-130	12/1/2016	$550,000

7.1.1.4 Ditch Dredging and Cleaning

In 2016, the City dredged approximately 16,000 linear feet (LF) of Cooper's Ditch and Poplar Branch, which outfall to the Chesapeake and Albemarle Canal in the North Landing River watershed (VAHU6 watershed AS12). The ditch drainage area is 6,918.43 acres, of which 26.9 percent is impervious area, 26.7 percent is forested area, and 46.4 percent is turf. In total, 37,350 cubic yards of dredge material were removed from the ditch. This project will remove accumulated sediments and restore the storage capacity and runoff treatment capacity of the system.

7.1.2 Illicit Discharge Detection and Elimination

Chapter 4 of the *City of Chesapeake, Virginia, MS4 Program Plan* outlines the methods and procedures to identify, track, and evaluate illicit discharges at stormwater outfalls (City 2017c). In compliance with the current Phase I MS4 permit, the City has mapped the location of stormwater outfalls and annually screens a subset of stormwater screening sites for dry weather flow.

7.1.2.1 Dry Weather Screening

Screening outfalls to detect illicit sewer connections and other potential bacteria sources is an important step to eliminating direct sources of bacteria to the MS4 and surface waters. In addition to removing illicit discharge, minimizing dry weather flows can reduce bacteria by maintaining a dry environment that is unfavorable for bacteria growth in the storm sewer system.

Based on the criteria outlined in Part I.B.2(I)2 of the City's MS4 permit, the City will annually select 50 sites for dry weather flow screening. The site selection will prioritize sites located near areas of concern, such as commercial car washes, pet kennels, restaurants, areas with a complaint history, and areas upstream of fragile ecosystems.

In 2016, the City performed dry weather screening at 50 locations throughout Chesapeake, including 12 sites in two of the TMDL Southern Rivers watersheds. No illicit discharges were detected, though standing water was observed in some outfalls, which is typical due to the elevation and flat topography typical to the area. The results of these screenings are included in Appendix B.

7.1.2.2 Illicit Discharge Investigation

As a part of the *City of Chesapeake, Virginia, MS4 Program Plan*, the City will investigate illicit discharges and improper disposals within the time frame specified by the MS4 permit (City 2017c). In FY2017, the City investigated 438 potential illicit discharges.

7.1.2.3 Spill Response

The City coordinates with the Fire Department and other City departments to prevent, contain, or respond to spills. Annually, the City records spills that qualify for immediate reporting.

7.1.3 Sewer Inspection and Rehabilitation

The City Department of Public Utilities maintains a sanitary sewer collection system comprising more than 1,000 miles of pipe and 270 pump stations within the city of Chesapeake. Wastewater is pumped to the Hampton Roads Sanitation District (HRSD) collection system and treated at one of HRSD's nine regional treatment facilities.

Wastewater infrastructure problems are mitigated through a process of risk assessment, inspection, and rehabilitation. Issues that can lead to a failure of wastewater infrastructure and introduction of untreated wastewater to groundwater or surface waters include infiltration and inflow (I/I) and sanitary sewer overflows (SSOs).

Structural defects that allow infiltration during wet weather events can also lead to sewage exfiltration during dry weather conditions. Therefore, resolving structural defects that lead to I/I can eliminate sources of bacteria during both wet and dry flow conditions. In addition, structural failure, including collapsed pipes and poor grade, can inhibit flow and cause the system to overflow. Debris and buildup in the pipe caused by the accumulation of fats, oils, and grease (FOG) can also lead to SSOs.

To identify and resolve structural defects and other infrastructure problems, the City performs smoke testing, closed-circuit television (CCTV) inspection, and rehabilitation of existing wastewater infrastructure. Per the *City of Chesapeake, Virginia, MS4 Program Plan*, the City will inspect a minimum of 189,000 LF of sanitary sewer annually (City 2017c).

7.1.3.1 CCTV Pipe Inspections

Table 7-4 summarizes the sewer pipe CCTV inspections per watershed that were performed between June 2008 and November 2017.

Table 7-4. CCTV Pipe Inspections in the Southern Rivers Watersheds		
Watershed	Segments Inspected	Linear Mile(s) Inspected
Albemarle and Chesapeake Canal	1,783	70.64
North Landing River	125	5.41
Northwest River	4	0.19

7.1.3.2 Sewer Smoke Testing

The City conducts routine smoke testing through its sewer service area to identify defects in the right-of-way or on private property. Potential defects include missing or broken plugs on cleanouts, broken pipes, loose couplings, cross connections with the storm sewer system, illicit connections, and bad seals at indoor plumbing. Defects identified through sewer smoke testing are repaired.

The City's goal is to smoke-test 10 percent of the gravity sewer pump station service areas every year. Therefore, the entire system will be tested every 10 years.

7.1.3.3 Capital Improvement Program

Sewer projects included in the City's CIP can repair structural deficiencies and reduce SSO occurrences. The City's FY2018 to FY2022 project list includes eight sewer projects that may impact the Southern Rivers watersheds, as shown in Table 7-5.

Table 7-5. FY2018–22 CIP Public Utilities				
Project Name	Location	Project Number	Estimated Completion Date	Total Expense
Sewer Management Operations and Maintenance	Citywide	13-160	7/1/2017	$3,000,000
Sewer Pump Station Safety Improvements	Citywide	35-200	6/30/2023	$4,000,000
Sewer Pump Station: Replacement and Rehabilitation	Citywide	21-220	6/30/2026	$2,700,000
Sewer Renewal: Additional Consent Order Capital	Citywide	05-180	6/30/2022	$264,261,609
Water and Sewer Pump Station Telemetry	Citywide	32-210	6/30/2018	$400,000
Sanitary Sewer Evaluation Study	Citywide	27-120	6/30/2018	$8,660,079
Sewer System Repairs: Phase I	Citywide	31-120	7/30/2017	$1,696,100
Sewer System Repairs: Phase II	Citywide	04-140	7/1/2017	$244,611

7.1.4 Pollution Prevention/Good Housekeeping Practices

The City currently practices good housekeeping at municipal facilities to prevent spill or stormwater pollution introduction to the MS4. In the first 36 months of the current permit term, the City will develop municipal stormwater pollution prevention plans (SWPPPs), continue its routine municipal yard inspection program, and continue employee training to implement good housekeeping at high-risk municipal facilities. Specific initiatives will include: (1) biennial spill and stormwater pollution prevention training for selected municipal staff, and (2) installing markers at stormwater inlets to the MS4 at high-priority municipal facilities with greater than 2 acres of impervious surfaces.

7.1.5 Septic-to-Sewer Conversions

Identifying and removing human sources of FIB is highly beneficial in reducing the human-health risks to recreational waters, and septic systems are an important source of human bacteria in surface waters. Failing onsite wastewater treatment systems are a potential source of untreated or poorly treated sewage that may enter the storm sewer system or a receiving water via groundwater flow, overland transport, or a leaking pipe (Council 2014).

The City actively assists homeowners with connecting to the City sewer system within its sewer service area. These activities concurrently reduce bacteria and nitrogen loads, and therefore also provide a source of credit for the Chesapeake Bay TMDL. Between 2006 and 2016, 203 homes were connected to the City's sanitary sewer system that previously discharged to a septic system in the Southern Rivers watersheds. Since the end of TMDL development in 2014, four homes were converted from a septic system and connected to the sanitary sewer system. The conversions completed in the Southern Rivers watershed since 2006 are located in VAHU6 AS12 (Chesapeake Canal) in the North Landing River watershed. Table 7-6 shows the completed and planned septic-to-sewer conversions in the Southern Rivers watersheds, and Table 7-7 categorizes these conversions by development. A full list of the properties converted from septic to sewer between 2006 and 2016 is included in Appendix B.

Table 7-6. Septic-to-Sewer Conversions 2006–19

Year	Connections
2006	16
2007	13
2008	0
2009	157
2010	3
2011	2
2012	7
2013	1
2014	1
2015	1
2016	2
2018	157
Total	360

Table 7-7. Conversions by Development Name, 2006–19

Development	Connections
Albemarle Acres	178
Ethridge Road	1
Bridgewood	16
Kempsville Road	8
Battlewood Meadows	157
Total	360

Through the Sanitary Sewer Cost Participation Program for Unserved Areas, neighborhoods without public water and sewer may petition the City for these services. In 2018 and 2019, 157 homes will be connected to the City sewer system from a septic tank because of the expected expansion of the sanitary sewer system to the Battlewood Meadows neighborhood in the North Landing River watershed. That project is expected to begin construction in May 2018 and will be completed in or around November 2019. Therefore, the total number of homes converted will be 360. The *Guidance Manual for TMDL Implementation Plans* (Implementation Guidance Manual) published by DEQ in

June 2017 states that repairing, replacing, or abandoning a septic system results in a 100 percent reduction of bacteria from that system (DEQ 2017).

7.1.6 Street Sweeping and Catch Basin Cleaning

Street sweeping and storm drain cleaning are conducted throughout the city. However, to date, the City does not track the curb lane miles treated or the mass of solids collected by watershed.

In FY2017, 9,017 lane miles were swept throughout all of Chesapeake. From those activities, 3,278 tons of debris were removed. Though the City currently does not track the lane miles swept in each watershed, the City is defining the routes by watershed and may be better able to quantify the lane miles swept by watershed in the future.

7.2 Public Outreach

Public education and outreach to citizens and businesses is an overarching source control practice that is necessary for other types of source controls to be effective. Education and outreach activities may include brochures, posters, websites, event attendance, utility bill inserts, television advertisements, articles in homeowner association newsletters, in-person meetings, and other approaches that effectively reach citizens and promote behavioral changes (Council 2014). This section describes the City's regional and local public outreach activities.

7.2.1 Regional Public Outreach

The City participates in askHRgreen.org, a public awareness campaign administered by the Hampton Roads Planning District Commission (HRPDC) comprising the cities and counties in the Hampton Roads region. The website is a central resource for environmental stewardship in Hampton Roads, including green landscaping practices and other topics related to stormwater quality and the MS4 permit.

The City is an active participant in the askHRgreen.org campaigns in the region, which include events and outreach through television, radio, social media, and other online resources. The campaigns address a range of issues, such as FOG, leaves and pet waste, recycling, and water conservation. In FY2017, 3,904 visitors (or 7.7 percent of visits) accessed the askHRgreen.org website from the city of Chesapeake. The following section provides briefly reviews campaigns that address sources of bacteria.

7.2.1.1 Regional Media Campaign

Through askHRGreen.com, the City participates in a regional media campaign to encourage Hampton Roads residents to clean up fallen leaves and pet waste. The program educates the public about the consequences of not collecting leaf litter and pet waste before it enters the stormwater system.

7.2.1.2 Fats, Oils, and Grease Campaign

FOG, which typically enters the sanitary sewer system from residential or commercial kitchens, can build up and block the flow of sewage through the system, leading to SSOs, which are major sources of human fecal bacteria in surface waterways. The askHRgreen.org campaign includes materials to educate citizens about the sources of FOG and provide resources to dispose of grease and oil.

7.2.1.3 Pet Waste Stations and Educational Materials

Pet waste stations may be requested by organizations directly through the City or askHRGreen.com. The Pet Waste Station Grant Program provides a pet waste station with a post, sign, bag dispenser,

waste can, hardware, and an initial supply of dog waste bags and can liners. In FY2017, five new pet waste stations were installed in Chesapeake. Across the city are 25 pet waste stations that were installed under the program, including one in the Albemarle Canal watershed, two in the North Landing River watershed, and one in the Northwest River watershed. Pet waste stations are 75 percent efficient to reduce bacteria loads in their vicinity.

The City also provides individual pet waste bag holders and an informational brochure to local veterinarians, Chesapeake Animal Services, and the Chesapeake Humane Society for distribution to patrons and customers, as well as conducting citizen outreach.

7.2.1.4 Regional Cleanup Events

Local governments also participate in recycling and cleanup events throughout the region, including the Great American Cleanup, Clean the Bay Day, and recycling events and campaigns.

7.2.1.5 Bay Star Homes

Homeowners in the Southern Rivers watersheds can pledge to become a Bay Star Home through askHRGreen.com. To qualify, homeowners must perform two actions in four categories: (1) Grow Green, (2) Water Connections, (3) Conserve Resources, and (4) Get Involved. These actions include practices that may reduce the sources or conveyance of bacteria to local waterways, such as avoiding litter, properly disposing of FOG, and picking up pet waste.

7.2.2 Local Public Outreach

The City also conducts outreach to students and the public about stormwater pollution. The City provides education and resources for citizens to report illicit discharges and promotes proper disposal of used oil, household hazardous waste, and FOG through targeted outreach via multiple media outlets, including websites, radio, cable television, local television, publications, and the City's Customer Service Center.

7.2.2.1 Outreach Materials

The City distributes informational materials to private homeowners about BMP inspection and maintenance.

7.2.2.2 Chesapeake Environmental Improvement Council

The Chesapeake Environmental Improvement Council (CEIC) was formed in 1983 to promote litter prevention, recycling, and beautification by citizens in the community.

The Adopt-a-Park and Adopt-a-Spot-in-a-Park programs allow civic and citizen organizations to perform various tasks on a regularly scheduled basis.

7.2.2.3 Community Events

The City conducts a program for recycling, reuse, and proper disposal of used motor vehicle fluid and household hazardous waste. As a part of that program, the City tracks the amount of material collected.

7.2.2.4 Voluntary Retrofit of Private BMPs

The City tracks and annually provides a summary of voluntary retrofits on private property to demonstrate pollutant reduction.

7.3 Existing Land Conservation Programs

This section describes existing land conservation programs in the Southern Rivers watersheds intended to conserve land, preserve the rural character of the southern portion of the city, and protect local military installations from encroachment of incompatible land uses. Through the conservation and conversion of land through these programs, the City may also help reduce bacteria.

7.3.1 NALF Fentress Encroachment Protection Acquisition Program

Through the Naval Auxiliary Landing Field (NALF) Fentress Encroachment Protection Acquisition Program (FEPAP), the City purchases parcels or restrictive easements near NALF Fentress at fair market value from willing sellers to prevent encroachment and incompatible uses and preserve the rural nature and agricultural heritage of the Fentress area. Property purchase is limited to the extents of the NALF Fentress Overlay District. Since its inception in 2015, more than 270 acres of land have been preserved.

7.3.2 Open Space and Agriculture Preservation Program

Through the Open Space and Agriculture Preservation (OSAP) program, the City purchases development rights from willing landowners of agricultural lands larger than 10 acres in exchange for a preservation easement on their property. The owner is compensated for the development rights and retains ownership as well as the ability to reside on the property and use the land for agricultural or open-space purposes. To date, 172 acres have been conserved through the purchase of two easements.

7.3.3 Navy Multi-Year Agreement/Readiness and Environmental Protection Initiative

Under the U.S. Navy Multi-Year Agreement (MYA)/Readiness and Environmental Protection Initiative (REPI), the City and U.S. Navy cooperatively purchase property fee simple or conservation easements at fair market value from willing sellers to prevent encroachment near the Naval Support Activity Hampton Roads-Northwest Annex and NALF Fentress and to preserve the rural nature and agricultural heritage of southern Chesapeake. To date, three properties have been acquired, leading to the protection of 1,324 acres.

7.4 Structural BMP and Program Effectiveness

Unlike the established BMP removal efficiencies for nutrient removal, there are not scientifically backed BMP removal efficiencies for bacteria. The following sections include removal efficiencies based on Appendix A of the Implementation Guidance Manual (DEQ 2017).

7.4.1 Program Effectiveness

The City will track certain metrics to document program implementation. Because of the limited data available to calculate the initial loads and effectiveness of programs to reduce bacteria, numeric reductions have not been determined for the City's current programs.

For informational purposes, one resource available in Virginia is Appendix A of the Implementation Guidance Manual (DEQ 2017). Appendix A of this Implementation Guidance Manual lists the effectiveness of some of the programs described above. Table 7-8 summarizes the program data.

Table 7-8. Bacteria Reduction Efficiency: Programs	
Program	Estimated Reduction Efficiency (percent)
Alternative waste treatment system	100
Connection to public sewer	100
Septic system pump-out	5
Repair septic system	100
Septic system installation/replacement	100
Pet waste disposal station	75
Pet waste composter/digester/fermentation	50
Pet waste management program	50–70
Pet waste confined canine unit	100

The Implementation Guidance Manual does not provide an estimate of bacteria reduction effectiveness for all City programs described in this Plan (DEQ 2017). Efficiencies for programs not mentioned will be referenced as more research becomes available.

7.4.2 Structural BMP Effectiveness

For structural BMPs, the City will track the number of BMPs implemented and the MS4 service area treated by BMPs.

The bacteria reductions for the City's current BMPs have not been calculated because of the limited data on the effectiveness of these structural BMPs to reduce bacteria. Significantly more studies and representative data are needed for all BMP types to increase the confidence in performance estimates regarding FIB (Council 2014).

As discussed in Section 7.1, the treatment processes provided by wet ponds, media filters, and bioretention practices would be expected to reduce FIB; however, this list is not exhaustive of all BMPs that may remove bacteria. For informational purposes, Appendix A of the Implementation Guidance Manual lists the effectiveness of some structural BMPs, which are shown in Table 7-9 (DEQ 2017).

Table 7-9. Bacteria Reduction Efficiency: Structural BMPs	
Program	Estimated Reduction Efficiency (percent)
Streambank protection and stabilization (e.g., riprap, gabion)	0.08
Infiltration trench	90
Bioretention	90
Rain garden	80
Bioswale	80
Filtering practice (e.g., sand filters)	35
Constructed wetland	80
Manufactured BMPs	80
Wet pond	70

Table 7-9. Bacteria Reduction Efficiency: Structural BMPs	
Program	Estimated Reduction Efficiency (percent)
Dry detention pond	30
Riparian buffer: forest	57
Riparian buffer: grass/shrub	50
Urban land use conversion: turf to trees	Land use conversion

7.5 Development and Growth Plans

The character of the Southern Rivers watersheds is mostly rural. As development continues and expands throughout the city and particularly in the Southern Rivers, a strategic approach to development and growth will permit consideration of practices and strategies to prevent or reduce bacteria in stormwater runoff.

7.5.1 Comprehensive Plan 2035

The Comprehensive Plan is a blueprint to guide the City's future growth and land use. The plan was adopted by the City Council in February 2014 and amended in November 2016. The plan includes continuation of the Urban, Suburban, and Rural Overlay districts. Most of the Southern Rivers area is located in the Rural Overlay District (City 2016).

As specified in the plan and City code (Article 5, Section 5-200), development within the Rural Overlay District should be consistent with the design guidelines of the Rural Character District. Densities will not exceed one unit per 3 acres to preserve and protect the rural character of the southern portion of the city. Together with the Rural Design Guidelines, *Public Facilities Manual*, Open Space and Agriculture Program, preservation programs, Subdivision Ordinance, Zoning Ordinance, and Cluster Ordinance, the Rural Overlay District is part of the City's cohesive rural preservation strategy (City 2018).

7.5.2 A Plan for the Northwest River Watershed

In March 2010, HRPDC released *City of Chesapeake: A Plan for the Northwest River Watershed*, which was developed in collaboration with the City and The Nature Conservancy (HRPDC 2010). The plan is consistent with the goals identified in the 2026 Comprehensive Plan, including protection of water quality and critical habitat, flood hazard mitigation, provision of opportunities for limited residential and commercial development, preservation of rural character, and control of encroachment on the Naval Support Activity Hampton Roads-Northwest Annex. Relevant to this Plan, *City of Chesapeake: A Plan for the Northwest River Watershed* recommends that the City continue and expand programs to upgrade stormwater BMPs, enhance agricultural BMPs, and inspect and pump-out septic systems and restore vegetated buffers adjacent to the Northwest River and its tributaries. For future development, the plan recommends that the City limit development adjacent to the Northwest River, expand the Conservation Corridor to all tributaries of the Northwest River, and minimize increases in impervious surfaces through low-impact development techniques (HRPDC 2010). The strategies identified by the City and HRPDC in *City of Chesapeake: A Plan for the Northwest River Watershed* are consistent with the strategies identified in this Plan.

7.5.3 Green Sea Blueway and Greenway Management Plan

The *Green Sea Blueway and Greenway Management Plan* is a regional collaboration with the City of Virginia Beach and Currituck County to conserve, protect, and manage open-space lands and

waterways in the Green Sea area for present and future generations to enjoy (HRPDC 2015). The study area includes portions of the North Landing River, Chesapeake and Albemarle Canal, and Currituck Sound watersheds. Through the *Green Sea Blueway and Greenway Management Plan*, the participating entities will protect and enhance water quality within the Green Sea area (HRPDC 2015).

7.6 Future Projects and Programs

This section outlines potential future projects and programs that the City may consider implementing. Each sub-section summarizes the tasks involved and suggested measurable goals. The following recommendations may be considered for the current Plan or evaluated for inclusion in future action plans.

7.6.1 Land Conversion

The City will consider land conversion from agriculture to forest for properties purchased under the existing conservation programs described in Section 7.3. The properties are currently leased for agricultural use, but City policy allows the City to prioritize land for recreational use, BMPs, or debris sites during storm events. Specifically, the City will evaluate converting the following leased properties from agriculture to forest in future permit terms:

- 1564 Mount Pleasant Road, 8.0 acres, North Landing River (AS12)
- 1653 Mt Pleasant Road, 16.0 acres, North Landing River (AS12)
- 1736 Mount Pleasant Road, 16.6 acres, North Landing River (AS12)
- 1102 Centerville Turnpike South, 15.2 acres, Pocaty River (AS15)
- 2500 Land of Promise Road, 133.0 acres, Pocaty River (AS15)
- Ballahack Road, 404.0 acres, Northwest River (AS09)

The total acres to be considered for conversion is 592.8 acres, including 40.6 acres in the North Landing River watershed and 148.2 acres in the Pocaty River watershed.

7.6.2 Forested Buffers

The City will also consider establishing forested buffers on conserved properties protected through the land conservation programs described in Section 7.3.

7.6.3 Bacteria Monitoring

A water quality improvement program can benefit from assessments, or monitoring, to identify pollutant sources and track or demonstrate progress toward the program's targets. Underlying a defensible monitoring plan is a set of goals that are intended to focus the monitoring effort on obtaining the information needed for a specific purpose.

DEQ has a statewide ambient monitoring program with specific stated goals. The probabilistic nature of the DEQ program generally allows for large-scale and long-term assessment of the state's surface waters with respect to water quality standards. Unfortunately, it does not generally provide the combination of sampling frequency and monitoring locations to allow for local-scale determination of specific areas of concern or temporal trends.

Developing and implementing a monitoring plan with the stated goals of identifying and characterizing the sources of the POCs can help the City understand if the programs and structural BMPs it has in place are reducing the POC. Short-term tracking (i.e., less than a 5-year permit cycle

or even a 2-year 305[b] assessment cycle) can be used so that the monitoring program can be adaptively managed to focus on the areas of interest.

The plan should focus on monitoring *E. coli* and *Enterococci* to align with the respective state water quality criteria. Monitoring should also consider the timing of inputs and hydrologic conditions. Bacteria are often conveyed by stormwater when groundwater inflows rise carrying bacteria from septic systems, and when overland flows convey pet wastes or illicit discharges to surface waters. Thus, monitoring after storm events offers the highest likelihood of identifying bacteria sources. Monitoring can be performed in intermittent or ephemeral conveyances as well as permanent waters, as long as there is a known connection from such waters to a TMDL water body.

The TMDLs summarized in this Plan indicate that sources of bacteria include humans, pets, wildlife, and agricultural activities. The City has limited (or no) control over wildlife and agricultural activities; therefore, a monitoring plan that incorporates prudent use of bacteria source tracking (BST) technology may provide deeper insight into specific sources of bacteria in the city's waters.

As noted above, monitoring can be targeted to specific locations and periods to identify or characterize bacteria inputs to the TMDL watersheds. For example, a stream or drainage feature in or adjacent to a dog park can be monitored following rain events to characterize the levels of bacteria carried to a TMDL water body. In addition to testing for *E. coli* or *Enterococcus* (depending on the nature of the receiving water), BST analysis can be performed to determine the pet waste proportion of the bacteria. Identifying specific locations where bacteria originate informs the planning for source control measures, and reduces the likelihood of expending resources to control bacteria in locations where loadings are shown to be small. The latter situation may be important in demonstrating compliance with TMDLs, because identifying locations or tributaries that are not conveying bacteria to TMDL water bodies will show where the City does not need to install projects for bacteria control.

Monitoring to identify and characterize sources should be prioritized to focus on the most likely locations first. For example, monitoring drainage features associated with areas of aging septic systems, SSO occurrences, illicit discharges, high pet densities, or homeless camps can be expected to have a greater likelihood of human and pet waste bacteria loadings than other areas. A simple screening process using land use and drainage maps may identify such locations, which could then be prioritized for monitoring at whatever level of intensity the City desires.

Monitoring can also be used to determine whether program implementation has reduced the applicable bacteria source. For example, monitoring drainage conveyances in an area where septic-to-sewer conversion is being implemented may show a reduction in human bacteria inputs to a TMDL water body.

Ideally, monitoring to identify sources would be combined with monitoring to show reductions associated with projects or programs. This should provide the most direct cause-and-effect demonstration of bacteria control resulting from the City's efforts. Such a demonstration is virtually impossible with the DEQ ambient monitoring program alone, because monitored locations are generally far from the bacteria sources, and the TMDL waters are subject to natural and anthropogenic bacteria inputs from many other sources and locations outside the City's MS4 service area.

A benefit of this targeted, site-specific monitoring is that it can be employed for a relatively short period to identify or confirm a source and then to determine whether a project has helped to control the source. Monitoring a few locations (e.g., upstream and downstream of a potential source) over several storm events could characterize the level of bacteria inputs. And monitoring several events after project installation should show whether the desired reductions have occurred. After such a

demonstration, monitoring resources can be reallocated to another location. Thus, monitoring efforts can be scaled, scheduled, and adapted, rather than making a commitment to a comprehensive, ongoing monitoring program. It may even be possible to include monitoring costs within specific budgets for projects or programs to reduce or eliminate the need to allocate funds to a separate monitoring program.

The City has already committed to identifying at least four sites in the collection system upstream of tidal influence to monitor stormwater for *Enterococcus*, *E. coli*, and/or fecal coliforms. BST may be included in that monitoring to determine if human sources of bacteria are present. The City's Public Works Environmental Quality Section will conduct quarterly monitoring of bacteria parameters at the identified sites.

During the current permit term, the City will evaluate the use of BST to assess the impact of projects and programs on bacteria from anthropogenic sources. If the City implements bacteria monitoring, it should develop a written monitoring plan, including a decision matrix for adaptively determining the nature, locations, and timing of monitoring activities. It should also include a quality assurance project plan to ensure the defensibility of the data acquired. An electronic database (e.g., customized Excel spreadsheet or Access database) should be used to store and manage the data and simplify reporting. Metadata should be maintained with the monitoring data to enable review of ancillary information like field observations regarding sampling or site conditions.

7.6.4 Structural BMPs

The City has conceptually evaluated the feasibility of nine structural BMPs in the Southern Rivers. Of the nine, five were selected for further evaluation. During the next permit term, the City will determine which, if any, will be constructed. The implemented structures and the associated reductions will be reported in the annual report.

Because of the small size of the MS4 service area—especially in the Northwest and Pocaty River watersheds—and the nature of the collection system, which comprises primarily flat, roadside ditches, many traditional BMPs are not feasible in the Southern Rivers. Therefore, the City intends to focus on other types of BMPs, such as land conversions.

7.6.5 Targeted Outreach

The City will explore creating an outreach program for small agriculture operations and private, non-permitted facilities of concern that may discharge bacteria to local waterways. These types of facilities may include boating slips and marinas, and equestrian facilities. The City will consider partnering with other agencies (including the City Agriculture Department and the Virginia Department of Conservation and Recreation) for outreach to agricultural facilities.

7.6.6 Additional Means and Methods

The City reserves the right to implement other pollutant reduction methods not called out in this Plan instead of or in addition to the projects and programs described in this section. A list of control measures that were implemented during the reporting period and the cumulative progress toward the compliance targets will be included in the City's annual report.

Section 8

Strategies to Reduce Total Phosphorus

To meet the WLA for the TP TMDLs in the Southern Rivers, the City will evaluate implementing structural practices or SWMFs, as well as potential land conversion and programmatic measures. As discussed in Section 3, the City will use the efficiencies defined by the Chesapeake Bay Guidance and Virginia Stormwater BMP Clearinghouse website to calculate the credit for SWMFs or BMPs in the Southern Rivers watersheds toward the TP TMDL (DEQ 2014, 2015). However, due to the topography of the Southern Rivers watersheds and the collection system of roadside ditches, opportunities for significant reductions from structural BMPs may be limited. This section includes a list of current and future projects and programs designed to reduce TP.

8.1 Current Implementation of Structural BMPs

Table 8-1 lists all publicly or privately owned BMPs with a maintenance agreement that are located in the TMDL watersheds; were installed after January 1, 2006; and include sufficient information to determine the amount of TP credit achieved by the BMP. Depending on the type of BMP, a combination of the following information is required to calculate the credit based on the Virginia Stormwater BMP Clearinghouse website: pervious and impervious acres treated by the BMP, whether the BMP is located in the coastal plain, and the hydrologic soil group of the underlying soil (DEQ 2014). Of the 40 BMPs identified in the Southern Rivers watersheds, 39 include sufficient information to determine the BMP type and efficiency. Of the 39 BMPs, one BMP is not yet constructed and does not have drainage area information, and another is a proprietary device for volume control and, therefore, not creditable by the DEQ BMP Clearinghouse; as a result, credit was calculated for 37 of the 40 BMPs.

Table 8-1. BMP Counts

TMDL Basin	MS4 Service Area (ac)	VAHU6 Watershed	BMP Count	Total by TMDL Basin	Drainage Area (ac)
Northwest River	6,279	AS07	0	13	268
		AS09	14		
		AS10	0		
North Landing River	8,101	AS12	23	24	260
Pocaty River	2,496	AS15	0	0	0
Total	16,876	N/A	38	38	530

The data provided by the City generally included the contributing drainage area of the BMP, site land use, and location. To determine the impervious acres treated by the BMP, each land use was assigned a percent imperviousness based on the NLCD. Residential land uses were defined as 35

percent impervious, commercial and mixed-use development as 70 percent, and rural or open-space areas as 8 percent. The hydrologic soil group was determined by comparing the BMP location and soil type and information from the Soil Survey Geographic Database (SSURGO). If a BMP was located within an area assigned to a dual hydrologic soil group (A/D, B/D, or C/D), the BMP was assumed to be located in an undrained area and assigned a hydrologic soil group of D.

Based on these assumptions, the existing BMPs in the Southern Rivers reduce the TP load by 35.48 pounds per year (lb/yr) in the Albemarle Canal-North Landing River watershed and by 75.48 lb/yr in the Northwest River watershed. A full summary of the BMPs and the calculated credit is provided in Appendix B.

8.1.1 Street Sweeping, Catch Basin Cleaning, and Pipe Washing

Street sweeping and catch basin cleaning are conducted throughout the city. However, to date, the City does not track the curb lane miles treated or the mass of solids collected in each watershed. These metrics are available only for the entire city; therefore, the City cannot determine the credit for only the TMDL watersheds. In FY2017, 9,017 lane miles were swept throughout the entire city with 3,278 tons of material collected. Though the City currently does not track the lane miles swept in each watershed, it is currently defining the routes by watershed to quantify the lane miles swept. Once the number of curb lanes miles swept is defined by watershed, the City will be better able to quantify the credit provided based on the technology, frequency, and seasonality of the street sweeping operations.

8.1.2 Ditch Dredging and Cleaning

In 2016, the City dredged approximately 16,000 LF of Cooper's Ditch and Poplar Branch, which drain to the Chesapeake and Albemarle Canal in the North Landing River watershed (VAHU6 watershed AS12). The ditch drainage area is 6,918.43 acres, of which 26.9 percent is impervious area, 26.7 percent is forested area, and 46.4 percent is turf. In total, 37,350 cubic yards of dredge material were removed from the ditch. The project will remove accumulated sediments and restore the storage capacity and runoff treatment capacity of the system. The project will result in a reduction of 357 lb/yr of TP.

8.1.3 Tree Plantings

The City plants trees as a part of municipal projects. Based on the recent Expert Panel recommendations, tree plantings can reduce the TP load by 23.8 percent for tree canopy over turf grass and 11.0 percent for canopy over impervious surfaces. In 2018, the City planted 2,000 loblolly pine seedlings in the TMDL watersheds.

8.2 Current Projects, Programs, and Plans

Many of the programs discussed in Section 7 may also contribute to TP reduction in the Southern Rivers watershed, including:

- Stormwater Infrastructure Management (Section 7.1.1)
- Illicit Discharge Detection and Elimination (Section 7.1.2)
- Pollution Prevention/Good Housekeeping Practices (Section 7.1.4)
- Public Outreach (Section 7.2)
- Existing Land Conservation Programs (Section 7.3)
- Development and Growth Plans (Section 7.5)

For more information about these programs, refer to Section 7.

8.3 Future Projects

This section outlines potential future projects and programs that the City may consider implementing to reduce TP loads to surface waters. Each sub-section summarizes the tasks involved and suggested measurable goals.

8.3.1 Capital Improvement Program

The City's approved CIP for FY2018 to FY2022 includes 38 stormwater projects, including $1.5 million for BMP renovation and rehabilitation between FY2018 and FY2022 (project 73-120). The CIP also includes six projects occurring exclusively in the Southern Rivers watersheds. Those projects are summarized in Table 8-2. A full list of the FY2018 to FY2022 stormwater projects is included in Appendix C.

Table 8-2. FY2018–22 Stormwater Projects

Project Name	Location	Project Number	Estimated Completion Date	Total Expense
Master Drainage Improvements II	Cooper's Ditch Watershed	40-210	6/30/2018	$2,908,000
	Sign Pine Drainage Ditch			
	Southern Chesapeake			
Shillelagh Road Drainage Outfall Improvements	Shillelagh Road	77-120	12/1/2018	$3,100,000
Whittamore Road Outfall Improvements	Whittamore Road	20-200	N/A	$300,000
Cooper's Ditch Dredging	Cooper's Ditch Watershed	04-100	12/1/2016	$2,000,000
Prince Edward Drive Outfall Improvements	Prince Edward Drive	09-130	11/1/2016	$600,000
Royce Drive Drainage Outfall Improvements	East/West Royce Drive	10-130	12/1/2016	$550,000

8.3.2 Structural BMPs

As discussed in Section 7.6.4, the City is currently exploring the feasibility of building or retrofitting stormwater BMPs on property that it owns. This may include structural BMPs or practices such as tree plantings. In addition to potential bacteria reductions, the BMPs will also reduce TP loads, which will be reported in the annual report.

In the current permit term, the City will consider implementing the BMPs in Table 8-3. The City may pursue implementing these BMPs depending on Stormwater Local Assistance Fund grant availability and other funding, the results of a feasibility analysis, its ability to acquire property, and other factors as yet to be determined.

Table 8-3. Proposed Structural BMPs

Project Name	Location	Drainage Area (ac)	Estimated TP Reduction (lb/yr)	Estimated Cost
Cooper's Ditch Level 2 Dry Swale	Albemarle/North Landing River	3.0	1.37	$204,000
Whittamore Road Level 2 Wet Pond	Albemarle/North Landing River	337.6	126.70	$1,355,000
Edinburgh Parkway Level 2 Wet Pond	Northwest River	92.4	23.81	$283,000
Hickory High School Level 2 Wet Pond	Northwest River	22.6	10.90	$244,000
Sign Pine Road Level 2 Wet Pond	Northwest River	4.1	1.50	#208,000

8.3.3 Land Conversion

The City will consider converting land from agriculture to forest on properties purchased under the existing conservation programs described in Section 8.2. The properties are currently leased for agricultural uses, but City policy allows it to prioritize land for recreational use, BMPs, or debris sites during storm events. As discussed in Section 7, the City will evaluate converting up to 592.8 acres of property in the TMDL watersheds from agriculture to forest, including 40.6 acres in the North Landing River, 148.2 acres in the Pocaty River, and 404 acres in the Northwest River.

8.3.4 Forested Buffers and Tree Plantings

The City will also consider establishing forested buffers on conserved properties, which provide additional stormwater filtering prior to entering the receiving water.

8.3.5 Additional Means and Methods

The City reserves the right to implement other pollutant reduction methods not called out in this Plan instead of or in addition to the projects and programs described in Sections 7.6 and 8.3. A list of control measures implemented during the reporting period and the cumulative progress toward the compliance targets will be reported in the City's annual report.

8.4 Load Reduction Summary

Based on the information and projects provided by the City to date, Tables 8-4, 8-5, and 8-6 summarize the progress toward the TP TMDL in the Albemarle Canal/North Landing River, Pocaty River, and Northwest River watersheds, respectively, from current and planned projects.

Table 8-4. Albemarle Canal/North Landing River TMDL Credit

Project	TP Reduction (lb/yr)
Implemented BMPs	35
Street Sweeping	TBD
Cooper's Ditch Dredging	357
Cooper's Ditch Dry Swale	1.4
Whittamore Road Wet Pond	127
Land Conversions	35
Total	555.4
Total required reductions	775
Remaining credit required	219.6

TBD = to be determined.

Table 8-5. Pocaty River TMDL Credit	
Project	TP Reduction (lb/yr)
Implemented BMPs	0
Street Sweeping	TBD
Land Conversion	127
Total	0
Total required reduction	569
Remaining credit required	442

Table 8-6. Northwest River TMDL Credit	
Project	TP Reduction (lb/yr)
Implemented BMPs	75
Street Sweeping	TBD
Hickory High School Wet Pond	10.9
Sign Pine Road Wet Pond	1.5
Edinburgh Parkway Wet Pond	24
Land Conversions	345
Total	456.4
Total required reductions	1,396
Remaining credit required	939.6

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Section 9

Current Permit Term Activities and Interim Milestones

This section includes the schedule of milestones to be implemented during the remaining permit term. The City will continue to conduct the non-structural BMPs described in Sections 7 and 8 and maintain existing structural BMPs, as described in Section 7.1.1.

The City will evaluate the proposed projects and programs that are identified in Section 7.6 and Section 8.3 for bacteria and TP, respectively. Evaluation results will be documented in the annual report.

During the current permit term, the City will connect 157 homes in the Battlewood Meadows neighborhood of the North Landing River watershed to the sanitary sewer system. In addition, the City will evaluate developing a bacteria monitoring program in the Southern Rivers watersheds; and identifying land conversion, or BMP retrofit, or implementation on City-owned or conserved property.

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Section 10

Methods of Assessment

The City must develop and implement methods to assess this Plan for its effectiveness in reducing the pollutants identified in the WLAs and assess facilities of concern, as described in Section 6. This section describes the assessment methods for bacteria and TP.

10.1 Bacteria

As discussed in previous sections, numeric efficiencies for some BMPs are not available and, for those BMPs where efficiencies are available, there is large variability in published data. Therefore, the City will assess structural and non-structural BMPs to reduce bacteria through the level of project/program implementation identified in this Plan. The data necessary to measure progress are summarized in Table 10-1. This information will be documented in the annual report.

Table 10-1. Data to Measure Progress for Bacteria-Reducing Programs and Practices

Project/Program Name	Proposed Metric
Adopt-a-Program (spot/highway)	Number of spots
Dry Weather Screening	Number of screening sites inspected
Illicit Discharge Investigations	Number of investigations
Inspection of MS4 connections of High Risk Facilities Without VPDES	Number inspected
Inspections of MS4 connections of VPDES Permitted Facilities	Number inspected
Private SWMF Inspection	Number of facilities inspected
Retrofit SWMF (voluntary implementation of residential stormwater BMPs)	Number projects completed
SWMF Installation	Number of SWMFs, design information
Sanitary Sewer Inspection Program	Linear feet inspected
Floatables Reduction Program	Number of sites surveyed for floatables
Storm Sewer Inspections (catch basins, drop inlets, manholes, culverts)	Number of structure/miles inspected
Street Sweeping	Curb lane miles swept
SWMF Inspections	Number inspected
Roadside and Off-road Drainage Ditch Cleaning	Number of miles cleaned

Table 10-1. Data to Measure Progress for Bacteria-Reducing Programs and Practices	
Project/Program Name	Proposed Metric
Bacteria Monitoring Program	Number of sites
CEIC beautification events	Number of cleanup events
Good Housekeeping Storm Drain Markers	Number of markers
Public Education/Outreach Events	Number of events/attendees
Catch Basin Cleanouts	Pounds of material removed
askHRgreen.org E-Newsletter	Number of subscribers
Fats, Oils, and Grease Media Campaigns	Number of impressions
Regional Outreach for Volunteer Opportunities	Number of attendees
Household Hazardous Waste Program	Number of attendees or pounds collected
Lawn Care Campaign	Number of impressions
Leaves Down the Drain and Pet Waste Campaign	Number of impressions
Pet Waste Stations	Number of pet waste stations established
Targeted Cleanup	Number of attendees
Septic-to-Sewer Conversions	Number of conversions
Pilot Program to Install Trash Screens at WM Yard	Number of catch basins protected
Pet Waste Bag and Brochure Distribution	Number of locations receiving brochures
Homeowner SWMF Inspection and Maintenance Materials	Number distributed
Tree Plantings	Number of trees planted, location
Land Conversion	Number of acres converted, land use
Bay Star Homes	Registrants in TMDL watersheds
Land Conservation	Acres conserved annually

10.2 Total Phosphorus

For TP, the City will assess the effectiveness of this Plan through credit calculation for implemented structural BMPs via the methods documented in the Chesapeake Bay Guidance. For structural BMPs with credit that is dependent upon the pollutant loads of the underlying land use, the land-based loading rates for the TMDL watersheds of the Southern Rivers were calculated from the land use

information in the TMDL reports; the relevant loading rates are included in Appendix B. The City will track and review the BMPs documented in this Plan as a part of the annual report.

Section 11

Actions During Future Permit Terms

The City must identify BMPs and other steps to be implemented during the next permit term. The current non-structural BMPs will be implemented during future permit terms; however, based on tracking and review, they may be modified versions of the current programs. Any land conversion projects that are identified in the current permit term will be implemented in future permit cycles.

Structural BMPs will continue to be implemented as outlined by the current and future revised *City of Chesapeake, Virginia, MS4 Program Plan* (City 2017c). As discussed above, the City will evaluate implementing the projects in Table 11-1.

Table 11-1. Proposed Structural BMPs

Project Name	Location	Drainage Area (ac)	Estimated TP Reduction (lb/yr)	Estimated Cost
Cooper's Ditch Level 2 Dry Swale	Albemarle/North Landing River	3.0	1.37	
Whittamore Road Level 2 Wet Pond	Albemarle/North Landing River	337.6	126.70	
Edinburgh Parkway Level 2 Wet Pond	Northwest River	92.4	23.81	
Hickory High School Level 2 Wet Pond	Northwest River	22.6	10.90	
Sign Pine Road Level 2 Wet Pond	Northwest River	4.1	1.50	

As required by the permit and/or as appropriate, the City will update this Plan to reflect modifications to the non-structural BMPs described herein, as well as the new structural BMPs installed throughout the city. An adaptive iterative approach will the guide the City's program revision methodology.

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Section 12

Legal Authority for TMDL Implementation

The following are existing codes and ordinances that reduce bacteria and nutrient transport to waterways.

12.1 MS4 Program Plan

A review of legal authority was completed during development of the *City of Chesapeake, Virginia, MS4 Program Plan* (City 2017c). That information is provided in Section 2.4 and Appendix D of the *City of Chesapeake, Virginia, MS4 Program Plan*.

12.2 Relevant Legal Authority

The following sub-sections present relevant legal authorities from the City of Chesapeake Code of Ordinances that reduce bacteria and nutrient transport to waterways.

12.2.1 Public Works Ordinance

Ordinances related to the environment are included in Chapter 26 of Part I of the Code of Ordinances. Relevant authorities are included in the following sections of the City code:

- **Article I. In General**
- **Article II. Environmental Improvement Council**
- **Article III. Erosion and Sediment Control**: The erosion and sediment control ordinance defines the threshold for land-disturbing activity on regulated residential land as 2,500 square feet throughout the city.
- **Article IV. Floodplain Management**
- **Article VI. Excavations, Division 3, Detention/Retention Areas**
- **Article VII. Stormwater Management**
- **Article X. Open Space and Agriculture Preservation**
- **Article XI. Northwest River Watershed Protection District**: The Northwest River Watershed Protection District is in the Northwest River watershed and is one of the major sources of drinking water for the city. The district encompasses 161 square miles, of which 103 square miles are in Chesapeake; the remaining area is part of the state of North Carolina. Figure 12-1 shows the extents of the Northwest River Watershed Protection District.

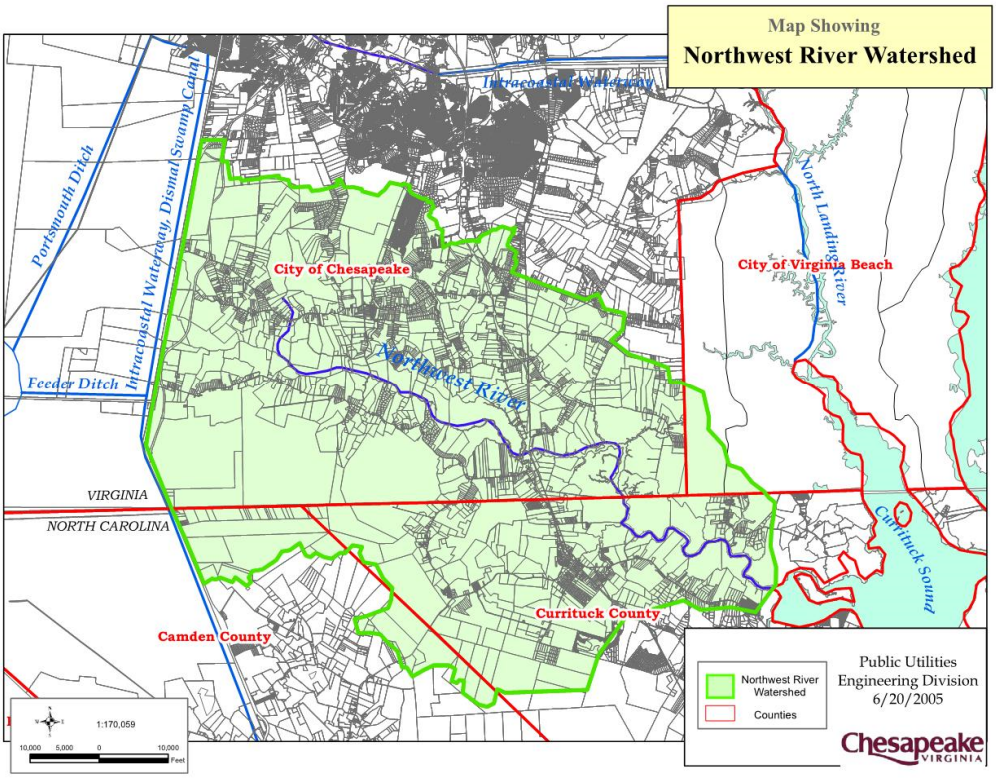

Figure 12-1. Northwest River Watershed Protection District boundary

Those developing proposed commercial and industrial developments or commercial and industrial development expansions within the Northwest River Watershed Protection District must apply for a runoff control permit with a runoff analysis and runoff control plan. The runoff analysis should describe the proposed development, existing characteristics of site runoff, and expected characteristics of site runoff after development is complete. The City may reject a permit and prevent development if it is determined to result in stormwater contamination or harm the city's drinking water supply. Though the focus of the runoff analysis is nutrient pollution, reviewing site conditions and limiting activities that may be in the district protects surface waters from bacteria pollution. In total, 15 applications have been reviewed and approved without objection since November 2005.

12.2.2 Parks, Recreation, and Tourism Ordinance

City code (Article I, Section 50-22) specifies that dog owners must dispose of dog waste while using dog parks.

12.2.3 Utilities Ordinance

Public Utilities maintains policies and ordinances that serve to extend sewer service in the TMDL watersheds of the Southern Rivers and, therefore, reduce the potential for pollution from septic systems. The following portions of the City code and the policies and procedures of the Public Utilities division are consistent with the goals of this Plan.

- **Article III. Service Regulations and Policies**: Per Article III, Section 78-52, properties within the HRSD service area that border a street or alley with a public sewer line must connect to that system within 2 years of the date when the public utility line became available. In the event of a failure by a septic system, the parcel must be connected to the public utility line within 60 days of the time when the failed system is determined to pose a hazard to public health.

  In the Chesapeake Bay watersheds, the owner must submit documentation to verify that the septic system was inspected by a certified or licensed professional who confirmed that the system is functioning properly and does not need to be pumped. The anticipated date for the next pump-out must be reported with the inspection report.
- **Chapter 30-563 and 30-567: Cost Participation Policy for Unserved Areas**
- **Northwest River Watershed Protection District Run-off Control Permit**
- **Public Utilities Policies and Procedures**

  Land Locked Property Policy 20.05

  Private Pump Stations 20.07

12.2.4 Zoning Ordinance

One purpose of the City zoning ordinance is to protect surface water and groundwater within the city. By establishing districts, the City can protect critical and environmentally sensitive areas and guide development in Chesapeake in a manner that protects surface water and groundwater. The following articles within the zoning ordinance include provisions relevant to this Plan:

- **Article II. Official Zoning Map and District Boundaries**
- **Article IV. Establishment of Districts**
- **Article V. Urban, Suburban, and Rural Overlay Districts**
- **Article X. Conservation and Agricultural Districts**
- **Article XII. Special Overlay Districts**
- **Article XIII. Supplemental Regulations**
- **Article XVIII. Development Site Plans**
- **Article XVIIII. Design, Development and Performance Standards**
- **Article XX. Administration, Enforcement, Variances and Other Relief**

12.2.5 Public Facilities Manual

The *Public Facilities Manual* outlines the design criteria, policy, standards, and technical specifications for public facilities in Chesapeake (City 2018).

Section 13

Public Comments

A public input period to review this Plan took place in June 2018. Comments from the public that were received during the comment period were reviewed and, if appropriate, incorporated into the Plan. Appendix D includes the list of public comments received and the City's response.

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Section 14

Conclusion

The City developed this Plan in accordance with the permit requirements and Local Guidance (DEQ 2016a).

The permit requires an estimated end date for achieving the WLAs. The City estimates an end date of 40 to 50 years, or 8 to 10 permit cycles, to achieve the WLAs based on the limited data available regarding BMP efficiencies and measure of effectiveness at the time of this plan development.

The Local Guidance specifies that "Demonstration of adequate progress may be achieved through tracking, monitoring, and/or reporting of BMP implementation, and/or other strategies as approved by DEQ as part of the TMDL Action Plan." Updates to this plan are anticipated in future permit cycles. As the overall tracking process continues during this MS4 permit term, the City will have a better ability to document its progress. This will allow for the development of more definitive WLA achievement dates for individual facets of the Action Plan, and for the plan overall.

For bacteria pollutants, it is understood that the WLA values referenced from the TMDL reports and assigned to the City may not represent the City's actual bacteria contribution to surface waters. Surface water interconnectivity to multiple MS4s and other land uses outside of the MS4, coupled with the lack of definitive removal rates for individual BMPs, makes it nearly impossible to predict whether City actions will reduce fecal bacteria concentrations in the stream to use standard levels. Additionally, current research indicates that most conventional stormwater controls in the BMP database (e.g., stormwater wetlands, wet ponds, and bioretention) cannot reduce FIB concentrations to primary contact stream standards (Council 2014). In combination with the difficulty in implementing structural BMPs in a rural area without a collection system other than roadside ditches, conventional stormwater controls may not be the best alternative to reduce bacteria and TP in the Southern Rivers. Therefore, the City will strongly evaluate using other BMPs, including land conversions, establishment of forest buffers, and programmatic measures to achieve the TMDLs in the Southern Rivers watersheds.

Per permit requirements, the City will continue to implement non-structural and structural BMPs to reduce bacteria loading to surface waters. The City is required to provide an updated Plan at the end of the current Phase I MS4 permit term in 2021. As more research becomes available, the City may update this Plan to implement the most effective structural BMPs. Modifications to this Plan will be documented in Appendix E at the time of Plan update. A placeholder (Appendix E) is currently included in this Plan for future updates.

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Section 15

Limitations

This document was prepared solely for the City of Chesapeake in accordance with professional standards at the time the services were performed and in accordance with the contract between the City of Chesapeake and Brown and Caldwell dated June 10, 2016. This document is governed by the specific scope of work authorized by the City of Chesapeake; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by the City of Chesapeake and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

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Section 16

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Appendix A: Maps

Figure A-1: TMDL Watersheds by VAHU6

Figure A-2: Preliminary MS4 Service Area

Figure A-3: MS4 Service Area

Figure A-4: Agriculture Exclusion Area

Figure A-5: Open Water Exclusion Area

Figure A-6: Wetland Exclusion Area

Figure A-7: Forested Land Exclusion Area

Figure A-8: All Exclusion Areas

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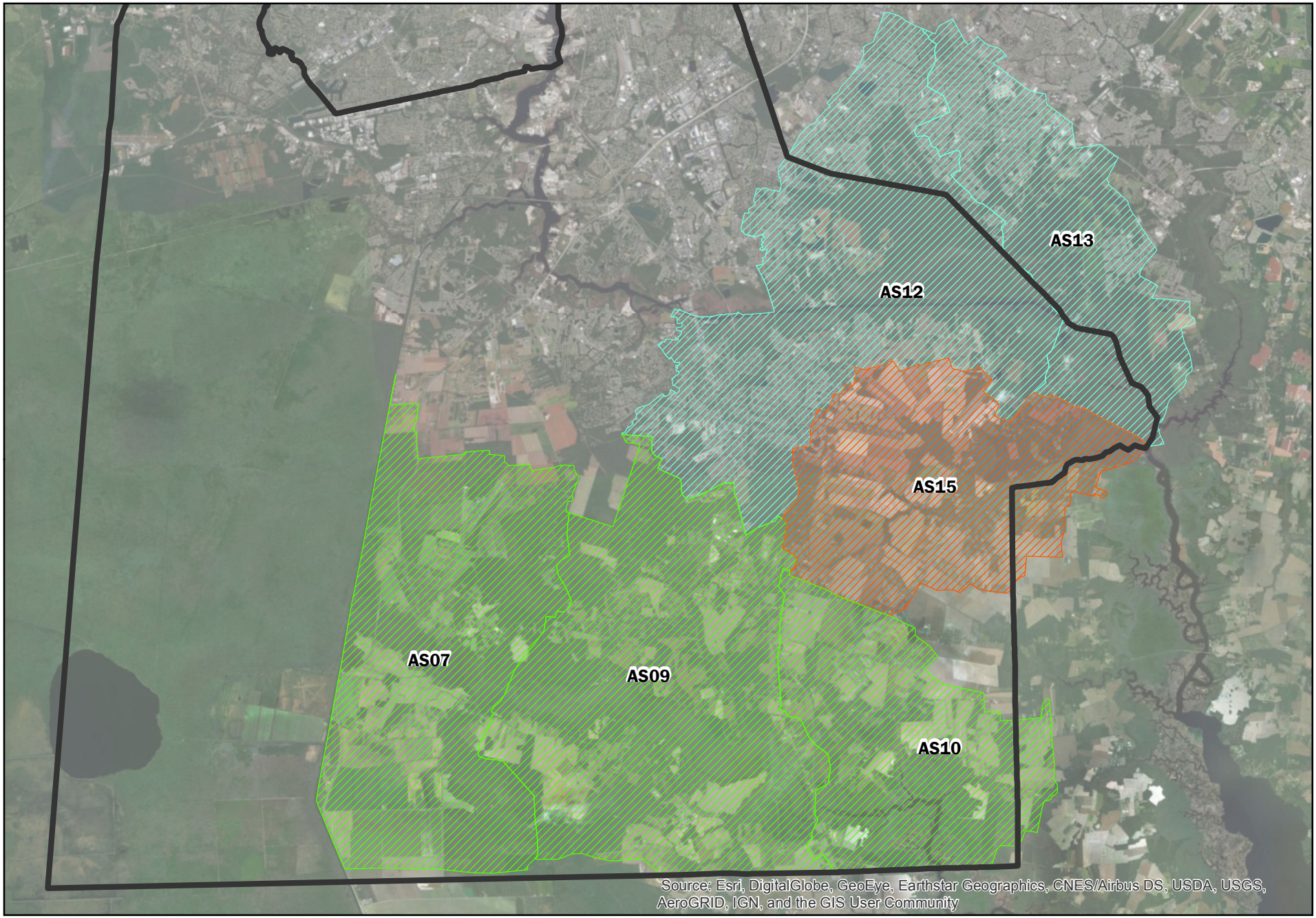


Brown AND Caldwell

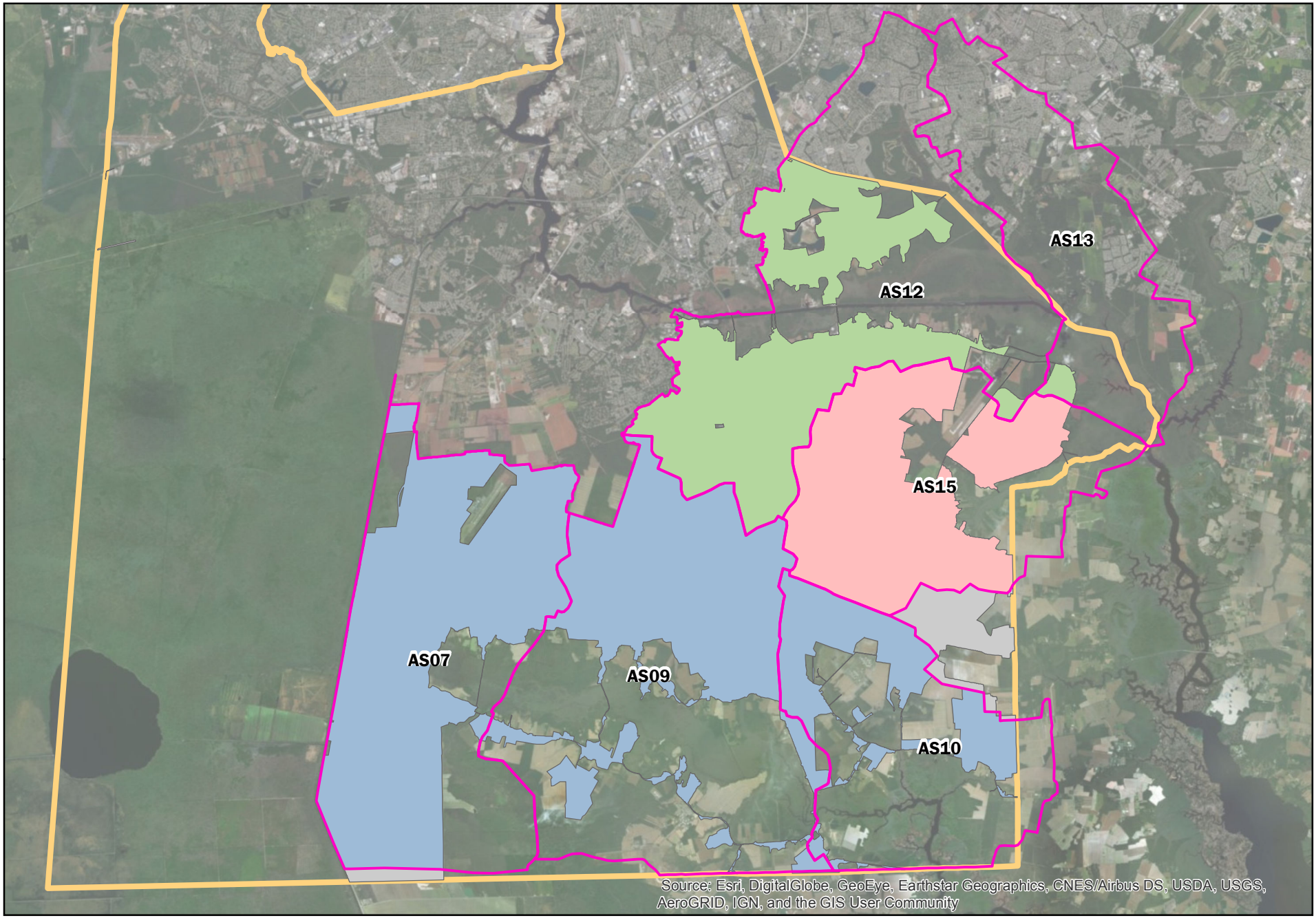
MS4 Service Area Delineation
Appendix A: Maps
Figure A-1: TMDL Watersheds (by VAHU6) in the Southern Rivers

TMDL Watersheds
- Northwest River
- North Landing River
- Pocaty River

City Boundary

N

0 1 2 Miles



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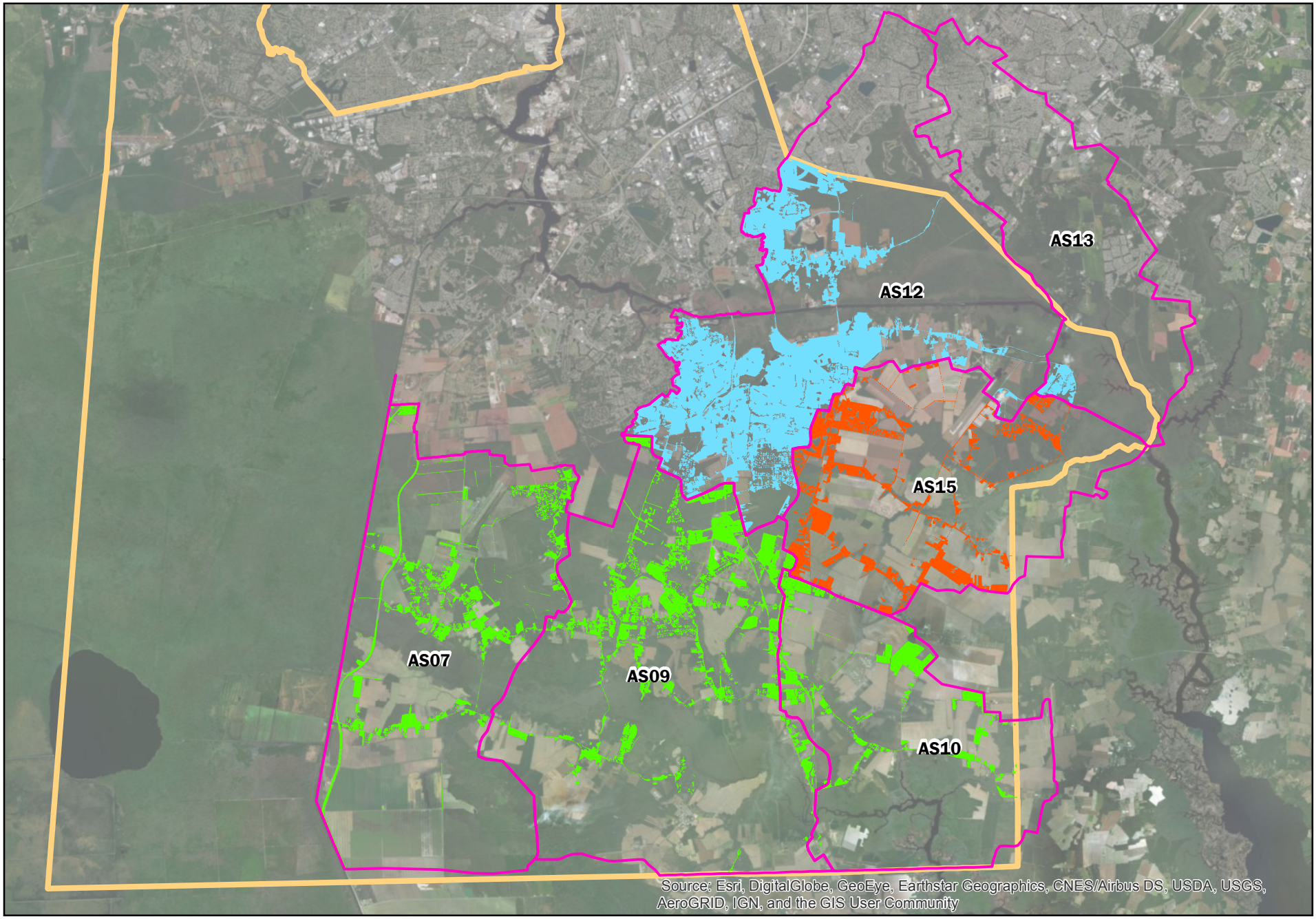
MS4 Service Area Delineation
Appendix A: Maps
Figure A-2: Preliminary MS4 Service Area in the Southern Rivers TMDL Watersheds

Preliminary MS4 Service Area
- Non-TMDL Watersheds
- Northwest River (AS07, AS09, AS10)
- North Landing River (AS12, AS13)
- Pocaty River (AS15)

- City Boundary
- TMDL Watersheds

N

0 1 2 Miles



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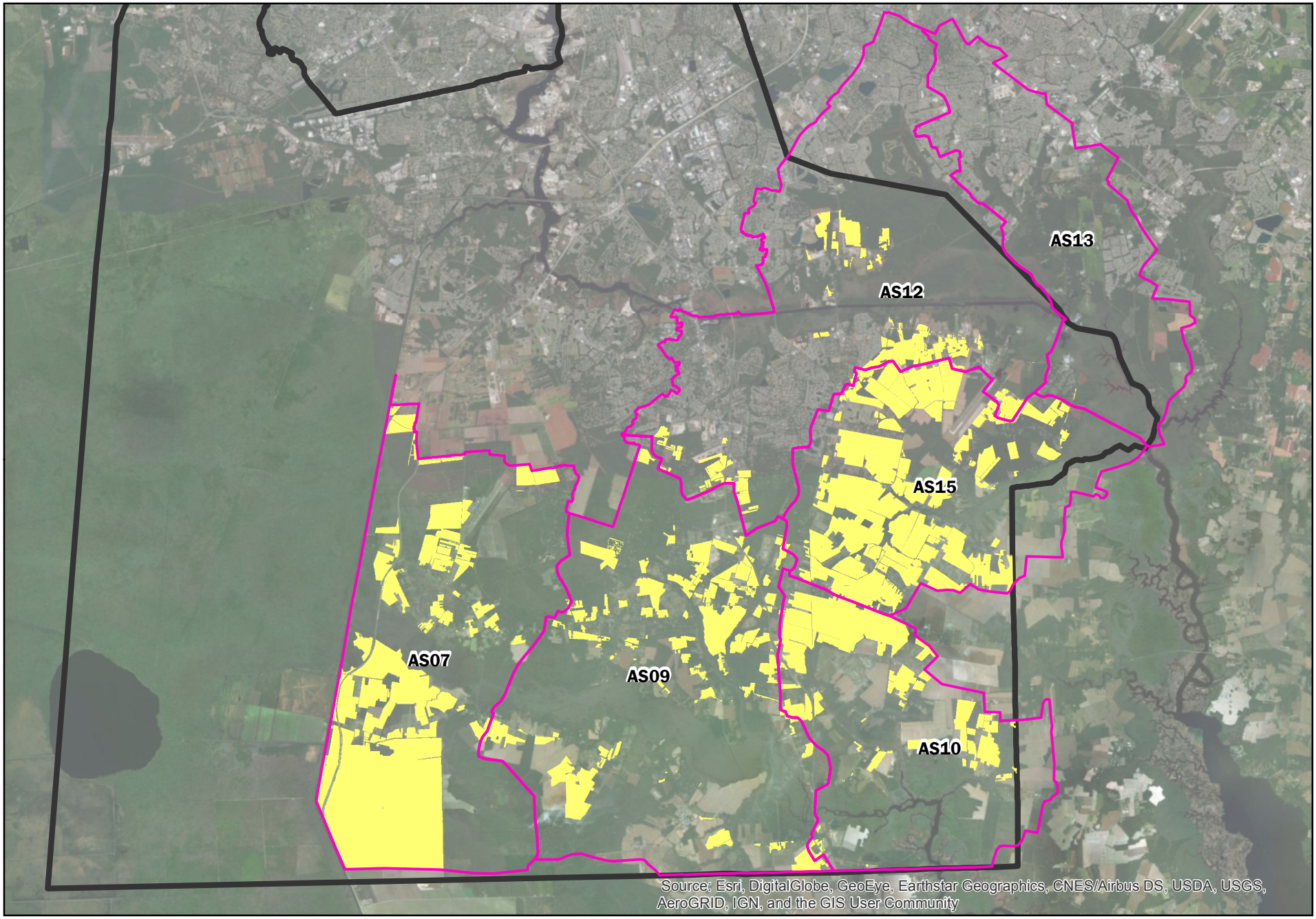
MS4 Service Area Delineation
Appendix A: Maps
Figure A-3: MS4 Service Area in the Southern Rivers TMDL Watersheds

MS4 Service Area
- Northwest River
- North Landing River
- Pocaty River

- City Boundary
- TMDL Watersheds

N

0 1 2 Miles



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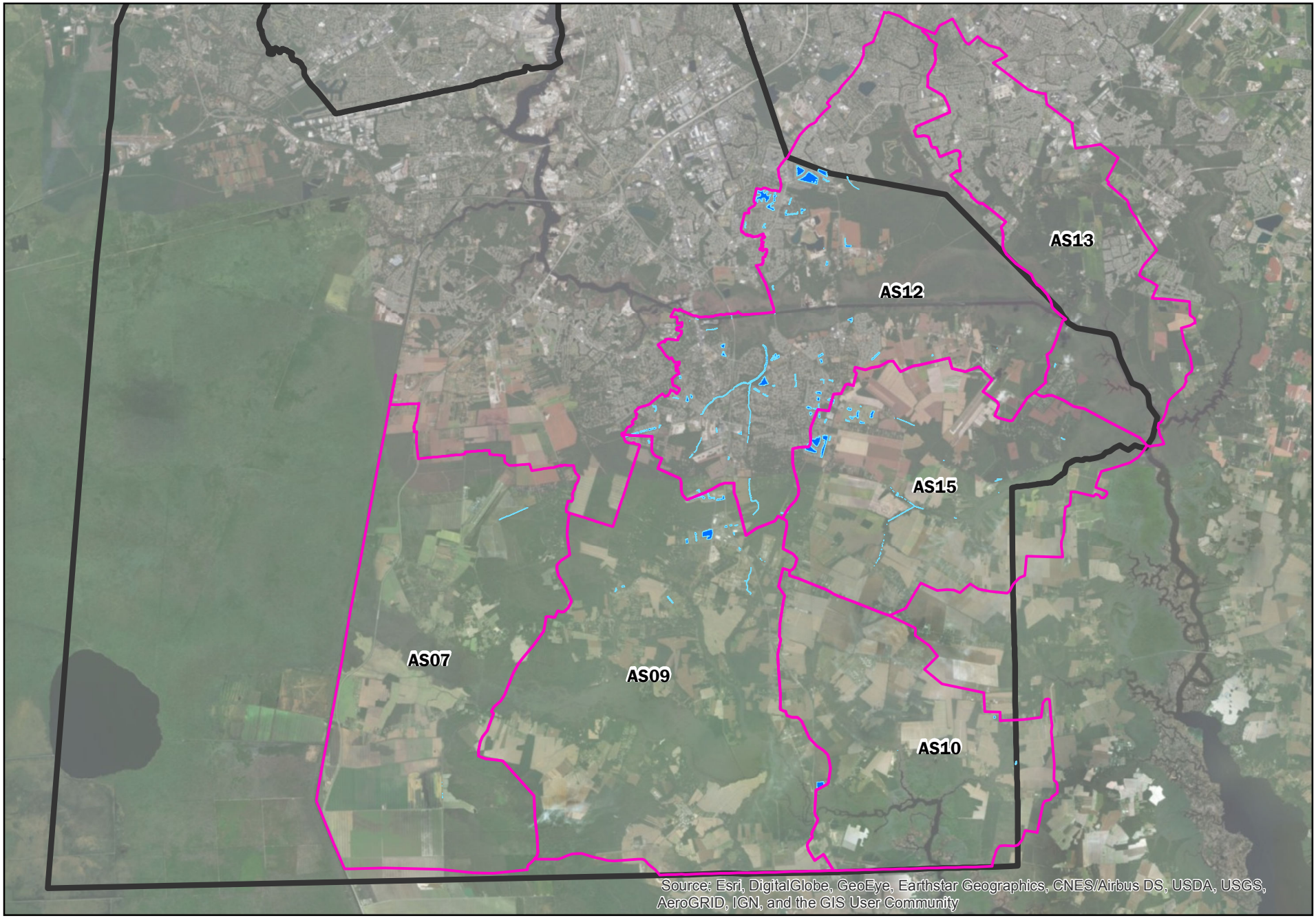
MS4 Service Area Delineation
Appendix A: Maps
Figure A-4: Agriculture Exclusion Area in the Southern Rivers TMDL Watersheds

Agriculture Exclusion Area
City Boundary
TMDL Watersheds

N

0 1 2 Miles



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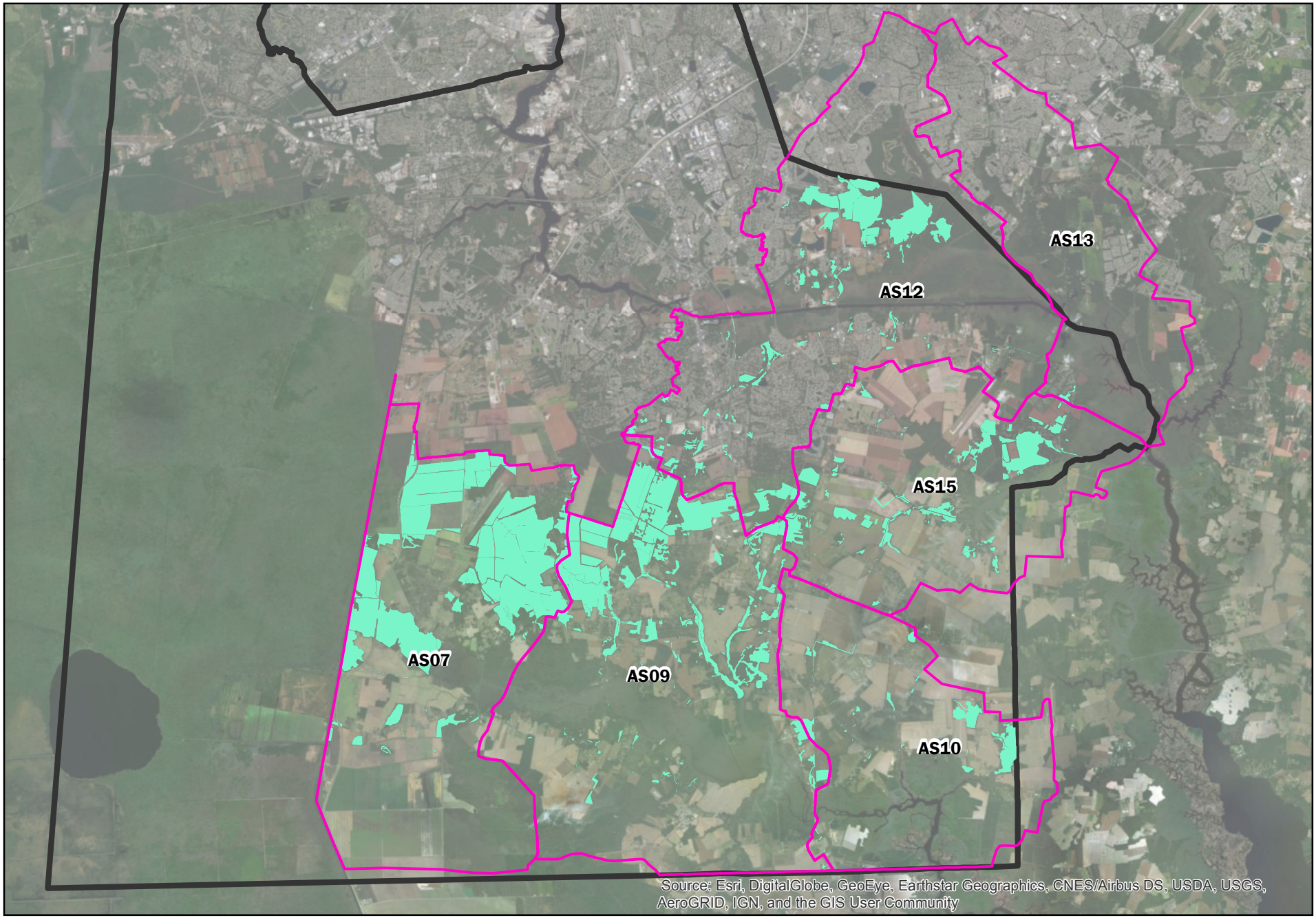
MS4 Service Area Delineation
Appendix A: Maps
Figure A-5: Open Water Exclusion Area in the Southern Rivers TMDL Watersheds

Open Water Exclusion Area
City Boundary
TMDL Watersheds

N

0 1 2 Miles



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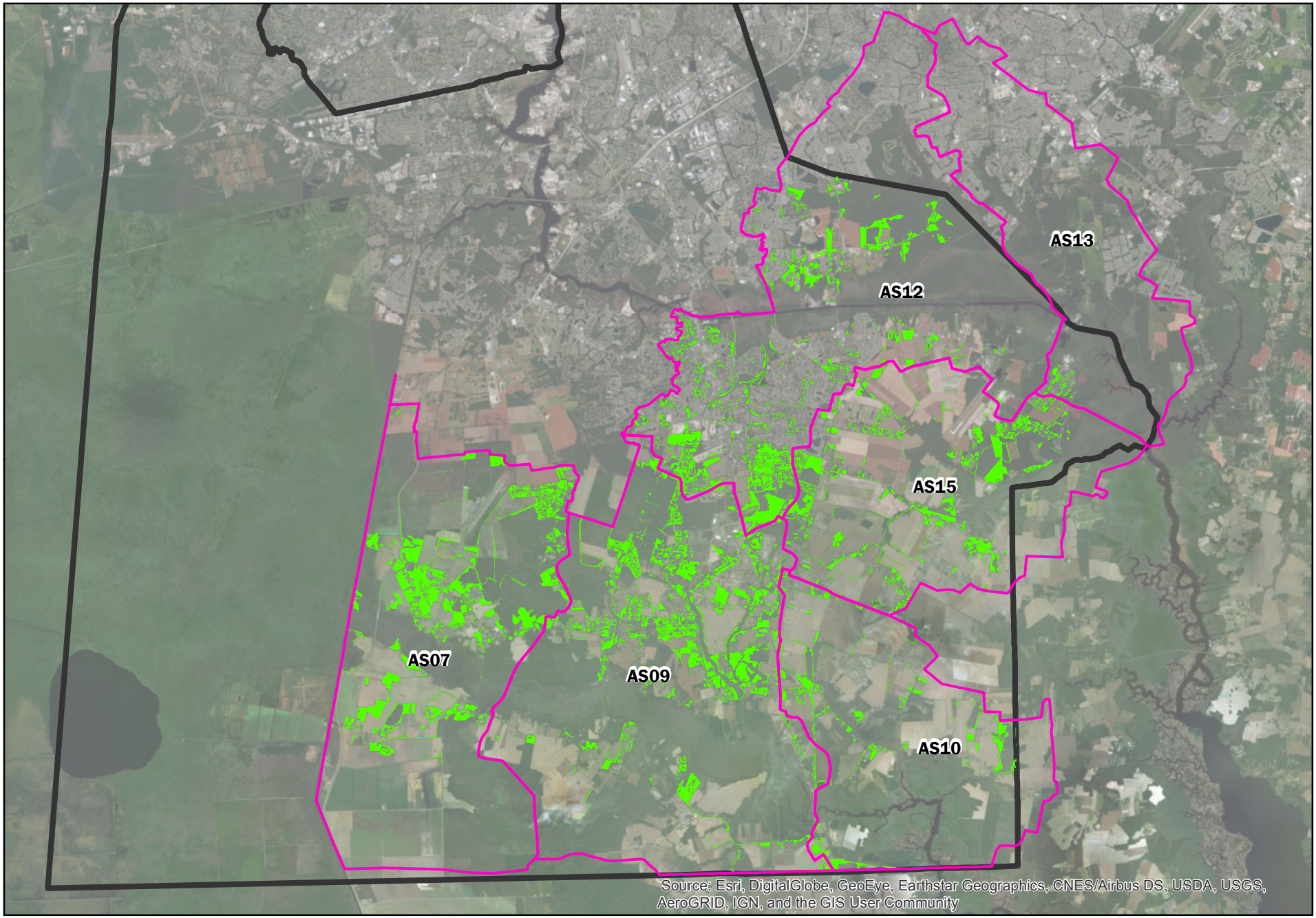
MS4 Service Area Delineation
Appendix A: Maps
Figure A-6: Wetland Exclusion Area in the Southern Rivers TMDL Watersheds

Wetland Exclusion Area
City Boundary
TMDL Watersheds

N

0 1 2 Miles



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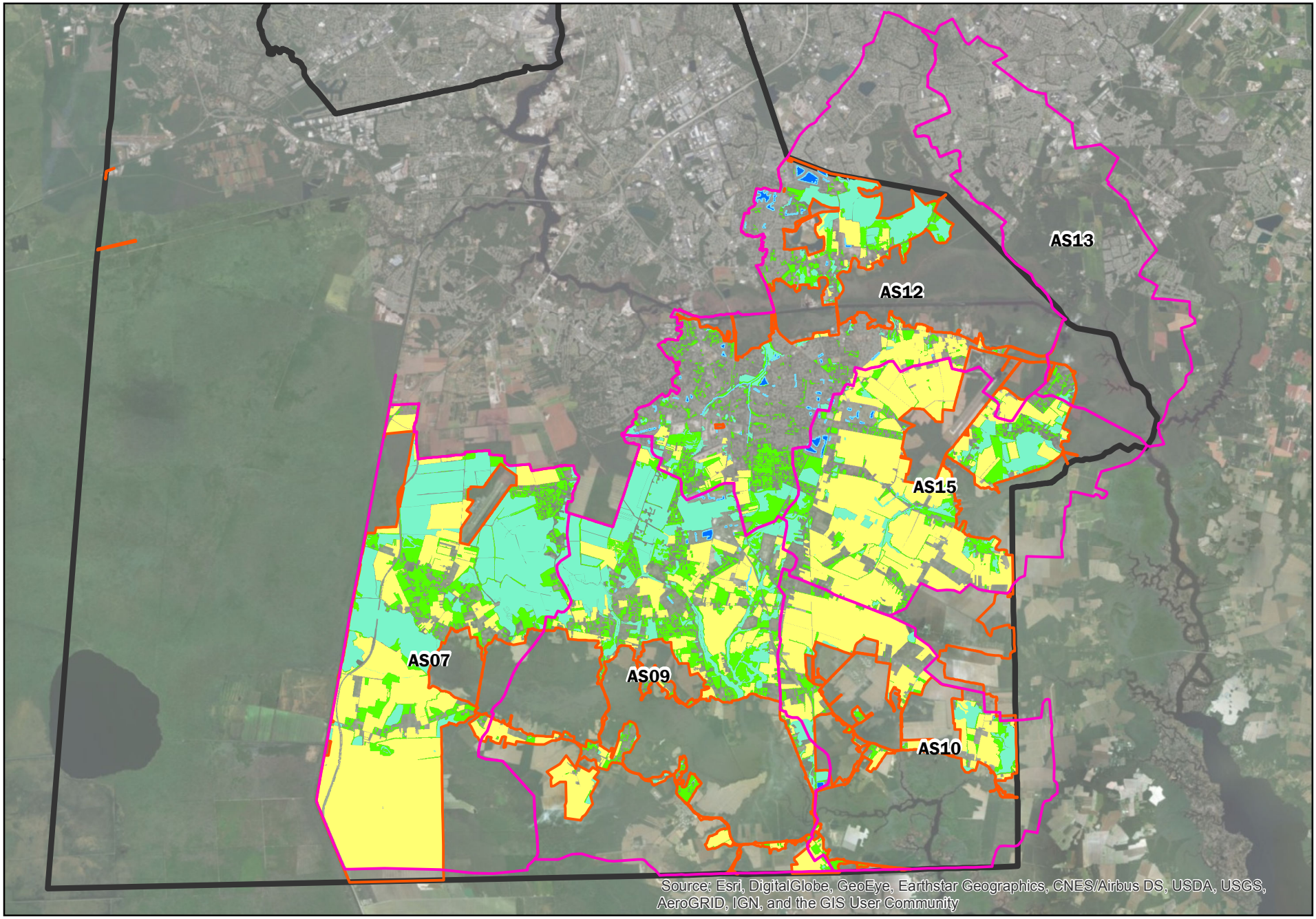
MS4 Service Area Delineation
Appendix A: Maps
Figure A-7: Forested Land Exclusion Area in the Southern Rivers TMDL Watersheds

Forested Land Exclusion Area
City Boundary
TMDL Watersheds

N
0 1 2
Miles



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MS4 Service Area Delineation
Appendix A: Maps
Figure A-8: MS4 Service Area Exclusion Areas in the Southern Rivers TMDL Watersheds

Agriculture Exclusion Area
Forested Land Exclusion Area
Open Water Exclusion Area
Wetland Exclusion Area
City Boundary
Preliminary MS4 Service Area
TMDL Watersheds

N

0 1 2 Miles

Appendix B: Credit Calculations and Supporting Information for Existing Best Management Practices

Existing Best Management Practices in the Southern Rivers

Creditable Best Management Practices in the Southern Rivers

Dry Weather Screening Results

Septic-to-Sewer Conversions

Land-based Loading Rates for Credit Calculations

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Table B-1. BMPs in the Southern Rivers Watersheds for Total Phosphorus Credit

Site ID	SWMF ID	Ownership Type	SWMF Maintenance Agreement	Lat	Long	Date Built	River Basin	Coastal Plain	BMP Type	Drainage Area (ac)	Land Use	% Impervious	Impervious Acres	Forested Acres	HSG	Undrained HSG	Runoff Storage (ac-ft)	Meet Clearinghouse Req	Clearinghouse Classification	Phosphorus Removed (lb/yr)
Brightleaf Meadows Condo (380000000000)	Brightleaf Meadows	Private	Yes	36.75906902	-76.20554924	3/21/2012	Albemarle Canal - North Landing River	Yes	Wet Ponds and Wetlands	3.575	Low Density Residential	35	1.25	0	B/D	D	0.298	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	0.45
Chapel Hill North Phase 2	Chapel Hill North Phase 2	Public	Yes	36.710761	76.198836	11/9/2008	Albemarle Canal - North Landing River	Yes	Wet Ponds and Wetlands	21	Medium Density Residential	35	7.35	0	B/D	D	0.083	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	2.54
Davidson Commons	Davidson Commons	Public	No	36.746086	76.211861	11/3/2015	Albemarle Canal - North Landing River	Yes	Dry Detention Ponds and Hydrodynamic Structures	2.1	Medium Density Residential	35	0.74	0	B/D	D	0.175	Virginia Stormwater BMP Clearinghouse efficiencies	Extended Detention Pond 1	0.09
Hailey's Cove	Hailey's Cove	Public	Yes	36.735152	76.197231	12/5/2015	Albemarle Canal - North Landing River	Yes	Wet Ponds and Wetlands	10	Medium Density Residential	35	3.50	0	C/D	D	0.833	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	1.26
Hanbury Manor Lake 1	Hanbury Manor Lake 1	Public	Yes	36.68685	76.234589	3/31/2016	Albemarle Canal - North Landing River	Yes	Wet Ponds and Wetlands	16.1	Medium Density Residential	35	5.64	0	C/D	D	1.342	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	2.03
Hanbury Manor Lake 1 - Hanbury Manor Lake 2	Hanbury Manor Lake 2	Public	Yes	36.685139	76.233661	3/31/2016	Albemarle Canal - North Landing River	Yes	Wet Ponds and Wetlands	6	Medium Density Residential	35	2.10	0	C/D	D	0.083	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	0.72
Hickory Manor Phase I Westfield @ Hickory Manor #1	Hickory Manor Phase I Westfield @ Hickory Manor #1	Public	No	36.6506	76.24378	5/7/2017	Northwest River	Yes	Wet Ponds and Wetlands	17.7	Medium Density Residential	35	6.20	0	B/D	D	1.475	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	5.00
Hickory Manor Phase I Westfield @ Hickory Manor #2	Hickory Manor Phase I Westfield @ HIckory Manor #2	Public	No	36.65005	76.24388	5/7/2017	Northwest River	Yes	Wet Ponds and Wetlands	16.83	Medium Density Residential	35	5.89	0	B/D	D	1.403	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	4.75
Hickory Manor Phase I Westfield @ HIckory Manor #3	HIckory Manor Phase I Westfield @ Hickory Manor #3	Public	No	36.65071	76.24037	5/7/2017	Northwest River	Yes	Wet Ponds and Wetlands	13.14	Medium Density Residential	35	4.60	0	B/D	D	1.095	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	3.71
HIckory Manor Phase I Westfield @ Hickory Manor #4	Hickory Manor Phase I Westfield @ Hickory Manor #4	Public	No	36.65083	76.2411	5/7/2017	Northwest River	Yes	Wet Ponds and Wetlands	53.31	Medium Density Residential	35	18.66	0	B/D	D	4.443	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	15.05
HIckory Manor Phase I Westfield @ Hickory Manor #5	Hickory Manor Phase I Westfield @ Hickory Manor #5	Public	No	36.64923	76.24582	5/7/2017	Northwest River	Yes	Wet Ponds and Wetlands	21.98	Medium Density Residential	35	7.69	0	B/D	D	1.832	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	6.21
Hickory Road East	Hickory Road East	Private	Yes	36.645387	76.213207	4/14/2014	Northwest River	Yes	Shallow swale/Conserved open space	1.53	Low Density Residential/Open space	35	0.54	0	C/D	D	0.128	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Swale 1	0.19
Johnstown Estates #1	Johnstown Estates #1	Public	No	36.689453	76.250422	3/30/2016	Albemarle Canal - North Landing River	Yes	Wet Ponds and Wetlands	1.15	Medium Density Residential	35	0.40	0	C/D	D	0.096	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	0.15
Johnstown Estates #1	Johnstown Estate #2	Public	No	36.689464	760.251528	3/30/2016	Albemarle Canal - North Landing River	Yes	Wet Ponds and Wetlands	8.28	Medium Density Residential	35	2.90	0	C/D	D	0.690	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	1.04
Johnstown Estates #1	Johnstown Estates #1	Public	No	36.68956	76.25075	1/30/2016	Albemarle Canal - North Landing River	Yes	Wet Ponds and Wetlands	1.15	Low Density Residential	35	0.40	0	C/D	D	0.096	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	0.15
Johnstown Estates #2	Johnstown Estates #2	Public	No	36.68958	76.25172	1/30/2016	Albemarle Canal - North Landing River	Yes	Wet Ponds and Wetlands	8.28	Low Density Residential	35	2.90	0	C/D	D	0.690	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	1.04
Jordan Hall #1	Jordan Hall	Public	Yes	36.697303	76.249633	7/15/2013	Albemarle Canal - North Landing River	Yes	Wet Ponds and Wetlands	26.02	Low Density Residential	35	9.11	0	B/D	D	2.168	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	3.28
Jordan Hall #2	Jordan Hall #2	Public	Yes	36.696589	76.248278	7/15/2013	Albemarle Canal - North Landing River	Yes	Wet Ponds and Wetlands	10.21	Medium Density Residential	35	3.57	0	A/D	D	0.851	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	1.29
MacDonald Glennon Subdivision (620000000000)	620000000000	Private	Yes	36.70761628	-76.15040302	7/23/2010	Albemarle Canal - North Landing River	Yes	Wet Ponds and Wetlands	17	Rural	8	1.36	0	C/D	D	0.083	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	0.54
Monarch Center (600000000000)	600000000000	Private	Yes	36.69099684	-76.23292923	7/30/2010	Albemarle Canal - North Landing River	Yes	Wet Ponds and Wetlands	5.6	Business/Commercial	70	3.92	0	B/D	D	0.083	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	1.37
Mt Pleasant Marketplace (490000000000)	490000000000	Private	Yes	36.71576985	-76.18906975	6/25/2010	Albemarle Canal - North Landing River	Yes	Wet Ponds and Wetlands	35.02	Business/Commercial	70	24.51	0	B	B	0.083	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	8.54
New Creation Community Church	New Creation Church	Private	Yes	36.740147	76.18431	6/30/2016	Albemarle Canal - North Landing River	Yes	Bioswale	0.58	Medium Density Mixed Use	70	0.41	0	B/D	D	0.048	Virginia Stormwater BMP Clearinghouse efficiencies	Dry Swale 2	0.23
New Creation Community Church	New Creation Church	Private	Yes	36.740147	76.18431	6/30/2016	Albemarle Canal - North Landing River	Yes	Bioswale	0.58	Medium Density Mixed Use	70	0.41	0	B/D	D	0.048	Virginia Stormwater BMP Clearinghouse efficiencies	Dry Swale 2	0.23
North Landing Cove (490000000000)	490000000000	Private	Yes	36.72536725	-76.18724585	7/23/2010	Albemarle Canal - North Landing River	Yes	Wet Ponds and Wetlands	8.56	Low Density Residential	35	3.00	0	B/D	D	0.083	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	1.08
Olah Landing #1	Olah Landing #1	Public	No	36.688478	76.246789	9/14/2015	Albemarle Canal - North Landing River	Yes	Wet Ponds and Wetlands	41	Low Density Residential	35	14.35	0	B/D	D	3.417	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	5.17
Olah Landing #2	Olah Landing #2	Public	No	36.688856	76.245028	8/14/2015	Albemarle Canal - North Landing River	Yes	Wet Ponds and Wetlands	16	Low Density Residential	35	5.60	0	A/D	D	1.333	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	2.02
The Retreat at Kemps River A	The Retreat at Kemps River A	Public	Yes	36.75928	76.19829	9/13/2017	Albemarle Canal - North Landing River	Yes	Wet Ponds and Wetlands	12.6	High Density Residential	35	4.41	0	C/D	D	1.050	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	1.59
The Retreat at Kemps River B (Not constructed yet)	The Retreat at Kemps River B	Public	Yes	36.76006	76.20409	9/13/2017	Albemarle Canal - North Landing River	Yes	Wet Ponds and Wetlands	TBD	Medium Density Residential	35	0	0	C/D	D	0.083	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	0
Viridian Reserve #1	Viridian Reserve #1	Public	Yes	36.680486	76.232594	6/10/2015	Northwest River	Yes	Wet Ponds and Wetlands	29.84	Medium Density Residential	35	10.44	0	A/D	D	2.487	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	8.43
Viridian Reserve #1	Viridian Reserve #1	Public	Yes	36.680486	76.232594	6/10/2015	Northwest River	Yes	Wet Ponds and Wetlands	29.84	Medium Density Residential	35	10.44	0	A/D	D	2.487	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	8.43
Viridian Reserve #1	Viridian Reserve #1	Public	Yes	36.680486	76.232594	6/10/2015	Northwest River	Yes	Wet Ponds and Wetlands	29.84	Medium Density Residential	35	10.44	0	A/D	D	2.487	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	8.43
Viridian Reserve #2	Viridian Reserve #2	Public	Yes	36.679789	76.235736	6/10/2015	Northwest River	Yes	Wet Ponds and Wetlands	15.12	Medium Density Residential	35	5.29	0	B/D	D	1.260	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	4.27
Viridian Reserve #3	Viridian Reserve #3	Public	Yes	36.678722	76.2385	6/10/2015	Northwest River	Yes	Wet Ponds and Wetlands	14.86	Medium Density Residential	35	5.20	0	B/D	D	1.238	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	4.20
Viridian Reserve #4	Viridian Reserve #4	Public	Yes	36.678261	76.240142	6/10/2015	Northwest River	Yes	Wet Ponds and Wetlands	14.86	Medium Density Residential	35	5.20	0	B/D	D	1.238	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	4.20
Viridian Reserve #5	Viridian Reserve #5	Public	Yes	36.677889	76.242625	6/10/2015	Northwest River	Yes	Wet Ponds and Wetlands	9.31	Medium Density Residential	35	3.26	0	B/D	D	0.776	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	2.63
Waters Bend Detention	Waters Bend Detention	Public	No	36.68972	76.25556	6/17/2016	Albemarle Canal - North Landing River	Yes	Dry Detention Ponds and Hydrodynamic Structures	5.9	Medium Density Residential	35	2.07	0	C/D	D	0.492	Virginia Stormwater BMP Clearinghouse efficiencies	Extended Detention Pond 1	0.25
Windlesham Plantation (609001000000)	0609001000150 - A	Private	Yes	36.69021395	-76.22582674	8/18/2010	Albemarle Canal - North Landing River	Yes	Wet Ponds and Wetlands	3.0162	Low Density Residential	35	1.06	0	B/D	D	0.251	Virginia Stormwater BMP Clearinghouse efficiencies	Wet Pond 1	0.38
CVS 1329 Kempsville Rd (380000000000)	380000000000 - Stormtech Storm Chamber Unit	Private	Yes	36.7625072	-76.2047768	4/28/2011	Northwest River	Yes	Stormtech Isolator Row	1.9	Business/Commercial	70	1.33	0	N/A	N/A	0.111	Virginia Stormwater BMP Clearinghouse efficiencies	Volume control facility - Not creditable	0.00
Mt Pleasant Veterinary Clinic (480000000000)	480000000000 - Filterra	Private	Yes	36.7112352	-76.2338291	6/14/2012	Albemarle Canal - North Landing River	Yes	Filterra Bioretention Systems	0.27	Low Density Residential	35	0.09	0	N/A	N/A	0.008	Virginia Stormwater BMP Clearinghouse efficiencies	Filterra (50% removal)	0.04

Table B-2. All BMPs in the Southern Rivers Watersheds

Site ID	SWMF ID	Ownership Type	SWMF Type	Contributing Drainage Area	Land Use	HUC	SWMF Maintenance Agreement	Lat	Long	Date Online	Permittee Name	Inspection Frequency	Status
700000000000	700000000000	Private	Retention Basin	0	Airport	AS07	Yes	36.66146524	-76.326828	1/1/1990	Chesapeake	1825	Active
930000000000	930000000000	Private	Vegetated Filter Strip	0	Business/Commercial	AS07	Yes	0	0	1/1/1990	Chesapeake	1825	Active
Hwy 17	Hwy 17	Public	Extended Detention Basin	0	Route 17 Corridor Study	AS07	N/A	36.6375873	-76.36297882	1/1/1990	Chesapeake	365	Active
Edinburgh	Edinburgh - Lake CC-2 N-1	Public	Retention Basin	0	Rural	AS09	No	0	0	1/1/1900	Chesapeake	365	Active
Edinburgh	Edinburgh - Lake CC-2 N-3	Public	Retention Basin	0	Rural	AS09	No	0	0	1/1/1900	Chesapeake	365	Active
Northwest Acres	Northwest Acres	Public	Retention Basin	0	Rural	AS09	No	36.5769	76.19689	11/24/1978	Chesapeake	1825	Active
730000000000	0730000001700 #1	Private	Retention Basin	0	Business/Commercial	AS09	Yes	36.65698976	-76.22657776	1/1/1990	Chesapeake	1825	Active
730000000000	0730000001700 #2	Private	Retention Basin	0	Business/Commercial	AS09	Yes	36.6544765	-76.2275219	1/1/1990	Chesapeake	1825	Active
970000000000	970000000000	Private	Detention Basin	0	Business/Commercial	AS09	Yes	36.60676917	-76.21171832	1/1/1990	Chesapeake	1825	Active
Edinburgh	Edinburgh - Lake 1	Public	Retention Basin	0	Low Density Residential	AS09	N/A	36.65439043	-76.23683453	1/1/1990	Chesapeake	365	Active
Edinburgh	Edinburgh - Lake 2	Public	Retention Basin	0	Low Density Residential	AS09	N/A	36.65242796	-76.24537468	1/1/1990	Chesapeake	365	Active
Hickory High/Hickory Middle Schools	Hickory High/Hickory Middle Schools - 1	School	Detention Basin	0	Institution/Government	AS09	Yes	36.65061176	-76.21727049	1/1/1990	Chesapeake	365	Active
Hickory High/Hickory Middle Schools	Hickory High/Hickory Middle Schools - 2	School	Retention Basin	0	Institution/Government	AS09	Yes	36.6479993	-76.21885836	1/1/1990	Chesapeake	365	Active
Hickory High/Hickory Middle Schools	Hickory High/Hickory Middle Schools - 3	School	Detention Basin	0	Institution/Government	AS09	Yes	36.6460668	-76.21709347	1/1/1990	Chesapeake	365	Active
Hickory High/Hickory Middle Schools	Hickory High/Hickory Middle Schools - 4	School	Detention Basin	0	Institution/Government	AS09	Yes	36.64738383	-76.21835411	1/1/1990	Chesapeake	365	Active
Hunters Ridge	Hunters Ridge - Lake 1	Public	Retention Basin	0	Low Density Residential	AS09	N/A	36.63841377	-76.27273321	1/1/1990	Chesapeake	365	Active
Hunters Ridge	Hunters Ridge - Lake 2	Public	Retention Basin	0	Low Density Residential	AS09	N/A	36.63593864	-76.27364516	1/1/1990	Chesapeake	365	Active
Village Farms	Village Farms	Public	Retention Basin	0	Rural	AS09	N/A	36.63509062	-76.2526381	1/1/1990	Chesapeake	365	Active
Clover Downs	Clover Downs	Private	Other SWMF	0	Low Density Residential	AS09	Yes	36.60408	76.20724	1/6/1996	Chesapeake	1825	Active
Hickory Road East	Hickory Road East	Private	space	1.53	Low Density Residential/Open Space	AS09	Yes	36.645387	76.213207	4/14/2014	Chesapeake	365	Active
Viridian Reserve #1	Viridian Reserve #1	Public	Retention Basin	29.84	Medium Density Residential	AS09	Yes	36.680486	76.232594	6/10/2015	Chesapeake	365	Active
Viridian Reserve #1	Viridian Reserve #1	Public	Retention Basin	29.84	Medium Density Residential	AS09	Yes	36.680486	76.232594	6/10/2015	Chesapeake	365	Active
Viridian Reserve #1	Viridian Reserve #1	Public	Retention Basin	29.84	Medium Density Residential	AS09	Yes	36.680486	76.232594	6/10/2015	Chesapeake	365	Active
Viridian Reserve #2	Viridian Reserve #2	Public	Retention Basin	15.12	Medium Density Residential	AS09	Yes	36.679789	76.235736	6/10/2015	Chesapeake	365	Active
Viridian Reserve #3	Viridian Reserve #3	Public	Retention Basin	14.86	Medium Density Residential	AS09	Yes	36.678722	76.2385	6/10/2015	Chesapeake	365	Active
Viridian Reserve #4	Viridian Reserve #4	Public	Retention Basin	14.86	Medium Density Residential	AS09	Yes	36.678261	76.240142	6/10/2015	Chesapeake	365	Active
Viridian Reserve #5	Viridian Reserve #5	Public	Retention Basin	9.31	Medium Density Residential	AS09	Yes	36.677889	76.242625	6/10/2015	Chesapeake	365	Active
Hickory Manor Phase I Westfield @ Hickory Manor #1	Hickory Manor Phase I Westfield @ Hickory Manor #1	Public	Retention Basin	17.7	Medium Density Residential	AS09	No	36.6506	76.24378	5/7/2017	Chesapeake	365	Active
Hickory Manor Phase I Westfield @ Hickory Manor #2	Hickory Manor Phase I Westfield @ HIckory Manor #2	Public	Retention Basin	16.83	Medium Density Residential	AS09	No	36.65005	76.24388	5/7/2017	Chesapeake	365	Active
Hickory Manor Phase I Westfield @ HIckory Manor #3	HIckory Manor Phase I Westfield @ Hickory Manor #3	Public	Retention Basin	13.14	Medium Density Residential	AS09	No	36.65071	76.24037	5/7/2017	Chesapeake	365	Active
HIckory Manor Phase I Westfield @ Hickory Manor #4	Hickory Manor Phase I Westfield @ Hickory Manor #4	Public	Retention Basin	53.31	Medium Density Residential	AS09	No	36.65083	76.2411	5/7/2017	Chesapeake	365	Active
HIckory Manor Phase I Westfield @ Hickory Manor #5	Hickory Manor Phase I Westfield @ Hickory Manor #5	Public	Retention Basin	21.98	Medium Density Residential	AS09	No	36.64923	76.24582	5/7/2017	Chesapeake	365	Active
Hickory Manor Phase I Westfield @ Hickory Manor #6	Hickory Manor Phase I Westfield @ Hickory Manor #6	Public	Manufactured BMP Systems	122.96	Medium Density Residential	AS09	No	36.6465	76.24028	5/7/2017	Chesapeake	365	Active
Edinburgh	Edinburgh - Lake CC-2 N-2	Public	Retention Basin	0	Rural	AS09	No	0	0		Chesapeake	365	Active
Edinburgh	Edinburgh - Lake CC-2 N-4	Public	Retention Basin	0	Rural	AS09	No	0	0		Chesapeake	365	Active
Hickory Elementary School	Hickory Elementary School - 1	School	Detention Basin	0	Institution/Government	AS10	Yes	36.63068034	-76.20887518	1/1/1990	Chesapeake	365	Active
Hickory Elementary School	Hickory Elementary School - 2	School	Detention Basin	0	Institution/Government	AS10	Yes	36.63165755	-76.21092975	1/1/1990	Chesapeake	365	Active
Uncle Bob's Mini Storage Retention Basin	Uncle Bob's Mini Storage Retention Basin	Private	Retention Basin	0	Business/Commercial	AS10	Yes	36.63117325	-76.20376825	1/1/1990	Chesapeake	1825	Active
Waterway Estates	Waterway Estates	Public	Retention Basin	0	Medium Density Residential	AS12	No	36.719172	76.181047	1/5/1982	Chesapeake	365	Active
Etheridge Meadows Section 1	Etheridge Meadows Section 1	Public	Retention Basin	0	Medium Density Residential	AS12	No	36.69956	76.21103	2/12/1984	Chesapeake	365	Active
Plantation Lakes Circle	Plantation Lakes Circle	Public	Retention Basin	1	Medium Density Mixed Use	AS12	No	36.768464	76.202714	5/1/1985	Chesapeake	365	Active
290000000000	290000000000	Private	Manufactured BMP Systems	0	Business/Commercial	AS12	Yes	36.76746208	-76.20367169	1/1/1990	Chesapeake	1825	Active
290000000000	290000000000	Private	Manufactured BMP Systems	0	Business/Commercial	AS12	Yes	36.76424334	-76.2062788	1/1/1990	Chesapeake	1825	Active
380000000000	380000000000	Private	Detention Basin	0	Business/Commercial	AS12	Yes	36.75482273	-76.20449781	1/1/1990	Chesapeake	1825	Active
380000000000	0380000000802 - #1	Private	Retention Basin	0	Business/Commercial	AS12	Yes	36.74959619	-76.1867094	1/1/1990	Chesapeake	1825	Active
380000000000	0380000000801 #1	Private	Retention Basin	11.33	Business/Commercial	AS12	Yes	36.7488225	-76.18503571	1/1/1990	Chesapeake	1825	Active
380000000000	380000000000	Private	Retention Basin	0	Residential/Medium Density Mixed Use	AS12	Yes	36.75017216	-76.20624661	1/1/1990	Chesapeake	1825	Active
380000000000	380000000000	Private	Detention Basin	0	Business/Commercial	AS12	Yes	36.73845423	-76.20755553	1/1/1990	Chesapeake	1825	Active
380000000000	0380000000801 #2	Private	Detention Basin	0	Business/Commercial	AS12	Yes	36.74894285	-76.18647337	1/1/1990	Chesapeake	1825	Active
480000000000	480000000000	Private	Detention Basin	0	Business/Commercial	AS12	Yes	36.71485821	-76.23940945	1/1/1990	Chesapeake	1825	Active
480000000000	480000000000	Private	Retention Basin	0	Institution/Government	AS12	Yes	36.70754747	-76.2335515	1/1/1990	Chesapeake	1825	Active
490000000000	490000000000	Private	Retention Basin	0	Conservation	AS12	Yes	36.72518666	-76.18938088	1/1/1990	Chesapeake	1825	Active
490000000000	490000000000	Private	Retention Basin	0	Business/Commercial	AS12	Yes	36.7373709	-76.18692398	1/1/1990	Chesapeake	1825	Active
590000000000	0590000001601 - #1	Private	Vegetated Filter Strip	0	Business/Commercial	AS12	Yes	36.71028693	-76.27115607	1/1/1990	Chesapeake	1825	Active
590000000000	0590000001601 - #2	Private	Manufactured BMP Systems	0	Business/Commercial	AS12	Yes	36.71017082	-76.27046943	1/1/1990	Chesapeake	1825	Active
594004000000	594004000000	Private	Manufactured BMP Systems	0	Business/Commercial	AS12	Yes	36.71033423	-76.26073837	1/1/1990	Chesapeake	1825	Active
600000000000	600000000000	Private	Manufactured BMP Systems	0	Business/Commercial	AS12	Yes	36.70023604	-76.23390555	1/1/1990	Chesapeake	1825	Active
730000000000	730000000000	Private	Retention Basin	0	Business/Commercial	AS12	Yes	36.67855571	-76.22880936	1/1/1990	Chesapeake	1825	Active
Albemarle Acres West	Albemarle Acres West - Lake 1	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.70810655	-76.19337201	1/1/1990	Chesapeake	365	Active

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Site ID	SWMF ID	Ownership Type	SWMF Type	Contributing Drainage Area	Land Use	HUC	SWMF Maintenance Agreement	Lat	Long	Date Online	Permittee Name	Inspection Frequency	Status
Albemarle Acres West	Albemarle Acres West - Lake 2	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.7064465	-76.19261026	1/1/1990	Chesapeake	365	Active
Alexis Forest	Alexis Forest	Public	Detention Basin	0	Low Density Residential	AS12	N/A	36.69204641	-76.2205267	1/1/1990	Chesapeake	365	Active
Briarwood Meadows	Briarwood Meadows - Lake 1	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.69658867	-76.24219894	1/1/1990	Chesapeake	365	Active
Briarwood Meadows	Briarwood Meadows - Lake 2	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.69623596	-76.24386191	1/1/1990	Chesapeake	365	Active
Camden Crossing	Camden Crossing	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.70244245	-76.24661922	1/1/1990	Chesapeake	365	Active
Carriage House Commons	Carriage House Commons - Lake B	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.68734903	-76.19217038	1/1/1990	Chesapeake	365	Active
Carriage House Commons	Carriage House Commons-lake A	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.68840725	-76.19156957	1/1/1990	Chesapeake	365	Active
Cedar Lakes Townhomes	Cedar Lakes Townhomes	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.70734104	-76.25609279	1/1/1990	Chesapeake	365	Active
Chesapeake Colony Estates	Chesapeake Colony Estates - Lake 1	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.71024822	-76.22988224	1/1/1990	Chesapeake	365	Active
Chesapeake Colony Estates	Chesapeake Colony Estates - Lake 2	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.71243284	-76.22983932	1/1/1990	Chesapeake	365	Active
Cheshire Forest	Cheshire Forest - Lake 1	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.69390464	-76.25614643	1/1/1990	Chesapeake	365	Active
Cheshire Forest	Cheshire Forest - Lake 2	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.69766397	-76.25472486	1/1/1990	Chesapeake	365	Active
Cheshire Forest	Cheshire Forest - Lake 3	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.69859302	-76.25528812	1/1/1990	Chesapeake	365	Active
Cheshire Forest	Cheshire Forest - Phase 4, Section 1	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.69969411	-76.26328111	1/1/1990	Chesapeake	365	Active
Clark Farm Estates	Clark Farm Estates	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.68359349	-76.21668041	1/1/1990	Chesapeake	365	Active
Coopers Creek Manor	Coopers Creek Manor	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.69617575	-76.2316364	1/1/1990	Chesapeake	365	Active
Coventry Meadows	Coventry Meadows	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.68512068	-76.21108532	1/1/1990	Chesapeake	365	Active
Etheridge Lakes	Etheridge Lakes - Lake 1	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.68991714	-76.19398355	1/1/1990	Chesapeake	365	Active
Etheridge Lakes	Etheridge Lakes - Lake 2N	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.69208943	-76.19421422	1/1/1990	Chesapeake	365	Active
Etheridge Lakes	Etheridge Lakes - Lake 3	Public	Retention Basin	0	Conservation	AS12	N/A	36.69247656	-76.19778156	1/1/1990	Chesapeake	365	Active
Etheridge Lakes	Etheridge Lakes - Lake 4	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.7008898	-76.19198799	1/1/1990	Chesapeake	365	Active
Etheridge Lakes	Etheridge Lakes - Lake 5	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.70077367	-76.18930042	1/1/1990	Chesapeake	365	Active
Etheridge Lakes	Etheridge Lakes - Lake 6	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.69486385	-76.18959546	1/1/1990	Chesapeake	365	Active
Etheridge Lakes	Etheridge Lakes - Lake 7	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.69684674	-76.1934793	1/1/1990	Chesapeake	365	Active
Etheridge Lakes	Etheridge Lakes - Lake 8	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.69519505	-76.19409084	1/1/1990	Chesapeake	365	Active
Etheridge Oaks	Etheridge Oaks	Public	Detention Basin	0	Medium Density Residential	AS12	N/A	36.70203816	-76.19123966	1/1/1990	Chesapeake	365	Active
Etheridge Pines	Etheridge Pines - Lake 1	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.69780591	-76.19756699	1/1/1990	Chesapeake	365	Active
Etheridge Pines	Etheridge Pines - Lake 2	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.69885109	-76.19734168	1/1/1990	Chesapeake	365	Active
Etheridge Point	Etheridge Point - Section 1, Lake 1	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.6970618	-76.21516228	1/1/1990	Chesapeake	365	Active
Etheridge Point	Etheridge Point - Section 1, Lake 2	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.69873926	-76.21863842	1/1/1990	Chesapeake	365	Active
Forest Lakes	Forest Lakes - Lake 1	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.69129795	-76.27208948	1/1/1990	Chesapeake	365	Active
Frost Estates	Frost Estates	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.69187865	-76.26239061	1/1/1990	Chesapeake	365	Active
Gilchrist Estates	Gilchrist Estates	Public	Detention Basin	0	Low Density Residential	AS12	N/A	36.73613064	-76.20769233	1/1/1990	Chesapeake	365	Active
Glasser Landing	Glasser Landing	Public	Detention Basin	0	Medium Density Residential	AS12	N/A	36.69944464	-76.22124553	1/1/1990	Chesapeake	365	Active
Great Bridge Commerce Center	Great Bridge Commerce Center	Public	Retention Basin	0	Business/Commercial	AS12	N/A	36.6865747	-76.23313308	1/1/1990	Chesapeake	365	Active
Great Bridge Middle School	Great Bridge Middle School	School	Retention Basin	0	Institution/Government	AS12	Yes	36.70756467	-76.23352736	1/1/1990	Chesapeake	365	Active
Greystone	Greystone - Lake 1	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.72915084	-76.21020555	1/1/1990	Chesapeake	365	Active
Greystone	Greystone - Lake 2	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.73158427	-76.20649338	1/1/1990	Chesapeake	365	Active
Hanbury Commons	Hanbury Commons	Public	Detention Basin	0	Low Density Residential	AS12	N/A	36.69339277	-76.23630345	1/1/1990	Chesapeake	365	Active
Hunningdon Lakes	Hunningdon Lakes - Lake 1	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.75449608	-76.2110424	1/1/1990	Chesapeake	365	Active
Hunningdon Lakes	Hunningdon Lakes - Lake 2	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.75738429	-76.20902538	1/1/1990	Chesapeake	365	Active
Hunningdon Lakes	Hunningdon Lakes - Lake 3	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.75752182	-76.21295214	1/1/1990	Chesapeake	365	Active
Kemp Bridge	Kemp Bridge - Lake 1	Public	Detention Basin	0	Low Density Residential	AS12	N/A	36.74795853	-76.20633245	1/1/1990	Chesapeake	365	Active
Kemp Bridge	Kemp Bridge - Lake 2	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.7482938	-76.20316207	1/1/1990	Chesapeake	365	Active
Kemp Woods	Kemp Woods - Lake 1	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.75594879	-76.20307088	1/1/1990	Chesapeake	365	Active
Kemp Woods	Kemp Woods - Lake 2	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.75303474	-76.19862914	1/1/1990	Chesapeake	365	Active
Kemp Woods	Kemp Woods - Lake 3	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.75200319	-76.20457292	1/1/1990	Chesapeake	365	Active
Kempsville Road	Kempsville Road - Lake 4	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.76845474	-76.20275438	1/1/1990	Chesapeake	365	Active
Mill Pond Forest	Mill Pond Forest	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.76196565	-76.18889809	1/1/1990	Chesapeake	365	Active
Oakbrooke Business & Technology Center	Oakbrooke Business & Technology Center - Lake A	Public	Retention Basin	0	Office, Research, and Commerce	AS12	N/A	36.73346734	-76.22007608	1/1/1990	Chesapeake	365	Active
Plantation Lakes	Plantation Lakes - Lake 1	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.76278219	-76.1941123	1/1/1990	Chesapeake	365	Active
Plantation Lakes	Plantation Lakes - Lake 2	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.76496531	-76.19889736	1/1/1990	Chesapeake	365	Active
Plantation North	Plantation North	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.76476763	-76.18812561	1/1/1990	Chesapeake	365	Active
Poplar Ridge South	Poplar Ridge South	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.7027048	-76.2027061	1/1/1990	Chesapeake	365	Active
Ramsgate	Ramsgate	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.69068282	-76.197052	1/1/1990	Chesapeake	365	Active
Ravenna	Ravenna	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.72126528	-76.178298	1/1/1990	Chesapeake	365	Active
Sandy Hill	Sandy Hill	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.70155215	-76.26184344	1/1/1990	Chesapeake	365	Active
Savanna Heights	Savanna Heights	Public	Detention Basin	0	Low Density Residential	AS12	N/A	36.69432402	-76.226964	1/1/1990	Chesapeake	365	Active

Table B-2. All BMPs in the Southern Rivers Watersheds

Site ID	SWMF ID	Ownership Type	SWMF Type	Contributing Drainage Area	Land Use	HUC	SWMF Maintenance Agreement	Lat	Long	Date Online	Permittee Name	Inspection Frequency	Status
Scenic Acres	Scenic Acres	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.69732848	-76.27576947	1/1/1990	Chesapeake	365	Active
Stonegate	Stonegate - Lake 1	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.68364511	-76.25925779	1/1/1990	Chesapeake	365	Active
Stonegate	Stonegate - Lake 2	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.68546483	-76.26619935	1/1/1990	Chesapeake	365	Active
Stonegate	Stonegate - Lake 2A	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.68580898	-76.26477242	1/1/1990	Chesapeake	365	Active
Stonegate	Stonegate - Lake 3	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.68611871	-76.2629807	1/1/1990	Chesapeake	365	Active
Stonegate	Stonegate - Lake 4	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.68685002	-76.25968695	1/1/1990	Chesapeake	365	Active
Stonegate	Stonegate - Lake 5	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.68740925	-76.25632346	1/1/1990	Chesapeake	365	Active
Stonegate	Stonegate - Lake 6	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.6882782	-76.2544781	1/1/1990	Chesapeake	365	Active
Stony Run Manor	Stony Run Manor	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.73945157	-76.20785058	1/1/1990	Chesapeake	365	Active
Stratford Terrace	Stratford Terrace	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.70880325	-76.17057323	1/1/1990	Chesapeake	365	Active
Vance Level	Vance Level	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.73664867	-76.18952036	1/1/1990	Chesapeake	365	Active
Vintage Estates	Vintage Estates	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.68855351	-76.27031922	1/1/1990	Chesapeake	365	Active
Waddell Estates	Waddell Estates	Public	Detention Basin	0	Low Density Residential	AS12	N/A	36.69279272	-76.27246499	1/1/1990	Chesapeake	365	Active
Warrington Hall	Warrington Hall - Lake 1	Public	Detention Basin	0	Low Density Residential	AS12	N/A	36.74678506	-76.20608032	1/1/1990	Chesapeake	365	Active
Warrington Hall	Warrington Hall - Lake 2	Public	Detention Basin	0	Low Density Residential	AS12	N/A	36.74277881	-76.20886445	1/1/1990	Chesapeake	365	Active
Warrington Hall	Warrington Hall - Lake 3	Public	Detention Basin	0	Low Density Residential	AS12	N/A	36.74269284	-76.20675087	1/1/1990	Chesapeake	365	Active
Warrington Hall	Warrington Hall - Lake 4	Public	Detention Basin	0	Low Density Residential	AS12	N/A	36.74176862	-76.20623052	1/1/1990	Chesapeake	365	Active
Waterford	Waterford	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.69336266	-76.26695037	1/1/1990	Chesapeake	365	Active
Westchester Estates	Westchester Estates	Public	Retention Basin	0	Low Density Residential	AS12	N/A	36.74091747	-76.20360732	1/1/1990	Chesapeake	365	Active
Centerville Baptist Church	Centerville Baptist Church	Private	Retention Basin	0	Low Density Residential	AS12	Yes	36.69776	76.18634	5/22/2000	Chesapeake	1825	Active
Seven Eleven Butts Station	Seven Eleven Butts Station	Public	Retention Basin	0	Medium Density Mixed Use	AS12	No	36.73312	76.18766	1/25/2001	Chesapeake	365	Active
Foxgate Forest	Foxgate Quarter	Public	Retention Basin	0	Low Density Residential	AS12	Yes	36.702414	76.25915	12/21/2002	Chesapeake	365	Active
Foxgate Forest	Foxgate Quarter	Public	Retention Basin	0	Low Density Residential	AS12	Yes	36.702414	76.25915	12/21/2002	Chesapeake	365	Active
Esprit Decor	Esprit Decor	Private	Detention Basin	0	Business/Commercial	AS12	Yes	36.68435	76.23501	12/27/2002	Chesapeake	1825	Active
Great Bridge Baptist	601004000000	Private	Bioretention Basins	0	Business/Commercial	AS12	Yes	36.70223	76.23501	4/15/2004	Chesapeake	1825	Active
Chapel Hill North Phase 2	Chapel Hill North Phase 2	Public	Retention Basin	21	Medium Density Residential	AS12	Yes	36.710761	76.198836	11/9/2008	Chesapeake	365	Active
Retreat at Greenbrier Condominium (294003000000)	294003000000 - Lake #1	Private	Retention Basin	45.52	Medium Density Mixed Use	AS12	Yes	36.76984703	-76.20971203	4/7/2009	Chesapeake	1825	Active
Cedar Lakes Condominium (595002000000)	595002000000	Private	Retention Basin	6.5	Low Density Residential/Open Space	AS12	Yes	36.71024822	-76.25554562	7/13/2009	Chesapeake	1825	Active
Mt Pleasant Marketplace (490000000000)	490000000000	Private	Retention Basin	35.02	Business/Commercial	AS12	Yes	36.71576985	-76.18906975	6/25/2010	Chesapeake	1825	Active
North Landing Cove (490000000000)	490000000000	Private	Retention Basin	8.56	Low Density Residential	AS12	Yes	36.72536725	-76.18724585	7/23/2010	Chesapeake	1825	Active
MacDonald Glennon Subdivision (620000000000)	620000000000	Private	Retention Basin	17	Rural	AS12	Yes	36.70761628	-76.15040302	7/23/2010	Chesapeake	1825	Active
Monarch Center (600000000000)	600000000000	Private	Retention Basin	5.6	Business/Commercial	AS12	Yes	36.69099684	-76.23292923	7/30/2010	Chesapeake	1825	Active
Windlesham Plantation (609001000000)	0609001000150 - A	Private	Detention Basin	3.0162	Low Density Residential	AS12	Yes	36.69021395	-76.22582674	8/18/2010	Chesapeake	1825	Active
CVS 1329 Kempsville Rd (380000000000)	380000000000 - Stormtech Storm Chamber Unit	Private	Manufactured BMP Systems	1.9	Business/Commercial	AS12	Yes	36.76250715	-76.20477676	4/28/2011	Chesapeake	1825	Active
Brightleaft Meadows Condo (380000000000)	Brightleaf Meadows	Private	Retention Basin	3.575	Low Density Residential	AS12	Yes	36.75906902	-76.20554924	3/21/2012	Chesapeake	1825	Active
Mt Pleasant Veterinary Clinic (480000000000)	480000000000 - Filterra	Private	Manufactured BMP Systems	0.27	Low Density Residential	AS12	Yes	36.71123518	-76.23382911	6/14/2012	Chesapeake	1825	Active
Jordan Hall #1	Jordan Hall	Public	Retention Basin	26.02	Low Density Residential	AS12	Yes	36.697303	76.249633	7/15/2013	Chesapeake	365	Active
Jordan Hall #2	Jordan Hall #2	Public	Retention Basin	10.21	Medium Density Residential	AS12	Yes	36.696589	76.248278	7/15/2013	Chesapeake	365	Active
Olah Landing #2	Olah Landing #2	Public	Retention Basin	16	Low Density Residential	AS12	No	36.688856	76.245028	8/14/2015	Chesapeake	365	Active
Olah Landing #1	Olah Landing #1	Public	Retention Basin	41	Low Density Residential	AS12	No	36.688478	76.246789	9/14/2015	Chesapeake	365	Active
Davidson Commons	Davidson Commons	Public	Detention Basin	2.1	Medium Density Residential	AS12	No	36.746086	76.211861	11/3/2015	Chesapeake	365	Active
Hailey's Cove	Hailey's Cove	Public	Retention Basin	10	Medium Density Residential	AS12	Yes	36.735152	76.197231	12/5/2015	Chesapeake	365	Active
Johnstown Estates #1	Johnstown Estates #1	Public	Retention Basin	1.15	Low Density Residential	AS12	No	36.68956	76.25075	1/30/2016	Chesapeake	365	Active
Johnstown Estates #2	Johnstown Estates #2	Public	Retention Basin	8.28	Low Density Residential	AS12	No	36.68958	76.25172	1/30/2016	Chesapeake	365	Active
Johnstown Estates #1	Johnstown Estates #1	Public	Retention Basin	1.15	Medium Density Residential	AS12	No	36.689453	76.250422	3/30/2016	Chesapeake	365	Active
Johnstown Estates #1	Johnstown Estate #2	Public	Retention Basin	8.28	Medium Density Residential	AS12	No	36.689464	760.251528	3/30/2016	Chesapeake	365	Active
Hanbury Manor Lake 1	Hanbury Manor Lake 1	Public	Retention Basin	16.1	Medium Density Residential	AS12	Yes	36.68685	76.234589	3/31/2016	Chesapeake	365	Active
Hanbury Manor Lake 1 - Hanbury Manor Lake 2	Hanbury Manor Lake 2	Public	Retention Basin	6	Medium Density Residential	AS12	Yes	36.685139	76.233661	3/31/2016	Chesapeake	365	Active
Tuckahoe Village	Tuckahoe Village	Public	Detention Basin	4.87	Low Density Residential	AS12	No	36.698614	76.272861	4/19/2016	Chesapeake	365	Active
Waters Bend Detention	Waters Bend Detention	Public	Detention Basin	5.9	Medium Density Residential	AS12	No	36.68972	76.25556	6/17/2016	Chesapeake	365	Active
New Creation Community Church	New Creation Church	Private	Dry Swale 2	0.58	Medium Density Mixed Use	AS12	Yes	36.740147	76.18431	6/30/2016	Chesapeake	365	Active
New Creation Community Church	New Creation Church	Private	Dry Swale 2	0.58	Medium Density Mixed Use	AS12	Yes	36.740147	76.18431	6/30/2016	Chesapeake	365	Active
The Retreat at Kemps River A	The Retreat at Kemps River A	Public	Retention Basin	12.6	High Density Residential	AS12	Yes	36.75928	76.19829	9/13/2017	Chesapeake	365	Active
The Retreat at Kemps River B (Not yet constructed)	The Retreat at Kemps River B	Public	Retention Basin	0	Medium Density Residential	AS12	Yes	36.76006	76.20409	9/13/2017	Chesapeake	365	Active
609001000000	0609001000150 - B	Private	Detention Basin	3.0162	Low Density Residential	AS12	Yes	36.69081617	-76.22626662		Chesapeake	1825	Active
Ashton Park	Ashton Park	Public	Detention Basin	0	Low Density Residential	AS12	No	36.6916012	-76.27107561		Chesapeake	365	Active
Chapel Hill Estates	Chapel Hill Estates - 1	Public	Retention Basin	0	Low Density Residential	AS12	No	36.71132334	-76.19822145		Chesapeake	365	Active
Chapel Hill Estates	Chapel Hill Estates - 2	Public	Retention Basin	0	Low Density Residential	AS12	No	36.71063312	-76.19929433		Chesapeake	365	Active
Madison Garden Estates	Madison Garden Estates	Public	Detention Basin	0	Low Density Residential	AS12	No	36.69100544	-76.22628272		Chesapeake	365	Active

Table B-2. All BMPs in the Southern Rivers Watersheds

Site ID	SWMF ID	Ownership Type	SWMF Type	Contributing Drainage Area	Land Use	HUC	SWMF Maintenance Agreement	Lat	Long	Date Online	Permittee Name	Inspection Frequency	Status
Wilson Heights	Wilson Heights	Public	Retention Basin	0	Low Density Residential	AS12	No	36.70682496	-76.25180662		Chesapeake	365	Active
500000000000	500000000000	Private	Retention Basin	0	Business/Commercial	AS15	Yes	36.71284567	-76.17490768	1/1/1990	Chesapeake	1825	Active
860000000000	860000000000	Private	Retention Basin	0	Business/Commercial	AS15	Yes	36.65041379	-76.20036721	1/1/1990	Chesapeake	1825	Active
Emerald Lakes Estates	Emerald Lakes Estates - Lake 1	Public	Retention Basin	0	Low Density Residential	AS15	N/A	36.67994963	-76.19769573	1/1/1990	Chesapeake	365	Active
Emerald Lakes Estates	Emerald Lakes Estates - Lake 2	Public	Retention Basin	0	Low Density Residential	AS15	N/A	36.68220394	-76.19516373	1/1/1990	Chesapeake	365	Active
Emerald Lakes Estates	Emerald Lakes Estates - Lake 3	Public	Retention Basin	0	Low Density Residential	AS15	N/A	36.68308155	-76.19198799	1/1/1990	Chesapeake	365	Active
Emerald Lakes Estates	Emerald Lakes Estates - Lake 4	Public	Retention Basin	0	Low Density Residential	AS15	N/A	36.68295679	-76.19009972	1/1/1990	Chesapeake	365	Active

Table B-3. Dry Weather Screening Locations in the Southern Rivers Watersheds			
Screening Point ID	Location	Watershed	Observations
16-14	945 Cantor Street	AS-09	
16-15	NE corner of Blacksmith Trail and Horseshoe Drive	AS-09	
16-16	1517 Gray Rock Road	AS-09	Standing water, semi-submerged
16-17	216 Carmichael Way	AS-09	Standing water
16-41	Hickory High School	AS-09	Wet basin
16-12	1313 Avonlea Court	AS-12	
16-13	East corner of Unser and Hassell Drive	AS-12	Standing water
16-18	220 Tara Circle	AS-12	Standing water
16-19	Mt Pleasant Road and Centerville Turnpike	AS-12	
16-20	408 Cayland Court	AS-12	
16-33	1012 Sharon Drive	AS-12	
16-40	Elmhurst Ave and Prospect Drive	AS-12	Wet basin

Table B-4. Septic to Sewer Conversions

Project Names	Watershed	Address	Yearly Totals										
			2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
		1405 Avon Drive				■							
		1408 Avon Drive				■							
		1409 Avon Drive				■							
		1412 Avon Drive				■							
		1416 Avon Drive				■							
		1417 Avon Drive				■							
		1418 Avon Drive				■							
		1420 Avon Drive				■							
		1421 Avon Drive				■							
		1424 Avon Drive				■							
		1425 Avon Drive				■							
		1428 Avon Drive				■							
		1429 Avon Drive				■							
		1404 Buxton Drive							■				
		1405 Buxton Drive				■							
		1408 Buxton Drive				■							
		1409 Buxton Drive				■							
		1412 Buxton Drive				■							
		1413 Buxton Drive				■							
		1414 Buxton Drive				■							
		1416 Buxton Drive				■							
		1417 Buxton Drive				■							
		1420 Buxton Drive									■		
		1421 Buxton Drive				■							
		1424 Buxton Drive				■							
		1425 Buxton Drive				■							
		420 Centerville Turnpike S.				■							
		424 Centerville Turnpike S.				■							
		428 Centerville Turnpike S.				■							
		432 Centerville Turnpike S.				■							
		433 Centerville Turnpike S.							■				
		436 Centerville Turnpike S.							■				
		440 Centerville Turnpike S.	■										
		444 Centerville Turnpike S.		■									
		448 Centerville Turnpike S.							■				
		504 Centerville Turnpike S.				■							
		512 Centerville Turnpike S.				■							
		516 Centerville Turnpike S.		■									
		520 Centerville Turnpike S.				■							
		521 Centerville Turnpike S.		■									
		524 Centerville Turnpike S.				■							
		528 Centerville Turnpike S.				■							
		529 Centerville Turnpike S.				■							
		412 Collington Drive				■							
		416 Collington Drive						■					
		420 Collington Drive				■							
		428 Collington Drive				■							
		432 Collington Drive				■							
		436 Collington Drive				■							
		440 Collington Drive				■							
		444 Collington Drive				■							
		448 Collington Drive				■							
		413 Corapeake Dr.				■							
Albemarle Acres	AS12	417 Corapeake Dr.				■							
		421 Corapeake Dr.	■										
		425 Corapeake Dr.				■							
		429 Corapeake Dr.				■							
		433 Corapeake Dr.				■							
		437 Corapeake Dr.				■							
		441 Corapeake Dr.											■
		444 Corapeake Dr.				■							
		445 Corapeake Dr.		■									
		448 Corapeake Dr.				■							
		449 Corapeake Dr.		■									
		500 Corapeake Dr.				■							
		501 Corapeake Dr.										■	
		504 Corapeake Dr.				■							
		505 Corapeake Dr.						■					
		509 Corapeake Dr.				■							
		513 Corapeake Dr.				■							
		516 Corapeake Dr.				■							
		517 Corapeake Dr.				■							
		520 Corapeake Dr.				■							
		521 Corapeake Dr.							■				
		528 Corapeake Dr.	■										
		529 Corapeake Dr.											■
		413 Fairfield Drive				■							
		416 Fairfield Drive				■							
		417 Fairfield Drive				■							
		420 Fairfield Drive				■							
		421 Fairfield Drive				■							
		424 Fairfield Drive				■							
		425 Fairfield Drive				■							
		428 Fairfield Drive				■							
		429 Fairfield Drive	■										
		432 Fairfield Drive				■							
		433 Fairfield Drive				■							
		436 Fairfield Drive				■							
		437 Fairfield Drive				■							
		440 Fairfield Drive				■							
		441 Fairfield Drive				■							
		442 Fairfield Drive				■							
		444 Fairfield Drive				■							
		445 Fairfield Drive				■							
		448 Fairfield Drive				■							
		500 Fairfield Drive				■							
		501 Fairfield Drive				■							
		504 Fairfield Drive				■							
		505 Fairfield Drive				■							
		508 Fairfield Drive				■							
		509 Fairfield Drive				■							
		512 Fairfield Drive	■										
		516 Fairfield Drive				■							
		520 Fairfield Drive				■							
		524 Fairfield Drive				■							
		525 Fairfield Drive				■							
		1325 Mount Pleasant Rd.				■							
		1405 Mount Pleasant Rd.				■							

Table B-4. Septic to Sewer Conversions

Project Names	Watershed	Address		Yearly Totals										
				2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Albemarle Acres	AS12	1417	Mount Pleasant Rd.				■							
		1419	Mount Pleasant Rd.				■							
		1429	Mount Pleasant Rd.		■									
		1425	Mount Pleasant Rd.				■							
		1400	Norlina Drive							■				
		1401	Norlina Drive				■							
		1404	Norlina Drive				■							
		1408	Norlina Drive				■							
		1412	Norlina Drive	■										
		1413	Norlina Drive				■							
		1416	Norlina Drive				■							
		1417	Norlina Drive				■							
		1420	Norlina Drive				■							
		1421	Norlina Drive				■							
		1424	Norlina Drive	■										
		1425	Norlina Drive				■							
		1428	Norlina Drive				■							
		1429	Norlina Drive				■							
		1432	Norlina Drive				■							
		1433	Norlina Drive	■										
		1456	Pamlico Blvd.				■							
		1352	Pamlico Blvd.				■							
		1356	Pamlico Blvd.				■							
		1360	Pamlico Blvd.				■							
		1400	Pamlico Blvd.				■							
		1408	Pamlico Blvd.				■							
		1412	Pamlico Blvd.				■							
		1413	Pamlico Blvd.				■							
		1416	Pamlico Blvd.				■							
		1417	Pamlico Blvd.				■							
		1420	Pamlico Blvd.				■							
		1421	Pamlico Blvd.		■									
		1424	Pamlico Blvd.				■							
		1425	Pamlico Blvd.				■							
		1428	Pamlico Blvd.				■							
		1429	Pamlico Blvd.				■							
		1432	Pamlico Blvd.				■							
		1433	Pamlico Blvd.				■							
		1436	Pamlico Blvd.				■							
		1437	Pamlico Blvd.				■							
		1440	Pamlico Blvd.				■							
		1441	Pamlico Blvd.				■							
		1444	Pamlico Blvd.				■							
		1445	Pamlico Blvd.				■							
		1448	Pamlico Blvd.		■									
		1405	Windfall Drive				■							
		1409	Windfall Drive				■							
		1413	Windfall Drive				■							
		1416	Windfall Drive				■							
		1417	Windfall Drive				■							
		1420	Windfall Drive				■							
		1421	Windfall Drive				■							
		1424	Windfall Drive				■							
		1425	Windfall Drive				■							
		1428	Windfall Drive				■							
		1433	Windfall Drive				■							
		1400	Windsor Blvd.				■							
		1401	Windsor Blvd.				■							
		1404	Windsor Blvd.				■							
		1405	Windsor Blvd.								■			
		1408	Windsor Blvd.				■							
		1412	Windsor Blvd.				■							
		1413	Windsor Blvd.		■									
		1416	Windsor Blvd.				■							
		1417	Windsor Blvd.				■							
		1420	Windsor Blvd.				■							
		1421	Windsor Blvd.				■							
		1424	Windsor Blvd.					■						
		1425	Windsor Blvd.				■							
Etheridge Road	AS12	615	Etheridge Road							■				
Bridgewood	AS12	504	Greenway Drive				■							
		505	Greenway Drive					■						
		508	Greenway Drive				■							
		509	Greenway Drive				■							
		512	Greenway Drive				■							
		513	Greenway Drive				■							
		516	Greenway Drive				■							
		517	Greenway Drive				■							
		520	Greenway Drive				■							
		521	Greenway Drive				■							
		529	Greenway Drive					■						
		504	Robin Court				■							
		509	Robin Court	■										
		504	Thrush Court		■									
		505	Thrush Court	■										
		508	Thrush Court		■									
Kempsville Road	AS12	1029	Kempsville Road		■									
		1049	Kempsville Road	■										
		1053	Kempsville Road	■										
		1061	Kempsville Road	■										
		1069	Kempsville Road		■									
		1073	Kempsville Road	■										
		1084	Kempsville Road	■										
		1092	Kempsville Road	■										
Total	Total			16	13	0	157	3	2	7	1	1	1	2

Table B-5. Land-based Loading Rates for Credit Calculations			
Land Cover	Albemarle Canal-North Landing River (lbs/ac-yr)	Pocaty River (lbs/ac-yr)	Northwest River (lbs/ac-yr)
Impervious	0.748	1.920	1.723
Pervious	0.029	0.070	0.037
Grass[1]	0.493	0.080	0.241
Forest[2]	0.008	0.007	0.007
Agriculture[3]	0.855	0.757	0.620

[1]Grass loading rate calculated from area and existing load of the open space (pervious) land use.

[2]Forest loading rate calculated from the area and existing load of the forest land use.

[3]Agriculture loading rate calculated from the area and existing load of the conventional tillage, conservation tillage, and hay land uses.

Appendix C: CIP Project List

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Table C-1. FY 2018-2022 Approved Capital Improvement Program Projects						
Project Name	Category	Project #	Location	Start Date	Est. Completion Date	Total Expense
Sewer Management Operations & Maintenance	Public Utilities	13-160	Citywide	7/1/2013	7/1/2017	$3,000,000.00
Sewer Pump Station Safety Improvements	Public Utilities	35-200	Citywide	7/1/2015	6/30/2023	$4,000,000.00
Sewer Pump Station: Replacement and Rehabilitation	Public Utilities	21-220	Citywide	7/1/2021	6/30/2026	$2,700,000.00
Sewer Renewal: Additional Consent Order Capital Requirement	Public Utilities	05-180	Citywide	7/1/2015	6/30/2022	$264,261,609.00
Water & Sewer Pump Station Telemetry Instillation and Upgrade	Public Utilities	32-210	Citywide	7/1/2016	6/30/2018	$400,000.00
Sanitary Sewer Evaluation Study	Public Utilities	27-120	Citywide	7/1/2007	6/30/2018	$8,660,079.00
Sewer System Repairs - Phase I	Public Utilities	31-120	Citywide	7/1/2007	7/30/2017	$1,696,100.00
Sewer System Repairs - Phase II	Public Utilities	04-140	Citywide	7/1/2012	7/1/2018	$244,611.00
BMP Restoration Citywide	Stormwater	73-120	Citywide	7/1/2011	12/2/2021	$2,900,000.00
Citywide Outfall Re-Grading and Restoration	Stormwater	03-160	Citywide	7/1/2012	12/1/2021	$1,520,000.00
Citywide System Rehab	Stormwater	43-170	Citywide	7/1/2012	12/1/2021	$3,700,000.00
Citywide Undesignated Drainage - Phase III	Stormwater	07-150	Citywide	7/1/2012	6/30/2022	$906,347.00
Master Drainage Improvements II	Stormwater	40-210	Cooper's Ditch Watershed Southern Chesapeake (Sub-Basins 2 & 3)	7/1/2016	6/30/2018	$1,908,000.00
Neighborhood Drainage Improvements - Phase II	Stormwater	08-150	Citywide	7/1/2012	N/A	$4,794,600.00
Shillelagh Rd. Drainage Outfall Improvements	Stormwater	77-120	Shillelagh Road	9/1/2016	12/1/2018	$3,100,000.00
Stormwater Mapping & Master Drainage Plan III	Stormwater	10-150	Citywide	7/1/2012	N/A	$1,200,000.00
Stormwater Quality Program - Phase II	Stormwater	11-150	Citywide	9/1/2012	N/A	$10,840,565.00
Whittamore Rd. Outfall Improvements	Stormwater	20-200	Whittamore Road	N/A	N/A	$300,000.00
Citywide Undesignated Drainage - Phase I	Stormwater	04-080	Citywide	7/1/2003	6/30/2022	$352,029.00
Cooper's Ditch Dredging	Stormwater	04-100	Cooper's Ditch Watershed	11/1/2013	12/1/2016	$2,000,000.00
Neighborhood Drainage Improvements - Phase I	Stormwater	05-121	Citywide	7/1/2011	12/1/2017	$2,221,983.00
Prince Edward Dr. Outfall Improvements	Stormwater	09-130	Prince Edward Drive	11/1/2013	11/1/2016	$600,000.00
Royce Dr. Drainage Outfall Improvements	Stormwater	10-130	East/West Royce Drive	1/1/2014	12/1/2016	$550,000.00
Stormwater Mapping & Master Drainage Plan II	Stormwater	06-120	Citywide	7/1/2011	N/A	$1,000,000.00
Stormwater Quality Program/VPDES Permit Compliance	Stormwater	05-140	Citywide	7/1/2011	N/A	$6,746,968.00

Appendix D: Public Comment

No comments were received during the public input period in June 2018.

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Appendix E: Modifications to the Plan

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