DRAFT

MS4 Southampton Creek & Wissahickon Creek TMDL Strategy

For
Upper Moreland Township
Montgomery County

April 2016

Prepared For:

Upper Moreland Township
117 Park Avenue
Willow Grove, PA 19090
(215) 659-3100

Prepared By:
Gilmore & Associates, Inc.
Engineers ♦ Land Surveyors ♦ Planners ♦ GIS Consultants
65 East Butler Avenue, Suite 100
New Britain, PA 18901
215-345-4330

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I. Introduction

Upper Moreland Township, located in Montgomery County, is comprised of 7.5 square miles of land situated within the Wissahickon Creek and Pennypack Creek watersheds. The Township owns and maintains a small municipal separate storm sewer system (MS4) requiring a National Pollutant Discharge Elimination System (NPDES) permit to allow discharge of stormwater runoff to waters of the Commonwealth of Pennsylvania. The Wissahickon Creek watershed and the Southampton Creek watershed have approved Total Maximum Daily Loads (TMDLs). These plans establish waste load allocations (WLA) for Upper Moreland Township limiting the amount of pollutants that are permitted to be discharged to waters of the Commonwealth of Pennsylvania. At the time of this Strategy, the Wissahickon TMDL plan has siltation (sediment) WLAs attributed to the Township and the Southampton TMDL plan has siltation and nutrient (total phosphorous) WLAs attributed to the Township. This MS4 TMDL Strategy is prepared to satisfy the siltation and nutrient WLAs of the Southampton Creek and siltation of the Wissahickon Creek TMDL Plans.

The intent of this MS4 TMDL Strategy is to establish the WLA of the Township and to present a plan to reduce waste loads discharged from the regulated small MS4 consistent with the WLAs in the approved Southampton Creek Watershed TMDL and Wissahickon Creek Watershed TMDL. Upon approval of these Strategies by the Pennsylvania Department of Environmental Protection (PADEP), the Township will provide MS4 TMDL Design Details for implementation of the Strategy. Together, these documents, the MS4 TMDL Strategies and the MS4 TMDL Design Details, comprise the MS4 TMDL Plans satisfying the requirement of the Township's NPDES MS4 Permit. Implementation of the TMDL Plan is an adaptive, iterative and dynamic process. The TMDL Plan will be evaluated and updated by the Township on an as-needed basis, based upon its effectiveness in reducing pollutant loads in discharges from the regulated small MS4, the reasonableness of achieving the WLAs, and the cost/benefit of the best management practices (BMPs) under consideration.

Upper Moreland Township has been engaged with watershed partners within the Southampton Creek Watershed to determine if joint planning efforts towards compliance with TMDL requirements will be beneficial to the municipalities. Several meetings have taken place in January – March 2016 with staff and engineers from Lower Moreland Township, Upper Southampton Township, Warminster Township, and Bryn Athyn Borough. The meetings provided great insight into the challenges that each municipality faces in terms of achieving pollutant reductions within the watershed. The current TMDL Strategy Plan, which is contained in this document, is intended to achieve compliance for Upper Moreland Township only. As outlined in the Southampton Creek TMDL strategy portion of this report, Upper Moreland Township is committed to exploring watershed wide initiatives in the future and will continue to work with adjacent municipalities within the Southampton Creek watershed to determine if viable joint planning efforts can have a mutual impact on water quality within the region.

II. Established TMDLs

Southampton Creek

The Southampton Creek watershed covers approximately 1.35 square miles of Upper Moreland Township. This watershed then flows into the main Pennypack Creek watershed, which encompasses almost all of Upper Moreland Township.

While no TMDL exists for the Pennypack Creek, which is an impaired stream for sediment, the USEPA established total phosphorous and sediment TMDLs for the Southampton Creek sub-watershed on June 30, 2008. The TMDL, titled *Nutrient and Sediment TMDLs for the Southampton Creek Watershed, Pennsylvania*, is for the Southampton Creek in Montgomery and Bucks counties within Hydrologic Unit Code 02040202 (Lower Delaware). TMDLs were also established for Upper Southampton & Warminster Townships in Bucks County and Lower Moreland Township, Upper Moreland Township, and Bryn Athyn Borough in Montgomery County.

Based on the land use loading rates, tables 1 and 2 show WLAs established for Upper Moreland Township:

Table 1: Summary of Southampton Creek required reductions to meet PADEP standards

UPPER MORELAND TOWNSHIP SOUTHAMPTON CREEK TMDL SUMMARY				
Pollutant	Existing Load	WLA	Reduction	Reduction
	(lb/year)	(lb/year)	(%)	(lb/year)
Sediment	347,199	229,252	34.0%	117,947
Nutrient (Total Phosphorus)	165.00	1.46	99.1%	163.54

Since required reduction percentages were not included in the TMDL for each municipality, information detailing how the required reductions were calculated is provided in the "Waste Load Calculations" section below and data are available in Appendix B.

Wissahickon Creek

In addition to the Southampton Creek Watershed, approximately 45.8 acres of land in Upper Moreland is located within the Wissahickon Creek watershed. The Wissahickon Creek has a TMDL approved by EPA in 2003, which establishes WLAs for sediment within each municipality in the watershed. Please refer to the *Upper Moreland Township Watershed Boundary Map*, included in Appendix A, for limits of the Southampton and Wissahickon Creek Watersheds within the Township.

Table 2: Summary of Wissahickon Creek required sediment reductions to meet PADEP standards

UPPER MORELAND TOWNSHIP WISSAHICKON CREEK TMDL SUMMARY				
Pollutant	Existing Load	WLA	Reduction	Reduction
	(lb/year)	(lb/year)	(%)	(lb/year)
Sediment	2,394	862	64.0%	1,532

III. Waste Load Calculations

The calculations described in this section are intended to provide baseline and allocated waste loads for the Township's goal of achieving the waste load removals outlined in the Southampton Creek TMDL. Only areas tributary to the Township MS4 were included as area contributing to waste loads.

MS4 Tributary Area

The existing pollutant loads presented in Section II, tables 1 and 2, are allocated to the entire Township area within the Southampton Creek watershed and Wissahickon Creek Watershed. The Township's permit obligation applies only to runoff collected by and discharged from the MS4. Tables 3 and 4 summarize areas which are not tributary to the Township's MS4. The pollutant loads generated from these non-tributary areas are parsed from the Township loads to determine that which is attributed to only the MS4. The Township reserves the right to modify parsed areas in the future. Any modification to parsed areas will be documented in future updates of the MS4 TMDL Plan. Please refer to the *TMDL Maps*, included in Appendix A, for limits of the parsed areas within the Southampton Creek and Wissahickon Creek Watershed in Upper Moreland Township.

Table 3: Percentage of Southampton Creek Watershed in Upper Moreland Township within MS4

Southampton Creek Watershed Parsed Areas		
Area Description	**Acres**	**%**
Township within Watershed	863	100.00%
Tributary to PennDOT Roads, R.R., R.O.W.	127.9	14.82%
Not Tributary to MS4	174.5	20.22%
Parsed from MS4	**302.4**	**35.04%**
Tributary to MS4	**560.6**	**64.96%**

Table 4: Percentage of Wissahickon Creek Watershed in Upper Moreland Township within MS4

Wissahickon Creek Watershed Parsed Areas		
Area Description	**Acres**	**%**
Township within Watershed	45.8	100.00%
Tributary to PennDOT Roads	32.4	70.79%
Not Tributary to MS4	0.0	0.00%
Parsed from MS4	**32.4**	70.79%
Tributary to MS4	**13.4**	29.21%

MS4 Waste Load Calculations

Tables 5 and 6 summarize the existing waste loads, WLAs, and required pollutant reductions attributed to the MS4 after accounting for parsed areas. The values presented in Section II are reduced by 35.04% for the Southampton Creek and by 70.79% for the Wissahickon Creek.

Table 5: Summary of Southampton Creek required reductions to meet PADEP standards based upon areas tributary to MS4

MS4 SOUTHAMPTON CREEK TMDL SUMMARY				
Pollutant	Existing Load	WLA	Reduction	Reduction
	(lb/year)	(lb/year)	(%)	(lb/year)
Sediment	225,540	148,922	34.0%	76,618.4
Nutrient (Total Phosphorus)	107.83	0.95	99.1%	106.9

Table 6: Summary of Wissahickon Creek required reductions to meet PADEP standards based upon areas tributary to MS4

MS4 WISSAHICKON CREEK TMDL SUMMARY				
Pollutant	Existing Load	WLA	Reduction	Reduction
	(lb/year)	(lb/year)	(%)	(lb/year)
Sediment	699.29	252	64.0%	447

IV. TMDL Compliance Strategy

As presented in Section III, Upper Moreland Township has a significant requirement to reduce sediment and total phosphorus discharging from the MS4. The Township plans to achieve the sediment and phosphorus reduction using two basic approaches listed below and described in subsequent sections.

- Quantify existing best management practices (BMPs)
- Implement new BMPs

The Township intends to implement this Strategy over the next 25 years. The Township intends that at or before the conclusion of 25 years, the sediment and nutrient reduction required in Section III will be achieved and the assumptions made in the approved watershed TMDL Plan regarding attaining water quality will be satisfied.

The Township anticipates that setting realistic goals which can be quantified by "measurable" success, the reduction percentages outlined in the approved watershed TMDL Plans can be met and water quality in all waterways within the Township will be positively impacted by implementation of this MS4 TMDL Strategy. Implementation of the MS4 TMDL Plan is an adaptive, iterative and dynamic process. The MS4 TMDL Plan will be evaluated and updated by the Township on an as-needed basis based upon its effectiveness in reducing pollutant loads in discharges from the regulated small MS4, the reasonableness of achieving the WLAs and the cost/benefit of the BMP under consideration. Therefore, it is intended that this Strategy, in its entirety, including the implementation term, may be modified by the Township periodically to reflect actual results, achievable goals and obstacles encountered during the process of implementation of this Strategy. As funding or other opportunities become available, the BMPs discussed below may be altered or new BMPs added to this TMDL Strategy.

Pollutant Load Concentration Method

In subsequent sections of this Strategy, pollutant load concentrations are required to quantify the amount of pollutants generated from areas tributary to existing and potential new BMPs. The Water Quality Analysis of Pollutant Loading method from Worksheet 12 of the PADEP's Pennsylvania Stormwater Best Management Practices Manual dated December 30, 2006 (PA BMP Manual) is utilized to approximate sediment generated on an annual basis. The method requires three input parameters:

- Pollutant event mean concentration (EMC) in mg/L from Table 8.3 of the PA BMP Manual
- Tributary area in acres (measured from a map)
- Annual runoff depth in feet

For the purposes of the Strategy, runoff depth was calculated using 4 years (2011 – 2014) of daily rain gauge data from the Ambler Borough Waste Water Treatment Plant (WWTP) and the SCS Runoff Curve Number Method (NRCS, TR-55) accounting for the initial abstraction and land cover classification. Since the Ambler Borough WWTP is within 8.5 miles of Upper Moreland Township, the rainfall data is considered representative of average rainfall in the Township. Based on this information, Table 7 shows the average annual runoff with respect to the type of land cover.

Table 7: Descriptions of various land types within Upper Moreland Township and their relative CN coefficient and average runoff per year

LAND COVER CLASSIFICATION	CN	AVERAGE ANNUAL RUNOFF (in/year)	AVERAGE ANNUAL RUNOFF (ft/year)
Forest	62	4.63	0.39
Meadow	60	4.10	0.34
Fertilized Planting Area	65	5.53	0.46
Native Planting Area	58	3.62	0.30
Lawn, Low Input	68	6.59	0.55
Lawn, High Input	65	5.53	0.46
Golf Course Fairway/Green	68	6.59	0.55
Grassed Athlethc Field	70	7.39	0.62
Rooftop	98	43.51	3.63
High Traffic Street/Highway	97	39.80	3.32
Medium Traffic Street	90	23.96	2.00
Low Traffic/Residential Street	89	22.47	1.87
Res. Driveway, Play Courts, etc.	98	43.51	3.63
High Traffic Parkng Lot	98	43.51	3.63
Low Traffic Parking Lot	98	43.51	3.63

Existing BMPs

The Southampton TMDL Plan was based on analysis completed through 2006. Several BMPs have been installed within the Township following the analysis included in the TMDL Plan. The following parameters are used to determine the sediment load from these areas and the reduction provided by the associated BMPs.

- Tributary area – determined by inspection of the storm sewer map.
- Area cover conditions – percentage of impervious pervious areas was determined from approved land development plans or from aerial photography.
- Runoff depth – values for impervious and lawn areas.
- TSS EMC – 21 mg/L and 58 mg/L were used for impervious areas to account for rooftops and low traffic parking areas respectively, 180 mg/L was used for lawns, low input.
- TP EMC – 0.13 mg/L and 0.15 mg/L were used for impervious areas to account for rooftops and low traffic parking areas respectively, 0.40 mg/L was used for lawns, low input.

While a detailed tabulation of the existing BMP calculations can be found in Appendix C, Table 8 shows a brief summary of the sediment and phosphorus reductions. Let it be noted, there are currently no existing BMPs within the Wissahickon Creek Watershed in Upper Moreland Township that were installed after the WLAs were established in the 2003 plan.

Table 8: Existing BMP measures within the Southampton Creek that reduce sediment and total phosphorus

EXISTING BMP SUMMARY WITHIN SOUTHAMPTON CREEK WATERSHED				
	Sediment Load	Sediment Reduction	Phosphorus Load	Phosphorus Reduction
	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)
4205 Shoemaker Road	28	24	0.08	0.07
LaRosa Shoemaker Road	140	119	0.41	0.35
TOTALS	168	143	0.49	0.42

Potential New BMPs

The Township anticipates that sediment and nutrient reduction from existing BMPs and from future projects subject to new Ordinance requirements will not achieve the substantial pollutant reduction required by the TMDL Plan. The Township includes with this Strategy several potential BMPs that may be implementable in striving to meet the WLA requirements. These potential BMPs may be on private property and therefore, no guarantee is provided that these BMPs can or will be implemented. Implementation of any BMP expected to contribute to achieving the goal of this Strategy will require planning, design, permitting approval, property owner consent, etc. Therefore, the potential BMPs presented in this MS4 TMDL Plan are to be considered conceptual in scope and in no way imply any obligation of the Township to implement these specific BMPs in the locations identified. As stated previously, implementation of the TMDL Plan is an adaptive, iterative and dynamic process. The TMDL Plan will be evaluated and updated by the Township on an as-needed basis based upon its effectiveness in reducing pollutant loads in discharges from the regulated small MS4, the reasonableness of achieving the WLAs and the cost/benefit of the BMP under consideration.

Street Sweeping Program

Previous to 2012, the Township utilized a sub-contractor for all street sweeping operations within the Township. In 2013, the Township purchased its own street sweeping machine, which is operated by the Township Public Works Department. Since street sweeping was sub-contracted, it was done on an as needed basis and each street in the Township was only swept twice a year. Per new Township procedures, each street within the Township is swept at least once a month, which equates to a 600% increase in sweeping from the time when the TMDL studies were conducted. The calculations provided in Appendix D of this report assume a 50% reduction in sediment and phosphorous for runoff that is generated from public right of ways. We believe this estimate to be conservative, considering the PA DEP BMP Manual cites that 85% removals for both TSS and TP can be achieved through a street sweeping program.

Streambank Restoration

The Southampton Creek TMDL attributes approximately 268,000 lbs/yr of sediment is generated from streambank erosion in Upper Moreland Township. There are several locations throughout the Township where the stream traverses land that is Township owned. As such, there is the potential for stabilization projects in this area that will reduce the future erosion of the waterway banks. The Township has had great success in the

past with stream bank enhancement projects and the naturalized techniques have been found to hold up extremely well over time and prevent future erosion.

Basin Retrofits

There are two existing basins in the Southampton Creek watershed portion of the Township, which have significant drainage areas. These basins were constructed prior to the use of current naturalized and low impact stormwater management techniques. As such, they provide no water quality function to the waterway. The basins can be retrofit with native, wet tolerant plantings, sediment fore-bays, amended soils, etc., which will provide water quality functions. Additionally, infiltration testing can be conducted to analyze the underlying soils to determine if groundwater recharge is feasible.

Potential Pollutant Reduction Summary

The Southampton Creek TMDL plan requires reductions in sediment and total phosphorus of 34.0% and 99.1%, respectively. The Wissahickon Creek TMDL plan requires a reduction in sediment of 64.0%. The potential decreases in sediment and phosphorus from the proposed BMPs can be seen in tables 9 and 10. Calculations supporting each BMP are provided in Appendix D.

Table 9: Tabulated sediment and phosphorus reductions from potential BMP practices to be implemented in the Southampton Creek Watershed

POTENTIAL BMP SUMMARY FOR SOUTHAMPTON CREEK WATERSHED				
BMP	Sediment Load (lb/yr)	Sediment Reduction (lb/yr)	Phosphorus Load (lb/yr)	Phosphorus Reduction (lb/yr)
Streetsweeping	53,169	26,584	213.24	106.62
Streambank Restoration	49,394	41,985	0.00	0.00
Basin Retrofits	12,042	10,235	45.43	38.61
TOTAL	**114,605**	**78,805**	**259**	**145**

*Streambank Restoration is under the assumption that 2,500 feet of streambank restoration will occur.

Table 10: Tabulated sediment reductions from potential BMP practices to be implemented in the Wissahickon Creek Watershed

POTENTIAL BMP SUMMARY FOR WISSAHICKON CREEK WATERSHED		
BMP	Sediment Load (lb/yr)	Sediment Reduction (lb/yr)
Streetsweeping	908	454

TMDL Compliance Strategy Summary

Tables 11 and 12 summarize the total sediment and phosphorus loads, the WLA and required sediment and phosphorus reductions within the MS4. The tables also show the pollutant reductions from the existing and potential BMP measures to exceed the MS4 required pollutant reductions.

Table 11: Summary of reductions in Southampton Creek Watershed

SOUTHAMPTON CREEK WATERSHED			
Description	Unit	Sediment	Phosphorus
MS4 Sediment Load	lb/year	225,540	107.18
MS4 Required Pollutant Reduction	%	34.0%	99.1%
MS4 Required Pollutant Reduction	**lb/year**	**76,618**	**106.24**
Existing BMPs	lb/year	-143	-0.42
Future Potential BMPs	lb/year	-78,805	-145.23
Pollutant Reduction Potential	**lb/year**	**-78,948**	**-145.65**
Net Potential Reduction	**lb/year**	**-2,330**	**-39.41**

Table 12: Summary of reductions in Wissahickon Creek Watershed

WISSAHICKON CREEK WATERSHED		
Description	Unit	Sediment
MS4 Sediment Load	lb/year	699
MS4 Required Pollutant Reduction	%	64.0%
MS4 Required Pollutant Reduction	**lb/year**	**447**
Existing BMPs	lb/year	0
Future Potential BMPs	lb/year	-454
Pollutant Reduction Potential	**lb/year**	**-454**
Net Potential Reduction	**lb/year**	**-7**

Table 11 indicates that implementation of this Strategy will reduce sediment pollution by 78,948 lbs/yr and phosphorus by 145.65 lbs/yr within the Southampton Creek watershed.

Table 12 indicates that 454 lbs/yr of sediment will be reduced from the Wissahickon Creek watershed. Given the required pollutant reductions, the potential pollutant reduction BMPs will exceed the requirements and make a significant impact on pollution reduction over the next 25 years. This plan shows that compliance with the requirements of each TMDL can be achieved.

V. Public Participation

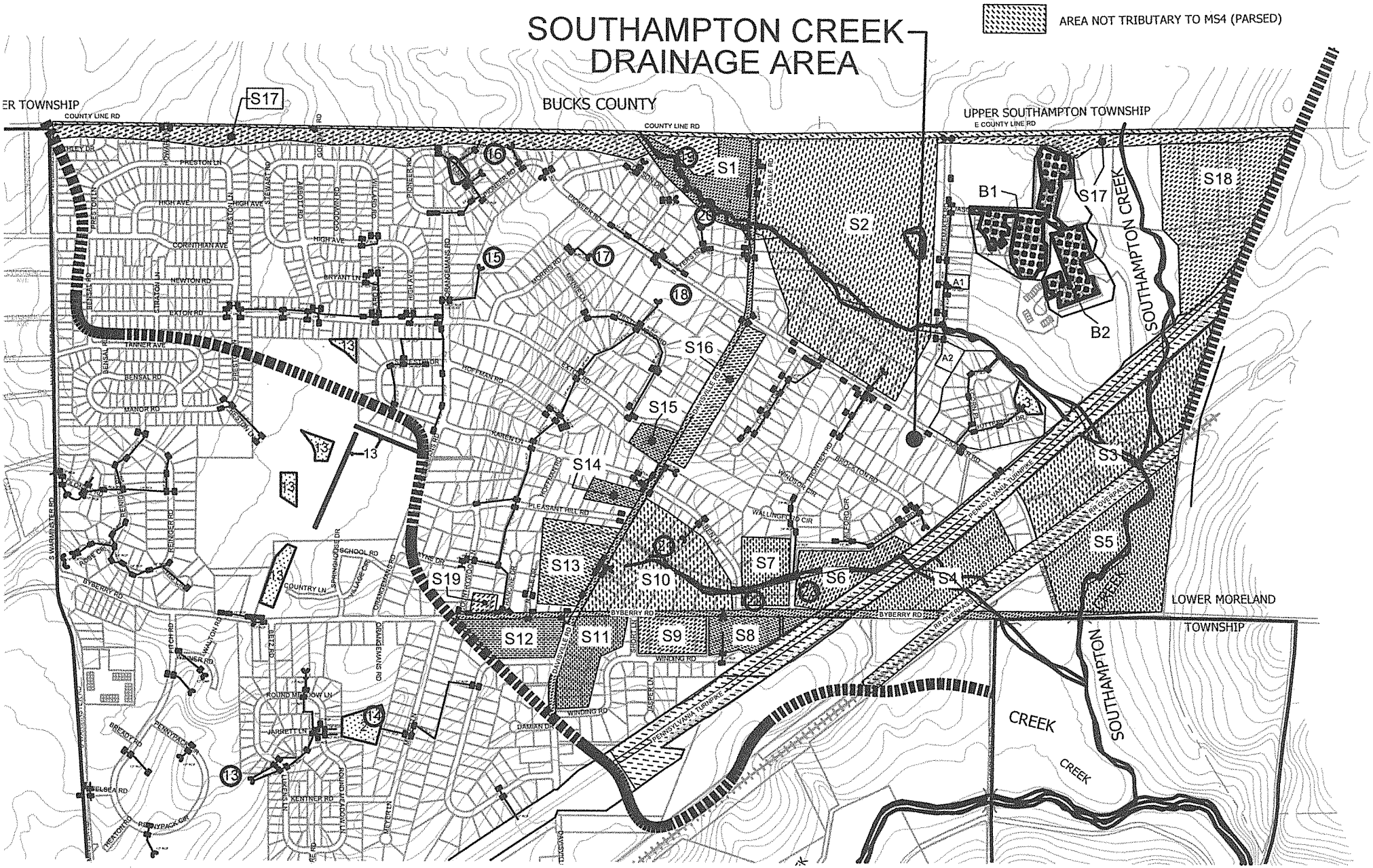
As part of the preparation of this MS4 TMDL Strategy, PADEP requires solicitation of public involvement and participation. The following are required:

- A copy of the MS4 TMDL Strategy must be available for public review.
- Publish, in a newspaper of general circulation in the area, a public notice containing a statement describing the Strategy, where it may be reviewed by the public, and the length of time provided for the receipt of comments.
- Accept written comments for a minimum of 30 days from the date of public notice.
- Accept any verbal or written comments from any interested member of the public at a public meeting or hearing.
- Consider and make a record of the consideration of each timely comment received from the public during the public comment period concerning the Strategy, identifying any changes made to the Strategy in response to the comment.

As required, a copy of the newspaper notice, a copy of all written comments received from the public, and a copy of the record of consideration of all timely comments received in the public comment period are included as Appendix E.

APPENDIX A

Upper Moreland Township Watershed Boundary Map & TMDL Map


SOUTHAMPTON CREEK
DRAINAGE AREA
AREA NOT TRIBUTARY TO MS4 (PARSED)
BUCKS COUNTY
UPPER SOUTHAMPTON TOWNSHIP
LOWER MORELAND TOWNSHIP
COUNTY LINE RD
E COUNTY LINE RD
BYBERRY RD
WINDING RD
DAVISVILLE RD
PENNSYLVANIA TURNPIKE
SOUTHAMPTON CREEK
S1
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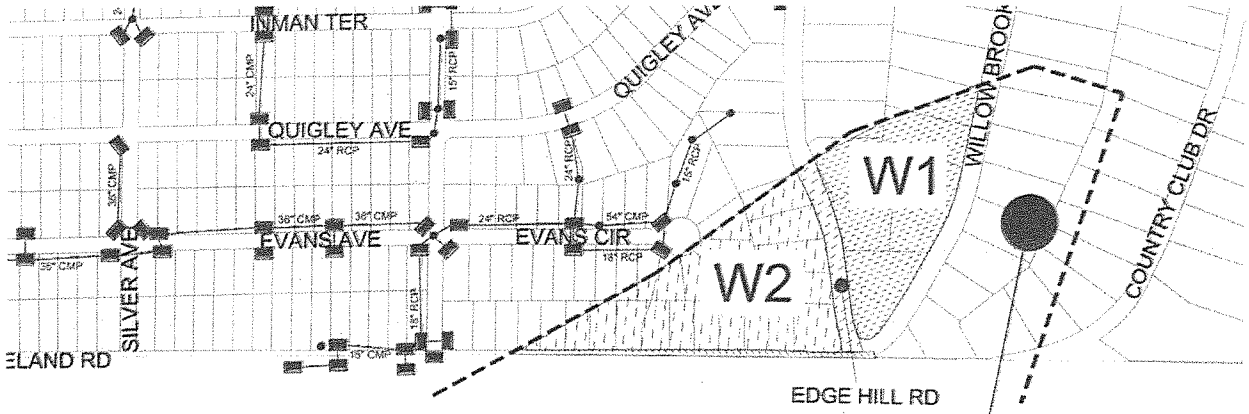
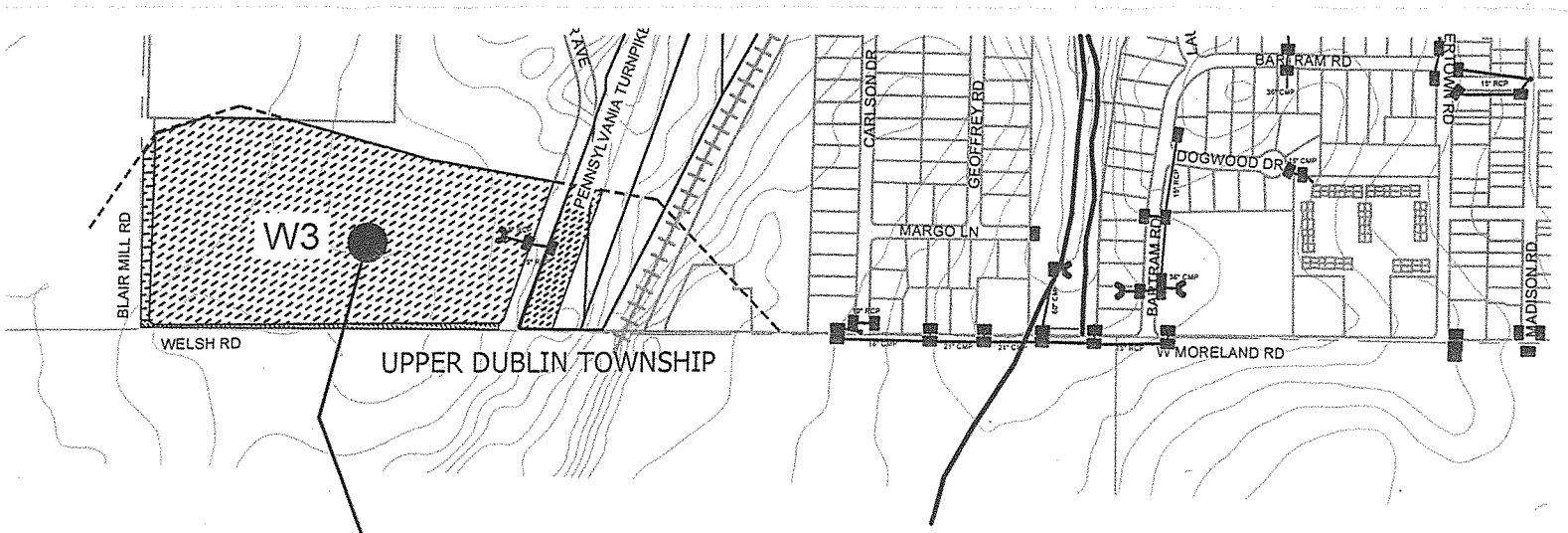


WISSAHICKON CREEK DRAINAGE AREA



WISSAHICKON CREEK DRAINAGE AREA

AREA NOT TRIBUTARY TO MS4 (PARSED)

APPENDIX B

Sediment and Total Phosphorous WLA Calculations –Southampton Creek Watershed

Appendix B1 - Sediment Waste Load Allocation Calculations for Southampton Creek Watershed

Land Use Source	Upper Moreland in Watershed (ac)	Existing Loading Rate (lb/ac/yr)	Existing Waste Load (lb/yr)	Target Loading Rate (lb/ac/yr)	Allocated Waste Load (lb/yr)	% Reduction
Hay/Pasture	14	93	1,302	42	565	56.61%
Cropland	7	758	5,306	623	4,160	21.60%
Forest	116	7	812	4	465	42.73%
Transitional Land	2	2,708	5,416	1,229	1,913	64.68%
Low Intensity Development	597	98	58,506	50	29,944	48.82%
High Intensity Development	127	56	7,112	45	5,672	20.25%
Streambank Erosion	22.09%	1,216,589	268,745	844,428	186,534	30.59%
TOTAL:	**863**		**347,199**		**229,252**	**33.97%**

NOTE:
Area of Upper Moreland in Watershed are from Table 18 "Sediment WLAs for MS4 Municipalities in Southampton Watershed" of Southampton Creek TMDL.
Existing Loading Rates (lb/ac/yr) based on Table 12 "Existing Sediment Load for Southampton Creek Watershed" of Southampton Creek TMDL.
Existing Waste Load (lb/yr) = Acres * Existing Loading
Target Loading Rates (lb/ac/yr) from Table 19 "Land Use Loading Rates for MS4 WLAs" of Southampton Creek TMDL
Allocated Waste Load (lb/yr) = Acres * Allocated Loading
Calculated Allocated Load (lb/yr) was compared to Table 18 "Sediment WLAs for MS4 Municipalities in Southampton Watershed" of Southampton Creek TMDL and found to be significantly similar
% Reduction = (Existing Waste Load - Allocated Waste Load)/Existing Waste Load
Upper Moreland Area based on "Township Maintained Rights-of-Way within the Southampton Creek Watershed" and Township-Owned Property within the Southampton Creek Watershed spreadsheets.

Appendix B2 - Total Phosphorous Waste Load Allocation Calculations for Southampton Creek Watershed

Land Use Source	Total Area (Ha)	Total Area (ac)	23 Year Existing Waste Load TP Mass (kg)	23 Year Existing Waste Load TP Weight (lb)	Existing Loading Rate TP (lb/ac/yr)	Upper Moreland Area (ac)	Upper Moreland Existing Load (lb/yr)	Upper Moreland Allocated Waste Load (lb/yr)	% Reduction
Hay/Pasture	19	46.95	3.26	231.42	0.2143	14	3.00	0.03	
Cropland	78	192.74	32.70	2,321.33	0.5236	7	3.67	0.03	
Coniferous Forest	25	61.78	0.12	8.52	0.0060		-	-	
Mixed Forest	28	69.19	0.13	9.23	0.0058	116	0.67	0.01	
Deciduous Forest	109	269.34	0.51	36.20	0.0058		0.00	0.00	
Transition	15	37.07	15.23	1,081.16	1.2682	2	-	-	
Low Intensity Development	973	2,404.33	56.56	4,015.12	0.0726	597	43.35	0.38	
High Intensity Development	329	812.98	46.51	3,301.69	0.1766	127	22.43	0.20	
Streambank			19.40	1,377.18	59.8775	22.09%	13.23	0.12	
Groundwater			116.88	8,297.17	360.7464	22.16%	79.94	0.70	
Septic System			3.41	242.07			0.00	0.00	
TOTAL:		**3,894.37**	**294.71**	**20,921.10**		**863**	**166.28**	**1.46**	**99.12%**

Total Area (Ha) and 23 Year Existing TP (kg) from Appendix C "Summary of AVGWLF Model Output for Southampton Watershed" of Southampton Creek TMDL
Total Area (ac) and 23 Year Existing TP (lb) are based on standard conversion factors
1 Ha = 2.47105 ac
1 kg = 2.20462 lbm
Weight (lb) = mass (lbm) * 32.2 ft/sec/sec
Existing Loading Rates (lb/ac/yr) = 23 Year Existing Waste Load TP (lb)/Total Area (ac)/23 years
Upper Moreland Area (Ac) from Table 18 "Sediment WLAs for MS4 Municipalities in Southampton Watershed" of Southampton Creek TMDL.
All Forest assumed to be Mixed Forest, since no Forest type breakdown is available and all 3 forest types have existing loading rate TP of 0.0002 lb/ac/yr.
Existing Load (lb/yr) = Upper Moreland Acres (Ac) * Existing Loading TP (lb/ac/yr)
Total Allocated Load (lb/yr) from Table 24 "TP WLAs for MS4 Municipalities in Southampton Watershed" of Southampton Creek TMDL
% Reduction = (Existing Waste Load - Allocated Waste Load)/Existing Waste Load * 100
Upper Moreland Area based on "Township Maintained Rights-of-Way within the Southampton Creek Watershed" and "Township-Owned Property within the Southampton Creek Watershed" spreadsheets

APPENDIX C

Existing Best Management Practices

Appendix C - Existing Best Management Practices

Southampton Drainage Area BMP Review

Southampton Drainage Area BMP- Sediment															
No.	LOCATION	G&A Project	TRIBUTARY AREA (ac)	IMPERVIOUS COVER (%)	IMPERVIOUS COVER (ac)	RUNOFF DEPTH (in)	TSS EMC IMPERVIOUS (mg/L)	IMPERVIOUS TSS (lb/year)	LAWN COVER (%)	LAWN COVER (ac)	RUNOFF DEPTH (in)	TSS EMC LAWN (mg/L)	LAWN TSS (lb/year)	TOTAL SEDIMENT (lb/year)	85% SEDIMENT REDUCTION (lb/year)
A1	4205 Shoemaker Road	10-03068	0.1	50%	0.05	33	39.5	15	50%	0.05	6.59	180	13	28	24
A2	LaRosa Shoemaker Road	13-10103	0.5	50%	0.25	33	39.5	73	50%	0.25	6.59	180	67	140	119
													TOTAL	168	143

Southampton Drainage Area BMP- Phosphorus															
No.	LOCATION	G&A Project	TRIBUTARY AREA (ac)	IMPERVIOUS COVER (%)	IMPERVIOUS COVER (ac)	RUNOFF DEPTH (in)	TP EMC IMPERVIOUS (mg/L)	IMPERVIOUS TP (lb/year)	LAWN COVER (%)	LAWN COVER (ac)	RUNOFF DEPTH (in)	TP EMC LAWN (mg/L)	LAWN TP (lb/year)	TOTAL TP (lb/year)	85% TP REDUCTION (lb/year)
A1	4205 Shoemaker Road	10-03068	0.1	50%	0.05	33	0.14	0.1	50%	0.05	6.59	0.4	0.0	0.1	0.1
A2	LaRosa Shoemaker Road	13-10103	0.5	50%	0.25	33	0.14	0.3	50%	0.25	6.59	0.4	0.1	0.4	0.3
													TOTAL	0.5	0.4

Runoff Volume = [Area, (ac)] * [Runoff Depth, (ft)]
Runoff depth is from Ambler Borough WWTP rain gauge from 2011 to 2014 and calculated using the SCS Runoff Curve Number method.

EMC = Event Mean Concentration (mg/L)
TSS EMC = 21 mg/L for Rooftops (Table A-1, PA BMP Manual)
TSS EMC = 58 mg/L for Low Traffic Parking Lot (Table A-1, PA BMP Manual)
TSS EMC Impervious = (21 + 58)/2 = 39.5
TSS EMC = 180 mg/L for Lawn, Low Input (Table A-1, PA BMP Manual)

TSS EMC = 0.13 mg/L for Rooftops (Table A-2, PA BMP Manual)
TSS EMC = 0.15 mg/L for Low Traffic Parking Lot (Table A-2, PA BMP Manual)
TSS EMC Impervious = (0.13 + 0.15)/2 = 0.14
TSS EMC = 0.40 mg/L for Lawn, Low Input (Table A-2, PA BMP Manual)

BMP Removal Efficiences from Table A-4, PA BMP Manual

	TSS	TP
6.4.2 Infiltration Basin	85%	85%

APPENDIX D

Potential New Best Management Practices

Appendix D1 - Streetsweeping BMPs

TOWNSHIP MAINTAINED RIGHT-OF-WAYS WITHIN THE SOUTHAMPTON CREEK WATERSHED

Street Name	Land Use (Classification)	Sidewalks	Curb	Roadway Length (ft)	Right-of-Way Width (ft)	Roadway Width (ft)	Impervious Area (sf)	Grass Area (sf)	Area (ac)	TSS Load (lb/yr)	Phosphorus (lb/yr)	50% TSS Streetsweeping Reduction (lb/yr)	50% TP Streetsweeping Reduction (lb/yr)
Abbotts	Low Traffic	YES	YES	1,478	50	30	57,658	16,262	1.70	1,214	4.89	607	2.4
Acorn Place	Low Traffic	YES	YES	528	50	30	20,592	5,808	0.61	434	1.74	217	0.9
Ashley Drive	Low Traffic	NO	YES	422	50	30	13,094	8,026	0.48	302	1.17	151	0.6
Bensal Road	Low Traffic	YES	YES	1,742	46	26	60,984	19,166	1.84	1,296	5.19	648	2.6
Brockton Road	Low Traffic	YES	YES	898	50	30	35,006	9,874	1.03	737	2.97	369	1.5
Bryant Road	Low Traffic	YES	YES	475	50	30	18,533	5,227	0.55	390	1.57	195	0.8
Bryers Road	Low Traffic	YES	YES	686	50	30	26,770	7,550	0.79	564	2.27	282	1.1
Butternut	Low Traffic	YES	YES	686	50	40	33,634	686	0.79	654	2.73	327	1.4
Centennial Road	Low Traffic	YES	YES	475	50	30	18,533	5,227	0.55	390	1.57	195	0.8
Colony Drive	Low Traffic	YES	YES	1,003	50	30	39,125	11,035	1.15	824	3.32	412	1.7
Corinthian Avenue	Low Traffic	YES	YES	1,426	50	30	55,598	15,682	1.64	1,171	4.71	585	2.4
Country Wood Lane	Low Traffic	NO	YES	898	56	36	33,211	17,054	1.15	746	2.92	373	1.5
Exton Road	Low Traffic	YES	YES	5,174	50	30	201,802	56,918	5.94	4,249	17.10	2,124	8.5
Francine Drive	Low Traffic	YES	YES	581	50	30	22,651	6,389	0.67	477	1.92	238	1.0
Frontier Road	Low Traffic	YES	YES	1,584	50	30	61,776	17,424	1.82	1,301	5.23	650	2.6
Gibson Drive	Low Traffic	YES	YES	2,059	50	30	80,309	22,651	2.36	1,691	6.80	845	3.4
Goodwin Road	Low Traffic	YES	YES	686	50	30	26,770	7,550	0.79	564	2.27	282	1.1
High Avenue	Low Traffic	YES	YES	3,274	50	30	127,670	36,010	3.76	2,688	10.82	1,344	5.4
Hoffman	Low Traffic	YES	YES	1,901	50	30	74,131	20,909	2.18	1,561	6.28	780	3.1
Howard Road	Low Traffic	YES	YES	317	50	30	12,355	3,485	0.36	260	1.05	130	0.5
Ivystream Road	Low Traffic	YES	YES	1,267	50	30	49,421	13,939	1.45	1,041	4.19	520	2.1
Jason Drive	Low Traffic	YES	YES	2,006	50	30	78,250	22,070	2.30	1,647	6.63	824	3.3
Jasper Lane	Low Traffic	YES	YES	581	50	30	22,651	6,389	0.67	477	1.92	238	1.0
Karen Lane	Low Traffic	YES	YES	3,274	50	30	127,670	36,010	3.76	2,688	10.82	1,344	5.4
Lisayne Road	Low Traffic	YES	YES	634	50	30	24,710	6,970	0.73	520	2.09	260	1.0
Milford Circle	Low Traffic	YES	YES	264	50	30	10,296	2,904	0.30	217	0.87	108	0.4
Minnie Lane	Low Traffic	YES	YES	528	50	30	20,592	5,808	0.61	434	1.74	217	0.9
Morris Road	Low Traffic	YES	YES	950	50	30	37,066	10,454	1.09	780	3.14	390	1.6
Newton Road	Low Traffic	NO	YES	1,478	46	26	39,917	28,090	1.56	944	3.61	472	1.8
Nicole Drive	Low Traffic	NO	YES	528	40	26	14,256	6,864	0.48	318	1.25	159	0.6
Orangemans Road	Low Traffic	YES	YES	2,587	60	40	126,763	28,457	3.56	2,624	10.64	1,312	5.3
Oakwood Drive	Low Traffic	YES	YES	634	50	30	24,710	6,970	0.73	520	2.09	260	1.0
Pleasant Hill Road	Low Traffic	YES	YES	1,795	50	30	70,013	19,747	2.06	1,474	5.93	737	3.0
Preston Lane	Low Traffic	YES	YES	3,538	50	30	137,966	38,914	4.06	2,905	11.69	1,452	5.8
Pioneer Road	Low Traffic	YES	YES	10,560	44	24	348,480	116,160	10.67	7,447	29.77	3,723	14.9
Shoemaker	Low Traffic	NO	YES	2,429	44	24	60,720	46,147	2.45	1,456	5.54	728	2.8
Short Lane	Low Traffic	YES	YES	370	50	30	14,414	4,066	0.42	303	1.22	152	0.6
Silvestri Drive	Low Traffic	YES	YES	1,373	50	30	53,539	15,101	1.58	1,127	4.54	564	2.3
Stewart Road	Low Traffic	YES	YES	739	50	30	28,829	8,131	0.85	607	2.44	303	1.2
Thistlewood Road	Low Traffic	YES	YES	1,848	50	30	72,072	20,328	2.12	1,517	6.11	759	3.1
Wallingford Circle	Low Traffic	NO	YES	317	50	30	9,821	6,019	0.36	227	0.88	113	0.4
Willard Road	Low Traffic	YES	YES	634	50	30	24,710	6,970	0.73	520	2.09	260	1.0
Winding Road	Low Traffic	YES	YES	2,059	50	30	80,309	22,651	2.36	1,691	6.80	845	3.4
Windsor Circle	Low Traffic	YES	YES	211	50	30	8,237	2,323	0.24	173	0.70	87	0.3
								TOTALS	75.30	53,169	213.24	26,584.47	106.62

TOWNSHIP MAINTAINED RIGHT-OF-WAYS WITHIN THE WISSAHICKON CREEK WATERSHED

Street Name	Land Use (Classification)	Sidewalks	Curb	Roadway Length (ft)	Right-of-Way Width (ft)	Roadway Width (ft)	Impervious Area (sf)	Grass Area (sf)	Area (ac)	TSS Load (lb/yr)	50% TSS Streetsweeping Reduction (lb/yr)
Country Club Drive	Low Traffic	NO	YES	760	60	20	15,960	29,640	1.05	490	245
Willow Brook Road	Low Traffic	NO	YES	800	40	20	16,800	15,200	0.73	418	209
								TOTALS	1.78	908.19	454.09

NOTE:
Pollutant Load = [EMC, (mg/L)] * [Runoff Volume, (ac*ft)] * [2.7, unit conversion]

EMC = Event Mean Concentration (mg/L)
TSS EMC = 86 mg/L for Low Traffic Residential Streets (Table A-1, PA BMP Manual)
TSS EMC = 180 mg/L for Lawn, Low Input (Table A-1, PA BMP Manual)
TP EMC = 0.36 for Low Traffic Residential Streets (Table A-2, PA BMP Manual)
TP EMC = 0.40 for Lawn, Low Input (Table A-2, PA BMP Manual)

BMP Removal Efficiences from Table A-4, PA BMP Manual

	TSS	TP
5.9.1 Streetsweeping	50%	50%

Reduced from PA BMP Manual values to be conservative

Runoff Volume = [Area, (ac)] * [Runoff Depth, (ft)]
Imperv. Runoff Depth = 43.5 in = 3.63 ft
Grass Runoff Depth = 6.6 in = 0.55 ft
Runoff depth is from Ambler Borough WWTP rain gauge from 2011 to 2014 and calculated using the SCS Runoff Curve Number method.

Appendix D2 - Streambank Restoration BMP

Total Length of Southampton Creek Stream in Upper Moreland Township	13,602	LF
Existing Streambank Erosion for Southampton Creek Watershed	1,216,589	lb/yr
Upper Moreland Township Percentage of Streambank Erosion	22.09	%
Upper Moreland Township Existing Streambank Erosion	268,745	lb/yr
Upper Moreland Township Annual Streambank Erosion Rate, per unit length of stream	19.76	lb/lf/yr
Upper Moreland Township Sediment from 2,500 LF Streambank (Both sides)	49,394	lb/yr
Upper Moreland Township Sediment Removed from 2,500 LF Streambank Restoration	**41,985**	**lb/yr**

References:
Length of Southampton Creek stream in Upper Moreland Township measured from mapping.
Existing Streambank Erosion for Watershed - Table 12, Southampton Watershed TMDL, 2008, EPA.
Upper Moreland Township's percentage of streambank erosion - Table 18, Southampton Watershed TMDL, 2008,

Assumption:
Streambank restoration eliminates 85% of erosion from streambanks

Appendix D3 - Potential Basin BMP Retrofits

Name	Impervious (sf)	Grass (sf)	Area (acres)	TSS Sediment Load (lb/yr)	Phosphorus Load (lb/yr)	85% TSS Reduction (lb/yr)	85% Phosphorus Reduction (lb/yr)
B1	317764	259004	13.24	7729.61	29.24	6570.17	24.85
B2	174156	154300	7.54	4312.12	16.19	3665.30	13.76
		Totals	20.78	12041.72	45.43	10235.47	38.61

NOTE:
Pollutant Load = [EMC, (mg/L)] * [Runoff Volume, (ac*ft)] * [2.7, unit conversion]

EMC = Event Mean Concentration (mg/L)
TSS EMC = 86 mg/L for Low Traffic Residential Streets (Table A-1, PA BMP Manual)
TSS EMC = 180 mg/L for Lawn, Low Input (Table A-1, PA BMP Manual)
TP EMC = 0.36 for Low Traffic Residential Streets (Table A-2, PA BMP Manual)
TP EMC = 0.40 for Lawn, Low Input (Table A-2, PA BMP Manual)

Runoff Volume = [Area, (ac)] * [Runoff Depth, (ft)]
Imperv. Runoff Depth = 43.5 in = 3.63 ft
Grass Runoff Depth = 6.6 in = 0.55 ft
Runoff depth is from Ambler Borough WWTP rain gauge from 2011 to 2014 and calculated using the SCS Runoff Curve Number method.

BMP Removal Efficiences from Table A-4, PA BMP Manual

	TSS	TP
6.4.5 Rain Garden/ Bioretention	85%	85%

APPENDIX E

Public Comment and Response