TOWNSHIP OF ABINGTON
MONTGOMERY COUNTY, PA

TOTAL MAXIMUM DAILY LOAD PLAN
POLLUTANT REDUCTION PLANS
POLLUTANT CONTROL MEASURES

NPDES INDIVIDUAL PERMIT APPLICATION TO DISCHARGE STORMWATER FROM MUNICIPAL SEPARATE STORM SEWER SYSTEMS

DRAFT REPORT

BCM PROJECT NO. Z057000047

May 3, 2017

BCM ENGINEERS
920 GERMANTOWN PIKE
PLYMOUTH MEETING, PA 19462
PHONE: 610-313-3100
Fax: 610-313-3151

BCM ENGINEERS
ATC GROUP SERVICES LLC

TOWNSHIP OF ABINGTON
MONTGOMERY COUNTY, PA

NPDES INDIVIDUAL PERMIT APPLICATION TO DISCHARGE STORMWATER FROM MUNICIPAL SEPARATE STORM SEWER SYSTEMS

TOTAL MAXIMUM DAILY LOAD PLAN
POLLUTANT REDUCTION PLANS
POLLUTANT CONTROL MEASURES

DRAFT REPORT
May 3, 2017

PREPARED BY:

Michael R. Filmyer, P.E.
Senior Project Manager
BCM Engineers

APPROVED BY:

Michael E. Powers, P.E.
Abington Township Engineer

Table of Contents

APPENDICES

TMDL PLAN

POLLUTANT REDUCTION PLANS

GENERAL

EXECUTIVE SUMMARY

1.0 Background Information

Abington Township is one of Montgomery County's oldest communities dating back to before 1700, however, the official date for the incorporation of the township is 1704. Abington is home to some of the county's oldest transportation routes, industries and churches. Abington Township adopted the First Class Township form of government in 1906. Today, Abington Township is a highly desirable residential area that contains a major shopping center, many small businesses, and a few of Montgomery County's largest employers. Communities within the township include Willow Grove, Roslyn, Glenside, Rydal, North Hills, and Meadowbrook.

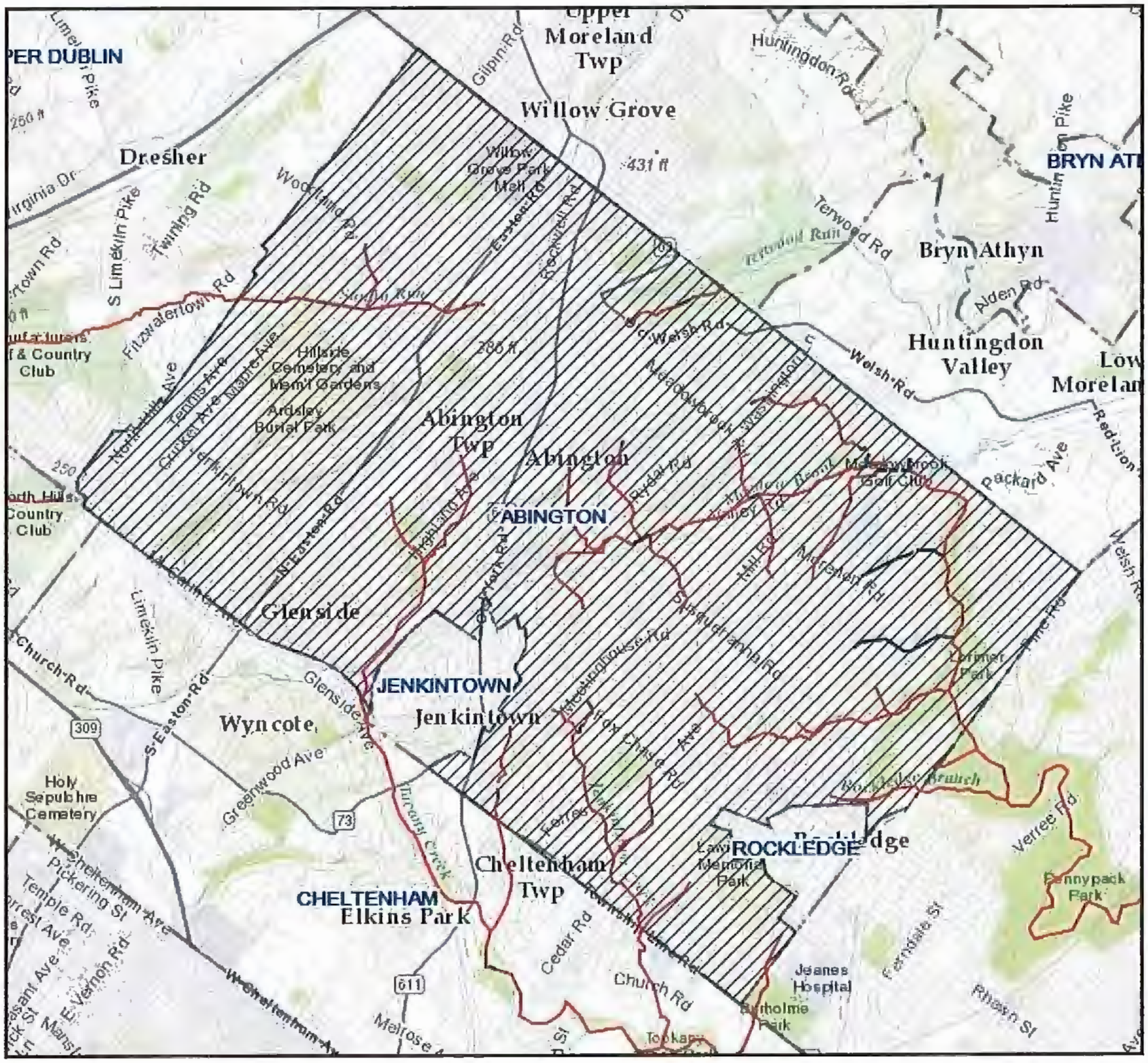
Over the years, the Abington Township has constructed a stormwater conveyance system throughout the township in order to direct stormwater to the natural drainage areas of the township. The township has three distinct watersheds or drainage areas within its borders. These watersheds are the Pennypack Watershed, the Wissahickon Watershed, and the Tookany/Tacony-Frankford Watershed.

The stormwater requirements of the federal Clean Water Act are administered under the Pennsylvania Department of Environmental Protection's Municipal Separate Storm Sewer (MS4) Program. In December 2002, PADEP issued a General Permit (PAG-13) for use by MS4s that fall under the National Pollutant Discharge Elimination System (NPDES) Phase II program. This permit required the implementation of a stormwater management program for minimizing the impacts from runoff. At this point, Abington Township was required to permit its stormwater conveyance system and received their first permit (PAG-130012) in March of 2003. Several extensions have occurred since the expiry of the initial 5 year permit period, the latest of which extended the original permit expiration date to June, 2013. After much debate and extensive delays, the Pennsylvania Department of Environmental Protection released its new permit requirements in late 2011. Abington Township submitted a renewal application on September 12, 2012, and received a new General Permit to operate their MS4 System on February 11, 2013. The coverage period for this permit is from March 16, 2013 thru March 15, 2018. Abington Township's current permit expires on March 15, 2018 and the township is required to apply for a renewal of the existing permit. This permit renewal must be submitted at least 180 days prior to the existing permit expiry, which is September 16, 2017.

As part of this new permit application, the Township is required to prepare a Wissahickon Creek TMDL Plan, Pollutant Reduction Plans (PRPs) and/or Pollutant Control Measures (PCMs) for all impaired streams in the Township. The following table outlines the impaired streams identified by the PADEP and the reason for the impairment listing.

ABINGTON TOWNSHIP TMDL-PRP/PCM REQUIREMENTS

IMPAIRED WATERS	REQUIREMENTS	OTHER CAUSES OF IMPAIRMENT
Pennypack Creek	Appendix B-Pathogens (4a); Appendix C-Priority Organics (4a) Appendix E-Organic Enrichment/Low D.O. (4a); Appendix E-Siltation (5)	Cause Unknown (5)
Wissahickon TMDL	TMDL Plan-Siltation; Suspended Solids (4a)	Cause Unknown (4a)
Meadow Brook	Appendix E-Siltation (5)	Cause Unknown (5)
Jenkintown Creek		Flow Alterations; Other Habitat Alterations; Water/Flow Variability (4c)
East Branch Jenkintown Creek		Flow Alterations; Other Habitat Alterations; Water/Flow Variability (4c)
Frankford Creek	Appendix C-PCB (4a); Appendix E-Organic Enrichment/Low D.O. (5)	Flow Alterations Other Habitat Alterations Water/Flow Variability (4c)s
Unnamed Tributaries to Wissahickon Creek		Other Habitat Alterations (4c)
Terwood Run	Appendix E-Siltation (5)	Cause Unknown (5)
Rockledge Branch	Appendix E-Siltation (5)	Cause Unknown (5)
Wissahickon Creek	Appendix E-Nutrients (4a); Appendix B-Pathogens (5)	Water/Flow Variability (4c)
Robinhood Brook	Appendix E-Siltation (5)	Cause Unknown (5)
Sandy Run	Appendix B-Pathogens (4a); Appendix E-DO/BOD; Nutrients (4a)	Other Habitat Alterations; Water/Flow Variability (4c)
Tacony Creek	Appendix E-Organic Enrichment/Low D.O. (5)	Flow Alterations; Other Habitat Alterations; Water/Flow Variability (4c)



Source: http://www.depgis.state.pa.us/MS4/index.html

Figure 1.0: Streams in Abington Township
Red-Impaired
Blue-Unimpaired

2.0 Wissahickon Creek TMDL Plan

Section 303(d) of the Clean Water Act and the U.S. Environmental Protection Agency's (EPA's) Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for water bodies that are not meeting their designated uses even though pollutant sources have implemented technology-based controls. A TMDL establishes the allowable load of a pollutant or other quantifiable parameter based on the relationship between pollutant sources and in-stream water quality. A TMDL provides the scientific basis for a state to establish water quality based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of the state's water resources (USEPA, 1991). The EPA issued *Nutrient and Siltation TMDL Development for Wissahickon Creek, PA Final Report* in October 2003. This document set specific siltation reduction guidelines that need to be met in order to improve the water quality of the Wissahickon Watershed. As stated earlier, one of the watersheds located in Abington Township is the Wissahickon Watershed, and as such, Abington Township is required to develop and implement a plan to achieve specific reductions in siltation and nutrients.

In addition to the above TMDL document, the EPA issued a *Draft Total Phosphorus TMDL for the Wissahickon Creek Watershed in May, 2013.* This TMDL has not been finalized as the Wissahickon Creek municipalities, environmental groups, and stakeholders are working along with the PADEP to develop methods to upgrade the health of the stream. This effort is being funded by the William Penn Foundation through the Delaware River Watershed Initiative.

As part of the last MS4 Permit renewal process, the Township submitted to the PADEP their *Total Maximum Daily Load Strategy Report*, dated September 14, 2012. This report outlined the methods to be used to attain the required siltation and nutrient reductions mandated in the approved TMDL. The plan has been updated to add additional BMPs that were part of Abington's successful Growing Greener Grant application. This update was added to the *Total Maximum Daily Load Design Details Report*, dated May 13, 20162. This plan now needs to be updated for the current permit application and additional BMPs added.

The TMDL plan calls for the construction and/or utilization of stormwater treatment facilities known as BMPs (Best Management Practices). The following table lists BMPs that are proposed for the Wissahickon Watershed:

ABINGTON TMDL PLAN COMPONENTS

WISSAHICKON CREEK TMDL PLAN (2003)	SILTATION LOADS	
SILTATION: ABINGTON'S EXISTING LOAD (2003 TMDL):	484,143.02	lbs/year
SILTATION: ABINGTON'S WLA REQUIREMENT (2003 TMDL):	128,913.40	lbs/year
SILTATION: ABINGTON'S REQUIRED REDUCTION (2003 TMDL):	355,229.62	lbs/year
SILTATION: ABINGTON'S PERCENT REDUCTION REQUIRED (2003 TMDL):	**73%**	

STEPL CURRENT MODELING (2017)		
2017 STEPL MODELING-ABINGTON'S BASE LOAD:	720,900	lbs/year
2017 STEPL MODELING-ABINGTON'S 73% REQUIRED REDUCTION:	526,257	lbs/year
2017 STEPL MODELING-ABINGTON'S WLA:	194,643	lbs/year

POLLUTANT REDUCTION: BMP's CONSTRUCTED (STEPL MODEL)		
Susquehanna Woods Stormwater Retention Basin (2005):	20,243	lbs/year
Roslyn Park Rain Garden (2009):	981.55	lbs/year
Riparian Buffer Replacement (2009):	2,683	lbs/year
Susquehanna Woods Basin #1 (2004):	7,724	lbs/year
Susquehanna Woods Basin #2 (2004):	4,652	lbs/year
Hamel Avenue Infiltration Basin (2007):	15,375	lbs/year
Sandy Run Streambank Stabilization (Woodland Road) (2009):	10,463	lbs/year
Sandy Run Streambank Stab. (Avondale & Susquehanna) (2013):	40,313	lbs/year
POLLUTANT REDUCTION: BMP's TO BE CONSTRUCTED (STEPL MODEL)		
Susquehanna Woods Basin #3 Retrofit:	20,138	lbs/year
Sandy Run Streambank Stabilization:	39,234	lbs/year
Madison Avenue Meadow Construction:	4,173	lbs/year
Roychester Park Rain Garden	4,716	lbs/year
Roychester Riparian Buffer Restoration	6,467	lbs/year
Roychester Park Bioretention/Infiltration Trench	1,729	lbs/year
Roychester Park Infiltration Berms/Ret. Grading	5,433	lbs/year
Evergreen Manor Park Infiltration Basin	15,829	lbs/year
Grove Park Streambank Restoration	195,000	lbs/year
Ardsley Wildlife Sanctuary Basin Renovations	142,475	lbs/year
TOTAL PROJECTED BMP POLLUTANT REDUCTION:	**537,629**	**lbs/year**

ABINGTON TMDL PLAN COMPONENTS

STEPL CURRENT MODELING (2017)	NITROGEN		PHOSPHORUS	
2017 STEPL MODELING-ABINGTON'S BASE LOAD:	17,649	lbs/year	2,745	lbs/year
2017 STEPL MODELING-ABINGTON'S REQUIRED REDUCTION (5% TOTAL NITROGEN & TOTAL PHOSPHORUS):	882	lbs/year	137	lbs/year

POLLUTANT REDUCTION: BMP's CONSTRUCTED (STEPL MODEL)				
Susquehanna Woods Stormwater Retention Basin (2005):	160	lbs/year	63	lbs/year
Roslyn Park Rain Garden (2009):	16	lbs/year	3	lbs/year
Riparian Buffer Replacement (2009):	29	lbs/year	8	lbs/year
Susquehanna Woods Basin #1 (2004):	67	lbs/year	12	lbs/year
Susquehanna Woods Basin #2 (2004):	32	lbs/year	7	lbs/year
Hamel Avenue Infiltration Basin (2007):	295	lbs/year	54	lbs/year
Sandy Run Streambank Stabilization (Woodland Road) (2009):	14	lbs/year	6	lbs/year
Sandy Run Streambank Stab. (Avondale & Susquehanna) (2013):	52	lbs/year	24	lbs/year
POLLUTANT REDUCTION: BMP's TO BE CONSTRUCTED (STEPL MODEL)				
Susquehanna Woods Basin #3 Retrofit:	153	lbs/year	26	lbs/year
Sandy Run Streambank Stabilization:	51	lbs/year	24	lbs/year
Madison Avenue Meadow Construction:	79	lbs/year	15	lbs/year
Roychester Park Rain Garden	90	lbs/year	17	lbs/year
Roychester Riparian Buffer Restoration	71	lbs/year	25	lbs/year
Roychester Park Bioretention/Infiltration Trench	33	lbs/year	4	lbs/year
Roychester Park Infiltration Berms/Ret. Grading	107	lbs/year	19	lbs/year
Evergreen Manor Park Infiltration Basin	314	lbs/year	58	lbs/year
Grove Park Streambank Restoration	254	lbs/year	117	lbs/year
Ardsley Wildlife Sanctuary Basin Renovations	612	lbs/year	71	lbs/year
TOTAL PROJECTED BMP POLLUTANT REDUCTION:	**2,428**	**lbs/year**	**553**	**lbs/year**

3.0 Pollutant Reduction Plans

As part of the new individual permit application, the Township is required to prepare Pollutant Reduction Plans for streams in the Township that are impaired for Nutrients and Sediment where there is no waste load allocation (WLA) in a Total Maximum Daily Load (TMDL).

These "Impaired Waters PRPs" require Township to estimate pollutant loads and reduce those loads ***within 5 years following DEP's approval of coverage.*** If the impairment which triggered the need for an Impaired Waters PRP is due to sediment alone, a minimum 10% sediment reduction is required. If the impairment is based on nutrients alone (phosphorus or nitrogen), a minimum 5% Total Phosphorus (TP) reduction is required. If the impairment is due to both sediment and nutrients, both sediment (10%) and TP (5%) must be controlled. The Township may propose a presumptive approach in which a 10% sediment reduction is assumed to also result in a 5% TP reduction. If the impairment is based on nutrients only or other surrogates for nutrients (e.g., "Excessive Algal Growth" and "Organic Enrichment/Low D.O."), a minimum 5% TP reduction is required.

The PRP plans calls for the construction and/or utilization of stormwater treatment facilities known as BMPs (Best Management Practices). The following tables lists BMPs that are proposed for the various watershed PRPs:

PENNYPACK CREEK PRP PLAN	**SILTATION LOADS**		**NUTRIENT (TP) LOADS**	
STEPL MODELING-WATERSHED EXISTING LOAD:	359,739	lbs/year	311	lbs/year
REQUIRED REDUCTION PERCENTAGE:	**10**	%	**5**	%
REDUCTION REQUIREMENT:	35,974	lbs/year	16	lbs/year
BMP's TO BE CONSTRUCTED	**SILTATION LOADS**		**NUTRIENT (TP) LOADS**	
Melmar Basin & Stabilization	6,600	lbs/year	8.8	lbs/year
Wyndmoor Basin & Stabilization	6,200	lbs/year	8.1	lbs/year
Irvin Road Streambank Stabilization	23,625	lbs/year	4.7	lbs/year
TOTAL PROJECTED BMP POLLUTANT REDUCTION:	**36,425**	**lbs/year**	**21.6**	**lbs/year**

MEADOWBROOK CREEK PRP PLAN	SILTATION LOADS	
STEPL MODELING-WATERSHED EXISTING LOAD:	549,236	lbs/year
REQUIRED REDUCTION PERCENTAGE:	**10**	%
REDUCTION REQUIREMENT:	54,924	lbs/year
BMP's TO BE CONSTRUCTED	**SILTATION LOADS**	
Streambank Stabilization Scout Preserve	33,750	lbs/year
Streambank Stabilization Bird Sanctuary	22,500	lbs/year
TOTAL PROJECTED BMP POLLUTANT REDUCTION:	**56,250**	**lbs/year**

ROBINHOOD BROOK PRP PLAN	SILTATION LOADS	
STEPL MODELING-WATERSHED EXISTING LOAD:	17,064	lbs/year
REQUIRED REDUCTION PERCENTAGE:	**10**	%
REDUCTION REQUIREMENT:	1,706	lbs/year
BMP's TO BE CONSTRUCTED	**SILTATION LOADS**	
Sharpless Road Filter Box	5,400	lbs/year
TOTAL PROJECTED BMP POLLUTANT REDUCTION:	**5,400**	**lbs/year**

ROCKLEDGE BRANCH (PENNYPACK) PRP PLAN	SILTATION LOADS	
STEPL MODELING-WATERSHED EXISTING LOAD:	17,081	lbs/year
REQUIRED REDUCTION PERCENTAGE:	**10**	%
REDUCTION REQUIREMENT:	1,708	lbs/year
BMP's TO BE CONSTRUCTED	**SILTATION LOADS**	
Rockledge Avenue Filter Box	4,200	lbs/year
TOTAL PROJECTED BMP POLLUTANT REDUCTION:	**4,200**	**lbs/year**

TERWOOD RUN PRP PLAN	SILTATION LOADS	
STEPL MODELING-WATERSHED EXISTING LOAD:	13,830	lbs/year
REQUIRED REDUCTION PERCENTAGE:	**10**	%
REDUCTION REQUIREMENT:	1,383	lbs/year
BMP's TO BE CONSTRUCTED	**SILTATION LOADS**	
Davidson Road Treatment/Filter Box	28,200	lbs/year
TOTAL PROJECTED BMP POLLUTANT REDUCTION:	**28,200**	**lbs/year**

TACONY AND FRANKFORD CREEKS PRP PLAN	NUTRIENT (TP) LOADS	
STEPL MODELING-WATERSHED EXISTING LOAD:	405	lbs/year
REQUIRED REDUCTION PERCENTAGE:	5	%
REDUCTION REQUIREMENT:	20.25	lbs/year
BMP's TO BE CONSTRUCTED		
Alverthorpe Park Extended Detention Basin	18.46	lbs/year
Alverthorpe Park Bioswale	7.54	lbs/year
TOTAL PROJECTED BMP POLLUTANT REDUCTION:	**26**	**lbs/year**

WISSAHICKON CREEK PRP PLAN	NUTRIENT (TP) LOADS	
STEPL MODELING-WATERSHED EXISTING LOAD:	233	lbs/year
REQUIRED REDUCTION PERCENTAGE:	5	%
REDUCTION REQUIREMENT:	11.65	lbs/year
BMP's TO BE CONSTRUCTED		
SEE TMDL PLAN: Hamel Avenue Basin	54	lbs/year
TOTAL PROJECTED BMP POLLUTANT REDUCTION:	54	**lbs/year**

SANDY RUN PRP PLAN	NUTRIENT (TP) LOADS	
STEPL MODELING-WATERSHED EXISTING LOAD:	2,511	lbs/year
REQUIRED REDUCTION PERCENTAGE:	5	%
REDUCTION REQUIREMENT:	125.55	lbs/year
BMP's TO BE CONSTRUCTED		
SEE TMDL PLAN: All BMPs Except Hamel Ave Basin	499	lbs/year
TOTAL PROJECTED BMP POLLUTANT REDUCTION:	**499**	**lbs/year**

4.0 Pollutant Control Measures

As part of the new individual permit application, the Township is required to prepare Pollutant Control Measures (PCMs) for streams in the Township that are impaired for pathogens (Permit Appendix B) and priority organic compounds (Permit Appendix C).

PCMs are activities undertaken by the MS4 permittee to identify and control pollutant loading to impaired waters from MS4s, regardless of whether a TMDL has been approved. PCMs are BMPs and other strategies that are in addition to the permittee's Stormwater Management Plan. PCMs must be implemented in Abington for the following impairments:

- Where surface waters are impaired for Pathogens (e.g., Fecal Coliform), Abington will implement the PCMs similar to those identified in Appendix B of the General Permit, in accordance with the schedule therein. ***A Pathogen PCM will be required for the Wissahickon Creek, Sandy Run Creek and the Pennypack Creek.***
- Where surface waters are impaired for Priority Organic Compounds (e.g., Polychlorinated Biphenyls (PCBs), pesticides, or other organic compounds), Abington will implement the PCMs similar to those identified in Appendix C of the General Permit, in accordance with the schedule therein. ***A Priority Organic Compounds PCM will be required for the Frankford Creek and the Pennypack Creek.***

5.0 BUDGET

The following table shows Total Projected Construction and Engineering Costs for implementing the Township of Abington's TMDL/PRP/PCM Program. The plan must be implemented within the following schedule:

TMDL Plan: Within five (5) years following PADEP approval of coverage, but can be extended if Township cannot meet the goals of the plan.

PCP Plans: Within five (5) years following PADEP approval of coverage.

PCM Plans:	**Pathogen Plans:**	Mapping:	September 30, 2019
		Inventory:	September 30, 2020
		Investigation:	September 30, 2022
		Enforcement:	September 30, 2022
PCM Plans:	**Priority Organics:**	Mapping:	September 30, 2019
		Inventory:	September 30, 2020
		Investigation:	September 30, 2022

TMDL BMP Cost Projections (5-10 Year Schedule)

	Budget			
POLLUTANT REDUCTION: BMP's CONSTRUCTED	**Construction**	**Engineering**	**Grant (Act & Pot)**	**Total**
Susquehanna Woods Stormwater Retention Basin (2005)	-	-	-	-
Roslyn Park Rain Garden (2009)	-	-	-	-
Riparian Buffer Replacement (2009)	-	-	-	-
Susquehanna Woods Basin #1 (2004)	-	-	-	-
Susquehanna Woods Basin #2 (2004)	-	-	-	-
Hamel Avenue Infiltration Basin (2007)	-	-	-	-
Sandy Run Streambank Stabilization (Woodland Road) (2009)	-	-	-	-
Sandy Run Streambank Stab. (Avondale & Susquehanna) (2013)	-	-	-	-

POLLUTANT REDUCTION: BMP's TO BE CONSTRUCTED	Construction	Engineering	Grant (Act & Pot)	Total
Susquehanna Woods Basin #3 Retrofit	$ 75,000.00	$ 11,250.00	$ -	$ 86,250.00
Sandy Run Streambank Stabilization:**	$ 60,000.00	$ 9,000.00	$ -	$ 69,000.00
Madison Avenue Meadow Construction	$ 30,000.00	$ 4,500.00	$ -	$ 34,500.00
Roychester Park Rain Garden	$ 43,960.00	$ 8,050.00	$ 7,800.00	$ 44,210.00
Roychester Riparian Buffer Restoration	$ 32,315.00	$ 8,280.00	$ 6,100.00	$ 34,495.00
Roychester Park Bioretention/Infiltration Trench	$ 21,390.00	$ 6,900.00	$ 4,235.00	$ 24,055.00
Roychester Park Infiltration Berms/Ret. Grading	$ 44,850.00	$ 9,430.00	$ 8,140.00	$ 46,140.00
Evergreen Manor Park Infiltration Basin	$ 28,635.00	$ 10,900.00	$ 5,935.00	$ 33,600.00
Grove Park Streambank Restoration	$ 2,300,000.00	$ 350,000.00	$ 2,000,000.00	$ 650,000.00
Ardsley Wildlife Sanctuary Basin Renovations	$ 500,000.00	$ 75,000.00	$ 300,000.00	$ 275,000.00
Estimated Project Costs for TMDL Plan BMPs	$ 3,136,150.00	$ 493,310.00	$ 2,332,210.00	$ 1,297,250.00

**2017 Capital Budget

PRP BMP Cost Projections (5 Year Schedule)

	Budget			
POLLUTANT REDUCTION: BMP's TO BE CONSTRUCTED	**Construction**	**Engineering**	**Grant (Act & Pot)**	**Total**
Pennypack Creek Melmar Rd Basin	$ 75,000.00	$ 11,250.00	$ -	$ 86,250.00
Pennypack Creek Wyndmoor LA Basin	$ 75,000.00	$ 11,250.00	$ -	$ 86,250.00
Pennypack Creek Irvin Road Streambank Stabilization**	$ 50,000.00	$ 7,500.00	$ -	$ 57,500.00
Meadowbrook Streambank Stabilization in Scout Preserve	$ 135,000.00	$ 8,050.00	$ -	$ 143,050.00
Meadowbrook Streambank Stabilization in Bird Sanctuary	$ 90,000.00	$ 8,280.00	$ -	$ 98,280.00
Robinhood Brook Sharpless Road Filter Box	$ 75,000.00	$ 6,900.00	$ -	$ 81,900.00
Rockledge Branch Rockledge Avenue Lane Filter Box	$ 75,000.00	$ 9,430.00	$ -	$ 84,430.00
Terwood Run Davidson Road Filter Box	$ 75,000.00	$ 10,900.00	$ -	$ 85,900.00
TTF Alverthorpe Park Extended Detention Basin	$ 100,000.00	$ 15,000.00	$ -	$ 115,000.00
TTF Alverthorpe Park Bioswale	$ 115,000.00	$ 17,250.00		$ 132,250.00
Wissahickon TMDL Measures	$ -	$ -	$ -	$ -
Sandy Run TMDL Measures	$ -	$ -	$ -	$ -
Estimated Project Costs for PRP Plan BMPs	$ 865,000.00	$ 105,810.00	$ -	$ 970,810.00

** 2017 Capital Budget

PCM Cost Projections (4 Year Schedule)

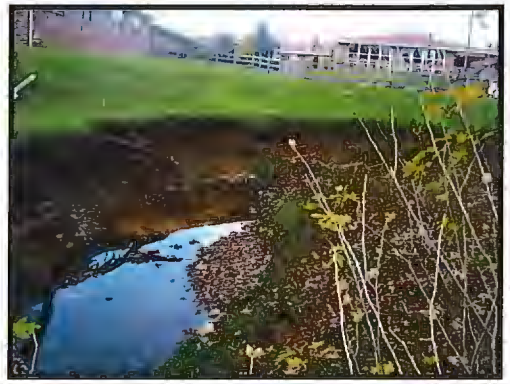
	Budget			
POLLUTANT REDUCTION: BMP's TO BE CONSTRUCTED	**Construction**	**Engineering**	**Grant (Act & Pot)**	**Total**
Pathogens: Wissahickon Creek	$ -	$ 5,000.00	$ -	$ 5,000.00
Pathogens: Sandy Run	$ -	$ 10,000.00	$ -	$ 10,000.00
Pathogens: Pennypack Creek	$ -	$ 10,000.00	$ -	$ 10,000.00
Priority Organic Compounds: Pennypack Creek	$ -	$ 10,000.00	$ -	$ 10,000.00
Priority Organic Compounds(PCB): Frankford Creek	$ -	$ 10,000.00	$ -	$ 10,000.00
Estimated Project Costs for PCM Plans	$ -	$ 45,000.00	$ -	$ 45,000.00

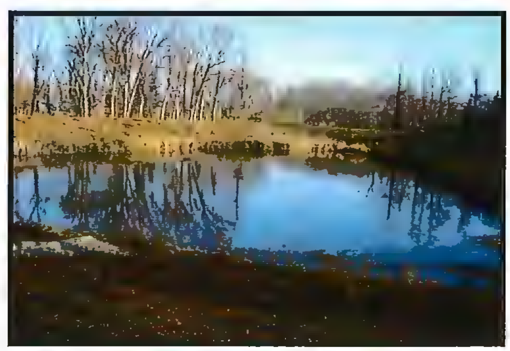
Total Projected Costs

Abington Township MS4: TMDL/PRP/PCM Program	Construction	Engineering	Grant (Act & Pot)	Total
Estimated Project Costs for TMDL Plan BMPs	$ 3,136,150.00	$ 493,310.00	$ 2,332,210.00	$ 1,297,250.00
Estimated Project Costs for PRP Plan BMPs	$ 865,000.00	$ 105,810.00	$ -	$ 970,810.00
Estimated Project Costs for PCM Plans	$ -	$ 45,000.00	$ -	$ 45,000.00
Total Projected Costs:	$ 4,001,150.00	$ 644,120.00	$ 2,332,210.00	$ 2,313,060.00

PART A

WISSAHICKON CREEK TMDL PLAN





PART A: WISSAHICKON CREEK TMDL PLAN

1.0 Background Information

1.1 Wissahickon Creek Watershed TMDL

The following information has been reproduced from the "Nutrient and Siltation TMDL Development for Wissahickon Creek, Pennsylvania, Final Report, October 2003."

Section 303(d) of the Clean Water Act and the U.S. Environmental Protection Agency's (EPA's) Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for water bodies that are not meeting their designated uses even though pollutant sources have implemented technology-based controls. A TMDL establishes the allowable load of a pollutant or other quantifiable parameter based on the relationship between pollutant sources and in-stream water quality. A TMDL provides the scientific basis for a state to establish water quality-based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of the state's water resources (USEPA, 1991).

As a result of biological investigations conducted by the Pennsylvania Department of Environmental Protection (PA DEP) that identified observed impacts on aquatic life and numerous exceedances of the applicable dissolved oxygen (DO) criteria, much of the Wissahickon Creek watershed has been listed on the State's 303(d) list of impaired waters. The watershed is heavily impacted by urbanization and is listed as impaired due to problems associated with elevated nutrient levels, low dissolved oxygen concentrations, siltation, chlorine, water/flow variability, oil and grease, and pathogens. The 2003 TMDL study fulfilled the requirements for nutrient and siltation TMDL development for all waters in the Wissahickon Creek basin included in the State's 303(d) list. Separate studies are underway to address those impairments resulting from chlorine, oil and grease, pathogens, and low dissolved oxygen concentrations. These studies will address the impairments through either direct TMDL development or additional monitoring to determine if recent changes in management practices have resulted in improved water quality conditions and subsequent removal of the stream segments from the 303(d) list. For those stream segments listed as impaired as a result of "water/flow variability" and "other habitat alterations," sources of impairments are related to those sources contributing to the nutrient and siltation impairments. Therefore, through implementation of best management practices to address nutrient and siltation TMDLs, these related impairments will be addressed indirectly.

The Wissahickon Creek drains approximately 64 square miles and extends 24.1 miles in a southeasterly direction through lower Montgomery and northwestern Philadelphia Counties. The Wissahickon Creek is designated for trout stocking, and is subject to all water quality criteria specific to this designated use and those defined for general statewide water uses including aquatic life, water supply, and recreation. As a result of biological investigations conducted by the Pennsylvania Department of Environmental Protection (PA DEP) that identified observed impacts on aquatic life and exceedances of applicable dissolved oxygen (DO) criteria, much of the Wissahickon Creek basin has been listed on the State's 303(d) list of impaired waters. The watershed is heavily impacted by urbanization and is listed as impaired due to problems associated with elevated nutrient levels, siltation, low dissolved oxygen concentrations, chlorine, water/flow variability, oil and grease, and pathogens. In 2003, TMDLs were approved to address impairments due to nutrients, siltation, and low dissolved oxygen levels. These were the impairments identified on Pennsylvania's 1996 Section 303(d) List. Future TMDLs will be required to address the chlorine and oil and grease impairments.

The Environmental Protection Agency Region III (EPA) established the Total Maximum Daily Loads (TMDLs) for the Wissahickon Creek basin to address those stream segments impaired as a result of excess nutrients and siltation. To address nutrient impairments, TMDLs have been established for ammonia nitrogen (NH3-N), nitrate-nitrite nitrogen (NO3+NO2-N), ortho-phosphate (ortho PO4), and carbonaceous biochemical oxygen demand (CBOD) in order to attain and maintain applicable Water Quality Standards (WQS). There are presently no numeric criteria for nutrients or siltation defined by WQS for these streams. As a result, consideration was given to all biological indicators and stressors identified in previous biological assessments of the Wissahickon Creek basin. In order to achieve and maintain that aquatic life use EPA determined the endpoint for the nutrient TMDL based on the link between nutrient concentrations, DO concentrations, and biological activity in the streams. Of the components of in stream biological activity, only DO has numeric criteria for protection of aquatic life in stream segments of the Wissahickon Creek basin. As a result, the nutrient TMDL endpoint is based on achieving and maintaining both the minimum and minimum daily average DO criteria for the critical period associated with trout stocking. For siltation impaired stream segments, TMDLs have been established based on target load endpoints estimated from a reference unimpaired watershed.

As part of the nutrient TMDLs, EPA has allocated specific amounts of NH3-N, NO3+NO2-N, orho-PO4, and CBOD to certain point and nonpoint sources necessary to restore and maintain applicable WQS for DO. These TMDLs recommend that five facilities have their National Pollution Discharge Elimination System (NPDES) permits modified when next reissued to reduce the amounts of pollutants that may be discharged. The nutrient TMDL and WLAs reported herein are contingent on the assumption that NPDES permits for Ambler Borough (PA0026603), Abington Township (PA0026867), Upper Gwynedd Township (PA0023256), and the Township of Upper Dublin (PA0029441) are amended to increase the effluent DO concentrations to a minimum of 7.0 mg/L.

TMDLs were determined for each of the most stringent applicable DO criteria necessary to provide aquatic life use protection as follows: Trout Stocking (February 15 to July 31) and Warm Water Fishes (remainder of year). For each DO criterion and impaired stream segment of Wissahickon Creek, EPA allocated waste load allocations (WLAs) for all point sources and load allocations (LAs) for all nonpoint sources as part of the TMDLs.

1.2 Hydrologic Unit Code (HUC)

Watersheds are delineated by USGS using a nationwide system based on surface hydrologic features. This system divides the country into 21 regions, 222 sub regions, 352 accounting units, and 2,262 cataloguing units. A hierarchical hydrologic unit code (HUC) consisting of 2 digits for each level in the hydrologic unit system is used to identify any hydrologic area. The 6 digit accounting units and the 8 digit cataloguing units are generally referred to as basin and sub-basin.

The HUC for the watershed that is included in the Abington Township's drainage area is as follows:

Mid Atlantic Watershed:		02
Delaware-Mid Atlantic Watershed:		0204
Lower Delaware watershed:		020402
Schuylkill Watershed:		02040203
Wissahickon Watershed:		0204020309
Lower Wissahickon Watershed:		020402030902
Includes:	Sandy Run	
	Pine Run	
	Unnamed Tributary	

1.3 Physical Characteristics

The following information has been reproduced from the "Nutrient and Siltation TMDL Development for Wissahickon Creek, Pennsylvania, Final Report, October 2003."

The Wissahickon Creek drains approximately 64 square miles and extends 24.1 miles in a southeasterly direction through lower Montgomery and northwestern Philadelphia Counties (Figure 1.1). Major tributaries in the basin include Sandy Run and Pine Run, draining a heavily urbanized area east of the mid-section of the watershed. Other tributaries to Wissahickon Creek include Trewellyn Creek, Willow Run - East, Willow Run - West, Rose Valley Tributary, Paper Mill Run, Creshiem Creek, Monoshone Creek, Prophecy Creek, Lorraine Run, Wises Mill Tributary, and Valley Road Tributary. All tributaries mentioned are included with the main stem of the Wissahickon Creek on Pennsylvania's 303(d) list of impaired waters.

The headwaters and upper portions of the watershed consist primarily of residential, agricultural, and wooded land use. The mid-section of the watershed is dominated by industrial, commercial, and residential land use. The lower 6.8 miles of the watershed is enclosed by Fairmount Park, which is maintained for recreational use. Tributaries of the lower portion of the watershed provide storm drainage from single and multi-family residential areas.

Biological investigations of Wissahickon Creek over the past 20 years have repeatedly documented a problem regarding eutrophic conditions in the main stem and tributaries (Boyer, 1975; Strekal, 1976; Boyer, 1989; Schubert, 1996; Boyer, 1997; Everett, 2002). Total phosphorus concentrations decreased substantially in 1988 as a result of a combination of the phosphate ban and wastewater treatment plant upgrades and/or phasing out of smaller treatment plants. However, levels are still significant enough to result in nuisance algal growth (Boyer, 1997). Results of a 1998 survey of the periphyton conducted by PA DEP indicate that excess nutrient levels in the Wissahickon Creek may be contributing to impairments found in the watershed by causing an alteration in the benthic community as a result of increasing algal biomass (Everett, 2002). Analysis of the periphyton data by the Academy of Natural Sciences of Philadelphia (ANSP) concluded that the Wissahickon Creek is a nutrient enriched system, with eutrophic conditions present in the stream as a whole. ANSP further concluded that this eutrophication can be attributed to sewage treatment plant (STP) effluents and possibly leached fertilizers and other runoff (West, 2000; Everett, 2002). As further evidence of eutrophic conditions, diurnal dissolved oxygen sampling performed by PA DEP in 1999 and 2002 showed repeated violations of State water quality criteria.

Another impact on the biological community and a source of impairment is the diminution of base flow. Several portions of the headwaters and tributaries have exhibited no base flow during PA DEP 1997 inspections conducted in conjunction with the Unassessed Waters Program, an August 2001 site visit conducted by PA DEP and EPA Region 3, and PA DEP data collection of summer 2002. Sources of base flow reduction may be a result of one or more of several activities, including the increase of impervious area and subsequent loss of groundwater recharge resulting from urbanization, and groundwater pumping and drawdown (personal communication with Alan Everett, PA DEP). Diminution of base flow is addressed directly as an impairment included in the 303(d) list under the category of Water/Flow Variability.

Habitat alteration is affected not only by increased biomass and diminution of base flow, but also hydraulic/hydrology changes resulting from increased urbanization. Generally, there are three major forms of habitat modification related to hydrologic/hydraulic enhancements caused by urbanization: (1) in stream modifications produced by increased storm flows (siltation, bank destabilization, embeddedness, etc.), (2) out-of-stream habitat alterations (riparian vegetation removal, bank alteration, etc.), and (3) stream encroachments (dams, enclosures, bridges, etc.). All three categories of habitat modification are interrelated and are addressed directly as a source of impairment for segments included in the 303(d) list for Habitat Alterations. Siltation and Water/Flow Variability are also addressed separately in the 303(d) list, but are related to Habitat Alterations. Since they are related to the same source of impairment, the management practices identified to relieve the nutrient and siltation impairments should have a positive impact on the habitat alteration impairments as well.

1.4 Abington Stream Segments

The Nutrient and Siltation TMDL Development for Wissahickon Creek, Pennsylvania, October 2003, lists three stream segments in the Lower Wissahickon Watershed that collect stormwater from areas in Abington Township. The segments are identified as the following:

Name	Impaired Segment
Sandy Run	971215-1133-ACE
Tributary Downstream of Sandy Run	971215-1130-ACE
Pine Run	971215-1300-ACE

2.0 Allocated Pollutant Loadings

2.1 TMDL Background

The Nutrient and Siltation TMDL Development for Wissahickon Creek, Pennsylvania, Final Report, October 2003, determined TMDLs for each of the most stringent applicable DO criteria necessary to provide aquatic life use protection as follows: Trout Stocking (February 15 to July 31) and Warm Water Fishes (remainder of year). For each DO criterion and impaired stream segment of Wissahickon Creek, EPA allocated waste load allocations (WLAs) for all point sources and load allocations (LAs) for all nonpoint sources as part of the TMDLs.

2.2 Abington Township

The Nutrient and Siltation TMDL Development for Wissahickon Creek, Pennsylvania, October 2003, lists three stream segments in the Lower Wissahickon Watershed that collect stormwater from areas in Abington Township. The segments are identified as the following:

Name	Impaired Segment
Sandy Run	971215-1133-ACE
Tributary Downstream of Sandy Run	971215-1130-ACE
Pine Run	971215-1300-ACE

2.2.1 Nutrients

The following table summarizes the existing loads (CBOD5, NH_3-N, NO_3+NO_2-N, Ortho PO_4-P)) and total Waste Load Allocations for Abington Township that have been established to address **Nutrient** Impairments for each stream segment of the Wissahickon Creek basin included in the State's 303(d) list.

TMDL Summary for Abington Township – Trout Stocking (February 15 to July 31)

	Nutrients			
	CBOD5 (lbs/day)	NH3-N (lbs/day)	NO3+NO2-N (lbs/day)	Ortho PO4-P (lbs/day)
Sandy Run 971215-1133- ACE				
TMDL	355.419	42.951	1323.189	73.638
Waste Load Allocation (lbs/day)	244.684	23.571	986.281	60.511
Load Allocation (lbs/day)	110.735	19.379	336.908	13.127
Pine Run 971215-1300-ACE				
TMDL	1.181	.040	0.986	0.100
Waste Load Allocation (lbs/day)	0.00	0.00	0.00	0.00
Load Allocation (lbs/day)	1.181	0.040	0.986	0.100

TMDL Summary for Abington Township - Warm Water Fishes (August 1 to February 14)

	Nutrients			
	CBOD5 (lbs/day)	NH3-N (lbs/day)	NO3+NO2-N (lbs/day)	Ortho PO4-P (lbs/day)
Sandy Run 971215-1133- ACE				
TMDL	456.179	86.835	1288.134	171.741
Waste Load Allocation (lbs/day)	326.145	65.235	986.281	150.935
Load Allocation (lbs/day)	130.034	21.600	301.853	20.805
Pine Run 971215-1300-ACE				
TMDL	1.181	.040	0.986	0.100
Waste Load Allocation (lbs/day)	0.00	0.00	0.00	0.00
Load Allocation (lbs/day)	1.181	0.040	0.986	0.100

2.2.2 Siltation

The following table summarizes the existing loads (stream bank erosion and overland load) and total Waste Load Allocations for Abington Township that have been established to address **Siltation** Impairments for each stream segment of the Wissahickon Creek basin included in the State's 303(d) list.

Name/Segment	Stream Bank Erosion			Overland Flow			Total WLAs (lbs/yr)
	Existing Load (lbs/yr)	WLA (lbs/yr)	Percent Reduction	Existing Load (lbs/yr)	WLA (lbs/yr)	Percent Reduction	
Sandy Run 971215-1133-ACE	119,671.74	39,491.67	.67	322,843.59	80,931.24	.75	120,422.91
Tributary Downstream of Sandy Run 971215-1130-ACE	1,862.83	1,602.03	.14	39,454.10	6,807.63	.83	8,409.66
Pine Run 971215-1300-ACE	69.89	23.06	.67	240.87	57.81	.76	80.87
Totals:	121,604.46	41,116.76	0.66	362,538.56	87,796.68	0.76	128,913.44

3.0 Pollutant Load Reduction Requirements

3.1 Abington Township Waste Load Allocation (2003 TMDL)

3.1.1 Nutrients (2003 TMDL)

All existing Load and Waste Load Allocations for Nutrient Reduction for Abington Township have been met due to the Township WWTP meeting the Discharge Requirements of NPDES Permit No. PA0026867. Therefore no additional treatment requirements for nutrients are required. The stormwater BMP Control Measures detailed in Section 4.0 do however remove Phosphorus and Nitrates from the storm water flows tributary to each BMP.

3.1.2 Siltation (2003 TMDL)

The following table summarizes the pollutant load reduction requirement for Abington Township that has been established to address **Siltation** Impairments for the Township:

Pollutant Load Reduction Requirement	
Abington Township's Existing Load:	484,143.02 lbs/year
Abington Township's WLA Requirement:	128,913.40 lbs/year
Abington Township's Required Reduction:	355,229.62 lbs/year

The above load reduction correspond to a 73% reduction of siltation. As per PADEP recommendations the TMDL plan should meet this percentage reduction requirement.

3.2 Abington Township Waste Load Allocation (2017 Modeling)

3.2.1 Nutrients (2015 Draft TMDL)

In May of 2015, the EPA issued a Draft Total Phosphorus TMDL for the Wissahickon Watershed. Currently this TMDL has not been finalized and the local municipalities that have Wastewater Treatment Facilities are currently negotiating new Phosphorus discharge limits from their treatment plants. It is proposed that the new discharge limits coupled with some reductions from stormwater Best Management Practices (BMPs) will meet the proposed TMDL waste load allocations. Currently, the Pennsylvania Environment Council, through funding from the William Penn Foundation is conducting a study on the Wissahickon Watershed and will develop recommendations for reducing nutrients and reducing impairments in the watershed. The stormwater BMP Control Measures detailed in Section 4.0 do remove Phosphorus and Nitrates from the storm water flows tributary to each BMP.

3.2.2 Siltation (2017 TMDL Modeling)

The current guidelines from the PADEP allow municipalities to utilize new modeling in the watershed to develop existing base loads. This same modeling will be utilized to develop anticipated reductions from the proposed stormwater BMPs being proposed by the Township in this plan.

The existing base loads and the anticipated reduction loads presented in this report were modeled utilizing a model developed by the USEPA called STEPL, Version 4.3. STEPL (Spreadsheet Tool for Estimating Pollutant Load) is a customizable spreadsheet-based model for use in Excel. Using simple algorithms, it calculates nutrient and sediment loads from different land uses and the load reductions from the implementation of best management practices (BMPs). Annual nutrient loading (nitrogen, phosphorus and 5-day biological oxygen demand) is calculated based on the runoff volume and pollutant concentrations. The annual sediment load from sheet and rill erosion is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. Loading reductions resulting from the implementation of BMPs are computed from the known BMP efficiencies.

The STEPL Model has been selected based upon the fact that Temple University's Center for Sustainable Communities is utilizing this model as they develop recommendations for stormwater treatment improvements in the Wissahickon Watershed. Temple University has been awarded a grant from the William Penn Foundation to provide oversight, expertise and support for what could potentially be dozens of restoration projects in the suburban portions of watersheds in the Philadelphia region. Abington Township has been working with their staffs to identify BMP sites and wish to standardize on the models used to estimate the pollutant loadings.

The following table summarizes the pollutant load reduction requirement for Abington Township that has been established to address **Siltation** Impairments for the Township using the STEPL Model:

Pollutant Load Reduction Requirement	
Abington Township's Existing Load:	720,900 lbs/year
Abington Township's WLA Requirement:	194,643 lbs/year
Abington Township's Required Reduction:	526,257 lbs/year

The above load reduction correspond to a 73% reduction of siltation, which is the requirement of the approved 2003 TMDL plan.

4.0 Control Measures

Abington Township has or will implement eighteen (18) Best Management Practice Control Measures in order to comply with the TMDL reduction requirements found in the Wissahickon TMDL Report, Dated October 2003. These Best Management Practices (BMPs) will be as outlined below. Details and calculations detailing pollutant load removals for each BMP is found in *Appendices A thru R*.

4.1 BMPs Constructed

Since the Wissahickon Creek TMDL Final Report was finalized in October 2003, the Township of Abington has constructed numerous control measures (BMPs) in the Sandy Run Watershed that control runoff to the main stream body and reduce the amount of sediment that is discharged into the stream. These BMPs include the following:

4.1.1 Susquehanna Woods Stormwater Retention Basin

The Susquehanna Woods Storm Water Retention Basin/Dam was constructed in 2005. The dam controls runoff from 144 Acres. The dam has a permanent pool behind the embankments. This BMP collects sediment from the upland areas. The pollutant reduction projected to be achieved by this BMP is 20,243 lbs/year. See *Appendix A* for backup calculations supporting the pollutant reduction projected for this BMP.

4.1.2 Susquehanna Woods Basin #1

The Susquehanna Woods Storm Water Basin #1 was constructed in 2004. The basin controls runoff from 45.73 Acres. The basin was constructed around a natural wooded area and impounds detains water within this area. The pollutant reduction projected to be achieved by this BMP is 7,724 lbs/year. See *Appendix B* for backup calculations supporting the pollutant reduction projected for this BMP.

4.1.3 Susquehanna Woods Basin #2

The Susquehanna Woods Storm Water Basin #2 was constructed in 2004. The basin controls runoff from 40.55 Acres. The basin was constructed around a natural wooded area and impounds detains water within this area. The pollutant reduction projected to be achieved by this BMP is 4,652 lbs/year. See *Appendix C* for backup calculations supporting the pollutant reduction projected for this BMP.

4.1.4 Hamel Avenue Infiltration Basin

The Hamel Avenue Infiltration Basin was constructed in 2007. The basin controls runoff from 54 Acres. The basin was constructed in a vacant lot the Township acquired when it received a grant to buy and remove a home with chronic flooding problems. The infiltration basin consists of a series of 60 inch diameter perforated pipes that are located in a bed of clean stone. Inlet and outlet structures allow maintenance of the facility. The pollutant reduction projected to be achieved by this BMP is 15,375 lbs/year. See *Appendix D* for backup calculations supporting the pollutant reduction projected for this BMP.

4.1.5 Riparian Buffer Replacement

The Roslyn Park Riparian Buffer Restoration Project was completed in two phases and completed in 2009. This BMP controls runoff from 24.3 Acres. The buffer was constructed in Roslyn Park, a Township Park mostly used for youth sports. The Sandy Run travels through the park and the Abington Township Environmental Advisory Committee received a grant to restore the buffer with native species. The pollutant reduction projected to be achieved by this BMP is 2,683 lbs/year. See *Appendix E* for backup calculations supporting the pollutant reduction projected for this BMP.

4.1.6 Roslyn Park Rain Garden

The Roslyn Park Rain Garden Project was constructed in 2009. This BMP controls runoff from the 1 Acre parking lot at the park. The rain garden was constructed in Roslyn Park, a Township Park mostly used for youth sports. The Abington Township Environmental Advisory Committee received a grant to construct the rain garden. The pollutant reduction projected to be achieved by this BMP is 982 lbs/year. See *Appendix F* for backup calculations supporting the pollutant reduction projected for this BMP.

4.1.7 Woodland Avenue Stream Bank Stabilization

The Woodland Avenue Stream Bank Stabilization Project was constructed in 2009. The stream bank in the area of the Roslyn Nursing Home just off of Woodland Road had severe bank erosion that was eroding away the bank approximately 2-3 inches a year. The bank was stabilized by structural methods and the erosion has stopped. The bank was approximately 6.2 feet high and 90 feet of stream bank was stabilized. The reduction of sediment has been estimated by utilizing the EPA's **Spreadsheet Tool for Estimating Pollutant Load** (STEPL) this model employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs). The pollutant reduction projected to be achieved by this BMP is 10,463 lbs/year. See *Appendix G* for backup calculations supporting the pollutant reduction projected for this BMP.

4.1.8 Sandy Run Stream Bank Stabilization Constructed

The Sandy Run Stream Bank Stabilization Project: The stream bank in various areas along the Sandy Run and its unnamed tributaries show evidence of erosion on the order of 2-3 inches a year. The banks will stabilized by structural methods in order to stop erosion. In 2013, the Township stabilized approximately 430 feet of stream bank at an estimated height of 5 foot. The reduction of sediment has been estimated by utilizing t Chesapeake Stormwater Network's ***Final Report Recommendations of expert Panel to define Removal Rates for Individual Stream Restoration Projects***. The pollutant reduction projected to be achieved by these constructed BMP is 40,313 lbs/year. See *Appendix H* for backup calculations supporting the pollutant reduction projected for this BMP.

4.2 BMPs to be Constructed

The Township of Abington proposes to construct additional control measures (BMPs) in the Sandy Run Watershed to control runoff to the main stream body and reduce the amount of sediment that is discharged into the stream. These BMPs include the following:

4.2.1 Sandy Run Stream Bank Stabilization

The Sandy Run Stream Bank Stabilization Project: The stream bank in various areas along the Sandy Run and its unnamed tributaries show evidence of erosion on the order of 2-3 inches a year. The banks will be stabilized by structural methods in order to stop erosion. The Township will stabilize approximately 195 additional feet of stream bank at an estimated height of 5 foot. The reduction of sediment has been estimated by utilizing the Chesapeake Stormwater Network's ***Final Report Recommendations of expert Panel to define Removal Rates for Individual Stream Restoration Projects***. The pollutant reduction projected to be achieved by this BMP is 39,234 lbs/year. See *Appendix I* for backup calculations supporting the pollutant reduction projected for this BMP.

4.2.2 Susquehanna Woods Basin #3 Retrofit

The Susquehanna Woods Storm Water Basin #3 was originally constructed in 2005. The basin controls runoff from 109 Acres. The basin was constructed at the outlet of a culvert that conveyed water under a SEPTA Regional Rail Line. The Township is currently working with PENNDOT to redesign to main arterial roads upland of the basin. As part of this project, the storm water drainage will be routed to this basin. The Township intends to modify the basin in order to detain and infiltrate the storm water.

The work to be done on this basin is projected to include the following:

- Expansion of the current basin.
- Transformation of the basin's floor into a bio-retention facility or rain garden.
- Infiltration Tests to determine the feasibility of groundwater recharge.

The pollutant reduction projected to be achieved by this BMP is 20,138 lbs/year. See *Appendix J for* backup calculations supporting the pollutant reduction projected for this BMP.

4.2.3 Madison Avenue Meadow Construction

After severe flooding in 1996, the Township received funding from FEMA to acquire and demolish sixteen (16) homes along the Sandy Run. These homes were situate on Madison Avenue. This work was completed and the area is now known as Deal Park. It is permanent open space and the area consists of mowed grass and trees. The Township proposes to construct a permanent meadow in the area of Deal Park where an existing storm water pipe discharges. Flow from this pipe will be redirected overland in the meadow prior to discharge to the stream. This BMP controls runoff from 15.2 Acres. The pollutant reduction projected to be achieved by this BMP is 4,173 lbs/year. See *Appendix K for* backup calculations supporting the pollutant reduction projected for this BMP.

4.2.4 Roychester Park Rain Garden

The proposed Roychester Park Rain Garden Project will be designed to treat/control stormwater flows from 20.6 Acres of residential areas to the east of the park. This area currently drains via storm sewer to a ditch adjacent to Cleveland Avenue which discharges to the Sandy Run. The pollutant reduction projected to be achieved by this BMP is 4,716 lbs/yr of silt, 17 lbs/yr of Phosphorus and 90 lbs/yr of Total Nitrogen. See *Appendix L* for backup calculations supporting the pollutant reduction projected for this BMP.

4.2.5 Roychester Riparian Buffer Restoration

The proposed Roychester Park Riparian Buffer Restoration Project will be designed to treat/control stormwater flows from 45.57 Acres of residential areas to the east and north of the park. This area currently drains overland which discharges to the Sandy Run. The pollutant reduction projected to be achieved by this BMP is 6,467 lbs/yr of silt, 25 lbs/yr of Phosphorus and 71 lbs/yr of Total Nitrogen. See *Appendix M* for backup calculations supporting the pollutant reduction projected for this BMP.

4.2.6 Roychester Park Bioretention/Infiltration Trench

The proposed Roychester Park Bioretention/Infiltration Trench Project will be designed to treat/control stormwater flows from 9 Acres of area consisting of the park's main parking lot, athletic, playing fields, and residential areas to the north of the park. This area currently drains overland and discharges to the Sandy Run. The pollutant reduction projected to be achieved by this BMP is 1,729 lbs/yr of silt, 4 lbs/yr of Phosphorus and 33 lbs/yr of Total Nitrogen. See *Appendix N* for backup calculations supporting the pollutant reduction projected for this BMP.

4.2.7 Roychester Park Infiltration Berms/Retentive Grading

The proposed Roychester Park Infiltration Berms/Retentive Grading Project will be designed to treat/control stormwater flows from 19.65 Acres from residential areas to the north of the park, which flows down Harding Avenue. This area currently drains overland and discharges to the Sandy Run. The pollutant reduction projected to be achieved by this BMP is 5,433 lbs/yr of silt, 19 lbs/yr of Phosphorus and 107 lbs/yr of Total Nitrogen. See *Appendix O* for backup calculations supporting the pollutant reduction projected for this BMP.

4.2.8 Evergreen Manor Park Infiltration Basin

The proposed Evergreen Manor Park Infiltration Basin Project will be designed to treat/control stormwater flows from 68.85 Acres from residential areas to the north of the park, and flow from the Willow Hill Elementary School and associated grass athletic playing fields. This area currently drains via a storm sewer and discharges into a ditch that runs through the wooded area of Evergreen Park. This ditch ultimately conveys storm water into a pipeline that conveys flow to the Sandy Run. This project overland and discharges to the Sandy Run. The proposed project calls for the construction of a non-regulated dam that will back up and retain flows in the wooded area to allow infiltration to occur and detain storm water upstream of the stream. The pollutant reduction projected to be achieved by this BMP is 15,829 lbs/yr of silt, 58 lbs/yr of Phosphorus and 314 lbs/yr of Total Nitrogen. See *Appendix P* for backup calculations supporting the pollutant reduction projected for this BMP.

4.2.9 Grove Park Stream Restoration

Abington Township has allocated matching funds for a project to study the Sandy run in Grove Park and ultimately to restore the stream in this area. Grove Park is a municipally owned park of approximately 2 acres. The park contains approximately 1,300 linear feet of Sandy Run Creek. About 400 linear feet of stream within the park are lined with gabion baskets on the banks and a 24 foot wide and 12 inches thick rebar enforced concrete channel on the stream bottom. The concrete channel provides no useful aquatic habitat and increases the velocity and temperature of the water, which impairs downstream habitat through increased sedimentation and water temperature. Downstream of the concrete lined stream bottom, the stream banks are lined with gabion baskets. The gabions provide lower quality habitat for aquatic species and prevent the stream bed from connecting to the surrounding floodplains.

The main stem of Sandy Run Creek was relocated to its current location in Grove Park. The original channel still exists, and while it does not have base flow; it serves as a high flow channel during storm events (Fig. 5). The vegetated buffer of this high flow channel has major invasive species issues, which degrade the habitat value of the riparian buffer.

This project in Grove Park would remove gabions and concrete channels and naturalize approximately 2,600 feet of stream bank. This proposed project is currently in the planning stage.

The pollutant reduction projected to be achieved by this BMP is 195,000 lbs/yr of silt, 117 lbs/yr of Phosphorus and 254 lbs/yr of Total Nitrogen. See *Appendix Q* for backup calculations supporting the pollutant reduction projected for this BMP.

4.2.10 Ardsley Wildlife Sanctuary Streambank Stabilization and Basin

The Ardsley Wildlife Sanctuary is owned by Abington Township and consists of 81 acres of undeveloped open space. The land use is primarily managed as a natural area and provides habitat for wildlife in what is an otherwise developed suburban community. The property contains a basin, approximately 0.75 acres in size. The Sandy Run watershed has been identified as a priority area for implementation of improved stormwater control measures. The Sandy Run has experienced significant damage as a result of flooding. The watershed and opportunities for implementation of flood reduction, improved stormwater control, greenway creation, and land acquisition has been the consideration of numerous watershed and regional open space studies.

The Wissahickon Creek Characterization Report completed in 2007 refers to flooding in 1996 which caused significant damage and loss of life in the Sandy Run Watershed. As a result of the flooding that year, FEMA acquired and removed thirteen homes from the Sandy Run Creek Floodplain.

The Pennsylvania Integrated Water Quality Monitoring and Assessment Report lists the Sandy Run watershed as impaired due to nutrients and siltation from urban runoff. In Abington Township, high levels of urbanization and poor stream bank stability deeply influence the watershed. Some portions of the creek have been redirected through storm sewers and replaced with impervious surfaces.

Implementation of this project will address DEP Department wide and regional Growing Greener goals.

The project would consist of approximately 500 feet of streambank stabilization utilizing bolder revetment at the toe of bank and natural biological stabilization along the eroded banks.

The overall project consists of the expansion of an existing secondary impoundment area north of the main basin. The project would also consist of the construction of a berm along the northeastern side of the basin, which would provide additional storage capacity. In addition, a fore basin may be designed to minimize siltation build up in the secondary basin. The pollutant reduction projected to be achieved by this BMP is142,475 lbs/yr of silt, 71 lbs/yr of Phosphorus and 612 lbs/yr of Total Nitrogen. See *Appendix R* for backup calculations supporting the pollutant reduction projected for this BMP.

5.0 Analysis and Timeline

5.1 Analysis

The combination of Structural BMPs that have been constructed, coupled with the proposed BMPs to be constructed are projected to remove 537,629 lbs/year. It is projected that Abington Township will be able to achieve the required 73% reduction in sediment pollution that is required by the Wissahickon TMDL.

The following charts are a summary of the BMP's included in Abington's plan.

ABINGTON TMDL PLAN COMPONENTS

WISSAHICKON CREEK TMDL PLAN (2003)	SILTATION LOADS	
SILTATION: ABINGTON'S EXISTING LOAD (2003 TMDL):	484,143.02	lbs/year
SILTATION: ABINGTON'S WLA REQUIREMENT (2003 TMDL):	128,913.40	lbs/year
SILTATION: ABINGTON'S REQUIRED REDUCTION (2003 TMDL):	355,229.62	lbs/year
SILTATION: ABINGTON'S PERCENT REDUCTION REQUIRED (2003 TMDL):	**73%**	

STEPL CURRENT MODELING (2017)		
2017 STEPL MODELING-ABINGTON'S BASE LOAD:	720,900	lbs/year
2017 STEPL MODELING-ABINGTON'S 73% REQUIRED REDUCTION:	526,257	lbs/year
2017 STEPL MODELING-ABINGTON'S WLA:	194,643	lbs/year

POLLUTANT REDUCTION: BMP's CONSTRUCTED (STEPL MODEL)		
Susquehanna Woods Stormwater Retention Basin (2005):	20,243	lbs/year
Roslyn Park Rain Garden (2009):	981.55	lbs/year
Riparian Buffer Replacement (2009):	2,683	lbs/year
Susquehanna Woods Basin #1 (2004):	7,724	lbs/year
Susquehanna Woods Basin #2 (2004):	4,652	lbs/year
Hamel Avenue Infiltration Basin (2007):	15,375	lbs/year
Sandy Run Streambank Stabilization (Woodland Road) (2009):	10,463	lbs/year
Sandy Run Streambank Stab. (Avondale & Susquehanna) (2013):	40,313	lbs/year
POLLUTANT REDUCTION: BMP's TO BE CONSTRUCTED (STEPL MODEL)		
Susquehanna Woods Basin #3 Retrofit:	20,138	lbs/year
Sandy Run Streambank Stabilization:	39,234	lbs/year
Madison Avenue Meadow Construction:	4,173	lbs/year
Roychester Park Rain Garden	4,716	lbs/year
Roychester Riparian Buffer Restoration	6,467	lbs/year
Roychester Park Bioretention/Infiltration Trench	1,729	lbs/year
Roychester Park Infiltration Berms/Ret. Grading	5,433	lbs/year
Evergreen Manor Park Infiltration Basin	15,829	lbs/year
Grove Park Streambank Restoration	195,000	lbs/year
Ardsley Wildlife Sanctuary Basin Renovations	142,475	lbs/year
TOTAL PROJECTED BMP POLLUTANT REDUCTION:	**537,629**	**lbs/year**

ABINGTON TMDL PLAN COMPONENTS

STEPL CURRENT MODELING (2017)	NITROGEN		PHOSPHORUS	
2017 STEPL MODELING-ABINGTON'S BASE LOAD:	17,649	lbs/year	2,745	lbs/year
2017 STEPL MODELING-ABINGTON'S REQUIRED REDUCTION (5% TOTAL NITROGEN & TOTAL PHOSPHORUS):	882	lbs/year	137	lbs/year

POLLUTANT REDUCTION: BMP's CONSTRUCTED (STEPL MODEL)				
Susquehanna Woods Stormwater Retention Basin (2005):	160	lbs/year	63	lbs/year
Roslyn Park Rain Garden (2009):	16	lbs/year	3	lbs/year
Riparian Buffer Replacement (2009):	29	lbs/year	8	lbs/year
Susquehanna Woods Basin #1 (2004):	67	lbs/year	12	lbs/year
Susquehanna Woods Basin #2 (2004):	32	lbs/year	7	lbs/year
Hamel Avenue Infiltration Basin (2007):	295	lbs/year	54	lbs/year
Sandy Run Streambank Stabilization (Woodland Road) (2009):	14	lbs/year	6	lbs/year
Sandy Run Streambank Stab. (Avondale & Susquehanna) (2013):	52	lbs/year	24	lbs/year
POLLUTANT REDUCTION: BMP's TO BE CONSTRUCTED (STEPL MODEL)				
Susquehanna Woods Basin #3 Retrofit:	153	lbs/year	26	lbs/year
Sandy Run Streambank Stabilization:	51	lbs/year	24	lbs/year
Madison Avenue Meadow Construction:	79	lbs/year	15	lbs/year
Roychester Park Rain Garden	90	lbs/year	17	lbs/year
Roychester Riparian Buffer Restoration	71	lbs/year	25	lbs/year
Roychester Park Bioretention/Infiltration Trench	33	lbs/year	4	lbs/year
Roychester Park Infiltration Berms/Ret. Grading	107	lbs/year	19	lbs/year
Evergreen Manor Park Infiltration Basin	314	lbs/year	58	lbs/year
Grove Park Streambank Restoration	254	lbs/year	117	lbs/year
Ardsley Wildlife Sanctuary Basin Renovations	612	lbs/year	71	lbs/year
TOTAL PROJECTED BMP POLLUTANT REDUCTION:	**2,428**	**lbs/year**	**553**	**lbs/year**

5.2 Budget and Schedule

The following table shows Total Projected Construction and Engineering Costs for implementing the Township of Abington's TMDL Program. The plan must be implemented within the following schedule:

- **TMDL Plan**: Within five (5) years following PADEP approval of coverage, but can be extended if Township cannot meet the goals of the plan.

TMDL BMP Cost Projections (5-10 Year Schedule)

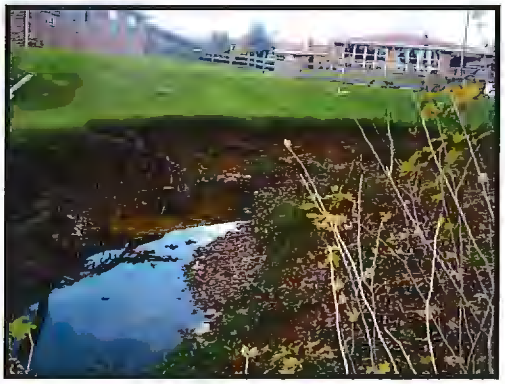
	Budget			
POLLUTANT REDUCTION: BMP's CONSTRUCTED	**Construction**	**Engineering**	**Grant (Act & Pot)**	**Total**
Susquehanna Woods Stormwater Retention Basin (2005)	-	-	-	-
Roslyn Park Rain Garden (2009)	-	-	-	-
Riparian Buffer Replacement (2009)	-	-	-	-
Susquehanna Woods Basin #1 (2004)	-	-	-	-
Susquehanna Woods Basin #2 (2004)	-	-	-	-
Hamel Avenue Infiltration Basin (2007)	-	-	-	-
Sandy Run Streambank Stabilization (Woodland Road) (2009)	-	-	-	-
Sandy Run Streambank Stab. (Avondale & Susquehanna) (2013)	-	-	-	-

POLLUTANT REDUCTION: BMP's TO BE CONSTRUCTED	**Construction**	**Engineering**	**Grant (Act & Pot)**	**Total**
Susquehanna Woods Basin #3 Retrofit	$ 75,000.00	$ 11,250.00	$ -	$ 86,250.00
Sandy Run Streambank Stabilization:**	$ 60,000.00	$ 9,000.00	$ -	$ 69,000.00
Madison Avenue Meadow Construction	$ 30,000.00	$ 4,500.00	$ -	$ 34,500.00
Roychester Park Rain Garden	$ 43,960.00	$ 8,050.00	$ 7,800.00	$ 44,210.00
Roychester Riparian Buffer Restoration	$ 32,315.00	$ 8,280.00	$ 6,100.00	$ 34,495.00
Roychester Park Bioretention/Infiltration Trench	$ 21,390.00	$ 6,900.00	$ 4,235.00	$ 24,055.00
Roychester Park Infiltration Berms/Ret. Grading	$ 44,850.00	$ 9,430.00	$ 8,140.00	$ 46,140.00
Evergreen Manor Park Infiltration Basin	$ 28,635.00	$ 10,900.00	$ 5,935.00	$ 33,600.00
Grove Park Streambank Restoration	$ 2,300,000.00	$ 350,000.00	$ 2,000,000.00	$ 650,000.00
Ardsley Wildlife Sanctuary Basin Renovations	$ 500,000.00	$ 75,000.00	$ 300,000.00	$ 275,000.00
Estimated Project Costs for TMDL Plan BMPs	$ 3,136,150.00	$ 493,310.00	$ 2,332,210.00	$ 1,297,250.00

**2017 Capital Budget

PART B

POLLUTANT REDUCTION PLANS



PART B: POLLUTANT REDUCTION PLANS

1.0 Background Information

As part of the new individual permit application, the Township is required to prepare Pollutant Reduction Plans for streams in the Township that are impaired for Nutrients and Sediment where there is no waste load allocation (WLA) in a Total Maximum Daily Load (TMDL).

These "Impaired Waters PRPs" require Township to estimate pollutant loads and reduce those loads ***within 5 years following DEP's approval of coverage.*** If the impairment which triggered the need for an Impaired Waters PRP is due to sediment alone, a minimum 10% sediment reduction is required. If the impairment is based on nutrients alone (phosphorus or nitrogen), a minimum 5% Total Phosphorus (TP) reduction is required. If the impairment is due to both sediment and nutrients, both sediment (10%) and TP (5%) must be controlled. The Township may propose a presumptive approach in which a 10% sediment reduction is assumed to also result in a 5% TP reduction. If the impairment is based on nutrients only or other surrogates for nutrients (e.g., "Excessive Algal Growth" and "Organic Enrichment/Low D.O."), a minimum 5% TP reduction is required.

The PRP plans calls for the construction and/or utilization of stormwater treatment facilities known as BMPs (Best Management Practices). The following sections detail the BMPs that are proposed for the various watersheds:

2.0 Pennypack Creek

2.1 Waste Load Allocation (2017 Modeling)

The current guidelines from the PADEP allow municipalities to utilize modeling in the watershed to develop existing base loads. This same modeling will be utilized to develop anticipated reductions from the proposed stormwater BMPs being proposed by the Township in this plan.

The existing base loads and the anticipated reduction loads presented in this report were modeled utilizing a model developed by the USEPA called STEPL, Version 4.3. STEPL (Spreadsheet Tool for Estimating Pollutant Load) is a customizable spreadsheet-based model for use in Excel. Using simple algorithms, it calculates nutrient and sediment loads from different land uses and the load reductions from the implementation of best management practices (BMPs). Annual nutrient loading (nitrogen, phosphorus and 5-day biological oxygen demand) is calculated based on the runoff volume and pollutant concentrations. The annual sediment load from sheet and rill erosion is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. Loading reductions resulting from the implementation of BMPs are computed from the known BMP efficiencies.

The STEPL Model has been selected based upon the fact that Temple University's Center for Sustainable Communities is utilizing this model as they develop recommendations for stormwater treatment improvements in the local watersheds surrounding Philadelphia. Temple University has been awarded a grant from the William Penn Foundation to provide oversight, expertise and support for what could potentially be dozens of restoration projects in the suburban portions of watersheds in the Philadelphia region. Abington Township has been working with their staffs to identify BMP sites and wish to standardize on the models used to estimate the pollutant loadings.

The following table summarizes the pollutant load reduction requirement for the Pennypack Creek using the STEPL Model:

Pollutant Load Reduction Requirement		
	Siltation	**Nutrients (TP)**
Pennypack Creek Watershed Existing Load:	359,739 lbs/year	311 lbs/year
Pennypack Creek's Required Reduction:	10%	5%
Pennypack Creek's Required Reduction:	35,974 lbs/year	16 lbs/year

2.2 Control Measures

In order to meet the reduction requirement, Abington Township will implement two (2) Best Management Practice Control Measures in order to comply with the PRP reduction requirements stated above. These Best Management Practices (BMPs) will be as outlined below. Details and calculations detailing pollutant load removals for each BMP is found in *Appendices S thru AA*.

2.2.1 Melmar Road Extended Detention Basin

The proposed Melmar Road Extended Detention Basin will control runoff from 61.4 Acres. The basin will be constructed at the outlet of a storm pipe that conveys storm water from the Melmar Road drainage area. As part of this project, the storm water drainage will be routed to this basin. The Township intends to construct the basin in order to detain and infiltrate the storm water. The work to be done on this basin is projected to include the following:

- Construction of extended basin.
- Design of the basin's floor as a bio-retention facility.
- Infiltration Tests to determine the feasibility of groundwater recharge.

The pollutant reduction projected to be achieved by this BMP is 6,600 lbs/year of sediment and 8.8 lbs/year of phosphorus. See *Appendix S for* backup calculations supporting the pollutant reduction projected for this BMP.

2.2.2 Wyndmoor Lane Extended Detention Basin

The proposed Wyndmoor Lane Extended Detention Basin will control runoff from 49 Acres. The basin will be constructed at the outlet of a storm pipe that conveys storm water from the Wyndmoor Lane drainage area. As part of this project, the storm water drainage will be routed to this basin. The Township intends to construct the basin in order to detain and infiltrate the storm water. The work to be done on this basin is projected to include the following:

- Construction of extended basin.
- Design of the basin's floor as a bio-retention facility.
- Infiltration Tests to determine the feasibility of groundwater recharge.

The pollutant reduction projected to be achieved by this BMP is 6,200 lbs/year of sediment and 8.1 lbs/year of phosphorus. See *Appendix S for* backup calculations supporting the pollutant reduction projected for this BMP.

2.2.3 Irvin Road Streambank Stabilization

The Irvin Road Stream Bank Stabilization Project: This steam is currently confined between two railroad tie walls. The Township has purchased the house that was located within 8-feet of the stream. This project entails the demolition of the railroad retaining walls and the natural restoration of the streambank. The ground will be sloped back and naturally stabilized with plantings. The reduction of sediment has been estimated by utilizing the Chesapeake Stormwater Network's ***Final Report Recommendations of expert Panel to define Removal Rates for Individual Stream Restoration Projects***. The pollutant reduction projected to be achieved by these constructed BMP is 23,625 lbs/year of silt, and 14.2 lbs/year of phosphorus. See *Appendix S* for backup calculations supporting the pollutant reduction projected for this BMP.

2.3 Reduction Summary

The following table is a summary of the expected load reductions obtained through the construction of the proposed BMPs.

PENNYPACK CREEK PRP PLAN	SILTATION LOADS		NUTRIENT (TP) LOADS	
STEPL MODELING-WATERSHED EXISTING LOAD:	359,739	lbs/year	311	lbs/year
REQUIRED REDUCTION PERCENTAGE:	**10**	%	**5**	%
REDUCTION REQUIREMENT:	35,974	lbs/year	16	lbs/year
BMP's TO BE CONSTRUCTED	**SILTATION LOADS**		**NUTRIENT (TP) LOADS**	
Melmar Basin & Stabilization	6,600		8.8	lbs/year
Wyndmoor Basin & Stabilization	6,200		8.1	lbs/year
Irvin Road Streambank Stabilization	23,625		14.2	lbs/year
TOTAL PROJECTED BMP POLLUTANT REDUCTION:	**36,425**	**lbs/year**	**31.1**	**lbs/year**

3.0 Meadowbrook Creek

3.1 Waste Load Allocation (2017 Modeling)

The current guidelines from the PADEP allow municipalities to utilize modeling in the watershed to develop existing base loads. This same modeling will be utilized to develop anticipated reductions from the proposed stormwater BMPs being proposed by the Township in this plan.

The existing base loads and the anticipated reduction loads presented in this report were modeled utilizing a model developed by the USEPA called STEPL, Version 4.3. STEPL (Spreadsheet Tool for Estimating Pollutant Load) is a customizable spreadsheet-based model for use in Excel. Using simple algorithms, it calculates nutrient and sediment loads from different land uses and the load reductions from the implementation of best management practices (BMPs). Annual nutrient loading (nitrogen, phosphorus and 5-day biological oxygen demand) is calculated based on the runoff volume and pollutant concentrations. The annual sediment load from sheet and rill erosion is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. Loading reductions resulting from the implementation of BMPs are computed from the known BMP efficiencies.

The STEPL Model has been selected based upon the fact that Temple University's Center for Sustainable Communities is utilizing this model as they develop recommendations for stormwater treatment improvements in the local watersheds surrounding Philadelphia. Temple University has been awarded a grant from the William Penn Foundation to provide oversight, expertise and support for what could potentially be dozens of restoration projects in the suburban portions of watersheds in the Philadelphia region. Abington Township has been working with their staffs to identify BMP sites and wish to standardize on the models used to estimate the pollutant loadings.

The following table summarizes the pollutant load reduction requirement for the Meadowbrook Creek using the STEPL Model:

Pollutant Load Reduction Requirement		
	Siltation	**Nutrients (TP)**
Meadowbrook Creek Existing Load:	549,236 lbs/year	NA
Meadowbrook Creek Required Reduction:	10%	NA
Meadowbrook Creek Required Reduction:	54,924 lbs/year	NA

3.2 Control Measures

In order to meet the reduction requirement, Abington Township will implement two (2) Best Management Practice Control Measures in order to comply with the PRP reduction requirements stated above. These Best Management Practices (BMPs) will be as outlined below. Details and calculations detailing pollutant load removals for each BMP is found in *Appendices S thru AA*.

3.2.1 Streambank Stabilization in Scout Preserve

The Meadowbrook Stream Bank Stabilization Project in the Scout Preserve near Meadowbrook and Valley Roads: The Scout Preserve Stream Bank Stabilization Project: The Township owns the scout preserve. This project entails the natural stabilization of 300 feet of 6ft high streambank. The ground will be sloped back and naturally stabilized with plantings and perhaps toe of bank bolder revetment. The reduction of sediment has been estimated by utilizing the Chesapeake Stormwater Network's ***Final Report Recommendations of expert Panel to define Removal Rates for Individual Stream Restoration Projects***. The pollutant reduction projected to be achieved by these constructed BMP is 33,750 lbs/year of silt. See *Appendix T* for backup calculations supporting the pollutant reduction projected for this BMP.

3.2.2 Streambank Stabilization in Bird Sanctuary

The Meadowbrook Stream Bank Stabilization Project in the Bird Sanctuary near Meadowbrook and Valley Roads: The Bird Sanctuary Stream Bank Stabilization Project: The Township owns the sanctuary. This project entails the natural stabilization of 200 feet of 6 foot high streambank. The ground will be sloped back and naturally stabilized with plantings and perhaps toe of bank bolder revetment. The reduction of sediment has been estimated by utilizing the Chesapeake Stormwater Network's ***Final Report Recommendations of expert Panel to define Removal Rates for Individual Stream Restoration Projects***. The pollutant reduction projected to be achieved by these constructed BMP is 22,500 lbs/year of silt. See *Appendix T* for backup calculations supporting the pollutant reduction projected for this BMP.

3.3 Reduction Summary

The following table is a summary of the expected load reductions obtained through the construction of the proposed BMPs.

MEADOWBROOK PRP PLAN	SILTATION LOADS	
STEPL MODELING-WATERSHED EXISTING LOAD:	359,739	lbs/year
REQUIRED REDUCTION PERCENTAGE:	**10**	%
REDUCTION REQUIREMENT:	35,974	lbs/year
BMP's TO BE CONSTRUCTED	**SILTATION LOADS**	
Streambank Stabilization in Scout Preserve	33,750	lbs/year
Streambank Stabilization in Bird Sanctuary	22,500	Lbs/year
TOTAL PROJECTED BMP POLLUTANT REDUCTION:	**56,250**	**lbs/year**

4.0 Robinhood Brook

4.1 Waste Load Allocation (2017 Modeling)

The current guidelines from the PADEP allow municipalities to utilize modeling in the watershed to develop existing base loads. This same modeling will be utilized to develop anticipated reductions from the proposed stormwater BMPs being proposed by the Township in this plan.

The existing base loads and the anticipated reduction loads presented in this report were modeled utilizing a model developed by the USEPA called STEPL, Version 4.3. STEPL (Spreadsheet Tool for Estimating Pollutant Load) is a customizable spreadsheet-based model for use in Excel. Using simple algorithms, it calculates nutrient and sediment loads from different land uses and the load reductions from the implementation of best management practices (BMPs). Annual nutrient loading (nitrogen, phosphorus and 5-day biological oxygen demand) is calculated based on the runoff volume and pollutant concentrations. The annual sediment load from sheet and rill erosion is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. Loading reductions resulting from the implementation of BMPs are computed from the known BMP efficiencies.

The STEPL Model has been selected based upon the fact that Temple University's Center for Sustainable Communities is utilizing this model as they develop recommendations for stormwater treatment improvements in the local watersheds surrounding Philadelphia. Temple University has been awarded a grant from the William Penn Foundation to provide oversight, expertise and support for what could potentially be dozens of restoration projects in the suburban portions of watersheds in the Philadelphia region. Abington Township has been working with their staffs to identify BMP sites and wish to standardize on the models used to estimate the pollutant loadings.

The following table summarizes the pollutant load reduction requirement for the Robinhood Brook using the STEPL Model:

Pollutant Load Reduction Requirement		
	Siltation	**Nutrients (TP)**
Robinhood Brook Existing Load:	17,064 lbs/year	NA
Robinhood Brook Required Reduction:	10%	NA
Robinhood Brook Required Reduction:	1,706 lbs/year	NA

4.2 Control Measures

In order to meet the reduction requirement, Abington Township will implement one (1) Best Management Practice Control Measure in order to comply with the PRP reduction requirements stated above. These Best Management Practices (BMPs) will be as outlined below. Details and calculations detailing pollutant load removals for each BMP is found in *Appendices S thru AA*.

4.2.1 Sharpless Road Filter Box

The Sharpless Road Filter Box Project would be designed to intercept 33.3 acres of an upstream area tributary to the Robinhood Brook. This box would be a commercially available unit designed to remove silt and other pollutants. Numerous manufacturers have developed proprietary devices to treat stormwater runoff. These devices have been designed to treat one or more of the common stormwater pollutants, such as solids, metals, oil and grease, nutrients and bacteria. The ability of inclined cells (lamella plates) to provide excellent treatment of stormwater for a variety of pollutants was demonstrated by Pitt et al. (1999) in the report on the multi-chambered treatment train (MCTT) at the University of Alabama at Birmingham. Prior research has shown that combining treatment technologies provides the best overall treatment efficiencies. The proposed filter box is a Hydrodynamic Separator, named "TERRE KLEEN™", which has been designed to efficiently guide the storm water flow through the unit and enhance the gravitational settling of the entrained particles in such a way that flow patterns are virtually in the opposite direction of the pull of gravity. Inclined plate cell technology offers five to ten fold increase in efficiency compared to conventional settling and swirl settling technology because of the increased area of settling and reduced depth of settling. A high repetition of plates can lead to a basin size reduction to 10%-20% of conventional settling area requirements. The primary separation of solids will take place in a receiving chamber where oils and large debris float or sink. A baffle wall and optional screen separate the inclined plate cells located in the secondary chamber. It is important to note that the bottom of the inclined plate cells is at an elevation that resembles a water condition where turbulence is the main cause in particle suspension. Those particles will settle as the water flows upward at an incline in the settling cell. The pollutant reduction projected to be achieved by these constructed BMP is 5,400 lbs/year of silt. See *Appendix U* for backup calculations supporting the pollutant reduction projected for this BMP.

4.3 Reduction Summary

The following table is a summary of the expected load reductions obtained through the construction of the proposed BMPs.

ROBINHOOD BROOK PRP PLAN	SILTATION LOADS	
STEPL MODELING-WATERSHED EXISTING LOAD:	17,064	lbs/year
REQUIRED REDUCTION PERCENTAGE:	**10**	%
REDUCTION REQUIREMENT:	1,706	lbs/year
BMP's TO BE CONSTRUCTED	**SILTATION LOADS**	
SHARPSLESS ROAD FILTER BOX	5,400	lbs/year
TOTAL PROJECTED BMP POLLUTANT REDUCTION:	**5,400**	**lbs/year**

5.0 Rockledge Branch

5.1 Waste Load Allocation (2017 Modeling)

The current guidelines from the PADEP allow municipalities to utilize modeling in the watershed to develop existing base loads. This same modeling will be utilized to develop anticipated reductions from the proposed stormwater BMPs being proposed by the Township in this plan.

The existing base loads and the anticipated reduction loads presented in this report were modeled utilizing a model developed by the USEPA called STEPL, Version 4.3. STEPL (Spreadsheet Tool for Estimating Pollutant Load) is a customizable spreadsheet-based model for use in Excel. Using simple algorithms, it calculates nutrient and sediment loads from different land uses and the load reductions from the implementation of best management practices (BMPs). Annual nutrient loading (nitrogen, phosphorus and 5-day biological oxygen demand) is calculated based on the runoff volume and pollutant concentrations. The annual sediment load from sheet and rill erosion is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. Loading reductions resulting from the implementation of BMPs are computed from the known BMP efficiencies.

The STEPL Model has been selected based upon the fact that Temple University's Center for Sustainable Communities is utilizing this model as they develop recommendations for stormwater treatment improvements in the local watersheds surrounding Philadelphia. Temple University has been awarded a grant from the William Penn Foundation to provide oversight, expertise and support for what could potentially be dozens of restoration projects in the suburban portions of watersheds in the Philadelphia region. Abington Township has been working with their staffs to identify BMP sites and wish to standardize on the models used to estimate the pollutant loadings.

The following table summarizes the pollutant load reduction requirement for the Rockledge Brook using the STEPL Model:

Pollutant Load Reduction Requirement		
	Siltation	**Nutrients (TP)**
Rockledge Branch Existing Load:	17,081 lbs/year	NA
Rockledge Branch Required Reduction:	10%	NA
Rockledge Branch Required Reduction:	1,708 lbs/year	NA

5.2 Control Measures

In order to meet the reduction requirement, Abington Township will implement one (1) Best Management Practice Control Measure in order to comply with the PRP reduction requirements stated above. These Best Management Practices (BMPs) will be as outlined below. Details and calculations detailing pollutant load removals for each BMP is found in *Appendices S thru AA*.

5.2.1 Rockledge Avenue Filter Box

The Rockledge Avenue Filter Box Project would be designed to intercept 26.5 acres of an upstream area tributary to the Rockledge Branch of the Pennypack Creek. This box would be a commercially available unit designed to remove silt and other pollutants. Numerous manufacturers have developed proprietary devices to treat stormwater runoff. These devices have been designed to treat one or more of the common stormwater pollutants, such as solids, metals, oil and grease, nutrients and bacteria. The ability of inclined cells (lamella plates) to provide excellent treatment of stormwater for a variety of pollutants was demonstrated by Pitt et al. (1999) in the report on the multi-chambered treatment train (MCTT) at the University of Alabama at Birmingham. Prior research has shown that combining treatment technologies provides the best overall treatment efficiencies. The proposed filter box is a Hydrodynamic Separator, named "TERRE KLEEN™", which has been designed to efficiently guide the storm water flow through the unit and enhance the gravitational settling of the entrained particles in such a way that flow patterns are virtually in the opposite direction of the pull of gravity. Inclined plate cell technology offers five to ten fold increase in efficiency compared to conventional settling and swirl settling technology because of the increased area of settling and reduced depth of settling. A high repetition of plates can lead to a basin size reduction to 10%-20% of conventional settling area requirements. The primary separation of solids will take place in a receiving chamber where oils and large debris float or sink. A baffle wall and optional screen separate the inclined plate cells located in the secondary chamber. It is important to note that the bottom of the inclined plate cells is at an elevation that resembles a water condition where turbulence is the main cause in particle suspension. Those particles will settle as the water flows upward at an incline in the settling cell. The pollutant reduction projected to be achieved by these constructed BMP is 4,200 lbs/year of silt. See *Appendix V* for backup calculations supporting the pollutant reduction projected for this BMP.

5.3 Reduction Summary

The following table is a summary of the expected load reductions obtained through the construction of the proposed BMPs.

ROBINHOOD BROOK PRP PLAN	SILTATION LOADS	
STEPL MODELING-WATERSHED EXISTING LOAD:	17,064	lbs/year
REQUIRED REDUCTION PERCENTAGE:	**10**	%
REDUCTION REQUIREMENT:	1,706	lbs/year
BMP's TO BE CONSTRUCTED	**SILTATION LOADS**	
ROCKLEDGE AVENUE FILTER BOX	4,200	lbs/year
TOTAL PROJECTED BMP POLLUTANT REDUCTION:	**4,200**	**lbs/year**

6.0 Terwood Run

6.1 Waste Load Allocation (2017 Modeling)

The current guidelines from the PADEP allow municipalities to utilize modeling in the watershed to develop existing base loads. This same modeling will be utilized to develop anticipated reductions from the proposed stormwater BMPs being proposed by the Township in this plan.

The existing base loads and the anticipated reduction loads presented in this report were modeled utilizing a model developed by the USEPA called STEPL, Version 4.3. STEPL (Spreadsheet Tool for Estimating Pollutant Load) is a customizable spreadsheet-based model for use in Excel. Using simple algorithms, it calculates nutrient and sediment loads from different land uses and the load reductions from the implementation of best management practices (BMPs). Annual nutrient loading (nitrogen, phosphorus and 5-day biological oxygen demand) is calculated based on the runoff volume and pollutant concentrations. The annual sediment load from sheet and rill erosion is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. Loading reductions resulting from the implementation of BMPs are computed from the known BMP efficiencies.

The STEPL Model has been selected based upon the fact that Temple University's Center for Sustainable Communities is utilizing this model as they develop recommendations for stormwater treatment improvements in the local watersheds surrounding Philadelphia. Temple University has been awarded a grant from the William Penn Foundation to provide oversight, expertise and support for what could potentially be dozens of restoration projects in the suburban portions of watersheds in the Philadelphia region. Abington Township has been working with their staffs to identify BMP sites and wish to standardize on the models used to estimate the pollutant loadings.

The following table summarizes the pollutant load reduction requirement for the Rockledge Brook using the STEPL Model:

Pollutant Load Reduction Requirement		
	Siltation	**Nutrients (TP)**
Terwood Run Existing Load:	13,830 lbs/year	NA
Terwood Run Required Reduction:	10%	NA
Terwood Run Required Reduction:	1,383 lbs/year	NA

6.2 Control Measures

In order to meet the reduction requirement, Abington Township will implement one (1) Best Management Practice Control Measure in order to comply with the PRP reduction requirements stated above. These Best Management Practices (BMPs) will be as outlined below. Details and calculations detailing pollutant load removals for each BMP is found in *Appendices S thru AA*.

6.2.1 Davidson Road Filter Box

The Davidson Road Filter Box Project would be designed to intercept 118 acres of an upstream area tributary to the Terwood Run. This box would be a commercially available unit designed to remove silt and other pollutants. Numerous manufacturers have developed proprietary devices to treat stormwater runoff. These devices have been designed to treat one or more of the common stormwater pollutants, such as solids, metals, oil and grease, nutrients and bacteria. The ability of inclined cells (lamella plates) to provide excellent treatment of stormwater for a variety of pollutants was demonstrated by Pitt et al. (1999) in the report on the multi-chambered treatment train (MCTT) at the University of Alabama at Birmingham. Prior research has shown that combining treatment technologies provides the best overall treatment efficiencies. The proposed filter box is a Hydrodynamic Separator, named "TERRE KLEEN™", which has been designed to efficiently guide the storm water flow through the unit and enhance the gravitational settling of the entrained particles in such a way that flow patterns are virtually in the opposite direction of the pull of gravity. Inclined plate cell technology offers five to ten fold increase in efficiency compared to conventional settling and swirl settling technology because of the increased area of settling and reduced depth of settling. A high repetition of plates can lead to a basin size reduction to 10%-20% of conventional settling area requirements. The primary separation of solids will take place in a receiving chamber where oils and large debris float or sink. A baffle wall and optional screen separate the inclined plate cells located in the secondary chamber. It is important to note that the bottom of the inclined plate cells is at an elevation that resembles a water condition where turbulence is the main cause in particle suspension. Those particles will settle as the water flows upward at an incline in the settling cell. The pollutant reduction projected to be achieved by these constructed BMP is 28,200 lbs/year of silt. See *Appendix W* for backup calculations supporting the pollutant reduction projected for this BMP.

6.3 Reduction Summary

The following table is a summary of the expected load reductions obtained through the construction of the proposed BMPs.

TERWOOD RUN PRP PLAN	**SILTATION LOADS**	
STEPL MODELING-WATERSHED EXISTING LOAD:	13,830	lbs/year
REQUIRED REDUCTION PERCENTAGE:	**10**	%
REDUCTION REQUIREMENT:	1,383	lbs/year
BMP's TO BE CONSTRUCTED	**SILTATION LOADS**	
DAVIDSON ROAD AVENUE FILTER BOX	28,200	lbs/year
TOTAL PROJECTED BMP POLLUTANT REDUCTION:	**28,200**	**lbs/year**

7.0 Wissahickon Creek

7.1 Waste Load Allocation (2017 Modeling)

The current guidelines from the PADEP allow municipalities to utilize modeling in the watershed to develop existing base loads. This same modeling will be utilized to develop anticipated reductions from the proposed stormwater BMPs being proposed by the Township in this plan.

The existing base loads and the anticipated reduction loads presented in this report were modeled utilizing a model developed by the USEPA called STEPL, Version 4.3. STEPL (Spreadsheet Tool for Estimating Pollutant Load) is a customizable spreadsheet-based model for use in Excel. Using simple algorithms, it calculates nutrient and sediment loads from different land uses and the load reductions from the implementation of best management practices (BMPs). Annual nutrient loading (nitrogen, phosphorus and 5-day biological oxygen demand) is calculated based on the runoff volume and pollutant concentrations. The annual sediment load from sheet and rill erosion is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. Loading reductions resulting from the implementation of BMPs are computed from the known BMP efficiencies.

The STEPL Model has been selected based upon the fact that Temple University's Center for Sustainable Communities is utilizing this model as they develop recommendations for stormwater treatment improvements in the local watersheds surrounding Philadelphia. Temple University has been awarded a grant from the William Penn Foundation to provide oversight, expertise and support for what could potentially be dozens of restoration projects in the suburban portions of watersheds in the Philadelphia region. Abington Township has been working with their staffs to identify BMP sites and wish to standardize on the models used to estimate the pollutant loadings.

The following table summarizes the pollutant load reduction requirement for the Wissahickon Creek using the STEPL Model:

Pollutant Load Reduction Requirement	
	Nutrients (TP)
Wissahickon Creek Existing Load:	268 lbs/year
Wissahickon Creek Required Reduction:	5%
Wissahickon Creek Required Reduction:	13.4 lbs/year

7.2 Control Measures

In order to meet the reduction requirement, Abington Township will implement one (1) Best Management Practice Control Measure in order to comply with the PRP reduction requirements stated above. These Best Management Practices (BMPs) will be as outlined below. Details and calculations detailing pollutant load removals for each BMP is found in *Appendices S thru AA*.

7.2.1 TMDL Measures-Hamel Avenue Infiltration Basin

The Hamel Avenue Infiltration Basin was constructed in 2007. The basin controls runoff from 54 Acres. The basin was constructed in a vacant lot the Township acquired when it received a grant to buy and remove a home with chronic flooding problems. The infiltration basin consists of a series of 60 inch diameter perforated pipes that are located in a bed of clean stone. Inlet and outlet structures allow maintenance of the facility. The pollutant reduction projected to be achieved by this BMP is 15,375 lbs/year of sediment and 54 lbs/year of Total phosphorous. See *Appendix D* for backup calculations supporting the pollutant reduction projected for this BMP.

7.3 Reduction Summary

The following table is a summary of the expected load reductions obtained through the construction of the proposed BMPs.

WISSAHICKON CREEK PRP PLAN	SILTATION LOADS		NUTRIENTS (TP)	
STEPL MODELING-WATERSHED EXISTING LOAD:	13,830	lbs/year	268	lbs/year
REQUIRED REDUCTION PERCENTAGE:	**10**	%	**5**	**%**
REDUCTION REQUIREMENT:	1,383	lbs/year	13.4	lbs/year
BMP's TO BE CONSTRUCTED	**SILTATION LOADS**			
TMDL BMP-Hamel Avenue Infiltration Basin	15,375	lbs/year	54	lbs/year
TOTAL PROJECTED BMP POLLUTANT REDUCTION:	**15,375**	**lbs/year**	**54**	**lbs/year**

8.0 Tacony and Frankford Creek

8.1 Waste Load Allocation (2017 Modeling)

The current guidelines from the PADEP allow municipalities to utilize modeling in the watershed to develop existing base loads. This same modeling will be utilized to develop anticipated reductions from the proposed stormwater BMPs being proposed by the Township in this plan.

The existing base loads and the anticipated reduction loads presented in this report were modeled utilizing a model developed by the USEPA called STEPL, Version 4.3. STEPL (Spreadsheet Tool for Estimating Pollutant Load) is a customizable spreadsheet-based model for use in Excel. Using simple algorithms, it calculates nutrient and sediment loads from different land uses and the load reductions from the implementation of best management practices (BMPs). Annual nutrient loading (nitrogen, phosphorus and 5-day biological oxygen demand) is calculated based on the runoff volume and pollutant concentrations. The annual sediment load from sheet and rill erosion is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. Loading reductions resulting from the implementation of BMPs are computed from the known BMP efficiencies.

The STEPL Model has been selected based upon the fact that Temple University's Center for Sustainable Communities is utilizing this model as they develop recommendations for stormwater treatment improvements in the local watersheds surrounding Philadelphia. Temple University has been awarded a grant from the William Penn Foundation to provide oversight, expertise and support for what could potentially be dozens of restoration projects in the suburban portions of watersheds in the Philadelphia region. Abington Township has been working with their staffs to identify BMP sites and wish to standardize on the models used to estimate the pollutant loadings.

The following table summarizes the pollutant load reduction requirement for the Tacony and Frankford Creeks using the STEPL Model:

Pollutant Load Reduction Requirement	
	Nutrients (TP)
Tacony & Frankford Creek Existing Load:	405 lbs/year
Tacony & Frankford Creek Required Reduction:	5%
Tacony & Frankford Creek Required Reduction:	20.25 lbs/year

8.2 Control Measures

In order to meet the reduction requirement, Abington Township will implement two (2) Best Management Practice Control Measure in order to comply with the PRP reduction requirements stated above. These Best Management Practices (BMPs) will be as outlined below. Details and calculations detailing pollutant load removals for each BMP is found in *Appendices S thru AA*.

8.2.1 Alverthorpe Park Extended Detention Basin

The Alverthorpe Park Extended Detention Basin will intercept the stormwater that currently flows to the Jenkintown Creek via Alverthorpe Pond. This basin would be constructed in the area near the Jenkintown Road entrance to the park. The stormwater is from a residential area just southwest of the park. The drainage area is 53.2 acres. The pollutant reduction projected to be achieved by the constructed BMP is 18.46 lbs/year of Total Phosphorus. The location of the proposed basin is an opening in woodland which has downed trees and invasive vines. There also is an impervious stockpile lot within drainage area to the proposed BMP. See *Appendix X* for backup calculations supporting the pollutant reduction projected for this BMP.

8.2.2 Alverthorpe Park Bioswale

The Alverthorpe Park Bioswale Project will intercept the stormwater that currently drains from the existing parking area of the park and lands above. The total drainage area is 55.9 acres. The parking lot is approximately 38,000 sq. ft. in size and drains towards Forrest Ave. There are no curbs and during storm events runoff from the parking lot sheet flows towards the front of the park. The proposal would be to capture the road runoff in a vegetated bioretention area with a subsurface stone trench. The overflow would discharge to the existing area of conveyance to the Jenkintown Creek. The vegetated bioretention area would be planted with deeper rooted native vegetation. The vegetation could include options such as low maintenance grasses, flowering perennials, or shrubs. This is a high visibility area near the park entrance that would provide storage and filtration of the parking lot runoff, as well as an educational opportunity for the park's users. The pollutant reduction projected to be achieved by the constructed BMP is 7.54 lbs/year of Total Phosphorus. See *Appendix X* for backup calculations supporting the pollutant reduction projected for this BMP.

8.3 Reduction Summary

The following table is a summary of the expected load reductions obtained through the construction of the proposed BMPs.

WISSAHICKON CREEK PRP PLAN	NUTRIENTS (TP)	
STEPL MODELING-WATERSHED EXISTING LOAD:	405	lbs/year
REQUIRED REDUCTION PERCENTAGE:	**5**	**%**
REDUCTION REQUIREMENT:	20.25	lbs/year
BMP's TO BE CONSTRUCTED		
Alverthorpe Extended Detension Basin	18.46	lbs/year
Alverthorpe Bioswale	7.54	lbs/year
TOTAL PROJECTED BMP POLLUTANT REDUCTION:	**26**	**lbs/year**

9.0 Sandy Run

9.1 Waste Load Allocation (2017 Modeling)

The current guidelines from the PADEP allow municipalities to utilize modeling in the watershed to develop existing base loads. This same modeling will be utilized to develop anticipated reductions from the proposed stormwater BMPs being proposed by the Township in this plan.

The existing base loads and the anticipated reduction loads presented in this report were modeled utilizing a model developed by the USEPA called STEPL, Version 4.3. STEPL (Spreadsheet Tool for Estimating Pollutant Load) is a customizable spreadsheet-based model for use in Excel. Using simple algorithms, it calculates nutrient and sediment loads from different land uses and the load reductions from the implementation of best management practices (BMPs). Annual nutrient loading (nitrogen, phosphorus and 5-day biological oxygen demand) is calculated based on the runoff volume and pollutant concentrations. The annual sediment load from sheet and rill erosion is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. Loading reductions resulting from the implementation of BMPs are computed from the known BMP efficiencies.

The STEPL Model has been selected based upon the fact that Temple University's Center for Sustainable Communities is utilizing this model as they develop recommendations for stormwater treatment improvements in the local watersheds surrounding Philadelphia. Temple University has been awarded a grant from the William Penn Foundation to provide oversight, expertise and support for what could potentially be dozens of restoration projects in the suburban portions of watersheds in the Philadelphia region. Abington Township has been working with their staffs to identify BMP sites and wish to standardize on the models used to estimate the pollutant loadings.

The following table summarizes the pollutant load reduction requirement for the Sandy Run using the STEPL Model:

Pollutant Load Reduction Requirement	
	Nutrients (TP)
Sandy Run Existing Load:	2,477 lbs/year
Sandy Run Required Reduction:	5%
Sandy Run Required Reduction:	123.84 lbs/year

9.2 Control Measures

In order to meet the reduction requirement, Abington Township will seventeen (17) Best Management Practice Control Measures as part of the TMDL Plan. These BMP Measures will also allow the Township to comply with the PRP reduction requirements stated above. These Best Management Practices (BMPs) will be as outlined in Part A of this report, *Wissahickon TMDL Plan*. Details and calculations detailing pollutant load removals for each BMP is found in *Appendices A thru R*.

9.2.1 TMDL Measures-All TMDL BMPs except Hamel Avenue Infiltration Basin

See Part A of this report for a description of the BMPs proposed for the Sandy Run Drainage Basin TMDL Plan.

9.3 Reduction Summary

The following table is a summary of the expected load reductions obtained through the construction of the proposed BMPs.

SANDY RUN PRP PLAN	NUTRIENTS (TP)	
STEPL MODELING-WATERSHED EXISTING LOAD:	2,477	lbs/year
REQUIRED REDUCTION PERCENTAGE:	**5**	**%**
REDUCTION REQUIREMENT:	123.85	lbs/year
BMP's TO BE CONSTRUCTED		
TMDL BMP-Hamel Avenue Infiltration Basin	499	lbs/year
TOTAL PROJECTED BMP POLLUTANT REDUCTION:	**499**	**lbs/year**

10.0 Budget and Schedule

The following table shows Total Projected Construction and Engineering Costs for implementing the Township of Abington's PRP Program. The plan must be implemented within the following schedule:

- **PCP Plans**: Within five (5) years following PADEP approval of coverage.

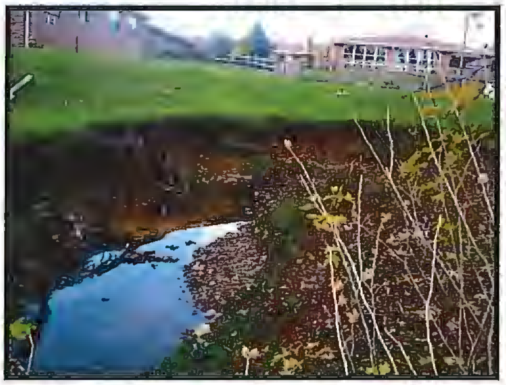
PRP BMP Cost Projections (5 Year Schedule)

POLLUTANT REDUCTION: BMP's TO BE CONSTRUCTED	Budget			
	Construction	Engineering	Grant (Act & Pot)	Total
Pennypack Creek Melmar Rd Basin	$ 75,000.00	$ 11,250.00	$ -	$ 86,250.00
Pennypack Creek Wyndmoor LA Basin	$ 75,000.00	$ 11,250.00	$ -	$ 86,250.00
Pennypack Creek Irvin Road Streambank Stabilization**	$ 50,000.00	$ 7,500.00	$ -	$ 57,500.00
Meadowbrook Streambank Stabilization in Scout Preserve	$ 135,000.00	$ 8,050.00	$ -	$ 143,050.00
Meadowbrook Streambank Stabilization in Bird Sanctuary	$ 90,000.00	$ 8,280.00	$ -	$ 98,280.00
Robinhood Brook Sharpless Road Filter Box	$ 75,000.00	$ 6,900.00	$ -	$ 81,900.00
Rockledge Branch Rockledge Avenue Lane Filter Box	$ 75,000.00	$ 9,430.00	$ -	$ 84,430.00
Terwood Run Davidson Road Filter Box	$ 75,000.00	$ 10,900.00	$ -	$ 85,900.00
TTF Alverthorpe Park Extended Detention Basin	$ 100,000.00	$ 15,000.00	$ -	$ 115,000.00
TTF Alverthorpe Park Bioswale	$ 115,000.00	$ 17,250.00		$ 132,250.00
Wissahickon TMDL Measures	$ -	$ -	$ -	$ -
Sandy Run TMDL Measures	$ -	$ -	$ -	$ -
Estimated Project Costs for PRP Plan BMPs	$ 865,000.00	$ 105,810.00	$ -	$ 970,810.00

** 2017 Capital Budget

PART C

POLLUTANT CONTROL MEASURES



PART C: POLLUTANT CONTROL MEASURES

1.0 Background Information

As part of the new individual permit application, the Township is required to prepare Pollutant Control Measures (PCMs) for streams in the Township that are impaired for pathogens (Permit Appendix B) and priority organic compounds (Permit Appendix C).

PCMs are activities undertaken by the MS4 permittee to identify and control pollutant loading to impaired waters from MS4s, regardless of whether a TMDL has been approved. PCMs are BMPs and other strategies that are in addition to the permittee's Stormwater Management Plan. PCMs must be implemented in Abington for the following impairments:

- Where surface waters are impaired for Pathogens (e.g., Fecal Coliform), Abington shall implement the PCMs similar to those identified in Appendix B of the General Permit, in accordance with the schedule therein. ***A Pathogen PCM will be required for the Wissahickon Creek, Sandy Run Creek and the Pennypack Creek.***
- Where surface waters are impaired for Priority Organic Compounds (e.g., Polychlorinated Biphenyls (PCBs), pesticides, or other organic compounds), Abington shall implement the PCMs similar to those identified in Appendix C of the General Permit, in accordance with the schedule therein. ***A Priority Organic Compounds PCM will be required for the Frankford Creek and the Pennypack Creek.***

2.0 PCM for Waters Impaired By Pathogens

Abington Township will implement the following Pathogen Pollutant Control Measures (PCMs) within the Wissahickon Creek, Sandy Run Creek and the Pennypack Creek storm sewershed.

Map and Inventory.

Abington Township will develop map(s) of the storm sewershed(s) associated with all outfalls that discharge to surface waters subject to Pathogens. The purpose is to identify the area the township is responsible for within its legal boundaries in developing a source inventory. The map(s) will be submitted to DEP with an Annual MS4 Status Report due no later than September 30, 2019.

Abington Township will develop an inventory of all suspected and known sources of bacteria in stormwater within the storm sewershed, at a minimum, that discharge to impaired waters. The inventory must identify whether the source is suspected or known, the basis for this determination, the responsible party (if known), and any corrective action Abington has taken or plans to take for any of these sources. The inventory will be submitted to DEP with an Annual MS4 Status Report due no later than September 30, 2020.

Investigation.

Abington Township will complete an investigation of each suspected source. This investigation will include stormwater sampling if the investigation is required as part of implementing the IDD&E program under MCM #3 of the SWMP, and otherwise is voluntary. The results of the investigation will be submitted to DEP with an Annual MS4 Status Report due no later than September 30, 2022.

Enforcement

Abington Township will enforce ordinances that prohibit illicit and illegal connections and discharges of sewage to the MS4. Anytime an illicit and illegal connection or discharge of sewage into the MS4 is discovered by the township, the township will report the finding in the subsequent Annual MS4 Status Report along with a description of corrective action by the township.

If not already established in its Stormwater Management Ordinance, Abington Township will enact an ordinance or develop and adopt an SOP that requires proper management of animal wastes on property owned by the township. If an ordinance or SOP already exists that controls animal wastes, it will be attached to the first Annual MS4 Status Report no later than September 30, 2018. If a new ordinance or SOP is enacted or adopted, the new ordinance or SOP will be attached to the first Annual MS4 Status Report due following enactment or adoption, but no later than September 30, 2022.

Documentation

Abington Township will document the progress of its investigations, source control efforts and BMPs to control sources of pathogens in its Annual MS4 Status Reports.

3.0 PCM for Waters Impaired By Priority Organic Compounds

Abington Township will implement the following Pollutant Control Measures (PCMs) within the Frankford Creek and the Pennypack Creek storm sewershed. Priority Organic Compounds, include, but are not limited to Polychlorinated Biphenyls (PCBs), Pesticides, and any other organic compound listed at 40 CFR Part 423, Appendix A.

Map and Inventory.

Abington Township will develop map(s) of the storm sewershed(s) associated with all outfalls that discharge to surface waters subject to Priority Organic Compounds. The purpose is to identify the area the Township is responsible for within its legal boundaries in developing a source inventory. Abington Township will submit to the PADEP with an Annual MS4 Status Report due no later than September 30, 2019.

Abington Township will develop an inventory of all suspected and known anthropogenic (caused or produced by humans) sources of Priority Organic Compounds in stormwater within the drainage area of outfalls discharging to impaired waters. The inventory will identify whether the source is suspected or known, the basis for this determination, the responsible party (if known), and any corrective action the township has taken or plans to take for any of these sources. Abington Township will submit, the inventory to the PADEP with an Annual MS4 Status Report due no later than September 30, 2020.

Investigation

Abington Township will complete an investigation of each suspected source. This investigation will include stormwater sampling if the investigation is required as part of implementing the IDD&E program under MCM #3 of the Township's Permit, and otherwise is voluntary. Abington Township will submit the results of the investigation to PADEP with an Annual MS4 Status Report due no later than September 30, 2022.

Where it is determined that sources of Priority Organic Compounds are being discharged in stormwater from industrial sites into the Township's MS4, the Township will notify the PADEP in writing within 90 days of the Township's findings. PADEP may require the owner or operator of the industrial site to submit an application for NPDES permit coverage and/or implement BMPs to reduce pollutant loadings. This written notification is required only once per industrial site.

The Township will document the progress of its investigations, source control efforts and BMPs to control sources of Priority Organic Compounds in its Annual MS4 Status Reports.

4.0 Budget and Schedule

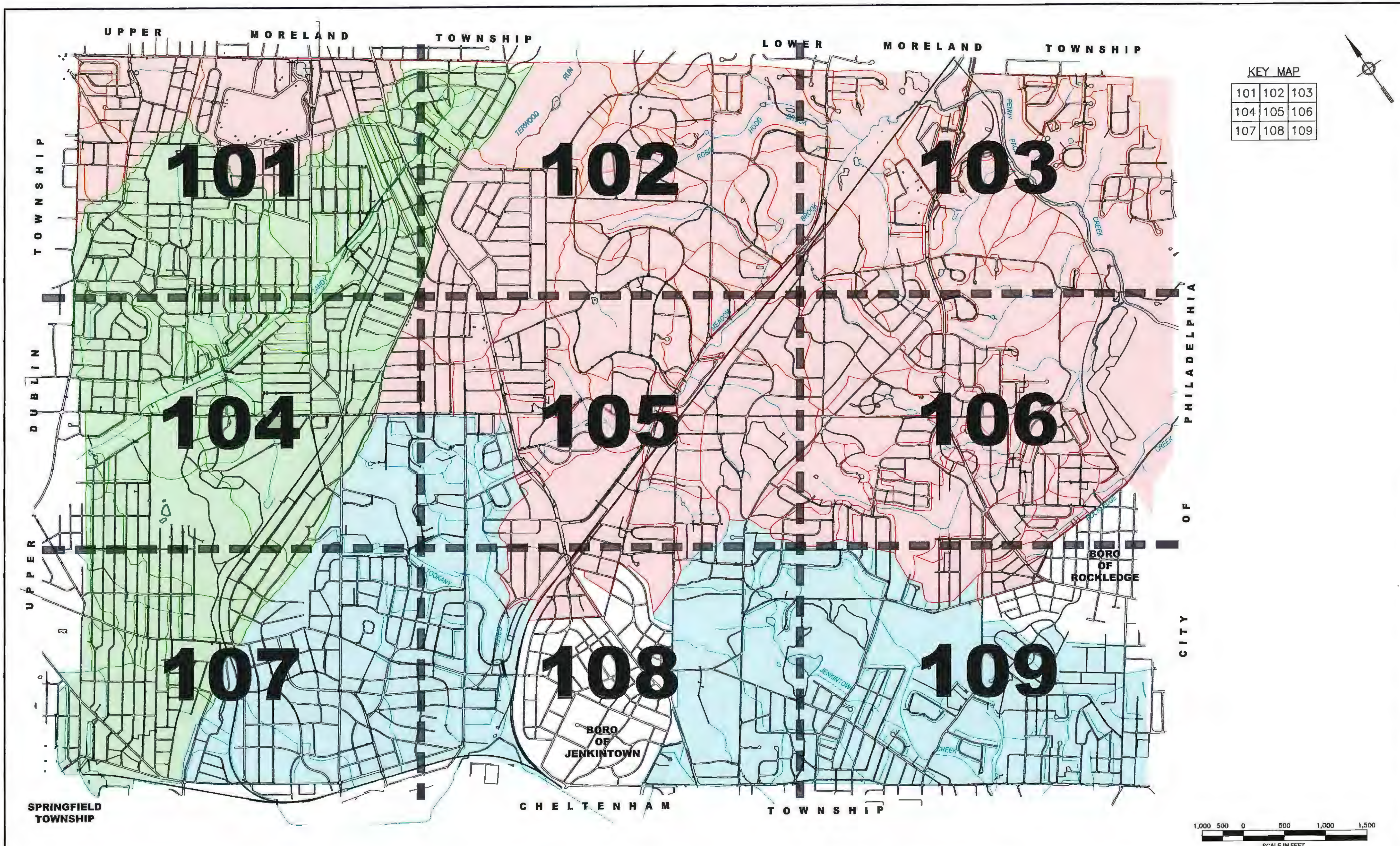
The following table shows Total Projected Construction and Engineering Costs for implementing the Township of Abington's PCM Program. The plan must be implemented within the following schedule:

- **PCM Plans: Pathogen Plans:**

	Mapping:	September 30, 2019
	Inventory:	September 30, 2020
	Investigation:	September 30, 2022
	Enforcement:	September 30, 2022

- **PCM Plans: Priority Organics:**

	Mapping:	September 30, 2019
	Inventory:	September 30, 2020
	Investigation:	September 30, 2022



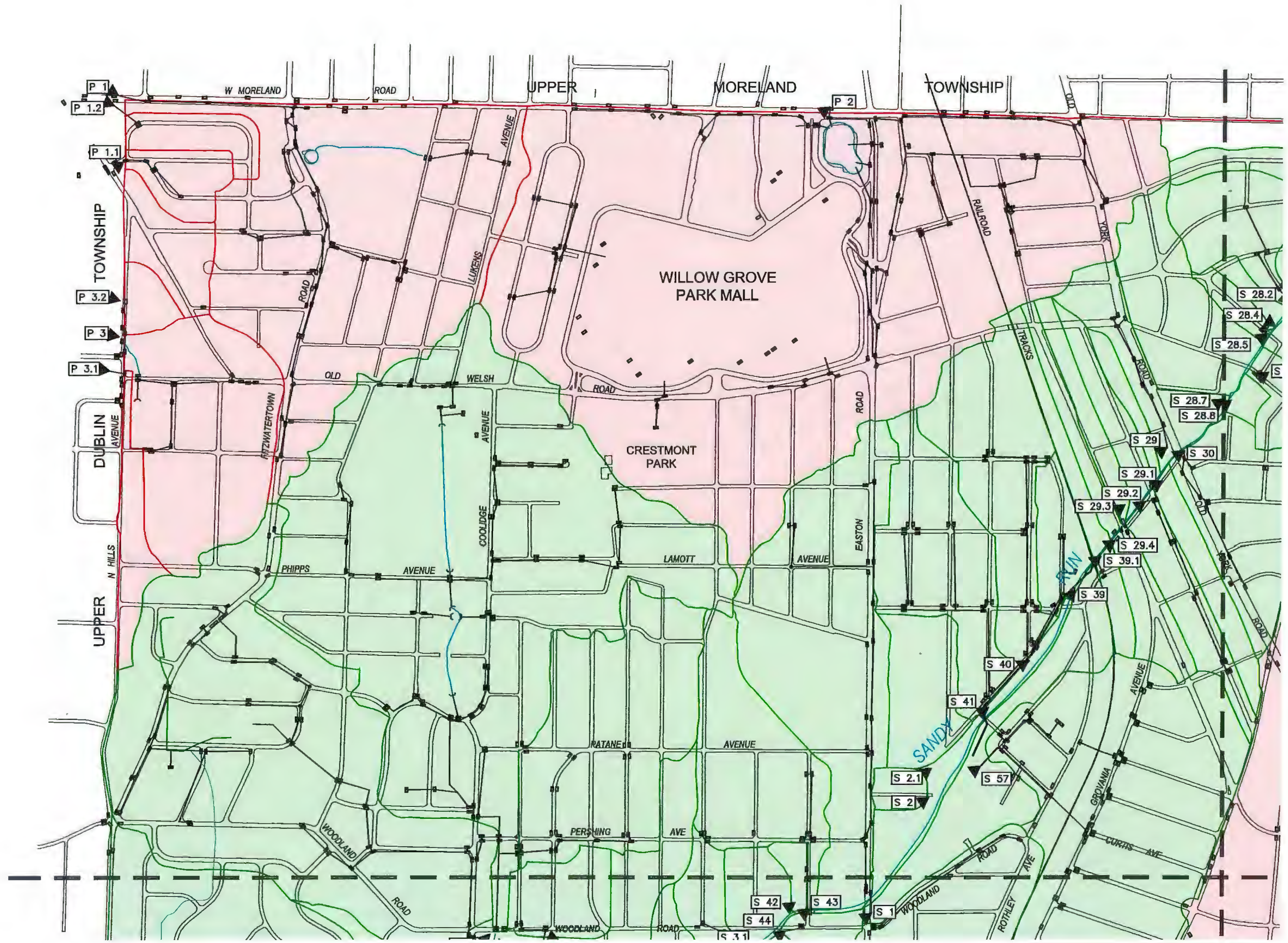
REVISIONS	DATE	ENGR.	DATE	ISSUED FOR

BCM ENGINEERS
ATC GROUP SERVICES LLC
920 Germantown Pike, Suite 200 Plymouth Meeting, PA 19462

DESIGN ENGR. MFP	APPROVED	SEAL	**ABINGTON TOWNSHIP** **MONTGOMERY COUNTY, PENNSYLVANIA** STORM SEWER SYSTEM MAP	SCALE 1" = 1,000'
DRAWN BY JPB				PROJECT NO. Z057000047
PROJECT ENGR. MF	APPROVED		ABINGTON TOWNSHIP STORM SEWER SYSTEM INLETS AND OUTFALLS	DRAWING NO. 100
PROJECT MGR. MF				SHEET OF
CHECKED BY	DATE MAY 3, 2017			

REGISTERED PROFESSIONAL ENGINEER

S:\57FILESERVER\CADD\ABINGTON\GIS\ABINGTON STORM MAP.dwg, 100, 5/2/2017 3:53:46 PM, 1:2.26326



KEY MAP

101	102	103
104	105	106
107	108	109

400 200 0 400 800 1,200
SCALE IN FEET

REVISIONS	DATE	ENGR.	DATE	ISSUED FOR

BCM ENGINEERS
ATC GROUP SERVICES LLC
920 Germantown Pike, Suite 200 Plymouth Meeting, PA 19462

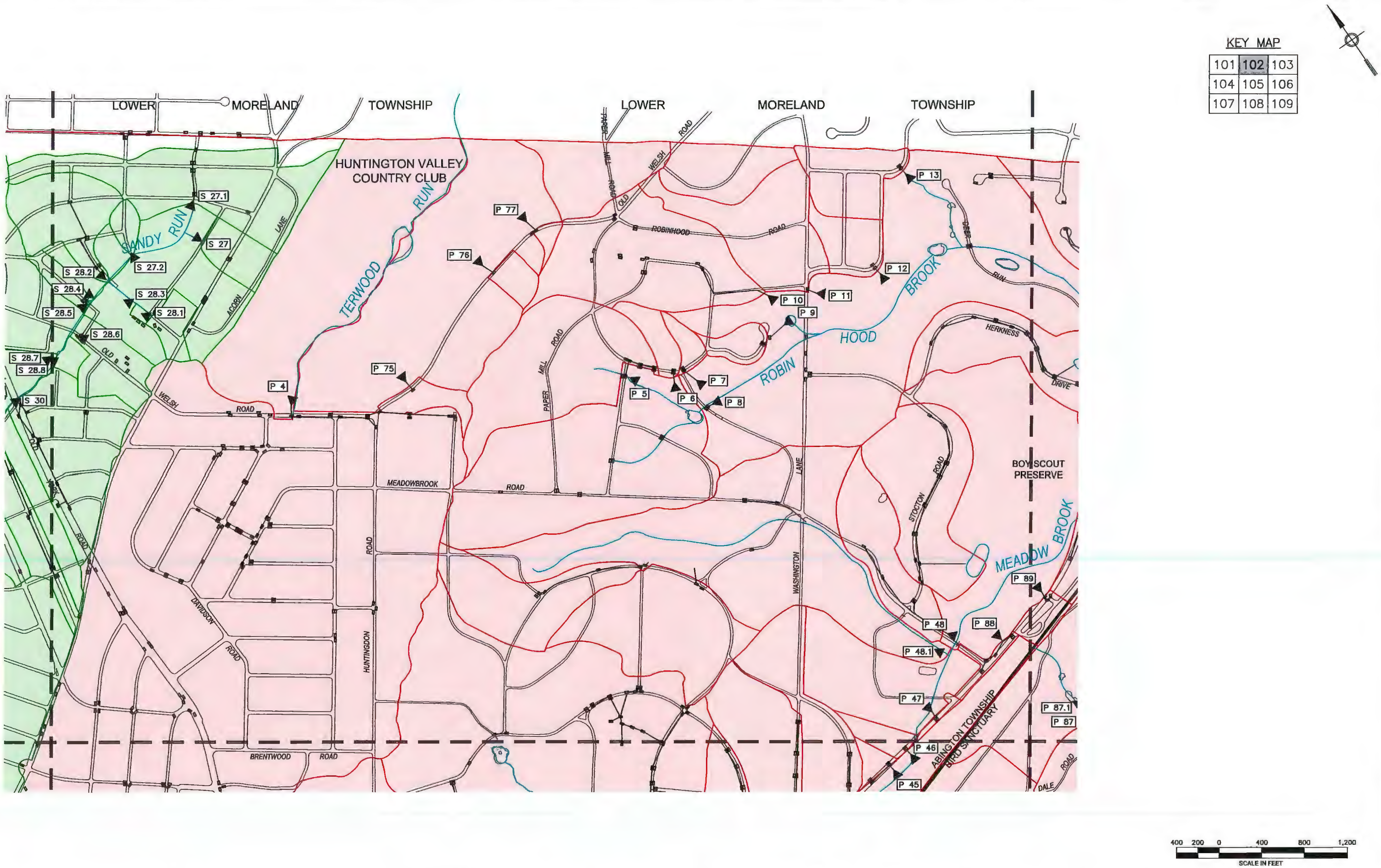
DESIGN ENGR. MFP
DRAWN BY JPB
PROJECT ENGR. MF
PROJECT MGR. MF
CHECKED BY
APPROVED
APPROVED
DATE MAY 3, 2017
SEAL
REGISTERED PROFESSIONAL ENGINEER

ABINGTON TOWNSHIP
MONTGOMERY COUNTY, PENNSYLVANIA
STORM SEWER SYSTEM MAP

ABINGTON TOWNSHIP
STORM SEWER SYSTEM
INLETS AND OUTFALLS

SCALE 1" = 400'
PROJECT NO. Z057000047
DRAWING NO. 101
SHEET OF

S:\57FILESERVER\CADD\ABINGTON\GIS\ABINGTON STORM MAP.dwg, 101, 5/2/2017 3:17:43 PM, 1:2.26326



REVISIONS	DATE	ENGR.	DATE	ISSUED FOR

BCM ENGINEERS
ATC GROUP SERVICES LLC
920 Germantown Pike, Suite 200 Plymouth Meeting, PA 19462

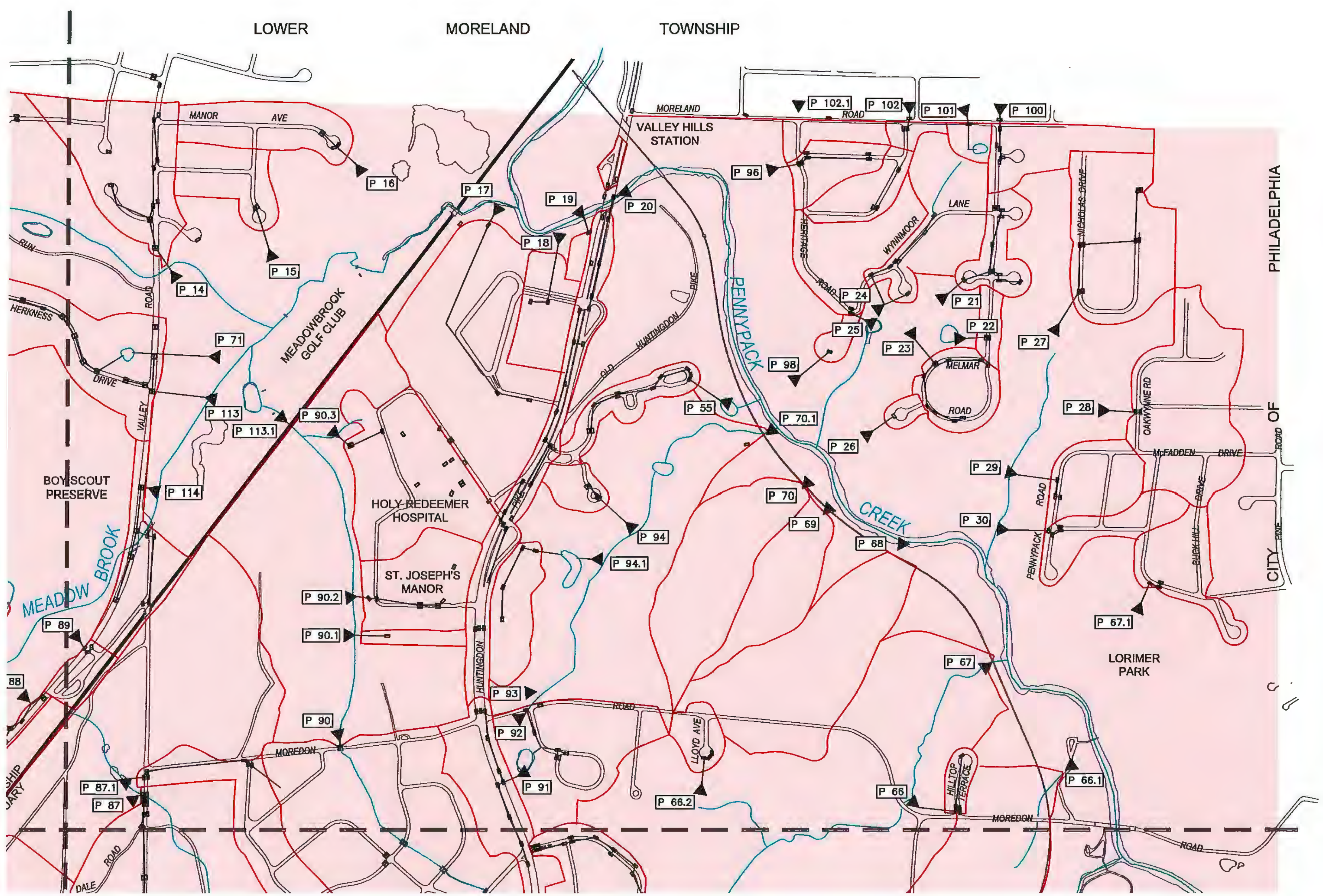
DESIGN ENGR. MFP	APPROVED	SEAL
DRAWN BY JPB		
PROJECT ENGR. MF	APPROVED	
PROJECT MGR. MF		
CHECKED BY	DATE MAY 3, 2017	

REGISTERED PROFESSIONAL ENGINEER

ABINGTON TOWNSHIP
MONTGOMERY COUNTY, PENNSYLVANIA
STORM SEWER SYSTEM MAP

ABINGTON TOWNSHIP
STORM SEWER SYSTEM
INLETS AND OUTFALLS

SCALE	1" = 400'
PROJECT NO.	Z057000047
DRAWING NO.	102
SHEET	OF



KEY MAP

101	102	103
104	105	106
107	108	109

400 200 0 400 800 1,200
SCALE IN FEET

REVISIONS	DATE	ENGR.	DATE	ISSUED FOR

BCM ENGINEERS
ATC GROUP SERVICES LLC
920 Germantown Pike, Suite 200 Plymouth Meeting, PA 19462

DESIGN ENGR. MFP	APPROVED	SEAL	
DRAWN BY JPB			
PROJECT ENGR. MF	APPROVED		
PROJECT MGR. MF			
CHECKED BY	DATE MAY 3, 2017		

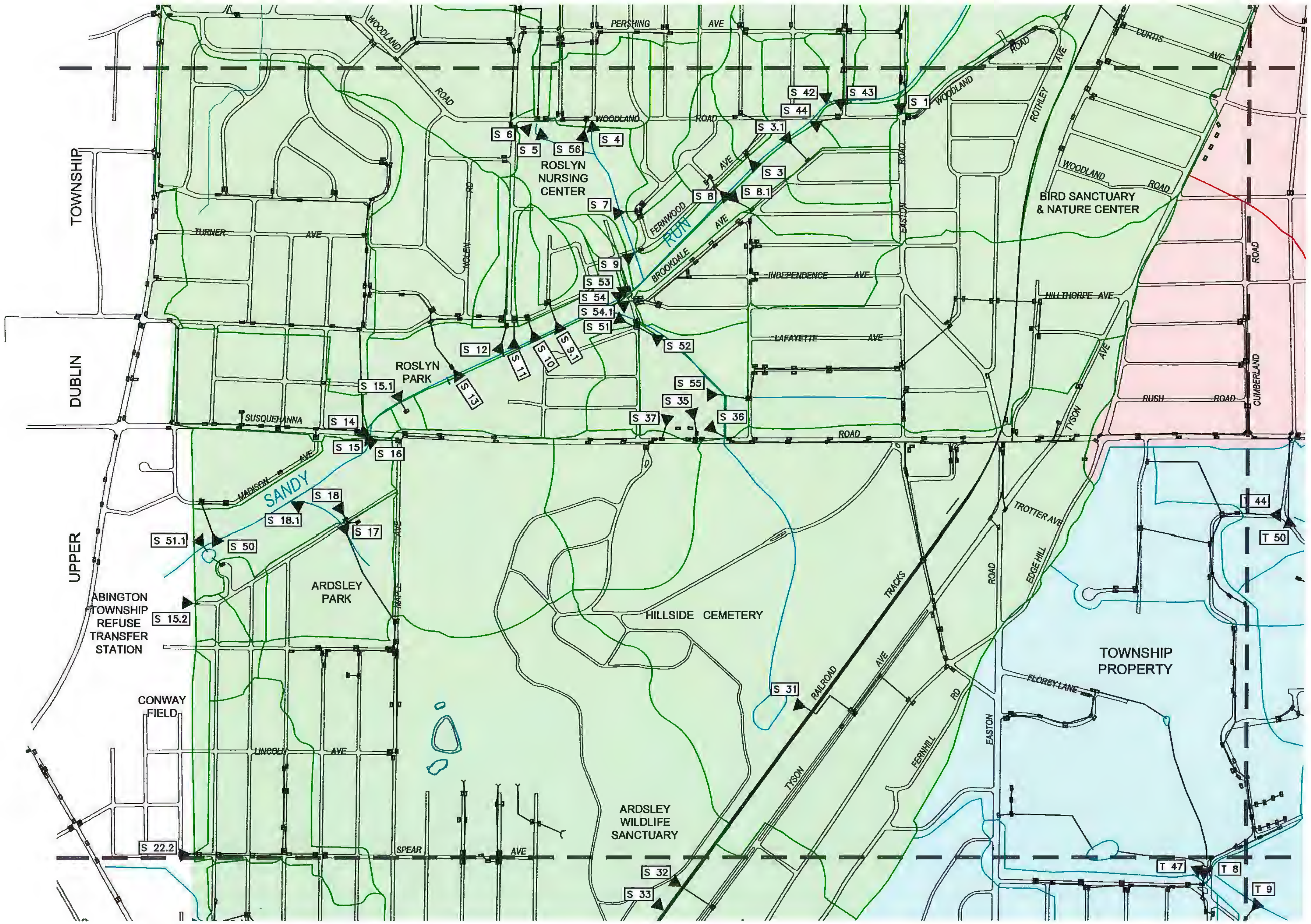
REGISTERED PROFESSIONAL ENGINEER

ABINGTON TOWNSHIP
MONTGOMERY COUNTY, PENNSYLVANIA
STORM SEWER SYSTEM MAP

ABINGTON TOWNSHIP
STORM SEWER SYSTEM
INLETS AND OUTFALLS

SCALE	1" = 400'
PROJECT NO.	Z057000047
DRAWING NO.	103
SHEET	OF

S:\57FILESERVER\CADD\ABINGTON\GIS\ABINGTON STORM MAP.dwg, 103, 5/2/2017 2:27:09 PM, 1:2.26326



KEY MAP

101	102	103
104	105	106
107	108	109

400 200 0 400 800 1,200

SCALE IN FEET

REVISIONS	DATE	ENGR.	DATE	ISSUED FOR

BCM ENGINEERS

ATC GROUP SERVICES LLC

920 Germantown Pike, Suite 200 Plymouth Meeting, PA 19462

DESIGN ENGR. MFP

DRAWN BY JPB

PROJECT ENGR. MF

PROJECT MGR. MF

CHECKED BY

APPROVED

APPROVED

DATE MAY 3, 2017

SEAL

REGISTERED PROFESSIONAL ENGINEER

ABINGTON TOWNSHIP

MONTGOMERY COUNTY, PENNSYLVANIA

STORM SEWER SYSTEM MAP

ABINGTON TOWNSHIP
STORM SEWER SYSTEM
INLETS AND OUTFALLS

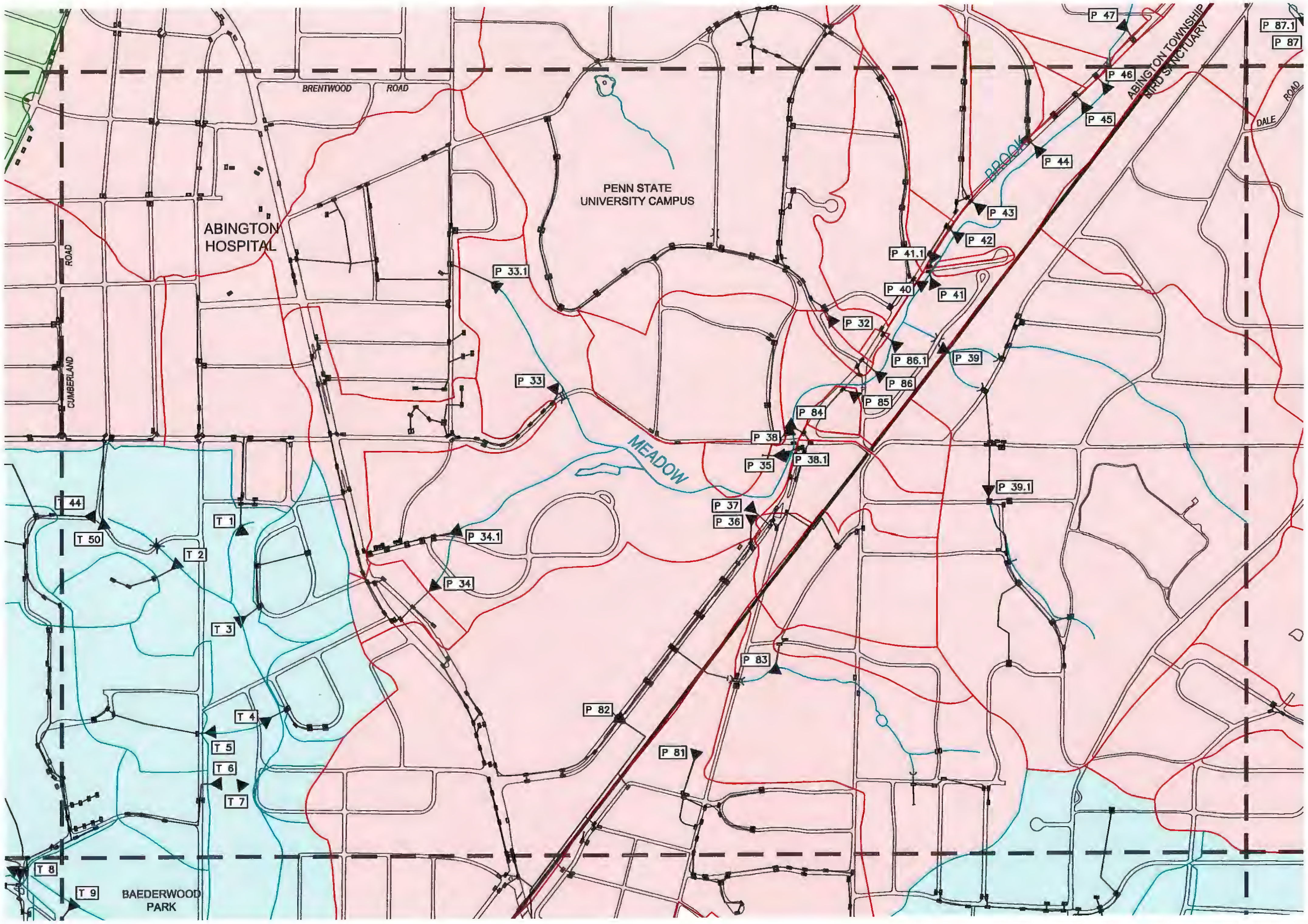
SCALE 1" = 400'

PROJECT NO. Z057000047

DRAWING NO. 104

SHEET of

S:\57FILESERVER\CADD\ABINGTON\GIS\ABINGTON STORM MAP.dwg, 104, 5/2/2017 1:52:45 PM, 1:2.26326



KEY MAP

101	102	103
104	105	106
107	108	109

400 200 0 400 800 1,200

SCALE IN FEET

REVISIONS	DATE	ENGR.	DATE	ISSUED FOR

BCM ENGINEERS

ATC GROUP SERVICES LLC

920 Germantown Pike, Suite 200 Plymouth Meeting, PA 19462

DESIGN ENGR. MFP	APPROVED	SEAL	
DRAWN BY JPB			
PROJECT ENGR. MF	APPROVED		
PROJECT MGR. MF			
CHECKED BY	DATE MAY 3, 2017		

REGISTERED PROFESSIONAL ENGINEER

ABINGTON TOWNSHIP

MONTGOMERY COUNTY, PENNSYLVANIA

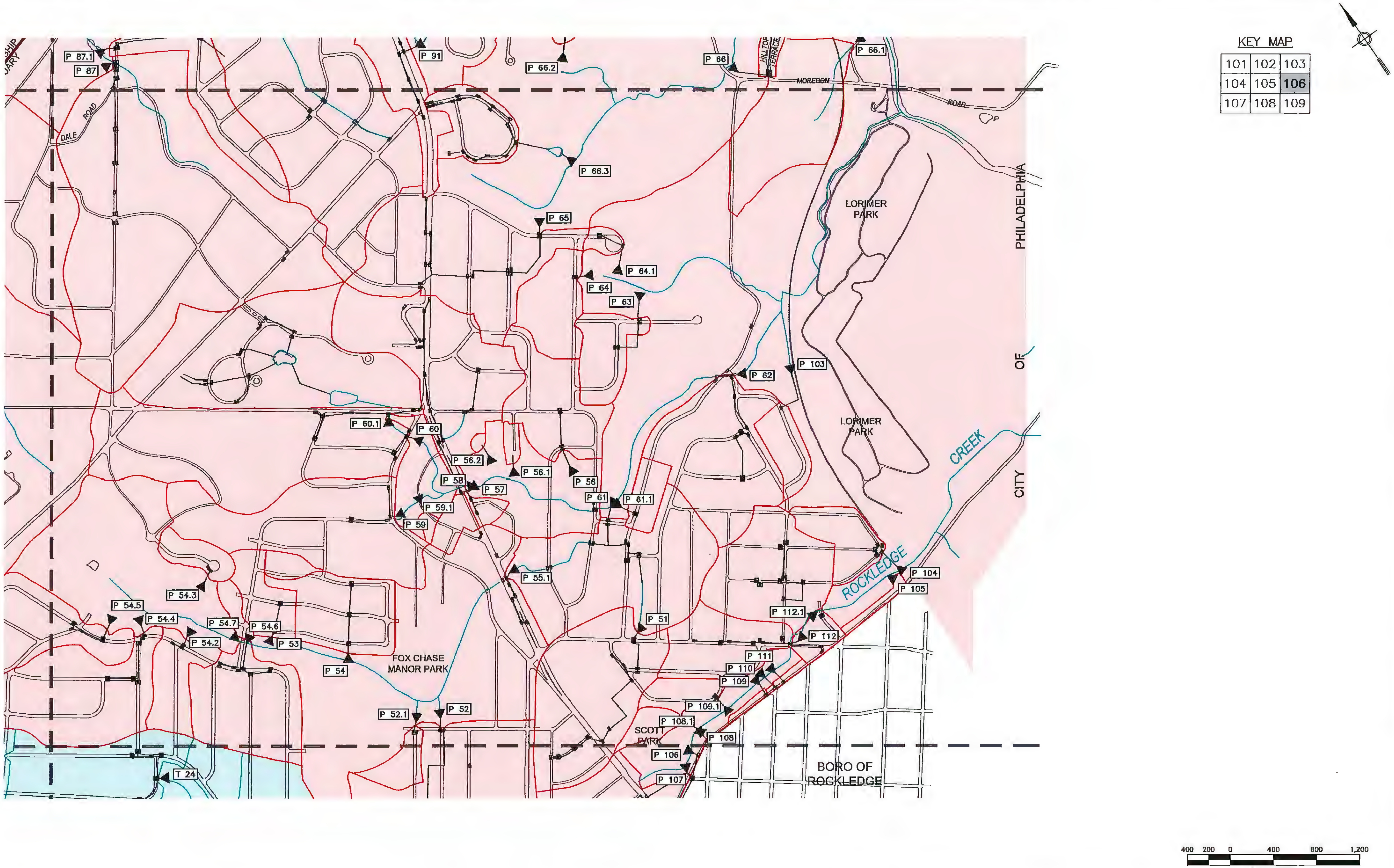
STORM SEWER SYSTEM MAP

ABINGTON TOWNSHIP

STORM SEWER SYSTEM

INLETS AND OUTFALLS

SCALE	1" = 400'
PROJECT NO.	Z057000047
DRAWING NO.	105
SHEET	OF



REVISIONS	DATE	ENGR.	DATE	ISSUED FOR

BCM ENGINEERS
ATC GROUP SERVICES LLC
920 Germantown Pike, Suite 200 Plymouth Meeting, PA 19462

DESIGN ENGR.	MFP
DRAWN BY	JPB
PROJECT ENGR.	MF
PROJECT MGR.	MF
CHECKED BY	

APPROVED

APPROVED

DATE MAY 3, 2017

SEAL

REGISTERED PROFESSIONAL ENGINEER

ABINGTON TOWNSHIP
MONTGOMERY COUNTY, PENNSYLVANIA
STORM SEWER SYSTEM MAP

ABINGTON TOWNSHIP
STORM SEWER SYSTEM
INLETS AND OUTFALLS

SCALE	1" = 400'
PROJECT NO.	Z057000047
DRAWING NO.	106
SHEET	of

S:\57FILESERVER\CADD\ABINGTON\GIS\ABINGTON STORM MAP.dwg, 106, 5/2/2017 3:18:45 PM, 1:2.26326

REVISIONS	DATE	ENGR.	DATE	ISSUED FOR

BCM ENGINEERS
ATC GROUP SERVICES LLC
920 Germantown Pike, Suite 200 Plymouth Meeting, PA 19462

DESIGN ENGR. MFP	APPROVED	SEAL	
DRAWN BY JPB			
PROJECT ENGR. MF	APPROVED		
PROJECT MGR. MF			
CHECKED BY	DATE MAY 3, 2017		

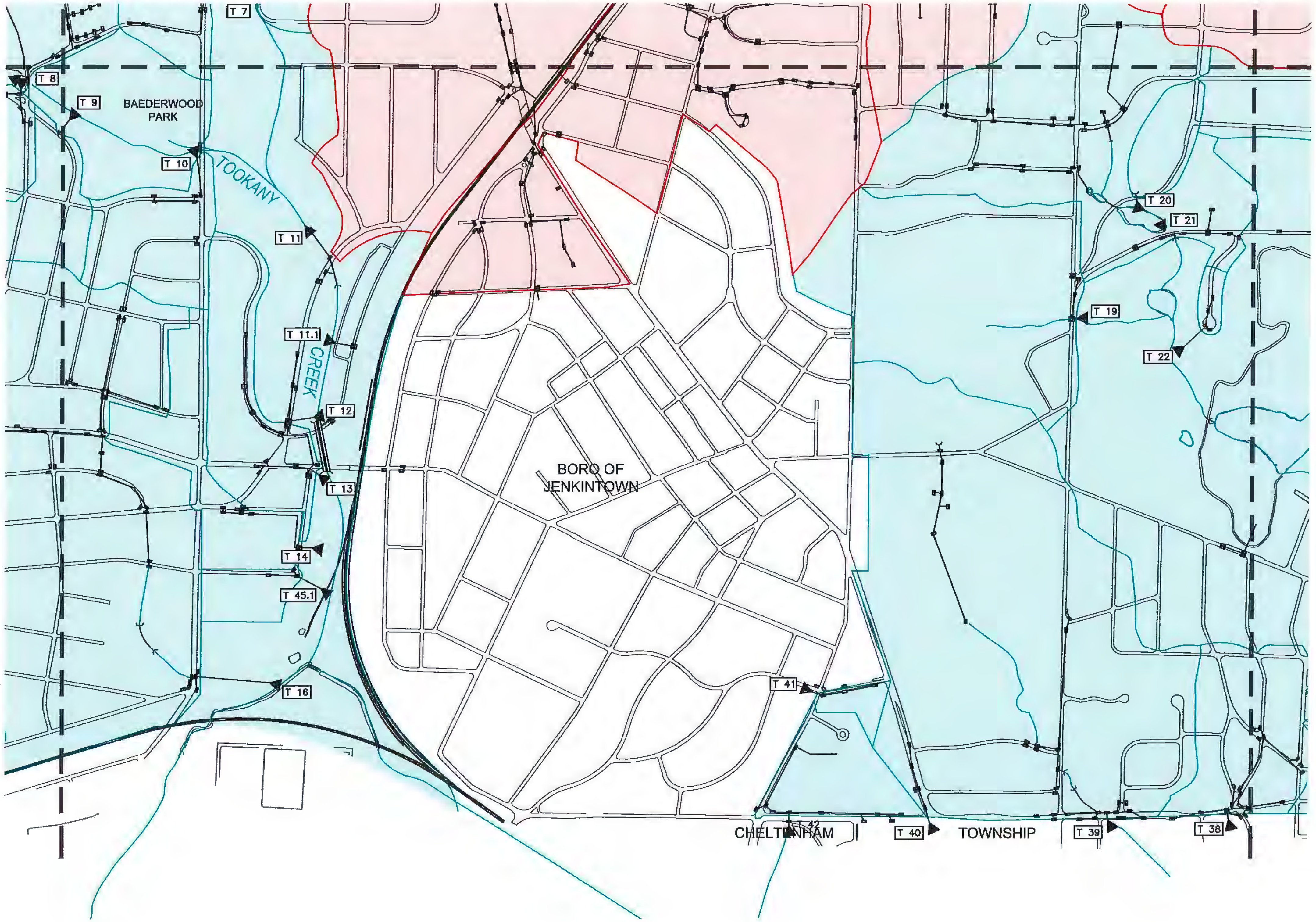
REGISTERED PROFESSIONAL ENGINEER

ABINGTON TOWNSHIP
MONTGOMERY COUNTY, PENNSYLVANIA
STORM SEWER SYSTEM MAP

ABINGTON TOWNSHIP
STORM SEWER SYSTEM
INLETS AND OUTFALLS

SCALE	1" = 400'
PROJECT NO.	Z057000047
DRAWING NO.	107
SHEET	of

S:\57FILESERVER\CADD\ABINGTON\GIS\ABINGTON STORM MAP.dwg, 107, 5/2/2017 3:19:10 PM, 1:2.26326



KEY MAP

101	102	103
104	105	106
107	108	109

400 200 0 400 800 1,200

SCALE IN FEET

REVISIONS	DATE	ENGR.	DATE	ISSUED FOR

BCM ENGINEERS

ATC GROUP SERVICES LLC

920 Germantown Pike, Suite 200 Plymouth Meeting, PA 19462

DESIGN ENGR. MFP	APPROVED	SEAL	
DRAWN BY JPB			
PROJECT ENGR. MF	APPROVED		
PROJECT MGR. MF			
CHECKED BY	DATE MAY 3, 2017		

REGISTERED PROFESSIONAL ENGINEER

ABINGTON TOWNSHIP

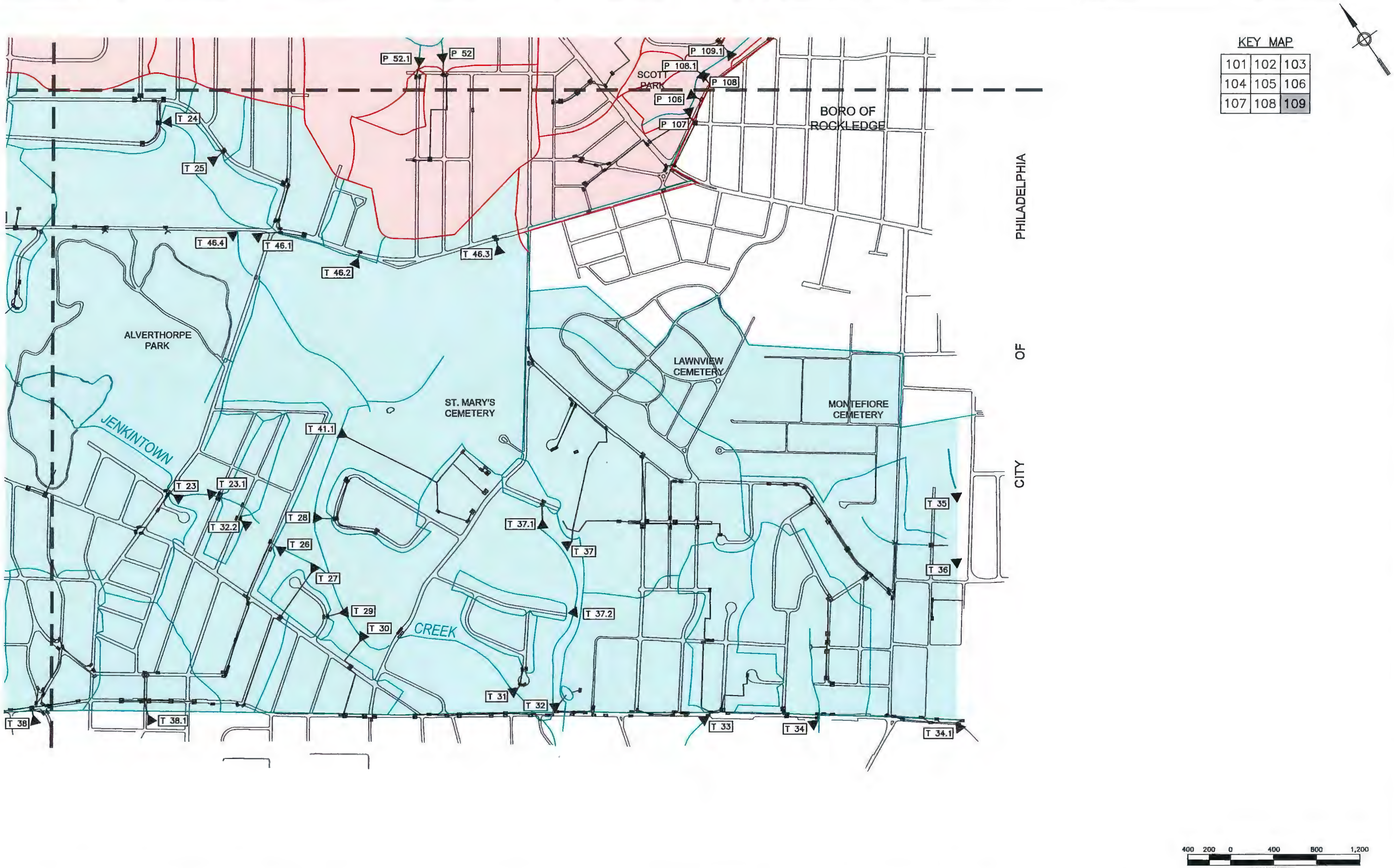
MONTGOMERY COUNTY, PENNSYLVANIA

STORM SEWER SYSTEM MAP

ABINGTON TOWNSHIP
STORM SEWER SYSTEM
INLETS AND OUTFALLS

SCALE	1" = 400'
PROJECT NO.	Z057000047
DRAWING NO.	108
SHEET	of

S:\57FILESERVER\CADD\ABINGTON\GIS\ABINGTON STORM MAP.dwg, 108, 5/2/2017 3:19:49 PM, 1:2.26326



REVISIONS	DATE	ENGR.	DATE	ISSUED FOR

BCM ENGINEERS
ATC GROUP SERVICES LLC
920 Germantown Pike, Suite 200 Plymouth Meeting, PA 19462

DESIGN ENGR. MFP	APPROVED	SEAL	
DRAWN BY JPB			
PROJECT ENGR. MF	APPROVED		
PROJECT MGR. MF			
CHECKED BY	DATE MAY 3, 2017		

REGISTERED PROFESSIONAL ENGINEER

ABINGTON TOWNSHIP
MONTGOMERY COUNTY, PENNSYLVANIA
STORM SEWER SYSTEM MAP

ABINGTON TOWNSHIP
STORM SEWER SYSTEM
INLETS AND OUTFALLS

SCALE	1" = 400'
PROJECT NO.	Z057000047
DRAWING NO.	109
SHEET	OF

S:\57FILESERVER\CADD\ABINGTON\GIS\ABINGTON STORM MAP.dwg, 109, 5/2/2017 3:20:38 PM, 1:2.26326

Engineering Individual Solutions

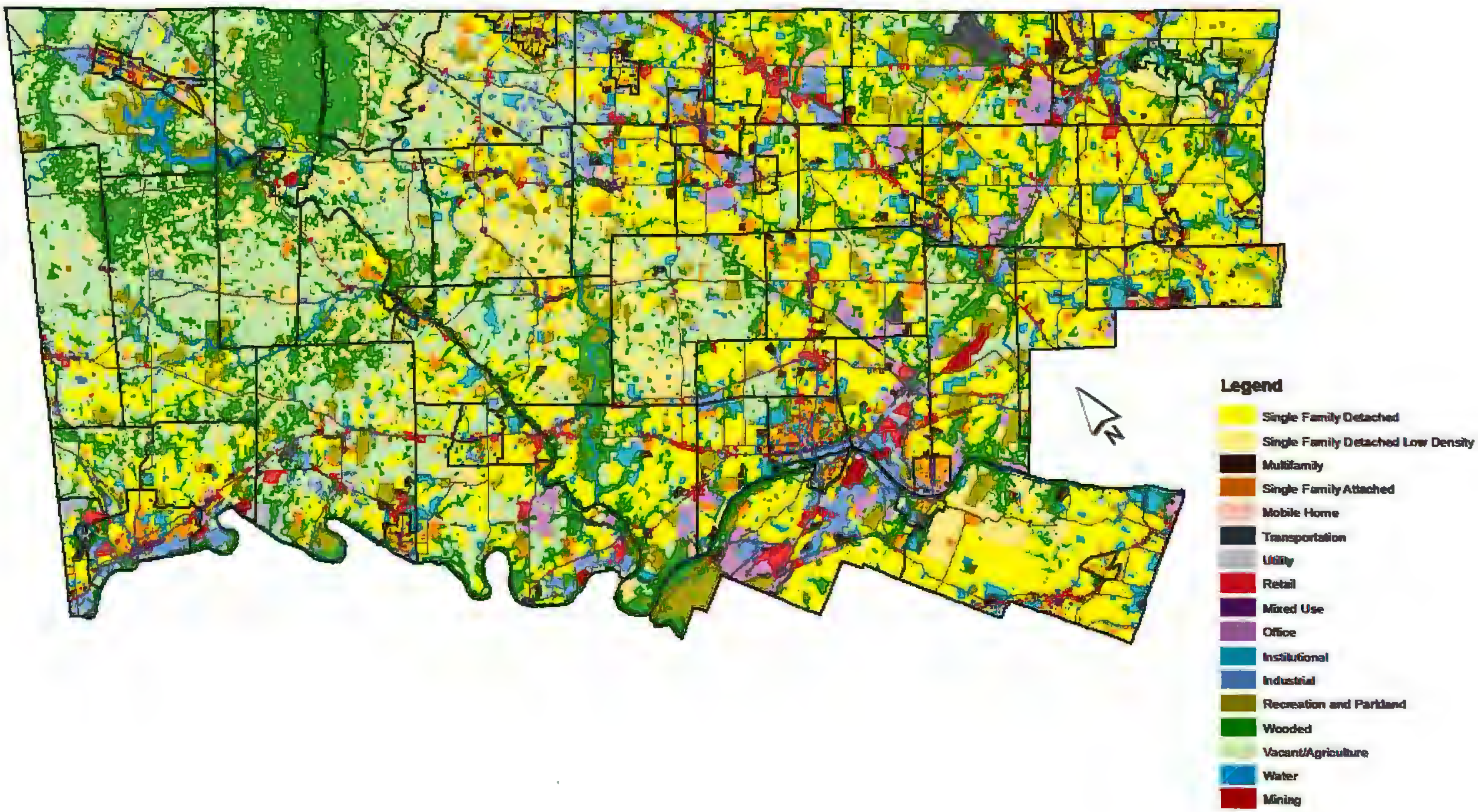
Appendix

BCM ENGINEERS

A Division of ATC

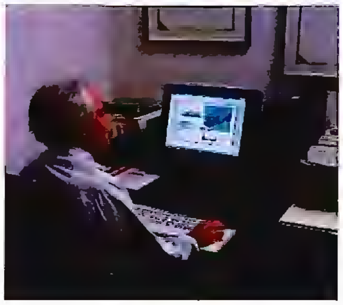
Montgomery County

Existing Land Use Map - 2010



Appendix A

Wissahickon TMDL
Susquehanna Woods Stormwater Retention Basin



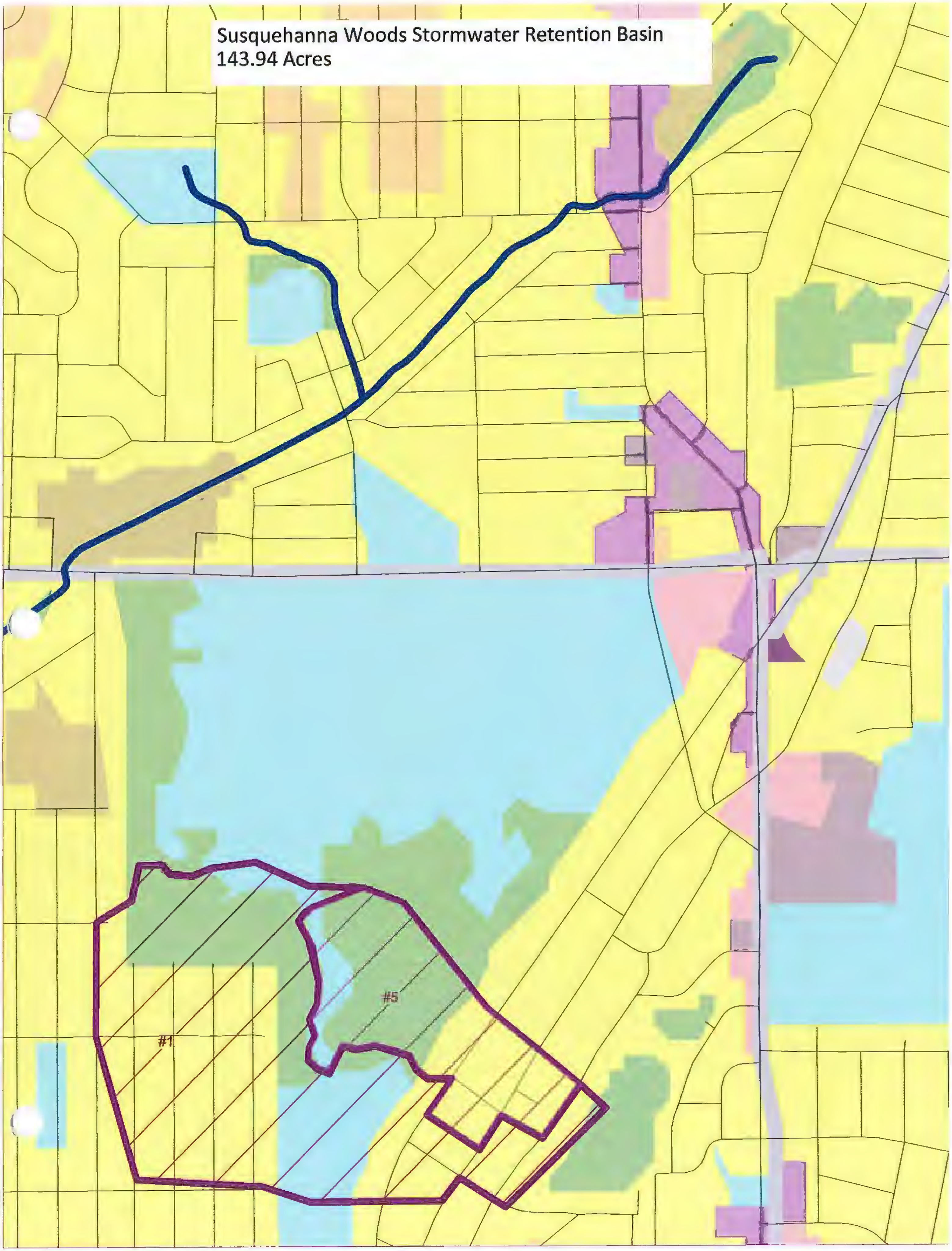
Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	17649.0	2745.6	67992.2	360.5	152.9	62.6	6.7	10.1	17496.1	2683.1	67985.4	350.3	0.9	2.3	0.0	2.81
Total	17649.0	2745.6	67992.2	360.5	152.9	62.6	6.7	10.1	17496.1	2683.1	67985.4	350.3	0.9	2.3	0.0	2.81
				720,900.33				20,243.31								

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)	
Urban	15086.69	2542.31	67745.60	324.05	
Cropland	0.00	0.00	0.00	0.00	
Pastureland	0.00	0.00	0.00	0.00	
Forest	65.75	29.44	169.35	4.24	
Feedlots	0.00	0.00	0.00	0.00	
User Defined	0.00	0.00	0.00	0.00	
Septic	0.00	0.00	0.00	0.00	
Gully	0.00	0.00	0.00	0.00	
Streambank	35.25	13.57	70.50	22.03	
Groundwater	2308.42	97.76	0.00	0.00	
Total	17496.12	2683.08	67985.45	350.33	700,657.02

Name: Susquehanna Woods Stormwater Retention Basin

Land Type	Acres	Percentage of Watershed	TSS Removal Effectivenes Used	TP Removal Effectiveness Used	TN Removal Effectiveness Used
Urban - Commercial	0.00	0.00%	60%	45%	20%
Urban - Industrial	0.00	0.00%	60%	45%	20%
Urban - Institutional	37.43	1.63%	60%	45%	20%
Urban - Transportation	0.00	0.00%	60%	45%	20%
Urban - Multi-Family	0.00	0.00%	60%	45%	20%
Urban - Single-Family	61.90	2.69%	60%	45%	20%
Urban-Cultivated	0.00	0.00%	60%	45%	20%
Urban - Vacant (developed)	0.00	0.00%	60%	45%	20%
Urban - Open Space	0.00	0.00%	60%	45%	20%
Cropland	0.00	0.00%	60%	45%	20%
Pastureland	0.00	0.00%	60%	45%	20%
Forest	44.62	1.94%	60%	45%	20%
User Defined	0.00	0.00%	60%	45%	20%
Total	143.94	6.25%			


Susquehanna Woods Stormwater Retention Basin
143.94 Acres
#5
#1

Appendix B

Wissahickon TMDL Susquehanna Woods Basin No. 1

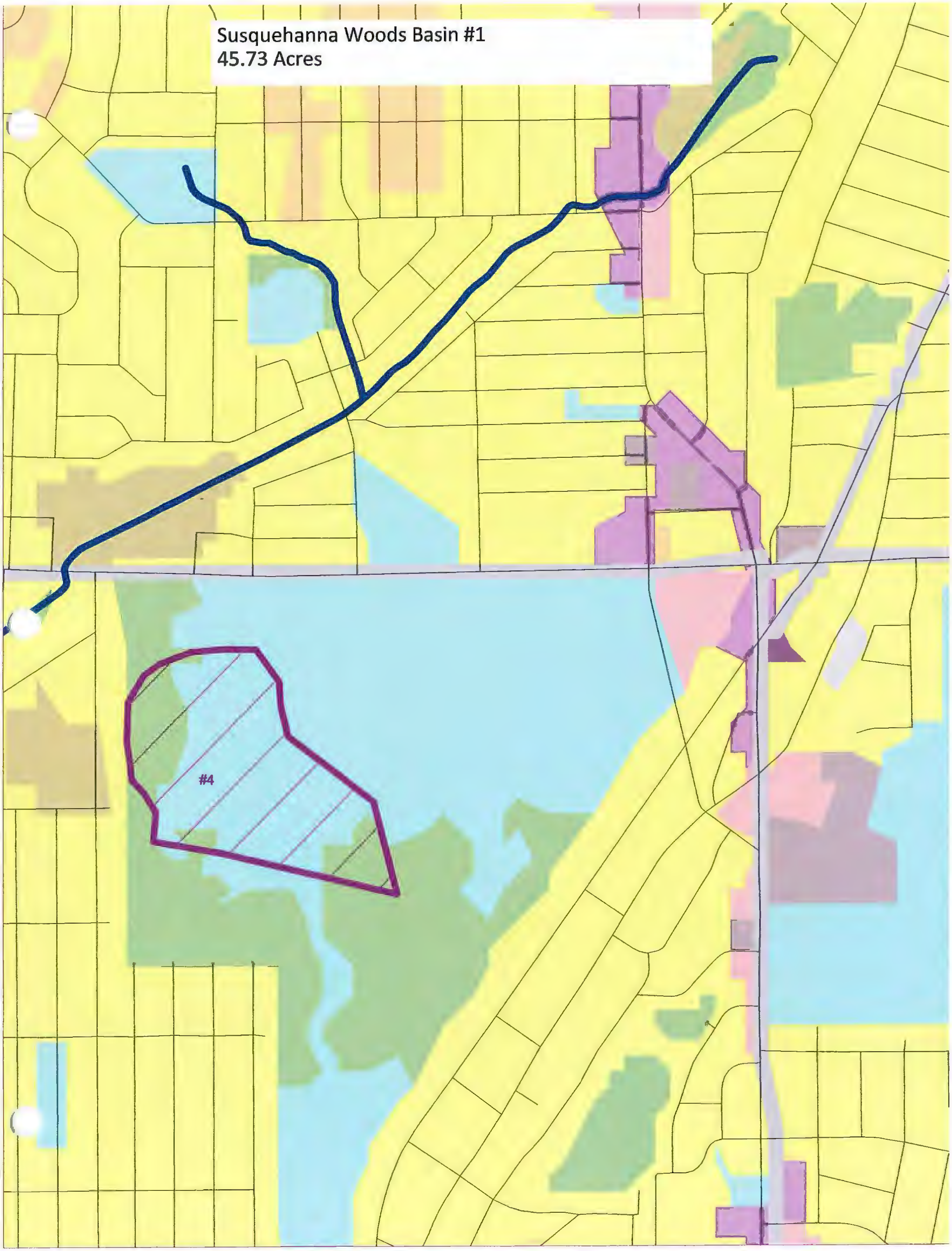
Total Load — This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	17649.0	2745.6	67992.2	360.5	67.1	11.5	1.2	3.9	17581.9	2734.1	67991.0	356.6	0.4	0.4	0.0	1.07
Total	17649.0	2745.6	67992.2	360.5	67.1	11.5	1.2	3.9	17581.9	2734.1	67991.0	356.6	0.4	0.4	0.0	1.07
				720,900.33				7,724.14								

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)	
Urban	15165.62	2588.36	67745.60	329.45	
Cropland	0.00	0.00	0.00	0.00	
Pastureland	0.00	0.00	0.00	0.00	
Forest	72.57	34.41	174.90	5.11	
Feedlots	0.00	0.00	0.00	0.00	
User Defined	0.00	0.00	0.00	0.00	
Septic	0.00	0.00	0.00	0.00	
Gully	0.00	0.00	0.00	0.00	
Streambank	35.25	13.57	70.50	22.03	
Groundwater	2308.42	97.76	0.00	0.00	
Total	17581.87	2734.10	67990.99	356.59	713,176.18

Name: Susquehanna Woods Basin #1

Land Type	Acres	Percentage of Watershed	TSS Removal Effectiveness Used	TP Removal Effectiveness Used	TN Removal Effectiveness Used
Urban - Commercial	0.00	0.00%	60%	20%	20%
Urban - Industrial	0.00	0.00%	60%	20%	20%
Urban - Institutional	37.95	1.65%	60%	20%	20%
Urban - Transportation	0.00	0.00%	60%	20%	20%
Urban - Multi-Family	0.00	0.00%	60%	20%	20%
Urban - Single-Family	0.00	0.00%	60%	20%	20%
Urban-Cultivated	0.00	0.00%	60%	20%	20%
Urban - Vacant (developed)	0.00	0.00%	60%	20%	20%
Urban - Open Space	0.00	0.00%	60%	20%	20%
Cropland	0.00	0.00%	60%	20%	20%
Pastureland	0.00	0.00%	60%	20%	20%
Forest	7.77	0.34%	60%	20%	20%
User Defined	0.00	0.00%	60%	20%	20%
Total	45.73	1.99%			


Susquehanna Woods Basin #1
45.73 Acres
#4

Appendix C

Wissahickon TMDL
Susquehanna Woods
Basin No. 2

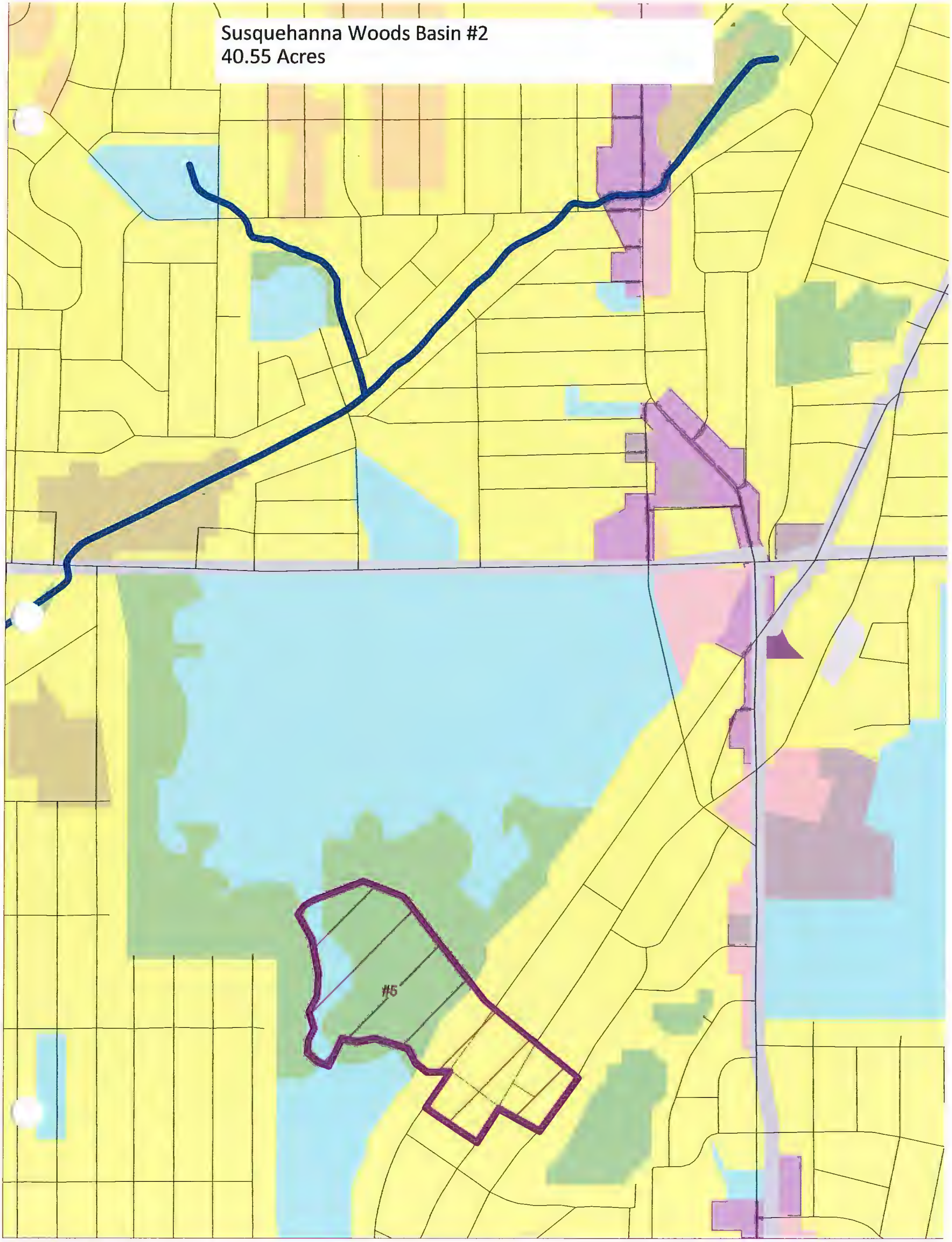
Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	17649.0	2745.6	67992.2	360.5	31.8	6.5	3.0	2.3	17617.2	2739.1	67989.2	358.1	0.2	0.2	0.0	0.65
Total	17649.0	2745.6	67992.2	360.5	31.8	6.5	3.0	2.3	17617.2	2739.1	67989.2	358.1	0.2	0.2	0.0	0.65
				720,900.33				4,652.01								

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)	
Urban	15202.86	2594.25	67745.60	331.27	
Cropland	0.00	0.00	0.00	0.00	
Pastureland	0.00	0.00	0.00	0.00	
Forest	70.64	33.55	173.07	4.82	
Feedlots	0.00	0.00	0.00	0.00	
User Defined	0.00	0.00	0.00	0.00	
Septic	0.00	0.00	0.00	0.00	
Gully	0.00	0.00	0.00	0.00	
Streambank	35.25	13.57	70.50	22.03	
Groundwater	2308.42	97.76	0.00	0.00	
Total	17617.17	2739.13	67989.17	358.12	716,248.31

Name: Susquehanna Woods Basin #2

Land Type	Acres	Percentage of Watershed	TSS Removal Effectiveness Used	TP Removal Effectiveness Used	TN Removal Effectiveness Used
Urban - Commercial	0.00	0.00%	60%	20%	20%
Urban - Industrial	0.00	0.00%	60%	20%	20%
Urban - Institutional	4.46	0.19%	60%	20%	20%
Urban - Transportation	0.00	0.00%	60%	20%	20%
Urban - Multi-Family	0.00	0.00%	60%	20%	20%
Urban - Single-Family	16.22	0.70%	60%	20%	20%
Urban-Cultivated	0.00	0.00%	60%	20%	20%
Urban - Vacant (developed)	0.00	0.00%	60%	20%	20%
Urban - Open Space	0.00	0.00%	60%	20%	20%
Cropland	0.00	0.00%	60%	20%	20%
Pastureland	0.00	0.00%	60%	20%	20%
Forest	19.87	0.86%	60%	20%	20%
User Defined	0.00	0.00%	60%	20%	20%
Total	40.55	1.76%			


Susquehanna Woods Basin #2
40.55 Acres
#5

Appendix D

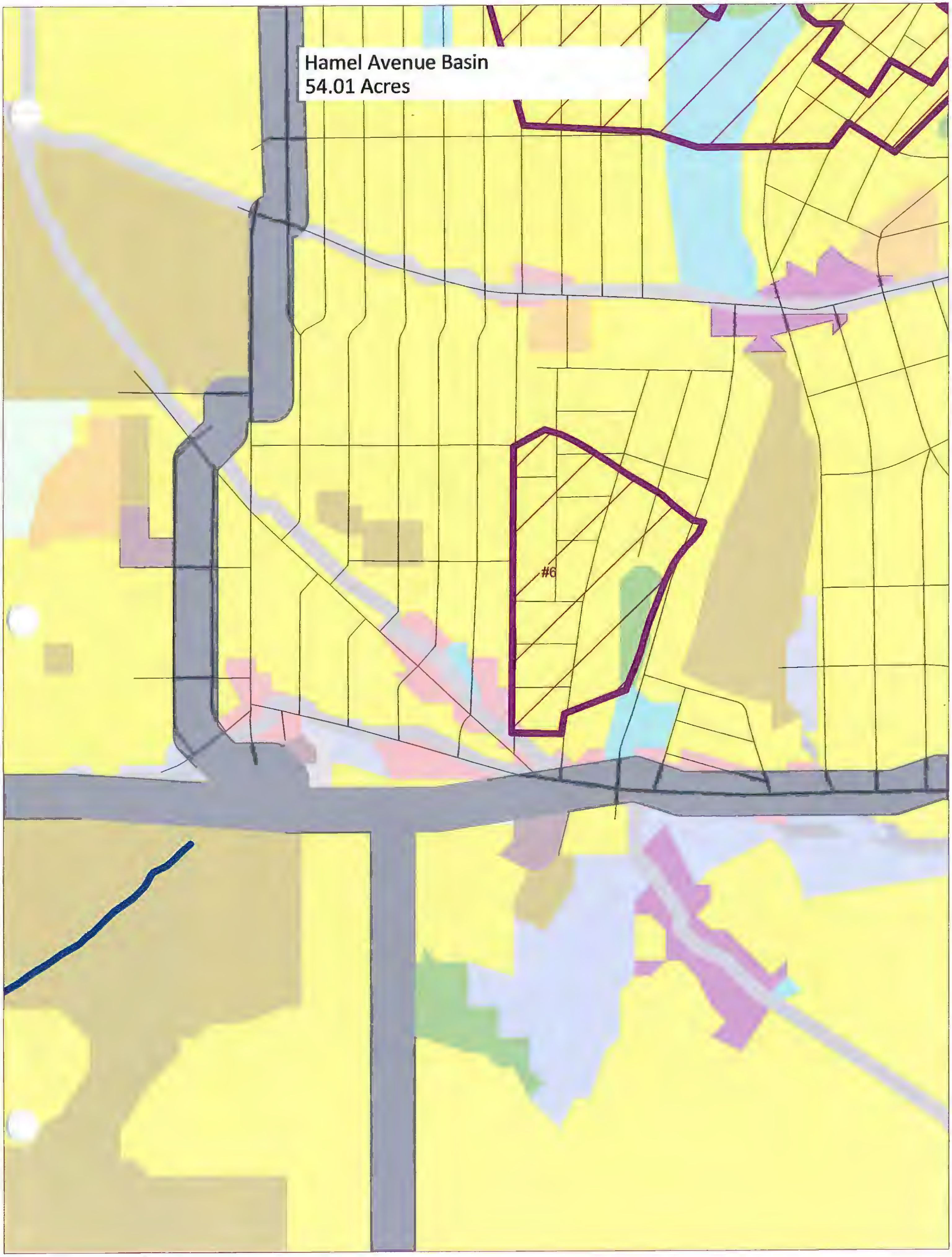
Wissahickon TMDL
Hamel Avenue Infiltration Basin

Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	17649.0	2745.6	67992.2	360.5	294.7	53.8	1.2	7.7	17354.3	2691.9	67991.0	352.8	1.7	2.0	0.0	2.13
Total	17649.0	2745.6	67992.2	360.5	294.7	53.8	1.2	7.7	17354.3	2691.9	67991.0	352.8	1.7	2.0	0.0	2.13
				720,900.33				15,375.06								

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)	
Urban	14939.18	2546.68	67745.60	325.62	
Cropland	0.00	0.00	0.00	0.00	
Pastureland	0.00	0.00	0.00	0.00	
Forest	71.49	33.87	174.91	5.11	
Feedlots	0.00	0.00	0.00	0.00	
User Defined	0.00	0.00	0.00	0.00	
Septic	0.00	0.00	0.00	0.00	
Gully	0.00	0.00	0.00	0.00	
Streambank	35.25	13.57	70.50	22.03	
Groundwater	2308.42	97.76	0.00	0.00	
Total	17354.35	2691.87	67991.01	352.76	705,525.27

			Name: Hamel Ave Infiltration Basin		
Land Type	Acres	Percentage of Watershed	TSS Removal Effectiveness Used	TP Removal Effectiveness Used	TN Removal Effectiveness Used
Urban - Commercial	0.00	0.00%	95%	85%	85%
Urban - Industrial	0.00	0.00%	95%	85%	85%
Urban - Institutional	0.00	0.00%	95%	85%	85%
Urban - Transportation	1.62	0.07%	95%	85%	85%
Urban - Multi-Family	0.00	0.00%	95%	85%	85%
Urban - Single-Family	47.53	2.06%	95%	85%	85%
Urban-Cultivated	0.00	0.00%	95%	85%	85%
Urban - Vacant (developed)	0.00	0.00%	95%	85%	85%
Urban - Open Space	0.00	0.00%	95%	85%	85%
Cropland	0.00	0.00%	95%	85%	85%
Pastureland	0.00	0.00%	95%	85%	85%
Forest	4.86	0.21%	95%	85%	85%
User Defined	0.00	0.00%	95%	85%	85%
Total	54.01	2.35%			


Hamel Avenue Basin
54.01 Acres
#6

BCM ENGINEERS
ATC GROUP SERVICES LLC

Appendix E

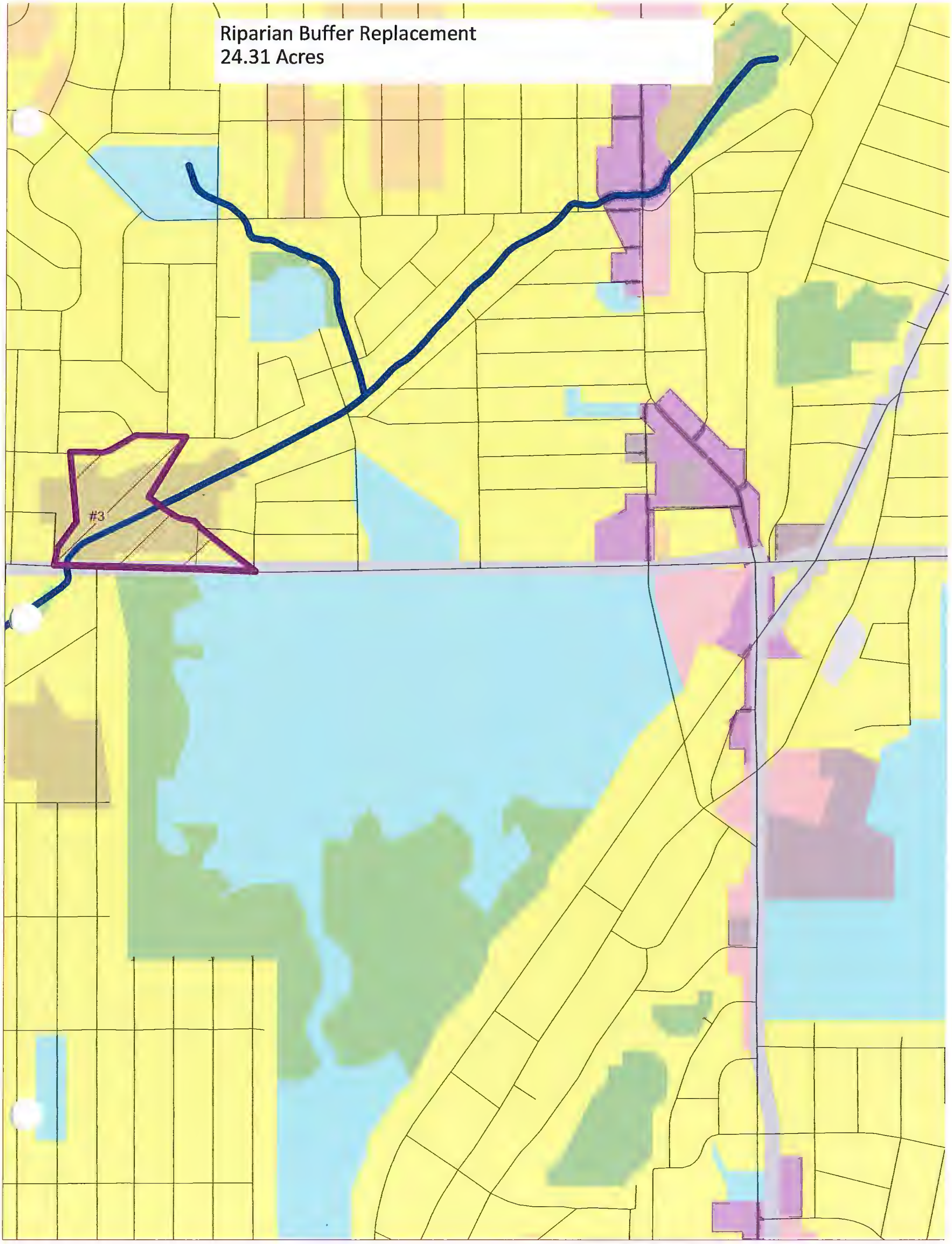
Wissahickon TMDL
Riparian Buffer Replacement

Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	17649.0	2745.6	67992.2	360.5	29.1	7.8	0.0	1.3	17619.9	2737.8	67992.2	359.1	0.2	0.3	0.0	0.37
Total	17649.0	2745.6	67992.2	360.5	29.1	7.8	0.0	1.3	17619.9	2737.8	67992.2	359.1	0.2	0.3	0.0	0.37
				720,900.33				2,683.04								

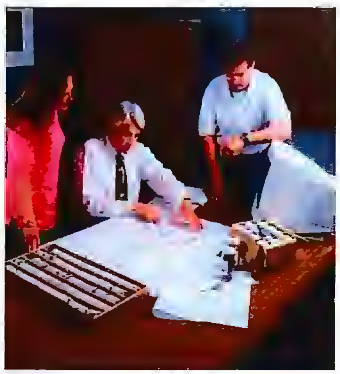
Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)	
Urban	15202.46	2591.54	67745.60	331.79	
Cropland	0.00	0.00	0.00	0.00	
Pastureland	0.00	0.00	0.00	0.00	
Forest	73.81	34.96	176.07	5.29	
Feedlots	0.00	0.00	0.00	0.00	
User Defined	0.00	0.00	0.00	0.00	
Septic	0.00	0.00	0.00	0.00	
Gully	0.00	0.00	0.00	0.00	
Streambank	35.25	13.57	70.50	22.03	
Groundwater	2308.42	97.76	0.00	0.00	
Total	17619.94	2737.84	67992.16	359.11	718,217.29

			Name: Riparian Buffer Replacement		
Land Type	Acres	Percentage of Watershed	TSS Removal Effectiveness Used	TP Removal Effectiveness Used	TN Removal Effectiveness Used
Urban - Commercial	0.00	0.00%	50%	50%	25%
Urban - Industrial	0.00	0.00%	50%	50%	25%
Urban - Institutional	0.00	0.00%	50%	50%	25%
Urban - Transportation	0.00	0.00%	50%	50%	25%
Urban - Multi-Family	0.00	0.00%	50%	50%	25%
Urban - Single-Family	7.54	0.33%	50%	50%	25%
Urban-Cultivated	0.00	0.00%	50%	50%	25%
Urban - Vacant (developed)	0.00	0.00%	50%	50%	25%
Urban - Open Space	16.77	0.73%	50%	50%	25%
Cropland	0.00	0.00%	50%	50%	25%
Pastureland	0.00	0.00%	50%	50%	25%
Forest	0.00	0.00%	50%	50%	25%
User Defined	0.00	0.00%	50%	50%	25%
Total	24.31	1.06%			


Riparian Buffer Replacement
24.31 Acres
#3

Appendix F

Wissahickon TMDL
Roslyn Park Rain Garden



Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year
W1	17649.0	2745.6	67992.2	360.5	16.2	2.9	0.0	0.5
Total	17649.0	2745.6	67992.2	360.5	16.2	2.9	0.0	0.5
				720,900.33				981.55

Watershed	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	17632.8	2742.8	67992.2	360.0	0.1	0.1	0.0	0.14
Total	17632.8	2742.8	67992.2	360.0	0.1	0.1	0.0	0.14

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)	
Urban	15215.36	2596.46	67745.60	332.64	
Cropland	0.00	0.00	0.00	0.00	
Pastureland	0.00	0.00	0.00	0.00	
Forest	73.81	34.96	176.07	5.29	
Feedlots	0.00	0.00	0.00	0.00	
User Defined	0.00	0.00	0.00	0.00	
Septic	0.00	0.00	0.00	0.00	
Gully	0.00	0.00	0.00	0.00	
Streambank	35.25	13.57	70.50	22.03	
Groundwater	2308.42	97.76	0.00	0.00	
Total	17632.84	2742.75	67992.16	359.96	719,918.78

Name: Roslyn Park Rain Garden/Bioswale

Land Type	Acres	Percentage of Watershed	TSS Removal Effectiveness Used	TP Removal Effectiveness Used	TN Removal Effectiveness Used
Urban - Commercial	0.00	0.00%	80%	75%	70%
Urban - Industrial	0.00	0.00%	80%	75%	70%
Urban - Institutional	0.00	0.00%	80%	75%	70%
Urban - Transportation	1.00	0.04%	80%	75%	70%
Urban - Multi-Family	0.00	0.00%	80%	75%	70%
Urban - Single-Family	0.00	0.00%	80%	75%	70%
Urban-Cultivated	0.00	0.00%	80%	75%	70%
Urban - Vacant (developed)	0.00	0.00%	80%	75%	70%
Urban - Open Space	0.00	0.00%	80%	75%	70%
Cropland	0.00	0.00%	80%	75%	70%
Pastureland	0.00	0.00%	80%	75%	70%
Forest	0.00	0.00%	80%	75%	70%
User Defined	0.00	0.00%	80%	75%	70%
Total	1.00	0.04%			

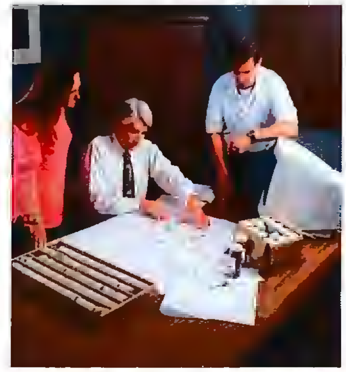

Roslyn Park Rain Garden
1 Acre
Google earth
400 ft
N

Appendix G

Wissahickon TMDL
Woodland Avenue
Streambank Stabilization

WOODLAND STREAMBANK STABILIZATION PROJECT

Reach	Bank Length (ft)	Bank Height (ft)	Bank Area (ft)	BKF Height (ft)	BEHI	Near Bank Stress	Predicted Erosion Rate (ft/yr)	Predicted Erosion Subtotal (CF/yr)	Predicted Erosion Subtotal (tons/yr)	Predicted Reach Total (tons/yr)	Predicted Erosion Rate (tons/ft/yr)	Predicted Erosion Rate (lbs/ft/yr)	Efficiency of Restoration Process	Predicted Reach Total (tons/yr)	Predicted Reach Total (lbs/yr)	Predicted Nitrogen Total (lbs/yr)	Predicted Phosphorus Total (lbs/yr)
1	90	6.2	558	3	High	Low	0.3	167.4	10.46	10.46	0.11625	232.5	50%	5.23125	10,463	13.60	6.28



Appendix H

Wissahickon TMDL
Sandy Run Streambank Stabilization Constructed

SUSQUEHANNA AND AVONDALE STREAMBANK STABILIZATION PROJECT

Reach	Bank Length (ft)	Bank Height (ft)	Bank Area (ft)	BKF Height (ft)	BEHI	Near Bank Stress	Predicted Erosion Rate (ft/yr)	Predicted Erosion Subtotal (CF/yr)	Predicted Erosion Subtotal (tons/yr)	Predicted Reach Total (tons/yr)	Predicted Erosion Rate (tons/ft/yr)	Predicted Erosion Rate (lbs/ft/yr)	Efficiency of Restoration Process	Predicted Reach Total (tons/yr)	Predicted Reach Total (lbs/yr)	Predicted Nitrogen Total (lbs/yr)	Predicted Phosphorus Total (lbs/yr)
1	430	5	2150	3	High	Low	0.3	645	40.31	40.31	0.09375	187.5	50%	20.15625	40,313	52.41	24.19

Stream: Avondale + Swag – Sandy Run Location:

Station: Observers:

Date: Stream Type: Valley Type:

Study Bank Height / Bankfull Height (C) BEHI

Study Bank Height (ft) =	6.2 (A)	Bankfull Height (ft) =	3 (B)	(A)/(B) =	(C)	2

Root Depth / Study Bank Height (E)

Root Depth (ft) =	2 (D)	Study Bank Height (ft) =	6.2 (A)	(D)/(A) =	.3 (E)	.3

Weighted Root Density (G)

Root Density as % =	10 (F)	(F) x (E) =	3 (G)	3

Bank Angle (H)

Bank Angle as *Degrees* =	45 (H)	45

Surface Protection (I)

Surface Protection as % =	0 (I)	0

Bank Material Adjustment:

- **Bedrock** (Overall Very Low BEHI)
- **Boulders** (Overall Low BEHI)
- **Cobble** (Subtract 10 points if uniform medium to large cobble)
- **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand)
- **Sand** (Add 10 points)
- **Silt/Clay** (no adjustment)

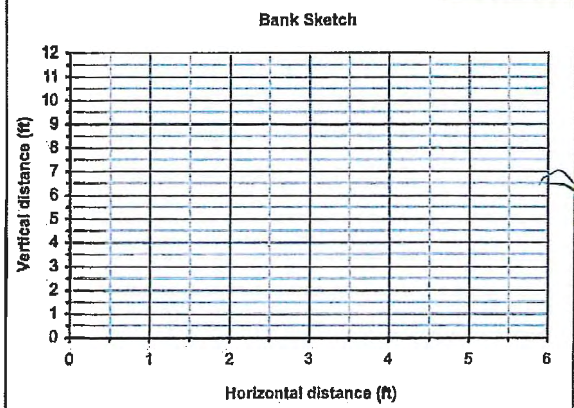
Bank Material Adjustment –

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage

53.

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	

Bank Sketch



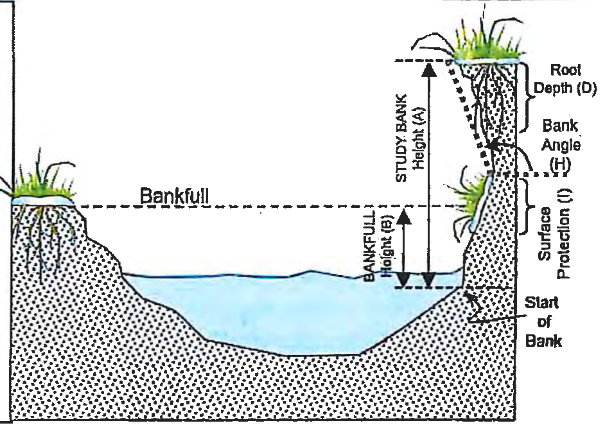


Figure 4. BEHI Assessment Form (Rosgen 2006)

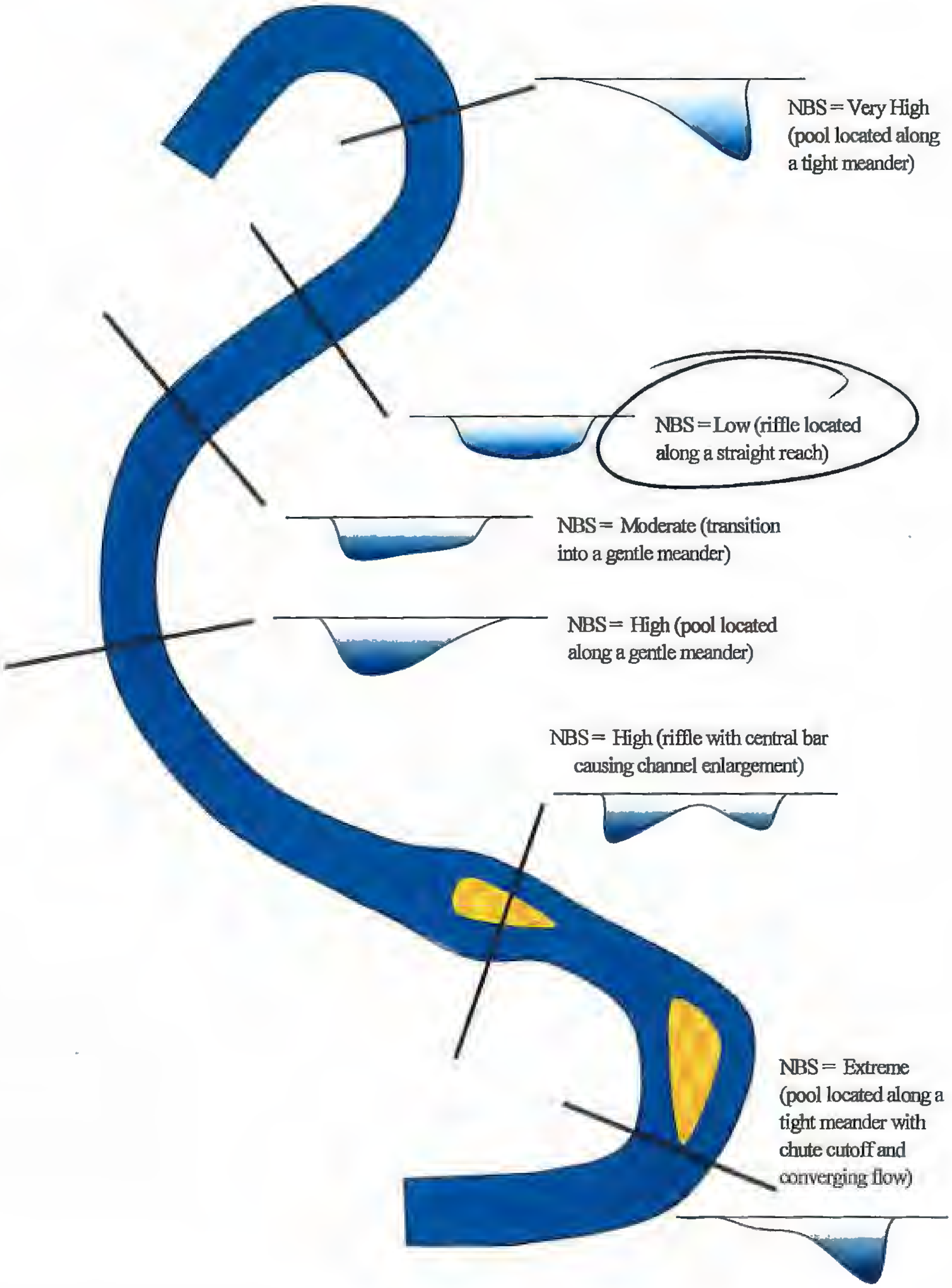


Figure 5. Near bank stress conditions (Rosgen 2001b).

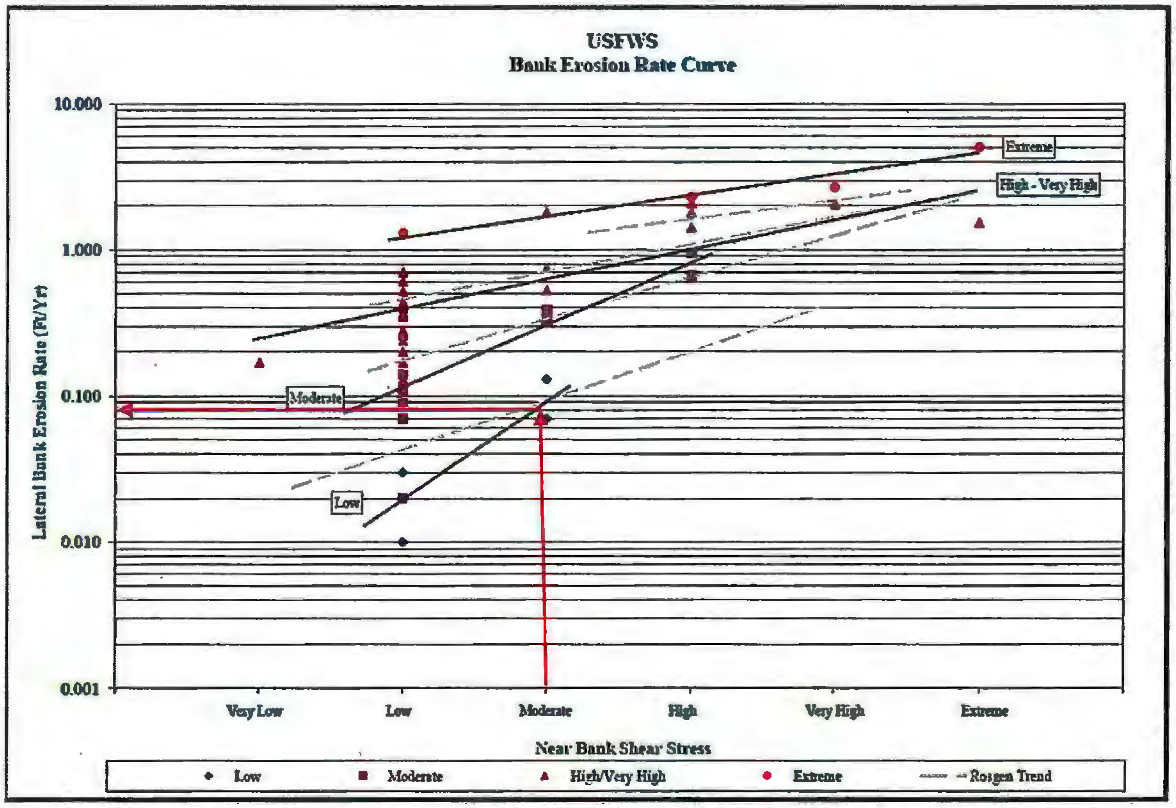


Figure B-1. Bank Erosion Rate Curve Developed by the USFWS

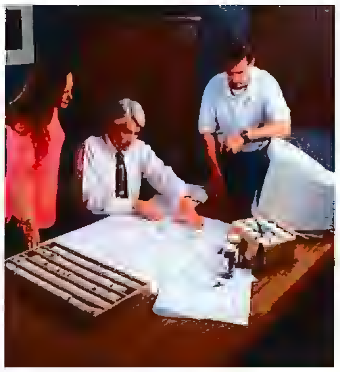
Stream bank erosion is predicted from the curve in Figure B-1 by first identifying the BEHI and NBS scores. For example, Bank 20 from Table B-3 had an NBS score of moderate and a BEHI score of low. By locating the moderate NBS score on the x axis of the Figure B-1 and following it straight up to the BEHI line for "low," the vertical axis shows a predicted erosion rate of 0.07 feet per year, as indicated by the red arrows on the figure.

To convert the erosion rate from feet per year to tons per year, a soil bulk density of 125 pounds/ft^3 was used. This estimate was obtained from a study by Van Eps et al. (2010) that sampled coarse and fine grain layers of stream banks in the West Fork White River watershed in Northwestern Arkansas to determine the in-situ bulk density and particle size distribution. The 125 pounds/ft^3 value used in the Protocol 1 example was calculated as the mean of the coarse and fine grain average bulk density measurements obtained by Van Eps et al. (2010). The bulk density from this study was used only as an example of typical values that might be found. The original bulk density data from the USFWS was not available. The protocol recommends that each project require its own bulk density analysis at several locations in the stream channel as bulk density can be highly variable.

From Van Eps et al. (2010):

Appendix I

Wissahickon TMDL Sandy Run Streambank Stabilization Future



ROSLYN PARK STREAMBANK STABILIZATION

Reach	Bank Length (ft)	Bank Height (ft)	Bank Area (ft)	BKF Height (ft)	BEHI	Near Bank Stress	Predicted Erosion Rate (ft/yr)	Predicted Erosion Subtotal (CF/yr)	Predicted Erosion Subtotal (tons/yr)	Predicted Reach Total (tons/yr)	Predicted Erosion Rate (tons/ft/yr)	Predicted Erosion Rate (lbs/ft/yr)	Efficiency of Restoration Process	Predicted Reach Total (tons/yr)	Predicted Reach Total (lbs/yr)	Predicted Nitrogen Total (lbs/yr)	Predicted Phosphorus Total (lbs/yr)
1	72	6	432	3	High	Low	0.3	129.6	8.10	8.10	0.1125	225	50%	4.05	8,100	10.53	4.86
2	123	4.5	553.5	3	High	Low	0.3	166.05	10.38	10.38	0.084375	168.75	150%	15.5671875	31,134	40.47	18.68
															39,234	51.00	23.54

Stream: Sandy Run - Roslyn Park Location:

Station: Observers:

Date: Stream Type: Valley Type:

Study Bank Height / Bankfull Height (C) BEHI

Study Bank Height (ft) =	6 (A)	Bankfull Height (ft) =	3 (B)	(A)/(B) =	2.0 (C)	2.0

Root Depth / Study Bank Height (E)

Root Depth (ft) =	1.5 (D)	Study Bank Height (ft) =	6 (A)	(D)/(A) =	0.25 (E)	0.25

Weighted Root Density (G)

Root Density as % =	0.25 (F)	(F) x (E) =	12.5 (G)	12.5

Bank Angle (H)

Bank Angle as *Degrees* =	(H)	45

Surface Protection (I)

Surface Protection as % =	— (I)	—

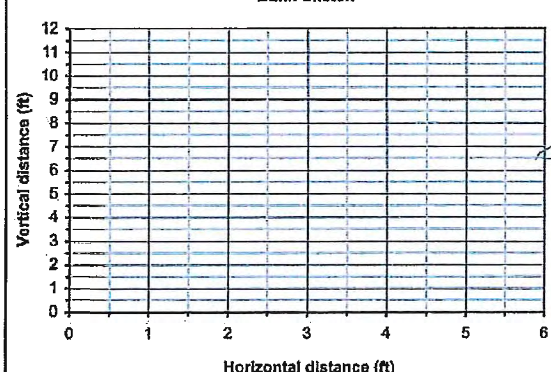
Bank Material Adjustment:
- **Bedrock** (Overall Very Low BEHI)
- **Boulders** (Overall Low BEHI)
- **Cobble** (Subtract 10 points if uniform medium to large cobble)
- **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand)
- **Sand** (Add 10 points)
- **Silt/Clay** (no adjustment)

Bank Material Adjustment: 5

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	65

Bank Sketch



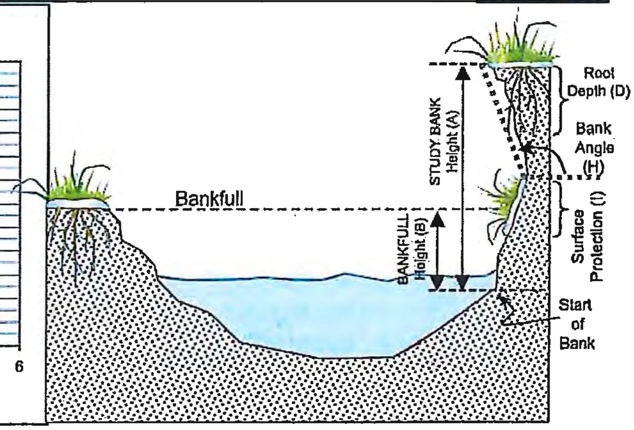


Figure 4. BEHI Assessment Form (Rosgen 2006)

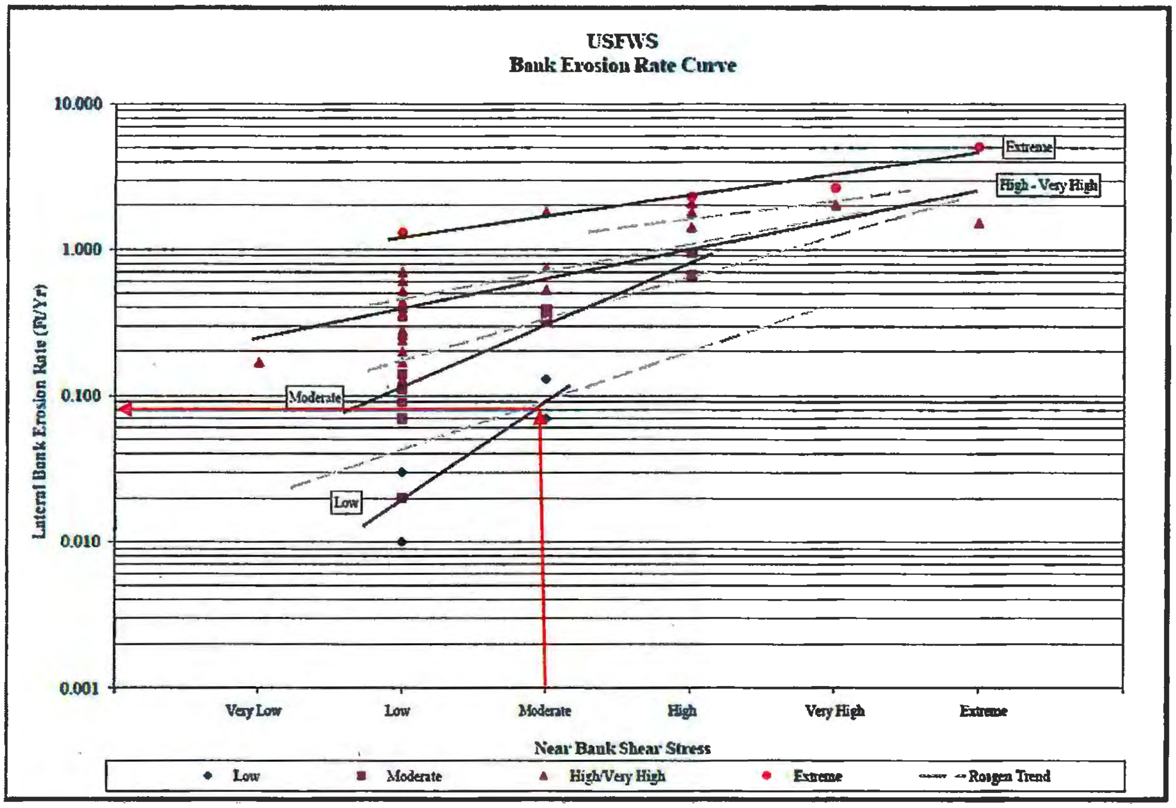


Figure B-1. Bank Erosion Rate Curve Developed by the USFWS

Stream bank erosion is predicted from the curve in Figure B-1 by first identifying the BEHI and NBS scores. For example, Bank 20 from Table B-3 had an NBS score of moderate and a BEHI score of low. By locating the moderate NBS score on the x axis of the Figure B-1 and following it straight up to the BEHI line for "low," the vertical axis shows a predicted erosion rate of 0.07 feet per year, as indicated by the red arrows on the figure.

To convert the erosion rate from feet per year to tons per year, a soil bulk density of 125 pounds/ft^3 was used. This estimate was obtained from a study by Van Eps et al. (2010) that sampled coarse and fine grain layers of stream banks in the West Fork White River watershed in Northwestern Arkansas to determine the in-situ bulk density and particle size distribution. The 125 pounds/ft^3 value used in the Protocol 1 example was calculated as the mean of the coarse and fine grain average bulk density measurements obtained by Van Eps et al. (2010). The bulk density from this study was used only as an example of typical values that might be found. The original bulk density data from the USFWS was not available. The protocol recommends that each project require its own bulk density analysis at several locations in the stream channel as bulk density can be highly variable.

From Van Eps et al. (2010):

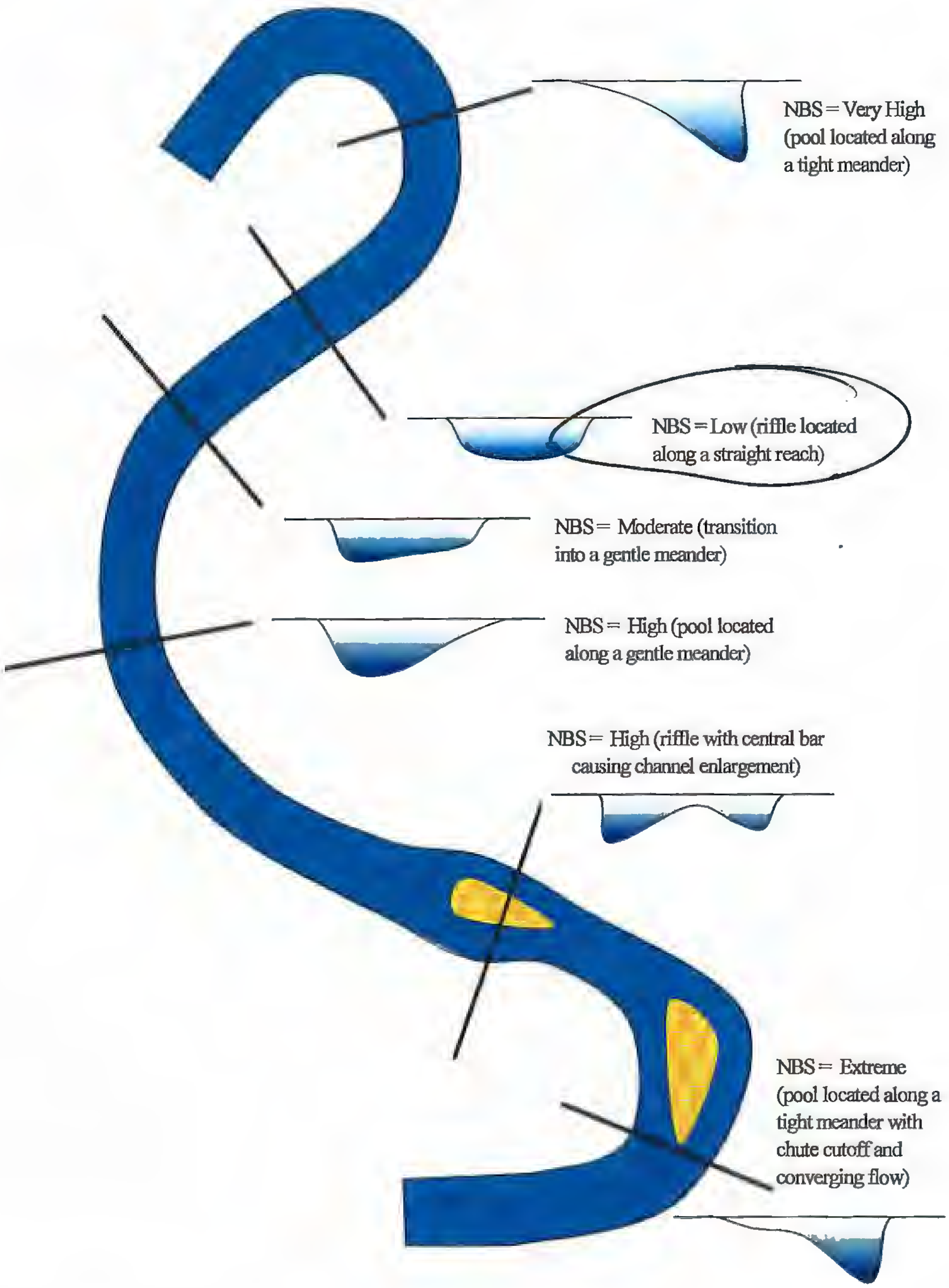


Figure 5. Near bank stress conditions (Rosgen 2001b).

Appendix J

Wissahickon TMDL Susquehanna Woods Basin No. 3 Retrofit

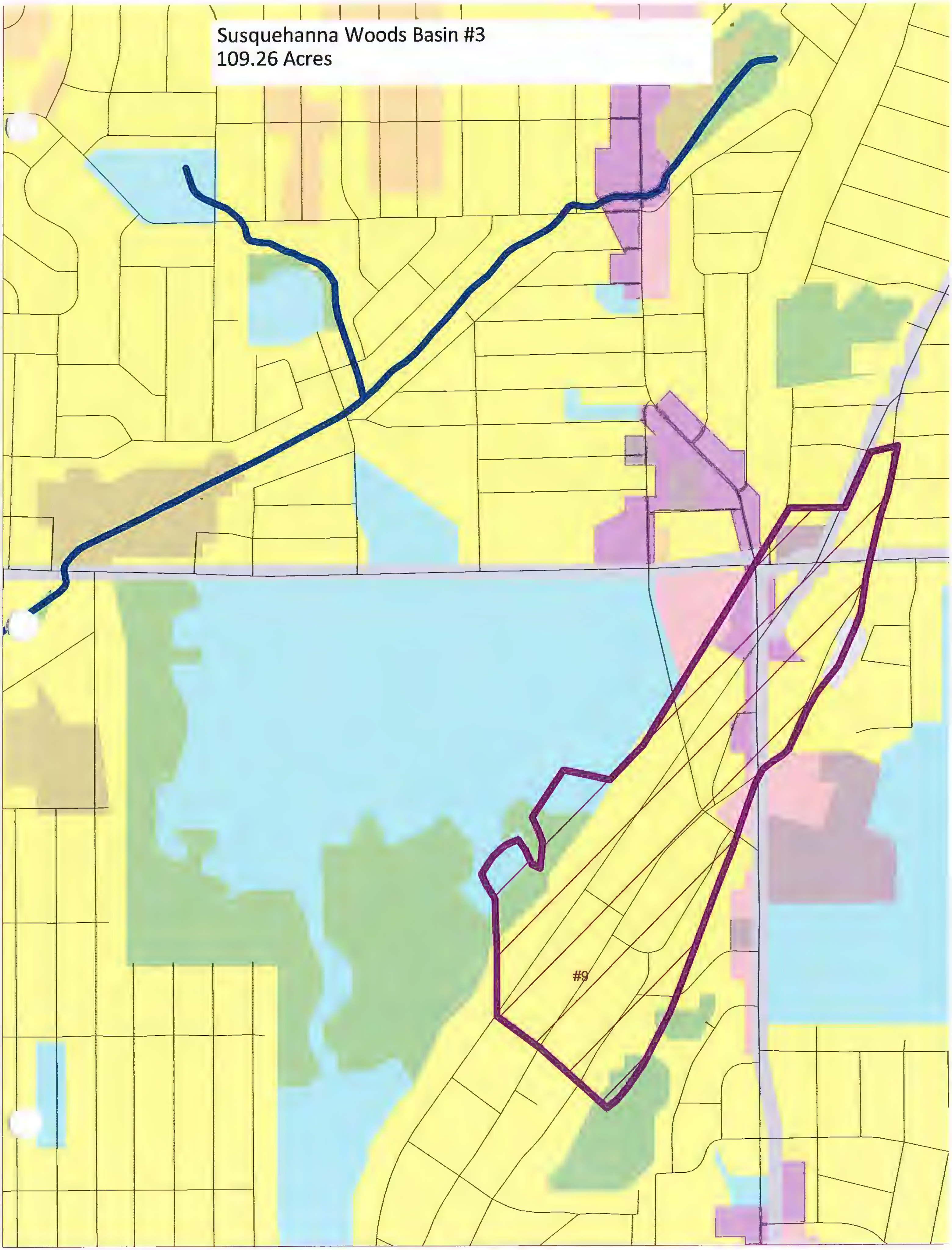
Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	17649.0	2745.6	67992.2	360.5	152.7	25.9	1.0	10.1	17496.3	2719.8	67991.2	350.4	0.9	0.9	0.0	2.79
Total	17649.0	2745.6	67992.2	360.5	152.7	25.9	1.0	10.1	17496.3	2719.8	67991.2	350.4	0.9	0.9	0.0	2.79
				720,900.33				20,137.99								

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)	
Urban	15079.88	2573.94	67745.60	323.21	
Cropland	0.00	0.00	0.00	0.00	
Pastureland	0.00	0.00	0.00	0.00	
Forest	72.77	34.49	175.08	5.14	
Feedlots	0.00	0.00	0.00	0.00	
User Defined	0.00	0.00	0.00	0.00	
Septic	0.00	0.00	0.00	0.00	
Gully	0.00	0.00	0.00	0.00	
Streambank	35.25	13.57	70.50	22.03	
Groundwater	2308.42	97.76	0.00	0.00	
Total	17496.31	2719.77	67991.18	350.38	700,762.33

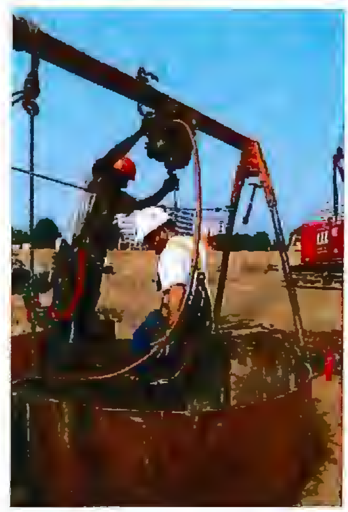
Name: Susquehanna Woods Basin #3

Land Type	Acres	Percentage of Watershed	TSS Removal Effectiveness Used	TP Removal Effectiveness Used	TN Removal Effectiveness Used
Urban - Commercial	9.83	0.43%	60%	20%	20%
Urban - Industrial	0.00	0.00%	60%	20%	20%
Urban - Institutional	8.74	0.38%	60%	20%	20%
Urban - Transportation	1.09	0.05%	60%	20%	20%
Urban - Multi-Family	2.19	0.09%	60%	20%	20%
Urban - Single-Family	80.85	3.51%	60%	20%	20%
Urban-Cultivated	0.00	0.00%	60%	20%	20%
Urban - Vacant (developed)	0.00	0.00%	60%	20%	20%
Urban - Open Space	0.00	0.00%	60%	20%	20%
Cropland	0.00	0.00%	60%	20%	20%
Pastureland	0.00	0.00%	60%	20%	20%
Forest	6.56	0.28%	60%	20%	20%
User Defined	0.00	0.00%	60%	20%	20%
Total	109.26	4.74%			


Susquehanna Woods Basin #3
109.26 Acres
#9

Appendix K

Wissahickon TMDL Madison Avenue Meadow Construction



Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

[illegible]

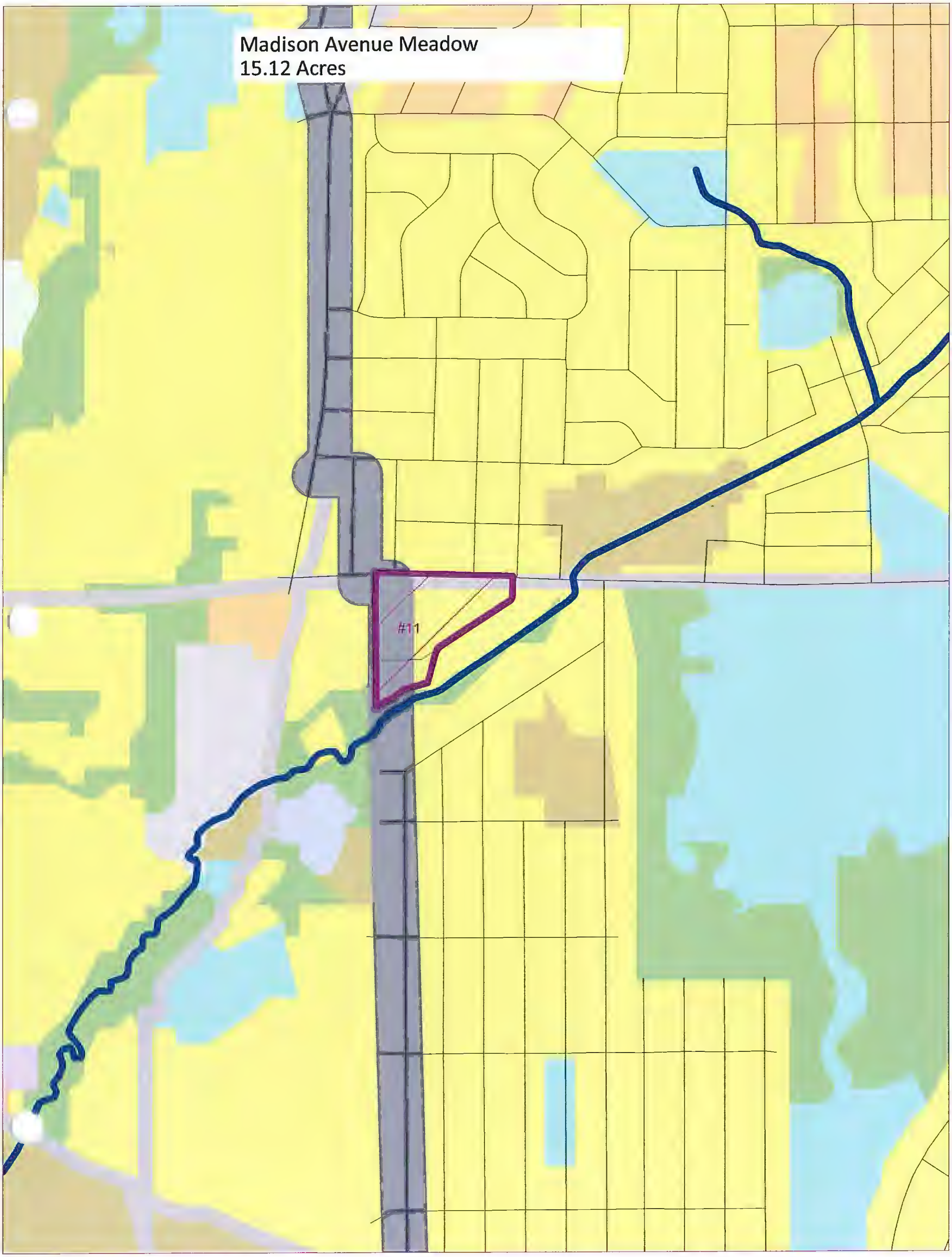
Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	17649.0	2745.6	67992.2	360.5	78.9	15.1	0.0	2.1	17570.1	2730.5	67992.2	358.4	0.4	0.6	0.0	0.58
Total	17649.0	2745.6	67992.2	360.5	78.9	15.1	0.0	2.1	17570.1	2730.5	67992.2	358.4	0.4	0.6	0.0	0.58
				720,900.33				4,172.99								

[illegible]

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)	
Urban	15152.66	2584.22	67745.60	331.04	
Cropland	0.00	0.00	0.00	0.00	
Pastureland	0.00	0.00	0.00	0.00	
Forest	73.81	34.96	176.07	5.29	
Feedlots	0.00	0.00	0.00	0.00	
User Defined	0.00	0.00	0.00	0.00	
Septic	0.00	0.00	0.00	0.00	
Gully	0.00	0.00	0.00	0.00	
Streambank	35.25	13.57	70.50	22.03	
Groundwater	2308.42	97.76	0.00	0.00	
Total	17570.15	2730.52	67992.16	358.36	716,727.34

[illegible] Name: Madison Avenue Meadow

Land Type	Acres	Percentage of Watershed	TSS Removal Effectiveness Used	TP Removal Effectiveness Used	TN Removal Effectiveness Used
Urban - Commercial	0.00	0.00%	80%	75%	70%
Urban - Industrial	0.00	0.00%	80%	75%	70%
Urban - Institutional	0.00	0.00%	80%	75%	70%
Urban - Transportation	0.91	0.04%	80%	75%	70%
Urban - Multi-Family	0.00	0.00%	80%	75%	70%
Urban - Single-Family	14.21	0.62%	80%	75%	70%
Urban-Cultivated	0.00	0.00%	80%	75%	70%
Urban - Vacant (developed)	0.00	0.00%	80%	75%	70%
Urban - Open Space	0.00	0.00%	80%	75%	70%
Cropland	0.00	0.00%	80%	75%	70%
Pastureland	0.00	0.00%	80%	75%	70%
Forest	0.00	0.00%	80%	75%	70%
User Defined	0.00	0.00%	80%	75%	70%
Total	15.12	0.66%			


Madison Avenue Meadow
15.12 Acres
#11

Appendix L

Wissahickon TMDL Roychester Park Rain Garden

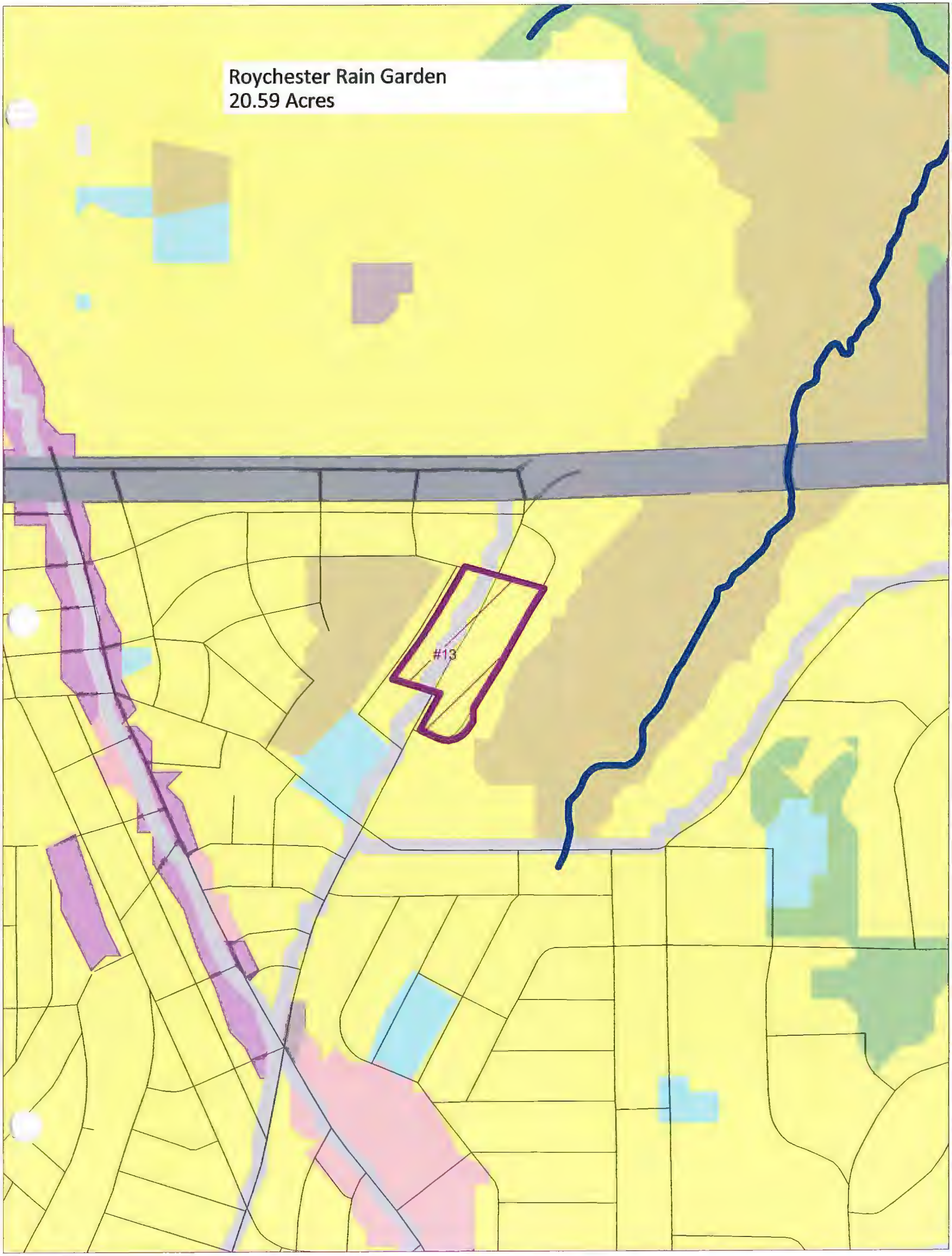
Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year
W1	17649.0	2745.6	67992.2	360.5	90.2	16.8	0.0	2.4
Total	17649.0	2745.6	67992.2	360.5	90.2	16.8	0.0	2.4
				720,900.33				4,716.13

Watershed	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	17558.8	2728.9	67992.2	358.1	0.5	0.6	0.0	0.65
Total	17558.8	2728.9	67992.2	358.1	0.5	0.6	0.0	0.65

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)	
Urban	15141.31	2582.59	67745.60	330.77	
Cropland	0.00	0.00	0.00	0.00	
Pastureland	0.00	0.00	0.00	0.00	
Forest	73.81	34.96	176.07	5.29	
Feedlots	0.00	0.00	0.00	0.00	
User Defined	0.00	0.00	0.00	0.00	
Septic	0.00	0.00	0.00	0.00	
Gully	0.00	0.00	0.00	0.00	
Streambank	35.25	13.57	70.50	22.03	
Groundwater	2308.42	97.76	0.00	0.00	
Total	17558.79	2728.88	67992.16	358.09	716,184.19

			Name: Roychester Rain Garden/Bioswale		
Land Type	Acres	Percentage of Watershed	TSS Removal Effectiveness Used	TP Removal Effectivenes s Used	TN Removal Effectivenes s Used
Urban - Commercial	0.00	0.00%	80%	75%	70%
Urban - Industrial	0.00	0.00%	80%	75%	70%
Urban - Institutional	0.00	0.00%	80%	75%	70%
Urban - Transportation	0.21	0.01%	80%	75%	70%
Urban - Multi-Family	0.00	0.00%	80%	75%	70%
Urban - Single-Family	17.30	0.75%	80%	75%	70%
Urban-Cultivated	0.00	0.00%	80%	75%	70%
Urban - Vacant (developed)	0.00	0.00%	80%	75%	70%
Urban - Open Space	3.09	0.13%	80%	75%	70%
Cropland	0.00	0.00%	80%	75%	70%
Pastureland	0.00	0.00%	80%	75%	70%
Forest	0.00	0.00%	80%	75%	70%
User Defined	0.00	0.00%	80%	75%	70%
Total	20.59	0.89%			

Roychester Rain Garden
20.59 Acres



Appendix M

Wissahickon TMDL
Roychester Park
Riparian Buffer Restoration

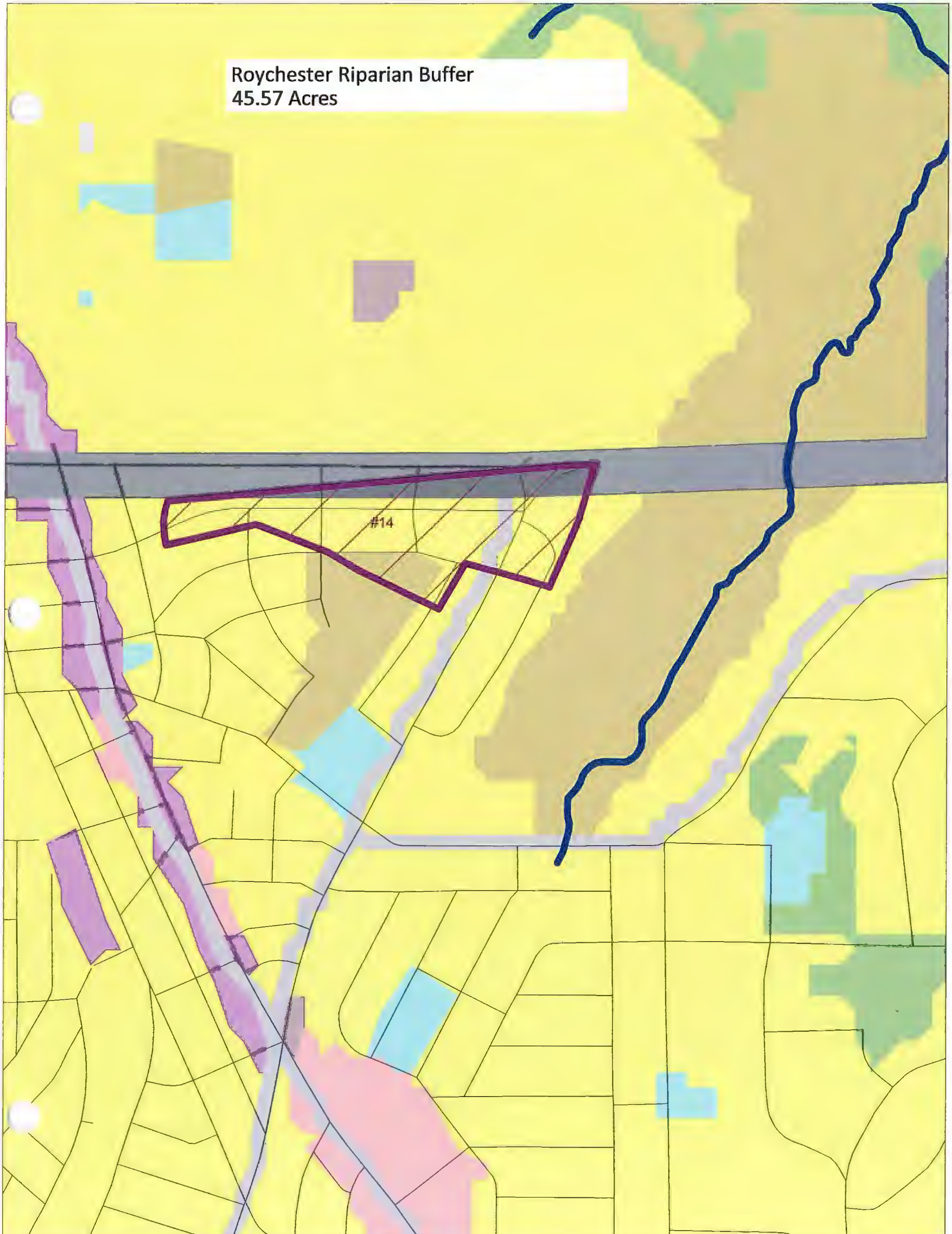
Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	17649.0	2745.6	67992.2	360.5	70.8	24.7	0.0	3.2	17578.2	2720.9	67992.2	357.2	0.4	0.9	0.0	0.90
Total	17649.0	2745.6	67992.2	360.5	70.8	24.7	0.0	3.2	17578.2	2720.9	67992.2	357.2	0.4	0.9	0.0	0.90
				720,900.33				6,467.45								

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)	
Urban	15160.67	2574.60	67745.60	329.89	
Cropland	0.00	0.00	0.00	0.00	
Pastureland	0.00	0.00	0.00	0.00	
Forest	73.81	34.96	176.07	5.29	
Feedlots	0.00	0.00	0.00	0.00	
User Defined	0.00	0.00	0.00	0.00	
Septic	0.00	0.00	0.00	0.00	
Gully	0.00	0.00	0.00	0.00	
Streambank	35.25	13.57	70.50	22.03	
Groundwater	2308.42	97.76	0.00	0.00	
Total	17578.16	2720.89	67992.16	357.22	714,432.88

Name: Roychester Riparian Buffer

Land Type	Acres	Percentage of Watershed	TSS Removal Effectiveness Used	TP Removal Effectiveness Used	TN Removal Effectiveness Used
Urban - Commercial	0.00	0.00%	50%	50%	25%
Urban - Industrial	0.00	0.00%	50%	50%	25%
Urban - Institutional	0.00	0.00%	50%	50%	25%
Urban - Transportation	0.23	0.01%	50%	50%	25%
Urban - Multi-Family	0.00	0.00%	50%	50%	25%
Urban - Single-Family	39.42	1.71%	50%	50%	25%
Urban-Cultivated	0.00	0.00%	50%	50%	25%
Urban - Vacant (developed)	0.00	0.00%	50%	50%	25%
Urban - Open Space	5.92	0.26%	50%	50%	25%
Cropland	0.00	0.00%	50%	50%	25%
Pastureland	0.00	0.00%	50%	50%	25%
Forest	0.00	0.00%	50%	50%	25%
User Defined	0.00	0.00%	50%	50%	25%
Total	45.57	1.98%			



Roychester Riparian Buffer
45.57 Acres
#14

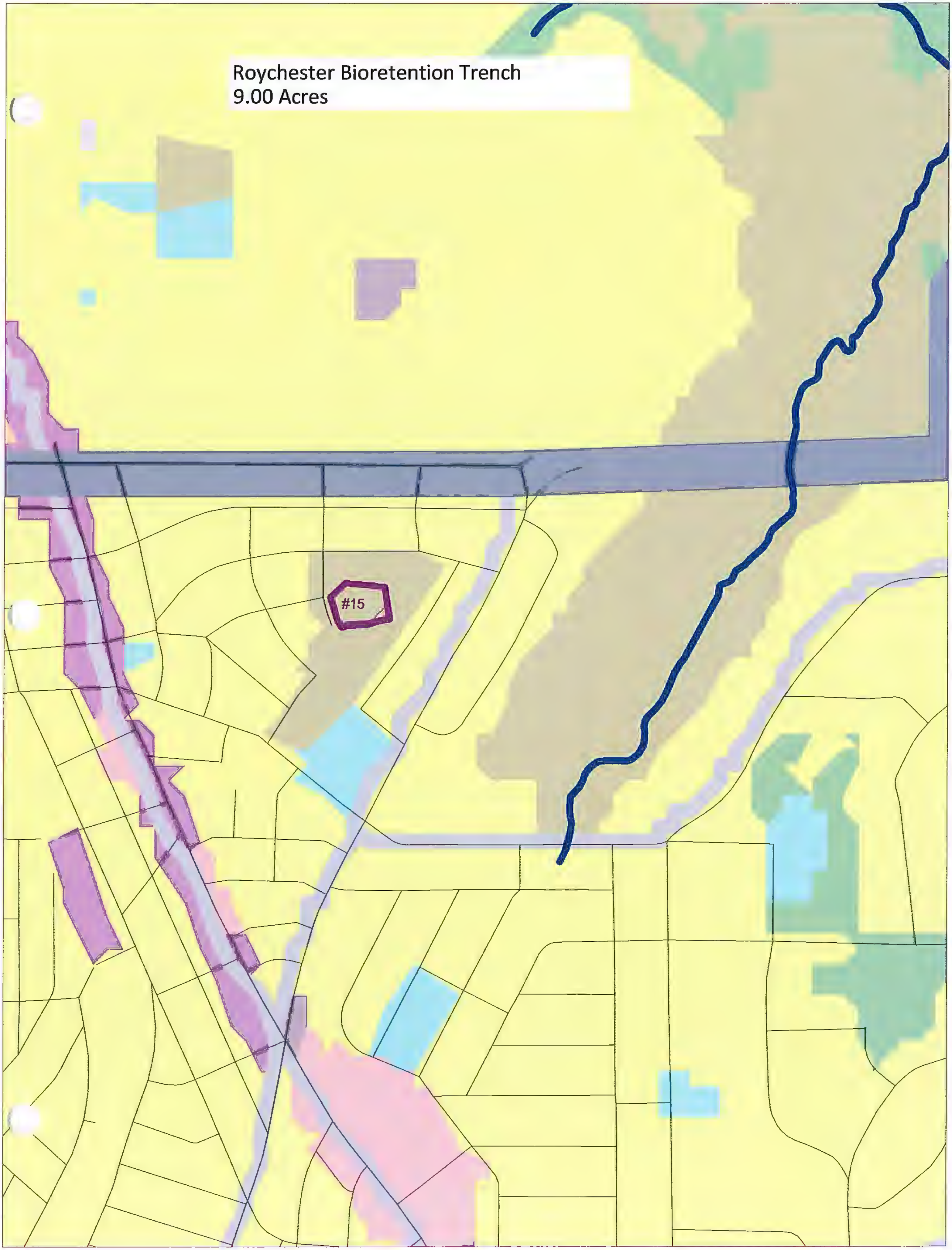
Appendix N

Wissahickon TMDL
Roychester Park
Bioretention/Infiltration Trench

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	17649.0	2745.6	67992.2	360.5	33.3	3.9	0.0	0.9	17615.7	2741.8	67992.2	359.6	0.2	0.1	0.0	0.24
Total	17649.0	2745.6	67992.2	360.5	33.3	3.9	0.0	0.9	17615.7	2741.8	67992.2	359.6	0.2	0.1	0.0	0.24
				720,900.33				1,728.62								

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)	
Urban	15198.21	2595.48	67745.60	332.26	
Cropland	0.00	0.00	0.00	0.00	
Pastureland	0.00	0.00	0.00	0.00	
Forest	73.81	34.96	176.07	5.29	
Feedlots	0.00	0.00	0.00	0.00	
User Defined	0.00	0.00	0.00	0.00	
Septic	0.00	0.00	0.00	0.00	
Gully	0.00	0.00	0.00	0.00	
Streambank	35.25	13.57	70.50	22.03	
Groundwater	2308.42	97.76	0.00	0.00	
Total	17615.69	2741.77	67992.16	359.59	719,171.70

			Name: Roychester Infiltration Trench		
Land Type	Acres	Percentage of Watershed	TSS Removal Effectiveness Used	TP Removal Effectiveness Used	TN Removal Effectiveness Used
Urban - Commercial	0.00	0.00%	95%	85%	85%
Urban - Industrial	0.00	0.00%	95%	85%	85%
Urban - Institutional	0.00	0.00%	95%	85%	85%
Urban - Transportation	0.00	0.00%	95%	85%	85%
Urban - Multi-Family	0.00	0.00%	95%	85%	85%
Urban - Single-Family	1.20	0.05%	95%	85%	85%
Urban-Cultivated	0.00	0.00%	95%	85%	85%
Urban - Vacant (developed)	0.00	0.00%	95%	85%	85%
Urban - Open Space	7.80	0.34%	95%	85%	85%
Cropland	0.00	0.00%	95%	85%	85%
Pastureland	0.00	0.00%	95%	85%	85%
Forest	0.00	0.00%	95%	85%	85%
User Defined	0.00	0.00%	95%	85%	85%
Total	9.00	0.39%			


Roychester Bioretention Trench
9.00 Acres
#15

Appendix O

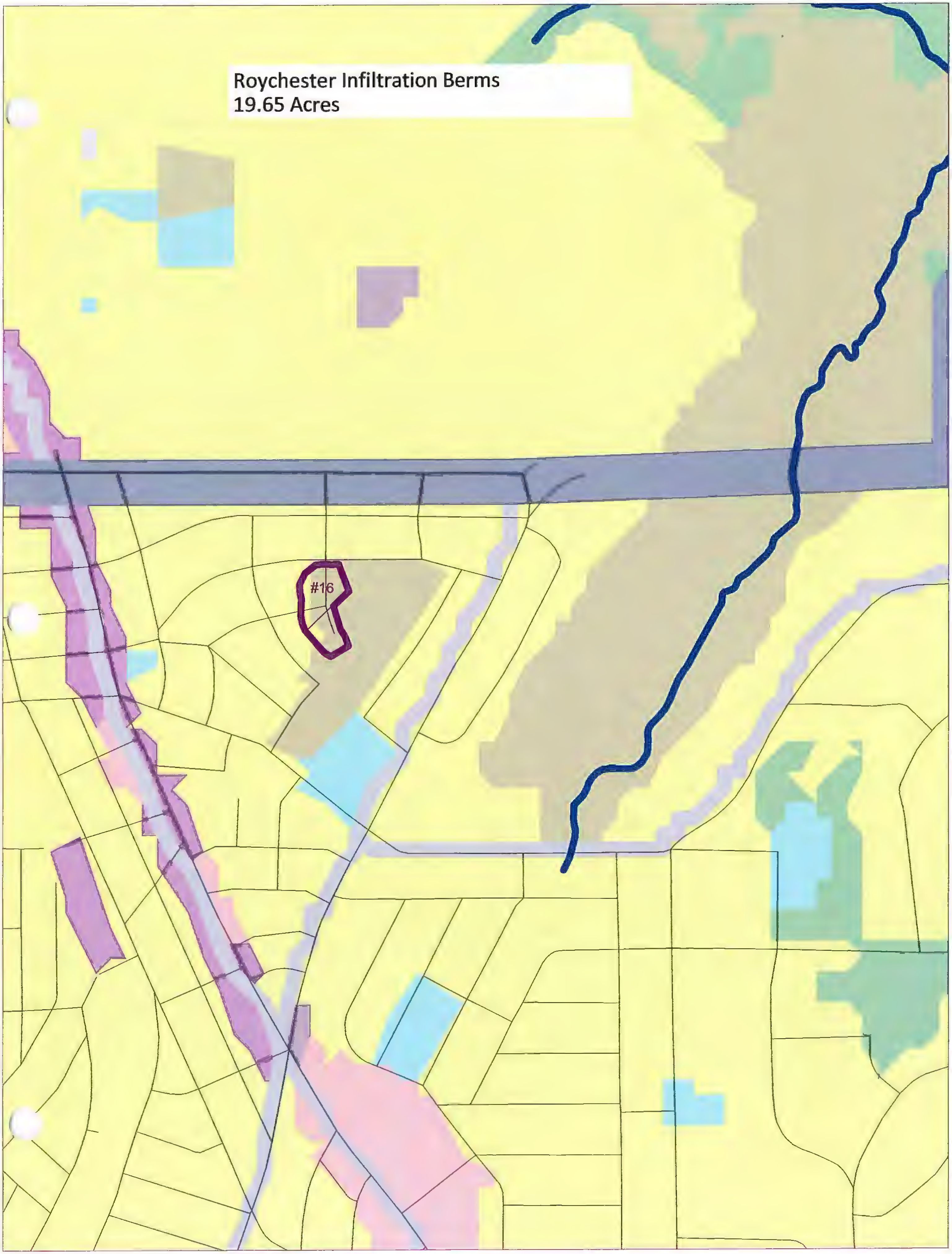
Wissahickon TMDL Roychester Park Infiltration Berms

Total Load	This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	17649.0	2745.6	67992.2	360.5	106.9	19.3	0.0	2.7	17542.1	2726.3	67992.2	357.7	0.6	0.7	0.0	0.75
Total	17649.0	2745.6	67992.2	360.5	106.9	19.3	0.0	2.7	17542.1	2726.3	67992.2	357.7	0.6	0.7	0.0	0.75
				720,900.33				5,433.15								

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)	
Urban	15124.61	2580.02	67745.60	330.41	
Cropland	0.00	0.00	0.00	0.00	
Pastureland	0.00	0.00	0.00	0.00	
Forest	73.81	34.96	176.07	5.29	
Feedlots	0.00	0.00	0.00	0.00	
User Defined	0.00	0.00	0.00	0.00	
Septic	0.00	0.00	0.00	0.00	
Gully	0.00	0.00	0.00	0.00	
Streambank	35.25	13.57	70.50	22.03	
Groundwater	2308.42	97.76	0.00	0.00	
Total	17542.10	2726.31	67992.16	357.73	715,467.18

			Name: Roychester Infiltration Berms		
Land Type	Acres	Percentage of Watershed	TSS Removal Effectiveness Used	TP Removal Effectiveness Used	TN Removal Effectiveness Used
Urban - Commercial	0.00	0.00%	95%	85%	85%
Urban - Industrial	0.00	0.00%	95%	85%	85%
Urban - Institutional	0.00	0.00%	95%	85%	85%
Urban - Transportation	0.00	0.00%	95%	85%	85%
Urban - Multi-Family	0.00	0.00%	95%	85%	85%
Urban - Single-Family	19.26	0.84%	95%	85%	85%
Urban-Cultivated	0.00	0.00%	95%	85%	85%
Urban - Vacant (developed)	0.00	0.00%	95%	85%	85%
Urban - Open Space	0.39	0.02%	95%	85%	85%
Cropland	0.00	0.00%	95%	85%	85%
Pastureland	0.00	0.00%	95%	85%	85%
Forest	0.00	0.00%	95%	85%	85%
User Defined	0.00	0.00%	95%	85%	85%
Total	19.65	0.85%			


Roychester Infiltration Berms
19.65 Acres
#16

ATC GROUP SERVICES LLC

Appendix P

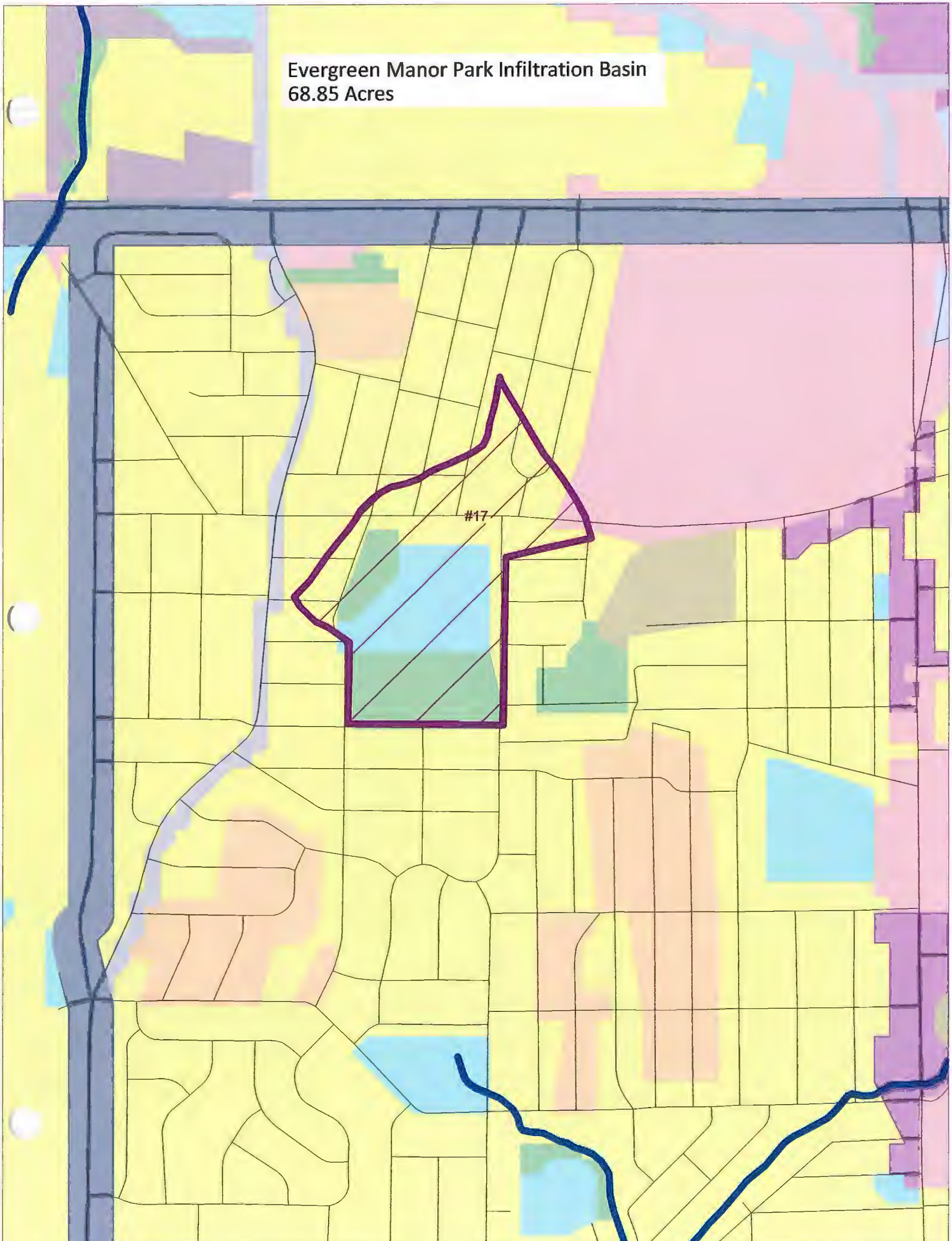
Wissahickon TMDL Evergreen Manor Park Infiltration Basin

Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	17649.0	2745.6	67992.2	360.5	314.4	58.0	4.4	7.9	17334.6	2687.7	67987.7	352.5	1.8	2.1	0.0	2.20
Total	17649.0	2745.6	67992.2	360.5	314.4	58.0	4.4	7.9	17334.6	2687.7	67987.7	352.5	1.8	2.1	0.0	2.20
				720,900.33				15,829.29								

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)	
Urban	14926.02	2545.57	67745.60	325.90	
Cropland	0.00	0.00	0.00	0.00	
Pastureland	0.00	0.00	0.00	0.00	
Forest	64.94	30.78	171.64	4.60	
Feedlots	0.00	0.00	0.00	0.00	
User Defined	0.00	0.00	0.00	0.00	
Septic	0.00	0.00	0.00	0.00	
Gully	0.00	0.00	0.00	0.00	
Streambank	35.25	13.57	70.50	22.03	
Groundwater	2308.42	97.76	0.00	0.00	
Total	17334.64	2687.68	67987.73	352.54	705,071.03

			Name: Evergreen Manor Park Infiltration Basin		
Land Type	Acres	Percentage of Watershed	TSS Removal Effectiveness Used	TP Removal Effectiveness Used	TN Removal Effectiveness Used
Urban - Commercial	0.00	0.00%	95%	85%	85%
Urban - Industrial	0.00	0.00%	95%	85%	85%
Urban - Institutional	15.83	0.69%	95%	85%	85%
Urban - Transportation	0.00	0.00%	95%	85%	85%
Urban - Multi-Family	0.00	0.00%	95%	85%	85%
Urban - Single-Family	34.42	1.49%	95%	85%	85%
Urban-Cultivated	0.00	0.00%	95%	85%	85%
Urban - Vacant (developed)	0.00	0.00%	95%	85%	85%
Urban - Open Space	0.00	0.00%	95%	85%	85%
Cropland	0.00	0.00%	95%	85%	85%
Pastureland	0.00	0.00%	95%	85%	85%
Forest	18.59	0.81%	95%	85%	85%
User Defined	0.00	0.00%	95%	85%	85%
Total	68.85	2.99%			


Evergreen Manor Park Infiltration Basin
68.85 Acres
#17

Appendix Q

Wissahickon TMDL
Grove Park
Streambank Restoration

GROVE PARK STREAM BANK RESTORATION PROJECT

Reach	Bank Length (ft)	Bank Height (ft)	Bank Area (ft)	BKF Height (ft)	BEHI	Near Bank Stress	Predicted Erosion Rate (ft/yr)	Predicted Erosion Subtotal (CF/yr)	Predicted Erosion Subtotal (tons/yr)	Predicted Reach Total (tons/yr)	Predicted Erosion Rate (tons/ft/yr)	Predicted Erosion Rate (lbs/ft/yr)	Efficiency of Restoration Process	Predicted Reach Total (tons/yr)	Predicted Reach Total (lbs/yr)	Predicted Nitrogen Total (lbs/yr)	Predicted Phosphorus Total (lbs/yr)
1	2600	4	10400	3	High	Low	0.3	3120	195.00	195.00	0.075	150	50%	97.5	195,000	253.50	117.00

Stream: Sandy Pt : Grove Park Location:

Station: Observers:

Date: Stream Type: Valley Type:

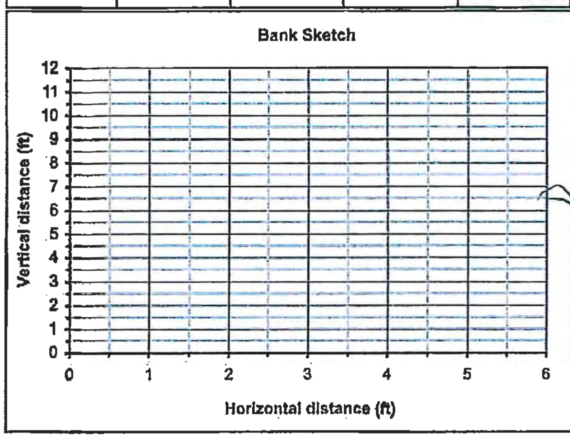
						BEHI
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	4 (A)	Bankfull Height (ft) =	2 (B)	(A)/(B) =	2.0 (C)	2.0
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1 (D)	Study Bank Height (ft) =	4 (A)	(D)/(A) =	.25 (E)	.25
Weighted Root Density (G)						
		Root Density as % =	10 (F)	(F) x (E) =	2.5 (G)	2.5
Bank Angle (H)						
				Bank Angle as Degrees =	(H)	4.56
Surface Protection (I)						
				Surface Protection as % =	(I)	0

Bank Material Adjustment:
- **Bedrock** (Overall Very Low BEHI)
- **Boulders** (Overall Low BEHI)
- **Cobble** (Subtract 10 points if uniform medium to large cobble)
- **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand)
- **Sand** (Add 10 points)
- **Silt/Clay** (no adjustment)

Bank Material Adjustment: -10

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	39.5



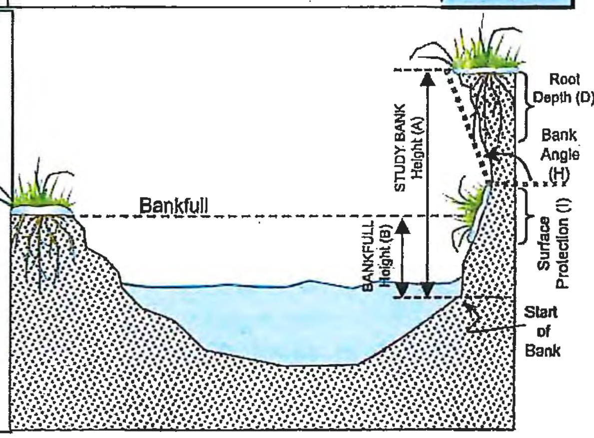


Figure 4. BEHI Assessment Form (Rosgen 2006)

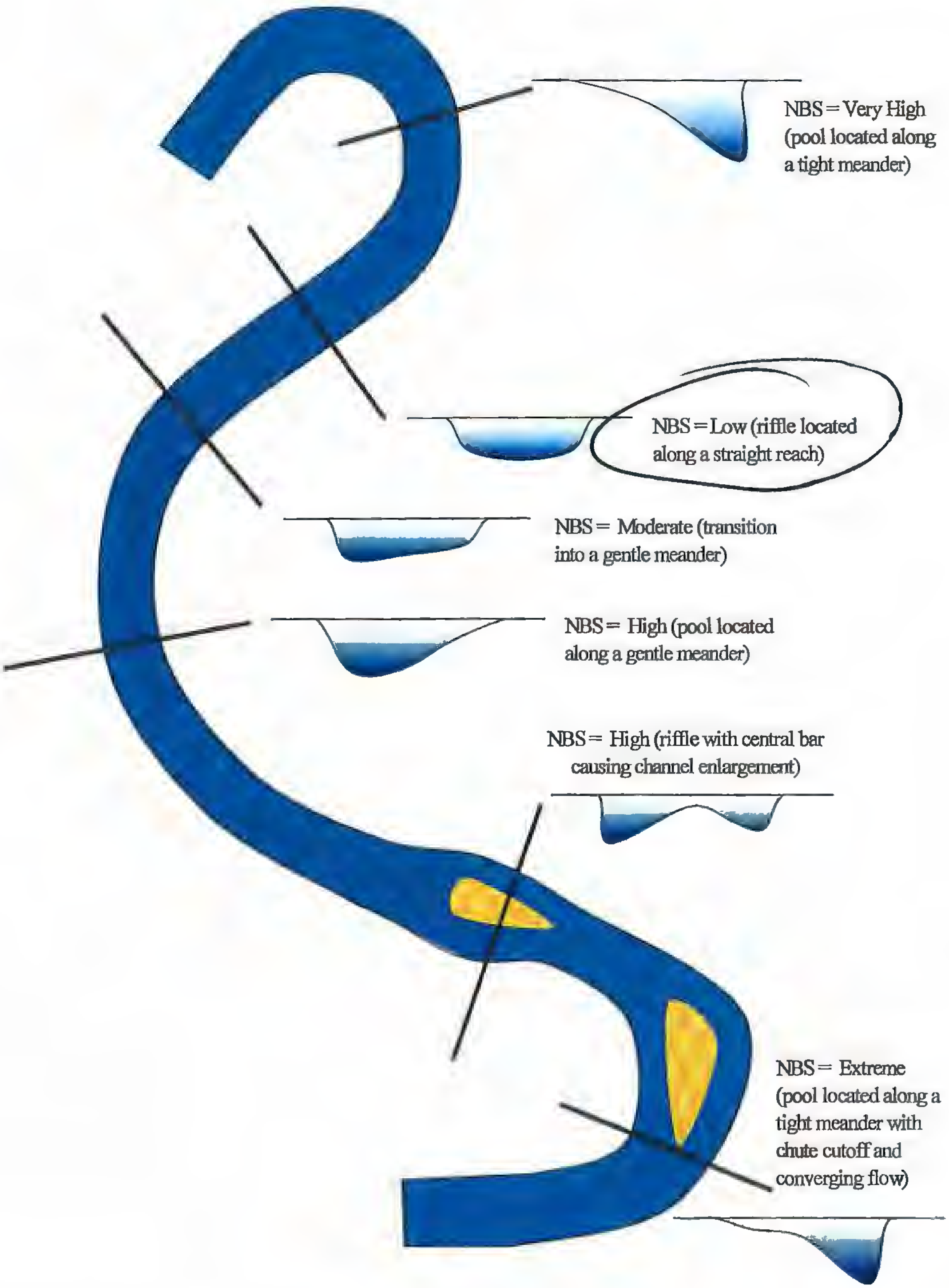


Figure 5. Near bank stress conditions (Rosgen 2001b).

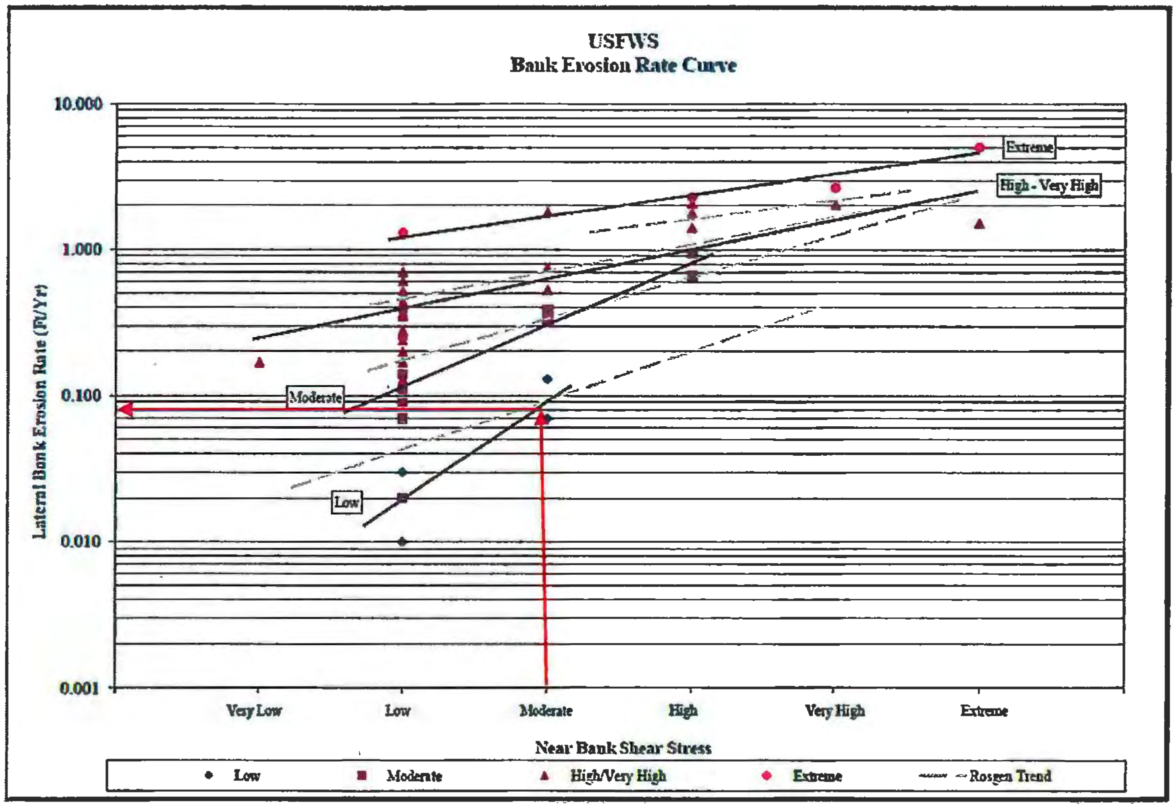


Figure B-1. Bank Erosion Rate Curve Developed by the USFWS

Stream bank erosion is predicted from the curve in Figure B-1 by first identifying the BEHI and NBS scores. For example, Bank 20 from Table B-3 had an NBS score of moderate and a BEHI score of low. By locating the moderate NBS score on the x axis of the Figure B-1 and following it straight up to the BEHI line for "low," the vertical axis shows a predicted erosion rate of 0.07 feet per year, as indicated by the red arrows on the figure.

To convert the erosion rate from feet per year to tons per year, a soil bulk density of 125 pounds/ft^3 was used. This estimate was obtained from a study by Van Eps et al. (2010) that sampled coarse and fine grain layers of stream banks in the West Fork White River watershed in Northwestern Arkansas to determine the in-situ bulk density and particle size distribution. The 125 pounds/ft^3 value used in the Protocol 1 example was calculated as the mean of the coarse and fine grain average bulk density measurements obtained by Van Eps et al. (2010). The bulk density from this study was used only as an example of typical values that might be found. The original bulk density data from the USFWS was not available. The protocol recommends that each project require its own bulk density analysis at several locations in the stream channel as bulk density can be highly variable.

From Van Eps et al. (2010):

Appendix R

Wissahickon TMDL
Ardsley Wildlife Sanctuary
Basin Renovation

ARDSLEY WILDLIFE STREAMBANK STABILIZATION PROJECT

Reach	Bank Length (ft)	Bank Height (ft)	Bank Area (ft)	BKF Height (ft)	BEHI	Near Bank Stress	Predicted Erosion Rate (ft/yr)	Predicted Erosion Subtotal (CF/yr)	Predicted Erosion Subtotal (tons/yr)	Predicted Reach Total (tons/yr)	Predicted Erosion Rate (tons/ft/yr)	Predicted Erosion Rate (lbs/ft/yr)	Efficiency of Restoration Process	Predicted Reach Total (tons/yr)	Predicted Sediment Total (lbs/yr)	Predicted Nitrogen Total (lbs/yr)	Predicted Phosphorus Total (lbs/yr)
1	600	10	6000	4	High	Low	0.3	1800	112.50	112.50	0.1875	375	50%	56.25	112,500	146.25	67.50

Stream: Ardsley wildlife TRIB Location:

Station: Observers:

Date: Stream Type: Valley Type:

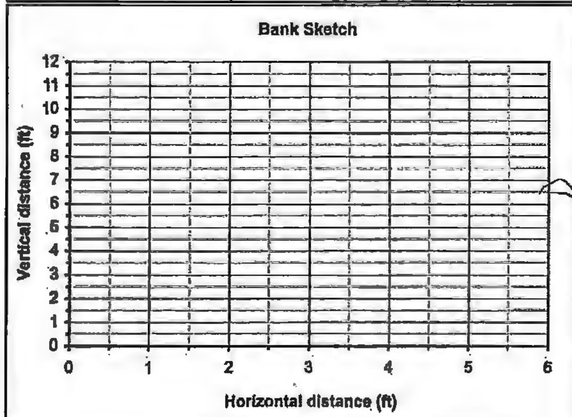
						BEHI
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	8 (A)	Bankfull Height (ft) =	4 (B)	(A)/(B) =	2.0 (C)	2.0
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	4 (D)	Study Bank Height (ft) =	8 (A)	(D)/(A) =	0.5 (E)	0.5
Weighted Root Density (G)						
		Root Density as % =	10 (F)	(F)x(E) =	5 (G)	5.
Bank Angle (H)						
				Bank Angle as Degrees =	(H)	70
Surface Protection (I)						
				Surface Protection as % =	0 (I)	0

Bank Material Adjustment:
- **Bedrock** (Overall Very Low BEHI)
- **Boulders** (Overall Low BEHI)
- **Cobble** (Subtract 10 points if uniform medium to large cobble)
- **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand)
- **Sand** (Add 10 points)
- **Silt/Clay** (no adjustment)

Bank Material Adjustment: 0

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	40



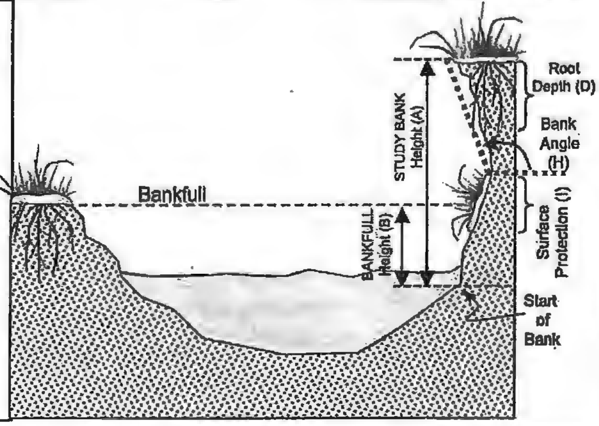


Figure 4. BEHI Assessment Form (Rosgen 2006)

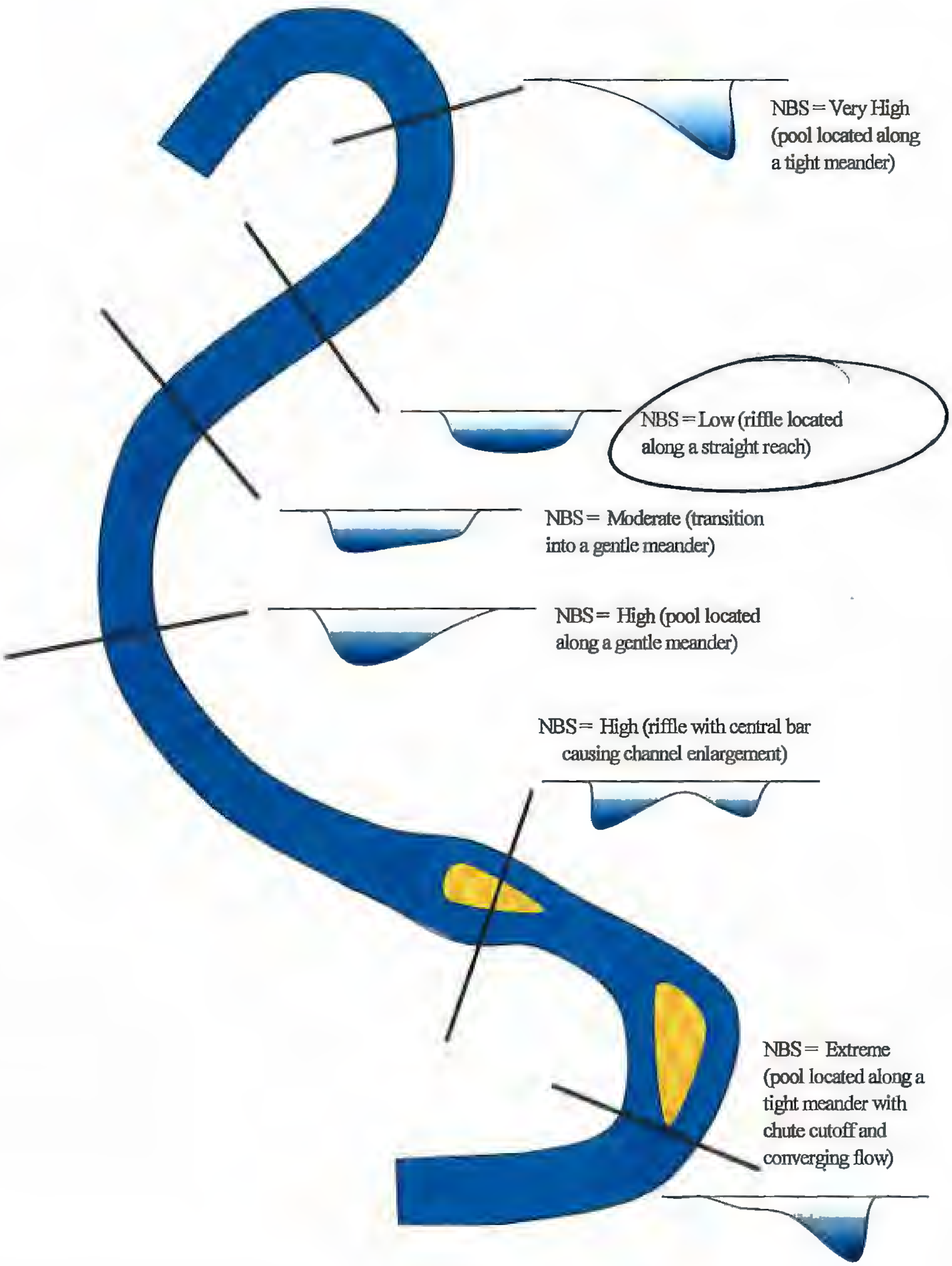


Figure 5. Near bank stress conditions (Rosgen 2001b).

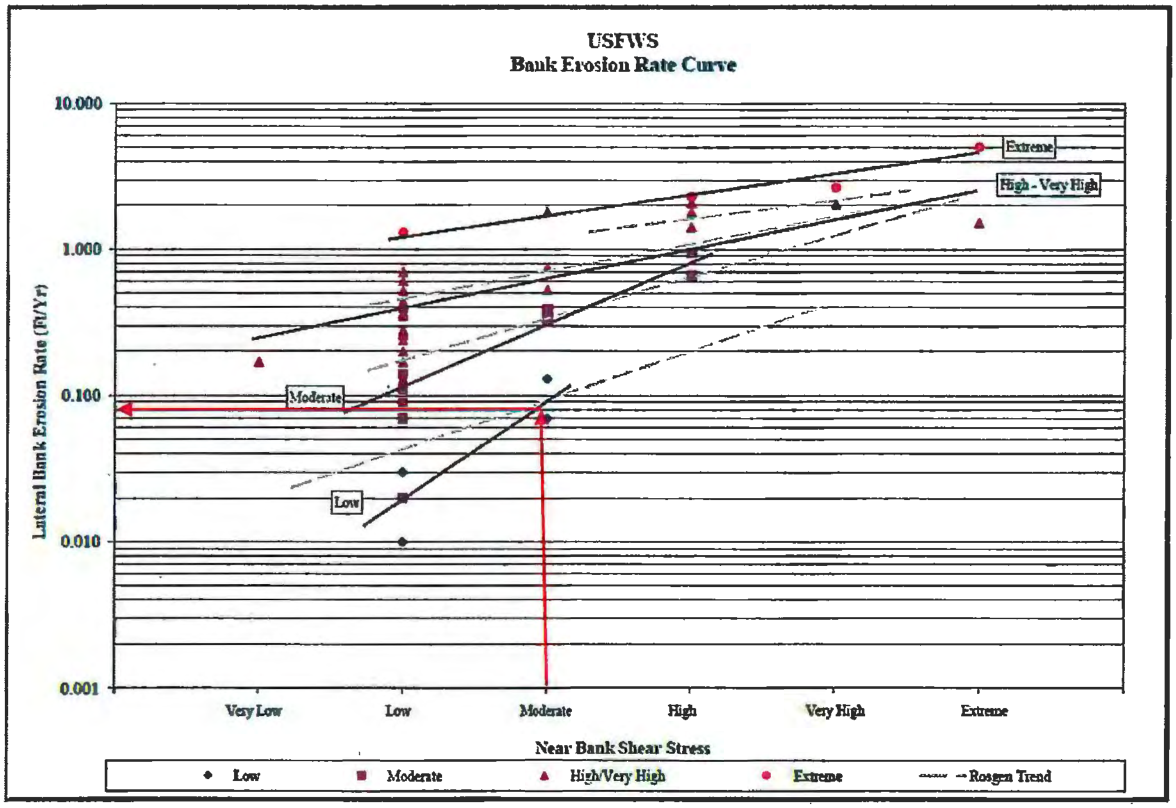


Figure B-1. Bank Erosion Rate Curve Developed by the USFWS

Stream bank erosion is predicted from the curve in Figure B-1 by first identifying the BEHI and NBS scores. For example, Bank 20 from Table B-3 had an NBS score of moderate and a BEHI score of low. By locating the moderate NBS score on the x axis of the Figure B-1 and following it straight up to the BEHI line for "low," the vertical axis shows a predicted erosion rate of 0.07 feet per year, as indicated by the red arrows on the figure.

To convert the erosion rate from feet per year to tons per year, a soil bulk density of 125 pounds/ft^3 was used. This estimate was obtained from a study by Van Eps et al. (2010) that sampled coarse and fine grain layers of stream banks in the West Fork White River watershed in Northwestern Arkansas to determine the in-situ bulk density and particle size distribution. The 125 pounds/ft^3 value used in the Protocol 1 example was calculated as the mean of the coarse and fine grain average bulk density measurements obtained by Van Eps et al. (2010). The bulk density from this study was used only as an example of typical values that might be found. The original bulk density data from the USFWS was not available. The protocol recommends that each project require its own bulk density analysis at several locations in the stream channel as bulk density can be highly variable.

From Van Eps et al. (2010):

Appendix S

Pollutant Reduction Plan Pennypack Creek

Total Load To BMP				
Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)
	lb/year	lb/year	lb/year	lb/year
W1	82.7	19.6	315.5	11,000.0
Total	82.7	19.6	315.5	11,000.0

Total BMP Reduction	TP (lb/yr)	TSS (lb/yr)
	8.8	6,600.0

1. BMP Drainage Area	NAME: Melmar Basin		
Land Type	Acres	TSS Removal Effectiveness (%)	TP Removal Effectiveness (%)
Urban - Commercial	0.00	60%	45%
Urban - Industrial	0.00	60%	45%
Urban - Institutional	0.00	60%	45%
Urban - Transportation	0.00	60%	45%
Urban - Multi-Family	0.00	60%	45%
Urban - Single-Family	50.35	60%	45%
Urban-Cultivated	0.00	60%	45%
Urban - Vacant (developed)	0.00	60%	45%
Urban - Open Space	0.00	60%	45%
Cropland	0.00	60%	45%
Pastureland	0.00	60%	45%
Forest	11.05	60%	45%
User Defined	0.00	60%	45%
Total	61.40		

Melmar Basin
Madison Rd
Pepper Rd
Winthrop Rd
Somerset Rd
Google earth
© 2016 Google
2000 ft
N

[illegible]				
Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)
	lb/year	lb/year	lb/year	lb/year
W1	82.7	18.0	315.5	10,333.3
Total	82.7	18.0	315.5	10,333.3

[illegible]	[illegible]	[illegible]
	8.1	6,200.0

[illegible]	NAME:	Wyndmoor Basin	
Land Type	Acres	TSS Removal Effectiveness (%)	TP Removal Effectiveness (%)
Urban - Commercial	0.00	60%	45%
Urban - Industrial	0.00	60%	45%
Urban - Institutional	0.00	60%	45%
Urban - Transportation	0.00	60%	45%
Urban - Multi-Family	0.00	60%	45%
Urban - Single-Family	12.70	60%	45%
Urban-Cultivated	0.00	60%	45%
Urban - Vacant (developed)	0.00	60%	45%
Urban - Open Space	0.00	60%	45%
Cropland	0.00	60%	45%
Pastureland	0.00	60%	45%
Forest	45.20	60%	45%
User Defined	0.00	60%	45%
Total	57.90		

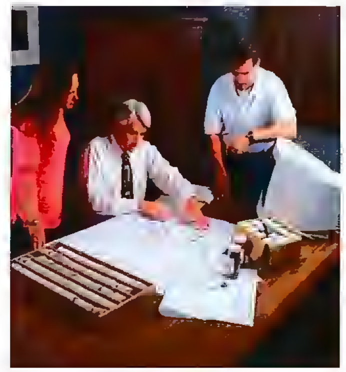
Wyndmoor Basin
Moreland Rd
2015
Google earth
© 2016 Google
2000 ft
N

IRVIN ROAD STREAMBANK STABILIZATION

Reach	Bank Length (ft)	Bank Height (ft)	Bank Area (ft)	BKF Height (ft)	BEHI	Near Bank Stress	Predicted Erosion Rate (ft/yr)	Predicted Erosion Subtotal (CF/yr)	Predicted Erosion Subtotal (tons/yr)	Predicted Reach Total (tons/yr)	Predicted Erosion Rate (tons/ft/yr)	Predicted Erosion Rate (lbs/ft/yr)	Efficiency of Restoration Process	Predicted Reach Total (tons/yr)	Predicted Reach Total (lbs/yr)	Predicted Nitrogen Total (lbs/yr)	Predicted Phosphorus Total (lbs/yr)
1	180	7	1260	3	High	Low	0.3	378	23.63	23.63	0.13125	262.5	50%	11.8125	23,625	30.71	14.18

Appendix T

Pollutant Reduction Plan Meadowbrook Creek



MEADOWBROOK SCOUT PRESERVE STREAMBANK STABILIZATION

Reach	Bank Length (ft)	Bank Height (ft)	Bank Area (ft)	BKF Height (ft)	BEHI	Near Bank Stress	Predicted Erosion Rate (ft/yr)	Predicted Erosion Subtotal (CF/yr)	Predicted Erosion Subtotal (tons/yr)	Predicted Reach Total (tons/yr)	Predicted Erosion Rate (tons/ft/yr)	Predicted Erosion Rate (lbs/ft/yr)	Efficiency of Restoration Process	Predicted Reach Total (tons/yr)	Predicted Reach Total (lbs/yr)	Predicted Nitrogen Total (lbs/yr)	Predicted Phosphorus Total (lbs/yr)
1	300	6	1800	3	High	Low	0.3	540	33.75	33.75	0.1125	225	50%	16.875	33,750	43.88	20.25

Stream: Meadow brook Scout Preser. Location:

Station: Observers:

Date: Stream Type: Valley Type:

						BEHI
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	6 (A)	Bankfull Height (ft) =	3 (B)	(A)/(B) =	2 (C)	2
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	2 (D)	Study Bank Height (ft) =	6 (A)	(D)/(A) =	,33 (E)	,33
Weighted Root Density (G)						
		Root Density as % =	.25 (F)	(F) x (E) =	(G)	—
Bank Angle (H)						
				Bank Angle as *Degrees* =	45 (H)	45
Surface Protection (I)						
				Surface Protection as % =	— (I)	—

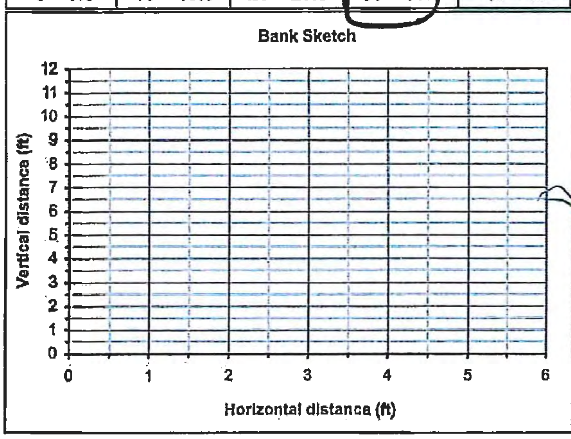
Bank Material Adjustment:

- **Bedrock** (Overall Very Low BEHI)
- **Boulders** (Overall Low BEHI)
- **Cobble** (Subtract 10 points if uniform medium to large cobble)
- **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand)
- **Sand** (Add 10 points)
- **Silt/Clay** (no adjustment)

Bank Material Adjustment

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	47.5



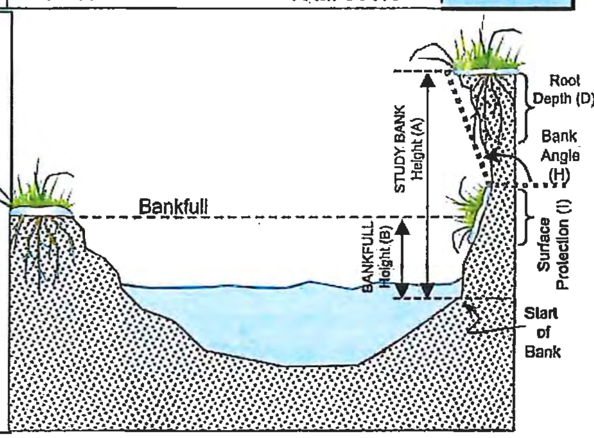


Figure 4. BEHI Assessment Form (Rosgen 2006)

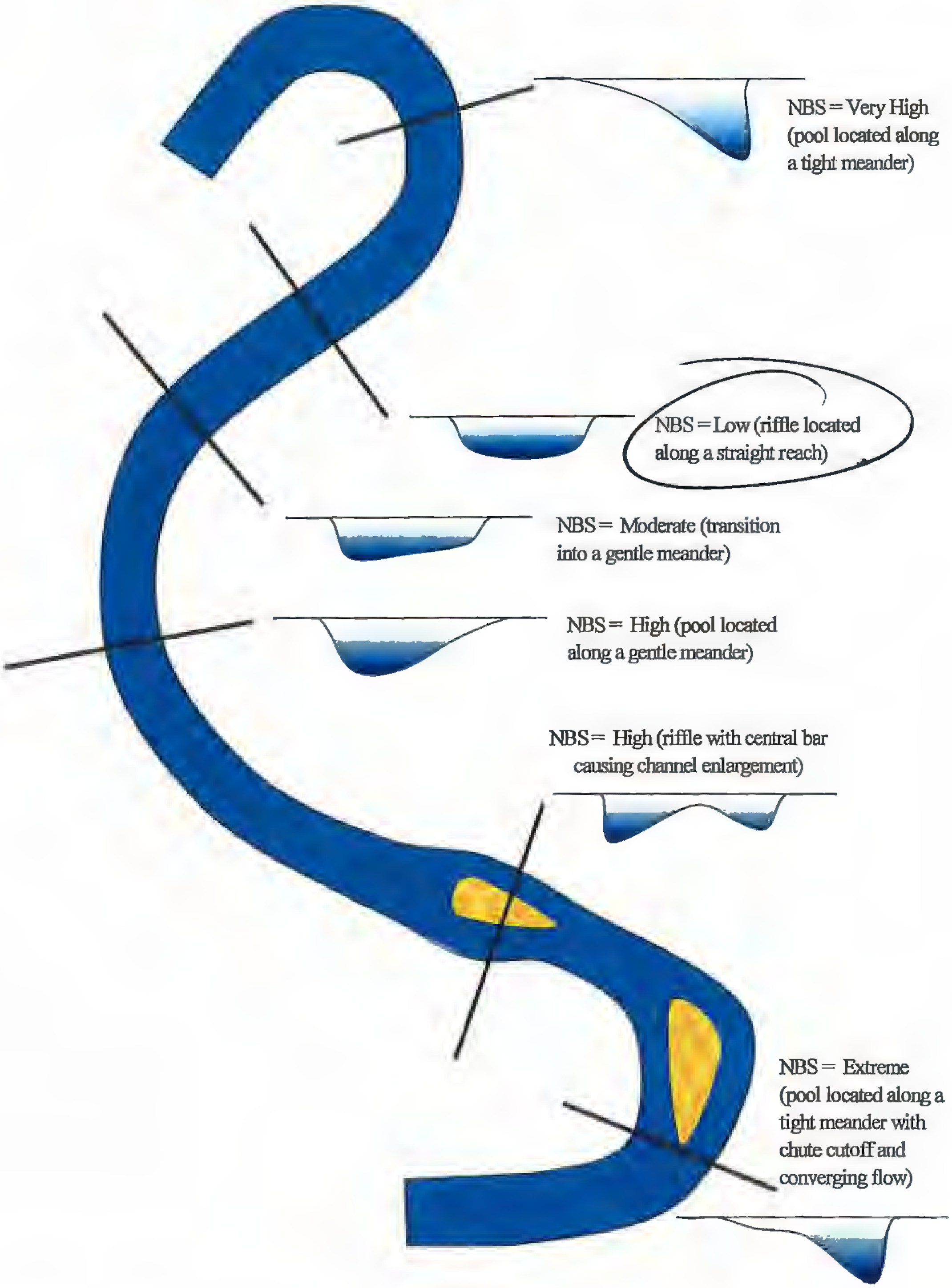


Figure 5. Near bank stress conditions (Rosgen 2001b).

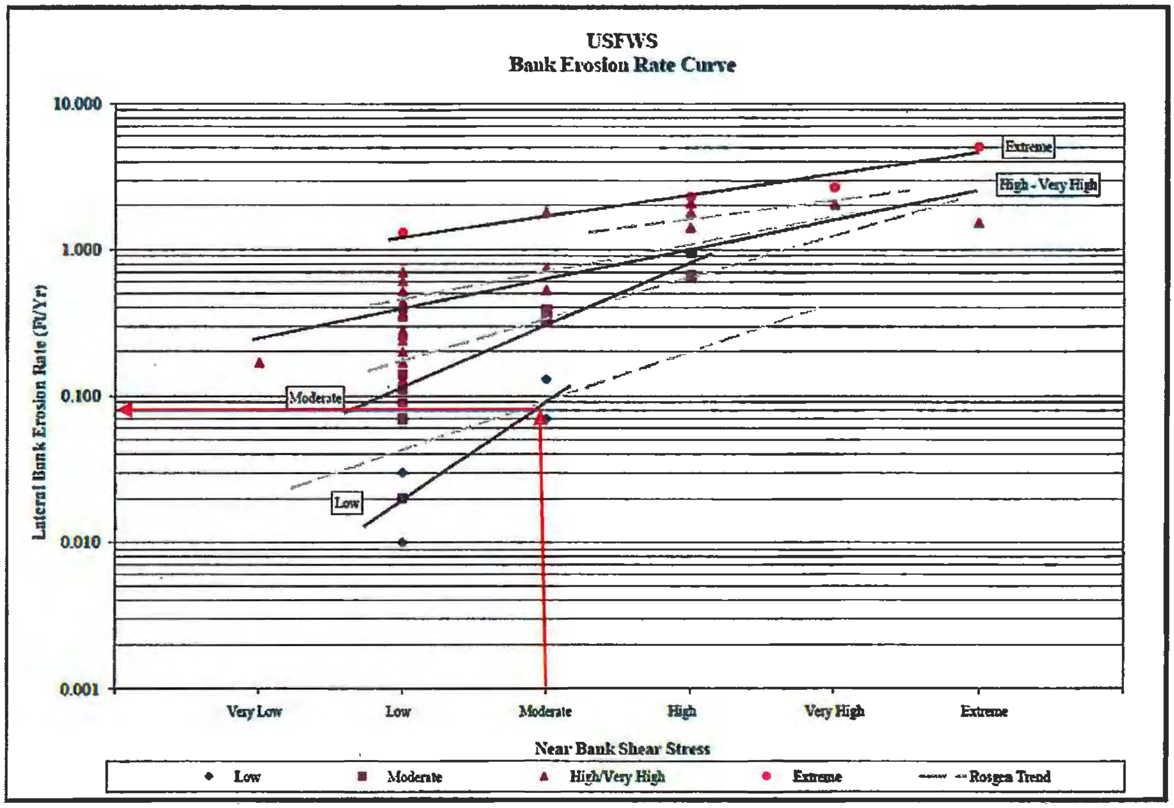


Figure B-1. Bank Erosion Rate Curve Developed by the USFWS

Stream bank erosion is predicted from the curve in Figure B-1 by first identifying the BEHI and NBS scores. For example, Bank 20 from Table B-3 had an NBS score of moderate and a BEHI score of low. By locating the moderate NBS score on the x axis of the Figure B-1 and following it straight up to the BEHI line for "low," the vertical axis shows a predicted erosion rate of 0.07 feet per year, as indicated by the red arrows on the figure.

To convert the erosion rate from feet per year to tons per year, a soil bulk density of 125 pounds/ft^3 was used. This estimate was obtained from a study by Van Eps et al. (2010) that sampled coarse and fine grain layers of stream banks in the West Fork White River watershed in Northwestern Arkansas to determine the in-situ bulk density and particle size distribution. The 125 pounds/ft^3 value used in the Protocol 1 example was calculated as the mean of the coarse and fine grain average bulk density measurements obtained by Van Eps et al. (2010). The bulk density from this study was used only as an example of typical values that might be found. The original bulk density data from the USFWS was not available. The protocol recommends that each project require its own bulk density analysis at several locations in the stream channel as bulk density can be highly variable.

From Van Eps et al. (2010):

MEADOWBROOK BIRD SANCTUARY STREAMBANK STABILIZATION

Reach	Bank Length (ft)	Bank Height (ft)	Bank Area (ft)	BKF Height (ft)	BEHI	Near Bank Stress	Predicted Erosion Rate (ft/yr)	Predicted Erosion Subtotal (CF/yr)	Predicted Erosion Subtotal (tons/yr)	Predicted Reach Total (tons/yr)	Predicted Erosion Rate (tons/ft/yr)	Predicted Erosion Rate (lbs/ft/yr)	Efficiency of Restoration Process	Predicted Reach Total (tons/yr)	Predicted Reach Total (lbs/yr)	Predicted Nitrogen Total (lbs/yr)	Predicted Phosphorus Total (lbs/yr)
1	200	6	1200	3	High	Low	0.3	360	22.50	22.50	0.1125	225	50%	11.25	22,500	29.25	13.50

Stream: Meadowbrook - Bird Sanc.		Location:
Station:		Observers:
Date:	Stream Type:	Valley Type:

Study Bank Height / Bankfull Height (C) — BEHI

Study Bank Height (ft) =	6 (A)	Bankfull Height (ft) =	3 (B)	(A)/(B) =	2 (C)	2

Root Depth / Study Bank Height (E)

Root Depth (ft) =	.5 (D)	Study Bank Height (ft) =	3 (A)	(D)/(A) =	.16 (E)	.16

Weighted Root Density (G)

Root Density as % =	25 (F)	(F) x (E) =	4 (G)	4

Bank Angle (H)

Bank Angle as *Degrees* =	(H)	30

Surface Protection (I)

Surface Protection as % =	(I)	-

Bank Material Adjustment:

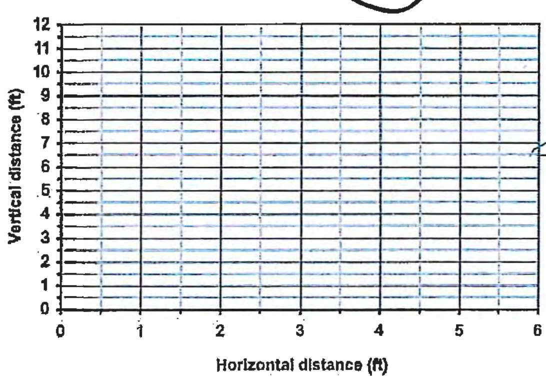
- **Bedrock** (Overall Very Low BEHI)
- **Boulders** (Overall Low BEHI)
- **Cobble** (Subtract 10 points if uniform medium to large cobble)
- **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand)
- **Sand** (Add 10 points)
- **Silt/Clay** (no adjustment)

Bank Material Adjustment: -

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	36.16

Bank Sketch



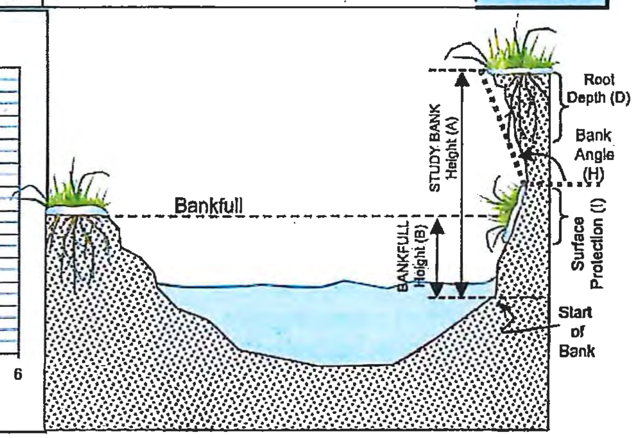


Figure 4. BEHI Assessment Form (Rosgen 2006)

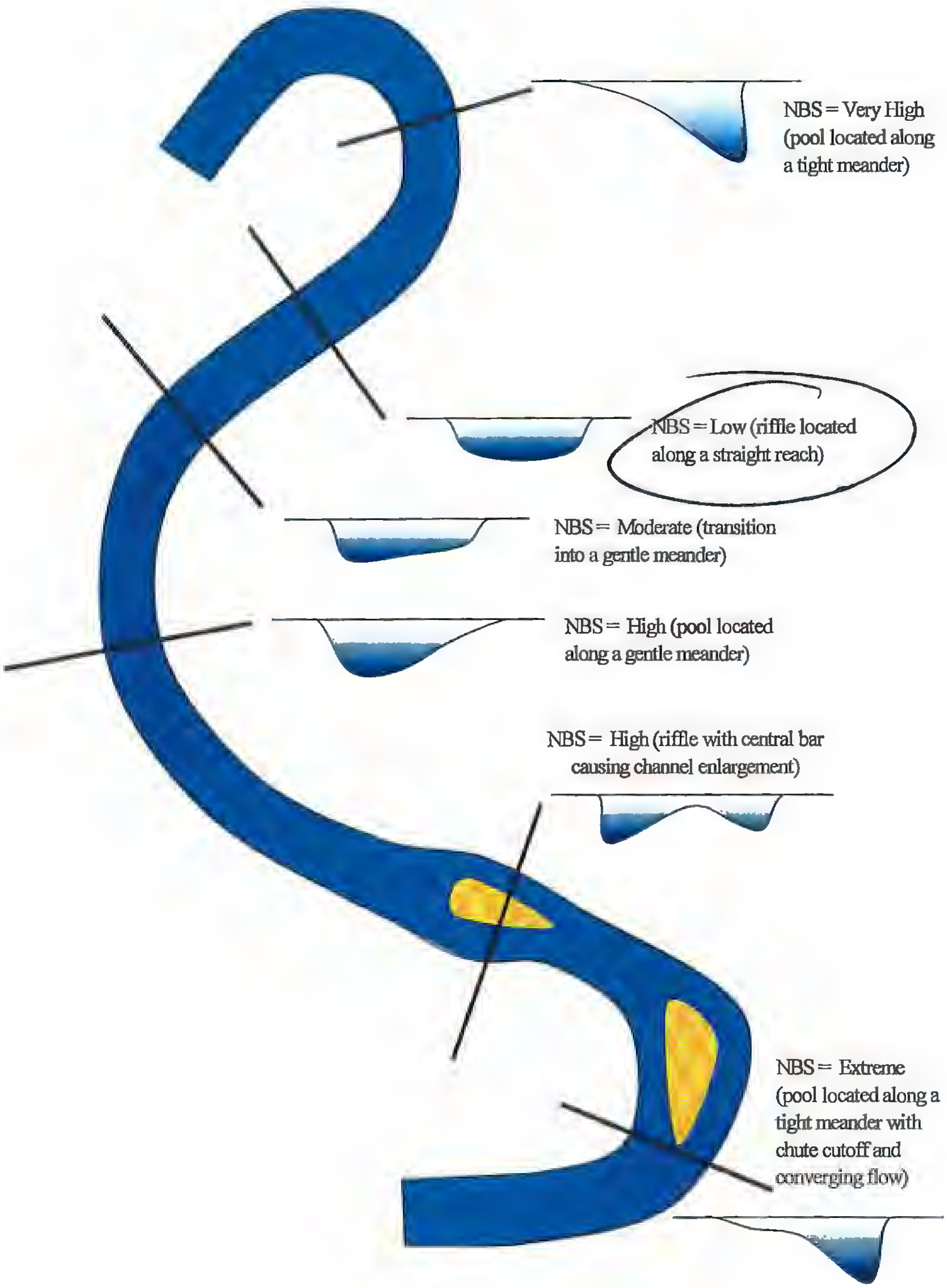


Figure 5. Near bank stress conditions (Rosgen 2001b).

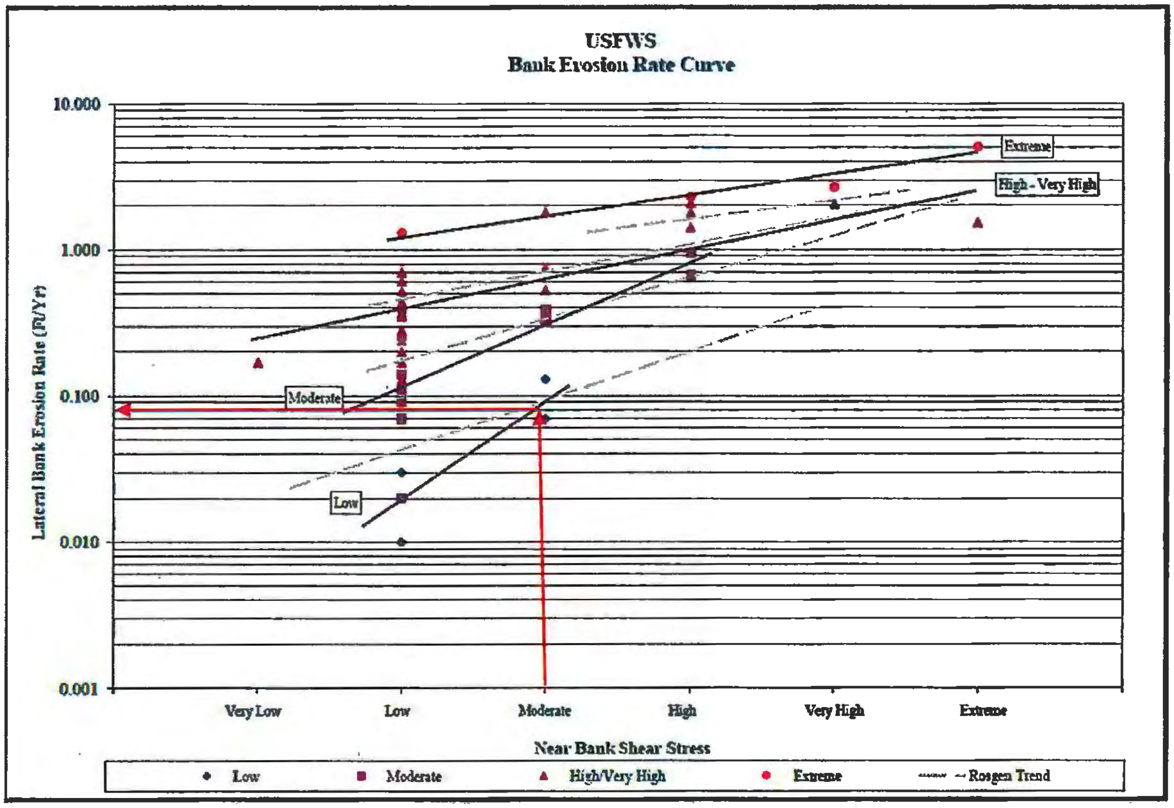


Figure B-1. Bank Erosion Rate Curve Developed by the USFWS

Stream bank erosion is predicted from the curve in Figure B-1 by first identifying the BEHI and NBS scores. For example, Bank 20 from Table B-3 had an NBS score of moderate and a BEHI score of low. By locating the moderate NBS score on the x axis of the Figure B-1 and following it straight up to the BEHI line for "low," the vertical axis shows a predicted erosion rate of 0.07 feet per year, as indicated by the red arrows on the figure.

To convert the erosion rate from feet per year to tons per year, a soil bulk density of 125 pounds/ft^3 was used. This estimate was obtained from a study by Van Eps et al. (2010) that sampled coarse and fine grain layers of stream banks in the West Fork White River watershed in Northwestern Arkansas to determine the in-situ bulk density and particle size distribution. The 125 pounds/ft^3 value used in the Protocol 1 example was calculated as the mean of the coarse and fine grain average bulk density measurements obtained by Van Eps et al. (2010). The bulk density from this study was used only as an example of typical values that might be found. The original bulk density data from the USFWS was not available. The protocol recommends that each project require its own bulk density analysis at several locations in the stream channel as bulk density can be highly variable.

From Van Eps et al. (2010):

ATC GROUP SERVICES LLC

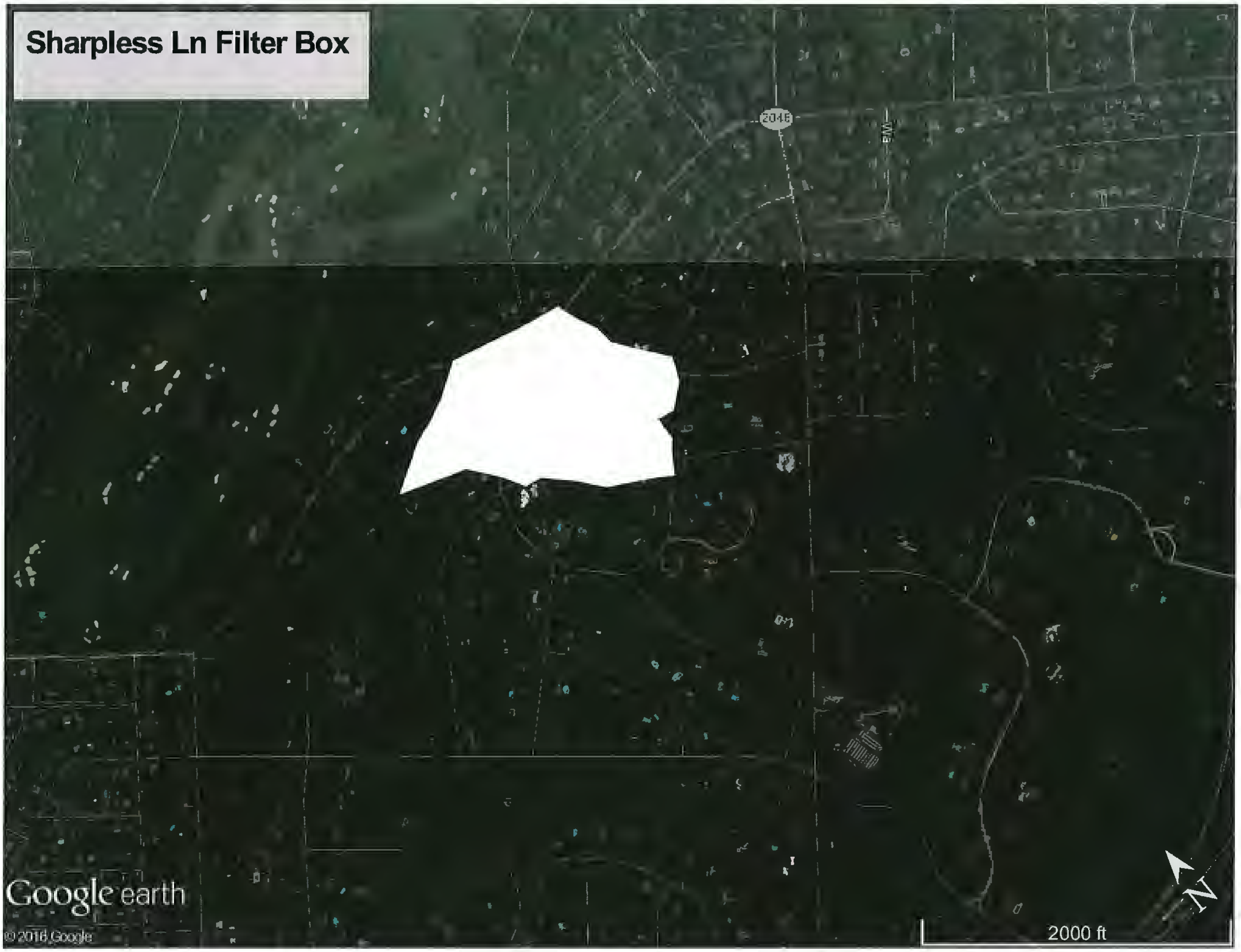
Appendix U

Pollutant Reduction Plan Robinhood Brook

Total Load to BMP				
Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)
	lb/year	lb/year	lb/year	lb/year
W1	148.5	27.0	675.0	6,750.0
Total	148.5	27.0	675.0	6,750.0

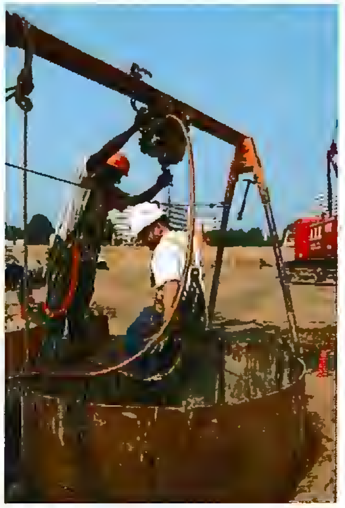
Total BMP Reduction	TP (lb/yr)	TSS (lb/yr)
	0.0	5,400.0

1. BMP Drainage Area	NAME:	Sharpless Rd Filter Box	
Land Type	Acres	TSS Removal Effectiveness (%)	TP Removal Effectiveness (%)
Urban - Commercial	0.00	80%	0%
Urban - Industrial	0.00	80%	0%
Urban - Institutional	0.00	80%	0%
Urban - Transportation	0.00	80%	0%
Urban - Multi-Family	0.00	80%	0%
Urban - Single-Family	33.30	80%	0%
Urban-Cultivated	0.00	80%	0%
Urban - Vacant (developed)	0.00	80%	0%
Urban - Open Space	0.00	80%	0%
Cropland	0.00	80%	0%
Pastureland	0.00	80%	0%
Forest	0.00	80%	0%
User Defined	0.00	80%	0%
Total	33.30		


Sharpless Ln Filter Box
2046
Google earth
© 2016 Google
2000 ft
N

Appendix V

Pollutant Reduction Plan
Rockledge Branch
Pennypack Creek



Total Load To BMP				
Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)
	lb/year	lb/year	lb/year	lb/year
W1	118.2	21.5	537.1	5,250.0
Total	118.2	21.5	537.1	5,250.0

Total BMP Reduction	TP (lb/yr)	TSS (lb/yr)
	0.0	4,200.0

5. BMP Drainage Area	NAME:	Rockledge Ave Filter Box	
Land Type	Acres	TSS Removal Effectiveness (%)	TP Removal Effectiveness (%)
Urban - Commercial	0.00	80%	0%
Urban - Industrial	0.00	80%	0%
Urban - Institutional	0.00	80%	0%
Urban - Transportation	0.00	80%	0%
Urban - Multi-Family	0.00	80%	0%
Urban - Single-Family	26.50	80%	0%
Urban-Cultivated	0.00	80%	0%
Urban - Vacant (developed)	0.00	80%	0%
Urban - Open Space	0.00	80%	0%
Cropland	0.00	80%	0%
Pastureland	0.00	80%	0%
Forest	0.00	80%	0%
User Defined	0.00	80%	0%
Total	26.50		


Rockledge Ave Filter Box
Mankin Ave
Brown Av
Shady Ln
Google earth
© 2016 Google
2000 ft

Appendix W

Pollutant Reduction Plan
Terwood Run

Total Load To BMP				
Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)
	lb/year	lb/year	lb/year	lb/year
W1	895.0	106.0	4140.8	35,250.0
Total	895.0	106.0	4140.8	35,250.0

Total BMP Reduction	TP (lb/yr)	TSS (lb/yr)
	0.0	28,200.0

3. BMP Drainage Area	NAME:	Davidson Rd Filter Box	
Land Type	Acres	TSS Removal Effectiveness (%)	TP Removal Effectiveness (%)
Urban - Commercial	67.80	80%	0%
Urban - Industrial	0.00	80%	0%
Urban - Institutional	0.00	80%	0%
Urban - Transportation	0.00	80%	0%
Urban - Multi-Family	0.00	80%	0%
Urban - Single-Family	45.20	80%	0%
Urban-Cultivated	0.00	80%	0%
Urban - Vacant (developed)	0.00	80%	0%
Urban - Open Space	0.00	80%	0%
Cropland	0.00	80%	0%
Pastureland	0.00	80%	0%
Forest	0.00	80%	0%
User Defined	0.00	80%	0%
Total	113.00		


Davidson Rd Filter Box
Jamison Ln
Revel
Rd
Google earth
© 2016 Google
3000 ft
N

Appendix X

Pollutant Reduction Plan
Tacony and Frankford Creek

Total Load To BMP				
Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)
	lb/year	lb/year	lb/year	lb/year
W1	105.5	24.7	276.7	5,175.2
Total	105.5	24.7	276.7	5,175.2

Total BMP Reduction	TP (lb/yr)	TSS (lb/yr)
	18.5	0.0

3. BMP Treatment Area	NAME:	Alverthorpe Park Bioswale	
Land Type	Acres	TSS Removal Effectiveness (%)	TP Removal Effectiveness (%)
Urban - Commercial	0.00	0%	75%
Urban - Industrial	0.00	0%	75%
Urban - Institutional	0.00	0%	75%
Urban - Transportation	0.00	0%	75%
Urban - Multi-Family	0.00	0%	75%
Urban - Single-Family	0.00	0%	75%
Urban-Cultivated	0.00	0%	75%
Urban - Vacant (developed)	0.00	0%	75%
Urban - Open Space	21.56	0%	75%
Cropland	0.00	0%	75%
Pastureland	0.00	0%	75%
Forest	32.34	0%	75%
User Defined	0.00	0%	75%
Total	53.90		

Alverthorpe Park Bioswale
Kirkwood St
Seminole Ave
Google earth
© 2016 Google
2000 ft
N

Total Load (no BMP)				
Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)
	lb/year	lb/year	lb/year	lb/year
W1	166.8	37.7	734.4	4,118.8
Total	166.8	37.7	734.4	4,118.8

Total BMP Reduction	TP (lb/yr)	TSS (lb/yr)
	7.5	0.0

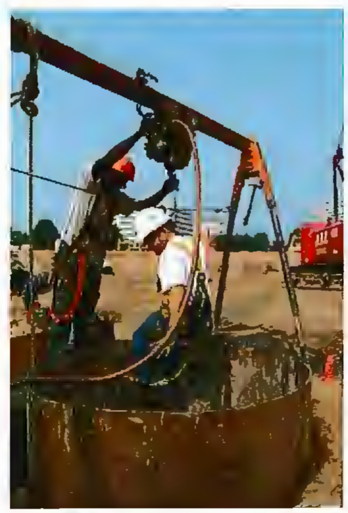
1. BMP Drainage Area	NAME:	Alverthorpe Park Extended Detention Basin	
Land Type	Acres	TSS Removal Effectiveness (%)	TP Removal Effectiveness (%)
Urban - Commercial	0.00	0%	20%
Urban - Industrial	0.00	0%	20%
Urban - Institutional	0.00	0%	20%
Urban - Transportation	0.00	0%	20%
Urban - Multi-Family	0.00	0%	20%
Urban - Single-Family	35.11	0%	20%
Urban-Cultivated	0.00	0%	20%
Urban - Vacant (developed)	0.00	0%	20%
Urban - Open Space	0.00	0%	20%
Cropland	0.00	0%	20%
Pastureland	0.00	0%	20%
Forest	17.56	0%	20%
User Defined	0.00	0%	20%
Total	52.67		


Alverthorpe Park Extended Detention Basin
Google earth
©2016 Google
2000 ft
N

BCM ENGINEERS
ATC GROUP SERVICES LLC

Appendix Y

Pollutant Reduction Plan
Wissahickon Creek



(SEE TMDL PLAN)

Appendix Z

Pollutant Reduction Plan
Sandy Run

(SEE TMDL PLAN)

Appendix AA

Public Notice
Public Comments

PUBLIC NOTICE

Abington Township MS4 Stormwater Plan

Abington Township is preparing a permit application for an Individual Stormwater Permit to be submitted in September of 2017 to the PA Department of Environmental Protection (PADEP) per the Federal Clean Water National Pollutant Discharge Elimination System (NPDES), PA Clean Streams Law and the PADEP-issued Municipal Separate Stormwater Sewer System (MS4) Permit for municipalities in watersheds with Total Maximum Daily Load (TMDL) and Pollution Reduction Plan (PRP) requirements.

A Public Meeting to present the Draft Plan will be held during the Public Work Committee's regularly scheduled meeting on May 3, 2017, at 7:00 pm, at Abington Township Municipal Building, 1176 Old York Road, Abington, PA 19001. The community is invited to provide verbal comments on the plan at the meeting.

In addition, members of the community have an opportunity to review and provide written comment on the plan, including the draft *Total Maximum Daily Load (TMDL) Plan and several Pollution Reduction Plans (PRPs)*. There will be a **30-Day Public Comment Period from May 4, 2017 - June 2, 2017** in order to allow the members of the public to read and submit written comments on the draft TMDL and PRP reports. A copy of the plan will be available on or before May 4, 2017 on the Township website, at www.abington.org, and a hardcopy can be reviewed in person at the Abington Township Municipal Building during normal business hours. Written comments can be submitted to the Township Engineer, Abington Township, 1176 Old York Road, Abington, PA 19001. All comments on the plan must be received by close of business, June 2, 2017.

The TMDL and PRP Plans Abington Township has prepared describe measures and steps the Township will implement in the coming years to reduce sediment and/or nutrient pollution in streams in the Wissahickon Watershed, the Tookany/Tacony-Frankford Watershed, and the Pennypack Watershed. The measures to be implemented include structural stormwater infiltration basins and trenches, stormwater recharge basins, stream bank restoration and stabilization measures, and other best management practices and control measures that reduce the volume and velocity of stormwater runoff flows entering creeks during storms.

Michael LeFevre
Township Manager

Mike Filmyer

From: Celeste Tompkins <ctompkins@abington.org>
Sent: Tuesday, April 11, 2017 10:31 AM
To: Mike Filmyer
Subject: FW: Public Notice
Attachments: MS4 Public Notice ADV.DOCX

Celeste T. Tompkins
Abington Township Engineering Dept.
1176 Old York Road
Abington, PA 19001
267-536-1042

From: Maria Wyrsta
Sent: Tuesday, April 11, 2017 10:00 AM
To: Maureen Schmid <mschmid@montgomerynews.com>
Cc: Celeste Tompkins <ctompkins@abington.org>
Subject: Public Notice

Maureen:
Good Morning!
Please advertise the attached Public Notice in Times Chronicle for Sunday's Dates – April 16th and April 23rd.
As always, please confirm.
Thank you so much.
Maria Wyrsta
Abington Township
Manager's Office
267-536-1003

ATC GROUP SERVICES LLC

Appendix BB

Abington Township Storm Sewer System Maps