EAST BRANDYWINE
Township

Pollutant Reduction Plan

Culbertson Run and
Unnamed Tributaries to Beaver Creek

May 19, 2017

Prepared For:

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1.0 Purpose and Scope

East Brandywine Township is required to develop and implement a Pollutant Reduction Plan (PRP) for Municipal Separate Storm Sewer System (MS4) discharges to Culbertson Run and unnamed tributaries (UNTs) to Beaver Creek as part of the 2018 National Pollutant Discharge Elimination System (NPDES) MS4 Individual Permit application to the Pennsylvania Department of Environmental Protection (PA DEP). This plan has been prepared based on the best and most current guidance made available by PA DEP. Definitions of relevant regulatory terms have been provided in Section 6.0 of this report.

2.0 Permit Requirements

In order to develop a PRP, it is important to have an understanding of the Township's requirements. East Brandywine Township is required by the PA DEP and Environmental Protection Agency (EPA) to reduce sediment pollution from stormwater discharges to surface waters impaired by sediment by ten (10) percent over the five (5) year permit term (March 16, 2018 to March 15, 2023) by implementing projects or Best Management Practices (BMPs).

East Brandywine has MS4 discharges or "outfalls" to Culbertson Run and unnamed tributaries (UNTs) to Beaver Creek, which are both listed by the 2014 Pennsylvania Integrated Water Quality Monitoring and Assessment Report (Integrated Report) as impaired for siltation (i.e. sediment) and highlighted in Table 1 below.

Table 1: MS4 Requirements Table (Municipal) Excerpt

MS4 Name	NPDES ID	Individual Permit Required?	Reason	Impaired Downstream Waters or Applicable TMDL Name	Requirement(s)	Other Cause(s) of Impairment
East Brandywine Twp, Chester County	PAI130524	Yes	Special Protection	Culbertson Run	Appendix E-Siltation (4a)	Other Habitat Alterations (4c)
				UNT to Beaver Creek	Appendix D-Siltation (4a)	
				Beaver Creek		Cause Unknown (4a), Other Habitat Alterations, Water/Flow Variability (4c)
				East Branch Brandywine Creek		Cause Unknown (4a), Other Habitat Alterations, Water/Flow Variability (4c)

East Brandywine Township is required to reduce the sediment loading to Culbertson Run and UNTs to Beaver Creek by ten (10) percent over the five (5) year permit term.

3.0 Background/Setting

East Brandywine Township comprises approximately 11.4 square miles located near the center of Chester County, in southeast Pennsylvania (Figure 1). The 2010 Urbanized Area (U.S. Census Bureau) covers 88 percent of the land area of the Township, with only a small portion in the southwestern portion located outside of it.

Figure 1: East Brandywine Township Location Map

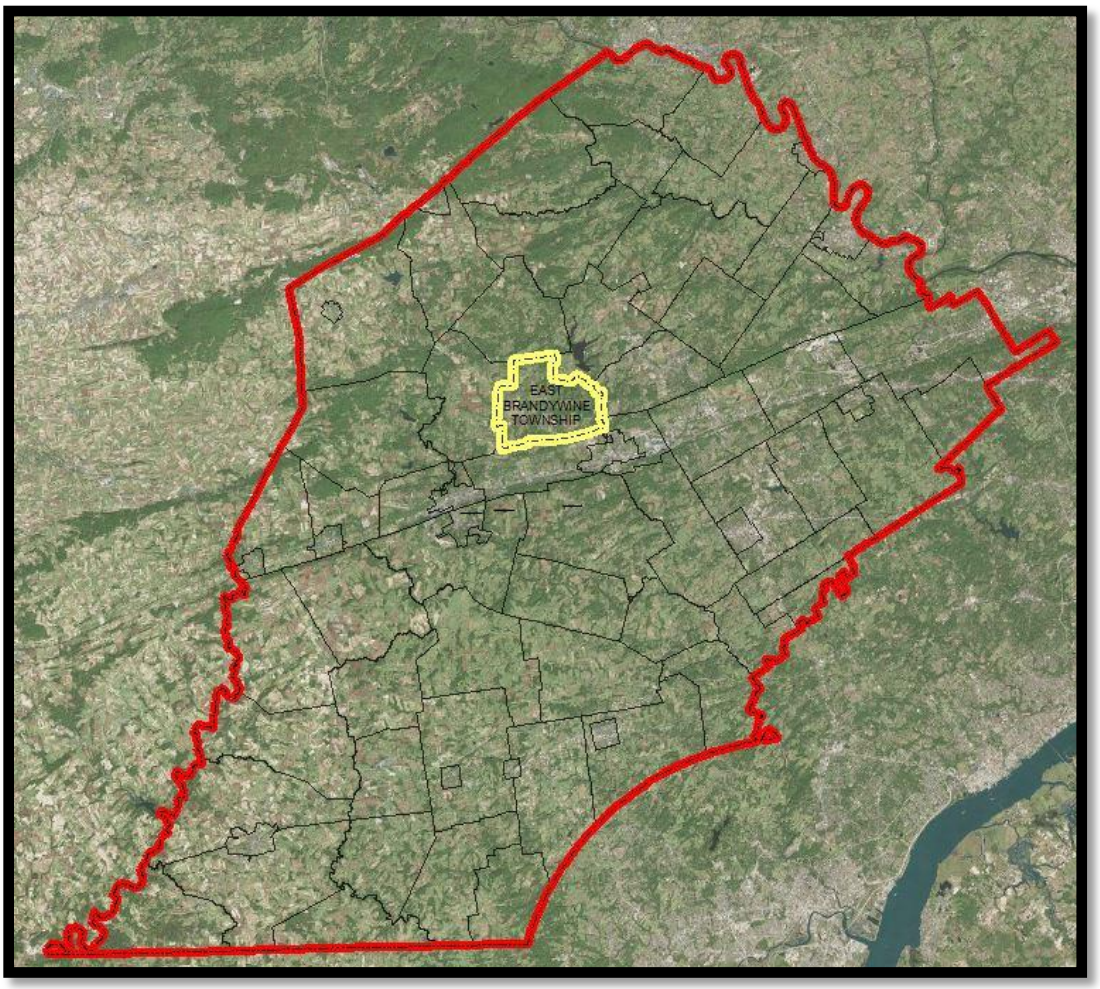
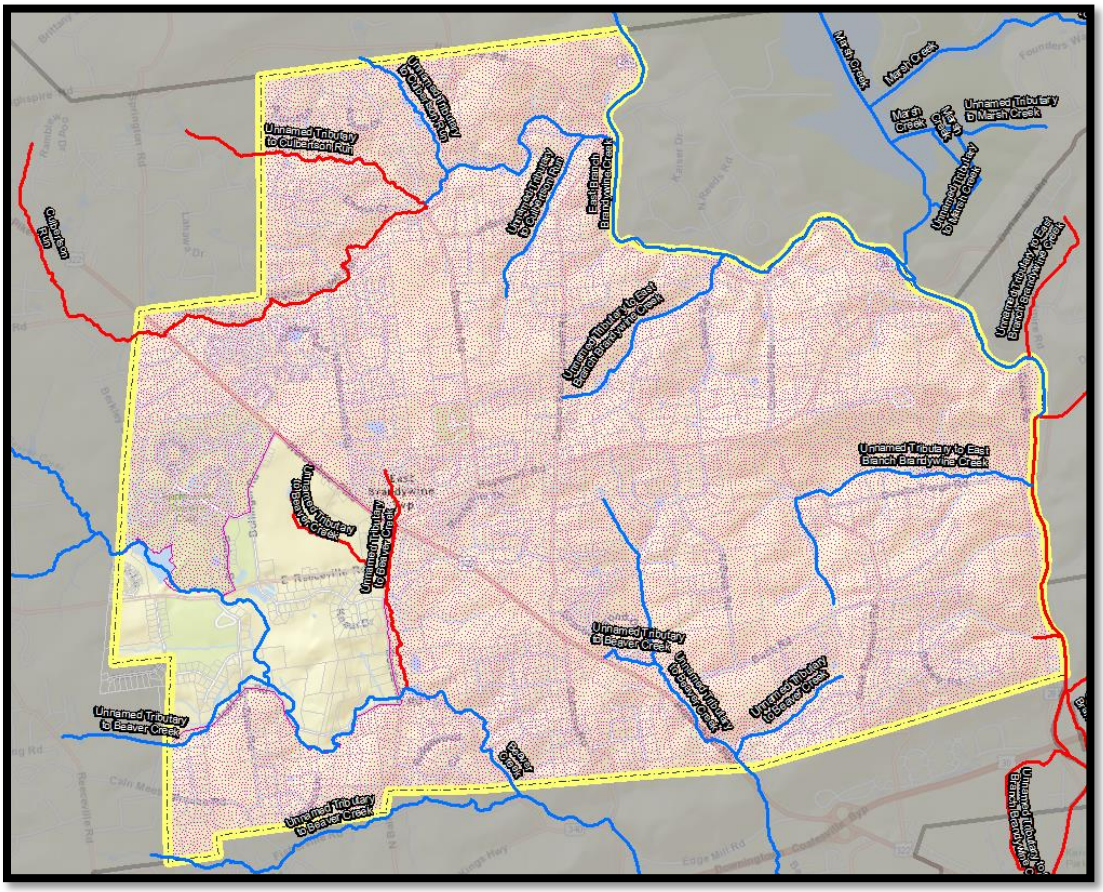


Figure 2 below displays a map of the streams that cross East Brandywine Township along with the 2010 Urbanized Area (hatched). Stream segments colored red indicate impaired portions of streams. A total of twenty-seven (27) MS4 outfalls discharge to the impaired portions of Culbertson Run and UNTs to Beaver Creek.

Figure 2: East Brandywine Township 2010 Urbanized Area (Hatched) and Impaired Streams (Red)



3.1 Culbertson Run

Culbertson Run flows across the northern portion of the Township in an east-northerly direction and into the East Branch Brandywine Creek at the eastern Township boundary. The upper reaches of Culbertson Run from the western Township boundary to Dilworth Road are listed as impaired for sediment. These sections of Culbertson Run and an unnamed tributary were listed as impaired for other habitat modifications in 2010. The portion of Culbertson Run from Dilworth Road to its mouth is not listed as impaired. Table 2 below lists the impairment information for the upper reaches from the 2014 Integrated Report.

There are seventeen (17) MS4 outfalls that discharge to the section of Culbertson Run listed as impaired for sediment. Refer to Appendices for MS4 mapping.

Table 2: 2014 Integrated Report – Culbertson Run

Impairment Cause	Impairment Source	Category	Assessed Use	Date Listed
Other Habitat Alterations	Habitat Modification	4c	Aquatic Life	2010
Siltation (sediment)	Agriculture	4a	Aquatic Life	2010

3.2 Unnamed Tributaries to Beaver Creek

Beaver Creek enters the Township at the western boundary and flows through the southwest corner in a southwesterly direction to where it exits at the southern Township boundary. One (1) UNT to Beaver Creek and its tributaries are listed as impaired for sediment. These UNTs originate in the west-central portion of the Township in the vicinity of Horseshoe Pike (Route 322). Table 2 below lists the impairment information for the UNTs from the 2014 Integrated Report.

There are ten (10) MS4 outfalls that discharge to the UNTs to Beaver Creek listed as impaired for sediment. Refer to Appendices for MS4 mapping.

Table 3: 2014 Integrated Report – UNTs to Beaver Creek

Impairment Cause	Impairment Source	Category	Assessed Use	Date Listed
Siltation (sediment)	Urban Runoff/Storm Sewers	4a	Aquatic Life	2010
Other Habitat Alterations	Urban Runoff/Storm Sewers	4c	Aquatic Life	2010

4.0 Pollutant Reduction

Per the MS4 permit and PRP Instructions document (3800-PM-BCW0100k Rev. 3/2017), the following sections are addressed and described below: Public Participation, Storm Sewersheds, Pollutants of Concern, Existing Sediment Loading, Proposed Best Management Practices (BMPs), Funding Mechanisms, and Operations and Maintenance.

4.1 Public Participation

East Brandywine Township made this PRP available to the public to review and provide comment for thirty (30) days, initiated by a public notice published in the Daily Local News. A copy of the public notice published in the Daily Local News is included in Appendix A. All timely comments received and a record of consideration of these comments are included in Appendix A.

The PRP will be presented at the Board of Supervisors workshop meeting on June 1, 2017. Comments will be accepted at this meeting from any interested members of the public.

4.2 Storm Sewersheds

Storm sewersheds that drain to each of the twenty-seven (27) outfalls were manually delineated in ArcMap 10.5 using two (2) foot topographic contours from the 2006-2008 PAMAP Program data published by the Pennsylvania Department of Conservation and Natural Resources (DCNR), while referencing Google Street View and multiple sources of aerial imagery.

“Parsing” provides an opportunity to eliminate areas within storm sewersheds from the existing pollutant load that do not drain to the MS4 and areas that are already covered by an NPDES permit for the control of stormwater. No areas were parsed out of the storm sewersheds in the development of this plan. No storm sewersheds extend outside of the municipal boundary. Therefore, the storm

sewershed boundaries are synonymous with the planning area boundaries. A map illustrating the storm sewersheds can be found in Appendix E.

The following table (Table 4) includes a list of outfalls and the associated storm sewershed acreage that drain to each outfall. Also listed is the receiving water for each outfall and United States Geological Survey (USGS) National Hydrography Dataset (NHD) Hydrologic Unit Code (HUC) 12 watershed.

Table 4: Storm Sewershed Acreage by Outfall

Receiving Water	HUC 12	Outfall Number	Storm Sewershed (acres)
Culbertson Run	Upper East Branch Brandywine Creek	6	1.52
		7	9.74
		8	14.29
		9	15.85
		24	8.30
		25	12.45
		26	9.47
		90	7.11
		91	2.74
		92	4.34
		93	45.50
		100	4.42
		101	3.64
		104	2.98
		105	1.69
		127	2.11
		130	3.17
UNTs to Beaver Creek	Beaver Creek	34	6.91
		35	3.81
		119	6.55
		120	5.60
		121	8.24
		122	4.97
		123	15.34
		124	16.80
		126	3.39
		129	0.38
		TOTAL:	**221.2**

4.3 Pollutants of Concern

There is one (1) pollutant of concern that East Brandywine Township is required to address: sediment. To meet the permit requirements, a minimum ten (10) percent sediment reduction has been demonstrated in this plan. Though not required, existing loading and BMP reduction calculations were also provided for phosphorous and nitrogen (Appendix C).

4.4 Existing Sediment Loading

To determine existing sediment loading to Culbertson Run and Beaver Creek, the general methodology described in the DEP guidance document entitled "Pollution Reduction Plan: A Methodology" was utilized.

Per the "Pollutant Aggregation Suggestions for MS4 Requirements Table Instructions" (dated April 4, 2017) and the "Pollutant Aggregation Suggestions for MS4 Requirements Table (Municipal)" (revised April 25, 2017), East Brandywine Township may achieve the ten (10) percent sediment pollutant reduction across the entire Planning Area (i.e. storm sewersheds), as opposed to a 10 percent reduction in the Planning Areas for each receiving impaired surface water. This is due to the UNTs to Beaver Creek and Culbertson Run both sharing a common pollutant with the downstream HUC 10.

Utilizing ArcGIS 10.5, 2011 National Land Cover Dataset (NLCD) data, the acreage of each land cover classification type within the storm sewersheds was calculated. The aggregate NLCD statistics within the storm sewersheds for each impaired receiving water is compiled below with a breakdown of the area by land cover classification type. Refer to Appendix F for the Land Cover Map.

Table 5: NLCD 2011 Land Cover to Impervious/Pervious Conversion

Receiving Waters Impaired by Sediment	HUC 12	HUC 10	Number of Storm Sewer-sheds	NLCD 2011 Land Cover within Storm Sewersheds	Area (acres)	Percent Impervious	Impervious Area (acres)	Pervious Area (acres)
UNTs to Beaver Creek	Beaver Creek	East Branch Brandywine Creek	10	Cultivated Crops	6.03	0	0.00	6.03
				Deciduous Forest	0.96	0	0.00	0.96
				Developed, Open Space	29.68	19	5.64	24.05
				Developed, Low Intensity	19.98	49	9.79	10.19
				Developed, Medium Intensity	1.51	79	1.19	0.32
				Developed, High Intensity	0.22	100	0.22	0.00
				Woody Wetlands	0.01	0	0.00	0.01
				Hay/Pasture	9.36	0	0.00	9.36
				Shrub/Scrub	0.83	0	0.00	0.83
Culbertson Run	Upper East Branch Brandywine Creek	East Branch Brandywine Creek	17	Cultivated Crops	38.92	0	0.00	38.92
				Deciduous Forest	12.36	0	0.00	12.36
				Developed, Open Space	47.95	19	9.11	38.84
				Developed, Low Intensity	27.49	49	13.47	14.02
				Evergreen Forest	0.05	0	0.00	0.05
				Hay/Pasture	13.06	0	0.00	13.06
				Shrub/Scrub	12.79	0	0.00	12.79
				TOTAL:	**221.2**		**39.42**	**181.79**

"Developed" land cover classifications were then converted to percent impervious coverage based on the NLCD 2011 definitions. The impervious percentages used are as follows:

- Developed, Open Space – 19% impervious
- Developed, Low Intensity – 49% impervious
- Developed, Medium Intensity – 79% impervious
- Developed, High Intensity – 100% impervious

All other land cover classifications were assumed to be 100 percent pervious. The "Developed Land Loading Rates for PA Counties" (Attachment B of the PRP Instructions) for Chester County were then applied for impervious developed and pervious developed land categories. This table is attached as Appendix B.

The existing sediment loading quantified from the entire Planning Area was 92,971.39 lbs/yr. A more detailed breakdown is located in Table 6 below. Please refer to Appendix D for supporting calculations. No existing BMPs were credited to reduce the existing sediment loading.

Table 6: Existing Sediment Loading for Stormwater Outfalls to Sediment Impaired Streams

Receiving Waters Impaired by Sediment	Category	Area (ac)	TSS [Sediment] (lbs/yr)
Culbertson Run	Impervious, Developed	22.58	33,977.93
	Pervious, Developed	130.04	24,073.00
UNT to Beaver Creek	Impervious, Developed	16.84	25,340.50
	Pervious, Developed	51.75	9,579.96
TOTAL:		**221.21**	**92,971.39**
Required 10% Reduction			**9,297.13**

4.5 Proposed Best Management Practices (BMPs)

East Brandywine Township proposes to meet the required 10 percent sediment load reduction for Culbertson Run and UNTs to Beaver Creek by implementing seven (7) BMPs throughout the Planning Area during the five (5) year permit term.

Five (5) infiltration trenches will be installed along portions of Hawthorne Drive, and a basin retrofit and bioretention swale will be implemented in East Brandywine Community Park. Maps of the proposed BMPs and their drainage areas are located in Appendix D. The BMP locations are also illustrated on the Storm Sewershed/Planning Area Map in Appendix E and the Land Cover Map in Appendix F.

BMP locations were identified by analyzing the most fiscally responsible solutions that will provide a water quality improvement and real-world benefit, while meeting the mandated pollutant reduction requirements. This analysis was performed in ArcMap 10.5 using aerial imagery, two (2)-foot topographic contours, and hydrologic data. Site visits were conducted to verify project viability and collect information and measurements of existing BMPs where applicable.

Where possible, BMPs that treat a larger drainage area were selected to reduce the number of BMPs to be implemented. Projects that are in planning or design phase within the Planning Area were prioritized (Hawthorne Drive Infiltration Trenches). After those opportunities were exhausted, existing BMPs on Township-owned property within the Planning Area were assessed for retrofit (East Brandywine Community Park Basin Retrofit). Lastly, new BMPs on Township-owned property within the Planning Area were explored (East Brandywine Community Park Bioswale).

Pollutant reductions resulting from the proposed BMPs were quantified using the same methodology described above for existing sediment loading with the drainage area for each BMP, then applying reduction rates. Reductions from new BMPs (infiltration trenches and bioretention swale) were calculated using the efficiency rates specified in the NPDES Stormwater Discharges from Small MS4s BMP Effectiveness Values table (May 2016). Reductions from retrofits of existing BMPs were calculated using the methodology in the "Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects" (revised January 20, 2015). Please refer to Appendix C for supporting calculations. Calculations for phosphorous and nitrogen loading have also been provided, though not required.

Sediment load reductions achieved through the proposed implementation of these BMPs are located in Table 7 below. A total reduction of eleven (11) percent has been achieved, exceeding the minimum required ten (10) percent.

Table 7: Sediment Load Reductions from Proposed BMPs

Receiving Waters Impaired By Sediment	BMP Name	Drainage Area (ac)	TSS Reduction		
			lbs/yr	% Reduction	% of Required Reduction
Culbertson Run	Hawthorne Drive Inf. Trench 1	6.18	2,666.47	5	46
	Hawthorne Drive Inf. Trench 2	3.11	1,763.00	3	30
	Hawthorne Drive Inf. Trench 3	0.93	514.58	1	9
	Hawthorne Drive Inf. Trench 4	0.76	520.54	1	9
	Hawthorne Drive Inf. Trench 5	3.58	2,459.96	4	42
UNT to Beaver Creek	Community Park Basin Retrofit	7.06	1,548.37	4	44
	Community Park Bioswale	2.76	983.31	3	28
	TOTAL:	**24.38**	**10,456.23**		
			OVERALL:	**11%**	**112%**

The proposed BMPs are described in more detail below.

Hawthorne Drive Infiltration Trenches

Five (5) infiltration trenches will be implemented within the right-of-way (ROW) of Hawthorne Drive, a Township-owned road. Vegetated swales will be located on the surface on the infiltration trench to safely convey overflow drainage. These infiltration trenches will address an ongoing erosion issue with the exiting roadside swales. The infiltration trenches have a combined drainage area of 14.56 acres and will achieve a total sediment reduction of 7,924.55 lbs/yr. The impaired receiving stream

for the infiltration trenches is Culbertson Run, which is located within the Upper East Branch Brandywine Hydrologic Unit Code (HUC) 12.

East Brandywine Community Park Basin Retrofit and Bioretention Swale

Two (2) BMPs will be installed in East Brandywine Community Park: a basin retrofit and a bioretention swale. The impaired receiving stream for these BMPs is an UNT to Beaver Creek, which is located within the Beaver Creek HUC 12. East Brandywine Community Park is located on the east side of Dilworth Road, across from Brandywine-Wallace Elementary School.

The proposed bioretention swale will be a new BMP located near the entrance of the park. The swale will convey stormwater into the basin, while providing added water quality benefit. The drainage area to the bioretention swale is 2.76 acres. A total sediment reduction of 983.31 lbs/yr will be achieved through the implementation of this project.

The proposed basin retrofit is located to the west of the parking lot of the park, between two (2) baseball diamonds. The basin will be retrofitted with subsurface piping and a stone infiltration bed. The current basin controls for peak flow and provides little water quality benefit. The proposed infiltration component will increase runoff storage, providing a greater pollutant reduction. The drainage area to this basin is 7.06 acres. A total sediment reduction of 1,548.37 lbs/yr will be achieved through the implementation of this project.

4.6 Funding Mechanisms

The funding mechanisms and estimated costs for the implementation of each proposed BMP are included in Table 8. It is anticipated that East Brandywine Township will be funding all proposed BMPs unless grant money is secured.

Table 8: Proposed BMP Funding Mechanisms

Proposed BMP	Property Owner	Funding Mechanism	Estimated Design Cost[1]	Estimated Construction Cost[2]	Total Estimated Cost
Hawthorne Drive Infiltration Trenches (5)	East Brandywine Township	East Brandywine Township (2016 Growing Greener Grant Application pending)	$49,000	$206,000	$255,000
Township Park Basin Retrofit	East Brandywine Township	East Brandywine Township	$21,000	$89,000	$126,000
Township Park Bioretention Swale	East Brandywine Township	East Brandywine Township	$15,000	$32,000	$47,000
		TOTAL:	**$69,000**	**$343,000**	**$412,000**

[1]Estimated Design Cost includes survey, design, engineering, any anticipated permitting, bid administration, and construction inspection. Developed based on 2017 costs/rates.

[2]Estimated Construction Cost includes construction, materials, and as-built survey. Developed based on 2017 costs/rates. It does NOT include costs associated with operations and maintenance (O&M).

4.7 Operations and Maintenance

To ensure the long-term effectiveness of these proposed BMPs, operation and maintenance (O&M) is crucial. As all the proposed BMPs are on Township property, it will be the responsibility of the Township to maintain the integrity of these facilities. The chart below (Table 9) outlines the responsible party and the necessary O&M practices required for each proposed BMP (Pennsylvania Stormwater BMP Manual, December 30, 2006).

As the current property owner, the Township is already performing some level of maintenance for these areas through mowing and sediment and debris removal. As a result, the anticipated increased operations and maintenance expenses of the new and/or retrofitted facilities in these locations will be minimal.

Table 9: Proposed BMP O&M Responsibilities

Proposed BMP	Property Owner	Responsible Party for O&M	O&M Responsibilities
Hawthorne Drive Infiltration Trenches (5)	East Brandywine Township	East Brandywine Township	• Inspect at least 2x per year • Clean inlets at least 2x per year • Maintain vegetation • Prohibit vehicular access • Avoid excessive compaction by mowers
Township Park Basin Retrofit	East Brandywine Township	East Brandywine Township	• Inspect at least 2x per year • Clean inlets at least 2x per year • Maintain vegetation • Remove invasive species • Prohibit vehicular access • Avoid excessive compaction by mowers • Drain-down time < 72 hours • Mow as appropriate (remove clippings) • Remove accumulated sediment
Township Park Bioretention Swale	East Brandywine Township	East Brandywine Township	• Inspect at least 2x per year • Pruning, weeding, watering • Re-spread mulch every 2-3 years • Remove sediment buildup • Repair and restabilize areas of erosion • Maintain vegetation

5.0 Conclusion

The required ten (10) percent sediment reduction has been achieved through the proposed implementation of five (5) infiltration trenches within the Hawthorne Drive right-of-way and a basin retrofit and bioretention swale in East Brandywine Community Park. These BMPs will be implemented by March 15, 2023.

6.0 Definitions

Best Management Practices (BMPs): Schedules of activities, prohibitions of practices, structural controls (e.g., infiltration trenches), design criteria, maintenance procedures, and other management practices to prevent or reduce pollution to the waters of the Commonwealth. BMPs include Erosion and Sedimentation Control Plans, Post Construction Stormwater Management Plans, MS4 TMDL Plans, Stormwater Management Act Plans, and other treatment requirements, operating procedures and practices to control runoff, spillage or leaks, sludge or waste disposal, drainage from raw material storage, and methods to reduce pollution, to recharge groundwater, to enhance stream base flow and to reduce the threat of flooding and stream bank erosion. [NPDES Stormwater Discharges from Small MS4s General Permit 5/2016 (PAG-13)]

Municipal Separate Storm Sewer System (MS4): All separate storm sewers that are defined as "large" or "medium" or "small" municipal separate storm sewer systems pursuant to 40 CFR §§ 122.26(b)(18), or designated as regulated under 40 CFR § 122.26(a)(1)(v). [PAG-13]

National Pollutant Discharge Elimination System (NPDES): A permit issued under 25 Pa. Code Chapter 92a (relating to National Pollutant Discharge Elimination System permitting, monitoring and compliance) for the discharge or potential discharge of pollutants from a point source to surface waters. [PAG-13]

Outfall: A "Point Source" as defined by 40 CFR § 122.2 is the point where an MS4 discharges stormwater to other surface waters of this Commonwealth. This does not include open conveyances connecting two municipal separate storm sewers, or pipes, tunnels or other conveyances which connect segments of the same stream and are used to convey waters of the Commonwealth (40 CFR § 122.26 (b) (9)). [PAG-13]

Owner or operator: The owner or operator of any "facility" or "activity" subject to regulation under the NPDES program. [PAG-13]'

Parsing: A process in which land area is removed from a Planning Area in order to calculate the actual or target pollutant loads that are applicable to an MS4. [NPDES from Small MS4 PRP Instructions-Attachment A]

Planning Area: All of the storm sewersheds that an MS4 must calculate existing loads and plan load reductions for. [NPDES from Small MS4 PRP Instructions]

Pollutant: Any contaminant or other alteration of the physical, chemical, biological, or radiological integrity of surface water which causes or has the potential to cause pollution as defined in section 1 of The Clean Streams Law, 35 P.S. § 691.1. [PAG-13]

Storm Sewershed: The catchment area that drains into the storm sewer system based on the surface topography in the area served by the storm sewer. (Source: NPDES Stormwater Discharges from Small MS4s General Permit [PAG-13]

Stormwater: Runoff from precipitation, snow melt runoff and surface runoff and drainage. "Stormwater" has the same meaning as "Storm Water." (Source: NPDES Stormwater Discharges from Small MS4s General Permit [PAG-13]

Urbanized Area (UA): Land area comprising one or more places (central place(s)) and the adjacent densely settled surrounding area (urban fringe) that together have a residential population of at least 50,000 and an overall population density of at least 1,000 people per square mile, as defined by the United States Bureau of the Census and as determined by the latest available decennial census. The UA outlines the extent of automatically regulated areas. UA maps are available at: http://www.epa.gov/npdes/stormwater/urbanmaps,
or at: http://www.epa.gov/enviro/html/em/index.html. [PAG-13]

Appendix A

Public Comment and Responses

Appendix B

Developed Land Loading Rates for PA Counties

ATTACHMENT B

DEVELOPED LAND LOADING RATES FOR PA COUNTIES[1,2,3]

County	Category	Acres	TN lbs/acre/yr	TP lbs/acre/yr	TSS (Sediment) lbs/acre/yr
Adams	impervious developed	10,373.2	33.43	2.1	1,398.77
	pervious developed	44,028.6	22.99	0.8	207.67
Bedford	impervious developed	9,815.2	19.42	1.9	2,034.34
	pervious developed	19,425	17.97	0.68	301.22
Berks	impervious developed	1,292.4	36.81	2.26	1,925.79
	pervious developed	5,178.8	34.02	0.98	264.29
Blair	impervious developed	3,587.9	20.88	1.73	1,813.55
	pervious developed	9,177.5	18.9	0.62	267.34
Bradford	impervious developed	10,423	14.82	2.37	1,880.87
	pervious developed	23,709.7	13.05	0.85	272.25
Cambria	impervious developed	3,237.9	20.91	2.9	2,155.29
	pervious developed	8,455.4	19.86	1.12	325.3
Cameron	impervious developed	1,743.2	18.46	2.98	2,574.49
	pervious developed	1,334.5	19.41	1.21	379.36
Carbon	impervious developed	25.1	28.61	3.97	2,177.04
	pervious developed	54.2	30.37	2.04	323.36
Centre	impervious developed	7,828.2	19.21	2.32	1,771.63
	pervious developed	15,037.1	18.52	0.61	215.84
Chester	impervious developed	1,838.4	21.15	1.46	1,504.78
	pervious developed	10,439.8	14.09	0.36	185.12
Clearfield	impervious developed	9,638.5	17.54	2.78	1,902.9
	pervious developed	17,444.3	18.89	1.05	266.62
Clinton	impervious developed	7,238.5	18.02	2.80	1,856.91
	pervious developed	11,153.8	16.88	0.92	275.81
Columbia	impervious developed	7,343.1	21.21	3.08	1,929.18
	pervious developed	21,848.2	22.15	1.22	280.39
Cumberland	impervious developed	8,774.8	28.93	1.11	2,065.1
	pervious developed	26,908.6	23.29	0.34	306.95
Dauphin	impervious developed	3,482.4	28.59	1.07	1,999.14
	pervious developed	9,405.8	21.24	0.34	299.62
Elks	impervious developed	1,317.7	18.91	2.91	1,556.93
	pervious developed	1,250.1	19.32	1.19	239.85
Franklin	impervious developed	13,832.3	31.6	2.72	1,944.85
	pervious developed	49,908.6	24.37	0.76	308.31
Fulton	impervious developed	3,712.9	22.28	2.41	1,586.75
	pervious developed	4,462.3	18.75	0.91	236.54
Huntington	impervious developed	7,321.9	18.58	1.63	1,647.53
	pervious developed	11,375.4	17.8	0.61	260.15
Indiana	impervious developed	589	19.29	2.79	1,621.25
	pervious developed	972	20.1	1.16	220.68
Jefferson	impervious developed	21.4	18.07	2.76	1,369.63
	pervious developed	20.4	19.96	1.24	198.60
Juniata	impervious developed	3,770.2	22.58	1.69	1,903.96
	pervious developed	8,928.3	17.84	0.55	260.68
Lackawana	impervious developed	2,969.7	19.89	2.84	1,305.05
	pervious developed	7,783.9	17.51	0.76	132.98
Lancaster	impervious developed	4,918.7	38.53	1.55	1,480.43
	pervious developed	21,649.7	22.24	0.36	190.93
Lebanon	impervious developed	1,192.1	40.58	1.85	1,948.53
	pervious developed	5,150	27.11	0.4	269.81
Luzerne	impervious developed	5,857	20.43	3	1,648.22
	pervious developed	13,482.9	19.46	0.98	221.19
Lycoming	impervious developed	10,031.7	16.48	2.57	1,989.64
	pervious developed	19,995.5	16	0.84	277.38

County	Category	Acres	TN lbs/acre/yr	TP lbs/acre/yr	TSS (Sediment) lbs/acre/yr
McKean	impervious developed	38.7	20.93	3.21	1,843.27
	pervious developed	5.3	22.58	1.45	249.26
Mifflin	impervious developed	5,560.2	21.83	1.79	1,979.13
	pervious developed	16,405.5	21.13	0.71	296.07
Montour	impervious developed	5,560.2	21.83	1.79	1,979.13
	pervious developed	16,405.5	21.13	0.71	296.07
Northumberland	impervious developed	8,687.3	25.73	1.54	2,197.08
	pervious developed	25,168.3	24.63	0.54	367.84
Perry	impervious developed	5,041.1	26.77	1.32	2,314.7
	pervious developed	9,977	23.94	0.51	343.16
Potter	impervious developed	2,936.3	16.95	2.75	1,728.34
	pervious developed	2,699.3	17.11	1.09	265.2
Schuylkill	impervious developed	5,638.7	30.49	1.56	1,921.08
	pervious developed	14,797.2	29.41	0.57	264.04
Snyder	impervious developed	4,934.2	28.6	1.11	2,068.16
	pervious developed	14,718.1	24.35	0.4	301.5
Somerset	impervious developed	1,013.6	25.13	2.79	1,845.7
	pervious developed	851.2	25.71	1.14	293.42
Sullivan	impervious developed	3,031.7	19.08	2.85	2,013.9
	pervious developed	3,943.4	21.55	1.31	301.58
Susquehanna	impervious developed	7,042.1	19.29	2.86	1,405.73
	pervious developed	14,749.7	20.77	1.21	203.85
Tioga	impervious developed	7,966.9	12.37	2.09	1,767.75
	pervious developed	18,090.3	12.22	0.76	261.94
Union	impervious developed	4,382.6	22.98	2.04	2,393.55
	pervious developed	14,065.3	20.88	0.69	343.81
Wayne	impervious developed	320.5	18.69	2.89	1,002.58
	pervious developed	509	21.14	1.31	158.48
Wyoming	impervious developed	3,634.4	16.03	2.53	2,022.32
	pervious developed	10,792.9	13.75	0.7	238.26
York	impervious developed	10,330.7	29.69	1.18	1,614.15
	pervious developed	40,374.8	18.73	0.29	220.4
All Other Counties	impervious developed	-	23.06	2.28	1,839
	pervious developed	-	20.72	0.84	264.96

Notes:

1 These land loading rate values may be used to derive existing pollutant loading estimates under DEP's simplified method for PRP development. MS4s may choose to develop estimates using other scientifically sound methods.

2 Acres and land loading rate values for named counties in the Chesapeake Bay watershed are derived from CAST. (The column for Acres represents acres within the Chesapeake Bay watershed). For MS4s located outside of the Chesapeake Bay watershed, the land loading rates for "All Other Counties" may be used to develop PRPs under Appendix E; these values are average values across the Chesapeake Bay watershed.

3 For land area outside of the urbanized area, undeveloped land loading rates may be used where appropriate. When using the simplified method, DEP recommends the following loading rates (for any county) for undeveloped land:

- TN – 10 lbs/acre/yr
- TP – 0.33 lbs/acre/yr
- TSS (Sediment) – 234.6 lbs/acre/yr

These values were derived by using the existing loads for each pollutant, according to the 2014 Chesapeake Bay Progress Run, and dividing by the number of acres for the unregulated stormwater subsector.

Appendix C

Supporting Calculations

Conversion from NLCD 2011 Land Use Designation to Impervious and Pervious Areas

MUNICIPALITY: East Brandywine Township
MS4 SEWER SHED: Culbertson Run
COUNTY: Chester

Developed Land:

Land Use[1]	Area (ac)	% Impervious[2]	Impervious Area (ac)	Pervious Area (ac)
Developed, Open Space	47.95	19	9.11	38.84
Developed, Low Intensity	27.49	49	13.47	14.02
Developed, Medium Intensity		79		
Developed, High Intensity		100		
Hay/Pasture	13.06	0		13.06
Cultivated Crops	38.92	0		38.92
Shrub/Scrub	12.79	0		12.79
Evergreen Forest	0.05	0		0.05
Deciduous Forest	12.36	0		12.36
Total	**152.62**		**22.58**	**130.04**

1. NLCD 2011 Land Use and Areas
2. Highest % of impervious used from each NLCD 2011 definition per PADEP

Existing Loads using Chesapeake Bay Loading Rates without BMPs

MUNICIPALITY: East Brandywine Township
MS4 SEWER SHED: Culbertson Run
COUNTY: Chester

Developed Land:

		Pollutant Loading Rates[1]			Pollutant Load		
Land Use	Area (ac)	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS [Sediment] (lbs/ac/yr)	TN (lbs/yr)	TP (lbs/yr)	TSS [Sediment] (lbs/yr)
Impervious,Developed	22.58	21.15	1.46	1,504.78	477.57	32.97	33977.93
Pervious, Developed	130.04	14.09	0.36	185.12	1832.26	46.81	24073.00
Culbertson Run Total Pollutant Load					**2,309.83**	**79.78**	**58,050.94**

1. From PADEP PRP Instructions Attachment B - Developed Land Loading Rates for PA Counties

Conversion from NLCD 2011 Land Use Designation to Impervious and Pervious Areas

MUNICIPALITY: East Brandywine Township
MS4 SEWER SHED: Unnamed Tributary to Beaver Creek
COUNTY: Chester

Developed Land:

Land Use[1]	Area (ac)	% Impervious[2]	Impervious Area (ac)	Pervious Area (ac)
Developed, Open Space	29.69	19	5.64	24.05
Developed, Low Intensity	19.98	49	9.79	10.19
Developed, Medium Intensity	1.51	79	1.19	0.32
Developed, High Intensity	0.22	100	0.22	
Hay/Pasture	9.36	0		9.36
Cultivated Crops	6.03	0		6.03
Shrub/Scrub	0.83	0		0.83
Woody Wetlands	0.01	0		0.01
Deciduous Forest	0.96	0		0.96
Total	**68.59**		**16.84**	**51.75**

1. NLCD 2011 Land Use and Areas
2. Highest % of impervious used from each NLCD 2011 definition per PADEP

Existing Loads using Chesapeake Bay Loading Rates without BMPs

MUNICIPALITY: East Brandywine Township
MS4 SEWER SHED: Unnamed Tributary to Beaver Creek
COUNTY: Chester

Developed Land:

		Pollutant Loading Rates[1]			Pollutant Load		
Land Use	Area (ac)	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS [Sediment] (lbs/ac/yr)	TN (lbs/yr)	TP (lbs/yr)	TSS [Sediment] (lbs/yr)
Impervious,Developed	16.84	21.15	1.46	1,504.78	356.17	24.59	25340.50
Pervious, Developed	51.75	14.09	0.36	185.12	729.16	18.63	9579.96
Unnamed Tribuatry to Beaver Creek Total Pollutant Load					**1,085.32**	**43.22**	**34,920.46**

Pollutant Removal Reductions using PADEP BMP Effectiveness Value Table for New BMPs

BMP NAME:	Hawthorne Drive Infiltration Trench 1
MUNICIPALITY:	East Brandywine Township
MS4 SEWERSHED	Culbertson Run
COUNTY:	Chester
BMP TYPE:	New BMP
LOCATION:	Hawthorne Drive
GPS LOCATION:	
TOTAL DRAINAGE AREA TREATED (ac):	6.18
TYPE OF BMP:	Infiltration trench with Vegetated Swale

Developed Land Imp/Pervious Calculations:

Land Use	Area (ac)	% Impervious	Impervious Area (ac)	Pervious Area (ac)
Developed, Open Space	1.36	19	0.26	1.10
Developed, Low Intensity	2.04	49	1.00	1.04
Developed, Medium Intensity		79		
Developed, High Intensity		100		
Pasture, Hay	0.31	0		0.31
Cultivated Crops	2.47	0		2.47
Total			**1.26**	**4.92**

Developed Land - Pollutant Reduction:

		Pollutant Loading Rate			BMP Effectiveness Value			Pollutant Load Reduction		
Land Use	Area (ac)	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS [Sediment] (lbs/ac/yr)	TN	TP	Sediment	TN (lbs/yr)	TP (lbs/yr)	TSS [Sediment] (lbs/yr)
Impervious,Developed	1.26	21.15	1.46	1,504.78	85%	85%	95%	22.65	1.56	1801.22
Pervious, Developed	4.92	14.09	0.36	185.12	85%	85%	95%	58.92	1.51	865.25
Total Pollutant Reduction								**81.58**	**3.07**	**2,666.47**

Pollutant Removal Reductions using PADEP BMP Effectiveness Value Table for New BMPs

BMP NAME:	Hawthorne Drive Infiltration Trench 2
MUNICIPALITY:	East Brandywine Township
MS4 SEWERSHED	Culbertson Run
COUNTY:	Chester
BMP TYPE:	New BMP
LOCATION:	Hawthorne Drive
GPS LOCATION:	
TOTAL DRAINAGE AREA TREATED (ac):	3.11
TYPE OF BMP:	Infiltration trench with Vegetated Swale

Developed Land Imp/Pervious Calculations:

Land Use[1]	Area (ac)	% Impervious[2]	Impervious Area (ac)	Pervious Area (ac)
Developed, Open Space	1.83	19	0.35	1.48
Developed, Low Intensity	1.28	49	0.63	0.65
Developed, Medium Intensity		79	0.00	0.00
Developed, High Intensity		100	0.00	0.00
Pasture, Hay		0	0.00	0.00
Cultivated Crops		0	0.00	0.00
Total			**0.97**	**2.14**

Developed Land - Pollutant Reduction:

		Pollutant Loading Rates[3]			BMP Effectiveness Value[4]			Pollutant Load Reduction		
Land Use	Area (ac)	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS [Sediment] (lbs/ac/yr)	TN	TP	Sediment	TN (lbs/yr)	TP (lbs/yr)	TSS [Sediment] (lbs/yr)
Impervious,Developed	0.97	21.15	1.46	1,504.78	85%	85%	95%	17.44	1.20	1386.65
Pervious, Developed	2.14	14.09	0.36	185.12	85%	85%	95%	25.63	0.65	376.35
Total Pollutant Reduction								**43.07**	**1.86**	**1,763.00**

1. NLCD 2011 Land Use and Areas
2. Highest % of impervious used from each NLCD 2011 definition per PADEP
3. From PADEP PRP Instructions Attachment B - Developed Land Loading Rates for PA Counties
4. Per PADEP NPDES BMP Effectiveness Values Table

Pollutant Removal Reductions using PADEP BMP Effectiveness Value Table for New BMPs

BMP NAME:	Hawthorne Drive Infiltration Trench 3
MUNICIPALITY:	East Brandywine Township
MS4 SEWERSHED	Culbertson Run
COUNTY:	Chester
BMP TYPE:	New BMP
LOCATION:	Hawthorne Drive
GPS LOCATION:	
TOTAL DRAINAGE AREA TREATED (ac):	0.93
TYPE OF BMP:	Infiltration bed with Vegetated Swale

Developed Land Imp/Pervious Calculations:

Land Use[1]	Area (ac)	% Impervious[2]	Impervious Area (ac)	Pervious Area (ac)
Developed, Open Space	0.58	19	0.11	0.47
Developed, Low Intensity	0.35	49	0.17	0.18
Developed, Medium Intensity		79	0.00	0.00
Developed, High Intensity		100	0.00	0.00
Pasture, Hay		0	0.00	0.00
Cultivated Crops		0	0.00	0.00
Total			**0.28**	**0.65**

Developed Land - Pollutant Reduction:

		Pollutant Loading Rates[3]			BMP Effectiveness Value[4]			Pollutant Load Reduction		
Land Use	Area (ac)	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS [Sediment] (lbs/ac/yr)	TN	TP	Sediment	TN (lbs/yr)	TP (lbs/yr)	TSS [Sediment] (lbs/yr)
Impervious,Developed	0.28	21.15	1.46	1,504.78	85%	85%	95%	5.03	0.35	400.27
Pervious, Developed	0.65	14.09	0.36	185.12	85%	85%	95%	7.78	0.20	114.31
Total Pollutant Reduction								**12.82**	**0.55**	**514.58**

1. NLCD 2011 Land Use and Areas
2. Highest % of impervious used from each NLCD 2011 definition per PADEP
3. From PADEP PRP Instructions Attachment B - Developed Land Loading Rates for PA Counties
4. Per PADEP NPDES BMP Effectiveness Values Table

Pollutant Removal Reductions using PADEP BMP Effectiveness Value Table for New BMPs

BMP NAME:	Hawthorne Drive Infiltration Trench 4
MUNICIPALITY:	East Brandywine Township
MS4 SEWERSHED	Culbertson Run
COUNTY:	Chester
BMP TYPE:	New BMP
LOCATION:	Hawthorne Drive
GPS LOCATION:	
TOTAL DRAINAGE AREA TREATED (ac):	0.76
TYPE OF BMP:	Infiltration bed with Vegetated Swale

Developed Land Imp/Pervious Calculations:

Land Use[1]	Area (ac)	% Impervious[2]	Impervious Area (ac)	Pervious Area (ac)
Developed, Open Space	0.19	19	0.04	0.15
Developed, Low Intensity	0.56	49	0.27	0.29
Developed, Medium Intensity		79	0.00	0.00
Developed, High Intensity		100	0.00	0.00
Pasture, Hay		0	0.00	0.00
Cultivated Crops		0	0.00	0.00
Total			**0.31**	**0.44**

Developed Land - Pollutant Reduction:

		Pollutant Loading Rates[3]			BMP Effectiveness Value[4]			Pollutant Load Reduction		
Land Use	Area (ac)	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS [Sediment] (lbs/ac/yr)	TN	TP	Sediment	TN (lbs/yr)	TP (lbs/yr)	TSS [Sediment] (lbs/yr)
Impervious,Developed	0.31	21.15	1.46	1,504.78	85%	85%	95%	5.57	0.38	443.16
Pervious, Developed	0.44	14.09	0.36	185.12	85%	85%	95%	5.27	0.13	77.38
Total Pollutant Reduction								**10.84**	**0.52**	**520.54**

1. NLCD 2011 Land Use and Areas
2. Highest % of impervious used from each NLCD 2011 definition per PADEP
3. From PADEP PRP Instructions Attachment B - Developed Land Loading Rates for PA Counties
4. Per PADEP NPDES BMP Effectiveness Values Table

Pollutant Removal Reductions using PADEP BMP Effectiveness Value Table for New BMPs

BMP NAME:	Hawthorne Drive Infiltration Trench 5
MUNICIPALITY:	East Brandywine Township
MS4 SEWERSHED	Culbertson Run
COUNTY:	Chester
RETROFIT CLASS:	New BMP
LOCATION:	Hawthorne Drive
GPS LOCATION:	
TOTAL DRAINAGE AREA TREATED (ac):	3.58
TYPE OF BMP:	Infiltration bed with Vegetated Swale

Developed Land Imp/Pervious Calculations:

Land Use[1]	Area (ac)	% Impervious[2]	Impervious Area (ac)	Pervious Area (ac)
Developed, Open Space	0.91	19	0.17	0.74
Developed, Low Intensity	2.62	49	1.28	1.34
Developed, Medium Intensity		79		
Developed, High Intensity		100		
Shrub/Scrub	0.05	0		0.05
Total			**1.46**	**2.12**

Developed Land - Pollutant Reduction:

		Pollutant Loading Rates[3]			BMP Effectiveness Value[4]			Pollutant Load Reduction		
Land Use	Area (ac)	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS [Sediment] (lbs/ac/yr)	TN	TP	Sediment	TN (lbs/yr)	TP (lbs/yr)	TSS [Sediment] (lbs/yr)
Impervious,Developed	1.46	21.15	1.46	1,504.78	85%	85%	95%	26.25	1.81	2087.13
Pervious, Developed	2.12	14.09	0.36	185.12	85%	85%	95%	25.39	0.65	372.83
Total Pollutant Reduction								**51.64**	**2.46**	**2,459.96**

1. NLCD 2011 Land Use and Areas
2. Highest % of impervious used from each NLCD 2011 definition per PADEP
3. From PADEP PRP Instructions Attachment B - Developed Land Loading Rates for PA Counties
4. Per PADEP NPDES BMP Effectiveness Values Table

Pollutant Removal Reductions using PADEP BMP Effectiveness Value Table for New BMPs

BMP NAME:	East Brandywine Community Park Bioswale
MUNICIPALITY:	East Brandywine Township
MS4 SEWERSHED	Unnamed Tributary to Beaver Creek
COUNTY:	Chester
BMP TYPE:	New BMP
LOCATION:	440 Dilworth Road
GPS LOCATION:	Lat: 40.0395 / Long: -75.7600
TOTAL DRAINAGE AREA TREATED (ac):	2.76
TYPE OF BMP:	Bioswale in B soils w/o underdrain

Developed Land Imp/Pervious Calculations:

Land Use[1]	Area (ac)	% Impervious[2]	Impervious Area (ac)	Pervious Area (ac)
Developed, Open Space	1.07	19	0.20	0.87
Developed, Low Intensity	0.23	49	0.11	0.12
Developed, Medium Intensity	0.22	79	0.17	0.05
Developed, High Intensity	0.06	100	0.06	
Pasture, Hay	1.05	0		1.05
Cultivated Crops	0.13	0		0.13
Total			**0.54**	**2.21**

Developed Land - Pollutant Reduction:

		Pollutant Loading Rates[3]			BMP Effectiveness Value[4]			Pollutant Load Reduction		
Land Use	Area (ac)	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS [Sediment] (lbs/ac/yr)	TN	TP	Sediment	TN (lbs/yr)	TP (lbs/yr)	TSS [Sediment] (lbs/yr)
Impervious,Developed	0.54	21.15	1.46	1,504.78	70%	75%	80%	8.07	0.60	655.84
Pervious, Developed	2.21	14.09	0.36	185.12	70%	75%	80%	21.81	0.60	327.47
Total Pollutant Reduction								**29.87**	**1.19**	**983.31**

1. NLCD 2011 Land Use and Areas
2. Highest % of impervious used from each NLCD 2011 definition per PADEP
3. From PADEP PRP Instructions Attachment B - Developed Land Loading Rates for PA Counties
4. Per PADEP NPDES BMP Effectiveness Values Table

Efficiency Rates for Stormwater Retrofit Projects using Cheasapeake Bay Panel Report

BMP NAME:	East Brandywine Community Park Basin Retrofit
MUNICIPALITY:	East Brandywine Township
MS4 SEWERSHED	UNT to Beaver Creek
COUNTY:	Chester
RETROFIT CLASS:	Existing BMP Enhancement
LOCATION:	440 Dilworth Road
GPS LOCATION:	Lat: 40.0395 / Long: -75.7600
TOTAL DRAINAGE AREA TREATED (ac):	7.06
TYPE OF BMP:	Ex. Surface Basin to be retrofitted with infiltration bed
CLASSIFICATION OF BMPs BASED ON RUNOFF REDUCTION CAPABILITY:	Runoff Reduction Practice (RR)

$$\textit{Amount of Runoff Volume treated (in)} = \frac{RS \times 12}{IA}$$

where:
RS = Runoff Storage Volume (ac-ft)
IA = Impervious Area (ac)

			Projected Removal Rates[1]		
Impervious area treated (ac)	Runoff Storage Volume (ac-ft)	Amount of Runof Volume treated (in)	TN (%)	TP (%)	TSS [Sediment] (%)
0.39	0.101	3.108	68	79	85

Pollutant Load to Township Park Basin A Basin Retrofit:

		Pollutant Loading Rates[2]			Pollutant Load		
Land Use	Area (ac)	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS [Sediment] (lbs/ac/yr)	TN (lbs/yr)	TP (lbs/yr)	TSS [Sediment] (lbs/yr)
Impervious,Developed	0.39	21.15	1.46	1,504.78	8.25	0.57	586.86
Pervious, Developed	6.67	14.09	0.36	185.12	93.98	2.40	1234.75
Total					**102.23**	**2.97**	**1,821.61**

	TN (lbs/yr)	TP (lbs/yr)	TSS [Sediment] (lbs/yr)
Pollutant Load reduced with Township Park Basin A Basin Retrofit:	69.52	2.35	1548.37

Note: It was assumed that the since the basin was dry even with no low flow orifice, the soils beneath the basin have naturally good infiltration rate and do not require an infiltration bed. An Furthermore, water quality benefits were assumed minimal as the basin was only designed for peak flow control, the existing basin has zero removal rate. To increase runoff storage volume a 42ft. x 42ft. infiltration basin is being proposed.

Sediment Load Reduction by BMPs

MUNICIPALITY: East Brandywine Township
MS4 SEWER SHED: Culbertson Run/UNT Beaver Creek
COUNTY: Chester

BMP Name	BMP Drainage Area (ac)	Pollutant Reduction by BMPs		
		TN (lbs/yr)	TP (lbs/yr)	TSS [Sediment] (lbs/yr)
Culbertson Run				
Hawthorne Drive Inf. Trench 1	6.18	81.58	3.07	2666.47
Hawthorne Drive Inf. Trench 2	3.11	43.07	1.86	1763
Hawthorne Drive Inf. Trench 3	0.93	12.82	0.55	514.58
Hawthorne Drive Inf. Trench 4	0.76	10.84	0.52	520.54
Hawthorne Drive Inf. Trench 5	3.58	51.64	2.46	2459.96
Sub Total	**14.56**	**199.95**	**8.46**	**7924.55**
UNT Beaver Creek				
Community Park Basin Retrofit	7.06	69.52	2.35	1548.37
Community Park Bioswale	2.76	29.87	1.19	983.31
Sub Total	**9.82**	**99.39**	**3.54**	**2531.68**
Total	**24.38**	**299.34**	**12**	**10456.23**

MS4 Sewershed	Storm sewershed Area (ac)	Existing Pollutant without BMPs			Pollutant Load with BMPs			% Reduction		
		TN (lbs/yr)	TP (lbs/yr)	TSS [Sediment] (lbs/yr)	TN (lbs/yr)	TP (lbs/yr)	TSS [Sediment] (lbs/yr)	TN	TP	TSS [Sediment]
Culbertson Run	152.62	2309.83	79.78	58,050.94	2109.88	71.32	50126.39	9%	11%	14%
UNT Beaver Creek	68.59	1085.32	43.22	34,920.46	985.93	39.68	32388.78	9%	8%	7%
Total	**152.62**	**3,395.15**	**123.00**	**92,971.39**	**3,095.81**	**111.00**	**82,515.16**	**9%**	**10%**	**11%**

Appendix D

Proposed BMP Maps

NOTES:

1. Drainage area to the proposed BMP equals the storm sewershed/ planning area.

2. Property Owners:
   -East Brandywine Township Right-of-Way

Hawthorne Drive Inf. Trench 4

Hawthorne Drive Inf. Trench 5

Hawthorne Drive Inf. Trench 3

Hawthorne Drive Inf. Trench 2

Hawthorne Drive Inf. Trench 1

0.76 acres

3.58 acres

0.93 acres

3.11 acres

6.17 acres

Brookfield CT
Lambeth CT
Chapel CT
Hawthorne DR
Wyndham CT
Windemere CT
Highland CT
Hastings CT
Hedgerow DR
Horseshoe PK
Gloucester DR
Gloucester CT
Cambridge CT
Suffolk CT
Canterbury CT
Somerset CT
Chatham CT
Essex CT
Pinebrooke Ct
Clearview DR
Yellowwood DR
Timber Pass
Brookside DR
Delancey PL
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PROPOSED BMPs

Legend

- MS4 Outfalls

Township Stormwater Structures
- Culvert
- Inflow
- Inlet
- Manhole
- Outflow
- Riser

State Stormwater Structures
- Culvert
- Inflow
- Inlet
- Manhole
- Outflow

Private Stormwater Structures
- Inflow
- Inlet
- Manhole
- Outflow
- Riser

Township Stormwater Conveyances
- Culvert
- Pipe
- Swale

State Stormwater Conveyances
- Bridge
- Culvert
- Pipe

Private Stormwater Conveyances
- Bridge
- Pipe
- Swale

- Infiltration Trench
- Storm Sewersheds/Planning Area
- Drainage Area to BMPs
- Existing BMPs

Streams
- Non-Impaired
- Impaired

Roads
- Township Road
- Private Road
- State Road

- 2ft Contours
- Parcels
- Township Boundary

Hawthorne Drive Infiltration Trenches

1 inch = 200 feet

0 100 200 400 Feet

CEDARVILLE Engineering Group, LLC

East Brandywine Township, Chester County, Pennsylvania

MAP UPDATED: MAY 2017

NOTES:

1. Drainage area to the proposed BMP equals the storm sewershed/ planning area.

2. Property Owners:
-East Brandywine Township
30-2-56.1
440 Dilworth Road
Downingtown, PA 19335

PROPOSED BMPs

Legend

- MS4 Outfalls

Township Stormwater Structures
- Culvert
- Inflow
- Inlet
- Manhole
- Outflow
- Riser

State Stormwater Structures
- Culvert
- Inflow
- Inlet
- Manhole
- Outflow

Private Stormwater Structures
- Inflow
- Inlet
- Manhole
- Outflow
- Riser

Township Stormwater Conveyances
- Culvert
- Pipe
- Swale

State Stormwater Conveyances
- Bridge
- Culvert
- Pipe

Private Stormwater Conveyances
- Bridge
- Pipe
- Swale

Streams
- Non-Impaired
- Impaired

- Proposed BMPs
- Storm Sewersheds/Planning Area
- Drainage Area to BMPs
- Existing BMPs

Roads
- Township Road
- Private Road
- State Road
- 2ft Contours
- Parcels
- Township Boundary

East Brandywine Community Park
Basin Retrofit

East Brandywine Community Park
Bioswale

1 inch = 100 feet

0 50 100 200 Feet

CEDARVILLE
Engineering Group, LLC

East Brandywine Township, Chester County, Pennsylvania

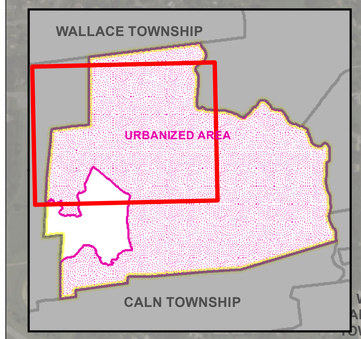
MAP UPDATED: MAY 2017

Appendix E

Storm Sewershed/Planning Area Map

DEP MS4 Aggregated Requirements Table

EAST BRANDYWINE TWP	PAI130524	Beaver Creek, Upper East Branch Brandywine Creek	Culbertson Run, Unnamed Tributaries to Beaver Creek	Appendix E-Siltation



UPPER UWCHLAN TOWNSHIP

PROPOSED BMPs

Name	Owner	BMP Location Number
Hawthorne Drive Inf. Trench 1	East Brandywine Township	1
Hawthorne Drive Inf. Trench 2	East Brandywine Township	2
Hawthorne Drive Inf. Trench 3	East Brandywine Township	3
Hawthorne Drive Inf. Trench 4	East Brandywine Township	4
Hawthorne Drive Inf. Trench 5	East Brandywine Township	5
East Brandywine Community Park Basin Retrofit	East Brandywine Township	6
East Brandywine Community Park Bioswale	East Brandywine Township	7

DISCLAIMER:
This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.

DRAWN BY: AR

1 inch = 450 feet

0 225 450 Feet

CEDARVILLE Engineering Group, LLC

EAST BRANDYWINE TOWNSHIP
POLLUTANT REDUCTION PLAN
STORM SEWERSHEDS MAP
CHESTER COUNTY, PA

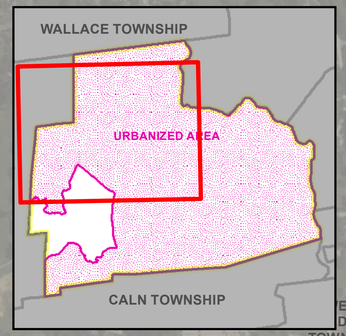
Legend
- MS4 Outfalls
- Proposed BMPs
- Stormwater Structures Township: Culvert, Inflow, Inlet, Manhole, Outflow, Riser
- Stormwater Structures State: Culvert, Inflow, Inlet, Manhole, Outflow
- Stormwater Structures Private: Inflow, Inlet, Manhole, Outflow, Riser
- Stormwater Conveyances Township: Culvert, Pipe, Swale
- Stormwater Conveyances State: Bridge, Culvert, Pipe
- Stormwater Conveyances Private: Bridge, Pipe, Swale
- HUC12 Boundaries
- Streams: Non-Impaired, Impaired
- Storm Sewersheds/Planning Area: Culbertson Run, UNT to Beaver Creek
- Roads: Township Road, State Road, Private Road
- Index Contours
- Township Boundary
- Area Opposite the 2010 Urbanized Area
- Parcels

Appendix F

Land Cover Map

DEP MS4 Aggregated Requirements Table

EAST BRANDYWINE TWP	PAI130524	Beaver Creek, Upper East Branch Brandywine Creek	Culbertson Run, Unnamed Tributaries to Beaver Creek	Appendix E-Siltation



WEST BRANDYWINE TOWNSHIP

UPPER UWCHLAN TOWNSHIP

PROPOSED BMPs

Name	Owner	BMP Location Number
Hawthorne Drive Inf. Trench 1	East Brandywine Township	1
Hawthorne Drive Inf. Trench 2	East Brandywine Township	2
Hawthorne Drive Inf. Trench 3	East Brandywine Township	3
Hawthorne Drive Inf. Trench 4	East Brandywine Township	4
Hawthorne Drive Inf. Trench 5	East Brandywine Township	5
East Brandywine Community Park Basin Retrofit	East Brandywine Township	6
East Brandywine Community Park Bioswale	East Brandywine Township	7

NOTES:
1. Land cover data is derived from the National Land Cover Database 2011 (NLCD 2011).

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DRAWN BY: AR

1 inch = 450 feet

0 225 450 Feet

CEDARVILLE Engineering Group, LLC

EAST BRANDYWINE TOWNSHIP
POLLUTANT REDUCTION PLAN
LAND COVER MAP
CHESTER COUNTY, PA

Legend
- MS4 Outfalls
- Proposed BMPs
- HUC12 Boundaries
- Streams
  - Non-Impaired
  - Impaired
- Storm Sewersheds/Planning Area
  - Culbertson Run
  - UNT to Beaver Creek
- Land Cover
  - 21- Developed, Open Space
  - 22- Developed, Low Intensity
  - 23- Developed, Medium Intensity
  - 24- Developed, High Intensity
  - 41- Deciduous Forest
  - 42- Evergreen Forest
  - 52- Shrub/Scrub
  - 81- Hay/Pasture
  - 82- Cultivated Crops
  - 90- Woody Wetlands
- Roads
  - Township Road
  - State Road
  - Private Road
- Index Contours
- Township Boundary
- Area Opposite the 2010 Urbanized Area
- Township Owned Parcels
- Parcels