Centre Region MS4 Partners

(College Township, Ferguson Township, Harris Township, Patton Township, The Pennsylvania State University – University Park Campus, Borough of State College)

Centre County, Pennsylvania

POLLUTANT REDUCTION PLAN

November 15, 2017
Last Revised November 22, 2019

Newell Tereska & MacKay Engineering

<u>Engineer's Certification</u>

Centre Region MS4 Partners
Pollutant Reduction Plan
Centre County, Pennsylvania

"I do hereby certify pursuant to the penalties of 18 PA C.S.A. Sec. 4904 and to the best of my knowledge and belief, that the information contained in the accompanying report has been prepared in accordance with accepted engineering practice, is true and correct, and is in conformance with procedures outlined in the "National Pollutant Discharge Elimination System (NPDES) Stormwater Discharges from Small Municipal Separate Storm Sewer Systems Pollutant Reduction Plan (PRP) Instructions" published by the Department of Environmental Protection and last revised in March of 2017.

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
SCOTT A. BROWN
ENGINEER
No. 042215-R

By: ______________________

Date: November 22, 2019

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INTRODUCTION

This Joint Pollutant Reduction Plan (PRP) has been prepared on behalf of the Centre Region MS4 Partners (Partners) including: College Township (PAI134803), Ferguson Township (PAI134805), Harris Township (PAI134801), Patton Township (PAI134802), Penn State University (PAI134807), and the Borough of State College (PAI134804). The Partners entered into a multi-municipal agreement articulating obligations and responsibilities of each Partner as related to this PRP. The Partners have also drafted an agreement articulating obligations for funding, constructing, and maintaining BMPs for which there will be shared responsibilities. A copy of this latter agreement is included in **Appendix G**.

The Centre Region Urban Area (**Figure 1**) includes portions of the Spring Creek and Spruce Creek Watersheds. For planning purposes, these watersheds were subdivided into six (6), headwater sub-watersheds. The five (5) Spring Creek Sub-Watersheds include Slab Cabin Run, Buffalo Run, Big Hollow Run, Logan Branch, and the Spring Creek mainstem which includes a small portion of Cedar Run. The one (1) Spruce Creek Sub-Watershed is Beaver Branch which makes up the eastern portion of the Spruce Creek Watershed. The valleys within the Beaver Branch and Spring Creek Sub-Watersheds are underlain by carbonate geology. Karst surface features (i.e. sinkholes, springs, etc) influence surface runoff characteristics within both the Beaver Branch and Spruce Creek Watersheds.

The Beaver Branch and Spring Creek Watersheds are hydrologically unique from other karst watersheds in Pennsylvania. Most stream reaches in the study area are perched above the groundwater table. Large springs at mountain bases are hydrologically driven by well-developed conduit flow. These springs are the headwaters of the Spring Creek and Beaver Branch watersheds.

Much of the runoff in the Spring Creek Watershed is intercepted by sinkholes and closed depressions. As such, many of the tributary drainageways (Big Hollow, for example) remain dry except during extreme rain events or when rain falls over frozen ground. In addition, valley soils have high permeability and large stream reaches lose flow to groundwater. These "streams" lack perennial base flow and can be classified as ephemeral. Ephemeral drainageways do not fit the classic definition of "surface waters" even though many have been identified as such on eMapPA and in Title 25, Chapter 93 of the Pennsylvania Code. The mainstems of Spring Creek, Spruce Creek, and Buffalo Run exhibit year-round base flow. However, other tributaries (e.g. Slab Cabin Run, Beaver Branch) only exhibit intermittent base flow. During typical summer and fall low-flow periods the intermittent tributaries are dry. As mentioned above, the Big Hollow Sub-Watershed is a classic ephemeral stream that only exhibits runoff following rain events.

It is noted that PRPs are surface water studies. The surface water and ground water divides for the Spring Creek Watershed are known to be different particularly in the western end of the watershed. The watershed boundaries used in this study reflect surface water boundaries.

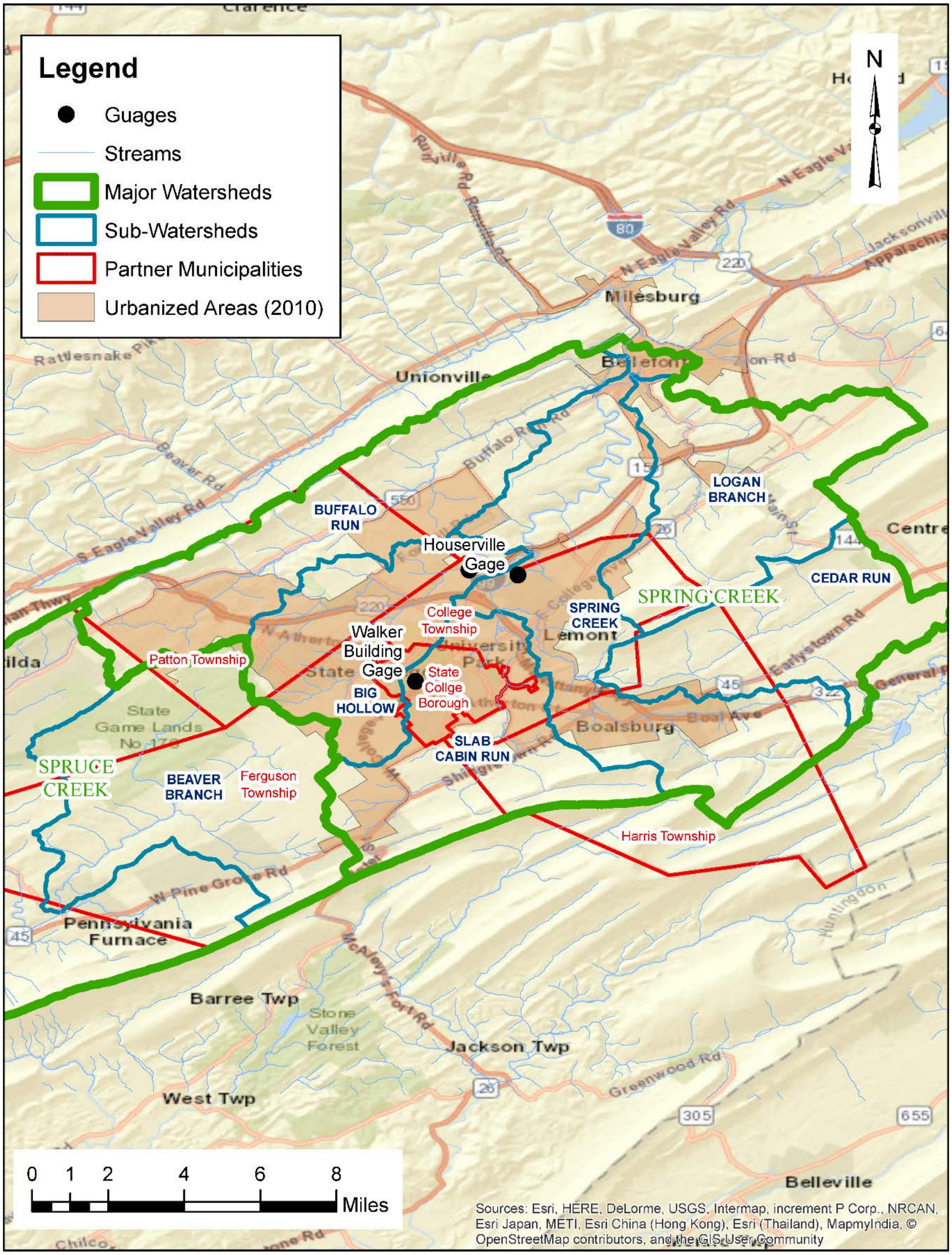

Figure 1. Centre Region Study Area

A. PUBLIC PARTICIPATION

A public participation meeting was held on October 25, 2017. A copy of the advertisement and a summary of the meeting presentation is included in **Appendix H**. As indicated in the meeting advertisement, the PRP was made available to the Public on September 29, 2017. Comments on the PRP were received by the Partners for 30 days. Comment summaries and the record of consideration are provided in **Appendix I**.

B. PLANNING AREA MAP

The PRP planning area map is provided in **Figure 2**. **Figure 2** illustrates the overall planning area along with watershed and municipal boundaries (**Appendix D** includes a color-coded Planning Area Map delineating planning areas for each Partner). Other elements included in **Figure 2** are parsed areas, land use, the location of impaired stream reaches, and the location of studied load reduction Best Management Practices (BMPs). A description of the areas parsed from the planning area is provided in Section D. A detailed description of primary and secondary BMPs selected to address pollution reduction is provided in Section E and **Appendices E** and **F**.

C. POLLUTANTS OF CONCERN

In accordance with the PAG-13 permit program, all MS4 permit holders are required to compute the existing pollutant load discharged from their sewershed in pounds per year (lb./year). Appendix D of the PAG-13 permit program requires permit holders within the Chesapeake Bay watershed, to develop a PRP that addresses siltation and nutrient impairments. Appendix E of the PAG-13 permit program requires that the PRP also address local stream impairments. To satisfy Appendix E requirements, the Partners must address impairments to Spring Creek, Slab Cabin Run, Buffalo Run, and Logan Branch as described in **Table 1**.

For Chesapeake Bay PRPs the pollution reduction goal is a minimum reduction of 10% for total suspended solids (TSS), 3% for total nitrogen (TN), and 5% for total phosphorus (TP). The PA DEP accepts that a 10% reduction in sediment will automatically reduce TN by 3% and TP by 5%.

For impaired waters "Organic Enrichment/Low D.O." is a surrogate for TP pollution. Streams that only have an "Organic Enrichment/Low D.O." impairment, like the section of Spring Creek downstream of the Bellefonte Fish Hatchery, are required to achieve a minimum of 5% TP reduction. Streams with a siltation impairment, like Buffalo Run, are required to achieve a minimum of 10% TSS reduction. Streams with both "Organic Enrichment/Low D.O." and siltation impairments identified, like most of Spring Creek, are required to meet both a 10% TSS reduction and a 5% TP reduction.

Table 1. MS4 Impaired Waters Requirements

Municipality/ NPDES ID	Description	Chesapeake Bay Nutrients/ Sediment	Spring Creek	Slab Cabin Run	**Logan Branch	Buffalo Run
College Township PAI134803	**Impairment**	Appendix D - Nutrients Siltation (4a)	Appendix E – Organic Enrichment/Low DO***; Siltation (5)	Appendix E - Siltation	Appendix E - Organic Enrichment/Low DO*** (5) Appendix C - PCB (5)* no required reduction this period	
	Reduction necessary to address impairment	10% sediment 3% TN 5% TP	10% sediment 5% TP	10% sediment	5% TP reduction	
Ferguson Township PAI134805	**Impairment**	Appendix D - Nutrients Siltation (4a)	Appendix E - Organic Enrichment/Low DO***; Siltation (5)	Appendix E - Siltation		
	Reduction necessary to address impairment	10% sediment 3% TN 5% TP	10% sediment 5% TP	10% sediment		
Harris Township PAI134801	**Impairment**	Appendix D - Nutrients Siltation (4a)	Appendix E - Organic Enrichment/Low DO***; Siltation (5)			
	Reduction necessary to address impairment	10% sediment 3% TN 5% TP	10% sediment 5% TP			
Patton Township PSI134802	**Impairment**	Appendix D - Nutrients Siltation (4a)	Appendix E - Organic Enrichment/Low DO*** (5)			Appendix E - Siltation
	Reduction necessary to address impairment	10% sediment 3% TN 5% TP	10% sediment 5% TP			10% sediment
Penn State (Main Campus) PAI134807	**Impairment**	Appendix D - Nutrients Siltation (4a)	Appendix E - Organic Enrichment/Low DO***; Siltation (5)	Appendix E-Siltation		
	Reduction necessary to address impairment	10% sediment 3% TN 5% TP	10% sediment 5% TP	10% sediment		
Borough of State College PAI134804	**Impairment**	Appendix D - Nutrients Siltation (4a)	Appendix E - Organic Enrichment/Low DO***; Siltation (5)	Appendix E-Siltation		
	Reduction necessary to address impairment	10% sediment 3% TN 5% TP	10% sediment 5% TP	10% sediment		

(Transcribed from the PA Department of Environmental Protection (PA DEP) MS4 requirements table, as accessed from http://www.depgis.state.pa.us/MS4/index.html on May 3, 2017.)

* In accordance with the PA DEP PAG-13 Program, pollution control program for Appendix C priority organic compounds, including polychlorinated biphenyls (PCBs), must be implemented upon permit coverage. The first step of this program is to inventory suspected sources of priority organics by 2020.

** Logan Branch is listed as an impaired water in College Township, however, the Township does not have any regulated MS4 facilities (e.g. roads, pipes, ditches, swales) that drain to Logan Branch.

*** Industrial Source (Bellefonte Fish Hatchery) located more than 5 stream miles downstream of the closest regulated outfall in Ferguson Township, Harris Township, Patton Township, Penn State, and the Borough of State College.

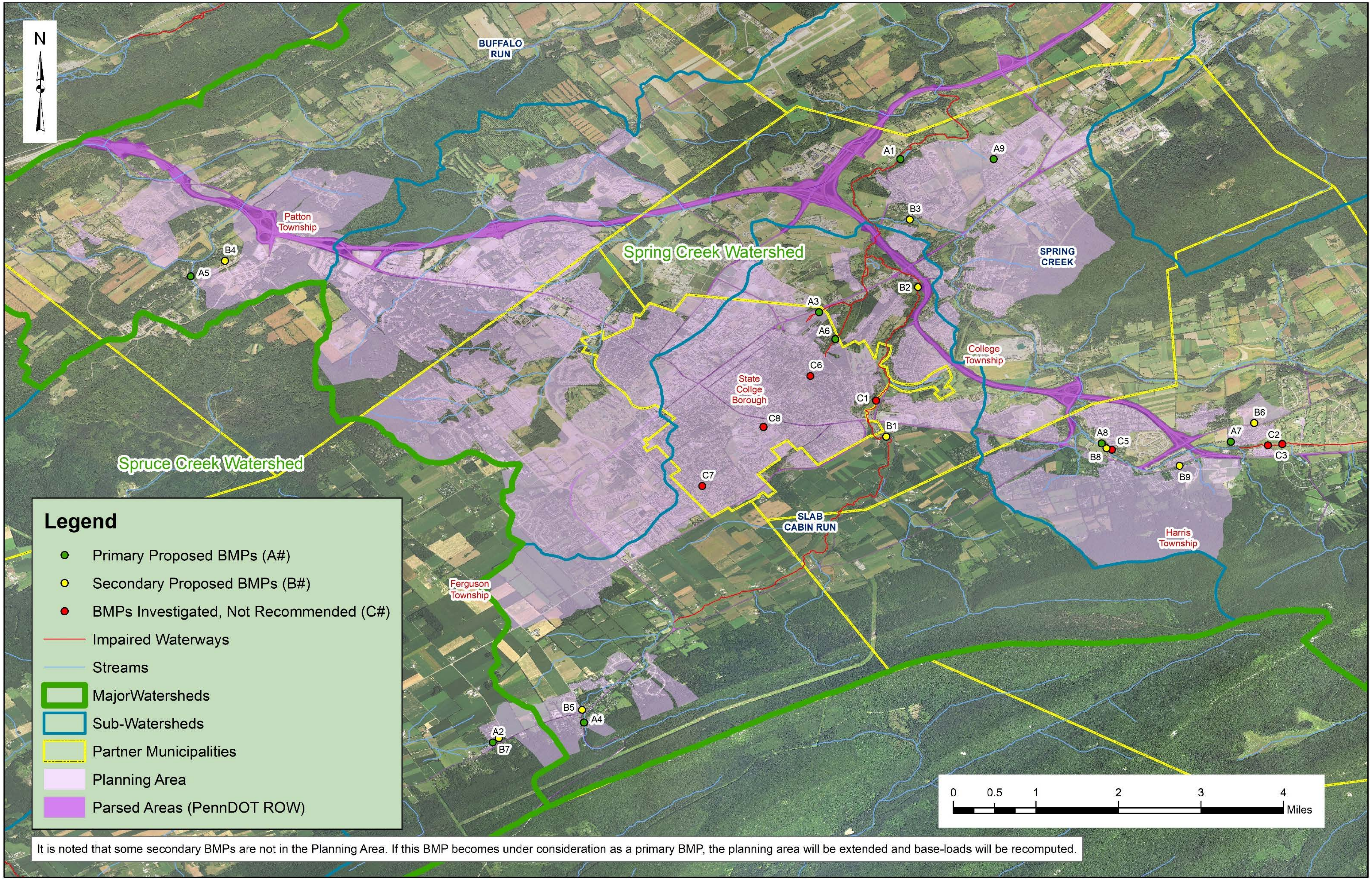

Figure 2. Planning Area Map

Although listed in **Table 1**, Logan Branch will not be addressed further in this PRP. As illustrated in **Figure 1**, a small headwaters portion of Logan Branch is located in eastern College Township. However, College Township does not have any regulated MS4 elements that discharge to Logan Branch or its tributaries. As such, Logan Branch is not in the planning area of the Partners.

The MS4 requirements presented in **Table 1** were developed by the PA DEP by drawing a 5-mile buffer around each municipality's urban area and delineating drainage within each buffer. If stormwater drainage from the urban area flowed into an impaired water within the 5-mile buffer, then that impairment was included as an MS4 requirement. In summary, the MS4 requirements are intended to address impaired waters that receive stormwater directly from an urban area or that are within 5-miles downstream of an urban area's stormwater discharge.

Using the approach outlined above, the PA DEP determined that all Partners are obligated to address the "Organic Enrichment/Low D.O." impairment identified on Spring Creek beginning at the Bellefonte Fish Hatchery. The PA DEP's requirements table identifies this impairment as being from an industrial source and not a result of urban runoff or sedimentation. A review of Partner regulated MS4 outfalls has indicated that all outfalls, except for some in College Township, are more than 5 stream-miles upstream of the identified source.

With respect to siting BMPs to address the impairments in **Table 1**, joint PRPs can calculate the pollutant load required for the entire planning area but can achieve load reductions by implementing projects in several locations. Load reductions need not be accomplished in each stream listed in the MS4 requirements table. Load reductions can be greater than that required in one impaired water and less than what is required in another impaired water if the total reduction required for the planning area is achieved.

As indicated in **Table 1**, each of the Partners is required to meet the Chesapeake Bay watershed sediment and nutrient load reductions plus at least one impaired water sediment or nutrient reduction. However, when load reductions are achieved in an impaired water, they are simultaneously met in the Chesapeake Bay. For example, a 10% TSS reduction project draining to an impaired section of Spring Creek would address the sediment reduction required for the Chesapeake Bay. Further, because the PA DEP accepts that a 10% reduction in sediment will also achieve the 3% TN reduction and the 5% TP reduction, a sediment reduction project on Spring Creek will also achieve nutrient reduction requirements.

D. DETERMINING EXISTING LOADS FOR POLLUTANTS OF CONCERN

Pollutant loads from the Partners' planning area were modeled with *MapShed (*GWLF-E). *MapShed* is a geographic information system (GIS) based user interface for the GWLF-E watershed modeling tool that has been specifically adapted for developing PRPs. The *MapShed* interface was developed by a research group at Penn State University led by Dr. Barry Evans. The *MapShed* GIS interface derives input data for the watershed simulation model called

Generalized Watershed Loading Function-Enhanced (GWLF-E). Working with funding provided by the PA DEP since 1999, Dr. Evans has worked closely with state agency personnel to develop a modeling system that can be used to support TMDL- and MS4-related watershed studies anywhere within the state of Pennsylvania. In recent PA DEP guidance for the developing PRPs, *MapShed* and GWLF-E have been identified as acceptable approaches for calculating baseline loads and load reductions in regulated areas.

In *MapShed* the user is prompted to load default and user supplied spatial GIS files (land-use, soils, watershed boundaries, sewershed boundaries, urban areas, etc.) and to provide "non-spatial" model parameters (e.g., beginning and end of the growing season, period of weather data to use, etc.). This information is processed, and basin-specific input parameters are written to **.gms* files for the GWLF-E model. *MapShed* also accesses Excel-formatted weather files containing daily temperature and precipitation information from a statewide weather database. The weather database contains approximately twenty-five (25) years of temperature and precipitation data for seventy-eight (78) weather stations across Pennsylvania. The weather data is subsequently written to the GWLF-E watershed model for use in runoff simulations.

The runoff and pollutant load routines in *MapShed* are process based and include load analysis from both upland and in-stream sources. The model includes a wide range of urban landscape and cover conditions, enabling *MapShed* (GWLF-E) to simulate the transport and attenuation of pollutant loads from agricultural and urban landscapes. *MapShed* also includes routines to evaluate the effectiveness of a range of agricultural and urban stormwater best management practices (BMPs), and includes routines conforming to the new "Performance Standard" approach being advanced by PA DEP and the USEPA. The BMP analysis routines require user input of tributary land use and rainfall capture or treatment volume for each BMP.

MapShed **(GWLF-E) Modeling Strategy for the Centre Region**

For the purposes of this study, model runs were executed for six (6) separate sub-watersheds within the Centre Region as identified in **Table 2**. Sub-watershed areas were selected to meet the 10-square mile minimum watershed area required to properly account for downstream channel impacts in accordance with PA DEP document 3800-PM-BCW100k PRP.

Five (5) of the modeled watersheds (Big Hollow, Buffalo Run, Cedar Run, Slab Cabin Run, and Spring Creek) are part of the larger Spring Creek Watershed that drains to Bald Eagle Creek at Milesburg. The sixth (6th) sub-watershed, Beaver Branch, is immediately to the west of the Spring Creek Watershed and is part of the Spruce Creek Watershed.

The modeling approach used to evaluate the existing regulatory pollutant loads involved determining the PRP planning area, updating observed land use inaccuracies, runoff model calibration, and evaluating pollution load reductions associated with existing stormwater BMPs. These steps are described in the following sections.

Table 2. 12-unit HUC Watersheds Modeled for the Centre Region PRP

HUC 12-Name	Watershed Modeled	12-unit HUC	Watershed Size
Cedar Run	Cedar Run	020502040101	17.5 mi^2
Beaver Branch	Beaver Branch	020503020401	29.2 mi^2
Big Hollow	Big Hollow	020502040103	17.1 mi^2
Buffalo Run	Buffalo Run	020502040105	27.3 mi^2
Slab Cabin Run	Slab Cabin Run and Roaring Run	020502040102	21.5 mi^2
Spring Creek-Bald Eagle Creek	Spring Creek and Galbraith Gap	020502040106	29.7 mi^2

Determining the PRP Planning Area

The PRP planning area map, illustrated in **Figure 2**, was developed from PA DEP guidance and training documents. Using current MS4 system maps, each of the Partner municipalities and institutions developed an overall system drainage area map. These maps were combined and modified to produce the final PRP planning area. Modifications included planning area adjustments to ensure consistency with PA DEP training guidance Scenarios 1 through 9 and parsing the PennDOT right-of-way (ROW). Because PennDOT has a separate MS4 permit, PennDOT roads and ROW were parsed from the planning area. The parsed PennDOT ROW was delineated from Centre County Tax parcel and PennDOT road centerline GIS data. Parsed areas are illustrated in dark pink in **Figure 2**.

Land Use Updates

The 2011 National Land Cover Database is the default land use file used by *MapShed* (GWLF-E). It was observed that the default land cover data did not reflect current land uses in one or more areas in five (5) of the sub-watersheds (Beaver Branch, Buffalo Run, Spring Creek, Slab Cabin Run, and Big Hollow). Aerial photography from 2016 was used to update land uses in these areas to more accurately reflect current conditions. The land-use adjustments were made in *MapShed* input files.

Model Calibration

When *MapShed* (GWLF-E) is used to model pollutant loads for a PRP, the PA DEP does not require that the model be calibrated. For PRP purposes, the statewide *MapShed* compatible data sets (available via the *MapShed* website - www.mapshed.psu.edu) along with standard runoff parameters are acceptable for modeling surface runoff. Given the unique karst influence on the hydrology of Spring Creek Watershed, and more specifically the Big Hollow Sub-Watershed, and the availability of stream flow data for both Spring Creek and Big Hollow, the runoff model in

MapShed (GWLF-E) was calibrated. This calibration resulted in a more realistic simulation of average daily surface runoff and associated pollutant loads from these watersheds. Model calibration is described in the following paragraphs.

<u>*Spring Creek*</u>

Available historic streamflow data from the Houserville USGS stream gage (USGS 01546400 - see **Figure 1**) was used to calibrate the hydrologic model in GWLF-E. As illustrated in **Figure 3**, prior to calibration GWLF-E simulated base flows were depressed and peak flows were accentuated relative to observed stream flows.

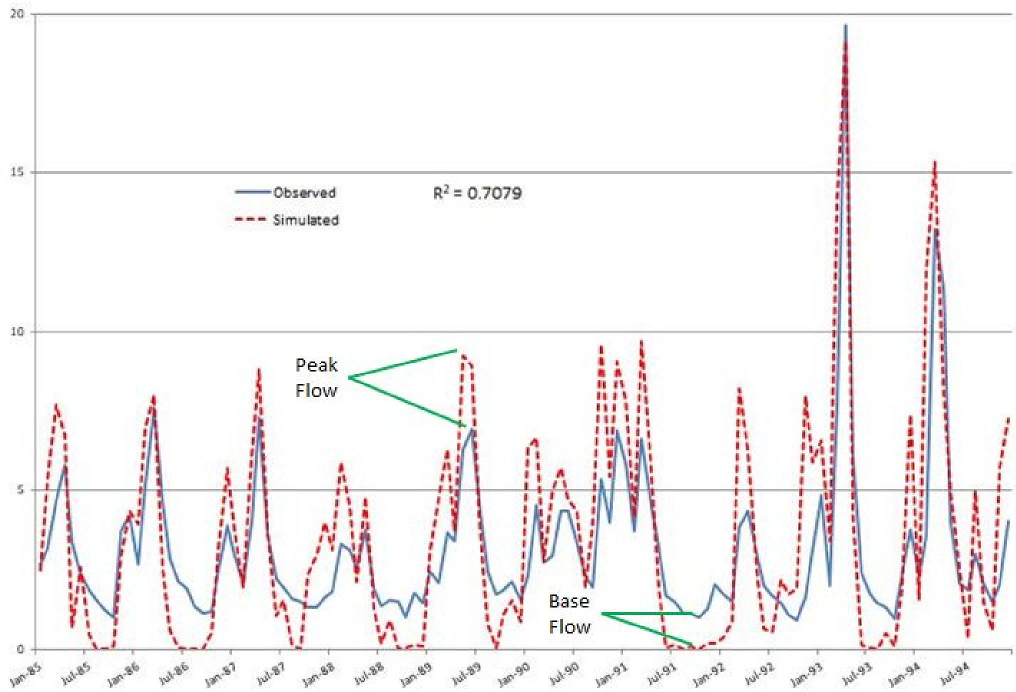

Figure 3. Pre-Calibration Observed and Simulated Houserville Stream Gage Flow Data (stream flows are in units of water depth [cm] over the watershed)

To improve simulated stream flow conditions, adjustments were made to various model parameters including minor adjustments to point source discharge coefficients, evapotranspiration rates, and groundwater recession rates. As illustrated in **Figure 4**, these adjustments increased base flows, decreased peak flows, and increased the correlation coefficient (R^2) from 0.71 to 0.77.

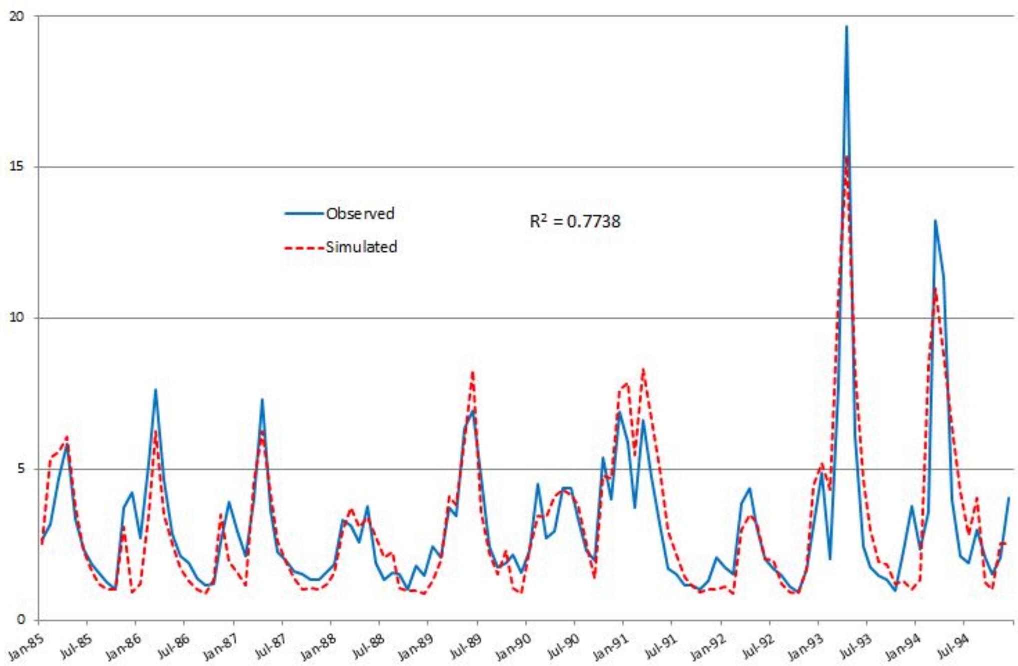

Figure 4. Post-Calibration Observed and Simulated Houserville Stream Gage Flow Data (stream flows are in units of water depth [cm] over the watershed)

<u>*Big Hollow*</u>

The Big Hollow Sub-Watershed is unique in that surface water flow rarely discharges from the Big Hollow to Spring Creek. Historical records compiled by Penn State University have shown that less than one percent (1%) of the precipitation that falls in the Big Hollow Sub-Watershed leaves as surface flow (see OPP, 2016 included in **Appendix A**). **Table 3** shows a snapshot of the historic precipitation and stream flow data compiled by staff at Penn State University. It is noted that **Table 3** only shows data for fifteen (15) days for the period 2/13/2007 through 7/29/2016 for the sake of space and brevity. Streamflow is from the University's stream gage and the precipitation data is from the Walker Building weather station on campus (see **Figure 1)**. For the period, February 13, 2007 through July 29, 2016, records show that while 384.63 inches of precipitation fell in the Big Hollow Sub-Watershed, only 0.31 inches discharged as stream flow. This amount represents only ***0.08%*** of the total water volume that fell as precipitation. In fact, during this 10-year period, only five (5) days had precipitation events that resulted in measurable stream flow at the University's gage. Therefore, pollutant loads associated with the Big Hollow would also be very small.

Model calibration to the Big Hollow observed data involved adjustments to key parameters affecting stream flow (primarily the curve numbers and groundwater (GW) seepage coefficient). With these adjustments, resulting stream flow volume was reduced to 0.57% of precipitation (0.22 cm of mean annual stream flow / 38.62 cm of mean annual precipitation). While this volume is still greater than that reflected in the observed stream flow records for Big Hollow, it

Table 3. Summary of Stream Flow Vs. Precipitation for the Big Hollow Sub-Watershed

Penn State Office of Physical Plant														
Big Hollow Gage 6 provisional data														
Data provided by Larry Fennessey, 2/3/2017														
Gage Location (approximate), 40.835488, -77.846445														
								Area	10940	ac	476546400	sq ft		
Date	Walker Daily Precip (in)	Big Hollow Gage 6 Event Peak Flow (cfs)	Big Hollow Gage 6 Ave Daily Flow (cfs)	Big Hollow Gage 6 Flow Duration (hrs)			Flow cf/day	Flow ft/day	Flow in/day					
2/13/2007	0.02	0	0	0			0	0	0					
2/14/2007	1.31	0	0	0			0	0	0					
2/15/2007	0.16	0	0	0			0	0	0					
2/16/2007	0.00	0	0	0			0	0	0					
2/17/2007	0.00	0	0	0			0	0	0					
2/18/2007	0.01	0	0	0			0	0	0					
2/19/2007	0.00	0	0	0			0	0	0					
2/20/2007	0.00	0	0	0			0	0	0					
7/23/2016	0.00	0	0	0			0	0	0					
7/24/2016	0.00	0	0	0			0	0	0					
7/25/2016	0.49	0	0	0			0	0	0					
7/26/2016	0.05	0	0	0			0	0	0					
7/27/2016	0.00	0	0	0			0	0	0					
7/28/2016	0.00	0	0	0			0	0	0					
7/29/2016	0.06	0	0	0			0	0	0					
Totals	384.63	813.00	140.50	1.48	0.00	0.00	12139200.00	0.03	0.31					
									0.08	Total flow as a percent of total precipitation				

Table Based on Data Compiled by the Penn State Office of Physical Plant (OPP, 2016).

was the lowest stream flow that could be reasonably driven with the GWLF-E model. The resulting stream flow was deemed to be adequate for simulating mean annual sediment loads associated with this sub-watershed. These calibrated model adjustments were used in final model runs to estimate pollutant loads for the Big Hollow Sub-Watershed.

Credit for Structural BMPs Implemented Prior to Developing the PRP

In accordance with PA DEP's PRP Instructions (document 3800-PM-BCW0100k), pollutant reduction credit was taken for structural BMPs constructed after local water quality and volume control ordinances were enacted and before this PRP was developed. **Appendix B.1** provides a table summarizing the BMPs that were applied to the pollution reduction credit. BMP types for which credit was taken include: 1) pervious pavement, 2) infiltration basins, 3) sub-surface detentions, 4) infiltration trenches, 5) raingarden/bioretention basins, 6) street trees, 7) constructed wetlands, 8) bioswales, 9) green roofs, 10) rainwater harvesting, 11) dry-extended detention basins, 12) detention basins, 13) retention basins, 14) under-drained basins, and 15) sediment traps.

The location of each of the BMPs for which credit was taken is illustrated in **Figure 5.** Operation and maintenance activities associated with these BMPs are detailed in **Appendix B.2**.

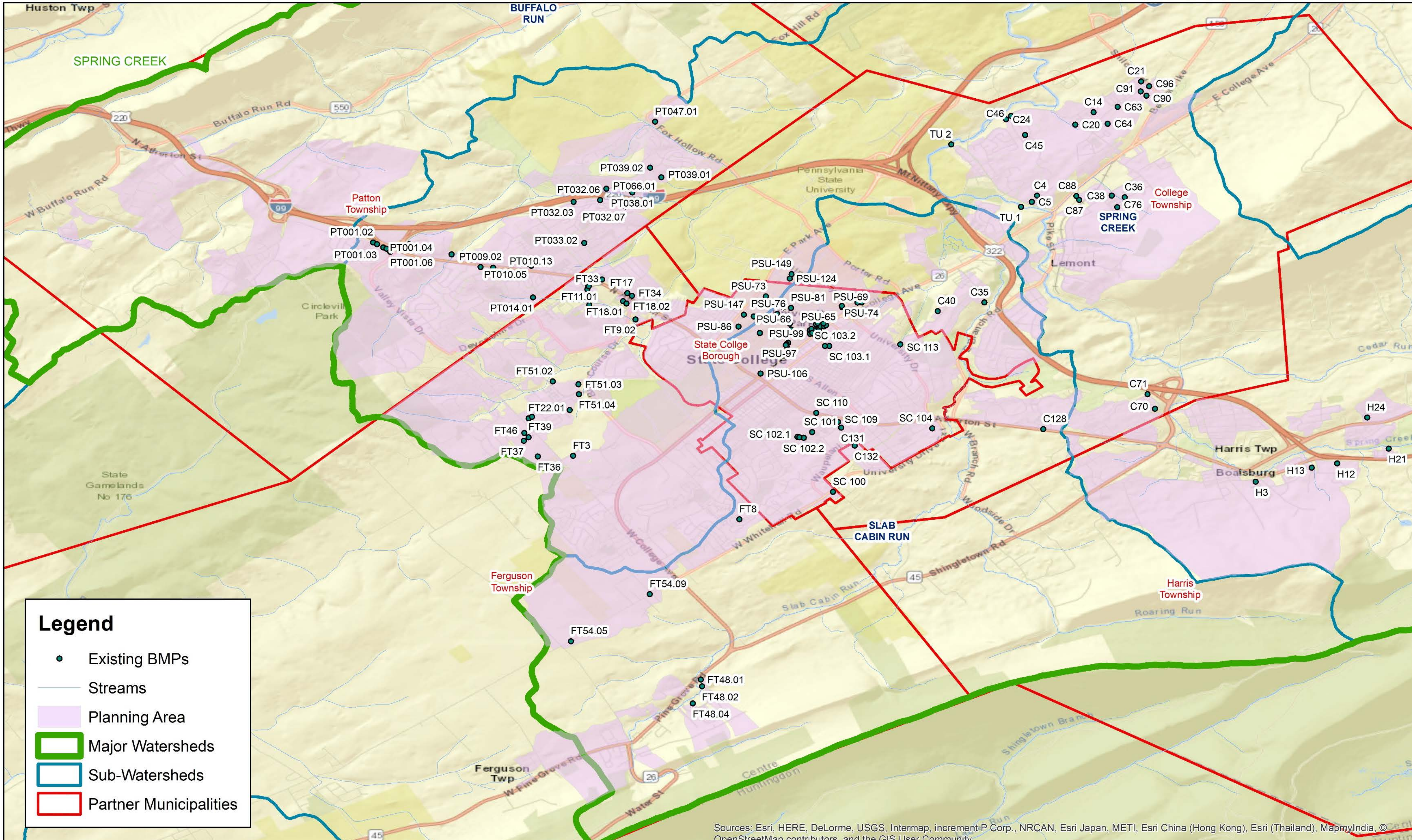

Figure 5. Structural BMPs Used for Pollution Load Reduction Credit

Operation and maintenance responsibilities for BMPs located in one of the Partner municipalities is the responsibility of the site owner/homeowner's association. Penn State has operation and maintenance responsibility for all BMPs on lands owned by the University. Under the Partners' separate MS4 permits, BMP owners are required to maintain BMP operation and function. Each of the Partner's MS4 permits includes an inspection program to ensure proper operation and maintenance. BMP owners are required to provided annual inspection reports to the permit holder upon request. If the BMP is not being maintained properly the municipal Partner can take enforcement action.

A data aggregation approach was applied to compute the BMP credit for existing BMPs in *MapShed* (GWLF-E). The credit computation is based on BMP removal rate adjuster curves for TSS, TN, and TP published in the expert panel report titled *Recommendations of the Expert Panel to Define Removal Rates for New State Stormwater Performance Standards*.

The aggregation analysis involved assessing land-use tributary to individual BMPs; applying imperviousness ratios for areas of low, medium, and high-density land-use; and computing the rainfall capture to each BMP. The rainfall capture (inches per impervious acre) to each BMP was computed by applying the following equation as defined by the expert panel report:

Rainfall Capture = (12*EP)/IA

Where, EP = Engineering Parameter which is the BMP capture volume in acre-feet
IA = Impervious Area in acres

For runoff reduction (RR) BMPs, the EP was assumed to be equal to the runoff removal volume. For stormwater treatment (ST) BMPs, the EP was assumed to be the design volume.

NTM aggregated the BMPs by 1) watershed, 2) municipality, and 3) BMP type (e.g. RR or ST). The total land area (categorized as low, medium, and high density) draining to all BMPs in an aggregated area and the average rainfall capture from all BMPs in the aggregated area were entered in GWLF-E. The sum of ST and RR reductions for each aggregated area was credited to the respective municipality and watershed to arrive at a reduced baseload for each municipality/watershed combination. Data supporting NTM's baseload computations, including the BMP aggregation data, are provided in **Appendix C**.

In addition to the BMP reductions modeled in *MapShed*, sediment removed by the in-stream sediment trap on Walnut Spring (a tributary to Slab Cabin Run) was subtracted from the Slab Cabin Run total. Records maintained by Borough of State College Department of Public Works, between 2014 and 2017, indicate that on average 64,882 lb./yr. of sediment is removed annually. This amount was subtracted from the load computed with *MapShed* (GWLF-E).

Existing TSS, TN, and TP baseloads for Beaver Branch, Buffalo Run, Spring Creek, and Slab Cabin Run are provided in **Table 4,** below. It is noted that Beaver Branch is not an impaired stream, but a portion of Ferguson Township's planning area drains to it. Therefore, the Chesapeake Bay Appendix D nutrient and siltation requirements must be met for this stream. It is also noted that the computed loads from the model outputs for Big Hollow, Cedar Run, and the Spring Creek main stem were summed to represent Spring Creek. The total loads presented in **Table 4** are apportioned by municipality in tables located in **Appendix D.3**.

Table 4. Existing Planning Area Loads to Each Watershed

Basin	Existing Sediment Load (lb./yr.)	Required Sediment Reduction (lb./yr.)	Existing Nitrogen Load (lb./yr.)	Required Nitrogen Reduction (lb./yr.)	Existing Phosphorus Load (lb./yr.)	Required Phosphorus Reduction (lb./yr.)
Beaver Branch	100,703	10,070	1,309	39	63	3
Slab Cabin Run	1,376,744	137,674	16,562	497	858	43
Spring Creek	1,060,450	106,045	14,721	442	590	30
Buffalo Run	329,245	32,925	7,059	212	218	11
Total:	**2,867,141**	**286,714**	**39,651**	**1,190**	**1,729**	**87**

E. BMPS TO ACHIEVE THE MINIMUM REQUIRED POLLUTANT LOAD REDUCTION

BMPs evaluated for pollutant load reduction include 1) stream restoration, 2) basin retrofits, and 3) street sweeping. Except for street sweeping, the locations of evaluated BMPs are illustrated in **Figure 2**. The PA DEP recommends that BMP effectiveness values published in PA DEP document 3800-PM-BWC0100m or Chesapeake Bay Program expert panel reports be consulted to compute BMP treatment capacity in pounds per year (lb./yr.).

The following Chesapeake Bay Expert Panel Reports were consulted for the analysis performed here:

- *Recommendations of the Expert Panel to Define Removal Rates for New State Stormwater Performance Standards*
- *Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects*
- *Recommendations of the Expert Panel to Define Removal Rates for Street and Storm Drain Cleaning Practices*
- *Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects*

For streambank restoration, a load reduction rate of 115 lb./LF/yr. is the accepted value for sediment reduction for analyses using *MapShed*. This rate is published in PRP instructions document 3800-PM-BCW0100K dated March 2017. It is noted that a lower rate of 44.88 lb./LF/yr. is required for projects that are modeled using the simplified approach. The difference in efficiency rates is based upon the fact that *MapShed* models in-stream bank erosion but the simplified method calculates average attenuated loads to the Chesapeake Bay. The Expert Panel Report for Stream Restoration was consulted when evaluating and selecting projects.

Stream Restoration Projects Evaluated

NTM engineering staff evaluated many of the streams on properties owned by, or for which the PRP Partner Municipalities had access. NTM visually assessed each stream section for instability and active erosion as evidenced by bank incision and undercutting. Stream reaches evaluated are listed in **Table 5**. Photographs taken of the evaluated reaches are included in **Appendix E**. Reach locations are identified by BMP number in **Figure 2**.

Basin Projects Evaluated

The following basins were evaluated as potential BMPs for this PRP:

- Westerly Parkway Reservoir and Community Wetland Retrofit (C8)
- Willowbrook Estates Basin Retrofit (A7)
- Penn Hills Basin Retrofit (A9)
- Rocky Ridge Basin Retrofit (B6)
- Grays Woods Basin Retrofit (B4)
- Boal Avenue Raingarden (B9)
- Easterly Parkway Open Space (C6)
- Orchard Park Basin Retrofit (C7)

The locations of these basins are illustrated on **Figure 2**.

The document *Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects* was consulted in this analysis. The adjustor curves provided in the expert panel report define removal rates based on rainfall captured per impervious area. The curves are asymptotic and reflect the fact that the BMP pollutant removal efficiency increases rapidly up to about 1.5 inches of rainfall capture per imperious acre but does not vary much for increasing capture volumes beyond that. Above 2.5 inches of rainfall capture, there is no additional pollutant removal efficiency gain.

For basin retrofit projects, the feasibility of increasing the captured rainfall to about 1.5 inches per impervious acre of tributary runoff was evaluated. For new basin projects, a feasible drainage area and basin footprint was defined and the pollutant removal from that basin was computed. These analyses were completed using *MapShed*. Impervious acreage is determined in *MapShed* based on the 2011 NLCD land cover database. Back up calculations for the basin projects are provided in **Appendix C**.

Table 5. Stream Reaches in the Centre Region Evaluated

Stream Reach	Location	Assessment	Photograph Number(s)
Beaver Branch			
UNT to Beaver Branch	Piney Ridge Subdivision Downstream of Wyoming Ave. (A2)	• channel incision and bank erosion downstream of Wyoming Avenue (350 LF)	38
UNT to Beaver Branch	Piney Ridge Subdivision Upstream of Wyoming Ave. (B7)	• some instability and bank erosion upstream of Wyoming Avenue (200 LF) • base-flow influenced by springs; seasonally dry	39, 40
Slab Cabin Watershed			
UNT to Slab Cabin Run (locally known as Thompson Run)	Upstream of duck pond (A3)	• deeply incised • actively eroding • previous restoration efforts failed	1, 2, 3, 4
Slab Cabin Run	Slab Cabin Park (B2)	• incised section near entrance where a pedestrian board bridge has been placed adjacent to the stream (see photo) • adjacent toe slope wetland discharges to stream at the above-mentioned pedestrian bridge • some minor instability at upstream edge of park	5, 6,7
UNT to Slab Cabin Run (locally known as Walnut Springs)	Walnut Springs Park (A6)	• some instability noted within park • instability previously described in Skelly and Loy's 2005 Park Management Study report • ongoing invasive species removal project	8, 9, 10
Slab Cabin Run	Kissinger Meadows (C1)	• stream section generally stable	11, 12

Slab Cabin Run	Meyers Everhart Farm (B1)	• instability due to bank trampling noted • nutrient inputs from cattle noted • some incision noted	13, 14, 15
Slab Cabin Run	Rt. 26 from Water Tower North to Route 45 (A4)	• forested section owned by Ferguson Township is stable • downstream, residential areas deeply incised and actively eroding	16, 17
Slab Cabin Run	From Rt. 26/45 downstream for 750 LF (B5)	• deeply incised and actively eroding	
Spring Creek Watershed			
Spring Creek	Spring Creek Park (B3)	• generally, stable • some erosion at paved area upstream of covered bridge • vanes previously installed by Fish and Boat Commission	18, 19, 20
Spring Creek	Fasick Park (C2)	• stable stream reach	21
Spring Creek	Mountain View Country Club (C3)	• stable stream reach	22, 23
Spring Creek	Military Museum Property Phase 1 (A8)	• active erosion downstream of dam and upstream of previous restoration project (approx. 300 LF)	29, 30, 31
Spring Creek	Military Museum Property Phase 2 (B7)	• some erosion and mud sill failure upstream of dam backwater to Old Boalsburg Pike (approx. 250 LF)	26, 27, 28
Spring Creek	Upstream of Old Boalsburg Pike (C5)	• active bank erosion upstream of bridge (approx. 100 LF)	24, 25
Spring Creek	Spring Creek Estates (A1)	• incised and actively eroding • shear bank faces	32, 33, 34
Buffalo Run Watershed			
UNT to Buffalo Run	Meeks Lane (A5)	• erosion evident • appears to be impaired by stormwater	35, 36, 37

Note: BMP number indicated in the location column corresponds to the BMP numbers provided in **Figure 2**.

Westerly Parkway Reservoir and Community Wetland Retrofit (C8)

The Westerly Parkway Reservoir has a 2.5-acre footprint and is nine (9) feet deep. It collects stormwater from southwestern State College and a portion of Ferguson Township. The drainage area to the reservoir is approximately 138 acres. In 2012, wetland plantings were added to the basin and walking trails were installed along the perimeter. The Reservoir and Community Wetland are open to the public except during significant rain events, when the site floods and gates surrounding the facility are locked.

The potential to retrofit the reservoir to reduce sediment loading in Slab Cabin Run was evaluated. It was determined that the existing basin captures an equivalent of approximately 4.0 inches of rainfall per impervious acre. Additional rainfall capture would not increase its efficiency as a runoff removal BMP. In addition, there was a significant investment in this BMP in 2012 to enhance stormwater treatment with wetland plantings. On this basis, it was determined that the Westerly Parkway Reservoir and Community Wetland is already achieving its maximum pollutant removal capacity. It was included as an existing BMP to reduce the baseline load, but no retrofits are proposed as part of this PRP.

Willowbrook Basin Retrofit (A7)

The Willowbrook Basin has a surface area of 1.07 acres and captures runoff from 44 acres in the Willowbrook Subdivision. Approximately 20% of this drainage area (8.8 acres) is impervious. The basin can be retrofit to have a 1.83 ac.-ft. runoff storage volume. Applying a conservative estimate for infiltration rate of 0.28 inches per hour, the stored runoff will be removed via infiltration in 72 hours. Entering the runoff storage volume of 1.83 ac-feet and an impervious area of 8.8 acres into the expert panel equation, a rainfall capture depth of 2.5 inches per impervious acre was computed.

Based on the adjustor curve, the 2.5 inches of rainfall capture will reduce TSS by 85%, TN by 68%, and TP by 78%. The rainfall capture volume and land area treated by the BMP was entered into the *MapShed* (GWLF-E) Urban BMP Editor. Based on this analysis, the retrofitted basin will treat 6,024 lb./yr. of sediment in the Spring Creek Watershed.

Penn Hills Basin Retrofit (A9)

The Penn Hills basin has a surface area of 1.38 acres and drains 70 acres. Approximately 17% of the drainage area (12 acres) is impervious. The basin can be retrofit to have a 2.41 ac-ft. runoff storage volume. Applying a conservative estimate for infiltration rate of 0.31 inches per hour, the stored runoff will be removed via infiltration in 72 hours. Entering the runoff storage volume of 2.41 ac.-ft. and an impervious area of 12 acres into the expert panel equation, a rainfall capture depth of 2.4 inches per impervious acre was computed.

Based on the adjustor curve, the 2.4 inches of rainfall capture will reduce TSS by 85%, TN by 67%, and TP by 78%. The rainfall capture volume and land area treated by the BMP was entered into the *MapShed* (GWLF-E) Urban BMP Editor. Based on this analysis, the retrofitted basin will treat 9,500 lb./yr. of sediment in the Spring Creek Watershed.

Rocky Ridge Basin Retrofit (B6)

The Rocky Ridge basin has a surface area of 0.50 acres and drains 86 acres. Approximately 11 acres of the drainage area is residential. The residential area is approximately 15% impervious, hence the impervious acreage is 1.65 acres. The remaining 75 acres is pervious open space which appears to be maintained as agricultural. The basin can be retrofit to have a 0.35 ac-ft. runoff storage volume. Applying a conservative estimate for infiltration rate of 0.28 inches per hour, the stored runoff would be removed via infiltration in 72 hours. Entering the runoff storage volume of 0.35 ac.-ft. and an impervious area of 1.65 acres into the expert panel equation, a rainfall capture depth of 2.5 inches per impervious acre results.

Based on the adjustor curve, the 2.5 inches of rainfall capture will reduce TSS by 85%, TN by 68%, and TP by 78%. The rainfall capture volume and residential land area treated by the BMP was entered into the *MapShed* (GWLF-E) Urban BMP Editor. Agricultural area was excluded from this analysis. Model results indicate that the retrofitted basin will treat 1,273 lb./yr. of sediment from the residential portion of the drainage area. This basin is in the Spring Creek Watershed as illustrated in **Figure 2**.

Grays Woods Basin Retrofit (B4)

The Grays Woods basin has a surface area of 0.40 acres and a 13.5-acre tributary drainage area. Approximately 15% of the drainage area (2 acres) is impervious. The basin can be retrofit to have a 0.40 ac-ft. runoff storage volume. Applying a conservative estimate for infiltration rate of 0.17 inches per hour, the stored runoff will be removed via infiltration in 72 hours. Entering the runoff storage volume of 0.39 ac.-ft. and an impervious area of 2 acres into the expert panel equation, a rainfall capture depth of 2.34 inches per imperious acre was computed.

Based on the adjustor curve, the 2.4 inches of rainfall capture will reduce TSS by 84%, TN by 67%, and TP by 78%. The rainfall capture volume and land area treated by the BMP was entered into the *MapShed* (GWLF-E) Urban BMP Editor. Based on this analysis, the retrofitted basin will treat 1,612 lb./yr. of sediment in the Spring Creek Watershed.

Boal Avenue Raingarden (B9)

The Boal Avenue Raingarden project was proposed by the Harris Township Tree Commission. The project will install raingardens and shade trees along Boal Avenue from the intersection with West Drive to the intersection with Discovery Drive. The specific project location, whether in PennDOT's parsed right-of-way or within lands owned by the Township, will be determined prior to construction.

The up-gradient planning area between Boal Avenue and Honeysuckle Drive drains through observation points to PennDOT right-of-way, and the 2020 census may further expand the

Urbanized Area southerly to Honeysuckle, Homestead & Kestrel Lanes. Due to the potential expansion of the urbanized area prior to the expiration of a 5-year permit, the project is being incorporated into this planning due to its location and potential benefits.

As noted in the PADEP MS4 Training Manual, a BMP downstream of a planning area must be an "in-line" installation to manage the direct contribution from the up-gradient planning area. Land acquisition/permissions would be incorporated into the design. The project will generate runoff reduction credit for the raingarden component and land use conversion credits for the urban shade tree component. The net pollution reduction gained from the project must be considered in conjunction with the additional base pollution load from extending the MS-4 partners planning area.

Easterly Parkway Open Space Infiltration Basin (C6)

There is a 0.07-acre empty parcel along Easterly Parkway in the Borough of State College and the Slab Cabin Run Watershed. A theoretical 18" deep raingarden was evaluated at this site. It was assumed that runoff would be captured from the 12.75-acre adjacent commercial-residential block. The adjacent block is approximately 20% impervious. The theoretical runoff storage volume was assumed to be 0.105 ac.-ft. and the runoff capture was computed to be 0.49 inches per impervious acre. Entering these assumptions into the *MapShed* (GWLF-E) Urban BMP Editor, it is estimated that the raingarden will remove 931 lb./yr. of sediment.

Orchard Park Basin Retrofit (C7)

Converting 2.55 acres of soccer fields to an infiltration basin was considered for sediment removal in the Slab Cabin Run Watershed. A theoretical basin with a capture depth of 1.5 feet and drainage area of 100 acres was evaluated. The theoretical infiltration basin would have a runoff storage volume of 3.83 ac.-ft. Applying the expert panel equation, the theoretical basin would have a runoff capture of 2.3 inches per impervious acre. Entering these data into the *MapShed* (GWLF-E) Urban BMP Editor, it was estimated that the infiltration basin would remove 14,873 lb./yr. of sediment.

Street Sweeping

Street sweeping was evaluated specifically for streets maintained by the Borough of State College. These credits would be applied to meet the nutrient and sediment reduction requirements in the Slab Cabin Run Watershed.

Street sweeping removal values must be calculated in accordance with the one of the methodologies outlined in 1) the *Recommendations of the Expert Panel to Define Removal Rates for Street and Storm Drain Cleaning Practices* or 2) the PA DEP BMP Effectiveness Values document 3800-PM-BCW0100m dated May 2016. The BMP effectiveness table specifies that streets must be swept a minimum of 25 times annually and provides a removal efficiency of 3%

TN, 3% TP, and 9% TSS, respectively. However, the expert panel report provides for 2% TN, 5% TP, and 11% TSS removal efficiency for the same sweeping frequency. The expert panel report values were applied to this PRP.

A GIS shapefile of the center lines of swept roads provided by the Borough of State College was used for the analysis. Data provided in the shapefile indicates 64 miles of roadway in the Borough can be swept. Of these 64 miles, 54 miles are in the Slab Cabin Run watershed and 10 miles are in the Spring Creek Watershed. All 64 miles are two-lane roads yielding 128 lane miles of roadway in the Borough of State College. In accordance with the expert panel report, each curb mile is equivalent to an acre. Developed land loading rates from the PRP Instructions document 3800-PM-BCW0100k were multiplied by the acres swept and percent reduction from the expert panel report to arrive at annual reduction in TSS, TN, and TP. These values are reported in **Table 6**.

Table 6. Annual Reduction in TSS, TN, and TP in the Slab Cabin Watershed by Street Sweeping in the Borough of State College

Sediment Reduction

Lane Miles	Curb Miles	Equivalent Acres	Centre County TSS Load (lb./ac./yr.)	TSS Removal (%) by Street Sweeping	TSS Pollutant Removal (lb./yr.)
54	108	108	1,771.63	11	21,047

Nitrogen Reduction

Lane Miles	Curb Miles	Equivalent Acres	Centre County TN Load (lb./ac./yr.)	TN Removal (%) by Street Sweeping	TN Pollutant Removal (lb./yr.)
54	108	108	19.21	2	41

Phosphorus Reduction

Lane Miles	Curb Miles	Equivalent Acres	Centre County TP Load (lb./ac./yr.)	TP Removal (%) by Street Sweeping	TP Pollutant Removal (lb./yr.)
54	108	108	2.32	5	13

Forest Buffer Project Evaluated

A 35-LF forested riparian buffer installed along a conservation easement in pastureland on the Meyer-Everhart Tract was considered (B1). For this analysis, it was assumed that dairy cattle will be restricted from accessing the stream. Credit generation computations were performed in accordance with protocols published in the *Recommendations of the Expert Panel to Reassess Removal Rates for Riparian Forests and Grass Buffers Best Management Practices* (Chesapeake Bay Program Forestry Working Group, October 2014).

For credit computation, the buffer is treated as a land use change. The land use conversion reduction efficiently credit for this project is summarized in **Table 7**. In accordance with the expert panel report, the TN credit can be taken for land area four (4) times the buffer area and the TP and TSS credit may be taken for an area two (2) times the buffer area. In addition, 0.014 lb. per LF of credit can be taken for in-stream nitrogen cycling via hyporheic exchange and denitrification in riparian soils. However, this PRP computation will focus on TSS credit. The 70 LF upland (e.g. 2 times the 35-LF buffer) land area evaluated is shown in **Figure 6**.

Table 7. Land Use Conversion Reduction Efficiency Applied to the Valley and Ridge (Karst) Agricultural Lands

Location	Forested Land (one side of the stream)			Grass (one or both sides of the stream)		
	TN	TP	TSS	TN	TP	TSS
Valley and Ridge Karst	34%	30%	40%	24%	30%	40%
Note: Effectiveness credit is applied to upslope land at a ratio of 1:4 for TN and 1:2 for TP and TSS.						

Figure 6. Location of Buffer and Adjacent Upland Credit Area.

The land-use conversion analysis was performed in *MapShed* (GWLF-E). The GWLF-E output indicates that the current sediment load in the non-forested riparian buffer is 5,684 lb./yr. Given that forest buffers are effective at reducing the sediment load by 40%, the TSS load reduction for the project is estimated to be 2,274 lb./yr. The first 34% of this load reduction (773 lb./yr.) is to be allocated to meet the Agricultural Component of the Phase II WIP. The remaining 1,501 lb. can be allocated to the Partners.

The land-use conversion analysis was performed in *MapShed* (GWLF-E). The GWLF-E output indicates that the current sediment load in the non-forested riparian buffer is 5,684 lb./yr. Given that forest buffers are effective at reducing the sediment load by 40%, the TSS load reduction for the project is estimated to be 2,274 lb./yr. The first 34% of this load reduction (773 lb./yr.) is to be allocated to meet the Agricultural Component of the Phase II WIP. The remaining 1,501 lb. can be allocated to the Partners.

BMPs Selected

The project evaluations presented above were discussed with the Partners. Each project was ranked as primary, secondary, or not to be considered at this time. The primary BMPs proposed to meet the pollution load reduction requirement in the Centre Region MS4 planning area include several stream restoration projects and retrofitting the Willowbrook Estates Subdivision Stormwater Basin. Secondary BMPs have been identified should engineering design and analysis indicate the primary selections to be infeasible. Primary BMP projects are illustrated in green and secondary BMP projects are illustrated in yellow in **Figure 2**.

Primary and secondary BMPs selected for each watershed in the Center Region MS4 planning area are summarized in **Tables 8** and **9**. These BMPs are also illustrated on the planning area map (**Figure 2**). **Tables 8** and **9** identify the stream restoration protocol appropriate to restoration sites. The stream restoration protocols are published in the Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects (Berg, et. al, 2014). As required in the PRP Instructions document 3800-PM-BCW0100m, names and land uses identified in **Tables 8** and **9** are in accordance with the Chesapeake Bay Program Model, as published in CAST (www.casttools.org).*

Each of the primary projects selected is described in more detail in a summary sheet in **Appendix F**. These descriptions provide the design concept and a narrative description of the sediment reduction computations. For the stream restoration projects, the descriptions provide documentation of qualification compliance as outlined in the PA DEP document titled *Considerations of Stream Restoration Projects in Pennsylvania for eligibility as an MS4 Best Management Practice* dated June 22, 2017.

Based on the analysis performed as a part of this study, the primary BMPs will meet the required regulatory load reductions for the Partners' planning area. The secondary BMPs provide alternative projects that can be implemented should one or more of the primary BMPs be found to be infeasible or undesirable. **Table 10** summarizes the load reductions required for each watershed and the loads provided by the primary and secondary BMP projects. Load reductions required versus those provided by the BMP projects apportioned to each municipality are provided in **Appendix D.4**.

The primary and secondary BMPs referenced above provide a menu of options for meeting regulatory load reduction requirements. It is noted that the Partners are not limited to the BMPs identified here. If other BMP options are identified they can be substituted if they meet qualifying standards and, singly or together with other BMPs being implemented, meet the regulatory pollutant load reduction requirements identified here.

Table 8. Primary BMPs by Watershed in the Centre Region Planning Area

Primary BMP Description	Watershed	Land Use	Expert Panel Protocol	TSS Reduction	Cost Sharing Partners
Piney Ridge Subdivision Stream Restoration - A2 (350 LF)	Beaver Branch	Pervious Developed	Protocol 1: Prevent Sediment during Stormflow	40,250 lb./yr.	Ferguson Twp. (100%)
			Beaver Branch Total (primary BMPs)	**40,250 lb./yr.**	
UNT to Slab Cabin Run (locally known as the Duck Pond Stream) Stream Restoration - A3 (1000 LF)	Slab Cabin Run	Pervious Urban	Protocol 1: Prevent Sediment during Stormflow	115,000 lb./yr.	Ferguson Twp. (17.5%) Penn State (62.5%) College Twp. (20%)
UNT to Slab Cabin Run (locally known as Walnut Springs) Segments 3 and 4 Stream Restoration - A6 (385 LF)	Slab Cabin Run	Pervious Developed	Protocol 1: Prevent Sediment during Stormflow and Protocol 3: Floodplain reconnection	44,275 lb./yr.	Borough of State College (100%)
Pine Grove Mills Route 26 Stream Restoration - A4 (300 LF)	Slab Cabin Run	Pervious Developed	Protocol 1: Prevent Sediment during Stormflow	34,500 lb./yr.	Ferguson Twp. (100%)
			Slab Cabin Total (primary BMPs)	**193,775 lb./yr.**	
Spring Creek Estates Stream Restoration - A1 (500 LF minimum)	Spring Creek	Pervious Developed	Protocol 1: Prevent Sediment during Stormflow	57,500 lb./yr. (minimum)	Grant Funded; Credit Partners include: College Twp. (95%) Harris Twp. (5%)
Willowbrook Basin Retrofit - A7	Spring Creek	Pervious Developed	NA	6,024 lb./yr.	Harris Township Twp. (100%)
Military Museum Stream Restoration Phase 1 (dam to previous restoration) -A8 (350 LF)	Spring Creek	Pervious Developed	Protocol 1: Prevent Sediment during Stormflow	40,250 lb./yr.	Harris Twp. (100%)
Penn Hills Basin Retrofit – A9	Spring Creek	Pervious Developed	NA	9,500 lb./yr.	College Twp.
			Spring Creek Total (primary BMPs)	**113,274lb./yr.**	
Meeks Lane Stream Restoration - A5 (320 LF)	Buffalo Run	Pervious Developed	Protocol 1: Prevent Sediment during Stormflow and Protocol 3: Floodplain restoration	36,800 lb./yr.	Patton Twp. (100%)
			Buffalo Run Total (primary BMPs)	**36,800 lb./yr.**	

Table 9. Secondary BMPs by Watershed in the Centre Region Planning Area

BMP Description	Watershed	Land Use	Expert Panel Protocol	TSS Reduction	Cost Sharing Partners
Wyoming Avenue Stream Restoration (upstream) – B7	Beaver Branch	Pervious Developed	Protocol 1: Prevent Sediment during Stormflow and Protocol 3: Floodplain restoration	23,000 lb./yr.	Ferguson Twp.
			Beaver Branch (secondary BMPs)	**23,000 lb./yr.**	
Meyer-Everhart Farm Streamside Forest Buffer (3,723 LF) - B1	Slab Cabin Run	Pasture	NA	1,501 lb./yr.	Borough of State College Ferguson Twp. College Twp. Harris Twp.
Street Sweeping in the Borough of State College (54 Center Line Miles)	Slab Cabin Run	Impervious Urban	NA	21,047 lb./yr.	Borough of State College
Stream Restoration Pine Grove Mills Downstream of the Route 45 and Route 26 Intersection – B5	Slab Cabin Run	Pervious Developed	Protocol 1: Prevent Sediment during Stormflow and Protocol 3: Floodplain restoration	23,000 lb./yr.	Ferguson Twp.
Slab Cabin Park Stream Restoration (750 LF) – B2	Slab Cabin Run	Pervious Developed	Protocol 1: Prevent Sediment during Stormflow and Protocol 3: Floodplain restoration	86,250 lb./yr.	College Twp.
			Slab Cabin Total (secondary BMPs)	**131,798 lb./yr.**	
Spring Creek Park Stream Restoration (300 LF) – B3	Spring Creek	Pervious Developed	Protocol 1: Prevent Sediment during Stormflow and Protocol 3: Floodplain restoration	34,500 lb./yr.	College Twp.
Stream Restoration Phase 2 (old Boalsburg Pike to dam, 300 LF) – B8	Spring Creek	Pervious Developed	Protocol 1: Prevent Sediment during Stormflow	34,500 lb./yr.	Harris Twp.
Rocky Ridge Basin Retrofit – B6	Spring Creek	Pervious Developed	Protocol 1: Prevent Sediment during Stormflow	1,273 lb./yr.	Harris Twp.
Boal Avenue Raingarden – B9	Spring Creek	Pervious Developed	Protocol 1: Prevent Sediment during Stormflow	To be determined	Harris Twp.
			Spring Creek Total (secondary BMPs)	70,273lb./yr.	
Grays Woods Basin Retrofit – B4	Buffalo Run	Pervious Developed	Protocol 1: Prevent Sediment during Stormflow	1,612 lb./yr.	Patton Twp.
			Buffalo Run Total (secondary BMPs)	1,612 lb./yr.	

Table 10. TSS Load Reductions

Basin	Required Sediment Reduction (lb./yr.)	Sediment Reduction from Primary BMPs (lb./yr.)	Excess Treatment Primary BMPs (lb./yr.)	Sediment Reduction from Secondary BMPs (lb./yr.)	Excess Treatment Primary + Secondary BMPs (lb./yr.)
Beaver Branch	10,070	40,250	30,180	23,000	53,180
Slab Cabin Run	137,674	193,775	56,101	131,798	187,899
Spring Creek	106,045	113,274	7,229	70,273	77,502
Buffalo Run	32,925	36,800	3,875	1,612	5,487
Total:	**286,714**	**384,099**	**97,385**	**226,683**	**324,068**

F. FUNDING MECHANISMS

Estimated costs associated with the proposed primary BMPs are presented in **Table 11**. In some cases, the cost of a project will be shared by multiple Partners. Cost sharing has been apportioned based on the load generated in the portion of the planning area within each Partner's jurisdiction. These costs are allocated by Municipality in **Table 12**.

All but one of the of BMPs proposed to meet pollution reduction requirements will be funded by the Partners. The BMPs will be financed with capital reserves and general funds. Some of the Partners are considering instituting stormwater fees to finance future projects, including operations and maintenance.

The one exception is the Spring Creek Estates Stream Restoration Project. This project is included in a broader project which received an award from the National Fish and Wildlife Foundation in August 2017. The grant plus committed matching contributions from other non-municipal entities will cover the entire capital cost of the project. Participating municipalities will be responsible for the cost of maintenance.

Table 11. Primary Project Cost Summary

Project	Lead Municipality or Institution	Costs						
		Capital Cost per Unit	Capital Unit	Annual O&M Cost per Unit	Design Life (yr.)	Unit Size	O&M Cost Over Life	Capital Cost
Piney Ridge Stream Restoration - UNT Beaver Branch (A2)	Ferguson Twp.	$225.00	LF	$3.05	20	350	$21,350	$78,750
Duck Pond Channel Restoration - UNT Slab Cabin Run (A3)	Penn State	$640.00	LF	$8.60	20	1000	$172,000	$640,000
Walnut Springs Stream Restoration - UNT Slab Cabin Run (A6)	SC Borough	$225.00	LF	$3.05	20	385	$23,485	$86,625
Pine Grove Mills Stream Restoration - Slab Cabin Run (A4)	Ferguson Twp.	$225.00	LF	$3.05	20	300	$18,300	$67,500
Spring Creek Estates Stream Restoration - Spring Creek (A1)	College Twp.	$225.00	LF	$3.05	20	500	$30,500	$112,500
Willowbrook Basin Retrofit - Spring Creek (A7)	Harris Twp.	$750.00	ACT	$50.00	50	60	$150,000	$45,000
Military Museum Stream Restoration Phase 1 - Spring Creek (A8)	Harris Twp.	$225.00	LF	$3.05	20	350	$21,350	$78,750
Meeks Lane Stream Restoration - UNT Buffalo Run (A5)	Patton Twp.	$225.00	LF	$3.05	20	320	$19,520	$72,000
Penn Hills Basin Retrofit – Spring Creek (A9)	College Twp.	$750.00	ACT	$50.00	50	70	$175,000	$52,500

Table 12. Municipal Cost Summary

Project	College Township		Ferguson Township		Harris Township		Patton Township		Penn State		Borough of State College	
	Annual O&M Cost	Capital Cost	Annual O&M Cost	Capital Cost	Annual O&M Cost	Capital Cost	Annual O&M Cost	Capital Cost	Annual O&M Cost	Capital Cost	Annual O&M Cost	Capital Cost
Piney Ridge Stream Restoration - UNT Beaver Branch (A2)	$0	$0	$1,068	$78,750	$0	$0	$0	$0	$0	$0	$0	$0
Duck Pond Channel Restoration - UNT Slab Cabin Run (A3)	$1,720	$128,000	$1,505	$112,000	$0	$0	$0	$0	$5,375	$400,000	$0	$0
Walnut Springs Stream Restoration - UNT Slab Cabin Run (A6)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,174	$86,625
Pine Grove Mills Stream Restoration - Slab Cabin Run (A4)	$0	$0	$915	$67,500	$0	$0	$0	$0	$0	$0	$0	$0
Spring Creek Estates Stream Restoration - Spring Creek (A1)	$1,449	$106,875	$0	$0	$76	$5,625	$0	$0	$0	$0	$0	$0
Willowbrook Basin Retrofit - Spring Creek (A7)	$0	$0	$0	$0	$3,000	$45,000	$0	$0	$0	$0	$0	$0
Military Museum Stream Restoration Phase 1 - Spring Creek (A8)	$0	$0	$0	$0	$1,068	$78,750	$0	$0	$0	$0	$0	$0
Meeks Lane Stream Restoration - UNT Buffalo Run (A5)	$0	$0	$0	$0	$0	$0	$976	$72,000	$0	$0	$0	$0
Penn Hills Basin Retrofit – Spring Creek (A9)	$3,500	$52,500	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total:	**$6,669**	**$287,375**	**$3,488**	**$258,250**	**$4,144**	**$129,375**	**$976**	**$72,000**	**$5,375**	**$400,000**	**$1,174**	**$86,625**

G. OPERATION AND MAINTENANCE (O&M) OF BMPS

Parties Responsible for O&M of Each BMP

Each Partner is responsible for ongoing operation and maintenance of the BMPs within their jurisdiction. The party responsible for maintaining the primary and secondary BMPs identified above are indicated in **Table 13.**

Activities Involved with O&M for Each BMP

Activities Associated with Basin BMPs

- Maintain as-built plans of all basins for future reference.
- Inspection Frequency: Twice per year (late spring and late fall preferred) and after runoff events causing local flooding/drainage issues.
- Inspect for accumulation of sediment, damage to outlet control structures, erosion control measures, signs of water contamination/spills, and slope stability of berms.
- Mow only as appropriate for vegetative cover species.
- The vegetation along the surface of the infiltration basin should be maintained in good condition and any bare spots revegetated as soon as possible.
- Remove accumulated sediment from basin as required. Restore original cross section and infiltration rate. Properly dispose of sediment.

Additional requirements for infiltration basins:

- Catch basins, inlets, and forebays up-gradient of infiltration basin should be inspected and cleaned at least two (2) times per year and after runoff events causing local flooding and drainage issues.
- After significant rainfall events inspect the basin water levels to ensure that runoff drains from the basin in 72 hours or less.
- Vehicles should not be parked or driven on an infiltration basin and care should be taken to avoid excessive compaction by mowers.

Activities Associated with Stream Restoration BMPs

- The responsible municipality should maintain as-built plans illustrating the installed structures.
- Digital photographs should be taken of the project reach immediately following construction, once annually, and following each over-bank flooding event.
- Areas of accretion and/or degradation should be photographed and measured to document post-restoration sediment dynamics.
- Stream reach should be stable over time; evidence of eroding banks and incision should be noted if observed.

Table 13. Party Responsible for Maintaining Proposed BMPs

Primary BMP Description	Watershed	Primary or Secondary	Responsible Party
Piney Ridge Subdivision Stream Restoration (350 LF)	Beaver Branch	Primary	Ferguson Twp.
UNT to Slab Cabin Run (locally known as Duck Pond Channel) Stream Restoration (1000 LF)	Slab Cabin Run	Primary	Penn State
UNT to Slab Cabin Run (locally known as Walnut Springs) Segments 3 and 4 Stream Restoration (385 LF)	Slab Cabin Run	Primary	Borough of State College
Pine Grove Mills Route 26 Stream Restoration (300 LF)	Slab Cabin Run	Primary	Ferguson Twp.
Spring Creek Estates Stream Restoration (500 LF (minimum))	Spring Creek	Primary	College Twp. in cooperation with Trout Unlimited
Willowbrook Basin Retrofit	Spring Creek	Primary	Harris Twp.
Military Museum Stream Restoration Phase 1 (from dam to previous restoration) (350 LF)	Spring Creek	Primary	Harris Twp.
Penn Hills Basin Retrofit	Spring Creek	Primary	College Twp.
Meeks Lane Stream Restoration (320 LF)	Buffalo Run	Primary	Patton Twp.
Wyoming Avenue (upstream)	Beaver Branch	Secondary	Ferguson Township
Meyer-Everhart Farm Streamside Forest Buffer (3,723 LF)	Slab Cabin Run	Secondary	Borough of State College, Ferguson Twp., College Twp., and Harris Twp. in cooperation with the Clearwater Conservancy
Street Sweeping in the Borough of State College (54 Center Line Miles)	Slab Cabin Run	Secondary	Borough of State College
Downstream of the Route 45 and Route 26 Intersection	Slab Cabin Run	Secondary	Ferguson Township
Slab Cabin Park Stream Restoration (200 LF)	Slab Cabin Run	Secondary	College Twp.
Spring Creek Park Stream Restoration (300 LF)	Spring Creek	Secondary	College Twp.
Stream Restoration Phase 2 (old Boalsburg Pike to dam) (300 LF)	Spring Creek		Harris Twp.
Grays Woods Basin Retrofit	Spring Creek		Patton Twp.
Rocky Ridge Basin	Spring Creek		Harris Twp.

- The responsible municipality should maintain the project with an adaptive mind set. If structures become displaced repeatedly or if accelerated erosion within the reach is noted, an action plan should be developed to make any necessary modifications/repairs to the flow control scheme.
- Any structures displaced or damaged during a flood event must be replaced and repaired immediately.

Activities Associated with Riparian Forest Buffer BMPs

- Riparian plantings shall be monitored for wildlife grazing, pest damage, and overall health. If plantings do not achieve an 85% survival rate replanting is necessary. Tree tubes, fencing, or other deterrents shall be installed to address wildlife damage, as necessary.
- Invasive species should be removed from the riparian zone.
- Fertilizing and watering may be necessary during plant establishment.

Activities Associated with Street Sweeping - Reporting, Tracking and Verifying

- Total qualifying lane miles swept annually must be shown on a route map. The HUC code for the watershed in which the sweeping occurs should be noted on the map.
- Average parking conditions along the route should be noted.
- Sweeper technology used (AST or MBT) should be recorded.
- Miles swept by date should be tallied. Number of sweeping passes per year, per route should be quantified.
- Volume of sweeper waste collected, wet mass of sweeper waste should be measured.
- Analytical results for dry weight of the sweeper waste and particle size distribution should be measured.
- Measuring the carbon, nitrogen, and phosphorus content of the sweeper waste is also recommended.

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Centre Region MS4 Partners PRP

APPENDIX A

Water Resource Publication OPP-WRP-SR-BH6:2016: Big Hollow Gage 6

NEWELL TERESKA & MACKAY ENGINEERING

Water Resource Publication

Big Hollow Gage 6

OPP-WRP-SR-BH6: 2016

Introduction and Objectives

The objective of this Special Report is to document that the Big Hollow, a subwatershed to Spring Creek located in Centre County, Pennsylvania, is an ephemeral drainageway and not under the jurisdiction of Municipal Separate Storm Sewer System (MS4) permits. Justification is provided using the University's Big Hollow Gage #6, which covers approximately a 9.5 year time period from 2/9/2007 to 7/29/2016. The drainage area to Gage 6 is 15.8 square miles, of which approximately 2.5 square miles are impervious (refer to Figure 1). The total drainage area to the Big Hollow is 17.2 square miles and the drainageway at the outlet can be seen in Figure 2. From Figure 2 it's obvious that frequent surface runoff does not occur at the outlet since there is no channelization or erosion. Unfortunately, experts not familiar with the local conditions have historically classified the Big Hollow incorrectly. For instance, the USGS quadrangle shows the Big Hollow as a perennial stream and the SRBC and PaDEP Chapter 93 define the Big Hollow as a cold water fishery (CWF). Local experts estimate that the Big Hollow has not experienced regular surface flow for over 10,000 years (personal communication with Dr. Richard Parizek, Penn State Professor Emeritus of Geosciences).

The University and the community collectively protect the Big Hollow and have historically used its sinkholes, recharge areas, and drainageways to control large scale drainage and augment the groundwater aquifer. Major sinkholes and recharge areas can be seen in Figure 3. Some may argue that the community is endangering the local groundwater because of these highly infiltrative areas, however, no long term impacts seem to have occurred due to stormwater filtering and best management practices used in the last 20+ years. Figure 4 shows the location of the major public well fields within and around the Big Hollow, which currently are all unfiltered groundwater sources (with the exception of the Harter-Thomas well field along Slab Cabin Run). Groundwater provides over 99% of potable water for the community and while local superfund sites have impacted groundwater quality as would be expected, major stormwater impacts have not occurred. The University and surrounding municipalities have science based ordinances that protect the Big Hollow, regardless of the requirements of the MS4 permit or program. Therefore, the MS4 partners have proposed removing the Big Hollow areas from their MS4 permits.

Penn State Big Hollow Gage 6:

The University's Big Hollow Gage #6 is located on the University's property within the main drainageway of the Big Hollow watershed. The gage also receives all flow from the majority of Innovation Park (refer to Figure 5). If surface water were being discharged from Innovation Park or moving down the main Big Hollow drainageway, it would be picked up at this gage. The gage sits on the upslope side of the Big Hollow Road in a small closed depression where the roadway crosses the Big Hollow without a culvert (refer to Figures 6 and 7). Any larger runoff events that come down the Big Hollow immediately fill up the closed depression and then overtop the roadway. The gage measuring point is located at the bottom of the closed depression, which sits approximately 1.24' below the roadway sag. The property owner that lives immediately adjacent to the gage has indicated that overtopping has historically occurred every couple of years due to major snowmelt events or hurricanes.

Since the gage was installed on February 9, 2007 through July 29, 2016, there has been over 385 inches of precipitation recorded at the University's Walker Building Weather Station. Several large precipitation events have occurred during this period of time including multiple significant design type events. Several moderate winter rainfall events have also occurred with snow covered or frozen ground conditions. A graph of all precipitation over the gaged time period can be seen in Figure 8, which represents the daily precipitation recorded at the Walker Building Weather Station.

Figure 9 shows the runoff data for Gage 6 over this same time period. The minor irregularities in the graph during the winter/spring are due to snow sitting on the gage. As can be seen, only five precipitation events flowed past the gage, and while no data were collected downstream, it's likely only four actually reached Spring Creek (8/20/2014 likely did not reach Spring Creek), or an average of once every approximately 2 years. The 3/5/2008 and 12/1/2010 events resulted in runoff at the gage and are considered winter runoff events. The 3/5/2008 event was from 2.34 inches of rainfall on a 5 inch snowpack. The 12/1/2010 event was from 3.07 inches of rainfall following 1 inch of rainfall 5-days prior. Figure 10 shows the actual event hydrograph for 3/5/2008, which had runoff going over the roadway for approximately 9 hours. The maximum depth of flow over the roadway was approximately 1.4' deep at the roadway sag. Figure 11 shows the runoff hydrograph for the 12/1/2010 event, which flowed over the road for approximately 7 hours.

Three summer/fall events occurred that resulted in runoff flowing past the gage, which occurred on 9/7/2011, 6/27/2013, and 8/20/2014. The 9/27/2011 event resulted from a daily rainfall of 3.11 inches (3.23 inches in 24 hours) shortly after 1.8 inches fell in the preceding two days (for a total rainfall of 4.91 inches over three days), which caused runoff over the roadway for approximately 9 hours (refer to Figure 12). The 6/27/2013 event was caused by a daily rainfall of 3.38 inches (3.73 inches in 24 hours) two days after 1.2 inches fell, which caused runoff over the roadway for approximately 6 hours (refer to Figure 13). The 8/20/2014 event appears to have been a high intensity event that occurred in part of the lower drainageway and was recorded as 1.23 inches of rainfall at the Walker Building. Flow only lasted approximately 2 hours over the road and this event is considered an anomaly.

The University has not estimated the peak flow rates or runoff volumes for these events; however, the total duration of flow over the road in 9.5 years was approximately 33 hours or 3.5 hours per years or 0.04% of the time. Ephemeral streams are generally defined as flowing only short durations in direct response to precipitation events and the stream channels are considered to never be in contact with groundwater, both conditions of which are true for the Big Hollow. Groundwater has been recorded historically well below the ground surface in the Big Hollow as indicated in Figures 15 and 16, which are data from two groundwater monitoring wells within the Big Hollow. Figure 15 documents that since 2008, groundwater in the upper Big Hollow watershed has not come within 50 ft of the ground surface at this location. Figure 16 documents that groundwater in the lower Big Hollow watershed has not come within 35 ft of the ground surface at the monitoring well location, which is directly adjacent to the ephemeral drainageway.

Conclusion:

The Big Hollow is an ephemeral stream as defined by the Pennsylvania Department of Environmental Protection (see definitions on the following page), which is supported by almost a decade of actual flow data and local groundwater wells. The MS4 permit is a surface water permit, which does not include ephemeral streams. Therefore, the MS4 partners are proposing to remove the Big Hollow drainage basin from their MS4 permits since there are no surface water outfalls. Protection of the Big Hollow will continue in accordance with municipal stormwater ordinances. Additionally, because there are no surface water discharges from the Big Hollow, the MS4 partners or other entities can also not claim surface water credits for other purposes such as sediments and/or nutrients.

Definitions:

From MS4 permit 3800-PM-BCW0100d 5/2016

Municipal separate storm sewer means a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains): (i) Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, stormwater, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the CWA that discharges to surface waters; (ii) Designed or used for collecting or conveying stormwater; (iii) Which is not a combined sewer; and (iv) Which is not part of a Publicly Owned Treatment Works (POTW) as defined at 40 CFR 122.2. (25 Pa. Code § 92a.32(a) and 40 CFR § 122.26(b)(8))

From 25 Pa. Code § 92a.2

Surface Waters means perennial and intermittent streams, rivers, lakes, reservoirs, ponds, wetlands, springs, natural seeps and estuaries, excluding water at facilities approved for wastewater treatment such as wastewater treatment impoundments, cooling water ponds and constructed wetlands used as part of a wastewater treatment process.

Perennial stream - A body of water flowing in a channel or bed composed primarily of substrates associated with flowing waters and capable, in the absence of pollution or other manmade stream disturbances, of supporting a benthic macroinvertebrate community which is composed of two or more recognizable taxonomic groups of organisms which are large enough to be seen by the unaided eye and can be retained by a United States Standard No. 30 sieve (28 meshs per inch, 0.595 mm openings) and live at least part of their life cycles within or upon available substrates in a body of water or water transport system.

Intermittent Stream means a body of water flowing in a channel or bed composed primarily of substrates associated with flowing water, which, during periods of the year, is below the local water table and obtains its flow from both surface runoff and groundwater discharges.

From 391-2000-014 4/12/2008

Ephemeral stream - A reach of stream that flows only during and for short periods following precipitation, and flows in low areas that may or may not have a well-defined channel. Ephemeral stream beds are located above the water table year-round. Groundwater is not a source of water for the stream. Some commonly used names for ephemeral streams include: stormwater channel, drain, swale, gully, hollow, saddle, and routinely and incorrectly as “dry streams.” The term is often used interchangeably with intermittent stream but the difference is in length of time of continuous flow (less than one month per year for ephemeral streams).

From 25 Pa. Code § 89.5

Ephemeral stream - A water conveyance which lacks substrates associated with flowing waters and flows only in direct response to precipitation in the immediate watershed or in response to melting snowpack and which is always above the local water table.

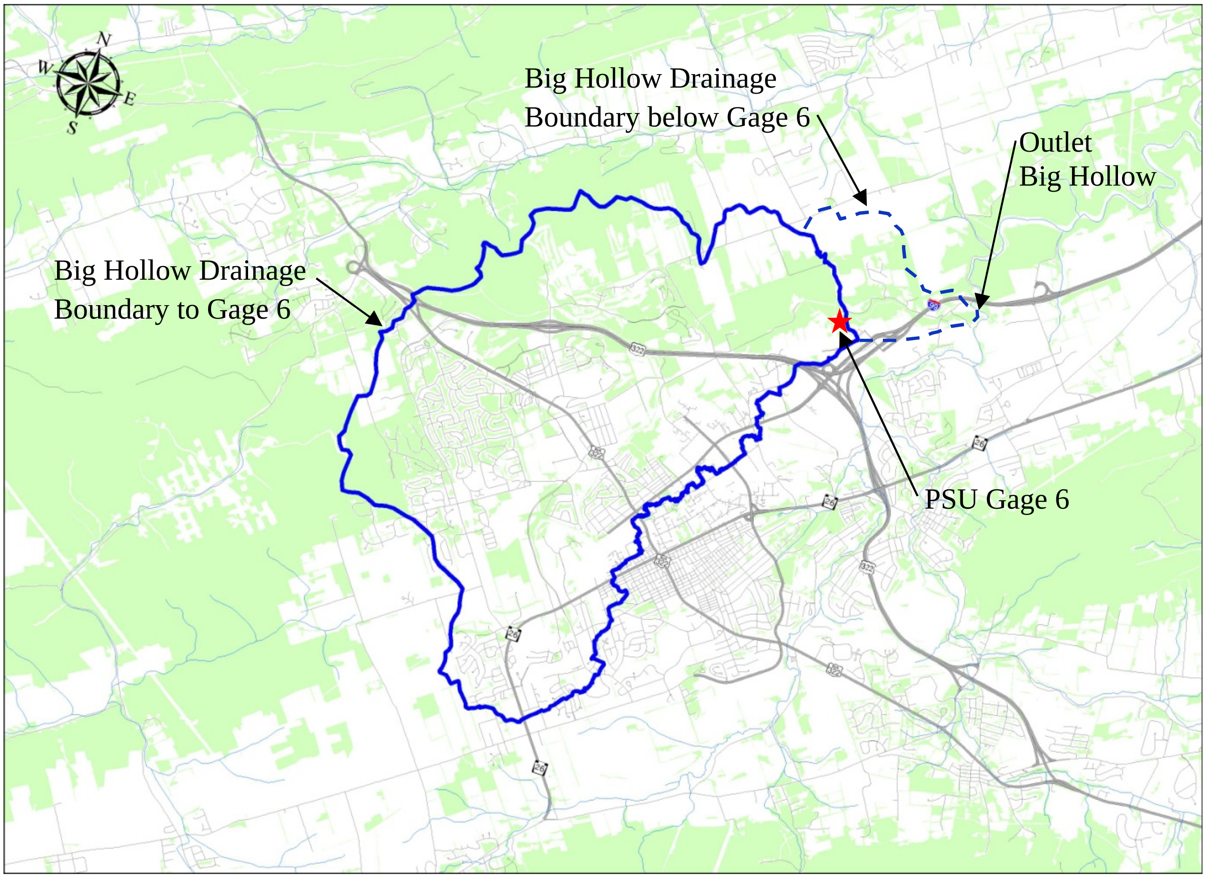

Figure 1. Map of PSU Big Hollow Gage 6 Drainage Area (15.8 sq mi, includes 2.5 sq mi imperviousness)

Figure 2. Big Hollow at Outlet (17.2 sq mi) has no Channel or Bed and Banks

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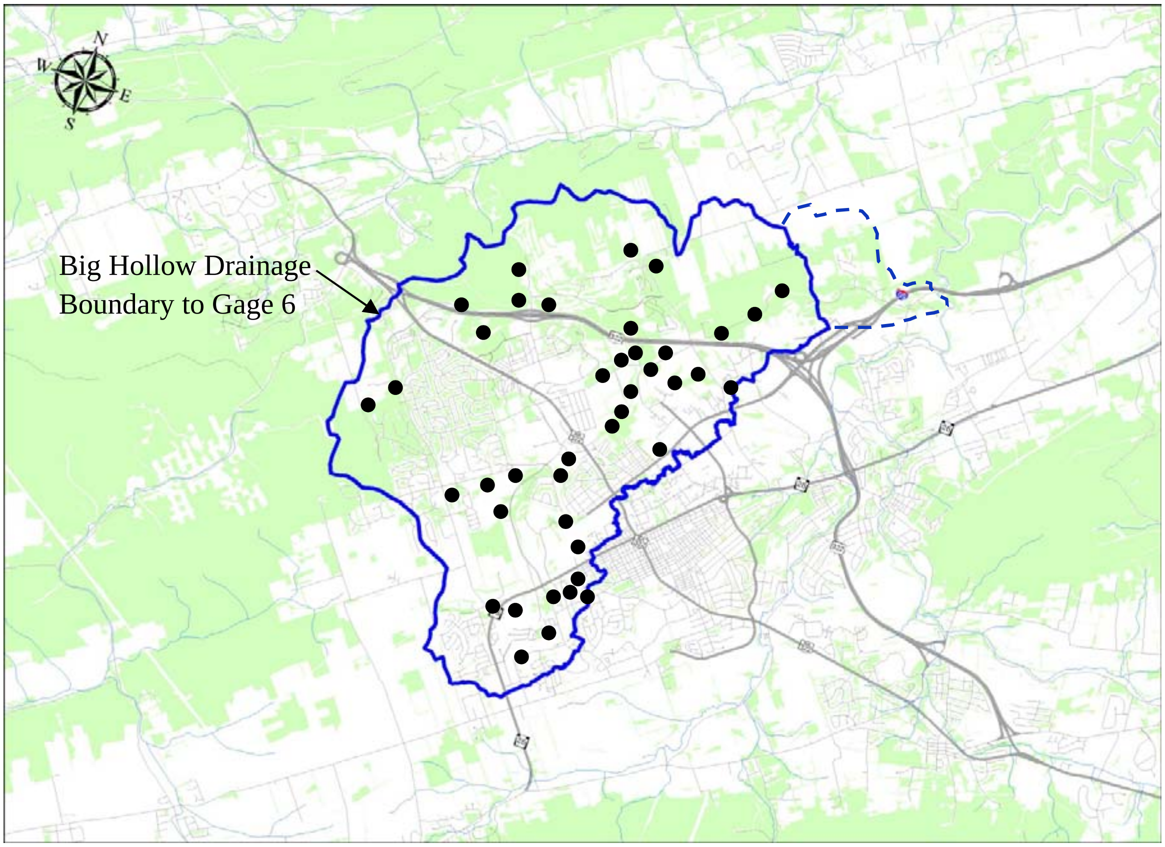

Figure 3. Map of Some of the Significant Sinkholes and Recharge Areas in the Big Hollow

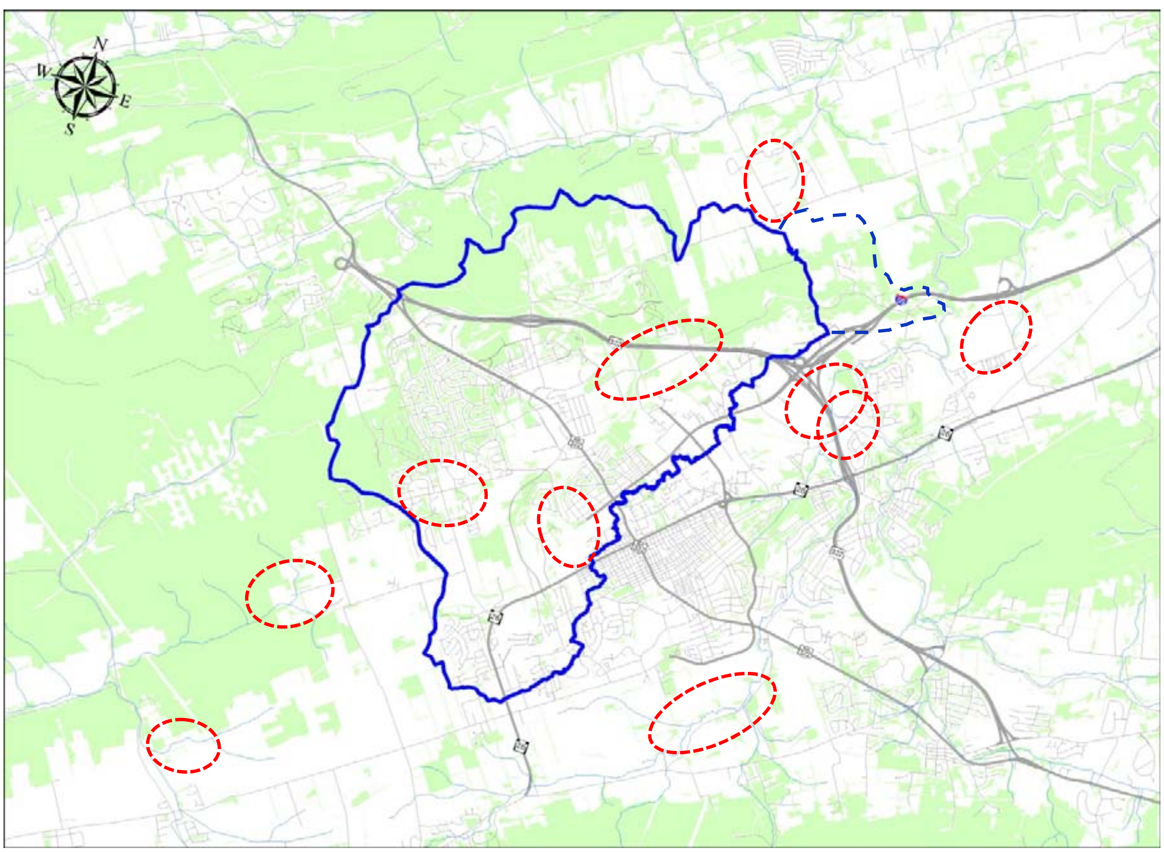

Figure 4. Public Water Wellfields within and around the Big Hollow

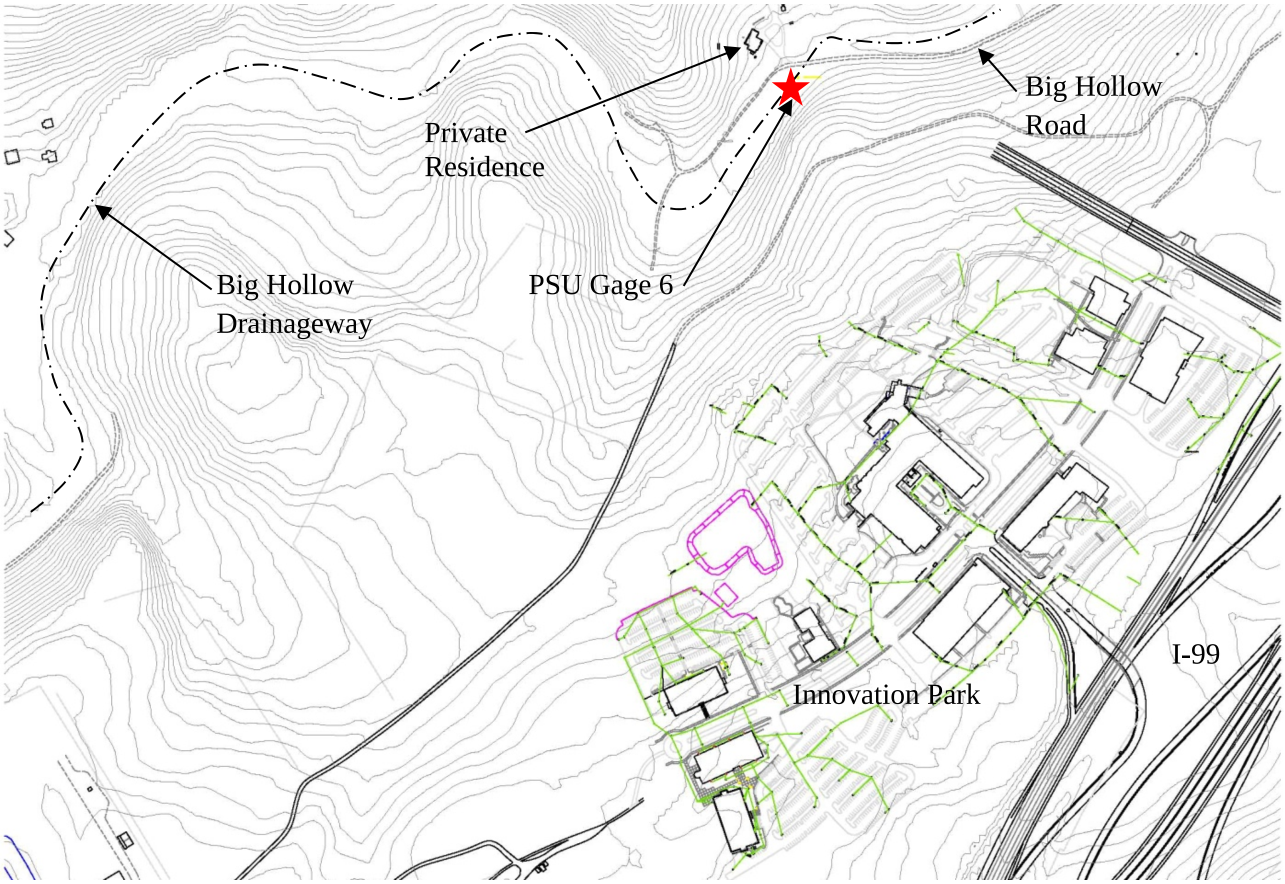

Figure 5. PSU Big Hollow Gage 6 in Relation to Innovation Park

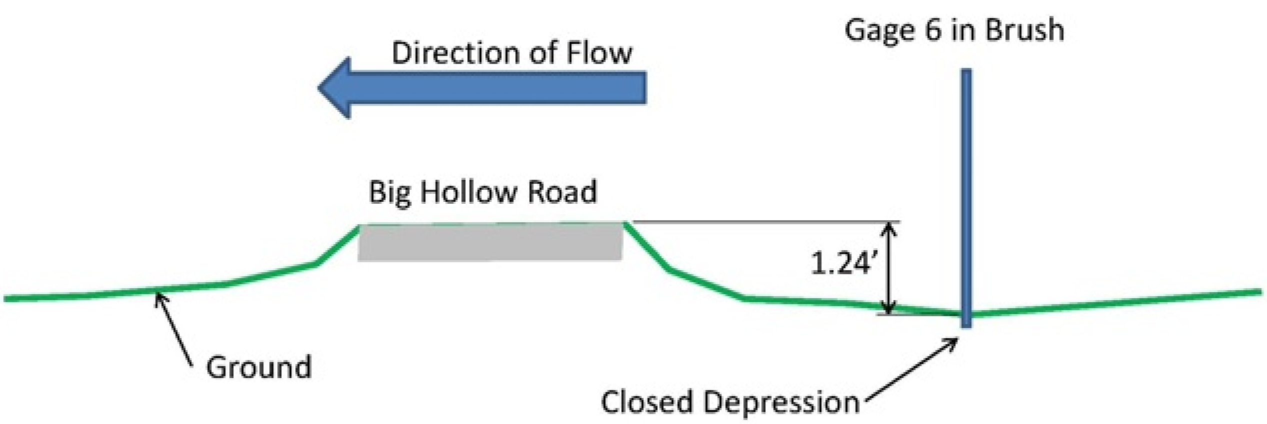

Figure 6. How Gage 6 sits in Relation to the Big Hollow Roadway

Figure 7. Photograph of Roadway Across Big Hollow with No Culvert (Gage 6 is located on the right side)

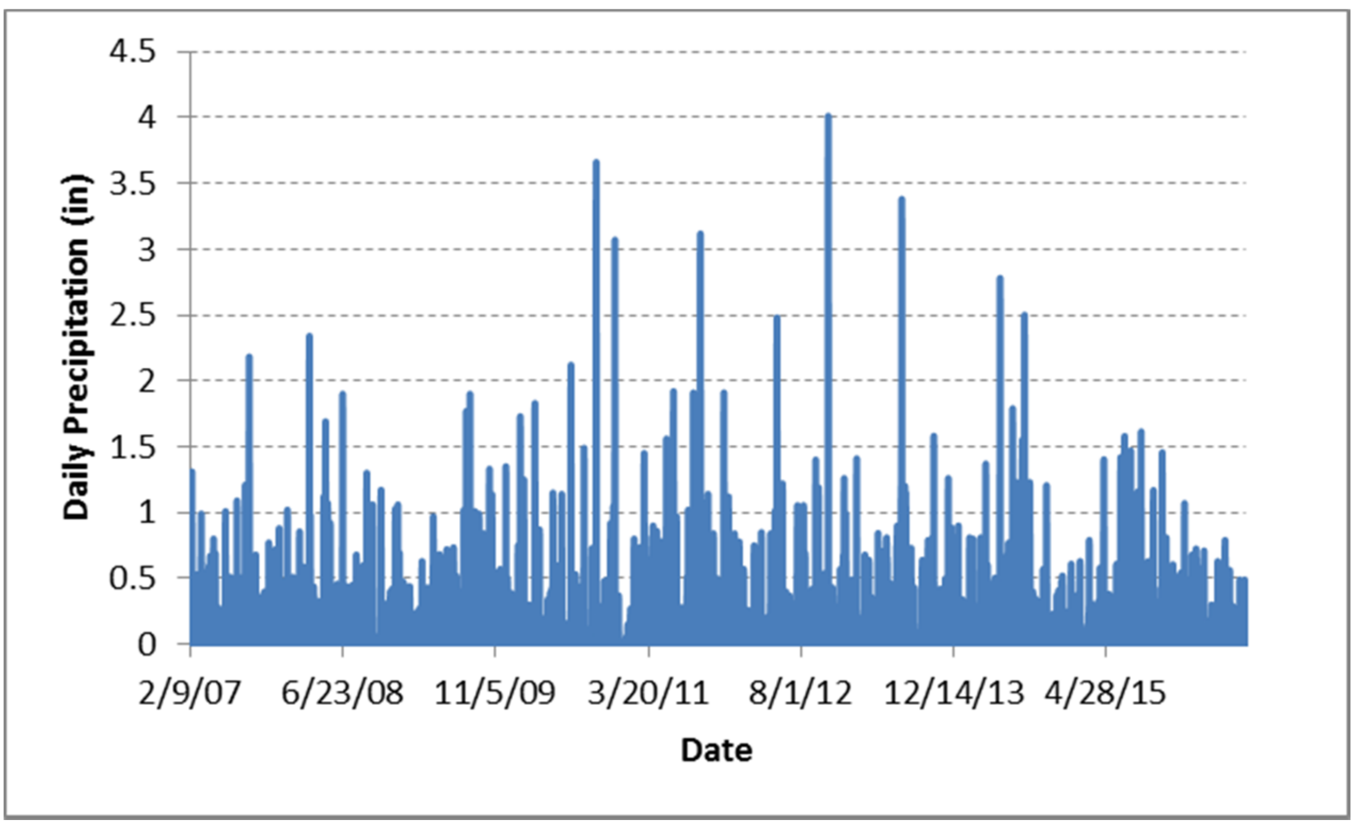

Figure 8. PSU Walker Building Daily Precipitation Data from 2/9/2007 to 7/29/2016

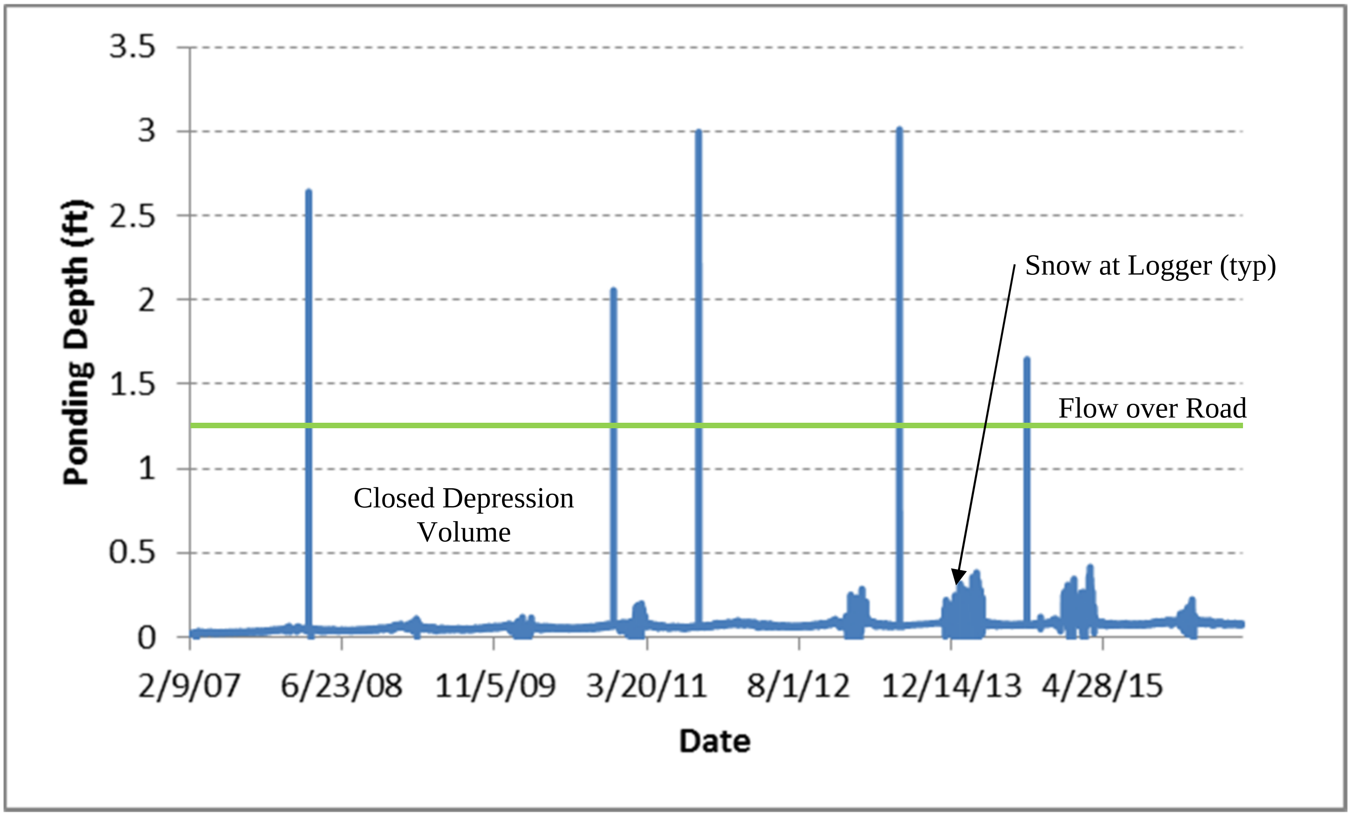

Figure 9. Gage 6 Runoff Data from 2/9/2007 through 7/29/2016

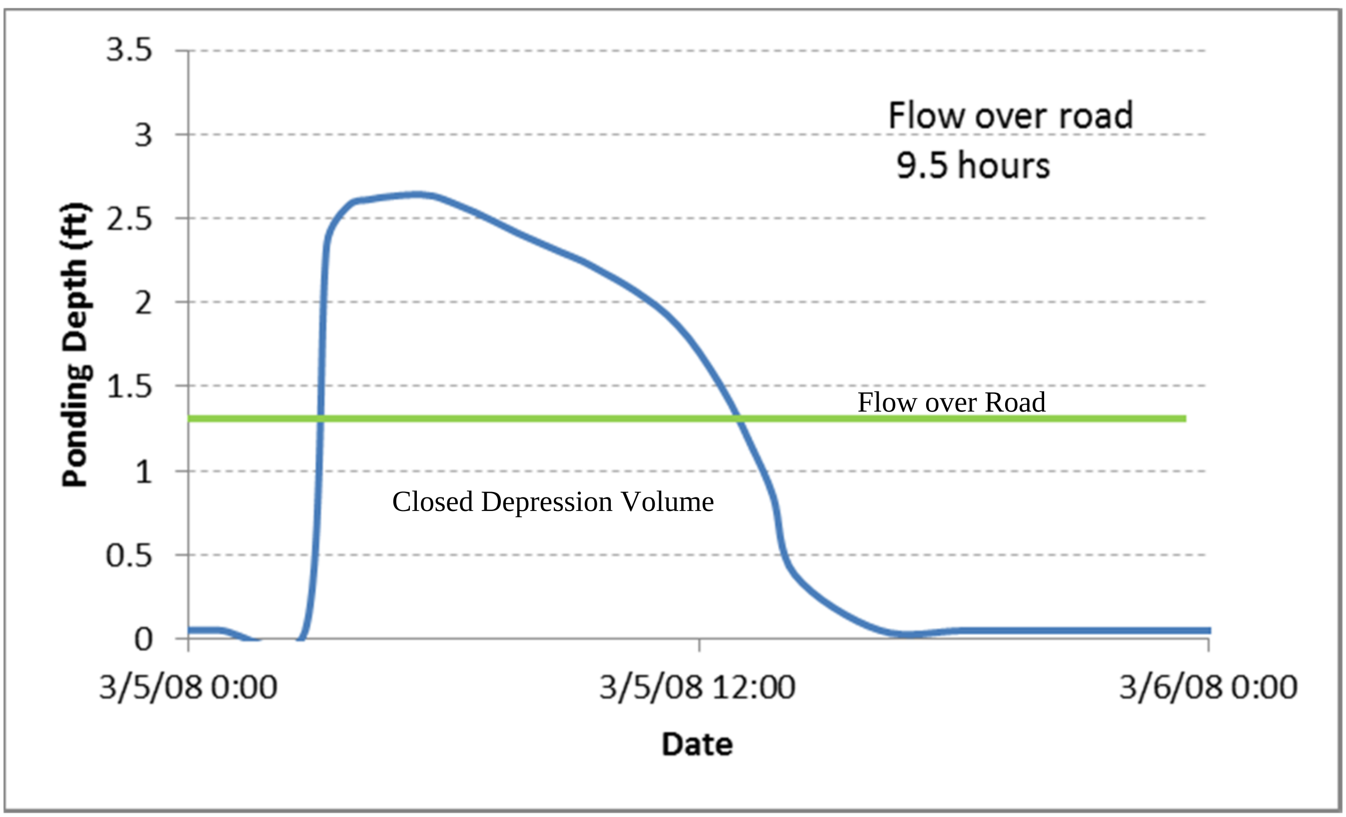

Figure 10. Runoff of March 5, 2008 (2.34” of Rainfall on a 5” snowpack)

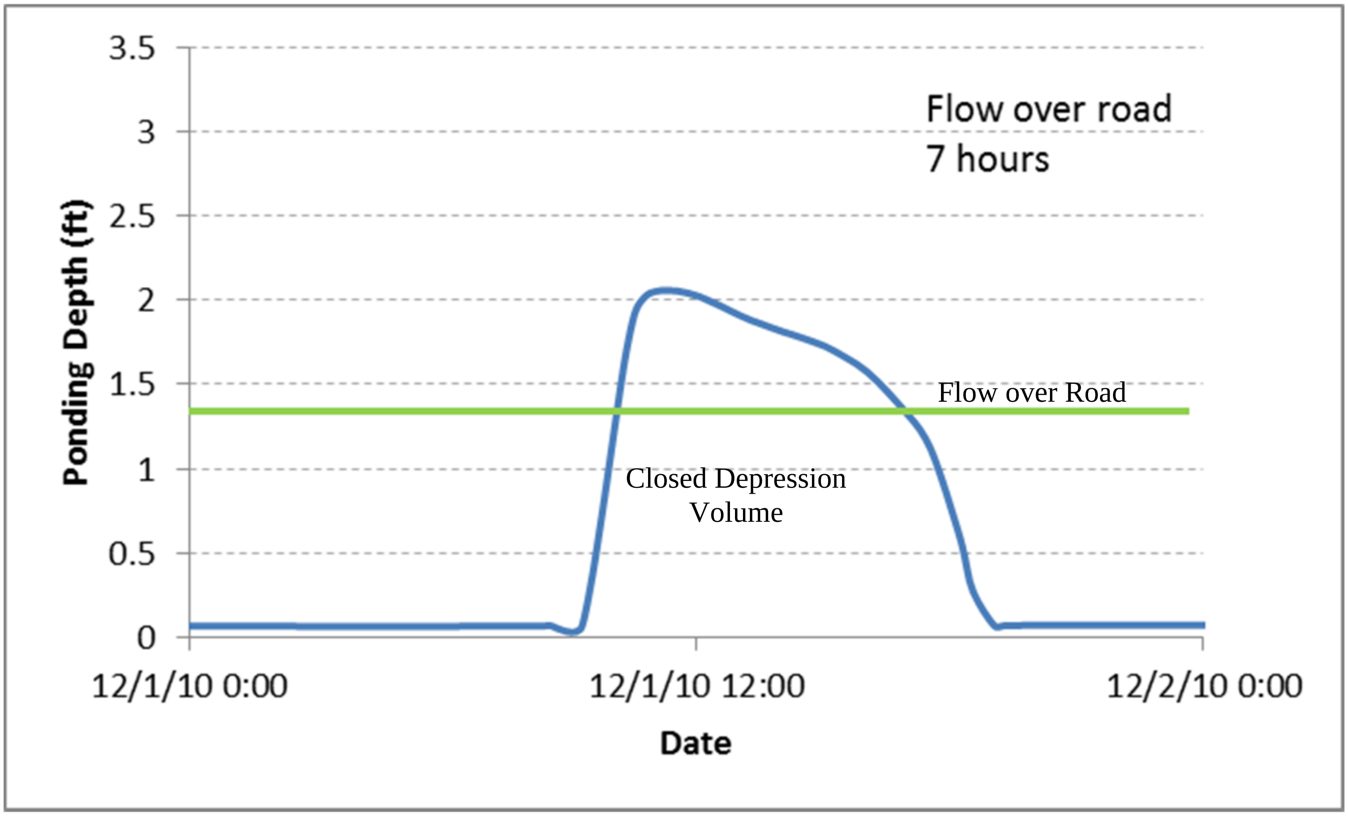

Figure 11. Runoff of December 1, 2010 (3.07” of Rainfall)

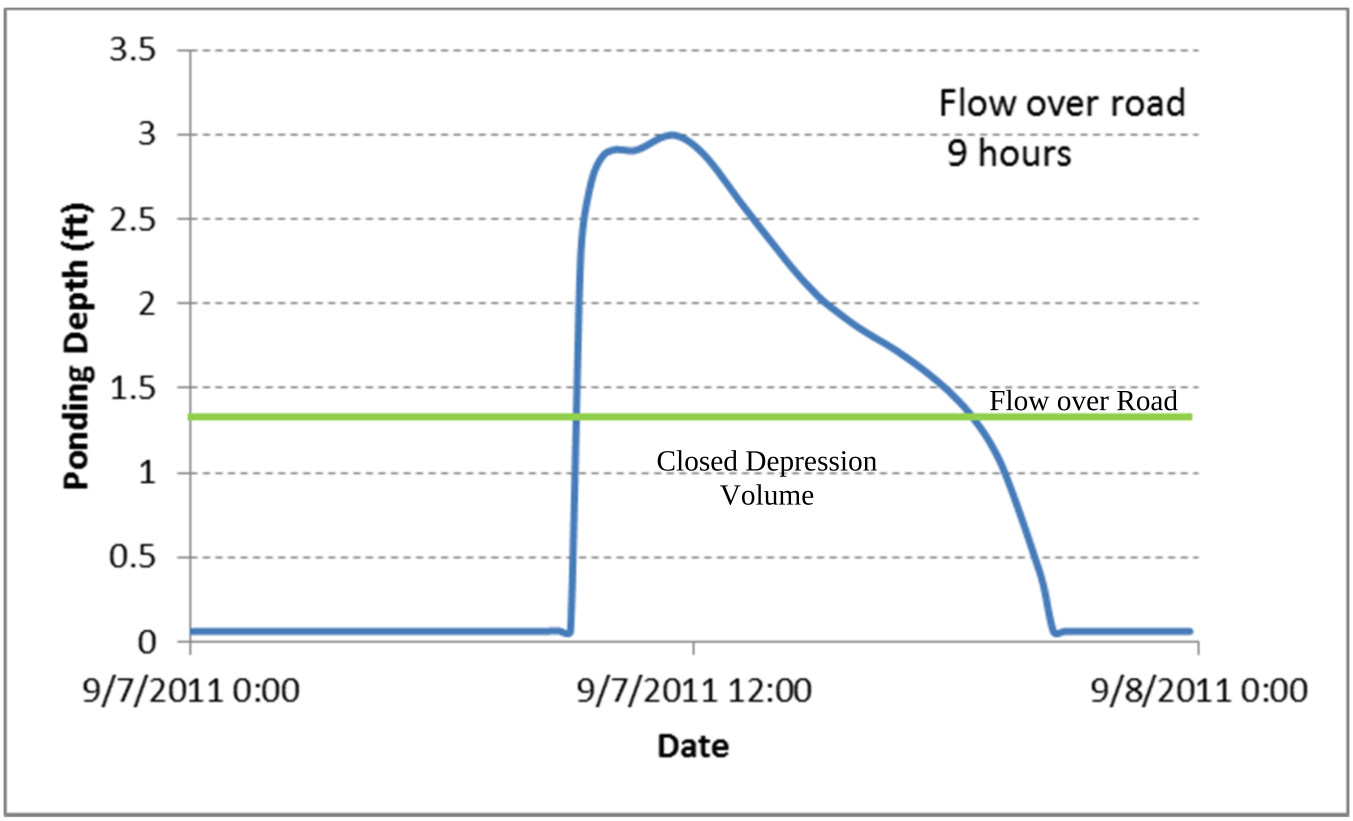

Figure 12. Runoff of September 7, 2011 (3.11” of Rainfall)

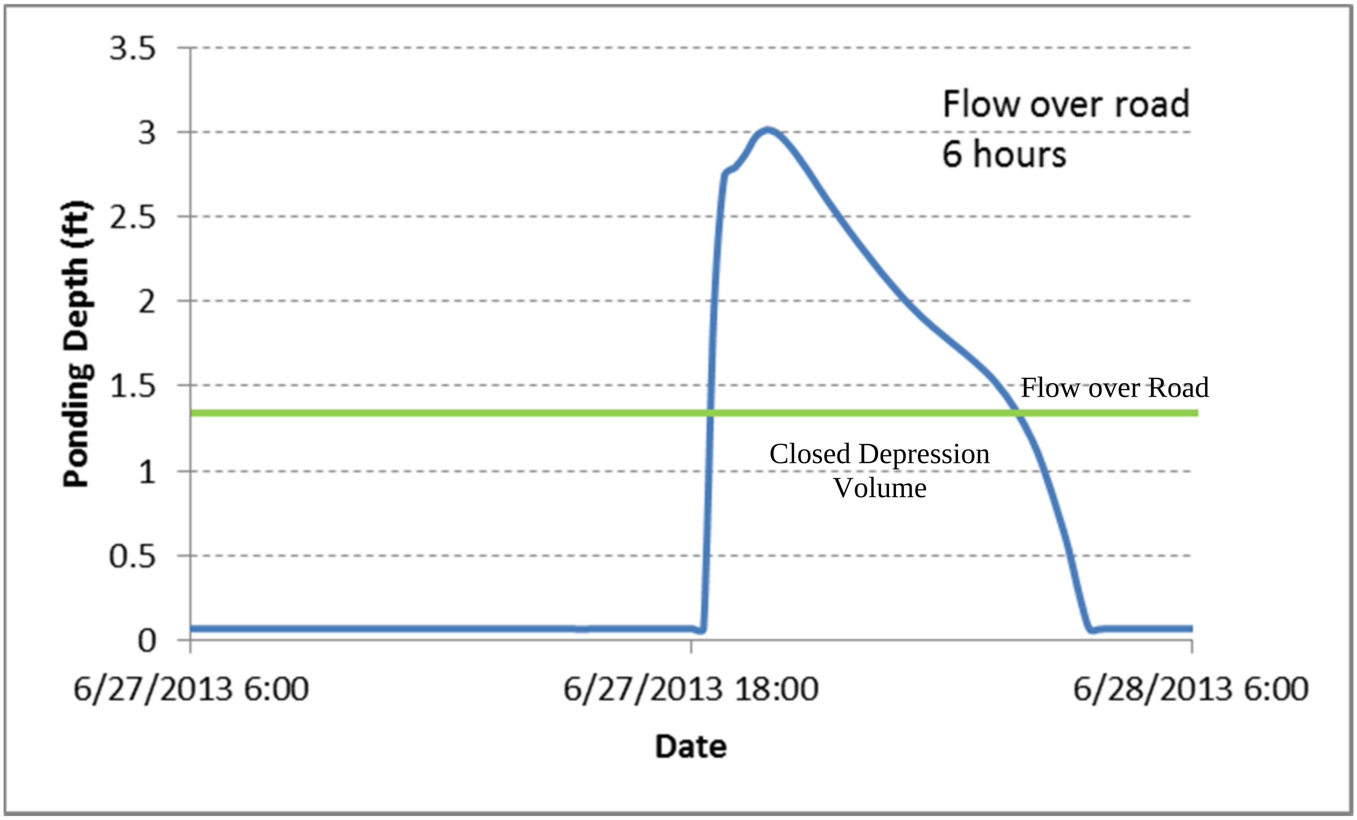

Figure 13. Runoff of June 27, 2013 (3.38” of Rainfall)

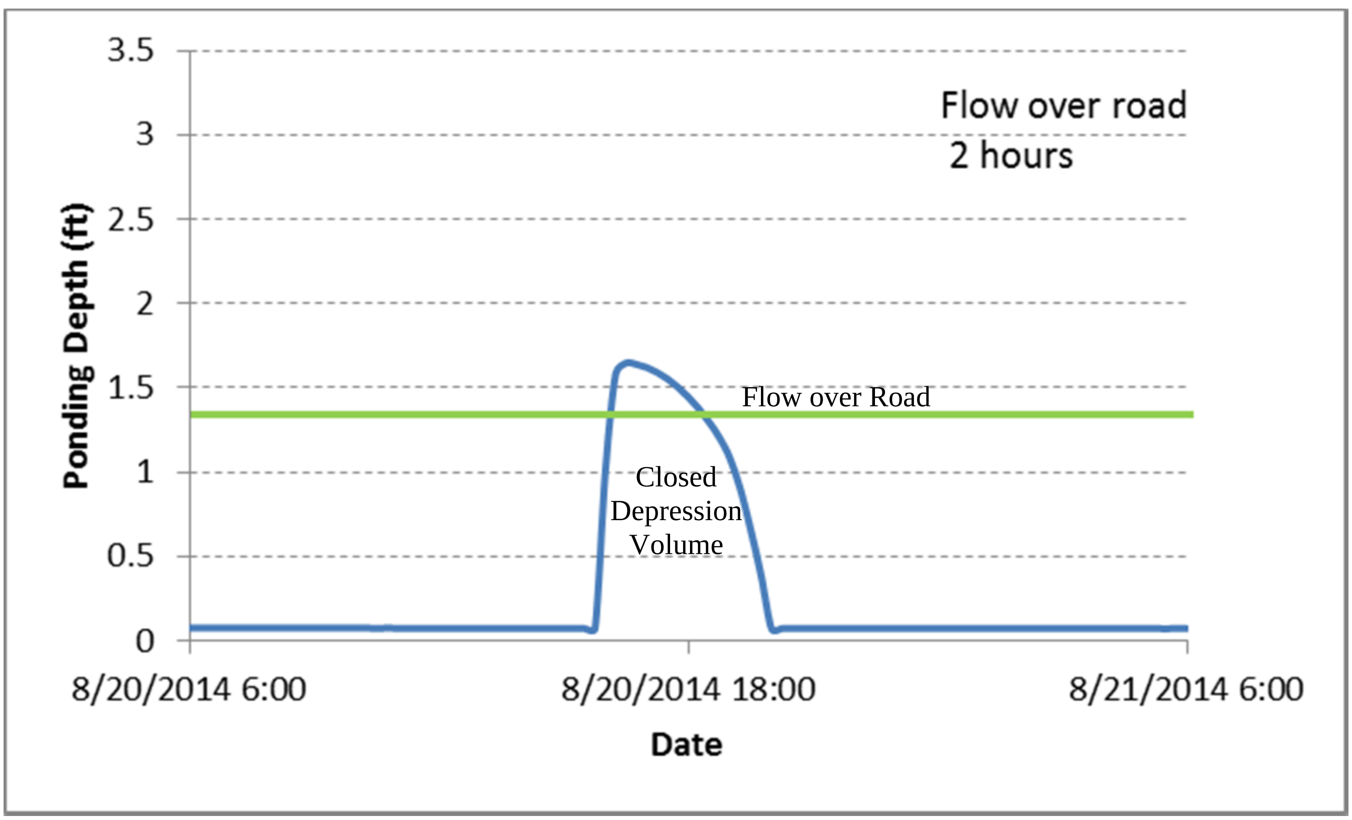

Figure 14. Runoff of August 20, 2014 (1.23” of Rainfall)

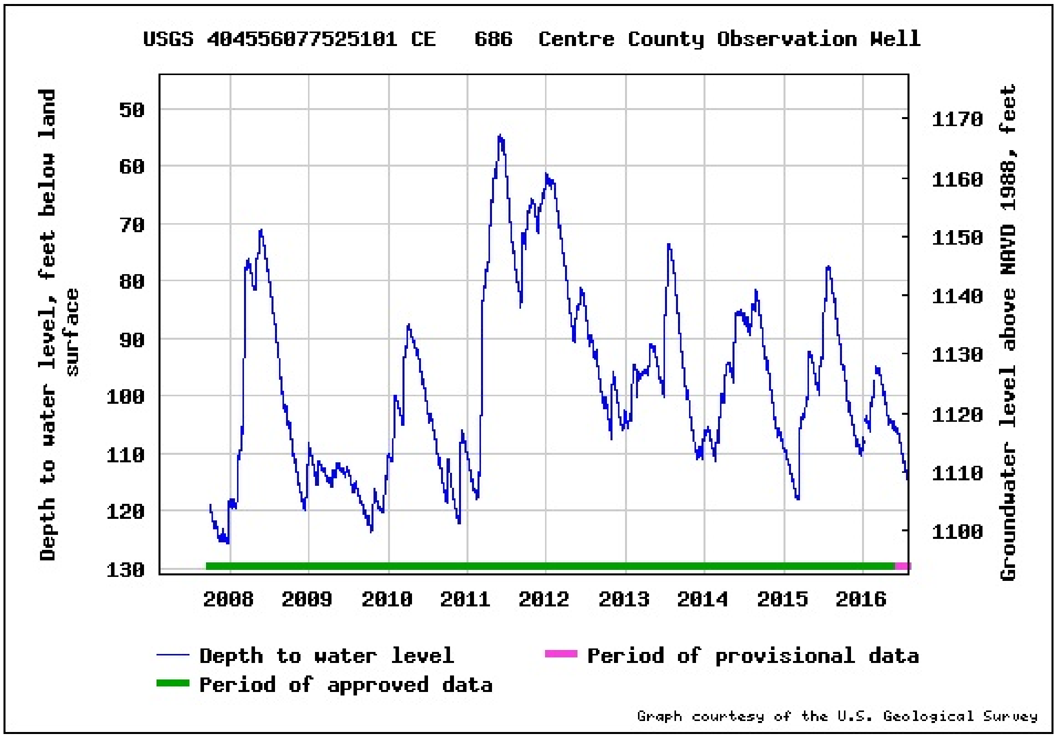

Figure 15. USGS 404556077525101 CE 686 Centre County Observation Well, Ground Elevation 1222.6 ft
Located in the Upper Portion of the Big Hollow

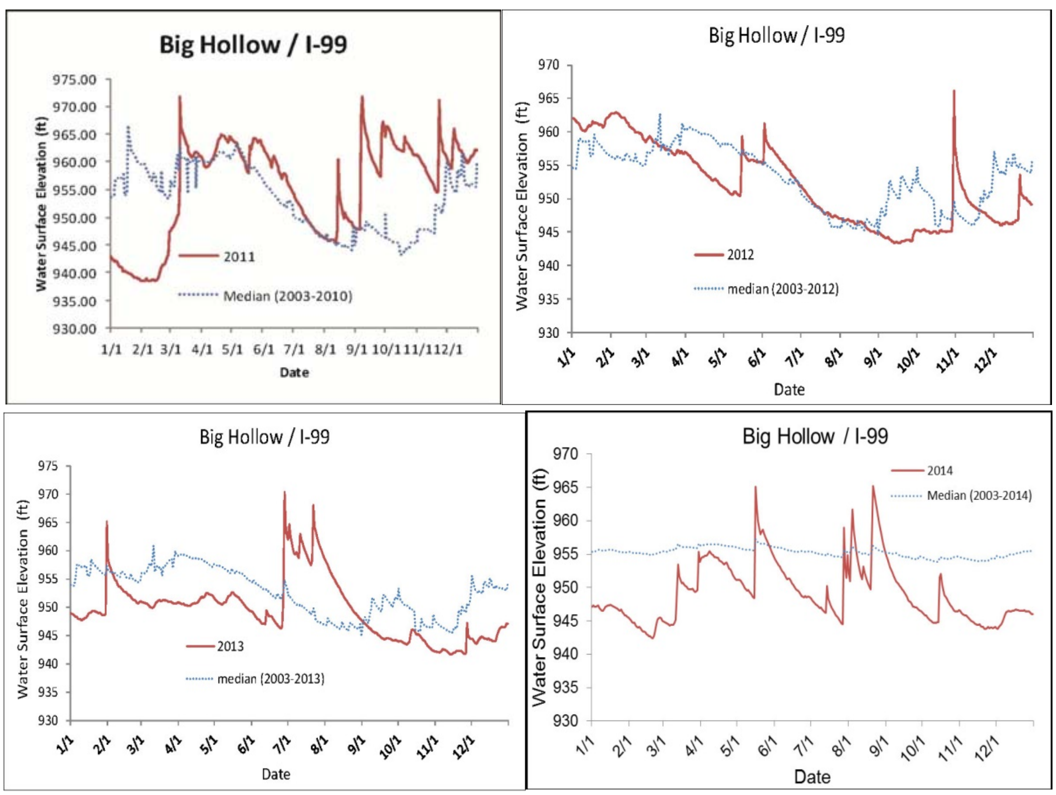

Figure 16. Big Hollow/I-99 Observation Well Collected by the WRMP, Ground Elevation 1010 ft
Located in the Lower Portion of the Big Hollow (Data available from 2003)

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APPENDIX B

Existing Structural BMPs

Newell Tereska & Mackay Engineering

Centre Region MS4 Partners PRP

B.1 Existing Structural BMPs Used for Credit to Reduce Baseload

EXISTING STRUCTURAL BMPS USED AS CREDIT TO REDUCE EXISTING BMP BASELOAD

BMP Identifier	Description of BMP	BMP Type	Longitude	Latitude	Date Installed	Municipality	Watershed	Permit Number
SC 100	Infiltration Basin	RR	-77.85334	40.77372	2005	Borough of State College	Slab Cabin	Unknown
SC 101	Infiltration Basin	RR	-77.85664	40.78319	Unknown*	Borough of State College	Slab Cabin	Unknown
SC 102.1	Rain Garden/ Bioretention	RR	-77.85900	40.78243	2011	Borough of State College	Slab Cabin	Unknown
SC 102.2	Rain Garden/ Bioretention	RR	-77.85797	40.78229	2011	Borough of State College	Slab Cabin	Unknown
SC 102.3	Rain Garden/ Bioretention	RR	-77.85841	40.78237	2011	Borough of State College	Slab Cabin	Unknown
SC 103.1	Rain Garden/ Bioretention	RR	-77.85396	40.79681	2012	Borough of State College	Slab Cabin	Unknown
SC 103.2	Rain Garden/ Bioretention	RR	-77.85463	40.79681	2012	Borough of State College	Slab Cabin	Unknown
SC 104	Underground Detention Piping	RR	-77.83765	40.78377	2012	Borough of State College	Slab Cabin	Unknown
SC 105	Rain Garden/ Bioretention	RR	-77.83616	40.78513	2012	Borough of State College	Slab Cabin	Unknown
SC 108	Infiltration Trench	RR	-77.85714	40.78478	2016	Borough of State College	Slab Cabin	Unknown
SC 109	Infiltration Basin	RR	-77.85256	40.78478	2013	Borough of State College	Slab Cabin	Unknown
SC 110	Stormwater Wetland	ST	-77.85599	40.78622	Unknown*	Borough of State College	Slab Cabin	Unknown
SC 113	Stormwater Wetland	ST	-77.83867	40.80334	Unknown*	Borough of State College	Slab Cabin	Unknown
Street Trees	Street Trees	RR	N/A	N/A	Various	Borough of State College	Big Hollow	Unknown
Street Trees	Street Trees	RR	N/A	N/A	Various	Borough of State College	Slab Cabin	Unknown
PSU-65	Extended Detention Subsurface	ST	-77.85565	40.79978	2003	Penn State University	Slab Cabin	Unknown
PSU-66	Infiltration Trench	RR	-77.85997	40.79941	2003	Penn State University	Slab Cabin	Unknown
PSU-69	Bioswale	RR	-77.85188	40.80293	2005	Penn State University	Slab Cabin	Unknown
PSU-70	Bioswale	RR	-77.85195	40.80313	2005	Penn State University	Slab Cabin	Unknown
PSU-73	Green Roof	RR	-77.86397	40.80465	2006	Penn State University	Big Hollow	Unknown

BMP Identifier	Description of BMP	BMP Type	Longitude	Latitude	Date Installed	Municipality	Watershed	Permit Number
PSU-74	Bioswale	RR	-77.84883	40.80369	2006	Penn State University	Slab Cabin	Unknown
PSU-75	Bioswale	RR	-77.84947	40.80367	2006	Penn State University	Slab Cabin	Unknown
PSU-76	Green Roof	RR	-77.86219	40.80188	2006	Penn State University	Slab Cabin	Unknown
PSU-81	Green Roof	RR	-77.86000	40.80283	2008	Penn State University	Slab Cabin	Unknown
PSU-86	Rainwater Harvesting	RR	-77.86829	40.79989	2010	Penn State University	Big Hollow	Unknown
PSU-88	Rainwater Harvesting	RR	-77.86025	40.80145	2010	Penn State University	Slab Cabin	Unknown
PSU-97	Extended Detention Subsurface	ST	-77.86045	40.79731	2011	Penn State University	Slab Cabin	Unknown
PSU-98	Green Roof	RR	-77.86067	40.79676	2011	Penn State University	Slab Cabin	Unknown
PSU-99	Green Roof	RR	-77.86069	40.79712	2011	Penn State University	Slab Cabin	Unknown
PSU-100	Rainwater Harvesting	RR	-77.86080	40.79694	2011	Penn State University	Slab Cabin	Unknown
PSU-101	Bioswale	RR	-77.86120	40.80292	2011	Penn State University	Slab Cabin	Unknown
PSU-102	Infiltration Trench	RR	-77.86018	40.80032	2012	Penn State University	Slab Cabin	Unknown
PSU-103	Extended Detention Subsurface	ST	-77.85806	40.80468	2012	Penn State University	Slab Cabin	PAS10F106(5)
PSU-106	Extended Detention Subsurface	ST	-77.86480	40.79244	2013	Penn State University	Slab Cabin	Unknown
PSU-107	Bioswale	RR	-77.85972	40.79608	2013	Penn State University	Slab Cabin	PAI-0414-03-017(3)
PSU-108	Extended Detention Subsurface	ST	-77.85557	40.79934	2013	Penn State University	Slab Cabin	PAS10F106(6)R
PSU-109	Rain Garden	RR	-77.85632	40.79928	2013	Penn State University	Slab Cabin	PAS10F106(6)R
PSU-110	Rain Garden	RR	-77.85702	40.79930	2013	Penn State University	Slab Cabin	PAS10F106(6)R
PSU-111	Rain Garden	RR	-77.85677	40.79951	2013	Penn State University	Slab Cabin	PAS10F106(6)R
PSU-112	Rain Garden	RR	-77.85531	40.79990	2013	Penn State University	Slab Cabin	PAS10F106(6)R
PSU-113	Rain Garden	RR	-77.85603	40.80024	2013	Penn State University	Slab Cabin	PAS10F106(6)R
PSU-114	Rain Garden	RR	-77.85578	40.80045	2013	Penn State University	Slab Cabin	PAS10F106(6)R

BMP Identifier	Description of BMP	BMP Type	Longitude	Latitude	Date Installed	Municipality	Watershed	Permit Number
PSU-116	Rain Garden	RR	-77.85641	40.79869	2013	Penn State University	Slab Cabin	PAS10F106(6)R
PSU-117	Rain Garden	RR	-77.85699	40.79871	2013	Penn State University	Slab Cabin	PAS10F106(6)R
PSU-118	Rain Garden	RR	-77.85665	40.79887	2013	Penn State University	Slab Cabin	PAS10F106(6)R
PSU-119	Rain Garden	RR	-77.85476	40.79991	2013	Penn State University	Slab Cabin	PAS10F106(6)R
PSU-120	Rain Garden	RR	-77.85446	40.80011	2013	Penn State University	Slab Cabin	PAS10F106(6)R
PSU-123	Rain Garden	RR	-77.85484	40.80039	2013	Penn State University	Slab Cabin	PAS10F106(6)R
PSU-124	Rain Garden	RR	-77.86019	40.80748	2014	Penn State University	Big Hollow	PAG2-0014-12-015
PSU-128	Green Roof	RR	-77.86032	40.79853	2014	Penn State University	Slab Cabin	PAI-0414-03-017(3)
PSU-143	Extended Detention Subsurface	ST	-77.86491	40.79885	2015	Penn State University	Slab Cabin	PAI-04-0014-15-006
PSU-145	Extended Detention Subsurface	ST	-77.86587	40.80149	2016	Penn State University	Big Hollow	PAG-02-0014-15-021
PSU-147	Pervious Pavement	RR	-77.86746	40.80177	2016	Penn State University	Big Hollow	Unknown
PSU-149	Extended Detention Subsurface	ST	-77.85991	40.80819	2016	Penn State University	Big Hollow	Unknown
PT066.01	Infiltration Basin	RR	-77.88920	40.82170	2016	Patton Township	Big Hollow	PARF10146R-2
PT038.01	Infiltration Basin	RR	-77.88510	40.82110	2015	Patton Township	Big Hollow	Unknown
PT039.02	Infiltration Basin	RR	-77.88230	40.82500	2014/2015	Patton Township	Big Hollow	Unknown
PT010.13	Infiltration Trench/Device	RR	-77.90450	40.80860	2016	Patton Township	Big Hollow	Unknown
PT010.05	Infiltration Basin	RR	-77.90180	40.80980	2009/2010	Patton Township	Big Hollow	Unknown
PT010.04	Detention Basin	ST	-77.90110	40.80950	2009/2010	Patton Township	Big Hollow	Unknown
PT032.06	Infiltration Basin	RR	-77.89020	40.81990	2006/2007	Patton Township	Big Hollow	Unknown
PT001.02	Retention Basin	ST	-77.92610	40.81320	2006/2007	Patton Township	Big Hollow	Unknown
PT001.03	Infiltration Basin	RR	-77.92550	40.81290	2006/2007	Patton Township	Big Hollow	Unknown
PT001.04	Retention Basin	ST	-77.92450	40.81240	2006/2007	Patton Township	Big Hollow	Unknown
PT001.05	Retention Basin	ST	-77.92400	40.81220	2006/2007	Patton Township	Big Hollow	Unknown

BMP Identifier	Description of BMP	BMP Type	Longitude	Latitude	Date Installed	Municipality	Watershed	Permit Number
PT001.06	Retention Basin	ST	-77.92340	40.81170	2006/2007	Patton Township	Big Hollow	Unknown
PT007.01	Infiltration Basin	RR	-77.91370	40.81130	2005/2006	Patton Township	Big Hollow	Unknown
PT047.01	Infiltration Basin	RR	-77.88150	40.83230	2005	Patton Township	Big Hollow	Unknown
PT039.01	Infiltration Basin	RR	-77.88050	40.82350	2004/2005	Patton Township	Big Hollow	Unknown
PT009.02	Infiltration Basin	RR	-77.90910	40.80930	2004/2005	Patton Township	Big Hollow	Unknown
PT010.12	Detention Basin	ST	-77.90710	40.80920	2004/2005	Patton Township	Big Hollow	Unknown
PT033.02	Detention Basin	ST	-77.89270	40.81310	Unknown*	Patton Township	Big Hollow	Unknown
PT032.07	Detention Basin	ST	-77.88620	40.81890	2003/2004	Patton Township	Big Hollow	Unknown
PT002.01	Detention Basin	ST	-77.92040	40.81290	2003	Patton Township	Big Hollow	Unknown
PT032.03	Detention Basin	ST	-77.89440	40.81960	2003	Patton Township	Big Hollow	Unknown
PT014.01	Detention Basin	RR	-77.90080	40.80450	2003	Patton Township	Big Hollow	Unknown
H23	Infiltration Basin	RR	-77.78896	40.77940	2008	Harris Township	Spring Creek	Unknown
H3	Infiltration Basin	RR	-77.78647	40.77534	2005	Harris Township	Spring Creek	Unknown
H24	Infiltration Basin	RR	-77.76885	40.78550	2013	Harris Township	Spring Creek	Unknown
H13	Infiltration Basin	RR	-77.77763	40.77757	2010	Harris Township	Spring Creek	Unknown
H12	Infiltration Basin	RR	-77.77358	40.77824	2010	Harris Township	Spring Creek	Unknown
H21	Infiltration Basin	RR	-77.76542	40.78058	2007	Harris Township	Spring Creek	Unknown
Street Trees	Street Trees	RR	N/A	N/A	N/A	Harris Township	Spring Creek	Unknown
FT3	Infiltration Basin	RR	-77.89446	40.77944	2014	Ferguson Township	Big Hollow	Unknown
FT9.02	Infiltration Basin	RR	-77.88460	40.80102	2015	Ferguson Township	Big Hollow	Unknown
FT33	Infiltration Basin	RR	-77.89223	40.80578	2014	Ferguson Township	Big Hollow	Unknown
FT34	Infiltration Trench	RR	-77.88517	40.80475	2013	Ferguson Township	Big Hollow	Unknown
FT39	Rain Garden	RR	-77.90151	40.78238	2013	Ferguson Township	Big Hollow	Unknown
FT1.02	Detention Basin	RR	-77.89427	40.80423	2006	Ferguson Township	Big Hollow	Unknown
FT8	Retention Basin	ST	-77.86817	40.76939	2006	Ferguson Township	Slab Cabin	Unknown
FT11.01	Bioretention	RR	-77.89204	40.80629	2008	Ferguson Township	Big Hollow	Unknown
FT11.02	Special Detention	ST	-77.89200	40.80627	2008	Ferguson Township	Big Hollow	Unknown
FT17	Infiltration Trench	RR	-77.88588	40.80517	2012	Ferguson Township	Big Hollow	Unknown

BMP Identifier	Description of BMP	BMP Type	Longitude	Latitude	Date Installed	Municipality	Watershed	Permit Number
FT18.01	Infiltration Basin	RR	-77.88656	40.80391	2010	Ferguson Township	Big Hollow	Unknown
FT18.02	Infiltration Trench	RR	-77.88603	40.80353	2010	Ferguson Township	Big Hollow	Unknown
FT22.01	Infiltration Trench	RR	-77.90151	40.78536	2005	Ferguson Township	Big Hollow	Unknown
FT22.02	Infiltration Trench	RR	-77.90098	40.78561	2005	Ferguson Township	Big Hollow	Unknown
FT36	Retention Basin	RR	-77.90003	40.77933	2005	Ferguson Township	Big Hollow	Unknown
FT41	Infiltration Basin	RR	-77.90050	40.78404	Unknown*	Ferguson Township	Big Hollow	Unknown
FT46	Retention Basin	RR	-77.90219	40.78303	2006	Ferguson Township	Big Hollow	Unknown
FT48.01	Retention Basin	RR	-77.87426	40.74403	2006	Ferguson Township	Slab Cabin	Unknown
FT48.02	Retention Basin	RR	-77.87406	40.74297	2006	Ferguson Township	Slab Cabin	Unknown
FT48.04	Retention Basin	RR	-77.87553	40.74027	2006	Ferguson Township	Slab Cabin	Unknown
FT54.05	Infiltration Trench	RR	-77.89480	40.75010	2012	Ferguson Township	Slab Cabin	Unknown
FT54.09	Infiltration Trench	RR	-77.88233	40.75755	2012	Ferguson Township	Slab Cabin	Unknown
FT61.01	Infiltration Trench	RR	-77.88988	40.80734	2005	Ferguson Township	Big Hollow	Unknown
FT61.03	Infiltration Trench	RR	-77.89081	40.80743	2005	Ferguson Township	Big Hollow	Unknown
FT61.04	Infiltration Trench	RR	-77.89052	40.80719	2005	Ferguson Township	Big Hollow	Unknown
FT37	Rain Garden	RR	-77.90226	40.78181	Unknown*	Ferguson Township	Big Hollow	Unknown
FT50.01	Infiltration Basin	RR	-77.89190	40.80329	2012	Ferguson Township	Big Hollow	Unknown
FT51.02	Infiltration Basin	RR	-77.89767	40.79120	2016	Ferguson Township	Big Hollow	Unknown
FT51.03	Infiltration Basin	RR	-77.89364	40.79074	2016	Ferguson Township	Big Hollow	Unknown
FT51.04	Infiltration Basin	RR	-77.89354	40.78917	2016	Ferguson Township	Big Hollow	Unknown
FT51.05	Infiltration Basin	RR	-77.89501	40.78667	2016	Ferguson Township	Big Hollow	Unknown
Street Trees	Street Trees	RR	N/A	N/A	N/A	Ferguson Township	Big Hollow	Unknown
Street Trees	Street Trees	RR	N/A	N/A	N/A	Ferguson Township	Slab Cabin	Unknown
Street Trees	Street Trees	RR	N/A	N/A	N/A	Ferguson Township	Slab Cabin	Unknown
C128	Underdrained Basin	RR	-77.82008	40.78367	2005	College Township	Slab Cabin	Unknown
C131	Infiltration Basin	RR	-77.85206	40.78390	2012	College Township	Slab Cabin	Unknown
C132	Infiltration Basin	RR	-77.84992	40.78105	2012	College Township	Slab Cabin	Unknown
C14	Infiltration Basin	RR	-77.81213	40.83379	2013	College Township	Spring Creek	Unknown

BMP Identifier	Description of BMP	BMP Type	Longitude	Latitude	Date Installed	Municipality	Watershed	Permit Number
C20	Detention Basin	ST	-77.81502	40.83182	Unknown*	College Township	Spring Creek	Unknown
C21	Detention Basin	ST	-77.80461	40.83867	2004	College Township	Spring Creek	Unknown
C24	Infiltration Basin	RR	-77.82598	40.83266	2005	College Township	Spring Creek	Unknown
C35	Infiltration Basin	RR	-77.82941	40.80369	2004	College Township	Slab Cabin	Unknown
C36	Infiltration Basin	RR	-77.80721	40.82033	2006	College Township	Spring Creek	Unknown
C38	Underdrained Basin	RR	-77.80925	40.82059	2006	College Township	Spring Creek	Unknown
C4	Detention Basin	ST	-77.82108	40.82058	2005	College Township	Spring Creek	Unknown
C40	Infiltration Basin	RR	-77.83678	40.80232	2003	College Township	Slab Cabin	Unknown
C45	Infiltration Basin	RR	-77.82297	40.83019	2005	College Township	Spring Creek	Unknown
C46	Infiltration Basin	RR	-77.82517	40.83319	2005	College Township	Spring Creek	Unknown
C5	Detention Basin	ST	-77.82189	40.81961	2005	College Township	Spring Creek	Unknown
C63	Infiltration Basin	RR	-77.80832	40.83462	2005	College Township	Spring Creek	Unknown
C64	Underdrained Basin	RR	-77.80989	40.83197	2005	College Township	Spring Creek	Unknown
C70	Infiltration Basin	RR	-77.80240	40.78686	2005	College Township	Spring Creek	Unknown
C71	Infiltration Basin	RR	-77.80360	40.78919	2005	College Township	Spring Creek	Unknown
C76	Underdrained Basin	RR	-77.80839	40.81875	2006	College Township	Spring Creek	Unknown
C87	Infiltration Basin	RR	-77.81440	40.81992	2014	College Township	Spring Creek	Unknown
C88	Infiltration Basin	RR	-77.81484	40.82053	2014	College Township	Spring Creek	Unknown
C90	Infiltration Basin	RR	-77.80377	40.83641	2014	College Township	Spring Creek	Unknown
C91	Infiltration Basin	RR	-77.80467	40.83708	2014	College Township	Spring Creek	Unknown
C96	Infiltration Basin	RR	-77.80335	40.83789	2013	College Township	Spring Creek	Unknown
Street Trees	Street Trees	RR	N/A	N/A	Various	College Township	Slab Cabin	Unknown
Street Trees	Street Trees	RR	N/A	N/A	Various	College Township	Spring Creek	Unknown

* Exact construction date unknown, but after enactment of water quality and volume control ordinances.

Centre Region MS4 Partners PRP

B.2 BMP – O&M Descriptions

BMP – O&M DESCRIPTIONS

The following are general operation and maintenance activities that are required for the BMPs that the MS4 Partners have used for pollution load reduction credit. Many of the BMPs are privately owned, however, they are routinely maintained. Each individual Centre Region MS4 Partner has an enforceable inspection program. As part of this program, the municipal partner can request the annual inspection reports for the BMPs. If the BMP is not being maintained properly the municipal partner can take enforcement action.

I. PERVIOUS PAVEMENT

- Vacuum pavement two (2) or three (3) times per year.
- Maintain planted areas adjacent to pavement.
- Immediately clean any soil deposited on pavement.
- Do not allow construction staging, soil/mulch storage, etc. on unprotected pavement surface.
- Clean inlets draining to the subsurface bed two (2) times per year.
- Abrasives such as sand or cinders should not be applied on or adjacent to the pervious pavement during Winter maintenance.

II. INFILTRATION BASIN

- Catch basins and inlets (up-gradient of infiltration basin) should be inspected and cleaned at least two (2) times per year and after runoff events.
- The vegetation along the surface of the infiltration basin should be maintained in good condition and any bare spots revegetated as soon as possible.
- Vehicles should not be parked or driven on an infiltration basin and care should be taken to avoid excessive compaction by mowers.
- Inspect the basin after runoff events and make sure that runoff drains down within seventy-two (72) hours.
- Inspect for accumulation of sediment, damage to outlet control structures, erosion control measures, signs of water contamination/spills, and slope stability of berms.
- Mow only as appropriate for vegetative cover species.
- Removed accumulated sediment from basin as required. Restore original cross section and infiltration rate. Properly dispose of sediment.

III. UNDERGROUND DETENTION PIPING/ SUBSURFACE EXTENDED DETENTION

- Inspect accessible subsurface structures (i.e. inlet and outlet structures, and cleanouts) for clogging, excessive debris, and sediment accumulation.
- Inspect for standing water within subsurface drainage facility and check for drain down time to ensure proper functionality.

IV. INFILTRATION TRENCH

- Regularly inspect to ensure adequate infiltration.
- Regularly inspect structural components (i.e. energy dissipator, inlet structure) to ensure they are functioning properly.
- Periodically trim plants to ensure their growth does not impede the flow of water through the structure.
- Remove invasive plants as necessary.
- Routinely remove accumulated trash and debris.
- Avoid running heavy equipment in the trenches to prevent soil compaction.
- Do not apply chemical pesticides or fertilizers to turf in and around infiltration structures.

V. RAIN GARDEN/BIORETENTION

- While vegetation is being established, pruning and weeding may be required.
- Detritus may also need to be removed every year. Perennial plants may be cut down at the end of the growing season.
- Mulch should be re-spread when erosion is evident and be replenished as needed. Once every two (2) to three (3) years, the entire area may require mulch replacement.
- Bioretention areas should be inspected at least two (2) times per year for sediment buildup, erosion, vegetative conditions, etc.
- During periods of extended drought, bioretention areas may require watering.
- Trees and shrubs should be inspected two (2) times per year to evaluate health.

VI. STREET TREES

- Initial maintenance routine should be completed for the initial two (2) to three (3) years of growth and may be necessary for up to five (5) years until tree growth and tree canopy begins to form.
- Properly stake and support trees during the first two (2) years after planting.
- Inspect trees at the beginning and end of the growing season to evaluate health.
- Prune any dead limbs and remove any weeds from around the tree trunk.
- During drought periods, watering may be required.

VII. CONSTRUCTED WETLAND/STORMWATER WETLAND

- During first growing season, vegetation should be inspected every two (2) to three (3) weeks.
- During the first two (2) years, constructed wetlands should be inspected at least four (4) times per year and after major storm events (> 2 inches in 24 hours).
- Inspections should assess the vegetation, erosion, flow channelization, bank stability, inlet/outlet conditions, and sediment/debris accumulation.

- Remove invasive plants as necessary.
- Remove any excessive amounts of accumulated sediment.
- Once established, inspections should be performed semiannually and after major storm events as well as rapid ice breakup.
- Vegetation should maintain at least an eighty-five percent (85%) cover of the emergent vegetation zone.
- Sediment should be removed from the forebay before it occupies fifty percent (50%) of the forebay, typically every three (3) to seven (7) years.

VIII. BIOSWALE

- Maintenance activities shall be completed annually and within forty-eight (48) hours after every major storm event (> 1 inch of rainfall).
- Inspect and correct erosion problems, damage to vegetation, and sediment and debris accumulation (address when > 3 inches at any spot or covering vegetation).
- Inspect vegetation on side slopes for erosion and formation of rills or gullies, correct as needed.
- Inspect for pools of standing water; dewater and discharge to an approved location and restore the design grade.
- Mow and trim vegetation to ensure safety, aesthetics, proper swale operation, or to suppress weeds and invasive vegetation. Mow only when swale is dry to avoid rutting.
- Inspect for litter and remove prior to mowing.
- Inspect for uniformity in cross section and longitudinal slope, correct as needed.
- Inspect swale inlet (curb cuts, pipes, etc.).

IX. GREEN ROOF

- During the plant establishment period, periodic irrigation may be required.
- During the plant establishment period, three (3) to four (4) visits to conduct basic weeding, fertilization, and in-fill planting is recommended. Thereafter, only two (2) annual visits for inspection and light weeding should be needed (irrigated assemblies will require more intensive maintenance).

X. RAINWATER HARVESTING

- Flush cisterns to remove sediment. Brush the inside surfaces and thoroughly disinfect.
- Do not allow water to freeze in devices during Winter months.

XI. DRY EXTENDED DETENTION BASIN

- Inspection and maintenance should take place on a quarterly basis and after every storm event greater than one (1) inch.
- Inspect all basin structures (i.e. basin bottoms, trash racks, outlet structures, riprap or

gabion structures, and inlets) for clogging, excessive debris, and sediment accumulation.

- Sediment removal should be conducted when the basin is completely dry. Sediment should be disposed of properly and once sediment is removed, disturbed areas need to be immediately stabilized and revegetated.
- Mowing and/or trimming of vegetation should be performed as necessary to sustain the system.
- Vegetated areas should be inspected annually for erosion.
- Vegetated areas should be inspected annually for unwanted growth of exotic/invasive species.
- Vegetative cover should be maintained at a minimum of ninety-five percent (95%). If vegetative cover has been reduced by ten percent (10%), vegetation should be reestablished.

XII. DETENTION BASIN

- Inspection and maintenance should take place on a quarterly basis and after every storm event greater than one (1) inch.
- Inspect all basin structures (i.e. basin bottoms, trash racks, outlet structures, riprap or gabion structures, and inlets) for clogging, excessive debris, and sediment accumulation.
- Mowing and/or trimming of vegetation should be performed as necessary to sustain the system.
- Vegetated areas should be inspected annually for erosion.
- Vegetated areas should be inspected annually for unwanted growth of exotic/invasive species.
- Vegetative cover should be maintained at a minimum of ninety-five percent (95%). If vegetative cover has been reduced by ten percent (10%), vegetation should be reestablished.

XIII. RETENTION BASIN

- During first growing season, vegetation should be inspected every two (2) to three (3) weeks.
- During the first two (2) years, retention basins should be inspected at least four (4) times per year and after major storm events (> 2 inches in 24 hours) or rapid ice breakup.
- Inspections should assess the vegetation, erosion, flow channelization, bank stability, inlet/outlet conditions, and sediment/debris accumulation.
- Pond drain should be inspected and tested four (4) times per year.
- Undesirable species should be carefully removed and desirable replacements planted if necessary.
- Vegetation should maintain at least an eighty-five percent (85%) cover of the emergent vegetation zone.

- Sediment should be removed from the forebay before it occupies fifty percent (50%) of the forebay, typically every five (5) to ten (10) years.

XIV. UNDER-DRAINED BASIN

- Inspection and maintenance should take place on a quarterly basis and after every storm event greater than one (1) inch.
- Inspect all basin structures (i.e. basin bottoms, trash racks, outlet structures, riprap or gabion structures, inlets, and underdrain valve) for clogging and excessive debris and sediment accumulation.
- Underdrain valve should remain in the shut position unless the basin does not drain.
- Mowing and/or trimming of vegetation should be performed as necessary to sustain the system.
- Vegetated areas should be inspected annually for erosion.
- Vegetated areas should be inspected annually for unwanted growth of exotic/invasive species.
- Vegetative cover should be maintained at a minimum of ninety-five percent (95%). If vegetative cover has been reduced by ten percent (10%), vegetation should be reestablished.

Centre Region MS4 Partners PRP

APPENDIX C

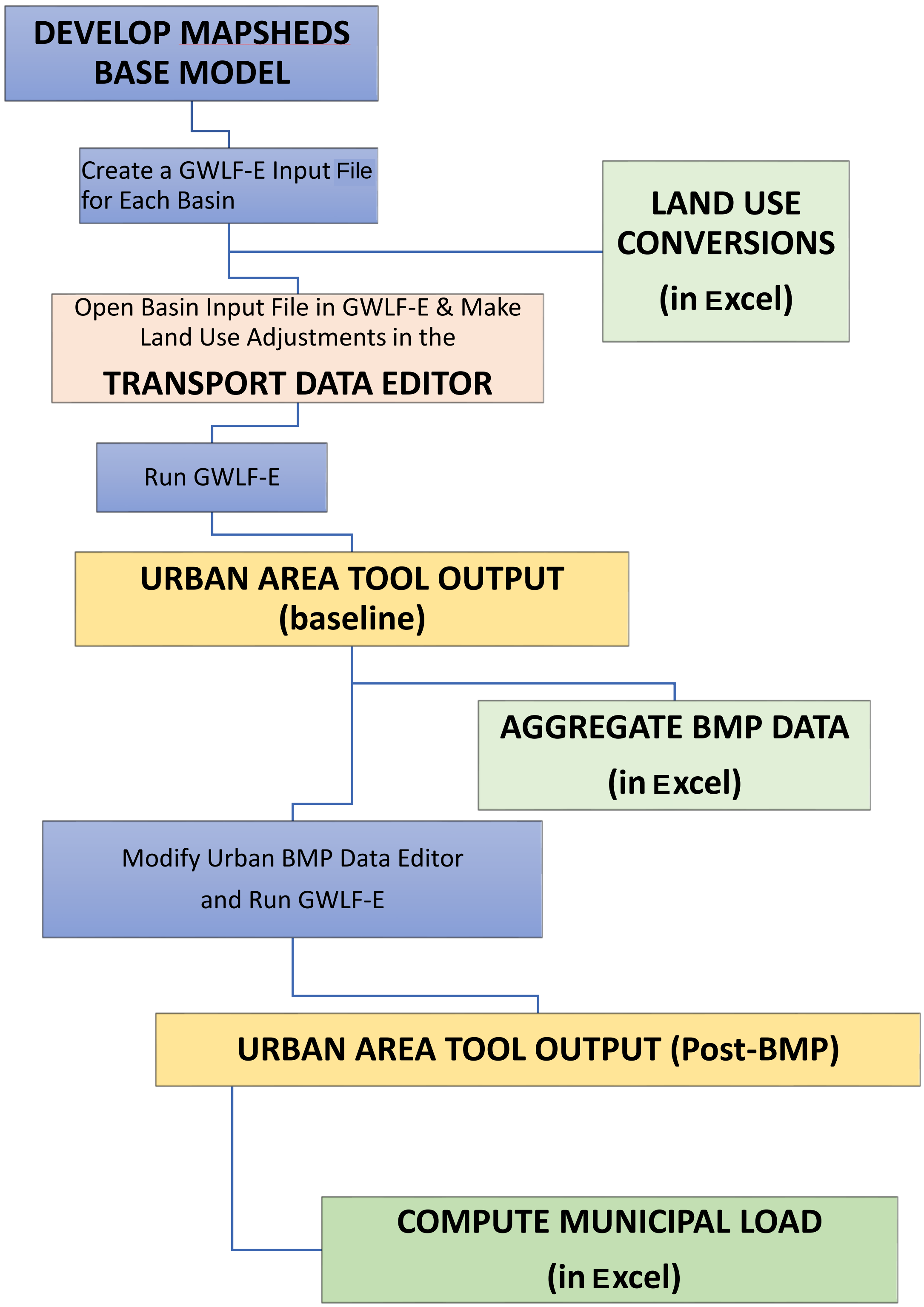
Data Supporting Pollutant Baseload Computations

Newell Tereska & Mackay
Engineering

APPENDIX C

Appendix C provides a flow chart outlining the modeling process applied to compute pollutant baseloads. The process used for the Centre Region MS4 PRP is explained in more detail in Section D of the PRP Report. For an overview of MapShed, the user is referred to Version 1.5 of the User Manual. Land use adjustments were made to MapShed's base model. The base model uses the 2011 National Land Cover Data Set. Adjustments were made to reflect land use changes over the last six (6) years.

The process shown here presents MapShed output for each watershed and follows with output specific to each municipality. While the modeling process was conducted in MapShed, accounting was computed in Excel. BMPs were aggregated in Excel and output from Mapshed was input to Excel for simple mathematical accounting.


DEVELOP MAPSHEDS BASE MODEL
Create a GWLF-E Input File for Each Basin
LAND USE CONVERSIONS (in Excel)
Open Basin Input File in GWLF-E & Make Land Use Adjustments in the TRANSPORT DATA EDITOR
Run GWLF-E
URBAN AREA TOOL OUTPUT (baseline)
AGGREGATE BMP DATA (in Excel)
Modify Urban BMP Data Editor and Run GWLF-E
URBAN AREA TOOL OUTPUT (Post-BMP)
COMPUTE MUNICIPAL LOAD (in Excel)

BEAVER BRANCH

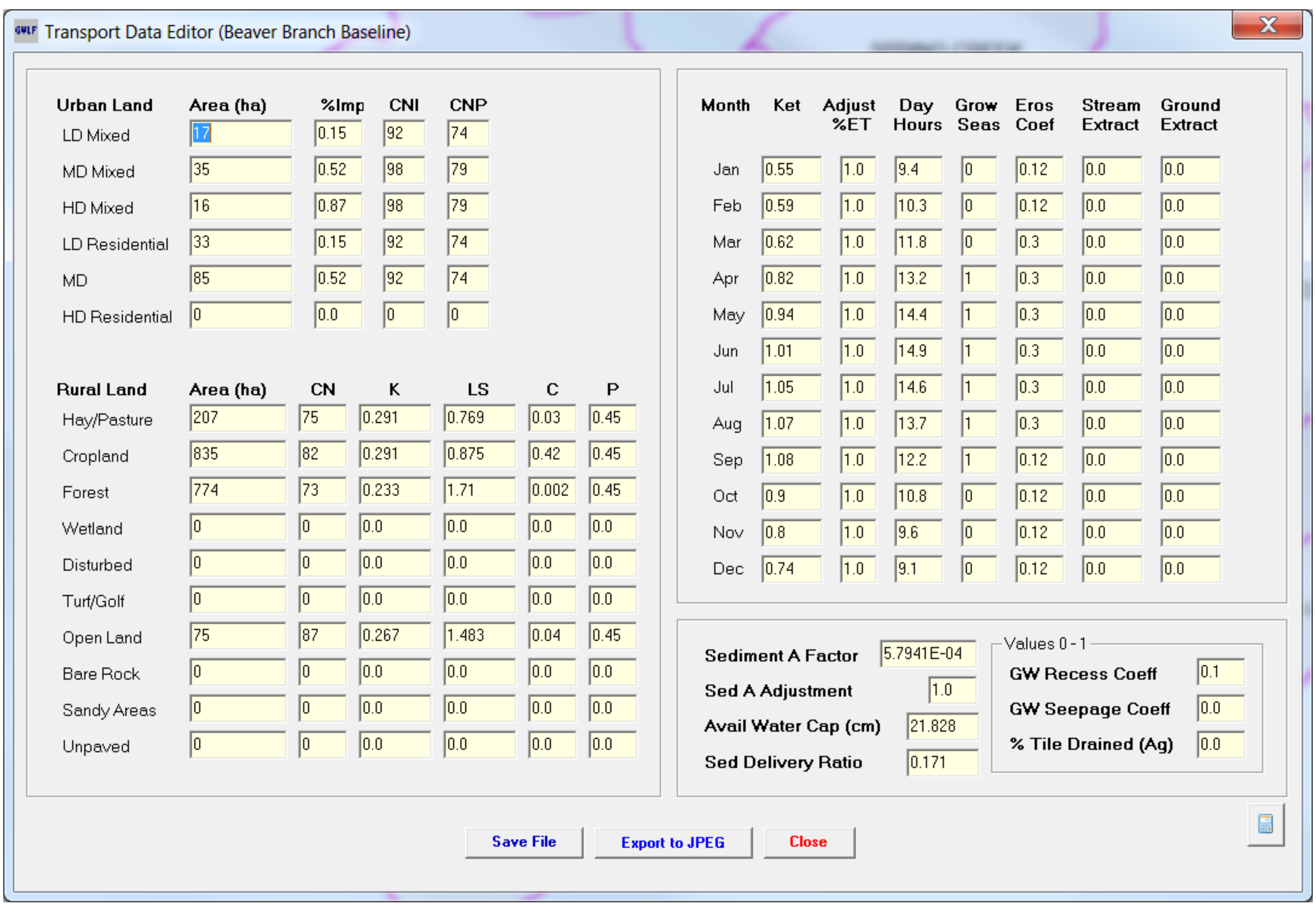
	Land Use From Mapshe	Revised Land Use
	Area (ha)	**Area (ha)**
LD Mixed	17	17
MD Mixed	35	35
HD Mixed	16	16
LD Residen	33	33
MD Mixed	85	85
HD Resider	0	0
Hay/Pastu	203	207
Cropland	839	835
Forest	774	774
Wetland	0	0
Distrurbed	0	0
Turf/Golf	0	0
Open Land	75	75
Bare Rock	0	0
Sandy Area	0	0
Unpaved	0	0
Total	**2077**	**2077**

LAND USE CONVERSIONS

(in Excel)

Open Basin Input File in GWLF-E & Make Land Use Adjustments in the

TRANSPORT DATA EDITOR



Transport Data Editor (Beaver Branch Baseline)

Urban Land	Area (ha)	%Imp	CNI	CNP
LD Mixed	17	0.15	92	74
MD Mixed	35	0.52	98	79
HD Mixed	16	0.87	98	79
LD Residential	33	0.15	92	74
MD	85	0.52	92	74
HD Residential	0	0.0	0	0

Rural Land	Area (ha)	CN	K	LS	C	P
Hay/Pasture	207	75	0.291	0.769	0.03	0.45
Cropland	835	82	0.291	0.875	0.42	0.45
Forest	774	73	0.233	1.71	0.002	0.45
Wetland	0	0	0.0	0.0	0.0	0.0
Disturbed	0	0	0.0	0.0	0.0	0.0
Turf/Golf	0	0	0.0	0.0	0.0	0.0
Open Land	75	87	0.267	1.483	0.04	0.45
Bare Rock	0	0	0.0	0.0	0.0	0.0
Sandy Areas	0	0	0.0	0.0	0.0	0.0
Unpaved	0	0	0.0	0.0	0.0	0.0

Month	Ket	Adjust %ET	Day Hours	Grow Seas	Eros Coef	Stream Extract	Ground Extract
Jan	0.55	1.0	9.4	0	0.12	0.0	0.0
Feb	0.59	1.0	10.3	0	0.12	0.0	0.0
Mar	0.62	1.0	11.8	0	0.3	0.0	0.0
Apr	0.82	1.0	13.2	1	0.3	0.0	0.0
May	0.94	1.0	14.4	1	0.3	0.0	0.0
Jun	1.01	1.0	14.9	1	0.3	0.0	0.0
Jul	1.05	1.0	14.6	1	0.3	0.0	0.0
Aug	1.07	1.0	13.7	1	0.3	0.0	0.0
Sep	1.08	1.0	12.2	1	0.12	0.0	0.0
Oct	0.9	1.0	10.8	0	0.12	0.0	0.0
Nov	0.8	1.0	9.6	0	0.12	0.0	0.0
Dec	0.74	1.0	9.1	0	0.12	0.0	0.0

Sediment A Factor	5.7941E-04
Sed A Adjustment	1.0
Avail Water Cap (cm)	21.828
Sed Delivery Ratio	0.171

Values 0 - 1

GW Recess Coeff	0.1
GW Seepage Coeff	0.0
% Tile Drained (Ag)	0.0

Save File | Export to JPEG | Close

BEAVER BRANCH

URBAN AREA TOOL OUTPUT (baseline)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\BeaverBranch\Output\B

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

GWLF-E Average Loads by Source for Watershed 7376

Source	Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	512	49802.42	97.30	277.87	0.54	61.93	0.12
Cropland	2063	3199855.41	1551.10	11343.27	5.50	1740.35	0.84
Forest	1913	22090.32	11.50	187.41	0.10	17.61	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	185	42571.26	230.10	203.84	1.10	21.78	0.12
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	42	617.29	14.70	15.65	0.37	1.70	0.04
MD Mixed	86	6283.17	73.10	118.21	1.37	13.29	0.15
HD Mixed	40	2866.01	71.70	54.04	1.35	6.08	0.15
LD Residential	82	1212.54	14.80	30.38	0.37	3.28	0.04
MD Residential	210	15278.03	72.80	287.11	1.37	32.30	0.15
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		233055.1		116.8		26.5	
Groundwater				25069.7		257.6	
Point Sources				0.0		0.0	
Septic Systems				642.6		0.0	
Totals	5133	3573632		38347		2182	

Print | Export to JPEG | Exit

BEAVER BRANCH

URBAN AREA TOOL OUTPUT (Ferguson)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\BeaverBranch\Output\B

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

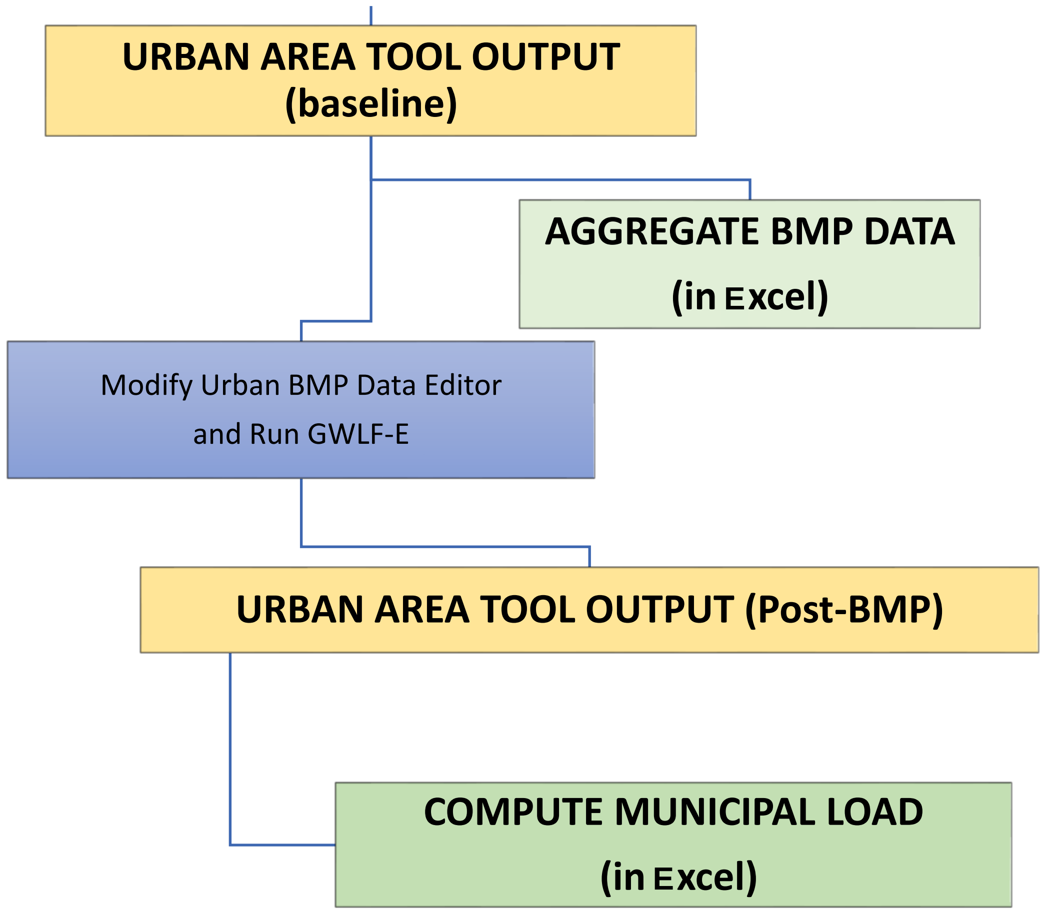
View loads for municipality: Ferguson Twp (00002)

		Sediment		Nitrogen		Phosphorus	
Source	**Source Area (ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**
Hay/Pasture	17	1654.10	97.30	9.20	0.54	2.00	0.12
Cropland	52	80657.20	1551.10	286.00	5.50	43.70	0.84
Forest	69	793.50	11.50	6.90	0.10	0.70	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	5	1150.50	230.10	5.50	1.10	0.60	0.12
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	7	102.90	14.70	2.60	0.37	0.30	0.04
MD Mixed	2	146.20	73.10	2.70	1.37	0.30	0.15
HD Mixed	5	358.50	71.70	6.80	1.35	0.80	0.15
LD Residential	2	29.60	14.80	0.70	0.37	0.10	0.04
MD Residential	25	1820.00	72.80	34.30	1.37	3.80	0.15
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						**Source Weighting**
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		13990.06		7.0		1.6	0.096
Groundwater				927.6		9.5	0.037
Point Sources				0.0		0.0	0.000
Septic Systems				19.3		0.0	0.030
Totals	**184**	**100702.6**		**1308.6**		**63.4**	

Print | Export to JPEG | Exit

BEAVER BRANCH
Ferguson

There are no existing BMPs that qualify for credit in the Beaver Branch Planning Area; therefore these steps do not apply.

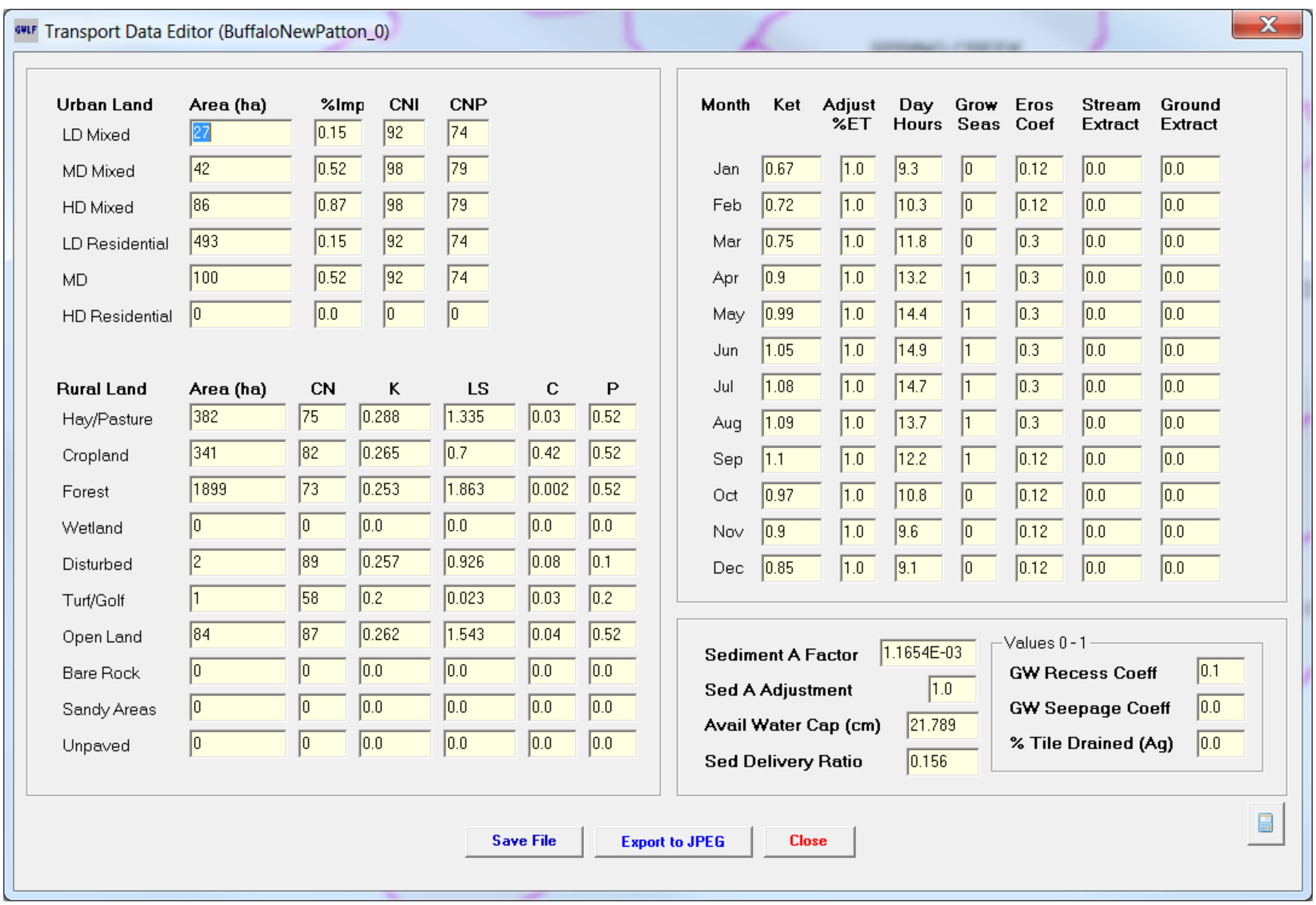


BUFFALO RUN

	Land Use From Mapsheds*	Revised Land Use
	Area (ha)	Area (ha)
LD Mixed	27	27
MD Mixed	42	42
HD Mixed	86	86
LD Resider	338	493
MD Mixed	74	100
HD Reside	0	0
Hay/Pastu	407	382
Cropland	386	341
Forest	1917	1899
Wetland	0	0
Distrurbed	2	2
Turf/Golf	1	1
Open Land	178	84
Bare Rock	0	0
Sandy Area	0	0
Unpaved	0	0
Total	**3458**	**3458**

LAND USE CONVERSIONS (in Excel)

Open Basin Input File in GWLF-E & Make Land Use Adjustments in the **TRANSPORT DATA EDITOR**



Transport Data Editor (BuffaloNewPatton_0)

Urban Land	Area (ha)	%Imp	CNI	CNP
LD Mixed	27	0.15	92	74
MD Mixed	42	0.52	98	79
HD Mixed	86	0.87	98	79
LD Residential	493	0.15	92	74
MD	100	0.52	92	74
HD Residential	0	0.0	0	0

Rural Land	Area (ha)	CN	K	LS	C	P
Hay/Pasture	382	75	0.288	1.335	0.03	0.52
Cropland	341	82	0.265	0.7	0.42	0.52
Forest	1899	73	0.253	1.863	0.002	0.52
Wetland	0	0	0.0	0.0	0.0	0.0
Disturbed	2	89	0.257	0.926	0.08	0.1
Turf/Golf	1	58	0.2	0.023	0.03	0.2
Open Land	84	87	0.262	1.543	0.04	0.52
Bare Rock	0	0	0.0	0.0	0.0	0.0
Sandy Areas	0	0	0.0	0.0	0.0	0.0
Unpaved	0	0	0.0	0.0	0.0	0.0

Month	Ket	Adjust %ET	Day Hours	Grow Seas	Eros Coef	Stream Extract	Ground Extract
Jan	0.67	1.0	9.3	0	0.12	0.0	0.0
Feb	0.72	1.0	10.3	0	0.12	0.0	0.0
Mar	0.75	1.0	11.8	0	0.3	0.0	0.0
Apr	0.9	1.0	13.2	1	0.3	0.0	0.0
May	0.99	1.0	14.4	1	0.3	0.0	0.0
Jun	1.05	1.0	14.9	1	0.3	0.0	0.0
Jul	1.08	1.0	14.7	1	0.3	0.0	0.0
Aug	1.09	1.0	13.7	1	0.3	0.0	0.0
Sep	1.1	1.0	12.2	1	0.12	0.0	0.0
Oct	0.97	1.0	10.8	0	0.12	0.0	0.0
Nov	0.9	1.0	9.6	0	0.12	0.0	0.0
Dec	0.85	1.0	9.1	0	0.12	0.0	0.0

Sediment A Factor	1.1654E-03
Sed A Adjustment	1.0
Avail Water Cap (cm)	21.789
Sed Delivery Ratio	0.156

Values 0 - 1

GW Recess Coeff	0.1
GW Seepage Coeff	0.0
% Tile Drained (Ag)	0.0

Save File | Export to JPEG | Close

BUFFALO RUN

URBAN AREA TOOL OUTPUT (baseline)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\BuffaloRun\Output\Buffal

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

GWLF-E Average Loads by Source for Watershed 0

Source	Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	944	166449.01	176.30	661.89	0.70	171.67	0.18
Cropland	843	1003610.36	1190.50	4026.06	4.78	679.13	0.81
Forest	4693	67615.78	14.40	486.60	0.10	55.69	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	5	286.60	57.30	0.71	0.14	0.22	0.04
Turfgrass	2	0.00	0.00	0.62	0.25	0.04	0.02
Open Land	208	51301.57	246.60	235.59	1.13	30.89	0.15
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	67	1036.17	15.50	24.87	0.37	2.67	0.04
MD Mixed	104	7363.44	70.80	179.70	1.73	19.60	0.19
HD Mixed	213	15101.66	70.90	367.97	1.73	40.15	0.19
LD Residential	1218	18937.71	15.50	453.89	0.37	48.63	0.04
MD Residential	247	17548.80	71.00	427.87	1.73	46.67	0.19
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	5.52894619						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		1159900.5		579.8		158.7	
Groundwater				22844.4		324.4	
Point Sources				0.0		0.0	
Septic Systems				5432.1		0.0	
Totals	8550	2509152		35722		1578	

Print | Export to JPEG | Exit

BUFFALO RUN
Patton Township

URBAN AREA TOOL OUTPUT
(Patton)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\BuffaloRun\Output\Buffal

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: Patton Twp (00004)

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	59	10401.70	176.30	41.30	0.70	10.60	0.18
Cropland	64	76192.00	1190.50	305.90	4.78	51.80	0.81
Forest	460	6624.00	14.40	46.00	0.10	4.60	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	67	16522.20	246.60	75.70	1.13	10.10	0.15
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	7	108.50	15.50	2.60	0.37	0.30	0.04
MD Mixed	20	1416.00	70.80	34.60	1.73	3.80	0.19
HD Mixed	17	1205.30	70.90	29.40	1.73	3.20	0.19
LD Residential	289	4479.50	15.50	106.90	0.37	11.60	0.04
MD Residential	101	7171.00	71.00	174.70	1.73	19.20	0.19
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						**Source Weighting**
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		209408.84		104.7		28.7	0.261
Groundwater				3792.2		53.9	0.166
Point Sources				0.0		0.0	0.000
Septic Systems				1879.5		0.0	0.346
Totals	**1084**	**333529.0**		**6593.5**		**197.8**	

Print | Export to JPEG | Exit

BUFFALO RUN
Patton Township

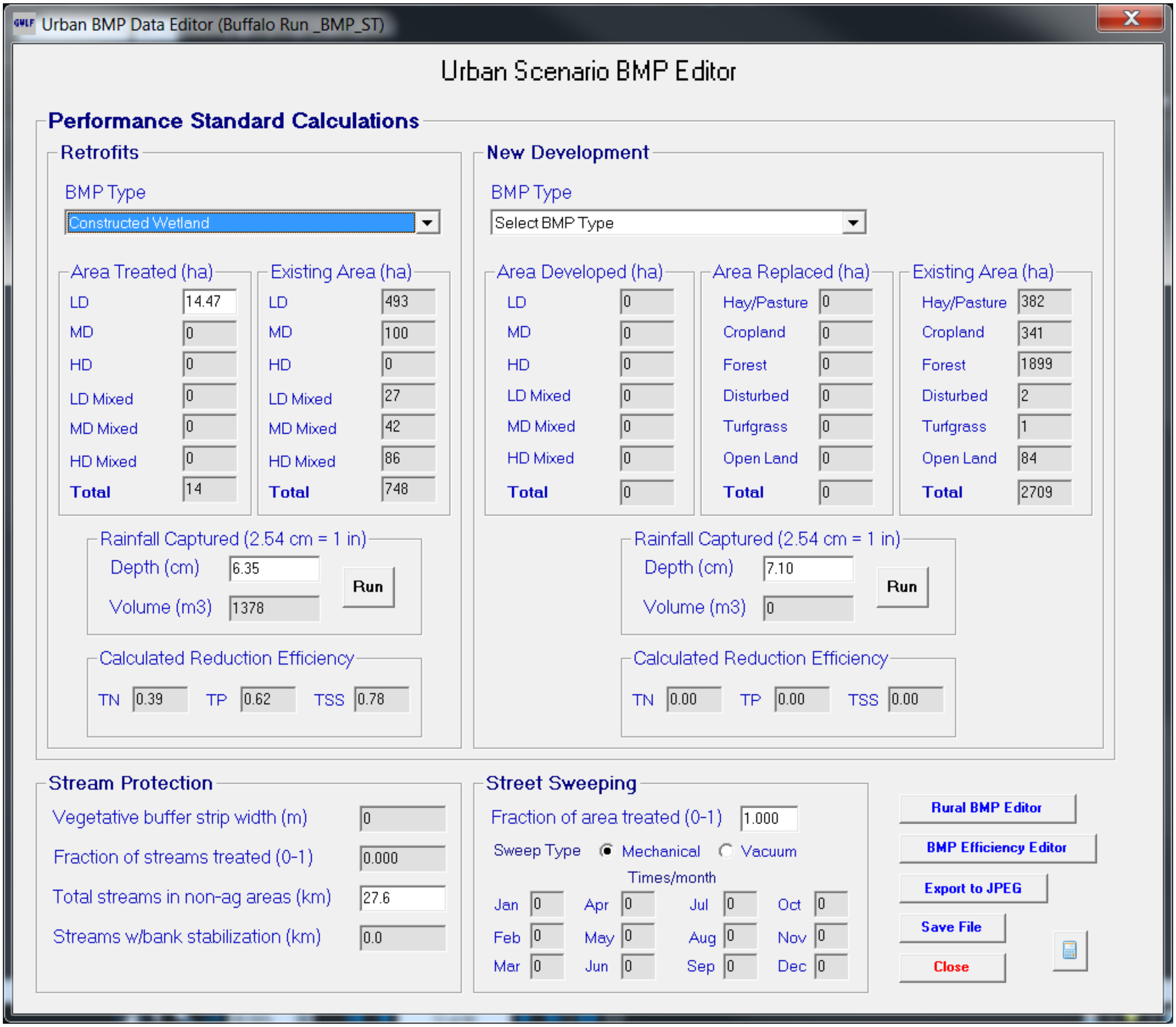
AGGREGATE BMP DATA (in Excel)

Land Area in Patton Township that drain to a Stormwater Treatment (ST) BMP						
ST	LD (hectacres treated)	MD (hectacres treated)	HD (hectacres treated)	LD Mixed (hectacres treated)	MD Mixed (hectacres treated)	HD Mixed (hectacres treated)
Buffalo Run	14.47	0.00	0.00	0.00	0.00	0.00
Big Hollow	5.21	3.87	0.00	1.01	1.28	0.53
	0.00	0.00	0.00	0.00	0.00	0.00
Land Area in Patton Township that drain to a Runoff Reduction (RR) BMP						
RR	LD (hectacres treated)	MD (hectacres treated)	HD (hectacres treated)	LD Mixed (hectacres treated)	MD Mixed (hectacres treated)	HD Mixed (hectacres treated)
Buffalo Run	0.00	0.00	0.00	0.00	0.00	0.00
Big Hollow	5.04	14.63	1.80	0.00	1.26	3.50
	0.00	0.00	0.00	0.00	0.00	0.00

	Average rainfall removal			Average rainfall removal	
ST	in	cm	RR	inches	cm
Big Hollow	2.41	6.11	Big Hollow	1.59	4.04
Buffalo Run	2.50	6.35	Buffalo Run	No BMPs	NA

BUFFALO RUN
Patton Township

Modify Urban BMP Data Editor and Run GWLF-E



BUFFALO RUN
Patton Township

URBAN AREA TOOL OUTPUT (Post-BMP)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\BuffaloRun\Output\Buffal

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

GWLF-E Average Loads by Source for Watershed 0

Source	Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	944	166449.01	176.30	661.89	0.70	171.67	0.18
Cropland	843	1003610.36	1190.50	4026.06	4.78	679.13	0.81
Forest	4693	67615.78	14.40	486.60	0.10	55.69	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	5	286.60	57.30	0.71	0.14	0.22	0.04
Turfgrass	2	0.00	0.00	0.62	0.25	0.04	0.02
Open Land	208	51301.57	246.60	235.59	1.13	30.89	0.15
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	67	1036.17	15.50	24.76	0.37	2.65	0.04
MD Mixed	104	7319.35	70.40	179.04	1.72	19.49	0.19
HD Mixed	213	14991.43	70.40	366.58	1.72	39.90	0.19
LD Residential	1218	18805.43	15.40	452.19	0.37	48.35	0.04
MD Residential	247	17416.52	70.50	426.26	1.73	46.39	0.19
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	5.52894619						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		1156035.8		577.6		158.7	
Groundwater				22844.4		324.4	
Point Sources				0.0		0.0	
Septic Systems				5432.1		0.0	
Totals	8550	2504868		35714		1578	

Print | Export to JPEG | Exit

COMPUTE MUNICIPAL LOAD (in Excel)

			Buffalo Run		
Row Letter	**Output**	**Computation**	**Total Sediment Load (lb)**	**Total Nitrogen Load (lb)**	**Total Phosphorus Load (lb)**
A	Buffalo Run Watershed Baseline		2,509,152	35,722	1,578
B	Buffalo Run Watershed Baseline with ST BMPs		2,504,868	35,714	1,578
C	Patton Baseline Load without BMPs	D=A-C	333,529	7,067	218
D	Patton Township Load After Modeling BMPs	E= B-D	329,245	7,059	218

SPRING CREEK

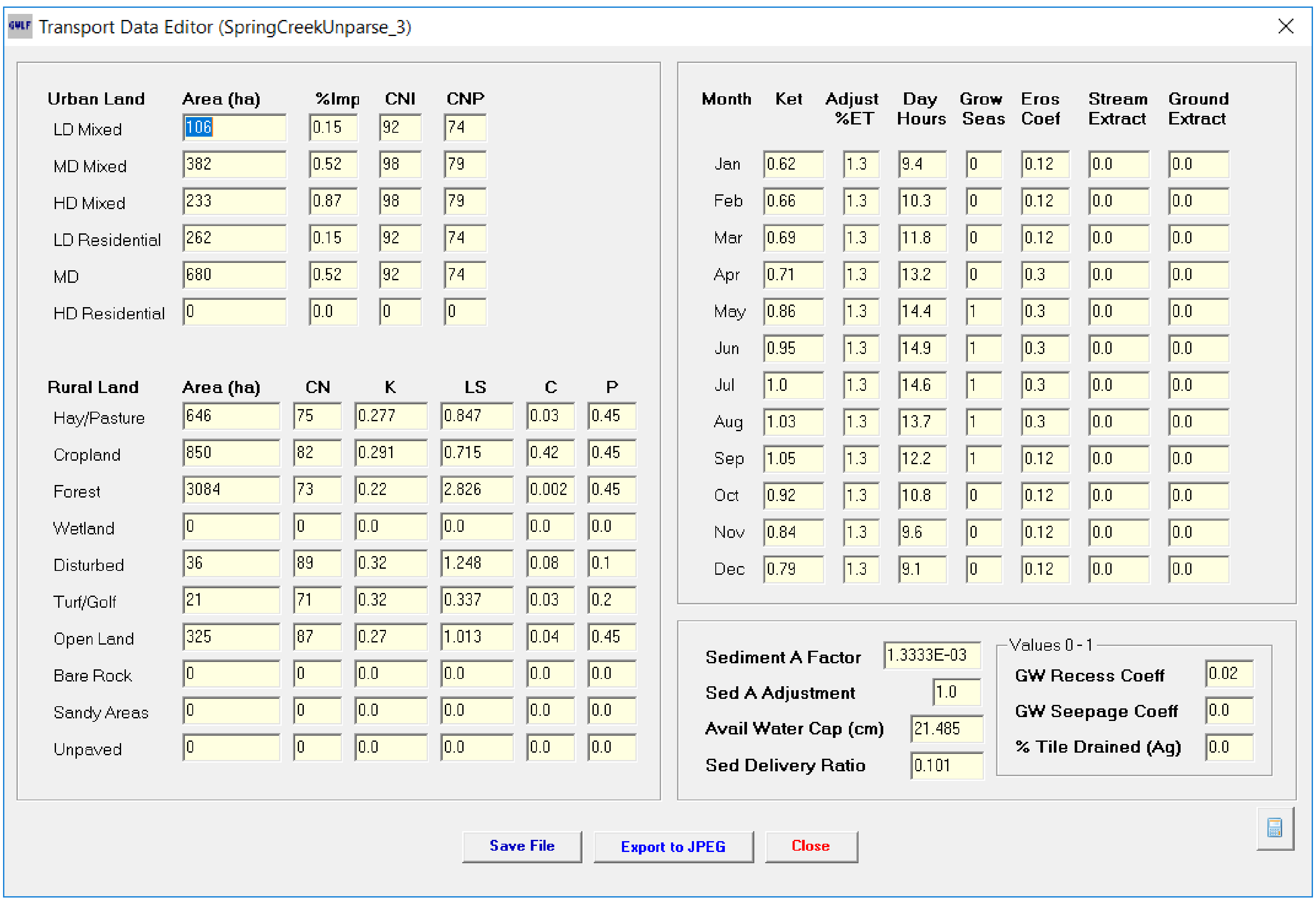
Spring Creek (3 subwatersheds) +Galbraith Gap		
	Land Use F	Revised Land Use
	Area (ha)	**Area (ha)**
LD Mixed	106	106
MD Mixed	382	382
HD Mixed	233	233
LD Residential	199	262
MD Mixed	634	680
HD Residential	0	0
Hay/Pasture	695	646
Cropland	911	850
Forest	3092	3084
Wetland	0	0
Distrurbed	36	36
Turf/Golf	21	21
Open Land	316	325
Bare Rock	0	0
Sandy Area	0	0
Unpaved	0	0
Total	**6625**	**6625**

LAND USE CONVERSIONS

(in Excel)

Open Basin Input File in GWLF-E & Make Land Use Adjustments in the

TRANSPORT DATA EDITOR



SPRING CREEK

URBAN AREA TOOL OUTPUT (baseline)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\UnParsedRunFiles\Outp

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

GWLF-E Average Loads by Source for Watershed 1

Source	Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	1596	92087.09	57.70	768.31	0.48	194.69	0.12
Cropland	2100	1504522.66	716.40	8271.10	3.94	1172.11	0.56
Forest	7621	77668.85	10.20	754.73	0.10	74.80	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	89	5180.86	58.20	13.23	0.15	4.32	0.05
Turfgrass	52	617.29	11.90	46.67	0.90	3.68	0.07
Open Land	803	72025.02	89.70	679.77	0.85	50.84	0.06
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	262	4122.64	15.70	102.80	0.39	11.09	0.04
MD Mixed	944	73458.03	77.80	1477.65	1.57	163.32	0.17
HD Mixed	576	44797.93	77.80	901.29	1.56	99.60	0.17
LD Residential	647	10207.40	15.80	254.08	0.39	27.43	0.04
MD Residential	1680	130756.17	77.80	2630.38	1.57	290.72	0.17
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	105.107869						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		3422934.6		1710.8		476.2	
Groundwater				29386.3		406.1	
Point Sources				0.0		0.0	
Septic Systems				3939.8		0.0	
Totals	16475	5438379		50937		2975	

Print | Export to JPEG | Exit

SPRING CREEK

URBAN AREA TOOL OUTPUT (College)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\UnParsedRunFiles\Outp

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: College Twp (00001)

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	171	9866.70	57.70	82.10	0.48	20.50	0.12
Cropland	124	88833.60	716.40	488.60	3.94	69.40	0.56
Forest	514	5242.80	10.20	51.40	0.10	5.10	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	82	7355.40	89.70	69.70	0.85	4.90	0.06
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	20	314.00	15.70	7.80	0.39	0.80	0.04
MD Mixed	230	17894.00	77.80	361.10	1.57	39.10	0.17
HD Mixed	47	3656.60	77.80	73.30	1.56	8.00	0.17
LD Residential	94	1485.20	15.80	36.70	0.39	3.80	0.04
MD Residential	524	40767.20	77.80	822.70	1.57	89.10	0.17
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						

Source	Sediment Total Load (lb)	Nitrogen Total Load (lb)	Phosphorus Total Load (lb)	Source Weighting
Farm Animals		0.0	0.0	0.000
Tile Drainage	0.00	0.0	0.0	0.000
Stream Bank	545271.92	272.5	75.9	0.234
Groundwater		4554.9	62.9	0.155
Point Sources		0.0	0.0	0.000
Septic Systems		752.5	0.0	0.191

	Source Area (ac)	Sediment Total Load (lb)	Nitrogen Total Load (lb)	Phosphorus Total Load (lb)
Totals	1806	720687.4	7573.3	379.5

Print | Export to JPEG | Exit

SPRING CREEK

URBAN AREA TOOL OUTPUT
(Harris)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\UnParsedRunFiles\Outp

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: Harris Twp (00003)

		Sediment		Nitrogen		Phosphorus	
Source	**Source Area (ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**
Hay/Pasture	166	9578.20	57.70	79.70	0.48	19.90	0.12
Cropland	101	72356.40	716.40	397.90	3.94	56.60	0.56
Forest	717	7313.40	10.20	71.70	0.10	7.20	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	69	6189.30	89.70	58.70	0.85	4.10	0.06
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	5	78.50	15.70	2.00	0.39	0.20	0.04
MD Mixed	27	2100.60	77.80	42.40	1.57	4.60	0.17
HD Mixed	17	1322.60	77.80	26.50	1.56	2.90	0.17
LD Residential	96	1516.80	15.80	37.40	0.39	3.80	0.04
MD Residential	462	35943.60	77.80	725.30	1.57	78.50	0.17
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	5						**Source Weighting**
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		410195.34		205.0		57.1	0.148
Groundwater				3291.3		45.5	0.112
Point Sources				0.0		0.0	0.000
Septic Systems				772.2		0.0	0.196
Totals	**1665**	**546594.7**		**5710.1**		**280.4**	

Print | Export to JPEG | Exit

SPRING CREEK
College Township

AGGREGATE BMP DATA (in Excel)

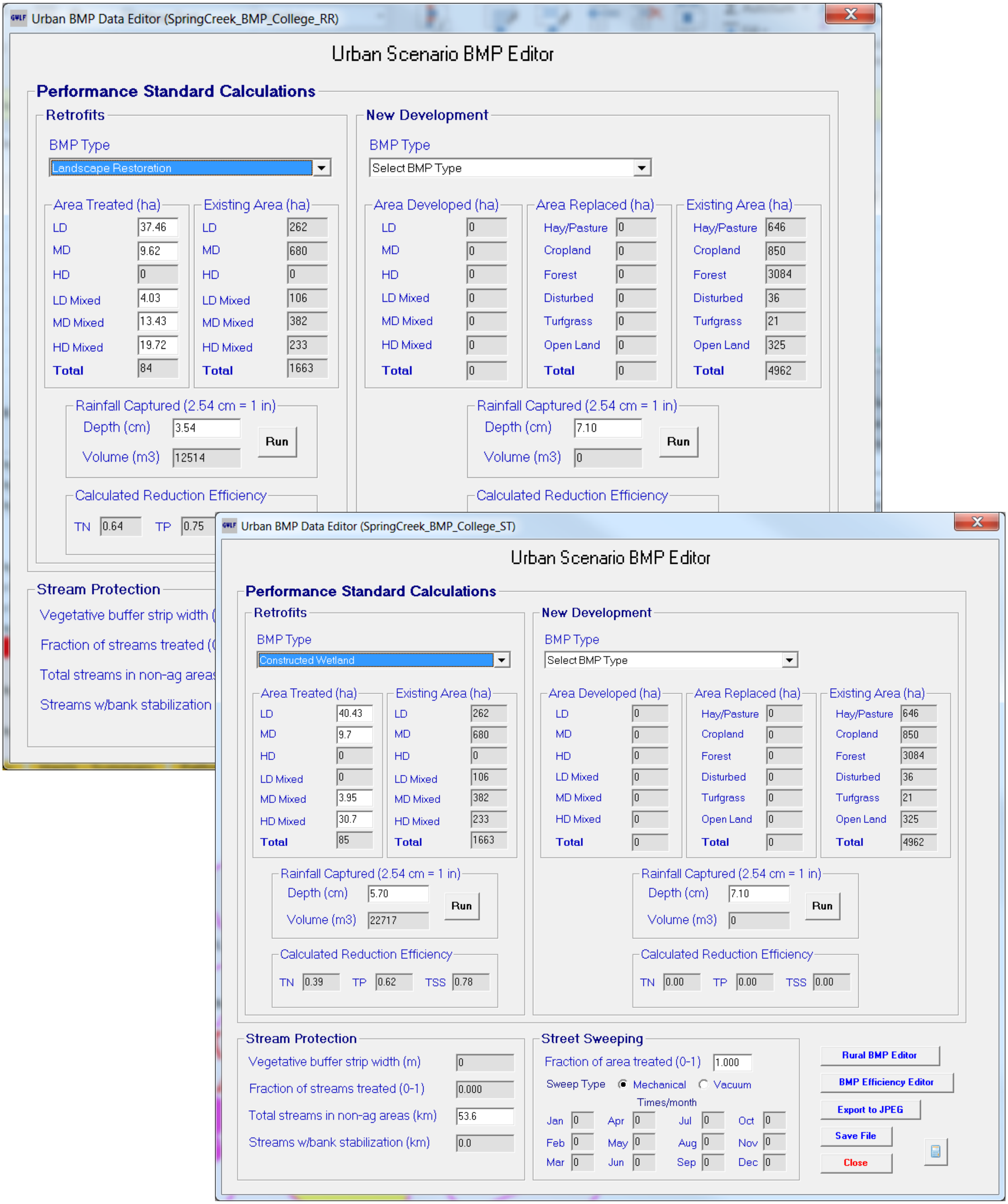
Land Area in College Township that drains to a Stormwater Treatment (ST) BMP						
ST	LD (hectacres treated)	MD (hectacres treated)	HD (hectacres treated)	LD Mixed (hectacres treated)	MD Mixed (hectacres treated)	HD Mixed (hectacres treated)
Spring Creek	40.43	9.70	0.00	0.00	3.93	30.73
Slab Cabin Run	0.00	0.00	0.00	0.00	0.00	0.00

Land Area in College Township that drains to a Runoff Reduction (RR) BMP						
RR	LD (hectacres treated)	MD (hectacres treated)	HD (hectacres treated)	LD Mixed (hectacres treated)	MD Mixed (hectacres treated)	HD Mixed (hectacres treated)
Spring Creek	37.46	9.62	0.00	4.03	13.43	19.72
Slab Cabin Run	10.40	10.40	0.00	0.62	3.40	0.12

	Average rainfall removal			Average rainfall removal	
ST	in	cm	RR	inches	cm
Spring Creek	2.24	5.70	Spring Creek	1.39	3.54
Slab Cabin Run	No BMPs		Slab Cabin Run	1.65	4.19

SPRING CREEK
College Township

Modify Urban BMP Data Editor
and Run GWLF-E



SPRING CREEK
College Township
RR BMPs

URBAN AREA TOOL OUTPUT (Post-BMP)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\SpringCreek\Output\Spr

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

GWLF-E Average Loads by Source for Watershed 2

		Sediment		Nitrogen		Phosphorus	
Source	**Area (ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**
Hay/Pasture	1596	92087.09	57.70	768.31	0.48	194.69	0.12
Cropland	2100	1504522.66	716.40	8271.10	3.94	1172.11	0.56
Forest	7621	77668.85	10.20	754.73	0.10	74.80	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	89	5180.86	58.20	13.23	0.15	4.32	0.05
Turfgrass	52	617.29	11.90	46.67	0.90	3.68	0.07
Open Land	803	72025.02	89.70	679.77	0.85	50.84	0.06
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	262	3990.37	15.20	99.91	0.38	10.74	0.04
MD Mixed	944	70856.57	75.10	1436.38	1.52	157.96	0.17
HD Mixed	576	43232.65	75.10	876.12	1.52	96.36	0.17
LD Residential	647	9854.66	15.20	246.98	0.38	26.52	0.04
MD Residential	1680	126148.51	75.10	2556.88	1.52	281.20	0.17
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	105.107869						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		3362922.5		1682.1		467.4	
Groundwater				29386.3		406.1	
Point Sources				0.0		0.0	
Septic Systems				3939.8		0.0	
Totals	**16475**	**5369107**		**50758**		**2947**	

Print | Export to JPEG | Exit

SPRING CREEK
College Township
ST BMPs

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\SpringCreek\Output\Spr

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

GWLF-E Average Loads by Source for Watershed 2

Source	Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	1596	92087.09	57.70	768.31	0.48	194.69	0.12
Cropland	2100	1504522.66	716.40	8271.10	3.94	1172.11	0.56
Forest	7621	77668.85	10.20	754.73	0.10	74.80	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	89	5180.86	58.20	13.23	0.15	4.32	0.05
Turfgrass	52	617.29	11.90	46.67	0.90	3.68	0.07
Open Land	803	72025.02	89.70	679.77	0.85	50.84	0.06
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	262	3968.32	15.10	100.82	0.38	10.76	0.04
MD Mixed	944	70636.11	74.80	1449.30	1.54	158.34	0.17
HD Mixed	576	43078.33	74.80	883.99	1.53	96.58	0.17
LD Residential	647	9810.57	15.20	249.19	0.39	26.59	0.04
MD Residential	1680	125751.67	74.90	2579.89	1.54	281.86	0.17
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	105.107869						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		3355221.8		1677.7		467.4	
Groundwater				29386.3		406.1	
Point Sources				0.0		0.0	
Septic Systems				3939.8		0.0	
Totals	16475	5360569		50801		2948	

Print | Export to JPEG | Exit

SPRING CREEK
College Township

COMPUTE MUNICIPAL LOAD
(in Excel)

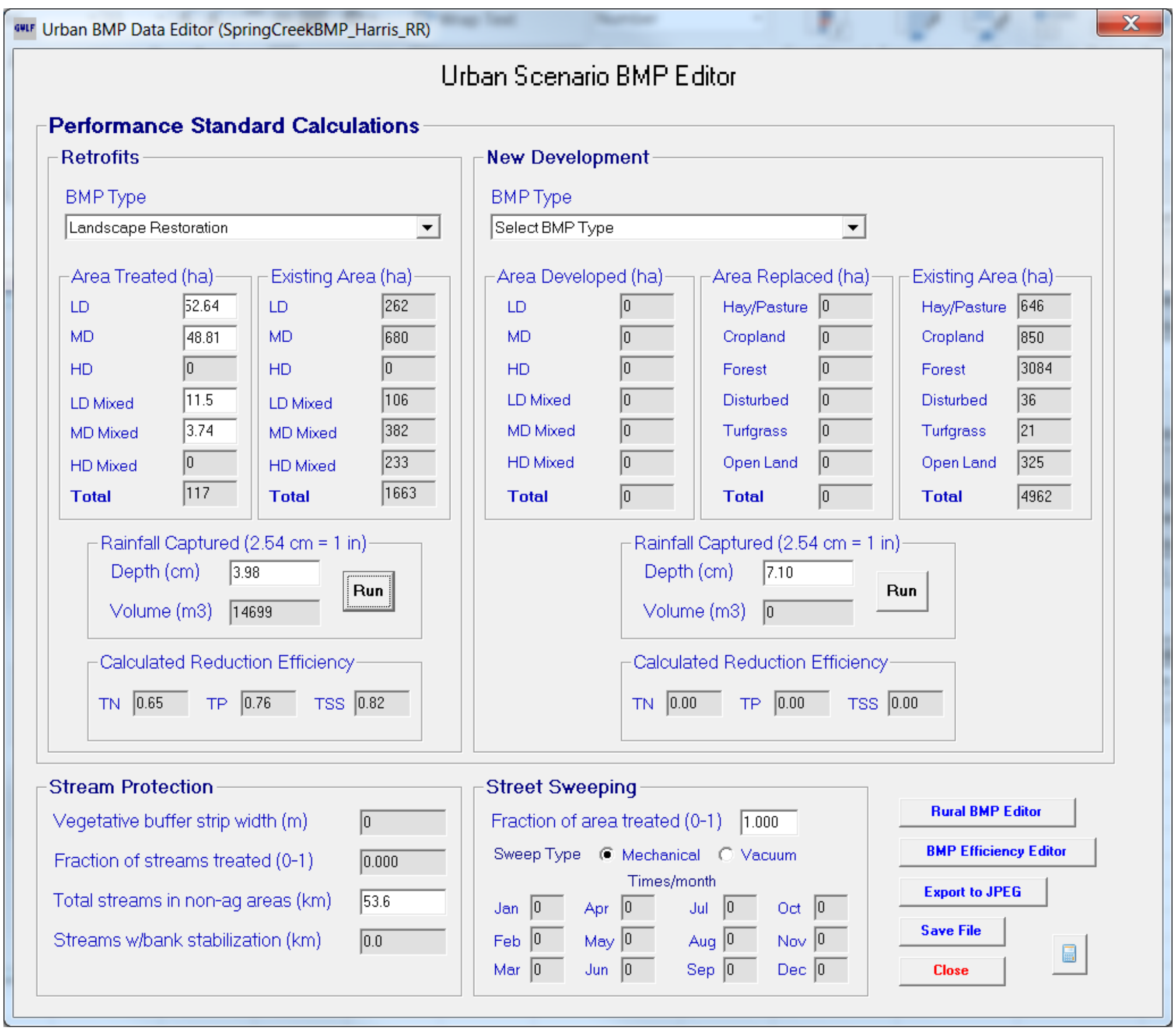
			Spring Creek		
Row Letter	**Output**	**Computation**	**Total Sediment Load (lb)**	**Nitrogen Load (lb)**	**Phosphorus Load (lb)**
A	Spring Creek Baseline		5,438,379	50,937	2,975
B	College Township Baseline Load Without BMPs		720,687	7,573	380
C	Spring Creek Watershed Load with College Township's ST Reductions		5,360,569	50,801	2,948
D	College Township ST Reduction	D = A-C	77,810	136	27
E	Spring Creek Watershed Load with College Township's RR Reductions		5,369,107	50,778	2,951
F	College Township RR Reduction	F = A-E	69,272	159	24
G	College Township Load After Modeling BMPs	G = B-(D+F)	573,605	7,278	329

SPRING CREEK
Harris Township

AGGREGATE BMP DATA (in excel)

Land Area in Harris Township that drains to a Runoff Reduction (RR) BMP						
RR	LD (hectacres treated)	MD (hectacres treated)	HD (hectacres treated)	LD Mixed (hectacres treated)	MD Mixed (hectacres treated)	HD Mixed (hectacres treated)
Spring Creek	52.6456	48.80917846	0	11.50317168	3.743346	0
Average rainfall removal			Average rainfall removal			
ST	in	cm	RR	inches	cm	
Spring Creek	No BMPs		Spring Creek	1.566050063	3.977767	

Modify Urban BMP Data Editor and Run GWLF-E



SPRING CREEK
Harris Township

URBAN AREA TOOL OUTPUT (Post-BMP)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\SpringCreek\Output\Spr

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

GWLF-E Average Loads by Source for Watershed 2

Source	Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	1596	92087.09	57.70	768.31	0.48	194.69	0.12
Cropland	2100	1504522.66	716.40	8271.10	3.94	1172.11	0.56
Forest	7621	77668.85	10.20	754.73	0.10	74.80	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	89	5180.86	58.20	13.23	0.15	4.32	0.05
Turfgrass	52	617.29	11.90	46.67	0.90	3.68	0.07
Open Land	803	72025.02	89.70	679.77	0.85	50.84	0.06
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	262	3968.32	15.10	99.74	0.38	10.71	0.04
MD Mixed	944	70702.25	74.90	1433.84	1.52	157.65	0.17
HD Mixed	576	43122.42	74.90	874.57	1.52	96.17	0.17
LD Residential	647	9832.62	15.20	246.54	0.38	26.48	0.04
MD Residential	1680	125883.95	74.90	2552.40	1.52	280.65	0.17
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	105.107869						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		3360206.4		1679.9		467.4	
Groundwater				29386.3		406.1	
Point Sources				0.0		0.0	
Septic Systems				3939.8		0.0	
Totals	16475	5365818		50747		2946	

Print | Export to JPEG | Exit

SPRING CREEK
Harris Township

COMPUTE MUNICIPAL LOAD
(in Excel)

			Spring Creek		
Row Letter	**Output**	**Computation**	**Total Sediment Load (lb)**	**Nitrogen Load (lb)**	**Phosphorus Load (lb)**
A	Spring Creek Baseline		5,438,379	50,937	2,975
B	Harris Township Baseline Load Without BMPs		546,595	5,710	280
C	Spring Creek Watershed Load with Harris Township's RR Reductions		5,365,818	50,747	2,946
D	Harris Township RR Reduction	D=A-C	72,561	190	29
E	Harris Township Load	E= B-D	474,034	5,520	251

SLAB CABIN RUN

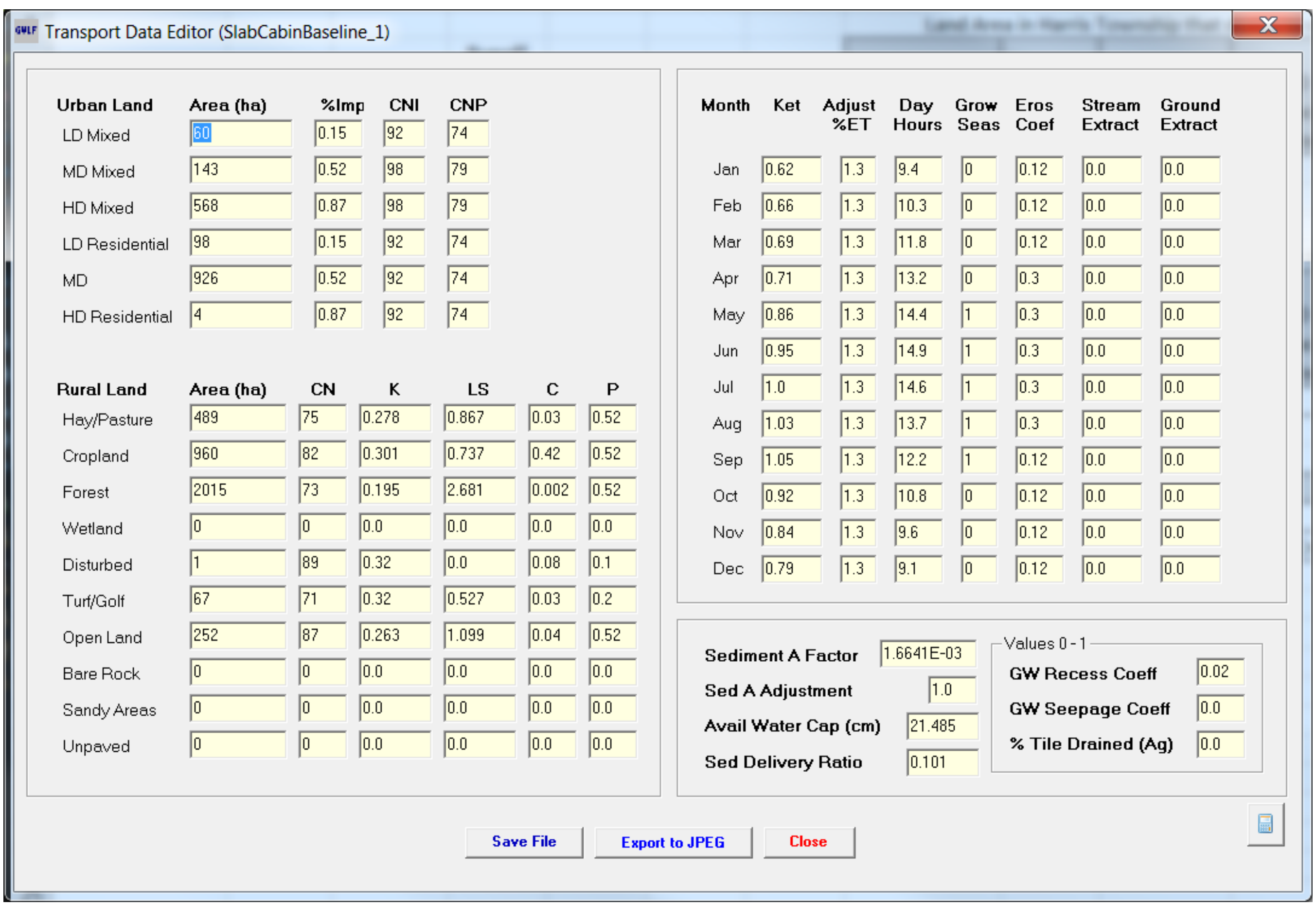
Slab Cabin + Roaring Run		
	Land Use From Mapsheds*	Revised Land Use
	Area (ha)	**Area (ha)**
LD Mixed	60	60
MD Mixed	143	143
HD Mixed	568	568
LD Residential	92	98
MD Mixed	924	926
HD Residential	4	4
Hay/Pasture	491	489
Cropland	966	960
Forest	2015	2015
Wetland	0	0
Distrurbed	1	1
Turf/Golf	67	67
Open Land	252	252
Bare Rock	0	0
Sandy Area	0	0
Unpaved	0	0
Total	**5583**	**5583**

LAND USE CONVERSIONS

(in Excel)

Open Basin Input File in GWLF-E & Make Land Use Adjustments in the

TRANSPORT DATA EDITOR



Transport Data Editor (SlabCabinBaseline_1)

Urban Land	Area (ha)	%Imp	CNI	CNP
LD Mixed	60	0.15	92	74
MD Mixed	143	0.52	98	79
HD Mixed	568	0.87	98	79
LD Residential	98	0.15	92	74
MD	926	0.52	92	74
HD Residential	4	0.87	92	74

Rural Land	Area (ha)	CN	K	LS	C	P
Hay/Pasture	489	75	0.278	0.867	0.03	0.52
Cropland	960	82	0.301	0.737	0.42	0.52
Forest	2015	73	0.195	2.681	0.002	0.52
Wetland	0	0	0.0	0.0	0.0	0.0
Disturbed	1	89	0.32	0.0	0.08	0.1
Turf/Golf	67	71	0.32	0.527	0.03	0.2
Open Land	252	87	0.263	1.099	0.04	0.52
Bare Rock	0	0	0.0	0.0	0.0	0.0
Sandy Areas	0	0	0.0	0.0	0.0	0.0
Unpaved	0	0	0.0	0.0	0.0	0.0

Month	Ket	Adjust %ET	Day Hours	Grow Seas	Eros Coef	Stream Extract	Ground Extract
Jan	0.62	1.3	9.4	0	0.12	0.0	0.0
Feb	0.66	1.3	10.3	0	0.12	0.0	0.0
Mar	0.69	1.3	11.8	0	0.12	0.0	0.0
Apr	0.71	1.3	13.2	0	0.3	0.0	0.0
May	0.86	1.3	14.4	1	0.3	0.0	0.0
Jun	0.95	1.3	14.9	1	0.3	0.0	0.0
Jul	1.0	1.3	14.6	1	0.3	0.0	0.0
Aug	1.03	1.3	13.7	1	0.3	0.0	0.0
Sep	1.05	1.3	12.2	1	0.12	0.0	0.0
Oct	0.92	1.3	10.8	0	0.12	0.0	0.0
Nov	0.84	1.3	9.6	0	0.12	0.0	0.0
Dec	0.79	1.3	9.1	0	0.12	0.0	0.0

Sediment A Factor	1.6641E-03
Sed A Adjustment	1.0
Avail Water Cap (cm)	21.485
Sed Delivery Ratio	0.101

Values 0 - 1

GW Recess Coeff	0.02
GW Seepage Coeff	0.0
% Tile Drained (Ag)	0.0

Save File | Export to JPEG | Close

SLAB CABIN RUN

URBAN AREA TOOL OUTPUT (baseline)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\SlabCabinRun\Output\S

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

GWLF-E Average Loads by Source for Watershed 1

Source	Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	1208	82761.53	68.50	607.68	0.50	141.98	0.12
Cropland	2372	2093509.64	882.60	10130.06	4.27	1382.01	0.58
Forest	4979	49317.41	9.90	490.24	0.10	44.86	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	2	0.00	0.00	0.09	0.04	0.04	0.02
Turfgrass	166	3042.38	18.40	151.13	0.91	10.93	0.07
Open Land	623	68188.98	109.50	551.79	0.89	41.87	0.07
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	148	2314.85	15.60	58.18	0.39	6.31	0.04
MD Mixed	353	25639.76	72.60	611.92	1.73	67.95	0.19
HD Mixed	1404	101809.47	72.50	2430.55	1.73	269.89	0.19
LD Residential	242	3769.90	15.60	95.04	0.39	10.30	0.04
MD Residential	2288	165986.04	72.50	3962.48	1.73	439.98	0.19
HD Residential	10	727.53	72.80	17.11	1.71	1.90	0.19
Water	6.43939472						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		2711842.4		1355.8		332.9	
Groundwater				24007.2		317.6	
Point Sources				0.0		0.0	
Septic Systems				1907.7		0.0	
Totals	**13801**	**5308910**		**46377**		**3069**	

Print | Export to JPEG | Exit

SLAB CABIN RUN

URBAN AREA TOOL OUTPUT
(College)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\UnParsedRunFiles\Outp

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: College Twp (00001)

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	17	1164.50	68.50	8.50	0.50	2.00	0.12
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	30	297.00	9.90	3.00	0.10	0.30	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	2	36.80	18.40	1.80	0.91	0.10	0.07
Open Land	42	4599.00	109.50	37.40	0.89	2.90	0.07
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	10	156.00	15.60	3.90	0.39	0.40	0.04
MD Mixed	72	5227.20	72.60	124.60	1.73	13.70	0.19
HD Mixed	37	2682.50	72.50	64.00	1.73	7.00	0.19
LD Residential	27	421.20	15.60	10.50	0.39	1.10	0.04
MD Residential	410	29725.00	72.50	709.30	1.73	77.90	0.19
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						

Source	Source Area (ac)	Sediment Total Load (lb)	Nitrogen Total Load (lb)	Phosphorus Total Load (lb)	Source Weighting
Farm Animals			0.0	0.0	0.000
Tile Drainage		0.00	0.0	0.0	0.000
Stream Bank		194546.62	97.2	23.9	0.109
Groundwater			1705.2	22.6	0.071
Point Sources			0.0	0.0	0.000
Septic Systems			228.9	0.0	0.120
Totals	647	238855.8	2994.3	151.9	

Print | Export to JPEG | Exit

SLAB CABIN RUN

URBAN AREA TOOL OUTPUT (Ferguson)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\UnParsedRunFiles\Outp

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: Ferguson Twp (00002)

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	86	5891.00	68.50	43.00	0.50	10.30	0.12
Cropland	309	272723.40	882.60	1319.40	4.27	179.20	0.58
Forest	168	1663.20	9.90	16.80	0.10	1.70	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	82	8979.00	109.50	73.00	0.89	5.70	0.07
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	10	156.00	15.60	3.90	0.39	0.40	0.04
MD Mixed	35	2541.00	72.60	60.60	1.73	6.70	0.19
HD Mixed	32	2320.00	72.50	55.40	1.73	6.10	0.19
LD Residential	2	31.20	15.60	0.80	0.39	0.10	0.04
MD Residential	304	22040.00	72.50	525.90	1.73	57.80	0.19
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						**Source Weighting**
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		204755.64		102.4		25.1	0.077
Groundwater				2329.6		30.8	0.097
Point Sources				0.0		0.0	0.000
Septic Systems				21.0		0.0	0.011
Totals	1028	521100.4		4551.8		323.9	

Print | Export to JPEG | Exit

SLAB CABIN RUN

URBAN AREA TOOL OUTPUT
(Penn State)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\UnParsedRunFiles\Outp

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: Psu (00005)

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	0	0.00	0.00	0.00	0.00	0.00	0.00
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	20	198.00	9.90	2.00	0.10	0.20	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	20	368.00	18.40	18.20	0.91	1.40	0.07
Open Land	7	766.50	109.50	6.20	0.89	0.50	0.07
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	5	78.00	15.60	2.00	0.39	0.20	0.04
MD Mixed	7	508.20	72.60	12.10	1.73	1.30	0.19
HD Mixed	494	35815.00	72.50	854.60	1.73	93.90	0.19
LD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						**Source Weighting**
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		243250.31		121.6		29.9	0.164
Groundwater				1513.1		20.0	0.063
Point Sources				0.0		0.0	0.000
Septic Systems				0.0		0.0	0.000
Totals	553	280984.0		2529.8		147.4	

Print | Export to JPEG | Exit

SLAB CABIN RUN

URBAN AREA TOOL OUTPUT
(State College Borough)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\UnParsedRunFiles\Outp

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: State College Boro (00006)

		Sediment		Nitrogen		Phosphorus	
Source	**Source Area (ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**
Hay/Pasture	0	0.00	0.00	0.00	0.00	0.00	0.00
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	17	168.30	9.90	1.70	0.10	0.20	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	32	588.80	18.40	29.10	0.91	2.20	0.07
Open Land	54	5913.00	109.50	48.10	0.89	3.80	0.07
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	7	109.20	15.60	2.70	0.39	0.30	0.04
MD Mixed	52	3775.20	72.60	90.00	1.73	9.90	0.19
HD Mixed	331	23997.50	72.50	572.60	1.73	62.90	0.19
LD Residential	5	78.00	15.60	2.00	0.39	0.20	0.04
MD Residential	1176	85260.00	72.50	2034.50	1.73	223.40	0.19
HD Residential	5	364.00	72.80	8.60	1.71	1.00	0.19
Water	0						**Source Weighting**
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		578901.52		289.4		71.1	0.351
Groundwater				4707.3		62.3	0.196
Point Sources				0.0		0.0	0.000
Septic Systems				42.0		0.0	0.022
Totals	1679	699155.5		7828.0		437.3	

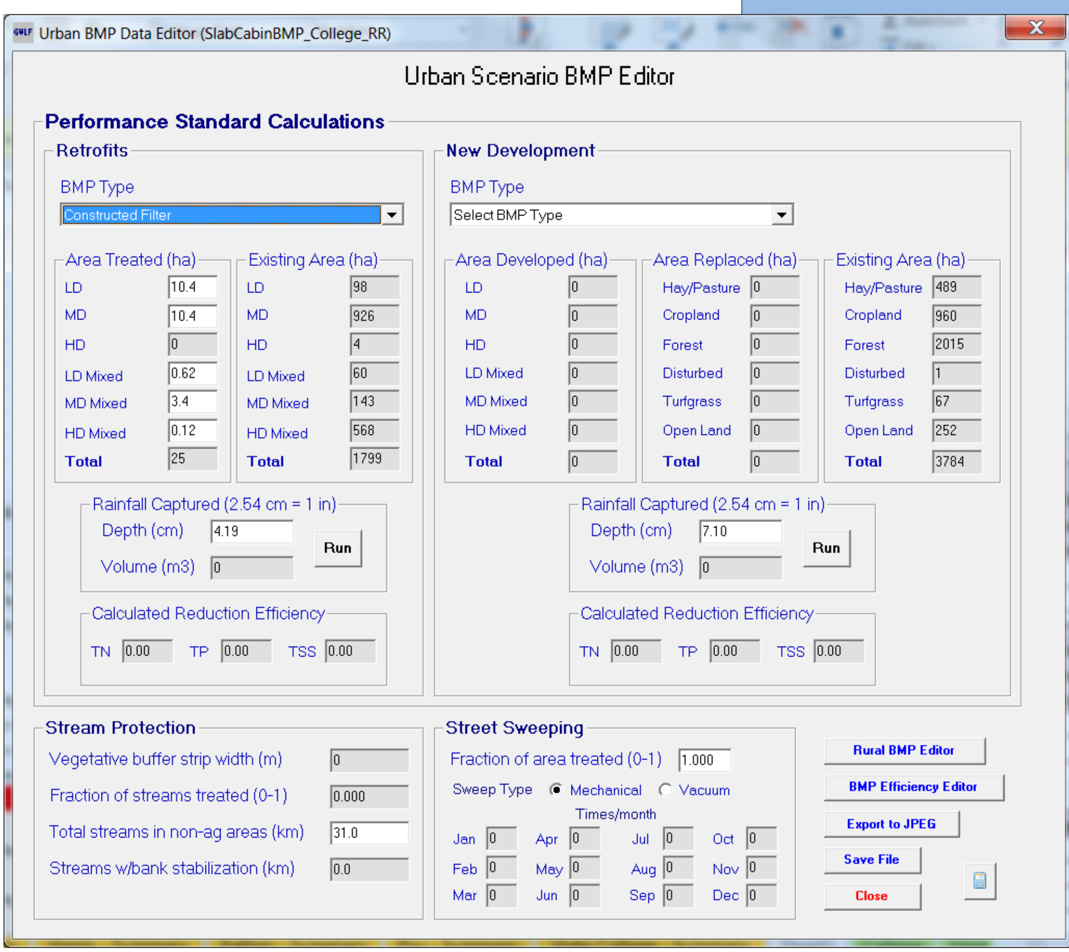
Print | Export to JPEG | Exit

Slab Cabin Run
College Township

AGGREGATE BMP DATA (in Excel)

Land Area in College Township that drains to a Stormwater Treatment (ST) BMP						
ST	LD (hectacres treated)	MD (hectacres treated)	HD (hectacres treated)	LD Mixed (hectacres treated)	MD Mixed (hectacres treated)	HD Mixed (hectacres treated)
Spring Creek	40.43	9.70	0.00	0.00	3.93	30.73
Slab Cabin Run	0.00	0.00	0.00	0.00	0.00	0.00
Land Area in College Township that drains to a Runoff Reduction (RR) BMP						
RR	LD (hectacres treated)	MD (hectacres treated)	HD (hectacres treated)	LD Mixed (hectacres treated)	MD Mixed (hectacres treated)	HD Mixed (hectacres treated)
Spring Creek	37.46	9.62	0.00	4.03	13.43	19.72
Slab Cabin Run	10.40	10.40	0.00	0.62	3.40	0.12
	Average rainfall removal			Average rainfall removal		
ST	in	cm	RR	inches	cm	
Spring Creek	2.24	5.70	Spring Creek	1.39	3.54	
Slab Cabin Run	No BMPs		Slab Cabin Run	1.65	4.19	

Modify Urban BMP Data Editor and Run GWLF-E



SLAB CABIN RUN
College Township

URBAN AREA TOOL OUTPUT (Post-BMP)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\UnParsedRunFiles\Outp

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

GWLF-E Average Loads by Source for Watershed 1

		Sediment		Nitrogen		Phosphorus	
Source	**Area (ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**
Hay/Pasture	1208	82761.53	68.50	607.68	0.50	141.98	0.12
Cropland	2372	2093509.64	882.60	10130.06	4.27	1382.01	0.58
Forest	4979	49317.41	9.90	490.24	0.10	44.86	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	2	0.00	0.00	0.09	0.04	0.04	0.02
Turfgrass	166	3042.38	18.40	151.13	0.91	10.93	0.07
Open Land	623	68188.98	109.50	551.79	0.89	41.87	0.07
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	148	2292.81	15.50	58.00	0.39	6.26	0.04
MD Mixed	353	25463.39	72.10	610.00	1.73	67.62	0.19
HD Mixed	1404	101170.13	72.10	2422.90	1.73	268.55	0.19
LD Residential	242	3747.86	15.50	94.73	0.39	10.23	0.04
MD Residential	2288	164927.82	72.10	3950.00	1.73	437.79	0.19
HD Residential	10	705.48	70.50	17.06	1.71	1.90	0.19
Water	6.43939472						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		2701052.9		1351.4		332.9	
Groundwater				24016.7		317.8	
Point Sources				0.0		0.0	
Septic Systems				1907.7		0.0	
Totals	13801	5296180		46359		3065	

Print | Export to JPEG | Exit

Increased treatment

SLAB CABIN RUN
College Township

COMPUTE MUNICIPAL LOAD
(in Excel)

Row Letter	Output	Computation	Total Sediment Load (lb)	Total Nitrogen Load (lb)	Total Phosphorus Load (lb)
A	Slab Cabin Run Watershed Baseline		5,308,910	46,377	3,069
B	Slab Cabin College Baseload without BMP		238,856	2,994	152
C	Slab Cabin Watershed Load with College Township's RR Reductions		5,296,180	46,359	3,065
D	College Township's RR Reductions	D= A-C	12,730	18	4
E	College Township Load After Modeling BMPs	E= B-D	226,126	2,976	148

SLAB CABIN RUN
Ferguson Township

AGGREGATE BMP DATA (in Excel)

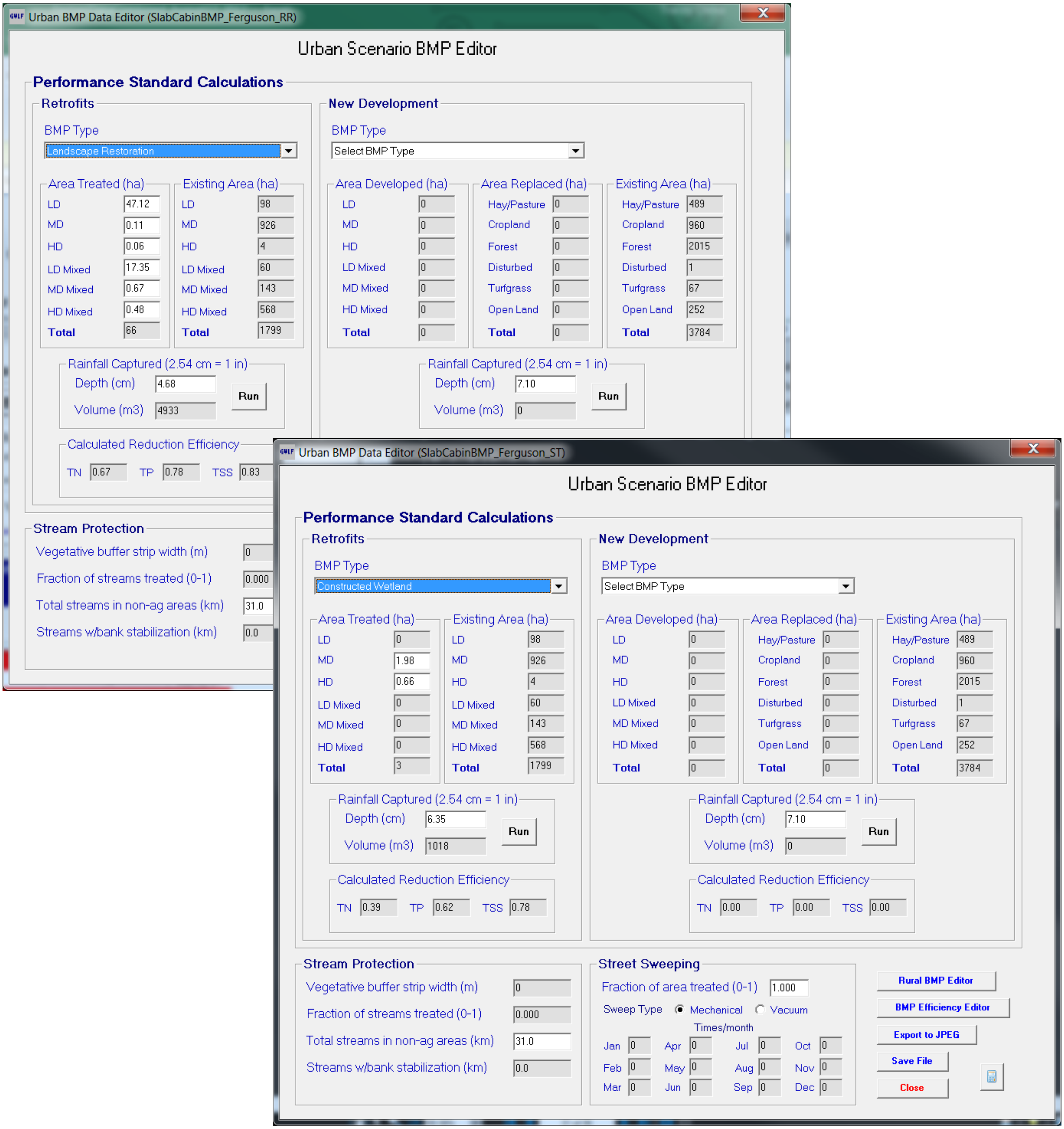
Land Area in Ferguson Township that drains to a Stormwater Treatment (ST) BMP						
ST	LD (hectacres treated)	MD (hectacres treated)	HD (hectacres treated)	LD Mixed (hectacres treated)	MD Mixed (hectacres treated)	HD Mixed (hectacres treated)
Big Hollow	0.00	0.00	0.00	0.00	0.15	0.25
Slab Cabin Run	0.00	1.98	0.66	0.00	0.00	0.00

Land Area in Ferguson Township that drains to a Runoff Reduction (RR) BMP						
RR	LD (hectacres treated)	MD (hectacres treated)	HD (hectacres treated)	LD Mixed (hectacres treated)	MD Mixed (hectacres treated)	HD Mixed (hectacres treated)
RR	LD	MD	HD	LD Mixed	MD Mixed	HD Mixed
Big Hollow	28.60	10.88	0.75	15.90	10.87	1.39
Slab Cabin Run	47.12	0.11	0.06	17.35	0.67	0.48

	Average rainfall removal			Average rainfall removal	
ST	in	cm	RR	inches	cm
Big Hollow	1.40	3.54	Big Hollow	1.32	3.34
Slab Cabin Run	2.50	6.35	Slab Cabin	1.84	4.68

SLAB CABIN RUN
Ferguson Township

Modify Urban BMP Data Editor
and Run GWLF-E



SLAB CABIN RUN
Ferguson Township

URBAN AREA TOOL OUTPUT (Post-BMP)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\UnParsedRunFiles\Outp

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

GWLF-E Average Loads by Source for Watershed 1

Source	Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	1208	82761.53	68.50	607.68	0.50	141.98	0.12
Cropland	2372	2093509.64	882.60	10130.06	4.27	1382.01	0.58
Forest	4979	49317.41	9.90	490.24	0.10	44.86	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	2	0.00	0.00	0.09	0.04	0.04	0.02
Turfgrass	166	3042.38	18.40	151.13	0.91	10.93	0.07
Open Land	623	68188.98	109.50	551.79	0.89	41.87	0.07
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	148	2292.81	15.50	57.81	0.39	6.26	0.04
MD Mixed	353	25419.30	72.00	607.90	1.72	67.42	0.19
HD Mixed	1404	100993.76	71.90	2414.61	1.72	267.82	0.19
LD Residential	242	3725.81	15.40	94.40	0.39	10.21	0.04
MD Residential	2288	164641.22	72.00	3936.49	1.72	436.63	0.19
HD Residential	10	705.48	70.50	17.00	1.70	1.90	0.19
Water	6.43939472						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		2699031.3		1349.2		332.9	
Groundwater				24016.7		317.8	
Point Sources				0.0		0.0	
Septic Systems				1907.7		0.0	
Totals	13801	5293630		46333		3063	

Print | Export to JPEG | Exit

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Unregulated Loads

Source	Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.98	0.12
Cropland	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	82.01	0.58
Forest	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.86	0.01
Wetland	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	00	0.00
Disturbed	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	04	0.02
Turfgrass	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.93	0.07
Open Land	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.87	0.07
Bare Rock	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	00	0.00
Sandy Areas	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	00	0.00
Unpaved Roads	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	00	0.00
LD Mixed	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	26	0.04
MD Mixed	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.62	0.19
HD Mixed	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8.55	0.19
LD Residential	242	3747.86	15.50	94.73	0.39	10.23	0.04
MD Residential	2288	164927.82	72.10	3950.00	1.73	437.79	0.19
HD Residential	10	705.48	70.50	17.06	1.71	1.90	0.19
Water	6.43939472						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		2701052.9		1351.4		332.9	
Groundwater				24016.7		317.8	
Point Sources				0.0		0.0	
Septic Systems				1907.7		0.0	
Totals	13801	5296180		46359		3065	

Print | Export to JPEG | Exit

SLAB CABIN RUN
Ferguson Township

COMPUTE MUNICIPAL LOAD
(in Excel)

Row Letter	Output	Computation	Total Sediment Load (lb)	Total Nitrogen Load (lb)	Total Phosphorus Load (lb)
A	Slab Cabin Run Watershed Baseline		5,308,910	46,377	3,069
B	Ferguson Township Baseline Load Without BMPs		521,100	4,552	324
C	Slab Cabin Run Watershed Load with Ferguson Township's RR Reductions		5,293,630	46,333	3,063
D	Ferguson Township RR Reductions	D=A-C	15,280	44	6
E	Slab Cabin Run Watershed Load with Ferguson Township's ST Reductions		5,296,180	46,359	3,065
F	Ferguson Township's ST Reduction	F = A-E	12,730	18	4
G	Ferguson Township Load	G = B-(D+F)	493,090	4,490	314

SLAB CABIN RUN
Penn State

AGGREGATE BMP DATA
(in Excel)

Land Area in University Park that drains to a Stormwater Treatment (ST) BMP

ST	LD (hectares treated)	MD (hectares treated)	HD (hectares treated)	LD Mixed (hectares treated)	MD Mixed (hectares treated)	HD Mixed (hectares treated)
Big Hollow	0.00	0.00	0.00	3.53	0.00	2.01
Slab Cabin	0.00	0.00	0.00	0.28	0.95	7.41

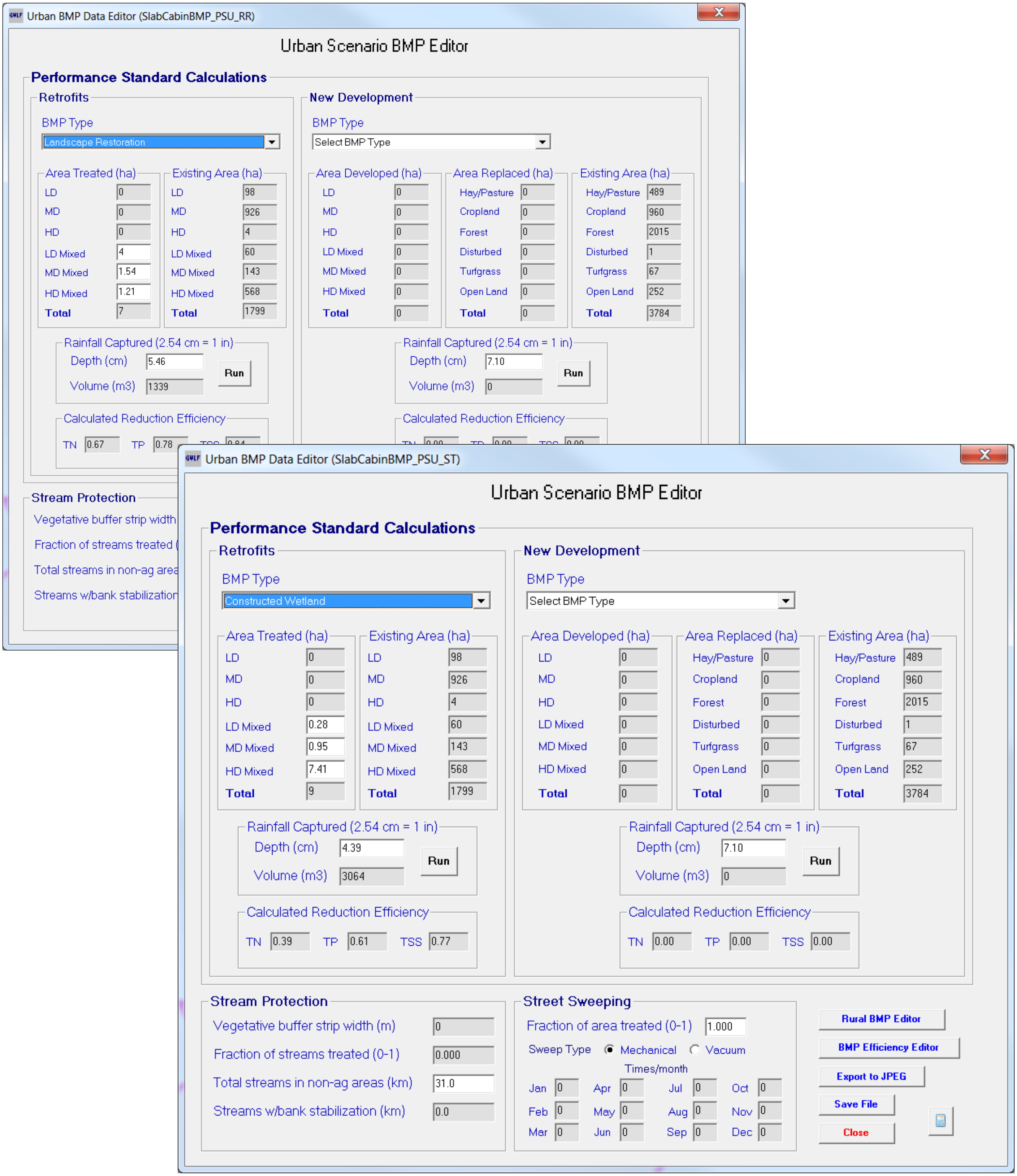
Land Area in University Park that drains to a Runoff Reduction (RR) BMP

RR	LD (hectares treated)	MD (hectares treated)	HD (hectares treated)	LD Mixed (hectares treated)	MD Mixed (hectares treated)	HD Mixed (hectares treated)
Big Hollow	0.00	0.00	0.00	0.00	0.02	0.51
Slab Cabin	0.00	0.00	0.00	4.00	1.54	1.21

	Average rainfall removal			Average rainfall removal	
ST	in	cm	RR	inches	cm
Big Hollow	2.40	6.10	Big Hollow	2.07	5.25
Slab Cabin	1.73	4.39	Slab Cabin	2.15	5.46

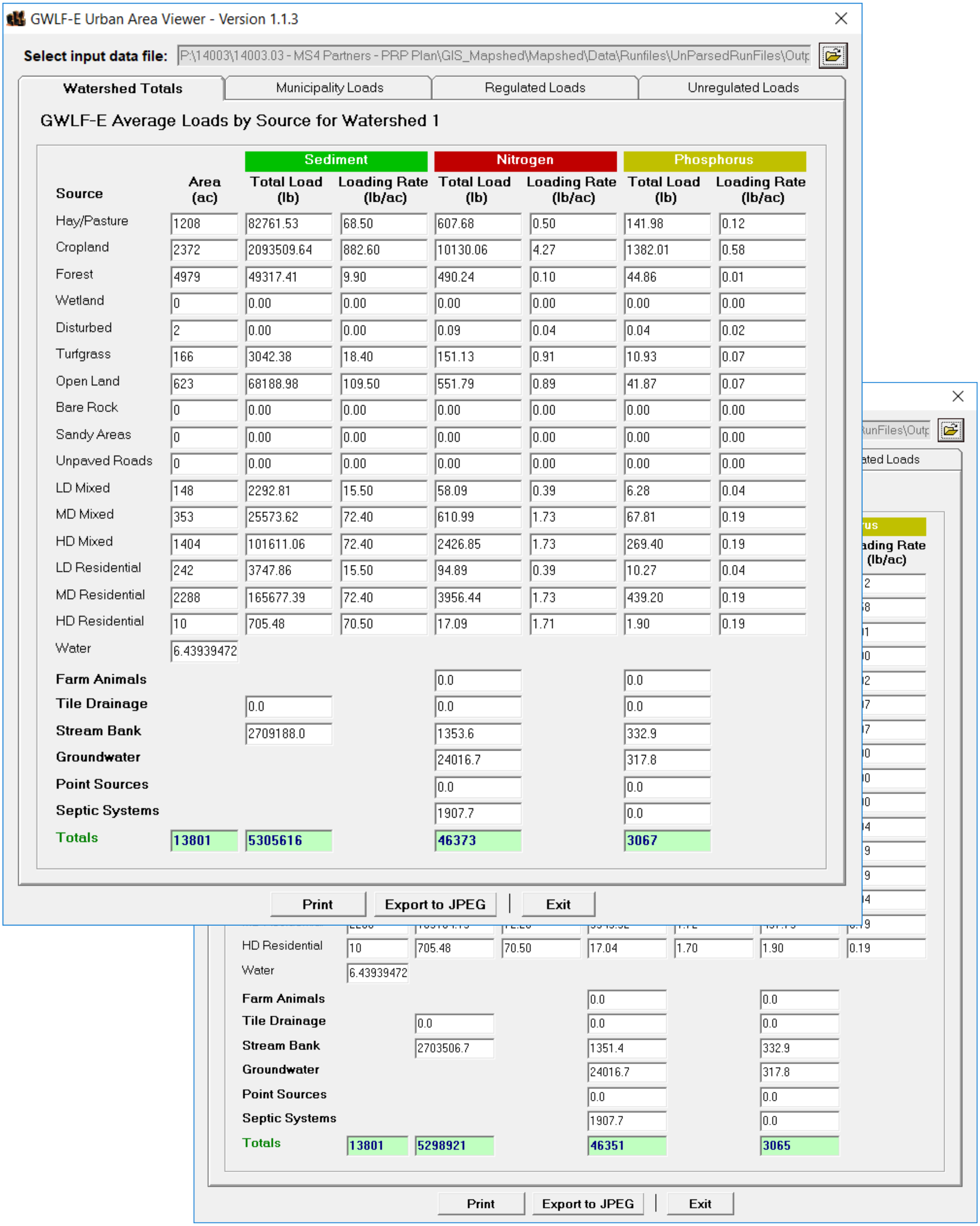
SLAB CABIN RUN
Penn State

Modify Urban BMP Data Editor and Run GWLF-E



SLAB CABIN RUN
Penn State

URBAN AREA TOOL OUTPUT (Post-BMP)



GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\UnParsedRunFiles\Outp

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

GWLF-E Average Loads by Source for Watershed 1

Source	Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	1208	82761.53	68.50	607.68	0.50	141.98	0.12
Cropland	2372	2093509.64	882.60	10130.06	4.27	1382.01	0.58
Forest	4979	49317.41	9.90	490.24	0.10	44.86	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	2	0.00	0.00	0.09	0.04	0.04	0.02
Turfgrass	166	3042.38	18.40	151.13	0.91	10.93	0.07
Open Land	623	68188.98	109.50	551.79	0.89	41.87	0.07
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	148	2292.81	15.50	58.09	0.39	6.28	0.04
MD Mixed	353	25573.62	72.40	610.99	1.73	67.81	0.19
HD Mixed	1404	101611.06	72.40	2426.85	1.73	269.40	0.19
LD Residential	242	3747.86	15.50	94.89	0.39	10.27	0.04
MD Residential	2288	165677.39	72.40	3956.44	1.73	439.20	0.19
HD Residential	10	705.48	70.50	17.09	1.71	1.90	0.19
Water	6.43939472						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		2709188.0		1353.6		332.9	
Groundwater				24016.7		317.8	
Point Sources				0.0		0.0	
Septic Systems				1907.7		0.0	
Totals	13801	5305616		46373		3067	

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Source	Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
HD Residential	10	705.48	70.50	17.04	1.70	1.90	0.19
Water	6.43939472						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		2703506.7		1351.4		332.9	
Groundwater				24016.7		317.8	
Point Sources				0.0		0.0	
Septic Systems				1907.7		0.0	
Totals	13801	5298921		46351		3065	

Print | Export to JPEG | Exit

SLAB CABIN RUN
Penn State

COMPUTE MUNICIPAL LOAD
(in Excel)

Row Letter	Output	Computation	Total Sediment Load (lb)	Total Nitrogen Load (lb)	Total Phosphorus Load (lb)
A	Slab Cabin Run Watershed Baseline		5,308,910	46,377	3,069
B	PSU Load Without BMPs		280,984	2,529	147
C	Slab Cabin Watershed with PSU ST Reductions		5,298,921	46,351	3,065
D	PSU ST Reductions	D = A-C	9,989	26	4
E	Slab Cabin Watershed with PSU RR Reductions		5,305,616	46,373	3,067
F	PSU RR Reductions	F = A-E	3,294	4	2
G	PSU Load	G = B-(D+F)	267,701	2,499	141

SLAB CABIN RUN
State College Borough

AGGREGATE BMP DATA (in Excel)

Land Area in State College Borough that drain to a Stormwater Treatment (ST) BMP

ST	LD (hectacres treated)	MD (hectacres treated)	HD (hectacres treated)	LD Mixed (hectacres treated)	MD Mixed (hectacres treated)	HD Mixed (hectacres treated)
Slab Cabin	0.00	208.85	0.00	0.00	69.62	0.00
Big Hollow	0.00	0.00	0.00	0.00	0.00	0.00

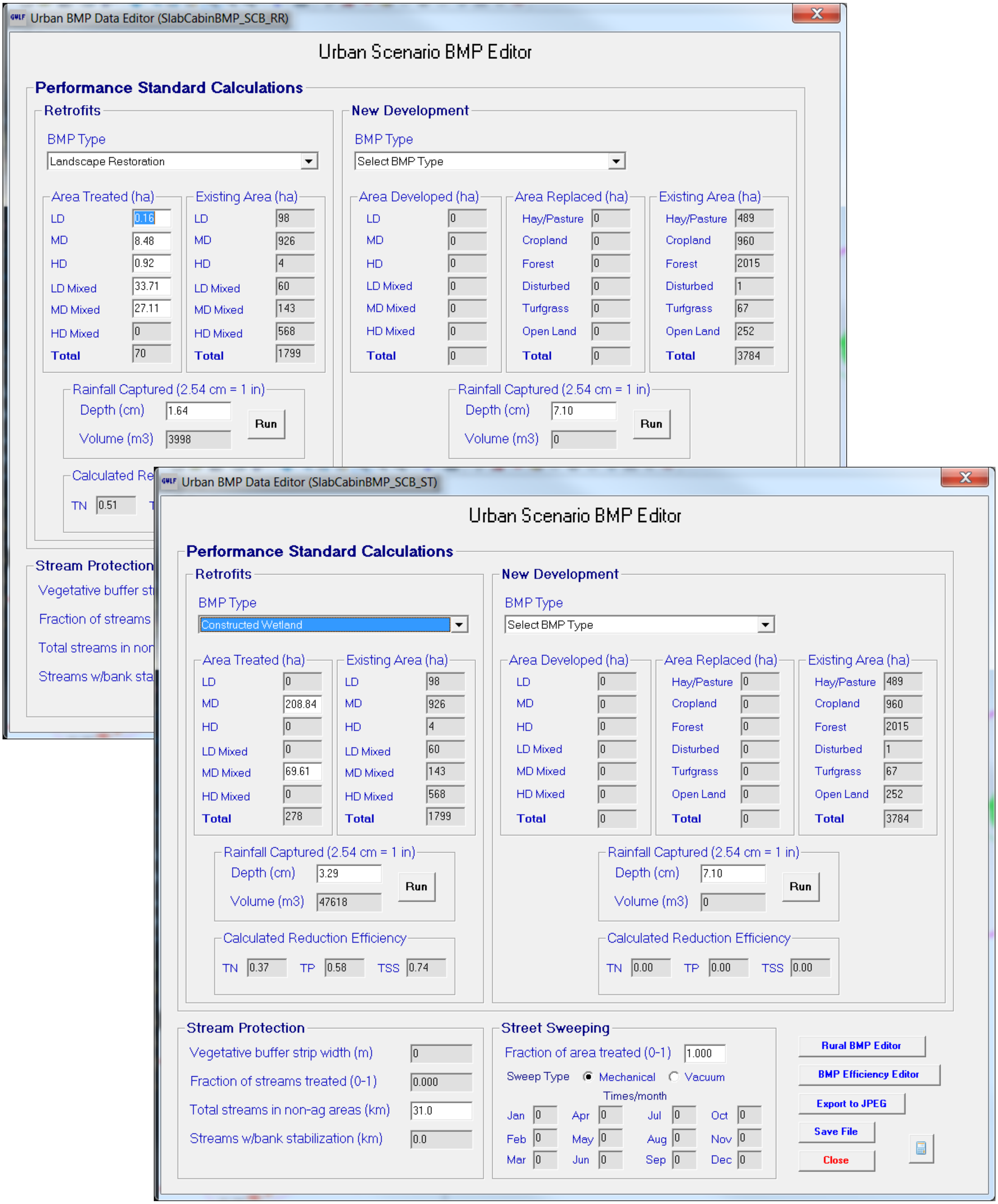
Land Area in University Park that drain to a Stormwater Treatment (ST) BMP

RR	LD (hectacres treated)	MD (hectacres treated)	HD (hectacres treated)	LD Mixed (hectacres treated)	MD Mixed (hectacres treated)	HD Mixed (hectacres treated)
Slab Cabin	0.16	8.48	0.92	33.72	27.12	0.00
Big Hollow	0.00	0.00	0.00	0.00	5.57	0.00

	Average rainfall removal			Average rainfall removal	
ST	in	cm	RR	in	cm
Slab Cabin	1.30	3.29	Slab Cabin	0.65	1.64
Big Hollow	NA	NA	Big Hollow	0.98	2.48

SLAB CABIN RUN
State College Borough

Modify Urban BMP Data Editor and Run GWLF-E



SLAB CABIN RUN
State College Borough

URBAN AREA TOOL OUTPUT (Post-BMP)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\UnParsedRunFiles\Outp

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

GWLF-E Average Loads by Source for Watershed 1

Source	Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	1208	82761.53	68.50	607.68	0.50	141.98	0.12
Cropland	2372	2093509.64	882.60	10130.06	4.27	1382.01	0.58
Forest	4979	49317.41	9.90	490.24	0.10	44.86	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	2	0.00	0.00	0.09	0.04	0.04	0.02
Turfgrass	166	3042.38	18.40	151.13	0.91	10.93	0.07
Open Land	623	68188.98	109.50	551.79	0.89	41.87	0.07
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	148	2270.76	15.30	57.52	0.39	6.22	0.04
MD Mixed	353	25264.98	71.60	604.86	1.71	67.02	0.19
HD Mixed	1404	100332.38	71.50	2402.49	1.71	266.21	0.19
LD Residential	242	3703.77	15.30	93.94	0.39	10.14	0.04
MD Residential	2288	163583.00	71.50	3916.73	1.71	434.00	0.19
HD Residential	10	705.48	70.50	16.91	1.69	1.87	0.19
Water	6.43939472						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		2682897.9		1340.4		330.7	
Groundwater				24016.7		317.8	
Point Sources				0.0		0.0	
Septic Systems				1907.7		0.0	
Totals	13801	5275578		46288		3056	

Print | Export to JPEG | Exit

edRunFiles\Outp

egulated Loads

horus Loading Rate (lb/ac)
0.12
0.58
0.01
0.00
0.02
0.07
0.07
0.00
0.00
0.00
0.04
0.18
0.18
0.04
0.18
0.17

Source	Area (ac)	Sediment Total Load (lb)	Nitrogen Total Load (lb)	Phosphorus Total Load (lb)
Water	6.43939472			
Farm Animals			0.0	0.0
Tile Drainage		0.0	0.0	0.0
Stream Bank		2530622.4	1265.5	310.9
Groundwater			24016.7	317.8
Point Sources			0.0	0.0
Septic Systems			1907.7	0.0
Totals	13801	5097795	45939	2985

Print | Export to JPEG | Exit

SLAB CABIN RUN
State College Borough

COMPUTE MUNICIPAL LOAD

(in Excel)

Row Letter	Output	Computation	Total Sediment Load (lb)	Total Nitrogen Load (lb)	Total Phosphorus Load (lb)
A	Slab Cabin Run Watershed Baseline		5,308,910	46,377	3,069
B	SCB Load Without BMPs		699,156	7,828	437
C	Slab Cabin Watershed with SCB RR BMPs		5,275,578	46,288	3,056
D	SCB RR Reduction	D=A-C	33,332	89	13
E	Slab Cabin Watershed with SCB ST BMPs		5,097,795	45,939	2,985
F	SCB ST Reduction	F = A-E	211,115	438	84
G	Walnut Springs Sediment Trap Reduction		64,882	704	85
H	SCB Load in Slab Cabin Run	H= B-(D+F+G)	389,827	6,597	255

Big Hollow

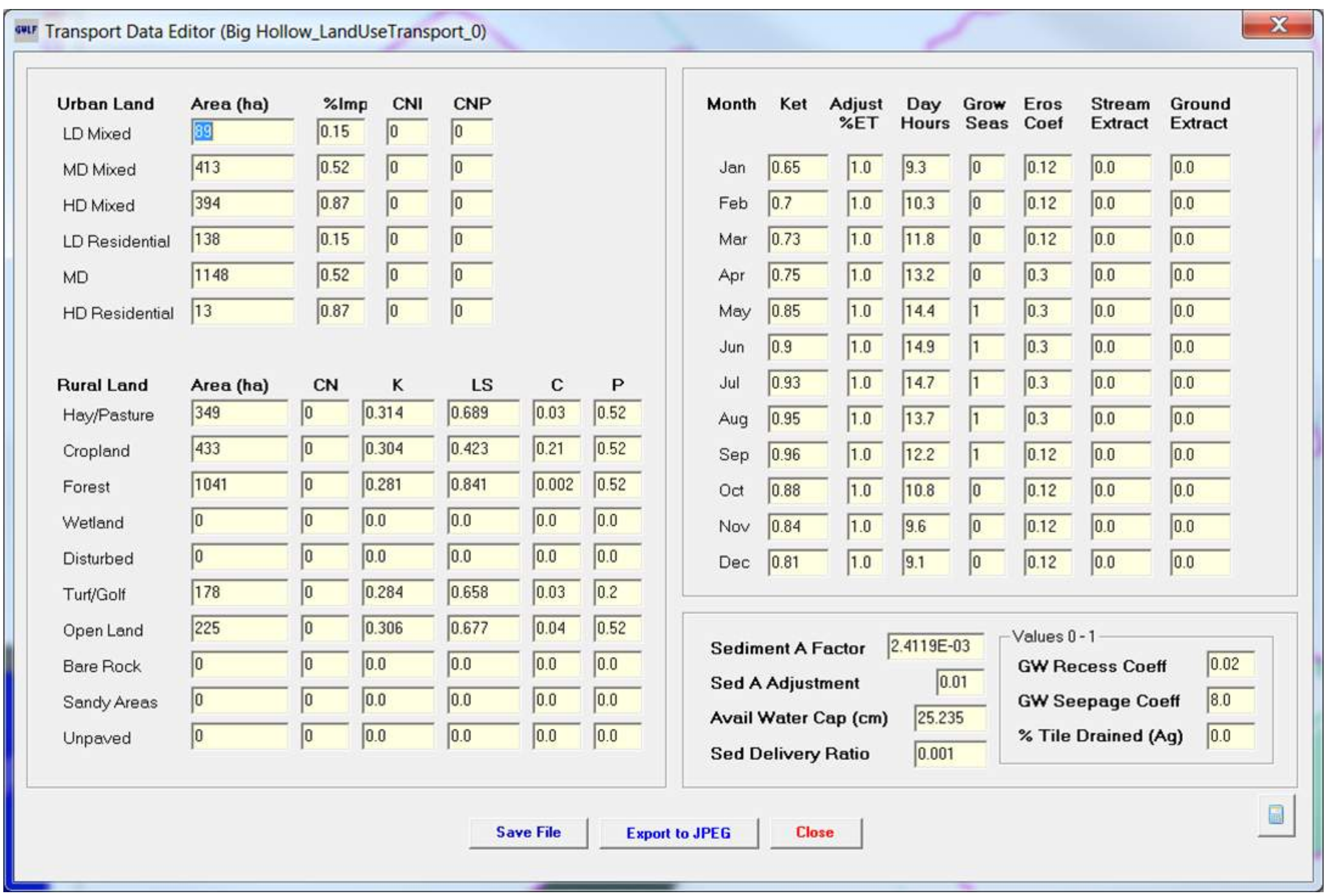
Big Hollow (two subsheds)		
	Land Use From Mapsheds*	Revised Land Use
	Area (ha)	**Area (ha)**
LD Mixed	89	89
MD Mixed	413	413
HD Mixed	394	394
LD Residential	131	138
MD Mixed	1115	1148
HD Residential	11	13
Hay/Pasture	352	349
Cropland	456	433
Forest	1055	1041
Wetland	0	0
Distrurbed	0	0
Turf/Golf	178	178
Open Land	227	225
Bare Rock	0	0
Sandy Area	0	0
Unpaved	0	0
Total	**4421**	**4421**

LAND USE CONVERSIONS

(in Excel)

Open Basin Input File in GWLF-E & Make Land Use Adjustments in the

TRANSPORT DATA EDITOR



Transport Data Editor (Big Hollow_LandUseTransport_0)

Urban Land	Area (ha)	%Imp	CNI	CNP
LD Mixed	89	0.15	0	0
MD Mixed	413	0.52	0	0
HD Mixed	394	0.87	0	0
LD Residential	138	0.15	0	0
MD	1148	0.52	0	0
HD Residential	13	0.87	0	0

Rural Land	Area (ha)	CN	K	LS	C	P
Hay/Pasture	349	0	0.314	0.689	0.03	0.52
Cropland	433	0	0.304	0.423	0.21	0.52
Forest	1041	0	0.281	0.841	0.002	0.52
Wetland	0	0	0.0	0.0	0.0	0.0
Disturbed	0	0	0.0	0.0	0.0	0.0
Turf/Golf	178	0	0.284	0.658	0.03	0.2
Open Land	225	0	0.306	0.677	0.04	0.52
Bare Rock	0	0	0.0	0.0	0.0	0.0
Sandy Areas	0	0	0.0	0.0	0.0	0.0
Unpaved	0	0	0.0	0.0	0.0	0.0

Month	Ket	Adjust %ET	Day Hours	Grow Seas	Eros Coef	Stream Extract	Ground Extract
Jan	0.65	1.0	9.3	0	0.12	0.0	0.0
Feb	0.7	1.0	10.3	0	0.12	0.0	0.0
Mar	0.73	1.0	11.8	0	0.12	0.0	0.0
Apr	0.75	1.0	13.2	0	0.3	0.0	0.0
May	0.85	1.0	14.4	1	0.3	0.0	0.0
Jun	0.9	1.0	14.9	1	0.3	0.0	0.0
Jul	0.93	1.0	14.7	1	0.3	0.0	0.0
Aug	0.95	1.0	13.7	1	0.3	0.0	0.0
Sep	0.96	1.0	12.2	1	0.12	0.0	0.0
Oct	0.88	1.0	10.8	0	0.12	0.0	0.0
Nov	0.84	1.0	9.6	0	0.12	0.0	0.0
Dec	0.81	1.0	9.1	0	0.12	0.0	0.0

Sediment A Factor	2.4119E-03
Sed A Adjustment	0.01
Avail Water Cap (cm)	25.235
Sed Delivery Ratio	0.001

Values 0 - 1

GW Recess Coeff	0.02
GW Seepage Coeff	8.0
% Tile Drained (Ag)	0.0

Save File | Export to JPEG | Close

Big Hollow

URBAN AREA TOOL OUTPUT (baseline)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\UnParsedRunFiles\Outp

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

GWLF-E Average Loads by Source for Watershed 0

Source	**Area (ac)**	**Sediment** Total Load (lb)	**Sediment** Loading Rate (lb/ac)	**Nitrogen** Total Load (lb)	**Nitrogen** Loading Rate (lb/ac)	**Phosphorus** Total Load (lb)	**Phosphorus** Loading Rate (lb/ac)
Hay/Pasture	862	529.11	0.60	1.06	0.00	0.29	0.00
Cropland	1070	2711.69	2.50	5.42	0.01	1.46	0.00
Forest	2572	110.23	0.00	0.22	0.00	0.07	0.00
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	440	88.18	0.20	0.18	0.00	0.04	0.00
Open Land	556	440.92	0.80	0.86	0.00	0.22	0.00
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	220	0.00	0.00	0.00	0.00	0.00	0.00
MD Mixed	1021	0.00	0.00	0.00	0.00	0.00	0.00
HD Mixed	974	0.00	0.00	0.00	0.00	0.00	0.00
LD Residential	341	0.00	0.00	0.00	0.00	0.00	0.00
MD Residential	2837	0.00	0.00	0.00	0.00	0.00	0.00
HD Residential	32	0.00	0.00	0.00	0.00	0.00	0.00
Water	14.1524218						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		2645.5		2.2		0.0	
Groundwater				503.5		7.2	
Point Sources				0.0		0.0	
Septic Systems				2742.6		0.0	
Totals	**10939**	**6526**		**3256**		**9**	

Print | Export to JPEG | Exit

Big Hollow

URBAN AREA TOOL OUTPUT
(Ferguson)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\UnParsedRunFiles\Outp

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: Ferguson Twp (00002)

		Sediment		Nitrogen		Phosphorus	
Source	**Source Area (ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**
Hay/Pasture	94	56.40	0.60	0.00	0.00	0.00	0.00
Cropland	213	532.50	2.50	2.10	0.01	0.00	0.00
Forest	133	0.00	0.00	0.00	0.00	0.00	0.00
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	15	3.00	0.20	0.00	0.00	0.00	0.00
Open Land	198	158.40	0.80	0.00	0.00	0.00	0.00
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	52	0.00	0.00	0.00	0.00	0.00	0.00
MD Mixed	309	0.00	0.00	0.00	0.00	0.00	0.00
HD Mixed	213	0.00	0.00	0.00	0.00	0.00	0.00
LD Residential	62	0.00	0.00	0.00	0.00	0.00	0.00
MD Residential	1174	0.00	0.00	0.00	0.00	0.00	0.00
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						**Source Weighting**
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		710.54		0.6		0.0	0.334
Groundwater				145.5		2.1	0.289
Point Sources				0.0		0.0	0.000
Septic Systems				523.8		0.0	0.191
Totals	**2463**	**1460.8**		**672.0**		**2.1**	

Print | Export to JPEG | Exit

Big Hollow

URBAN AREA TOOL OUTPUT
(Patton)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\UnParsedRunFiles\Outp

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: Patton Twp (00004)

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	20	12.00	0.60	0.00	0.00	0.00	0.00
Cropland	77	192.50	2.50	0.80	0.01	0.00	0.00
Forest	299	0.00	0.00	0.00	0.00	0.00	0.00
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	54	10.80	0.20	0.00	0.00	0.00	0.00
Open Land	62	49.60	0.80	0.00	0.00	0.00	0.00
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	17	0.00	0.00	0.00	0.00	0.00	0.00
MD Mixed	331	0.00	0.00	0.00	0.00	0.00	0.00
HD Mixed	116	0.00	0.00	0.00	0.00	0.00	0.00
LD Residential	106	0.00	0.00	0.00	0.00	0.00	0.00
MD Residential	909	0.00	0.00	0.00	0.00	0.00	0.00
HD Residential	27	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						

Source	Source Area (ac)	Sediment Total Load (lb)	Nitrogen Total Load (lb)	Phosphorus Total Load (lb)	Source Weighting
Farm Animals			0.0	0.0	0.000
Tile Drainage		0.00	0.0	0.0	0.000
Stream Bank		578.68	0.5	0.0	0.270
Groundwater			110.3	1.6	0.219
Point Sources			0.0	0.0	0.000
Septic Systems			899.6	0.0	0.328
Totals	2018	843.6	1011.2	1.6	

Print | Export to JPEG | Exit

Big Hollow

URBAN AREA TOOL OUTPUT
(Penn State)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\UnParsedRunFiles\Outp

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: Psu (00005)

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	44	26.40	0.60	0.00	0.00	0.00	0.00
Cropland	35	87.50	2.50	0.40	0.01	0.00	0.00
Forest	10	0.00	0.00	0.00	0.00	0.00	0.00
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	193	38.60	0.20	0.00	0.00	0.00	0.00
Open Land	32	25.60	0.80	0.00	0.00	0.00	0.00
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	10	0.00	0.00	0.00	0.00	0.00	0.00
MD Mixed	27	0.00	0.00	0.00	0.00	0.00	0.00
HD Mixed	183	0.00	0.00	0.00	0.00	0.00	0.00
LD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Residential	7	0.00	0.00	0.00	0.00	0.00	0.00
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						Source Weighting
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		143.05		0.1		0.0	0.061
Groundwater				21.1		0.3	0.042
Point Sources				0.0		0.0	0.000
Septic Systems				0.0		0.0	0.000
Totals	541	321.2		21.6		0.3	

Print | Export to JPEG | Exit

Big Hollow

URBAN AREA TOOL OUTPUT
(State College Borough)

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\UnParsedRunFiles\Outp

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: State College Boro (00006)

		Sediment		Nitrogen		Phosphorus	
Source	**Source Area (ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**
Hay/Pasture	0	0.00	0.00	0.00	0.00	0.00	0.00
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	0	0.00	0.00	0.00	0.00	0.00	0.00
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	2	0.40	0.20	0.00	0.00	0.00	0.00
Open Land	0	0.00	0.00	0.00	0.00	0.00	0.00
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Mixed	0	0.00	0.00	0.00	0.00	0.00	0.00
HD Mixed	25	0.00	0.00	0.00	0.00	0.00	0.00
LD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Residential	272	0.00	0.00	0.00	0.00	0.00	0.00
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						**Source Weighting**
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		102.65		0.1		0.0	0.056
Groundwater				20.6		0.3	0.041
Point Sources				0.0		0.0	0.000
Septic Systems				0.0		0.0	0.000
Totals	299	103.1		20.7		0.3	

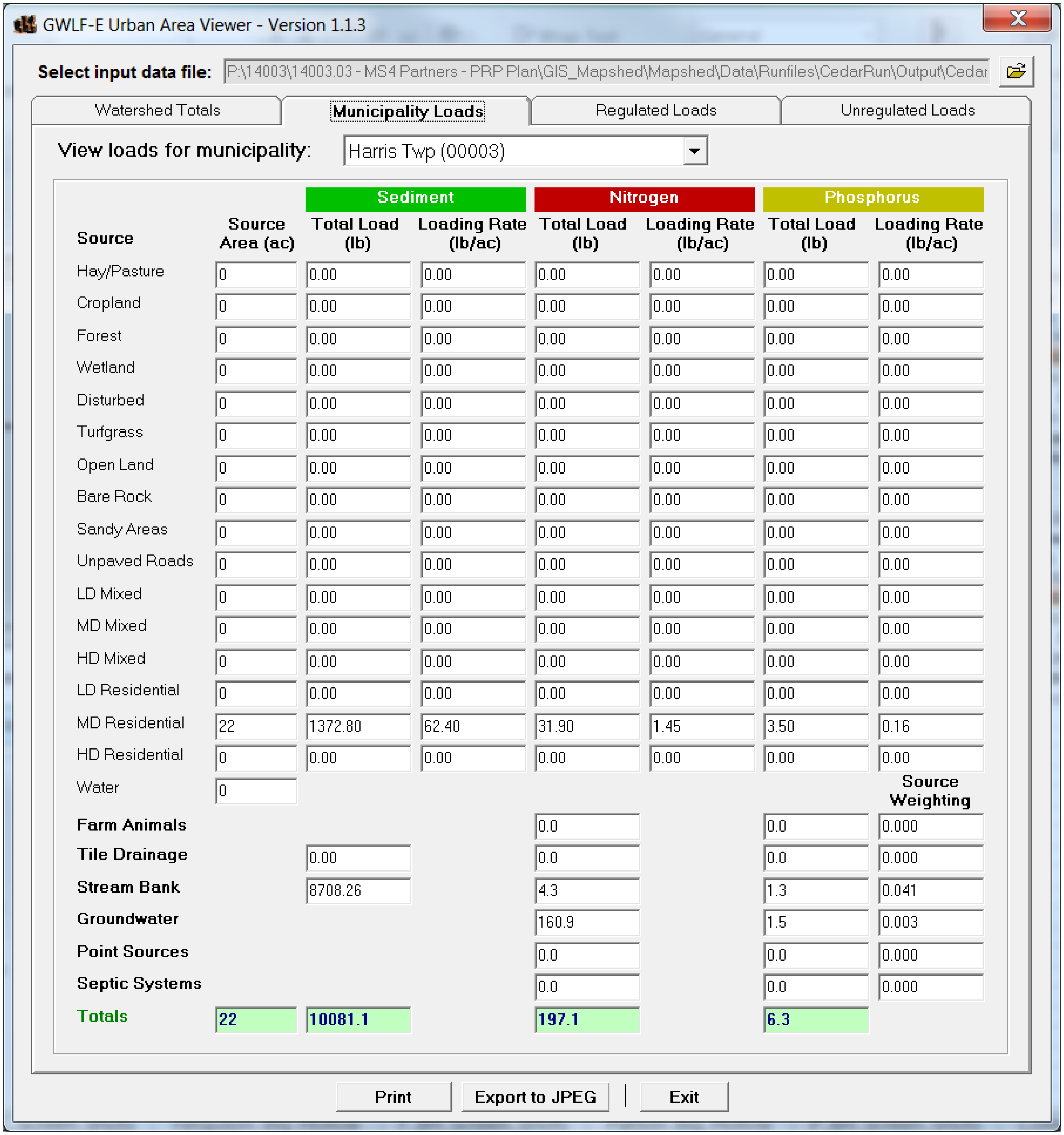
Print | Export to JPEG | Exit

URBAN AREA TOOL OUTPUT (Post-BMP)

BMPs did not have any impact on the baseline load; therefore the baseline load is the final load

Cedar Run
Harris Township

No Land use Changes or BMPs in Cedar Run Watershed



GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\CedarRun\Output\Cedar

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

View loads for municipality: Harris Twp (00003)

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	0	0.00	0.00	0.00	0.00	0.00	0.00
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	0	0.00	0.00	0.00	0.00	0.00	0.00
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	0	0.00	0.00	0.00	0.00	0.00	0.00
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Mixed	0	0.00	0.00	0.00	0.00	0.00	0.00
HD Mixed	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Residential	22	1372.80	62.40	31.90	1.45	3.50	0.16
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						Source Weighting
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		8708.26		4.3		1.3	0.041
Groundwater				160.9		1.5	0.003
Point Sources				0.0		0.0	0.000
Septic Systems				0.0		0.0	0.000
Totals	22	10081.1		197.1		6.3	

Print | Export to JPEG | Exit

Basin Retrofits - Supporting Computations

Westerly Parkway Retrofit #C8

Local ID	DA (acres)	DA (Hectares)	Tributary Imperv. Area (acres)	BMP Type	Watershed	Design Volume** (ac-ft)	Rainfall Capture in/IA
SC 110	139.00	56.25	72.28	ST	Slab Cabin	24.56	4.08

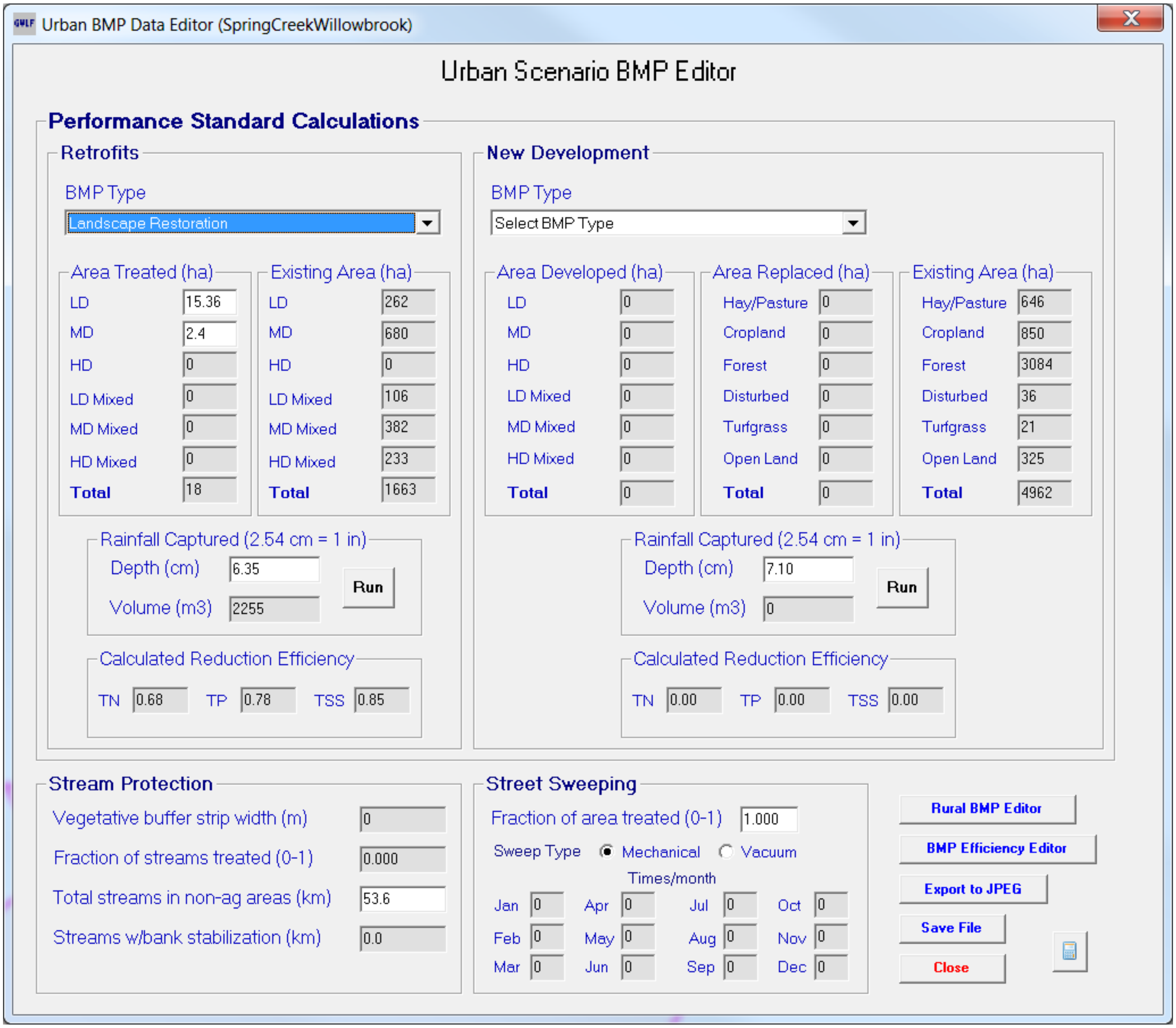
Rainfall Capture = (12*EP)/IA

Where, EP = Engineering Parameter which is the BMP capture volume in acre-feet
IA = impervious area in acres.

Willowbrook Basin Retrofit #A7

Surface area of basin (ac)	1.07		
Basin Depth (ft)	1.31		
Runoff Storage (ac-ft) Volume, liberal assumption of 2.5 inches of rainfall removal	1.80		
Imperviousness Acres in Drainage Area (ac), provided by Tsp	8.80		
Rainfall Removed (inches)	**2.45**		
Runoff Removal Depth (ft)	**1.71**		
Rainfall Removed (cm)	6.23		
Infiltration rate needed remove 20 inches in 72 hours	0.28	inches per hour	
Drainage Area (acres), provided by Tsp	44.00		
Drainage Area (hectares), provided by Tsp	17.81		
Percent Imperviousness	0.20		
How to Replicate 20% Imperviousness in Mapsheds			
	Hectares	Impervious Hectares	
LD (15% imperv)	15.36	2.30	
MD (52% imperv)	2.40	1.25	
Drainage Area Total	17.76	3.55	
Weighted Imperviousness	20%		
	TSS	**TN**	**TP**
Baseline Spring Creek Sediment Load (lbs)	5,438,379	50937	2975
Baseline with Willowbrook (lbs)	5,432,355	50935	2975
Load Reduction from Willowbrook (lbs)	**6,024**	**2**	**0**

Willowbrook Basin Retrofit #A7
GWLF-E Urban BMP Input



Willowbrook Basin Retrofit #A7
Urban Area Tool Output

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\SpringCreek\Output\Will

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

GWLF-E Average Loads by Source for Watershed 2

Source	Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	1596	92087.09	57.70	768.31	0.48	194.69	0.12
Cropland	2100	1504522.66	716.40	8271.10	3.94	1172.11	0.56
Forest	7621	77668.85	10.20	754.73	0.10	74.80	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	89	5180.86	58.20	13.23	0.15	4.32	0.05
Turfgrass	52	617.29	11.90	46.67	0.90	3.68	0.07
Open Land	803	72025.02	89.70	679.77	0.85	50.84	0.06
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	262	4122.64	15.70	102.80	0.39	11.09	0.04
MD Mixed	944	73458.03	77.80	1477.65	1.57	163.32	0.17
HD Mixed	576	44797.93	77.80	901.29	1.56	99.60	0.17
LD Residential	647	10207.40	15.80	254.08	0.39	27.43	0.04
MD Residential	1680	130756.17	77.80	2630.38	1.57	290.72	0.17
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	105.107869						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		3416911.5		1708.6		476.2	
Groundwater				29386.3		406.1	
Point Sources				0.0		0.0	
Septic Systems				3939.8		0.0	
Totals	16475	5432355		50935		2975	

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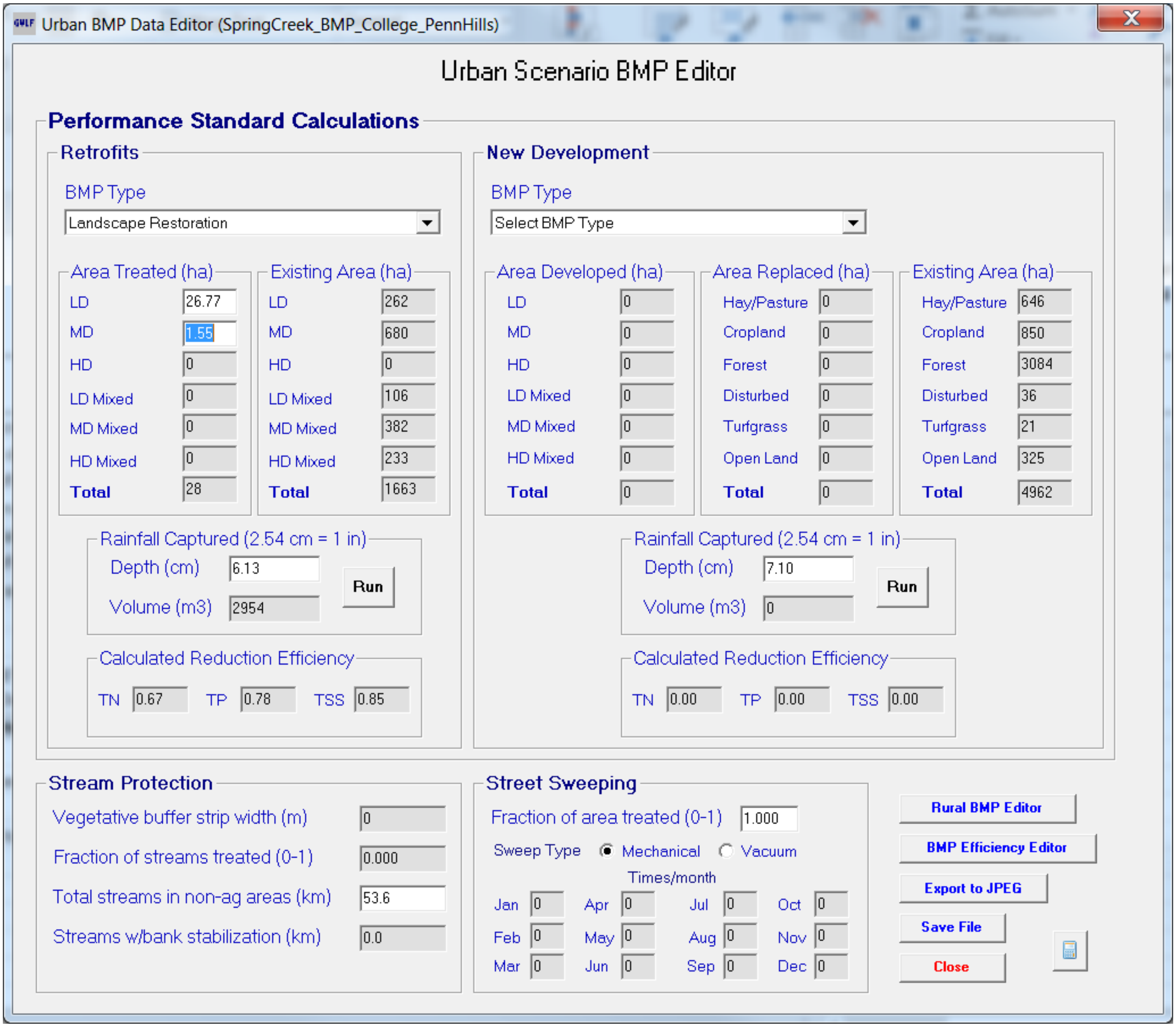
Penn Hills Basin Retrofit #A9

Penn Hills Basin		
surface area of basin (ac), estimated from GIS data	1.38	
Capture Depth depth (ft), selected to get close to 2.5 in on expert panel curve	1.75	
Runoff Storage Volume (ac-ft), assumption for 2.5 inch rainfall removal	2.5	
Runoff Removal depth ft	1.81	
Imperviousness Acres in Drainage Area (ac), provided by Tsp	12	
Rainfall Removed (inches)	**2.5**	
Infiltration rate to remove 22 inches (1.81 ft) in 72 hours	0.31	inches per hour
Drainage Area hectacres	28.32802	
Baseline Spring Creek Sediment Load	5,438,379	
Extended Detention	5428879	
Load Reduction from C-20	**9,500**	**removed sediment**
Percent Imperviousness	17%	
How to Replicate 17% imperviousness in Mapsheds		
hectacres	Urban Land Category	Imperviousness
26.77	LD	4.0155
1.55	MD	0.806
28.32	weighted imperviousness	17%

Penn Hills Basin Retrofit #A9
GWLF-E Urban BMP Input



Penn Hills Basin Retrofit #A9
Urban Area Tool Output

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\SpringCreek\Output\Per

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

GWLF-E Average Loads by Source for Watershed 2

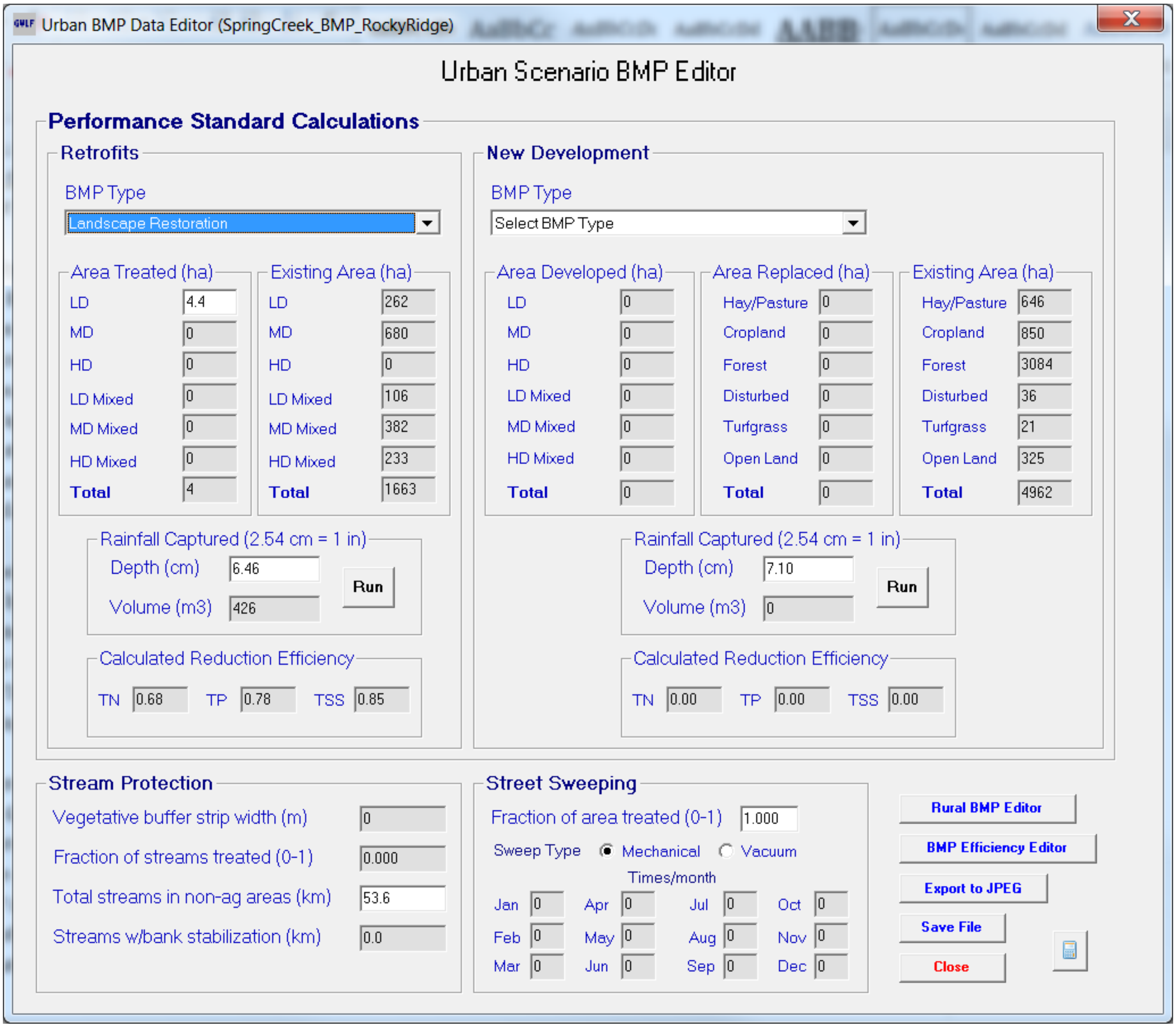
Source	Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	1596	92087.09	57.70	768.31	0.48	194.69	0.12
Cropland	2100	1504522.66	716.40	8271.10	3.94	1172.11	0.56
Forest	7621	77668.85	10.20	754.73	0.10	74.80	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	89	5180.86	58.20	13.23	0.15	4.32	0.05
Turfgrass	52	617.29	11.90	46.67	0.90	3.68	0.07
Open Land	803	72025.02	89.70	679.77	0.85	50.84	0.06
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	262	4100.60	15.70	102.38	0.39	11.05	0.04
MD Mixed	944	73083.24	77.40	1471.76	1.56	162.57	0.17
HD Mixed	576	44577.47	77.40	897.70	1.56	99.14	0.17
LD Residential	647	10163.31	15.70	253.07	0.39	27.29	0.04
MD Residential	1680	130094.78	77.40	2619.89	1.56	289.38	0.17
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	105.107869						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		3414757.6		1706.4		476.2	
Groundwater				29386.3		406.1	
Point Sources				0.0		0.0	
Septic Systems				3939.8		0.0	
Totals	16475	5428879		50911		2972	

Print | Export to JPEG | Exit

Rocky Ridge Basin Retrofit (#B6)

Rocky Ridge Basin Retrofit			
surface area of basin (ac)	0.50		
Runoff Storage Volume (ac-ft), liberal assumption of 2.5 inch rainfall removal	0.35		
Imperviousness Acres in Drainage Area (ac)	1.65		
Rainfall Removed (inches)	**2.5**	6.465455	cm
Infiltration rate to remove 20 inches in 72 hours	0.28	inches per hour	
Spring Creek Baseline	5,438,379		
Low Density with 2.5 inches of runoff removal	5,437,106		
Sediment reduction	**1,273.00**		
will need to excavate to get 2.5 inches of Runoff Reduction			
How to Replicate 15% imperviousness in Mapsheds			
	Urban Land Category	Imperviousness	
4.4	LD		

Rocky Ridge Basin Retrofit (#B6)
GWLF-E Urban BMP Input



Rocky Ridge Basin Retrofit (#B6)
Urban Area Tool Output

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\SpringCreek\Output\Roc

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

GWLF-E Average Loads by Source for Watershed 2

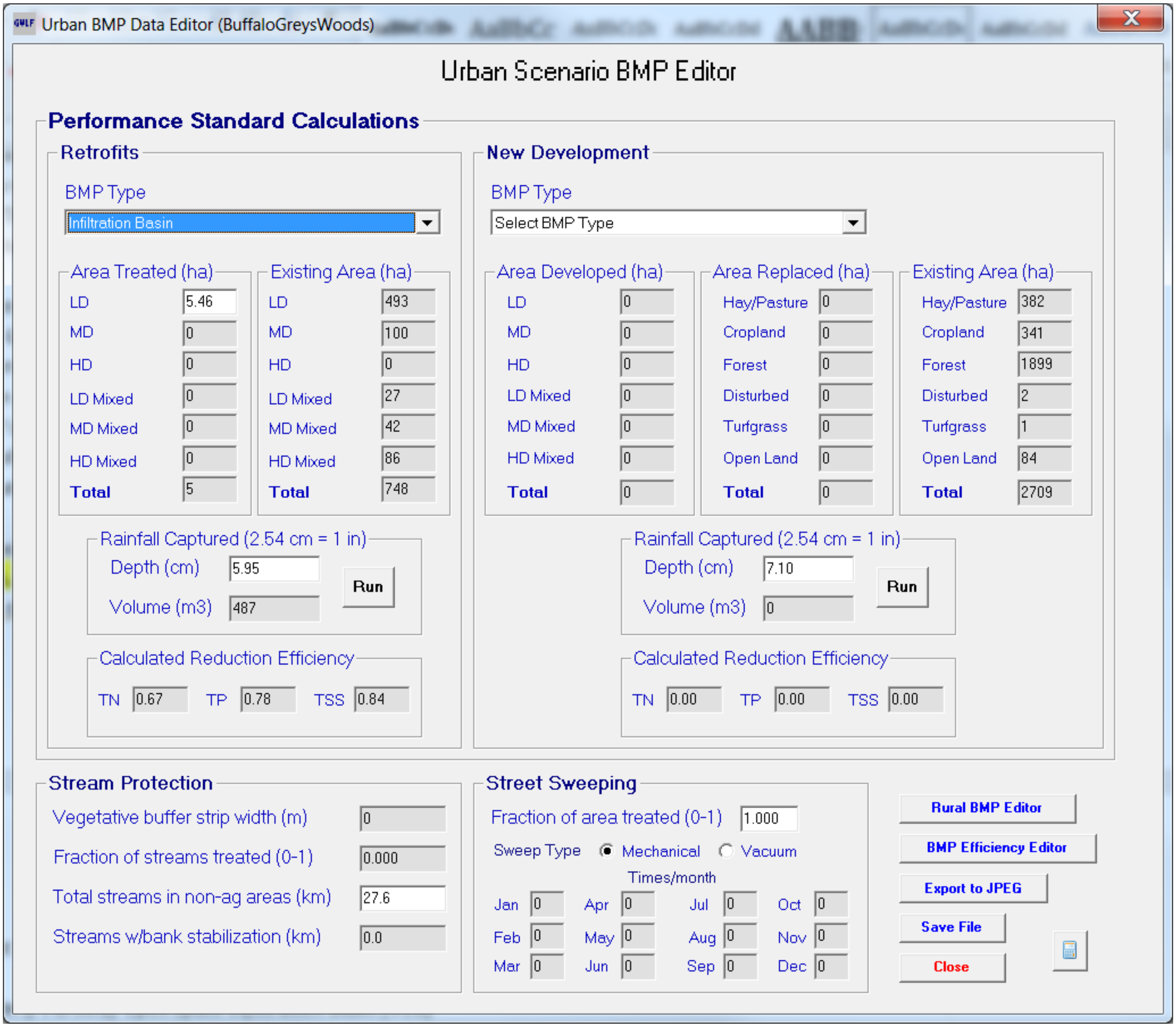
Source	Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	1596	92087.09	57.70	768.31	0.48	194.69	0.12
Cropland	2100	1504522.66	716.40	8271.10	3.94	1172.11	0.56
Forest	7621	77668.85	10.20	754.73	0.10	74.80	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	89	5180.86	58.20	13.23	0.15	4.32	0.05
Turfgrass	52	617.29	11.90	46.67	0.90	3.68	0.07
Open Land	803	72025.02	89.70	679.77	0.85	50.84	0.06
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	262	4122.64	15.70	102.74	0.39	11.09	0.04
MD Mixed	944	73413.93	77.80	1476.83	1.56	163.21	0.17
HD Mixed	576	44775.89	77.70	900.79	1.56	99.56	0.17
LD Residential	647	10207.40	15.80	253.93	0.39	27.40	0.04
MD Residential	1680	130667.98	77.80	2628.92	1.56	290.55	0.17
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	105.107869						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		3421816.8		1710.8		476.2	
Groundwater				29386.3		406.1	
Point Sources				0.0		0.0	
Septic Systems				3939.8		0.0	
Totals	16475	5437106		50934		2975	

Print | Export to JPEG | Exit

Greys Woods Basin Retrofit (#B4)

Greys Woods Basin			
Basin Surface Area (acres)	0.40		
Drainage Area (acres)	13.53175	5.466827	hectacres
LD Residential, % impervious	15%		
Acres of Impervious	2.029762		
Capture Depth (feet)	1		
RS (Runoff Storage Volume) acre-feet	0.40		
Runoff Capture	2.34	5.951112	cm
Infiltration rate to remove 12 inches in 72 hours	0.17		
Buffalo Run Baseline	2509152		
Greys Woods Run	2507540		
	1612		

Greys Woods Basin Retrofit (#B4)
GWLF-E Urban BMP Input



Greys Woods Basin Retrofit (#B4)
Urban Area Tool Output

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\BuffaloRun\Output\Grey:

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

GWLF-E Average Loads by Source for Watershed 0

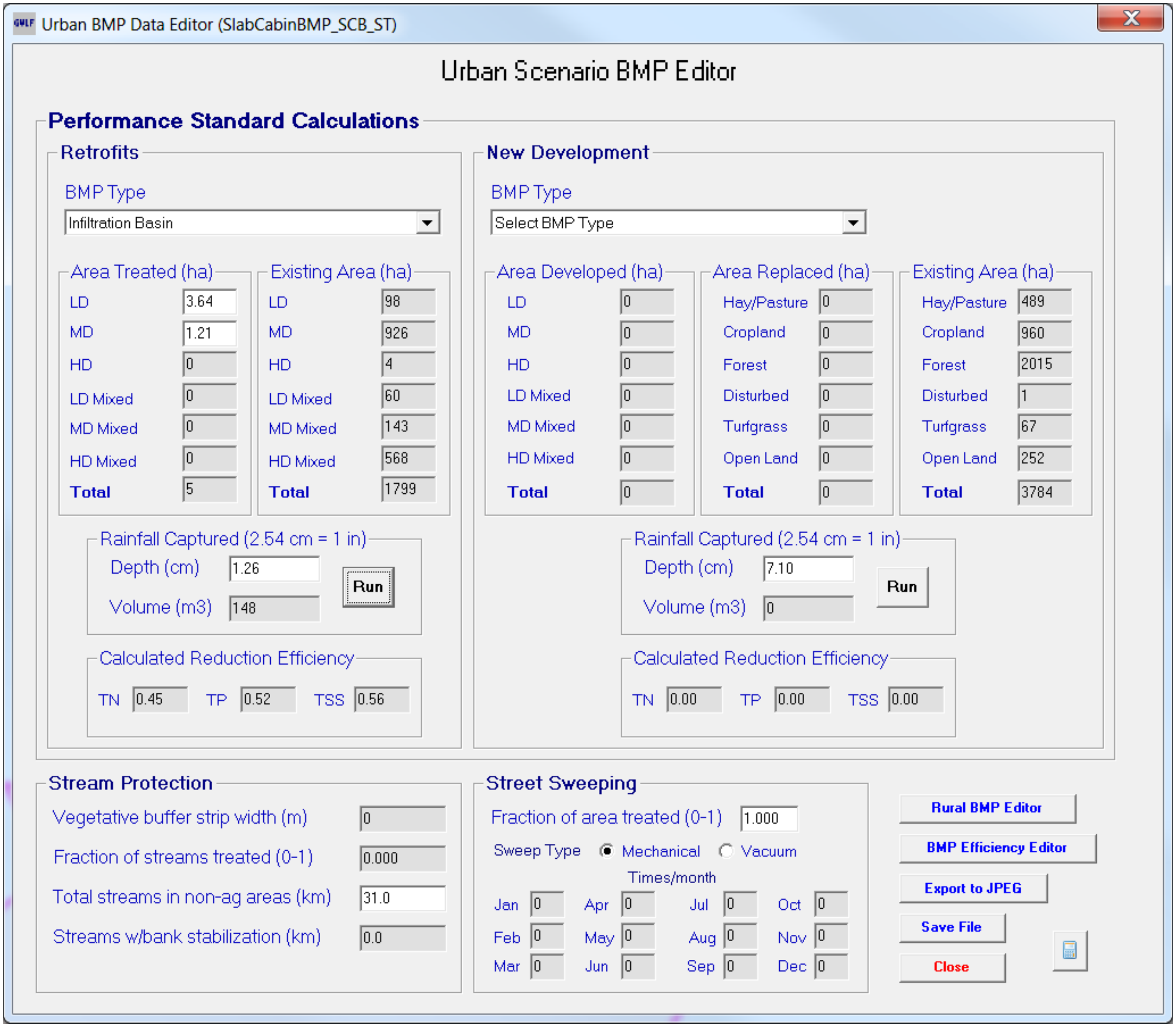
Source	Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	944	166449.01	176.30	661.89	0.70	171.67	0.18
Cropland	843	1003610.36	1190.50	4026.06	4.78	679.13	0.81
Forest	4693	67615.78	14.40	486.60	0.10	55.69	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	5	286.60	57.30	0.71	0.14	0.22	0.04
Turfgrass	2	0.00	0.00	0.62	0.25	0.04	0.02
Open Land	208	51301.57	246.60	235.59	1.13	30.89	0.15
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	67	1036.17	15.50	24.80	0.37	2.65	0.04
MD Mixed	104	7341.39	70.60	179.26	1.72	19.56	0.19
HD Mixed	213	15057.57	70.70	367.07	1.72	40.01	0.19
LD Residential	1218	18893.62	15.50	452.79	0.37	48.50	0.04
MD Residential	247	17504.70	70.90	426.84	1.73	46.54	0.19
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	5.52894619						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		1158443.2		579.8		158.7	
Groundwater				22844.4		324.4	
Point Sources				0.0		0.0	
Septic Systems				5432.1		0.0	
Totals	8550	2507540		35719		1578	

Print | Export to JPEG | Exit

Easterly Parkway Open Space Infiltration Basin (#C6)

Easterly Parkway						
Basin Surface Area (acres)	0.07					
Drainage Area (acres)	12.75					
			LD Mixed	9	0.15	3.64
LD Residential, % impervious	20%		MD Mixed	3	0.52	1.21
				12	0.24	
Acres of Impervious	2.55					
Capture Depth (feet)	1.5					
RS (Runoff Storage Volume) acre-feet	0.105					
Runoff Capture	0.49	1.26	cm			
Infiltration rate to remove 18 inches in 72 hours	0.25					
Slab Cabin Baseline	5308910					
Easterly Output	5307979					
	931					

Easterly Parkway Open Space Infiltration Basin (#C6)
GWLF-E Urban BMP Input



Easterly Parkway Open Space Infiltration Basin (#C6)
Urban Area Tool Output

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\SlabCabinRun\SCB_BM

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

GWLF-E Average Loads by Source for Watershed 1

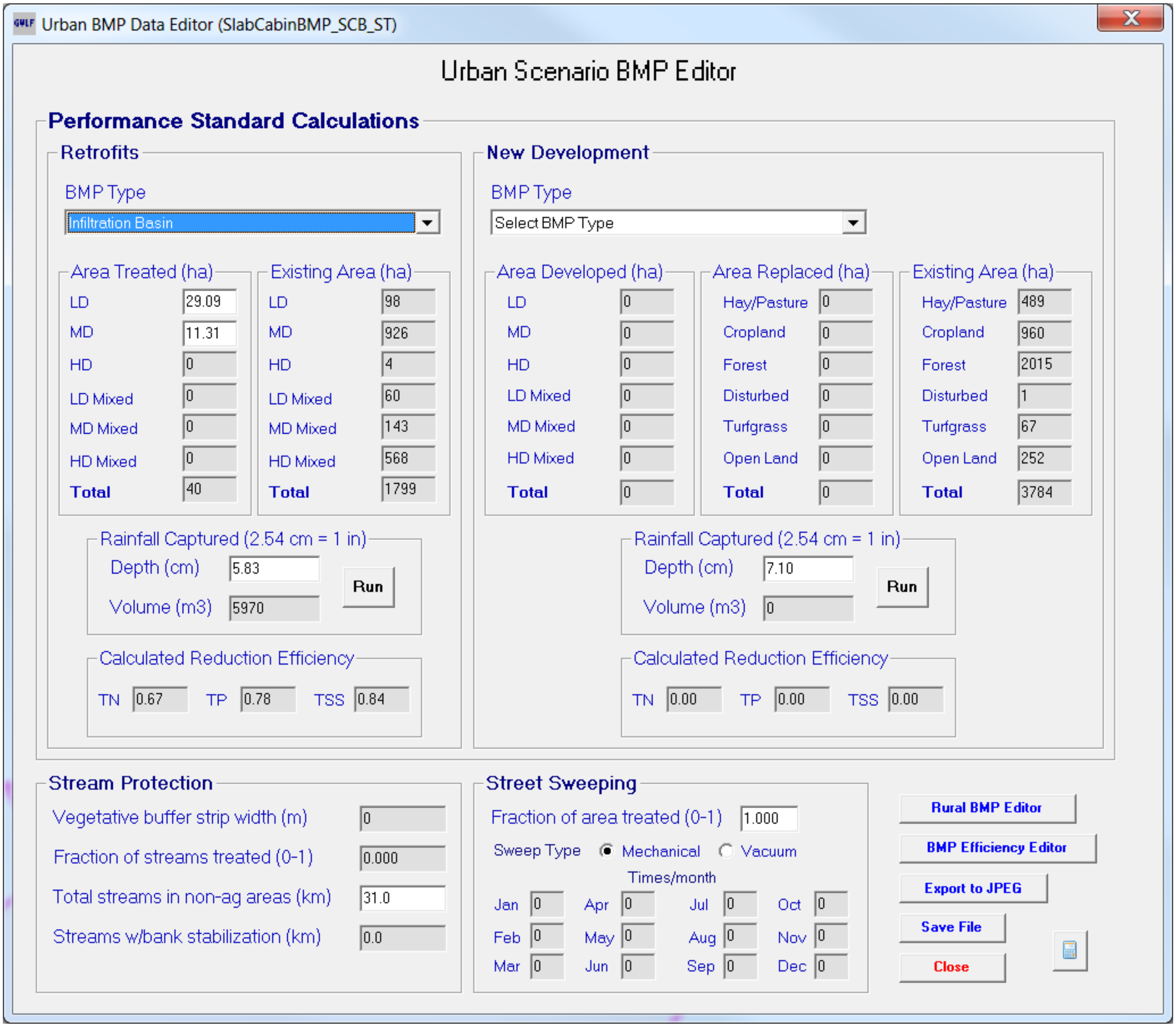
Source	Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	1208	82761.53	68.50	607.68	0.50	141.98	0.12
Cropland	2372	2093509.64	882.60	10130.06	4.27	1382.01	0.58
Forest	4979	49317.41	9.90	490.24	0.10	44.86	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	2	0.00	0.00	0.09	0.04	0.04	0.02
Turfgrass	166	3042.38	18.40	151.13	0.91	10.93	0.07
Open Land	623	68188.98	109.50	551.79	0.89	41.87	0.07
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	148	2314.85	15.60	58.18	0.39	6.31	0.04
MD Mixed	353	25639.76	72.60	611.92	1.73	67.95	0.19
HD Mixed	1404	101809.47	72.50	2430.55	1.73	269.89	0.19
LD Residential	242	3769.90	15.60	95.04	0.39	10.30	0.04
MD Residential	2288	165986.04	72.50	3962.48	1.73	439.98	0.19
HD Residential	10	727.53	72.80	17.11	1.71	1.90	0.19
Water	6.43939472						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		2710912.0		1355.8		332.9	
Groundwater				24016.7		317.8	
Point Sources				0.0		0.0	
Septic Systems				1907.7		0.0	
Totals	13801	5307979		46386		3069	

Print | Export to JPEG | Exit

Orchard Park Infiltration Basin (#C7)

Orchard Park						
Basin Surface Area (acres)	2.55					
Drainage Area (acres)	100					
			LD Mixed	72	0.15	29.088
LD Residential, % impervious	20%		MD Mixed	28	0.52	11.312
				100	0.2536	
Acres of Impervious	20					
Capture Depth (feet)	1.5					
RS (Runoff Storage Volume) acre-feet	3.825					
Runoff Capture	2.295	5.8293				
Infiltration rate to remove 18 inches in 72 hours	0.25					
	5308910					
Orchard	5294037					
	14,873.00					

Orchard Park Infiltration Basin (#C7)
GWLF-E Urban BMP Input



Orchard Park Infiltration Basin (#C7)
Urban Area Tool Output

GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: P:\14003\14003.03 - MS4 Partners - PRP Plan\GIS_Mapshed\Mapshed\Data\Runfiles\SlabCabinRun\SCB_BM

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

GWLF-E Average Loads by Source for Watershed 1

Source	Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	1208	82761.53	68.50	607.68	0.50	141.98	0.12
Cropland	2372	2093509.64	882.60	10130.06	4.27	1382.01	0.58
Forest	4979	49317.41	9.90	490.24	0.10	44.86	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	2	0.00	0.00	0.09	0.04	0.04	0.02
Turfgrass	166	3042.38	18.40	151.13	0.91	10.93	0.07
Open Land	623	68188.98	109.50	551.79	0.89	41.87	0.07
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	148	2292.81	15.50	57.81	0.39	6.26	0.04
MD Mixed	353	25419.30	72.00	608.01	1.72	67.44	0.19
HD Mixed	1404	100993.76	71.90	2415.08	1.72	267.88	0.19
LD Residential	242	3725.81	15.40	94.42	0.39	10.21	0.04
MD Residential	2288	164663.26	72.00	3937.24	1.72	436.71	0.19
HD Residential	10	705.48	70.50	17.00	1.70	1.90	0.19
Water	6.43939472						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		2699417.1		1349.2		332.9	
Groundwater				24016.7		317.8	
Point Sources				0.0		0.0	
Septic Systems				1907.7		0.0	
Totals	13801	5294037		46334		3063	

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Centre Region MS4 Partners PRP

APPENDIX D

Sediment and Nutrient Loads Apportioned to MS4 Partners

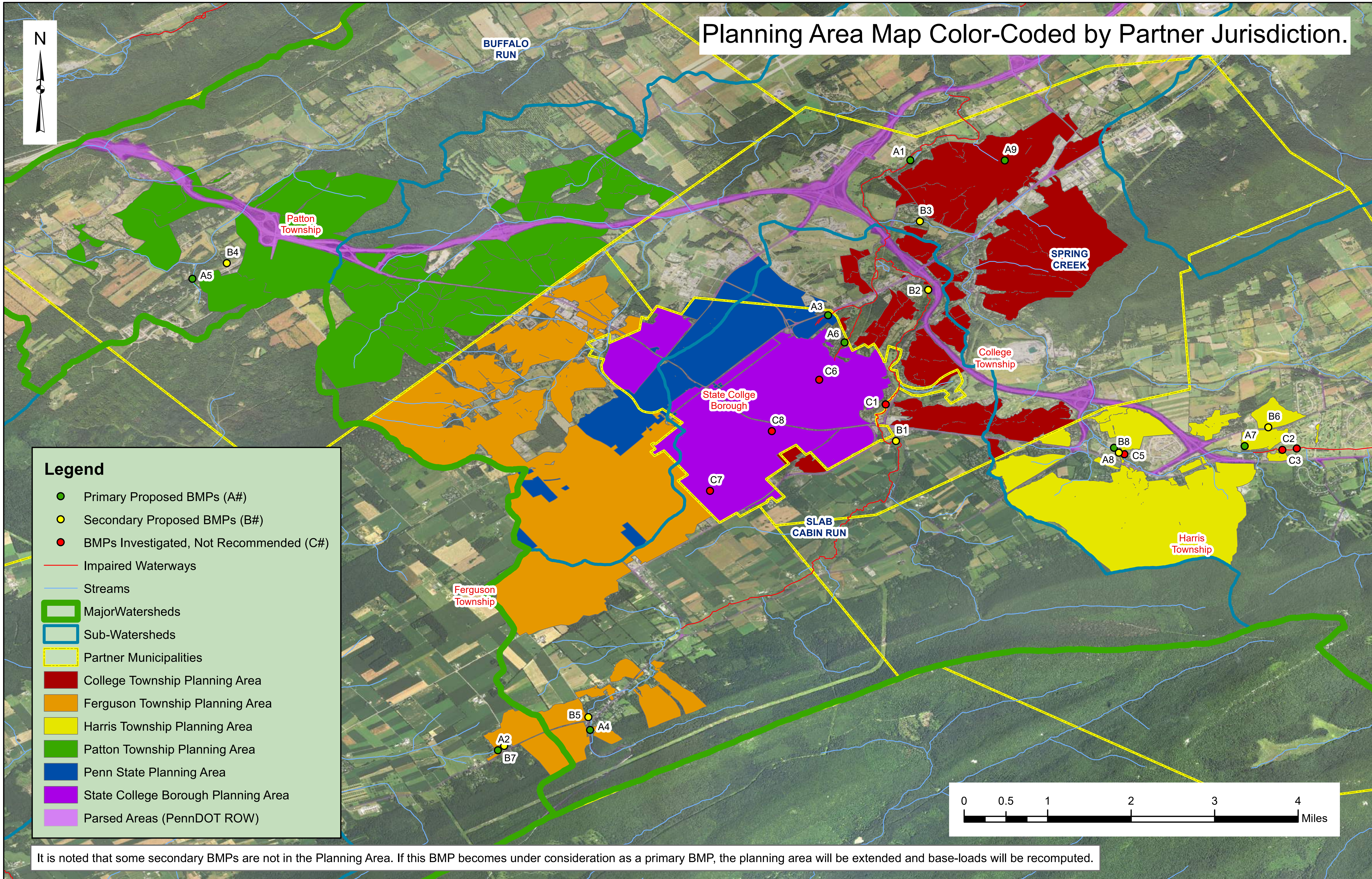
NEWELL TERESKA & MACKAY
ENGINEERING

APPENDIX D

The tables in Appendix D apportion loads and load reductions to each of the Centre Region MS4 Partners. Section D.1 provides a color-coded Planning Area Map showing the Partners' jurisdictions. Section D.2 summarizes the computations used to arrive at each Partner's TSS baseload. Section D.3 provides existing pollutant load summaries (TSS only) by watershed and Partner. Section D.4 provides summary tables identifying load reduction requirements and load reductions provided by proposed primary and secondary BMPs versus apportioned by Watershed and Partner.

Centre Region MS4 Partners PRP

D.1 Planning Area Map by Partner Jurisdiction


Planning Area Map Color-Coded by Partner Jurisdiction.
N
BUFFALO RUN
SPRING CREEK
SLAB CABIN RUN
Patton Township
College Township
State Collge Borough
Ferguson Township
Harris Township
A1
A2
A3
A4
A5
A6
A7
A8
A9
B1
B2
B3
B4
B5
B6
B7
B8
C1
C2
C3
C5
C6
C7
C8
Legend
Primary Proposed BMPs (A#)
Secondary Proposed BMPs (B#)
BMPs Investigated, Not Recommended (C#)
Impaired Waterways
Streams
MajorWatersheds
Sub-Watersheds
Partner Municipalities
College Township Planning Area
Ferguson Township Planning Area
Harris Township Planning Area
Patton Township Planning Area
Penn State Planning Area
State College Borough Planning Area
Parsed Areas (PennDOT ROW)
0
0.5
1
2
3
4
Miles
It is noted that some secondary BMPs are not in the Planning Area. If this BMP becomes under consideration as a primary BMP, the planning area will be extended and base-loads will be recomputed.

Centre Region MS4 Partners PRP

D.2 Baseload Computations for Each Partner Planning Area

Table D.2-1. Beaver Branch

	Total Sediment	Total Nitrogen	Total Phosphorus
Ferguson Township Planning Area (without BMPs)	100,703	1,309	63
Ferguson Township Stormwater Treatment BMP Credit	-	-	-
Ferguson Township Runoff Reduction Treatment BMP Credit	-	-	-
Ferguson Township Planning Area	100,703	1,309	63
Planning Area Total	**100,703**	**1,309**	**63**

Table D.2-2. Buffalo Run

	Total Sediment	Total Nitrogen	Total Phosphorus
Patton Township Planning Area (without BMPs)	333,529	7,067	218
Patton Township Stormwater Treatment BMP Credit	4,284	8	-
Patton Township Runoff Reduction Treatment BMP Credit	-	-	-
Patton Township Planning Area	329,245	7,059	218
Planning Area Total	**329,245**	**7,059**	**218**

Table D.2-3. Spring Creek

	Total Sediment	Total Nitrogen	Total Phosphorus
College Township Planning Area (without BMPs)	720,687	7,573	380
College Township Stormwater Treatment BMP Credit	77,810	136	27
College Township Runoff Reduction BMP Credit	69,272	159	24
College Township Planning Area	573,605	7,278	329
Ferguson Township Planning Area (without BMPs)	1,461	672	2
Ferguson Township Stormwater Treatment Credit	-	-	-
Ferguson Township Runoff Reduction Treatment Credit	-	-	-
Ferguson Township Planning Area	1,461	672	2
Harris Township Planning Area (without BMPs)	556,676	5,907	286
Harris Township Stormwater Treatment BMP Credit	-	-	-
Harris Township Runoff Reduction BMP Credit	72,561	190	29
Harris Township Planning Area	484,115	5,717	257
Patton Township Planning Area (without BMPs)	844	1,011	2
Patton Township Stormwater Treatment Credit	-	-	-
Patton Township Runoff Reduction Treatment Credit	-	-	-
Patton Township Planning Area	844	1,011	2
Borough of State College Planning Area (without BMPs)	103	21	-
Borough of State College Stormwater Treatment Credit	-	-	-
Borough of State College Runoff Reduction Treatment Credit	-	-	-
Borough of State College Planning Area	103	21	-
Penn State Planning Area (without BMPs)	321	22	-
Penn State Stormwater Treatment Credit	-	-	-
Penn State Runoff Reduction Treatment Credit	-	-	-
Penn State Planning Area	321	22	-
Planning Area Total	**1,060,450**	**14,721**	**590**

Table D.2-4. Slab Cabin Run

	Total Sediment	Total Nitrogen	Total Phosphorus
College Township Planning Area (without BMPs)	238,856	2,994	152
College Township Stormwater Treatment BMP Credit	-	-	-
College Township Runoff Reduction BMP Credit	12,730	18	4
College Township Load	226,126	2,976	148
Ferguson Township Planning Area (without BMPs)	521,100	4,552	324
Ferguson Township Runoff Reduction BMP Credit	15,280	44	6
Ferguson Township Stormwater Treatment BMP Credit	12,730	18	4
Ferguson Township Planning Area	493,090	4,490	314
Borough of State College Planning Area (without BMPs)	699,156	7,828	437
Borough of State College Runoff Reduction BMP Credit	33,332	89	13
Borough of State College Stormwater Treatment BMP Credit	211,115	438	84
Borough of State College Walnut Springs Sediment Trap Removal	64,882	704	85
Borough of State College Planning Area	389,827	6,597	255
Penn State Planning Area (without BMPs)	280,984	2,529	147
Penn State Runoff Reduction BMP Credit	3,294	4	2
Penn State Stormwater Treatment BMP Credit	9,989	26	4
Penn State Planning Area	267,701	2,499	141
Planning Area Total	**1,376,744**	**16,562**	**858**

D.3 Sediment Loads Apportioned to Each Partner Planning Area

Table D.3-1. Regional Planning Area Existing Pollutant Load Summary

Watershed/Condition	TSS (lb./yr.)	TN (lb./yr.)	TP (lb./yr.)
Beaver Branch			
Baseload	100,703	1,309	63
Existing BMP Credit	0	0	0
Adjusted Baseload	100,703	1,309	63
Required Load Reduction	**10,070**	**39**	**3**
Buffalo Run			
Baseload	333,529	7,067	218
Existing BMP Credit	4,284	8	0
Adjusted Baseload	329,245	7,059	218
Required Load Reduction	**32,925**	**212**	**11**
Spring Creek			
Baseload	1,280,093	15,206	670
Existing BMP Credit	219,643	485	80
Adjusted Baseload	1,060,450	14,721	590
Required Load Reduction	**106,045**	**442**	**30**
Slab Cabin Run			
Baseload	1,740,096	17,903	1,060
Existing BMP Credit	363,352	1,341	202
Adjusted Baseload	1,376,744	16,562	858
Required Load Reduction	**137,674**	**497**	**43**
MS4 Planning Area Totals			
Total Baseload	3,454,420	41,484	2,011
Total Existing BMP Credit	587,279	1,834	282
Total Adjusted Baseload	2,867,141	39,650	1,729
Total Required Load Reduction	**286,714**	**1,190**	**86**

Table D.3-2. College Township Existing Pollutant Load Summary

Watershed/Condition	TSS (lb./yr.)	TN (lb./yr.)	TP (lb./yr.)
Spring Creek			
Baseload	720,687	7,573	380
Existing BMP Credit	147,082	295	51
Adjusted Baseload	573,605	7,278	329
Required Load Reduction	**57,361**	**218**	**16**
Slab Cabin Run			
Baseload	238,856	2,994	152
Existing BMP Credit	12,730	18	4
Adjusted Baseload	226,126	2,976	148
Required Load Reduction	**22,613**	**89**	**7**
Total Regulatory Load Reduction:	**79,973**	**308**	**24**

Table D.3-3 Ferguson Township Existing Pollutant Load Summary

Watershed/Condition	TSS (lb./yr.)	TN (lb./yr.)	TP (lb./yr.)
Beaver Branch			
Baseload	100,703	1,309	63
Existing BMP Credit	0	0	0
Adjusted Baseload	100,703	1,309	63
Required Load Reduction	**10,070**	**39**	**3**
Spring Creek			
Baseload	1,461	672	2
Existing BMP Credit	0	0	0
Adjusted Baseload	1,461	672	2
Required Load Reduction	**146**	**20**	**0**
Slab Cabin Run			
Baseload	521,100	4,552	324
Existing BMP Credit	28,010	62	10
Adjusted Baseload	493,090	4,490	314
Required Load Reduction	**49,309**	**135**	**16**
Total Regulatory Load Reduction:	**59,525**	**194**	**19**

Table D.3-4. Harris Township Existing Pollutant Load Summary

Watershed/Condition	TSS (lb./yr.)	TN (lb./yr.)	TP (lb./yr.)
Spring Creek			
Baseload	556,676	5,907	286
Existing BMP Credit	72,561	190	29
Adjusted Baseload	484,115	5,717	257
Required Load Reduction	**48,412**	**172**	**13**
Total Regulatory Load Reduction:	**48,412**	**172**	**13**

Table D.3-5. Patton Township Existing Pollutant Load Summary

Watershed/Condition	TSS (lb./yr.)	TN (lb./yr.)	TP (lb./yr.)
Buffalo Run			
Baseload	333,529	7,067	218
Existing BMP Credit	4,284	8	0
Adjusted Baseload	329,245	7,059	218
Required Load Reduction	**32,925**	**212**	**11**
Spring Creek			
Baseload	844	1,011	2
Existing BMP Credit	0	0	0
Adjusted Baseload	844	1,011	2
Required Load Reduction	**84**	**30**	**0**
Total Regulatory Load Reduction:	**33,009**	**242**	**11**

Table D.3-6. Penn State Existing Pollutant Load Summary

Watershed/Condition	TSS (lb./yr.)	TN (lb./yr.)	TP (lb./yr.)
Spring Creek			
Baseload	321	22	0
Existing BMP Credit	0	0	0
Adjusted Baseload	321	22	0
Required Load Reduction	**32**	**1**	**0**
Slab Cabin Run			
Baseload	280,984	2,529	147
Existing BMP Credit	13,283	30	6
Adjusted Baseload	267,701	2,499	141
Required Load Reduction	**26,770**	**75**	**7**
Total Regulatory Load Reduction:	**26,802**	**76**	**7**

Table D.3-7. State College Borough Existing Pollutant Load Summary

Watershed/Condition	TSS (lb./yr.)	TN (lb./yr.)	TP (lb./yr.)
Spring Creek			
Baseload	103	22	0
Existing BMP Credit	0	0	0
Adjusted Baseload	103	22	0
Required Load Reduction	**10**	**1**	**0**
Slab Cabin Run			
Baseload	699,156	7,828	437
Existing BMP Credit	309,329	1,231	182
Adjusted Baseload	389,827	6,597	255
Required Load Reduction	**38,983**	**198**	**13**
Total Regulatory Load Reduction:	**38,993**	**199**	**13**

Centre Region MS4 Partners PRP

D.4 BMP Load Reduction Apportioned to Each Partner Planning Area

Table D.4-1. Proposed Primary BMP TSS Load Reduction Summary by Watershed

Watershed/BMP Description	Primary/ Secondary	BMP Load Reduction (lb./yr.)	Partners Participating
Beaver Branch			
Pinney Ridge Stream Restoration (A2)	P	40,250	Ferguson Township
Wyoming Avenue Stream Restoration (B7)	S	23,000	Ferguson Township
Required TSS Load Reduction		***10,070***	
Excess Treatment Primary Projects		*30,180*	
Excess Treatment Primary and Secondary Projects:		*53,180*	
Buffalo Run			
Meeks Lane Stream Restoration (A5)	P	36,800	Patton Township
Grays Woods Basin Retrofit (B4)	S	1,612	Patton Township
Required TSS Load Reduction		***32,925***	
Excess Treatment Primary Projects		*3,875*	
Excess Treatment Primary and Secondary Projects:		*5,487*	
Slab Cabin Run			
UNT Slab Cabin Run Restoration - Duck Pond Channel (A3)	P	115,000	Ferguson and College Townships, and Penn State
Pine Grove Mills Slab Cabin Run Restoration (A4)	P	34,500	Ferguson Township
UNT Slab Cabin Run Restoration - Walnut Springs (A6)	P	44,275	Borough of State College
Myer-Everhart Streamside Buffer (B1)	S	1,501	All Partners
Street Sweeping	S	21,047	Borough of State College
Pine Grove Mills Slab Cabin Run Restoration D/S SR 45/26 (B5)	S	23,000	Ferguson Township
Slab Cabin Park Stream Restoration (B2)	S	86,250	College Township
Required TSS Load Reduction		***137,674***	
Excess Treatment Primary Projects		*56,101*	
Excess Treatment Primary and Secondary Projects:		*187,899*	
Spring Creek			
Spring Creek Estates Stream Restoration (A1)	P	57,500	College and Harris Townships
Military Museum Stream Restoration - Phase 1 (A8)	P	40,250	Harris Township
Willowbrook Basin Retrofit (A7)	P	6,024	Harris Township
Penn Hills Basin Retrofit (A9)	P	9,500	College Township
Spring Creek Park Restoration (B3)	S	34,500	College Township
Military Museum Stream Restoration - Phase 2 (B8)	S	34,500	Harris Township
Rocky Ridge Basin Retrofit (B6)	S	1,273	Harris Township
Required TSS Load Reduction		***106,045***	
Excess Treatment Primary Projects		*7,229*	
Excess Treatment Primary and Secondary Projects:		*77,502*	

Table D.4-2. College Township Proposed Primary BMP TSS Load Reduction Summary

Watershed/BMP Description	Primary/ Secondary	BMP Load Reduction (lb./yr.)	Partner Share (lb./yr.)	Notes
Spring Creek				
Spring Creek Estates Stream Restoration (A1)	P	57,500	54,500	Shared with Harris Township.
Penn Hills Basin Retrofit (A9)	P	9,500	9,500	
Spring Creek Park Restoration (B3)	S	34,500	34,500	
		Required TSS Load Reduction	***57,361***	
		Excess Treatment Primary Projects	*6,639*	
		Excess Treatment Primary and Secondary Projects:	*41,139*	
Slab Cabin Run				
UNT Slab Cabin Run Restoration - Duck Pond Channel (A3)	P	115,000	23,000	Shared with Penn State, Ferguson Township and Borough of State College.
Slab Cabin Park Stream Restoration (B2)	S	86,250	86,250	
Myer-Everhart Streamside Buffer (B1)	S	1,501	1,501	100% allocated but may be shared with Ferguson and Harris Townships, and Borough of State College (all or some).
		Required TSS Load Reduction	***22,613***	
		Excess Treatment Primary Projects	*387*	
		Excess Treatment Primary and Secondary Projects:	*88,138*	

Table D.4-3. Ferguson Township Proposed Primary BMP TSS Load Reduction Summary

Watershed/BMP Description	Primary/ Secondary	BMP Load Reduction (lb./yr.)	Partner Share (lb./yr.)	Notes
Beaver Branch				
Pinney Ridge Stream Restoration (A2)	P	40,250	40,250	
Wyoming Avenue Stream Restoration (B7)	S	23,000	23,000	
Required TSS Load Reduction			***10,070***	
Excess Treatment Primary Projects			*30,180*	
Excess Treatment Primary and Secondary Projects:			*53,180*	
Spring Creek				
Pine Grove Mills Slab Cabin Restoration (A4)	P	40,250	250	Allocating 250 lbs. from Slab Cabin Run Watershed (Project A4 below) to meet Spring Creek Requirements.
Required TSS Load Reduction			***146***	
Excess Treatment Primary Projects			*104*	
Excess Treatment Primary and Secondary Projects:			*104*	
Slab Cabin Run				
UNT Slab Cabin Run Restoration - Duck Pond Channel (A3)	P	115,000	20,125	Shared with Penn State, College Township, and Borough of State College.
Pine Grove Mills Slab Cabin Restoration (A4)	P	34,500	34,250	
Myer-Everhart Streamside Buffer (B1)	S	1,501	1,501	100% allocated but may be shared with College and Harris Townships, and Borough of State College (all or some).
Required TSS Load Reduction			***49,309***	
Excess Treatment Primary Projects			*5,066*	
Excess Treatment Primary and Secondary Projects:			*6,567*	

Table D.4-4. Harris Township Proposed Primary BMP TSS Load Reduction Summary

Watershed/BMP Description	Primary/ Secondary	BMP Load Reduction (lb./yr.)	Partner Share (lb./yr.)	Notes
Spring Creek				
Spring Creek Estates Stream Restoration (A1)	P	57,500	3,000	Shared with College Township.
Military Museum Stream Restoration - Phase 1 (A8)	P	40,250	40,250	
Willowbrook Basin Retrofit (A7)	P	6,024	6,024	
Military Museum Stream Restoration - Phase 2 (B8)	S	34,500	34,500	
Myer-Everhart Streamside Buffer (B1)	S	1,501	1,501	100% allocated but may be shared with Ferguson and College Townships, and Borough of State College (all or some).
Rocky Ridge Basin Retrofit (B6)	S	1,273	1,273	
Required TSS Load Reduction			***48,412***	
Excess Treatment Primary Projects			*862*	
Excess Treatment Primary and Secondary Projects:			*38,136*	

Table D.4-5. Patton Township Proposed Primary BMP TSS Load Reduction Summary

Watershed/BMP Description	Primary/ Secondary	BMP Load Reduction (lb./yr.)	Partner Share (lb./yr.)	Notes
Buffalo Run				
Meeks Lane Stream Restoration (A5)	P	36,800	36,500	Allocating 300 lbs. to Spring Creek watershed to meet Chesapeake Bay Requirement (Spring Creek discharges are more than 500 LF upstream of impairment in UNT Spring Creek (Big Hollow Run))
Grays Woods Basin Retrofit (B4)	S	1,612	1,612	
Required TSS Load Reduction			***32,925***	
Excess Treatment Primary Projects			*3,575*	
Excess Treatment Primary and Secondary Projects:			*5,187*	
Spring Creek				
Meeks Lane Stream Restoration (A5)	P	36,800	300	See Note for project A5 above.
Required TSS Load Reduction			***84***	
Excess Treatment Primary Projects			*216*	
Excess Treatment Primary and Secondary Projects:			*216*	

Table D.4-6. Penn State Proposed Primary BMP TSS Load Reduction Summary

Watershed/BMP Description	Primary/ Secondary	BMP Load Reduction (lb./yr.)	Partner Share (lb./yr.)	Notes
Spring Creek				
UNT Slab Cabin Run Restoration - Duck Pond Channel (A3)	P	115,000	35	Allocating 35 lbs. from Slab Cabin Run Watershed (Project A3 below) to meet Spring Creek Requirements.
Required TSS Load Reduction			***32***	
Excess Treatment Primary Projects			*3*	
Excess Treatment Primary and Secondary Projects:			*3*	
Slab Cabin Run				
UNT Slab Cabin Run Restoration - Duck Pond Channel (A3)	P	115,000	71,840	Shared with College and Ferguson Townships, and Borough of State College.
Required TSS Load Reduction			***26,770***	
Excess Treatment Primary Projects			*45,070*	
Excess Treatment Primary and Secondary Projects:			*45,070*	

Table D.4-7. Borough of State College Proposed Primary BMP TSS Load Reduction Summary

Watershed/BMP Description	Primary/ Secondary	BMP Load Reduction (lb./yr.)	Partner Share (lb./yr.)	Notes
Spring Creek				
UNT Slab Cabin Run Restoration - Walnut Springs (A6)	P	44,275	75	Allocating 75 lbs. from Walnut Springs Stream Restoration (Project A6 below) to meet Spring Creek Requirements.
Required TSS Load Reduction			***10***	
Excess Treatment Primary Projects			*65*	
Excess Treatment Primary and Secondary Projects:			*65*	
Slab Cabin Run				
UNT Slab Cabin Run Restoration - Walnut Springs (A6)	P	44,275	44,200	
Street Sweeping	S	21,047	21,047	
Myer-Everhart Streamside Buffer (B1)	S	1,501	1,501	100% allocated but may be shared with College and Harris Townships, and Borough of State College (all or some).
Required TSS Load Reduction			***38,983***	
Excess Treatment Primary Projects			*5,217*	
Excess Treatment Primary and Secondary Projects:			*27,765*	

Centre Region MS4 Partners PRP

APPENDIX E

Photographs of BMPs Evaluated

Newell Tereska & Mackay Engineering

	**Photo #1** **Culvert Inlet** *Thompson Run – Actively eroding banks*
	**Photo #2** *Thompson Run – Actively eroding via bank slumping*

Photo #3

Thompson Run – Deeply incised channel that is disconnected from the floodplain

Photo #4

Thompson Run – Deeply incised channel that is disconnected from the floodplain; limestone rip-rap illustrate failed attempts at stabilization

Photo #5

Slab Cabin Run – At Slab Cabin Park – Bank erosion

Photo #6

Slab Cabin Run – At Slab Cabin Park – Eroded bank

	**Photo #7** *Slab Cabin Run – At Slab Cabin Park – Stable reach downstream of Slab Cabin Park*
	**Photo #8** *Walnut Springs – Active bank erosion*

Photo #9

Walnut Springs – Undercut banks

Photo #10

Walnut Springs – Ongoing invasive species removal project

	**Photo #11** *Slab Cabin Run – Kissinger Meadows – Fairly stable banks*

	**Photo #12** *Slab Cabin Run – Kissinger Meadows – Stable banks, erosion minor*

Photo #13

Slab Cabin Run – Meyer Everhart Farm – Aquatic vegetation growth due to nutrients

Photo #14

Slab Cabin Run – Meyer Everhart Farm – Bank instability at a cattle-crossing

Photo #15

Slab Cabin Run – Meyer Everhart Farm – Channel Overview

Photo #16

Slab Cabin Run – Pine Grove Mills – Severely incised channel, illustrated by the undercut stormwater pipe.

	**Photo #17** *Slab Cabin Run – Pine Grove Mills – Lack of Riparian buffer, incised channel, active erosion, attempts at stabilization have been made with rock*

	**Photo #18** *Spring Creek – Spring Creek Park –Well vegetated channel*

Photo #19

Spring Creek – Spring Creek Park – Mud sill in lower restoration area

Photo #20

Spring Creek – Spring Creek Park - Rock vanes

Photo #21

Spring Creek – Fasick Park – Typical view of stream, stable stream reach

Photo #22

Spring Creek – Mountain View Country Club – Stabilized drainageway

	**Photo #23** *Spring Creek – Mountain View Country Club – Headwater wetland*
	**Photo #24** *Spring Creek – Pennsylvania Military Museum – Upstream of Boalsburg Pike, exposed roots on the right side of the bank illustrate bank erosion.*

	**Photo #25** *Spring Creek – Upstream of Boalsburg Pike, steep and incised bank*
	**Photo #26** *Spring Creek – Pennsylvania Military Museum – Upstream of dam*

Photo #27

Spring Creek – Pennsylvania Military Museum – Channel section

Photo #28

Spring Creek – Pennsylvania Military Museum – Upstream of dam, incised stream

Photo #29

Spring Creek – Pennsylvania Military Museum - Downstream of dam

Photo #30

Spring Creek – Pennsylvania Military Museum – Downstream of dam

Photo #31

Spring Creek – Pennsylvania Military Museum – Downstream of dam

Photo #32

Spring Creek – Spring Creek Estates – Actively eroding banks

Photo #33

Spring Creek – Spring Creek Estates – Actively eroding banks

Photo #34

Spring Creek – Spring Creek Estates – Actively eroding banks

Photo #35

UNT to Buffalo Run – Meeks Lane – Actively eroding channel

Photo #36

UNT to Buffalo Run – Meeks Lane – Actively eroding channel

Photo #37

UNT to Buffalo Run – Meeks Lane – Actively eroding channel

Photo #38

UNT to Beaver Branch at Piney Ridge Subdivision – Bank slumping

	**Photo #39** *UNT to Beaver Branch at Piney Ridge Subdivision – Incised and eroded bank*

	**Photo #40** *UNT to Beaver Branch at Piney Ridge Subdivision – Bank erosion threatening shed*

Centre Region MS4 Partners PRP

APPENDIX F

Primary BMP Summary Sheets

NEWELL
TERESKA &
MACKAY
ENGINEERING

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Duck Pond Inflow Channel Stream Restoration

Stream restoration, via hard armoring, will be conducted along approximately 1,000 ft. of the Duck Pond Inflow Channel. The Duck Pond Inflow Channel is identified on eMapPA as an unnamed tributary (UNT) to Slab Cabin Run. Locally it is considered an UNT to Thompson Run which is tributary to Slab Cabin Run. This project will result in 115,000 lb./yr. of TSS reduction based on applying the 115 lb./LF credit allowed. The channel is within Penn State University's MS4 permit Urban Area. Thompson Run and its tributaries are defined as impaired due to sediment. The Chapter 93 classification of Thompson Run is as a high quality cold water fishery (HQ-CWF). As discussed below, past experience and analysis dictate that hard armor is required to control scour and erosion in this channel reach. The drainage area to the subject reach is 867 acres (1.35 sq. mi.) and is approximately 50% impervious.

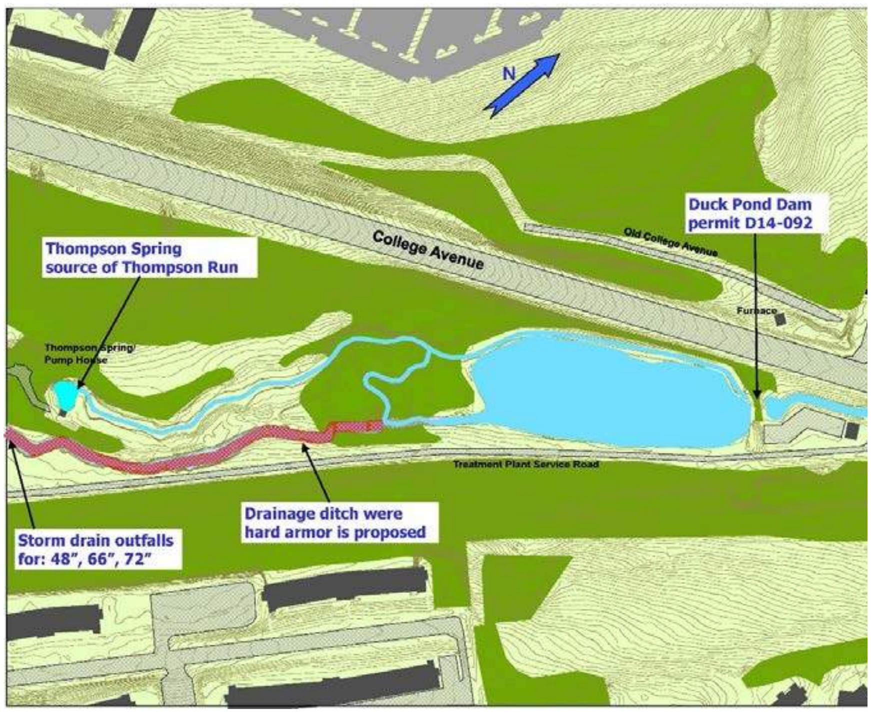


Figure 1. Schematic of the section of Thompson Run where the stream restoration project is proposed

The University has design standards and a Master Plan that provide guidance for controlling storm runoff. Additionally, projects on the University Park Campus are subject to MS4 compliant stormwater ordinances enacted by the underlying municipalities (College Township and the Borough of State College). The Borough of State College also has a MS4 compliant stormwater ordinance for new development. While these ordinances and standards require that storm runoff from new development and some re-development be reduced, significant changes to the flow regime in the Duck Pond Channel are not realistic as the majority of the tributary drainage area was built out without stormwater controls. In addition, the density of existing private development does not provide opportunities for the size and extent of stormwater controls that would be needed to have a meaningful impact on peak rates and water quality.

The Duck Pond Channel receives runoff from three major pipe outfalls (48 in., 66 in., and 72 in.), two (2) of which are owned by the Borough and one owned by the University. The 1 year peak discharge exceeds 600 cfs and channel velocities exceed 20 ft./s. On May 1, 2017, the PA DEP, the Pennsylvania Fish and Boat Commission, and the US Army Corps of Engineers concurred with the hard armor project to stabilize the channel to reduce sediment being transported downstream and issued Penn State a Joint 404 Permit (E14-574).

It is noted that this channel has a history of instability. Scouring during the 1996 floods threatened to undermine the University's wastewater treatment plant fence. In 1997, the University and the Borough of State College jointly proposed a similar hard armor project for the subject channel with the intent of slowing in-channel velocity and preventing further scour. However, in response to concerns that hard armor did not consider the environmental sensitivity of the area, a bioengineered (soft armoring) project was installed in 2002. The soft armoring project include bio-logs and fascines. Unfortunately, the soft armoring failed shortly after installation and the stream has since incised an additional 1 foot based on bank pin data. Because soft armor proved non-resilient to the peak flows in this stream reach, hard armament has been selected to stabilize the channel.

The June 22, 2017 PA DEP memo titled *Considerations of Stream Restoration in Pennsylvania for Eligibility as an MS4 Best Management Practice* addresses relevant criteria for BMP projects. The following italicized statements are criteria published in the memo. The text following the italicized statements explain how this project meets those criteria.

Permittee must document existing channel or streambank erosion and actively enlarging or incising urban stream condition prior to the restoration (an existing problem).

The duck pond inflow channel has been actively eroding for the last two decades. As mentioned above, the floods of 1996 resulted in significant erosion to the streambank. Bioengineering efforts in 2002 failed to stabilize the stream reach. Based on surveyed channel geometry before the bioengineering project and current surveyed conditions and an assumed bulk density of 2.0 g/cm^3, it is estimated that bank is currently eroding at a rate of 102 lb./yr.

Photograph 1. Duck pond channel following bioengineered stabilization

The stream section receives runoff from the downtown retail and commercial district of the Borough of State College and from University Park. These urban areas were constructed before stormwater management regulations were in place. Yet, both the Borough and University actively seek stormwater retrofit opportunities.

Effectiveness is most readily demonstrated for projects in 1st to 3rd order streams (small). Large projects will require additional documentation.

The duck pond channel is a first order channel.

Photograph 2. One of two raingarden retrofit projects installed at the corner of Allen Street and Beaver Ave in the Borough of State College

The project must address at least 100 LF of stream channel.

The project addresses 1000 LF of stream corridor.

Impervious areas upstream of the project must be sufficiently treated to address peak flows that may exceed engineering design thresholds or compromise channel form and function.

Despite the challenge in siting stormwater management BMPs in the urban corridor, the Borough and University have both proactively constructed stormwater BMP retrofits. For example, the Borough has constructed raingardens along Allen and Barnard Street. While it is noted that systems of this size and nature are insufficient to address peak flows in the urban corridor, they make stormwater readily visible to the public. As such they provide minor peak flow reduction and significant public education.

The Penn State Engineering Services maintains an active Stormwater Master Plan. This is a living document that identifies existing stormwater management problems and provides guidelines for stormwater management associated with new construction and building rehabilitation. The University's Engineering Services sees frequent building rehabilitation projects on campus as an opportunity for stormwater retrofit.

The project must address both sides of the channel on sites where a need to do so is evident.

This project addresses both sides of the stream.

The goal is to apply a comprehensive approach that may employ a mix of techniques appropriate to the site, creating long-term stability of the streambed, streambanks, and floodplain.

The goal of this project is long-term stability. Over time, a comprehensive mix of approaches has been tried. Trial with bioengineering resulted in failure. The channel receives runoff from three major pipe outfalls (48 in., 66 in., and 72 in.). As such, hard armament is the most appropriate stabilization technique given peak flow discharge to this site.

Photograph 3. Stormwater discharge pipes at the beginning of the project reach

Streambank or streambed armoring may be used where necessary to maintain channel stability but the length of stream that is armored (such as with rip-rap and gabions) may not be included in the load reduction calculation.

The armoring project has been included in the load reduction computation. Given the extensive erosion that has occurred at this site, this is an appropriate urban sediment reduction project.

Projects must maximize floodplain reconnection with minimal channel invert elevation increase required to achieve this objective. Restoration bank height ratios must be 1.0 or less.

Photograph 4. Aerial view of the Thompson Run project site

The proposed stabilization design for the inflow channel will make use of artificial “floodplains” constructed as part of the 2001 stabilization project. The previous project will be improved upon by reducing flow elevations and making more effective use of channel overflow areas between the inflow channel and Thompson Run. There are no residences or structures that can be affected by this work. The ultimate control on downstream flood flow elevations is the Duck Pond dam which will not be altered by the project.

A permanent 35’ minimum riparian buffer.

A permanent 35 ft. buffer will be maintained on both sides of the channel. The project section is wooded.

Walnut Springs Park Stream Restoration

The stream in Walnut Springs Park is an unnamed tributary (UNT) to Thompson Run. At the park entrance the stream is an ephemeral, stormwater conveyance channel (**Photograph 1**). The UNT receives perennial flow from several springs as it flows through the park. A check dam has been installed at the downstream end of the ephemeral reach. Sediment from the ephemeral reach is periodically dredged by the Borough of State College Department of Public Works. The drainage area to the UNT is 0.83 sq. mi. which is predominantly medium density residential.

Photograph 1. UNT to Thompson Run looking upstream toward University Park

The Walnut Spring Park stream restoration project proposed as part of this Pollution Reduction Plan (PRP) will grade banks to connect incised stream sections to the floodplain. Restored banks and floodplain will be vegetated with native riparian plantings in conjunction with an ongoing invasive species removal program being conducted in the park.

The June 22, 2017 DEP memo titled *Considerations of Stream Restoration in Pennsylvania for Eligibility as an MS4 Best Management Practice* addresses relevant criteria for BMP projects. The following italicized statements are criteria published in the memo. The text following the italicized statements explain how this project meets those criteria.

Permittee must document existing channel or streambank erosion and actively enlarging or incising urban stream condition prior to the restoration (an existing problem).

The Walnut Springs project addresses an existing urban problem. The stream receives discharge from the medium density development in the Borough of State College. Over-widening and bank incision are evident throughout the park. These conditions are being actively accelerated by urban runoff. Active streambank erosion and incision is documented in photographs (See **Appendix E** of the Pollution Reduction Plan Report). Records maintained by Department of Public Works, between 2014 and 2017, record an average of 64,882 lb./yr. of sediment removal during that period. A StreamStats Flow Report generated at the point where stormwater from the Borough's collection system discharges to the UNT in the park, indicates a baseflow of 2.52 cfs and a 100-year peak flow of 261 cfs. These data illustrate the significance of storm flow to the system. A wetland was constructed in the park to mitigate downstream peak flow discharged to Slab Cabin Run. However, accelerated runoff upstream of the wetland continues to degrade the UNT. Active degradation is an existing problem that must be addressed.

Effectiveness is most readily demonstrated for projects in 1st to 3rd order streams (small). Large projects will require additional documentation.

The UNT in Walnut Springs Park is a first order stream, therefore this criterion is met.

The project must address at least 100 LF of stream channel.

The project proposed in Walnut Springs Park is 385 LF and, therefore, meets the criteria. At a rate of 115 lb./LF/yr., the project in Walnut Springs Park will generate 44,275 lb./yr. of sediment credit.

Impervious areas upstream of the project must be sufficiently treated to address peak flows that may exceed engineering design thresholds or compromise channel form and function.

The tributary drainage area is medium density urban development in the Borough of State College. This area was developed prior to current stormwater regulations. It is noted that a portion of the drainage area is detained in the Westerly Parkway Wetland. The Westerly Parkway Wetland was constructed in 2012 to provide stormwater treatment in addition to detention.

The Walnut Springs Wetland was constructed downstream of the subject reach. This wetland provides some peak flow mitigation upstream of Slab Cabin Run. In doing so, it mitigates peak flow to Millbrook Marsh a significant ecological resource that provides recreation and environmental education opportunities to local residents and Penn State University students.

There is little additional area in the tributary drainage area available to address peak flow. NTM evaluated the potential of developing a stormwater BMP on a small (0.07 ac) parcel along Easterly Parkway however, it was concluded that the parcel was too small to site a cost-effective BMP.

The project must address both sides of the channel on sites where a need to do so is evident.

Streambank restoration and floodplain reconnection is proposed on both banks of the stream.

The goal is to apply a comprehensive approach that may employ a mix of techniques appropriate to the site, creating long-term stability of the streambed, streambanks, and floodplain.

Streambank restoration proposed herein will enhance the BMP treatment train already in-place in the tributary drainage basin. The BMP treatment train includes 1) stormwater detention and treatment in the Westerly Parkway Wetland, 2) sediment trapping and energy quelling upstream of the sediment trap check dam, 3) stream restoration and floodplain reconnection (this project), and 4) stormwater detention, infiltration, and treatment in the Walnut Springs Wetland. As such this project is part of a mix of techniques aimed at creating long-term stability to the streambed, streambank, floodplain, and watershed.

Streambank or streambed armoring may be used where necessary to maintain channel stability but the length of stream that is armored (such as with rip-rap and gabions) may not be included in the load reduction calculation.

Armoring is not included in the proposed restoration project.

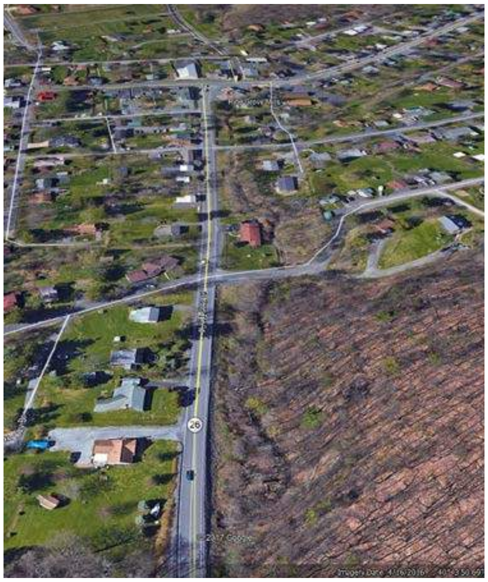
Projects must maximize floodplain reconnection with minimal channel invert elevation increase required to achieve this objective. Restoration bank height ratios must be 1.0 or less.

The objective of this project is floodplain reconnection with a bank height ratio of 1V:2H or less, as such this criterion is met.

A permanent 35' minimum riparian buffer.

This project will be inside Walnut Springs Park. The riparian buffer will exceed 35 ft.

Slab Cabin Run Stream Restoration in Pine Grove Mills



Photograph 1. Aerial view of the stream section and adjacent landscape.

The headwaters of Slab Cabin Run begin near Route 26 south of Pine Grove Mills. The mountain stream parallels Route 26 to Route 45. The slope of this reach is approximately 7.5%.

The stream is forested until reaching the village of Pine Grove Mills (**Photograph 1**). Within the village, Slab Cabin Run is constricted and flanked by residential properties and there is little riparian buffer. Bank erosion in this section of the stream is significant (**Photograph 2**). Runoff from adjacent properties accelerates the bank erosion. It is expected that the storm pipe shown in **Photograph 3** once had additional cover, exposure of this pipe is evidence of recent erosion.

Because the stream section is steeply sloping, a step-pool stabilization scheme is recommended. A step-pool design will provide grade control with cross vanes and natural rock bank-toe protection that will mimic the step-pool morphology evident in the stable, upstream reach (**Photograph 4**). A step-pool design will both reduce erosive stream velocity and enhance fish habitat.

The June 22, 2017 PA DEP memo titled *Considerations of Stream Restoration in Pennsylvania for Eligibility as an MS4 Best Management Practice* addresses relevant criteria for BMP projects. The following italicized statements are criteria published in the memo. The text following the italicized statements explain how this project meets those criteria.

Permittee must document existing channel or streambank erosion and actively enlarging or incising urban stream condition prior to the restoration (an existing problem).

An urban stream condition is evidenced by the difference in bank erosion when the upstream forested reach is compared to the downstream residential reach. This contrast is shown in **Photographs 2** and **4**.

Effectiveness is most readily demonstrated for projects in 1st to 3rd order streams (small). Large projects will require additional documentation.

Slab Cabin Run is a first order stream and this project will be conducted near the headwaters.

Photograph 2. Actively eroding section of Slab Cabin Run, located along Route 26 in the village of Pine Grove Mills (Ferguson Twp.)

The project must address at least 100 LF of stream channel.

The proposed project will address approximately 300 LF. At a rate of 115 lb./LF/yr., the project on Slab Cabin Run will generate 34,500 lb./yr. of sediment credit.

Photograph 3. Eroded streambank upstream end of reach

Impervious areas upstream of the project must be sufficiently treated to address peak flows that may exceed engineering design thresholds or compromise channel form and function.

The upstream section of the reach is forested and stable. There is little impervious area upstream of the project, with the exception of the Route 26 roadway surface which is not under municipal control.

The project must address both sides of the channel on sites where a need to do so is evident.

Erosion through the proposed project reach affects both channel banks. A step-pool alignment will dissipate energy and provide a solution that creates channel stability and habitat enhancement within natural and residential site constraints.

The goal is to apply a comprehensive approach that may employ a mix of techniques appropriate to the site, creating long-term stability of the streambed, streambanks, and floodplain.

The step-pool design is appropriate for the site. Step-pools will mimic the character of steep mountain streams like the upstream, stable conditions illustrated in **Photograph 4**.

Streambank or streambed armoring may be used where necessary to maintain channel stability but the length of stream that is armored (such as with rip-rap and gabions) may not be included in the load reduction calculation.

Bank armoring separate from the step-pool approach outlined above is not proposed.

Photograph 4. Stable reach immediately upstream of the proposed project.

Projects must maximize floodplain reconnection with minimal channel invert elevation increase required to achieve this objective. Restoration bank height ratios must be 1.0 or less.

Significant floodplain connection is not a characteristic of natural mountain streams (see **Photograph 4**). Minor floodplain benching, similar to that illustrated in **Figure 1** will be included in the project.

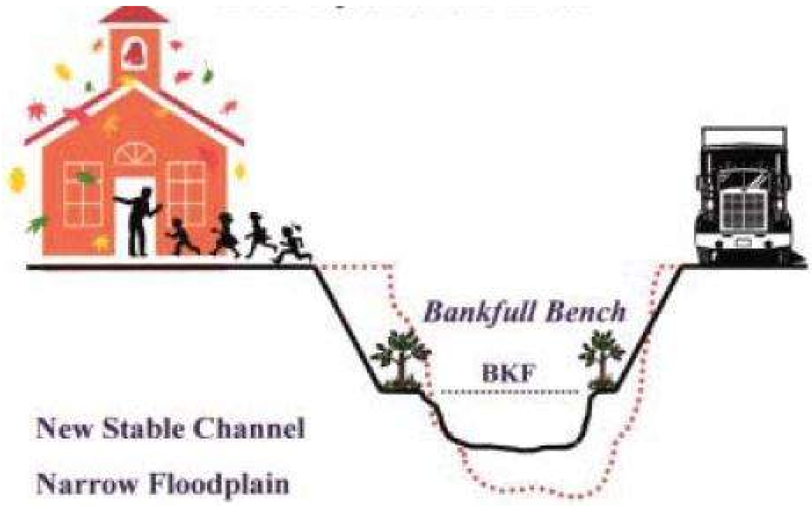


Figure 1. Narrow floodplain bench for steep streams (Doll et al. 2003. Stream Restoration: A Natural Channel Design Handbook. Raleigh: North Carolina State University.)

A permanent 35' minimum riparian buffer.

Given the residential lot sizes, a 35-ft. forested riparian buffer is not feasible. However, riparian plantings will be maximized to the extent feasible.

Buffalo Run Along Meeks Lane

Photograph 1. Eroded banks along the UNT to Buffalo Run

A headwater unnamed tributary (UNT) to Buffalo Run along Meeks Lane shows evidence of undercutting and bank erosion. The channel appears to be a gaining stream. The stream is spring fed within the project area.

The June 22, 2017 PA DEP memo titled *Considerations of Stream Restoration in Pennsylvania for Eligibility as an MS4 Best Management Practice* addresses relevant criteria for BMP projects. The following italicized statements are criteria published in the memo. The text following the italicized statements explain how this project meets those criteria.

Permittee must document existing channel or streambank erosion and actively enlarging or incising urban stream condition prior to the restoration (an existing problem).

As shown in the photographs the stream is actively incising. The stream is in the planning area. Runoff from a small sub-division drains to the stream.

Effectiveness is most readily demonstrated for projects in 1st to 3rd order streams (small). Large projects will require additional documentation.

The UNT to Buffalo Run is a headwater stream.

The project must address at least 100 LF of stream channel.

The proposed project will address approximately 320 LF. At a rate of 115 lb./LF/yr., the project along Meeks Lane will generate 36,800 lb./yr. of sediment credit.

Impervious areas upstream of the project must be sufficiently treated to address peak flows that may exceed engineering design thresholds or compromise channel form and function.

There is an area adjacent to the stream that detains stormwater (**Photograph 2**). Improvements to this basin will be evaluated as part of the engineering study.

The project must address both sides of the channel on sites where a need to do so is evident.

The project will address both sides of the stream.

Photograph 2. Adjacent area that detains stormwater

The goal is to apply a comprehensive approach that may employ a mix of techniques appropriate to the site, creating long-term stability of the streambed, streambanks, and floodplain.

To be comprehensive, the stormwater detention area will be evaluated in conjunction with this project.

Streambank or streambed armoring may be used where necessary to maintain channel stability but the length of stream that is armored (such as with rip-rap and gabions) may not be included in the load reduction calculation.

Armoring is not proposed as part of this project.

Projects must maximize floodplain reconnection with minimal channel invert elevation increase required to achieve this objective. Restoration bank height ratios must be 1.0 or less.

Floodplain connection can be achieved on the left bank of this project. However, due to the proximity of Meeks Lane, there is limited opportunity for floodplain connection on the right bank.

A permanent 35' minimum riparian buffer.

A 35-ft. buffer will remain on the left bank of the stream. However, due to the proximity of Meeks Lane, the right bank buffer will be more narrow.

Spring Creek Estates Open Space Stream Restoration

Photograph 1. Eroded section of Spring Creek adjacent to Spring Creek Estates

This stream restoration project is being undertaken by the United States Department of Interior Fish and Wildlife Service (USFWS). The project area is currently instable and the banks are actively eroding (**Photograph 1**). The USFWS is has designed the project with the objective of improving fish habitat by addressing bank instability. The project includes mudsills, log vanes, rock toes, rock cross vanes, random boulder clusters, and placement of large woody debris.

The June 22, 2017 PA DEP memo titled *Considerations of Stream Restoration in Pennsylvania for Eligibility as an MS4 Best Management Practice* addresses relevant criteria for BMP projects. The following italicized statements are criteria published in the memo. The text following the italicized statements explain how this project meets those criteria.

Permittee must document existing channel or streambank erosion and actively enlarging or incising urban stream condition prior to the restoration (an existing problem).

As shown in **Photograph 1** the stream is actively eroding. The project is within the Center Region MS4 urban planning area.

Effectiveness is most readily demonstrated for projects in 1st to 3rd order streams (small). Large projects will require additional documentation.

This project is being conducted in Spring Creek, a 3rd order stream.

The project must address at least 100 LF of stream channel.

The proposed project totals approximately 2,500 LF. The Centre Region Partner, College Township, plans to acquire an easement to maintain a minimum of 500 LF of the project. At a rate of 115 lb./LF/yr., a 500 LF easement will generate 57,500 lb./yr. of sediment credit. However, the project could generate up to 287,500 lb./yr. of sediment if College Township acquires additional easement.

Impervious areas upstream of the project must be sufficiently treated to address peak flows that may exceed engineering design thresholds or compromise channel form and function.

Previous efforts have been made to establish a riparian buffer along this reach of stream. The village of Houserville drains to the project area. This village was developed in the mid-century to 1980's, before stormwater management was common practice. All new development in the village must comply with College Township's Act 167 Plan and will therefore control peak flow. Retrofitting the existing housing developments with stormwater management BMPs is not feasible without condemnation and land acquisition.

The project must address both sides of the channel on sites where a need to do so is evident.

Streambank stabilization will be conducted on both sides of the stream.

The goal is to apply a comprehensive approach that may employ a mix of techniques appropriate to the site, creating long-term stability of the streambed, streambanks, and floodplain.

The total project takes a comprehensive approach and integrates raingardens, riparian plantings, streambank stabilizing vanes, and habitat structures.

Streambank or streambed armoring may be used where necessary to maintain channel stability but the length of stream that is armored (such as with rip-rap and gabions) may not be included in the load reduction calculation.

Armoring is not included in the proposed restoration project.

Projects must maximize floodplain reconnection with minimal channel invert elevation increase required to achieve this objective. Restoration bank height ratios must be 1.0 or less.

Floodplain reconnection is not proposed as part of this project.

A permanent 35' minimum riparian buffer.

Riparian plantings, extending at least 35 ft., are proposed for the right bank.

Piney Ridge Subdivision Stream Restoration

Photograph 1. UNT Beaver Branch Downstream of Wyoming in the Piney Ridge Subdivision

The headwaters of Beaver Branch begin in western Ferguson Township. The project area includes 350 LF of an unnamed tributary (UNT) to Beaver Branch located south of Wyoming Avenue in the Piney Ridge Subdivision. This stream segment is an intermittent headwaters stream that is spring fed during low flow periods and often runs dry during extended periods of no precipitation. The stream segment has a Chapter 93 designation of high quality, cold water fishes (HQ-CWF).

The stream runs through a residential subdivision (Piney Ridge) and is flanked by residential properties with a riparian buffer zone consisting of lawns and some mature trees (**Photograph 1**). The channel through the project reach is incised with some undercut banks. Bank erosion is evident throughout the stream reach with evidence of sediment deposition in the channel particularly near the downstream end of the proposed project reach (**Photograph 2**). Residents indicate that the sediment deposition causes flooding particularly in the downstream areas.

Stream restoration in this reach will be facilitated with the use of low alternating vanes and some cross vanes. It may also be possible to create a small floodplain bench adjacent to the low flow channel. Some additional riparian buffer plantings should also be provided.

Photograph 2. Sediment deposition in channel

The June 22, 2017 PA DEP memo titled *Considerations of Stream Restoration in Pennsylvania for Eligibility as an MS4 Best Management Practice* addresses relevant criteria for BMP projects. The following italicized statements are criteria published in the memo. The text following the italicized statements explain how this project meets those criteria.

Permittee must document existing channel or streambank erosion and actively enlarging or incising urban stream condition prior to the restoration (an existing problem).

Active bank erosion and stream instability are evidenced in **Photographs 1** and **2** above. Residents have reported the loss of riparian trees, sediment deposition, and increased flooding as a result of the stream instability.

Effectiveness is most readily demonstrated for projects in 1st to 3rd order streams (small). Large projects will require additional documentation.

The UNT to Beaver Branch is a 1st order stream.

The project must address at least 100 LF of stream channel.

The proposed project will address approximately 350 LF of eroded and unstable stream channel. At a rate of 115 lb./LF/yr., the project in the Piney Ridge subdivision will generate 40,250 lb./yr. of sediment credit.

Impervious areas upstream of the project must be sufficiently treated to address peak flows that may exceed engineering design thresholds or compromise channel form and function.

This intermittent stream forms as an erosional gully originating in agricultural and forested/mountain lands upstream. The most significant tributary impervious area, other than the homes and roadways in the Piney Ridge Subdivision, are state and other local roads. Runoff from any future developments will be controlled through Ferguson Township's MS4 compliant stormwater management ordinances. While these ordinances will control storm runoff from new development, significant changes to the flow regime in the UNT to Beaver Branch are not realistic because runoff capture and control to the extent necessary would require significant residential land condemnation.

The project must address both sides of the channel on sites where a need to do so is evident.

Erosion through the proposed project reach affects both channel banks. During project design a solution will be developed to address bank erosion along both the north and south channel banks.

The goal is to apply a comprehensive approach that may employ a mix of techniques appropriate to the site, creating long-term stability of the streambed, streambanks, and floodplain.

The proposed approach using alternating vanes, floodplain benching, and site appropriate riparian plantings provides a mix of techniques appropriate to the site for long-term stability.

Streambank or streambed armoring may be used where necessary to maintain channel stability but the length of stream that is armored (such as with rip-rap and gabions) may not be included in the load reduction calculation.

Stream bed and bank armoring are not proposed.

Projects must maximize floodplain reconnection with minimal channel invert elevation increase required to achieve this objective. Restoration bank height ratios must be 1.0 or less.

Floodplain benching within the confines of the existing subdivision and residential lots is part of the proposed solution.

A permanent 35' minimum riparian buffer.

Given the residential lot sizes and configurations, a 35-ft. forested riparian buffer is not feasible. However, riparian plantings will be maximized to the extent possible.

Spring Creek Restoration at the Pennsylvania Military Museum

Photograph 1. Stream reach downstream of Military Museum dam (looking downstream)

The project area includes 350 LF of Spring Creek immediately upstream of a stream restoration project completed in the late 1990's. The site is located on the Pennsylvania Military Museum grounds in Harris Township. This section of Spring Creek is perennial with a Chapter 93 designation of high quality, cold water fishes (HQ-CWF).

Lands tributary to the project area include residential and some commercial properties. Most development occurred prior to the advent of modern stormwater regulations. As illustrated in **Photographs 1** through **3**, the stream is incised with little floodplain connection. The incision in this reach is aggravated by the dam located at the upstream end of the reach (**Photograph 2**).

Stream restoration in this reach will be facilitated with the use of low alternating vanes. Cross vanes will be used to provide grade control. To the extent possible a floodplain bench and riparian planting area will be created adjacent to the low flow channel. Habitat enhancing mud sills may also be employed.

The June 22, 2017 PA DEP memo titled *Considerations of Stream Restoration in Pennsylvania for Eligibility as an MS4 Best Management Practice* addresses relevant criteria for BMP projects. The following italicized statements are criteria published in the memo. The text following the italicized statements explain how this project meets those criteria.

Permittee must document existing channel or streambank erosion and actively enlarging or incising urban stream condition prior to the restoration (an existing problem).

Active bank erosion and lack of floodplain connectivity are evidenced in **Photographs 1** through **3**. This project would be a continuation of the restoration project previously constructed immediately downstream.

Photograph 2. Incised steep cut banks with little floodplain connectivity (looking upstream)

Photograph 3. Steep cut incised channel bank

Effectiveness is most readily demonstrated for projects in 1st to 3rd order streams (small). Large projects will require additional documentation.

This reach of Spring Creek is a 3rd order stream.

The project must address at least 100 LF of stream channel.

The proposed project will address approximately 350 LF of eroded stream channel. At a rate of 115 lb./LF/yr., the project along this section Spring Creek will generate 40,250 lb./yr. of sediment credit.

Impervious areas upstream of the project must be sufficiently treated to address peak flows that may exceed engineering design thresholds or compromise channel form and function.

Opportunities for installation of stormwater control facilities upstream of the project location to address peak runoff have been investigated. Most of the urban development tributary to this channel segment was constructed prior to the advent of modern stormwater management ordinances. The lack of existing basins and open space areas close to development is limited. One opportunity, the Willowbrook Basin Retrofit, has been identified as a viable project and will be advanced in the next permit period. In addition, runoff from all development which occurred after 2003 has been controlled through Harris Township's MS4 compliant stormwater management ordinances. While these ordinances control runoff from recent and future development activities, significant changes to the flow regime in this reach of Spring Creek are not realistic since runoff capture and control to the extent necessary would require significant land condemnation for new stormwater control facilities.

The project must address both sides of the channel on sites where a need to do so is evident.

Erosion through the proposed project reach affects both channel banks. This project will address erosion along both channel banks.

The goal is to apply a comprehensive approach that may employ a mix of techniques appropriate to the site, creating long-term stability of the streambed, streambanks, and floodplain.

The proposed approach using alternating vanes, cross vanes, floodplain benching/connection, and site appropriate riparian plantings provides a mix of techniques appropriate to the site for long-term stability.

Streambank or streambed armoring may be used where necessary to maintain channel stability but the length of stream that is armored (such as with rip-rap and gabions) may not be included in the load reduction calculation.

Stream bed and bank armoring are not proposed.

Projects must maximize floodplain reconnection with minimal channel invert elevation increase required to achieve this objective. Restoration bank height ratios must be 1.0 or less.

Floodplain benching/reconnection within the confines of existing site constraints will be used as part of the restoration project.

A permanent 35' minimum riparian buffer.

The restoration project will include a planted riparian buffer area consistent with site constraints and having a maximum 35 ft. width.

Willowbrook Basin Retrofit (H6)

Photograph 1. Willowbrook Basin (BMP A7)

This project involves retrofitting a 1.7-acre stormwater management basin in Willowbrook Estates to include a runoff reduction function. The existing basin, illustrated in **Photograph 1**, was originally constructed in the mid 1980's to provide peak runoff control from the 50-acre subdivision. The basin covers approximately 1.7 acres and captures runoff from approximately 90% of the subdivision. The basin is currently vegetated with meadow grasses and wildflowers, and consists predominantly of Nolan Soils. Nolan soils (Hydrologic Soil Group B) are well drained, and have good infiltration characteristics.

As illustrated in **Photograph 2**, the basin outlet structure consists of a 24-in. primary outlet pipe with a 2 ft. by 4 ft. horizontal overflow orifice with trash rack. The total drainage area tributary to the basin is approximately 149 acres which includes 44 acres within Willowbrook Estates, runoff from an upstream partially developed subdivision with a separate stormwater facility, and agricultural lands.

Photograph 2. Outlet structure for Willowbrook Basin (BMP A7)

Preliminary analysis indicates that the basin can be retrofit to provide a minimum of 1.83 ac-ft. of runoff reduction from the 8.8 acres of tributary impervious area in Willowbrook Estates.

Applying a conservative infiltration rate of 0.28 inches per hour, runoff will be removed via infiltration in 72 hours. Entering a runoff storage volume of 1.83 ac.-ft. and an impervious area of 8.8 acres into the expert panel equation, a rainfall capture depth of 2.5 inches per impervious acre was computed.

Based on the adjustor curve, the 2.5 inches of rainfall capture will reduce TSS by 85%, TN by 68%, and TP by 78%. The rainfall capture volume and land area treated by the BMP was entered into the *MapShed* (GWLF-E) Urban BMP Editor. Based on this analysis, the retrofitted basin will treat 6,024 lb./yr. of sediment in the Spring Creek Watershed.

Penn Hills Basin Retrofit (A9)

This project involves retrofitting a 1.38-acre stormwater management basin in Penn Hills to include a runoff reduction function. The existing basin, illustrated in **Photograph 1**, was originally constructed in the mid 1980's to provide peak runoff control from 70 acres of the subdivision. Approximately 17% of the drainage area (12 acres) is impervious. The basin is currently vegetated with meadow grasses and wildflowers and consists predominantly of Hagerstown and Opequon Soils. These soils (Hydrologic Soil Group B) are well drained and have good infiltration characteristics.

Photograph 1. Penn Hills basin

Preliminary analysis indicates that the basin can be retrofit to provide a minimum of 2.4 ac-ft. of runoff reduction from the 12 acres of tributary impervious area in Penn Hills.

Applying a conservative infiltration rate of 0.31 inches per hour, runoff will be removed via infiltration in 72 hours. Entering a runoff storage volume of 1.8 ac.-ft. and an impervious area of 4.8 acres into the expert panel equation, a rainfall capture depth of 2.4 inches per impervious acre was computed.

Based on the adjustor curve, the 2.5 inches of rainfall capture will reduce TSS by 85%, TN by 67%, and TP by 78%. The rainfall capture volume and land area treated by the BMP was entered into *MapShed's* (GWLF-E) Urban BMP Editor. Based on this analysis, the retrofitted basin will treat 9,500 lb./yr. of sediment in the Spring Creek Watershed.

Centre Region MS4 Partners PRP

APPENDIX G

Multi-Municipal Agreement

NEWELL
TERESKA &
MACKAY
ENGINEERING

MS4 PARTNERSHIP

COOPERATIVE AGREEMENT

THIS AGREEMENT is made this_________day of________________, 2017, by and among the municipalities of College, Harris, Ferguson, and Patton Townships; the Borough of State College; and The Pennsylvania State University (PSU) (collectively, the "MS4 Partners"), executing this Cooperative Agreement (hereinafter referred to as "Agreement") for the purpose of:

1) contractual obligation for the continued monitoring of the existing Regional Chesapeake Bay Pollutant Reduction Plan and Impaired Waters Plan, hereinafter referred to as Pollutant Reduction Plan (PRP);

2) establishing agreement parameters for any cooperative effort on Projects and/or Programs which comply with the pollutant reduction goals associated with the Regional PRP.

Except with respect to PSU, this Agreement is authorized and required pursuant to applicable law, including, but not limited to, 53 Pa.C.S. §2303 (53pa.C.S.A Section 481 et. Seq.)

BACKGROUND

WHEREAS, each of the MS4 Partners is located within the Spring Creek Watershed and is subject to the National Pollutant Discharge Elimination System (NPDES) permitting for stormwater discharges from a regulated Small Municipal Separate Storm Sewer Systems Permit (MS4 permit) process administered by the Pennsylvania Department of Environmental Protection on behalf of the United States Environmental Protection Agency, which requires a significant reduction of the amount of sediment, and by proxy, the instantaneous quantity of nitrogen and phosphorus in the stormwater discharged to the Spring Creek to comply with the Regional Chesapeake Bay Pollutant Reduction Plan and Impaired Waters Plan, hereinafter referred to as Pollutant Reduction Plan (PRP); and

WHEREAS, all municipal MS4 Partners shall adopt an Ordinance approving this Agreement to effectuate their participation. The Pennsylvania State University shall sign this document to effectuate their participation.

INTENDING TO BE LEGALLY BOUND, THE MS4 PARTNERS AGREE AS FOLLOWS:

Section 1. **Guiding Principles.** The MS4 Partners have a mutual interest in restoring the impaired waters within their respective urbanized areas within the 2010 State College Urbanized Areas. Projects identified within the Regional PRP that reduce the annual amount of nitrogen, phosphorous and sediment entering impaired surface waters within a respective urbanized area and which benefit any or all of the MS4 Partners will require a sub-agreement specific to the project to be signed by those MS4 Partners electing to participate in the project.

Section 2. **SubAgreement Requirements.** Any project and/or program that complies with the Regional PRP is available to all MS4 Partners.

Section 3. **Financing.**

Contribution Formula by MS4 Partners for a Sub-Agreement Regarding Any Project and/or Program. The MS4 Partners have agreed that for each sub-agreement, each Participant to that agreement shall be obligated to fund their portion of the Project cost based upon the percentage of pounds of sediment removed for that Participant as compared to the total pounds of sediment removed by the proposed project. The funding of each entity shall adequately cover all costs including, but not limited to consultant fees, permit fees, advertising costs, construction costs and continued maintenance costs.

Section 4. **Effective Date**. This Agreement shall become effective upon execution of the final signature and, where applicable, adoption of an Authorizing Ordinance. Notwithstanding the foregoing, in no event (including if one or more MS4 Partners does not execute this agreement and, where applicable, adopt an Authorizing Ordinance) will the amount of contributions due from each Participant exceed its share of the consultant's fees as outlined in Paragraph 3.b. above without the consent of such Participant.

Section 5. **Applicable Law**. The MS4 Partners agree and affirm that Pennsylvania law applies to this Agreement and all matters covered by and addressed by this Agreement. It is acknowledged and agreed that the sole and exclusive jurisdiction and venue for any dispute relating to any matter covered by this Agreement, and/or regarding any dispute over the enforcement or interpretation of this Agreement, shall rest with the Centre County Court of Common Pleas. The MS4 Partners hereby submit to the exclusive jurisdiction of that Court.

Section 6. **Integration**. This Agreement contains the entire agreement between the MS4 Partners. There are no understandings or agreements, verbal or otherwise, in relation hereto, except those expressly and specifically set forth herein. The MS4 Partners have not relied upon any statement, projection, disclosure, report, information, or any other representation or warranty except for those as may be specifically and expressly set forth in this Agreement.

Section 7. **No Oral Modification**. This Agreement may not be modified except in writing executed by all MS4 Partners. This Agreement shall be amended only in writing, by duly authorized representatives of all MS4 Partners, and such revision(s) must be approved by official action of each Participant jurisdiction, and as required by any applicable law of the Commonwealth.

Section 8. **Severability**. No determination by any court, governmental body, arbitration, or other judicial body, that any provision of this Agreement or any amendment that may be created hereto, is invalid or unenforceable in any instance shall affect the validity or enforceability of any other provision of the Agreement or applicable amendment. Each provision shall be valid and enforceable to the fullest extent permitted by applicable law, and shall be construed where and whenever possible as being consistent with applicable law.

Section 9. Exemption from taxation. The MS4 Partners shall have the same exemption from taxation as its participating municipalities.

Section 10. **Negotiated Agreement**. This Agreement has been negotiated by the MS4 Partners and embodies terms that were arrived at through mutual negotiation and joint effort, and the MS4 Partners shall be considered to have contributed equally to the preparation of this Agreement. The MS4 Partners warrant and represent that the terms and conditions of this Agreement have been discussed and negotiated between them and are voluntarily and knowingly accepted for the purpose of making a full and final compromise between the MS4

Partners, as referenced herein. The MS4 Partners further acknowledge that they understand the facts and their respective legal rights and obligations pursuant to this Agreement.

IN WITNESS WHEREOF, the MS4 Partners hereto have caused this Intergovernmental Cooperative Agreement for the Implementation of the Centre Regional Pollutant Reduction Plan to be executed and effective on ________________________.

WITNESS/ATTEST	**COLLEGE TOWNSHIP**
______________________________	__________________________________
Adam Brumbaugh, Manager/Secretary	D. Richard Francke, Chair of Council

Signature date:_________________________

Participation authorized by Ordinance No________, passed at a meeting of the governing body on______________________, 2017.

WITNESS/ATTEST	**FERGUSON TOWNSHIP**
______________________________	__________________________________
David G. Pribulka, Secretary	Steve Miller, Chairman

Signature date:__________________

Participation authorized by Ordinance No__, passed at a meeting of the governing body on ________________________, 2017.

WITNESS/ATTEST **HARRIS TOWNSHIP**

________________________________ ____________________________________

Amy K. Farkas, Manager Bruce Lord, Chairman

Signature date:___________________________

Participation authorized by Ordinance No_________, passed at a meeting of the governing body on_______________________, 2017.

WITNESS/ATTEST **PATTON TOWNSHIP**

________________________________ ____________________________________

Douglas J. Erickson, Manager/Secretary Eliot Abrams, Chairman

Signature date:___________________________

Participation authorized by Ordinance No_________, passed at a meeting of the governing body on______________________________, 2017.

WITNESS/ATTEST **THE PENNSYLVANIA STATE UNIVERSITY**

________________________________ ____________________________________

Susan J. Wiedemer, Assistant Treasurer

Signature date:___________________________, 2017

WITNESS/ATTEST **STATE COLLEGE BOROUGH**

______________________________ ______________________________

Thomas J Fountaine, Manager/Secretary Thomas E. Daubert, President

Signature date:_________________________

Participation authorized by Ordinance No________, passed at a meeting of the governing body on ____________________, 2017.

Centre Region MS4 Partners PRP

APPENDIX H

Public Meeting Documentation

Newell Tereska & Mackay Engineering

Centre Region MS4 Partners PRP

H.1 2017 Public Meeting

Legals & Public Notices | Legals & Public Notices | Legals & Public Notices

PUBLIC NOTICE

The Centre Region Municipal Separate Storm Sewer System (MS4) Partners consisting of College Ferguson Harris and Patton Township, The Pennsylvania State University - University Park Campus, and State College Borough have developed a Joint Pollution Reduction Plan (PRP) for Spring Creek, Slab Cabin Run, Buffalo Run, Logan Branch and the Chesapeake Bay. The PRP determines existing sediment and nutrient pollutant loadings associated with stormwater runoff and proposes potential Best Management Practices (BMPs) to reduce the pollutant loads to meet requirements of each Partner's pending MS4 Permit renewal.

The PRP is available for viewing at each of the MS4 Partner offices by contacting one of the following individuals:

College Township - Linda Magro; lmagro@collegetownship.org or (814) 231-3021

Ferguson Township - Marcella Bell; mbell@twp.ferguson.pa.us or (814) 238-4651

Harris Township - Deb Lang; secretary@harristownship.org or (814) 466-6228

Patton Township - Nicole Harter; patton@twp.patton.pa.us or (814) 234-0271

The Pennsylvania State University - Sandra Lightner; skl100@psu.edu or (814) 863-2340

State College Borough - Judy Aitieri; publicworksdept@statecollegepa.us or (814) 234-7140

Written comments on the PRP will be accepted for a period of 30 days from the date of this public notice by mailing to Mr. Scott Brown, P.E., D.WRE, NTM Engineering, Inc., 341 Science Park Rd, Suite 203, State College, PA 16803, or by e-mail at sbrown@ntmeng.com. Verbal or written comments will also be accepted during a presentation of the PRP at a workshop to be held on Oct 25, 2017 at 6 PM at the College Township Municipal Bldg, 1481 E. College Ave, State College, PA 16801. All comments will be tabulated and addressed within the final PRP.

CENTRE DAILY TIMES

RECEIVED OCT 09 2017

AFFIDAVIT OF PUBLICATION

Account #	Ad Number	Identification	PO	Amount	Cols	Lines
120316	0003304920	PUBLIC NOTICE The Centre Region Municipal S		$264.75	3	44

Attention:

FERGUSON TOWNSHIP
3147 RESEARCH DR
STATE COLLEGE, PA 16801

PUBLIC NOTICE

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Approval
No.
Fund 01
Paid
#
Vendor # 10203

COMMONWEALTH OF PENNSYLVANIA

COUNTY OF CENTRE

ANDREW STRAGER, being duly sworn, according to law says that he/she is an agent of the Centre Daily Times, a daily newspaper of general circulation, having its place of business in State College, Centre County, Pennsylvania, and having been established in the year 1898; that the advertisement appeared in said newspaper, that the affiant is not interested in the subject matter of the notice or advertisement; that all of the allegations contained herein relative to the time, place and character of the publication are true.

1 Insertion(s)

Published On:
September 29, 2017

Witness Signature

Sworn and Subscribed to me this 3rd day of October

Tessa M. Woodring
Notary Signature

COMMONWEALTH OF PENNSYLVANIA
NOTARIAL SEAL
Tessa M. Woodring, Notary Public
College Twp., Centre County
My Commission Expires Sept. 20, 2021
MEMBER, PENNSYLVANIA ASSOCIATION OF NOTARIES

3400 East College Avenue, State College, PA 16801 (814) 238-5000 (800) 327-5500

Centre Region MS4 Partners Pollution Reduction Plan

NTM Engineering Services :: Hydrologic & Hydraulic Modeling :: Stormwater Planning & Design :: Bridge Design & Inspection :: Technical Training & Course Development :: www.ntmeng.com

Newell Tereska & Mackay Engineering

Agenda

- Overview of the PRP Process
- Load Computations
- Load Reduction BMPs
- Costs
- General Questions/Discussion
- Receive Official Comments

Newell Tereska & Mackay Engineering

Overview of the PRP Process

- Municipal Separate Storm Sewer System (MS4) National Pollutant Discharge Elimination System (NPDES) Permit
  - Regulates Municipal/Institutional stormwater discharges to impaired surface waters (Chesapeake Bay and locally impaired surface waters).
  - Stormwater conveyance systems - roadside ditches, municipal streets, curbs/gutters, man-made channels and storm drains.
  - Permits are renewed on a 5-year cycle
  - 2018 permit renewal applications require a Pollutant Reduction Plan

NEWELL TERESKA & MACKAY ENGINEERING

Overview of the PRP Process

- Pollution Reduction Plan (PRP)
  - Establish Total Suspended Sediment (TSS), Total Nitrogen, and Total Phosphorus (TP) Base Loads from Storm Runoff
  - Establish a Plan for reducing Pollutant Loads to impaired waters through implementation of Best Management Practices (BMPs)
  - Impaired Waters
    - Chesapeake Bay
    - Local impaired waters

NEWELL TERESKA & MACKAY ENGINEERING

Load Reduction Summary

- All Waters in the Chesapeake Bay
  - 10% TSS reduction
  - 3% TN reduction
  - 5% TP reduction

DEPs Presumptive Approach:

If a 10% reduction in TSS is achieved then so to is a 3% reduction in TN and a 5% reduction in TP

NEWELL TERESKA & MACKAY ENGINEERING

Analysis Approach

- Determined the planning area
- Eliminate (parse) non-applicable areas
- Determine the existing pollutant load
  - Modeled using MapShed
  - Model calibrated to existing flow data for Big Hollow and Spring Creek remainder (PSU and Houserville USGS Gate).
  - Assessed Credits for existing BMPs
- Determined regulatory load reduction (10% TSS)
- Evaluated BMPs

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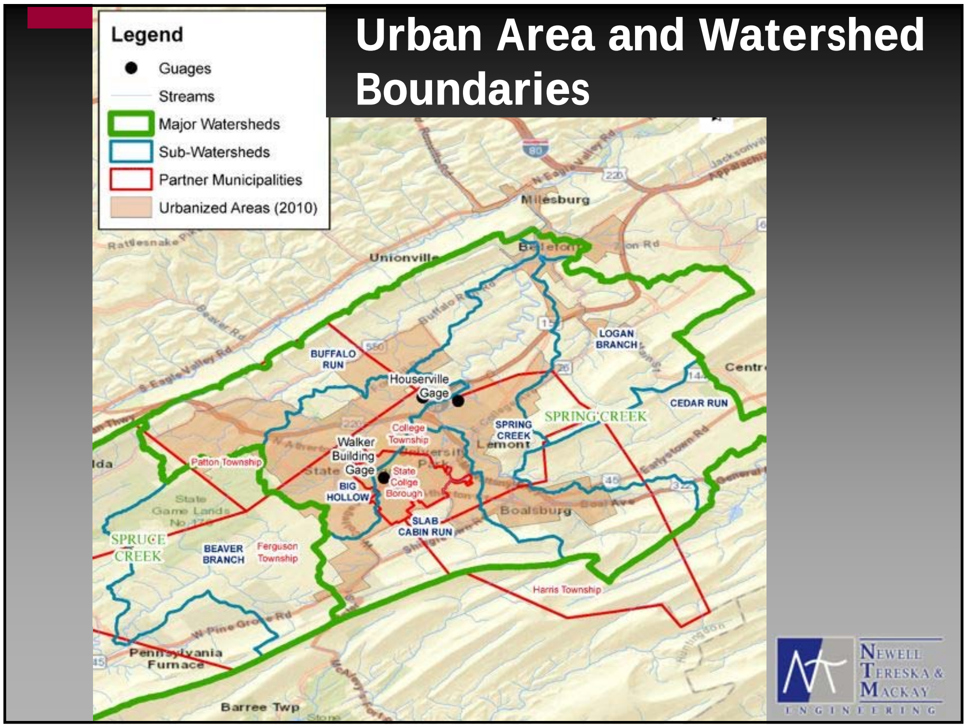
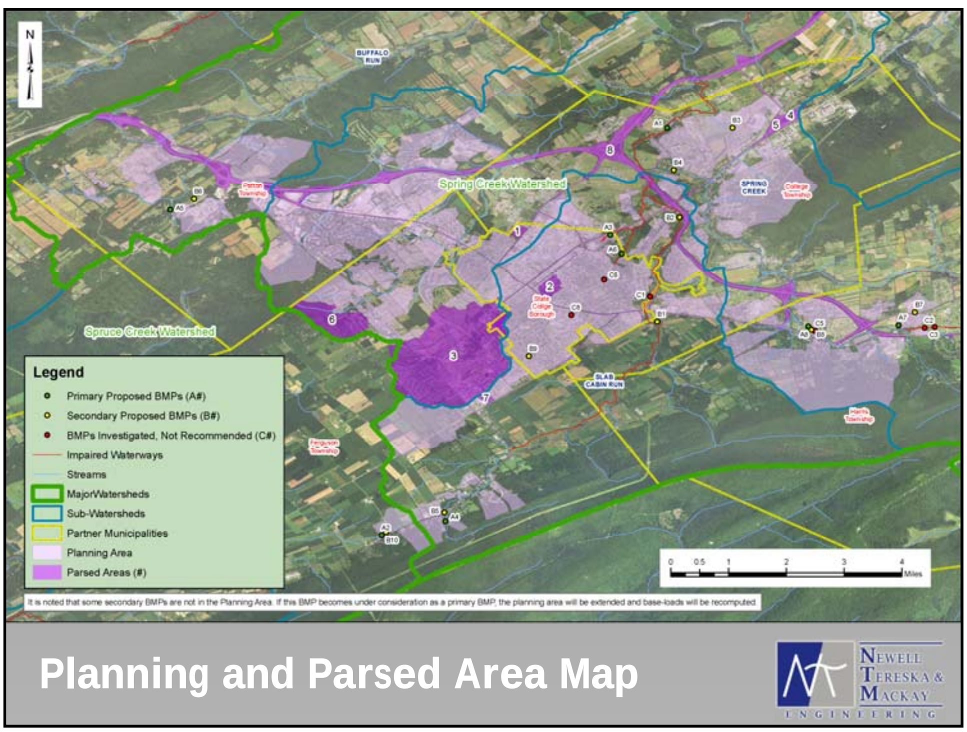
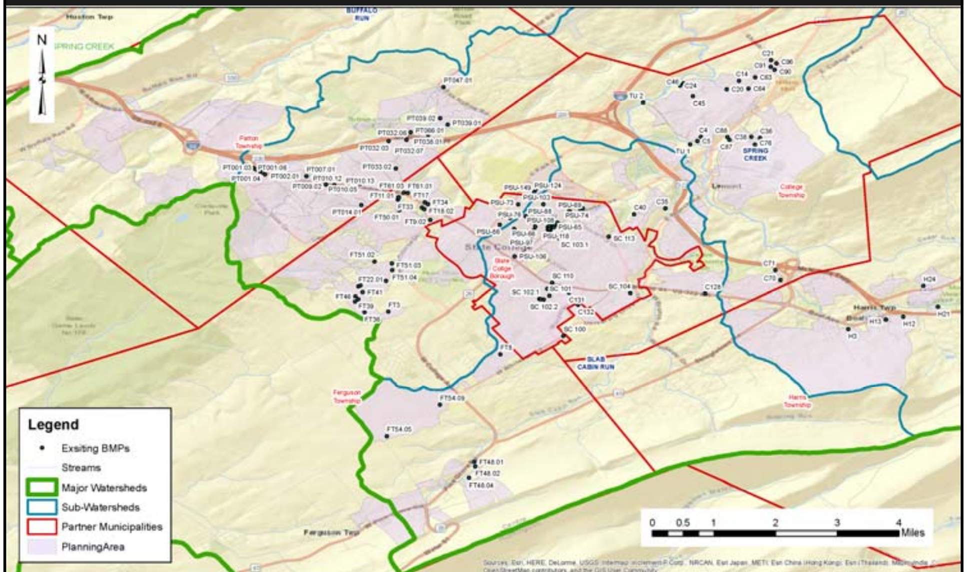

Urban Area and Watershed Boundaries
Legend
Guages
Streams
Major Watersheds
Sub-Watersheds
Partner Municipalities
Urbanized Areas (2010)
Milesburg
Bellefonte
Unionville
BUFFALO RUN
LOGAN BRANCH
Houserville Gage
College Township
SPRING CREEK
CEDAR RUN
SPRING CREEK
Lemont
Walker Building Gage
Patton Township
BIG HOLLOW
State College Borough
SLAB CABIN RUN
Boalsburg
SPRUCE CREEK
BEAVER BRANCH
Ferguson Township
Harris Township
Pennsylvania Furnace
Barree Twp
NEWELL TERESKA & MACKAY ENGINEERING


Legend
Primary Proposed BMPs (A#)
Secondary Proposed BMPs (B#)
BMPs Investigated, Not Recommended (C#)
Impaired Waterways
Streams
MajorWatersheds
Sub-Watersheds
Partner Municipalities
Planning Area
Parsed Areas (#)
Spring Creek Watershed
Spruce Creek Watershed
Planning and Parsed Area Map
NEWELL TERESKA & MACKAY ENGINEERING

H - 8



Existing BMPs Used for Baseload Reduction

NEWELL TERESKA & MACKAY ENGINEERING

Base Load and Regulatory Load Reductions

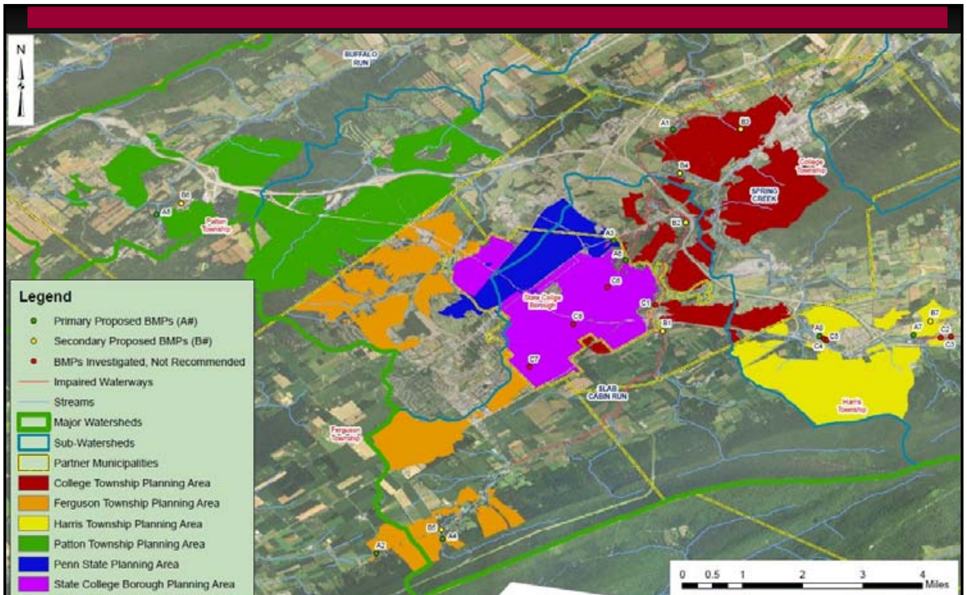
Watershed	Existing Sediment Load (lb./yr.)	Required Sediment Reduction (lb./yr.)	Existing Nitrogen Load (lb./yr.)	Required Nitrogen Reduction (lb./yr.)	Existing Phosphorus Load (lb./yr.)	Required Phosphorus Reduction (lb./yr.)
Beaver Branch (Ferguson Township only)	**100,703**	**10,070**	**1,309**	**39**	**63**	**3**
Slab Cabin Run	**1,344,394**	**134,439**	**16,165**	**485**	**830**	**41**
College Twp	225,948	22,595	2,960	89	147	7
Ferguson Twp	483,862	48,386	4,341	130	300	15
Borough of State College	366,797	36,680	6,352	191	241	12
Penn State	267,787	26,778	2,512	75	142	7
Spring Creek	**1,028,340**	**102,834**	**13,741**	**412**	**569**	**28**
College Twp	542,540	54,254	6,958	208	309	15
Ferguson Twp	610	61	219	7	1	-
Harris Twp	484,115	48,412	5,522	166	257	13
Patton Twp	844	84	1,011	30	2	-
Borough of State College	91	9	18	1	-	-
Penn State	140	14	13	0	-	-
Buffalo Run (Patton Township only)	**329,245**	**33,925**	**7,059**	**212**	**218**	**11**
Total:	**2,802,682**	**280,268**	**38,274**	**1,148**	**1,680**	**84**

NEWELL TERESKA & MACKAY ENGINEERING

Plan for TSS Load Reduction

- BMP’s
  - 17 stream reaches
  - 7 basin retrofits
  - Street Sweeping
  - Forest Buffer (Meyer-Everhart)
- Primary and Secondary BMPs selected in conjunction with Partner Engineers

Newell Tereska & Mackay Engineering



Primary and Secondary BMP Locations

Newell Tereska & Mackay Engineering

Primary BMPs

Watershed/ Primary BMP	Watershed	Load Reduction (lb./yr.)	Cost Sharing Partners
Piney Ridge Phase 1 Stream Restoration (350 LF)	Beaver Branch	40,250	Ferguson Township (100%)
Duck Pond Channel Stream Restoration (1000 LF)	Slab Cabin	115,000	College Township (20%) Ferguson (17.5%) Penn State (62.5%)
Walnut Springs Phase 3 & 4 Stream Restoration (385 LF)	Slab Cabin	44,275	Borough of State College (100%)
Pine Grove Mills Phase 1 Stream Restoration (300 LF)	Slab Cabin	34,500	Ferguson Township (100%)
Spring Creek Estates Stream Restoration (500 LF)	Spring Creek	57,500	College Township (95%) Harris Township (5%)
Willowbrook Basin Retrofit	Spring Creek	6,024	Harris Township (100%)
Pa Military Museum Stream Restoration Phase 1 (350 LF)	Spring Creek	40,250	Harris Township (100%)
Meeks Lane Stream Restoration (320 LF)	Buffalo Run	36,800	Patton Township (100%)

Note: These BMPs are identified in the PRP to demonstrate one approach to meeting the regulatory load reduction. This list is not set in concrete; alternate BMP's can be implemented.

NEWELL TERESKA & MACKAY ENGINEERING

Secondary BMPs

Watershed/ Primary BMP	Watershed	Load Reduction (lb./yr.)	Cost Sharing Partners
Piney Ridge Phase 2 Stream Restoration (200 LF)	Beaver Branch	23,000	Ferguson Twp
Meyer-Everhart Streamside Forest Buffer	Slab Cabin	1,501	College Township Ferguson Harris Borough of State College
Street Sweeping	Slab Cabin	21,047	Borough of State College
Pine Grove Mills Phase 2 Stream Restoration (200 LF)	Slab Cabin	23,000	Ferguson Township
Slab Cabin Park Stream Restoration (750 LF)	Spring Creek	86,250	College Township
Orchard Park Basin Retrofit	Spring Creek	6,024	Borough of State College
Penn Hills Basin Retrofit	Spring Creek	9,500	College Township
Spring Creek Park Stream Restoration (300 LF)	Spring Creek	34,500	College Township
Pa Military Museum Stream Restoration Phase 2 (350 LF)	Spring Creek	40,250	Harris Township
Rocky Ridge Basin Retrofit	Spring Creek	1,273	Harris Township
Grays Woods Basin Retrofit	Buffalo Run	36,800	Patton Township

Note: These BMPs are identified in the PRP to demonstrate one approach to meeting the regulatory load reduction. This list is not set in concrete; alternate BMP's can be implemented.

NEWELL TERESKA & MACKAY ENGINEERING

Load Reduction Achieved By the Project's Described

Basin	Required Sediment Reduction (lb./yr.)	Sediment Reduction from Primary BMPs (lb./yr.)	Excess Load from Primary BMPs (lb./yr.)	Sediment Reduction from Secondary BMPs (lb./yr.)	Excess Load from Primary + Secondary BMPs (lb./yr.)
Beaver Branch	10,070	40,250	30,180	23,000	53,180
Slab Cabin Run	134,439	193,775	59,336	146,671	206,007
Spring Creek	102,834	103,774	940	79,773	80,713
Buffalo Run	32,925	36,800	3,875	1,612	5,487
Total:	280,268	374,599	94,331	251,056	345,387

Note: Total load reduction from all BMPs is 223% of requirement.

Cost Summary

Project	College Township		Ferguson Township		Harris Township		Patton Township		Penn State		Borough of State College	
	Annual O&M Cost	Capital Cost	Annual O&M Cost	Capital Cost	Annual O&M Cost	Capital Cost	Annu al O&M Cost	Capital Cost	Annual O&M Cost	Capital Cost	Annual O&M Cost	Capital Cost
Piney Ridge Stream Restoration PH 1	$0	$0	$1,068	$78,750	$0	$0	$0	$0	$0	$0	$0	$0
Duck Pond Channel Restoration	$1,720	$128,000	$1,505	$112,000	$0	$0	$0	$0	$5,375	$400,000	$0	$0
Walnut Springs Stream Restoration	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,174	$86,625
Pine Grove Mills Stream Restoration	$0	$0	$915	$67,500	$0	$0	$0	$0	$0	$0	$0	$0
Spring Creek Estates Stream Restoration	$1,449	$106,875	$0	$0	$76	$5,625	$0	$0	$0	$0	$0	$0
Willowbrook Basin Retrofit	$0	$0	$0	$0	$3,000	$45,000	$0	$0	$0	$0	$0	$0
Military Museum Stream Restoration Phase 1	$0	$0	$0	$0	$1,068	$78,750	$0	$0	$0	$0	$0	$0
Meeks Lane Stream Restoration	$0	$0	$0	$0	$0	$0	$976	$72,000	$0	$0	$0	$0
Total:	**$3,169**	**$234,875**	**$3,488**	**$258,250**	**$4,144**	**$129,375**	**$976**	**$72,000**	**$5,375**	**$400,000**	**$1,174**	**$86,625**

Note: 1. Estimated capital costs include easement acquisition and construction. Engineering and permitting is not included.
2. These BMPs are identified in the PRP to demonstrate one approach to meeting the regulatory load reduction. This list is not set in concrete; alternate BMP's can be implemented.

Questions

NTM Engineering Services :: Hydrologic & Hydraulic Modeling :: Stormwater Planning & Design :: Bridge Design & Inspection :: Technical Training & Course Development :: www.ntmeng.com

Newell Tereska & Mackay Engineering

Comments

NTM Engineering Services :: Hydrologic & Hydraulic Modeling :: Stormwater Planning & Design :: Bridge Design & Inspection :: Technical Training & Course Development :: www.ntmeng.com

Newell Tereska & Mackay Engineering

CENTRE REGION
MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4) PARTNERS
POLLUTANT REDUCTION PLAN

RECORD OF PUBLIC MEETING

COLLEGE TOWNSHIP MUNICIPAL BUILDING
OCTOBER 25, 2017 6:00 P.M.

The Centre Region Municipal Separate Storm Sewer System (MS4) Partners consisting of College, Ferguson, Harris, and Patton Township, The Pennsylvania State University, University Park Campus, and State College Borough held a public meeting at the College Township Municipal Building on the Joint Pollutant Reduction Plan (PRP) for Spring Creek, Slab Cabin Run, Buffalo Run, Logan Branch, and the Chesapeake Bay. Mr. Ron Seybert from Ferguson Township welcomed all attendees and made brief introduction of the MS4 Partner representatives that were in attendance. See attached list of attendees.

Mr. Seybert gave a brief explanation of the purpose of the PRP to determine existing sediment and nutrient pollutant loadings associated with stormwater runoff and propose potential Best Management Practices (BMPs) to reduce the pollutant loads to meet requirements of each Partner's pending MS4 Permit renewal. Mr. Seybert also noted that the draft PRP was published and advertised for public comment on September 29, 2017. Mr. Seybert further explained the format of the evening with Mr. Scott Brown of NTM Engineering providing a review of the document followed by a time of general questions and answers, finishing with a time of formal questions and comments that attendees would like to have addressed. Mr. Seybert also clarified that comments did not need to be stated this evening, and that written comments will be accepted by NTM Engineering until the end of the day on October 29, 2017.

Mr. Brown of NTM Engineering and the Stormwater Engineer Consultant for the MS4 Partners gave a presentation on the PRP. Mr. Brown's presentation is attached to this record of public meeting. General questions and comments were received and answered by NTM Engineering staff and MS4 Partner representatives after the presentation.

After the general question and answer session, the time to receive official questions and comments was announced. There were no official questions or comments provided by any of the attendees to be addressed as part of the PRP. Mr. Seybert again stated that the public comment period will end on October 29, 2017 at 11:59 p.m. and that comments or questions could be forward to NTM Engineering. After that, all formal comments would be summarized and addressed in the final PRP to be submitted to the Department of Environmental Protection (DEP).

End of public meeting record.

Attachments: Attendance Record
PRP Presentation Slides

SIGN-IN

CENTRE REGION MS4 PARTNERS POLLUTANT REDUCTION PLAN PUBLIC MEETING

Wednesday, October 25, 2017

Name	Address
TODD GIDDINGS	780 BEAVER BRANCH ROAD PENNSYLVANIA FURNACE, PA 16865
DEB NARDONE	2555 N. ATHERTON ST STATE COLLEGE PA 16803
Robert Carline	1244 westerly Pkwy Unit 30 State College 16801
Suzy Yetter	2555 N. Atherton St State College, PA 16803
DAVID MODRICKER	FERGUSON TOWNSHIP PUBLIC WORKS
Kent Baker	College Township
Matt Keefer	261 Liberty St Boalsburg
Katie Ombalski	451 Bailey lane Boalsburg PA 16827
Lauren Lewis	234 Gerald St State College, PA 16801
RICH FRANCKE	1621 ELIZABETH RD STATE COLLEGE, PA 16801
Jennifer Kollz	1201 Shamrock Ave State College PA 16801
Scot Chambers	1965 Park Forest Ave. State College PA 16803
Amy KERNER	243 S ALLEN ST STATE COLLEGE PA 16801
LARRY FENNESSEY	OPP PENN STATE UNIVERSITY PARK PA 16802
Deb Hoag	State College Borough 243 S. Allen St State College PA 16801
DON FRANSON	HARRIS TOWNSHIP P.O. BOX 20 BOALSBURG

Ron Seybert — Ferguson Township 3147 Research Dr. S.C., PA 16801

Tracey Olexa — 263 Osmond St; St. College PA 16801

Scott Brown — 1314 SPRINGFIELD CIRCLE BOALSBURG PA 16827

Centre Region MS4 Partners PRP

H.2 2019 Public Meeting

CENTRE DAILY TIMES

AFFIDAVIT OF PUBLICATION

Account #	Ad Number	Identification	PO	Amount	Cols	Depth
117456	0004406113	PUBLIC NOTICE The Centre Region Municipal S	Legal Notice	$244.97	3	4.28 In

Attention: Summer Krape

FERGUSON TOWNSHIP
3147 RESEARCH DR
STATE COLLEGE, PA 16801

PUBLIC NOTICE

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The PRP is available for viewing at each of the MS4 Partner offices by contacting one of the following individuals:

College Township - Linda Magro; **lmagro@collegetownship.org** or (814) 231-3021

Ferguson Township - Summer Krape; **skrape@twp.ferguson.pa.us** or (814) 238-4651

Harris Township - Deb Lang; **secretary@harristownship.org** or (814) 466-6228

Patton Township - Nicole Harter; **patton@twp.patton.pa.us** or (814) 234-0271

The Pennsylvania State University - Shayla Branstetter; **srb492@psu.edu** or (814) 863-2340

State College Borough - Denise Dobo; **publicworksdept@statecollegepa.us** o r (814) 234-7140

Written comments on the PRP will be accepted for a period of 30 days from the date of this public notice by mailing to Mr. Scott Brown, P.E., D.WRE, NTM Engineering, Inc., 341 Science Park Rd, Suite 203, State College, PA 16803, or by e-mail at **sbrown@ntmeng.com.** Verbal or written comments will also be accepted during a presentation of the PRP at a workshop to be held on Wednesday, October 30, 2019 at 6:00 P.M. at the College Township Municipal Bldg, 1481 E. College Ave, State College, PA 16801. All comments will be tabulated and addressed within the final PRP.

VICTORIA RODELA, being duly sworn, according to law says that he/she is an agent of the Centre Daily Times, a daily newspaper of general circulation, having its place of business in State College, Centre County, Pennsylvania, and having been established in the year 1898; that the advertisement appeared in said newspaper, that the affiant is not interested in the subject matter of the notice or advertisement; that all of the allegations contained herein relative to the time, place and character of the publication are true.

1 Insertion(s)

Published On:
October 07, 2019

THE STATE OF TEXAS

COUNTY OF DALLAS

[signature]
Witness Signature

Subscribed and sworn to before me, this 7th day of October in the year of 2019

LIZBETH AILEEN CORDERO
My Notary ID # 131868068
Expires January 25, 2023

[signature]
Notary Signature

Extra charge for lost or duplicate affidavits.
Legal document please do not destroy!

Centre Region MS4 Partners
Revised Pollution Reduction Plan

NTM Engineering Services :: Hydrologic & Hydraulic Modeling :: Stormwater Planning & Design :: Bridge Design & Inspection :: Technical Training & Course Development :: **www.ntmeng.com**

Newell Tereska & Mackay Engineering

Agenda

- Overview of the PRP Process
- Regulatory Load Reduction Requirements
- Revised Pollutant Load Computations
- Load Reduction BMPs
- General Questions/Discussion
- Receive Official Comments

NEWELL TERESKA & MACKAY ENGINEERING

Overview of the PRP Process

- Municipal Separate Storm Sewer System (MS4) National Pollutant Discharge Elimination System (NPDES) Permit
  - Regulates Municipal/Institutional stormwater discharges to impaired surface waters (Chesapeake Bay and locally impaired surface waters).
  - Stormwater conveyance systems - roadside ditches, municipal streets, curbs/gutters, man-made channels and storm drains.
  - Permits are renewed on a 5-year cycle
  - 2018 permit renewal applications required a Pollutant Reduction Plan
  - Centre Region MS4 Partners Submitted Renewal Applications Late 2017 / early 2018 with original PRP.

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Overview of the PRP Process

- Pollution Reduction Plan (PRP)
  - Establish Total Suspended Sediment (TSS), Total Nitrogen, and Total Phosphorus (TP) Base Loads from Storm Runoff
  - Establish a Plan for reducing Pollutant Loads to impaired waters through implementation of Best Management Practices (BMPs)
  - Impaired Waters
    - Chesapeake Bay
    - Local impaired waters

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Load Reduction Summary

- All Waters in the Chesapeake Bay
  - 10% TSS reduction
  - 3% TN reduction
  - 5% TP reduction

DEPs Presumptive Approach:

If a 10% reduction in TSS is achieved then so to is a 3% reduction in TN and a 5% reduction in TP

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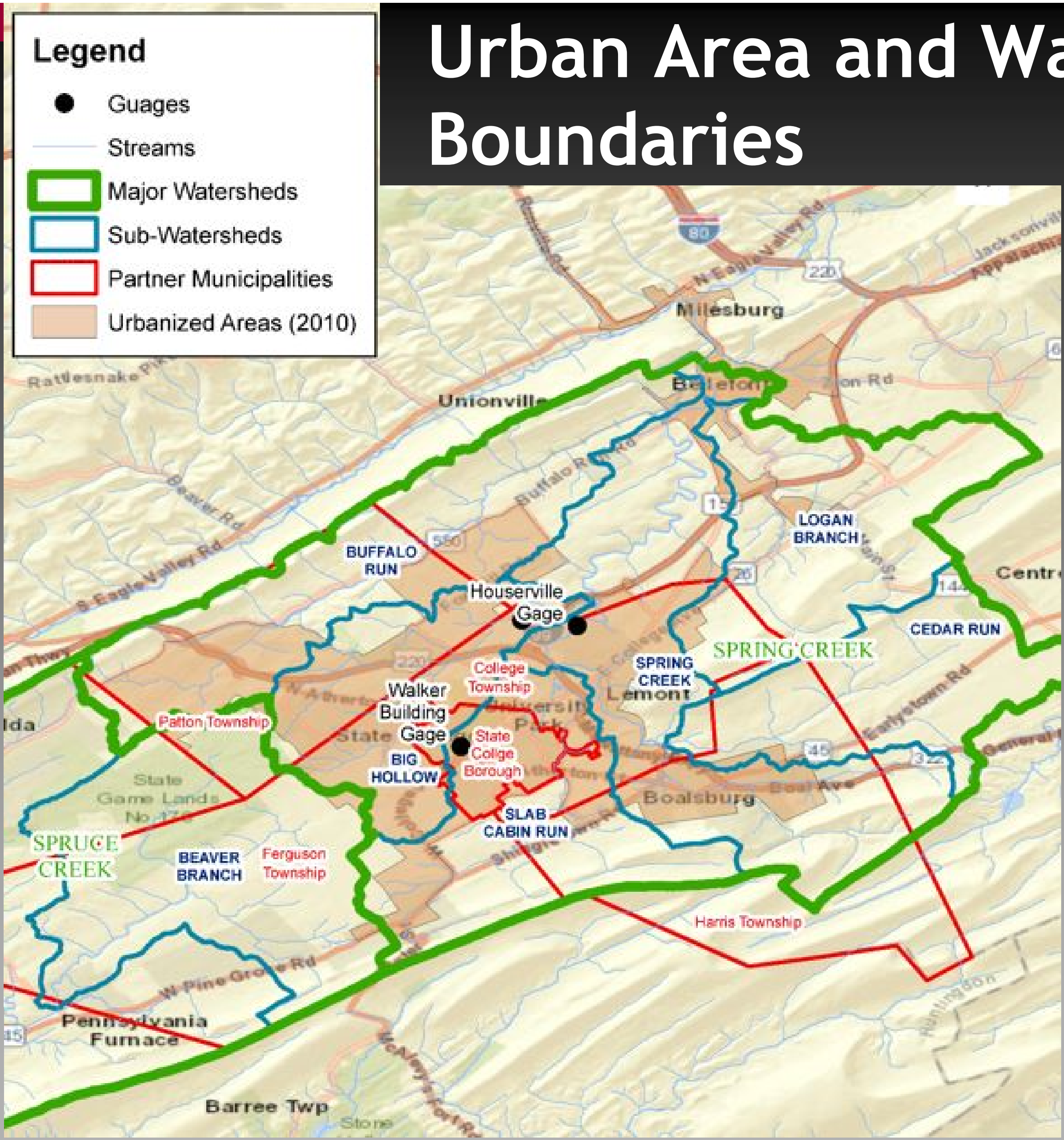
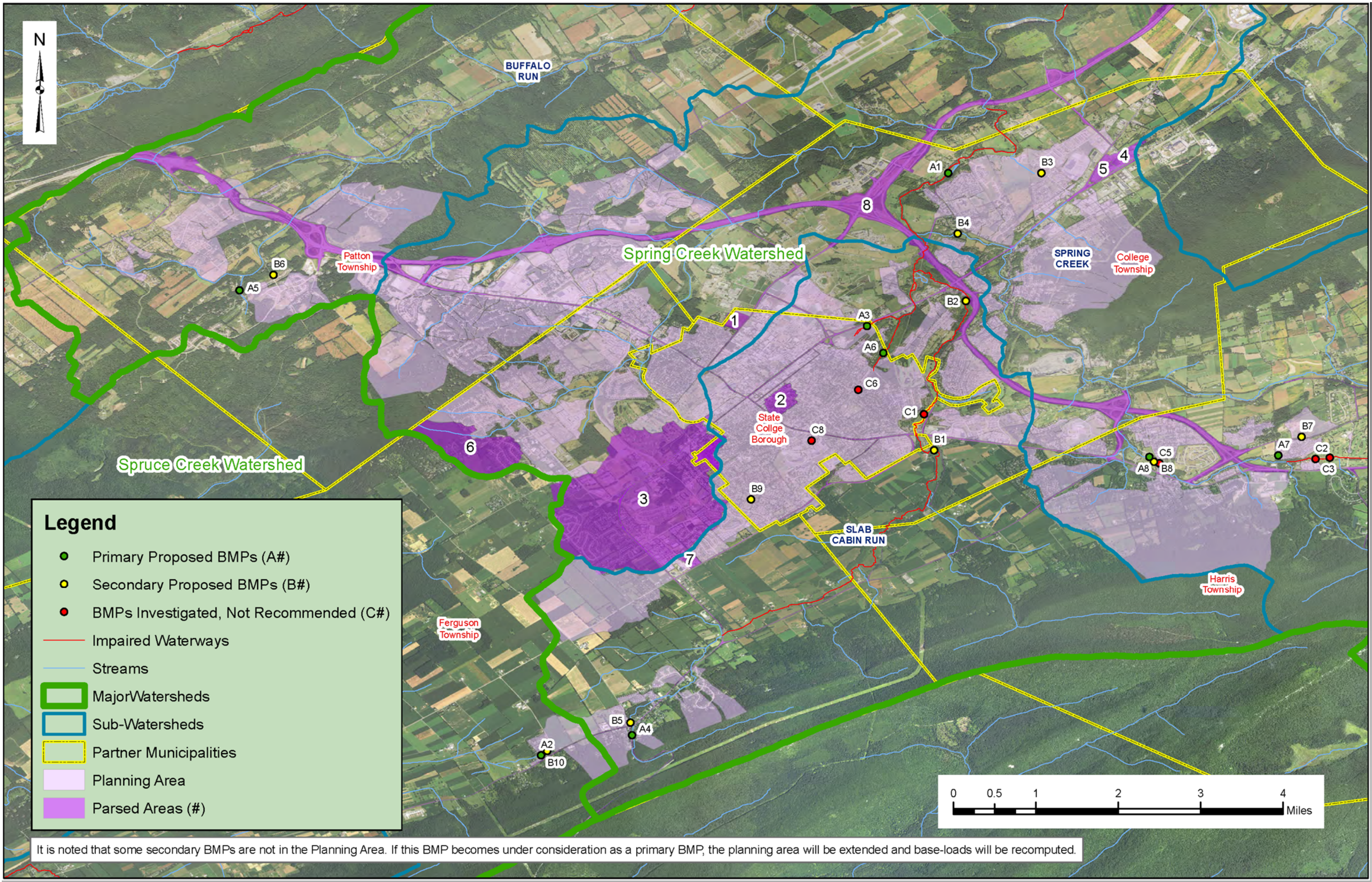
Analysis Approach

- Determined the planning area
- Eliminate (parse) non-applicable areas
- Determine the existing pollutant load
  - Modeled using MapShed
  - Model calibrated to existing flow data for Big Hollow and Spring Creek remainder (PSU and Houserville USGS Gate).
  - Assessed Credits for existing BMPs
- Determined regulatory load reduction (10% TSS)
- Identify BMPs to meet load reduction requirements

Newell Tereska & Mackay Engineering

Urban Area and Watershed Boundaries





2017 Planning and Parsed Area Map

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Parsed Areas

Parse Point Description	Parse Point	Watershed	Municipality
Infiltration Meadow at the Arboretum	1	Big Hollow	Penn State/University Park
Memorial Field Sinkhole	2	Slab Cabin Run	Borough of State College
Corl Street Dry Well	3	Big Hollow	Borough of State College, Penn State, and Ferguson Township
Sears Sinkhole	4	Spring Creek	College Township
McDonalds Sinkhole	5	Spring Creek	College Township
North Foxpointe Drive	6	Big Hollow	Ferguson Township
West Whitehall Road Sinkhole	7	Slab Cabin Run	Ferguson Township
PennDOT Roads and ROW	8	All	All Municipalities

Base Load and Regulatory Load Reductions

Watershed	Existing Sediment Load (lb./yr.) Parsed Analysis	Existing Sediment Load (lb./yr.) Unparsed Analysis	Net Change (lb./yr.)	Required Sediment Reduction (lb./yr.) Parsed Analysis	Required Sediment Reduction (lb./yr.) Unparsed Analysis	Net Change (lb./yr.)
Beaver Branch (Ferguson Township only)	**100,703**	**100,703**	**0**	**10,070**	**10,070**	**0**
Slab Cabin Run	**1,344,394**	**1,376,744**	**32,350**	**134,439**	**137,674**	**3,235**
College Twp	225,948	226,126	178	22,595	22,613	18
Ferguson Twp	483,862	493,090	9,228	48,386	49,309	923
Borough of State College	366,797	389,827	23,030	36,680	38,983	2,303
Penn State	267,787	267,701	-86	26,778	26,770	-8
Spring Creek	**1,028,340**	**1,060,450**	**32,109**	**102,834**	**106,045**	**3,211**
College Twp	542,540	573,605	31,065	54,254	57,361	3,107
Ferguson Twp	610	1,461	851	61	146	85
Harris Twp	484,115	484,115	0	48,412	48,412	0
Patton Twp	844	844	0	84	84	0
Borough of State College	91	103	12	9	10	1
Penn State	140	321	181	14	32	18
Buffalo Run (Patton Township only)	**329,245**	**329,245**	**0**	**32,925**	**32,925**	**0**
Total:	**2,802,682**	**2,867,142**	**64,460**	**280,268**	**286,714**	**6,446**

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Plan for TSS Load Reduction

- BMP's
  - Stream Restoration Reaches
    (17 considered; 11 selected)
  - 7 basin retrofits
    (7 considered; 4 selected)
  - Street Sweeping
  - Forest Buffer (Meyer-Everhart)
- Primary and Secondary BMPs selected in conjunction with Partner Engineers

Newell Tereska & Mackay Engineering

Primary BMPs

Watershed/ Primary BMP	Watershed	Load Reduction (lb./yr.)	Cost Sharing Partners
Piney Ridge Phase 1 Stream Restoration (350 LF)	Beaver Branch	40,250	Ferguson Township (100%)
Duck Pond Channel Stream Restoration (1000 LF)	Slab Cabin	115,000	College Township (20%)
			Ferguson (17.5%)
			Penn State (62.5%)
Walnut Springs Phase 3 & 4 Stream Restoration (385 LF)	Slab Cabin	44,275	Borough of State College (100%)
Pine Grove Mills Phase 1 Stream Restoration (300 LF)	Slab Cabin	34,500	Ferguson Township (100%)
Spring Creek Estates Stream Restoration (500 LF)	Spring Creek	57,500	College Township (95%)
			Harris Township (5%)
Willowbrook Basin Retrofit	Spring Creek	6,024	Harris Township (100%)
Pa Military Museum Stream Restoration Phase 1 (350 LF)	Spring Creek	40,250	Harris Township (100%)
Penn Hills Basin Retrofit	Spring Creek	9,500	College Township (100%)
Meeks Lane Stream Restoration (320 LF)	Buffalo Run	36,800	Patton Township (100%)

Note: These BMPs are identified in the PRP to demonstrate one approach to meeting the regulatory load reduction. This list is not set in concrete; alternate BMP's can be implemented.

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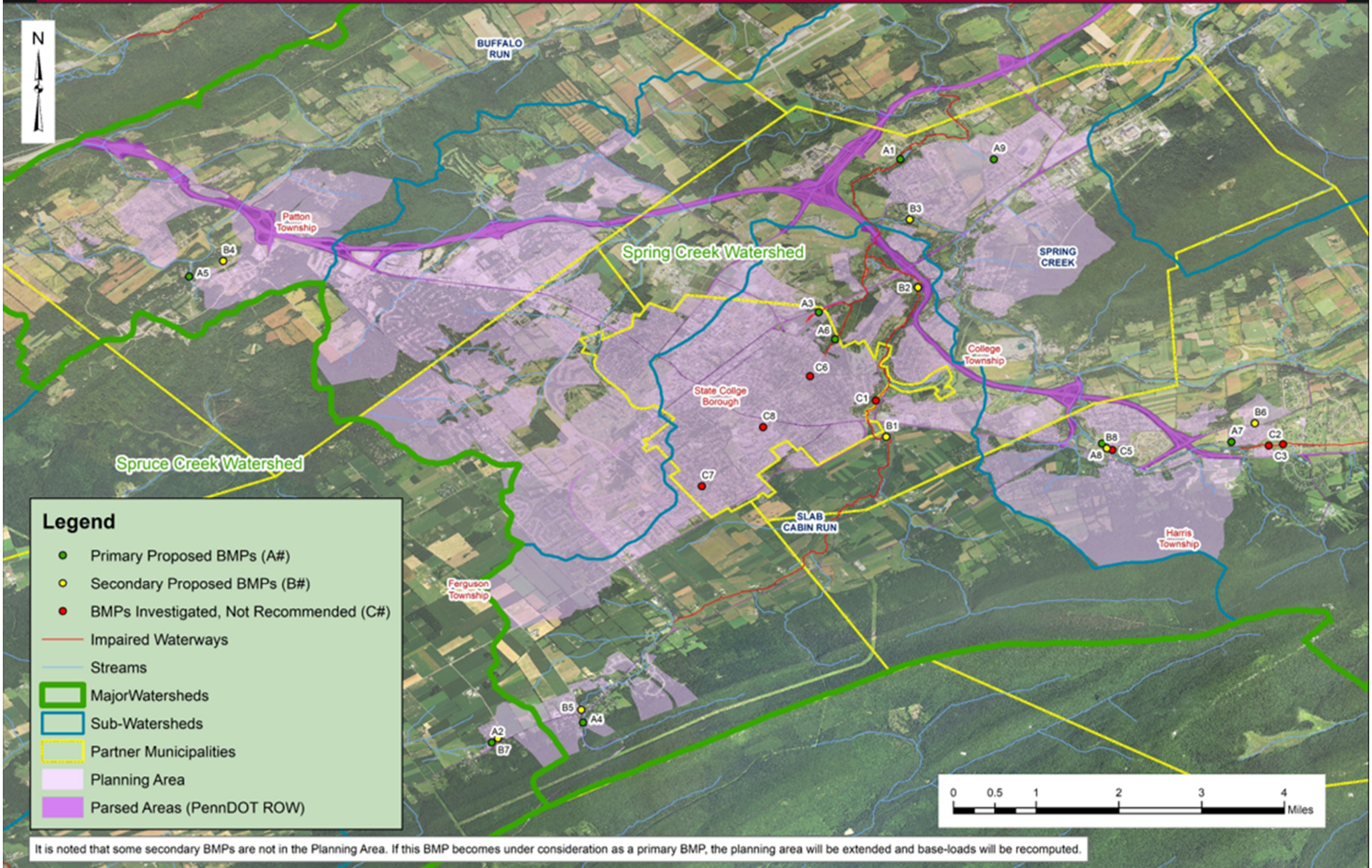

2019 Planning & BMP Location Map

Newell Tereska & Mackay Engineering

Secondary BMPs

Watershed/ Primary BMP	Watershed	Load Reduction (lb./yr.)	Cost Sharing Partners
Piney Ridge Phase 2 Stream Restoration (200 LF)	Beaver Branch	23,000	Ferguson Twp
Meyer-Everhart Streamside Forest Buffer	Slab Cabin	1,501	College Township
			Ferguson
			Borough of State College
Street Sweeping	Slab Cabin	21,047	Borough of State College
Pine Grove Mills Phase 2 Stream Restoration (200 LF)	Slab Cabin	23,000	Ferguson Township
Slab Cabin Park Stream Restoration (750 LF)	Slab Cabin	86,250	College Township
Spring Creek Park Stream Restoration (300 LF)	Spring Creek	34,500	College Township
Pa Military Museum Stream Restoration Phase 2 (300 LF)	Spring Creek	34,500	Harris Township
Rocky Ridge Basin Retrofit	Spring Creek	1,273	Harris Township
Grays Woods Basin Retrofit	Buffalo Run	1,612	Patton Township

Note: These BMPs are identified in the PRP to demonstrate one approach to meeting the regulatory load reduction. This list is not set in concrete; alternate BMP's can be implemented.

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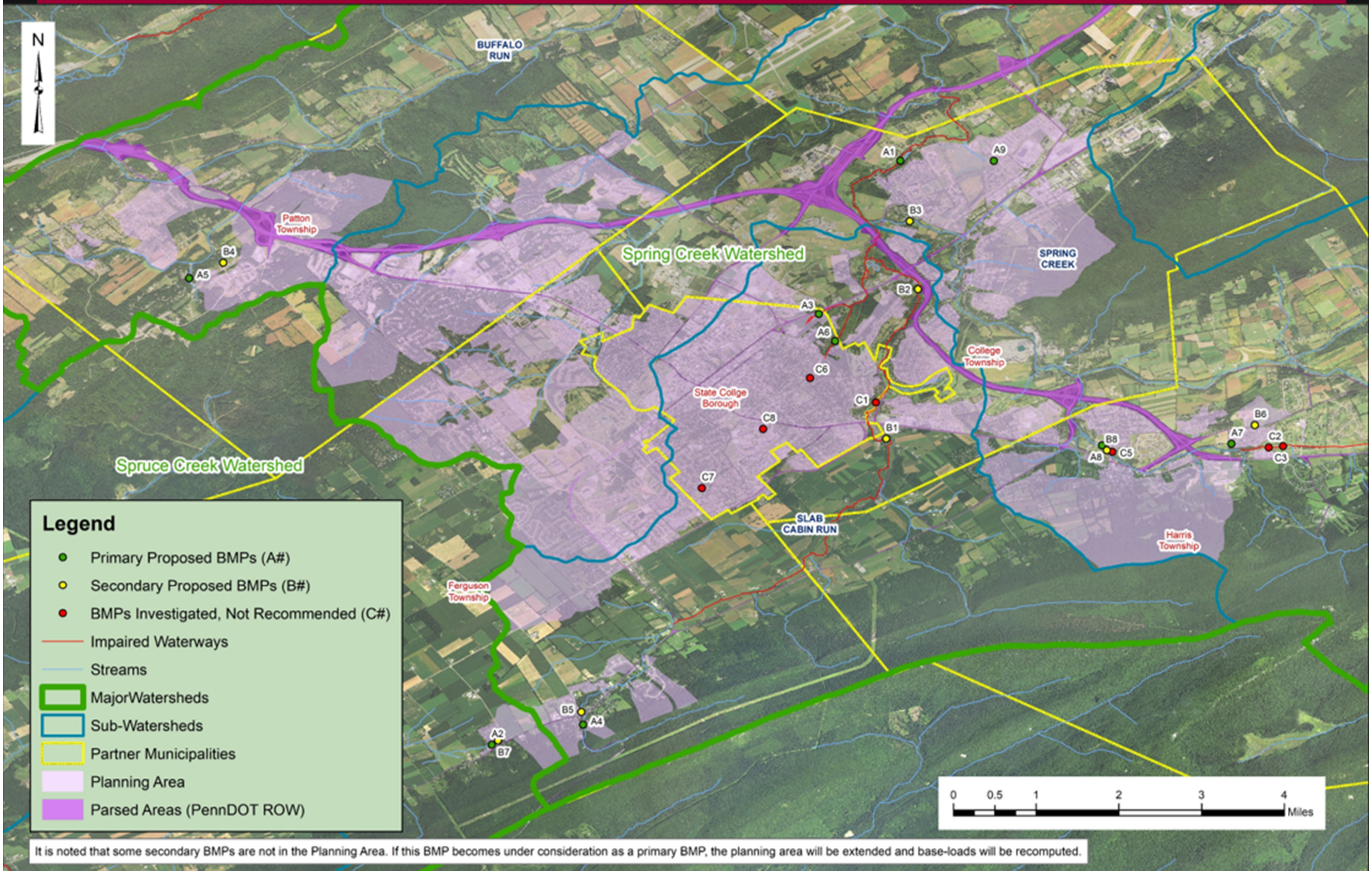

2019 Planning & BMP Location Map

Newell Tereska & Mackay Engineering

Load Reduction Achieved By the Project's Described

Basin	Required Sediment Reduction (lb./yr.)	Sediment Reduction from Primary BMPs (lb./yr.)	Excess Treatment from Primary BMPs (lb./yr.)	Sediment Reduction from Secondary BMPs (lb./yr.)	Excess Treatment from Primary + Secondary BMPs (lb./yr.)
Beaver Branch	10,070	40,250	30,180	23,000	53,180
Slab Cabin Run	137,674	193,775	56,101	131,798	187,899
Spring Creek	106,045	113,274	7,229	70,273	77,502
Buffalo Run	32,925	36,800	3,875	1,612	5,487
Total:	286,714	384,099	97,385	226,683	324,068

Note: Total load reduction from all BMPs is 213% of requirement.

Newell Tereska & Mackay Engineering

Cost Summary

Project	College Township		Ferguson Township		Harris Township		Patton Township		Penn State		Borough of State College	
	Annual O&M Cost	Capital Cost	Annual O&M Cost	Capital Cost	Annual O&M Cost	Capital Cost	Annual O&M Cost	Capital Cost	Annual O&M Cost	Capital Cost	Annual O&M Cost	Capital Cost
Piney Ridge Stream Restoration PH 1	$0	$0	$1,068	$78,750	$0	$0	$0	$0	$0	$0	$0	$0
Duck Pond Channel Restoration	$1,720	$128,000	$1,505	$112,000	$0	$0	$0	$0	$5,375	$400,000	$0	$0
Walnut Springs Stream Restoration	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,174	$86,625
Pine Grove Mills Stream Restoration	$0	$0	$915	$67,500	$0	$0	$0	$0	$0	$0	$0	$0
Spring Creek Estates Stream Restoration	$1,449	$106,875	$0	$0	$76	$5,625	$0	$0	$0	$0	$0	$0
Willowbrook Basin Retrofit	$0	$0	$0	$0	$3,000	$45,000	$0	$0	$0	$0	$0	$0
Military Museum Stream Restoration Phase 1	$0	$0	$0	$0	$1,068	$78,750	$0	$0	$0	$0	$0	$0
Penn Hills Basin Retrofit	$3,500	$52,500	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Meeks Lane Stream Restoration	$0	$0	$0	$0	$0	$0	$976	$72,000	$0	$0	$0	$0
Total:	**$6,669**	**$287,375**	**$3,488**	**$258,250**	**$4,144**	**$129,375**	**$976**	**$72,000**	**$5,375**	**$400,000**	**$1,174**	**$86,625**

Note: 1. Estimated capital costs include easement acquisition and construction. Engineering and permitting is not included.
2. These BMPs are identified in the PRP to demonstrate one approach to meeting the regulatory load reduction. This list is not set in concrete; alternate BMP's can be implemented.

NEWELL TERESKA & MACKAY ENGINEERING

Written Comments

Received through November 6th

Scott Brown, PE, D. WRE,
NTM Engineering, Inc.
341 Science Park Road, Suite 203
State College, PA 16803

or

sbrown@ntmeng.com

Questions

CENTRE REGION

MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4) PARTNERS

POLLUTANT REDUCTION PLAN

RECORD OF PUBLIC MEETING

COLLEGE TOWNSHIP MUNICIPAL BUILDING

OCTOBER 30, 2019 / 6:00 PM

The Centre Region Municipal Separate Storm Sewer System (MS4) Partners consisting of College, Ferguson, Harris, and Patton Townships, The Pennsylvania State University, University Park Campus, and State College Borough held a public meeting at the College Township Municipal Building on the Joint Pollutant Reduction Plan (PRP) for Spring Creek, Slab Cabin Run, Buffalo Run, Logan Branch, and the Chesapeake Bay.

A sign-in sheet is attached for all in attendance. The only individuals to attend the public meeting were representatives from NTM Engineering who performed the analysis and each of the MS4 Partners. No individuals showed up to see the presentation or ask questions.

Mr. Brown from NTM Engineering prepared a Power Point Presentation and presented the information to the MS4 Partner representatives in attendance. There were no questions on the material presented. Harris Township indicated they may submit a comment. The Power Point Presentation is attached.

End of public meeting record.

Attachments: Sign-in sheet
PowerPoint Presentation Slides

MS4

Chesapeake Bay Pollution Reduction Plan

October 30, 2019 6 p.m.
2481 E. College Avenue, State College, PA 16801

Sign In Sheet

Name	Organization	Phone	Email
Don Franson	College Twp	814 231 3021	dfranson@collegetownship.org
Ron Seybert	Ferguson Twp	814 238 4651	rseybert@twp.ferguson.pa.us
Scott Brown	NTM Engineering	814 862 9191	sbrown@ntmeng.com
Larry Fennessey	PSU	814 863-8745	LAF8@PSU.EDU
Steve Casson	Patton Township	814-996-4272	scasson@twp.patton.pa.us
Jere Northridge	Harris Township	814 231 3021	jnorthridge@collegetownship.org
Deb Hoag	State College Borough	814-234-7140	DHoag@statecollegepa.us

Centre Region MS4 Partners PRP

APPENDIX I

Record of Consideration of Public Comments

NEWELL TERESKA & MACKAY ENGINEERING

Centre Region MS4 Partners PRP

I.1 2017 Comments

CENTRE REGION MS4 PARTNERS
PRP COMMENT RESPONSES

COMMENTS FROM CLEARWATER CONSERVANCY:

Comment 1:

Structural BMPs provide the greatest pollutant reductions for meeting Chesapeake Bay TMDL and Impaired Waters goals. All streams in the planning area are impaired by sediment and nutrients, requiring reductions in all 3 parameters (sediment, nitrogen, and phosphorus). We encourage a holistic approach to the proposed stream restoration projects – one which integrates stormwater management techniques while improving local water quality, aquatic and riparian habitat and overall ecological integrity of our streams. Simply "hardarmoring" stream sections are not encouraged.

Response 1:

The preference for "holistic approaches" over hard armoring is recognized. As indicated in Appendix F of the *Centre Region MS4 Partners Pollutant Reduction Plan,* the projects proposed at: Walnut Springs Park, Slab Cabin Run in Pine Grove Mills, Buffalo Run, the Spring Creek Estates, Piney Ridge Subdivision, and the Military Museum are all based upon a holistic approach.

Hard armoring is proposed at the Duck Pond Inflow channel. As reported in Appendix F of the PRP report, a soft armor restoration project was installed to restore this channel in 2002. The project failed shortly after installation. The 1-year discharge in the Duck Pond channel exceeds 600 cfs with velocities exceeding 20 fps. A holistic approach to stream restoration sometimes includes floodplain reconnection. Floodplain reconnection is not viable here because of potential negative impacts to the Thompson Spring outfall channel.

Comment 2:

Shared Responsibility and Collaboration for Stream Restoration: Of the BMP's evaluated, ClearWater Conservancy, along with our partners like Trout Unlimited, have outstanding reputations for our stream restoration work and long-term stewardship and maintenance on our projects sites. Please see attached map for those locations. Our relationships with landowners across the basin are an asset we can provide to the MS4 partners. Our capacity to monitor, maintain and steward the improved properties is a service we can offer in partnership to the municipalities as well.

Response 2:

The ClearWater Conservancy and Trout Unlimited have implemented numerous stream restoration projects locally. Projects from both organizations (i.e. the Meyers-Everhart Initiative and Spring Creek Estates) are included in the list of BMPs considered in this PRP. As the MS4 partners move forward with implementing the PRP, opportunities to facilitate mutually-beneficial collaboration will be explored.

Comment 3:

Credits for structural BMPs from existing community projects: Stream restoration projects implemented after local water quality and volume control ordinances were enacted and prior to this PRP are eligible for pollution load reductions under the current requirements. ClearWater Conservancy has completed numerous stream restoration projects eligible for municipal BMP credits, potentially helping the municipalities quickly reach their obligations outlined in the PRP. (A table and map with description and location of projects was attached.) We understand that landowner agreements which provide the MS4 partners access is needed and can be provided (municipal ownership or control of the site is not required).

Response 3:

We understand that The ClearWater Conservancy and others have been involved in stream restoration projects over the years. It is noted that credits for projects implemented by Trout Unlimited were quantified. However, because the MS4 partners have not had authority or control over maintaining these or other BMPs not under their control, they could not be included in the baseload reduction calculations (per DEP guidance). In addition, since they were installed in advance of this PRP they could not be applied to meet the pollution reduction requirements of this PRP.

Comment 4:

Utilization of existing data: The Water Resources Monitoring Project has more than 18 years of water quality data available. Should monitoring data be needed to help ground truth the model, the WRMP is a good resource for existing data and future water quality monitoring needs.

Response 4:

It is acknowledged that a significant amount of data has been collected through the Water Resources Monitoring Project. In the future, these data will be considered for PRP Planning.

Comment 5:

Meeting the reduction requirements by 2023 is achievable with this current plan. Should 2nd round of NPDES permits require additional reductions, ClearWater Conservancy would like to identify itself as a potentially key resource and partner for developing the proactive strategy for achieving goals for Phase 2. As we look to implement potential stream restoration projects with willing landowners, we can be an ally in providing nutrient reductions to benefit the MS4 partners.

Response 5:

The ClearWater Conservancy's role in local stream restoration and conservation projects is recognized. The MS4 partners will consider the ClearWater Conservancy as a resource should the 2nd round of NPDES permits require additional reductions.

Comment 6:

Last, we will continue to support the proactive municipal work to prevent pollution to our waterways. We encourage the continuation of rigorous, proactive planning across our region in order to efficiently and effectively reduce the sources of sediment and nutrient pollution, thereby circumventing costly curative fixes to the problem.

Response 6:

The MS4 partners and ClearWater Conservancy share the mutual goal of smart planning to protect our local resources.

COMMENTS FROM TODD GIDDINGS:

Comment 7:

I very much appreciate your use of numerical simulation modeling to calculate the sediment loads because this method achieved better results than if other less-complex calculation methods were used.

Response 7:

The MS4 partners are committed to applying good science to model the local watersheds, thank you for your support.

Comment 8:

The headwaters areas of Beaver Branch and Slab Cabin Run adjoin each other near Pine Grove Mills. Their forests have similar soils, slopes, tree species, and aspects, and hence it would appear that their forest sediment loading coefficients should be almost identical instead of 11.5 and 9.9 lbs./acre.

Response 8:

In a modeling context, the loads delivered to the outlet of a given watershed by different land use/cover types relate to two factors: 1) the degree of erosion that occurs on that point on the landscape, and 2) the amount of the eroded soil that is ultimately delivered from point of erosion to the outlet. With respect to the first factor, the amount of soil initially eroded is primarily related to the inherent erodibility of the soil (the "K" factor), and the slope (both the steepness and length). The latter is represented by the "LS" factor. As either of these factors increase, more erosion is simulated by the model.

Within the model, the amount of sediment delivered to the watershed outlet is then governed by the "sediment delivery ratio" (SDR). Because this SDR value is difficult to determine for any given area without extensive field work, empirical algorithms are used to estimate it. Within MapShed (i.e., GWLF-E), the Vanoni method, is used, where the SDR value is calculated as:

SDR = 0.451(b-0.298)

where,

b= the area of the watershed in km^2.

Applying this equation, larger watershed sizes result in smaller SDR values. Everything else being equal, smaller SDR values result in less sediment delivered to the outlet. Implicitly, this routine accounts for the fact that natural attenuating processes which reduce sediment loads are greater in large watersheds (i.e., sediment deposition).

Effectively, the product of SDR x K x LS dictates the amount of sediment delivered to the outlet of a given watershed, with larger values producing higher sediment loads. The Beaver Branch watershed has 20.77 km^2 and an SDR of 0.1826. The Slab Cabin Run Watershed is more than twice as large, 55.83 km^2, and has an SDR of 0.136. The K factor and LS values for forest land in the Beaver Branch and Slab Cabin Run watersheds are 0.233 and 1.71, and 0.195 and 2.681, respectively. These values result in products of 0.0681 and 0.0528, respectively, which translates to slightly higher sediment loads from forest land in the Beaver Run watershed than in the Slab Cabin Watershed.

Comment 9:
I expected the Forest sediment loading coefficient for Buffalo Run of 14.4 lbs./acre to be lower than the Forest coefficients in the other watersheds due to the presence of the high infiltration capacity Morrison Sandy Loam and Gatesburg Sand soils beneath the forests in Patton Township.

Response 9:
Referring to the response for Comment 8 above, the SDR for the Buffalo Run watershed is 0.156, and the K and LS values for forest land in the watershed are 0.253 and 1.863, respectively. The combined SDR x K x LS value is 0.0735, which is greater than both the Beaver Branch and Slab Cabin watersheds described above. This translates to greater sediment loads being produced by forest land in this watershed as well.

Comment 10:
Use of the data from the Water Resources Monitoring Project stream gage located just upstream of South Atherton Street on Slab Cabin Run would allow the model to be calibrated for this hydrologically unique watershed to provide improved calculated load values.

Response 10:
The WRMP gages use baseflow calibrated rating curves. In other words, they produce the best results for low flows. That said, even in the low flow range these gages produce flows that are $\pm$ 30%. At higher flows, the gauge data is so far out of the rating curve range that interpolation is inappropriate. While these data help the community establish long-term records, the data is not sufficiently accurate for hydrologic model calibration.

Comment 11:
The Beneficial Reuse water that is discharged into Slab Cabin Run contains essentially no sediment, Nitrogen, or Phosphorus, and is thereby providing a BMP-type impact that could be taken into account in this study.

Response 11:
It is acknowledged that the Beneficial Reuse project is a Wastewater BMP that discharges treated

water into Slab Cabin Run at Kissinger Meadow. The Beneficial Reuse water has been treated to have essentially no sediment, nitrogen or phosphorus. While the Beneficial Reuse water does not deliver land-based sediment and nutrients to the stream, it does contribute significant flow to the stream. UAJA is permitted to discharge between 1 MGD (1.9 cfs) and 3 MGD (5.6 cfs) per day. The in-stream lateral erosion rate (LER) is driven by flow. The added discharge from the Beneficial Reuse BMP will increase the downstream annual sediment and associated nutrient loads as a result of lateral erosion processes. On balance, the mitigative effect of the "pollutant-free" Beneficial Reuse Wastewater BMP at the UAJA outfall is believed to be off-set by the increase in streambank erosion caused by increased flow to Slab Cabin Run.

When viewed from a watershed perspective, while the beneficial reuse water contains no total nitrogen or total phosphorus due to the removal of all nutrients by the advanced water treatment process, the rejected nutrients remain at UAJA's wastewater treatment plant. Due to UAJA's current management strategy, UAJA has discharged average monthly total nitrogen concentrations up to 20mg/L into Spring Creek over the last 5 years according to the State's on-line Discharge Monitoring Reports (DMR), which are high, compared to other wastewater treatment plants of similar size within the Chesapeake Bay watershed in the State.

Comment 12:
A change in the requirements for an area to be parsed that were selected for use in this study could allow some of the unique hydrologic characteristics of Beaver Branch to impact its calculated loads.
Response 12:
A conservative approach was taken when parsing areas based on subsurface hydrology. With respect to sinkholes and drywells, only areas definitively known to have zero discharge were parsed. The subsurface hydrologic characteristics of Beaver Branch have not been instrumented sufficiently to calibrate a parsed model for Beaver Branch.

COMMENTS FROM THE SPRING CREEK CHAPTER OF TROUT UNLIMITED:

Comment Summary 13:
"The Spring Creek Chapter of Trout Unlimited enthusiastically supports the Joint Pollutant Reduction Plan that has been developed for the MS4 Partners of the Centre Region." "We evaluated 15 separate projects including 26 site practices completed on Spring Creek since 1990. The results have produced reduced nutrient inputs by 9,725 pounds of nitrogen, 2,641 pounds of phosphorous and 459 tons of sediment per year. The projects include riparian buffer plantings of more than 6,000 native shrubs and trees covering more than 17 acres, over half a mile of fencing, and 0.16 miles of stream restored along Spring Creek." "We plan three projects along Spring Creek in 2018 including one on Rock Road (with Pa. Fish and Boat Commission), along Spring Creek Estates (with U.S. Fish and Wildlife Service), and at the Gordon D. Kissinger meadow. The impacts of these projects are projected to be an overall reduction of approximately 1,138 pounds of nitrogen, 298 pounds of phosphorus and 145 tons of sediment."

Response 13:

The MS4 partners thanks the Spring Creek Chapter of Trout Unlimited for their support. We look forward to partnering with your organization on the Spring Creek Estates project to further nutrient and sediment reduction in Spring Creek.

Centre Region MS4 Partners PRP

I.2 2019 Comments

CENTRE REGION MS4 PARTNERS
PRP COMMENT RESPONSES
2019

COMMENTS FROM THE HARRIS TOWNSHIP SHADE TREE COMMISSION:

Comment 1:

The CBPRP contains several viable options for BMPs to satisfy the permit requirements. The Harris Township Shade Tree Commission would like the concept of a Raingarden System on Boal Ave in Harris Township incorporated into the CBPRP, perhaps as a supplemental appendix, as a future viable BMP to satisfy permit requirements.

Response 1:

The MS4 partners thank the Shade Tree Commission for sharing the concept of a Raingarden System on Boal Ave. Raingardens are a structural BMP that can generate runoff reduction credits. In addition, this project would also qualify for land use conversion credits as an Urban Tree Planting BMP. For urban tree canopy expansion projects, each tree planted is equivalent to converting 1/300 of an acre of impervious land use to tree canopy land use. The MS-4 partners will consider this project in the suite of BMPs implemented for pollution reduction.