# MS4 Pollution Reduction Plan (PRP)

## Perkiomen Township

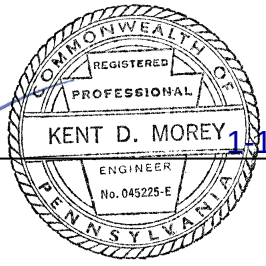
August 2017
Revised January 2021

# MS4 Pollution Reduction Plan (PRP)

Prepared for: Perkiomen Township
1 Trappe Road
Collegeville PA 19426

August 2017
Revised January 2021

Prepared by: Spotts, Stevens and McCoy




1-11-21

Kent D. Morey, P.E.



SSM File 100685.0141

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## Table of Contents

## GENERAL DESCRIPTION

Perkiomen Township (the MS4) is located in the Perkiomen Valley of Montgomery County, Pennsylvania. The Township is bordered by the Perkiomen Creek / Skippack Township to the east; Collegeville and Trappe Boroughs and Upper Providence to the south; Limerick Township to the west; and Lower Frederick Township and Schwenksville Borough to the north. The northern portion of the Township is located north of the confluence of Perkiomen Creek and East Branch Perkiomen Creek. The Township is roughly 4.9 square miles. As of 2010, the population is 9,139 people. The Township is a Second-Class Township governed by a five-member Board of Supervisors. There is currently 28.06 miles of roadway maintained by the Township.

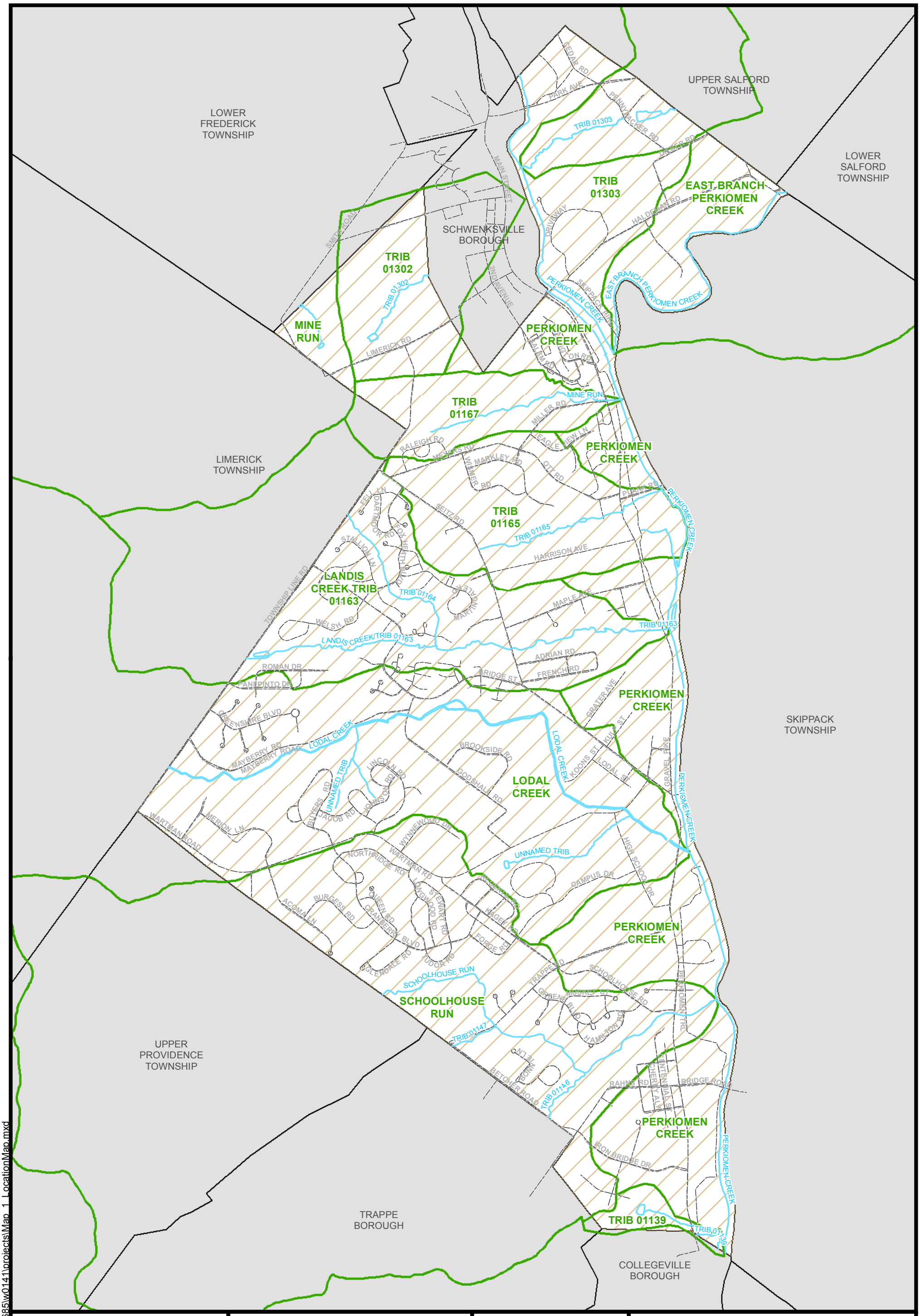
The Township is primarily residential with a mix of commercial, manufacturing and institutional (school) land uses. The Urbanized Area (UA) from the 2010 census covers the entire Township. The extents of the UA are shown on Map #1. All maps associated with this document may be found in Section B.

The Township has decided to revise its original Pollution Reduction Plan (PRP) prepared and submitted to PaDEP in 2017. Subsequent to that submission, PaDEP provided comments of the plan and circa late 2018 it was discovered that a sanitary sewer line next to a stream had become exposed. The stream is Tributary 01164 and the exposed sewer occurred approximate 180-190 ft upstream of its confluence with Trib 01163 (aka Landis Creek). The Township recognized that work would be required in the stream to repair the stream embankment over the sewer line and at the same time it may be possible to utilize stream restoration as a Best Management Practice (BMP) to achieve its permit requirements and forego conversion of the detention basins in Perkiomen Green as suggested by the 2017 PRP. This revised report includes revisions as required by PaDEP's review and demonstrates that the stream restoration is a feasible alternative.

## SECTION A – PUBLIC PARTICIPATION

The newspaper ad and any public comments will be added he

# SECTION B - MAPS




**Map 1**
**Location Map**
**Perkiomen Township**
**Montgomery County, PA**

Stream
Road
Watershed
Urbanized Area
Municipal Boundary

N
0 1,000 2,000
Feet
1:20,000

Data Source and Revisions:
Streams, (NHD) USGS, 2009
Roads, PennDOT, 2013
Municipal Boundaries, PennDOT, 2012

08/03/17

SSM
SPOTTS | STEVENS | MCCOY
Engineering and Environmental Services
Reading | Lehigh Valley | Central Pennsylvania
P: 610.621.2000 F: 610.621.2001
ssmgroup.com

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# Map #2
# Perkiomen Township
# Storm Sewer Mapping
# Montgomery County, PA

| | | |
|---|---|---|
| Inlet | Private Swale | Township Maintained Detention Basin |
| Manhole | Township Swale | Proposed BMP - Stream Restoration |
| Structures | Private Pipe | Storm Sewershed |
| Outlet | Township Pipe | Parsed Area |
| Observation Point | Private Road | Unimpaired Watershed |
| Outfall | Local Road | Impaired Watershed |
| Stream | State Road | Parcel |
| 10-ft Interval Contour | Private Detention Basin | |

N

0 1,000 2,000 Feet

1 inch = 600 feet

Data Source:
Storm Sewer System, SSM, 2020
Streams, NHD USGS, 2009
Roads, PENNDOT, 2013
Boundaries, PENNDOT, 2012
Contours, LIDAR, 2011
Aerials, Esri, 2017
Watershed, SSM, 2018
Parcels, Montgomery Co., 2015

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## SECTION C – POLLUTANTS OF CONCERN

There are three primary watersheds within the Township and a fourth secondary watershed identified by the Pennsylvania Department of Environmental Resources (PaDEP) in the requirements table (included at the end of this section) or have sub watersheds that are impaired. The overall watersheds are shown on Map #2. Their names and impairments are:

| Impaired Downstream Waters Name | Impairment | Appendix |
|---|---|---|
| Unnamed Tributaries to Perkiomen Creek[1] | Siltation | E |
| Schoolhouse Run | Siltation | E |
| Perkiomen Creek | Pathogens | B |

[1]The tributaries listed are (north to south) Trib 01167, Trib 01165 and Trib 01163. All of these flow in a west to east direction into the Perkiomen Creek. Trib 01167 is the first stream south of Schwenksville Borough. It enters the Perkiomen Creek near Miller Road. The second tributary is Trib 01165. It is parallel and just north of Harrison Ave. The third tributary is Trib 01163 and locally but mistakenly referred to as Landis Creek. This includes a tributary to it identified as Trib 01164.

PaDEP requires that the MS4 address each impairment in accordance with the appendix noted. For those impairments that require the Township to address impairments of Sediment (Siltation), the MS4 is required to prepare a Pollution Reduction Plan (PRP) that demonstrates that the pollutant reduction(s) (lbs/year) proposed in the PRP have been achieved within 5 years following the PaDEP's approval of coverage under the General Permit. Sediments shall be reduced by 10%. The following pollution reduction plan demonstrates that Perkiomen Township will reduce sediments by 10% in accordance with the General Permit requirements.

Since the Unnamed Tributaries to Perkiomen Creek and Schoolhouse Run are within the same USGS HUC-12 watershed boundary, Perkiomen Township has chosen to aggregate the loading reduction requirements and treat the entire loading for all of these watersheds with the minimum amount of BMPs.

| MS4 Name | NPDES ID | Individual Permit Required? | Reason | Impaired Downstream Waters or Applicable TMDL Name | Requirement(s) | Other Cause(s) of Impairment |
|---|---|---|---|---|---|---|
| **Montgomery County** | | | | | | |
| NARBERTH BORO | PAG130080 | No | | Gulley Run | | Water/Flow Variability (4c) |
| | | | | Schuylkill River | Appendix C-PCB (4a) | |
| | | | | Indian Creek | Appendix C-PCB (5), Appendix E-Siltation (5) | Cause Unknown (5), Other Habitat Alterations, Water/Flow Variability (4c) |
| | | | | East Branch Indian Creek | Appendix C-PCB (5), Appendix E-Siltation (5) | Cause Unknown (5), Other Habitat Alterations, Water/Flow Variability (4c) |
| | | | | Cobbs Creek | Appendix B-Pathogens (5), Appendix C-PCB (5), Appendix E-Siltation (5) | Cause Unknown (5), Other Habitat Alterations, Water/Flow Variability (4c) |
| NEW HANOVER TWP | PAG130020 | No | | Swamp Creek | Appendix E-Siltation (5) | Cause Unknown (5) |
| | | | | Schuylkill River | Appendix C-PCB (4a) | |
| NORRISTOWN BORO | PAG130159 | Yes | TMDL Plan | Sawmill Run | Appendix E-Siltation (5) | Turbidity (5), Water/Flow Variability (4c) |
| | | | | Schuylkill River PCB TMDL | Appendix C-PCB (4a) | |
| | | | | Stony Creek | Appendix E-Siltation (5) | Turbidity (5), Water/Flow Variability (4c) |
| | | | | Unnamed Tributaries to Stony Creek | | Cause Unknown (5) |
| NORTH WALES BORO | PAG130005 | Yes | TMDL Plan | Wissahickon TMDL | TMDL Plan-Siltation, Suspended Solids (4a) | Cause Unknown (4a) |
| | | | | Wissahickon Creek | Appendix E-Nutrients (4a), Appendix B-Pathogens (5) | Other Habitat Alterations, Water/Flow Variability (4c) |
| PENNSBURG BORO | PAG130063 | No | | Green Lane Reservoir | Appendix E-Organic Enrichment/Low D.O. (4a) | |
| PERKIOMEN TWP | PAG130069 | No | | Schoolhouse Run | Appendix E-Siltation (5) | |
| | | | | Unnamed Tributaries to Perkiomen Creek | Appendix E-Siltation (5) | Water/Flow Variability (4c) |
| | | | | Perkiomen Creek | Appendix B-Pathogens (5) | |
| PLYMOUTH TWP | PAG130008 | Yes | TMDL Plan | Schuylkill River PCB TMDL | Appendix C-PCB (4a) | |
| | | | | Sawmill Run | Appendix E-Siltation (5) | Turbidity (5), Water/Flow Variability (4c) |
| | | | | Plymouth Creek | Appendix E-Siltation (5) | Water/Flow Variability (4c) |
| | | | | Diamond Run | Appendix E-Siltation (5) | Water/Flow Variability (4c) |
| POTTSTOWN BORO | PAG130033 | Yes | TMDL Plan | Unnamed Tributaries to Manatawny Creek | Appendix E-Siltation (5) | Flow Alterations, Other Habitat Alterations (4c) |
| | | | | Schuylkill River PCB TMDL | Appendix C-PCB (4a) | |
| RED HILL BORO | PAG130164 | No | | Green Lane Reservoir | Appendix E-Organic Enrichment/Low D.O. (4a) | |

# SECTION D – DETERMINE EXISTING LOADING FOR POLLUTANTS OF CONCERN

## Sewershed Mapping

As required by the original permit, Perkiomen Township had mapped their entire storm sewer system prior to the current permit renewal. In order to meet the requirements of the permit renewal for load reductions, efficiently map sewersheds, and provide a PRP that identifies Best Management Practices (BMPs) that can meet the required 10% sediment reductions, the Township has taken a very systematic approach to delineating storm sewersheds.

The overall storm sewersheds were delineated first, parsing out areas not within the impaired watersheds and only upstream of the lowest outfall area. PennDOT roadways along with areas such as roadways that only produced sheet flow within 300' of the stream were also parsed out of the sewersheds. These maps were not finalized nor were existing loading calculations finalized until the Township, along with its engineer, identified potential areas for BMPs. Originally, the Township considered utilizing some of the 6 conventional detention basins located within the subdivision known as Perkiomen Greene located at the southern portion of the Township and along Schoolhouse Run. All of these basins were designed as conventional basins solely for rate control with grass bottom interiors. The intent was to convert several or all of these facilities into wet ponds or bio-retention facilities to meet the permit requirements.

However, an opportunity arose to implement stream restoration when a sanitary sewer line became exposed next to a stream. The stream is Tributary 01164 and the exposed sewer occurred approximate 180-190 ft upstream of its confluence with Trib 01163 (aka Landis Creek).

## Existing Loading and Reduction Calculations

The Township Engineer chose to use the simplified method (excel spreadsheet) for the calculations. The data source for the impervious and pervious areas were developed from the 2011 National Land Cover Database (NLCD 2011).

As identified in the calculations, the required 10% load reduction is 41,788 lbs/yr of sediment.

The following calculations provide the existing loading for all of the sewersheds:

# Perkiomen Township Sediment Loading

**Existing Sediment Loading**

| | Impervious | | Pervious | | Total |
|---|---|---|---|---|---|
| Outfall | Area (acres) | Load (lbs/yr) | Area (acres) | Load (lbs/yr) | Load (lbs/yr) |
| 1 | 0.86 | 1,589 | 1.27 | 335 | 1,925 |
| 3 | 0.66 | 1,209 | 3.13 | 830 | 2,039 |
| 4 | 0.08 | 145 | 0.08 | 21 | 166 |
| 5 | 0.04 | 80 | 0.01 | 2 | 82 |
| 6 | 0.39 | 726 | 4.53 | 1,200 | 1,926 |
| 7 | 1.36 | 2,495 | 1.76 | 467 | 2,962 |
| 8 | 0.54 | 994 | 1.76 | 467 | 1,460 |
| 9 | 0.95 | 1,743 | 1.04 | 276 | 2,019 |
| 10 | 0.82 | 1,506 | 0.91 | 241 | 1,747 |
| 11 | 0.25 | 451 | 0.32 | 86 | 537 |
| 13 | 1.82 | 3,355 | 2.71 | 717 | 4,072 |
| 14 | 1.26 | 2,321 | 1.74 | 460 | 2,781 |
| 15 | 0.61 | 1,130 | 1.04 | 276 | 1,406 |
| 17 | 5.74 | 10,552 | 17.54 | 4,649 | 15,201 |
| 18 | 2.62 | 4,819 | 5.28 | 1,399 | 6,218 |
| 19 | 0.48 | 887 | 1.91 | 507 | 1,394 |
| 20 | 2.37 | 4,357 | 5.55 | 1,472 | 5,829 |
| 21 | 0.61 | 1,130 | 0.55 | 146 | 1,276 |
| 23 | 3.19 | 5,870 | 5.67 | 1,502 | 7,372 |
| 24 | 2.51 | 4,612 | 2.92 | 774 | 5,386 |
| 25 | 0.37 | 689 | 0.05 | 12 | 701 |
| 26 | 0.73 | 1,343 | 0.99 | 262 | 1,605 |
| 27 | 0.53 | 973 | 0.11 | 30 | 1,003 |
| 28 | 11.18 | 20,558 | 12.18 | 3,228 | 23,786 |
| 29 | 0.16 | 303 | 0.04 | 11 | 314 |
| 30 | 0.65 | 1,200 | 0.51 | 135 | 1,335 |
| 31 | 9.57 | 17,603 | 15.68 | 4,154 | 21,757 |
| 32 | 3.24 | 5,951 | 3.79 | 1,003 | 6,954 |
| 33 | 5.75 | 10,576 | 12.38 | 3,279 | 13,855 |
| 34 | 0.50 | 929 | 0.46 | 122 | 1,050 |
| 36 | 2.60 | 4,778 | 6.59 | 1,746 | 6,524 |
| 37 | 3.96 | 7,279 | 17.48 | 4,632 | 11,911 |
| 38 | 3.55 | 6,522 | 10.07 | 2,668 | 9,190 |
| 39 | 0.94 | 1,738 | 1.81 | 479 | 2,217 |
| 40 | 1.77 | 3,254 | 1.16 | 306 | 3,560 |
| 41 | 1.40 | 2,567 | 12.86 | 3,407 | 5,973 |
| 42 | 4.45 | 8,184 | 9.51 | 2,519 | 10,704 |
| 43 | 5.57 | 10,249 | 14.79 | 3,919 | 14,168 |
| 44 | 0.49 | 892 | 1.43 | 378 | 1,270 |
| 45 | 0.58 | 1,076 | 0.24 | 63 | 1,139 |
| 46 | 1.44 | 2,645 | 0.80 | 212 | 2,857 |
| 48 | 0.13 | 241 | 0.86 | 229 | 470 |
| 49 | 0.94 | 1,728 | 0.97 | 258 | 1,986 |

| | | | | | |
|---|---|---|---|---|---|
| 50 | 4.06 | 7,458 | 3.66 | 969 | 8,427 |
| 51 | 3.30 | 6,076 | 2.32 | 613 | 6,690 |
| 52 | 2.66 | 4,897 | 1.46 | 386 | 5,282 |
| 53 | 7.06 | 12,992 | 5.56 | 1,473 | 14,465 |
| 54 | 4.09 | 7,524 | 3.47 | 919 | 8,443 |
| 55 | 1.91 | 3,504 | 1.35 | 357 | 3,861 |
| 56 | 1.16 | 2,138 | 2.46 | 653 | 2,791 |
| 57 | 1.98 | 3,634 | 4.80 | 1,272 | 4,906 |
| 58 | 2.88 | 5,301 | 4.90 | 1,299 | 6,601 |
| 59 | 3.80 | 6,984 | 9.89 | 2,622 | 9,606 |
| 61 | 0.42 | 776 | 0.41 | 107 | 884 |
| 62 | 6.90 | 12,687 | 7.97 | 2,113 | 14,800 |
| 64 | 15.35 | 28,229 | 15.81 | 4,190 | 32,419 |
| 68 | 4.34 | 7,983 | 4.96 | 1,314 | 9,297 |
| 69 | 0.20 | 359 | 0.12 | 31 | 390 |
| 70 | 0.44 | 814 | 1.18 | 311 | 1,125 |
| 71 | 0.33 | 603 | 0.44 | 117 | 720 |
| 72 | 0.68 | 1,245 | 3.55 | 941 | 2,186 |
| 73 | 1.59 | 2,920 | 1.41 | 374 | 3,294 |
| 74 | 6.54 | 12,031 | 10.58 | 2,804 | 14,835 |
| 75 | 6.15 | 11,310 | 10.95 | 2,902 | 14,212 |
| 76 | 5.65 | 10,388 | 7.14 | 1,892 | 12,280 |
| 77 | 7.32 | 13,468 | 8.10 | 2,147 | 15,615 |
| 78 | 1.15 | 2,115 | 1.88 | 498 | 2,613 |
| 79 | 2.18 | 4,017 | 2.40 | 637 | 4,654 |
| 80 | 1.79 | 3,286 | 1.84 | 488 | 3,774 |
| 80 | 0.77 | 1,413 | 2.21 | 586 | 1,999 |
| 82 | 0.10 | 182 | 0.08 | 20 | 203 |
| 83 | 0.06 | 113 | 0.08 | 21 | 133 |
| 84 | 0.04 | 82 | 0.08 | 21 | 103 |
| OP 002 | 0.53 | 980 | 0.66 | 175 | 1,155 |
| | | | | | |
| | | | | | |
| | | | | Total Loading = | 417,885 |
| | | | | Req. 10% red.= | 41,788 |
| | | | | | |
| | | | | | |
| | Imp (lbs/ac/yr) | | Perv (lbs/ac/yr) | | |
| | 1839.00 | | 264.96 | | |
| | | | | | |

## SECTION E – SELECT BMPS TO ACHIEVE THE MINIMUM REQUIRED REDUCTIONS IN POLLUTANT LOADING

As noted above in Section D, when the sanitary sewer became exposed, the Township realized an opportunity to utilize stream restoration as a BMP to meet their MS4 PRP requirements and at the same time provide streambank protection for the sanitary sewer line. Subsequently, the two Homeowner's Associations that would need to be involved with the project have agreed to allow the Township to implement approximately 950 feet of stream restoration starting at the confluence of the two tributaries (Tribs 01163 and 01164). A feasibility study was conducted by Land Studies, Inc. in February 2020 (see Section H) and determined that with the 950 LF of stream restoration, the Township can provide a sediment load reduction of 42,636 lbs/yr or almost 850 lbs/yr more than required to meet the permit 10% reduction requirement. Therefore, no other BMPs are required

# SECTION F – IDENTIFY FUNDING MECHANISM(S)

## Background

Perkiomen Township realizes the importance to establish a designed infrastructure to reduce pollution being transmitted to our waterways and, even more importantly, properly plan for the installation of such facilities, including how to finance the costs of these installations. A proper sequencing plan of installations and a pro-active financing plan increase the potential for success to accomplish our goals of reducing our waterway pollution.

As noted by the above calculations, Perkiomen Township has identified that by implementing stream restoration the required load reductions may be met. The Township has already earmarked funds to help pay for the stream restoration. The estimate for the stream restoration including design, permitting and construction is $320,000 to $380,000.

The Township's revenues are principally the Earned Income Tax and the mileage rate. Presently, the Township has not created a storm sewer user fee to pay for the implementation and maintenance of the BMPs to be installed as part of the Pollution Reduction Plan. The present plan is to cover these costs through the Capital Reserve Funds of the Township. However, the Township will consider other options should they become available (e.g. grants, volunteers, etc.) or if they deem other methods (e.g. storm sewer user fee, etc.) to be a better means to finance these projects.

## Goal

The goal of the Perkiomen Township BMP Installation and Financing Plan is relatively simple. The program will be arranged to allow some flexibility in the event of extenuating circumstances taking place outside of the Perkiomen Township Pollution Reduction Plan that may conflict with or impact the ability to implement this plan. Once the BMPs are completed, routine maintenance will likely be completed by Township staff. However, should any maintenance or repairs extend beyond their capabilities, the Township will hire a contractor that is capable of providing the appropriate services.

## Strategies to Achieve Measurable Goals

The Township has been able to plan, prepare, and arrange financing to complete the required BMP since submittal of the original PRP. Obviously, due to the nature of the work, the stream restoration will need to be constructed during suitable weather conditions free from freezing temperatures.

## Timing of Projects

The Township will need to first secure the necessary permits before construction may start. If everything goes smoothly, it's possible that construction may take place in the fall of 2021. However, if permits are delayed, construction would start in the spring of 2022 and functioning by the end of the permit period.

## Method of Installation

Perkiomen Township will publicly bid the project and their engineer will oversee the construction.

## Financing

All material, labor and equipment costs associated with the installation of these facilities will be paid for through the Perkiomen Township's Capital Reserve Fund or Storm Sewer User Fund. Presently, Perkiomen Township has not created a Storm Sewer User Fee. The initial course of action will be to fund these improvements through the Township's Capital Reserve Fund. However, the Township will consider pursuing federal and state grants to assist in financing all or portions of the project. If it is determined that the funding source must be altered, that determination will be made depending upon the most prudent course of action in implementing the PRP.

## SECTION G – IDENTIFY RESPONSIBLE PARTIES FOR OPERATION AND MAINTENANCE (O&M) OF BMPS

The Township recognizes the importance of maintenance and this is especially important during the first five years after construction, particularly years 1-3. The following are estimated maintenance costs provided by LandStudies, Inc based on historic pricing and anticipated site conditions:

- Year 1 & 2 – estimate $17,500 per year – This could come down based on the final restoration footprint. Assumes 2 engineering inspections to assess restoration function and site stability (focus on sewer cover), and includes preparation and filling of annual reports with regulatory agencies. Also assumes 6 maintenance visits to ID & address problematic species, including spraying, pruning and potentially meadow mowing/trimming as necessary. May also include contingency for reseeding & matting/planting replacements as necessary.

- Year 3 – estimate $7,500 – Typically only require 1 engineering inspection. Assume 2 to 4 maintenance visits.

- Years 4 & 5 – estimate $3,000 to $5,000 as necessary, 2 -4 maintenance visits

- After year 5, any maintenance should be infrequent and minimal and any routine maintenance will be completed by the Township. However, should any maintenance or repairs extend beyond their capabilities, the Township will hire a contractor that is capable of providing the appropriate services.

# SECTION H – STREAM RESTORATION FEASIBILITY STUDY

# Perkiomen Creek Tributary

**Restoration Feasibility Summary**
**LSI Project No. D-1336.1-19**
February 14, 2020
REV 1: 2/20/2020

## 1.1 Introduction

This report outlines the findings of a feasibility study conducted by LandStudies, Inc (LSI), on behalf of Spotts, Stevens & McCoy (SSM) as the Engineer-of-Record for Perkiomen Township. The goal of the effort was to assess the potential for stream restoration to achieve goals of the township's Pollutant Reduction Plan (PRP) while restoring cover and providing stabilization over an existing exposed sewer line.

The study is focused along an approximately 300-LF target restoration reach on a perennial unnamed tributary to Perkiomen Creek. The reach extends upstream from a private lane bridge culvert off of Bridge St in Perkiomen (see accompanying assessment figure). The assessment covered a 950-LF assessment reach to establish upstream and downstream conditions. The Chapter 93 designated stream use is TSF (trout stocking) with a watershed drainage area of 0.23 square miles to the confluence with its receiving stream, approximately 160-LF downstream of the culvert.

## 1.2 Site Assessment

From the Fox Heath Boulevard bridge and continuing roughly 600-LF downstream to the upstream extents of the assessment (*photo 1 location*), the stream is confined within a relatively stable, narrow valley, evidenced by exposed bedrock in outer meanders along both the left and right bank walls. From this location, the topography transitions to an unconfined valley, with dense tree cover for the remainder of the reach. As the valley opens, the channel remains pinned along the right valley wall, quickly becoming entrenched and overwide, approximately 12' wide with 3' to 4' eroding banks. This condition continues approximately 350-LF until the valley turns from a northwest- southeast orientation to a north-south orientation. Here, the stream continues flowing roughly southeast, crossing the valley and encountering a series of debris jams. The debris jams *(photo 3)* temporarily hold the upstream channel stable, allowing for backwater during increased flow events, and consequently reducing erosion in this area until a time at which the debris jam fails.

Downstream of the series of debris jams, a secondary channel enters the system from the left bank *(photo 4).* Roughly 100' downstream of the confluence, the channel becomes pinned along the left valley, evidenced by bedrock exposed along the left bottom bank. Left bank erosion continues downstream of the confluence as mature trees are undermined with exposed, undercut roots and near vertical unvegetated banks *(photo 6)*. Further downstream, a large depositional feature formed in the backwater of a debris jam forces flow

into the right bank causing erosion (Photo 7). Downstream of the debris jam, the channel again becomes pinned along the left valley wall. Overall channel dimensions through this portion are similar to upstream, 3' to 4' banks and 12' wide. The channel is highly variable and unstable, with large bars forming upstream of bends or the numerous debris jams.

The stream continues to exhibit aggressive erosion through the remainder of the site upstream of the Bridge St. culvert. The lateral erosion taking place in this area has exposed a sewer line that has since been covered with rip rap in an attempt to prevent further damage. The eroded, now riprapped bank, is approximately 8.5' high at this location. From the washout, the channel makes a sharp right meander at the road embankment before entering the 6' wide x 4.7' tall CMP and concrete headwall. The relatively large culvert opening provides little downstream control to minimize erosion upstream at the exposed sewer.

Downstream of the bridge, the outfall endwall drops approximately 1.5' into an actively scouring pool. Overland flows coming off the road are resulting in slope failure around the left wingwall (Photo 12). The stream continues roughly 160-LF to the confluence with the receiving stream. This section exhibits erosion and system instability similar to the upstream conditions. The sewer line exposed upstream of the bridge continues to parallel the stream downstream. Towards the confluence, left bank erosion is encroaching towards a raised manhole shown in Photo 14.

## 1.3 Feasibility Determination

The exposed sewer line is a symptom of the lateral erosion present throughout the reach. Re-aligning the channel with the culvert, increasing flow capacity to reduce erosive shear stresses and providing a stable left bank would restore cover to the exposed utility and reduce the potential for future encroachments. A Soil Lift Fill Bank, as shown in Figure 1, may be suitable to address the exposed utility and re-establish a stable left bank, while helping to realign the channel with the existing culvert. Further hydraulic modeling during the engineering design effort would be necessary to determine stability and indicate whether a rock-toe soil lift may be more appropriate.

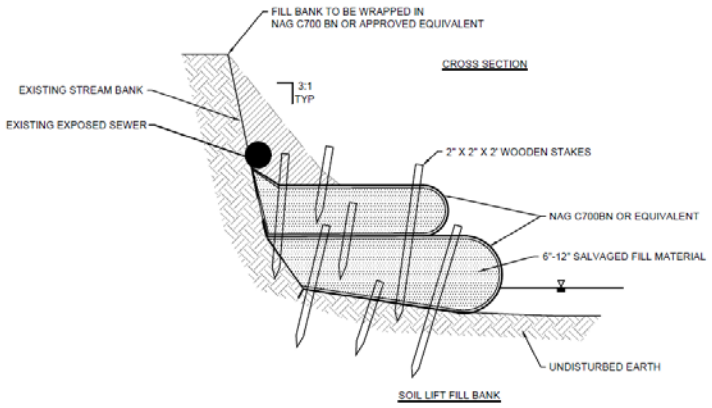

*Figure 1: Soil Lift Fill Bank*

There is also opportunity for restoration to achieve pollutant load reductions upstream of the washout. The roughly 300-LF target restoration reach, as detailed in the Existing Conditions Assessment, is characterized by tortuous meanders and actively eroding banks indicative of legacy sediments impairing the historical channel and floodplain. The unconfined valley is conducive to a restoration approach that would establish a low-lying floodplain bench on one or both sides of the channel and provide sloped banks further stabilized by native vegetation. The floodplain bench provides a buffer between baseflow conditions and the streambanks, while the increased flow capacity serves to reduce flow velocities and shear stresses, minimizing the potential for bank erosion. Gently sloping the banks will allow for native vegetation establishment, creating habitat and providing additional stability. Figure 2 shows a conceptual rendering of this restoration approach.

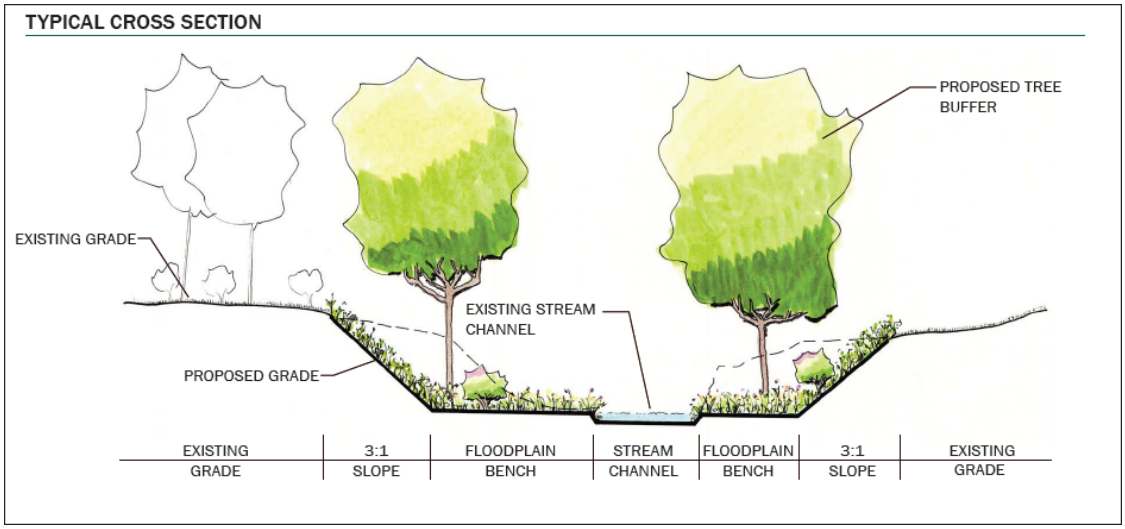


*Figure 2: Typical Cross Section Concept Rendering*

Based on the similar conditions displayed through the site assessment, there is potential to extend the restoration effort through the entirety of the reach, including approximately 790-LF upstream of the bridge and another 160-LF downstream to the confluence. The additional considerations associated with this effort are expanded upon in the subsequent sections of this report.

## 1.4 Sediment and Nutrient Loading Analysis

Estimated annual load reductions were calculated based on revised default removal rates per linear foot of qualifying stream restoration outlined in, *Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects* (Shueler and Stack, 2014). The revised default rates dictate a total nitrogen (TN) removal rate of 0.075 lbs/ft/yr; total phosphorus (TP) removal rates of 0.068 lbs/ft/yr; and total suspended solids (TSS) removal rate of 44.88 lbs/ft/yr for noncoastal plain streams. Table 1 provides

estimated load reductions associated with restoration of the Target Restoration Reach and the entire Site Assessment Reach:

*Table 1: Estimated Annual Load Reductions*

| **Annual Load Reductions** (lbs/yr) | **Target Restoration Reach** (300-LF) | **Total Site Assessment Reach** (950-LF) |
|---|---|---|
| Total Suspended Solids (TSS) | 13,464 | 42,636 |
| Total Nitrogen (TN) | 22.5 | 71.25 |
| Total Phosphorus (TP) | 20.4 | 64.6 |

The Target Restoration reach values provide load reduction estimates for 300-LF immediately upstream of the bridge and washout, while the Total Site Assessment Reach offers potential reductions if the full 950-LF assessment reach were to be restored.

## 1.5 Design & Permitting Considerations

A design and permitting effort for the potential restoration approach would require additional field work and data collection to establish baseline existing conditions and site constraints. This effort would include topographic survey, fluvial geomorphic assessment, wetland determination/delineation and a subsurface investigation. Data collected in the field would be processed and utilized alongside known soil, geologic and hydrologic background data to inform the design development.

Based on the collected data, proposed restoration grading would be developed using AutoCAD Civil 3D. The efficacy of the design would be analyzed with two-dimensional hydraulic modeling using U.S. Army Corps of Engineers HEC-RAS software. This process allows for the design to be iteratively refined to minimize erosive potential and work to ensure the best proposed solution.

Once the design is finalized, the project will require Chapter 102 and Chapter 105 / Section 404 Permit authorization. Regulatory authorization may take six months or more from the initial permit submittal. The following authorizations are anticipated for this restoration:

- E&S Plan Authorization -- Montgomery County Conservation District (MCCD)
- Restoration Waiver per 25 PA Code Chapter 105.12.a.16 (Waiver 16) -- PA Dept of Environmental Protection (PADEP)
- PASPGP-5 -- US Army Corps of Engineers (USACE)

While PA DEPs General Permit for Bank Rehabilitation (GP-3) provides a simplified authorization for bank stabilization, the GP does not allow for channel relocation. In order to provide a long-term improvement and best address the risk for future erosion, the channel needs to be realigned with the culvert, and moved away from the exposed line. For this

reason, the Chapter 105 PA DEP authorization is anticipated to require a permit waiver for restoration activities (Waiver 16).

Once the design is finalized and there is consensus from the applicable regulators, a detailed construction cost estimate may be developed to further planning and inform the contractor procurement process. With a detailed engineering design and anticipated regulatory authorization, the project should be eligible for a variety of federal and state grants that may be pursued to fund all or parts of the construction effort.

Table 2 provides estimated costs of Design & Permitting services for various potential project reach lengths. The table provides estimates for just the Target Restoration Reach; an estimate for the entire Site Assessment Reach; and a reach that would consist of the Target Reach plus the 160-LF downstream of the bridge, all under the same ownership as the target reach. Each estimate includes $5,000 for optional grant writing services and a detailed construction cost opinion based on the proposed design.

## 1.6 Construction Cost Estimate

The construction costs presented in this section were developed based on actual costs for previously constructed restoration projects in the region. Unit pricing is further refined in cooperation with independent contractors experienced in restoration work. Below is a description of proposed tasks:

- Site Work: mobilization, clearing & grubbing, harvesting and placement of woody debris, excavation and channel grading, soil lift construction
- Erosion & Sediment Control: construction entrance(s), construction fence, silt fence, compost filter sock, temporary bypass pumping, erosion control blanket, straw mulch
- Seeding & Landscaping: bench and bank seeding, turf seeding, herbaceous plug planting, tree & shrub installation
- Professional Services which may include bid document support, stakeout, engineering oversight and as-built survey and preparation.

Based on historical unit costs and site considerations, estimated costs (+/-25%) for the construction effort as outlined above are provided in Table 2.

## 1.7 Summary

The site assessment revealed an unstable system characterized by eroding banks throughout the reach. The exposed sewer line may be addressed through bank stabilization practices detailed in the Feasibility Determination, while significant sediment and nutrient load reductions may be achieved through additional stream restoration upstream of the washout.

While the feasibility study focused on a 300-LF Target Restoration Reach, similar degraded conditions up- and downstream of the target site present the opportunity for up to 950-LF of restoration practices if desired for additional pollutant load reductions. A summary of the estimated costs, load reductions and unit costs per pound of reduction are presented in Table 2.

*Table 2: Costs & Loading Summary*

| | **Annual Total Suspended Sediment Load Reductions** (lbs.) | **Design & Permitting Costs** | **Construction Costs** (+/- 25%) | **Unit Cost** ($/lb.) |
|---|---|---|---|---|
| **Target Restoration Reach** (300-LF) | 13,464 | $40,000 | $ 83,000.00 | $ 9.13 |
| **Target Reach + Downstream of Bridge to Confluence** (460-LF) | 20,645 | $50,000 | $ 126,000.00 | $ 8.53 |
| **Total Site Assessment Reach** (950-LF) | 42,636 | $70,000 | $ 240,000.00 | $ 7.27 |

## 1.8 Attachments

Feasibility Assessment Figure
Assessment Photo Sheet

SPOTTS | STEVENS | MCCOY

ssmgroup.com


READING
1047 North Park Road; PO Box 6307
Reading PA 19610-0307
P: 610.621.2000 | F: 610.621.2001

LEHIGH VALLEY
Roma Corporate Center
1605 North Cedar Crest Boulevard; Suite 106
Allentown PA 18104
P. 610.849.9700

LANCASTER
701 Creekside Lane
Lititz PA 17543
P: 717.568.2678

WEST CHESTER
101 East Evans Street
West Chester, PA 19380
P: 610.430.1382