Joint Pollutant Reduction Plan

Paxton Creek Watershed TMDL, Chesapeake Bay PRP,
Wildwood Lake PRP, and UNT Spring Creek PRP

Photos (above) credit: PCWEA, CRW

Capital Region Water
Lower Paxton Township
Susquehanna Township

September 15, 2017
Revised December 27, 2019

Joint Pollutant Reduction Plan
Paxton Creek Watershed TMDL Plan
Chesapeake Bay PRP
Wildwood Lake PRP
UNT Spring Creek PRP

CAPITAL REGION WATER
LOWER PAXTON TOWNSHIP
SUSQUEHANNA TOWNSHIP

DAUPHIN COUNTY, PENNSYLVANIA

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EXECUTIVE SUMMARY

Capital Region Water (City of Harrisburg), Lower Paxton Township, and Susquehanna Township, Dauphin County, Pennsylvania herein referred to as the "Municipal Entities", by virtue of an intergovernmental cooperation agreement, have prepared this Chesapeake Bay Pollutant Reduction Plan (CBPRP), Total Maximum Daily Load (TMDL) Plan, and Pollutant Reduction Plan (PRP) to address Paxton Creek, Wildwood Lake and an unnamed tributary (UNT) to Spring Creek, referred herein as the "Joint Plan," to meet the pollutant load reductions requirements for the 2018 MS4 permit renewal process. The Joint Plan was developed to address the watershed pollutant load reduction requirements mandated by the United States Environmental Protection Agency (EPA) and the Pennsylvania Department of Environmental Protection (PADEP). Comments on the 2017 Joint plan were received from PADEP in a letter dated April 9, 2019. A subsequent meeting to review the comments occurred on June 10, 2019 with representatives of the Municipal Entities and PADEP staff. This plan revision updates the plan in terms of pollutant base loading process, project identification, and anticipated implementation based upon the comments, discussion, and progress made since the draft plan was submitted to PADEP. Being that the surface waters of the major streams in the region (Paxton Creek, Spring Creek, and Beaver Creek) all drain to the Susquehanna River, and ultimately to the Chesapeake Bay, goals for water quality compliance can be accomplished through implementation of one (1) comprehensive Joint Plan focusing efforts on the Paxton Creek Watershed, which contains the most regulated stream. Further, this Joint Plan addresses the Appendix E requirement for an unnamed tributary (UNT) to Spring Creek, the Appendix E requirement for Wildwood Lake – which is located within the Paxton Creek Watershed, and Capital Region Water's combined sewer system that discharges to Paxton Creek and the Susquehanna River.

The Municipal Entities previously developed a collaborative TMDL Strategy, submitted to PADEP in December 2015. The research, field work, analysis, and project selection approach from that Strategy are the basis of this Joint Plan, with updates where regulatory objectives have changed and based on further field work and analysis. The TMDL Strategy should be referenced during the review of this Joint Plan for past research completed that provided the framework for this Joint Plan. True to the sentiment in the TMDL Strategy, the three (3) entities' intention regarding this Joint Plan is to continue to collaborate through implementing a unified, cost-effective plan that meets the regulatory objectives facing each municipal entity.

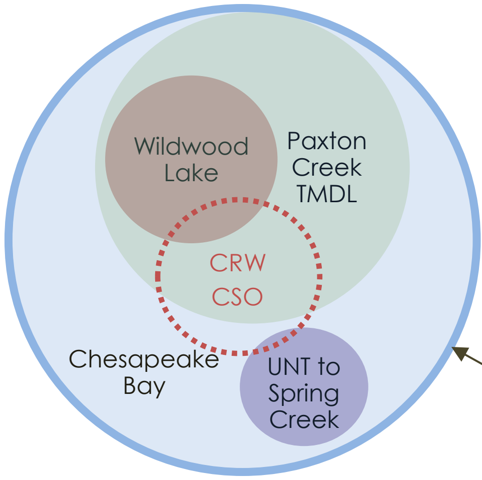
The impaired waters and pollutants of concern for each participating Municipal Entity were determined by referencing the PADEP's Pollutant Aggregation Suggestions for MS4 Requirements Table (Municipal) (last revised 9/8/2017). GIS software was used to map stream impairments and determine the planning area associated with each impaired waterway. Model My Watershed modeling software was used to calculate the baseline pollutant loading in pounds per year for the entire Paxton Creek Watershed, as well as the baseline pollutant load for the larger Joint Planning Area, which encompasses the Chesapeake Bay Pollutant Reduction Plan planning areas of each jurisdiction.

Through successful implementation of the Joint Plan, the following objectives will be achieved:

- Short-term sediment load reduction of 10% for the Paxton Creek TMDL
- Long-term 35% sediment load reduction necessary to meet the prescribed WLAs for Paxton Creek TMDL
- Appendix-D CBPRP, 10% sediment load reduction for the Municipal Entities' combined Chesapeake Bay Planning Areas (Joint Planning Area)
- Appendix-E Siltation, 10% sediment load reduction for Wildwood Lake
- Appendix-E Siltation, 10% sediment load reduction for the UNT to Spring Creek

These goals will be achieved within five (5) years of PADEP's issuance of each Municipal Entities' Individual MS4 Permit (Exhibit A).

Exhibit A. Joint Planning Area Watershed Connectivity Exhibit



PRP Planning Areas:

- UNT to Spring Creek Watershed (Appendix-E PRP)
- Wildwood Lake Watershed (Appendix-E PRP)
- Paxton Creek Watershed (TMDL)
- Chesapeake Bay Watershed (Appendix-D CBPRP)

Joint Planning Area

The permit-required pollutant load reductions are based upon corresponding stream impairments. For waters with only siltation (TSS) impairments, or when the PADEP's "Presumptive Approach" is being utilized, a 10% reduction of sediment pollutant load is required. The Paxton Creek Watershed is subject to a mandatory 35% sediment load reduction, necessary to meet the Wasteload Allocations listed in the Errata to the 2008 Paxton Creek TMDL Report. The required long-term 35% sediment load reduction for the Paxton Creek Watershed and the 10% sediment load reduction for the Joint Planning Area will be achieved concurrently through implementation of the Joint Plan during the upcoming five (5) permit term. Table A presents a summary of the Municipal Entities' short-term pollutant load reduction requirements for the upcoming five (5) year permit term. The existing pollutant loads take into account several baseline load reductions for installed BMPs and existing hydrological conditions within the Planning Area.

As a Joint Plan, this document will address both the PRP requirements, pollutant reductions required for individual impaired waters, as well as the Chesapeake Bay and TMDL impairments. The individual impaired water planning areas and the Paxton Creek TMDL planning area are included within the larger Joint Planning Area, therefore any pollutant load reductions achieved within the Joint Planning and Paxton Creek TMDL planning areas will also be counted towards achieving the individual Appendix-E PRP sediment load reduction goals for the Wildwood Lake and the UNT to Spring Creek. Implementation of the Joint Plan over the first five years of the upcoming permit term will result in each of the Municipal Entities achieving the required sediment load reductions (Table A) for all of their respective impaired streams requiring Pollutant Reduction Plans, per PADEP's Municipal Requirements Table. The results of a watershed analysis using Model My Watershed modeling software confirms the feasibility of achieving all required sediment load reductions through implementation of the Joint Plan.

The inherent complexity of implementing numerous, large-scale projects in a five-year timeframe with limited annual cash flow and limited land control, necessitates a significant number of alternate projects be identified and included in this plan in order to provide flexibility during implementation. Early action projects are identified with an "EAP" notation. As projects are completed and reported on in each MS4's Annual Reports, plan implementation progress will be quantified. The plan goal will be accomplished once the implemented projects meet the joint planning area load reduction goal. For those planned projects that are not completed during the individual permit term because the goal has been met, the MS4s reserve the possibility of implementing the projects in the future should there be a new regulatory water quality improvement goal.

Table A. Short-Term (5-yr) Pollutant Load Reduction Requirements by PRP Planning Area

Planning Area	Impairment	Existing Sediment Load (lb/yr)	Required Sediment Load Reduction	Sediment Reduction Required (lb/yr)
Paxton Creek TMDL	Sediment / Siltation	3,630,159	10%	363,016
Joint Planning Area	Sediment / Nutrients	16,943,984	10%	1,694,398
Wildwood Lake	Sediment / Siltation	2,825,290	10%	282,529
UNT to Spring Creek	Sediment / Siltation	45,137	10%	4,514

Further analysis of the Model My Watershed modeling effort revealed that the majority of the sediment load was a result of streambank erosion. As such, the BMP implementation strategy developed to meet the pollutant load reduction goals relies largely on stream restoration projects (Table B), rather than land-based BMPs. The proposed stream restoration projects will rely, where practical, on vegetative stabilization and floodplain reconnection rather than hard armoring of eroding streambanks. Each project will incorporate riparian buffer restoration and naturalization of the adjacent floodway as appropriate. Stream restoration locations were chosen in part based on geographic location, targeting the Paxton Creek Watershed, because severe erosion areas were observed in the field and secondary benefits related to work in those areas increased the project priority. Because the Paxton Creek Watershed accounts for a large portion of the Joint Planning Area and the entire Wildwood Lake Watershed, implementing stream restoration projects in the Paxton Creek Watershed provides sediment load reductions for each of the overlapping Planning Areas.

Table B. Proposed BMPs and Associated Sediment Reductions

Map Reference	BMP Name	Benefiting Watershed(s)	Latitutde	Longitude	Length (ft)	Reduction (lbs)
BMP-01	Fox Hunt - Stream Restoration	Paxton Creek TMDL, Wildwood Lake, CBPRP	40.335491°	-76.879814°	750	86,250
BMP-02	Stonebridge Apartments	Paxton Creek TMDL, Wildwood Lake, CBPRP	40.301103°	-76.823866°	1,450	166,750
BMP-03	Wildwood Lake, Black Run	Paxton Creek TMDL, Wildwood Lake, CBPRP	40.307771°	-76.882665°	1,075	123,625
BMP-04	Veteran's Park South	Paxton Creek TMDL, Wildwood Lake, CBPRP	40.293398°	-76.859017°	1,000	115,000
BMP-05	Veteran's Park North	Paxton Creek TMDL, Wildwood Lake, CBPRP	40.294232°	-76.860350°	1,150	132,250
BMP-06	CWP – Shutt Mill Rd/Walker Mill Road	Paxton Creek TMDL, Wildwood Lake, CBPRP	40.316231°	-76.870776°	4,400	505,171
BMP-07	Susquehanna Union Green	Paxton Creek TMDL, Wildwood Lake, CBPRP	40.325675°	-76.855535°	2,600	505,700
BMP-08	Bradley Drive	Paxton Creek TMDL, Wildwood Lake, CBPRP	40.319371°	-76.860073°	950	109,250
BMP-09	Black Run - North	Paxton Creek TMDL, Wildwood Lake, CBPRP	40.316022°	-76.870342°	3,368	387,320
BMP-10	Black Run - South	Paxton Creek TMDL, Wildwood Lake, CBPRP	40.311085°	-76.871213°	2,000	230,000
BMP-11	Pines Apartment Complex	Paxton Creek TMDL, Wildwood Lake, CBPRP	40.289522°	-76.840440°	1,450	166,750
BMP-12	Capital Area Greenbelt	UNT to Spring Creek, CBPRP	40.272602°	-76.841858°	1,800	207,000
BMP-13	Walker Mill Road Stream and Retrofit	Paxton Creek TMDL, Wildwood Lake, CBPRP	40.305650°	-76.866050°	600	79,400
BMP-14	CRW UNT to Spring Creek GSI Projects	UNT to Spring Creek, CBPRP	40.269089°	-76.844171°	N/A	23,024
BMP-15	CRW Street Sweeping (25 times per year)	Paxton Creek, UNT to Spring Creek, CBPRP	N/A	N/A	N/A	29,864
BMP-16	Combined Sewer System Rehabilitation & Optimization	N/A	N/A	N/A	N/A	355,000
	Total Proposed Sediment Reduction:					**3,222,354**

The implementation of the proposed BMPs listed in Table B will provide the necessary sediment load reductions for each Municipal Entity to accomplish their respective pollutant load reduction requirements for the upcoming five (5) year MS4 permit term (Table C).

Table C. Proposed Early Action Project BMPs' Sediment Reductions by PRP Planning Area

Planning Area	Impairment	Required Sediment Load Reduction (lb/yr)	Proposed Sediment Load Reduction (lb/yr)	Required Reduction Goal Achieved? (Yes/No)
Paxton Creek TMDL	Sediment / Siltation	363,016	2,132,159	Yes
Joint Planning Area	Sediment / Nutrients*	1,694,398	3,222,534	Yes
Wildwood Lake	Sediment / Siltation	282,529	2,102,295	Yes
UNT to Spring Creek	Sediment / Siltation	4,514	230,024	Yes

*Presumptive approach used to meet nutrient reduction requirements

The BMP strategy proposed herein will be implemented by the Municipal Entities as outlined in the Intergovernmental Cooperation Agreements ("Agreements") between each of the three (3) participating municipal entities. Funds will be sourced through a variety of mechanisms, including any collected stormwater fees, municipal funds, available grants, partnerships, and public donation of materials and manpower.

Public participation was integrated into the development process through providing the public with a draft copy of the 2017 Joint Plan, which was made available for a thirty (30) day public review and comment period. The Joint Plan was also presented during a public meeting held on August 15, 2017 at the Lower Paxton Municipal Building, at which time the public was provided an opportunity to ask questions and make comments. Additionally, the plan was made available for viewing on the participant's respective websites, and a notice was placed in *The Patriot News* and *Paxton Herald* stating the intent of the proposed Joint Plan. The public comment review period was renewed for the 2019 revision, including a public meeting held on November 19, 2019 and advertisement in *The Patriot News* and *Paxton Herald*.

INTRODUCTION

Capital Region Water (City of Harrisburg), Lower Paxton Township, and Susquehanna Township, Dauphin County, Pennsylvania herein referred to as the "Municipal Entities", by virtue of an intergovernmental cooperation agreement, have prepared this Chesapeake Bay Pollutant Reduction Plan (CBPRP), Total Maximum Daily Load (TMDL) Plan, and Pollutant Reduction Plan (PRP) to address Paxton Creek, Wildwood Lake and an unnamed tributary (UNT) to Spring Creek, referred herein as the "Joint Plan," to meet the pollutant load reductions requirements for the 2018 MS4 permit renewal process. The Joint Plan was developed to address the watershed pollutant load reduction requirements mandated by the United States Environmental Protection Agency (EPA) and the Pennsylvania Department of Environmental Protection (PADEP). Comments on the 2017 Joint plan were received from PADEP by a letter dated April 9, 2019. A subsequent meeting to review the comments occurred on June 10, 2019 with representatives of the Municipal Entities and PADEP staff. This plan revision updates the plan in terms of pollutant base loading process, project identification, and anticipated implementation based upon the comments, discussion, and progress made since the draft plan was submitted to PADEP.

This Joint Plan demonstrates how to meet all of the Municipal Entities' sediment load reductions required through the implementation of a Chesapeake Bay Pollutant Reduction Plan; a TMDL Plan benefiting the Paxton Creek Watershed; and the various Appendix E Pollutant Reduction Plans listed in PADEP's MS4 Requirements Table[1] for Municipal MS4s. Capital Region Water's requirements are identified as the City of Harrisburg's requirements on the MS4 Requirements Table, as Capital Region Water is the system operator.

Each of the Municipal Entities own, operate, and maintain Small Municipal Separate Storm Sewer Systems (MS4s). MS4s in each community discharge stormwater to Paxton Creek, which is subject to a TMDL for sediment. As such, each Municipal Entity is required to prepare and submit to PADEP a TMDL Plan addressing how they intend to meet the sediment load reductions and Wasteload Allocations (WLAs) prescribed in EPA's Paxton Creek Watershed TMDL Report[2]. Additionally, as owners and operators of MS4s that discharge stormwater to the Chesapeake Bay Watershed, each community is required to prepare and submit a Chesapeake Bay Pollutant Reduction Plan, describing how the MS4 will reduce the sediment load of stormwater discharging to the Bay's watershed by 10% during the next five (5) year permit term. PADEP also mandates any MS4 discharging stormwater to a stream impaired for sediment and/or nutrients complete an Appendix E – Pollutant Reduction Plan, addressing how the MS4 intends to reduce the sediment pollutant loading of stormwater discharging to the impaired stream by 10% in the next five (5) year permit term.

Being that the surface waters of the major regional streams (Paxton Creek, Spring Creek, and Beaver Creek) all drain to the Susquehanna River, and ultimately to the Chesapeake Bay, goals for water quality compliance can be accomplished through implementation of one (1) comprehensive Joint Plan focusing efforts on the Paxton Creek Watershed, which is the most regulated waterbody. Further, this Joint Plan addresses the Appendix E requirement for an unnamed tributary (UNT) to Spring Creek, the Appendix E

[1] PADEP, Municipal Requirements Table (Municipal), Rev. 9/8/2017

[2] US EPA, Nutrient and Sediment Total Maximum Daily Load in Paxton Creek Watershed, Pennsylvania, June 30, 2008

requirement for Wildwood Lake, which is located within the Paxton Creek Watershed, and Capital Region Water's combined sewer system (CSS) that discharges to Paxton Creek and the Susquehanna River.

Capital Region Water operates a combined sewer system within the City of Harrisburg, including approximately 1,720 acres draining to Paxton Creek and another 661 acres draining directly to the Susquehanna River. The 2008 Paxton Creek TMDL Report incorrectly categorized CRW's combined sewer system as part of the City of Harrisburg MS4. In addition, CRW's existing combined sewer system, by way of treatment in the currently captures and treats about 53% of the average annual runoff generated within the combined sewer service area, providing land-based sediment load reductions as well as decreases in the frequency and magnitude of runoff discharged to Paxton Creek, partially mitigating streambank erosion. The 2008 Paxton Creek TMDL Report does not account for any of this load reduction and consequently overestimates sediment loads attributed to the City of Harrisburg and its MS4. Section D.3 of this Joint Pollution Reduction Plan partitions this load and takes credit for load reductions achieved by the existing combined sewer system.

CRW is currently under a partial Consent Decree with EPA and PADEP, resulting in a requirement to prepare and implement a long-term control plan (LTCP) to reduce combined sewer overflows (CSOs). CRW's CSO LTCP was submitted for review in 2018. The goals of the CSO LTCP are the same as the Paxton Creek TMDL and Chesapeake Bay PRP – reduce flows, establish a less erosive flow regime, and remove land-based sediment loads with the operation of structural BMPs. CRW will implement short- and long-term control measures that further reduce the frequency, magnitude, and sediment load attributable to CSOs discharged to the Paxton Creek and the Susquehanna River. This Joint Pollution Reduction Plan includes an initial estimate of the short-term load reduction anticipated to be achieved through implementation of early-action projects under the LTCP. Land-based pollutant load reductions attributable to the existing operation and short-term enhancements to CRW's combined sewer system were determined directly from hydrologic/hydraulic modeling performed in support of the LTCP. Streambank erosion loads and load reductions attributable to CRW's combined sewer system are determined by extrapolating sediment loads defined for high-density development using the Generalized Watershed Loading Function (GWLF-E) watershed model. This sediment load reduction will be analyzed further as the LTCP is implemented.

The Municipal Entities previously developed a collaborative TMDL Strategy, submitted to PADEP in December 2015. The research, field work, analysis, and project selection approach from that Strategy are the basis of this Joint Plan, with updates where regulatory objectives have changed, refinement related to the LTCP development, and based on field work and analysis completed in 2017. The TMDL Strategy developed in 2015 should be referenced during the review of this Joint Plan for past research completed that provided the framework for this Joint Plan. True to the sentiment in the TMDL Strategy, the three (3) entities' intention regarding this Joint Plan is to continue to collaborate through implementing a unified, cost-effective plan that meets the regulatory objectives facing each municipal entity.

SECTION A: PUBLIC PARTICIPATION

A complete copy of the 2017 Joint Plan was made available for public to review from August 2, 2017 to September 1, 2017. The availability of the document was publicized in *The Patriot News* and *The Paxton Herald* on August 1, 2017 and August 2, 2017, respectively. The published public notices contained a brief description of the Joint Plan, the dates and locations at which the Joint Plan was available for review by the public, and the length of time provided for the receipt of comments.

A copy of the 2017 public notices are included in Appendix A. Public comments were accepted for thirty (30) days following the publication date of the public notice. Several public comments were received. Copies of all public comments and the responses related to each comment are included in Appendix A.

A public meeting was held on August 15, 2017 at the Lower Paxton Township Municipal Building to present the information contained in this Joint Plan to the public. Comments and questions regarding the Joint Plan were received during the public presentation. A copy of the 2017 plan presentation meeting minutes are included in Appendix A.

For the 2019 plan revision, a complete copy of the Plan was made available for the public to review from November 7, 2019 to December 9, 2019. The availability of the document was publicized in *The Patriot News* and *The Paxton Herald* on November 6, 2019 and November 7, 2019, respectively. The published public notices contained a brief description of the Joint Plan, the dates and locations at which the Joint Plan was available for review by the public, and the length of time provided for the receipt of comments. A copy of the public notices are included in Appendix A. One written public comment was received from The Friends of Wildwood Lake Nature Center, Inc. voicing their support for the Joint Plan. No additional public comments were received. A public meeting was held on November 19, 2019 at the Lower Paxton Township Municipal Building to present the information contained in this Joint Plan to the public. A copy of the letter of support and the public presentation are included in Appendix A.

SECTION B: MAP

The maps located in Appendix B of this Joint Plan, depict the Municipal Entities Municipal Separate Storm Sewer System (MS4) service area, as required by the National Pollutant Discharge Elimination System (NPDES) Individual Permit to Discharge Stormwater from Small Municipal Separate Storm Sewer Systems (MS4s) Application Instructions[3]. It should be noted that there are four (4) PRP planning areas, or sub-watersheds, included in the overall Joint Planning Area watershed (Table 1). As such, pollutant load reductions achieved in smaller sub-watersheds count toward meeting the pollutant load reductions requirements of the larger watershed in which it is contained (Exhibit 1). This is essential for understanding how pollutant load reductions will be shared for these interconnected planning areas.

Exhibit 1. Joint Planning Area Watershed Connectivity

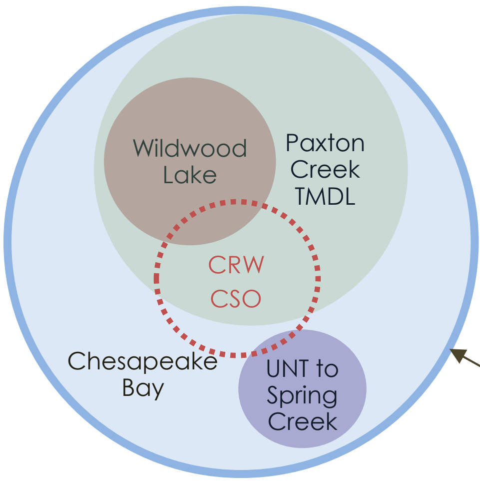


Table 1. Impaired Watersheds in Joint Planning Area

PRP Planning Areas
UNT to Spring Creek Watershed (Appendix-E PRP)
Wildwood Lake Watershed (Appendix-E PRP)
Paxton Creek Watershed (TMDL)
Chesapeake Bay Watershed (Appendix-D CBPRP

CRW Stormwater System Description

CRW is currently in the process of mapping its combined sanitary/storm and separate storm sewer systems and continues to more precisely identify its CSOs, MS4 outfalls, and the areas draining to each. CRW's system is characterized as follows:

- Most stormwater generated within the City of Harrisburg drains to CRW's combined sewer system and discharges to receiving waters at 59 combined sewer overflow (CSO) outfalls.
- CRW also owns and operates an MS4, consisting of underground storm sewers and connected inlets that drain a portion of the remainder of the City. Separate (to MS4 Outfall) areas differ from Table 2-15 of the 2008 TMDL Report due to corrections in the Paxton Creek watershed identified by CRW's current sewer system mapping efforts; delineation of the combined sewer system area, other MS4s, and direct drainage; and differences in the latest Harrisburg City municipal boundary.
- The City of Harrisburg continues to own and operate an MS4 consisting of ditches, curbs, gutters, and other surface drainage features within road right-of-way, as well as MS4s serving various City-owned properties (e.g. municipal buildings, parks, recreation centers). Most, but not all, of the City's MS4 discharges into CRW's MS4, with the remainder discharging directly to receiving waters.

[3] PADEP, form 3800-PM-BCW0200a, (rev. 1/2017)

Stormwater BMPs are installed within the City limits and will continue to be required to be installed for new land development projects, as regulated by local ordinance. As the overall combined and separate systems continue to be better defined and BMPs are mapped, those BMPs will be managed as part of the overall CRW MS4 permit program.

Lower Paxton Township and Susquehanna Township Stormwater System Description

The MS4s in each Township are similar in that they were constructed later than the system within the City limits and include outfalls, pipes, inlets, swales, and BMPs that discharge to the overall system. There are no combined sewer systems in the two townships. The Townships are largely suburban in nature, instituting flood mitigation regulations for new construction for decades, and land development projects constructed since the TMDL was established have been under stricter stormwater regulation than development constructed during the 1970s, 1980s, and 1990s. Between the municipal entities, the majority of recent development projects has occurred within the Townships' borders, and land development projects constructed since 2003 have been designed with BMP installations required by Act 167–compliant stormwater quantity and quality ordinances.

Planning Area Delineations

The urbanized area and topographic contributing drainage located within the municipal boundaries of the City of Harrisburg, Susquehanna Township, and Lower Paxton Township is considered to be the overall Joint Planning Area for the purpose of this Joint Plan. The Joint Planning Area incorporates the entire Paxton Creek Watershed, the entire Wildwood Lake Watershed, the watershed to unnamed tributary (UNT) 10126 to Spring Creek, as well as the regulated portions of the Chesapeake Bay Watershed for Harrisburg City (CRW), Lower Paxton Township, and Susquehanna Township. By virtue of the watersheds existing within the municipal urbanized areas, but not having specific impairments, the Joint Planning Area also encompasses portions of the Beaver Creek, Spring Creek, and Susquehanna River Watersheds. The planning area is characterized by primarily developed land of medium to high intensity with areas of open space and forest. Few agricultural uses exist within the Joint Planning Area (Appendix B – Land Use Map).

Table 2. Joint Planning Area Description of Various Land Uses and Drainage Area Categories

Land Use Code	Land Use	CRW (ac.)	Susq. Twp. (ac.)	Lower Paxton Twp. (ac.)	Total (ac.)
11	Water	2,287	1,178	9	3,474
21	Developed, Open Space	412	1,551	3,858	5,821
22	Developed, Low Intensity	1,139	2,666	5,011	8,816
23	Developed, Medium Intensity	1,846	1,170	1,737	4,753
24	Developed High Intensity	1,484	0	522	2,006
31	Barren Land (Rock/Sand/Clay)	0	413	0	413
41	Deciduous Forest	213	1,954	3,977	6,144
42	Evergreen Forest	3	2	9	14
43	Mixed Forest	0	8	5	13
52	Shrub/Scrub	0	6	11	17
71	Grasslands/Herbaceous	0	25	43	68
81	Pasture/Hay	40	561	2,402	3,003
82	Cultivated Crops	8	158	457	623
90	Woody Wetlands	29	22	9	60
95	Emergent Herbaceous Wetlands	12	2	3	17
				Joint Planning Area	34,829*
				* Based on Model My Watershed Land Use Analysis Results	
Within the Joint Planning Area:					
Separate Storm Sewer System (MS4) Area		885	4,878	9,901	15,664
Combined Sewer Service (CSS) Area		2,534	12	0.0	2,546

The Municipal Entities intend to provide a leadership role in achieving PADEP's pollutant reduction objectives throughout their jurisdictional boundaries; therefore, no parsing of the planning area is done with this plan update. The planning area and modeled pollutant loading area are equal. The planning area, however, is unique and comprised of the following types of stormwater runoff dischargers:

- Joint PRP MS4: This subarea results in pollutant loading calculations that are the direct responsibility of the Municipal Entities. It is determined by mapping of the MS4s operated by each of the Municipal Entities and using topographic information to delineate areas that drain into these systems.

- Combined Sewer System (CSS): This is the area within the City of Harrisburg served by combined sewers (i.e., a sewer designed to collect stormwater and wastewater in the same pipe), defined as the area tributary to the 59 combined sewer regulator structures that divert wastewater to CRW's Advanced Wastewater Treatment Facility (AWTF). It includes pockets of separate storm sewer that drain into a combined sewer. CRW's City Beautiful H2O Program Plan (CBH2OPP), CRW's Integrated Stormwater/Wastewater Management Plan prepared according to US EPA integrated planning guidelines, includes more detailed maps and descriptions of how this system was delineated an is available upon request of CRW.

For the purpose of this Joint PRP, pollutant contributions from and pollutant removal achieved by the CSS include both land-based sediment capture within the combined sewer area and streambank erosion control. These reductions are attributed to flow volume/velocity reductions from existing and proposed future combined sewer system operation. Combined sewer effects on flows and loads are credited in this PRP for two reasons: (1) The Paxton Creek TMDL appeared to include the CSS in its load calculation and (2) under US EPA integrated planning guidelines, communities are encouraged to seek the most cost-effective method of achieving water quality compliance, regardless of the permitting vehicle used to regulate discharges. Since CRW's CSOs contribute to water quality issues within the Joint Planning Area and CRW is required to reduce these CSOs, it is appropriate to include the combined sewer area in its overall Joint PRP strategy.

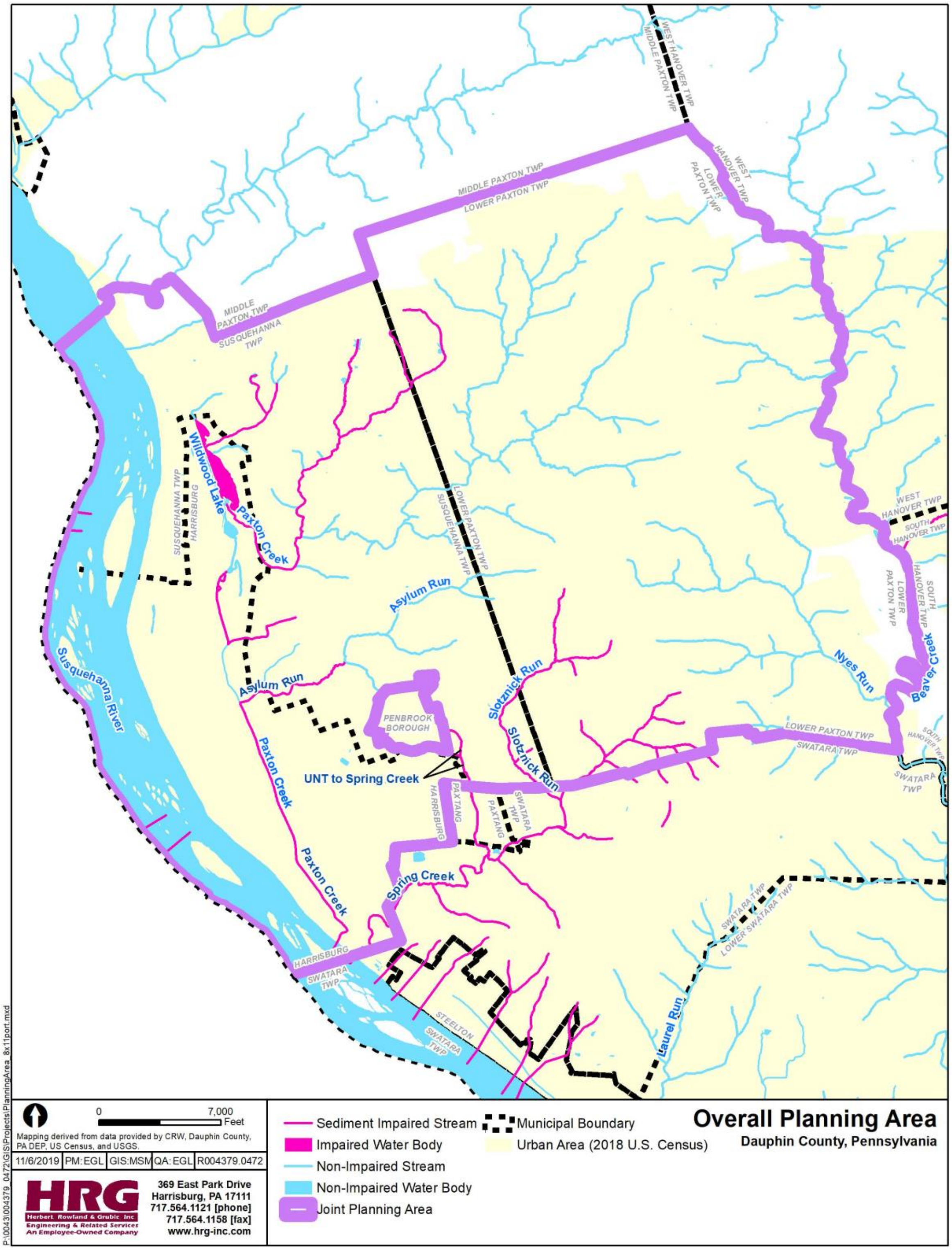
- Other Named MS4s and Industrial Permittees: There are several other entities in the Joint Planning Area that own/operate permitted storm sewer systems, including PennDOT, Dixon University, and the Lancaster County Solid Waste Authority. The Municipal Entities are already in collaboration with PennDOT on pollutant reduction projects and intend to collaborate with other permitted entities as opportunities arise.

- Public Properties with Direct Discharges: These public entities are not served by the MS4s operated by the Municipal Entities, and many own and operate drainage systems that may be considered "municipal" under US EPA and PADEP stormwater regulations, including the United States government, the Commonwealth of Pennsylvania (e.g., Farm Show property and other properties owned by the Commonwealth outside the CSS), Dauphin County, and public universities (e.g., Harrisburg Area Community College). These properties are subject to stormwater fees and/or considered potential participants in collaborative projects within the Joint Planning Area.

- Private Properties with Direct Discharges: These are properties abutting a Water of the Commonwealth that, based on available MS4 mapping and topography, do not appear to drain through an MS4 operated by a Municipal Entity but still contribute to the overall watershed impairment. This includes much of the major rail line passing through Harrisburg, which is served by its own drainage system that does not enter the MS4, based on best available information.

- Non-Urban Areas: These are the areas that are not considered to be urbanized according to the 2010 US Census and, per US EPA and PADEP regulations, are not considered part of the MS4 pollutant loading contribution. However, the updated MS4 regulations have clarified this characterization by indicating that if the non-urban areas are tributary to urban areas, they indeed are included in the planning area and contribute to water quality.

EXHIBIT 2. OVERALL PLANNING AREA MAP



SECTION C: POLLUTANT(S) OF CONCERN

The Pollutants of Concern for the Planning Area were determined by referencing the PADEP's Pollutant Aggregation Suggestions for MS4 Requirements Table (Municipal)[4]. A summary table of the Pollutants of Concern listed by the watershed is shown below (Table 3). The Requirements Table also indicate watersheds that are impaired for reasons that do not require a pollutant reduction plan. These requirements will need to be addressed in the future by way of pollutant control measures (PCMs), and those watersheds are also identified in Appendix C.

This Joint Plan's focus is for MS4 PRP Appendix D and E. As such, not all impairments listed in the Municipal Requirements Table are included as Pollutants of Concern for the purpose of this Joint Plan.

Table 3. MS4 Requirements Table Pollutant Reduction Plan Requirements

Impaired Watershed	Pollutants of Concern	DEP-Assigned Municipal Entity
Chesapeake Bay	Appendix D - Nutrients, Siltation (4a)	CRW, LPT, SUSQ
Paxton Creek TMDL	TMDL Plan - Siltation (4a)	CRW, LPT, SUSQ
Wildwood Lake	Appendix E - Siltation (5)	CRW, SUSQ
UNT to Spring Creek	Appendix E - Siltation (5)	CRW, SUSQ

Likely sources of these pollutants in the Municipalities have been identified by PADEP as follows:

<u>Siltation - Sediment (TSS):</u>
Streambank erosion
Construction / earth moving activities
Agricultural activities
Urban runoff

<u>Nutrients (TN, TP):</u>
Lack of adequate stream buffer
Heavy use of lawn fertilizers
Urban runoff

TSS – Total Suspended Solids
TN – Total Nitrogen
TP – Total Phosphorus

CRW – Capital Region Water
LPT – Lower Paxton Township
SUSQ – Susquehanna Township

[4] PADEP, MS4 Requirements Table (Municipal) (rev. 9/8/2017)

SECTION D: EXISTING LOADING FOR POLLUTANT(S) OF CONCERN

D.1 Paxton Creek TMDL Background

The basis of the Paxton Creek sediment TMDL was studied during the development of the 2015 TMDL Strategy. The Paxton Creek watershed (hydrologic unit code [HUC] 02050305) consists of approximately 17,421 acres of predominantly medium to high intensity urban development in and near Harrisburg, Pennsylvania. Table 4 shows the approximate breakdown of the watershed by jurisdiction and type of drainage, as understood during the development of the 2015 TMDL Strategy. A watershed analysis conducted at that time indicated that approximately fifty-five percent (55%) of the watershed discharges to Paxton Creek through MS4s, ten percent (10%) through combined sewer outfalls (CSOs), eleven percent (11%) through other MS4s, eight percent (8%) direct drainage to Paxton Creek, and sixteen percent (16%) outside urbanized areas. Notwithstanding that the urbanized area changed with the 2018 permit term and the planning area has increased with this 2019 plan revision, these percentages are still generally reflective of the watershed.

Table 4. Approximate Drainage Areas within Paxton Creek Watershed, from 2015 TMDL Strategy

Jurisdiction	Approximate Drainage Area (acres)					
	Separate (to MS4 Outfall)	Combined (to CSO)	Other MS4s[1]	Direct Drainage[2]	Non-Urban Area[3]	Total
Capital Region Water/ City of Harrisburg	148	1,720	461	254	765	3,348
Lower Paxton Township	4,664	0	254	592	1,885	7,395
Susquehanna Township	4,618	0	1,091	616	88	6,413
Middle Paxton Township	0	0	0	2	98	100
Penbrook Borough	132	0	31	0	0	163
Swatara Township	0	0	2	0	0	2
Total	9,562	1,720	1,839	1,464	2,836	17,421
Percentage of Paxton Creek Watershed	55%	10%	11%	8%	16%	100%

[1] For example, PennDOT, Commonwealth of Pennsylvania, Harrisburg Area Community College, Dauphin County

[2] Private property not discharging to an MS4, where known; included in Separate (to MS4 Outfall) area where unknown

[3] Non-urban areas are areas not defined as an urbanized area by the 2000 U.S. Census, as was the prevailing urbanized area determination at the time of the Strategy development

PADEP has determined that approximately thirty (30) miles of Paxton Creek and its tributaries fail to meet water quality standards and are listed on the 303(d) list of impaired waters for 2014. Section 303(d) of the Federal Clean Water Act requires States to identify all impaired surface waters not supporting designated uses even after required water pollution control technologies have been applied. Known as the 303(d) List, the DEP's report, *2014 Pennsylvania Integrated Water Quality Monitoring and Assessment Report,* identifies those water body segments that require the development of total maximum daily loads (TMDLs) to assure future compliance with water quality standards. The latest 303(d) data released in 2016 has been utilized to identify the impaired creek segments herein and, to the author's knowledge, no stream segment has been restudied by PADEP to date in an effort to remove them from the impairment list.

To efficiently assess stream impairment, PADEP primarily uses biological assessment of aquatic macroinvertebrates because aquatic life use is a reliable indicator of long-term pollution problems and stream degradation. Therefore, the stream and watershed characteristics that may have led to the Paxton Creek's degradation and subsequent 303(d) listing are primary indicators of stream habitat alterations, accelerated flow and erosion, and degraded riparian areas. Increased runoff volume and velocity from uncontrolled impervious surfaces can destabilize stream channels, particularly near unprotected outfalls. Stream encroachments can also lead to degraded riparian areas by removing natural ecosystems that protect streams (e.g., floodplains, riparian cover, etc.).

Previous watershed assessments have identified recurring themes of streambank erosion and instream erosion; however, at the time the studies occurred, the watershed still exhibited signs of past less-regulated land development practices. With the inception of new stormwater regulations in 2010 that required additional water quality practices and over-detention, in addition to tighter sediment and erosion controls during the construction phase, the stream should start to exhibit the benefits of those regulatory changes. Past assessments occurred at a time when a significant portion of the watershed was in development, likely 15-percent of the watershed on average at one time. To that end, continued stream assessment is warranted to determine biological indicators of improvement and visual indications of restored stream banks. Should additional water quality sampling, biological surveys, and habitat assessments be completed and used by PADEP in the future due to the anticipated work to be done in the watershed, it is possible for water quality attainment to be achieved and the desired warm water fishery (WWF) indicators to be restored.

Regarding one of the regulatory catalysts for this plan, the EPA regulatory document for the Paxton Creek sediment TMDL identified nonpoint sources, MS4 sources, and a combined sewer overflow (CSO) source, which are all required to reduce base load sediment by varying percentages equaling a 35% percent sediment load reduction for the watershed (Table 5). The purpose of this Joint Plan is to focus on the MS4 and CSO sources, though, due to a previous analysis of acreages associated with those sources, it is anticipated that the load allocations in the regulatory document should be refined based upon updated local mapping and analysis being completed during the development of CRW's LTCP. This Joint Plan focuses on the waste load allocation (WLA) related to MS4 land sources such as agriculture, forest, open space, low intensity development, and high intensity development and the MS4's in-stream erosion WLA. Nonpoint sources are not required to be mitigated by municipalities, and the CSO WLA is included in our plan by way of incorporating the land associated with the CSOs in the planning area.

Functioning as targets, the existing load by land use equates to the sediment loading the model identifies per land use type. The allocated load is the "pollution diet" that those land uses should be held to in order for the watershed to meet water quality goals. So, when the Municipal Entities meet or exceed the 35% sediment reduction goal, they will meet or exceed the allocated load. Table 5 is provided for regulatory reference; the load allocations are recalculated by way of this plan in order to determine a more accurate 35% reduction goal since the model used to develop the regulation is no longer available for use.

Table 5. Paxton Creek TMDL Allocations by Land Use/Source from 2008 EPA TMDL Report

Source	Land Use / Source	Existing Load (lb/yr)	Allocated Load (lb/yr)	Percent Reduction
Nonpoint Sources	Agriculture	4,400	3,800	14%
	Forest	17,600	17,600	0%
	Open Space	40,200	34,000	15%
	Low Intensity Development	26,200	22,200	15%
	High Intensity Development	28,800	24,400	15%
	Instream Erosion	793,400	485,800	39%
	Nonpoint Source Subtotal:	**910,600**	**587,800**	**35%**
MS4	Agriculture	22,000	18,800	15%
	Forest	86,400	86,400	0%
	Open Space	197,200	168,000	15%
	Low Intensity Development	128,600	108,800	15%
	High Intensity Development	141,400	119,600	15%
	Instream Erosion	3,901,000	2,388,800	39%
	MS4 Subtotal:	**4,476,600**	**2,889,600**	**35%**
CSO		29,000	24,600	15%
Permitted Facilities		14,000	14,000	0%
	Total:	**5,430,200**	**3,515,800**	

Note: Existing and allocated loads presented as shown in Table 7-7 Recommended TMDL Allocations for Paxton Creek in the 2008 EPA TMDL Report, converted to lb/year

The EPA regulatory document identifies that the majority of the sediment load in the Paxton Creek watershed eighty-six percent (86%) is derived from in-stream erosion, and it assigns the highest load reduction target to that source.

D.2 Baseline Pollutant Load Calculations

Joint Planning Area

Due to similar sediment reduction goals between municipalities and their impaired watersheds requiring PRPs, a large overall planning boundary was developed that encompassed each of the municipal PRP watersheds, as well as the Paxton Creek TMDL watershed, in order to incorporate all planning objectives into one (1) Joint Planning Area. This approach allows the three (3) participating Municipal Entities to share the burden of the required sediment loads necessary for MS4 permit compliance through a combined effort to implement well planned, cost-effective BMPs in the locations that offer the greatest water quality benefit to both the Paxton Creek and Chesapeake Bay Watersheds. The Joint Planning Area is an expanded planning area that encompasses the urbanized areas within the municipal jurisdictions, including the Paxton Creek watershed, Capital Region Water's CSS area, and the three Municipal Entities' required CBPRP planning areas.

By partnering with neighboring municipalities, each participant will achieve their individual municipal PRP sediment load reduction requirements while allowing proposed BMPs to be implemented in locations that best address the source of the sedimentation occurring throughout the impaired watershed of the combined Joint Planning Area watershed. This approach eliminates the need for municipalities to install BMPs in locations that may not be sources of pollution simply to theoretically satisfy prescribed regulatory load reduction goals. Not only is this integrated approach the most cost effective approach for the municipalities involved to meet their permit requirements, it is the most beneficial to the water quality of the local streams, as well as the Susquehanna River and Chesapeake Bay.

The joint planning area baseline and existing pollutant load calculations were computed using Model My Watershed (MMW), a watershed-modeling web app available through Stroud Water Research Center's WikiWatershed web based toolkit. Model My Watershed is a web-based watershed modeling tool that, in a similar manner to the previously utilized desktop version of the MapShed modeling software, "uses hydrology, land cover, soils, topography, weather, pollutant discharges, and other critical environmental data to model sediment and nutrient transport within a watershed[5]." This web application calculates the existing pollutant loading from the Joint Planning Area in terms of pounds per year (lbs/yr) and evaluates existing and proposed BMP-based pollutant reductions using PADEP-approved BMP effectiveness values.

Due to compatibility and stability issues with the now technically unsupported desktop version of MapShed modeling software used in the 2017 Plan, at PADEP's suggestion, MMW version 1.25.0 was used to calculate the baseline pollutant loading in pounds per year for the baseline pollutant load for the larger Joint Planning Area in this 2019 Plan. Like the desktop MapShed software, MMW utilizes the same Generalized Watershed Loading Functions - Enhanced (GWLF-E) model to simulate runoff, sediment, and nutrients (nitrogen and phosphorus) loads from a watershed over a multi-year time period, but is not reliant upon the unsupported MapWindow GIS Package.

An assumption that 20% of the existing streams in both planning areas were adjoined by a forested buffer area, 35-feet in width, was made based on a review of satellite imagery from April 2016 and based upon local knowledge. The existing buffer was incorporated into the MMW model to replicate actual field conditions of the modeled watersheds.

Existing detention basins were not included in the model, as MMW offers no water quality benefit to standard detention basins. Each municipality's baseline pollutant loads for the planning areas were determined using MMW's Urbanized Area tool.

The joint planning area MMW model was calibrated to determine sediment loads for the Joint Planning Area utilizing a Streambank Erosion Adjustment Factor of 0.74 in order to meet a baseload similar to the calibrated 2017 MapShed Model (Table 6). The described modeling approach and parameters were presented to and approved by PADEP's TMDL Section in October 2019, and are further described below.

Table 6. Joint Planning Area Calibration Output Comparison

Source	Joint Planning Area - Annual Sediment Load (lb/yr)		
	GWLF-E Model 2017 Baseline	Uncalibrated 2019 Model My Watershed Baseline	Calibrated 2019 Model My Watershed Baseline
Joint Planning Area Sediment Load	17,335,200	53,841,714	17,507,254

Table 7**Error! Reference source not found.** lists the MMW modeling results for the Joint Planning Area in terms of percentage of watershed land area and baseline sediment load by municipality. Because the municipalities are comprised of varying intensiveness of land uses, the land area does not equate to the sediment load.

[5]Evans, B., & Corradini, K. (n.d.). MapShed Overview Page. Retrieved August 18, 2015, from http://www.mapshed.psu.edu/overview.htm

Table 7. Municipal Baseline Pollutant Loading for the Joint Planning Area

MS4 Permittee	Percentage of Watershed	Baseline Sediment Load (lb/yr)
CRW (City of Harrisburg)	16%	3,667,006
Township of Lower Paxton	57%	9,324,542
Township of Susquehanna	27%	4,141,959
Joint Planning Area Total:	**100%**	**17,507,254***

*Total Baseline Sediment Load based on MMW results for the entire watershed, not the sum of the individual municipalities.
Refer to Appendix D of this report for modeling outputs.

Paxton Creek TMDL and UNT to Spring Creek Planning Areas

Notwithstanding that the Joint Planning Area is the prevailing sediment reduction target area, the subwatersheds with impairments were modeled separately in MMW in order to confirm that local impairment goals are met by focusing projects in the impaired subwatersheds. The original AVGWLF model and associated data sets used by U.S. EPA to develop the 2008 Paxton Creek TMDL were not available for use in the preparation of the this Plan or the 2017 Plan. As such, the process to develop, validate, and apply the model of the Paxton Creek watershed began by developing a new projected baseline, 2008 condition model to simulate average annual sediment loads from land sources (non-point) and instream erosion. A preliminary baseline model of the Paxton Creek watershed was conducted using the default parameters to determine the inconsistency between the results generated using the AVGWLF model of the 2008 TMDL Report and those calculated via the new Model My Watershed modeling application. The initial MMW baseline model for the Paxton Creek watershed yielded a total sediment load much greater than the 2,715.1 tons per year (5,430,200 lb/yr) baseline load cited in EPA's 2008 TMDL Report, whose sediment goals are a regulation influencing the pollutant reduction effort.

Similar to the 2008 Paxton Creek TMDL, the MMW model of the projected 2008 baseline sediment loads was created using the application's data sets without the addition of existing or proposed control measures or BMPs. Due to the significant discrepancy between the two models, the MMW model of the projected 2008 baseline was adjusted to achieve a baseline sediment load consistent with existing annual MS4 loads published in the 2008 TMDL Report. Specifically, the instream erosion sediment load was significantly greater, which can be attributed to differences in the lateral erosion rate calculation or the precipitation, land use, or runoff characteristics used to calculate stream flow between the 2008 AVGWLF model and the latest GWLF-E (MMW) model. The AVGWLF model incorrectly assigned much of the streambank load to agricultural sources (the prevailing assumption at the time), while the GWLF-E (MMW) incorrectly assigns higher bank erosion rates based on urban runoff rather than stream instability when estimating streambank erosion rates on a watershed basis. To account for the discrepancies between the differing models and remove the equivalent contributory load associated with the areas of direct drainage within the Paxton Creek Watershed that do not enter the MS4, the Streambank Erosion Adjustment Factor, was set to 1.05 in order to achieve a baseline sediment of relatively consistent with the 2008 Paxton Creek TMDL baseline and the previously submitted 2017 Joint Plan (Table 8).

Table 8. Paxton Creek TMDL Calibration Output Comparison

Source	Paxton Creek TMDL Watershed - Annual Sediment Load (lb/yr)		
	AVGWLF Model 2008 Baseline*	Uncalibrated 2019 Model My Watershed Baseline	Calibrated 2019 Model My Watershed Baseline
Land-Based Sediment Load	694,400	883,800	326,729
Instream Erosion Sediment Load	4,694,400	13,958,800	3,709,400
CSOs	29,000	Included in land-based and stream erosion sediment load	Included in land-based and stream erosion sediment load
Point Sources	14,000	Not modeled/ N/A	Not modeled/ N/A
Total	**5,430,200**	**14,842,600**	**4,036,129**
*From Table 6-8 of 2008 EPA TMDL Report, converted to lbs/yr			

The Spring Creek Planning Area did not require calibration to match previous modeling as the updated model actually yielded lower results than the 2017 GWLF-E model. A Streambank Erosion Adjustment Factor of 1.5 (default) was used (Table 9).

Table 9. UNT Spring Creek Planning Area Calibration Output Comparison

Source	UNT Spring Creek Watershed - Annual Sediment Load (lb/yr)		
	GWLF-E Model 2017 Baseline	Uncalibrated 2019 Model My Watershed Baseline*	Calibrated 2019 Model My Watershed Baseline*
UNT Spring Creek Sediment Load	85,000	45,137	45,137
*Default streambank erosion adjustment factor was used since the 2017 baseline was not exceeded			

D.3 Existing Pollutant Load Adjustment for Previously Implemented BMPs

Seven (7) existing stormwater quality projects (EX-01 through EX-07) were completed in the Paxton Creek Watershed prior to the completion of this Joint Plan and are being utilized as credit to reduce the baseline sediment loading estimates for the watershed (Table 12). These projects were installed after 2008 and meet the requirements for water quality credit regarding design and ongoing operation and maintenance. An additional existing stream restoration BMP (EX-07) was constructed in 2013 in the Spring Creek Watershed and is being utilized as credit to reduce the baseline loading estimates for the Joint Planning Area. Unfortunately, it is not located within the watershed of the UNT to Spring Creek, which has a local impairment for sediment. Existing BMP locations are provided on BMP Location Maps in Appendix B.

Further, pollutant load reductions associated with CRW's CSS have been included in the existing load calculations. The existing CSS provides pollutant reduction through the capture of approximately 50% of the combined sewage generated within a typical year, completely removing it from discharges to Paxton Creek and the Susquehanna River. The volume captured is conveyed to and treated at CRW's Advanced Wastewater Treatment Facility.

The 2008 Paxton Creek TMDL included the area served by CRW's CSS in the area attributed to CRW's (i.e., City of Harrisburg's) MS4. In this plan, we:

1. Divide the sediment loads attributable to CRW/Harrisburg between those associated with the CSS and the MS4,
2. Account for load reductions attributable to the current operation of CRW's CSS, which captures approximately 50% of the combined sewage volume (which is predominantly composed of stormwater) generated within the CSS during a typical year for treatment at CRW's AWTF, and
3. Account for future load reductions attributable to near-term enhancements to operation of CRW's CSS, which are projected to capture an additional 30% of the combined sewage volume generated within the CSS during a typical year for treatment at CRW's AWTF.

Long-term CSO control is required under CRW's Partial Consent Decree (PCD) with DEP and EPA. Estimates of stormwater volumes/loads within the CSS were informed by hydrologic and hydraulic modeling conducted with the US EPA Stormwater Management Model (SWMM) Version 5. CSS loads/load reductions were projected according to the methodology presented in the Paxton Creek Watershed TMDL Strategy (dated December 31, 2015), which was reviewed and discussed with DEP prior to preparation of the 2017 Joint PRP and 2019 revision.

In-stream erosion sediment load attributable to the CSS is defined as the share of the total streambank erosion sediment load from the TMDL and/or Model My Watershed calculations proportionate to the CSS area/land use characteristics (Exhibit 2). Table 3-4 and Appendix A.10 (page A-25) from the TMDL Strategy projected an estimated in-stream erosion reduction from a reduction in CSS volume captured. This value along with the estimated runoff volume from this Model My Watershed model projected an erosion rate reduction per unit volume (i.e. pounds of sediment reduced per million gallons of runoff volume reduced). This erosion reduction rate was then applied to the estimated combined sewer overflow volume reduction under a City Beautiful H2O Program Plan[6] (CBH2OPP) scenario to project an estimate of sediment load reduction from instream erosion. This value was then subtracted from the estimated streambank load estimates from the Model My Watershed results. Separate calculations were prepared for the Paxton Creek TMDL and Susquehanna Chesapeake Bay Pollutant Reduction Plan load reduction estimates.

Exhibit 2. In-stream Sediment Load Reduction Equation

Joint PRP In-Stream Sediment Load Attributed to CRW CSS

$$SBS_{CSS} = SBS_{CRW\text{-}TOT} - CSS_{VOL} * SBS_{Rate}$$

where:

SBS_{CSS} = Reduction In-Stream Sediment Load from CSS operation (lb)

$SBS_{CRW\text{-}TOT}$ = Total In-Stream Sediment Load attributed to CRW/Harrisburg (lb)

CSS_{VOL} = Estimated Volume Captured by Existing CRW CSS Operation (gal)

SBS_{Rate} = In-stream erosion rate (lb / gal), from 2015 Paxton Creek TMDL Strategy

Land-based runoff sediment load: To estimate the sediment load reduction from changes in land-based runoff, the iteration of available Model My Watershed model results prepared for the 2017 Joint PRP was utilized to estimate a land-based sediment load per unit volume (pounds of sediment reduced per million gallons of runoff volume reduced) for the entire CRW drainage area. The estimates of runoff and sediment provided by the Model My Watershed results were then apportioned by drainage area type and area (MS4, CSS, direct discharge) to estimate the land-based sediment load associated with CSS (

[6] https://capitalregionwater.com/cbh2o/

Exhibit 3). The estimates of sediment load were then reduced by the same portion as CSO volume reductions (i.e., 10% reduction in CSO volume equals 10% reduction in CSO sediment load). CSO volume estimates were provided by an estimate of CSO volumes projected by the current (at the time of plan preparation) CRW hydrologic and hydraulic model simulation, to account for a more calibrated model of the CSO system versus Model My Watershed, to estimate current and projected future runoff volumes for CSO system improvements. Separate calculations were prepared for the Paxton Creek TMDL and Susquehanna Chesapeake Bay Pollutant Reduction Plan load reduction estimates.

Exhibit 3. Land-Based Sediment Load Reduction Equation.

2017 PRP Land-Based Runoff Sediment Load from CSS changes calculation method

$$LBS_{CSS} = LBS_{CRW\text{-}TOT} * A_{CSS} / A_{CRW\text{-}TOT} - LBS_{CRW\text{-}TOT} / CSS_{VOL} * CSO_{VOL}$$

where:

LBS_{CSS} = Reductions in Land-Based Sediment Load from existing CSS operations (lb)

$LBS_{CRW\text{-}TOT}$ = Total Land-Based Sediment Load from CRW Harrisburg (lb)

A_{CSS} = Area draining to the CRW CSS (acres)

$A_{CRW\text{-}TOT}$ = Total Area in CRW/Harrisburg (acres)

$LBS_{CRW\text{-}TOT}$ =Total Land-Based Sediment Load from CRW/Harrisburg (lbs)

CSS_{VOL} = Runoff volume from CSS area (gal)

CSO_{VOL} = CSO volume from existing CSS operation (gal)

Table 10 provides estimates of sediment load reduction provided by the CSS discharging to Paxton Creek. It includes the corrected sediment load attributable to the CRW/City of Harrisburg sediment load as applicable to the TMDL. Table 11 provides estimates of sediment load reductions provided by the combined sewer system attributable to the Joint Planning Area (including those attributable to Paxton Creek in Table 10). For streambank erosion sediment load reductions, this was based on an analysis using PADEP's MapShed simulation completed as part of the 2015 TMDL Strategy. The method assumed potential LTCP-related discharge reductions by removing the CSS drainage area and the resulting reductions in streambank erosion were related to a reduction in discharge volume. Further detail can be reviewed in the 2015 TMDL Strategy – Appendix A, Section A.10. For land based and point source reductions of sediment load, this was based on the reduction in discharge volume (i.e., reducing combined sewer overflow volume reduces sediment load by the same proportion).

Table 10. Summary of CRW/City of Harrisburg Paxton Creek Corrected Sediment Loads from the Combined Sewer System

Scenario	Land-Based Sediment Load (ton/yr)	Streambank Erosion Sediment Load (ton/yr)	Total CSS Sediment Load (ton/yr)	Total CSS Sediment Load (lb/yr)	Reduction from Existing
Sediment Load Reported in 2008 TMDL	18	364	382	764,000	---
Corrected Sediment Load from Existing Combined Sewer System	16	332	348	696,000	5%

Modeling results indicate that the existing CSS operation has resulted in a 32-ton load reduction attributed to the Paxton Creek Watershed for the TMDL, which equates to a 6,000 pound reduction. This reduction is credited as existing BMP CSS-01.

Table 11. Summary of CRW/City of Harrisburg Sediment Loads from the Combined Sewer System Attributable to the Joint Planning Area

Scenario	Land-Based Sediment Load (ton/yr)	Streambank Erosion Sediment Load (ton/yr)	Total CSS Sediment Load (ton/yr)	Total CSS Sediment Load (lb/yr)	Reduction from Existing
Sediment Load Reported in 2008 TMDL	51	1,547	1,598	3,197,000	---
Corrected Sediment Load from Existing Combined Sewer System	41	1,516	1,557	3,113,000	2%

Modeling results indicate that the existing CSS operation has already resulted in a 41-ton load reduction attributed to the Joint Planning Area, which equates to an 85,000-pound reduction, 17,000 pounds more than the Paxton Creek Watershed TMDL sediment load reduction. The existing BMP sediment load reduction values for CRW's CSS operation are indicated as project CSS-01 (68,000 lb) and CSS-02 (17,000 lb) in Table 12.

Table 12. Installed BMPs.

Map Reference	BMP Name	Planning Area Credit	Sediment Load Reduction (lbs/yr)*
EX-01	Paxton Church / Reichert Rd. Rain Garden and Stream Restoration (240 ft.)	Joint Planning Area / Paxton Creek TMDL	40,012
EX-02	Fox Hunt Rd. Stream Restoration (375 ft.)	Joint Planning Area / Paxton Creek TMDL	43,125
EX-03	UNT to Asylum Run Retention Basin and Stream Restoration (350 ft.)	Joint Planning Area / Paxton Creek TMDL	72,025
EX-04	Elmerton Ave. Bio-retention Basin	Joint Planning Area / Paxton Creek TMDL	17,191
EX-05	Black Run Stream Restoration (800 ft.)	Joint Planning Area / Paxton Creek TMDL	92,000
EX-06	Asylum Run Bio-retention and Stream Restoration (400 ft.)	Joint Planning Area / Paxton Creek TMDL	73,617
EX-07	Dowhower Rd Buffer and Stream Restoration (1,220 ft.)	Joint Planning Area	140,300
CSS-01	CRW Combined Sewer System Sediment Capture Performance to Paxton Creek Watershed Allowance	Joint Planning Area / Paxton Creek TMDL	68,000
CSS-02	CRW Combined Sewer System Sediment Capture Performance to Susquehanna River Allowance	Joint Planning Area	17,000
		Total Existing BMP Sediment Load Reduction:	**563,270**

*BMP reduction values derived using Joint Planning Area Model My Watershed parameters

The existing sediment loading for each planning area adjusted down to account for the sediment load reductions achieved by the existing BMPs listed in Table 12 is shown on Table 13 and is calculated out on the following pages. Simply, the existing sediment baseline loads for each planning area were determined by subtracting the existing BMP sediment load reduction from the respective planning area's baseline sediment load.

Paxton Creek Baseline Sediment Load by Municipality – Municipal baseline sediment load values compared to percentage of land area within the Paxton Creek Watershed.

MS4 Permittee	Percentage of Paxton Creek TMDL Planning Land Area	Baseline Sediment Load (lbs/year)
CRW (City of Harrisburg)	19.5%	990,680
Township of Lower Paxton	43.1%	1,595,261
Susquehanna Township	37.4%	1,456,454
Paxton Creek TMDL Planning Area Total:	**100%**	**4,036,129***
*Total Baseline Sediment Load based on MMW model results for the entire watershed, not the sum of the individual municipalities.		

Paxton Creek Watershed Planning Area Baseline Sediment Load = 4,036,129 lbs/yr

Existing BMP Sediment Load Reduction for the Paxton Creek TMDL Watershed =

40,012 lbs + 43,125 lbs + 72,025 lbs + 17,191 lbs + 92,000 lbs + 73,617 lbs + 68,000 lbs **= 405,970 lbs**

Municipal Entities' Paxton Creek TMDL Planning Area Existing Sediment Load

Adjusted Existing Sediment Load = Baseline Sediment Load – Existing BMP Sediment Load Reduction

Adjusted Existing Sediment Load = 4,036,129 lbs – 405,970 lbs = **3,630,159 lbs**

Joint Planning Area Baseline Sediment Load by Municipality – Municipal baseline sediment load values compared to percentage of land area within the Joint Planning Area Watershed.

MS4 Permittee	Percentage of Joint Planning Area	Baseline Sediment Load (lbs/yr)
CRW (City of Harrisburg)	16.0%	3,667,006
Township of Lower Paxton	57.0 %	9,324,542
Township of Susquehanna	27.0%	4,141,959
Joint Planning Area Total:	**100%**	**17,507,254***
*Total Baseline Sediment Load based on model results for the entire watershed, not the sum of the individual municipalities.		

Municipal Entities' Joint Planning Area Baseline Sediment Load = 17,507,254 lbs/yr

Existing BMP Sediment Load Reduction for the Joint Permit Area =

40,012 lbs + 43,125 lbs + 72,025 lbs + 17,191 lbs + 92,000 lbs + 73,617 lbs + 140,300 lbs + 68,000 lbs + 17,000 lbs **= 563,270 lbs**

Municipal Entities' Paxton Creek TMDL Planning Area Existing Sediment Load

Adjusted Existing Sediment Load = Baseline Sediment Load – Existing BMP Sediment Load Reduction

Adjusted Existing Sediment Load = 17,507,254 lbs – 563,270 lbs = **16,943,984 lbs**

Table 13. Existing Sediment Loading by Planning Area, Adjusted for Existing BMPs (Model My Watershed Model Summary)

Planning Area	Drainage Area (acres)	Adjusted Existing Sediment Load (lbs/yr)
Paxton Creek TMDL Watershed	17,053	3,630,159
Joint Planning Area Watershed	34,829	16,943,984

SECTION E: WASTELOAD ALLOCATION(S) (WLAs)

On June 30, 2008, EPA established nutrient and sediment TMDLs for the Paxton Creek Watershed. In a letter dated August 15, 2013, EPA withdrew the nutrient TMDL based on Pennsylvania's 2012 Integrated Report that revised the impairment status of Paxton Creek. The sediment TMDL remains and assigns a sediment (total suspended solids) waste load allocation (WLA) to each MS4 in the Paxton Creek Watershed. In order for each Municipal Entity to meet their respective WLA, each Municipal Entity is required to complete a 35% reduction of the total existing sediment load (Table 14).

Table 14. Paxton Creek Watershed - Waste Load Allocations (WLAs) and Required Reductions*.

MS4 Permittee	Baseline Sediment Load (lb/yr)	Approved Sediment WLA (lb/yr)	Percent Reduction Required
CRW (City of Harrisburg)	803,000	518,200	35%
Lower Paxton Township	1,660,800	1,072,000	35%
Middle Paxton Township	400	200	35%
Penbrook Borough	48,800	31,600	35%
Susquehanna Township	1,949,200	1,258,200	35%
Swatara Township	14,400	9,400	35%
Paxton Creek Watershed Total:	**4,476,600**	**2,889,600**	**35%**

* Note: WLAs provided in EPA regulatory document, Table 7-4, Paxton Creek MS4 Wasteload Allocation by Municipalities from the August 28, 2013 errata document issued by EPA, converted to lb/yr.

Further, a WLA is provided in the EPA regulatory document for the CSO in the Paxton Creek Watershed. Since that area is included in the overall Joint Planning Area and the original CSO WLA calculation has not been able to be replicated, it is anticipated that sediment load reductions achieved through implementation of Capital Regional Water's Community Greening Plan (April 2017), which establishes guidance for green infrastructure for stormwater maintenance activities to remove accumulated sediment from CRW's combined sewer system, will be attributable to the Joint Planning Area sediment reduction goals. Additionally, implementation of CRW's Long Term Control Plan as well as operational changes related to CSO regulators, pumping stations, and/or the Advanced Wastewater Treatment Facility in accordance with CRW's CSO Nine Minimum Control Plan will all result in significant sediment load reductions attributable to the Joint Planning Area sediment reduction goals. Simply, it is anticipated that work completed to comply with CSOs will count toward the Municipal Entities' water quality goals.

For the purpose of this Joint Plan and in order to be able to implement the plan based on the latest available model, the EPA WLAs were re-modeled according to the 35% reduction requirement. So, the WLAs will be met when the modern model (Model My Watershed) yields a 35% reduction of the modeled baseline rather than the approach of calculating reductions using incompatible methods in order to meet the 2008 WLA lb/yr goal.

SECTION F: ANALYSIS OF TMDL OBJECTIVES

F.1 Long-Term TMDL Sediment Load Reduction

The Municipal Entities intend to achieve the required long-term 35% sediment load reduction goal prescribed by the EPA's Paxton Creek Watershed TMDL Report during the upcoming five-year MS4 permit term. Because other pollutant reduction goals overlap, and projects can be focused within the area of greatest impairment (the Paxton Creek Watershed), the Municipal Entities intend to accomplish this through the construction of BMPs necessary to achieve the larger Appendix D CBPRP 10% sediment load reduction (Table 16) for the Joint Planning Area during the upcoming five (5) year permit term. It is more cost-effective to focus the efforts on the Paxton Creek to fulfill the objectives of the long-term TMDL goal and the short-term (five-year) Chesapeake Bay PRP goal.

Table 15. Long-Term Pollutant Load Reduction for the Paxton Creek Watershed Planning Area

Watershed	Impairment	Existing Pollutant Load (lb/yr)	Percent Reduction Required	Long-Term Load Reduction Goal (lb/yr)
Paxton Creek TMDL	Sediment / Siltation	3,630,159	35%	**1,270,906**

F.2 Short-Term TMDL Sediment Load Reduction

The minimum 10% short-term sediment load reduction required for the Paxton Creek TMDL Watershed will be accomplished upon completion of a portion of BMPs proposed herein. BMPs proposed in this Joint Plan have been located throughout the Paxton Creek Watershed in order to achieve the entire required sediment load reduction in both the TMDL (Table 15 and Table 16) and Chesapeake Bay planning areas (Table 17), as well as the two (2) impaired Appendix E, PRP watersheds (Table 18). Short-term sediment load reduction requirements have been quantified for the TMDL Planning Area (Table 15).

Table 16. Short-Term Pollutant Load Reduction for the Paxton Creek Watershed

Watershed	Impairment	Existing Pollutant Load (lb/yr)	Percent Reduction Required	Short-Term Load Reduction Goal (lb/yr)
Paxton Creek TMDL	Sediment / Siltation	3,630,159	10%	**363,016**

F.3 CBPRP (Joint Planning Area) Sediment Load Reduction Goal

Utilizing the "Presumptive Approach," as described in PADEP's PRP Instructions,[7] the Municipal Entities intend to achieve the required 10% Appendix-D, CBPRP sediment load reduction goal through construction, operation and maintenance of the sediment load reducing BMPs proposed in this Joint Plan. The pollutants of concern for the Appendix D, CBPRP are total suspended solids (TSS), total phosphorus (TP), and total nitrogen (TN) with required loading reductions of 10%, 5%, and 3%, respectively. However, it is presumed that within the Joint Planning Area watershed, the TP and TN goals will be achieved when a 10% reduction in

[7] PADEP, Document 3800-PM-BCW0100k, Rev. 3/2017

sediment is achieved[8]. Therefore, only the required 10% sediment load reduction goal is calculated herein as a requirement for the Appendix D CBPRP (Table 17).

Table 17. Appendix D, CBPRP Sediment Load Reduction

Watershed	Impairment	Existing Pollutant Load (lb/yr)	Percent Reduction Required	Pollutant Reduction Goal (lb/yr)
Joint Planning Area	Sediment / Siltation	16,943,984	10%	**1,694,398**

F.4 Appendix-E Sediment Load Reduction Goal

Two (2) watersheds within the Joint Planning Area have water quality impairments required to be addressed as a result of regulation through PAG-13 General Permit, Appendix-E (nutrients and/or sediment in stormwater discharges to impaired waterways), which is anticipated to be the basis of the Individual Permits for which the Municipal Entities are required to apply. Appendix-E impairments for siltation require a minimum 10% sediment reduction within the impaired water planning area. Refer back to Exhibit 1 for a graphic representation of the overlapping sediment load reduction goals across the Joint Planning Area.

Since the 19-square mile Wildwood Lake Watershed lies completely within the larger Joint Planning Area, the required Appendix-E sediment reductions will be accomplished implicitly through implementation of this Joint Plan. The majority of the tributary improvements proposed herein address upstream erosion and sedimentation that will provide benefit to Wildwood Lake.

The 0.5-square mile watershed to the impaired UNT to Spring Creek also is located within the larger Joint Planning Area. The required Appendix-E sediment reductions will be accomplished through implementation of this Joint Plan, and BMPs targeting that watershed have been identified. Pollutant loading and the associated sediment reduction goals are a subset of the overall Joint Planning Area reduction goal (Table 18).

Table 18. Appendix E, Sediment Load Reduction for Impaired Streams

Watershed	Impairment	Existing Pollutant Load (lb/yr)	Percent Reduction Required	Pollutant Reduction Goal (lb/yr)
Wildwood Lake	Sediment / Siltation	2,825,290*	10%	**282,529**
UNT to Spring Creek	Sediment / Siltation	45,137	10%	**4,514**
*70% of the baseline sediment load for the Paxton Creek Watershed, based on drainage area				

[8] PADEP - PRP Instructions, Document # 3800-PM-BCW0100k, Rev. 3/2017

SECTION G: SELECT BMPS TO ACHIEVE THE MINIMUM REQUIRED REDUCTIONS

G.1 Paxton Creek TMDL Watershed Sediment Load Reductions

G.1 Stream Assessment and Field Investigations

Detailed stream assessments and storm sewer system investigations were conducted during development of the Paxton Creek Watershed TMDL Strategy in 2015, and additional field assessments were carried out in spring 2017 in support of the development of this Joint Plan. The Unified Stream Assessment (USA) methodology was utilized in an effort to establish a baseline valuation of stream quality as it relates to the potential for erosion and sedimentation within the watershed, in line with the targeted stream assessment completed in 2015. A detailed description of the methodological approach can be referenced in Section 5 of the 2015 TMDL Strategy.

The results of the Model My Watershed modeling calculations, coupled with the findings of the extensive field work effort, helped to identify streambank erosion as the primary source of sediment generated within the urbanized portion of the Joint Planning Area. For this reason, coupled with the greater sediment reduction efficiency value of 115 lbs/ft approved by PADEP during the two year gap between when the Paxton Creek TMDL Strategy was developed and the creation of the 2017 Joint Pollutant Reduction Plan, targeting the contributory factors of streambank erosion by means of floodplain restoration, bank stabilization and riparian buffer establishment along streams provides the greatest sediment load reductions on a per project and per cost basis. The use of the 115 lbs/ft sediment reduction efficiency value, which will need to be verified on a project by project basis during plan implementation based on the prevailing DEP guidance of the time, reduced the length of stream work necessary to meet the reduction requirements identified in the Paxton Creek TMDL Strategy. Additionally, runoff capture via combined sewer system upgrades and installations of proposed green infrastructure projects associated with CRW's LTCP and Community Greening Plan will greatly reduce erosive conditions in the Lower Paxton Creek watershed and improve water quality in the Susquehanna River and Chesapeake Bay.

Upon recognizing streambank stabilization as the most advantageous BMP approach, stream reaches with severe degradation within the Paxton Creek Watershed, as identified in 2015 during the Initial Stream Assessment outlined in Section 5 of the TMDL Strategy, and additional reaches within the impaired UNT to Spring Creek Watershed identified during the 2017 site selection effort, were chosen as a pool of Potential BMP Candidates from which to establish Final BMP Selections that achieve the minimum required reductions.

In addition to the severity of stream bank degradation and potential for sediment load reduction through BMP implementation, there were several other factors which influenced the selection of the final BMP sites. Constructability issues (site constraints, accessibility, staging and stockpiling needs) and project costs, outlined in detail herein, were important considerations, as were specific recommendations from the Municipal Entities. Candidate project sites demonstrating threats to buildings and/or infrastructure, such as exposed utilities due to severe stream erosion, were given priority when choosing final projects to include in the Joint Plan as they stand to provide the greatest benefit to the Municipal Entities and their constituents. Further, as individual goals for Paxton Creek and UNT to Spring Creek were better understood, projects were prioritized accordingly.

One such site was an existing basin located along Walker Mill Road in Susquehanna Township. It was a strong candidate because it is a municipally owned standard detention basin that could easily be retrofitted to provide additional water quality benefits and sediment reductions. In addition, the outlet structure was failing and needed repaired. This basin is located just upstream of a degraded stream reach of Paxton Creek.

During the Initial Stream Assessment for the TMDL Strategy, the impaired individual stream reaches were identified in the report as numbered Stream Segments (e.g. SS-1, SS-2, etc.). Since the TMDL Strategy served as the basis for this Joint Plan, and in an effort to maintain uniformity throughout the BMP selection process, this nomenclature was maintained in the Joint Plan. The expanded set of Stream Segments that make up the Potential BMP Candidates considered during BMP selection, as well as the Final BMP Selections, including the Walker Mill Road Basin BMP are presented on the BMP Prototype Key Map included in Appendix F.

It is important to note that the proposed concept designs outlined in this report were developed for modeling purposes intended to demonstrate the potential for required sediment load reductions to be achieved during detailed restoration design outside of the scope of this plan. The final BMP selections are subject to change during detailed construction design and permitting efforts or based upon changes or other unforeseen circumstances related to the evaluation criteria. For this reason, the BMP Prototype Key Map, and the Detailed Concept Cost Opinions and Prototype Cost Estimates presented in detail in this report to function as planning tools to be utilized to efficiently and effectively identify quality alternative BMPs in the event one of the project sites becomes ineligible for any of the reasons outlined above.

G.1.2 Concept Site Selection

Based upon the findings of the field assessments, four (4) reaches within the assessment area were selected to serve as prototypical representations of the various stream reaches present throughout the Joint Planning Area. The initial concept sites included 1,070 LF of Black Run immediately downstream of Shutt Mill Park; 1,430 LF of Asylum Run through the Stonebridge Apartments originating from an outfall below Colonial Road across from the Colonial Park Mall; 840 LF of an unnamed tributary to Asylum Run at Veteran's Park; and 710 LF of Paxton Creek through the Harrisburg Area Community College (HACC) campus. Detailed surveys and existing conditions analyses were conducted at the four (4) concept sites to provide thorough insight into stream characteristics throughout the Joint Planning Area. During the detailed existing conditions investigation, the HACC Campus site was eliminated from consideration for Streambank Stabilization efforts based upon the limited potential for sediment load reduction to be achieved from BMP implementation outlined in detail in the modeling discussion.

G.1.3 Existing Conditions Hydraulic Modeling

The existing conditions of the concept sites – excluding the HACC Campus Site – and the vast majority of the assessment reaches exhibit obvious signs of horizontal and vertical degradation directly related to unstable channel dimensions and disassociation with the active floodplain. The incised channel conditions prevent high flows from accessing the floodplain resulting in high flow velocities and excessive shear stresses within the channel during even mild runoff events, and, in turn, significant channel and bank erosion. Hydraulic models of the existing site conditions were developed using the United States Army Corps of Engineers HEC-RAS version 5.0.3 two-dimensional (2D) model. Site survey and hydrology data were utilized along with LiDAR contours from the DCNR's PAMAP program provided the basis for the model.

The HEC-RAS model was run using the 100-yr flow rate from the Paxton Creek Act 167 hydrology model for each site. While each of the existing conditions concept models, excluding the HACC Campus site, demonstrate erosive potential resulting from even the 1- and 2-yr flow events, utilizing the 100-yr flow rate provides a conservative condition to ensure proposed concept designs are capable of withstanding extreme flow conditions. Designing the proposed concept sites to withstand a lesser flow condition leaves the potential for the sites to degrade and fail in more severe conditions, eliminating any limited benefit that may have been derived from preventing erosion during lesser events.

The 2D model provided hydraulic conditions, specifically shear stress results, used to analyze the potential for channel and bank erosion in the existing geometry and flow conditions. The shear stress results of the existing conditions modeling, as well as the proposed concept modeling discussed subsequently in this report, are presented on sheets 4, 6, and 8 of 9 in the accompanying figures in Appendix F.

Black Run Site (SS-03) - Existing Conditions

At the upstream portion of the Black Run site, the stream sits against a steep valley wall on the right bank with four to five foot tall eroded banks along private lawns on the left bank. The stream cuts across the valley approximately 600-feet downstream of Shutt Mill Park becoming pinned against the steep left valley wall with vertical bank heights of three- to four-feet on the right bank for the remainder of the reach. The existing conditions model at the Black Run site exhibits significant shear stresses upwards of three-pounds per foot in the existing channel for the majority of the assessment reach, with the highest shear stresses nearing five-pounds per foot where the channel transitions across the valley.

Stonebridge Apartments Site (SS-14) - Existing Conditions

The Stonebridge Apartments existing conditions model demonstrates erosive conditions for the majority of the site with shear stresses in excess of three-pounds per foot and over six-pounds per foot in some locations. The most significant shear stresses occur in the upstream portion of the reach at the outfall beneath Colonial Road, at sharp meanders in the existing channel, and at encroachments in the form of pedestrian footbridges. The downstream-most 200-feet of the site are protected during high flows by a backwater condition created by the culvert crossing at North Arlington Avenue.

Veteran's Park Site (SS-18) - Existing Conditions

The existing reach at Veteran's Park is characterized by its steep valley slope and highly eroded channel with vertical bank heights in excess of six-feet. The 2D model reveals shear stresses greater than eight-pounds per foot throughout the reach during the 100-year flow event. It is also worth noting that the highly channelized system prevents even the 100-year event from escaping the channel and accessing the floodplain.

HACC Campus Site (SS-20) - Existing Conditions

The HACC Campus reach, along with the majority of Paxton Creek downstream of Wildwood Lake, differs from the rest of the watershed in that the site exhibits relatively stable banks and significant sediment deposition. The existing conditions indicate that the reach is not the most beneficial location to focus restoration efforts. This was corroborated through the 2D modeling results. Low slopes and frequent crossings result in backwater conditions through this reach, which tends to protect the bed and banks from scour. The dam at Wildwood Lake also serves to mitigate the peak flow during rainfall events, limiting the impact downstream of the lake. While dredging efforts within Paxton Creek downstream of the Wildwood Lake dam and behind the dam itself may provide ecological uplift outside of the scope of this project, the 2D model yielded shear stress results of less than two pounds per square foot through the reach during the 100-year flow event, indicating very little likelihood of stream bank erosion in the existing condition. For this reason, the HACC Campus site was removed from consideration as a concept prototype. That being said, structural failures causing localized erosion or infrastructure degradation may exist in this reach that may warrant additional consideration for restoration.

G.1.4 Proposed Restoration Concept and Hydraulic Analysis

Conceptual restoration design approaches were developed for each of the three (3) viable restoration sites with the intent of minimizing erosion potential, creating stable stream banks, and demonstrating a site concept that may be applied at the prototype locations throughout the Joint Planning area to achieve minimum required reductions. The concept grading for the three (3) sites were developed using the 2D model to refine the design over multiple iterations in order to optimize results. The shear stress results of the final proposed concept designs are presented in Appendix G alongside the existing conditions results for comparison. The shear stress results serve to demonstrate the feasibility of the concept restoration approaches to reduce erosion rates. Conceptual Renderings are provided along with comparisons of the existing and proposed shear stress results from the hydraulic analysis in Appendix F.

The proposed restoration concepts provide low-energy stream channel systems with good floodplain connectivity and stable epifaunal substrate. The concept grading allows increased flows to access the entire floodplain, allocating energy uniformly throughout the site and eliminating points of concentrated high shear stresses. This distribution of shear stress across the floodplain not only reduces erosion rates for the extent of the site, but also provides the potential for sediment entering the site from upstream to deposit on the restored floodplain, reducing the amount of sediment passing through the site and continuing downstream.

Black Run Site (SS-03) – Floodplain Restoration Concept – Proposed Conditions

The Floodplain Restoration Concept design includes significant floodplain cutting to reduce the bank heights below one-foot, providing floodplain connectivity during high flow events. The 2D model demonstrates successful mitigation of the high shear stresses present in the existing condition as the concept grading results in shear stresses under 1.5-pounds per foot for the majority of the site. Higher shears near 3-pounds per foot at the up and downstream tie-ins are expected as flow transitions between the restored concept site and the constricted existing condition.

Stonebridge Apartments Site (SS-14) – Constrained Corridor Concept – Proposed Conditions

The 20-feet wide floodplain proposed at the Constrained Corridor Concept results in shear stresses reduced from near 6-pounds per foot in the existing condition to less than 2.5-pounds per foot in the proposed condition. The grading extents are limited by apartment buildings, pedestrian bridges and onsite utilities. These constrictions may require armoring in addition to that required at the upstream tie-in. The downstream tie-in remains protected during high flows by a backwater condition created by the culvert crossing at North Arlington Avenue.

Veteran's Park Site (SS-18) – Steep Slope Concept – Proposed Conditions

The Steep Slope Concept requires filling the existing channel to achieve a widened, stable floodplain. The concept yields improved shear stress results – less than 2.5-pounds per foot for the majority of the reach. These stresses increase over 6-pounds per foot at the bottom portion of the site as the slope must increase and floodplain width decrease in order to tie-in to the existing main stem. A step-pool channel system through this portion is proposed to effectively mitigate the erosion potential posed by high shear stresses.

Comparison of the existing and proposed concept shear stress figures demonstrates a reduction of the most severe shear stresses, with stresses distributed uniformly across the concept sites, avoiding excessive shears at any one location and reducing the potential for erosion. The 2D modeling provides justification that the concept designs may be applied throughout the Joint Planning Area prototypes to achieve target sediment load reductions.

G.1.5 Prototype Development and Application

The concept designs described above were applied to the remaining assessment reaches based upon criteria outlined below. The prototype assignments are presented on the BMP Prototype Key Map (Appendix F) and in Table 19.

The Floodplain Restoration Concept {Black Run Prototype} sites consist of 2nd and 3rd order perennial streams generally characterized by valley slopes less than 3.5%, 100-year peak flows over 1,200 cubic feet per second (cfs), and drainage areas greater than one-square mile. The site locations contain relatively few buildings of structures likely to impact restoration efforts. The restoration approach consists of significant floodplain cutting to achieve stable channel depths and valley slopes and widths. Structural armoring is minimal and generally limited to upstream and downstream tie-ins.

The sites that fall under the Constrained Corridor Concept {Stonebridge Apartment Prototype} consist of intermittent or perennial 1st and 2nd order streams generally characterized by valley slopes less than 3.5%, 100-year peak flows less than 1,200 cfs, and drainage areas less than one-square mile. Restoration efforts likely require less cut than the Black Run Prototype sites and may be limited to some extent by adjacent buildings or structures. The restoration approach requires cutting to achieve stable channel depths and valley slopes and widths. Structural armoring may be required where site constraints exist in addition to upstream and downstream tie-ins.

Steep Slope Concept {Veteran's Park Prototype} sites consist of 1st or small 2nd order streams generally characterized by valley slopes greater than 3.5% and drainage areas less than one-square mile. The restoration approach requires significant fill in the existing channel to achieve stable valley widths. The approach requires extensive structural armoring due to steep slopes with heavily armored step-pool systems utilized in some instances.

Table 19, below, provides the Prototype assigned to each assessment stream segment. The total breakdown shows eight (8) Floodplain Restoration sites, ten (10) Constrained Corridor sites, and four (4) Steep Slope sites. Stream Segment SS-20 was represented by the HACC Campus concept site which was eliminated from consideration as previously discussed.

Table 19. Prototype Application to Assessment Stream Segments

Assessment Stream Segment	Prototype	Length (LF)
SS-01	Constrained Corridor	2,262
SS-02	Constrained Corridor	6,838
SS-03*	Floodplain Restoration	8,195
SS-04	Floodplain Restoration	594
SS-05	Constrained Corridor	2,769
SS-06	Floodplain Restoration	2,794
SS-07	Constrained Corridor	4,270
SS-08	Constrained Corridor	2,703
SS-09	Floodplain Restoration	9,110
SS-10	Floodplain Restoration	2,090
SS-11	Constrained Corridor	2,312
SS-12	Constrained Corridor	1,110
SS-13	Constrained Corridor	11,219
SS-14*	Constrained Corridor	4,834
SS-15	Constrained Corridor	2,162
SS-16	Steep Slope	4,789
SS-17	Steep Slope	1,060
SS-18*	Steep Slope	2,761
SS-19	Floodplain Restoration	5,954
SS-20	Downstream of Wildwood Lake – eliminated from consideration	
SS-21	Steep Slope	1,879
SS-22	Floodplain Restoration	3,866
SS-23	Floodplain Restoration	1,786
An asterisk (*) denotes a concept site along all or part of the assessment reach		

The prototypes are intended to serve as a planning tool to map potential restoration efforts that may be applied to degraded reaches throughout the watershed in order to achieve sediment load reduction targets outlined in this Joint Plan. During plan implementation, detailed site design efforts may reveal unforeseen circumstances which may impact final BMP site location. Should some of these sites prove to be more successful than others, the project list may be revised to target optimal site locations in order to provide the most cost-effective BMPs with the highest likelihood for success.

G.2 BMP Selection Process

The results of the existing conditions Model My Watershed model demonstrate that the majority of the sediment load generated within the urbanized area of the Joint Planning Area originates from streambank erosion. As such, project locations identified herein for improvement are based on the ability to implement streambank stabilization and riparian buffer restoration BMPs, rather than land-based BMPs, such as bio-retention or infiltration BMPs. BMP locations came as a result of the aforementioned stream assessment conducted in 2015 and 2017, and from recommendations by municipal staff. Candidate project sites demonstrating threats to buildings and/or infrastructure, such as exposed utilities due to severe stream erosion, were given priority when choosing final projects to include in the Joint Plan. The remaining sites were evaluated and chosen based upon which sites offered the greatest potential for sediment load reduction in locations that offered accessibility and promising community support. BMP Location Maps are included in Appendix B.

The Final BMP Site selections outlined in this Plan were determined based upon careful scrutiny of the field assessment findings and the concept analysis efforts while building upon the findings of the TMDL Strategy and taking into special consideration the needs of the Municipal Entities regarding which projects provide the greatest added benefit to the community for the lowest anticipated cost.

The selected BMP sites represent an optimized approach to meeting the following goals for each of the participating Municipal Entities in the first permit term, beginning upon approval of this Joint Plan and the municipal Individual Permits.

- Short-term sediment load reduction of 10% for the Paxton Creek TMDL
- Long-term 35% sediment load reduction necessary to meet the prescribed WLAs for Paxton Creek TMDL
- Appendix-D CBPRP, 10% sediment load reduction for the Municipal Entities' combined Chesapeake Bay Planning Areas (Joint Planning Area)
- Appendix-E Siltation, 10% sediment load reduction for Wildwood Lake
- Appendix-E Siltation, 10% sediment load reduction for the UNT to Spring Creek

Proposed BMPs include detention basin retrofit/bioretention and floodplain restoration projects that provide streambank stabilization and establish riparian forest buffers (Table 20) located throughout the urbanized area of the Municipal Entities' respective jurisdictions.

Many of the floodplain restoration projects being proposed are located in Susquehanna Township due to the findings of the Joint Planning Area field assessment. The assessment showed that while not pristine, the streams located in the head-waters of the watershed, namely those located in Lower Paxton Township, displayed little streambank erosion, and contained very few areas of significant silt and sediment deposition compared to the Susquehanna Township sites. Many reaches located further downstream in Susquehanna Township exhibited moderate to severe streambank erosion, undercutting and bank failure. These reaches offer the greatest potential for reducing the amount of silt and sediment impacting the Paxton Creek, Spring Creek and Chesapeake Bay Watersheds. For that reason, many of the stream restoration project locations chosen as a result of the stream assessments lie within Susquehanna Township and the Spring Creek Watershed. By concentrating efforts on heavily impacted streams, rather than simply dividing the number of proposed BMPs projects evenly between the participating Municipal Entities, the Joint Plan offers an optimal approach to achieving the sediment load reductions assigned to each municipality.

The proposed BMP sites align closely with the findings of the TMDL Strategy which served as the foundation for the Joint Plan. Section 6 of the 2015 TMDL Strategy identified eighteen (18) potential "early-action" projects (EAPs) exhibiting evidence of severe degradation and significant restoration potential. Of the thirteen (13) floodplain restoration BMPs proposed in this plan, six (6) sites were included in the TMDL Strategy as EAPs. The remaining proposed BMPs are located along stream segments that were unable to be evaluated during development of the 2015 TMDL Strategy.

The proposed BMP projects have not undergone engineering design. The project descriptions are conceptual and intended for planning purposes. Proposed projects have been evaluated in terms of preliminary feasibility and anticipated pollutant load reductions in order to meet the goals of this Joint Plan.

The proposed BMPs will be designed in accordance with the Pennsylvania BMP Manual design guidance and all local ordinances. Additionally, as many of the proposed projects are primarily floodplain restorations, additional details and calculations for each proposed project developed during the design and implementation project phases will be documented in the Annual MS4 Status Reports.

A summary of the type and scale of BMP projects included in this Joint Plan is listed in Table 20. The table references the assessment stream segment from which the BMP was derived and also indicates whether the BMP was presented as an EAP in the 2015 TMDL Strategy. It should be noted that the BMP Stream Lengths may not match the Assessment Stream Segment Lengths presented in Table 20, as the BMPs may cover only a portion of the initial stream segment based upon the site characteristics and sediment reduction goals.

The sediment load reductions achieved through the implementation of each floodplain restoration presented in this Joint Plan were determined using a value of 115 lb/ft, per PADEP guidance[9]. A comprehensive list of the individual BMP projects to be implemented is provided in Appendix G and their locations are shown on the BMP Location Maps in Appendix B and BMP Prototype Key Map in Appendix F.

[9] PADEP, TMDL Plan Instructions, Form 3800-PM-BCW0200d,(Rev. 3/2017)

Table 20. Proposed Floodplain Restoration Projects

Map Reference	Floodplain Restoration BMP Name	Assessment Stream Segment	Early Action Project	Lat./ Long.	Planning Area	Stream Length (LF)	Reduction (lbs)
BMP-01	Fox Hunt - Stream Restoration	SS-21	EAP-1	40.335491° -76.879814°	Paxton Creek / Joint Plan	750	86,250
BMP-02	Stonebridge Apartments	SS-14	EAP-2	40.301103° -76.823866°	Paxton Creek / Joint Plan	1,450	166,750
BMP-03	Wildwood Lake, Black Run	SS-01	N/A	40.307771° -76.882665°	Paxton Creek / Joint Plan	1,075	123,625
BMP-04	Veteran's Park South	SS-18	N/A	40.293398° -76.859017°	Paxton Creek / Joint Plan	1,000	115,000
BMP-05	Veteran's Park North	SS-18	N/A	40.294232° -76.860350°	Paxton Creek / Joint Plan	1,150	132,250
BMP-06	CWP – Shutt Mill Rd/Walker Mill Road	N/A	EAP-3	40.306631° -76.870776°	Paxton Creek / Joint Plan	4,400	505,171
BMP-07	Susquehanna Union Green	N/A	EAP-4	40.325675° -76.855535°	Paxton Creek / Joint Plan	2,600	505,70010
BMP-08	Bradley Dr	N/A	N/A	40.319371° -76.860073°	Paxton Creek / Joint Plan	950	109,250
BMP-09	Black Run - North	SS-03	EAP-5	40.316022° -76.870342°	Paxton Creek / Joint Plan	3,368	387,320
BMP-10	Black Run - South	SS-03	EAP-6	40.311085° -76.871213°	Paxton Creek / Joint Plan	2,000	230,000
BMP-11	Pines Apartment Complex	SS-16	N/A	40.289522° -76.840440°	Paxton Creek / Joint Plan	1,450	166,750
BMP-12	Capital Area Greenbelt	SS-23	N/A	40.272602° -76.841858°	UNT Spring Creek / Joint Plan	1,800	207,000
BMP-13	Walker Mill Road Stream Only	N/A	EAP-7	40.305650° -76.866050°	Paxton Creek / Joint Plan	600	69,000

Notwithstanding that implementation of the 2015 TMDL Strategy was not required until approved by PADEP, a few early action projects have been acted upon by the Municipal Entities. Stonebridge Apartments (BMP-02 and EAP-2) is under design and is anticipated to include floodplain restoration and select streambank stabilization. The actual reduction credit will be calculated upon final design. The project is funded through a Commonwealth Finance Agency Watershed Restoration and Protection Grant.

[10] Expert Panel Report Credit Protocols

Further, land-based BMP opportunities will be implemented where feasible. A detention basin retrofit project is proposed for an existing detention basin along Walker Mill Road in Susquehanna Township, paired with stream restoration in its vicinity (Table 21). The basin serves as the primary stormwater management facility for a large residential housing development and currently discharges to an impaired section of Paxton Creek. The retrofit is likely to include modifications to the existing outlet structure, excavation and soil modification in the basin floor, wetland plantings, shrubs, shade trees, and naturalized basin walls. A concept design rendering for the proposed Walker Mill detention basin retrofit has been included in Appendix H of this plan.

Table 21. Proposed Detention Basin Retrofit Project.

Map Reference	Early Action Project	BMP Name	Lat./Long.	Drainage Area (Acre)	Reduction (lbs)
BMP-13	EAP-8	Walker Mill Road Basin Retrofit Only	40.305650° -76.866050°	23.4	21,473
				Totals:	**21,473**

Further, Capital Region Water is proposing to conduct street sweeping at the credit-required frequency rate on a portion of its service to provide additional sediment reduction credit to the Joint Plan. Both Lower Paxton Township and Susquehanna Township currently perform street sweeping, but not as frequently. CRW's workforce will utilize a regenerative air vacuum sweeper and sweeping will be conducted at a frequency of no less than twenty-five (25) times per year in accordance with current PADEP guidelines. The expected annual sediment load reduction achieved through CRW's street sweeping efforts is 29,864 pounds (Table 22) based on a managed impervious street surface area of 166 acres located in CRW's MS4 service area. As per PADEP PRP Instructions, sediment load reduction values for the proposed street sweeping activities were not calculated using Model My Watershed, but rather with the following calculation using PADEP approved loading rates and a removal efficiency of 9%.

Impervious Road Surface Area x Sediment Loading Rate[11] x Reduction Efficiency[12] = Load Reduction

Table 22. Proposed Street Sweeping Reduction Credit

BMP #	Early Action Project	BMP Name	Managed Area (Acre)	Reduction (lbs)
BMP-15	EAP-9	CRW Street Sweeping (25 times per year)	166.0	29,864
			Totals:	**29,864**

As described in general terms herein, CRW is currently developing its CSO Long-Term Control Plan (LTCP)[13] under the terms of a Consent Decree between CRW, EPA, and PADEP. The LTCP will address sediment load reductions attributed to the combined sewer system (CSS). Load reduction opportunities will be more specific as the LTCP evolves. CRW anticipates that several early action projects may be defined and partially implemented during the five-year implementation time frame of the Joint Pollution Reduction Plan.

Table 23 provides estimates of sediment load reduction provided by the CSS discharging to Paxton Creek. It includes the corrected sediment load attributable to CRW/City of Harrisburg sediment load as applicable to the TMDL. Table 24 provides estimates of sediment load reductions provided by the CSS attributable to the Joint Planning Area and directly attributable to Paxton Creek. For streambank erosion sediment load reductions, this was based on an analysis using PADEP's MapShed simulation completed as part of the 2015

[11] PADEP PRP Instructions Form 3800-PM-BCW0100k (rev 3/2017)
[12] Pollution Reduction Plan: A Methodology – Street Sweeping Expert Panel Report, from Fall 2016 MS4 Workshop
13 Due for submittal to DEP on April 1, 2018

TMDL Strategy. The method assumed potential LTCP-related discharge reductions by removing the CSS drainage area and the resulting reductions in streambank erosion were related to the reduction in discharge volume. Further detail can be reviewed in the TMDL Strategy - Appendix A, Section A.10. For land based and point source reductions of sediment load this was based on the reduction in discharge volume (i.e., reducing combined sewer overflow volume reduces sediment load by the same portion).

Table 23 and Table 24 scenarios are described as follows:

The Sediment Load Reported in 2008 TMDL is the adjusted sediment load to match 2008 Paxton Creek TMDL Study, matching the CRW/City of Harrisburg baseline pollutant load from **Error! Reference source not found.**.

The Corrected Sediment Load accounting for Combined Sewer System performance is a representation of Harrisburg's combined and stormwater systems accounting for reductions in sediment load provided by combined sewer system operation.

The Rehabilitated Combined Sewer System performance is a representation of the Capital Region Water combined and stormwater sewer systems after several remedial improvements have been completed. These include cleaning of the interceptors, reduced combined sewer regulator restriction due to Brown & Brown regulator control operation, and the utilization of a new Front Street Pump Station.

The Optimized Combined Sewer System is a representation of the Capital Region Water combined and stormwater sewer systems after improvements to the combined sewer regulators to maximize flow to the interceptors while limiting sewer surcharging.

Table 23. Summary of Paxton Creek CSO Sediment Load Reductions

Scenario	Land-Based Sediment Load (tons)	Streambank Erosion Sediment Load (tons)	Total CSS Sediment Load (tons)	Total CSS Sediment Load (lbs)	Reduction from Existing
Sediment Load Reported in 2008 TMDL	18	364	382	764,000	---
Corrected Sediment Load from Existing Combined Sewer System	16	332	348	696,000	5%
Rehabilitated Combined Sewer System	14	292	306	612,000	12%
Optimized Combined Sewer System	7	178	185	370,000	31%

Future combined system rehab/optimization will reduce an additional 41 to 102 tons which exceeds the 10% load reduction required for the Paxton Creek TMDL (Table 23).

Table 24. Summary of Total Susquehanna River CSO Sediment Load Reductions from the Combined Sewer System using Model My Watershed Assumptions.

Scenario	Land-Based Sediment Load (tons)	Streambank Erosion Sediment Load (tons)	Total CSS Sediment Load (tons)	Total CSS Sediment Load (lbs)	Reduction from Existing
Sediment Load Reported in 2008 TMDL	51	1,547	1,598	3,196,000	---
Corrected Sediment Load from Existing Combined Sewer System	41	1,516	1,557	3,114,000	2%
Rehabilitated Combined Sewer System	33	1,476	1,509	3,018,000	5%
Optimized Combined Sewer System	18	1,361	1,379	2,758,000	11%

Future combined system rehab/optimization will remove an additional 47 to 112 tons which has the potential to exceed the 10% load reduction required for the Chesapeake Bay PRP (Table 24).

UNT to Spring Creek – Appendix E Sediment Load Reduction Strategy

Several additional projects were included in the Joint Pollutant Reduction Plan to adequately address the Appendix-E PRP requirements prescribed to CRW and Susquehanna Township for UNT 10126 to Spring Creek. CRW is proposing three (3) water quality BMPs within the Harrisburg City municipal boundary and will conduct street sweeping activities on approximately 15 acres of impervious roadway to achieve further sediment load reductions for the unnamed tributary. The BMPs will be implemented through CRW's Green Infrastructure Program. Due to the anticipated primary and secondary benefits, a stream restoration project (BMP-12) is proposed to add further water quality benefit to the impaired stream (Table 25). The project will be located along the Capital Area Greenbelt and will likely facilitate a continued partnership with the Capital Area Greenbelt Association and the municipal entities.

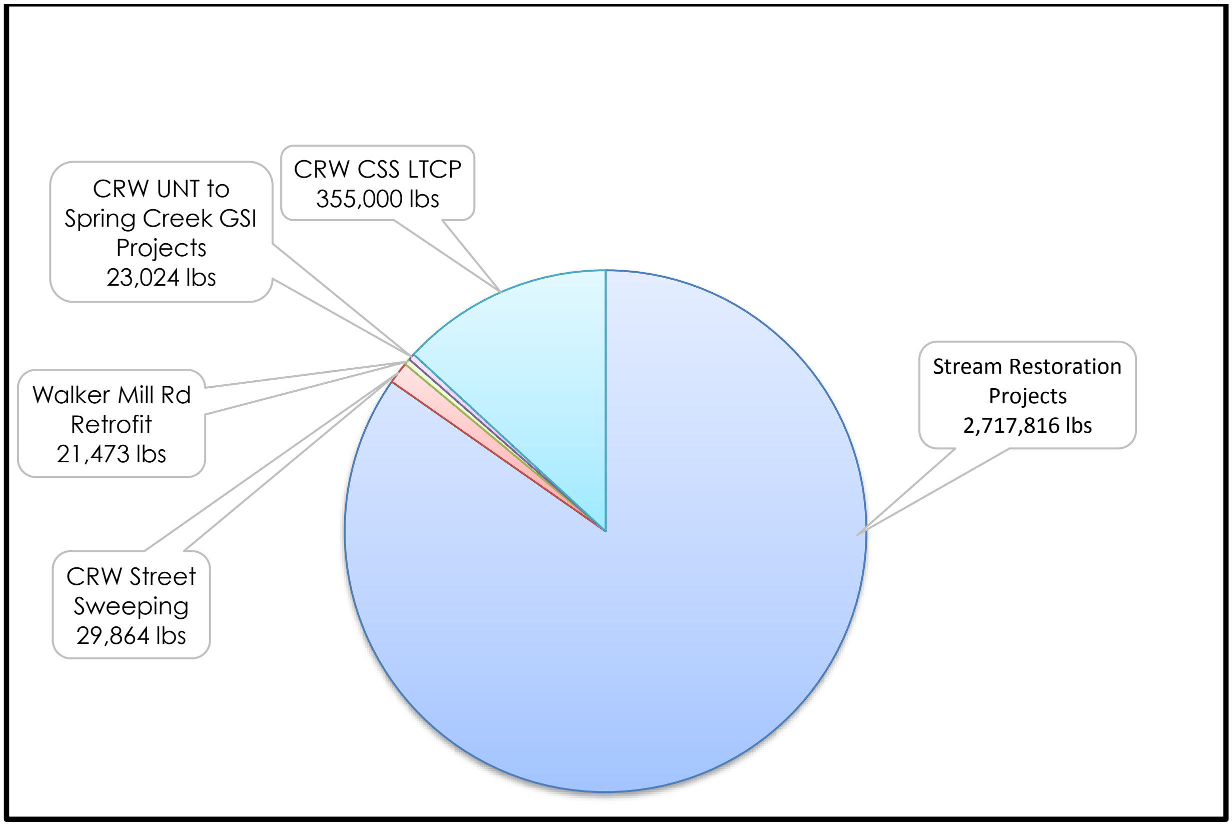
Table 25. UNT to Spring Creek Projects

Map Reference	Early Action Project	Alternate BMP Name	Lat./ Long.	Stream Length (ft)	Reduction (lbs)
BMP-12	N/A	Capital Area Greenbelt Stream Project	40.272602° -76.841858°	1,800	207,000
BMP-14	EAP-10	CRW UNT to Spring Creek GSI Projects	40.269089° -76.844171°	N/A	23,024
			Totals:	**1,800**	**230,024**

Implementation of the proposed BMPs listed in Table 25 (BMP-12 & BMP-14) will result in a total sediment load reduction of 230,024 pounds, exceeding the Appendix-E PRP sediment load reductions required of CRW and Susquehanna Township for the UNT to Spring Creek (Table 18). This provides a significant credit cushion for compliance for the impairment goal and the five-year implementation time frame.

A mixture of proposed projects have been identified by the Municipal Entities according to the feasibility of installation, cost effectiveness, and local buy-in. Exhibit 4 describes the proportionality of stream restoration projects and land-based/utility improvement-based projects proposed for consideration to meet the sediment reduction goals.

Exhibit 4. Proposed Sediment Load Reduction for the Joint Planning Area by Source.



Total Proposed Joint Planning Area Sediment Load Reduction Potential =
Floodplain Restoration Projects +
Detention Basin Retrofit +
Street Sweeping +
UNT to Spring Creek Projects +
CSS Optimization (CRW LTCP)

2,717,816 lbs. + 21,473 lbs. + 29,864 lbs. + 23,024 lbs. + 355,000 lbs. = ***<u>3,147,177 lb Reduction Potential</u>***

Joint Planning Area Sediment <u>Load Reduction Goal = 1,694,398 lb</u>

Alternate Projects

The inherent complexity of implementing numerous, large-scale projects in a five-year timeframe with limited annual cash flow and limited land control, necessitates a significant number of alternate projects be identified and included in this plan in order to provide flexibility during implementation. Early action projects are identified with an "EAP" notation. As projects are completed and reported on in each MS4's Annual Reports, plan implementation progress will be quantified. The plan goal will be accomplished once the implemented projects meet the joint planning area load reduction goal. For those planned projects that are not completed during the individual permit term because the goal has been met, the MS4s reserve the possibility of implementing the projects in the future should there be a new regulatory water quality improvement goal.

Additional stream restoration project locations (Table 26) have been identified as alternate sites should any stream restoration projects proposed in Table 20 be deemed to be unachievable during the five-year plan implementation. The Municipal Entities recognize their ability to review and revise the sediment reduction strategy put forth in this Joint Plan and may elect to do so in at some point in the future in accordance with PADEP regulations. Projects on the primary BMP project lists may shift to the alternative project list based upon actual feasibility upon initiation of the project and, conversely, alternate stream restoration projects may shift to the primary project list. The prototypes will also serve as a long-term tool to select future project locations and anticipate the type of approach to take. Actual stream restoration project implementation will occur based on the anticipated stream reduction credit potential based upon the prevailing PADEP guidance at the time of implementation.

Table 26. Alternate Stream Restoration Projects

Map Reference	Alternate BMP Name	Lat.	Long.	Stream Length (ft)	Sediment Reduction (lb/yr)
ALT-01	Edgemont Rd. at Locust Ln.	40.301103°	-76.823866°	1,450	166,750
ALT-02	Valley Road	40.304856°	-76.835807°	1,800	207,000
ALT-03	Earl Drive Ph. 01	40.316231°	-76.813565°	1,560	179,400
ALT-04	Earl Drive Ph. 02	40.317573°	-76.808472°	900	103,500
ALT-05	Earl Drive Ph. 03	40.317575°	-76.803402°	2,435	280,025
ALT-06	Hankin Property Stream	40.317949°	-76.818916°	3,162	363,630
ALT-07	Fairfax Village Stream	40.341735°	-76.822635°	2,885	331,775
			Totals:	**14,192**	**1,632,080**

The Municipal Entities in no way commit to implementing each of projects listed in this Joint Plan as "Proposed" or "Alternate" within the upcoming five-year permit term to commence upon permit issuance by PADEP. The Municipal Entities reserve the right to select any number or combination of projects proposed herein, either in-part or in-total, in order to meet their prescribed sediment load reduction requirements.

G.3 General Project Concept – Floodplain Restoration, Streambank Stabilization, Grade Controls and Buffer Establishment

Floodplain restoration and associated streambank stabilization efforts directly address the causes of erosion and sedimentation and prevent further erosion and degradation by replacing disturbed or cut back streambanks with stable, shallow channels, restoring floodplain connectivity and ultimately resulting in lower sediment and nutrient loads entering the watershed. Dense vegetative cover will be established throughout the floodplain to provide further stabilization while also serving to promote plant uptake of pollutant laden runoff in order to reduce the amount of nutrients and sediment eventually reaching the local waterways. Vegetative stabilization relies on the root structures of established plantings to stabilize the streambank and provide scour protection. In addition, incised streambanks will be regraded at a reduced slope to prevent further incision by allowing the stream to reconnect to the surrounding floodplain. This method offers a relatively low-maintenance and inexpensive means of stabilization and provides a naturalized appearance to the rehabilitated streambank that is conducive to flood control and restoring natural habitat.

Velocity reduction will be achieved by creating a condition in which increased flows distribute evenly across the extent of the densely vegetated floodplain. Reduced flow depths, uniform slopes and increased surface roughness from vegetative cover all contribute to help minimize flow velocity. Subsurface grade control structures may be utilized to prevent downcutting within the channel, while above-ground instream structures, including rock vanes and step pools, will only be utilized to prevent erosion when high shear stress and high flow velocities are otherwise unavoidable, such as the up- and downstream extents of a restoration site. The structures will be constructed of natural materials such as rock, root wads, and logs. The exact number and locations for the proposed instream structures will be determined during the completion of the engineering design and upon approval of the Joint Plan.

The Municipal Entities intend to perform riparian buffer restoration on the segments of stream to be stabilized. The goal of the riparian buffer projects is to naturalize the existing floodplain and reestablish buffer areas along the stream segments to a minimum width of 35 feet. The restorations will include the removal and replacement of dead, diseased, and/or invasive vegetation; as well as new plantings in areas where buffers have diminished in size. The riparian buffer restoration projects will be implemented concurrently with the stabilization projects in order to maximize the nutrient load reduction potential of each segment of stream to be enhanced and will be incorporated into the engineered design.

The proposed floodplain restoration projects will contribute to restored stream and enhanced buffer in the Joint Planning Area, greatly reducing the amount of sedimentation due to instream erosion. Further details regarding stream restoration techniques and Concept Renderings of each restoration approach are included in Appendix F.

G.4 General Project Concept - Detention Basin Retrofit

It is proposed in the Joint Pollutant Reduction Plan to perform one (1) detention basin retrofit on an existing 16,500 square foot detention basin, located along Walker Mill Road in Susquehanna Township. The basin retrofit project was chosen as a proposed BMP due to the existing structural integrity issue with the berm that needs to be addressed, and it discharges to Black Run, which is impaired for sediment. The detention basin retrofit will incorporate stabilization of the basin outfall and the adjoining stream, providing improved water quality and enhanced flood control. Detention basins are designed to receive, temporarily hold, and discharge stormwater at a controlled rate. While they can provide rate and volume mitigation, detention basins traditionally offer limited water quality benefit. Detention basin retrofits transform these simple catch, store, and release ponds into BMPs which provide infiltration, bioretention, and improved sediment and nutrient removal capabilities. This is achieved by extending the storage time with structure modifications, improving soil conditions to allow for greater infiltration rates, and naturalizing the basins with native and/or wetland plant species. While the extent and

nature of the retrofit will rely on the results of future engineering investigations, the proposed basin retrofit will reduce the quantity and increase the quality of the stormwater runoff reaching the impaired streams.

The location of the proposed detention basin retrofit project is displayed on the BMP Prototype Key Map in Appendix F. Should property owners indicate to the Municipal Entities that they have interest in retrofitting detention basins they own, it is anticipated that those completed projects will be included in the Annual MS4 Status Reports and count toward the Joint Plan sediment reduction goals. Detention basin retrofits may become more cost-effective during plan implementation, and new candidates identified during the five-year term will be reviewed for inclusion in this plan.

G.5 Cost Opinion

Cost opinions were developed to support the municipal entities' continued planning and funding efforts. A detailed cost opinion was created for each of the three (3) concept prototype designs, outlined subsequently in this section. A unit cost per linear foot was established for each prototype based on the detailed concept cost estimates and applied to the final BMP sites to provide an approximation of the total costs required to achieve all sediment load reduction goals.

One of the primary cost considerations is the amount of cut material generated or fill material required depending on the concept. It was assumed that additional cut material generated during construction will be disposed of on site or hauled no more than three (3) miles from the site. For the Steep Slope Concept Site which requires significant fill material, it is assumed that clean fill will be imported from within three (3) miles of the site. Due to the cut volumes generated at some sites and significant fill volumes required at others, and based upon the aggressive BMP implementation schedule, outlined in Section G.6, and proximity of BMP locations in relation to each other, construction may be coordinated to haul cut from one BMP site to be stockpiled at sites requiring fill. The soil is assumed to be clean and free of contaminants.

The detailed concept cost opinions are intended to provide an estimate based upon the prototype definitions presented in Section G.1.4., so site features unique to the specific concept but not characteristic of the prototype in general were excluded from the detailed concept cost opinions to avoid influencing the prototype unit cost approximations. For example, the Stonebridge Apartment site (SS-14) – the basis for the Constrained Corridor Concept – contains multiple pedestrian footbridges across the stream reach. The removal and replacement of these bridges would have a significant impact on the cost of implementing this project, however that cost was not considered for the cost opinion as footbridges are not present at the majority of the other constrained corridor prototype sites.

Additional exclusions from the detailed concept costs include:

- Compaction or soil testing
- Rock excavation, removal and disposal
- Relocation or repair of existing utilities
- Post construction monitoring and maintenance

G.5.1 Detailed Concept Cost Opinions

Floodplain Restoration Concept

The detailed Floodplain Restoration Concept Cost Opinion presented in Table 27 below, provides a total cost of $605,933 for the concept site. This cost is the highest of the three sites, which makes sense as the prototype represents the largest reaches in the Joint Planning Area. The primary cost driver for this concept is the total amount of estimated cut volume, which should serve as some indicator of the potential sedimentation load at these sites if left unmitigated. The unit cost opinion comes out to $566 per linear foot, which matches exactly the unit cost for the Steep Slope Concept. It was assumed that these two sites, while on opposite sides of the spectrum in terms of restoration approach, would have similar unit costs based on the significant amount of either cut or fill at these locations and the extensive intervention required at Steep Slope sites.

Table 27. Floodplain Restoration Concept Detailed Cost Opinion.

Description	Approx. Quantity	Unit	Unit Price	Total Price
Design/Permit	1	LS	$120,000	$120,000
Mobilization (% of total)	1	LS	N/A	$10,000
Survey & Construction Layout	1	LS	$3,600	$3,600
Clearing and Grubbing	1	LS	$18,000	$18,000
Erosion and Sedimentation Controls	1,070	LF	$24	$25,680
Excavation, Haul Over the Road within 3 mi	11,376	CY	$18	$204,768
Seeding/ Stabilization	107,500	SF	$0.54	$58,050
Wetland Planting - Herbaceous Plugs 1.5' o.c. (5500 sf)	2,800	EA	$3.60	$10,080
Native Tree Planting, #7	20	EA	$162	$3,240
Native Shrub Planting, #2	100	EA	$54	$5,400
Educational Signage (18x24" NPS Standard)	1	EA	$2,100	$2,100
As-Built Survey	1	LS	$2,100	$2,100
Construction Contingency	1	LS	$30,000	$30,000
Additional Cost to Provide Performance Bond, Construction Management Fees If Necessary (% of total)	10	%	N/A	$49,500
Prevailing Wage Multiplier (17% of total construction costs)	17	%	N/A	$63,415
			Total Cost Opinion (+/- 20%):	**$605,933**
			Unit Cost Per Linear Foot:	**$566 / LF**

Constrained Corridor Concept

The Constrained Corridor Concept represents the cheapest unit cost of the three restoration approaches at a cost of $360 per linear foot and an overall opinion of $514,696. However, it is worth noting these constricted sites are more likely to be impacted by adjacent buildings or other infrastructure including utilities, sidewalks and pedestrian bridges. As mentioned previously, these types of constraints are unique to each site and, therefore, were not included in the cost estimate; however, they must be accounted for on a project-by-project basis during engineering design.

Table 28. Constrained Corridor Concept Detailed Cost Opinion.

Description	Approximate Quantity	Unit	Unit Price	Total Price
Design/Permit	1	LS	$120,000	$120,000
Mobilization (% of total)	1	LS	$10,000	$10,000
Survey & Construction Layout	1	LS	$3,600	$3,600
Erosion and Sedimentation Controls Budget	1,430	LF	$13	$18,590
Clearing & Grubbing	1	LS	$9,000	$9,000
Excavation, Haul within 3 mi	3,625	CY	$45	$163,125
Seeding/ Stabilization	30,000	SF	$0.75	$22,500
Native Tree Planting, #7	10	EA	$162	$1,620
Native Shrub Planting, #2	50	EA	$54	$2,700
Meadow - Steep Slope Seeding & Stabilization	60,000	SF	$0.5	$30,000
As-Built Survey	1	LS	$6,000	$6,000
Educational Signage (18x24" NPS Standard)	2	EA	$2,100	$4,200
Construction Contingency	1	LS	$30,000	$30,000
Additional Cost to Provide Performance Bond, Construction Management Fees If Necessary (% of total)	10	%	N/A	$42,134
Prevailing Wage Multiplier (17% of total construction costs)	17	%	N/A	$51,227
			Total Cost Opinion (+/- 20%):	**$514,696**
			Unit Cost Per Linear Foot:	**$360 / LF**

Steep Slope Concept

As previously discussed, the unit cost opinion of $590 per linear foot matches that of the Floodplain Restoration concept. The overall cost opinion for the Steep Slope Concept is $495,912. The volume of imported fill is one of the primary cost drivers, along with the extensive armoring/slope intervention effort anticipated at these locations. At the Steep Slope concept site, the "armoring" is in the form of a step-pool system at the downstream tie-in. Other potential "armoring" efforts at steep slope sites include scour pools, rock underlayment and armored banks. It is recognized that simple armoring with rock or other means may not meet the intent of the stream restoration credit but may be the right solution for a project, especially in the instance of protecting utilities and structures. Those hard-armored areas would not be included in the ultimate project credit calculation.

Table 29. Steep Slope Concept Detailed Cost Opinion

Description	Approximate Quantity	Unit	Unit Price	Total Price
Design/Permit	1	LS	$120,000	$120,000
Mobilization (% of total)	1	LS	$10,000	$10,000
Survey & Construction Layout	1	LS	$3,600	$3,600
Erosion and Sedimentation Controls Budget	840	LF	$26	$21,840
Clearing & Grubbing	1	LS	$18,000	$18,000
Floodplain Fill	1,638	CY	$31	$50,778
Rip Rap Fill	1,486	CY	$66	$98,076
Rock Step Pools	65	LF	$510	$33,150
Seeding/ Stabilization	26,000	SF	$0.45	$13,000
As-Built Survey	1	LS	$6,000	$6,000
Educational Signage (18x24" NPS Standard)	1	EA	$2,100	$2,100
Construction Contingency	1	LS	$30,000	$30,000
Additional Cost to Provide Performance Bond, Construction Management Fees If Necessary (% of total)	10	%	N/A	$40,655
Prevailing Wage Multiplier (17% of total construction costs)	17	%	N/A	$48,713
			Total Cost Opinion (+/- 20%):	**$495,912**
			Unit Cost Per Linear Foot:	**$590 / LF**

Walker Mill Road Basin Retrofit Concept Cost Opinion

The cost opinion for the Walker Mill Road Basin Retrofit totals $604,244. This cost covers improvements to the existing basin as well as the cost of scour pool stabilization and armoring at the basin outfall. No unit cost is provided for the basin retrofit as the concept is unique to this location and will not be applied elsewhere to achieve the reduction goals of the Joint Plan.

Table 30. Walker Mill Road Basin Retrofit Concept Cost Opinion

Description	Approximate Quantity	Unit	Unit Price	Total Price
Design / Permit	1	LS	$72,000	$72,000
Mobilization (% of total)	1	LS	$10,000	$10,000
Clearing and Grubbing (varies)	1,500	SF	$3.00	$4,500
Stake-out/Survey	1	LS	$3,600	$3,600
Rock Construction Entrance	1	EA	$3,000	$3,000
Construction Safety Fence	600	LF	$4.20	$2,520
Traffic Control	1	LS	$1,000	$1,000
R-5 Plunge Pool	175	TN	$78	$13,650
Steep Slope Stream Restoration	600	LF	$571	$342,600
Seeding and Soil Amendments	22,700	SF	$0.30	$6,810
Straw Mulch	2,700	SF	$0.18	$486
Misc E&S Controls	1	LS	$7,200	$7,200
Excavation and Hauling (3 mi radius)	440	CY	$21.90	$9,636
Ripping, Spread Compost (2.5" Depth), Final Grade	15,000	SF	$0.84	$12,600
Erosion Control Blanket; Single Net Straw - Biodegradable	2,222	SY	$3.3	$7,332
Herbaceous Wetland Plugs	400	EA	$5	$2,000
Native Conservation Plants; #3 Shrubs	15	EA	$78	$1,170
Deciduous Shade Trees; #10-15 Cont.	8	EA	$420	$3,360
Small Flowering Trees; #5-7 Cont.	15	EA	$108	$1,620
Footpath Repairs	100	LF	$18	$1,800
Construction Management	1	LS	$10,800	$10,800
As-built Survey	1	EA	$3,600	$3,600
Contingency for Unknowns	1	LS	$8,400	$8,400
Additional Cost to Provide Performance Bond, If Necessary (% of total)	1.5	%	N/A	$6,779
Prevailing Wage Multiplier (17% of Construction Costs)	17	%	N/A	$67,781
Total Cost Opinion (+/- 20%)				$604,244

G.5.2 Prototype Unit Cost Approximation

Table 31 presents approximated total costs for each of the selected BMPs as well as an overall cost for the implementation of all of the primary stream restoration and basin retrofit sites included in the plan. The cost of each project was calculated by applying the appropriate prototype unit cost for the length of the BMP reach. Cost estimates were provided in the 2017 Plan based upon construction costs from the three previous construction years. Since two construction seasons have passed since the 2017 Plan submission and local contractors are gaining more experience, the costs have been updated to reflect current market conditions observed through the public bidding process.

Table 31. Proposed Stream Restoration Projects' Cost.

Map Reference	Restoration BMP Name	Assessment Stream Segment	Prototype	Stream Length (LF)	Unit Cost ($/LF)	Total Cost ($)
BMP-01	Fox Hunt Stream Restoration	SS-21	Steep Slope	750	$590	$442,500
BMP-02	Stonebridge Apartments	SS-14	Constrained Corridor	1,450	$360	$522,000
BMP-03	Wildwood Lake, Black Run	SS-03	Constrained Corridor	1,075	$360	$387,000
BMP-04	Veteran's Park South	SS-18	Steep Slope	1,000	$590	$590,000
BMP-05	Veteran's Park North	SS-18	Steep Slope	1,150	$590	$678,500
BMP-06	CWP-Shutt Mill Rd / Walker Mill Rd	N/A	Floodplain Restoration	4,400	$566	$2,490,400
BMP-07	Susquehanna Union Green	N/A	Floodplain Restoration	2,600	$566	$1,471,600
BMP-08	Bradley Drive	N/A	Constrained Corridor	950	$360	$342,000
BMP-09	Black Run - North	SS-03	Floodplain Restoration	3,368	$566	$1,906,288
BMP-10	Black Run - South	SS-03	Floodplain Restoration	2,000	$566	$1,132,000
BMP-11	Pines Apartment Complex	SS-16	Steep Slope	1,450	$590	$855,500
BMP-12	Capital Area Greenbelt Stream	SS-23	Floodplain Restoration	1,800	$566	$1,018,800
BMP-13	Walker Mill Rd. Stream Restoration	N/A	Steep Slope	600	$590	$354,000
BMP-13	Walker Mill Rd. Basin Retrofit	N/A	Basin Retrofit	N/A	--	$604,244
Total Stream Restoration and Basin Retrofit Rounded Implementation Cost						**$12,795,000**

Note 1. Total cost if stream restoration projects proceed and the Municipal Entities elect to overshoot the Individual permit reduction goal or budget for future, as yet, unknown sediment reduction requirements

Note 2. Table 32 maps out a schedule for a combination of projects that are anticipated to meet the sediment reduction goal, including stream restoration and land-based sediment reduction projects. That implementation plan would cost on the order of **$8,923,000** for the stream restoration projects, in addition to the costs associated with street sweeping and GSI projects in the UNT to Spring Creek watershed. These costs might be shared with land developers and PennDOT.

G.6 Partnerships

The Municipal Entities continue to seek out partnerships for future stormwater management BMP accomplishments of other NPDES permit holders. Their accomplishments could count toward meeting the plan goals, provided that they meet pollutant reduction plan criteria and the Joint Plan is revised per PADEP guidance described in Appendices D and E of the 2018 PAG-13 NPDES permit. A few specific partnerships are described herein.

PennDOT Partnership

It is required for municipalities to develop a plan assuming no reliance on other entities with which there is no cooperation agreement. However, it is anticipated that the Municipal Entities will continue to engage PennDOT during the implementation of the plan so that joint credit opportunities can be identified and achieved. Further, PennDOT has indicated that there is an intention to coordinate PennDOT projects with local municipalities during the permit term to coordinate water quality opportunities.

Specific to the Paxton Creek watershed, PennDOT Central Office developed a Paxton Creek Flood Control and Rehabilitation study, and they have met with DEP Southcentral Regional Office and the Municipal Entities to describe the anticipated restoration plan and benefits. The work is intended to mitigate flooding conditions through the lower end of the Paxton Creek watershed, primarily benefiting the city-limits, while constructing a stream ecosystem. One of the plan goals is to restore the Paxton Creek channel from its outlet to Wildwood Lake to the Susquehanna River. A restoration concept plan goal, as of the date of this Pollutant Reduction Plan, is to reduce the 100-year flood elevation by three (3) feet (from 317 feet to 314 feet). Removal of a box culvert under an abandoned Norfolk Southern railroad spur south of Paxton Street is essential to make the project feasible because it is the most significant obstruction identified in the reach and restricts the flow of the creek during flood events. The restoration concepts include ecosystem support and water quality benefits that will be intended to be tied to the overall pollutant reduction goals in this Plan and the LTCP. Three restoration design segments are considered

1. North Paxton Greenway
    a. Location: Wildwood Park Drive to Herr Street
    b. Stream Restoration Length: 7,600 linear feet
2. Paxton Creek Park
    a. Location: Herr Street to Berryhill Street
    b. Stream Restoration Length: 5,300 linear feet
3. South Paxton Greenway
    a. Location: Berryhill Street to the Susquehanna River
    b. Stream Restoration Length: 5,400 linear feet

It is anticipated that water quality BMPs incorporated into PennDOT's Plan will improve water quality in the Paxton Creek, Susquehanna River, and Chesapeake Bay Watersheds. At a minimum, the Plan is likely to contain volume and rate controls that will reduce streambank erosion throughout the western portion of the Joint Planning Area.

As other opportunities become available, PennDOT and the Municipal Entities will share any reductions achieved through partnership projects, provided the Municipal Entities either contribute funding or agree to perform the long-term operation and maintenance responsibilities for the additional or enhanced stormwater controls. As part of the Annual MS4 Status Reports submitted under this permit, PennDOT will provide a list of actions taken by the Department to support municipalities in achieving their PRP goals in sediment-impaired watersheds in urbanized areas.

Other Reportable BMPs

Notwithstanding that the Joint Plan outlines enough planned projects to meet the combined reduction goals, pollutant reduction planning requirements are also intended to be met through municipal actions and approvals. Examples of BMP reporting opportunities are described below. Any permit-eligible BMP documentation for pollutant reductions will be accepted for inclusion in the Annual MS4 Status Reports.

Stormwater Inlet Cleaning

As part of on-going MS4 maintenance, each of the Municipal Entities routinely remove solids from their MS4s. However, at this time, no pollutant reduction has been allotted to storm sewer system solids removal because tracking of this removed material has not been to the degree required to accurately calculate the pollutant load reduction as described in the PADEP BMP effectiveness values table[14]. It is anticipated that the Municipal Entities will track and record inlet cleaning in accordance with PADEP requirements and will report those activities in their respective Annual MS4 Status Reports. The reported reduction will contribute toward meeting the sediment reduction goal.

Land Development BMPs Installed on Sites with Less than One-Acre of Disturbance

To the extent that local municipal ordinances require the installation of stormwater BMPs at construction sites where land disturbance will be less than one-acre, those BMPs can be reported in the Annual MS4 Status Reports and the reported reductions will contribute toward the sediment reduction goal.

Street Sweeping

Municipalities that regularly conduct street sweeping (at least 25 times per year) may use this practice for pollutant load reduction credit as long as street sweeping is conducted in accordance with the minimum standards outlined in the Chesapeake Bay Program expert panel report for street sweeping and the guidance provided on the PADEP BMP Effectiveness Tables. The reported load reduction will contribute toward meeting the sediment reduction goal. This data will also be tracked and included in the Annual MS4 Status Reports and as credit toward the plan goal. It is planned for CRW to track street sweeping activities within the context of this plan. Should the Townships also start street sweeping at the prescribed frequency, that credit will be included in future Annual Reports.

G.7 BMP Implementation Schedule

A preliminary implementation schedule has been provided (Table 32); however, the exact order of construction of the proposed BMPs will rely on the results of the engineering investigation, design, and permitting process. The proposed stream restoration projects will likely require a Joint Permit Application (JPA) and will be subject to PADEP and United States Army Corps of Engineers (USACOE) review; restoration waivers will be pursued where applicable.

---

[14] PADEP Document 3800-PM-BCW010m, NPDES Stormwater Discharges from Small MS4s BMP Effectiveness Values (Rev. 5/2016)

Table 32. Implementation Schedule for Proposed Early Action BMPs

Map Reference	BMP Type	Permitting & Engineering Design (Permit Year)	Construction (Permit Year)[15]
BMP-01	Fox Hunt - Stream Restoration	2	2
BMP-02	Stonebridge Apartments	In Progress	2
BMP-07	Susquehanna Union Green	In Progress	3
BMP-06	CWP – Shutt Mill Rd/Walker Mill Road	2	3
BMP-13	Walker Mill Rd. Stream Restoration	1	3
BMP-13	Walker Mill Rd. Basin Retrofit	2	3
BMP-09	Black Run - North	2	4
BMP-10	Black Run - South	2	4
BMP-15	CRW Street Sweeping	Complete	1-5
BMP-14	CRW GSI Projects	4	5

G.8 Long-Term Paxton Creek TMDL Watershed Sediment Load Reductions

As previously stated, the Municipal Entities intend to achieve all required pollutant load reduction goals prescribed by the WLAs included in the Paxton Creek Watershed TMDL Report and those associated with PADEP's Appendix-D and Appendix-E pollutant reduction plans within five (5) years of PADEP's issuance to each municipality's Individual Permit. As such, the Municipal Entities maintain no quantifiable, long-term pollutant load reduction goals; however, the Municipal Entities will continue to maintain BMPs installed through the implementation of this Joint Plan. The Municipal Entities will also review and evaluate the effectiveness of the Joint Plan and make appropriate revisions should they be deemed necessary for the continuation of improving the water quality in local streams and national waterways.

[15] Anticipated permit years beginning in March of each year: 1 = 2020, 2 = 2021, 3 = 2022, 4 = 2023, 5 = 2024; the actual permit year will be based upon the date of Individual Permit issuance

G.9 Long Term Control Plan/Combined Sewer Overflows Stormwater BMPs

As previously stated, one of the Municipal Entities, CRW, is required to address stormwater discharges to the combined sanitary/storm sewer. CRW, with assistance from CDM Smith, has submitted a long-term control plan that addresses this issue. Previously, CRW identified green infrastructure strategies intended to be implemented that accomplish the long-term control plan goals through a Community Greening Plan – a Green Stormwater Infrastructure Plan for Harrisburg. Being that the majority of the goals of the Chesapeake Bay Pollutant Reduction Plan, MS4, Paxton Creek TMDL, and combined sewer overflow mitigation program ultimately rely on reduced stormwater velocities, thereby reducing the frequency and energy associated with discharges to streams, it is anticipated that as projects are implemented, sediment reduction credits may also result.

SECTION H: IDENTIFY FUNDING MECHANISMS

The Joint Pollutant Reduction Plan proposed herein will be implemented by the Municipal Entities as outlined in the Intergovernmental Cooperation Agreements ("Agreements") between each of the three (3) Municipal Entities. Funds will be sourced through a variety of mechanisms, including collected stormwater fees, municipal funds, available grants, partnerships, and public donation of materials and manpower.

All three Municipal Entities are currently in varying stages of assessing and implementing a municipal stormwater fee to help generate revenue to be used for the future implementation of the Joint Plan as well as addressing much needed improvements to the aging stormwater infrastructure in their respective communities. Lower Paxton Township began collecting stormwater fees in 2019 and a credit policy is anticipated to be developed in the near future. Susquehanna Township is amending its municipal authority's articles of incorporation to give it powers to manage stormwater and collect dedicated fee revenue for the stormwater utility. It is anticipated that stormwater billings will start during the second quarter of 2020. Capital Region Water's stormwater fee proposal is currently under public comment review but is planned for implementation in 2020.

A cost-sharing agreement between the Municipal Entities and PennDOT is currently being developed offering the potential of $1,000,000 in municipal funds (shared contribution from the Municipal Entities) and $1,000,000 in PennDOT funds to be used toward the project level costs of construction of water quality BMPs in the Joint Planning Area. The successful partnership between PennDOT and the Municipalities was the driving factor in the decision not to parse PennDOT roadways from the baseline sediment load if land parsing been an option for the complex planning area in MMW. Past PennDOT partnerships in central Pennsylvania have yielded a range of $/lb value. For the purpose of planning, we assume that should a project be let by PennDOT, it may yield a winning bid amount of $15/lb reduction. That means that a PennDOT/Municipal Entity project has the potential to yield an approximately 130,000 lb reduction. This plan currently does not rely on this contribution; it is also possible that the partially PennDOT-funded reduction may be accomplished by constructing one of the projects identified in this plan.

Future cost sharing will be conducted in a manner consistent with the executed Agreements (Appendix I). Per the Agreements: "Costs associated with implementation of the Plan and related BMPs shall be apportioned among the Participants based upon the percentage of load reduction attributed to each Participant in the Plan for each BMP, plus an equal share to apportion the percentage of load reduction outside of the municipal boundaries or service area of the Participants, until such time as additional contributions are received from other entities." The Agreements also states that "Each Participant shall be responsible for its own out-of-pocket costs and its own solicitor's fees."

SECTION I: OPERATIONS AND MAINTENANCE (O&M) OF BMPS

Once implemented, the BMPs outlined in this Joint Plan will be operated and maintained by the Municipal Entities to ensure that they continue to produce the expected pollutant reductions. The O&M activities will be reported in the Annual MS4 Status Reports submitted in accordance with the Individual Permit requirements.

The general list of the activities involved with O&M for each BMP and the frequency at which O&M activities will occur are as follows:

O&M requirements for the streambank stabilization and buffer restoration projects shall include:

- Ensure disturbed areas are kept free of foot and/or vehicular traffic until full stabilization has occurred – year round
- Regular watering of plantings during first growing season. Planting in the fall may reduce the need for additional watering – seasonally
- Conduct site visits to ensure plantings are healthy and sufficiently watered, weeds are properly managed, sufficient mulch is in place until site is stabilized and planting have become established – monthly
- Conduct site visits to ensure all disturbed earth remains stabilized and erosion or cutting of the streambank has not taken place. Any destabilized earth or active streambank erosion shall be repaired immediately upon discovery – monthly
- Conduct inspections once streambank is stabilized and plants have become established – biannually
- Immediately upon notice; repair any rills, gullies, or streambank cutting that may occur – year round
- Remove weeds and invasive plant species during each growing season. Naturally growing native vegetation should be left intact to promote stabilization of the streambank and surrounding area – seasonally
- Replace mulch as needed – biannually
- Remove accumulated trash and debris – monthly
- Remove and replace dead and diseased plantings – biannually
- Keep machinery and vehicles away from stabilized areas – year round

O&M requirements for the retrofit bio-retention basins shall include:

- Conduct regular inspections until site is stabilized and plantings are established – monthly
- Immediately upon notice, repair any erosion issues in the basin – year round
- Remove and replace dead or diseased plantings – biannually
- Remove weeds and invasive species from the basin – quarterly
- Remove accumulated sediment and debris – monthly
- Mulch as necessary – biannually
- Use no chemical herbicides or pesticides – year round
- Maintain a "No Mow Zone" around the perimeter of the basin – year round
- Ensure outlet structures remain unobstructed and free of debris – monthly

The contractor shall be responsible for the operation and maintenance of all streambank restoration, basin retrofits and riparian buffer projects until all features of the project have been successfully constructed to the specifications and design standards set forth by the Design Engineer. The Contractor shall remain responsible for operation and maintenance of the streambank restoration and buffer project(s) until 70% permanent vegetative stabilization has been achieved. Once construction of the project(s) is complete and stabilization has occurred, the Municipal Entities shall be responsible for implementing all Operation and Maintenance procedures to ensure the streambank stabilization and buffer improvements remained operationally functional and physically consistent with the original design.

APPENDIX A – PUBLIC PARTICIPATION EXHIBITS

2017

- Public Notice
- Public Meeting Presentation
- Public Meeting Minutes
- Record of Consideration (Public Comment Responses)
- Public Comments

2019

- Public Notice
- Public Meeting Presentation
- Public Meeting Minutes
- Record of Consideration (Public Comment Responses)
- Public Comments

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NOTICE OF PUBLIC PARTICIPATION AND PUBLIC MEETING FOR REGIONAL TMDL AND CHESAPEAKE BAY POLLUTANT REDUCTION PLAN

Capital Region Water (CRW), Susquehanna Township, and Lower Paxton Township hereby give notice of the 30-day public comment period for its National Pollutant Discharge Elimination (NPDES) Stormwater Discharges from Small Municipal Separate Storm Sewer Systems (MS4) Pollutant Reduction Plan (PRP). Best management practices (BMPs) are proposed in the regional Plan to satisfy Paxton Creek Total Maximum Daily Load (TMDL) sediment reduction requirements and PRP requirements for the Chesapeake Bay and local stream impairments. The 30-day public comment period begins November 7, 2019 and ends December 9, 2019. During that time, the plan will be available on the CRW website (https://capitalregionwater.com) and a hard copy will be available at each municipal office. The public is invited to review this document and provide written comments. The regional Plan will be discussed at a public meeting on November 19, 2019 starting at 7PM at the Lower Paxton Township Municipal Building, 425 Prince Street, Harrisburg, PA.

Joint Pollutant Reduction Plan

By Capital Region Water | November 7, 2019 0 Comment

MUNICIPAL WEBSITE NOTICE

NOTICE OF PUBLIC PARTICIPATION AND PUBLIC MEETING FOR REGIONAL TMDL AND CHESAPEAKE BAY POLLUTANT REDUCTION PLAN

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The plan has been revised per comments received from PADEP including planning area expansion, mapping updates, additional proposed project locations, and updated modeling methodology.

The public is invited to review this document at the website below and provide written comments to the City Beautiful H_2O Program Manager. Hard copies of the document will also be available for review at each partner location (CRW, Susquehanna Township and Lower Paxton Township) and comments will be accepted in writing at each location.

Claire Maulhardt, PLA
212 Locust Street, Suite 500, Harrisburg, PA 17101
E-mail: info@capitalregionwater.com

The 30-day public comment period begins November 7, 2019 and ends December 9, 2019.

The Regional Plan will be discussed at a public meeting on November 19, 2019 starting at 7PM at the Lower Paxton Township Municipal Building, 425 Prince Street, Harrisburg, PA.

###

Capital Region Water, Lower Paxton Township, and Susquehanna Township have committed to working together on a Joint Pollutant Reduction Plan (PRP) which includes the Paxton Creek Watershed Total Maximum Daily Load (TMDL) Plan, the Chesapeake Bay PRP, the Wildwood Lake PRP, and the UNT Spring Creek PRP to reduce sediment from stormwater discharges and stream bank erosion and improve the health of Paxton Creek, Beaver Creek, Spring Creek, and the Chesapeake Bay. The approach outlined in the Paxton Creek Strategy is the basis of this Joint Plan, with updates where regulatory objectives have changed and based on further field work and analysis.

2019 Joint Pollutant Reduction Plan

Appendix A – Public Participation Exhibits

Appendix B – Mapping

Appendix C – PADEP Municipal MS4 Requirements

Appendix D – Baseline & Existing Pollutant Loading

Appendix E – Wasteload Allocations

Appendix F – Stream Analysis Exhibits

Appendix G – Proposed BMP Sediment Reduction Calculations

Appendix H – Project Sheets

Appendix I – Intergovernmental Cooperation Agreements

Appendix J – Supplemental Information

2017 Joint Pollutant Reduction Plan

Photo Credit: Rhonda Hakundy-Jones, PCWEA

Background

In 2013, The Pennsylvania Department of Environmental Protection(DEP) determined that English of Paxton Creek (approximately 40 percent) are considered impaired by sediment, with over 86 percent of the sediment contributed by stream erosion. To address this impairment, the United States Environmental Protection Agency (EPA) published a TMDL Report that requires all entities discharging stormwater or combined sewer overflows to Paxton Creek to collectively reduce sediment loads by 35 percent.

DEP requires entities discharging to a stream subject to a TMDL to prepare and implement a 2-phase TMDL Plan, consisting of:

- A TMDL Strategy (due December 31, 2015) that outlines the type and extent of projects, operational practices, and/or policies they plan to implement to meet the TMDL.
- A TMDL Plan (Due September 15, 2017) that provides site-specific information and an implementation schedule for the proposed controls.

As the primary dischargers to Paxton Creek, Capital Region Water, Lower Paxton Township, and Susquehanna Township proposed, and DEP agreed, that a single TMDL Strategy for the entire watershed would satisfy permit requirements and be more cost effective than separate initiatives.

Joint Pollutant Reduction Plan

Capital Region Water, Lower Paxton Township, and Susquehanna Township have expanded the partnership further to include requirements for the Chesapeake Bay Pollutant Reduction Plan (CBPRP), Total Maximum Daily Load (TMDL) Plan, and Pollutant Reduction Plan (PRP) to address Wildwood Lake and an unnamed tributary (UNT) to Spring Creek. This Joint Pollutant Reduction Plan, “Joint Plan,” will meet the pollutant load reductions requirements necessary for the upcoming MS4 permit process. The Joint Plan was developed to address the watershed pollutant load reduction requirements mandated by the United States Environmental Protection Agency (EPA) and the Pennsylvania Department of Environmental Protection (PADEP).

Through successful implementation of the Joint Plan, the following objectives will be achieved:

- Short-term sediment load reduction of 10% for the Paxton Creek TMDL
- Long-term 35% sediment load reduction necessary to meet the prescribed WLAs for Paxton Creek TMDL

- Appendix-D CBPRP, 10% sediment load reduction for the Municipal Entities’ combined Chesapeake Bay Planning Areas (Joint Planning Area)
- Appendix-E Siltation, 10% sediment load reduction for Wildwood Lake
- Appendix-E Siltation, 10% sediment load reduction for the UNT to Spring Creek

These goals will be achieved within five (5) years of PADEP’s issuance of each Municipal Entities’ Individual MS4 Permit.

2019 Joint Pollutant Reduction Plan

English

Appendix A – Public Participation Exhibits

Appendix B – Mapping

Appendix C – PADEP Municipal MS4 Requirements

Appendix D – Baseline & Existing Pollutant Loading

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2017 Joint Pollutant Reduction Plan

Paxton Creek Watershed **TMDL Strategy**

English

Category: Project

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Public Notice - Regional TMDL & Chesapeake Bay PRP Public Participation

NOTICE OF PUBLIC PARTICIPATION AND PUBLIC MEETING FOR
REGIONAL TMDL AND CHESAPEAKE BAY POLLUTANT REDUCTION PLAN

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Public Notice - Regional TMDL & Chesapeake Bay PRP Public Participation
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- MISSION -

To achieve our vision, Lower Paxton Township will work to meet and exceed the needs of a growing Township in a cost efficient manner.

- SLOGAN -

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Public Works Department
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6:30 a.m. to 2:30 p.m.

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Regional TMDL & Cheseapeake Bay Pollutant Reductio Plan - Notice of Public Participation and Public Meeting

POSTED ON: NOVEMBER 6, 2019 - 12:00PM

NOTICE OF PUBLIC PARTICIPATION AND PUBLIC MEETING FOR

REGIONAL TMDL AND CHESAPEAKE BAY POLLUTANT REDUCTION PLAN

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Claire Maulhardt, PLA
212 Locust Street, Suite 500, Harrisburg, PA 17101
E-mail: info@capitalregionwater.com

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WEBSITE: https://capitalregionwater.com/jointprp/

1900 Linglestown Road,
Harrisburg, PA 17110
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Fax: (717) 540-4298
Email: info@susquehannatwp.com

The Friends of Wildwood Lake Nature Center, Inc.

Supporting Wildwood Park & Benjamin Olewine, III Nature Center

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RECEIVED
DEC 12 2019
Capital Region Water

December 5, 2019

Claire Maulhardt
Capital Region Water
212 Locust Street, Suite 500
Harrisburg, PA 17101

RE: Friends of Wildwood Comments on Paxton Creek Joint Pollution Reduction Plan developed by Capital Region Water, Lower Paxton Township and Susquehanna Township (collectively, the Municipal Entities)

Dear Ms. Maulhardt and Municipal Entities:

The Friends of Wildwood (FOWW) are the 501 (c)(3) support organization for Dauphin County's Wildwood Park (Park) and the Benjamin Olewine III Nature Center (Nature Center), located in Harrisburg City. While Wildwood Park is known as an area for education and recreation, one of the features of the park is Wildwood Lake (Lake), which is fed by both Paxton Creek and Fox Run. The Lake is home to numerous birds, turtles, and other aquatic life as well as a benefit to the park's other inhabitants. Over the years as a result of the significant land development upstream, the "bottom of the lake has become high." It is because of this, the FOWW are writing to express their support toward the implementation of the Joint Pollution Reduction Plan (Plan), which will have a positive and direct impact on the Park's future. The FOWW look forward to working with the Municipal Entities to help achieve the goals of the plan.

The Lake as well as Paxton Creek are both considered impaired for sediment and require the implementation of a Total Mass Daily Load (TMDL) to improve water quality by completing Best Management Practices (BMPs) to reduce sediment loads. In 2015, the FOWW paid for a feasibility study conducted by Herbert, Rowland & Grubic to determine if restoration, including sediment removal from the Lake would be a possibility. A copy of the study is available on our website (www.wildwoodlake.org). Since our comments on the 2017 Joint Pollution Reduction Plan, Dauphin County was awarded a DEP grant to assist in the design and permitting to move forward with a restoration project on the Lake, which was also supported by a Dauphin County Gaming grant and by the FOWW. The grant will make lake restoration a "shovel ready" project. The planned restoration project will be most effective with the implement of the proposed Plan, which will reduce the amount of sediment that is carried to Wildwood Lake by Paxton Creek and Fox Run. Numerous proposed BMPs including 01 (Fox Run), 06, 07, 08, 09, 10, 13 (please note is in Susquehanna Township) and 17 are upstream of the Lake, with BMPs 06, 09 (Black Run), 10 (Black Run), 13 and 17 having the most direct impact on the Lake and our lake restoration efforts.

The Friends of Wildwood Lake Nature Center, Inc.

Supporting Wildwood Park & Benjamin Olewine, III Nature Center

100 Wildwood Way • Harrisburg, PA 17110 • Phone (717) 221-0292 • www.wildwoodlake.org

With numerous significant rain events within the past 2 years, these areas are in need of erosion control attention. The lake restoration project itself may assist the Municipal Entities in meeting their pollution reduction goals now and in the future.

In addition, the FOWW would like to offer support toward the pollution reduction goals with a stream bank project that is on-going at the time of this letter, on the bank of Paxton Creek behind the Nature Center. This project was funded with support from a DEP Growing Greener grant. The project will stabilize 200 feet of the stream bank and prevent further erosion just prior to Paxton Creek reaching the Lake near the Morning Glory outfall. This project completes a portion of proposed BMP-03, which addresses about 1100 feet of stream bank from Route 322 and continuing behind the Olewine Nature Center, wuth restoration efforts. Please contact Chris Rebert, Park Manager at 717-221-0292 so we may provide information you may need to use this portion of the project toward your goals.

The FOWW support the implementation of the BMPs proposed in the 2019 Plan, which will reduce the volume of sediment reaching Paxton Creek and its tributaries, Wildwood Lake, the Susquehanna River and ultimately the Chesapeake Bay. Please also consider our on-site efforts and plans to reduce sediment loading and returning a portion of the Lake to function as a sediment trap for future generations in the Harrisburg area.

Thank you for the opportunity to provide comments on the Joint Pollution Reduction Plan.

Sincerely,

Heather Dock

Heather Dock
Friends of Wildwood President

5066677

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08/01/2017

NOTICE OF PUBLIC PARTICIPATION AND PUBLIC MEETING FOR REGIONAL TMDL AND CHESAPEAKE BAY POLLUTANT REDUCTION PLAN

Capital Region Water (CRW), Susquehanna Township, and Lower Paxton Township hereby give notice of the 30-day public comment period for its National Pollutant Discharge Elimination (NPDES) Stormwater Discharges from Small Municipal Separate Storm Sewer Systems (MS4) Pollutant Reduction Plan (PRP). Best management practices (BMPs) are proposed in the regional Plan to satisfy Paxton Creek Total Maximum Daily Load (TMDL) sediment reduction requirements and PRP requirements for the Chesapeake Bay and local stream impairments. The 30-day public comment period begins August 2, 2017 and ends September 1. At that time, the plan will be available on the CRW website (https://capitalregionwater.com) and a hard copy will be available at each municipal office. The public is invited to review this document and provide written comments. The regional Plan will be discussed at a public meeting on August 15, 2017 starting at 6PM at the Lower Paxton Township Municipal Building, 425 Prince Street, Harrisburg, PA.

Paxton Herald Proof

1 col x 5.5” @ $42.23 including $4.00 notary fee.
Runs 08-02-17
Changes by 12 noon Monday please.

The Paxton Herald
101 Lincoln St.
Harrisburg, PA 17112
717-545-9868

From:

Erin G. Letavic, P.E.
Project Manager
Herbert, Rowland & Grubic, Inc.
369 East Park Drive
Harrisburg, PA 17111
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Original Text:

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Ad Content Proof

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Joint Pollutant Reduction Plan

Paxton Creek Watershed TMDL, Chesapeake Bay PRP,
Wildwood Lake PRP, and UNT to Spring Creek PRP

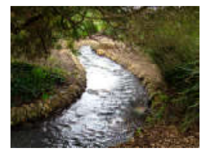


Public Meeting:
- *August 15, 2017 6PM*

2018 PAG-13 - Regulation

NPDES (National Pollutant Discharge Elimination System) Individual Permit (PAG-13) for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems (MS4s)

- Water Quality Permit
- Improved quality of local streams
- Quality ←→ Developed Land and Stormwater Controls

2018 PAG-13

NPDES (National Pollutant Discharge Elimination System) Individual Permit (PAG-13) for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems (MS4s)

Updated permit requires:

- ✓ Pollution Control Measures (PCMs)
- ✓ Updated list of authorized non-stormwater discharges
- ✓ Increased public involvement
- ✓ Clearer requirements for public access
- ✓ Pollutant Reduction Plans – Chesapeake Bay and locally impaired waters

Pollutant Reduction Plans – 2018 PAG-13

TMDL Plan
- Address goals outlined in EPA TMDL Report

Appendix D
- Estimate existing sediment (TSS), Total Phosphorus (TP), and Total Nitrogen (TN) loads <u>to the Chesapeake Bay</u>
- Identify BMPs to reduce pollutant loads by 10%, 5% and 3% respectively within 5 years*

Appendix E
- Estimate existing TSS, TP, TN loads <u>to locally impaired waters</u>
- Identify BMPs to reduce pollutant loads by 10%, 5% and 3% respectively within 5 years*

**Presumptive approach in which a 10% sediment reduction is assumed to also result in a 5% TP reduction and a 3% TN reduction.*

Existing Pollutant Loading

- Why sediment focus?
  - EPA model
- Why lb/yr?
  - Model correlates water quality level to sediment
  - Not a literal pounds removal

The Watershed Cooperative: Why Collaborate?

- Continuation of partnership initiated in 2015
- Progressive approach to achieving water quality improvements.
- Long-term partnership to define, implement integrated solutions.
- Seek affordable schedule considering regional financial capabilities.
- Collaboration to seek outside financial support.

Paxton Creek Watershed Facts

- Paxton Creek drains over 27 square miles of metropolitan Harrisburg.
- Pennsylvania DEP considers 30 miles of Paxton Creek and its tributaries impaired by sediment and habitat degradation (303(d) list).
- Over 85 percent of the sediment is contributed by stream erosion (TMDL report).

Pollutant Reduction Plan Requirements

- New for 2018-2023 permit term

Short-Term (5-yr) Pollutant Load Reduction Requirements by PRP Planning Area

Planning Area	Impairment	Existing Sediment Load (lbs/yr)	Required Sediment Load Reduction	Sediment Reduction Required (lbs/yr)
Paxton Creek TMDL	Sediment / Siltation	3,335,625	10%	333,563
Wildwood Lake	Sediment / Siltation	2,334,938	10%	233,494
UNT to Spring Creek	Sediment / Siltation	85,000	10%	8,500
Joint Planning Area	Sediment / Nutrients	16,250,525	10%	1,625,053

Long-Term Pollutant Load Reduction Requirements (Paxton Creek TMDL only)
1,167,469 lb/yr

Pollutant Reduction Plan Requirements

- Joint Planning Area

Paxton Creek Watershed Facts

- In 2008, USEPA defined a *Total Maximum Daily Load (TMDL)* for Paxton Creek – the allowable sediment load to resolve impairment. (Note: Phosphorus was removed from the TMDL at a later date)

Source	Land Use / Source	Existing Load (ton/year)	Allocated Load (ton/year)	Percent Reduction
Nonpoint Sources	Agriculture	2.2	1.9	14%
	Forest	8.8	8.8	0%
	Open Space	20.1	17.0	15%
	Low Intensity Development	13.1	11.1	15%
	High Intensity Development	14.4	12.2	15%
	Instream Erosion	396.7	242.9	39%
	Nonpoint Source Subtotal	455.3	293.9	35%
Municipal Separate Storm Sewer Systems (MS4)	Agriculture	11	9.4	15%
	Forest	43.2	43.2	0%
	Open Space	98.6	83.5	15%
	Low Intensity Development	64.3	54.4	15%
	High Intensity Development	70.7	59.8	15%
	Instream Erosion	1950.5	1194.4	39%
	MS4 Subtotal	2,238.3	1,444.8	35%
CSO		14.5	12.3	15%
Permitted Facilities		7.0	7.0	0%
	Total	2,715.1	1,757.9	35%

Additional Watershed Facts

- The City of Harrisburg, Lower Paxton Township, and Susquehanna Township comprise over 94 percent of the Paxton Creek Watershed
- Middle Paxton Township, Penbrook Borough, and Swatara Township also contribute.
- Capital Region Water (CRW) owns and operates combined and separate storm sewer systems within the City of Harrisburg.

MS4 Permittee	Percentage of Watershed	Baseline Sediment Load (ton/year)
CRW (City of Harrisburg)	21.2 %	1,954.8
Township of Lower Paxton	46.0 %	4,241.6
Township of Susquehanna	26.8 %	2,471.2
Load contributing land outside Joint Planning Area	6%	N/A
Paxton Creek TMDL Planning Area Total:	100%	8,667.6

Wildwood Lake

- Impaired
- Exists within the Paxton Creek watershed
- Upstream improvements are anticipated to reduce the sediment loading to Wildwood Lake
- 233,494 lb/yr goal (accomplished through upstream projects)

UNT to Spring Creek Watershed

- CRW drainage area: 124 acres
- Susquehanna Twp. drainage area: 260 acres
- Sediment reduction required: 8,500 lbs

- Proposed BMPs:
  - Street Sweeping
  - Detention Facility
  - GSI
  - Capital Area Greenbelt Stream Restoration

Responding to the TMDL – CSS v. MS4

- CRW Combined Sewer System (CSS)
  - Significant portion of the City of Harrisburg is <u>not</u> an MS4
  - Stormwater is conveyed via <u>combined sewer</u>
  - CRW is developing a Long Term Control Plan
    - Increase stormwater capture in the CSS
  - EXISTING CSS Sediment Reductions
    - Paxton Creek: 105 tons (17% *of Exist Mapsheds Load*)
    - Susquehanna River: 191 tons (7% *of Mapsheds Load*)
  - FUTURE CSS Sediment Reductions
    - Paxton Creek: 106 tons (17% *of Exist Mapsheds Load*)
    - Susquehanna River: 190 tons (7% *of Exist Mapsheds Load*)

Responding to the TMDL and PRP Requirements

- A MapShed model of Paxton Creek matching the 2008 TMDL existing loading was created.
- Existing projects were included in model to reduce baseline.
  - Stream restoration
  - CSS projects

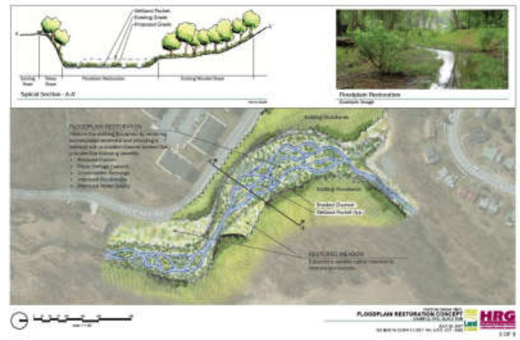
- <u>1,625,053 lb/yr joint planning area reduction goal</u>

Watershed Assessment

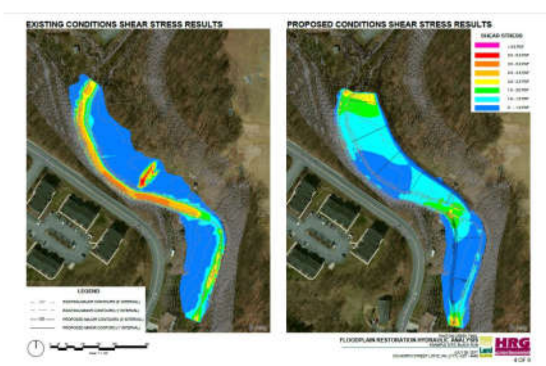
- Utilized stream assessment data from Strategy
- Continued same assessment protocol for areas not previously viewed
- Candidate project selection
- Prototypes for use during implementation
  - Guide project selection process
  - Provide alternates

Watershed Assessment

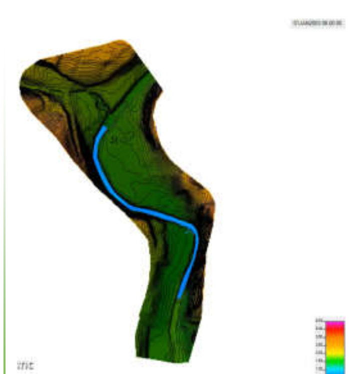
Floodplain Restoration Prototype



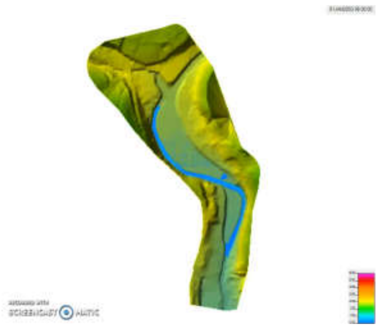
Floodplain Restoration Prototype



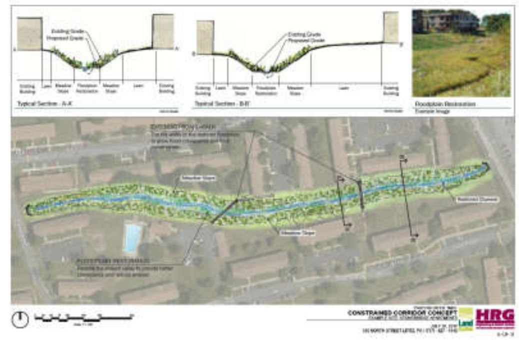
Floodplain Restoration Prototype - existing



Floodplain Restoration Prototype - proposed

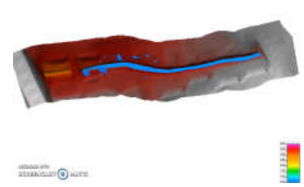


Constrained Corridor Prototype

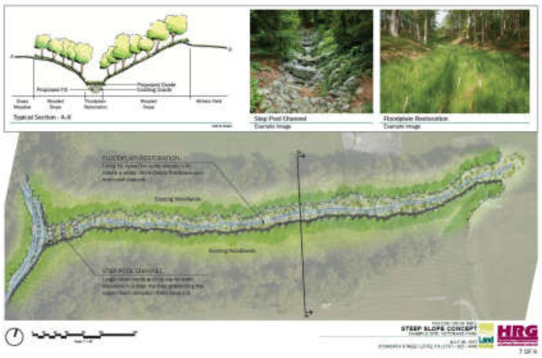


Constrained Corridor Prototype

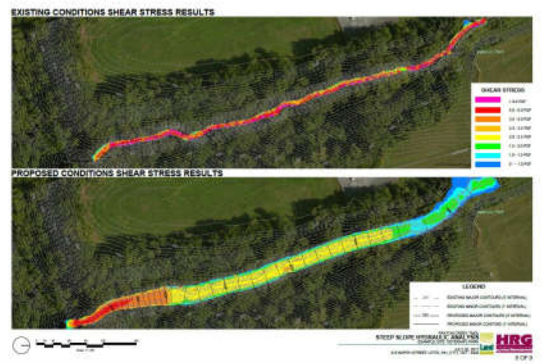
Constrained Corridor – existing and proposed



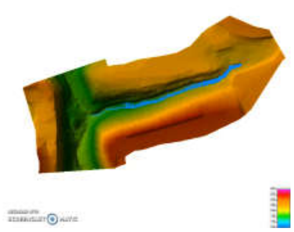
Steep Slope Prototype



Steep Slope Prototype



Steep Slope – existing and proposed



Proposed Projects – Stream Based

Map Reference	Floodplain Restoration BMP Name	Assessment Stream Segment	Early Action Project	Planning Area	Stream Length (LF)	Reduction (lbs)
BMP-01	Fox Hunt - Stream Restoration	SS-21	EAP-1	Paxton Creek / Joint Plan	750	86,250
BMP-02	Stonebridge Apartments	SS-14	EAP-2	Paxton Creek / Joint Plan	1,800	207,000
BMP-03	Wildwood Lake, Black Run	SS-01	N/A	Paxton Creek / Joint Plan	1,075	123,625
BMP-04	Veteran's Park South	SS-18	N/A	Paxton Creek / Joint Plan	1,000	115,000
BMP-05	Veteran's Park North	SS-18	N/A	Paxton Creek / Joint Plan	1,150	132,250
BMP-06	Earl Drive Ph. 01	SS-13	EAP-3	Paxton Creek / Joint Plan	1,560	179,400
BMP-07	Earl Drive Ph. 02	SS-13	EAP-16	Paxton Creek / Joint Plan	900	103,500
BMP-08	Earl Drive Ph. 03	SS-13	EAP-14	Paxton Creek / Joint Plan	2,435	280,025
BMP-09	Black Run - North	SS-03	N/A	Paxton Creek / Joint Plan	3,368	387,320
BMP-10	Black Run - South	SS-03	N/A	Paxton Creek / Joint Plan	2,000	230,000
BMP-11	Pines Apartment Complex	SS-16	EAP-10	Paxton Creek / Joint Plan	1,450	166,750
BMP-12	Capital Area Greenbelt	SS-23	N/A	UNT Spring Creek / Joint Plan	1,800	207,000
BMP-13	Walker Mill Road Stream Only	N/A	N/A	Paxton Creek / Joint Plan	600	69,000
				Totals:	19,888	2,287,120

Floodplain Restoration Components

Proposed Projects – Land Based

Map Reference	BMP Name	Planning Area	Managed Area (ac)	Reduction (lbs)
BMP-13	Walker Mill Road Basin Retrofit	Paxton Creek / Joint Plan	23.4	10,400
BMP-14	CRW UNT to Spring Creek GSI Projects	UNT Spring Creek / Joint Plan	--	10,886
BMP-15	CRW Streetsweeping	Paxton Creek / Joint Plan	166	36,500
N/A	CSO reductions	Paxton Creek / Joint Plan	--	210,000
N/A	CSO reductions	Joint Plan	--	380,000
			Total:	647,786

Land Based BMP – Basin Retrofit

TMDL and PRP Goals

- Goal: 1,625,053 lb/yr
- Project allocation: 2,934,906 lb/yr

- Intentionally overshooting the goal
  - Flexibility during implementation
  - Challenging logistics
  - Credit policy will likely change (based on monitored effectiveness of the BMPs)
  - Identified projects with secondary benefits

Next Steps

- **Public comment period** **Aug 2-Sept 1, 2017**
- **Revise report** **Sept 2-14, 2017**
- **Submit report** **Sept 15, 2017**
- **Implementation**
  - Start in 2018
  - Complete in 2023 (5 years)

We want your feedback

- Review the strategy, submit your comments at:
  - https://capitalregionwater.com/jointprp
  - Capital Region Water, 212 Locust Street, Suite 500, Harrisburg, PA
  - Lower Paxton Township, 425 Prince Street, Harrisburg, PA
  - Susquehanna Township, 1900 Linglestown Road, Harrisburg, PA.
- Ask questions / provide comments tonight.
- Future Board considerations:
  - Budget/funding
  - Long-term support
  - Water quality awareness

Questions?

PAXTON CREEK WATERSHED JOINT POLLUTANT REDUCTION PLAN PUBLIC MEETING

AUGUST 15, 2017 AT 6:00 PM

LOWER PAXTON TOWNSHIP

IN ATTENDENCE

Joint Plan Entity Staff:
Claire Maulhardt, Capital Region Water
David Stewart, Capital Region Water
Elizabeth Logan, Susquehanna Township
George Wolfe, Lower Paxton Township
Randy Allen, Lower Paxton Township

Consultants:
Ben Ehrhart, Land Studies
Erin Letavic, HRG Inc.
Matt Bonanno, HRG, Inc.
Rachel Kirkham, CDM Smith

Other:
Allison Doughery, Burg Magazine
Bill Hawk
Bryan Genesse
Dave Sheppard
Thomas Au
Gary Rothrock
Sean Sanderson

The meeting began at 6:00 p.m.

Claire Maulhardt, the City Beautiful H2O Program Manager for Capital Region Water (CRW), began the presentation by welcoming everyone and explained that the Paxton Creek Watershed Joint Pollutant Reduction Plan (PRP) is an expansion of the 2015 Paxton Creek Total Maximum Daily Load (TMDL) Strategy. The plan is a joint collaboration between Capital Region Water (City of Harrisburg), Lower Paxton Township, and Susquehanna Township and will be used to fulfill obligations for the Paxton Creek TMDL as well as the PRP requirements for the Chesapeake Bay, Wildwood Lake, and the unnamed tributary to Spring Creek. It also covers Beaver Creek which does not have any pollution reduction requirements.

She explained that the three entities are required by federal law to submit a Notice of Intent (NOI) to apply for a National Pollutant Discharge Elimination System (NPDES) Individual Permit (PAG-13) for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems (MS4s) by September 15, 2017. This permit cycle requires the creation of a PRP for the Chesapeake Bay and locally impaired waters. The PRP has to provide an implementation plan to reduce pollution by 10% in these watersheds over the next five years. Paxton Creek also has a TMDL requiring a 35% sediment reduction of the pollutant load.

Ms. Maulhardt outlined the Watershed Cooperative and the importance of collaborating together. This long-term partnership is more affordable for all entities involved, provides integrated solutions across the board, and helps leverage outside financial support. 94% of the watershed is within the municipal boundaries of Lower Paxton Township, Susquehanna Township and Capital Region Water – who operates the storm sewer system for the City of Harrisburg.

She then reviewed some facts about the Paxton Creek Watershed. 30 miles of Paxton Creek and its tributaries is impaired due to stream erosion. The 2018-2023 TMDL plan requires a 9,000 ton reduction in sediment per year. This equals a reduction of 3,335,625 lbs./year in sediment. In addition the PRPs require a reduction of 16,250,525 lbs./year within the joint planning area. Upstream improvements to Black Run are anticipated to reduce the sediment loading to Wildwood Lake. There is also a long-term goal of removing existing sediment from Wildwood Lake; however this is not part of the current plan. CRW and Susquehanna Township are also required to reduce sediment loads for an unnamed tributary to Spring Creek.

Ms. Maulhardt explained that a portion of the City of Harrisburg is a combined sewer. Stormwater combines with sewer and is taken into an interceptor and then into the waste water treatment facility. When there are large rainfall events, the system cannot handle the amount of water and there are overflows that occur into the Susquehanna River and Paxton Creek. CRW is developing a long-term control plan to reduce these overflow occurrences. Currently they hold 35% of the rainfall that goes to waste water treatment facility. They hope to capture 58% of the rainfall to reduce the load reduction.

This Joint PRP is focusing on stream restoration. A more detailed stream assessment was performed and used to identify projects over the five year term to meet the total reduction goal. The impaired stream corridors were mapped and used to identify potential projects to meet the required pollutant load reduction. Thirteen projects were chosen, and the majority fall under three different prototypes.

Ben Ehrhart from Land Studies discussed the three different prototypes and how the stream reaches were accessed and typical conditions identified to create these three prototypes. To develop these concepts, they used a 2D Hydrologic model which allowed Land Studies to test concepts to see what the stream is doing now, and how the proposed projects will improve the stream corridor. The three prototypes include floodplain restoration, constrained streams, and steep slopes. These are just conceptual, not a detailed design. These concepts provide flexibility to allow implementation at alternative locations in case one of the 13 sites would become unfavorable.

Erin Letavic with Herbert, Rowland, & Grubic, Inc. provided reasoning behind the selection of the 13 sites. The sites were selected based on severity of erosion, property ownership, and potential to impact infrastructure. The objective is to address the Paxton Creek regulatory issues and also tie it into possible public improvements that need to be addressed as well, not just get credits for a plan. Early action projects were previously identified in the strategy, and have been vetted with some work already starting. She also reviewed the different components of floodplain restoration which could include floodplain connections, bioengineered bank stabilization, natural drainage channels, grade control, and outlet protection/velocity dissipation.

Ms. Maulhardt provided a summary of the land based projects that are proposed. This includes a basin retrofit, street sweeping in the City of Harrisburg, and reductions in the combined sewer overflows from CRW's system. After a brief summary and review of the next steps in the process Ms. Maulhardt opened the meeting for questions from the audience.

<u>Audience Questions</u>

1. **Question:** Mr. Au asked if there were any changes to municipal ordinances as a result of this PRP.

   Response: The PRP will not require any ordinance changes. There may be some changes required by the Individual NPDES Permit, but it depends on what each municipality already has in place.

2. **Question:** Mr. Au asked if the PRP recommends any plans to address Wildwood Lake as it fills up with sediment and reduces the capacity to store stormwater.

   Response: The PRP does not address sediment at Wildwood Lake, as this is a longer term project than the 5-year time frame the entities have to correct the pollution problems.

3. **Question**: Mr. Rothrock asked if the majority of the projects were located in Susquehanna Township.

   Response: The majority of the proposed projects are located in Susquehanna Township. The City of Harrisburg has the least amount of projects due to the lack of space to make improvements. Another reason the majority of projects are in Susquehanna Township is that the majority of the Township is within the Paxton Creek Watershed, where only half of Lower Paxton Township is within the Paxton Creek Watershed.

4. **Question:** Mr. Rothrock asked if work has already begun at Stonebridge Apartments.

   Response: No one present was aware of any work beginning on the streambank in that location in relationship to streambank restoration.

With no more questions, the meeting concluded at 6:33 p.m.

Prepared by: Elizabeth Logan, AICP

Public Comment Record of Consideration

Comment #1

Received from: Thomas Y. Au, Sierra Club

Date: 9/1/2017

Comment: Thank you for developing a plan to reduce sediment load from stormwater in our townships and city.

Urban stormwater is a major cause of pollution that is costly for municipalities to treat, for industrial and commercial businesses to control, and for facilities that deliver our drinking water. Polluted runoff also impacts habitat for fish and wildlife as well as our ability to enjoy healthy waterways for recreation. All of us can do more to reduce polluted stormwater flow.

The 13 designated BMP projects are a good start at reducing sediment and pollution loads. These projects would use engineered and landscaped features to capture and mitigate stormwater flows. As outlined in the plan, these will reduce sediment load by 10% if implemented fully. There appears to be some uncertainty about the funding of these projects however. The plan should clarify the municipalities' commitment to fund the projects.

In addition to the 13 BMP projects, there are additional opportunities to reduce sediment load from "green infrastructure" measures, which are not discussed in the plan. These would include measures such as planting vegetated riparian buffers where not none currently exist, installing rain gardens, installing pervious paving, and planting bio-swales. We have seen such projects work in new construction in the municipalities. We would like the plan to discuss measures to implement these green infrastructure measures more broadly.

Thank you for the opportunity to comment.

Thomas Y. Au, Conservation Chair

Sierra Club, Governor Pinchot Chapter

1528 Dogwood Drive

Harrisburg, PA 17110

Response to comment: Comment acknowledged. Thank you for supporting the efforts of CRW, Lower Paxton Township, and Susquehanna Township in improving water quality in local waterways and beyond. The Municipal Entities (Participants) involved in the development of the Joint Plan have entered into an Intergovernmental Agreement in part to ensure cost sharing is fair and consistent between the parties involved in the future implementation of the Plan. Additional language regarding the Agreement has been added to Section H of the Joint Plan. Additionally, CRW is currently in the process of developing a Long-term Control Plan for the Combined Sewer System service area in which they intend to implement green infrastructure measures throughout the service area to provide volume controls and reduce flow through the combined system. Exact details of the nature and extent of the proposed green infrastructure activities are still in development and is expected to be submitted to PADEP in April of 2018.

Comment #2

Received from: Sloan Auchincloss, Harrisburg property owner

Date: 8/3/2017

Comment: Bravo to Capital Region Water for taking the lead on improving Paxton Creek watershed by attenuating sediment!

To complement that effort, I recommend that the plan include convict labor* on work-release to collect detritus contributors along riparian areas. Wind storms are primary delivery means of harmful plastic bags and packaging that accumulate. Thoughtless individuals are culprits too because they use the stream bed as a convenient dumping site.

Such action, efficient and economical, will protect biota for better quality of life for our community.

Sloan Auchincloss
Harrisburg, PA property owner

*Convicts often have community service as part of their sentences, so clean-up would count toward time sentenced by court.

Response to comment: Comment acknowledged. Thank you for supporting the efforts of CRW, Lower Paxton Township, and Susquehanna Township in improving water quality in local waterways and beyond.

Comment # 3

Received from: Jim Caufield, Friends of Wildwood Lake Nature Center, Inc.

Date: 9/1/2017

Comment: To the Municipal Entities:

The Friends of Wildwood Lake Nature Center, Inc. ("FOWW") is a 501(c) (3) organization that supports Wildwood Park and the Benjamin Olewine III Nature Center at 100 Wildwood Way, Harrisburg, PA 17110. As you are aware, Wildwood Park includes Wildwood Lake, which features diverse aquatic ecosystems for thousands of plant and animal species and provides important flood protection for the City of Harrisburg. In recent years, FOWW has become increasingly concerned regarding the sediment problem in Wildwood Lake, which has significantly reduced the depth of the lake, causing increased flooding in the area and risk to plant and animal habitats.

FOWW supports the Joint Pollutant Reduction Plan ("Plan") of the Municipal Entities dated August 2, 2017, which includes a proposed sediment load reduction of 10% for Wildwood Lake within five years of approval of the Municipal Entities' MS4 permits. A l 0% sediment load reduction will produce benefits within the lake itself, as well as downstream water bodies, including the Susquehanna River and the Chesapeake Bay. As stated within the Plan, streambank erosion is the main cause of the sediment problem in the region, and a focus on lake and stream restoration projects is the best way to advance long-term improvement to water quality.

FOWW also would like to specifically highlight one of the best management practices ("BMPs") identified by the Municipal Entities, BMP-03. BMP-03 is a stream restoration project proposed for Black Run, a stream that discharges to the eastern portion of Wildwood Lake. The Plan proposes a number of improvements to Black Run, including addressing severe erosion and sediment deposits, evaluating and reconstructing existing crossings, and removing debris. Each of these steps will result in reduced runoff and sediment deposits in Wildwood Lake. FOWW strongly supports BMP-03, as well as the other BMPs that will indirectly result in less future runoff to the tributaries of Wildwood Lake.

FOWW supports the Municipal Entities' adoption of the Joint Pollutant Reduction Plan. Although Wildwood Lake will require significant additional sediment reduction and restoration work to provide the same ecosystem and flood prevention benefits offered a century ago, the Joint Pollutant Reduction Plan will result in many water quality benefits to Wildwood Lake, the Susquehanna River, and the Chesapeake Bay. FOWW appreciates the inclusion of Wildwood Lake within the Plan, and hopes the Municipal Entities will continue to consider future projects related to the restoration and improvement of Wildwood Lake.

FOWW appreciates the opportunity to provide comments regarding the draft Joint Pollutant

Reduction Plan of Capital Region Water, Lower Paxton Township, and Susquehanna Township. Thank you.

Regards,

Jim Caufield, President

Friends of Wildwood Lake Nature Center, Inc.

Response to comment: Comment acknowledged. Thank you for supporting the efforts of CRW, Lower Paxton Township, and Susquehanna Township in improving water quality in local waterways and beyond. The Municipal Entities recognize the importance of Wildwood Lake to the City of Harrisburg and surrounding communities in terms of flood control, recreation, and supporting wildlife.

Comment #4

Received from: Justina Wasicek, Susquehanna Township resident

Date: 9/1/2017

Comment:

To Capital Region Water & Partners Susquehanna Twp and Lower Paxton,

I definitely support the plan to reduce pollution and sedimentation from stormwater runoff. In fact, I think that these are very modest goals and I would like to see more done in this regard.

I would like to see more stream buffers along the creeks and streams. I would like to see Susquehanna Township encourage developers and commercial, church, and government entities to use permeable surfaces in the parking lots. We have several large parking surfaces – associated with the Farm Show, Capital Blue Cross, HACC, churches, etc, that could help reduce runoff with permeable surfaces, rain gardens and more trees. It would also be good to encourage builders to create some bio-swales or vegetated areas like rain gardens that would help filter and store water and also provide some habitat for small animals.

This will be true of the former State Hospital grounds are developed too-- care should be taken not to increase runoff and preserve the nature of the beautiful arboretum.

I live near Paxton Creek and it floods near Paxton Church Road sometimes. Wildwood Lake is also showing the effects of too much sedimentation.

Thank you for devising this plan, and I appreciate your efforts in reducing pollution and stormwater runoff.

Sincerely,

Justina Wasicek

Susquehanna Township

Response to comment: Comment acknowledged. Thank you for supporting the efforts of CRW, Lower Paxton Township, and Susquehanna Township in improving water quality in local waterways and beyond. The stream restoration projects presented in the Plan will incorporate riparian buffers where practical and warranted. The exact locations and extent will be decided during the implementation phase. All three of the Municipal Entities have land development and stormwater management ordinances that encourage developers to incorporate the use of Low Impact Design (LID) techniques such as permeable paving, bioretention, etc… into their designs. The municipalities will continue to encourage the use of LID techniques and will continue to enforce their local stormwater management ordinances to ensure proper stormwater management techniques are being implemented during the development process.

Greenly, Alex

From: Claire Maulhardt <claire.maulhardt@capitalregionwater.com>
Sent: Wednesday, September 06, 2017 8:52 AM
To: Letavic, Erin
Cc: Logan, Elizabeth (Betsy); rallen@lowerpaxton-pa.gov
Subject: FW: MS4 Chesapeake Bay Pollution Reduction Plan

Claire Maulhardt | City Beautiful H_2O Program Manager
888-510-0606 | Direct: 717-216-5269
Capital Region Water
212 Locust Street, Suite 500 | Harrisburg, PA 17101
Investing in Our Community from Raindrop to River
capitalregionwater.com | Facebook | Twitter | YouTube

From: Capital Region Water Info
Sent: Friday, September 01, 2017 4:40 PM
To: Claire Maulhardt <claire.maulhardt@capitalregionwater.com>
Subject: FW: MS4 Chesapeake Bay Pollution Reduction Plan

From: Thomas Y. Au [mailto:thomxau@gmail.com]
Sent: Friday, September 1, 2017 9:24 AM
To: Capital Region Water Info <info@capitalregionwater.com>
Subject: MS4 Chesapeake Bay Pollution Reduction Plan

September 1, 2017

Capital Region Water

212 Locust Street, Suite 500

Harrisburg, PA 17101-7107

Thank you for developing a plan to reduce sediment load from stormwater in our townships and city.

Urban stormwater is a major cause of pollution that is costly for municipalities to treat, for industrial and commercial businesses to control, and for facilities that deliver our drinking water. Polluted runoff also impacts habitat for fish and wildlife as well as our ability to enjoy healthy waterways for recreation. All of us can do more to reduce polluted stormwater flow.

The 13 designated BMP projects are a good start at reducing sediment and pollution loads. These projects would use engineered and landscaped features to capture and mitigate stormwater flows. As outlined in the plan, these will reduce sediment load by 10% if implemented fully. There appears to be some uncertainty about the funding of these projects however. The plan should clarify the municipalities' commitment to fund the projects.

In addition to the 13 BMP projects, there are additional opportunities to reduce sediment load from "green infrastructure" measures, which are not discussed in the plan. These would include measures such as planting vegetated riparian buffers where not none currently exist, installing rain gardens, installing pervious paving, and planting bio-swales. We have seen such projects work in new construction in the municipalities. We would like the plan to discuss measures to implement these green infrastructure measures more broadly.

Thank you for the opportunity to comment.

Thomas Y. Au, Conservation Chair

Sierra Club, Governor Pinchot Chapter

1528 Dogwood Drive

Harrisburg, PA 17110

--
Thomas Au
717-234-7445
thomxau@gmail.com

Greenly, Alex

From: Letavic, Erin
Sent: Thursday, August 31, 2017 8:46 AM
To: Greenly, Alex; Bonanno, Matthew
Subject: FW: Web Site Inquiry/Paxton Creek Sediment Control

Paxton Creek comment

Erin G. Letavic
Herbert, Rowland & Grubic, Inc.

From: Claire Maulhardt [mailto:claire.maulhardt@capitalregionwater.com]
Sent: Wednesday, August 30, 2017 1:35 PM
To: Letavic, Erin <eletavic@hrg-inc.com>; rallen@lowerpaxton-pa.gov; Logan, Elizabeth (Betsy) <blogan@susquehannatwp.com>; David Stewart <david.stewart@capitalregionwater.com>; Kratzer, David <dkratzer@susquehannatwp.com>; George Wolfe <gwolfe@lowerpaxton-pa.gov>
Subject: FW: Web Site Inquiry/Paxton Creek Sediment Control

I received only this comment so far. See below.

Claire Maulhardt | City Beautiful H2O Program Manager
888-510-0606 | Direct: 717-216-5269
Capital Region Water
212 Locust Street, Suite 500 | Harrisburg, PA 17101
Investing in Our Community from Raindrop to River
capitalregionwater.com | Facebook | Twitter | YouTube

-----Original Message-----
From: Capital Region Water Info
Sent: Wednesday, August 30, 2017 10:58 AM
To: Claire Maulhardt <claire.maulhardt@capitalregionwater.com>
Subject: FW: Web Site Inquiry/Paxton Creek Sediment Control

-----Original Message-----
From: Sloan Auchincloss [mailto:sloanauchincloss@gmail.com]
Sent: Thursday, August 3, 2017 12:28 PM
To: Capital Region Water Info <info@capitalregionwater.com>
Subject: Web Site Inquiry/Paxton Creek Sediment Control

Bravo to Capital Region Water for taking the lead on improving Paxton Creek watershed by attenuating sediment!

To complement that effort, I recommend that the plan include convict labor* on work-release to collect detritus contributors along riparian areas. Wind storms are primary delivery means of harmful plastic bags and packaging that accumulate. Thoughtless individuals are culprits too because they use the stream bed as a convenient dumping site.

Such action, efficient and economical, will protect biota for better quality of life for our community.

Sloan Auchincloss
Harrisburg, PA property owner

*Convicts often have community service as part of their sentences, so clean-up would count toward time sentenced by court.

The Friends of Wildwood Lake Nature Center, Inc.

Supporting Wildwood Park & Benjamin Olewine, III Nature Center

100 Wildwood Way • Harrisburg, PA 17110 • Phone (717) 221-0292 • www.wildwoodlake.org

September 1, 2017

Capital Region Water
100 Pine Drive
Harrisburg, PA 17103
info@capitalregionwater.com

RE: Comments of the Friends of Wildwood Lake Nature Center, Inc. to the Joint Pollutant Reduction Plan of Capital Region Water, Lower Paxton Township, and Susquehanna Township (collectively, the "Municipal Entities")

To the Municipal Entities:

The Friends of Wildwood Lake Nature Center, Inc. ("FOWW") is a 501(c)(3) organization that supports Wildwood Park and the Benjamin Olewine III Nature Center at 100 Wildwood Way, Harrisburg, PA 17110. As you are aware, Wildwood Park includes Wildwood Lake, which features diverse aquatic ecosystems for thousands of plant and animal species and provides important flood protection for the City of Harrisburg. In recent years, FOWW has become increasingly concerned regarding the sediment problem in Wildwood Lake, which has significantly reduced the depth of the lake, causing increased flooding in the area and risk to plant and animal habitats.

FOWW supports the Joint Pollutant Reduction Plan ("Plan") of the Municipal Entities dated August 2, 2017, which includes a proposed sediment load reduction of 10% for Wildwood Lake within five years of approval of the Municipal Entities' MS4 permits. A 10% sediment load reduction will produce benefits within the lake itself, as well as downstream water bodies, including the Susquehanna River and the Chesapeake Bay. As stated within the Plan, streambank erosion is the main cause of the sediment problem in the region, and a focus on lake and stream restoration projects is the best way to advance long-term improvement to water quality.

FOWW also would like to specifically highlight one of the best management practices ("BMPs") identified by the Municipal Entities, BMP-03. BMP-03 is a stream restoration project proposed for Black Run, a stream that discharges to the eastern portion of Wildwood Lake. The Plan proposes a number of improvements to Black Run, including addressing severe erosion and sediment deposits, evaluating and reconstructing existing crossings, and removing debris. Each of these steps will result in reduced runoff and sediment deposits in Wildwood Lake. FOWW

The Friends of Wildwood Lake Nature Center, Inc.
Supporting Wildwood Park & Benjamin Olewine, III Nature Center

100 Wildwood Way • Harrisburg, PA 17110 • Phone (717) 221-0292 • www.wildwoodlake.org

strongly supports BMP-03, as well as the other BMPs that will indirectly result in less future runoff to the tributaries of Wildwood Lake.

FOWW supports the Municipal Entities' adoption of the Joint Pollutant Reduction Plan. Although Wildwood Lake will require significant additional sediment reduction and restoration work to provide the same ecosystem and flood prevention benefits offered a century ago, the Joint Pollutant Reduction Plan will result in many water quality benefits to Wildwood Lake, the Susquehanna River, and the Chesapeake Bay. FOWW appreciates the inclusion of Wildwood Lake within the Plan, and hopes the Municipal Entities will continue to consider future projects related to the restoration and improvement of Wildwood Lake.

FOWW appreciates the opportunity to provide comments regarding the draft Joint Pollutant Reduction Plan of Capital Region Water, Lower Paxton Township, and Susquehanna Township.

Thank you.

Regards,

Jim Caufield /TKH
Jim Caufield, President
Friends of Wildwood Lake Nature Center, Inc.

Greenly, Alex

From:	Claire Maulhardt <claire.maulhardt@capitalregionwater.com>
Sent:	Wednesday, September 06, 2017 8:18 AM
To:	Letavic, Erin
Cc:	Logan, Elizabeth (Betsy); rallen@lowerpaxton-pa.gov
Subject:	FW: Joint Pollutant Reduction Plan

Please compile this with other public comments. I have a few more I will be forwarding.

Claire Maulhardt | City Beautiful H_2O Program Manager
888-510-0606 | Direct: 717-216-5269
Capital Region Water
212 Locust Street, Suite 500 | Harrisburg, PA 17101
Investing in Our Community from Raindrop to River
capitalregionwater.com | Facebook | Twitter | YouTube

From: Andrew Bliss
Sent: Tuesday, September 05, 2017 4:00 PM
To: Claire Maulhardt <claire.maulhardt@capitalregionwater.com>
Subject: FW: Joint Pollutant Reduction Plan

Public comment for PRP:

Andrew Bliss | Community Outreach Manager
888-510-0606 | Direct: 717-216-5254 | Mobile: 717-421-5861
Capital Region Water
212 Locust Street, Suite 500 | Harrisburg, PA 17101
Investing in Our Community from Raindrop to River
capitalregionwater.com | Facebook | Twitter | YouTube

From: Capital Region Water Info
Sent: Sunday, September 03, 2017 7:57 PM
To: Andrew Bliss <andrew.bliss@capitalregionwater.com>; Tanya Dierolf <tanya.dierolf@capitalregionwater.com>
Subject: FW: Joint Pollutant Reduction Plan

From: J Wasicek [mailto:jawasicek@gmail.com]
Sent: Friday, September 1, 2017 10:41 PM
To: Capital Region Water Info <info@capitalregionwater.com>
Subject: Joint Pollutant Reduction Plan

Sept. 1, 2017

To Capital Region Water & Partners Susquehanna Twp and Lower Paxton, I definitely support the plan to reduce pollution and sedimentation from stormwater run off. In fact, I think that these are very modest goals and I would like to see more done in this regard.

I would like to see more stream buffers along the creeks and streams. I would like to see Susquehanna Township encourage developers and commercial, church, and government entities to use permeable surfaces in the parking lots. We have several large parking surfaces – associated with the Farm Show, Capital Blue Cross,HACC, churches, etc, that could help reduce runoff with permeable surfaces, rain gardens and more trees. It would also be good to encourage builders to create some bio-swales or vegetated areas like rain gardens that would help filter and store water and also provide some habitat for small animals.

This will be true if the former State Hospital grounds are developed too-- care should be taken not to increase runoff and preserve the nature of the beautiful arboretum.

I live near Paxton Creek and it floods near Paxton Church Road sometimes. Wildwood Lake is also showing the effects of too much sedimentation.

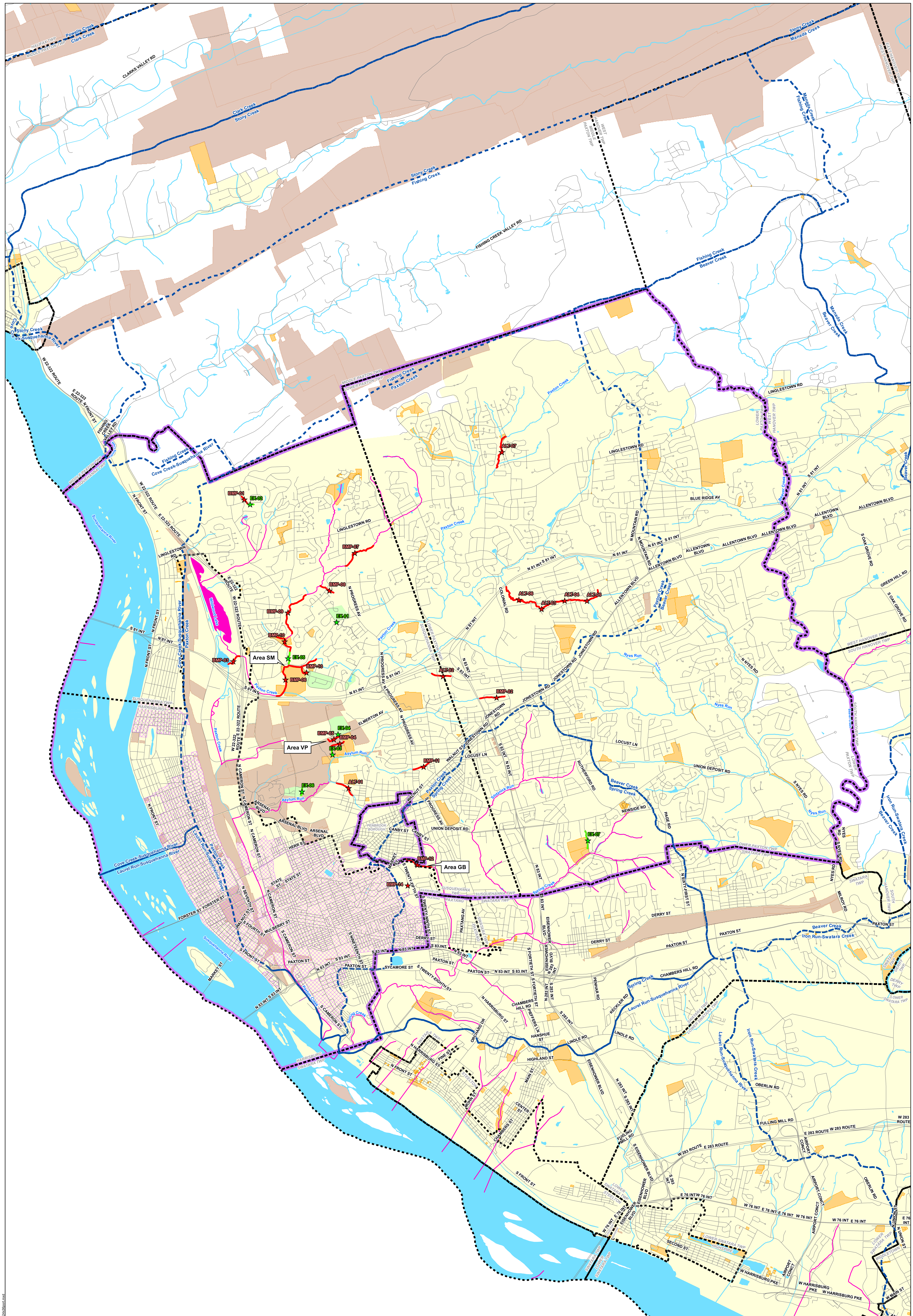
Thank you for devising this plan, and I appreciate your efforts in reducing pollution and stormwater runoff.

Sincerely,

Justina Wasicek

Susquehanna Township

APPENDIX B – MAPPING



NOTE: Planning area outside of the CSO service area is the MS4 service area.
Sediment impaired stream layer is sourced from PA DEP and displays more tributaries than for which a PRP is required.

2,500 0 2,500 Feet

Mapping derived from data provided by CRW, Dauphin County, PA DEP, US Census, USGS, and Center for Watershed Protection, Inc.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

HRG Herbert, Rowland & Grubic, Inc. Engineering & Related Services An Employee-Owned Company

Land Studies

- Existing BMP
- Proposed BMP
- Existing Approximate Length Of Stream In Project
- Proposed Approximate Length Of Stream In Project
- BMP Drainage Area
- Sediment Impaired Stream
- Non-Impaired Stream
- Municipal Boundary
- CSO Service Area
- Local Government Property
- Urban Area (2018 U.S. Census)
- Watershed Boundary (HUC-12)
- Joint Planning Area

Joint Planning Area, BMP Project Locations And CWP Project Focus Areas

Dauphin County, Pennsylvania

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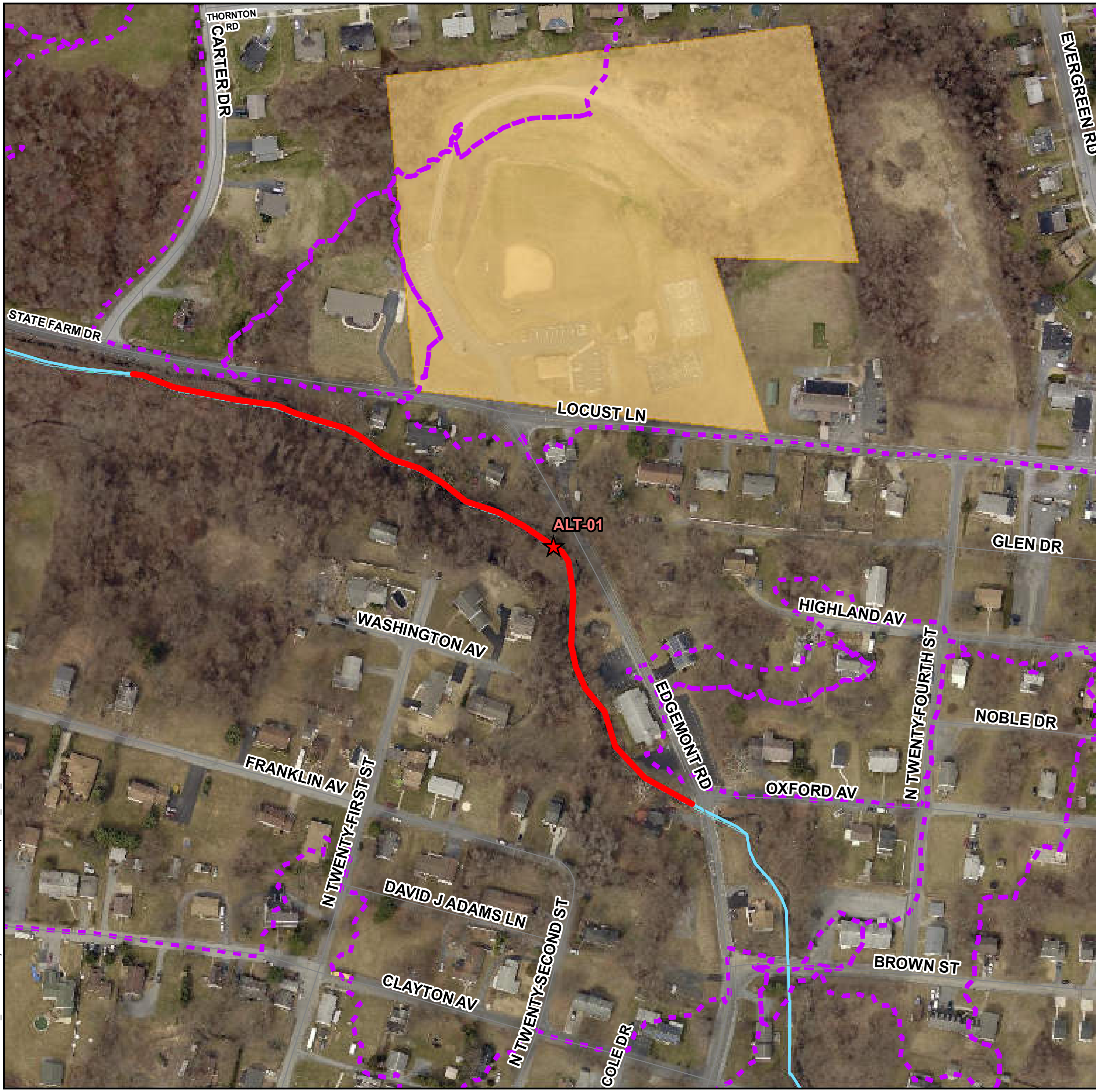
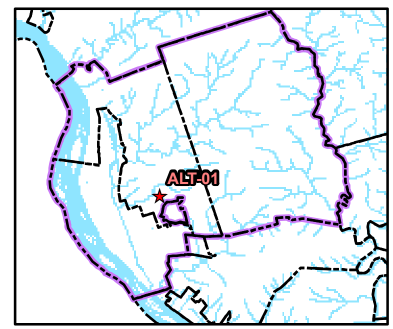
Edgemont Rd. at Locust Ln. ALT-01

Joint Planning Area
Dauphin County, Pennsylvania



- Proposed BMP
- Proposed Approximate Length Of Stream In Project
- Non-Impaired Stream
- Road
- Municipal Property
- Municipal Boundary
- Stormsewer Shed Boundary
- Watershed Boundary (HUC-12)



0 250 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

HRG Herbert, Rowland & Grubic, Inc. Engineering & Related Services An Employee-Owned Company

Land Studies

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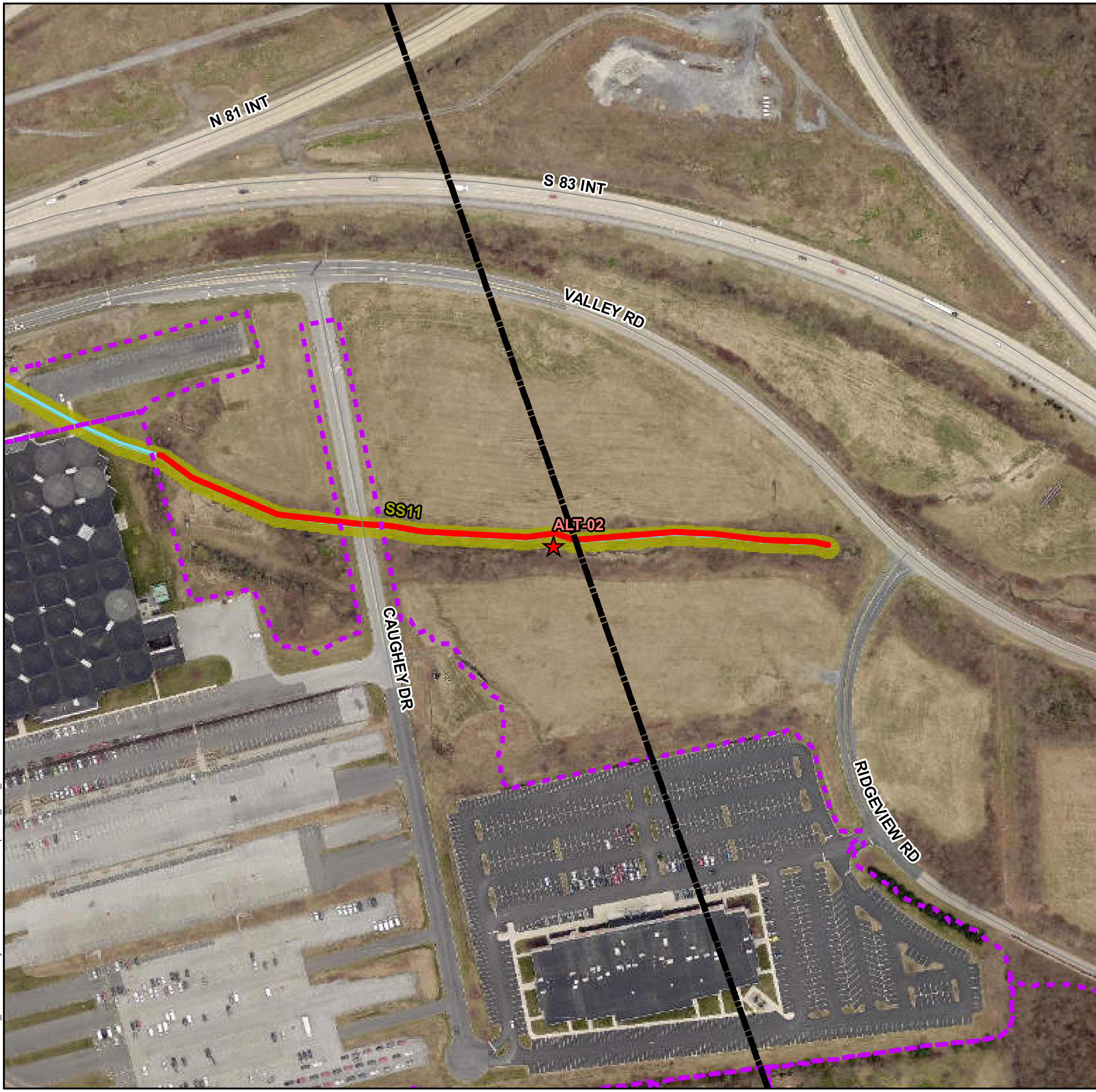
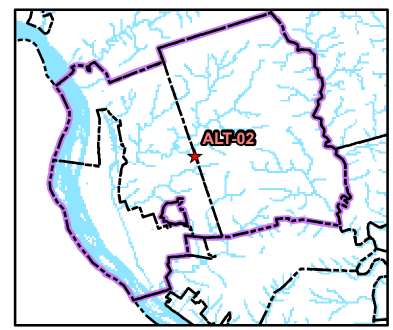


Valley Road ALT-02

Joint Planning Area
Dauphin County, Pennsylvania

Proposed BMP
Proposed Approximate Length Of Stream In Project
Previous Stream Assessment Reach
Non-Impaired Stream
Road
Municipal Boundary
Stormsewer Shed Boundary
Watershed Boundary (HUC-12)



0 250 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

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HRG Herbert, Rowland & Grubic, Inc. Engineering & Related Services An Employee-Owned Company

Land Studies

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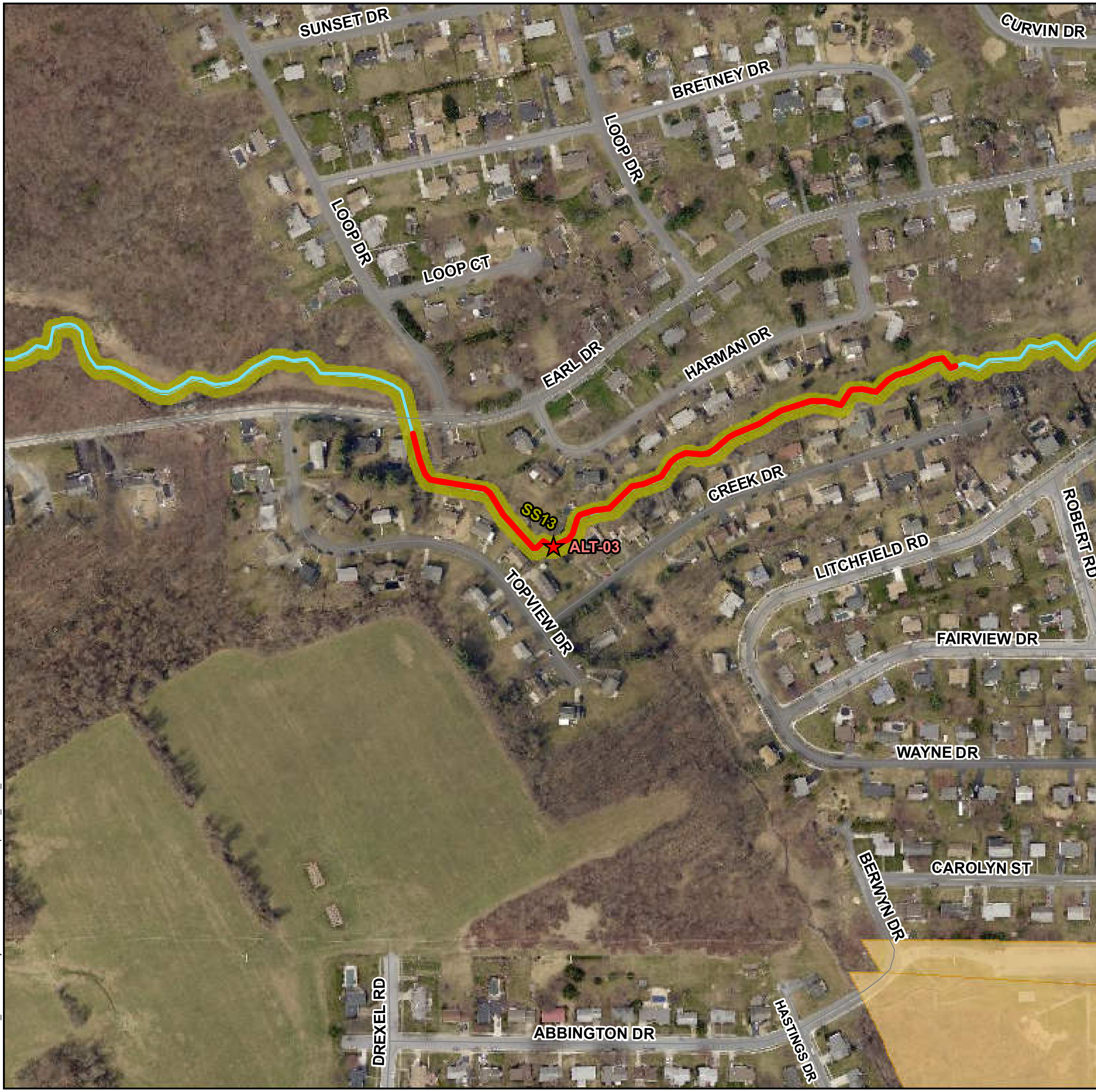

Earl Drive
Phase 01
ALT-03

Joint Planning Area
Dauphin County, Pennsylvania

Proposed BMP
Proposed Approximate Length Of Stream In Project
Previous Stream Assessment Reach
Non-Impaired Stream
Road
Municipal Property
Municipal Boundary
Watershed Boundary (HUC-12)

0 350 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

HRG Herbert, Rowland & Grubic, Inc. Engineering & Related Services An Employee-Owned Company

Land Studies

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Earl Drive
Phase 02
ALT-04

Joint Planning Area
Dauphin County, Pennsylvania

Proposed BMP

Proposed Approximate Length Of Stream In Project

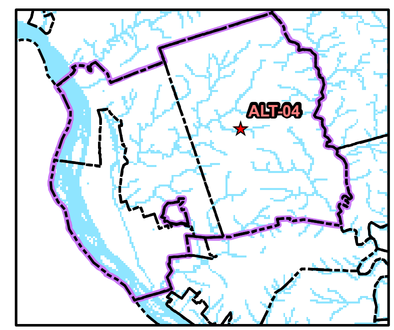
Previous Stream Assessment Reach

Non-Impaired Stream

Road

Municipal Boundary

Watershed Boundary (HUC-12)



0 200 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

HRG Herbert, Rowland & Grubic, Inc. Engineering & Related Services An Employee-Owned Company

Land Studies

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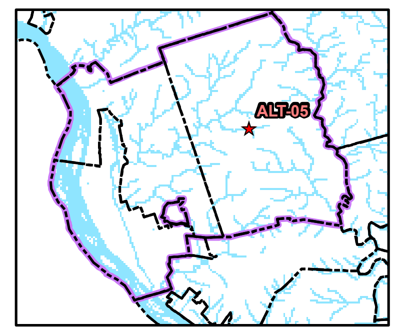
Earl Drive Phase 03 ALT-05

Joint Planning Area
Dauphin County, Pennsylvania

- Proposed BMP
- Proposed Approximate Length Of Stream In Project
- Previous Stream Assessment Reach
- Non-Impaired Stream
- Road
- Municipal Property
- Municipal Boundary
- Watershed Boundary (HUC-12)



0 400 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

HRG Herbert, Rowland & Grubic, Inc. Engineering & Related Services An Employee-Owned Company

Land Studies

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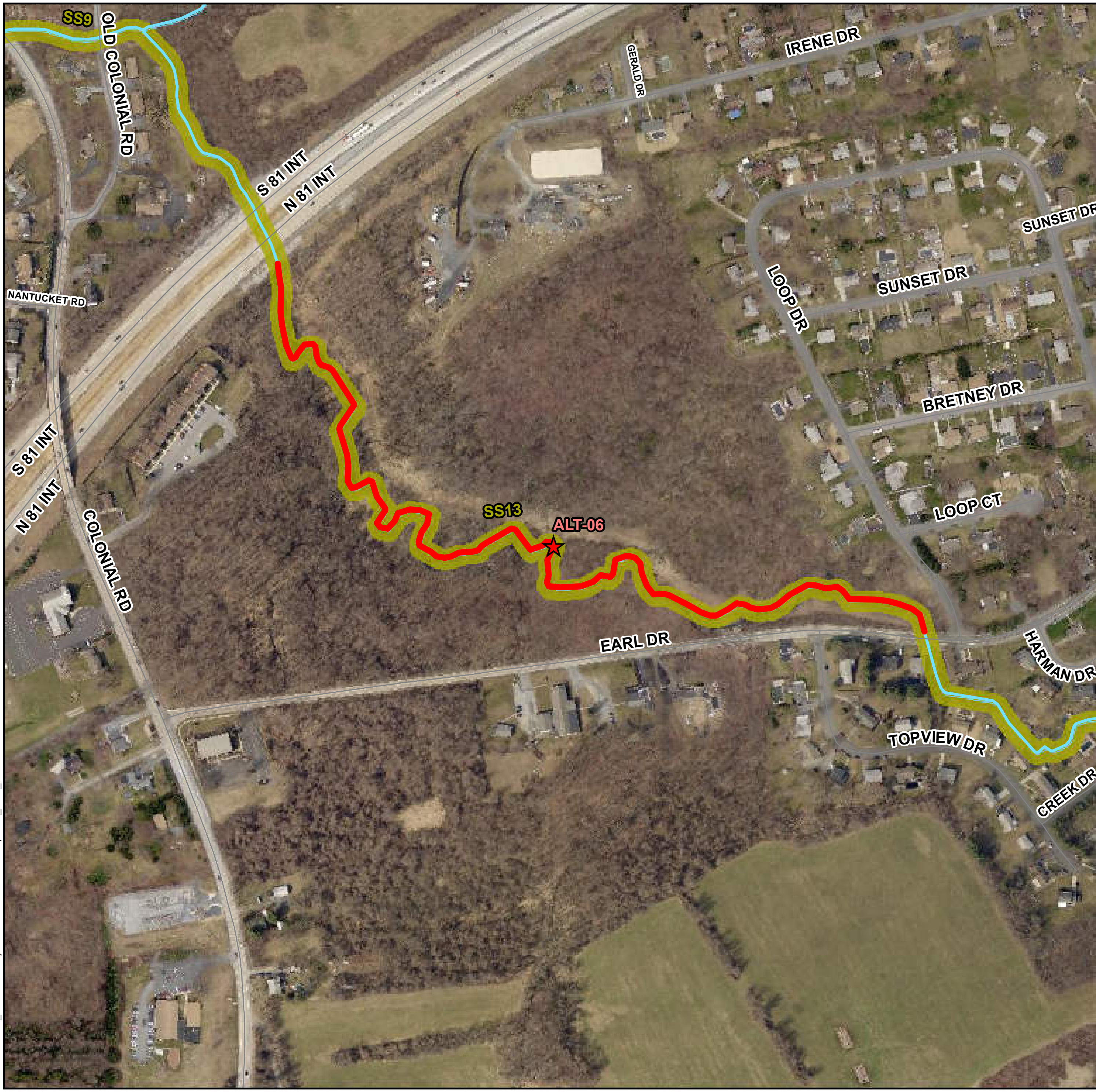
Hankin Property ALT-06

Joint Planning Area
Dauphin County, Pennsylvania



Proposed BMP
Proposed Approximate Length Of Stream In Project
Previous Stream Assessment Reach
Non-Impaired Stream
Road
Municipal Boundary
Watershed Boundary (HUC-12)

0 400 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

HRG Herbert, Rowland & Grubic, Inc. Engineering & Related Services An Employee-Owned Company

Land Studies

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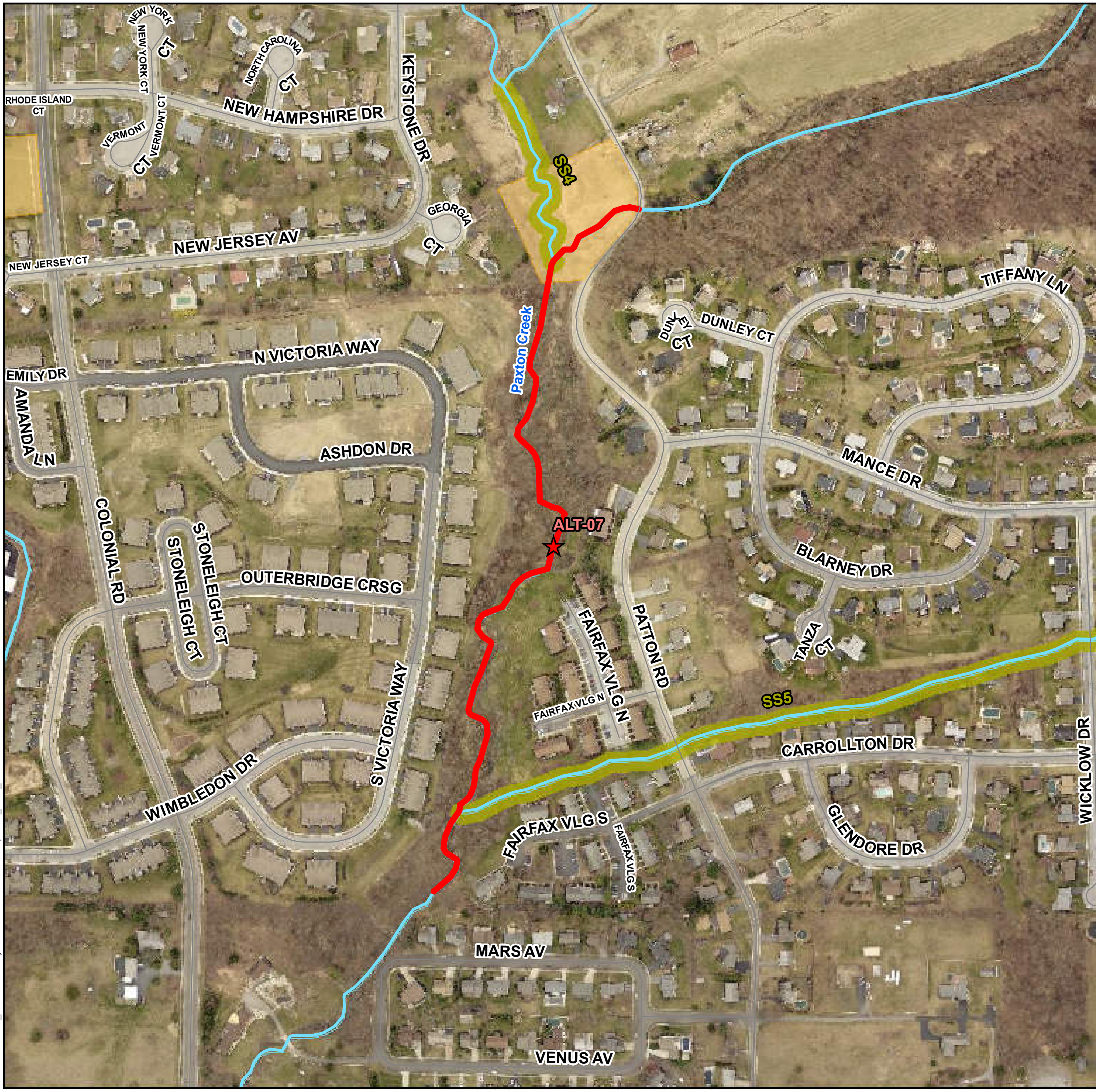
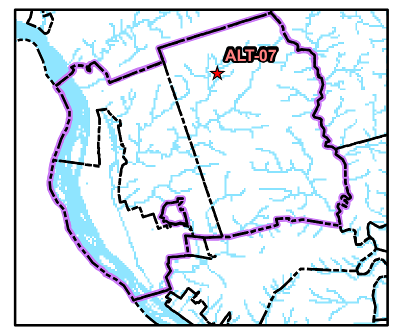


Fairfax Village ALT-07

Joint Planning Area
Dauphin County, Pennsylvania

- Proposed BMP
- Proposed Approximate Length Of Stream In Project
- Previous Stream Assessment Reach
- Non-Impaired Stream
- Road
- Municipal Property
- Municipal Boundary
- Watershed Boundary (HUC-12)



0 400 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

HRG Herbert, Rowland & Grubic, Inc. Engineering & Related Services An Employee-Owned Company

Land Studies

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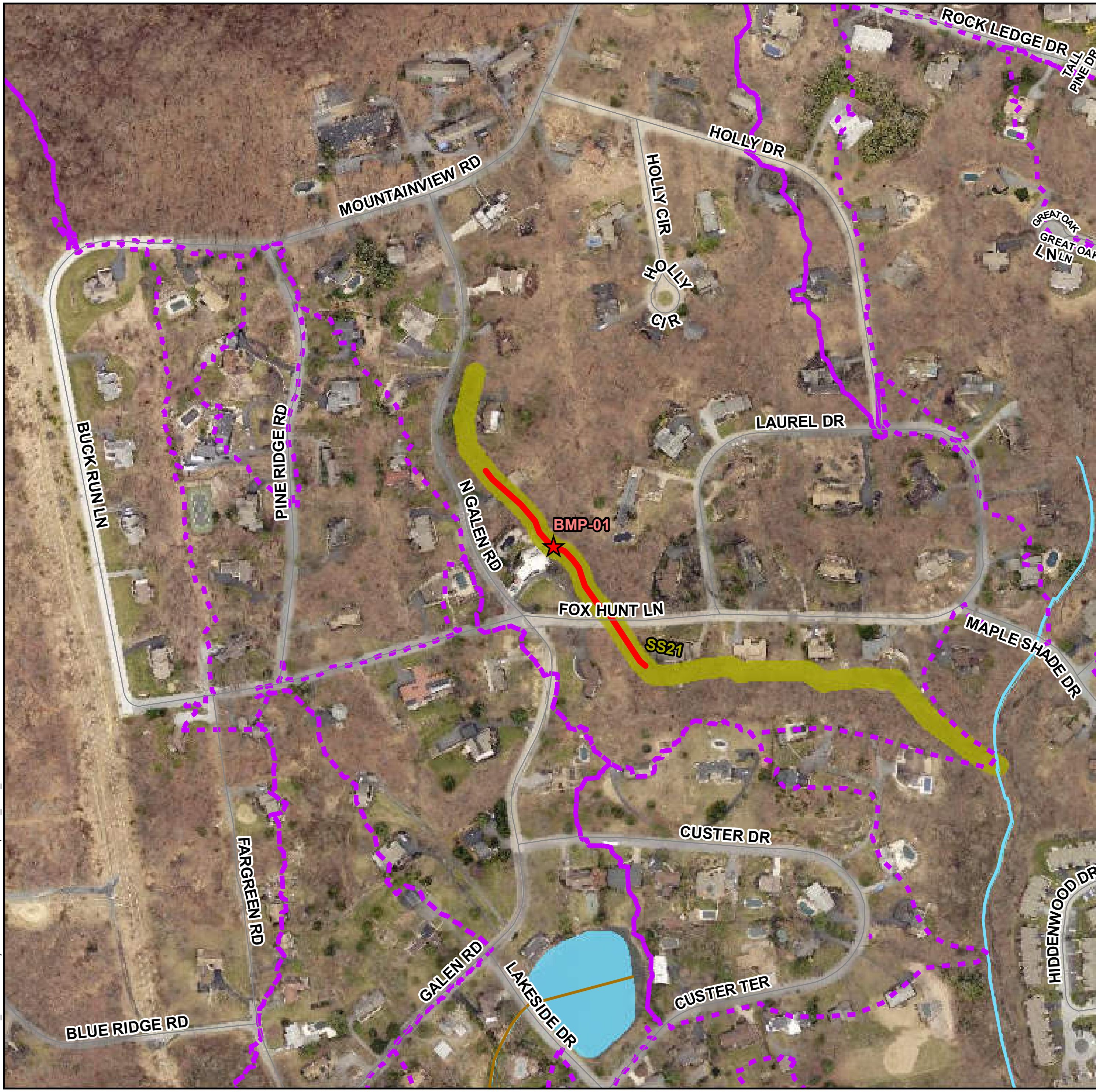
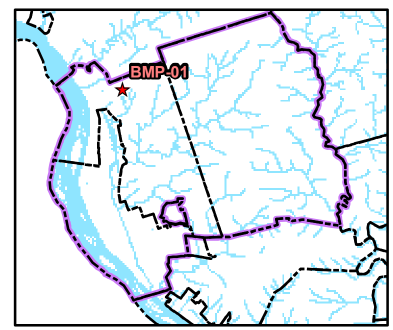
Fox Hunt - Stream Restoration BMP-01

Joint Planning Area
Dauphin County, Pennsylvania



- Proposed BMP
- Proposed Approximate Length Of Stream In Project
- Previous Stream Assessment Reach
- Sediment Impaired Stream
- Non-Impaired Stream
- Road
- Municipal Boundary
- Stormsewer Shed Boundary
- Watershed Boundary (HUC-12)



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Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

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HRG Herbert, Rowland & Grubic, Inc. Engineering & Related Services An Employee-Owned Company

Land Studies

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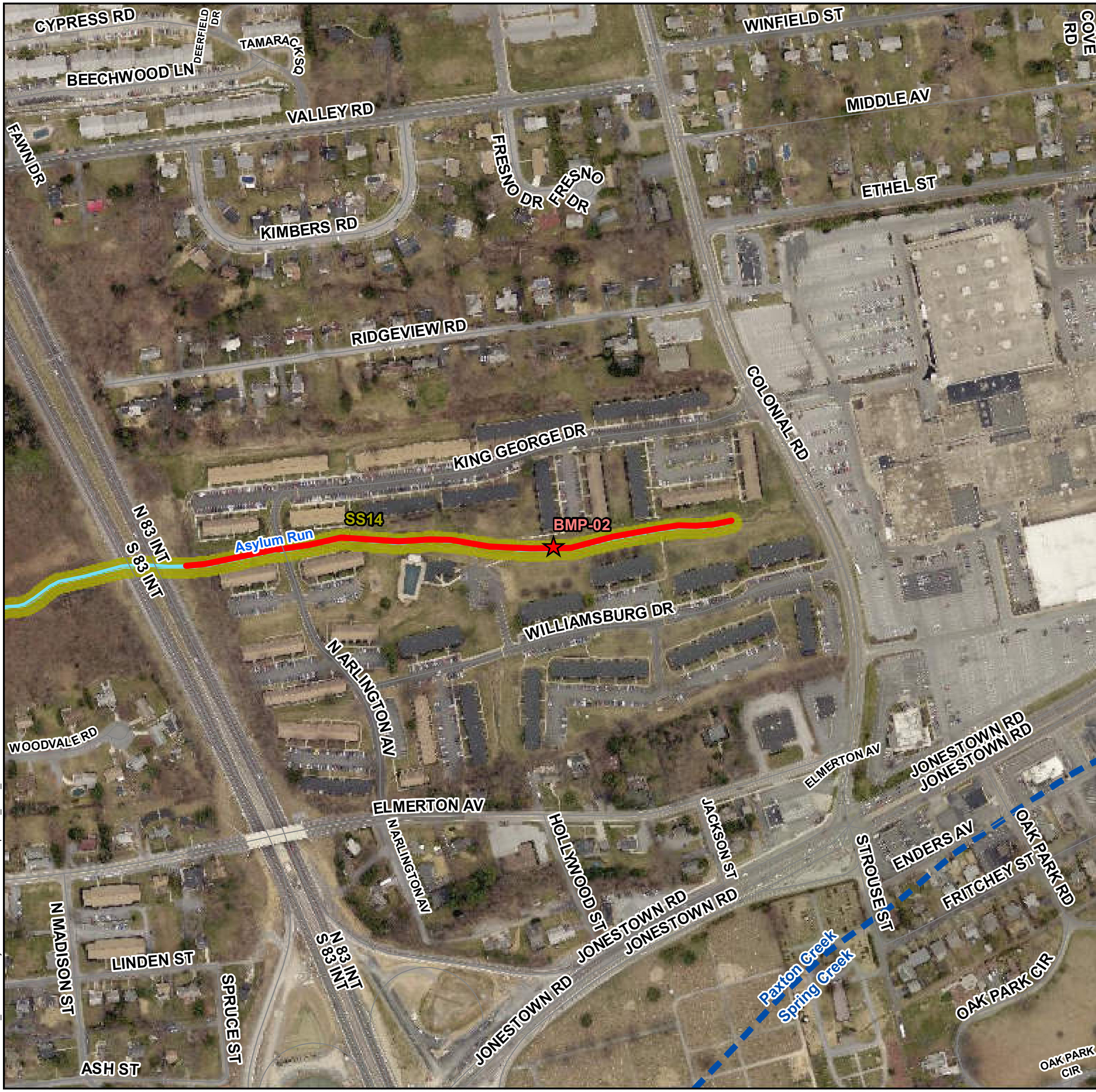
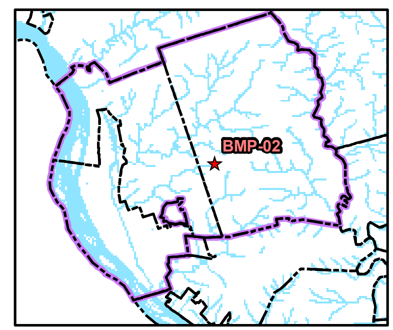


Stonebridge Apartment Complex BMP-02

Joint Planning Area
Dauphin County, Pennsylvania

- Proposed BMP
- Proposed Approximate Length Of Stream In Project
- Previous Stream Assessment Reach
- Sediment Impaired Stream
- Non-Impaired Stream
- Road
- Municipal Boundary
- Watershed Boundary (HUC-12)



0 400 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

HRG Herbert, Rowland & Grubic, Inc. Engineering & Related Services An Employee-Owned Company

Land Studies

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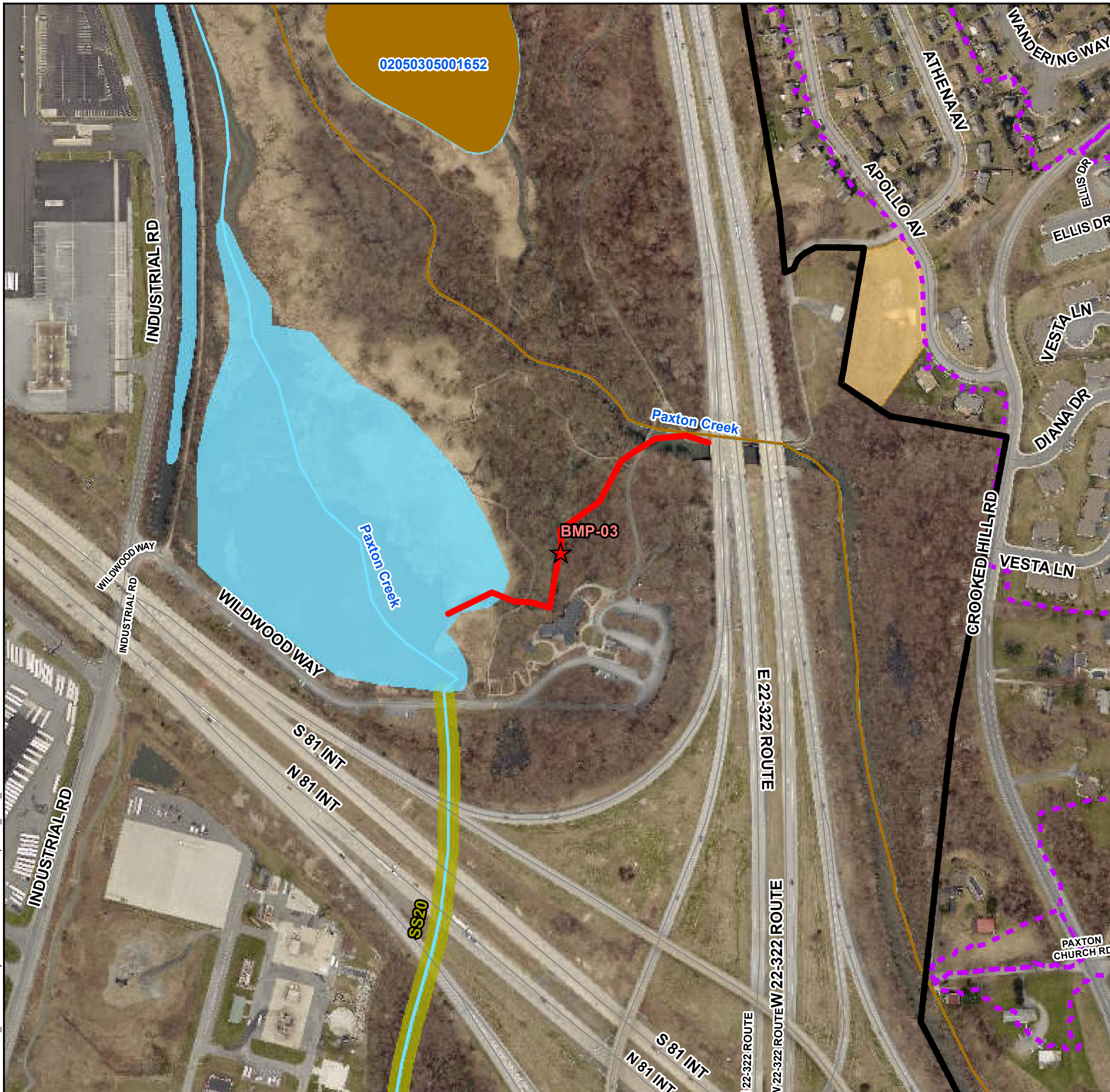
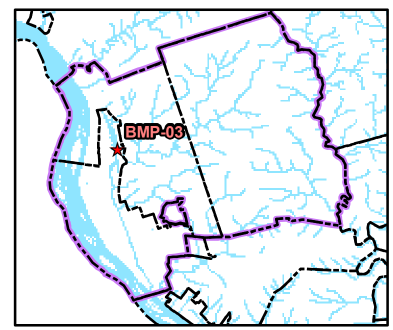


Wildwood Lake, Black Run BMP-03

Joint Planning Area
Dauphin County, Pennsylvania

- Proposed BMP
- Proposed Approximate Length Of Stream In Project
- Previous Stream Assessment Reach
- Sediment Impaired Stream
- Impaired Water Body
- Non-Impaired Stream
- Road
- Municipal Property
- Municipal Boundary
- Stormsewer Shed Boundary
- Watershed Boundary (HUC-12)



0 400 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

HRG Herbert, Rowland & Grubic, Inc. Engineering & Related Services An Employee-Owned Company

Land Studies

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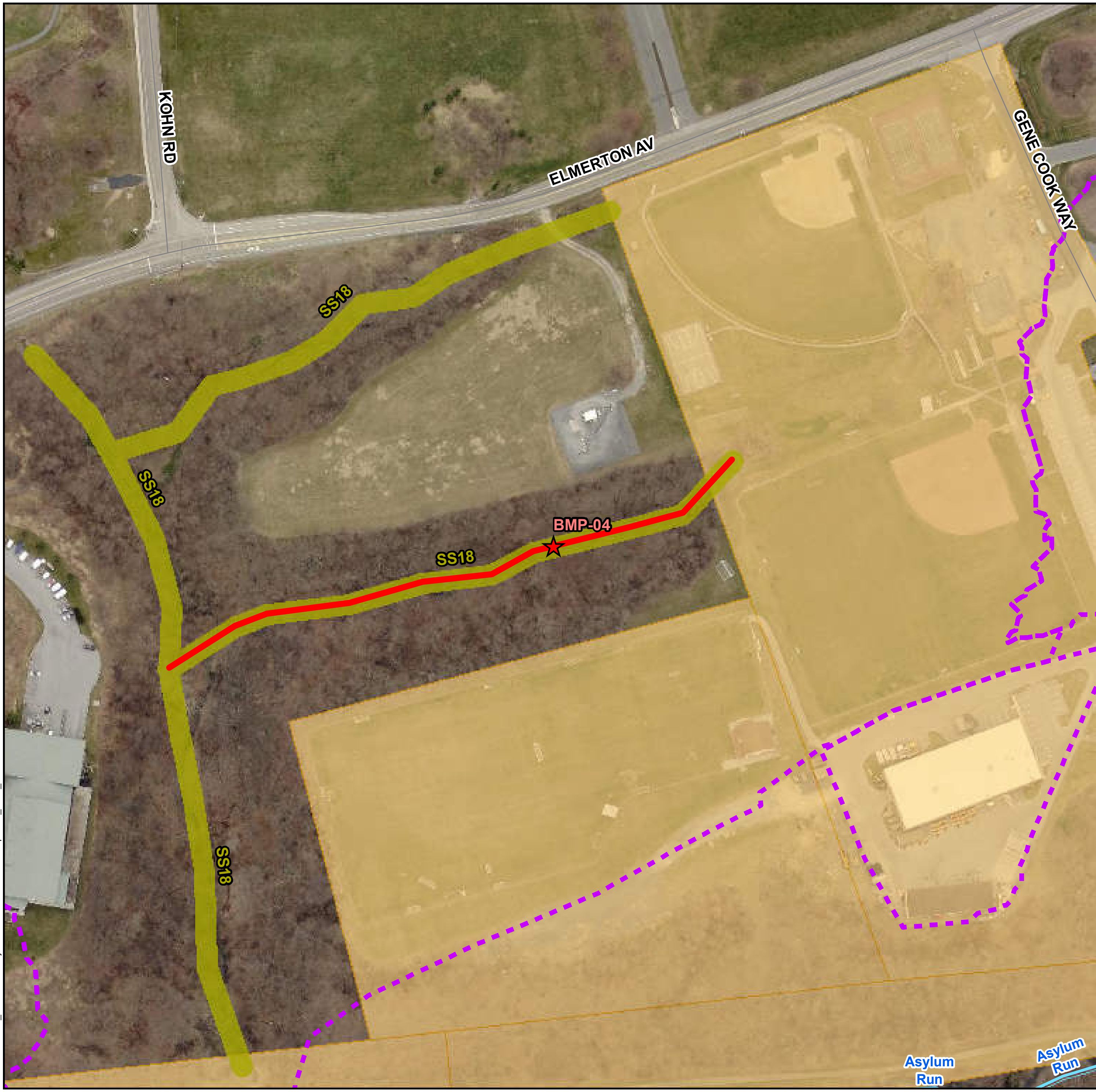
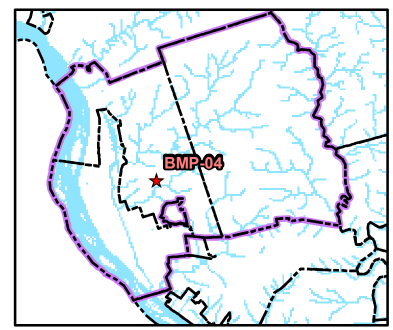


Vetran's Park South BMP-04

Joint Planning Area
Dauphin County, Pennsylvania

- Proposed BMP
- Proposed Approximate Length Of Stream In Project
- Previous Stream Assessment Reach
- Non-Impaired Stream
- Road
- Municipal Property
- Municipal Boundary
- Stormsewer Shed Boundary
- Watershed Boundary (HUC-12)



0 200 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

HRG Herbert, Rowland & Grubic, Inc. Engineering & Related Services An Employee-Owned Company

Land Studies

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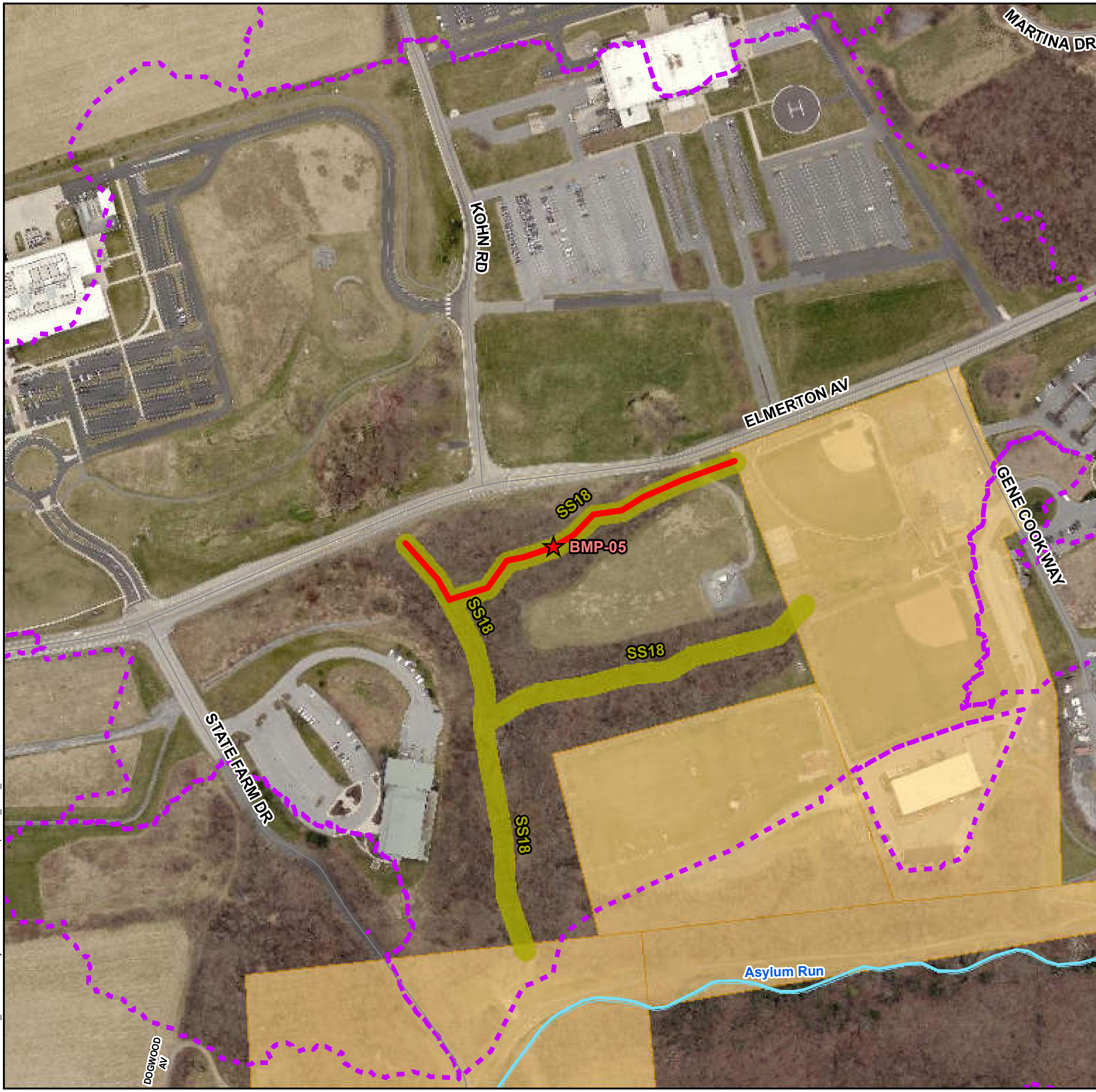
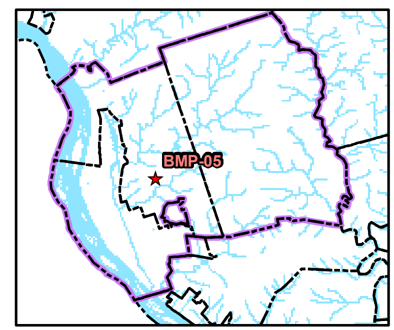


Vetran's Park North BMP-05

Joint Planning Area
Dauphin County, Pennsylvania

- Proposed BMP
- Proposed Approximate Length Of Stream In Project
- Previous Stream Assessment Reach
- Non-Impaired Stream
- Road
- Municipal Property
- Municipal Boundary
- Stormsewer Shed Boundary
- Watershed Boundary (HUC-12)



0 350 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

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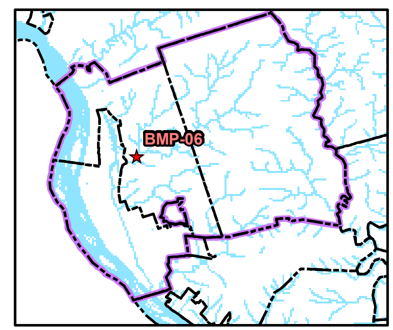
CWP - Shutt Mill Rd Walker Mill Road BMP-06

Joint Planning Area
Dauphin County, Pennsylvania

Proposed BMP
Proposed Approximate Length Of Stream In Project
Previous Stream Assessment Reach
Sediment Impaired Stream
Non-Impaired Stream
Road
Municipal Property
Municipal Boundary
Stormsewer Shed Boundary
Watershed Boundary (HUC-12)



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Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

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Land Studies

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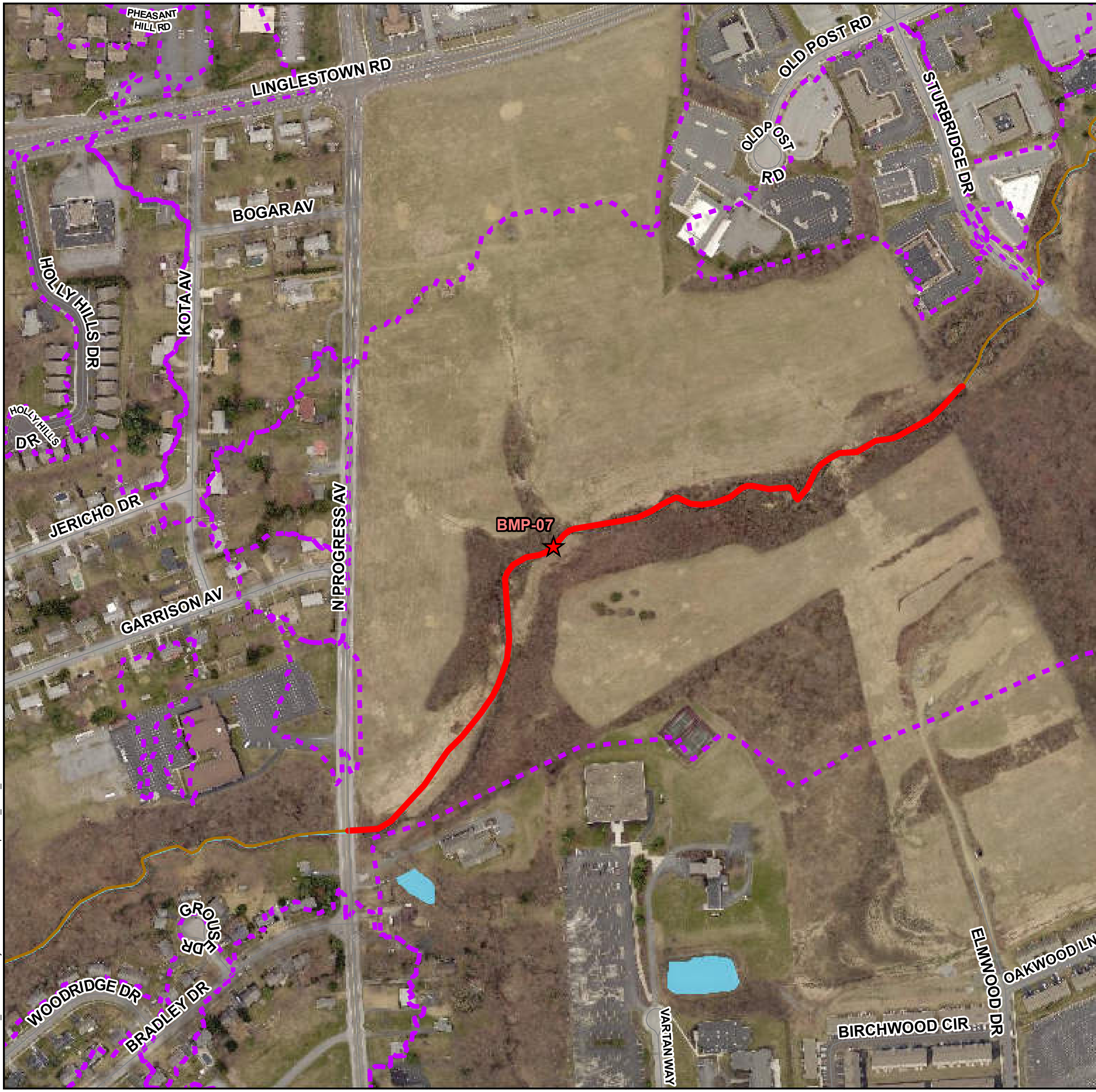
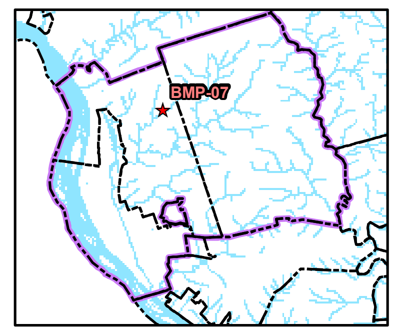


Susquehanna Union Green BMP-07

Joint Planning Area
Dauphin County, Pennsylvania

Proposed BMP
Proposed Approximate Length Of Stream In Project
Sediment Impaired Stream
Road
Municipal Boundary
Stormsewer Shed Boundary
Watershed Boundary (HUC-12)



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Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

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Land Studies

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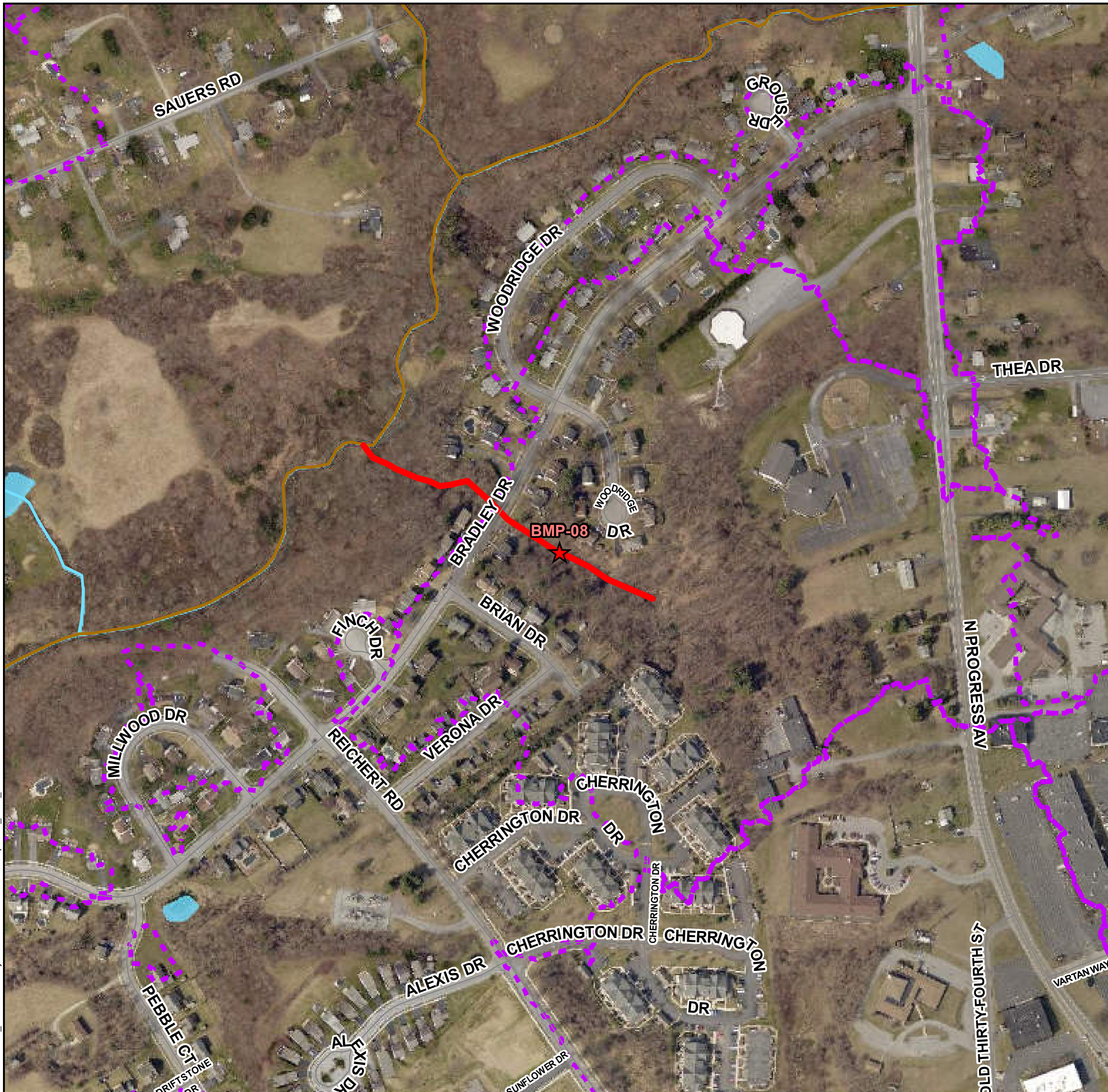
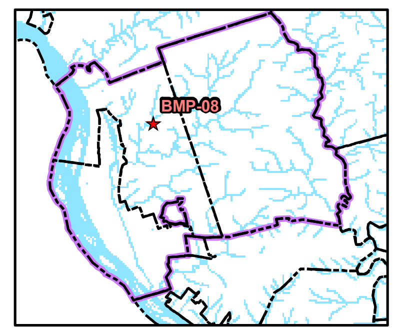
Bradley Dr

BMP-08

Joint Planning Area
Dauphin County, Pennsylvania



Legend:
- Proposed BMP
- Proposed Approximate Length Of Stream In Project
- Sediment Impaired Stream
- Non-Impaired Stream
- Road
- Municipal Boundary
- Stormsewer Shed Boundary
- Watershed Boundary (HUC-12)



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Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

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Land Studies

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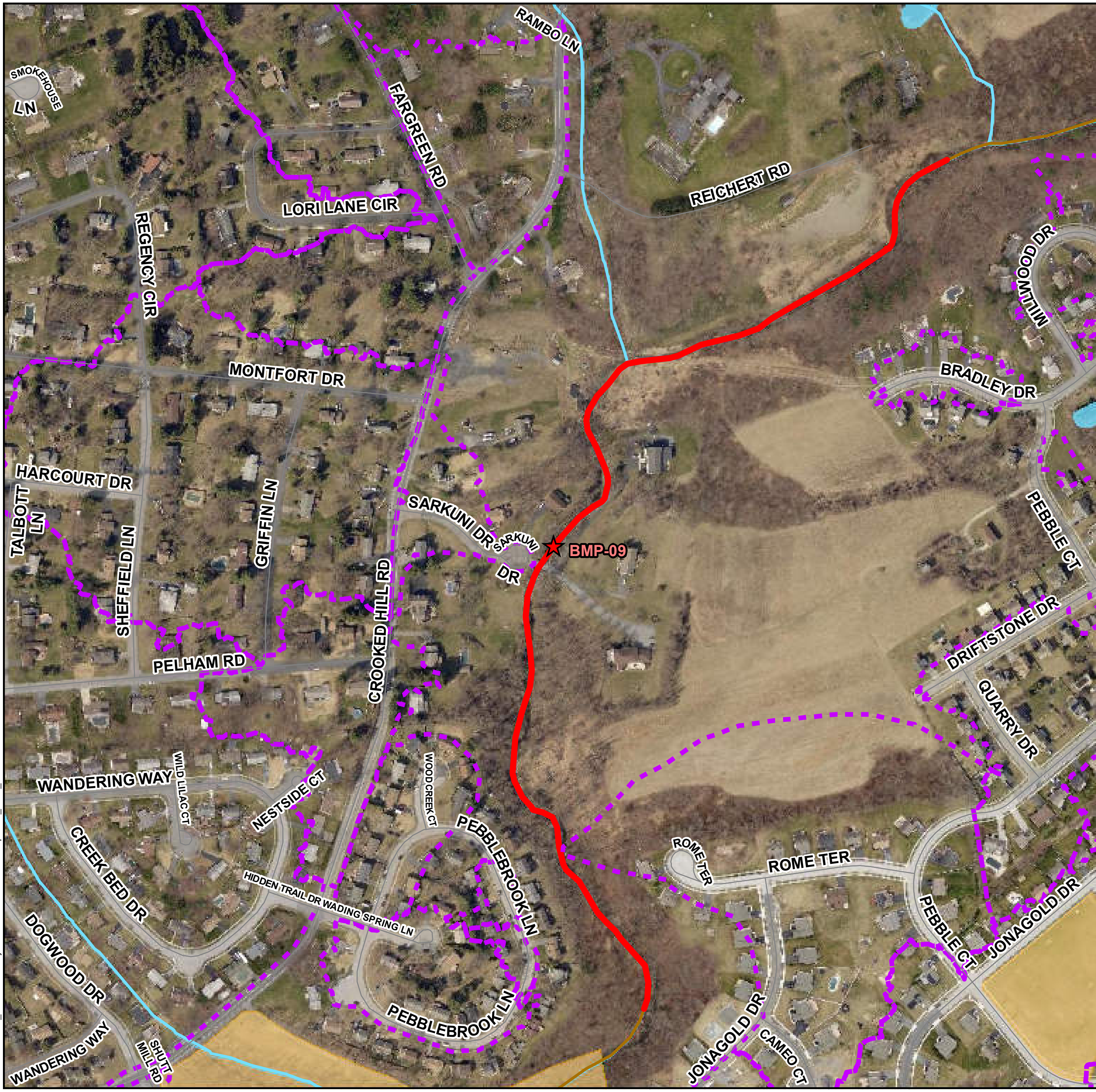
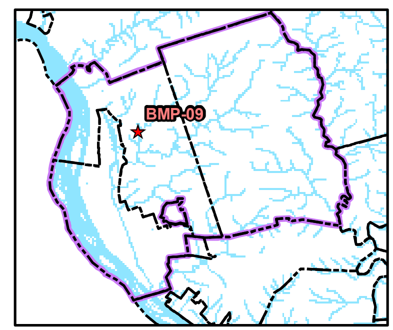


Black Run North BMP-09

Joint Planning Area
Dauphin County, Pennsylvania

- Proposed BMP
- Proposed Approximate Length Of Stream In Project
- Sediment Impaired Stream
- Non-Impaired Stream
- Road
- Municipal Property
- Municipal Boundary
- Stormsewer Shed Boundary
- Watershed Boundary (HUC-12)



0 400 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

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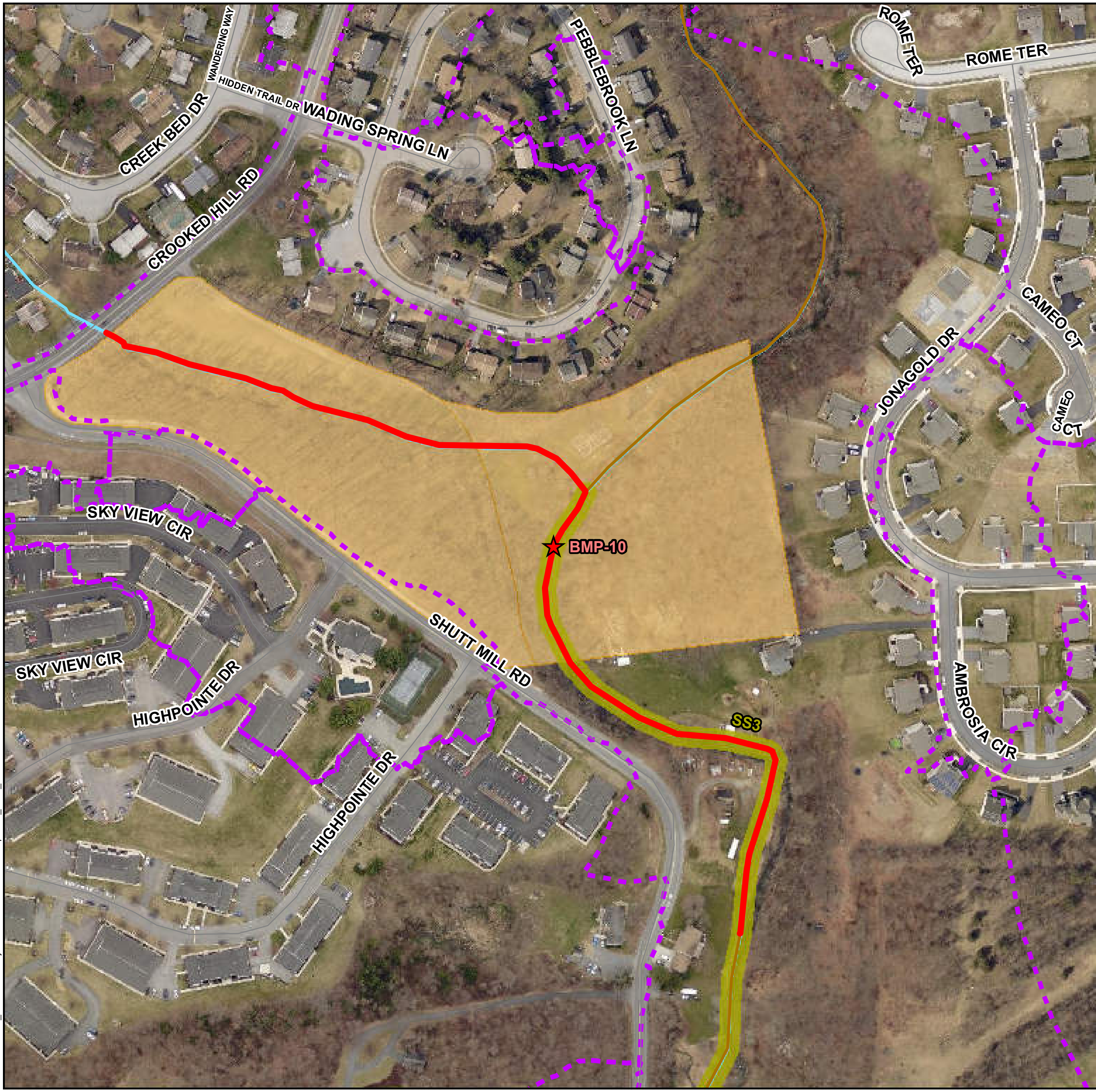
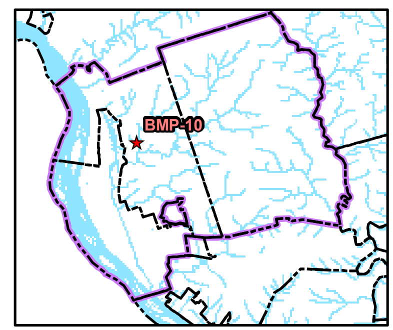
Land Studies



Black Run South BMP-10

Joint Planning Area
Dauphin County, Pennsylvania

- Proposed BMP
- Proposed Approximate Length Of Stream In Project
- Previous Stream Assessment Reach
- Sediment Impaired Stream
- Non-Impaired Stream
- Road
- Municipal Property
- Municipal Boundary
- Stormsewer Shed Boundary
- Watershed Boundary (HUC-12)



0 250 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

HRG Herbert, Rowland & Grubic, Inc. Engineering & Related Services An Employee-Owned Company

Land Studies

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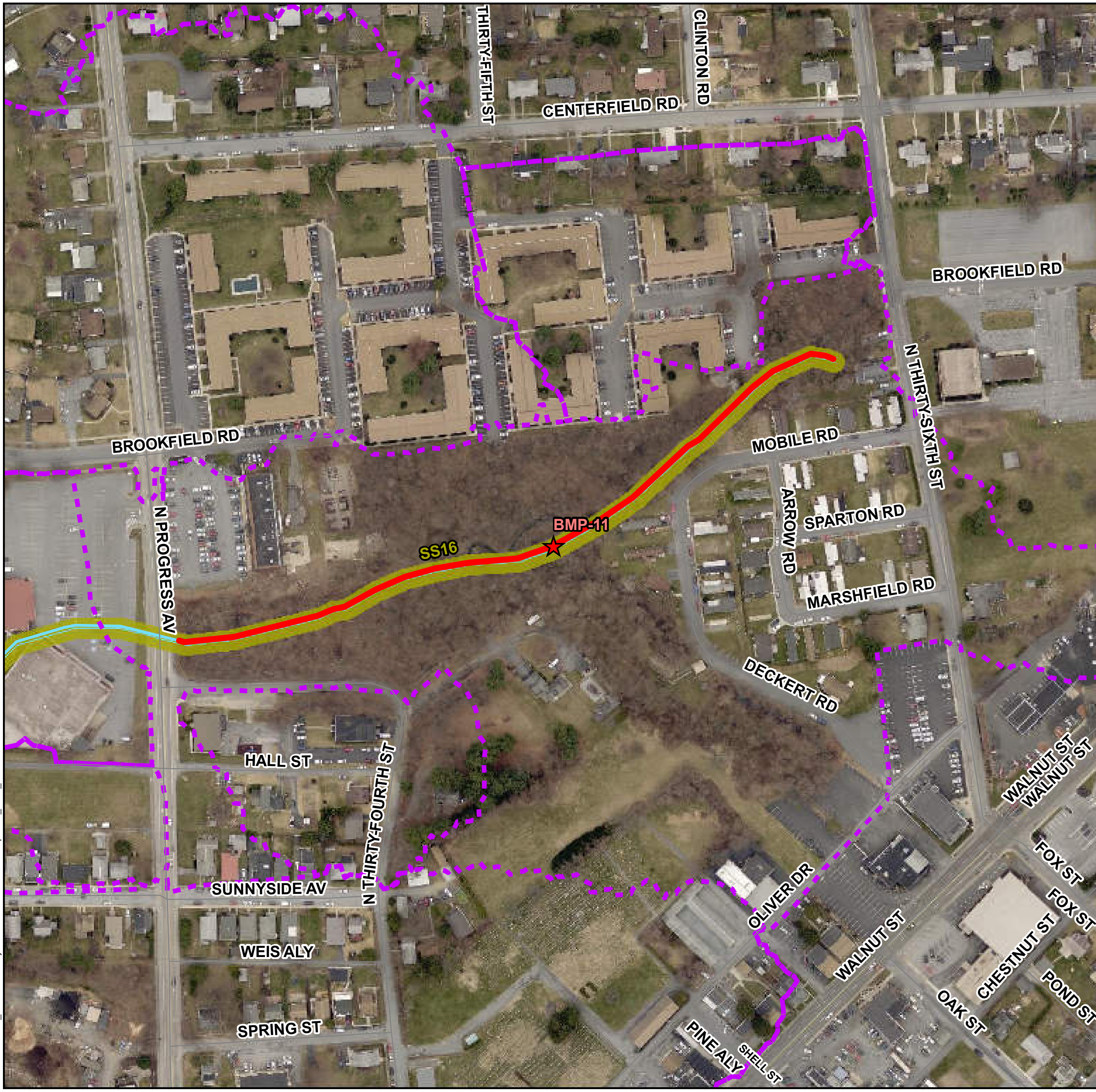


Pines Apartment Complex BMP-11

Joint Planning Area
Dauphin County, Pennsylvania

Proposed BMP

Proposed Approximate Length Of Stream In Project

Previous Stream Assessment Reach

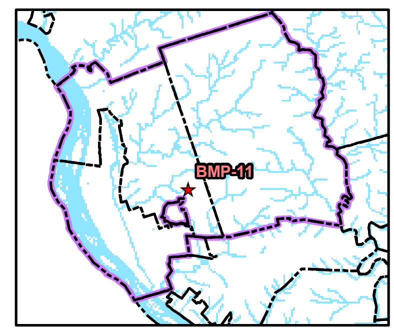
Non-Impaired Stream

Road

Municipal Boundary

Stormsewer Shed Boundary

Watershed Boundary (HUC-12)



0 250 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

HRG Herbert, Rowland & Grubic, Inc. Engineering & Related Services An Employee-Owned Company

Land Studies

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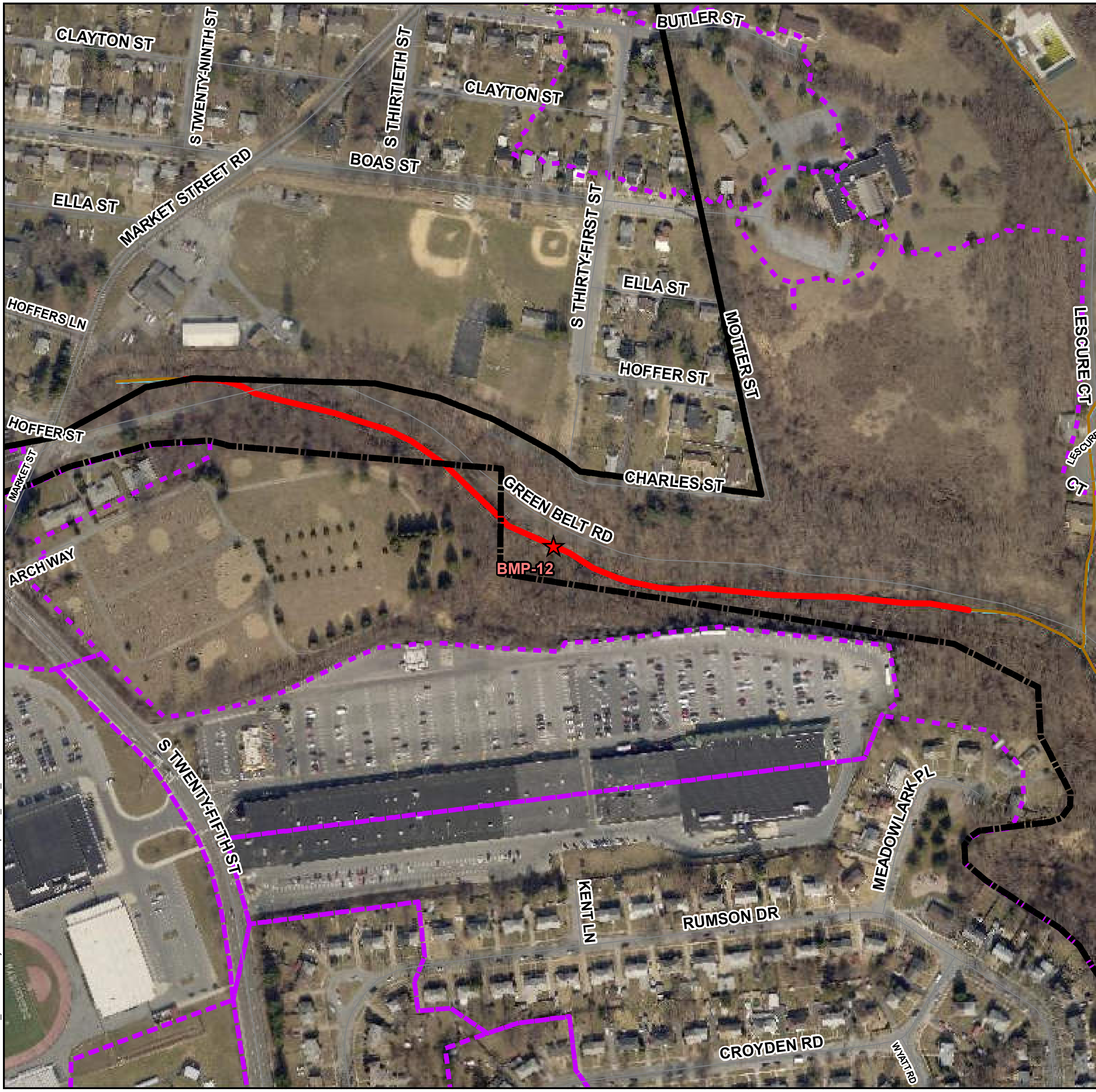
Capital Area Greenbelt BMP-12

Joint Planning Area
Dauphin County, Pennsylvania



Proposed BMP

Proposed Approximate Length Of Stream In Project

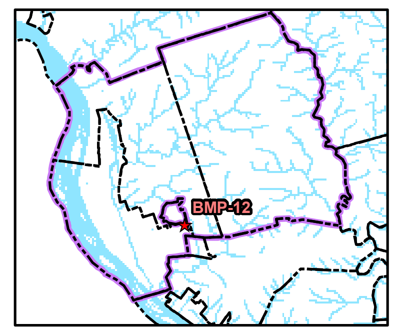
Sediment Impaired Stream

Road

Municipal Boundary

Stormsewer Shed Boundary

Watershed Boundary (HUC-12)



0 300 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

HRG Herbert, Rowland & Grubic, Inc. Engineering & Related Services An Employee-Owned Company

Land Studies

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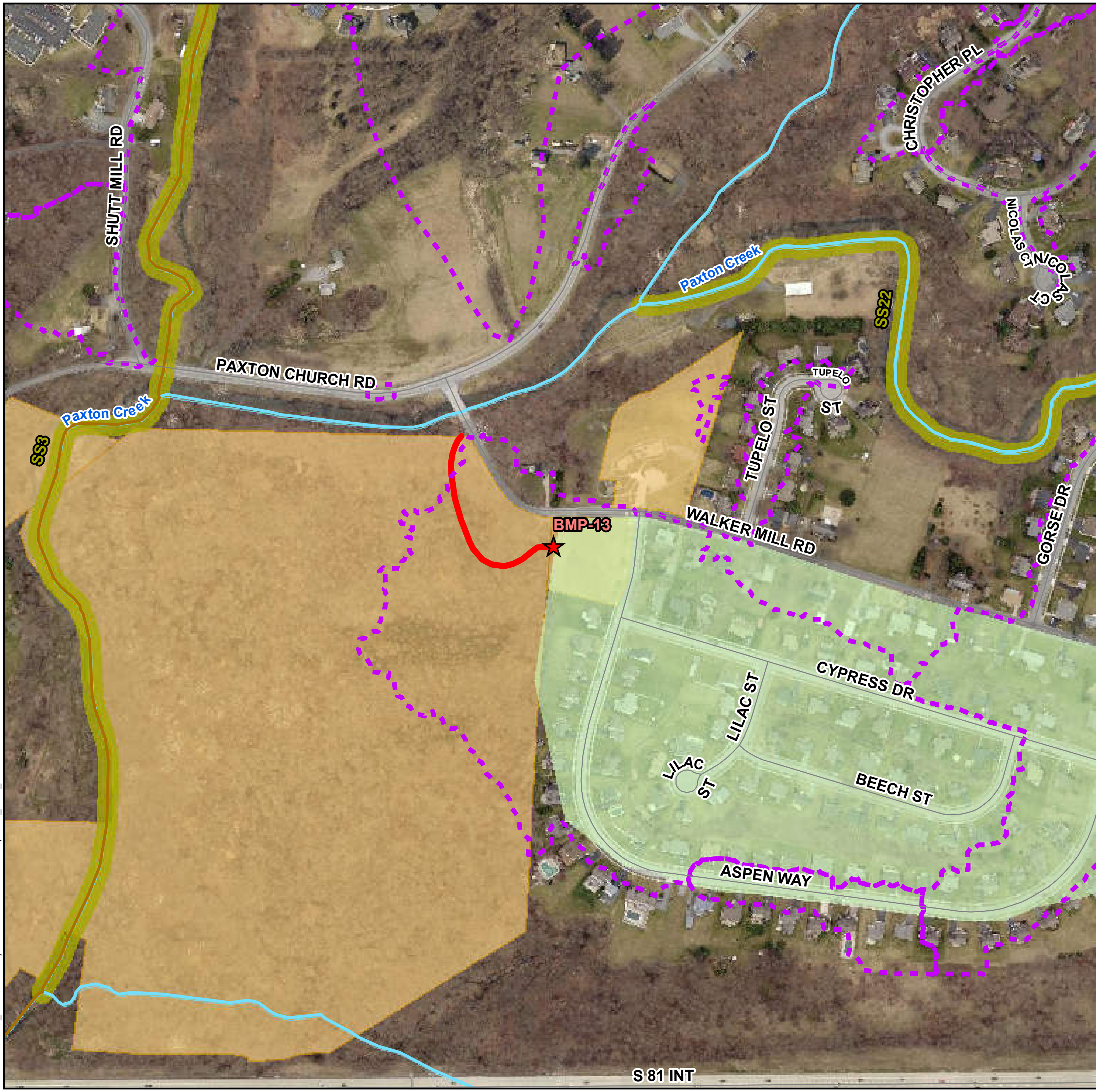
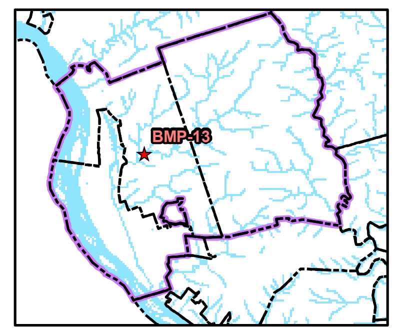
Walker Mill Road Stream and Retrofit BMP-13

Joint Planning Area
Dauphin County, Pennsylvania



- Proposed BMP
- BMP Drainage Area
- Proposed Approximate Length Of Stream In Project
- Previous Stream Assessment Reach
- Sediment Impaired Stream
- Non-Impaired Stream
- Road
- Municipal Property
- Municipal Boundary
- Stormsewer Shed Boundary
- Watershed Boundary (HUC-12)



0 400 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

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Land Studies

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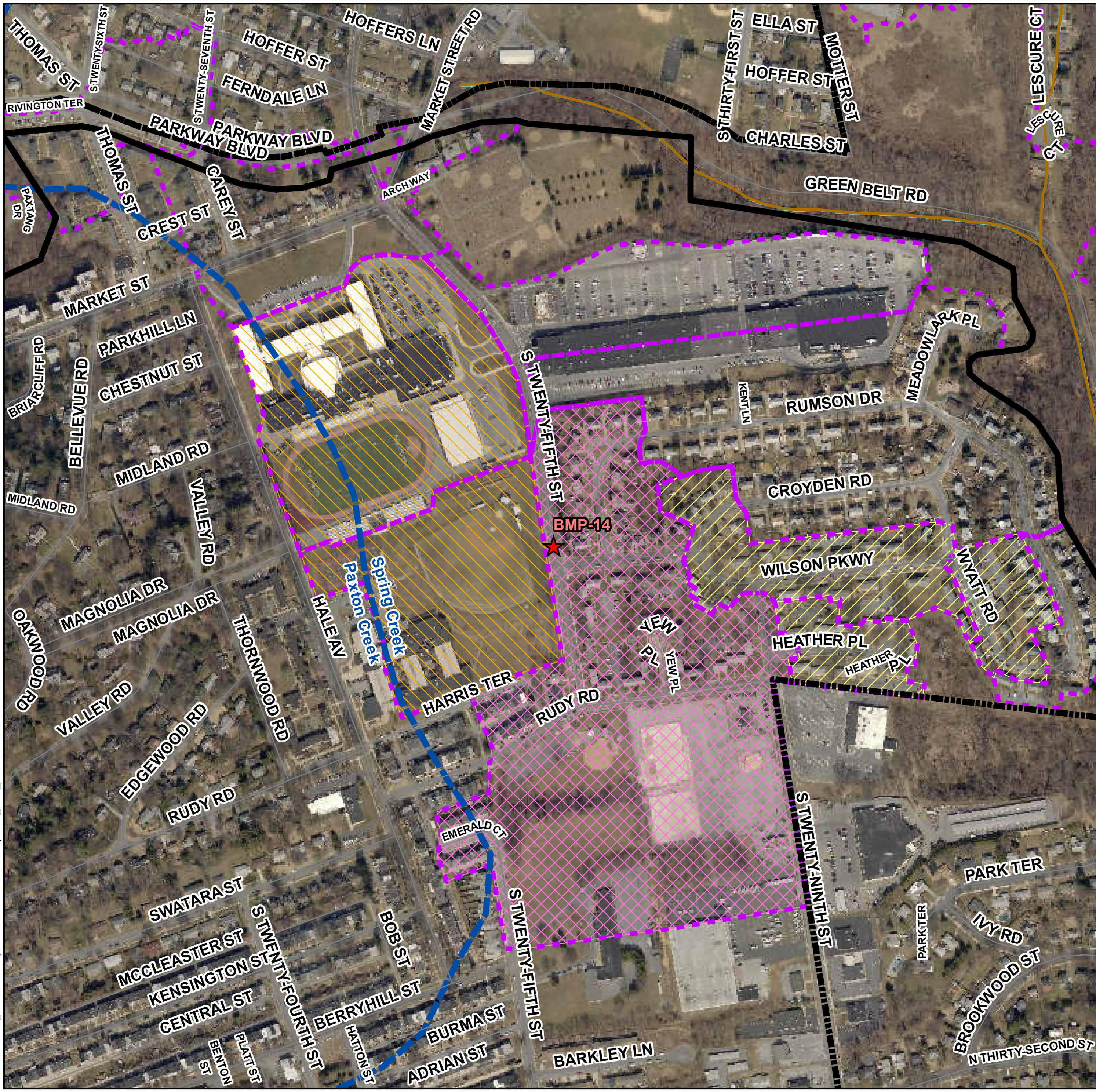


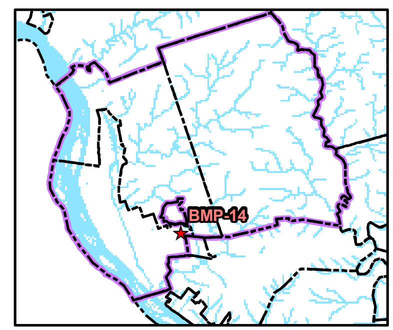
UNT To Spring Creek BMP-14

Joint Planning Area
Dauphin County, Pennsylvania

- ★ Proposed BMP
- Sediment Impaired Stream
- Road
- Municipal Boundary
- Stormsewer Shed Boundary
- Watershed Boundary (HUC-12)

Potential BMP Site

- Harrisburg High School GSI
- School District Park GSI & Detention Facility
- Wilson Parkway & Wyatt Road Detention Facility



0 500 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

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Land Studies

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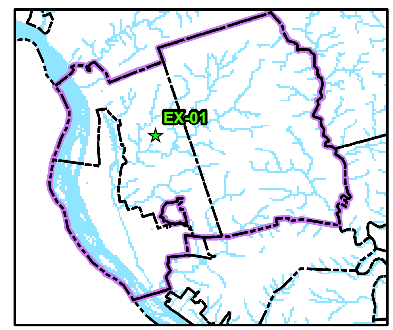
Paxton Church/Reichert Rd.

Rain Garden and Stream Restoration (240 ft.)

EX-01

Joint Planning Area
Dauphin County, Pennsylvania

Legend:
- Existing BMP
- BMP Drainage Area
- Road
- Municipal Boundary
- Stormsewer Shed Boundary
- Watershed Boundary (HUC-12)



0 350 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

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HRG Herbert, Rowland & Grubic, Inc. Engineering & Related Services An Employee-Owned Company

Land Studies

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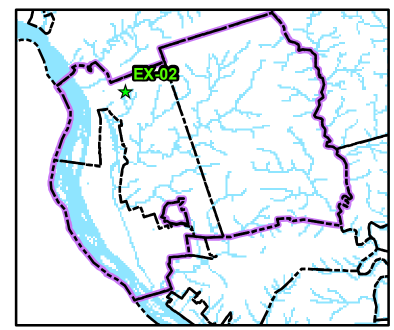
Fox Hunt Rd.

Stream Restoration (375 ft.)

EX-02

Joint Planning Area
Dauphin County, Pennsylvania

- Existing BMP
- Existing Approximate Length Of Stream In Project
- Previous Stream Assessment Reach
- Sediment Impaired Stream
- Non-Impaired Stream
- Road
- Municipal Boundary
- Stormsewer Shed Boundary
- Watershed Boundary (HUC-12)



0 250 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

HRG Herbert, Rowland & Grubic, Inc. Engineering & Related Services An Employee-Owned Company

Land Studies

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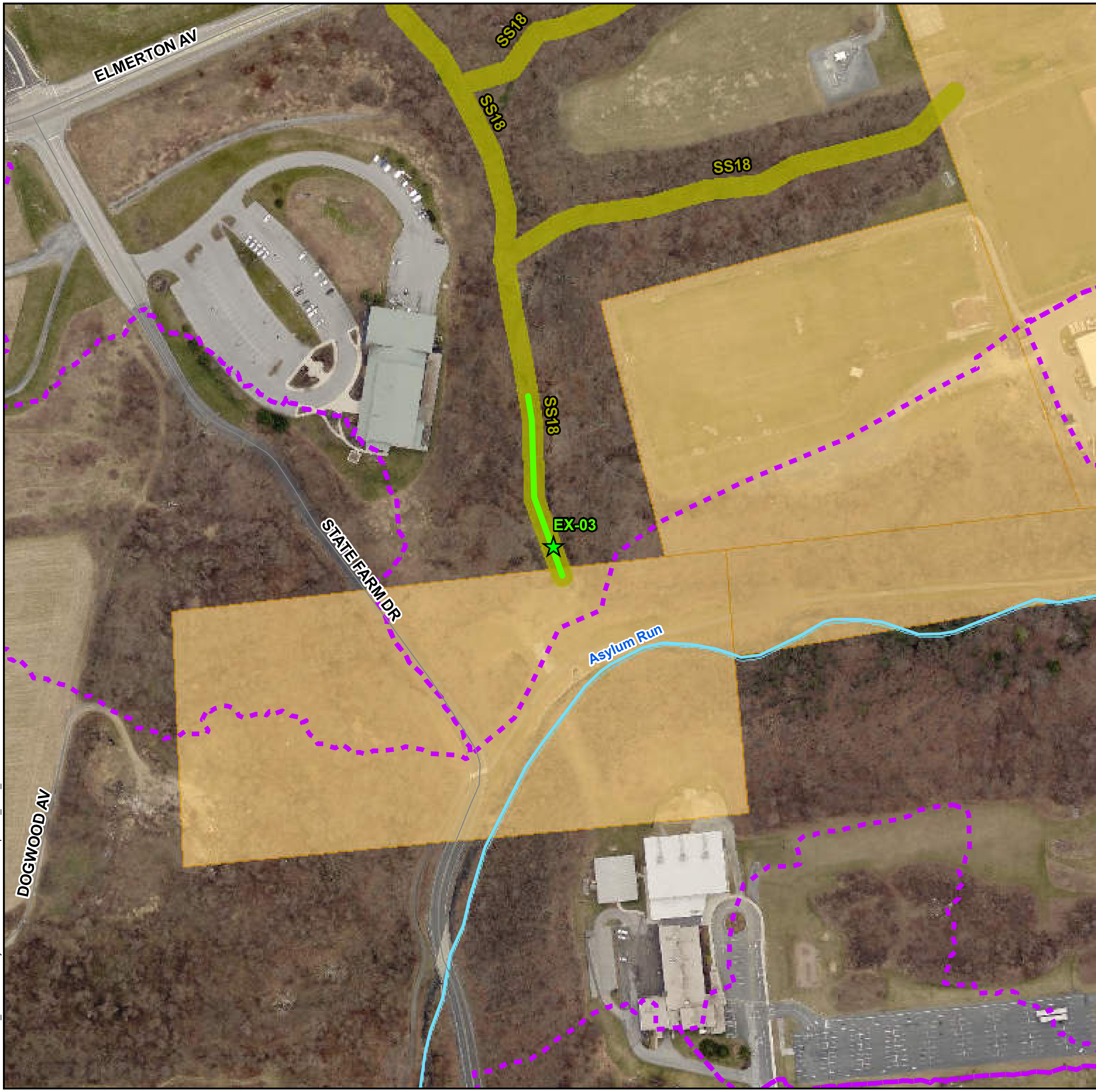


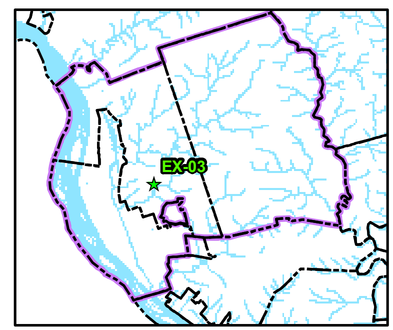
UNT to Asylum Run

Retention Basin and Stream Restoration (350 ft.)

EX-03

Joint Planning Area
Dauphin County, Pennsylvania

Existing BMP
Existing Approximate Length Of Stream In Project
Previous Stream Assessment Reach
Non-Impaired Stream
Road
Municipal Property
Municipal Boundary
Stormsewer Shed Boundary
Watershed Boundary (HUC-12)



0 250 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

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HRG Herbert, Rowland & Grubic, Inc. Engineering & Related Services An Employee-Owned Company

Land Studies

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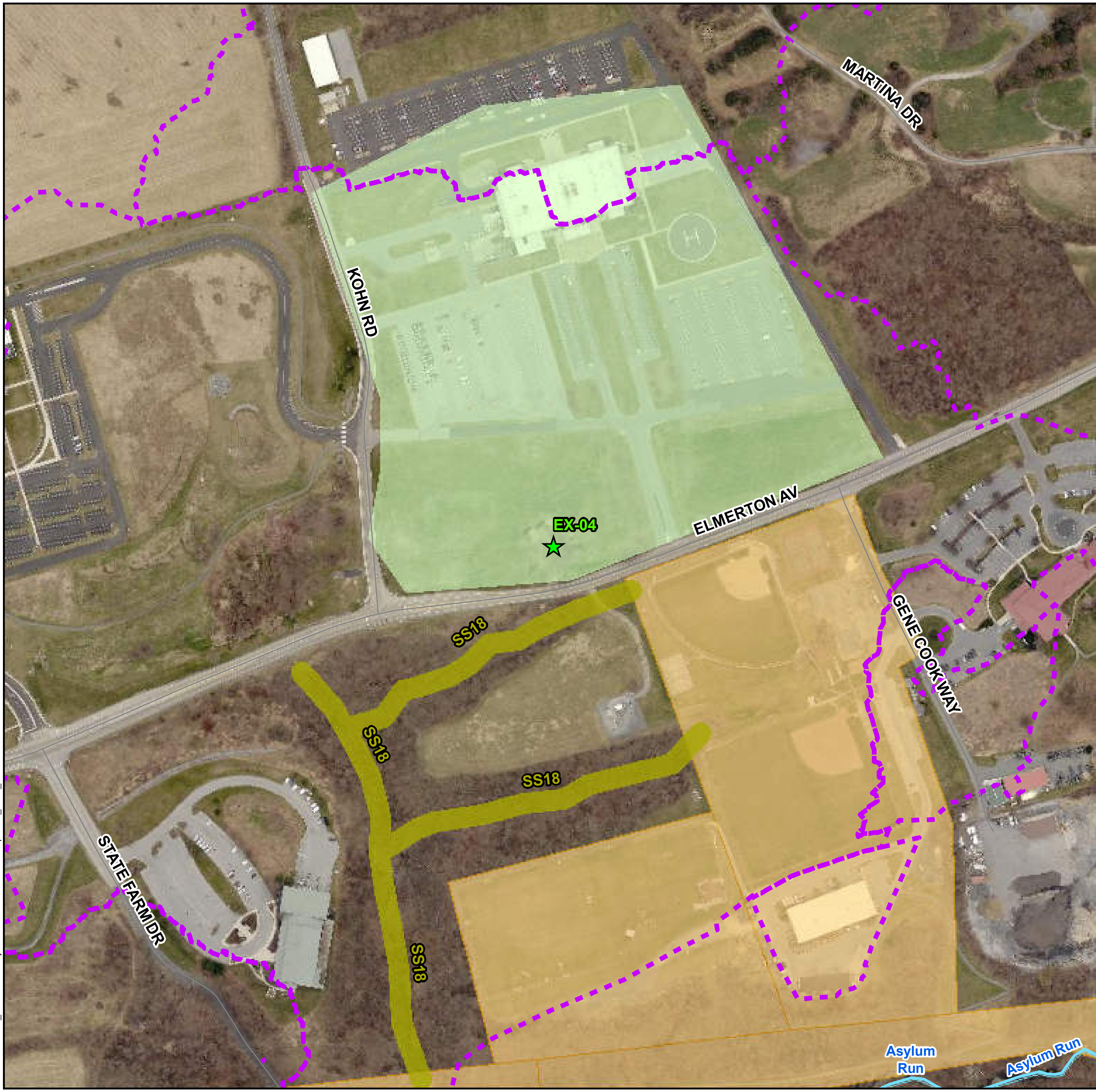
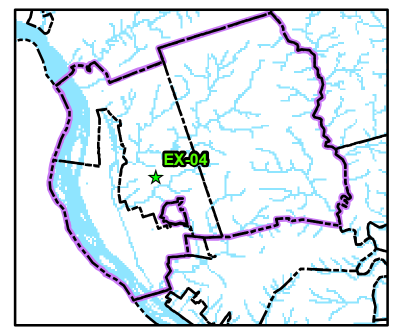
Elmerton Ave Bio-retention Basin EX-04

Joint Planning Area
Dauphin County, Pennsylvania



Existing BMP
BMP Drainage Area
Previous Stream Assessment Reach
Non-Impaired Stream
Road
Municipal Property
Municipal Boundary
Stormsewer Shed Boundary
Watershed Boundary (HUC-12)



0 350 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

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Land Studies

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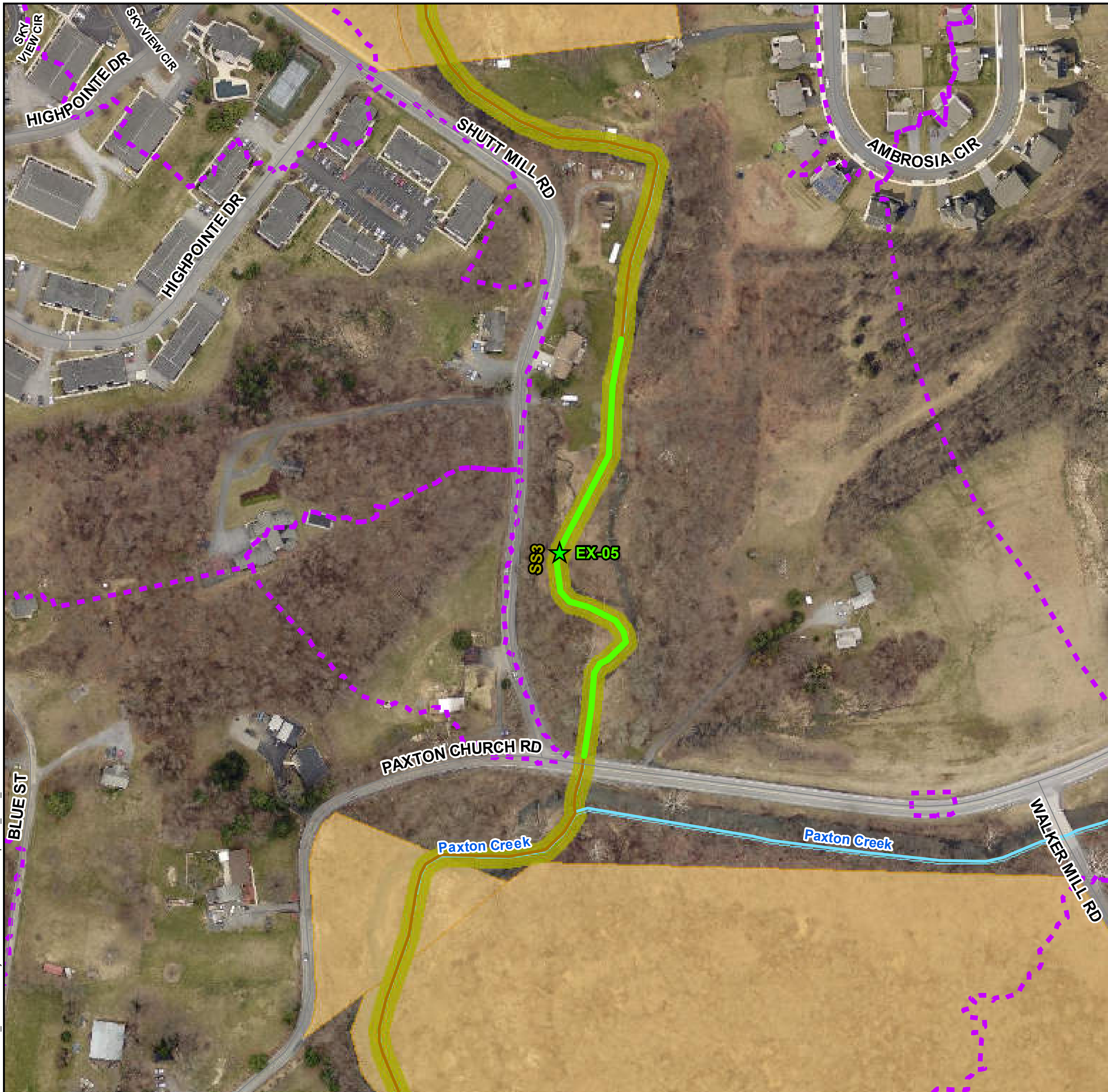
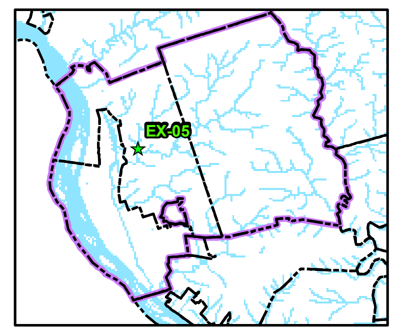


Black Run
Stream Restoration (800 ft.)
EX-05

Joint Planning Area
Dauphin County, Pennsylvania

- Existing BMP
- Existing Approximate Length Of Stream In Project
- Previous Stream Assessment Reach
- Sediment Impaired Stream
- Non-Impaired Stream
- Road
- Municipal Property
- Municipal Boundary
- Stormsewer Shed Boundary
- Watershed Boundary (HUC-12)



0 250 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

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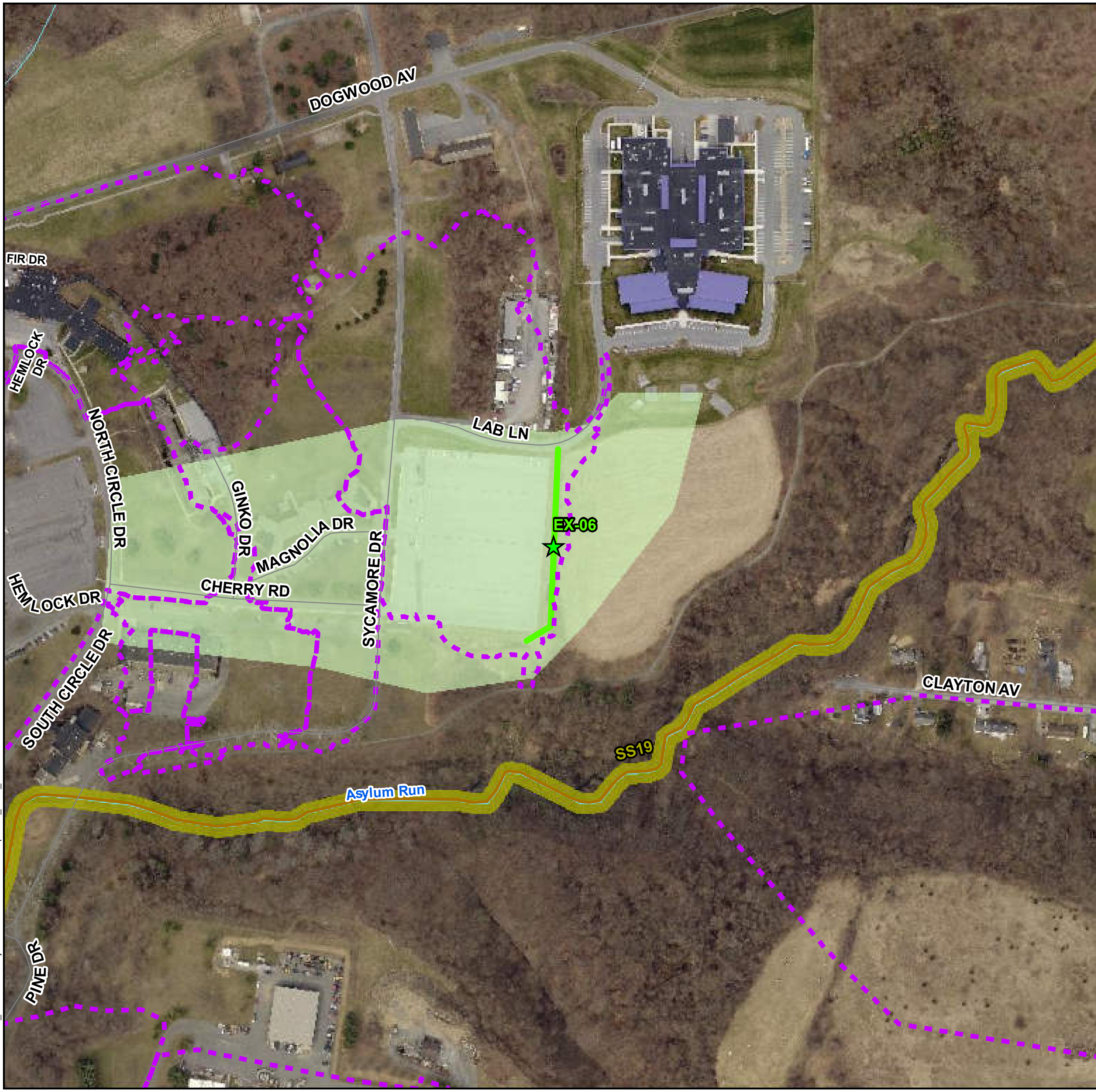
Land Studies

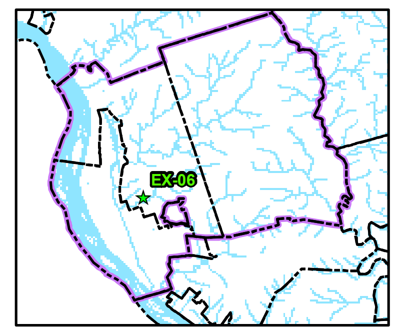
Asylum Run Bio-retention and Stream Restoration (400 ft.)

EX-06

Joint Planning Area
Dauphin County, Pennsylvania



Existing BMP
BMP Drainage Area
Existing Approximate Length Of Stream In Project
Previous Stream Assessment Reach
Sediment Impaired Stream
Road
Municipal Boundary
Stormsewer Shed Boundary
Watershed Boundary (HUC-12)



0 350 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

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Land Studies

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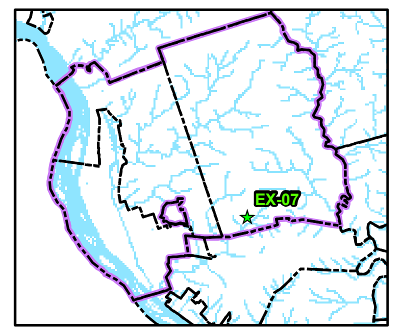
Dowhower Rd Buffer and Stream Restoration (1,220 ft.)

EX-07

Joint Planning Area
Dauphin County, Pennsylvania

- Existing BMP
- Existing Approximate Length Of Stream In Project
- Sediment Impaired Stream
- Non-Impaired Stream
- Road
- Municipal Property
- Municipal Boundary
- Watershed Boundary (HUC-12)



0 400 Feet

Mapping derived from data provided by CDM Smith, Dauphin County, PA DEP, USGS, and ESRI.

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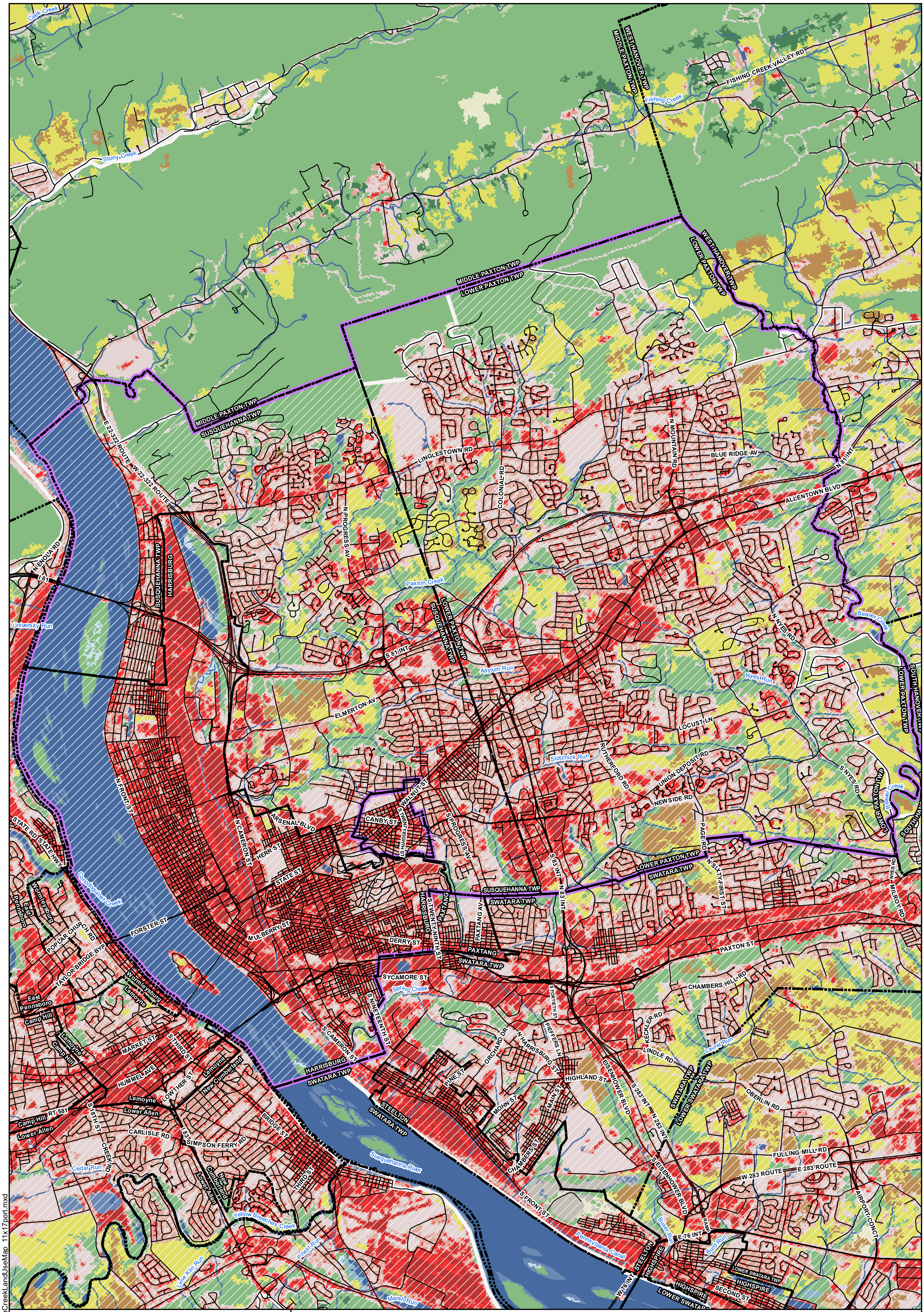
HRG Herbert, Rowland & Grubic, Inc. Engineering & Related Services An Employee-Owned Company

Land Studies



5,000 0 5,000 Feet

Mapping derived from data provided by Dauphin County, York County, Cumberland County, USGS, US Census, and MRLC.

11/6/2019	PM: EGL	GIS: MSM	QA: EGL	R004379.0472

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Land Studies

- Road
- Municipal Boundary
- Open Water
- Developed, Open Space
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Barren Land (Rock/Sand/Clay)
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrub/Scrub
- Grassland/Herbace...
- Pasture/Hay
- Cultivated Crops
- Woody Wetlands
- Emergent Herbaceous Wetlands
- Joint Planning Area
- Urban Areas (2018)

Land Use Map
Joint Planning Area
Dauphin County, Pennsylvania

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APPENDIX C – PADEP MUNICIPAL MS4 REQUIREMENTS

Municipal Requirements Tables

Pollutant Aggregation Tables

MS4 Name	NPDES ID	Individual Permit Required?	Reason	Impaired Downstream Waters or Applicable TMDL Name	Requirement(s)	Other Cause(s) of Impairment
Dauphin County						
CONEWAGO TWP	PAG133621	No		Chesapeake Bay Nutrients/Sediment	Appendix D-Nutrients, Siltation (4a)	
				Iron Run	Appendix E-Siltation (5)	
				Conewago Creek	Appendix E-Nutrients, Siltation, Suspended Solids (4a), Appendix B-Pathogens (5)	
				Spring Creek	Appendix E-Siltation (5)	Flow Alterations, Other Habitat Alterations (4c)
DAUPHIN BORO	PAG133550*	No		Chesapeake Bay Nutrients/Sediment	Appendix D-Nutrients, Siltation (4a)	
				Susquehanna River	Appendix C-PCB (5)	
DERRY TWP	PAG133637	No		Susquehanna River	Appendix C-PCB (5)	
				Unnamed Tributaries to Spring Creek		Water/Flow Variability (4c)
				Unnamed Tributaries to Swatara Creek	Appendix E-Siltation (5)	
				Spring Creek	Appendix E-Siltation (5)	Flow Alterations, Other Habitat Alterations (4c)
				Iron Run	Appendix E-Siltation (5)	
				Chesapeake Bay Nutrients/Sediment	Appendix D-Nutrients, Siltation (4a)	
EAST HANOVER TWP	PAG133551*	No		Bow Creek	Appendix E-Siltation (5)	
				Unnamed Tributaries to Manada Creek	Appendix B-Pathogens (5)	
				Unnamed Tributaries to Bow Creek	Appendix E-Nutrients (4a), Appendix C-Priority Organics (5)	
				Chesapeake Bay Nutrients/Sediment	Appendix D-Nutrients, Siltation (4a)	
				Raccoon Creek	Appendix E-DO/BOD (4a)	Flow Alterations (4c)
				Manada Creek	Appendix B-Pathogens (5)	
				Unnamed Tributaries to Raccoon Creek	Appendix B-Pathogens (5)	
HARRISBURG CITY	PAG133642*	Yes	TMDL Plan, IP	Wildwood Lake	Appendix E-Nutrients, Suspended Solids (4a)	
				Unnamed Tributaries to Spring Creek	Appendix E-Siltation (5)	
				Paxton Creek	Appendix B-Pathogens (5)	Other Habitat Alterations, Water/Flow Variability (4c)
				Paxton Creek TMDL	TMDL Plan-Siltation, Suspended Solids (4a)	
				Spring Creek		Cause Unknown (5)
				Susquehanna River	Appendix C-PCB (5)	
				Asylum Run	Appendix B-Pathogens (5)	Water/Flow Variability (4c)
				Chesapeake Bay Nutrients/Sediment	Appendix D-Nutrients, Siltation (4a)	
HIGHSPIRE BORO	PAG133544	No		Burd Run		Cause Unknown (5)
				Susquehanna River	Appendix C-PCB (5)	
				Chesapeake Bay Nutrients/Sediment	Appendix D-Nutrients, Siltation (4a)	
HUMMELSTOWN BORO	PAG133556	No		Chesapeake Bay Nutrients/Sediment	Appendix D-Nutrients, Siltation (4a)	

C-1

MS4 Name	NPDES ID	Individual Permit Required?	Reason	Impaired Downstream Waters or Applicable TMDL Name	Requirement(s)	Other Cause(s) of Impairment
Dauphin County						
LONDONDERRY TWP	PAG133547	No		Conewago Creek	Appendix E-Nutrients, Siltation, Suspended Solids (4a)	
				Lynch Run	Appendix E-Siltation (4a)	Cause Unknown, Turbidity (4a)
				Susquehanna River	Appendix C-PCB (5)	
				Iron Run	Appendix E-Siltation (5)	
				Chesapeake Bay Nutrients/Sediment	Appendix D-Nutrients, Siltation (4a)	
				Unnamed Tributaries to Conewago Creek	Appendix E-Organic Enrichment/Low D.O. (4a)	Other Habitat Alterations (4c)
				Unnamed Tributaries to Swatara Creek	Appendix E-Siltation (5)	
LOWER PAXTON TWP	PAG133643	Yes	TMDL Plan	Unnamed Tributaries to Nyes Run		Flow Alterations, Other Habitat Alterations (4c)
				Chesapeake Bay Nutrients/Sediment	Appendix D-Nutrients, Siltation (4a)	
				Nyes Run	Appendix B-Pathogens (5)	
				Paxton Creek	Appendix B-Pathogens (5)	Other Habitat Alterations, Water/Flow Variability (4c)
				Susquehanna River	Appendix C-PCB (5)	
				Spring Creek		Cause Unknown (5)
				Slotznick Run		Cause Unknown (5)
				Asylum Run	Appendix B-Pathogens (5)	Water/Flow Variability (4c)
				Paxton Creek TMDL	TMDL Plan-Siltation, Suspended Solids (4a)	
LOWER SWATARA TWP	PAG133543	No		Unnamed Tributaries to Sherman Creek	Appendix E-Siltation (5)	Other Habitat Alterations (4c)
				Susquehanna River	Appendix C-PCB (5)	
				Chesapeake Bay Nutrients/Sediment	Appendix D-Nutrients, Siltation (4a)	
				Burd Run		Cause Unknown (5)
				Unnamed Tributaries to Susquehanna River	Appendix E-Siltation (5)	Cause Unknown (5), Other Habitat Alterations (4c)
MIDDLE PAXTON TWP	PAG133688*	Yes	SP	Susquehanna River	Appendix C-PCB (5)	
				Chesapeake Bay Nutrients/Sediment	Appendix D-Nutrients, Siltation (4a)	
MIDDLETOWN BORO	PAG133645	No		Susquehanna River	Appendix C-PCB (5)	
				Unnamed Tributaries to Susquehanna River	Appendix E-Siltation (5)	Other Habitat Alterations (4c)
				Chesapeake Bay Nutrients/Sediment	Appendix D-Nutrients, Siltation (4a)	
				Unnamed Tributaries to Sherman Creek	Appendix E-Siltation (5)	Other Habitat Alterations (4c)
PAXTANG BORO	PAG133554	No		Chesapeake Bay Nutrients/Sediment	Appendix D-Nutrients, Siltation (4a)	
				Spring Creek		Cause Unknown (5)
				Susquehanna River	Appendix C-PCB (5)	
				Unnamed Tributaries to Spring Creek	Appendix E-Siltation (5)	

MS4 Name	NPDES ID	Individual Permit Required?	Reason	Impaired Downstream Waters or Applicable TMDL Name	Requirement(s)	Other Cause(s) of Impairment
Dauphin County						
PENBROOK BORO	PAG133555	Yes	TMDL Plan	Paxton Creek	Appendix B-Pathogens (5)	Other Habitat Alterations, Water/Flow Variability (4c)
				Unnamed Tributaries to Spring Creek	Appendix E-Siltation (5)	
				Susquehanna River	Appendix C-PCB (5)	
				Spring Creek		Cause Unknown (5)
				Paxton Creek TMDL	TMDL Plan-Siltation, Suspended Solids (4a)	
				Chesapeake Bay Nutrients/Sediment	Appendix D-Nutrients, Siltation (4a)	
				Asylum Run	Appendix B-Pathogens (5)	Water/Flow Variability (4c)
ROYALTON BORO	PAG133641*	No		Chesapeake Bay Nutrients/Sediment	Appendix D-Nutrients, Siltation (4a)	
				Susquehanna River	Appendix C-PCB (5)	
SOUTH HANOVER TWP	PAG133500	No		Manada Creek	Appendix B-Pathogens (5)	
				Unnamed Tributaries to Beaver Creek	Appendix E-Siltation (5)	Flow Alterations (4c)
				Chesapeake Bay Nutrients/Sediment	Appendix D-Nutrients, Siltation (4a)	
STEELTON BORO	PAG133625	No		Susquehanna River	Appendix C-PCB (5)	
				Pennsylvania Canal	Appendix E-Siltation (5)	
				Unnamed Tributaries to Spring Creek	Appendix E-Siltation (5)	
				Unnamed Tributaries to Susquehanna River	Appendix E-Siltation (5)	
				Unnamed Tributaries to Swatara Creek	Appendix E-Siltation (5)	
				Chesapeake Bay Nutrients/Sediment	Appendix D-Nutrients, Siltation (4a)	
SUSQUEHANNA TWP	PAG133633	Yes	TMDL Plan	Slotznick Run		Cause Unknown (5)
				Chesapeake Bay Nutrients/Sediment	Appendix D-Nutrients, Siltation (4a)	
				Paxton Creek	Appendix B-Pathogens (5)	Other Habitat Alterations, Water/Flow Variability (4c)
				Paxton Creek TMDL	TMDL Plan-Siltation, Suspended Solids (4a)	
				Asylum Run	Appendix B-Pathogens (5)	Water/Flow Variability (4c)
				Spring Creek		Cause Unknown (5)
				Unnamed Tributaries to Asylum Run		Other Habitat Alterations (4c)
				Unnamed Tributaries to Spring Creek	Appendix E-Siltation (5)	
				Wildwood Lake	Appendix E-Nutrients, Suspended Solids (4a)	
				Susquehanna River	Appendix C-PCB (5)	

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MS4 Name	Permit Number	HUC 12 Name	Impaired Downstream Waters or Applicable TMDL Name	Requirement(s)
Dauphin County				
CONEWAGO TWP	PAG133621	Conewago Creek	Conewago Creek	Appendix B-Pathogens
		Conewago Creek, Laurel Run-Susquehanna River	Chesapeake Bay Nutrients\Sediment, Conewago Creek	Appendix D-Siltation/Nutrients, Appendix E-Nutrients, Siltation, Suspended Solids
		Spring Creek, Swatara Creek-Susquehanna River	Chesapeake Bay Nutrients\Sediment, Iron Run, Spring Creek	Appendix D-Siltation/Nutrients, Appendix E-Nutrients, Siltation, Suspended Solids
DAUPHIN BORO	PAG133550	Cove Creek-Susquehanna River, Laurel Run-Susquehanna River	Susquehanna River	Appendix C-PCB
		Cove Creek-Susquehanna River, Laurel Run-Susquehanna River, Stony Creek	Chesapeake Bay Nutrients\Sediment	Appendix D-Siltation/Nutrients
DERRY TWP	PAG133637	Spring Creek, Swatara Creek-Susquehanna River	Chesapeake Bay Nutrients\Sediment, Iron Run, Spring Creek, Unnamed Tributaries to Swatara Creek	Appendix D-Siltation/Nutrients, Appendix E-Siltation
		Laurel Run-Susquehanna River	Chesapeake Bay Nutrients\Sediment, Susquehanna River	Appendix C-PCB, Appendix D-Siltation/Nutrients
EAST HANOVER TWP	PAG133551	Bow Creek-Swatara Creek	Bow Creek, Raccoon Creek, Unnamed Tributaries to Bow Creek	Appendix C-Priority Organics, Appendix E-DO/BOD, Nutrients, Siltation
		Bow Creek-Swatara Creek, Manada Creek, Swatara Creek-Susquehanna	Bow Creek, Chesapeake Bay Nutrients\Sediment, Manada Creek, Raccoon Creek, Unnamed Tributaries to Bow Creek, Unnamed Tributaries to Manada Creek , Unnamed Tributaries to Raccoon Creek	Appendix B-Pathogens, Appendix D-Siltation/Nutrients, Appendix E-DO/BOD, Nutrients, Siltation
HARRISBURG CITY	PAI133524	Laurel Run-Susquehanna River, Paxton Creek, Spring Creek	Asylum Run, Paxton Creek, Unnamed Tributaries to Spring Creek, Wildwood Lake	Appendix E-Nutrients, Siltation, Suspended Solids
		Cove Creek-Susquehanna River, Laurel Run-Susquehanna River, Paxton Creek, Spring Creek	Asylum Run, Chesapeake Bay Nutrients\Sediment, Paxton Creek, Paxton Creek TMDL, Unnamed Tributaries to Spring Creek, Wildwood Lake	Appendix D-Siltation/Nutrients, Appendix E-Nutrients, Siltation, Suspended Solids, TMDL Plan-Siltation, Suspended Solids
		Laurel Run-Susquehanna River, Paxton Creek	Asylum Run, Paxton Creek, Paxton Creek TMDL	Appendix B-Pathogens, TMDL Plan-Siltation, Suspended Solids
		Cove Creek-Susquehanna River, Laurel Run-Susquehanna River, Paxton Creek, Spring Creek	Asylum Run, Chesapeake Bay Nutrients\Sediment, Paxton Creek, Paxton Creek TMDL, Unnamed Tributaries to Spring Creek, Wildwood Lake	Appendix D-Siltation/Nutrients, Appendix E-Nutrients, Siltation, Suspended Solids, TMDL Plan-Siltation, Suspended Solids
		Cove Creek-Susquehanna River, Laurel Run-Susquehanna River	Susquehanna River	Appendix C-PCB
HIGHSPIRE BORO	PAG133544	Laurel Run-Susquehanna River	Chesapeake Bay Nutrients\Sediment, Susquehanna River	Appendix C-PCB, Appendix D-Siltation/Nutrients
HUMMELSTOWN BORO	PAG133556	Laurel Run-Susquehanna River	Chesapeake Bay Nutrients\Sediment	Appendix D-Siltation/Nutrients
		Swatara Creek-Susquehanna River	Chesapeake Bay Nutrients\Sediment	Appendix D-Siltation/Nutrients
LONDONDERRY TWP	PAG133547	Hartman Run-Susquehanna River	Chesapeake Bay Nutrients\Sediment, Susquehanna River	Appendix C-PCB, Appendix D-Siltation/Nutrients
		Conewago Creek, Laurel Run-Susquehanna River	Chesapeake Bay Nutrients\Sediment, Conewago Creek, Lynch Run, Unnamed Tributaries to Conewago Creek	Appendix D-Siltation/Nutrients, Appendix E-Nutrients, Organic Enrichment/Low D.O., Siltation, Suspended Solids
		Laurel Run-Susquehanna River	Susquehanna River	Appendix C-PCB
		Swatara Creek-Susquehanna River	Chesapeake Bay Nutrients\Sediment, Iron Run, Unnamed Tributaries to Swatara Creek	Appendix D-Siltation/Nutrients, Appendix E-Nutrients, Organic Enrichment/Low D.O., Siltation, Suspended Solids

MS4 Name	Permit Number	HUC 12 Name	Impaired Downstream Waters or Applicable TMDL Name	Requirement(s)
Dauphin County				
LOWER PAXTON TWP	PAG133643	Beaver Creek	Nyes Run	Appendix B-Pathogens
		Beaver Creek, Swatara Creek-Susquehanna River	Chesapeake Bay Nutrients\Sediment	Appendix D-Siltation/Nutrients
		Laurel Run-Susquehanna River, Paxton Creek, Spring Creek	Asylum Run, Chesapeake Bay Nutrients\Sediment, Paxton Creek, Paxton Creek TMDL	Appendix D-Siltation/Nutrients, Appendix E-Siltation, Suspended Solids, TMDL Plan-Siltation, Suspended Solids
		Laurel Run-Susquehanna River, Paxton Creek	Asylum Run, Paxton Creek, Paxton Creek TMDL	Appendix B-Pathogens, Appendix E-Siltation, Suspended Solids, TMDL Plan-Siltation, Suspended Solids
		Laurel Run-Susquehanna River	Susquehanna River	Appendix C-PCB
LOWER SWATARA TWP	PAG133543	Swatara Creek-Susquehanna River	Chesapeake Bay Nutrients\Sediment	Appendix D-Siltation/Nutrients
		Laurel Run-Susquehanna River	Chesapeake Bay Nutrients\Sediment, Susquehanna River, Unnamed Tributaries to Sherman Creek, Unnamed Tributaries to Susquehanna River	Appendix C-PCB, Appendix D-Siltation/Nutrients, Appendix E-Siltation
MIDDLE PAXTON TWP	PAG133688	Cove Creek-Susquehanna River, Laurel Run-Susquehanna River	Susquehanna River	Appendix C-PCB
		Clark Creek, Cove Creek-Susquehanna River, Fishing Creek-Dauphin County, Fishing Creek-Perry County, Laurel Run-Susquehanna River, Stony Creek	Chesapeake Bay Nutrients\Sediment	Appendix D-Siltation/Nutrients
MIDDLETOWN BORO	PAG133645	Swatara Creek-Susquehanna River	Chesapeake Bay Nutrients\Sediment	Appendix D-Siltation/Nutrients
		Laurel Run-Susquehanna River	Chesapeake Bay Nutrients\Sediment, Susquehanna River, Unnamed Tributaries to Sherman Creek, Unnamed Tributaries to Susquehanna River	Appendix C-PCB, Appendix D-Siltation/Nutrients, Appendix E-Siltation
PAXTANG BORO	PAG133554	Spring Creek	Unnamed Tributaries to Spring Creek	Appendix E-Siltation
		Laurel Run-Susquehanna River	Susquehanna River	Appendix C-PCB
		Laurel Run-Susquehanna River, Spring Creek	Chesapeake Bay Nutrients\Sediment, Unnamed Tributaries to Spring Creek	Appendix D-Siltation/Nutrients, Appendix E-Siltation
PENBROOK BORO	PAG133555	Laurel Run-Susquehanna River, Paxton Creek	Asylum Run, Paxton Creek, Paxton Creek TMDL	Appendix B-Pathogens, TMDL Plan-Siltation, Suspended Solids
		Laurel Run-Susquehanna River, Paxton Creek, Spring Creek	Asylum Run, Chesapeake Bay Nutrients\Sediment, Paxton Creek, Paxton Creek TMDL, Unnamed Tributaries to Spring Creek	Appendix D-Siltation/Nutrients, Appendix E-Siltation, Suspended Solids, TMDL Plan-Siltation, Suspended Solids
		Laurel Run-Susquehanna River	Susquehanna River	Appendix C-PCB
ROYALTON BORO	PAG133641	Laurel Run-Susquehanna River	Chesapeake Bay Nutrients\Sediment, Susquehanna River	Appendix C-PCB, Appendix D-Siltation/Nutrients
		Swatara Creek-Susquehanna River	Chesapeake Bay Nutrients\Sediment	Appendix D-Siltation/Nutrients
		Hartman Run-Susquehanna River	Chesapeake Bay Nutrients\Sediment, Susquehanna River	Appendix C-PCB, Appendix D-Siltation/Nutrients
SOUTH HANOVER TWP	PAG133500	Beaver Creek, Manada Creek, Swatara Creek-Susquehanna River	Chesapeake Bay Nutrients\Sediment, Unnamed Tributaries to Beaver Creek	Appendix D-Siltation/Nutrients, Appendix E-Siltation
			Chesapeake Bay Nutrients\Sediment, Unnamed Tributaries to Beaver Creek	Appendix D-Siltation/Nutrients, Appendix E-Siltation
		Manada Creek, Swatara Creek-Susquehanna River	Manada Creek	Appendix B-Pathogens
		Beaver Creek	Unnamed Tributaries to Beaver Creek	Appendix E-Siltation
STEELTON BORO	PAG133625	Laurel Run-Susquehanna River	Chesapeake Bay Nutrients\Sediment, Pennsylvania Canal, Susquehanna River, Unnamed Tributaries to Spring Creek, Unnamed Tributaries to Susquehanna River, Unnamed Tributaries to Swatara Creek	Appendix C-PCB, Appendix D-Siltation/Nutrients, Appendix E-Siltation

MS4 Name	Permit Number	HUC 12 Name	Impaired Downstream Waters or Applicable TMDL Name	Requirement(s)
Dauphin County				
SUSQUEHANNA TWP	PAG133633	Laurel Run-Susquehanna River, Paxton Creek, Spring Creek	Asylum Run, Paxton Creek, Unnamed Tributaries to Spring Creek, Wildwood Lake	Appendix E-Nutrients, Siltation, Suspended Solids
		Cove Creek-Susquehanna River, Laurel Run-Susquehanna River	Susquehanna River	Appendix C-PCB
		Cove Creek-Susquehanna River, Laurel Run-Susquehanna River, Paxton Creek, Spring Creek	Asylum Run, Chesapeake Bay Nutrients\Sediment, Paxton Creek, Paxton Creek TMDL, Unnamed Tributaries to Spring Creek, Wildwood Lake	Appendix D-Siltation/Nutrients, Appendix E-Nutrients, Siltation, Suspended Solids, TMDL Plan-Siltation, Suspended Solids
			Asylum Run, Chesapeake Bay Nutrients\Sediment, Paxton Creek, Paxton Creek TMDL, Unnamed Tributaries to Spring Creek, Wildwood Lake	Appendix D-Siltation/Nutrients, Appendix E-Nutrients, Siltation, Suspended Solids, TMDL Plan-Siltation, Suspended Solids
		Laurel Run-Susquehanna River, Paxton Creek	Asylum Run, Paxton Creek, Paxton Creek TMDL	Appendix B-Pathogens, TMDL Plan-Siltation, Suspended Solids
SWATARA TWP	PAG133615	Laurel Run-Susquehanna River	Susquehanna River	Appendix C-PCB
		Beaver Creek, Swatara Creek-Susquehanna River	Chesapeake Bay Nutrients\Sediment	Appendix D-Siltation/Nutrients
		Laurel Run-Susquehanna River, Spring Creek	Chesapeake Bay Nutrients\Sediment, Pennsylvania Canal, Unnamed Tributaries to Spring Creek, Unnamed Tributaries to Susquehanna River, Unnamed Tributaries to Swatara Creek	Appendix D-Siltation/Nutrients, Appendix E-Siltation
WEST HANOVER TWP	PAG133545	Beaver Creek, Manada Creek	Unnamed Tributaries to Beaver Creek, Unnamed Tributaries to Manada Creek	Appendix E-Nutrients, Siltation
		Manada Creek, Swatara Creek-Susquehanna River	Manada Creek, Walnut Run	Appendix B-Pathogens
		Beaver Creek, Manada Creek, Swatara Creek-Susquehanna River	Chesapeake Bay Nutrients\Sediment, Unnamed Tributaries to Beaver Creek, Unnamed Tributaries to Manada Creek	Appendix D-Siltation/Nutrients, Appendix E-Nutrients, Siltation

APPENDIX D – BASELINE & EXISTING POLLUTANT LOADING CALCULATIONS

Existing BMP Summaries

Seven (7) existing stormwater quality projects (EX-01 – EX-07) were completed in the Paxton Creek Watershed prior to the completion of this Joint Plan and are being utilized as credit to reduce the baseline sediment loading estimates for the watershed (Table 1). These projects were installed after 2003 and meet the requirements for water quality credit regarding design and ongoing operation and maintenance. Stream restoration BMP EX-07 was constructed in 2013 in the Spring Creek Watershed and is being utilized as credit to reduce the baseline loading estimates for the Joint Planning Area (Table 1). It is not located within the watershed of the UNT to Spring Creek, which has a local impairment for sediment. Existing BMP locations are provided within the BMP Location Maps section.

Table 1: Installed BMPs

Map Reference	BMP Name & Type	Latitude	Longitude	Planning Area Credit	Sediment Load Reduction (lbs/yr)
EX-01	Paxton Church / Reichert Rd. Rain Garden and Stream Restoration (240 ft.)	40°18'51.53"	-76°51'34.89"	Joint Planning Area / Paxton Creek TMDL	40,012
EX-02	Fox Hunt Rd. Stream Restoration (375 ft.)	40°20'4.41"	-76°52'40.27"	Joint Planning Area / Paxton Creek TMDL	43,125
EX-03	UNT to Asylum Run Retention Basin and Stream Restoration (350 ft.)	40°17'09.41"	-76°52'03.21"	Joint Planning Area / Paxton Creek TMDL	72,025
EX-04	Elmerton Ave. Bio-retention Basin	40°17'41.81"	-76°51'33.35"	Joint Planning Area / Paxton Creek TMDL	17,191
EX-05	Black Run Stream Restoration (800 ft.)	40°18'29.34"	-76°52'12.05"	Joint Planning Area / Paxton Creek TMDL	92,000
EX-06	Asylum Run Bio-retention and Stream Restoration (400 ft.)	40°17'28.18"	-76°51'38.66"	Joint Planning Area / Paxton Creek TMDL	73,617
EX-07	Dowhower Rd Buffer and Stream Restoration (1,220 ft.)	40°16'38.05"	-76°48'14.72"	Joint Planning Area	140,300
CSS-01	CRW Combined Sewer System Sediment Capture Performance to Paxton Creek Watershed Allowance	N/A	N/A	Joint Planning Area / Paxton Creek TMDL	68,000
CSS-02	CRW Combined Sewer System Sediment Capture Performance to Susquehanna River Allowance	N/A	N/A	Joint Planning Area	17,000
				Total Existing BMP Sediment Load Reduction:	**563,270**

Existing BMP Summaries: EX-01 *Paxton Church / Reichert Rd. Rain Garden and Stream Restoration*

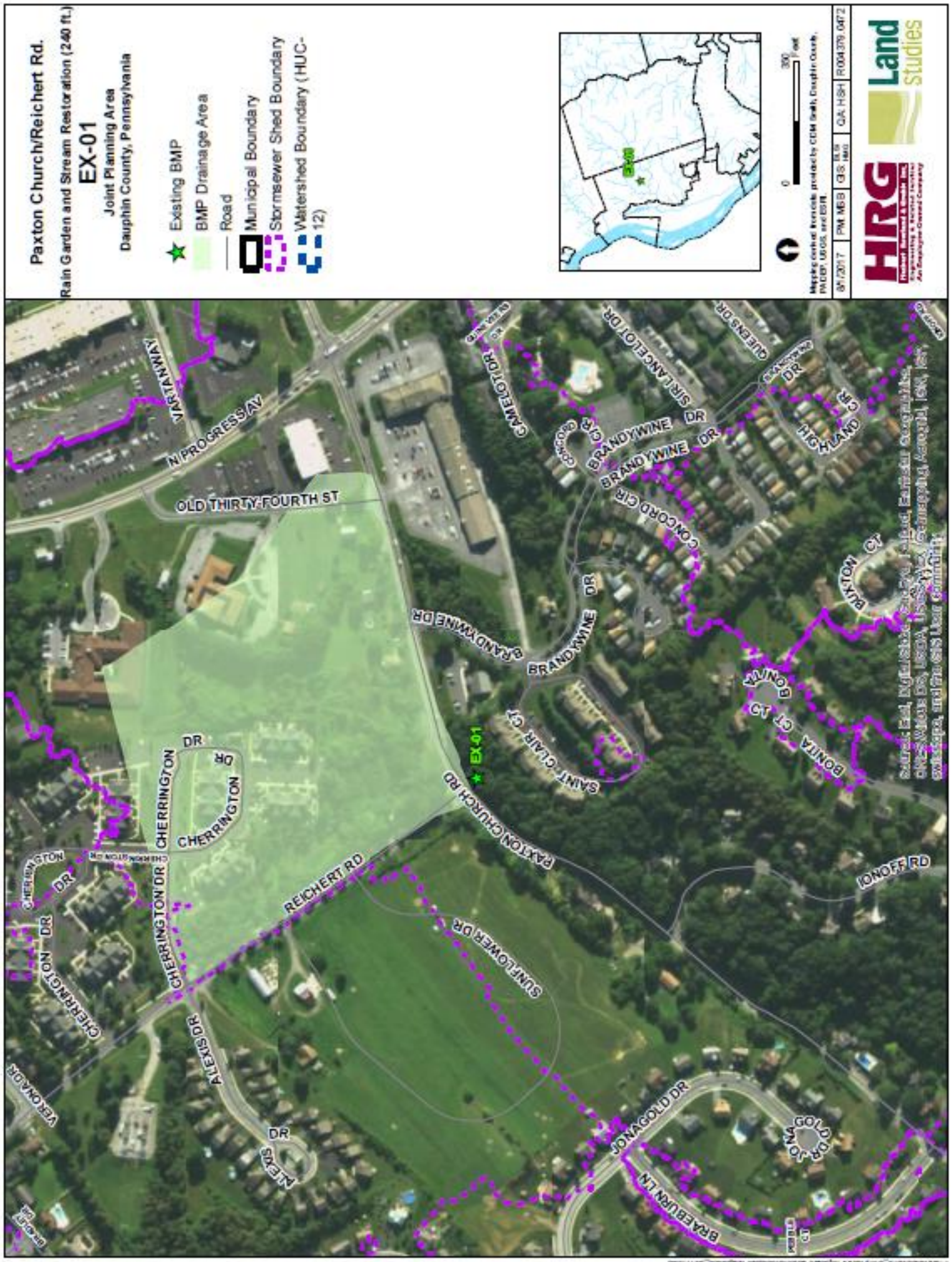
The Paxton Church Road/Reichert Road Rain Garden and Stream Restoration was completed in 2009 by the Paxton Creek Watershed and Education Association, Inc. (PCWEA) in cooperation with Susquehanna Township and HRG. The rain garden was designed to collect runoff from Paxton Church Road before discharging into Paxton Creek. The stream restoration practice consisted of bank stabilization to protect erosion onto the road through the use of geotextiles and flood bench grading and a community effort from PCWEA to provide a 30-foot-wide buffer along the stream channel. Susquehanna Township is the responsible entity to ensure maintenance and responsibility for the stream and rain garden. The rain garden continues to operate as the design intended; the stream restoration measures have minimized further incision of the stream bank and the planted buffer continues to grow.

EX-01 Rain Garden Sediment Load Reduction = 12,412 lbs

EX-01 Stream Restoration Sediment Load Reduction = 240 ft x 115 lbs/ft = 27,600 lbs

EX-01 Total Sediment Reduction = 12,412 lbs + 27,600 lbs = <u>40,012 lbs</u>

Existing BMP, EX – 01 Location Map

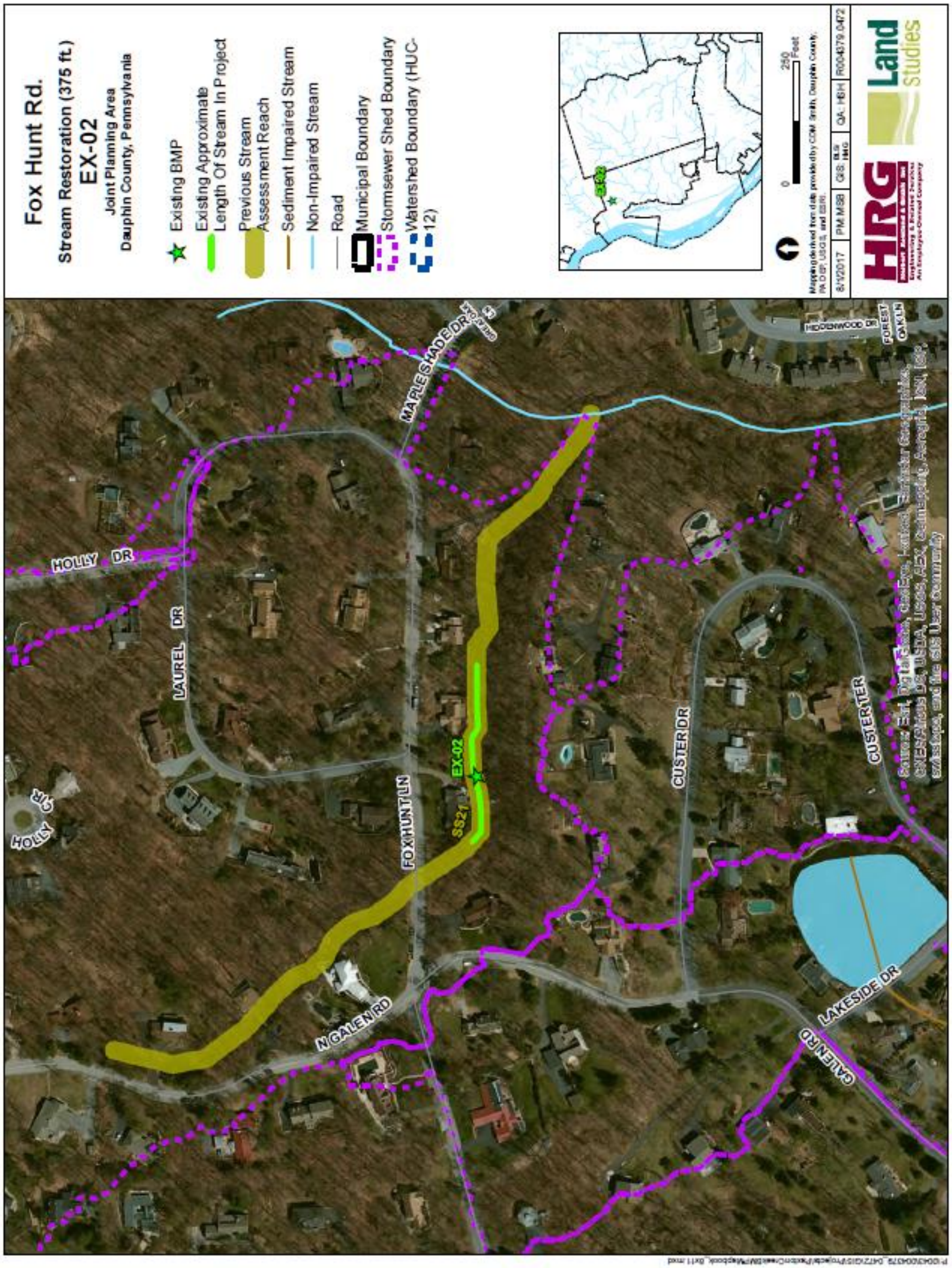


Existing BMP Summaries: **EX – 02** Fox *Hunt Rd. Stream Restoration*

Fox Hunt Road Stream Restoration was completed in 2014. The project consisted of the replacement of a sanitary sewer line and stream erosion repairs of 375-feet of a heavily eroded UNT to Paxton Creek. The channel was designed to convey the flow of the 100-year storm with a drainage area of 71 acres. Live stakes were planted along both sides of the new stream bank to reduce the severe erosion previously seen along the stream. Concrete weir pools were placed approximately every 50 feet along the new channel to create a riffle and pool system. The entity responsible for the operation and maintenance of the new stream channel is Susquehanna Township and the BMP is operating as designed.

EX-02 Stream Restoration Sediment Load Reduction = 375 ft x 115 lbs/ft = 43,125 lbs

Existing BMP, EX – 02 Location Map



Existing BMP Summaries: **EX-03** *UNT to Asylum Run Retention Basin and Stream Restoration*

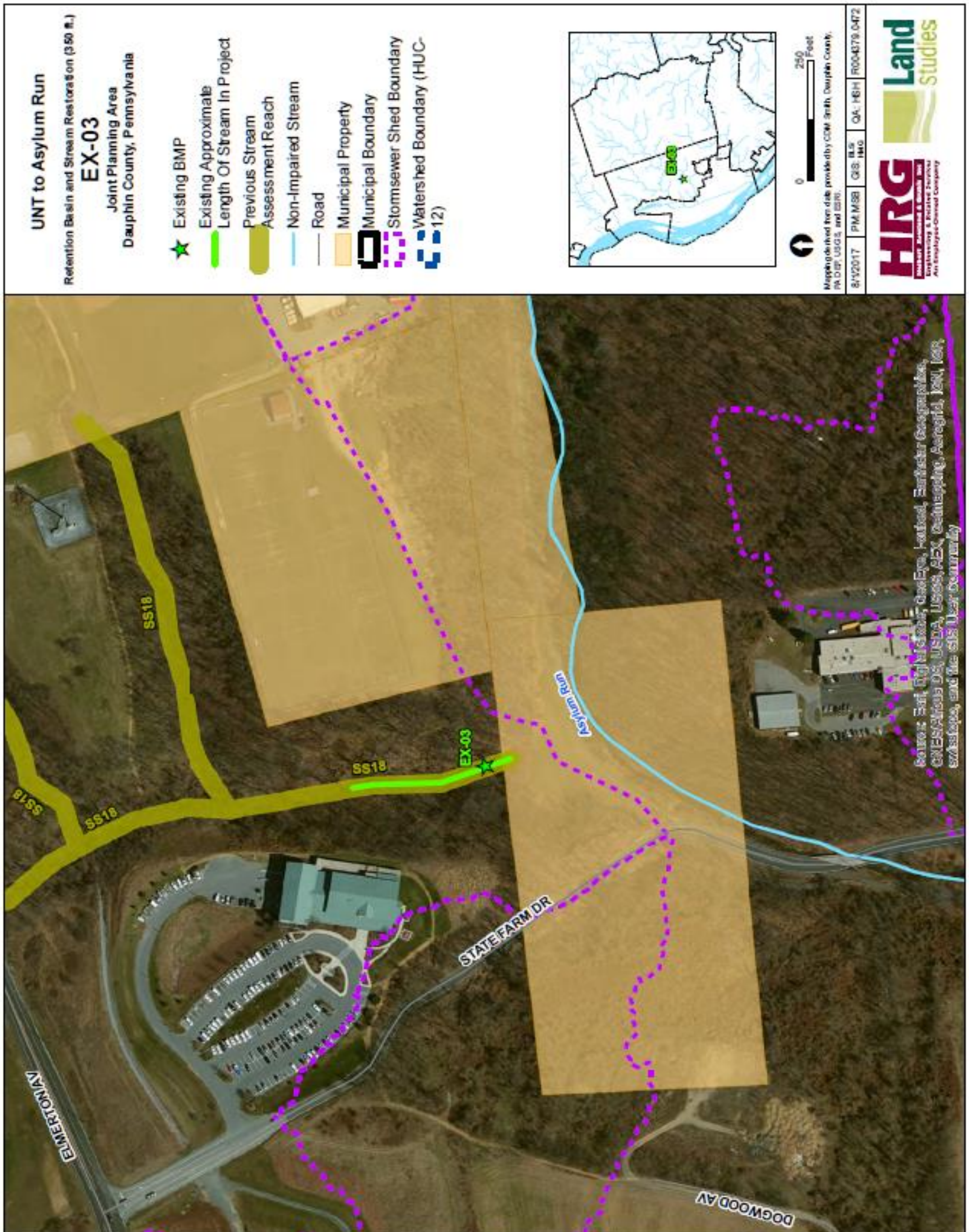
The UNT to Asylum Run Retention Basin and Stream Restoration consisted of the construction of a bio-retention basin to collect and infiltrate stormwater runoff from a 44-acre drainage area, in-stream grade control through the use of check dams, and stream buffer plantings along approximately 350 linear feet of stream (UNT of Asylum Run). The project was completed in 2013 and operation and maintenance is under the responsibility of Susquehanna Township. Both BMPs are operating as designed.

EX-03 Retention Basin Load Reduction = 31,775 lbs

EX-03 Stream Restoration Sediment Load Reduction = 350 ft x 115 lbs/ft = 40,250 lbs

EX-03 Total Sediment Reduction = 31,775 lbs + 40,250 lbs = 72,025 lbs

Existing BMP, EX - 03 Location Map

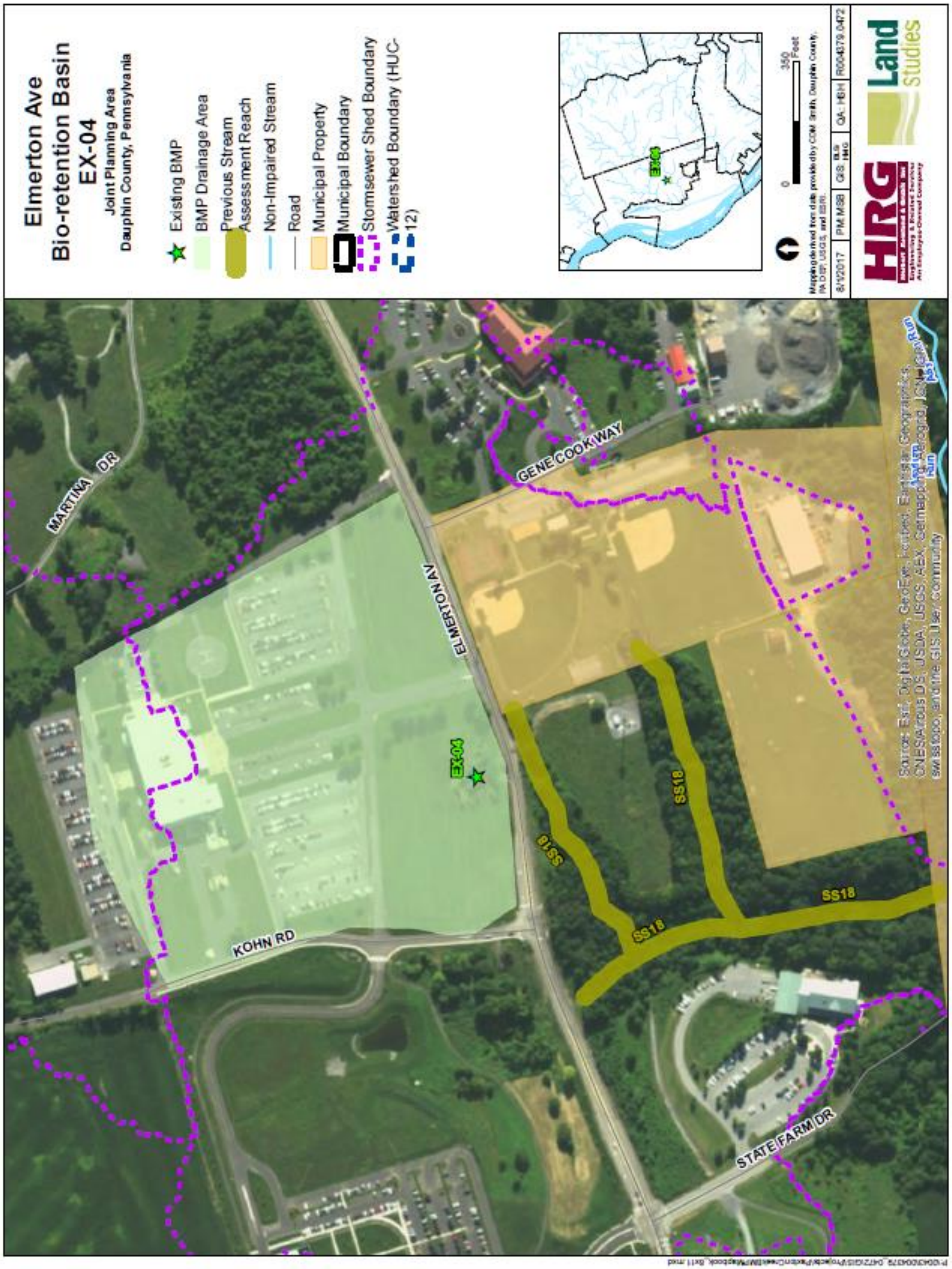


Existing BMP Summaries: EX – 4 Elmerton *Ave. Bio-retention Basin*

Elmerton Avenue Bio-retention Basin was constructed in 2009 to reduce stormwater related issues for the Police State Barracks. The basin was designed to capture and infiltrate the flow coming from a 27.5-acre drainage area. The Pennsylvania State Police are the responsible entity for all operation and maintenance. The bio-retention continues to function as the design intended.

EX-04 Bioretention Basin Sediment Load Reduction = 17,191 lbs

Existing BMP, EX – 04 Location Map

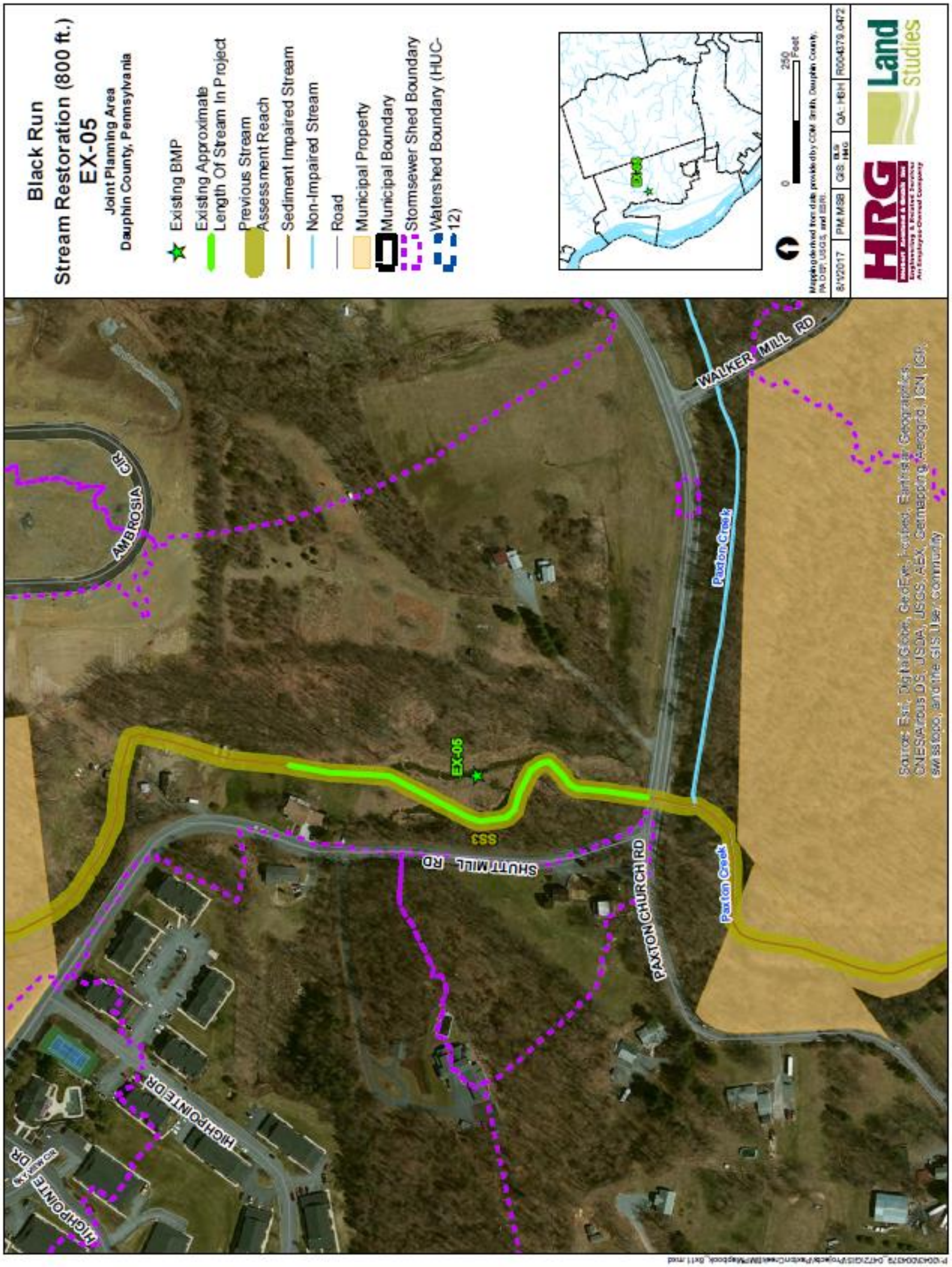


Existing BMP Summaries: **EX – 05** *Black Run Stream Restoration*

Black Run Stream Restoration was completed in 2007. The project consisted of approximately 800-feet of stream restoration. The rapid rate of erosion through this stream was identified as a problem including sedimentation in Wildwood Lake. The installed solution included grade controls along the stream. Check dams and j-hooks were installed to create a riffle and pool system. A portion of the channel was abandoned and is now used to convey stormwater over a longer path to the stream. Live stakes were planted along the bank to help provide long-term stabilization and reduce the amount of erosion during high flow events. In total there were more than 1200 native trees and shrubs installed by community volunteers. The entity responsible for operation and maintenance is Susquehanna Township. The stream restoration continues to function according to the design.

EX-05 Stream Restoration Sediment Load Reduction = 800 ft x 115 lbs/ft = 92,000 lbs

Existing BMP, EX – 05 Location Map



Existing BMP Summaries: **EX-06** *Asylum Run Bio-retention and Stream Restoration*

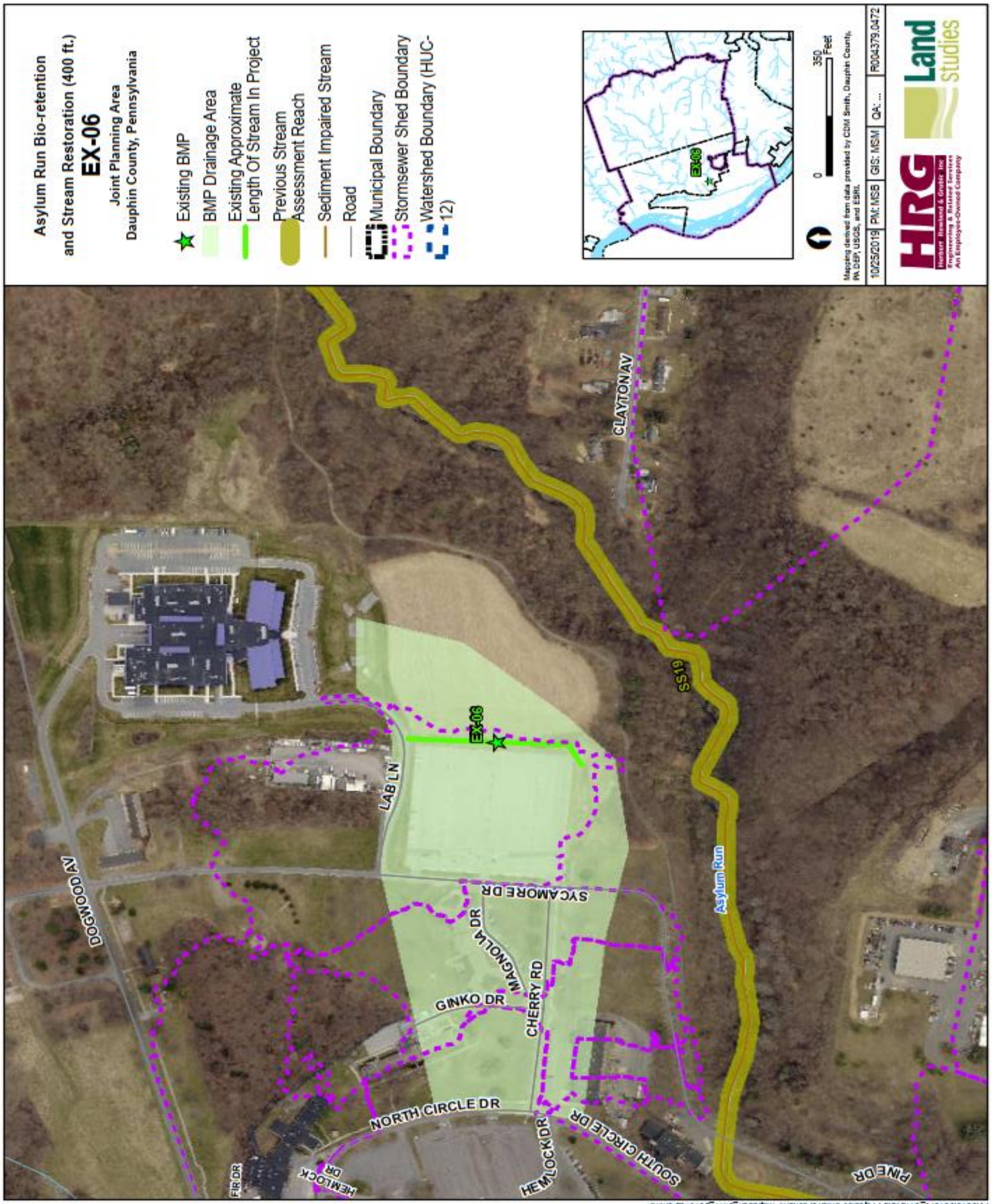
The Asylum Run Bio-Retention Basin and Stream Restoration was completed in 2013. The Retention Basin is designed to infiltrate stormwater from the 100-acre drainage area. The stream restoration portion included 400-feet of stream embankments and stream bed that were regraded to provide a 10% slope with varying step pools to reduce erosion of the stream bank and scour from the upstream culvert. The responsible entity for operation and maintenance is Susquehanna Township and the constructed BMPs are operating as intended.

EX-06 Bio-retention Sediment Load Reduction = 27,617 lbs

EX-06 Stream Restoration Sediment Load Reduction = 400 ft x 115 lbs/ft = 46,000 lbs

EX-06 Total Sediment Reduction = 27,617 lbs + 46,000 lbs = <u>73,617 lbs</u>

Existing BMP, EX - 06 Location Map



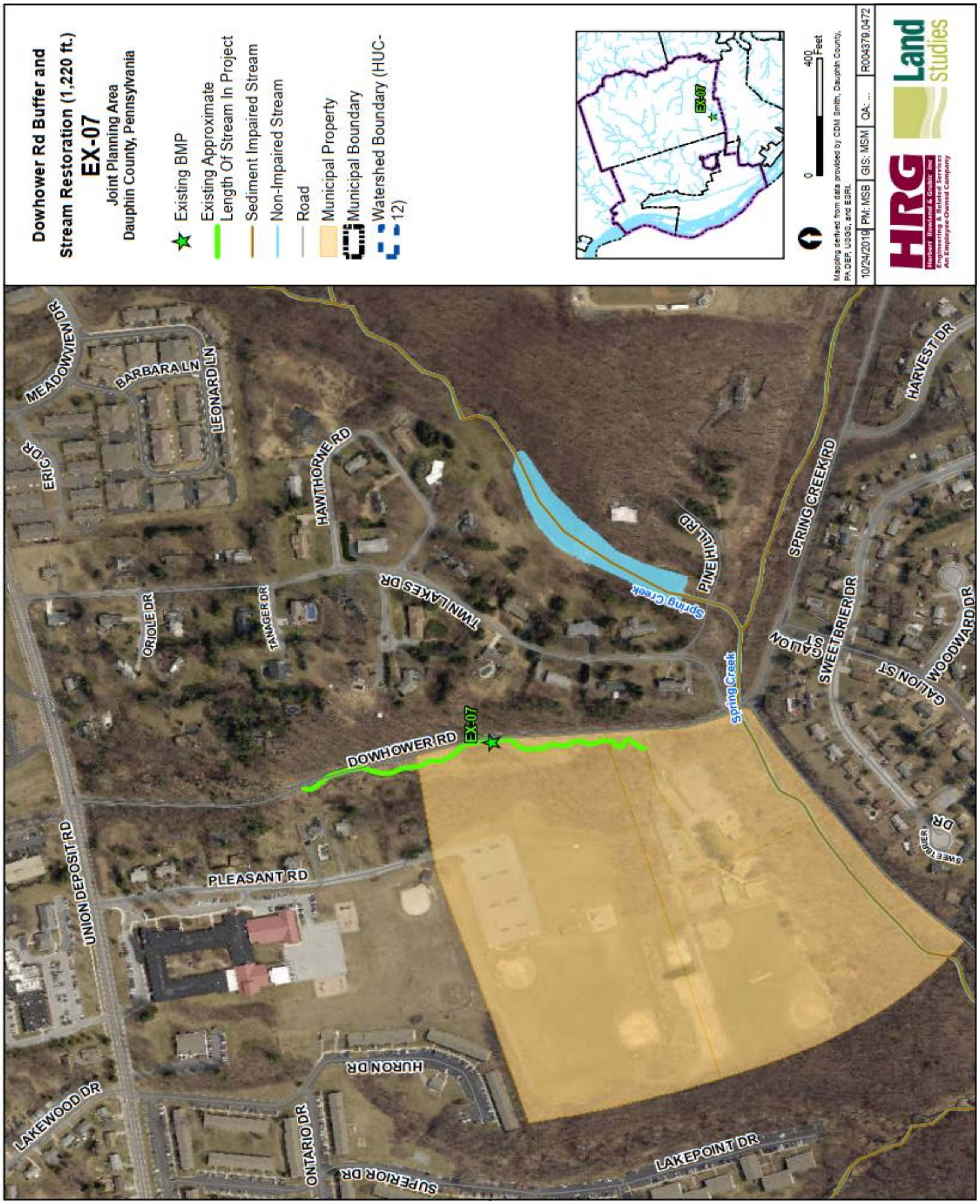
Existing BMP Summaries: **EX – 07** *Dowhower Rd Buffer and Stream Restoration*

Dowhower Road Buffer and Stream Restoration was a project constructed in 2013. The goal of this project was to reduce erosion and migration of the UNT to Spring Creek along Dowhower Road. The erosion of the bank caused areas of guiderail to be exposed. The project consisted of the relocation of 1200-linear feet of an existing channel approximately 30 feet to the west. A 30-foot wide buffer was planted from the stream bank to the existing guide rail location. Lower Paxton Township assumes responsibility for the continuing function of the restoration and buffer and there is no sign of accelerated erosion along the re-constructed stream channel. It is operating as designed.

EX-07 Stream Restoration Sediment Load Reduction = 1,220 ft x 115 lbs /ft = <u>140,300 lbs</u>*

*EX-07 sediment load reduction applies only to the Joint Planning Area, not the Paxton Creek TMDL Watershed

Existing BMP, EX - 07 Location Map



CSS-01 CRW Combined Sewer System Existing Sediment Removal from Paxton Creek Watershed

Joint Planning Area / Paxton Creek TMDL Sediment Load Reduction = 68,000 lbs

CSS-02 CRW Combined Sewer System Existing Sediment Removal from Susquehanna River

Joint Planning Area Sediment Load Reduction = 17,000 lbs

<u>Paxton Creek Baseline Sediment Load by Municipality</u> – Municipal baseline sediment load values compared to percentage of land area within the Paxton Creek Watershed.

MS4 Permittee	Percentage of Paxton Creek TMDL Planning Land Area	Baseline Sediment Load (lbs/year)
CRW (City of Harrisburg)	19.5%	990,680
Township of Lower Paxton	43.1%	1,595,261
Susquehanna Township	37.4%	1,456,454
Paxton Creek TMDL Planning Area Total:	**100%**	**4,036,129***
*Total Baseline Sediment Load based on MMW model results for the entire watershed, not the sum of the individual municipalities.		

Paxton Creek Watershed Planning Area Baseline Sediment Load = 4,036,129 lbs/yr

Existing BMP Sediment Load Reduction for the Paxton Creek TMDL Watershed =

40,012 lbs + 43,125 lbs + 72,025 lbs + 17,191 lbs + 92,000 lbs + 73,617 lbs + 68,000 lbs **= 405,970 lbs**

Municipal Entities' Paxton Creek TMDL Planning Area Existing Sediment Load

Adjusted Existing Sediment Load = Baseline Sediment Load – Existing BMP Sediment Load Reduction

Adjusted Existing Sediment Load = 4,036,129 lbs – 405,970 lbs = **<u>3,630,159 lbs</u>**

<u>Joint Planning Area Baseline Sediment Load by Municipality</u> – Municipal baseline sediment load values compared to percentage of land area within the Joint Planning Area Watershed.

MS4 Permittee	Percentage of Joint Planning Area	Baseline Sediment Load (lbs/yr)
CRW (City of Harrisburg)	16.0%	3,667,006
Township of Lower Paxton	57.0 %	9,324,542
Township of Susquehanna	27.0%	4,141,959
Joint Planning Area Total:	**100%**	**17,507,254***
*Total Baseline Sediment Load based on model results for the entire watershed, not the sum of the individual municipalities.		

Municipal Entities' Joint Planning Area Baseline Sediment Load = 17,507,254 lbs/yr

Existing BMP Sediment Load Reduction for the Joint Permit Area =

40,012 lbs + 43,125 lbs + 72,025 lbs + 17,191 lbs + 92,000 lbs + 73,617 lbs + 140,300 lbs + 68,000 lbs + 17,000 lbs **= 563,270 lbs**

Municipal Entities' Paxton Creek TMDL Planning Area Existing Sediment Load

Adjusted Existing Sediment Load = Baseline Sediment Load – Existing BMP Sediment Load Reduction

Adjusted Existing Sediment Load = 17,507,254 lbs – 563,270 lbs = **<u>16,943,984 lbs</u>**

APPENDIX E – WASTELOAD ALLOCATIONS

Paxton Creek Watershed Report WLA Table

Paxton Creek Watershed MS4 Wasteload Allocations

Jurisdiction	Existing Load (ton/yr)	Allocated Load (ton/yr)	Percent Reduction
City of Harrisburg	401.5	259.1	35%
Township of Lower Paxton	830.4	536	35%
Township of Middle Paxton	0.2	0.1	35%
Borough of Penbrook	24.4	15.8	35%
Township of Susquehanna	974.6	629.1	35%
Township of Swatara	7.2	4.7	35%
Total	2,238.3	1,444.8	35%

Note: WLAs presented as shown in Table 7-4 Paxton Creek MS4 Wasteload Allocation by Municipalities from the August 28, 2013 errata document issued by EPA.

APPENDIX F – STREAM ANALYSIS EXHIBITS

PAXTON CREEK TMDL

BMP PROTOTYPE REFERENCE MAP

JULY 26, 2017

315 NORTH STREET LITITZ, PA | (717) - 627 - 4440

Land Studies

HRG Herbert, Rowland & Grubic, Inc. Engineering & Related Services AN EMPLOYEE-OWNED COMPANY

PAXTON CREEK TMDL

BMP PROTOTYPE REFERENCE MAP

JULY 26, 2017

315 NORTH STREET LITITZ, PA | (717) - 627 - 4440

Land studies

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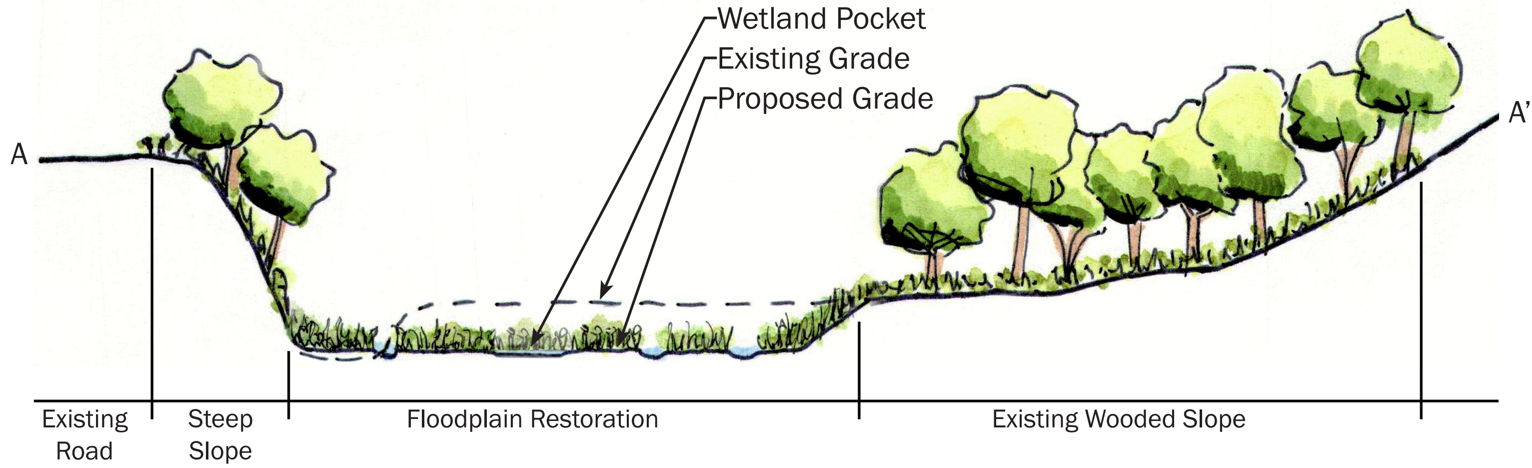
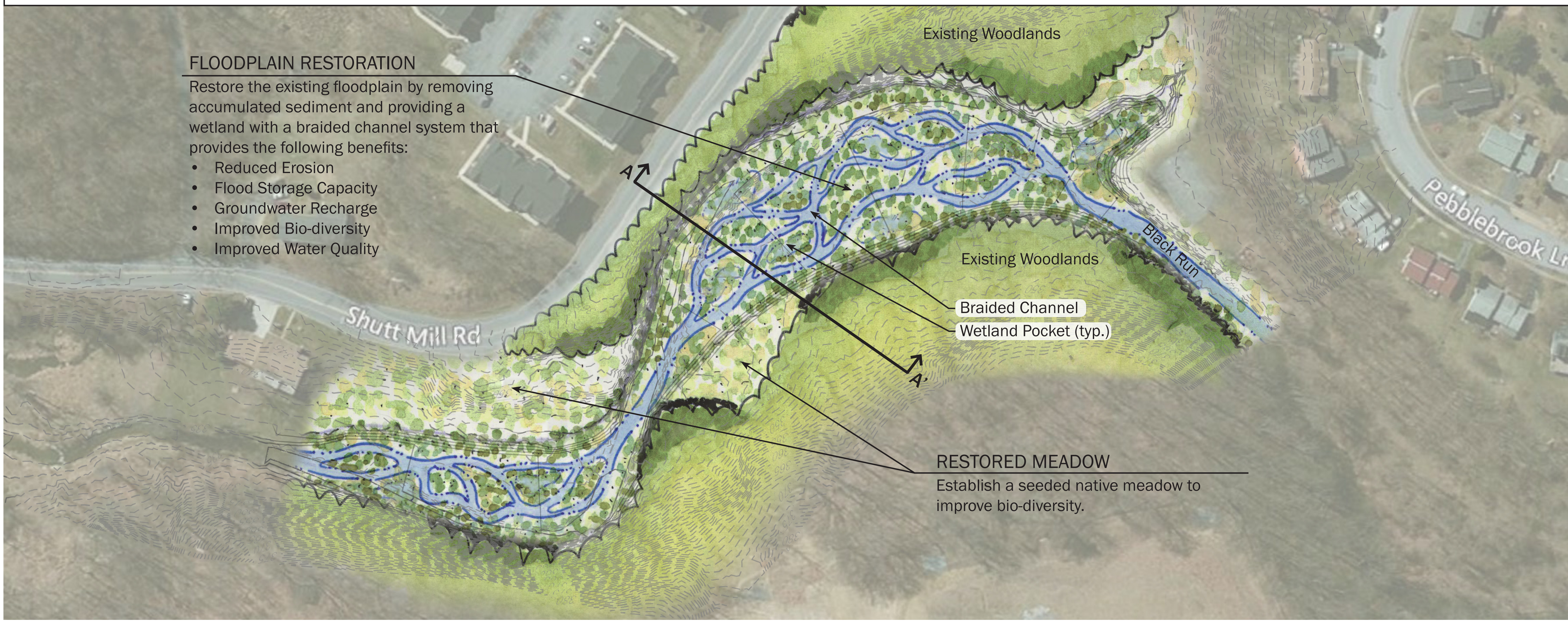


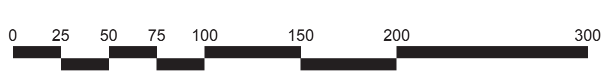
Typical Section - A-A'

Not to Scale

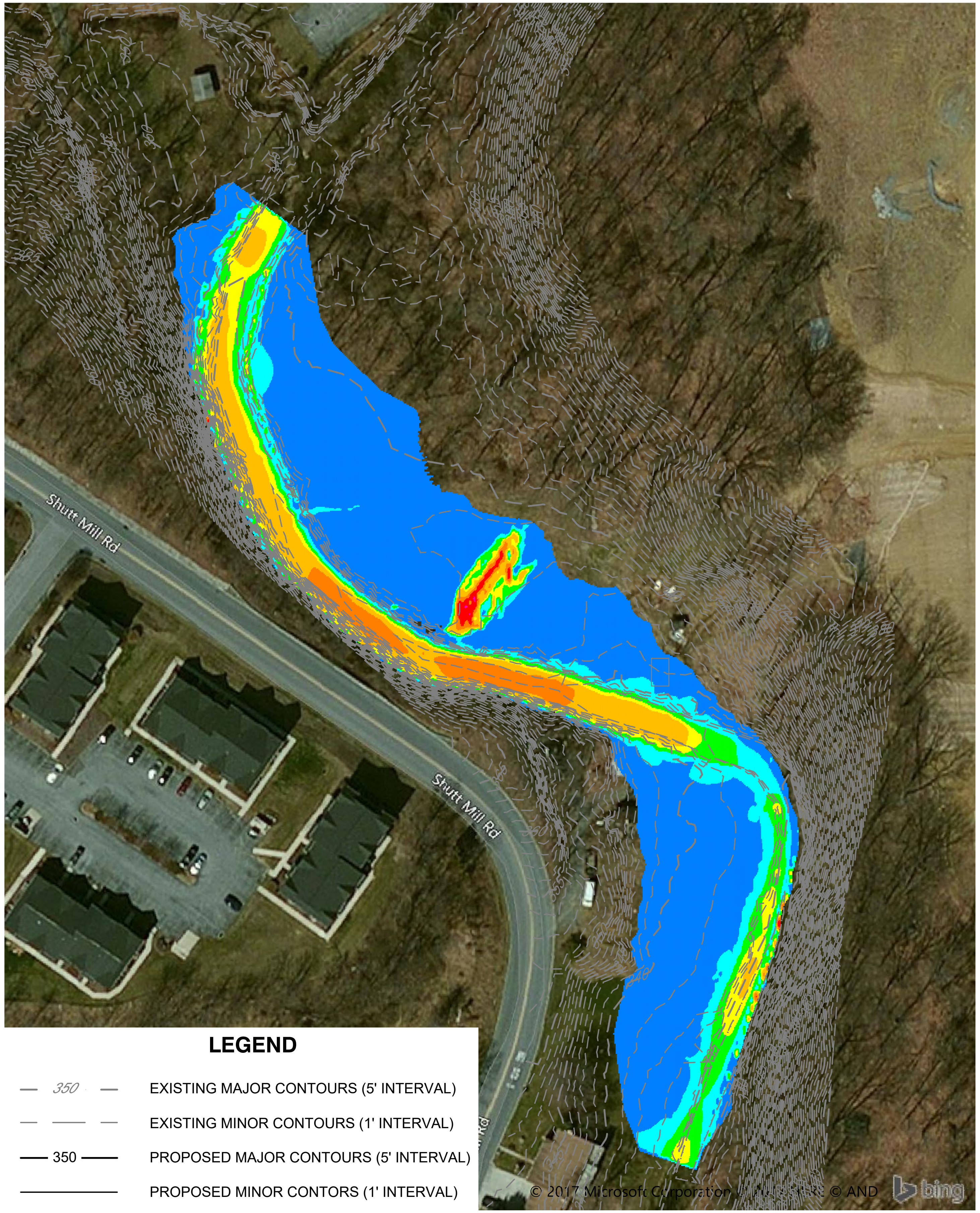
Floodplain Restoration

Example Image

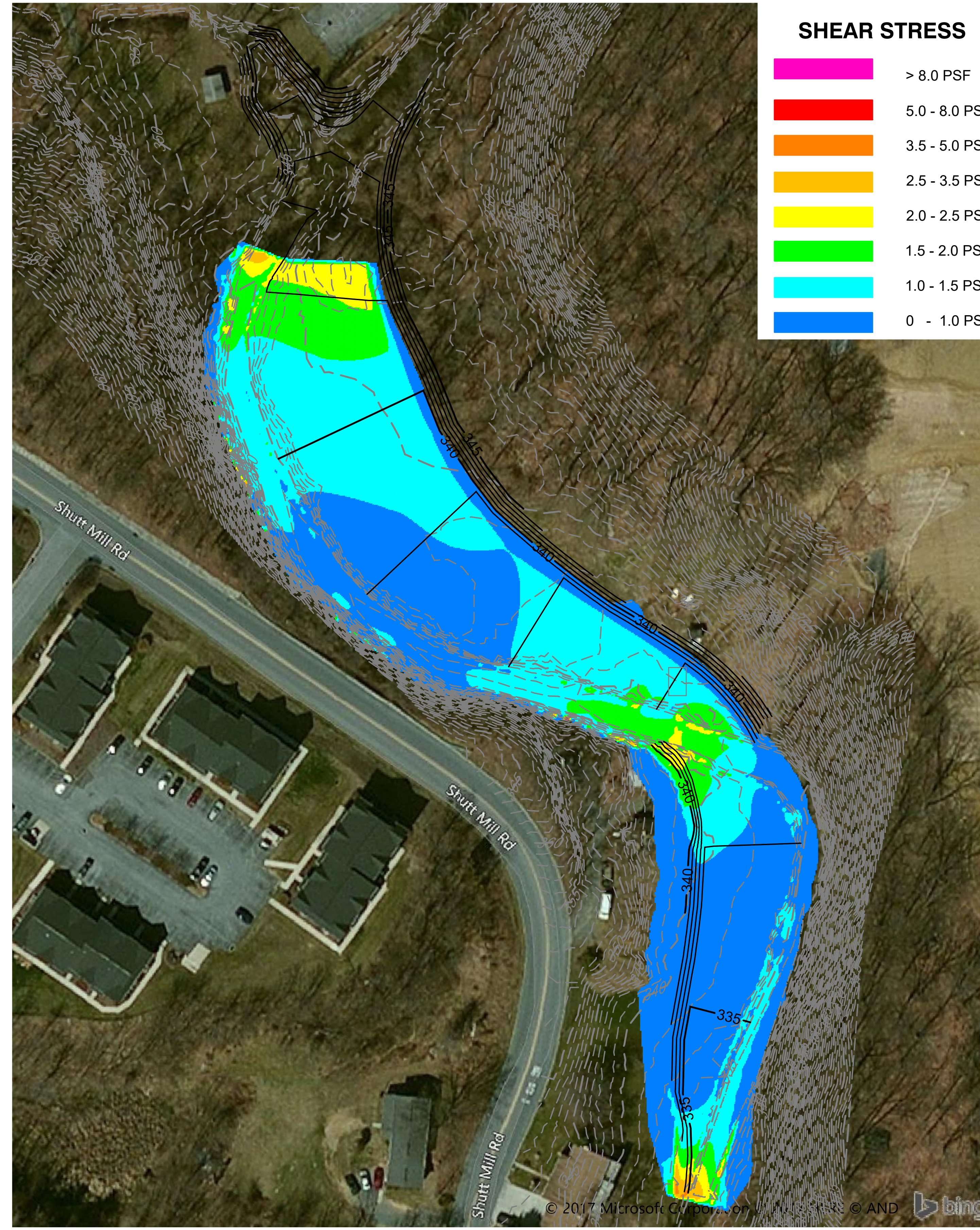




EXISTING CONDITIONS SHEAR STRESS RESULTS



PROPOSED CONDITIONS SHEAR STRESS RESULTS



SHEAR STRESS

- > 8.0 PSF
- 5.0 - 8.0 PSF
- 3.5 - 5.0 PSF
- 2.5 - 3.5 PSF
- 2.0 - 2.5 PSF
- 1.5 - 2.0 PSF
- 1.0 - 1.5 PSF
- 0 - 1.0 PSF

LEGEND

- 350 EXISTING MAJOR CONTOURS (5' INTERVAL)
- EXISTING MINOR CONTOURS (1' INTERVAL)
- 350 PROPOSED MAJOR CONTOURS (5' INTERVAL)
- PROPOSED MINOR CONTORS (1' INTERVAL)

0 25 50 100 150 200 300

Scale: 1" = 100'

PAXTON CREEK TMDL

FLOODPLAIN RESTORATION HYDRAULIC ANALYSIS

EXAMPLE SITE: BLACK RUN

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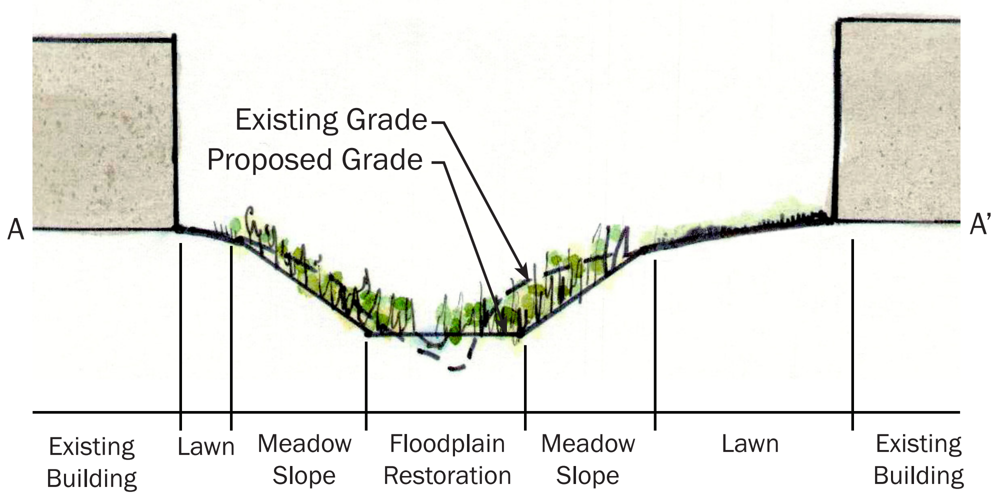
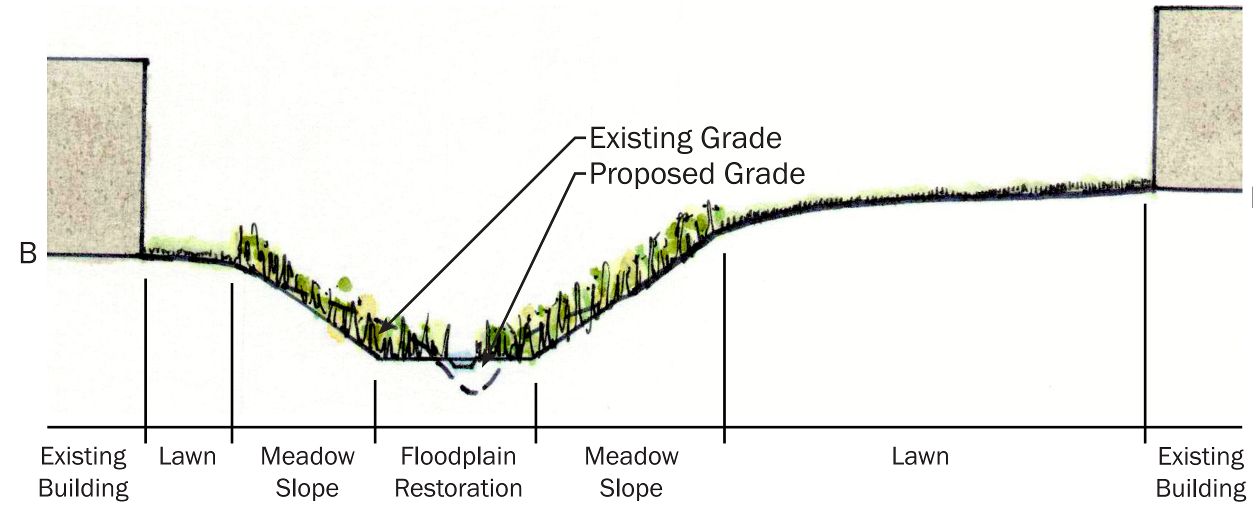


Typical Section - A-A'

Not to Scale

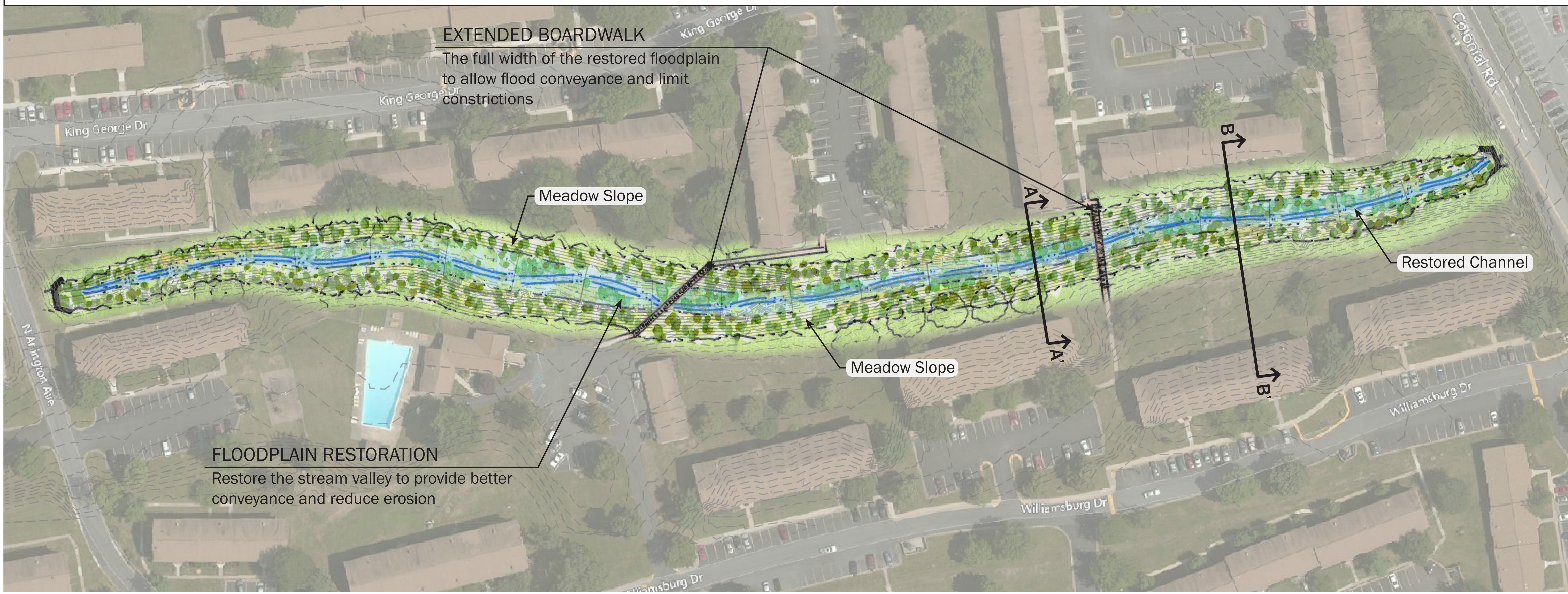


Typical Section - B-B'

Not to Scale

Floodplain Restoration

Example Image



0 25 50 75 100 150 200 300

Scale: 1" = 100'

PAXTON CREEK TMDL

CONSTRAINED CORRIDOR CONCEPT

EXAMPLE SITE: STONEBRIDGE APARTMENTS

JULY 26, 2017

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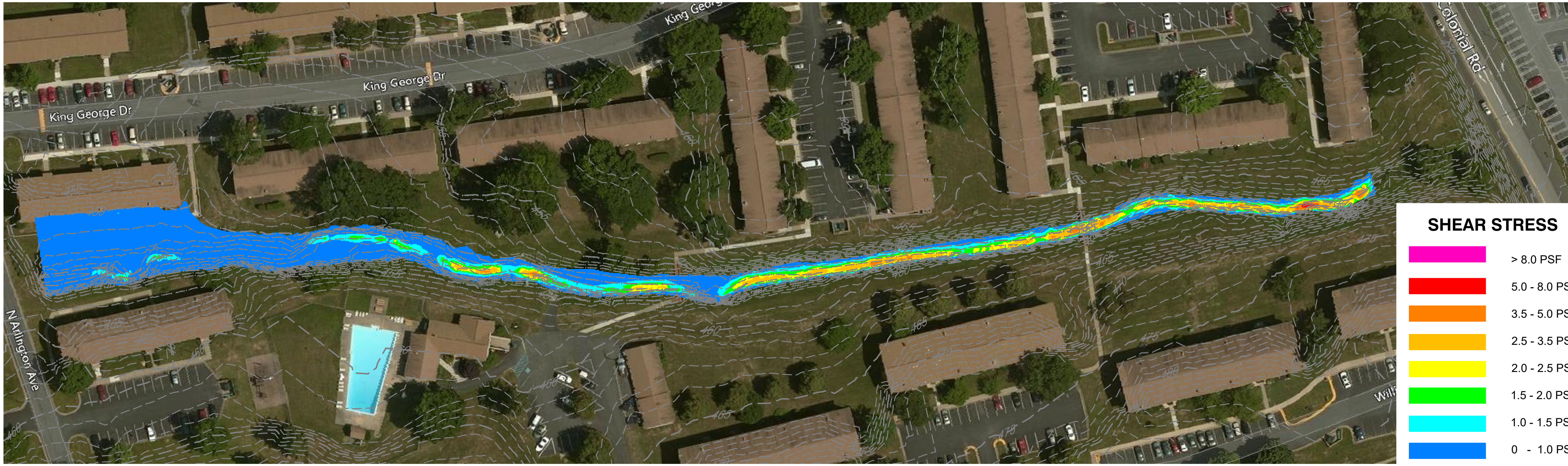
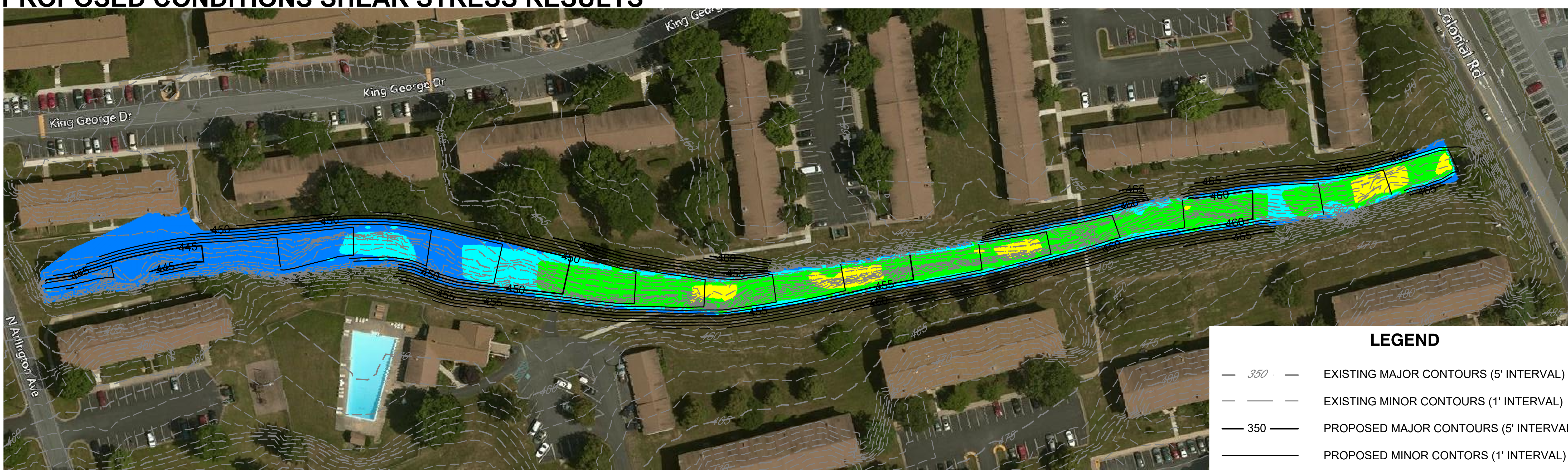
HRG Engineering & Related Services AN EMPLOYEE-OWNED COMPANY

EXISTING CONDITIONS SHEAR STRESS RESULTS



PROPOSED CONDITIONS SHEAR STRESS RESULTS



0 25 50 100 150 200 300

Scale: 1" = 100'

PAXTON CREEK TMDL

CONSTRAINED CORRIDOR HYDRAULIC ANALYSIS

EXAMPLE SITE: STONEBRIDGE APARTMENTS

JULY 26, 2017

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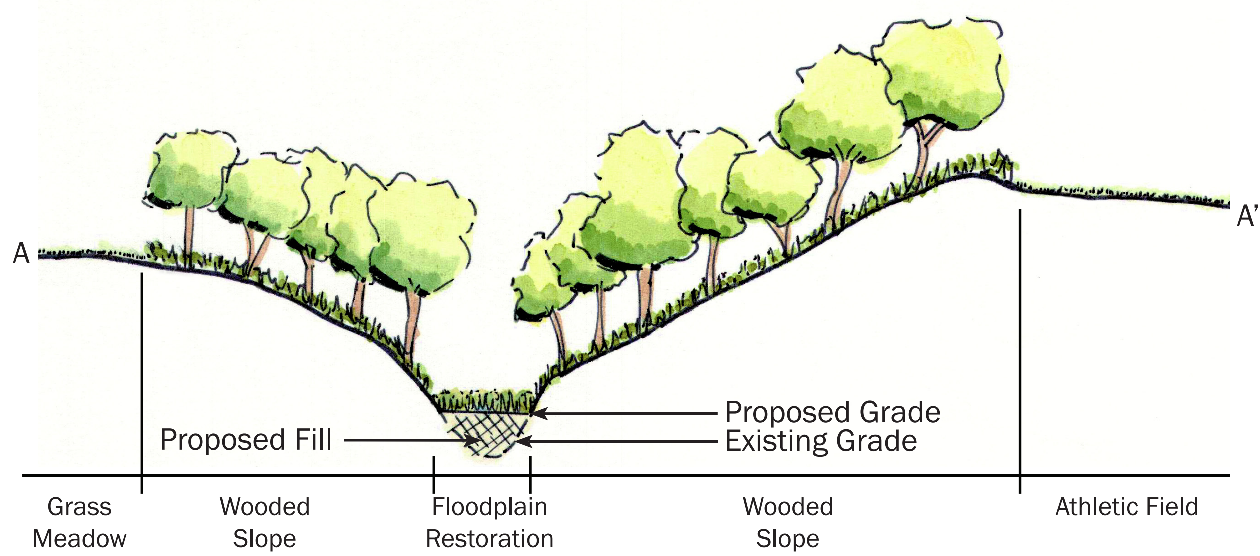
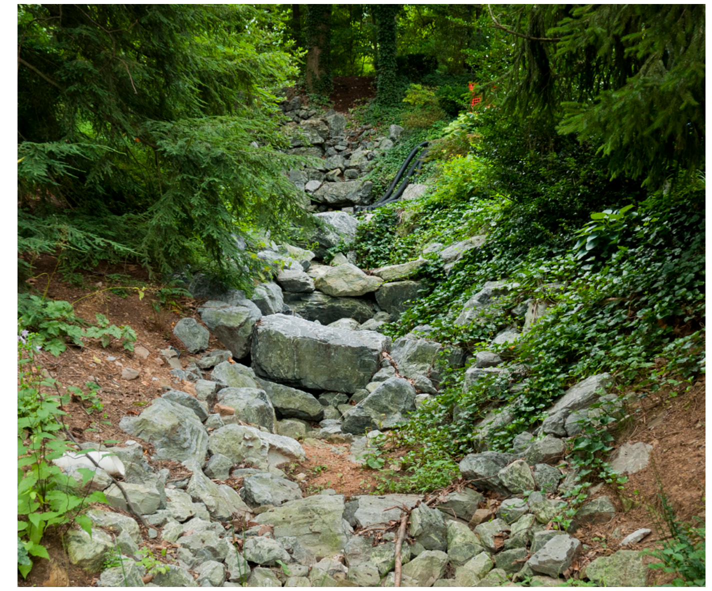


Typical Section - A-A'

Not to Scale

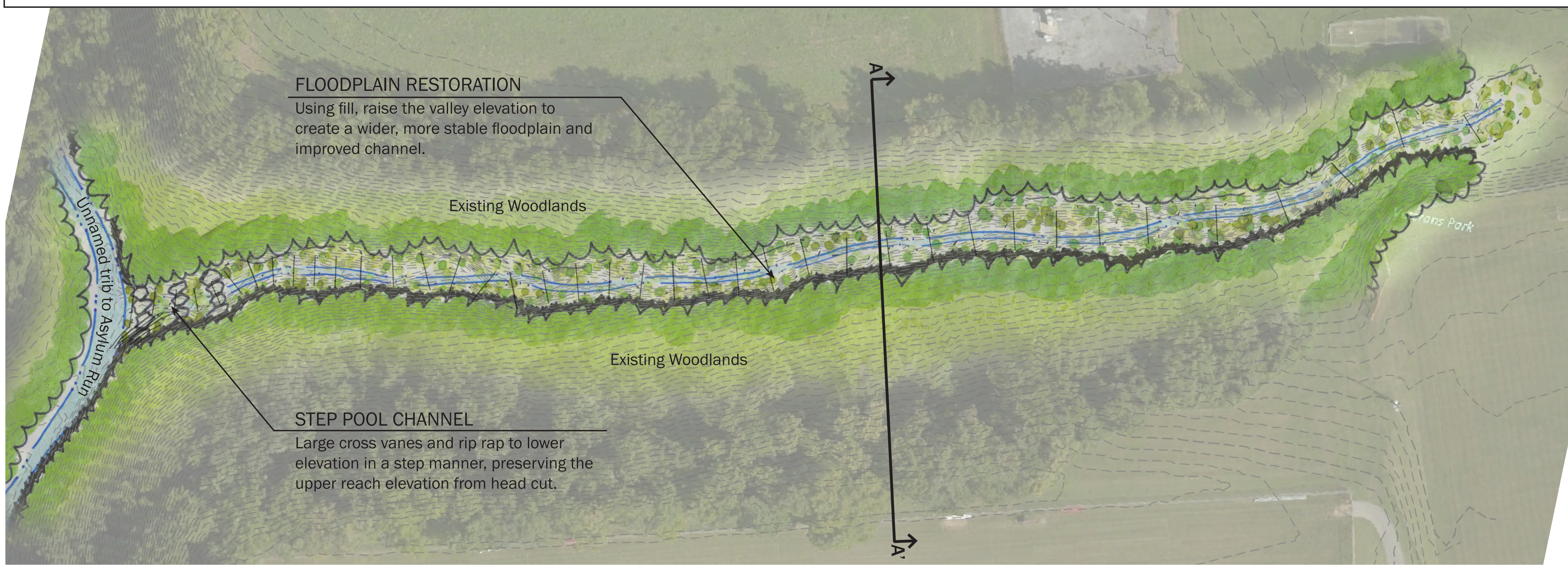


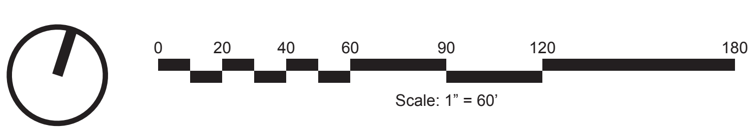
Step Pool Channel

Example Image

Floodplain Restoration

Example Image





PAXTON CREEK TMDL

STEEP SLOPE CONCEPT

EXAMPLE SITE: VETERAN'S PARK

JULY 26, 2017

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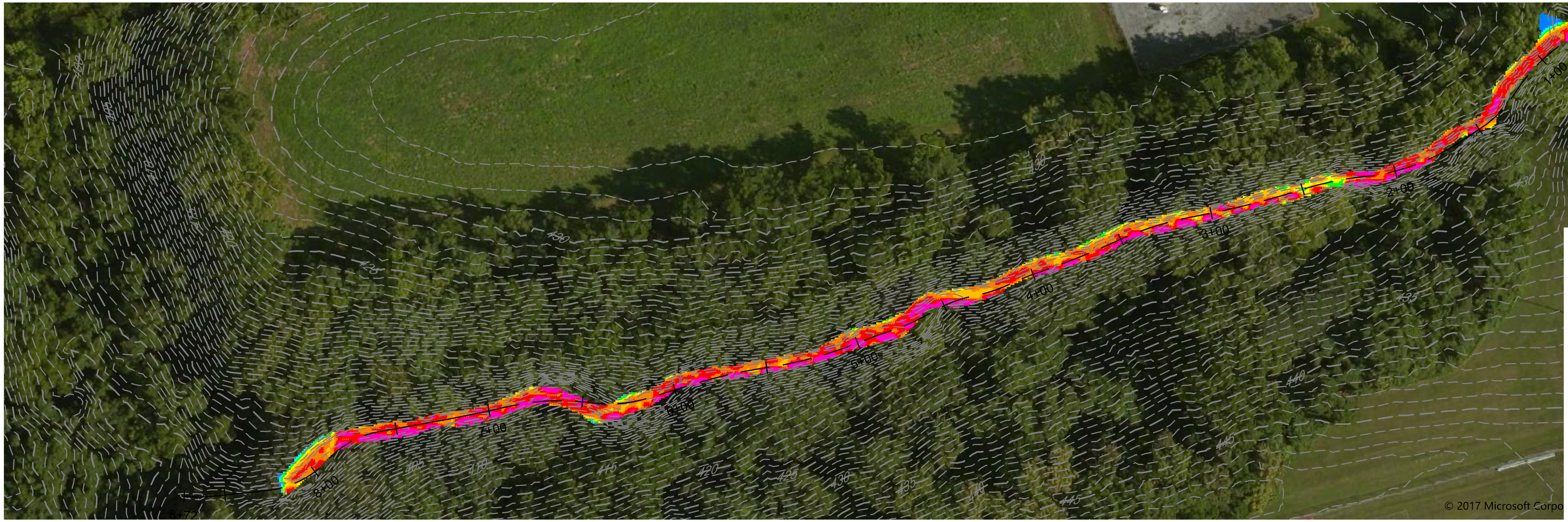
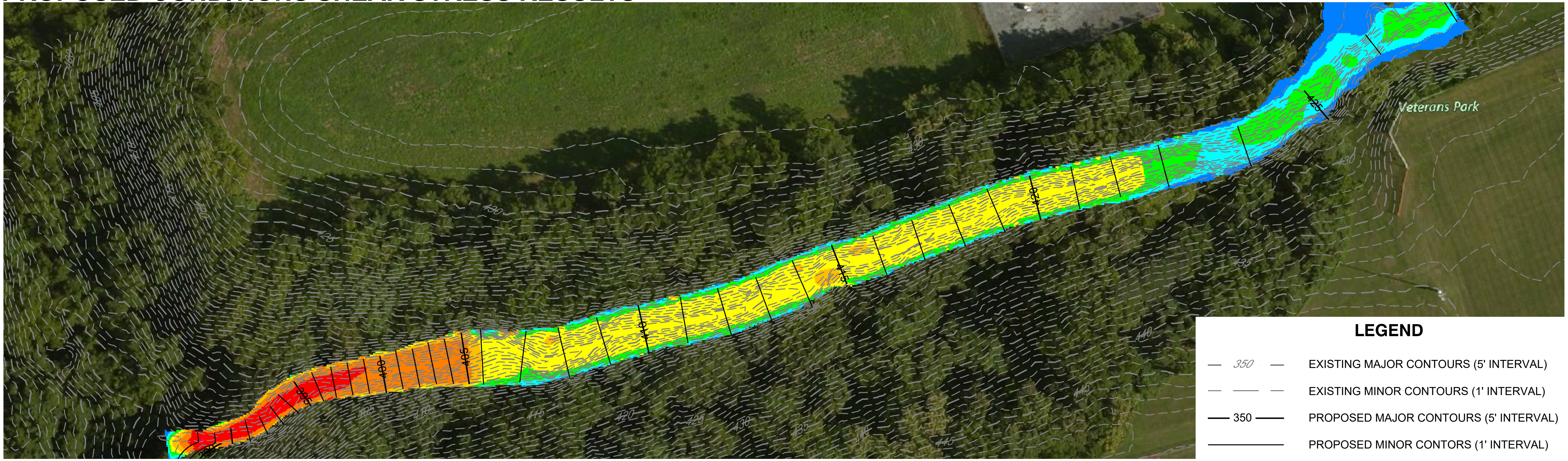
EXISTING CONDITIONS SHEAR STRESS RESULTS



SHEAR STRESS

(magenta)	> 8.0 PSF
(red)	5.0 - 8.0 PSF
(orange)	3.5 - 5.0 PSF
(light orange)	2.5 - 3.5 PSF
(yellow)	2.0 - 2.5 PSF
(green)	1.5 - 2.0 PSF
(cyan)	1.0 - 1.5 PSF
(blue)	0 - 1.0 PSF

PROPOSED CONDITIONS SHEAR STRESS RESULTS



LEGEND

- 350 — EXISTING MAJOR CONTOURS (5' INTERVAL)
- EXISTING MINOR CONTOURS (1' INTERVAL)
- 350 — PROPOSED MAJOR CONTOURS (5' INTERVAL)
- PROPOSED MINOR CONTORS (1' INTERVAL)

0 15 30 60 90 120 180

Scale: 1" = 60'

PAXTON CREEK TMDL

STEEP SLOPE HYDRAULIC ANALYSIS

EXAMPLE SITE: VETERAN'S PARK

JULY 26, 2017

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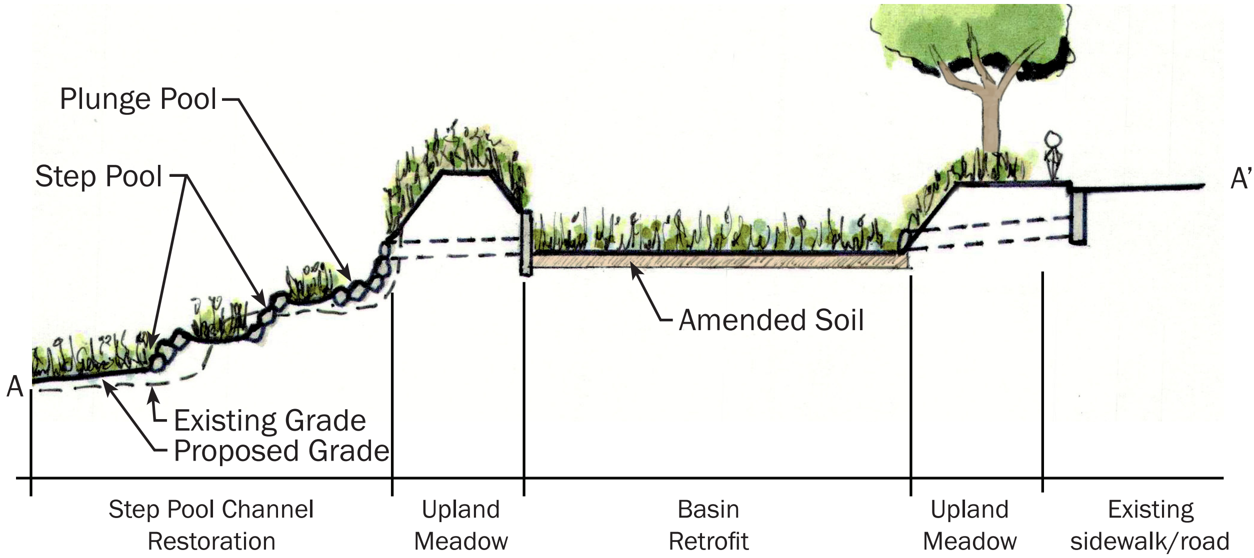
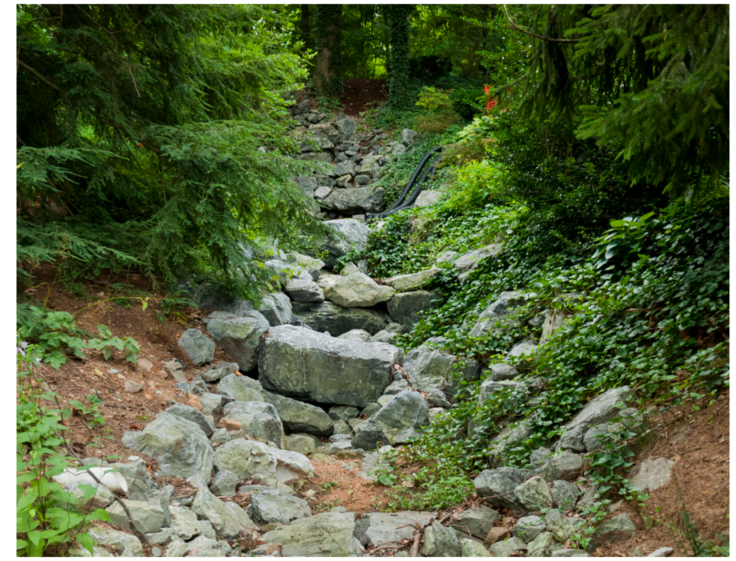


Typical Section - A-A'

Not to Scale



Step Pool Channel

Example Image

Basin Retrofit

Example Image

0 20 40 60 90 120 180

Scale: 1" = 60'

PAXTON CREEK TMDL

WALKER MILL ROAD BASIN RETROFIT CONCEPT

JULY 18, 2017

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APPENDIX G – PROPOSED BMP SEDIMENT REDUCTION CALCULATIONS

Proposed BMP Pollutant Reduction Calculations

Map Reference	BMP Name	Lat.	Long.	Length (ft)	Reduction (lbs)
BMP-01	Fox Hunt - Stream Restoration	40.335491°	-76.879814°	750	86,250
BMP-02	Stonebridge Apartments	40.301103°	-76.823866°	1,450	166,750
BMP-03	Wildwood Lake, Black Run	40.307771°	-76.882665°	1,075	123,625
BMP-04	Veteran's Park South	40.293398°	-76.859017°	1,000	115,000
BMP-05	Veteran's Park North	40.294232°	-76.860350°	1,150	132,250
BMP-06	CWP – Shutt Mill Rd/Walker Mill Road	40.316231°	-76.870776°	4,400	505,171
BMP-07	Susquehanna Union Green	40.325675°	-76.855535°	2,600	505,700
BMP-08	Bradley Dr	40.319371°	-76.860073°	950	109,250
BMP-09	Black Run - North	40.316022°	-76.870342°	3,368	387,320
BMP-10	Black Run - South	40.311085°	-76.871213°	2,000	230,000
BMP-11	Pines Apartment Complex	40.289522°	-76.840440°	1,450	166,750
BMP-12	Capital Area Greenbelt	40.272602°	-76.841858°	1,800	207,000
BMP-13	Walker Mill Road Stream and Retrofit	40.305650°	-76.866050°	600	79,400
BMP-14	CRW UNT to Spring Creek GSI Projects	40.269089°	-76.844171°	N/A	23,024
BMP-15	CRW Street Sweeping (25 times per year)	N/A	N/A	N/A	29,864
BMP-16	Combined Sewer System Rehabilitation & Optimization	N/A	N/A	N/A	355,000
				Total Proposed BMP Sediment Reduction:	**3,222,354**
				Joint Planning Area Sediment Reduction Goal:	**1,694,398**

Urban BMP Load Reduction Calculation Table

INSTRUCTIONS TO MUNICIPALITY: Each row in the table below should represent a different BMP drainage area. Choose the dominant land use draining to the BMP.
If a BMP has multiple land uses in the drainage area, these drainage areas should be represented on a subsequent row with the same BMP name. The treatment depth should be the same for a given BMP (even if it has multiple drainage areas).
If one of the drainage areas to the same BMP has NO impervious cover, use the Manual Override column to type in the treatment depth (in/imp. ac) of the primary drainage area containing impervious cover.
The examples below show the various options and should be deleted before tallying reductions. Notice one example demonstrates when a drainage area covers two land uses (see row 14 and 15).

Project Name	BMP Name	BMP Type	Existing or Proposed	Year Installed	MapShed Land Cover of Drainage Area	Drainage Area (ac)	Treatment Depth (in)	Stream Restoration* Length (ft) - Qualified projects only	Impervious Area (ac)	Treatment Depth (in/imp. ac)	Effective Treatment Depth (in/imp. ac)	Impervious (%)	TSS Load (lbs/yr)	TP Load (lbs/yr)	TN Load (lbs/yr)	TSS Reduction (%)	TP Reduction (%)	TN Reduction (%)	TSS Reduction (lbs/yr)	TSS Reduction (tons/yr)	TP Reduction (lbs/yr)	TN Reduction (lbs/yr)
Project_name	BMP_name	BMP_type	Existing?	YearInstalled	drainageLandCoverClass	drainageArea_ac	treatmentDepth_in	lengthTreatedStream_ft	impervArea_a	treatmentDe	treatmentDepthNo	impervFractio	TSS_Load_lbP	TP_Load_lbPe	TN_Load_lbPe	TSS_Reductior	TP_Reduction	TN_Reduction	TSS_Reduction_lbPerY	TSS_Reduction_ton	TP_Reduction_	TN_Reduction_
EX-01	Paxton Church / Reichert Rain Garden	RR	Existing	2009	Md_Mixed	20	1.00		10.40	1.92	1.92	52.0%	14,820.95	5.60	43.60	83.7%	78.0%	66.7%	12,412.25	6.21	4.37	29.10
EX-01	Paxt Church / Reichert Stream Restoration	Stream Restoration	Existing	2009				240	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	27,600.00	13.80	41.76	46.08
EX-02	Fox Hunt Stream Restoration	Stream Restoration	Existing	2014				375	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	43,125.00	21.56	65.25	72.00
EX-03	UNT to Asylum Run Dry Ext Det Basin	RR	Existing	2013	Md_Mixed	51.2	1.00		26.62	1.92	1.92	52.0%	37,941.62	14.34	111.62	83.7%	78.0%	66.7%	31,775.37	15.89	11.18	74.49
EX-03	UNT to Asylum Run Stream Resto	Stream Restoration	Existing	2013				350	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	40,250.00	20.13	60.90	67.20
EX-04	Elmerton Ave. Bio-retention Basin	RR	Existing	2009	Md_Mixed	27.7	1.00		14.40	1.92	1.92	52.0%	20,527.01	7.76	60.39	83.7%	78.0%	66.7%	17,190.97	8.60	6.05	40.30
EX-05	Black Run Stream Restoration	Stream Restoration	Existing	2007				800	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	92,000.00	46.00	139.20	153.60
EX-06	Asylum Run Bio-retention	RR	Existing	2013	Md_Mixed	44.5	1.00		23.14	1.92	1.92	52.0%	32,976.61	12.46	97.01	83.7%	78.0%	66.7%	27,617.27	13.81	9.72	64.74
EX-06	Asylum Run Stream Restoration	Stream Restoration	Existing	2013				400	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	46,000.00	23.00	69.60	76.80
EX-07	Dowhower Stream Restoration	Stream Restoration	Existing	2013				1220	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	140,300.00	70.15	212.28	234.24
BMP-01	Fox Hunt	Stream Restoration	Proposed					750	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	86,250.00	43.13	130.50	144.00
BMP-02	Stonebridge Apartments	Stream Restoration	Proposed					1800	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	207,000.00	103.50	313.20	345.60
BMP-03	Wildwood Lake, Black Run	Stream Restoration	Proposed					1075	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	123,625.00	61.81	187.05	206.40
BMP-04	Veteran's Park, South	Stream Restoration	Proposed					1000	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	115,000.00	57.50	174.00	192.00
BMP-05	Veteran's Park, North	Stream Restoration	Proposed					1150	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	132,250.00	66.13	200.10	220.80
BMP-06	CWP - Shuttmill / Walker Mill Rd.	Stream Restoration	Proposed					4400	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	506,000.00	253.00	765.60	844.80
BMP-07	Susquehanna Union Green	Stream Restoration	Proposed					2600	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	299,000.00	149.50	452.40	499.20
BMP-08	Bradley Drive	Stream Restoration	Proposed					950	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	109,250.00	54.63	165.30	182.40
BMP-09	Black Run, North	Stream Restoration	Proposed					3368	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	387,320.00	193.66	586.03	646.66
BMP-10	Black Run, South	Stream Restoration	Proposed					2000	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	230,000.00	115.00	348.00	384.00
BMP-11	Pines Apartments	Stream Restoration	Proposed					1450	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	166,750.00	83.38	252.30	278.40
BMP-12	Capital Area Greenbelt	Stream Restoration	Proposed					1800	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	207,000.00	103.50	313.20	345.60
BMP-13	Walker Mill Rd. Stream	Stream Restoration	Proposed					600	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	69,000.00	34.50	104.40	115.20
BMP-13	Walker Mill Rd. Basin	RR	Proposed		Md_Mixed	34.6	1.00		17.99	1.92	1.92	52.0%	25,640.24	9.69	75.43	83.7%	78.0%	66.7%	21,473.20	10.74	7.56	50.34
BMP-14	CRW GSI - UNT to Spring Creek	RR	Proposed		Md_Mixed	37.1	1.00		19.29	1.92	1.92	52.0%	27,492.86	10.39	80.88	83.7%	78.0%	66.7%	23,024.73	11.51	8.10	53.97

NOTE: the above table is an Excel Table, which has specia https://support.office.com/en-us/article/overview-of-excel-tables-7ab0bb7d-3a9e-4b56-a3c9-6c94334e492c
ADD ROWS by right-clicking a row number inside the Table, and chosing "Insert". This will automatically copy formulas and update links throughout this workbook.

TOTAL LBS REDUCED	**3,161,213.80**	**1,580.61**	**4,628.06**	**5,367.91**
Existing TOTAL LBS REDUCED	**478,270.86**	**239.14**	**620.31**	**858.54**
Proposed TOTAL LBS REDUCED	**2,682,942.93**	**1,341.47**	**4,007.74**	**4,509.37**
Project Name				
LBS REDUCED	-	-	-	-
LBS REDUCED	-	-	-	-
LBS REDUCED	-	-	-	-
LBS REDUCED	-	-	-	-

Cells requiring user input for all BMPs
Cells requiring user input for BMP efficiencies calculated using Performance Standard approach
Cells requiring user input for non-Performance Standard BMPs (e.g., streambank stabilization and street sweeping)
Cell values calculated based on user input
Optional user input for treatment depth in non-developed areas (e.g., cropland)
Optional user input

405118.1 **Available stream length (ft) in Non-Ag Areas in the entire watershed (from MMW Output tab)**
0.0 **Available stream length (ft) in Non-Ag Areas in the smaller target area (from MMW Output tab)**

APPENDIX H – PROJECT SHEETS

Fox Hunt Stream Restoration (BMP-01)

Susquehanna Township, Dauphin County

General Information

Ownership:	Private
Impacted Properties Anticipated:	5
Watershed:	Paxton Creek
Stream Restoration Length (ft):	750
Restoration Prototype:	Veterans Park

Location

Latitude:	40.335491
Longitude:	-76.879814

Pollutant Load Reduction

Stream Restoration TSS (lbs/yr):	86,250
Cost ($/lbs)	4.14

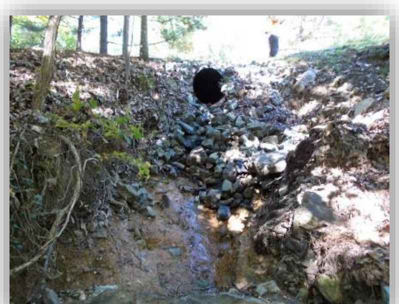
Secondary Benefits

Protects private property:	Yes
Protects infrastructure:	Yes
Publically accessible:	No

Notes

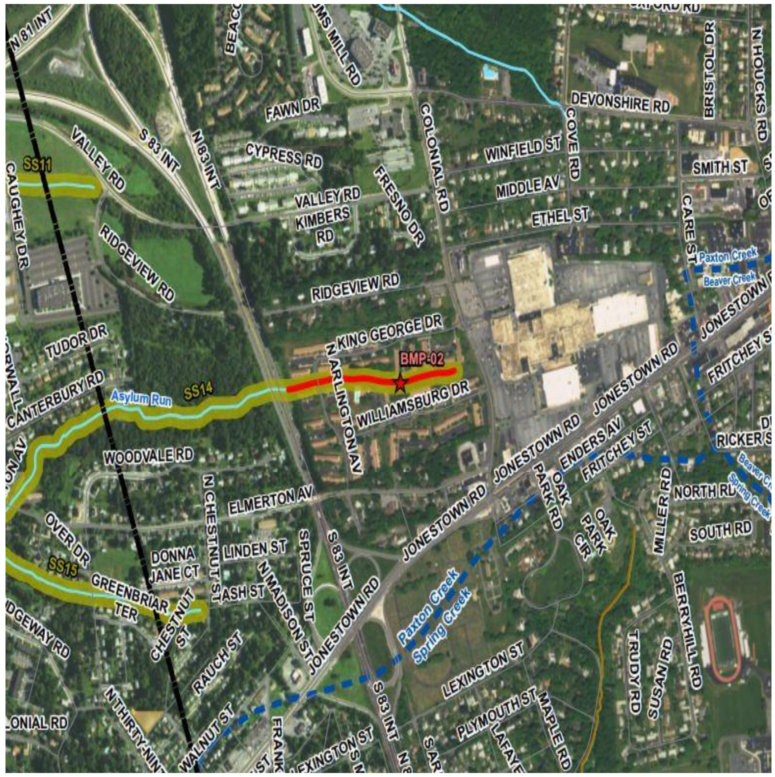
- Existing outfalls to be evaluated/reconstructed
- Existing culvert crossings to be evaluated/reconstructed
- Exposed and suspended utility crossings to be relocated/lowered
- Existing stream crossings/pedestrian bridge structures to be evaluated
- Severe erosion and sediment deposits to be addressed
- Existing stream bed slope to be modified with grade control devices/structures
- Existing debris and fallen trees to be removed

<u>STREAM ASSESSMENT PHOTOS:</u>



Stonebridge Apartments (BMP-02)

Lower Paxton Township, Dauphin County



General Information

Ownership:	Private
Impacted Properties Anticipated:	2
Watershed:	Paxton Creek
Stream Restoration Length (ft):	1,450
Restoration Prototype:	Stonebridge

Location

Latitude:	40.301103
Longitude:	-76.823866

Pollutant Load Reduction

Stream Restoration TSS (lbs/yr):	166,750
Cost ($/lb)	2.47

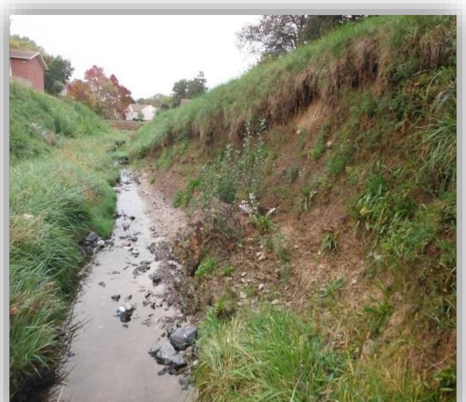
Secondary Benefits

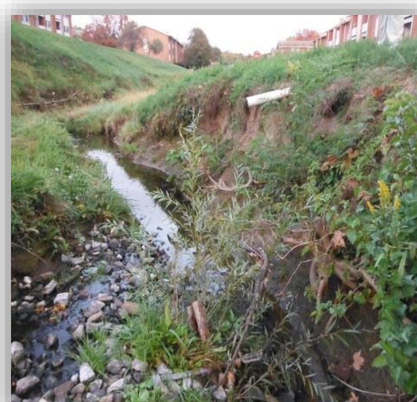
Protects private property:	Yes
Protects infrastructure:	Yes
Publically accessible:	Yes

Notes

- Existing outfalls to be evaluated/reconstructed
- Existing culvert crossings to be evaluated/reconstructed
- Exposed and suspended utility crossings to be relocated/lowered
- Existing stream crossings/pedestrian bridge structures to be evaluated
- Severe erosion and sediment deposits to be addressed

<u>STREAM ASSESSMENT PHOTOS:</u>





Wildwood Lake – Black Run (BMP-03)

City of Harrisburg, Dauphin County

General Information

Ownership:	Public
Impacted Properties Anticipated:	1
Watershed:	Paxton Creek
Stream Restoration Length (ft):	1,075
Restoration Prototype:	Black Run

Location

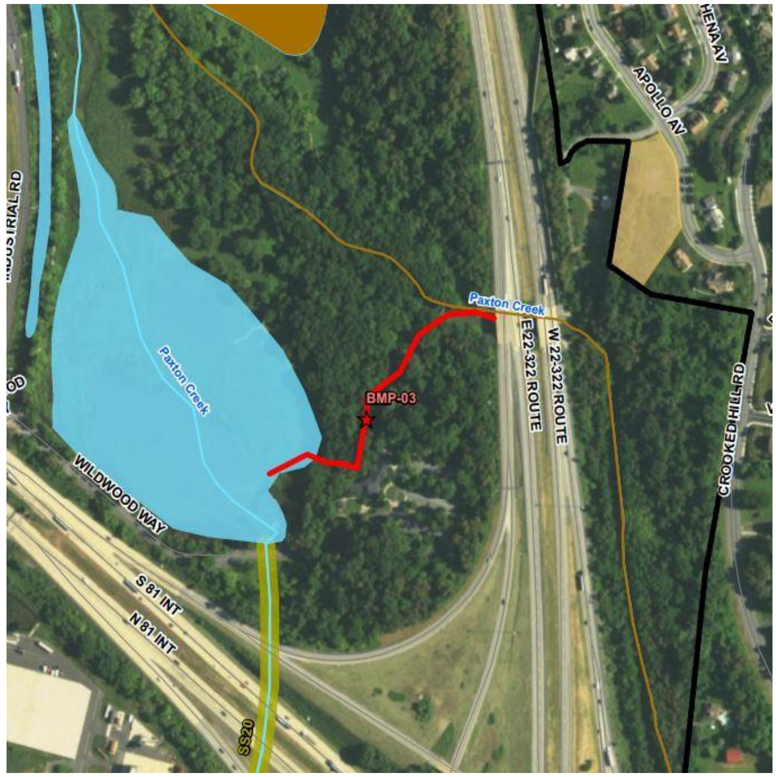
Latitude:	40.307771
Longitude:	-76.882665

Pollutant Load Reduction

Stream Restoration TSS (lbs/yr):	123,625
Cost ($/lb)	4.14

Secondary Benefits

Protects private property:	No
Protects infrastructure:	Yes
Publically accessible:	Yes



Notes

- Existing outfalls to be evaluated/reconstructed
- Existing culvert crossings to be evaluated/reconstructed
- Exposed and suspended utility crossings to be relocated/lowered
- Existing stream crossings/pedestrian bridge structures to be evaluated
- Severe erosion and sediment deposits to be addressed
- Existing debris and fallen trees to be removed

STREAM ASSESSMENT PHOTOS:

Veteran's Park - South (BMP-04)

Susquehanna Township, Dauphin County

General Information

Ownership:	Public
Impacted Properties Anticipated:	2
Watershed:	Paxton Creek
Stream Restoration Length (ft):	1,000
Restoration Prototype:	Veterans Park

Location

Latitude:	40.293398
Longitude:	-76.859017

Pollutant Load Reduction

Stream Restoration TSS (lbs/yr):	115,000
Cost ($/lb)	4.14

Secondary Benefits

Protects private property:	No
Protects infrastructure:	No
Publically accessible:	Yes

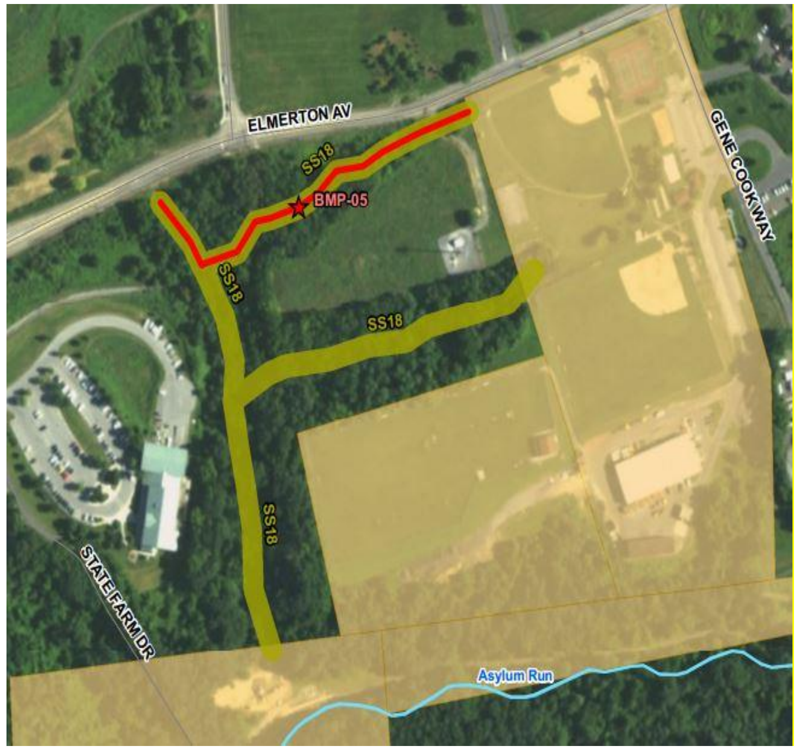
Notes

- Existing outfalls to be evaluated/reconstructed
- Existing culvert crossings to be evaluated/reconstructed
- Severe erosion and sediment deposits to be addressed
- Existing debris and fallen trees to be removed

<u>STREAM ASSESSMENT PHOTOS:</u>

Veteran's Park - North (BMP-05)

Susquehanna Township, Dauphin County



General Information

Ownership:	Public
Impacted Properties Anticipated:	2
Watershed:	Paxton Creek
Stream Restoration Length (ft):	1,150
Restoration Prototype:	Veterans Park

Location

Latitude:	40.294232
Longitude:	-76.860350

Pollutant Load Reduction

Stream Restoration TSS (lbs/yr):	132,250
Cost ($/lb)	3.60

Secondary Benefits

Protects private property:	No
Protects infrastructure:	Yes
Publically accessible:	Yes

Notes

- Existing outfalls to be evaluated/reconstructed
- Severe erosion and sediment deposits to be addressed

STREAM ASSESSMENT PHOTOS:

CWP – Shutt Mill Rd. / Walker Mill Rd. (BMP-06)

Susquehanna Township, Dauphin County

General Information

Ownership:	Private
Impacted Properties Anticipated:	6
Watershed:	Paxton Creek
Stream Restoration Length (ft):	4,400
Restoration Prototype:	Black Run

Location

Latitude:	40.306851
Longitude:	-76.879732

Pollutant Load Reduction

Stream Restoration TSS (lbs/yr):	505,171
Cost ($/lb)	4.76

Secondary Benefits

Protects private property:	Yes
Protects infrastructure:	No
Publically accessible:	No

Notes

- Severe erosion and sediment deposits to be addressed
- Existing debris and fallen trees to be removed
- Floodplain reconnection

Susquehanna Union Green (BMP-07)

Susquehanna Township, Dauphin County

General Information

Ownership:	Private
Impacted Properties Anticipated:	1
Watershed:	Paxton Creek
Stream Restoration Length (ft):	2,600
Restoration Prototype:	Black Run

Location

Latitude:	40.325675
Longitude:	-76.855535

Pollutant Load Reduction

Stream Restoration TSS (lbs/yr):	505,700*
Cost ($/lb)	4.76

Secondary Benefits

Protects private property:	Yes
Protects infrastructure:	Yes
Publically accessible:	Yes

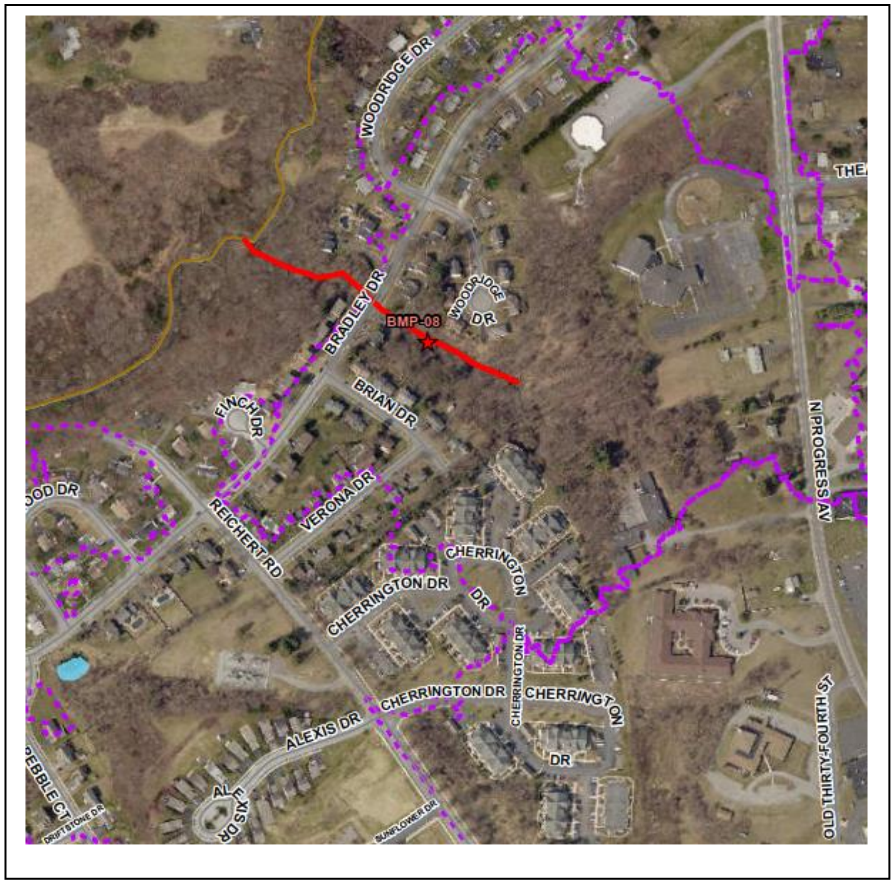
Notes

- Floodplain Restoration
- Establish Riparian Buffer
- Realign Stream Channel
- Existing sediment, debris and fallen trees to be removed

*Based on Expert Panel Report Credit Protocols

Bradley Drive (BMP-08)

Susquehanna Township, Dauphin County



General Information

Ownership:	Private
Impacted Properties Anticipated:	9
Watershed:	Paxton Creek
Stream Restoration Length (ft):	950
Restoration Prototype:	Stonebridge

Location

Latitude:	40.317575
Longitude:	-76.803402

Pollutant Load Reduction

Stream Restoration TSS (lbs/yr):	109,250
Cost ($/lb)	2.47

Secondary Benefits

Protects private property:	Yes
Protects infrastructure:	No
Publically accessible:	No

Notes

- Severe erosion and sediment deposits to be addressed
- Existing debris and fallen trees to be removed
- Reestablish buffer

Black Run - North (BMP-09)

Susquehanna Township, Dauphin County

General Information

Ownership:	Private
Impacted Properties Anticipated:	21
Watershed:	Paxton Creek
Stream Restoration Length (ft):	3,368
Restoration Prototype:	Black Run

Location

Latitude:	40.316022
Longitude:	-76.870342

Pollutant Load Reduction

Stream Restoration TSS (lbs/yr):	387,320
Cost ($/lb)	4.14

Secondary Benefits

Protects private property:	Yes
Protects infrastructure:	Yes
Publically accessible:	Yes

Notes

- Severe bank erosion and sediment deposits to be addressed
- Address streambank under cutting & lack of buffer
- Address failed endwall structures

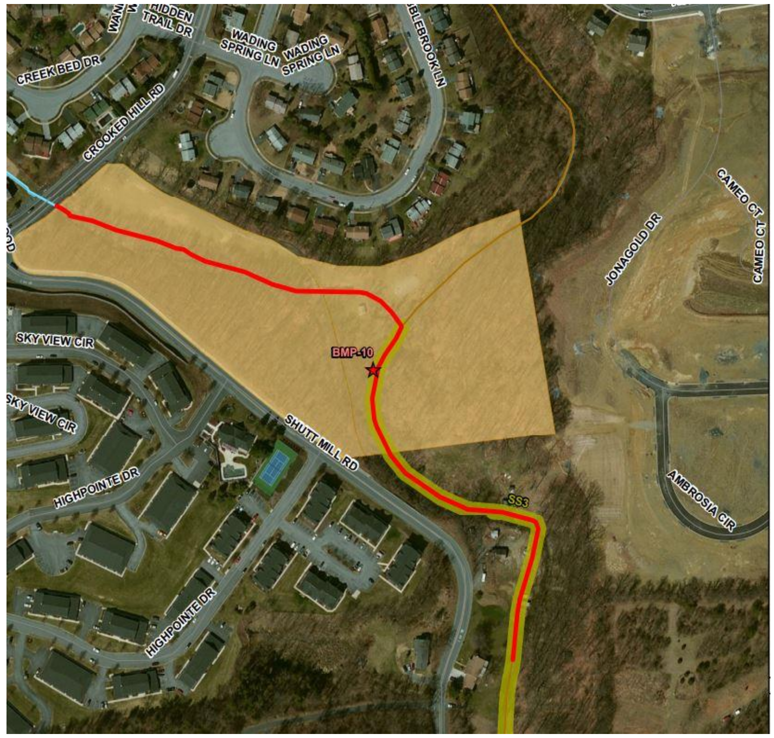
<u>STREAM ASSESSMENT PHOTOS:</u>

Black Run - South (BMP-10)

Susquehanna Township, Dauphin County

General Information

Ownership:	Private
Impacted Properties Anticipated:	6
Watershed:	Paxton Creek
Stream Restoration Length (ft):	2,000
Restoration Prototype:	Black Run



Location

Latitude:	40.311085
Longitude:	-76.871213

Pollutant Load Reduction

Stream Restoration TSS (lbs/yr):	230,000
Cost ($/lb)	4.14

Secondary Benefits

Protects private property:	Yes
Protects infrastructure:	Yes
Publically accessible:	Yes

Notes

- Existing outfalls to be evaluated/reconstructed
- Existing culvert crossings to be evaluated/reconstructed
- Severe erosion and sediment deposits to be addressed
- Existing stream bed slope to be modified with grade control devices/structures
- Existing debris and fallen trees to be removed

<u>STREAM ASSESSMENT PHOTOS:</u>

Pines Apartment Complex (BMP-11)

Susquehanna Township, Dauphin County

General Information

Ownership:	Private
Impacted Properties Anticipated:	6
Watershed:	Paxton Creek
Stream Restoration Length (ft):	1,450
Restoration Prototype:	Veterans Park

Location

Latitude:	40.289522
Longitude:	-76.840440

Pollutant Load Reduction

Stream Restoration TSS (lbs/yr):	166,750
Cost ($/lb)	4.14

Secondary Benefits

Protects private property:	Yes
Protects infrastructure:	Yes
Publically accessible:	No

Notes

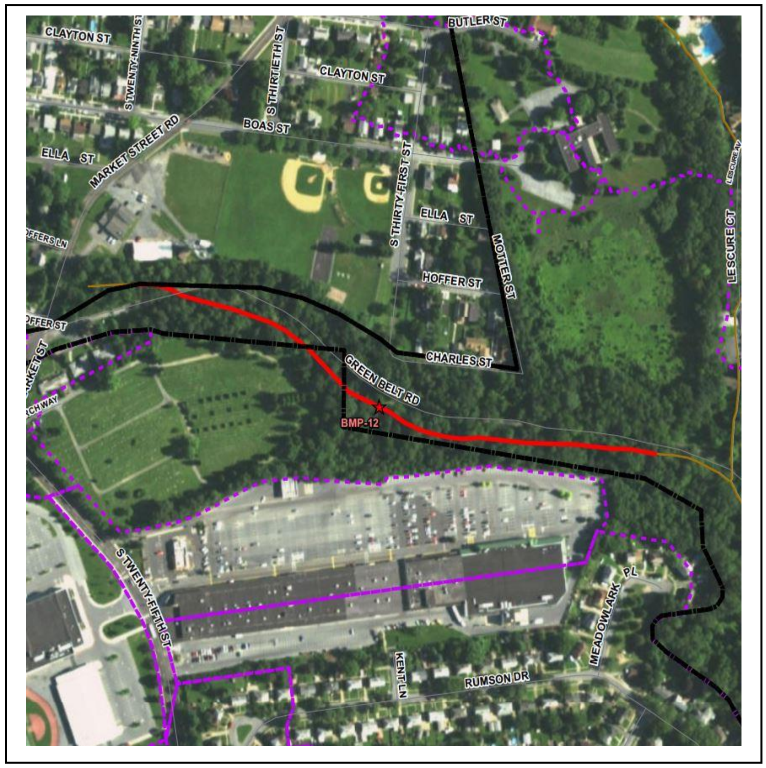
- Existing outfalls to be evaluated/reconstructed
- Existing culvert crossings to be evaluated/reconstructed
- Severe erosion and sediment deposits to be addressed
- Existing debris and fallen trees to be removed

STREAM ASSESSMENT PHOTOS:

Capital Area Greenbelt (BMP-12)

Susquehanna Township, Dauphin County

General Information



Ownership:	Public
Impacted Properties Anticipated:	1
Watershed:	Spring Creek
Stream Restoration Length (ft):	1,800
Restoration Prototype:	Stonebridge

Location

Latitude:	40.272602
Longitude:	-76.841858

Pollutant Load Reduction

Stream Restoration TSS (lbs/yr):	207,000
Cost ($/lb)	2.47

Secondary Benefits

Protects private property:	Yes
Protects infrastructure:	Yes
Publically accessible:	Yes

Notes

- Existing outfalls to be evaluated/reconstructed
- Existing culvert crossings to be evaluated/reconstructed
- Severe erosion and sediment deposits to be addressed
- Failing utility stream crossings to be addressed

<u>STREAM ASSESSMENT PHOTOS:</u>

Walker Mill Road (BMP-13)

City of Harrisburg, Dauphin County

General Information

Ownership: Private
Impacted Properties Anticipated: 1
Watershed: Paxton Creek
Stream Restoration Length (ft): 600
Restoration Prototype: Veterans Park

Location

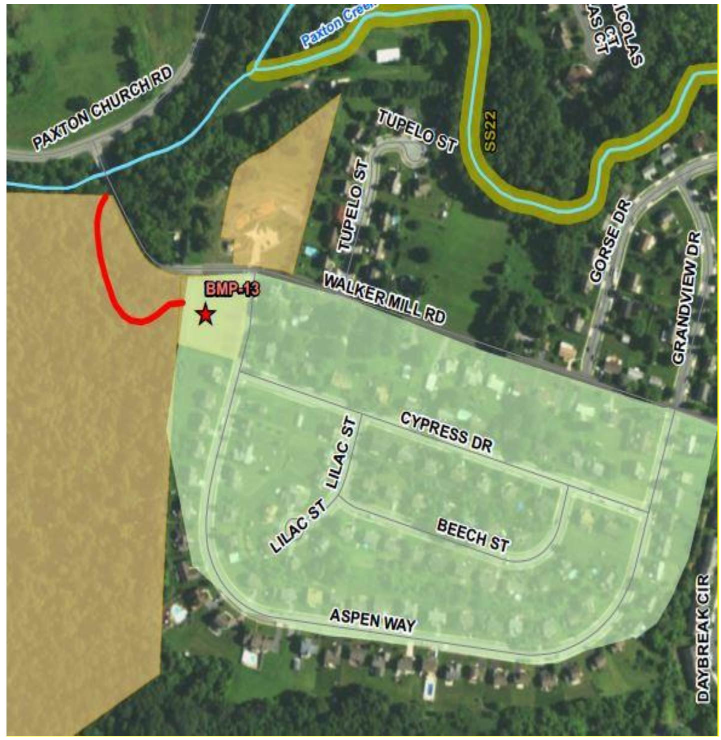
Latitude: 40.305650
Longitude: -76.866050

Pollutant Load Reduction

Stream Restoration TSS (lbs/yr): 69,000
Cost ($/lb) 4.14

Secondary Benefits

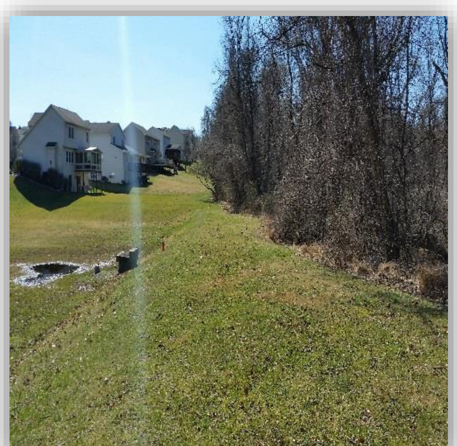
Protects private property: Yes
Protects infrastructure: Yes
Publically accessible: Yes



Notes

- Modify existing basin outfall structure
- Over-excavate basin floor, install modified soils
- Vegetate basin w/ wetland species
- Vegetate surrounding area w/ native trees & shrubs
- Conduct stabilization of basin berm and adjacent streambank

<u>STREAM ASSESSMENT PHOTOS:</u>



CONSTRUCTION PLAN
FOR
LOGAN TRACT TRAILS - SUSQUEHANNA TOWNSHIP
SUSQUEHANNA TOWNSHIP, DAUPHIN, PENNSYLVANIA
JULY 6, 2017

LOCATION MAP

SCALE: 1" = 1,000'

INDEX OF DRAWINGS		
Sheet No.	Drawing No.	Sheet Title
1	CV	COVER SHEET
2	NT	CONSTRUCTION NOTES
3	EC	EXISTING CONDITIONS PLAN
4	MP	MASTER PLAN
5	SI–1	SITE PLAN
6	SI–2	TRAILHEAD DETAIL SITE PLAN
7	ES–1	TRAILHEAD EROSION AND SEDIMENT CONTROL PLAN
8	PR–1	TRAIL & STREAM CROSSING PROFILE
9	DT–1	CONSTRUCTION DETAILS

OWNER/DEVELOPER

SUSQUEHANNA TOWNSHIP
1900 LINGLESTOWN ROAD
HARRISBURG, PENNSYLVANIA, 17110
BOB REICHARD, DIRECTOR OF
PARKS AND RECREATION
(717) 545–4751

HRG
Herbert, Rowland & Grubic, Inc.
Engineering & Related Services
AN EMPLOYEE-OWNED COMPANY

369 East Park Drive
Harrisburg, PA 17111
(717) 564-1121
Fax (717) 564-1158
hrg@hrg-inc.com
www.hrg-inc.com

SURVEY NOTES

1. THIS SURVEY HORIZONTALLY REFERENCES THE NORTH AMERICAN DATUM OF 1983 (NAD83 – 2011), PENNSYLVANIA STATE PLANE COORDINATE SYSTEM, SOUTH ZONE (3702) AS ESTABLISHED BY FIELD SURVEY BY HERBERT, ROWLAND & GRUBIC, INC., PERFORMED FROM 1–19–17 TO 2–01–17.
2. THIS SURVEY VERTICALLY REFERENCES THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88) AS ESTABLISHED BY FIELD SURVEY BY HERBERT, ROWLAND & GRUBIC, INC., PERFORMED PERFORMED FROM 1–19–17 TO 2–01–17.
3. THIS PLAN WAS PREPARED WITHOUT THE BENEFIT OF A TITLE REPORT AND MAY BE SUBJECT TO EASEMENTS AND OTHER RESTRICTIONS, EITHER RECORDED OR UNRECORDED. THE SURVEYOR HAS MADE NO INVESTIGATION OR INDEPENDENT SEARCH FOR EASEMENT OF RECORD, ENCUMBRANCES, RESTRICTIVE COVENANTS, OWNERSHIP TITLE EVIDENCE OR ANY OTHER FACTS THAT AN ACCURATE AND CURRENT TITLE SEARCH MAY DISCLOSE OTHER THAN WHAT IS SHOWN ON THIS PLAN.
4. THE LOCATIONS OF UTILITIES AS SHOWN HEREON ARE BASED ON ABOVEGROUND FEATURES, FIELD OBSERVATIONS\SURVEY, AND RECORD DRAWINGS PROVIDED BY UTILITY COMPANIES. LOCATIONS OF UNDERGROUND UTILITIES/STRUCTURES MAY VARY FROM LOCATIONS SHOWN HEREON. ADDITIONAL BURIED UTILITIES/STRUCTURES MAY BE ENCOUNTERED. NO EXCAVATIONS WERE MADE DURING THE PROGRESS OF THIS SURVEY TO LOCATE BURIED UTILITIES/STRUCTURES. IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO FIELD VERIFY THE EXACT LOCATION AND DEPTH OF ALL UTILITY LINES PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION ACTIVITIES, THE CONTRACTOR SHALL CONTACT ALL UTILITY COMPANIES IN COMPLIANCE WITH ACT 187 TO VERIFY THE EXACT LOCATION OF ALL UNDERGROUND UTILITIES. A PA ONE CALL WAS PERFORMED PRIOR TO FIELD SURVEYING. SERIAL NOS. 20170180142, DATED 1–18–17.
5. SITE BENCHMARK:
   (BM1) CHISELED "□" AT NE CORNER OF CONCRETE RISER BOX AT BOTTOWM OF STORMWATER POND ELEVATION OF 372.69
   (BM2) CHISELED "+" ON FLANGE BOLT OF MAIN OPENING OF FIRE HYDRANT EAST SIDE OF ASPEN WAY, JUST SOUTH OF CYPRESS DRIVE, ELEVATION OF 380.75
6. THE METES AND BOUNDS DESCRIPTION ON THIS PLAN WERE TAKEN FROM A RECORDED FINAL SUBDIVISION PLAN (INSTRUMENT NUMBER 20160001597), DATED OCTOBER 21, 2015 BETWEEN JOSEPH L. & LINDA K. TAYLOR AND THE SUSQUEHANNA TOWNSHIP AUTHORITY.

   THE PURPOSE OF THE ABOVE REFERENCED RECORDED SUBDIVISION PLAN WAS TO SUBDIVIDE A 1.9643 ACRE AREA (LOT 2A) ADJACENT AND SOUTH OF PAXTON CHURCH ROAD FROM THE EXISTING TAYLOR TRACT KNOWN AS TAX I.D. NO. 62–019–039, AS DESCRIBED IN DEED BOOK 3402 PG 160; SAID AREA IS INTENDED TO BE ADDED TO THE SUSQUEHANNA TOWNSHIP AUTHORITY TRACT KNOWN AS TAX I.D. NO. 62–022–119, AS DESCRIBED IN INSTRUMENT NO. 20130038060.

   AS OF THE TIME OF THIS CONSTRUCTION PLAN NO DEED HAS BEEN RECORDED TO FORMALLY CONVEY LOT 2A.

GRADING NOTES

1. PRIOR TO THE COMMENCEMENT OF CONSTRUCTION ACTIVITIES, THE CONTRACTOR SHALL CONTACT ALL APPLICABLE UTILITY PROVIDERS IN COMPLIANCE WITH UNDERGROUND UTILITY LINE PROTECTION LAW OR PA ACT 287 AS AMENDED TO VERIFY THE EXACT LOCATION AND DEPTH OF ALL UTILITY LINES PRIOR TO THE START OF CONSTRUCTION ACTIVITIES.
2. HERBERT, ROWLAND & GRUBIC, INC. MAKES NO GUARANTEE AS TO THE PRECISE LOCATIONS OR DEPTHS OF ANY UNDERGROUND UTILITIES. IN ADDITION THERE MAY BE OTHER ACTIVE OR ABANDONED UNDERGROUND UTILITY LINES AND STRUCTURES OF WHICH THE DESIGNER AND SURVEYOR HAVE NOT BEEN ADVISED. THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO AVOID DISTURBING ALL EXISTING UTILITY LINES WHETHER MAPPED, MARKED OR ENCOUNTERED DURING CONSTRUCTION. PRIOR TO THE COMMENCEMENT OF CONSTRUCTION ACTIVITIES, IT IS IMPERATIVE THAT SUCH UTILITY LOCATIONS, DEPTHS, SIZES AND MATERIAL TYPES BE VERIFIED THROUGH THE PA ONE CALL SYSTEM 1–(800)–242–1776 OR THROUGH THE INDIVIDUAL UTILITY INSTALLER OR PROVIDER. IF THERE ARE ANY CONFLICTS DUE TO EXISTING OR PROPOSED SITE CONDITIONS; THE CONTRACTOR SHALL NOTIFY THE ENGINEER OR OWNER FOR FIELD ADJUSTMENT APPROVAL.
3. THE CONTRACTOR IS NOT ENTITLED TO ANY ADDITIONAL COMPENSATION FROM THE OWNER FOR DAMAGE TO EXISTING UTILITIES, STRUCTURES OR APPURTENANCES DURING THE CONSTRUCTION PERIOD OF THE PROJECT. ANY DAMAGE SHALL BE REPLACED TO MEET OR EXCEED THE EXISTING CONDITION AT THE CONTRACTOR'S EXPENSE.
4. NO WETLAND AREAS HAVE BEEN FOUND ON OR NEAR THE LIMIT OF EARTH DISTURBANCE ON THIS PROJECT.
5. ALL CONSTRUCTION ACTIVITY SHALL COMPLY WITH ALL GOVERNING FEDERAL, STATE AND LOCAL JURISDICTIONAL AGENCIES REGULATIONS, WHICH INCLUDE BUT ARE NOT LIMITED TO THE STREAM CROSSING AND TRAIL INSTALLATION/PRESERVATION.
6. DURING THE EXCAVATION OF THE STONE PATH SYSTEM, THE CONTRACTOR SHALL REMOVE ALL UNSUITABLE SUB–GRADE MATERIAL AND REPLACE IT WITH CRUSHED AGGREGATE STONE. ANY UNSUITABLE MATERIAL ENCOUNTERED SHALL BE REMOVED AND DISPOSED OF ACCORDINGLY.
7. THE CONTRACTOR SHALL FIELD VERIFY THAT THE PROPOSED TRAIL AND ALL RELATED IMPROVEMENTS WILL NOT CONFLICT WITH MATURE TREES WITH A 6" DIAMETER CALIPER OR GREATER AND ANY UNIQUE NATURAL FEATURES AND CONDITIONS NOT DELINEATED OR DISPLAYED WITHIN THE LIMIT OF WORK. IF A CONFLICT SHOULD OCCUR, THE CONTRACTOR SHALL NOTIFY THE ENGINEER OR OWNER IMMEDIATELY PRIOR TO THE REMOVAL OF ANY OF THE AFOREMENTIONED NATURAL CONDITIONS OR VEGETATION.
8. THE CONTRACTOR SHALL ENSURE THAT POSITIVE DRAINAGE WILL BE PROVIDED ACROSS THE ENTIRE PROJECT AREA AND SURFACE RUNOFF WILL BE DIRECTED TO EXISTING DRAINAGE FACILITIES AND PATTERNS.
9. CONTRACTOR IS RESPONSIBLE TO FIELD VERIFY THAT ALL GRADES ALONG THE STONE PATH AND ALL RELATED IMPROVEMENTS ARE IN STRICT COMPLIANCE WITH THE CURRENT ADA ACCESSIBILITY STANDARDS AND REQUIREMENTS, AS AMENDED.
10. PROVIDE A SMOOTH TRANSITION FROM THE EDGE OF THE AT–GRADE STONE TRAIL TO MEET ALL EXISTING GRADES. CUT SLOPES SHALL NOT TO EXCEED 2:1 AND FILL SLOPES NOT TO EXCEED 3:1.
11. MAXIMUM CROSS SLOPE OF THE STONE TRAIL SHALL NOT EXCEED 2% THROUGHOUT THE ENTIRE PROJECT AREA.
12. ALL PROPOSED ELEVATIONS ON THE PATH SYSTEM INDICATE THE FINISHED GRADES UNLESS OTHERWISE SPECIFICALLY NOTED.
13. THE CONTRACTOR SHALL ENSURE THAT A MINIMUM 10' CLEARING HEIGHT AND A MINIMUM 2' CLEARING ON EACH SIDE OF THE PROPOSED STONE TRAIL WILL BE PROVIDED. THE CONTRACTOR WILL NEED TO PERFORM SELECTIVE CUTTING AND PRUNING OF EXISTING VEGETATION TO ENSURE THE REQUIRED MINIMUM HEIGHTS CAN BE ACHIEVED. THE REMOVAL OF ENTIRE TREES AND UNDERSTORY VEGETATION IS DISCOURAGED AND SHOULD BE APPROVED BY THE OWNER AND PROJECT PARTNERS.

EROSION AND SEDIMENTATION NOTES

1. ONLY LIMITED UP–SLOPE DISTURBANCE WILL BE PERMITTED TO PROVIDE ACCESS TO CONTROL MEASURES FOR GRADING AND ACQUIRING BORROW TO CONSTRUCT THOSE CONTROLS AS REQUIRED.
2. EROSION AND SEDIMENTATION CONTROLS MUST BE CONSTRUCTED, STABILIZED, AND FUNCTIONAL BEFORE GENERAL SITE DISTURBANCE WITHIN THE TRIBUTARY AREAS OF THOSE CONTROLS.
3. AFTER FINAL SITE STABILIZATION HAS BEEN ACHIEVED, TEMPORARY EROSION AND SEDIMENTATION CONTROL MUST BE REMOVED. AREAS DISTURBED DURING REMOVAL OF THE CONTROLS MUST BE STABILIZED.
4. VEHICLES MAY ONLY ENTER AND EXIT AT THE LOCATION OF APPROVED CONSTRUCTION ENTRANCES.
5. STOCK PILE HEIGHTS MUST NOT EXCEED 35 FEET NOR SHALL THE SIDE SLOPES EXCEED 2:1. STOCK PILES SHALL BE LOCATED ON SITE BY THE CONTRACTOR AT LOCATIONS APPROVED BY THE COUNTY CONSERVATION DISTRICT. NO STOCKPILES ARE TO BE PLACED WITHIN DELINEATED WETLAND AREAS OR THE ASSUMED FLOODWAY LIMITS.
6. UNTIL THE SITE IS STABILIZED, ALL EROSION AND SEDIMENTATION CONTROLS MUST BE MAINTAINED PROPERLY. MAINTENANCE MUST INCLUDE INSPECTIONS OF ALL EROSION AND SEDIMENTATION CONTROLS AFTER EACH STORM EVENT AND ON A WEEKLY BASIS. ALL PREVENTATIVE AND REMEDIAL MAINTENANCE WORK, INCLUDING CLEANOUT, REPAIR, REPLACEMENT, REGRADING, RESEEDING, REMULCHING, AND RENETTING MUST BE PERFORMED IMMEDIATELY.
7. COMPOST FILTER SOCKS MUST BE INSTALLED PARALLEL TO EXISTING CONTOURS OR CONSTRUCTED LEVEL ALIGNMENTS. ENDS OF THE SOCK MUST EXTEND 10', TRAVELING UP–SLOPE AT 45° TO THE ALIGNMENT OF THE MAIN FENCING SECTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROPER CONSTRUCTION, STABILIZATION, AND MAINTENANCE OF ALL EROSION AND SEDIMENTATION CONTROLS AND RELATED ITEMS INCLUDED ON THIS PLAN.
8. SHOULD UNFORESEEN EROSIVE CONDITIONS DEVELOP DURING CONSTRUCTION, THE CONTRACTOR SHALL TAKE ACTION TO REMEDY SUCH CONDITIONS AND TO PREVENT DAMAGE TO ADJACENT PROPERTIES AS A RESULT OF INCREASED RUNOFF AND/OR SEDIMENT DISPLACEMENT. STOCKPILES OF WOOD CHIPS, HAY BALES, CRUSHED STONE AND OTHER MULCHES SHALL BE HELD IN READINESS TO DEAL IMMEDIATELY WITH EMERGENCY PROBLEMS OF EROSION.
9. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROTECTION OF EXISTING TREES, SHRUBS, WETLAND AREAS AND ENVIRONMENTALLY SENSITIVE AREAS TO REMAIN FROM UNNECESSARY DAMAGE.
10. THE CONTRACTOR IS ADVISED TO BECOME THOROUGHLY FAMILIAR WITH THE PROVISIONS OF APPENDIX 64, EROSION CONTROLS AND REGULATIONS, TITLE 25, PART 1, DEPARTMENT OF ENVIRONMENTAL RESOURCES, SUB–PART C, PROTECTION OF NATURAL RESOURCES, ARTICLE III, WATER RESOURCES, CHAPTER 102, EROSION CONTROL.
11. THE CONTRACTOR WILL BE RESPONSIBLE FOR THE REMOVAL OF ANY EXCESS MATERIAL AND MAKE SURE SITE(S) RECEIVING THE EXCESS HAS AN APPROVED EROSION CONTROL PLAN THAT MEETS THE CONDITIONS OF CHAPTER 102 AND/OR OTHER STATE, FEDERAL REGULATIONS.
12. ALL BUILDING MATERIALS AND WASTES MUST BE REMOVED FROM THE SITE AND RECYCLED OR DISPOSED IN ACCORDANCE WITH THE DEPARTMENT'S SOLID WASTE MANAGEMENT REGULATIONS § AT 25 PA. CODE 260.1 ET. SEQ., § 287.1 ET. SEQ. § 271.1 ET. SEQ.. NO BUILDING MATERIAL AND OR WASTES OR UNUSED BUILDING MATERIALS SHALL BE BURIED, DUMPED, OR DISCHARGED AT THE SITE.
13. IF BMP'S ARE FOUND TO BE INOPERATIVE OR INEFFECTIVE DURING CONSTRUCTION, OR ANY OTHER TIME, THE CONTRACTOR SHALL IMMEDIATELY REMEDY THE DEFICIENCIES. DOCUMENTATION SHOULD INCLUDE WHAT STEPS ARE BEING TAKEN TO REDUCE, ELIMINATE AND PREVENT RECURRENCE OF THE PROBLEM.
14. THE CONTRACTOR SHALL TAKE ALL REASONABLE STEPS TO MINIMIZE OR PREVENT ANY DISCHARGE THAT IS IN VIOLATION WITH LOCAL, STATE AND FEDERAL REGULARY LAWS WHICH HAS A REASONABLE LIKELIHOOD OF ADVERSELY AFFECTING HUMAN HEALTH OR ENVIRONMENT.
15. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROPER CONSTRUCTION, STABILIZATION, AND MAINTENANCE OF ALL EROSION AND SEDIMENTATION CONTROLS AND RELATED ITEMS INCLUDED ON THIS PLAN.

STABILIZATION NOTES

1. PERMANENT STABILIZATION IS DEFINED AS A MINIMUM UNIFORM 70% PERENNIAL VEGETATIVE COVER OR OTHER PERMANENT NON–VEGETATIVE COVER WITH A DENSITY SUFFICIENT TO RESIST ACCELERATED SURFACE EROSION AND SUBSURFACE CHARACTERISTICS SUFFICIENT TO RESIST SLIDING AND OTHER MOVEMENTS.
2. IMMEDIATELY AFTER EARTH DISTURBANCE ACTIVITIES CEASE, THE OPERATOR SHALL STABILIZE THE DISTURBED AREAS. DURING NON–GERMINATING PERIODS, MULCH MUST BE APPLIED AT THE SPECIFIED RATES.

MAINTENANCE PROGRAM NOTES

1. UNTIL THE SITE IS STABILIZED, ALL EROSION AND SEDIMENT CONTROL BMPS MUST BE MAINTAINED PROPERLY. MAINTENANCE MUST INCLUDE INSPECTIONS OF ALL EROSION AND SEDIMENT CONTROL BMPS AFTER EACH RUNOFF EVENT AND ON A WEEKLY BASIS. ALL PREVENTATIVE AND REMEDIAL MAINTENANCE WORK, INCLUDING CLEANOUT, REPAIR, REPLACEMENT, RE–GRADING, RESEEDING, RE–MULCHING AND RE–NETTING MUST BE PERFORMED IMMEDIATELY. IF EROSION AND SEDIMENT CONTROL BMPS FAIL TO PERFORM AS EXPECTED, REPLACEMENT BMPS OR MODIFICATIONS OF THOSE INSTALLED WILL BE REQUIRED.

LEGEND

	Monument
	Iron Pipe
	Iron Pin
	Benchmark
	Property Line
	Legal Right–of–Way Line
	Setback Line
540	*Existing Contour Major*
	Existing Contour Minor
	Existing Ditch Or Swale
	Existing Shrub
	Existing Coniferous Tree
	Existing Deciduous Tree
	Tree/Brush Line
	Shrub Row
	Existing Curb
	Existing Edge of Road
	Existing Edge of Gravel
X	*Existing Fence*
	Existing Sign
	Existing Sign And Posts
	Existing Bollard
MB	*Existing Mailbox*
CTVU	*Existing Underground Cable TV Line*
T,CTV	*Existing Above Ground Telephone and Cable TV Line*
	Existing Telephone Pole
E	*Existing Above Ground Electric Line*
EU	*Existing Underground Electric Line*
E,T	*Existing Above Ground Electric, Telephone and Cable TV Line*
E,T,CTV	*Existing Above Ground Electric and Telephone Line*
	Existing Electric Pole
	Existing Light Standard
	Existing Guy Wire
	Existing Traffic Signal Pole
G	*Existing Gas Line*
GM	*Existing Gas Meter*
S	*Existing Sanitary Sewer Line*
12" CMP	*Existing Storm Sewer Line*
San. MH	*Existing Sanitary Sewer Manhole*
CO	*Existing Cleanout*
	Existing Storm Sewer Inlet
Storm MH	*Existing Storm Sewer Manhole*
W	*Existing Water Line*
WV	*Existing Water Valve*
FH	*Existing Fire Hydrant*
WM	*Existing Water Meter*
	Existing Water Spigot
	Infiltration Test

	PROPOSED EASEMENT
1010	PROPOSED CONTOUR
X 410.00	PROPOSED SPOT ELEVATION
X BC 410.00	PROPOSED BOTTOM OF CURB SPOT ELEVATION
X TC 410.00	PROPOSED TOP OF CURB SPOT ELEVATION
X HP 410.00	PROPOSED HIGH POINT SPOT ELEVATION
X LP 410.00	PROPOSED LOW POINT SPOT ELEVATION
	PROPOSED CURB
20	PROPOSED PARKING SPACE QUANTITY TAG
	PROPOSED SIGN
	PROPOSED BOLLARD
LOD	LIMIT OF DISTURBANCE
RCE	ROCK CONSTRUCTION ENTRANCE
CFS–12	COMPOST FILTER SOCKS – 12"
CFS–18	COMPOST FILTER SOCKS – 18"
CeA / ErB	SOIL BOUNDARIES
T	PROPOSED TELEPHONE LINE
E	PROPOSED ELECTRIC LINE
FOT	PROPOSED FIBER OPTIC LINE
E	PROPOSED ELECTRICAL BOX
	PROPOSED LIGHT STANDARD
G	PROPOSED GAS LINE
GV	PROPOSED GAS VALVE
GM	PROPOSED GAS METER
S	PROPOSED SANITARY LINE
	PROPOSED SANITARY/STORM MANHOLE
CO	PROPOSED SANITARY CLEANOUT
W	PROPOSED WATER LINE
WV	PROPOSED WATER VALVE
FH	PROPOSED FIRE HYDRANT
WM	PROPOSED WATER METER
	PROPOSED D–W ENDWALL
	PROPOSED RECTANGULAR INLET
	PROPOSED STORM SEWER
	PROPOSED CIRCULAR INLET
	PROPOSED FILTER BAG INLET PROTECTION
	EROSION MATTING –NAG P550
	EROSION MATTING –NAG P300
	EROSION MATTING – NAG S75
	PROPOSED RIP–RAP APRON

PA ONE CALL

ACT 199 OF 2004

PENNSYLVANIA ONE CALL SYSTEM, INC. 1-800-242-1776 STOP-CALL BEFORE YOU DIG!

PENNSYLVANIA ACT 287 (1974) AS AMENDED BY ACT 199 (2004) REQUIRES NOTIFICATION BY EXCAVATORS, DESIGNERS, OR ANY PERSON PREPARING TO DISTURB THE EARTH'S SURFACE ANYWHERE IN THE COMMONWEALTH.
PA ONE–CALL SERIAL NO. 20170180142 HAS BEEN ASSIGNED TO THIS PROJECT ON 2–02–17.
* ADDED BY HRG. NOT ON PA ONE CALL LIST.

PA ONE CALL - UTILITY RESPONSE LIST

COMCAST CABLE COMMUNICATIONS INC. (SB)

PA COMMONWEALTH OF OFFICE OF ADMIN (OAD)

PPL ELECTRIC UTILITIES CORPORATION (PRD)

SUEZ WATER PENNSYLVANIA INC. (DH)

SUSQUEHANNA TWP AUTH/SUSQUEHANNA TWP (XD1)

UGI UTILITIES INC. (UI)

VERIZON PENNSYLVANIA LLC (HC)

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CONSTRUCTION NOTES
FOR
LOGAN TRACT TRAILS - SUSQUEHANNA TOWNSHIP

SUSQUEHANNA TOWNSHIP | DAUPHIN | PENNSYLVANIA

PROJ. MGR. – WRS
DESIGN– WRS
CADD– TLB
CHECKED–SBB
SCALE– AS SHOWN
DATE– 2017.07.06

DRAWING NO. **NT**

PROJECT R000242.0488

CURVE TABLE						
CURVE	RADIUS	LENGTH	TANGENT	DELTA	CHORD BEARING	DISTANCE
C1	161.50'	173.35'	96.08'	61°29'55"	S58°30'58"E	165.14'
C2	318.10'	28.30'	14.16'	5°05'50"	S28°23'30"W	28.29'
C3	258.10'	269.01'	148.17'	59°43'02"	S61°24'17"W	257.00'
C4	480.00'	209.44'	106.41'	25°00'00"	N85°03'33"E	207.78'

LEGEND

WETLANDS

GRAPHIC SCALE

100' 50' 0' 100'

SCALE: 1"=100'

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EXISTING CONDITIONS PLAN
FOR
LOGAN TRACT TRAILS - SUSQUEHANNA TOWNSHIP

SUSQUEHANNA TOWNSHIP DAUPHIN PENNSYLVANIA

PROJ. MGR. – WRS
DESIGN– WRS
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SCALE– AS SHOWN
DATE– 2017.07.06

DRAWING NO.
EC
SHEET NO. 3 OF 9
PROJECT R000242.0488

SITE ASSESSMENT AND DESIGN OPPORTUNITIES

**DEVELOP A HIERARCHY FOR PROPOSED TRAILS RANGING FROM ADA ACCESSIBLE TO NOVICE THROUGH ADVANCED.

1. NODE #1 – INTER RECREATIONAL CONNECTION. VEHICULAR PARKING AREA AND USE OF EXISTING PARK FACILITIES AND BITUMINOUS WALKWAY TO BE UPGRADED AND IMPROVED.
2. FUTURE PICNIC GROVE AREA PASSIVE RECREATIONAL AREA. PEDESTRIAN TRAIL HEAD FOR PROPERTY. MINIMIZE ENVIRONMENTAL IMPACTS. MAINTAIN EXISTING TREE COVER/CANOPY. CLEAR THICK UNDERSTORY AND INVASIVE SPECIES. CONFIRM ADA ACCESSIBILITY REQUIREMENTS FOR SPECIFIED USE.
3. NODE #3; TRAIL OPTIONS TO TRAVERSE LARGER PROPERTY TRAIL LOOP OR SMALLER INTERNAL LOOP TO NODE #15. (SEE #15 FOR DESCRIPTION).

**GREEN TRAIL WOULD HAVE AN INTERMEDIATE TRAIL DESIGNATION DUE TO STEEPER SLOPES. THE PRELIMINARY CONCEPTUAL DESIGN INTENT IS TO ALIGN THE TRAIL TO FOLLOW ALONG EXISTING TOPOGRAPHIC FEATURES AND MAINTAIN A CONSISTENT ELEVATION (0–5% VERTICAL SLOPE IS OPTIMUM) TO MINIMIZE THE NEED FOR EXCESSIVE GRADING AND RELATED ENVIRONMENTAL IMPACTS.

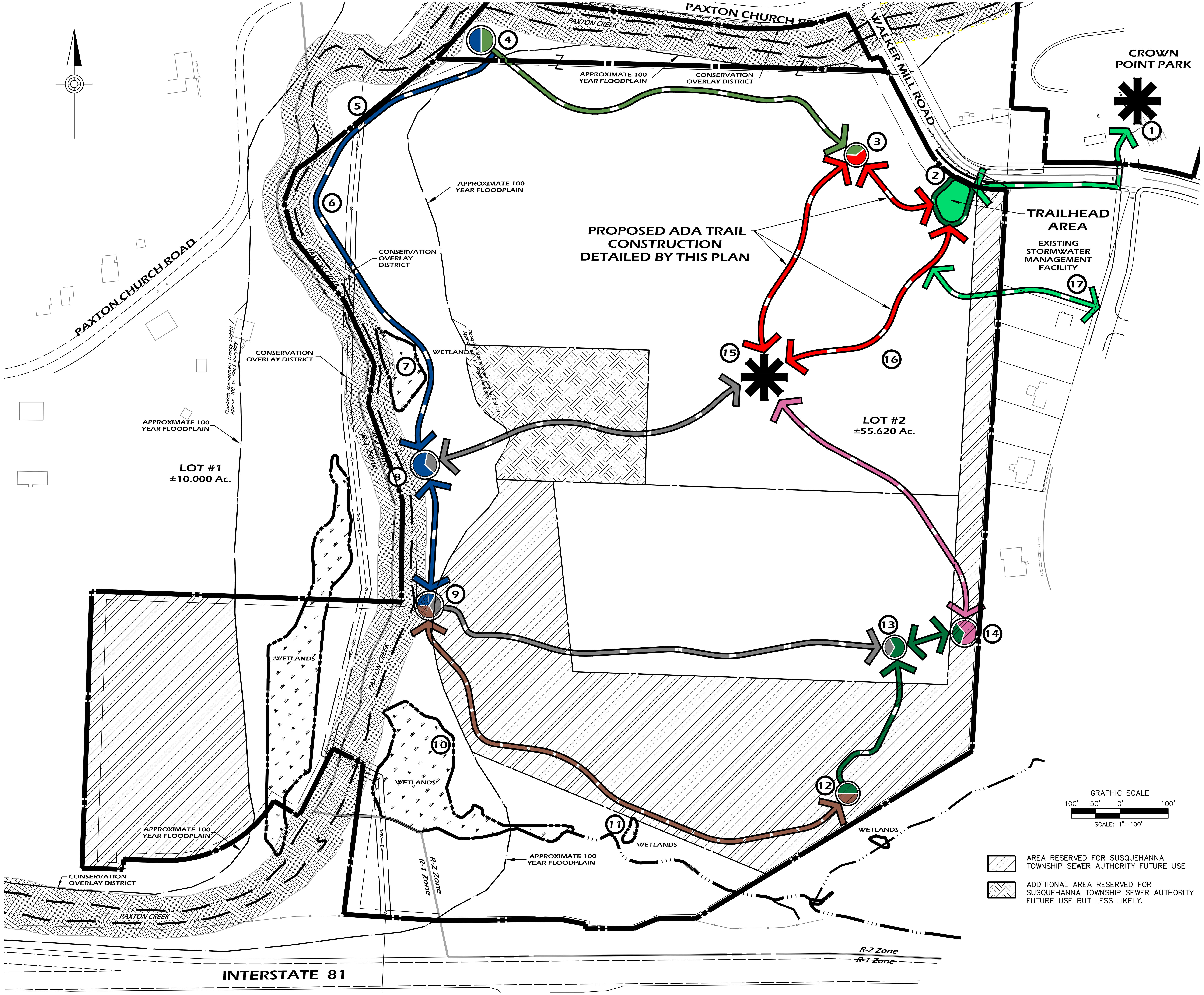
4. NODE #4 TRANSITION BETWEEN TRAIL TYPES FROM GREEN TO BLUE. AREA OFFERS VIEWS TO PAXTON CREEK ABOVE EXISTING CREEK BANKS. LITTLE TO NO EARTH DISTURBANCE REQUIRED TO PROVIDE FOR BLUE TRAIL ALIGNMENT. INCORPORATING INTERPRETIVE AREAS AND SIGNAGE ALONG THE RIPARIAN ROUTE ARE RECOMMENDED TO ENHANCE THE USERS KNOWLEDGE OF THE NATURAL ENVIRONMENT AND THE IMPORTANCE OF THE NATURAL SURROUNDINGS WHILE HIKING THIS PORTION OF TRAIL. THE INTERPRETIVE AREAS/SIGNAGE SHOULD SUMMARIZE THE IMPORTANCE OF THE UNIQUE RIPARIAN ECOLOGY OF THE PAXTON CREEK, THE ASSOCIATED WILDLIFE AND HABITAT, EXISTING NATIVE DOMINANT TYPES OF RIPARIAN VEGETATION , UNDERSTORY, STREAM BANK STABILIZATION. THE USER SHOULD ALSO BE INFORMED AND HAVE AN UNDERSTANDING OF THE IMPORTANCE OF FLOODPLAIN AREAS AND IMPACTS ON THE ECOLOGY DURING LARGE STORM EVENTS. OTHER AREAS OF INTEREST THAT CAN BE DISCUSSED ARE THE UNDERLYING GEOLOGY AND FLOODPLAIN SOIL COMPOSITION AND TYPES. THIS AREA ALSO APPEALS TO THE THE HUMAN SENSES OF SIGHT AND SOUND.

**BLUE TRAIL IS RELATIVELY FLAT AND EASILY TRAVERSABLE. FOLLOW THE EXISTING TOPOGRAPHIC BENCH ALONG PAXTON CREEK.

5. NODE #5 OFFERS VIEWS TO PAXTON CREEK AND AND SURROUNDING RIPARIAN AREAS.
6. NODE #6 OFFERS VIEWS TO PAXTON CREEK AND SURROUNDING RIPARIAN AREAS. THERE IS AN OPPORTUNITY TO PROVIDE INTERPRETIVE SIGNAGE TO ELABORATE ON THE IMPORTANCE OF THE PAXTON CREEK AND WATERSHED (LOCALLY AND REGIONALLY).
7. NATIVE WETLAND AREA. EDUCATIONAL OPPORTUNITY TO ELABORATE ON WETLAND CHARACTERISTICS AND THE BASIC CRITERIA USED TO DELINEATE WETLANDS, WETLAND FUNCTION AND THE ENVIRONMENTAL IMPORTANCE OF THEIR PROTECTION. WETLANDS IN GENERAL, HAVE SEVERAL BENEFICIAL FUNCTIONS TO THE NATURAL ENVIRONMENT WHICH INCLUDE BUT ARE NOT LIMITED TO; TRAPPING INTERMITTENT FLOODWATERS ALONG THE PAXTON CREEK, RECHARGING THE LOCAL GROUNDWATER SUPPLIES, FILTERING AND DEPOSITING OF SURFACE POLLUTANTS AND PROVIDING RIPARIAN AND NATIVE WILDLIFE HABITAT.
8. NODE #8 – ALTERNATE TRAIL OPTIONS TO CONTINUE ALONG LOWLAND AREAS OR CHOOSE – (MAROON) INTERMEDIATE/ADVANCED TRAIL THAT TRAVERSE ALONG A NATURAL TOPOGRAPHIC DRAW, DIVIDE/EXISTING DRAINAGE AREA FROM UPLAND AREAS THAT DRAIN TO THE PAXTON CREEK.
9. NODE #9 ALTERNATE TRAIL OPTIONS TO CONTINUE ALONG LOWLAND AREAS OR CHOOSE (MAROON) INTERMEDIATE/ADVANCED TRAIL THAT TRAVERSE ALONG A VERY STEEP RIDGE LINE THAT EXTENDS TO THE HIGHEST ELEVATION OF THE PROPERTY TO INCLUDE NODES #13 & #14 ALONG THE TRAIL ROUTE. THE ORANGE TRAIL OPTION CONTINUES ALONG THE LOWLAND AREA AND FOLLOWS THE TOPOGRAPHIC ELEVATIONS TO MINIMIZE ENVIRONMENTAL IMPACTS AND THE NEED TO MODIFY THE EXISTING TOPOGRAPHY.

**THE MAROON TRAILS ARE MORE CHALLENGING TO NAVIGATE THEN THE PREVIOUS PROPOSED. THESE TRAILS OFFERS A NICE VISUAL COMPARISON OF TWO VERY DIFFERENT AND UNIQUE ECOLOGICAL LANDSCAPES THAT HAVE BEEN HIKED/OBSERVED. THE MAROON COLORED TRAILS PROVIDE A COMPREHENSIVE CROSS SECTION OF THE NATURAL TOPOGRAPHIC CONDITIONS IN RELATION TO THE DIVERSITY AND CHANGE OF PLANT COMMUNITIES/TYPES (I.E.. RIPARIAN AND LOWLAND HABITATS IN COMPARISON WITH RIDGE AND UPLAND HABITATS). THE ADVANCED AND INTERMEDIATE TRAIL TYPES (MAROON) ARE INTENDED TO BE A PRIMITIVE TYPE OF TRAIL WITH LIMITED MARKINGS AND MINIMAL ENVIRONMENTAL IMPACTS. DUE TO THE EXISTING TOPOGRAPHIC CONDITIONS (STEEP SLOPES), THESE TYPES OF TRAIL ARE NOT AN ADA ACCESSIBLE USE.

10. TAN TRAIL ROUTE, NATIVE WETLAND AREA. THERE IS ANOTHER EDUCATIONAL OPPORTUNITY TO ELABORATE ON WETLAND CHARACTERISTICS AND THE BASIC CRITERIA USED TO DELINEATE WETLANDS, WETLAND FUNCTION AND THE ENVIRONMENTAL IMPORTANCE OF THEIR PROTECTION. WETLANDS HAVE SEVERAL BENEFICIAL FUNCTIONS TO THE NATURAL ENVIRONMENT. FURTHER RESEARCH SHOULD BE COMPLETED.
11. CONTINUATION OF THE TAN TRAIL ALONG THE LOWLAND AREAS TO CREATE A LOOP TRAIL SYSTEM FOR THE ENTIRE PROPERTY. THE EXISTANCE OF A TRIBUTARY THAT FEEDS THE EXISTING WETLANDS. INCORORPORATE INTERPRETIVE SIGNAGE WHICH SUMMARIZES THE IMPORTANCE OF CONTINUOUS AND INTERMITTENT SURFACE WATERS THAT PROMOTED AND CONTRIBUTE TO THE EXISTENCE AND FUNCTION OF WETLAND SYSTEMS.
12. NODE #12 – VIEWING AREA. UNIQUE TOPOGRAPHIC FEATURES AND DIFFERENT TYPES OF PLANT SPECIES WITHIN THE UPPER CANOPY TREES AND UNDERSTORY VEGETATION ARE VIEWED FROM THIS AREA.
13. DARK GREEN TRAIL EXTENDS UPLAND FROM NODE #12 TO #13 WHICH ARE MORE CHALLENGING DUE TO THE STEEPER SLOPES.
14. NODE #13 TRAIL OPTIONS TO MAROON TRAIL THAT EXTENDS BACK DOWN TO NODE #9 ALONG THE PAXTON CREEK OR CAN CONTINUE ALONG THE DARK GREEN TRAIL TO THE HIGHEST POINT OF THE PROPERTY, NODE #14.
15. NODE #14 IS THE HIGHEST ELEVATION OF THE PROPERTY AND CAN OFFER VIEWS TO THE LOWER AREAS AND TRAILS, HOWEVER THE ADJOINING RESIDENTIAL PROPERTIES ARE IN CLOSE PROXIMITY AND VISIBLE FROM THIS AREA. THIS NODE AND TRAIL ALIGNMENTS ARE ALSO SUBJECT TO CHANGE AND BE IMPACTED DUE TO ITS LOCATION WITHIN THE RESERVED AREA DEDICATED FOR THE SUSQUEHANNA SEWER AUTHORITY'S FUTURE USE.
16. MAGENTA TRAIL EXTENDS FROM THE HIGHEST ELEVATION AND TERMINATES AT NODE #15.
17. NODE #15 IS A USEABLE CENTRALIZED LOCATION TO INCORPORATE AN OUTDOOR EDUCATIONAL SPACE/INTERPRETIVE CENTER. THE AREA OFFERS A CENTRALIZED HUB FOR THE PROPOSED TRAIL TYPES AND COMPLETES A SMALLER LOOP FROM THE PEDESTRIAN TRAIL HEAD AT NODE #2. THE SMALLER INTERNAL LOOP TO THE INTERPRETIVE AREA IS IN CLOSE PROXIMITY TO THE VEHICULAR AND PEDESTRIAN TRAIL HEADS AND THE THE AREA IS INTENDED TO BE USED FOR OUTDOOR ENVIRONMENTAL CLASSROOM/ ACTIVITIES AND CENTRALIZED GATHERING POINT FOR USERS.
18. THE YELLOW TRAIL IS INTENDED TO BE USED FOR A SMALLER INTERNAL LOOP TRAIL FOR THE NOVICE USER AND IS INTENDED TO BE DESIGNED IN COMPLIANCE WITH ADA ACCESSIBILITY STANDARDS AND PROVIDE INTER CONNECTION WITH NODE #15 (INTERPRETIVE AREA) AND NODE #2 (PICNIC GROVE). THIS PORTION OF TRAIL WILL BE MORE DEFINED, DESIGNED AND CONSTRUCTED IN SUCH A MANNER THAT THE TRAIL WILL BE READILY ACCESSIBLE TO AND UTILIZED BY INDIVIDUALS WITH DISABILITIES. THE INTENT OF THE YELLOW TRAIL IS TO BE UTILIZED AS AN ACCESSIBLE ADA DESIGNATED ROUTE WHICH WILL REQUIRE ADDITIONAL DETAILED TOPOGRAPHIC INFORMATION/SURVEY AND ADA ACCESSIBLE DESIGN. THE DESIGNATION OF THIS TRAIL IS SUBJECT TO CHANGE IF THE RESULTS OF DETAILED ANALYSIS WOULD CONCLUSIVELY DETERMINE THAT THE CONSTRUCTION OF THE TRAILTO MEET THE ADA GUIDELINES ARE STRUCTURALLY IMPRACTICABLE DUE TO THE EXISTING TOPOGRAPHIC CONDITIONS AND TERRAIN. FURTHER ANALYSIS AND DETAILED DESIGN ARE REQUIRED.
19. OPTIONAL TRAIL EXTENSION THROUGH RESERVED STORMWATER MANAGEMENT AREA TO PROVIDE FOR TRAIL CONNECTION WITH EXISTING PEDESTRIAN SIDEWALK SYSTEM WITHIN THE PUBLIC RIGHT OF WAY OF ADJOINING NEIGHBORHOODS.



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MASTER PLAN
FOR
LOGAN TRACT TRAILS - SUSQUEHANNA TOWNSHIP

SUSQUEHANNA TOWNSHIP — DAUPHIN — PENNSYLVANIA

PROJ. MGR. – WRS
DESIGN– WRS
CADD– TLB
CHECKED–SBB
SCALE– AS SHOWN
DATE– 2017.07.06

DRAWING NO. MP
SHEET NO. 4 OF 9
PROJECT R000242.0488

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SITE PLAN FOR LOGAN TRACT TRAILS - SUSQUEHANNA TOWNSHIP

SUSQUEHANNA TOWNSHIP | DAUPHIN | PENNSYLVANIA

PROJ. MGR. – WRS
DESIGN– WRS
CADD– TLB
CHECKED– SBB
SCALE– AS SHOWN
DATE– 2017.07.06

DRAWING NO.
SI-1
SHEET NO.
5 OF 9
PROJECT R000242.0488

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TRAILHEAD DETAIL SITE PLAN
FOR
LOGAN TRACT TRAILS - SUSQUEHANNA TOWNSHIP

SUSQUEHANNA TOWNSHIP | DAUPHIN | PENNSYLVANIA

PROJ. MGR. — WRS
DESIGN— WRS
CADD— TLB
CHECKED—SBB
SCALE— AS SHOWN
DATE— 2017.07.06

DRAWING NO.
SI-2
SHEET NO.
6 OF 9
PROJECT R000242.0488

EROSION AND SEDIMENTATION NOTES

1. PROPOSED LIMIT OF DISTURBANCE: 38,137 S.F. (0.88 ACRES)

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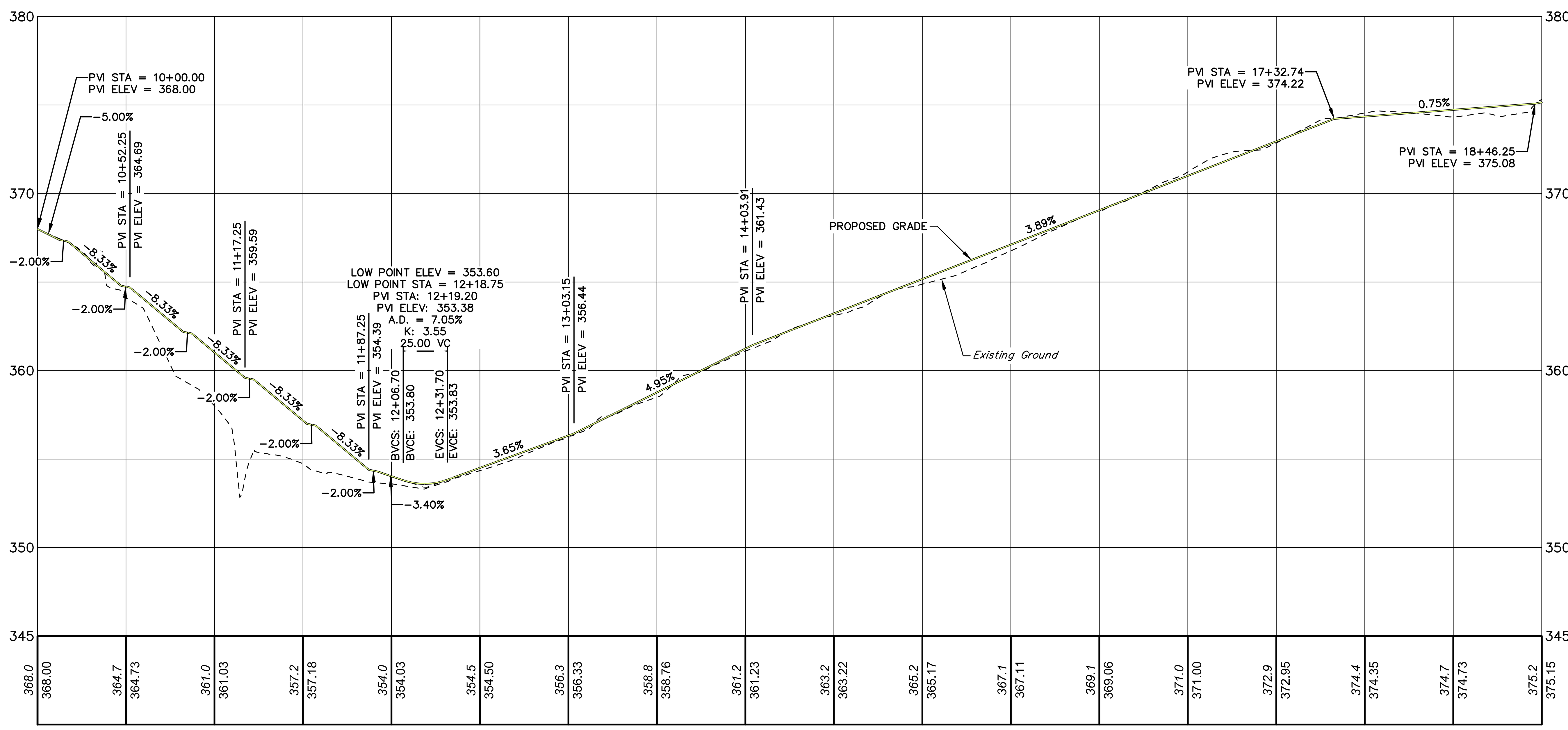
TRAILHEAD EROSION AND SEDIMENT CONTROL PLAN
FOR
LOGAN TRACT TRAILS - SUSQUEHANNA TOWNSHIP

SUSQUEHANNA TOWNSHIP DAUPHIN PENNSYLVANIA

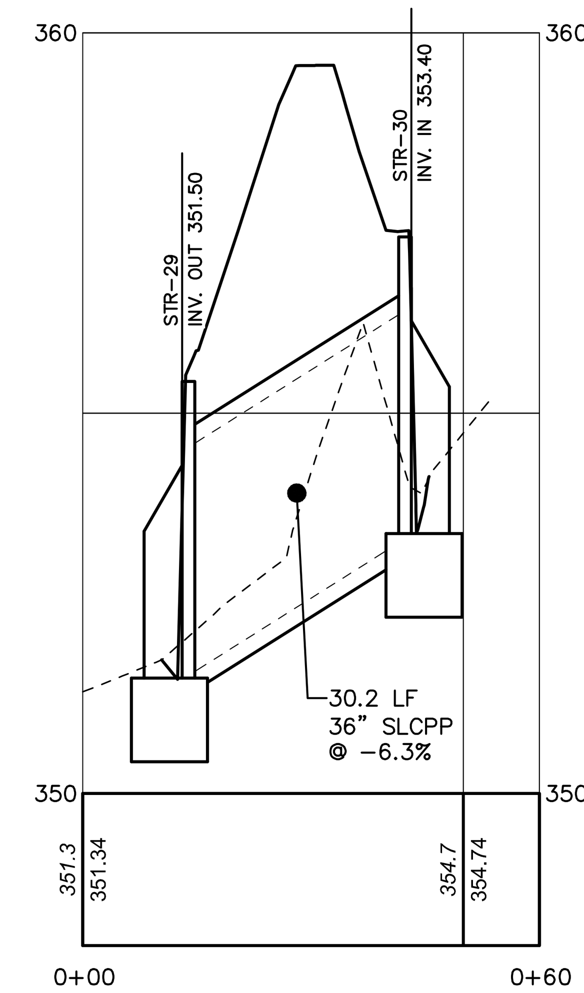
PROJ. MGR. – WRS
DESIGN– WRS
CADD– TLB
CHECKED–SBB
SCALE– AS SHOWN
DATE– 2017.07.06

DRAWING NO.
ES-1
SHEET NO.
7 OF 9
PROJECT R000242.0488



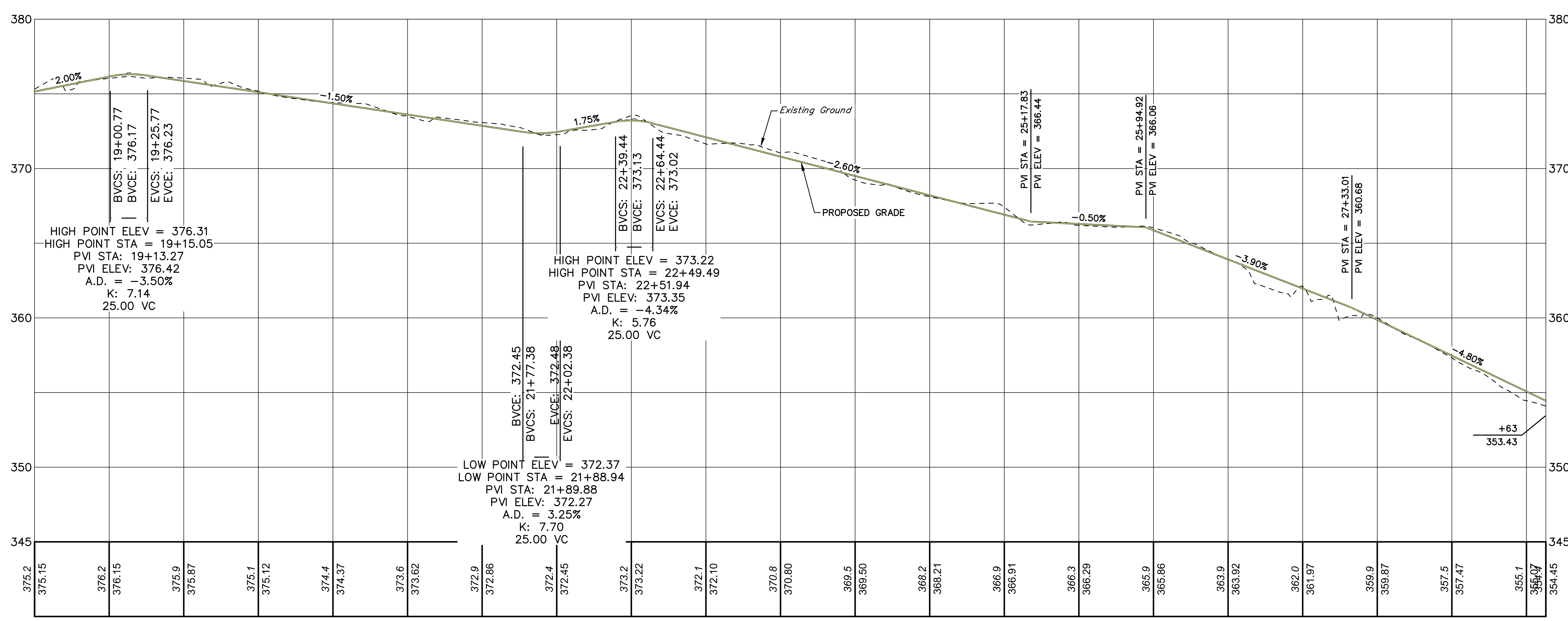
LOGAN TRAIL PROFILE
STA. 10+00.00 - 18+50.00

HORIZ: 50' 25' 0' 50'
VERT: 5' 2.5' 0' 5'
SCALE IN FEET



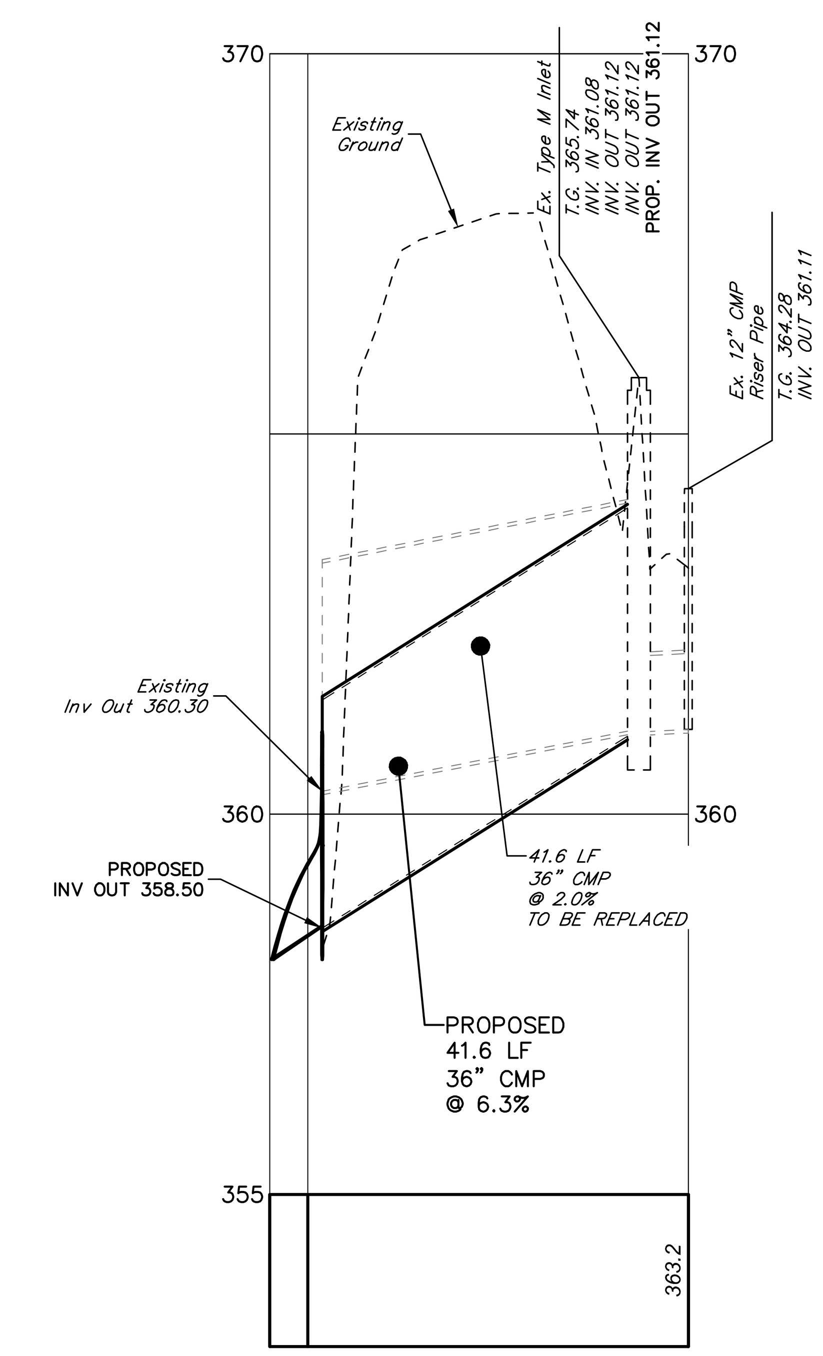
36" SLCPP STREAM CROSSING PROFILE

HORIZ: 20' 10' 0' 20'
VERT: 2' 1' 0' 2'
SCALE IN FEET



LOGAN TRAIL PROFILE
STA. 18+50.00 - 27+26.00

HORIZ: 50' 25' 0' 50'
VERT: 5' 2.5' 0' 5'
SCALE IN FEET



36" CMP BASIN OUTLET PIPE REPLACEMENT PROFILE

HORIZ: 20' 10' 0' 20'
VERT: 2' 1' 0' 2'
SCALE IN FEET

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TRAIL & STREAM CROSSING PROFILE
FOR
LOGAN TRACT TRAILS - SUSQUEHANNA TOWNSHIP

SUSQUEHANNA TOWNSHIP DAUPHIN PENNSYLVANIA

PROJ. MGR. – WRS
DESIGN– WRS
CADD– TLB
CHECKED–SBB
SCALE– AS SHOWN
DATE– 2017.07.06

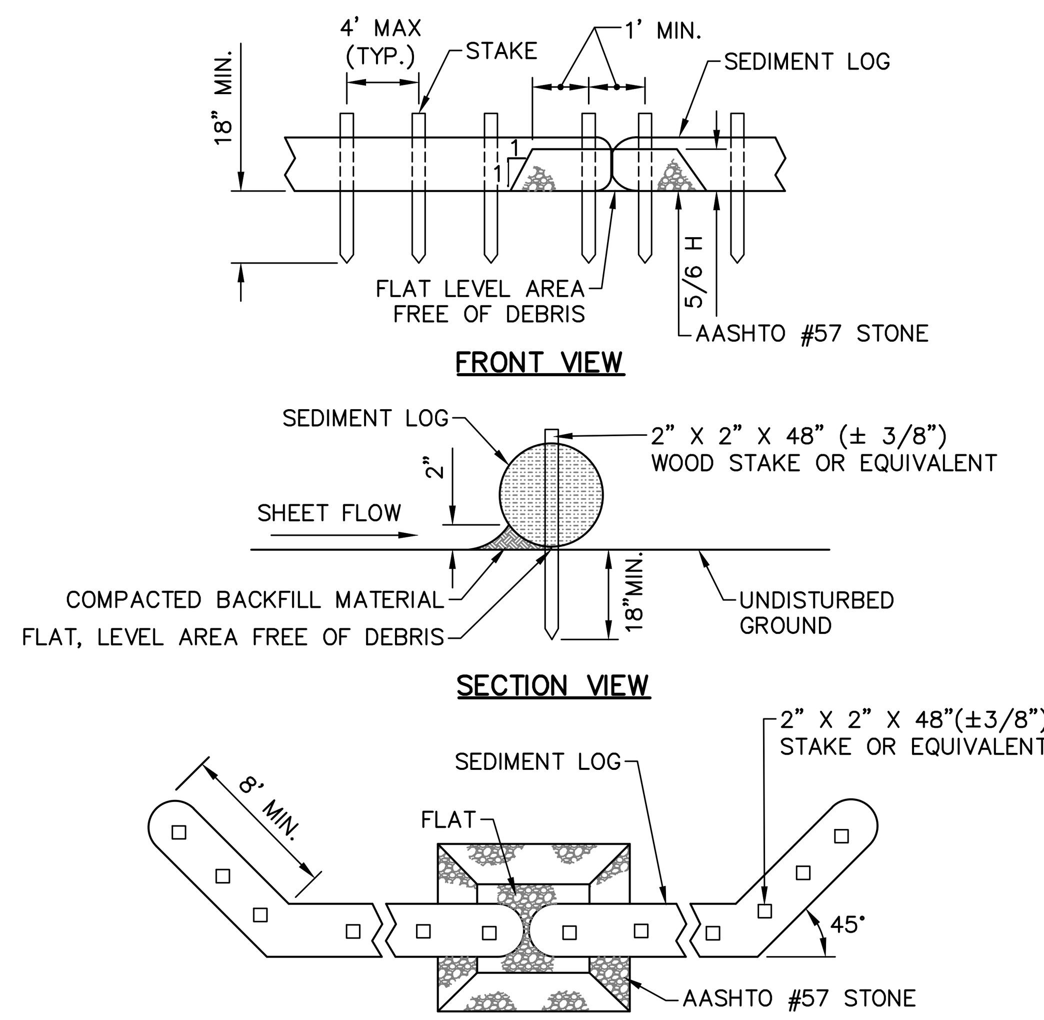
DRAWING NO.
PR-1
SHEET NO.
8 OF 9
PROJECT R000242.0488

TABLE 4.1
COMPOST SOCK FABRIC MINIMUM SPECIFICATIONS

MATERIAL TYPE	3 MIL HDPE	5 MIL HDPE	5 MIL HDPE	MULTI-FILAMENT POLYPROPYLENE (MFPP)	HEAVY DUTY MULTI-FILAMENT POLYPROPYLENE (MFPP)
MATERIAL CHARACTERISTICS	PHOTO-DEGRADABLE	PHOTO-DEGRADABLE	BIO-DEGRADABLE	PHOTO-DEGRADABLE	PHOTO-DEGRADABLE
SOCK DIAMETERS	12" 18"	12" 18" 24" 32"	12" 18" 24" 32"	12" 18" 24" 32"	12" 18" 24" 32"
MESH OPENING	3/8"	3/8"	3/8"	3/8"	1/8"
TENSILE STRENGTH	–	26 PSI	26 PSI	44 PSI	202 PSI
ULTRAVIOLET STABILITY % ORIGINAL STRENGTH (ASTM G-155)	23% @ 1000 HRS	23% @ 1000 HRS	–	100% @ 1000 HRS	100% @ 1000 HRS
MINIMUM FUNCTIONAL LOGEVITY	6 MONTHS	9 MONTHS	6 MONTHS	1 YEAR	2 YEARS
TWO-PLY SYSTEMS					
INNER CONTAINMENT NETTING			HDPE BIAXIAL NET		
			CONTINUOUSLY WOUND		
			FUSION-WELDED JUNCTURES		
			3/4"x3/4" MAX. APERTURE SIZE		
OUTER FILTRATION MESH			COMPOSITE POLYPROPYLENE FABRIC (WOVEN LAYER AND NON-WOVEN FLEECE MECHANICALLY FUSED VIA NEEDLE PUMCH)		
			3/16" MAX. APERTURE SIZE		
SOCK FABRICS COMPOSED OF BURLAP MAY BE USED ON PROJECTS LASTING 6 MONTHS OR LESS.					

TABLE 4.2
COMPOST STANDARDS

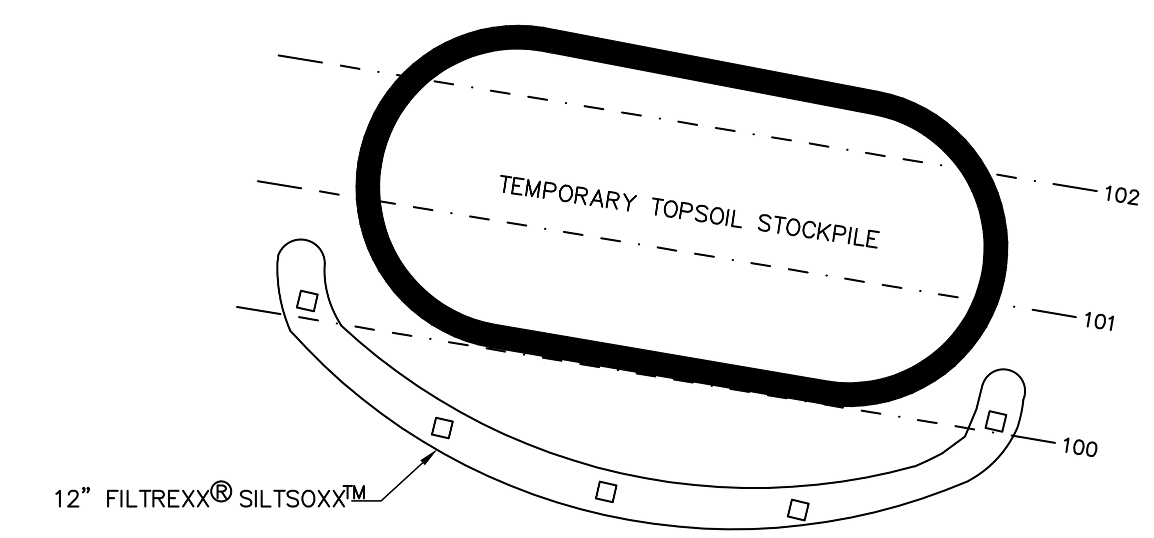
ORGANIC MATTER CONTENT	25% – 100% (DRY WEIGHT BASIS)
ORGANIC PORTION	FIBROUS AND ELONGATED
pH	5.5 – 8.5
MOISTURE CONTENT	30% – 60%
PARTICLE SIZE	30% – 50% PASS THROUGH 3/8" SIEVE
SOLUBLE SALT CONCENTRATION	5.0 dS/m (mmhos/cm) MAX.



NOTES:

1. SEDIMENT LOG PLACEMENT AREA SHALL BE PREPARED SO THAT IT IS FREE OF ALL DEBRIS, INCLUDING ROCKS, STICKS, ROOTS, ETC. A 2" LAYER OF COMPACTED FILL MATERIAL SHALL BE PLACED ON THE UPSLOPE SIDE OF THE LOG TO PREVENT UNDERCUTTING. WHERE MORE THAN ONE LOG IS REQUIRED TO OBTAIN SPECIFIED LENGTH, LOGS SHALL BE TIGHTLY ABUTTED AND SECURELY STAKED (OR OVERLAPPED BY 12" MIN.). A LAYER OF AASHTO #57 STONE SHALL BE PLACED WHERE ABUTTING LOGS COME TOGETHER (EXTENDING 2 FT. ON BOTH SIDES OF THE LOG). A 6" THICK LAYER OF COMPOST ON THE UPSLOPE SIDE MAY BE SUBSTITUTED FOR THE STONE. SEDIMENT FILTER LOGS SHALL BE PLACED AT EXISTING LEVEL GRADE. ENDS SHALL BE EXTENDED UPSLOPE AT 45° TO THE MAIN FILTER LOG ALIGNMENT FOR A MINIMUM OF 8 FEET.
2. SEDIMENT FILTER LOGS SHALL BE INSPECTED WEEKLY AND AFTER EACH RUNOFF EVENT. SEDIMENT DEPOSITS SHALL BE CLEANED FROM THE LOG WHEN IT REACHES HALF THE HEIGHT OF THE LOG. DAMAGED FILTER LOGS SHALL BE REPLACED WITHIN 24 HOURS OF INSPECTION. A SUPPLY OF FILTER LOGS SHALL BE MAINTAINED ON SITE FOR THIS PURPOSE.

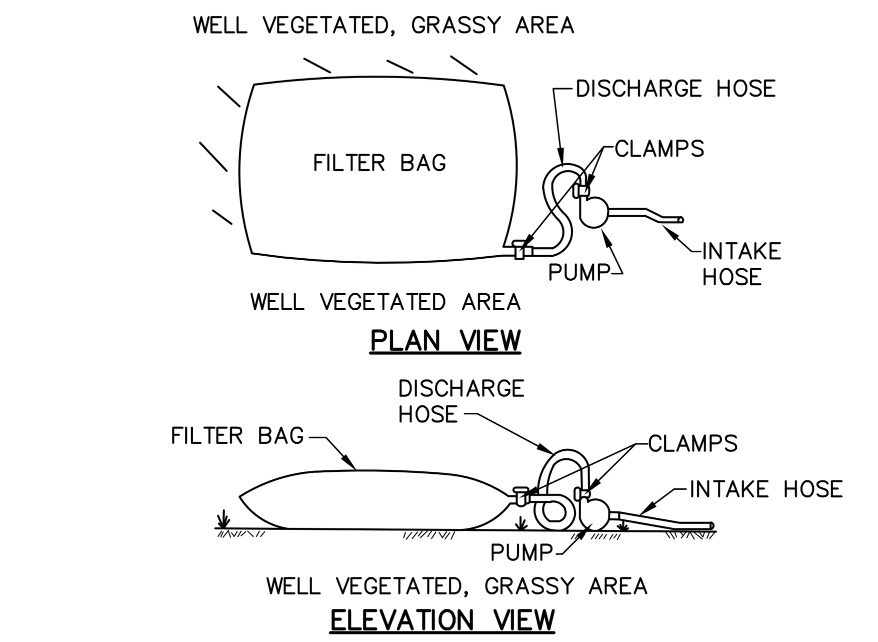
STANDARD CONSTRUCTION DETAIL #4-11
SEDIMENT FILTER LOG (FIBER LOG)
NOT TO SCALE



NOTES:

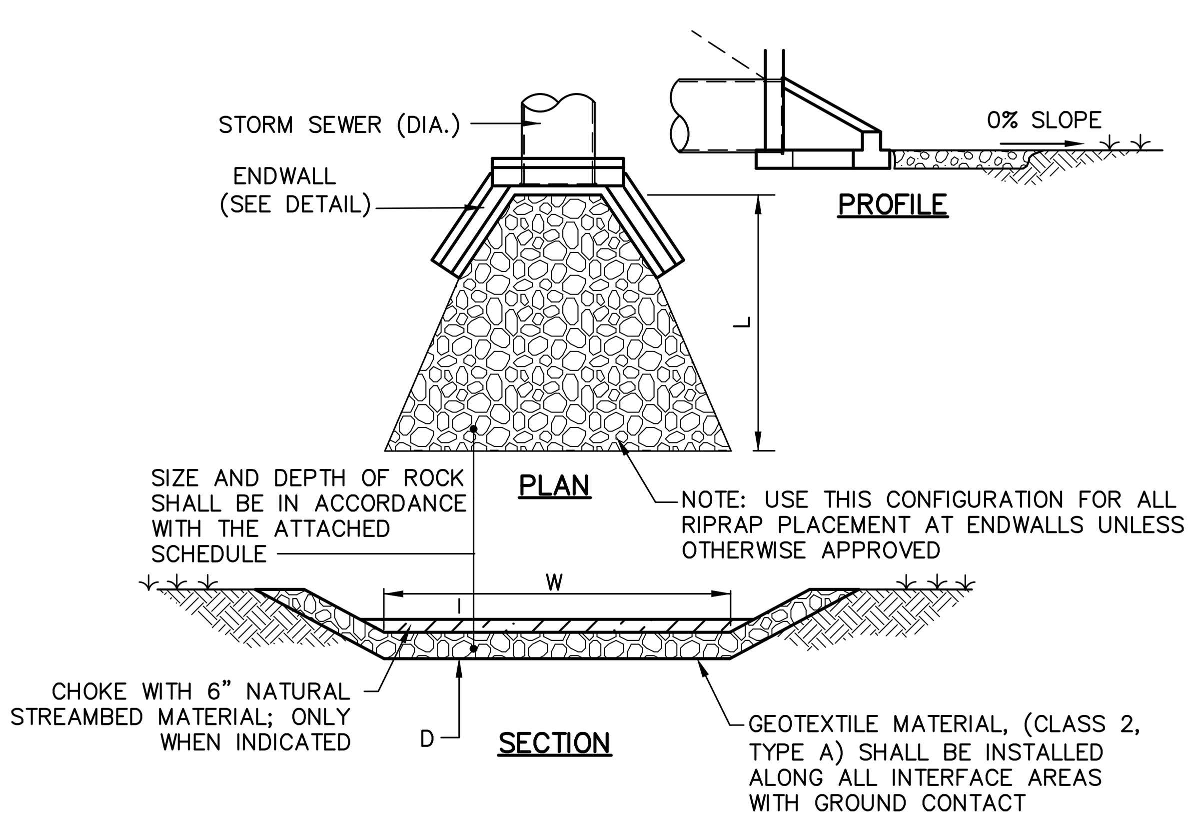
1. THE TOPSOIL STOCKPILE SHALL NOT EXCEED 35-FEET IN HEIGHT WITH SIDE SLOPES OF 2:1 OR FLATTER. SILTSOXX SHALL BE PLACED ON THE DOWN-SLOPE SIDE(S) IMMEDIATELY UPON THE INITIATION OF STORAGE. UPON COMPLETION OF CONSTRUCTION, THE TOPSOIL SHALL BE GRADED TO A SAFE CONFIGURATION AND PERMANENTLY SEEDED AND MULCHED.
2. IF TOPSOIL MUST BE REMOVED FROM THE PROJECT SITE, THE CONTRACTOR MUST CONTACT THE CONSERVATION DISTRICT WITHIN THE COUNTY THEY PLAN TO WASTE OR STOCKPILE EXCAVATED MATERIAL IN ORDER TO ENSURE THAT AN APPROVED E&S PLAN IS IN PLACE.
3. THE TEMPORARY TOPSOIL STICKPILE SHALL BE IMMEDIATELY SEEDED AS PER TEMPORARY SEEDING SCHEDULE.

TEMPORARY TOPSOIL STOCKPILE
NOT TO SCALE



NOTES:
1. USE FILTER BAGS MADE FROM NON-WOVEN GEOTEXTILE MATERIAL SEWN WITH HIGH STRENGTH, DOUBLE STITCHED "J" TYPE SEAMS, CAPABLE OF TRAPPING PARTICLES LARGER THAN 150 MICRONS.
2. A SUITABLE MEANS OF ACCESSING THE BAG WITH MACHINERY REQUIRED FOR DISPOSAL PURPOSES MUST BE PROVIDED. REPLACE FILTER BAGS WHEN THEY BECOME 1/2 FULL. KEEP SPARE BAGS AVAILABLE FOR REPLACEMENT OF THOSE THAT HAVE FAILED OR ARE FILLED.
3. PLACE BAGS IN WELL-VEGETATED (GRASSY) AREA, AND DISCHARGE ONTO STABLE, EROSION RESISTANT AREAS. WHERE THIS IS NOT POSSIBLE, PROVIDE A GEOTEXTILE FLOW PATH. DO NOT PLACE BAGS ON SLOPES GREATER THAN 5%.
4. INSERT PUMP DISCHARGE HOSE INTO THE BAGS IN THE MANNER SPECIFIED BY THE MANUFACTURER AND SECURELY CLAMPED.
5. THE PUMPING RATE SHOULD BE NO GREATER THAN 750 GPM OR 1/2 THE MAXIMUM SPECIFIED BY THE MANUFACTURER, WHICHEVER IS LESS. PUMP INTAKES SHOULD BE FLOATING AND SCREENED.
6. INSPECT FILTER BAGS DAILY. IF ANY PROBLEM IS DETECTED, CEASE PUMPING IMMEDIATELY AND DO NOT RESUME UNTIL THE PROBLEM IS CORRECTED.

PUMPED WATER FILTER BAG
NOT TO SCALE

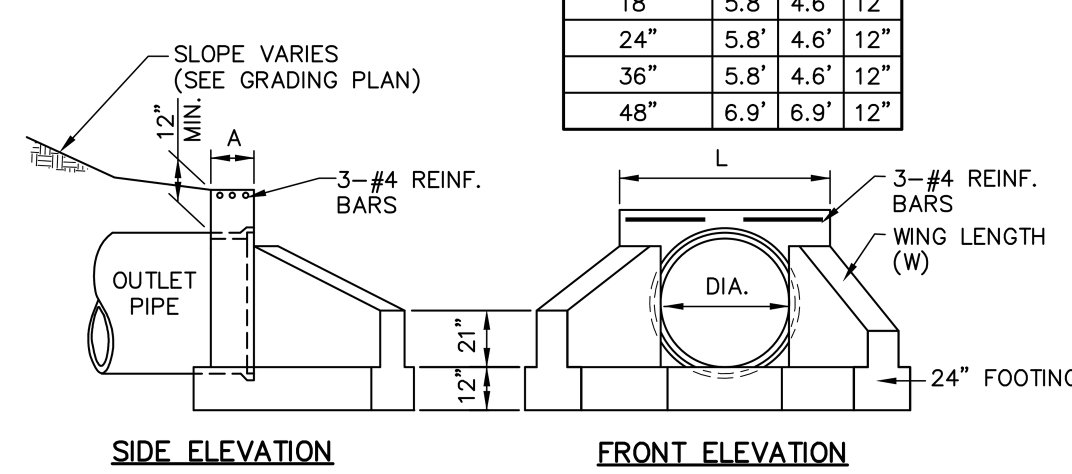


ENDWALL NO.	PIPE DIAMETER (DIA.)	LENGTH L	WIDTH W	RIPRAP SIZE	DEPTH D
EW-1	42"x29"	10'	14.5' *	R-3	24"

NOTES:
1. CONSTRUCT ALL APRONS TO THE DIMENSIONS SHOWN. ADJUST TERMINAL WIDTHS AS NECESSARY TO MATCH RECEIVING CHANNELS.
2. EXTEND RIPRAP ON BACK SIDE OF APRON TO AT LEAST 1/2 DEPTH OF PIPE ON BOTH SIDES TO PREVENT SCOUR AROUND PIPE.
3. INSPECT ALL APRONS ON AT LEAST A WEEKLY BASIS AND AFTER EACH RUNOFF EVENT.
4. REPLACE DISPLACED RIRPAP WITHIN THE APRON IMMEDIATELY
5. *MAY BE WIDER THAN STREAM CHANNEL WIDTH. PROVIDE RIPRAP AT WIDTH CONSISTENT WITH STREAM CHANNEL AND CHOKE WITH 6" (0.5') OF NATURAL STREAMBED MATERIAL.

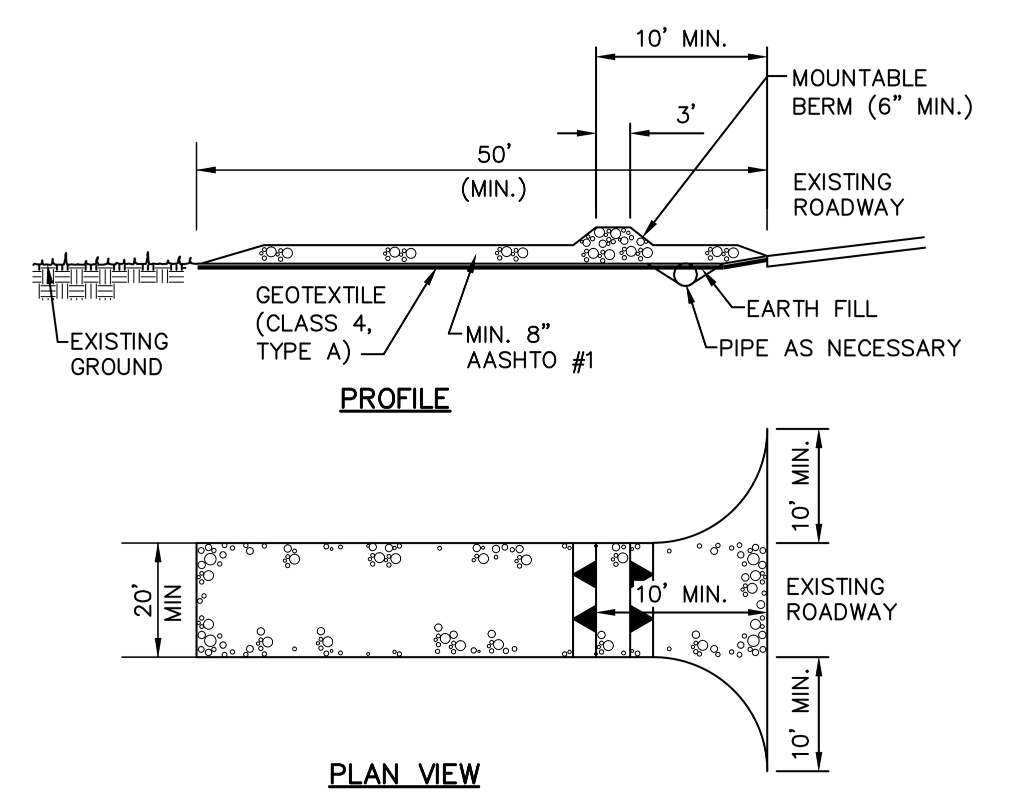
RIPRAP APRON DETAIL
NOT TO SCALE

PIPE DIA.	L	W	A
18"	5.8'	4.6'	12"
24"	5.8'	4.6'	12"
36"	5.8'	4.6'	12"
48"	6.9'	6.9'	12"



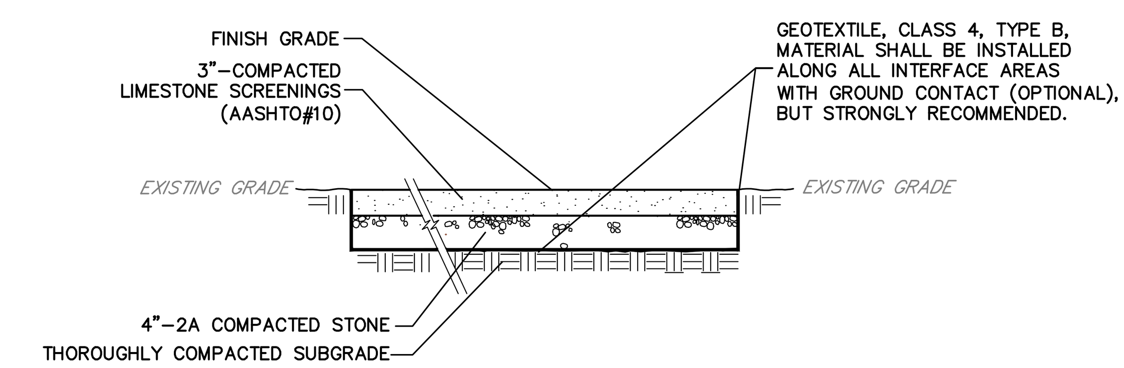
NOTES:
1. CONSTRUCT IN ACCORDANCE WITH PENNDOT PUBLICATION 72 RC-31
2. USE 48" D-W ENDWALL SIZING FOR 42"X29" PIPE.

TYPE D-W ENDWALL DETAIL
NOT TO SCALE



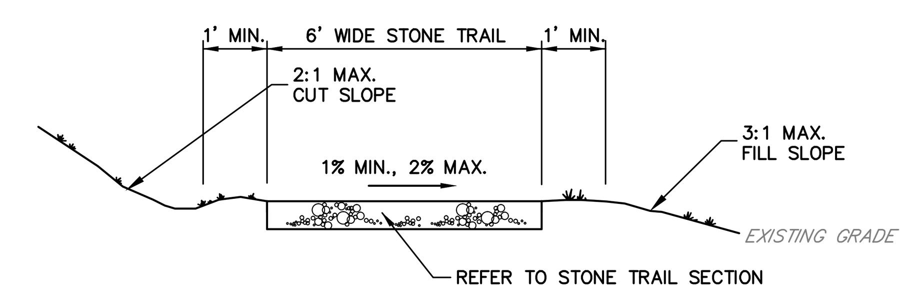
NOTES:
1. TOPSOIL SHOULD BE REMOVED PRIOR TO INSTALLATION OF ROCK CONSTRUCTION ENTRANCE.
2. EXTEND ROCK OVER FULL DISTANCE OF ENTRANCE.
3. RUNOFF SHALL BE DIVERTED FROM ROADWAY TO A SUITABLE SEDIMENT REMOVAL BMP PRIOR TO ENTERING ROCK CONSTRUCTION ENTRANCE.
4. MOUNTABLE BERM SHOULD BE INSTALLED WHEREVER OPTIONAL CULVERT PIPE IS USED. PIPE TO BE SIZED APPROPRIATELY FOR SIZE OF DITCH BEING CROSSED.
5. MAINTENANCE: ROCK CONSTRUCTION ENTRANCE THICKNESS SHALL BE CONSTANTLY MAINTAINED TO THE SPECIFIED DIMENSIONS BY ADDING ROCK. A STOCKPILE SHALL BE MAINTAINED ON SITE FOR THIS PURPOSE. ALL SEDIMENT DEPOSITED ON PAVED ROADWAYS SHALL BE REMOVED AND RETURNED TO THE CONSTRUCTION SITE IMMEDIATELY. IF EXCESSIVE AMOUNTS OF SEDIMENT ARE BEING DEPOSITED ON ROADWAY, EXTEND LENGTH OF ROCK CONSTRUCTION ENTRANCE BY 50' INCREMENTS UNTIL CONDITION IS ALLEVIATED OR INSTALL A WASH RACK. WASHING THE ROADWAY OR SWEEPING THE DEPOSITS INTO ROADWAY DITCHES, SEWERS, CULVERTS, OR OTHER DRAINAGE WAYS IS NOT ACCEPTABLE.

ROCK CONSTRUCTION ENTRANCE
NOT TO SCALE



NOTE
1. PROVIDE FOR POSITIVE DRAINAGE ACROSS PATHS AT ALL POINTS WITH A MINIMUM 1% CROSS SLOPE AND A MAXIMUM CROSS SLOPE 2%.
2. REFER TO PENNDOT PUBLICATION 408, SECTION(S) 210, 212 & 350.

STONE TRAIL SECTION
NOT TO SCALE



1. PROVIDE FOR POSITIVE DRAINAGE ACROSS PATHS AT ALL POINTS WITH A MINIMUM 1% CROSS SLOPE AND A MAXIMUM CROSS SLOPE 2%.
2. REFER TO PENNDOT PUBLICATION 408, SECTION(S) 210, 212 & 350.

TYPICAL STONE TRAIL DETAIL
NOT TO SCALE

NO.	REVISION	DATE	BY

HRG
Herbert, Rowland & Grubic, Inc.
Engineering & Related Services
AN EMPLOYEE-OWNED COMPANY

369 East Park Drive
Harrisburg, PA 17111
(717) 564-1121
Fax (717) 564-1158
hrg@hrg-inc.com
www.hrg-inc.com

SUSQUEHANNA TOWNSHIP
1900 LINGLESTOWN ROAD
HARRISBURG, PENNSYLVANIA, 17110
(717) 545-4751

CONSTRUCTION DETAILS
FOR
LOGAN TRACT TRAILS - SUSQUEHANNA TOWNSHIP

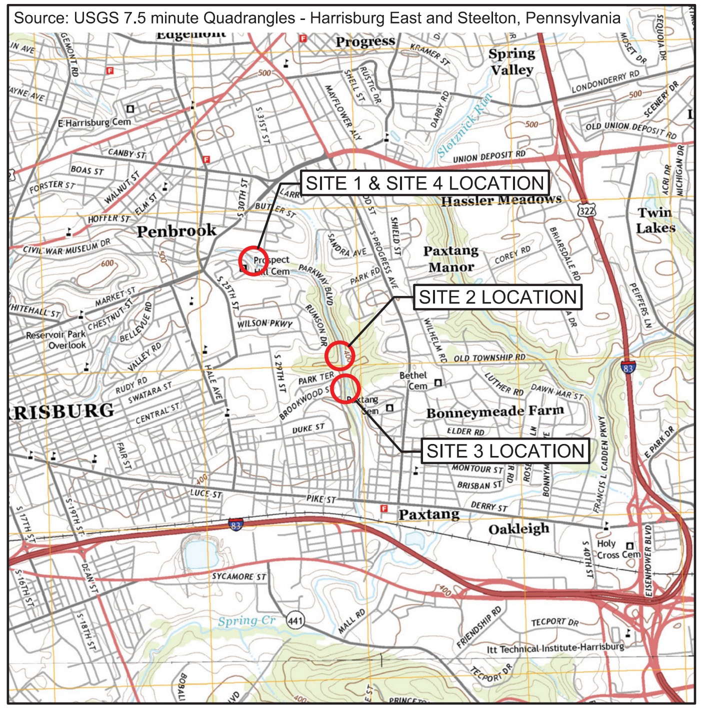
SUSQUEHANNA TOWNSHIP DAUPHIN PENNSYLVANIA

PROJ. MGR. – WRS	
DESIGN– WRS	
CADD– TLB	
CHECKED–SBB	
SCALE– AS SHOWN	
DATE– 2017.07.06	

DRAWING NO.
DT-1
SHEET NO.
9 OF 9
PROJECT R000242.0488

PAXTANG PARKWAY WATERSHED RESTORATION - PHASE 1

CITY OF HARRISBURG
PAXTANG BOROUGH
SUSQUEHANNA TOWNSHIP
DAUPHIN COUNTY, PENNSYLVANIA



SITE LOCATION MAP

0' 2000' 4000'

SCALE IN FEET

PROJECT CONTACTS		
DAUPHIN COUNTY PARKS AND RECREATION		
CARL DICKSON, DIRECTOR	(717) 599-5188	cdickson@dauphinc.org
CAPITOL AREA GREENBELT ASSOCIATION		
SCOTT SHEPLER, PAXTANG PARKWAY STEWARD	(717) 236-0261	scottshepler2207@gmail.com
CITY OF HARRISBURG		
WAYNE MARTIN, CITY ENGINEER	(717) 255-3091	wsmartin@cityofhbg.com
PAXTANG BOROUGH		
KELDEEN STAMBAUGH, BOROUGH MANAGER	(717) 564-4770	paxtangchief-manager@comcast.net
PENBROOK BOROUGH		
JAMES ARMBRUSTER, BOROUGH MANAGER	(717) 232-3733	penbrookmanager@outlook.com
SUSQUEHANNA TOWNSHIP		
ROBERT REICHARD, DIRECTOR OF PARKS & RECREATION	(717) 909-9278	breichard@susquehannatwp.com
SKELLY AND LOY, INC.		
CARROL F. EHRHART, RLA	(717) 232-0593	cehrhart@skellyloy.com
MICHAEL E. LOWER, PE	(717) 232-0593	mlower@skellyloy.com
TODD A. MOSES	(717) 232-0593	tmoses@skellyloy.com

PENNSYLVANIA ONE CALL SYSTEM, INC. 1-800-242-1776 STOP-CALL BEFORE YOU DIG!

811 Know what's below. Call before you dig.

FINAL DESIGN SERIAL NO's: __________

PRELIMINARY DESIGN SERIAL NO's: 20153211762 20153211763 20153211764 20153211765

PREPARED FOR

DAUPHIN COUNTY PENNSYLVANIA PARKS & RECREATION

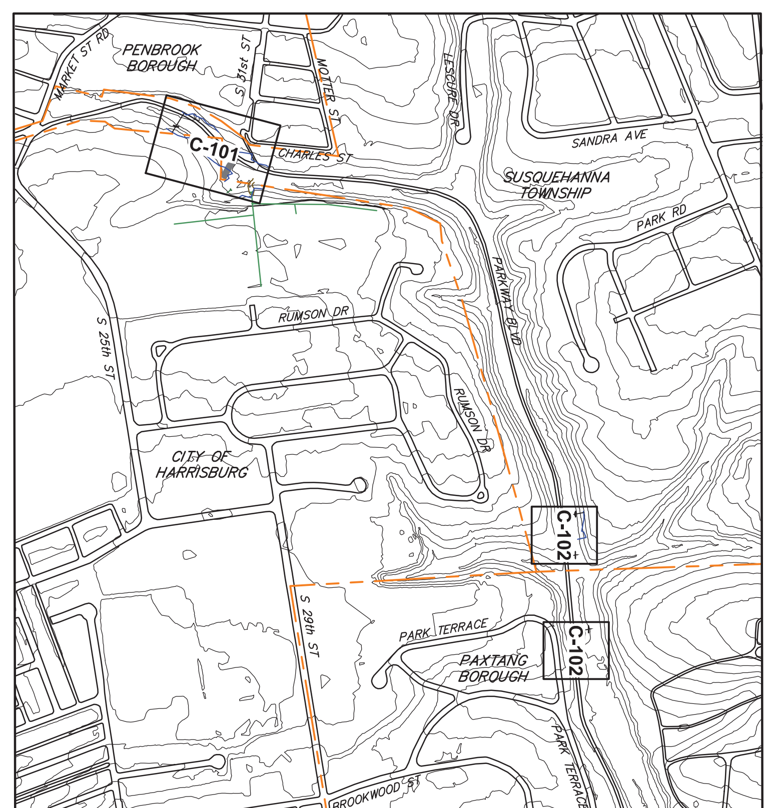
DAUPHIN COUNTY PARKS AND RECREATION

100 FORT HUNTER RD
HARRISBURG, PA 17110

PREPARED BY

SKELLY AND LOY, INC.
ENGINEERS-CONSULTANTS

449 EISENHOWER BOULEVARD
SUITE 300
HARRISBURG, PENNSYLVANIA 17111-2302



INDEX MAP

0' 500' 1000'

SCALE IN FEET

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C-201	PROFILES
C-301	TYPICAL SECTIONS
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EROSION & SEDIMENT POLLUTION CONTROL DRAWINGS	
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LANDSCAPE DRAWINGS	
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LS-501 THRU LS-503	LANDSCAPE DETAILS

I, MICHAEL E. LOWER, DO HEREBY CERTIFY PURSUANT TO THE PENALTIES OF 18 PA. C.S.A., SECTION 4904 TO THE BEST OF MY KNOWLEDGE, INFORMATION, AND BELIEF THAT THE INFORMATION CONTAINED IN THE ACCOMPANYING PLANS, SPECIFICATIONS, AND REPORTS HAS BEEN PREPARED IN ACCORDANCE WITH ACCEPTED ENGINEERING PRACTICE, IS TRUE AND CORRECT, AND IS IN CONFORMANCE WITH CHAPTER 105 OF THE RULES AND REGULATIONS OF THE DEPARTMENT OF ENVIRONMENTAL PROTECTION.

2016-12-09

DRAWING NO. G-001

PAXTANG PARKWAY
WATERSHED RESTORATION - PHASE 1
CITY OF HARRISBURG, PAXTANG BOROUGH, SUSQUEHANNA TOWNSHIP
DAUPHIN COUNTY, PA

COVER

DSGN	DFTSMN	CHKR	APPV	SCALE	Plotted on
MEL	JRG		MEL	AS SHOWN	2016-12-09

REV	DESCRIPTION	BY	APPV	DATE

q:\r13-0290.001 paxtang parkway\sheets\pax_parkway.dwg

449 EISENHOWER BOULEVARD
SUITE 300
HARRISBURG, PA 17111
TEL: (717)232-0593
FAX: (717)232-1799
www.skellyloy.com

PROJECT NUMBER: R13-0290.001
TASK: 01
SUBTASK: 01
DATE: OCTOBER 31, 2016

GENERAL NOTES

1. AT LEAST THREE WORKING DAYS PRIOR TO PERFORMING ANY DIGGING, EXCAVATING, OR EARTH-DISTURBANCE ACTIVITIES, THE CONTRACTOR SHALL CONTACT THE PENNSYLVANIA ONE CALL SYSTEM (DIAL 811 OR DIAL 1-800-242-1776 OR WWW.PAONECALL.ORG) TO LOCATE UTILITIES WITHIN THE PROJECT AREA.

2. ALL DIMENSIONS AND LOCATIONS OF THE IMPROVEMENTS, ENHANCMENTS, AND STRUCTURES ARE SUBJECT TO CHANGE AT THE DIRECTION OF THE ENGINEER IF UNFORESEEN FIELD ISSUES (BEDROCK, UTILITIES, ETC.) NECESSITATE CHANGES. THE ENGINEER WILL COORDINATE ANY NECESSARY FIELD CHANGES WITH PA DEP, USACE, DAUPHIN COUNTY CONSERVATION DISTRICT, AND OTHER AGENCIES AND SECURE APPROVAL PRIOR TO INITIATING THE CHANGES.

3. UNDERGROUND UTILITIES SHOWN HEREON HAVE NOT BEEN PHYSICALLY LOCATED BY THE ENGINEER. HOWEVER, THE INFORMATION WAS OBTAINED FROM EXISTING PLANS AND SURFACE FACILITIES. SKELLY AND LOY, INC. MAKES NO GUARANTEE THAT UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN SERVICE OR ABANDONED. SKELLY AND LOY, INC. DOES NOT WARRANT THAT UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED ALTHOUGH THEY ARE SHOWN AS ACCURATELY AS POSSIBLE FROM THE INFORMATION AVAILABLE.

4. DAMAGE TO ANY AND ALL INFRASTRUCTURE OR PERSONAL PROPERTY SHALL BE REPAIRED OR REPLACED BY THE CONTRACTOR AT NO COST TO THE LANDOWNER(S). THE CONTRACTOR SHALL TAKE EVERY NECESSARY PRECAUTION TO PREVENT DAMAGE TO ROADS, BRIDGES, RAIL LINES AND AMENITIES, UTILITIES, DRAINAGE FEATURES, AND PRIVATE PROPERTY. REPAIR WORK SHALL CONFORM TO MUNICIPAL/UTILITY STANDARDS OR THE DIRECTION OF THE ENGINEER.

5. ALL SOIL FILL MATERIAL SHALL BE COMPACTED TO 95% PROCTOR, UNLESS OTHERWISE NOTED.

6. BASE MAPPING CONTOUR DATA IS A COMBINATION OF FIELD ACQUIRED INFORMATION AND TOPOGRAPHIC CONTOURS MAPPED AT AN INTERVAL OF 2 FEET (AS DOWNLOADED FROM THE PAMAP PROGRAM). CONTOURS WERE DERIVED FROM A BARE-EARTH DIGITAL ELEVATION MODEL CONSTRUCTED FROM PAMAP LIDAR (LIGHT DETECTION AND RANGING) ELEVATION POINTS.

7. HORIZONTAL COORDINATES (NORTHING AND EASTING) ARE BASED UPON NAD83, PA STATE PLANE, SOUTH ZONE, US SURVEY FEET.

8. VERTICAL ELEVATIONS ARE BASED UPON NAVD88, US SURVEY FEET.

9. ALL DIMENSIONS ARE PROVIDED IN ENGLISH UNITS.

STANDARD E&S PLAN NOTES

1. ALL EARTH DISTURBANCES, INCLUDING CLEARING AND GRUBBING AS WELL AS CUTS AND FILLS SHALL BE DONE IN ACCORDANCE WITH THE APPROVED E&S PLAN. A COPY OF THE APPROVED DRAWINGS (STAMPED, SIGNED AND DATED BY THE REVIEWING AGENCY) MUST BE AVAILABLE AT THE PROJECT SITE AT ALL TIMES. THE REVIEWING AGENCY SHALL BE NOTIFIED OF ANY CHANGES TO THE APPROVED PLAN PRIOR TO IMPLEMENTATION OF THOSE CHANGES. THE REVIEWING AGENCY MAY REQUIRE A WRITTEN SUBMITTAL OF THOSE CHANGES FOR REVIEW AND APPROVAL AT ITS DISCRETION.

2. AT LEAST 7 DAYS PRIOR TO STARTING ANY EARTH DISTURBANCE ACTIVITIES, INCLUDING CLEARING AND GRUBBING, THE OWNER AND/OR OPERATOR SHALL INVITE ALL CONTRACTORS, THE LANDOWNER, APPROPRIATE MUNICIPAL OFFICIALS, THE E&S PLAN PREPARER, THE PCSM PLAN PREPARER, THE LICENSED PROFESSIONAL RESPONSIBLE FOR OVERSIGHT OF CRITICAL STAGES OF IMPLEMENTATION OF THE PCSM PLAN, AND A REPRESENTATIVE FROM THE LOCAL CONSERVATION DISTRICT TO AN ON-SITE PRECONSTRUCTION MEETING.

3. AT LEAST 3 DAYS PRIOR TO STARTING ANY EARTH DISTURBANCE ACTIVITIES, OR EXPANDING INTO AN AREA PREVIOUSLY UNMARKED, THE PENNSYLVANIA ONE CALL SYSTEM INC. SHALL BE NOTIFIED AT 1-800-242-1776 FOR THE LOCATION OF EXISTING UNDERGROUND UTILITIES.

4. ALL EARTH DISTURBANCE ACTIVITIES SHALL PROCEED IN ACCORDANCE WITH THE SEQUENCE PROVIDED ON THE PLAN DRAWINGS. DEVIATION FROM THAT SEQUENCE MUST BE APPROVED IN WRITING FROM THE LOCAL CONSERVATION DISTRICT OR BY THE DEPARTMENT PRIOR TO IMPLEMENTATION.

5. AREAS TO BE FILLED ARE TO BE CLEARED, GRUBBED, AND STRIPPED OF TOPSOIL TO REMOVE TREES, VEGETATION, ROOTS AND OTHER OBJECTIONABLE MATERIAL.

6. CLEARING, GRUBBING, AND TOPSOIL STRIPPING SHALL BE LIMITED TO THOSE AREAS DESCRIBED IN EACH STAGE OF THE CONSTRUCTION SEQUENCE. GENERAL SITE CLEARING, GRUBBING AND TOPSOIL STRIPPING MAY NOT COMMENCE IN ANY STAGE OR PHASE OF THE PROJECT UNTIL THE E&S BMPS SPECIFIED BY THE BMP SEQUENCE FOR THAT STAGE OR PHASE HAVE BEEN INSTALLED AND ARE FUNCTIONING AS DESCRIBED IN THIS E&S PLAN.

7. AT NO TIME SHALL CONSTRUCTION VEHICLES BE ALLOWED TO ENTER AREAS OUTSIDE THE LIMIT OF DISTURBANCE BOUNDARIES SHOWN ON THE PLAN MAPS. THESE AREAS MUST BE CLEARLY MARKED AND FENCED OFF BEFORE CLEARING AND GRUBBING OPERATIONS BEGIN.

8. TOPSOIL REQUIRED FOR THE ESTABLISHMENT OF VEGETATION SHALL BE STOCKPILED AT THE LOCATION(S) SHOWN ON THE PLAN MAPS(S) IN THE AMOUNT NECESSARY TO COMPLETE THE FINISH GRADING OF ALL EXPOSED AREAS THAT ARE TO BE STABILIZED BY VEGETATION. EACH STOCKPILE SHALL BE PROTECTED IN THE MANNER SHOWN ON THE PLAN DRAWINGS. STOCKPILE HEIGHTS SHALL NOT EXCEED 35 FEET. STOCKPILE SLOPES SHALL BE 2H:1V OR FLATTER.

9. IMMEDIATELY UPON DISCOVERING UNFORESEEN CIRCUMSTANCES POSING THE POTENTIAL FOR ACCELERATED EROSION AND/OR SEDIMENT POLLUTION, THE OPERATOR SHALL IMPLEMENT APPROPRIATE BEST MANAGEMENT PRACTICES TO MINIMIZE THE POTENTIAL FOR EROSION AND SEDIMENT POLLUTION AND NOTIFY THE LOCAL CONSERVATION DISTRICT AND/OR THE REGIONAL OFFICE OF THE DEPARTMENT.

10. ALL BUILDING MATERIALS AND WASTES SHALL BE REMOVED FROM THE SITE AND RECYCLED OR DISPOSED OF IN ACCORDANCE WITH THE DEPARTMENT'S SOLID WASTE MANAGEMENT REGULATIONS AT 25 PA. CODE 260.1 ET SEQ., 271.1, AND 287.1 ET. SEQ. NO BUILDING MATERIALS OR WASTES OR UNUSED BUILDING MATERIALS SHALL BE BURNED, BURIED, DUMPED, OR DISCHARGED AT THE SITE.

11. ALL OFF-SITE WASTE AND BORROW AREAS MUST HAVE AN E&S PLAN APPROVED BY THE LOCAL CONSERVATION DISTRICT OR THE DEPARTMENT FULLY IMPLEMENTED PRIOR TO BEING ACTIVATED.

12. THE CONTRACTOR IS RESPONSIBLE FOR ENSURING THAT ANY MATERIAL BROUGHT ON SITE IS CLEAN FILL. FORM FP-001 MUST BE RETAINED BY THE PROPERTY OWNER FOR ANY FILL MATERIAL AFFECTED BY A SPILL OR RELEASE OF A REGULATED SUBSTANCE BUT QUALIFYING AS CLEAN FILL DUE TO ANALYTICAL TESTING.

13. ALL PUMPING OF WATER FROM ANY WORK AREA SHALL BE DONE ACCORDING TO THE PROCEDURE DESCRIBED IN THIS PLAN, OVER UNDISTURBED VEGETATED AREAS.

14. VEHICLES AND EQUIPMENT MAY NEITHER ENTER DIRECTLY NOR EXIT DIRECTLY FROM THE WORKSITE ONTO PARKWAY BLVD (TRAIL). ALL VEHICLES SHALL USE THE ESTABLISHED ROCK CONSTRUCTION ENTRANCES.

15. UNTIL THE SITE IS STABILIZED, ALL EROSION AND SEDIMENT BMPS SHALL BE MAINTAINED PROPERLY. MAINTENANCE SHALL INCLUDE INSPECTIONS OF ALL EROSION AND SEDIMENT BMPS AFTER EACH RUNOFF EVENT AND ON A WEEKLY BASIS. ALL PREVENTATIVE AND REMEDIAL MAINTENANCE WORK, INCLUDING CLEAN OUT, REPAIR, REPLACEMENT, REGRADING, RESEEDING, REMULCHING AND RENETTING MUST BE PERFORMED IMMEDIATELY. IF THE E&S BMPS FAIL TO PERFORM AS EXPECTED, REPLACEMENT BMPS, OR MODIFICATIONS OF THOSE INSTALLED WILL BE REQUIRED.

16. A LOG SHOWING DATES THAT E&S BMPS WERE INSPECTED AS WELL AS ANY DEFICIENCIES FOUND AND THE DATE THEY WERE CORRECTED SHALL BE MAINTAINED ON THE SITE AND BE MADE AVAILABLE TO REGULATORY AGENCY OFFICIALS AT THE TIME OF INSPECTION.

17. SEDIMENT TRACKED ONTO ANY PUBLIC ROADWAY OR SIDEWALK SHALL BE RETURNED TO THE CONSTRUCTION SITE BY THE END OF EACH WORK DAY AND DISPOSED IN THE MANNER DESCRIBED IN THIS PLAN. IN NO CASE SHALL THE SEDIMENT BE WASHED, SHOVELED, OR SWEPT INTO ANY ROADSIDE DITCH, STORM SEWER, OR SURFACE WATER.

18. ALL SEDIMENT REMOVED FROM BMPS SHALL BE DISPOSED OF IN THE MANNER DESCRIBED ON THE PLAN DRAWINGS.

19. AREAS WHICH ARE TO BE TOPSOILED SHALL BE SCARIFIED TO A MINIMUM DEPTH OF 3 TO 5 INCHES -- 6 TO 12 INCHES ON COMPACTED SOILS -- PRIOR TO PLACEMENT OF TOPSOIL. AREAS TO BE VEGETATED SHALL HAVE A MINIMUM 4 INCHES OF TOPSOIL IN PLACE PRIOR TO SEEDING AND MULCHING. FILL OUTSLOPES SHALL HAVE A MINIMUM OF 2 INCHES OF TOPSOIL.

20. ALL FILLS SHALL BE COMPACTED AS REQUIRED TO REDUCE EROSION, SLIPPAGE, SETTLEMENT, SUBSIDENCE OR OTHER RELATED PROBLEMS. FILL INTENDED TO SUPPORT BUILDINGS, STRUCTURES AND CONDUITS, ETC. SHALL BE COMPACTED IN ACCORDANCE WITH LOCAL REQUIREMENTS OR CODES.

21. ALL EARTHEN FILLS SHALL BE PLACED IN COMPACTED LAYERS NOT TO EXCEED 9 INCHES IN THICKNESS.

22. FILL MATERIALS SHALL BE FREE OF FROZEN PARTICLES, BRUSH, ROOTS, SOD, OR OTHER FOREIGN OR OBJECTIONABLE MATERIALS THAT WOULD INTERFERE WITH OR PREVENT CONSTRUCTION OF SATISFACTORY FILLS.

23. FROZEN MATERIALS OR SOFT, MUCKY, OR HIGHLY COMPRESSIBLE MATERIALS SHALL NOT BE INCORPORATED INTO FILLS.

24. FILL SHALL NOT BE PLACED ON SATURATED OR FROZEN SURFACES.

25. SEEPS OR SPRINGS ENCOUNTERED DURING CONSTRUCTION SHALL BE HANDLED IN ACCORDANCE WITH THE STANDARD AND SPECIFICATION FOR SUBSURFACE DRAIN OR OTHER APPROVED METHOD.

26. ALL GRADED AREAS SHALL BE PERMANENTLY STABILIZED IMMEDIATELY UPON REACHING FINISHED GRADE. CUT SLOPES IN COMPETENT BEDROCK AND ROCK FILLS NEED NOT BE VEGETATED. SEEDED AREAS WITHIN 50 FEET OF A SURFACE WATER, OR AS OTHERWISE SHOWN ON THE PLAN DRAWINGS, SHALL BE BLANKETED ACCORDING TO THE STANDARDS OF THIS PLAN.

27. IMMEDIATELY AFTER EARTH DISTURBANCE ACTIVITIES CEASE IN ANY AREA OR SUBAREA OF THE PROJECT, THE OPERATOR SHALL STABILIZE ALL DISTURBED AREAS. DURING NON-GERMINATING MONTHS, MULCH OR PROTECTIVE BLANKETING SHALL BE APPLIED AS DESCRIBED IN THE PLAN. AREAS NOT AT FINISHED GRADE, WHICH WILL BE REACTIVATED WITHIN 1 YEAR, MAY BE STABILIZED IN ACCORDANCE WITH THE TEMPORARY STABILIZATION SPECIFICATIONS. THOSE AREAS WHICH WILL NOT BE REACTIVATED WITHIN 1 YEAR SHALL BE STABILIZED IN ACCORDANCE WITH THE PERMANENT STABILIZATION SPECIFICATIONS.

28. PERMANENT STABILIZATION IS DEFINED AS A MINIMUM UNIFORM, PERENNIAL 70% VEGETATIVE COVER OR OTHER PERMANENT NON-VEGETATIVE COVER WITH A DENSITY SUFFICIENT TO RESIST ACCELERATED EROSION. CUT AND FILL SLOPES SHALL BE CAPABLE OF RESISTING FAILURE DUE TO SLUMPING, SLIDING, OR OTHER MOVEMENTS.

29. E&S BMPS SHALL REMAIN FUNCTIONAL AS SUCH UNTIL ALL AREAS TRIBUTARY TO THEM ARE PERMANENTLY STABILIZED OR UNTIL THEY ARE REPLACED BY ANOTHER BMP APPROVED BY THE LOCAL CONSERVATION DISTRICT OR THE DEPARTMENT.

30. UPON COMPLETION OF ALL EARTH DISTURBANCE ACTIVITIES AND PERMANENT STABILIZATION OF ALL DISTURBED AREAS, THE OWNER AND/OR OPERATOR SHALL CONTACT THE LOCAL CONSERVATION DISTRICT FOR AN INSPECTION PRIOR TO REMOVAL/CONVERSION OF THE E&S BMPS.

31. AFTER FINAL SITE STABILIZATION HAS BEEN ACHIEVED, TEMPORARY EROSION AND SEDIMENT BMPS MUST BE REMOVED OR CONVERTED TO PERMANENT POST CONSTRUCTION STORMWATER MANAGEMENT BMPS. AREAS DISTURBED DURING REMOVAL OR CONVERSION OF THE BMPS SHALL BE STABILIZED IMMEDIATELY. IN ORDER TO ENSURE RAPID REVEGETATION OF DISTURBED AREAS, SUCH REMOVAL/CONVERSIONS ARE TO BE DONE ONLY DURING THE GERMINATING SEASON.

32. UPON COMPLETION OF ALL EARTH DISTURBANCE ACTIVITIES AND PERMANENT STABILIZATION OF ALL DISTURBED AREAS, THE OWNER AND/OR OPERATOR SHALL CONTACT THE LOCAL CONSERVATION DISTRICT TO SCHEDULE A FINAL INSPECTION.

33. FAILURE TO CORRECTLY INSTALL E&S BMPS, FAILURE TO PREVENT SEDIMENT-LADEN RUNOFF FROM LEAVING THE CONSTRUCTION SITE, OR FAILURE TO TAKE IMMEDIATE CORRECTIVE ACTION TO RESOLVE FAILURE OF E&S BMPS MAY RESULT IN ADMINISTRATIVE, CIVIL, AND/OR CRIMINAL PENALTIES BEING INSTITUTED BY THE DEPARTMENT AS DEFINED IN SECTION 602 OF THE PENNSYLVANIA CLEAN STREAMS LAW. THE CLEAN STREAMS LAW PROVIDES FOR UP TO $10,000 PER DAY IN CIVIL PENALTIES, UP TO $10,000 IN SUMMARY CRIMINAL PENALTIES, AND UP TO $25,000 IN MISDEMEANOR CRIMINAL PENALTIES FOR EACH VIOLATION.

CUT AND FILL MATERIALS

1. IF ALL CUT AND FILL MATERIALS WILL BE USED ON THE SITE, A CLEAN FILL DETERMINATION IS NOT REQUIRED BY THE CONTRACTOR UNLESS THERE IS A BELIEF THAT A SPILL OR RELEASE OF A REGULATED SUBSTANCE OCCURRED ON SITE.

2. SHOULD THE SITE REQUIRE FILL IMPORTED FROM AN OFF SITE LOCATION, THE CONTRACTOR WILL BE RESPONSIBLE FOR PERFORMING ENVIRONMENTAL DUE DILIGENCE AND THE DETERMINATION OF CLEAN FILL.

3. ALL FILL MATERIAL MUST BE USED IN ACCORDANCE WITH PA DEP'S POLICY "MANAGEMENT OF FILL", DOCUMENT NUMBER 258-2182-773.

4. ENVIRONMENTAL DUE DILIGENCE IS DEFINED AS: INVESTIGATIVE TECHNIQUES, INCLUDING, BUT NOT LIMITED TO, VISUAL PROPERTY INSPECTIONS, ELECTRONIC DATA BASE SEARCHES, REVIEW OF PROPERTY OWNERSHIP, REVIEW OF PROPERTY USE HISTORY, SANBORN MAPS, ENVIRONMENTAL QUESTIONNAIRES, TRANSACTION SCREENS, ANALYTICAL TESTING, ENVIRONMENTAL ASSESSMENTS OR AUDITS. ANALYTICAL TESTING IS NOT A REQUIRED PART OF DUE DILIGENCE UNLESS VISUAL INSPECTION AND/OR REVIEW OF THE PAST LAND USE OF THE PROPERTY INDICATES THAT THE FILL MAY HAVE BEEN SUBJECTED TO A SPILL OR RELEASE OF REGULATED SUBSTANCE. IF THE FILL MAY HAVE BEEN AFFECTED BY A SPILL OR RELEASE OF A REGULATED SUBSTANCE, IT MUST BE TESTED TO DETERMINE IF IT QUALIFIES AS CLEAN FILL. TESTING SHOULD BE PERFORMED IN ACCORDANCE WITH APPENDIX A OF PA DEP'S POLICY "MANAGEMENT OF FILL".

5. CLEAN FILL IS DEFINED AS: UNCONTAMINATED, NON-WATER SOLUBLE, NON-DECOMPOSABLE, INERT, SOLID MATERIAL. THE TERM INCLUDES SOIL, ROCK, STONE, DREDGED MATERIAL, USED ASPHALT, AND BRICK, BLOCK OR CONCRETE FROM CONSTRUCTION AND DEMOLITION ACTIVITIES THAT IS SEPARATE FROM OTHER WASTE AND IS RECOGNIZABLE AS SUCH. THE TERM DOES NOT INCLUDE MATERIALS PLACED IN OR ON THE WATERS OF THE COMMONWEALTH UNLESS OTHERWISE AUTHORIZED. (THE TERM "USED ASPHALT" DOES NOT INCLUDE MILLED ASPHALT OR ASPHALT THAT HAS BEEN PROCESSED FOR RE-USE.)

6. FILL MATERIALS AFFECTED BY A SPILL OR RELEASE OF A REGULATED SUBSTANCE STILL QUALIFIES AS CLEAN FILL PROVIDED THE TESTING REVEALS THAT THE FILL MATERIAL CONTAINS CONCENTRATIONS OF REGULATED SUBSTANCES THAT ARE BELOW THE RESIDENTIAL LIMITS IN TABLES FP-1A AND FP-1B FOUND IN PA DEP'S POLICY "MANAGEMENT OF FILL". ANY PERSON PLACING CLEAN FILL THAT HAS BEEN AFFECTED BY A SPILL OR RELEASE OF A REGULATED SUBSTANCE MUST USE FORM FP-001 TO CERTIFY THE ORIGIN OF THE FILL MATERIAL AND THE RESULTS OF THE ANALYTICAL TESTING TO QUALIFY THE MATERIAL AS CLEAN FILL. FORM FP-001 MUST BE RETAINED BY THE OWNER OF THE PROPERTY RECEIVING THE FILL.

7. FILL MATERIAL THAT DOES NOT QUALIFY AS CLEAN FILL IS REGULATED FILL. REGULATED FILL IS WASTE AND MUST BE MANAGED IN ACCORDANCE WITH PA DEP'S MUNICIPAL OR RESIDUAL WASTE REGULATIONS BASED ON 25 PA CODE CHAPTERS 287 RESIDUAL WASTE MANAGEMENT OR 271 MUNICIPAL WASTE MANAGEMENT, WHICHEVER IS APPLICABLE.

PROTECTION OF EXISTING TREES

1. THE ENGINEER SHALL MARK ALL TREES WHICH ARE HEALTHY AND TO BE RETAINED WITHIN OR IMMEDIATELY ADJACENT TO THE CONSTRUCTION ZONE (I.E. VICINITY OF THE CONSTRUCTION CORRIDOR, CONSTRUCTION ACCESS ROUTES, AND STOCKPILE LOCATIONS).

2. ESTABLISH A TREE PROTECTION ZONE (TPZ) AROUND ALL TREES TO BE RETAINED. UNLESS OTHERWISE REQUIRED BY SITE CONSTRAINTS, THE TPZ SHALL BE 12" IN RADIAL DISTANCE AWAY FROM THE TREE FOR EVERY INCH OF DIAMETER AT BREAST HEIGHT. WHERE CONSTRAINED BY SITE CONDITIONS AND/OR CONSTRUCTION REQUIREMENTS, THE TPZ SHALL BE AS WIDE AS FEASIBLE.

3. WHERE SPACE ALLOWS, INSTALL TEMPORARY PROTECTIVE FENCE (DETAIL ES-A) TO DEMARCATE THE TPZ.

4. CARE SHALL BE TAKEN TO AVOID BOTH REGULAR PEDESTRIAN AND HEAVY EQUIPMENT INCURSIONS INTO THE TPZ. NO CONSTRUCTION OR OTHER MATERIALS SHALL BE STORED WITHIN THE TPZ.

5. CUT AND REMOVE ONLY THOSE TREES AND OTHER WOODY VEGETATION FROM ACCESS ROUTES AND TEMPORARY STOCKPILE LOCATIONS AS IS ABSOLUTELY NECESSARY.

6. PLACE A MINIMUM 6-INCH LAYER OF MULCH WITHIN THE TPZ IF FREQUENT ACCESS TO THIS AREA IS REQUIRED BY THE CONSTRUCTION CREW OR IF THERE IS A POTENTIAL FOR INADVERTENT HEAVY EQUIPMENT INCURSIONS INTO THIS AREA. THE MULCH CAN BE LAID OVER A SUITABLE GEOTEXTILE FOR EASY RECOVERY AFTER CONSTRUCTION IF DESIRED.

7. A MINIMUM 6-INCH THICK LAYER OF WOODY MULCH SHALL BE PLACED ON ACCESS ROUTES AND WITHIN STOCKPILE AREAS WITHIN WOODED AREAS TO MINIMIZE SOIL COMPACTION AND ROOT DAMAGE. SHREDDED BARK MULCH OR MULCH CHIPPED FROM COARSE WOODY DEBRIS (E.G. MATERIAL SALVAGED FROM SITE GRUBBING) ARE ACCEPTABLE MATERIALS.

8. ANY LARGE (≥ 2 INCHES DIAMETER) LIVING ROOTS OF RETAINED TREES WHICH BECOME EXPOSED OR MUST BE PRUNED FOR PROJECT CONSTRUCTION, OR WHICH HAVE BEEN OTHERWISE DAMAGED OR EXPOSED, SHALL BE TREATED BY MAKING A CLEAN SAW CUT BEHIND THE SHATTERED PART OF THE ROOT. PRESERVE AS MUCH OF THE ROOT AS POSSIBLE.

9. MOVEMENT OF HEAVY EQUIPMENT ALONG AND WITHIN CONSTRUCTION ACCESS ROUTES AND STOCKPILE LOCATIONS IN WOODED AREAS SHALL NOT OCCUR DURING WET SOIL CONDITIONS. SOIL COMPACTION IN AN EXISTING WOODED AREA CAN PERMANENTLY DAMAGE MATURE TREES AND COMPACTION CANNOT BE SUCCESSFULLY RELIEVED IN AREAS WITH DENSE SURFACE ROOT NETWORKS.

10. “WET SOIL CONDITIONS” ARE DEEMED PRESENT IF THERE ARE PUDDLES OF STANDING WATER ON THE SURFACE OR IF A SAMPLE OF SOIL TAKEN AT A DEPTH OF 6 INCHES BELOW THE SURFACE IS SATURATED. THE SOIL IS SATURATED IF FREE WATER CAN BE SQUEEZED FROM A FIST-SIZED SAMPLE OF THE SOIL.

CLEARING AND GRUBBING

1. TREES AND SHRUBS TO BE REMOVED OR RETAINED IN THE WORK AREA VICINITY SHALL BE DETERMINED BY THE ENGINEER PRIOR TO PROJECT CONSTRUCTION.

2. AS DIRECTED BY THE ENGINEER, TREES TO BE CUT MAY BE RETAINED AND CHIPPED ONSITE FOR RE-USE AS MULCH, OR SHALL OTHERWISE BE REMOVED FROM THE SITE AND DISPOSED OF PROPERLY.

SURFACE PREPARATION

1. FINAL GRADING SHALL RESULT IN SURFACES TO BE TREATED WITH SEED AND MULCH THAT ARE FREE OF SIGNIFICANT SURFACE OBSTRUCTIONS SUCH AS WOODY DEBRIS, DEMOLITION DEBRIS OR LARGE STONES. SURFACES TO BE TREATED WITH MATTING SHALL ALSO BE FREE OF ALL LOOSE STONES AND HARD CLODS LARGER THAN 2 INCHES.

2. FINISHED GRADES SHALL BE LEFT IN A ROUGHENED, LOOSENED CONDITION (TO A DEPTH OF AT LEAST 6 INCHES) TO PROVIDE A GOOD SEEDBED. ANY SURFACES THAT ARE SMOOTH AND COMPACTED, SUCH AS MACHINE-BLADED SURFACES, SHALL BE CULTIVATED TO ACHIEVE THIS LOOSENED CONDITION. ANY AREAS OF ESPECIALLY HEAVY COMPACTION OR DENSE SUBSOIL WHICH ARE ENCOUNTERED (AS IDENTIFIED BY THE ENGINEER) SHALL BE CULTIVATED TO A DEPTH OF AT LEAST 12 INCHES.

EROSION CONTROL BLANKET, WOVEN COIR MATTING

1. EROSION CONTROL BLANKET, WOVEN COIR MATTING SHALL BE UNDYED, FLEXIBLE, NON-TREATED BIODEGRADABLE COCONUT HUSK (COIR) WOVEN INTO A DIMENSIONALLY STABLE, UNIFORM, OPEN PLAIN WEAVE MESH WITH 1/2" SQUARE OPENINGS. NO PLASTICS, POLYMERS, METAL REINFORCEMENTS, OR OTHER NON-BIODEGRADABLE MATERIALS SHALL BE INCORPORATED AS A PART OF THE EROSION CONTROL BLANKET. USE: BIO-D MAT 70 [ROLANKA]; OR APPROVED EQUAL.

2. ADJACENT MATTING STRIPS SHALL BE OVERLAPPED SHINGLE FASHION IN BOTH A DOWNSLOPE AND DOWNSTREAM DIRECTION (SEE PLAN DETAIL). BOTH DOWNSLOPE AND DOWNSTREAM OVERLAPS SHALL BE AT LEAST 18 INCHES WIDE WITHIN THE NEAR-BANK ZONE.

3. METAL STAPLES ARE NOT ACCEPTABLE AS FASTENERS. THE MATTING SHALL BE FASTENED USING ONE OF THE TYPES OF BIODEGRADABLE MATTING FASTENERS SHOWN IN THE PLANS.

4. PRIOR TO PLACEMENT OF THE EROSION CONTROL BLANKET, THE SOIL SURFACE SHALL BE SEEDED WITH A PERMANENT SEED MIX AND MULCHED.

CONSTRUCTION OVERSIGHT

1. ALL IN-STREAM CONSTRUCTION SHALL BE SUBSTANTIALLY GUIDED BY, AND SUBJECT TO THE APPROVAL OF, AN ENGINEER OR STREAM RESTORATION SPECIALIST WITH FIELD EXPERIENCE IN APPLIED FLUVIAL GEOMORPHOLOGY AND IN-STREAM AND RIPARIAN HABITAT IMPROVEMENT (HEREAFTER REFERRED TO AS THE “ENGINEER”).

WETLAND PROTECTION DURING CONSTRUCTION

1. PROTECT DELINEATED WETLAND AREAS IN THE IMMEDIATE VICINITY OF THE PROJECT CONSTRUCTION AREA, CONSTRUCTION ACCESS ROUTES, AND STOCKPILE LOCATIONS.

2. INSTALL TEMPORARY PROTECTIVE FENCE (DETAIL ES-A) TO DEMARCATE THE DELINEATED WETLAND AREA BOUNDARY IN THE IMMEDIATE VICINITY OF ALL WORK AREAS.

3. NO ENTRANCE INTO PROTECTED WETLAND AREAS IS PERMITTED DURING CONSTRUCTION.

DEMOLITION AND ABONDONMENT

1. THE CONTRACTOR SHALL EXERCISE CARE IN DEMOLITION OPERATIONS TO AVOID DAMAGE TO EXISTING INFRASTRUCTURE TO BE PRESERVED AND TO TREES AND OTHER WOODY VEGETATION TO BE RETAINED.

2. THE CONTRACTOR SHALL PROCEED WITH THE DEMOLITION AND REMOVAL OF CONCRETE STRUCTURES ONLY AFTER PRIOR CONSULTATION WITH THE ENGINEER.

GENERAL ROCK STRUCTURE NOTES

1. ALL ROCK STRUCTURES (CROSS ROCK VANES) SHALL BE CONSTRUCTED UNDER THE DIRECT SUPERVISION OF AND SUBJECT TO THE APPROVAL OF AN ENGINEER EXPERIENCED IN THE PRINCIPLES OF FLUVIAL GEOMORPHOLOGY.

2. ROCK STRUCTURES AND BEDDING SHALL BE INSTALLED IN ACCORDANCE WITH THE DETAILS SHOWN AND SHALL ACHIEVE THE FOLLOWING MINIMUM FLUVIAL GEOMORPHOLOGICAL OBJECTIVES: 1) TO ALLOW NORMAL BEDLOAD SEDIMENT TRANSPORT TO OCCUR, 2) TO ALLOW AQUATIC ORGANISMS (FIN FISH) TO HAVE FREE MIGRATION ACCESS ACROSS THE STRUCTURE, 3) TO MAINTAIN STREAM BANK AND BED STABILIZATION, 4) TO PROVIDE HABITAT FOR FISH AND OTHER AQUATIC ORGANISMS, AND 5) TO REDIRECT FLOW VELOCITY VECTORS AWAY FROM THE STREAM BANK TO PREVENT EROSIVE FORCES AT THE BANK. THE CONTRACTOR IS RESPONSIBLE FOR MEETING THESE FLUVIAL GEOMORPHOLOGICAL OBJECTIVES.

3. ENSURE THAT EACH STRUCTURE AND EACH ROCK IN EACH STRUCTURE MEET THE FOLLOWING MINIMUM REQUIREMENTS:
- THE TOP SURFACE OF THE TOP ROCKS IN THE THROAT OF THE STRUCTURES BLENDS SMOOTHLY WITH THE STREAMBED SURFACE DIRECTLY UPSTREAM OF THE STRUCTURE.
- THE STRUCTURE “ROLLS” OR “FOLDS” THE WATER IN THE STREAM TOWARD THE SCOUR POOL LOCATED DIRECTLY DOWNSTREAM OF THE THROAT OF THE STRUCTURE (CENTERED ON THE CENTERLINE FOR A CROSS ROCK VANE).
- ROCKS ARE PLACED SUCH THAT NO EDDIES OF WATER ARE DEFLECTED TOWARD THE STREAM BANK OR TOWARD ANY PART OF THE STRUCTURE THAT WOULD RESULT IN UNDERMINING OF THE FOOTER ROCKS.
- WATER FLOWING OVER THE COMPLETED CROSS ROCK VANE FLOWS SMOOTHLY FROM THE RIFFLE ONTO THE THROAT OF THE STRUCTURE, CASCADES OVER THE FACE OF THE THROAT, DISSIPATES TURBULENTLY WITHIN THE POOL, FLOWS AT A LOW SLOPE OUT OF THE SCOUR POOL, AND FLOWS SMOOTHLY INTO THE NEXT RIFFLE DOWNSTREAM.

4. ROCK STRUCTURES SHALL BE CONSTRUCTED OF ANGULAR, FLAT, OR CUBED ROCK. INDIVIDUAL ROCKS SHALL BE DENSE, SOUND, AND FREE FROM CRACKS, SEAMS AND OTHER DEFECTS CONDUCIVE TO ACCELERATED DETERIORATION. THE DRY WEIGHT DENSITY OF EACH ROCK SHALL BE 150 POUNDS PER CUBIC FOOT OR GREATER. NO CONCRETE, MAN-MADE ROCKS, OR SOFT ROCKS (SUCH AS SHALE) SHALL BE USED FOR THE CONSTRUCTION OF THE ROCK STRUCTURES. THE ENGINEER SHALL BE GIVEN THE OPPORTUNITY TO INSPECT THE ROCK AT THE SENDING QUARRY PRIOR TO THE FIRST DELIVERY. PROVIDE CERTIFIED WEIGH SLIPS FOR EACH LOAD OF ROCK PRIOR TO INCORPORATING INTO THE PROJECT.

5. CONSTRUCTION OF THE ROCK STRUCTURES REQUIRES INDIVIDUAL SELECTION AND PLACEMENT OF EACH ROCK IN EACH STRUCTURE.

6. EXTEND EXCAVATION FOR PLACEMENT OF THE FOOTER ROCKS A MINIMUM OF 4.0' BELOW THE FINAL THALWEG ELEVATION OR TO TOP OF BEDROCK IF BEDROCK IS ENCOUNTERED AT DEPTHS LESS THAN 4.0' AT THE POINT OF PLACEMENT.

7. FOOTER ROCKS SHALL BE PLACED INDIVIDUALLY AND KEYED INTO CHANNEL BED AND BANKS AS SHOWN IN THE CROSS ROCK VANE DETAIL. LAY ROCKS IN AN APPROXIMATELY FLAT ORIENTATION, CANTED ACCORDING TO THE DETAIL. ROCKS SHALL NOT BE STOOD ON EDGE OR END.

8. PLACE TOP ROCKS INDIVIDUALLY AND UPSTREAM OF FOOTER ROCKS AS SHOWN. AGAIN, LAY ROCKS IN AN APPROXIMATELY FLAT ORIENTATION, CANTED ACCORDING TO THE DETAIL. ROCKS SHALL NOT BE STOOD ON EDGE OR END. PLACE THE TOP SURFACE OF THE TOP ROCKS WITHIN THE THROAT (CENTER) SECTION OF THE CROSS ROCK VANES AT THE STREAMBED INVERT (THALWEG) ELEVATION. PLACE THE TOP ROCKS TO CREATE A RELATIVELY UNIFORM SURFACE ALONG THE TOP PLANE OF THE THROAT, VANE ARMS, AND SILLS. PLACE THE TOP ROCKS LINEARLY (END-TO-END) WITH TIGHT, CONTINUOUS SURFACE CONTACT WITH ADJACENT TOP ROCKS TO FORM A STABLE STRUCTURE.

9. ENSURE THAT NO ROCKS ARE LOOSE OR CAPABLE OF BEING MOVED OR ROLLED OUT OF PLACE. THE STRUCTURAL INTEGRITY OF THE COMPLETELY ASSEMBLED STRUCTURE SHALL BE VERIFIED BY SITUATING THE HYDRAULIC EXCAVATOR IMMEDIATELY UPSTREAM OF THE STRUCTURE AND PUSHING THE ROCKS TOWARD THE SCOUR HOLE. NO ONE ROCK SHALL BE CAPABLE OF BEING PUSHED INTO THE SCOUR POOL WITHOUT SIGNIFICANTLY DISPLACING OR REARRANGING ADJOINING STRUCTURE ROCKS.

10. THE LANDWARD ENDS OF THE FLOODPLAIN SILLS (POINTS X AND Y ON THE DETAIL) SHALL EXTEND A MINIMUM OF 10 FEET INTO THE UNDISTURBED FLOODPLAIN.

11. NO SIGNIFICANT VOIDS SHALL EXIST BETWEEN ADJOINING FOOTER ROCKS, AND BETWEEN ADJOINING FOOTER AND TOP ROCKS. TO PREVENT WATER-PIPING BETWEEN STRUCTURE ROCKS, THE CONTRACTOR SHALL CHINK BY HAND ALL UNDESIRABLE VOIDS WITH SMALL BOULDERS, COBBLE, ROCK FRAGMENTS, AND/OR GRAVEL. CHINKING SHALL BE CONDUCTED FOR ALL VOIDS GREATER THAN OR EQUAL TO 3 INCHES IN SIZE.

12. MATERIAL EXCAVATED FOR THE FOOTER ROCKS MAY BE USED FOR FILL ON THE UPSTREAM SIDE OF THE VANE ARMS. THE CONTRACTOR SHALL REGRADE OR RESHAPE THE CHANNEL AFTER THE CONSTRUCTION OF THE ROCK STRUCTURE TO PROVIDE THE PROPER DESIGN DIMENSIONS.

13. CONSTRUCT ALL CROSS ROCK VANES TO WITHIN 1' OF THE HORIZONTAL DESIGN DIMENSIONS AND TO WITHIN 0.1' OF THE DESIGN ELEVATIONS. THE ENGINEER OR HIS REPRESENTATIVE WILL INSPECT THE STREAM FLOW AND HYDRAULIC CHARACTERISTICS OF THE WATER IN THE STREAM CHANNEL AFTER CONSTRUCTION OF THE CROSS ROCK VANE. IF DIRECTED BY THE ENGINEER OR HIS REPRESENTATIVE AFTER THE HYDRAULIC INSPECTION, REMOVE AND RELOCATE STRUCTURES AS DIRECTED TO MEET THE PERFORMANCE SPECIFICATIONS AT NO ADDITIONAL COST.

14. INDIVIDUAL ROCKS USED IN THE CONSTRUCTION OF THE IN-STREAM STRUCTURES SHALL CONFORM TO THE DIMENSION SPECIFICATIONS IN THE ROCK SIZING TABLE.

15. THE RATIOS OF (LENGTH/HEIGHT) AND (WIDTH/HEIGHT) FOR EACH ROCK SHALL BE GREATER THAN OR EQUAL TO 1.50.

16. DUE TO THE WIDE RANGE OF ACCEPTABLE ROCK THICKNESSES, ACHIEVEMENT OF THE MINIMUM EMBEDMENT DEPTH MAY REQUIRE MORE LAYERS OF ROCK THAN DEPICTED IN THE ROCK STRUCTURE DETAIL.

BOULDER BANK REVETMENT

1. THE BOULDER BANK REVETMENT SHALL BE INSTALLED AS GENERALLY SHOWN ON THE PLANS AND AS DIRECTED BY THE ENGINEER. THE INTENT IS TO ACHIEVE A STABLE, 'NATURAL-APPEARING' BANK REVETMENT WHICH IS SOMEWHAT IRREGULAR IN PLANFORM AND SECTION. THIS WILL PROVIDE A COMPLEX SHORELINE ENVIRONMENT.

2. BOULDERS FOR THE BOULDER BANK REVETMENT SHALL CONSIST OF SELECT BLOCK-SHAPED ROCK (BLOCKSTONE) WITH THE DIMENSIONS INDICATED IN THE ROCK TABLE.

3. BANK BATTER (FACE ANGLE) SHALL GENERALLY BE 1H:1V, OR AS OTHERWISE DIRECTED BY THE ENGINEER.

4. EMBED FOOTER ROCK IN A TOE TRENCH EXCAVATED TO A MINIMUM DEPTH OF 4.0' BELOW THALWEG UNLESS OTHERWISE DIRECTED BY THE ENGINEER.

5. CARE SHALL BE TAKEN TO INSLOPE PLACED BOULDERS DOWN AND INTO THE BANK (I.E. PLACE BOULDERS “DOWN AT THE HEEL”) TO ENSURE BOULDER STABILITY, AS SHOWN IN THE PLAN DETAILS.

6. THE ELEVATION OF THE TOP OF THE BOULDER BANK REVETMENT SHALL FOLLOW THE PROPOSED BANKFULL ELEVATION SHOWN ON THE PROFILE, OR AS OTHERWISE DIRECTED BY THE ENGINEER.

7. INTERSPERSE DIFFERENT BOULDER SIZES IN THE REVETMENT TO ACHIEVE A NATURAL APPEARANCE. OFFSET THE JOINTS BETWEEN BOULDERS IN ADJACENT COURSES IN A ONE-OVER-TWO PATTERN IN FACE VIEW.

8. SLIGHTLY STAGGER THE BOULDERS ALONG THE LENGTH OF THE BANK TO CREATE MINOR UNDULATIONS ALONG THE ROCK-PROTECTED BANKLINE.

9. ADJACENT BOULDERS IN ANY COURSE SHALL BE TIGHTLY WEDGED TOGETHER END-TO-END AND THOROUGHLY SEATED ONE ON TOP OF THE OTHER SO THAT THEY ARE STABLE. NO BOULDER IN THE BANK REVETMENT SHALL BE UNSTABLE UNDERFOOT OR SUSCEPTIBLE TO DISPLACEMENT BY STREAM FORCES.

10. COARSE AGGREGATE FILTER MATERIAL (PENNDOT 2A OR EQUAL) SHALL BE PLACED ON THE LANDWARD SIDE OF THE JOINTS BETWEEN BOULDERS IN THE REVETMENT. THE GRAVEL FILTER “POCKET” SHALL BE AT LEAST 6 INCHES THICK AT THE POINT OPPOSITE THE JOINT. A CONTINUOUS GRAVEL FILTER LAYER BEHIND THE REVETMENT IS NOT REQUIRED.

11. LARGER VOIDS BETWEEN ADJACENT BOULDERS SHALL BE HAND-CHINKED FROM BEHIND WITH APPROPRIATELY-SIZED ROCK FRAGMENTS BEFORE INSTALLATION OF THE FINER GRAVEL FILTER MATERIAL AND SOIL BACKFILL.

12. THE UPSTREAM ENDS OF THE BOULDER BANK REVETMENT SHALL CURL AWAY FROM THE BANKFULL CHANNEL AND KEY AT LEAST 5 FEET INTO THE BANK HORIZONTALLY, OR SHALL BE OTHERWISE TERMINATED AS DIRECTED BY THE ENGINEER.

FLOODPLAIN GRADING

1. THE WATERSIDE EDGE OF THE RECONSTRUCTED FLOODPLAIN SHALL BE AT BANKFULL ELEVATION. THE FLOODPLAIN SURFACE LANDWARD OF THE BANKFULL CHANNEL MARGIN SHALL HAVE A MAXIMUM OF SLOPE OF NO GREATER THAN 4%.

2. CONSTRUCT THE FLOODPLAIN SURFACE ELEVATION TO WITHIN A TOLERANCE OF 0.2 FEET.

TOPSOIL

1. ANY TOPSOIL USED IN THIS PROJECT SHALL BE A HUMUS-BEARING LOAM, SILT LOAM, SANDY LOAM, OR SANDY CLAY LOAM CAPABLE OF SUSTAINING HEALTHY PLANT GROWTH. TOPSOIL SHALL NOT BE A MIXTURE OF CONTRASTING TEXTURED SUBSOILS AND SHALL BE FREE OF STONES LARGER THAN 1 INCH, CLODS THAT CANNOT BE CRUMBLED, ROOTS, TWIGS, AND OTHER FOREIGN MATERIAL SUCH AS SLAG AND CONCRETE. THE TOPSOIL SHALL HAVE A PH RANGE OF 5.5 TO 7.5 AND AN UNAMENDED ORGANIC MATTER CONTENT OF AT LEAST 2% BY UNIT DRY WEIGHT MEASUREMENT.

2. AN 'ENGINEERED SOIL', FORMULATED FOR THE SPECIFIC APPLICATION, MAY BE SUBSITUTUED FOR TOPSOIL, PER PRIOR APPROVAL BY A VEGETATION RESTORATION SPECIALIST (RESTORATION ECOLOGIST OR LANDFSCAPE ARCHITECT). AN ENGINEERED SOIL CONSISTS OF A SPECIFIC MIXTURE OF MINERAL FINES AND ORGANIC CONSTITUENTS, SUCH AS MATURE COMPOST OR BIOCHAR.

COMPOST

1. COMPOST SHALL BE “MATURE” (AGED), STABLE (FINISHED), LOW-MOISTURE (<35%) COMPOST DERIVED FROM VEGETATIVE RESIDUES. THE COMPOST SHALL BE FREE OF VISIBLE CONTAMINANTS AND SHALL BE LARGELY DECOMPOSED AND ACTIVELY UNDER GOING HUMIFICATION. SUITABLE COMPOST WILL HAVE A DARK BROWN TO BLACK COLOR AND A SOIL-LIKE OR MUSTY ODOR. THERE SHALL BE NO RECOGNIZABLE PLANT FRAGMENTS WITHIN THE MATERIAL.

WOODY MULCH

1. WOODY MULCH SHALL BE 4-INCH LONG OR LESS, COMMERCIALLY-AVAILABLE, SHREDDED BARK MULCH (PREFERRED) OR LOCALLY 'CHIPPED' WOODY DEBRIS (PREFERABLY “STRINGY”). EITHER MATERIAL SHALL HAVE A NATURAL COLOR AND SHALL BE FREE OF CONTAMINANTS AND FOREIGN MATERIALS. VERY COARSE, COMMERCIALLY-AVAILABLE “BARK CHIPS” OR PELLETIZED WOOD PIECES ARE UNACCEPTABLE.

SHRUB AND TREE PLANTINGS

NOTE: PLANTING PRESCRIPTIONS FOR THIS PROJECT HAVE BEEN PREPARED UNDER THE ASSUMPTION THAT THE ACQUISITION AND PLANTING OF ALL TREE AND SHRUBS WILL BE CONDUCTED BY COMMUNITY VOLUNTEERS.

1. PLANT ONLY SPECIES NATIVE OR FORMERLY KNOWN TO BE NATIVE TO THE SOUTHWESTERN QUADRANT OF PENNSYLVANIA (GREAT VALLEY OR PIEDMONT PA ECOREGIONS). ALL PLANTS LISTED IN THE PLANTING TABLE CONFORM TO THIS SPECIFICATION.

2. ALL NURSERY STOCK SHOULD BE GROWN OUT IN EITHER THE EASTERN BROADLEAF FOREST (OCEANIC) PROVINCE ECOREGION OR OUTER COASTAL PLAN MIXED FOREST PROVINCE (NORTH PART) ECOREGION.

3. THE SPECIES INDICATED IN THE PLANTING TABLE ARE RECOMMENDATIONS ONLY. THIS LIST IS BASED ON SKELLY AND LOY EXPERIENCE TO DATE IN TERMS OF GENERAL NURSERY STOCK AVAILABILITY AND PLANTING SUCCESS. WOODY SPECIES SUBSTITUTIONS ARE ACCEPTABLE, PENDING CONSULTATION WITH A VEGETATION RESTORATION SPECIALIST.

4. WILD BLACK CHERRY (PRUNUS SEROTINA) IS UNLIKLEY TO BE AVAILABLE FROM LOCAL NURSERIES. THIS SPECIES SHOULD BE COLLECTED AS TRANSPLANTS SALVAGED FROM ACCEPTABLE DONOR SITES (APPROVED BY THE PROPERTY OWNER).

5. SALVAGED BLACK CHERRY PLANTS SHOULD CONSIST OF SMALL SEEDLINGS WITH A COMPACT ROOT SYSTEM. TRANSPLANTS SHOULD BE LIFTED FROM THEIR ORIGINAL LOCATION AT LEAST ONE YEAR PRIOR TO OUTPLANTING AT THE RESTORATION SITE. THE PLANTS SHOULD BE REMOVED WITH AS MUCH INTACT SOIL/ROOT MASS AS POSSIBLE AND PLACED IN A CONTAINER SUBSTANTIALLY LARGER THAN THE ROOT BALL, BACKFILLING WITH GOOD SOIL. MAINTAIN THE TRANSPLANTS AS ORDINARY NURSERY STOCK BEFORE OUTPLANTING.

6. THE RECOMMENDED AVERAGE PLANT SPACING WITHIN BANK STABILIZATION AREAS IS 6 FEET ON CENTER FOR SHRUBS AND SMALL TREES AND 15 FEET ON CENTER FOR MEDIUM TO LARGE TREES. THESE DENSITIES EQUAL 4 LARGE TO MEDIUM TREES PER 1000 SF AND 28 SHRUBS OR SMALL TREES PER 1000 SF (ASSUMES A SHRUB PLANTING DENSITY UNRELATED TO TREE PLANTING).

7. IN ORDER TO CREATE MORE “NATURAL-APPEARING” PLANT GROUPINGS, THE ACTUAL FIELD PLACEMENT OF CONTAINERIZED WOODY PLANTS ON BANKS AND ELSEWHERE SHOULD BE “RANDOMIZED”, WITH A SOMEWHAT VARIABLE SPACING BETWEEN PLANTS (NOT A UNIFORM SPACING). SHRUB SPECIES WHICH NATURALLY GROW IN THICKETS (E.G. MEADOWSWEET, ARROWWODD, ETC.) MAY BE PLANTED ON 30- TO 40-INCH CENTERS IN ORDER TO CREATE MORE “NATURAL-APPEARING” PLANT GROUPINGS.

8. ALL TREES WHICH WILL BE MEDIUM TO LARGE AT MATURITY SHOULD BE PLANTED A MINIMUM OF 6 FEET LANDWARD OF THE LANDSIDE EDGE OF ANY BOULDER REVETMENT.

9. THE MINIMUM TREE AND SHRUB CONTAINER SIZE IS 1 GALLON (#1). IT IS RECOMMENDED THAT SOME PERCENTAGE (TO BE DETERMINED) OF THE TREE PLANTINGS IN THE STREAM STABILIZATION AREAS BE LARGER BALLED-AND-BURLAPPED STOCK IN ORDER TO ACHIEVE AN INSTANT VISUAL IMPACT.

10. ACCEPTABLE NURSERY STOCK FOR PLANTING SHALL BE TYPICAL OF THEIR SPECIES, WITH NORMALLY DEVELOPED BRANCHES, FOLIAGE AND ROOT SYSTEMS. PROVIDE ONLY HEALTHY, VIGOROUS PLANTS FREE FROM OBVIOUS DEFECTS SUCH SWOLLEN AREAS, DEAD STEMS OR LEAVES, SUNSCALD INJURIES, FROST CRACKS, BARK ABRASIONS, PLANT DISEASES, INSECT EGGS, BORERS, AND ALL FORMS OF INFESTATION.

11. CONTAINER-GROWN STOCK SHALL HAVE GROWN IN THE CONTAINER LONG ENOUGH FOR ROOT SYSTEMS TO HAVE DEVELOPED A FIRM HOLD ON THE SOIL. NO PLANTS SHALL BE LOOSE IN THE CONTAINER AND CONTAINER STOCK SHALL NOT BE POT BOUND. IF BALLED-AND-BURLAPPED PLANTS ARE USED, THESE SHOULD NOT HAVE A LOOSE OR DRIED-OUT ROOT BALL.

12. PRIOR TO OUTPLANTING, DELIVER, STORE AND HANDLE LIVING PLANT MATERIALS ACCORDING TO BEST PROFESSIONAL HORTICULTURAL STANDARDS. PLANTING STOCK STOCKPILED ONSITE SHOULD BE PROTECTED FROM SUN AND WIND TO THE MAXIMUM EXTENT POSSIBLE.

13. WOODY PLANTS SHOULD IDEALLY BE PLANTED DURING THE PERIODS OCTOBER 15 TO NOVEMBER 30 OR APRIL 1 TO MAY 30. FALL PLANTING IS PREFERRED FOR LOW-MAINTENANCE SITE RESTORATION. AS CONDITIONS WARRANT, THESE DATES MAY BE ALTERED WITH THE APPROVAL OF THE VEGETATION RESTORATION SPECIALIST.

14. NO PLANT SHALL BE INSTALLED IN FROZEN OR SATURATED SOILS OR DURING VERY WINDY CONDITIONS. THE SOIL IN THE CONTAINER SHOULD BE MOIST JUST PRIOR TO OUTPLANTING (SOAK THE ROOT BALL 24 HOURS IN ADVANCE OF PLANTING).

15. DECIDUOUS SHRUBS AND TREES IN LEAF OR BROADLEAF EVERGREEN SHRUBS PLANTED IN THE FALL MAY BE SPRAYED WITH AN ANTI-DESICCANT PRIOR TO PLANTING (RECOMMENDED). A SUITABLE ANTI-DESICCANT IS WILT-PRUF ®, OR APPROVED EQUAL. APPLY ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.

16. THE FOLLOWING AMENDMENTS ARE TO BE INCLUDED IN EACH PLANTING HOLE ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.

A) HEALTHY START ® 3-4-3 NATURAL GRANULAR FERTILIZER, OR APPROVED EQUAL. AT THE DIRECTION OF THE VEGETATION RESTORATION SPECIALIST, THE FERTILIZER APPLICATION CAN BE REDUCED OR OMITTED, DESPENDING ON THE OUTCOME OF A LABORATORY SOIL TEST (RECOMMENDED).

B) HORTA-SORB® WATER-ABSORBING GEL (HYDROGEL), OR APPROVED EQUAL.

C) 1/4 CUP (2 OUNCES) OF SURFACE SOIL TAKEN FROM THE NEARBY WOODLAND (TO PROVIDE A NATURAL MICROBIAL AND MYCHORRIHIZAL INOCULANT). THE SOIL USED FOR THIS PURPOSE SHALL BE SALVAGED FROM WIDELY DISPERSED LOCATIONS AND THE UPPER 8 INCHES OF MINERAL SOIL BELOW THE LITTER AND DUFF LAYER. COLLECTION OF INOCULANT SHOULD BE SUPERVISED BY A VEGETATION RESTORATION SPECIALIST.

D) MATURE COMPOST.

GENERAL CONTAINER AND B&B STOCK INSTALLATION GUIDELINES

1. SET PLANTS IN PREPARED AREAS ACCORDING TO BEST PROFESSIONAL STANDARDS AND AS GENERALLY INDICATED IN THE PLANTING DETAILS.

2. IF ALREADY PRESENT, CLEAR AWAY WOODY MULCH OR CUT AND FOLD BACK THE ECB AND EXCAVATE A PLANTING HOLE.

3. IN FLOOD-PRONE AREAS COVERED WITH ECB, DELAYING THE INSTALLATION OF WOODY PLANTINGS UNTIL THE GROUNDCOVER HAS BEGUN TO GROW INTO THE ECB MESH IS RECOMMENDED. THIS WILL HELP TO ENSURE THAT THE ECB IS WELL ANCHORED PRIOR TO ANY EARLY POST-CONSTRUCTION FLOOD FLOWS.

4. IN ALL CASES, CUT THE SMALLEST 'L' SLIT FEASIBLE INTO THE ECB SUFFICIENT TO EXCAVATE THE APPROPRIATELY-SIZED PLANTING HOLE. TEMPORARILY FOLD BACK THE ECB AND SECURE BEFORE DIGGING.

5. EXCAVATE A PLANTING HOLE WHICH IS AT LEAST THREE (3) TIMES THE DIAMETER OF THE ROOT BALL (AS MEASURED AT THE TOP OF THE HOLE). ENSURE THAT THE WALLS AND FLOOR OF THE PLANTING HOLE ARE IN A THOROUGHLY ROUGHENED (SCORED) CONDITION TO ENCOURAGE SEEDLING ROOT EXTENSION.

6. A LARGE PLANTING HOLE IS NOT REQUIRED WHERE THE SURFACE SOIL CONSISTS OF UNCOMPACTED TOPSOIL OR HAS PREVIOUSLY BEEN CULTIVATED AND LOOSENED TO A DEPTH OF AT LEAST 8 INCHES. IN THESE CASES, EXCAVATING A PLANTING HOLE THAT HAS A TOPWIDTH OF 1-1/2 TIMES THE WIDTH OF THE ROOT BALL IS ADEQUATE. ROUGHENING THE SIDES OF THE HOLE IS STILL REQUIRED.

7. CAREFULLY REMOVE THE PLANT FROM THE CONTAINER TO RFETAIN AS MUCH SOIL AS POSSIBLE. SQUEEZE OR STRONGLY TAP THE PLASTIC CONTAINER TO FACILITATE REMOVAL.

8. GENTLY LOOSEN THE ROOTS OF OTHERWISE HEALTHY CONTAINER PLANTS WITH COILED AND MATTED FINE ROOTS BEFORE PLANTING. BUTTERFLY ROOTBOUND CONTAINER STOCK AND PRUNE ANY EXTRA LONG OR KINKED ROOTS.

9. APPLY FERTILIZER AND HYDROGEL ACCORDING TO MANUFACTURER'S RECOMMENDATIONS. OMIT OR REDUCE FERTILIZER AMOUNT IF INDICATED BY SOIL TEST (AFTER CONSULTATION WITH THE VEGETATION RESTORATION SPECIALIST).

10. ADD SALVAGED NATURAL SOIL INOCULANT AROUND THE BASE OF THE ROOT BALL.

11. ALL INSTALLED CONTAINERIZED PLANTINGS SHALL HAVE THE TOP OF THE SOIL/ROOT MASS FLUSH WITH, OR SLIGHTLY HIGHER THAN, THE ADJACENT GROUND.

12. AFTER THE PLANT IS SET, BACKFILL THE PLANTING HOLE WITH A MIXTURE OF 7 PARTS LOCALLY EXCAVATED SOIL AND 3 PARTS MATURE COMPOST, THOROUGHLY MIXED TOGETHER. FIRMLY HAND COMPACT THE BACKFILL DURING INSTALLATION.

13. DISCARD EXCESS EXCAVATED SOIL BY UNIFORMLY BROADCASTING IN A SUITABLE, VEGETATION COVERED AREA.

14. THOROUGHLY WATER IN THE PLANT IN THE IMMEDIATE VICINITY OF THE ROOT BALL DURING BACKFILLING. USE AT LEAST ONE GALLON FOR 1-3 GALLON (#1 TO #3) CONTAINER PLANTINGS. USE 2 GALLONS OF WATER FOR A BALLED-AND-BURLAPPED PLANTING. IF WEATHER REMAINS DRY, WATER AGAIN AT THE SAME RATE APPROXIMATELY 24 HOURS AFTER INITIAL PLANTING.

15. OMIT A WATERING MOAT AROUND PLANTS INSTALLED IN FLOOD-PRONE AREAS TO BE COVERED WITH ECB AND/OR MULCH MAT.

16. AFTER PLANTING, RESTORE THE FOLDED BACK ECB TO COVER THE AREA AROUND THE PLANTING, TRIMMING AS NECESSARY. RE-ANCHOR THE ECB WITH A MINIMUM OF TWO ECB ANCHOR STAKES (FASTENERS), DRIVEN TO A SECURE HOLD.

POST-INSTALLATION PLANT PROTECTION AND MAINTENANCE

1. INSTALL MULCH (OVER THE TOP OF ANY ECB) AROUND ALL WOODY PLANTINGS WHERE MULCH MAT IS NOT INSTALLED (SEE BELOW). MULCHING IS REQUIRED FOR MOISTURE RETENTION AND WEED SUPPRESSION.

2. THE WOODY MULCH SHALL BE APPLIED AS A ±3-INCH DEEP LAYER AND SHOULD COVER A DIAMETER OF AT LEAST 3 FEET CENTERED OVER THE PLANT STEM. PLACE MULCH NO CLOSER THAN 2 INCHES TO THE ROOT COLLAR OF THE PLANTING STOCK.

3. INSTALL A FULLY BIODEGRADABLE MULCH MAT AROUND ALL PLANTINGS WITHIN 20 HORIZONTAL FEET OF THE STREAMBANK, OR AS OTHERWISE DIRECTED BY THE VEGETATION RESTORATION SPECIALIST. IN ECB-COVERED AREAS, INSTALL THE MULCH MAT ON TOP OF THE ECB. SYNTHETIC WEED MATS SHOULD NOT BE USED AS THEY RETARD THE DEVELOPMENT OF AN ORGANIC-RICH SURFACE SOIL LAYER.

4. A MINIMUM 3-FOOT X 3-FOOT SQUARE (OR 3-FOOT DIAMETER) MULCH MAT CAN BE FABRICATED FROM BIOD-WEEDMAT ™, (MANUFACTURED BY ROLANKA INTERNATIONAL), FROM ANY MULTI-LAYED FULLY BIODEGRADABLE ECB (E.G. NORTH AMERICAN GREEN BIONET S150BN), OR FROM A SIMILAR FULLY BIODEGRADABLE PRODUCT. INSTALL AROUND THE PLANTING AND STAKE SECURELY. FULLY BIODEGRADABLE COMMERCIAL MULCH MATS ARE AN OPTION BUT MAY NOT BE READILY AVAILABLE.

5. ANY MULCH LAYER OR MAT SHOULD BE MAINTAINED FOR AT LEAST 3 FULL GROWING SEASONS AFTER PLANTING.

6. INSTALL SOME COMBINATION OF PLANT PROTECTION DEVICES (E.G. TREE SHELTERS, PLANTING TUBES, WIRE SCREEN EXCLOSURES, TREE TAPE, CHEMICAL ANIMAL REPELLENT, ETC.) ON ALL CONTAINERIZED WOODY PLANTINGS, AS DIRECTED BY THE VEGETATION RESTORATION SPECIALIST.

7. BASED ON RECENT RESEARCH, VENTED SOLID WALL (E.G. BLUE-X ®) OR FINE MESH (E.G. FREEGRO ®) TUBES ARE RECOMMENDED FOR INDIVIDUAL SMALL TREE PLANTINGS. WIRE CAGES SHOULD BE INSTALLED AROUND ALL SHRUB PLANTING ESPECIALLY PALATABLE TO DEER OR IMMEDIATELY AFTER THE FIRST SERIOUS HERBIVORY IS NOTED.

8. PLANTING TUBES MUST BE BURIED TO PRECENT VOLE DAMAGE, PER MANUFACTURER'S SPECIFICATIONS. INSTALL ANY WEED MAT OR MULCH AFTER THE PLANTING TUBE IS INSTALLED.

9. BRACE PLANTED SMALL TREES OVER 1 INCH CALIPER AND/OR 6 FEET IN HEIGHT, OR AS DIRECTED BY THE VEGETATION RESTORTATION SPECIALIST. BRACING MATERIALS SHALL BE HARDWOOD OR SOFTWOOD STAKES AND SOFT, FLEXIBLE STRAPPING (PREFERABLY BIODEGRADABLE) WHICH WILL NOT DAMAGE THE TRUNK.

10. BRACE NO HIGHER THAN 1/3 THE HEIGHT OF THE TREE'S LEADER. ATTACH THE STRAPPING LOOSELY SO IT WILL NOT ABRADE THE TRUNK. REMOVE ALL BRACING NO LATER THAN THE THIRD FULL GROWING SEASON AFTER PLANTING.

11. AN ALTERNATE TREE BRACING METHOD IS RECOMMENDED (SEE DETAIL). USE ANY STOUT STAKE AND ATTACH THIS TO THE TREE WITH A STRIP OF SCRAP COTTON CLOTH. LOOSELY CUSHION THE TRUNK WITH SEVERAL WRAPS BEFORE TYING OFF.

LOWER RIPARIAN ZONE SHRUBS (SEE PLANTING TABLE)

1. ALL LOWER RIPARIAN SHRUBS WILL BE INSTALLED IN THE ZONE BETWEEN THE NORMAL WATER SURFACE AND ±6 INCHES ABOVE THE BANKFULL ELEVATION. ALL LOWER RIPARIAN SHRUBS OTHER THAN ALDER SHOULD BE INSTALLED AS LIVE STAKES (UNROOTED CUTTINGS) TO SAVE COST.

2. THE OVERALL SPACING OF LIVE STAKES IS 3 FEET CENTER-TO-CENTER BUT THIS CAN VARY ALONG ROCK-LINED BANKS.

LIVE STAKING

1. LIVE STAKES (DORMANT, UNROOTED CUTTINGS) SHOULD BE HARVESTED AND INSTALLED DURING THE DORMANT SEASON (BETWEEN LEAF DROP IN THE FALL AND BUD BREAK IN THE SPRING). (SEE EXCEPTION, BELOW).

2. CUTTINGS FOR LIVE STAKES SHALL BE FROM HEALTHY, PLIANT (NOT BRITTLE) YOUNG BRANCHES AND SHALL BE REASONABLY STRAIGHT. ANY SIDE BRANCHES SHALL BE NEATLY TRIMMED OFF.

3. LIVE STAKES SHALL GENERALLY BE FROM 18 INCHES TO 4 FEET IN LENGTH AND FROM 1/2 TO 1-1/2 INCH IN DIAMETER.

4. SOAK ALL FRESHLY HARVESTED (OR PREVIOUSLY REFRIGERATED) LIVE STAKES BY IMMERSING THE GROWING ENDS IN WATER FOR A MINIMUM OF 2 DAYS PRIOR TO PLANTING. THE OPTIMUM SOAKING PERIOD IS 7-10 DAYS. IF SOAKED FOR AN EXTENDED PERIOD, THE WATER SHOULD BE CHANGED EVERY OTHER DAY.

5. THE STAKE STOOL (INSERTION) ENDS SHOULD BE IMMERSED TO A DEPTH OF AT LEAST 6 INCHES DURING SOAKING. KEEP THE IMMERSED LIVE STAKES AWAY FROM WIND AND SUNLIGHT PRIOR TO INSTALLATION.

6. ANY LIVE STAKES INSTALLED WITHOUT PRE-SOAKING SHOULD BE HARVESTED NO MORE THAN 72 HOURS PRIOR TO INSTALLATION. THESE STAKES MUST BE KEPT CONTINUOUSLY MOIST AND AWAY FROM WIND AND SUNLIGHT PRIOR TO INSTALLATION.

DRAWING NO. G-002

PAXTANG PARKWAY
WATERSHED RESTORATION - PHASE 1
CITY OF HARRISBURG, PAXTANG BOROUGH, SUSQUEHANNA TOWNSHIP
DAUPHIN COUNTY, PA
NOTES

DSGN MEL
DFTSMN JRG
CHKR
APPV MEL
SCALE AS SHOWN
Plotted on: 2017-07-20

REV	DESCRIPTION	BY	APPV	DATE
1	REVISION TO GENERAL NOTE 2 PER DEP COMMENTS	JRG	MEL	7/19/17

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2017-07-21

SKELLY and LOY
449 EISENHOWER BOULEVARD
SUITE 300
HARRISBURG, PA 17111
TEL: (717)232-0593
FAX: (717)232-1799
www.skellyloy.com

PROJECT NUMBER: R13-0290.001
TASK: 01
SUBTASK: 01
DATE: OCTOBER 31, 2016

7. DO NOT INSTALL LIVE STAKES IN DRY OR FROZEN SOILS.

8. INSERT LIVE STAKES INTO THE GROUND SURFACE WITH THE GROWING (TOPGROWTH) END UP. THE STOOL END OF THE CUTTING SHOULD BE CUT AT AN ANGLE, WITH THE GROWING END CUT FLAT (TO CLEARLY DISTINGUISH ENDS).

9. LIVE STAKES MAY BE INSTALLED AT ANY ANGLE, FROM PERPENDICULAR TO HORIZONTAL. THE GROWING TIP OF THE STAKE SHOULD NOT POINT DOWNWARD AFTER INSTALLATION.

10. MAKE A PILOT HOLE FOR THE LIVE STAKE TO THE PLANNED DEPTH OF INSERTION IF THE GROUND IS FIRM. THE PILOT HOLE SHOULD BE NO DEEPER THAN THE PLANNED DEPTH OF INSERTION AND THE PILOT HOLE DIAMETER SHOULD BE SLIGHTLY SMALLER THAN THE DIAMETER OF THE CUTTING.

11. MANUALLY PUSH THE LIVE STAKE INTO THE GROUND TO FINAL DEPTH. A WOODEN MALLET OR WOOD TAMPING SURFACE CAN BE USED IF THE STAKE MUST BE DRIVEN IN FURTHER AGAINST RESISTANCE. TAMP THE END OF THE STAKE ONLY WITH SUFFICIENT FORCE TO INSERT IT.

12. LIVE STAKES SHALL BE INSTALLED SO THAT 3/4 TO 4/5 OF THE TOTAL LENGTH OF THE STAKE IS BELOW GROUND. ENSURE THAT THERE ARE AT LEAST 2 BUD SCALES ABOVE GROUND.

13. FOOT TAMP THE SOIL AROUND THE STAKE AFTER INSERTION TO ENSURE GOOD SOIL-TO-STAKE CONTACT AND TO REMOVE VOIDS AROUND THE PLANTED STEM. IMMEDIATELY WATER THE STAKE IN IF FEASIBLE.

14. STAKES INSERTED TO REFUSAL (WITH AT LEAST 1/2 OF THE STAKE LENGTH ALREADY BURIED) MAY BE TRIMMED OFF SO THAT NO MORE THAN 8 INCHES OF THE STAKE IS ABOVE GROUND. ENSURE THAT THERE ARE AT LEAST 2 BUD SCALES REMAINING ABOVE GROUND. OTHERWISE, REMOVE AND REPLACE.

15. REMOVE AND REPLACE ANY LIVE STAKES THAT CANNOT BE INSERTED TO SUFFICIENT DEPTH OR THAT HAVE BECOME SPLIT OR OTHERWISE BADLY DAMAGED DURING INSTALLATION. MAKE A CLEAN CUT ON STAKES WHERE THE END OF THE STAKE HAS BEEN DAMAGED BY POUNDING.

16. LIVE STAKES SHOULD BE INSTALLED THROUGH THE MESH OF THE ECB SO AS TO NOT COMPROMISE THE INTEGRITY OF THE BLANKET. WITH LARGE DIAMETER STAKES, SPREAD THE MESH OPENING APART, TAKING CARE NOT TO CUT ANY OF THE STRANDS.

17. IIVE STAKES SUBJECTED TO A 7-10 DAY SOAKING PERIOD WILL TYPICALLY DEVELOP LARGE ROOT NODULES ALONG THE STEM. INSTALL THESE STAKES INTO OVER-LARGE HOLES TO AVOID REMOVING THE NODULES DURING INSERTION. IN THIS CASE, BACKFILL AROUND THE STAKE WITH A MIXED SOIL-WATER SLURRY TO ENSURTE THAT NO AIR POCKETS ARE LEFT AROUND THE STAKE.

POST-PLANTING MAINTENANCE

1. TO ENSURE SUCCESSFUL ESTABLISHMENT, NURSERY STOCK WOODY PLANTINGS WILL REQUIRE REGULAR IRRIGATION, ESPECIALLY DURING THE FIRST GROWING SEASON AFTER OUTPLANTING. MONITOR NEW PLANTINGS FOR SIGNS OF MOISTURE STRESS (CONSULT A VEGETATION RESTORATION SPECIALIST). SUPPLEMENTAL IRRIGATION WILL BE REQUIRED FOR NEW PLANTINGS DURING PROLONGED PERIODS OF DRY AND/OR VERY HOT WEATHER.

2. LIVE STAKES SHOULD BE REGULARLY IRRIGATED DURING AT LEAST THE FIRST 6 WEEKS OF THE FIRST GROWING SEASON AFTER INSTALLATION IF RAINFALL INSUFFICIENT. SUPPLEMENTAL IRRIGATION WILL BE REQUIRED FOR NEW LIVE STAKE PLANTINGS DURING PROLONGED PERIODS OF DRY AND/OR VERY HOT WEATHER.

3. WEED-FREE MULCH OR INTACT WEED MATS SHOULD BE MAINTAINED FOR AT LEAST 3 YEARS AFTER INITIAL PLANTING.

4. PLANTING SURVIVAL (SPECIES AND PERCENT SURVIVING) SHOULD BE SYSTEMATICALLY ASSESSED DURING THE SECOND GROWING SEASON AFTER SITE PLANTING. THE TYPE, DURATION AND EXTENT OF POST-PLANTING HERBIVORY PROTECTION SHOULD BE ASSESSESED BY A VEGETATION RESTORATION SPECIALIST DURING THIS SAME PERIOD.

MAINTENANCE SCHEDULE

1. ALL EROSION CONTROL BMPS SHALL BE INSPECTED AND MAINTAINED AT LEAST WEEKLY, BEFORE ANY ANTICIPATED PRECIPITATION, AND AFTER ALL PRECIPITATION EVENTS.

2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONDUCTING THE REGULAR INSPECTIONS OF THE BMPS AND FOR PERFORMING ANY REQUIRED MAINTENANCE.

3. THE FOLLOWING MAINTENANCE INSTRUCTIONS, CLEANOUT LEVELS, AND REPAIR TIME FRAMES SHALL BE STRICTLY ADHERED TO.

BMP: STANDARD SILT FENCE (18" HIGH)
MAINTENANCE: INSPECT WEEKLY AND AFTER EACH RUNOFF EVENT. INITIATE NEEDED REPAIRS IMMEDIATELY AFTER INSPECTION. ANY SECTION UNDERMINED OR OVERTOPPED SHALL BE REPLACED WITH A ROCK FILTER OUTLET.
CLEANOUT LEVEL: 1/2 THE ABOVE GROUND HEIGHT OF THE FENCE.
REPAIR TIME FRAME: ACCUMULATED SEDIMENT SHALL BE REMOVED WITHIN 24 HOURS. ROCK FILTER OUTLET REPLACEMENTS SHALL BE ACCOMPLISHED IMMEDIATELY.

BMP: ROCK FILTER OUTLET
MAINTENANCE: INSPECT WEEKLY AND AFTER EACH RUNOFF EVENT. INITIATE NEEDED REPAIRS IMMEDIATELY AFTER INSPECTION.
CLEANOUT LEVEL: 1/3 THE HEIGHT OF THE OUTLET.
REPAIR TIME FRAME: ACCUMULATED SEDIMENT SHALL BE REMOVED WITHIN 24 HOURS.

BMP: ROCK CONSTRUCTION ENTRANCE/EXIT
MAINTENANCE: THICKNESS SHALL BE CONSTANTLY MAINTAINED TO THE SPECIFIED DIMENSIONS BY ADDING ROCK. A STOCKPILE SHALL BE MAINTAINED ON SITE FOR THIS PURPOSE. REMOVAL AND REPLACEMENT MAY BE REQUIRED IF ROCK IS TOO CLOGGED.
CLEANOUT LEVEL: SEDIMENT IS TRACKED ONTO THE ROADWAY.
REPAIR TIME FRAME: SEDIMENT TRACKED ONTO ROADWAYS SHALL BE REMOVED AND RETURNED TO THE CONSTRUCTION SITE IMMEDIATELY.

BMP: PUMPED WATER FILTER BAG
MAINTENANCE: INSPECT DAILY. SPARE BAGS SHALL BE KEPT AVAILABLE FOR REPLACEMENT OF THOSE THAT HAVE FAILED OR ARE FILLED. KEEP PUMP INTAKE SCREENS FLOATING AND FREE OF DEBRIS.
CLEANOUT LEVEL: REPLACE SEDIMENT FILTER BAG WHEN 1/2 FULL.
REPAIR TIME FRAME: IF PROBLEMS ARE DETECTED, CEASE PUMPING IMMEDIATELY AND DO NOT RESUME PUMPING UNTIL THE PROBLEMS ARE CORRECTED.

BMP: COMPOST FILTER SOCK
MAINTENANCE: TRAFFIC SHALL NOT BE PERMITTED TO CROSS FILTER SOCKS. INSPECT WEEKLY AND AFTER EACH RUNOFF EVENT. INITIATE NEEDED REPAIRS IMMEDIATELY AFTER INSPECTION.
CLEANOUT LEVEL: 1/2 THE ABOVE-GROUND HEIGHT OF THE SOCK
REPAIR TIME: DAMAGED SOCKS SHALL BE REPAIRED ACCORDING TO MANUFACTURER'S SPECIFICATIONS OR REPLACED WITHIN 24 HOURS OF INSPECTION. BIODEGRADABLE FILTER SOCKS SHALL BE REPLACED AFTER 6 MONTHS; PHOTODEGRADABLE SOCKS AFTER 1 YEAR. POLYPROPYLENE SOCKS SHALL BE REPLACED ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.

BMP: PUMP BYPASS
MAINTENANCE: ROUTINELY INSPECT BYPASS PUMP AND TEMPORARY PIPING TO ENSURE PROPOER OPERATION. INSPECT IMPERVIOUS DIKES FOR LEAKS AND REPAIR ANY DAMAGE. INSPECT DISCHARGE POINT FOR EROSION. ENSURE FLOW IS ADEQUATELY DIVERTED THROUGH PIPE.
CLEANOUT LEVEL: CLOGGED/CLOGGING UPTAKE. ADEQUATE FLOW IN DIVERSION PIPE IS REDUCED.
REPAIR TIME FRAME: CEASE BYPASS PUMPING OPERATIONS WITHIN 1 HOUR AND REMOVE ACCUMULATED SEDIMENT BY END OF EACH WORK DAY. PUMP BYPASS SHALL NOT BE REINSTALLED UNTIL ACCUMULATED SEDIMENT HAS BEEN REMOVED.

BMP: TEMPORARY COFFERDAM
MAINTENANCE: INSPECT ONCE PER HOUR DURING BYPASS PUMPING OPERATIONS. ADD ADDITIONAL LAYERS OF SANDBAGS AS REQUIRED TO MAINTAIN POOLING LEVELS BELOW THE BOTTOM OF THE TOP LAYER OF SANDBAGS. ADJUST AND REPLACE SANDBAGS AS INSPECTION REQUIRES. SEAL SURFACE OF COFFERDAM WITH PLASTIC SHEETING IF LEAKS ARE NOTED.
CLEANOUT LEVEL: ½ THE HEIGHT OF THE COFFERDAM.
REPAIR TIME FRAME: CEASE BYPASS PUMPING OPERATIONS WITHIN 1 HOUR AND REMOVE ACCUMULATED SEDIMENT BY END OF EACH WORK DAY. PUMP BYPASS SHALL NOT BE REINSTALLED UNTIL ACCUMULATED SEDIMENT HAS BEEN REMOVED.

4. ALL SEDIMENT REMOVED FROM EROSION CONTROL BMPS SHALL BE USED AS FILL MATERIAL WITHIN THE PROJECT LIMITS.

5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING WEEKLY INSPECTIONS OF THE SITE BMPS AND INSPECTIONS AFTER EVERY STORMWATER EVENT. EACH INSPECTION MUST BE DOCUMENTED AND ALL REPAIR AND MAINTENANCE WORK MUST ALSO BE DOCUMENTED.

GENERAL PROJECT STARTUP SEQUENCE

1. AT LEAST 7 DAYS PRIOR TO STARTING ANY EARTH DISTURBANCE ACTIVITIES (INCLUDING CLEARING AND GRUBBING), THE OWNER AND/OR OPERATOR SHALL INVITE ALL CONTRACTORS, THE LANDOWNER, APPROPRIATE MUNICIPAL OFFICIALS, THE E&S PLAN PREPARER, THE PCSM PLAN PREPARER, AND A REPRESENTATIVE FROM THE DAUPHIN COUNTY CONSERVATION DISTRICT AND/OR PA DEP TO AN ON-SITE PRECONSTRUCTION MEETING.

2. UPON INSTALLATION OR STABILIZATION OF ALL PERIMETER SEDIMENT CONTROL BMPS AND AT LEAST 3 DAYS PRIOR TO PROCEEDING WITH THE BULK EARTH DISTURBANCE ACTIVITIES, THE PERMITTEE OR CO-PERMITTEE SHALL PROVIDE NOTIFICATION TO THE DAUPHIN COUNTY CONSERVATION DISTRICT AND/OR PA DEP.

3. AT LEAST 3 DAYS PRIOR TO STARTING ANY EARTH DISTURBANCE ACTIVITIES, OR EXPANDING INTO AN AREA PREVIOUSLY UNMARKED, THE PENNSYLVANIA ONE CALL SYSTEM INC. SHALL BE NOTIFIED AT 1-800-242-1776 FOR THE LOCATION OF EXISTING UNDERGROUND UTILITIES.

4. ALL EARTH DISTURBANCE ACTIVITIES SHALL PROCEED IN ACCORDANCE WITH THE SEQUENCE PROVIDED ON THE PLAN DRAWINGS. DEVIATION FROM THAT SEQUENCE MUST BE APPROVED BY THE DAUPHIN COUNTY CONSERVATION DISTRICT OR BY PA DEP PRIOR TO IMPLEMENTATION. EACH STEP OF THE SEQUENCE SHALL BE COMPLETED BEFORE PROCEEDING TO THE NEXT STEP, EXCEPT WHERE NOTED.

UNIVERSAL INSTRUCTIONS

1. THE CONSTRUCTION ACCESS ROUTE SHALL BE THE EXISTING PARKWAY BOULEVARD PAVED TRAIL WITH ENTRY AND EXIT NORTH OF THE PROPOSED CONSTRUCTION OFF MARKET STREET. (CONTRACTOR SHALL COORDINATE SECURITY PROTOCOLS (GATE LOCKING AND UNLOCKING) WITH MR. SCOTT SHEPLER OF CAPITAL AREA GREENBELT ASSOCIATION (CAGA), TELEPHONE NUMBER: 717-236-0261.)

A. THE TRAIL SHALL REMAIN OPERATIONAL DURING CONSTRUCTION. CONSTRUCTION FENCING AND SIGNAGE SHALL BE USED TO SAFELY DIRECT TRAIL USERS AROUND CONSTRUCTION ACTIVITY AND PREVENT UNAUTHORIZED CONSTRUCTION SITE ENTRY.

B. IN THE EVENT TEMPORARY TRAIL CLOSURES ARE REQUIRED, CLOSURE PROCEDURES SHALL BE COORDINATED THOUGH DAUPHIN COUNTY PARKS AND RECREATION DEPARTMENT AND CAGA.

2. ACTIVE PROJECT SITE SHALL BE SECURED DAILY AND ANY TRACKED MUD SHALL BE REMOVED FROM THE TRAIL SURFACE BY THE CLOSE OF EACH WORKDAY.

CONSTRUCTION SEQUENCE - SITE 1 AND 4

1. PRIOR TO INITIATING EARTH DISTURBANCE, INSTALL TEMPORARY PROTECTIVE FENCING AND OTHER PERIMETER EROSION CONTROL BMPs WHERE SHOWN ON THE PLANS. ADJUSTMENTS TO THE LOCATION OF THE TEMPORARY PROTECTIVE FENCING WILL BE DETERMINED IN THE FIELD BY THE ENGINEER.

2. REMOVE AND DISPOSE OF WOODY DEBRIS, ALONG ACCESS #1 FROM PARKWAY TRAIL TO SITE #4 (STA 0+00.0), ACCORDING TO APPLICABLE LOCAL, STATE, AND FEDERAL REGULATIONS.

3. INSTALL SILT FENCE AROUND DESIGNATED TEMPORARY STOCKPILE LOCATION(S). PLACE EXCAVATED AND STORED MATERIALS IN STOCKPILE LOCATIONS. IMMEDIATELY STABILIZE TOPSOIL STOCKPILES.

4. REMOVE AND REPLACE (OR RESET) CULVERT HEADWALL IN SITE 4.

5. COMMENCE THE SCOUR POOL ROCK RAMP, AND SCOUR POOL, CONVEYANCE CHANNEL ROCK RAMP CONSTRUCTION WORK. STARTING AT THE SCOUR POOL OUTFALL KLINE PLAZA CULVERT INVERT (STA 0+71.012.2) AND WORKING UPSTREAM DOWNSTREAM TOWARD THE KLINE PLAZA CULVERT INVERT SCOUR POOL OUTFALL (STA 0+12.268.0). CONTINUE CONSTRUCTION OF CONVEYANCE CHANNEL WORKING DOWNSTREAM TOWARD CONFLUENCE WITH SITE1 CHANNEL GRADING WORK (STA 1+00.0). PLACE EXCESS EXCAVATION MATERIAL IN THE TEMPORARY STOCKPILE LOCATION DEPICTED ON THE PLAN.

6. AT THE END OF EACH WORKDAY, APPLY TEMPORARY OR PERMANENT SEEDING (AS APPROPRIATE) AND MULCH TO AREAS DISTURBED DURING THE WORK DAY.

7. FINE GRADE ANY REMAINING DISTURBED AREA, SEED AND MULCH.

8. INSTALL EROSION CONTROL BLANKET (WOVEN COIR MATTING) WHERE SHOWN.

9. INSTALL TEMPORARY COFFERDAM AND PUMP BY-PASS #1 WITHIN PARKWAY CREEK. THE LENGTH OF THE BY-PASSED STREAM SHALL BE LIMITED TO LENGTH OF THE STREAM WORK THAT CAN BE INSTALLED IN 10 CONSECUTIVE WORKING DAYS.

10. COMMENCE THE BANK STABILIZATION/CHANNEL CONSTRUCTION WORK AT SITE 1 DURING LOW FLOW CONDITIONS, STARTING AT THE DOWNSTREAM END OF SITE 1 (STA 5+65.7) AND WORKING UPSTREAM TOWARDS THE SITE 1 STARTING POINT (STA 0+64.2). PLACE EXCESS EXCAVATION MATERIAL IN THE TEMPORARY STOCKPILE LOCATION AS DEPICTED ON THE PLAN. DO NOT COMPLETELY BLOCK THE MAIN CHANNEL OF PARKWAY CREEK.

11. AT THE END OF EACH WORK DAY, APPLY TEMPORARY OR PERMANENT SEEDING (AS APPROPRIATE) AND MULCH TO AREAS DISTURBED DURING THE WORK DAY.

12. CONSTRUCT THE STREAM CHANNEL AND FLOOD-PRONE AREAS FROM STA 5+65.7 TO STA 3+14.0 IN ACCORDANCE WITH THE DESIGN DRAWINGS. BACKFILL AND STABILIZE ALL DISTURBED AREAS AS REQUIRED.

13. WHEN SITE 1 STREAM CHANNEL AND FLOOD-PRONE AREA CONSTRUCTION REACHES CONFLUENCE WITH SITE 4 CONVEYANCE CHANNEL (STA 5+18.0), BLEND CONVEYANCE CHANNEL INVERT WITH FLOOD-PRONE AREA FOR NATURAL FLOW TO RECONSTRUCTED CHANNEL.

14. REMOVE AND DISPOSE OF EXISTING 46" RCP CULVERT, ACCORDING TO APPLICABLE LOCAL, STATE, AND FEDERAL REGULATIONS, WHEN EQUIPMENT ACCESS TO SITE 4 IS NO LONGER NECESSARY. ENGINEER WILL VERIFY THAT WORK IS SATISFACTORILY COMPLETE ON SITE 4 BEFORE PROCCEDING WITH REMOVAL OF CULVERT.

15. EXCAVATE AND CONSTRUCT CROSS ROCK VANE(S) AT
STA 4+54.07
STA 3+82.77
STA 3+27.40
STA 2+55.79
STA 1+92.01
STA 1+21.01

16. INSPECT THE INSTALLED STREAM STRUCTURES TO VERIFY THAT THEY ARE FUNCTIONING AS NOTED IN THE STRUCTURE NOTES. TAKE IMMEDIATE ACTION TO CORRECT ANY DEFICIENCIES IN THE PERFROMANCE OF EACH STRUCTURE, AND ADJUST ALL STREAM STRUCTURES AS DIRECTED BY THE ENGINEER.

17. RESTORE CONSTRUCTION VEHICLE PATHS AND DISTURBED AREAS. PERMANENTLY SEED AND MULCH THE ACCESS. PROVIDE EROSION CONTROL BLANKET PROTECTION AS NEEDED TO PROTECT GERMINATING SEED.

18. UPON COMPLETION OF ALL EARTH DISTURBANCE ACTIVITIES AT SITES 1 AND 4 AND PERMANENT STABILIZATION OF ALL DISTURBED AREAS, THE CONTRACTOR SHALL CONTACT THE DAUPHIN COUNTY CONSERVATION DISTRICT FOR A FINAL INSPECTION PRIOR TO THE REMOVAL OF THE TEMPORARY BMPS.

SITE 2 CONSTRUCTION SEQUENCE

1. PRIOR TO INITIATING EARTH DISTURBANCE IN SITE 2, INSTALL TEMPORARY PROTECTIVE FENCING AND OTHER PERIMETER EROSION CONTROL BMPs WHERE SHOWN ON THE PLANS. ADJUSTMENTS TO THE LOCATION OF THE TEMPORARY PROTECTIVE FENCING WILL BE DETERMINED IN THE FIELD BY THE ENGINEER.

2. CHOOSE STOCKPILE LOCATIONS AND INSTALL SILT BARRIER FENCE. PLACE THE EXCAVATED AND STORED MATERIALS IN STOCKPILE LOCATIONS. IMMEDIATELY STABILIZE TOPSOIL STOCKPILE.

3. COMMENCE THE BANK STABILIZATION/CHANNEL CONSTRUCTION WORK AT SITE 2 DURING LOW FLOW CONDITIONS, STARTING AT THE DOWNSTREAM END OF SITE 2 (STA 2+45.3) AND WORKING UPSTREAM TOWARDS THE SITE 2 STARTING POINT (STA 0+88.1). PLACE EXCESS EXCAVATION MATERIAL IN THE TEMPORARY STOCKPILE LOCATION AS DEPICTED ON THE PLAN.

4. AT THE END OF EACH WORK DAY, APPLY TEMPORARY OR PERMANENT SEEDING (AS APPROPRIATE) AND MULCH TO AREAS DISTURBED DURING THE WORK DAY.

5. INSTALL TEMPORARY COFFERDAM AND PUMP BY-PASS #3 WITHIN PARKWAY CREEK. THE LENGTH OF THE BY-PASSED STREAM SHALL BE LIMITED TO LENGTH OF THE STREAM WORK THAT CAN BE INSTALLED IN 10 CONSECUTIVE WORKING DAYS.

6. CONSTRUCT THE STREAM CHANNEL AND FLOOD-PRONE AREAS FROM STA 2+45.3 TO STA 0+88.1 IN ACCORDANCE WITH THE DESIGN DRAWINGS. BACKFILL AND STABILIZE ALL DISTURBED AREAS AS REQUIRED.

7. CONSTRUCT BOULDER BANK REVETMENTS AS STREAM CHANNEL AND FLOOD-PRONE AREAS REACH TOE STATIONS OF BOULDER BANK REVETMENT IN ACCORDANCE WITH THE DESIGN DRAWINGS.
RIGHT BANK
FROM 2+15.69 TO 1+18.39

8. INSPECT THE INSTALLED STREAM STRUCTURES TO VERIFY THAT THEY ARE FUNCTIONING AS NOTED IN THE STRUCTURE NOTES. TAKE IMMEDIATE ACTION TO CORRECT ANY DEFICIENCIES IN THE PERFROMANCE OF EACH STRUCTURE, AND ADJUST ALL STREAM STRUCTURES AS DIRECTED BY THE ENGINEER.

9. RESTORE CONSTRUCTION VEHICLE PATHS AND DISTURBED AREAS. PERMANENTLY SEED AND MULCH THE ACCESS. PROVIDE EROSION CONTROL BLANKET PROTECTION AS NEEDED TO PROTECT GERMINATING SEED.

10. UPON COMPLETION OF ALL EARTH DISTURBANCE ACTIVITIES AT SITE 2 AND PERMANENT STABILIZATION OF ALL DISTURBED AREAS, THE CONTRACTOR SHALL CONTACT THE DAUPHIN COUNTY CONSERVATION DISTRICT FOR A FINAL INSPECTION PRIOR TO THE REMOVAL OF THE TEMPORARY BMPS.

SITE 3 CONSTRUCTION SEQUENCE

1. PRIOR TO INITIATING EARTH DISTURBANCE IN SITE 3, INSTALL TEMPORARY PROTECTIVE FENCING AND OTHER PERIMETER EROSION CONTROL BMPs WHERE SHOWN ON THE PLANS. ADJUSTMENTS TO THE LOCATION OF THE TEMPORARY PROTECTIVE FENCING WILL BE DETERMINED IN THE FIELD BY THE ENGINEER.

2. CHOOSE STOCKPILE LOCATIONS AND INSTALL SILT BARRIER FENCE. PLACE THE EXCAVATED AND STORED MATERIALS IN STOCKPILE LOCATIONS. IMMEDIATELY STABILIZE TOPSOIL STOCKPILE.

3. COMMENCE THE BANK STABILIZATION/CHANNEL CONSTRUCTION WORK AT SITE 3 DURING LOW FLOW CONDITIONS, STARTING AT THE DOWNSTREAM END OF SITE 3 (STA 2+24.8) AND WORKING UPSTREAM TOWARDS THE SITE 3 ENDING POINT (STA 0+71.1). PLACE EXCESS EXCAVATION MATERIAL IN THE TEMPORARY STOCKPILE LOCATION A DEPICTED ON THE PLAN.

4. AT THE END OF EACH WORK DAY, APPLY TEMPORARY OR PERMANENT SEEDING (AS APPROPRIATE) AND MULCH TO AREAS DISTURBED DURING THE WORK DAY.

5. INSTALL TEMPORARY COFFERDAM AND PUMP BY-PASS #4 WITHIN PARKWAY CREEK. THE LENGTH OF THE BY-PASSED STREAM SHALL BE LIMITED TO LENGTH OF THE STREAM WORK THAT CAN BE INSTALLED IN 10 CONSECUTIVE WORKING DAYS.

6. CONSTRUCT THE STREAM CHANNEL AND FLOOD-PRONE AREAS FROM STA 2+24.8 TO STA 0+71.1 IN ACCORDANCE WITH THE DESIGN DRAWINGS. BACKFILL AND STABILIZE ALL DISTURBED AREAS AS REQUIRED.

7. CONSTRUCT BOULDER BANK REVETMENTS AS STREAM CHANNEL AND FLOOD-PRONE AREAS REACH TOE STATIONS OF BOULDER BANK REVETMENT IN ACCORDANCE WITH THE DESIGN DRAWINGS.
RIGHT BANK
FROM 2+09.50 TO 1+24.13

8. INSPECT THE INSTALLED STREAM STRUCTURES TO VERIFY THAT THEY ARE FUNCTIONING AS NOTED IN THE STRUCTURE NOTES. TAKE IMMEDIATE ACTION TO CORRECT ANY DEFICIENCIES IN THE PERFROMANCE OF EACH STRUCTURE, AND ADJUST ALL STREAM STRUCTURES AS DIRECTED BY THE ENGINEER.

9. RESTORE CONSTRUCTION VEHICLE PATHS AND DISTURBED AREAS. PERMANENTLY SEED AND MULCH THE ACCESS. PROVIDE EROSION CONTROL BLANKET PROTECTION AS NEEDED TO PROTECT GERMINATING SEED.

10. UPON COMPLETION OF ALL EARTH DISTURBANCE ACTIVITIES AT SITE 3 AND PERMANENT STABILIZATION OF ALL DISTURBED AREAS, THE CONTRACTOR SHALL CONTACT THE DAUPHIN COUNTY CONSERVATION DISTRICT FOR A FINAL INSPECTION PRIOR TO THE REMOVAL OF THE TEMPORARY BMPS.

PROJECT CLOSEOUT SEQUENCE

1. UPON PROJECT COMPLETION, HAUL ANY LEFTOVER MATERIAL OFF THE SITE TO AN APPROVED LOCATION. SEED AND MULCH STOCKPILE AREAS AND ANY REMAINING DISTURBED AREAS.

2. REMOVE TEMPORARY ACCESS ROUTES AND PARKING/STAGING AREAS. BACKFILL AND STABILIZE AREAS AS REQUIRED.

3. REMOVE STABILIZED ROCK CONSTRUCTION ENTRANCES. BACKFILL AND STABILIZE ALL DISTURBED AREAS AS REQUIRED.

4. REVEGETATE ALL DISTURBED AREAS IN ACCORDANCE WITH THE SPECIFICATIONS FOR PERMANENT EROSION AND SEDIMENT CONTROL MEASURES.

5. UPON REACHING SITE STABILIZATION, REMOVE ANY REMAINING TEMPORARY EROSION AND SEDIMENT CONTROL BMPS.

EXISTING FEATURES LEGEND

420 / 418 — PAMAP LIDAR CONTOURS
PARCEL BOUNDARY
STREAM CENTERLINE
MUNICIPAL BOUNDARY
OH — OVERHEAD ELECTRIC LINES
SANITARY SEWER
FEMA F.I.R.M. FLOODWAY OR ASSUMED FLOODWAY
AE — FEMA F.I.R.M. ZONE AE
X — FEMA F.I.R.M. FLOODWAY ZONE X
PIPE OUTFALL
MANHOLE LID
INLET
CHANNEL
WETLAND

PROPOSED FEATURES LEGEND

CONSTRUCTION BASELINE
GRADING DAYLIGHT LINE
GRADE INFLECTION LINE
BANKFULL CHANNEL
THALWEG
BOULDER BANK REVETMENT
CROSS ROCK VANE

PROJECT NUMBER: R13-0290.001
TASK: 01 SUBTASK: 01
DATE: OCTOBER 31, 2016

SKELLY AND LOY
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COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
MICHAEL EUGENE LOWER
ENGINEER
PE071798

REV	DESCRIPTION	BY	APPV	DATE

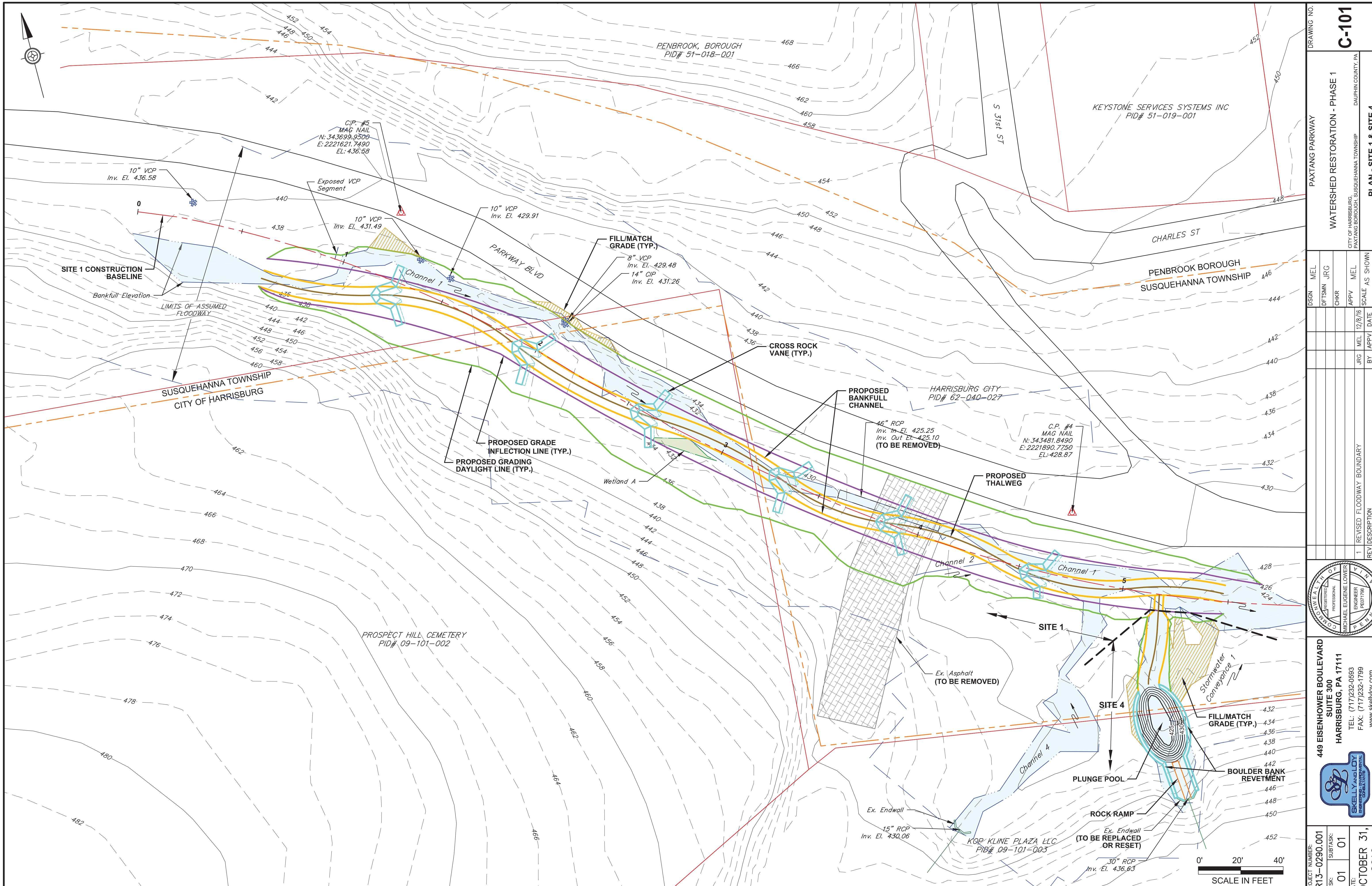
q: \r13-0290.001 paxtang parkway\sheets\pax_parkway.dwg

DSGN MEL
DFTSMN JRG
CHKR
APPV MEL
SCALE AS SHOWN
Plotted on: 2016-12-09

PAXTANG PARKWAY
WATERSHED RESTORATION - PHASE 1
CITY OF HARRISBURG,
PAXTANG BOROUGH, SUSQUEHANNA TOWNSHIP
DAUPHIN COUNTY, PA

NOTES

DRAWING NO.
G-003


PENBROOK, BOROUGH
PID# 51-018-001
KEYSTONE SERVICES SYSTEMS INC
PID# 51-019-001
S 31st ST
CHARLES ST
PENBROOK BOROUGH
SUSQUEHANNA TOWNSHIP
PARKWAY BLVD
C.P. #5
MAG NAIL
N: 343699.9500
E: 2221621.7490
EL: 436.58
10" VCP
Inv. El. 436.58
Exposed VCP
Segment
10" VCP
Inv. El. 431.49
10" VCP
Inv. El. 429.91
FILL/MATCH
GRADE (TYP.)
8" VCP
Inv. El. 429.48
14" CIP
Inv. El. 431.26
SITE 1 CONSTRUCTION
BASELINE
Bankfull Elevation
LIMITS OF ASSUMED
FLOODWAY
Channel 1
CROSS ROCK
VANE (TYP.)
SUSQUEHANNA TOWNSHIP
CITY OF HARRISBURG
PROPOSED GRADE
INFLECTION LINE (TYP.)
PROPOSED GRADING
DAYLIGHT LINE (TYP.)
Wetland A
PROPOSED
BANKFULL
CHANNEL
HARRISBURG CITY
PID# 62-040-027
46" RCP
Inv. In El. 425.25
Inv. Out El. 425.10
(TO BE REMOVED)
C.P. #4
MAG NAIL
N: 343481.8490
E: 2221890.7750
EL: 428.87
PROPOSED
THALWEG
Channel 2
Channel 1
SITE 1
PROSPECT HILL CEMETERY
PID# 09-101-002
Ex. Asphalt
(TO BE REMOVED)
SITE 4
Stormwater
Conveyance 1
FILL/MATCH
GRADE (TYP.)
Channel 4
PLUNGE POOL
BOULDER BANK
REVETMENT
ROCK RAMP
Ex. Endwall
(TO BE REPLACED
OR RESET)
Ex. Endwall
15" RCP
Inv. El. 430.06
KGP KLINE PLAZA LLC
PID# 09-101-003
30" RCP
Inv. El. 436.63
0' 20' 40'
SCALE IN FEET
DRAWING NO.
C-101
PAXTANG PARKWAY
WATERSHED RESTORATION - PHASE 1
CITY OF HARRISBURG,
PAXTANG BOROUGH, SUSQUEHANNA TOWNSHIP
DAUPHIN COUNTY, PA
PLAN - SITE 1 & SITE 4
DSGN MEL
DFTSMN JRG
CHKR
APPV MEL
SCALE AS SHOWN
Plotted on: 2016-12-09
1 REVISED FLOODWAY BOUNDARY JRG MEL 12/8/16
REV DESCRIPTION BY APPV DATE
q:\r13-0290.001 paxtang parkway\sheets\pax_parkway.dwg
COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL ENGINEER
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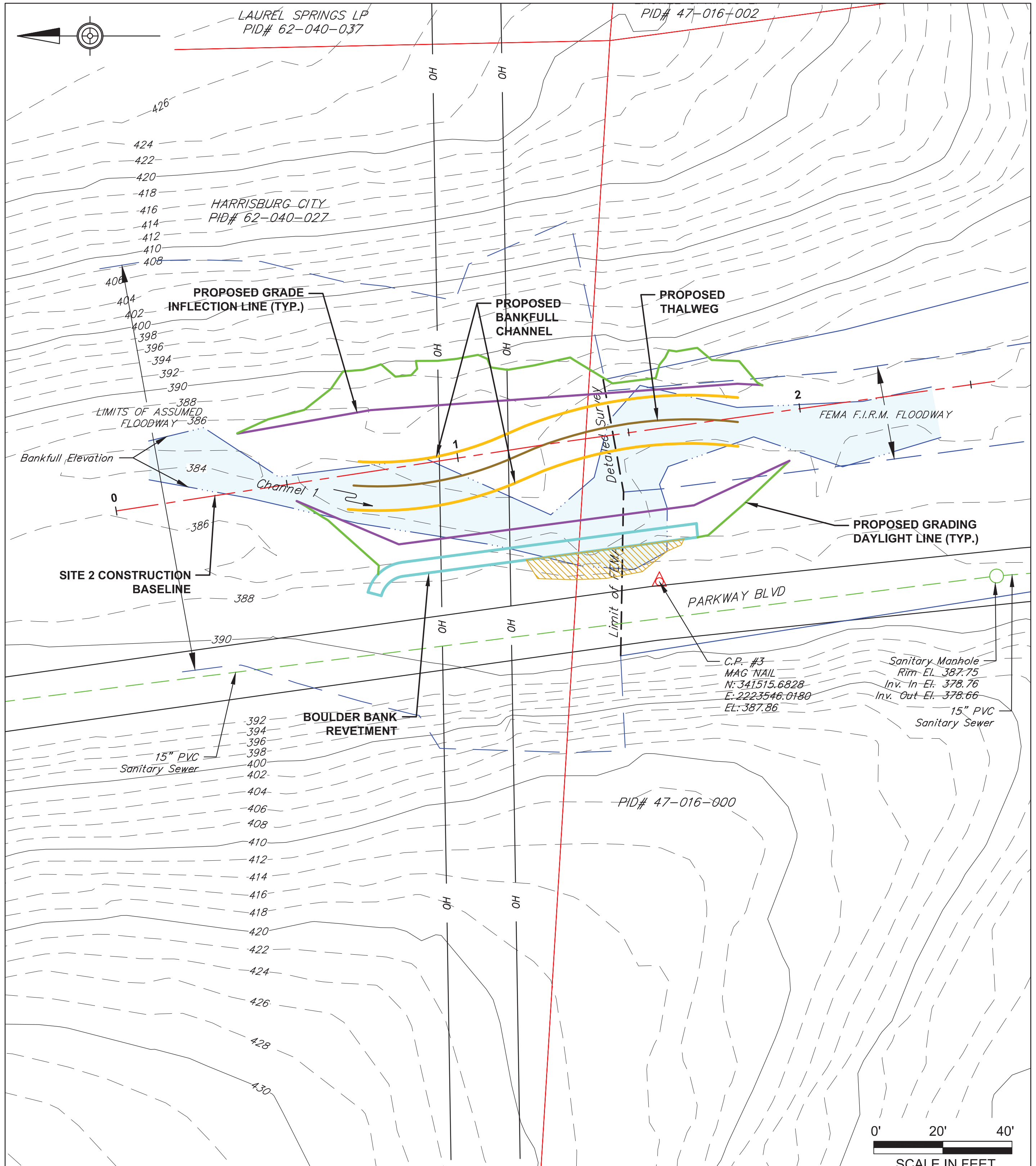
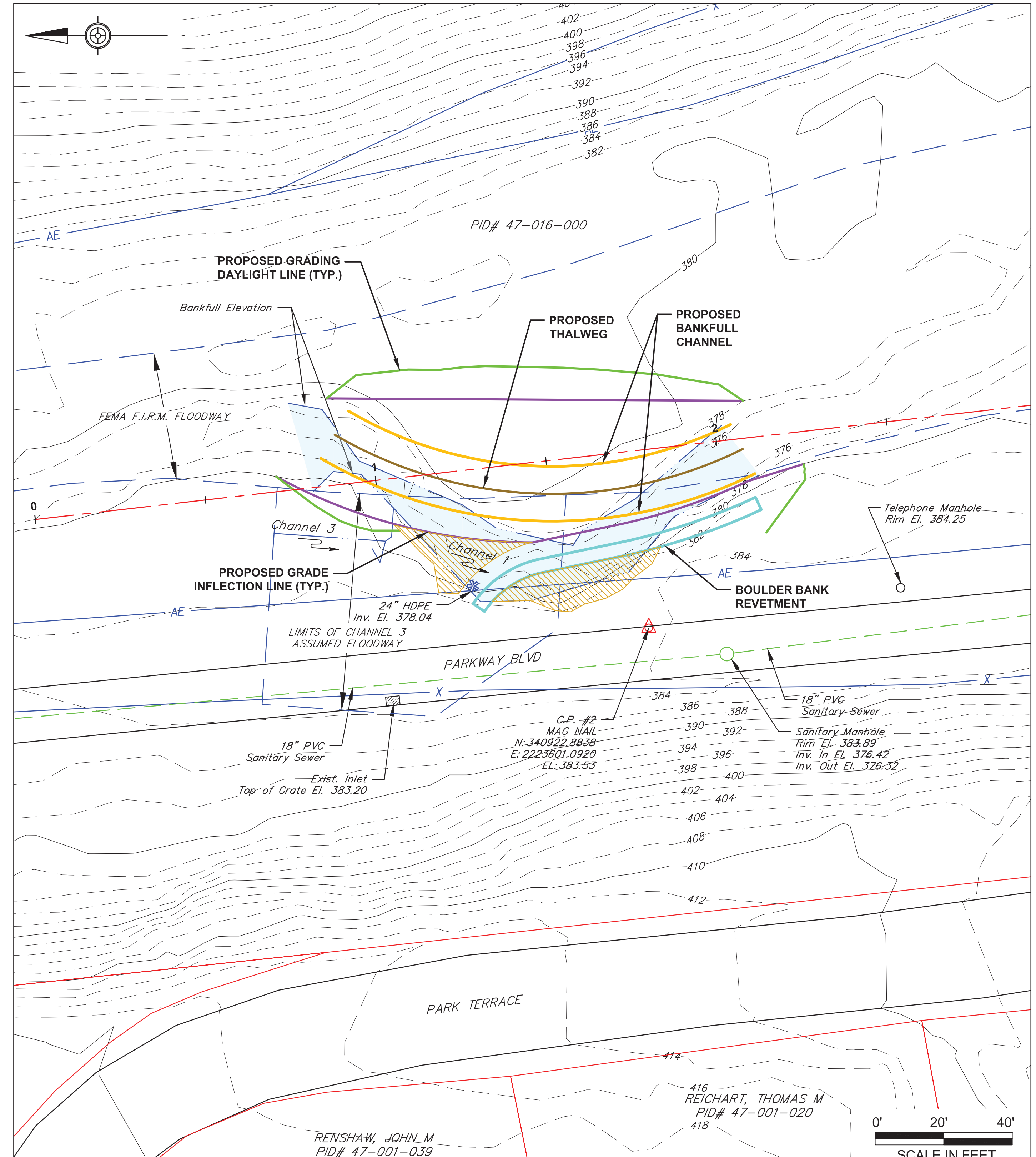
www.skellyloy.com
SKELLY and LOY
PROJECT NUMBER:
R13-0290.001
TASK: 01
SUBTASK: 01
DATE:
OCTOBER 31, 2016



PLAN - SITE 2



PLAN - SITE 3

DRAWING NO. **C-102**

PAXTANG PARKWAY

WATERSHED RESTORATION - PHASE 1

CITY OF HARRISBURG, PAXTANG BOROUGH, SUSQUEHANNA TOWNSHIP — DAUPHIN COUNTY, PA

PLAN - SITE 2 & SITE 3

REV	DESCRIPTION	BY	APPV	DATE
1	REVISED FLOODWAY BOUNDARY	JRG	MEL	12/8/16

DSGN MEL
DFTSMN JRG
CHKR
APPV MEL
SCALE AS SHOWN
Plotted on: 2016-12-09

q: \r13-0290.001 paxtang parkway\sheets\pax_parkway.dwg

COMMONWEALTH OF PENNSYLVANIA — REGISTERED PROFESSIONAL ENGINEER — MICHAEL EUGENE LOWER — PE071798

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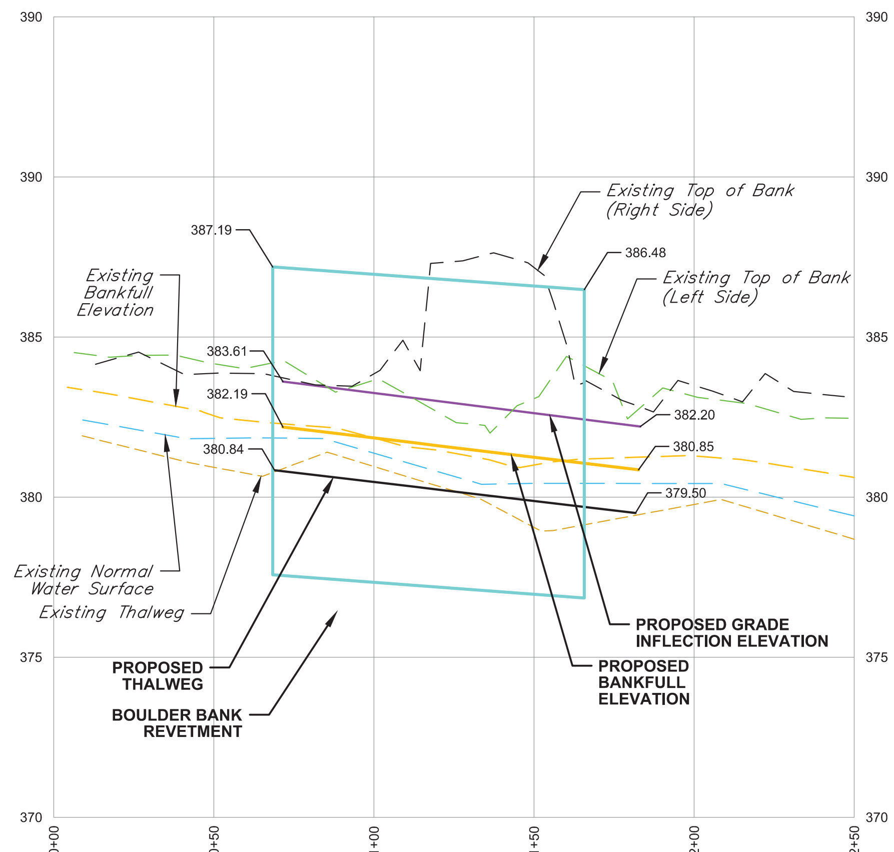
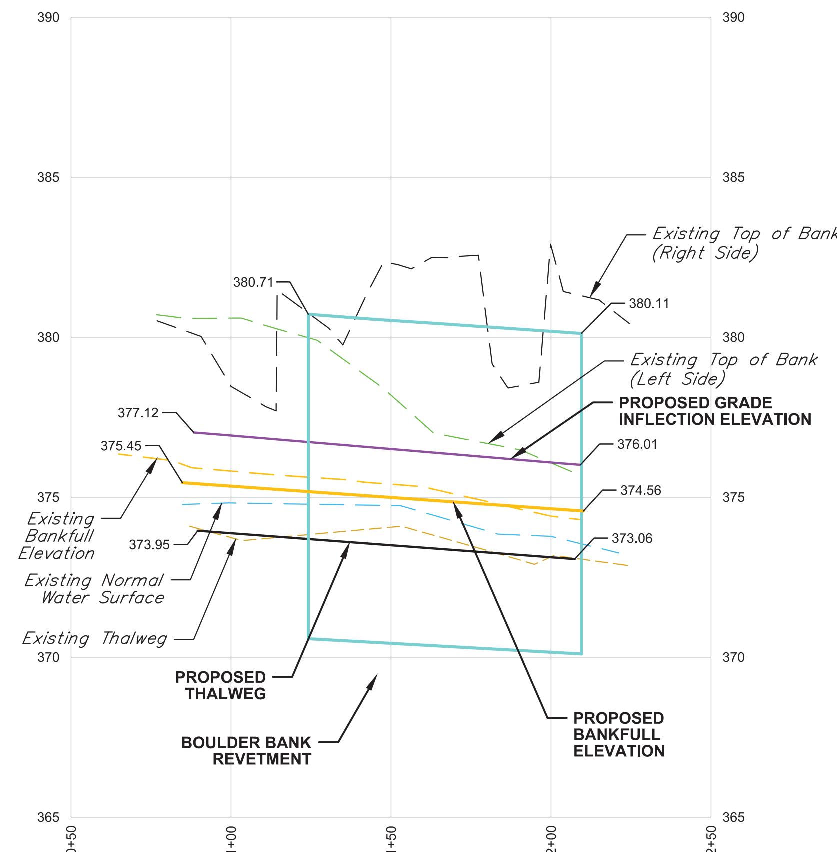
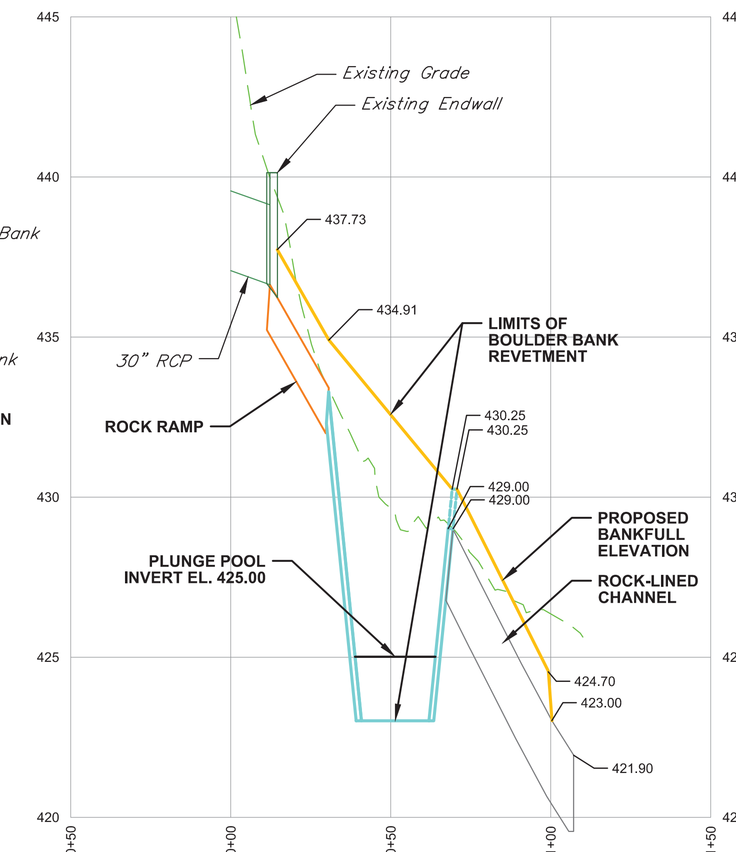
PROJECT NUMBER: R13-0290.001
TASK: 01 SUBTASK: 01
DATE: OCTOBER 31, 2016



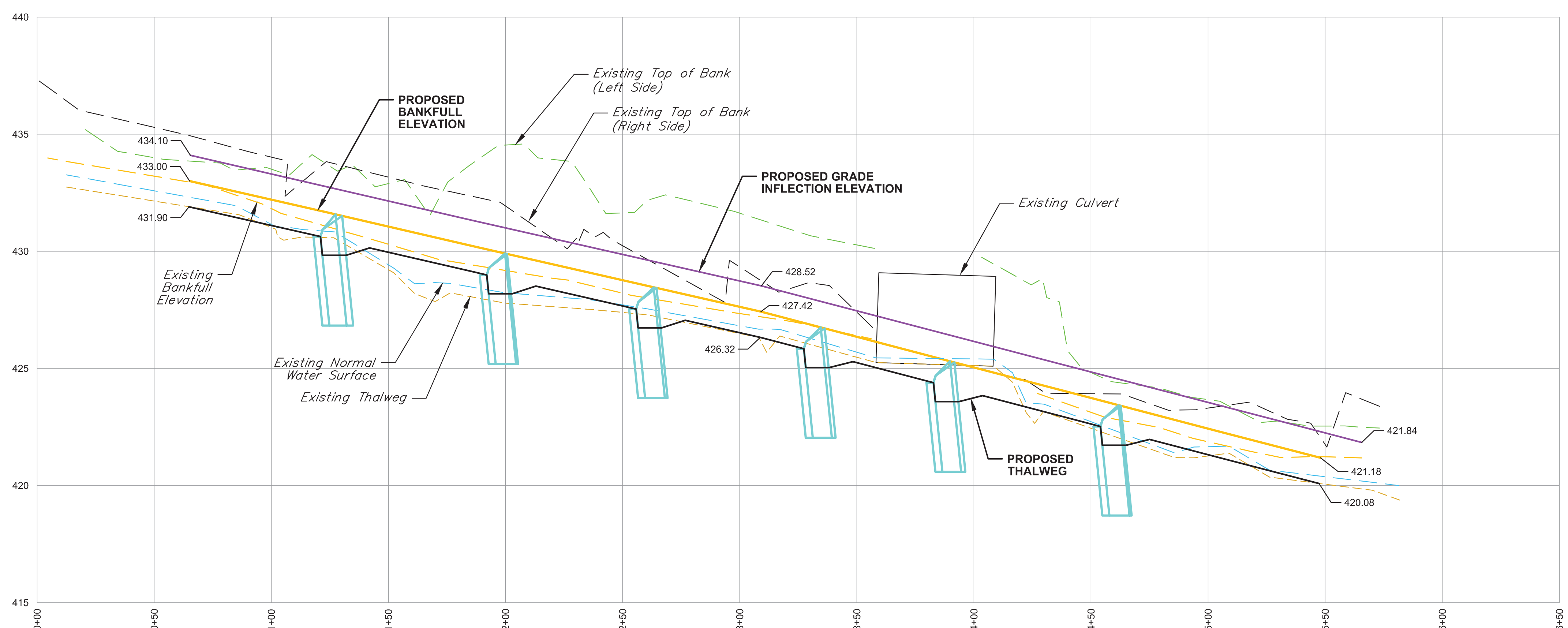
PROPOSED STREAM CENTERLINE PROFILE - SITE 2



PROPOSED STREAM CENTERLINE PROFILE - SITE 3



PROPOSED ROCK RAMP PROFILE - SITE 4



PROPOSED STREAM CENTERLINE PROFILE - SITE 1

SCALE:

VERTICAL 3 1.5 0

0 15 30 HORIZONTAL

DRAWING NO. C-201

PAXTANG PARKWAY
WATERSHED RESTORATION - PHASE 1
CITY OF HARRISBURG, PAXTANG BOROUGH, SUSQUEHANNA TOWNSHIP
DAUPHIN COUNTY, PA

PROFILES

DSGN MEL
DFTSMN JRG
CHKR
APPV MEL
SCALE AS SHOWN
Plotted on: 2016-12-09

REV | DESCRIPTION | BY | APPV | DATE

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COMMONWEALTH OF PENNSYLVANIA
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SKELLY and LOY

PROJECT NUMBER: R13-0290.001
TASK: 01
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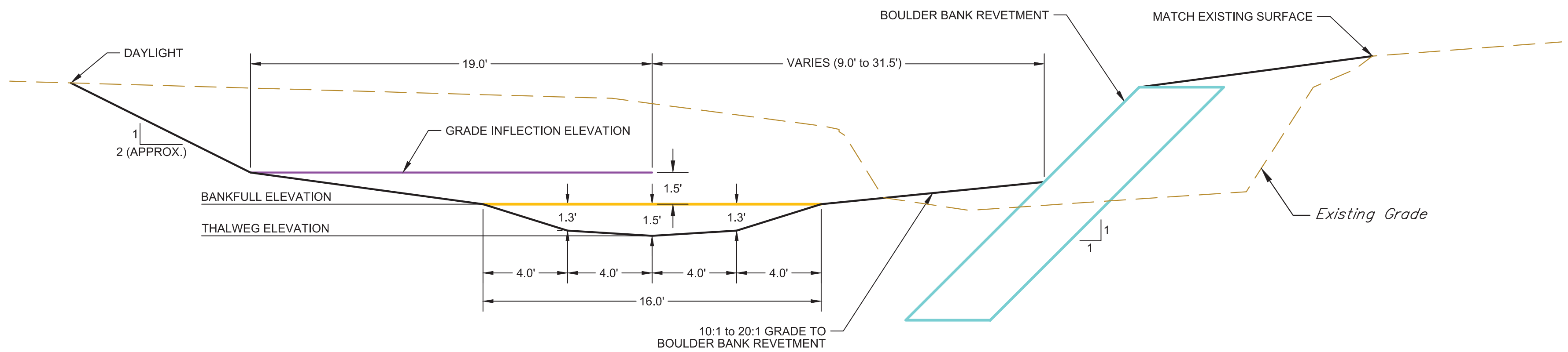
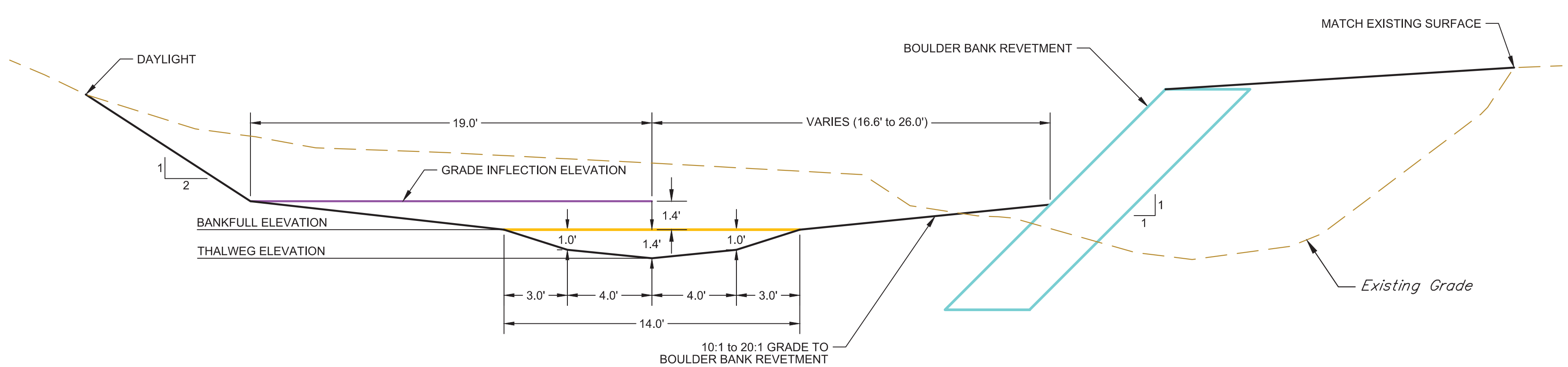
DATE: OCTOBER 31, 2016



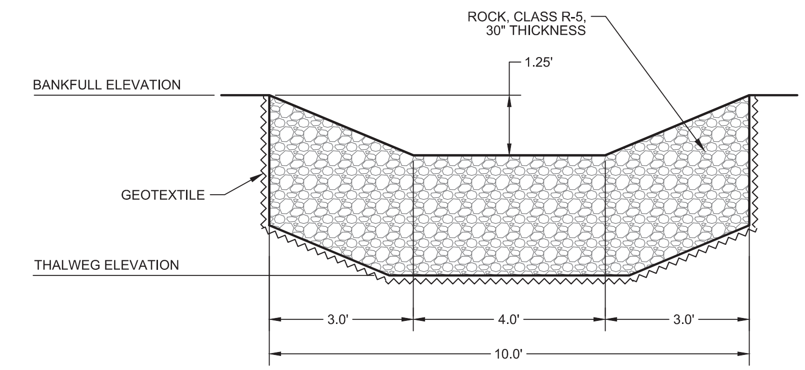
RIFFLE

TYPICAL SECTIONS - SITE 3
SCALE: 1"=4'

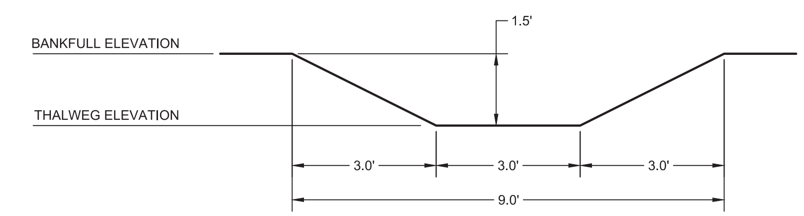


RIFFLE

TYPICAL SECTIONS - SITE 2
SCALE: 1"=4'

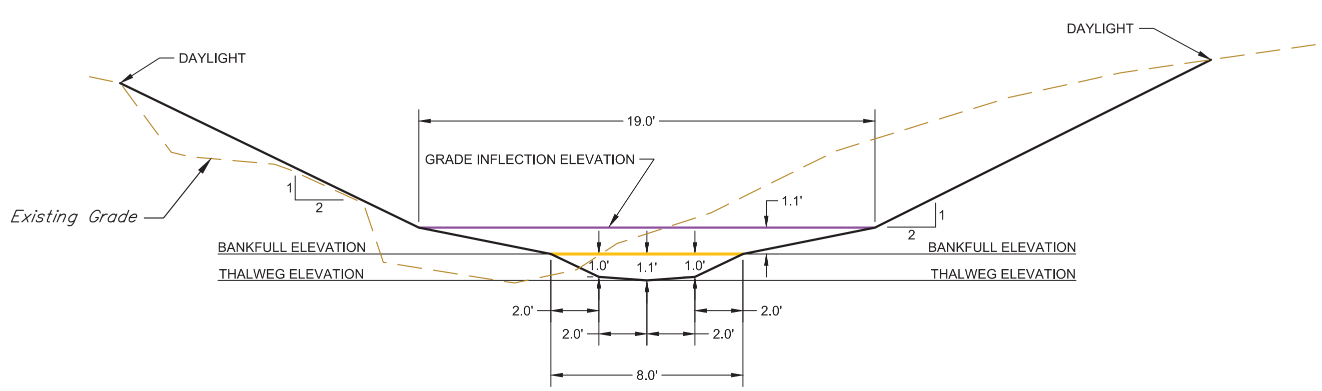


ROCK-LINED CHANNEL

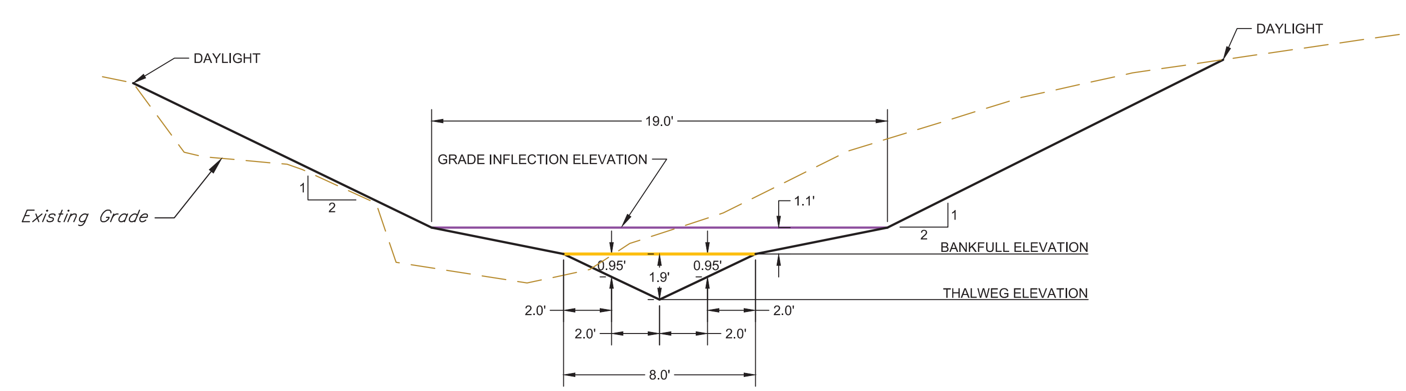


ROCK RAMP

TYPICAL SECTIONS - SITE 4
SCALE: 1"=2'



RIFFLE



TYPICAL SECTIONS - SITE 1
SCALE: 1"=4'

DRAWING NO. C-301

PAXTANG PARKWAY
WATERSHED RESTORATION - PHASE 1
CITY OF HARRISBURG, PAXTANG BOROUGH, SUSQUEHANNA TOWNSHIP
DAUPHIN COUNTY, PA

TYPICAL SECTIONS

DSGN MEL
DFTSMN JRG
CHKR
APPV MEL
SCALE AS SHOWN
Plotted on: 2016-12-09

REV DESCRIPTION BY APPV DATE

q:\r13-0290.001 paxtang parkway\sheets\pax_parkway.dwg

COMMONWEALTH OF PENNSYLVANIA
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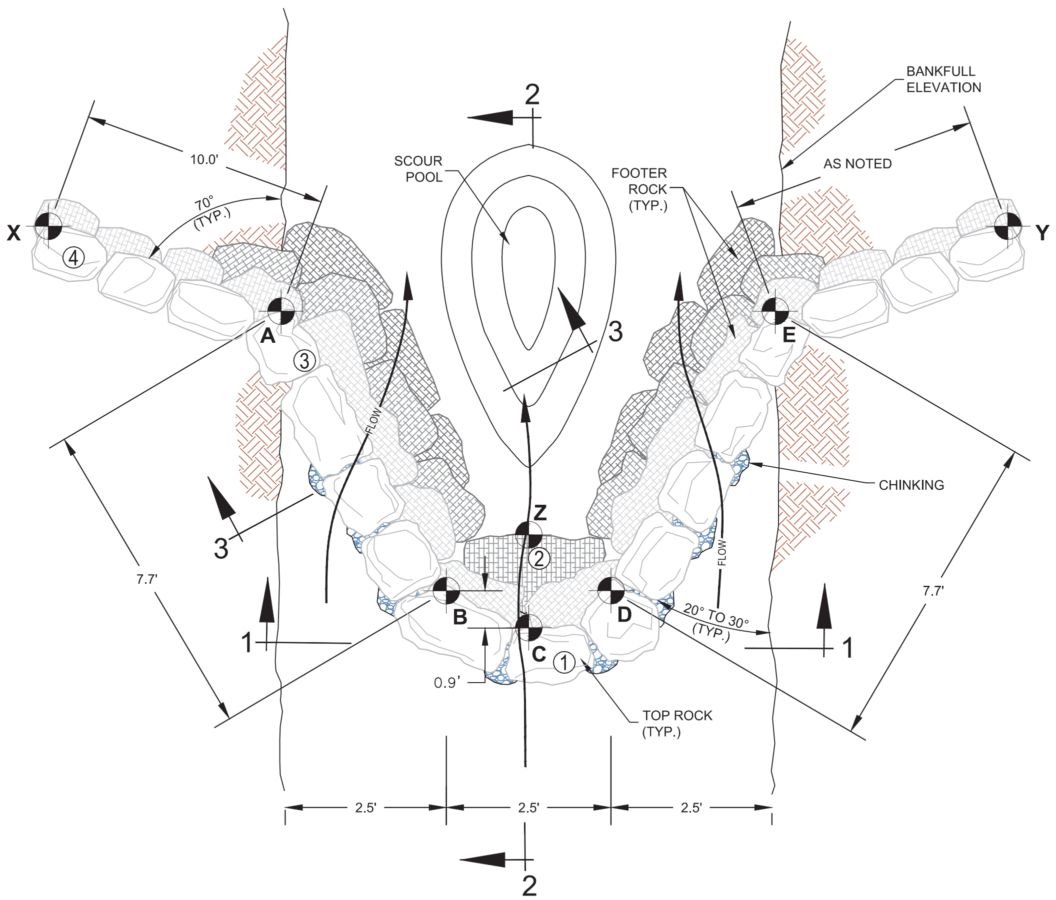
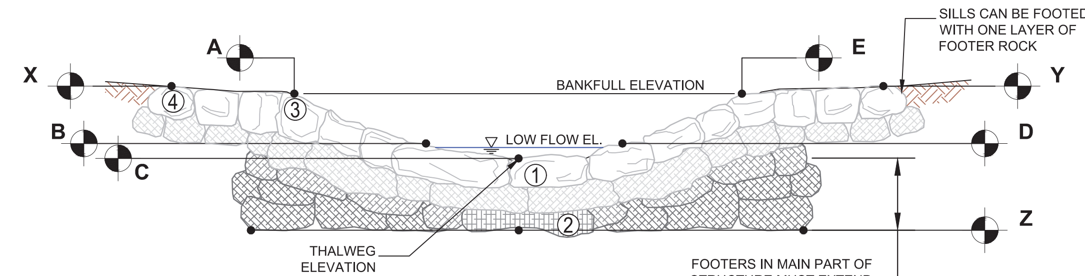
SKELLY and LOY

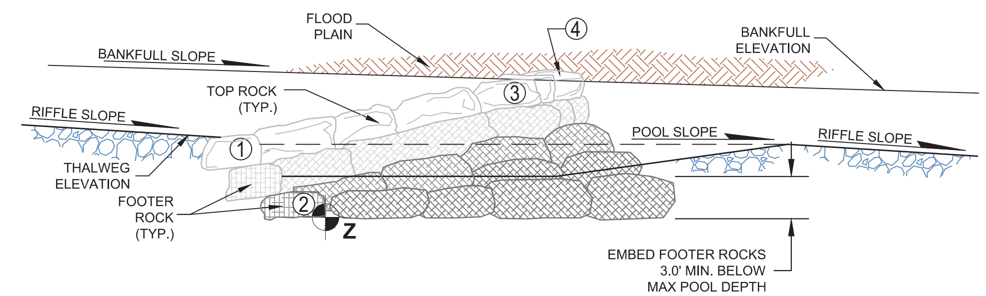
PROJECT NUMBER: R13-0290.001
TASK: 01
SUBTASK: 01
DATE: OCTOBER 31, 2016



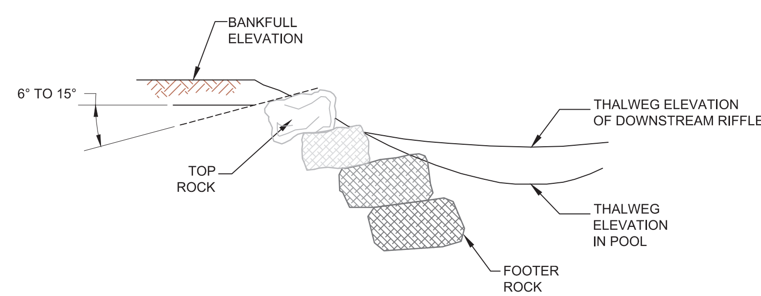
PLAN VIEW



SECTION 1 VIEW



SECTION 2 VIEW



SECTION 3

ROCK SIZING TABLE			
CROSS ROCK VANE	LENGTH	WIDTH	HEIGHT
MINIMUM (FEET)	3.0	3.0	1.5
MAXIMUM (FEET)	5.0	5.0	4.0

A CROSS ROCK VANE (CRV)

NOT TO SCALE

ROCK STRUCTURE	CONSTRUCTION POINT	NORTH	EAST	STATION	OFFSET	LT/RT	ELEVATION	LENGTH
CROSS ROCK VANE 1	X	343,674.6069	2,221,616.4357	1+27.34	- 7.73	LT	434.48	10.0
	A	343,666.5903	2,221,610.4579	1+27.42	2.27	LT	431.58	7.8
	B	343,666.1430	2,221,602.6739	1+21.41	7.30	LT	430.93	1.6
	C	343,665.1248	2,221,601.4285	1+21.01	8.86	--	430.63	1.6
	D	343,663.5890	2,221,601.9071	1+22.33	9.81	RT	430.93	7.8
	E	343,658.9284	2,221,608.1572	1+30.27	9.76	RT	431.51	10.0
	Y	343,648.9446	2,221,608.7312	1+37.02	17.29	RT	432.52	
	Z						426.84	

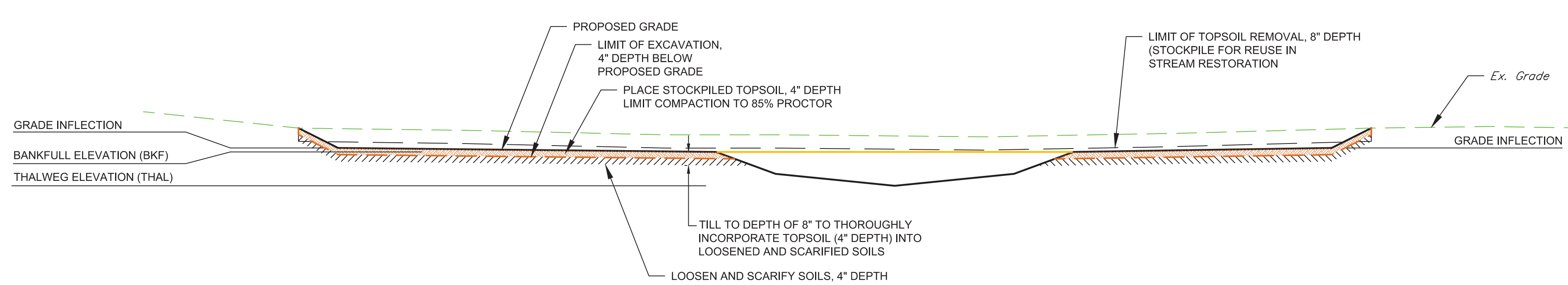
ROCK STRUCTURE	CONSTRUCTION POINT	NORTH	EAST	STATION	OFFSET	LT/RT	ELEVATION	LENGTH
CROSS ROCK VANE 2	X	343,623.7915	2,221,676.6270	2+04.97	- 9.20	LT	430.87	10.0
	A	343,620.5097	2,221,667.1808	2+00.65	- 0.20	LT	429.89	7.8
	B	343,624.5069	2,221,660.4866	1+93.06	1.64	LT	429.29	1.6
	C	343,624.3628	2,221,658.8840	1+92.01	2.85	--	428.99	1.6
	D	343,622.8230	2,221,658.4188	1+92.75	4.28	RT	429.29	7.8
	E	343,615.4580	2,221,660.9774	1+99.80	7.76	RT	429.91	10.0
	Y	343,606.8721	2,221,655.8509	2+02.29	17.46	RT	434.45	
	Z						425.20	

ROCK STRUCTURE	CONSTRUCTION POINT	NORTH	EAST	STATION	OFFSET	LT/RT	ELEVATION	LENGTH
CROSS ROCK VANE 3	X	343,584.7599	2,221,722.1747	2+65.34	-13.40	LT	432.15	10.0
	A	343,578.9443	2,221,714.0398	2+63.32	- 3.60	LT	428.46	7.8
	B	343,580.8882	2,221,706.4892	2+56.47	0.15	LT	427.83	1.6
	C	343,580.2975	2,221,704.9930	2+55.79	1.61	--	427.53	1.6
	D	343,578.6889	2,221,704.9812	2+56.88	2.78	RT	427.83	7.8
	E	343,572.3463	2,221,709.5156	2+64.50	4.31	RT	428.43	10.0
	Y	343,562.6621	2,221,707.0223	2+69.21	13.12	RT	431.05	
	Z						423.75	

ROCK STRUCTURE	CONSTRUCTION POINT	NORTH	EAST	STATION	OFFSET	LT/RT	ELEVATION	LENGTH
CROSS ROCK VANE 4	X	343,534.1958	2,221,778.1004	3+41.67	-11.52	LT	428.02	10.0
	A	343,530.9333	2,221,768.6475	3+36.29	- 3.07	LT	426.71	7.8
	B	343,534.9442	2,221,761.9615	3+28.55	- 1.97	LT	426.14	1.6
	C	343,534.8034	2,221,760.3590	3+27.40	- 0.84	--	425.84	1.6
	D	343,533.2645	2,221,759.8903	3+28.01	0.64	RT	426.14	7.8
	E	343,525.8943	2,221,762.4340	3+34.62	4.76	RT	426.75	10.0
	Y	343,517.3189	2,221,757.2897	3+35.98	14.66	RT	430.55	
	Z						422.05	

ROCK STRUCTURE	CONSTRUCTION POINT	NORTH	EAST	STATION	OFFSET	LT/RT	ELEVATION	LENGTH
CROSS ROCK VANE 5	X	343,508.2213	2,221,819.4486	3+90.93	- 15.45	LT	429.00	10.0
	A	343,500.8223	2,221,812.7215	3+89.82	- 5.51	LT	425.31	7.8
	B	343,501.1321	2,221,804.9308	3+83.33	- 1.19	LT	424.69	1.6
	C	343,500.2394	2,221,803.5925	3+82.77	0.32	--	424.39	1.6
	D	343,498.6644	2,221,803.9199	3+83.96	1.40	RT	424.69	7.8
	E	343,493.4194	2,221,809.6888	3+91.69	2.27	RT	425.26	10.0
	Y	343,483.4273	2,221,809.2915	3+97.07	10.66	RT	427.07	
	Z						420.60	

ROCK STRUCTURE	CONSTRUCTION POINT	NORTH	EAST	STATION	OFFSET	LT/RT	ELEVATION	LENGTH
CROSS ROCK VANE 6	X	343,464.4358	2,221,879.9308	4+67.25	- 10.04	LT	424.28	10.0
	A	343,458.7125	2,221,871.7305	4+62.68	- 1.13	LT	423.40	7.8
	B	343,460.7423	2,221,864.2024	4+55.10	0.72	LT	422.82	1.6
	C	343,460.1686	2,221,862.6995	4+54.07	1.95	--	422.52	1.6
	D	343,458.5602	2,221,862.6695	4+54.82	3.37	RT	422.82	7.8
	E	343,452.1666	2,221,867.1317	4+61.75	6.82	RT	423.43	5.5
	Y	343,446.8321	2,221,865.6935	4+63.01	12.19	RT	425.88	
	Z						418.73	



B TOPSOIL REMOVAL AND REPLACEMENT

0' 2' 4' 8'
Scale

DRAWING NO. C-501

PAXTANG PARKWAY
WATERSHED RESTORATION - PHASE 1
CITY OF HARRISBURG, PAXTANG BOROUGH, SUSQUEHANNA TOWNSHIP
DAUPHIN COUNTY, PA

DETAILS

DSGN MEL
DFTSMN JRG
CHKR
APPV MEL
SCALE AS SHOWN
Plotted on: 2016-12-09

REV DESCRIPTION BY APPV DATE

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COMMONWEALTH OF PENNSYLVANIA
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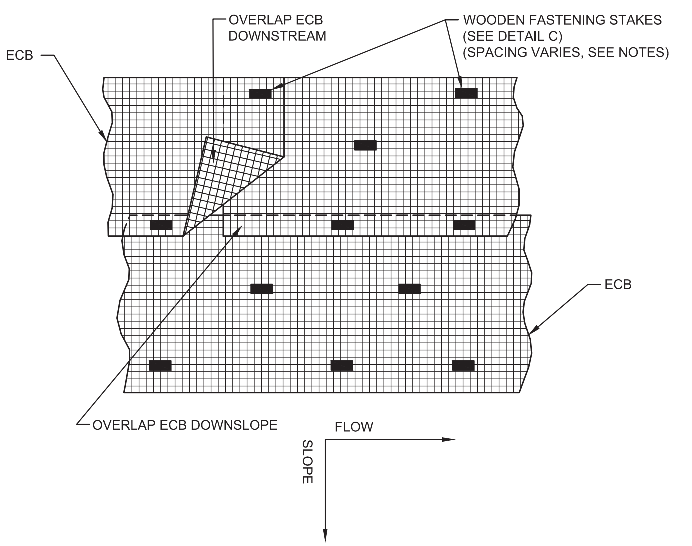
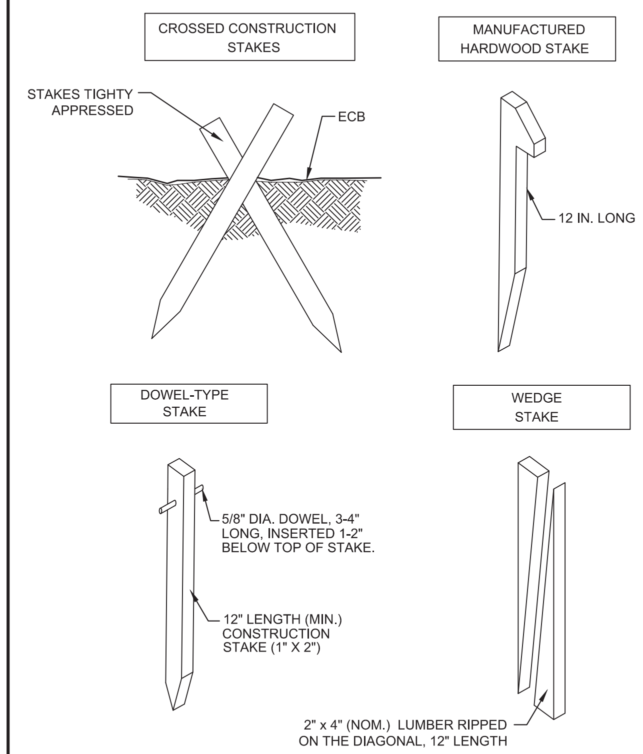
www.skellyloy.com

SKELLY and LOY

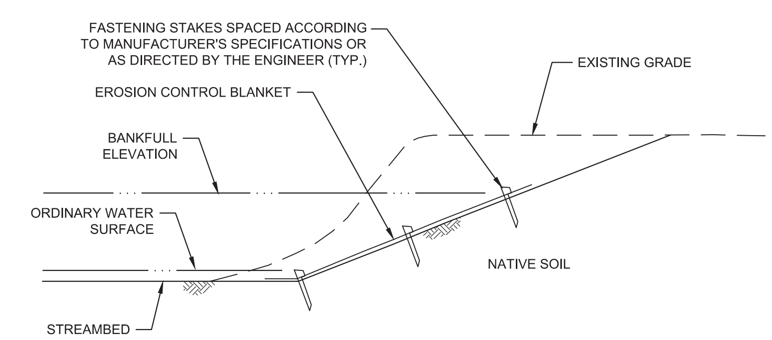
PROJECT NUMBER: R13-0290.001
TASK: 01
SUBTASK: 01
DATE: OCTOBER 31, 2016



C EROSION CONTROL BLANKET (ECB) INSTALLATION
NOT TO SCALE

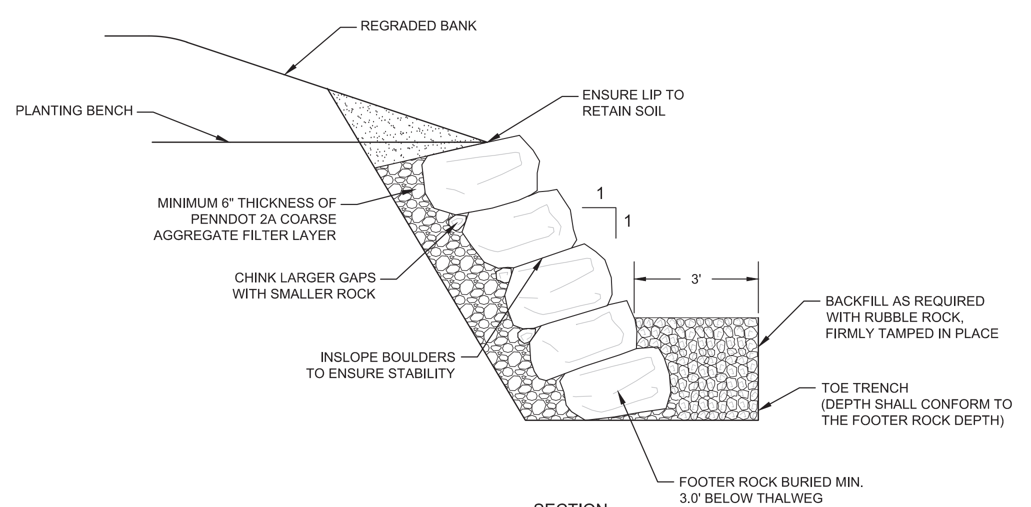


D EROSION CONTROL BLANKET FASTENERS - DETAIL
NOT TO SCALE

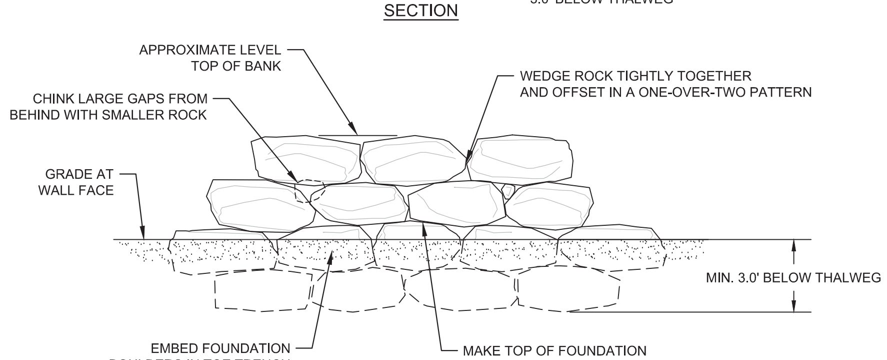


NOTE: INSTALL SEED AND MULCH ON BANK TO THE VICINITY OF THE ORDINARY WATER SURFACE PRIOR TO PLACING EROSION CONTROL BLANKET.

E BANK REGRADING
NOT TO SCALE



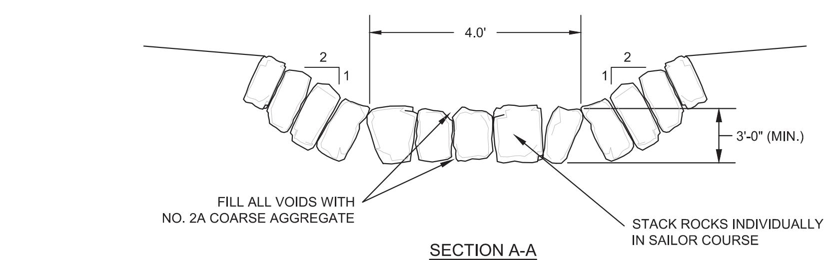
SECTION



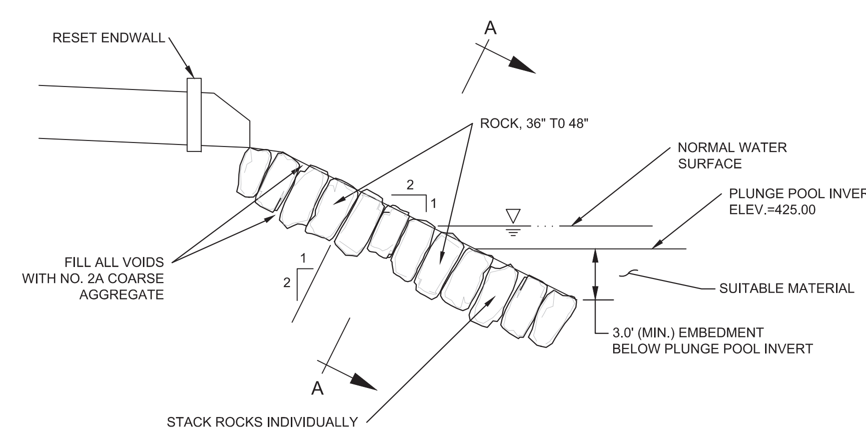
ELEVATION

ROCK SIZING TABLE			
STACKED ROCK WALL	LENGTH	WIDTH	HEIGHT
MINIMUM (FT)	3.0	3.0	1.5
MAXIMUM (FT)	5.0	5.0	4.0

F BOULDER BANK REVETMENT
NOT TO SCALE



SECTION A-A



PROFILE

ROCK SIZING TABLE			
ROCK RAMP	LENGTH	WIDTH	HEIGHT
MINIMUM (FT)	3.0	3.0	1.5
MAXIMUM (FT)	5.0	5.0	4.0

G ROCK RAMP
NOT TO SCALE

DRAWING NO. C-502

PAXTANG PARKWAY
WATERSHED RESTORATION - PHASE 1
CITY OF HARRISBURG, PAXTANG BOROUGH, SUSQUEHANNA TOWNSHIP
DAUPHIN COUNTY, PA
DETAILS

DSGN MEL
DFTSMN JRG
CHKR
APPV MEL
SCALE AS SHOWN
Plotted on: 2016-12-09

REV DESCRIPTION BY APPV DATE
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COMMONWEALTH OF PENNSYLVANIA
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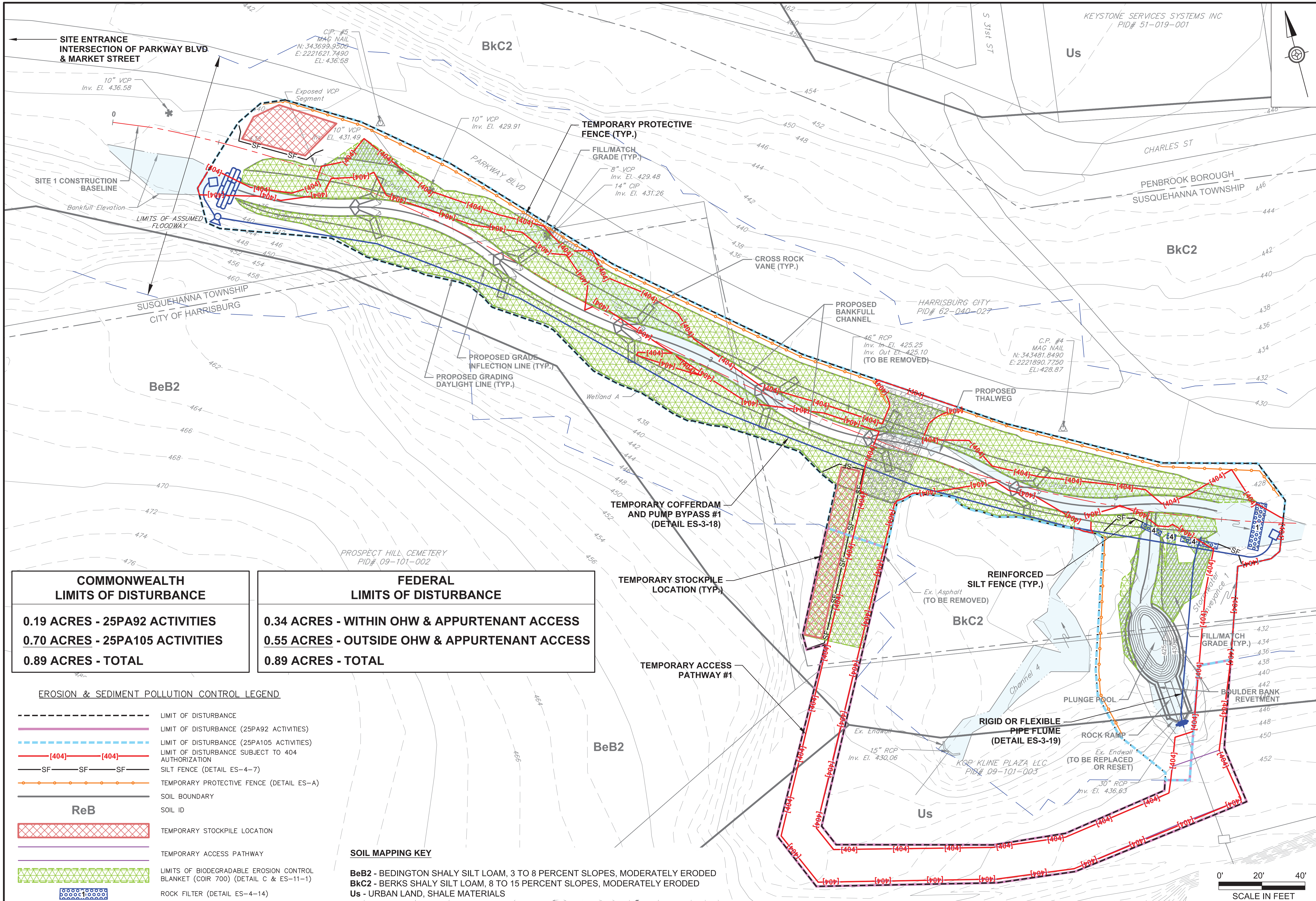
SKELLY and LOY

PROJECT NUMBER: R13-0290.001
TASK: 01
SUBTASK: 01
DATE: OCTOBER 31, 2016



COMMONWEALTH LIMITS OF DISTURBANCE
0.19 ACRES - 25PA92 ACTIVITIES
0.70 ACRES - 25PA105 ACTIVITIES
0.89 ACRES - TOTAL

FEDERAL LIMITS OF DISTURBANCE
0.34 ACRES - WITHIN OHW & APPURTENANT ACCESS
0.55 ACRES - OUTSIDE OHW & APPURTENANT ACCESS
0.89 ACRES - TOTAL

EROSION & SEDIMENT POLLUTION CONTROL LEGEND

- LIMIT OF DISTURBANCE
- LIMIT OF DISTURBANCE (25PA92 ACTIVITIES)
- LIMIT OF DISTURBANCE (25PA105 ACTIVITIES)
- [404] LIMIT OF DISTURBANCE SUBJECT TO 404 AUTHORIZATION
- SF SILT FENCE (DETAIL ES-4-7)
- TEMPORARY PROTECTIVE FENCE (DETAIL ES-A)
- SOIL BOUNDARY
- ReB SOIL ID
- TEMPORARY STOCKPILE LOCATION
- TEMPORARY ACCESS PATHWAY
- LIMITS OF BIODEGRADABLE EROSION CONTROL BLANKET (COIR 700) (DETAIL C & ES-11-1)
- ROCK FILTER (DETAIL ES-4-14)

SOIL MAPPING KEY

BeB2 - BEDINGTON SHALY SILT LOAM, 3 TO 8 PERCENT SLOPES, MODERATELY ERODED
BkC2 - BERKS SHALY SILT LOAM, 8 TO 15 PERCENT SLOPES, MODERATELY ERODED
Us - URBAN LAND, SHALE MATERIALS

DRAWING NO. **ES-101**

PAXTANG PARKWAY
WATERSHED RESTORATION - PHASE 1
CITY OF HARRISBURG, PAXTANG BOROUGH, SUSQUEHANNA TOWNSHIP, DAUPHIN COUNTY, PA
EROSION & SEDIMENT POLLUTION CONTROL PLANS - SITE 1 & SITE 4

DSGN MEL · DFTSMN JRG · CHKR · APPV MEL · SCALE AS SHOWN · Plotted on: 2017-07-20

REV	DESCRIPTION	BY	APPV	DATE
2	ADDED FEDERAL LOD TABLE AND BOUNDARY	JRG	MEL	7/20/17
1	REVISED FLOODWAY BOUNDARY AND LOD	JRG	MEL	12/8/16

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MICHAEL EUGENE LOWER · PROFESSIONAL ENGINEER · COMMONWEALTH OF PENNSYLVANIA

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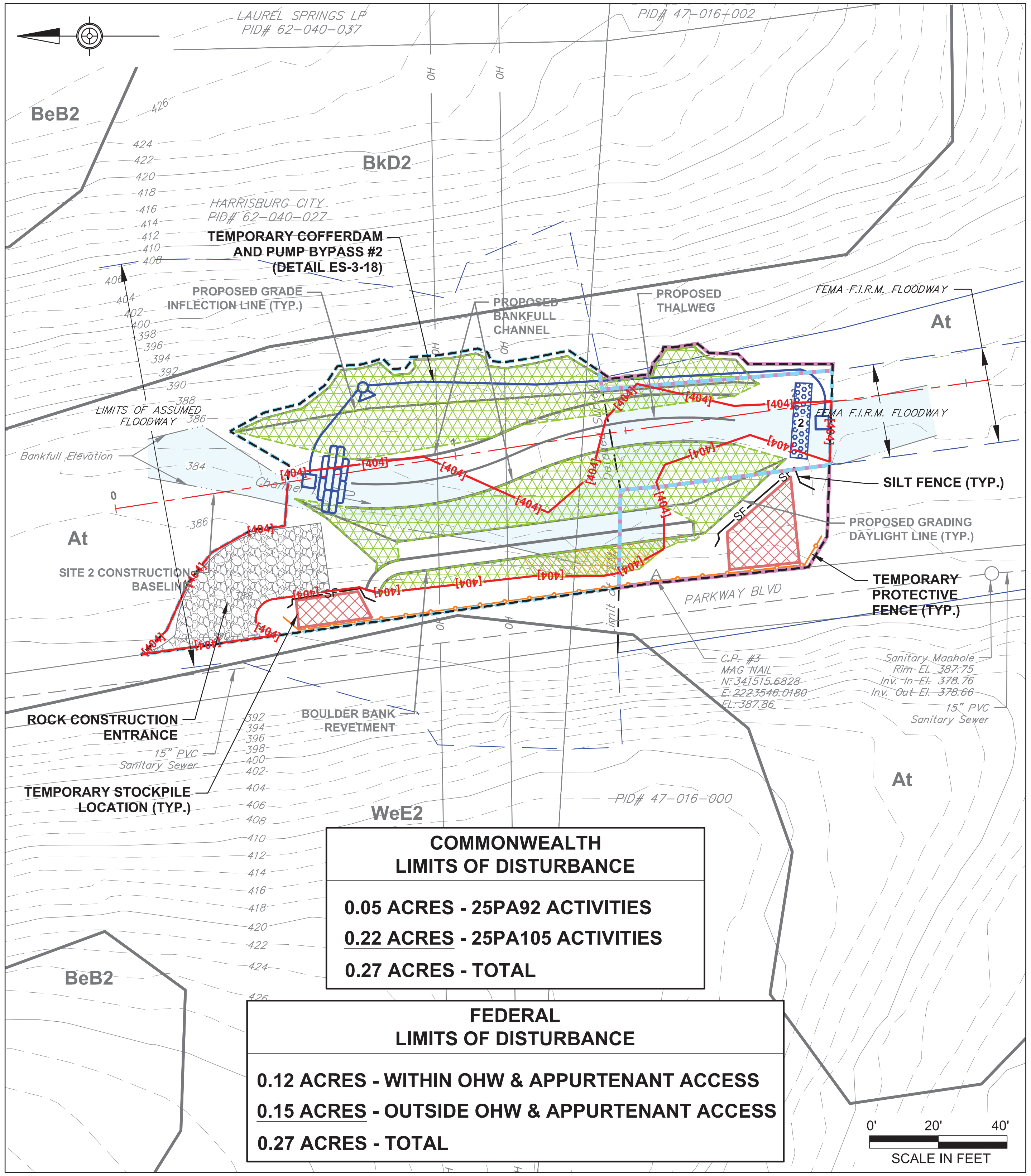
www.skellyloy.com

PROJECT NUMBER: R13-0290.001 · TASK: 01 · SUBTASK: 01 · DATE: OCTOBER 31, 2016



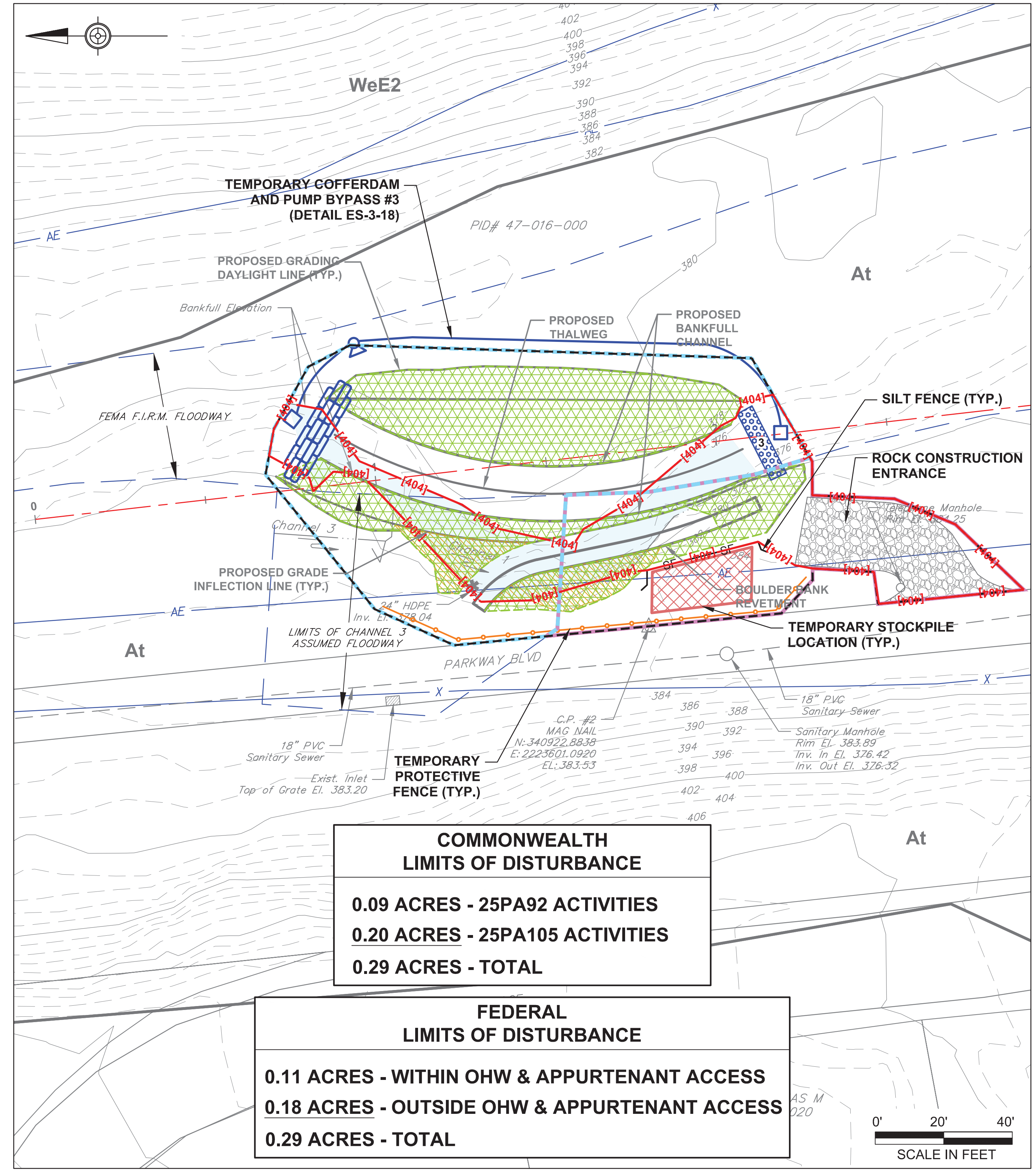
COMMONWEALTH LIMITS OF DISTURBANCE

0.05 ACRES - 25PA92 ACTIVITIES
0.22 ACRES - 25PA105 ACTIVITIES
0.27 ACRES - TOTAL

FEDERAL LIMITS OF DISTURBANCE

0.12 ACRES - WITHIN OHW & APPURTENANT ACCESS
0.15 ACRES - OUTSIDE OHW & APPURTENANT ACCESS
0.27 ACRES - TOTAL

EROSION & SEDIMENT POLLUTION CONTROL PLAN - SITE 2



COMMONWEALTH LIMITS OF DISTURBANCE

0.09 ACRES - 25PA92 ACTIVITIES
0.20 ACRES - 25PA105 ACTIVITIES
0.29 ACRES - TOTAL

FEDERAL LIMITS OF DISTURBANCE

0.11 ACRES - WITHIN OHW & APPURTENANT ACCESS
0.18 ACRES - OUTSIDE OHW & APPURTENANT ACCESS
0.29 ACRES - TOTAL

EROSION & SEDIMENT POLLUTION CONTROL PLAN - SITE 3

EROSION & SEDIMENT POLLUTION CONTROL LEGEND

- LIMIT OF DISTURBANCE
- LIMIT OF DISTURBANCE (25PA92 ACTIVITIES)
- LIMIT OF DISTURBANCE (25PA105 ACTIVITIES)
- [404] LIMIT OF DISTURBANCE SUBJECT TO 404 AUTHORIZATION
- SF SILT FENCE (DETAIL ES-4-7)
- TEMPORARY PROTECTIVE FENCE (DETAIL ES-A)
- SOIL BOUNDARY
- ReB SOIL ID
- TEMPORARY STOCKPILE LOCATION
- TEMPORARY ACCESS PATHWAY
- LIMITS OF BIODEGRADABLE EROSION CONTROL BLANKET (COIR 700) (DETAIL C & ES-11-1)
- ROCK FILTER (DETAIL ES-4-14)

SOIL MAPPING KEY

At - ATKINS SILT LOAM
BeB2 - BEDINGTON SHALY SILT LOAM, 3 TO 8 PERCENT SLOPES, MODERATELY ERODED
BeC2 - BEDINGTON SHALY SILT LOAM, 8 TO 15 PERCENT SLOPES, MODERATELY ERODED
BkD2 - BERKS SHALY SILT LOAM, 15 TO 25 PERCENT SLOPES, MODERATELY ERODED
WeE2 - WEIKERT SHALY SILT LOAM, 25 TO 40 PERCENT SLOPES, MODERATELY ERODE

DRAWING NO. ES-102

PAXTANG PARKWAY
WATERSHED RESTORATION - PHASE 1
CITY OF HARRISBURG, PAXTANG BOROUGH, SUSQUEHANNA TOWNSHIP, DAUPHIN COUNTY, PA
EROSION & SEDIMENT POLLUTION CONTROL PLANS - SITE 2 & SITE 3

REV	DESCRIPTION	BY	APPV	DATE
2	ADDED FEDERAL LOD TABLE AND BOUNDARY	JRG	MEL	7/20/17
1	REVISED FLOODWAY BOUNDARY AND LOD	JRG	MEL	12/8/16

DSGN MEL | DFTSMN JRG | CHKR | APPV MEL | SCALE AS SHOWN

Plotted on: 2017-07-20
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COMMONWEALTH OF PENNSYLVANIA — REGISTERED PROFESSIONAL ENGINEER — MICHAEL EUGENE LOWER — PE071706

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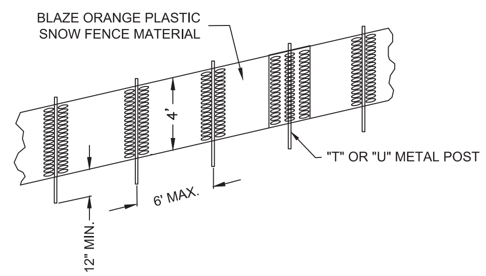
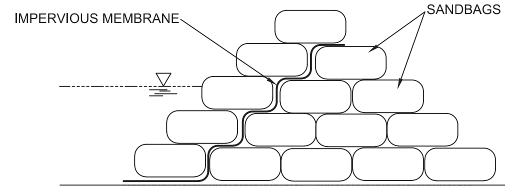
PROJECT NUMBER: R13-0290.001
TASK: 01 SUBTASK: 01
DATE: OCTOBER 31, 2016



NOTES:

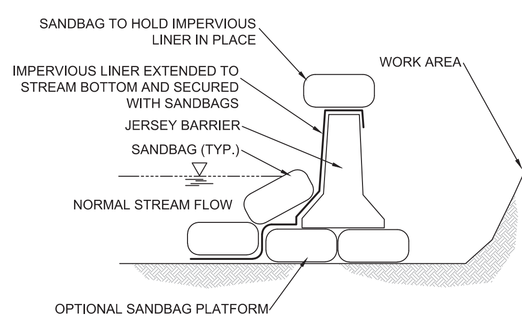
1. INSTALL THE FENCE USING A METAL "T" OR "U" POST DRIVEN INTO THE GROUND TO A DEPTH OF 12 TO 18 INCHES. POSTS SHOULD BE SPACED EVERY 6 FEET. NOTE: NOTCHED POSTS ARE IDEAL TO PREVENT THE FENCE FROM SLIPPING.
2. SECURE THE FENCE TO THE POST USING THREE WIRE TIES, WRAPPED AROUND THE FENCE STRAND AND THE POST. TENSION WIRE OR ROPE MAY BE USED AS A TOP STRINGER AND WOVEN THROUGH THE TOP ROW OF STRANDS TO PREVENT POTENTIAL SAGGING.
3. TWO ROLLS OF SAFETY FENCE MAY BE OVERLAPPED AT THE INTERSECTION OF A POST AND SECURED WITH WIRE TIES.

ES-A TEMPORARY PROTECTIVE FENCE
NOT TO SCALE



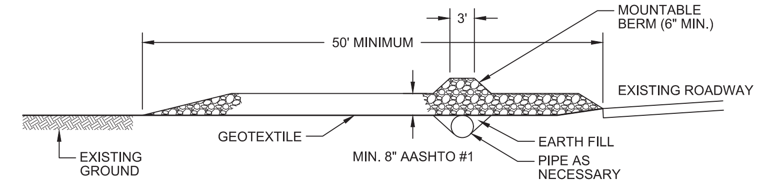
2 BAG MIN. HEIGHT ABOVE NORMAL BASE FLOW

STACKED SANDBAGS OPTION

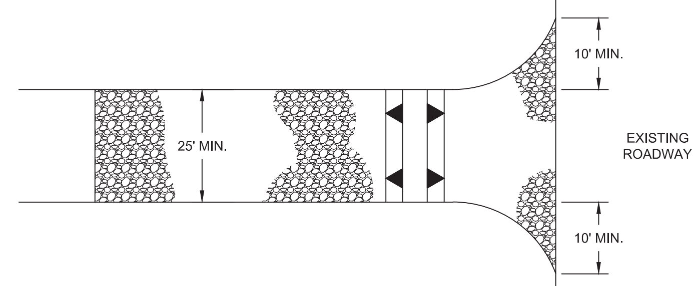


JERSEY BARRIER OPTION

ES-3-15 SANDBAG DIVERSION DAM OR COFFERDAM
NOT TO SCALE



PROFILE



PLAN VIEW

ES-3-1 ROCK CONSTRUCTION ENTRANCE

1. REMOVE TOPSOIL PRIOR TO INSTALLATION OF ROCK CONSTRUCTION ENTRANCE. EXTEND ROCK OVER FULL WIDTH OF ENTRANCE.
2. RUNOFF SHALL BE DIVERTED FROM ROADWAY TO A SUITABLE SEDIMENT REMOVAL BMP PRIOR TO ENTERING ROCK CONSTRUCTION ENTRANCE.
3. MOUNTABLE BERM SHALL BE INSTALLED WHEREVER OPTIONAL CULVERT PIPE IS USED AND PROPER PIPE COVER AS SPECIFIED BY MANUFACTURER IS NOT OTHERWISE PROVIDED. PIPE SHALL BE SIZED APPROPRIATELY FOR SIZE OF DITCH BEING CROSSED.
4. MAINTENANCE: ROCK CONSTRUCTION ENTRANCE THICKNESS SHALL BE CONSTANTLY MAINTAINED TO THE SPECIFIED DIMENSIONS BY ADDING ROCK. A STOCKPILE SHALL BE MAINTAINED ON SITE FOR THIS PURPOSE. ALL SEDIMENT DEPOSITED ON PAVED ROADWAYS SHALL BE REMOVED AND RETURNED TO THE CONSTRUCTION SITE IMMEDIATELY. IF EXCESSIVE AMOUNTS OF SEDIMENT ARE BEING DEPOSITED ON ROADWAY, EXTEND LENGTH OF ROCK CONSTRUCTION ENTRANCE BY 50 FOOT INCREMENTS UNTIL CONDITION IS ALLEVIATED OR INSTALL WASH RACK. WASHING THE ROADWAY OR SWEEPING THE DEPOSITS INTO ROADWAY DITCHES, SEWERS, CULVERTS, OR OTHER DRAINAGE COURSES IS NOT ACCEPTABLE.

ES-3-1 ROCK CONSTRUCTION ENTRANCE
NOT TO SCALE

STANDARD E&S WORKSHEET # 21
Temporary and Permanent Vegetative Stabilization Specifications

PROJECT NAME: PAXTANG PARKWAY
LOCATION: CITY OF HARRISBURG, PAXTANG BOROUGH, SUSQUEHANNA TOWNSHIP, DAUPHIN COUNTY, PA
PREPARED BY: CFE DATE: 2016-06-03
CHECKED BY: ______ DATE: ______

SPECIFICATIONS: The Department recommends the use of the Penn State publication, "Erosion Control and Conservation Plantings on Noncropland," as the standard to use for the selection of species, seed specifications, mixtures, liming and fertilizing, time of seeding, and seeding methods. Specifications for these items may also be obtained from PennDOT's Publication # 408, Section 804 or by contacting the applicable county conservation district. Upon selection of a reference, that reference should be used to provide all specifications for seeding, mulching, and soil amendments. The following specification will be used for this project:

(TEMPORARY)
*SPECIES: ANNUAL RYE
% PURE LIVE SEED: 100 %
APPLICATION RATE: 48 LB./ACRE
FERTILIZER TYPE: NONE (X-X-X)
FERTILIZER APPL. RATE: ______ LB./ACRE
LIMING RATE: NONE T./ACRE
MULCH TYPE: STRAW
MULCHING RATE: 3.0 T./ACRE

(PERMANENT) TOPSOIL PLACEMENT DEPTH: 4 IN.
*SPECIES: ERNMX- 203(ERNST SED PA CENTRAL LOWLAND PROVINCE RIPARIAN MIX)
% PURE LIVE SEED: 100 %
APPLICATION RATE 20 LB/AC (W/ COVER CROP OF GRAIN RYE @ 30 LB/AC) LB./ACRE
FERTILIZER TYPE: NONE (X-X-X)
FERTILIZER APPL. RATE: N/A LB./ACRE
LIMING RATE: N/A T./ACRE
MULCH TYPE: HYDROMULCH AND TACKIFIER
MULCHING RATE: PER SEED MANUFACTURER T./ACRE
ANCHOR MATERIAL: TACKIFIER OVER ALL APPLICATION, #700 COIR TOE OF SLOPE (13')
ANCHORING METHOD: WOOD STAKE FASTENERS
RATE OF ANCHOR MATERIAL APPL.: ______ LB./ACRE
SEEDING SEASON DATES: MARCH 15 TO MAY 15 OR AUGUST 15 TO OCTOBER 15

(PERMANENT - STEEP SLOPE)
TOPSOIL PLACEMENT DEPTH: ______ IN.
*SPECIES: ______
% PURE LIVE SEED: ______ %
APPLICATION RATE: ______ LB./ACRE
FERTILIZER TYPE: ______ (X-X-X)
FERTILIZER APPL. RATE: ______ LB./ACRE
LIMING RATE: ______ T./ACRE
MULCH TYPE: ______
MULCHING RATE: ______ T./ACRE
ANCHOR MATERIAL: ______
ANCHORING METHOD: ______
RATE OF ANCHOR MATERIAL APPL.: ______ LB./ACRE
SEEDING SEASON DATES: ______

*If more than one species is used, indicate application rate for each species.
Note: This worksheet should be added to the plan drawings.

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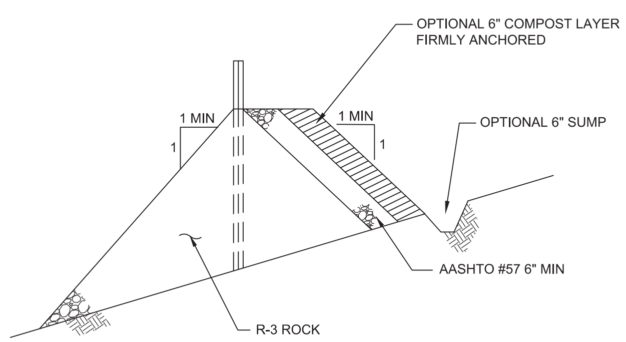
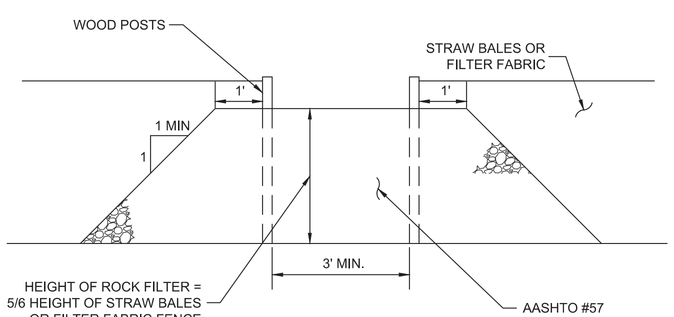


OUTLET CROSS-SECTION

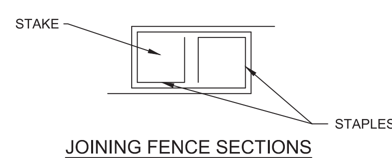


UP-SLOPE FACE

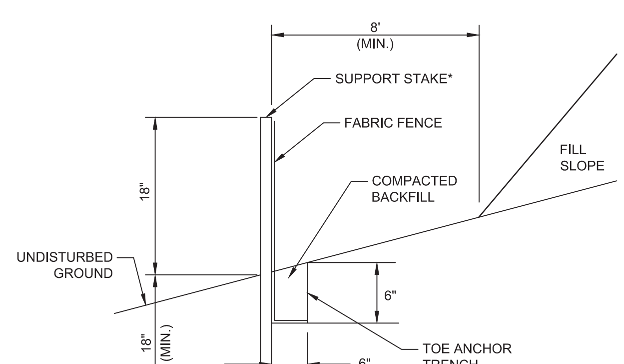
ES-4-6 ROCK FILTER OUTLET

1. A ROCK FILTER OUTLET SHALL BE INSTALLED WHERE FAILURE OF A SILT FENCE OR STRAW BALE BARRIER HAS OCCURRED DUE TO CONCENTRATED FLOW. ANCHORED COMPOST LAYER SHALL BE USED ON UPSLOPE FACE IN HQ AND EV WATERSHEDS.
2. SEDIMENT SHALL BE REMOVED WHEN ACCUMULATIONS REACH 1/3 THE HEIGHT OF THE OUTLET.

ES-4-6 ROCK FILTER OUTLET
NOT TO SCALE



JOINING FENCE SECTIONS



* STAKES SPACED @ 8' MAXIMUM. USE 2" X 2" (±3/8") WOOD OR EQUIVALENT STEEL (U OR T) STAKES.

ES-4-7 STANDARD SILT FENCE (18" HIGH)

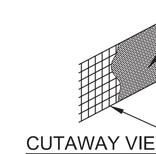
1. FABRIC SHALL HAVE THE MINIMUM PROPERTIES AS SHOWN IN TABLE 4.3.

TABLE 4.3
FABRIC PROPERTIES FOR SILT FENCE

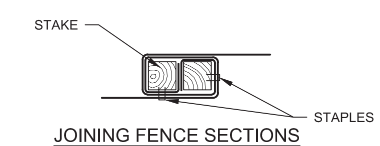
FABRIC PROPERTY	MINIMUM ACCEPTABLE VALUE	TEST METHOD
GRAB TENSILE STRENGTH (LB)	120	ASTM D1682
ELONGATION AT FAILURE (%)	20% MAX.	ASTM D1682
MULLEN BURST STRENGTH (PSI)	200	ASTM D 3786
TRAPEZOIDAL TEAR STRENGTH (LB)	50	
PUNCTURE STRENGTH (LB)	40	ASTM D 751 (MODIFIED)
SLURRY FLOW RATE (GAL/MIN/SF)	0.3	ASTM 5141
EQUIVALENT OPENING SIZE	30	US STD. SIEVE CW-02215
ULTRAVIOLET RADIATION STABILITY (%)	80	ASTM G-26

2. FABRIC WIDTH SHALL BE 30" MINIMUM. STAKES SHALL BE HARDWOOD OR EQUIVALENT STEEL (U OR T) STAKES.
3. SILT FENCE SHALL BE PLACED AT LEVEL EXISTING GRADE. BOTH ENDS OF THE FENCE SHALL BE EXTENDED AT LEAST 8 FEET UP SLOPE AT 45 DEGREES TO THE MAIN FENCE ALIGNMENT (SEE FIGURE 4.1).
4. SEDIMENT SHALL BE REMOVED WHEN ACCUMULATIONS REACH HALF THE ABOVEGROUND HEIGHT OF THE FENCE.
5. ANY SECTION OF SILT FENCE WHICH HAS BEEN UNDERMINED OR TOPPED SHALL BE IMMEDIATELY REPLACED WITH A ROCK FILTER OUTLET (STANDARD CONSTRUCTION DETAIL ES-4-6).
6. FENCE SHALL BE REMOVED AND PROPERLY DISPOSED OF WHEN TRIBUTARY AREA IS PERMANENTLY STABILIZED.

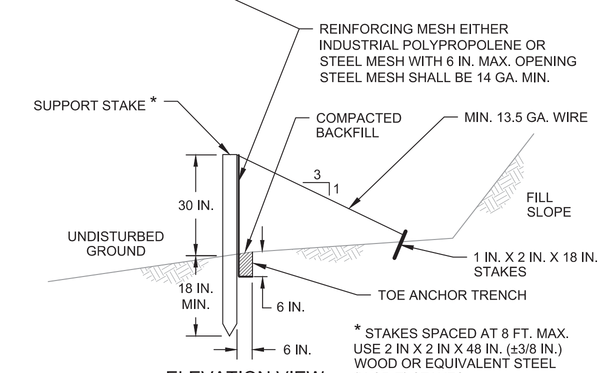
ES-4-7 STANDARD SILT FENCE (18" HIGH)
NOT TO SCALE



CUTAWAY VIEW



JOINING FENCE SECTIONS



* STAKES SPACED AT 8 FT. MAX. USE 2 IN X 2 IN X 48 IN. (±3/8 IN.) WOOD OR EQUIVALENT STEEL (U OR T) STAKES

ELEVATION VIEW

NOTES:

FABRIC SHALL HAVE THE MINIMUM PROPERTIES AS SHOWN IN TABLE 4.3 OF THE PA DEP EROSION CONTROL MANUAL.

FABRIC WIDTH SHALL BE 42 IN. MINIMUM. STAKES SHALL BE HARDWOOD OR EQUIVALENT STEEL (U OR T) STAKES. AN 18 IN. SUPPORT STAKE SHALL BE DRIVEN 12 IN. MINIMUM INTO UNDISTURBED GROUND.

SILT FENCE SHALL BE PLACED AT LEVEL EXISTING GRADE. BOTH ENDS OF THE FENCE SHALL BE EXTENDED AT LEAST 8 FEET UP SLOPE AT 45 DEGREES TO THE MAIN FENCE ALIGNMENT.

SEDIMENT SHALL BE REMOVED WHEN ACCUMULATIONS REACH HALF THE ABOVE GROUND HEIGHT OF THE FENCE.

ANY SECTION OF SILT FENCE WHICH HAS BEEN UNDERMINED OR TOPPED SHALL BE IMMEDIATELY REPLACED WITH A ROCK FILTER OUTLET (STANDARD CONSTRUCTION DETAIL # 4-6).

FENCE SHALL BE REMOVED AND PROPERLY DISPOSED OF WHEN TRIBUTARY AREA IS PERMANENTLY STABILIZED.

ES-4-8 REINFORCED SILT FENCE (30" HIGH)
NOT TO SCALE

DRAWING NO. ES-501

PAXTANG PARKWAY
WATERSHED RESTORATION - PHASE 1
CITY OF HARRISBURG, PAXTANG BOROUGH, SUSQUEHANNA TOWNSHIP, DAUPHIN COUNTY, PA
EROSION & SEDIMENT POLLUTION CONTROL DETAILS

DSGN MEL | DFTSMN JRG | CHKR | APPV MEL | SCALE AS SHOWN | Plotted on: 2016-12-09

REV | DESCRIPTION | BY | APPV | DATE

q:\r13-0290.001 paxtang parkway\sheets\pax_parkway.dwg

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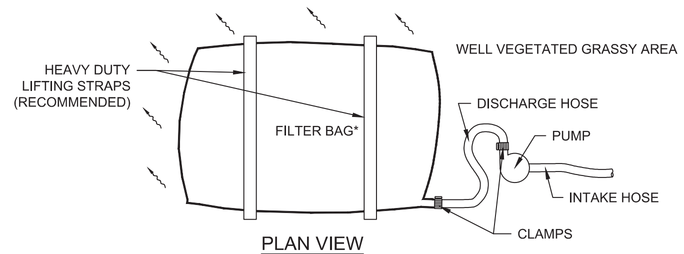
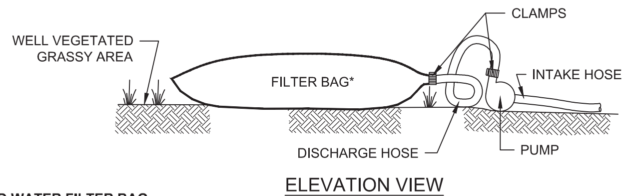
PROJECT NUMBER: R13-0290.001
TASK: 01 SUBTASK: 01
DATE: OCTOBER 31, 2016





ES-3-16 PUMPED WATER FILTER BAG

1. LOW VOLUME FILTER BAGS SHALL BE MADE FROM NON-WOVEN GEOTEXTILE MATERIAL SEWN WITH HIGH STRENGTH, DOUBLE STITCHED "J" TYPE SEAMS. THEY SHALL BE CAPABLE OF TRAPPING PARTICLES LARGER THAN 150 MICRONS. HIGH VOLUME FILTER BAGS SHALL BE MADE FROM WOVEN GEOTEXTILES THAT MEET THE FOLLOWING STANDARDS:

PROPERTY	TEST METHOD	MINIMUM STANDARD
AVG. WIDE WIDTH STRENGTH	ASTM D-4884	60 LB/IN
GRAB TENSILE	ASTM D-4632	205 LB
PUNCTURE	ASTM D-4833	110 LB
MULLEN BURST	ASTM D-3786	350 PSI
UV RESISTANCE	ASTM D-4355	70%
AOS % RETAINED	ASTM D-4751	80 SIEVE

2. A SUITABLE MEANS OF ACCESSING THE BAG WITH MACHINERY REQUIRED FOR DISPOSAL PURPOSES SHALL BE PROVIDED. FILTER BAGS SHALL BE REPLACED WHEN THEY BECOME 1/2 FULL OF SEDIMENT. SPARE BAGS SHALL BE KEPT AVAILABLE FOR REPLACEMENT OF THOSE THAT HAVE FAILED OR ARE FILLED. BAGS SHALL BE PLACED ON STRAPS TO FACILITATE REMOVAL UNLESS BAGS COME WITH LIFTING STRAPS ALREADY ATTACHED.

3. BAGS SHALL BE LOCATED IN WELL-VEGETATED (GRASSY) AREA, AND DISCHARGE ONTO STABLE, EROSION RESISTANT AREAS. WHERE THIS IS NOT POSSIBLE, A GEOTEXTILE UNDERLAYMENT AND FLOW PATH SHALL BE PROVIDED. BAGS MAY BE PLACED ON FILTER STONE TO INCREASE DISCHARGE CAPACITY. BAGS SHALL NOT BE PLACED ON SLOPES GREATER THAN 5%. FOR SLOPES EXCEEDING 5%, CLEAN ROCK OR OTHER NON-ERODIBLE AND NON-POLLUTING MATERIAL MAY BE PLACED UNDER THE BAG TO REDUCE SLOPE STEEPNESS.

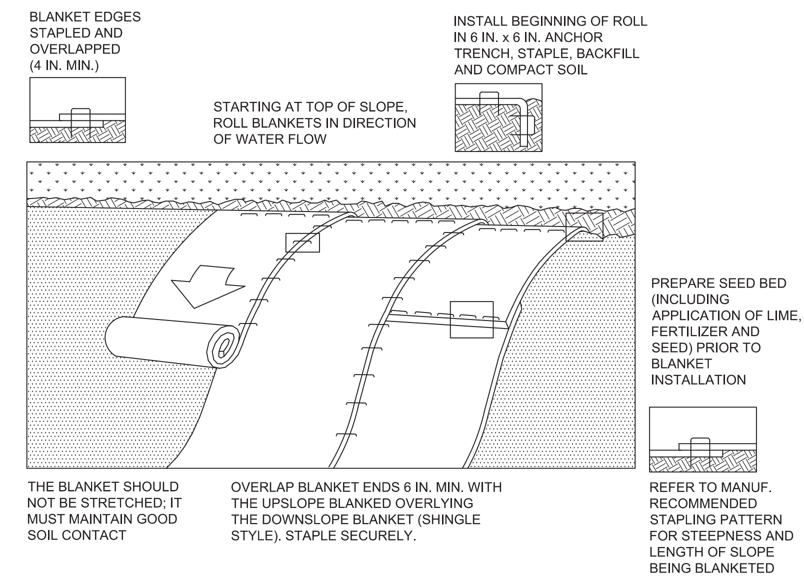
4. NO DOWNSLOPE SEDIMENT BARRIER IS REQUIRED FOR MOST INSTALLATIONS. COMPOST BERM OR COMPOST FILTER SOCK SHALL BE INSTALLED BELOW BAGS LOCATED IN HQ OR EV WATERSHEDS, WITHIN 50 FEET OF ANY RECEIVING SURFACE WATER OR WHERE GRASSY AREA IS NOT AVAILABLE.

5. THE PUMP DISCHARGE HOSE SHALL BE INSERTED INTO THE BAGS IN THE MANNER SPECIFIED BY THE MANUFACTURER AND SECURELY CLAMPED. A PIECE OF PVC PIPE IS RECOMMENDED FOR THIS PURPOSE.

6. THE PUMPING RATE SHALL BE NO GREATER THAN 750 GPM OR 1/2 THE MAXIMUM SPECIFIED BY THE MANUFACTURER, WHICHEVER IS LESS. PUMP INTAKES SHALL BE FLOATING AND SCREENED.

7. FILTER BAGS SHALL BE INSPECTED DAILY. IF ANY PROBLEM IS DETECTED, PUMPING SHALL CEASE IMMEDIATELY AND NOT RESUME UNTIL THE PROBLEM IS CORRECTED.

ES-3-16 PUMPED WATER FILTER BAG
NOT TO SCALE



NOTES:

SEED AND SOIL AMENDMENTS SHALL BE APPLIED ACCORDING TO THE RATES IN THE PLAN DRAWINGS PRIOR TO INSTALLING THE BLANKET.

PROVIDE ANCHOR TRENCH AT TOE OF SLOPE IN SIMILAR FASHION AS AT TOP OF SLOPE.

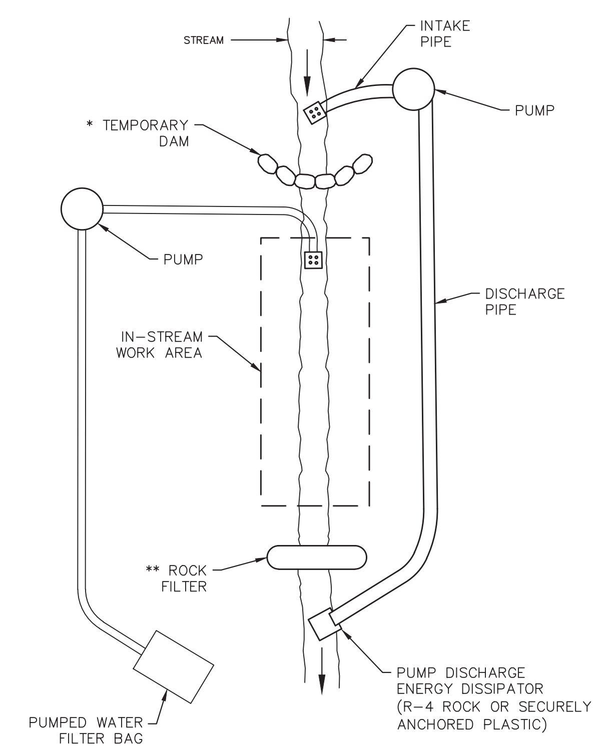
SLOPE SURFACE SHALL BE FREE OF ROCKS, CLODS, STICKS, AND GRASS.

BLANKET SHALL HAVE GOOD CONTINUOUS CONTACT WITH UNDERLYING SOIL THROUGHOUT ENTIRE LENGTH. LAY BLANKET LOOSELY AND STAKE OR STAPLE TO MAINTAIN DIRECT CONTACT WITH SOIL. DO NOT STRETCH BLANKET.

THE BLANKET SHALL BE STAPLED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.

BLANKETED AREAS SHALL BE INSPECTED WEEKLY AND AFTER EACH RUNOFF EVENT UNTIL PERENNIAL VEGETATION IS ESTABLISHED TO A MINIMUM UNIFORM 70% COVERAGE THROUGHOUT THE BLANKETED AREA. DAMAGED OR DISPLACED BLANKETS SHALL BE RESTORED OR REPLACED WITHIN 4 CALENDAR DAYS.

ES-11-1 EROSION CONTROL BLANKET INSTALLATION



ES-3-18 TEMPORARY COFFERDAM AND PUMP BYPASS AROUND IN-CHANNEL WORK AREAS

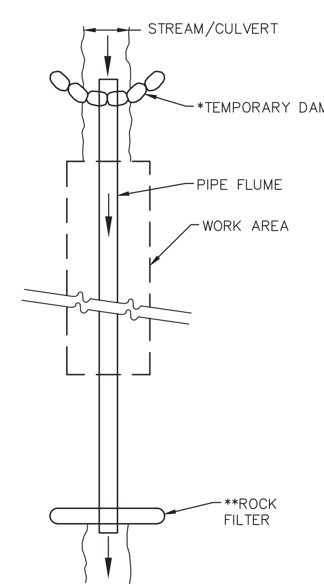
* SANDBAGS (STANDARD CONSTRUCTION DETAIL ES-3-15), JERSEY BARRIERS, OR OTHER NON-EROSIVE MATERIAL, NO EARTH FILL. DO NOT EXCAVATE A SUMP FOR THE PUMP INTAKE.

** SEE STANDARD CONSTRUCTION DETAIL ES-4-14. FOR LOW GRADIENT CHANNELS, THE ROCK FILTER MAY BE REPLACED BY AN IMPERVIOUS COFFERDAM TO PREVENT BACKFLOW INTO THE WORK AREA.

1. PUMP INTAKE SHALL BE MAINTAINED A SUFFICIENT DISTANCE FROM BOTTOM TO PREVENT SEDIMENT FROM ENTERING THE SYSTEM.

2. TEMPORARY COFFERDAM AND PUMP BYPASS CONSTRUCTION SEQUENCE:
A) SET UP BYPASS PUMP AND TEMPORARY PIPING. PLACE OUTLET OF TEMPORARY PIPE TO MINIMIZE EROSION AT DISCHARGE SITE OR PROVIDE TEMPORARY ENERGY DISSIPATION MEASURES. FIRMLY ANCHOR PUMP AND PIPING.
B) CONSTRUCT OUTLET PROTECTION IF NEEDED.
C) CONSTRUCT TEMPORARY COFFERDAM UPSTREAM OF WORK AREA TO IMPOUND WATER FOR BYPASS PUMP INTAKE. USE FLOATING INTAKE FOR PUMPS WHERE POSSIBLE.
D) CONSTRUCT A ROCK FILTER DOWNSTREAM OF WORK AREA AND UPSTREAM OF TEMPORARY PIPE DISCHARGE.
E) CHECK OPERATION OF PUMP AND PIPING SYSTEM.
F) PERFORM CONSTRUCTION WITHIN THE WORK AREA.
G) IF NECESSARY, DEWATER IN-STREAM WORK AREA AND DISCHARGE WATER THROUGH A PUMPED WATER FILTER BAG IN ACCORDANCE WITH DETAIL ES-3-16.
H) UPON COMPLETION OF CONSTRUCTION, REMOVE THE TEMPORARY COFFERDAM, BYPASS PUMP, TEMPORARY PIPE AND ROCK FILTER.

ES-3-18 TEMPORARY COFFERDAM AND PUMP BYPASS AROUND IN-CHANNEL WORK AREAS
NOT TO SCALE



ES-3-19 RIGID OR FLEXIBLE PIPE FLUME THROUGH A WORK AREA

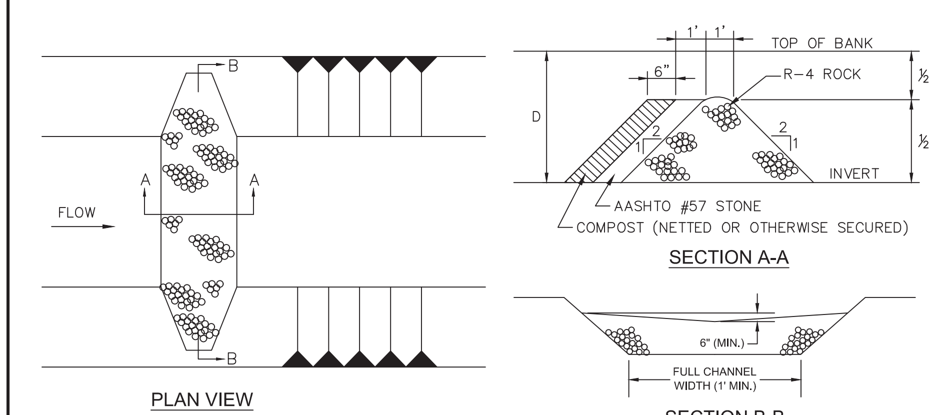
* SANDBAGS (STANDARD CONSTRUCTION DETAIL ES-3-15), JERSEY BARRIERS, OR OTHER NON-EROSIVE MATERIAL, NO EARTH FILL.

** SEE STANDARD CONSTRUCTION DETAIL ES-4-14. FOR LOW GRADIENT CHANNELS, THE ROCK FILTER MAY BE REPLACED BY AN IMPERVIOUS COFFERDAM TO PREVENT BACKFLOW INTO THE WORK AREA.

RIGID OR FLEXIBLE PIPE FLUME THROUGH A WORK AREA CONSTRUCTION SEQUENCE:
A) INSTALL TEMPORARY PIPE THROUGH THE WORK AREA. PLACE OUTLET OF TEMPORARY PIPE TO MINIMIZE EROSION AT DISCHARGE SITE OR PROVIDE TEMPORARY ENERGY DISSIPATION MEASURES.
B) CONSTRUCT A COFFERDAM UPSTREAM OF THE WORK AREA TO DIVERT FLOW THROUGH THE TEMPORARY PIPE. ANCHOR AND SEAL TEMPORARY PIPE SECURELY AT INLET.
C) CONSTRUCT A ROCK FILTER DOWNSTREAM OF WORK AREA AND UPSTREAM OF TEMPORARY PIPE DISCHARGE.
D) PERFORM CONSTRUCTION ACTIVITIES WITHIN THE WORK AREA.
E) UPON COMPLETION OF CONSTRUCTION, REMOVE THE TEMPORARY COFFERDAM, TEMPORARY PIPE, AND ROCK FILTER.

ES-3-19 RIGID OR FLEXIBLE PIPE FLUME THROUGH A WORK AREA
NOT TO SCALE

FOR 3' ≤ D, USE R-4
FOR 2' ≤ D, USE R-3
NOT APPLICABLE FOR D < 2'



ES-4-14 ROCK FILTER

FILTER NO.	LOCATION	D (FT.)	RIPRAP SIZE
1	IMMEDIATELY DOWNSTREAM OF SITE 1 LIMIT OF WORK	3.5	R-4
2	IMMEDIATELY DOWNSTREAM OF SITE 2 LIMIT OF WORK	2.5	R-4
3	IMMEDIATELY DOWNSTREAM OF SITE 3 LIMIT OF WORK	3.5	R-4
4	IMMEDIATELY DOWNSTREAM OF SITE 4 AT CONFLUENCE OF EXISTING STREAM	3.5	R-4

1. SEDIMENT SHALL BE REMOVED WHEN ACCUMULATIONS REACH 1/2 THE HEIGHT OF THE FILTER.

2. IMMEDIATELY UPON STABILIZATION OF EACH CHANNEL, INSTALLER SHALL REMOVE ACCUMULATED SEDIMENT, REMOVE ROCK FILTER, AND STABILIZE DISTURBED AREAS.

ES-4-14 ROCK FILTER
NOT TO SCALE

DRAWING NO. ES-502

PAXTANG PARKWAY
WATERSHED RESTORATION - PHASE 1
CITY OF HARRISBURG, PAXTANG BOROUGH, SUSQUEHANNA TOWNSHIP DAUPHIN COUNTY, PA
EROSION & SEDIMENT POLLUTION CONTROL DETAILS

DSGN MEL | DFTSMN JRG | CHKR | APPV MEL | SCALE AS SHOWN
Plotted on: 2016-12-09

REV | DESCRIPTION | BY | APPV | DATE

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www.skellyloy.com

PROJECT NUMBER: R13-0290.001
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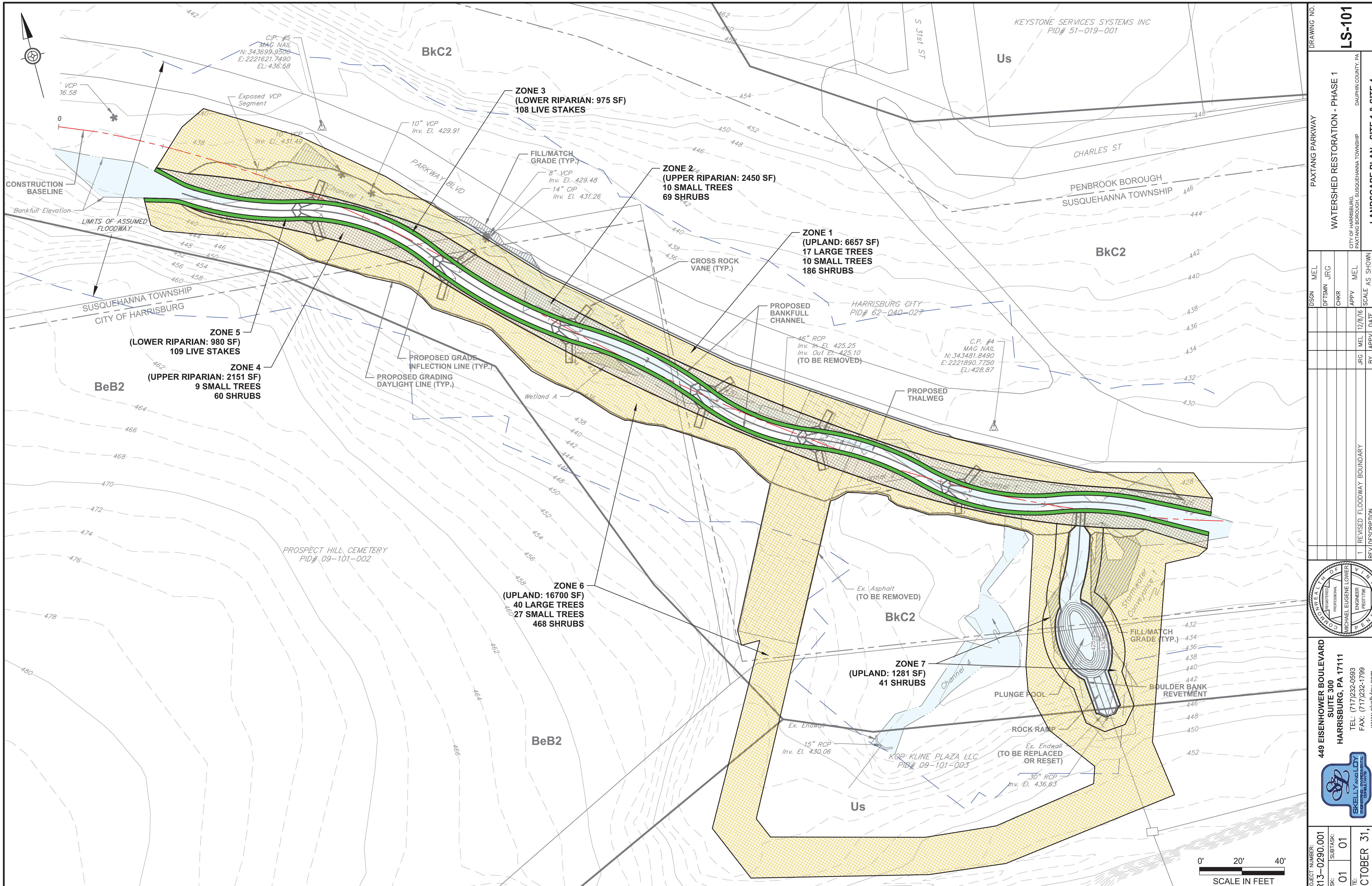

ZONE 1
(UPLAND: 6657 SF)
17 LARGE TREES
10 SMALL TREES
186 SHRUBS
ZONE 2
(UPPER RIPARIAN: 2450 SF)
10 SMALL TREES
69 SHRUBS
ZONE 3
(LOWER RIPARIAN: 975 SF)
108 LIVE STAKES
ZONE 4
(UPPER RIPARIAN: 2151 SF)
9 SMALL TREES
60 SHRUBS
ZONE 5
(LOWER RIPARIAN: 980 SF)
109 LIVE STAKES
ZONE 6
(UPLAND: 16700 SF)
40 LARGE TREES
27 SMALL TREES
468 SHRUBS
ZONE 7
(UPLAND: 1281 SF)
41 SHRUBS
CONSTRUCTION BASELINE
Bankfull Elevation
LIMITS OF ASSUMED FLOODWAY
FILL/MATCH GRADE (TYP.)
CROSS ROCK VANE (TYP.)
PROPOSED BANKFULL CHANNEL
PROPOSED THALWEG
PROPOSED GRADE INFLECTION LINE (TYP.)
PROPOSED GRADING DAYLIGHT LINE (TYP.)
PLUNGE POOL
ROCK RAMP
BOULDER BANK REVETMENT
Ex. Asphalt (TO BE REMOVED)
Ex. Endwall (TO BE REPLACED OR RESET)
46" RCP Inv. In El. 425.25 Inv. Out El. 425.10 (TO BE REMOVED)
15" RCP Inv. El. 430.06
30" RCP Inv. El. 436.63
10" VCP Inv. El. 429.91
8" VCP Inv. El. 429.48
14" CIP Inv. El. 431.26
Exposed VCP Segment
C.P. #5 MAG NAIL N: 343699.9500 E: 2221621.7490 EL: 436.58
C.P. #4 MAG NAIL N: 343481.8490 E: 2221890.7750 EL: 428.87
KEYSTONE SERVICES SYSTEMS INC PID# 51-019-001
HARRISBURG CITY PID# 62-040-027
PROSPECT HILL CEMETERY PID# 09-101-002
KOP KLINE PLAZA LLC PID# 09-101-003
PARKWAY BLVD
CHARLES ST
S 31st ST
PENBROOK BOROUGH
SUSQUEHANNA TOWNSHIP
CITY OF HARRISBURG
Wetland A
Stormwater Conveyance 1
Channel 4
BkC2
BeB2
Us
SCALE IN FEET
0' 20' 40'
DRAWING NO. LS-101
PAXTANG PARKWAY
WATERSHED RESTORATION - PHASE 1
CITY OF HARRISBURG, PENBROOK BOROUGH, SUSQUEHANNA TOWNSHIP
DAUPHIN COUNTY, PA
LANDSCAPE PLAN - SITE 1 & SITE 4
DSGN MEL
DFTSMN JRG
CHKR
APPV MEL
SCALE AS SHOWN
Plotted on: 2016-12-09
1 REVISED FLOODWAY BOUNDARY JRG MEL 12/8/16
REV DESCRIPTION BY APPV DATE
q: \r13-0290.001 paxtang parkway\sheets\pax_parkway.dwg
MICHAEL EUGENE LOWER
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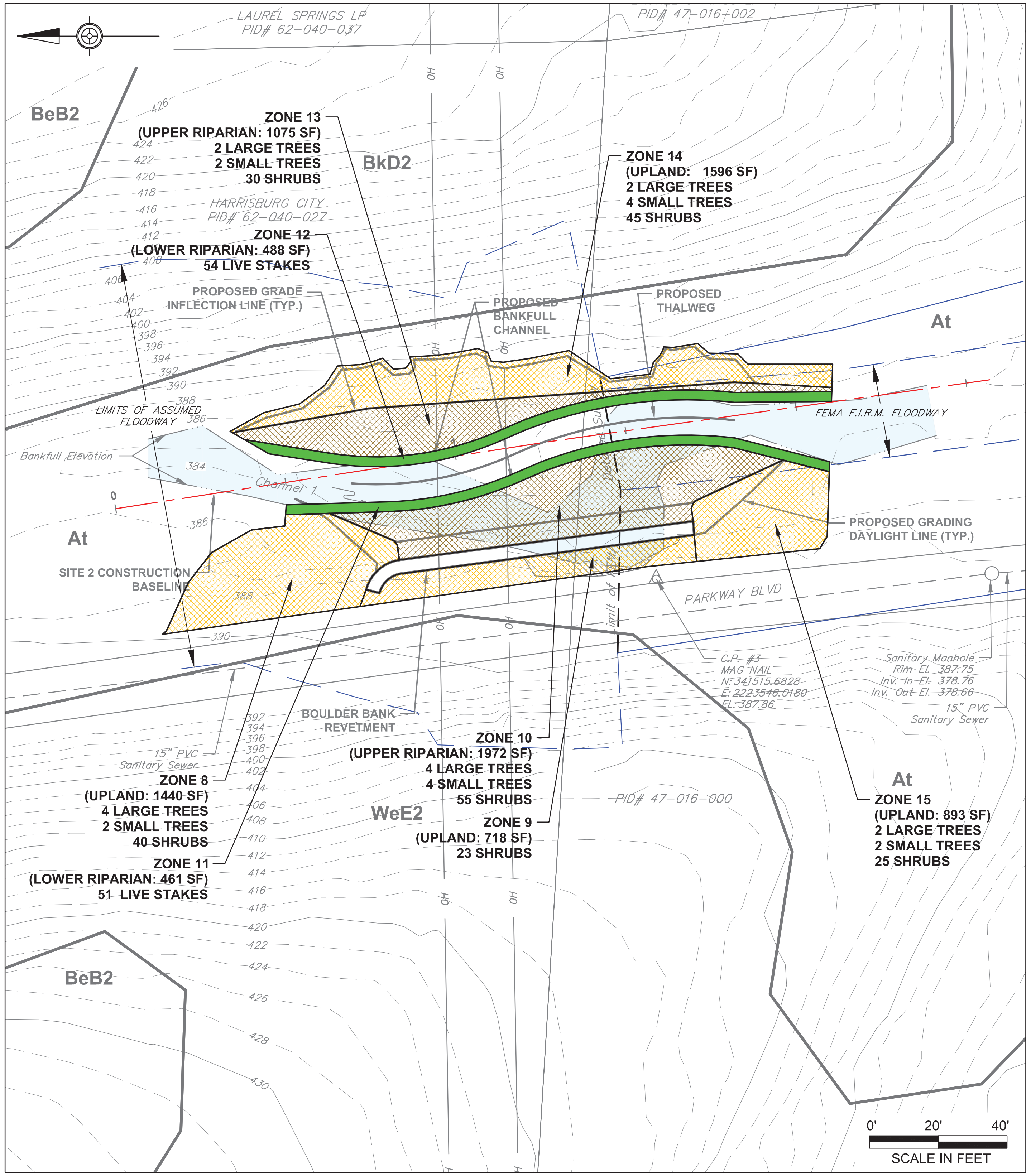
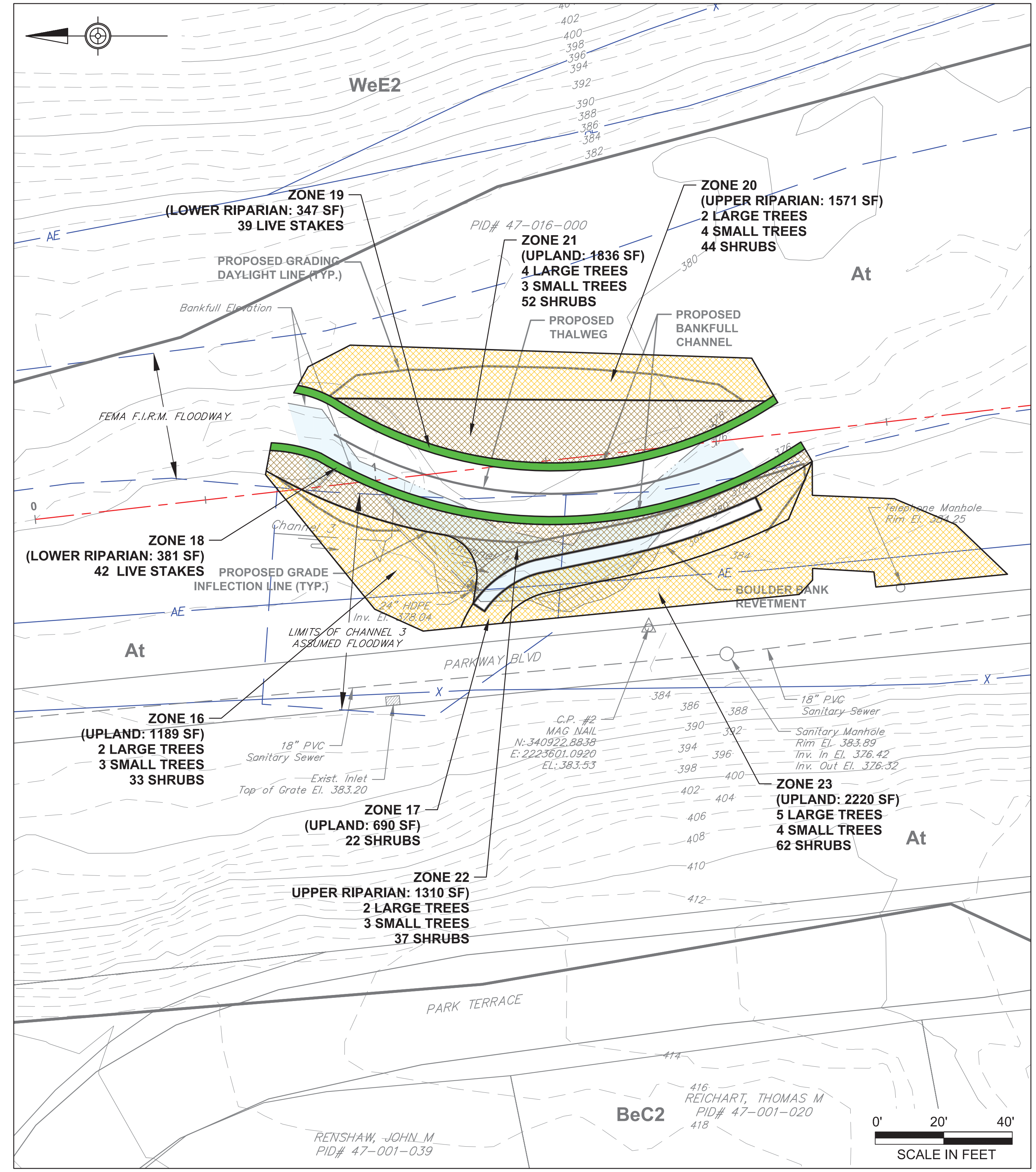


LANDSCAPE PLAN - SITE 2



LANDSCAPE PLAN - SITE 3

LANDSCAPE LEGEND

DRAWING NO. LS-102

PAXTANG PARKWAY
WATERSHED RESTORATION - PHASE 1
CITY OF HARRISBURG, PAXTANG BOROUGH, SUSQUEHANNA TOWNSHIP, DAUPHIN COUNTY, PA
LANDSCAPE PLAN - SITE 2 & SITE 3

DSGN MEL | DFTSMN JRG | CHKR | APPV MEL | SCALE AS SHOWN | Plotted on: 2016-12-09

REV	DESCRIPTION	BY	APPV	DATE
1	REVISED FLOODWAY BOUNDARY	JRG	MEL	12/8/16

q:\r13-0290.001 paxtang parkway\sheets\pax_parkway.dwg

COMMONWEALTH OF PENNSYLVANIA — REGISTERED PROFESSIONAL ENGINEER — MICHAEL EUGENE LOWER — PE071786

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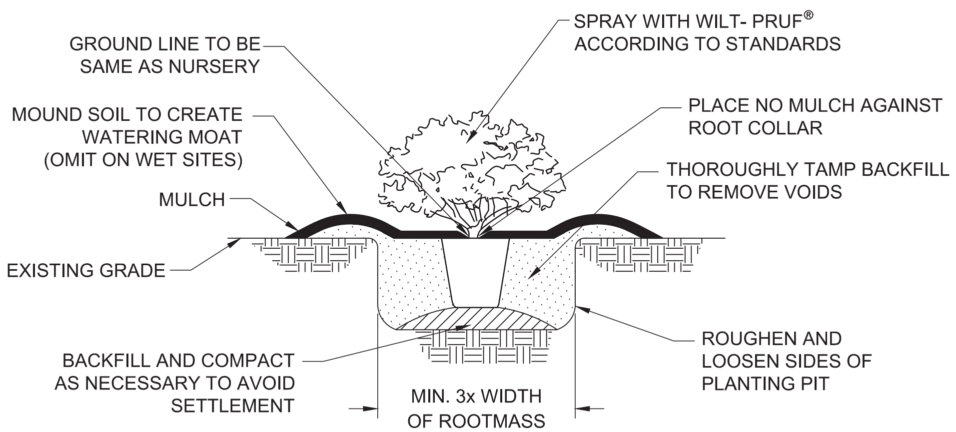
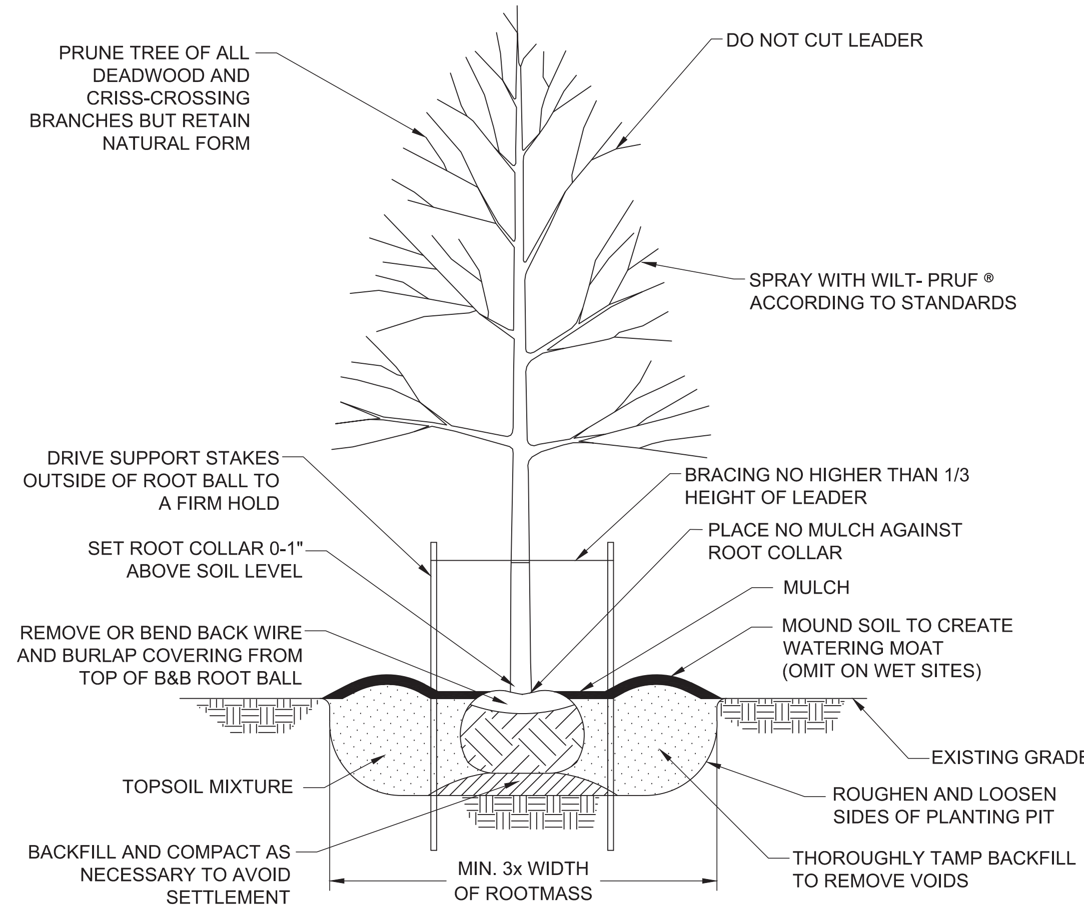
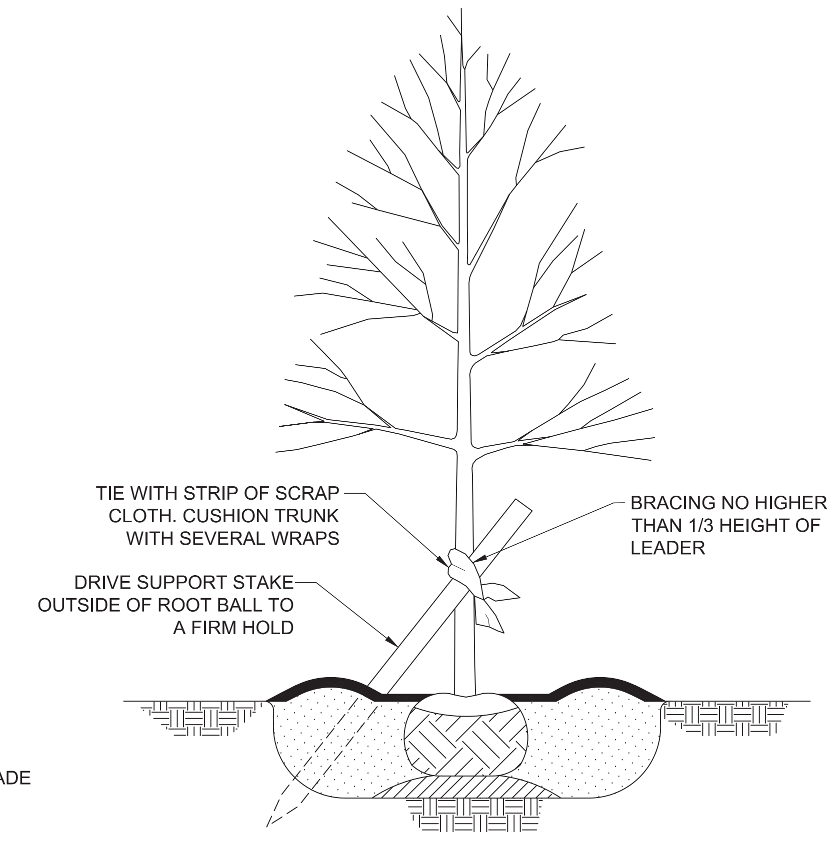


LS-A CONTAINER PLANTING DETAIL
NOT TO SCALE

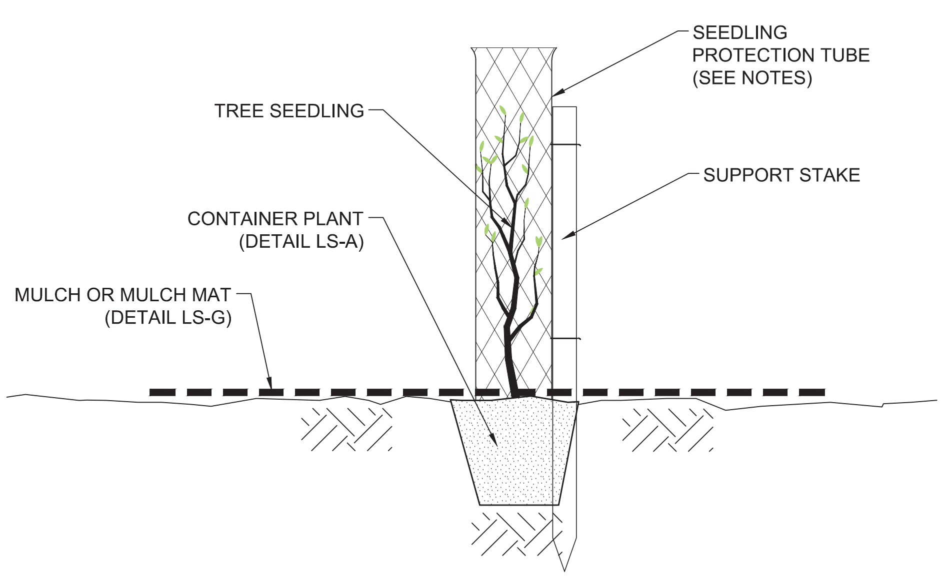


DETAIL

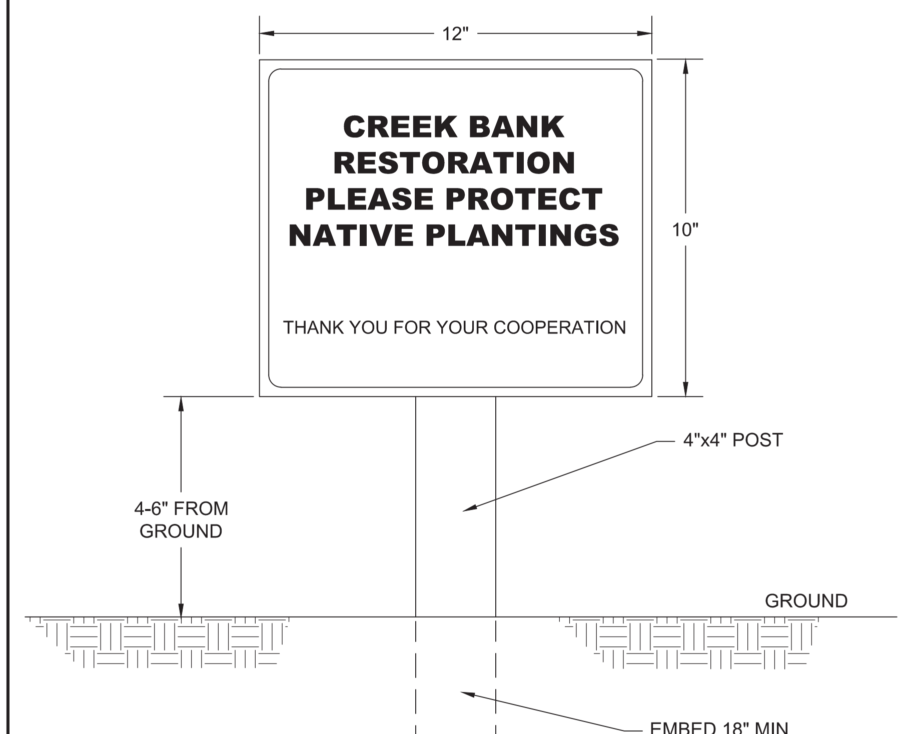


ALTERNATE METHOD

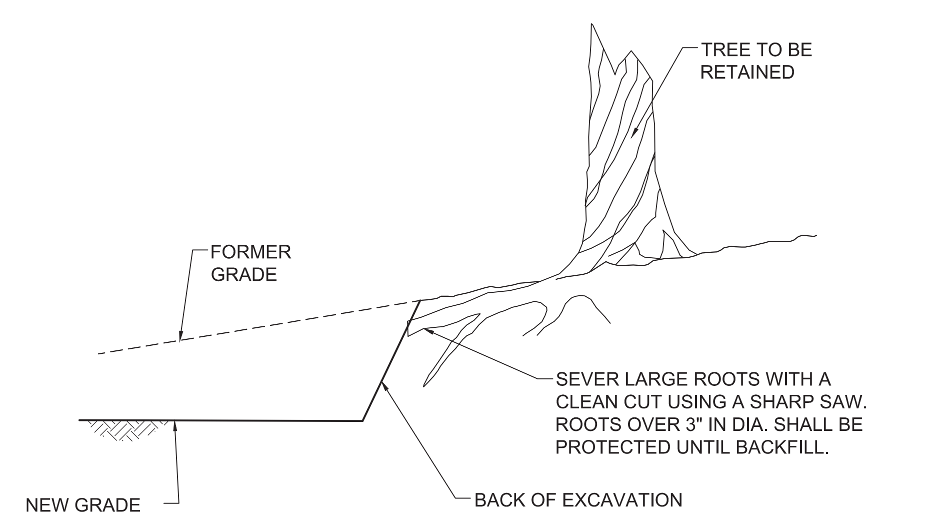
LS-B TREE PLANTING
NOT TO SCALE



LS-C TREE SEEDLING PROTECTION
NOT TO SCALE



LS-D PLANTING AREA PROTECTION SIGN
NOT TO SCALE



SECTION

LS-E ROOT PRUNING IN THE VICINITY OF RETAINED TREES
NOT TO SCALE

DRAWING NO. LS-501

PAXTANG PARKWAY
WATERSHED RESTORATION - PHASE 1
CITY OF HARRISBURG, PAXTANG BOROUGH, SUSQUEHANNA TOWNSHIP, DAUPHIN COUNTY, PA
LANDSCAPE DETAILS

DSGN MEL
DFTSMN JRG
CHKR
APPV MEL
SCALE AS SHOWN
Plotted on: 2016-12-09

REV | DESCRIPTION | BY | APPV | DATE

q:\r13-0290.001 paxtang parkway\sheets\pax_parkway.dwg

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REGISTERED PROFESSIONAL ENGINEER
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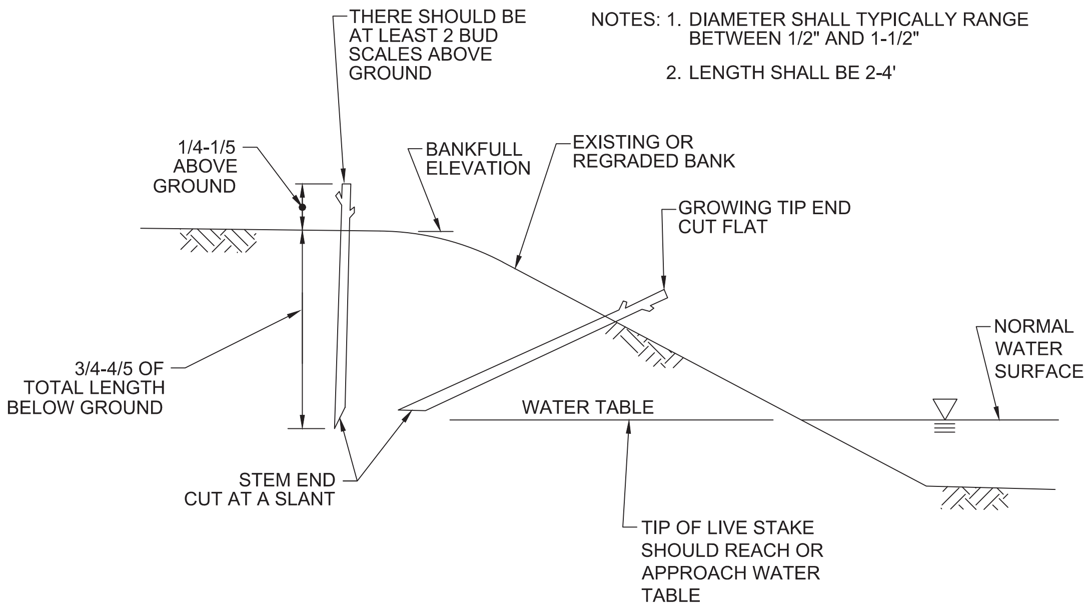
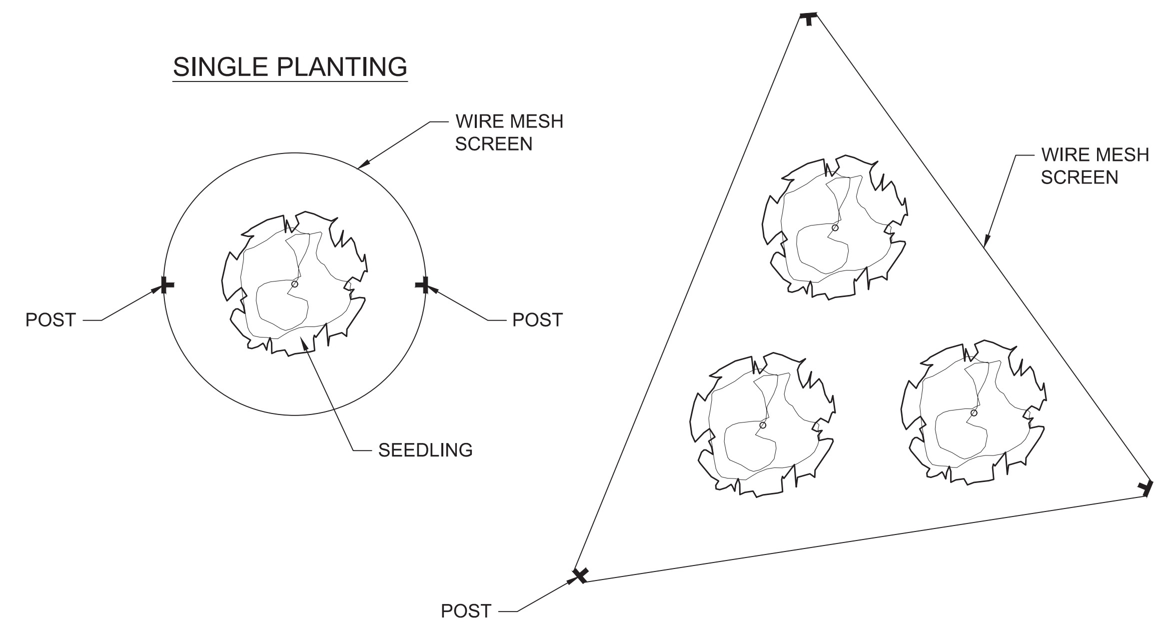
TEL: (717)232-0593
FAX: (717)232-1799
www.skellyloy.com
SKELLY and LOY

PROJECT NUMBER: R13-0290.001
TASK: 01
SUBTASK: 01
DATE: OCTOBER 31, 2016

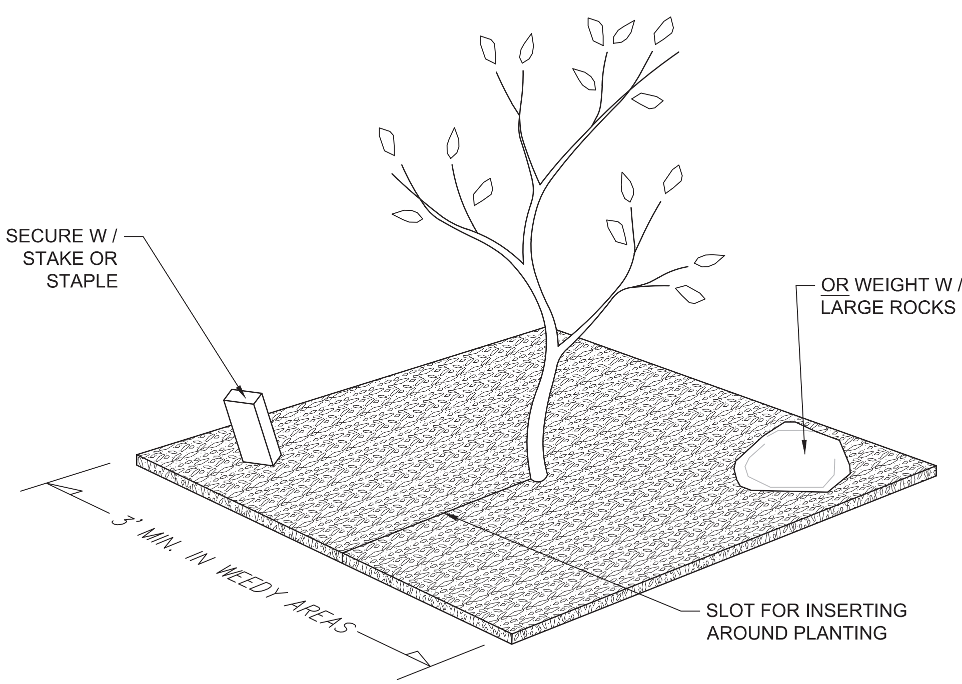


LS-F LIVE STAKE DETAIL
NOT TO SCALE

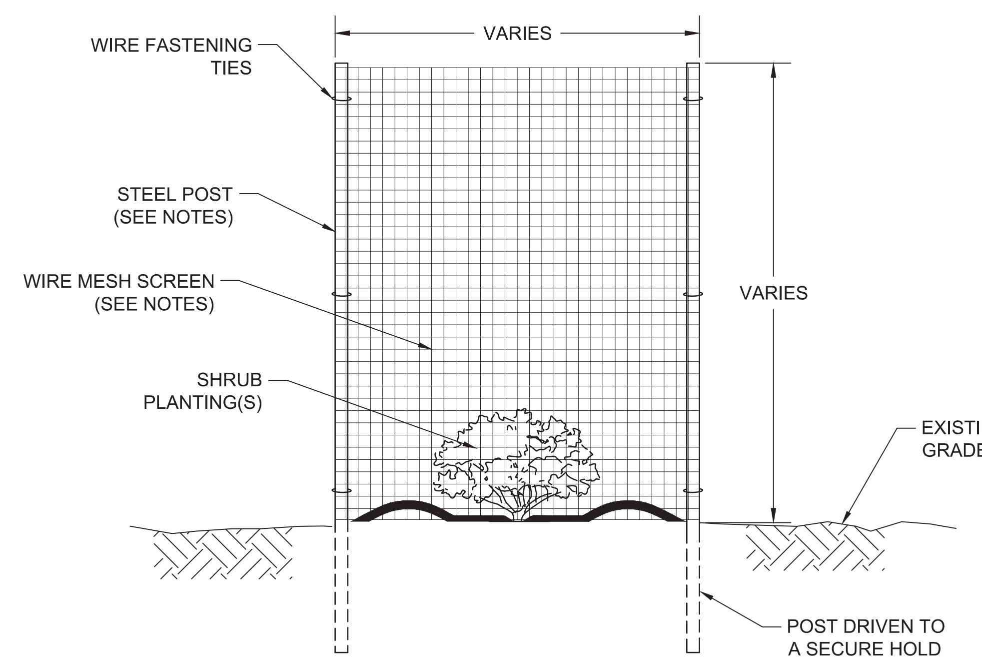
CLUSTER PLANTING



PLAN VIEW SHOWING PLACEMENT OPTIONS



LS-G MULCH MAT APPLICATION
NOT TO SCALE



SECTION

LS-H WIRE CAGE PLANT PROTECTION
NOT TO SCALE

DRAWING NO. LS-502

PAXTANG PARKWAY
WATERSHED RESTORATION - PHASE 1
CITY OF HARRISBURG, PAXTANG BOROUGH, SUSQUEHANNA TOWNSHIP DAUPHIN COUNTY, PA
LANDSCAPE DETAILS

DSGN MEL
DFTSMN JRG
CHKR
APPV MEL
SCALE AS SHOWN
Plotted on: 2016-12-09

REV | DESCRIPTION | BY | APPV | DATE

q:\r13-0290.001 paxtang parkway\sheets\pax_parkway.dwg

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL ENGINEER
MICHAEL EUGENE LOWER
PE077786

449 EISENHOWER BOULEVARD
SUITE 300
HARRISBURG, PA 17111
TEL: (717)232-0593
FAX: (717)232-1799
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SKELLY and LOY
ENGINEERING - ENVIRONMENTAL CONSULTANTS

PROJECT NUMBER: R13-0290.001
TASK: 01
SUBTASK: 01
DATE: OCTOBER 31, 2016

PLANTING TABLE - WOODY SPECIES

TYPE	COMMON NAME	BOTANICAL NAME	INDICATOR	WATER	LIGHT	PLANTING ZONE	QUANTITIES
MEDIUM TO LARGE TREES	RED MAPLE	*ACER RUBRUM*	FAC	WET - AVERAGE	SUN / PART SHADE	RU / U	**86**
	WILD BLACK CHERRY	*PRUNUS SEROTINA*	FACU	DRY - MOIST	SUN / SHADE	U	
	SHAGBARK HICKORY	*CARYA OVATA*	FACU	AVERAGE	SUN / SHADE	U	
	SWEET GUM	*LIQUIDAMBAR STYRACIFLUA*	FAC	AVERAGE	SUN	RU / U	
	TULIP POPLAR	*LIRIODENDRON TULIPIFERA*	FACU	AVERAGE	SUN	U	
	BLACK GUM	*NYSSA SYLVATICA*	FAC	WET - AVERAGE	SHADE / PART SHADE	RU / U	
	AMERICAN SYCAMORE	*PLATANUS OCCIDENTALIS*	FACW	AVERAGE - WET	SUN	RU	
	WHITE OAK	*QUERCUS ALBA*	FACU	AVERAGE - DRY	SUN	U	
	RED OAK	*QUERCUS RUBRA*	FACU	AVERAGE - DRY	SUN	U	
SMALL TREE	SPECKLED ALDER	*ALNUS INCANA*	FACW	WET - AVERAGE	SUN / PART SHADE	RU / RL	**87**
	SERVICEBERRY	*AMELANCHIER ARBOREA*	FAC	MOIST - AVERAGE	SUN / PART SHADE	RU / U	
	EASTERN REDBUD	*CERCIS CANADENSIS*	FACU	AVERAGE	SUN / PART SHADE	U	
	FLOWERING DOGWOOD	*CORNUS FLORIDA*	FACU	AVERAGE	SUN / PART SHADE	U	
	RED-OSIER DOGWOOD	*CORNUS SERICEA*	FACW	WET - AVERAGE	SUN / PART SHADE	RU / RL	
	WITCH-HAZEL	*HAMAMELIS VIRGINIANA*	FAC	AVERAGE	SUN / PART SHADE	U	
SHRUB	BLACK CHOKECHERRY	*ARONIA MELANOCARPA*	FAC	MOIST - AVERAGE	SUN / PART SHADE	RU / U	**1292**
	SUMMERSWEET	*CLETHRA ALNIFOLIA*	FAC	AVERAGE - WET	SUN / PART SHADE	RU / U	
	BEAKED HAZELNUT	*CORYLUS CORNUTA*	FACU	AVERAGE - DRY	SUN / PART SHADE	U	
	WINTERBERRY	*ILEX VERTICILLATA*	FACW	WET - AVERAGE	SUN / PART SHADE	RU	
	SPICEBUSH	*LINDERA BENZOIN*	FACW	MOIST - AVERAGE	SHADE / PART SHADE	RU	
	NINEBARK	*PHYSOCARPUS OPULIFOLIUS*	FACW	MOIST - AVERAGE	SUN / PART SHADE	RU / RL	
	WILD ROSE	*ROSA VIRGINIANA*	FAC	MOIST	SUN	RU	
	WILLOW	*SALIX SPP.*	FACW-OBL	MOIST - WET	SUN / PART SHADE	RL	
	COMMON ELDERBERY	*SAMBUCUS CANADENSIS*	FACW	WET - MOIST	SUN / PART SHADE	RL	
	MEADOWSWEET	*SPIRAEA LATIFOLIA*	FAC	MOIST - AVERAGE	SUN	RU	
	ARROWWOOD	*VIBURNUM DENTATUM*	FAC	AVERAGE - MOIST	SUN / SHADE	RU / U	
	NANNYBERRY	*VIBURNUM LENTAGO*	FAC	AVERAGE-MOIST	SUN / SHADE	RU / U	
LIVE STAKE	RED-OSIER DOGWOOD	*CORNUS SERICEA*	FACW	WET - AVERAGE	SUN / PART SHADE	RU / RL	**403**
	NINEBARK	*PHYSOCARPUS OPULIFOLIUS*	FACW	MOIST - AVERAGE	SUN / PART SHADE	RU / RL	
	WILLOW (SHRUB)	*SALIX SPP.*	FACW-OBL	MOIST - WET	SUN / PART SHADE	RL	

NOTES:

1. "WATER": PLANT PREFERS WET, MOIST, AVERAGE OR DRY SOILS (OR SOME COMBINATION OF THESE) DURING GROWING SEASON.
2. "LIGHT": SUN = FULL SUN; PART SHADE = TOLERATES PART SHADE; SHADE = TOLERATES FULL SHADE.
3. INDICATED CONTAINER SIZE IS RECOMMENDED MINIMUM.
4. PLANTING ZONES: U = UPLAND; RU = UPPER RIPARIAN; RL = LOWER RIPARIAN.
5. UPPER RIPARIAN ZONE (RU) = FLOOD-PRONE ZONE ABOVE BANKFULL ELEVATION.
6. LOWER RIPARIAN ZONE (RL) = AT AND BELOW BANKFULL ELEVATION.
7. QUANTITIES REFLECT A "RANDOMIZED" OR "CLUMPED" ARRANGEMENT FOR BOTH TREES AND SHRUBS.
8. ALL CONTAINER PLANTING LOCATIONS SHALL BE FIELD STAKED BY A RESTORATION SPECIALIST PRIOR TO OUTPLANTING.
9. ALL WOODY CONTAINER STOCK PLANTINGS SHALL BE MARKED WITH COLORED RIBBON TO FACILITATE AFTERCARE.
10. USE NATIVE SHRUB-FORMING WILLOW (SALIX) SPECIES ONLY. SEE NOTES. DO NOT PLANT BLACK WILLOW (SALIX NIGRA).
11. DO NOT USE NON-SUCKERING CULTIVARS OF ANY SPECIES (E.G. RED-OSIER DOGWOOD).

DRAWING NO. LS-503

PAXTANG PARKWAY
WATERSHED RESTORATION - PHASE 1
CITY OF HARRISBURG, PAXTANG BOROUGH, SUSQUEHANNA TOWNSHIP
DAUPHIN COUNTY, PA
LANDSCAPE DETAILS

DSGN MEL | DFTSMN JRG | CHKR | APPV MEL | SCALE AS SHOWN | Plotted on: 2016-12-09

REV | DESCRIPTION | BY | APPV | DATE

q:\r13-0290.001 paxtang parkway\sheets\pax_parkway.dwg

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL ENGINEER
MICHAEL EUGENE LOWER

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449 EISENHOWER BOULEVARD
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FAX: (717)232-1799
www.skellyloy.com

PROJECT NUMBER: R13-0290.001
TASK: 01 SUBTASK: 01
DATE: OCTOBER 31, 2016

NOTES:
1) THIS PLAN IS BASED ON AERIAL MAPPING BY NOREAST MAPPING
2) EXISTING CONDITION SITE FEATURES AND TOPOGRAPHY ARE BASED ON A FIELD SURVEY BY RAUDENBUSH ENGINEERING, INC., PERFORMED IN APRIL 2017.
3) HORIZONTAL DATUM IS BASED UPON THE NORTH AMERICAN DATUM OF 1983 [NAD83(2011)], PENNSYLVANIA STATE PLANE COORDINATE SYSTEM, SOUTH ZONE.
4) VERTICAL DATUM IS BASED UPON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
5) WETLAND DELINEATION PERFORMED BY VORTEX ENVIRONMENTAL, INC IN APRIL 2017
6) PREDOMINANT SOILS IN THE PROJECT AREA ARE:
   a. ATKINS SILT LOAM (At)
   b. PHILO SILT LOAM (Ph)
   c. WEIKERT SHALY SILT LOAM (WeE2) 25 TO 40% SLOPES
   d. BRINKERTON AND ARMAGH SILT LOAMS (BtB2) 3 TO 8% SLOPES
   e. BERKS SHALY SILT LOAM (BkD2) 15 TO 25% SLOPES
   f. COMLY SILT LOAM (CoB2) 2 TO 8% SLOPES
5) THE FOLLOWING UTILITIES ARE KNOWN TO EXIST WITHIN THE LIMITS OF EXCAVATION:
   a. SANITARY SEWER
6) THE LOCATIONS OF UTILITIES AS SHOWN HEREON ARE BASED UPON ABOVEGROUND FEATURES, SURFACE MARKINGS, FIELD OBSERVATIONS, AND RECORD DRAWINGS PROVIDED BY UTILITY COMPANIES. ACTUAL LOCATIONS OF UTILITIES AND STRUCTURES MAY VARY FROM LOCATIONS SHOWN HEREON AND ADDITIONAL BURIED UTILITIES AND STRUCTURES MAY BE ENCOUNTERED. NO EXCAVATIONS WERE MADE DURING THE PROGRESS OF THIS SURVEY TO LOCATE BURIED UTILITIES AND STRUCTURES.
7) IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO FIELD VERIFY THE EXACT LOCATION AND DEPTH OF ALL UTILITY LINES PRIOR TO THE START OF ANY CONSTRUCTION ACTIVITIES.
8) FLUVIAL SYSTEMS ARE DYNAMIC AND CHANGE OVER TIME. THE EXISTING CONDITIONS TOPOGRAPHY REPRESENTS THE CONDITIONS AT THE TIME OF THE FIELD SURVEY. DESIGN MODIFICATIONS MAY BE NECESSARY TO ACCOMMODATE CHANGES IN SITE CONDITIONS AT THE TIME OF CONSTRUCTION. LANDSTUDIES SHALL BE CONSULTED TO VERIFY THE EXISTING SITE CONDITIONS AND IDENTIFY CONSTRUCTION MODIFICATIONS THAT MAY BE NECESSARY BASED ON THOSE CONDITIONS.
9) IMPROVEMENTS OUTSIDE OF CHAPTER 105 PERMIT BOUNDARY ARE SHOWN FOR REFERENCE ONLY. SEE "FINAL SUBDIVISION & LAND DEVELOPMENT PLAN - PHASE I" OR "EROSION AND SEDIMENTATION CONTROL PLAN" FOR SUSQUEHANNA UNION GREEN BY H.F. LENZ FOR DESIGN INFORMATION.

LEGEND

- EXISTING WATERS EDGE
- EXISTING 100 YEAR FLOODPLAIN
- EXISTING WETLANDS
- EXISTING MAJOR CONTOURS
- EXISTING MINOR CONTOURS
- EX-SS EXISTING SEWER LINE
- EXISTING ROADS
- EXISTING TREE LINE
- EXISTING BRIDGES
- SOIL BOUNDARIES
- CHAPTER 105 BOUNDARY
- PROPERTY BOUNDARIES
- PROPOSED MAJOR CONTOURS
- PROPOSED MINOR CONTOURS
- ORANGE CONSTRUCTION FENCE

PA 042324

717-627-4440
fax: 717-627-4660
landstudies.com
land@landstudies.com
315 North Street | Lititz, PA 17543

Land studies

PROJECT:
SUSQUEHANNA UNION GREEN
HAWTHORNE SPE, LLC.
3605 VARTAN WAY SUITE 301
HARRISBURG PA, 17110

SHEET TITLE:
KEY MAP
PERMIT PLAN SET
BLACK RUN FLOODPLAIN RESTORATION
SUSQUEHANNA TOWNSHIP
DAUPHIN COUNTY, PENNSYLVANIA

REVISIONS

NO.	DATE	DESCRIPTION
1	11/30/18	TWP COMMENTS
2	12/20/18	PERMIT SUBMIT
3	01/08/19	COMMENT RESPONSE
4	05/17/2019	COMMENT RESPONSE
5	6/28/2019	ELMWOOD DRIVE
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PROJECT NUMBER: D-1137.2-18
DRAWN BY: JS
CHECKED BY: BE
DATE: 11/9/2018
SCALE: 1" = 100'
KEY MAP
SHEET NUMBER:
2
OF 15

APPENDIX I – INTERGOVERNMENTAL COOPERATION AGREEMENTS

Executed Agreements

INTERGOVERNMENTAL COOPERATION AGREEMENT FOR THE PREPARATION AND IMPLEMENTATION OF THE JOINT POLLUTION REDUCTION PLAN

THIS AGREEMENT is made this 23rd day of August, 2017, (the "Agreement"), by and among Susquehanna Township and Lower Paxton Township (collectively, Susquehanna Township and Lower Paxton Township are referred to herein as the "Municipalities") and Capital Region Water ("CRW") (collectively, the Municipalities and CRW may sometimes be referred to as the "Participants") for the development and implementation of a Chesapeake Bay Pollutant Reduction Plan, Paxton Creek TMDL Watershed Plan, and a Pollutant Reduction Plan to address Wildwood Lake and an unnamed tributary to Spring Creek ("Joint Pollution Reduction Plan" or "Plan").

This Intergovernmental Cooperation Agreement is authorized and required pursuant to applicable law including, but not limited to, 53 Pa.C.S.A. § 2301, *et seq*.

RECITALS

WHEREAS, the Participants each own, operate, and maintain Small Municipal Separate Storm Sewer Systems ("MS4s") that discharge to the Susquehanna River, Paxton Creek, Spring Creek, and/or Beaver Creek; and

WHEREAS, Paxton Creek, Spring Creek, and Beaver Creek all drain to the Susquehanna River and ultimately the Chesapeake Bay; and

WHEREAS, the Participants wish to engage in a collaborative process of preparing and implementing a Joint Pollution Reduction Plan consisting of a Chesapeake Bay Pollutant Reduction Plan, Paxton Creek Watershed TMDL Plan, and Pollutant Reduction Plan to address Wildwood Lake and an unnamed tributary to Spring Creek (the "Plan"); and

WHEREAS, the Participants desire that CRW shall serve as the point of contact for the Participants to the extent necessary for the development and implementation of the Plan; and

WHEREAS, each Participant will create, operate, and maintain Best Management Practices ("BMP") Projects within its municipal boundaries or service area designed to reduce sediment; and

WHEREAS, as set forth in this Agreement, the Participants shall equally share in the cost to develop the Plan; and

WHEREAS, the purpose of this Agreement is to set forth, *inter alia*, how the Participants will cooperate to create and revise the Plan, and the obligations of each Participant; and

WHEREAS, the Participants agree and acknowledge that nothing in this Agreement, or the resultant actions herefrom, shall prohibit, prevent, or interfere with any Participant's ability to comply with applicable Pennsylvania law and regulation, Federal law and regulation, applicable regulatory agency rules and policies, permit requirements, Pennsylvania Department of Environmental Protection ("DEP") directives, or United States Environmental Protection Agency directives, and local ordinances; and

WHEREAS, all Participants shall adopt an Ordinance (or Resolution if Participant is a municipal authority) approving this Agreement to effectuate their participation.

NOW, THEREFORE, the Participants hereto, in consideration of the mutual promises, covenants, and undertakings herein contained, each binding itself and representing that it has proper legal authority to enter into this Agreement, and intending to be legally bound, agree as follows:

1. **Recitals**. All of the Recitals hereto are incorporated herein by reference as if fully set forth at length.

2. **Guiding Principle**. The Participants have a mutual interest in working together in a cooperative manner to develop and implement the Plan, and to work together in a cooperative manner to achieve the objectives set forth in this Agreement.

3. **Organization**. The Municipalities agree that CRW shall serve as the point of contact to the extent that it is necessary for the Participants to coordinate the development and implementation of the Plan as further set forth in this Agreement.

4. **Functions, Powers and Responsibilities**. Each Participant shall be responsible for the following functions and responsibilities and shall have the following powers:

A. Work cooperatively to oversee, supervise, and administer the development and implementation of the Plan.

B. Oversee, supervise, and administer BMP Projects, including ensuring that BMP Projects are constructed as approved, within its municipal boundaries or service area.

C. Approve for payment and pay appropriate invoices submitted for development of the Plan.

D. Manage and administer all funds related to individual BMP Projects within its municipal boundaries or service area.

E. Facilitate the implementation of new BMP Projects within its municipal boundaries or service area (including, but not limited to, design, permitting, construction, operation, monitoring, maintenance, and approval). The Participants may transfer such obligations for design, construction, operation and maintenance, and monitoring to qualified third parties, but each Participant shall remain responsible to ensure that the contracted third parties are performing the required tasks satisfactorily to the benefit of all Participants.

F. Each Participant must ensure that all applicable notice requirements are satisfied and advertisements are drafted and published as required by applicable laws, including, but not limited to, the Pennsylvania Sunshine Act.

G. Each Participant shall retain all records, as that term is defined by the Pennsylvania Right-to-Know Law, for the time period required by applicable law but not less than six (6) years. Each Participant shall make available to the other Participants for review and copying any records related to the Plan and the activities undertaken pursuant to this Agreement upon submission of written request no less than five (5) business days prior to the desired date of review. Each Participant may waive the requirement for written request in its discretion.

H. Municipalities agree to act in good faith and to cooperate in all reasonable respects with CRW insofar as CRW is acting as the point of contact to coordinate the development and implementation of the Plan as further set forth in this Agreement.

I. Participants agree to take any and all legislative or other acts necessary to implement the purposes of this Agreement.

J. Participants agree to perform their obligations and duties under this Agreement in a competent and business-like manner and shall exercise due care, diligence, and control in connection with costs, fees, and expenses related to such performance.

K. Participants agree and consent to the placement, ownership, continued operation, and ongoing maintenance of new BMP Projects within its municipal boundaries or service area consistent with this Agreement and the Plan. If necessary, Participants agree to obtain any real property necessary for the placement, ownership, operation, and maintenance of BMP Projects including the use of eminent domain pursuant to the Eminent Domain Code, 26 Pa.C.S.A. § 101, *et seq*.

L. Participants agree to continue the operation and maintenance with respect to any and all existing BMPs created before the formation and implementation of this Agreement. All aspects of said operation and maintenance, including all administrative and document related tasks, shall be solely the responsibility of the Participant that operated and maintained the existing BMP before the formation and implementation of this Agreement, to be performed at the sole cost and expense of said Participant.

M. Participants shall collaborate with one another to the extent practicable to take all necessary actions to acquire grants or other funding that can be used to fund the Plan's implementation and/or the actions and activities undertaken pursuant to this Agreement or the Plan.

5. Enforcement Actions. If any compliance or enforcement action (including the pursuit of a civil penalty, issuance of an Notice of Violation ("NOV"), Order, or any other compliance notice or action) is initiated by either the Commonwealth of Pennsylvania or the Federal Government in any way related to the Plan or implementation actions and activities undertaken pursuant to this Agreement, the Participants shall discuss the enforcement action, whether any one or more Participants are responsible for the alleged violation(s), and determine what responsive action(s) shall be. Where an act of malfeasance, misfeasance, negligence, or other misconduct of a Participant results in a civil penalty, issuance of an NOV or other compliance action, a fine, or a damages award of any kind, or other breach of the terms of this Agreement, the responsible Participant shall indemnify and hold harmless the non-responsible Participants with respect thereto.

6. Financing of the Plan

A. Costs associated with the development of the Plan shall be borne equally by the Participants.

B. Costs associated with implementation of the Plan and related BMPs shall be apportioned among the Participants based upon the percentage of load reduction attributed to each Participant in the Plan for each BMP plus an equal share to apportion the percentage of load reduction outside of the municipal boundaries or service area of the Participants until such time as additional contributions are received from other entities.

C. Each Participant shall be responsible for its own out-of-pocket costs and its own solicitor's fees.

7. Effective Date.

A. The Effective Date of this Agreement shall be August 23, 2017. It is the intent of the Participants, however, that the terms of this Agreement shall apply to any work related to the development and implementation of the Plan conducted after August 23, 2017, regardless of the Effective Date of this Agreement.

B. This Agreement shall become effective as to each Participant upon execution and, where applicable, adoption of an authorizing ordinance or resolution, and execution of this Agreement.

8. Term. This Agreement shall commence upon the Effective Date. The Agreement shall terminate as to each Participant on the date that said Participant's MS4 Permit expires unless revised or terminated by mutual written consent of all the Participants hereto in accordance with this Agreement.

9. Authorization. Participants certify that they are authorized to enter into and execute this Agreement in the exercise and/or performance of their governmental functions, powers, or responsibilities. Participants further certify that they are not the subject of any pending lawsuits, regulatory fines, consent decrees, or other similar sanction of whatever kind related to the Plan. Each Participant shall undertake best efforts to resolve any and all such lawsuits, fines, consent decrees, or similar sanctions prior to that Participant's execution of this Agreement. In the event a Participant is unable to resolve such lawsuits, fines, consent decrees, or similar sanctions prior to execution of this Agreement, the Participant agrees to fully indemnify and defend all other Participants from any associated damages and liability.

10. **Applicable Law**. The Participants 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 Dauphin County Court of Common Pleas. The Participants hereby submit to the exclusive jurisdiction of that Court.

11. **Alternative Dispute Resolution.** The Participants agree to resolve disputes expeditiously. If a dispute arises among the Participants regarding the terms or the implementation of this agreement, the following steps will be taken prior to filing action in the Court of Common Pleas of Dauphin County, Commonwealth of Pennsylvania, as provided for in Paragraph 10: The Party that seeks resolution will provide a written statement of its dispute, along with any rationale or supporting documents, to the other Participants within five (5) working days of occurrence of the dispute. All Participants will engage in discussions in an attempt to arrive at a consensus and resolve the dispute. If no resolution is reached within fifteen (15) working days of receipt of the statement of dispute, the dispute may be elevated in writing, along with any rationale or supporting documents to the relevant Participants' respective chief executive officer or his designees. The principal contacts for the Participants will engage in discussions to seek consensus. If resolution is not reached by the chief executive officers within thirty (30) working days of his receipt of the written statement of the dispute, the Participants may employ the services of a dispute resolution specialist to assist in the resolution of disputes prior to filing action in the Court of Common Pleas of Dauphin County.

12. **Integration**. This Agreement contains the entire agreement between the Participants. There are no understandings or agreements, verbal or otherwise, in relation hereto, except those expressly and specifically set forth herein. The Participants 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.

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

14. **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.

15. **Representation by Counsel**. This Agreement has been negotiated by the Participants through their respective legal counsel and embodies terms that were arrived at through mutual negotiation and joint effort, and the Participants shall be considered to have contributed equally to the preparation of this Agreement. The Participants warrant and represent that the terms and conditions of this Agreement have been discussed and negotiated between them, and their respective counsel, and are voluntarily and knowingly accepted for the purpose of making a full and final compromise between the Participants, as referenced herein. The Participants further acknowledge that they understand the facts and their respective legal rights and obligations pursuant to this Agreement.

16. **Counterparts**. This Agreement may be executed in counterparts, each of which will be an original, and all of which taken together shall constitute one and the same instrument.

17. **Execution by Facsimile or Electronic Scanning**. Delivery of an executed counterpart of this Agreement by facsimile, or by electronically scanning and e-mailing an executed counterpart signature page, while not specifically required, will be acknowledged by the Participants as being equally as effective as delivery of a manually executed counterpart of this Agreement. The use of a signature page received by facsimile, or through an electronic scan and e-mail, shall not affect the validity, enforceability, or binding effect of this Agreement.

18. **Fees and Costs**. Unless otherwise expressly stated herein, the Participants agree to bear their own fees and costs in connection with or incurred related to the matters between them, and relating to this Agreement.

19. **Signatures**. The Participants hereto, and the undersigned individuals and/or representatives, represent and warrant that they have the authority to enter into this Agreement and be legally bound hereby.

IN WITNESS WHEREOF, the Participants hereto have caused this Intergovernmental Cooperation Agreement for the Preparation and Implementation of the Plan.

[SIGNATURE PAGE TO FOLLOW]

ATTEST:

Secretary

(SEAL)

CAPITAL REGION WATER

By: ____________________________

~~(Vice)~~ Chairperson

ATTEST:

____

Secretary

(SEAL)

SUSQUEHANNA TOWNSHIP

By: ____________________________

(Vice) President

ATTEST:

____

Secretary

(SEAL)

LOWER PAXTON TOWNSHIP

By: ____________________________

(Vice) Chairperson

CAPITAL REGION WATER

RESOLUTION NO. 2017-098

INTERGOVERNMENTAL COOPERATION AGREEMENT FOR THE PREPARATION AND IMPLEMENTATION OF THE JOINT POLLUTANT REDUCTION PLAN

WHEREAS, Capital Region Water, a municipal authority incorporated under the Act of May 2, 1945 (P.L. 382, No. 164), known as the Municipality Authorities Act of 1945;

WHEREAS, Capital Region Water agrees to enter into the Intergovernmental Cooperation Agreement between Susquehanna Township and Lower Paxton Township (collectively referred to as the Municipalities) and Capital Region Water for the development and implementation of a Chesapeake Bay Pollutant Reduction Plan, Paxton Creek TMDL Watershed Plan, and a Pollutant Reduction Plan to address Wildwood Lake and an unnamed tributary to Spring Creek (Joint Pollution Reduction Plan);

WHEREAS, the Chairperson and Secretary of Capital Region Water be authorized to execute the Intergovernmental Cooperation Agreement for the Preparation and Implementation of the Joint Pollutant Reduction Plan on behalf of Capital Region Water.

NOW THEREFORE, BE IT RESOLVED by the Board of Directors, that Capital Region Water hereby authorizes the Chairperson and Secretary to execute the Intergovernmental Cooperation Agreement for the Preparation and Implementation of the Joint Pollutant Reduction Plan on behalf of Capital Region, which Agreement shall be attached hereto as Exhibit "A".

Duly adopted this 23rd of August, 2017 by the Board of Directors of Capital Region Water in lawful session duly assembled.

ATTEST:

Secretary

CAPITAL REGION WATER

By: ____________________

Chairperson

CERTIFICATE

I, the undersigned Secretary of Capital Region Water, certify that the foregoing Resolution was adopted by a majority vote of the Board of Directors at a meeting duly convened according to law and held on August 23, 2017, at which meeting a quorum was present; said Resolution was adopted by an aye or nay vote; said Resolution and the vote thereon showing how each member voted have been recorded in the Minutes of said Board of Directors; and said Resolution remains in effect, unaltered and unamended as of the date of this Certificate.

IN WITNESS WHEREOF, I set my hand and official seal of Capital Region Water, this 23rd day of August, 2017.

Secretary

(SEAL)

LOWER PAXTON TOWNSHIP

ORDINANCE 17-13

AN ORDINANCE AUTHORIZING THE TOWNSHIP OF LOWER PAXTON TO ENTER INTO AN INTERGOVERNMENTAL COOPERATION AGREEMENT WITH THE TOWNSHIP OF SUSQUEHANNA AND CAPITAL REGION WATER FOR THE PREPARATION AND IMPLEMENTATION OF JOINT POLLUTANT REDUCTION PLAN.

WHEREAS, Susquehanna Township and Lower Paxton Township are political subdivisions and Capital Region Water (CRW) is a municipal authority formed by the City of Harrisburg, all located within Dauphin County, Pennsylvania and herein jointly referred to as the "Participants";

WHEREAS, the Participants each own, operate, and maintain Small Municipal Separate Storm Sewer Systems ("MS4s") that discharge to the Susquehanna River, Paxton Creek, Spring Creek, and/or Beaver Creek, and ultimately the Chesapeake Bay; and

WHEREAS, the Participants wish to engage in a collaborative process of preparing and implementing a Joint Pollution Reduction Plan, consisting of a Chesapeake Bay Pollutant Reduction Plan, Paxton Creek Watershed TMDL Plan, and Pollutant Reduction Plan to address Wildwood Lake and an unnamed tributary to Spring Creek (the "Plan"); and

WHEREAS, the Participants have prepared an Intergovernmental Cooperation Agreement for the preparation and implementation of a Joint Pollutant Reduction Plan as authorized and required pursuant to applicable law including, but not limited to, 53 Pa.C.S.A. § 2301, et seq.; and

WHEREAS, the Participants have determined that it is in their respective interests to enter into such an Agreement for said project;

NOW, THEREFORE, BE AND IT IS HEREBY ORDAINED AND ENACTED by the Board of Supervisors of the Township of Lower Paxton, Dauphin County, Pennsylvania, as follows:

<u>Section 1.</u> The caption of and recitals to this Ordinance, as set forth above are incorporated herein by reference.

<u>Section 2.</u> The Board of Supervisors of Township of Lower Paxton deems it necessary and expressly authorizes its officers, in accordance with the requirements of the aforesaid Intergovernmental Cooperation Act, to enter into and execute an Intergovernmental Cooperation Agreement (the "Agreement") to provide for the legal and institutional mechanisms for preparing and implementing a Joint Pollution Reduction Plan, consisting of a Chesapeake Bay Pollutant Reduction Plan, Paxton Creek Watershed TMDL Plan, and Pollutant Reduction Plan to address Wildwood Lake and an unnamed tributary to Spring Creek (the "Plan").

<u>Section 3</u>. In the event that any provision, section, sentence, clause or part of this Ordinance shall be held to be invalid, illegal or unconstitutional by a court of competent jurisdiction, such invalidity, illegality or unconstitutionality shall not affect or impair the remaining provisions, sections, sentences, clauses or parts of this Ordinance, it being the intent of the Township Board of Supervisors that the remainder of the Ordinance shall be and shall remain in full force and effect.

Section 4. This Ordinance shall take effect and be in force five (5) days after its enactment.

DULY ORDAINED AND ENACTED this 12th day of September, 2017, by the Board of Supervisors of the Township of Lower Paxton, Dauphin County, Pennsylvania.

BOARD OF SUPERVISORS
LOWER PAXTON TOWNSHIP

Attest:

William B. Hawk, Township Secretary

William L. Hornung, Chairman

Gary A. Crissman., Vice-Chairman

William B. Hawk, Supervisor

William C. Seeds, Sr., Supervisor

Robin Lindsey, Supervisor

INTERGOVERNMENTAL COOPERATION AGREEMENT FOR THE PREPARATION AND IMPLEMENTATION OF THE JOINT POLLUTION REDUCTION PLAN

THIS AGREEMENT is made this 12 day of September, 2017, (the "Agreement"), by and among Susquehanna Township and Lower Paxton Township (collectively, Susquehanna Township and Lower Paxton Township are referred to herein as the "Municipalities") and Capital Region Water ("CRW") (collectively, the Municipalities and CRW may sometimes be referred to as the "Participants") for the development and implementation of a Chesapeake Bay Pollutant Reduction Plan, Paxton Creek TMDL Watershed Plan, and a Pollutant Reduction Plan to address Wildwood Lake and an unnamed tributary to Spring Creek ("Joint Pollution Reduction Plan" or "Plan").

This Intergovernmental Cooperation Agreement is authorized and required pursuant to applicable law including, but not limited to, 53 Pa.C.S.A. § 2301, *et seq*.

RECITALS

WHEREAS, the Participants each own, operate, and maintain Small Municipal Separate Storm Sewer Systems ("MS4s") that discharge to the Susquehanna River, Paxton Creek, Spring Creek, and/or Beaver Creek; and

WHEREAS, Paxton Creek, Spring Creek, and Beaver Creek all drain to the Susquehanna River and ultimately the Chesapeake Bay; and

WHEREAS, the Participants wish to engage in a collaborative process of preparing and implementing a Joint Pollution Reduction Plan consisting of a Chesapeake Bay Pollutant Reduction Plan, Paxton Creek Watershed TMDL Plan, and Pollutant Reduction Plan to address Wildwood Lake and an unnamed tributary to Spring Creek (the "Plan"); and

WHEREAS, the Participants desire that CRW shall serve as the point of contact for the Participants to the extent necessary for the development and implementation of the Plan; and

WHEREAS, each Participant will create, operate, and maintain Best Management Practices ("BMP") Projects within its municipal boundaries or service area designed to reduce sediment; and

WHEREAS, as set forth in this Agreement, the Participants shall equally share in the cost to develop the Plan; and

WHEREAS, the purpose of this Agreement is to set forth, *inter alia*, how the Participants will cooperate to create and revise the Plan, and the obligations of each Participant; and

WHEREAS, the Participants agree and acknowledge that nothing in this Agreement, or the resultant actions herefrom, shall prohibit, prevent, or interfere with any Participant's ability to comply with applicable Pennsylvania law and regulation, Federal law and regulation, applicable regulatory agency rules and policies, permit requirements, Pennsylvania Department of Environmental Protection ("DEP") directives, or United States Environmental Protection Agency directives, and local ordinances; and

WHEREAS, all Participants shall adopt an Ordinance (or Resolution if Participant is a municipal authority) approving this Agreement to effectuate their participation.

NOW, THEREFORE, the Participants hereto, in consideration of the mutual promises, covenants, and undertakings herein contained, each binding itself and representing that it has proper legal authority to enter into this Agreement, and intending to be legally bound, agree as follows:

1. **Recitals**. All of the Recitals hereto are incorporated herein by reference as if fully set forth at length.

2. **Guiding Principle**. The Participants have a mutual interest in working together in a cooperative manner to develop and implement the Plan, and to work together in a cooperative manner to achieve the objectives set forth in this Agreement.

3. **Organization**. The Municipalities agree that CRW shall serve as the point of contact to the extent that it is necessary for the Participants to coordinate the development and implementation of the Plan as further set forth in this Agreement.

4. **Functions, Powers and Responsibilities**. Each Participant shall be responsible for the following functions and responsibilities and shall have the following powers:

A. Work cooperatively to oversee, supervise, and administer the development and implementation of the Plan.

B. Oversee, supervise, and administer BMP Projects, including ensuring that BMP Projects are constructed as approved, within its municipal boundaries or service area.

C. Approve for payment and pay appropriate invoices submitted for development of the Plan.

D. Manage and administer all funds related to individual BMP Projects within its municipal boundaries or service area.

E. Facilitate the implementation of new BMP Projects within its municipal boundaries or service area (including, but not limited to, design, permitting, construction, operation, monitoring, maintenance, and approval). The Participants may transfer such obligations for design, construction, operation and maintenance, and monitoring to qualified third parties, but each Participant shall remain responsible to ensure that the contracted third parties are performing the required tasks satisfactorily to the benefit of all Participants.

F. Each Participant must ensure that all applicable notice requirements are satisfied and advertisements are drafted and published as required by applicable laws, including, but not limited to, the Pennsylvania Sunshine Act.

G. Each Participant shall retain all records, as that term is defined by the Pennsylvania Right-to-Know Law, for the time period required by applicable law but not less than six (6) years. Each Participant shall make available to the other Participants for review and copying any records related to the Plan and the activities undertaken pursuant to this Agreement upon submission of written request no less than five (5) business days prior to the desired date of review. Each Participant may waive the requirement for written request in its discretion.

H. Municipalities agree to act in good faith and to cooperate in all reasonable respects with CRW insofar as CRW is acting as the point of contact to coordinate the development and implementation of the Plan as further set forth in this Agreement.

I. Participants agree to take any and all legislative or other acts necessary to implement the purposes of this Agreement.

J. Participants agree to perform their obligations and duties under this Agreement in a competent and business-like manner and shall exercise due care, diligence, and control in connection with costs, fees, and expenses related to such performance.

K. Participants agree and consent to the placement, ownership, continued operation, and ongoing maintenance of new BMP Projects within its municipal boundaries or service area consistent with this Agreement and the Plan. If necessary, Participants agree to obtain any real property necessary for the placement, ownership, operation, and maintenance of BMP Projects including the use of eminent domain pursuant to the Eminent Domain Code, 26 Pa.C.S.A. § 101, *et seq*.

L. Participants agree to continue the operation and maintenance with respect to any and all existing BMPs created before the formation and implementation of this Agreement. All aspects of said operation and maintenance, including all administrative and document related tasks, shall be solely the responsibility of the Participant that operated and maintained the existing BMP before the formation and implementation of this Agreement, to be performed at the sole cost and expense of said Participant.

M. Participants shall collaborate with one another to the extent practicable to take all necessary actions to acquire grants or other funding that can be used to fund the Plan's implementation and/or the actions and activities undertaken pursuant to this Agreement or the Plan.

5. **<u>Enforcement Actions</u>**. If any compliance or enforcement action (including the pursuit of a civil penalty, issuance of an Notice of Violation ("NOV"), Order, or any other compliance notice or action) is initiated by either the Commonwealth of Pennsylvania or the Federal Government in any way related to the Plan or implementation actions and activities undertaken pursuant to this Agreement, the Participants shall discuss the enforcement action, whether any one or more Participants are responsible for the alleged violation(s), and determine what responsive action(s) shall be. Where an act of malfeasance, misfeasance, negligence, or other misconduct of a Participant results in a civil penalty, issuance of an NOV or other compliance action, a fine, or a damages award of any kind, or other breach of the terms of this Agreement, the responsible Participant shall indemnify and hold harmless the non-responsible Participants with respect thereto.

6. **Financing of the Plan**

A. Costs associated with the development of the Plan shall be borne equally by the Participants.

B. Costs associated with implementation of the Plan and related BMPs shall be apportioned among the Participants based upon the percentage of load reduction attributed to each Participant in the Plan for each BMP plus an equal share to apportion the percentage of load reduction outside of the municipal boundaries or service area of the Participants until such time as additional contributions are received from other entities.

C. Each Participant shall be responsible for its own out-of-pocket costs and its own solicitor's fees.

7. **Effective Date**.

A. The Effective Date of this Agreement shall be September 12, 2017. It is the intent of the Participants, however, that the terms of this Agreement shall apply to any work related to the development and implementation of the Plan conducted after September 12th, regardless of the Effective Date of this Agreement.

B. This Agreement shall become effective as to each Participant upon execution and, where applicable, adoption of an authorizing ordinance or resolution, and execution of this Agreement.

8. **Term**. This Agreement shall commence upon the Effective Date. The Agreement shall terminate as to each Participant on the date that said Participant's MS4 Permit expires unless revised or terminated by mutual written consent of all the Participants hereto in accordance with this Agreement.

9. **Authorization**. Participants certify that they are authorized to enter into and execute this Agreement in the exercise and/or performance of their governmental functions, powers, or responsibilities. Participants further certify that they are not the subject of any pending lawsuits, regulatory fines, consent decrees, or other similar sanction of whatever kind related to the Plan. Each Participant shall undertake best efforts to resolve any and all such lawsuits, fines, consent decrees, or similar sanctions prior to that Participant's execution of this Agreement. In the event a Participant is unable to resolve such lawsuits, fines, consent decrees, or similar

sanctions prior to execution of this Agreement, the Participant agrees to fully indemnify and defend all other Participants from any associated damages and liability.

10. **Applicable Law**. The Participants 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 Dauphin County Court of Common Pleas. The Participants hereby submit to the exclusive jurisdiction of that Court.

11. **Alternative Dispute Resolution.** The Participants agree to resolve disputes expeditiously. If a dispute arises among the Participants regarding the terms or the implementation of this agreement, the following steps will be taken prior to filing action in the Court of Common Pleas of Dauphin County, Commonwealth of Pennsylvania, as provided for in Paragraph 10: The Party that seeks resolution will provide a written statement of its dispute, along with any rationale or supporting documents, to the other Participants within five (5) working days of occurrence of the dispute. All Participants will engage in discussions in an attempt to arrive at a consensus and resolve the dispute. If no resolution is reached within fifteen (15) working days of receipt of the statement of dispute, the dispute may be elevated in writing, along with any rationale or supporting documents to the relevant Participants' respective chief executive officer or his designees. The principal contacts for the Participants will engage in discussions to seek consensus. If resolution is not reached by the chief executive officers within thirty (30) working days of his receipt of the written statement of the dispute, the Participants may employ the services of a dispute resolution specialist to assist in the resolution of disputes prior to filing action in the Court of Common Pleas of Dauphin County.

12. **Integration**. This Agreement contains the entire agreement between the Participants. There are no understandings or agreements, verbal or otherwise, in relation hereto, except those expressly and specifically set forth herein. The Participants 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.

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

14. **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.

15. **Representation by Counsel**. This Agreement has been negotiated by the Participants through their respective legal counsel and embodies terms that were arrived at through mutual negotiation and joint effort, and the Participants shall be considered to have contributed equally to the preparation of this Agreement. The Participants warrant and represent that the terms and conditions of this Agreement have been discussed and negotiated between them, and their respective counsel, and are voluntarily and knowingly accepted for the purpose of making a full and final compromise between the Participants, as referenced herein. The Participants further acknowledge that they understand the facts and their respective legal rights and obligations pursuant to this Agreement.

16. **Counterparts**. This Agreement may be executed in counterparts, each of which will be an original, and all of which taken together shall constitute one and the same instrument.

17. **Execution by Facsimile or Electronic Scanning**. Delivery of an executed counterpart of this Agreement by facsimile, or by electronically scanning and e-mailing an executed counterpart signature page, while not specifically required, will be acknowledged by the Participants as being equally as effective as delivery of a manually executed counterpart of this Agreement. The use of a signature page received by facsimile, or through an electronic scan and e-mail, shall not affect the validity, enforceability, or binding effect of this Agreement.

18. **Fees and Costs**. Unless otherwise expressly stated herein, the Participants agree to bear their own fees and costs in connection with or incurred related to the matters between them, and relating to this Agreement.

19. **Signatures**. The Participants hereto, and the undersigned individuals and/or representatives, represent and warrant that they have the authority to enter into this Agreement and be legally bound hereby.

IN WITNESS WHEREOF, the Participants hereto have caused this Intergovernmental Cooperation Agreement for the Preparation and Implementation of the Plan.

[SIGNATURE PAGE TO FOLLOW]

ATTEST:

CAPITAL REGION WATER

By: ______________________
(Vice) Chairperson

____
Secretary

(SEAL)

ATTEST:

SUSQUEHANNA TOWNSHIP

By: ______________________
(Vice) President

____
Secretary

(SEAL)

ATTEST:

LOWER PAXTON TOWNSHIP

By: ______________________
(Vice) Chairperson

____
Secretary

(SEAL)

INTERGOVERNMENTAL COOPERATION AGREEMENT FOR THE PREPARATION AND IMPLEMENTATION OF THE JOINT POLLUTION REDUCTION PLAN

THIS AGREEMENT is made this 14th day of September, 2017, (the "Agreement"), by and among Susquehanna Township and Lower Paxton Township (collectively, Susquehanna Township and Lower Paxton Township are referred to herein as the "Municipalities") and Capital Region Water ("CRW") (collectively, the Municipalities and CRW may sometimes be referred to as the "Participants") for the development and implementation of a Chesapeake Bay Pollutant Reduction Plan, Paxton Creek TMDL Watershed Plan, and a Pollutant Reduction Plan to address Wildwood Lake and an unnamed tributary to Spring Creek ("Joint Pollution Reduction Plan" or "Plan").

This Intergovernmental Cooperation Agreement is authorized and required pursuant to applicable law including, but not limited to, 53 Pa.C.S.A. § 2301, *et seq.*

RECITALS

WHEREAS, the Participants each own, operate, and maintain Small Municipal Separate Storm Sewer Systems ("MS4s") that discharge to the Susquehanna River, Paxton Creek, Spring Creek, and/or Beaver Creek; and

WHEREAS, Paxton Creek, Spring Creek, and Beaver Creek all drain to the Susquehanna River and ultimately the Chesapeake Bay; and

WHEREAS, the Participants wish to engage in a collaborative process of preparing and implementing a Joint Pollution Reduction Plan consisting of a Chesapeake Bay Pollutant Reduction Plan, Paxton Creek Watershed TMDL Plan, and Pollutant Reduction Plan to address Wildwood Lake and an unnamed tributary to Spring Creek (the "Plan"); and

WHEREAS, the Participants desire that CRW shall serve as the point of contact for the Participants to the extent necessary for the development and implementation of the Plan; and

WHEREAS, each Participant will create, operate, and maintain Best Management Practices ("BMP") Projects within its municipal boundaries or service area designed to reduce sediment; and

WHEREAS, as set forth in this Agreement, the Participants shall equally share in the cost to develop the Plan; and

WHEREAS, the purpose of this Agreement is to set forth, *inter alia*, how the Participants will cooperate to create and revise the Plan, and the obligations of each Participant; and

WHEREAS, the Participants agree and acknowledge that nothing in this Agreement, or the resultant actions herefrom, shall prohibit, prevent, or interfere with any Participant's ability to comply with applicable Pennsylvania law and regulation, Federal law and regulation, applicable regulatory agency rules and policies, permit requirements, Pennsylvania Department of Environmental Protection ("DEP") directives, or United States Environmental Protection Agency directives, and local ordinances; and

WHEREAS, all Participants shall adopt an Ordinance (or Resolution if Participant is a municipal authority) approving this Agreement to effectuate their participation.

NOW, THEREFORE, the Participants hereto, in consideration of the mutual promises, covenants, and undertakings herein contained, each binding itself and representing that it has proper legal authority to enter into this Agreement, and intending to be legally bound, agree as follows:

1. **<u>Recitals</u>**. All of the Recitals hereto are incorporated herein by reference as if fully set forth at length.

2. **<u>Guiding Principle</u>**. The Participants have a mutual interest in working together in a cooperative manner to develop and implement the Plan, and to work together in a cooperative manner to achieve the objectives set forth in this Agreement.

3. **<u>Organization</u>**. The Municipalities agree that CRW shall serve as the point of contact to the extent that it is necessary for the Participants to coordinate the development and implementation of the Plan as further set forth in this Agreement.

4. **<u>Functions, Powers and Responsibilities</u>**. Each Participant shall be responsible for the following functions and responsibilities and shall have the following powers:

A. Work cooperatively to oversee, supervise, and administer the development and implementation of the Plan.

B. Oversee, supervise, and administer BMP Projects, including ensuring that BMP Projects are constructed as approved, within its municipal boundaries or service area.

C. Approve for payment and pay appropriate invoices submitted for development of the Plan.

D. Manage and administer all funds related to individual BMP Projects within its municipal boundaries or service area.

E. Facilitate the implementation of new BMP Projects within its municipal boundaries or service area (including, but not limited to, design, permitting, construction, operation, monitoring, maintenance, and approval). The Participants may transfer such obligations for design, construction, operation and maintenance, and monitoring to qualified third parties, but each Participant shall remain responsible to ensure that the contracted third parties are performing the required tasks satisfactorily to the benefit of all Participants.

F. Each Participant must ensure that all applicable notice requirements are satisfied and advertisements are drafted and published as required by applicable laws, including, but not limited to, the Pennsylvania Sunshine Act.

G. Each Participant shall retain all records, as that term is defined by the Pennsylvania Right-to-Know Law, for the time period required by applicable law but not less than six (6) years. Each Participant shall make available to the other Participants for review and copying any records related to the Plan and the activities undertaken pursuant to this Agreement upon submission of written request no less than five (5) business days prior to the desired date of review. Each Participant may waive the requirement for written request in its discretion.

H. Municipalities agree to act in good faith and to cooperate in all reasonable respects with CRW insofar as CRW is acting as the point of contact to coordinate the development and implementation of the Plan as further set forth in this Agreement.

I. Participants agree to take any and all legislative or other acts necessary to implement the purposes of this Agreement.

J. Participants agree to perform their obligations and duties under this Agreement in a competent and business-like manner and shall exercise due care, diligence, and control in connection with costs, fees, and expenses related to such performance.

K. Participants agree and consent to the placement, ownership, continued operation, and ongoing maintenance of new BMP Projects within its municipal boundaries or service area consistent with this Agreement and the Plan. If necessary, Participants agree to obtain any real property necessary for the placement, ownership, operation, and maintenance of BMP Projects including the use of eminent domain pursuant to the Eminent Domain Code, 26 Pa.C.S.A. § 101, *et seq*.

L. Participants agree to continue the operation and maintenance with respect to any and all existing BMPs created before the formation and implementation of this Agreement. All aspects of said operation and maintenance, including all administrative and document related tasks, shall be solely the responsibility of the Participant that operated and maintained the existing BMP before the formation and implementation of this Agreement, to be performed at the sole cost and expense of said Participant.

M. Participants shall collaborate with one another to the extent practicable to take all necessary actions to acquire grants or other funding that can be used to fund the Plan's implementation and/or the actions and activities undertaken pursuant to this Agreement or the Plan.

5. **Enforcement Actions**. If any compliance or enforcement action (including the pursuit of a civil penalty, issuance of an Notice of Violation ("NOV"), Order, or any other compliance notice or action) is initiated by either the Commonwealth of Pennsylvania or the Federal Government in any way related to the Plan or implementation actions and activities undertaken pursuant to this Agreement, the Participants shall discuss the enforcement action, whether any one or more Participants are responsible for the alleged violation(s), and determine what responsive action(s) shall be. Where an act of malfeasance, misfeasance, negligence, or other misconduct of a Participant results in a civil penalty, issuance of an NOV or other compliance action, a fine, or a damages award of any kind, or other breach of the terms of this Agreement, the responsible Participant shall indemnify and hold harmless the non-responsible Participants with respect thereto.

6. **Financing of the Plan**

A. Costs associated with the development of the Plan shall be borne equally by the Participants.

B. Costs associated with implementation of the Plan and related BMPs shall be apportioned among the Participants based upon the percentage of load reduction attributed to each Participant in the Plan for each BMP plus an equal share to apportion the percentage of load reduction outside of the municipal boundaries or service area of the Participants until such time as additional contributions are received from other entities.

C. Each Participant shall be responsible for its own out-of-pocket costs and its own solicitor's fees.

7. **Effective Date**.

A. The Effective Date of this Agreement shall be September 14, 2017. It is the intent of the Participants, however, that the terms of this Agreement shall apply to any work related to the development and implementation of the Plan conducted after September 14th, regardless of the Effective Date of this Agreement.

B. This Agreement shall become effective as to each Participant upon execution and, where applicable, adoption of an authorizing ordinance or resolution, and execution of this Agreement.

8. **Term**. This Agreement shall commence upon the Effective Date. The Agreement shall terminate as to each Participant on the date that said Participant's MS4 Permit expires unless revised or terminated by mutual written consent of all the Participants hereto in accordance with this Agreement.

9. **Authorization**. Participants certify that they are authorized to enter into and execute this Agreement in the exercise and/or performance of their governmental functions, powers, or responsibilities. Participants further certify that they are not the subject of any pending lawsuits, regulatory fines, consent decrees, or other similar sanction of whatever kind related to the Plan. Each Participant shall undertake best efforts to resolve any and all such lawsuits, fines, consent decrees, or similar sanctions prior to that Participant's execution of this Agreement. In the event a Participant is unable to resolve such lawsuits, fines, consent decrees, or similar sanctions prior to execution of this Agreement, the Participant agrees to fully indemnify and defend all other Participants from any associated damages and liability.

10. **Applicable Law**. The Participants 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 Dauphin County Court of Common Pleas. The Participants hereby submit to the exclusive jurisdiction of that Court.

11. **Alternative Dispute Resolution.** The Participants agree to resolve disputes expeditiously. If a dispute arises among the Participants regarding the terms or the implementation of this agreement, the following steps will be taken prior to filing action in the Court of Common Pleas of Dauphin County, Commonwealth of Pennsylvania, as provided for in Paragraph 10: The Party that seeks resolution will provide a written statement of its dispute, along with any rationale or supporting documents, to the other Participants within five (5) working days of occurrence of the dispute. All Participants will engage in discussions in an attempt to arrive at a consensus and resolve the dispute. If no resolution is reached within fifteen (15) working days of receipt of the statement of dispute, the dispute may be elevated in writing, along with any rationale or supporting documents to the relevant Participants' respective chief executive officer or his designees. The principal contacts for the Participants will engage in discussions to seek consensus. If resolution is not reached by the chief executive officers within thirty (30) working days of his receipt of the written statement of the dispute, the Participants may employ the services of a dispute resolution specialist to assist in the resolution of disputes prior to filing action in the Court of Common Pleas of Dauphin County.

12. **Integration**. This Agreement contains the entire agreement between the Participants. There are no understandings or agreements, verbal or otherwise, in relation hereto, except those expressly and specifically set forth herein. The Participants 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.

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

14. **<u>Severability</u>**. 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.

15. **<u>Representation by Counsel</u>**. This Agreement has been negotiated by the Participants through their respective legal counsel and embodies terms that were arrived at through mutual negotiation and joint effort, and the Participants shall be considered to have contributed equally to the preparation of this Agreement. The Participants warrant and represent that the terms and conditions of this Agreement have been discussed and negotiated between them, and their respective counsel, and are voluntarily and knowingly accepted for the purpose of making a full and final compromise between the Participants, as referenced herein. The Participants further acknowledge that they understand the facts and their respective legal rights and obligations pursuant to this Agreement.

16. **<u>Counterparts</u>**. This Agreement may be executed in counterparts, each of which will be an original, and all of which taken together shall constitute one and the same instrument.

17. **<u>Execution by Facsimile or Electronic Scanning</u>**. Delivery of an executed counterpart of this Agreement by facsimile, or by electronically scanning and e-mailing an executed counterpart signature page, while not specifically required, will be acknowledged by the Participants as being equally as effective as delivery of a manually executed counterpart of this Agreement. The use of a signature page received by facsimile, or through an electronic scan and e-mail, shall not affect the validity, enforceability, or binding effect of this Agreement.

18. **<u>Fees and Costs</u>**. Unless otherwise expressly stated herein, the Participants agree to bear their own fees and costs in connection with or incurred related to the matters between them, and relating to this Agreement.

19. **<u>Signatures</u>**. The Participants hereto, and the undersigned individuals and/or representatives, represent and warrant that they have the authority to enter into this Agreement and be legally bound hereby.

IN WITNESS WHEREOF, the Participants hereto have caused this Intergovernmental Cooperation Agreement for the Preparation and Implementation of the Plan.

[SIGNATURE PAGE TO FOLLOW]

ATTEST:

CAPITAL REGION WATER

____
Secretary

By: __________________________
(Vice) Chairperson

(SEAL)

ATTEST:

SUSQUEHANNA TOWNSHIP

____
Secretary

By: __________________________
(~~Vice~~) President

(SEAL)

ATTEST:

LOWER PAXTON TOWNSHIP

____
Secretary

By: __________________________
(Vice) Chairperson

(SEAL)

ORDINANCE 17-14

AN ORDINANCE OF SUSQUEHANNA TOWNSHIP, DAUPHIN COUNTY, PENNSYLVANIA, AUTHORIZING AN INTERGOVERNMENTAL COOPERATION AGREEMENT FOR THE PREPARATION AND IMPLEMENTATION OF THE JOINT POLLUTION REDUCTION PLAN

WHEREAS, the Board of Commissioners of Susquehanna Township has determined that the public health, welfare and safety would be served by entering into an Inter-Governmental Cooperation Agreement for the Preparation and implementation of a Joint Pollution Reduction Plan together with Lower Paxton Township and Capital Region Water.

BE IT ENACTED AND ORDAINED, by the Board of Commissioners of Susquehanna Township, Dauphin County, Pennsylvania, and it is hereby enacted and ordained by authority of the same:

SECTION 1. The Intergovernmental Cooperation Agreement for the Preparation and implementation of the joint pollution reduction plan between Capital Region Water, Susquehanna Township and Lower Paxton Township is authorized, entered into and confirmed.

SECTION 2. Pursuant to 53 P.C.S.A. §2307, the said Intergovernmental Agreement is for the development of an Intermunicipal Plan to reduce pollution entering the Chesapeake Bay by jointly constructing 13 specific projects including stream bank stabilization on the Paxton Creek and at Wildwood Lake and a tributary of Spring Creek. Each party to the Agreement shall share equally in the cost to prepare the plan with Susquehanna Township paying its proportionate share as set forth in the Agreement for construction. This Ordinance shall effectuate the said Agreement and approve participation. There are no additional conditions of Agreement, delegation of authority or creation of a separate entity. The term of the Agreement is from the execution and adoption of an Ordinance by each participant until the plan is approved by the Pennsylvania Department of Environmental Protection and executed.

SECTION 3. All Ordinances or parts of Ordinances inconsistent with this Ordinance are hereby repealed insofar as they are inconsistent herewith.

SECTION 4. In the event any provision, section, sentence, clause or part of this Ordinance shall be held to be invalid, illegal or unconstitutional by a Court of competent jurisdiction, such invalidity, illegality or unconstitutionality shall not effect or impair the remaining provisions, sections, sentences, clauses or parts of this Ordinance, it being the intent of the Board of Commissioners that the remainder of the Ordinance shall be and shall remain in full force and effect.

SECTIONS 5. This Ordinance shall be effective upon execution.

Enacted and ordained this **14th** day of **September**, 2017.

ATTEST:

David W. Kratzer, Jr., Manager

BOARD OF COMMISSIONERS
TOWNSHIP OF SUSQUEHANNA

Frank Lynch, President

APPENDIX J – SUPPLEMENTAL INFORMATION

Center for Watershed Protection Report September 2019

2017 Joint Pollutant Reduction Plan Modeling Approach

Prioritizing Stream Restoration in Paxton Creek

September 2019

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Acronym Definitions

BANCS	Bank Assessment for Non-point source Consequences of Sediment
BMP	Best Management Practice
CBP	Chesapeake Bay Program
DEM	Digital Elevation Model
DEP	Department of Environmental Protection
DoD	DEM of Difference
GIS	Geographic Information System(s)
LiDAR	Light Detection and Ranging
MS4	Municipal Separate Storm Sewer System
PRP	Pollutant Reduction Plan
TMDL	Total Maximum Daily Load
WSI	Watershed Science Institute

Acknowledgements
The Center for Watershed Protection, Inc. wishes to thank the National Fish and Wildlife Foundation for funding this effort. The Center also wishes to acknowledge the staff at Susquehanna Township, Capital Region Water, and Lower Paxton Township for their assistance and active participation in all aspects of this project.

Introduction
The Center for Watershed Protection, Inc. (the Center), through funding from the National Fish and Wildlife Foundation, assisted the municipalities within the Paxton Creek Watershed with an evaluation of potential stream restoration sites. The 13 stream sites were identified in the municipalities' Joint Pollutant Reduction Plan (Joint PRP) which covers the Paxton Creek Watershed TMDL, Chesapeake Bay Plan PRP, Wildwood Lake PRP, and the UNT Spring Creek PRP. The stream sites were all located in the City of Harrisburg, Susquehanna Township, and Lower Paxton Township (Figure 1).

Upon inspection, it was determined that several of the proposed stream restoration sites were not good candidates for restoration. Generally, the sites lacked the annual erosion to justify costly restoration design and construction, had topography that created difficult access for construction equipment, had the potential to damage habitat, or were politically not eligible due to a lack of landowner support. The Center determined that five of the 13 sites had potential for restoration. In order to aid in the identification of additional restoration sites, the Center engaged the Water Science Institute (WSI) to create a geographic information system (GIS) map of the watershed to indicate erosive and depositional conditions along streambanks in the Paxton Creek Watershed. The GIS process utilized Digital Elevation Models (DEMs) created by Light Detection and Ranging (LiDAR) data obtained in 2008, and 2016. The DEMs from the separate years were differenced against each other (2016 data subtracted from the 2008 data), showing where the elevation of the streambank had changed negative (indicating erosion) and positive (indicating deposition). The process performed by WSI is referred to as creating a DEM of difference (DoD). The process assisted in the identification of another major reach of stream that had strong potential for restoration.

The Center analyzed the erosion potential of six restoration sites (Figure 2). Five of the sites were selected from the municipalities' Joint PRP. The final was selected from the DoD. In total, 10,335 linear feet of stream banks were assessed using the Bank Assessment for Non-point source Consequences of Sediment (BANCS) method. The potential sediment reduction benefits of stream restoration projects at those locations were calculated following the guidance of the Chesapeake Bay Program (CBP) Stream Restoration Expert Panel Report (Schueler and Stack 2014). Currently, the Pennsylvania Department of Environmental Protection (DEP) guidance discusses the application of two different methods in the CBP Stream Restoration Expert Panel Report, the default rate method, and the BANCS method. The two sediment calculation methods correlate to the Phase 5.3.2 Chesapeake Bay Watershed Model. As a result of changes for the Phase 6 Watershed Model, it is unclear how the existing stream restoration credit reductions should be calculated and reported. The Center developed an approach that utilizes elements of the Phase 6 calculation method. The Center engaged the DEP to discuss the ability to use this method for sediment reduction reporting and believes it to be a logical approach. However, the DEP advised of the need for further evaluation before final approval is granted.

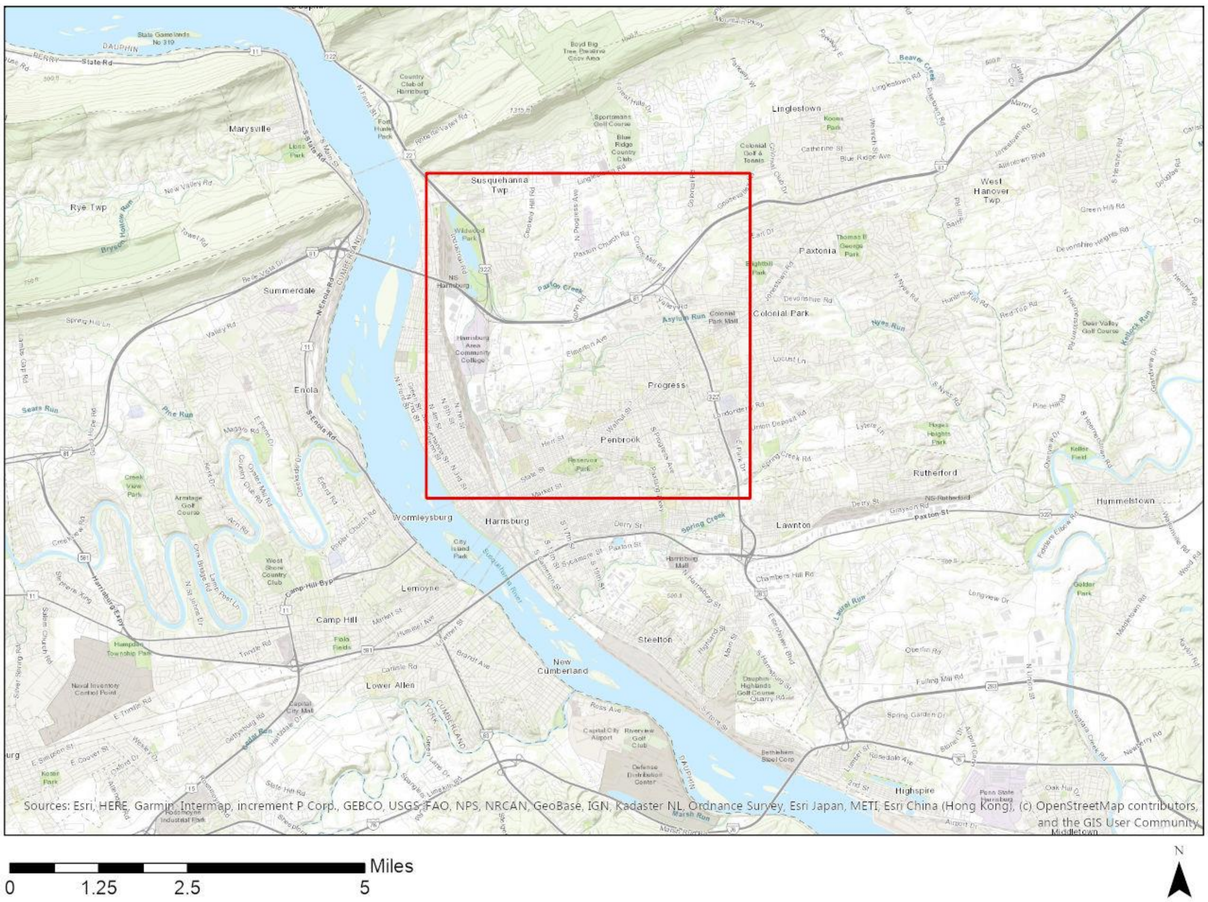

Figure 1. Approximate area of stream analysis in Harrisburg, Susquehanna Township, and Lower Paxton Township.

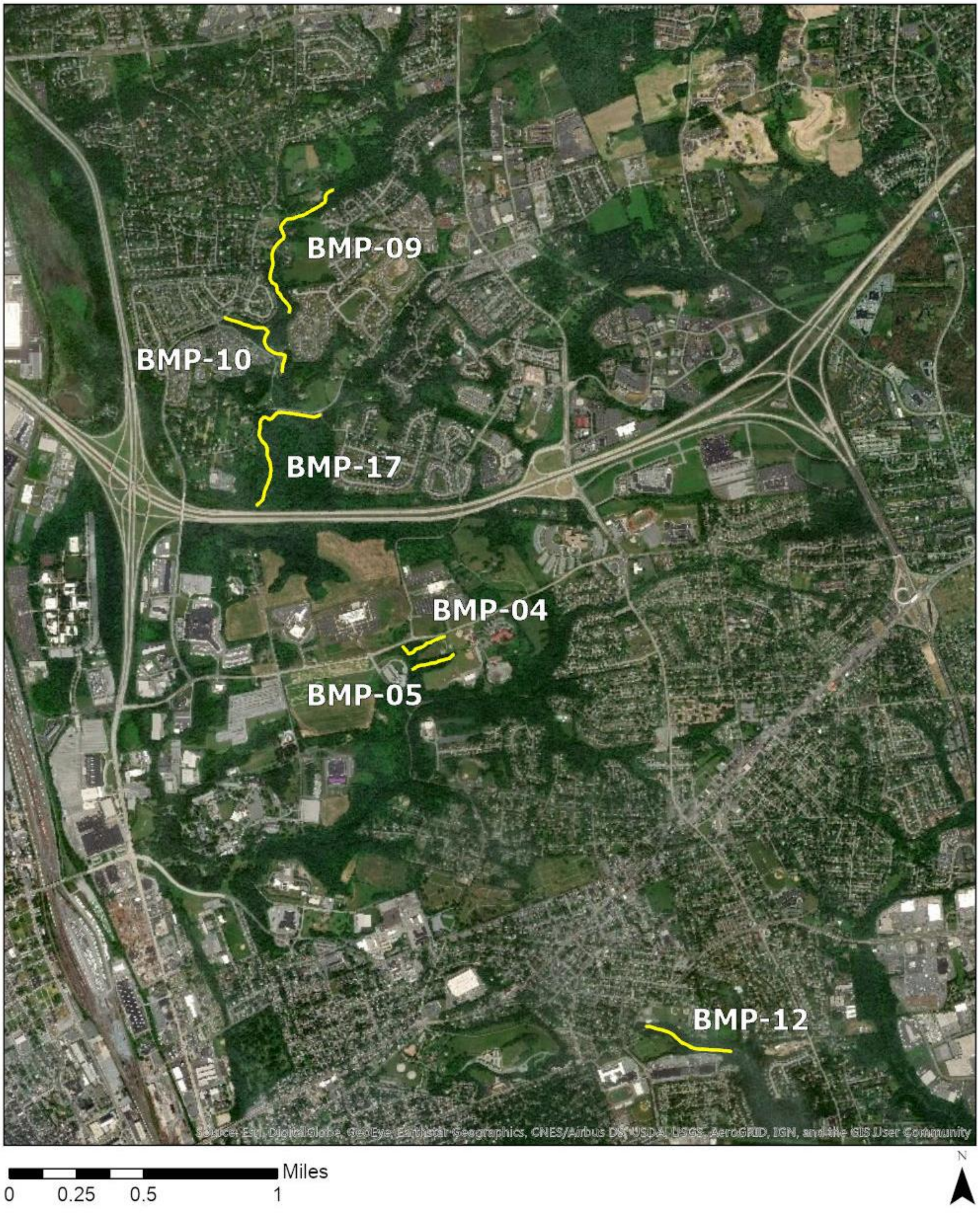

Figure 2. Locations of six potential stream restoration sites.

DEMs of Difference

After an initial reconnaissance of the 13 restoration sites provided in the Joint PRP and discussing the local landowner and political issues with the municipalities, field work by the Center yielded only five stream sites with the potential for restoration. The Joint PRP sediment reduction goal is significant at 1,625,053 lbs/yr, and with the need for future water quality improvement work within Paxton Creek, the Center sought to find another potential restoration site within the watershed.

Therefore, the Center engaged the Water Science Institute (WSI) to create a GIS map of the watershed to indicate erosive and depositional conditions along streambanks in the Paxton Creek Watershed. The GIS process utilized LiDAR DEMs obtained from 2008 and 2016. The DEMs were differenced against each other (2016 data subtracted from the 2008 data), showing where the elevation of the streambank had changed negative (indicating erosion) and positive (indicating deposition). The process performed by WSI is referred to as creating a DEM of difference (DoD). By scanning the resulting DoD GIS watershed map, an area of high erosion was apparent near coordinates 40.307081, -76.870258, in Susquehanna Township (Figure 3). The process assisted in the identification of another major reach of stream that had strong potential for restoration, which was added to the BMP list as BMP-17 (Figure 2).

Further analysis was also performed with the DoD GIS map in an attempt to measure the erosion and depositional changes that occurred. While this analysis was not entirely successful due to various issues, such as removing inaccurate water surface elevation data and accurately determining the error in measurement, the analysis is a very promising direction for future study.

As the greatest error propagated through the analysis is due to the older, less sophisticated 2008 LiDAR information, WSI was employed to fly drones over BMPs-5, -12, and -17, to gather photogrammetry data that could be processed into highly accurate GIS DEMs. The drone gathered DEMs were then differenced against the much more accurate 2016 data set, eliminating the need to utilize the 2008 LiDAR data. The resulting report from WSI is included as Appendix C.

Please note that the WSI analysis accidentally refers to BMP -17 as BMP -10, did not analyze the entirety of BMP -17, and misplaced BANCS data for BMP -17 with the actual BMP -10 data.

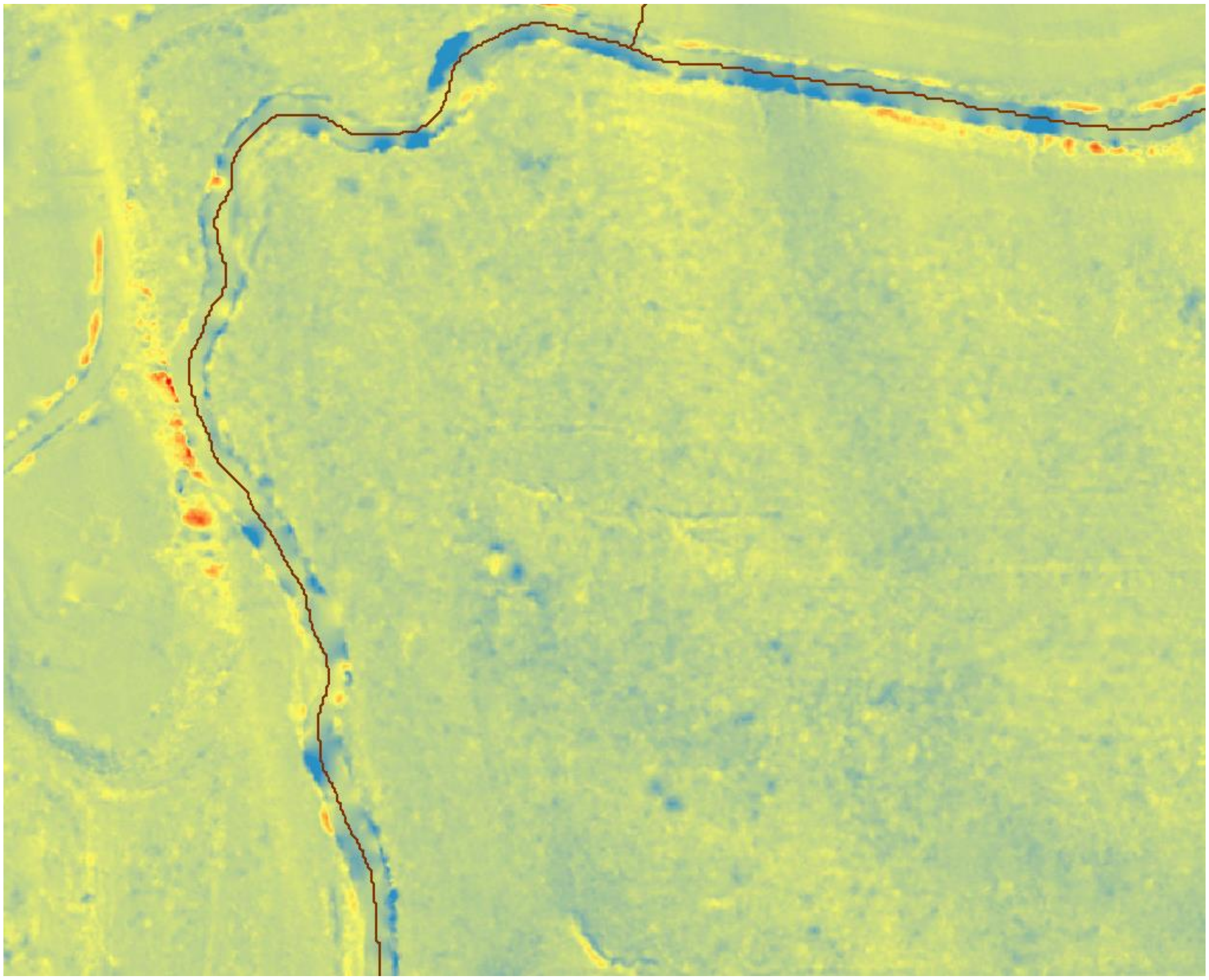

Figure 3. DoD map of Paxton Creek indicating erosion (in blue) and deposition (in red). The site would later be chosen for analysis as BMP-17 utilizing the BANCS method.

BANCS Assessment

Protocol 1 of the Stream Restoration Expert Panel (Schueler and Stack 2014) provides an annual mass nutrient and sediment reduction credit for qualifying stream restoration practices that prevent channel or bank erosion that would otherwise be delivered downstream from an actively enlarging or incising stream. This protocol allows for credit estimation through both a modeling approach (i.e., BANCS assessment) or monitoring approach. A BANCS assessment was conducted for six proposed stream restoration sites (Figure 2).

Method

The BANCS model evaluates bank characteristics and flow distribution along river reaches through quantitative assessments of Bank Erosion Hazard Index (BEHI) and Near-Bank Stress (NBS). The BEHI is a field method to evaluate bank erodibility potential at a typical study bank or a study bank length. Several bank characteristics are measured including top of bank and bankfull height, rooting depth, root density, bank angle, percent bank protection, bank composition, and bank material stratification. NBS is used to estimate bank stress associated with bankfull flows. The use of stream pattern, shape, and depositional areas provides a rapid method to estimate NBS for a study reach for general assessment. The BEHI is used in conjunction with NBS to predict bank erosion quantities and rate of erosion using existing bank erodibility curves, which are graphs that relate combinations of BEHI and NBS ratings with actual erosion rates (Rosgen, 2001; U.S. FWS, 2016a; U.S. FWS, 2016b). Estimated erosion rates from the bank erodibility curves are then multiplied by the bank height, length of a similar bank condition, and the soil bulk density, providing an estimate of sediment loss per year.

During May 2018 to February 2019, Center staff performed BANCS assessments on the six stream sites (Figure 2). Using GPS-enabled field tablets, the team identified, mapped, photo documented, and completed a BANCS assessment for each eroding bank in the identified reach. The data was then imported from the field tablet into a series of spreadsheets, which provides both specific data on each bank, as well as a summary of all banks in the study reach. The results of this analysis are represented in Appendix A. A map depicting each erosive stream segment analyzed during the field work is also provided in Appendix A.

Bulk Density

The CBP Stream Restoration Expert Panel Report recommends that each project require its own bulk density analysis from multiple locations within the stream channel. Bulk density has a large impact on the estimated annual sediment loading rate, as it is the bulk density (in lb/ft^3) which is multiplied by the volume of sediment eroded (in ft^3) to obtain the load of sediment removed (in lb).

Bulk density samples were collected by Dr. Robert Walter of WSI. A shovel was used to remove approximately 4 cups of soil from representative locations along the streambank profiles of BMPs -04, -05, -09, -10, and -12. Bulk density sample analysis was conducted by Dr. Robert Walter of WSI and analyzed in his laboratory at Franklin and Marshall College.

The average bulk density for all the samples obtained was applied to the BANCS calculations to obtain an estimated sediment load. The average result was utilized for two reasons. First, this report is providing further information for planning and prioritizing stream restoration projects. The design parameters and precise boundaries are not known as of this time. Once the design boundaries are known, bulk density samples should be obtained from several representative locations along the stream bank within the boundaries of the restoration and utilized for site-specific crediting. Second, a CBP workgroup is reviewing Protocol 1 in order to make recommendations to improve its guidance and methods on how soil bulk density samples should be collected and analyzed. Therefore, the requirements for sample collection may change.

The soil bulk density results are summarized in Table 1. The procedure used to determine soil bulk density from the watershed representative samples is included as Appendix B.

Table 1. Bulk density results for selected banks.

Site ID	Bulk Density (lbs/ft³)
BMP-04	76.16
BMP-05A	72.42
BMP-05B	76.16
BMP-09A	69.92
BMP-10A	67.42
BMP-10B	72.42
BMP-12A	69.30
BMP-12B	74.91
BMP-12C	69.30
Average of Bulk Density Samples	**72.42**

BANCS Results

The results of the BANCS analysis are provided in Appendix A. Each stream segment is listed with the ID, length, height, erosion rate without crediting qualifiers (no sediment delivery ratios or performance efficiencies), erosion load without crediting qualifiers, and the erosion load as calculated in three variations using DEP and CBP requirements for sediment crediting.

Stream Restoration Crediting in the Chesapeake Bay Program

Currently, the CBP is operating under the Phase 6 Watershed Model. However, much of the DEP guidance that exists for MS4 crediting is based on the Phase 5.3.2 Watershed Model. As a result of the changes for the Phase 6 Watershed Model, there is limited guidance as to how stream restoration reductions should be calculated and reported. The Center developed an approach utilizing aspects of the sediment delivery ratio in the Phase 6 stream restoration calculation method.

Default Rate

The DEP MS4 guidance currently includes two different generic loading rate values that may be applied as a "default rate" for stream restoration crediting. The first comes from the Streambank Restoration Expert Panel Report (Schueler and Stack 2014). The document provides a default rate value of 44.88 lbs/ft/yr to be applied to stream restoration projects. However, the DEP MS4 guidance document, "National Pollutant Discharge Elimination System (NPDES) Stormwater Discharges from Small Municipal Separate Storm Sewer Systems Pollutant Reduction Plan (PRP) Instructions" (PRP Instructions) states:

> Where existing sediment loads were calculated using modeling at a local watershed scale, the default rate to be used is 115 lb/ft/yr. This default rate comes from a convergence of MapShed modeled streambank erosion loads from a group of urbanized watersheds, the 248 lb/ft default edge-of-field (EOF) rate in the Expert Panel Report with the 50% efficiency uncertainty factor specified for the Protocols applied, and field data were collected following the

> BANCS methodology where projects have been implemented and load reductions calculated using the Protocols (pg. 3).

However, the PRP Instructions further states:

> NOTE – Use of default effectiveness values (44.88 lb/ft/yr and 115 lb/ft/yr) will be accepted for the subsequent permit term. It is recommended that the data required to complete load calculations using the Protocols be collected during the design phase for use in subsequent load reduction calculations (pg. 3).

As the Joint PRP for Paxton Creek provided the default rate of 115 lb/ft/yr for planning level stream restoration analysis, the Center utilized the same value as PRP Crediting Option 1. To calculate the sediment reductions from a stream restoration project, the length of the stream segment is simply multiplied by the default rate of 115 lbs/ft/yr to obtain a sediment load reduced per year. There is no use of the soil bulk density as there is in the BANCS method. Consistent with the CBP Stream Restoration Protocol, the Center strongly encourages the use of the BANCS stream restoration crediting protocols over the use of the default rate to gain a more thorough understanding of the erosive losses within the stream channel.

Sediment Delivery Ratios

The current Phase 5.3.2 PRP crediting method utilizing Protocol 1 in the CBP Expert Panel Report requires that sediment load calculated from the BANCS assessment must be multiplied by a sediment delivery ratio of 0.181. The ratio is required as the Phase 5.3.2 model predicts that of the sediment erosion predicted from the BANCS assessment, only 0.181 lb of every 1 lb will reach the Chesapeake Bay.

Instead of one generic sediment delivery ratio, as in the Phase 5.3.2 model, the Phase 6 model now has two sediment delivery ratios: one that is applied to calculate "stream-to-river" losses, and one that is applied to account for "river-to-bay" losses. Further, the stream-to-river losses have been discretized to provide specific delivery ratios to each of the major stream segments within the Chesapeake Bay watershed. The specific stream-to-river sediment delivery ratio for the sections of Paxton Creek that were analyzed is 0.4042622. The river-to-bay sediment delivery ratio is 0.4688981. In order to calculate the load delivered to the Chesapeake Bay, the stream-to-river and river-to-bay sediment delivery ratios are multiplied together yielding a value of 0.190. The product of those two delivery ratios replaces the 0.181 ratio that is was generically applied in the Phase 5.3.2 model.

For the purposes of local MS4 implementation and local water quality restoration as a primary focus from DEP, the Center explored adaptations to the CBP Phase 6 methods to estimate pollutant load reductions from stream restoration projects. The Center engaged the DEP to discuss the potential to use only the stream-to-river sediment delivery ratio for PRP crediting, as the Commonwealth may apply the river-to-bay ratio to determine Pennsylvania crediting. The DEP was not able to issue a final approval of the method at this time, as there are ongoing conversations regarding stream restoration crediting in the CBP Office. However, for the analysis provided herein, only the stream-to-river ratio of 0.4042622 is utilized to determine the Phase 6 credit model sediment reductions without the application of the river-to-bay ratio.

Restoration Efficiencies

The CBP Stream Restoration Expert Panel requires that a 50% restoration efficiency must be applied to the nutrient and sediment PRP load reductions, to account for the uncertainty in the effectiveness of the stream restoration activity. However, the current Protocol allows for up to 100% restoration efficiency to be applied for pre and post construction monitoring. There is currently a CBP workgroup that is seeking to update Protocol 1 from the Expert Panel Report. As of the submission of this report, the workgroup is strongly considering providing varying levels of restoration efficiency based on the level of monitoring effort performed in both pre and post construction phases. For example, a 75% restoration efficiency may be provided by the workgroup for instances where BANCS analysis is performed, bulk density samples are obtained, and bank profiles are created using cross section data for both pre and post construction monitoring. Greater efficiencies may be applied by engaging in more extensive and robust pre and post construction monitoring over longer periods of time.

PRP Crediting Options

There are several considerations in determining the appropriate strategy for crediting stream restoration projects, such as utilizing the default rate, or determining the appropriate sediment delivery ratios and restoration efficiencies. Further, the sediment reduction crediting methodologies are ever evolving. The Center has provided three separate PRP Crediting Options for the municipalities to assist in determining the most beneficial method to calculate the sediment erosion from the banks analyzed, including the default rate applied to the lengths of stream with eroding banks, the CBP Phase 5.3.2 method with a 50% efficiency, and the CBP Phase 6 method with a 50% efficiency applied. The 50% efficiency was chosen as it is the baseline credit provided with no additional monitoring work required. The PRP Crediting Options are summarized in Table 2. However, if the municipalities choose to engage in monitoring, the BANCS crediting values may be obtained for both the Phase 5.3.2 and the Phase 6 by multiplying the desired efficiency by the Erosion Load provided in the Bank Erosion Summary Tables provided for each BMP in Appendix A. If the Phase 5.3.2 result is desired, multiply the product by 0.181 to apply the sediment delivery ratio. If the Phase 6 result is desired, multiply by 0.4042622 to determine the stream to river sediment delivery or by 0.190 to determine the load delivered to the Chesapeake Bay.

Table 2. PRP crediting options.

PRP Crediting Option	Description
1- Default Rate	115 lbs/ft/yr multiplied by the length of stream segment analyzed
2- Phase 5.3.2 BANCS Method with 50% Efficiency	Stream-to-river sediment delivery ratio of 0.181 applied with a 50% restoration efficiency
3- Phase 6 BANCS Method with 50% Efficiency	Stream-to-river sediment delivery ratio of 0.4042622 applied with a 50% restoration efficiency

Results and Discussion

DEMs of Difference

After an initial reconnaissance of the 13 restoration sites provided in the Joint PRP and discussing the local landowner and political issues with the municipalities, field work by the Center yielded only five stream sites with the potential for restoration. With the significant Joint PRP sediment reduction goal at 1,625,053 lbs/yr, the Center sought to find another potential restoration site within the watershed by utilizing the DoD map created by the WSI. Analysis of the DoD GIS watershed map indicated a stream reach with high erosion near coordinates 40.307081, -76.870258, in Susquehanna Township (Figure 3). The process assisted in the identification of another major reach of stream that had strong potential for restoration, which was added to the BMP list as BMP-17 (Figure 2).

Further analysis was also performed with the DoD GIS map to measure the erosion and depositional changes that occurred between the 2008 to 2016 LiDAR data sets. The analysis was not fully successful but was determined to contain a great deal of potential, and guided the Center to several key questions that must be resolved to implement this measurement technique in the future. For example, the Center determined the need to develop a cost and time effective method to eliminate the data noise that occurs when generating DEMs across stream channels. The data noise occurs due to LiDAR's inability to penetrate water surfaces. When differenced, the data noise gives a false sense of change where none may have occurred. Another key area of future study is the quantification of the error in measurement, which is key in accurately understanding the measurement data.

As the greatest error propagated through the analysis is due to the older, less sophisticated 2008 LiDAR information, WSI was employed to fly drones over BMPs -5, -12, and -17, to gather photogrammetry data that could be processed into highly accurate GIS DEMs. The drone flybys occurred during late November and early December 2018. The DEMs processed from the drone photogrammetry were differenced against the much more accurate 2016 data set, eliminating the need to utilize the 2008 LiDAR data. The intent was to produce a much more accurate DoD. The resulting report from WSI is included as Appendix C.

While the error was decreased by differencing the more accurate data sets, the length of the differencing data analysis was decreased significantly (from 2016 to 2018 compared to 2008 to 2016) resulting in a less thorough change analysis. Additionally, further investigation is required to determine precisely how much more accurate the 2016 to 2018 differenced data is, and if the increased accuracy is worth the cost associated with gathering the data.

The WSI drone analysis is included as Appendix C. Note the WSI analysis accidentally refers to BMP -17 as BMP -10, analyzed a small section of BMP -17, and misplaced BANCS data for BMP -17 with the actual BMP 10 data.

PRP Crediting Options

A summary of the results of the PRP crediting calculations is provided in Table 3. Additionally, in Table 3 the results of the BANCS analysis are provided but with no crediting qualifiers applied (i.e. no percent efficiency and no sediment delivery ratio). The default rate calculation yields a substantial sediment reduction for all of the stream sites analyzed. Due to the increased sediment delivery ratio, the Phase 6 BANCS method calculation values are consistently greater than the Phase 5.3.2 method. However, comparing the BANCS analysis with no crediting qualifiers results to the default rate calculation results, yields four BMPs (-05, -09, -10, and -17) that have greater erosion rates calculated from the BANCS with no crediting qualifiers.

The fact is important to note and is the central parameter selected in the prioritization of these stream restoration projects. As described in the BANCS Assessment Method section above, the BANCS analysis factors in site specific characteristics such as top of bank and bankfull height, rooting depth, root density, bank angle, percent bank protection, bank composition, soil bulk density, as well as stream pattern, shape, and depositional areas. However, as described in the Default Rate section of this report, the default rate calculation does not apply any site-specific characteristics of the bank or the stream channel and is simply the product of multiplying the length of a stream segment by 115 lbs/ft/yr to obtain a sediment load reduced per year.

Table 3. Summary of the sediment reductions associated with each PRP crediting options with the results of the BANCS method with no crediting qualifiers applied.

PRP Crediting Option	BMP-04	BMP-05	BMP-09	BMP-10	BMP-12	BMP-17	Totals
Potential Restoration Length (ft)	458.8	818.1	1,833.0	1,921.4	911.1	4392.8	**10,335.2**
Default Rate (lb/yr)	52,762	94,082	210,795	220,961	104,777	505,172	**1,188,549**
BANCS with No Crediting Qualifiers (lb/yr)	37,291	137,867	444,508	240,001	51,567	1,072,228	**1,983,462**
Phase 5.3.2 BANCS Method with 50% Efficiency (lb/yr)	3,375	12,477	40,228	21,720	4,667	97,037	**179,504**
Phase 6 BANCS Method with 50% Efficiency (lb/yr)	7,538	27,867	89,849	48,512	10,423	216,731	**400,920**

Prioritization

As discussed in the Default Rate section above, the PADEP is allowing for the use of the default rate calculation for crediting during the current permit term. However, PADEP also recommends that the data is gathered to calculate reductions using Protocol 1 of the Stream Restoration Expert Panel Report. The primary load reduction calculation in Protocol 1 is the BANCS method.

While the credit from the default rate calculation is greater than the other PRP Crediting Options, and is easy to calculate, it is beneficial to compare this credit value with the BANCS results with no crediting qualifiers applied. As the BANCS method is determined from site specific parameters, comparing the default rate results with the BANCS provides perspective on whether a proposed project will not simply obtain sediment credit, but will deliver environmental benefit by reducing bank erosion and providing biological uplift. In order to evaluate the relationship between the BANCS results with no crediting qualifiers applied, and the default rate calculation, a ratio was created using the following equation:

$$BANCS\ to\ Default\ Ratio = \frac{BANCS_{No\ Qualifiers}}{Default\ Rate\ Calc}$$

There are four stream sites, identified as BMPs -05, -09, -10, and -17, that have a BANCS to Default Ratio greater than 1 (Table 4). Before reducing the sediment reduction values by assuming a 50% efficiency and applying a sediment delivery ratio, these projects would deliver a greater sediment reduction on average than 115 lb/ft/yr. These four projects have the potential to greatly increase water quality and not just obtain sediment reduction numbers for crediting purposes alone. Therefore, BMPs -05, -09, -10, and -17 should be prioritized for implementation over BMPs -04 and -12. Of the four prioritized projects, BMPs -09 and -17 have BANCS to Default Ratios greater than 2. As such, BMPs -09 and -17 are recommended as the top two priority projects.

Susquehanna Township owns a vast majority of the land surrounding BMP-17, and therefore it is recommended that BMP-17 is the top priority project due to the need for restoration, the potential for true biological uplift through restoration, and that landownership rests with Susquehanna Township. The list of prioritized projects and summary reason for their ranking is provided in Table 4.

Table 4. Prioritized list of projects analyzed in the Paxton Creek Watershed.

Project BMP ID	BANCS w/ no Qualifiers to Default Rate Calc Ratio	Prioritization Rank	Reason for Ranking
BMP-17	2.12	1	Township owns land, and highest ratio
BMP-09	2.11	2	High ratio and project is upstream of BMP-17
BMP-10	1.09	3	Project is immediately upstream of BMP-17 and contains a great deal of deposition that may be eligible for increased crediting
BMP-05	1.47	4	Located adjacent to Veteran's Park with ease of property access, high ratio
BMP-04	0.71	5	Located adjacent to Veteran's Park with ease of property access, low ratio
BMP-12	0.49	6	Lowest ratio

The Joint PRP sets a sediment reduction goal of 1,625,053 lb/yr. A summary of the PRP Crediting Options is available in Table 5. Note that if all six of the stream sites analyzed are restored by the lengths that were analyzed and documented for each BMP in the Appendix A, the municipalities would accomplish a 1,188,549 lb/yr sediment reduction, which is 73% of the total load reduction goal.

Table 5. Comparison of BANCS results with the municipalities' Joint PRP required sediment reduction.

PRP Crediting Option 1 Default Rate (lbs/yr)	BANCS with No Crediting Qualifiers (lb/yr)	PRP Crediting Option 2 Phase 5.3.2 BANCS Method with 50% Efficiency (lbs/yr)	PRP Crediting Option 3 Phase 6 BANCS Method with 50% Efficiency (lbs/yr)	PRP Required Sediment Reduction (lbs/yr)
1,188,549	1,983,462	179,504	400,920	1,625,053

Summary

The Center evaluated the 13 proposed stream restoration sites (BMPs) from the municipalities Joint PRP. it was determined that several of the proposed stream restoration sites were not good candidates for restoration due to a number of issues, such as lack of erosion, presence of bedrock, potential loss of valuable habitat, and lack of landowner support. However, the Center found five BMPs from the list of 13 that were good candidates for restoration. Using LiDAR data to create a DoD aided in finding a sixth project for evaluation, and yielded several key areas for future study that will hopefully lead to the ability to use this change detection practice as a means to accurately measure the erosion and deposition within a stream corridor. For the current study however, a BANCS analysis was performed to evaluate the erosive potential and generate three sediment crediting options for the six BMPs. The sediment crediting values were used with other factors to prioritize the restoration sites for implementation.

The PADEP is allowing for the use of the default rate calculation for crediting during the current permit term. Which is simply the product of multiplying the length of stream restoration proposed by 115 lb/ft/yr, contains no information about the stream itself, or how actively it is eroding. While the credit from the default rate calculation is greater than the other PRP Crediting Options, and is easy to calculate, it is beneficial to compare this credit value with one derived from actual site-specific physical parameters within the stream channel. As restoration efforts are costly, focusing on projects that both receive sediment reduction credit and provide actual environmental benefit through biological uplift is recommended. Therefore, a ratio was derived by dividing the BANCS results with no crediting qualifiers applied by the default rate calculation results. The ratio was used with other factors to rank and prioritize the projects for implementation. Through conversation with the municipalities, it is determined that the highest priorities are BMPs-17 and -9.

References

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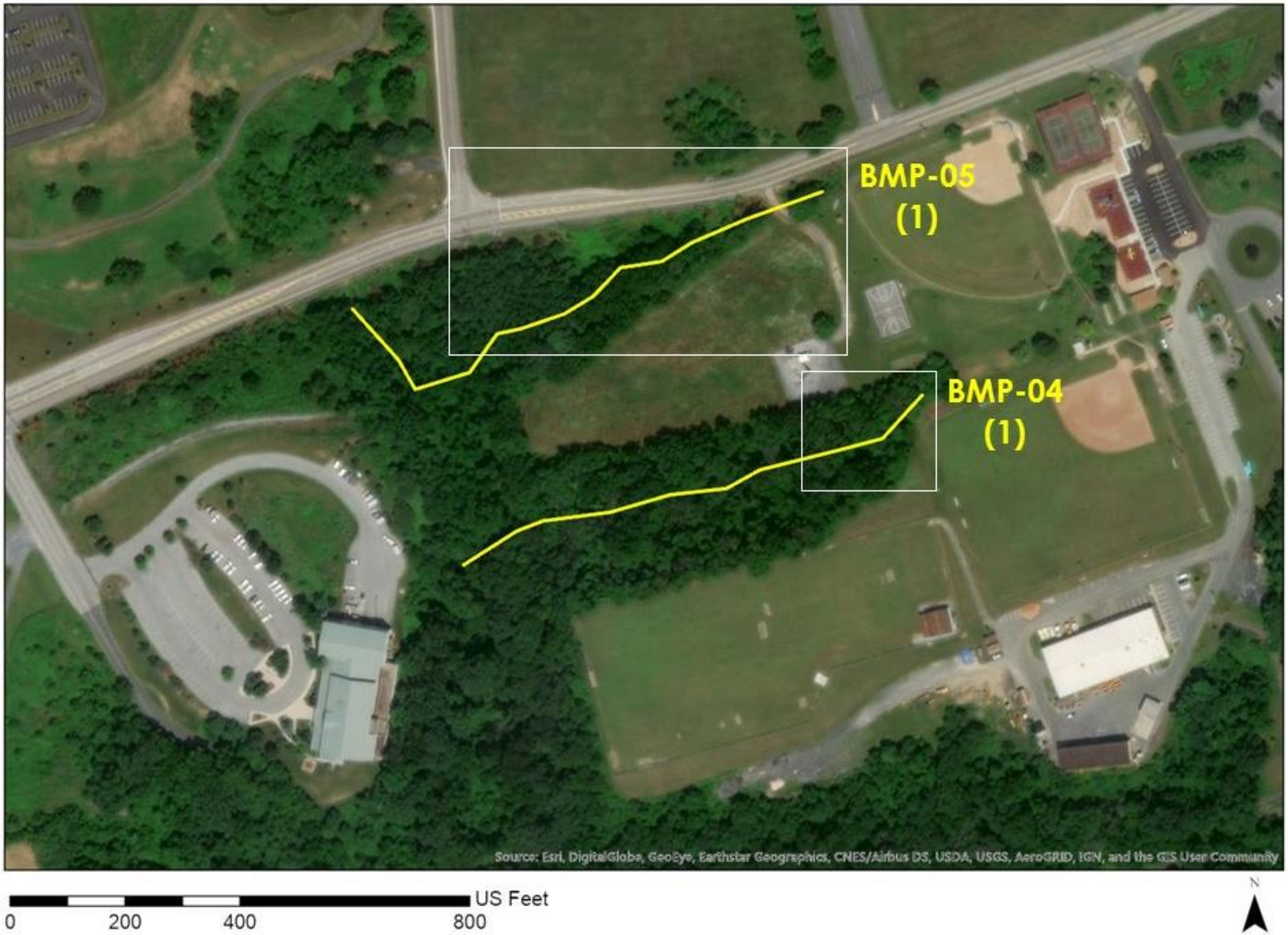
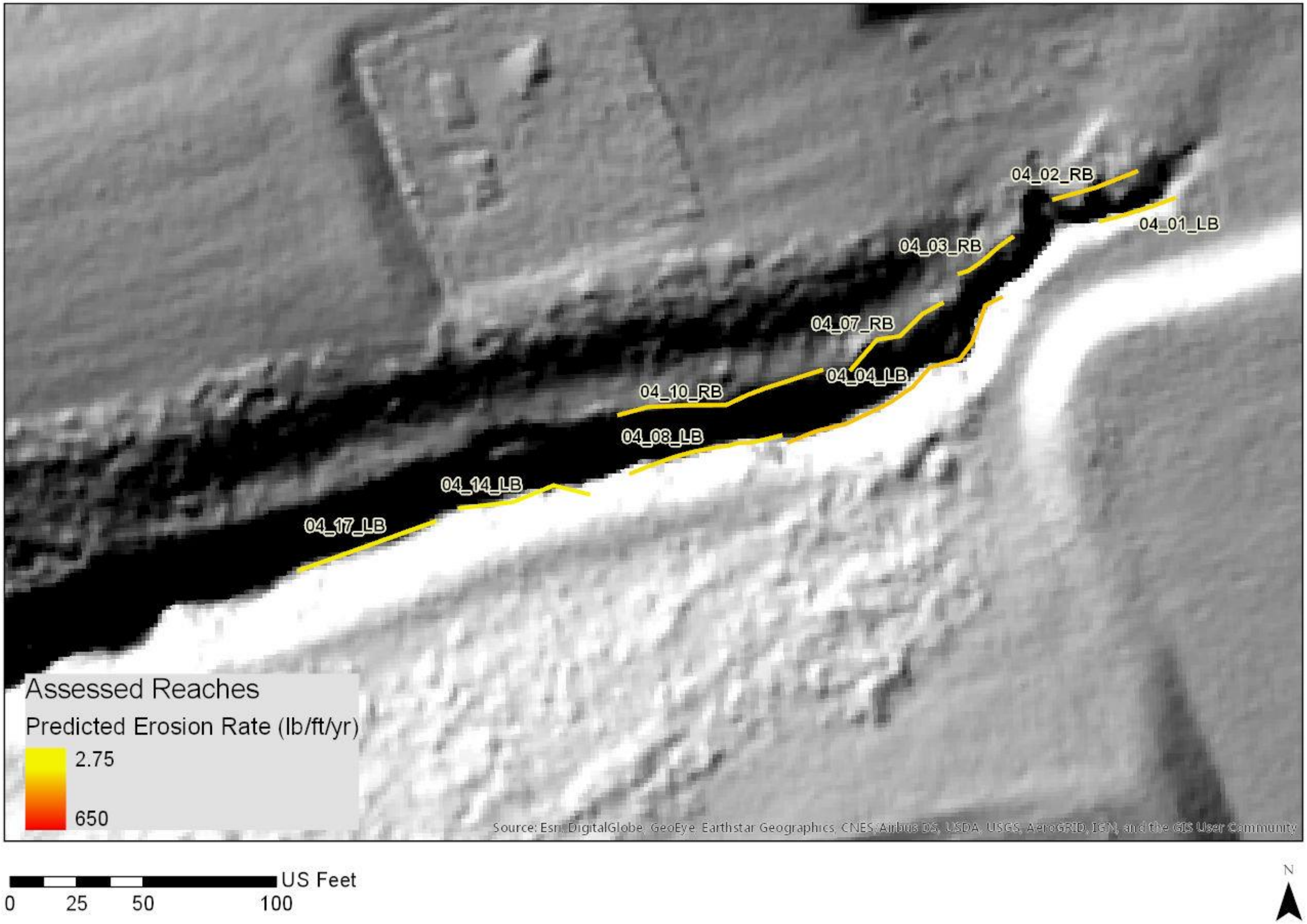
United States Fish & Wildlife Service (U.S. F&WS). 2016b. Standards for Estimating Near-Bank Stress. Chesapeake Bay Field Office, Annapolis, MD. Stream Habitat Assessment and Restoration Program.

Appendix A. Stream Site Pictures with BANCS Analysis Areas Identified

BMP-04 & BMP-05



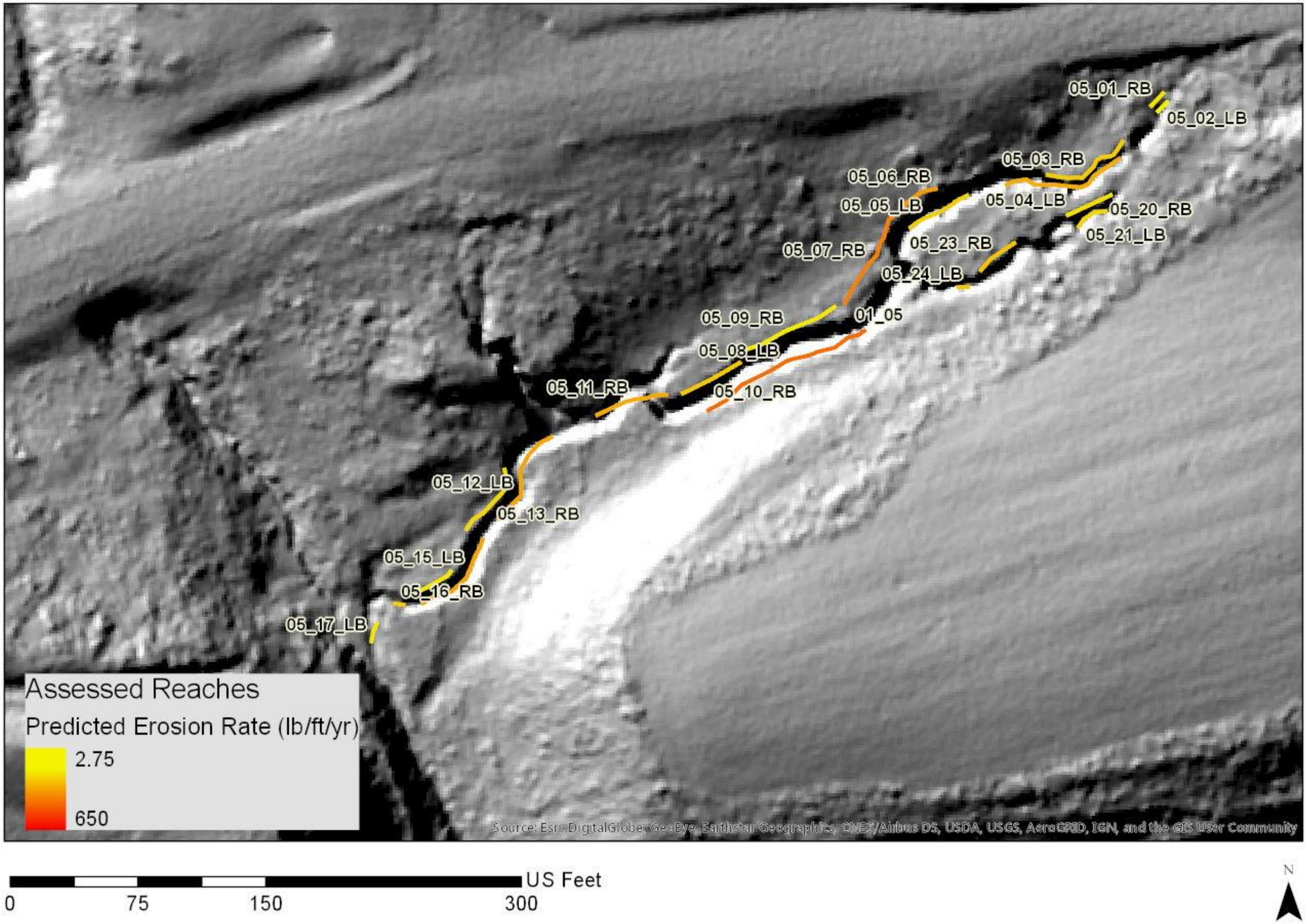
BMP-04 (1)


04_02_RB
04_01_LB
04_03_RB
04_07_RB
04_04_LB
04_10_RB
04_08_LB
04_14_LB
04_17_LB
Assessed Reaches
Predicted Erosion Rate (lb/ft/yr)
2.75
650
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
0 25 50 100
US Feet
N

Bank Erosion Summary Table for BMP-04

ID	Length (ft)	Height (ft)	Erosion Rate (lbs/ft/yr)	Erosion Load (lbs/yr)	PRP Crediting Option 1 Default Rate (lbs/yr)	PRP Crediting Option 2 Phase 5.3.2 Bay Method 50% Eff. (lbs/yr)	PRP Crediting Option 3 Phase 6 Bay Method 50% Eff. (lbs/yr)
04_1LB	28.7	3.5	76.0	2183.5	3302.4	197.6	441.4
04_2RB	32.5	4.4	95.6	3105.5	3736.1	281.0	627.7
04_3RB	24.1	3.5	76.0	1828.8	2765.9	165.5	369.7
04_4LB	101.3	6.3	136.9	13864.6	11649.5	1254.8	2802.5
04_7RB	44.2	3.2	69.5	3073.2	5083.7	278.1	621.2
04_8LB	58.3	3.0	65.2	3796.5	6698.8	343.6	767.4
04_10RB	78.6	4.0	86.9	6830.1	9038.7	618.1	1380.6
04_17LB	71.1	1.5	32.6	2317.6	8178.7	209.7	468.5
04_14RB	20.1	1.6	14.5	290.7	2308.3	26.3	58.8
Total	**458.8**			**37,291**	**52,762**	**3,375**	**7,538**

BMP-05 (1)

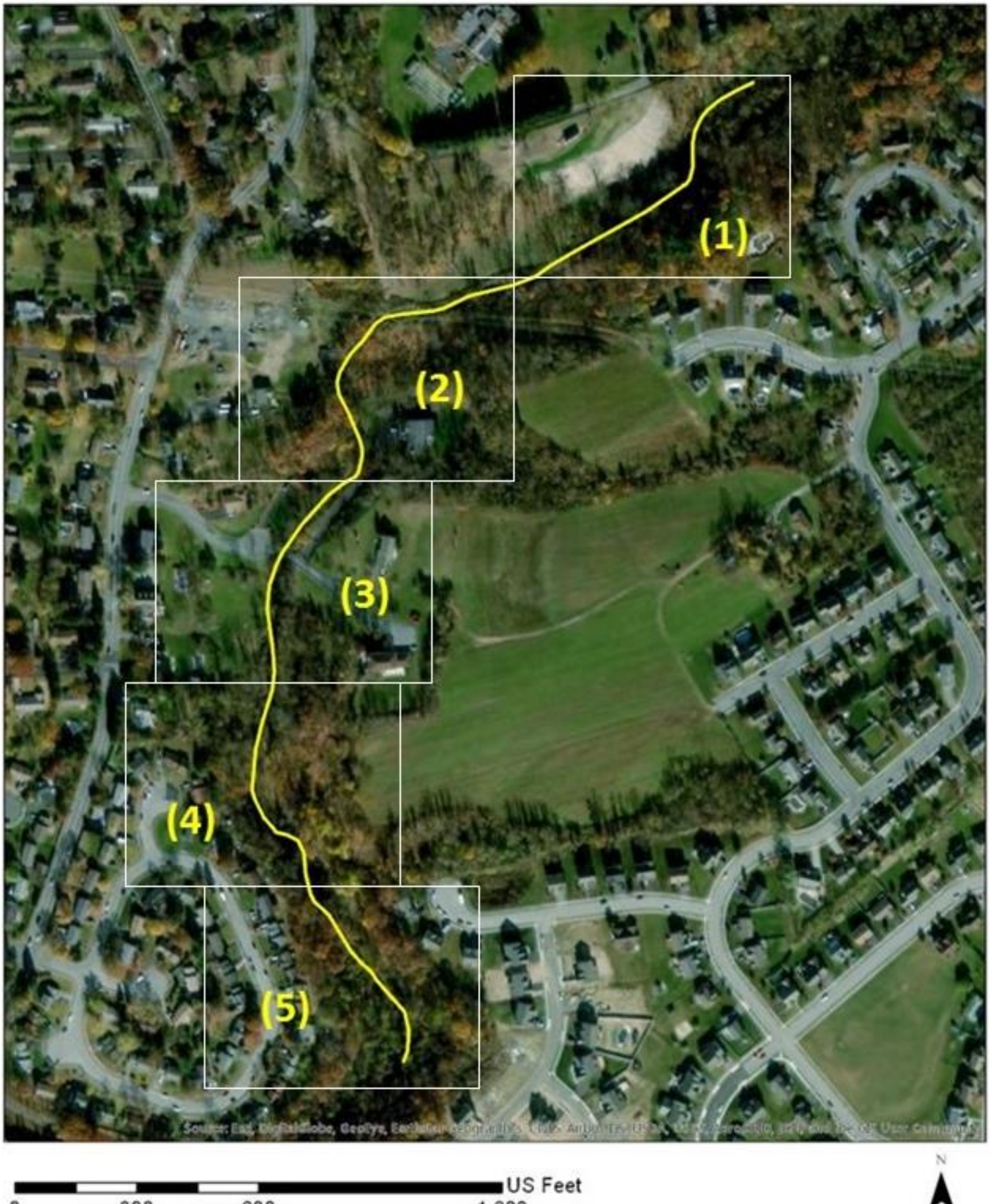


05_01_RB
05_02_LB
05_03_RB
05_06_RB
05_04_LB
05_05_LB
05_20_RB
05_21_LB
05_23_RB
05_07_RB
05_24_LB
05_09_RB
01_05
05_08_LB
05_11_RB
05_10_RB
05_12_LB
05_13_RB
05_15_LB
05_16_RB
05_17_LB
Assessed Reaches
Predicted Erosion Rate (lb/ft/yr)
2.75
650
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
0
75
150
300
US Feet
N

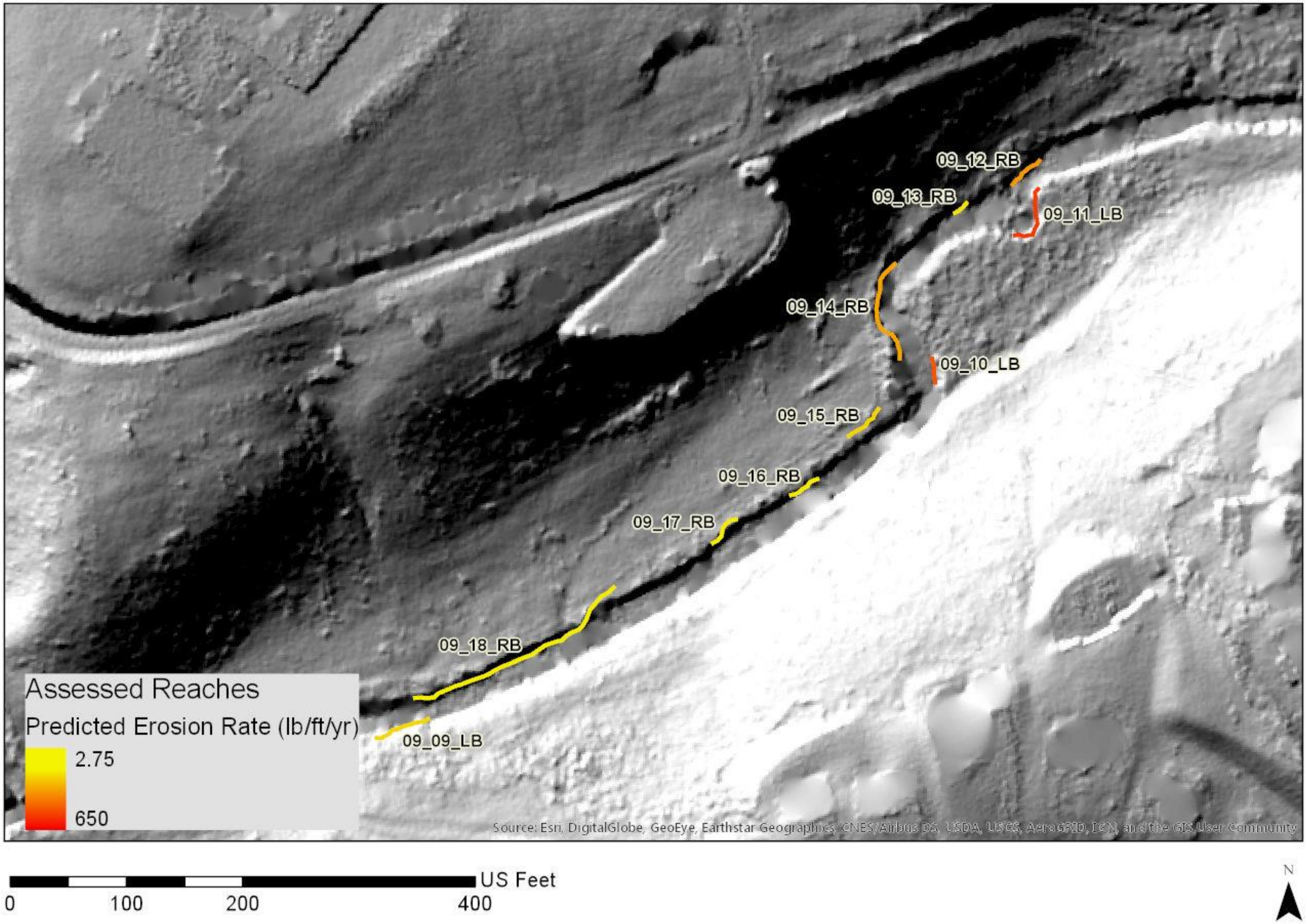
Bank Erosion Summary Table for BMP-05

ID	Length (ft)	Height (ft)	Erosion Rate (lbs/ft/yr)	Erosion Load (lbs/yr)	PRP Crediting Option 1 Default Rate (lbs/yr)	PRP Crediting Option 2 Phase 5.3.2 Bay Method 50% Eff. (lbs/yr)	PRP Crediting Option 3 Phase 6 Bay Method 50% Eff. (lbs/yr)
05_1RB	9.8	1.6	46.3	453.6	1125.5	41.1	91.7
05_2LB	7.4	1.5	13.6	99.9	845.9	9.0	20.2
05_03RB	54.0	5.1	110.8	5984.7	6211.7	541.6	1209.7
05_04LB	73.2	4.1	190.0	13917.8	8423.0	1259.6	2813.2
05_5LB	38.1	4.6	99.9	3808.0	4382.1	344.6	769.7
05_6RB	26.1	5.0	231.7	6053.4	3004.1	547.8	1223.6
05_7RB	58.4	6.6	305.9	17868.0	6717.6	1617.1	3611.7
05_8LB	105.1	7.7	356.9	37491.4	12081.5	3393.0	7578.2
05_09RB	63.4	6.5	32.9	2088.3	7288.5	189.0	422.1
05_10RB	37.8	5.4	117.3	4431.3	4343.8	401.0	895.7
05_11RB	43.0	4.2	194.7	8369.6	4944.6	757.4	1691.7
05_12LB	60.4	4.5	208.6	12591.9	6943.2	1139.6	2545.2
05_13RB	44.1	3.7	80.4	3548.9	5077.2	321.2	717.3
05_14LB	50.0	1.7	36.9	1846.6	5750.1	167.1	373.3
05_15LB	54.3	2.9	210.0	11407.9	6246.9	1032.4	2305.9
05_16RB	5.0	1.7	98.5	488.6	570.5	44.2	98.8
05_17LB	10.4	1.9	41.3	429.0	1195.1	38.8	86.7
05_20RB	28.4	2.7	58.7	1665.1	3264.4	150.7	336.6
05_21LB	19.1	3.6	78.2	1491.0	2192.4	134.9	301.4
05_23RB	25.2	5.9	128.2	3230.0	2897.9	292.3	652.9
05_24LB	5.0	5.5	119.5	601.9	579.3	54.5	121.7
Total	**818.4**			**137,867**	**94,086**	**12,477**	**27,867**

BMP-09

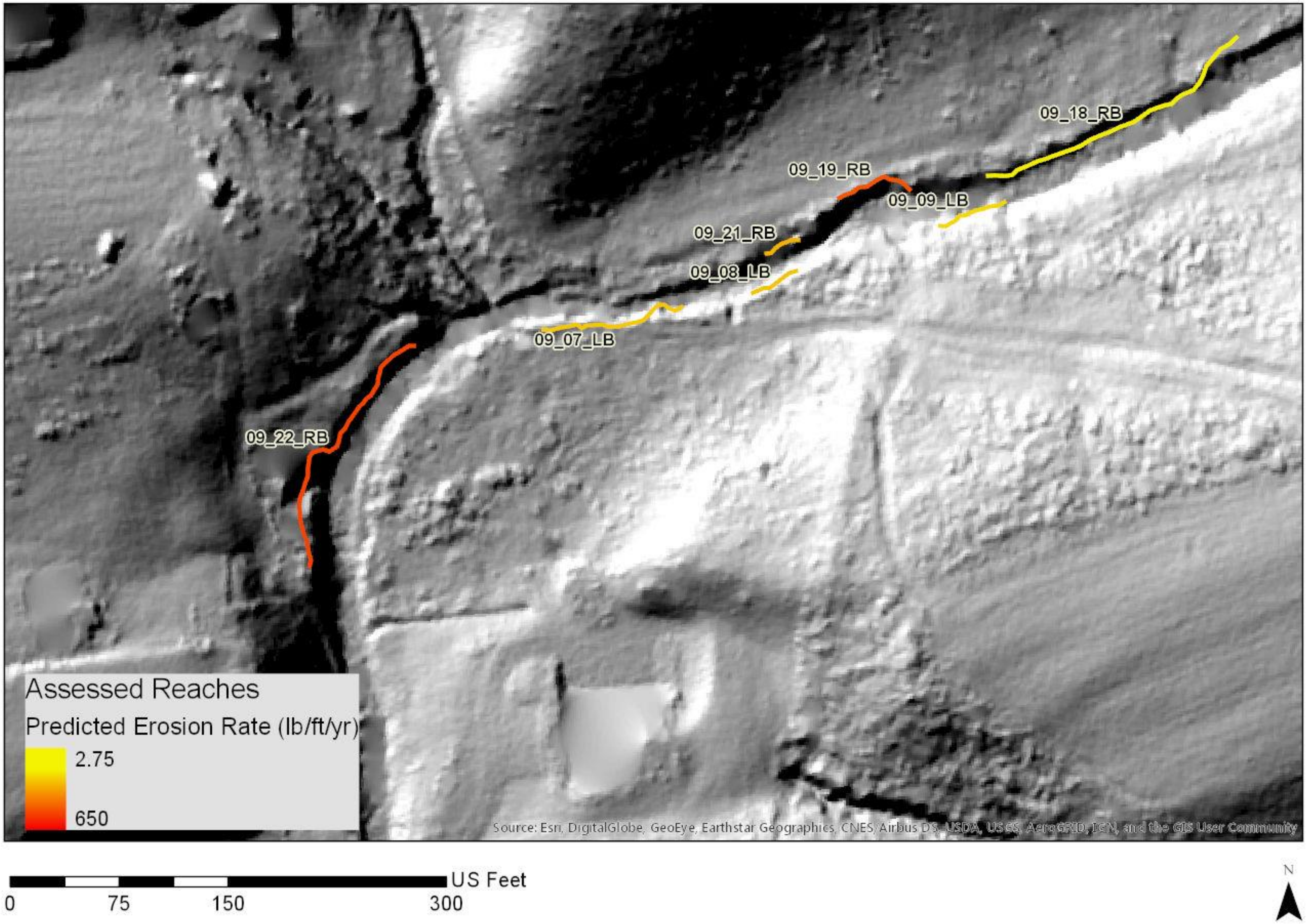


BMP-09 (1)



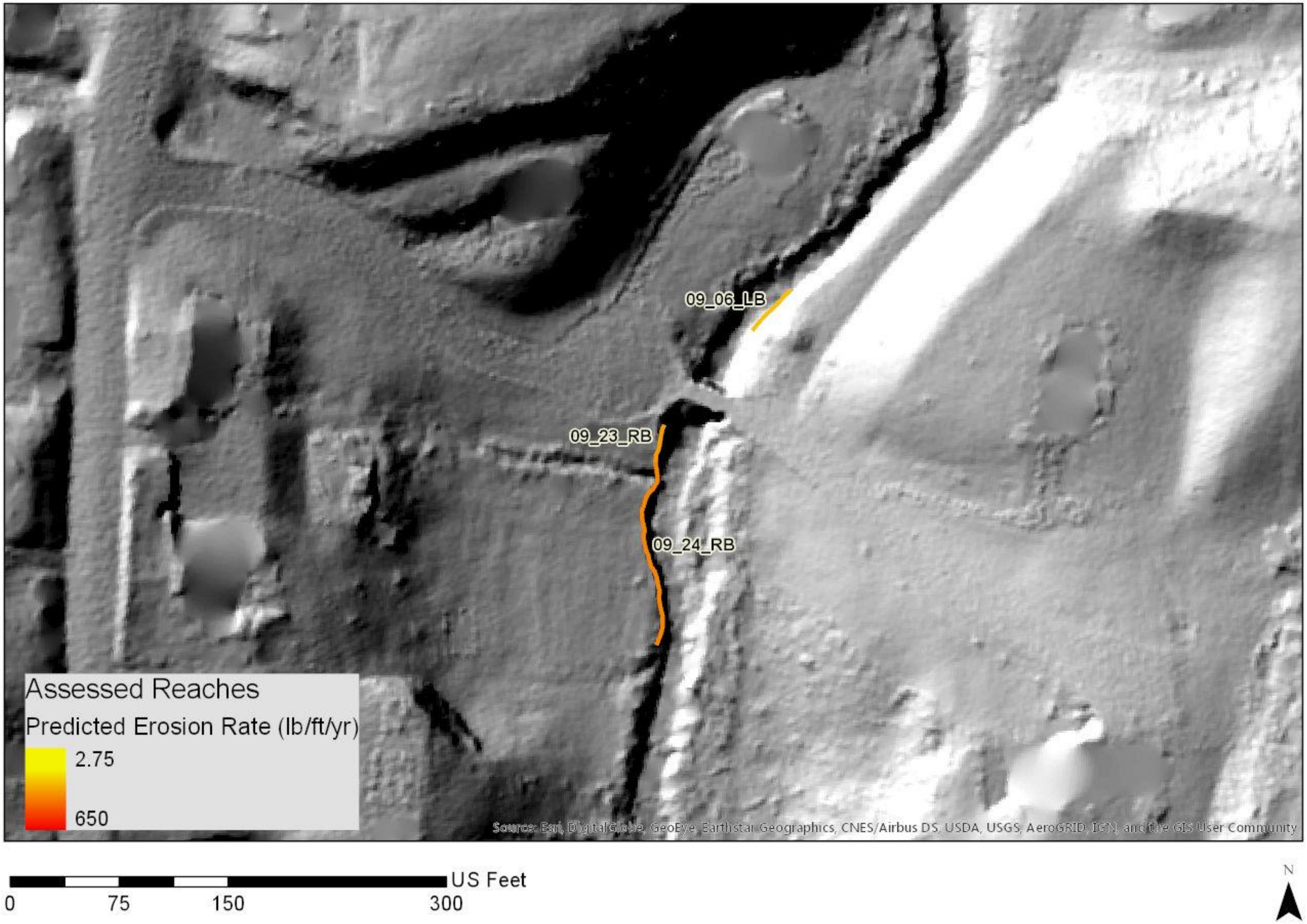
09_12_RB
09_13_RB
09_11_LB
09_14_RB
09_10_LB
09_15_RB
09_16_RB
09_17_RB
09_18_RB
09_09_LB
Assessed Reaches
Predicted Erosion Rate (lb/ft/yr)
2.75
650
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
US Feet
0
100
200
400
N

BMP-09 (2)

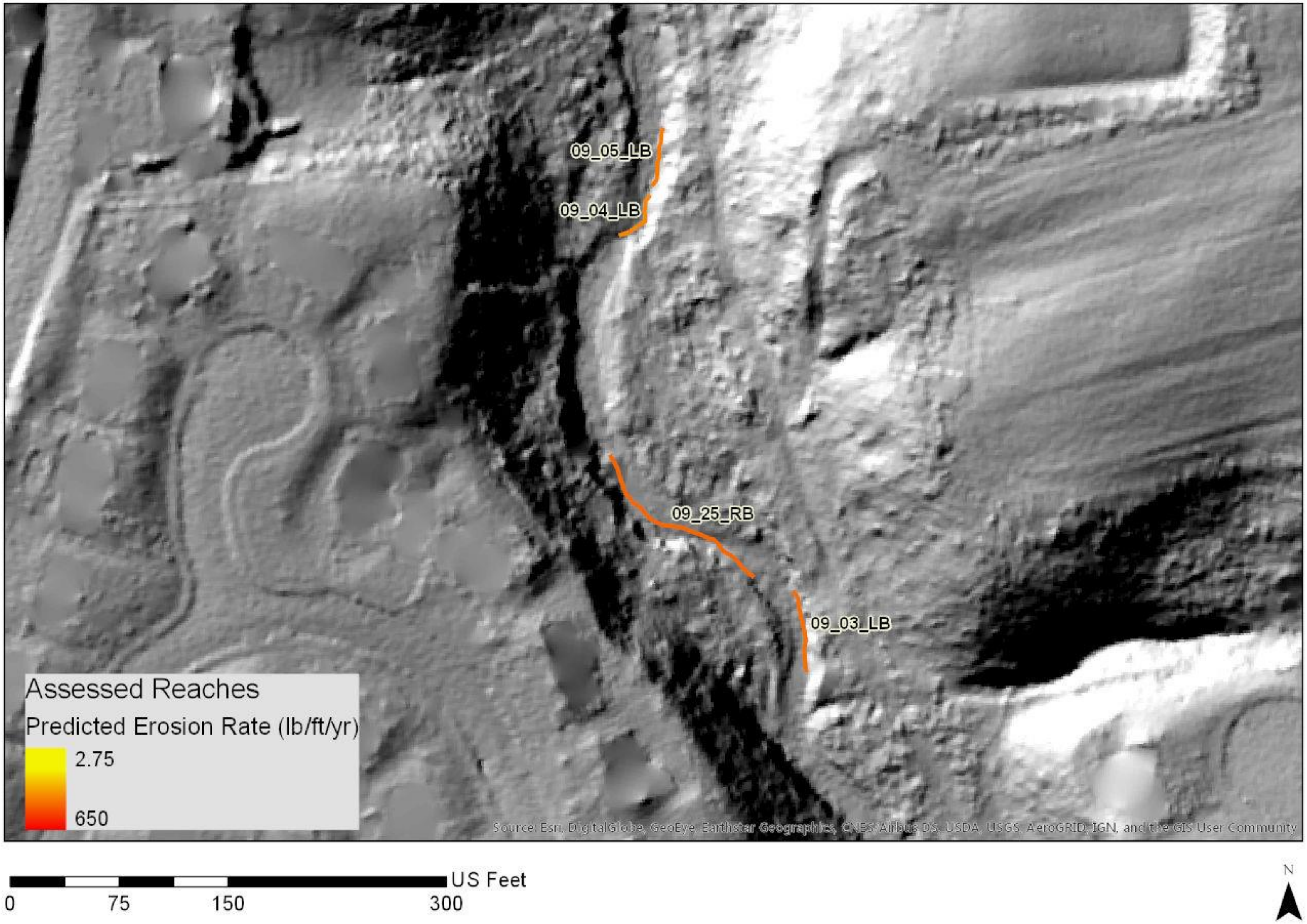


09_18_RB
09_19_RB
09_09_LB
09_21_RB
09_08_LB
09_07_LB
09_22_RB
Assessed Reaches
Predicted Erosion Rate (lb/ft/yr)
2.75
650
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
0
75
150
300
US Feet
N

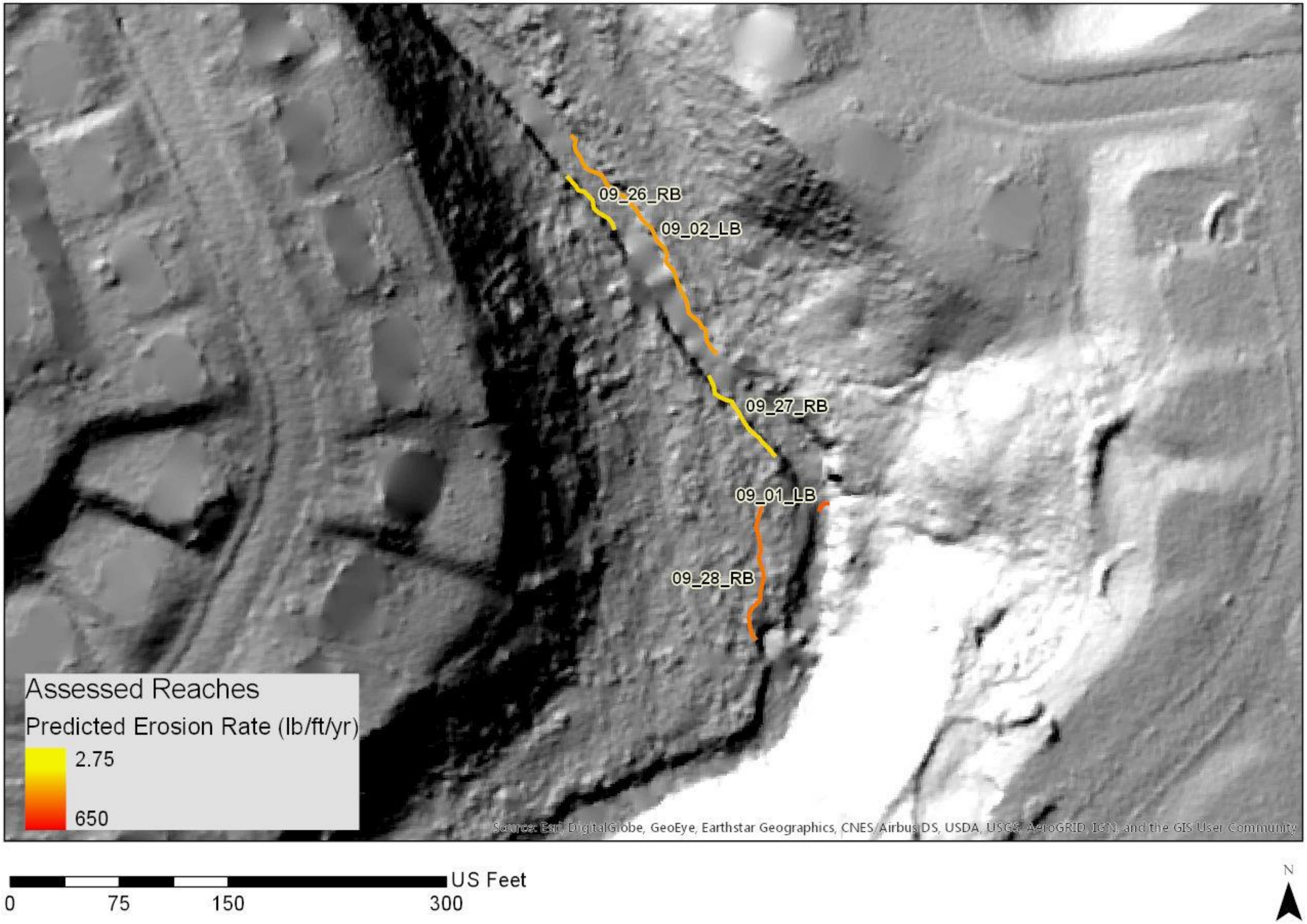
BMP-09 (3)


09_06_LB
09_23_RB
09_24_RB
Assessed Reaches
Predicted Erosion Rate (lb/ft/yr)
2.75
650
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
0
75
150
300
US Feet
N

BMP-09 (4)


09_05_LB
09_04_LB
09_25_RB
09_03_LB
Assessed Reaches
Predicted Erosion Rate (lb/ft/yr)
2.75
650
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
US Feet
0
75
150
300
N

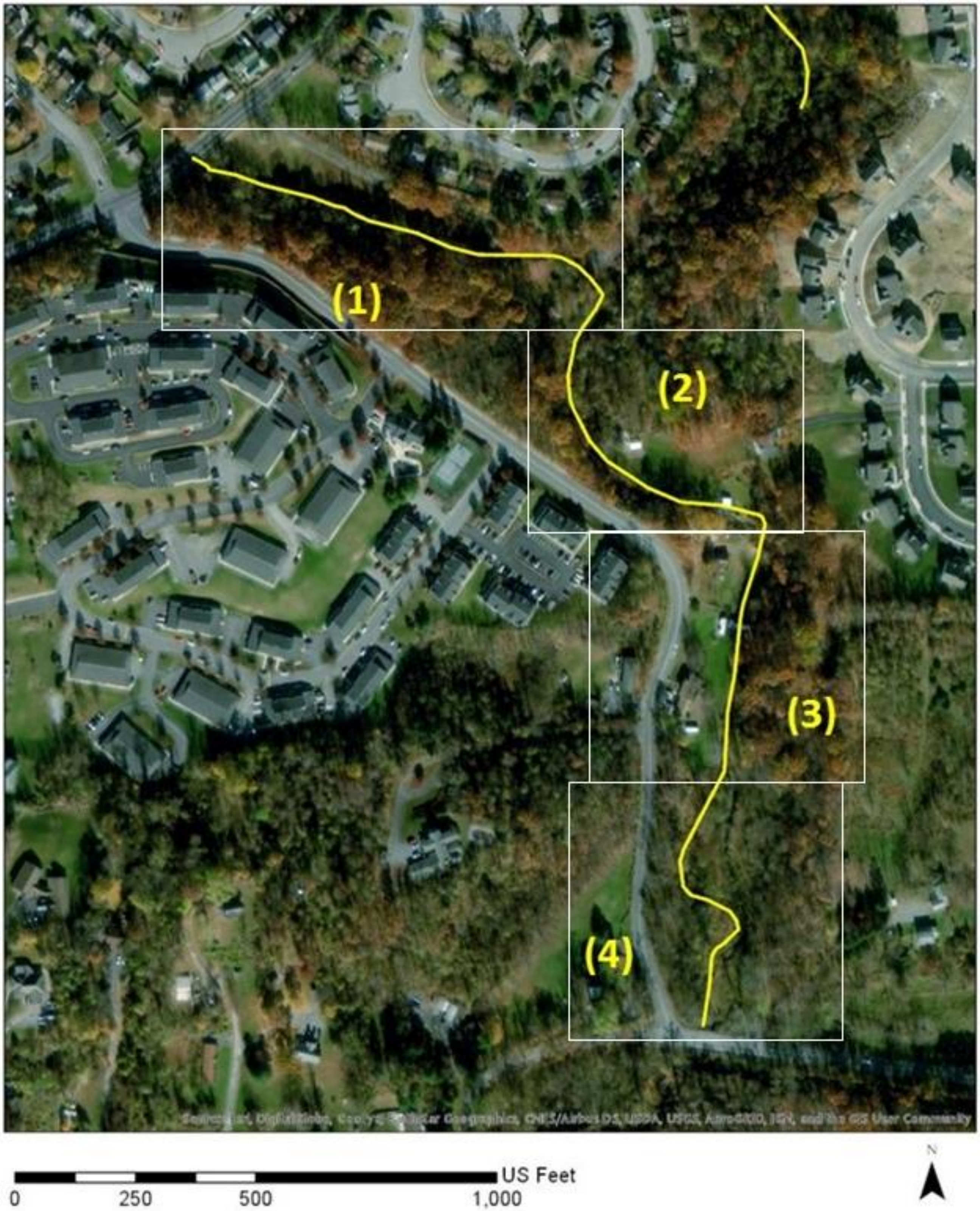
BMP-09 (5)


09_26_RB
09_02_LB
09_27_RB
09_01_LB
09_28_RB
Assessed Reaches
Predicted Erosion Rate (lb/ft/yr)
2.75
650
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
US Feet
0
75
150
300
N

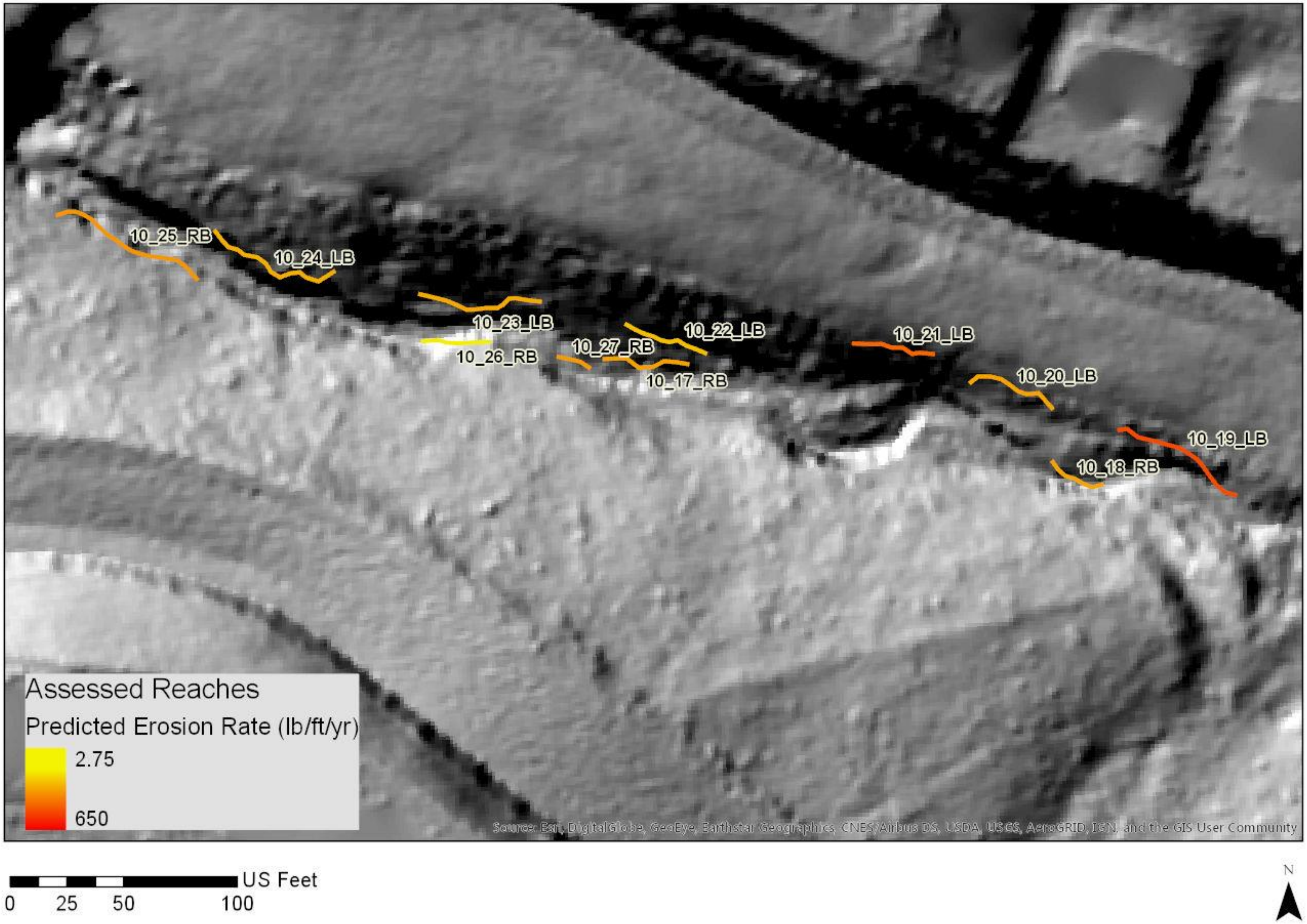
Bank Erosion Summary Table for BMP-09

ID	Length (ft)	Height (ft)	Erosion Rate (lbs/ft/yr)	Erosion Load (lbs/yr)	PRP Crediting Option 1 Default Rate (lbs/yr)	PRP Crediting Option 2 Phase 5.3.2 Bay Method 50% Eff. (lbs/yr)	PRP Crediting Option 3 Phase 6 Bay Method 50% Eff. (lbs/yr)
09_1LB	15.0	9.0	417.1	6256.8	1725.0	566.2	1264.7
09_2LB	189.8	4.9	227.1	43105.7	21828.3	3901.1	8713.0
09_3LB	53.4	4.9	354.8	18945.9	6140.2	1714.6	3829.6
09_4LB	38.1	4.0	289.7	11040.5	4383.2	999.2	2231.6
09_5LB	36.2	6.9	319.8	11570.8	4161.0	1047.2	2338.8
09_6LB	35.8	6.4	139.0	4982.1	4120.7	450.9	1007.0
09_7LB	103.9	4.2	121.7	12644.5	11952.3	1144.3	2555.8
09_8LB	37.1	4.6	133.2	4944.9	4267.8	447.5	999.5
09_9LB	48.8	3.7	80.4	3925.7	5616.3	355.3	793.5
09_10LB	19.0	3.4	430.9	8185.9	2184.8	740.8	1654.6
09_11LB	57.6	3.9	494.2	28466.9	6623.7	2576.3	5754.0
09_12RB	31.5	3.4	246.2	7764.8	3626.7	702.7	1569.5
09_13RB	12.8	2.0	43.4	558.3	1477.7	50.5	112.9
09_14RB	86.2	3.0	217.2	18721.3	9910.0	1694.3	3784.1
09_15RB	36.0	3.1	89.8	3229.3	4135.7	292.3	652.7
09_16RB	29.6	2.7	24.4	723.6	3404.9	65.5	146.3
09_17RB	30.8	2.9	26.3	808.4	3541.3	73.2	163.4
09_18RB	203.5	2.6	23.5	4790.3	23406.7	433.5	968.3
09_19RB	65.9	3.4	430.9	28387.7	7576.6	2569.1	5738.0
09_21RB	30.0	3.8	176.1	5283.5	3450.0	478.2	1068.0
09_22RB	199.9	10.2	472.7	94495.0	22987.4	8551.8	19100.4
09_23RB	26.5	5.1	236.4	6257.7	3044.6	566.3	1264.9
09_24RB	130.8	4.1	296.9	38823.5	15037.4	3513.5	7847.4
09_25RB	134.1	5.2	376.6	50492.5	15420.0	4569.6	10206.1
09_26RB	48.2	2.8	81.1	3908.2	5541.4	353.7	790.0
09_27RB	72.4	3.6	78.2	5664.6	8329.2	512.6	1145.0
09_28RB	60.0	2.7	342.2	20530.1	6900.0	1858.0	4149.8
Total	**1832.9**			**444,508**	**210,793**	**40,228**	**89,849**

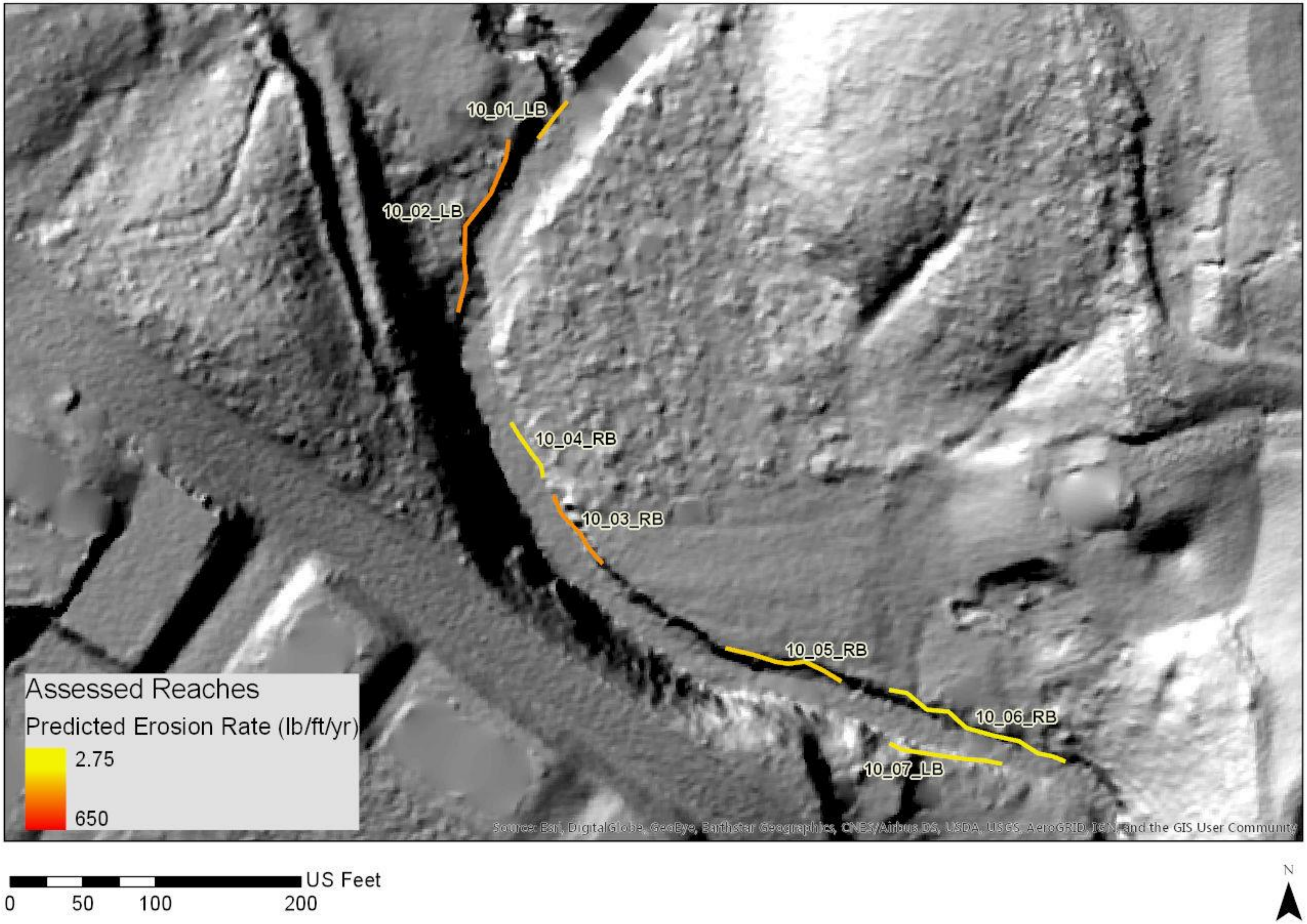
BMP-10



BMP-10 (1)

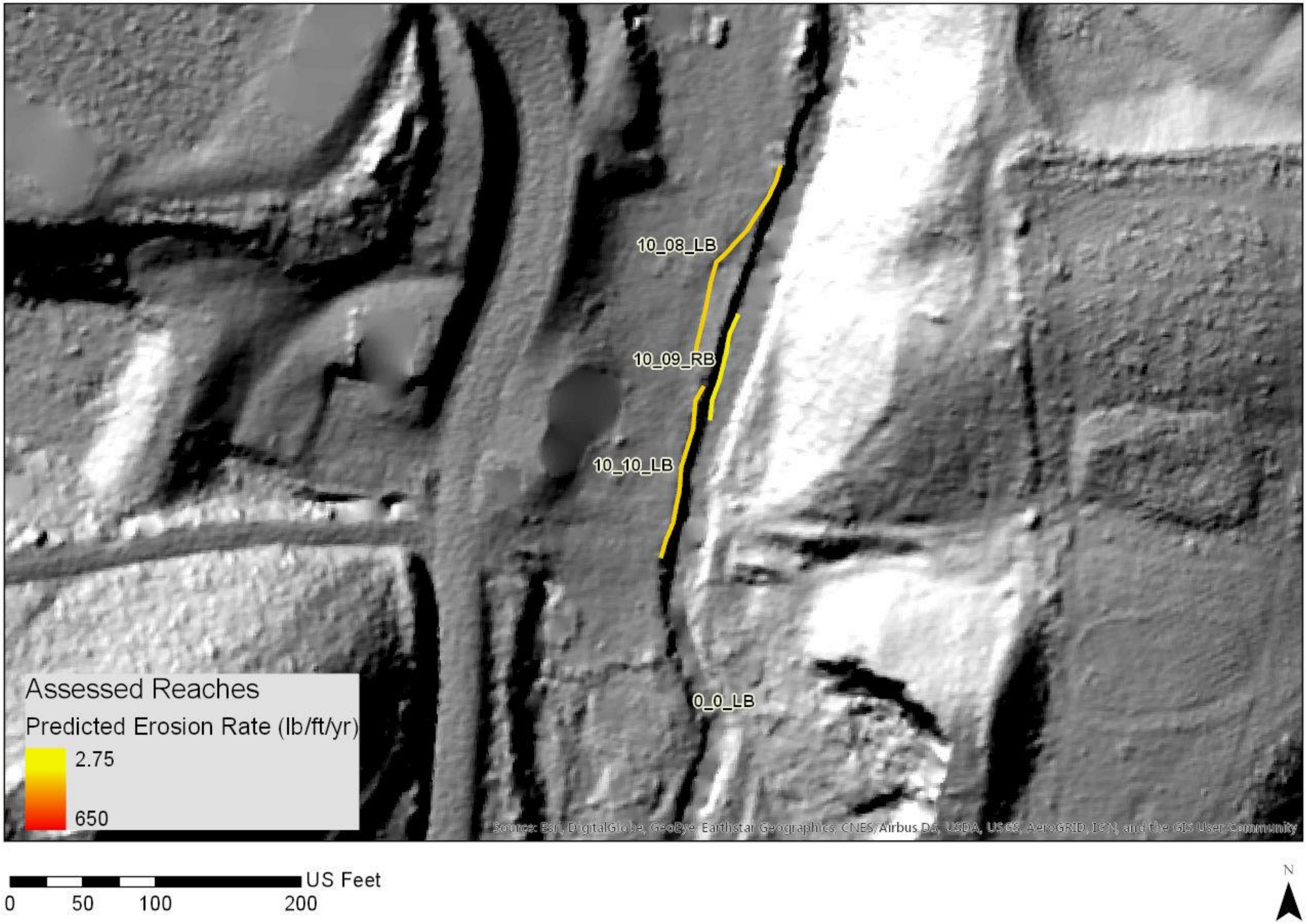

10_25_RB
10_24_LB
10_23_LB
10_26_RB
10_27_RB
10_22_LB
10_17_RB
10_21_LB
10_20_LB
10_19_LB
10_18_RB
Assessed Reaches
Predicted Erosion Rate (lb/ft/yr)
2.75
650
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
0 25 50 100 US Feet
N

BMP-10 (2)

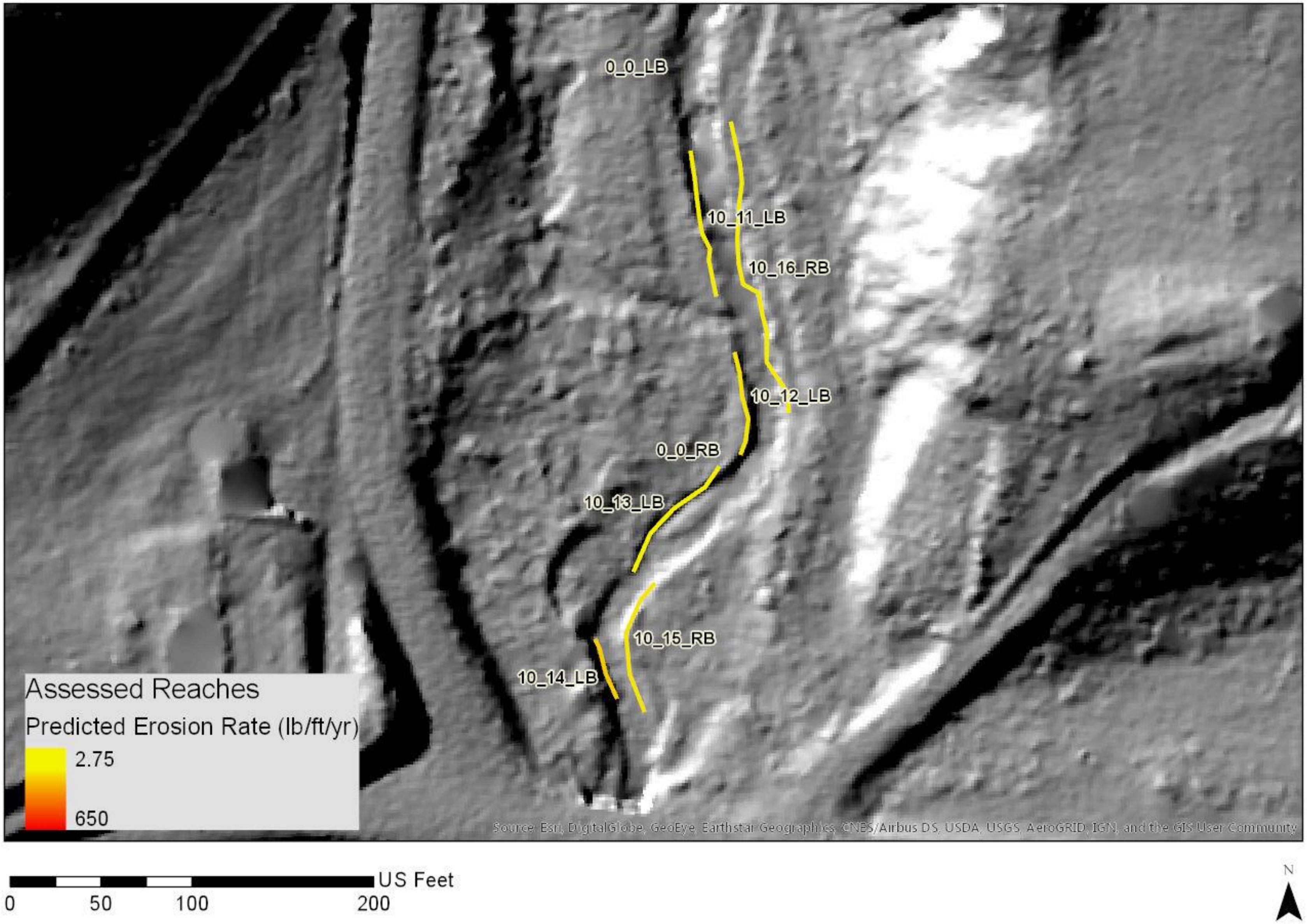


10_01_LB
10_02_LB
10_04_RB
10_03_RB
10_05_RB
10_06_RB
10_07_LB
Assessed Reaches
Predicted Erosion Rate (lb/ft/yr)
2.75
650
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
0
50
100
200
US Feet
N

BMP-10 (3)


10_08_LB
10_09_RB
10_10_LB
0_0_LB
Assessed Reaches
Predicted Erosion Rate (lb/ft/yr)
2.75
650
0
50
100
200
US Feet
N

BMP-10 (4)


0_0_LB
10_11_LB
10_16_RB
10_12_LB
0_0_RB
10_13_LB
10_15_RB
10_14_LB
Assessed Reaches
Predicted Erosion Rate (lb/ft/yr)
2.75
650
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
0
50
100
200
US Feet
N

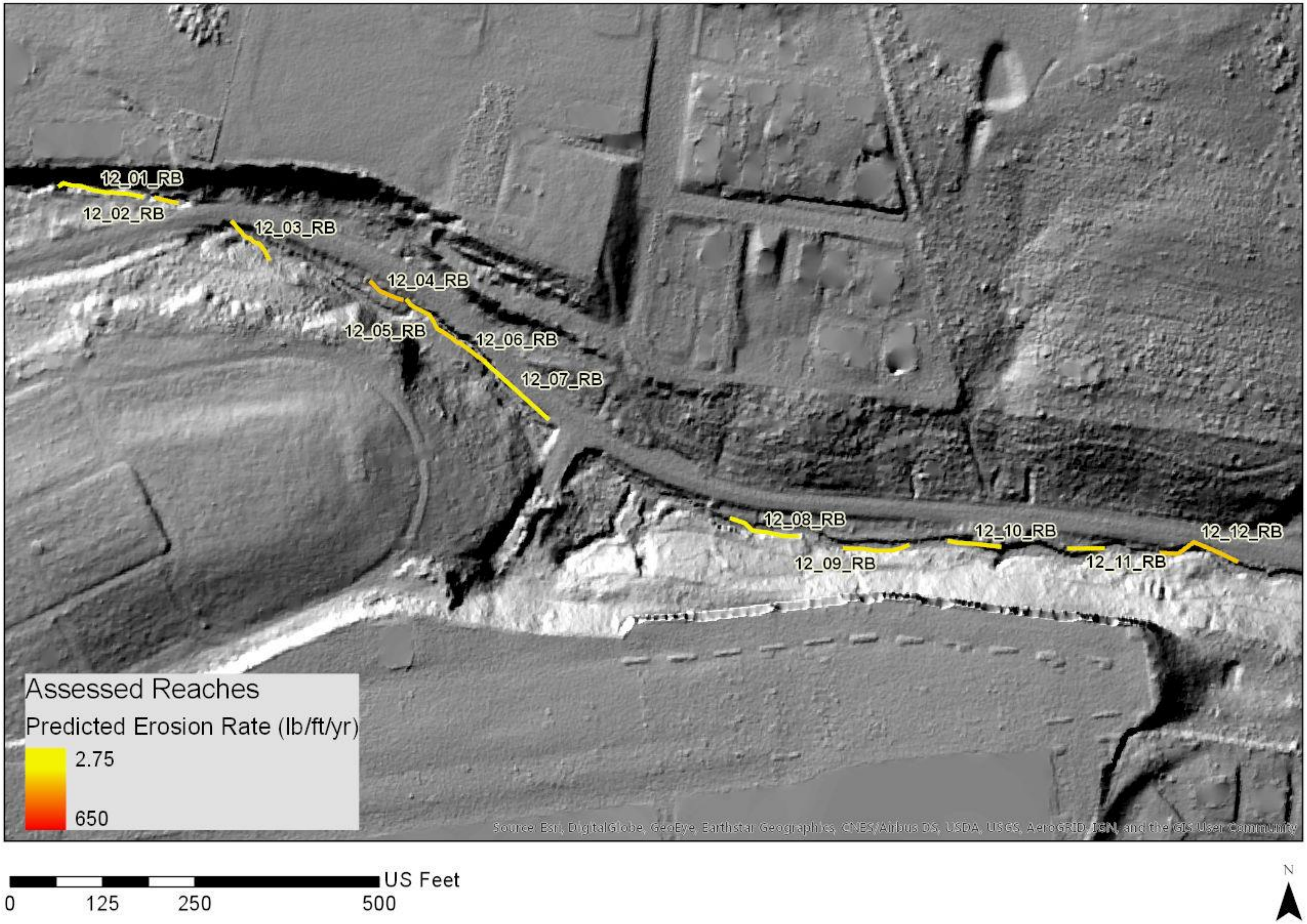
Bank Erosion Summary Table for BMP-10

ID	Length (ft)	Height (ft)	Erosion Rate (lbs/ft/yr)	Erosion Load (lbs/yr)	PRP Crediting Option 1 Default Rate (lbs/yr)	PRP Crediting Option 2 Phase 5.3.2 Bay Method 50% Eff. (lbs/yr)	PRP Crediting Option 3 Phase 6 Bay Method 50% Eff. (lbs/yr)
10_1LB	29.7	5.2	150.6	4477.8	3418.7	405.2	905.1
10_2LB	135.6	5.0	289.7	39278.4	15593.9	3554.7	7939.4
10_3RB	55.0	5.9	273.4	15047.6	6328.4	1361.8	3041.6
10_4RB	45.2	5.0	45.3	2047.0	5201.1	185.3	413.8
10_5RB	84.1	5.9	106.8	8978.7	9666.7	812.6	1814.9
10_6RB	137.0	3.0	27.2	3721.5	15759.6	336.8	752.2
10_7LB	76.5	4.1	37.1	2837.6	8792.5	256.8	573.6
10_8LB	188.1	3.4	98.5	18528.8	21635.6	1676.9	3745.2
10_9RB	73.6	2.6	23.5	1731.4	8459.9	156.7	350.0
10_10LB	127.7	3.2	92.7	11833.5	14681.3	1070.9	2391.9
10_11LB	79.9	2.9	26.3	2098.2	9191.7	189.9	424.1
10_12LB	54.6	2.7	48.9	2671.1	6284.1	241.7	539.9
10_13LB	80.1	1.4	12.7	1014.7	9208.3	91.8	205.1
10_14LB	34.2	4.9	106.5	3642.0	3934.5	329.6	736.2
10_15RB	78.1	2.4	43.4	3392.0	8977.6	307.0	685.6
10_16RB	169.1	2.7	24.4	4133.4	19448.7	374.1	835.5
10_17_RB	38.5	3.1	224.5	8641.2	4426.6	782.0	1746.7
10_18_RB	25.5	2.9	210.0	5350.2	2929.8	484.2	1081.5
10_19_LB	61.3	6.2	449.0	27521.5	7049.2	2490.7	5563.0
10_20_LB	41.5	3.0	217.2	9005.7	4767.1	815.0	1820.3
10_21_LB	35.8	5.2	376.6	13484.0	4117.9	1220.3	2725.5
10_22_LB	37.6	2.0	144.8	5452.0	4329.0	493.4	1102.0
10_23_LB	55.5	2.8	202.8	11246.9	6378.8	1017.8	2273.4
10_24_LB	62.6	2.6	188.3	11790.4	7201.4	1067.0	2383.2
10_25_RB	71.0	3.5	253.5	17994.5	8164.5	1628.5	3637.2
10_26_RB	29.3	2.4	21.7	636.1	3367.0	57.6	128.6
10_27_RB	14.3	5.2	241.0	3445.1	1643.9	311.8	696.4
Total	**1,921.4**			**240,001**	**220,958**	**21,720**	**48,512**

BMP-12


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
US Feet
0
200
400
800
N

BMP-12 (1)

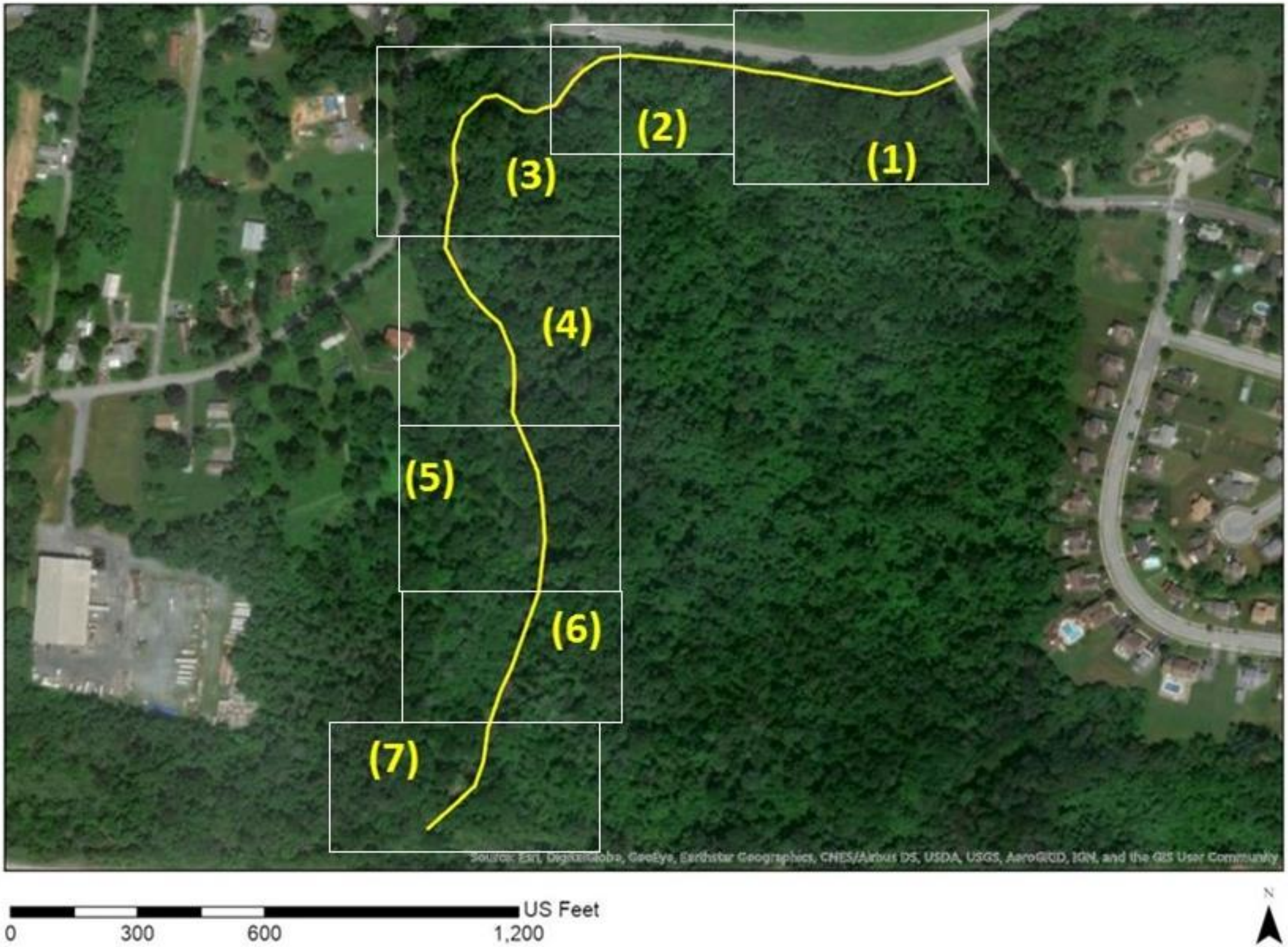


12_01_RB
12_02_RB
12_03_RB
12_04_RB
12_05_RB
12_06_RB
12_07_RB
12_08_RB
12_09_RB
12_10_RB
12_11_RB
12_12_RB
Assessed Reaches
Predicted Erosion Rate (lb/ft/yr)
2.75
650
0
125
250
500
US Feet
N

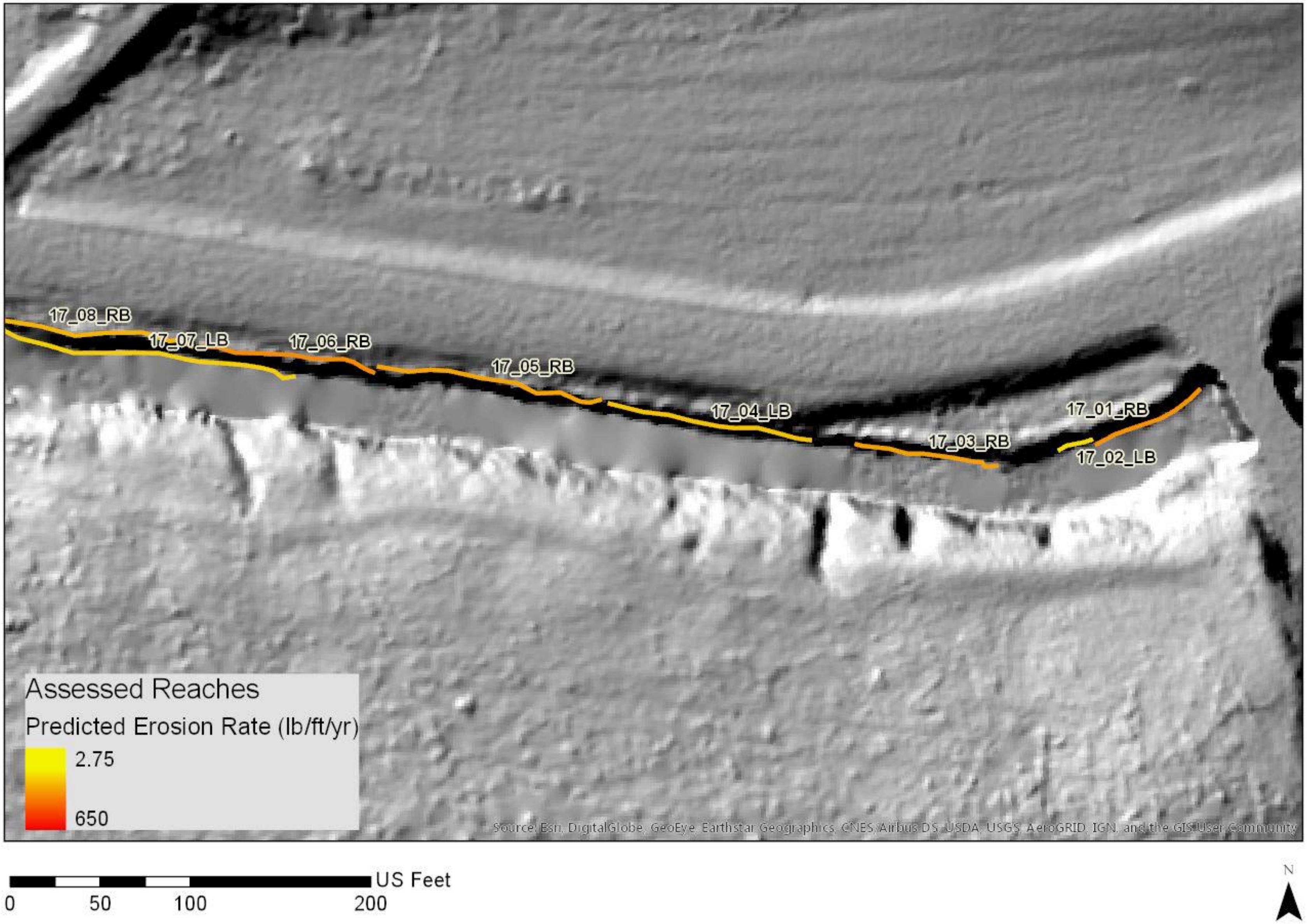
Bank Erosion Summary Table for BMP-12

ID	Length (ft)	Height (ft)	Erosion Rate (lbs/ft/yr)	Erosion Load (lbs/yr)	PRP Crediting Option 1 Default Rate (lbs/yr)	PRP Crediting Option 2 Phase 5.3.2 Bay Method 50% Eff. (lbs/yr)	PRP Crediting Option 3 Phase 6 Bay Method 50% Eff. (lbs/yr)
12_1RB	113.8	1.3	2.7	308.9	13082.8	28.0	62.4
12_2RB	28.5	3.2	69.5	1982.3	3279.2	179.4	400.7
12_3RB	72.1	2.7	58.7	4226.5	8286.1	382.5	854.3
12_4RB	48.1	2.6	150.6	7242.9	5529.8	655.5	1464.0
12_5RB	90.8	4.1	89.1	8085.1	10438.6	731.7	1634.3
12_6RB	39.9	3.5	76.0	3034.6	4589.6	274.6	613.4
12_7RB	112.6	2.0	18.1	2038.4	12948.1	184.5	412.0
12_8RB	94.5	3.8	8.3	780.4	10870.6	70.6	157.7
12_9RB	86.4	2.3	50.0	4317.2	9936.0	390.7	872.6
12_10RB	67.6	1.7	49.2	3328.0	7771.9	301.2	672.7
12_11RB	45.4	2.3	50.0	2270.8	5226.2	205.5	459.0
12_12RB	111.5	2.7	125.1	13952.1	12822.1	1262.7	2820.2
Total	**911.1**			**51,567**	**104,781**	**4,667**	**10,423**

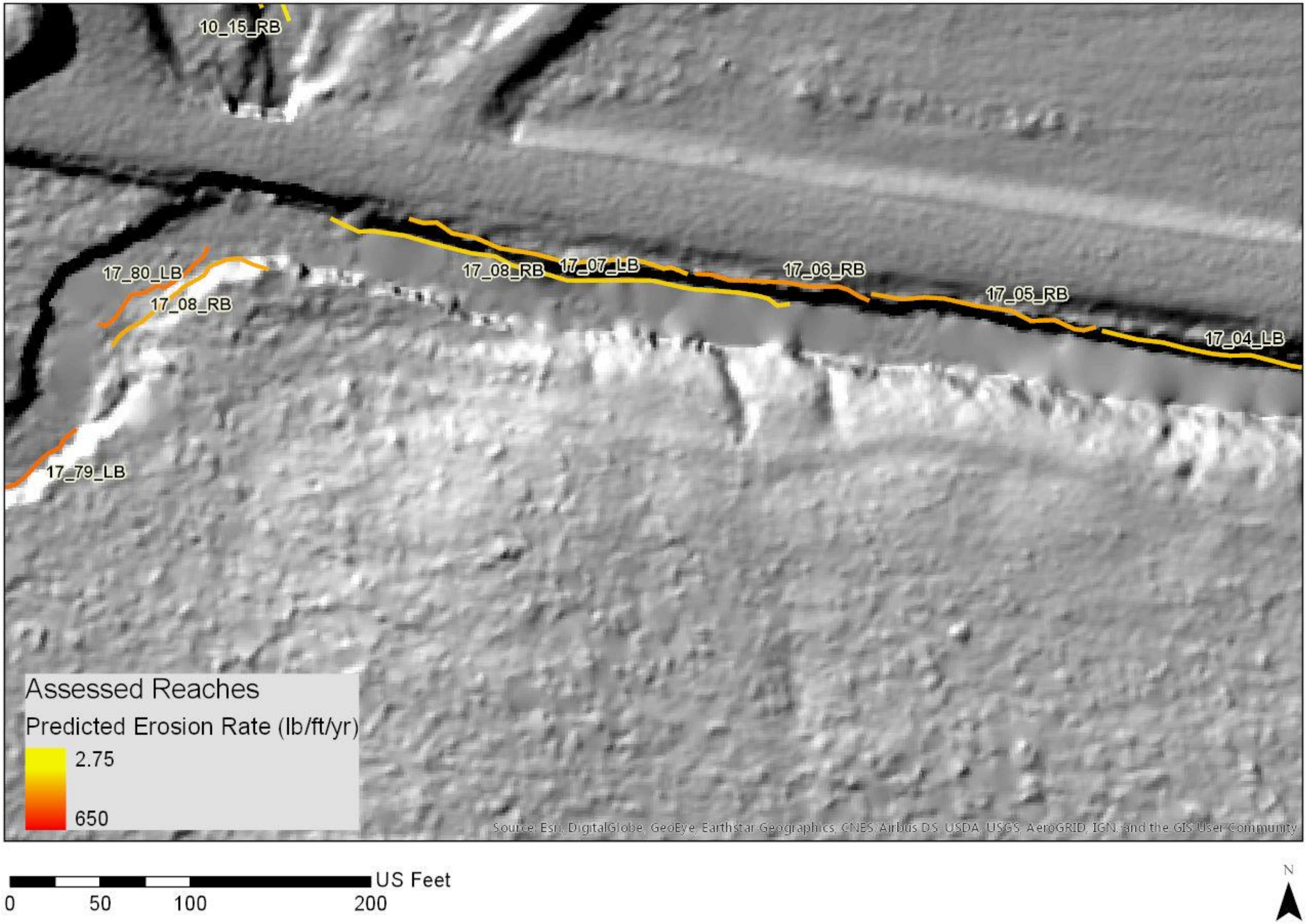
BMP-17


(1)
(2)
(3)
(4)
(5)
(6)
(7)
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
US Feet
0
300
600
1,200
N

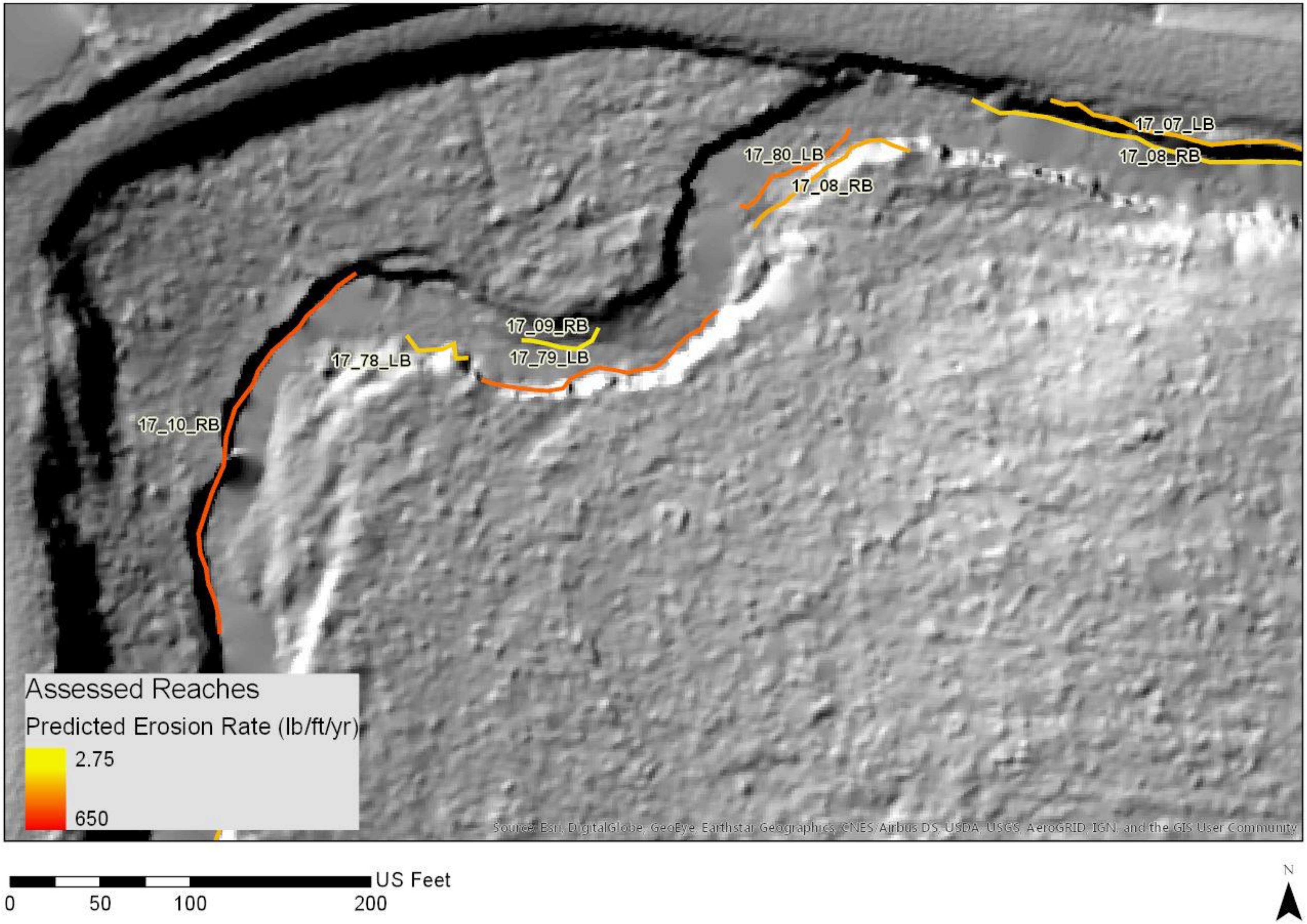
BMP-17 (1)


17_08_RB
17_07_LB
17_06_RB
17_05_RB
17_04_LB
17_03_RB
17_01_RB
17_02_LB
Assessed Reaches
Predicted Erosion Rate (lb/ft/yr)
2.75
650
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
0
50
100
200
US Feet
N

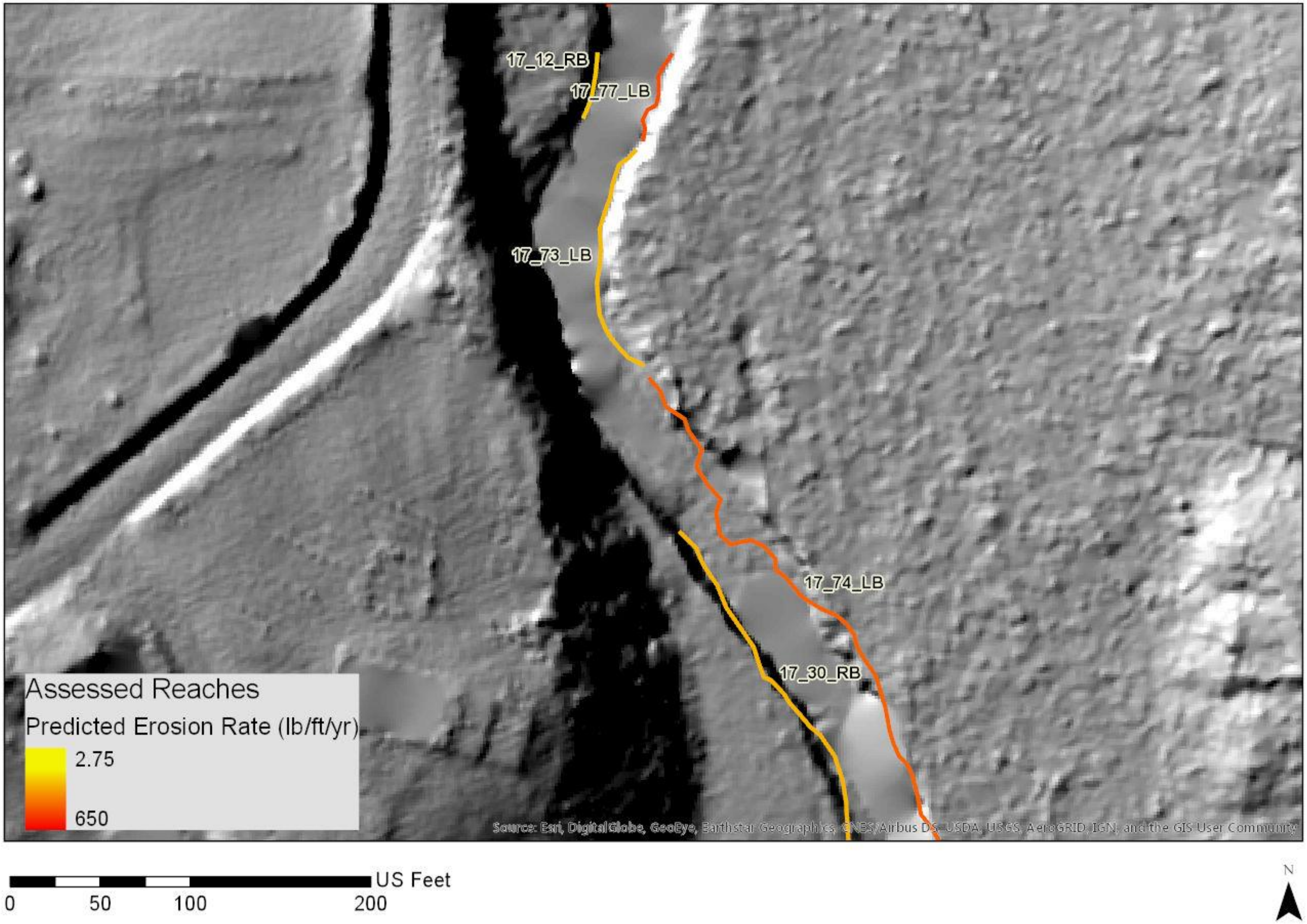
BMP-17 (2)


10_15_RB
17_80_LB
17_08_RB
17_08_RB
17_07_LB
17_06_RB
17_05_RB
17_04_LB
17_79_LB
Assessed Reaches
Predicted Erosion Rate (lb/ft/yr)
2.75
650
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
0
50
100
200
US Feet
N

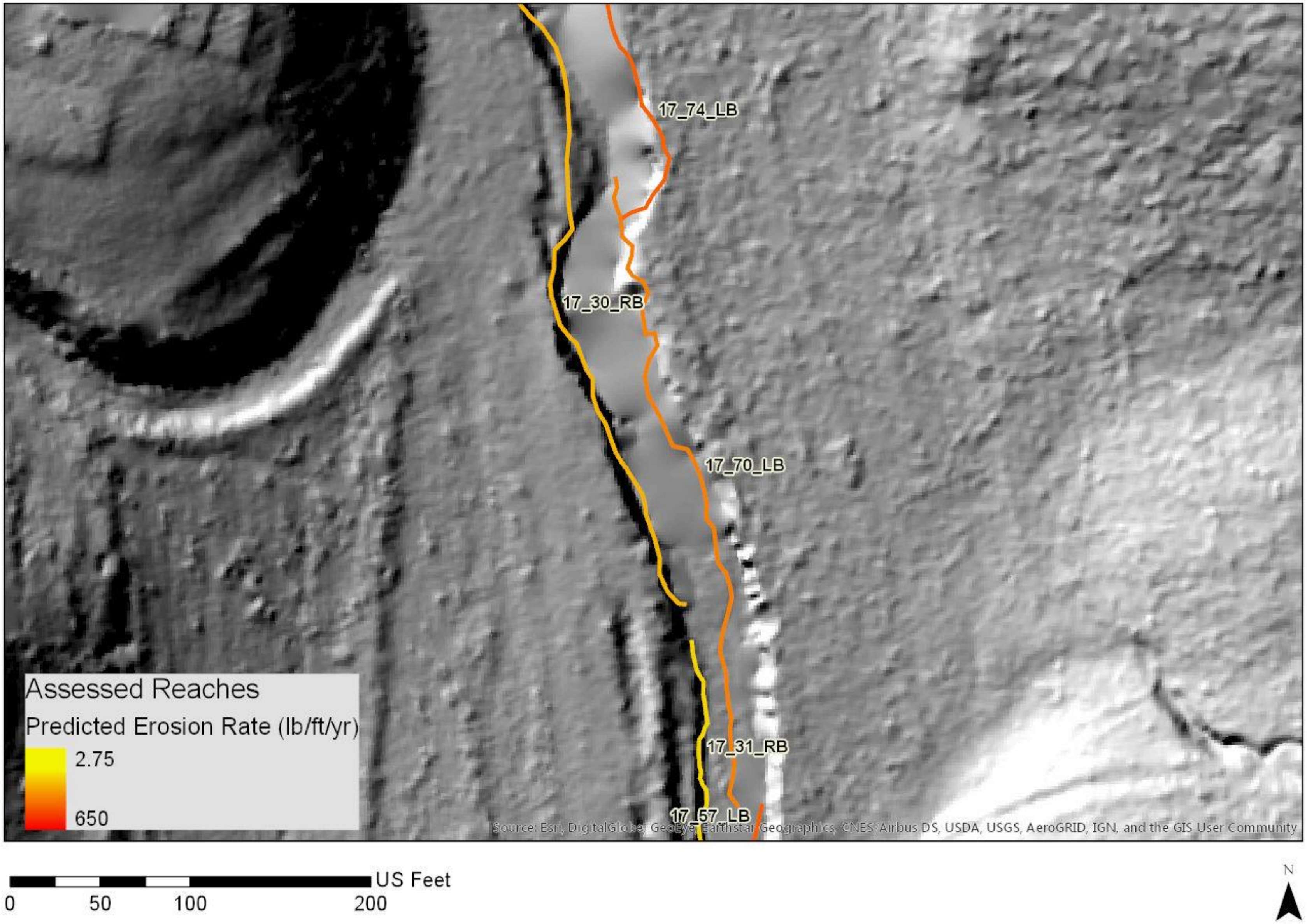
BMP-17 (3)


17_07_LB
17_08_RB
17_80_LB
17_08_RB
17_09_RB
17_78_LB
17_79_LB
17_10_RB
Assessed Reaches
Predicted Erosion Rate (lb/ft/yr)
2.75
650
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
US Feet
0
50
100
200
N

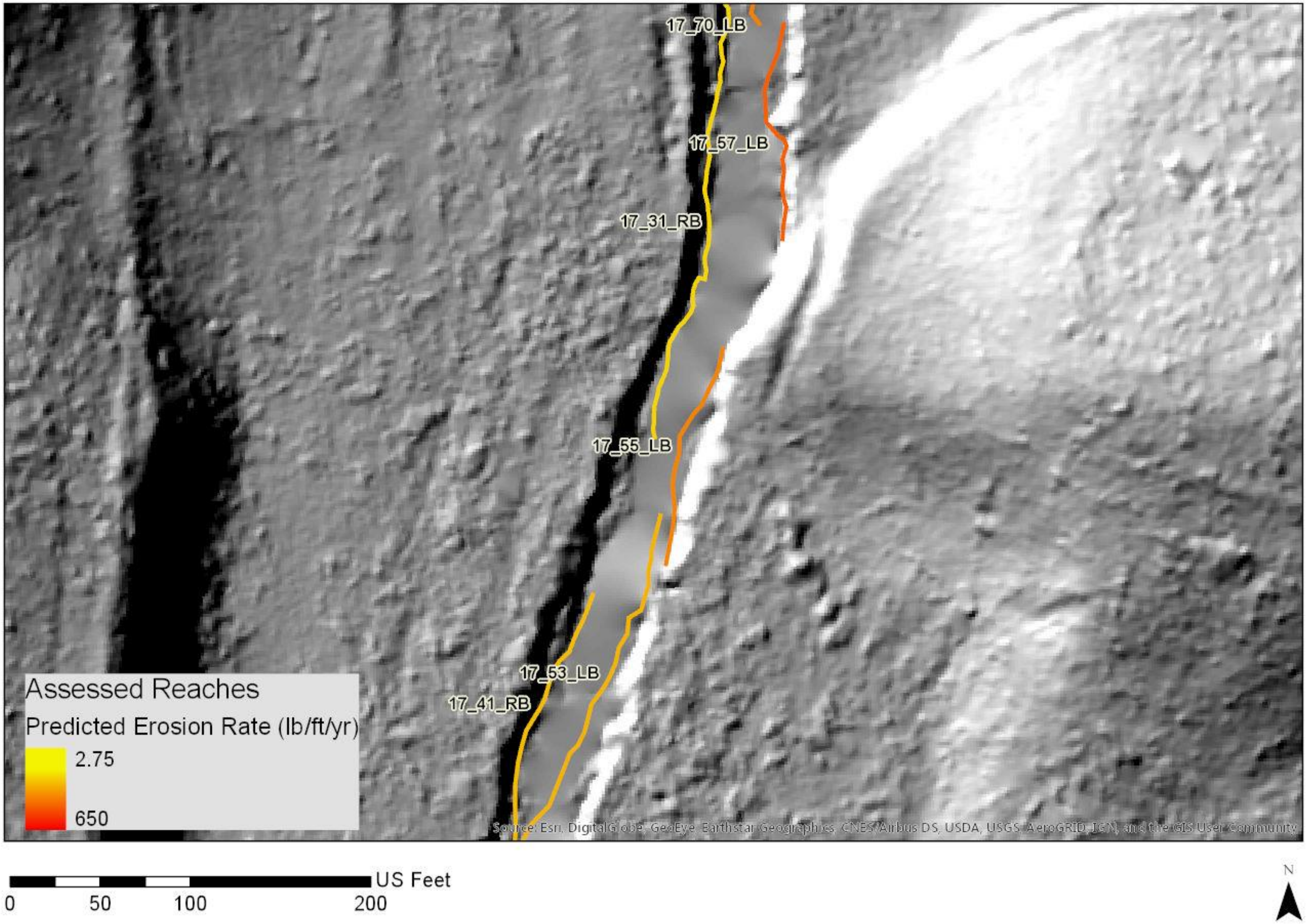
BMP-17 (4)


17_12_RB
17_77_LB
17_73_LB
17_74_LB
17_30_RB
Assessed Reaches
Predicted Erosion Rate (lb/ft/yr)
2.75
650
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
0
50
100
200
US Feet
N

BMP-17 (5)

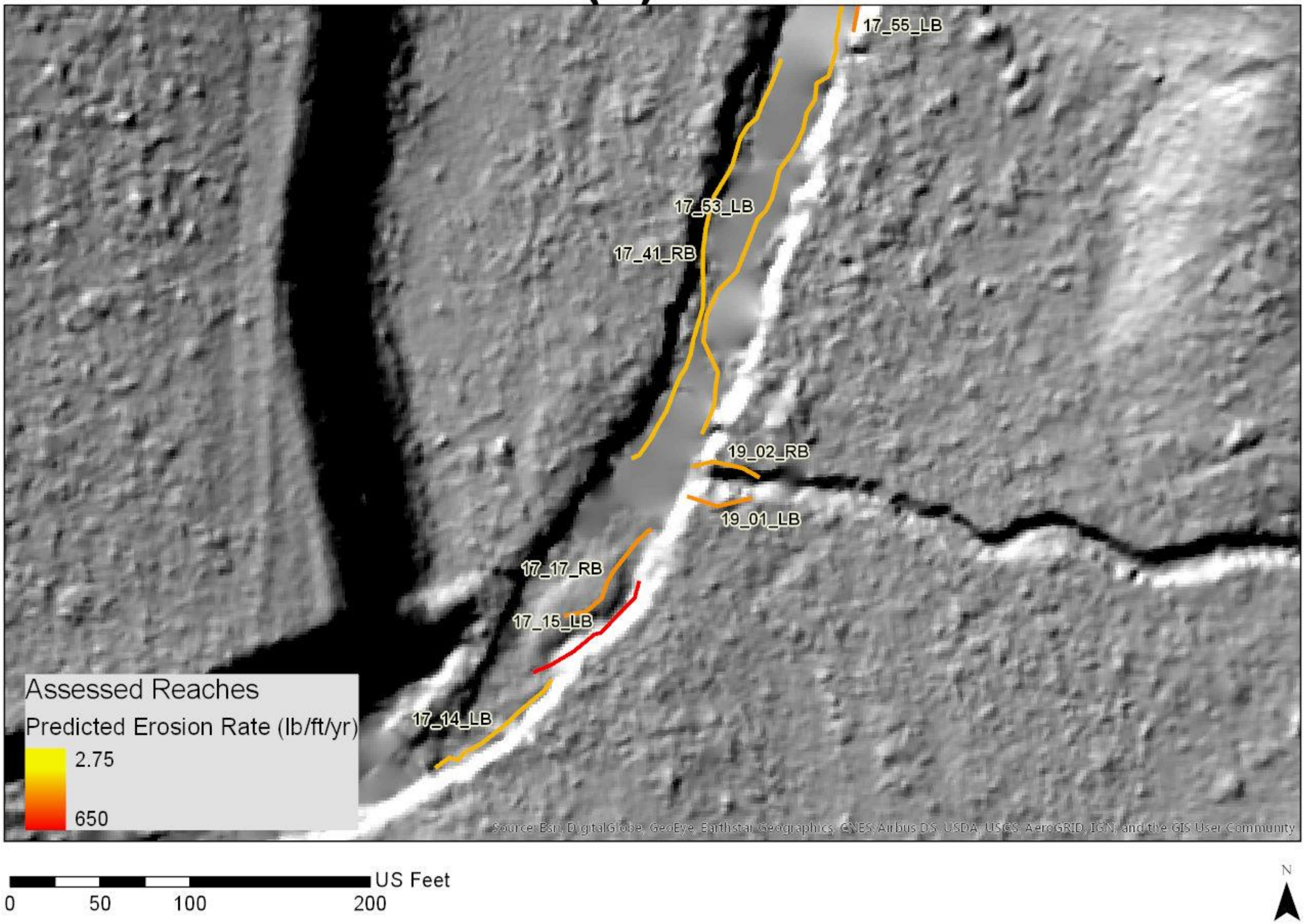

17_74_LB
17_30_RB
17_70_LB
17_31_RB
17_57_LB
Assessed Reaches
Predicted Erosion Rate (lb/ft/yr)
2.75
650
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
0
50
100
200
US Feet
N

BMP-17 (6)



17_70_LB
17_57_LB
17_31_RB
17_55_LB
17_53_LB
17_41_RB
Assessed Reaches
Predicted Erosion Rate (lb/ft/yr)
2.75
650
0
50
100
200
US Feet
N

BMP-17 (7) & BMP-19



Bank Erosion Summary Table for BMP-17

ID	Length (ft)	Height (ft)	Erosion Rate (lbs/ft/yr)	Erosion Load (lbs/yr)	PRP Crediting Option 1 Default Rate (lbs/yr)	PRP Crediting Option 2 Phase 5.3.2 Bay Method 50% Eff. (lbs/yr)	PRP Crediting Option 3 Phase 6 Bay Method 50% Eff. (lbs/yr)
17_1_RB	64.9	5.6	259.5	16854.7	7468.2	1525.4	3406.9
17_10_RB	230.2	6	434.5	100010.1	264770.0	9050.9	20215.1
17_12_RB	35.5	2.8	129.8	4608.7	4084.2	417.09	931.6
17_14_LB	81.5	5.7	165.1	13462.9	9377.0	1218.4	2721.3
17_15_LB	78.6	6.3	798.4	62734.9	9036.3	5677.5	12680.7
17_17_RB	69.7	3.7	267.9	18687.2	8020.6	1691.1	3777.3
17_2_LB	18.3	3.2	69.5	1270.4	2101.5	115.0	256.8
17_3_RB	79.7	4.8	222.5	17721.9	9161.1	1603.8	3582.1
17_30_RB	488.8	6.1	176.7	86375.3	56216.1	7817.0	17459.1
17_31_RB	337.5	3.1	89.8	30308.3	38815.1	2742.9	6126.3
17_4_LB	113.2	4.7	136.1	15414.3	13020.5	1395.0	3115.7
17_41_RB	241.0	5.2	150.6	36302.2	27716.0	3285.3	7337.8
17_5_RB	126.1	4.6	213.2	26874.5	14496.5	2432.1	5432.2
17_53_LB	275.6	6.1	176.7	48695.6	31692.8	4407.0	9842.9
17_55_LB	126.8	6.5	301.3	38186.0	14577.1	3455.8	7718.6
17_57_LB	126.5	5.5	398.3	50400.9	14552.5	4561.3	10187.6
17_6_RB	96.9	6	278.1	26939.0	11140.6	2438.0	5445.2
17_7_LB	260.5	5.5	99.6	25940.8	29960.0	2347.6	5243.4
17_70_LB	384.1	6.7	310.5	119278.1	44174.0	10794.7	24109.8
17_73_LB	134.6	5.4	156.4	21051.6	15477.2	1905.2	4255.2
17_74_LB	391.8	5.4	391.1	153222.8	45059.9	13866.7	30971.1
17_77_LB	53.0	6.1	441.7	23411.9	6094.9	2118.8	4732.3
17_78_LB	44.5	5.2	113.0	5028.5	5118.9	455.1	1016.4
17_79_LB	147.2	5	362.1	53287.7	16924.6	4822.6	10771.1
17_8.5_RB	78.0	4.7	340.4	26532.6	8964.8	2401.2	5363.1
17_8_RB	158.4	5.9	170.9	27072.2	18216.8	2450.0	5472.1
17_80_LB	103.5	4.3	199.3	20624.5	11901.3	1866.5	4168.9
17_9_RB	46.4	2.3	41.6	1931.0	5333.0	174.8	390.3
Total	**4,392.8**			**1,072,228**	**505,171**	**97,037**	**216,731**

Appendix B. Procedure for Determining Soil Bulk Density

Obtain Dry Sample (Oven Dry @ ~65°C overnight)

1. Start with ~25 g dry soil and gentle break apart with fingers over clean scrap paper (i.e., **discarded, clean printer paper works well**). Hand pick out obvious large rock or mineral particles or pieces of organic material > 2 mm in size.

2. Use a **2 mm sieve** to remove all particles larger than sand.

3. Use mortar and pestle to gently break >2 mm soil aggregates, if any, into <2 mm particles. Note: preserve mineral and rock fragments, and organic matter >2 mm in a separate cube but do not use for bulk density measurement.

4. Obtain a clean, dry plastic cube (provided by Prof. Walter).

Plastic Cube = 8 cc (2x2x2 cm)

http://www.ascscientific.com/boxes.html

5. **Weigh and record mass of empty cube** to two decimal places (place small piece of cellophane tape over hole, if present, and include that measurement of mass of "empty cube").

11. Fill with distilled water to top of cube and weigh (repeat at least three times on same cube). Record the average mass and standard deviation (use Excel to calculate). Use this average to **determine volume** of the cube (assume distilled water at air temperature has a density of 1.00 g/cm^3).

10. Empty cube and completely dry cube (use compressed air if necessary).

6. **Fill with < 2 mm soil**, tamp down "finger tight," close lid, and tap on table to settle particles.

7. Remove lid and add soil until cube is filled. Tamp down gently, level off sample to top of cube using plastic straight edge and replace lid. Repeat as needed until soil remains level with top of cube.

8. **Weigh and record mass of cube with soil**.

9. Empty cube, refill with soil, and reweigh at least three times: calculate the average and standard deviation of the measured masses (use Excel).

12. Use recorded masses and assume density of water to be 1.00 g/cm^3 to calculate bulk density.

13. What are the sources of error in this method? Can your group devise a better way to measure soil bulk density? If so, explain your procedure.

Note: (1) Always use weighing paper on balance; (2) Don't forget to tare; (3) record all measurements immediately; (4) clean up all spills on weighing pan; (5) keep weighing area spotless; and (6) **Show all work**.

Table Layout:

Sample #	**EC(g)**	**C + Water (g)**	**CV (cm^3)**	**C+Soil (g)**	**BD**

Where: EC = Empty Cube, C = cube, CV = Cube Volume, and BD = Bulk Density

Appendix C. WSI Report for Drone Analysis

WATER SCIENCE INSTITUTE

DEM Differencing Change Detection Analysis Report
for 3 BMP sites in the Paxton Creek Watershed,
Dauphin County, Pennsylvania

January 2019

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WATER SCIENCE INSTITUTE

TABLE OF CONTENTS

I. Introduction

Water Science Institute (WSI) staff field checked and photographed all 13 BMP sites provided by the Center for Watershed Protection (CWP) in April and May, 2018. All field photos are available upon request. Some photos are provided in this report to represent particular erosional and depositional features. Staff who worked on this project include the following: Dorothy Merritts, Robert Walter, Michael Rahnis, Evan Lewis, Logan Lewis, and Shelby Sawyer. The final results and report were reviewed by WSI Executive Director Joseph Sweeney.

Three of the thirteen sites, BMPs 5, 10, and 12, (Fig. 1), were deemed most suitable for evaluating bank and bed erosion with change detection for the following reasons:

- The period of detection is limited because only the most recent airborne lidar data for the Paxton Creek watershed area (March 2016) is of sufficient accuracy and resolution to be of use. WSI began work in 2018, limiting the period of time for which we performed change detection to less than 3 years.

- Small streams are more difficult to detect with remote sensing technology, such as lidar and drone photogrammetry, and heavy canopy further compounds the problems associated with detecting change in small channels. The majority of the 13 pre-selected BMP sites had small channels and heavy canopy cover. These shared site characteristics, as well as the short change detection period of 2.7 years (980 – 984 days), meant that many of the pre-selected sites were not suitable for change detection via remote sensing.

- Many of the 13 BMP sites are not stream channels formed in legacy sediment. Many are manmade "ditches" created by construction activities associated with road building (e.g., channels relocated to the valley margins) or suburban development in conjunction with stormwater infrastructure. However, the three sites we selected have notable amounts of legacy sediment.

- Of the there sites that were found to be most suitable, relatively heavy canopy still resulted in challenging conditions for drone photogrammetry.

To reduce error and uncertainty as much as possible, WSI flew the drone in late November and early December, 2018, in leaf-off conditions. The provided workflow summary (pg. 7) documents the strategies we used to minimize uncertainty due to remaining canopy. Canopy includes not only leaves on plants, but also branches and other types of vegetation mass.

WSI monitors a control site in order to assess the effects of canopy, and has been able to reduce uncertainty in volume of bank and bed erosion estimates to ~20-30%. For this project in the Paxton Creek watershed, WSI calculated erosion volume uncertainties that ranged from ~21 to 31% (Tbl. 1).

II. Results

BMP 5, Veterans Park, Asylum Run

At BMP 5, Veterans Park, the small stream channel(s) of Asylum Run are incising in response to something that happened downstream of the area that we evaluated (Fig. 2 and 3). It is likely that a debris jam or other grade control structure(s) failed or was removed. As a result of the change in bed elevation downstream, multiple knickpoints (steps in the bed elevation profile; Fig. 3) have formed along the channel. These are still migrating upstream. They have cut below the relatively thin (1 to 3 ft) cover of legacy sediment into underlying colluvium (poorly sorted mixture ranging from clay to cobble size sediment derived from interbedded shale and sandstone) and, at some reaches, the channels have eroded into highly fractured bedrock.

The reach of the channel downstream of a knickpoint has higher banks than the reach immediately upstream, because the bed has been eroded (incised) and lowered in elevation. In addition, because bank erosion is greater in the downstream reach with higher banks that were recently incised, the channel in the downstream reach widens more rapidly than upstream of the knickpoint. These changes in channel bed elevation, bank height, and channel width can be seen at multiple locations in the field at BMP 5.

Evidence of bank erosion via freeze-thaw processes also was widespread during our April field visit. Small gravel bars are beginning to form in reaches where banks are highest (and hence bed shear stresses greatest), generally just downstream of knickpoints in the channel. Coarse sediment in these gravel bars, and hence the bars themselves--migrate downstream along the channel during high flow events. Sediment accumulation at point bars, which are likely to grow with time and channel widening, further enhances bank erosion and meander formation by directing deeper flow to the opposite bank.

The changes in bed elevation and bank widening are so recent and rapid at the BMP 5 site that the roots of a large tree estimated to be ~30 yrs old completely span the channel at one location, leaving the trunk of the tree perched over the channel (Fig. 3). In addition, the left side of a weir (facing downstream) with gage plate installed by the Susquehanna River Basin Commission (SRBC) has been cut around and abandoned by bed incision and bank erosion (inset photo, Fig. 3). James Shellenberger of SRBC informed us that the weir was installed ~2008 and monitored for about 8 years. This indicates that at least several feet of bank erosion occurred on left bank between 2008 and ~2018.

The change detection analysis that we completed for BMP 5 shows that bed erosion is dominant, but also reveals that bank erosion is most prominent in reaches where bed erosion has occurred. This finding is in agreement with the geomorphic analysis based on field work provided in the previous paragraph. Average rates of erosion for this BMP site are ~2 ft^3/ft/yr, or 59 ± 18 tons/yr for the length of stream evaluated (935 ft).

BMP 10, “Shutt Mill Road”, Paxton Creek

Average rates of erosion for BMP site 10 are ~2 ft^3/ft/yr, or 70 ± 15 tons/yr for the length of stream evaluated (860 ft). Located along the main stem of Paxton Creek, BMP 10 has higher banks than the other 2 BMP sites evaluated here (Fig. 4 and 5). In addition, the banks consist predominantly of fine-grained legacy sediment. Relatively large bars are located on the insides of meander bends. Falling trees along eroding banks, and debris jams formed by logs and branches along the channel, are numerous. Evidence of bank erosion via freeze-thaw processes was widespread during our April field visit.

Bank erosion rates for this site might be slightly higher than at BMP 5. Before rounding to the cubic ft, for example, erosion rates at BMP 10 are 2.2 ft^3/ft/yr, whereas at BMP 5 they are 1.6 ft^3/ft/yr. In addition, some erosion at BMP 5 is lowering of the bed, although bank erosion is active.

BMP 12, “Greenbelt”, Spring Creek watershed

From up to downstream, the small channel at BMP 12, on a small tributary to Spring Creek, is impacted by a road along the left valley margin, several stormwater structures that include a large culvert under a road crossing, and a small dam (Fig. 6 and 7). Because of these features, bed and bank erosion are highly variable along the 1325 ft of stream evaluated here.

Overall, average erosion rates for this BMP site are ~0.3 ft^3/ft/yr, or 16 ± 4 tons/yr for the 1325 ft of stream evaluated here. This is about an order of magnitude less than rates of erosion along streams at BMP 5 and 10. However, most of the bank erosion at BMP 12 is concentrated in a few reaches away from the impact of the grade control structures noted above. Locally, erosion rates for the reaches that are actively eroding are similar to those at BMP 5 and 10.

At the upstream end of the reach, banks are low but bed incision is occurring. Legacy sediment is only 1 to 3 ft thick, and the channel has incised below this historic sediment and into colluvium similar to that exposed at BMP 5 (clay to cobble sized sediment derived from interbedded shale and sandstone). In several places the channel is located on the right valley margin and cutting into bedrock. Erosion of streams in bedrock and coarse grained colluvium along the valley margins are likely to be much lower than in finer grained legacy sediment that typically is thicker near the valley center.

In the middle of the length of stream evaluated, a large culvert with road crossing locally limits bed incision and hence bank height upstream. Downstream of this culvert a small dam has caused significant deposition and aggradation of the bed. No bank erosion occurs in this stretch between the culvert and dam, but does occur farther upstream of the road bed with culvert, and immediately downstream of the dam. If this small dam were removed, the stretch of stream between the dam and culvert with road crossing would be likely to have substantial bank erosion, although of generally sandier sediment than the older legacy sediment along this stream.

III. CENTER FOR WATERSHED PROTECTION / WATER SCIENCE INSTITUTE *AMENDED* LETTER OF AGREEMENT

1) WSI will produce a digital elevation model of the entire Paxton Creek Watershed from LiDAR point cloud data. WSI will provide a differencing analysis for change detection (between two available LiDAR data sets) that will visually display areas of high, medium and low erosion rate complete with the functionality that allows the user to click on stream segments to view the calculated erosion rates with the error in measurement for that estimate. We will incorporate canopy layering and parcel data to further enhance the map's usefulness. [WSI provided these on June 20, 2018.]

2) WSI and the Center for Watershed Protection have identified 3 sites (see subparagraph d below) from the targeted list provided to WSI, in part, from the Joint Pollutant Reduction Plan for the Paxton Creek Watershed TMDL. WSI has done and will continue to work in the following manner.

   a) WSI has driven to all sites and has determined which 3 sites may provide the best results;

   b) Each of the 3 selected sites has been field inspected and will be mapped with high-resolution DEMs produced from photogrammetry using a drone by December 15, 2018.

   c) WSI will compile the results of the DEMS generated from photogrammetry and perform the differencing analysis between the latest available LiDAR flyover and the drone DEM in a manner that provides the least possible error in measurement. The results of the differencing will be incorporated into the digital map described in Task 1 providing both the measured erosion and the error in measurement. This will give an accurate baseline of the pre-restoration conditions for developing proposed TMDL reductions. The final map deliverable will be provided by January 31, 2019.

   d) In consultation with the Center for Watershed Protection, WSI has selected the following 3 sites:

      i) Site 5 - Veterans Park;
      ii) New site located south of Site 10 on Paxton Creek;
      iii) Site 12

WSI will provide the raw data acquired for these sites to the Center for Watershed Protection.

IV. DEM Change Detection Workflow Summary

- Selected three sites in partnership with the Center for Watershed Protection.

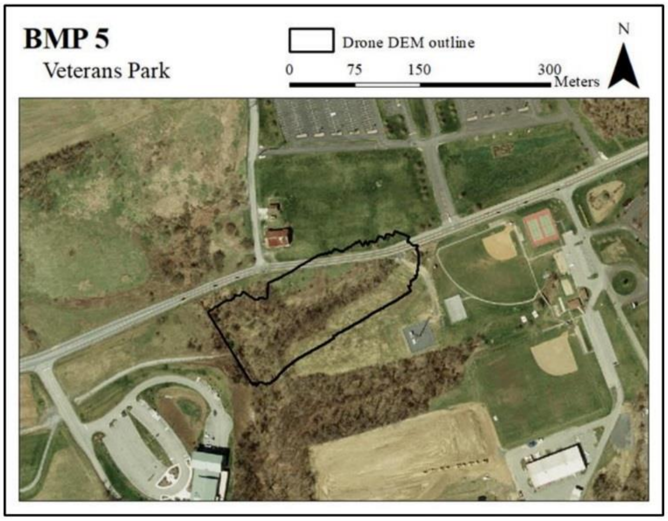
- Performed a field site evaluation at each site to attain ideal flight altitudes (100 - 150 ft). Ideal altitudes are just above treetops and wires, yet low enough to get high resolution imagery. (Maximize resolution, avoid hazards.)

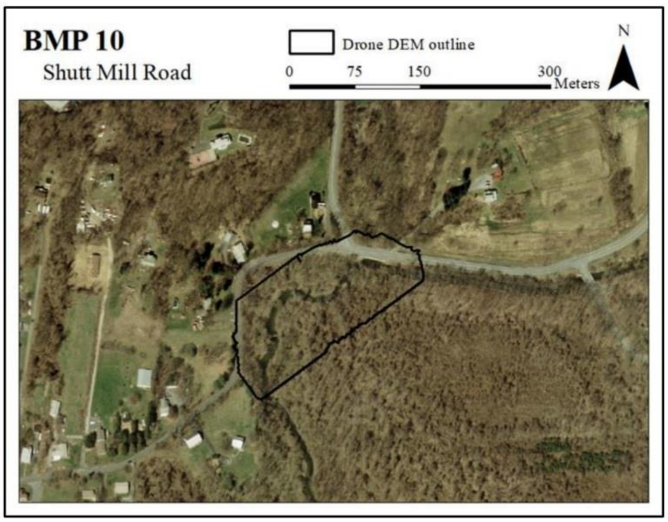
- At each site, team flew a DJI Phantom 4 drone to generate photogrammetric DEMs of the selected reaches, and surveyed targets for ground control.
  - Team dispersed 20 ground control pads across each site, with emphasis on bank edges. Ground control pads are black-and-white wooden squares (~ 1 x 1ft), or (~ 0.3 x 0.3 m).
  - Ground control positions were surveyed with a Trimble R8 GNSS RTK GPS unit with base station and rover. Survey vertical measurement error ranged from 0.5 cm - 2 cm.
  - RTK GPS base data corrected through NOAA OPUS solutions.
  - Site flown using a DJI Phantom 4 Pro and planned using DJI Flight Planner and Litchi software
  - Each site was flown in triplicate, capturing images of the entirety of each site at 120 degree offset to maximize resolution of ground beneath canopy.

- Processed photogrammetric data using Agisoft, a 3-D modeling and mapping software.
  - Photos stitched together.
  - Tie point cloud generated ("High" Accuracy).
  - Reconstruction uncertainty thresholded.
  - Projection accuracy thresholded.
  - Points optimized.
  - Ground control added. All target survey pads were used to construct the DEMs. Ground control serves the purpose of "pinning" the model into a real-space coordinate system that matches its location in reality. Agisoft builds the model around these known points.
  - Reprojection error thresholded.
  - Cloud optimized and dense point cloud generated.
  - DEM error calculated using projected accuracy from RTK GPS ground control points. (Point cloud made in AgiSoft was adjusted to fit RTK GPS survey ground control points, and AgiSoft provides vertical accuracy, in meters, for DEM).
  - Canopy/vegetation removed.
  - DEM built and projected.

- Used ArcMap 10.6.1 to difference 2016 Lidar DEM ("USGS QL2 LiDAR for Dauphin County, PA 2016", 8 cm vertical accuracy) from the drone-flown DEMs (November, 2018) to detect change.
  - Repeat DEMs were projected over each other and areas of interest were clipped out and aligned. Holes in the data, such as those caused by dense vegetation, are manually clipped out when possible to reduce overall error. Because the majority of our ground control targets are placed near stream banks, clipping the DEM close to the channel helps ensure that any warp, or error, is minimized as much as possible.
  - DEMs were subtracted from each other to generate change detection output.
  - Change detection was thresholded according to range of calculated error.
  - Change detection raster was converted into shapefile.
  - Attributes from change detection raster were spatially joined to polygons.
  - Calculated error was added and subtracted from volume change calculations.
  - The final product is a shapefile layer of erosion at each site with area, volume and error +/- ranges.

V. Figures





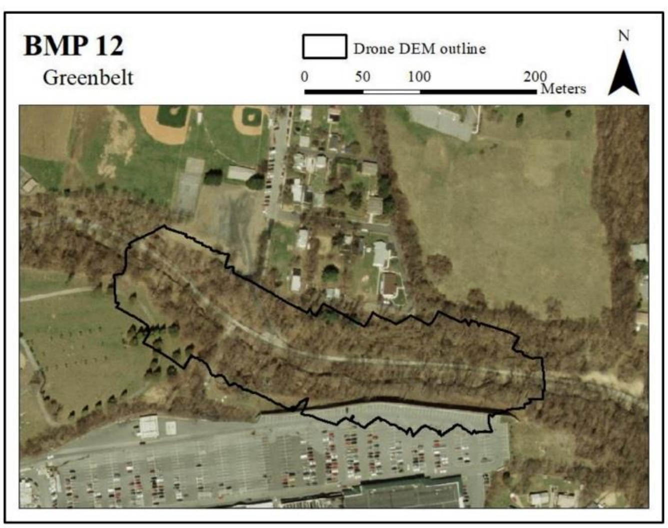
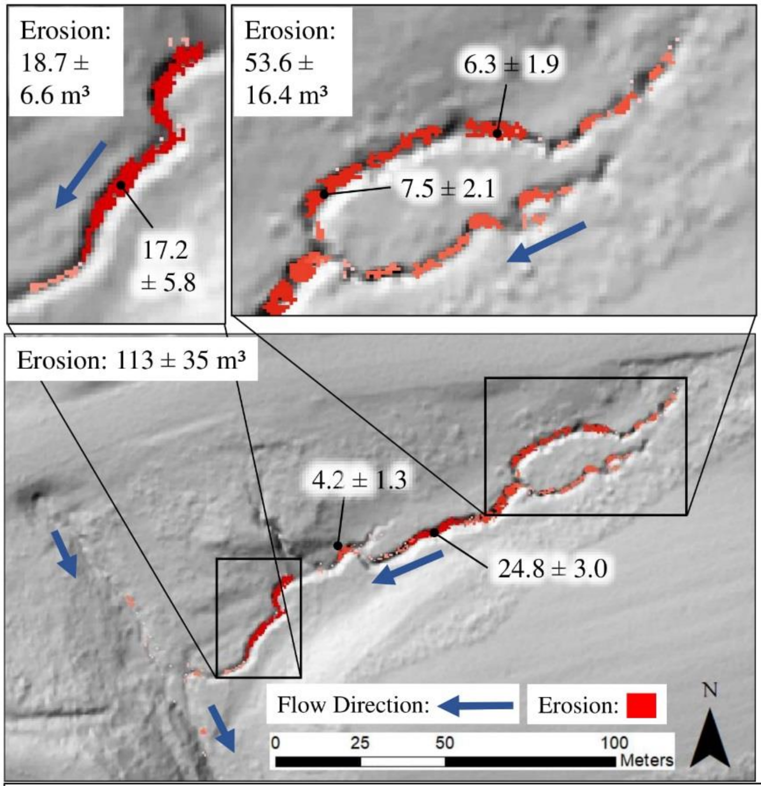


Figure 1. Site locations (2005 orthoimagery).



BMP 5	Veterans Park
Lidar Date	3-24-2016
Drone Flight Date	11-28-2018
Period Duration	2.7 years 980 days
Stream length	285 m 935 ft
Total erosion volume	113 ± 35 m^3 3991 ± 1236 ft^3 147 ± 45 tons
Erosion/year	42 ± 13 m^3/yr 1483 ± 459 ft^3/yr 59 ± 18 tons/yr
Erosion/stream length/year	~0.2 m^3/m/yr ~2 ft^3/ft/yr ~0.1 tons/ft/yr

Figure 2. BMP 5, Veterans Park, DEM differencing results. Hillshade from 2016 lidar.

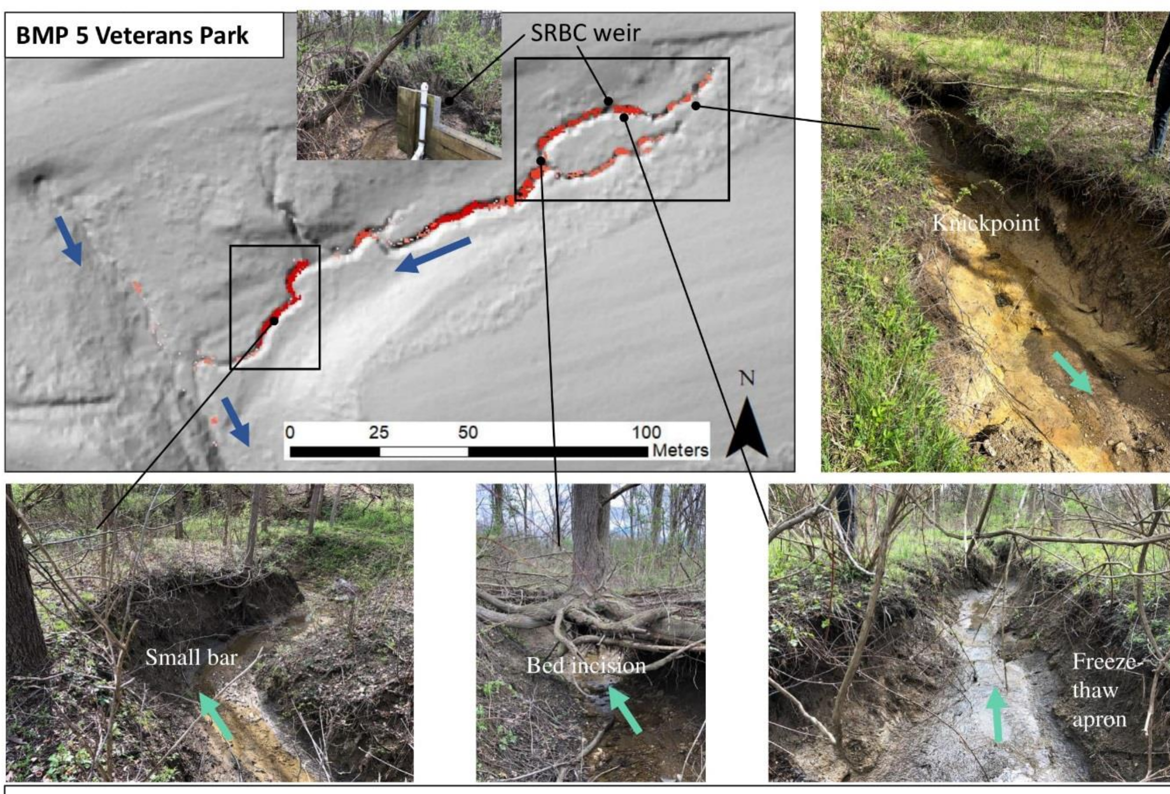


Figure 3. BMP 5, Veterans Park, DEM differencing results and field photos from April 29, 2018. Lines indicate field photo sites. Hillshade from 2016 lidar. Inset photo of SRBC weir is facing left bank, in downstream direction.

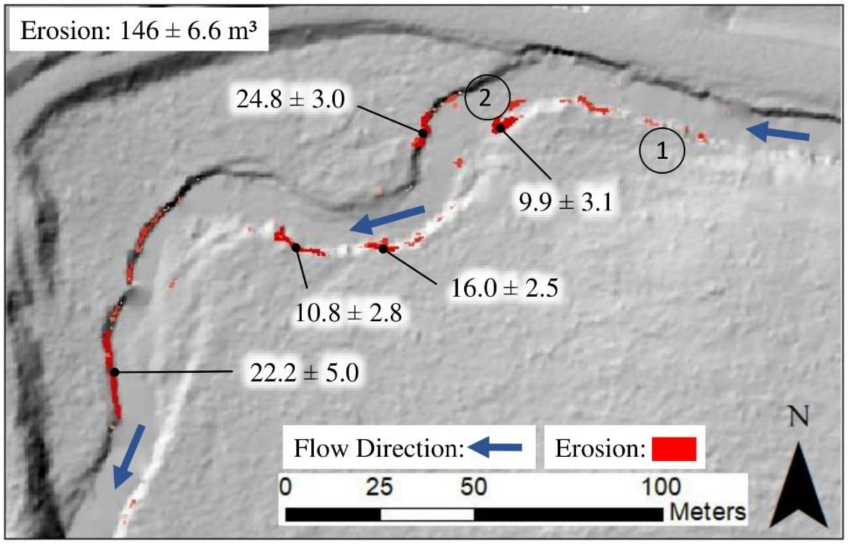


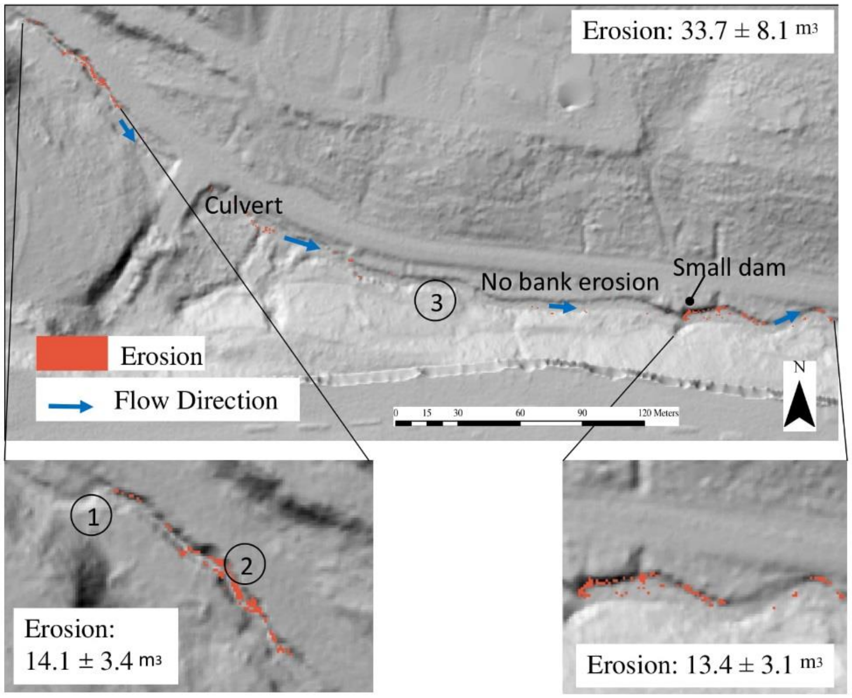
Figure 4. BMP 10, Shutt Mill Road, DEM differencing results. Circles with numbers are field photo sites (Fig. 5).

BMP 10	**Shutt Mill Road**
Lidar Date	3-24-2016
Drone Flight Date	11-30-2018
Period Duration	2.7 years 982 days
Stream length	262 m 860 ft
Total erosion volume	146 ± 31 m^3 5156 ± 1095 ft^3 190 ± 40 tons
Erosion/year	54 ± 11 m^3/yr 1907 ± 389 ft^3/yr 70 ± 15 tons/yr
Erosion/stream length/year	0.2 m^3/m/yr 2 ft^3/ft/yr ~0.1 tons/ft/yr

Photo site 1

Photo site 2

Figure 5. BMP 10, Shutt Mill Road, field photos, April 29, 2018.



BMP 12	Greenbelt
Lidar Date	3-24-2016
Drone Flight Date	12-3-2018
Period Duration	2.7 years 984 days
Stream length	404 m 1325 ft
Total erosion volume	34 ± 8.1 m³ 1201 ± 286 ft³ 43.8 ± 10.5 tons
Erosion/year	13 ± 3 m³/yr 489 ± 106 ft³/yr 16.3 ± 3.9 tons/yr
Erosion/stream length/year	~0.03 m³/m/yr ~0.3 ft³/ft/yr ~0.01 tons/ft/yr

Figure 6. BMP 12, "Greenbelt", DEM differencing results. Circles with numbers are field photo sites (Fig. 7).

Photo site 1

Photo site 2

Photo site 3

Figure 7. BMP 12, "Greenbelt". All field photos from April 29, 2018, except bottom right from December 3, 2018.

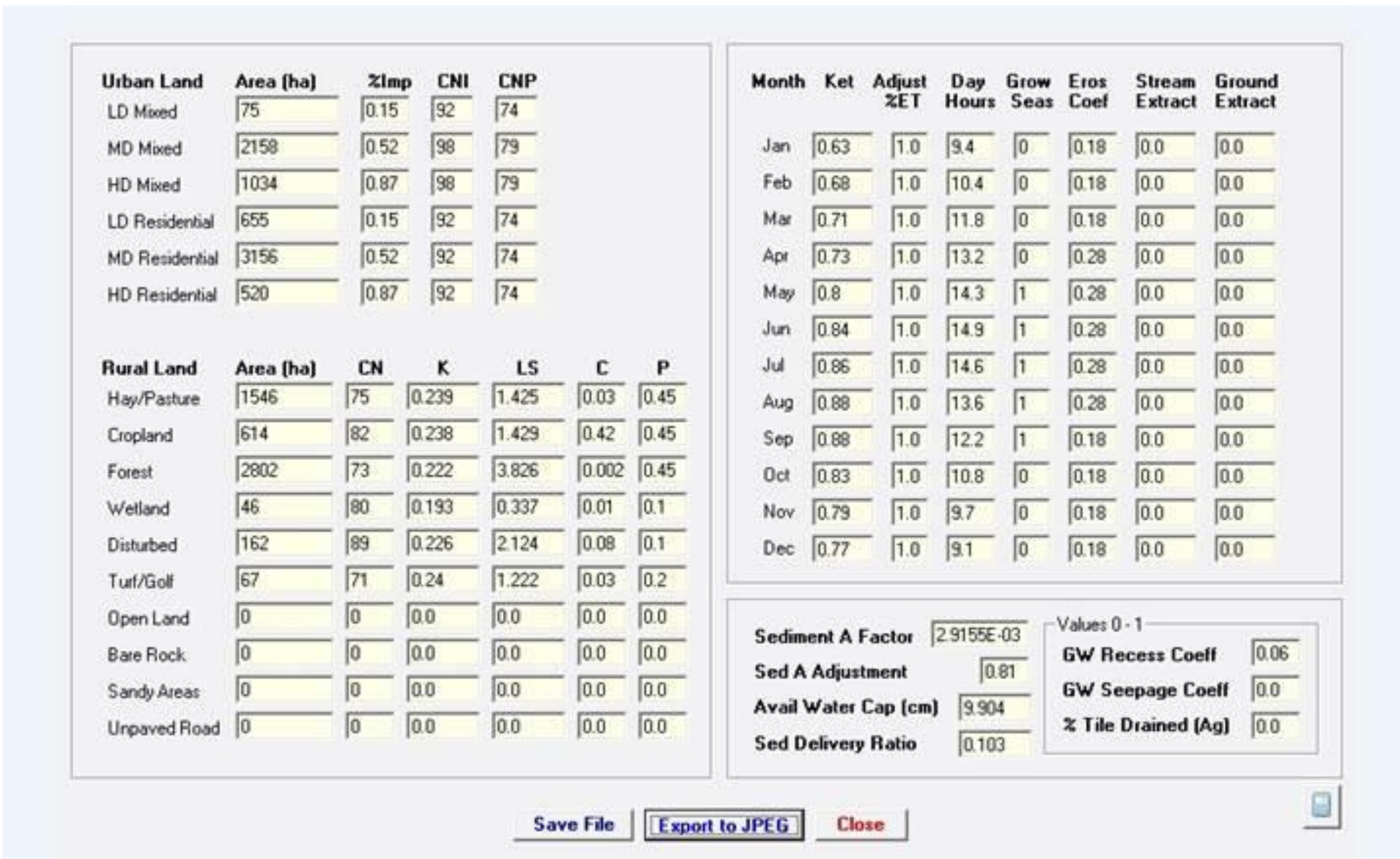
VI. Tables

		BMP 5--Veterans Park	BMP 10--Shutt Mill Road	BMP 12--Greenbelt
	Lidar Date	3/24/16	3/24/16	3/25/16
	Drone Flight Date	11/28/18	11/30/18	12/3/18
Drone-lidar DEM difference	Period Duration	2.7 years	2.7 years	2.7 years
		980 days	982 days	984 days
	Stream length analyzed	285 m	262 m	404 m
		935 ft	860 ft	1325 ft
	Total erosion	113 ± 35 m³	146 ± 31 m³	34 ± 8.1 m³
		3991 ± 1236 ft³	5156 ± 1095 ft³	1201 ± 286 ft³
		147 ± 45 tons	190 ± 40 tons	43.8 ± 10.5 tons
	Erosion / year	42 ± 13 m³/yr	54 ± 11 m³/yr	13 ± 3 m³/yr
		1483 ± 459 ft³/yr	1907 ± 389 ft³/yr	489 ± 106 ft³/yr
		59 ± 18 tons/yr	70 ± 15 tons/yr	16 ± 4 tons/yr
	Erosion/stream length/year	~0.2 m³/m/yr	~0.2 m³/m/yr	~0.03 m³/m/yr
		~2 ft³/ft/yr	~2 ft³/ft/yr	~0.3 ft³/ft/yr
		~0.1 tons/ft/yr	~0.1 tons/ft/yr	~0.01 tons/ft/yr
BANCS erosion estimate	Stream length	818 ft	1449 ft	911 ft
	Erosion/year	1904 ft³/yr	1732 ft³/yr	712 ft³/yr
	Erosion/stream length/year	~ 2 ft³/ft/yr	~1 ft³/ft/yr	~1 ft³/ft/yr

Table 1. DEM-differencing results for drone photogrammetry (2018) and airborne lidar (2016) by WSI, and comparison with BANCS erosion estimates from CWP (data from M. Hickman).

2017 Joint Pollutant Reduction Plan Modeling Approach

Running the GWLF-E model for the total Joint Planning Area from the Mapshed Basin layer provided by GIS resulted in 31,716 acres of differing land uses as shown below. Parsing acreage (public land, direct drainage, and railroad) for each municipality was provided by GIS in a spreadsheet and subtracted from the corresponding land use for the entire planning area with the exception of water except (not available for edit in the GWLF-E Transport Data Editor) resulting in a parsed area of 12,464 acres. Parsing was conducted manually due the Mapshed software's inability to create an input file for a heavy parsed GIS layer lacking physical continuity.



Urban Land	Area (ha)	%Imp	CNI	CNP
LD Mixed	75	0.15	92	74
MD Mixed	2158	0.52	98	79
HD Mixed	1034	0.87	98	79
LD Residential	655	0.15	92	74
MD Residential	3156	0.52	92	74
HD Residential	520	0.87	92	74

Rural Land	Area (ha)	CN	K	LS	C	P
Hay/Pasture	1546	75	0.239	1.425	0.03	0.45
Cropland	614	82	0.238	1.429	0.42	0.45
Forest	2802	73	0.222	3.826	0.002	0.45
Wetland	46	80	0.193	0.337	0.01	0.1
Disturbed	162	89	0.226	2.124	0.08	0.1
Turf/Golf	67	71	0.24	1.222	0.03	0.2
Open Land	0	0	0.0	0.0	0.0	0.0
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 Road	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	0.63	1.0	9.4	0	0.18	0.0	0.0
Feb	0.68	1.0	10.4	0	0.18	0.0	0.0
Mar	0.71	1.0	11.8	0	0.18	0.0	0.0
Apr	0.73	1.0	13.2	0	0.28	0.0	0.0
May	0.8	1.0	14.3	1	0.28	0.0	0.0
Jun	0.84	1.0	14.9	1	0.28	0.0	0.0
Jul	0.86	1.0	14.6	1	0.28	0.0	0.0
Aug	0.88	1.0	13.6	1	0.28	0.0	0.0
Sep	0.88	1.0	12.2	1	0.18	0.0	0.0
Oct	0.83	1.0	10.8	0	0.18	0.0	0.0
Nov	0.79	1.0	9.7	0	0.18	0.0	0.0
Dec	0.77	1.0	9.1	0	0.18	0.0	0.0

Sediment A Factor	2.9155E-03
Sed A Adjustment	0.81
Avail Water Cap (cm)	9.904
Sed Delivery Ratio	0.103

Values 0 - 1

GW Recess Coeff	0.06
GW Seepage Coeff	0.0
% Tile Drained (Ag)	0.0

Save File Export to JPEG Close

<u>Total Area of Unparsed Planning Area Basin Layer</u> = 12,835 hectares = 31,716 Acres

The parsing acreage (public land, direct drainage, and railroad) for each municipality was provided by GIS in a spreadsheet and subtracted from the corresponding land use for the entire planning area with the exception of water except (not available for edit in the GWLF-E Transport Data Editor) resulting in a parsed area of 12,464 acres plus the 3,519 acres of water attributed land use, totaling 15,983 total acres of parsed area to be removed from the Joint Planning Area in the Urbanized Area Viewer.

Joint Planning Area

Land Use #	Land Use	CRW	LPT	Susq	Land Use Totals (acre)	Land Use Totals (hect)
1	Water	2,299.49	11.52	1,208.26	3,519.27	1,424.20
2	LD Mix-Urb	-	40.77	3.44	44.21	17.89
3	Hi Mix-Urb	125.82	483.91	367.62	977.35	395.52
4	Hay/Past	41.14	1,555.11	630.61	2,226.86	901.18
5,6	Crop	1.16	544.59	143.89	689.64	279.09
7,8,9	Forest	188.66	2,831.65	1,472.46	4,492.77	1,818.16
10,11	Wetland	68.89	12.91	10.94	92.74	37.53
12,13,15	Disturbed	33.21	100.74	110.66	244.61	98.99
16	Turf/Golf	-	152.65	-	152.65	61.78
17	LD-Dens Res	0.30	173.19	262.08	435.57	176.27
18	MD-Dens Res	2.11	1,339.65	431.09	1,772.85	717.45
19	HD-Dens Res	1.96	28.14	46.54	76.64	31.02
20	MD-Mix-Urb	143.47	511.60	602.44	1,257.51	508.90
21	Open Land	-	-	-	-	-
22	Bare Rock	-	-	-	-	-
Municipal Totals		2,906.21	7,786.43	5,290.03	15,982.67	6,467.96

Subtracting the 12,464 acres of land use excluding water land use from the total Joint Planning Acreage of 31,716, resulting in a Parsed Joint Planning Area total of 19,252 acre Parsed Joint Planning Watershed as noted in the Report and used to model the existing baseline and proposed BMP pollutant load reductions.

Urban Land	Area (ha)	%Imp	CNI	CNP
LD Mixed	57	0.15	92	74
MD Mixed	1649	0.52	98	79
HD Mixed	638	0.87	98	79
LD Residential	479	0.15	92	74
MD Residential	2439	0.52	92	74
HD Residential	489	0.87	92	74

Rural Land	Area (ha)	CN	K	LS	C	P
Hay/Pasture	645	75	0.239	1.425	0.03	0.45
Cropland	335	82	0.238	1.429	0.42	0.45
Forest	984	73	0.222	3.826	0.002	0.45
Wetland	8	80	0.193	0.337	0.01	0.1
Disturbed	63	89	0.226	2.124	0.08	0.1
Turf/Golf	5	71	0.24	1.222	0.03	0.2
Open Land	0	0	0.0	0.0	0.0	0.0
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 Road	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	0.63	1.0	9.4	0	0.18	0.0	0.0
Feb	0.68	1.0	10.4	0	0.18	0.0	0.0
Mar	0.71	1.0	11.8	0	0.18	0.0	0.0
Apr	0.73	1.0	13.2	0	0.28	0.0	0.0
May	0.8	1.0	14.3	1	0.28	0.0	0.0
Jun	0.84	1.0	14.9	1	0.28	0.0	0.0
Jul	0.86	1.0	14.6	1	0.28	0.0	0.0
Aug	0.88	1.0	13.6	1	0.28	0.0	0.0
Sep	0.88	1.0	12.2	1	0.18	0.0	0.0
Oct	0.83	1.0	10.8	0	0.18	0.0	0.0
Nov	0.79	1.0	9.7	0	0.18	0.0	0.0
Dec	0.77	1.0	9.1	0	0.18	0.0	0.0

Sediment A Factor	2.9155E-03
Sed A Adjustment	0.81
Avail Water Cap (cm)	9.904
Sed Delivery Ratio	0.103

Values 0 - 1

GW Recess Coeff	0.06
GW Seepage Coeff	0.0
% Tile Drained (Ag)	0.0

Save File | Export to JPEG | Close

<u>Total Area of Parsed Planning Area Basin Layer</u> = 7,791 hectares = 19,252 Acres

<u>Parsed Area</u> = 31,716 – 19,252 = 12,464 Acres

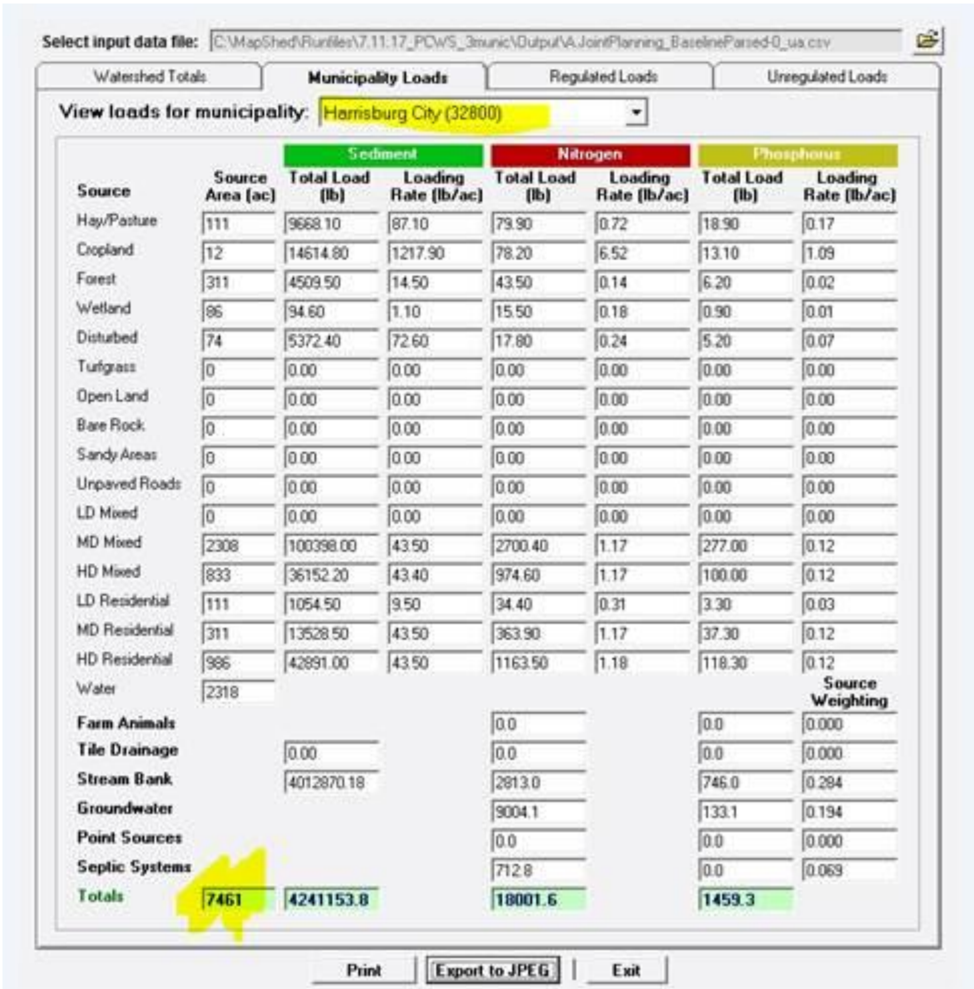
Joint Planning Area

Land Use #	Land Use	CRW	LPT	Susq	Land Use Totals (acre)	Land Use Totals (hect)
1	Water	2,299.49	11.52	1,208.26	3,519.27	1,424.20
2	LD Mix-Urb	-	40.77	3.44	44.21	17.89
3	Hi Mix-Urb	125.82	483.91	367.62	977.35	395.52
4	Hay/Past	41.14	1,555.11	630.61	2,226.86	901.18
5,6	Crop	1.16	544.59	143.89	689.64	279.09
7,8,9	Forest	188.66	2,831.65	1,472.46	4,492.77	1,818.16
10,11	Wetland	68.89	12.91	10.94	92.74	37.53
12,13,15	Disturbed	33.21	100.74	110.66	244.61	98.99
16	Turf/Golf	-	152.65	-	152.65	61.78
17	LD-Dens Res	0.30	173.19	262.08	435.57	176.27
18	MD-Dens Res	2.11	1,339.65	431.09	1,772.85	717.45
19	HD-Dens Res	1.96	28.14	46.54	76.64	31.02
20	MD-Mix-Urb	143.47	511.60	602.44	1,257.51	508.90
21	Open Land	-	-	-	-	-
22	Bare Rock	-	-	-	-	-
Municipal Totals		2,906.21	7,786.43	5,290.03	15,982.67	6,467.96

Total Area of Parsed Land Use = 15,983 – 3,519 = 12,464 Acres

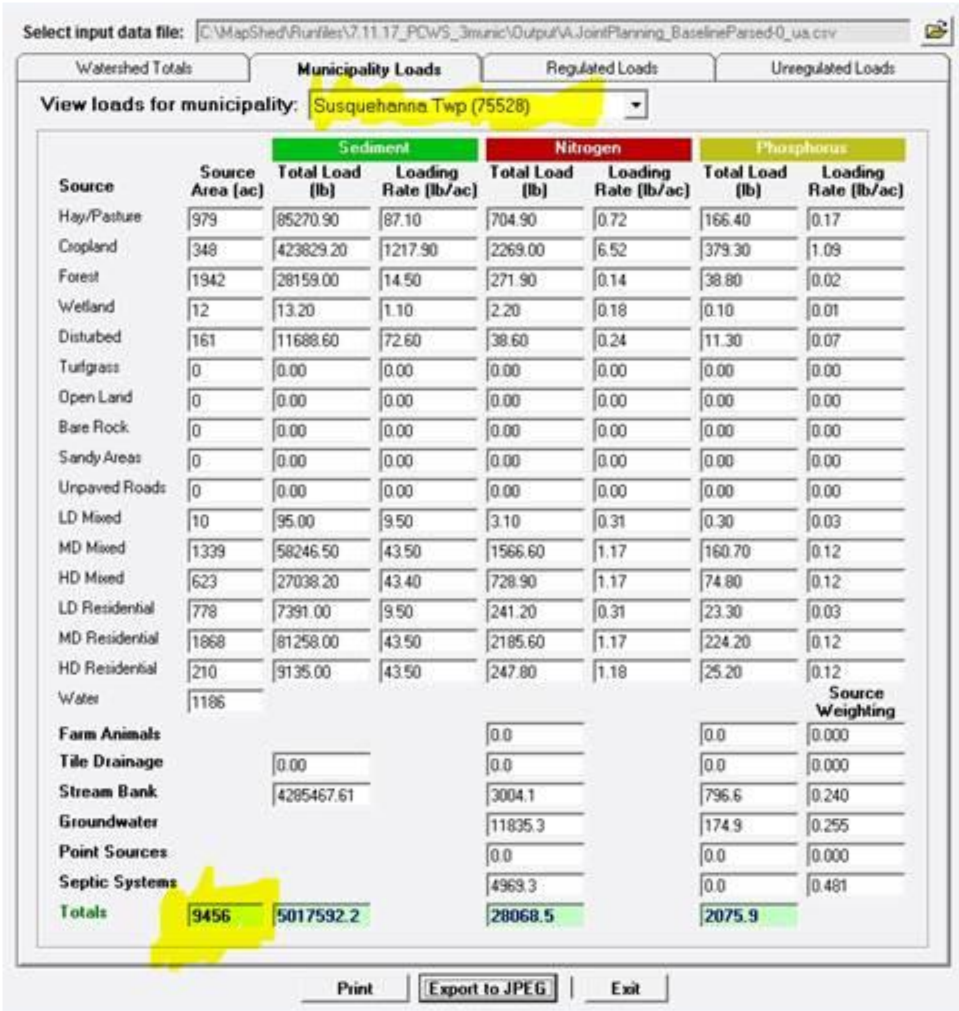
Unable to parse water 3,519 acres of land use #1 in GWLF-E Transport Data editor

The unparsed Joint Planning was established by using Mapshed's Urbanized Area Viewer Tool and the GWLF-E output file created by the modeling effort by summing the UA attributed to each municipality.



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	111	9668.10	87.10	79.90	0.72	18.90	0.17
Cropland	12	14614.80	1217.90	78.20	6.52	13.10	1.09
Forest	311	4509.50	14.50	43.50	0.14	6.20	0.02
Wetland	86	94.60	1.10	15.50	0.18	0.90	0.01
Disturbed	74	5372.40	72.60	17.80	0.24	5.20	0.07
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	2308	100398.00	43.50	2700.40	1.17	277.00	0.12
HD Mixed	833	36152.20	43.40	974.60	1.17	100.00	0.12
LD Residential	111	1054.50	9.50	34.40	0.31	3.30	0.03
MD Residential	311	13528.50	43.50	363.90	1.17	37.30	0.12
HD Residential	986	42891.00	43.50	1163.50	1.18	118.30	0.12
Water	2318						Source Weighting
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		4012870.18		2813.0		746.0	0.284
Groundwater				9004.1		133.1	0.194
Point Sources				0.0		0.0	0.000
Septic Systems				712.8		0.0	0.069
Totals	7461	4241153.8		18001.6		1459.3	

Harrisburg = 7,461 acres



Select input data file: C:\MapShed\Runfiles\7.11.17_PCWS_3munic\Output\A JointPlanning_BaselineParsed-0_ua.csv

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

View loads for municipality: Susquehanna Twp (75528)

		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	979	85270.90	87.10	704.90	0.72	166.40	0.17
Cropland	348	423829.20	1217.90	2269.00	6.52	379.30	1.09
Forest	1942	28159.00	14.50	271.90	0.14	38.80	0.02
Wetland	12	13.20	1.10	2.20	0.18	0.10	0.01
Disturbed	161	11688.60	72.60	38.60	0.24	11.30	0.07
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	10	95.00	9.50	3.10	0.31	0.30	0.03
MD Mixed	1339	58246.50	43.50	1566.60	1.17	160.70	0.12
HD Mixed	623	27038.20	43.40	728.90	1.17	74.80	0.12
LD Residential	778	7391.00	9.50	241.20	0.31	23.30	0.03
MD Residential	1868	81258.00	43.50	2185.60	1.17	224.20	0.12
HD Residential	210	9135.00	43.50	247.80	1.18	25.20	0.12
Water	1186						Source Weighting
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		4285467.61		3004.1		796.6	0.240
Groundwater				11835.3		174.9	0.255
Point Sources				0.0		0.0	0.000
Septic Systems				4969.3		0.0	0.481
Totals	9456	5017592.2		28068.5		2075.9	

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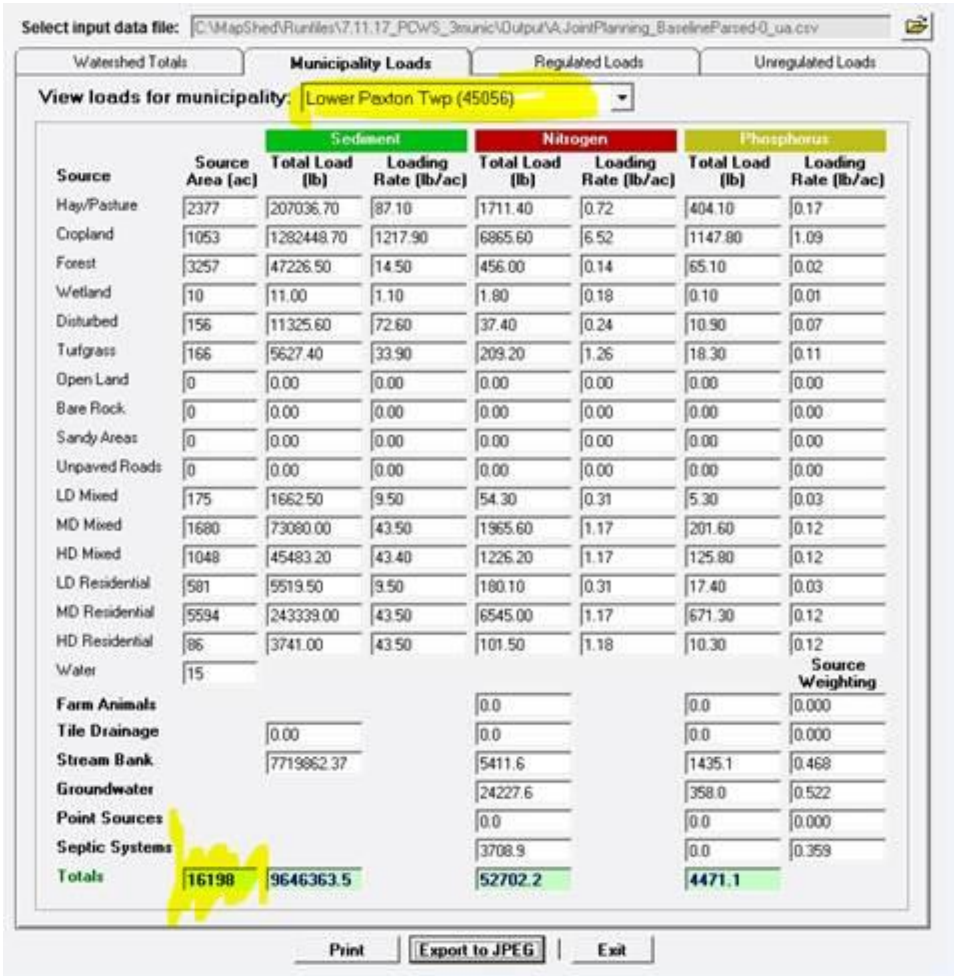
Susquehanna Twp. = 9,456 acres



Select input data file: C:\MapShed\Runfiles\7.11.17_PCWS_3munic\Output\A.JointPlanning_BaselineParsed-0_ua.csv

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

View loads for municipality: Lower Paxton Twp (45056)

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	2377	207036.70	87.10	1711.40	0.72	404.10	0.17
Cropland	1053	1282448.70	1217.90	6865.60	6.52	1147.80	1.09
Forest	3257	47226.50	14.50	456.00	0.14	65.10	0.02
Wetland	10	11.00	1.10	1.80	0.18	0.10	0.01
Disturbed	156	11325.60	72.60	37.40	0.24	10.90	0.07
Turfgrass	166	5627.40	33.90	209.20	1.26	18.30	0.11
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	175	1662.50	9.50	54.30	0.31	5.30	0.03
MD Mixed	1680	73080.00	43.50	1965.60	1.17	201.60	0.12
HD Mixed	1048	45483.20	43.40	1226.20	1.17	125.80	0.12
LD Residential	581	5519.50	9.50	180.10	0.31	17.40	0.03
MD Residential	5594	243339.00	43.50	6545.00	1.17	671.30	0.12
HD Residential	86	3741.00	43.50	101.50	1.18	10.30	0.12
Water	15						Source Weighting
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		7719862.37		5411.6		1435.1	0.468
Groundwater				24227.6		358.0	0.522
Point Sources				0.0		0.0	0.000
Septic Systems				3708.9		0.0	0.359
Totals	16198	9646363.5		52702.2		4471.1	

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Lower Paxton Twp. = 16,198 acres

<u>Planning Area (Non Parsed) based on Urban Area Viewer Output</u> = 7,461 + 9,456 + 16,198 = 33,115 acres

<u>Planning Area (Parsed) based on Urban Area Viewer Output</u> = 35,242 – 15,983 (rounded to 15,990 acres) acres of parsed area including the 3,519 acres attributed to water land use resulting in an initial Joint Planning Area of 19,252 acres

Select input data file: C:\MapShed\Runfiles\7.11.17_PCWS_3munic\Output\7.11.17_PCWS_3munic.-0_ua.csv

Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

GWLF-E Average Loads by Source for Watershed 0

		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	3820	332457.09	87.00	2734.24	0.72	664.58	0.17
Cropland	1517	1847143.06	1217.60	9894.19	6.52	1656.09	1.09
Forest	6924	100067.82	14.50	993.29	0.14	109.39	0.02
Wetland	114	132.28	1.20	20.22	0.18	1.08	0.01
Disturbed	400	29056.93	72.60	96.89	0.24	28.79	0.07
Turfgrass	166	5511.56	33.30	208.69	1.26	17.66	0.11
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	185	1763.70	9.50	57.89	0.31	5.82	0.03
MD Mixed	5333	230383.06	43.20	6381.41	1.20	662.42	0.12
HD Mixed	2555	110385.45	43.20	3057.64	1.20	317.40	0.12
LD Residential	1619	15366.22	9.50	505.61	0.31	50.86	0.03
MD Residential	7799	336932.48	43.20	9332.61	1.20	968.76	0.12
HD Residential	1285	55512.40	43.20	1537.70	1.20	159.61	0.12
Water	3525.4393						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		21430442.0		15022.3		3983.8	
Groundwater				80199.5		1185.2	
Point Sources				0.0		0.0	
Septic Systems				10331.1		0.0	
Totals	35242	24495154		140373		9811	

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