East Hempfield Township Pollutant Reduction Plan

East Hempfield, PA
August 9, 2017

Prepared for:
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Introduction

This pollutant reduction plan (PRP) was developed for East Hempfield Township as a requirement of Permit PAG#133632 for their municipal separate storm sewer system (MS4). The PRP outlines the actions the Township will take to address pollutant loads to the Little Conestoga Creek and Chiques Creek within the MS4 that drain to the Chesapeake Bay/impaired waters. These actions include public participation, mapping of outfalls and other discharges, pollutant load calculations, best management practices (BMPs) selection, identification of potential funding sources and partners, and operations and maintenance (O&M) activities.

A. Public Participation

Public participation is an essential part of the PRP because it enhances buy-in from landowners that may have an impact on pollutant discharges, can uncover missing elements or errors in calculations, and builds cooperative partnerships among the municipality and other entities.

A copy of the draft PRP was released via public notice on June 26, 2017 to LNP. The notice ran for 1 day. A copy of the public notice is included in Appendix A. The public was given 30 days to provide commentary on the contents of the PRP. The PRP was available at the Township office from June 26, 2017 to July 26, 2017 as well as electronically on East Hempfield Township's website. Opportunity for comment was also provided during East Hempfield's regularly scheduled board meeting on July 19, 2017. No verbal or written public comments were received.

B. Map

East Hempfield Township is located entirely within the Chesapeake Bay Basin. The Chiques watershed comprises approximately 15% of the Township (1,986 acres). The Chiques Creek is a tributary of the Susquehanna River. The Little Conestoga Creek Watershed represents approximately 85% of the Township (11,569 acres). The Little Conestoga Creek is a tributary of the Conestoga Creek, a tributary of the Susquehanna River. Figure 1 identifies the subwatershed basins within East Hempfield as well as impaired and attaining streams from the DEP 2014 Integrated List and the location of the 2010 Census urban area. Additional maps are provided in Appendix B. Map B1 identifies the land cover types throughout the Township and within the Planning Areas. Excluded area, outfalls and proposed BMPs are also shown on the map. Map B2 includes the same information except an on an aerial photograph instead of the land cover dataset. Planning areas include all non-excluded areas on the maps and are primarily designated by subwatershed.

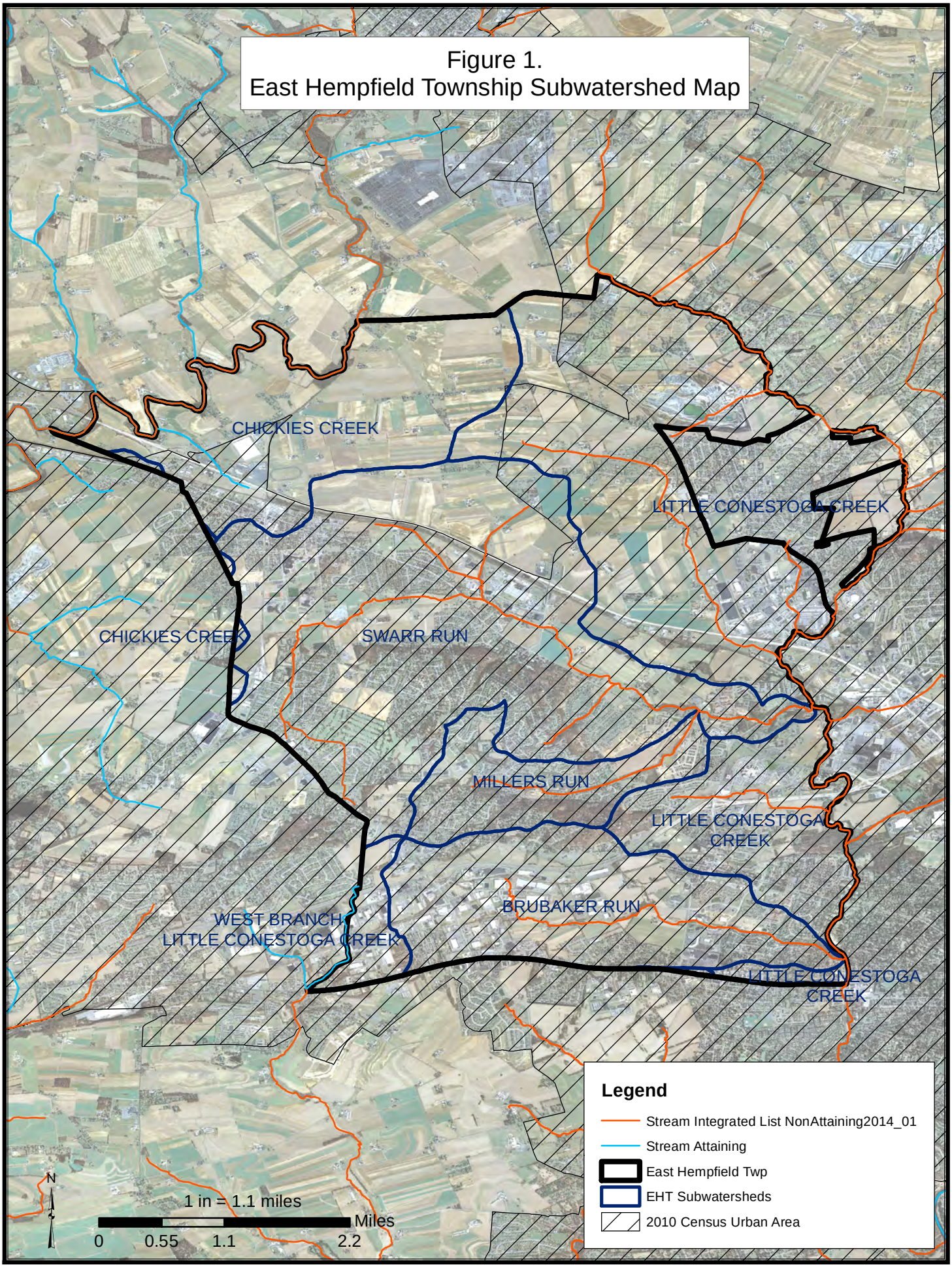


Figure 1.
East Hempfield Township Subwatershed Map
CHICKIES CREEK
LITTLE CONESTOGA CREEK
CHICKIES CREEK
SWARR RUN
MILLERS RUN
LITTLE CONESTOGA CREEK
BRUBAKER RUN
WEST BRANCH LITTLE CONESTOGA CREEK
LITTLE CONESTOGA CREEK
Legend
Stream Integrated List NonAttaining2014_01
Stream Attaining
East Hempfield Twp
EHT Subwatersheds
2010 Census Urban Area
N
1 in = 1.1 miles
Miles
0
0.55
1.1
2.2

C. Pollutants of Concern

Because East Hempfield discharges stormwater to a local impaired water, specifically the Chiques Creek and the Little Conestoga Creek and its tributaries, it must reduce pollutant loads associated with those impairments. As shown in Figure 1, all streams within the Township are impaired or directly upstream of impaired waters. Any proposed BMPs that target the impaired waters discharges will have a beneficial impact on the Chesapeake Bay. East Hempfield is subject to both a CBPRP and an impaired waters PRP but will combine their CBPRP and Impaired Waters PRP into one document.

For the purposes of this PRP, designated MS4 Planning Areas are based on the watersheds of impaired waters listed in the DEP MS4 Requirements Table. Table 1 shows each of the affected subwatersheds within East Hempfield and the pollutant(s) that are of concern to that area as shown on the DEP MS4 requirements table revised 4/7/2017. In planning areas where sediment is listed as a concern the Township must reduce sediment loading by 10 percent; where nutrients are listed as a concern the Township must reduce phosphorus by 5 percent and nitrogen by 3 percent. East Hempfield is using the presumptive approach in which it is assumed that a 10% sediment reduction will also accomplish the required nutrient reduction, therefore only sediment loads within each MS4 planning area are reported in this PRP.

Table 1. Impaired Downstream Waters and Requirements

MS4 Planning Area	Pollutant(s) of Concern
West Branch Little Conestoga Creek	Appendix E – Siltation (5)
Swarr Run	Appendix B – Pathogens (5)*, Appendix E – Nutrients, Siltation (5)
Millers Run	Appendix B – Pathogens (5)*, Appendix E – Nutrients, Siltation (5)
Brubaker Run	Appendix B – Pathogens (5)*, Appendix E – Nutrients, Siltation (5)
Little Conestoga Creek	Appendix B – Pathogens (5)*, Appendix E – Nutrients, Siltation (5)
Chiques Creek	Appendix E – Siltation (5)
Chesapeake Bay Nutrients/Sediment	Appendix D-Nutrients, Siltation (4a)

*Details on Appendix B Pollutants are not included within the scope of this CBPRP / PRP; however the Township is currently an approach to address the pathogen impairments and resulting Pollutant Control Measures framework.

D. Existing Load for Pollutants of Concern

East Hempfield has two primary watersheds: the Chiques and the Little Conestoga. East Hempfield has used MapShed to calculate the existing load within their designated MS4 planning areas within the Little Conestoga watershed and the DEP Simplified Method to determine existing loads within the Chiques watershed. Prior to running MapShed, East Hempfield went through a desktop and field verification exercise to establish MS4 planning areas. Since 82% of East Hempfield is considered urban area, and the municipality is fairly developed with significant MS4 infrastructure, it was beneficial to first identify areas that could be parsed and assume the rest of the municipality is part of the planning area.

East Hempfield used the following process to parse areas and establish their MS4 planning area for the PRP. Prior to beginning PRP development, East Hempfield began identifying outfalls within the Township and compiling spatial data.

As part of PRP development East Hempfield's outfall mapping was added to a base map with the 2010 UA, National Hydrology Dataset (NHD) streams, topography, and watershed boundaries in order to aid in the field drainage boundary assessment to establish MS4 planning areas for the PRP. Mapping also included areas that could be parsed outright such as state owned road right of ways and parcels with individual industrial stormwater management permits.

The field review then continued to field verify outfalls on NHD streams with matching observed general drainage flow to the map (or determining that the regulated system (inlets, curb and gutter, etc.) tied to the end point adequately collects stormwater run-off from the drainage areas reviewed). This process involves a visual tracing against the system map. Areas that were field verified that do not drain to regulated outfalls were parsed out (excluded). Areas were field verified as not part of the regulated system where runoff disperses through sheet flow or incidental dispersion or drain directly to the stream without entering the MS4 system. Watershed based planning areas were then drawn to capture the remaining area.

The following entities have coverage under their own stormwater permit and are excluded from the East Hempfield Planning Area.

- East Petersburg Borough (MS4 Permit)
- Manor Township (MS4 Permit)
- West Hempfield Township (MS4 Permit)
- Air Prod & Chem Inc (Industrial Stormwater)
- Bird in Hand Woodworks (Industrial Stormwater)
- Euromax Intl Inc (Industrial Stormwater)
- Fabral Inc (Industrial Stormwater)
- Hershey Foods Corp (Industrial Stormwater)
- GSM IND (Industrial Stormwater)
- Hubbard Feeds Inc (Industrial Stormwater)
- Kellogg USA Inc (Industrial Stormwater)

- Lancaster Truckbodies (Industrial Stormwater)
- Land O Lakes Purina Feed LLC (Industrial Stormwater)
- Pennsy Supply Inc (Industrial Stormwater)
- Roberts Oxygen Co Inc (Industrial Stormwater)
- Westrock-Southern Container Inc (Industrial Stormwater)

D.1 Little Conestoga Existing Load

In order to model loads from MS4 Planning areas in MapShed a base model run of the entire Little Conestoga watershed 65.5 square mile drainage area was performed. Each watershed-based planning area was digitized as an urban area in MapShed and the base model was rerun for each planning area. The MapShed UA tool was then used to establish the loading for each planning area. Only one contiguous UA could be run in MapShed per model run. Therefore, in order to keep the number of MapShed model runs reasonable, the planning areas were kept as large as possible within a watershed. Land use acreage and corresponding load adjustments were made to some of the MapShed model runs to account for excluded areas that were included in the modeled planning areas and vice versa where smaller "islands" of land that are included in the planning area could not reasonably be included in the model run. Table 2 shows the sediment loading rates for each land cover type for the East Hempfield Township Model Runs. Table 3 shows the sediment load per MS4 Planning Area. Since such a small portion of East Hempfield Township is in the West Branch Little Conestoga Watershed, a separate HUC12, DEP approved aggregating loads for East Hempfield within the entire Little Conestoga watershed.

In those areas where structural BMPs are currently in place and functioning, the existing loading estimate was adjusted to account for pollutant reductions from those BMPs. Article VI of East Hempfield's Stormwater Management Ordinance describes Operation and Maintenance (O&M) requirements. East Hempfield requires the submittal of an O&M plan that includes but is not limited to BMP inspection annually for the first 5 years and once every three years thereafter. The Ordinance also specifies who is responsible for maintenance under various situations.

East Hempfield Township created an inventory of their existing and functioning BMPs from NPDES permit data and stormwater management plans filed with the Township. BMPs were identified as runoff reduction (RR) or stormwater treatment (ST) practices. One RR and one ST model run (as applicable) per subwatershed was completed by aggregating existing BMP data in the MapShed Urban BMP Editor to determine the sediment reductions resulting from the existing BMPs. The sediment load for each BMP model run was compared to the Little Conestoga Baseline watershed model run and the difference was attributed to the existing BMPs included in the BMP editor. See Table 4. The BMP inventory and calculated information needed to populate the MapShed Urban BMP Editor is provided as Appendix D. Screenshots of the Urban BMP editor for each model run is included in Appendix C. In addition to stormwater BMPs a 1,500 foot stream restoration of Swarr Run completed by the Lancaster County Conservation District was included as an existing BMP. The stream stabilization included root wads, log and rock vanes, rock, livestock crossings and fencing

and excavated floodplain terraces. Project is still functioning and an established forested buffer has formed.

Based on these existing load calculations it was determined East Hempfield's existing loading is 7,083,859 lbs. The minimum sediment reduction required for East Hempfield in the Little Conestoga Watershed is 708,386 lbs. (as shown in Table 3). Since such a small portion of East Hempfield Township is in the West Branch Little Conestoga Watershed loads for the entire Little Conestoga watershed, including the West Branch, were aggregated within East Hempfield Township, as reviewed with DEP staff.

Table 2. East Hempfield MapShed Sediment Land Use Loading Rates – Little Conestoga Watershed

MapShed Land Cover	Loading Rate (lb/ac)	Total Load (lb)
Hay/Pasture	112.4	118,919
Cropland	1467.1	2,469,129
Forest	12.5	5,313
Wetland	4.5	167
Disturbed	40.7	6,960
Turfgrass	36.0	7,128
Open Land	163.3	124,271
LD Mixed	14.8	5,742
MD Mixed	65.2	99,104
HD Mixed	65.2	69,894
LD Residential	14.8	5,195
MD Residential	65.2	194,948
HD Residential	65.3	1,306
Water	0.0	0

Table 3. Existing loads by MS4 Planning Area

Planning Area Name	Total Acres (adjusted)	Land Use Sediment Load (lbs)	Streambank Sediment Load (lbs)	Total Mapshed Sediment Load (lb)	Existing BMP Load Reductions (lb)	Final Planning Area Existing Load (lbs)
Little Conestoga Watershed	1,765	720,913	1,019,938	1,740,851	30,000	1,710,851
Swarr Run Watershed	3,141	600,903	2,431,873	3,032,776	247,100	2,785,676
Miller Run Watershed	863	89,235	608,989	698,224	0*	698,224
Brubaker Run Watershed	1,731	416,279	1,344,820	1,761,099	69,800	1,691,299
West Branch Watershed	188.9	49,053	148,757	197,810	0	197,810
Total				7,430,759	346,900	**7,083,859**
Little Conestoga 10% Reduction						**708,386**

*Miller Run existing BMPs were included in the Swarr existing BMP model Run. Miller Run is a tributary of Swarr Run.

Table 4. Summary of Existing Stormwater BMP Model Run Results

Existing BMP model runs	Little Conestoga Baseline Model Sediment Load (T)	New Sediment Load (T)	Sediment Reduction (T)	Sediment Reduction (lb)
Little Conestoga RR	22452.7	22439.4	13.3	26,600
Little Conestoga ST	22452.7	22451.0	1.7	3,400
Swarr Run RR	22452.7	22420.7	32.0	64,000
Swarr Run ST	22452.7	22447.4	5.30	10,600
Brubaker Run RR	22452.7	22423.7	29.0	58,000
Brubaker Run ST	22452.7	22446.8	5.90	11,800
Total				**174,400**

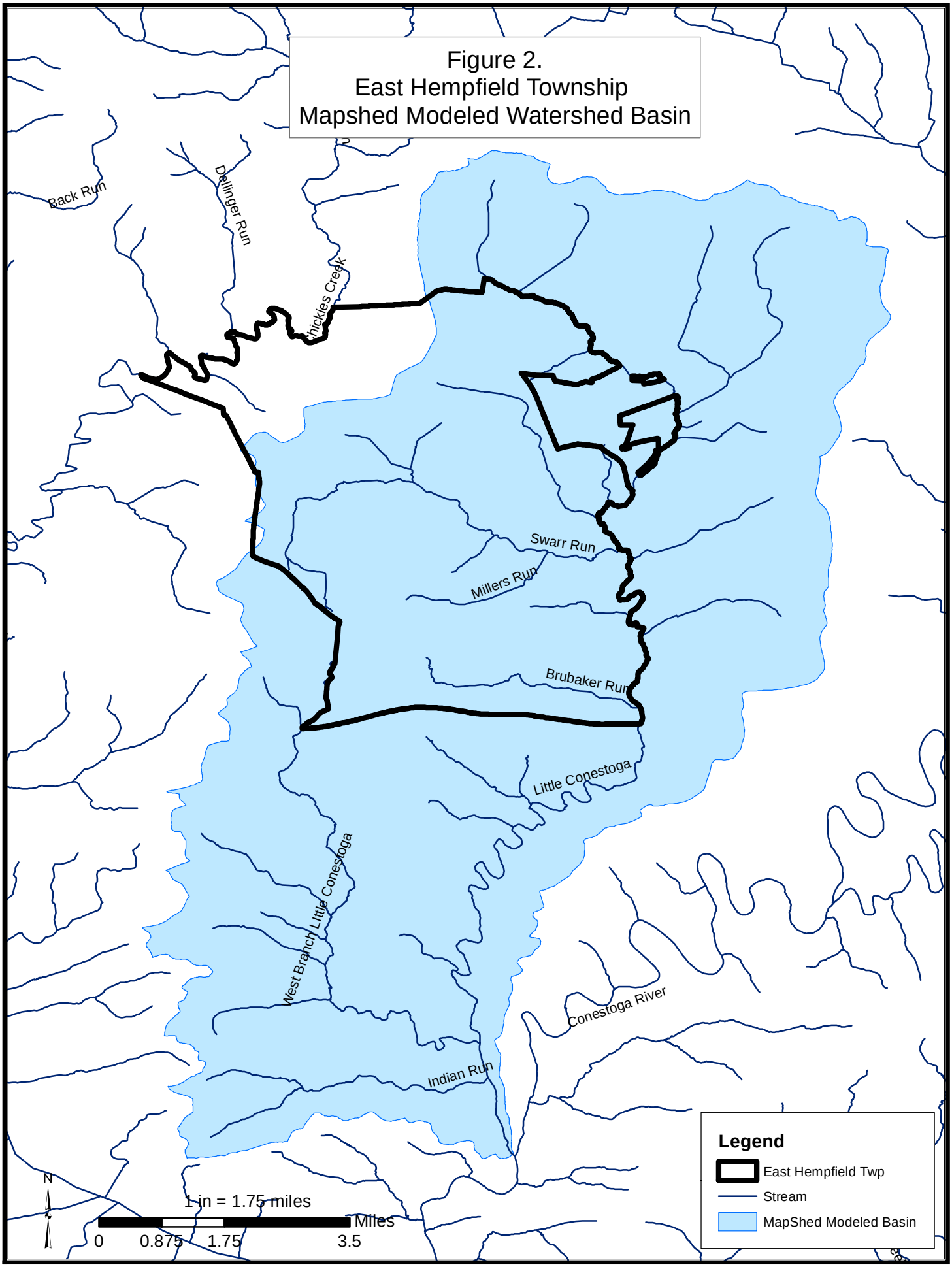


Figure 2.
East Hempfield Township
Mapshed Modeled Watershed Basin
Back Run
Dellinger Run
Chickies Creek
Swarr Run
Millers Run
Brubaker Run
Little Conestoga
West Branch Little Conestoga
Conestoga River
Indian Run
N
1 in = 1.75 miles
Miles
0
0.875
1.75
3.5
Legend
East Hempfield Twp
Stream
MapShed Modeled Basin

D.2 Chiques Creek Watershed Existing Load

Due to the small size of the Chiques Creek watershed within East Hempfield Township it was determined the Simplified Method was the best approach. The following percent cover and sediment loading rate was used in the calculations.

Table 5. Statewide MS4 Land Cover Estimates for East Hempfield Township and Developed Land Use Loading Rates for Pa Counties – Lancaster County

UA % Impervious	32%
UA % Pervious	68%
Non-UA %Impervious	27%
Non-UA % Pervious	73%

	Sediment (lb/ac/yr)
UA Impervious Loading	1480.43
UA Pervious Loading	190.93
Undeveloped (Non UA) Loading	234.6

There is 257.7 acres within East Hempfield's planning area in the Chiques Creek watershed. Based on the impervious/pervious percent cover in Table 5 this equates to 82.5 acres impervious at 1,480.43 lbs/ac loading rate and 175.2 acres pervious at 190.93 lb/ac loading rate for a total of 155,546 lbs of sediment. The required 10% reduction is therefore 15,555 lbs. See Appendix B Map 2 for the Chiques Planning area.

E. BMPs Selected to Achieve the Minimum Required Reductions in Pollutant Loading

Based on the 10% sediment reduction targets established above, East Hempfield Township has identified a strategy to meet the minimum load reductions within 5 years following DEP's approval of permit coverage. The nutrient reduction requirements for the impaired waters are assumed to be addressed by the 10 percent sediment reductions.

Since East Hempfield has a small planning area in the Chiques watershed and neighboring West Hempfield Township has a small planning area in the West Branch Little Conestoga watershed, the two municipalities will develop a MOU to work together to implement projects that will meet their own PRP sediment reductions requirements as well as the other municipality's sediment reduction requirements. The projects and reductions are described in greater detail below.

Summary of Alternatives and Selection of BMPs

East Hempfield Township evaluated approximately eight stormwater BMP projects and approximately ten stream restoration projects in the Little Conestoga watershed considering the following criteria:

- Sediment reductions

- Cost per pound of pollutant reduction
- Ownership (public versus private land)
- Funding and Workforce availability
- Community benefit (site accessibility, visibility to the public, ability of public to experience benefits)
- Connectivity to other completed or proposed stormwater BMPs
- Timeframe to implement

The purpose of the evaluation was to determine the BMPs that would reduce the most pollutants for the least amount of money while getting closer to the goal of removing streams from the impaired waters list and protecting the Chesapeake Bay. After reviewing each of the BMPs and their order on the list, East Hempfield Township selected the following BMPS described in sections 1 and 2, below.

E.1. Little Conestoga Watershed

The minimum sediment reduction required for East Hempfield in the Little Conestoga Watershed is 708,386 lbs. sediment (as shown in Table 3). Since such a small portion of East Hempfield Township is in the West Branch Little Conestoga Watershed loads for the entire Little Conestoga watershed, including the West Branch, were aggregated within East Hempfield Township, as reviewed with DEP staff.

East Hempfield Township proposes the implementation of the following BMPs within the storm sewershed to meet this pollutant load reduction. These BMPs will be implemented by the end of the 5 year permit cycle. The UNT to Swarr Run restoration will be implemented to satisfy East Petersburg Borough and West Hempfield Township's PRP requirements in the West Branch Little Conestoga watershed as described below. A summary of all the proposed BMPs and how they meet the required load reduction is included as Table 6. These BMPs exceed the required PRP load reductions planned for the three municipalities at 118% of the needed sediment reductions. Detailed information about each project is provided below.

Table 6. Summary of Proposed BMPs in the Little Conestoga Watershed

BMP ID Number	BMP Project	Sediment Load Reduction (lbs/yr)
1	Brubaker Run Floodplain Restoration	790,821
2	UNT to Swarr Run Stream Restoration	83,375
	Total Load Reduction	**880,596**
	Required East Hempfield Township	708,386
	Required East Petersburg Borough	15,000
	Required West Hempfield Township	17,606
	Total Required Load Reduction	**740,992**

BMP 1 Brubaker Run Floodplain Restoration Project

The Brubaker Run Floodplain Restoration associated with the Lime Spring Square development project is a 4,350 LF floodplain restoration that is being implemented in the Brubaker Run Watershed. This floodplain restoration is a public-private partnership between East Hempfield and Oak Tree Development Group. The 8.6 acre floodplain restoration

project is part of the 98.16 acre Lime Spring Square commercial development project and, in addition to being an ecological restoration of the stream and floodplain corridor, is intended to provide stormwater management services as part of the Township NPDES permit requirements for the land development activity. The anticipated sediment load reduction resulting from the project will far exceed the water quality impacts of the proposed land development activity. Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects (Schueler and Stack, 2014) was used to calculate the sediment load reduction resulting from the restoration. Appendix E summarizes the field assessment, monitoring, and calculations used to predict the sediment load reduction provided by the restoration project, the sediment load resulting from the land development site, and the net sediment reduction anticipated as a result of the overall project. The results are summarized in Table 7 below. The Brubaker Run floodplain restoration project will result in 790,821 lbs. of sediment reduction that can be applied to East Hempfield's Pollution Reduction Plan.

Table 7. Brubaker Run Floodplain Restoration Sediment Reduction

	Sediment (lb)
Brubaker Run Floodplain Restoration Base Sediment Reduction	797,221
Annualized sediment load from development site	6,400
Net Brubaker Run Sediment Reduction with NPDES requirement removed	790,821

BMP 2: Unnamed Tributary to Swarr Run Stream Restoration

As described above, East Hempfield Township will implement this additional stream restoration project to meet West Hempfield Township's required load reductions in the Little Conestoga watershed. East Petersburg Borough will also contribute to the project to acquire 15,000 lbs of sediment reduction since limited opportunities exist within the Borough. A Memorandum of Understanding (MOU) will be developed through the existing Central Lancaster County Council of Governments Agreement between East Hempfield Township, East Petersburg Borough, and Manheim Township. The MOU will identify East Petersburg as a financial partner in this stream restoration project for a portion of the project to cover the monetary value for 15,000 lbs. of sediment reduction that will be included in East Petersburg's sediment load reduction BMPs. An additional MOU will identify West Hempfield Township as a financial partner in the project to achieve all their Little Conestoga load reductions, approximately 17,606 lbs., through the implementation of this project. East Hempfield will likewise achieve their required 15,555 lb. Chiques Creek watershed sediment load reduction through West Hempfield's proposed BMP project described in Section E2. West Hempfield will contribute a payment equivalent to the cost to reduce approximately 2,051 lbs. of sediment reduction to cover the difference in amounts "traded."

The proposed stream restoration project will restore approximately 725 LF of an Unnamed Tributary to Swarr Run within the Little Conestoga Watershed. The reach is vertically and laterally eroding and threatening the structural integrity of two adjacent stormwater basins. According to the DEP PRP Instructions a 115 lb. /ft. sediment load reduction can be applied

to this project resulting in 83,375 lbs. of sediment reduction for the total project. This reach of stream, located between Pinetree Way and Huntington Place in East Hempfield Township, will require coordination with private landowners. The project location is shown on Map B2.

Table 8.

	Sediment (lb)
Unnamed Tributary to Swarr Run Stream Restoration	83,375
East Petersburg Borough's allocated reduction	15,000
West Hempfield Townships allocated reduction	17,606
Net Reduction remaining	50,769

Additional Voluntary BMP Implementation Planned in the Little Conestoga Watershed

East Hempfield is planning to implement multiple voluntary rain gardens and bioretention areas in the Little Conestoga Watershed. The BMPs are described in this report to show that the Township is doing additional work above and beyond MS4 PRP requirements.

Load reductions expected from these voluntary BMPs were calculated using MapShed. Individual model runs were completed for each proposed BMP by entering the required site-specific planning level BMP information into the MapShed Urban BMP Editor for the Little Conestoga Baseline watershed model. The new reduced loading resulting from the BMP was then subtracted from the Baseline Little Conestoga Watershed loading of 22,452.7 Tons and the difference is attributed to the implementation of the BMP. Screenshots from the MapShed Urban BMP Editor used in each model run are provided in Appendix C.

East Hempfield Township intends to construct two rain gardens to treat runoff from their maintenance facility located at the Township offices and within the Swarr Run watershed. Preliminary design characteristics are provided in Table 9 below. Since MapShed was used to calculate the existing load it was also used to calculate the load reduction resulting from the implementation of the rain gardens. Screenshots from the MapShed Urban BMP Editor used in the model run are provided in Appendix C.

Table 9. Maintenance Facility Rain Garden

BMP	BMP Area (ac)	Acres Treated (ac)	BMP Depth Treated (ft)	Runoff Storage (RS) (ac ft)	Impervious Area (IA) (ac)	(RS)(12)/IA (Min=0, Max=2.5)	MapShed BMP sediment removal (lb)
Maintenance Facility Rain Garden 1 and 2	0.1	1.35	0.5	0.050	0.5	1.2	1,000

The Village Grande community in the Miller Run watershed intends to construct five bio-retention areas to treat runoff at outfall locations within the common open space of the Village Grande development. Conceptual design characteristics are provided in Table 10 below. Screenshots from the MapShed Urban BMP Editor used in the model run are provided in Appendix C.

Table 10. Village Grande Bio- retention Area Conceptual Design

BMP	Total BMP Area (ac)	Total Acres Treated (ac)	BMP Depth Treated (ft)	Runoff Storage (RS) (ac ft)	Impervious Area (IA) (ac)	(RS)(12)/IA (Min=0, Max=2.5)	MapShed BMP sediment removal (lb)
Village Grande Bio-retention Areas	0.24	11.3	0.5	0.12	4.25	0.34	7,200

E.2. Chiques Creek Watershed

East Hempfield's minimum required sediment reduction in the Chiques Creek watershed is 15,555 lbs. sediment. Since such a small portion of East Hempfield Township is in the Chiques watershed, East Hempfield will partner with West Hempfield to implement a project that achieves their required PRP load reductions.

West Hempfield Township proposes the implementation of the following BMP to meet this pollutant load reduction. This BMP will be implemented by the end of the 5 year permit cycle.

BMP 3: Streambank Stabilization UNT to Chiques Creek

West Hempfield Township plans to stabilize approximately 1,260 LF of streambank along an UNT to Chiques Creek. This small stream flows through an agricultural property located at 940 Farmdale Road. The stream receives discharge from 5 regulated outfalls and stormwater flows from approximately 190 acres of upland develop area.

According to the DEP PRP Instructions 44.88 lb. /ft. sediment load reduction can be applied to this project resulting in 56,549 lbs. of sediment reduction of which East Hempfield needs 15,500 lbs. See Figure 3 for project location.

Figure 3. Location of Stream Stabilization Project in West Hempfield Township

F. Funding Mechanism Identification

In order to install and maintain the BMPs listed in Section E, East Hempfield proposes the following sponsors/partners and funding sources.

Table 11. BMP funding Sources – Need Additional Input from Township

BMP#	Sponsor/Partner/Funding Sources
1	The Oak Tree Development Group is funding the Brubaker Run floodplain restoration in conjunction with the development project
2	East Hempfield Township has committed budget funds to install the rain gardens at their maintenance facility
3	West Hempfield Township will fund the project. East and West Hempfield will "trade" sediment reductions as described in PRP.

G. Responsible Parties for Operation and Maintenance (O&M) of BMPs

All stormwater BMPs installed under this PRP are subject to East Hempfield's stormwater management ordinance. Article VI of the ordinance describes O&M requirements. The ordinance requires that the BMPs are inspected at a minimum annually for the first five years and once every three years thereafter.

The Operation and Maintenance (O&M) activities for each BMP are included in the table below. If the BMP is located on private land, the landowner must convey an easement to the Township to allow for access for periodic inspections and maintenance, as needed. Actual O&M activities will be listed in the Annual MS4 Status Report sent to the PADEP under the General Permit. See Table 12 for additional O&M information.

Table 12. BMP O&M Activities

BMP #	Parties Responsible for O&M	O&M Activities	Frequency for O&M Activities
1	Oak Tree Development Group	PCSM O&M Plan	Biannual inspections for first three years and annual inspections thereafter. Additional inspections following large storm events
2	The Township will be responsible for the first 2 years and will train the HOA to take over O&M thereafter.	Inspection, vegetation management and invasive species control, plant replacement	Biannual inspections for first three years and annual inspections thereafter. Additional inspections following large storm events
3	West Hempfield Township	O&M will be determined by West Hempfield. General O&M - Inspection of stability and plant survival, management of invasive species	O&M will be determined by West Hempfield Township. Generail O&M - biannual inspections for first three years and annual inspections thereafter. Additional inspections following large storm events.

H. Works Cited

Integrated List Non-Attaining 2014_01. Office of Water Management, Bureau of Water Supply & Wastewater Management, Water Quality Assessment and Standards Division.

LandStudies, Inc. July 29, 2015. Little Conestoga Watershed Action Plan. Lancaster County, PA.

Schueler, T. and C. Lane. January 20, 2015. Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit. Chesapeake Bay Program Urban Stormwater Workgroup.

Schueler, T. and B. Stack. September 2014. Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects. Chesapeake Bay Stormwater Network and Center for Watershed Protection.

Pennsylvania Department of Environmental Protection (PADEP). 2016. PRP / TMDL Plans MS4 Workshop. Harrisburg, PA.

Appendix A

Public Participation: Proof of Publication

Invoice No. 3792534

PROOF OF PUBLICATION NOTICE IN

State of Pennsylvania}
} ss:
County of Lancaster}

An Affiant of the County and State aforesaid, being duly sworn, deposes and says that the LNP, a daily newspaper of general circulation published at Lancaster, County and State aforesaid, was established 1794-1877 since which date said daily newspaper has been regularly issued in said county, and that a copy of the printed notice or publication is attached hereto exactly the same as was printed and published in the regular editions and issues of said daily newspaper on the following dates:

26TH DAY OF JUNE 2017

Affiant further deposes that he/she is the Clerk duly authorized by the LNP Media Group, Inc., a corporation, publisher of said LNP, a newspaper of general circulation, to verify the foregoing statement under oath, and also declares that affiant is not interested in the subject matter of the aforesaid notice or advertisement and that all allegations in the foregoing statement as to time, place and character of publication are true.

NOTICE OF OPPORTUNITY FOR PUBLIC REVIEW AND COMMENT PROPOSED NUTRIENTS/SEDIMENT POLLUTANT REDUCTION PLAN (PRP) AND CHESAPEAKE BAY POLLUTANT REDUCTION PLAN (CBPRP) OF THE GENERAL PERMIT FOR STORM WATER DISCHARGES FROM THE SMALL MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4)

NOTICE IS HEREBY GIVEN that the Board of Supervisors of East Hempfield Township (Township) will receive public comment(s) on the proposed Nutrient/Sediment Pollutant Reduction Plan (PRP) and Chesapeake Bay PRP required for the 2018-2023 General MS4 Permit. The proposed PRP and CBPRP include:

(1) Identification of structural Best Management Practices (BMPs) for implementation to reduce loadings of nutrients and sediment as required by the MS4 Permit;

(2) Methodology used to calculate existing nutrients/sediment loadings and corresponding reductions; and

(3) Locations of local waterways with nutrients/sediment impairments.

BACKGROUND INFORMATION

The Pennsylvania Department of Environmental Protection (PADEP) adopted and issued the Small MS4 Statewide General Permit (PAG-13) in 2003. In 2016, the PADEP issued a revised Small MS4 Statewide General Permit (PAG-13) for the 2018-2023 permit cycle. The revised MS4 Permit includes requirements for the development and implementation of a PRP for local waterways receiving discharges from the regulated MS4 with nutrients and/or sediment impairments, and a CBPRP for municipalities located in the Chesapeake Bay drainage basin. The Township is located in the Chesapeake Bay drainage basin.

For the PRP, the Township is required to reduce existing loadings of nutrients and sediment for locally impaired waterways from its regulated MS4 during the 5-year MS4 Permit cycle commencing in March 2018 as follows:

(1) 10% reduction in sediment, and

(2) 5% reduction in Total Phosphorus.

For the CBPRP, the Township is required to reduce existing loadings of nutrients and sediment to local waterways from its regulated MS4 during the 5-year MS4 Permit cycle commencing in March 2018 as follows:

(1) 10% reduction in sediment,

(2) 5% reduction in Total Phosphorus, and

(3) 3% reduction in Total Nitrogen.

The PRP and CBPRP can and is combined into a single document.

DOCUMENT AVAILABILITY

The proposed PRP and CBPRP are available for review at the Township office from 8:00 A.M. to 4:30 P.M. Monday-Friday during the period of June 26th, 2017 to July 26th, 2017, or download at www.easthempfield.org.

Interested parties may request a paper copy or electronic copy by contacting Jon E. Beck, Director of Development Services at (717) 898-3100 x 230 or planning@easthempfield.org.

SUBMISSION OF COMMENTS

The Township shall accept written comments during the review period. Interested parties may submit written comments by mail or hand delivery. Written comments must be received by 12:00 noon on July 26th, 2017, and addressed to:

Jon E. Beck
Director of Development Services
EAST HEMPFIELD TOWNSHIP
1700 NISSLEY ROAD, P.O. BOX 128
LANDISVILLE, PA 17538

Comments may be submitted electronically, in PDF text format (if less than 1 megabyte in total size), to planning@easthempfield.org. Please also indicate in the subject line, "Comments–East Hempfield Township PRP and CBPRP."

The Board of Supervisors will also provide an opportunity for interested parties to provide comments during the regularly scheduled meeting to be held on July 19th, 2017, at 7:00 P.M.

CONTACT INFORMATION

Questions about this notice may be directed to Jon E. Beck at (717) 898-3100 x 230 or planning@easthempfield.org.

Dated: June 22, 2017
Jon E. Beck
Director of Development Services

Connie M. Hoff
(Affiant's Signature)

COPY OF NOTICE OF PUBLICATION

Sworn and subscribed to before me this
26TH DAY OF JUNE 2017

Carole A. Good
Notary Public

Commonwealth of Pennsylvania
NOTARIAL SEAL
CAROLE A. GOOD, Notary Public
Lancaster City, Lancaster County, PA
My Commission Expires Feb. 25, 2018

Appendix B

Maps: Item B1) East Hempfield Planning Area and Landuse Types; Item B3) East Hempfield Planning Areas with Outfalls and Proposed BMPs

B1 East Hempfield PRP Map
Land Cover and Planning Area

LITTLE CONESTOGA CREEK
PLANNING AREA

CHICKIES CREEK
PLANNING AREA

SWARR RUN
PLANNING AREA

LITTLE CONESTOGA CREEK
PLANNING AREA

CHICKIES CREEK

MILLERS RUN
PLANNINGA AREA

BRUBAKER RUN
PLANNING AREA

WEST BRANCH
PLANNING AREA

2

1

Legend

- Proposed BMP
- Outfall
- NHD Stream
- Urban Area
- Excluded Areas
- Planning Areas

MapShed South Central Land Use 2011

- Water
- Low Density Mixed Urban
- High-Density Mixed Urban
- Hay/Pasture
- Cropland
- Forest
- Forest
- Forest
- Wetland
- Wetland
- Disturbed
- Turf/Golf
- Low-Density Residential
- Medium Density Residential
- High Density Residential
- Medium Density Mixed Urban
- Open Land

1 in = 2,000 feet

0 1,000 2,000 4,000 6,000 8,000 Feet

N

Land Studies

B2 East Hempfield PRP Map
Planning Area

CHICKIES CREEK PLANNING AREA

SWARR RUN PLANNING AREA

LITTLE CONESTOGA CREEK PLANNING AREA

MILLERS RUN PLANNINGA AREA

WEST BRANCH PLANNING AREA

BRUBAKER RUN PLANNING AREA

LITTLE CONESTOGA CREEK PLANNING AREA

1 = 2,000 feet

Feet 0 1,000 2,000 4,000 6,000 8,000

N

Land Studies

Legend

- Proposed BMP
- EHT Outfalls
- Stream Integrated List NonAttaining 2014_01
- Stream Integrated List Attaining
- Urban Area
- EHT Excluded Areas
- Planning Areas
- Municipal Rd
- State Rd
- East Hempfield Twp

Appendix C

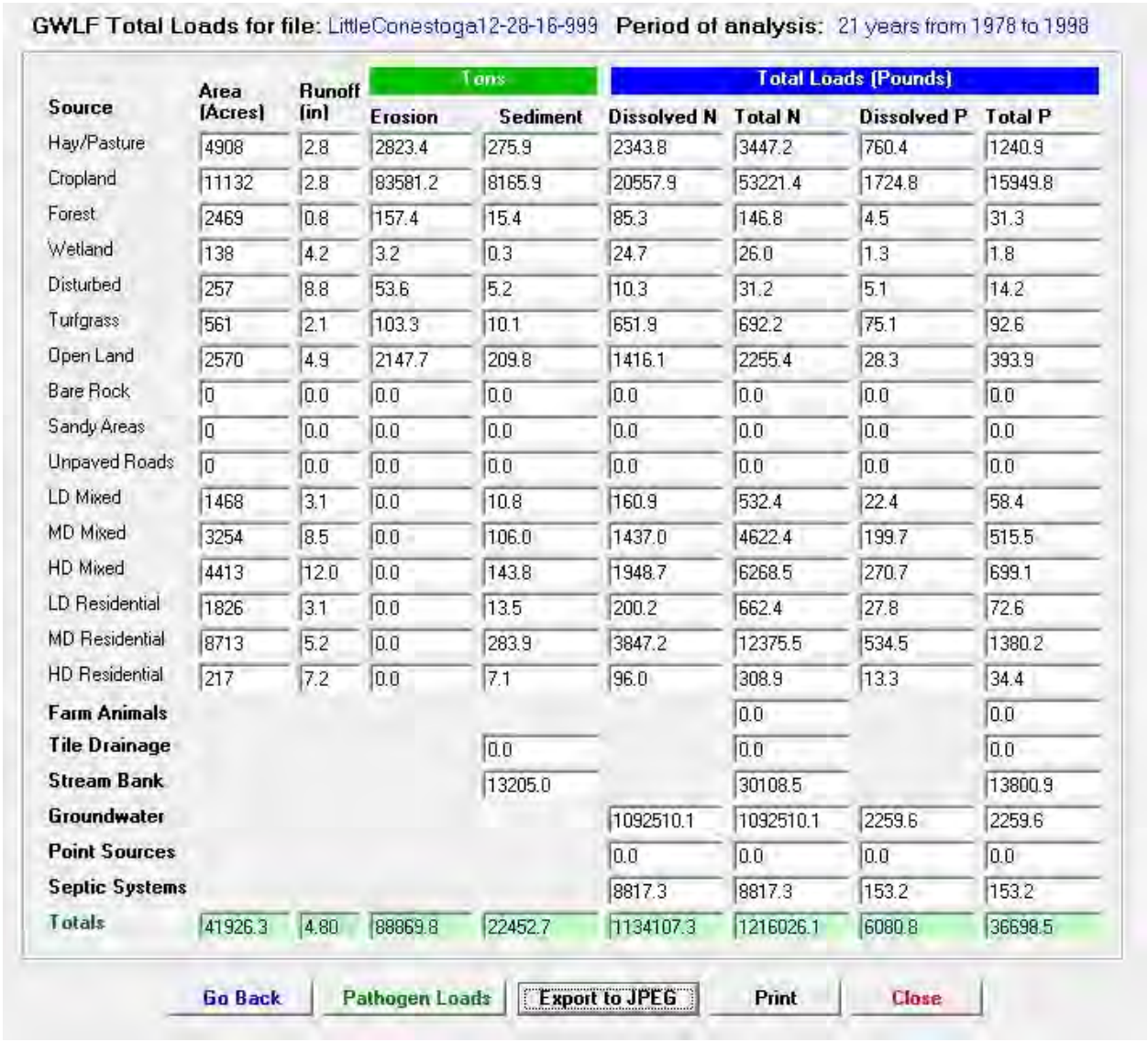
MapShed Modeling Supporting Data

Little Conestoga Baseline Watershed Input and Results

The following screenshots represent the input for the baseline watershed model. The following data was customized in this model run:

- Percent bank fraction was adjusted so soil nutrient concentration match what is included in the "Recommendation of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects (2014). N – 2.28 lb/T and P – 1.05 lb/T
- Groundwater concentrations were customized based on data acquired from the Groundwater Monitoring Network data downloaded from the PADEP Wave GIS tool accessed on December 28, 2016.
- No rural or urban BMP data, point source or animal data was included in the model run.

Little Conestoga Baseline Watershed Results



GWLF Total Loads for file: LittleConestoga12-28-16-999 **Period of analysis:** 21 years from 1978 to 1998

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dissolved N	Total N	Dissolved P	Total P
Hay/Pasture	4908	2.8	2823.4	275.9	2343.8	3447.2	760.4	1240.9
Cropland	11132	2.8	83581.2	8165.9	20557.9	53221.4	1724.8	15949.8
Forest	2469	0.8	157.4	15.4	85.3	146.8	4.5	31.3
Wetland	138	4.2	3.2	0.3	24.7	26.0	1.3	1.8
Disturbed	257	8.8	53.6	5.2	10.3	31.2	5.1	14.2
Turfgrass	561	2.1	103.3	10.1	651.9	692.2	75.1	92.6
Open Land	2570	4.9	2147.7	209.8	1416.1	2255.4	28.3	393.9
Bare Rock	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sandy Areas	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unpaved Roads	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LD Mixed	1468	3.1	0.0	10.8	160.9	532.4	22.4	58.4
MD Mixed	3254	8.5	0.0	106.0	1437.0	4622.4	199.7	515.5
HD Mixed	4413	12.0	0.0	143.8	1948.7	6268.5	270.7	699.1
LD Residential	1826	3.1	0.0	13.5	200.2	662.4	27.8	72.6
MD Residential	8713	5.2	0.0	283.9	3847.2	12375.5	534.5	1380.2
HD Residential	217	7.2	0.0	7.1	96.0	308.9	13.3	34.4
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				13205.0		30108.5		13800.9
Groundwater					1092510.1	1092510.1	2259.6	2259.6
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					8817.3	8817.3	153.2	153.2
Totals	41926.3	4.80	88869.8	22452.7	1134107.3	1216026.1	6080.8	36698.5

Go Back | Pathogen Loads | Export to JPEG | Print | Close

Little Conestoga Baseline Watershed Transport Data

Urban Land	Area (ha)	%Imp	CNI	CNP
LD Mixed	594	0.15	92	74
MD Mixed	1317	0.52	98	79
HD Mixed	1786	0.87	98	79
LD Residential	739	0.15	92	74
MD Residential	3526	0.52	92	74
HD Residential	88	0.87	92	74

Rural Land	Area (ha)	CN	K	LS	C	P
Hay/Pasture	1986	75	0.333	0.765	0.03	0.45
Cropland	4505	75	0.336	0.707	0.42	0.45
Forest	999	60	0.342	1.239	0.002	0.45
Wetland	56	80	0.335	0.406	0.01	0.1
Disturbed	104	89	0.325	0.48	0.08	0.1
Turf/Golf	227	71	0.326	0.563	0.03	0.2
Open Land	1040	82	0.332	0.836	0.04	0.45
Bare Rock	0	0	0.0	0.0	0.0	0.0
Sandy Areas	0	0	0.0	0.0	0.0	0.0
Unpaved 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	0.12	0.0	0.0
Feb	0.68	1.0	10.4	0	0.12	0.0	0.0
Mar	0.71	1.0	11.8	0	0.3	0.0	0.0
Apr	0.84	1.0	13.2	1	0.3	0.0	0.0
May	0.91	1.0	14.3	1	0.3	0.0	0.0
Jun	0.95	1.0	14.8	1	0.3	0.0	0.0
Jul	0.98	1.0	14.6	1	0.3	0.0	0.0
Aug	0.99	1.0	13.6	1	0.3	0.0	0.0
Sep	1.0	1.0	12.2	1	0.3	0.0	0.0
Oct	1.01	1.0	10.8	1	0.12	0.0	0.0
Nov	0.9	1.0	9.7	0	0.12	0.0	0.0
Dec	0.84	1.0	9.2	0	0.12	0.0	0.0

		Values 0 - 1	
Sediment A Factor	2.4057E-03	GW Recess Coeff	0.1
Sed A Adjustment	1.0	GW Seepage Coeff	0.0
Avail Water Cap (cm)	23.406	% Tile Drained (Ag)	0.0
Sed Delivery Ratio	0.098		

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Little Conestoga Baseline Watershed Nutrient Data

Dissolved Runoff Coefficients (mg/L)

Rural Runoff	Dissolved N	Dissolved P
Hay/Pasture	0.75	0.24330
Cropland	2.9	0.24330
Forest	0.19	0.01
Wetland	0.19	0.01
Disturbed	0.02	0.01
Turf/Golf	2.5	0.28786
Open Land	0.5	0.01
Bare Rock	0	0
Sandy Areas	0	0
Unpaved Rd	0	0

	N	P	Sed
Groundwater (mg/L)	9.67	0.02	
Tile Drain (mg/L)	15	0.1	50
Soil Conc (mg/Kg)	2000	871	
% Bank Frac (0-1)	0.57	0.6	

Nitrogen and Phosphorus Loads from Point Sources and Septic Systems

Point Source Loads/Discharge

Month	Kg N	Kg P	MGD
Jan	0.0	0.0	0.0
Feb	0.0	0.0	0.0
Mar	0.0	0.0	0.0
Apr	0.0	0.0	0.0
May	0.0	0.0	0.0
Jun	0.0	0.0	0.0
Jul	0.0	0.0	0.0
Aug	0.0	0.0	0.0
Sep	0.0	0.0	0.0
Oct	0.0	0.0	0.0
Nov	0.0	0.0	0.0
Dec	0.0	0.0	0.0

Septic System Populations

Normal	Pond	Short Cir	Direct
2458	0	84	0
2458	0	84	0
2458	0	84	0
2458	0	84	0
2458	0	84	0
2458	0	84	0
2458	0	84	0
2458	0	84	0
2458	0	84	0
2458	0	84	0
2458	0	84	0
2458	0	84	0

Growing season uptake (g/d): N 1.6 P 0.4

Per Capita Tank Load (g/d): N 12 P 2.5

Urban Buildup (kg/Ha/day)

	Area (Ha)	Nitrogen Acc Imp	Nitrogen Acc Perv	Nitrogen Dis Fract	Phosphorus Acc Imp	Phosphorus Acc Perv	Phosphorus Dis Fract	TSS Acc Imp	TSS Acc Perv
LD Mixed	594	0.095	0.015	0.33	0.0095	0.0021	0.4	2.8	0.8
MD Mixed	1317	0.105	0.015	0.33	0.0105	0.0021	0.4	6.2	0.8
HD Mixed	1786	0.11	0.015	0.33	0.0115	0.0021	0.4	2.8	0.8
LD Residential	739	0.095	0.015	0.28	0.0095	0.0019	0.37	2.5	1.3
MD Residential	3526	0.1	0.015	0.28	0.0115	0.0039	0.37	6.2	1.1
HD Residential	88	0.105	0.015	0.28	0.012	0.0078	0.37	5	1.5

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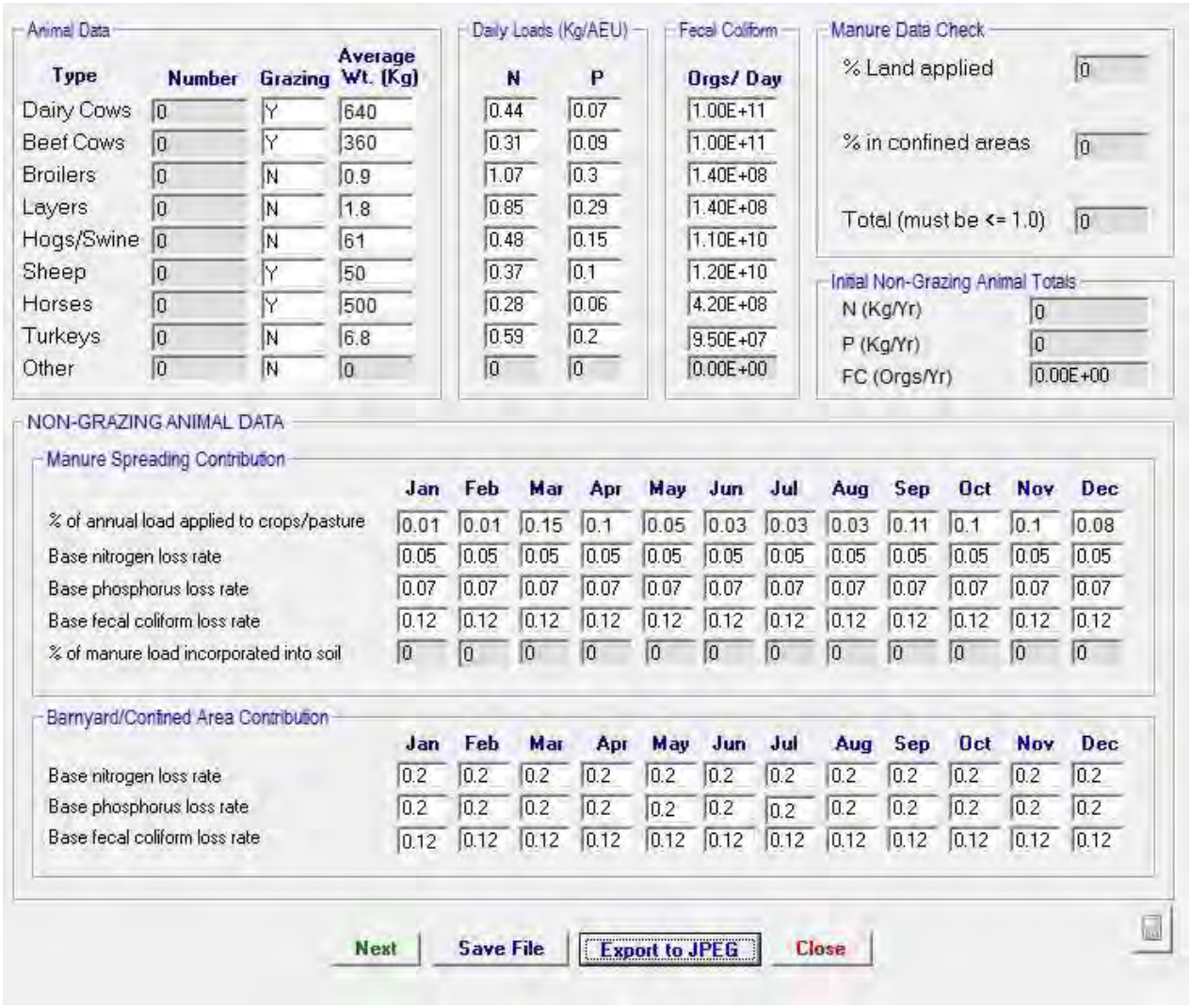
Little Conestoga Baseline Watershed Animal Data



Animal Data

Type	Number	Grazing	Average Wt. (Kg)
Dairy Cows	0	Y	640
Beef Cows	0	Y	360
Broilers	0	N	0.9
Layers	0	N	1.8
Hogs/Swine	0	N	61
Sheep	0	Y	50
Horses	0	Y	500
Turkeys	0	N	6.8
Other	0	N	0

Daily Loads (Kg/AEU)

N	P
0.44	0.07
0.31	0.09
1.07	0.3
0.85	0.29
0.48	0.15
0.37	0.1
0.28	0.06
0.59	0.2
0	0

Fecal Coliform

Orgs/ Day
1.00E+11
1.00E+11
1.40E+08
1.40E+08
1.10E+10
1.20E+10
4.20E+08
9.50E+07
0.00E+00

Manure Data Check

% Land applied	0
% in confined areas	0
Total (must be <= 1.0)	0

Initial Non-Grazing Animal Totals

N (Kg/Yr)	0
P (Kg/Yr)	0
FC (Orgs/Yr)	0.00E+00

NON-GRAZING ANIMAL DATA

Manure Spreading Contribution

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
% of annual load applied to crops/pasture	0.01	0.01	0.15	0.1	0.05	0.03	0.03	0.03	0.11	0.1	0.1	0.08
Base nitrogen loss rate	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Base phosphorus loss rate	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Base fecal coliform loss rate	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
% of manure load incorporated into soil	0	0	0	0	0	0	0	0	0	0	0	0

Barnyard/Confined Area Contribution

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Base nitrogen loss rate	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Base phosphorus loss rate	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Base fecal coliform loss rate	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12

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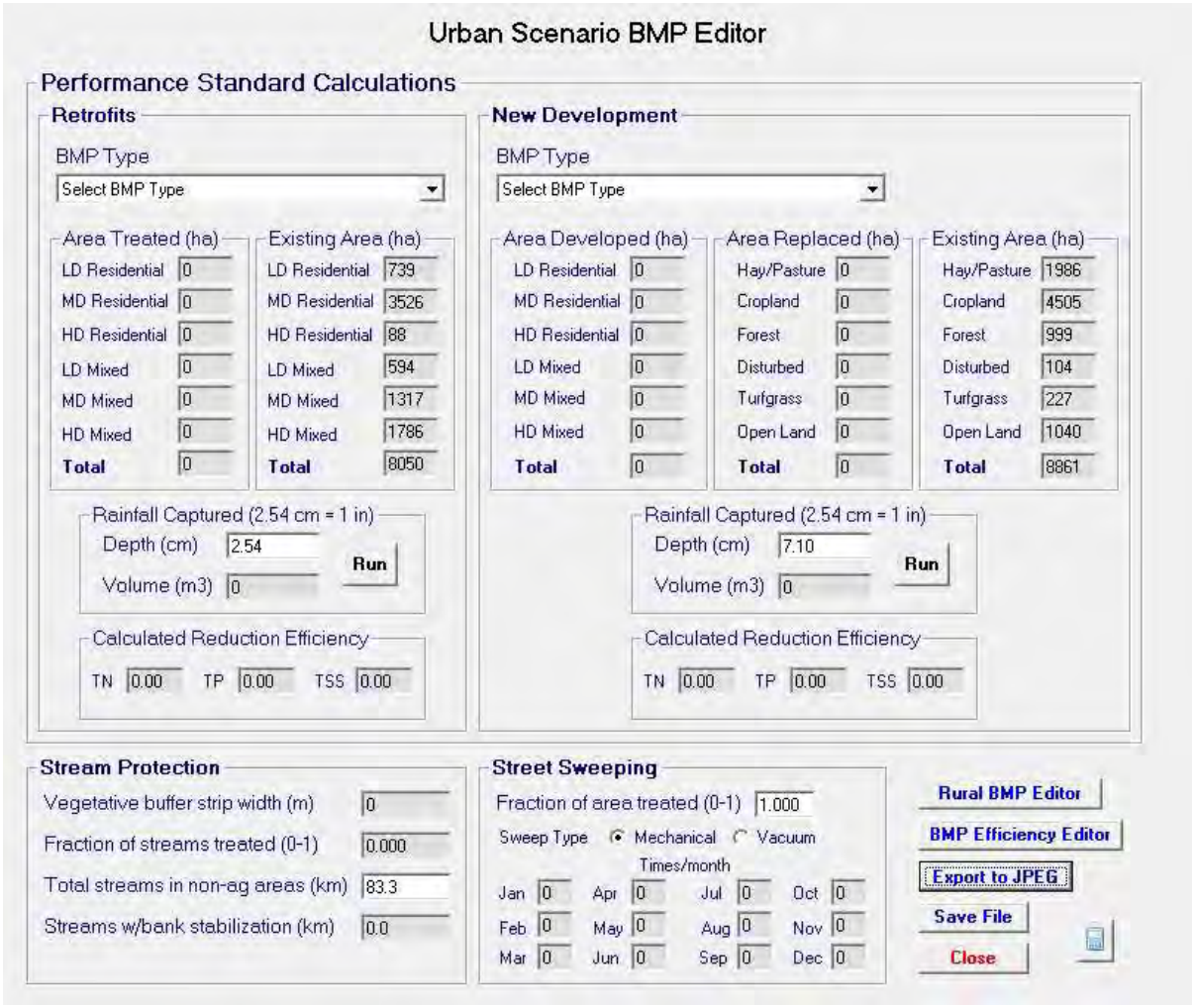
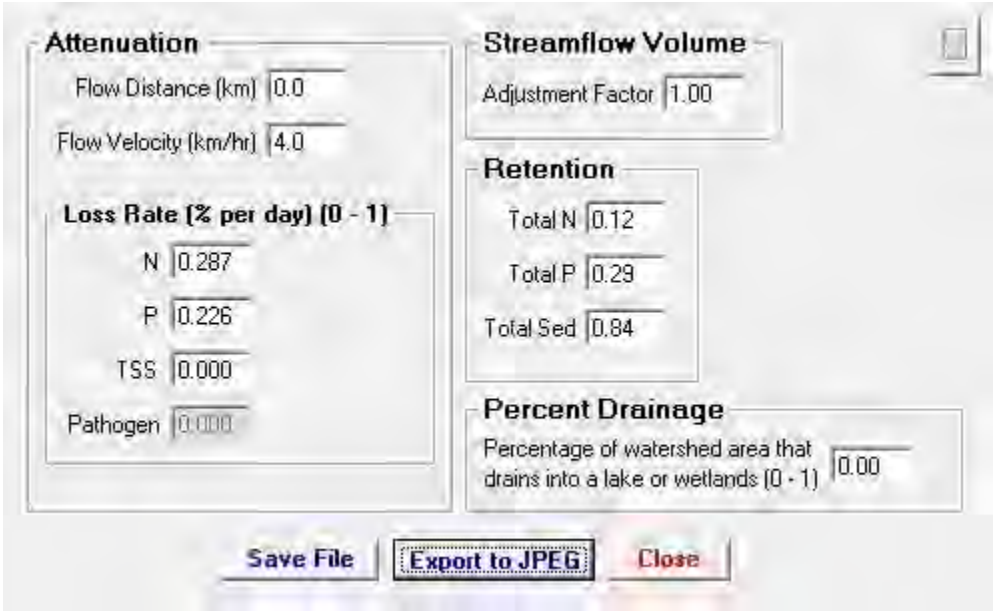
Little Conestoga Baseline Watershed Rural BMP Data

Little Conestoga Baseline Watershed Urban BMP Data



Little Conestoga Baseline Watershed Input Data



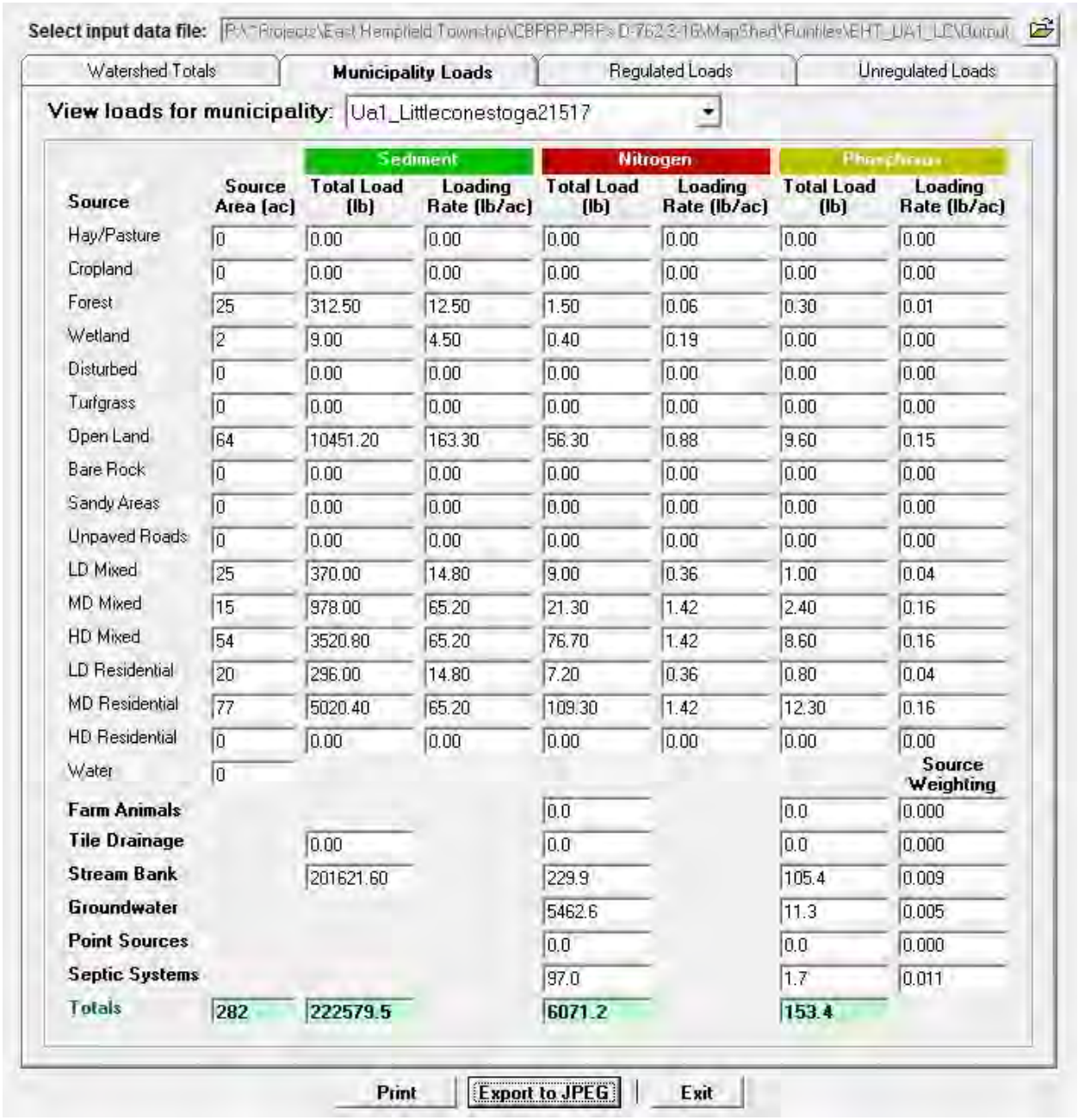
MapShed Planning Area UA Tool Results

The exact same input used for the Little Conestoga Baseline Watershed Run was used for each MS4 Planning Area model run. The only difference between each of these model runs was the Urban Area layer file and lookup table. The Urban areas digitized for each model run captured as much acreage as possible while excluding as much as the parsed ground as was reasonable possible to get the most accurate loading rates. In some cases land use acreage adjustments were still necessary to exclude parsed area and include "islands" of planning area that weren't captured in the model run. The sum of all model runs and acreage adjustments is included in Table 3 in the Existing Loads section of the PRP.

Based on the location of the Main Stem Little Conestoga watershed and Brubaker Run watershed, four and two model runs were required, respectively, The sum of the loading from each model run is included in Table 3 of the Existing Loads section of the PRP.

Screen shots of the UA Tool for each Urban Area MS4 Planning Area Run is provided below.

Little Conestoga MS4 Planning UA Main Stem Model Run 1



Select input data file: P:\~Projects\East Hempfield Township\CBPRP-PRPs D-762.3-16\MapShed\Runfiles\EHT_UA1_LC\Output

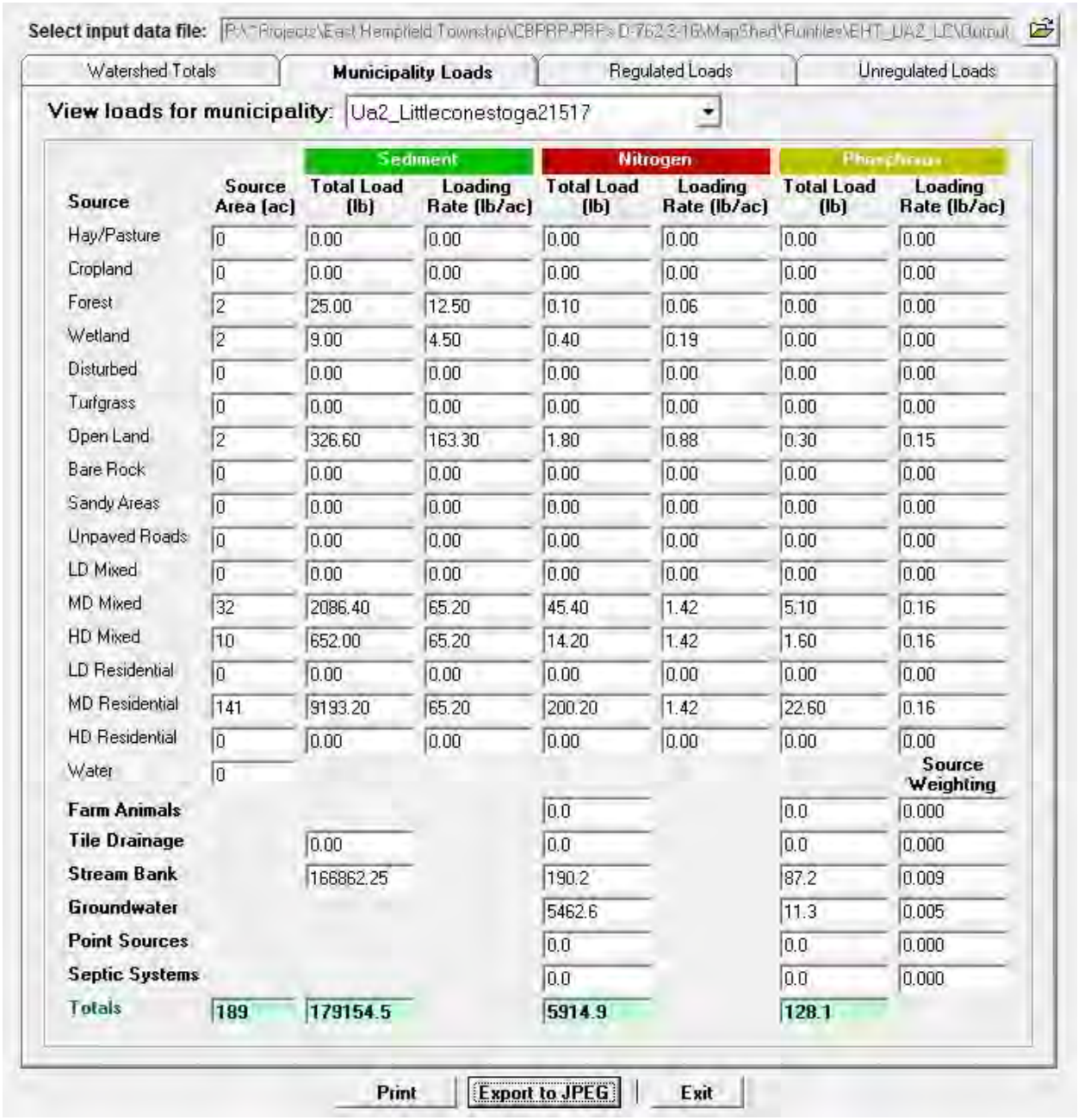
Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: Ua1_Littleconestoga21517

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	0	0.00	0.00	0.00	0.00	0.00	0.00
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	25	312.50	12.50	1.50	0.06	0.30	0.01
Wetland	2	9.00	4.50	0.40	0.19	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	64	10451.20	163.30	56.30	0.88	9.60	0.15
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	25	370.00	14.80	9.00	0.36	1.00	0.04
MD Mixed	15	978.00	65.20	21.30	1.42	2.40	0.16
HD Mixed	54	3520.80	65.20	76.70	1.42	8.60	0.16
LD Residential	20	296.00	14.80	7.20	0.36	0.80	0.04
MD Residential	77	5020.40	65.20	109.30	1.42	12.30	0.16
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						
							Source Weighting
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		201621.60		229.9		105.4	0.009
Groundwater				5462.6		11.3	0.005
Point Sources				0.0		0.0	0.000
Septic Systems				97.0		1.7	0.011
Totals	282	222579.5		6071.2		153.4	

Print | Export to JPEG | Exit

Little Conestoga MS4 Planning UA Main Stem Model Run 2



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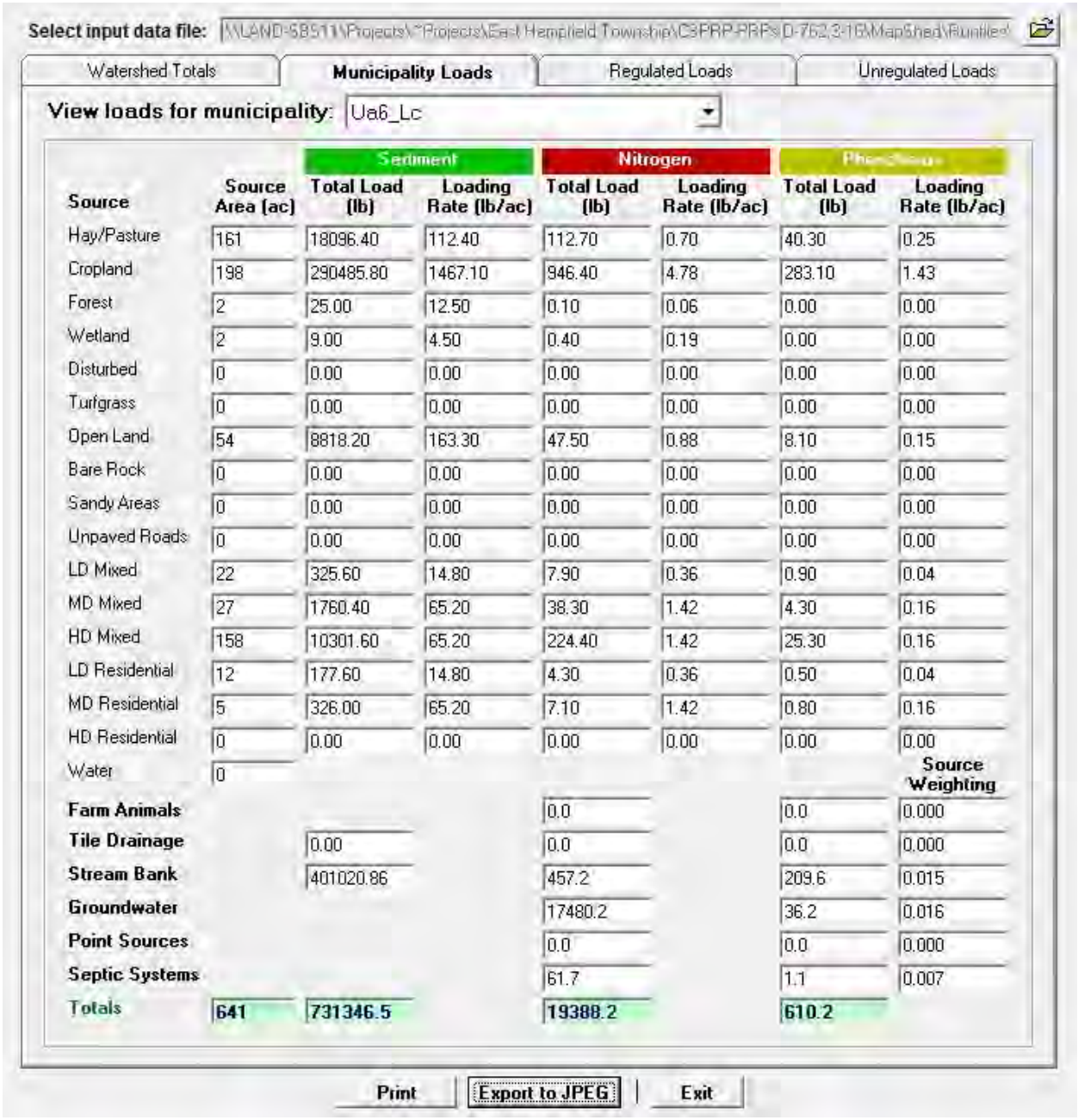
Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: Ua2_Littleconestoga21517

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	0	0.00	0.00	0.00	0.00	0.00	0.00
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	2	25.00	12.50	0.10	0.06	0.00	0.00
Wetland	2	9.00	4.50	0.40	0.19	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	2	326.60	163.30	1.80	0.88	0.30	0.15
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Mixed	32	2086.40	65.20	45.40	1.42	5.10	0.16
HD Mixed	10	652.00	65.20	14.20	1.42	1.60	0.16
LD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Residential	141	9193.20	65.20	200.20	1.42	22.60	0.16
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						
							Source Weighting
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		166862.25		190.2		87.2	0.009
Groundwater				5462.6		11.3	0.005
Point Sources				0.0		0.0	0.000
Septic Systems				0.0		0.0	0.000
Totals	**189**	**179154.5**		**5914.9**		**128.1**	

Print | Export to JPEG | Exit

Little Conestoga MS4 Planning UA Main Stem Model Run 3



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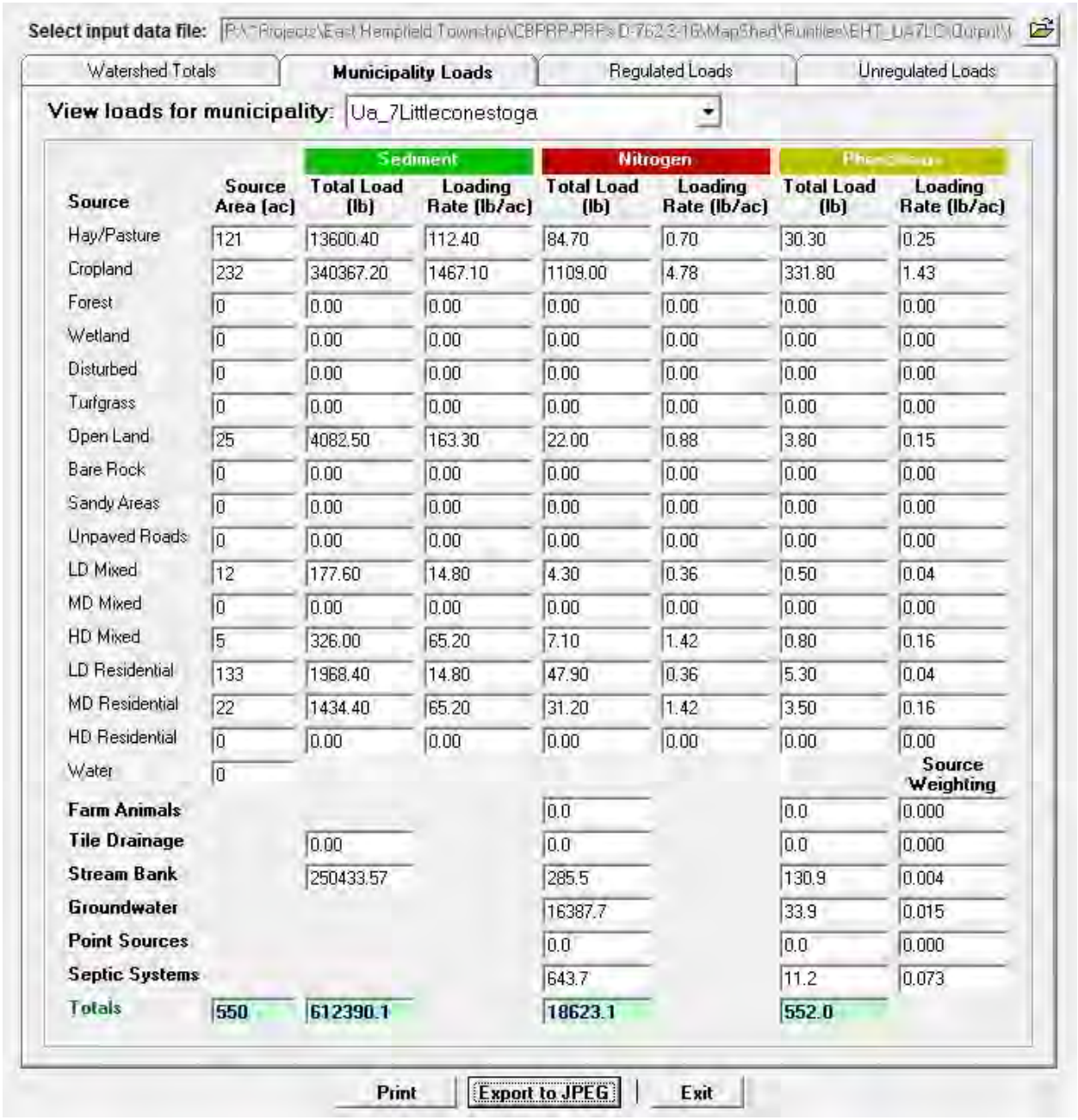
Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: Ua6_Lc

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	161	18096.40	112.40	112.70	0.70	40.30	0.25
Cropland	198	290485.80	1467.10	946.40	4.78	283.10	1.43
Forest	2	25.00	12.50	0.10	0.06	0.00	0.00
Wetland	2	9.00	4.50	0.40	0.19	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	54	8818.20	163.30	47.50	0.88	8.10	0.15
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	22	325.60	14.80	7.90	0.36	0.90	0.04
MD Mixed	27	1760.40	65.20	38.30	1.42	4.30	0.16
HD Mixed	158	10301.60	65.20	224.40	1.42	25.30	0.16
LD Residential	12	177.60	14.80	4.30	0.36	0.50	0.04
MD Residential	5	326.00	65.20	7.10	1.42	0.80	0.16
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						
							Source Weighting
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		401020.86		457.2		209.6	0.015
Groundwater				17480.2		36.2	0.016
Point Sources				0.0		0.0	0.000
Septic Systems				61.7		1.1	0.007
Totals	**641**	**731346.5**		**19388.2**		**610.2**	

Print | Export to JPEG | Exit

Little Conestoga MS4 Planning UA Main Stem Model Run 4



Select input data file: P:\~Projects\East Hempfield Township\CBPRP-PRPs D-7623-16\MapShed\Runfiles\EHT_UA7LC\Output\

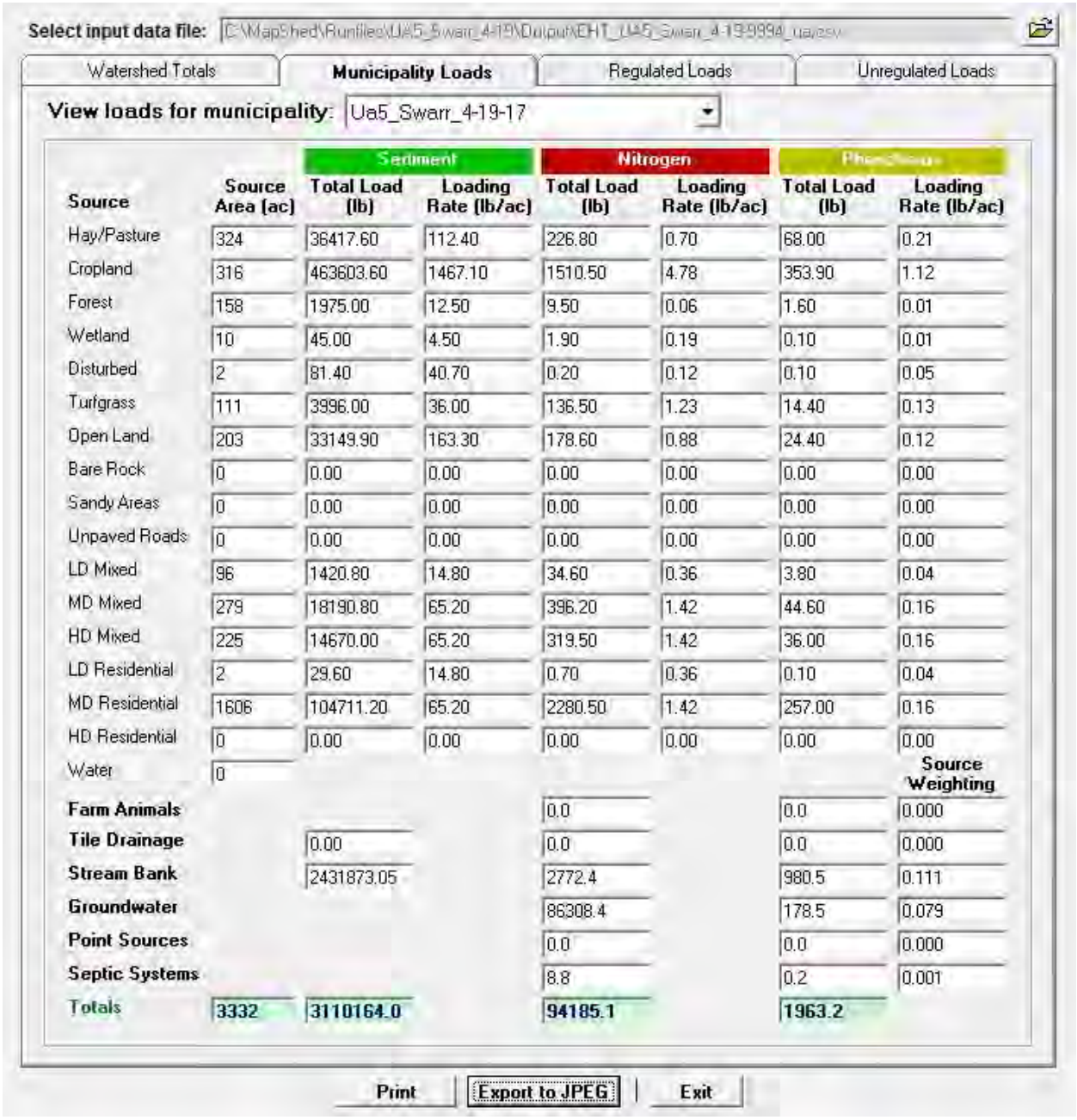
Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: Ua_7Littleconestoga

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	121	13600.40	112.40	84.70	0.70	30.30	0.25
Cropland	232	340367.20	1467.10	1109.00	4.78	331.80	1.43
Forest	0	0.00	0.00	0.00	0.00	0.00	0.00
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	25	4082.50	163.30	22.00	0.88	3.80	0.15
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	12	177.60	14.80	4.30	0.36	0.50	0.04
MD Mixed	0	0.00	0.00	0.00	0.00	0.00	0.00
HD Mixed	5	326.00	65.20	7.10	1.42	0.80	0.16
LD Residential	133	1968.40	14.80	47.90	0.36	5.30	0.04
MD Residential	22	1434.40	65.20	31.20	1.42	3.50	0.16
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						
							Source Weighting
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		250433.57		285.5		130.9	0.004
Groundwater				16387.7		33.9	0.015
Point Sources				0.0		0.0	0.000
Septic Systems				643.7		11.2	0.073
Totals	550	612390.1		18623.1		552.0	

Print | Export to JPEG | Exit

Swarr Run MS4 Planning Area UA



Select input data file: C:\MapShed\Runfiles\UA5_Swarr_4-19\Output\EHT_UA5_Swarr_4-19.9994_ua.csv

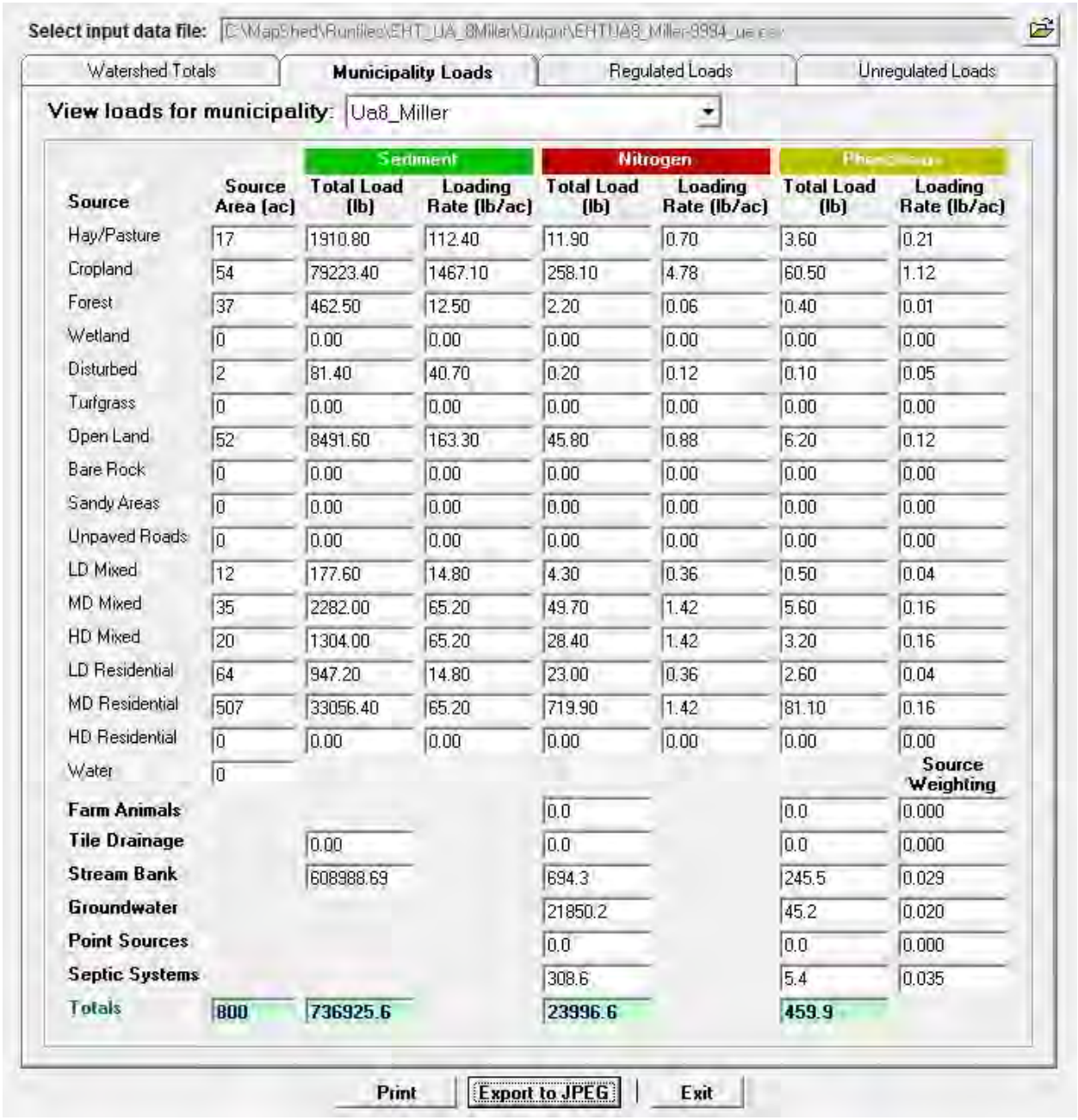
Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: Ua5_Swarr_4-19-17

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	324	36417.60	112.40	226.80	0.70	68.00	0.21
Cropland	316	463603.60	1467.10	1510.50	4.78	353.90	1.12
Forest	158	1975.00	12.50	9.50	0.06	1.60	0.01
Wetland	10	45.00	4.50	1.90	0.19	0.10	0.01
Disturbed	2	81.40	40.70	0.20	0.12	0.10	0.05
Turfgrass	111	3996.00	36.00	136.50	1.23	14.40	0.13
Open Land	203	33149.90	163.30	178.60	0.88	24.40	0.12
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	96	1420.80	14.80	34.60	0.36	3.80	0.04
MD Mixed	279	18190.80	65.20	396.20	1.42	44.60	0.16
HD Mixed	225	14670.00	65.20	319.50	1.42	36.00	0.16
LD Residential	2	29.60	14.80	0.70	0.36	0.10	0.04
MD Residential	1606	104711.20	65.20	2280.50	1.42	257.00	0.16
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						
							Source Weighting
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		2431873.05		2772.4		980.5	0.111
Groundwater				86308.4		178.5	0.079
Point Sources				0.0		0.0	0.000
Septic Systems				8.8		0.2	0.001
Totals	3332	3110164.0		94185.1		1963.2	

Print | Export to JPEG | Exit

Miller Run MS4 Planning Area



Select input data file: C:\MapShed\Runfiles\EHT_UA_8Miller\Output\EHTUA8_Miller-9994_ue.csv

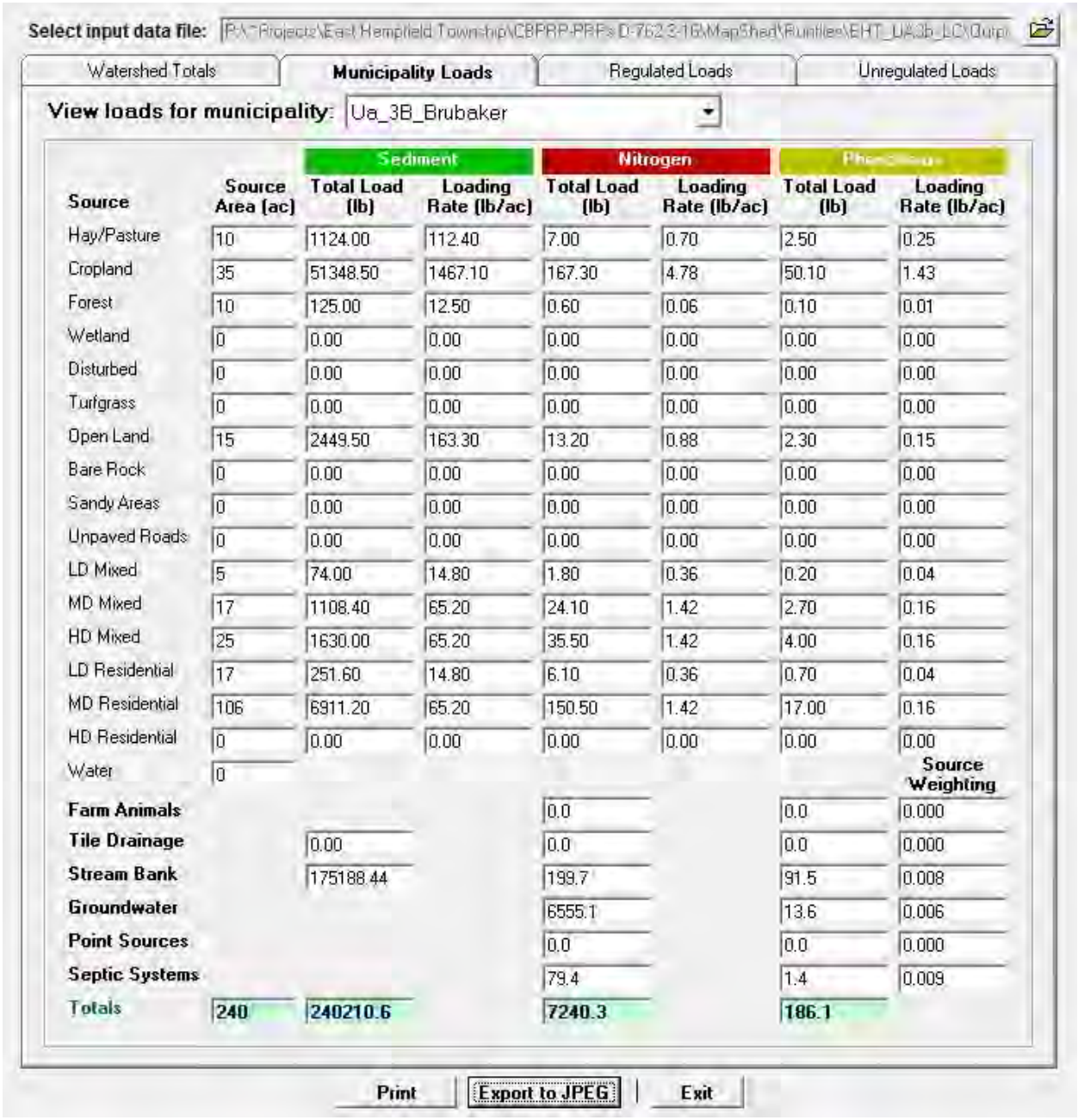
Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: Ua8_Miller

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	[illegible] Total Load (lb)	[illegible] Loading Rate (lb/ac)
Hay/Pasture	17	1910.80	112.40	11.90	0.70	3.60	0.21
Cropland	54	79223.40	1467.10	258.10	4.78	60.50	1.12
Forest	37	462.50	12.50	2.20	0.06	0.40	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	2	81.40	40.70	0.20	0.12	0.10	0.05
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	52	8491.60	163.30	45.80	0.88	6.20	0.12
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	12	177.60	14.80	4.30	0.36	0.50	0.04
MD Mixed	35	2282.00	65.20	49.70	1.42	5.60	0.16
HD Mixed	20	1304.00	65.20	28.40	1.42	3.20	0.16
LD Residential	64	947.20	14.80	23.00	0.36	2.60	0.04
MD Residential	507	33056.40	65.20	719.90	1.42	81.10	0.16
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						
							Source Weighting
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		608988.69		694.3		245.5	0.029
Groundwater				21850.2		45.2	0.020
Point Sources				0.0		0.0	0.000
Septic Systems				308.6		5.4	0.035
Totals	800	736925.6		23996.6		459.9	

Print | Export to JPEG | Exit

Brubaker Run MS4 Planning Area UA Model Run 1



Select input data file: P:\~Projects\East Hempfield Township\CBPRP-PRPs D-762.2-16\MapShed\Runfiles\EHT_UA3b_LC\Outp

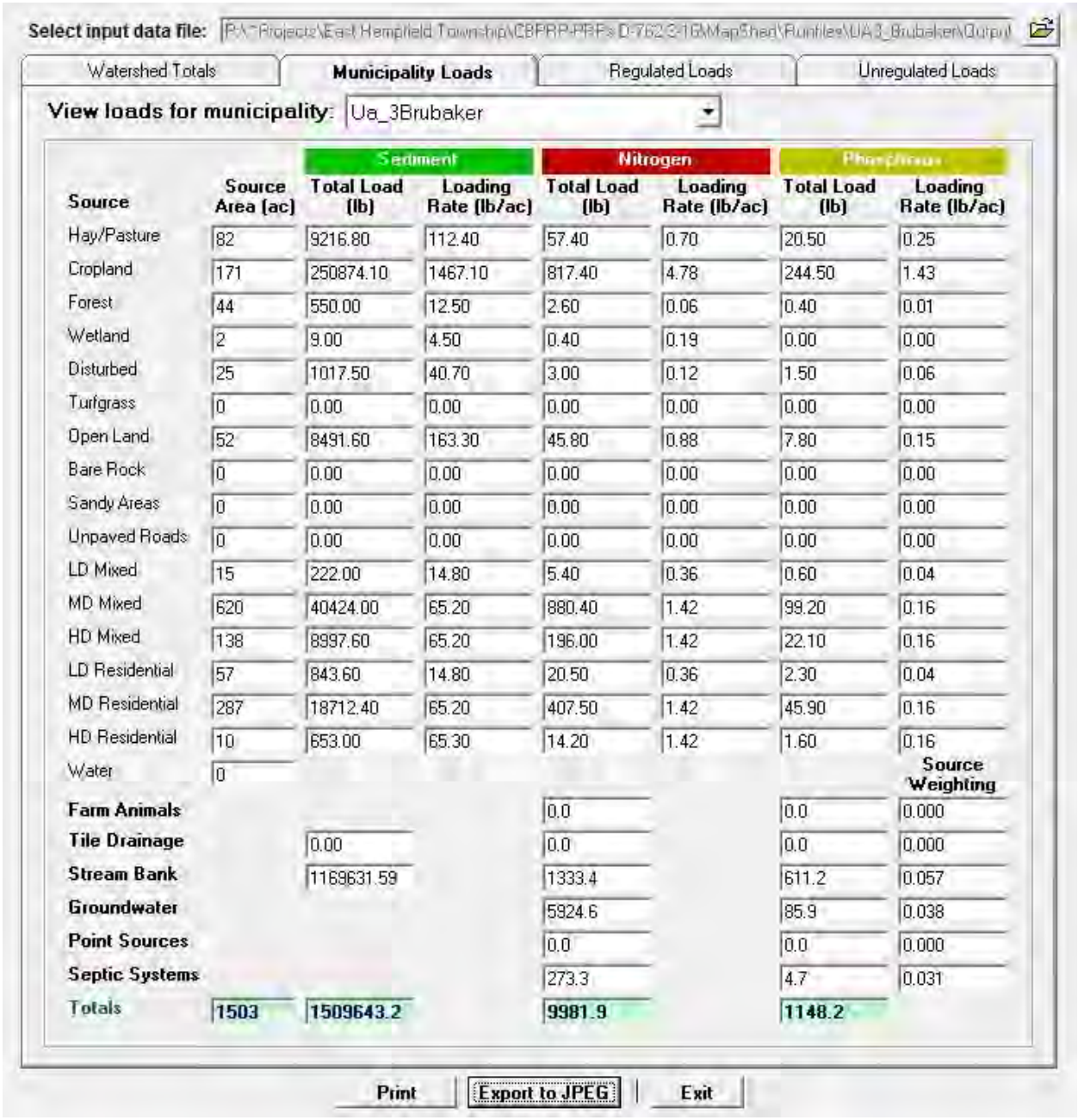
Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: Ua_3B_Brubaker

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	10	1124.00	112.40	7.00	0.70	2.50	0.25
Cropland	35	51348.50	1467.10	167.30	4.78	50.10	1.43
Forest	10	125.00	12.50	0.60	0.06	0.10	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	15	2449.50	163.30	13.20	0.88	2.30	0.15
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	5	74.00	14.80	1.80	0.36	0.20	0.04
MD Mixed	17	1108.40	65.20	24.10	1.42	2.70	0.16
HD Mixed	25	1630.00	65.20	35.50	1.42	4.00	0.16
LD Residential	17	251.60	14.80	6.10	0.36	0.70	0.04
MD Residential	106	6911.20	65.20	150.50	1.42	17.00	0.16
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						
							Source Weighting
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		175188.44		199.7		91.5	0.008
Groundwater				6555.1		13.6	0.006
Point Sources				0.0		0.0	0.000
Septic Systems				79.4		1.4	0.009
Totals	**240**	**240210.6**		**7240.3**		**186.1**	

Print | Export to JPEG | Exit

Brubaker Run MS4 Planning Area UA Model Run 2



Select input data file: P:\~Projects\East Hempfield Township\CBPRP-PRPs D-762.2-16\MapShed\Runfiles\UA3_Brubaker\Output\

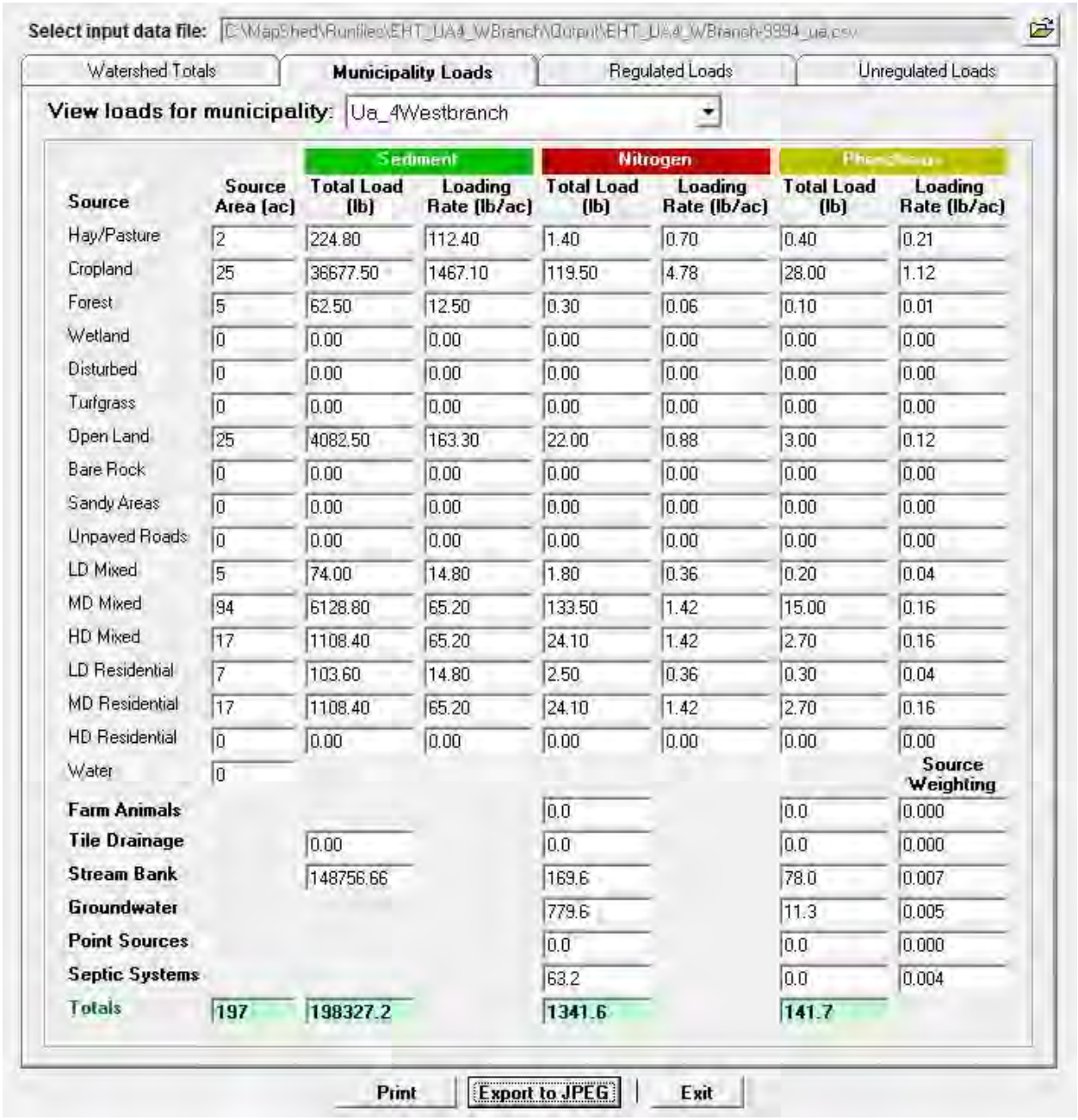
Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: Ua_3Brubaker

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	82	9216.80	112.40	57.40	0.70	20.50	0.25
Cropland	171	250874.10	1467.10	817.40	4.78	244.50	1.43
Forest	44	550.00	12.50	2.60	0.06	0.40	0.01
Wetland	2	9.00	4.50	0.40	0.19	0.00	0.00
Disturbed	25	1017.50	40.70	3.00	0.12	1.50	0.06
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	52	8491.60	163.30	45.80	0.88	7.80	0.15
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	15	222.00	14.80	5.40	0.36	0.60	0.04
MD Mixed	620	40424.00	65.20	880.40	1.42	99.20	0.16
HD Mixed	138	8997.60	65.20	196.00	1.42	22.10	0.16
LD Residential	57	843.60	14.80	20.50	0.36	2.30	0.04
MD Residential	287	18712.40	65.20	407.50	1.42	45.90	0.16
HD Residential	10	653.00	65.30	14.20	1.42	1.60	0.16
Water	0						
							Source Weighting
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		1169631.59		1333.4		611.2	0.057
Groundwater				5924.6		85.9	0.038
Point Sources				0.0		0.0	0.000
Septic Systems				273.3		4.7	0.031
Totals	**1503**	**1509643.2**		**9981.9**		**1148.2**	

Print | Export to JPEG | Exit

West Branch MS4 Planning Area UA



Select input data file: C:\MapShed\Runfiles\EHT_UA4_WBranch\Output\EHT_UA4_WBranch9994_ua.csv

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

View loads for municipality: Ua_4Westbranch

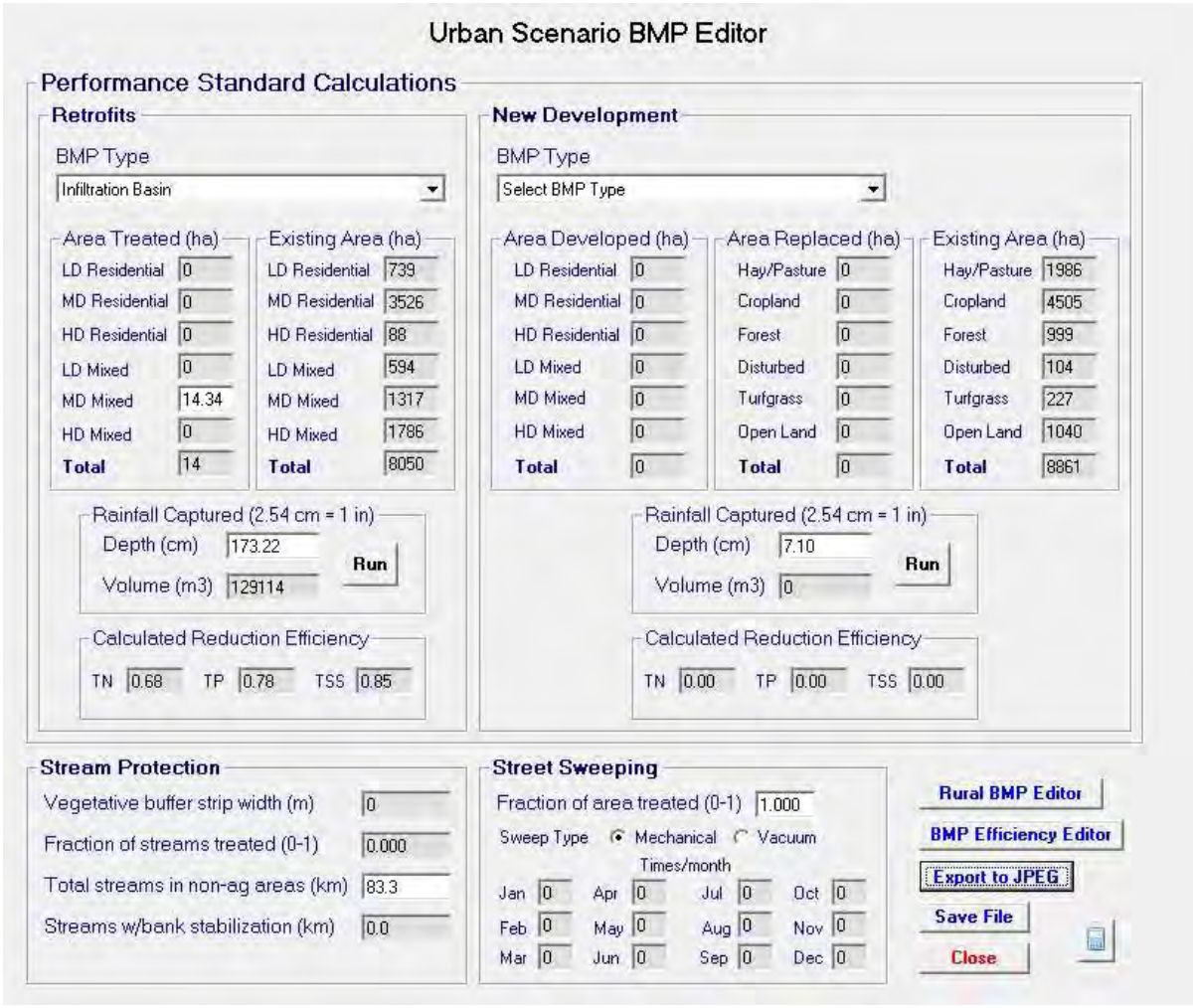
		Sediment		Nitrogen		Phosphorus	
Source	**Source Area (ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**
Hay/Pasture	2	224.80	112.40	1.40	0.70	0.40	0.21
Cropland	25	36677.50	1467.10	119.50	4.78	28.00	1.12
Forest	5	62.50	12.50	0.30	0.06	0.10	0.01
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	25	4082.50	163.30	22.00	0.88	3.00	0.12
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	5	74.00	14.80	1.80	0.36	0.20	0.04
MD Mixed	94	6128.80	65.20	133.50	1.42	15.00	0.16
HD Mixed	17	1108.40	65.20	24.10	1.42	2.70	0.16
LD Residential	7	103.60	14.80	2.50	0.36	0.30	0.04
MD Residential	17	1108.40	65.20	24.10	1.42	2.70	0.16
HD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
Water	0						
							Source Weighting
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		148756.66		169.6		78.0	0.007
Groundwater				779.6		11.3	0.005
Point Sources				0.0		0.0	0.000
Septic Systems				63.2		0.0	0.004
Totals	**197**	**198327.2**		**1341.6**		**141.7**	

Print | Export to JPEG | Exit

Existing Stormwater BMP Model Runs

The following screen shots represent the entries into the Urban BMP Editor in the MapShed model as well as the MapShed model run results. Aside from the inputs into the Urban BMP editor, all inputs matched the Little Conestoga Baseline Watershed Run.

Little Conestoga Watershed Existing Runoff Reduction BMPs Input



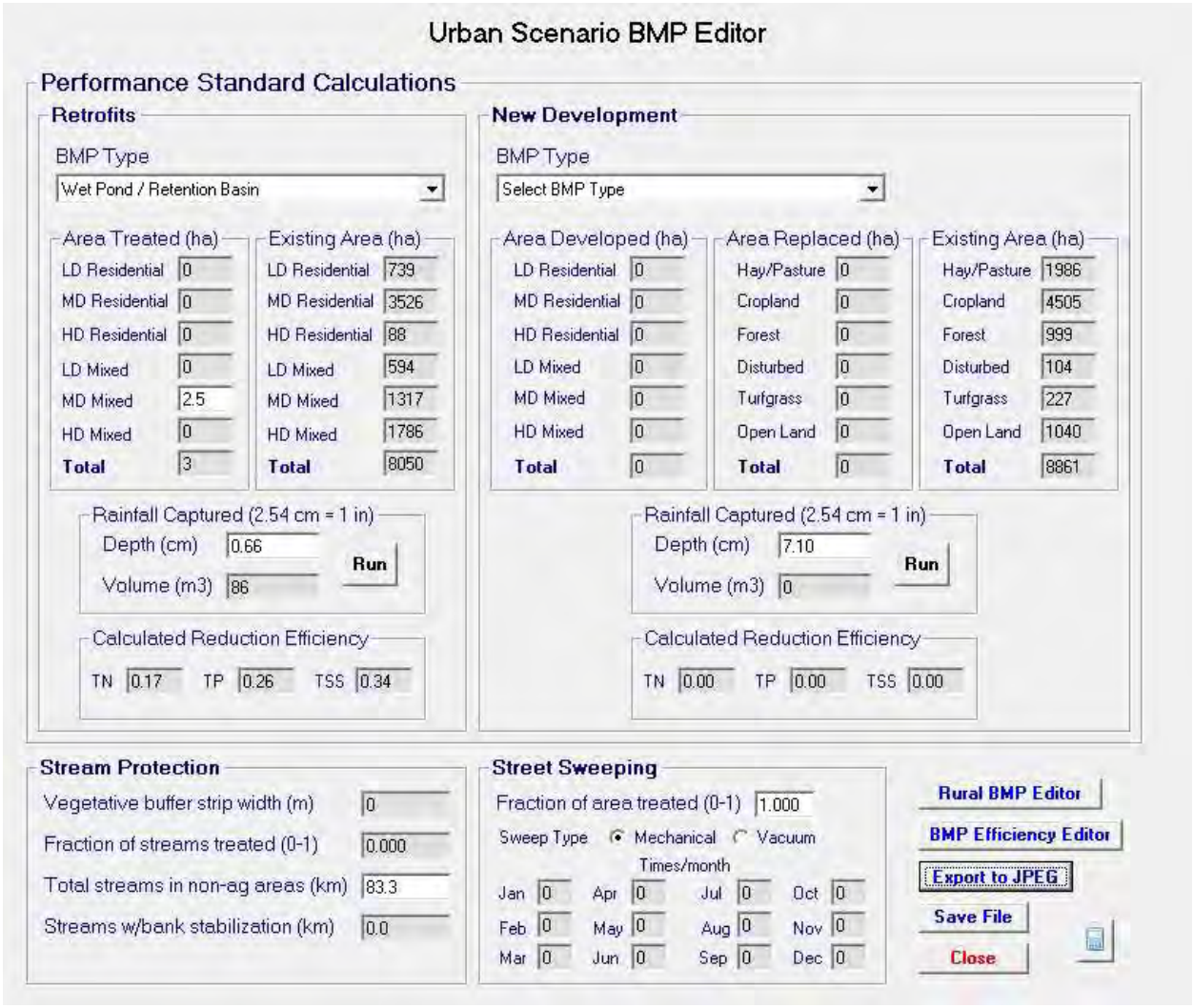
Little Conestoga Watershed Existing Runoff Reduction BMPs Results

GWLF Total Loads for file: EHT_LCexBMPrr-9994 **Period of analysis:** 21 years from 1978 to 1998

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dissolved N	Total N	Dissolved P	Total P
Hay/Pasture	4908	2.8	2823.4	275.9	2343.8	3447.2	760.4	1240.9
Cropland	11132	2.8	83581.2	8165.9	20557.9	53221.4	1724.8	15949.8
Forest	2469	0.8	157.4	15.4	85.3	146.8	4.5	31.3
Wetland	138	4.2	3.2	0.3	24.7	26.0	1.3	1.8
Disturbed	257	8.8	53.6	5.2	10.3	31.2	5.1	14.2
Turfgrass	561	2.1	103.3	10.1	651.9	692.2	75.1	92.6
Open Land	2570	4.9	2147.7	209.8	1416.1	2255.4	28.3	393.9
Bare Rock	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sandy Areas	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unpaved Roads	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LD Mixed	1468	3.1	0.0	10.8	160.7	531.8	22.4	58.3
MD Mixed	3254	8.5	0.0	105.9	1435.3	4617.0	199.4	514.8
HD Mixed	4413	12.0	0.0	143.6	1946.4	6261.2	270.4	698.2
LD Residential	1826	3.1	0.0	13.5	200.0	661.6	27.8	72.5
MD Residential	8713	5.2	0.0	283.5	3842.7	12361.1	533.8	1378.4
HD Residential	217	7.2	0.0	7.1	95.9	308.5	13.3	34.4
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				13192.5		30079.8		13789.9
Groundwater					1092510.1	1092510.1	2259.6	2259.6
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					8817.3	8817.3	153.2	153.2
Totals	41926.3	4.80	88869.8	22439.4	1134098.3	1215968.6	6079.4	36683.7

Go Back | Pathogen Loads | Export to JPEG | Print | Close

Little Conestoga Watershed Existing Stormwater Treatment BMPs Input



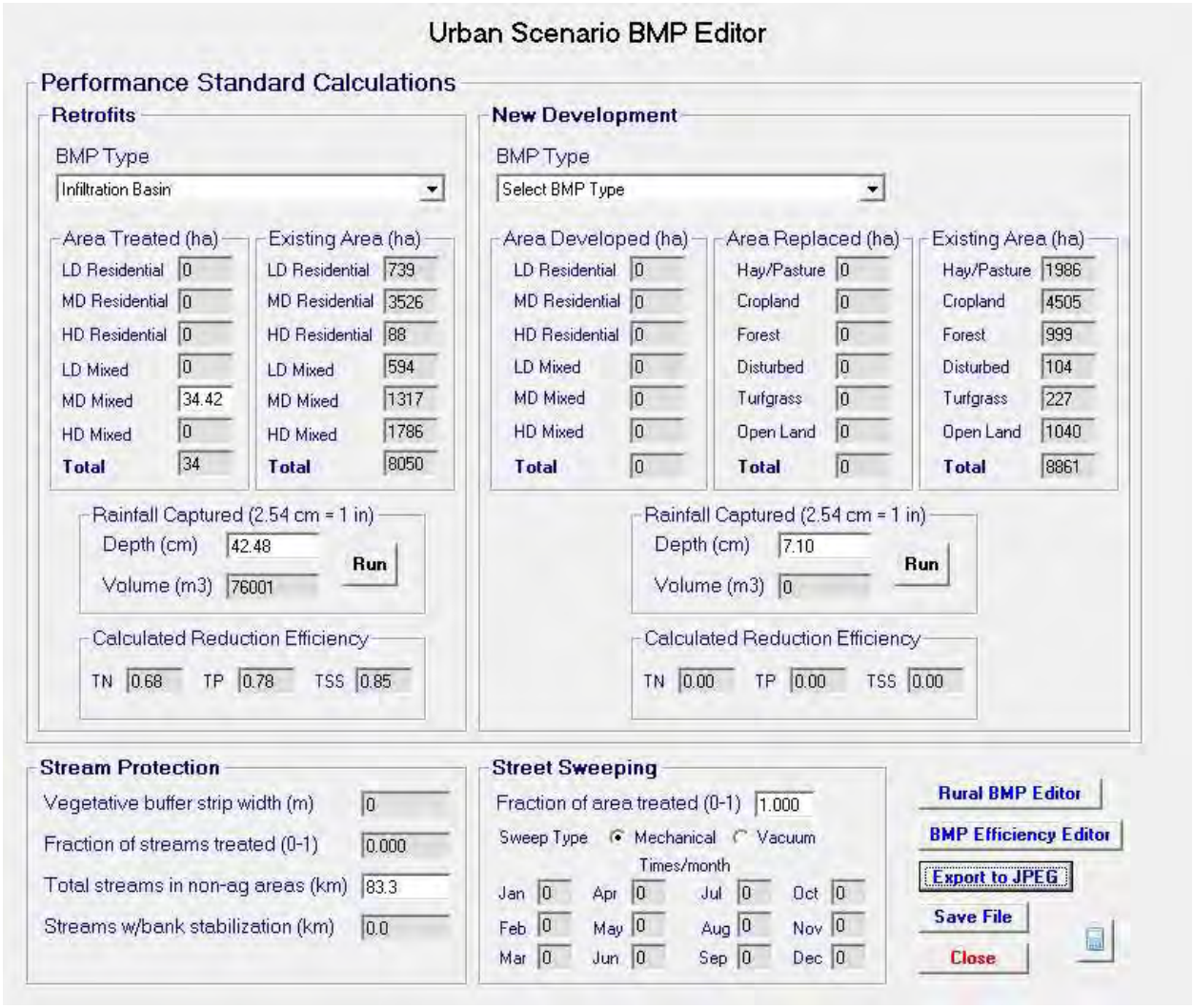
Little Conestoga Watershed Existing Stormwater Treatment BMPs Results

GWLF Total Loads for file: EHT_LCexBMPst-9994 **Period of analysis:** 21 years from 1978 to 1998

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dissolved N	Total N	Dissolved P	Total P
Hay/Pasture	4908	2.8	2823.4	275.9	2343.8	3447.2	760.4	1240.9
Cropland	11132	2.8	83581.2	8165.9	20557.9	53221.4	1724.8	15949.8
Forest	2469	0.8	157.4	15.4	85.3	146.8	4.5	31.3
Wetland	138	4.2	3.2	0.3	24.7	26.0	1.3	1.8
Disturbed	257	8.8	53.6	5.2	10.3	31.2	5.1	14.2
Turfgrass	561	2.1	103.3	10.1	651.9	692.2	75.1	92.6
Open Land	2570	4.9	2147.7	209.8	1416.1	2255.4	28.3	393.9
Bare Rock	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sandy Areas	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unpaved Roads	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LD Mixed	1468	3.1	0.0	10.8	160.9	532.4	22.4	58.4
MD Mixed	3254	8.5	0.0	106.0	1436.9	4622.2	199.6	515.5
HD Mixed	4413	12.0	0.0	143.8	1948.6	6268.2	270.7	699.0
LD Residential	1826	3.1	0.0	13.5	200.2	662.3	27.8	72.6
MD Residential	8713	5.2	0.0	283.8	3847.0	12374.9	534.5	1380.1
HD Residential	217	7.2	0.0	7.1	96.0	308.8	13.3	34.4
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				13203.4		30104.1		13800.9
Groundwater					1092510.1	1092510.1	2259.6	2259.6
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					8817.3	8817.3	153.2	153.2
Totals	41926.3	4.80	88869.8	22451.0	1134106.9	1216020.4	6080.7	36698.3

Go Back | Pathogen Loads | Export to JPEG | Print | Close

Swarr Run Watershed Existing Runoff Reduction BMPs Input



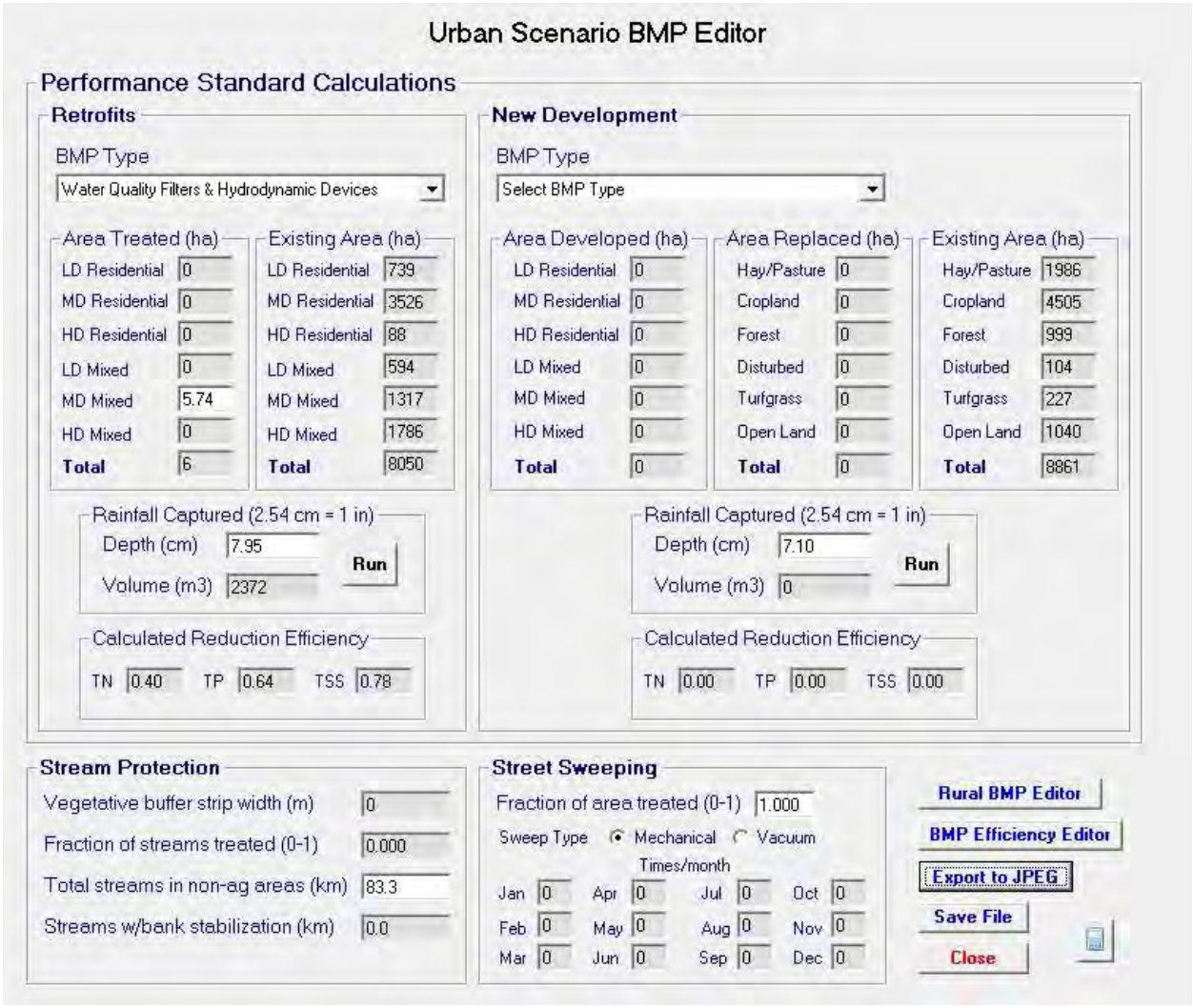
Swarr Run Watershed Existing Runoff Reduction BMPs Results

GWLF Total Loads for file: EHT_SRexBMPrr-9994 **Period of analysis:** 21 years from 1978 to 1998

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dissolved N	Total N	Dissolved P	Total P
Hay/Pasture	4908	2.8	2823.4	275.9	2343.8	3447.2	760.4	1240.9
Cropland	11132	2.8	83581.2	8165.9	20557.9	53221.4	1724.8	15949.8
Forest	2469	0.8	157.4	15.4	85.3	146.8	4.5	31.3
Wetland	138	4.2	3.2	0.3	24.7	26.0	1.3	1.8
Disturbed	257	8.8	53.6	5.2	10.3	31.2	5.1	14.2
Turfgrass	561	2.1	103.3	10.1	651.9	692.2	75.1	92.6
Open Land	2570	4.9	2147.7	209.8	1416.1	2255.4	28.3	393.9
Bare Rock	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sandy Areas	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unpaved Roads	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LD Mixed	1468	3.1	0.0	10.8	160.5	530.9	22.3	58.2
MD Mixed	3254	8.5	0.0	105.7	1432.9	4609.5	199.0	513.9
HD Mixed	4413	12.0	0.0	143.3	1943.2	6250.9	269.9	696.9
LD Residential	1826	3.1	0.0	13.4	199.7	660.5	27.8	72.4
MD Residential	8713	5.2	0.0	282.9	3836.4	12340.9	532.8	1375.8
HD Residential	217	7.2	0.0	7.1	95.7	308.0	13.3	34.3
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				13175.0		30040.2		13770.1
Groundwater					1092510.1	1092510.1	2259.6	2259.6
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					8817.3	8817.3	153.2	153.2
Totals	41926.3	4.80	88869.8	22420.7	1134085.8	1215888.4	6077.4	36658.7

Go Back | Pathogen Loads | Export to JPEG | Print | Close

Swarr Run Watershed Existing Stormwater Treatment BMPs Input



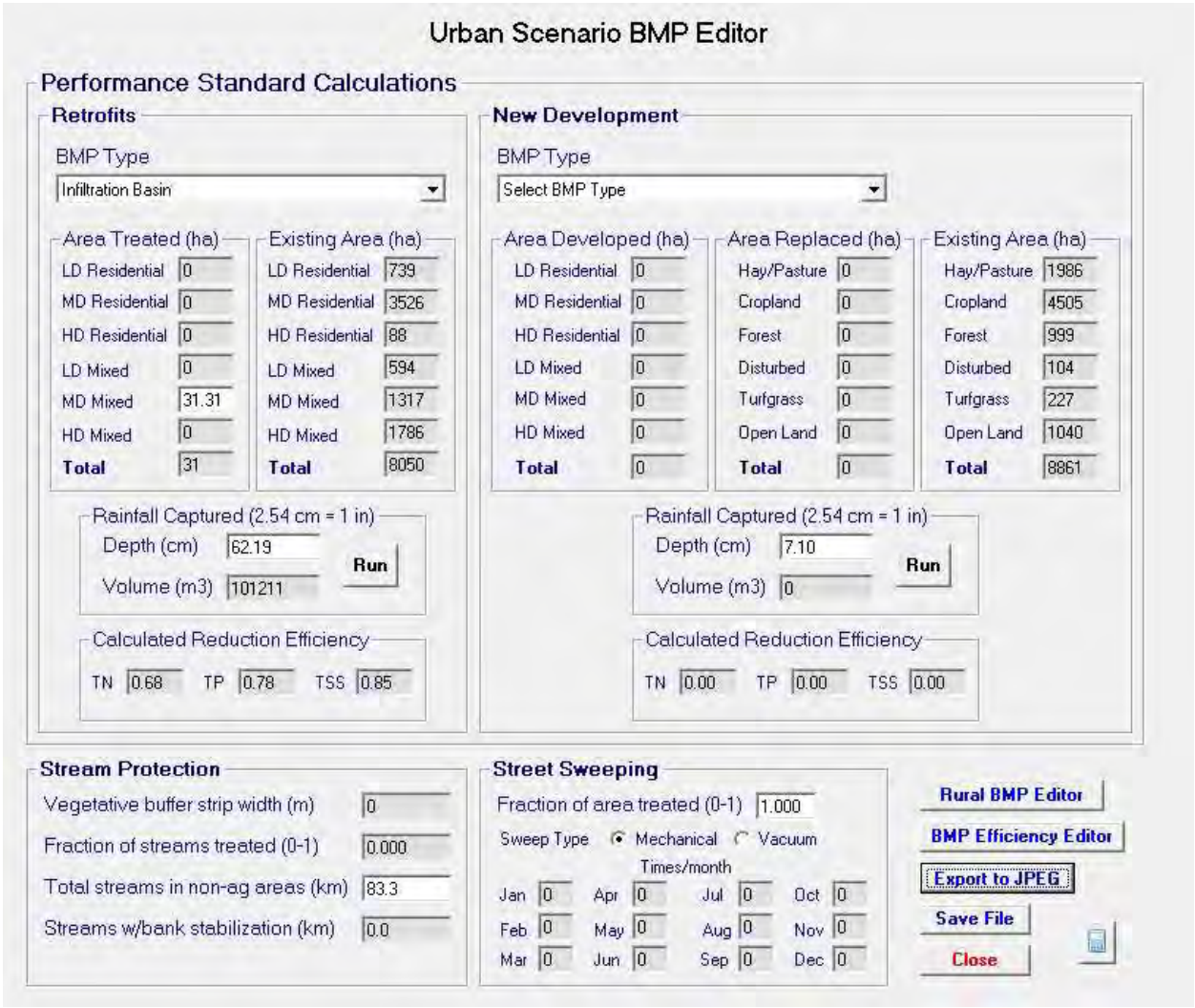
Swarr Run Watershed Existing Stormwater Treatment BMPs Results

GWLF Total Loads for file: EHT_SRexBMPst-9994 **Period of analysis:** 21 years from 1978 to 1998

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dissolved N	Total N	Dissolved P	Total P
Hay/Pasture	4908	2.8	2823.4	275.9	2343.8	3447.2	760.4	1240.9
Cropland	11132	2.8	83581.2	8165.9	20557.9	53221.4	1724.8	15949.8
Forest	2469	0.8	157.4	15.4	85.3	146.8	4.5	31.3
Wetland	138	4.2	3.2	0.3	24.7	26.0	1.3	1.8
Disturbed	257	8.8	53.6	5.2	10.3	31.2	5.1	14.2
Turfgrass	561	2.1	103.3	10.1	651.9	692.2	75.1	92.6
Open Land	2570	4.9	2147.7	209.8	1416.1	2255.4	28.3	393.9
Bare Rock	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sandy Areas	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unpaved Roads	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LD Mixed	1468	3.1	0.0	10.8	160.9	532.2	22.4	58.3
MD Mixed	3254	8.5	0.0	106.0	1436.6	4621.1	199.6	515.3
HD Mixed	4413	12.0	0.0	143.7	1948.2	6266.8	270.6	698.8
LD Residential	1826	3.1	0.0	13.5	200.2	662.2	27.8	72.6
MD Residential	8713	5.2	0.0	283.7	3846.1	12372.1	534.3	1379.6
HD Residential	217	7.2	0.0	7.1	96.0	308.8	13.3	34.4
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				13200.0		30095.3		13796.5
Groundwater					1092510.1	1092510.1	2259.6	2259.6
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					8817.3	8817.3	153.2	153.2
Totals	41926.3	4.80	88869.8	22447.4	1134105.2	1216006.1	6080.3	36692.9

Go Back | Pathogen Loads | Export to JPEG | Print | Close

Brubaker Run Watershed Existing Runoff Reduction BMPs Input



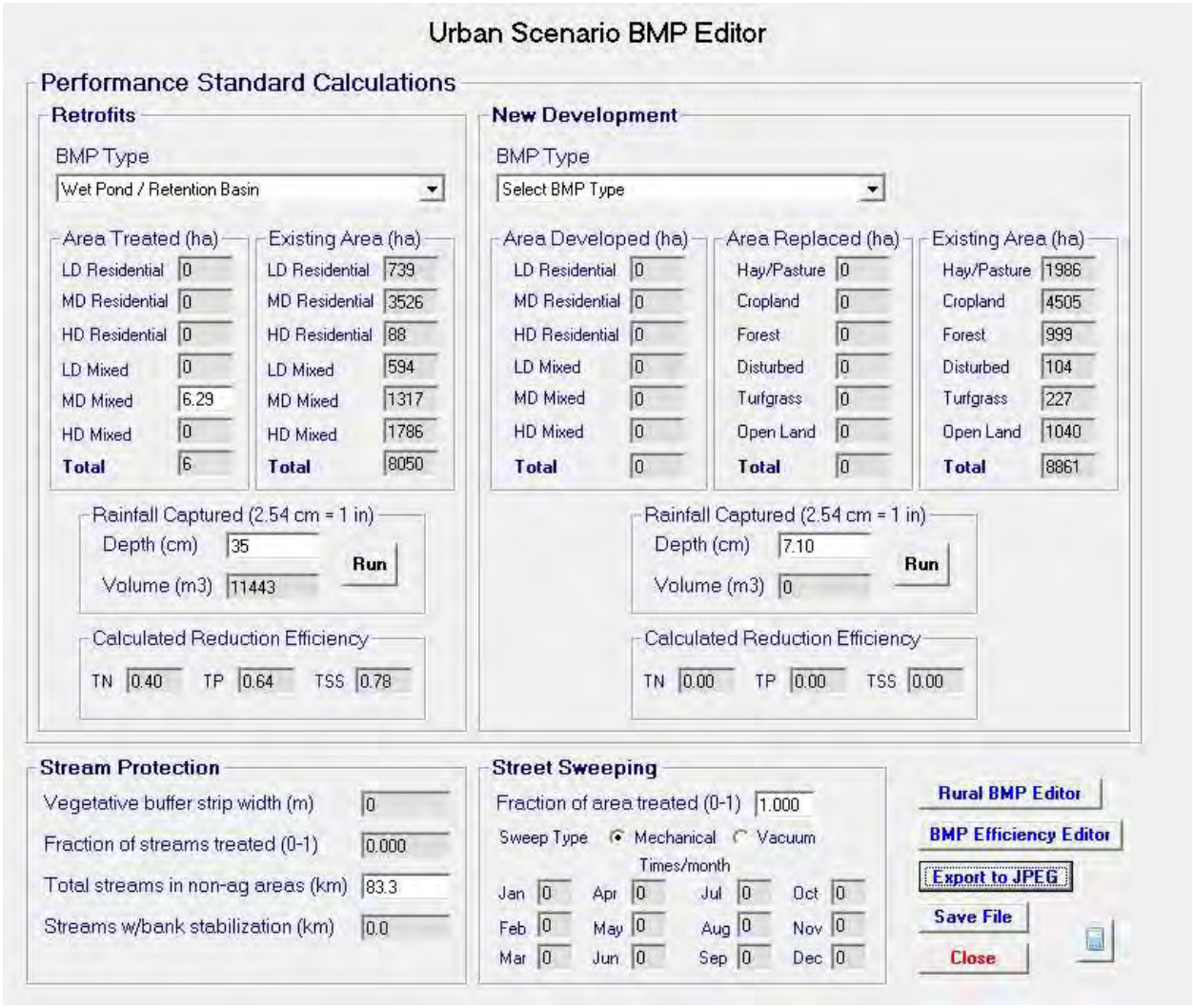
Brubaker Run Watershed Runoff Reduction BMPs Results

GWLF Total Loads for file: EHT_BRexBMPrr-9994 **Period of analysis:** 21 years from 1978 to 1998

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dissolved N	Total N	Dissolved P	Total P
Hay/Pasture	4908	2.8	2823.4	275.9	2343.8	3447.2	760.4	1240.9
Cropland	11132	2.8	83581.2	8165.9	20557.9	53221.4	1724.8	15949.8
Forest	2469	0.8	157.4	15.4	85.3	146.8	4.5	31.3
Wetland	138	4.2	3.2	0.3	24.7	26.0	1.3	1.8
Disturbed	257	8.8	53.6	5.2	10.3	31.2	5.1	14.2
Turfgrass	561	2.1	103.3	10.1	651.9	692.2	75.1	92.6
Open Land	2570	4.9	2147.7	209.8	1416.1	2255.4	28.3	393.9
Bare Rock	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sandy Areas	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unpaved Roads	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LD Mixed	1468	3.1	0.0	10.8	160.5	531.0	22.3	58.2
MD Mixed	3254	8.5	0.0	105.7	1433.3	4610.6	199.1	514.0
HD Mixed	4413	12.0	0.0	143.3	1943.7	6252.5	270.0	697.1
LD Residential	1826	3.1	0.0	13.4	199.7	660.7	27.8	72.4
MD Residential	8713	5.2	0.0	283.0	3837.4	12344.0	533.0	1376.2
HD Residential	217	7.2	0.0	7.1	95.8	308.1	13.3	34.3
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				13177.8		30044.6		13774.5
Groundwater					1092510.1	1092510.1	2259.6	2259.6
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					8817.3	8817.3	153.2	153.2
Totals	41926.3	4.80	88869.8	22423.7	1134087.7	1215899.1	6077.7	36664.0

Go Back | Pathogen Loads | Export to JPEG | Print | Close

Brubaker Run Watershed Existing Stormwater Treatment BMPs Input



Brubaker Run Watershed Existing Stormwater Treatment BMPs Results

GWLF Total Loads for file: EHT_BRexBMPst-9994 **Period of analysis:** 21 years from 1978 to 1998

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dissolved N	Total N	Dissolved P	Total P
Hay/Pasture	4908	2.8	2823.4	275.9	2343.8	3447.2	760.4	1240.9
Cropland	11132	2.8	83581.2	8165.9	20557.9	53221.4	1724.8	15949.8
Forest	2469	0.8	157.4	15.4	85.3	146.8	4.5	31.3
Wetland	138	4.2	3.2	0.3	24.7	26.0	1.3	1.8
Disturbed	257	8.8	53.6	5.2	10.3	31.2	5.1	14.2
Turfgrass	561	2.1	103.3	10.1	651.9	692.2	75.1	92.6
Open Land	2570	4.9	2147.7	209.8	1416.1	2255.4	28.3	393.9
Bare Rock	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sandy Areas	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unpaved Roads	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LD Mixed	1468	3.1	0.0	10.8	160.9	532.2	22.4	58.3
MD Mixed	3254	8.5	0.0	106.0	1436.5	4621.0	199.6	515.3
HD Mixed	4413	12.0	0.0	143.7	1948.1	6266.6	270.6	698.8
LD Residential	1826	3.1	0.0	13.5	200.2	662.2	27.8	72.6
MD Residential	8713	5.2	0.0	283.7	3846.0	12371.8	534.3	1379.5
HD Residential	217	7.2	0.0	7.1	96.0	308.8	13.3	34.4
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				13199.5		30095.3		13796.5
Groundwater					1092510.1	1092510.1	2259.6	2259.6
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					8817.3	8817.3	153.2	153.2
Totals	41926.3	4.80	88869.8	22446.8	1134105.0	1216005.4	6080.3	36692.7

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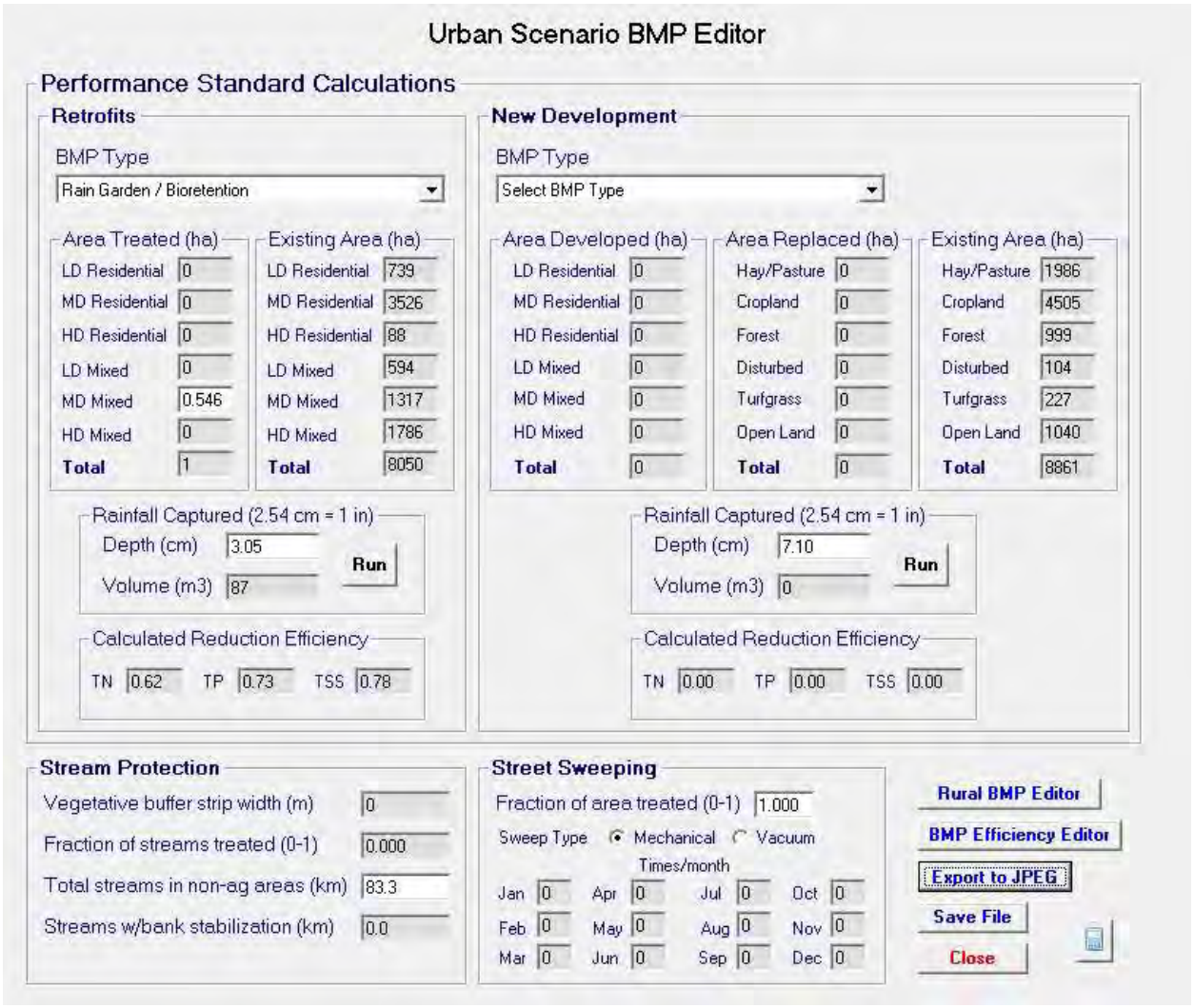
Proposed BMP Urban BMP Editor Screenshots

Maintenance Facility Rain Gardens Input



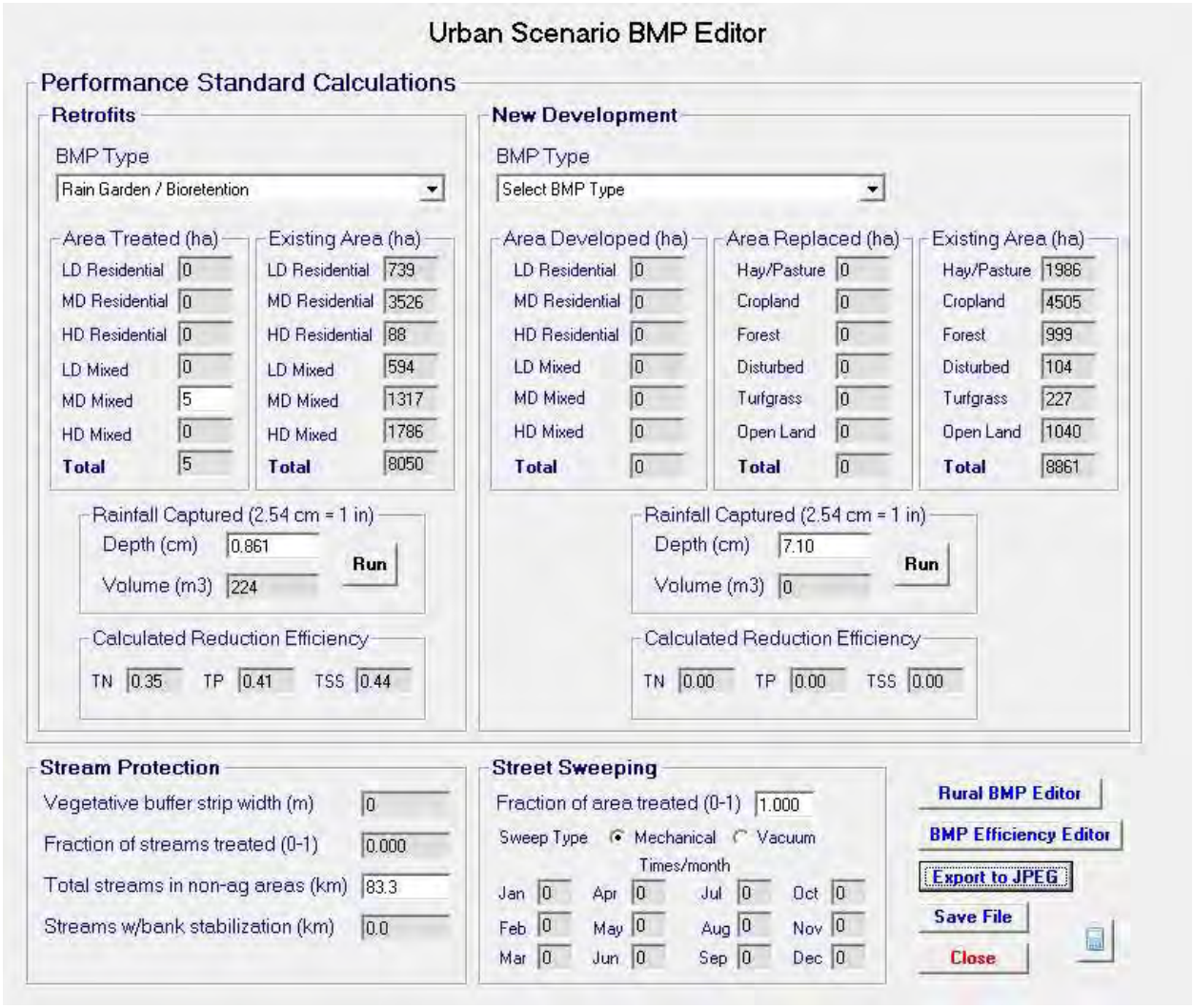
Maintenance Facility Rain Gardens Results

GWLF Total Loads for file: LittleConestoga_12-28-16_R **Period of analysis:** 21 years from 1978 to 1998

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dissolved N	Total N	Dissolved P	Total P
Hay/Pasture	4908	2.8	2823.4	275.9	2343.8	3447.2	760.4	1240.9
Cropland	11132	2.8	83581.2	8165.9	20557.9	53221.4	1724.8	15949.8
Forest	2469	0.8	157.4	15.4	85.3	146.8	4.5	31.3
Wetland	138	4.2	3.2	0.3	24.7	26.0	1.3	1.8
Disturbed	257	8.8	53.6	5.2	10.3	31.2	5.1	14.2
Turfgrass	561	2.1	103.3	10.1	651.9	692.2	75.1	92.6
Open Land	2570	4.9	2147.7	209.8	1416.1	2255.4	28.3	393.9
Bare Rock	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sandy Areas	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unpaved Roads	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LD Mixed	1468	3.1	0.0	10.8	160.9	532.4	22.4	58.4
MD Mixed	3254	8.5	0.0	106.0	1436.9	4622.2	199.7	515.5
HD Mixed	4413	12.0	0.0	143.8	1948.6	6268.2	270.7	699.1
LD Residential	1826	3.1	0.0	13.5	200.2	662.3	27.8	72.6
MD Residential	8713	5.2	0.0	283.9	3847.0	12375.0	534.5	1380.1
HD Residential	217	7.2	0.0	7.1	96.0	308.8	13.3	34.4
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				13204.6		30106.3		13800.9
Groundwater					1092510.1	1092510.1	2259.6	2259.6
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					8817.3	8817.3	153.2	153.2
Totals	41926.3	4.80	88869.8	22452.2	1134107.0	1216022.9	6080.7	36698.3

Go Back | Pathogen Loads | Export to JPEG | Print | Close

Village Grande Bioretention Area Input



Village Grande Bioretention Area Results

GWLF Total Loads for file: LittleConestoga_12-28-16_V **Period of analysis:** 21 years from 1978 to 1998

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dissolved N	Total N	Dissolved P	Total P
Hay/Pasture	4908	2.8	2823.4	275.9	2343.8	3447.2	760.4	1240.9
Cropland	11132	2.8	83581.2	8165.9	20557.9	53221.4	1724.8	15949.8
Forest	2469	0.8	157.4	15.4	85.3	146.8	4.5	31.3
Wetland	138	4.2	3.2	0.3	24.7	26.0	1.3	1.8
Disturbed	257	8.8	53.6	5.2	10.3	31.2	5.1	14.2
Turfgrass	561	2.1	103.3	10.1	651.9	692.2	75.1	92.6
Open Land	2570	4.9	2147.7	209.8	1416.1	2255.4	28.3	393.9
Bare Rock	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sandy Areas	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unpaved Roads	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LD Mixed	1468	3.1	0.0	10.8	160.9	532.3	22.4	58.3
MD Mixed	3254	8.5	0.0	106.0	1436.7	4621.4	199.6	515.4
HD Mixed	4413	12.0	0.0	143.8	1948.3	6267.2	270.7	698.9
LD Residential	1826	3.1	0.0	13.5	200.2	662.2	27.8	72.6
MD Residential	8713	5.2	0.0	283.8	3846.4	12372.9	534.4	1379.8
HD Residential	217	7.2	0.0	7.1	96.0	308.8	13.3	34.4
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				13201.6		30099.7		13798.7
Groundwater					1092510.1	1092510.1	2259.6	2259.6
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					8817.3	8817.3	153.2	153.2
Totals	41926.3	4.80	88869.8	22449.1	1134105.7	1216012.1	6080.5	36695.6

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Appendix D
Existing BMP Inventory

Appendix D. East Hempfield Township Existing BMP Documentation

NPDES#	BMP Type	Date	Location	Watershed	RR or ST	BMP/ treated Volume (cf)	Drainage Area Treated (ac)	Impervious Area Treated (ac)	Pervious Area (ac)	Runoff Storage (RS)(12)/IA (in)
PAG02003614059	Infiltration Basin and Trench	2015	2907 Columbia Ave, Lanaster	Brubaker Run	RR	4476	1.00	0.67	0.33	1.84
PAG02003612003	Infiltration Basin (2), Bioinfiltration Area	2013	630 Centerville Road, Lancaster PA	Brubaker Run	RR	17263	5	1.52	3.40	3.13
PAG02003613085	Infiltration Basin (2), Rain Garden	2016	2501 Noll Drive, Lancaster PA	Brubaker Run	RR	117961	18.23	9.73	8.50	3.34
PAG02003611059	Infiltration Basin	2012	500 Running Pump Road, Lancaster PA	Brubaker Run	RR	5059	11.49	0.63	10.86	2.20
PAG02003613070	Infiltration Basin, Rain Garden	2014	near 378 Running Pump Road, Lancaster PA	Brubaker Run	RR	125888	29.85	24.58	5.27	1.41
PAG2003603076	Subsurface Infiltration Bed (3)	2003	90 Good Drive, Lancaster PA	Brubaker Run	RR	1125	0.20	0.20	0.00	1.57
PAG2003605084	Infiltration Basin with forebay	2003	625 Community Way, Lancaster PA	Brubaker Run	RR	41556	3.00	2.25	0.75	5.09
PAG2003607082	Subsurface infiltration (2)/2009	2009	301 Rohrestown Road, Lancaster PA	Brubaker Run	RR	59472	5.68	5.68	0.00	2.88
PAG02003610008	Infiltration Basin/July 2011	2011	3050 Hempland Road, Lancaster	Brubaker Run	RR	1211	2.60	2.60	0.00	0.13
PAG2003605131	Swales (3), Subsurface Infiltration	2007	Intersection of noll Drive & Rohrestown Road	Brubaker Run	RR	4200	0.40	0.40	0.00	2.89
TOTAL RR FOR BRUBAKER RUN						**378211**	**77.36**	**48.261**	**29.102**	**24.49**
TOTAL RR FOR BRUBAKER RUN (MAPSHED CONVERSION - hectares and centimeter)							**31.31**	**19.530**	**11.894**	**62.19**
PAG02003611059	Dry Extended Detention Basin	2012	500 Running Pump Road, Lancaster PA	Brubaker Run	ST	3315	2.39	0.17	2.22	5.49
PAG02003612032	Dry Extended Detention Basin (with Amended Soils/Plantings)	2014	3001 Industry Drive, Lancaster PA	Brubaker Run	ST	28322	3.17	3.17	0.00	2.46
PAG02003611040	Water Quality Inserts/Inlets (Under Construction)	2017	1800 Villiage Circle, Lancaster PA	Brubaker Run	ST	50639	9.08	4.66	4.42	2.99
PAG2003605128	Water Quality Inserts/Inlets	2007	3101 Columbia Ave, Lancaster PA	Brubaker Run	ST	9376	0.90	0.90	0.00	2.87
TOTAL ST FOR BRUBAKER RUN						**91652**	**15.54**	**8.90**	**6.64**	**13.81**
TOTAL ST FOR BRUBAKER RUN (MAPSHED CONVERSION - hectares and centimenter)							**6.29**	**3.60**	**2.69**	**35.08**
PAG2003607004	Infiltration Basin (Under construction)	2017	(Near 241 Bethel Drive) 40.059237, -76.365064	Little Conestoga	RR	16901	5.70	1.36	4.34	3.42
PAG2003604081	Pervious Pavement, Infiltration Bed, Vegetated Swale (5)	2013	5240 Main Street, East Petersburg, PA	Little Conestoga	RR	28054	1.73	1.47	0.26	5.26
PAG2003604061	Subsurface Infiltration (Seepage Pit)	2010	5120 Main Street, East Petersburg PA	Little Conestoga	RR	3136	0.03	0.03	0.00	28.80
PAG02003611033	Vegetated Swales, Rain Garden	2012	1107 Enterprise Road, East Petersburg PA	Little Conestoga	RR	11076	1.72	1.72	0.00	1.77
PAG02003611062	Rain Garden/Bioretention, Runoff Capture and Reuse	2014	2102 Harrisburg Pike, Lancaster PA	Little Conestoga	RR	25476	7.25	6.06	1.19	1.16
PAG02003613081	Infiltration Trench	2015	2211-2213 Leabrook Road, Lancaster PA	Little Conestoga	RR	454	0.04	0.04	0.00	3.13
PAG2003605043	Infiltration Basin, Vegetated Swale (2)	2008	1780 Rohrestown Road, Lancaster PA	Little Conestoga	RR	5205	6.80	1.41	5.39	1.02
PAG10-0-383-R	Infiltration Basin	2003	690 Good Drive Lancaster PA	Little Conestoga	RR	124442	12.08	1.45	10.63	23.64
TOTAL RR FOR LITTLE CONESTOGA						**214744**	**35.45**	**13.54**	**21.81**	**68.20**
TOTAL RR FOR LITTLE CONESTOGA (MAPSHED CONVERSION - hectares and centimeter)							**14.34**	**5.48**	**8.83**	**173.22**
PAG02003611062	Dry Extended Detention Basin	2014	2102 Harrisburg Pike, Lancaster PA	Little Conestoga	ST	1220	2.28	1.90	0.38	0.18
PAG02003610065	Dry Extended Detention Basin/ (2014)	2014	2080 Spring Valley Road, Lancaster PA	Little Conestoga	ST	475	3.90	1.58	2.32	0.08
TOTAL ST FOR LITTLE CONESTOGA						**1695**	**6.18**	**3.48**	**2.70**	**0.26**
TOTAL ST FOR LITTLE CONESTOGA (MAPSHED CONVERSION - hecatares and centimer)							**2.50**	**1.41**	**1.09**	**0.66**
PAG02003611038-R	Subsurface Infiltration Bed (4)		Mimosa Lane, Lancaster PA	Millers Run	RR	24089	4.86	3.99	0.87	1.66
PAG2003604055	Dry wells/August 2008	2008	3,7,11,15,19 Twin Oaks Hollow	Millers Run	RR	2105	0.21	0.21	0.00	2.76
PAG2003604055	Vegetated Swales (6)	2008	near 724 Dorsea Road, Lancaster PA	Millers Run	RR	2879	4.94	1.29	3.65	0.61
PAG2003603104/PAG2	Vegetated Swales, Subsurface Infiltration Bed	2015	near 2250 Harrisburg Pike, Lancaster PA	Millers Run	RR	94671	44.37	35.93	8.44	0.73
PAG02003612034	Infiltration trenches, Swales (2), Subsurface Infiltration Area	2015	3485 Nolt Road Lancaster PA	Swarr Run	RR	7331	10.91	0.44	10.47	4.59
PAG2003609012	Vegetated Swales (2)	2016	near 1400 McGovernville Road, Lancaster PA	Swarr Run	RR	67	2.83	1.25	1.58	0.01
PAG02003614081	Rain Garden/Bioretention	2015	1908 McFarland Drive, Landisville, PA	Swarr Run	RR	4757	0.50	0.50	0.00	2.62
PAG02003613038	Vegetated Swale	2013	200 Church Street Landisville PA	Swarr Run	RR	3416	0.71	0.71	0.00	1.33
PAG2003604069	Vegetated Swale (2)	2009	near 206-226 Meadow Creek Drive, Landisville PA	Swarr Run	RR	546	2.69	1.43	1.26	0.11
PAG2003604055	Bioinfiltration	2014	near 2442 Harrisburg Ave, Lancaster PA /1286 Getz Way L	Swarr Run	RR	20168	6.02	6.02	0.00	0.92
PAG2003603044	Infiltration Basin	2008	3435 Nolt Road, Lancaster PA	Swarr Run	RR	29396	7.00	5.87	1.13	1.38
TOTAL RR FOR SWARR RUN						**189425**	**85.04**	**57.64**	**27.40**	**16.72**
TOTAL RR FOR SWARR RUN (MAPSHED CONVERSION - hectares and centimeters)							**34.42**	**23.33**	**69.61**	**42.48**
PAG02003611038-R	Constructed wetlands (2)		Mimosa Lane, Lancaster PA	Millers Run	ST	697	13.54	3.99	9.55	0.05
PAG2003607093	Water Quality Inserts/Inlets (2) /November 2009		near 3115 Nolt Road, Lancaster PA	Swarr Run	ST	7275	0.65	0.65	0.00	3.08
TOTAL ST FOR SWARR RUN						**7972**	**14.19**	**4.64**	**9.55**	**3.13**
TOTAL ST FOR SWARR RUN (MAPSHED CONVERSION - hectares and centimeters)							**5.74**	**1.88**	**3.86**	**7.95**
	Swar Run Stream Stabilization and Buffer	**2003**	**2701 State Road Lancaster**	**Swarr Run**		**1500 ft**				

Appendix E

Brubaker Run Floodplain Restoration Load Reduction Summary

East Hempfiled Township PRP Appendix E
Brubaker Run Floodplain Restoration
Load Reduction Summary
June 14, 2016

Introduction

The Brubaker Run Floodplain Restoration associated with the Lime Spring Square development project is a 4,350 LF floodplain restoration that is being implemented in the Brubaker Run Watershed. This floodplain restoration is a public-private partnership between East Hempfield Township and Oak Tree Development Group. The 8.6 acre floodplain restoration project is part of the 98.16 acre Lime Spring Square commercial development project and, in addition to being an ecological restoration of the stream and floodplain corridor, is intended to provide stormwater management services as part of the Township and NPDES permit requirements for the land development activity. The anticipated sediment load reduction resulting from the project will far exceed the water quality impacts of the proposed land development activity. This summary documents the field assessment, monitoring, and calculations used to predict the sediment load reduction provided by the restoration project, the sediment load resulting from the land development site, and the net sediment reduction anticipated as a result of the overall project.

Site Assessment and Monitoring

As part of the geomorphic site assessment completed prior to the floodplain restoration design bank erosion rate estimates were developed using the Bank Assessment for Non-Point Source Consequences of Sediment (BANCS, Rosgen 2001) assessment procedures. In addition bank pins were placed in four locations in December 2015 to measure actual bank erosion in strategic, representative locations within the project reach. The preliminary BANCS assessment results were calibrated using seventeen months of bank pin data collected by measuring actual bank pin exposure at each of the four bank pin sites. This calibration provided a revised annual reach-wide bank erosion rate in tons per year.

Load Reduction Calculations

Load reduction calculations for the Brubaker Run floodplain restoration project were developed using the procedures established in the Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects (Schueler and Stack, 2014). The largest part of these calculated load reductions is a function of the elimination of bank erosion as a source of sediment, as defined by Protocol 1 of the Expert Panel procedures. The Expert Panel report recommends using the BANCS method or monitoring to estimate bank erosion rates and identifies some uncertainty and potential for subjectivity in using the BANCS method. Using measured bank pin data to calibrate the BANCS results significantly reduces the potential variability in the data and provides a much more robust

estimate of the actual reach-wide erosion rates. This reduces the "uncertainty" on the front-end of the load reduction estimates for the Brubaker Run site.

The Expert Panel report cites limited effectiveness of stream restoration projects in reducing sediment loads, but the technical basis for this assumption is based on a sample size of one. The protocols are intended to address a wide range of restoration projects, however, different design approaches inherently have varying long term rates of stability. The floodplain restoration design at Brubaker Run (similar to numerous other floodplain restoration projects) has two factors that will lead to an extremely high efficiency with regard to sediment load reductions:

- Streambank sediment is the single greatest contributor to sediment loading. This design approach completely removes that source of sediment from the floodplain. If the sediment is not there to erode, it can't contribute to the in-stream sediment load. This differs from other restoration approaches that manage shear stress, and subsequent erosion, using structures (rock or log vanes, root wads, etc.)
- The design shear stress of the restored floodplain is generally 1 lb/sf or less. This low-stress condition is created by a design geometry that facilitates out of bank flow during small storm events and maintains low depths and velocities even during high flow events. This creates inherent systemic stability and nearly eliminates the possibility of destabilization due to extreme storm events that may compromise a weak point in other types of restoration projects.

These factors reduce the "uncertainty" on the post-restoration side by insuring that the project becomes a sediment sink rather than a sediment source.

The protocol prescribes an "Uncertainty Factor" of 50% to be applied to the bank erosion rates when determining the calculated sediment load reduction. Flexibility is granted to states to adjust this uncertainty factor when more data is available to justify such an adjustment. Based on the discussion above, a 100% efficiency value could be applied for this project, given the level of data available and the design approach used. Based on negotiations with PA DEP staff, East Hempfield Township is proposing a 75% efficiency value for the bank erosion reduction component of the load reduction calculations, with the option to increase that efficiency based on turbidity data that will be collected as part of the NPDES permit requirements for the Lime Spring Square development project.

Additional sediment load reduction resulting from the filtration of runoff from upstream in the watershed is estimated using Protocol 3 from the Expert Panel report. While this value is significantly less than the Protocol 1 estimate, it is included in the total anticipated load reduction, as shown on the attached calculation summary. Protocol 2 addresses Nitrogen load reduction and is not included with this discussion.

Before load reductions can be realized by East Hempfield Township towards the Pollutant Reduction Plan (PRP) requirement, the load reduction required to offset the land development activity under the NPDES permit for Lime Spring Square needs to be achieved. The NPDES requirement is based on a 2-year storm event, while the PRP load reduction and Expert Panel protocols are based on an annual loading rate. To determine the annual sediment loading resulting from the commercial development area, the 98.16 ac parcel was multiplied by the annual MapShed loading rate for the medium density mixed land use category which is 65.2 lbs. /ac. (see Table 2 in the PRP text). This equates to 6,400 lbs. per year loading from the development site that must be removed to meet NPDES permit requirements. The floodplain restoration mitigates all peak rate and volume impacts resulting from the development site, so additional downstream bank erosion loading is not a factor and does not need to be considered in this calculation.

Based on the discussion provided above, and the attached Sediment Load Reduction Calculations, the net sediment load reduction to be realized by the Brubaker Run Floodplain Restoration

Brubaker Run Floodplain Restoration Sediment Reduction

	Sediment (lb./yr)
Brubaker Run Floodplain Restoration Base Sediment Reduction	797,221
Annualized sediment load from development site (NPDES Requirement)	6,400
Net Brubaker Run Sediment Reduction with NPDES requirement removed	**790,821**

Brubaker Run FPR
Load Reduction Summary

Load Reduction Method	Nitrogen (lb/yr)	Phosphorus (lb/yr)	Sediment (lb/yr)
Protocol 1	1,643	227	782,348
Protocol 2	3,479	N/A	N/A
Protocol 3	651	27	14,873
Total	5,773	254	797,221

Protocol #1 - Bank Erosion Prevention Nutrient and Sediment Load Reductions				
		N (lb/T) *	P (lb/T)*	Sediment (lb/yr/ft of reach)**
Existing Loading Rate	On-site	4.2	0.58	239.8
Restored Reach Length	On-site	4,350	lf	
Reduction for Site (Current Annual Yield, lb/yr)		N***	P***	Sediment****
	On-site	2,190.6	302.5	1,043,130.0
	Total (lb/yr)	2,190.6	302.5	1,043,130.0
	Load Credited†(lb/yr) =	1,642.9	226.9	782,347.5

* Nitrogen Concentrations determined from soil test results; Phosphorus concentrations based on data from CBP 2014

**Sediment Loading Rate determined from BANCS assessent

***N and P Yields = Nutrient Concentration x Total Sediment Yield

****Annual Sediment Yield = Sediment Loading Rate x Reach Length

† Load Credited based on 25% reduction factor, as prescribed in CBP 2014

Protocol #2 - Base Flow Reductions in Hyporheic Zone Nutrient Load Reductions		
Length of Stream Reconnected to Floodplain	4,350	ft
Estimated Channel Width	7	ft
Additional Width of Hyporheic Zone	79	ft
Assumed Depth of Hyporheic Zone	2	ft
Hyporheic Box Volume	749,232	cf
Bulk Density of Soil	96	lb/cf
Hyporheic Exchange Rate	2.65.E-04	lb/day/ton
TN Credit	**3,478.53**	**lb/yr**

Protocol #3 - Storm Flow Floodplain Reconnection Nutrient and Sediment Load Reductions				
TN				
Annual Loads	Impervious	Pervious	Total	
lb/ ac/yr*	38.53	22.24		
lb/ yr	18,301.75	20,007.10	38,308.85	
		Annual Reduction**=	1,040.87	
		Adjusted Annual Reduction* **	**651.21**	lb

TP				
Annual Loads	Impervious	Pervious	Total	
lb/ ac/yr*	1.55	0.36		
lb/ yr	736.25	323.86	1060.11	
		Annual Reduction**=	43.21	
		Adjusted Annual Reduction* **	**27.03**	lb

TSS				
Annual Loads	Impervious	Pervious	Total	
lb/ ac/yr*	1,480.43	190.93		
lb/ yr	703,204.25	171,760.63	874,964.88	
		Annual Reduction**=	23,773.31	
		Adjusted Annual Reduction* **	**14,873.45**	lb

* Annual loading from Edge of Stream Unit Loading Rates provided By CBWM v. 5.3.2

** Annual Reductions = Total Annual Load * % Removal

*** Adjusted annual reduction = Annual reduction * adjustment factor based on ratio of project size to watershed