NPDES Stormwater Discharges from MS4

Total Maximum Daily Load (TMDL) & Pollutant Reduction Plan for Upper Moreland Township

Upper Moreland Township

Montgomery County, Pennsylvania

July 28, 2017

Prepared For:

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MS4 Pollutant Reduction Plan
for
Upper Moreland Township
Montgomery County, Pennsylvania

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Upper Moreland Township, Montgomery County, is submitting this TMDL and Pollution Reduction Plan (PRP) in accordance with the requirements of *Individual Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems* (MS4); specifically, in accordance with the *MS4 Requirements Table (Municipal) Anticipated Obligations for Subsequent NPDES Permit Term*. Upper Moreland Township must create a TMDL and PRP due to discharges from their MS4 to Impaired Downstream Waters, which are listed as impaired within the below table:

MS4 Name	NPDES ID	Individual Permit Required?	Reason	Impaired Downstream Waters or Applicable TMDL Name	Requirement(s)	Other Cause(s) of Impairment
Montgomery County						
UPPER MORELAND TWP	PAG130019	Yes	TMDL Plan	Southampton Creek		Flow Alterations, Other Habitat Alterations, Water/Flow Variability (4c)
				Wissahickon TMDL	TMDL Plan-Siltation, Suspended Solids (4a)	Cause Unknown (4a)
				Southampton Creek TMDL	TMDL Plan-Nutrients, Organic Enrichment/Low D.O., Siltation (4a)	
				Round Meadow Run	Appendix E-Siltation (5)	Cause Unknown (5)
				Pennypack Creek	Appendix E-Siltation (5)	Cause Unknown (5), Flow Alterations, Other Habitat Alterations, Water/Flow Variability (4c)
				Terwood Run	Appendix E-Siltation (5)	Cause Unknown (5)

Last Revised 2017-06-26

Upper Moreland Township is required to develop a PRP for the Pennypack Creek (including Round Meadow Run & Terwood Run) along with establishing compliance with the Southampton Creek TMDL for Nutrients & Sediment as well as the Wissahickon TMDL for siltation. A TMDL Strategy Plan titled “MS4 Southampton Creek & Wissahickon Creek TMDL Strategy” was submitted to PA DEP for review and approval in May 2016. To date, no review comments or approval letter has been received. This PRP document is intended to be a supplement to the previously submitted TMDL Strategy. The purpose of this PRP is to outline how Upper Moreland will comply with the Individual Permit requirement to reduce 10% of sediment and 5% of nutrient loads form the MS4 to waters impaired by such pollutants. In accordance with guidance provided by DEP, achieving a 10% reduction in sediment will also cause nutrients to be reduced by 5%. As such, only sediment loading was considered in the pre and post improvement analysis for this report. The intent of this MS4 TMDL/PRP is to establish the existing loading of sediment and pollutants discharged from the MS4 to Impaired Downstream Waters, and to present a plan to reduce these loadings. Since nearly all tributaries within the

Urbanized Area of the Township ultimately drain to the Pennypack Creek, a township-wide, approach was taken to provide a 10% reduction in sediment across the Township rather than analyzing each tributary separately. This approach was suggested by PA DEP. In addition to the Pennypack Creek watershed, there is a *de minimis* area of the Wissahickon Creek watershed which is located within Upper Moreland Township, of which all but 7 acres was removed during the parsing process. As such, the Township proposes to provide street sweeping and remove sediment from existing stormwater inlets to reduce the 133 lbs/yr required within this small drainage area.

This Plan is organized to follow the "Required PRP Elements" presented in the PRP Instructions included as part of the *PAG-13 MS4 Individual Permit* instruction packages. This Plan will be evaluated and updated by Upper Moreland Township on an as-needed basis, based on 1) its effectiveness in reducing pollutant loads in discharges from the regulated small MS4, 2) the reasonableness of achieving the reductions, and 3) the cost/benefit of the BMP"(s) under consideration. If this occurs, Upper Moreland Township will work with the Department of Environmental Protection (DEP) for review and approval of any revisions or updates. The "potential BMPs" listed in this document are intended to show that compliance with the required reductions can be achieved within the coming permit term March 2018 to March 2023. The Township reserves the right to implement a combination of the listed BMPs, remove BMPs, and/or add additional BMPs should the opportunity to implement them present itself within the permit term.

Each MS4 PRP must include the following Required PRP Elements:

Section A: Public Participation
Section B: Map
Section C: Pollutants of Concern
Section D: Determine Existing Loading for Pollutants of Concern
Section E: Select BMPs to Achieve the Minimum Required Reductions in Pollutant Loading
Section F: Identify Funding Mechanisms
Section G: Identify Responsible Parties for Operation and Maintenance (O&M) of BMPs

A. Public Participation

As part of the preparation of this MS4 TMDL/PRP, public participation is required. The public participation measures that are required are:

- A complete copy of the TMDL/PRP shall be available for public review.
- A public notice containing a statement describing the plan, where it may be reviewed by the public and the length of time provided for the receipt of comments shall be published by the MS4 in a newspaper of general circulation in the area.
- Written comments shall be accepted by the MS4 for a minimum of 30 days from the date of public notice.
- The MS4 shall accept comments from any interested member of the public at a public meeting, which may include a regularly scheduled meeting of the governing body of the municipality or municipal authority that is the permittee.
- Consider, and make a record of the consideration of, each timely comment received from the public during the public comment period concerning the plan, identifying any changes made to the plan in response to the comment.

A copy of the newspaper public notice, copies of all written comments received from the public, and a copy of the MS4's record of consideration of all timely comments received in the public comment period are included with this TMDL/PRP. Note that all comments received during the public comment period were considered. Revisions to the TMDL/PRP in response to those comments were made as applicable. All required documentation of public participation, as outlined above, is included as Appendix B.

- Date TMDL/PRP public notice was published in newspaper: August 1, 2017
- Date TMDL/PRP was made available for public review/comment: August 1, 2017
- End date for receipt of written comments (30 days from the date of public notice): September 7, 2017
- Date TMDL/PRP listed on the public meeting agenda: August 7, 2017
- Date TMDL/PRP comments were accepted at a public meeting: August 7, 2017

B. Map

Mapping is an integral part of developing the TMDL/PRP and requires a level of detail suitable to determine the topography, MS4 drainage areas and loading for the listed impairments. The MS4 TMDL/PRP map shows the storm sewershed boundaries. The MS4 TMDL/PRP map also shows the proposed locations of BMPs that will be implemented in efforts to achieve the required pollutant load reductions. The storm sewershed boundaries shown on the Upper Moreland Township MS4 TMDL/PRP Map constitute the combined storm sewershed of all MS4 outfalls within the MS4's jurisdiction that discharge to the Pennypack Creek Watershed. The Township does not have any outfalls within the Wissahickon Creek Watershed.

Upper Moreland Township MS4 TMDL/PRP Map identifies the storm sewershed boundaries, as well as, the proposed locations of structural BMPs to be implemented to achieve required pollutant load reductions. The Township's MS4 TMDL/PRP Map is included in Appendix B.

The Township's MS4 TMDL/PRP Map shows parsed areas, which are areas within the Township that are excluded in the calculation of existing pollutant loading due to the area not contributing flow to the Township's MS4. Examples of parsed areas include; drainage to PennDOT, Turnpike and/or Railroad Rights-of-ways, drainage to private roads (which do not connect to the Township's MS4), and direct drainage to the creek.

C. Pollutants of Concern

Identify the pollutants of concern. For all TMDL/PRPs, Upper Moreland Township shall calculate existing loading of the pollutant(s) of concern in lbs/year; calculate the minimum reduction in loading in lbs/year; select BMP(s) to reduce loading; and demonstrate that the selected BMPs will achieve the minimum reductions.

For TMDL/PRPs developed for impaired water, the pollutants are based on the impairment listing as provided in the reference TMDL Plan and Appendix A of this document: the *MS4 Requirements Table (Municipal) Anticipated Obligations for Subsequent NPDES Permit Term (Appendix E)*. If the impairment is based on siltation only, a minimum of 10% sediment reduction is required. If the impairment is based on nutrients only or other surrogates for nutrients (e.g., "Excessive Algal Growth" and "Organic Enrichment/Low D.O."), a minimum 5% TP reduction is required. If the impairment is due to both siltation and nutrients, both sediment (10% reduction) and TP (5% reduction) must be addressed. A minimum 10% reduction is required for sediments within the listed impaired waters, as well as, a 5% reduction for Nutrients within the Southampton Creek. As discussed previously, PA DEP has determined the required 10% sediment reduction to be the limiting factor. As such, the plan will identify BMPs that can be implemented to achieve the required reduction in siltation and it will be assumed that a 5% reduction in nutrients will be achieved across the Township's MS4 planning area. The MS4 TMDL/PRP presents the minimum reduction in loading for each impairment as pounds per year (lbs/yr). The Southampton Creek TMDL (June 2008) identifies the required reduction of 34% of sediment within Upper Moreland's MS4 that is tributary to the creek. Since the previously submitted Southampton Creek TMDL Strategy Plan contemplated a 25 year period and this PRP proposes to reduce 10% of sediment within 5 years, the Township remains on track to hit the 34% sediment reduction required by the TMDL within the 25 year period identified in the TMDL Strategy (Submitted May 2016). Lastly, this plan proposes to reduce 5% of nutrients discharged from the Township's MS4 within the upcoming 5 year permit term. The WLA for nutrients in the Upper Moreland section of the Southampton Creek TMDL was stated as 1.46 lb/yr, which represented an unattainable 99.12% reduction. While the BMPs contemplated in this PRP will reduce loading by 5% in the next permit term, the Township plans to address nutrients in the Southampton Creek in subsequent permit terms. Including, but not limited to outfall sampling to determine the actual existing nutrient load from the Township's MS4.

D. Determine Existing Loading for Pollutants of Concern

In accordance with DEP requirements, existing loading must be calculated and reported as of the date of the development of this TMDL/PRP. Any methodology that calculates existing pollutant loading in terms of pounds per year, evaluates BNP-based pollutant reductions utilizing BMP effectiveness values contained in Document 3800-PM-BCW0100m (see Appendix D-1) or Chesapeake Bay Program expert panel reports, uses average annual precipitation conditions and is based on sound science may be considered acceptable. For the purpose of determining existing pollutant loads for this report, the MapShed program was utilized.

The date the existing loading was calculated is July 19, 2017. Upper Moreland Township's permit obligation applies only to runoff collected by and discharged from the MS4. The storm sewershed land area that is collected by and discharges from the MS4 to various tributaries of the Pennypack Creek has been delineated using PAMAP data known as Light Detection and Ranging (LiDAR) contours. LiDAR contours were also utilized in determining the areas for parsing. The following table summarizes the storm sewershed land areas. The sediment loads generated from these non-tributary areas are subtracted (parsed) from the total storm sewershed load to determine what is attributed to the MS4.

As previously mentioned, in modeling the existing load, the software program known as MapShed was utilized in the development of this MS4 TMDL/PRP to determine the source areas and the total load of listed impairments based on the existing land uses. MapShed is a customized GIS interface that is used to create input data for an enhanced version of the GWLF watershed model originally developed at Cornell University. MapShed was improved by Dr. Barry Evans and his group at PSIEE using AVGWLF, a GIS-based watershed modeling tool that uses hydrology, land cover, soils, topography, weather, pollutant discharges, and other critical environmental data to model sediment and nutrient transport within a watershed. Located on the next page is the information from MapShed displaying the source area and existing loading for the Upper Moreland Township Planning Area portion of the MS4 that drains to the Pennypack Creek:

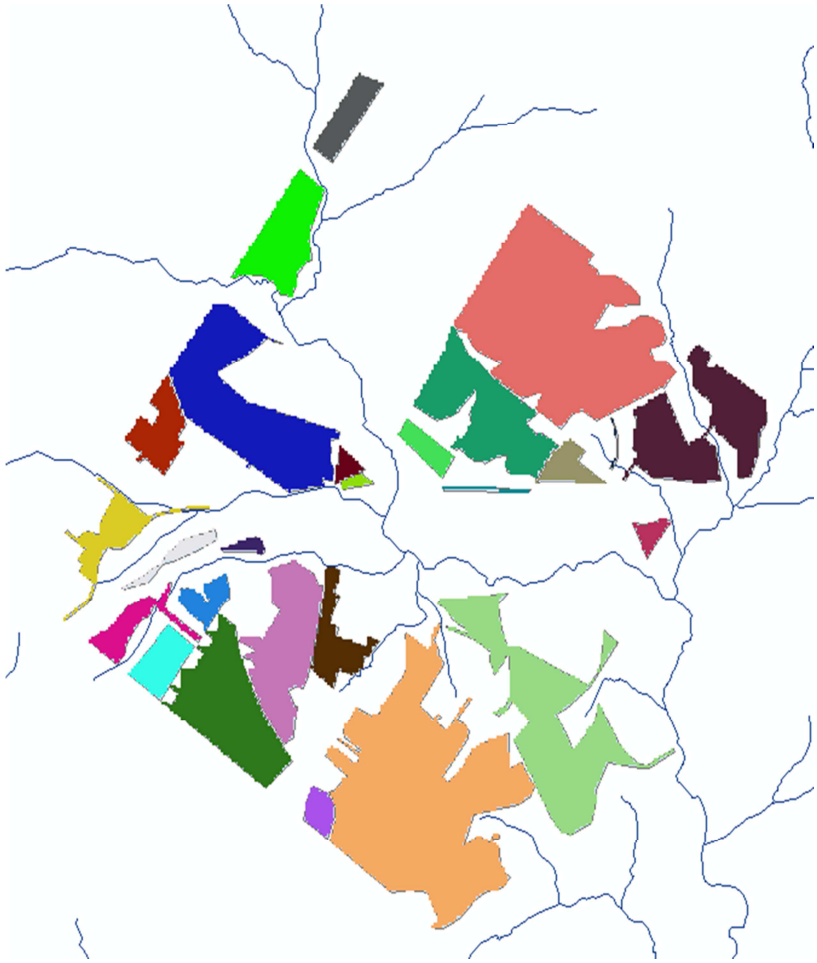


FIGURE 1: MAPSHED AREAS

Table D-1: SUMMARY OF AREAS

Upper Moreland Township's Planning Area	
Upper Moreland Twp Area (ac)	5,133
Area Parsed (ac)	2,694
Area Parsed (%)	52%
Upper Moreland Twp Planning Area (ac)	2,439

Table D-2: SUMMARY OF AREAS AND LOADING

Pennypack Creek Township Planning Areas		
Parcel	**Load (lbs)**	**Area (ac)**
0	40,128	34
1	99,681	86
2	196,191	216
3	58,489	50
4	58,426	49
5	29,338	34
6	38,519	42
7	146,163	154
8	22,488	22
9	18,766	15
10	8,053	5
11	122,079	129
12	41,296	47
13	19,829	17
14	420,680	496
15	187,893	235
16	10,649	9
17	1,063	2
18	15,967	19
19	2,591	4
20	132,386	148
21	375,407	435
22	24,020	24
23	10,543	9
24	148,228	158
25	0	0
Total Baseline Load for Planning Area	**2,228,873.0**	2,439
Required Sediment Reduction (10%)	**222,887.3**	***Areas from MapShed**
Proposed Reduction	**225,640.0**	

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

Upper Moreland Township has a requirement to reduce siltation and nutrients. Implementation of BMPs or land use changes must be proposed that will result in meeting the minimum required reduction in pollutant loading with the storm sewershed(s) identified by the MS4. These BMP(s) must be implemented within five (5) years of DEP's approval of coverage under the PAG-13 Individual Permit, and must be located within the watershed of the applicable impaired waters, on either public or private property. BMPs that will be implemented by others (either in cooperation with the Township or otherwise) within the storm sewershed that will result in net pollution loading reductions (not E&S BMPs to satisfy Chapter 102 requirements) may be included within the TMDL/PRP.

The names and descriptions of BMPs and land uses reported in the TMDL/PRP are in accordance with the Chesapeake Bay Program Model; names and descriptions are available through "CAST" (www.casttool.org, see "Documentation", "Source Data" and worksheets "Land Use Definitions" and "BMP Definitions").

Upper Moreland Township plans to achieve the sediment reduction by designing, constructing, operating and maintaining Best Management Practices (BMPs). Upper Moreland Township is required to implement this plan for 10% siltation reduction over the next five (5) years and carry over the remaining TMDL reduction requirement until the subsequent terms.

Table E-1 is a summary of the proposed BMPs under consideration, including location, type, and list impairment removed. Specific locations and drainage areas are depicted on the map found in Appendix B:

TABLE E-1: SUMMARY OF BMPS

	Proposed BMPs			
MapShed #	**BMP #**	**Type**	**Location**	**TSS Reduction**
3	1	Rain Garden Retrofit	Upper Moreland Middle School	3,298
2	2	Basin Retrofit	Upper Moreland Middle School	26,489
7	3	Extended Detention Basin Retrofit	Jason Drive (South)	8,720
6	4	Extended Detention Basin Retrofit	Jason Drive (North)	19,357
5	5	Basin Retrofit	Butternut Dr. & Acorn Pl.	18,393
4	6	Bioswale	Huntingdon Road & Mason Mills Rd	23,074
	7	Streambank Stabilization	Pennypack Circle (500 LF)	22,440
	8	Streambank Stabilization	Terwood Park (275 LF)	12,342
0	9	Bioswale	Mill Road	52,014
1	10	New Basin	Boileau Park	17,073
	11	Streambank Stabilization	Huntingdon Valley Country Club (500 LF)	22,440

As illustrated in Table D-2, the load after proposed BMPs are implemented for the Pennypack Creek Storm Sewershed is required to be reduced by at least 222,887 lb/yr. As demonstrated above in Table E-1 the proposed total load reduction can be met by implementing the BMPs contemplated at this time. This PRP is a working document and in the event that any of the above-listed BMPs cannot be implemented, the Township understands that this plan will need to be revised in order to achieve compliance within the current 5 year permit term. The Township remains fully committed to meeting applicable water standards and has the ability to revise the plan and include detailed BMP design and additional BMPs for consideration if additional controls are required in the long-term.

F. Identify Funding Mechanism(s)

The Municipality intends to apply for all related grants, such as Growing Greener, Watershed Restoration Protection, DCNR, ect. The Municipality intends to utilize general funds to cover the design and construction costs for the proposed BMPs should grant money not be awarded. Once the PRP has been approved by PADEP, the Municipality intends to authorize design of the BMPs, upon which time a feasibility and cost analysis will be prepared to determine the order for which the potential BMPs will be implemented.

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

Once implemented, the BMPs must be maintained in order to continue producing the expected pollutant reductions. Actual O&M activities will be identified by the MS4 in their Annual MS4 Status Reports, submitted under the Permit.

Applicants must identify the following for each selected BMP:

- The parties responsible for ongoing O&M;
- The activities involved with O&M for each BMP; and
- The frequency at which O&M activities will occur

Table G-1

BMP O&M TABLE			
Type	**Location**	**Responsible Party**	**Activities & Frequency**
Rain Garden Retrofit	Upper Moreland Middle School	Upper Moreland SD	Per PA BMP Manual
Basin Retrofit	Upper Moreland Middle School	Upper Moreland SD	Per PA BMP Manual
Extended Detention Basin Retrofit	Jason Drive (South)	Upper Moreland Township	Per PA BMP Manual
Extended Detention Basin Retrofit	Jason Drive (North)	Upper Moreland Township	Per PA BMP Manual
Basin Retrofit	Butternut Dr. & Acorn Pl.	Upper Moreland Township	Per PA BMP Manual
Bioswale	Huntingdon Road & Mason Mills Rd	Upper Moreland Township	Per PA BMP Manual
Streambank Stabilization	Pennypack Circle (500 LF)	Upper Moreland Township	Per PA BMP Manual
Streambank Stabilization	Terwood Park (275 LF)	Upper Moreland Township	Per PA BMP Manual
Bioswale	Mill Road	Upper Moreland Township	Per PA BMP Manual
New Basin	Boileau Park	Upper Moreland Township	Per PA BMP Manual
Streambank Stabilization	Huntingdon Valley Country Club (500 LF)	Upper Moreland Township	Per PA BMP Manual

As shown above, Upper Moreland Township will be responsible for ownership and maintenance of all constructed BMPs with the exception of the Rain Garden and Basin Retrofit on the School District's Middle School property. The Township will ensure continued maintenance of the Middle School BMPs through an Ownership & Maintenance covenant prepared by the Township Solicitor.

H. GENERAL INFORMATION

Terms: The term "nutrients" refers to "Total Nitrogen" (TN) and "Total Phosphorus" (TP) unless specifically stated otherwise in DEP's latest Integrated Report. The terms "sediment," "siltation," and "suspended solids" all refer to inorganic solids and are hereinafter referred to as "sediment."

Pollutants of Concern and Required Reductions: For all TMDL/PRPs, MS4s shall calculate existing loading of the pollutant(s) of concern, in lbs/year; calculate the minimum reduction in loading, in lbs/year; select BMP(s) to reduce loading; and demonstrate that the selected BMP(s) will achieve the minimum reductions.

For PRPs developed for impaired waters (Appendix E), the pollutant(s) are based on the impairment listing, as provided in the MS4 Requirements Table. If the impairment is based on siltation only, a minimum 10% sediment reduction is required. If the impairment is based on nutrients only or other surrogates for nutrients (e.g., "Excessive Algal Growth" and "Organic Enrichment/Low D.O."), a minimum 5% TP reduction is required. If the impaired is due to both siltation and nutrients, both sediment (10% reduction) and TP (5% reduction) must be addressed.

Existing Pollutant Loading: Existing loading must be calculated and reported as of the date of the development of the TMDL/PRP. MS4s may not claim credit for street sweeping and other non-structural BMPs implemented in the past. If structural BMPs were implemented prior to development of the TMDL/PRP and continue to be operated and maintained, the MS4 may claim pollutant reduction credit in the form of reduced existing loading.

> **NOTE** – An MS4 may not reduce its obligations for achieving pollutant load reductions through previously installed BMPs. An MS4 may only use such BMPs to reduce its estimate of existing pollutant loading. For example, if a rain garden was installed ten years ago and is expected to remove 100 lbs of sediment annually, and the overall annual loading of sediment in the storm sewershed is estimated to be 1,000 lbs without specifically addressing the rain garden, an MS4 may not claim that the rain garden satisfies its obligations to reduce sediment loading by 10%. The MS4 may, however, use the rain garden to demonstrate that existing loading is 900 lbs instead of 1,000 lbs, and 90 lbs rather than 100 lbs needs to be reduced during the term of permit coverage.

BMP Effectiveness: All MS4s must use the BMP effectiveness values contained within DEP's BMP Effectiveness Values document (3800-PM-BCW0100m) or Chesapeake Bay Program expert panel reports for BMPs listed in those resources when determining pollutant load reductions in TMDL/PRPs. For BMPs not listed in 3800-PM-BCW0100m or expert panel reports, MS4s may use effectiveness values from other technical resources; such resources must be documented in the TMDL/PRP.

Combining PRPs: If the MS4 discharges into multiple local surface waters impaired for nutrients and/or sediment, one PRP may be submitted to satisfy Appendix E but calculations and BMP selections must be completed independently for the storm sewershed of each impaired water. If, for example, an MS4 permittee must complete three PRPs according to the MS4 Requirements Table for three separate surface waters, storm sewershed maps must be developed, existing loads must be calculated, and BMPs must be implemented for pollutant reductions independently within those storm sewersheds. In other words, BMPs cannot be

implemented in one storm sewershed to count toward pollutant reductions in an entirely separate storm sewershed for a different impaired water.

Where local surface waters are impaired for nutrients and/or sediment, and those waters are tributary to a larger body of water that is also impaired, MS4s can propose BMPs within the upstream impaired waters to meet the pollutant reduction requirements of both the upstream and downstream waters. For example, if Stream A flows through a municipality that is tributary to Stream B, both are impaired and the MS4 has discharges to both streams, the MS4 can implement BMPs in the storm sewershed of Stream A to satisfy pollutant reduction requirements for both Streams A and B. In general, the MS4 permittee would not be able to satisfy pollutant reduction requirements for both streams if BMPs were only implemented in the storm sewershed of Stream B; however, on a case by case basis DEP will consider such proposals where it can be demonstrated that implementing BMPs in the upstream storm sewershed is infeasible.

If, however, Stream A does not flow into Stream B, both are impaired and the MS4 has discharges to both streams, in general DEP would expect that BMPs be implemented in the storm sewershed of both streams to meet pollutant reduction requirements.

MS4s participating in collaborative efforts are encouraged to contact DEP's Bureau of Clean Water during the PRP development phase for feedback on proposed approaches.

Joint PRPs: MS4s may develop and submit a joint PRP, regardless of whether the MS4s will be submitting a "joint NOI" or are already co-permittees. In general, the MS4s participating in a joint PRP should have contiguous land areas. The "study area" to be mapped is the combined storm sewershed for all MS4 jurisdictions.

BMP Selection: MS4s may propose and take credit for only those BMPs that are not required to meet regulatory requirements or otherwise go above and beyond regulatory requirements. For example, a BMP that was installed to meet Chapter 102 NPDES permit requirements for stormwater associated with construction activities may not be used to meet minimum pollutant reductions unless the MS4 can demonstrate that the BMP exceeded regulatory requirements; if this is done, the MS4 may take credit for only those reductions that will occur as a result of exceeding regulatory requirements.

> **NOTE** – Street sweeping may be proposed as a BMP for pollutant loading reductions if 1) street sweeping is not the only method identified for reducing pollutant loading, and 2) the BMP effectiveness values contained in 3800-PM-BCW0100m or Chesapeake Bay Program expert panel reports are utilized.

Submission of PRP: Attach one copy of the PRP with the NOI or individual permit application that is submitted to the regional office of DEP responsible for reviewing the NOI or application. In addition, one copy of the PRP (not the NOI or application) must be submitted to DEP's Bureau of Clean Water (BCW). BCW prefers electronic copies of PRPs, if possible. Email the electronic version of the PRP, including map(s) (if feasible), to RA-EPPAMS4@pa.gov. If the MS4 determines that submission of an electronic copy is not possible, submit a hard copy to: PA Department of Environmental Protection, Bureau of Clean Water, 400 Market Street, PO Box 8774, Harrisburg, PA 17105-8774.

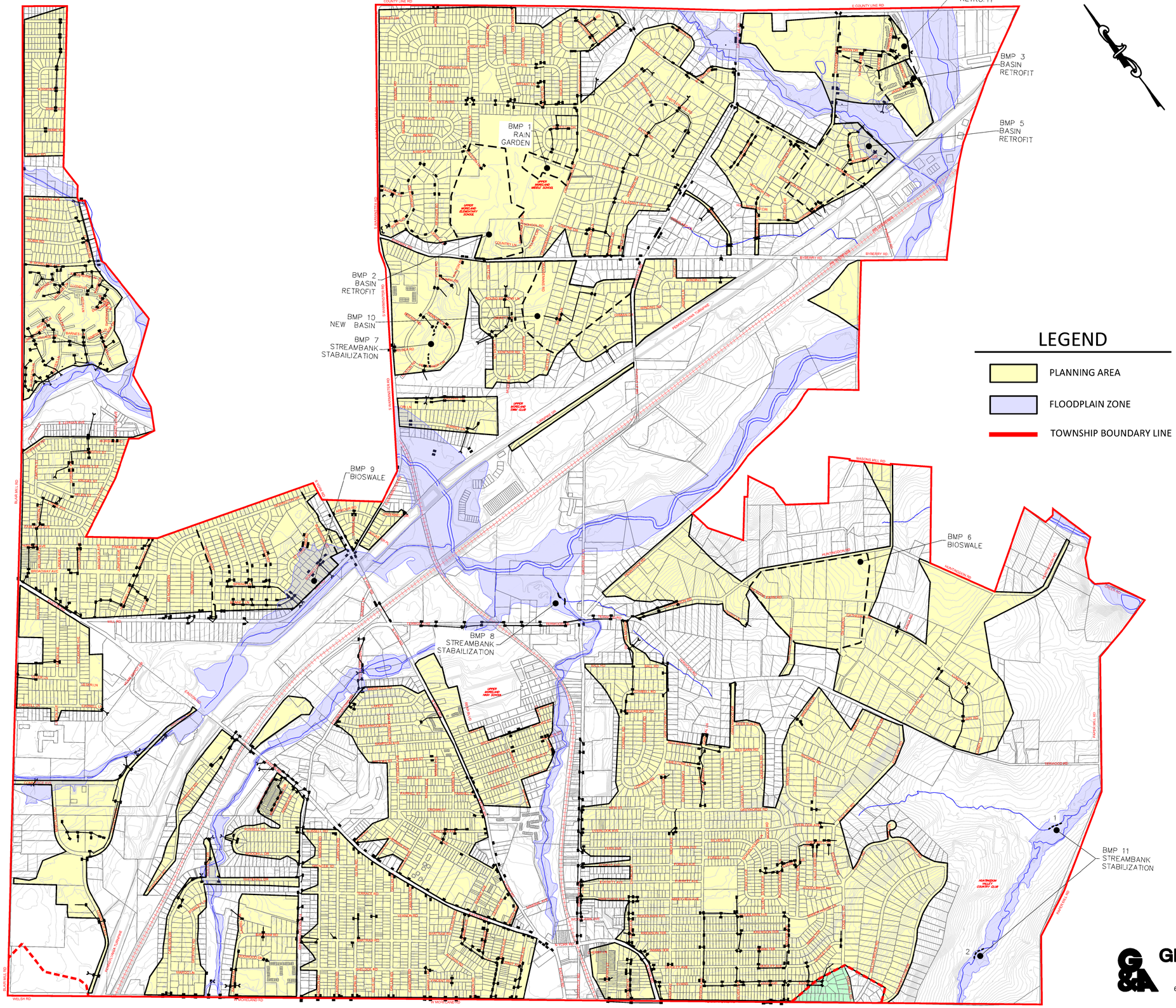
PRP Implementation and Final Report: Under the PAG-13 General Permit, the permittee must achieve the required pollutant load reductions within 5 years following DEP's approval of coverage under the General Permit, and must submit a report demonstrating compliance with the minimum pollutant load reductions as an attachment to the first Annual MS4 Status Report that is due following completion of the 5th year of General Permit coverage. For example, if DEP issues written approval of coverage to a permittee on June 1, 2018, the required pollutant load reductions must be implemented by June 1, 2023 and the final report documenting the BMPs that were implemented (with appropriate calculations) must be attached to the annual report that is due September 30, 2023. In general, the same methodology used to calculate the existing pollutant loads should be used in the final report to demonstrate the reductions. If BMP effectiveness values are updated in DEP's BMP Effectiveness Values document or Chesapeake Bay Program expert panel reports between the time the PRP is approved and the time the final report is developed, those updated effectiveness values may be used.

APPENDIX A

APPENDIX B

UPPER MORELAND TOWNSHIP
POLLUTANT REDUCTION PLAN (PRP)
PENNYPACK CREEK & WISSAHICKON CREEK WATERSHEDS

DATE: JULY 26, 2017



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APPENDIX C

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF CLEAN WATER

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
STORMWATER DISCHARGES FROM
SMALL MUNICIPAL SEPARATE STORM SEWER SYSTEMS
BMP EFFECTIVENESS VALUES

This table of BMP effectiveness values (i.e., pollutant removal efficiencies) is intended for use by MS4s that are developing and implementing Pollutant Reduction Plans and TMDL Plans to comply with NPDES permit requirements. The values used in this table generally consider pollutant reductions from both overland flow and reduced downstream erosion, and are based primarily on average values within the Chesapeake Assessment Scenario Tool (CAST) (www.casttool.org). Design considerations, operation and maintenance, and construction sequences should be as outlined in the Pennsylvania Stormwater BMP Manual, Chesapeake Bay Program guidance, or other technical sources. The Department of Environmental Protection (DEP) will update the information contained in this table as new information becomes available. Interested parties may submit information to DEP for consideration in updating this table to DEP's MS4 resource account, RA-EPPAMS4@pa.gov. Where an MS4 proposes a BMP not identified in this document or in Chesapeake Bay Program expert panel reports, other technical resources may be consulted for BMP effectiveness values. Note – TN = Total Nitrogen and TP = Total Phosphorus.

BMP Name	BMP Effectiveness Values			BMP Description
	TN	TP	Sediment	
Wet Ponds and Wetlands	20%	45%	60%	A water impoundment structure that intercepts stormwater runoff then releases it to an open water system at a specified flow rate. These structures retain a permanent pool and usually have retention times sufficient to allow settlement of some portion of the intercepted sediments and attached nutrients/toxics. Until recently, these practices were designed specifically to meet water quantity, not water quality objectives. There is little or no vegetation living within the pooled area nor are outfalls directed through vegetated areas prior to open water release. Nitrogen reduction is minimal.
Dry Detention Basins and Hydrodynamic Structures	5%	10%	10%	Dry Detention Ponds are depressions or basins created by excavation or berm construction that temporarily store runoff and release it slowly via surface flow or groundwater infiltration following storms. Hydrodynamic Structures are devices designed to improve quality of stormwater using features such as swirl concentrators, grit chambers, oil barriers, baffles, micropools, and absorbent pads that are designed to remove sediments, nutrients, metals, organic chemicals, or oil and grease from urban runoff.
Dry Extended Detention Basins	20%	20%	60%	Dry extended detention (ED) basins are depressions created by excavation or berm construction that temporarily store runoff and release it slowly via surface flow or groundwater infiltration following storms. Dry ED basins are designed to dry out between storm events, in contrast with wet ponds, which contain standing water permanently. As such, they are similar in construction and function to dry detention basins, except that the duration of detention of stormwater is designed to be longer, theoretically improving treatment effectiveness.

BMP Name	BMP Effectiveness Values			BMP Description
	TN	TP	Sediment	
Infiltration Practices w/ Sand, Veg.	85%	85%	95%	A depression to form an infiltration basin where sediment is trapped and water infiltrates the soil. No underdrains are associated with infiltration basins and trenches, because by definition these systems provide complete infiltration. Design specifications require infiltration basins and trenches to be built in good soil, they are not constructed on poor soils, such as C and D soil types. Engineers are required to test the soil before approval to build is issued. To receive credit over the longer term, jurisdictions must conduct yearly inspections to determine if the basin or trench is still infiltrating runoff.
Filtering Practices	40%	60%	80%	Practices that capture and temporarily store runoff and pass it through a filter bed of either sand or an organic media. There are various sand filter designs, such as above ground, below ground, perimeter, etc. An organic media filter uses another medium besides sand to enhance pollutant removal for many compounds due to the increased cation exchange capacity achieved by increasing the organic matter. These systems require yearly inspection and maintenance to receive pollutant reduction credit.
Filter Strip Runoff Reduction	20%	54%	56%	Urban filter strips are stable areas with vegetated cover on flat or gently sloping land. Runoff entering the filter strip must be in the form of sheet-flow and must enter at a non-erosive rate for the site-specific soil conditions. A 0.4 design ratio of filter strip length to impervious flow length is recommended for runoff reduction urban filter strips.
Filter Strip Stormwater Treatment	0%	0%	22%	Urban filter strips are stable areas with vegetated cover on flat or gently sloping land. Runoff entering the filter strip must be in the form of sheet-flow and must enter at a non-erosive rate for the site-specific soil conditions. A 0.2 design ratio of filter strip length to impervious flow length is recommended for stormwater treatment urban filter strips.
Bioretention – Raingarden (C/D soils w/ underdrain)	25%	45%	55%	An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. This BMP has an underdrain and is in C or D soil.
Bioretention / Raingarden (A/B soils w/ underdrain)	70%	75%	80%	An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. This BMP has an underdrain and is in A or B soil.

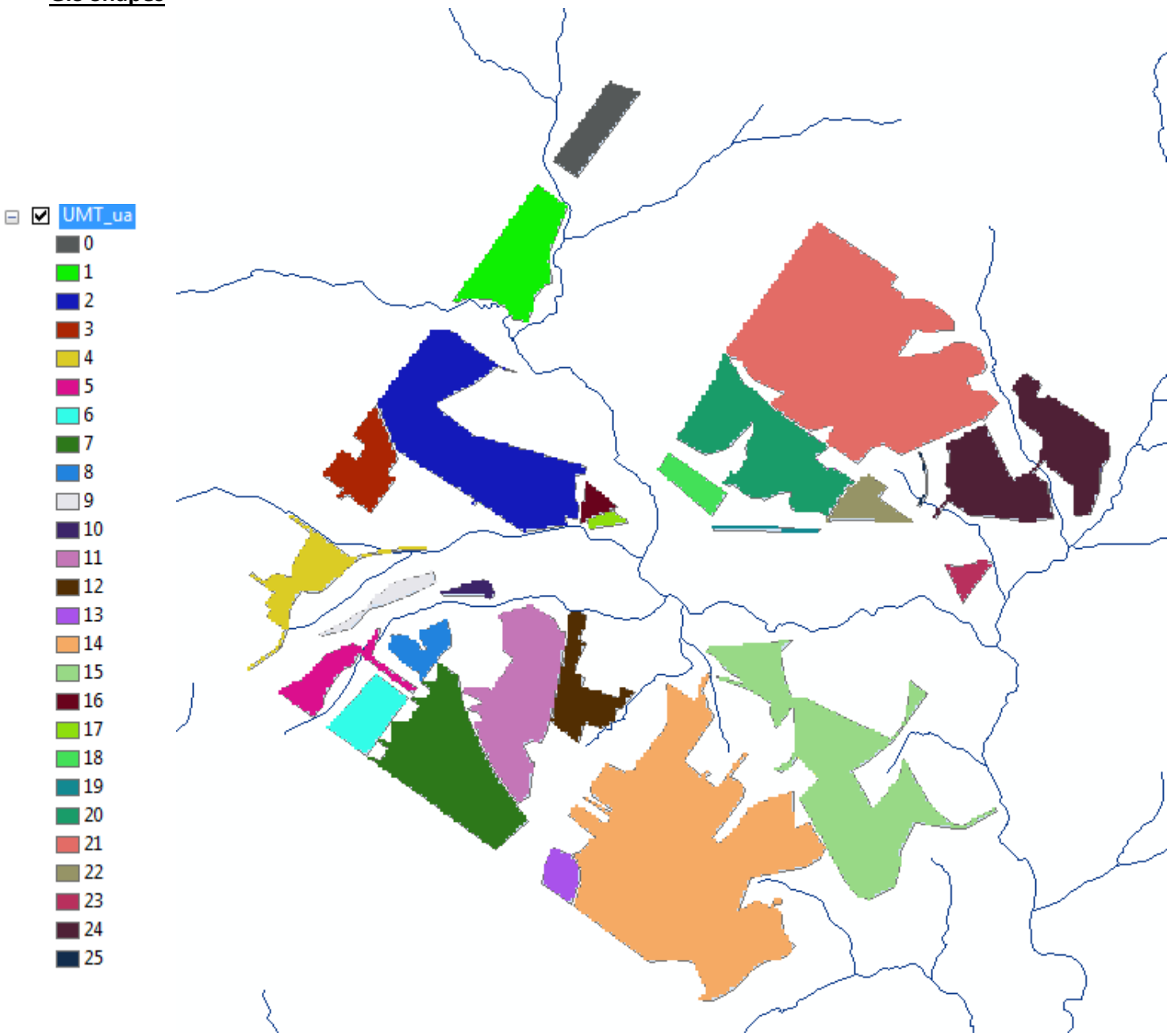
BMP Name	BMP Effectiveness Values			BMP Description
	TN	TP	Sediment	
Bioretention / Raingarden (A/B soils w/o underdrain)	80%	85%	90%	An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. This BMP has no underdrain and is in A or B soil.
Vegetated Open Channels (C/D Soils)	10%	10%	50%	Open channels are practices that convey stormwater runoff and provide treatment as the water is conveyed, includes bioswales. Runoff passes through either vegetation in the channel, subsoil matrix, and/or is infiltrated into the underlying soils. This BMP has no underdrain and is in C or D soil.
Vegetated Open Channels (A/B Soils)	45%	45%	70%	Open channels are practices that convey stormwater runoff and provide treatment as the water is conveyed, includes bioswales. Runoff passes through either vegetation in the channel, subsoil matrix, and/or is infiltrated into the underlying soils. This BMP has no underdrain and is in A or B soil.
Bioswale	70%	75%	80%	With a bioswale, the load is reduced because, unlike other open channel designs, there is now treatment through the soil. A bioswale is designed to function as a bioretention area.
Permeable Pavement w/o Sand or Veg. (C/D Soils w/ underdrain)	10%	20%	55%	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has an underdrain, no sand or vegetation and is in C or D soil.
Permeable Pavement w/o Sand or Veg. (A/B Soils w/ underdrain)	45%	50%	70%	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has an underdrain, no sand or vegetation and is in A or B soil.
Permeable Pavement w/o Sand or Veg. (A/B Soils w/o underdrain)	75%	80%	85%	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has no underdrain, no sand or vegetation and is in A or B soil.
Permeable Pavement w/ Sand or Veg. (A/B Soils w/ underdrain)	50%	50%	70%	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has an underdrain, has sand and/or vegetation and is in A or B soil.

BMP Name	BMP Effectiveness Values			BMP Description
	TN	TP	Sediment	
Permeable Pavement w/ Sand or Veg. (A/B Soils w/o underdrain)	80%	80%	85%	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has no underdrain, has sand and/or vegetation and is in A or B soil.
Permeable Pavement w/ Sand or Veg. (C/D Soils w/ underdrain)	20%	20%	55%	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has an underdrain, has sand and/or vegetation and is in C or D soil.
Stream Restoration	0.075 lbs/ft/yr	0.068 lbs/ft/yr	44.88 lbs/ft/yr	An annual mass nutrient and sediment reduction credit for qualifying stream restoration practices that prevent channel or bank erosion that otherwise would be delivered downstream from an actively enlarging or incising urban stream. Applies to 0 to 3rd order streams that are not tidally influenced. If one of the protocols is cited and pounds are reported, then the mass reduction is received for the protocol.
Forest Buffers	25%	50%	50%	An area of trees at least 35 feet wide on one side of a stream, usually accompanied by trees, shrubs and other vegetation that is adjacent to a body of water. The riparian area is managed to maintain the integrity of stream channels and shorelines, to reduce the impacts of upland sources of pollution by trapping, filtering, and converting sediments, nutrients, and other chemicals. (Note – the values represent pollutant load reductions from stormwater draining through buffers).
Tree Planting	10%	15%	20%	The BMP effectiveness values for tree planting are estimated by DEP. DEP estimates that 100 fully mature trees of mixed species (both deciduous and non-deciduous) provide pollutant load reductions for the equivalent of one acre (i.e., one mature tree = 0.01 acre). The BMP effectiveness values given are based on immature trees (seedlings or saplings); the effectiveness values are expected to increase as the trees mature. To determine the amount of pollutant load reduction that can credited for tree planting efforts: 1) multiply the number of trees planted by 0.01; 2) multiply the acreage determined in step 1 by the pollutant loading rate for the land prior to planting the trees (in lbs/acre/year); and 3) multiply the result of step 2 by the BMP effectiveness values given.
Street Sweeping	3%	3%	9%	Street sweeping must be conducted 25 times annually. Only count those streets that have been swept at least 25 times in a year. The acres associated with all streets that have been swept at least 25 times in a year would be eligible for pollutant reductions consistent with the given BMP effectiveness values.

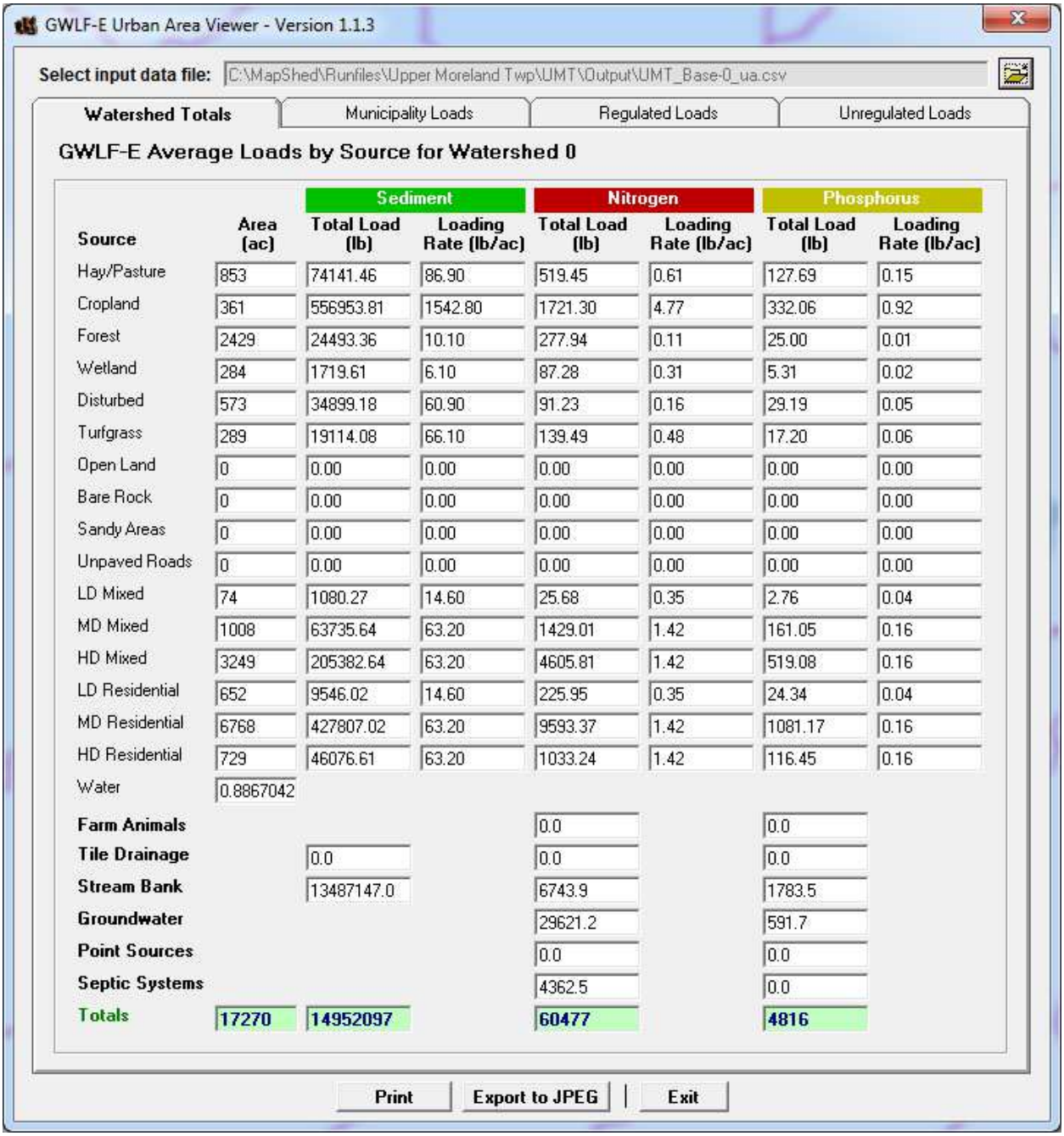
BMP Name	BMP Effectiveness Values			BMP Description
	TN	TP	Sediment	
Storm Sewer System Solids Removal	0.0027 for sediment, 0.0111 for organic matter	0.0006 for sediment, 0.0012 for organic matter	1 – TN and TP concentrations	This BMP (also referred to as "Storm Drain Cleaning") involves the collection or capture and proper disposal of solid material within the storm system to prevent discharge to surface waters. Examples include catch basins, stormwater inlet filter bags, end of pipe or outlet solids removal systems and related practices. Credit is authorized for this BMP only when proper maintenance practices are observed (i.e., inspection and removal of solids as recommended by the system manufacturer or other available guidelines). The entity using this BMP for pollutant removal credits must demonstrate that they have developed and are implementing a standard operating procedure for tracking the material removed from the sewer system. Locating such BMPs should consider the potential for backups onto roadways or other areas that can produce safety hazards. To determine pollutant reductions for this BMP, these steps must be taken: 1) Measure the weight of solid/organic material collected (lbs). Sum the total weight of material collected for an annual period. Note – do not include refuse, debris and floatables in the determination of total mass collected. 2) Convert the annual wet weight captured into annual dry weight (lbs) by using site-specific measurements (i.e., dry a sample of the wet material to find its weight) or by using default factors of 0.7 (material that is predominantly wet sediment) or 0.2 (material that is predominantly wet organic matter, e.g., leaf litter). 3) Multiply the annual dry weight of material collected by default or site-specific pollutant concentration factors. The default concentrations are shown in the BMP Effectiveness Values columns. Alternatively, the material may be sampled (at least annually) to determine site-specific pollutant concentrations. DEP will allow up to 50% of total pollutant reduction requirements to be met through this BMP. The drainage area treated by this BMP may be no greater than 0.5 acre unless it can be demonstrated that the specific system proposed is capable of treating stormwater from larger drainage areas. For planning purposes, the sediment removal efficiency specified by the manufacturer may be assumed, but no higher than 80%.

APPENDIX D

GIS Shapes



Baseline:



GWLF-E Urban Area Viewer - Version 1.1.3

Select input data file: C:\MapShed\Runfiles\Upper Moreland Twp\UMT\Output\UMT_Base-0_ua.csv

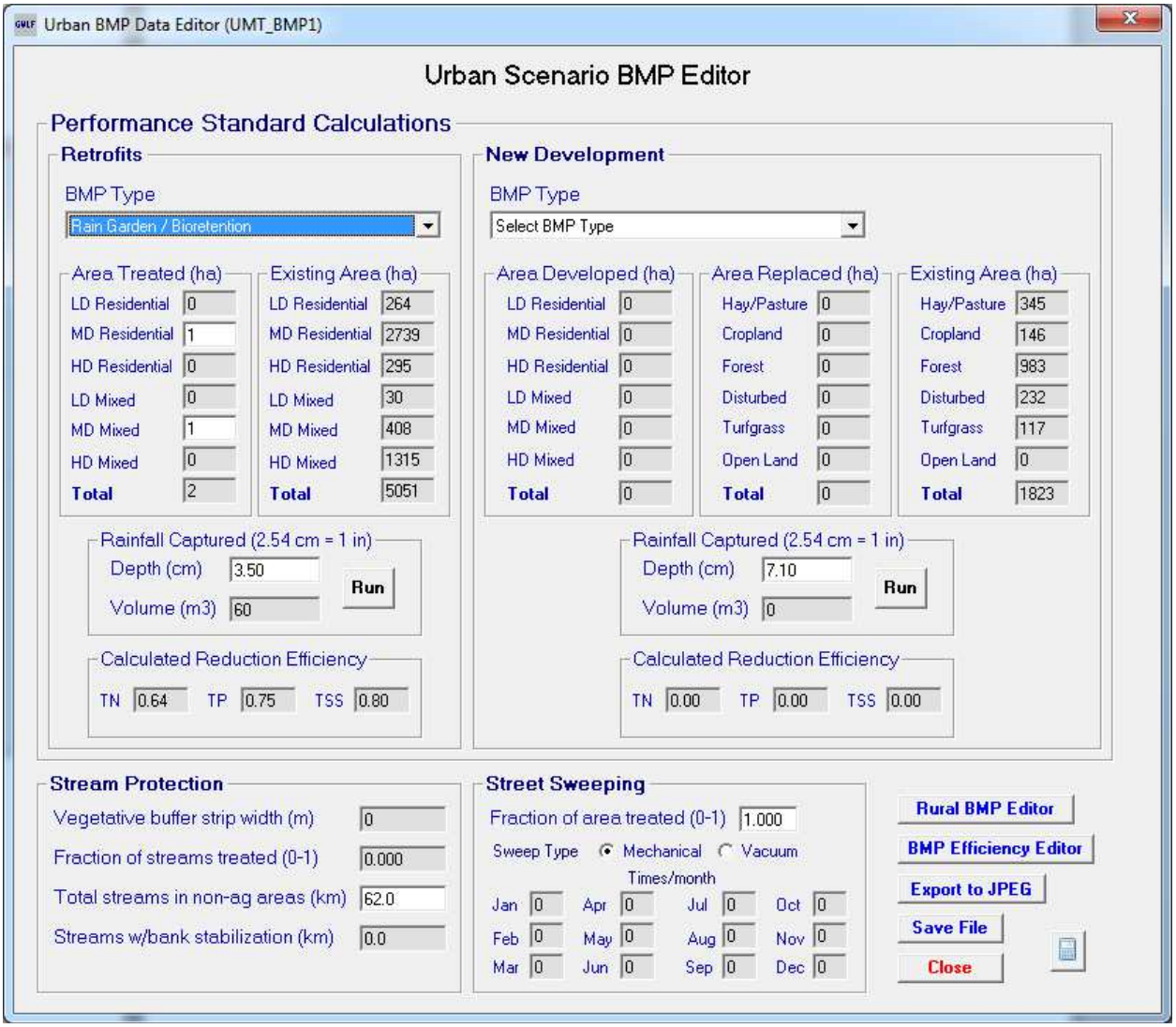
Watershed Totals | Municipality Loads | Regulated Loads | Unregulated Loads

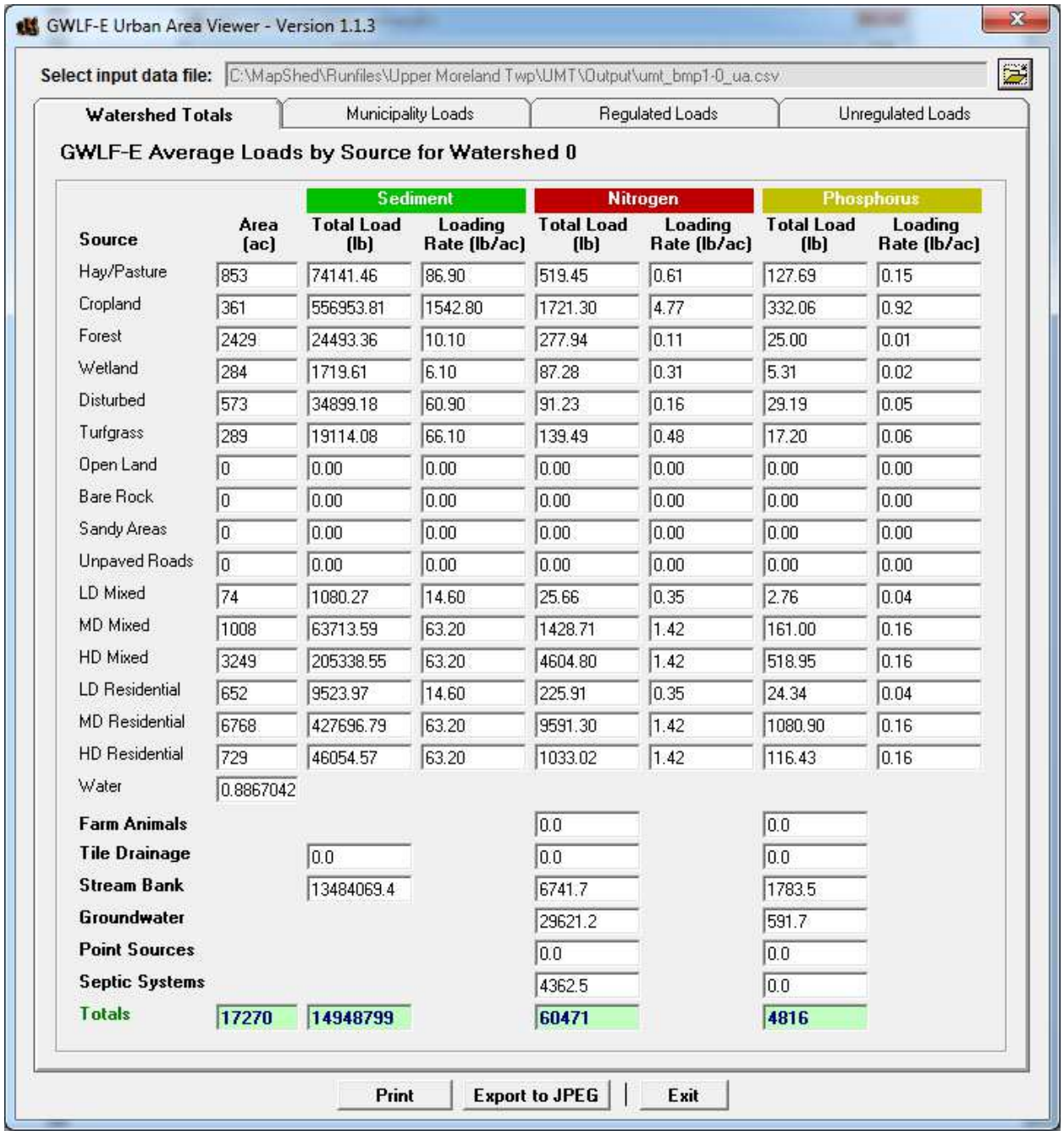
GWLF-E Average Loads by Source for Watershed 0

Source	Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	853	74141.46	86.90	519.45	0.61	127.69	0.15
Cropland	361	556953.81	1542.80	1721.30	4.77	332.06	0.92
Forest	2429	24493.36	10.10	277.94	0.11	25.00	0.01
Wetland	284	1719.61	6.10	87.28	0.31	5.31	0.02
Disturbed	573	34899.18	60.90	91.23	0.16	29.19	0.05
Turfgrass	289	19114.08	66.10	139.49	0.48	17.20	0.06
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	74	1080.27	14.60	25.68	0.35	2.76	0.04
MD Mixed	1008	63735.64	63.20	1429.01	1.42	161.05	0.16
HD Mixed	3249	205382.64	63.20	4605.81	1.42	519.08	0.16
LD Residential	652	9546.02	14.60	225.95	0.35	24.34	0.04
MD Residential	6768	427807.02	63.20	9593.37	1.42	1081.17	0.16
HD Residential	729	46076.61	63.20	1033.24	1.42	116.45	0.16
Water	0.8867042						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		13487147.0		6743.9		1783.5	
Groundwater				29621.2		591.7	
Point Sources				0.0		0.0	
Septic Systems				4362.5		0.0	
Totals	**17270**	**14952097**		**60477**		**4816**	

Print | Export to JPEG | Exit

BMP (1)


Urban BMP Data Editor (UMT_BMP1)
Urban Scenario BMP Editor
Performance Standard Calculations
Retrofits
BMP Type
Rain Garden / Bioretention
Area Treated (ha)
LD Residential 0
MD Residential 1
HD Residential 0
LD Mixed 0
MD Mixed 1
HD Mixed 0
Total 2
Existing Area (ha)
LD Residential 264
MD Residential 2739
HD Residential 295
LD Mixed 30
MD Mixed 408
HD Mixed 1315
Total 5051
Rainfall Captured (2.54 cm = 1 in)
Depth (cm) 3.50
Volume (m3) 60
Run
Calculated Reduction Efficiency
TN 0.64 TP 0.75 TSS 0.80
New Development
BMP Type
Select BMP Type
Area Developed (ha)
LD Residential 0
MD Residential 0
HD Residential 0
LD Mixed 0
MD Mixed 0
HD Mixed 0
Total 0
Area Replaced (ha)
Hay/Pasture 0
Cropland 0
Forest 0
Disturbed 0
Turfgrass 0
Open Land 0
Total 0
Existing Area (ha)
Hay/Pasture 345
Cropland 146
Forest 983
Disturbed 232
Turfgrass 117
Open Land 0
Total 1823
Rainfall Captured (2.54 cm = 1 in)
Depth (cm) 7.10
Volume (m3) 0
Run
Calculated Reduction Efficiency
TN 0.00 TP 0.00 TSS 0.00
Stream Protection
Vegetative buffer strip width (m) 0
Fraction of streams treated (0-1) 0.000
Total streams in non-ag areas (km) 62.0
Streams w/bank stabilization (km) 0.0
Street Sweeping
Fraction of area treated (0-1) 1.000
Sweep Type Mechanical Vacuum
Times/month
Jan 0 Apr 0 Jul 0 Oct 0
Feb 0 May 0 Aug 0 Nov 0
Mar 0 Jun 0 Sep 0 Dec 0
Rural BMP Editor
BMP Efficiency Editor
Export to JPEG
Save File
Close


GWLF-E Urban Area Viewer - Version 1.1.3
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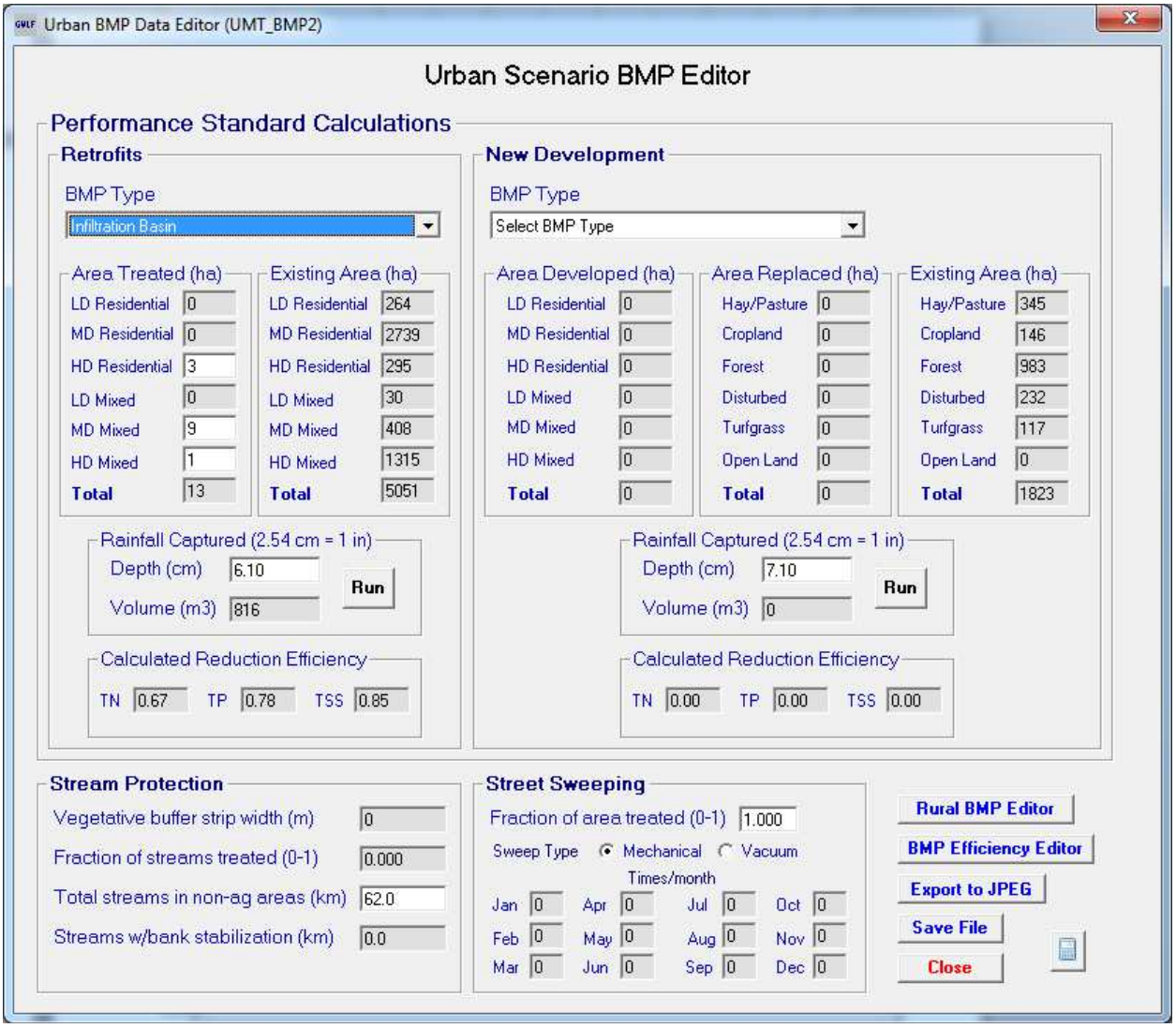
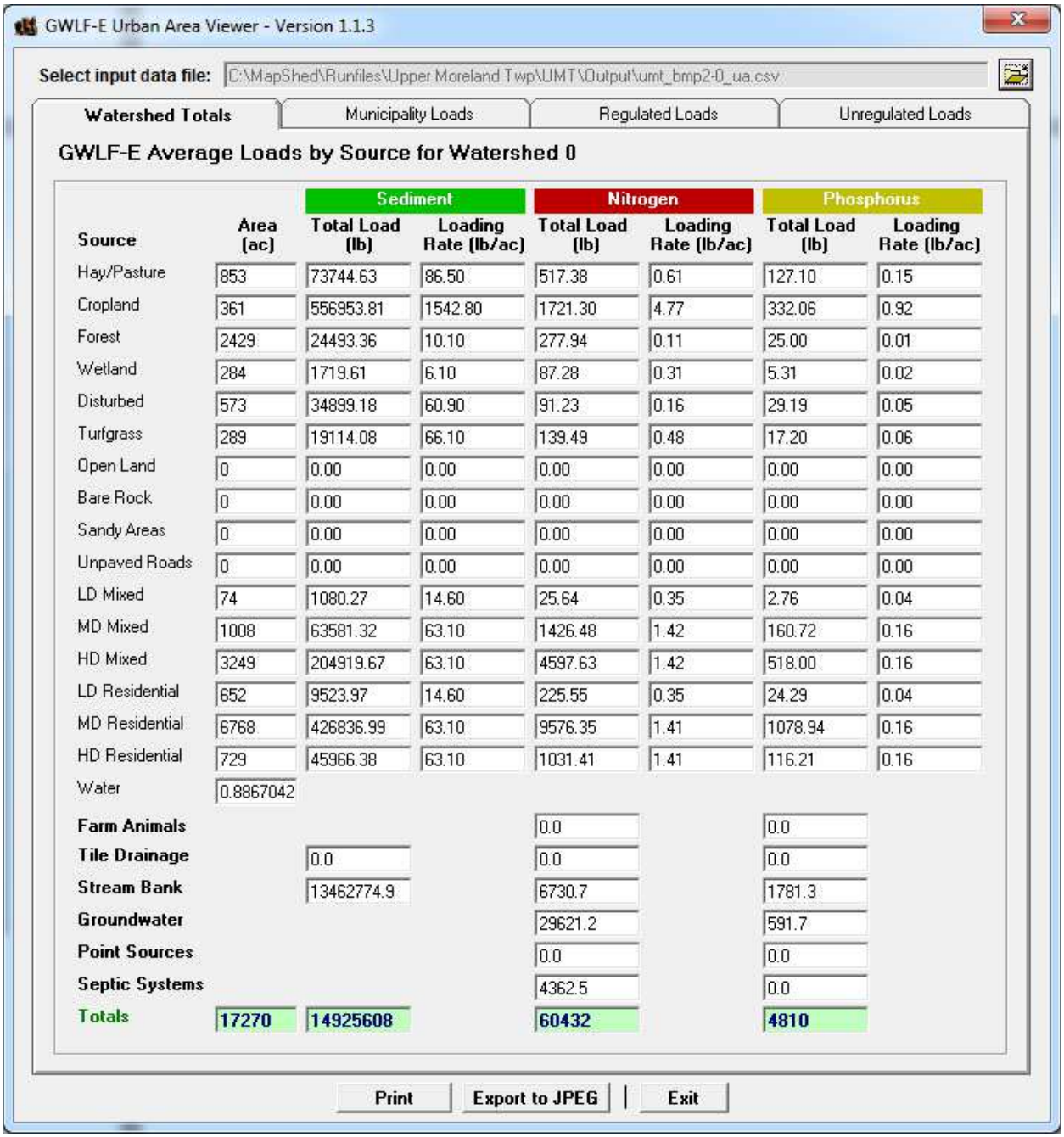
Watershed Totals
Municipality Loads
Regulated Loads
Unregulated Loads
GWLF-E Average Loads by Source for Watershed 0
Sediment
Nitrogen
Phosphorus
Source
Area (ac)
Total Load (lb)
Loading Rate (lb/ac)
Total Load (lb)
Loading Rate (lb/ac)
Total Load (lb)
Loading Rate (lb/ac)
Hay/Pasture 853 74141.46 86.90 519.45 0.61 127.69 0.15
Cropland 361 556953.81 1542.80 1721.30 4.77 332.06 0.92
Forest 2429 24493.36 10.10 277.94 0.11 25.00 0.01
Wetland 284 1719.61 6.10 87.28 0.31 5.31 0.02
Disturbed 573 34899.18 60.90 91.23 0.16 29.19 0.05
Turfgrass 289 19114.08 66.10 139.49 0.48 17.20 0.06
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 74 1080.27 14.60 25.66 0.35 2.76 0.04
MD Mixed 1008 63713.59 63.20 1428.71 1.42 161.00 0.16
HD Mixed 3249 205338.55 63.20 4604.80 1.42 518.95 0.16
LD Residential 652 9523.97 14.60 225.91 0.35 24.34 0.04
MD Residential 6768 427696.79 63.20 9591.30 1.42 1080.90 0.16
HD Residential 729 46054.57 63.20 1033.02 1.42 116.43 0.16
Water 0.8867042
Farm Animals 0.0 0.0
Tile Drainage 0.0 0.0 0.0
Stream Bank 13484069.4 6741.7 1783.5
Groundwater 29621.2 591.7
Point Sources 0.0 0.0
Septic Systems 4362.5 0.0
Totals 17270 14948799 60471 4816
Print
Export to JPEG
Exit

BMP (2)


Urban BMP Data Editor (UMT_BMP2)
Urban Scenario BMP Editor
Performance Standard Calculations
Retrofits
BMP Type
Infiltration Basin
Area Treated (ha)
LD Residential 0
MD Residential 0
HD Residential 3
LD Mixed 0
MD Mixed 9
HD Mixed 1
Total 13
Existing Area (ha)
LD Residential 264
MD Residential 2739
HD Residential 295
LD Mixed 30
MD Mixed 408
HD Mixed 1315
Total 5051
Rainfall Captured (2.54 cm = 1 in)
Depth (cm) 6.10
Volume (m3) 816
Run
Calculated Reduction Efficiency
TN 0.67 TP 0.78 TSS 0.85
New Development
BMP Type
Select BMP Type
Area Developed (ha)
LD Residential 0
MD Residential 0
HD Residential 0
LD Mixed 0
MD Mixed 0
HD Mixed 0
Total 0
Area Replaced (ha)
Hay/Pasture 0
Cropland 0
Forest 0
Disturbed 0
Turfgrass 0
Open Land 0
Total 0
Existing Area (ha)
Hay/Pasture 345
Cropland 146
Forest 983
Disturbed 232
Turfgrass 117
Open Land 0
Total 1823
Rainfall Captured (2.54 cm = 1 in)
Depth (cm) 7.10
Volume (m3) 0
Run
Calculated Reduction Efficiency
TN 0.00 TP 0.00 TSS 0.00
Stream Protection
Vegetative buffer strip width (m) 0
Fraction of streams treated (0-1) 0.000
Total streams in non-ag areas (km) 62.0
Streams w/bank stabilization (km) 0.0
Street Sweeping
Fraction of area treated (0-1) 1.000
Sweep Type Mechanical Vacuum
Times/month
Jan 0 Apr 0 Jul 0 Oct 0
Feb 0 May 0 Aug 0 Nov 0
Mar 0 Jun 0 Sep 0 Dec 0
Rural BMP Editor
BMP Efficiency Editor
Export to JPEG
Save File
Close


GWLF-E Urban Area Viewer - Version 1.1.3
Select input data file:
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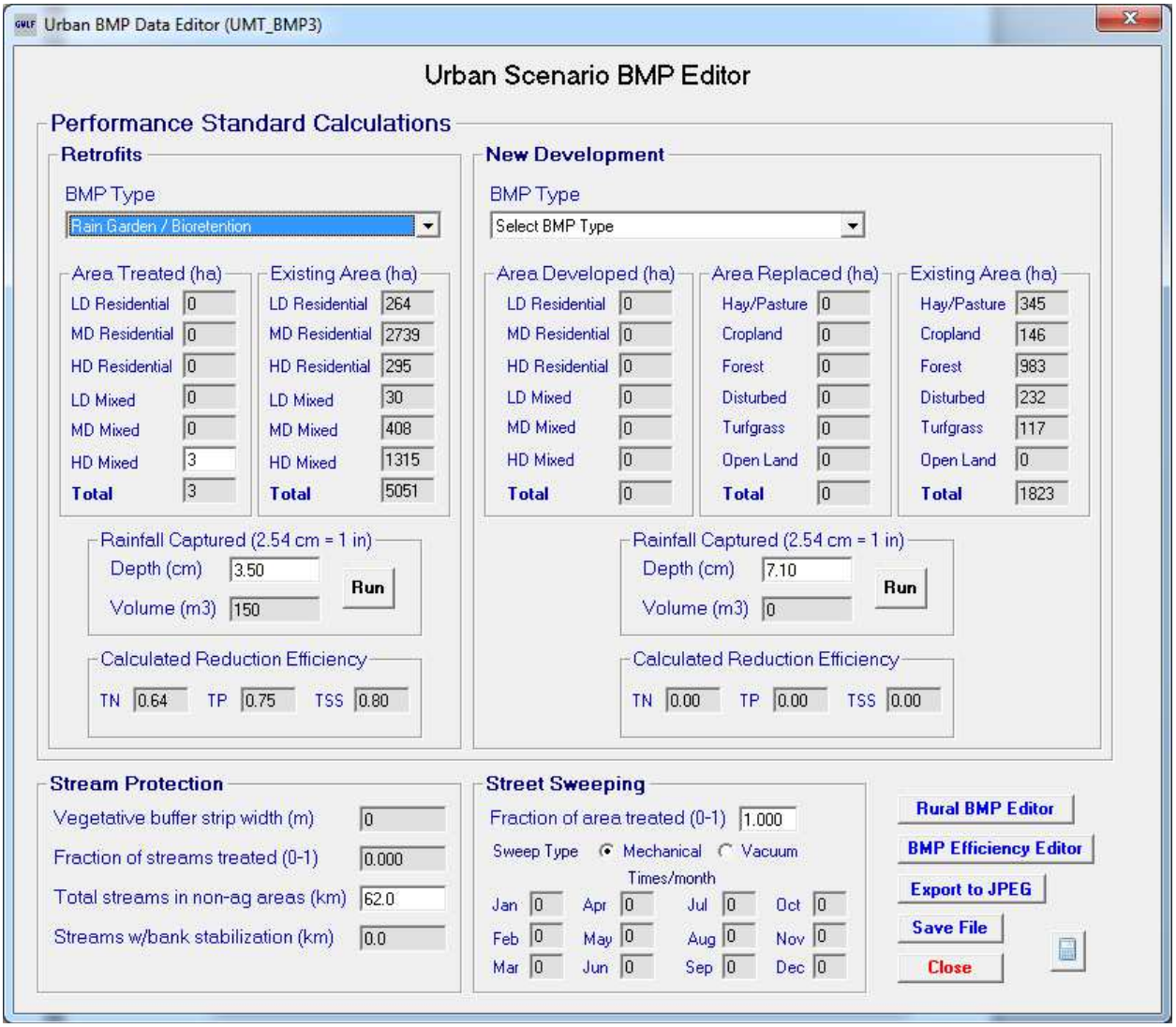
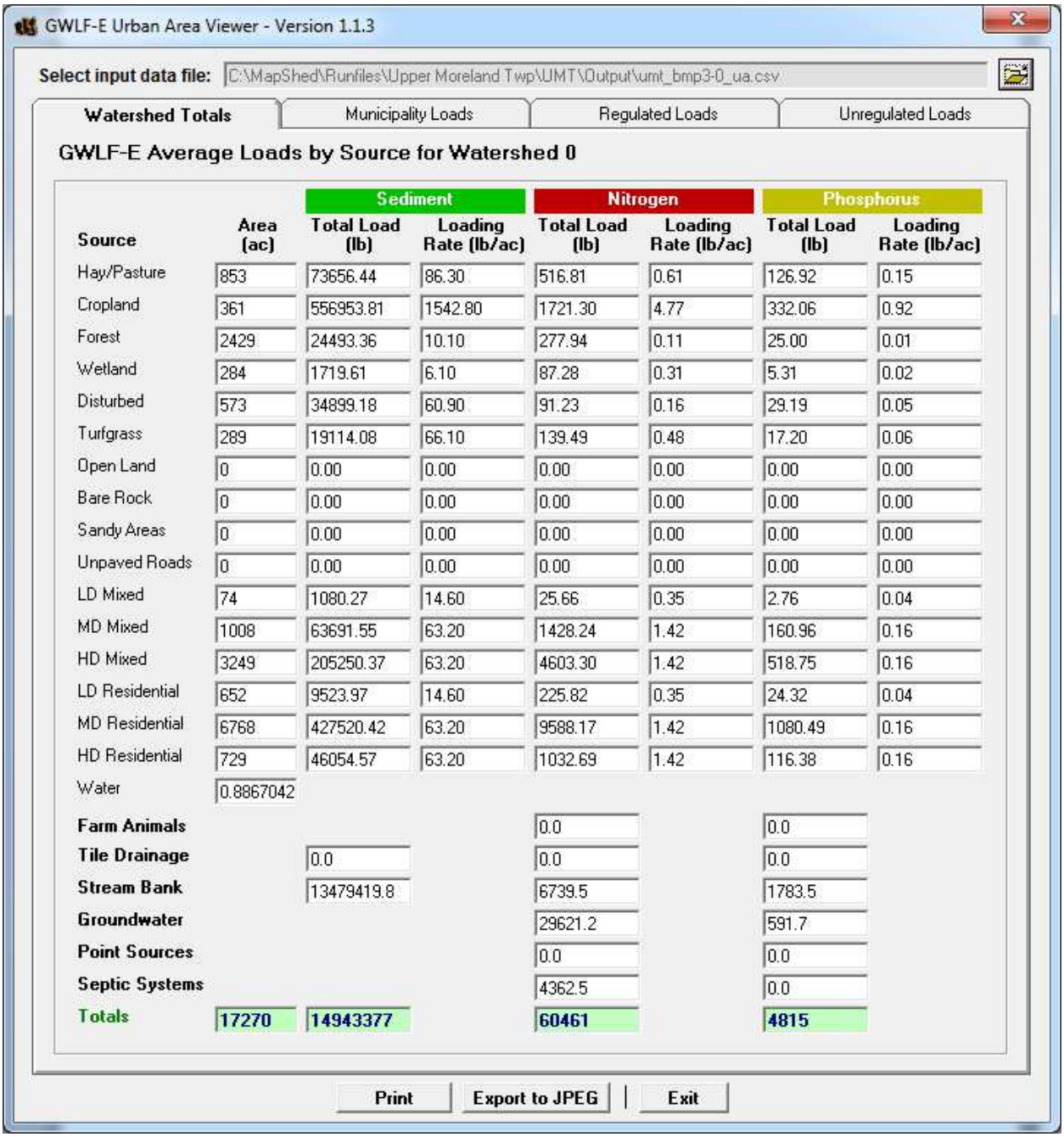
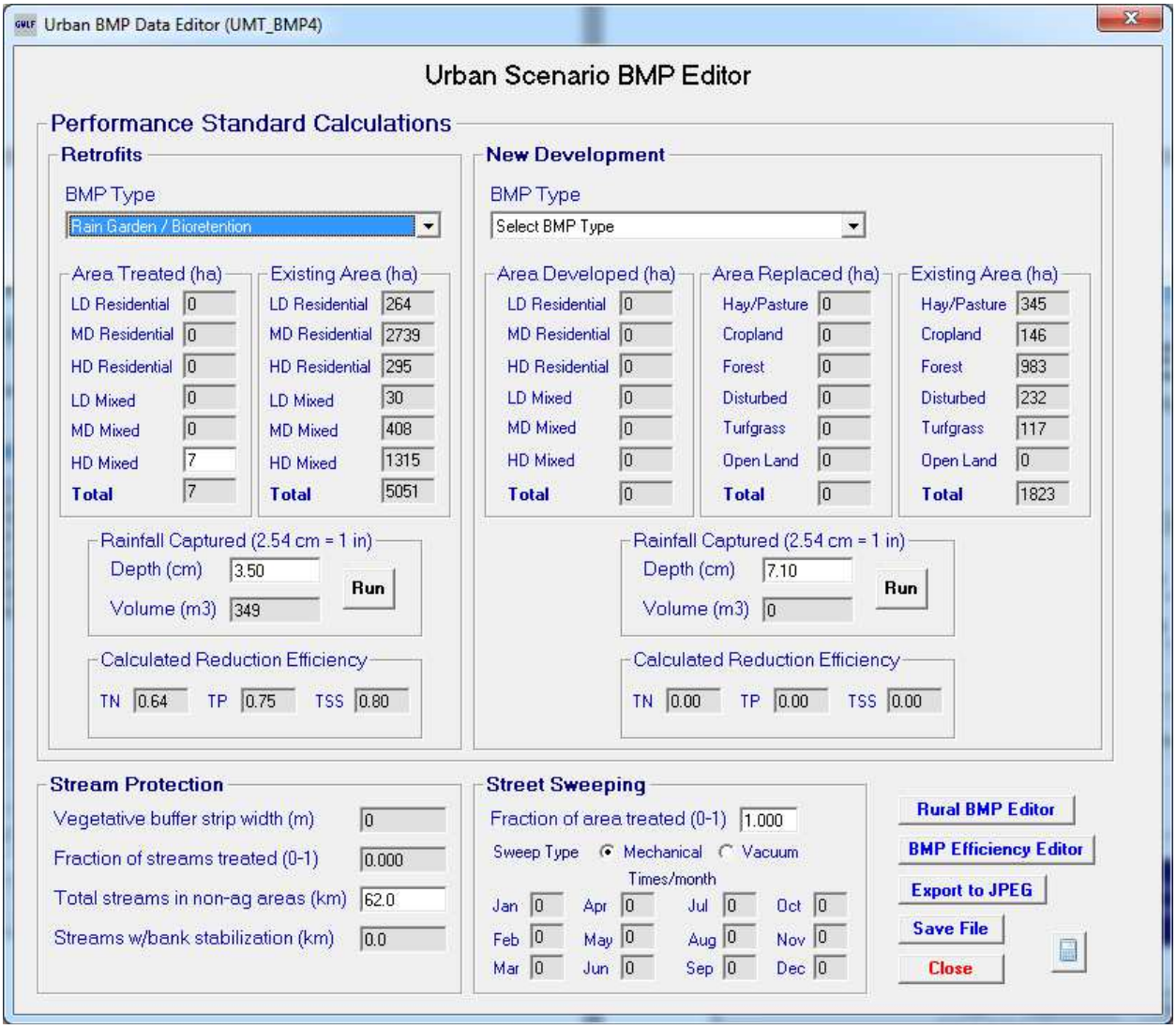
Watershed Totals
Municipality Loads
Regulated Loads
Unregulated Loads
GWLF-E Average Loads by Source for Watershed 0
Sediment
Nitrogen
Phosphorus
Source
Area (ac)
Total Load (lb)
Loading Rate (lb/ac)
Total Load (lb)
Loading Rate (lb/ac)
Total Load (lb)
Loading Rate (lb/ac)
Hay/Pasture 853 73744.63 86.50 517.38 0.61 127.10 0.15
Cropland 361 556953.81 1542.80 1721.30 4.77 332.06 0.92
Forest 2429 24493.36 10.10 277.94 0.11 25.00 0.01
Wetland 284 1719.61 6.10 87.28 0.31 5.31 0.02
Disturbed 573 34899.18 60.90 91.23 0.16 29.19 0.05
Turfgrass 289 19114.08 66.10 139.49 0.48 17.20 0.06
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 74 1080.27 14.60 25.64 0.35 2.76 0.04
MD Mixed 1008 63581.32 63.10 1426.48 1.42 160.72 0.16
HD Mixed 3249 204919.67 63.10 4597.63 1.42 518.00 0.16
LD Residential 652 9523.97 14.60 225.55 0.35 24.29 0.04
MD Residential 6768 426836.99 63.10 9576.35 1.41 1078.94 0.16
HD Residential 729 45966.38 63.10 1031.41 1.41 116.21 0.16
Water 0.8867042
Farm Animals 0.0 0.0
Tile Drainage 0.0 0.0 0.0
Stream Bank 13462774.9 6730.7 1781.3
Groundwater 29621.2 591.7
Point Sources 0.0 0.0
Septic Systems 4362.5 0.0
Totals 17270 14925608 60432 4810
Print
Export to JPEG
Exit

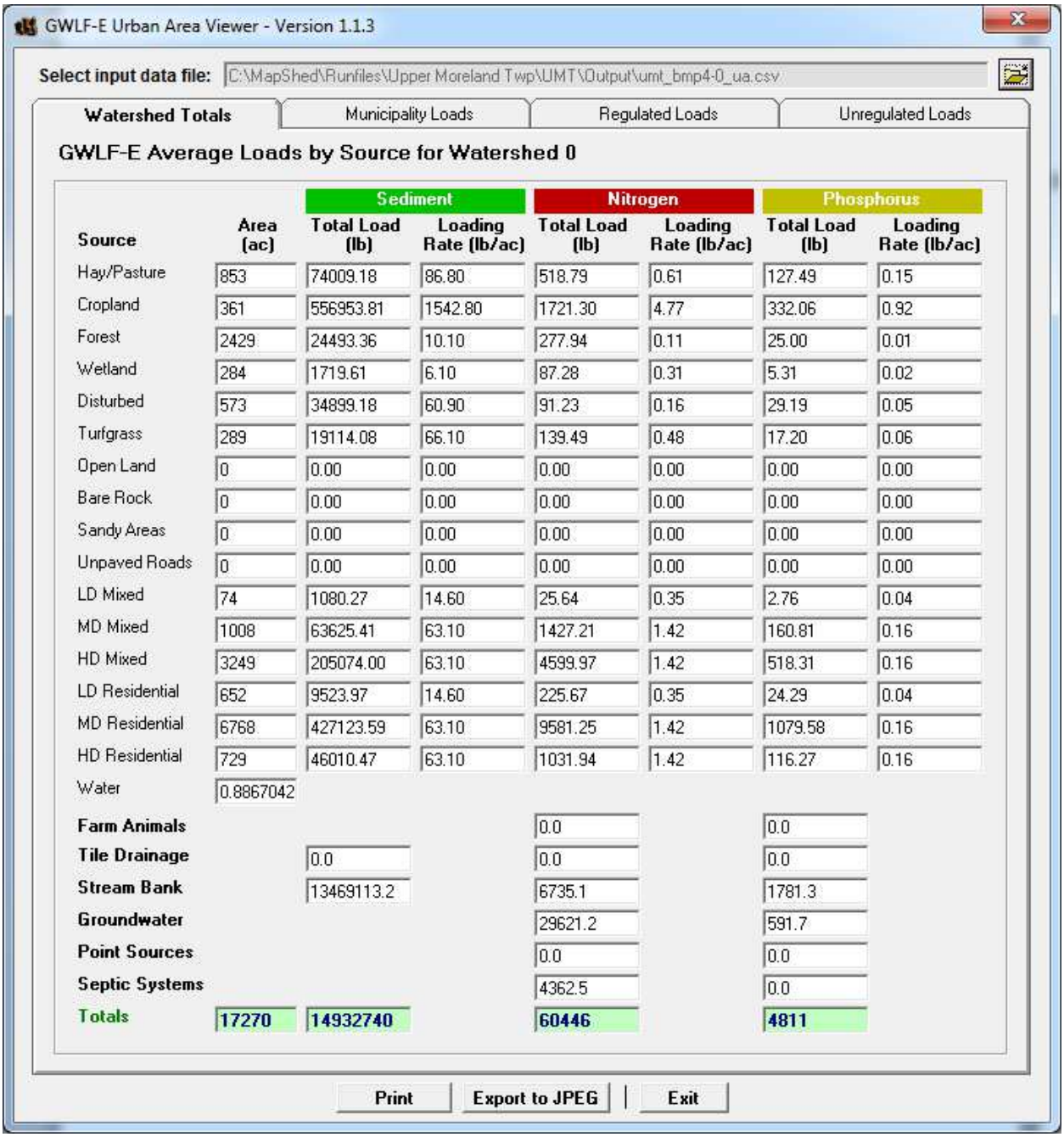
BMP (3): Basin Retrofit at Jason Drive (Southern basin)



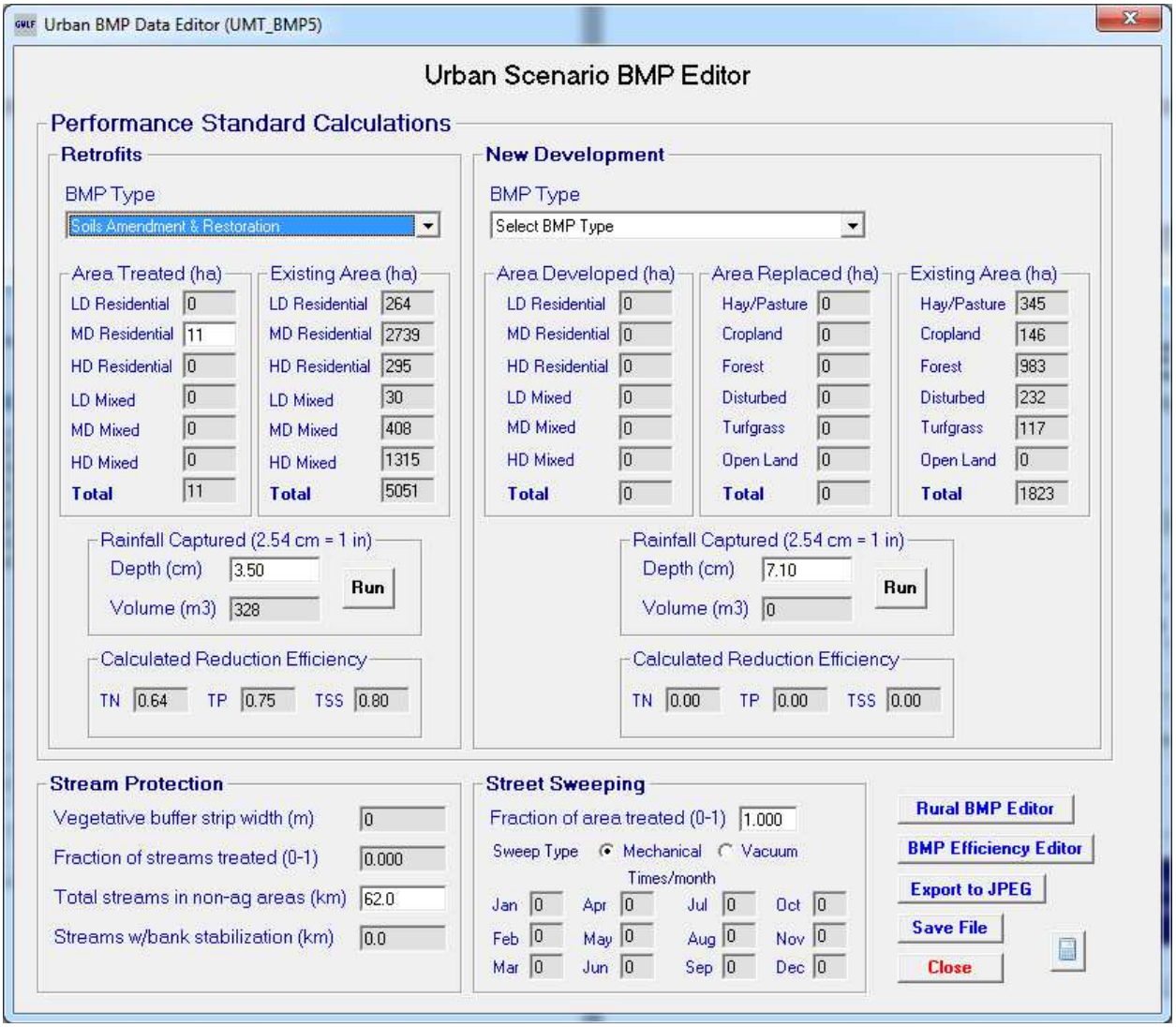

GWLF-E Urban Area Viewer - Version 1.1.3
Select input data file:
C:\MapShed\Runfiles\Upper Moreland Twp\UMT\Output\umt_bmp3-0_ua.csv
Watershed Totals
Municipality Loads
Regulated Loads
Unregulated Loads
GWLF-E Average Loads by Source for Watershed 0
Sediment
Nitrogen
Phosphorus
Source
Area (ac)
Total Load (lb)
Loading Rate (lb/ac)
Total Load (lb)
Loading Rate (lb/ac)
Total Load (lb)
Loading Rate (lb/ac)
Hay/Pasture 853 73656.44 86.30 516.81 0.61 126.92 0.15
Cropland 361 556953.81 1542.80 1721.30 4.77 332.06 0.92
Forest 2429 24493.36 10.10 277.94 0.11 25.00 0.01
Wetland 284 1719.61 6.10 87.28 0.31 5.31 0.02
Disturbed 573 34899.18 60.90 91.23 0.16 29.19 0.05
Turfgrass 289 19114.08 66.10 139.49 0.48 17.20 0.06
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 74 1080.27 14.60 25.66 0.35 2.76 0.04
MD Mixed 1008 63691.55 63.20 1428.24 1.42 160.96 0.16
HD Mixed 3249 205250.37 63.20 4603.30 1.42 518.75 0.16
LD Residential 652 9523.97 14.60 225.82 0.35 24.32 0.04
MD Residential 6768 427520.42 63.20 9588.17 1.42 1080.49 0.16
HD Residential 729 46054.57 63.20 1032.69 1.42 116.38 0.16
Water 0.8867042
Farm Animals 0.0 0.0
Tile Drainage 0.0 0.0 0.0
Stream Bank 13479419.8 6739.5 1783.5
Groundwater 29621.2 591.7
Point Sources 0.0 0.0
Septic Systems 4362.5 0.0
Totals 17270 14943377 60461 4815
Print
Export to JPEG
Exit

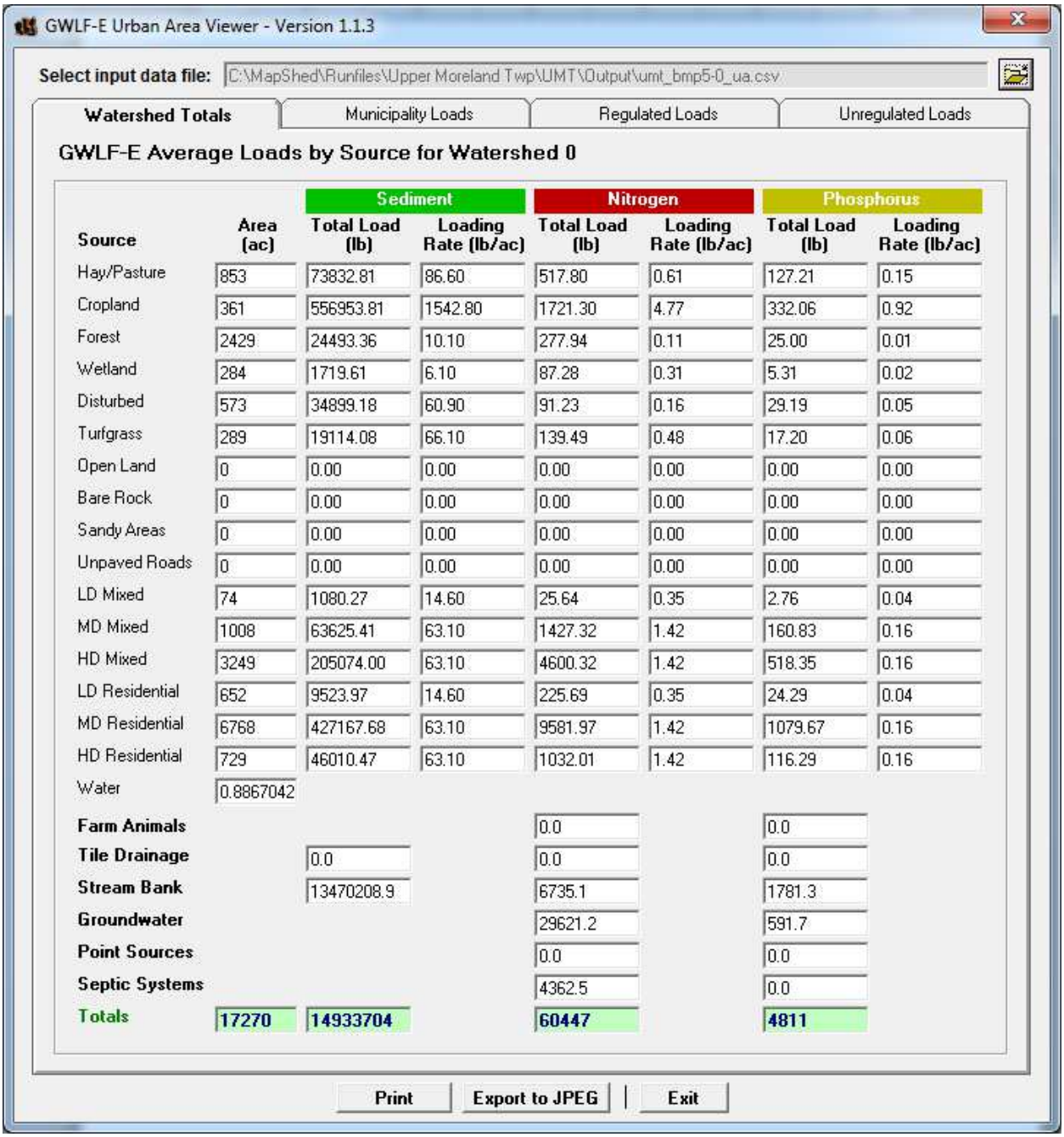
BMP (4): Basin Retrofit at Jason Drive (Northern basin)



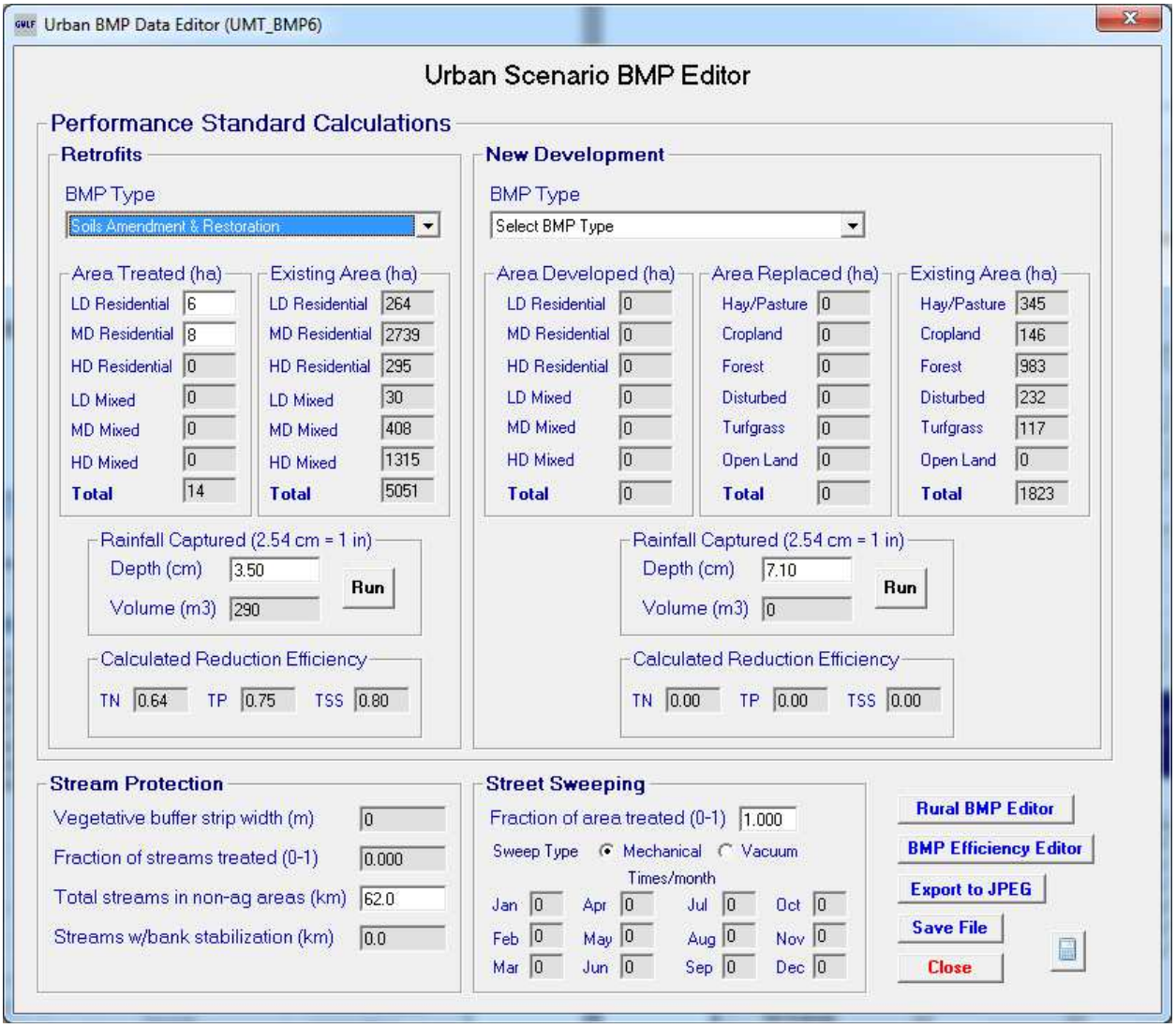

GWLF-E Urban Area Viewer - Version 1.1.3
Select input data file:
C:\MapShed\Runfiles\Upper Moreland Twp\UMT\Output\umt_bmp4-0_ua.csv
Watershed Totals
Municipality Loads
Regulated Loads
Unregulated Loads
GWLF-E Average Loads by Source for Watershed 0
Sediment
Nitrogen
Phosphorus
Source
Area (ac)
Total Load (lb)
Loading Rate (lb/ac)
Total Load (lb)
Loading Rate (lb/ac)
Total Load (lb)
Loading Rate (lb/ac)
Hay/Pasture 853 74009.18 86.80 518.79 0.61 127.49 0.15
Cropland 361 556953.81 1542.80 1721.30 4.77 332.06 0.92
Forest 2429 24493.36 10.10 277.94 0.11 25.00 0.01
Wetland 284 1719.61 6.10 87.28 0.31 5.31 0.02
Disturbed 573 34899.18 60.90 91.23 0.16 29.19 0.05
Turfgrass 289 19114.08 66.10 139.49 0.48 17.20 0.06
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 74 1080.27 14.60 25.64 0.35 2.76 0.04
MD Mixed 1008 63625.41 63.10 1427.21 1.42 160.81 0.16
HD Mixed 3249 205074.00 63.10 4599.97 1.42 518.31 0.16
LD Residential 652 9523.97 14.60 225.67 0.35 24.29 0.04
MD Residential 6768 427123.59 63.10 9581.25 1.42 1079.58 0.16
HD Residential 729 46010.47 63.10 1031.94 1.42 116.27 0.16
Water 0.8867042
Farm Animals 0.0 0.0
Tile Drainage 0.0 0.0 0.0
Stream Bank 13469113.2 6735.1 1781.3
Groundwater 29621.2 591.7
Point Sources 0.0 0.0
Septic Systems 4362.5 0.0
Totals 17270 14932740 60446 4811
Print
Export to JPEG
Exit

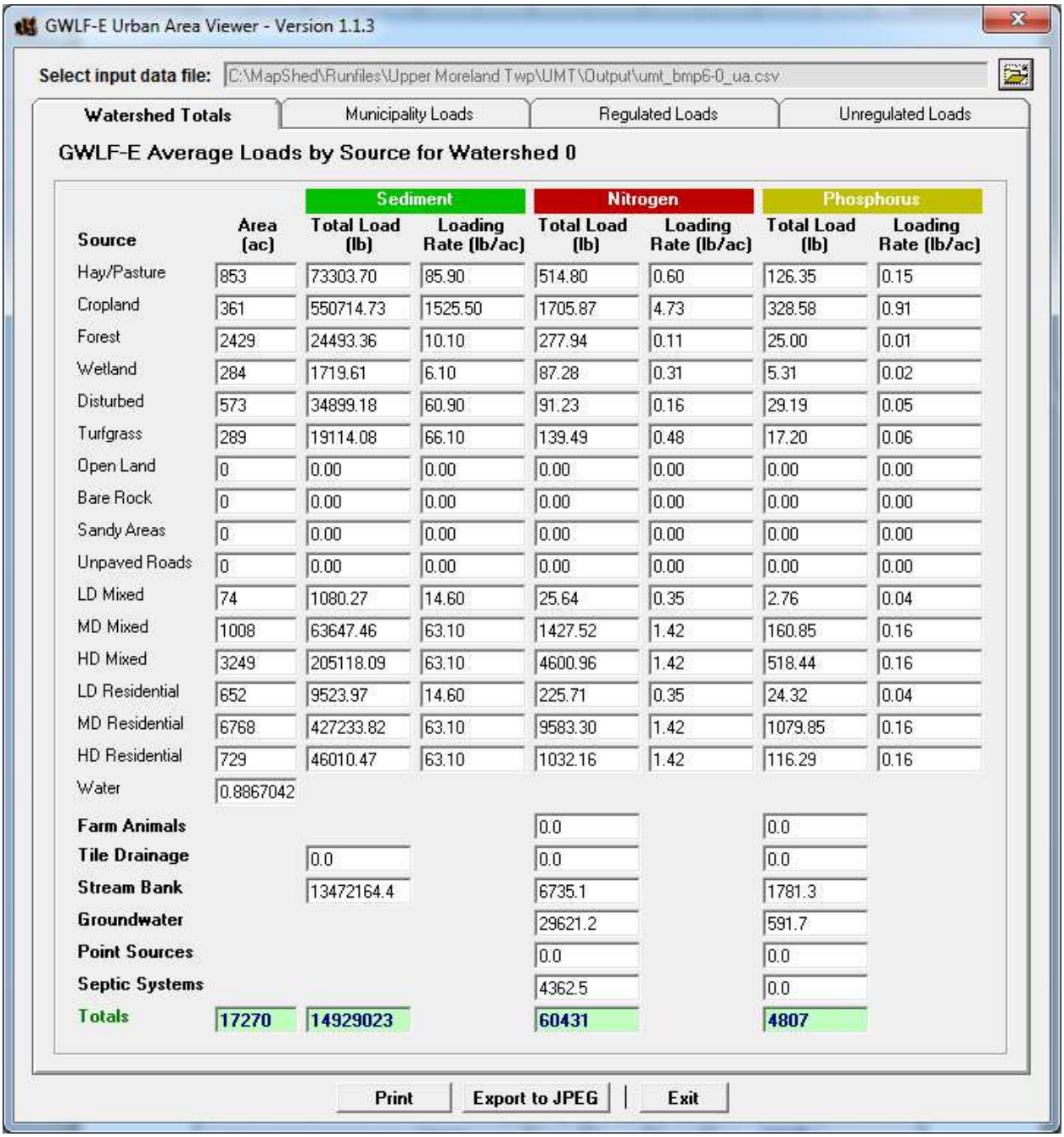
BMP (5)


Urban BMP Data Editor (UMT_BMP5)
Urban Scenario BMP Editor
Performance Standard Calculations
Retrofits
BMP Type
Soils Amendment & Restoration
Area Treated (ha)
LD Residential 0
MD Residential 11
HD Residential 0
LD Mixed 0
MD Mixed 0
HD Mixed 0
Total 11
Existing Area (ha)
LD Residential 264
MD Residential 2739
HD Residential 295
LD Mixed 30
MD Mixed 408
HD Mixed 1315
Total 5051
Rainfall Captured (2.54 cm = 1 in)
Depth (cm) 3.50
Volume (m3) 328
Run
Calculated Reduction Efficiency
TN 0.64 TP 0.75 TSS 0.80
New Development
BMP Type
Select BMP Type
Area Developed (ha)
LD Residential 0
MD Residential 0
HD Residential 0
LD Mixed 0
MD Mixed 0
HD Mixed 0
Total 0
Area Replaced (ha)
Hay/Pasture 0
Cropland 0
Forest 0
Disturbed 0
Turfgrass 0
Open Land 0
Total 0
Existing Area (ha)
Hay/Pasture 345
Cropland 146
Forest 983
Disturbed 232
Turfgrass 117
Open Land 0
Total 1823
Rainfall Captured (2.54 cm = 1 in)
Depth (cm) 7.10
Volume (m3) 0
Run
Calculated Reduction Efficiency
TN 0.00 TP 0.00 TSS 0.00
Stream Protection
Vegetative buffer strip width (m) 0
Fraction of streams treated (0-1) 0.000
Total streams in non-ag areas (km) 62.0
Streams w/bank stabilization (km) 0.0
Street Sweeping
Fraction of area treated (0-1) 1.000
Sweep Type Mechanical Vacuum
Times/month
Jan 0 Apr 0 Jul 0 Oct 0
Feb 0 May 0 Aug 0 Nov 0
Mar 0 Jun 0 Sep 0 Dec 0
Rural BMP Editor
BMP Efficiency Editor
Export to JPEG
Save File
Close


GWLF-E Urban Area Viewer - Version 1.1.3
Select input data file:
C:\MapShed\Runfiles\Upper Moreland Twp\UMT\Output\umt_bmp5-0_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 853 73832.81 86.60 517.80 0.61 127.21 0.15
Cropland 361 556953.81 1542.80 1721.30 4.77 332.06 0.92
Forest 2429 24493.36 10.10 277.94 0.11 25.00 0.01
Wetland 284 1719.61 6.10 87.28 0.31 5.31 0.02
Disturbed 573 34899.18 60.90 91.23 0.16 29.19 0.05
Turfgrass 289 19114.08 66.10 139.49 0.48 17.20 0.06
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 74 1080.27 14.60 25.64 0.35 2.76 0.04
MD Mixed 1008 63625.41 63.10 1427.32 1.42 160.83 0.16
HD Mixed 3249 205074.00 63.10 4600.32 1.42 518.35 0.16
LD Residential 652 9523.97 14.60 225.69 0.35 24.29 0.04
MD Residential 6768 427167.68 63.10 9581.97 1.42 1079.67 0.16
HD Residential 729 46010.47 63.10 1032.01 1.42 116.29 0.16
Water 0.8867042
Farm Animals 0.0 0.0
Tile Drainage 0.0 0.0 0.0
Stream Bank 13470208.9 6735.1 1781.3
Groundwater 29621.2 591.7
Point Sources 0.0 0.0
Septic Systems 4362.5 0.0
Totals 17270 14933704 60447 4811
Print
Export to JPEG
Exit

BMP (6)


Urban BMP Data Editor (UMT_BMP6)
Urban Scenario BMP Editor
Performance Standard Calculations
Retrofits
BMP Type
Soils Amendment & Restoration
Area Treated (ha)
LD Residential 6
MD Residential 8
HD Residential 0
LD Mixed 0
MD Mixed 0
HD Mixed 0
Total 14
Existing Area (ha)
LD Residential 264
MD Residential 2739
HD Residential 295
LD Mixed 30
MD Mixed 408
HD Mixed 1315
Total 5051
Rainfall Captured (2.54 cm = 1 in)
Depth (cm) 3.50
Volume (m3) 290
Run
Calculated Reduction Efficiency
TN 0.64 TP 0.75 TSS 0.80
New Development
BMP Type
Select BMP Type
Area Developed (ha)
LD Residential 0
MD Residential 0
HD Residential 0
LD Mixed 0
MD Mixed 0
HD Mixed 0
Total 0
Area Replaced (ha)
Hay/Pasture 0
Cropland 0
Forest 0
Disturbed 0
Turfgrass 0
Open Land 0
Total 0
Existing Area (ha)
Hay/Pasture 345
Cropland 146
Forest 983
Disturbed 232
Turfgrass 117
Open Land 0
Total 1823
Rainfall Captured (2.54 cm = 1 in)
Depth (cm) 7.10
Volume (m3) 0
Run
Calculated Reduction Efficiency
TN 0.00 TP 0.00 TSS 0.00
Stream Protection
Vegetative buffer strip width (m) 0
Fraction of streams treated (0-1) 0.000
Total streams in non-ag areas (km) 62.0
Streams w/bank stabilization (km) 0.0
Street Sweeping
Fraction of area treated (0-1) 1.000
Sweep Type Mechanical Vacuum
Times/month
Jan 0 Apr 0 Jul 0 Oct 0
Feb 0 May 0 Aug 0 Nov 0
Mar 0 Jun 0 Sep 0 Dec 0
Rural BMP Editor
BMP Efficiency Editor
Export to JPEG
Save File
Close



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	853	73303.70	85.90	514.80	0.60	126.35	0.15
Cropland	361	550714.73	1525.50	1705.87	4.73	328.58	0.91
Forest	2429	24493.36	10.10	277.94	0.11	25.00	0.01
Wetland	284	1719.61	6.10	87.28	0.31	5.31	0.02
Disturbed	573	34899.18	60.90	91.23	0.16	29.19	0.05
Turfgrass	289	19114.08	66.10	139.49	0.48	17.20	0.06
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	74	1080.27	14.60	25.64	0.35	2.76	0.04
MD Mixed	1008	63647.46	63.10	1427.52	1.42	160.85	0.16
HD Mixed	3249	205118.09	63.10	4600.96	1.42	518.44	0.16
LD Residential	652	9523.97	14.60	225.71	0.35	24.32	0.04
MD Residential	6768	427233.82	63.10	9583.30	1.42	1079.85	0.16
HD Residential	729	46010.47	63.10	1032.16	1.42	116.29	0.16
Water	0.8867042						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		13472164.4		6735.1		1781.3	
Groundwater				29621.2		591.7	
Point Sources				0.0		0.0	
Septic Systems				4362.5		0.0	
Totals	**17270**	**14929023**		**60431**		**4807**	

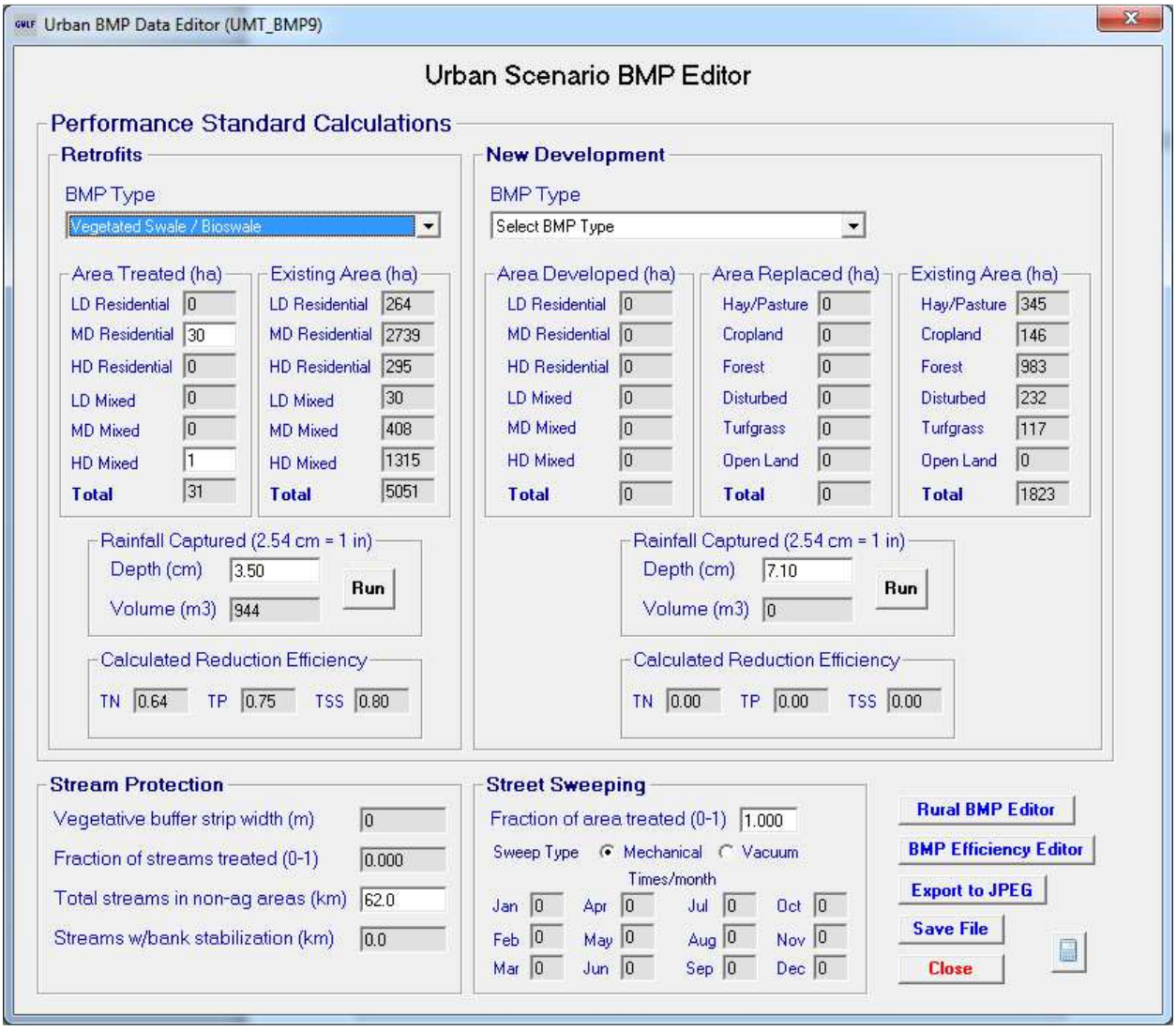
BMP (7)

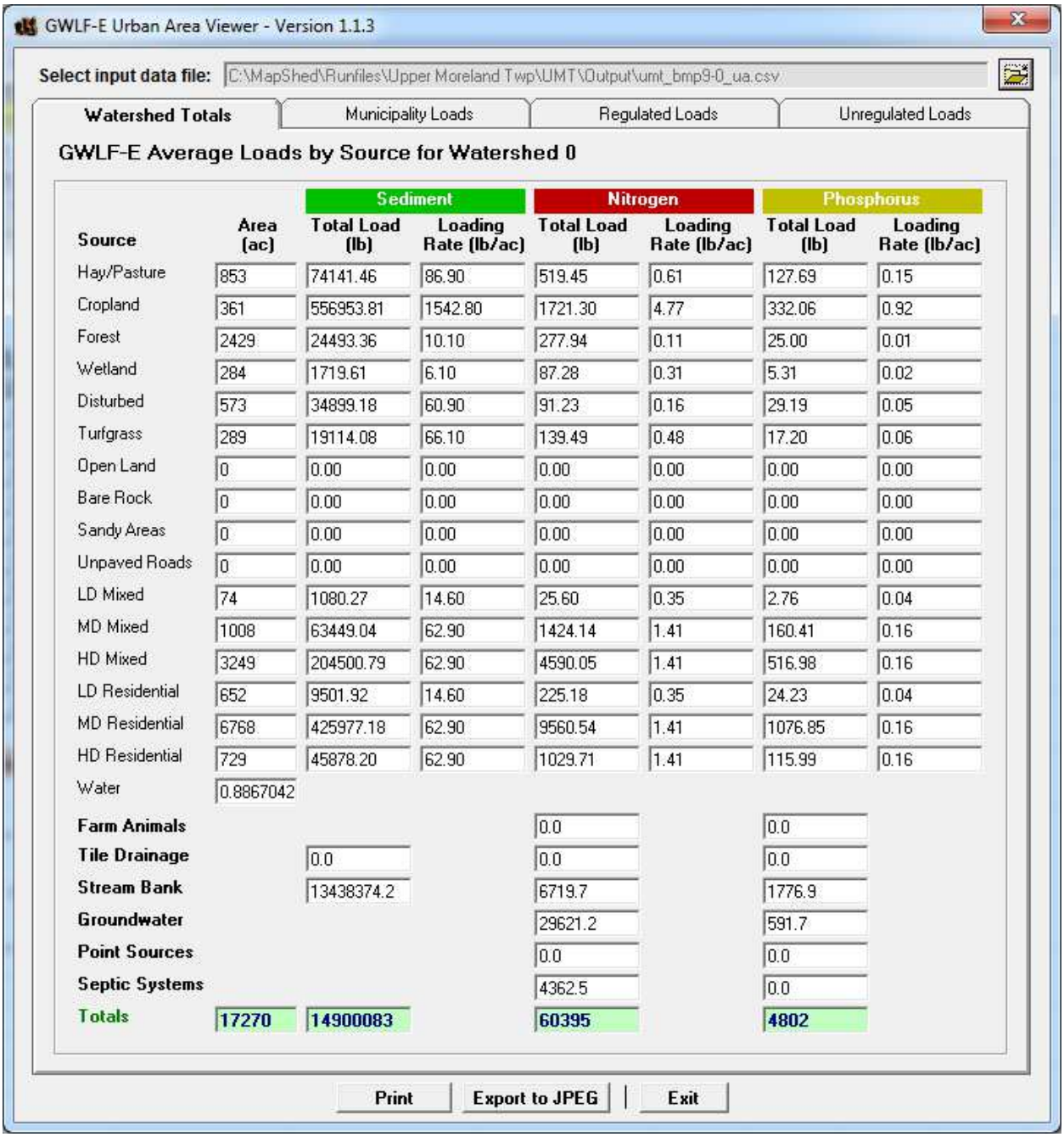
Streambank Restoration	
Streambank Length (ft)	500
TSS lbs/ft/yr	44.88
Reduction (lbs)	22,440

BMP (8)

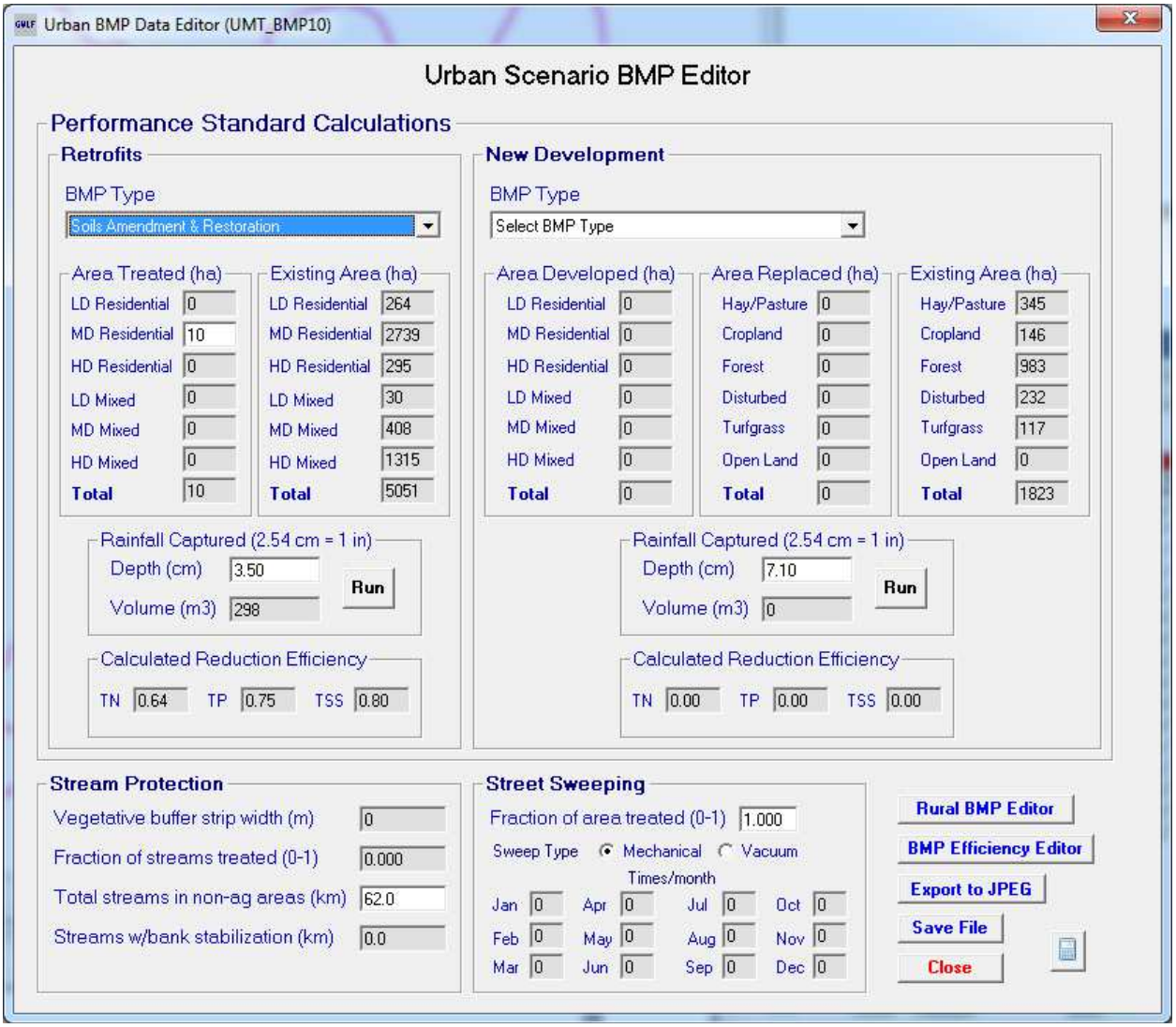
Streambank Restoration	
Streambank Length (ft)	275
TSS lbs/ft/yr	44.88
Reduction (lbs)	12,342

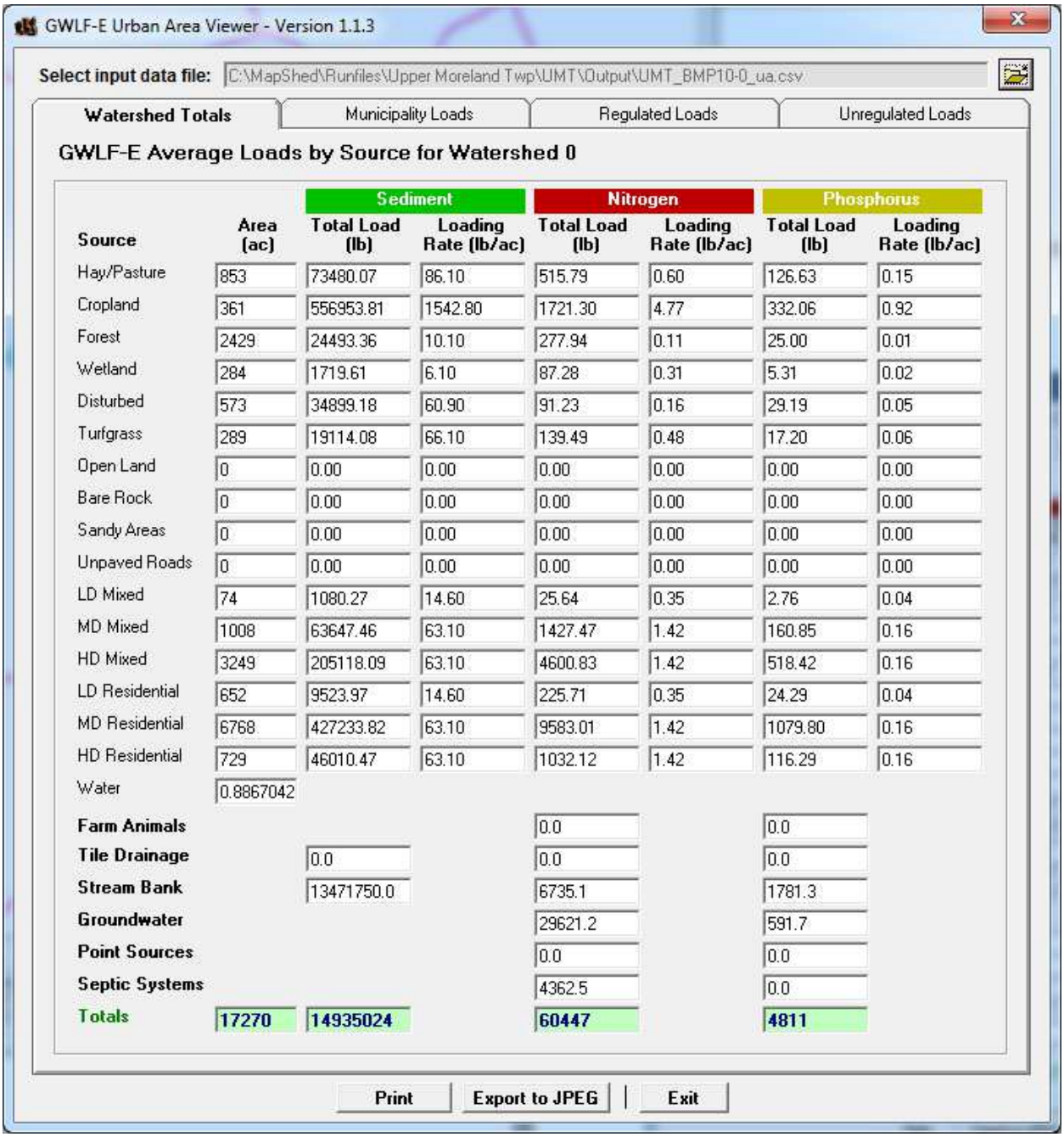
BMP (9)




GWLF-E Urban Area Viewer - Version 1.1.3
Select input data file:
C:\MapShed\Runfiles\Upper Moreland Twp\UMT\Output\umt_bmp9-0_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 853 74141.46 86.90 519.45 0.61 127.69 0.15
Cropland 361 556953.81 1542.80 1721.30 4.77 332.06 0.92
Forest 2429 24493.36 10.10 277.94 0.11 25.00 0.01
Wetland 284 1719.61 6.10 87.28 0.31 5.31 0.02
Disturbed 573 34899.18 60.90 91.23 0.16 29.19 0.05
Turfgrass 289 19114.08 66.10 139.49 0.48 17.20 0.06
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 74 1080.27 14.60 25.60 0.35 2.76 0.04
MD Mixed 1008 63449.04 62.90 1424.14 1.41 160.41 0.16
HD Mixed 3249 204500.79 62.90 4590.05 1.41 516.98 0.16
LD Residential 652 9501.92 14.60 225.18 0.35 24.23 0.04
MD Residential 6768 425977.18 62.90 9560.54 1.41 1076.85 0.16
HD Residential 729 45878.20 62.90 1029.71 1.41 115.99 0.16
Water 0.8867042
Farm Animals 0.0 0.0
Tile Drainage 0.0 0.0 0.0
Stream Bank 13438374.2 6719.7 1776.9
Groundwater 29621.2 591.7
Point Sources 0.0 0.0
Septic Systems 4362.5 0.0
Totals 17270 14900083 60395 4802
Print
Export to JPEG
Exit

BMP (10)


Urban BMP Data Editor (UMT_BMP10)
Urban Scenario BMP Editor
Performance Standard Calculations
Retrofits
BMP Type
Soils Amendment & Restoration
Area Treated (ha)
LD Residential 0
MD Residential 10
HD Residential 0
LD Mixed 0
MD Mixed 0
HD Mixed 0
Total 10
Existing Area (ha)
LD Residential 264
MD Residential 2739
HD Residential 295
LD Mixed 30
MD Mixed 408
HD Mixed 1315
Total 5051
Rainfall Captured (2.54 cm = 1 in)
Depth (cm) 3.50
Volume (m3) 298
Run
Calculated Reduction Efficiency
TN 0.64 TP 0.75 TSS 0.80
New Development
BMP Type
Select BMP Type
Area Developed (ha)
LD Residential 0
MD Residential 0
HD Residential 0
LD Mixed 0
MD Mixed 0
HD Mixed 0
Total 0
Area Replaced (ha)
Hay/Pasture 0
Cropland 0
Forest 0
Disturbed 0
Turfgrass 0
Open Land 0
Total 0
Existing Area (ha)
Hay/Pasture 345
Cropland 146
Forest 983
Disturbed 232
Turfgrass 117
Open Land 0
Total 1823
Rainfall Captured (2.54 cm = 1 in)
Depth (cm) 7.10
Volume (m3) 0
Run
Calculated Reduction Efficiency
TN 0.00 TP 0.00 TSS 0.00
Stream Protection
Vegetative buffer strip width (m) 0
Fraction of streams treated (0-1) 0.000
Total streams in non-ag areas (km) 62.0
Streams w/bank stabilization (km) 0.0
Street Sweeping
Fraction of area treated (0-1) 1.000
Sweep Type Mechanical Vacuum
Times/month
Jan 0 Apr 0 Jul 0 Oct 0
Feb 0 May 0 Aug 0 Nov 0
Mar 0 Jun 0 Sep 0 Dec 0
Rural BMP Editor
BMP Efficiency Editor
Export to JPEG
Save File
Close

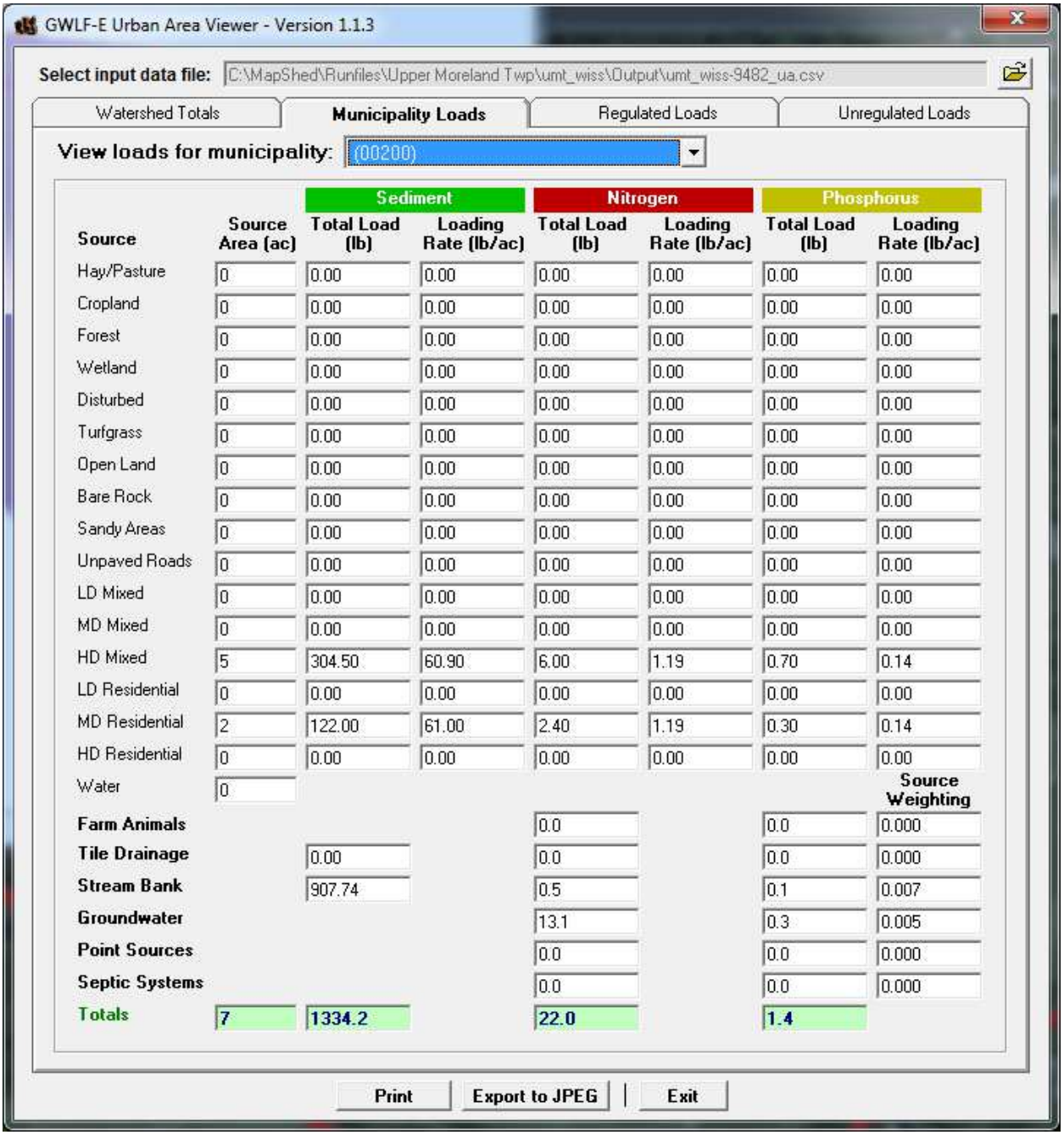


Source	Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	853	73480.07	86.10	515.79	0.60	126.63	0.15
Cropland	361	556953.81	1542.80	1721.30	4.77	332.06	0.92
Forest	2429	24493.36	10.10	277.94	0.11	25.00	0.01
Wetland	284	1719.61	6.10	87.28	0.31	5.31	0.02
Disturbed	573	34899.18	60.90	91.23	0.16	29.19	0.05
Turfgrass	289	19114.08	66.10	139.49	0.48	17.20	0.06
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	74	1080.27	14.60	25.64	0.35	2.76	0.04
MD Mixed	1008	63647.46	63.10	1427.47	1.42	160.85	0.16
HD Mixed	3249	205118.09	63.10	4600.83	1.42	518.42	0.16
LD Residential	652	9523.97	14.60	225.71	0.35	24.29	0.04
MD Residential	6768	427233.82	63.10	9583.01	1.42	1079.80	0.16
HD Residential	729	46010.47	63.10	1032.12	1.42	116.29	0.16
Water	0.8867042						
Farm Animals				0.0		0.0	
Tile Drainage		0.0		0.0		0.0	
Stream Bank		13471750.0		6735.1		1781.3	
Groundwater				29621.2		591.7	
Point Sources				0.0		0.0	
Septic Systems				4362.5		0.0	
Totals	**17270**	**14935024**		**60447**		**4811**	

BMP (11)

Streambank Restoration	
Streambank Length (ft)	500
TSS lbs/ft/yr	44.88
Reduction (lbs)	22,440

UPPER MORELAND TOWNSHIP – WISSAHICKON



Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	0	0.00	0.00	0.00	0.00	0.00	0.00
Cropland	0	0.00	0.00	0.00	0.00	0.00	0.00
Forest	0	0.00	0.00	0.00	0.00	0.00	0.00
Wetland	0	0.00	0.00	0.00	0.00	0.00	0.00
Disturbed	0	0.00	0.00	0.00	0.00	0.00	0.00
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	0	0.00	0.00	0.00	0.00	0.00	0.00
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Mixed	0	0.00	0.00	0.00	0.00	0.00	0.00
HD Mixed	5	304.50	60.90	6.00	1.19	0.70	0.14
LD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Residential	2	122.00	61.00	2.40	1.19	0.30	0.14
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		907.74		0.5		0.1	0.007
Groundwater				13.1		0.3	0.005
Point Sources				0.0		0.0	0.000
Septic Systems				0.0		0.0	0.000
Totals	7	1334.2		22.0		1.4	