OPOSSUM CREEK WATERSHED TMDL

Adams and Cumberland Counties

Prepared for:

Pennsylvania Department of Environmental Protection

April 30, 2013

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TMDL SUMMARIES

1. The impaired stream segments addressed by this Total Maximum Daily Load (TMDL) are located in Menallen, Cooke, Dickinson, Tyrone, and Butler Townships, Pennsylvania. The stream segments drain approximately 33.8 square miles as part of State Water Plan subbasin 7F. The aquatic life existing uses for Opossum Creek, including its tributaries, are Trout Stocking Fishery and Migratory Fishes (25 Pa. Code Chapter 93).

2. Pennsylvania's 2010 303(d) list identified 34.87 miles within the Opossum Creek Watershed as impaired by sediment from agricultural land use practices. The listings were based on data collected in 2001 through the Pennsylvania Department of Environmental Protection's (PADEP's) Surface Water Monitoring Program. In order to ensure attainment and maintenance of water quality standards in the Opossum Creek Watershed, mean annual loadings for sediment will need to be limited to 22,779.8374 pounds per day (lbs/day).

   The major components of the Opossum Creek Watershed TMDL are summarized below.

Opossum Creek Watershed Components	**Sediment (lbs/day)**
TMDL (Total Maximum Daily Load)	22,779.8374
MOS (Margin of Safety)	2,277.9837
WLA (Waste Load Allocation)	484.8244
LA (Load Allocation)	20,017.0293

3. Mean annual sediment loadings are estimated at 36,423.1632 lbs/day. To meet the TMDL, the sediment loadings will require reductions of 38 percent.

4. Permit PA009326 (Motts Inc.) has a sediment waste load allocation (WLA) of 216.9700 lbs/day. Permit PA0088455 (Rice Foods) has a sediment WLA of 10.0140 lbs/day. Permit PA0247154 (Opossum Valley Municipal Authority) has a sediment WLA of 3.0420 lbs/day. Bulk reserves of 227.7984 lbs/day for sediment has been inserted into the TMDL to reflect dynamic permit activity.

5. The adjusted load allocation (ALA) is the actual portion of the load allocation (LA) distributed among nonpoint sources receiving reductions, or sources that are considered controllable. Controllable sources receiving allocations are hay/pasture, cropland, developed lands, and streambanks. The sediment TMDL includes a nonpoint source ALA of 19,379.4950. Sediment loadings from all other sources, such as forested, wetlands, groundwater, and septic systems were maintained at their existing levels. Allocations of sediment to controllable nonpoint sources, or the ALA, for the Opossum Creek Watershed TMDL are summarized below.

Opossum Creek: Adjusted Load Allocations for Sources of Sediment			
Pollutant	**TMDL Loading (lbs/day)**	**Adjusted Load Allocation (lbs/day)**	**% Reduction**
Sediment	22,779.8374	19,379.4950	15

6. Ten percent of the Opossum Creek Watershed sediment TMDL was set-aside as a margin of safety (MOS). The MOS is that portion of the pollutant loading that is reserved to account for any uncertainty in the data and computational methodology used for the analysis. The MOS for the sediment TMDL is 2,277.9837 lbs/day.

7. The continuous simulation model used for developing the Opossum Creek Watershed TMDL considers seasonal variation through a number of mechanisms. Daily time steps are used for weather data and water balance calculations. The model requires specification of the growing season and hours of daylight for each month. The model also considers the months of the year when manure is applied to the land. The combination of these actions accounts for seasonal variability.

WATERSHED BACKGROUND

The Opossum Creek Watershed is approximately 34 square miles in area. The headwaters of Opossum Creek are located inside the northwestern portion of Adams County, a few miles north of Bendersville, Pa. The watershed is located on the U.S. Geological Survey (USGS) 7.5 minute quadrangles of Arendtsville, Biglerville, Dickinson, and Mount Holly Springs, Pa. The stream flows southeast to its confluence with Conewago Creek. The major tributaries to Opossum Creek include several unnamed tributaries (UNTs). State Route 34 provides access to the eastern portion of the watershed. Numerous township roads provide access to the Opossum Creek Watershed and its tributaries.

The TMDL watershed is located within the Gettysburg-Newark Lowland Section of the Piedmont physiographic province (50 percent) and the South Mountain Section of the Blue Ridge physiographic province (50 percent). The highest elevations are located in the northwestern portion of the watershed. The total change in elevation in the watershed is approximately 1100 feet from the headwaters to the mouth.

The majority of the rock type in the upland portions of the watershed is metamorphic/igneous (75 percent), predominantly associated in the form of metarhyolite (Figure 1). The remaining rock types found in the watershed are shale and limestone (25 percent combined), predominantly associated as a Heidlersburg Member and with the Gettysburg Formation.

The Highfield-Arendtsville-Catoctin series is the predominant soil type in the TMDL watershed. This soil is listed as a coarse-loam and is mostly associated on top of the broad ridges and hills of the watershed (Figure 2). Other dominant soils in the watershed consist of Edgemont-Highfield-Buchanan, Ungers-Penn-Klinesville, and Neshaminy-Lehigh-Glenelg.

Based on GIS datasets created in 2001, land use values were calculated for the TMDL watershed. Agriculture was the dominant land use at approximately 60 percent (Figure 3). Forested land uses account for approximately 36 percent of the watershed. Developed areas are 4 percent of the watershed, covering low-intensity residential and transitional.

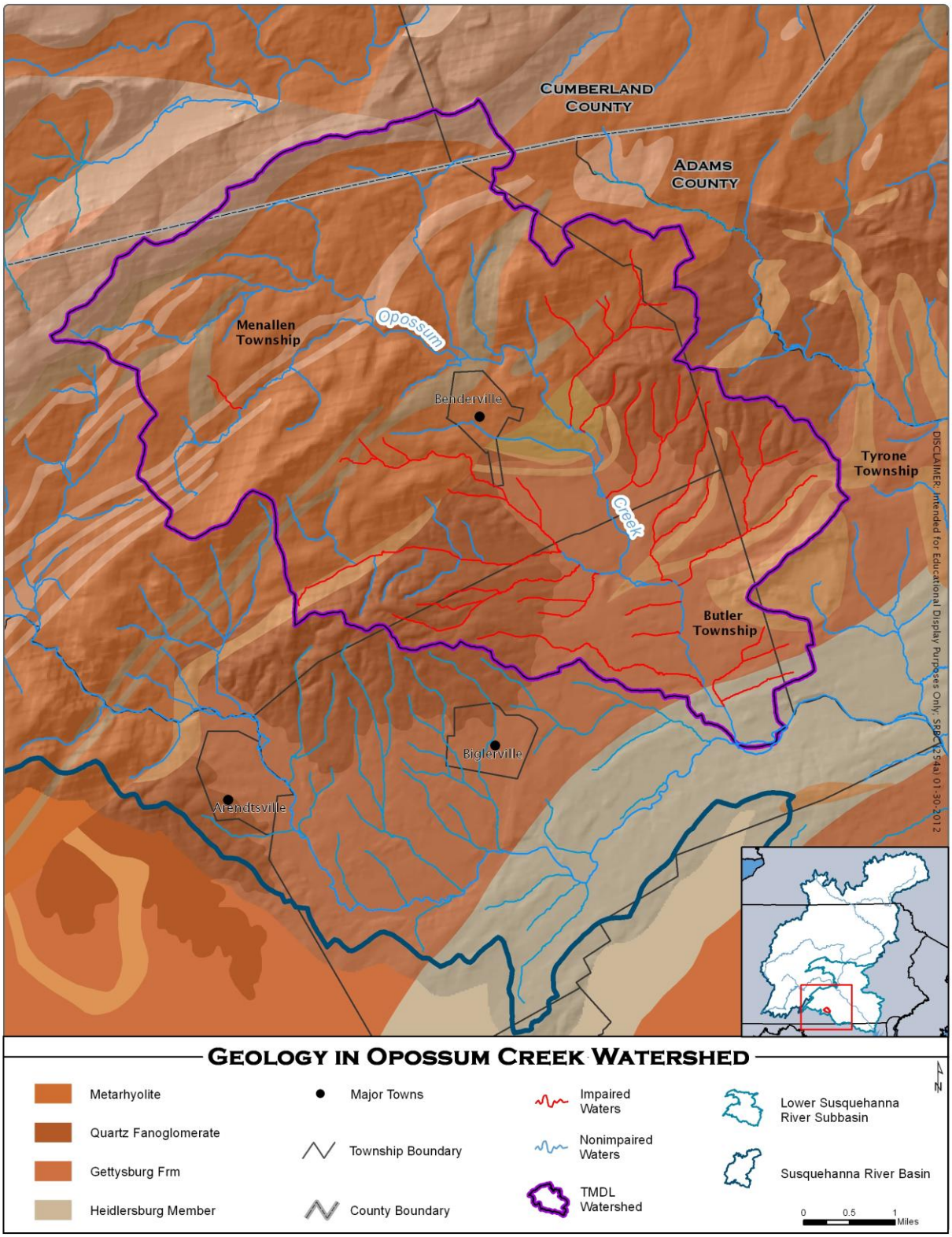

Figure 1. Geology Map of Opossum Creek Watershed

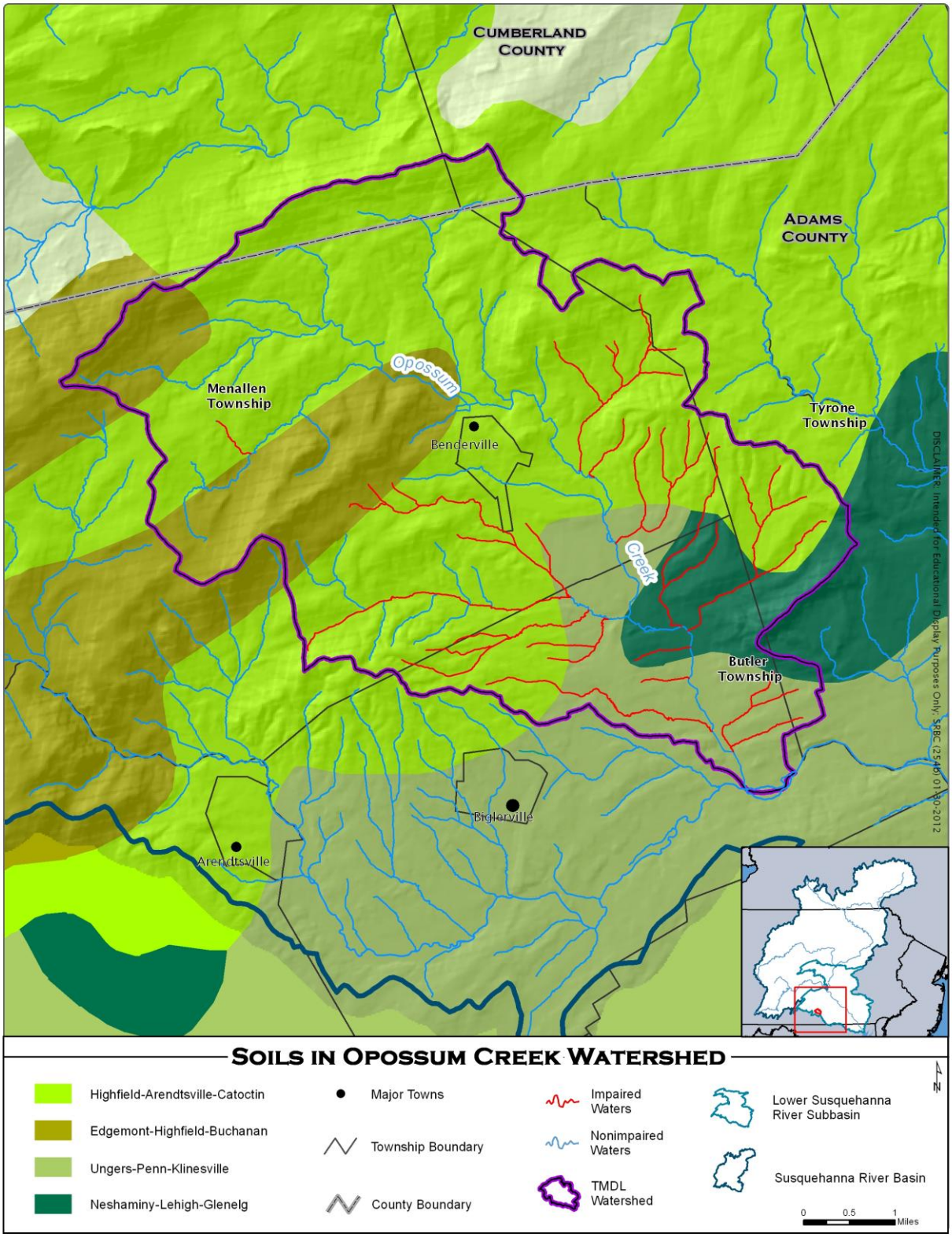

Figure 2. Soils Map of Opossum Creek Watershed

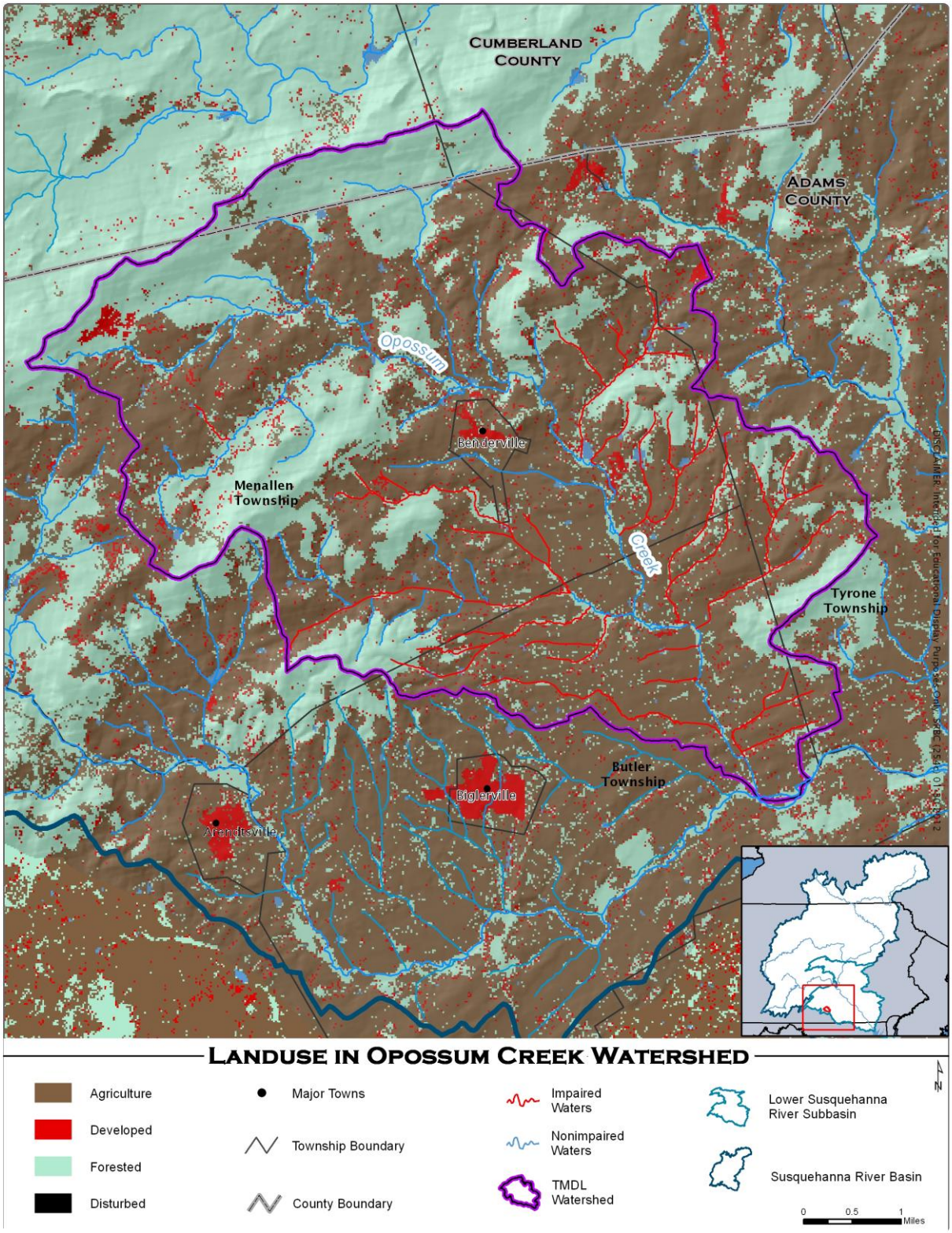

Figure 3. Land Use Map of Opossum Creek Watershed

Figure 4. Lack of Riparian Vegetation and Streambank Fencing in the Opossum Creek Watershed

Surface Water Quality

Pennsylvania's 2010 edition of the 303(d) list identified 34.87 miles of the Opossum Creek Watershed as impaired by siltation emanating from agricultural practices (Table 1).

Table 1. Integrated Water Quality Monitoring and Assessment Report Listed Segments

State Water Plan (SWP) Subbasin: 7F				
HUC: 02050306 – Lower Susquehanna				
Watershed – Opossum Creek				
Source	**EPA 305(b) Cause Code**	**Miles**	**Designated Use**	**Use Designation**
Agriculture*	Siltation	34.87	TSF, MF	Aquatic Life

* Please see Attachment H for more details.

In general, soil erosion is a major problem in the Opossum Creek Watershed. Unrestricted access of livestock to streams results in trampled streambanks, excessive stream sedimentation, and sparse streamside buffers and riparian vegetation. Large areas of row crops and use of conventional tillage, as well as unrestricted cattle access to streams, combine to leave the soil vulnerable to erosion.

APPROACH TO TMDL DEVELOPMENT

Pollutants & Sources

Sediment has been identified as the pollutant causing designated use impairments in the Opossum Creek Watershed, with the source(s) listed as agricultural. At present, there are no point source contributions within the segments addressed in this TMDL.

As stated in previous sections, the land use is dominantly agriculture. Pasture and croplands extend right up to the streambanks with little to no riparian buffer zones present. Livestock have unlimited access to streambanks throughout most of the watershed. Based on visual observations, streambank erosion is severe in most reaches of the streams.

TMDL Endpoints

In an effort to address the sediment problem found in the Opossum Creek Watershed, a TMDL was developed to establish loading limits for sediment. The TMDL is intended to address sediment impairments from developed land uses that were first identified in Pennsylvania's 2010 303(d) list, as well as other nonpoint sources such as agriculture.

Reference Watershed Approach

The TMDL developed for the Opossum Creek Watershed addresses sediment. Because neither Pennsylvania nor the U.S. Environmental Protection Agency (USEPA) has instream numerical

water quality criteria for sediment, a method was developed to implement the applicable narrative criteria. The method for these types of TMDLs is termed the "Reference Watershed Approach." Meeting the water quality objectives specified for this TMDL will result in the impaired stream segment attaining its designated uses.

The Reference Watershed Approach compares two watersheds: one attaining its uses and one that is impaired based on biological assessments. Both watersheds ideally have similar land use/cover distributions. Other features such as base geologic formation should be matched to the extent possible; however, most variations can be adjusted for in the model. The objective of the process is to reduce the loading rate of pollutants in the impaired stream segment to a level equivalent to the loading rate in the nonimpaired, reference stream segment. This load reduction will result in conditions favorable to the return of a healthy biological community to the impaired stream segments.

Selection of the Reference Watershed

In general, three factors are considered when selecting a suitable reference watershed. The first factor is to use a watershed that the PADEP has assessed and determined to be attaining water quality standards. The second factor is to find a watershed that closely resembles the impaired watershed in physical properties such as land cover/land use, physiographic province, and geology/soils. Finally, the size of the reference watershed should be within 20-40 percent of the impaired watershed area. The search for a reference watershed for the Opossum Creek Watershed to satisfy the above characteristics was done by means of a desktop screening using several GIS coverages, including the Multi-Resolution Land Characteristics (MRLC), Landsat-derived land cover/use grid, Pennsylvania's streams database, and geologic rock types.

Middle Creek was selected as the reference watershed for developing the Opossum Creek Watershed TMDL. Middle Creek is located just east of Brickerville, in Lancaster County, Pa. (Figure 5). The watershed is located in State Water Plan subbasin 7J, a tributary to Cocalico Creek, and protected uses include aquatic life and recreation. The tributary is currently designated as a Warm Water Fishery (25 Pa. Code Chapter 93). Based on PADEP assessments, Middle Creek is currently attaining its designated uses. The attainment of designated uses is based on sampling done by PADEP as part of its State Surface Water Assessment Program.

Drainage area, location, and other physical characteristics of the impaired segments of the Opossum Creek Watershed were compared to the Middle Creek Watershed (Table 2). Agricultural land is a dominant land use category in the Opossum Creek Watershed (60 percent) and Middle Creek (46 percent). The geology, soils, and precipitation in both are also similar (Table 2).

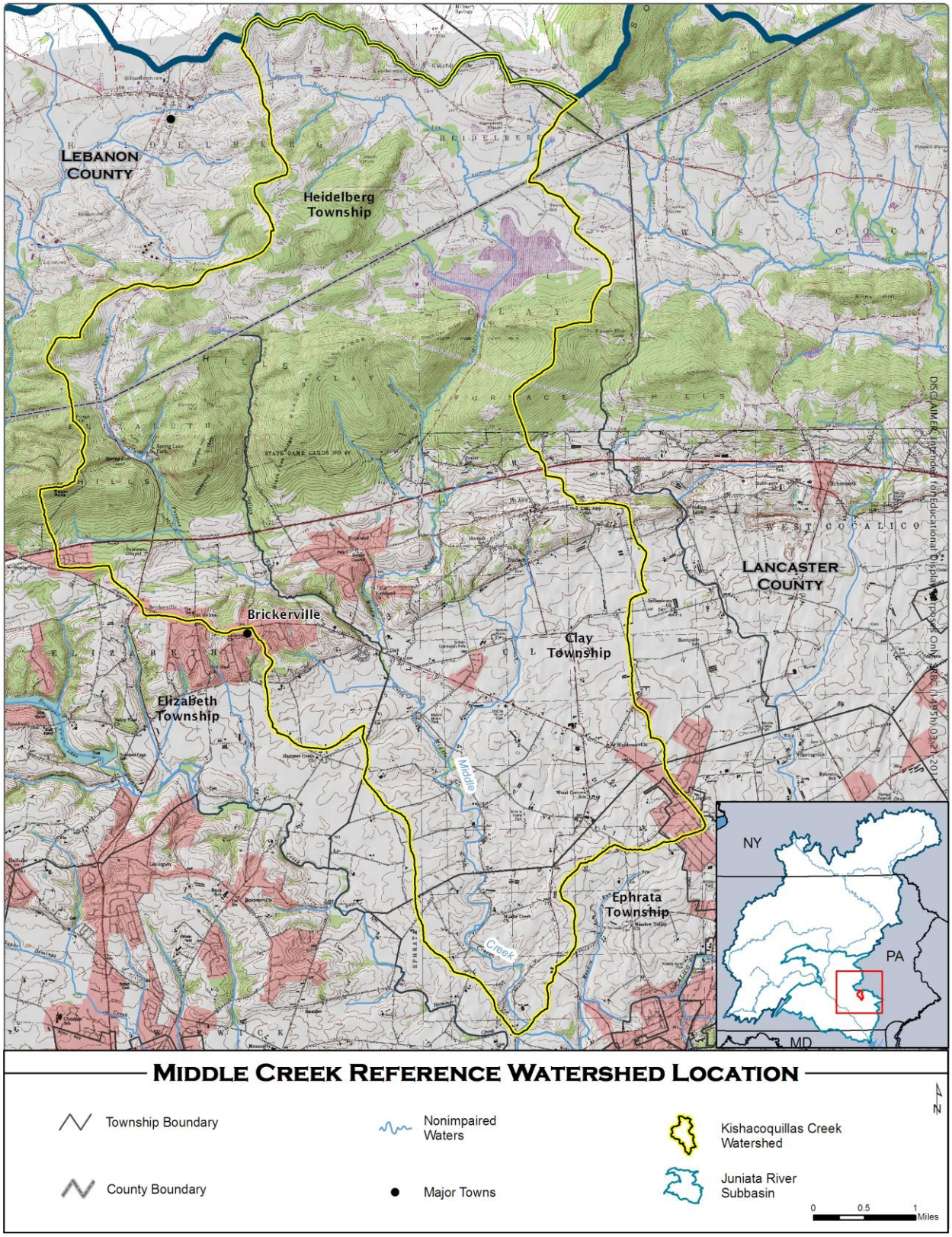

Figure 5. Location Map for Reference Watershed Middle Creek

Table 2. Comparison Between Opossum Creek Watershed and Middle Creek Watershed

Attribute	Watershed	
	Opossum Creek Watershed	**Middle Creek**
Physiographic Province	Gettysburg-Newark Lowland Section: Piedmont (50%) South Mountain Section: Blue Ridge (50%)	Gettysburg-Newark Lowland Section: Piedmont (55%) Piedmont Lowland Section: Piedmont (40%) Great Valley Section: Ridge and Valley (5%)
Area (acres)	21,522.9	20,220.7
Land Use % Agriculture Forested Other	 41.40 50.18 8.42	 42.40 44.93 12.67
Soils Dominant Group – B%	100.0	50.0
Surface Geology - Metamorphic %	80.0	10.0
Average Rainfall (in)	41.6, 24 years	41.3, 24 years
Average Runoff (in)	0.12, 24 years	0.21, 24 years

Watershed Assessment and Modeling

The TMDL for the impaired segments of the Opossum Creek Watershed was developed using the ArcView Generalized Watershed Loading Function model (AVGWLF) as described in Attachment C. The AVGWLF model was used to establish existing loading conditions for the impaired segments of the Opossum Creek Watershed and the Middle Creek reference watershed. All modeling inputs have been attached to this TMDL as Attachments D and E. SRBC staff visited the watershed in winter 2011 and spring 2012. The field visits were conducted to get a better understanding of existing conditions that might influence the AVGWLF model.

The AVGWLF model produced information on watershed size, land use, and sediment loading. The sediment loadings represent an annual average over a 24-year period, from 1975 to 1998, and for the Opossum Creek Watershed and Middle Creek Watershed, respectively. This information was then used to calculate existing unit area loading rates for the two watersheds. Acreage and sediment loading information for both the impaired watershed and the reference watershed are shown in Tables 3 and 4, respectively.

Table 3. Existing Sediment Loads for Opossum Creek Watershed

Pollutant Source	Acreage	Sediment	
		Mean Annual Loading (lbs/day)	Unit Area Loading (lbs/ac/day)
HAY/PAST	6,531.0	1,944.2192	0.2977
CROPLAND	2,379.6	24,062.1918	10.1119
FOREST	10,801.0	636.3836	0.0589
WETLANDS	244.6	1.1507	0.0047
TURF_GRASS	108.7	97.9726	0.9013
UNPAVED_RD	2.5	3.0137	1.2055
TRANSITION	34.6	44.7123	1.2923
LO_INT_DEV	1,420.9	478.4110	0.3367
Streambank		9,155.1083	-
TOTAL	21,522.9	36,423.1632	1.6923

Table 4. Existing Sediment Loads for Middle Creek Watershed

Pollutant Source	Acreage	Sediment	
		Mean Annual Loading (lbs/day)	Unit Area Loading (lbs/ac/day)
HAY/PAST	3,721.4	781.0959	0.2099
CROPLAND	4,853.1	7,744.1096	1.5957
FOREST	9,086.1	1,033.9726	0.1138
WETLANDS	311.4	1.1507	0.0037
UNPAVED_RD	22.2	51.1781	2.3053
TRANSITION	121.1	100.1096	0.8267
LO_INT_DEV	1,907.7	550.6301	0.2886
HI_INT_DEV	197.7	19.5068	0.0987
Streambank	-	11,119.5417	-
TOTAL	20,220.7	21,401.2951	1.0584

TMDLS

The targeted TMDL value for the Opossum Creek Watershed was established based on current loading rates for sediment in the Middle Creek reference watershed. Biological assessments have determined that Middle Creek is currently attaining its designated uses.

Reducing the loading rate of sediment in the Opossum Creek Watershed to levels equivalent to those in the reference watershed will provide conditions favorable for the reversal of current use impairments.

Background Pollutant Conditions

There are two separate considerations of background pollutants within the context of this TMDL. First, there is the inherent assumption of the reference watershed approach that because of the similarities between the reference and impaired watershed, the background pollutant contributions will be similar. Therefore, the background pollutant contributions will be considered when determining the loads for the impaired watershed that are consistent with the

loads from the reference watershed. Second, the AVGWLF model implicitly considers background pollutant contributions through the soil and the groundwater component of the model process.

Targeted TMDLs

The targeted TMDL value for sediment was determined by multiplying the total area of the Opossum Creek Watershed (21,522.9 acres) by the appropriate unit-area loading rate for the Middle Creek reference watershed (Table 4). The existing mean annual loading of sediment to Opossum Creek Watershed (36,423.1632 lbs/day) will need to be reduced by 38 percent to meet the targeted TMDL of 22,779.8374 lbs/day.

Table 5. Targeted TMDL for Opossum Creek Watershed

Pollutant	Area (ac)	Unit Area Loading Rate Middle Creek Reference Watershed (lbs/ac/day)	Targeted TMDL for Opossum Creek (lbs/day)
Sediment	21,522.9	1.0584	22,779.8374

Targeted TMDL values were used as the basis for load allocations and reductions in the Opossum Creek Watershed, using the following two equations:

1. TMDL = WLA + LA + MOS
2. LA = ALA + LNR

where:

TMDL = Total Maximum Daily Load
WLA = Waste Load Allocation (point sources)
LA = Load Allocation (nonpoint sources)
ALA = Adjusted Load Allocation
LNR = Loads not Reduced

Margin of Safety

The MOS is that portion of the pollutant loading that is reserved to account for any uncertainty in the data and computational methodology used for the analysis. For this analysis, the MOS is explicit. Ten percent of the targeted TMDL for sediment was reserved as the MOS. Using 10 percent of the TMDL load is based on professional judgment and will provide an additional level of protection to the designated uses of Opossum Creek Watershed. The MOS used for the sediment TMDL is shown below.

Opossum Creek Watershed:
MOS (sediment) = 22,779.8374 lbs/day (TMDL) x 0.1 = 2,277.9837 lbs/day

Waste Load Allocation

The WLA portion of the TMDL equation is the total loading of a pollutant that is assigned to point sources. Reviewing the PADEP's permitting files identified three point source discharges for sediment and phosphorus in the watershed.

Motts Incorporated discharges into the streams covered by this TMDL, permit number PA0009326. The monthly average for suspended solids is 25.0 mg/L, which was included in the AVGWLF modeling runs for determining existing conditions. The design flow for Motts Incorporated is 1.04 million gallons per day (mgd). Based on the monthly average for this facility, the potential for sediment load if the Motts Incorporated capacities were fully utilized is 216.9700 lbs/day. This loading rate based on the design capacities of the plant is used in the final TMDL allocations (WLA).

Rice Foods discharges into the streams covered by this TMDL, permit number PA0088455. The monthly average for suspended solids is 30.0 mg/L, which was included in the AVGWLF modeling runs for determining existing conditions. The design flow for Rice Foods is 0.04 mgd. Based on the monthly average for this facility, the potential for sediment load if the Rice Foods capacities were fully utilized is 10.0140 lbs/day. This loading rate based on the design capacities of the plant is used in the final TMDL allocations (WLA).

The Opossum Valley Municipal Authority discharges into the streams covered by this TMDL, permit number PA0247154. The monthly average for suspended solids is 30.0 mg/L, which was included in the AVGWLF modeling runs for determining existing conditions. The design flow for the Opossum Valley Municipal Authority is 0.1200 mgd. Based on the monthly average for this facility, the potential for sediment load if the Opossum Valley Municipal Authority capacities were fully utilized is 30.0420 lbs/day. This loading rate based on the design capacities of the plant is used in the final TMDL allocations (WLA).

The bulk reserve is explicit and is calculated as one percent of the targeted TMDL. This bulk reserve enables the TMDL to account for the dynamic nature of permit activity (Table 6).

Table 6. Waste Load Allocations for the Opossum Creek Watershed

Name	NPDES Permit #	Sediment WLA (lb/yr)	Sediment WLA(lb/day)
Motts Incorporated	PA0009326	79,194.0500	216.9700
Rice Foods	PA0088455	3,655.1100	10.0140
Opossum Valley Municipal Authority	PA0247154	10,965.3300	30.0420
Bulk Reserve	-	83,146.4160	227.7984
Total		**176,960.906**	**484.8244**

Adjusted Load Allocation

The ALA is the actual portion of the LA distributed among those nonpoint sources receiving reductions. It is computed by subtracting those nonpoint source loads that are not being considered for reductions (loads not reduced or LNR) from the LA. Sediment reductions were made to the hay/pasture, cropland, developed areas (sum of LO_INT_DEV, TURF_GRASS, and

TRANSITION), and streambanks. Those land uses/sources for which existing loads were not reduced (FOREST and WETLANDS) were carried through at their existing loading values (Table 7).

Table 7. Load Allocations, Loads not Reduced, and Adjusted Load Allocation for Opossum Creek

Component	Sediment (lbs/day)
Load Allocation	20,017.0293
Loads not Reduced	637.5343
FOREST	636.3836
WETLANDS	1.1507
Adjusted Load Allocation	19,379.4950

TMDLs

The sediment TMDL established for the Opossum Creek Watershed consists of a LA, ALA, and MOS. The individual components of the TMDL are summarized in Table 8.

Table 8. Load Allocations, Loads not Reduced, and Adjusted Load Allocation for Opossum Creek

Component	Sediment (lbs/day)
TMDL (Total Maximum Daily Load)	22,779.8374
MOS (Margin of Safety)	2,277.9837
WLA (Waste Load Allocation)	484.8244
LA (Load Allocation)	20,017.0293
LNR (Loads not Reduced)	637.5343
ALA (Adjusted Load Allocation)	19,379.4950

CALCULATION OF SEDIMENT LOAD REDUCTIONS

The ALA established in the previous section represents the annual total sediment loads that are available for allocation between contributing sources in the Opossum Creek Watershed. The ALA for sediment was allocated between agriculture, developed areas, and streambanks. LA and reduction procedures were applied to the entire Opossum Creek Watershed using the Equal Marginal Percent Reduction (EMPR) allocation method (Attachment F). The LA and EMPR procedures were performed using MS Excel, and results are presented in Attachment G.

In order to meet the sediment TMDL, the load currently emanating from controllable sources must be reduced (Table 8). This can be achieved through reductions in current sediment loadings from cropland, from hay/pasture, developed areas, and streambanks (Table 9).

Table 9. Sediment Load Allocations and Reductions for Opossum Creek Watershed

Pollutant Source	Acres	Unit Area Loading Rate (lbs/ac/day)		Pollutant Loading (lbs/day)		% Reduction
		Current	Allowable	Current	Allowable (LA)	
Sediment						
Hay/Pasture	6,531.0	0.2977	0.1855	1,944.2192	1,211.3966	38
Cropland	2,379.6	10.1119	5.0743	24,062.1918	12,074.9010	50
Developed	1,566.7	0.3984	0.2482	624.1096	388.8678	38
Streambanks	-	-	-	9,155.1083	5,704.3296	38
Total				35,785.6289	19,379.4950	46

CONSIDERATION OF CRITICAL CONDITIONS

The AVGWLF model is a continuous simulation model which uses daily time steps for weather data and water balance calculations. Monthly calculations are made for sediment loads based on the daily water balance accumulated to monthly values. Therefore, all flow conditions are taken into account for loading calculations. Because there is generally a significant lag time between the introduction of sediment to a waterbody and the resulting impact on beneficial uses, establishing these TMDLs using average annual conditions is protective of the waterbody.

CONSIDERATION OF SEASONAL VARIATIONS

The continuous simulation model used for these analyses considers seasonal variation through a number of mechanisms. Daily time steps are used for weather data and water balance calculations. The model requires specification of the growing season and hours of daylight for each month. The model also considers the months of the year when manure is applied to the land. The combination of these actions by the model accounts for seasonal variability.

RECOMMENDATIONS FOR IMPLEMENTATION

TMDLs represent an attempt to quantify the pollutant load that may be present in a waterbody and still ensure attainment and maintenance of water quality standards. The Opossum Creek Watershed TMDL identifies the necessary overall load reductions for sediment currently causing use impairments and distributes those reduction goals to the appropriate nonpoint sources. Reaching the reduction goals established by this TMDL will only occur through Best Management Practices (BMPs). BMPs that would be helpful in lowering the amounts of sediment reaching Opossum Creek include the following: streambank stabilization and fencing; riparian buffer strips; strip cropping; conservation tillage; stormwater retention wetlands; and heavy use area protection, among many others.

The Natural Resources Conservation Service maintains a *National Handbook of Conservation Practices* (NHCP), which provides information on a variety of BMPs. The NHCP is available online at http://www.ncg.nrcs.usda.gov/nhcp_2.html. Many of the practices described in the handbook could be used in the Opossum Creek Watershed to help limit sediment impairments.

Determining the most appropriate BMPs, where they should be installed, and actually putting them into practice, will require the development and implementation of restoration plans. Development of any restoration plan will involve the gathering of site-specific information regarding current land uses and existing conservation practices. This type of assessment has been ongoing in the Opossum Creek Watershed, and it is strongly encouraged to continue.

The Chesapeake Bay TMDL, established by EPA in 2010, requires reductions of nitrogen, phosphorus and sediment loads throughout the Bay watershed to meet water quality standards that protect the designated uses in the Bay and its tidal tributaries. Pennsylvania's Phase I and Phase II WIPs together with the State's schedule of two-year milestones provide implementation strategies and a time line for achieving sediment reductions across Pennsylvania's Chesapeake Bay watershed to meet Chesapeake Bay interim target loads by 2017, equivalent to 60% of the final target goals set for 2025 to fully implement the Chesapeake Bay TMDL in Pennsylvania. A Phase III Plan will be developed in 2018 to address the additional reductions needed from 2018 through 2025 to meet the final targets.

The sediment reductions for the Bay TMDL are independent of those needed to implement any TMDLs developed to address sediment-related impairments in Pennsylvania's non-tidal waterbodies, although their reduction goals and strategies do overlap. For example, the implementation planning framework, developed by the Bay watershed jurisdictions in partnership with EPA, provides a staged approach to achieving Bay TMDL sediment reduction goals that is also applicable to implementation of sediment TMDLs in local non-tidal watersheds. In short, sediment reductions required to meet the Chesapeake Bay TMDL will also support the restoration and protection of local water quality and vice versa. Links to Chesapeake Bay TMDL related documents are provided below.

PADEP Chesapeake Bay Program website:
http://www.portal.state.pa.us/portal/server.pt/community/chesapeake_bay_program/10513

Pennsylvania's Phase I WIP:
http://files.dep.state.pa.us/Water/Chesapeake%20Bay%20Program/ChesapeakePortalFiles/WIPs/REVISED%20FINAL%20Chesapeake%20Bay%20WIP%20-%20sent%20to%20EPA%2012-23-10.pdf

Pennsylvania's Phase II WIP:
http://files.dep.state.pa.us/Water/Chesapeake%20Bay%20Program/ChesapeakePortalFiles/4-2-2012/Clean%20FINAL%20Phase%202%20WIP%203-30-2012%20(2).pdf

Pennsylvania's Phase II WIP Wastewater Supplement:
http://files.dep.state.pa.us/Water/Wastewater%20Management/EDMRPortalFiles/Phase_2_WIP_Supplement.pdf

Pennsylvania's Milestones for 2012-2013:
http://files.dep.state.pa.us/Water/Chesapeake%20Bay%20Program/ChesapeakePortalFiles/7-9-2012/PA%20FINAL%202012-2013%20Milestones.pdf

By developing a sediment TMDL for the Opossum Creek Watershed, PADEP continues to support design and implementation of restoration plans to correct current use impairments. PADEP welcomes local efforts to support watershed restoration plans. For more information about this TMDL, interested parties should contact the appropriate watershed manager in PADEP's Southcentral Regional Office (717-705-4700).

PUBLIC PARTICIPATION

A notice of availability for comments on the draft Opossum Creek Watershed TMDL was published in the Pa. Bulletin on June 8, 2013, and *newspaper* on date, to foster public comment on the allowable loads calculated. A public meeting was held on June 17, 2013, at the Menallen Township building to discuss the proposed TMDL. The public participation process (which ended on July 8, 2013) was provided for the submittal of comments. Comments and responses are summarized in Attachment H.

Notice of final TMDL approval will be posted on the PADEP's web site.

REFERENCES

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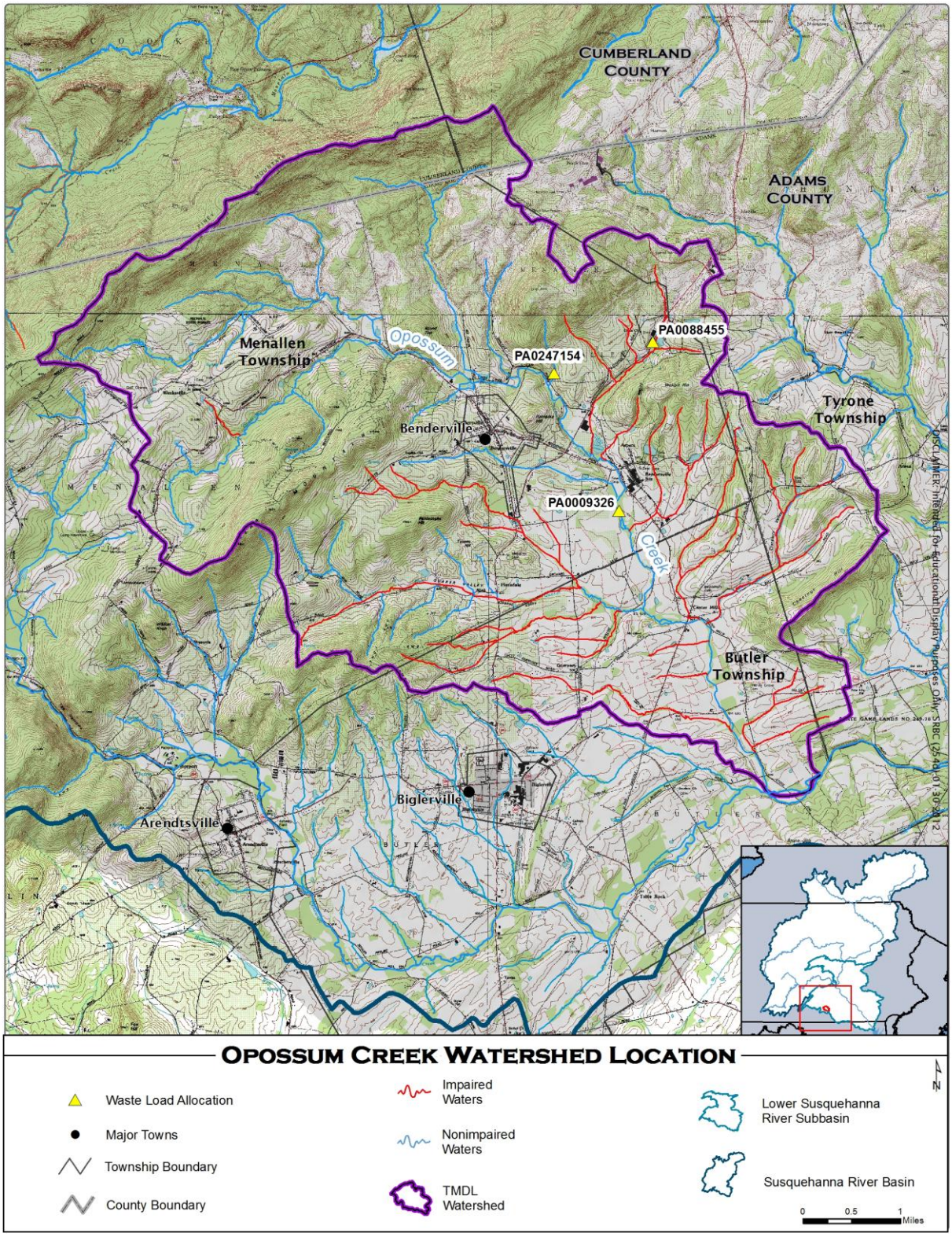
Attachment A

Opossum Creek Watershed Impaired Waters


Cumberland County
Adams County
Menallen Township
Opossum
Creek
PA0088455
PA0247154
PA0009326
Tyrone Township
Butler Township
Benderville
Biglerville
Arendtsville
DISCLAIMER: Intended for Educational/Display Purposes Only. SRBC (25-10) 01/30/2012
Opossum Creek Watershed Location
Waste Load Allocation
Major Towns
Township Boundary
County Boundary
Impaired Waters
Nonimpaired Waters
TMDL Watershed
Lower Susquehanna River Subbasin
Susquehanna River Basin
0
0.5
1
Miles

Attachment B

Information Sheet for the Opossum Creek Watershed TMDL

What is being proposed?
Total Maximum Daily Load (TMDL) plans have been developed to improve water quality in the Opossum Creek Watershed.

Who is proposing the plans? Why?
The Pennsylvania Department of Environmental Protection (PADEP) is proposing to submit the plans to the U.S. Environmental Protection Agency (USEPA) for review and approval as required by federal regulation. In 1995, USEPA was sued for not developing TMDLs when Pennsylvania failed to do so. PADEP has entered into an agreement with USEPA to develop TMDLs for certain specified waters over the next several years. This TMDL has been developed in compliance with the state/USEPA agreement.

What is a TMDL?
A TMDL sets a ceiling on the pollutant loads that can enter a waterbody so that it will meet water quality standards. The Clean Water Act requires states to list all waters that do not meet their water quality standards even after pollution controls required by law are in place. For these waters, the state must calculate how much of a substance can be put in the water without violating the standard, and then distribute that quantity to all the sources of the pollutant on that waterbody. A TMDL plan includes waste load allocations for point sources, load allocations for nonpoint sources, and a margin of safety. The Clean Water Act requires states to submit their TMDLs to USEPA for approval. Also, if a state does not develop the TMDL, the Clean Water Act states that USEPA must do so.

What is a water quality standard?
The Clean Water Act sets a national minimum goal that all waters be "fishable" and "swimmable." To support this goal, states must adopt water quality standards. Water quality standards are state regulations that have two components. The first component is a designated use, such as "warm water fishes" or "recreation." States must assign a use or several uses to each of their waters. The second component relates to the instream conditions necessary to protect the designated use(s). These conditions or "criteria" are physical, chemical, or biological characteristics such as temperature and minimum levels of dissolved oxygen, and maximum concentrations of toxic pollutants. It is the combination of the "designated use" and the "criteria" to support that use that make up a water quality standard. If any criteria are being exceeded, then the use is not being met and the water is said to be in violation of water quality standards.

What is the purpose of the plans?
The Opossum Creek Watershed is impaired due to sediment emanating from agricultural runoff. The plans include a calculation of the loading for sediment that will correct the problem and meet water quality objectives.

Why was the Opossum Creek Watershed selected for TMDL development?
In 2008, PADEP listed segments of the Opossum Creek Watershed under Section 303(d) of the federal Clean Water Act as impaired due to causes linked to sediment.

What pollutants do these TMDLs address?
The proposed plans provide calculations of the stream's total capacity to accept sediment.

Where do the pollutants come from?
The sediment related impairments in the Opossum Creek Watershed come from nonpoint sources of pollution, primarily overland runoff from developed areas and agricultural lands, as well as from streambank erosion.

How was the TMDL developed?
PADEP used a reference watershed approach to estimate the necessary loading reduction of sediment that would be needed to restore a healthy aquatic community. The reference watershed approach is based on selecting a nonimpaired watershed that has similar land use characteristics and determining the current loading rates for the pollutants of interest. This is done by modeling the loads that enter the stream, using precipitation and land use characteristic data. For this analysis, PADEP used the AVGWLF model (the Environmental Resources Research Institute of the Pennsylvania State University's Arcview-based version of the Generalized Watershed Loading Function model developed by Cornell University). This modeling process uses loading rates in the nonimpaired watershed as a target for load reductions in the impaired watershed. The impaired watershed is modeled to determine the current loading rates and determine what reductions are necessary to meet the loading rates of the nonimpaired watershed. The reference stream approach was used to set allowable loading rates in the affected watershed because neither Pennsylvania nor USEPA has instream numerical water quality criteria for sediment.

How much pollution is too much?
The allowable amount of pollution in a waterbody varies depending on several conditions. TMDLs are set to meet water quality standards at the critical flow condition. For a free flowing stream impacted by nonpoint source pollution loading of sediment, the TMDL is expressed as an annual loading. This accounts for pollution contributions over all streamflow conditions. PADEP established the water quality objectives for sediment by using the reference watershed approach. This approach assumes that the impairment is eliminated when the impaired watershed achieves loadings similar to the reference watershed. Reducing the current loading rates for sediment in the impaired watershed to the current loading rates in the reference watershed will result in meeting the water quality objectives.

How will the loading limits be met?
Best Management Practices (BMPs) will be encouraged throughout the watershed to achieve the necessary load reductions.

How can I get more information on the TMDL?
To request a copy of the full report, contact William Brown at (717) 783-2938 between 8:00 a.m. and 3:00 p.m., Monday through Friday. Mr. Brown also can be reached by mail at the Office of Water Management, PADEP, Rachel Carson State Office Building, 400 Market Street, Harrisburg, PA 17105 or by e-mail at wbrown@state.pa.us.

How can I comment on the proposal?
You may provide e-mail or written comments postmarked no later than July 5, 2010 to the above address.

Attachment C

AVGWLF Model Overview & GIS-Based Derivation of Input Data

The TMDL for the Opossum Creek Watershed was developed using the Generalized Watershed Loading Function or GWLF model. The GWLF model provides the ability to simulate runoff, sediment, and nutrient (nitrogen and phosphorus) loadings from the watershed given variable-size source areas (e.g., agricultural, forested, and developed land). It also has algorithms for calculating septic system loads, and allows for the inclusion of point source discharge data. It is a continuous simulation model, which uses daily time steps for weather data and water balance calculations. Monthly calculations are made for sediment and nutrient loads, based on the daily water balance accumulated to monthly values.

GWLF is a combined distributed/lumped parameter watershed model. For surface loading, it is distributed in the sense that it allows multiple land use/cover scenarios. Each area is assumed to be homogenous in regard to various attributes considered by the model. Additionally, the model does not spatially distribute the source areas, but aggregates the loads from each area into a watershed total. In other words, there is no spatial routing. For subsurface loading, the model acts as a lumped parameter model using a water balance approach. No distinctly separate areas are considered for subsurface flow contributions. Daily water balances are computed for an unsaturated zone as well as a saturated subsurface zone, where infiltration is computed as the difference between precipitation and snowmelt minus surface runoff plus evapotranspiration.

GWLF models surface runoff using the Soil Conservation Service Curve Number (SCS-CN) approach with daily weather (temperature and precipitation) inputs. Erosion and sediment yield are estimated using monthly erosion calculations based on the Universal Soil Loss Equation (USLE) algorithm (with monthly rainfall-runoff coefficients) and a monthly composite of KLSCP values for each source area (e.g., land cover/soil type combination). The KLSCP factors are variables used in the calculations to depict changes in soil loss erosion (K), the length slope factor (LS), the vegetation cover factor (C), and conservation practices factor (P). A sediment delivery ratio based on watershed size, transport capacity, and average daily runoff is applied to the calculated erosion for determining sediment yield for each source area. Surface nutrient losses are determined by applying dissolved nitrogen and phosphorus coefficients to surface runoff and a sediment coefficient to the yield portion for each agricultural source area. Point source discharges also can contribute to dissolved losses to the stream and are specified in terms of kilograms per month. Manured areas, as well as septic systems, can also be considered. Urban nutrient inputs are all assumed to be solid-phase, and the model uses an exponential accumulation and washoff function for these loadings. Subsurface losses are calculated using dissolved nitrogen and phosphorus coefficients for shallow groundwater contributions to stream nutrient loads, and the subsurface submodel only considers a single, lumped-parameter contributing area. Evapotranspiration is determined using daily weather data and a cover factor dependent upon land use/cover type. Finally, a water balance is performed daily using supplied or computed precipitation, snowmelt, initial unsaturated zone storage, maximum available zone storage, and evapotranspiration values. All of the equations used by the model can be viewed in GWLF Users Manual.

For execution, the model requires three separate input files containing transport-, nutrient-, and weather-related data. The transport (TRANSPRT.DAT) file defines the necessary parameters for each source area to be considered (e.g., area size, curve number, etc.), as well as global parameters (e.g., initial storage, sediment delivery ratio, etc.) that apply to all source areas. The

nutrient (NUTRIENT.DAT) file specifies the various loading parameters for the different source areas identified (e.g., number of septic systems, urban source area accumulation rates, manure concentrations, etc.). The weather (WEATHER.DAT) file contains daily average temperature and total precipitation values for each year simulated.

The primary sources of data for this analysis were Geographic Information System (GIS) formatted databases. A specially designed interface was prepared by the Environmental Resources Research Institute of the Pennsylvania State University in ArcView (GIS software) to generate the data needed to run the GWLF model, which was developed by Cornell University. The new version of this model has been named AVGWLF (ArcView Version of the Generalized Watershed Loading Function).

In using this interface, the user is prompted to identify required GIS files and to provide other information related to "non-spatial" model parameters (e.g., beginning and end of the growing season, the months during which manure is spread on agricultural land, and the names of nearby weather stations). This information is subsequently used to automatically derive values for required model input parameters, which are then written to the TRANSPRT.DAT, NUTRIENT.DAT, and WEATHER.DAT input files needed to execute the GWLF model. For use in Pennsylvania, AVGWLF has been linked with statewide GIS data layers such as land use/cover, soils, topography, and physiography; and includes location-specific default information such as background nitrogen and phosphorus concentrations and cropping practices. Complete GWLF-formatted weather files also are included for 80 weather stations around the state.

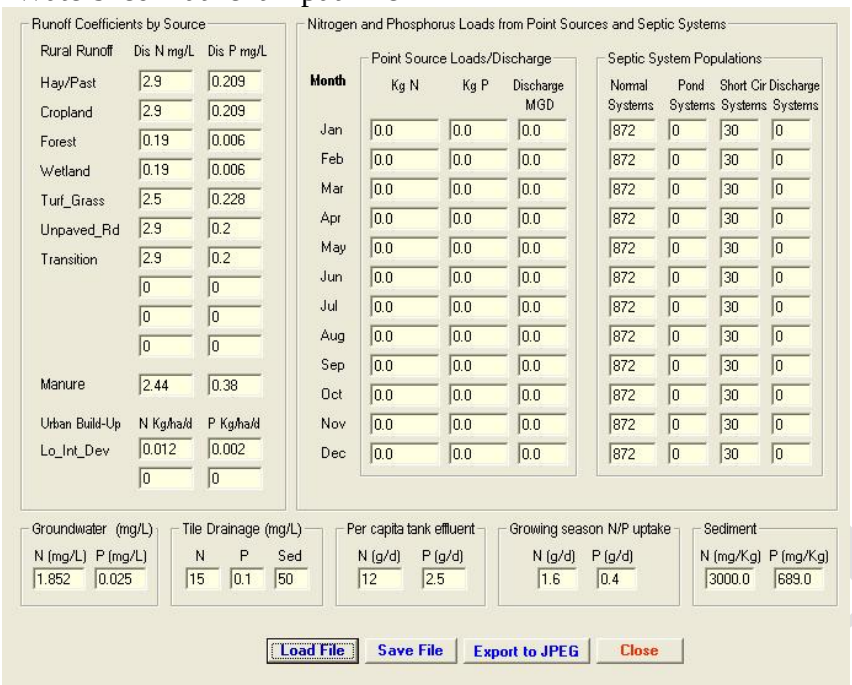
The following table lists the statewide GIS data sets and provides an explanation of how they were used for development of the input files for the GWLF model.

GIS Data Sets	
DATASET	**DESCRIPTION**
Censustr	Coverage of Census data including information on individual homes septic systems. The attribute *usew_sept* includes data on conventional systems, and *sew_other* provides data on short-circuiting and other systems.
County	The County boundaries coverage lists data on conservation practices, which provides C and P values in the Universal Soil Loss Equation (USLE).
Gwnback	A grid of background concentrations of N in groundwater derived from water well sampling.
Landuse5	Grid of the MRLC that has been reclassified into five categories. This is used primarily as a background.
Majored	Coverage of major roads. Used for reconnaissance of a watershed.
MCD	Minor civil divisions (boroughs, townships, and cities).
Npdespts	A coverage of permitted point discharges. Provides background information and cross check for the point source coverage.
Padem	100-meter digital elevation model. Used to calculate landslope and slope length.
Palumrlc	A satellite image derived land cover grid that is classified into 15 different land cover categories. This dataset provides land cover loading rate for the different categories in the model.
Pasingle	The 1:24,000 scale single line stream coverage of Pennsylvania. Provides a complete network of streams with coded stream segments.
Physprov	A shapefile of physiographic provinces. Attributes *rain_cool* and *rain_warm* are used to set recession coefficient.
Pointsrc	Major point source discharges with permitted nitrogen and phosphorus loads.
Refwater	Shapefile of reference watersheds for which nutrient and sediment loads have been calculated.
Soilphos	A grid of soil phosphorus loads, which has been generated from soil sample data. Used to help set phosphorus and sediment values.
Smallsheds	A coverage of watersheds derived at 1:24,000 scale. This coverage is used with the stream network to delineate the desired level watershed.
Statsgo	A shapefile of generalized soil boundaries. The attribute *mu_k* sets the k factor in the USLE. The attribute *mu_awc* is the unsaturated available capacity, and the *muhsg_dom* is used with land use cover to derive curve numbers.
Strm305	A coverage of stream water quality as reported in Pennsylvania's 305(b) report. Current status of assessed streams.
Surfgeol	A shapefile of the surface geology used to compare watersheds of similar qualities.
T9sheds	Data derived from a PADEP study conducted at PSU with N and P loads.
Zipcode	A coverage of animal densities. Attribute *aeu_acre* helps estimate N & P concentrations in runoff in agricultural lands and over manured areas.
Weather Files	Historical weather files for stations around Pennsylvania to simulate flow.

Attachment D

AVGWLF Model Inputs for the Opossum Creek Watershed

Opossum Creek Watershed Nutrient Input File



Runoff Coefficients by Source

Rural Runoff	Dis N mg/L	Dis P mg/L
Hay/Past	2.9	0.209
Cropland	2.9	0.209
Forest	0.19	0.006
Wetland	0.19	0.006
Turf_Grass	2.5	0.228
Unpaved_Rd	2.9	0.2
Transition	2.9	0.2
	0	0
	0	0
	0	0
Manure	2.44	0.38
Urban Build-Up	N Kg/ha/d	P Kg/ha/d
Lo_Int_Dev	0.012	0.002
	0	0

Nitrogen and Phosphorus Loads from Point Sources and Septic Systems

Month	Point Source Loads/Discharge Kg N	Kg P	Discharge MGD	Septic System Populations Normal Systems	Pond Systems	Short Cir Systems	Discharge Systems
Jan	0.0	0.0	0.0	872	0	30	0
Feb	0.0	0.0	0.0	872	0	30	0
Mar	0.0	0.0	0.0	872	0	30	0
Apr	0.0	0.0	0.0	872	0	30	0
May	0.0	0.0	0.0	872	0	30	0
Jun	0.0	0.0	0.0	872	0	30	0
Jul	0.0	0.0	0.0	872	0	30	0
Aug	0.0	0.0	0.0	872	0	30	0
Sep	0.0	0.0	0.0	872	0	30	0
Oct	0.0	0.0	0.0	872	0	30	0
Nov	0.0	0.0	0.0	872	0	30	0
Dec	0.0	0.0	0.0	872	0	30	0

Groundwater (mg/L) N (mg/L)	P (mg/L)	Tile Drainage (mg/L) N	P	Sed	Per capita tank effluent N (g/d)	P (g/d)	Growing season N/P uptake N (g/d)	P (g/d)	Sediment N (mg/Kg)	P (mg/Kg)
1.852	0.025	15	0.1	50	12	2.5	1.6	0.4	3000.0	689.0

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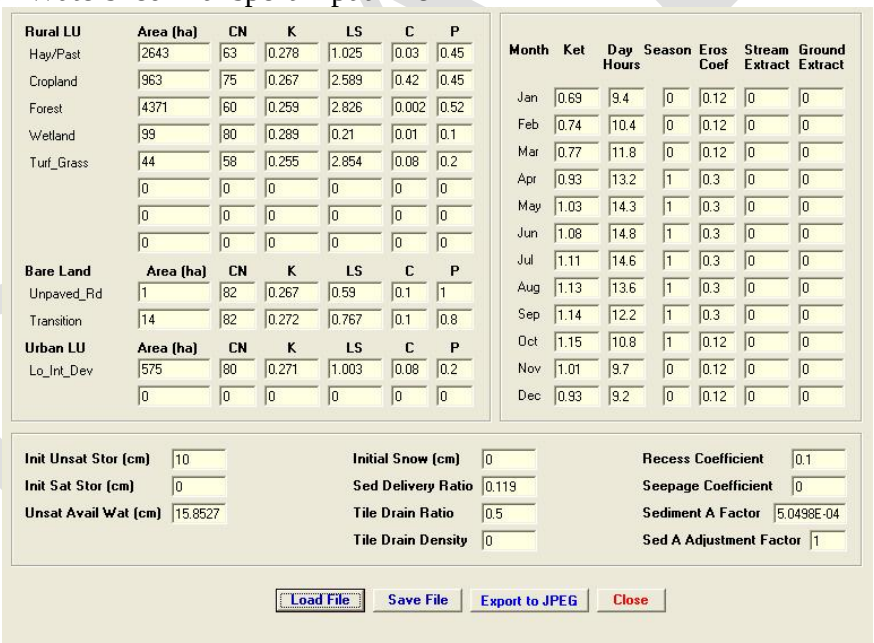
Opossum Creek Watershed Transport Input File



Rural LU	Area (ha)	CN	K	LS	C	P
Hay/Past	2643	63	0.278	1.025	0.03	0.45
Cropland	963	75	0.267	2.589	0.42	0.45
Forest	4371	60	0.259	2.826	0.002	0.52
Wetland	99	80	0.289	0.21	0.01	0.1
Turf_Grass	44	58	0.255	2.854	0.08	0.2
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
Bare Land	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
Unpaved_Rd	1	82	0.267	0.59	0.1	1
Transition	14	82	0.272	0.767	0.1	0.8
Urban LU	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
Lo_Int_Dev	575	80	0.271	1.003	0.08	0.2
	0	0	0	0	0	0

Month	Ket	Day Hours	Season	Eros Coef	Stream Extract	Ground Extract
Jan	0.69	9.4	0	0.12	0	0
Feb	0.74	10.4	0	0.12	0	0
Mar	0.77	11.8	0	0.12	0	0
Apr	0.93	13.2	1	0.3	0	0
May	1.03	14.3	1	0.3	0	0
Jun	1.08	14.8	1	0.3	0	0
Jul	1.11	14.6	1	0.3	0	0
Aug	1.13	13.6	1	0.3	0	0
Sep	1.14	12.2	1	0.3	0	0
Oct	1.15	10.8	1	0.12	0	0
Nov	1.01	9.7	0	0.12	0	0
Dec	0.93	9.2	0	0.12	0	0

Init Unsat Stor (cm)	10	Initial Snow (cm)	0	Recess Coefficient	0.1
Init Sat Stor (cm)	0	Sed Delivery Ratio	0.119	Seepage Coefficient	0
Unsat Avail Wat (cm)	15.8527	Tile Drain Ratio	0.5	Sediment A Factor	5.0498E-04
		Tile Drain Density	0	Sed A Adjustment Factor	1

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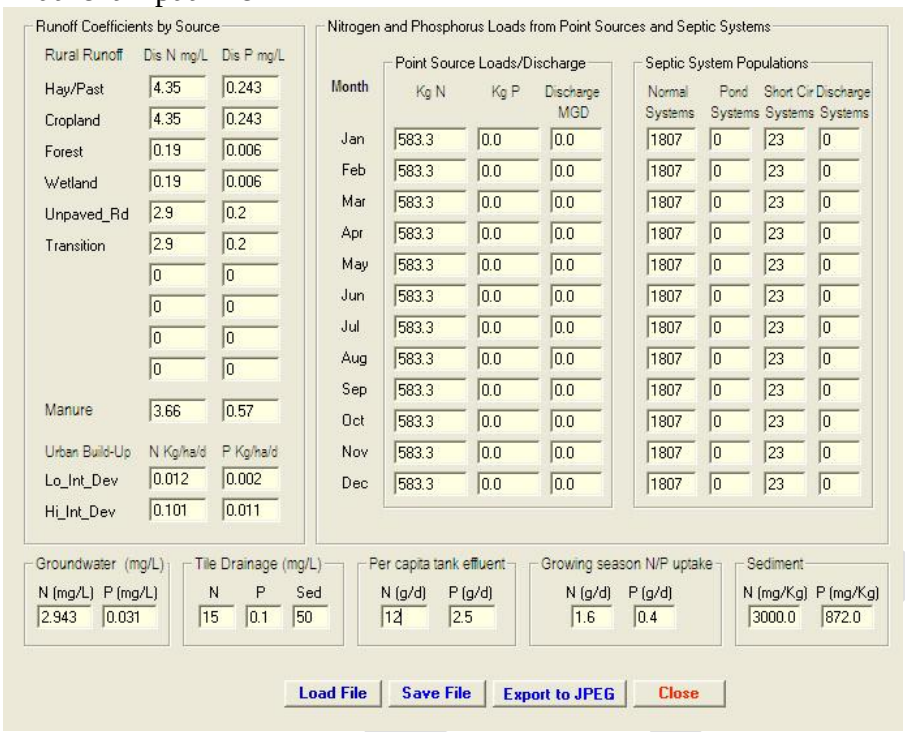
Attachment E

AVGWLF Model Inputs for the Middle Creek Reference Watershed

Middle Creek Nutrient Input File



Runoff Coefficients by Source

Rural Runoff	Dis N mg/L	Dis P mg/L
Hay/Past	4.35	0.243
Cropland	4.35	0.243
Forest	0.19	0.006
Wetland	0.19	0.006
Unpaved_Rd	2.9	0.2
Transition	2.9	0.2
	0	0
	0	0
	0	0
	0	0
Manure	3.66	0.57

Urban Build-Up	N Kg/ha/d	P Kg/ha/d
Lo_Int_Dev	0.012	0.002
Hi_Int_Dev	0.101	0.011

Nitrogen and Phosphorus Loads from Point Sources and Septic Systems

Month	Point Source Loads/Discharge Kg N	Kg P	Discharge MGD	Septic System Populations Normal Systems	Pond Systems	Short Cir Systems	Discharge Systems
Jan	583.3	0.0	0.0	1807	0	23	0
Feb	583.3	0.0	0.0	1807	0	23	0
Mar	583.3	0.0	0.0	1807	0	23	0
Apr	583.3	0.0	0.0	1807	0	23	0
May	583.3	0.0	0.0	1807	0	23	0
Jun	583.3	0.0	0.0	1807	0	23	0
Jul	583.3	0.0	0.0	1807	0	23	0
Aug	583.3	0.0	0.0	1807	0	23	0
Sep	583.3	0.0	0.0	1807	0	23	0
Oct	583.3	0.0	0.0	1807	0	23	0
Nov	583.3	0.0	0.0	1807	0	23	0
Dec	583.3	0.0	0.0	1807	0	23	0

Groundwater (mg/L) N (mg/L)	P (mg/L)	Tile Drainage (mg/L) N	P	Sed	Per capita tank effluent N (g/d)	P (g/d)	Growing season N/P uptake N (g/d)	P (g/d)	Sediment N (mg/Kg)	P (mg/Kg)
2.943	0.031	15	0.1	50	12	2.5	1.6	0.4	3000.0	872.0

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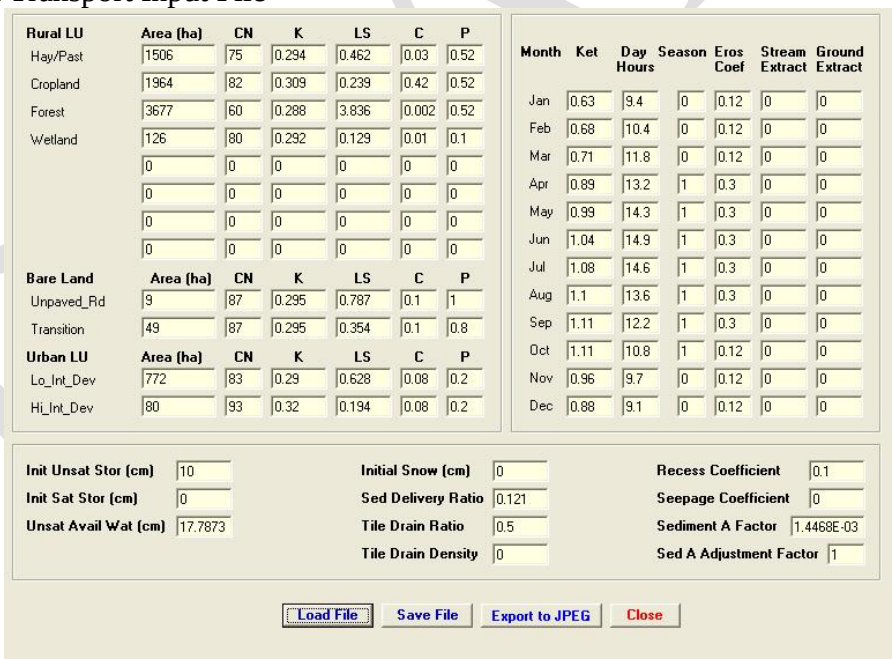
Middle Creek Transport Input File



Rural LU	Area (ha)	CN	K	LS	C	P
Hay/Past	1506	75	0.294	0.462	0.03	0.52
Cropland	1964	82	0.309	0.239	0.42	0.52
Forest	3677	60	0.288	3.836	0.002	0.52
Wetland	126	80	0.292	0.129	0.01	0.1
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
Bare Land	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
Unpaved_Rd	9	87	0.295	0.787	0.1	1
Transition	49	87	0.295	0.354	0.1	0.8
Urban LU	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
Lo_Int_Dev	772	83	0.29	0.628	0.08	0.2
Hi_Int_Dev	80	93	0.32	0.194	0.08	0.2

Month	Ket	Day Hours	Season	Eros Coef	Stream Extract	Ground Extract
Jan	0.63	9.4	0	0.12	0	0
Feb	0.68	10.4	0	0.12	0	0
Mar	0.71	11.8	0	0.12	0	0
Apr	0.89	13.2	1	0.3	0	0
May	0.99	14.3	1	0.3	0	0
Jun	1.04	14.9	1	0.3	0	0
Jul	1.08	14.6	1	0.3	0	0
Aug	1.1	13.6	1	0.3	0	0
Sep	1.11	12.2	1	0.3	0	0
Oct	1.11	10.8	1	0.12	0	0
Nov	0.96	9.7	0	0.12	0	0
Dec	0.88	9.1	0	0.12	0	0

Init Unsat Stor (cm)	10	Initial Snow (cm)	0	Recess Coefficient	0.1
Init Sat Stor (cm)	0	Sed Delivery Ratio	0.121	Seepage Coefficient	0
Unsat Avail Wat (cm)	17.7873	Tile Drain Ratio	0.5	Sediment A Factor	1.4468E-03
		Tile Drain Density	0	Sed A Adjustment Factor	1

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Attachment F

Equal Marginal Percent Reduction Method

The Equal Marginal Percent Reduction (EMPR) allocation method was used to distribute Adjusted Load Allocations (ALAs) between the appropriate contributing nonpoint sources. The load allocation and EMPR procedures were performed using the MS Excel and results are presented in Attachment G. The five major steps identified in the spreadsheet are summarized below:

1. Calculation of the TMDL based on impaired watershed size and unit area loading rate of the reference watershed.

2. Calculation of Adjusted Load Allocation based on TMDL, Margin of Safety, and existing loads not reduced.

3. Actual EMPR Process.

    a. Each land use/source load is compared with the total ALA to determine if any contributor would exceed the ALA by itself. The evaluation is carried out as if each source is the only contributor to the pollutant load of the receiving waterbody. If the contributor exceeds the ALA, that contributor would be reduced to the ALA. If a contributor is less than the ALA, it is set at the existing load. This is the baseline portion of the EMPR.
    b. After any necessary reductions have been made in the baseline, the multiple analyses are run. The multiple analyses will sum all of the baseline loads and compare them to the ALA. If the ALA is exceeded, an equal percent reduction will be made to all contributors' baseline values. After any necessary reductions in the multiple analyses, the final reduction percentage for each contributor can be computed.

4. Calculation of total loading rate of all sources receiving reductions.

5. Summary of existing loads, final load allocations, and percent reduction for each pollutant source.

Attachment G

Equal Marginal Percent Reduction Calculations for the Opossum Creek Watershed TMDL

Step 1: TMDL Total Load

Load = loading rate in ref. * Acres in Impaired

22779.8374

Step 2: Adjusted LA = (TMDL total load - MOS) - uncontrollable

19379.4950 19379

SEDIMENT LOADING

Step 3:	Non-MS4 Daily Average Load	Load Sum	Check	Initial Adjust	Recheck	% reduction allocation	Load Reductior	Initial LA	Acres	Allowable Loading Rate	% Reduction
Hay/Past.	1944.2192	35785.629	good	1944	ADJUST	0.06	732.823	1211.397	6531.00	0.185	38%
Cropland	24062.1918		bad	19379	11723	0.62	7304.594	12074.901	2379.60	5.074	50%
Developed	624.1096		good	624		0.02	235.242	388.868	1566.70	0.248	38%
Streambank	9155.1083		good	9155		0.29	3450.779	5704.330			38%
Total	35785.6289			31102.932		1.00		19379.495			

Step 4 All Ag. Loading Rat 1.49

Step 5:	Acres	Allowable (Target) Loading Rate	Final LA	Current Loading Rates	Current Load	% Red.
Final Hay/Past. LA	6531.00	0.1855	1211.3966	0.2977	1944.2192	38%
Final Cropland LA	2379.60	5.0743	12074.9010	10.1119	24062.1918	50%
Developed	1566.70	0.2482	388.8678	0.3984	624.1096	38%
Streambank			5704.3296		9155.1083	38%
Total			19379.4950		35785.6289	46%

Opossum Creek

Attachment H

Opossum Creek Watershed Impaired Segment Listings

Stream Name / *Use Designation (Assessment ID)* / *Source*	*Cause*	*Date*	*TMDL Date*
Hydrologic Unit Code: 02050306-Lower Susquehanna			
Opossum Creek Unnamed Of (ID:133624865)			
HUC: 02050306			
Aquatic Life (13015) - 0.2 miles			
Agriculture	Siltation	2008	2021
Opossum Creek Unnamed Of (ID:133624867)			
HUC: 02050306			
Aquatic Life (13015) - 0.56 miles			
Agriculture	Siltation	2008	2021
Opossum Creek Unnamed Of (ID:57469395)			
HUC: 02050306			
Aquatic Life (13015) - 0.32 miles			
Agriculture	Siltation	2008	2021
Opossum Creek Unnamed Of (ID:57469535)			
HUC: 02050306			
Aquatic Life (13015) - 0.48 miles			
Agriculture	Siltation	2008	2021
Opossum Creek Unnamed Of (ID:57469725)			
HUC: 02050306			
Aquatic Life (13015) - 0.92 miles			
Agriculture	Siltation	2008	2021
Opossum Creek Unnamed Of (ID:57469963)			
HUC: 02050306			
Aquatic Life (13017) - 0.49 miles			
Agriculture	Siltation	2008	2021
Opossum Creek Unnamed Of (ID:57470081)			
HUC: 02050306			
Aquatic Life (13017) - 0.72 miles			
Agriculture	Siltation	2008	2021
Opossum Creek Unnamed Of (ID:57470091)			
HUC: 02050306			
Aquatic Life (13020) - 0.41 miles			
Agriculture	Siltation	2008	2021
Opossum Creek Unnamed Of (ID:57470181)			
HUC: 02050306			
Aquatic Life (13020) - 0.63 miles			
Agriculture	Siltation	2008	2021
Opossum Creek Unnamed Of (ID:57470291)			
HUC: 02050306			
Aquatic Life (13017) - 1.18 miles			
Agriculture	Siltation	2008	2021
Opossum Creek Unnamed Of (ID:57470471)			
HUC: 02050306			
Aquatic Life (13020) - 1.06 miles			
Agriculture	Siltation	2008	2021
Opossum Creek Unnamed Of (ID:57470637)			
HUC: 02050306			
Aquatic Life (13019) - 1.05 miles			
Agriculture	Siltation	2008	2021

Stream Name / *Use Designation (Assessment ID)* / *Source*	*Cause*	*Date*	*TMDL Date*
Opossum Creek Unnamed Of (ID:57471293)			
HUC: 02050306			
Aquatic Life (13020) - 0.56 miles			
Agriculture	Siltation	2008	2021
Opossum Creek Unnamed Of (ID:57471521)			
HUC: 02050306			
Aquatic Life (13020) - 0.9 miles			
Agriculture	Siltation	2008	2021
Opossum Creek Unnamed To (ID:57470085)			
HUC: 02050306			
Aquatic Life (13015) - 2.41 miles			
Agriculture	Siltation	2008	2021
Opossum Creek Unnamed To (ID:57470105)			
HUC: 02050306			
Aquatic Life (13015) - 0.85 miles			
Agriculture	Siltation	2008	2021
Opossum Creek Unnamed To (ID:57470319)			
HUC: 02050306			
Aquatic Life (13008) - 0.58 miles			
Agriculture	Siltation	2008	2021
Opossum Creek Unnamed To (ID:57470429)			
HUC: 02050306			
Aquatic Life (13017) - 1.88 miles			
Agriculture	Siltation	2008	2021
Opossum Creek Unnamed To (ID:57470819)			
HUC: 02050306			
Aquatic Life (13019) - 2.48 miles			
Agriculture	Siltation	2008	2021
Opossum Creek Unnamed To (ID:57470837)			
HUC: 02050306			
Aquatic Life (13020) - 2.55 miles			
Agriculture	Siltation	2008	2021
Opossum Creek Unnamed To (ID:57471069)			
HUC: 02050306			
Aquatic Life (13018) - 0.65 miles			
Agriculture	Siltation	2008	2021
Opossum Creek Unnamed To (ID:57471277)			
HUC: 02050306			
Aquatic Life (13018) - 0.55 miles			
Agriculture	Siltation	2008	2021
Opossum Creek Unnamed To (ID:57471475)			
HUC: 02050306			
Aquatic Life (13018) - 3.08 miles			
Agriculture	Siltation	2008	2021
Opossum Creek Unnamed To (ID:57471545)			
HUC: 02050306			
Aquatic Life (13020) - 1.29 miles			
Agriculture	Siltation	2008	2021

Stream Name ***Use Designation (Assessment ID)*** ***Source***	***Cause***	***Date***	***TMDL Date***
Quaker Run HUC: 02050306			
Aquatic Life (13013) - 3.31 miles			
Agriculture	Siltation	2008	2021
Aquatic Life (13018) - 0.68 miles			
Agriculture	Siltation	2008	2021
Quaker Run_Unnamed_Of (ID:57471249) HUC: 02050306			
Aquatic Life (13018) - 0.61 miles			
Agriculture	Siltation	2008	2021
Quaker Run_Unnamed_Of (ID:57471285) HUC: 02050306			
Aquatic Life (13018) - 0.77 miles			
Agriculture	Siltation	2008	2021
Quaker Run_Unnamed_To (ID:57471137) HUC: 02050306			
Aquatic Life (13018) - 1.19 miles			
Agriculture	Siltation	2008	2021
Quaker Run_Unnamed_To (ID:57471171) HUC: 02050306			
Aquatic Life (13018) - 2.51 miles			
Agriculture	Siltation	2008	2021

Attachment I

Comment & Response Document for the Opossum Creek Watershed TMDL