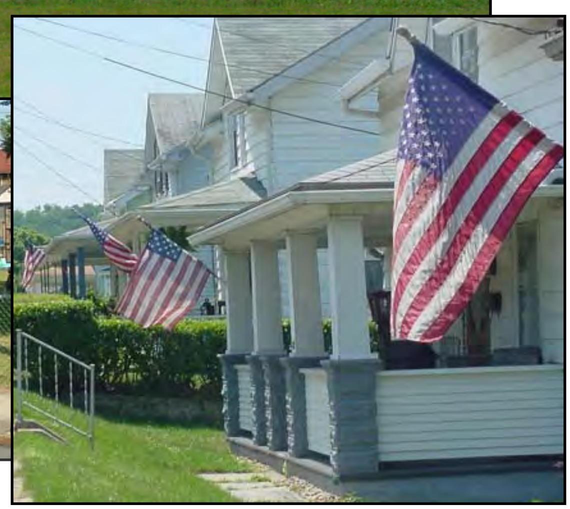
319 Watershed Implementation Plan:

Hungry Run



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Watershed Background:

Hungry Run, located within Mifflin County, Pennsylvania, is a tributary to Kishacoquillas Creek- 12A of the State Water Plan. Bounded by Jacks Mountain to the north, and smaller ridges such as Chestnut ridge and Laurel ridge to the south, Hungry Run is a small watershed of only 8 square miles, or 5310 acres. Although the stream itself is not very long, only 4.7 miles, Hungry Run flows through three political jurisdictions in Mifflin County. It originates in Decatur Township, and flows through Derry Township before joining Kishacoquillas Creek in Burnham Borough.

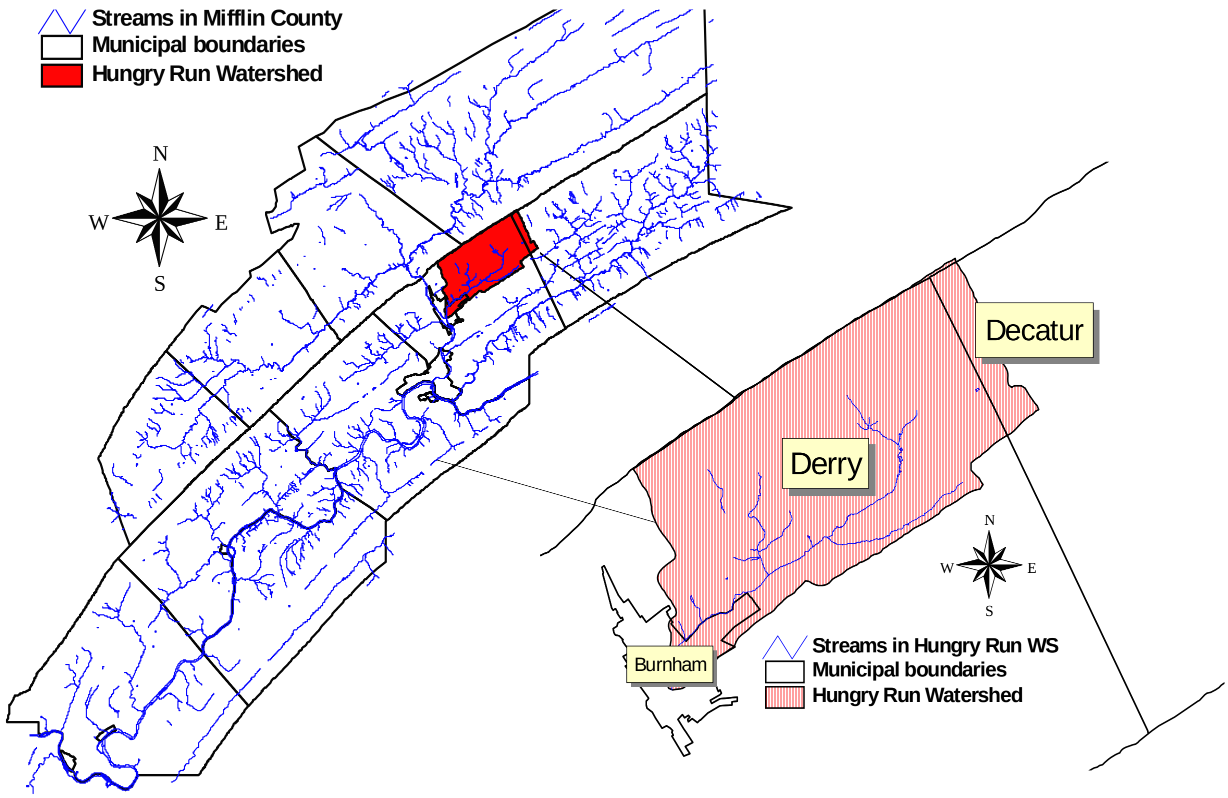


Figure 1. Map of Mifflin County with the Hungry Run Watershed highlighted in red, and a second map of just the Hungry Run Watershed showing the political jurisdictions of Burnham Borough, Derry Township and Decatur Township.

Topography, Geology, and Soils:

Hungry Run is situated in the "Ridge and Valley" physiographic province. Elevation in this watershed ranges from 600 feet to 1862 feet above sea level. Two small tributaries begin on the forested Jacks Mountain and flow downward to join Hungry Run in the valley and a third small tributary joins Hungry Run from between Chestnut and Laurel ridges in the town of Vira. The ridges are composed of residual and colluvial materials weathered from acid sandstone and some shale and are covered in the Hazleton-Laidig-Buchanan soil association. The valley soils were formed from impure shaly limestone, acid red and gray shale and part of the Edom-Klinesville-Weikert soil association. Edom, the predominant soil in this association, is deep and well drained.

The ridges in this watershed are primarily wooded. Farms in this watershed are in the narrow valley, which also happens to be where the streams are located. Erosion potential for the whole watershed is significant with only 15% of the acres having 0-8% slope, 24 % of the acres having 8-15% slope and the remaining 61% of the acres having over 15% slope (Table 1).

Table 1. Number of acres and percent slope in the Hungry Run Watershed

	0 to 8% Slope (acres)	**8 to 15% Slope (acres)**	**Over 15% Slope (acres)**
	792	1297	3270
% of Hungry Run Watershed	15%	24%	61%


Burnham
HARDWARE
& GIFTS

Land Use:

Although a portion (about 1/3) of Burnham Borough, a residential Borough, is within this watershed, the watershed is still primarily forested land (62%). Residential development only comprises about 6% of the landuse in this watershed and an additional 1% is other developed land such as churches, parking lots, ball fields, and other commercial ventures (Figure 2). Agriculture (31%) is the other major land use in the watershed and is considered the source of impairment according to PA DEP.

According to <u>Paths and Bridges to the 21st Century: Mifflin County Comprehensive Plan 2000</u>, most of the watershed is projected to be "Rural Development" areas, or "Natural Resource" areas (Table 2). The purpose of Rural Development Areas are to help preserve the existing agricultural and natural resource production economies, and also to protect the quality of the groundwater supply, the open space and the rural character presently found in these areas. Natural Resource areas delineate those areas unsuitable for development and protect the county's environmentally sensitive resources.

The area along Vira Road before Old Park Road is zoned "High Growth- Residential". Much that area is already residential housing, so this will not be a future change to the watershed.

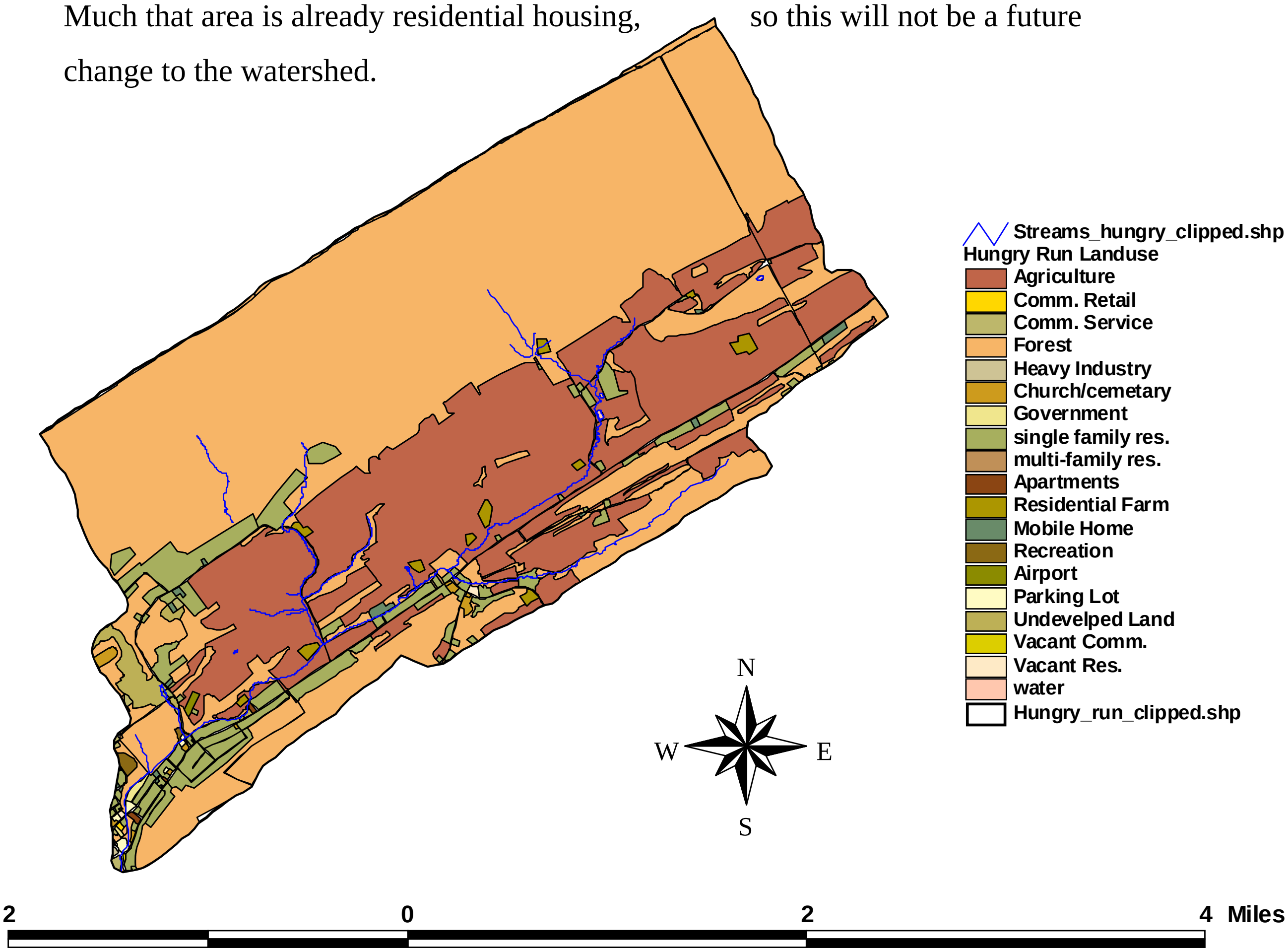


Figure 2. Current Landuse in the Hungry Run Watershed

Similarly, the areas that are zoned "Urban Center" already are urban centers. Some subdivision is occurring in the Hungry Run Watershed on Old Park Road, but it appears to be in an area zoned "Limited Growth".

Table 2. Mifflin County's Future Land Use Plan Classifications

Rural Development Area	To help preserve the existing agricultural and natural resource production economies, and rural character, as well as protect the culture that is unique to the County's Plain Sect population.
Natural Resource Protection Area	To delineate those areas unsuitable for development and to protect the County's environmentally sensitive resources.
High Growth (residential) (Industrial & Commercial)	Encourage the development of this urban fringe area by designating appropriate areas for medium and high density residential development as well as commercial and industrial uses.
Village Centers	Delineates developed areas such as Allensville, Belleville, Milroy, and Reedsville. These areas have mixed residential, commercial, industrial and public uses, and generally do not have zoning. Furthermore, they have lot sizes equaling one acre or less, may have access to water or sewer, and are within ½ mile of a state highway.
Limited Growth Areas	Encourage the development of livable, planned communities that promote a variety of residential opportunities, provide public facilities, goods and services, adequate open space and recreational opportunities, and employment at a neighborhood scale.

Source: Paths and Bridges to the 21st Century: Mifflin County Comprehensive Plan 2000

Water Quality Standards:

Designated uses and the standards for water quality can be found in the Commonwealth of Pennsylvania, Pennsylvania Code, Title 25, Environmental Protection, Chapter 93, Water Quality Standards (Chapter 93). Chapter 93 outlines protected water uses, statewide water uses, and the water quality standards that protected water uses must meet. Hungry Run is not specifically mentioned in the Chapter 93 standards, but instead is one of the "un-named" tributaries to Kishacoquillas Creek and is classified as Trout Stocked Fisheries (TSF). The Aquatic Life Definition for TSF is, "Maintenance of stocked trout from February 15 to July 31 and maintenance and propagation of fish species and additional flora and fauna which are indigenous to a warm water habitat." (Chapter 93).

Except where otherwise noted, water quality standards apply to all surface waters. Since Hungry Run is classified as TSF it must meet specific standards found in Ch. 93 in addition to the standards that apply to all surface water. For standards specific to TSF refer to Table 3 below.

Table 3. Water Quality Standards for TSF and Temperature Ranges

Parameter	***Criteria***
Dissolved Oxygen (DO)	Min daily avg. for February 15-July 31 is 6.0 mg/L; minimum 5.0 mg/L daily Min daily avg. for remainder of year is 5.0 mg/L; minimum 4.0 mg/L daily
Alkalinity	Minimum 20 mg/L as $CaCO_3$ (except where natural conditions are less)
Iron (Fe)	30 day avg. of 1.5 mg/L as total recoverable
pH	6.0 to 9.0 inclusive
Total Residual Chlorine	Four-day avg. 0.011 mg/L; 1-hour avg. 0.019 mg/L

(Reference: Commonwealth of PA)

Temperature

Critical Use Period	**Temperature (˚F)**
January 1-31	40
February 1-29	40
March 1-31	46
April 1-15	52
April 16-30	58
May 1-15	64
May 16-31	68
June 1-15	70
June 16-30	72
July 1-31	74
August 1-15	80
August 16-30	87
September 1-15	84
September 16-30	78
October 1-15	72
October 16-31	66
November 1-15	58
November 16-30	50
December 1-31	42

(Reference: Commonwealth of PA)

Assessment of Water Quality:

In accordance with The Clean Water Act (CWA), the primary federal law that protects our nation's waters, all states must identify and report on water quality. The Pennsylvania Department of Environmental Protection (PA DEP) conducted a statewide survey of unassessed waters to determine if the waters were meeting their Chapter 93 designated uses. In this survey the PA DEP sampled macroinvertebrates throughout the state and classified streams as either attaining the designated use, or not attaining the designated use thereby being "impaired". Hungry Run was found to be "impaired" by PA DEP and subsequently listed on the 2002 CWA Section 303 (d) list of impaired waters for excessive siltation and nutrients due to agriculture (See Appendix A for the DEP data).

In 2003 the Lewistown Area High School began the Lower Kishacoquillas Creek Watershed Assessment which included one sample site on Hungry Run (Tables 4 & 5). The students tested water chemistry, heavy metals following storm events, macroinvertebrates, and riparian habitat (See Appendix B for more extensive data). The results of the assessment conducted by the students concurred with the PA DEP results, the watershed is impaired.

Table 4. Total Suspended Solids (mg/L) detected at a sample site on Hungry Run from June 2004 to July 2005

Date	HURU 1.8
Jun-04	17
Jul-04	6
Aug-04	5
Sep-04	*
Oct-04	ND
Nov-04	ND
Dec-04	8
Jan-05	6
Feb-05	ND
Mar-05	13
Jun-05	9
Jul-05	ND

* no data for that month

Table 5. Summary Water Chemistry Statistics for Hungry Run from June 2004 to July 2005

Category	Avg	Max	Min
Air Temp in F	61.7	82	34
Stream Temp in F	56.6	71	41
pH	7.4	8.3	6.9
Conductivity (mS)	339.5	437	196
Alkalinity (mg/L CaCO3)	201.7	260	140
Dissolved 02 (mg/L)	9.2	13	6
Nitrate-N (mg/L)	2.2	3.26	0.98
Sulfate (mg/L)	24	33	2.78
Total Phosphorus	ND		
Fecal Coliform (col/100)	985.6	3200	20
Total Suspended Solids	9.1	17	5
Ammonia-Nitrogen (mg/L)	0.1	0.12	0.12

While sediment and nutrients were found to be a problem, certain heavy metals such as aluminum, iron, lead and zinc, which were sampled during storm events, were also found to exceed the U.S. Environmental Protection Agency's level of toxicity on occasion (*Lower Kishacoquillas Creek Watershed Assessment).*

Total Maximum Daily Loads:

The United States Environmental Protection Agency (EPA) and PA DEP must set guidelines and determine conditions that will return impaired waters to a status that meets the water quality standards identified in Chapter 93. To accomplish this task, water bodies that do not meet water quality standards may be assigned a total maximum daily load (TMDL), which quantifies the loading capacity of a stressor and which enables the water body to meet the standards. This ultimately provides a quantitative scheme for allocating loadings among pollutant sources.

A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and non-point sources. The calculation must include a margin of safety to ensure that the body of water can be used for the purposes that PA DEP has designated and must also account for seasonal variation in water quality (Reference: EPA-6). TMDL's are established in accordance with the EPA Section 319 (h) of the Clean Water Act and focus on non-point source management.

The goal of a TMDL report is to provide detailed technical and scientific documentation that identifies the water quality impairment and the causes of impairment. An important part of TMDL determination is the use of scientific and mathematic models in conjunction with stream sampling. Current loading rates and TMDL endpoints are determined from the models.

Sampling can then be done to check these values and also determine if change is being made over time as the load reductions and additional BMP's are implemented. It is also important that a TMDL be reasonable for the watershed(s) for which they are proposed. Public participation and input is an important factor in TMDL development (Reference: PA DEP-3).

At this time, TMDLs have not been developed for the Hungry Run watershed; however they are expected to be established as soon as 2015. Once completed, the calculated loads will be compared with the loads projected for this watershed by PRedICT and adjustments will be made accordingly. The goal of this plan is to reduce sediment and nutrient pollution in Hungry Run to the point that biological organisms return in significant numbers, allowing the stream to be removed from the State's Impaired Streams List and precluding the need for development of a TMDL.

Problem Identification: Sedimentation and Nutrient Loading

1. Agriculture

The Pennsylvania Department of Environmental Protection identified sedimentation and nutrient loading due to the agricultural practices in the watershed as the primary threats to water quality.

Agricultural BMP's are designed to remedy the problems of sedimentation and nutrient loading associated with farming. The Conservation District is working with willing landowners to implement agricultural BMP's to reduce sediment and nutrient loading in the Hungry Run Watershed, with the ultimate goal of meeting the water quality standards for Trout Stocked Fisheries.

Given the fact that there are few farms in this watershed, this should be a reasonable goal. Currently 17 of the 24 farms in the watershed have conservation plans or farm plans. Plans incorporate the various BMP's prescribed for a given farm. In those plans, BMP's are prescribed to be implemented. Most plans identify multiple BMP's, which address the various aspects of farming such as row crops, hay fields, pasture, and animal feeding operations.

2. Urban Runoff

These two pictures were taken while standing in the same location. Picture one demonstrates how the water flows from Vira Rd. down Oak St. to picture 2- the Burnham Lions Club

Hungry Run is not listed as an Urban Runoff impaired stream on the 303(d) list, but there are sections of the stream are eroding due to urban influences. The Burnham Lions Club building is located within feet of Hungry Run (picture below). During Hurricane Ivan in September 2004 a significant portion of the bank next to the building eroded. The situation at the Lions Club is made more problematic due to the road, Oak St., that flows directly from Freedom Avenue down to the blacktop parking lot of the Lions club (see pictures above).

Hungry Run behind the Burnham Lions Club building

Hungry Run in the Freedom Avenue Methodist Church parking lot.

The section of stream near the Burnham Brethren Church has been straightened, channelized, and stabilized using wooden boards as the protective edge. These practices slow down the transport of sediment and instead, cause sediment to settle out and collect in these locations.

These two pictures were taken behind the Burnham Brethren Church. The pictures, not taken following a rain, demonstrate a stagnant, cloudy, sediment filled channel. Notice the wooden "spikes" on the left edge of the stream in the picture on the left. These are holding the wooden board used to prevent bank erosion. Notice also the grass is mowed directly to the edge of the stream

Many typical urban problems are also found in this watershed such as downspouts that empty onto streets instead of a pervious surface such as a lawn or garden, mowing directly to the stream edge, and buildings in the flood plain.

3. Sewage

With the increase in development in this watershed, sewage is potentially an issue. The only waste water treatment facility that services the watershed is located in Burnham Borough. Although this waste water treatment plant services approximately 900 customers, many of them are not located within the Hungry Run watershed. The majority of Hungry Run is located in Derry Township which is not serviced by a sewage treatment facility, however dose have an On-Lot pump out ordinance.

4. Unpaved Roads

There are only 1.32 miles of unpaved municipal road within the watershed. However, there are many more miles of privately owned unpaved roads including many logging roads. None of the unpaved municipal roads are managed or protected using the Dirt and Gravel Road Program, implemented by the State Conservation Commission in 1997 through State Act 606 and administered locally by the Conservation District.

5. Water Detention Basins and Constructed Wetlands

The Hungry Run watershed has a lack of water detention basins and constructed wetlands. Efficiency values in PRedICT for both structures rank them as two of the more efficient BMP's, particularly for sediment control. They are also very effective modes of storm water management, allowing storm water and runoff to slowly infiltrate into streams.

Prioritization:

1. Agriculture -

According to the Farm Service Agency's records, there are 24 farms with individual farm numbers assigned to them in the Hungry Run watershed. The Conservation District mapped these farms using ArcView. The majority of the farmland is located adjacent to Hungry Run.

Due to the predominance of agriculture- related reasons for impairment and listing on the 303 (d) list, agricultural practices were given the highest priority for remediation.

In order to determine which individual farms would receive priority; all farms were ranked on 8 factors including farm size, distance from stream, slope, soil type(s), livestock stream access, having an up-to-date conservation plan, having a concrete barnyard, and having a manure storage tank or waste treatment system. Farms with a higher total score were considered to be of higher priority because they potentially have the greatest negative impact on the watershed, and farms with lower total scores were given a lesser priority. A score of one implied that the farming practices employed are not creating a significant threat to water quality, and a score of five implied that the farming practices employed are creating a very significant threat to water quality (See Figure 3). The farms with higher total scores were evaluated first in an attempt to establish nutrient reducing and cost effective BMP's.

Actual implementation of the prescribed BMP's will be based upon land owner cooperation, permits, cost, feasibility, and availability of technical services. However, farms with highest priority values will still be contacted first, and the District will continue to communicate with the landowner in an attempt to install various BMP's.

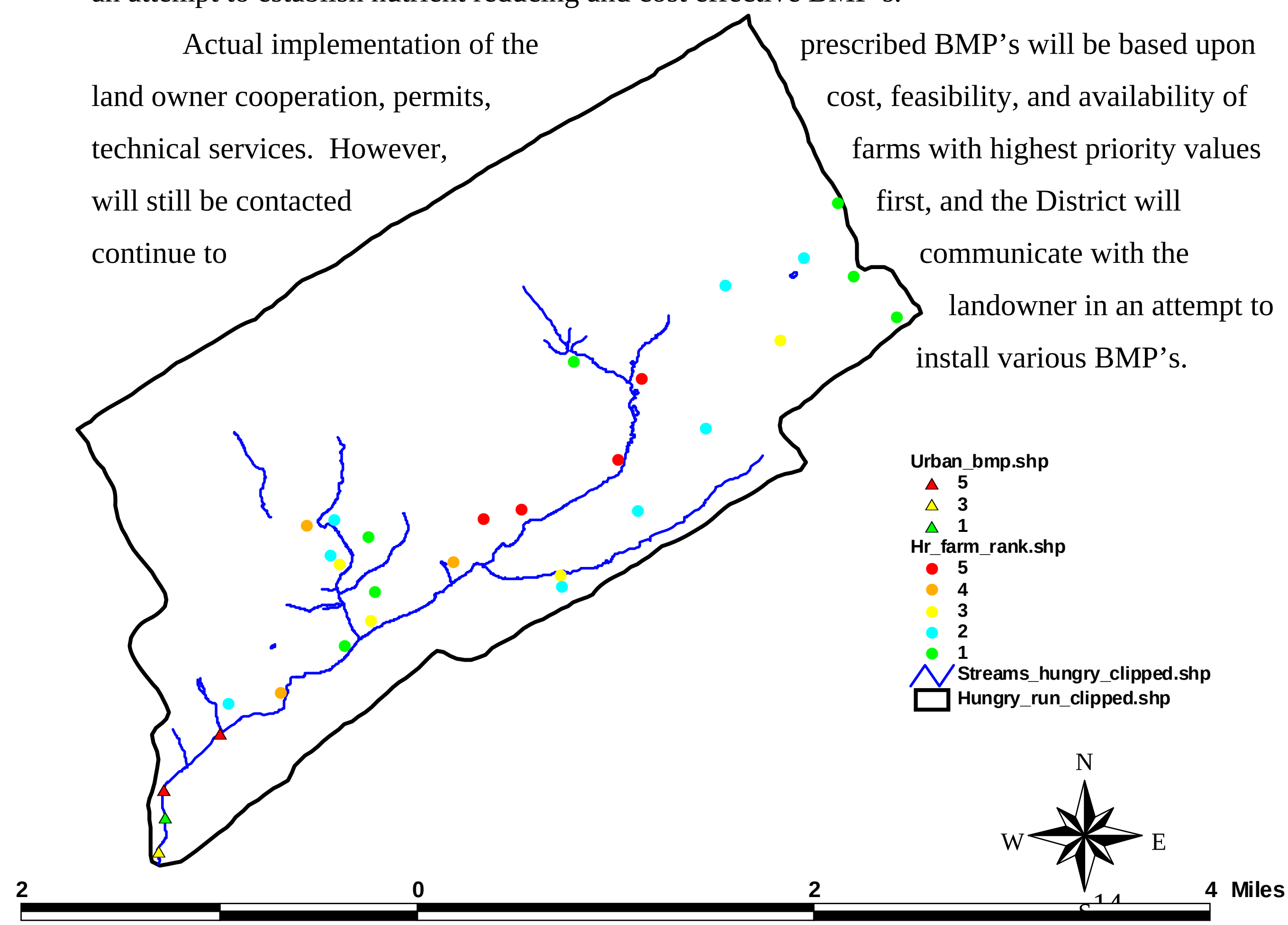


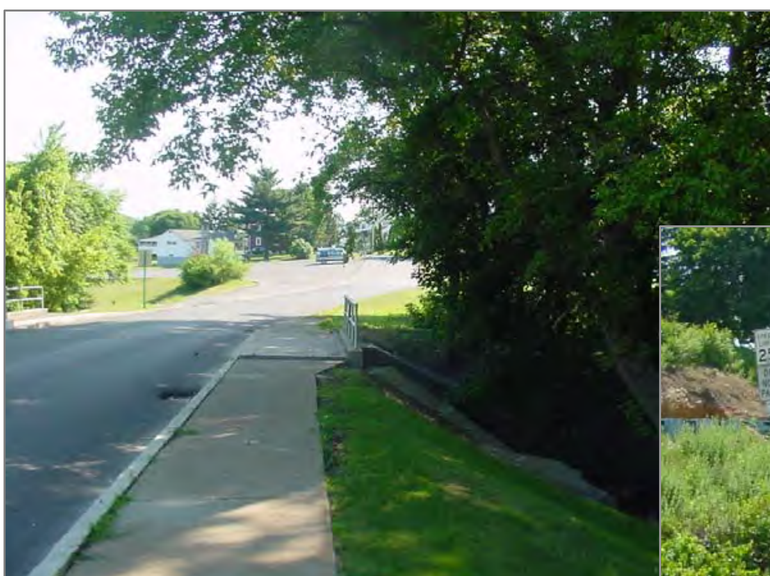
Figure 3. Map of Hungry Run Watershed- Prioritized Project Sites



2. Urban-

Urban storm water issues also warranted attention in 4 locations in the watershed (See Figure 3, pg.14). This stream is not listed due to "urban runoff", but clearly areas of the stream are being impacted by urbanization. Approximately 2,150 feet of Hungry Run within the Borough of Burnham is directly impacted by development. This portion of the stream would benefit from Urban BMP's and/or riparian herbaceous cover or riparian forest cover.

The four urban storm water issues were not ranked in the same manner as the farms. Instead, they were ranked on the likelihood they would be addressed. Site 4 is not likely to be addressed any time soon due to space limitations; however, it is included in the plan so that it may be addressed sometime in the future.



3. Sewage

According to the Mifflin County Assessment data, of the 645 parcels in the Hungry Run watershed, 261parcels (40%) have municipal sewer hook-ups. Derry Township has adopted an On-Lot Pump Out ordinance which requires a regular service and inspection of the septic system. This type of ordinance goes a long way to addressing potential problems in private on-lot systems.

4. Unpaved Roads

Unpaved roads are a proven source of sedimentation and nutrient loading through run-off. A 908 foot section of unpaved municipal road has been identified by the municipality and the Conservation District as a potential worksite for the Dirt and Gravel Road Program.

A demonstration site on a private field lane in the Hungry Run watershed has been installed. The Conservation District is organizing a field day to highlight the importance of maintaining both farm lanes and field lanes to private land owners.

5. Water Detention basins and Constructed Wetlands

Prior to 2002, water detention basins had to be created during construction, but did not have to be permanent features. Since then such structures must be permanently installed under law. Because of this relatively new legislation, there are very few of either in the watershed. Both Derry Township and the Borough of Burnham adopted the Kishacoquillas Stormwater Ordinance in 2004 and are currently complying with this ordinance.

Past Management Measures:

This Conservation District is a valuable resource in the County and serves to assist all landowners address their natural resources needs. The Conservation District has been, and will continue, to work with farmers in the Hungry Run watershed. The following is a summary of work the Conservation District has already completed in the Hungry Run watershed. This information was used to run various scenarios in PRedICT.

Table 6 (below) shows past BMP's installed between January 1990 and December 2000. No Conservation Plans were written in this watershed, or BMP's installed from 2001 to 2007.

Table 6. Best Management Practices (BMP's) Installed between January 1990 and December 2000.

BMP Title and NRCS Code No.	Total Acreage
Conservation Plan (003)	754
Conservation Crop Rotation (328)	615
Contour Farming (330)	416
Nutrient Management (590)	398
Residue and Tillage Management (329)	332
Contour strip-cropping (585)	285
Cover Crop (340)	154

Current Management Measures: *Projects Scheduled for Implementation*

Newly revised Conservation Plans has been written for three farms, all being operated by the same farmer. These acres are reflected in Table 7 (below).

Table 7. Best Management Practices (BMP's) scheduled for Implementation after January 2007.

BMP Title and NRCS Code No.	Total Acreage
Conservation Plan (003)	115
Conservation Crop Rotation (328)	71
Contour Farming (330)	71
Nutrient Management (590)	71
Residue and Tillage Management (329)	71
Contour Strip-cropping (585)	71

Past, Current, and Future Projects for Implementation:

All 26 farms in the Hungry Run watershed are listed in Table 8 along with which BMPs have previously been installed, and which BMP's are proposed for installation. Cost estimates for proposed BMPs are also included in the table and are based on the costs outlined in Table 9. Farms without Conservation Plans were prescribed to have them written. Ten main BMP's were prescribed for every farm based on the current conservation plans in the watershed. Table 9 demonstrates that some of the farms have already installed a few of these BMPs, while other farms have not installed any. The prescribed BMP's are: Conservation Crop Rotation (328), Contour Farming (330), Nutrient Management (590), Residue and Tillage Management (329), Cover Crop (340), Fence (382), Barnyard Runoff Control (357), Waste Management System (312), Riparian Herbaceous cover (390) and Riparian Forested Buffer (391). While many farms currently have some type of residue management an emphasis was placed on no-till in the proposed BMP's. Also, in order to reduce sediment, the largest problem pollutant, streambank fencing and riparian buffers were prescribed for any farm that bordered a section of stream. Since barnyard run-off control, waste management systems, waste storage facilities, and water and sediment control basins are all important and efficient BMP's, each farm without one was proposed a Waste Management System (312) and Barnyard Run-off Control (357).

Ideally, all of the proposed BMP's would be installed. Due to the fact there are only a few farmers, it may actually be possible to achieve this goal. We are hoping to meet these goals by implementing our public participation and information section of this plan as well as working with the PA DEP to develop funding sources and cost share contracts for these projects.

Following the proposed agricultural BMP's are a few Urban BMP's. Working within the Borough of Burnham to make improvements to the stream would also aid the stream recovery process. Once the stream leaves the agricultural land it is challenged by buildings, channelization, storm drains, and other inputs that do not allow the stream to connect to the flood plain and utilize the sediment being transported in a productive way. Additionally, eroding banks in the Borough contribute to the sedimentation problem. The proposed Urban BMP's would reduce erosion and provide habitat thus improving water quality in Hungry Run.

Table 8. Estimated Costs per Farm for BMP installation

Agricultural

No.	*Rank	Total acres in HRW	**Acres Treated	Installed BMP's and Code No.	Proposed **Acres Treated	Proposed BMP's	Estimated Cost per Unit	Total Cost
1	5	136.60	133.5	Conservation Crop Rotation (328)	133.5	Cover Crop (340)	$40.00	$5,340
			29	Contour farming (330)	1150 ft.	Fence (382)	$1.85	$2,127.50
			133.5	Nutrient Management (590)	1 (No.)	Barnyard Runoff Control (357)	$30,000	$30,000
			133.5	Pest Management (595)	1 (No.)	Waste Management System (312)	$65,000	$65,000
			61	Residue and Tillage Management (329)	2	Riparian Herbaceous Cover (390)	$290.00	$580.00
					2	Riparian Forested Buffer (391)	$1,090.00	$2,180.00
2	1	19.60	21.3	Conservation Crop Rotation (328)	21	Cover Crop (340)	$40.00	$852.00
			21.3	Contour farming (330)				
			28.3	Nutrient Management (590)				
			21.3	Residue and Tillage Management (329)				
			21.3	Contour Strip-cropping (585)				
3	5	95.90	79.9	Conservation Crop Rotation (328)	79.9	Nutrient Management (590)	$18.00	$1,438.20
			3.1	Contour farming (330)	79.9	Residue and Tillage Management (329)	$20.00	$1,598.00
				Contour Strip-cropping (585)	79.9	Cover Crop (340)	$40.00	$3,196.00
					1400ft	Fence (382)	$1.85	$2,590.00
					1 (No.)	Barnyard Runoff Control (357)	$30,000	$30,000
					1 (No.)	Waste Management System (312)	$65,000	$65,000
					2.26	Riparian Herbaceous Cover (390)	$290.00	$655.40
					2.26	Riparian Forested Buffer (391)	$1,090.00	$2,463.40
4	1	60.30	60.3	Conservation Crop Rotation (328)		None		
			60.3	Contour farming (330)				
			60.3	Nutrient Management (590)				
			60.3	Pest Management (595)				
			60.3	Residue and Tillage Management (329)				
			60.3	Cover Crop (340)				
5	4	57.30	23.4	CREP		None		
			35.1	Conservation Crop Rotation (328)				
			35.1	Contour Farming (330)				

			35.1	Nutrient Management (590)				
6	1	11.10		None	11.10	Conservation Plan (003)	$800.00	$800.00
					11.10	Conservation Crop Rotation (328)	$8.00	$88.80
					11.10	Contour farming (330)	$15.00	$166.50
					11.10	Nutrient Management (590)	$18.00	$199.80
					11.10	Residue and Tillage Management (329)	$20.00	$222.00
					11.10	Cover Crop (340)	$40.00	$444.00
7	3	49.29		None	49.29	Conservation Plan (003)		
					49.29	Conservation Crop Rotation (328)	$8.00	$394.32
					49.29	Contour farming (330)	$15.00	$739.35
					49.29	Nutrient Management (590)	$18.00	$887.22
					49.29	Residue and Tillage Management (329)	$20.00	$985.80
					49.29	Cover Crop (340)	$40.00	$1,971.60
					1900 ft.	Fence (382)	$1.85	$3,515.00
					1 (No.)	Barnyard Runoff Control (357)	$30,000	$30,000
					1 (No.)	Waste Management System (312)	$65,000	$65,000
					3	Riparian Herbaceous Cover (390)	$290.00	$870.00
					3	Riparian Forested Buffer (391)	$1,090.00	$3,270.00
8	5	165.80	33	Conservation Crop Rotation (328)	33	Nutrient Management (590)	$18.00	$594.00
			56	Contour farming (330)	33	Cover Crop (340)	$40.00	$1,320.00
			33	Residue and Tillage Management (329)	2270 ft.	Fence (382)	$1.85	$4,199.50
			33	Contour Strip-cropping (585)	1 (No.)	Barnyard Runoff Control (357)	$30,000	$30,000
					3.6	Riparian Herbaceous Cover (390)	$290.00	$1,044.00
					3.6	Riparian Forested Buffer (391)	$1,090.00	$3,924.00
9	1	66.32	153.1	Conservation Crop Rotation (328)		None		
			153.1	Cover Crop (340)				
			153.1	Nutrient Management (590)				
			153.1	Residue and Tillage Management (329)				
10	2	123.43	153.1	Conservation Cover Crop (328)	1 (No.)	Barnyard Runoff Control (357)	$30,000	$30,000

			153.1	Cover Crop (340)	1 (No.)	Waste Management System (312)	$65,000	$65,000
			153.1	Nutrient Management (590)	2580 ft.	Fence (382)	$1.85	$4,773
			153.1	Residue and Tillage Management (329)	4	Riparian Herbaceous Cover (390)	$290.00	$1,160.00
					4	Riparian Forested Buffer (391)	$1,090.00	$4,360.00
11	5	97.10		None	97.10	Conservation Plan (003)	$800.00	$800.00
					97.10	Conservation Crop Rotation (328)	$8.00	$776.80
					97.10	Contour farming (330)	$15.00	$1,456.50
					97.10	Nutrient Management (590)	$18.00	$1,747.80
					97.10	Residue and Tillage Management (329)	$20.00	$1,942.00
					97.10	Cover Crop (340)	$40.00	$3,884.00
					2000 ft.	Fence (382)	$1.85	$3,700.00
					3.20	Riparian Herbaceous Cover (390)	$290.00	$928.00
					3.20	Riparian Forested Buffer (391)	$1,090.00	$3,488.00
12	3	44.03		None	44.03	Conservation Plan (003)	$800.00	$800.00
					44.03	Conservation Crop Rotation (328)	$8.00	$352.24
					44.03	Contour farming (330)	$15.00	$660.45
					44.03	Nutrient Management (590)	$18.00	$792.54
					44.03	Residue and Tillage Management (329)	$20.00	$880.60
					44.03	Cover Crop (340)	$40.00	$1,761.20
					2550 ft	Fence (382)	$1.85	$4,717.50
					4.00	Riparian Herbaceous Cover (390)	$290.00	$1,160.00
					4.00	Riparian Forested Buffer (391)	$1,090.00	$4,360.00
13	2	160.30	30.4	Conservation Cover Crop (328)		None		
				Cover Crop (340)				
				Nutrient Management (590)				
				Residue and Tillage Management (329)				
14	2	12.00	12.6	Conservation Crop Rotation (328)	200 ft.	Fence (382)	$1.85	$370
			12.6	Contour farming (330)	1 (No.)	Barnyard Runoff Control (357)	$30,000	$30,000
			12.6	Nutrient Management (590)	1 (No.)	Waste Management System (312)	$65,000	$65,000
				Pest Management (595)	0.3	Riparian Herbaceous Cover (390)	$290.00	$87.00
			12.6	Residue and Tillage Management (329)	0.3	Riparian Forested Buffer (391)	$1,090.00	$327.00
				Contour Strip-cropping (585)				
				Forage Harvest Management (667)				

				Pasture/Hay Planting (512)				
15	1	21.70		Conservation Crop Rotation (328)		Cover Crop (340)	$40.00	
				Contour farming (330)				
				Nutrient Management (590)				
				Residue and Tillage Management (329)				
				Contour Strip-cropping (585)				
16	2	36.30		Conservation Crop Rotation (328)	1 (No.)	Barnyard Runoff Control (357)	$30,000	$30,000
				Nutrient Management (590)	1 (No.)	Waste Management System (312)	$65,000	$65,000
				Pest Management (595)				
				Residue and Tillage Management (329)				
17	1	18.50		None	18.50	Conservation Plan (003)	$800.00	$800.00
					18.50	Conservation Crop Rotation (328)	$8.00	$148.00
					18.50	Contour farming (330)	$15.00	$277.50
					18.50	Nutrient Management (590)	$18.00	$333.00
					18.50	Residue and Tillage Management (329)	$20.00	$370.00
					18.50	Cover Crop (340)	$40.00	$740.00
					1800 ft.	Fence (382)	$1.85	
					1 (No.)	Barnyard Runoff Control (357)	$30,000	$30,000
					1 (No.)	Waste Management System (312)	$65,000	$65,000
					2.9	Riparian Herbaceous Cover (390)	$290.00	$841.00
					2.9	Riparian Forested Buffer (391)	$1,090.00	$3,161.00
18	2	12.70	3	Conservation Crop Rotation (328)		None		
			3	Contour Farming (330)				
19	3	51.90	51.9	Conservation Crop Rotation (328)		None		
			51.9	Contour farming (330)				
			51.9	Nutrient Management (590)				
			51.9	Residue and Tillage Management (329)				
			28.2	Contour Strip-cropping (585)				
			51.9	Cover and green manure crop (340)				
			1	Grassed waterway (412)				
20	3	102.10	41.5	Conservation Crop Rotation (328)	41.5	Nutrient Management (590)	$18.00	$747.00
			41.5	Residue and Tillage Management (329)	41.5	Cover Crop (340)	$40.00	$1,660.00

			41.5	Contour Strip-cropping (585)	1 (No.)	Barnyard Runoff Control (357)	$30,000	$30,000
			41.5	Cover and green manure crop (340)	1 (No.)	Waste Management System (312)	$65,000	$65,000
				Grassed waterway (412)				
21	1	16.86		Conservation Crop Rotation (328)		None		
				Contour farming (330)				
				Residue and Tillage Management (329)				
				Cover and green manure crop (340)				
22	4	47.63	67.1	Conservation Crop Rotation (328)	1400 ft.	Fence (382)	$1.85	$2,590
			67.1	Contour farming (330)	2.2	Riparian Herbaceous Cover (390)	$290.00	$638.00
			67.1	Nutrient Management (590)	2.2	Riparian Forested Buffer (391)	$1,090.00	$2,398.00
			67.1	Residue and Tillage Management (329)				
			67.1	Contour Strip-cropping (585)				
			1	Grassed waterway (412)				
23	2	67.10	67.1	Conservation Crop Rotation (328)		None		
			67.1	Contour farming (330)				
			67.1	Nutrient Management (590)				
			67.1	Residue and Tillage Management (329)				
			59.8	Contour Strip-cropping (585)				
			1	Grassed waterway (412)				
24	2	10.90		None	10.90	Conservation Plan (003)	$800.00	$800.00
					10.90	Conservation Crop Rotation (328)	$8.00	$87.20
					10.90	Contour farming (330)	$15.00	$163.50
					10.9	Nutrient Management (590)	$18.00	$196.20
					10.90	Residue and Tillage Management (329)	$20.00	$218.00
					10.90	Cover Crop (340)	$40.00	$436.00
25	4	10.36		None	10.36	Conservation Plan (003)	$800.00	$800.00
					10.36	Conservation Crop Rotation (328)	$8.00	$82.88
					10.36	Contour farming (330)	$15.00	$155.40
					10.36	Nutrient Management (590)	$18.00	$186.48
					10.36	Residue and Tillage Management (329)	$20.00	$207.20
					10.36	Cover Crop (340)	$40.00	$414.40
					1000.00	Fence (382)	$1.85	$1,850

					1 (No.)	Barnyard Runoff Control (357)	$30,000	$30,000
					1.6	Riparian Herbaceous Cover (390)	$290.00	$464.00
					1.6	Riparian Forested Buffer (391)	$1,090.00	$1,744.00
26	2	94.90	88.8	Conservation Crop Rotation (328)		None		
			88.8	Contour farming (330)				
			88.8	Nutrient Management (590)				
			88.8	Residue and Tillage Management (329)				
						Total for Agricultural BMP's		**$936,450**
		Urban						
					834 ft.	Stream Channel Stabilization (580)	$80.00	$66,720
1	5				2150 ft.	Stream Channel Stabilization (580)	$80.00	$172,000
2	5				3.4	Riparian Herbaceous Cover (390)	$290.00	$986.00
					3.4	Riparian Forested Buffer (391)	$1,090.00	$3,706.00
3	1				2	Riparian Herbaceous Cover (390)	$290.00	$580.00
					2	Riparian Forested Buffer (391)	$1,090.00	$2,180.00
4	3				600 ft	Stream Channel Stabilization (580)	$80.00	$4,800.00
					1	Riparian Herbaceous Cover (390)	$290.00	$290.00
						Total for Urban BMP's		**$251,262**
						Total for all suggested Improvements		**$1,187,712**

*Rank: 5= highest priority 1= lowest priority
**Acre, feet or number depending on the BMP

Technical and Financial Assistance for BMP's

The estimated cost of each BMP was determined by NRCS projections of costs for Mifflin County and can be found in Table 9 along with potential funding sources. These costs were used to estimate costs of BMP projects in Table 8, where the total cost of BMP design, construction, and installation are shown for each farm within the watershed.

Table 9. Technical and Financial Assistance Needed for BMP Installation

BMP Title	Construction Cost	Annual Operations and Maintenance Cost*	Potential Sources of Funding
Conservation Crop Rotation (328)	$8.00 / acre	---	319 Program, various USDA farm bill programs
Contour Farming (330)	$15.00 / acre	---	319 Program, various USDA farm bill programs
Nutrient Management (590)	$18.00/acre	$.90 / acre	319 Program, various USDA farm bill programs
Residue Management, No-Till (329A)	$20.00 / acre	---	319 Program, various USDA farm bill programs
Cover Crop (340)	$40.00 /acre	---	319 Program, various USDA farm bill programs
Barnyard Run-off Control (357)	$30,000.00	$1500.00	319 Program, various USDA farm bill programs
Waste Management System (313)	$65,000.00	$3,250.00	319 Program, various USDA farm bill programs
Riparian Forested Buffer (391)	$ 1090.00/ acre	$55.00/ acre	319 Program, various USDA farm bill programs
Riparian Herbaceous Cover (390)	$290.00 / acre	$14.50 / acre	319 Program, various USDA farm bill programs
Fence (382)	$1.85 / foot	$.09 / foot	319 Program, various USDA farm bill programs
Stream Channel Stabilization (580) Riprap or gabion	$80.00 / foot	$4.00 / foot	319 Program, various USDA farm bill programs
Stream bank protection (580) Bio-engineering	$50.00/ foot	$2.50 / foot	319 Program, various USDA farm bill programs

** Operation and maintenance costs calculate at 5% of design and construction cost*

[Information in this table was obtained from the 2007 NRCS EQUIP Cost List and costs currently charged in Mifflin County]

BMP and Watershed Modeling:

A model of the Hungry Run watershed was created using ArcView GIS and additional modeling software created by Penn State University and PA DEP. Initially BMP's were entered into ArcView Non-Point Source Tool (AVNPS Tool). These were mapped in ArcView using digital orthographic photos, a variety of other ArcView layers, and conservation plans that had been written for specific farms in the watershed. Conservation Plans detail the BMP's installed on a particular farm and include a digital photo and acreage of each practice. The Hungry Run Watershed was delineated using ArcView Generalized Watershed Loading Function (AVGWLF) and additional baseline information was determined. Scenario files were created in AVNPS Tool using this information and the BMP data. These scenario files used the PA DEP unassessed waters date of May 2000 as a reference date or end date for BMP installation so that load reductions occurring after that date can be credited towards attainment.

The scenario files were then used in the Pollution Reduction Impact Comparison Tool (PRedICT). PRedICT used the data from the AVNPS Tool scenario files and put it into a model that allowed one to compare past, present and future changes in sediment, nitrogen, and phosphorous based on characteristics of installed BMP's as well as other factors such as area, land use, and sewers. When a scenario file is modeled in PRedICT, everything before the reference date is labeled as "Existing" and everything after as "Future." PRedICT is able to calculate the percent of acres affected for each BMP in the watershed. In PRedICT, an efficiency value, determined from literature and previous research, has been assigned to eleven individual BMP's plus eight additional practices determined to significantly impact water quality. These are then used to determine the overall impact of these BMP's with the goal of reducing sediment and nutrient loading. PRedICT also calculates estimates of current and proposed project costs, based on current prices, which can be altered by the user as needed.

Model Predictions for Past, Existing and Future BMP's:

Three scenario files for the Hungry Run watershed were created and run using PRedICT. These scenario files allow for analysis and calculations of load reductions at multiple points in time. Scenario files were created and analyzed from the 24 years preceding 2000; for practices installed from 2000- 2007; and for projected projects. The final scenario file modeling the projected projects using PRedICT, showed the greatest impact.

The scenario file created for BMP's installed between May 2000 and December 2007 showed a good start, with phosphorous having the largest reduction of the three pollutants. The model showed an 11% reduction in sediment to1307455 total pounds of sediment, a 26.4% reduction in nitrogen to 36039 total pounds of nitrogen, and a 65.2% reduction in phosphorous to 2812 total pounds of phosphorous. To view the report for this scenario see Appendix C. Projected projects, or BMP's to be installed after 2007, had the greatest impact (see Appendix D for the report of this scenario). This scenario showed a 46.8% reduction in sediment to 780514 total pounds of sediment, a 33% reduction in nitrogen to 27724 total pounds of Nitrogen and a 74.2% reduction in phosphorous to 1562 total pounds of phosphorous. It is expected that these load reductions will result in the Hungry Run's removal from the State Impaired Streams List prior to 2015, thus precluding the need for development of a TMDL in the watershed

Public Information and Participation:

The Conservation District staff will inform the public of progress through meetings, field days and brochures or when inquiries are made at the district office. They will be open to answer any questions at public meetings, at their office, by phone, or by email which will be distributed through brochures and on surveys.

Implementation Schedule:

Only 7 farms (farm #'s 6,7,11,12,17,24, and 25 in Table 8) do not have Conservation Plans. The Conservation District will immediately begin outreach to these farmers to find out what they are currently doing on the farms. Most of the work needs to be done on farms that do currently have a Conservation Plan. The fact that the farmers are already working with NRCS and the Conservation District will make planning additional projects significantly easier.

The staff at the Conservation District feels that the goal of working with each of the farmers to clean up Hungry Run is an attainable goal and that as long as farmers are able to come up with some funding of their own for cost-share, this watershed could be cleaned up within the next 5 years. The limiting factors will be match money from the farmers to install all of the BMP's proposed.

Projects for 2008:

Grant proposals will be submitted for 4 farms in this watershed.

If funding is granted, implementation for these projects will occur in 2009

Projects for 2009:

Grant proposals will be submitted for 4 farms in this watershed.

If funding is granted, implementation for these projects will occur in 2010

Projects for 2010:

Grant proposals will be submitted for 4 farms in this watershed.

If funding is granted, implementation for these projects will occur in 2011

Projects for 2011:

Grant proposals will be submitted for 4 farms in this watershed.

If funding is granted, implementation for these projects will occur in 2012

Projects for 2012:

Grant proposals will be submitted for 4 farms in this watershed.

If funding is granted, implementation for these projects will occur in 2013

Other projects will continue to be scheduled until upcoming TMDL load allocation requirements are met and as many proposed projects as possible are finished. The Conservation District is committed to successful completion of this implementation plan and will continue to submit proposals until the goals for the watershed are met.

Water Quality Monitoring and Evaluation and Methods:

Monitoring the impacts Agricultural BMP's have on sediment can be difficult. The Pennsylvania Department of Environmental Protection (PA DEP) will use the March 2007 "Assessment and Listing Methodology for Integrated Water Quality Monitoring and Assessment Reporting: Clean Water Act, Sections 305(b) / 303(d)" protocols to determine if the installed practices are having the desired effects.

Every five years PA DEP will conduct an In-stream Comprehensive Evaluation (ICE). Water bodies with remediation projects will be targeted for ICE as will sites that will assist in TMDL development. PA DEP's new ICE protocol uses Indexes of Biotic Integrity (IBI) for fish and macroinvertebrates, instead of using identification only to the Family level as was previously done. The numerical or narrative water quality criteria established for each designated use will be the measure with which the Department will determine attainment.

Mifflin County Conservation District staff and/or interns will monitor stream profiles, pebble counts and macroinvertebrate surveys biennially at two locations in the watershed as time or money permits. One monitoring site will be located on Hungry Run as it leaves agricultural land uses and nears Burnham Borough and the other monitoring site will be near the mouth of the stream, where it joins Kishacoquillas Creek. District monitoring will provide interim measures of progress in reducing sediment loads and restoring biological organisms in between the more comprehensive DEP monitoring visits.

***Remedial Actions*:**

The Mifflin County Conservation District will review the Hungry Run BMP implementation schedule and monitoring data annually to assess progress in the restoration effort. If it is determined that progress is not meeting expectations, the District may suggest and/or implement additional BMPs, retrofit existing BMPs and/or revisit the assumptions, methods, and predictions developed in this plan.

Appendix A

PA DEP 303 (d) Designatied Use Attainment Sample Data:

Chemical:

Location	PH	TEMP	COND	DO
Hungry Run 1	8.0	9.7	507.0	14.5
Hungry Run 2	8.0	14.5	370.0	10.7
Hungry Run 3	8.2	13.9	480.0	10.7
Hungry Run 4	7.5	16.4	396.0	8.9

PA DEP Habitat Assessment Results

Sample Location	Hungry Run 1	Hungry Run 2	Hungry Run 3	Hungry Run 4
Date	9/29/2000 10:30	10/26/2001 9:30	10/26/2001 10:30	8/24/2001 9:45
Instream Cover (Fish)	10	15	10	13
Epifaunal Substrate	10	16	7	9
Embeddedness	4	17	7	5
Velocity/Depth Regimes	10	16	10	9
Channel Alteration	15	15	10	13
Sediment Deposition	5	17	3	12
Score Side one	54	96	47	61
Frequency of Riffles	5	17	3	12
Channel Flow Status	8	15	15	15
Condition of Banks	15	17	10	5
Bank Vegetative Protection	14	18	12	7
Grazing or Other Disruptive	12	17	9	13
Riparian Vegetative width	10	10	8	12
Totals (side 2)	64	94	57	64
Totals (side 1)	54	96	47	61
Station Score	118	190	104	125

GISKEY	LONG	LAT	SWP	SURVNAME	TAXA1
20000929-103(	-77.544747	40.647876	12A	Unassessed Screer	Asellidae(P)
20001026-093(	-77.565356	40.631033	12A	Unassessed Screer	Amphipoda(VA)
20001026-103(	-77.563193	40.637254	12A	Unassessed Screer	Amphipoda(VA)
20010824-094!	-77.518852	40.664228	12A	Unassessed Screer	Aeshnidae(P)

TAXA1
Asellidae(P)
Amphipoda(VA)
Amphipoda(VA)
Aeshnidae(P)
TAXA2
Chironomidae (red)(P)
Ancylidae(R)
Baetidae(C)
Baetidae(R)
TAXA3
Elmidae(A)
Annelida(C)
Chironomidae(other)(P)
Chironomidae(other)(P)
TAXA4
Ephemeridae(R)
Asellidae(R)
Elmidae(VA)
Elmidae(A)
TAXA5
Hirudinea(R)
Baetidae(R)
Ephemerellidae(C)
Hydropsychidae(A)
TAXA6
Hydropsychidae(R)
Brachycentridae(R)
Heptageniidae(C)
Leptophlebiidae(P)
TAXA7
Oligochaeta(P)
Cambaridae(R)
Hydropsychidae(A)
Oligochaeta(A)
TAXA8
Sialidae(P)
Chironomidae(other)(P)
Philopotamidae(P)
Sialidae(P)
TAXA9
Tabanidae(R)
Corydalus(R)

Psephenidae(C)
Tipulidae(P)
TAXA10
Turbellaria(P)
Elmidae(C)
Sialidae(R)
Tricorythidae(R)
TAXA11
Ephemerellidae(P)
Tipulidae(R)
Turbellaria(C)
TAXA12
Heptageniidae(P)
Turbellaria(C)
Uenoidae(C)
TAXA13
Psephenidae(R)
TAXA14
Rhyacophilidae(C)
TAXA15
Turbellaria(C)

Appendix B

Lower Kishacoquillas Creek Assessment data- Hungry Run

Chemical:

Location	Date	Time	Air Temp in C	Weather	Stream Temp in C	pH	Conductivity (mS)	(mg/L CaCO3)	Dissolved O2 (mg/L)	Nitrate-N (mg/L)	Sulfate (mg/L)	Total Phosphorus
HURU1.8-TSF												
HURU1.8												
HURU1.8	6/16/2004	1333	27	Partly Clou	18	8	347	220mg/L	11	2.14	28.4	ND
HURU1.8	7/26/2004	1030	26	PC/Rain	12	7.4	381	220	8	1.82	30	ND
HURU1.8	7/27/2004	1011		Rain	19.7	8.2						
HURU 1.8	9/28/2004	1430	17	Rain	18	7.73	281	160 mg/l	7			
HURU 1.8	10/17/2004	1525		Partly Clou	11	7.6	381	220 mg/l	11	3.26	33	ND
HURU 1.8	8/11/2004	1218	28	Sunny	21.9	8.3	196	11	6	0.98	11	ND
HURU 1.8	8/19/2004	943	24	Rain	17.1	7.5						
HURU 1.8	11/4/2004	1610	7	Rain	10	7.3						
HURU 1.8	11/4/2004	1610	7	Rain	10	7.3	325	200	8			ND
HURU 1.8	12/19/2004	1600	1	Cloudy	5	6.9	357	160	13	3.04	27.8	ND
HURU 1.8	1/13/2005	1400	14	Cloudy	10	7.3	253	140	10	2.14	23.2	ND
HURU 1.8	1/26/2005	1650	34	Cloudy	44	6.9	338	160		3.24	27.6	ND
HURU 1.8	2/8/2005	915	6	Cloudy/shc	7	7.5	363		11	2.42	27.9	ND
HURU 1.8	3/30/2005	630	14.3	Cloudy	9.4	7	262	21	8	1.82	22.6	ND
HURU 1.8	6/6/2005	1115	28	Sunny	20	7.2	405	200	9			

Coliform (col/100m)	Suspended Solids mg/L	Nitrogen (mg/L)	Aluminum (AL)	Iron (FE)	Lead (Pb)	Manganese (MN)	Zinc (ZN)	Hardness
1730	17	ND						
2400	6	ND						
			4.5	3.61	ND	0.19	0.03	
			0.8	0.55	ND	0.018	ND	
727	ND	0.12						
909	5	ND						
			0.2	0.19	ND	0.023	ND	
			ND	0.13	ND	0.017	ND	
818		ND						
135	8	ND						
31	6	ND						153
117	ND	ND						
380	ND	ND						220
20	13	ND						

Habitat Assessment Results

Sample Location	HURU1.8
Date	6/28/2004
Instream Cover (Fish)	8
Epifaunal Substrate	10
Embeddedness	7
Velocity/Depth Regimes	6
Channel Alteration	12
Sediment Deposition	13
Score Side one	56
Frequency of Riffles	16
Channel Flow Status	16
Condition of Banks	4
Bank Vegetative Protection	14
Grazing or Other Disruptive	10
Riparian Vegetative width	11
Totals (side 2)	71
Totals (side 1)	56
Station Score	127
NOTES	
Numeric code (for graphing)	
Alpha code	M
Optimal - 240-187	
Suboptimal - 186-127	
Marginal - 126-68	X
Poor - 67-0	

*done by Anne, Amanda, Rob before they looked at many sites

** done by Amanda & Josh after looking at sites in Big Valley

Macroinvertebrate Sample results

		Kick #1	Kick #2
Sample Location	HURU1.8	HURU1.8	HURU1.8
Date	6/6/2004	7/6/2004	7/6/2004
1 Abundance Low		N	
2 Seven or Fewer Families		N	
3. Three or fewer Mayflies		N	
4. Stoneflies Collectively Present		N	
5. Mayflies & Caddisflies Collectively Abundant		Y	
6. July- Sept : at least 4 EPT families w/Hilsenhoff of 4 or Less		N	
6. Nov- May :at least 6 ETP families w/Hilsenhoff of 4 or Less			
7. Four or more families with a Hilsenhoff of 3 or Less		N	
8. Six or more families with a Hilsenhoff of 4 or Less		N	
9. Dominant Family with Hilsenhoff of 4 or less		N	
10. Dominant Family with Hilsenhoff greater than 5		N	
11. Seven or more Families w/ Hilsenhoff of 6 or more		N	
12. Sample dominated by Families with a mean Hils of 5 or less		Y	
13. Sample dominated by Families with a mean Hils of 6 or more		N	
14. Hab. Ass. #3 + Hab. Ass. #6 = 24 or less			
15. Hab. Ass. #9 + Hab. Ass. #10 = 24 or less			
16. Total Habitat score 140 or less			
Miscellaneous			
1. Annelida (9)			
2. Bryozoa (4)			
3. Hirudinea (8)		P	P
4. Hydracarina (7)			
5. Oligocheata (10)	P	P	
6. Tubificidae (10)			
7. Turbellaria (9)			
8. Other worms (9)			
Gastropoda			
9. Ancylidae (7)			
10. Hydrobiidae (8)			
11. Lymnaeidae (7)			
12. Physidae (8)			
13. Planorbidae (6)			
14. Pleuroceridae (7)			
15. Valvatidae (2)			
16. Viviparidae (8)			
Bivalvia			
17. Corbicuiidae (4)			
18. Sphaeriidae (8)			
19. Unionidae (4)			
Isopoda			
20. Asellidae (8)			
Amphipoda			
21. Amphipoda (6)			
22. Crangonyctidae (4)			
23. Gammaridae (4)	C	VA	A
24. Talitridae (8)			

Decopoda			
25. Cambaridae (6)		R	R
Insecta			
Mayflies- Ephemeroptera			
26. Ameletidae (0)			
27. Baetidae (6)	P	A+	C
28. Baetiscidae (3)			
29. Caenidae (7)	P		
30. Ephemerellidae (2)	P	A	C
31. Ephemeridae (4)			
32. Heptageniidae (3)			
33. Isonychiidae (3)	R		
34. Leptophlebiidae (4)			
35. Neoephemeridae (3)			
36. Polymitarcyidae (2)			
37. Potamanthidae (4)			
38. Siphionuridae (7)			
39. Tricorythidae (4)			
Dragonflies- Odonata			
40. Aeshnidae (3)			
41. Cordulegastridae (3)			
42. Corduliidae (5)			
43. Macromiinae (3)			
44. Gomphidae (4)			
45. Libellulidae (9)			
Damselflies- Odonata			
46. Calopterygidae (5)			
47. Coenagrionidae (8)			
48. Lestidae (9)			
Stoneflies- Plecoptera			
49. Capniidae (3)			
50. Chloroperlidae (0)			
51. Leuctridae (0)			
52. Nemouridae (2)			
53. Peltoperlidae (2)			
54. Perlidae (3)			
55. Perlodidae (2)			
56. Pteronarcyidae(0)			
57. Taeniopterygidae (2)			
Beetles - Coleoptera			
58. Dryopidae (5)			
59. Dytiscidae (5)			
60. Elmidae (5)		VA	VA
61. Gyrinidae (4)			
62. Hydrophilidae (5)			
63. Psephenidae (4)			
64. Ptilodactylidae (5)			
Dobsonflies & Alderflies- Magaloptara			
65. Corydalidae (3)			
66. Corydalus (4)			
67. Nigronia (2)			

68. Sialidae (6)			
Spongillaflies- Neuroptera			
69. Sisyridae (1)			
Caddisflies- Trichoptera			
70. Brachycentridae (1)			
71. Glossosomatidae (0)	A		
72. Helicopsychidae (3)			
73. Hydropsychidae (5)	C	A	A+
74. Hydroptilidae (4)			
75. Lepidostomatidae (1)			
76. Leptoceridae (5)			
77. Limnephilidae (4)		R	R
78. Molannidae (6)			
79. Odontoceridae (0)			
80. Philopotamidae (3)			
81. Phryganeidae (4)			
82. Polycentropodidae (6)			
83. Psychomyiidae (2)			
84. Rhyacophilidae (1)			
85. Uenoidae (3)			
86. Moths- Lepidoptera			
True Flies- Diptera			
87. Athericidae (2)			
88. Blephariceridae (0)			
89. Ceratopogonidae (6)			
90. Chironomidae (red) (10)			
91. Chironomidae (other) (6)			
92. Dixidae (1)			
93. Dolichopodidae (4)			
94. Empididae (6)			
95. Psychodidae (10)			
96. Simuliidae (6)		VA	VA
97. Tabanidae (6)			
98. Tipulidae (4)	R	R	R
99. Other Diptera (6+)			
Total "other" Taxa			
SAMPLE Total # Taxa		12	11
Code of Dominant Taxa		#60	

	Kick #1	Kick #2
HURU1.8	HURU1.8	HURU1.8
8/18/2004	6/8/2005	6/8/2005
	C	P
	C	
		R
	P	
A	A	A

A		R
P	VA	A
		R
R		
R	C	R
	P	A
	VA	VA

R C
A

A VA VA

P R

C
C P

P C C

R P R

14 17
#60

Appendix C

Mean Annual Load Data Editor

Load Data Type	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
UPLAND EROSION/RUNOFF			
Row Crops	800149	3703	477
Hay/Pasture	49888	841	97
High Density Urban	0	0	0
Low Density Urban	0	0	0
Unpaved Road	0	0	0
Other	445313	1586	198
STREAMBANK EROSION	172810	9	4
GROUNDWATER/SUBSURFACE		22376	359
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		4	0
TOTAL	1468160	37107	2918
BASIN AREA	5333	Acres	

Agricultural Land BMP Scenario Editor

Land Use	Acres		BMP1	BMP2	BMP3	BMP4	BMP5	BMP6	BMP7	BMP8
Row Crops	1144	% Existing	33	0	31	0	0	35		6
		% Future	40	0	46	0	0	58		14
Hay/Pasture	731	% Existing				0	0	35	0	0
		% Future				0	0	58	0	0

Agricultural Land on Slope > 3%	669	Acres
Streams in Agricultural Areas	7.0	Miles
Total Stream Length	13.8	Miles
Unpaved Road Length	1.3	Miles

	Existing	Future
Stream Miles with Vegetated Buffer Strips	0.3	1.0
Stream Miles with Fencing	0.3	1.0
Stream Miles with Stabilization	0.0	0.0
Unpaved Road Miles w/E & S Controls	1.3	1.3

	% Existing	% Future
AWMS (Livestock)	20.0	20.0
AWMS (Poultry)	0.0	0.0
Runoff Control	0.0	0.0
Phytase in Feed	0.0	0.0

Urban Land BMP Scenario Editor

High Density Urban					
		Acres	1144	% Impervious Surface	50
Constructed Wetlands		**Bioretention Areas**		**Detention Basins**	
% Existing	33	% Existing	0	% Existing	0
% Future	0	% Future	0	% Future	0
% Drainage Area Used	5	% Drainage Area Used	6	% Drainage Area Used	3
Impervious Acres Drained	0.0	Impervious Acres Drained	0.0	Impervious Acres Drained	0.0
CW Acres Required	0.0	BA Acres Required	0.0	DB Acres Required	0.0

Low Density Urban					
		Acres	17	% Impervious Surface	25
Constructed Wetlands		**Bioretention Areas**		**Detention Basins**	
% Existing	0	% Existing	0	% Existing	50
% Future	0	% Future	0	% Future	50
% Drainage Area Used	3	% Drainage Area Used	6	% Drainage Area Used	2
Impervious Acres Drained	0.0	Impervious Acres Drained	0.0	Impervious Acres Drained	0.0
CW Acres Required	0.0	BA Acres Required	0.0	DB Acres Required	0.0

Vegetated Stream Buffers				
			Existing	Future
Stream miles in high density urban areas	.9	Stream miles in high density urban areas w/buffers	.6	.9
		High Density Urban Streambank Stabilization	.2	.9
Stream miles in low density urban areas	0	Stream miles in low density urban areas w/buffers	0	0
		Low Density Urban Streambank Stabilization	0	0

Septic Systems and Point Source Discharge Scenario Editor

Number of persons on septic systems	Existing	19		
	Future	19		
Spetic systems converted by treatment type %	Secondary	0	Tertiary	0
	Existing Point Source Load		No	
		Primary	**Secondary**	**Tertiary**
Distribution of pollutant discharge by treatment type %	Existing	0	0	0
	Future	0	0	0
		Primary to Secondary	**Primary to Tertiary**	**Secondary to Tertiary**
Distribution of treatment upgrades %		0	0	0

Rural and Urban BMP Load Reduction Efficiency Editor

BMP Type	Nitrogen	Phosphorus	Sediment	Pathogens
BMP 1	0.25	0.36	0.35	
BMP 2	0.50	0.38	0.64	
BMP 3	0.23	0.40	0.41	
BMP 4	0.95	0.94	0.92	
BMP 5	0.96	0.98	0.92	
BMP 6	0.70	0.28		
BMP 7	0.43	0.34	0.13	
BMP 8	0.44	0.42	0.71	
Vegetated Buffer Strips	0.64	0.52	0.58	0.70
Streambank Fencing	0.56	0.78	0.76	1.00
Streambank Stabilizatio	0.95	0.95	0.95	
Unpaved Roads (lbs/ft)	0.02	0.0035	2.55	
AWMS (Livestock)	0.75	0.75		0.75
AWMS (Poultry)	0.14	0.14		0.14
Runoff Control	0.15	0.15		0.15
Phytase in Feed		0.21		

Urban BMP Load Reduction Efficiency Editor				
BMP Type	Nitrogen	Phosphorus	Sediment	Pathogens
Constructed Wetlands	0.53	0.51	0.88	0.71
Bioretention Areas	0.46	0.61	0.10	0.82
Detention Basins	0.40	0.51	0.93	0.71

Wastewater BMP Load Reduction Efficiency Editor

	Nitrogen	Phosphorus
Conversion of Septic Systems to Secondary Treatment Plant	0.14	0.10
Conversion of Septic Systems to Tertiary Treatment Plant	0.56	0.60
Conversion of Primary Treatment to Secondary Treatment	0.14	0.10
Conversion of Primary Treatment to Tertiary Treatment	0.56	0.60
Conversion of Secondary Treatment to Tertiary Treatment	0.42	0.50

BMP Cost Editor

Agricultural Cost Editor	
Conservation Tillage (per acre)	$20.00
Cropland Protection (per acre)	$25.00
Grazing Land Management (per acre)	$360.00
Streambank Fencing (per acre)	$23.00
Streambank Fencing (per mile)	$15,000.00
Streambank Stabilization (per foot)	$80.00
Vegetated Buffer Strip (per mile)	$4,626.00
Terraces and Diversions (per acre)	$500.00
AWMS Livestock (per AEU)	$1,250.00
AWMS Poultry (per AEU)	$520.00
Runoff Control (per AEU)	$600.00
Phytase in Feed (per AEU)	$2.50
Nutrient Management (per acre)	$110.00
Ag to Wetland Conversion (per acre)	$5,000.00
Unpaved Roads (per foot)	$5.58
Ag to Forest Conversion (per acre)	$5,000.00

Urban Cost Editor	
Constructed Wetlands (per acre)	$13,400.00
Bioretention Areas (per acre)	$8,000.00
Detention Basins (per acre)	$10,700.00

Septic System and Point Source Upgrades	
Conversion of Septic Systems to Centralized Sewage Treatment (per home)	$15,000.00
Conversion From Primary to Secondary Sewage Treatment (per capita)	$250.00
Conversion From Primary to Tertiary Sewage Treatment (per capita)	$300.00
Conversion From Secondary to Tertiary Sewage Treatment (per capita)	$150.00

Estimated Load Reductions

	Existing (lbs)		
UPLAND EROSION/RUNOFF	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
Row Crops	800149	3703	477
Hay/Pasture	49888	841	97
High Density Urban	0	0	0
Low Density Urban	0	0	0
Unpaved Roads	0	0	0
Other	445313	1586	198
STREAMBANK EROSION	172810	9	4
GROUNDWATER/SUBSURFACE		22376	359
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		4	0
FARM ANIMALS		8588	1783
TOTALS	**1468160**	**37107**	**2918**

	Future (lbs)		
LAND EROSION/RUNOFF	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
Row Crops	646106	2654	373
Hay/Pasture	49888	706	91
High Density Urban	0	0	0
Low Density Urban	0	0	0
Unpaved Roads	0	0	0
Other	445313	1586	198
STREAMBANK EROSION	166148	9	4
GROUNDWATER/SUBSURFACE		22368	351
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		4	0
FARM ANIMALS		8713	1795
TOTALS	**1307455**	**36039**	**2812**
PERCENT REDUCTIONS	11.0	26.4	65.2
TOTAL SCENARIO COST	$720,758.30		
Ag BMP Cost (%)	13.8		
WW Upgrade Cost (%)	0.0		
Urban BMP Cost (%)	0.0		
Stream Protection Cost (%)	86.2		
Unpaved Road Protection Cost (%)	0		

Pathogen Loads		
Source	**Existing (orgs/month)**	**Future (orgs/month)**
Farm Animals	1.065e+15	9.913e+14
WWTP	0.000e+00	0.000e+00
Septic Systems	1.457e+11	1.457e+11
Urban Areas	1.873e+10	1.480e+10
Wildlife	5.628e+12	5.628e+12
Totals	1.071e+15	9.971e+14
PERCENT REDUCTIONS		6.91
TOTAL SCENARIO COST	$720,758.30	

Appendix D

Mean Annual Load Data Editor

Load Data Type	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
UPLAND EROSION/RUNOFF			
Row Crops	800149	3703	477
Hay/Pasture	49888	841	97
High Density Urban	0	0	0
Low Density Urban	0	0	0
Unpaved Road	0	0	0
Other	445313	1586	198
STREAMBANK EROSION	172810	9	4
GROUNDWATER/SUBSURFACE		22376	359
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		4	0
TOTAL	1468160	37107	2918
BASIN AREA	5333	Acres	

Agricultural Land BMP Scenario Editor

Land Use	Acres		BMP1	BMP2	BMP3	BMP4	BMP5	BMP6	BMP7	BMP8
Row Crops	1144	% Existing	0	0	16	0	0	35		6
		% Future	0	70	16	0	0	100		14
Hay/Pasture	731	% Existing				0	0	35	0	0
		% Future				0	0	100	0	0

Agricultural Land on Slope > 3%	669	Acres
Streams in Agricultural Areas	7.0	Miles
Total Stream Length	13.8	Miles
Unpaved Road Length	1.3	Miles

	Existing	Future
Stream Miles with Vegetated Buffer Strips	0.3	7.0
Stream Miles with Fencing	0.3	7.0
Stream Miles with Stabilization	0.0	0.0
Unpaved Road Miles w/E & S Controls	1.3	1.3

	% Existing	% Future
AWMS (Livestock)	20.0	100.0
AWMS (Poultry)	0.0	0.0
Runoff Control	0.0	100.0
Phytase in Feed	0.0	0.0

Urban Land BMP Scenario Editor

High Density Urban					
		Acres	1144	% Impervious Surface	50
Constructed Wetlands		Bioretention Areas		Detention Basins	
% Existing	0	% Existing	0	% Existing	0
% Future	0	% Future	0	% Future	0
% Drainage Area Used	5	% Drainage Area Used	6	% Drainage Area Used	3
Impervious Acres Drained	0.0	Impervious Acres Drained	0.0	Impervious Acres Drained	0.0
CW Acres Required	0.0	BA Acres Required	0.0	DB Acres Required	0.0

Low Density Urban					
		Acres	17	% Impervious Surface	25
Constructed Wetlands		Bioretention Areas		Detention Basins	
% Existing	0	% Existing	0	% Existing	50
% Future	0	% Future	0	% Future	50
% Drainage Area Used	3	% Drainage Area Used	6	% Drainage Area Used	2
Impervious Acres Drained	0.0	Impervious Acres Drained	0.0	Impervious Acres Drained	0.0
CW Acres Required	0.0	BA Acres Required	0.0	DB Acres Required	0.0

Vegetated Stream Buffers				
			Existing	Future
Stream miles in high density urban areas	.9	Stream miles in high density urban areas w/buffers	.6	.9
		High Density Urban Streambank Stabilization	.2	.9
Stream miles in low density urban areas	0	Stream miles in low density urban areas w/buffers	0	0
		Low Density Urban Streambank Stabilization	0	0

Septic Systems and Point Source Discharge Scenario Editor

Number of persons on septic systems	Existing	19		
	Future	19		
Spetic systrems converted by treatment type %	Secondary	0	Tertiary	0
	Existing Point Source Load		No	
		Primary	Secondary	Tertiary
Distribution of pollutant discharge by treatment type %	Existing	0	0	0
	Future	0	0	0
		Primary to Secondary	Primary to Tertiary	Secondary to Tertiary
Distribution of treatment upgrades %		0	0	0

Rural and Urban BMP Load Reduction Efficiency Editor

BMP Type	Nitrogen	Phosphorus	Sediment	Pathogens
BMP 1	0.25	0.36	0.35	
BMP 2	0.50	0.38	0.64	
BMP 3	0.23	0.40	0.41	
BMP 4	0.95	0.94	0.92	
BMP 5	0.96	0.98	0.92	
BMP 6	0.70	0.28		
BMP 7	0.43	0.34	0.13	
BMP 8	0.44	0.42	0.71	
Vegetated Buffer Strips	0.64	0.52	0.58	0.70
Streambank Fencing	0.56	0.78	0.76	1.00
Streambank Stabilizatio	0.95	0.95	0.95	
Unpaved Roads (lbs/ft)	0.02	0.0035	2.55	
AWMS (Livestock)	0.75	0.75		0.75
AWMS (Poultry)	0.14	0.14		0.14
Runoff Control	0.15	0.15		0.15
Phytase in Feed		0.21		
Urban BMP Load Reduction Efficiency Editor				
BMP Type	**Nitrogen**	**Phosphorus**	**Sediment**	**Pathogens**
Constructed Wetlands	0.53	0.51	0.88	0.71
Bioretention Areas	0.46	0.61	0.10	0.82
Detention Basins	0.40	0.51	0.93	0.71

Wastewater BMP Load Reduction Efficiency Editor

	Nitrogen	Phosphorus
Conversion of Septic Systems to Secondary Treatment Plant	0.14	0.10
Conversion of Septic Systems to Tertiary Treatment Plant	0.56	0.60
Conversion of Primary Treatment to Secondary Treatment	0.14	0.10
Conversion of Primary Treatment to Tertiary Treatment	0.56	0.60
Conversion of Secondary Treatment to Tertiary Treatment	0.42	0.50

BMP Cost Editor

Agricultural Cost Editor	
Conservation Tillage (per acre)	$30.00
Cropland Protection (per acre)	$25.00
Grazing Land Management (per acre)	$360.00
Streambank Fencing (per acre)	$15.00
Streambank Fencing (per mile)	$15,000.00
Streambank Stabilization (per foot)	$80.00
Vegetated Buffer Strip (per mile)	$4,624.00
Terraces and Diversions (per acre)	$500.00
AWMS Livestock (per AEU)	$1,300.00
AWMS Poultry (per AEU)	$520.00
Runoff Control (per AEU)	$600.00
Phytase in Feed (per AEU)	$2.50
Nutrient Management (per acre)	$110.00
Ag to Wetland Conversion (per acre)	$5,000.00
Unpaved Roads (per foot)	$5.58
Ag to Forest Conversion (per acre)	$5,000.00
Urban Cost Editor	
Constructed Wetlands (per acre)	$13,400.00
Bioretention Areas (per acre)	$8,000.00
Detention Basins (per acre)	$10,700.00
Septic System and Point Source Upgrades	
Conversion of Septic Systems to Centralized Sewage Treatment (per home)	$15,000.00
Conversion From Primary to Secondary Sewage Treatment (per capita)	$250.00
Conversion From Primary to Tertiary Sewage Treatment (per capita)	$300.00
Conversion From Secondary to Tertiary Sewage Treatment (per capita)	$150.00

Estimated Load Reductions

	Existing (lbs)		
UPLAND EROSION/RUNOFF	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
Row Crops	800149	3703	477
Hay/Pasture	49888	841	97
High Density Urban	0	0	0
Low Density Urban	0	0	0
Unpaved Roads	0	0	0
Other	445313	1586	198
STREAMBANK EROSION	172810	9	4
GROUNDWATER/SUBSURFACE		22376	359
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		4	0
FARM ANIMALS		8588	1783
TOTALS	**1468160**	**37107**	**2918**

	Future (lbs)		
LAND EROSION/RUNOFF	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
Row Crops	176267	481	137
Hay/Pasture	49888	458	79
High Density Urban	0	0	0
Low Density Urban	0	0	0
Unpaved Roads	0	0	0
Other	445313	1586	198
STREAMBANK EROSION	109046	7	2
GROUNDWATER/SUBSURFACE		22339	336
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		4	0
FARM ANIMALS		2850	809
TOTALS	**780514**	**27724**	**1562**
PERCENT REDUCTIONS	46.8	33.0	74.2
TOTAL SCENARIO COST	$1,492,262.50		
Ag BMP Cost (%)	13.7		
WW Upgrade Cost (%)	0.0		
Urban BMP Cost (%)	0.0		
Stream Protection Cost (%)	57.4		
Unpaved Road Protection Cost (%)	0		

Pathogen Loads		
Source	Existing (orgs/month)	Future (orgs/month)
Farm Animals	1.065e+15	3.152e+14
WWTP	0.000e+00	0.000e+00
Septic Systems	1.457e+11	1.457e+11
Urban Areas	1.873e+10	1.480e+10
Wildlife	5.628e+12	5.628e+12
Totals	1.071e+15	3.210e+14
PERCENT REDUCTIONS		70.03
TOTAL SCENARIO COST	$1,492,262.50	