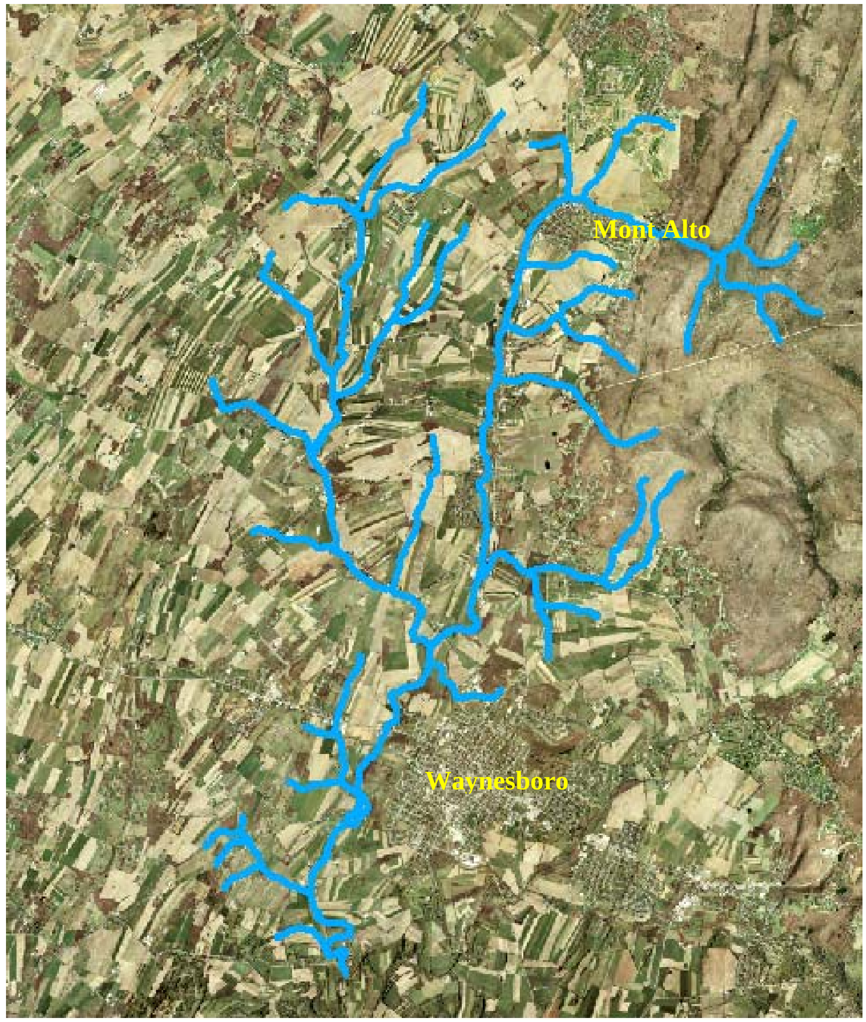
WATERSHED IMPLEMENTATION PLAN

April 2008

West Branch of Antietam Creek

Franklin County, Pennsylvania



Antietam Watershed Association
PO Box 331
Waynesboro, PA 17268
www.antietamws.org

Prepared by:
RETTEW Associates, Inc.
3020 Columbia Ave.
Lancaster, PA 17603

Antietam Watershed Association

RETTEW
We answer to you.

West Branch of Antietam Creek

Watershed Implementation Plan

April 2008

This plan was developed for use by the Antietam Watershed Association

This plan was developed with technical and financial support of the Pennsylvania Department of Environmental Protection and the United States Environmental Protection Agency through the section 319 program under the federal Clean Water Act.

This plan was prepared by RETTEW Associates, Inc.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS LISTING

TMDL	Total Maximum Daily Loads
BMP(s)	Best Management Practice(s)
GIS	Geographic Information Systems
GPS	Global Positioning System
EPA	United States Environmental Protection Agency
PADEP	Pennsylvania Department of Environmental Protection
AWA	Antietam Watershed Association
RETTEW	Rettew Associates, Inc.

I. INTRODUCTION

This report is only concerned with the West Branch of Antietam Creek located in Franklin County, Pennsylvania.

Total Maximum Daily Loads (TMDL) have not been developed for the West Branch of Antietam Creek; though a draft TMDL was completed for an un-named tributary within the West Branch by the Interstate Commission on the Potomac River basin in May of 2002. It was never finalized.

According to the 2006 Pennsylvania Integrated Water Quality Monitoring and Assessment Report, the West Branch of Antietam Creek has 22.46 miles of degraded stream. Pennsylvania Department of Environmental Protection (PADEP) biological surveys indicate the impairment is mainly due to excessive amounts of sediment and nutrients.

In February of 2006, the Antietam Watershed Association (AWA) solicited proposals from environmental consulting firms in the interest of completing a Watershed Implementation Plan. RETTEW Associates, Inc. (RETTEW), a Lancaster County based engineering and environmental consulting firm, was chosen to complete the task. Funding for designing the plan was provided by the PADEP and the United States Environmental Protection Agency (EPA) through the Section 319 Program under the Federal Clean Water Act.

Because of already known impairments previously identified in the 2006 Pennsylvania Integrated Water Quality Monitoring and Assessment Report, this Watershed Implementation Plan focuses mainly on agricultural related non-point source pollution; however several urban related problems are identified. Specifically, RETTEW developed a Watershed Implementation Plan (on behalf of the AWA) designed to reduce sediment and nutrient inputs.

RETTEW began collecting field data in April of 2007 and completed data collection by July of 2007. Data was processed and modeled using PADEP's "Predict" modeling tool in October of 2007 and the Watershed Implementation Plan was finalized in April of 2008.

II. BACKGROUND

The West Branch of Antietam Creek is located in Franklin County, Pennsylvania near Waynesboro and Mont Alto. The West Branch comprises 41.4-square miles and is a drainage to Antietam Creek and ultimately the Potomac River. Pennsylvania municipalities occupying a portion of the West Branch include Guilford Township, Quincy Township, Washington Township, the Borough of Waynesboro, and the Borough of Mont Alto. The West Branch generally flows in a southerly direction from its headwaters in Mont Alto State Park to its confluence with the East branch of Antietam Creek about 1.5-miles south of Waynesboro. Significant roadways within the West Branch include Route 997, Route 316, and Route 16. ***See Fig #1 - Location Map below.***

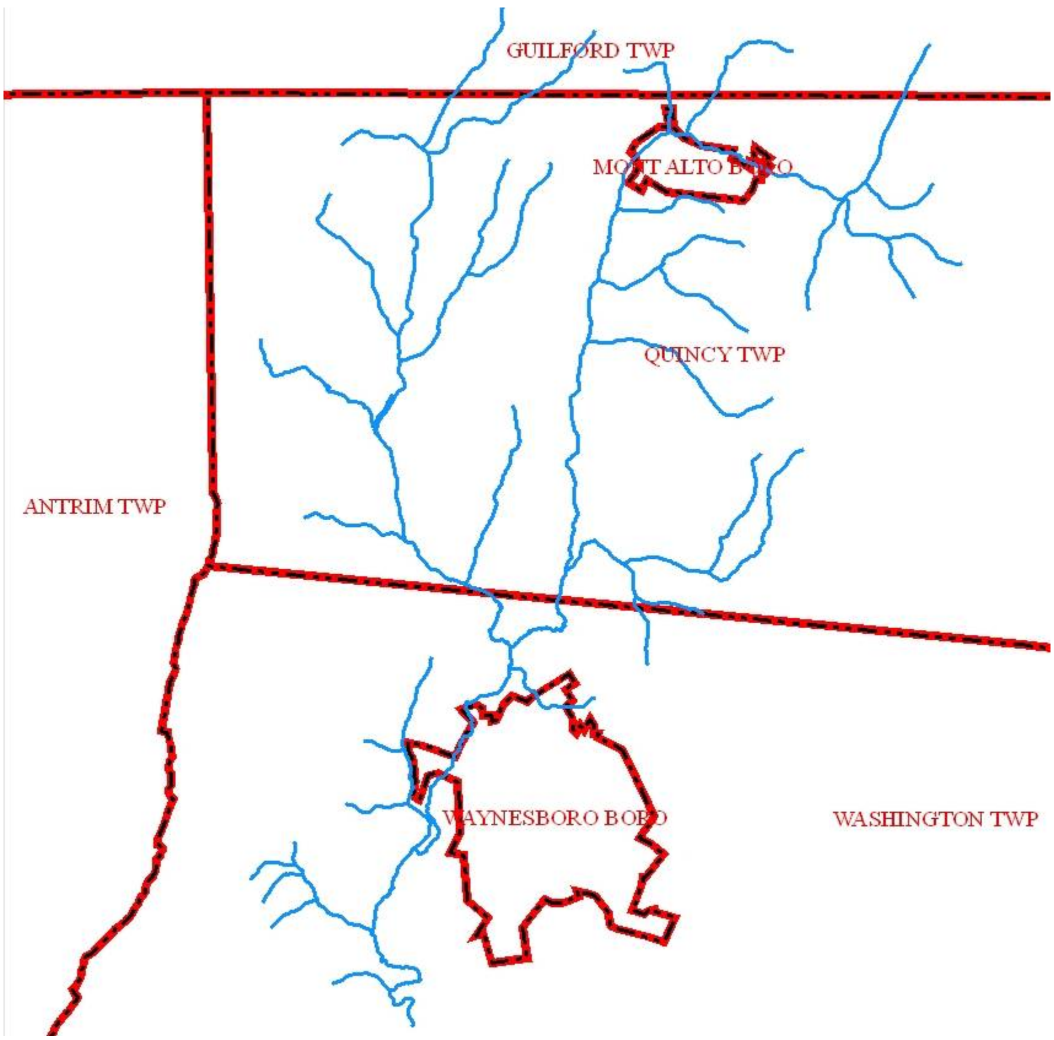


Fig #1 - Location Map

Pennsylvania does not have established water quality standards for sediment and nutrients such as nitrogen and phosphorous; however Chapter 93 of the PA Code classifies stream uses, includes an "aquatic life" designation for the West Branch. The headwaters in Mont Alto State Park are classified as "trout stocked", while the remainder of the West Branch is classified as "Coldwater Fishes". In the opinion of RETTEW, this coldwater classification could be better defined and described as a cool water fishery, hosting such fish species as White sucker and Creek chub. It is doubtful any coldwater species such as trout would persist year round in the main stem of the West Branch in the area of Waynesboro.

Above – Winter Time in Mont Alto – Cold, Clear Waters

The majority of the West Branch is in agricultural production (approximately 76.1%) with many of the main stem and tributary floodplains actively pastured or cultivated for crop production. Major crops include corn, soybeans and alfalfa. Livestock operations include dairy cattle, beef cattle, poultry, hogs and a very unique Elk farm. Most pastureland grazing dairy and beef cattle lack adequate riparian buffer zones (i.e. livestock has free access to the stream). ***See Fig #2 - Landuse Map below.***

Because of the predominating, intense agricultural land use, it stands to reason that water quality impairments are heavily linked to non-point agricultural sources. Excessive loadings of sediment and nutrients are credited as being significant causes of water quality impairment. ***Table #1*** as seen below designates these impairments.

Therefore this Watershed Implementation Plan is mainly concerned with reducing sediment and nutrient inputs from agricultural sources; however several urban problems are discussed. The plan concentrates on prescribing various, appropriate agricultural "best management practices" (BMPs) to discovered problem areas throughout the West Branch. The prescribed BMPs fall into four main categories, these being: soil conservation farming practices, pastureland management practices, nutrient management practices, and riparian corridor management practices. Mentioned urban related BMPs are associated mainly with streambank stabilization and forest buffer establishment.

Examples of soil conservation farming practices include strip cropping, no till, crop rotation, residue management, terracing, farming on the contour and other methods that serve to preserve the soil resource and arrest its erosion and migration to watercourses.

Examples of pastureland management practices include rotational grazing and other methods that help preserve the integrity of the vegetative cover; which in turn controls soil loss and nutrients attached to the soil particles such as phosphorous.

Examples of nutrient management practices include manure storages, balanced application rates of manure and commercial fertilizers and barnyard and feedlot controls that assist in the gathering of animal wastes so as to allow their collection for proper application rather than uncontrolled release.

Examples of riparian corridor management practices include the establishment of forest and vegetative buffers, streambank fencing and streambank stabilization.

As stated previously, phosphorous readily links to soil particles. Therefore controlling soil erosion not only reduces sediment input to a watercourse, but also reduces the introduction of phosphorus.

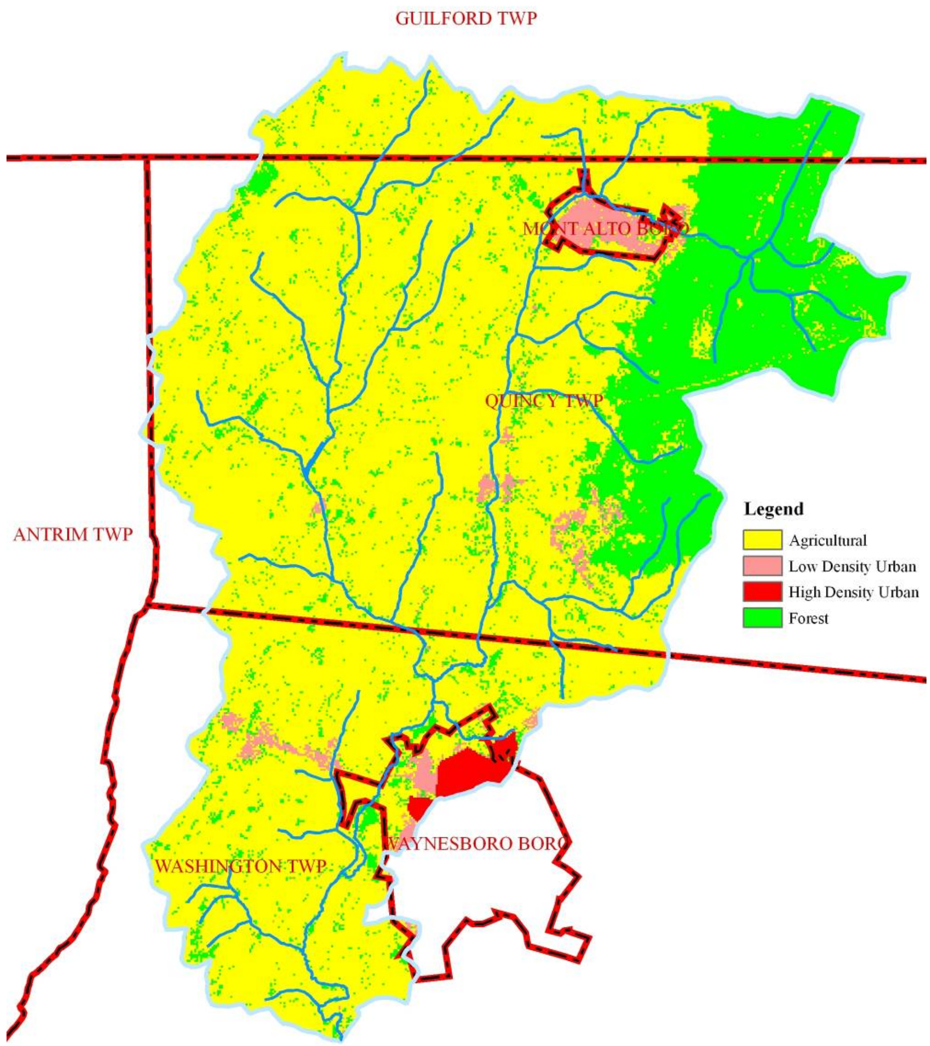


Fig #2 - Landuse Map

Table #1

WEST BRANCH OF ANTIETAM CREEK – IMPAIRED REACHES PER 2006 PENNSYLVANIA INTEGRATED WATER QUALITY MONITORING AND ASSESSMENT REPORT

Identification N^{o}. and Name	Stream Use	Miles Impaired	Cause
#9953 – West Branch	Aquatic Life	1.40	Nutrients, silt and flow variability due to grazing and residential runoff
#9944 – West Branch UNT #59260	Aquatic Life	1.79	Nutrients, silt due to grazing
#9944 – West Branch UNT #59261	Aquatic Life	0.51	Nutrients, silt due to grazing
#9944 – West Branch UNT #59262	Aquatic Life	0.51	Nutrients, silt due to grazing
#9944 – West Branch UNT #59263	Aquatic Life	1.56	Nutrients, silt due to grazing
#9946 – West Branch UNT #59264	Aquatic Life	1.70	Nutrients, silt due to grazing
#9946 – West Branch UNT #59265	Aquatic Life	0.64	Nutrients, silt due to grazing
#9951 – West Branch UNT #59267	Aquatic Life	2.89	Nutrients, silt due to agriculture
#9955 – West Branch UNT #59267	Aquatic Life	1.80	Nutrients, silt due to agriculture
#9959 – West Branch UNT #59267	Aquatic Life	1.10	Silt due to agriculture
#9958 – West Branch UNT #59270	Aquatic Life	1.77	Silt due to agriculture
#9959 – West Branch UNT #59271	Aquatic Life	0.44	Silt due to agriculture
#9962 – West Branch UNT #59272	Aquatic Life	2.61	Silt due to cropping
#9962 – West Branch UNT #59273	Aquatic Life	1.18	Silt due to cropping
#9956 – West Branch UNT #59274	Aquatic Life	1.82	Nutrients, silt due to agriculture
#9955 – West Branch UNT #59276	Aquatic Life	0.74	Nutrients, silt due to agriculture
	TOTAL 22.46 Miles Impaired		

Note: UNT means “un-named tributary”

To assist the reader in the comprehension of the impaired stream reaches listed in the 2006 Pennsylvania Integrated Water Quality Monitoring and Assessment Report, ***Fig #3 - Impaired Reaches Map*** is provided below. The color **RED** denotes impairment, while **GREEN** indicates a non-impaired condition. However, it should be understood that even though a stream section appears green and non-impaired, it doesn't mean that problems don't exist within that section of stream. On the contrary, field inspections reveal many significant physical problems within the green sections of this map, but PADEP's means of analyzing their biological collected data tends to merge many adjacent problem areas into one, longer stream section problem area, rather than to isolate each and every individual problem area.

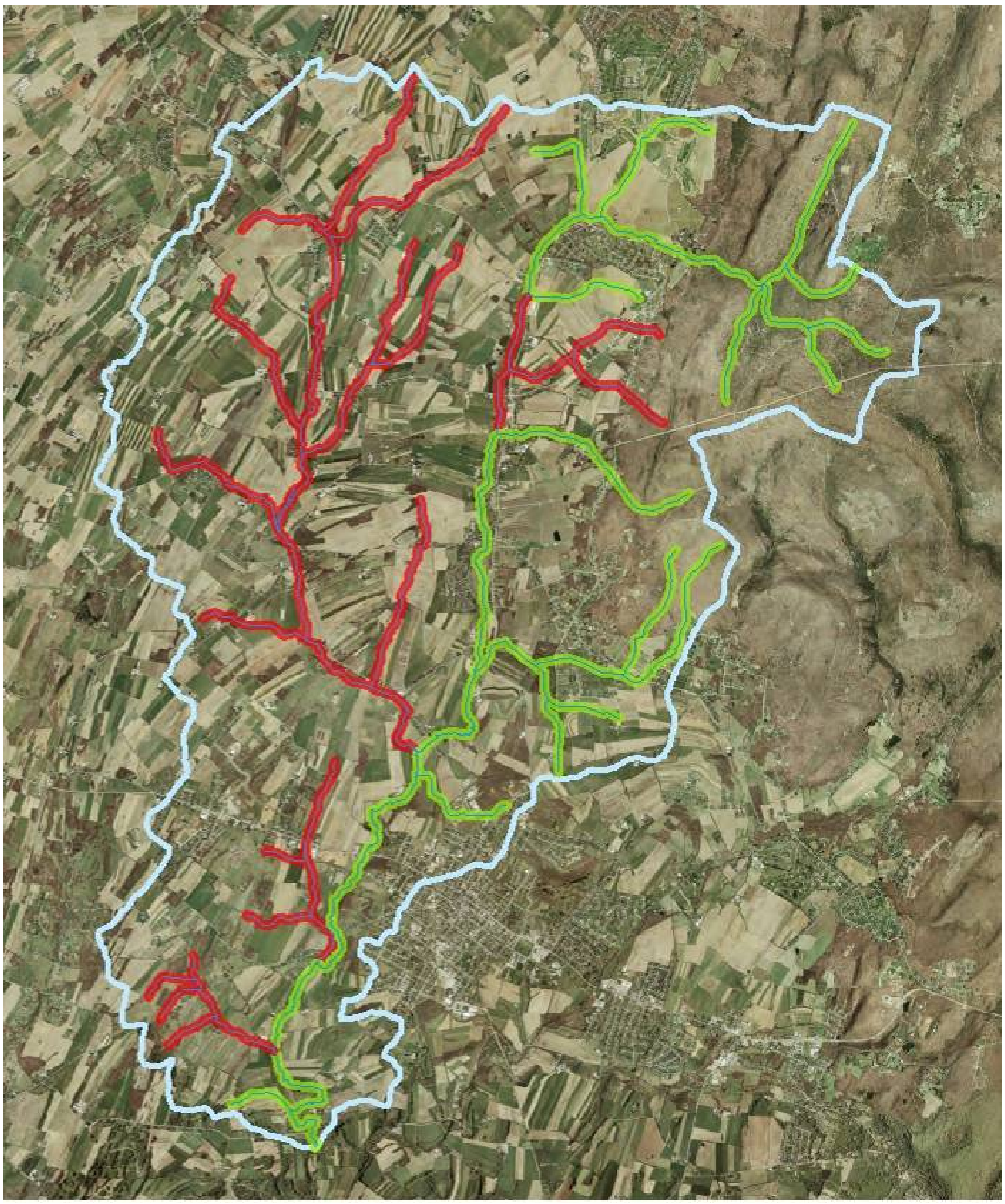


Fig #3 – Impaired Reaches Map

Non-Agricultural Sources and Ways to Address Them

As previously discussed, 76.1% or 20,164-acres of the West Branch Watershed is in agricultural production. Of the remainder, 0.8% or 212-acres is in high density urban landuse at Waynesboro, 2.5% or 662-acres is in low density urban landuse including the Borough of Mont Alto, and 20.6% or 5,458-acres is in a forested condition including a portion of the Mont Alto State Park.

Even though the 2006 Pennsylvania Integrated Water Quality Monitoring and Assessment Report emphasize nutrient and sediment/silt loadings due to agricultural landuse, it does recognize that stormwater runoff from residential development and variability in stream flow influenced by development contributes to the impairment of certain reaches within the West Branch. Eroding streambanks themselves are another source of both sediment and phosphorus not necessarily linked to agricultural practices.

<u>Legacy Sediment</u>

Since about 2001, there has also been increasing awareness within Pennsylvania about "legacy sediment". Legacy sediment is a term used to describe an unnatural rate of deposition typically due to a dam within a stream channel and related floodplain. During the early settlement of Pennsylvania and the construction of literally hundreds of mill operations, damming streams as a source of hydraulic power was common practice. Present day finds many of these historic dams still in place on many Pennsylvania streams. Very few still serve their original purpose, while the majority serve only as a historical clue of days gone by. However the sediment that built up over the years behind these dams is proving to be a significant problem in regards to stream restoration endeavors. The artificially stacked up sediment is easily eroded when dams are breached or removed. In some cases, streams have re-routed around dams, and the erosion of these previously stacked up legacy sediments yields tons of sediment loading to downstream reaches.

Case in point, the West Branch of Antietam Creek has nine (9) of these old dams, which at best may serve as an aesthetic icon or possibly a family type heirloom of sorts (i.e. because great grandfather built the dam back in 1890 and it was always there). And possibly some owners might not even care about the dam, but never spent the time, money and effort to remove them. Whatever the case, each and every dam RETTEW identified within the West Branch is causing a problem in an environmental sense. Most are intact and still impounding water, thus causing localized sedimentation and thermal pollution problems. A few are partially breached and the process of eroding legacy sediments downstream has begun. The AWA should seriously consider approaching the various dam owners and inquire as to whether the owner might be agreeable to removing their dam.

It is out of the scope of this study to thoroughly investigate the nine dams, and because dam removal can be rather complex, this report does not further elaborate on the costs of removing these dams nor provides any pollutant reduction value associated with their removal. But generally speaking, it has been RETTEW's experience that smaller dam removal projects (dam less than 5-feet high and 80-feet long) cost approximately $15,000.00 for design and permit application preparation and $30,000.00 in demolition and site restoration work. Larger dams (dam between 5 to 10-feet in height and 80 to 200-feet long) cost approximately $25,000.00 to $35,000.00 for design and permit application preparation and $40,000.00 to $70,000.00 in demolition and site restoration work. Keep in mind these are rough cost estimates and each dam removal project will vary in difficulty. Dams that impound a large amount of sediment that will need to be removed are more expensive undertakings than dams that have been partially breached. Difficulties in accessing the dam site for surveying and demolition also increase removal costs.

Groundwater and Stormwater

Some level of nutrient and sediment contribution to surface waters is a natural occurrence. For example, forest conditions contribute both sediment and phosphorus to the West Branch, and groundwater can contribute nutrient loadings as baseflow to the creek. Modeling for the West Branch estimates nitrogen loading at 181,577 pounds per year and phosphorus loading at 1,963 pounds per year via the groundwater contribution. It is not realistic to reduce loadings to levels below background contributions of nutrients or sediment to streams under natural conditions. It should be noted, however, that nutrient concentrations in groundwater can be elevated by human activities such as agriculture, lawn fertilizers and malfunctioning septic systems. Thus addressing these practices through implementing BMPs to reduce direct loadings to surface waters may also reduce loadings to groundwater and, therefore, reduce the nutrient groundwater contribution to the West Branch.

Stormwater runoff from development is another contributor of nutrients and sediment to streams. All earth disturbance of one acre or more must obtain an NPDES permit for stormwater discharges associated with construction activities. As part of this permit process, developers must submit and implement an erosion and sediment control plan to control runoff during construction, as well as a post-construction stormwater management plan to provide long term control of runoff once construction is completed.

Above – A View of Rte. 997 at Quincy

Nutrient and sediment loadings from stormwater runoff can be reduced by ensuring that these plans maximize infiltration BMPs to the extent possible and control volume, rate and quality of runoff so that water quality is protected and the physical degradation of streams and streambanks is prevented. PADEP now has a new statewide Stormwater BMP Manual, which contains detailed technical guidance on how to manage stormwater runoff to protect water quality. The manual places a strong emphasis on low impact site design and use of existing site conditions and infiltration to replicate the natural hydrologic cycle. As such, use of the manual in land development planning should help reduce sediment and nutrient loadings from stormwater.

Many of the municipalities located in the West Branch are considered "municipal separate storm sewer systems" or "MS4s". MS4 municipalities hold NPDES permits that regulate stormwater discharges within their municipal-wide storm sewer systems through the application of six minimum control measures. Thus the MS4 permitting program can also lead to sediment and nutrient loading reductions from stormwater.

Although not accounted for in the 2006 Pennsylvania Integrated Water Quality Monitoring and Assessment Report, one needs to assume failing septic systems on private lots play a role in introducing nutrients to the West Branch; though most dwellings along Route 997 are hooked up to public sewer. Septic system owners can play a role in protecting water quality by ensuring that systems are up-to-date and functioning properly.

Above – Sewage Treatment Plant along Rte. 997

Several urban BMP strategies that AWA can strive to educate landowners about include: (1) erosion & sediment controls, (2) forest buffers, (3) grass buffers, (4) septic denitrification, (5) street sweeping, (6) stormwater management-filtration, (7) stormwater management-infiltration practices, (8) stormwater management-wet ponds & wetlands, and (9) urban stream restoration.

The urban BMP strategies listed above are designed to reduce sediment and/or nutrient loading to surface waters. Therefore, as AWA and its partner organizations and agencies (such as the Franklin County Conservation District) seek to implement the recommendations of this plan, it will look to partner with willing landowners to install appropriate BMPs. Improving water quality of the West Branch through implementation of this Watershed Implementation Plan will go a long way toward ongoing efforts to restore the Antietam Watershed and the Potomac River.

In preparation of the Watershed Implementation Plan, RETTEW was ever cognizant of the necessity of keeping the plan realistic. One needs to keep in mind the plan was prepared to serve as a restoration strategy for AWA.

AWA is an organization comprised of local, volunteer stakeholders who simply wish to improve and protect their local stream. The organization has no law enforcement capability, but rather works on the premise of educating and cooperatively working with landowners. The group focuses heavily on the stream corridors and landuse immediately adjacent to those corridors. Historically, watershed associations have been very successful implementing streambank fencing, streambank stabilization and forest buffer planting projects throughout Pennsylvania, while relying on the local county conservation districts to undertake conservation measures on crop fields. AWA has worked affectively with landowners in the East Branch and that experience should serve them well on the West Branch.

III. DATA COLLECTION

RETTEW began collecting field data in April of 2007 and completed data collection by July of 2007. Because of monetary constraints related to this project and others like it, it is vital the best effort be put forth to collect as much site specific data as possible utilizing the most cost effective means available. Considering the size of this watershed and its some 62.44-miles of stream corridors, RETTEW was faced with a challenging task.

Knowing the previously noted impaired reaches listed in the 2006 Pennsylvania Integrated Water Quality Monitoring and Assessment Report, it was understood that a substantial amount of various BMPs would need to be prescribed to have any significant reductions in sediment and phosphorous loading when modeled.

RETTEW and AWA felt it very important to have seen and assessed the actual sites where BMPs are being proposed rather than relying heavily on planned but possibly not implemented or maintained conservation plans for the farms or aged aerial photography flown from too high an altitude to allow for proper analysis of ground conditions.

Therefore it was vital to collect real time data of actual ground conditions on sites where BMPs would be prescribed. Considering the above, RETTEW chose to utilize low altitude colored aerial video footage as a first reconnaissance, followed by an adequate amount of ground truthing. RETTEW collected their own aerial footage thus insuring the sought after photography was properly captured.

Prior to doing so, the methodology was approved by the PADEP and the EPA. RETTEW had previously utilized similar methodology in preparing other state and federal funded watershed assessments.

Before flying, flight plans were prepared by RETTEW environmental staff so as to insure capture of the correct stream corridors and anticipated impaired reaches. Emphasis was placed upon those previously determined impaired stream segments as identified by PADEP and previously scouted locations determined by AWA and RETTEW environmental staff.

The flight crew was given specific instruction and descriptions of what to look for and photograph. When the flight crew recognized potential problem areas, several passes from different angles were taken in order to insure proper capture of the area in question. Typically, this involved lower altitude passes.

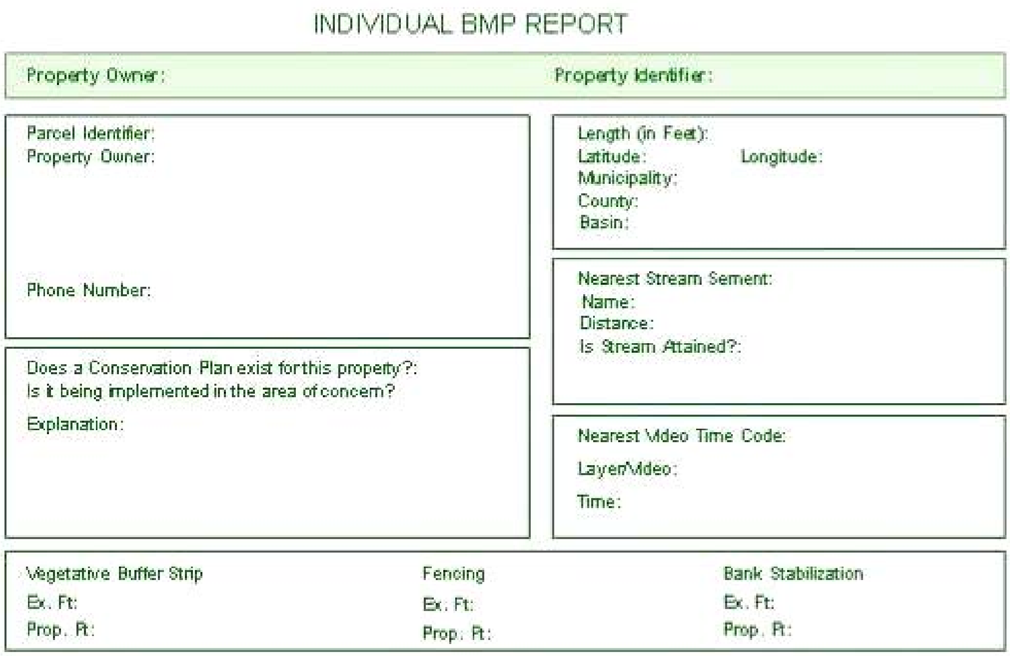
Most aerial videoing took place from an altitude between 400 – 600 feet above the ground. The video was time coded and linked to a GPS unit so that site locations could be known and in turn linked to GIS programming for further analysis and planning.

After the flights were completed, collected video footage was post-processed. This involved dividing out the various sub-watersheds using the associated time code and collected GPS coordinates. Once adequately post-processed, the video footage was placed on a DVD disk for viewing at any time. All 62.44-miles of collected stream corridor video are on the DVD.

Example of aerial footage clip

At the same time, RETTEW staff combined the known flight paths with GIS technology; thus a flight path layer can be "turned on" while using ArcView. The flight paths simply depict and indicate where the helicopter flew. Using other ArcView available functions, a user can use the time code viewed on the video clips to find that exact point within the GIS program mapping by selecting the proper flight path. This then allows the user to earmark the potential problem site, typically indicated by drawing a line or polygon along or around the area of concern.

Once a potential problem site is created, still other ArcView functions are utilized to bring up a data sheet for that particular site. RETTEW IT staff set up the programming to automatically generate the data sheet with already known information concerning the particular location. A linear distance or acreage was also automatically generated, so the size or length of a problem area is known and can be modeled. The data sheet allows the user (in this case a RETTEW watershed specialist) to record information about the potential problem site. The user can describe existing land use and management conditions by writing descriptions and selecting from a provided listing of BMP categories. The BMP categories on the data sheet are the very same as those used in the modeling process discussed later in this report. ***See Fig #4 - Sample Data Sheet below.***


INDIVIDUAL BMP REPORT

Property Owner:
Property Identifier:

Parcel Identifier:
Property Owner:

Phone Number:

Length (in Feet):
Latitude:
Longitude:
Municipality:
County:
Basin:

Nearest Stream Sement:
Name:
Distance:
Is Stream Attained?:

Does a Conservation Plan exist for this property?:
Is it being implemented in the area of concern?
Explanation:

Nearest Video Time Code:
Layer/Video:
Time:

Vegetative Buffer Strip
Ex. Ft:
Prop. Ft:

Fencing
Ex. Ft:
Prop. Ft:

Bank Stabilization
Ex. Ft:
Prop. Ft:

Fig #4 - Sample Data Sheet

And so the aerial video footage and the data sheet completion process was used as a first reconnaissance of the watershed and a means of determining potential problem areas and future improvement work locations. With this information in hand, RETTEW staff then took to the field to field verify (ground truth) what were thought to be potential problem areas. Data sheets for the areas of concern were then appropriately revised as necessary with found field conditions. RETTEW staff did not field visit every earmarked problem area. Rather 40% or 70 of the sites were visited to confirm the aerial assessment procedure.

PADEP officials accompanied RETTEW on 24 site visits, as did AWA members, so as to have a better understanding of the West Branch and the progress RETTEW was making and the nature of their findings. It was noted that the low altitude aerial photography RETTEW had taken depicted greater detail and a better overall understanding of a potential problem areas than could be ascertained by simply looking at a site from the ground. The aerial view allows one to quickly understand the size of the problem and how it is related to the topography surrounding it.

In total 173 problem sites were recorded where specific BMPs should be implemented in order to achieve significant sediment and nutrient reduction. ***See Fig #5, page 19.*** Site specific data sheets that were prepared for these problem areas are not included within the pages of the public report for confidentiality reasons. However AWA has the data sheets and will use them as guidance when approaching landowners in the future. Again, it is important to note AWA is working to improve the West Branch on a volunteer oriented basis.

IV. MODELING AND RESULTS

In recent years, PADEP has relied heavily upon GIS technology for collecting and organizing watershed data. The Pennsylvania State University Environmental Resources Research Institute has been assisting PADEP on developing GIS based technology for its watershed management programs. There exists a variety of GIS-based watershed assessment tools given the task at hand.

One such tool facilitates the use of the GWLF (Generalized Watershed Loading Function) model via a GIS software (ArcView) interface. This tool (called AVGWLF) has recently been selected by PADEP to help support ongoing TMDL projects within Pennsylvania.

As per the PADEP and Penn State's model user guide, the model serves to: (1) derive input data for GWLF for use in an "impaired" watershed, (2) simulate nutrient and sediment loads within the impaired watershed, (3) compare simulated loads within the impaired watershed against loads simulated for a nearby "reference" watershed that exhibits similar landscape, development and agricultural patterns, but which also has been deemed to be unimpaired, and (4) identify and evaluate pollution mitigation strategies that could be applied in the impaired watershed to achieve pollutant loads similar to those calculated for the reference watershed.

Existing landuse, management schemes and already installed/practiced BMPs for modeling purposes were derived through a combination of various means. To further explain, PADEP worked with RETTEW in using GWLF to determine current pollutant loadings on an annual basis. This involved determining management schemes (what management practices were being used) for each of these landuses. These determinations were based upon on-site observation while in the field, aerial photography, communications with the Franklin County Conservation District, and low altitude aerial video-logging conducted by RETTEW. Loading rates of sediment, nitrogen and phosphorous could then be calculated for the existing condition through the continued used of GWLF.

Once existing loading rates were calculated (using GWLF), RETTEW (again with further assistance from PADEP) utilized a version of the AVGWLF model known as "PRedICT" to run prescribed BMP simulations of the West Branch. BMPs that were installed since the initial PADEP biological surveys (that had lead to various stream segments being identified as being impaired) were considered in the model runs. ***See Appendix A for the PRedICT model runs***

If all 173 identified problem areas are "fixed" according to the prescribed BMPs found within this Watershed Implementation Plan, the following significant reductions as described in the following ***Table #2 - Anticipated Reductions*** can be anticipated.

CAUSE OF IMPAIRMENT	CURRENT ANNUAL LOADING RATE	PLANNED ANNUAL LOADING RATE WITH THE 173 BMP IMPLEMENTATIONS
SEDIMENT	26,256,000 lbs/yr	18,747,072 lbs/yr 29% reduction
NITROGEN	302,166 lbs/yr	265,449 lbs/yr 12% reduction
PHOSPHORUS	18,544 lbs/yr	14,492 lbs/yr 22% reduction

Table #2 - Anticipated Reductions

BMP implementation on agricultural land is responsible for the majority of the anticipated load reductions, however improvements to stream channels with the urban areas also provides a significant reduction in sediment and phosphorus.

Table 3 – Agricultural Land BMP Percentages provides a breakdown of the various cropland and pastureland conservation practices by percentage (%) comparing existing to proposed conditions. As can be seen, there is a proposed increase in some BMP usage, but nothing too dramatic. The majority of farmers already use adequate soil conservation practices on their crop fields. However the stream corridors running through many of these farms are severely damaged due to poor barnyard management and free livestock access to the stream. BMPs expressed in linear distance units such as feet or miles are not listed in ***Table #3*** but are accounted for elsewhere in this writing (e.g. streambank fencing, streambank stabilization, etc.).

Table 3 – Agricultural Land BMP Percentages

BMP PERCENTAGE OF CROPLAND & ROW CROPS ACREAGE		
BMP	CURRENT CONDITION	PLANNED CHANGE PER BMP INSTALLATION
BMP #1 Cropland Protection	34%	35%
BMP #2 Conservation Tillage	20%	21%
BMP #3 Stripcropping & Contour Farming	37%	No change - 37%
BMP #4 Agricultural	0%	No change - 0%

Land to Forest Land Conversion		
BMP #5 Agricultural Land to Wetland Conversion	0%	No change – 0%
BMP #6 Nutrient management	50%	52%
BMP #8 Terraces & Diversions	5%	7%
Note: BMPs #1 through #5 and #8 cannot equal over 100%. Likewise BMP #6 cannot equal over 100%		
BMP PERCENTAGE OF HAY & PASTURELAND ACREAGE		
BMP	CURRENT CONDITION	PLANNED CHANGE PER BMP INSTALLATION
BMP #4 Agricultural Land to Forest Land Conversion	0%	No change - 0%
BMP #5 Agricultural Land to Wetland Conversion	0%	1%
BMP #6 Nutrient management	25%	No change - 25%
BMP #7 Grazing land management	15%	19%
BMP #8 Terraces & Diversions	0%	No change – 0%
Note: BMPs #4, #5, #7 and #8 cannot equal over 100%		

Table 3 – Agricultural Land BMP Percentages - continued

As previously noted in this writing, it is outside the abilities of the AWA to write and coordinate the review and implementation of nutrient management plans – rather that work is best performed by the Franklin County Conservation District and the local Natural Resources Conservation Service.

Repair of streams running through agricultural lands will dramatically reduce loading rates of sediment and nutrients. Of the 43.5-miles of stream located in agricultural lands, all 43.5-miles are proposed to include vegetated/forest buffers. Of the 43.5-miles only 11.3-miles currently have adequate buffers. In addition 18.6 miles of stream fencing and 19.4-miles of bank stabilization are proposed. The fencing is necessary to keep livestock off the streambanks and out of the water, while the bank stabilization is needed to repair eroding banks. Some bank stabilization will be realized by simply keeping livestock off and out of the stream channels.

Additionally 2.7-miles of vegetated buffer is proposed within high density urban areas (such as Mont Alto and Waynesboro), and 2.5-miles of vegetated buffer is proposed within low density urban areas (many times within the backyards of single lot homes).

As discussed above, this Watershed Implementation Plan is to serve as a restoration blueprint for AWA. AWA seeks to improve water quality by working with willing landowners to install BMPs and conduct stream improvement projects. As such, the group focuses its outreach, education and project assistance on stream corridors and the lands adjacent to them. Feasible projects include working with farmers to install streambank fencing, plant riparian buffers, or conduct streambank stabilization activities. As a nonprofit 501(c)(3) organization, AWA is eligible to apply for grants to fund projects on behalf of interested landowners, thus providing a valuable service to interested farmers and other landowners who may simply lack the time or resources to develop project plans, research funding opportunities and write grant applications.

In developing this Watershed Implementation Plan, RETTEW was careful to propose the types of projects that AWA could feasibly implement, given its nature as an all-volunteer grassroots organization. There was no logical basis to propose projects or BMPs that will never feasibly be implemented by the group.

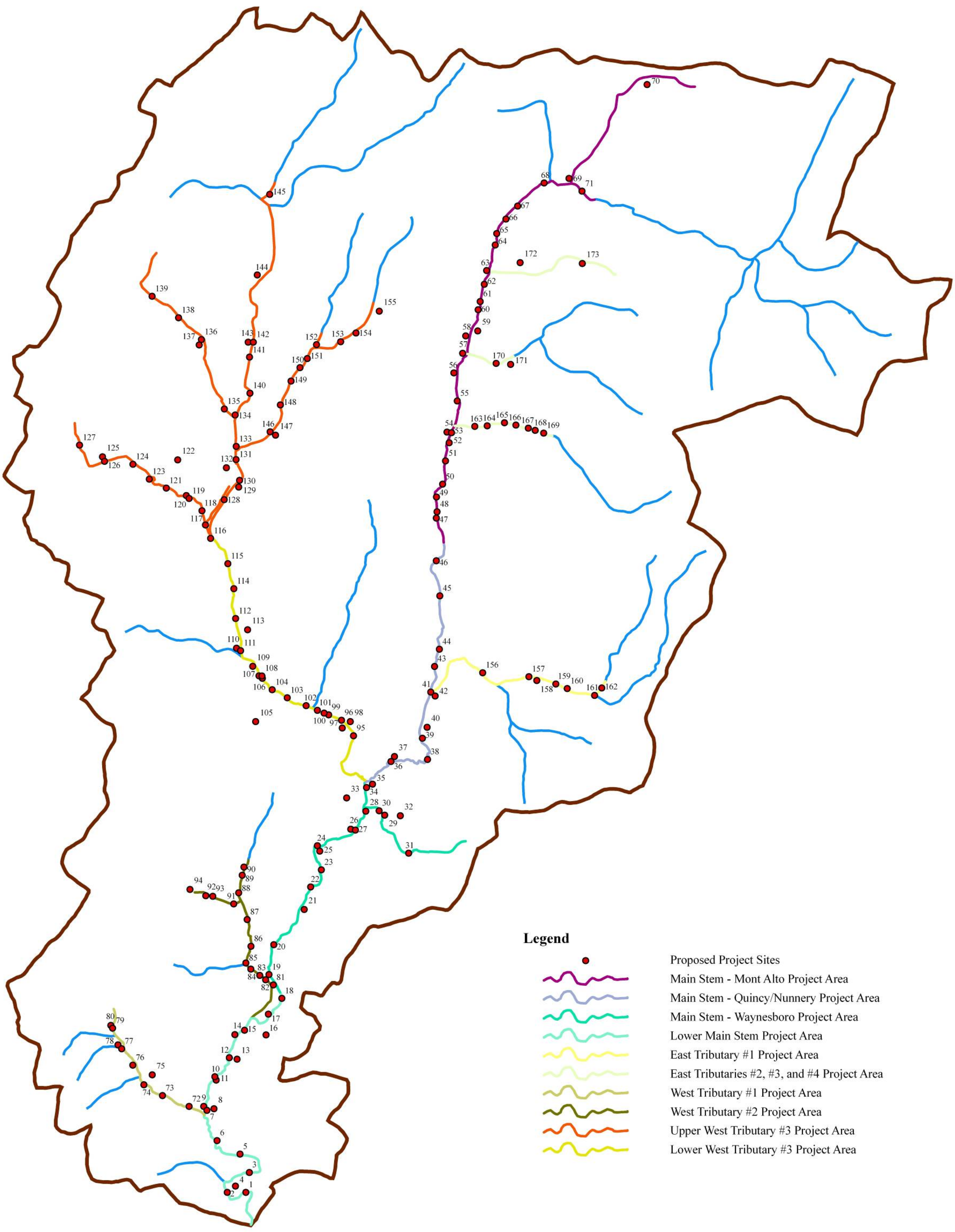
Nonetheless, implementation of all proposed projects identified in this Watershed Implementation Plan will require significant time and financial resources. Based on PADEP's implementation cost estimates derived from the PRedICT model, the cost estimate to install all proposed BMPs (not including dam removal costs) is $12,728,849.85. ***See Appendix A for the PRedICT model runs.*** The PRedICT model calculates costs by using established Chesapeake Bay program costs per acre and/or mile of each particular prescribed BMP. Additional administrative and maintenance costs, as well as inflationary concerns, are ultimately likely to make the price tag even higher. Even if AWA were to receive grants in the amount of $530,368.74 per year to fund restoration projects, under present cost estimates it would take at least 24 years to fully implement this plan. Additionally dam removal projects will need to be investigated on a case by case basis as described earlier in this writing. Clearly land use practices will change over the next 24 years, requiring continuing adaptation and modification of the BMPs proposed in this plan. Reaching agreements with landowners to embark on projects often takes years of outreach and partnership building. In addition, the West Branch is but one of a multitude of impaired waters in Pennsylvania competing for the same limited funding sources.

As stated, land use within the watershed is not static. Presently, much land within the West Branch remains in agricultural use. However, recent trends in this region show an increased conversion of farmland to residential or commercial development. As this trend continues, new threats to water quality will arise, such as stormwater runoff from developed impervious surfaces and over application of lawn chemicals and fertilizers. These new threats will, in many cases, require implementation of different BMPs to address them. Moreover, given expected future land use trends, it must be anticipated that existing landowners may wish to preserve the development potential of their lands, and thus implementation of BMPs may be restricted to areas in and along riparian corridors, floodplains and wetlands where development may already be difficult or prohibited because of local ordinances or state or federal regulations. For all of these reasons, this plan will have to be reconsidered and modified as landuse changes within the watershed.

V. RESTORATION RECOMMENDATIONS

For confidentiality reasons, landowner names are not listed in this report, rather proposed project locations are identified by a site number. ***See Fig. #5 Project Locations Map below.*** The AWA has been provided data sheets specifically identifying proposed project locations that correspond to the site number seen on the map below.

Fig #5



Project Locations Map

It is best to begin restoration activities in the headwaters and first and second order tributaries. ***Table #4 – Project Implementation Schedule*** outlines the recommended sequence for the 173 planned BMP sites.

Table #4 strategically groups identified potential project areas/tasks so that restoration activities are implemented in a logical fashion; generally undertaking work in smaller sub-watersheds and then progressing downstream into the bottom reaches of the main stem. In other words, work will begin at the top and proceed downstream. It is rather illogical to skip haphazardly around the entire West Branch doing various projects, only to have "fixed" problem areas still being negatively impacted from upstream problem areas. It is far more rewarding from both a psychological and biological viewpoint to complete work in a sub-watershed knowing that it is taken care of and no longer negatively influences the overall health of the entire watershed.

Also of special interest, a total of **nine (9) dams** were identified within the West Branch. The dams range in size and type of construction, but all are having a negative impact on the aquatic ecosystem. The dams create localized sedimentation problems, serve as thermal sinks, and obstruct fish passage. The AWA should make the removal of these dams a priority. Removing dams within the Commonwealth of Pennsylvania is rather common with assistance provided by the Pennsylvania Fish and Boat Commission and American Rivers. Contacts for these two conservation organizations are as follows:

David P. Kristine, Fisheries Biologist
Pennsylvania Fish and Boat Commission
Benner Spring Fish Research Station
1735 Shiloh Road
State College, PA 16801-8495
(814) 353-2237 phone
(814) 355-8264 fax
dkristine@state.pa.us

Sara Deuling, Dam Removal Associate
American Rivers
355 North 21st Street, Suite 309
Camp Hill, PA 17001
(717) 763-0741 phone
(717) 763-0743 fax
sdeuling@amrivers.org

The nine (9) dams are located as follows:

Site #5	Lower Main Stem	
Site #50	Mont Alto Area – Main Stem	
Site #55	Mont Alto Area – Main Stem	
Site #58	Mont Alto Area – Main Stem	
Site #60	Mont Alto Area – Main Stem	
Site #84	West Tributary #2	
Site #101	Lower West Tributary #3	
Site #106	Lower West Tributary #3	Note: American Rivers working w/ owner
Site #108	Lower West Tributary #3	

To kick-off restoration work, RETTEW recommends a pilot project for the John Blair Farm (identified as sites 24-28). As a result of a public meeting, Mr. Blair has expressed an interest in working with the AWA and conservation practices on his farm would serve as a great example to others in the area. This work would be very visible and recognizable from a public road.

Table #4 – Project Implementation Schedule

Upper West Tributary #3 2008-2013 Estimated cost - $2,219,485.70 Estimated load reduction for sediment – 1,730,813 lbs. Estimated load reduction for nitrogen – 6,122 lbs. Estimated load reduction for phosphorous – 721 lbs.	
Site #117	2,637.54-feet of vegetated buffer
Site #118	896.85-feet of vegetated buffer 897-feet of stream fencing 800-feet of bank stabilization
Site #119	1,832.18-feet of vegetated buffer 600-feet of bank stabilization
Site #120	5.90-acres of conservation tillage
Site #121	2,812.28-feet of vegetated buffer 800-feet of bank stabilization
Site #122	76.86-acres of cropland protection
Site #123	1,579.03-feet of vegetated buffer
Site #124	2,498.70-feet of vegetated buffer 2,499-feet of stream fencing
Site #125	18.27-acres of cropland protection
Site #126	2,234.13-feet of vegetated buffer
Site #127	4,246.53-feet of vegetated buffer 4,247-feet of stream fencing 1,500-feet of bank stabilization
Site #128	some fencing but too close to stream 688.90-feet of vegetated buffer 689-feet of stream fencing 400-feet of bank stabilization
Site #129	5.26-acres of conservation tillage
Site #130	2,917.32-feet of vegetated buffer 2,917-feet of stream fencing 2,000-feet of bank stabilization
Site #131	1,556.48-feet of vegetated buffer 750-feet of stream fencing 1,200-feet of bank stabilization
Site #132	24.15-feet of conservation tillage
Site #133	643.15-feet of vegetated buffer 643-feet of stream fencing 350-feet of bank stabilization
Site #134	1,775.05-feet of vegetated buffer 1,775-feet of stream fencing 1,000-feet of bank stabilization
Site #135	398.47-feet of vegetated buffer

Table #4 – Project Implementation Schedule - continued

Site #136	2,737.46-feet of vegetated buffer 2,737-feet of fencing 2,000-feet of bank stabilization
Site #137	39.83-acres of grazing land management
Site #138	3,485.22-feet of vegetated buffer
Site #139	1,825.65-feet of vegetated buffer 900-feet of stream fencing
Site #140	2,499.19-feet of vegetated buffer 2,499-feet of stream fencing 900-feet of bank stabilization
Site #141	was fenced, but no more wire, posts still there 1,138.18-feet of vegetated buffer 1,600-feet of stream fencing 600-feet of bank stabilization
Site #142	1,663.01-feet of vegetated buffer
Site #143	7.21-acres of conservation tillage
Site #144	fenced but no buffer 2,050.16-feet of vegetated buffer
Site #145	1,172.02-feet of vegetated buffer
Site #146	955.51-feet of vegetated buffer
Site #147	12.55-acres of conservation tillage
Site #148	2,764.69-feet of vegetated buffer 2,765-feet of stream fencing 2,500-feet of bank stabilization
Site #149	2,914.05-feet of vegetated buffer 2,914-feet of stream fencing 2,400-feet of bank stabilization
Site #150	204.82-feet of vegetated buffer 204.82-feet of bank stabilization
Site #151	1,365.23-feet of vegetated buffer 500-feet of bank stabilization
Site #152	2,282.26-feet of vegetated buffer
Site #153	1,451.79-feet of vegetated buffer 1,452-feet of stream fencing 800-feet of bank stabilization
Site #154	1,540.82-feet of vegetated buffer
Site #155	20.29-acres of terraces and diversions

Table #4 – Project Implementation Schedule - continued

Lower West Tributary #3 **2013-2016** **Estimated cost - $1,601,209.64 (doesn't include dam removals)** **Estimated load reduction for sediment – 1,174,745 lbs.** **Estimated load reduction for nitrogen – 4,447 lbs.** **Estimated load reduction for phosphorous – 409 lbs.**	
Site #95 Site #96	2,169.04-feet of vegetated buffer 2,169-feet of stream fencing 1,300-feet of bank stabilization 2,072.57-feet of vegetated buffer 1,400-feet of bank stabilization
Site #97	2.49-acres of cropland protection
Site #98	0.57-acres of agricultural use to wetland conversion actually a business location
Site #99	189.88-feet of vegetated buffer
Site #100	178.57-feet of vegetated buffer 178.57-feet of bank stabilization
Site #101	**dam removal** 429-feet of vegetated buffer 200-feet of bank stabilization
Site #102	1,700.59-feet of vegetated buffer
Site #103	1,955.87-feet of vegetated buffer 1,956-feet of stream fencing 1,500-feet of bank stabilization
Site #104	1,426.69-feet of vegetated buffer 1,427-feet of stream fencing 1,426.69-feet of bank stabilization
Site #105	93.98-acres of grazing land management
Site #106	**dam removal** approximately a 1.63-acre impoundment
Site #107	small pond related to Site #106 – could be converted to wetland if/when the dam is removed
Site #108	related to Sites #106 and 107 another **small dam removal** 3,839.06-feet of vegetated buffer 3,000-feet of bank stabilization
Site #109	0.22-acres of grazing land management
Site #110	2.44-acres of agricultural use to wetland conversion
Site #111	2,778.69-feet of vegetated buffer 2,779-feet of stream fencing 2,300-feet of bank stabilization
Site #112	4,373.97-feet of vegetated buffer 2,000-feet of bank stabilization
Site #113	36.63-acres of conservation tillage

Site #114	413.09-feet of vegetated buffer 413-feet of stream fencing 200-feet of bank stabilization
Site #115	377.27-feet of vegetated buffer
Site #116	261.33-feet of vegetated buffer

East Tributaries #2,3,4 **2016-2018** **Estimated cost - $260,774.54** **Estimated load reduction for sediment – 1,415,975 lbs.** **Estimated load reduction for nitrogen – 4,454 lbs.** **Estimated load reduction for phosphorous – 510 lbs.**	
Site #163	611.12-feet of vegetated buffer
Site #164	1,432.95-feet of vegetated buffer 300-feet of bank stabilization
Site #165	1,401.88-feet of vegetated buffer
Site #166	721.93-feet of vegetated buffer 240-feet of bank stabilization
Site #167	285.93-feet of vegetated buffer 100-feet of bank stabilization
Site #168	908.31-feet of vegetated buffer
Site #169	550.02-feet of vegetated buffer
Site #170	1,085.81-feet of vegetated buffer 300-feet of stream fencing 100-feet of bank stabilization
Site #171	9.04-acres of grazing land management
Site #172	54.28-feet of terraces and diversions
Site #173	101.08-acres of terraces and diversions

Mont Alto Area – Main Stem **2018-2022** **Estimated cost - $1,806,654.74 (doesn't include dam removals)** **Estimated load reduction for sediment – 642,879 lbs.** **Estimated load reduction for nitrogen – 4,672 lbs.** **Estimated load reduction for phosphorous – 517 lbs.**	
Site #47	675.39-feet of vegetated buffer 300-feet of bank stabilization
Site #48	689.35-feet of vegetated buffer 400-feet of bank stabilization
Site #49	1,250.04-feet of vegetated buffer 1,250.04-feet of bank stabilization
Site #50	**dam removal** 903.37-feet of vegetated buffer 400-feet of bank stabilization has some stream fencing already

Table #4 – Project Implementation Schedule - continued

Site #51	was fenced and planted with buffer by AWA tree tubes should be removed on some tree 3,755.84 of vegetated buffer (installed) 1,500-feet of stream fencing (installed) 2,500-feet of bank stabilization (to develop as buffer matures)
Site #52	1.31-acres of agricultural use to wetland conversion
Site #53	1,800.35-feet of vegetated buffer 1,800-feet of stream fencing 1,100-feet of bank stabilization
Site #54	14.35-acres of grazing land management
Site #55	**dam removal** 500-feet of vegetated buffer 800-feet of bank stabilization
Site #56	contains some "dump piles" of cardboard boxes, etc. 774.17-feet of vegetated buffer 300-feet of bank stabilization
Site #57	10.48-acres of agricultural use to wetland conversion previously drained wetland via ditches
Site #58	**dam removal** 7.08-acres of agricultural use to wetland conversion previously drained wetland via ditches
Site #59	poor manure management 7.00-acres of terraces and diversion
Site #60	**dam removal** 978.32-feet of vegetated buffer 978-feet of stream fencing 600-feet of bank stabilization
Site #61	595.04-feet of vegetated buffer 595.04-feet of bank stabilization
Site #62	578.56-feet of vegetated buffer 300-feet of bank stabilization
Site #63	1,777.90-feet of vegetated buffer 500-feet of bank stabilization
Site #64	stormwater runoff from parking lot 1,033.71-feet of vegetated buffer 500-feet of bank stabilization
Site #65	1,599.14-feet of vegetated buffer 1,300-feet of bank stabilization
Site #66	needs of stabile crossing for horses 800-feet of vegetated buffer 450-feet of stream fencing 600-feet of bank stabilization

Table #4 – Project Implementation Schedule - continued

Site #67	stormwater runoff from road and parking lot 1,300-feet of vegetated buffer 1,527-feet of stream fencing 600-feet of bank stabilization
Site #68	802.75-feet of vegetated buffer 803-feet of stream fencing 300-feet of bank stabilization
Site #69	6.80-acres of terraces and diversions
Site #70	12.97-acres of terraces and diversions
Site #71	1,800-feet of vegetated buffer 1,971-feet of stream fencing 700-feet of bank stabilization

East Tributary #1 **2022-2023** **Estimated cost - $183,807.07** **Estimated load reduction for sediment – 16,803 lbs.** **Estimated load reduction for nitrogen – 4,331 lbs.** **Estimated load reduction for phosphorous – 450 lbs.**	
Site #156	1,186.27-feet of vegetated buffer
Site #157	1,363.73-feet of vegetated buffer 900-feet of bank stabilization
Site #158	junk pile along stream
Site #159	2,604.48-feet of vegetated buffer
Site #160	1,043.20-feet of vegetated buffer 1,043-feet of stream fencing
Site #161	manure management needed 681.71-feet of vegetated buffer 400-feet of stream fencing 600-feet of bank stabilization
Site #162	1,064.18-feet of vegetated buffer

Quincy/Nunnery Area –Main Stem **2023-2025** **Estimated cost - $1,703,718.20** **Estimated load reduction for sediment – 389,648 lbs.** **Estimated load reduction for nitrogen – 1,553 lbs.** **Estimated load reduction for phosphorous – 173 lbs**	
Site #36	3,004.07-feet of vegetated buffer 3,004-feet of stream fencing 3,004.07-feet of bank stabilization
Site #37	12.74-acres of grazing land management
Site #38	3,335.98-feet of vegetated buffer 4,000-feet of stream fencing 2,000-feet of bank stabilization

Table #4 – Project Implementation Schedule - continued

Site #39	1,777.35-feet of vegetated buffer 2,600-feet of stream fencing 600-feet of bank stabilization
Site #40	9.45-acres of agricultural use to wetland conversion
Site #41	1,991.36-feet of vegetated buffer 1,991-feet of stream fencing 1,700-feet of bank stabilization
Site #42	12.21-acres of grazing land management
Site #43	560.81-feet of vegetated buffer 250-feet of stream fencing 560.81-feet of bank stabilization
Site #44	1,039.34-feet of vegetated buffer 1,039.34-feet of bank stabilization
Site #45	buffer planting site by AWA 4,337.41-feet of vegetated buffer (installed) 3,000-feet of bank stabilization (to develop as buffer matures)
Site #46	1,532.10-feet of vegetated buffer 1,532.10-feet of bank stabilization

Waynesboro Area – Main Stem 2025-2027 Estimated cost - $1,657,032.44 Estimated load reduction for sediment – 920,314 lbs. Estimated load reduction for nitrogen – 3,179 lbs. Estimated load reduction for phosphorous – 385 lbs		
Site #19	1,491.84-feet of vegetated buffer 1,491.84-feet of bank stabilization	
Site #20	880-feet of bank stabilization	
Site #21	3.12-acres of parking area generating stormwater runoff – could be treated with wet pond basin or passive wetland treatment area	
Site #22	1,583.30-feet of vegetated buffer 800-feet of bank stabilization stormwater runoff problems	
Site #23	456.83-feet of vegetated buffer 456.83-feet of bank stabilization	
Site #24	newly installed tile 2,309.43-feet of vegetated buffer 2,000-feet of bank stabilization	Proposed Pilot Projects 24-28 John Blair Farm
Site #25	3.31-acres of cropland protection	
Site #26	5.19-acres of agricultural use to wetland conversion	
Site #27	farm lane bridge is a bit of an obstruction 5,357.83-feet of vegetated buffer 5,358-feet of stream fencing 2,500-feet of bank stabilization	
Site #28	2.23-acres of agricultural use to wetland conversion	

Table #4 – Project Implementation Schedule - continued

Site #29	8.25-acres of grazing land management
Site #30	1,547.83-feet of vegetated buffer 1,548-feet of stream fencing 1,547.83-feet of bank stabilization
Site #31	residential area 1,540.47-feet of vegetated buffer
Site #32	32.34-acres of terraces and diversions
Site #33	36.59-acres of terraces and diversion
Site #34	3,059.89-feet of vegetated buffer 3,059.89-feet of bank stabilization
Site #35	19.53-acres of cropland protection

West Tributary #2 **2027-2029** **Estimated cost - $1,213,360.54 (doesn't include dam removal)** **Estimated load reduction for sediment – 135,017 lbs.** **Estimated load reduction for nitrogen – 661 lbs.** **Estimated load reduction for phosphorous – 80 lbs**	
Site #81	690.47-feet of vegetated buffer 260-feet of bank stabilization
Site #82	508.73-feet of vegetated buffer 508.73-feet of bank stabilization
Site #83	400-feet of vegetated buffer 300-feet of bank stabilization
Site #84	**dam removal** 154.03-feet of vegetated buffer 154.03-feet of bank stabilization
Site #85	1,058.31-feet of vegetated buffer 1,058-feet of stream fencing 700-feet of bank stabilization
Site #86	2,619.48-feet of vegetated buffer 2,619-feet of stream fencing 2,000-feet of bank stabilization
Site #87	2,500-feet of vegetated buffer 2,400-feet of stream fencing 2,000-feet of bank stabilization
Site #88	2,101.15-feet of vegetated buffer 2,101-feet of stream fencing 1,000-feet of bank stabilization
Site #89	788.52-feet of vegetated buffer
Site #90	529.15-feet of vegetated buffer 529-feet of stream fencing 529.15-feet of bank stabilization

Table #4 – Project Implementation Schedule - continued

Site #91	1,658.32-feet of vegetated buffer 400-feet of stream fencing 1,658.32-feet of bank stabilization
Site #92	3.23-acres of agricultural use to wetland conversion
Site #93	2,020.59-feet of vegetated buffer 1,000-feet of bank stabilization
Site #94	3.40-acres of agricultural use to wetland conversion

West Tributary #1 **2029-2030** **Estimated cost - $335,334.95** **Estimated load reduction for sediment – 118,215 lbs.** **Estimated load reduction for nitrogen – 558 lbs.** **Estimated load reduction for phosphorous – 71 lbs**	
Site #72	1,985.41-feet of vegetated buffer
Site #73	2,890.81-feet of vegetated buffer 2,891-feet of stream fencing 1,000-feet of bank stabilization
Site #74	1,148.40-feet of vegetated buffer 450-feet of bank stabilization
Site #75	12.50-acres of stripcropping and contour farming
Site #76	2,451.84-feet of vegetated buffer
Site #77 Site #78	158.30-feet of vegetated buffer 158-feet of stream fencing 0.69-acres of agricultural use to wetland conversion
Site #79	1,377.23-feet of vegetated buffer 1,377-feet of stream fencing 1,377.23-feet of bank stabilization
Site #80	1.91-acres of agricultural use to wetland conversion

Lower Main Stem **2030-2032** **Estimated cost - $1,747,472.03 (doesn't include dam removal)** **Estimated load reduction for sediment – 964,519 lbs.** **Estimated load reduction for nitrogen – 6,740 lbs.** **Estimated load reduction for phosphorous – 736 lbs**	
Site #1	1,800-feet of vegetated buffer 2,031-feet of stream fencing 1,500-feet of bank stabilization
Site #2	1,500-feet of vegetated buffer 3,201-feet of stream fencing 2,000-feet of bank stabilization

Table #4 – Project Implementation Schedule - continued

Site #3	3,431.59-feet of vegetated buffer 3,432-feet of stream fencing 2,300-feet of bank stabilization
Site #4	60.68-acres of grazing land management
Site #5	**dam removal** 1,082.69-feet of vegetated buffer 1,082.69-feet of bank stabilization
Site #6	1,642.56-feet of vegetated buffer 1,643-feet of stream fencing 500-feet of bank stabilization
Site #7	3,675.93-feet of vegetated buffer 3,676-feet of stream fencing 1,500-feet of bank stabilization
Site #8	11.93-acres of conservation tillage
Site #9	8.82-acres of grazing land management
Site #10	3,189.79-feet of vegetated buffer 3,190-feet of stream fencing 2,800-feet of bank stabilization
Site #11	14.08-acres of terraces and diversions
Site #12	1,340.94-feet of vegetated buffer 1,200-feet of bank stabilization
Site #13	11.05-acres of conservation tillage
Site #14	questionable manure pit – overflow/leaking? 4.29-acres of grazing land management
Site #15	1,800-feet of vegetated buffer 1,000-feet of bank stabilization
Site #16	1,787.95-feet of earthen farm land with erosion to stream
Site #17	private park area 1,305.26-feet of vegetated buffer 1,305.26-feet of bank stabilization
Site #18	private park area 702.82-feet of vegetated buffer 702.82-feet of bank stabilization

Table #4 – Project Implementation Schedule

VI. PUBLIC PARTICIPATION AND INVOLVEMENT

At this time, AWA is the only existing watershed organization for Antietam Creek and will take the lead on implementing this Watershed Implementation Plan as landowner cooperation and funds are secured.

There are, however, several other entities with which AWA will partner to implement this plan. These include the Franklin County Conservation District, Natural Resources Conservation Service, the Chesapeake Bay Foundation and the various municipalities.

All of these entities will play a critical role in implementation of the restoration projects set forth in this plan. As this plan addresses agricultural sources, the assistance of farm agencies such as those listed above is invaluable. These agencies have established relationships with area farmers, have the expertise to provide necessary technical assistance and have the staff and resources to facilitate the implementation of agricultural BMPs to improve water quality. AWA is privileged to have a strong working relationship with the Franklin County Conservation Districts and their watershed specialist, and anticipates a successful and growing partnership with all area farm agencies that will aid in implementation of this plan.

AWA should have no problem convincing landowners and other stakeholders that a healthy stream is a good thing – obviously no landowner wants a polluted creek! So it really comes down to what is exactly being proposed on their property, and how it might affect them. For example eroding streambanks are in no one's interest, and landowners are very open to having them stabilized. However installing BMPs such as streambank fencing and a wide forest buffer may raise concerns about weed growth and the perceived loss of pastureland. These types of conservation measures will take some education effort on the part of AWA. But the group has had success on the East Branch and in fact already has done two forest buffer planting projects on the West Branch!

However regardless of the number of willing partners and landowners, project implementation requires funding. The present cost estimate for implementation of all projects identified in this plan stands at $12,728,849.85 (not including dam removal costs). Potential funding sources include the following:

- EPA Section 319 Program
- Pennsylvania Growing Greener I and II
- USDA's CRP, CREP and Environmental Quality Incentives Programs
- Pennsylvania Fish and Boat Commission's "Adopt a Stream" program

As with project implementation, AWA will be flexible in considering funding sources and willing to seek new funding sources as they become available.

AWA is a volunteer watershed organization. As such, it is well positioned to identify landowners and other individuals and organizations who may be interested in the implementation of the potential stream improvement projects identified in this plan.

AWA is actively engaged in outreach and publicity work to educate landowners about watershed protection and restoration issues. Their members speak at local civic organizations and schools, sponsor guest presentations, and run display booths at local events such as community fairs and fund raising dinners. The AWA holds monthly meetings which are open to the public. They held a special public meeting in the fall of 2007 to make stakeholders aware of this very Watershed Implementation Plan (the fact that it was being developed and what the findings were to date). AWA will continue to use these community outreach and educational events as tools to develop partnerships with landowners on potential projects.

AWA develops and distributes a newsletter on a periodic basis. A future edition of the newsletter will be mailed to all riparian landowners along the creek and will include a feature article on this plan and how AWA can assist West Branch landowners interested in participating in voluntary stream improvement projects.

AWA also maintains a website at **www.antietamws.org**. The website provides information regarding their many existing restoration projects, and this Watershed Implementation Plan project.

VII. MONITORING RESTORATION PROGRESS

Monitoring Implementation

The 173 project opportunities identified in this report set forth precise goals for BMP implementation and identify those BMPs for each project area, down to the linear foot and acre. The BMPs recommended for each project will serve as measurables to track interim progress as this plan is implemented. They include:

1. feet of riparian corridor management practices including the establishment of forest and vegetative buffers, streambank fencing and streambank stabilization.

2. acres of soil conservation farming practices including strip cropping, crop rotation, residue management, terracing, farming on the contour and other prescribed methods that serve to preserve the soil resource and arrest its erosion and migration to watercourses

3. acres of pastureland management practices including rotational grazing and other methods that help preserve the integrity of the vegetative cover; which in turn controls soil loss and nutrients attached to the soil particles such as phosphorous.

4. acres of nutrient management practices including manure storages, balanced application rates of manure and commercial fertilizers and barnyard and feedlot controls that assist in the gathering of animal wastes so as to allow their collection for proper application rather than uncontrolled release.

With respect to the first item, riparian corridor management practices may consist of one or more necessary riparian BMPs: streambank fencing, riparian buffer planting or streambank stabilization. In some cases where active grazing is occurring, all three may be required. With respect to the remaining three items, as explained above, AWA will collaborate with the Franklin County Conservation District and USDA local farm agency offices for implementation. It is anticipated that the District and agencies will establish their own priorities and interim goals consistent with their respective capabilities and missions. AWA will maintain oversight of project implementation and will track restoration progress.

Monitoring Water Quality Improvement

As this plan is implemented, water quality in the West Branch will improve. Water quality monitoring will be conducted on a sub-watershed basis as defined in ***Table #4 – Project Implementation Schedule***. The monitoring of streambank profiles, streambed composition, aquatic habitat, and macroinvertebrate numbers and diversity should produce a measurable understanding of how the creek is responding to installed BMPs. PADEP is currently developing training for this type of monitoring.

It is not necessary to monitor each and every BMP installation, but rather monitor strategic locations within each sub-watershed to track recovery. Exact monitoring locations are not defined at this time, but it is typically assumed monitoring would take place at the downstream end of the sub-watershed and several midpoints within the sub-watershed (likely where various tributaries intersect so as to allow for further dissecting of recovery or lack of it within the sub-watershed).

AWA will conduct sampling of the macroinvertebrate and fish community and will monitor streambank profiles and conduct pebble counts prior to the installation of BMP projects, and bi-annually thereafter to record recovery of stream reaches.

Once implementation of this Watershed Implementation Plan is underway, PADEP will return to selected monitoring points on a sub-watershed basis at least once every five years to measure water quality improvement. Improvement will be demonstrated by stabile streambanks, increases in pebble counts and, ultimately, reappearance of a diverse macroinvertebrate population at monitoring points throughout the West Branch.

When stream reaches are thought to be successfully recovered, PADEP will be invited to conduct an official re-assessment of the stream condition; with the ultimate goal being that of removing currently impaired stream segments from the Pennsylvania's 303(d) listing of impaired waters.

AWA will also seek the assistance of the Franklin County Conservation District's watershed specialist to provide guidance and quality control of this monitoring and additionally will seek partnership with the Senior Environmental Corps and their established monitoring program within Franklin County.

Because of uncertainty concerning landowner participation, funding and many other factors, AWA cannot guarantee or commit to any of the specific implementation projects that are recommended in this plan. However, through its continued volunteer monitoring program, AWA will be able to gather data necessary to evaluate the future success of any of such projects that are implemented.

AWA will meet on an annual, year end basis to determine the status of plan implementation and progress being made towards meeting nutrient and sediment reduction goals. If it is deemed timely, adequate progress is not being achieved; adjustments in overall plan implementation will be made. Such adjustments could involve improving landowner contact and communication, seeking other funding sources and in-kind contributions, improvements to or use of new BMPs, and possibly changes to the priorities set forth in the implementation plan.

Goals & Milestones

Milestones are based on implementing BMPs within the sub-watershed drainage areas defined in this writing. Implementing these BMPs will result in a reduction in sediment, nitrogen and phosphorous loading. As well, these anticipated reductions are listed and planned on a sub-watershed basis. Therefore as all the recommended BMPs are completed in a sub-watershed within the assigned timeframe (period of years typically) it is then understood the corresponding reductions in sediment, nitrogen and phosphorous are well on the way to being achieved; thus the "milestone" for that sub-watershed has been met.

Monitoring then of streambank profiles, streambed composition, aquatic habitat, and macroinvertebrate numbers and diversity will serve as a means of determining how the biological and physical environment is responding to said BMP installation and assumed reductions in sediment, nitrogen and phosphorous loading per a sub-watershed basis. Strategic monitoring locations and monitoring activity within a sub-watershed will be established and conducted prior to and after BMPs installations within said sub-watershed.

The following goals or milestones can be derived from Table #4 - "Project Implementation Schedule" of this report. If project implementation goes according to this schedule, the AWA will be able to gage progress made in terms of sediment, nitrogen and phosphorous reduction as expressed in pounds or percentage.

<u>Upper West Tributary #3 - 2008-2013</u>
Estimated load reduction for sediment – 1,730,813 lbs. or 6.7%
Estimated load reduction for nitrogen – 6,122 lbs. or 2.0%
Estimated load reduction for phosphorous – 721 lbs. or 4.4%

<u>Lower West Tributary #3 - 2013-2016</u>
Estimated load reduction for sediment – 1,174,745 lbs. or 4.5% (11.2% cumulative)
Estimated load reduction for nitrogen – 4,447 lbs. or 1.4% (3.4% cumulative)
Estimated load reduction for phosphorous – 409 lbs. or 2.3% (6.7% cumulative)

<u>East Tributaries #2,3,4 - 2016-2018</u>
Estimated load reduction for sediment – 1,415,975 lbs. or 5.5% (16.7% cumulative0
Estimated load reduction for nitrogen – 4,454 lbs. or 1.5% (4.9% cumulative)
Estimated load reduction for phosphorous – 510 lbs. or 3.2% (9.9% cumulative)

Mont Alto Area – Main Stem - 2018-2022
Estimated load reduction for sediment – 642,879 lbs. or 2.5% (19.2% cumulative)
Estimated load reduction for nitrogen – 4,672 lbs. or 1.6% (6.5% cumulative)
Estimated load reduction for phosphorous – 517 lbs. or 2.6% (12.5% cumulative)

East Tributary #1 - 2022-2023
Estimated load reduction for sediment – 16,803 lbs. or 0.1% (19.3% cumulative)
Estimated load reduction for nitrogen – 4,331 lbs. or 1.4% (7.9% cumulative)
Estimated load reduction for phosphorous – 450 lbs. or 1.1% (13.6% cumulative)

Quincy/Nunnery Area –Main Stem - 2023-2025
Estimated load reduction for sediment – 389,648 lbs. or 1.5% (20.8% cumulative)
Estimated load reduction for nitrogen – 1,553 lbs. or 0.5% (8.4% cumulative)
Estimated load reduction for phosphorous – 173 lbs or 2.2% (15.8% cumulative)

Waynesboro Area – Main Stem - 2025-2027
Estimated load reduction for sediment – 920,314 lbs. or 3.5% (24.3% cumulative)
Estimated load reduction for nitrogen – 3,179 lbs. or 1.1% (9.5% cumulative)
Estimated load reduction for phosphorous – 385 lbs or 0.5% (16.3% cumulative)

West Tributary #2 - 2027-2029
Estimated load reduction for sediment – 135,017 lbs. or 0.5% (24.8% cumulative)
Estimated load reduction for nitrogen – 661 lbs. or 0.2% (9.7% cumulative)
Estimated load reduction for phosphorous – 80 lbs or 0.6% (16.9% cumulative)

West Tributary #1 - 2029-2030
Estimated load reduction for sediment – 118,215 lbs. or 0.5% (25.3% cumulative)
Estimated load reduction for nitrogen – 558 lbs. or 0.1% (9.8% cumulative)
Estimated load reduction for phosphorous – 71 lbs or 0.4% (17.3% cumulative)

Lower Main Stem - 2030-2032
Estimated load reduction for sediment – 964,519 lbs. or 3.7% (29.0% cumulative as seen in Table #2, page 16)
Estimated load reduction for nitrogen – 6,740 lbs. or 2.2% (12% cumulative as seen in Table #2, page 16)
Estimated load reduction for phosphorous – 736 lbs or 4.7% (22.0% cumulative as seen in Table #2, page 16)

RESOURCE LITERATURE

Commonwealth of Pennsylvania. Pennsylvania Code. Title 25 Environmental Protection. Department of Environmental Protection. Chapter 93. Water Quality Standards. Harrisburg, PA.

Pennsylvania State University Environmental Resources Research Institute. 2007. PRedICT version 2.0.8 users guide. The Pennsylvania State University. University Park, PA.

Interstate Commission on the Potomac River. 2002. Total Maximum Daily Loads (TMDLs) Plan for West Branch Antietam Creek UNT (draft). Department of Environmental Protection. Harrisburg, PA.

Pennsylvania Integrated Water Quality Monitoring and Assessment Report. 2006. PA Dept. of Environmental Protection. Harrisburg, PA.

BMP KEY

BMP #1	Cropland Protection
BMP #2	Conservation Tillage
BMP #3	Stripcropping & Contour Farming
BMP #4	Agricultural Land to Forest Land Conversion
BMP #5	Agricultural Land to Wetland Conversion
BMP #6	Nutrient management
BMP #7	Grazing land management
BMP #8	Terraces & Diversions

Mean Annual Load Data Editor

Load Data Type	Total Sed (lbs)	Total N (lbs)	Total P (lbs)
UPLAND EROSION/RUNOFF			
Row Crops	14438000	73426	9925
Hay/Pasture	692000	12564	1092
High Density Urban	6000	83	9
Low Density Urban	38000	27	4
Unpaved Road	34000	150	22
Other	9006000	33928	5376
STREAMBANK EROSION	2042000	102	44
GROUNDWATER/SUBSURFACE		181577	1963
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		309	109
TOTAL	26256000	302166	18544
BASIN AREA	26496	Acres	

Agricultural Land BMP Scenario Editor

Land Use	Acres		BMP1	BMP2	BMP3	BMP4	BMP5	BMP6	BMP7	BMP8
Row Crops	11295	% Existing	34	20	37	0	0	50		5
		% Future	35	21	37	0	0	52		7
Hay/Pasture	7284	% Existing				0	0	25	15	0
		% Future				0	1	25	19	0

Agricultural Land on Slope > 3%	5,456	Acres
Streams in Agricultural Areas	43.5	Miles
Total Stream Length	62.4	Miles
Unpaved Road Length	9.8	Miles

	Existing	Future
Stream Miles with Vegetated Buffer Strips	11.3	43.5
Stream Miles with Fencing	0.1	18.7
Stream Miles with Stabilization	0.3	19.7
Unpaved Road Miles w/E & S Controls	4.9	5.2

Urban Land BMP Scenario Editor

High Density Urban					
	Acres	212	% Impervious Surface		50
Constructed Wetlands		**Bioretention Areas**		**Detention Basins**	
% Existing		% Existing	0	% Existing	0
% Future	.5	% Future	0	% Future	0
% Drainage Area Used	.5	% Drainage Area Used	6	% Drainage Area Used	3
Impervious Acres Drained	1.1	Impervious Acres Drained	0.0	Impervious Acres Drained	0.0
CW Acres Required	0.1	BA Acres Required	0.0	DB Acres Required	0.0

Low Density Urban					
	Acres	650	% Impervious Surface		25
Constructed Wetlands		**Bioretention Areas**		**Detention Basins**	
% Existing	0	% Existing	0	% Existing	0
% Future	0	% Future	0	% Future	0
% 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	4	Stream miles in high density urban areas w/buffers	0	2.7
		High Density Urban Streambank Stabilization	.1	.1
Stream miles in low density urban areas	3.6	Stream miles in low density urban areas w/buffers	.2	2.7
		Low Density Urban Streambank Stabilization	.2	.2

Septic Systems and Point Source Discharge Scenario Editor

Number of persons on septic systems	Existing	0		
	Future	0		
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
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	0.98
BMP 6	0.70	0.60	
BMP 7	0.43	0.34	0.68
BMP 8	0.44	0.42	0.71
Vegetated Buffer Strips	0.64	0.52	0.58
Streambank Fencing	0.56	0.78	0.76
Streambank Stabilization	0.95	0.95	0.95
Unpaved Roads (lbs/ft)	0.02	0.0035	2.55

Urban BMP Load Reduction Efficiency Editor

BMP Type	Nitrogen	Phosphorus	Sediment
Constructed Wetlands	0.53	0.51	0.88
Bioretention Areas	0.46	0.61	0.10
Detention Basins	0.40	0.51	0.93

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)	$10.00
Streambank Fencing (per mile)	$10,560.00
Streambank Stabilization (per foot)	$50.00
Vegetated Buffer Strip (per mile)	$9,900.00
Terraces and Diversions (per acre)	$500.00
Nutrient Management (per acre)	$500.00
Ag to Wetland Conversion (per acre)	$13,000.00
Unpaved Roads (per foot)	$7.00
Ag to Forest Conversion (per acre)	$6,000.00
Urban Cost Editor	
Constructed Wetlands (per acre)	$42,000.00
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	14438000	73426	9925
Hay/Pasture	692000	12564	1092
High Density Urban	6000	83	9
Low Density Urban	38000	27	4
Unpaved Roads	34000	150	22
Other	9006000	33928	5376
STREAMBANK EROSION	2042000	102	44
GROUNDWATER/SUBSURFACE		181577	1963
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		309	109
TOTALS	**26256000**	**302166**	**18544**
	Future (lbs)		
LAND EROSION/RUNOFF	**Total Sed (lbs)**	**Total N (lbs)**	**Total P (lbs)**
Row Crops	8040719	37479	5936
Hay/Pasture	666396	12227	1066
High Density Urban	3619	47	6
Low Density Urban	22694	15	3
Unpaved Roads	31346	150	22
Other	9006000	33928	5376
STREAMBANK EROSION	976299	55	21
GROUNDWATER/SUBSURFACE		181240	1953
POINT SOURCE DISCHARGE		0	0
SEPTIC SYSTEMS		309	109
TOTALS	**18747072**	**265449**	**14492**
PERCENT REDUCTIONS	28.7	12.2	22.0
TOTAL SCENARIO COST	$12,728,849.85		
Ag BMP Cost (%)	10.1		
WW Upgrade Cost (%)	0.0		
Urban BMP Cost (%)	0.4		
Stream Protection Cost (%)	89.4		
Unpaved Road Protection Cost (%)	.2		