FINAL

HARMON CREEK WATERSHED TMDL
Washington County

For Acid Mine Drainage Affected Segments

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Pennsylvania Department of Environmental Protection

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Introduction

This report presents the Total Maximum Daily Loads (TMDLs) developed for segments in the Harmon Creek Watershed (Attachments A). These were done to address the impairments noted on the 1996 Pennsylvania Section 303(d) list of impaired waters, required under the Clean Water Act, and covers one segment on this list (shown in Table 1). High levels of metals and suspended solids caused these impairments. All impairments resulted from acid drainage from abandoned coalmines. The TMDL addresses the three primary metals associated with acid mine drainage (iron, manganese, aluminum).

Table 1. 303(d) Sub-List								
State Water Plan (SWP) Subbasin: 20-D Raccoon Creek								
Year	**Miles**	**Segment ID**	**DEP Stream Code**	**Stream Name**	**Designated Use**	**Data Source**	**Source**	**EPA 305(b) Cause Code**
1996	5	4504	33112	Harmon Creek	WWF	305(b) Report	RE	Metals & Suspended Solids
1998	5.84	4504	33112	Harmon Creek	WWF	SWMP	AMD	Metals & Suspended Solids
2002	5.9	4504	33112	Harmon Creek	WWF	SWMP	AMD	Metals & Suspended Solids
2004	4.3	4504	33112	Harmon Creek	WWF	SWMP	AMD	Metals & Suspended Solids
2004	1.6	4504b	33145	Harmon Creek Unt 33145	WWF	SWMP	AMD	Metals & Suspended Solids

Resource Extraction=RE
Warm Water Fishes = WWF
Surface Water Monitoring Program = SWMP
Abandoned Mine Drainage = AMD

See Attachment D, *Excerpts Justifying Changes Between the 1996, 1998, 2002 and 2004 Section 303(d) Lists.*

[1] Pennsylvania's 1996, 1998, and 2002 Section 303(d) lists were approved by the Environmental Protection Agency (EPA). The 1996 Section 303(d) list provides the basis for measuring progress under the 1997 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

The use designations for the stream segments in this TMDL can be found in PA Title 25 Chapter 93.

Directions to Harmon Creek Watershed

The Harmon Creek Watershed is located in southwestern Pennsylvania approximately 20 miles west of Pittsburgh, occupying the northwestern portion of Washington County. Harmon Creek enters the Ohio River in the town of Weirton, Ohio. The watershed area is found on portions of the United States Geological Survey maps covering Burgettstown, Avella, Weirton, and Steubensville East 7.5-Minute Quadrangles. This report focuses on the AMD impaired segment of Harmon Creek, which begins at Ward Run and extends to the headwaters. Harmon Creek downstream of Ward Run has been found to be attaining its uses. Although there are many abandoned surface mine features in the basin, vegetation in the form of forest, meadows and wetlands cover virtually all areas. Aquatic life and terrestrial wildlife is diverse and abundant in the watershed.

The Harmon Creek basin can be accessed by traveling west from Pittsburgh on U.S. Route 279 to U.S. Route 22. Take U.S. Route 22 west to its intersection with State Highway 18. The Harmon Creek Watershed lies to the southwest of this intersection.

Geology

The Harmon Creek Watershed lies within the Pittsburgh low plateau section of the Allegheny Plateau Physiographic Province. The area of the watershed within Pennsylvania consists of approximately 20 square miles. Topography consists of gently rolling hills with maximum relief generally less than 500 feet. Elevations within the watershed range from approximately 900 feet MSL to 1,400 feet MSL. Surface geology is composed of sandstones and shale and at least one major coal seam and it's associated underclay. The strata are upper Pennsylvanian in age (approximately 300 million years old) and are contained within the Upper Conemaugh and Monongahela series. The major coal seam is the Pittsburgh coal. The dominant local structural feature is the Aunt Clara Dome. The center of the dome is located just to the northeast of the watershed. Strata in the watershed dip gently to the southeast on the order of 4 percent.

Segments addressed in this TMDL

There are no active mining operations in the watershed. All of the discharges in the watershed are from abandoned mines and will be treated as non-point sources. Each segment on the PA Section 303(d) list will be addressed as a separate TMDL. These TMDLs will be expressed as long-term, average loadings. Due to the nature and complexity of mining effects on the watershed, expressing the TMDL as a long-term average gives a better representation of the data used for the calculations. See Attachment C for TMDL calculations.

Clean Water Act Requirements

Section 303(d) of the 1972 Clean Water Act requires states, territories, and authorized tribes to establish water quality standards. The water quality standards identify the uses for each waterbody and the scientific criteria needed to support that use. Uses can include designations for drinking water supply, contact recreation (swimming), and aquatic life support. Minimum goals set by the Clean Water Act require that all waters be “fishable” and “swimmable.”

Additionally, the federal Clean Water Act and the Environmental Protection Agency’s (EPA) implementing regulations (40 CFR Part 130) require:

- States to develop lists of impaired waters for which current pollution controls are not stringent enough to meet water quality standards (the list is used to determine which streams need TMDLs);

- States to establish priority rankings for waters on the lists based on severity of pollution and the designated use of the waterbody; states must also identify those waters for which TMDLs will be developed and a schedule for development;

- States to submit the list of waters to EPA every two years (April 1 of the even numbered years);

- States to develop TMDLs, specifying a pollutant budget that meets state water quality standards and allocate pollutant loads among pollution sources in a watershed, e.g., point and nonpoint sources; and

- EPA to approve or disapprove state lists and TMDLs within 30 days of final submission.

Despite these requirements, states, territories, authorized tribes, and EPA had not developed many TMDLs. Beginning in 1986, organizations in many states filed lawsuits against the EPA for failing to meet the TMDL requirements contained in the federal Clean Water Act and its implementing regulations. While EPA has entered into consent agreements with the plaintiffs in several states, other lawsuits still are pending across the country.

In the cases that have been settled to date, the consent agreements require EPA to backstop TMDL development, track TMDL development, review state monitoring programs, and fund studies on issues of concern (e.g., AMD, implementation of nonpoint source Best Management Practices (BMPs), etc.).

These TMDLs were developed in partial fulfillment of the 1997 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

Section 303(d) Listing Process

Prior to developing TMDLs for specific waterbodies, there must be sufficient data available to assess which streams are impaired and should be on the Section 303(d) list. With guidance from the EPA, the states have developed methods for assessing the waters within their respective jurisdictions.

The primary method adopted by the Pennsylvania Department of Environmental Protection (DEP) for evaluating waters changed between the publication of the 1996 and 1998 Section 303(d) lists. Prior to 1998, data used to list streams were in a variety of formats, collected under differing protocols. Information also was gathered through the Section 305(b)[2] reporting process. DEP is now using the Statewide Surface Waters Assessment Protocol (SSWAP), a modification of the EPA's 1989 Rapid Bioassessment Protocol II (RBP-II), as the primary mechanism to assess Pennsylvania's waters. The SSWAP provides a more consistent approach to assessing Pennsylvania's streams.

The assessment method requires selecting representative stream segments based on factors such as surrounding land uses, stream characteristics, surface geology, and point source discharge locations. The biologist selects as many sites as necessary to establish an accurate assessment for a stream segment; the length of the assessed stream segment can vary between sites. All the biological surveys included kick-screen sampling of benthic macroinvertebrates and habitat evaluations. Benthic macroinvertebrates are identified to the family level in the field.

After the survey is completed, the biologist determines the status of the stream segment. The decision is based on habitat scores and a series of narrative biological statements used to evaluate the benthic macroinvertebrate community. If the stream is determined to be impaired, the source and cause of the impairment is documented. An impaired stream must be listed on the state's Section 303(d) list with the source and cause. A TMDL must be developed for the stream segment and each pollutant. In order for the process to be more effective, adjoining stream segments with the same source and cause listing are addressed collectively, and on a watershed basis.

Basic Steps for Determining a TMDL

Although all watersheds must be handled on a case-by-case basis when developing TMDLs, there are basic processes or steps that apply to all cases. They include:

1. Collection and summarization of pre-existing data (watershed characterization, inventory contaminant sources, determination of pollutant loads, etc.);
2. Calculating TMDL for the waterbody using EPA approved methods and computer models;
3. Allocating pollutant loads to various sources;
4. Determining critical and seasonal conditions;
5. Public review and comment period on draft TMDL;
6. Submittal of final TMDL; and
7. EPA approval of the TMDL.

Watershed History

Early settlers arrived in the Harmon Creek area around 1780. They were mainly of English decent and came from the south and east following Braddock's Road. The gentler slopes in the

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[2] Section 305(b) of the Clean Water Act requires a biannual description of the water quality of the waters of the state.

watershed were cleared of forest and used for farming. Other areas remained forested. The area is rural and very sparsely populated.

Sometime around 1900 it was noted that the watershed contained significant areas underlain by the Pittsburgh coal seam. The Pittsburgh coal lies above the general drainage. Underground mining of the Pittsburgh coal continued in the basin from the early 1900's to around 1960. The Pittsburgh coal was also surface and auger mined during the middle of the 20th century. Surface mining included "daylighting" of the abandoned Pittsburgh coal deep mines to recover remnant coal and mining of untouched coal reserves. The last surface mining permit issued in the watershed was in 1976. There has been no mining of any type for several years.

Currently, the largest commercial interest in the watershed is two popular music concert venues, which attract musical performers of national recognition. The other major land use in the basin is a significant portion of State Gamelands #117. The remainder of the watershed is mostly wildlife habitat and lesser amounts of farmland.

AMD Methodology

A two-step approach is used for the TMDL analysis of AMD impaired stream segments. The first step uses a statistical method for determining the allowable instream concentration at the point of interest necessary to meet water quality standards. This is done at each point of interest (sample point) in the watershed. The second step is a mass balance of the loads as they pass through the watershed. Loads at these points will be computed based on average annual flow.

The statistical analysis described below can be applied to situations where all of the pollutant loading is from non-point sources as well as those where there are both point and non-point sources. The following defines what are considered point sources and non-point sources for the purposes of our evaluation; point sources are defined as permitted discharges or a discharge that has a responsible party, non-point sources are then any pollution sources that are not point sources. For situations where all of the impact is due to nonpoint sources, the equations shown below are applied using data for a point in the stream. The load allocation made at that point will be for all of the watershed area that is above that point. For situations where there are point-source impacts alone, or in combination with nonpoint sources, the evaluation will use the point-source data and perform a mass balance with the receiving water to determine the impact of the point source.

Allowable loads are determined for each point of interest using Monte Carlo simulation. Monte Carlo simulation is an analytical method meant to imitate real-life systems, especially when other analyses are too mathematically complex or too difficult to reproduce. Monte Carlo simulation calculates multiple scenarios of a model by repeatedly sampling values from the probability distribution of the uncertain variables and using those values to populate a larger data set. Allocations were applied uniformly for the watershed area specified for each allocation point. For each source and pollutant, it was assumed that the observed data were log-normally distributed. Each pollutant source was evaluated separately using @Risk[3] by performing 5,000

[3] @Risk – Risk Analysis and Simulation Add-in for Microsoft Excel, Palisade Corporation, Newfield, NY, 1990-1997.

iterations to determine the required percent reduction so that the water quality criteria, as defined in the *Pennsylvania Code. Title 25 Environmental Protection, Department of Environmental Protection, Chapter 93, Water Quality Standards*, will be met instream at least 99 percent of the time. For each iteration, the required percent reduction is:

PR = maximum {0, (1-Cc/Cd)} where (1)

PR = required percent reduction for the current iteration

Cc = criterion in mg/l

Cd = randomly generated pollutant source concentration in mg/l based on the observed data

Cd = RiskLognorm(Mean, Standard Deviation) where (1a)

Mean = average observed concentration

Standard Deviation = standard deviation of observed data

The overall percent reduction required is the 99th percentile value of the probability distribution generated by the 5,000 iterations, so that the allowable long-term average (LTA) concentration is:

LTA = Mean * (1 – PR99) where (2)

LTA = allowable LTA source concentration in mg/l

Once the allowable concentration and load for each pollutant is determined, mass-balance accounting is performed starting at the top of the watershed and working down in sequence. This mass-balance or load tracking is explained below.

Load tracking through the watershed utilizes the change in measured loads from sample location to sample location, as well as the allowable load that was determined at each point using the @Risk program.

There are two basic rules that are applied in load tracking; rule one is that if the sum of the measured loads that directly affect the downstream sample point is less than the measured load at the downstream sample point it is indicative that there is an increase in load between the points being evaluated, and this amount (the difference between the sum of the upstream and downstream loads) shall be added to the allowable load(s) coming from the upstream points to give a total load that is coming into the downstream point from all sources. The second rule is that if the sum of the measured loads from the upstream points is greater than the measured load at the downstream point this is indicative that there is a loss of instream load between the evaluation points, and the ratio of the decrease shall be applied to the load that is being tracked (allowable load(s)) from the upstream point.

Tracking loads through the watershed gives the best picture of how the pollutants are affecting the watershed based on the information that is available. The analysis is done to insure that water quality standards will be met at all points in the stream. The TMDL must be designed to meet standards at all points in the stream, and in completing the analysis, reductions that must be made to upstream points are considered to be accomplished when evaluating points that are lower in the watershed. Another key point is that the loads are being computed based on average annual flow and should not be taken out of the context for which they are intended, which is to depict how the pollutants affect the watershed and where the sources and sinks are located spatially in the watershed.

For pH TMDLs, acidity is compared to alkalinity as described in Attachment B. Each sample point used in the analysis of pH by this method must have measurements for total alkalinity and total acidity. Net alkalinity is alkalinity minus acidity, both in units of milligrams per liter (mg/**l**) $CaCO_3$. Statistical procedures are applied, using the average value for total alkalinity at that point as the target to specify a reduction in the acid concentration. By maintaining a net alkaline stream, the pH value will be in the range between six and eight. This method negates the need to specifically compute the pH value, which for streams affected by low pH from AMD may not a true reflection of acidity. This method assures that Pennsylvania's standard for pH is met when the acid concentration reduction is met.

Information for the TMDL analysis performed using the methodology described above is contained in the "TMDLs by Segment" section of this report.

TMDL Endpoints

One of the major components of a TMDL is the establishment of an instream numeric endpoint, which is used to evaluate the attainment of applicable water quality. An instream numeric endpoint, therefore, represents the water quality goal that is to be achieved by implementing the load reductions specified in the TMDL. The endpoint allows for a comparison between observed instream conditions and conditions that are expected to restore designated uses. The endpoint is based on either the narrative or numeric criteria available in water quality standards.

Because most of the pollution sources in the watershed are nonpoint sources, the larges part of the TMDL is expressed as Load Allocations (LAs). All allocations will be specified as long-term average daily concentrations. These long-term average concentrations are expected to meet water-quality criteria 99% of the time as required in PA Title 25 Chapter 96.3(c). The following table shows the applicable water-quality criteria for the selected parameters.

Table 2. Applicable Water Quality Criteria

Parameter	*Criterion Value (mg/l)*	*Total Recoverable/Dissolved*
Aluminum (Al)	0.75	Total Recoverable
Iron (Fe)	1.50	30 day average; Total Recoverable
Manganese (Mn)	1.00	Total Recoverable

pH *	6.0-9.0	N/A

*The pH values shown will be used when applicable. In the case of freestone streams with little or no buffering capacity, the TMDL endpoint for pH will be the natural background water quality.

TMDL Elements (WLA, LA, MOS)

$$TMDL = WLA + LA + MOS$$

A TMDL equation consists of a waste load allocation (WLA), load allocation (LA), and a margin of safety (MOS). The WLA is the portion of the load assigned to point sources. The LA is the portion of the load assigned to non-point sources. The MOS is applied to account for uncertainties in the computational process. The MOS may be expressed implicitly (documenting conservative processes in the computations) or explicitly (setting aside a portion of the allowable load). The TMDL allocations in this report are based on available data. Other allocation schemes could also meet the TMDL.

Allocation Summary

These TMDLs will focus remediation efforts on the identified numerical reduction targets for each watershed. The reduction schemes in Table 3 for each segment are based on the assumption that all upstream allocations are achieved and take into account all upstream reductions. Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. As changes occur in the watershed, the TMDLs may be re-evaluated to reflect current conditions. An implicit MOS based on conservative assumptions in the analysis is included in the TMDL calculations.

The allowable LTA concentration in each segment is calculated using Monte Carlo Simulation as described previously. The allowable load is then determined by multiplying the allowable concentration by the flow and a conversion factor at each sample point. The allowable load is the TMDL.

Each permitted discharge in a segment is assigned a waste load allocation and the total waste load allocation for each segment is included in this table. There are currently no permitted discharges in the watershed and therefore all waste load allocations are equal to zero. The difference between the TMDL and the WLA at each point is the load allocation (LA) at the point. The LA at each point includes all loads entering the segment, including those from upstream allocation points. The percent reduction is calculated to show the amount of load that needs to be reduced within a segment in order for water quality standards to be met at the point.

In some instances, instream processes, such as settling, are taking place within a stream segment. These processes are evidenced by a decrease in measured loading between consecutive sample points. It is appropriate to account for these losses when tracking upstream loading through a segment. The calculated upstream load lost within a segment is proportional to the difference in the measured loading between the sampling points.

Table 3. TMDL Component Summary for the Harmon Creek Watershed

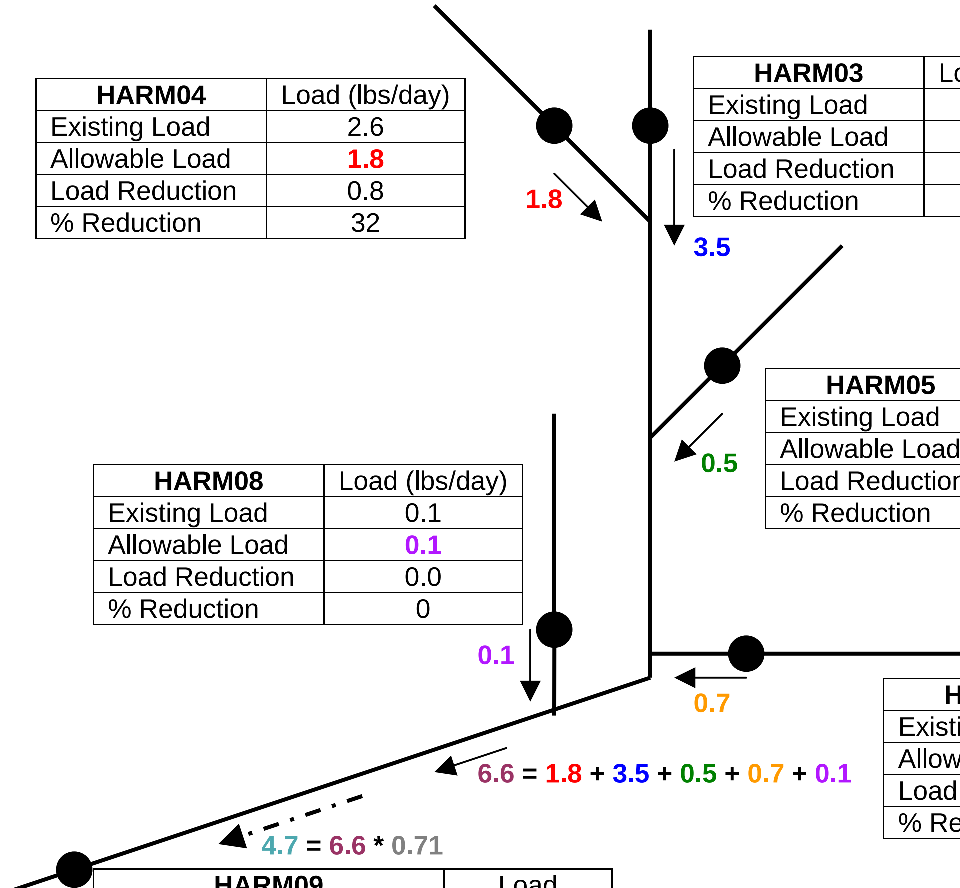
Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
HARM01	*Mouth of Unnamed Tributary 33145*						
	Fe	1.2	1.2	NA	NA	0.0	0
	Mn	1.0	1.0	NA	NA	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	0.0	0.0	NA	NA	0.0	0
HARM02	*Harmon Creek, upstream of Tributary 33145*						
	Fe	1.7	1.7	NA	NA	0.0	0
	Mn	2.5	2.5	NA	NA	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	0.0	0.0	NA	NA	0.0	0
HARM03	*Harmon Creek, upstream of Tributary 33144*						
	Fe	3.6	3.6	NA	NA	0.0	0
	Mn	3.5	3.5	NA	NA	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	0.0	0.0	NA	NA	0.0	0
HARM04	*Mouth of Unnamed Tributary 33144*						
	Fe	1.1	1.1	NA	NA	0.0	0
	Mn	2.6	1.8	0.0	1.8	0.8	32
	Al	ND	NA	NA	NA	0.0	0
	Acidity	0.0	0.0	NA	NA	0.0	0
HARM05	*Mouth of Unnamed Tributary 33143*						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	0.5	0.5	NA	NA	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	0.0	0.0	NA	NA	0.0	0
HARM07	*Mouth of Unnamed Tributary 33141*						
	Fe	2.8	2.2	0.0	2.2	0.6	21
	Mn	0.7	0.7	NA	NA	0.0	0
	Al	7.4	1.6	0.0	1.6	5.8	79
	Acidity	0.0	0.0	NA	NA	0.0	0
HARM08	*Mouth of Unnamed Tributary 33140*						
	Fe	0.7	0.7	NA	NA	0.0	0
	Mn	0.1	0.1	NA	NA	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	0.0	0.0	NA	NA	0.0	0
HARM09	*Harmon Creek, downstream of Unnamed Tributary 33140*						
	Fe	9.5	9.5	NA	NA	0.0	0
	Mn	5.3	5.3	NA	NA	0.0	0
	Al	12.2	12.2	NA	NA	0.0	0
	Acidity	0.0	0.0	NA	NA	0.0	0

Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
HARM11	*Unnamed Tributary 33136*						
	Fe	6.9	6.9	NA	NA	0.0	0
	Mn	10.1	3.8	0.0	3.8	6.3	62
	Al	ND	NA	NA	NA	0.0	0
	Acidity	0.0	0.0	NA	NA	0.0	0
HARM12	*Mouth of Unnamed Tributary 33137*						
	Fe	1.7	1.7	NA	NA	0.0	0
	Mn	15.5	2.3	0.0	2.3	13.2	85
	Al	12.9	2.3	0.0	2.3	10.6	82
	Acidity	0.0	0.0	NA	NA	0.0	0
HARM13	*Mouth of Unnamed Tributary 33133*						
	Fe	9.5	5.5	0.0	5.5	4.0	42
	Mn	3.9	3.9	NA	NA	0.0	0
	Al	12.2	10.1	0.0	10.1	2.1	17
	Acidity	0.0	0.0	NA	NA	0.0	0
HARM14	*Harmon Creek, upstream of Ward Run*						
	Fe	29.2	29.2	NA	NA	0.0	0
	Mn	12.3	12.3	NA	NA	0.0	0
	Al	28.2	28.2	NA	NA	0.0	0
	Acidity	0.0	0.0	NA	NA	0.0	0
HARM16	*Ward Run*						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	0.7	0.7	NA	NA	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	0.0	0.0	NA	NA	0.0	0
HARM15	*Mouth of Ward Run*						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	0.7	0.7	NA	NA	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	0.0	0.0	NA	NA	0.0	0

ND, not detected. NA, meets WQS. No TMDL necessary.

In the instance that the allowable load is equal to the existing load (e.g. iron point HARM01, Table 3), the simulation determined that water quality standards are being met instream 99% of the time and no TMDL is necessary for the parameter at that point. Although no TMDL is necessary, the loading at the point is considered at the next downstream point. In addition, when all measured values are below the method detection limit, denoted by ND (e.g. aluminum point HARM01, Table 3), no TMDL is necessary. In this case the accounting for upstream loads is not carried through to the next downstream point. Rather, there is a disconnect noted and the allowable load is considered to start over because the water quality standard is satisfied.

Following is an example of how the allocations, presented in Table 3, for a stream segment are calculated. For this example, manganese allocations for HARM09 of Harmon Creek are shown. As demonstrated in the example, all upstream contributing loads are accounted for at each point. Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. Attachment A contains a map of the sampling point locations for reference.



HARM04	Load (lbs/day)
Existing Load	2.6
Allowable Load	1.8
Load Reduction	0.8
% Reduction	32

HARM03	Load (lbs/day)
Existing Load	3.5
Allowable Load	3.5
Load Reduction	0.0
% Reduction	0

HARM05	Load (lbs/day)
Existing Load	0.5
Allowable Load	0.5
Load Reduction	0.0
% Reduction	0

HARM08	Load (lbs/day)
Existing Load	0.1
Allowable Load	0.1
Load Reduction	0.0
% Reduction	0

HARM07	Load (lbs/day)
Existing Load	0.7
Allowable Load	0.7
Load Reduction	0.0
% Reduction	0

HARM09	Load (lbs/day)
Existing Load	5.3
Difference in Existing Load	-2.2
Load tracked	6.6
% Load lost	29
% Load tracked	71
Total Load tracked	4.7
Allowable Load	5.3
Load Reduction	0.0
% Reduction	0

Impairment due to suspended solids

The suspended solids/siltation impairment noted in the Harmon Creek Watershed is due to sediment contributions from abandoned mine land, croplands and transitional lands. An existing sediment load was computed using the GWLF model. This model is being used by the Department to address sedimentation problems in other watersheds throughout the Commonwealth. A reference watershed approach is used to determine the sediment load reduction needed for this watershed. Kings Creek and Aunt Clara Fork Kings Creek watershed was selected for use as the reference watershed. Kings Creek and Aunt Clara Fork Kings Creek watershed does not have a sediment problem, and is an appropriate reference for this purpose. The sediment reduction goal for the TMDL is based on setting the watershed-loading rate of the impaired Harmon Creek equal to the watershed-loading rate in the un-impaired Kings Creek and Aunt Clara Fork Kings Creek. The load reduction for sediment in the Harmon Creek Watershed was assigned to croplands, coalmines and transitional lands.

The TMDL for sediment is 6,404,021 lbs/day, which results in a 24% reduction in croplands, a 24% reduction in coal and a 33% reduction in transitional land loading. A more detailed explanation of sediment calculations is contained in Attachment D.

Recommendations

There is currently no watershed group focused on the Harmon Creek Watershed. It is recommended that agencies work with local interests to form a watershed organization. This watershed organization could then work to implement projects to achieve the reductions recommended in this TMDL document. Data shows that Harmon Creek is not adversely affected by AMD; however, Unnamed Tributaries 33144, 33141, 33136, 33133 and 33137 have slight metals impairments. These impairments could be lessened with passive treatment.

Two primary programs provide maintenance and improvement of water quality in the watershed. DEP's efforts to reclaim abandoned mine lands, coupled with its duties and responsibilities for issuing NPDES permits, will be the focal points in water quality improvement.

Additional opportunities for water quality improvement are both ongoing and anticipated. Historically, a great deal of research into mine drainage has been conducted by DEP's Bureau of Abandoned Mine Reclamation, which administers and oversees the Abandoned Mine Reclamation Program in Pennsylvania; the United States Office of Surface Mining; the National Mine Land Reclamation Center; the National Environmental Training Laboratory; and many other agencies and individuals. Funding from EPA's CWA Section 319(a) Grant program and Pennsylvania's Growing Greener program has been used extensively to remedy mine drainage impacts. These many activities are expected to continue and result in water quality improvement.

The DEP Bureau of Mining and Reclamation administers an environmental regulatory program for all mining activities, mine subsidence regulation, mine subsidence insurance, and coal refuse disposal; conducts a program to ensure safe underground bituminous mining and protect certain structures form subsidence; administers a mining license and permit program; administers a regulatory program for the use, storage, and handling of explosives; provides for training, examination, and certification of applicants for blaster's licenses; administers a loan program for bonding anthracite underground mines and for mine subsidence; and administers the EPA Watershed Assessment Grant Program, the Small Operator's Assistance Program (SOAP), and the Remining Operators Assistance Program (ROAP).

Mine reclamation and well plugging refers to the process of cleaning up environmental pollutants and safety hazards associated with a site and returning the land to a productive condition, similar to DEP's Brownfields program. Since the 1960s, Pennsylvania has been a national leader in establishing laws and regulations to ensure reclamation and plugging occur after active operation is completed.

Pennsylvania is striving for complete reclamation of its abandoned mines and plugging of its orphaned wells. Realizing this task is no small order, DEP has developed concepts to make abandoned mine reclamation easier. These concepts, collectively called Reclaim PA, include legislative, policy land management initiatives designed to enhance mine operator, volunteer land DEP reclamation efforts. Reclaim PA has the following four objectives.

- To encourage private and public participation in abandoned mine reclamation efforts
- To improve reclamation efficiency through better communication between reclamation partners
- To increase reclamation by reducing remining risks
- To maximize reclamation funding by expanding existing sources and exploring new sources.

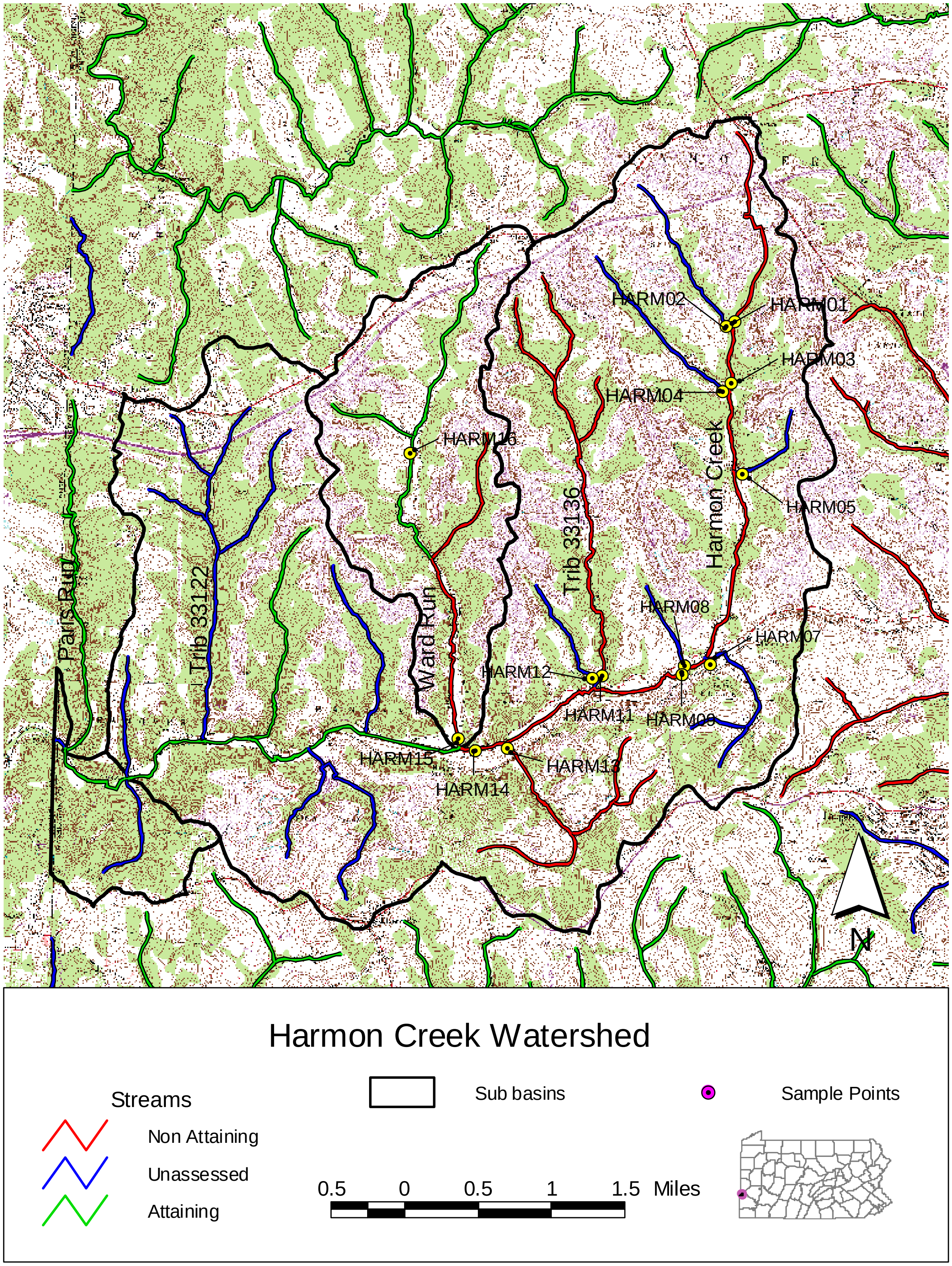
Reclaim PA is DEP's initiative designed to maximize reclamation of the state's quarter million acres of abandoned mineral extraction lands. Abandoned mineral extraction lands in Pennsylvania constituted a significant public liability – more than 250,000 acres of abandoned surface mines, 2,400 miles of streams polluted with mine drainage, over 7,000 orphaned and abandoned oil and gas wells, widespread subsidence problems, numerous hazardous mine openings, mine fires, abandoned structures and affected water supplies – representing as much as one third of the total problem nationally.

Public Participation

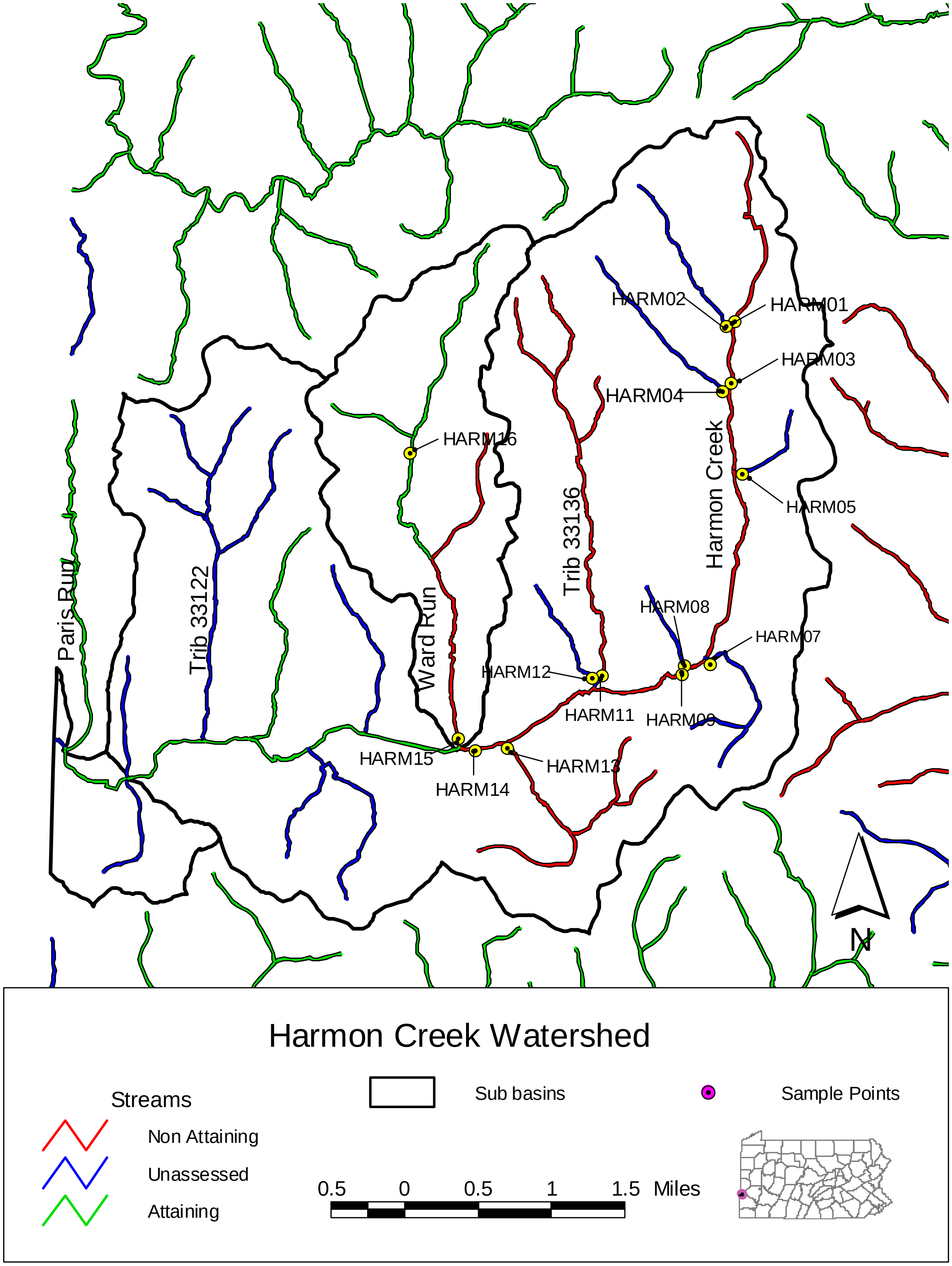
Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on December 4, 2004 and the *Beaver County Times/Allegheny Times* on January 18, 2005 to foster public comment on the allowable loads calculated. The public comment period on this TMDL was open from December 4, 2004 to February 2, 2005. A public meeting was held on January 25, 2005 at the Raccoon Creek State Park Office to discuss the proposed TMDL.

Attachment A

Harmon Creek Watershed Maps



HARM02
HARM01
HARM03
HARM04
HARM16
HARM05
Harmon Creek
Trib 33136
Trib 33122
Paris Run
Ward Run
HARM08
HARM07
HARM12
HARM11
HARM09
HARM15
HARM13
HARM14
N
Harmon Creek Watershed
Streams
Non Attaining
Unassessed
Attaining
Sub basins
Sample Points
0.5
0
0.5
1
1.5
Miles


HARM01
HARM02
HARM03
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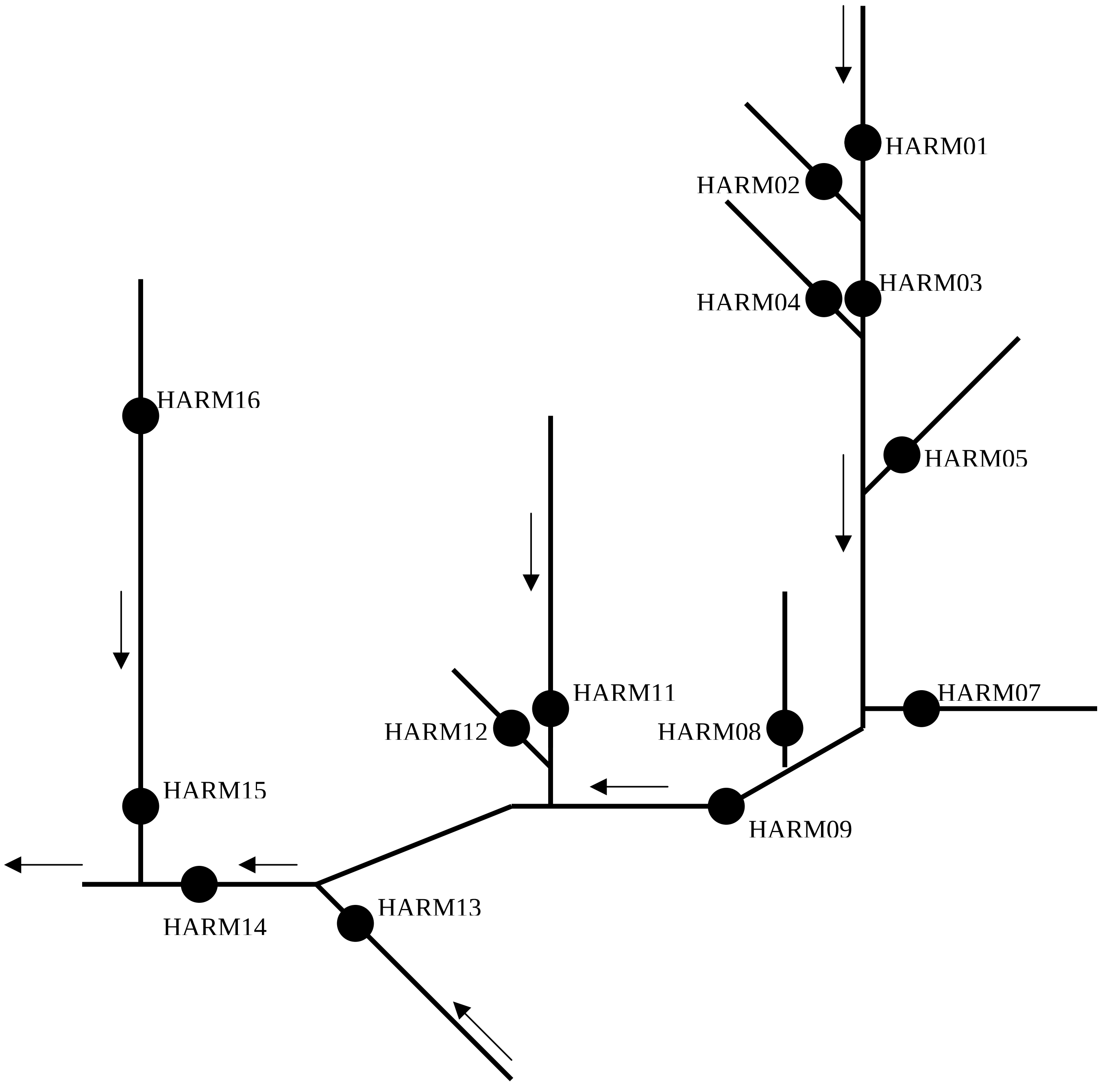
HARM07
HARM08
HARM09
HARM11
HARM12
HARM13
HARM14
HARM15
HARM16
Paris Run
Trib 33122
Ward Run
Trib 33136
Harmon Creek
N
Harmon Creek Watershed
Streams
Non Attaining
Unassessed
Attaining
Sub basins
Sample Points
0.5 0 0.5 1 1.5 Miles

Harmon Creek Sampling Station Diagram
Arrows indicates direction of flow.
Diagram not to scale.



Attachment B

Method for Addressing Section 303(d) Listings for pH

Method for Addressing Section 303(d) Listings for pH

There has been a great deal of research conducted on the relationship between alkalinity, acidity, and pH. Research published by the Department of Environmental Protection demonstrates that by plotting net alkalinity (alkalinity-acidity) vs. pH for 794 mine sample points, the resulting pH value from a sample possessing a net alkalinity of zero is approximately equal to six (Figure 1). Where net alkalinity is positive (greater than or equal to zero), the pH range is most commonly six to eight, which is within the EPA's acceptable range of six to nine and meets Pennsylvania water quality criteria in Chapter 93.

The pH, a measurement of hydrogen ion acidity presented as a negative logarithm, is not conducive to standard statistics. Additionally, pH does not measure latent acidity. For this reason, and based on the above information, Pennsylvania is using the following approach to address the stream impairments noted on the Section 303(d) list due to pH. The concentration of acidity in a stream is at least partially chemically dependent upon metals. For this reason, it is extremely difficult to predict the exact pH values, which would result from treatment of abandoned mine drainage. Therefore, net alkalinity will be used to evaluate pH in these TMDL calculations. This methodology assures that the standard for pH will be met because net alkalinity is a measure of the reduction of acidity. When acidity in a stream is neutralized or is restored to natural levels, pH will be acceptable. Therefore, the measured instream alkalinity at the point of evaluation in the stream will serve as the goal for reducing total acidity at that point. The methodology that is applied for alkalinity (and therefore pH) is the same as that used for other parameters such as iron, aluminum, and manganese that have numeric water quality criteria.

Each sample point used in the analysis of pH by this method must have measurements for total alkalinity and total acidity. Net alkalinity is alkalinity minus acidity, both being in units of milligrams per liter (mg/l) $CaCO_3$. The same statistical procedures that have been described for use in the evaluation of the metals is applied, using the average value for total alkalinity at that point as the target to specify a reduction in the acid concentration. By maintaining a net alkaline stream, the pH value will be in the range between six and eight. This method negates the need to specifically compute the pH value, which for mine waters is not a true reflection of acidity. This method assures that Pennsylvania's standard for pH is met when the acid concentration reduction is met.

There are several documented cases of streams in Pennsylvania having a natural background pH below six. If the natural pH of a stream on the Section 303(d) list can be established from its upper unaffected regions, then the pH standard will be expanded to include this natural range. The acceptable net alkalinity of the stream after treatment/abatement in its polluted segment will be the average net alkalinity established from the stream's upper, pristine reaches added to the acidity of the polluted portion in question. Summarized, if the pH in an unaffected portion of a stream is found to be naturally occurring below six, then the average net alkalinity for that portion (added to the acidity of the polluted portion) of the stream will become the criterion for the polluted portion. This "natural net alkalinity level" will be the criterion to which a 99 percent confidence level will be applied. The pH range will be varied only for streams in which a natural unaffected net alkalinity level can be established. This can only be done for streams that have upper segments that are not impacted by mining activity. All other streams will be required to reduce the acid load so the net alkalinity is greater than zero 99% of time.

Reference: *Rose, Arthur W. and Charles A. Cravotta, III 1998. Geochemistry of Coal Mine Drainage. Chapter 1 in Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania. Pa. Dept. of Environmental Protection, Harrisburg, Pa.*

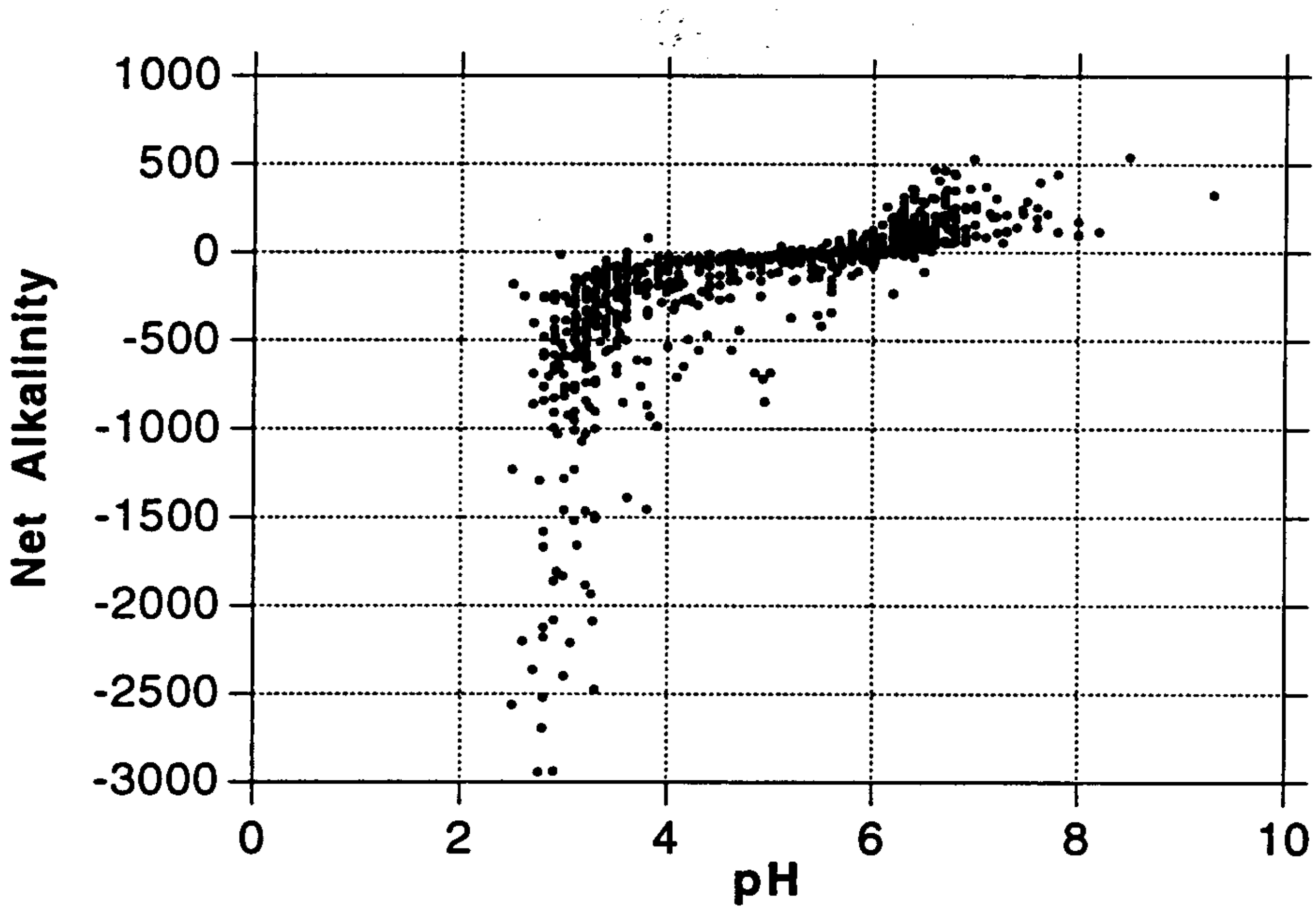


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Attachment C
TMDLs By Segment

Harmon Creek

The TMDL for the Harmon Creek Watershed consists of load allocations of nine tributaries and four sampling sites along the stream.

Harmon Creek is listed as impaired on the Pennsylvania Section 303(d) list by both high metals and suspended solids from AMD as being the cause of the degradation to the stream. For all sampling events pH values fell within the acceptable range and the stream was net alkaline at all points. No TMDLs for pH are necessary for this portion of the watershed. The method and rationale for addressing pH is contained in Attachment B.

An allowable long-term average in-stream concentration was determined at each sample point for aluminum, iron, manganese, and acidity. The analysis is designed to produce an average value that, when met, will be protective of the water-quality criterion for that parameter 99% of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water-quality criteria 99% of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean and standard deviation of the data set, 5000 iterations of sampling were completed, and compared against the water-quality criterion for that parameter. For each sampling event a percent reduction was calculated, if necessary, to meet water-quality criteria. A second simulation that multiplied the percent reduction times the sampled value was run to insure that criteria were met 99% of the time. The mean value from this data set represents the long-term average concentration that needs to be met to achieve water-quality standards.

TMDL Calculations - Sample Point HARM01, mouth of Unnamed Tributary 33145

The TMDL for sample point HARM01 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point HARM01. The average flow (0.36 MGD), measured at point HARM01, is used for these computations.

This segment was included on the 1996, 1998, and 2002 PA Section 303(d) lists for metals and suspended solids impairments from AMD. Sample data at point HARM01 shows pH ranging between 7.8 and 8.2; pH is not addressed as part of this TMDL.

All values for aluminum are below the method detection limit, denoted by ND. Water quality analysis determined that the measured iron and manganese loads are equal to the allowable iron and manganese loads. Because WQS are met, TMDLs for metals are not necessary.

Table C1. TMDL Calculations at Point HARM01

Flow = 0.36 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.41	1.2	0.41	1.2
Mn	0.34	1.0	0.34	1.0
Al	ND	ND	NA	NA
Acidity	0.00	0.0	0.00	0.0
Alkalinity	178.60	535.5		

Table C2. Calculation of Load Reduction Necessary at Point HARM01

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	1.2	1.0	ND	0.0
Allowable Load	1.2	1.0	NA	0.0
Load Reduction	0.0	0.0	0.0	0.0
Total % Reduction	0	0	0	0

TMDL Calculations - Sample Point HARM02, Harmon Creek upstream of Unnamed Tributary 33145

The TMDL for sample point HARM02 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point HARM02. The average flow (0.54 MGD), measured at point HARM02, is used for these computations.

There is currently no entry for this segment on the PA Section 303(d) list for impairments from AMD. Sample data at point HARM02 shows pH ranging between 7.4 and 8.0; pH is not addressed as part of this TMDL.

All values for aluminum are below the method detection limit, denoted by ND. Water quality analysis determined that the measured iron and manganese loads are equal to the allowable iron and manganese loads. Because WQS are met, TMDLs for metals are not necessary.

Table C3. TMDL Calculations at Point HARM02

Flow = 0.54 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.39	1.7	0.39	1.7
Mn	0.57	2.5	0.57	2.5
Al	ND	ND	NA	NA
Acidity	0.00	0.0	0.00	0.0
Alkalinity	109.23	489.3		

Table C4. Calculation of Load Reduction Necessary at Point HARM02

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	1.7	2.5	ND	0.0
Allowable Load	1.7	2.5	NA	0.0
Load Reduction	0.0	0.0	0.0	0.0
Total % Reduction	0	0	0	0

TMDL Calculations - Sampling Point HARM03, Harmon Creek upstream of Unnamed Tributary 33144

The TMDL for sampling point HARM03 consists of a load allocation of the area between sample points HARM01, HARM02, and HARM03. The load allocation for this stream segment was computed using water-quality sample data collected at point HARM03. The average flow (0.87 MGD), measured at the point, is used for theses computations.

This segment was included on the 1996, 1998, and 2002 PA Section 303(d) lists for metals and suspended solids impairments from AMD. Sample data at point HARM03 shows pH ranging between 7.7 and 8.5; pH is not addressed as part of this TMDL.

All values for aluminum are below the method detection limit, denoted by ND. Water quality analysis determined that the measured iron and manganese loads are equal to the allowable iron and manganese loads. Because WQS are met, TMDLs for metals are not necessary.

Table C5. TMDL Calculations at Point HARM03				
Flow = 0.87 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.49	3.6	0.49	3.6
Mn	0.48	3.5	0.48	3.5
Al	ND	ND	NA	NA
Acidity	0.00	0.0	0.00	0.0
Alkalinity	140.37	1,019.6		

The calculated load reductions for all the loads that enter point HARM03 must be accounted for in the calculated reductions. A comparison of measured loads between points HARM01, HARM02, and HARM03 shows that there is additional loading entering the segment for iron. The total segment iron load is the sum of the upstream-allocated loads plus the additional load entering within the segment. There are no necessary reductions at HARM03.

Table C6. Calculation of Load Reduction Necessary at Point HARM03				
	Fe	Mn	Al	Acidity

	(lbs/day)	(lbs/day)	(lbs/day)	(lbs/day)
Existing Load	3.6	3.5	ND	0.0
Difference in Existing Load	0.7	0.0	-	0.0
Load tracked from upstream	2.9	3.5	-	0.0
Total Load tracked between points	3.6	3.5	-	0.0
Allowable Load at HARM03	3.6	3.5	NA	0.0
Additional Reduction at HARM03	0.0	0.0	0.0	0.0
% Reduction required at HARM03	0	0	0	0

TMDL Calculations - Sample Point HARM04, mouth of Unnamed Tributary 33144

The TMDL for sample point HARM04 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point HARM04. The average flow (0.44 MGD), measured at point HARM04, is used for these computations.

There is currently no entry for this tributary on the PA Section 303(d) list for impairments from AMD. Sample data at point HARM04 shows pH ranging between 7.2 and 8.0; pH is not addressed as part of this TMDL.

All values for aluminum are below the method detection limit, denoted by ND. Water quality analysis determined that the measured iron load is equal to the allowable iron load. Because WQS are met, TMDLs for iron and aluminum are not necessary.

Table C7. TMDL Calculations at Point HARM04

Flow = 0.44 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.31	1.1	0.31	1.1
Mn	0.71	2.6	0.49	1.8
Al	ND	ND	NA	NA
Acidity	0.00	0.0	0.00	0.0
Alkalinity	98.97	360.7		

Table C8. Calculation of Load Reduction Necessary at Point HARM04

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	1.1	2.6	ND	0.0
Allowable Load	1.1	1.8	NA	0.0
Load Reduction	0.0	0.8	0.0	0.0
Total % Reduction	0	32	0	0

TMDL Calculations - Sample Point HARM05, mouth of Unnamed Tributary 33143

The TMDL for sample point HARM05 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point HARM05. The average flow (0.33 MGD), measured at point HARM05, is used for these computations.

There is currently no entry for this tributary on the PA Section 303(d) list for impairments from AMD. Sample data at point HARM05 shows pH ranging between 7.2 and 7.8; pH is not addressed as part of this TMDL.

Iron and aluminum values are below the method detection limits, denoted by ND. In addition, the allowable manganese load is equal to the measured load. TMDLs for iron, aluminum, and manganese at point HARM05 are not necessary because WQS are met. The measured manganese load is considered at the next downstream point, HARM09.

Table C9. TMDL Calculations at Point HARM05

Flow = 0.33 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	ND	ND	NA	NA
Mn	0.16	0.5	0.16	0.5
Al	ND	ND	NA	NA
Acidity	0.00	0.0	0.00	0.0
Alkalinity	73.97	203.9		

Table C10. Calculation of Load Reduction Necessary at Point HARM05

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	ND	0.5	ND	0.0
Allowable Load	NA	0.5	NA	0.0
Load Reduction	0.0	0.0	0.0	0.0
Total % Reduction	0	0	0	0

TMDL Calculations - Sampling Point HARM07, mouth of Unnamed Tributary 33141

The TMDL for sample point HARM07 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point HARM07. The average flow (0.33 MGD), measured at point HARM07, is used for these computations.

There is currently no entry for this tributary on the PA Section 303(d) list for impairments from AMD. Sample data at point HARM07 shows pH ranging between 7.8 and 8.1; pH is not addressed as part of this TMDL.

Water quality analysis determined that the measured and allowable manganese loads are equal. Because the WQS is met, a TMDL for manganese is not necessary. The measured manganese load is considered at the next downstream point, HARM09.

Table 11. TMDL Calculations at Point HARM07				
Flow = 0.33 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	1.00	2.8	0.79	2.2
Mn	0.27	0.7	0.27	0.7
Al	2.66	7.4	0.56	1.6
Acidity	0.00	0.0	0.00	0.0
Alkalinity	245.60	684.8		

Table C12. Calculation of Load Reduction Necessary at Point HARM07				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	2.8	0.7	7.4	0.0
Allowable Load	2.2	0.7	1.6	0.0
Load Reduction	0.6	0.0	5.8	0.0
Total % Reduction	21	0	79	0

TMDL Calculations - Sample Point HARM08, mouth of Unnamed Tributary 33140

The TMDL for sample point HARM08 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point HARM08. The average flow (0.25 MGD), measured at point HARM08, is used for these computations.

There is currently no entry for this tributary on the PA Section 303(d) list for impairments from AMD. Sample data at point HARM08 shows pH ranging between 7.0 and 8.2; pH is not addressed as part of this TMDL.

Aluminum values are below the method detection limits, denoted by ND. In addition, the measured iron and manganese load are equal to the allowable iron and manganese loads. TMDLs for iron, aluminum, and manganese at point HARM08 are not necessary because WQS are met. The measured iron and manganese loads are considered at the next downstream point, HARM09.

Table 13. TMDL Calculations at Point HARM08				
Flow = 0.25 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.32	0.7	0.32	0.7
Mn	0.07	0.1	0.07	0.1
Al	ND	ND	NA	NA
Acidity	0.00	0.0	0.00	0.0
Alkalinity	196.13	408.7		

Table C14. Calculation of Load Reduction Necessary at Point HARM08				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	0.7	0.1	ND	0.0
Allowable Load	0.7	0.1	NA	0.0
Load Reduction	0.0	0.0	0.0	0.0
Total % Reduction	0	0	0	0

TMDL Calculations - Sampling Point HARM09, Harmon Creek downstream of Unnamed Tributary 33140

The TMDL for sampling point HARM09 consists of a load allocation of the area between sample points HARM03, HARM04, HARM05, HARM07, HARM08, and HARM09. The load allocation for this stream segment was computed using water-quality sample data collected at point HARM09. The average flow (2.86 MGD), measured at the point, is used for theses computations.

This segment was included on the 1996, 1998, and 2002 PA Section 303(d) lists for metals and suspended solids impairments from AMD. Sample data at point HARM09 shows pH ranging between 8.0 and 8.1; pH is not addressed as part of this TMDL.

Water quality analysis determined that the measured metals loads are equal to the allowable metals loads. Because WQS are met, no TMDLs for metals are necessary.

Table C15. TMDL Calculations at Point HARM09				
Flow = 2.86 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.40	9.5	0.40	9.5
Mn	0.22	5.3	0.22	5.3
Al	0.51	12.2	0.51	12.2
Acidity	0.00	0.0	0.00	0.0
Alkalinity	162.00	3,865.4		

The calculated load reductions for all the loads that enter point HARM09 must be accounted for in the calculated reductions. A comparison of measured loads between points HARM03, HARM04, HARM05, HARM07, HARM08 and HARM09 shows that there is additional loading entering the segment for iron and aluminum and a loss of manganese load. For the iron and aluminum, the total segment load is the sum of the upstream loads and the additional load entering the segment. For the loss of manganese load, the percent of load lost within the segment is calculated and applied to the upstream loads to determine the amount of the upstream load that is tracked through the segment.

Table C16. Calculation of Load Reduction Necessary at Point HARM09				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	9.5	5.3	12.2	0.0
Difference in Existing Loads	1.4	-2.2	4.7	0.0
Load tracked from upstream	7.6	6.6	1.6	0.0
% Load lost	-	29	-	-
% Load tracked	-	71	-	-
Total Load tracked between points	9.0	4.7	6.3	0.0
Allowable Load at HARM09	9.5	5.3	12.2	0.0
Load Reduction at HARM09	0.0	0.0	0.0	0.0
% Reduction required at HARM09	0	0	0	0

TMDL Calculations - Sample Point HARM11, mouth of Unnamed Tributary 33136

The TMDL for sample point HARM11 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point HARM11. The average flow (1.58 MGD), measured at point HARM11, is used for these computations.

There is currently no entry for this segment on the PA Section 303(d) list for impairments from AMD. Sample data at point HARM11 shows pH ranging between 6.8 and 8.0; pH is not addressed as part of this TMDL.

Aluminum values are below the method detection limit, denoted by ND. In addition, the measured iron load is equal to the allowable iron load. TMDLs for iron and aluminum at point HARM11 are not necessary because WQS are met. The measured iron load is considered at the next downstream point, HARM14.

Table 17. TMDL Calculations at Point HARM11				
Flow = 1.58 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.53	6.9	0.53	6.9
Mn	0.77	10.1	0.29	3.8
Al	ND	ND	NA	NA
Acidity	0.00	0.0	0.00	0.0
Alkalinity	77.43	1,018.1		

Table C18. Calculation of Load Reduction Necessary at Point HARM11				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	6.9	10.1	ND	0.0
Allowable Load	6.9	3.8	NA	0.0
Load Reduction	0.0	6.3	0.0	0.0
Total % Reduction	0	62	0	0

TMDL Calculations - Sample Point HARM12, mouth of Unnamed Tributary 33137

The TMDL for sample point HARM12 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point HARM12. The average flow (0.60 MGD), measured at point HARM12, is used for these computations.

There is currently no entry for this segment on the PA Section 303(d) list for impairments from AMD. Sample data at point HARM12 shows pH ranging between 7.2 and 7.9; pH is not addressed as part of this TMDL.

The measured iron load is equal to the allowable iron load. A TMDL for iron at point HARM12 is not necessary because the WQS is met. The measured iron load is considered at the next downstream point, HARM14.

Table 19. TMDL Calculations at Point HARM12

Flow = 0.60 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.34	1.7	0.34	1.7
Mn	3.10	15.5	0.47	2.3
Al	2.58	12.9	0.46	2.3
Acidity	0.00	0.0	0.00	0.0
Alkalinity	60.37	301.3		

Table C20. Calculation of Load Reduction Necessary at Point HARM12

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	1.7	15.5	12.9	0.0
Allowable Load	1.7	2.3	2.3	0.0
Load Reduction	0.0	13.2	10.6	0.0
Total % Reduction	0	85	82	0

TMDL Calculations - Sample Point HARM13, mouth of Unnamed Tributary 33133

The TMDL for sample point HARM13 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point HARM13. The average flow (1.63 MGD), measured at point HARM13, is used for these computations.

There is currently no entry for this segment on the PA Section 303(d) list for impairments from AMD. Sample data at point HARM13 shows pH ranging between 8.0 and 8.2; pH is not addressed as part of this TMDL.

The measured manganese load is equal to the allowable manganese load. A TMDL for manganese at point HARM13 is not necessary because the WQS is met. The measured manganese load is considered at the next downstream point, HARM14.

Table 21. TMDL Calculations at Point HARM13				
Flow = 1.63 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.70	9.5	0.41	5.5
Mn	0.29	3.9	0.29	3.9
Al	0.90	12.2	0.75	10.1
Acidity	0.00	0.0	0.00	0.0
Alkalinity	163.50	2,222.4		

Table C22. Calculation of Load Reduction Necessary at Point HARM13				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	9.5	3.9	12.2	0.0
Allowable Load	5.5	3.9	10.1	0.0
Load Reduction	4.0	0.0	2.1	0.0
Total % Reduction	42	0	17	0

TMDL Calculations - Sampling Point HARM14, Harmon Creek upstream of Ward Run

The TMDL for sampling point HARM14 consists of a load allocation of the area between sample points HARM09, HARM11, HARM12, HARM13, and HARM14. The load allocation for this stream segment was computed using water-quality sample data collected at point HARM14. The average flow (6.74 MGD), measured at the point, is used for theses computations.

This segment was included on the 1996, 1998, and 2002 PA Section 303(d) lists for metals and suspended solids impairments from AMD. Sample data at point HARM14 shows pH ranging between 7.8 and 8.1; pH is not addressed as part of this TMDL.

Water quality analysis determined the measured metals loads are equal to the allowable metals loads. TMDLs for metals are not necessary at HARM14 because WQS are met.

Table C23. TMDL Calculations at Point HARM14				
Flow = 6.74 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.52	29.2	0.52	29.2
Mn	0.22	12.3	0.22	12.3
Al	0.50	28.2	0.50	28.2
Acidity	0.00	0.0	0.00	0.0
Alkalinity	138.07	7,758.4		

The calculated load reductions for all the loads that enter point HARM14 must be accounted for in the calculated reductions. A comparison of existing loads between points HARM09, HARM11, HARM12, HARM13 and HARM14 shows that there is additional loading entering the segment for iron and a loss of manganese and aluminum loading. The total segment iron load is the sum of the upstream loads and any additional loading within the segment. For loss of manganese and aluminum load, the percent load lost within the segment is applied to the upstream loads to determine the amount of load tracked through the segment.

Table C24. Calculation of Load Reduction Necessary at Point HARM14				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	29.2	12.3	28.2	0.0
Difference in Existing Loads	1.5	-22.4	-9.1	0.0
Load tracked from upstream	23.1	14.7	18.8	0.0
% Load lost	-	64	24	-
% Load tracked	-	36	76	-
Total Load tracked between points	24.6	5.2	14.2	0.0
Allowable Load at HARM14	29.2	12.3	28.2	0.0
Load Reduction at HARM14	0.0	0.0	0.0	0.0
% Reduction required at HARM14	0	0	0	0

TMDL Calculations - Sample Point HARM16, Ward Run

The TMDL for sample point HARM16 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point HARM16. The average flow (0.68 MGD), measured at point HARM16, is used for these computations.

There is currently no entry for this tributary on the PA Section 303(d) list for impairments from AMD. Sample data at point HARM16 shows pH ranging between 7.3 and 7.6; pH is not addressed as part of this TMDL.

Iron and aluminum concentrations are below the detection limits, denoted by ND. The measured manganese load is equal to the allowable manganese load. TMDLs for metals at point HARM16 are not necessary because WQS are met. The measured manganese load is considered at the next downstream point, HARM15.

Table 25. TMDL Calculations at Point HARM16				
Flow = 0.68 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	ND	ND	NA	NA
Mn	0.12	0.7	0.12	0.7
Al	ND	ND	NA	NA
Acidity	0.00	0.0	0.00	0.0
Alkalinity	55.40	312.2		

Table C26. Calculation of Load Reduction Necessary at Point HARM16				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)

Existing Load	ND	0.7	ND	0.0
Allowable Load	NA	0.7	NA	0.0
Load Reduction	0.0	0.0	0.0	0.0
Total % Reduction	0	0	0	0

TMDL Calculations - Sampling Point HARM15, mouth of Ward Run

The TMDL for sampling point HARM15 consists of a load allocation of the area between sample points HARM15 and HARM16. The load allocation for this stream segment was computed using water-quality sample data collected at point HARM15. The average flow (0.75 MGD), measured at the point, is used for theses computations.

This segment is not included on the PA Section 303(d) lists for impairments from AMD. Sample data at point HARM15 shows pH ranging between 7.3 and 7.8; pH is not addressed as part of this TMDL.

Iron and aluminum concentrations are below the detection limits, denoted by ND. The measured manganese load is equal to the allowable manganese load. TMDLs for metals at point HARM15 are not necessary because WQS are met.

Table C27. TMDL Calculations at Point HARM15				
Flow = 0.75 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	ND	ND	NA	NA
Mn	0.12	0.7	0.12	0.7
Al	ND	ND	NA	NA
Acidity	0.00	0.0	0.00	0.0
Alkalinity	59.96	374.9		

The calculated load reductions for all the loads that enter point HARM15 must be accounted for in the calculated reductions. A comparison of existing loads between points HARM15 and HARM16 shows that there is no additional loading entering the segment for iron, aluminum, or manganese.

Table C28. Calculation of Load Reduction Necessary at Point HARM15				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	ND	0.7	ND	0.0
Difference in Existing Loads	-	0.0	-	0.0
Load tracked from HARM16	-	0.7	-	0.0
Total Load tracked between points	-	0.7	-	0.0
Allowable Load at HARM15	NA	0.7	NA	0.0
Additional Reduction at HARM15	0.0	0.0	0.0	0.0
% Reduction required at HARM15	0	0	0	0

Margin of Safety

For this study the margin of safety is applied implicitly. A MOS is implicit because the allowable concentrations and loadings were simulated using Monte Carlo techniques and employing the @Risk software. Other margins of safety used for this TMDL analysis include the following:

- Effluent variability plays a major role in determining the average value that will meet water-quality criteria over the long-term. The value that provides this variability in our analysis is the standard deviation of the dataset. The simulation results are based on this variability and the existing stream conditions (an uncontrolled system). The general assumption can be made that a controlled system (one that is controlling and stabilizing the pollution load) would be less variable than an uncontrolled system. This implicitly builds in a margin of safety.
- An additional MOS is provided because the calculations were done with a daily Fe average instead of the 30-day average

Seasonal Variation

Seasonal variation is implicitly accounted for in these TMDLs because the data used represents all seasons.

Critical Conditions

The reductions specified in this TMDL apply at all flow conditions. A critical flow condition could not be identified from the data used for this analysis.

Attachment D
Harmon Creek Sediment Calculations

Harmon Creek Sediment TMDL Calculations

The AVGWLF model produced information on watershed size, land use, and sediment loading. The sediment loads represent an annual average over the 23 years simulated by the model (1975 to 1998). This information was then used to calculate existing unit area loading rates for the Harmon Creek and Kings Creek and Aunt Clara Fork Kings Creek Watersheds.

Table A. Existing Loading Values for Harmon Creek (impaired)			
Source	Area (ac)	Sediment (lbs.)	Unit Area Load (lb/ac/yr)
HAY/PAST	867	77,476	89
CROPLAND	1,082	1,323,182	1,223
FOREST	9,074	67,874	7
QUARRY	272	104,604	385
COAL_MINES	10	185	19
UNPAVED_RD	20	79,109	3,995
TRANSITION	1,129	4,862,558	4,306
LO_INT_DEV	423	30,753	73
HI_INT_DEV	42	305	7
Stream Bank		1,158,491	
Total	12,919	7,704,537	596

Table B. Existing Loading Values for Kings Creek and Aunt Clara Fork Kings Creek Watershed (reference)			
Source	Area (ac)	Sediment (lbs.)	Unit Area Load (lb/ac/yr)
HAY/PAST	1,856	84,628	46
CROPLAND	1,895	1,226,852	647
FOREST	9,617	52,166	5
QUARRY	87	18,016	208
COAL_MINES	10	925	93
TURF_GRASS	173	6,161	36
UNPAVED_RD	47	225,406	4,806
TRANSITION	1,203	2,661,017	2,211
LO_INT_DEV	260	23,067	89
Stream Bank		3,210,744	
Total	15,148	7,508,983	496

The TMDL target sediment load for Harmon Creek is the product of the unit area sediment-loading rate in the reference watershed (Kings Creek and Aunt Clara Fork Kings Creek) and the total area of the impaired watershed (Harmon Creek). These numbers and the resulting TMDL target load are shown in Table C on the following page.

Table C. TMDL Total Load Computation			
Pollutant	Unit Area Loading Rate in Kings Creek and Aunt Clara Fork Kings Creek Watershed (lbs/acre/yr)	Total Watershed Area in Harmon Creek (acres)	TMDL Total Load (lbs/year)
Sediment	496	12,919	6,404,021

Targeted TMDL values were used as the basis for load allocations and reductions in the Harmon Creek Watershed, using the following equation

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

Where:

TMDL = Total Maximum Daily Load
LA = Load Allocation
ALA = Adjusted Load Allocation
LNR = Loads Not Reduced
WLA = Waste Load Allocation
MOS = Margin of Safety

<u>Waste Load Allocation</u>

No waste load allocations exist in the Harmon Creek Watershed.

<u>Margin of Safety</u>

The margin of safety (MOS) is that portion of the pollution loading that is reserved to account for any uncertainty in the data and computational methodology used for the analysis. The Margin of Safety (MOS) for this analysis is explicit. Ten percent of the TMDL was reserved as the MOS.

MOS = 0.1 * 6,404,021

MOS = 640,402 lbs/yr

<u>Load Allocation</u>

The Load Allocation (LA), the portion of the load consisting of all nonpoint sources in the watershed, was computed by subtracting the Margin of Safety from the TMDL total load.

LA = TMDL – MOS - WLA

LA = 6,404,021 – 640,402 – 0

LA = 5,763,619 lbs/day

Adjusted Load Allocation

The adjusted load allocation (ALA) is the actual portion of the LA distributed among those non-point sources receiving reductions. It is computed by subtracting those non-point source loads that are not being considered for reductions (loads not reduced or LNR) from the LA. Reductions in the Harmon Creek Watershed were applied to COAL_MINES/QUARRY, TRANSITIONAL LAND and CROPLAND sources for sediment. Those land uses/sources for which existing loads were not reduced (HAY/PAST, FOREST, UNPAVED_RD, LO_INT_DEV, HI_INT_DEV and Stream bank) kept their current loading values, Table D. The ALA for sediment is 4,245,008 lbs/yr.

Table D. Load Allocation, Loads Not Reduced and Adjusted Load Allocations for the Harmon Creek Sediment TMDL	
	Sediment (lbs./yr)
Load Allocation	5,763,619
Loads Not Reduced	1,518,611
Hay/Past	77,476
FOREST	67,874
unpaved_rd	79,109
QUARRY	104,604
lo_int_dev	30,753
hi_int_dev	305
stream bank	1,158,491
Adjusted load allocation	4,245,008

TMDL

The sediment TMDL for the Harmon Creek Watershed consists of a Load Allocation and a Margin of Safety (MOS). The individual components of the TMDL are summarized in Table E.

Table E. TMDL, WLA, MOS, LA, LNR and ALA for Harmon Creek Sediment TMDL	
TMDL (Total Maximum Daily Load)	6,404,021
WLA (Waste Load Allocation)	0
MOS (Margin of Safety)	640,402
LA (Load Allocation)	5,763,619
LNR (Loads Not Reduced)	1,518,611
ALA (Adjusted Load Allocation)	4,245,008

Calculation of Sediment Load Reductions

Adjusted Load Allocations established in the previous section represents the sediment load that is available for allocation between contributing sources in the Harmon Creek Watershed. Data needed for load reduction analysis, including land use distribution, were obtained by GIS analysis. The Equal Marginal Percent Reduction (EMPR) allocation method (Attachment F) was used to distribute the ALA between the appropriate contributing land uses.

Table F contains the results of the sediment EMPR analysis for the appropriate contributing land uses in the Harmon Creek Watershed. The load allocation for each land use is shown, along with the percent reduction of current loads necessary.

Table F. Sediment Load Allocations & Reductions for the Harmon Creek Watershed						
Pollutant Source	Acres	Unit Area Loading Rate (lbs/ac/yr)		Pollutant Loading (lbs/yr)		Percent Reduction
		Current	Allowable	Current	Allowable	
COAL_MINE/QUARRY	10	18.69	14.25	185	141	24%
CROPLAND	1082	1222.57	932.01	1323182	1008718	24%
TRANSITIONAL	1129	4305.82	2865.62	4862558	3236149	33%
TOTAL				6185926	4245008	31%

Consideration of Critical Conditions

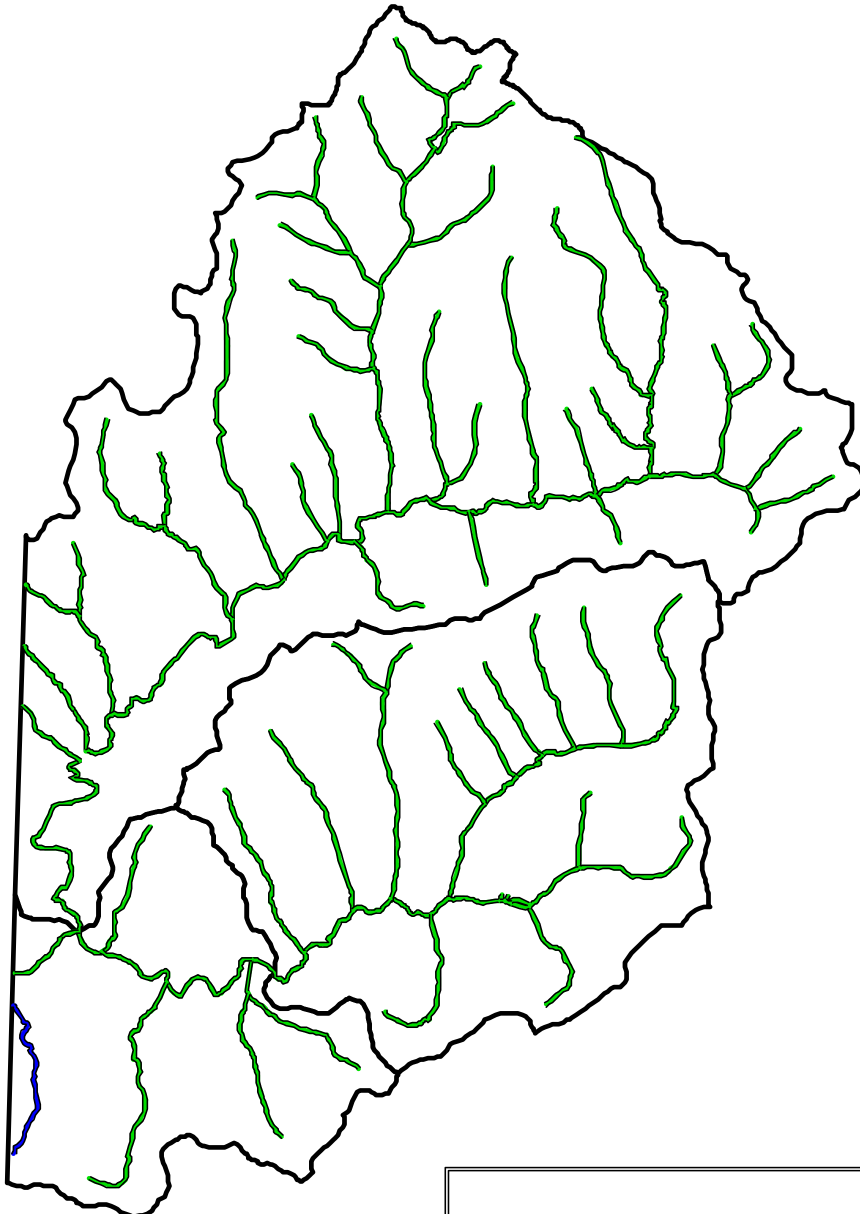
The AVGWLF model is a continuous simulation model, which uses daily time steps for weather data and water balance calculations. Monthly calculations are made for sediment loads based on the daily water balance accumulated to monthly values. Therefore, all flow conditions are taken into account for loading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

Consideration of Seasonal Variations

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

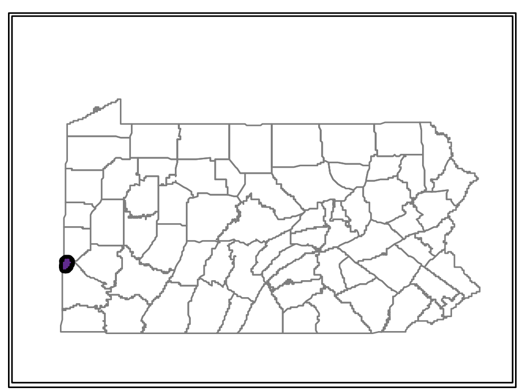
Attachment E

Map of Reference Watershed Kings Creek and Aunt Clara Fork Kings Creek



Kings Creek and Aunt Clara
Fork Kings Creek

Reference Watershed



Attachment F

AVGWLF Model Overview & GIS-Based Derivation of Input Data

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

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

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

For execution, the model requires three separate input files containing transport-, nutrient-, and weather-related data. The transport (TRANSPRT.DAT) file defines the necessary parameters for each source area to be considered (e.g., area size, curve number, etc.) as well as global parameters (e.g., initial storage, sediment delivery ratio, etc.) that apply to all source areas. The nutrient (NUTRIENT.DAT) file specifies the various loading parameters for the different source areas identified (e.g., number of septic systems, urban source area accumulation rates, manure concentrations, etc.). The weather (WEATHER.DAT) file contains daily average temperature and total precipitation values for each year simulated.

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

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

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

Attachment G

Equal Marginal Percent Reduction (EMPR)

Equal Marginal Percent Reduction (EMPR) (An Allocation Strategy)

The Equal Marginal Percent Reduction (EMPR) allocation method was used to distribute Adjusted Load Allocations (ALAs) between the appropriate contributing nonpoint sources. The load allocation and EMPR procedures were performed using a MS Excel spreadsheet. The 5 major steps identified in the spreadsheet are summarized below:

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

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

Step 3: Actual EMPR Process:

a. Each land use/source load is compared with the total ALA to determine if any contributor would exceed the ALA by itself. The evaluation is carried out as if each source is the only contributor to the pollutant load of the receiving waterbody. If the contributor exceeds the ALA, that contributor would be reduced to the ALA. If a contributor is less than the ALA, it is set at the existing load. This is the baseline portion of EMPR.

b. After any necessary reductions have been made in the baseline, the multiple analyses are run. The multiple analyses will sum all of the baseline loads and compare them to the ALA. If the ALA is exceeded, an equal percent reduction will be made to all contributors' baseline values. After any necessary reductions in the multiple analyses, the final reduction percentage for each contributor can be computed.

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

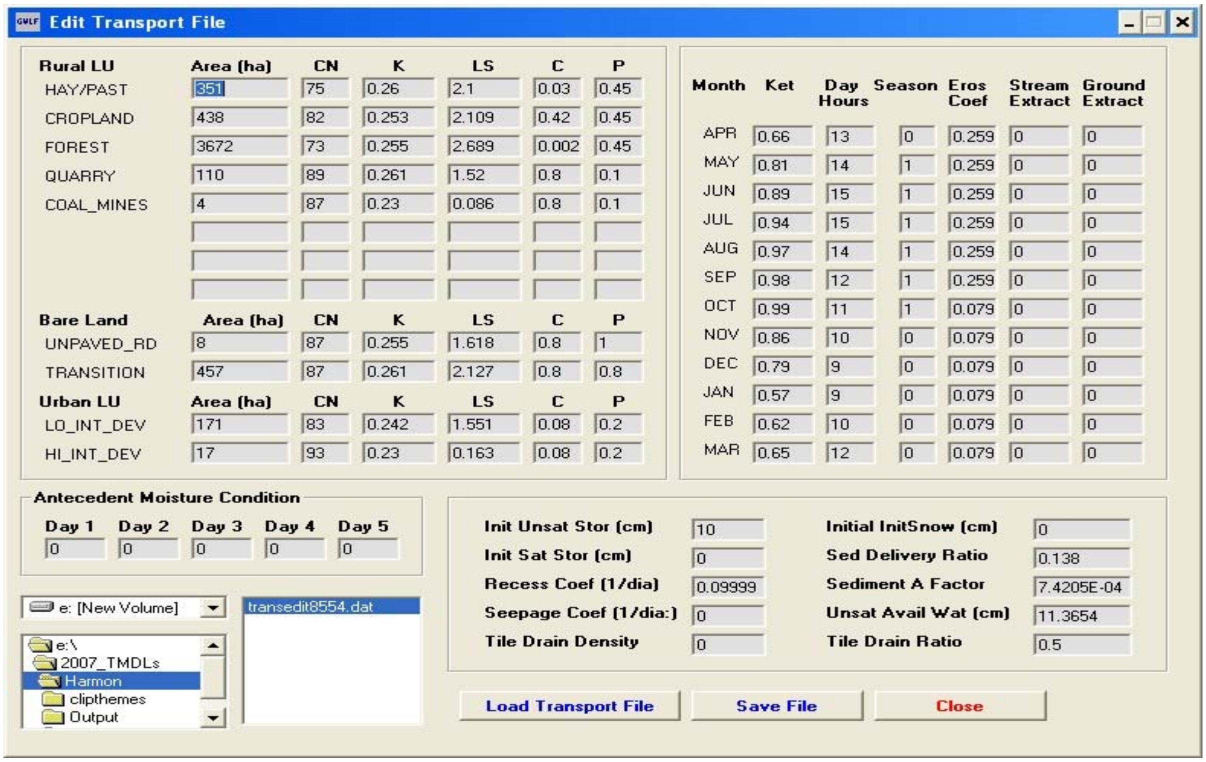
Step 5: Summary of existing loads, final load allocations, and % reduction for each pollutant source.

Equal Marginal Percent Reduction Calculations in Lbs. for Harmon Creek

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Step 1:	TMDL Total Load				Step 2:	Adjusted LA = (MDL total load - ((MOS) - loads not reduced)						
2		Load = TP loading rate in ref. * Acres in Impaired					4245008	4245008					
3		6404021											
4													
5													
6			Annual Average					% reduction				Allowable	
7	Step 3:		Load	Load Sum	Check	Initial Adjust	Recheck	allocation	Load Reduction	Initial LA	Acres	Loading Rate	% Reduction
8		Coal	185.1	6185926.0	good	185	ADJUST	0.00	44	141	10	14.25	23.8%
9							1323367						
10		Cropland	1323182.4		good	1323182		0.24	314465	1008718	1082	932.01	23.8%
11													
12		Transitional	4862558.5		bad	4245008		0.76	1008859	3236149	1129	2865.62	33.4%
13													
14						5568375		1.00		1008859			
15													
16	Step 4:	All Ag. Loading Rate	923.69										
17													
18				Allowable (Target)		Current							
19	Step 5:		Acres	loading rate	Final LA	Loading Rates	Current Load	% Red.					
20		Coal	10	14.25	141	18.69	185	24%					
21													
22		Cropland	1082	932.01	1008718	1222.57	1323182	24%					
23													
24		transitional	1129	2865.62	3236149	4305.82	4862558	33%					
25					4245008		6185926	31%					

Attachment H
AVGWLF OUTPUT

AVGWLF Transport File and Model Output for Harmon Creek



Edit Transport File

Rural LU	Area (ha)	CN	K	LS	C	P
HAY/PAST	351	75	0.26	2.1	0.03	0.45
CROPLAND	438	82	0.253	2.109	0.42	0.45
FOREST	3672	73	0.255	2.689	0.002	0.45
QUARRY	110	89	0.261	1.52	0.8	0.1
COAL_MINES	4	87	0.23	0.086	0.8	0.1
Bare Land	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
UNPAVED_RD	8	87	0.255	1.618	0.8	1
TRANSITION	457	87	0.261	2.127	0.8	0.8
Urban LU	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
LO_INT_DEV	171	83	0.242	1.551	0.08	0.2
HI_INT_DEV	17	93	0.23	0.163	0.08	0.2

Month	Ket	Day Hours	Season	Eros Coef	Stream Extract	Ground Extract
APR	0.66	13	0	0.259	0	0
MAY	0.81	14	1	0.259	0	0
JUN	0.89	15	1	0.259	0	0
JUL	0.94	15	1	0.259	0	0
AUG	0.97	14	1	0.259	0	0
SEP	0.98	12	1	0.259	0	0
OCT	0.99	11	1	0.079	0	0
NOV	0.86	10	0	0.079	0	0
DEC	0.79	9	0	0.079	0	0
JAN	0.57	9	0	0.079	0	0
FEB	0.62	10	0	0.079	0	0
MAR	0.65	12	0	0.079	0	0

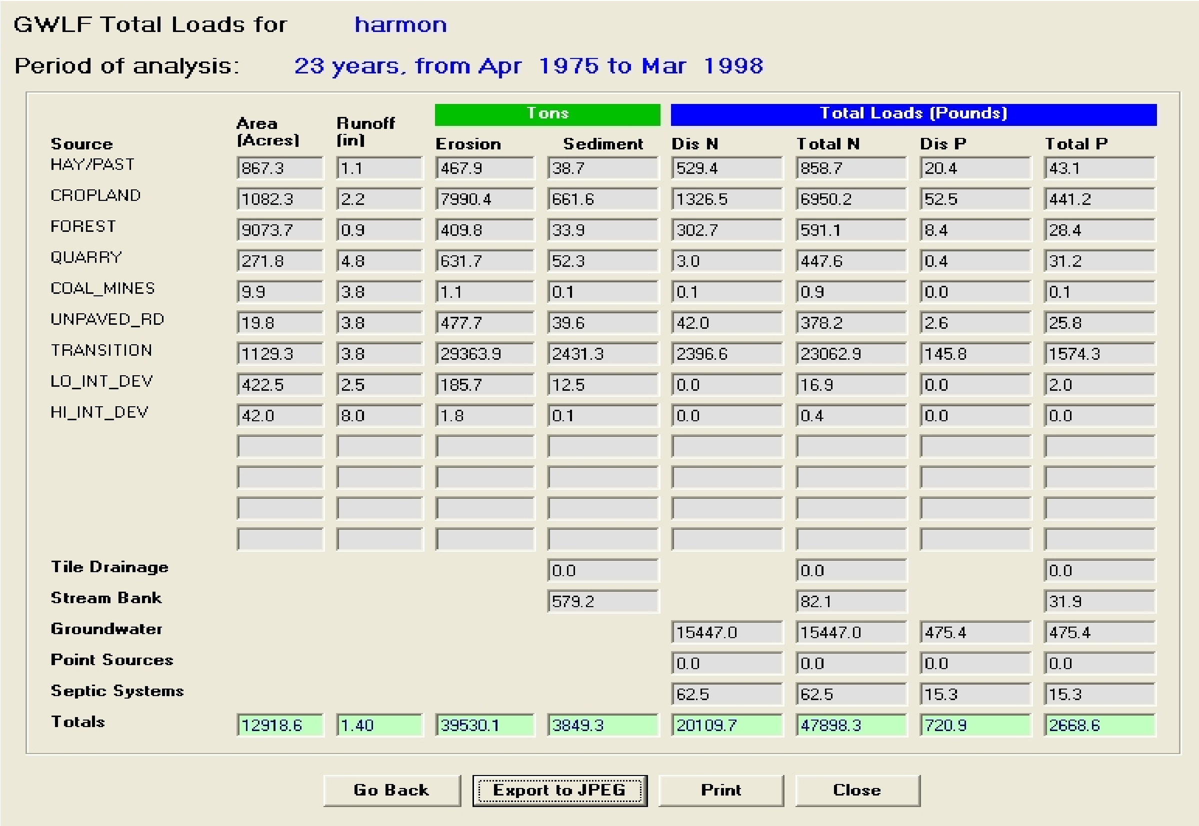
Antecedent Moisture Condition

Day 1	Day 2	Day 3	Day 4	Day 5
0	0	0	0	0

Init Unsat Stor (cm)	10	Initial InitSnow (cm)	0
Init Sat Stor (cm)	0	Sed Delivery Ratio	0.138
Recess Coef (1/dia)	0.09999	Sediment A Factor	7.4205E-04
Seepage Coef (1/dia:)	0	Unsat Avail Wat (cm)	11.3654
Tile Drain Density	0	Tile Drain Ratio	0.5

e: [New Volume]
e:\
2007_TMDLs
Harmon
clipthemes
Output
transedit8554.dat

Load Transport File | Save File | Close



GWLF Total Loads for harmon

Period of analysis: 23 years, from Apr 1975 to Mar 1998

Source	Area (Acres)	Runoff (in)	Tons: Erosion	Tons: Sediment	Total Loads (Pounds): Dis N	Total N	Dis P	Total P
HAY/PAST	867.3	1.1	467.9	38.7	529.4	858.7	20.4	43.1
CROPLAND	1082.3	2.2	7990.4	661.6	1326.5	6950.2	52.5	441.2
FOREST	9073.7	0.9	409.8	33.9	302.7	591.1	8.4	28.4
QUARRY	271.8	4.8	631.7	52.3	3.0	447.6	0.4	31.2
COAL_MINES	9.9	3.8	1.1	0.1	0.1	0.9	0.0	0.1
UNPAVED_RD	19.8	3.8	477.7	39.6	42.0	378.2	2.6	25.8
TRANSITION	1129.3	3.8	29363.9	2431.3	2396.6	23062.9	145.8	1574.3
LO_INT_DEV	422.5	2.5	185.7	12.5	0.0	16.9	0.0	2.0
HI_INT_DEV	42.0	8.0	1.8	0.1	0.0	0.4	0.0	0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				579.2		82.1		31.9
Groundwater					15447.0	15447.0	475.4	475.4
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					62.5	62.5	15.3	15.3
Totals	12918.6	1.40	39530.1	3849.3	20109.7	47898.3	720.9	2668.6

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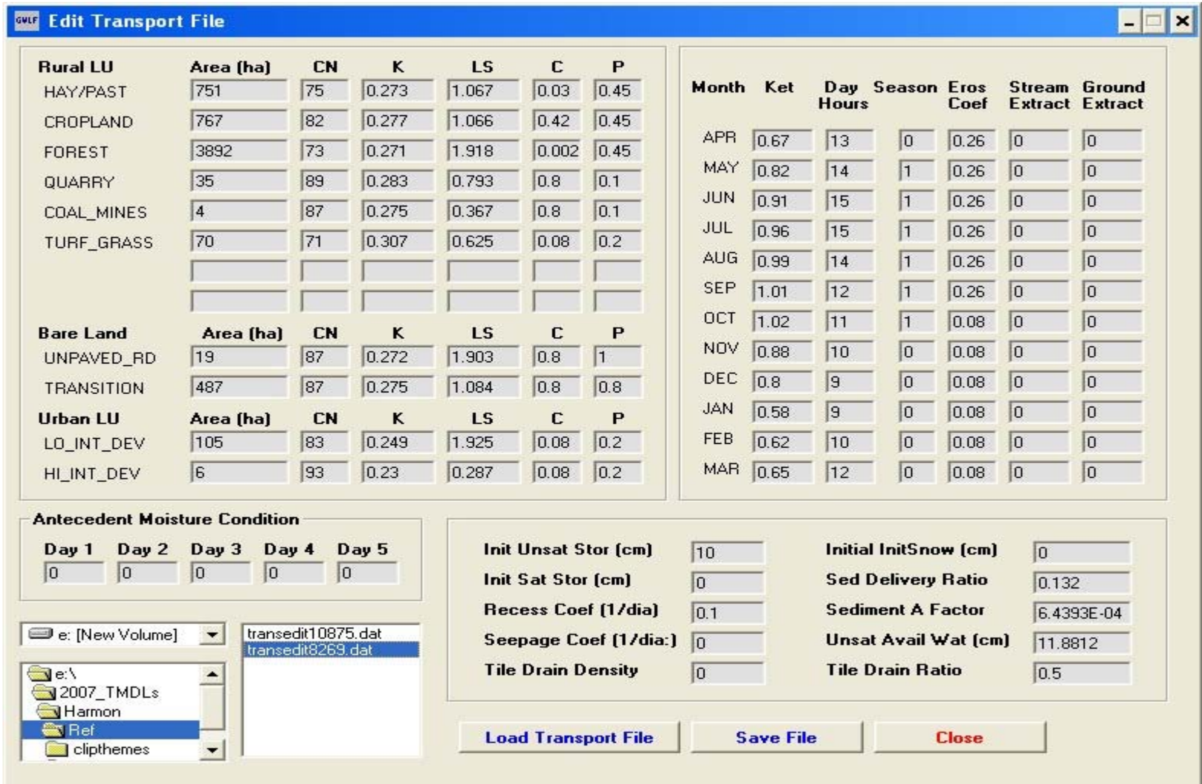
AVGWLF Transport File and Model Output for Kings Creek and Aunt Clara Fork Kings Creek



Edit Transport File

Rural LU	Area (ha)	CN	K	LS	C	P
HAY/PAST	751	75	0.273	1.067	0.03	0.45
CROPLAND	767	82	0.277	1.066	0.42	0.45
FOREST	3892	73	0.271	1.918	0.002	0.45
QUARRY	35	89	0.283	0.793	0.8	0.1
COAL_MINES	4	87	0.275	0.367	0.8	0.1
TURF_GRASS	70	71	0.307	0.625	0.08	0.2
Bare Land	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
UNPAVED_RD	19	87	0.272	1.903	0.8	1
TRANSITION	487	87	0.275	1.084	0.8	0.8
Urban LU	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
LO_INT_DEV	105	83	0.249	1.925	0.08	0.2
HI_INT_DEV	6	93	0.23	0.287	0.08	0.2

Month	Ket	Day Hours	Season	Eros Coef	Stream Extract	Ground Extract
APR	0.67	13	0	0.26	0	0
MAY	0.82	14	1	0.26	0	0
JUN	0.91	15	1	0.26	0	0
JUL	0.96	15	1	0.26	0	0
AUG	0.99	14	1	0.26	0	0
SEP	1.01	12	1	0.26	0	0
OCT	1.02	11	1	0.08	0	0
NOV	0.88	10	0	0.08	0	0
DEC	0.8	9	0	0.08	0	0
JAN	0.58	9	0	0.08	0	0
FEB	0.62	10	0	0.08	0	0
MAR	0.65	12	0	0.08	0	0

Antecedent Moisture Condition

Day 1	Day 2	Day 3	Day 4	Day 5
0	0	0	0	0

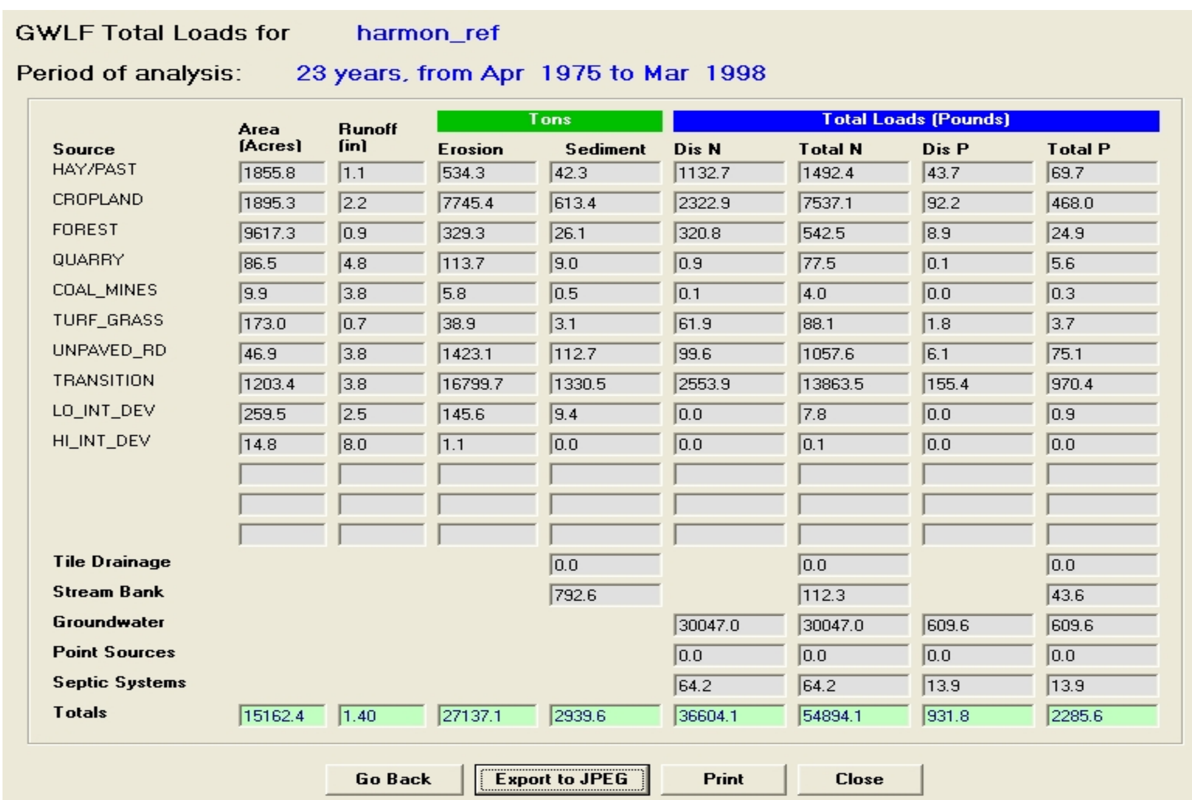
Init Unsat Stor (cm)	10	Initial InitSnow (cm)	0
Init Sat Stor (cm)	0	Sed Delivery Ratio	0.132
Recess Coef (1/dia)	0.1	Sediment A Factor	6.4393E-04
Seepage Coef (1/dia:)	0	Unsat Avail Wat (cm)	11.8812
Tile Drain Density	0	Tile Drain Ratio	0.5

e: [New Volume]

e:\
2007_TMDLs
Harmon
Ref
clipthemes

transedit10875.dat
transedit8269.dat

Load Transport File | Save File | Close



GWLF Total Loads for harmon_ref

Period of analysis: 23 years, from Apr 1975 to Mar 1998

Source	Area (Acres)	Runoff (in)	Tons: Erosion	Tons: Sediment	Total Loads (Pounds): Dis N	Total N	Dis P	Total P
HAY/PAST	1855.8	1.1	534.3	42.3	1132.7	1492.4	43.7	69.7
CROPLAND	1895.3	2.2	7745.4	613.4	2322.9	7537.1	92.2	468.0
FOREST	9617.3	0.9	329.3	26.1	320.8	542.5	8.9	24.9
QUARRY	86.5	4.8	113.7	9.0	0.9	77.5	0.1	5.6
COAL_MINES	9.9	3.8	5.8	0.5	0.1	4.0	0.0	0.3
TURF_GRASS	173.0	0.7	38.9	3.1	61.9	88.1	1.8	3.7
UNPAVED_RD	46.9	3.8	1423.1	112.7	99.6	1057.6	6.1	75.1
TRANSITION	1203.4	3.8	16799.7	1330.5	2553.9	13863.5	155.4	970.4
LO_INT_DEV	259.5	2.5	145.6	9.4	0.0	7.8	0.0	0.9
HI_INT_DEV	14.8	8.0	1.1	0.0	0.0	0.1	0.0	0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				792.6		112.3		43.6
Groundwater					30047.0	30047.0	609.6	609.6
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					64.2	64.2	13.9	13.9
Totals	15162.4	1.40	27137.1	2939.6	36604.1	54894.1	931.8	2285.6

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Attachment I

Excerpts Justifying Changes Between the 1996, 1998, 2002 and 2004 Section 303(d) Lists

The following are excerpts from the Pennsylvania DEP Section 303(d) narratives that justify changes in listings between the 1996, 1998, 2002 and 2004 lists. The Section 303(d) listing process has undergone an evolution in Pennsylvania since the development of the 1996 list.

In the 1996 Section 303(d) narrative, strategies were outlined for changes to the listing process. Suggestions included, but were not limited to, a migration to a Global Information System (GIS), improved monitoring and assessment, and greater public input.

The migration to a GIS was implemented prior to the development of the 1998 Section 303(d) list. As a result of additional sampling and the migration to the GIS some of the information appearing on the 1996 list differed from the 1998 list. Most common changes included:

1. mileage differences due to recalculation of segment length by the GIS;
2. slight changes in source(s)/cause(s) due to new EPA codes;
3. changes to source(s)/cause(s), and/or miles due to revised assessments;
4. corrections of misnamed streams or streams placed in inappropriate SWP subbasins; and
5. unnamed tributaries no longer identified as such and placed under the named watershed listing.

Prior to 1998, segment lengths were computed using a map wheel and calculator. The segment lengths listed on the 1998 Section 303(d) list were calculated automatically by the GIS (ArcInfo) using a constant projection and map units (meters) for each watershed. Segment lengths originally calculated by using a map wheel and those calculated by the GIS did not always match closely. This was the case even when physical identifiers (e.g., tributary confluence and road crossings) matching the original segment descriptions were used to define segments on digital quad maps. This occurred to some extent with all segments, but was most noticeable in segments with the greatest potential for human errors using a map wheel for calculating the original segment lengths (e.g., long stream segments or entire basins).

Attachment J

Water Quality Data Used In TMDL Calculations

Monitoring Point	Date	Flow	pH	Alkalinity	Acidity	Iron	Manganese	Aluminum
		gpm		mg/L	mg/L	mg/L	mg/L	mg/L
HARM01	5/1/2003	198	8.2	172.6	0	ND	0.07	ND
Latitude	6/4/2003	411	7.8	160.2	0	0.342	0.408	ND
40-24-44	7/15/2003	216	8.1	192	0	0.312	0.306	ND
Longitude	7/28/2003	392	7.9	143.4	0	0.58	0.412	ND
80-25-59	8/18/2003	101	7.9	203.8	0	ND	0.245	ND
	10/1/2003	180	8.1	199.6	0	ND	0.574	ND
	Average	249.66667	8.00000	178.60000	0.00000	0.41133	0.33583	NA
	St Dev	124.13326	0.15492	23.95496	0.00000	0.14684	0.17178	NA
HARM02	5/1/2003	58	7.6	86.4	0	0.345	0.643	ND
Latitude	6/4/2003	756	7.5	110.4	0	0.323	0.665	ND
40-24-42	7/15/2003	368	7.9	118.2	0	0.327	0.596	ND
Longitude	7/28/2003	603	7.7	107.2	0	0.373	0.499	ND
80-26-03	8/18/2003	133	7.4	109	0	0.562	0.619	ND
	10/1/2003	320	8	124.2	0	ND	0.377	ND
	Average	373.00000	7.68333	109.23333	0.00000	0.38600	0.56650	NA
	St Dev	268.04776	0.23166	12.89429	0.00000	0.10034	0.10922	NA
HARM03	4/25/2003	534	8.5	118.8	0	ND	0.373	ND
Latitude	6/4/2003	1317	8	124.6	0	ND	0.507	ND
40-24-22	7/15/2003	709	8.1	153	0	ND	0.398	ND
Longitude	7/28/2003	199	8	134.8	0	0.761	0.611	ND
80-26-00	8/18/2003	374	7.7	156	0	0.396	0.433	ND
	10/1/2003	496	8	155	0	0.319	0.552	ND
	Average	604.83333	8.05000	140.36667	0.00000	0.49200	0.47900	NA
	St Dev	388.04093	0.25884	16.50959	0.00000	0.23612	0.09322	NA
HARM04	4/25/2003	346	8	87	0	ND	0.357	ND
Latitude	6/4/2003	436	7.3	86.8	0	ND	0.753	ND
40-24-19	7/15/2003	268	7.7	97.4	0	0.31	1.09	ND
Longitude	7/28/2003	344	7.6	104	0	ND	0.795	ND
80-26-04	8/18/2003	194	7.2	112.6	0	ND	0.747	ND
	10/1/2003	233	7.8	106	0	ND	0.538	ND
	Average	303.50000	7.60000	98.96667	0.00000	0.31000	0.71333	NA
	St Dev	88.57031	0.30332	10.52951	0.00000	NA	0.24858	NA
HARM05	4/25/2003	898	7.6	71	0	ND	0.119	ND
Latitude	6/4/2003	100	7.2	66.4	0	ND	0.218	ND
40-23-50	7/15/2003	89	7.6	69.4	0	ND	0.144	ND
Longitude	7/28/2003	118	7.7	76.8	0	ND	0.189	ND
80-25-54	8/18/2003	36	7.2	77	0	ND	0.101	ND
	10/1/2003	136	7.8	83.2	0	ND	0.218	ND
	Average	229.50000	7.51667	73.96667	0.00000	NA	0.16483	NA
	St Dev	329.24748	0.25626	6.15456	0.00000	NA	0.05069	NA

Monitoring Point	Date	Flow	pH	Alkalinity	Acidity	Iron	Manganese	Aluminum
		gpm		mg/L	mg/L	mg/L	mg/L	mg/L
HARM07	7/15/2002	100	8.1	232	0	0.591	0.097	ND
Latitude	5/1/2003	188	7.8	238.2	0	0.88	0.352	2.91
40-22-42	6/4/2003	304	8	246.6	0	0.805	0.277	2.43
Longitude	7/15/2003	339	8	253.6	0	1.13	0.266	2.81
80-26-06	7/28/2003	358	8	251.4	0	1.41	0.266	2.25
	8/18/2003	104	7.9	251.8	0	1.2	0.349	2.91
	Average	232.16667	7.96667	245.60000	0.00000	1.00267	0.26783	2.66200
	St Dev	116.83564	0.10328	8.68101	0.00000	0.29822	0.09268	0.30351
HARM08	7/15/2002	80	7	56	0	ND	0.096	ND
Latitude	5/1/2003	187	8	224.2	0	ND	0.067	ND
40-22-41	6/4/2003	294	8.1	214.4	0	ND	ND	ND
Longitude	7/15/2003	159	8.2	230.8	0	0.318	0.055	ND
80-26-18	7/28/2003	246	8.2	221.8	0	ND	0.072	ND
	8/18/2003	75	7.9	229.6	0	ND	0.052	ND
	Average	173.50000	7.90000	196.13333	0.00000	0.31800	0.06840	NA
	St Dev	87.87889	0.45607	68.90477	0.00000	NA	0.01750	NA
HARM09	5/1/2003	1356	8	151.4	0	ND	0.134	ND
Latitude	6/4/2003	3566	8.1	141.4	0	ND	0.36	ND
40-22-38	7/15/2003	1236	8	209	0	ND	0.209	0.506
Longitude	7/28/2003	2708	8	149	0	0.4	0.276	0.514
80-26-19	8/18/2003	1068	8.1	159.2	0	ND	0.122	ND
	Average	1986.80000	8.04000	162.00000	0.00000	0.40000	0.22020	0.51000
	St Dev	1097.70269	0.05477	27.03035	0.00000	NA	0.09982	0.00566
HARM11	7/15/2002		8	204	0	ND	0.057	ND
Latitude	5/1/2003	2640	7.5	52.4	0	ND	0.537	ND
40-22-37	6/4/2003	689	7.5	56.8	0	0.521	1.23	ND
Longitude	7/15/2003	886	7.4	50.8	0	ND	1.12	ND
80-26-56	7/28/2003	972	6.8	48.4	0	0.536	1.3	ND
	8/18/2003	287	7.5	52.2	0	ND	0.35	ND
	Average	1094.80000	7.45000	77.43333	0.00000	0.52850	0.76567	NA
	St Dev	903.26281	0.38341	62.06531	0.00000	0.01061	0.52037	NA
HARM12	7/15/2002	825	7.9	132	0	0.348	1.27	ND
Latitude	5/1/2003	77	7.2	36.2	0	ND	4.05	2.77
40-22-36	6/4/2003	1136	7.4	42.4	0	ND	2.94	2.91
Longitude	7/15/2003	136	7.4	58	0	0.326	3.21	2.69
80-27-01	7/28/2003	269	7.3	52.4	0	ND	2.93	1.67
	8/18/2003	51	7.3	41.2	0	0.345	4.22	2.85
	Average	415.66667	7.41667	60.36667	0.00000	0.33967	3.10333	2.57800
	St Dev	454.71647	0.24833	35.98498	0.00000	0.01193	1.05568	0.51432

Monitoring Point	Date	Flow	pH	Alkalinity	Acidity	Iron	Manganese	Aluminum
		gpm		mg/L	mg/L	mg/L	mg/L	mg/L
HARM13	7/15/2002		8	166	0	ND	0.102	ND
Latitude	5/1/2003	624	8.2	165	0	ND	0.187	ND
40-22-10	6/4/2003	1277	8.1	156.4	0	0.316	0.55	ND
Longitude	7/15/2003	1066	8.1	158.2	0	0.503	0.311	ND
80-27-39	7/28/2003	1951	8	162	0	1.28	0.386	0.899
	8/18/2003	741	8.2	173.4	0	ND	0.176	ND
	Average	1131.80000	8.10000	163.50000	0.00000	0.69967	0.28533	0.89900
	St Dev	526.09096	0.08944	6.11980	0.00000	0.51121	0.16497	NA
HARM14	7/15/2002	1400	7.8	144	0	ND	ND	ND
Latitude	5/1/2003	2706	8.1	140.4	0	ND	0.139	ND
40-22-09	6/4/2003	8474	8	130.4	0	ND	0.373	ND
Longitude	7/15/2003	5157	7.9	130	0	ND	0.236	ND
80-27-54	7/28/2003	8515	8	139.8	0	0.52	0.29	0.501
	8/18/2003	1822	8.1	143.8	0	ND	0.058	ND
	Average	4679.00000	7.98333	138.06667	0.00000	0.52000	0.21920	0.50100
	St Dev	3229.62611	0.11690	6.33046	0.00000	NA	0.12386	NA
HARM15	7/15/2002	150	7.3	64	0	ND	ND	ND
Latitude	5/1/2003	1190	7.7	58.4	0	ND	0.069	ND
40-22-13	7/15/2003	161	7.5	57.2	0	ND	0.183	ND
Longitude	7/28/2003	689	7.4	56	0	ND	0.156	ND
80-28-02	8/18/2003	413	7.8	64.2	0	ND	0.056	ND
	Average	520.60000	7.54000	59.96000	0.00000	NA	0.11600	NA
	St Dev	434.36425	0.20736	3.87402	0.00000	NA	0.06298	NA
HARM16	5/1/2003	891	7.6	57.4	0	ND	0.116	ND
Latitude	6/4/2003	7336	7.4	64.2	0	0.78	1.08	0.62
40-23-54	7/15/2003	332	7.4	51.6	0	ND	0.136	ND
Longitude	7/28/2003	348	7.3	49.6	0	ND	0.152	ND
80-28-28	8/18/2003	306	7.6	63	0	ND	0.062	ND
	Average	1842.60000	7.46000	57.16000	0.00000	0.78000	0.30920	0.62000
	St Dev	3080.57897	0.13416	6.55347	0.00000	NA	0.43223	NA

Attachment K

Comment and Response

Comments/Responses on the Harmon Creek Watershed TMDL

A 60-day public comment period was open on the Harmon Creek Watershed Draft TMDL from December 4, 2004 until February 2, 2005. During this time, no comments were received.