FINAL

MOOSE CREEK WATERSHED TMDL
Clearfield 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 Moose 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 and one segment from a subsequent list (shown in Table 1). High levels of metals, and in some areas depressed pH, 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) and pH.

Table 1. 303(d) Sub-List

State Water Plan (SWP) Subbasin: 08-B Chest Creek

Year	Miles	Segment ID	DEP Stream Code	Stream Name	Designated Use	Data Source	Source	EPA 305(b) Cause Code
1996	3	7178	26613	Woods Run	CWF	305(b) Report	RE	Metals
1998	2.48	7178	26613	Woods Run	CWF	SWMP	AMD	Metals
2002	2.4	7178	26613	Woods Run	CWF	SWMP	AMD	Metals
2004	2.3	7178	26613 (26615 & 26616)	Woods Run (Unnamed Tributaries to Woods Run)	CWF	SWAP	AMD	Metals
1996	Not on 303(d) list.							
1998	Not on 303(d) list.							
2002	7.8	990504-1105-JLR	26609 & 26613	Moose Creek & Woods Run	CWF CWF	SWAP	AMD	Metals & pH
2004	5.9	990504-1105-JLR	26609 (26610, 26611 & 26612)	Moose Creek (Unnamed Tributaries to Moose Creek)	CWF	SWAP	AMD	Metals & pH
2004	1.6	990504-1105-JLR	26613 (26614)	Woods Run (Unnamed Tributary to Woods Run)	CWF	SWAP	AMD	Metals & pH

Resource Extraction=RE
Cold Water Fishes = CWF
Surface Water Monitoring Program = SWMP
Surface Water Assessment Program=SWAP
Abandoned Mine Drainage = AMD

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[1] Pennsylvania's 1996, 1998, and 2002 Section 303(d) lists were approved by the Environmental Protection Agency (EPA). Approval of the 2004 Pennsylvania Integrated Water Quality Monitoring and Assessment Report is pending. 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.*

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

Moose Creek is designated as a CWF from the mouth to the Moose Creek Reservoir. Upstream of the reservoir, Moose Creek is designated as a High Quality-CWF. The use designations for the stream segments in this TMDL can be found in PA Title 25 Chapter 93.

Directions to the Moose Creek Watershed

The Moose Creek Watershed is located in North Central Pennsylvania, occupying a central portion of Clearfield County within Lawrence and Pine Townships and Clearfield Borough. The watershed area is found on United States Geological Survey maps covering Clearfield and Elliott Park 7.5-Minute Quadrangles. Land uses within the watershed include reclaimed and abandoned mine lands in the mid-section of the watershed, forestland in the headwaters of the watershed, and the borough of Clearfield in the lower section of the watershed.

The Moose Creek Watershed consists of the main stem, Woods Run, and several unnamed tributaries. The Moose Creek watershed area is 12.3 square miles and the Woods Run watershed area is 2.56 square miles. Moose Creek flows from the northwest to the southeast. Moose Creek flows from an elevation of 2200 feet in its headwaters to an elevation of 1100 feet at its confluence with the West Branch of the Susquehanna River in Clearfield Borough

The Moose Creek Watershed is located in an area that is easily accessed. Many roads cross or parallel the stream in the lower reaches. Moose Creek can be reached by traveling west on SR 322 from Clearfield towards Penfield. The roadway runs parallel to Moose Creek for approximately 1.5 miles upon exiting Clearfield Borough on SR 322. There are several bridges on SR 322 that cross over Moose Creek. There are signs at each bridge indicating that the road passes over Moose Creek. The roadway continues up the mountain between the Moose Creek Watershed (on the right) and the Woods Run Watershed (on the left) into the headwaters. The headwaters areas are located in forestlands with limited access by vehicle.

Segments addressed in this TMDL

There are three active mining operations in the watershed (Attachment A). These permits are the Swisher Contracting Novey 1 Mine SMP 17990118 (NPDES PA 0242730), Swisher Contracting Butler 2 Mine SMP 17030107 (NPDES PA0243485), and the Sky Haven Coal Company, Inc. Butler 1 Mine SMP 17800147 (no NPDES permit). Mining is complete on the Sky Haven permit; however, the operation is actively treating a post-mining discharge. Since liability exists for this discharge, it is considered to be a point-source discharge and is assigned a waste load allocation. Both Swisher Contracting sites have preexisting discharges. These permits, therefore, are issued under DEP's subchapter F regulations, which provide that the permittee's effluent limits are based on baseline pollution conditions rather than standard coal mining BAT standards. Therefore, the subchapter F discharges on these sites are treated as nonpoint source for the purpose of doing the TMDL, however, waste load allocations are assigned to the permitted NPDES discharge points for these two active mine sites.

All of the remaining discharges in the watershed are from abandoned mines and are 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.

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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.

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

Mining has been conducted within the Moose Creek Watershed from the late 1800's up to present day. Several of the unnamed tributaries to Moose Creek are severely impaired do to the past mining practices. Deep mines were the first method of mining in the watershed. Many of these mines were left abandoned after coal was removed. In the mid 1900's surface mining was prevalent across the watershed. Like the deep mines these mines were also left unreclaimed and abandoned after coal was removed. Current mining within the watershed has reclaimed or will be reclaiming some of the abandoned mine lands and eliminating underground mines and highwalls. This, along with alkaline addition within the current mine sites, should help improve the water quality within the watershed.

The following are the most recent mining activities within the watershed:

The Sky Haven Coal, Inc., Butler #1 permit (SMP17800147, no NPDES permit) was issued in October of 1980. This permit added additional acreage to the already existing MDP4574/SM31 permit issued in 1974. The total permitted area was 486 acres with 298 acres affected. The coal seams mined were the Upper Kittanning (104 acres), Middle Kittanning (167 acres) and the Lower Kittanning (215 acres). Mining was completed and the site backfilled in the fall of 1984. Water quality problems developed early in the mining process. Actions such as alkaline addition in the backfill, liming the pit, and segregating the pit cleanings were taken in the fall and winter of 1981. This failed to improve the discharge.

An abatement plan was developed and implemented in the spring of 1986. The plan consisted of treating the water with a series of 6 wetland ponds prior to discharging the water from the site. The system could not meet effluent standards at all times. A liming machine was added at the beginning of the series of wetland ponds. The system still could not meet effluent standards. In late 1992 it was discovered that base flow was entering directly into the wetland ponds. Sky Haven then installed a soda ash dispenser in the middle of the series of wetland ponds.

In the summer of 2002 the treatment system was renovated. Several of the lower four wetland ponds were backfilled. The upper two ponds were cleaned out and currently serve as settling ponds after treatment with soda ash briquettes. The treatment system only discharges after rain events or snow melt. Flows are usually around 1 gallon per minute in dry times and 15 gallons per minute during wet times. The system remains active today.

The Swisher Contracting, Inc., Woolridge #1 permit (SMP 17980104, NPDES PA0237922) was issued on June 25, 1998. The total permit area was 84 acres with 69 acres to be affected. The coal seams mined were the Upper Kittanning (3 acres), Middle Kittanning (27 acres) and the Lower Kittanning (28 acres). This mining reclaimed 43 acres of abandoned mine land and eliminated 10 acres of abandoned underground mines. Mining was completed and the site backfilled in the fall of 2000. The site is currently in Stage II Bond Release.

The Swisher Contracting, Inc., Novey #1 permit (SMP 17990118, NPDES PA0242730) was issued on July 13, 2000. The total permit area is 152 acres with 120 acres affected. The coal seams being mined are the Upper Kittanning (8 acres), Middle Kittanning (40 acres) and the Lower Kittanning (71 acres). The mining will reclaim 93 acres of abandoned mine land and eliminate 10 acres of underground mines. Mining at this site commenced in August of 2000 and continues as of August 2004. There are two preexisting discharges, MP75 and MP138, contained within the permitted area.

The Swisher Contracting, Inc., Butler #2 permit (SMP17030107, NPDES PA0243485) was issued on February 18, 2004. The total permit area is 45.2 acres with 25.6 acres to be affected. The coal seams to be mined are the Middle Kittanning (15.6 acres) and the Upper Kittanning (5.3 acres). This mining will eliminate 4.1 acres of abandoned mine land, 15.6 acres of abandoned underground mines and 950 feet of highwall. Mining commenced on this site in February of 2004 and continues as of August 2004. There are five preexisting discharges, MP33, MP36, MP37, MP39, and MP44, contained within the permitted area.

The reduction necessary to meet applicable water quality standards from preexisting conditions (including discharges from areas coextensive with areas permitted under the remining program Subchapter F or G) are expressed in the LA portion of the TMDL. The WLAs express the basis for applicable effluent limitations on point sources. Except for any expressed assumptions, any WLA allocated to a remining permittee does not require the permittee to necessarily implement the reductions from preexisting conditions set forth in the LA. Additional requirements for the permittee to address the preexisting conditions are set forth in the applicable NPDES/mining permit. The map in attachment A shows the location of the preexisting discharges. The individual discharges are not assigned load allocations, however; discharge affects on the stream are taken into account at the closest downstream sampling point and it is noted that the discharge is a contributing pollutant source to the segment.

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 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:

$$PR = \text{maximum } \{0, (1 - Cc/Cd)\} \text{ where} \qquad (1)$$

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

$$Cd = \text{RiskLognorm(Mean, Standard Deviation) where} \qquad (1a)$$

Mean = average observed concentration

Standard Deviation = standard deviation of observed data

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

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:

$$LTA = Mean * (1 - PR99) \text{ where} \qquad (2)$$

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.

Method to Quantify Treatment Pond Pollutant Load

The following is an explanation of the quantification of the potential pollution load reporting to the stream from permitted pit water treatment ponds that discharge water at established effluent limits.

Surface coal mines remove soil and overburden materials to expose the underground coal seams for removal. After removal of the coal the overburden is replaced as mine spoil and the soil is replaced for revegetation. In a typical surface mining operation the overburden materials is removed and placed in the previous cut where the coal has been removed. In this fashion, an active mining operation has a pit that progresses through the mining site during the life of the mine. The pit may have water reporting to it, as it is a low spot in the local area. Pit water can be the result of limited shallow groundwater seepage, direct precipitation into the pit, and surface runoff from partially regarded areas that have been backfilled but not yet revegetated. Pit water is pumped to nearby treatment ponds where it is treated to the required treatment pond effluent limits. The standard effluent limits are as follows, although stricter effluent limits may be applied to a mining permit's effluent limits to insure that the discharge of treated water does not cause in-stream limits to be exceeded.

Standard Treatment Pond Effluent Limits:
Alkalinity > Acidity
$6.0 \le pH \le 9.0$
$Fe \le 3.0$ mg/l
$Mn \le 2.0$ mg/l
$Al \le 2.0$ mg/l

Discharge from treatment ponds on a mine site is intermittent and often varies as a result of precipitation events. Measured flow rates are almost never available. If accurate flow data are available, it is used along with the Best Available Technology (BAT) limits to quantify the WLA for one or more of the following: aluminum, iron, and manganese. The following formula is used:

$$\text{Flow (MGD)} \times \text{BAT limit (mg/l)} \times 8.34 = \text{lbs/day}$$

The following is an approach that can be used to determine a waste load allocation for an active mining operation when treatment pond flow rates are not available. The methodology involves quantifying the hydrology of the portion of a surface mine site that contributes flow to the pit and then calculating waste load allocation using NPDES treatment pond effluent limits.

The total water volume reporting to ponds for treatment can come from two primary sources: direct precipitation to the pit and runoff from the unregraded area following the pit's progression through the site. Groundwater seepage reporting to the pit is considered negligible compared to the flow rates resulting from precipitation.

In an active mining scenario, a mine operator pumps pit water to the ponds for chemical treatment. Pit water is often acidic with dissolved metals in nature. At the treatment ponds, alkaline chemicals are added to increase the pH and encourage dissolved metals to precipitate and settle. Pennsylvania averages 41.4 inches of precipitation per year (Mid-Atlantic River Forecast Center, National Weather Service, State College, PA, 1961-1990, ttp://www.dep.state.pa.us/dep/subject/hotopics/drought/PrecipNorm.htm). A maximum pit dimension without special permit approval is 1500 feet long by 300 feet wide. Assuming that 5 percent of the precipitation evaporates and the remaining 95 percent flows to the low spot in the active pit to be pumped to the treatment ponds, results in the following equation and average flow rates for the pit area.

41.4 in. precip./yr x 0.95 x 1 ft./12/in. x 1500’x300’/pit x 7.48 gal/ft^3 x 1yr/365days x 1day/24hr. x 1hr./60 min. =

= 21.0 gal/min average discharge from direct precipitation into the open mining pit area.

Pit water can also result from runoff from the unregraded and revegetated area following the pit. In the case of roughly backfilled and highly porous spoil, there is very little surface runoff. It is estimated that 80 percent of precipitation on the roughly regraded mine spoil infiltrates, 5 percent evaporates, and 15 percent may run off to the pit for pumping and potential treatment (Jay Hawkins, Office of Surface Mining, Department of the Interior, Personal Communications 2003). Regrading and revegetation of the mine spoil is conducted as the mining progresses. DEP encourages concurrent backfilling and revegetation through its compliance efforts and it is in the interest of the mining operator to minimize the company’s reclamation bond liability by keeping the site reclaimed and revegetated. Experience has shown that reclamation and revegetation is accomplished two to three pit widths behind the active mining pit area. DEP uses three pit widths as an area representing potential flow to the pit when reviewing the NPDES permit application and calculating effluent limits based on best available treatment technology and insuring that in-stream limits are met. The same approach is used in the following equation, which represents the average flow reporting to the pit from the unregraded and unrevegetated spoil area.

41.4 in. precip./yr x 3 pit areas x 1 ft./12/in. x 1500’x300’/pit x 7.48 gal/ft^3 x 1yr/365days x 1day/24hr. x 1hr./60 min. x 15 in. runoff/100 in. precipitation =

= 9.9 gal./min. average discharge from spoil runoff into the pit area.

The total average flow to the pit is represented by the sum of the direct pit precipitation and the water flowing to the pit from the spoil area as follows:

Total Average Flow = Direct Pit Precipitation + Spoil Runoff

Total Average Flow = 21.0 gal./min + 9.9 gal./min. = 30.9 gal./min.

The resulting average waste load from a permitted treatment pond area is as follows.

Allowable Iron Waste Load Allocation:
30.9 gal./min. x 3 mg/l x 0.01202 = 1.1 lbs./day

Allowable Manganese Waste Load Allocation:
30.9 gal./min. x 2 mg/l x 0.01202 = 0.7 lbs./day

Allowable Aluminum Waste Load Allocation:
30.9 gal./min. x 2 mg/l x 0.01202 = 0.7 lbs./day

(Note: 0.01202 is a conversion factor to convert from a flow rate in gal/min. and a concentration in mg/l to a load in units of lbs./day.)

There is little or no documentation available to quantify the actual amount of water that is typically pumped from active pits to treatment ponds. Experience and observations suggest that the above approach is very conservative and overestimates the quantity of water, creating a large margin of safety in the methodology. County specific precipitation rates can be used in place of the long-term state average rate, although the margin of safety is greater than differences from individual counties. It is common for many mining sites to have very “dry” pits that rarely accumulate water that would require pumping and treatment.

Also, it is the goal of DEP’s permit review process to not issue mining permits that would cause negative impacts to the environment. As a step to insure that a mine site does not produce acid mine drainage, it is common to require the addition of alkaline materials (waste lime, baghouse lime, limestone, etc.) to the backfill spoil materials to neutralize any acid-forming materials that may be present. This practice of ‘alkaline addition’ or the incorporation of naturally occurring alkaline spoil materials (limestone, alkaline shale or other rocks) may produce alkaline pit water with very low metals concentrations that does not require treatment. A comprehensive study in 1999 evaluated mining permits issued since 1987 and found that only 2.2 percent resulted in a post-mining pollution discharge (Evaluation of Mining Permits Resulting in Acid Mine Drainage 1987-1996: A Post Mortem Study, March 1999). As a result of efforts to insure that acid mine drainage is prevented, most mining operations have alkaline pit water that often meets effluent limits and requires little or no treatment.

While most mining operations are permitted and allowed to have a standard, 1500’ x 300’ pit, most are well below that size and have a corresponding decreased flow and load. Where pit dimensions are greater than the standard size or multiple pits are present, the calculations to define the potential pollution load can be adjusted accordingly. Hence, the above calculated Waste Load Allocation is very generous and likely high compared to actual conditions that are generally encountered. A large margin of safety is included in the WLA calculations.

This is an explanation of the quantification of the potential pollution load reporting to the stream from permitted pit water treatment ponds that discharge water at established effluent limits. This allows for including active mining activities and their associated Waste Load in the TMDL calculations to more accurately represent the watershed pollution sources and the reductions necessary to achieve in-stream limits. When a mining operation is concluded its WLA is available for a different operation. Where there are indications that future mining in a watershed are greater than the current level of mining activity, an additional WLA amount may be included to allow for future mining.

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 waste load allocation is the portion of the load assigned to point sources. The load allocation is the portion of the load assigned to non-point sources. The margin of safety is applied to account for uncertainties in the computational process. The margin of safety 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 (WLA) and the total WLA for each segment is included in this table. There are currently three permits in the watershed each with one discharge. 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 Moose 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 %
MOOS07	*Moose Creek below Moose Creek Reservoir*						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	2.8	2.8	NA	NA	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	187.2	63.7	0.0	63.7	123.5	66
MOOS06	*Moose Creek, upstream of Woods Run*						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	36.2	36.2	NA	NA	0.0	0
	Al	49.8	29.4	0.0	29.4	20.4	41
	Acidity	1,439.4	316.7	0.0	316.7	999.2	76

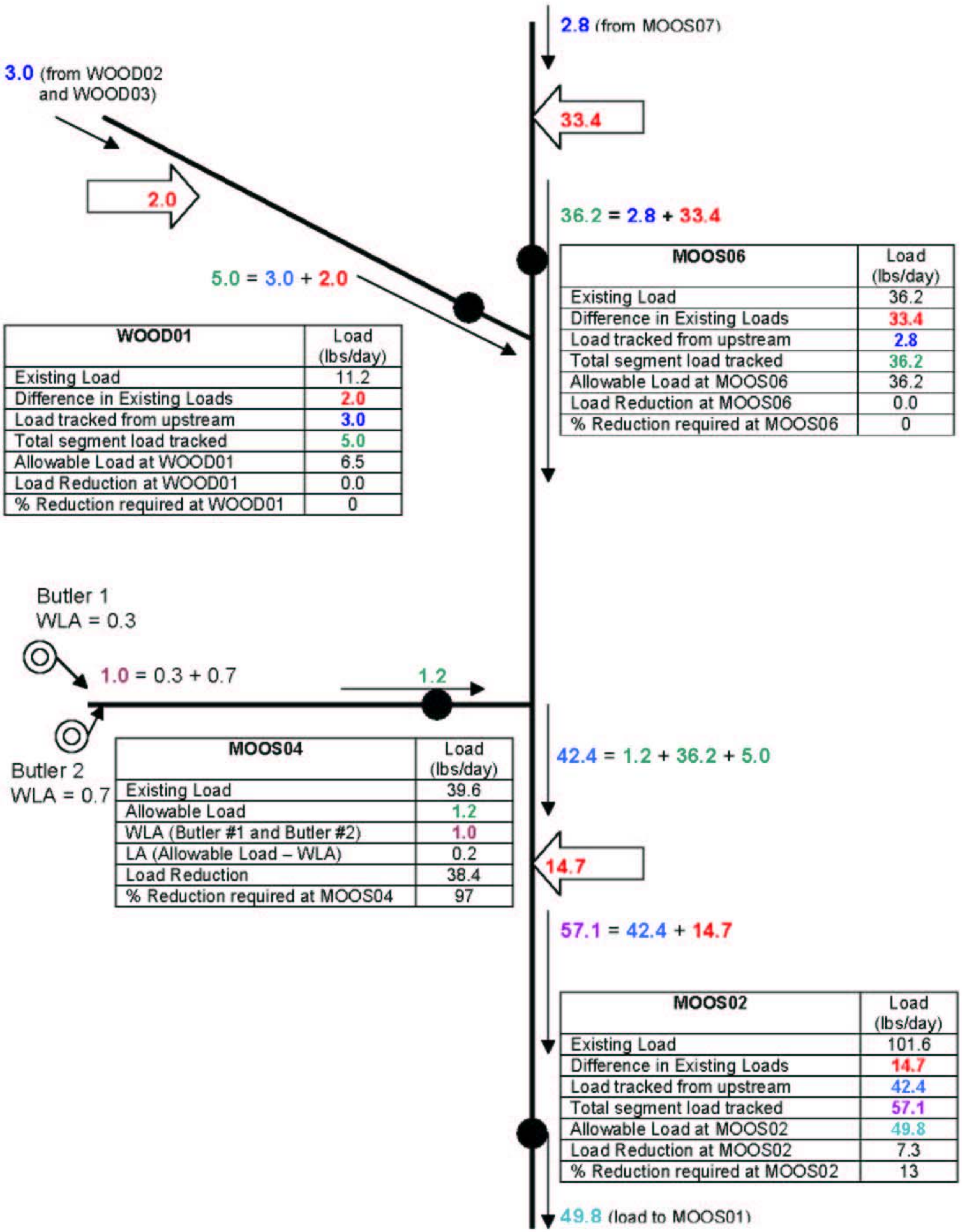
Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
WOOD05	*Woods Run, upstream of Unnamed Tributary 26615*						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	0.6	0.6	NA	NA	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	44.5	22.7	0.0	22.7	21.8	49
WOOD04	*Mouth of Unnamed Tributary 26615*						
	Fe	3.8	2.4	0.0	2.4	1.5	38
	Mn	9.9	2.5	0.0	2.5	7.4	75
	Al	3.7	3.5	0.0	3.5	0.2	5
	Acidity	171.9	12.0	0.0	12.0	159.9	93
WOOD03	*Woods Run, upstream of Unnamed Tributary 26614*						
	Fe	8.0	8.0	NA	NA	0.0	0
	Mn	8.7	4.8	0.0	4.7	0.0	0
	Al	13.3	13.3	NA	NA	0.0	0
	Acidity	164.4	60.8	0.0	60.8	0.0	0
WOOD02	*Mouth of Unnamed Tributary 26614*						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	0.4	0.4	NA	NA	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	15.0	6.9	0.0	6.9	8.1	54
WOOD01	*Mouth of Woods Run*						
	Fe	11.0	11.0	NA	NA	0.0	0
	Mn	11.2	6.5	0.0	6.5	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	147.9	59.2	0.0	59.2	0.0	0
MOOS04	*Mouth of Unnamed Tributary 26610*						
	Fe	2.1	2.1	1.6	0.5	0.0	0
	Mn	39.6	1.2	1.0	0.2	38.4	97
	Al	15.5	1.0	1.0	0.0	14.5	94
	Acidity	170.2	0.0	0.0	0.0	170.2	100
MOOS02	*Moose Creek at Paradise School Road*						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	101.6	49.8	0.0	49.8	7.3	13
	Al	76.5	38.3	0.0	38.3	3.3	8
	Acidity	2,539.5	355.5	0.0	355.5	770.5	68
MOOS01	*Mouth of Moose Creek*						
	Fe	ND	NA	1.1	NA	0.0	0
	Mn	128.9	56.7	0.7	56.0	20.4	26
	Al	96.6	44.4	0.7	43.7	14.0	24
	Acidity	2,895.3	376.4	0.0	376.4	334.9	47

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

In the instance that the allowable load is equal to the measured load (e.g. manganese MOOS07, Table 3), the simulation determined that water quality standards are being met instream 99% of the time and therefore 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. iron point MOOS07, 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.

Although a TMDL for iron is not necessary at MOOS01 because the water quality standard is met, a WLA is assigned to the Swisher Contracting Novey 1 Mine. Because the standard is met for iron at MOOS01, the actual allowed load is the water quality standard times the flow at the point, which is equal to 134.5 lbs/day. The iron WLA of 1.1 lbs/day for the segment is acceptable and will not have a negative impact on water quality within segment. A TMDL is also not necessary for iron at MOOS04 because the WQS is met; however, WLAs are assigned to the Butler 1 and Butler 2 mines.

Following is an example of how the allocations, presented in Table 3, for a stream segment are calculated. For this example, manganese allocations for the segment of Moose Creek between points MOOS06, WOOD01, MOOS04, and MOOS02. 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. These analyses follow the example. Attachment A contains a map of the sampling point locations for reference.



WOOD01	Load (lbs/day)
Existing Load	11.2
Difference in Existing Loads	2.0
Load tracked from upstream	3.0
Total segment load tracked	5.0
Allowable Load at WOOD01	6.5
Load Reduction at WOOD01	0.0
% Reduction required at WOOD01	0

MOOS06	Load (lbs/day)
Existing Load	36.2
Difference in Existing Loads	33.4
Load tracked from upstream	2.8
Total segment load tracked	36.2
Allowable Load at MOOS06	36.2
Load Reduction at MOOS06	0.0
% Reduction required at MOOS06	0

MOOS04	Load (lbs/day)
Existing Load	39.6
Allowable Load	1.2
WLA (Butler #1 and Butler #2)	1.0
LA (Allowable Load – WLA)	0.2
Load Reduction	38.4
% Reduction required at MOOS04	97

MOOS02	Load (lbs/day)
Existing Load	101.6
Difference in Existing Loads	14.7
Load tracked from upstream	42.4
Total segment load tracked	57.1
Allowable Load at MOOS02	49.8
Load Reduction at MOOS02	7.3
% Reduction required at MOOS02	13

All waste load allocations were calculated using the methodology explained previously in the *Method to Quantify Treatment Pond Pollutant Load* section of the report. The Novey 1 and Butler 2 Mines allocations are calculated using the pit area method to calculate flow and the Butler 1 allocation is calculated with the measured discharge average flow. Waste load allocations for the Butler 1 and Butler 2 Mines are incorporated into the calculations at MOOS04 and the Novey 1 Mine at MOOS01. No required reductions of these permits are necessary at this time. All necessary reductions are assigned to non-point sources.

Table 4 below contains the waste load allocations for the three active mine sites.

Table 4. Waste Load Allocation of Permitted Discharges

Parameter	Allowable Average Monthly Conc. (mg/L)	Average Flow (MGD)	WLA (lbs/day)
Swisher Contracting, Novey 1 Mine, SMP 17990188, NPDES PA0242730			
Fe	3.0	0.0445	1.1
Mn	2.0	0.0445	0.7
Al	2.0	0.0445	0.7
Swisher Contracting, Butler 2 Mine, SMP 17030107, NPDES PA0243485			
Fe	3.0	0.0445	1.1
Mn	2.0	0.0445	0.7
Al	2.0	0.0445	0.7
Sky Haven Coal Company, Inc., Butler 1 Mine, SMP 17800147, no NPDES			
Fe	3.0	0.02	0.5
Mn	2.0	0.02	0.3
Al	2.0	0.02	0.3

Recommendations

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. The active mine sites, along with future interests in remining other areas of the watershed, will eliminate abandoned spoils, highwalls and underground mines. This remining, along with the high alkaline addition rates, should have a positive impact on the water quality within the watershed. 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.

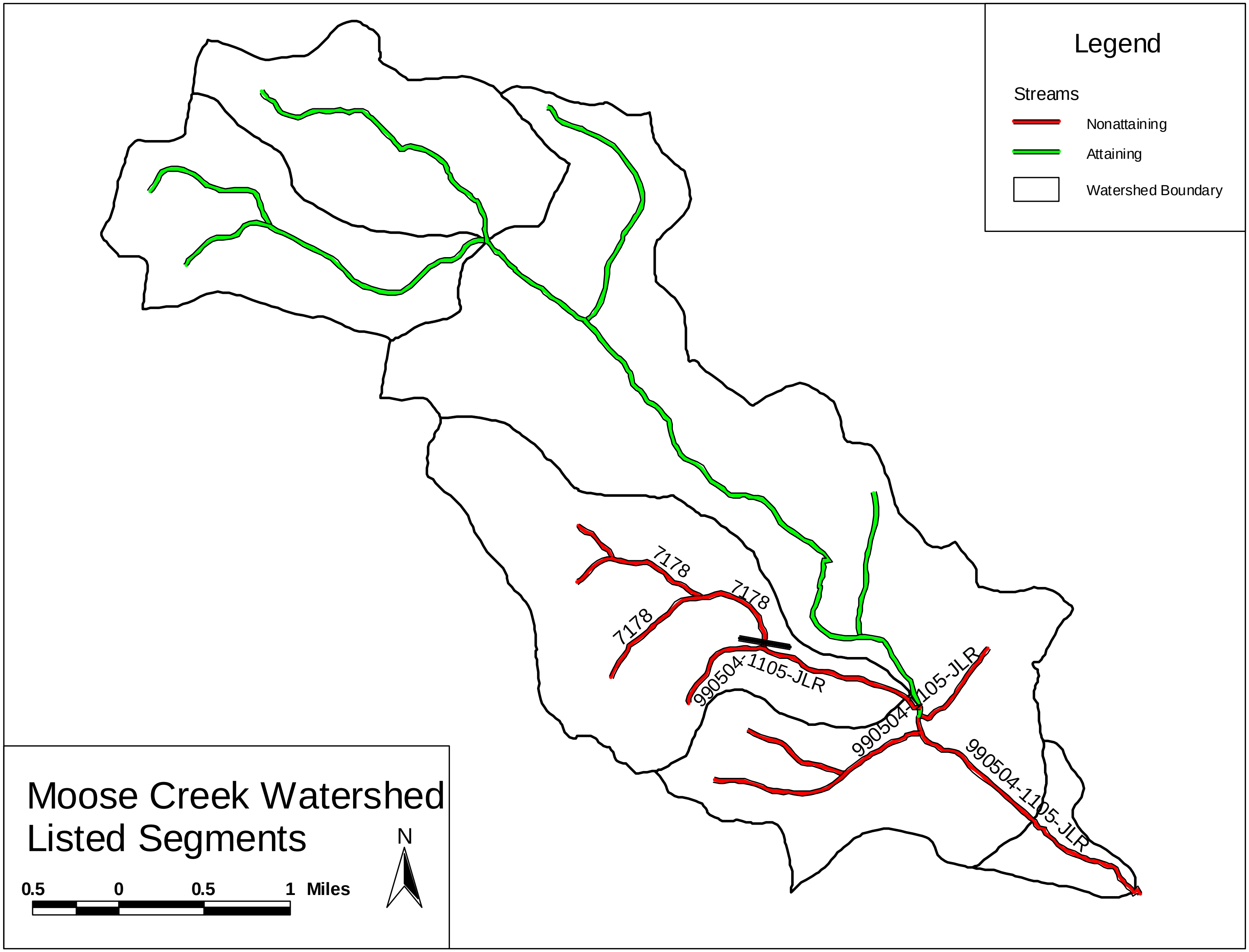
Reclaim PA is DEP's initiative designed to maximize reclamation of the state's quarter million acres of abandoned mineral extraction lands. Abandoned mineral extraction lands in Pennsylvania constituted a significant public liability – more than 250,000 acres of abandoned surface mines, 2,400 miles of 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 September 25, 2004 and *The Progress* on October 12 and October 19, 2004 to foster public comment on the allowable loads calculated. The public comment period on this TMDL was open from September 25 to November 24, 2004. A public meeting was held on October 27, 2004 at the Clearfield County Multi-Service Center to discuss the proposed TMDL.

Attachment A

Moose Creek Watershed Maps


Legend
Streams
Nonattaining
Attaining
Watershed Boundary
7178
7178
7178
990504-1105-JLR
990504-1105-JLR
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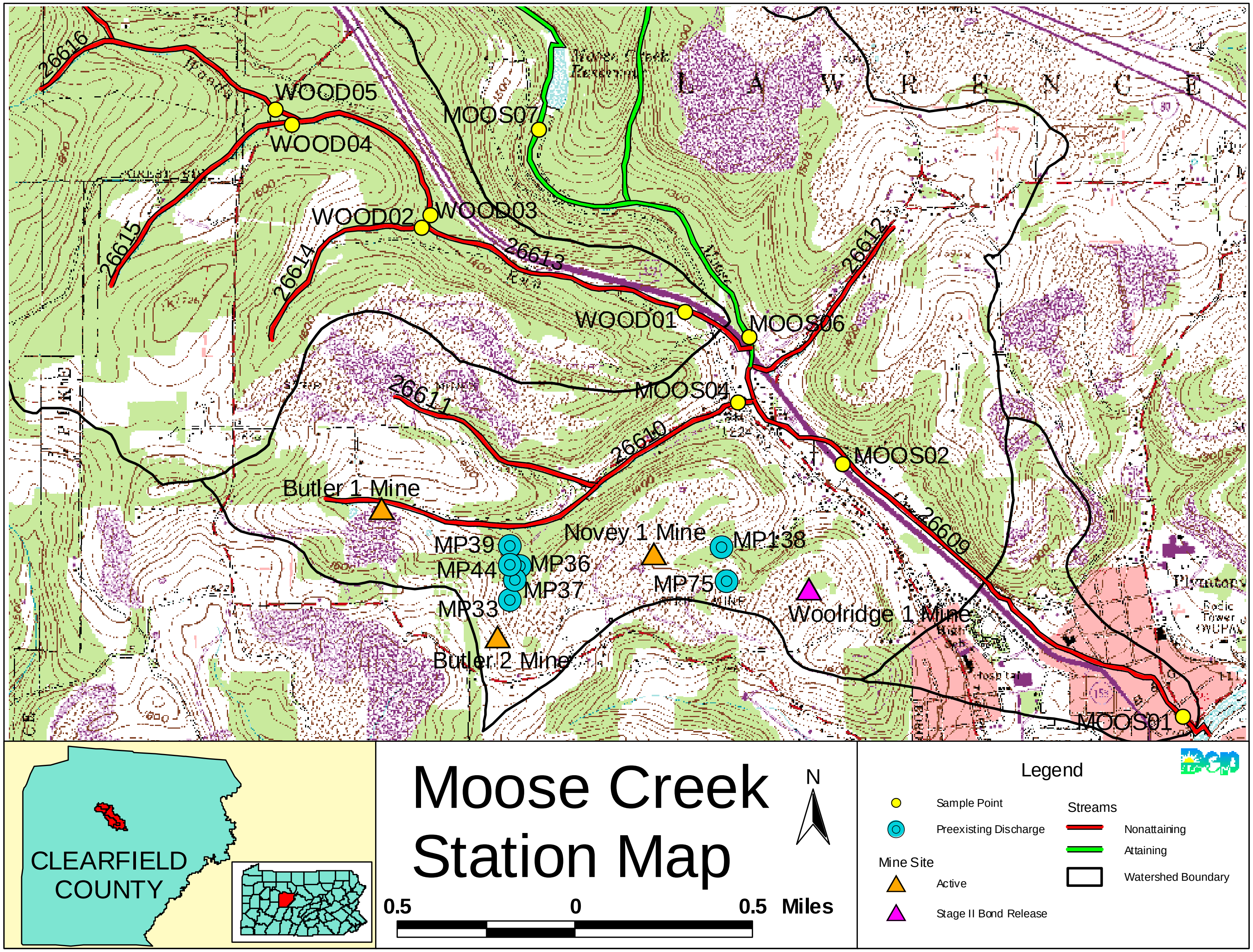
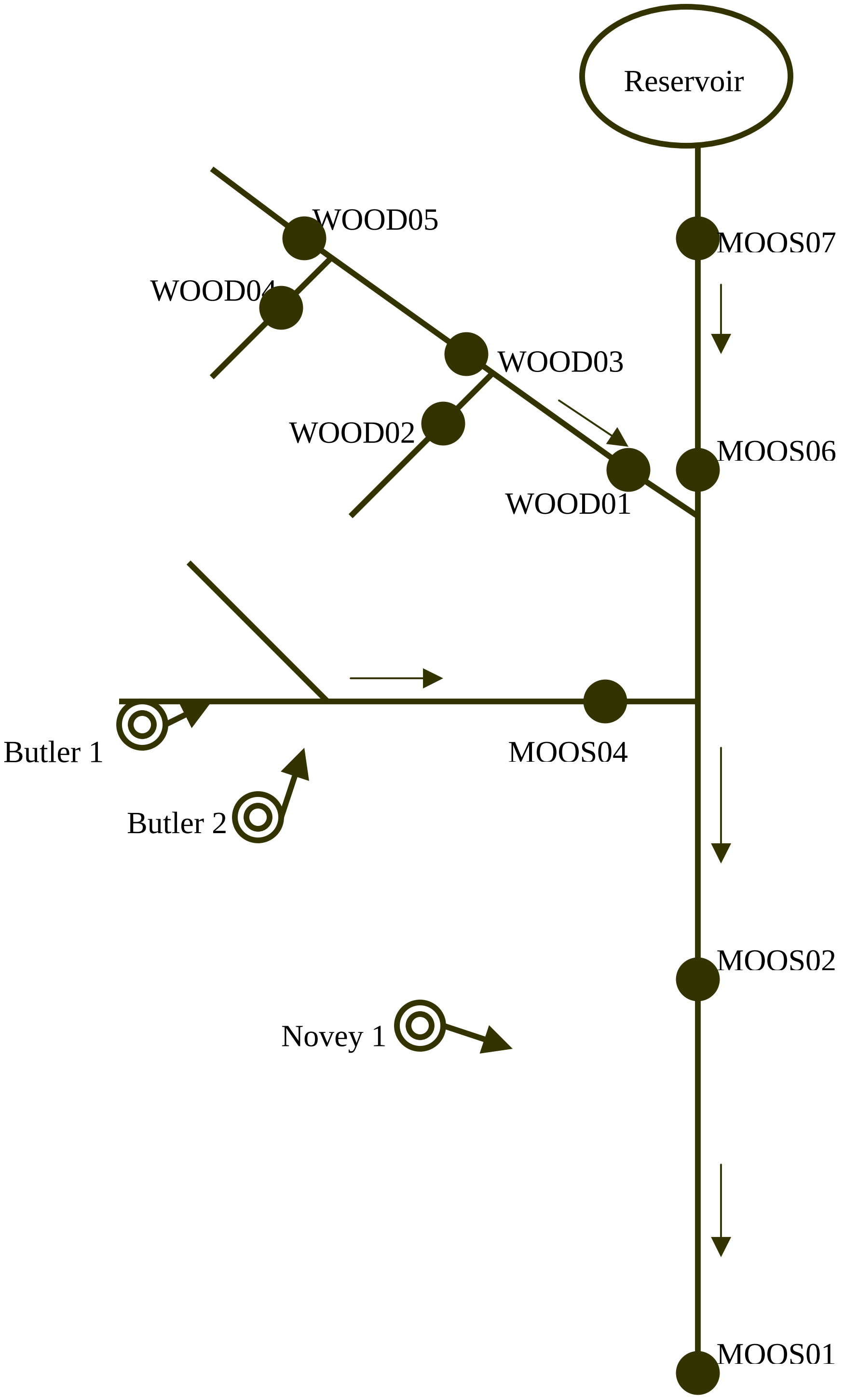
Moose Creek Watershed
Listed Segments
N
0.5
0
0.5
1
Miles



Moose Creek Station Map

Moose Creek Sampling Station Diagram
Arrows indicate 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.*

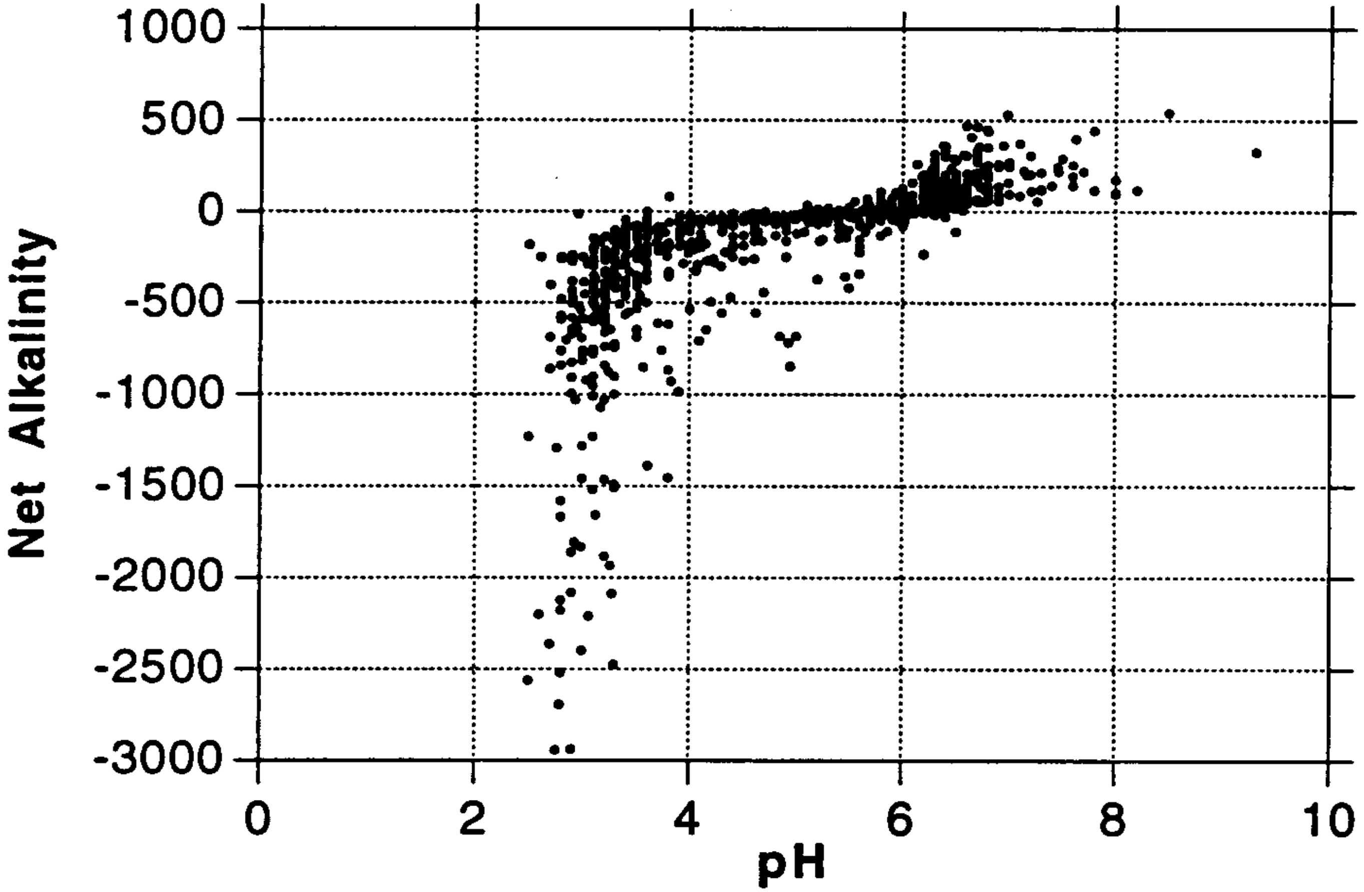


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Attachment C

TMDLs By Segment

Moose Creek Watershed

The TMDL for the Moose Creek Watershed consists of three waste load allocations and load allocations of two tributaries and four sampling sites along Moose Creek. Woods Run, a tributary to Moose Creek, consists of load allocations of two tributaries and three sampling sites along stream. Data was collected in 2001, 2002, and 2003 for completion of the TMDL. The data is included in Attachment E of the report.

Moose Creek and Woods Run are both listed as impaired on the PA Section 303(d) list by both high metals and low pH from AMD as being the cause of the degradation to the stream. The objective is to reduce acid loading to the stream that will in turn raise the pH to the acceptable range. The result of this analysis is an acid loading reduction that equates to meeting standards for pH (see TMDL Endpoint section in the report, Table 2). The method and rationale for addressing pH is contained in Attachment B.

An allowable long-term average in-stream concentration was determined at all sample points for iron, aluminum, 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 MOOS07, Moose Creek below Moose Creek Reservoir

The TMDL for sample point MOOS07 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 MOOS07. The average flow of 6.51 MGD, measured at the point, is used for these computations.

This segment is not included on the PA Section 303(d) list and was found to be attaining its designated uses. Sample data at point MOOS07 shows pH ranging between 6.2 and 6.8. Although the water quality standard for pH is met the simulation determined that a reduction in acidity is necessary.

All iron and aluminum concentrations at point MOOS07 are below the detectable limit, denoted by ND. The simulation determined that the measured and allowable manganese loading are equal. Because WQS are met, TMDLs for metals are not necessary at the MOOS07.

Table C1. TMDL Calculations at Point MOOS07				
Flow = 6.51 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	0.05	2.8	0.05	2.8
Al	ND	ND	NA	NA
Acidity	3.45	187.2	1.17	63.7
Alkalinity	10.05	545.5		

Table C2. Calculation of Load Reduction Necessary at Point MOOS07				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	ND	2.8	ND	187.2
Allowable Load	NA	2.8	NA	63.7
Load Reduction	0.0	0.0	0.0	123.5
% Reduction	0	0	0	66

TMDL Calculations - Sample Point MOOS06, Moose Creek upstream of Woods Run

The TMDL for sample point MOOS06 consists of a load allocation to all of the area between sample points MOOS07 and MOOS06 (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point MOOS06. The average flow of 7.33 MGD, measured at the point, is used for these computations.

This segment is not included on the PA Section 303(d) list and was found to be attaining its designated uses. Sample data at point MOOS06 shows pH ranging between 5.1 and 5.6; pH is addressed as part of this TMDL.

All iron concentrations at point MOOS06 are below the detectable limit, denoted by ND. The simulation determined the measured manganese load is equal to the allowable manganese load. Because WQS are met, TMDLs for iron and manganese are not necessary at MOOS06.

Table C3. TMDL Calculations at Point MOOS06				
Flow = 7.33 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	0.59	36.2	0.59	36.2
Al	0.81	49.8	0.48	29.4
Acidity	23.55	1439.4	5.18	316.7
Alkalinity	7.10	434.0		

The calculated load reductions for all the loads that enter point MOOS06 must be accounted for in the calculated reductions at the sample point shown is Table C4. A comparison of measured loads between points MOOS07 and MOOS06 shows that there is additional loading entering the segment for manganese, aluminum, and acidity. The total segment load is the sum of the load tracked from upstream points and the additional load entering the segment. Because iron is below the detection limits under the current conditions, it is not necessary to account for the upstream iron load.

Table C4. Calculation of Load Reduction Necessary at Point MOOS06

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	ND	36.2	49.8	1,439.4
Difference in Existing Load between MOOS06 & MOOS07	-	33.4	49.8	1,252.2
Load tracked from MOOS07	-	2.8	0.0	63.7
Total Load tracked between points MOOS06 & MOOS07	-	36.2	49.8	1,315.9
Allowable Load at MOOS06	NA	36.2	29.4	316.7
Load Reduction at MOOS06	0.0	0.0	20.4	999.2
% Reduction required at MOOS06	0	0	41	76

TMDL Calculations - Sampling Point WOOD05, Woods Run upstream of Unnamed Tributary 26615

The TMDL for sampling point WOOD05 consists of a load allocation of the area the sample point (Attachment A). The load allocation for this stream segment was computed using water-quality sample data collected at point WOOD05. The average flow of 1.40 MGD, measured at the point, is used for theses computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. Sample data at point WOOD05 shows pH ranging between 5.4 and 6.0; pH will be addressed as part of this TMDL because of the mining impacts.

All iron and aluminum concentrations at point WOOD05 are below the detectable limit, denoted by ND. The simulation determined that the measured and allowable manganese loading are equal. Because WQS are met, TMDLs for metals are not necessary at the point.

Table C5. TMDL Calculations at Point WOOD05				
Flow = 1.40 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	0.05	0.6	0.05	0.6
Al	ND	ND	NA	NA
Acidity	3.80	44.5	1.94	22.7
Alkalinity	7.77	90.9		

Table C6. Calculation of Load Reduction Necessary at Point WOOD05				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	ND	0.6	ND	44.5
Allowable Load	NA	0.6	NA	22.7
Load Reduction	0.0	0.0	0.0	21.8
% Reduction Segment	0	0	0	49

TMDL Calculations - Sample Point WOOD04, Mouth of Unnamed Tributary 26615

The TMDL for sample point WOOD04 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 WOOD04. The average flow of 0.83 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. Sample data at point WOOD04 shows pH ranging between 4.8 and 6.2; pH will be addressed as part of this TMDL because of the mining impacts.

Table C7. TMDL Calculations at Point WOOD04				
Flow = 3.36 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.56	3.8	0.34	2.4
Mn	1.44	9.9	0.36	2.5
Al	0.54	3.7	0.51	3.5
Acidity	24.90	171.9	1.74	12.0
Alkalinity	8.07	55.7		

Table C8. Calculation of Load Reduction Necessary at Point WOOD04				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	3.8	9.9	3.7	171.9
Allowable Load	2.4	2.5	3.5	12.0
Load Reduction	1.5	7.4	0.2	159.9
% Reduction	38	75	5	93

TMDL Calculations - Sample Point WOOD03, Woods Run upstream of Unnamed Tributary 26614

The TMDL for sample point WOOD03 consists of a load allocation to all of the area between points WOOD05, WOOD04, and WOOD03 (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point WOOD03. The average flow of 3.16 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. Sample data at point WOOD04 shows pH ranging between 5.5 and 6.2; pH will be addressed as part of this TMDL because of the mining impacts.

The simulation determined the measured iron and aluminum loadings are equal to the allowable loadings. Because WQS are met, TMDLs for iron and aluminum are not necessary.

Table C9. TMDL Calculations at Point WOOD03				
Flow = 3.16 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.30	8.0	0.30	8.0
Mn	0.33	8.7	0.18	4.7
Al	0.50	13.3	0.50	13.3
Acidity	6.23	164.4	2.31	60.8
Alkalinity	7.67	202.2		

The calculated load reductions for all the loads that enter point WOOD03 must be accounted for in the calculated reductions at the sample point shown is Table C10. A comparison of measured loads between points WOOD05, WOOD04, and WOOD03 shows that there is a loss of loading within the segment for manganese and acidity and an increase in load for iron and aluminum. For manganese and acidity, 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. The total segment iron and aluminum load is the sum of the upstream load and any additional load entering the segment.

Table C10. Calculation of Load Reduction Necessary at Point WOOD03

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	8.0	8.7	13.3	164.4
Difference in Existing Load between WOOD05, WOOD04 & WOOD03	4.1	-1.8	9.6	-52.0
Load tracked from WOOD04 & WOOD05	2.4	3.1	3.5	34.7
Percent load lost	-	17	-	24
Percent of load tracked	-	83	-	76
Total Load tracked between points WOOD03, WOOD04 & WOOD05	6.5	2.6	13.1	26.4
Allowable Load at WOOD03	8.0	4.8	13.3	60.8
Load Reduction at WOOD03	0.0	0.0	0.0	0.0
% Reduction required at WOOD03	0	0	0	0

TMDL Calculations - Sample Point WOOD02, Mouth of Unnamed Tributary 26614

The TMDL for sample point WOOD02 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 WOOD02. The average flow of 0.42 MGD, measured at the point, is used for these computations.

This segment was included on the 2002 PA Section 303(d) list for metals and pH impairments from AMD. Sample data at point WOOD02 shows pH ranging between 5.3 and 6.2; pH will be addressed as part of this TMDL because of the mining impacts.

All iron and aluminum concentrations at point WOOD05 are below the detectable limit, denoted by ND. The simulation determined that the measured and allowable manganese loading are equal. Because WQS are met, TMDLs for metals are not necessary at the point.

Table C11. TMDL Calculations at Point WOOD02

Flow = 0.42 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	0.13	0.4	0.13	0.4
Al	ND	ND	NA	NA
Acidity	4.32	15.0	1.99	6.9
Alkalinity	8.08	28.1		

Table C12. Calculation of Load Reduction Necessary at Point WOOD02				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	ND	0.4	ND	15.0
Allowable Load	NA	0.4	NA	6.9
Load Reduction	0.0	0.0	0.0	8.1
% Reduction	0	0	0	54

TMDL Calculations - Sampling Point WOOD01, Mouth of Woods Run

The TMDL for sampling point WOOD01 consists of a load allocation of the area between sample points WOOD03, WOOD02, and WOOD01. The load allocation for this stream segment was computed using water-quality sample data collected at point WOOD01. The average flow of 4.16 MGD, measured at the point, is used for theses computations.

This segment was included on the 2002 PA Section 303(d) list for metals and pH impairments from AMD. Sample data at point WOOD01 shows pH ranging between 5.2 and 6.8; pH will be addressed as part of this TMDL because of the mining impacts.

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

Table C13. TMDL Calculations at Point WOOD01				
Flow = 4.16 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.32	11.0	0.32	11.0
Mn	0.32	11.2	0.19	6.5
Al	ND	ND	NA	NA
Acidity	4.27	147.9	1.71	59.2
Alkalinity	9.03	313.1		

The calculated load reductions for all the loads that enter point WOOD01 must be accounted for in the calculated reductions at the sample point shown in Table C14. A comparison of measured loads between points WOOD01, WOOD02, and WOOD03 shows that there is additional iron and manganese loading and a loss of acidity loading within the segment. For loss of acidity 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. For iron and manganese, the total segment load is the sum of the load tracked from upstream points and the additional load entering the segment. Because aluminum at WOOD01 is below the detectable limits under the current conditions, it is not necessary to account for the upstream aluminum load.

Table C14. Calculation of Load Reduction Necessary at Point WOOD01				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	11.0	11.2	ND	147.9
Difference in Existing Load between WOOD01, WOOD02 & WOOD03	3.0	2.0	-	-31.5
Load tracked from WOOD03 & WOOD02	6.5	3.0	-	33.3
Percent loss due to instream process	-	-	-	18
Percent of loads tracked through segment	-	-	-	82
Total Load tracked between points WOOD01, WOOD02 & WOOD03	9.5	5.0	-	27.4
Allowable Load at WOOD01	11.0	6.5	NA	59.2
Load Reduction at WOOD01	0.0	0.0	0.0	0.0
% Reduction required at WOOD01	0	0	0	0

Waste Load Allocation – Butler 1 and Butler 2 Sites

The Swisher Contracting SMP 1703017 (NPDES PA0243485), Butler 2 site and the Sky Haven Coal Company, Inc. SMP 17800147 (no NPDES permit), Butler 1 site, both have permitted treatment facilities. The waste load allocations for the Butler 2 mine were calculated as described in the *Method to Quantify Treatment Pond Pollutant Loading* section of the report. The waste load allocations for the Butler 1 mine were calculated with measured flows and permit limits. Waste load allocations for the two mining operations are incorporated into the calculations at MOOS04, the mouth of Unnamed Tributary 26610. For both operations this is the first downstream monitoring point that receives all the potential flow of treated water from the two individual sites.

Table C15. Waste Load Allocations Butler 1 and Butler 2 Mine Sites			
Parameter	**Monthly Avg. Allowable Conc. (mg/L)**	**Average Flow (MGD)**	**Allowable Load (lbs/day)**
Butler 1 Site			
Fe	3.0	0.02	0.5
Mn	2.0	0.02	0.3
Al	2.0	0.02	0.3
Butler 2 Site			
Fe	3.0	0.0446	1.1
Mn	2.0	0.0446	0.7
Al	2.0	0.0446	0.7

TMDL Calculations - Sampling Point MOOS04, Mouth of Unnamed Tributary 26610

The TMDL for sampling point MOOS04 consists of waste load allocations of two permitted mining operations and a load allocation of the area above the sample point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point MOOS04. The average flow of 0.34 MGD, measured at the point, is used for theses computations.

This segment was included on the 2002 PA Section 303(d) list for metals and pH impairments from AMD. Sample data at point MOOS04 shows pH ranging between 3.7 and 4.5; pH will be addressed as part of this TMDL because of the mining impacts.

Water quality analysis determined that the existing and allowable iron loads are equal. Because the WQS is met, a TMDL for iron is not necessary. Although a TMDL is not necessary WLAs are assigned to the permitted discharges located on the segment. Affects from the MP33, MP36, MP37, MP39, and MP44 preexisting discharges on the Butler 2 site are accounted for in the load allocations for MOOS04.

Table C16. TMDL Calculations at Point MOOS04

Flow = 0.34 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.75	2.1	0.75	2.1
Mn	14.15	39.6	0.42	1.2
Al	5.55	15.5	0.36	1.0
Acidity	60.89	170.2	0.00	0.0
Alkalinity	0.97	2.7		

Table C17. Calculation of Load Reduction Necessary at Point MOOS04

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	2.1	39.6	15.5	170.2
Allowable Load	2.1	1.2	1.0	0.0
WLA (Butler #1 and Butler #2)	1.6	1.0	1.0	0.0
LA	0.5	0.2	0.0	0.0
Load Reduction	0.0	38.4	14.5	170.2
% Reduction required at MOOS04	0	97	93.5	100

TMDL Calculations - Sample Point MOOS02, Moose Creek at Paradise School Road

The TMDL for sample point MOOS02 consists of a load allocation to the area between points MOOS02, MOOS04, MOOS06, and WOOD01 (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point MOOS02. The average flow of 9.37 MGD, measured at the point, is used for these computations.

This segment was included on the 2002 PA Section 303(d) list for metals and pH impairments from AMD. Sample data at point MOOS02 shows pH ranging between 5.0 and 5.4; pH will be addressed as part of this TMDL because of the mining impacts.

All values for iron are below the method detection limit, denoted by ND. Because the WQS is met, a TMDL for iron is not necessary.

Table C18. TMDL Calculations at Point MOOS02

Flow = 9.37 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	1.30	101.6	0.64	49.8
Al	0.98	76.5	0.49	38.3
Acidity	32.50	2,539.5	4.55	355.5
Alkalinity	7.05	550.9		

The calculated load reductions for all the loads that enter point MOOS02 must be accounted for in the calculated reductions at the sample point shown in Table C19. A comparison of measured loads between points MOOS02, MOOS04, MOOS06, and WOOD01 shows that there is additional aluminum, manganese, and acidity loading to the segment. The total segment load is the sum of the load tracked from upstream points and the additional load entering the segment. Because iron at MOOS02 is below detection limits under the current conditions, it is not necessary to consider the upstream iron load.

Table C19. Calculation of Load Reduction Necessary at Point MOOS02

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	ND	101.6	76.5	2,539.5
Difference in Existing Load between MOOS02, MOOS04, MOOS06 & WOOD01	-	14.7	11.3	781.9
Load tracked from MOOS04, MOOS06 & WOOD01	-	42.4	30.4	344.1
Total Load tracked between points MOOS02, MOOS04, MOOS06 & WOOD01	-	57.1	41.6	1,126.0
Allowable Load at MOOS02	NA	49.8	38.3	355.5
Load Reduction at MOOS02	0.0	7.3	3.3	770.5
% Reduction required at MOOS02	0	13	8	68

Waste Load Allocation – Novey 1 Site

The Swisher Contracting SMP 17990118 (NPDES PA0242730), Novey 1 site has a permitted treatment facility. The waste load allocation was calculated as described in the *Method to Quantify Treatment Pond Pollutant Loading* section of the report. The waste load allocation for the mining operation is incorporated into the calculations at MOOS01. This is the first downstream monitoring point that receives all the potential flow of treated water from the site.

Table C20. Waste Load Allocations Novey 1 Site			
Parameter	**Monthly Avg. Allowable Conc. (mg/L)**	**Average Flow (MGD)**	**Allowable Load (lbs/day)**
Novey 1 Site			
Fe	3.0	0.0446	1.1
Mn	2.0	0.0446	0.7
Al	2.0	0.0446	0.7

TMDL Calculations - Sample Point MOOS01, Mouth of Moose Creek

The TMDL for sample point MOOS01 consists of a waste load allocation to one permitted mining operation and a load allocation to all of the area between points MOOS01 and MOOS02 (Attachment A). The load allocation for segment was computed using water-quality sample data collected at point MOOS01. The average flow of 10.75 MGD, measured at the point, is used for these computations.

This segment was included on the 2002 PA Section 303(d) list for metals and pH impairments from AMD. Sample data at point MOOS02 shows pH ranging between 5.0 and 5.7; pH will be addressed as part of this TMDL because of the mining impacts.

All values for iron are below the method detection limit, denoted by ND. Because the WQS is met, a TMDL for iron is not necessary. Although a TMDL is not necessary a WLA is assigned to the permitted discharge located on the segment. The acceptable iron load at the point is the flow of 10.75 MGD times the criterion of 1.5 mg/L times a conversion factor, or 134.5 lbs/day. The WLA of 1.1 lbs/day is significantly less than this value and therefore is an acceptable loading to the segment. Affects from the MP75 and MP138 preexisting discharges on the Novey 1 site are accounted for in the load allocations for MOOS01.

Table C21. TMDL Calculations at Point MOOS01				
Flow = 10.75 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	1.44	128.9	0.63	56.7
Al	1.08	96.6	0.50	44.4
Acidity	32.30	2,895.3	4.20	376.4
Alkalinity	7.30	654.3		

The calculated load reductions for all the loads that enter point MOOS01 must be accounted for in the calculated reductions at the sample point shown in Table C22. A comparison of measured loads between points MOOS01 and MOOS02 shows that there is additional aluminum, manganese, and acidity loading to the segment. The total segment load is the sum of the load tracked from upstream points and the additional load entering the segment. Because iron at

MOOS01 is below detection limits under the current conditions, it is not necessary to consider the upstream iron load.

Table C22. Calculation of Load Reduction Necessary at Point MOOS01				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	ND	128.9	96.6	2,895.3
Difference in Existing Load between MOOS01 & MOOS02	-	27.3	20.1	355.8
Load tracked from MOOS02	-	49.8	38.3	355.5
Total Load tracked between points MOOS01 & MOOS02	-	77.1	58.4	711.3
Allowable Load at MOOS01	NA	56.7	44.4	376.4
WLA (Novey #1)	1.1	0.7	0.7	0.0
LA	-	56.0	43.7	376.4
Load Reduction at MOOS01	0.0	20.4	14.0	334.9
% Reduction required at MOOS01	0	26	24	47

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
- The method used to calculate a flow for a WLA using the area of the pit and unregraded portions is conservative and an implicit margin of safety.

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

Excerpts Justifying Changes Between the 1996, 1998, and 2002 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, and 2002 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 E

Water Quality Data Used In TMDL Calculations

Monitoring Point	**Date**	**pH**	**Alkalinity**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Flow**
		Lab	**mg/l**	**mg/l**	**mg/L**	**mg/L**	**mg/L**	**gpm**
MOOS07	12/2/2002	6.5	11	0	<0.3	0.05	<0.5	1472
Latitude	1/20/2003	6.7	9.6	0	<0.3	0.05	<0.5	3635
41-03-13.72	6/17/2003	6.2	9.8	13.80	<0.3	0.05	<0.5	5120
Longitude	9/8/2003	6.8	9.8	0.00	<0.3	0.054	<0.5	7850
78-28-35.84	Average	6.55000	10.05000	3.45000	NA	0.05100	NA	4519.25000
At V-notch weir below reservoir	St Dev	0.26458	0.64031	6.90000	NA	0.00200	NA	2678.45893
MOOS06	12/2/2003	5.1	7.6	23.6	<0.3	0.72	0.99	1772
Latitude	1/20/2003	5.1	6.6	27.6	<0.3	0.64	0.86	3779
41-02-42.3	6/17/2003	5.6	7.0	20.00	<0.3	0.43	0.59	6704
Longitude	9/8/2003	5.6	7.2	23.00	<0.3	0.59	0.82	8103
78-27-38.35	Average	5.35000	7.10000	23.55000	ND	0.59225	0.81400	5089.50000
Moose Crk upstream Woods Run	St Dev	0.28868	0.41633	3.12570	NA	0.11831	0.16698	2852.54325
MOOS04	8/29/2000	3.9	0	90	0.8	22.39	7.55	88
Latitude	12/26/2003	4	0	50	1.07	12.65	5.09	N/M
41-02-37.46	2/8/2001	4	0	48	1.1	11.38	4.02	100
Longitude	5/29/2001	3.9	0	46	0.81	13.4	4.84	125
78-27-43.90	8/24/2001	3.7	0	76	1	18.3	6.09	75
	10/29/2001	3.8	0	52	1	13.7	4.5	185
mouth unnamed tributary 26610	2/12/2002	3.9	0	42	0.66	6.09	3.4	250
	6/12/2002	3.9	0	56	0.64	13.2	6.03	350
	8/15/2002	4.5	8	90	0.69	30.3	10.3	75
	11/22/2002	4.1	2	38	0.59	8.49	4.23	125
	2/3/2003	3.9	0	80	1	18.7	7.88	175
	5/16/2003	4.2	2	44	0.64	6.22	2.81	150
	8/22/2003	3.9	0	54	0.38	15.4	6.55	100
	6/17/2003	3.9	0.4	75.40	0.49	11.40	5.26	576

Monitoring Point	Date	pH	Alkalinity	Acidity	Iron	Manganese	Aluminum	Flow
		Lab	mg/l	mg/l	mg/L	mg/L	mg/L	gpm
MOOS04	9/8/2003	4.0	2.2	72.00	0.36	10.60	4.72	885
	Average	3.97333	0.97333	60.89333	0.74880	14.14800	5.55133	232.78571
	St Dev	0.18696	2.11777	17.81891	0.24438	6.32369	1.93313	231.87304
MOOS02	12/3/2002	5.1	7.6	37.00	<0.3	1.27	1.09	2303
Latitude	1/20/2003	5	6.6	41.00	<0.3	1.73	1.21	3997
41-02-28.27	6/17/2003	5.3	6.6	27.00	<0.3	1.03	0.75	9941
Longitude	9/8/2003	5.4	7.4	25.00	<0.3	1.17	0.87	9784
78-27-23.49	Average	5.20000	7.05000	32.50000	ND	1.30000	0.97950	6506.25000
Paradise School Road	St Dev	0.15811	0.45552	6.68954	NA	0.26249	0.18109	3409.72135
MOOS01	12/3/2003	5.4	7.8	38	<0.3	1.38	1.3	2057
Latitude	1/20/2003	5.0	6.8	39.60	<0.3	1.85	1.19	3767
41-01-50.76	6/17/2003	5.5	6.8	27.20	<0.3	1.16	0.87	9976
Longitude	9/8/2003	5.7	7.8	24.40	<0.3	1.36	0.95	14055
78-26-18.54	Average	5.40000	7.30000	32.30000	NA	1.43750	1.07800	7463.75000
Mouth of Moose Creek	St Dev	0.29439	0.57735	7.62015	NA	0.29239	0.20081	5557.42395
WOOD05	3/1/2001	5.4	10.0	1.20	<0.3	0.059	<0.5	1281
	4/10/2001	5.9	7.4	2.20	<0.3	0.05	<0.5	1580
Latitude	5/15/2001	5.7	7.0	0.80	<0.3	0.05	<0.5	464
41-03-21	6/25/2001	6	9.4	3.60	<0.3	0.05	<0.5	2091
Longitude	8/7/2001	5.6	6.0	7.40	<0.3	0.05	<0.5	125
78-29-14	8/28/2001	5.9	6.8	7.60	<0.3	0.05	<0.5	306
Woods Run upstream of	Average	5.75000	7.76667	3.80000	ND	0.05150	ND	974.18552
unnamed trib 26615	St Dev	0.22583	1.57692	3.02523	NA	0.00367	NA	791.99574

Monitoring Point	Date	pH	Alkalinity	Acidity	Iron	Manganese	Aluminum	Flow
		Lab	mg/l	mg/l	mg/L	mg/L	mg/L	gpm
WOOD04	3/1/2001	5.0	9.8	6	0.3	0.84	0.5	486
	4/10/2001	4.9	6.8	7	0.3	1.03	0.522	867
Latitude	5/15/2001	5.1	7.2	7.2	0.3	1.93	0.724	159
41-03-18	6/25/2001	4.8	7.4	28.4	0.3	0.61	0.5	1780
Longitude	8/7/2001	5.2	6.6	54.8	0.63	2.65	0.5	70
78-29-14	8/28/2001	6.2	10.6	46	1.5	1.57	0.5	88
	Average	5.20000	8.06667	24.90000	0.55500	1.43817	0.54100	575.00000
mouth of unnamed trib 26615	St Dev	0.50990	1.69548	21.64431	0.48140	0.76660	0.09008	664.89999
WOOD03	3/1/2001	5.8	10.8	3.6	0.3	0.348	0.5	2951
	4/10/2001	5.6	7.0	3.2	0.3	1.07	0.525	3708
Latitude	5/15/2001	5.5	7.0	1.2	0.31	0.267	0.5	520
41-03-05	6/25/2001	6.0	7.2	11.4	0.3	0.196	0.5	5231
Longitude	8/7/2001	5.8	6.4	9.4	0.3	0.05	0.5	268
78-28-44	8/28/2001	6.2	7.6	8.6	0.3	0.05	0.5	498
Woods Run upstream of	Average	5.81667	7.66667	6.23333	0.30167	0.33017	0.50417	2196.12519
unnamed trib 26614	St Dev	0.25626	1.58325	4.09374	0.00408	0.38122	0.01021	2072.52829
WOOD02	3/1/2001	6.0	11.4	3.2	<0.3	0.21	<0.5	430
	4/10/2001	5.8	7.2	2.4	<0.3	0.129	<0.5	443
Latitude	5/15/2001	5.6	7.2	0.2	<0.3	0.05	<0.5	23
41-03-03	6/25/2001	6.2	8.0	6.4	<0.3	0.159	<0.5	513
Longitude	8/28/2001	5.3	6.6	9.4	<0.3	0.079	<0.5	41
78-28-47	Average	5.78000	8.08000	4.32000	ND	0.12540	ND	289.94418
mouth of unnamed trib 26614	St Dev	0.34928	1.92146	3.60721	NA	0.06352	NA	237.56021

Monitoring Point	**Date**	**pH**	**Alkalinity**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Flow**
		Lab	**mg/l**	**mg/l**	**mg/L**	**mg/L**	**mg/L**	**gpm**
WOOD01	3/1/2001	5.2	10.0	2.4	0.3	0.246	<0.5	3972
	4/10/2001	5.4	7.0	2.6	0.3	1.04	<0.5	4517
Latitude	5/15/2001	5.6	7.2	1.2	0.3	0.231	<0.5	804
41-02-49	6/25/2001	5.6	9.2	12.4	0.398	0.246	<0.5	6814
Longitude	8/7/2001	6.4	8.8	7.0	0.3	0.054	<0.5	462
78-27-48	8/28/2001	6.8	12.0	0.0	0.3	0.117	<0.5	751
	Average	5.83333	9.03333	4.26667	0.31633	0.32233	ND	2886.50054
mouth of Woods Run	St Dev	0.62503	1.86082	4.63667	0.04001	0.36033	NA	2608.93118

Attachment F

Comment and Response

Comments/Responses on the Moose Creek Watershed TMDL

EPA Region III Comments

Comment:
Due to the large amount of load lost in the segments between points WOOD05, WOOD04, and WOOD03, it would be expected that significant impacts on the calculated reductions needed for the metals and acidity in the Moose Creek TMDL. It would be very helpful for our review if you can promptly provide the reasonable explanations for the large negative LAs (-578 lbs/d Acidity, -7.6 lbs/d Fe, -32.2 lbs/d Mn and -1.9 lbs/d Al) and the confirmed LTA concentrations for Al, Fe, Mn and Acidity at the Point WOOD03. I could not seem to get the calculated LTAs (based on statistical theory for 99th significance level assuming data follow Lognormal distributions) agreed with your submitted numbers.

Response:
It was determined that the flows used at WOOD04 were incorrect and were considerably higher than the actual measured flows. This resulted in the seemingly large loss of load between points WOOD03, WOOD04, and WOOD05. With the correct flows, the loading scenario is now appropriate.

For the calculated LTA concentrations, the simulation was completed a second time with the same results.