MONTOUR RUN WATERSHED TMDL
Allegheny County

For Acid Mine Drainage Affected Segments

Prepared by:

Pennsylvania Department of Environmental Protection

September 27, 2004

TABLE OF CONTENTS

TABLES

ATTACHMENTS

TMDL[1]
Montour Run Watershed
Allegheny County, Pennsylvania

Introduction

This report presents the Total Maximum Daily Loads (TMDLs) developed for segments in the Montour Run 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 depressed pH caused these impairments. These impairments resulted from acid drainage from abandoned coalmines. The TMDL addresses the three primary metals associated with acid mine drainage (iron, manganese, and aluminum) and pH. In addition to the AMD impairments, Montour Run was also listed for organic enrichment, low DO, nutrients, and siltation from urban runoff and storm sewers in 1998 and unionized ammonia and priority organics from other sources in 2002. These impairments are not addressed in this TMDL, but will be addressed at a later date.

Table 1. 303(d) Sub-List								
State Water Plan (SWP) Subbasin: 20-G Sewickley Creek								
Year	**Miles**	**Segment ID**	**DEP Stream Code**	**Stream Name**	**Designated Use**	**Data Source**	**Source**	**EPA 305(b) Cause Code**
1996	0.5	9958	36684	Montour Run	TSF	305(b) Report	RE	Metals
1998	26.18	9958	36684	Montour Run	TSF	Outside Source	AMD	Metals & pH
2002	36.9	9958	36701, 36684, 36728, 36723	McClarens Run, Montour Run, North Fork Montour Run, South Fork Montour Run	TSF	SWMP	AMD	Metals & pH
2004	36.9	9958	36701, 36684, 36728, 36723	McClarens Run, Montour Run, North Fork Montour Run, South Fork Montour Run	TSF	SWMP	AMD	Metals & pH

Resource Extraction=RE
Trout Stocking = TSF
Abandoned Mine Drainage = AMD
Surface Water Monitoring Program = SWMP

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

[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.*

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

Directions to the Montour Run Watershed

The Montour Run Watershed is located in southwestern Pennsylvania, occupying the west central portion of Allegheny County and comprises portions of Moon, Findlay, Robinson, and North Fayette townships as well as a portion of the Borough of Coraopolis. The watershed is found on portions of the United States Geological survey maps for the Ambridge, Aliquippa, Clinton, and Oakdale PA 7.5-Minute Quadrangles. The area within the watershed consists of approximately 36.6 square miles. Montour Run drains to the Ohio River near the Borough of Coraopolis.

Dominant land uses within the watershed include residential development, ranging from low to high density, industrial and commercial development, and open spaces. Approximately one quarter of the watershed area is occupied by the Pittsburgh International Airport (PIA). Mining historically occurred throughout the watershed, however; the western third of the watershed is the most heavily impacted by AMD.

To access the watershed from Greensburg, Pa., take Rt. 51 north to Rt. 60 west. From here make a right onto Beaver Grade Road and Montour Run crosses underneath of the road.

Geology of the Montour Run Watershed

Montour Run is located in the Allegheny Plateau physiographic province. The Allegheny Plateau covers much of western Pennsylvania and the area consists primarily of extensively forested uplands and several major river valleys dissect the highlands.

Structurally, Montour Run is located on the southwestern flank of the Brady's Bend Syncline, which is plunging southwest. The headwaters are located right off of Candor Dome, near lmperial. Montour Run has a drainage basin of 37 square miles, and runs about 12.8 miles northeast from where its headwaters begin. The general strike in the area is about 40 degrees northwest, while the dip of the area strata is almost horizontal, on the order of less than 1 degree trending southward.

The topography of the area has been altered by construction as the Pittsburgh International Airport, which occupies around 25% of the watershed. The area otherwise consists of gently rolling hills with slopes on the order of less than 5 %. The maximum elevation around the stream is 1300 feet, and the minimum elevation is around 700 feet, where Montour Run enters the Ohio River.

Rocks of Upper Pennsylvanian age to lower Permian age underlie the Montour Run Watershed in Allegheny County. Montour Run encounters the following formations: Glenshaw group (oldest), the Monongahela formation, and the Waynesburg formation (youngest). These Pennsylvanian and Permian aged rocks consist of alternating sandstones, shales and coal beds, with an occasional interbedded limestone. The most significant strata in this series is the Pittsburgh coal seam of the Monongahela group, which has been extensively deep mined. Drainage from these deep mines is the primary source of pollution to Montour Run.

Segments addressed in this TMDL

There is one active mining operation in the watershed, Olszewski Contracting Co., Inc. Imperial site SMP 02010101. All of the remaining discharges in the watershed are from abandoned mines and will be treated as non-point sources. Each segment on the 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.

---

[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 the 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 and comment period on draft TMDL;
6. Submittal of final TMDL; and
7. EPA approval of the TMDL.

Watershed History

Mining began in the mid 19th century in some portions of the watershed. The Imperial Coal Company operated three mines by 1889 and controlled the Montour Railroad. With the practice of strip mining in the 1930's, most of the deep shaft mines were closed. There are at least 20 abandoned mines located within the Montour Run Watershed and several degraded, high volume deep mine discharges. Most of these discharges are located in the headwaters of Montour Run along the outlying western portions of the watershed. A majority of the AMD in the watershed comes from old deep mines from the early 1900's and strip mining operations abandoned in the 1950's and 60's. Exposed alkaline material in the lower elevations of the Conemaugh Group strata neutralize the acid produced by the Pittsburgh Coal Seam mining operations resulting in highly alkaline streams.

The 2003 Montour Run Watershed Association "Abandoned Mine Drainage Cleanup Plan" identifies twelve of the major AMD discharges in the watershed, following is a short description of each discharge, refer to the map in Attachment A for discharge locations ("Abandoned Mine Drainage Cleanup Plan", MRWA, 2003).

MP5 – This discharge is located in the headwaters of the West Fork of Enlow Run near the edge of Moon-Clinton Road (SR 3089).

NFMU9 – A severely impacted seep zone along the east side of SR 30 that drains to the North Fork Montour Run headwaters.

MP2 – This discharge issues from the base of a strip mine spoil and drains directly to the headwaters of North Fork Montour Run approximately 400 feet downstream of the NFMU9 discharge.

NFMU5 – Discharge consisting of both surface and deep mine discharges. The area is a gently sloping stream valley bounded to the south by reclaimed strip mines and bounded to the north by residential/lawn areas.

NFMU6 - This discharge flows in a broad gently sloping stream valley. This site is a former mine-impacted land that is reverting to unmanaged woodland.

MP6 – Discharge consisting of both surface and underground mines located along Boggs Road.

SFMU2 - Discharge from the toe of spoil from an abandoned mine. This site is characterized by an impacted wetland area and flows into the South Fork Montour Run headwaters.

SFMS6 - An abandoned underground mine discharge to an unnamed tributary to South Fork Montour Run.

SFMS7 – Drain from an abandoned underground mine issues in a diffuse seep zone generally bound by Santiago to the north, Old Steubenville Pike to the south, a completed strip mine/fill area to the west, and Santiago Road to the east.

SFMD7 – Discharge from an abandoned underground mine near Wilson School and upgradient of a townhouse complex accessed from Meander Street.

SFMD3 – Abandoned mine discharge issues from a seep area along the Montour Trail and North Star Road and drains to South Fork Montour Run.

MKR3 - A deep mine that discharges directly to the headwaters of Milk Run.

There is one active surface mining permit in the watershed, the Olszewski Contracting Co., Inc. Imperial Coal Mine, SMP 02010101. Located on the permit area is one pre-law discharge. The permit, therefore, is 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 discharge on this site is treated as a nonpoint source for the purpose of doing the TMDL, however, waste load allocations are assigned to the permitted NPDES discharge points for this mine site.

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. Table 2 contains the average concentration and flow from the abandoned discharge located on the Imperial site. The map in attachment A shows the location of this discharge. The individual discharge is not assigned a load allocation, 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.

Table 2. Imperial Site Pre-existing Discharge Average Loading

Discharge	Acidity	Iron	Manganese	Aluminum
	lbs/day	lbs/day	lbs/day	lbs/day
D4	37	-	-	5

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 non-point 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 non-point 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:

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

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

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.

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 <= pH <= 9.0
Fe <= 3.0 mg/l
Mn <= 2.0 mg/l
Al <= 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:

Flow (MGD) X BAT limit (mg/l) X 8.34 = 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 TMDLs' component makeup will be 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 3. 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 4 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 is currently one permitted discharge in the watershed. 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 4. TMDL Component Summary for the Montour Run Watershed

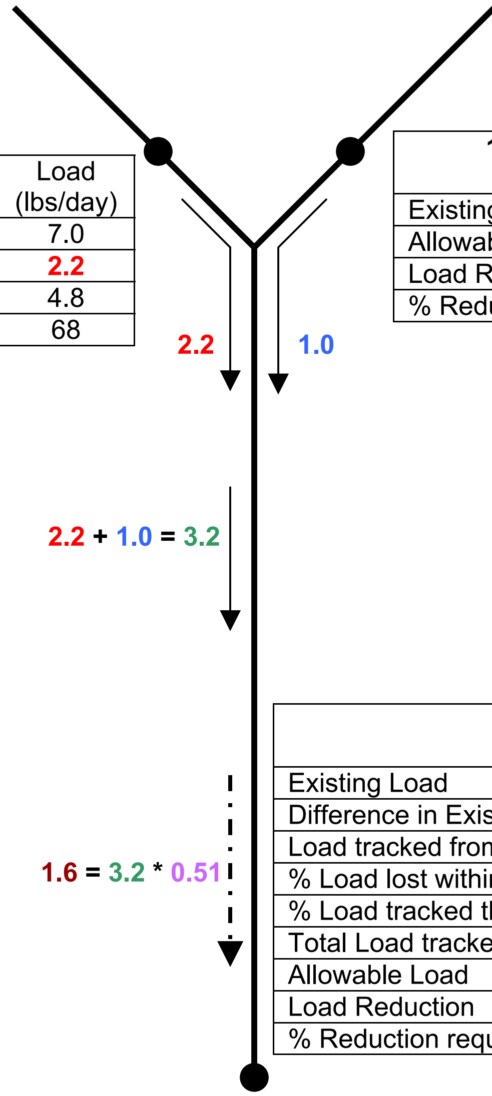
Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
1	*Mouth of Montour Run*						
	Fe	38.8	38.8	NA	NA	0.0	0
	Mn	8.7	8.7	NA	NA	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	ND	NA	NA	NA	0.0	0
2	*Mouth of Unnamed Tributary 36691(locally, Salamander Run)*						
	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	ND	NA	NA	NA	0.0	0
3	*Montour Run, upstream of Unnamed Tributary 36691*						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	6.8	6.8	NA	NA	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	ND	NA	NA	NA	0.0	0
4	*Mouth of Unnamed Tributary 36694 (locally, Grimm Creek)*						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	ND	NA	NA	NA	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	ND	NA	NA	NA	0.0	0
5	*Montour Run, upstream of Unnamed Tributary 36694*						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	5.1	5.1	NA	NA	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	ND	NA	NA	NA	0.0	0
6	*Mouth of McClarens Run*						
	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	ND	NA	NA	NA	0.0	0
9	*Montour Run, upstream of McClarens Run*						
	Fe	4.9	4.9	NA	NA	0.0	0
	Mn	2.0	2.0	NA	NA	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	ND	NA	NA	NA	0.0	0
10	*Mouth of Unnamed Tributary 36707 (locally, Milk Run)*						
	Fe	1.5	1.5	NA	NA	0.0	0
	Mn	1.8	1.8	NA	NA	0.0	0
	Al	16.0	1.9	0.0	1.9	14.1	88
	Acidity	ND	NA	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 %
11	*Mouth of Unnamed Tributary 36710 (locally, Enlow Run)*						
	Fe	5.5	5.5	NA	NA	0.0	0
	Mn	4.1	3.3	0.0	3.3	0.0	0
	Al	16.5	9.1	0.0	9.1	7.2	44
	Acidity	ND	NA	NA	NA	0.0	0
12	*Mouth of Unnamed Tributary 36711 (locally, East Fork Enlow Run)*						
	Fe	2.1	2.1	NA	NA	0.0	0
	Mn	1.0	1.0	NA	NA	0.0	0
	Al	ND	ND	NA	NA	0.0	0
	Acidity	ND	ND	NA	NA	0.0	0
13	*Unnamed Tributary 36710, upstream of Unnamed Tributary 36711 (locally West Fork Enlow Run)*						
	Fe	8.2	1.9	0.0	1.9	6.3	77
	Mn	7.0	2.2	0.0	2.2	4.8	68
	Al	5.3	5.1	0.0	5.1	0.2	3
	Acidity	ND	NA	NA	NA	0.0	0
14	*Montour Run, upstream of Unnamed Tributary 36710*						
	Fe	4.9	4.9	NA	NA	0.0	0
	Mn	6.1	5.8	0.0	5.8	0.0	0
	Al	18.4	10.7	0.0	10.7	0.0	0
	Acidity	ND	NA	NA	NA	0.0	0
15	*Mouth of North Fork Montour Run*						
	Fe	3.9	3.7	0.1	3.6	0.2	7
	Mn	9.2	5.3	0.1	5.2	3.9	43
	Al	7.1	1.4	0.1	1.3	5.7	80
	Acidity	ND	NA	NA	NA	0.0	0
16	*Mouth of South Fork Montour Run*						
	Fe	4.3	4.3	NA	NA	0.0	0
	Mn	3.8	3.8	NA	NA	0.0	0
	Al	13.0	1.4	0.0	1.4	11.6	89
	Acidity	ND	NA	NA	NA	0.0	0

ND, values below the detection limit.
NA meets WQS. No TMDL necessary.

In the instance that the allowable load is equal to the existing load (e.g. iron point 1, Table 4), 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 1, Table 4), 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 4 are calculated. For this example, manganese allocations for points 11, 12, and 13 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. These analyses follow the example. Attachment A contains a map of the sampling point locations for reference.



13	Load (lbs/day)
Existing Load	7.0
Allowable Load	2.2
Load Reduction	4.8
% Reduction	68

12	Load (lbs/day)
Existing Load	1.0
Allowable Load	1.0
Load Reduction	0.0
% Reduction	0

11	Load (lbs/day)
Existing Load	4.1
Difference in Existing Load between 11, 12 & 13	-3.9
Load tracked from 12 & 13	3.2
% Load lost within segment	49
% Load tracked through segment	51
Total Load tracked between points 11, 12 & 13	1.6
Allowable Load	3.3
Load Reduction	0.0
% Reduction required	0

A waste load allocation is assigned to the permitted mine drainage treatment pond contained on the Olszewski Contracting Co., Inc. SMP 02010101 Imperial site. Waste load allocations are calculated using the methodology explained previously in the *Method to Quantify Treatment Pond Pollutant Load* section of the report. There are two permitted pits with dimensions of 243' x 120' and 123' x 40' for a combined area of 34,080 square feet. This value is used in calculating the waste load allocations. The treatment pond location can be found on the map in Attachment A. The WLA for TPA is being evaluated at sample point 15.

No required reductions of permit limits are required at this time. All necessary reductions are assigned to non-point sources. Table 5 below contains the WLA for the mine drainage treatment pond located on the Imperial site.

Table 5. Waste Load Allocations of Permitted Discharges

Parameter	Allowable Average Monthly Conc. (mg/L)	Calculated Average Flow (MGD)	WLA (lbs/day)
Olszewski Contracting Co., Inc. Imperial site (NPDES PA0200751)			
TPA			
Fe	3.0	0.0035	0.09
Mn	2.0	0.0035	0.06
Al	2.0	0.0035	0.06

Recommendations

The Montour Run Watershed Association (MRWA) was incorporated in March 2000, formalizing and extending the work of an informal coalition previously identified as the Montour Valley Alliance (MVA). The MVA, formed in 1995 under the leadership of the Hollow Oak Land Trust (HOLT). Shortly after its formation, the MVA retained the U.S. Army Corps of Engineers (USACOE), Pittsburgh District, to conduct an in-depth study of water quality in Montour Run. This study, published in 1997, identified areas of significant water quality impairment and highlighted opportunities for remediation of many of the problems. Motivated by the findings of the water quality study, the MVA sponsored the Montour Run Watershed Planning Project, under which a “River Conservation and Land-Use Plan for the Montour Run Watershed” was developed. The watershed plan, which enabled the Montour Run Watershed to be listed on the Pennsylvania Rivers Conservation Registry of the Pennsylvania Department of Conservation and Natural Resources (DCNR), included a set of 61 recommended actions to protect aquatic, biological, land, cultural, educational, and recreational resources within the watershed. One of the recommendations found in the plan included the ranking and remediation of abandoned mine drainage (AMD) sites within the watershed.

In May 2000, funded by a grant from the Western Pennsylvania Coalition for Abandoned Mine Reclamation (WPCAMR), MRWA sponsored the workshop, "Attacking Abandoned Mine Drainage in the Montour Run Watershed," as a first step toward remediation of mine drainage flows into the Montour Run and its tributaries. This workshop was conducted to identify treatment methods that might be useable in remediating the discharges and to identify shortfalls in the information needed to rank them and to determine the best treatment approaches. Attending this workshop was a variety of stakeholders including concerned citizens, private engineering and mining firms, members of academia, and representatives from local, county, state and federal agencies (MRWA).

On December 18, 2000 MRWA was awarded an AMD Watershed Assessment Grant through the Pennsylvania Department of Environmental Protection, Bureau of Mining and Reclamation. The grant was for the "Montour Run Streambank Stabilization" project. The project stabilized a total of 1460 feet of eroded streambanks at twelve sites along the main stem of Montour Run. Carbonate rock linings and riparian buffer plantings were utilized to stabilize the streambanks. This project has reduced the sediment loading to Montour Run and has thus improved the water quality.

In September 2003 MRWA completed an "Abandoned Mine Drainage Cleanup Plan". A Growing Greener Grant funded the project. The final project report identifies and describes options to passively treat 12 abandoned mine discharges in the watershed. The discharges were ranked according to potential environmental benefits through remediation and overall project feasibility. Implementation of the Plan's recommendations will be the next step to improve the water quality of the Montour Run Watershed.

On September 18, 2003 MRWA was awarded two Growing Greener Grants, one for the "Boggs Road Mine Drainage Remediation System" project and the other for the “Clinton Road Acid Mine Drainage Remediation System” project. The Boggs Road Discharge is an alkaline-iron discharge with an average iron concentration of 16.9 mg/l and an average flow of 31gpm. Approximately 3 1/4 tons/year of iron from this discharge enters the South Fork Montour Run. . This project will design and construct a passive treatment system to treat the Boggs Road Discharge. This remediation system will improve about 2 1/2 miles of tributary and 12 miles of the main stem of Montour Run. The Clinton Road Discharge is acidic with high concentrations of manganese and aluminum. This project will design and construct a passive treatment system to treat the Clinton Road Discharge. The average flow is between 50-75gpm. The discharge produces approximately 125 lbs/day of acidity, 6 lbs/day of manganese, and 14 lbs/day of aluminum. This remediation system will improve about one mile of Enlow Run and about 9 miles of the main stem of Montour Run.

In March 2004 MRWA submitted a Growing Greener Grant application for the "North Fork Montour Run Restoration-Phase I" project. This project proposes to design and construct a passive treatment system to treat the NFMU9 discharge. The NFMU9 discharge is acidic with an average flow of 40gpm. The average acidity, iron, manganese, and aluminum concentrations are 101 mg/l, 16 mg/l, 8 mg/l, and 7 mg/l, respectively. The projected decrease in pollutant loading to North Fork Montour Run is estimated to be 19,000 lbs/year of acidity and 6,000 lbs/year of metals. The project is expected to improve about 2 miles of North Fork Montour Run.

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 1960's, 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.

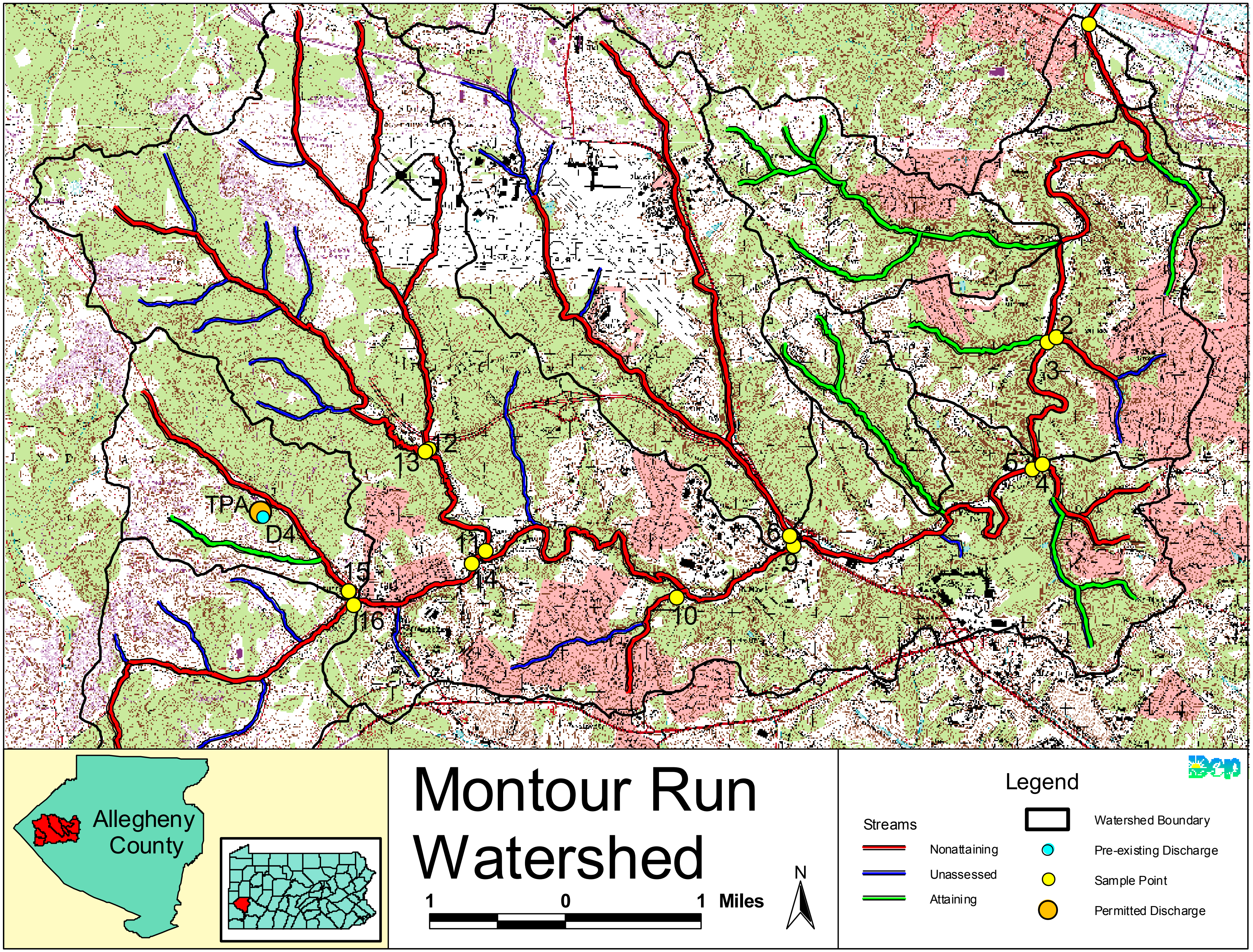
Reclaim PA is DEP's initiative designed to maximize reclamation of the state's quarter million acres of abandoned mineral extraction lands. Abandoned mineral extraction lands in Pennsylvania constituted a significant public liability – more than 250,000 acres of abandoned surface mines, 2,400 miles of 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

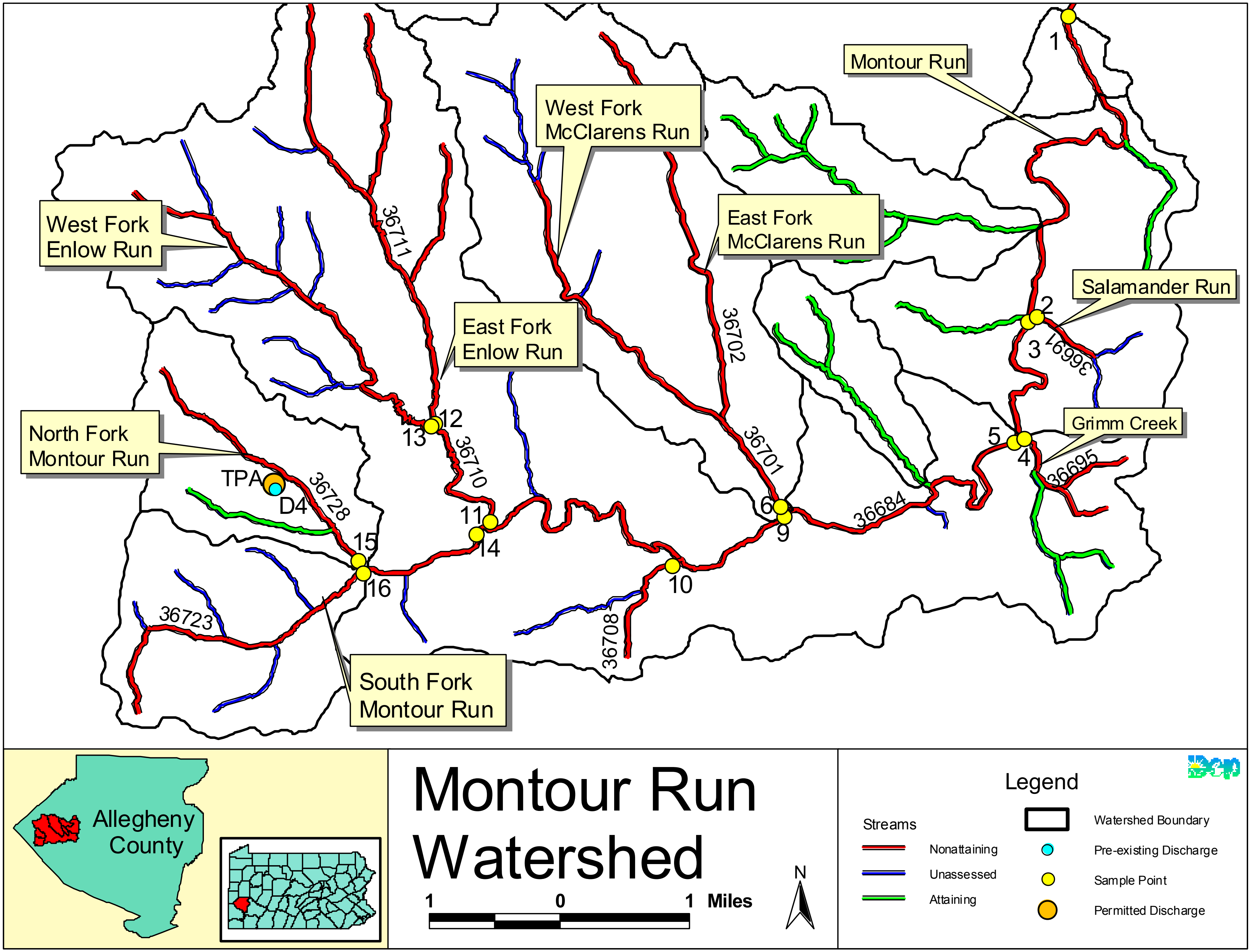
Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on July 17, 2004 and the *Suburban Gazette* on July 7, 2004 to foster public comment on the allowable loads calculated. The public comment period on this TMDL was open from July 17, 2004 to September 16, 2004. A public meeting was held on July 20, 2004 at the Robinson Township Municipal Building in Pittsburgh to discuss the proposed TMDL.

Attachment A

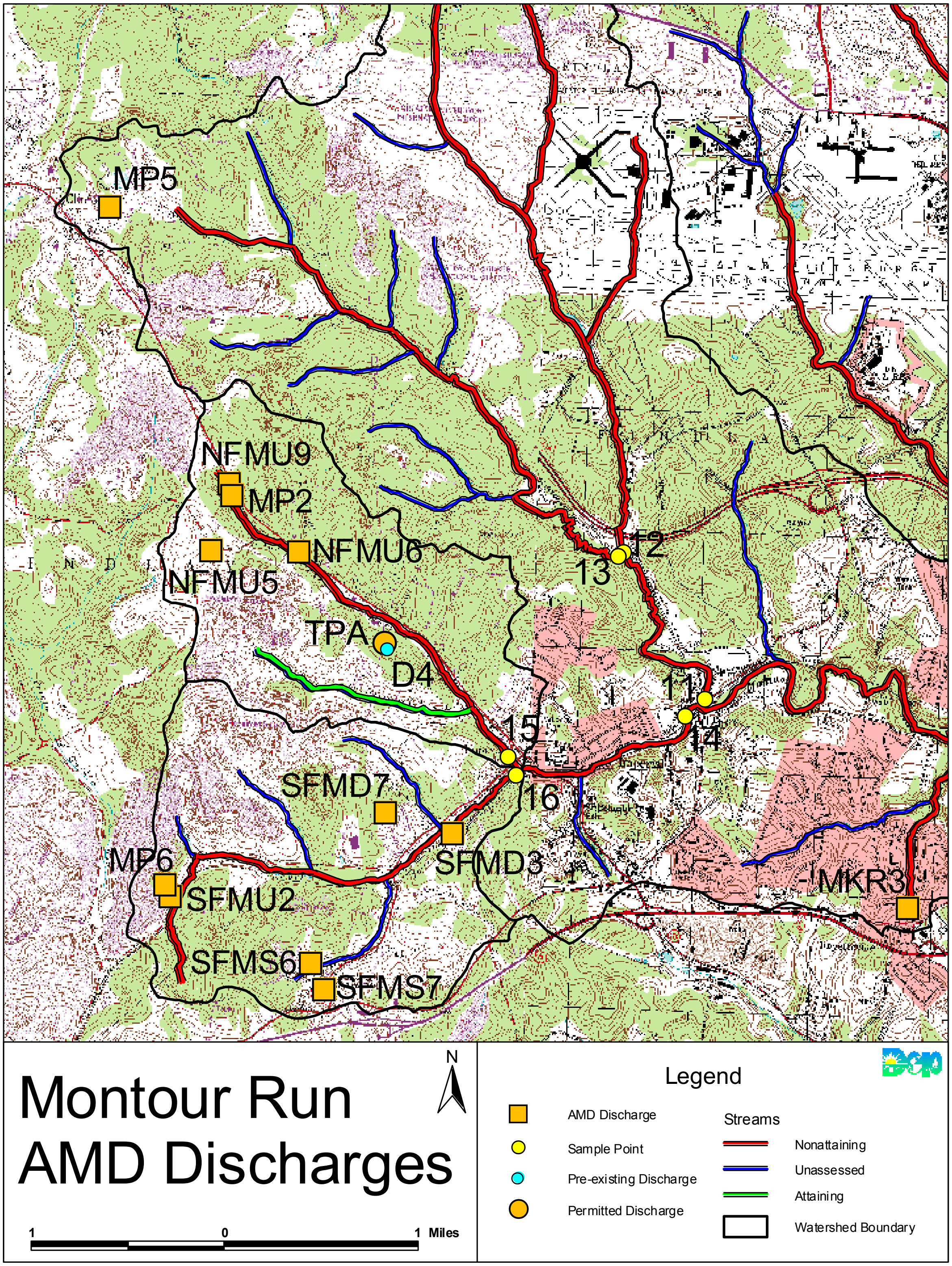
Montour Run Watershed Maps



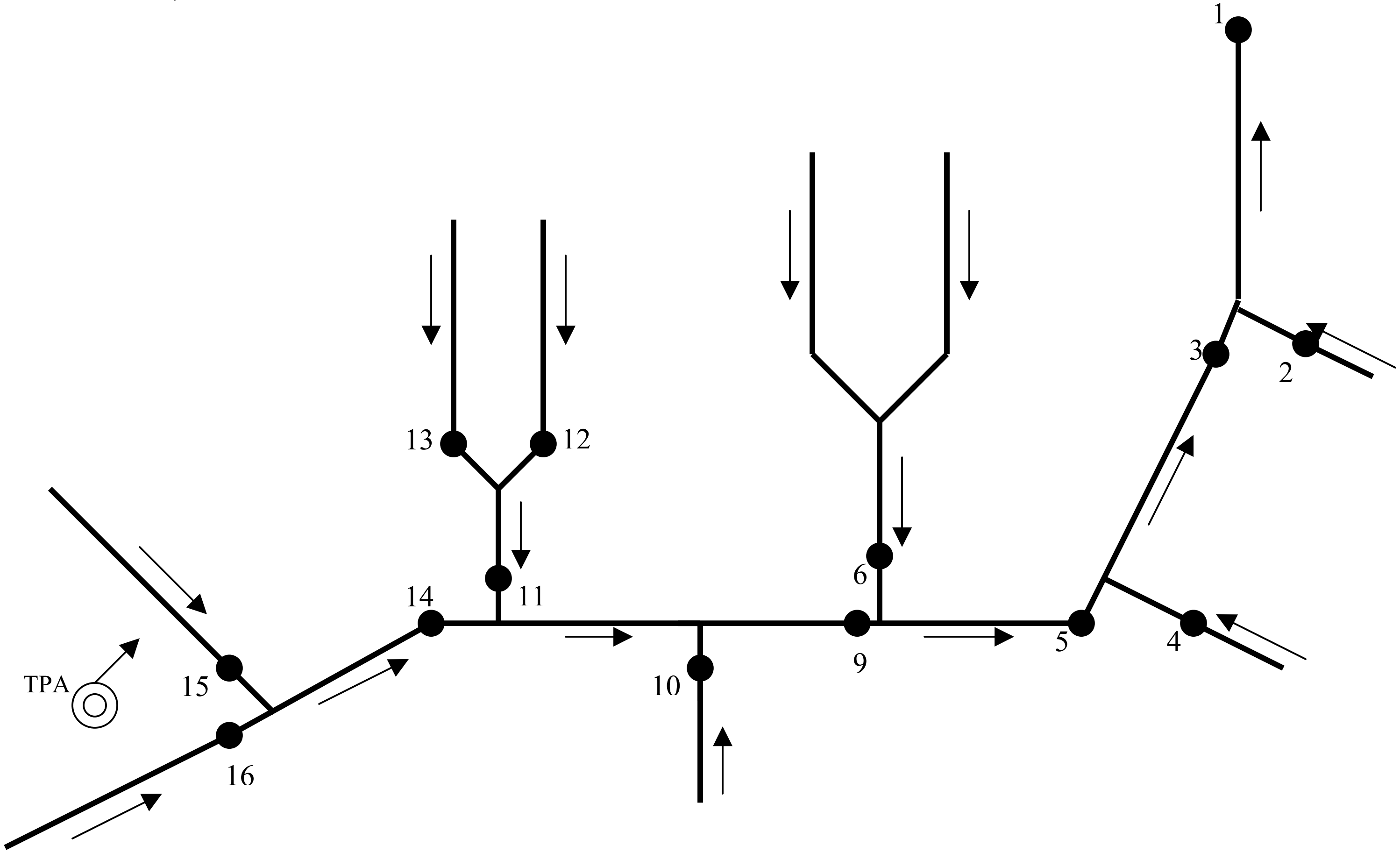
1
2
3
4
5
6
9
10
11
12
13
14
15
16
TPA
D4
Allegheny County
Montour Run Watershed
1
0
1
Miles
N
Legend
Streams
Nonattaining
Unassessed
Attaining
Watershed Boundary
Pre-existing Discharge
Sample Point
Permitted Discharge



Montour Run
West Fork McClarens Run
East Fork McClarens Run
West Fork Enlow Run
East Fork Enlow Run
Salamander Run
Grimm Creek
North Fork Montour Run
South Fork Montour Run
TPA
D4
36711
36710
36702
36701
36684
36697
36695
36728
36723
36708
1
2
3
4
5
6
9
10
11
12
13
14
15
16
Allegheny County
Montour Run Watershed
1 0 1 Miles
N
Legend
Streams
Nonattaining
Unassessed
Attaining
Watershed Boundary
Pre-existing Discharge
Sample Point
Permitted Discharge


MP5
NFMU9
MP2
NFMU6
NFMU5
TPA
D4
12
13
11
14
15
16
SFMD7
SFMD3
MP6
SFMU2
SFMS6
SFMS7
MKR3
Montour Run
AMD Discharges
N
1
0
1 Miles
Legend
AMD Discharge
Sample Point
Pre-existing Discharge
Permitted Discharge
Streams
Nonattaining
Unassessed
Attaining
Watershed Boundary

Montour Run Sampling Station Diagram
Arrows represent 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.*

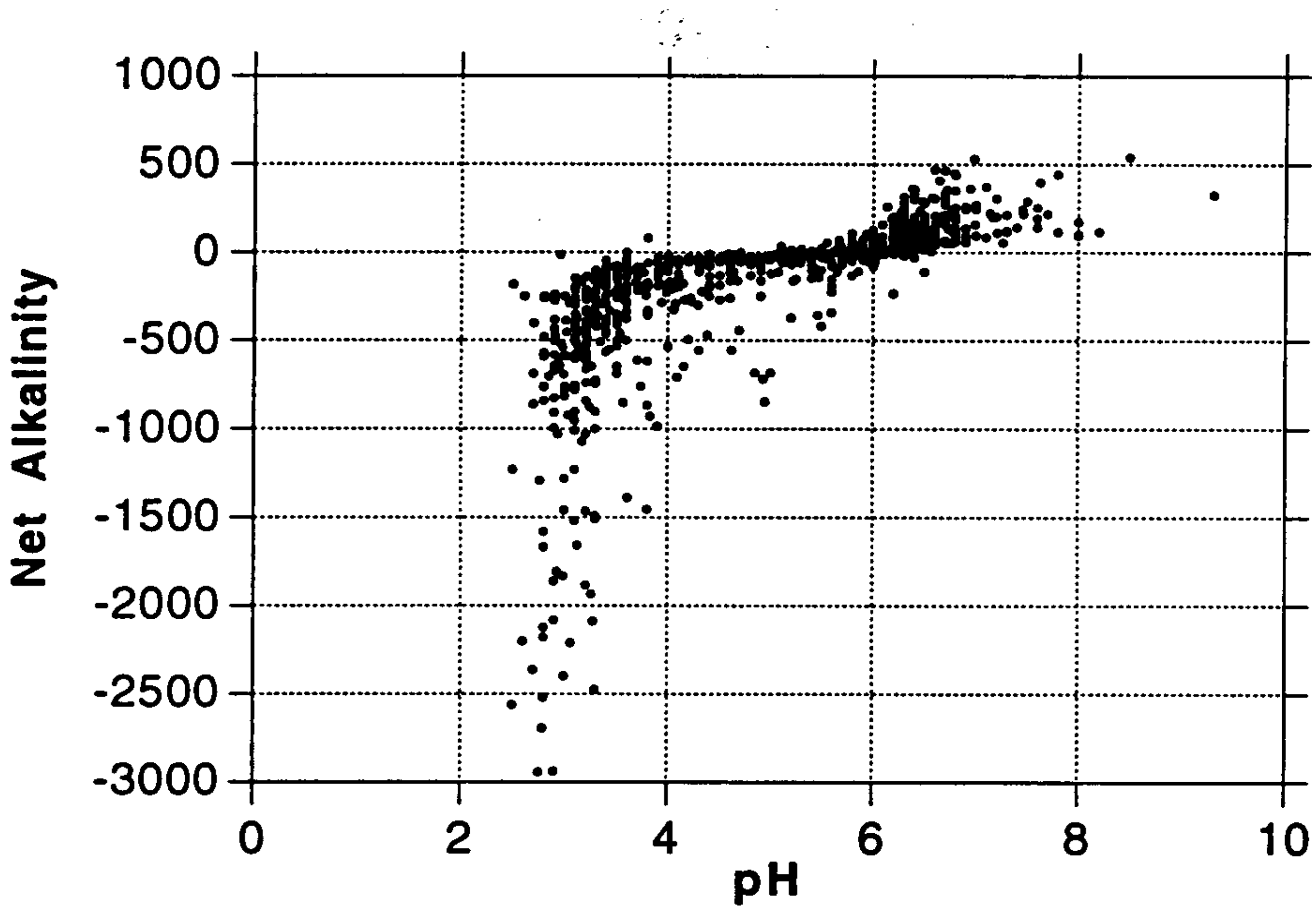


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Attachment C
TMDLs By Segment

Montour Run

The TMDL for Montour Run consists of load allocations of five tributaries and two sampling sites along the stream. A waste load allocation is assigned to the treatment pond discharge on the Olszewski Contracting Co., Inc. Imperial site (NPDES PA0200751). Analysis completed at seven additional points in the watershed determined that water quality standards are met under current conditions and therefore no TMDLs are necessary. Following is an explanation of the TMDL for each allocation point.

Montour Run is listed as impaired on the PA Section 303(d) list by high metals and depressed pH from AMD. For pH, 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.

Acidity was not detected at any of the sampling points. TMDLs for acidity are not necessary at any point because the WQS is met at all points. TMDLs are required for metals at the following points: 10, 11, 13, 14, 15, and 16. WQS are met for all parameters at all remaining sample points. This is consistent with the location of the AMD sources.

An allowable long-term average in-stream concentration was determined at each point for iron, manganese, aluminum, 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 16, mouth of South Fork Montour Run

The TMDL for Montour Run consists of a load allocation to all of the area above sampling point 16 (Attachment A). The load allocation for this stream segment was computed using water-quality sample data collected at point 16. The average flow of 0.76 MGD, measured at the sampling point, is used for these computations.

There is an entry for this segment on the PA Section 303(d) list for metals and pH impairments from AMD. Sample data at point 16 shows pH ranging between 6.9 and 7.8; pH is not addressed as part of this TMDL.

Water quality analysis determined that the allowable iron and manganese loads are equal to the measured loads. Because WQS are met, TMDLs for iron and manganese are not necessary. Although TMDLs are not necessary for iron and manganese, the loads are considered at the next downstream point, 14.

Table C1. TMDL Calculations at Point 16				
Flow = 0.76 MGD	Measured		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.68	4.3	0.68	4.3
Mn	0.60	3.8	0.60	3.8
Al	2.06	13.0	0.23	1.4
Acidity	ND	ND	NA	NA
Alkalinity	90.84	573.2		

Table C2. Calculation of Load Reduction Necessary at Point 16				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	4.3	3.8	13.0	ND
Allowable Load	4.3	3.8	1.4	NA
Load Reduction	0.0	0.0	11.6	0.0
% Reduction Segment	0	0	89	0

Waste Load Allocation – Olszewski Contracting Co., Inc. Imperial Site, TPA

The Olszewski Contracting Co., Inc., SMP 02010101, has one permitted treatment pond located within the permitted area. TPA, located on the map in Attachment A, discharges to the North Fork Montour Run upstream of 15. The waste load allocation for TPA was calculated as described in the *Method to Quantify Treatment Pond Pollutant Loading* section of the report. The following table shows the waste load allocation for the discharge.

Table C3. Waste Load Allocations Imperial site			
Parameter	**Monthly Avg. Allowable Conc. (mg/L)**	**Average Flow (MGD)**	**Allowable Load (lbs/day)**
TPA			
Fe	3.0	0.0035	0.09
Mn	2.0	0.0035	0.06
Al	2.0	0.0035	0.06

TMDL Calculations - Sampling Points 15, mouth of North Fork Montour Run

The TMDL for sampling point 15 consists of a waste load allocation to one treatment pond discharge and a load allocation to all of the area above the sampling point shown in Attachment A. The load allocation for this tributary was computed using water-quality sample data collected at point 15. The average flow of 0.80 MGD, measured at the sampling point, is used for these computations

There is an entry for this segment on the PA Section 303(d) list for metals and pH impairments from AMD. Sample data at point 15 shows pH ranging between 7.2 and 7.9; pH is not addressed as part of this TMDL.

Affects from the preexisting discharge D4, located on the Olszewski Contracting Co., Inc. Imperial site, are incorporated into the LA portion of the TMDL for point 15.

Table C4. TMDL Calculations at Point 15				
Flow = 0.80 MGD	Measured		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.59	3.9	0.55	3.7
Mn	1.38	9.2	0.79	5.3
Al	1.06	7.1	0.21	1.4
Acidity	ND	ND	NA	NA
Alkalinity	97.92	656.2		

Table C5. Calculation of Load Reduction Necessary at Point 15				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	3.9	9.2	7.1	ND
Allowable Load	3.7	5.3	1.4	NA
WLA (TPA)	0.1	0.1	0.1	-
LA	3.6	5.2	1.3	-
Load Reduction	0.2	3.9	5.7	0.0
% Reduction Segment	7	43	80	0

TMDL Calculations - Sampling Point 14, Montour Run upstream of Unnamed Tributary 36710

The TMDL for sampling point 14 consists of a load allocation to all of the area between sampling points 14, 15, and 16 shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point 14. The average flow of 1.71 MGD, measured at the sampling point, is used for these computations

There is an entry for this segment on the PA Section 303(d) list for metals and pH impairments from AMD. Sample data at point 14 shows pH ranging between 7.2 and 8.1; pH is not addressed as part of this TMDL.

Water quality analysis determined the allowable iron load is equal to the measured iron load. Because the WQS is met, a TMDL for iron is not necessary at 14. Although a TMDL for iron is not necessary, iron loads at 14 are considered at the next downstream point, 9.

Table C6. TMDL Calculations at Point 14

Flow = 1.71 MGD	Measured		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.34	4.9	0.34	4.9
Mn	0.43	6.1	0.40	5.8
Al	1.29	18.4	0.75	10.7
Acidity	ND	ND	NA	NA
Alkalinity	104.96	1498.5		

The calculated load reductions for all the loads that enter point 14 must be accounted for in the calculated reductions at sample point 14 shown in Table C7. A comparison of measured loads between points 14, 15, and 16 shows a decrease in loading for all metals. For loss of loading, the percent of load lost within the segment is calculated and applied to the upstream- allocated loads to determine the amount of load that is tracked through the segment. No additional reductions are necessary for metals at 14.

Table C7. Calculation of Load Reduction Necessary at Point 14

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	4.9	6.1	18.4	ND
Difference in Existing Load between 14, 15 & 16	-3.3	-6.9	-1.7	-
Load tracked from 15 & 16	7.9	9.1	2.8	-
Percent loss due to instream process	40	53	8	
Percent of loads tracked through segment	60	47	92	
Total Load tracked between points 14, 15 & 16	4.7	4.3	2.6	-
Allowable Load at 14	4.9	5.8	10.7	NA
Load Reduction at 14	0.0	0.0	0.0	0.0
% Reduction required at 14	0	0	0	0

TMDL Calculation - Sample Point 13, Unnamed Tributary 36710, upstream of Unnamed Tributary 36711 (locally, mouth of West Fork Enlow Run)

The TMDL for sample point 13 consists of a load allocation to all of the area above sample point 13 shown in Attachment A. The load allocation for this tributary is computed using water-quality sample data collected at point 13. The average flow of 0.82 MGD, measured at the sampling point, is used for these computations.

There is an entry for this segment on the PA Section 303(d) list for metals and pH impairments from AMD. Sample data at point 13 shows pH ranging between 6.9 and 7.6; pH is not addressed as part of this TMDL.

Table C8. TMDL Calculations at Point 13

Flow = 0.82 MGD	Measured		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	1.20	8.2	0.28	1.9
Mn	1.02	7.0	0.33	2.2
Al	0.77	5.3	0.75	5.1
Acidity	ND	ND	NA	NA
Alkalinity	72.20	492.0		

Table C9. Calculation of Load Reduction Necessary at Point 13

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	8.2	7.0	5.3	ND
Allowable Load	1.9	2.2	5.1	NA
Load Reduction	6.3	4.8	0.2	0.0
% Reduction Segment	77	68	3	0

TMDL Calculations - Sample Point 12, mouth of Unnamed Tributary 36711 (locally, East Fork Enlow Run)

The TMDL for sampling point 12 consists of a load allocation to all of the area above sample point 12 shown on the map in Attachment A. The load allocation for this tributary was computed using water-quality sample data collected at point 12. The average flow of 0.69 MGD, measured at the sampling point, is used for these computations.

There is an entry for this segment on the PA Section 303(d) list for metals and pH impairments from AMD. Sample data at point 12 shows pH ranging between 7.7 and 8.1; 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 loading is equal to the allowable loading. Because WQS are met, TMDLs for iron, aluminum, and manganese are not necessary. Although TMDLs for metals are not necessary, the iron and manganese loads are considered at the next downstream point, 11. Aluminum is not considered, however, because it is not detected at 12.

Table C10. TMDL Calculations at Point 12				
Flow = 0.69 MGD	Measured		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.37	2.1	0.37	2.1
Mn	0.18	1.0	0.18	1.0
Al	ND	ND	NA	NA
Acidity	ND	ND	NA	NA
Alkalinity	252.32	1455.1		

Table C11. Calculation of Load Reduction Necessary at Point 12				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	2.1	1.0	ND	ND
Allowable Load	2.1	1.0	NA	NA
Load Reduction	0.0	0.0	0.00	0.0
% Reduction Segment	0	0	0	0

TMDL Calculations - Sampling Point 11, mouth of Unnamed Tributary 36710 (locally, Enlow Run)

The TMDL for sampling point 11 consists of a load allocation to all of the area between sampling points 11, 12, and 13 shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point 11. The average flow of 1.47 MGD, measured at the sampling point, is used for these computations.

There is an entry for this segment on the PA Section 303(d) list for metals and pH impairments from AMD. Sample data at point 11 shows pH ranging between 7.2 and 8.2; pH is not addressed as part of this TMDL.

Water quality analysis determined that the allowable iron load is equal to the measured iron load. Because the WQS is met, a TMDL for iron is not necessary at point 11. Although a TMDL is not necessary for iron, the iron load at 11 is considered at the next downstream point, 9.

Table C12. TMDL Calculations at Point 11				
Flow = 1.47 MGD	Measured		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.45	5.5	0.45	5.5
Mn	0.34	4.1	0.27	3.3
Al	1.35	16.5	0.74	9.1
Acidity	ND	ND	NA	NA
Alkalinity	137.48	1682.5		

The calculated load reductions for all the loads that enter point 11 must be accounted for in the calculated reductions at sample point 11 shown in Table C13. A comparison of measured loads between points 11, 12, and 13 shows a decrease in loading within the segment for iron and manganese and an increase in aluminum. For loss of iron and manganese loading, the percent of load lost within the segment is calculated and applied to the upstream-allocated loads to determine the amount of load that is tracked through the segment. For aluminum, the total segment load is the sum of the upstream-allocated loads plus the additional loading that enters the segment. An additional reduction is necessary to the segment for aluminum.

Table C13. Calculation of Load Reduction Necessary at Point 11				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	5.5	4.1	16.5	ND
Difference in Existing Load between 11, 12 & 13	-4.8	-3.9	11.2	-
Load tracked from 12 & 13	4.0	3.2	5.1	-
Percent loss due to instream process	46	49	-	-
Percent of loads tracked through segment	54	51	-	-
Total Load tracked between points 11, 12 & 13	2.2	1.6	16.3	-
Allowable Load at 11	5.5	3.3	9.1	NA
Load Reduction at 11	0.0	0.0	7.2	0.0
% Reduction required at 11	0	0	44	0

TMDL Calculation – Sample Point 10, mouth of Unnamed Tributary 36707 (locally Milk Run)

The TMDL for sampling point 10 consists of a load allocation to all of the area above sample point 10 shown on the map in Attachment A. The load allocation for this tributary was computed using water-quality sample data collected at point 10. The average flow of 0.50 MGD, measured at the sampling point, is used for these computations.

There is an entry for this segment on the PA Section 303(d) list for metals and pH impairments from AMD. Sample data at point 10 shows pH ranging between 6.9 and 7.7; pH is not addressed as part of this TMDL.

Water quality analysis determined that the measured iron and manganese loading is equal to the allowable loading at sample point 10. Because WQS are met, TMDLs for iron and manganese are not necessary. Although TMDLs are not necessary for iron or manganese, the loadings are considered at the next downstream point, 9.

Table C14. TMDL Calculations at Point 10				
Flow = 0.50 MGD	Measured		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.35	1.5	0.35	1.5
Mn	0.42	1.8	0.42	1.8
Al	3.80	16.0	0.46	1.9
Acidity	ND	ND	NA	NA
Alkalinity	74.36	312.6		

Table C15. Calculation of Load Reduction Necessary at Point 10				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	1.5	1.8	16.0	ND
Allowable Load	1.5	1.8	1.9	NA
Load Reduction	0.0	0.0	14.1	0.0
% Reduction Segment	0	0	88	0

TMDL Calculation - Sample Point 9, Montour Run upstream of McClarens Run

The TMDL for sample point 9 consists of a load allocation to all of the area between sample point 9 and sample points 10, 11, and 14 shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point 9. The average flow of 1.91 MGD, measured at the sampling point, is used for these computations.

There is an entry for this segment on the PA Section 303(d) list for metals and pH impairments from AMD. Sample data at point 9 shows pH ranging between 7.7 and 8.3; 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 loading is equal to the allowable loading. Because WQS are met, TMDLs for iron, manganese, or aluminum are not necessary. Although TMDLs are not necessary for iron and manganese, the loading is considered at the next downstream point, 5.

Table C16. TMDL Calculations at Point 9				
Flow = 1.91 MGD	Measured		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.31	4.9	0.31	4.9
Mn	0.12	2.0	0.12	2.0
Al	ND	ND	NA	NA
Acidity	ND	ND	NA	NA
Alkalinity	179.80	2862.8		

The calculated load reductions for all the loads that enter point 9 must be accounted for in the calculated reductions at sample point 9 shown in Table C17. A comparison of measured loads between points 9, 10, 11, and 14 shows that there is a loss in iron and manganese load within the segment. For loss of loading, the percent of load lost within the segment is calculated and applied to the upstream loads to determine the amount of load that is tracked through the segment.

Table C17. Calculation of Load Reduction Necessary at Point 9				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	4.9	2.0	ND	ND
Difference in Existing Load between 9, 10, 11 & 14	-7.0	-10.0	-	-
Load tracked from 10, 11 & 14	8.3	7.7	-	-
Percent loss due to instream process	59	84	-	-
Percent of loads tracked through segment	41	16	-	-
Total Load tracked between points 9, 10, 11 & 14	3.4	1.3	-	-
Allowable Load at 9	4.9	2.0	NA	NA
Load Reduction at 9	0.0	0.0	0.0	0.0
% Reduction required at 9	0	0	0	0

TMDL Calculation - Sample Point 6, mouth of McClarens Run

The TMDL for sample point 6 consists of a load allocation to all of the area above sample point 6 shown in Attachment A. The load allocation for this tributary was computed using water-quality sample data collected at point 6. The average flow of 3.49 MGD, measured at the sampling point, is used for these computations.

There is an entry for this segment on the PA Section 303(d) list for metals and pH impairments from AMD. Sample data at point 6 shows pH ranging between 7.9 and 8.2; pH is not addressed as part of this TMDL.

All values for iron and aluminum are below the method detection limit, denoted by ND. Water quality analysis determined that the measured manganese loading is equal to the allowable manganese loading. Because WQS are met, TMDLs for iron, manganese, and aluminum are not necessary. Although a TMDL for manganese is not necessary, the loading is considered at the next downstream point, 5.

Table C18. TMDL Calculations at Point 6				
Flow = 3.49 MGD	Measured		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	ND	ND	NA	NA
Mn	0.10	2.8	0.10	2.8
Al	ND	ND	NA	NA
Acidity	ND	ND	NA	NA
Alkalinity	149.16	4345.5		

Table C19. Calculation of Load Reduction Necessary at Point 6				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	ND	2.8	ND	ND
Allowable Load	NA	2.8	NA	NA
Load Reduction	0.0	0.0	0.0	0.0
% Reduction Segment	0	0	0	0

TMDL Calculation - Sample Point 5, Montour Run upstream of Unnamed Tributary36694

The TMDL for sample point 5 consists of a load allocation to all of the area between sample point 5 and sample points 6 and 9 shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point 5. The average flow of 7.54 MGD, measured at the sampling point, is used for these computations.

There is an entry for this segment on the PA Section 303(d) list for metals and pH impairments from AMD. Sample data at point 5 shows pH ranging between 8.0 and 8.3; pH is not addressed as part of this TMDL.

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

Table C20. TMDL Calculations at Point 5				
Flow = 7.54 MGD	Measured		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	ND	ND	NA	NA
Mn	0.08	5.1	0.08	5.1
Al	ND	ND	NA	NA
Acidity	ND	ND	NA	NA
Alkalinity	135.16	8501.8		

The calculated load reductions for all the loads that enter point 5 must be accounted for in the calculated reductions at sample point 5 shown in Table C21. A comparison of measured loads between points 5, 6, and 9 shows that there is a decrease in manganese load within the segment For loss of loading, the percent of load lost within the segment is calculated and applied to the upstream loads to determine the amount of load that is tracked through the segment.

Table C21. Calculation of Load Reduction Necessary at Point 5				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	ND	5.1	ND	ND
Difference in Existing Load between 5, 6 & 9	-	0.3	-	-
Load tracked from 6 & 9	-	4.1	-	-
Percent load lost		6		
Percent load tracked between 5, 6 & 9		94		
Total Load tracked between points 5, 6 & 9	-	3.8	-	-
Allowable Load at 5	NA	3.9	NA	NA
Load Reduction at 5	0.0	0.0	0.0	0.0
% Reduction required at 5	0	0	0	0

TMDL Calculation – Sample Point 4, Mouth of Unnamed Tributary 36694 (locally Grimm Creek)

No TMDLs are necessary at point 4. Values are below the method detection limits for all parameters.

TMDL Calculation - Sample Point 3, Montour Run upstream of Unnamed Tributary36691

The TMDL for sample point 3 consists of a load allocation to all of the area between sample point 3 and sample points 4 and 5 shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point 3. The average flow of 8.02 MGD, measured at the sampling point, is used for these computations.

There is an entry for this segment on the PA Section 303(d) list for metals and pH impairments from AMD. Sample data at point 3 shows pH ranging between 8.0 and 8.4; pH will not be addressed as part of this TMDL.

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

Table C22. TMDL Calculations at Point 3				
Flow = 8.02 MGD	Measured		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	ND	ND	NA	NA
Mn	0.10	6.8	0.10	6.8
Al	ND	ND	NA	NA
Acidity	ND	ND	NA	NA
Alkalinity	131.16	8770.9		

The calculated load reductions for all the loads that enter point 3 must be accounted for in the calculated reductions at sample point 3 shown in Table C23. A comparison of measured loads between points 3, 4, and 5 shows that there is an increase in manganese load within the segment The total segment manganese load is the sum of the upstream load and the segment load.

Table C23. Calculation of Load Reduction Necessary at Point 3				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	ND	6.8	ND	ND
Difference in Existing Load between 3, 4 & 5	-	1.7	-	-
Load tracked from 4 & 5	-	3.8	-	-
Total Load tracked between points 3, 4 & 5	-	5.5	-	-
Allowable Load at 3	NA	6.8	NA	NA
Load Reduction at 3	0.0	0.0	0.0	0.0
% Reduction required at 3	0	0	0	0

TMDL Calculation – Sample Point 2, Mouth of Unnamed Tributary 36691 (locally, Salamander Run)

The TMDL for sampling point 2 consists of a load allocation to all of the area above sample point 2 shown on the map in Attachment A. The load allocation for this tributary was computed using water-quality sample data collected at point 2. The average flow of 0.26 MGD, measured at the sampling point, is used for these computations.

There is an entry for this segment on the PA Section 303(d) list for metals and pH impairments from AMD. Sample data at point 2 shows pH ranging between 7.2 and 7.8; pH is not addressed as part of this TMDL.

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

Table C24. TMDL Calculations at Point 2				
Flow = 0.26 MGD	Measured		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	ND	ND	NA	NA
Mn	0.25	0.5	0.25	0.5
Al	ND	ND	NA	NA
Acidity	ND	ND	NA	NA
Alkalinity	84.40	181.6		

Table C25. Calculation of Load Reduction Necessary at Point 2				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	ND	0.5	ND	ND
Allowable Load	NA	0.5	NA	NA
Load Reduction	0.0	0.0	0.0	0.0
% Reduction Segment	0	0	0	0

TMDL Calculation - Sample Point 1, mouth of Montour Run

The TMDL for sample point 1 consists of a load allocation to all of the area between sample point 1 and sample points 2 and 3 shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point 1. The average flow of 7.55 MGD, measured at the sampling point, is used for these computations.

There is an entry for this segment on the PA Section 303(d) list for metals and pH impairments from AMD. Sample data at point 1 shows pH ranging between 7.5 and 8.4; 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 loads. Because WQS are met, TMDLs for iron, manganese, and aluminum are not necessary.

Table C26. TMDL Calculations at Point 1				
Flow = 7.55 MGD	Measured		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.62	38.8	0.62	38.8
Mn	0.14	8.7	0.14	8.7
Al	ND	ND	NA	NA
Acidity	ND	ND	NA	NA
Alkalinity	129.80	8174.6		

The calculated load reductions for all the loads that enter point 1 must be accounted for in the calculated reductions at sample point 1 shown in Table C27. A comparison of measured loads between points 1, 2, and 3 shows that there is an increase in iron and manganese load within the segment The total segment is the sum of the upstream load and the segment load.

Table C27. Calculation of Load Reduction Necessary at Point 1				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	38.8	8.7	ND	ND
Difference in Existing Load between 1, 2 & 3	38.8	1.3	-	-
Load tracked from 2 & 3	0.0	6.1	-	-
Total Load tracked between points 1, 2 & 3	38.8	7.4	-	-
Allowable Load at 1	38.8	8.7	NA	NA
Load Reduction at 1	0.0	0.0	0.0	0.0
% Reduction required at 1	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 that 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

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 list. 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

Station	Date	Flow	pH	Alkalinity	Acidity	Fe	Mn	Al
		gpm		mg/L	mg/L	mg/L	mg/L	mg/L
1	**Mouth of Montour Run**							
	7/16/2002	3200	7.5	122.0	0	ND	0.213	ND
Latitude	7/3/2003	7528	8.1	131.4	0	0.616	0.143	ND
40-30-49	7/30/2003	9555	8.3	130.8	0	ND	ND	ND
Longitude	8/21/2003	2781	8.2	131.4	0	ND	0.058	ND
80-09-00	10/8/2003	3156	8.4	133.4	0	ND	ND	ND
	Average	5244.00000	8.10000	129.80000	0.00000	0.61600	0.13800	ND
	St Dev	3098.60557	0.35355	4.46990	0.00000	NA	0.07762	NA
2	**Mouth of Unnamed Tributary 36691 (Salamander Run)**							
	7/16/2002	40	7.2	76.0	0	ND	0.255	ND
Latitude	6/27/2003	276	7.8	81.6	0	ND	0.095	ND
40-28-48	7/30/2003	200	7.6	89.8	0	ND	0.153	ND
Longitude	8/21/2003	296	7.6	88	0	ND	0.358	ND
80-09-13	10/8/2003	84	7.7	86.6	0	ND	0.394	ND
	Average	179.20000	7.58000	84.40000	0.00000	ND	0.25100	ND
	St Dev	113.89118	0.22804	5.59821	0.00000	NA	0.12831	NA
3	**Montour Run, upstream of Unnamed Tributary 36691**							
	7/16/2002	2200	8.2	126.0	0	ND	0.054	ND
Latitude	6/27/2003	10507	8.2	136.6	0	ND	0.081	ND
40-28-46	7/30/2003	8400	8.2	136.2	0	ND	0.052	ND
Longitude	8/21/2003	2933	8.4	132.2	0	ND	ND	ND
80-09-17	10/8/2003	3801	8	124.8	0	ND	0.220	ND
	Average	5568.20000	8.20000	131.16000	0.00000	ND	0.10175	ND
	St Dev	3668.20402	0.14142	5.54869	0.00000	NA	0.07993	NA
4	**Mouth of Unnamed Tributary 36694 (Grimm Creek)**							
	6/16/2003	431	8.1	153.4	0	ND	ND	ND
Latitude	6/27/2003	242	8.2	178.2	0	ND	ND	ND
40-27-59	7/30/2003	403	8.1	158.8	0	ND	ND	ND
Longitude	8/21/2003	116	8.2	158.6	0	ND	ND	ND
80-09-18	10/8/2003	156	8.2	171.6	0	ND	ND	ND
	Average	269.60000	8.16000	164.12000	0.00000	ND	ND	ND
	St Dev	142.39487	0.05477	10.34273	0.00000	NA	NA	NA
5	**Montour Run, upstream of Unnamed Tributary 36694**							
	7/16/2002	2100	8.3	122.0	0	ND	ND	ND
Latitude	6/27/2003	10607	8	129.6	0	ND	0.098	ND
40-27-57	7/30/2003	7358	8.2	141.8	0	ND	ND	ND
Longitude	8/21/2003	2962	8.2	132.8	0	ND	0.064	ND
80-09-23	10/8/2003	3161	8.3	149.6	0	ND	ND	ND
	Average	5237.60000	8.20000	135.16000	0.00000	ND	0.08100	ND
	St Dev	3628.41939	0.12247	10.75026	0.00000	NA	0.02404	NA

Station	Date	Flow	pH	Alkalinity	Acidity	Fe	Mn	Al
		gpm		mg/L	mg/L	mg/L	mg/L	mg/L
6	**Mouth of McClarens Run**							
	7/16/2002	600	8	194.0	0	ND	ND	ND
Latitude	6/26/2003	4729	7.9	110.8	0	ND	0.099	ND
40-27-29	7/30/2003	4314	8	124.6	0	ND	0.083	ND
Longitude	8/21/2003	1740	8.1	112.6	0	ND	0.110	ND
80-11-25	10/8/2003	746	8.2	203.8	0	ND	ND	ND
	Average	2425.80000	8.04000	149.16000	0.00000	ND	0.09733	ND
	St Dev	1968.22412	0.11402	45.84613	0.00000	NA	0.01358	NA
9	**Montour Run upstream of McClarens Run**							
	7/16/2002	1400	8.3	110.0	0	ND	0.138	ND
Latitude	6/26/2003	1378	7.7	223.0	0	0.310	0.217	ND
40-27-25	7/30/2003	1382	8.1	203.2	0	ND	ND	ND
Longitude	8/21/2003	385	8.2	232.6	0	ND	0.058	ND
80-11-23	10/8/2003	2084	8.3	130.2	0	ND	0.080	ND
	Average	1325.80000	8.12000	179.80000	0.00000	0.31000	0.12325	ND
	St Dev	606.49831	0.24900	55.97732	0.00000	NA	0.07103	NA
10	**Mouth of Unnamed Tributary 36707 (Milk Run)**							
	7/16/2002	30	7.5	142.0	0	ND	ND	ND
Latitude	6/26/2003	431	6.9	50.4	0	0.393	0.458	4.93
40-27-04	7/30/2003	756	7.6	77.4	0	0.342	0.383	3.29
Longitude	8/21/2003	183	7.5	39	0	0.310	0.453	4.01
80-12-21	10/9/2003		7.7	63	0	ND	0.373	2.95
	Average	350.00000	7.44000	74.36000	0.00000	0.34833	0.41675	3.79500
	St Dev	317.11512	0.31305	40.42855	0.00000	0.04186	0.04498	0.87626
11	**Mouth of Unnamed Tributary 36710 (Enlow Run)**							
	7/16/2002	700	8.1	208.0	0	ND	0.052	ND
Latitude	6/26/2003	1542	7.2	92.6	0	0.448	0.720	1.350
40-27-20	7/30/2003	1351	7.9	119.6	0	ND	0.518	ND
Longitude	8/21/2003	689	8.2	99.6	0	ND	0.329	ND
80-13-58	10/9/2003	813	8.1	167.6	0	ND	0.065	ND
	Average	1019.00000	7.90000	137.48000	0.00000	0.44800	0.33680	1.35000
	St Dev	399.01441	0.40620	49.11489	0.00000	NA	0.28928	NA
12	**Mouth of Unnamed Tributary 36711 (E. Fork Enlow Run)**							
	7/17/2002	150	7.7	318.0	0	ND	0.542	ND
Latitude	6/26/2003	857	7.8	242.8	0	ND	0.100	ND
40-27-59	7/30/2003	475	8.0	218.0	0	0.391	0.091	ND
Longitude	8/21/2003	164	8.1	227.4	0	0.407	0.069	ND
80-14-28	10/9/2003	755	8.0	255.4	0	0.315	0.105	ND
	Average	480.20000	7.92000	252.32000	0.00000	0.37100	0.18140	ND
	St Dev	326.54816	0.16432	39.41081	0.00000	0.04915	0.20205	NA

Station	Date	Flow	pH	Alkalinity	Acidity	Fe	Mn	Al
		gpm		mg/L	mg/L	mg/L	mg/L	mg/L
13	**Enlow Run upstream of Unnamed Tributary 36711 (W. Fork Enlow Run)**							
	7/17/2002	250	7.6	78	0	0.369	0.349	ND
Latitude	6/26/2003	1103	6.9	57.4	0	ND	0.652	ND
40-27-58	7/30/2003	701	7.6	76.8	0	0.335	1.130	ND
Longitude	8/21/2003	411	7.5	73.6	0	ND	0.958	ND
80-14-30	10/9/2003	372	7.3	75.2	0	2.91	2.030	0.771
	Average	567.40000	7.38000	72.20000	0.00000	1.20467	1.02380	0.77100
	St Dev	342.08961	0.29496	8.43801	0.00000	1.47696	0.63672	NA
14	**Montour Run, upstream of Unnamed Tributary 36710**							
	7/16/2002	600	7.9	86	0	ND	0.208	ND
Latitude	6/26/2003	1554	7.2	93.8	0	0.342	0.729	1.290
40-27-15	7/30/2003	1691	8	117.4	0	ND	0.545	ND
Longitude	8/21/2003	928	8.1	98.8	0	ND	0.365	ND
80-14-05	10/9/2003	1171	7.9	128.8	0	ND	0.302	ND
	Average	1188.80000	7.82000	104.96000	0.00000	0.34200	0.42980	1.29000
	St Dev	447.37982	0.35637	17.64279	0.00000	NA	0.20768	NA
15	**Mouth of North Fork Montour Run**							
	7/17/2002	225	7.6	76	0	0.394	1.24	0.56
Latitude	6/26/2003	871	7.2	92.6	0	1.05	1.56	2.18
40-27-03	7/30/2003	714	7.9	113.6	0	0.438	1.33	0.83
Longitude	8/21/2003	466	7.8	92	0	0.474	1.51	0.686
80-15-07	10/9/2003	514	7.9	115.4	0	ND	1.25	ND
	Average	558.00000	7.68000	97.92000	0.00000	0.58900	1.37800	1.06400
	St Dev	246.77621	0.29496	16.54727	0.00000	0.30907	0.14856	0.75213
16	**Mouth of South Fork Montour Run**							
	7/17/2002	175	7.7	80	0	ND	0.542	0.729
Latitude	6/26/2003	669	6.9	74	0	0.615	0.730	3.970
40-26-58	7/30/2003	788	7.8	99	0	0.735	0.640	2.180
Longitude	8/21/2003	453	7.8	82.6	0	ND	0.632	1.350
80-15-04	10/9/2003	542	7.8	118.6	0	ND	0.441	ND
	Average	525.40000	7.60000	90.84000	0.00000	0.67500	0.59700	2.05725
	St Dev	233.38659	0.39370	18.07064	0.00000	0.08485	0.10969	1.40690

Attachment F
Comment and Response

Comments/Responses on the Montour Run Watershed TMDL

EPA Region III Comments (Received 09/16/2004)

Comment:
Several of the data sets used in developing the TMDLs include results that are less than the detection levels. In the @RISK analysis, the "less than" values were replaced with the detection limit. However, in tracking loads downstream, the where a parameter's entire data set was "less than" and a TMDL is not required at that point, a zero load was tracked downstream. EPA prefers a load based on a concentration of ½ of or the detection limit be tracked downstream. For example, aluminum at points 12, 9, 8, 7, etc., all samples are "less than" and no load is tracked downstream.

Response:
The "less than" detect values are not being considered in the water quality analysis for Montour Run. The report has been updated accordingly. ND denotes values below the detection limit. No load is carried at points where all values are below the detection limit as explained in the report.

Comment:
Format (equation numbers) pages 9 & 10.

Response:
Corrected.