

LICK RUN WATERSHED TMDL

Clearfield County

Prepared for:

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TMDL¹
Lick Run Watershed
Clearfield County, Pennsylvania

INTRODUCTION

This report presents the Total Maximum Daily Load (TMDL) developed for stream segments in the Lick Run Watershed (Attachment A). This was done to address impairments noted on the 1996, 1998, 2002, and draft 2004 Pennsylvania Section 303(d) lists required under the Clean Water Act and covers eight segments on this list (Table 1). High levels of metals and depressed pH caused these impairments. All impairments resulted from acid drainage from abandoned coal mines. The TMDL addresses the three primary metals (iron, manganese, aluminum) associated with acid mine drainage (AMD) and pH.

Table 1. Lick Run Segments Addressed

<i>State Water Plan (SWP) Subbasin: 08-C Susquehanna River</i>								
Year	Miles	Segment ID	DEP Stream Code	Stream Name	Designated Use	Data Source	Source	EPA 305(b) Cause Code
1996	3.7	9351	26082	Lick Run	HQ-CWF	305(b) Report	RE	Metals
1996	3.8	7170	26088	Fork Run	HQ-CWF	305(b) Report	RE	Metals
1998	3.33	9351	26082	Lick Run	HQ-CWF	SWMP	AMD	Metals
1998	3.65	7170	26088	Fork Run	HQ-CWF	SWMP	AMD	pH
2002	1.9	990707-0955-LMS	26083	Flegals Run	HQ-CWF	Unassessed Waters	AMD	Metals, pH
2002	2.7	990707-0955-LMS	26082	Lick Run	HQ-CWF	Unassessed Waters	AMD	Metals, pH
2002	2.7	7170	26088	Fork Run	HQ-CWF	Unassessed Waters	AMD	Metals
2002	0.9	9351	26082	Lick Run	HQ-CWF	Unassessed Waters	AMD	pH
2004	1.9	990707-0955-LMS	26083	Flegals Run	HQ-CWF	Unassessed Waters	AMD	Metals, pH
2004	2.7	7170	26088	Fork Run	HQ-CWF	Unassessed Waters	AMD	Metals
2004	2.3	20030929-1804-LMS	26084	Jerry Run	HQ-CWF	Unassessed Waters	AMD	pH
2004	0.5	990707-0955-LMS	26085	UNT Lick Run	HQ-CWF	Unassessed Waters	AMD	Metals, pH
2004	1.2	20030929-1801-LMS	26085	UNT Lick Run	HQ-CWF	Unassessed Waters	AMD	Metals, pH
2004	1.5	990707-0955-LMS	26082	Lick Run	HQ-CWF	Unassessed Waters	AMD	Metals, pH
2004	0.9	9351	26082	Lick Run	HQ-CWF	Unassessed Waters	AMD	Metals, pH
2004	0.7	20030929-1801-LMS	26086	UNT Lick Run	HQ-CWF	Unassessed Waters	AMD	Metals, pH

See Attachment B, Excerpts Justifying Changes Between the 1996, 1998, 2002, and draft 2004 Section 303(d) lists. The use designations for the stream segments in this TMDL can be found in PA Title 25 Chapter 93.

HQ-CWF = High Quality Cold Water Fishes
 RE = Resource Extraction
 AMD = Abandoned Mine Drainage
 SWMP = Surface Water Monitoring Program

¹ Pennsylvania's 1996, 1998, and 2002 Section 303(d) lists were approved by the U.S. Environmental Protection Agency. The draft 2004 Section 303(d) list had not yet been approved at the time this document was written. The 1996 Section 303(d) list provides the basis for measuring progress under the 1996 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA*.

LOCATION

The Lick Run Watershed is approximately 27.5 square miles in area. It is located in parts of Goshen, Lawrence, and Pine Townships, Clearfield County, Pennsylvania. Lick Run flows southeast from its headwaters located in Moshannon State Forest and State Game Land 90 to its confluence with the West Branch Susquehanna River. The Lick Run Watershed is forested from the headwaters until the towns of Goshen and Baney Settlement where coal mining begins. Below Goshen and Baney Settlement, the majority of the watershed has been disturbed by strip mining. Lick Run Watershed can be accessed traveling on Interstate 80 to State Route 879. State Route 879 crosses Lick Run near the mouth; smaller township roads can be used to access other parts of the watershed.

SEGMENTS ADDRESSED IN THIS TMDL

The Lick Run Watershed is affected by pollution from AMD. This pollution has caused high levels of metals and low pH in the mainstem of Lick Run, unnamed tributaries (26085 and 26086), and tributaries Jerry Run, Flegals Run, and Fork Run. The mainstem is impaired from the impaired unnamed tributaries to Lick Run to its confluence with the West Branch Susquehanna River. Jerry and Flegals Runs are impaired for their entire lengths, while Fork Run is impaired from its headwaters to a mile from the confluence with Lick Run.

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 U.S. Environmental Protection Agency’s (USEPA) 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 USEPA 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
- USEPA to approve or disapprove state lists and TMDLs within 30 days of final submission.

Despite these requirements, states, territories, authorized tribes, and USEPA have not developed many TMDLs since 1972. Beginning in 1986, organizations in many states filed lawsuits against the USEPA for failing to meet the TMDL requirements contained in the federal Clean Water Act and its implementing regulations. While USEPA has entered into consent agreements with the plaintiffs in several states, many lawsuits still are pending across the country.

In the cases that have been settled to date, the consent agreements require USEPA 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, etc.). These TMDLs were developed in partial fulfillment of the 1996 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 USEPA, the states have developed methods for assessing the waters within their respective jurisdictions.

The primary method adopted by the Pennsylvania Department of Environmental Protection (PADEP) 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. PADEP is now using the Unassessed Waters Protocol (UWP), a modification of the USEPA Rapid Bioassessment Protocol II (RPB-II), as the primary mechanism to assess Pennsylvania's waters. The UWP 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 stream segment can vary between sites. All the biological surveys include kick-screen sampling of benthic macroinvertebrates, habitat surveys, and measurements of pH, temperature, conductivity, dissolved oxygen, and alkalinity. Benthic macroinvertebrates are identified to the family level in the field.

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

After the survey is completed, the biologist determines the status of the stream segment. The decision is based on the performance of the segment using a series of biological metrics. 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 documented source and cause. A TMDL must be developed for the stream segment. A TMDL is for only one pollutant. If a stream segment is impaired by two pollutants, two TMDLs must be developed for that stream segment. In order for the process to be more effective, adjoining stream segments with the same source and cause listing are addressed collectively, and on a watershed basis.

BASIC STEPS FOR DETERMINING A TMDL

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

1. Collection and summarization of pre-existing data (watershed characterization, inventory contaminant sources, determination of pollutant loads, etc.);
2. Calculate TMDL for the waterbody using USEPA approved methods and computer models;
3. Allocate pollutant loads to various sources;
4. Determine critical and seasonal conditions;
5. Submit draft report for public review and comments; and
6. USEPA approval of the TMDL.

This document will present the information used to develop the Lick Run Watershed TMDL.

WATERSHED BACKGROUND

The Lick Run Watershed lies within the Pittsburgh Low Plateau Section of the Appalachian Plateaus Province. There is a vertical drop in the watershed of 1,200 feet from its headwaters to its mouth. The average annual precipitation is 42 inches. The region is characterized by warm summers and long, cold winters. Temperatures change frequently and sometimes rapidly.

The watershed is dominated primarily by forested and agricultural land uses. Forested land makes up 65.9 percent of the watershed and 27.7 percent of the area is considered agricultural land. Developed areas comprise 3.9 percent and disturbed lands (abandoned coal mines, quarries, etc.) totals 2.5 percent of the watershed. Forested land covers the northern two-thirds of the watershed. While over one-quarter of the land use is considered to be agricultural, the majority of these areas are reclaimed strip mines that are grassy fields. These areas look similar to hay fields.

Lick Run Watershed is primarily sandstone rock, which accounts for 79.1 percent of the watershed. Interbedded sedimentary rock comprises the remaining 20.9 percent of the area. The predominant soil associations in the watershed are the Hazleton-Cookport-Ernest and Hazleton-Dekalb-Buchanan series accounting for 48 percent and 28.4 percent, respectively. The remaining portion of the watershed is comprised of the Gilpin-Ernest-Cavode and Udorthents-

Ernest-Gilpin soil associations (14.8 percent and 8.8 percent, respectively). Currently, the entire basin of Lick Run is listed as a HQ-CWF by Pennsylvania Code Title 25.

Historical data shows that mining began in this area in the early nineteenth century and continues at present time. Currently, there is one active surface mining permit in the watershed, which has been the predominant mining type; however, there was a small amount of deep mining in the watershed. SRBC conducted a water quality and biological survey on the West Branch Susquehanna River in the summer of 1983, which included a site on Lick Run. No fish were observed during the assessment and a crayfish was the only macroinvertebrate present. The water quality of Lick Run was very poor with pH and manganese not meeting state standards (SRBC, 1985).

Lick Run begins in Moshannon State Forest and flows through forested lands until Baney Settlement. At this point, large portions of the watershed are reclaimed and unreclaimed mined lands. Several impaired tributaries enter Lick Run, including Fork, Jerry, and Flegals Runs. A stream survey was conducted on Lick Run in 1931 by the Pennsylvania Fish and Boat Commission (PFBC) and found it to be “one of the best streams in this section of Clearfield County” (PFBC, 1931). In 1957, Lick Run was surveyed again and the PFBC recommended no longer stocking Lick Run below the confluence of Fork Run. When the stream was surveyed again in 1980, it stated that the headwaters were naturally acidic and had little buffering capacity due to the sandstone and shale geology (Arway, 1982). With a low buffering capacity, heavy rains were able to shift the pH, leading to the PFBC removing the entire length of Lick Run from the trout stocking program in 1985.

Fork Run is listed as impaired by metals from AMD and is the most upstream impaired tributary to enter Lick Run. Fork Run enters Lick Run about a mile north of Baney Settlement. The Fork Run Watershed is mostly forested with only small areas disturbed by coal mining. The stream was surveyed by the PFBC in 1932 and approved for trout sticking (PFBC, 1932).

Jerry Run is another impaired tributary to enter Lick Run, and it enters about 2.5 miles from the confluence with the West Branch Susquehanna River. The landscape of this watershed is dominated by abandoned and reclaimed mine lands, with one active strip mine still operating. Sky Haven Coal, Inc. (17970101) is permitted to mine in both Jerry Run and Flegals Run. The PFBC conducted a stream survey on Jerry Run in 1931, and found no pollution (PFBC, 1931). Jerry Run was still meeting water quality standards in 1956, as noted by the Shawville Coal Company application (Arway, 1982).

Flegals Run is the last tributary to enter Lick Run before it confluence with the West Branch Susquehanna River. Flegals Run begins as AMD discharges from abandoned mine lands. The majority of the watershed is being mined or is reclaimed or abandoned mine lands. A stream survey by the PFBC was conducted in 1949 and no pollution was found in the stream (PFBC, 1949). Mining occurred in the 1950s and was not reclaimed (Arway, 1982).

The Shawville Coal Company, Glen Irvan Coal Company, and possibly other coal companies, began mining in Jerry and Flegals Runs Watersheds in the 1950s, however, most of the mined areas were not reclaimed. Al Hamilton Contracting Company remained in these watersheds in

1982. While performing site investigations, PADEP found a deep mine discharge to Jerry Run and several other deep mine discharges in Flegals Run (PADER, 1982). When Al Hamilton Contracting Company completed re-mining the area, the area was regraded and reseeded, however, several of the discharges remain. A couple of the spoil piles also remain in the Flegals Run Watershed (PADER, 1982).

Six pre-existing discharges have been identified in the watershed by Sky Haven Coal, Inc. The reduction necessary to meet applicable water quality standards from preexisting conditions (including discharges from areas coextensive with areas permitted under the re-mining 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 re-mining permittee does not require Sky Haven Coal, Inc. to necessarily implement the reductions from preexisting conditions set forth in the LA. Additional requirements for Sky Haven Coal, Inc. to address the preexisting conditions are set forth in the applicable NPDES/mining permit. The individual discharges are not assigned load allocations, however; discharge affects on the stream are taken into account at the closest downstream sampling point and it is noted that the discharge is a contributing pollutant source to the segment.

AMD METHODOLOGY

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

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

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

distributed. Each pollutant source was evaluated separately using @Risk³ by performing 5,000 iterations to determine the required percent reduction so that the water quality criteria, as defined in the *Pennsylvania Code, Title 25 Environmental Protection, Department of Environmental Protection, Chapter 93, Water Quality Standards*, will be met instream at least 99 percent of the time. For each iteration, the required percent reduction is:

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

PR = required percent reduction for the current iteration

Cc = criterion in mg/l

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

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

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:

$$LTA = \text{Mean} * (1 - PR_{99}) \text{ where} \quad (2)$$

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

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

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 the following section. 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:

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

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

The total water volume reporting to ponds for treatment can come from two primary sources: direct precipitation to the pit and runoff from the ungraded 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, <http://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.

$$41.4 \text{ in. precip./yr} \times 0.95 \times 1 \text{ ft./12/in.} \times 1500' \times 300' / \text{pit} \times 7.48 \text{ gal/ft}^3 \times 1 \text{ yr}/365 \text{ days} \times 1 \text{ day}/24 \text{ hr.} \\ \times 1 \text{ hr.}/60 \text{ min.} =$$

$$= 21.0 \text{ gal/min average discharge from direct precipitation into the open mining pit area.}$$

Pit water also can result from runoff from the ungraded 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. The Pa. 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. Pa. 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 ungraded and unvegetated spoil area.

$$41.4 \text{ in. precip./yr} \times 3 \text{ pit areas} \times 1 \text{ ft./12/in.} \times 1500' \times 300' / \text{pit} \times 7.48 \text{ gal/ft}^3 \times 1 \text{ yr/365days} \times 1 \text{ day/24hr.} \times 1 \text{ hr./60 min.} \times 15 \text{ in. runoff/100 in. precipitation} =$$

$$= 9.9 \text{ gal./min. average discharge from spoil runoff into the pit area.}$$

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:

$$\text{Total Average Flow} = \text{Direct Pit Precipitation} + \text{Spoil Runoff}$$

$$\text{Total Average Flow} = 21.0 \text{ gal./min} + 9.9 \text{ gal./min.} = 30.9 \text{ gal./min.}$$

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

Allowable Iron Waste Load Allocation:

$$30.9 \text{ gal./min.} \times 3 \text{ mg/l} \times 0.01202 = 1.1 \text{ lbs./day}$$

Allowable Manganese Waste Load Allocation:

$$30.9 \text{ gal./min.} \times 2 \text{ mg/l} \times 0.01202 = 0.7 \text{ lbs./day}$$

Allowable Aluminum Waste Load Allocation:

$$30.9 \text{ gal./min.} \times 2 \text{ mg/l} \times 0.01202 = 0.7 \text{ lbs./day}$$

(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 Pa. 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 waste load allocation 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 waste load allocation is available for a different operation. Where there are indications that future mining in a watershed is greater than the current level of mining activity, an additional waste load allocation 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 acceptable 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 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 of the nature of the pollution sources in the watershed, the TMDLs component makeup will be load allocations that are specified above a point in the stream segment. All allocations will be specified as long-term average daily concentrations. These long-term average daily concentrations are expected to meet water quality criteria 99 percent of the time. Pennsylvania Title 25 Chapter 96.3(c) specifies that a minimum 99 percent level of protection is required. All metals criteria evaluated in this TMDL are specified as total recoverable. Pennsylvania does have dissolved criteria for iron; however, the data used for this analysis report iron as total recoverable. Table 2 shows the water quality criteria for the selected parameters.

Table 2. Applicable Water Quality Criteria

Parameter	Criterion Value (mg/l)	Total Recoverable/Dissolved
Aluminum (Al)	0.75	Total Recoverable
Iron (Fe)	1.50	30-day average; Total Recoverable
	0.3	Dissolved
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. These values are typically as low as 5.4 (Pennsylvania Fish and Boat Commission).

TMDL ELEMENTS (WLA, LA, MOS)

A TMDL equation consists of a wasteload allocation (WLA), load allocation (LA) and a margin of safety (MOS). The WLA is the portion of the load assigned to point sources. The LA is the portion of the load assigned to nonpoint sources. The MOS is applied to account for uncertainties in the computational process. The MOS may be expressed implicitly (documenting conservative processes in the computations) or explicitly (setting aside a portion of the allowable load).

TMDL ALLOCATIONS SUMMARY

Methodology for dealing with pH impairments is discussed in Attachment D. Information for the TMDL analysis using the methodology described above is contained in the TMDLs by segment section in Attachment E.

This TMDL will focus remediation efforts on the identified numerical reduction targets for each watershed. As changes occur in the watershed, the TMDL may be reevaluated to reflect current conditions. Table 3 presents the estimated reductions identified for all points in the watershed. Attachment E gives detailed TMDLs by segment analysis for each allocation point.

Table 3. Summary Table–Lick Run Watershed

Station	Parameter	Existing Load (lbs/day)	Allowable Load (lbs/day)	WLA	LA	Load Reduction (lbs/day)	Percent Reduction
FR01	Mouth of Fork Run						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	5.7	5.7	0.0	5.7	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	414.5	111.9	0.0	111.9	302.6	73
	Alkalinity	218.0					
LR04	Lick Run above confluence of Fork Run						
	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	1,646.0	708.1	0.0	708.1	937.9	57
	Alkalinity	1,247.7					
LRT02	Confluence of UNT 26087 with Lick Run						
	Fe	ND	NA	NA	NA	0.0	0

Station	Parameter	Existing Load (lbs/day)	Allowable Load (lbs/day)	WLA	LA	Load Reduction (lbs/day)	Percent Reduction
	Mn	7.8	1.5	0.0	1.5	6.3	81
	Al	8.4	1.4	0.0	1.4	7.0	84
	Acidity	271.0	19.0	0.0	19.0	252.0	93
	Alkalinity	28.3					
LR03	Lick Run between UNT 26087 and UNT 26085						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	642.3	50.8	0.0	50.8	585.2	92
	Al	ND	NA	NA	NA	0.0	0
	Acidity	3,288.4	954.5	0.0	954.5	841.4	47
	Alkalinity	1,947.2					
LRT01	UNT 26085 near confluence with Lick Run						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	128.2	8.9	0.0	8.9	119.3	93
	Al	60.8	4.8	0.0	4.8	56.0	92
	Acidity	1,154.9	104.0	0.0	104.0	1,050.9	91
	Alkalinity	169.2					
JR02	Jerry Run in disturbed areas						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	43.6	6.2	0.0	6.2	37.4	86
	Al	18.3	5.8	0.0	5.8	12.5	68
	Acidity	418.0	50.1	0.0	50.1	367.9	88
	Alkalinity	70.9					
JR01	Jerry Run near confluence with Lick Run						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	44.4	6.2	0.0	6.2	0.8	2
	Al	15.6	4.8	0.0	4.8	0.1	1
	Acidity	536.2	48.9	0.0	48.9	70.5	13
	Alkalinity	76.8					
LR02	Lick Run right before Flegals Run enters						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	202.1	105.0	0.0	105.0	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	5,871.2	881.9	0.0	881.9	1,117.2	56
	Alkalinity	2,020.9					
FL02	Flegals Run above WLA						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	4.4	1.2	0.0	1.2	3.2	73
	Al	4.9	0.9	0.0	0.9	4.0	82
	Acidity	97.4	3.9	0.0	3.9	93.5	96
	Alkalinity	4.7					
FL01	Mouth of Flegals Run						
	Fe	4.6	3.9	1.1	2.8	0.7	15
	Mn	5.9	3.8	0.7	3.1	0.0	0
	Al	11.9	1.5	0.7	0.8	6.4	81
	Acidity	13.7	13.7	0.0	13.7	0.0	0
	Alkalinity	205.3					
LR01	Lick Run near confluence with the West Branch Susquehanna River						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	180.4	103.1	0.0	103.1	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	5,764.9	865.9	0.0	865.9	11.8	0
	Alkalinity	1,889.0					

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

In the instance that the allowable load is equal to the measured load (e.g. manganese LR02, Table 3), the simulation determined that water quality standards are being met instream 99 percent of the time and therefore no TMDL is necessary for the parameter at that point. Although no TMDL is necessary, the loading at the point is considered at the next downstream point. In addition, when all measured values are below the method detection limit, denoted by ND (e.g. iron point FR01, Table 3), no TMDL is necessary. In this case the accounting for upstream loads is not carried through to the next downstream point. Rather, there is a disconnect noted and the allowable load is considered to start over because the water quality standard is satisfied.

A WLA is being assigned to the permitted operation (Sky Haven Coal, Inc. SHEM) for iron, manganese, and aluminum. Acidity is narratively addressed to be exceeded by the alkalinity at all times, because a numeric standard was not included in the permit, no WLA is assigned for this parameter. The WLA was calculated using the methodology explained in the *Method to Quantify Treatment Pond Pollutant Load* section of this report. No required reduction of this permit is necessary at this time because there are nonpoint contributions upstream and downstream of the discharge that when reduced will satisfy the TMDL. Table 4 contains the WLA for the permitted operation.

Table 4. Waste load Allocation of Permitted Operation

<i>Parameter</i>	<i>Allowable Average Monthly Conc. (mg/l)</i>	<i>Average Flow (MGD)</i>	<i>Allowable Load (lbs/day)</i>
SHEM			
Fe	3.0	0.0446	1.1
Mn	2.0	0.0446	0.7
Al	2.0	0.0446	0.7

RECOMMENDATIONS

There is currently no watershed group in the Lick Run Watershed area. It is recommended that agencies work with local interests to form a watershed organization. This watershed organization could then work to implement projects to achieve the reductions recommended in this TMDL document.

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

Reclaim PA is PADEP's initiative designed to maximize reclamation of the state's quarter million acres of abandoned mineral extraction lands. Abandoned mineral extraction lands in Pennsylvania constitute a significant public liability - more than 250,000 acres of abandoned surface mines, 2,400 miles of stream polluted with AMD, 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.

Since the 1960's, Pennsylvania has been a national leader in establishing laws and regulations to ensure mine reclamation and well plugging occur after active operation is completed. 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 PADEP's Brownfields Program. Pennsylvania is striving for complete reclamation of its abandoned mines and plugging of its orphan wells. Realizing this task is no small order, PADEP has developed Reclaim PA, a collection of concepts to make abandoned mine reclamation easier. These concepts include legislative, policy, and land management initiatives designed to enhance mine operator/volunteer/PADEP 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 remaining risks.
- To maximize reclamation funding by expanding existing sources and exploring new sources.

PUBLIC PARTICIPATION

In the beginning stages of the Lick Run Watershed TMDL, an early notification letter was sent to inform stakeholders and interested parties that a TMDL would be completed in their watershed and offer them the opportunity to submit information for TMDL development.

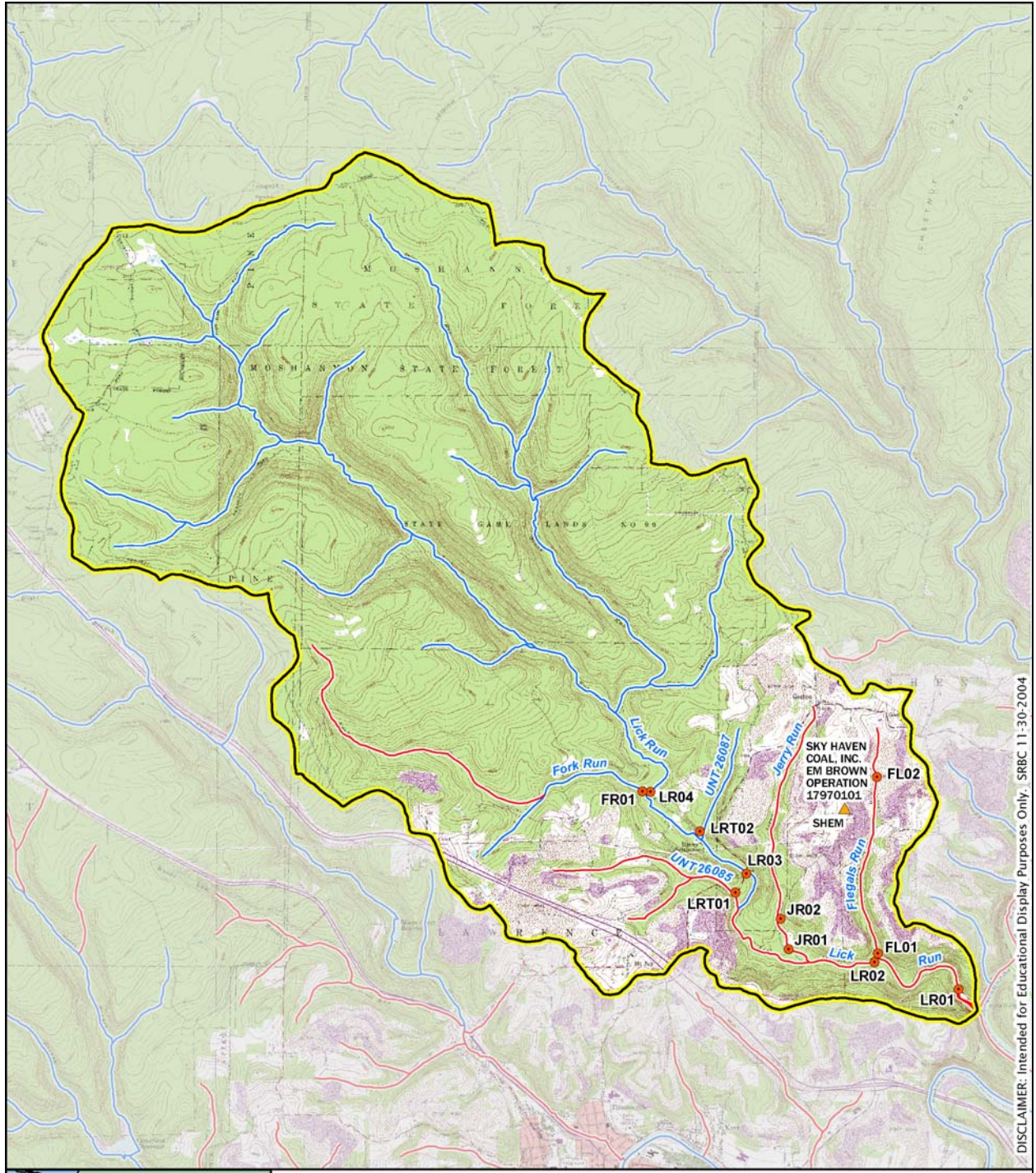
Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on January 8, 2005, and *The Progress* on January 21, 2005, to foster public comment on the allowable loads calculated. A public meeting was held on January 27, 2005, at the Clearfield County Conservation District in Clearfield, Pa., to discuss the proposed TMDL.

REFERENCES

- Arway, John. 1982. Information on Jerry Run, Flegals Run, and Lick Run, Clearfield County. Letter to Mr. Dave Wolfe, PADER, Bureau of Water Quality Management, Williamsport Regional Office.
- Pennsylvania Fish and Boat Commission. 1931. Stream Survey Report: Jerry Run. Commonwealth of Pennsylvania, Board of Fish Commissioners.
- . 1931. Stream Survey Report: Lick Run. Commonwealth of Pennsylvania, Board of Fish Commissioners.
- . 1932. Stream Survey Report: Fork Run. Commonwealth of Pennsylvania, Board of Fish Commissioners.
- . 1949. Stream Survey Report: Flegals Run. Commonwealth of Pennsylvania, Board of Fish Commissioners.
- Pennsylvania Department of Environmental Protection. 1982. Mine Inspectors Report on Application for Mine Drainage Permit 17820122, Al Hamilton Contracting Company.
- Susquehanna River Basin Commission. 1985. Water Quality and Biological Survey of the West Branch Susquehanna River. Resource Quality Management & Protection Division.
- Watershed Restoration Action Strategy (Draft). 2001. State Water Plan 08C: Clearfield Creek Watershed (West Branch Susquehanna River), Clearfield and Cambria Counties.

Attachment A

Lick Run Watershed Map



DISCLAIMER: Intended for Educational Display Purposes Only. SRBC 11-30-2004



LICK RUN TOPOGRAPHY

IN STREAM SAMPLE POINT FOR LOAD CALCULATIONS
 WASTE LOAD ALLOCATION
 IMPAIRED STREAM*
 UNASSESSED STREAM*
 ATTAINED STREAM*

N
 WATERSHED BOUNDARY

0 0.5 1 Miles
 1:65,000

*SOURCE: PA DEP 2004 303(d) & 2002 305(b) STREAMS, 5 DIGIT NUMBERS REFER TO STREAM SEGMENT IDS; TOPOGRAPHY FROM USGS

Attachment B

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

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

In the 1996 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 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 USEPA 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 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). The 2002 Pa. Section 303(d) list was written in a manner similar to the 1998 Section 303(d) list.

In 2004, Pennsylvania developed the Integrated List of All Waters. The water quality status of Pennsylvania's waters is summarized using a five-part categorization of waters according to their water quality standard (WQS) attainment status. The categories represent varying levels of WQS attainment, ranging from Category 1, where all designated water uses are met, to Category 5, where impairment by pollutants requires a TMDL to correct. These category determinations are based on consideration of data and information consistent with the methods outlined by the Statewide Surface Water Assessment Program. Each PADEP five-digit waterbody segment is placed in one of the WQS attainment categories. Different segments of the same stream may appear on more than one list if the attainment status changes as the water flows downstream. The listing categories are as follows:

- Category 1: Waters attaining all designated uses.
- Category 2: Waters where some, but not all, designated uses are met. Attainment status of the remaining designated uses is unknown because data are insufficient to categorize a water consistent with the state's listing methodology.

- Category 3: Waters for which there are insufficient or no data and information to determine, consistent with the state's listing methodology, if designated uses are met.
- Category 4: Waters impaired for one or more designated use but not needing a TMDL. States may place these waters in one of the following three subcategories:
- TMDL has been completed.
 - Expected to meet all designated uses within a reasonable timeframe.
 - Not impaired by a pollutant.
- Category 5: Waters impaired for one or more designated uses by any pollutant. Category 5 includes waters shown to be impaired as the result of biological assessments used to evaluate aquatic life use even if the specific pollutant is not known unless the state can demonstrate that nonpollutant stressors cause the impairment or that no pollutant(s) causes or contribute to the impairment. Category 5 constitutes the Section 303(d) list that USEPA will approve or disapprove under the Clean Water Act. Where more than one pollutant is causing the impairment, the water remains in Category 5 until all pollutants are addressed in a completed USEPA-approved TMDL or one of the delisting factors is satisfied.

Attachment C

Mining Permits in the Lick Run Watershed

Permit Number	Company Name	Status
17970101	Sky Haven Coal, Inc. EM Brown 1 Operation	Active

Attachment D

Method for Addressing 303(d) Listings for pH

Method for Addressing 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 Pa. 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 USEPA's acceptable range of six to nine and meets Pennsylvania water quality criteria in Pa. Code, 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 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) CaCO₃. 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 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. 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 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 meet a minimum net alkalinity of zero.

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.*

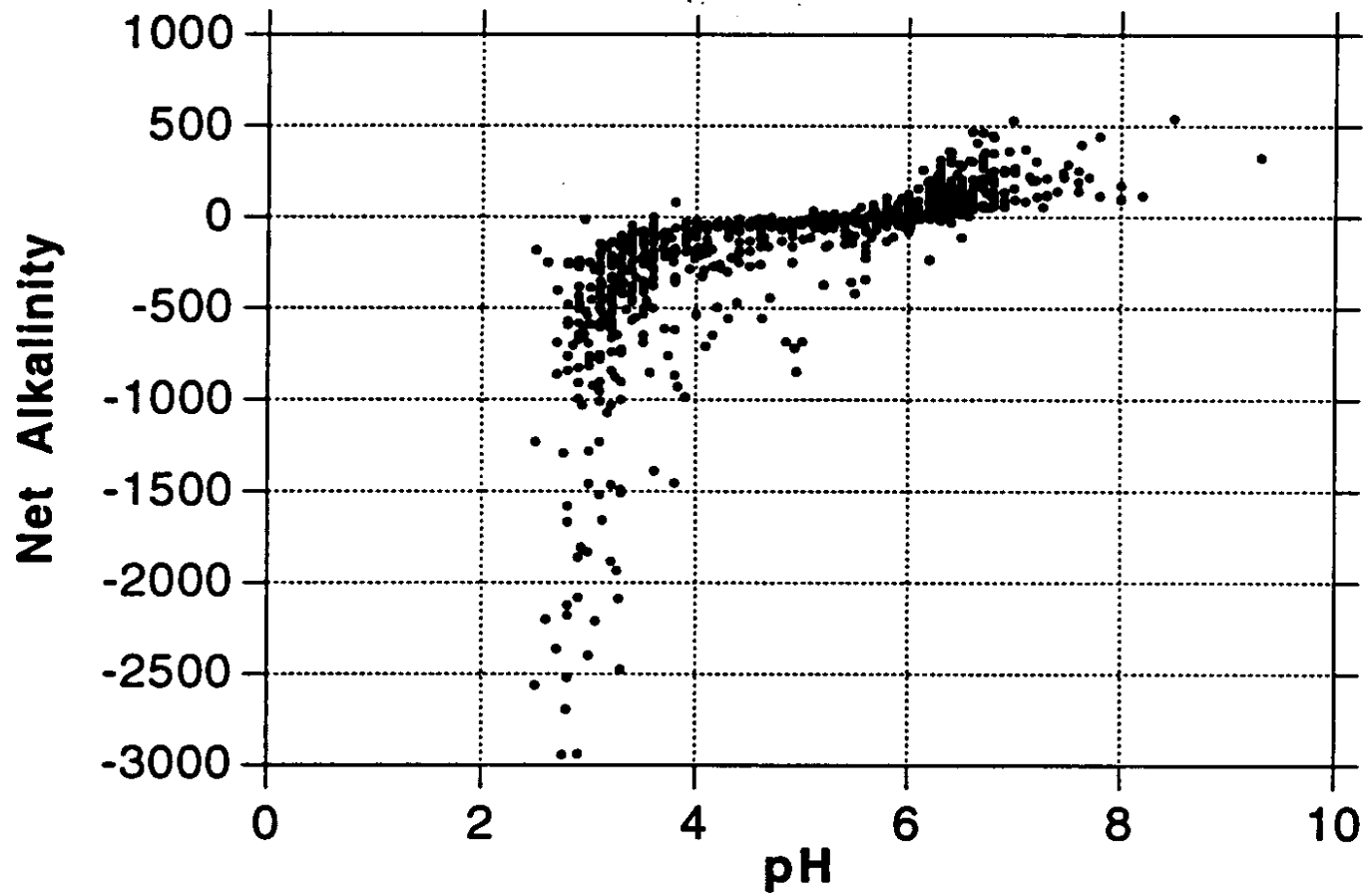


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania.

Attachment E

TMDLs By Segment

Lick Run

The TMDL for the Lick Run Watershed consists of load allocations for five tributaries and four sampling sites along the mainstem. A waste load allocation is assigned to the one active mining operation in the watershed.

Lick Run is listed as impaired on the Section 303(d) list by high metals and low pH from AMD as the cause of the degradation to the stream. 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 C.

An allowable long-term average instream concentration for iron, manganese, aluminum, and acidity was determined at each sample point. The analysis is designed to produce a long-term average value that, when met, will be protective of the water quality criterion for that parameter 99 percent 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 percent of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean and the standard deviation of the data set, 5,000 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 percent of the time. The mean value from this data set represents that long-term daily average concentration that needs to be met to achieve water quality standards.

Fork Run above FR01

Fork Run above point FR01 is impaired by AMD for the first 2.5 miles, while the remaining mile before the confluence has been determined to be reaching its attained use. Fork Run begins in Moshannon State Forest and is above most of the coal mining influences in the Lick Run Watershed.

The TMDL for Fork Run consists of a load allocation to all of the watershed area above point FR01. Sandstone geology naturally produces little to no buffering capacity leading to high acidity levels as found in Fork Run. Addressing the high acidity above this point, addresses the impairment. An instream flow measurement was available for point FR01 (3.80 mgd). The load allocations for made at point FR01 for this stream segment are listed in Table E1.

	<i>Measured Sample Data</i>		<i>Allowable</i>		<i>Reduction Identified</i>
	<i>Conc. (mg/l)</i>	<i>Load (lb/day)</i>	<i>LTA Conc. (mg/l)</i>	<i>Load (lb/day)</i>	<i>Percent</i>
Fe	ND	NA	NA	NA	0
Mn	0.18	5.7	0.18	5.7	0
Al	ND	NA	NA	NA	0
Acidity	13.08	414.5	3.53	111.9	73
Alkalinity	6.88	218.0			

All values shown in this table are long-term average daily values.

The TMDL for Fork Run at point FR01 requires that a load allocation be made for all areas above FR01 for total acidity.

Lick Run above LR04

Lick Run above point LR04 has been determined to be reaching is attained use. Point LR04 is located on the mainstem of Lick Run right above the confluence of Fork Run. The headwaters begin in Moshannon State Forest and flow through State Game Land 90. The area is sparsely populated and is located above most coal mining influences in the watershed.

While Lick Run above LR04 is not listed as impaired on the 303(d) List, the water quality data set in Attachment F shows impairment does exist for acidity, therefore a TMDL was completed for this segment. The TMDL for this section of Lick Run consists of a load allocation to all of the watershed area above point LR04. Addressing the natural high levels of acidity caused by sandstone geology, addresses the impairment for the segment. An instream flow measurement was available for point LR04 (20.41 mgd). The load allocations made at point LR04 for this stream segment are presented in Table E2.

	<i>Measured Sample Data</i>		<i>Allowable</i>		<i>Reduction Identified</i>
	<i>Conc. (mg/l)</i>	<i>Load (lb/day)</i>	<i>LTA Conc. (mg/l)</i>	<i>Load (lb/day)</i>	<i>Percent</i>
Fe	ND	NA	NA	NA	0
Mn	ND	NA	NA	NA	0
Al	ND	NA	NA	NA	0
Acidity	9.67	1,646.0	4.16	708.1	57
Alkalinity	7.33	1,247.7			

All values shown in this table are long-term average daily values.

The TMDL for Lick Run at point LR04 requires that a load allocation be made for all areas above LR04 for total acidity.

UNT Lick Run above LRT02

UNT Lick Run above LRT02 represents UNT Lick Run, stream code 26087, above LRT02. UNT Lick Run drains into Lick Run at Baney Settlement; it drains some of the most upstream coal mining disturbances in the watershed. UNT Lick Run has been determined to be reaching its attained use.

While UNT Lick Run, stream code 26087, is not listed as impaired on the 303(d) List, the water quality data set in Attachment F shows impairment does exist for manganese, aluminum, and acidity, therefore a TMDL was completed for this tributary. The TMDL for UNT Lick Run, stream code 26087, consists of a load allocation to all of the watershed area above LTR02. Addressing the mining impacts above this point addresses the impairment from the segment. An

instream flow measurement was available for point LRT02 (0.60 mgd). The load allocations made at point LRT02 for this stream segment are presented in Table E3.

	<i>Measured Sample Data</i>		<i>Allowable</i>		<i>Reduction Identified</i>
	<i>Conc. (mg/l)</i>	<i>Load (lb/day)</i>	<i>LTA Conc. (mg/l)</i>	<i>Load (lb/day)</i>	<i>Percent</i>
Fe	ND	NA	NA	NA	0
Mn	1.56	7.8	0.30	1.5	81
Al	1.67	8.4	0.27	1.4	84
Acidity	54.15	271.0	3.79	19.0	93
Alkalinity	5.65	28.3			

All values shown in this table are long-term average daily values.

The TMDL for UNT Lick Run, stream code 26087, at point LRT02 requires that a load allocation be made for all areas above LRT02 for total manganese, total aluminum, and total acidity.

Lick Run Between LR04 and LR03

Lick Run between LR04 and LR03 represents Lick Run after receiving water from Fork Run and UNT Lick Run 26087. Lick Run between LR04 and LR03 has been determined to be reaching its attained use. This segment of Lick Run is draining areas that have been mined.

While Lick Run between LR04 and LR03 is not listed as impaired on the 303(d) List, the water quality data set in Attachment F shows impairment for manganese and acidity, therefore a TMDL was completed for this stream segment. The TMDL for this segment of Lick Run consists of a load allocation to all of the watershed area between points LR04 and LR03. Addressing mining impacts between these points addresses the impairment for the segment. An instream flow measurement was available for point LR03 (30.44 mgd). The load allocations made at LR03 for this stream segment are presented in Table E4.

	<i>Measured Sample Data</i>		<i>Allowable</i>	
	<i>Conc.(mg/l)</i>	<i>Load (lb/day)</i>	<i>LTA Conc. (mg/l)</i>	<i>Load(lb/day)</i>
Fe	ND	NA	NA	NA
Mn	2.53	642.3	0.20	50.8
Al	ND	NA	NA	NA
Acidity	12.97	3,288.4	3.76	954.5
Alkalinity	7.67	1,947.2		

All values shown in this table are long-term average daily values.

The loading reductions for points FR01, LR04, and LRT02 were used to show the total load that was removed from upstream sources. For each parameter, the total load that was removed

upstream was subtracted from the existing load at point LR03. The value was compared to the allowable load at point LR03. Reductions at point LR03 are necessary for any parameter that exceeds the allowable load at this point. Necessary reductions at point LR03 are shown in Table E5.

<i>Table E5. Reductions Necessary at Point LR03</i>				
	<i>Iron (lb/day)</i>	<i>Manganese (lb/day)</i>	<i>Aluminum (lb/day)</i>	<i>Acidity (lb/day)</i>
Existing Loads at LR03	ND	642.3	ND	3,288.4
Existing load from upstream points (FR01, LR04, & LRT02)	*	13.5	8.4	2,331.5
Difference of existing load and upstream existing load	*	628.8	-8.4	956.9
Percent load loss due to instream process	*	0	100	0
Allowable load from upstream points	*	7.2	1.4	839.0
Percent load remaining at LR03	*	100	0	100
Total load at LR03	*	636.0	0.0	1,795.9
Allowable load at LR03	NA	50.8	NA	954.5
Load Reduction at LR03 (Total load at LR03 – Allowable load at LR03)	NA	585.2	NA	841.4
Percent Reduction required at LR03	0	92	0	47

The TMDL for Lick Run at point LR03 requires that a load allocation be made for all areas between LR04 and LR03 for total manganese and total acidity.

UNT Lick Run above LRT01

UNT Lick Run above LRT01 represents UNT Lick Run, stream code 26085, above LRT01. UNT Lick Run drains into Lick Run about one-third mile downstream from point LR03. Another small unnamed tributary, stream code 26086, drains into to UNT Lick Run. These two small tributaries drain mainly coal mining areas. Both stream code 26085 and 26086 have been determined to be impaired by AMD.

The TMDL for UNT Lick Run consists of a load allocation to all of the watershed area above LRT01. Addressing the mining impacts above this point addresses the impairment for the segment. An instream flow measurement was available for point LRT01 (2.54 mgd). The load allocations made at LRT01 for this stream segment are presented in Table E6.

Table E6. Reductions for Lick Run Above LRT01

	<i>Measured Sample Data</i>		<i>Allowable</i>		<i>Reduction Identified</i>
	<i>Conc. (mg/l)</i>	<i>Load (lb/day)</i>	<i>LTA Conc. (mg/l)</i>	<i>Load (lb/day)</i>	<i>Percent</i>
Fe	ND	NA	NA	NA	0
Mn	6.05	128.2	0.42	8.9	93
Al	2.87	60.8	0.23	4.8	92
Acidity	54.52	1,154.9	4.91	104.0	91
Alkalinity	8.28	175.4			

All values shown in this table are long-term average daily values.

The TMDL for UNT Lick Run, stream code 26085, at point LRT01 requires that a load allocation be made for all areas above point LRT01 for total manganese, total aluminum, and total acidity.

Jerry Run above JR02

Jerry Run above JR02 represents Jerry Run above point JR02. This segment of Jerry Run is impaired by AMD. The majority of the drainage area for point JR02 is reclaimed and abandoned mine lands.

The TMDL for this section of Jerry Run consists of a load allocation to all of the watershed area above point JR02. Addressing the mining impacts above this point addresses the impairment for the segment. An instream flow measurement was available for point JR02 (1.25 mgd). The load allocations made at point JR02 for this stream segment are presented in Table E8.

Table E8. Reductions for Jerry Run Above JR02

	<i>Measured Sample Data</i>		<i>Allowable</i>		<i>Reduction Identified</i>
	<i>Conc. (mg/l)</i>	<i>Load (lb/day)</i>	<i>LTA Conc. (mg/l)</i>	<i>Load (lb/day)</i>	<i>Percent</i>
Fe	ND	NA	NA	NA	0
Mn	4.18	43.6	0.59	6.2	86
Al	1.76	18.3	0.56	5.8	68
Acidity	40.10	418.0	4.81	50.1	88
Alkalinity	6.80	70.9			

All values shown in this table are long-term average daily values.

The TMDL for Jerry Run at point JR02 requires that a load allocation be made for all areas above point JR02 for total manganese, total aluminum, and total acidity.

Jerry Run Between JR02 and JR01

Jerry Run between JR02 and JR01 represents the section of Jerry Run between JR02 and JR01. This section of Jerry Run is impaired by AMD. The drainage area for Jerry Run is dominated by reclaimed and abandoned mine lands.

The TMDL for this section of Jerry Run consists of a load allocation to all of the watershed area between JR02 and JR01. Addressing the mining impacts between JR02 and JR01 addresses the impairment. An instream flow measurement was available for point JR01 (1.22 mgd). The load allocations made at point JR01 for this stream segment are presented in Table E9.

	<i>Measured Sample Data</i>		<i>Allowable</i>	
	<i>Conc. (mg/l)</i>	<i>Load (lb/day)</i>	<i>LTA Conc. (mg/l)</i>	<i>Load (lb/day)</i>
Fe	ND	NA	NA	NA
Mn	4.36	44.4	0.61	6.2
Al	1.53	15.6	0.47	4.8
Acidity	52.70	536.2	4.81	48.9
Alkalinity	7.55	76.8		

All values shown in this table are long-term average daily values.

The loading reduction for point JR02 was used to show the total load that was removed from upstream sources. For each parameter, the total load that was removed upstream was subtracted from the existing load at point JR01. The value was compared to the allowable load at point JR01. Reductions at point JR01 are necessary for any parameter that exceeds the allowable load at this point. Necessary reductions at point JR01 are shown in Table E10.

	<i>Iron (lb/day)</i>	<i>Manganese (lb/day)</i>	<i>Aluminum (lb/day)</i>	<i>Acidity (lb/day)</i>
Existing Load at JR01	ND	44.4	15.6	536.2
Existing load from upstream points	*	43.6	18.3	418.0
Difference of existing load and upstream existing load	*	0.8	-2.7	118.2
Percent load loss due to instream process	*	0	15	0
Allowable loads from upstream points	*	6.2	5.8	50.1
Percent load remaining at JR01	*	100	85	100
Total load at JR01	*	7.0	4.9	168.3
Allowable load at JR01	NA	6.2	4.8	48.9
Load Reduction at JR01 (Total load at JR01 – Allowable load at JR01)	NA	0.8	0.1	70.5
Percent Reduction required at JR02	0	11	2	42

The TMDL for Jerry Run at point JR01 requires that a load allocation be made for all areas between point JR02 and JR01 for total manganese, total aluminum, and total acidity.

Lick Run Between LR03 and LR02

Lick Run between LR03 and LR02 represents the section of Lick Run between LR03 and LR02. This section of Lick Run is impaired by AMD. Point LR02 is located on Lick Run just upstream of where Flegals Run enters Lick Run.

The TMDL for this section of Lick Run consists of a load allocation to all of the watershed area between LR03 and LR02. Addressing the mining impacts between LR03 and LR02 addresses the impairment. An instream flow measurement was available for point LR02 (31.47 mgd). The load allocations made at point LR02 for this stream segment are presented in Table E11

	<i>Measured Sample Data</i>		<i>Allowable</i>	
	<i>Conc. (mg/l)</i>	<i>Load (lb/day)</i>	<i>LTA Conc. (mg/l)</i>	<i>Load (lb/day)</i>
Fe	ND	NA	NA	NA
Mn	0.77	202.1	0.40	105.0
Al	ND	NA	NA	NA
Acidity	22.37	5,871.2	3.36	881.9
Alkalinity	7.70	2,020.9		

All values shown in this table are long-term average daily values.

The loading reductions for points LR03, LRT01, and JR01 were used to show the total load that was removed from upstream sources. For each parameter, the total load that was removed upstream was subtracted from the existing load at point LR02. The value was compared to the allowable load at point LR02. Reductions at point LR02 are necessary for any parameter that exceeds the allowable load at this point. Necessary reductions at point LR02 are shown in Table E12.

	<i>Iron (lb/day)</i>	<i>Manganese (lb/day)</i>	<i>Aluminum (lb/day)</i>	<i>Acidity (lb/day)</i>
Existing Load at LR02	ND	202.1	ND	5,871.2
Existing load from upstream points	*	814.9	76.4	4,979.5
Difference of existing load and upstream existing load	*	-612.8	-76.4	891.7
Percent load loss due to instream process	*	75	100	0
Allowable loads from upstream points	*	65.9	9.6	1,107.4
Percent load remaining at LR02	*	25	0	100
Total load at LR02	*	16.5	0	1,999.1
Allowable load at LR02	NA	105.0	NA	881.9
Load Reduction at LR02 (Total load at LR02 – Allowable load at LR02)	NA	0.0	NA	1,117.2
Percent Reduction required at LR02	0	0	0	56

The TMDL for Lick Run at point LR02 requires that a load allocation be made for all areas between point LR03 and LR02 for total acidity.

Flegals Run above Point FL02

Flegals Run above point FL02 represents Flegals Run above FL02. The headwaters and point FL02 are located in reclaimed and abandoned mine lands. Flegals Run has been determined to be impaired by AMD.

The TMDL for Flegals Run consists of a load allocation to all of the watershed area above FL02. Addressing the mining impacts above this point addresses the impairment for the segment. An instream flow measurement was available for point FL02 (0.20 mgd). The load allocations made at FL02 for this stream segment are presented in Table E13.

	<i>Measured Sample Data</i>		<i>Allowable</i>		<i>Reduction Identified</i>
	<i>Conc. (mg/l)</i>	<i>Load (lb/day)</i>	<i>LTA Conc. (mg/l)</i>	<i>Load (lb/day)</i>	<i>Percent</i>
Fe	ND	NA	NA	NA	0
Mn	2.63	4.4	0.71	1.2	73
Al	2.93	4.9	0.53	0.9	82
Acidity	58.4	97.4	2.34	3.9	96
Alkalinity	2.83	4.7			

All values shown in this table are long-term average daily values.

The TMDL for Flegals Run at point FL02 requires that a load allocation be made for all areas above point FL02 for total manganese, total aluminum, and total acidity.

SHEM: Sky Haven Coal, Inc. EM Brown 1 Operation

Sky Haven Coal, Inc., MP#17970101, operates a surface mine in the Flegals Run Watershed along the stream channel. Any discharge from the operations treatment pond is treated to the Best Available Technology (BAT) limits, assigned to the permit before it enters Flegals Run.

SHEM is considered to be a point source discharge in the watershed; therefore, the allocation made at this point is a waste load allocation (WLA). The WLAs for iron, manganese, and aluminum were calculated using the methodology described in the *Method to Quantify Treatment Pond Pollutant Load* section in Attachment D. Table E14 shows the waste load allocations for the discharge.

<i>Parameter</i>	<i>Monthly Avg. Allowable Conc. (mg/l)</i>	<i>Average Flow (MGD)</i>	<i>Allowable Load (lbs/day)</i>
Fe	3.0	0.0446	1.1
Mn	2.0	0.0446	0.7
Al	2.0	0.0446	0.7

Flegals Run Between FL02 and FL01

Flegals Run between FL02 and FL01 represents the section of Flegals Run between FL02 and FL01. This section of Flegals Run has been determined to be impaired by AMD. Flegals Run is

the last tributary to enter Lick Run before it confluence with the West Branch Susquehanna River. A WLA is given to Sky Haven Coal, Inc., permit 17970101.

The TMDL for this section of Flegals Run consists of a load allocation to all of the watershed area between FL02 and FL01. Addressing the mining impacts between FL02 and FL01 addresses the impairment. An instream flow measurement was available for point FL01 (1.31 mgd). The load allocations made at point FL01 for this stream segment are presented in Table E15.

Table E15. Long Term Average (LTA) Concentrations for Flegals Run Between FL02 and FL01

	<i>Measured Sample Data</i>		<i>Allowable</i>	
	<i>Conc. (mg/l)</i>	<i>Load (lb/day)</i>	<i>LTA Conc. (mg/l)</i>	<i>Load (lb/day)</i>
Fe	0.42	4.6	0.36	3.9
Mn	0.54	5.9	0.35	3.8
Al	1.09	11.9	0.14	1.5
Acidity	1.25	13.7	1.25	13.7
Alkalinity	17.74	193.8		

All values shown in this table are long-term average daily values.

The loading reduction for point FL02 was used to show the total load that was removed from upstream sources. For each parameter, the total load that was removed upstream was subtracted from the existing load at point FL01. The value was compared to the allowable load at point FL01. Reductions at point FL01 are necessary for any parameter that exceeds the allowable load at this point. Necessary reductions at point FL01 are shown in Table E16.

Table E16. Reductions Necessary at Point FL01

	<i>Iron (lb/day)</i>	<i>Manganese (lb/day)</i>	<i>Aluminum (lb/day)</i>	<i>Acidity (lb/day)</i>
Existing Load at FL01	4.6	5.9	11.9	13.7
Existing load from upstream points	NA	4.4	4.9	97.4
Difference of existing load and upstream existing load	4.6	1.5	7.0	-83.7
Percent load loss due to instream process	0	0	0	86
Allowable loads from upstream points	NA	1.2	0.9	3.9
Percent load remaining at FL01	100	100	100	14
Total load at FL01	4.6	2.7	7.9	0.5
Allowable load at FL01	3.9	3.8	1.5	13.7
Waste load allocation (SHEM)	1.1	0.7	0.7	0.0
Remaining load at FL01 (LA)	2.8	3.1	0.8	13.7
Load Reduction at FL01 (Total load at FL01 – Allowable load at FL01)	0.7	0.0	6.4	0.0
Percent Reduction required at FL01	15	0	81	0

The TMDL for Flegals Run at point FL01 requires that a load allocation be made for areas between points FL02 and FL01 for total iron and total aluminum.

Lick Run Between LR02 and LR01

Lick Run between LR02 and LR01 represents the section of Lick Run between LR02 and LR01. This section of Lick Run has been determined to be impaired by AMD. Point LR01 is located less than a mile upstream from the confluence with the West Branch Susquehanna River.

The TMDL for this section of Lick Run consists of a load allocation to all of the watershed area between LR02 and LR01. Addressing the mining impacts between LR02 and LR01 addresses the impairment. An instream flow measurement was available for point LR01 (30.90 mgd). The load allocations made at point LR01 for this stream segment are presented in Table E17.

	Measured Sample Data		Allowable	
	Conc. (mg/l)	Load (lb/day)	LTA Conc. (mg/l)	Load (lb/day)
Fe	ND	NA	NA	NA
Mn	0.70	180.4	0.40	103.1
Al	ND	NA	NA	NA
Acidity	22.37	5,764.9	3.36	865.9
Alkalinity	7.33	1,889.0		

All values shown in this table are long-term average daily values.

The loading reductions for points LR02 and FL01 were used to show the total load that was removed from upstream sources. For each parameter, the total load that was removed upstream was subtracted from the existing load at point LR01. The value was compared to the allowable load at point LR01. Reductions at point LR01 are necessary for any parameter that exceeds the allowable load at this point. Necessary reductions at point LR01 are shown in Table E18.

	Iron (lb/day)	Manganese (lb/day)	Aluminum (lb/day)	Acidity (lb/day)
Existing Load at LR01	ND	180.4	ND	5,764.9
Existing load from upstream points	4.6	208.0	11.9	5,884.9
Difference of existing load and upstream existing load	-4.6	-27.6	-11.9	-120.0
Percent lead loss due to instream process	100	13	100	2
Allowable loads from upstream points	3.9	108.8	1.5	895.6
Percent load remaining at LR01	0	87	0	98
Total load at LR01	0.0	94.7	0.0	877.7
Allowable load at LR01	NA	103.1	NA	865.9
Load Reduction at LR01 (Total load at LR01 – Allowable load at LR01)	NA	0.0	NA	11.8
Percent Reduction required at LR01	0	0	0	1

The TMDL for Lick Run at point LR01 requires that a load allocation be made for all areas between points LR02 and LR01 for total acidity.

Margin of Safety (MOS)

For each TMDL calculated in this study the MOS is applied implicitly. A MOS is built in because the allowable concentrations and loadings were simulated using Monte Carlo techniques and by 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.
- A MOS is also the fact that the calculations were performed with a daily iron average instead of the 30 day average.

Seasonal Variation

Seasonal variation is implicitly accounted for in each TMDL because the data used represent all seasons.

Critical Conditions

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

Attachment F

Water Quality Data Used In TMDL Calculations

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid (mg/l)	Alk (mg/l)	Fe (mg/l)	Mn (mg/l)	Al (mg/l)	pH
FR01	FORK1.0	SRBC-604(b) Report	*	12/10/02	1,304.12	10.8	6.0	<0.3	0.148	<0.5	5.2
	FORK1.0	SRBC-604(b) Report	*	4/8/03	5,672.55	18.2	6.6	<0.3	0.189	<0.5	5.0
	FORK1.0	SRBC-604(b) Report	*	5/19/03	3,940.24	8.6	6.4	<0.3	0.185	<0.5	5.1
	FORK1.0	SRBC-604(b) Report	*	6/23/03	1,902.95	12.0	8.8	<0.3	<0.05	<0.5	5.6
	FORK1.0	SRBC-604(b) Report	*	7/21/03	372.93	15.8	6.6	<0.3	0.182	<0.5	5.1

Average= 2,638.56 13.08 6.88 <0.3 0.176 <0.5 5.2
StDev= 2,142.10 3.87 1.10 0.02 0.23

LR04	LICK4.0	SRBC-604(b) Report	*	12/10/02	1,911.57	9.0	7.0	<0.3	<0.05	<0.5	5.8
	LICK4.0	SRBC-604(b) Report	*	1/27/03	3,726.6	8.4	7.2	<0.3	<0.05	<0.5	5.6
	LICK4.0	SRBC-604(b) Report	*	4/8/03	38,028.21	13.8	6.8	<0.3	0.06	<0.5	5.1
	LICK4.0	SRBC-604(b) Report	*	5/19/03	26,431.76	7.0	6.6	<0.3	<0.05	<0.5	5.4
	LICK4.0	SRBC-604(b) Report	*	6/23/03	13,134.33	8.6	9.4	<0.3	2.81	2.7	6.1
	LICK4.0	SRBC-604(b) Report	*	7/21/03	1,804.30	11.2	7.0	<0.3	<0.05	<0.5	5.6

Average= 14,172.80 9.67 7.33 <0.3 1.44 2.7 5.6
StDev= 15,052.45 2.44 1.03 1.94 0.34

LRT02	LRTR2.0	SRBC-604(b) Report	*	4/8/03	986.31	47.2	5.8	<0.3	1.90	2.57	4.4
	LRTR2.0	SRBC-604(b) Report	*	5/19/03	230.16	45.6	4.6	<0.3	1.82	1.69	4.3
	LRTR2.0	SRBC-604(b) Report	*	6/23/03	185.64	60.6	7.8	<0.3	0.098	0.5	4.2
	LRTR2.0	SRBC-604(b) Report	*	7/22/03	275.27	63.2	4.4	<0.3	2.41	1.9	4.2

Average= 419.34 54.15 5.65 <0.3 1.56 1.67 4.38
StDev= 379.74 9.04 1.56 1.01 0.86 0.10

LR03	LICK3.0	SRBC-604(b) Report	*	12/10/02	6,146.20	12.8	8.0	<0.3	1.61	<0.5	5.6
	LICK3.0	SRBC-604(b) Report	*	1/28/03	2,264.76	13.8	7.4	<0.3	1.49	<0.5	5.6
	LICK3.0	SRBC-604(b) Report	*	4/7/03	58,079.29	9.8	6.6	<0.3	1.20	<0.5	5.1
	LICK3.0	SRBC-604(b) Report	*	5/20/03	31,037.03	8.0	7.4	<0.3	0.83	<0.5	6.0
	LICK3.0	SRBC-604(b) Report	*	6/23/03	16,294.64	12.8	9.0	<0.3	6.81	3.49	5.8
	LICK3.0	SRBC-604(b) Report	*	7/22/03	12,995.46	20.6	7.6	1.16	3.26	<0.5	5.6

Average= 21,136.23 12.97 7.67 1.16 2.53 3.49 5.62
StDev= 20,656.05 4.33 0.80 2.26 0.30

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid (mg/l)	Alk (mg/l)	Fe (mg/l)	Mn (mg/l)	Al (mg/l)	pH
LRT01	LRTR1.0	SRBC-604(b) Report	*	12/10/02	516.25	73.6	8.6	0.311	9.84	5.39	4.6
	LRTR1.0	SRBC-604(b) Report	*	4/7/03	3,293.66	47.4	7.8	<0.3	4.34	3.06	4.8
	LRTR1.0	SRBC-604(b) Report	*	5/20/03	694.12	49.8	7.6	<0.3	6.10	3.00	4.7
	LRTR1.0	SRBC-604(b) Report	*	6/23/03	1,316.96	57.8	9.4	0.324	4.41	1.30	4.7
	LRTR1.0	SRBC-604(b) Report	*	7/22/03	3,013.04	44.0	8.0	<0.3	5.54	1.58	5.0

Average = 1,766.20 54.52 8.28 0.32 6.05 2.87 4.76
StDev = 1,303.25 11.82 0.73 0.01 2.25 1.62 0.15

JR02	JERR2.0	SRBC-604(b) Report	*	4/8/03	1,588.05	34.2	6.6	<0.3	3.14	2.05	4.6
	JERR2.0	SRBC-604(b) Report	*	5/20/03	644.03	36.4	6.4	<0.3	3.86	1.61	4.5
	JERR2.0	SRBC-604(b) Report	*	6/24/03	452.11	44.6	8.0	0.324	4.26	1.72	4.5
	JERR2.0	SRBC-604(b) Report	*	7/22/03	788.82	45.2	6.2	<0.3	5.44	1.64	4.4

Average= 868.25 40.1 6.8 0.32 4.18 1.76 4.5
StDev= 499.29 5.62 0.82 0.96 0.20 0.08

JR01	JERR1.0	SRBC-604(b) Report	*	4/8/03	1,690.30	42.2	7.0	<0.3	3.26	1.98	4.6
	JERR1.0	SRBC-604(b) Report	*	5/20/03	348.88	54.8	7.0	<0.3	4.18	1.46	4.6
	JERR1.0	SRBC-604(b) Report	*	6/24/03	436.31	53.6	8.8	0.34	4.46	1.29	4.7
	JERR1.0	SRBC-604(b) Report	*	7/22/03	925.09	60.2	7.4	0.40	5.54	1.39	4.7

Average= 850.14 52.7 7.55 0.37 4.36 1.53 4.65
StDev= 614.82 7.57 0.85 0.04 0.94 0.31 0.06

LR02	LICK2.0	SRBC-604(b) Report	*	12/10/02	11,315.35	25.8	8.0	<0.3	1.16	0.681	5.2
	LICK2.0	SRBC-604(b) Report	*	1/28/03	7,065.01	20.8	7.0	<0.3	0.996	0.618	5.0
	LICK2.0	SRBC-604(b) Report	*	4/8/03	51,556.74	14.4	7.4	<0.3	0.505	<0.5	5.2
	LICK2.0	SRBC-604(b) Report	*	5/20/03	30,934.21	12.4	7.2	<0.3	0.313	<0.5	5.6
	LICK2.0	SRBC-604(b) Report	*	6/24/03	16,061.87	34.8	8.8	<0.3	0.565	<0.5	5.2
	LICK2.0	SRBC-604(b) Report	*	7/22/03	14,177.45	26.0	7.8	<0.3	1.09	<0.5	5.6

Average= 21,851.77 22.37 7.7 <0.3 0.77 0.65 5.3
StDev= 16,655.08 8.30 0.65 0.35 0.04 0.24

FL02	FLEG2.0	SRBC-604(b) Report	*	12/10/02	33.75	61.4	1.0	<0.3	3.14	3.53	4.0
	FLEG2.0	SRBC-604(b) Report	*	1/28/03	200.63	50.2	2.4	<0.3	2.18	2.57	4.1

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid (mg/l)	Alk (mg/l)	Fe (mg/l)	Mn (mg/l)	Al (mg/l)	pH
	FLEG2.0	SRBC-604(b) Report	*	4/7/03	369.84	57.2	0.8	<0.3	2.54	3.11	4.0
	FLEG2.0	SRBC-604(b) Report	*	5/20/03	50.31	62.0	2.8	<0.3	2.91	3.18	4.1
	FLEG2.0	SRBC-604(b) Report	*	6/24/03	121.50	58.2	6.0	<0.3	2.24	2.29	4.2
	FLEG2.0	SRBC-604(b) Report	*	7/22/03	43.18	61.4	4.0	<0.3	2.73	2.92	4.2

Average= 136.53 58.4 2.83 <0.3 2.62 2.93 4.1
StDev= 130.75 4.46 1.95 0.38 0.45 0.09

FL01	MP04	Sky Haven Coal, Inc.	17900118	7/17/91	*	0.0	19.0	0.30	0.534	0.50	6.7
	MP04	Sky Haven Coal, Inc.	17900118	10/9/91	*	0.0	22.0	0.30	0.586	0.50	6.6
	MP04	Sky Haven Coal, Inc.	17900118	3/10/93	*	0.0	18.0	0.516	1.01	0.50	6.9
	MP04	Sky Haven Coal, Inc.	17900118	11/18/93	*	2.4	13.2	0.729	0.734	0.572	6.1
	MP04	Sky Haven Coal, Inc.	17900118	5/31/94	*	0.0	18.2	<0.3	0.727	<0.5	6.3
	MP04	Sky Haven Coal, Inc.	17900118	6/4/94	539	*	14.5	0.27	0.83	0.10	6.85
	MP04	Sky Haven Coal, Inc.	17900118	8/9/94	400	*	15.5	0.24	0.70	1.20	6.55
	MP04	Sky Haven Coal, Inc.	17900118	12/9/94	1,350	9.0	14.0	0.20	0.72	0.50	6.55
	MP04	Sky Haven Coal, Inc.	17900118	2/13/95	1,000	*	15.0	0.32	0.60	1.06	6.25
	MP04	Sky Haven Coal, Inc.	17900118	4/10/95	*	1.2	14.6	<0.3	0.53	<0.5	6.2
	MP04	Sky Haven Coal, Inc.	17900118	6/19/95	800	8.5	8.0	1.10	1.50	3.28	5.85
	MP04	Sky Haven Coal, Inc.	17900118	9/7/95	90	*	16.0	0.13	0.06	1.26	6.15
	MP04	Sky Haven Coal, Inc.	17900118	12/1/95	1,000	*	19.5	1.41	0.76	1.36	6.6
	MP04	Sky Haven Coal, Inc.	17900118	3/13/96	2,000	*	16.5	1.25	0.76	5.66	6.0
	MP04	Sky Haven Coal, Inc.	17900118	6/4/96	800	*	17.5	0.20	0.45	0.76	6.15
	MP04	Sky Haven Coal, Inc.	17900118	8/1/96	600	*	19.0	0.19	0.24	0.88	5.9
	MP04	Sky Haven Coal, Inc.	17900118	9/19/96	*	0.0	17.4	<0.3	0.498	<0.5	6.5
	MP04	Sky Haven Coal, Inc.	17900118	12/12/96	2,000	0.5	12.0	0.32	0.79	0.74	6.1
	MP04	Sky Haven Coal, Inc.	17900118	3/26/97	2,000	*	14.0	0.26	0.52	1.08	6.55
	MP04	Sky Haven Coal, Inc.	17900118	5/29/97	1,100	*	16.5	0.32	0.74	0.98	6.6
	MP04	Sky Haven Coal, Inc.	17900118	6/5/97	*	3.4	12.8	<0.3	0.406	<0.5	6.1
	MP04	Sky Haven Coal, Inc.	17900118	8/22/97	600	*	17.0	0.21	0.26	0.78	5.9
	MP04	Sky Haven Coal, Inc.	17900118	9/25/97	*	0.0	26.0	<0.3	0.084	<0.5	6.2
	MP04	Sky Haven Coal, Inc.	17900118	10/23/97	400	*	17.5	0.42	0.69	0.92	6.2
	MP04	Sky Haven Coal, Inc.	17900118	1/28/98	*	*	15.0	0.23	0.55	0.72	5.5
	MP04	Sky Haven Coal, Inc.	17900118	6/5/98	1,000	*	17.5	0.24	0.44	0.68	5.7
	MP04	Sky Haven Coal, Inc.	17900118	7/29/98	225	*	15.0	0.18	0.27	0.82	6.35
	MP04	Sky Haven Coal, Inc.	17900118	12/23/98	400	0.0	15.0	0.34	0.68	0.70	6.25

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid (mg/l)	Alk (mg/l)	Fe (mg/l)	Mn (mg/l)	Al (mg/l)	pH
	MP04	Sky Haven Coal, Inc.	17900118	8/11/99	*	0.0	24.0	<0.3	0.06	<0.5	6.2
	FLEG1.0	SRBC-604(b) Report	*	12/10/02	612.30	0.0	28.0	<0.3	0.451	<0.5	6.7
	FLEG1.0	SRBC-604(b) Report	*	1/28/03	535.68	0.0	25.0	<0.3	0.468	<0.5	6.7
	FLEG1.0	SRBC-604(b) Report	*	4/8/03	2,416.10	0.0	15.6	<0.3	0.548	0.581	6.6
	FLEG1.0	SRBC-604(b) Report	*	5/20/03	522.84	0.0	20.8	<0.3	0.30	<0.5	7.3
	FLEG1.0	SRBC-604(b) Report	*	6/24/03	793.67	0.0	26.2	<0.3	0.25	<0.5	7.2
	FLEG1.0	SRBC-604(b) Report	*	7/22/03	639.76	0.0	25.0	0.502	0.221	<0.5	7.0

Average= 909.35 1.25 17.74 0.42 0.54 1.09 6.38
StDev= 619.53 2.72 4.51 0.35 0.29 1.14 0.41

LR01	LICK1.0	SRBC-604(b) Report	*	12/9/02	1,760.18	37.4	7.2	<0.3	1.10	<0.5	5.9
	LICK1.0	SRBC-604(b) Report	*	1/28/03	6,968.55	19.2	7.6	<0.3	0.903	0.51	5.4
	LICK1.0	SRBC-604(b) Report	*	4/8/03	59,564.65	21.8	7.6	<0.3	0.471	<0.5	5.4
	LICK1.0	SRBC-604(b) Report	*	5/20/03	30,696.15	16.4	6.8	<0.3	0.306	<0.5	5.5
	LICK1.0	SRBC-604(b) Report	*	6/24/03	16,348.90	15.2	9.2	<0.3	0.487	<0.5	5.8
	LICK1.0	SRBC-604(b) Report	*	7/22/03	13,411.30	24.2	8.0	<0.3	0.937	<0.5	5.9

Average= 21,458.29 22.37 7.73 <0.3 0.70 0.51 5.65
StDev= 21,101.00 8.08 0.83 0.32 0.24

"*" signifies no data were collected

Note: All concentrations are in units of milligrams per liter (mg/l); all discharge measurements are in units of gallons per minute (GPM)

Attachment G

Comment and Response

No formal comments were received for Lick Run Watershed TMDL.