FINAL

UNION RUN WATERSHED TMDL

Westmoreland County

For Acid Mine Drainage Affected Segments

<u>Prepared by</u>:

Pennsylvania Department of Environmental Protection

August 26, 2004

TABLE OF CONTENTS

TABLES

ATTACHMENTS

TMDL[1]
Union Run Watershed
Westmoreland County, Pennsylvania

Introduction

This report presents the Total Maximum Daily Loads (TMDLs) developed for segments in the Union 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 metal, elevated suspended solids, and in some areas depressed pH, caused these impairments. All impairments resulted from acid drainage from abandoned coalmines. The TMDL addresses the three primary metals associated with acid mine drainage (iron, manganese, aluminum) and pH.

Table 1. 303(d) Sub-List								
State Water Plan (SWP) Subbasin: 18-C Loyalhanna Creek								
Year	**Miles**	**Segment ID**	**DEP Stream Code**	**Stream Name**	**Designated Use**	**Data Source**	**Source**	**EPA 305(b) Cause Code**
1996	3.2	5012	43417	Union Run	WWF	305(b) Report	RE	Metals
1998	3.67	5012	43417	Union Run	WWF	SWMP	AMD	Metals
2002	11.8	New survey; new id. 990526-0845-ALF	43417	Union Run	WWF	SWAP	AMD	Metals, pH, & Suspended Solids

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

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

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

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

Directions to the Union Run Watershed

The Union Run Watershed is located in southwestern Pennsylvania, occupying the north central portion of Westmoreland County. The watershed area is found on United States Geological Survey maps covering portions of the Derry and Latrobe 7.5-Minute Quadrangles. The area within the watershed consists of 7.31 square miles. Union Run is located within Derry Township, Westmoreland County, PA. From Greensburg, PA follow Rt. 119 East to the intersection with Rt. 22. Follow Rt. 22 to the intersection with Rt. 981. At the light turn right onto Rt. 981. Union Run passes under Rt. 981 at Township road 839.

Segments addressed in this TMDL

There are no active mining operations in the watershed. All of the discharges in the watershed are from abandoned mines and will be treated as non-point sources. Each segment on the 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

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

segments with the same source and cause listing are addressed collectively, and on a watershed basis.

Basic Steps for Determining a TMDL

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

1. Collection and summarization of pre-existing data (watershed characterization, inventory contaminant sources, determination of pollutant loads, etc.);
2. Calculating 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 period on draft TMDL
6. Submittal of final TMDL to EPA; and
7. EPA approval of the TMDL.

Watershed History

Union Run is located in Derry Township, Westmoreland County and is part of the Allegheny River Basin. It flows directly into Loyalhanna Creek approximately 1½ miles north of Latrobe, PA. Loyalhanna Creek flows to the Kiskiminetas River, which empties to the Allegheny. The Union Run Watershed is located on the Pittsburgh Low Plateau of the Appalachian Plateau Physiographic Province. The maximum elevation on a few hilltops reaches around 1,400 feet and the minimum elevation is about 970 feet near the confluence with the Loyalhanna.

Mining in the watershed was contained to the upper half of the Union Run and near the town of Superior. Approximately 66 percent of the watershed is agricultural land and about a 25 percent is forestland. The small communities of New Derry and Peanut are located on the eastern edge of the watershed.

The area was settled prior to 1769. Farming and trade continued to be the primary occupation till the 1870's when coal mining became of interest. The Loyalhanna mining community built around the Loyalhanna Coal and Coke Co., was said to be the first shaft mine in Derry Township sunk to a depth of 210 feet in 1871. Peak operations were reached between 1904-1908. The mine closed around 1917 and flooding of the mine forced the other mines in the area to close also. The surface mining of coal took place between 1953-1988 in the watershed. There are no active surface or deep mines in the area today. The watershed continues to be rural in nature with no changes anticipated in the near future.

AMD Methodology

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

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

Allowable loads are determined for each point of interest using Monte Carlo simulation. Monte Carlo simulation is an analytical method meant to imitate real-life systems, especially when other analyses are too mathematically complex or too difficult to reproduce. Monte Carlo simulation calculates multiple scenarios of a model by repeatedly sampling values from the probability distribution of the uncertain variables and using those values to populate a larger data set. Allocations were applied uniformly for the watershed area specified for each allocation point. For each source and pollutant, it was assumed that the observed data were log-normally distributed. Each pollutant source was evaluated separately using @Risk[3] by performing 5,000 iterations to determine the required percent reduction so that the water quality criteria, as defined in the *Pennsylvania Code. Title 25 Environmental Protection, Department of Environmental Protection, Chapter 93, Water Quality Standards,* will be met instream at least 99 percent of the time. For each iteration, the required percent reduction is:

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

PR = required percent reduction for the current iteration

Cc = criterion in mg/l

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

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

Mean = average observed concentration

Standard Deviation = standard deviation of observed data

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

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

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

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 at the downstream point this is indicative that there is a loss of instream load between the evaluation points, and the ratio of the decrease shall be applied to the load that is being tracked (allowable load(s)) from the upstream point.

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

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

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

TMDL Endpoints

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

Because most of the pollution sources in the watershed are nonpoint sources, the largest pat of the TMDL is expressed as Load Allocations (LAs). 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 concentrations are expected to meet water-quality criteria 99% of the time as required in PA Title 25 Chapter 96.3(c). The following table shows the applicable water-quality criteria for the selected parameters.

Table 2. Applicable Water Quality Criteria

Parameter	***Criterion Value (mg/l)***	***Total Recoverable/Dissolved***
Aluminum (Al)	0.75	Total Recoverable
Iron (Fe)	1.5	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 nonpoint sources. The margin of safety is applied to account for uncertainties in the computational process. The margin of safety may be expressed implicitly (documenting conservative processes in the computations) or explicitly (setting aside a portion of the allowable load). The TMDL allocations in this report are based on available data. Other allocation schemes could also meet the TMDL.

Allocation Summary

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

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

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

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

Table 3. TMDL Component Summary for the Union Run Watershed

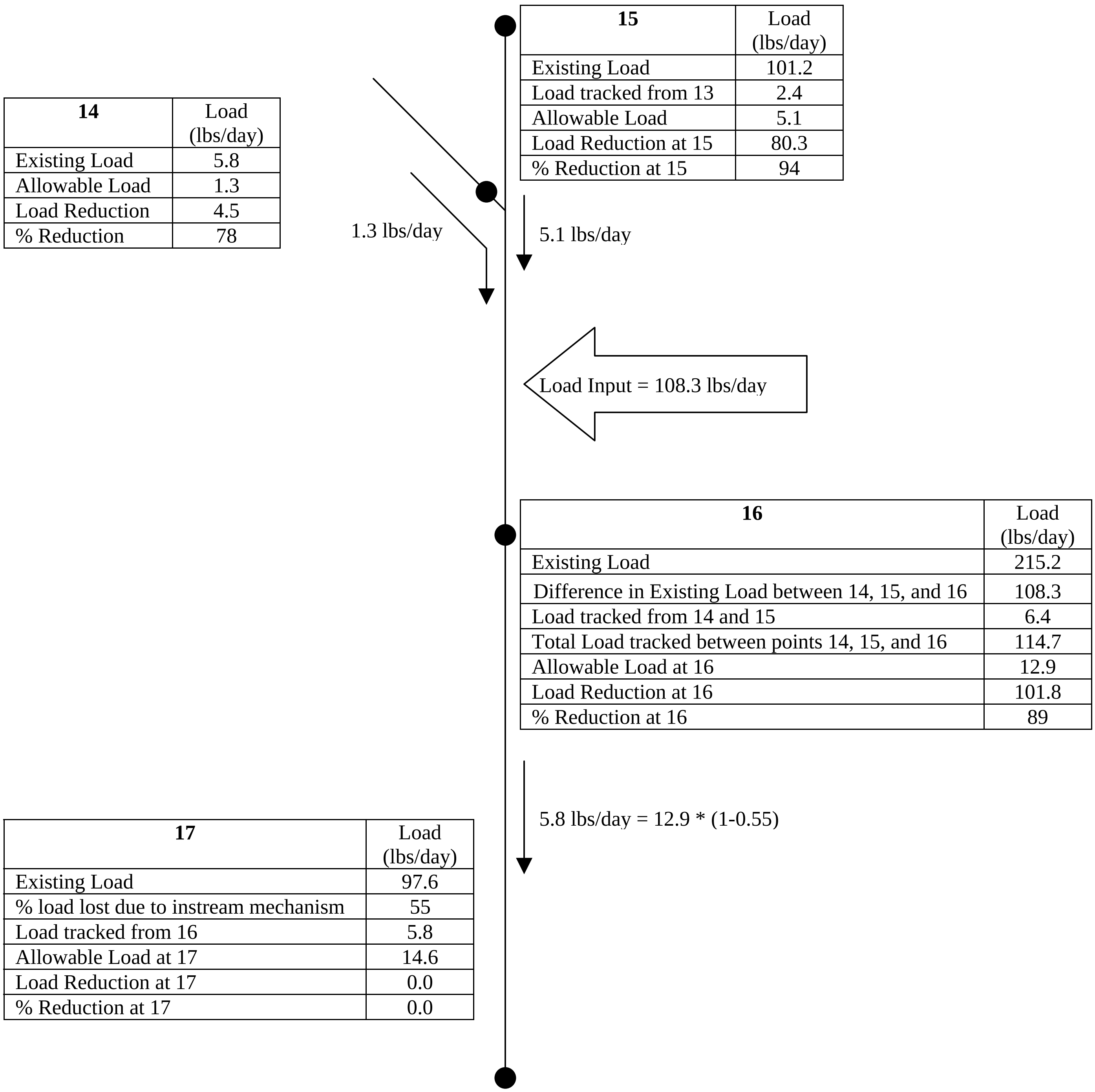
Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
1	*Union Run, headwaters*						
	Fe	0.09	0.05	0.0	0.05	0.04	45
	Mn	0.04	0.02	0.0	0.02	0.02	49
	Al	0.06	0.06	NA	NA	0.0	0
	Acidity	0.00	0.0	NA	NA	0.0	0
2	*Mouth of Unnamed Tributary 43437*						
	Fe	1.0	0.3	0.0	0.3	0.7	72
	Mn	0.2	0.2	NA	NA	0.0	0
	Al	0.86	0.77	0.0	0.77	0.1	11
	Acidity	0.0	0.0	NA	NA	0.0	0
5	*Mouth of Unnamed Tributary 43434*						
	Fe	0.5	0.2	0.0	0.2	0.3	60
	Mn	3.5	0.4	0.0	0.4	3.1	89
	Al	1.6	0.1	0.0	0.1	1.5	91
	Acidity	32.0	2.2	0.0	2.2	29.8	93
6	*Union Run, upstream of Unnamed Tributary 43429*						
	Fe	14.8	1.2	0.0	1.2	12.6	91
	Mn	23.1	0.9	0.0	0.9	19.1	95
	Al	34.7	0.3	0.0	0.3	32.9	99
	Acidity	418.1	0.0	0.0	0.0	388.3	100

Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
9	*Unnamed Tributary 43429, headwaters*						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	0.03	0.03	NA	NA	0.0	0
	Al	0.23	0.23	NA	NA	0.0	0
	Acidity	0.0	0.0	NA	NA	0.0	0
7	*Mouth of Unnamed Tributary 43429*						
	Fe	1.0	1.0	NA	NA	0.0	0
	Mn	0.4	0.4	NA	NA	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	0.0	0.0	NA	NA	0.0	0
13	*Union Run, downstream of Unnamed Tributary 43429*						
	Fe	18.2	2.4	0.0	2.4	2.2	48
	Mn	27.3	1.6	0.0	1.6	3.5	68
	Al	35.4	0.7	0.0	0.7	0.3	29
	Acidity	278.1	11.1	0.0	11.1	0.0	0
15	*Union Run, upstream of Unnamed Tributary 43426*						
	Fe	101.2	5.1	0.0	5.1	80.3	94
	Mn	51.1	3.1	0.0	3.1	22.3	88
	Al	80.7	2.4	0.0	2.4	43.6	95
	Acidity	847.6	33.9	0.0	33.9	395.7	92
14	*Mouth of Unnamed Tributary 43426*						
	Fe	5.8	1.3	0.0	1.3	4.5	78
	Mn	12.9	0.5	0.0	0.5	12.4	96
	Al	29.6	0.3	0.0	0.3	29.3	99
	Acidity	233.3	9.3	0.0	9.3	224.0	96
16	*Union Run, upstream of Unnamed Tributary 43423*						
	Fe	215.2	12.9	0.0	12.9	101.8	89
	Mn	118.6	10.7	0.0	10.7	47.5	82
	Al	176.9	7.1	0.0	7.1	62.3	90
	Acidity	1999.9	40.0	0.0	40.0	922.2	96
17	*Mouth of Union Run*						
	Fe	97.6	14.6	0.0	14.6	0.0	0
	Mn	112.4	10.1	0.0	10.1	0.0	0
	Al	164.6	6.6	0.0	6.6	0.0	0
	Acidity	1782.6	71.3	0.0	71.3	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 measured load (e.g. manganese point 2, Table 3), the simulation determined that water quality standards are being met instream 99% of the time and therefore no TMDL is necessary for the parameter at that point. Although no TMDL is necessary, the loading at the point is considered at the next downstream point. In addition, when all measured values are below the method detection limit, denoted by ND (e.g. iron point 9, Table 3), no TMDL is necessary. In this case the accounting for upstream loads is not carried through to the next downstream point. Rather, there is a disconnect noted and the allowable load is considered to start over because the water quality standard is satisfied.

Following is an example of how the allocations, presented in Table 3, for a stream segment are calculated. For this example, iron allocations for points 14, 15, 16, and 17 of Union Run 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.



15	Load (lbs/day)
Existing Load	101.2
Load tracked from 13	2.4
Allowable Load	5.1
Load Reduction at 15	80.3
% Reduction at 15	94

14	Load (lbs/day)
Existing Load	5.8
Allowable Load	1.3
Load Reduction	4.5
% Reduction	78

16	Load (lbs/day)
Existing Load	215.2
Difference in Existing Load between 14, 15, and 16	108.3
Load tracked from 14 and 15	6.4
Total Load tracked between points 14, 15, and 16	114.7
Allowable Load at 16	12.9
Load Reduction at 16	101.8
% Reduction at 16	89

17	Load (lbs/day)
Existing Load	97.6
% load lost due to instream mechanism	55
Load tracked from 16	5.8
Allowable Load at 17	14.6
Load Reduction at 17	0.0
% Reduction at 17	0.0

Recommendations

To date no projects have been constructed in order to address the affects of abandoned mines and abandoned mine lands in the watershed. It is recommended that the Department work with local organizations to address the affects of AMD in the Union Run Watershed.

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

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

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

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

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

- To encourage private and public participation in abandoned mine reclamation efforts
- To improve reclamation efficiency through better communication between reclamation partners
- To increase reclamation by reducing remining risks

- To maximize reclamation funding by expanding existing sources and exploring new sources.

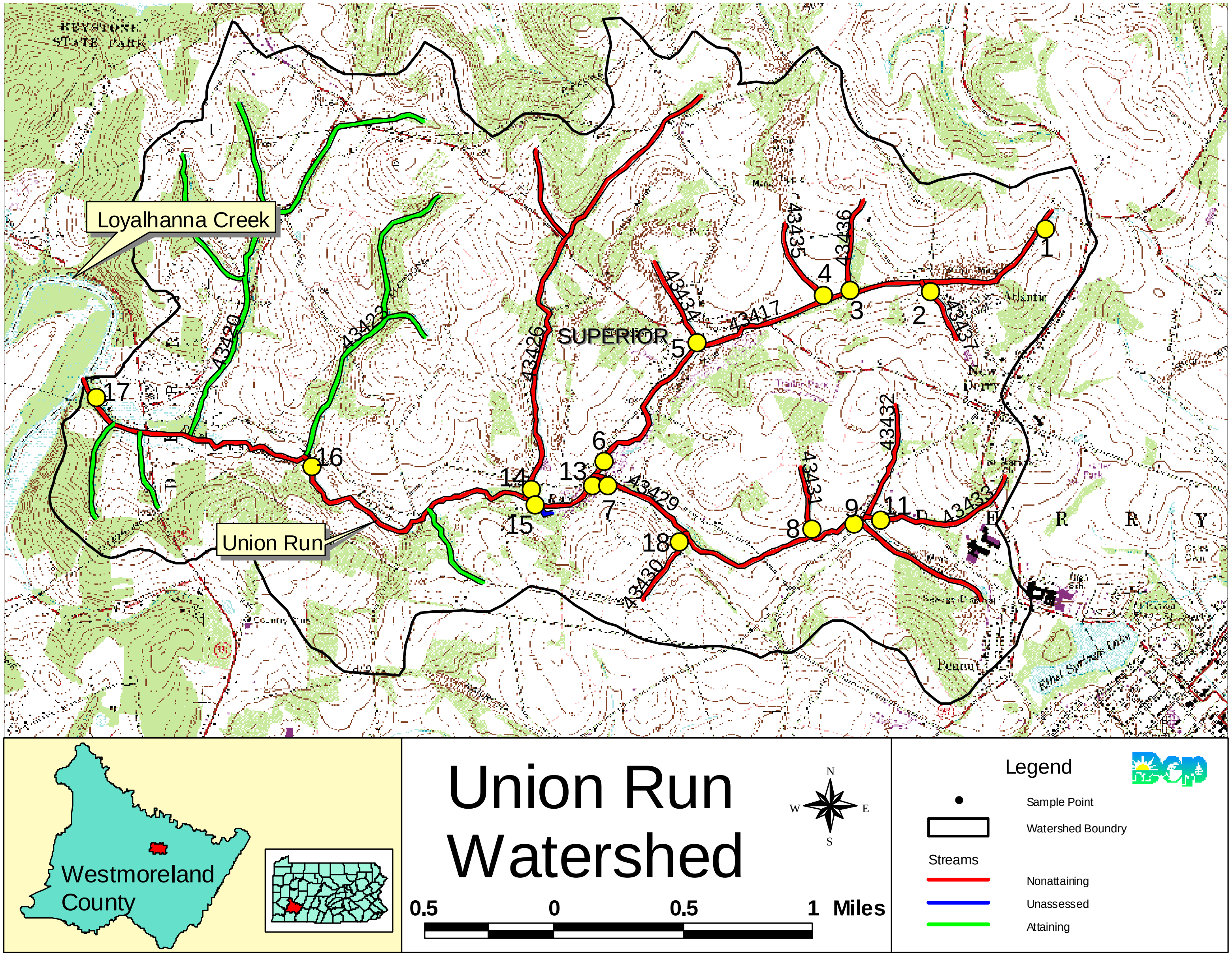
Reclaim PA is DEP's initiative designed to maximize reclamation of the state's quarter million acres of abandoned mineral extraction lands. Abandoned mineral extraction lands in Pennsylvania constituted a significant public liability – more than 250,000 acres of abandoned surface mines, 2,400 miles of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

Public Participation

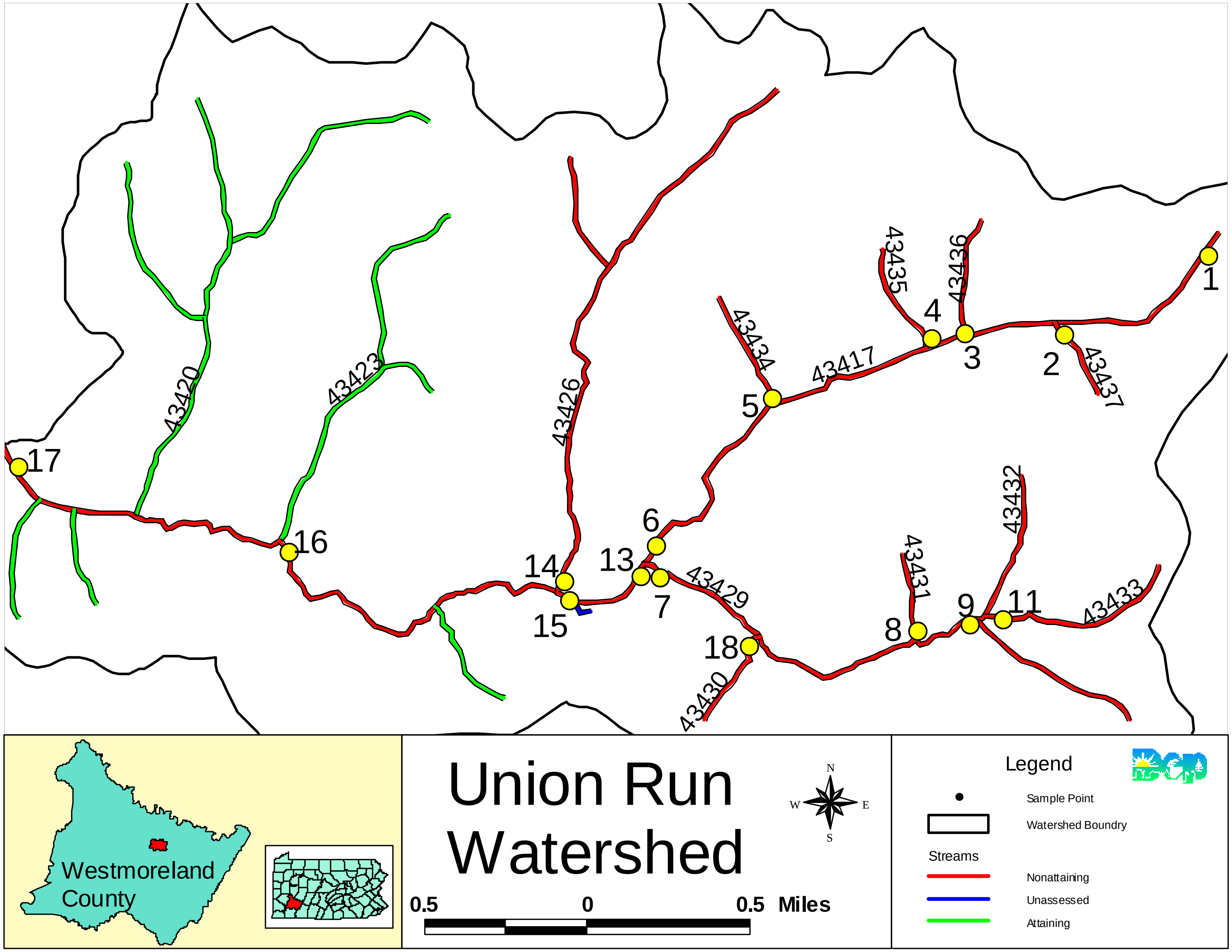
Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on May 1, 2004 and the *Tribune-Review* on April 27, 2004 to foster public comment on the allowable loads calculated. The public comment period on this TMDL was open from May 1, 2004 to July 1, 2004. A public meeting was held on May 5, 2004 at the Stonelodge Environmental Center, Keystone State Park, in New Alexandria, PA to discuss the proposed TMDL.

Attachment A

Union Run Watershed Maps

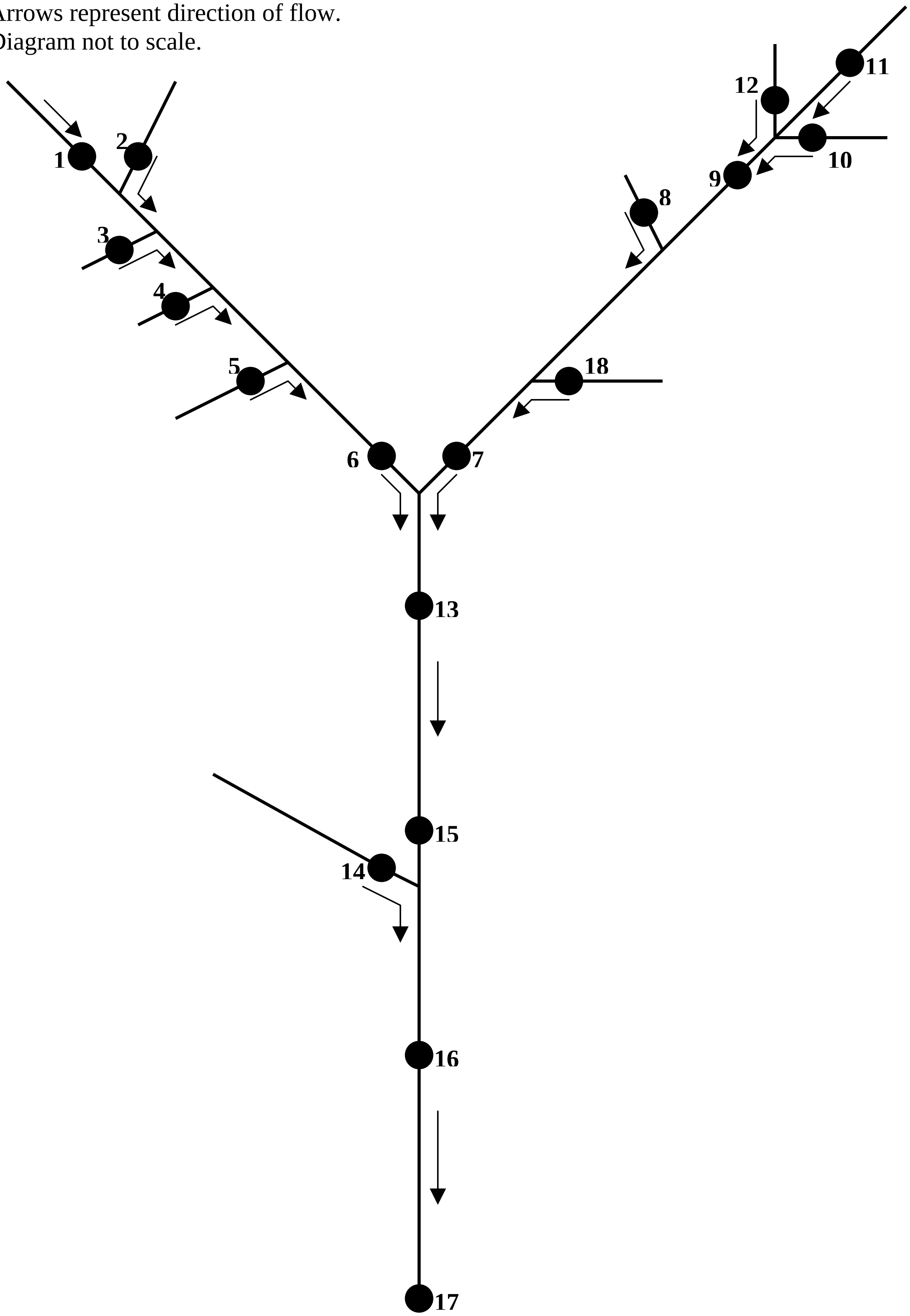


Loyalhanna Creek
Union Run
SUPERIOR
43417
43420
43423
43426
43429
43430
43431
43432
43433
43434
43435
43436
43437
1
2
3
4
5
6
7
8
9
11
13
14
15
16
17
18
Westmoreland County
Union Run Watershed
N
S
E
W
0.5
0
0.5
1 Miles
Legend
Sample Point
Watershed Boundry
Streams
Nonattaining
Unassessed
Attaining



Union Run Watershed
Westmoreland County
Legend
Sample Point
Watershed Boundry
Streams
Nonattaining
Unassessed
Attaining
0.5
0
0.5
Miles
N
S
E
W
43420
43423
43426
43417
43434
43435
43436
43437
43429
43430
43431
43432
43433
1
2
3
4
5
6
7
8
9
11
13
14
15
16
17
18

Union Run Sampling Station Diagram
Arrows represent direction of flow.
Diagram not to scale.



Attachment B

Method for Addressing Section 303(d) Listings for pH and Surface Mining Control and Reclamation Act

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 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 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.*

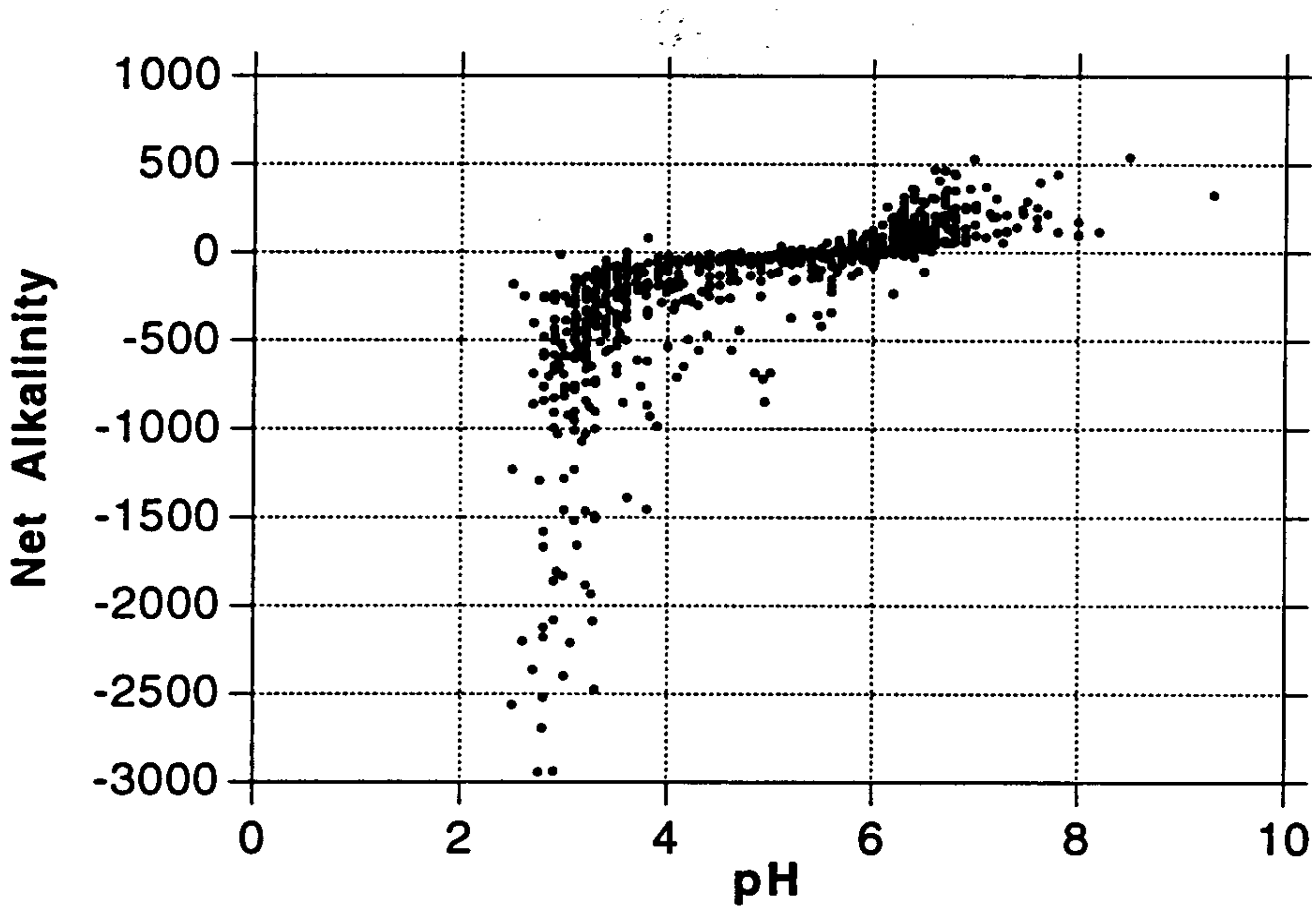


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Surface Mining Control and Reclamation Act

The Surface Mining Control and Reclamation Act of 1977 (SMCRA, Public Law 95-87) and its subsequent revisions were enacted to established a nationwide program to, among other things, protect the beneficial uses of land or water resources, and pubic health and safety from the adverse effects of current surface coal mining operations, as well as promote the reclamation of mined areas left without adequate reclamation prior to August 3, 1977. SMCRA requires a permit for the development of new, previously mined, or abandoned sites for the purpose of surface mining. Permittees are required to post a performance bond that will be sufficient to ensure the completion of reclamation requirements by the regulatory authority in the event that the applicant forfeits. Mines that ceased operating by the effective date of SMCRA, (often called "pre-law" mines) are not subject to the requirements of SMCRA.

Title IV of the Act is designed to provide assistance for reclamation and restoration of abandoned mines, while Title V states that any surface coal mining operations shall be required to meet all applicable performance standards. Some general performance standards include:

- Restoring the affected land to a condition capable of supporting the uses which it was capable of supporting prior to any mining,

- Backfilling and compacting (to insure stability or to prevent leaching of toxic materials) in order to restore the approximate original contour of the land with all highwalls being eliminated, and topsoil replaced to allow revegetation, and

- Minimizing the disturbances to the hydrologic balance and to the quality and quantity of water in surface and ground water systems both during and after surface coal mining operations and during reclamation by avoiding acid or other toxic mine drainage.

For purposes of these TMDLs, point sources are identified as NPDES-permitted discharge points, and nonpoint sources include discharges from abandoned mine lands, including but not limited to, tunnel discharges, seeps, and surface runoff. Abandoned and reclaimed mine lands were treated in the allocations as nonpoint sources because there are no NPDES permits associated with these areas. In the absence of an NPDES permit, the discharges associated with these land uses were assigned load allocations.

The decision to assign load allocations to abandoned and reclaimed mine lands does not reflect any determination by EPA as to whether there are, in fact, unpermitted point source discharges within these land uses. In addition, by establishing these TMDLs with mine drainage discharges treated as load allocations, EPA is not determining that these discharges are exempt from NPDES permitting requirements.

Related Definitions

Pre-Act (Pre-Law) - Mines that ceased operating by the effective date of SMCRA and are not subject to the requirements of SMCRA.

Bond – A instrument by which a permittee assures faithful performance of the requirements of the acts, this chapter, Chapters 87-90 and the requirements of the permit and reclamation plan.

Postmining pollution discharge – A discharge of mine drainage emanating from or hydrologically connected to the permit area, which may remain after coal mining activities have been completed, and which does not comply with the applicable effluent requirements described in Chapters 87.102, 88.92, 88.187, 88.292, 89.52 or 90.102. The term includes minimal-impact postmining discharges, as defined in Section of the Surface Mining Conservation and Reclamation Act.

Forfeited Bond – Bond money collected by the regulatory authority to complete the reclamation of a mine site when a permittee defaults on his reclamation requirements.

Attachment C

TMDLs By Segment

Union Run

The TMDL for Union Run consists of load allocations of four tributaries and six sampling sites along the stream. No waste load allocations are assigned because there are currently no permitted discharges in the Union Run Watershed. Following is an explanation of the TMDL for each allocation point.

Union Run is listed as impaired on the PA Section 303(d) list by both high metals and suspended solids and depressed pH from AMD. The elevated suspended solids listing is due to iron precipitate and therefore by removing the metals loading to the stream, the suspended solids will in turn be removed. 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 3). The method and rationale for addressing pH is contained in Attachment B.

TMDLs are not calculated for sampling points 3, 4, 11, 8, and 18. The tributaries on which these points are located were not flowing during the sampling events. For sampling points 8 and 18, there was flow only for the first round of sampling. Water quality data from this sampling event shows low metals concentrations and pH between 6 and 9 for both points.

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

TMDL Calculations - Sample Point 1, headwaters Union Run

The TMDL for Union Run consists of a load allocation to all of the area above sampling point 1 (Attachment A). The load allocation for this stream segment was computed using water-quality sample data collected at point 1. The average flow of 0.01 MGD, measured at the sampling point, is used for these computations.

This segment appeared on the 1996 and 1998 PA Section 303(d) lists for metals impairments. A reassessment of the segment in 1999 resulted in the addition of depressed pH and suspended solids as causes of impairment to the 2002 PA Section 303(d) list. Sample data at point 1 shows pH ranging between 7.6 and 10.1; pH will not be addressed as part of this TMDL. There are no mining impacts upstream of this point and the measured values of pH are representative of natural conditions.

Table C1. TMDL Calculations at Point 1				
Flow = 0.01 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	1.02	0.09	0.56	0.05
Mn	0.48	0.04	0.24	0.02
Al	0.66	0.06	0.66	0.06
Acidity	0.00	0.0	0.00	0.0
Alkalinity	102.50	8.6		

Table C2. Calculation of Load Reductions Necessary at Point 1				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	0.09	0.04	0.06	0.0
Allowable Load	0.05	0.02	0.06	0.0
Load Reduction	0.04	0.02	0.0	0.0
% Reduction Segment	45	49	0	0

TMDL Calculations - Sampling Points 2, mouth of Unnamed Tributary 43437

The TMDL for sampling point 2 consists of 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 2. The average flow of 0.12 MGD, measured at the sampling point, is used for these computations

This segment is on the 1996 and 1998 PA Section 303(d) lists for metals impairments. A reassessment of the segment in 1999 resulted in the addition of depressed pH and suspended solids as causes of impairment to the 2002 PA Section 303(d) list. Sample data at point 2 shows pH ranging between 7.6 and 7.8, pH will not be addressed in this TMDL.

Because the stream meets WQS, no TMDL is necessary for manganese. There are no allocation points upstream of point 2; therefore, accounting for loads allocated upstream is not necessary at point 2.

Table C3. TMDL Calculations at Point 2				
Flow = 0.12 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	1.01	1.0	0.28	0.3
Mn	0.22	0.2	0.22	0.2
Al	0.85	0.86	0.75	0.77
Acidity	0.00	0.0	0.00	0.0
Alkalinity	180.88	184.6		

Table C4. Calculation of Load Reductions Necessary at Point 2				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	1.0	0.2	0.86	0.0
Allowable Load = TMDL	0.3	0.2	0.77	0.0
Load Reduction	0.7	0.0	0.1	0.0
% Reduction Segment	72	0	11	0

TMDL Calculations - Sampling Point 5, mouth of Unnamed Tributary 43434

The TMDL for sampling point 5 consists of a load allocation to all of the area above sample point 5 shown on the map in Attachment A. The load allocation for this tributary was computed using water-quality sample data collected at point 5. The average flow of 0.059 MGD, measured at the sampling point, is used for these computations.

This segment appeared on the 1996 and 1998 PA Section 303(d) lists for metals impairments. A reassessment of the segment in 1999 resulted in the addition of depressed pH and suspended solids as causes of impairment to the 2002 PA Section 303(d) list. Sample data at point 5 shows pH ranging between 4.7 and 5.9; pH will be addressed as part of this TMDL because of the mining impacts.

There are no allocation points upstream of point 5; therefore, accounting for loads allocated upstream is not necessary at point 5.

Table C5. TMDL Calculations at Point 5				
Flow = 0.059 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.96	0.5	0.38	0.2
Mn	7.10	3.5	0.78	0.4
Al	3.25	1.6	0.29	0.1
Acidity	65.32	32.0	4.57	2.2
Alkalinity	9.27	4.5		

Table C6. Calculation of Load Reductions Necessary at Point 5				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	0.5	3.5	1.6	32.0
Allowable Load = TMDL	0.2	0.4	0.1	2.2
Load Reduction	0.3	3.1	1.5	29.8
% Reduction Segment	60	89	91	93

TMDL Calculations - Sample Point 6, Union Run upstream confluence with Unnamed Tributary 43429

The TMDL for sample point 6 consists of a load allocation to all of the area between sample point 6 and sample points 1, 2, and 5 shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point 6. The average flow of 0.17 MGD, measured at the sampling point, is used for these computations.

This segment appeared on the 1996 and 1998 PA Section 303(d) lists for metals impairments. A reassessment of the segment in 1999 resulted in the addition of depressed pH and suspended solids as causes of impairment to the 2002 PA Section 303(d) list. Sample data at point 6 shows pH ranging between 3.0 and 3.1; pH will be addressed as part of this TMDL because of the mining impacts.

Table C7. TMDL Calculations at Point 6

Flow = 0.17 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	10.67	14.8	0.85	1.2
Mn	16.62	23.1	0.66	0.9
Al	24.96	34.7	0.25	0.3
Acidity	300.64	418.1	0.00	0.0
Alkalinity	0.00	0.0		

The calculated load reductions for all the loads that enter point 6 must be accounted for in the calculated reductions at sample point 6 shown is Table C8. Points 1, 2, and 5 are upstream of point 6. The existing loads at these points are compared to the existing loads at 6 to determine whether load is input or lost within the segment. For this segment, there is an increase in load for all parameters. The total segment load is the sum of the upstream allocated loads and any additional loading within the segment.

The upstream acidity load is greater than the allowable load at point 6. The extra loading is accounted for in the reduction at 6 because the reduction is based on all loads to the segment, upstream and direct.

Table C8. Calculation of Load Reductions Necessary at Point 6

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	14.8	23.1	34.7	418.1
Difference in Existing Load between 1, 2, 5, and 6	13.3	19.4	32.2	386.1
Load tracked from 1, 2 and 5 (Upstream Load)	0.5	0.6	1.0	2.2
Total Segment Load	13.8	20.0	33.2	388.3
Allowable Load = TMDL	1.2	0.9	0.3	0.0
Load Reduction	12.6	19.1	32.9	388.3
% Reduction Segment	91	95	99	100

TMDL Calculations - Sample Point 9, Unnamed Tributary 43429, downstream confluence with Unnamed Tributary 43432

A TMDL for point 9 is not necessary. The simulation determined that WQS are met for all parameters at 9. All values for iron fell below the method detection limits, denoted by ND.

Table C9. TMDL Calculations at Point 9				
Flow = 0.05 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	ND	ND	NA	NA
Mn	0.07	0.03	0.07	0.03
Al	0.56	0.23	0.56	0.23
Acidity	0.00	0.0	0.00	0.0
Alkalinity	196.10	82.4		

Table C10. Calculation of Load Reductions Necessary at Point 9				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	ND	0.03	0.23	0.0
Allowable Load	NA	0.03	0.23	0.0
Load Reduction	0.0	0.0	0.0	0.0
% Reduction Segment	0	0	0	0

TMDL Calculations – Sample Point 7, mouth of Unnamed Tributary 43429

A TMDL for point 7 is not necessary. WQS are met for all parameters at 7. Although no TMDLs are necessary, any loads measured at 7 will be included as upstream loading at the next downstream point. In addition, because no acidity was measured in tributary 43249, alkalinity from 7 will provide buffering capacity in the next downstream segment.

Table C11. TMDL Calculations at Point 7				
Flow = 0.22 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.54	1.0	0.54	1.0
Mn	0.22	0.4	0.22	0.4
Al	ND	ND	NA	NA
Acidity	0.00	0.0	0.00	0.0
Alkalinity	115.92	210.8		

Table C12. Calculation of Load Reductions Necessary at Point 7				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	1.0	0.4	ND	0.0
Allowable Load	1.0	0.4	NA	0.0
Load Reduction	0.0	0.0	0.0	0.0
% Reduction Segment	0	0	0	0

TMDL Calculations - Sample Point 13, Union Run downstream confluence with Unnamed Tributary 43429

The TMDL for sample point 13 consists of a load allocation to all of the area between sample point 13 and sample points 6 and 7 shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point 13. The average flow of 0.37 MGD, measured at the sampling point, is used for these computations.

This segment appeared on the 1996 and 1998 PA Section 303(d) lists for metals impairments. A reassessment of the segment in 1999 resulted in the addition of depressed pH and suspended solids as causes of impairment to the 2002 PA Section 303(d) list. Sample data at point 13 shows pH ranging between 4.2 and 5.6; pH is addressed as part of this TMDL because of the mining impacts.

Table C13. TMDL Calculations at Point 13				
Flow = 0.37 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	5.84	18.2	0.76	2.4
Mn	8.76	27.3	0.53	1.6
Al	11.35	35.4	0.23	0.7
Acidity	89.12	278.1	3.56	11.1
Alkalinity	11.20	34.9		

The calculated load reductions for all the loads that enter point 13 must be accounted for in the calculated reductions at sample point 13 shown is Table C14. Points 6 and 7 are upstream of point 13. The existing loads at these points are compared to the existing loads at 13 to determine whether load is input or lost within the segment. For this segment, there is an increase in load for all metals. The total segment load is the sum of the upstream allocated loads and any additional loading within the segment.

To determine the amount of current acidity loading to the segment, the difference in existing loads is calculated. This is done by first neutralizing acidity from point 6 with alkalinity from point 7. The result of this is 207.3 lbs/day ($418.1_{acidity}$ - $210.8_{alkalinity}$) of acidity from point 6 enters the segment. The difference between the existing load at 13 and the amount of acidity that passes from upstream (point 6) is the additional load that enters the segment (278.1-207.3 = 70.8 lbs/day). Because the allowable load that passes from point 6 is 0.0 lbs/day, the 210.8 lbs/day of alkalinity from point 7 is available to neutralize acid load entering within the segment, which results in no necessary reduction for acidity to the segment. The remaining buffering capacity (210.8 – 70.8 = 140.0 lbs/day) is carried through to the next downstream segment.

Table C14. Calculation of Load Reductions Necessary at Point 13				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	18.2	27.3	35.4	278.1
Difference in Existing Load between 6, 7, and 13	2.4	3.8	0.7	70.8
Load tracked from 6 and 7 (Upstream Load)	2.2	1.3	0.3	0.0
Total Segment Load	4.6	5.1	1.0	70.8
Allowable Load = TMDL	2.4	1.6	0.7	11.1
Load Reduction	2.2	3.5	0.3	0.0
% Reduction Segment	48	68	29	0

TMDL Calculations - Sample Point 15, Union Run upstream confluence with Unnamed Tributary 43426

The TMDL for sample point 15 consists of a load allocation to all of the area between sample point 15 and sample point 13 shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point 15. The average flow of 1.03 MGD, measured at the sampling point, is used for these computations.

This segment appeared on the 1996 and 1998 PA Section 303(d) lists for metals impairments. A reassessment of the segment in 1999 resulted in the addition of depressed pH and suspended solids as causes of impairment to the 2002 PA Section 303(d) list. Sample data at point 15 shows pH ranging between 3.6 and 7.0; pH is addressed as part of this TMDL because of the mining impacts.

Table C15. TMDL Calculations at Point 15				
Flow = 1.03 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	11.74	101.2	0.59	5.1
Mn	5.93	51.1	0.36	3.1
Al	9.36	80.7	0.28	2.4
Acidity	98.37	847.6	3.93	33.9
Alkalinity	11.53	99.4		

The calculated load reductions for all the loads that enter point 15 must be accounted for in the calculated reductions at sample point 15 shown is Table C16. Point 13 is upstream of point 15. The existing loads at 13 are compared to the existing loads at 15 to determine whether load is input of lost within the segment. For this segment, there is an increase in load for all parameters. The total segment load is the sum of the upstream allocated loads and any additional loading within the segment.

Although there is an allowable load of 11.1 lbs/day of acidity at point 13, no acidity load is passed from point 13 to point 15. A load of 140.0 lbs/day of alkalinity is passed from point 13, which is used to neutralize a portion of the acidity load entering the segment. The remaining acidity load entering the segment is 429.6 (569.6 –140.0) lbs/day.

Table C16. Calculation of Load Reductions Necessary at Point 15				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	101.2	51.1	80.7	847.6
Difference in Existing Load between 13 and 15	83.0	23.8	45.3	569.6
Load tracked from 13 (Upstream Load)	2.4	1.6	0.7	0.0
Total Segment Load	85.4	25.4	46.0	429.6
Allowable Load = TMDL	5.1	3.1	2.4	33.9
Load Reduction	80.3	22.3	43.6	395.7
% Reduction Segment	94	88	95	92

TMDL Calculations - Sample Point 14, mouth of Unnamed Tributary 43426

The TMDL for sample point 14 consists of a load allocation to all of the area above sampling point 14 (Attachment A). The load allocation for this stream segment was computed using water-quality sample data collected at point 14. The average flow of 0.49 MGD, measured at the sampling point, is used for these computations.

This segment appeared on the 1996 and 1998 PA Section 303(d) lists for metals impairments. A reassessment of the segment in 1999 resulted in the addition of depressed pH and suspended solids as causes of impairment to the 2002 PA Section 303(d) list. Sample data at point 14 shows pH ranging between 3.2 and 7.0; pH will be addressed as part of this TMDL because of the mining impacts downstream. There are no allocation points upstream of point 14; therefore, accounting for loads allocated upstream is not necessary at point 14.

Table C17. TMDL Calculations at Point 14				
Flow = 0.49 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	1.42	5.8	0.31	1.3
Mn	3.15	12.9	0.13	0.5
Al	7.25	29.6	0.07	0.3
Acidity	57.13	233.3	2.29	9.3
Alkalinity	19.97	81.5		

Table C18. Calculation of Load Reductions Necessary at Point 14				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	5.8	12.9	29.6	233.3
Allowable Load = TMDL	1.3	0.5	0.3	9.3
Load Reduction	4.5	12.4	29.3	224.0
% Reduction Segment	78	96	99	96

TMDL Calculations - Sample Point 16, Union Run upstream confluence with Unnamed Tributary 43423

The TMDL for sample point 16 consists of a load allocation to all of the area between sample point 16 and sample points 14 and 15 shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point 16. The average flow of 2.34 MGD, measured at the sampling point, is used for these computations.

This segment appeared on the 1996 and 1998 PA Section 303(d) lists for metals impairments. A reassessment of the segment in 1999 resulted in the addition of depressed pH and suspended solids as causes of impairment to the 2002 PA Section 303(d) list. Sample data at point 16 shows pH ranging between 3.4 and 5.7; pH will be addressed as part of this TMDL because of the mining impacts.

Table C19. TMDL Calculations at Point 16				
Flow = 2.34 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	11.01	215.2	0.66	12.9
Mn	6.07	118.6	0.55	10.7
Al	9.05	176.9	0.36	7.1
Acidity	102.27	1999.9	2.05	40.0
Alkalinity	5.33	104.3		

The calculated load reductions for all the loads that enter point 16 must be accounted for in the calculated reductions at sample point 16 shown is Table C20. Points 14 and 15 are upstream of point 16. The existing loads at these points are compared to the existing loads at 16 to determine whether load is input or lost within the segment. For this segment there is an increase in load for all parameters. The total segment load is the sum of the upstream allocated loads and any additional loading within the segment.

The upstream acidity load is greater than the allowable load at point 16. The extra loading is accounted for in the reduction at 16 because the reduction is based on all loads to the segment, upstream and direct.

Table C20. Calculation of Load Reductions Necessary at Point 16				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	215.2	118.6	176.9	1999.9
Difference in Existing Load between 14, 15, and 16	108.3	54.6	66.7	919.0
Load tracked from 14 and 15 (Upstream Load)	6.4	3.6	2.7	43.2
Total Segment Load	114.7	58.2	69.4	962.2
Allowable Load = TMDL	12.9	10.7	7.1	40.0
Load Reduction	101.8	47.5	62.3	922.2
% Reduction Segment	89	82	90	96

TMDL Calculations - Sample Point 17, mouth of Union Run

The TMDL for sample point 17 consists of a load allocation to all of the area between sample point 17 and sample point 16 shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point 17. The average flow of 2.85 MGD, measured at the sampling point, is used for these computations.

This segment appeared on the 1996 and 1998 PA Section 303(d) lists for metals impairments. A reassessment of the segment in 1999 resulted in the addition of depressed pH and suspended solids as causes of impairment to the 2002 PA Section 303(d) list. Sample data at point 17 shows pH ranging between 3.3 and 6.8; pH is addressed as part of this TMDL because of the mining impacts.

Table C21. TMDL Calculations at Point 17

Flow = 2.85 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	4.10	97.6	0.62	14.6
Mn	4.73	112.4	0.43	10.1
Al	6.92	164.6	0.28	6.6
Acidity	74.97	1782.6	3.00	71.3
Alkalinity	9.50	225.9		

The calculated load reductions for all the loads that enter point 17 must be accounted for in the calculated reductions at sample point 17 shown is Table C22. There is a decrease in existing loads for all parameters between points 16 and 17 indicated by the negative numbers in the second row of Table C22. This indicates that instream processes, such as settling, are taking place within the segment. To determine the total segment the load, the percent decrease in existing loads between 16 and 17 is applied to the upstream loads entering the segment. There are no additional reductions necessary at point 17.

Table C22. Calculation of Load Reductions Necessary at Point 17

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	97.6	112.4	164.6	1782.6
Difference in Existing Load between 16 and 17	-117.6	-6.2	-12.4	-217.3
Percentage of load lost due to instream process	55	5	7	11
Load from 16 (Upstream Load)	12.9	10.7	7.1	40.0
Percentage of Upstream Load that reaches 17	45	95	93	89
Total Segment Load	5.8	10.1	5.9	35.6
Allowable Load = TMDL	14.6	10.1	6.6	71.3
Load Reduction	0.0	0.0	0.0	0.0
% Reduction Segment	0	0	0	0

Margin of Safety

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

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

Seasonal Variation

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

Critical Conditions

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

Attachment D

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 (gpm)	pH	Alk (mg/L)	Acidity (mg/L)	Fe (mg/L)	Mn (mg/L)	Al (mg/L)
1	6/19/2002	25	7.6	118	0	0.767	0.178	ND
Latitude:	7/23/2002	0						
40 21’ 38”	3/25/2003	0						
Longitude:	4/15/2003	1	9.6	105.8	0	1.45	0.973	ND
79 18’ 49”	5/13/2003	1	9	109.2	0	1.44	0.621	0.657
	6/10/2003	1	10.1	77	0	0.431	0.143	ND
	Average	7.00000	9.07500	102.50000	0.00000	1.02200	0.47875	0.657
	St Dev	12.00000	1.08128	17.76026	0.00000	0.50735	0.39484	NA
2	6/19/2002	300	7.7	194	0	0.409	0.117	ND
Latitude:	7/23/2002	0						
40 21’ 25”	3/25/2003	25	7.7	156	0	ND	0.068	ND
Longitude:	4/15/2003	50	7.8	162.4	0	ND	0.54	ND
79 19’ 19”	5/13/2003	10	7.8	189.4	0	0.324	0.143	ND
	6/10/2003	40	7.6	202.6	0	2.29	0.222	0.845
	Average	85.00000	7.72000	180.88000	0.00000	1.00767	0.21800	0.845
	St Dev	121.14041	0.08367	20.47564	0.00000	1.11135	0.18843	NA
3	6/19/2002	0						
Latitude:	7/23/2002	0						
40 21’ 25”	3/25/2003	0						
Longitude:	4/15/2003	0						
79 19’ 40”	5/13/2003	0						
	6/10/2003	0						
4	6/19/2002	0						
Latitude:	7/23/2002	0						
40 21’ 24”	3/25/2003	0						
Longitude:	4/15/2003	0						
79 19’ 47”	5/13/2003	0						
	6/10/2003	0						
5	6/19/2002	30	4.8	7.8	49.4	1.55	6.69	4.07
Latitude:	7/23/2002	5	5.9	12.8		2.19	7.47	ND
40 21’ 14”	3/25/2003	50	4.7	8.2	92.8	0.41	6.36	4.15
Longitude:	4/15/2003	80	4.7	8.4	72.4	0.456	7.2	4.77
79 20’ 20”	5/13/2003	30	5	9	46.2	0.658	8	2.86
	6/10/2003	50	4.9	9.4	65.8	0.499	6.89	3.12
	Average	40.83333	5.00000	9.26667	65.32000	0.96050	7.10167	3.24500
	St Dev	25.38044	0.45607	1.82282	18.87146	0.73773	0.58595	1.51817

Station	Date	Flow (gpm)	pH	Alk (mg/L)	Acidity (mg/L)	Fe (mg/L)	Mn (mg/L)	Al (mg/L)
6	6/19/2002	40	3.1	0	326.4	10.3	17.1	31.3
Latitude:	7/23/2002	0						
40 20’ 50”	3/25/2003	117	3.1	0	345.2	10.3	14.1	25
Longitude:	4/15/2003	325	3.1	0	300	12.2	19	33
79 20’ 44”	5/13/2003	47	3	0	288	13.5	18.6	33.2
	6/10/2003	50	3.1	0	243.6	7.05	14.3	2.29
	Average	115.80000	3.08000	0.00000	300.64000	10.67000	16.62000	24.95800
	St Dev	121.01116	0.04472	0.00000	38.93235	2.43557	2.32099	13.10215
7	6/19/2002	100	7.7	118	0	0.477	0.155	ND
Latitude:	7/23/2002	0						
40 20’ 45”	3/25/2003	135	8.6	92	0	0.314	0.229	ND
Longitude:	4/15/2003	415	8.8	97.8	0	0.336	0.14	ND
79 20’ 43”	5/13/2003	7	7.5	119.8	0	0.872	0.266	ND
	6/10/2003	100	7.6	152	0	0.718	0.312	ND
	Average	151.40000	8.04000	115.92000	0.00000	0.54340	0.22040	NA
	St Dev	154.82991	0.61074	23.56718	0.00000	0.24419	0.07295	NA
8	6/19/2002	15	6.8	36	0	0.896	0.161	0.587
Latitude:	7/23/2002	0						
40 20’ 37”	3/25/2003	0						
Longitude:	4/15/2003	0						
79 19’ 49”	5/13/2003	0						
	6/10/2003	0						
	Average	15	6.8	36	0	0.896	0.161	0.587
	St Dev	NA	NA	NA	NA	NA	NA	NA
9	6/19/2002	40	7.6	178	0	ND	0.113	0.557
Latitude:	7/23/2002	0						
40 20’ 38”	3/25/2003	10	8.2	193	0	ND	ND	ND
Longitude:	4/15/2003	60	8.1	195.6	0	ND	ND	ND
79 19’ 38”	5/13/2003	0						
	6/10/2003	30	7.8	217.8	0	ND	ND	ND
	Average	35.00000	7.92500	196.10000	0.00000	NA	0.06575	NA
	St Dev	20.81666	0.27538	16.41503	0.00000	NA	0.03150	NA
11	6/19/2002	0						
Latitude:	7/23/2002	0						
40 20’ 39”	3/25/2003	0						
Longitude:	4/15/2003	0						
79 19’ 31”	5/13/2003	0						
	6/10/2003	0						

Station	Date	Flow (gpm)	pH	Alk (mg/L)	Acidity (mg/L)	Fe (mg/L)	Mn (mg/L)	Al (mg/L)
13	6/19/2002	125	4.6	9	88.2	4.98	7.79	14.04
Latitude:	7/23/2002	0						
40 20’ 45”	3/25/2003	230	4.4	8.2	129.6	6.48	9.13	16.9
Longitude:	4/15/2003	740	4.6	10.4	28	5.43	8.04	13.6
79 20’ 47”	5/13/2003	54	4.2	7	154.4	8.64	12.2	2.12
	6/10/2003	150	5.6	21.4	45.4	3.65	6.64	10.1
	Average	259.80000	4.68000	11.20000	89.12000	5.83600	8.76000	11.35200
	St Dev	275.70854	0.54037	5.83438	53.73092	1.86771	2.11685	5.69773
14	6/19/2002	125	6.7	30	0	0.889	0.421	0.908
Latitude:	7/23/2002	5	3.2	0	292.8	4.18	16.5	39.1
40 20’ 44”	3/25/2003	150	6.2	14.4	29.2	0.77	0.736	0.881
Longitude:	4/15/2003	1035	6.6	21	0	0.611	0.352	0.678
79 21’ 03”	5/13/2003	325	6.2	15	20.8	1.43	0.665	1.42
	6/10/2003	400	7	39.4	0	0.638	0.217	0.517
	Average	340.00000	5.98333	19.96667	57.13333	1.41967	3.14850	7.25067
	St Dev	369.16121	1.39774	13.66538	116.13080	1.38479	6.54376	15.60590
15	6/19/2002	400	4.5	10.2	129.6	14.5	6.94	11.9
Latitude:	3/25/2003	1015	3.7	0	145.6	16.7	8.25	13.9
40 20’ 41”	4/15/2003	1250	4.3	8	128.4	12.8	7.91	12.4
Longitude:	5/13/2003	740	3.6	0	97	11.9	5.68	8.26
79 21’ 02”	6/10/2003	500	4.7	11.6	89.6	13.9	6.61	9.2
	Average	717.50000	4.63333	11.53333	98.36667	11.73967	5.93450	9.36283
	St Dev	352.55851	1.23882	14.53859	52.65593	5.67958	2.94910	4.81122
16	6/19/2002	2900	4.5	8.6	106.4	9.92	5.74	8.53
Latitude:	7/23/2002	200	3.4	0	155.2	19.2	8.02	12.8
40 20’ 48”	3/25/2003	2320	3.7	0	110.2	9.35	6.82	10.2
Longitude:	4/15/2003	2540	4.5	8.8	88.2	12.5	5.52	8.74
79 22’ 01”	5/13/2003	910	3.5	0	109.2	8.05	6.55	9.62
	6/10/2003	900	5.7	14.6	44.4	7.01	3.74	4.4
	Average	1628.33333	4.21667	5.33333	102.26667	11.00500	6.06500	9.04833
	St Dev	1096.65704	0.87274	6.22725	35.99015	4.42722	1.44468	2.74587
17	6/19/2002	2350	4.6	7.4	75.2	6.56	4.67	6.73
Latitude:	7/23/2002	450	3.3	0	131.8	3.75	7.73	12.7
40 21’ 01”	3/25/2003	2420	4.5	6.8	94.2	4.78	5.32	8.04
Longitude:	4/15/2003	3350	4.8	9	58	5.15	3.57	5.07
79 22’ 58”	5/13/2003	1110	3.7	0	90.6	1.96	5.2	7.65
	6/10/2003	2200	6.8	33.8	0	2.42	1.87	1.33

Station	Date	Flow (gpm)	pH	Alk (mg/L)	Acidity (mg/L)	Fe (mg/L)	Mn (mg/L)	Al (mg/L)
17	Average	1980.00000	4.61667	9.50000	74.96667	4.10333	4.72667	6.92000
	St Dev	1034.75601	1.21559	12.51351	44.16395	1.74017	1.95437	3.73905
18	6/19/2002	10	6.9	38	0	0.783	0.207	ND
Latitude:	7/23/2002	0						
40 20’ 34”	3/25/2003	0						
Longitude:	4/15/2003	0						
79 20’ 24”	5/13/2003	0						
	6/10/2003	0						
	Average	10	6.9	38	0	0.783	0.207	NA
	St Dev	NA	NA	NA	NA	NA	NA	NA

Attachment F
Comment and Response

Comments/Responses on Union Run Watershed TMDL

EPA Region III Comments

Comment:
This comment is regarding the "negative" LAs when the upstream load is separated from the LA shown in the TMDL Report's summary table. Pages 35 and 36 describe the method for accounted for instream processes and adds the statement, "(i)t also indicated that no additional loading is directly entering the segment." EPA disagrees. It is unknown which of the two following scenarios exist:

a. The direct drainage (LA) to the segment is zero and instream processes reduce the upstream iron load by 55%, or
b. The direct drainage (LA) to the segment is greater than zero and the instream processes reduce the combined upstream LA iron loads by more than 55%.

The "no additional loading" statement should be removed from the TMDL report.

Response:
The statement was removed.

Comment:
Similarly, EPA disagrees with the second paragraph on page 12. There is no indication that direct drainage (LA) to the segments has been monitored or that LA can be ruled out. The paragraph should be removed.

Response:
The paragraph was removed.

Comment:
The TMDLs for the national tracking system at 17 are the sum of the LAs for the watershed:

Iron	21.7l lbs/day
Manganese	10.51 lbs/day
Aluminum	7.1 lbs/day
Acidity	73.4 lbs/day

The negative LAs were included in the above summations.

Response:
The Department is not responsible for updating or maintaining the national TMDL tracking system, however; the Department has discussed with EPA the accounting methods used to populate the tracking system.