FINAL

SAXMAN RUN WATERSHED TMDL
Westmoreland County

For Acid Mine Drainage Affected Segments

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Pennsylvania Department of Environmental Protection

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Introduction

This report presents the Total Maximum Daily Loads (TMDLs) developed for segments in the Saxman Run Watershed (Attachments A). These were done to address the impairments noted on the 1996 Pennsylvania Section 303(d) list of impaired waters, required under the Clean Water Act, and covers one segment on this list (shown in Table 1). High levels of metals caused these impairments. In 1999 the segment was reassessed and suspended solids was added a cause of impairment on the 2002 PA Section 303(d) list. 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. In addition to the AMD impairments, Saxman Run is listed for nutrients from small residential runoff and siltation from removal of vegetation. These impairments are not addressed in this TMDL, but will be addressed at a later date.

Table 1. 303(d) Sub-List
State Water Plan (SWP) Subbasin: 18-C Loyalhanna Creek

Year	Miles	Segment ID	DEP Stream Code	Stream Name	Designated Use	Data Source	Source	EPA 305(b) Cause Code
1996	4.7	NA	43448	Saxman Run	WWF	305(b) Report	RE	Metals
1998	4.7	NA - Part C of list	43448	Saxman Run	WWF	305(b) Report	AMD	Metals
2002	2.3	New assessment, new id 990526-1300-ALF	43448	Saxman Run	WWF	SWAP	AMD	Metals & Suspended Solids
2004	1.6	990526-1300-ALF	43448	Saxman Run	WWF	SWAP	AMD	Metals & Suspended Solids
2004	0.9	990526-1300-ALF	43449	Saxman Run Unt.	WWF	SWAP	AMD	Metals & Suspended Solids

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

[1] Pennsylvania's 1996, 1998, and 2002 Section 303(d) lists were approved by the Environmental Protection Agency (EPA). EPA approval of the 2004 Pennsylvania Integrated Water Quality Monitoring and Assessment Report is pending. The 1996 Section 303(d) list provides the basis for measuring progress under the 1997 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

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

Directions to the Saxman Run Watershed

The Saxman Run Watershed is located in Southwestern Pennsylvania, occupying the northern central portion of Westmoreland County within Derry Township. The 6.6 square mile watershed is found on portions of the United States Geological Survey maps covering Derry and Latrobe 7.5-Minute Quadrangles. Landuses within the watershed include agriculture, mining, forestland, and low-density development. The stream and its tributaries flow past numerous small towns such as, Burds Crossing, Peanut, Bradenville, Loyalhanna, and Snydertown. The mouth of the stream reaches Loyalhanna Creek in the city of Latrobe. Saxman Run can be accessed by taking Route 981 North from U.S. Route 30 near Latrobe. The upper part of Saxman Run can be reached by taking Route 217 North of U.S. Route 30 from the town of Kingston.

Segments addressed in this TMDL

There is one active mining operation in the watershed, MB Energy's Saxman Run Mine site SMP 65010101. All of the remaining discharges in the watershed are from abandoned mines and will be treated as non-point sources. Each segment on the Section 303(d) list will be addressed as a separate TMDL. These TMDLs will be expressed as long-term, average loadings. Due to the nature and complexity of mining effects on the watershed, expressing the TMDL as a long-term average gives a better representation of the data used for the calculations. See Attachment C for TMDL calculations.

Clean Water Act Requirements

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

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

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

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

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

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

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

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

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

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

Section 303(d) Listing Process

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

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

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

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

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

Basic Steps for Determining a TMDL

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

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

Watershed History

The Saxman Run Watershed is located in the Allegheny Plateau Physiographic Province. Most of the watershed consists of rolling hills, but the far eastern part of the watershed reaches parts of Chestnut Ridge. Maximum elevation in the Saxman Run Watershed up on Chestnut Ridge is 2,090 feet and the minimum elevation at the confluence with Loyalhanna Creek is 975 feet.

The watershed is in the Uniontown-Latrobe Syncline. The axis of the syncline trends northeast and southwest. The western flanks of the syncline are gently dipping, but the eastern flanks are very steep coming off Chestnut Ridge.

Surface mining has disturbed much of the area, but deep mine discharges have a huge impact on parts of Saxman Run. The three major contributing discharges are the Lower Saxman Run, Upper Saxman Run, and West Derry, see map Attachment A. The upper part of the stream is impacted by discharges from abandoned underground mines on the Upper Freeport coal seam. The lower parts are severely impacted by discharges from abandoned underground mines on the Pittsburgh coal seam.

Currently, there is one active surface mine in the Saxman Run Watershed. This permit was issued to M. B. Energy, Inc. in 2001, SMP No. 65010101. This operation is mining on the Lower Freeport coal seam. There are no active underground mines in the watershed. The underground mines in the upper reaches of Saxman Run on the Upper Freeport coal seam were mined by Ridge Coal Company.

The mine drainage treatment facilities for the permit area are assigned a waste load allocation. Discharge rate and frequency vary as a function of precipitation and runoff. The method to quantify the treatment facility discharges is explained in the *Method to Quantify Treatment Pond Pollutant Load* section of the report. It has been determined that effects from sedimentation ponds are negligible because their potential discharges are based on infrequent and temporary events and the ponds should rarely discharge if reclamation and revegetation is concurrent. In addition, sedimentation ponds are designed in accordance with PA Code Title 25 Chapter 87.108 (h) to at minimum contain runoff from a 10-year 24-hour precipitation event. The structures are permitted under NPDES No. PA 0202908

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

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

LTA = Mean * (1 – PR99) where (2)

LTA = allowable LTA source concentration in mg/l

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

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

There are two basic rules that are applied in load tracking; rule one is that if the sum of the measured loads that directly affect the downstream sample point is less than the measured load at the downstream sample point it is indicative that there is an increase in load between the points being evaluated, and this amount (the difference between the sum of the upstream and

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

downstream loads) shall be added to the allowable load(s) coming from the upstream points to give a total load that is coming into the downstream point from all sources. The second rule is that if the sum of the measured loads from the upstream points is greater than the measured load at the downstream point this is indicative that there is a loss of instream load between the evaluation points, and the ratio of the decrease shall be applied to the load that is being tracked (allowable load(s)) from the upstream point.

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

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

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

Method to Quantify Treatment Pond Pollutant Load

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

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

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

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

Flow (MGD) X BAT limit (mg/l) X 8.34 = lbs/day

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

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

In an active mining scenario, a mine operator pumps pit water to the ponds for chemical treatment. Pit water is often acidic with dissolved metals in nature. At the treatment ponds, alkaline chemicals are added to increase the pH and encourage dissolved metals to precipitate and settle. Pennsylvania averages 41.4 inches of precipitation per year (Mid-Atlantic River Forecast Center, National Weather Service, State College, PA, 1961-1990, 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 in. precip./yr x 0.95 x 1 ft./12/in. x 1500'x300'/pit x 7.48 gal/ft^3 x 1yr/365days x 1day/24hr. x 1hr./60 min. =

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

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

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

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

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

Total Average Flow = Direct Pit Precipitation + Spoil Runoff

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

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

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

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

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

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

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

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

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

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

TMDL Endpoints

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

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

Table 2. Applicable Water Quality Criteria

Parameter	Criterion Value (mg/l)	Total Recoverable/Dissolved
Aluminum (Al)	0.75	Total Recoverable
Iron (Fe)	1.50	30 day average; Total Recoverable
Manganese (Mn)	1.00	Total Recoverable
pH *	6.0-9.0	N/A

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

TMDL Elements (WLA, LA, MOS)

$$TMDL = WLA + LA + MOS$$

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

Allocation Summary

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

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

Each permitted discharge in a segment is assigned a waste load allocation (WLA) and the total WLA for each segment is included in this table. There is currently one permit in the watershed with three treatment pond discharges. 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 Saxman 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 %
SXMN08	*Saxman Run downstream of Unnamed Tributary 43454*						
	Fe	390.7	11.7	1.8	9.9	379.0	97
	Mn	68.0	8.2	1.2	7.0	59.8	88
	Al	365.3	3.7	1.2	2.5	361.6	99
	Acidity	3,602.8	0.0	0.0	0.0	3,602.8	100
SXMN07	*Mouth of Unnamed Tributary 43450*						
	Fe	0.8	0.8	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
SXMN06	*Saxman Run downstream of Unnamed Tributary 43450*						
	Fe	120.0	13.2	0.0	13.2	0.0	0
	Mn	47.3	7.6	0.0	7.6	0.0	0
	Al	232.1	4.6	0.0	4.6	0.0	0
	Acidity	1,942.3	19.4	0.0	19.4	0.0	0
SXMN05	*Saxman Run upstream of Upper Saxman discharge*						
	Fe	816.9	24.5	0.0	24.5	676.2	97
	Mn	126.3	20.2	0.0	20.2	64.7	76
	Al	128.2	5.1	0.0	5.1	0.0	0
	Acidity	1,755.6	474.0	0.0	474.0	0.0	0.0
SXMN04	*Saxman Run downstream of Upper Saxman discharge*						
	Fe	960.8	48.0	0.0	48.0	120.4	71
	Mn	152.1	28.9	0.0	28.9	17.1	37
	Al	209.1	16.7	0.0	16.7	65.5	80
	Acidity	3,289.6	427.6	0.0	427.6	1,106.4	72
SXMN03	*Saxman Run upstream of Lower Saxman discharge*						
	Fe	1063.1	53.2	0.0	53.2	97.1	65
	Mn	197.0	35.5	0.0	35.5	38.3	52
	Al	244.5	19.6	0.0	19.6	32.5	62
	Acidity	3,906.2	468.7	0.0	468.7	575.5	55

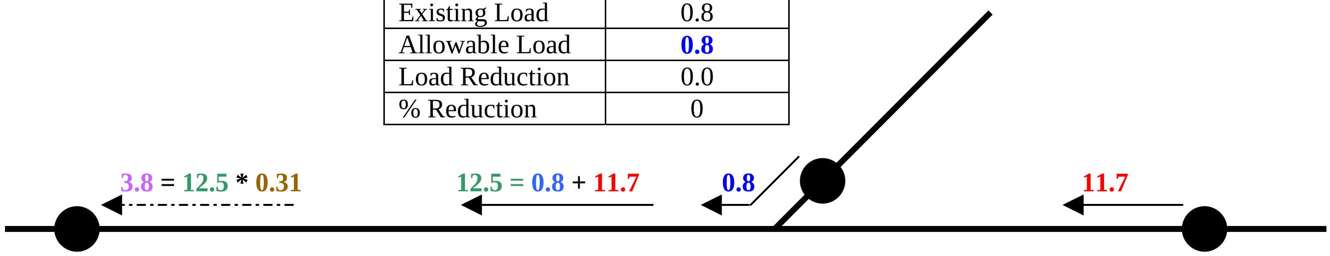
Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
SXMN02	*Saxman Run downstream of Lower Saxman discharge*						
	Fe	2,558.5	76.8	0.0	76.8	1,471.8	95
	Mn	333.8	66.8	0.0	66.8	105.5	61
	Al	178.7	12.5	0.0	12.5	1.8	13
	Acidity	6,072.6	1,943.2	0.0	1,943.2	691.9	26
SXMN01	*Mouth of Saxman Run*						
	Fe	2,214.6	88.6	0.0	88.6	0.0	0
	Mn	355.4	71.1	0.0	71.1	17.3	20
	Al	313.4	40.7	0.0	40.7	106.5	72
	Acidity	6,470.6	1,423.5	0.0	1,423.5	917.7	39

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

In the instance that the allowable load is equal to the measured load (e.g. iron SXMN07, Table 3), the simulation determined that water quality standards are being met instream 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. aluminum point SXMN07, 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 SXMN06, SXMN07 and SXMN08 of Saxman 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.

SXMN07	Load (lbs/day)
Existing Load	0.8
Allowable Load	**0.8**
Load Reduction	0.0
% Reduction	0



SXMN06	Load (lbs/day)
Existing Load	120.0
Difference in Existing Load between SXMN08, SXMN07 & SXMN06	-271.5
Load tracked from upstream	**12.5**
Percent loss due to instream process	69
Percent load tracked from upstream	**31**
Total Load tracked	**3.8**
Allowable Load	13.2
Load Reduction	0.0
% Reduction	0

SXMN08	Load (lbs/day)
Existing Load	390.7
Allowable Load	**11.7**
Load Reduction	379.0
% Reduction	97

All waste load allocations were calculated using the methodology explained previously in the *Method to Quantify Treatment Pond Pollutant Load* section of the report. Waste load allocations are assigned to the three discharges on the Saxman Run permit for iron and manganese. Waste load allocations are also being developed for aluminum to provide an allowance for the discharge of aluminum, which may occur, even though the parameter is not included in either permit. The maximum permitted pit dimension for the Saxman Run site is 750' x 300'or 225,000 square feet. This value is used in calculating the waste load allocations. Treatment pond locations can be found on the map in Attachment A. Waste load allocations for the existing mining operation were incorporated into the calculations at SXMN08. This is the first downstream monitoring point that receives all the potential flow of treated water from the three treatment ponds. No required reductions of these permits are necessary at this time. All necessary reductions are assigned to non-point sources.

Table 4. Waste Load Allocation of Permitted Discharges

Parameter	Allowable Average Monthly Conc. (mg/L)	Calculated Average Flow (MGD)	WLA (lbs/day)
Saxman Run Site (NPDES PA0202908)			
TP1			
Fe	3.0	0.0223	0.6
Mn	2.0	0.0223	0.4
Al	2.0	0.0223	0.4

Parameter	Allowable Average Monthly Conc. (mg/L)	Calculated Average Flow (MGD)	WLA (lbs/day)
TP2			
Fe	3.0	0.0223	0.6
Mn	2.0	0.0223	0.4
Al	2.0	0.0223	0.4
TP3			
Fe	3.0	0.0223	0.6
Mn	2.0	0.0223	0.4
Al	2.0	0.0223	0.4

Recommendations

The Loyalhanna Creek Mine Drainage Coalition (LCMDC), comprised of representatives from the PA DEP (Bureau of District Mining Operations - DMO and Bureau of Abandoned Mine Reclamation - BAMR), the Loyalhanna Watershed Association (LWA), Saint Vincent College (SVC), USDA Natural Resources Conservation Service (NRCS), and the Westmoreland Conservation District (WCD), has been actively working on projects for the three main Saxman Run Discharges: Lower Saxman Run Discharge (1,500 - 2,000 GPM), Upper Saxman Run Discharge (average 3,600 GPM), and the West Derry Discharge (average 200 GPM). Another partner in these projects has been the US Army Corps of Engineers (COE), Pittsburgh District. The COE has installed flow measuring devices at the Upper Saxman Run Discharge and at the West Derry Discharge. The COE has developed a Project Management Plan (Section 206) for the restoration and remediation of the Upper and Lower Saxman Run Discharges.

The Lower and Upper Saxman Run Discharges and the West Derry Discharge are actively being monitored (water chemistry and flows) by the Loyalhanna Watershed Association. The West Derry Discharge is currently under investigation by the Greensburg DMO to determine if the water quality has been reaffected by recent surface mining activities above the discharge.

Saint Vincent College received a Round 4 Growing Greener Grant on August 7, 2002, in the amount of $221,079.60 for a demonstration project on the Lower Saxman Run Discharge. The project will demonstrate the use of a new and innovative treatment process, known as Activated Iron Sludge/Sequencing Batch Reactor (AIS/SBR) Process, to treat and remove iron oxides from the mine drainage. The project also incorporates an anoxic limestone drain (ALD) to generate alkalinity. A 200 GPM portion of the discharge flow will be directed through the treatment process for this demonstration. This project will also investigate the modification of the existing Latrobe Municipal Authority's waste water treatment plant to an AIS mine drainage treatment facility. This facility could treat up to 12 MGD of mine drainage in the Saxman Run/Loyalhanna Creek Watersheds.

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.

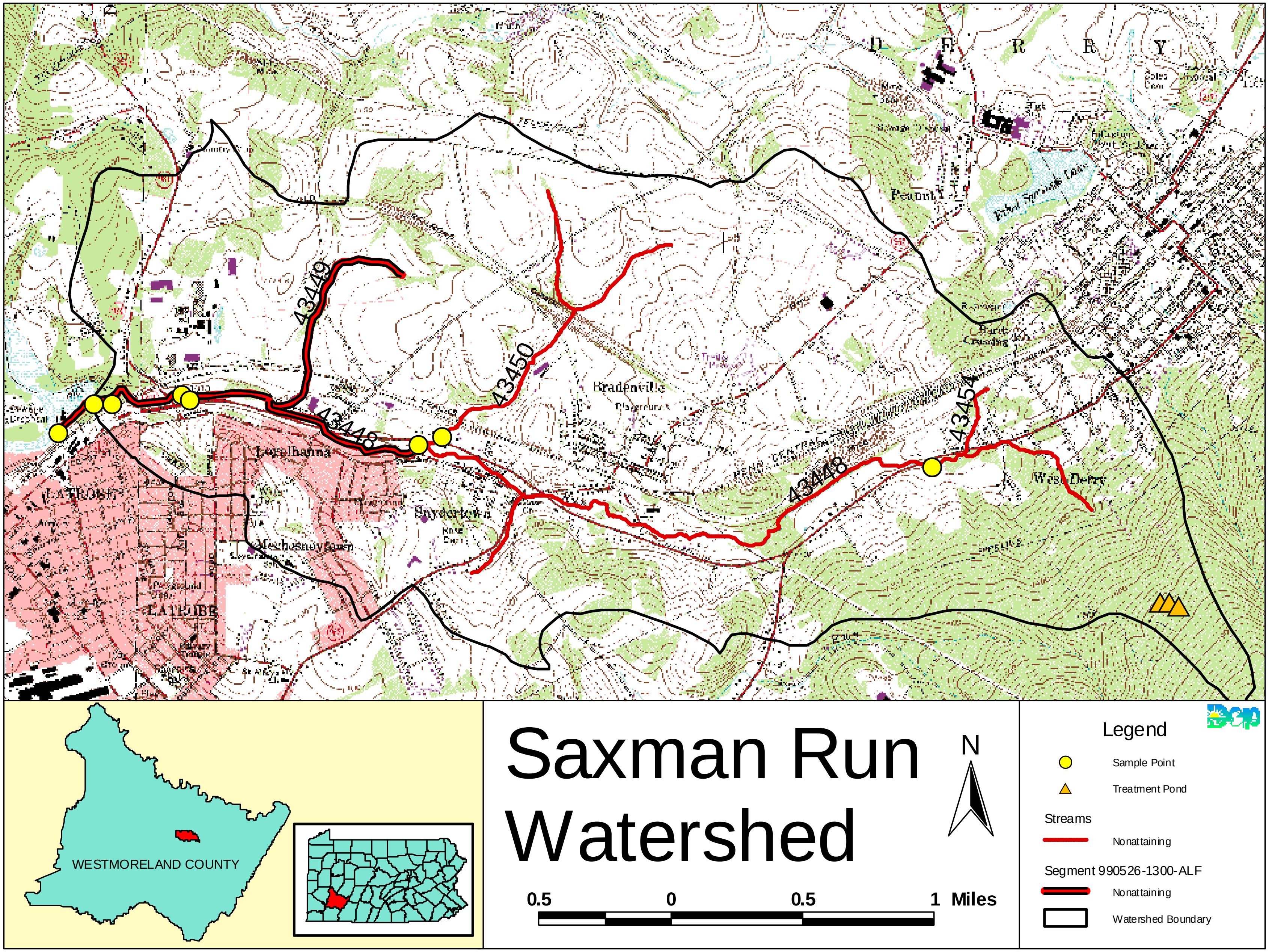
Reclaim PA is DEP's initiative designed to maximize reclamation of the state's quarter million acres of abandoned mineral extraction lands. Abandoned mineral extraction lands in Pennsylvania constituted a significant public liability – more than 250,000 acres of abandoned surface mines, 2,400 miles of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

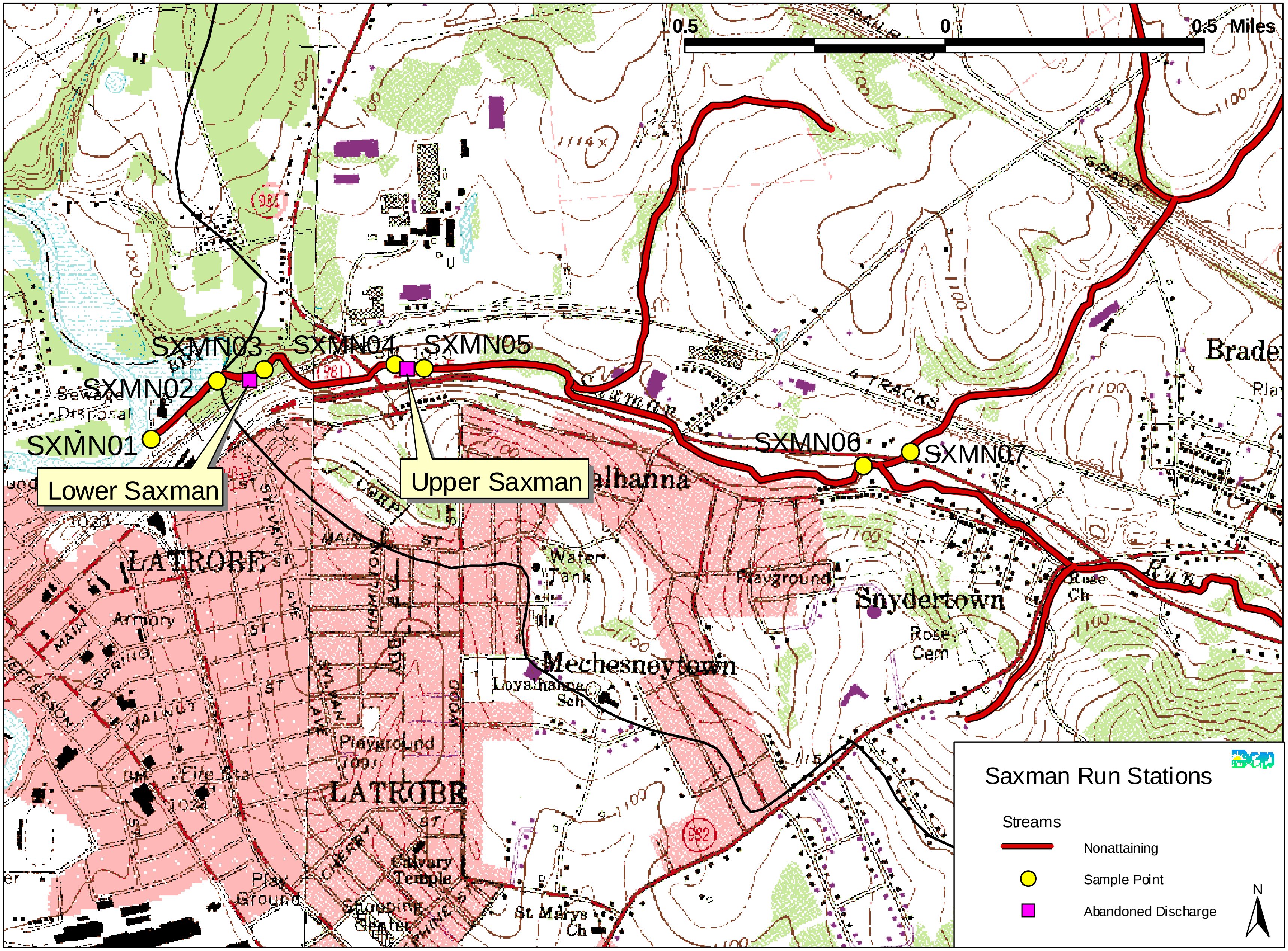
Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on September 04, 2004 and the *Latrobe Bulletin* on September 29, 2004 to foster public comment on the allowable loads calculated. The public comment period on this TMDL was open from September 4, 2004 to November 4, 2004. A public meeting was held on October 7, 2004 at the Unity Township Municipal Building, to discuss the proposed TMDL.

Attachment A

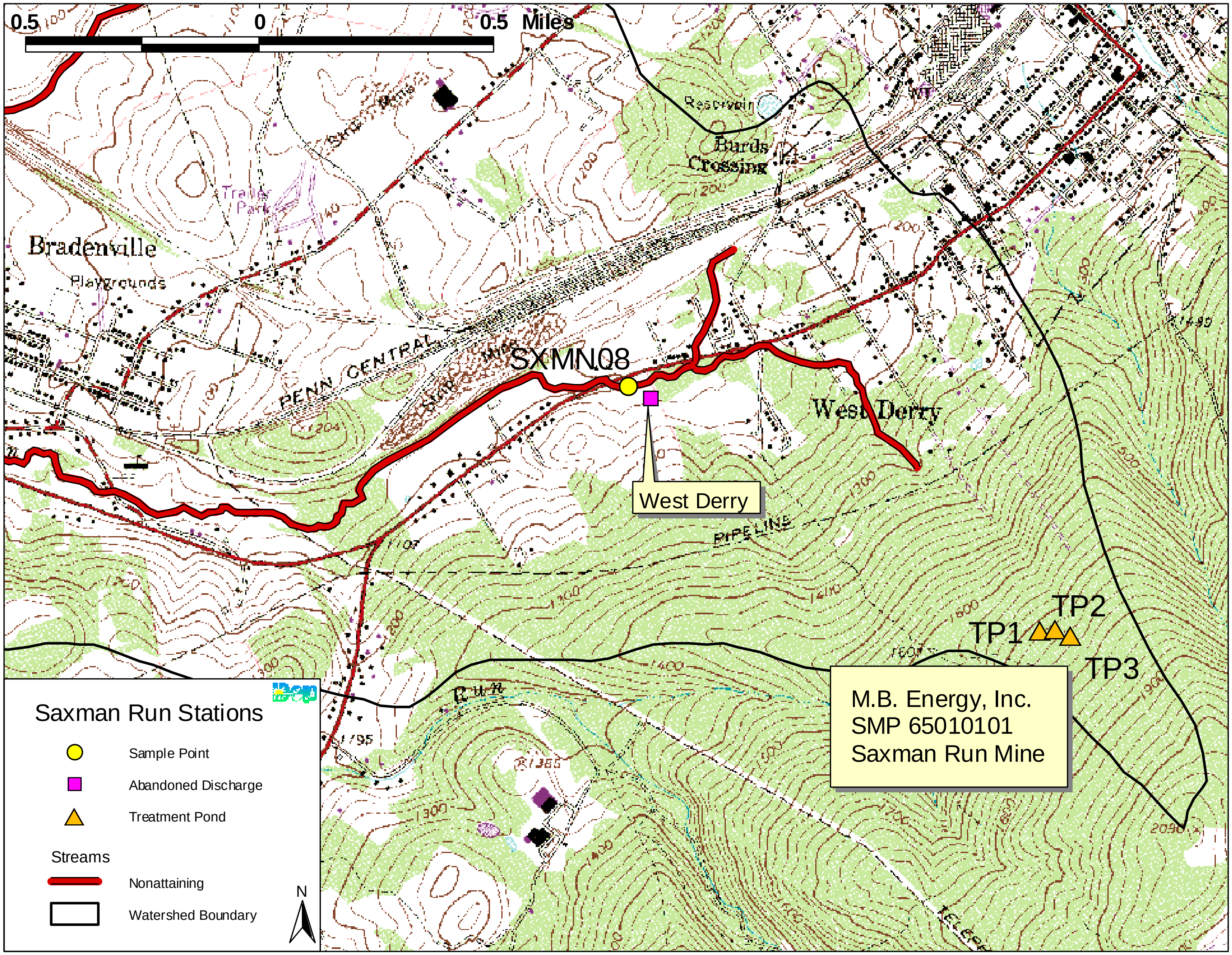
Saxman Run Watershed Maps



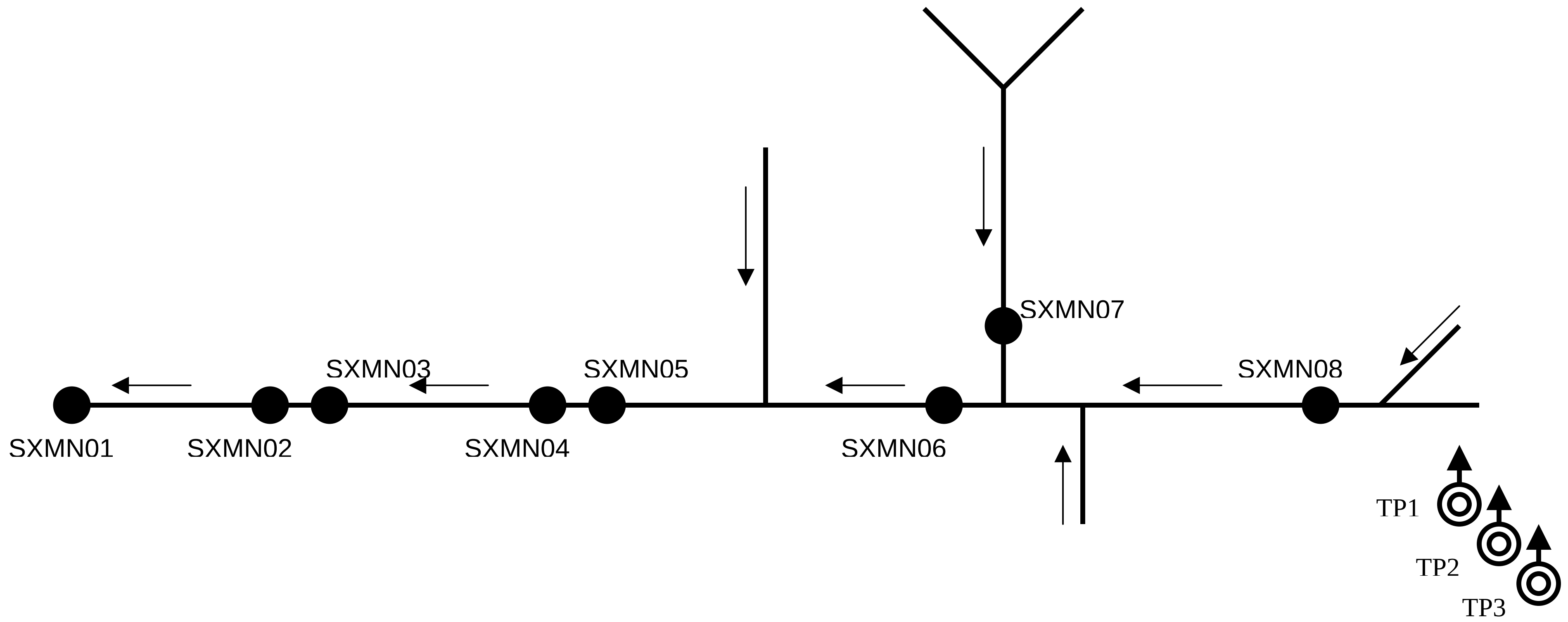
Saxman Run
Watershed
N
0.5
0
0.5
1 Miles
Legend
Sample Point
Treatment Pond
Streams
Nonattaining
Segment 990526-1300-ALF
Nonattaining
Watershed Boundary
WESTMORELAND COUNTY
43449
43450
43448
43454



0.5
0
0.5 Miles
SXMN01
SXMN02
SXMN03
SXMN04
SXMN05
SXMN06
SXMN07
Lower Saxman
Upper Saxman
LATROBE
Snydertown
Mechesneytown
Saxman Run Stations
Streams
Nonattaining
Sample Point
Abandoned Discharge
N


0.5
0
0.5 Miles
Bradenville
Playgrounds
Trailer Park
Reservoir
Hurds Crossing
PENN CENTRAL
SXMN08
West Derry
West Derry
PIPELINE
TP1
TP2
TP3
M.B. Energy, Inc.
SMP 65010101
Saxman Run Mine
Run
Saxman Run Stations
Sample Point
Abandoned Discharge
Treatment Pond
Streams
Nonattaining
Watershed Boundary
N

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



Attachment B

Method for Addressing Section 303(d) Listings for pH

Method for Addressing Section 303(d) Listings for pH

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

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

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

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

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

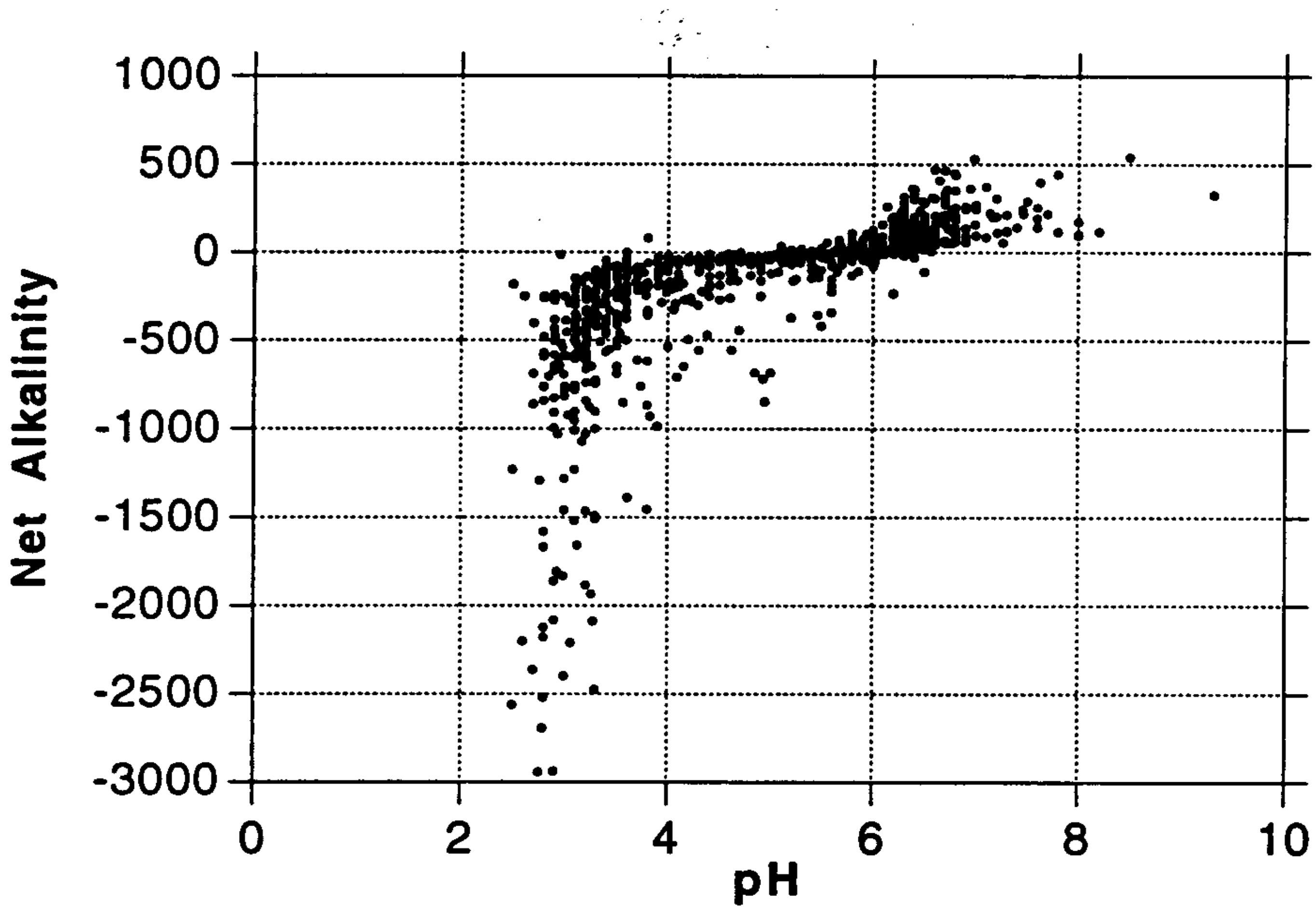


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Attachment C
TMDLs By Segment

Saxman Run

The TMDL for the Saxman Run Watershed consists of load allocations of one tributary and seven sampling sites along the stream. Waste load allocations are assigned to treatment discharges from the MB Energy's Saxman Run site.

Saxman Run is listed as impaired on the PA Section 303(d) list by both high metals and suspended solids from AMD as being the cause of degradation to the stream. The suspended solids listing is metal precipitate and will be remedied with removal of the metals impairments.

Although Saxman Run is not listed for pH impairments, the stream violates the WQS and therefore pH is addressed in this TMDL. The objective is to reduce acid loading to the stream that will in turn raise the pH to the acceptable range. The result of this analysis is an acid loading reduction that equates to meeting standards for pH (see TMDL Endpoint section in the report, Table 2). The method and rationale for addressing pH is contained in Attachment B.

An allowable long-term average in-stream concentration was determined at each sample point for aluminum, iron, manganese, and acidity. The analysis is designed to produce an average value that, when met, will be protective of the water-quality criterion for that parameter 99% of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water-quality criteria 99% of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean and standard deviation of the data set, five thousand 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.

Waste Load Allocation – Saxman Run Site, SMP 65010101, NPDES PA0202908

The waste load allocations for the three treatment pond discharges located on MB Energy's Saxman Run site (SMP 65010101) are calculated as described in the *Method to Quantify Treatment Pond Pollutant Loading* section of the report. Waste load allocations for the three existing treatment ponds are incorporated into the calculations at SXMN08. This is the first downstream monitoring point that receives all the potential flow of treated water from the three discharges. Although aluminum is not included in the permit, a waste load allocation is being calculated using the standard BAT limit for aluminum and the estimated flow. The following table shows the waste load allocations for the discharges.

Table C1. Waste Load Allocations Saxman Run Site			
Parameter	**Monthly Avg. Allowable Conc. (mg/L)**	**Average Flow (MGD)**	**Allowable Load (lbs/day)**
TP1			
Fe	3.0	0.0223	0.6
Mn	2.0	0.0223	0.4
Al	2.0	0.0223	0.4
TP2			
Fe	3.0	0.0223	0.6
Mn	2.0	0.0223	0.4
Al	2.0	0.0223	0.4
TP3			
Fe	3.0	0.0223	0.6
Mn	2.0	0.0223	0.4
Al	2.0	0.0223	0.4

TMDL Calculations - Sample Point SXMN08, Saxman Run downstream of Unnamed Tributary 43454 and West Derry discharge

The TMDL for sample point SXMN08 consists of waste load allocations of the three permitted discharges on the Saxman Run site and a load allocation to all of the area above the point (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point SXMN08. The average flow of 1.56 MGD, measured at the point, is used for these computations.

This segment is not included on the PA Section 303(d) lists for impairments from AMD. The segment is listed for nutrients from small residential runoff and siltation from removal of vegetation; however, these impairments are not addressed in this TMDL. Sample data at point SXMN08 shows pH ranging between 3.0 and 3.4; pH will be addressed as part of this TMDL because of the mining impacts.

Table C2. TMDL Calculations at Point SXMN08				
Flow = 1.56 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	30.08	390.7	0.90	11.7
Mn	5.23	68.0	0.63	8.2
Al	28.12	365.3	0.28	3.7
Acidity	277.36	3,602.8	0.00	0.0
Alkalinity	3.40	44.2		

Table C3. Calculation of Load Reduction Necessary at Point SXMN08				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Measured Load	390.7	68.0	365.3	3,602.8
Allowable Load	11.7	8.2	3.7	0.0
Part of Allowable Load assigned to WLA	1.8	1.2	1.2	0.0
Part of Allowable Load assigned to LA	9.9	7.0	2.5	0.0
Load Reduction	379.0	59.8	361.6	3,602.8
% Reduction required	97	88	99	100

TMDL Calculations - Sample Point SXMN07, Mouth of Unnamed Tributary 43450

This segment is not included on the PA Section 303(d) lists for impairments from AMD. The segment is listed for nutrients from small residential runoff and siltation from removal of vegetation; however, these impairments are not addressed in this TMDL.

Sample data at point SXMN07 shows pH ranging between 7.2 and 7.6; pH will not be addressed as part of this TMDL. All values for aluminum are below the method detection limits, denoted by ND. The existing iron and manganese loads are equal to the allowable loads. Because WQS are met, TMDLS are not necessary for iron, aluminum, manganese, or acidity at SXMN07. Although TMDLs are not necessary at SXMN07, all measured loads at SXMN07 are considered at the next downstream point, SXMN06.

Table C4. TMDL Calculations at Point SXMN07				
Flow = 0.21 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.44	0.8	0.44	0.8
Mn	0.20	0.4	0.20	0.4
Al	ND	ND	NA	NA
Acidity	0.00	0.0	0.00	0.0
Alkalinity	7.60	13.3		

Table C5. Calculation of Load Reduction Necessary at Point SXMN07				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Measured Load	0.8	0.4	ND	0
Allowable Load	0.8	0.4	NA	0
Load Reduction	0.0	0.0	0.0	0.0
% Reduction required	0	0	0	0

TMDL Calculations - Sampling Point SXMN06, Saxman Run downstream of Unnamed Tributary 43450

The TMDL for sampling point SXMN06 consists of a load allocation of the area between sample points SXMN06, SXMN07, and SXMN08. The load allocation for this stream segment was computed using water-quality sample data collected at point SXMN06. The average flow of 1.64 MGD, measured at the point, is used for theses computations.

This segment is not included on the PA Section 303(d) lists for impairments from AMD. The segment is listed for nutrients from small residential runoff and siltation from removal of vegetation; however, these impairments are not addressed in this TMDL.

Sample data at point SXMN06 shows pH ranging between 3.7 and 6.4; pH will be addressed as part of this TMDL because of the mining impacts.

Table C6. TMDL Calculations at Point SXMN06				
Flow = 1.64 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	8.76	120.0	0.96	13.2
Mn	3.45	47.3	0.55	7.6
Al	16.93	232.1	0.34	4.6
Acidity	141.72	1,942.3	1.42	19.4
Alkalinity	6.40	87.7		

The calculated load reductions for all the loads that enter point SXMN06 must be accounted for in the calculated reductions at the sample point shown in Table C7. A comparison of measured loads between points SXMN06, SXMN07, and SXMN08 shows that there is loss of loading for all parameters within the segment. The percent of load lost within the segment is calculated and applied to the upstream allocated loads entering the segment to determine the amount of the upstream load that is tracked through the segment.

Table C7. Calculation of Load Reduction Necessary at Point SXMN06				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Measured Load	120.0	47.3	232.1	1,942.3
Difference in Measured Load s	-271.5	-21.0	-133.2	-1,660.5
Load tracked from SXMN08 & SXMN07	12.5	8.5	3.7	0.0
% Load lost	69	31	36	46
% Load tracked	31	69	64	54
Total Load tracked between SXMN06, SXMN07 & SXMN08	3.8	5.9	2.3	0.0
Allowable Load at SXMN06	13.2	7.6	4.6	19.4
Load Reduction at SXMN06	0.0	0.0	0.0	0.0
% Reduction required at SXMN06	0	0	0	0

TMDL Calculations - Sample Point SXMN05, Saxman Run upstream of Upper Saxman discharge

The TMDL for sample point SXMN05 consists of a load allocation to all of the area between SXMN05 and SXMN06 (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at the point. The average flow of 4.15 MGD, measured at point SXMN05, 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 added suspended solids as a cause of impairment to the 2002 PA Section 303(d) list. Although pH is not listed as a cause of impairment, sample data at point SXMN05 shows pH ranging between 5.0 and 6.6; pH is addressed as part of this TMDL because of the mining impacts.

Table C8. TMDL Calculations at Point SXMN05				
Flow = 4.15 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	23.60	816.9	0.71	24.5
Mn	3.65	126.3	0.58	20.2
Al	3.70	128.2	0.15	5.1
Acidity	50.72	1,755.6	13.69	474.0
Alkalinity	6.60	228.5		

The calculated load reductions for all the loads that enter point SXMN05 must be accounted for in the calculated reductions at the sample point shown in Table C9. A comparison of measured loads between points SXMN05 and SXMN06 shows that there is loss of aluminum and acidity loading and an increase of iron and manganese loading within the segment. The percent of load lost within the segment is calculated and applied to the upstream aluminum and acidity loads entering the segment to determine the amount of the upstream load that is tracked through the segment. For iron and manganese, the total segment load is the sum of the upstream allocated loads plus the additional loading that enters the segment.

Table C9. Calculation of Load Reduction Necessary at Point SXMN05				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Measured Load	816.9	126.3	128.2	1,755.6
Difference in Measured Load between SXMN05 & SXMN06	696.9	79.0	-103.9	-186.7
Load tracked from SXMN06	3.8	5.9	2.3	0.0
% Load lost	-	-	45	10
% Load tracked			55	90
Total Load tracked between points SXMN05 & SXMN06	700.7	84.9	1.3	0.0
Allowable Load at SXMN05	24.5	20.2	5.1	474.0
Load Reduction at SXMN05	676.2	64.7	0.0	0.0
% Reduction required at SXMN05	97	76	0	0

TMDL Calculations - Sample Point SXMN04, Saxman Run downstream of Upper Saxman discharge

The TMDL for sample point SXMN04 consists of a load allocation to all of the area between SXMN04 and SXMN05 (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at the point. The average flow of 4.65 MGD, measured at the 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 added suspended solids as a cause of impairment to the 2002 PA Section 303(d) list. Although pH is not listed as a cause of impairment, sample data at point SXMN04 shows pH ranging between 4.9 and 6.3; pH will be addressed as part of this TMDL because of the mining impacts.

Table C10. TMDL Calculations at Point SXMN04				
Flow = 4.65 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	24.78	960.8	1.24	48.0
Mn	3.92	152.1	0.75	28.9
Al	5.39	209.1	0.43	16.7
Acidity	84.84	3,289.6	11.03	427.6
Alkalinity	6.30	244.3		

The calculated load reductions for all the loads that enter point SXMN04 must be accounted for in the calculated reductions at the sample point shown in Table C11. A comparison of measured loads between points SXMN04 and SXMN05 shows that there is an increase of loading for all parameters within the segment. The total segment load is the sum of the upstream allocated loads plus the additional loading that enters the segment.

Table C11. Calculation of Load Reduction Necessary at Point SXMN04				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Measured Load	960.8	152.1	209.1	3,289.6
Difference in Measured Loads	143.9	25.8	80.9	1,534.0
Load tracked from SXMN05	24.5	20.2	1.3	0.0
Total Load tracked between points SXMN04 & SXMN05	168.4	46.0	82.2	1,534.0
Allowable Load at SXMN04	48.0	28.9	16.7	427.6
Load Reduction at SXMN04	120.4	17.1	65.5	1,106.4
% Reduction required at SXMN04	71	37	80	72

TMDL Calculations - Sample Point SXMN03, Saxman Run upstream of Lower Saxman discharge

The TMDL for sample point SXMN03 consists of a load allocation to all of the area between SXMN03 and SXMN04 (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at the point. The average flow of 5.52 MGD, measured at the 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 added suspended solids as a cause of impairment to the 2002 PA Section 303(d) list. Although pH is not listed as a cause of impairment, sample data at point SXMN03 shows pH ranging between 4.9 and 6.3; pH will be addressed as part of this TMDL because of the mining impacts.

Table C12. TMDL Calculations at Point SXMN03

Flow = 5.52 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	23.10	1,063.1	1.16	53.2
Mn	4.28	197.0	0.77	35.5
Al	5.31	244.5	0.42	19.6
Acidity	84.88	3,906.2	10.19	468.7
Alkalinity	6.30	289.9		

The calculated load reductions for all the loads that enter point SXMN03 must be accounted for in the calculated reductions at the sample point shown in Table C13. A comparison of measured loads between points SXMN03 and SXMN04 shows that there is an increase of loading for all parameters within the segment. The total segment load is the sum of the upstream allocated loads plus the additional loading that enters the segment.

Table C13. Calculation of Load Reduction Necessary at Point SXMN03

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Measured Load	1,063.1	197.0	244.5	3,906.2
Difference in Measured Loads	102.3	44.9	35.4	616.6
Load tracked from SXMN04	48.0	28.9	16.7	427.6
Total Load tracked between points SXMN03 & SXMN04	150.3	73.8	52.1	1,044.2
Allowable Load at SXMN03	53.2	35.5	19.6	468.7
Load Reduction at SXMN03	97.1	38.3	32.5	575.5
% Reduction required at SXMN03	65	52	62	55

TMDL Calculations - Sample Point SXMN02, Saxman Run downstream of Lower Saxman discharge

The TMDL for sample point SXMN02 consists of a load allocation to all of the area between SXMN02 and SXMN03 (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at the point. The average flow of 9.42 MGD, measured at the 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 added suspended solids as a cause of impairment to the 2002 PA Section 303(d) list. Although pH is not listed as a cause of impairment, sample data at point SXMN02 shows pH ranging between 5.1 and 6.0; pH will be addressed as part of this TMDL because of the mining impacts.

Table C14. TMDL Calculations at Point SXMN02				
Flow = 9.42 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	32.56	2,558.5	0.98	76.8
Mn	4.25	333.8	0.85	66.8
Al	2.27	178.7	0.16	12.5
Acidity	77.28	6,072.6	24.73	1,943.2
Alkalinity	6.00	471.5		

The calculated load reductions for all the loads that enter point SXMN02 must be accounted for in the calculated reductions at the sample point shown in Table C15. A comparison of measured loads between points SXMN02 and SXMN03 shows that there is a decrease in aluminum loading and an increase in iron, manganese, and acidity loading within the segment. The percent of aluminum load lost within the segment is calculated and applied to the upstream allocated load entering the segment to determine the amount of the upstream load that is tracked through the segment. For iron, manganese, and acidity the total segment load is the sum of the upstream allocated loads plus the additional loading that enters the segment.

Table C15. Calculation of Load Reduction Necessary at Point SXMN02				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Measured Load	2,558.5	333.8	178.7	6,072.6
Difference in Measured Loads	1,495.4	136.8	-65.8	2,166.4
Load tracked from SXMN03	53.2	35.5	19.6	468.7
Percent loss due to instream process	-	-	27	-
Percent load tracked from SXMN03	-	-	73	-
Total Load tracked between points SXMN02 & SXMN03	1,548.6	172.3	14.3	2,635.1
Allowable Load at SXMN02	76.8	66.8	12.5	1,943.2
Load Reduction at SXMN02	1,471.8	105.5	1.8	691.9
% Reduction required at SXMN02	95	61	13	26

TMDL Calculations - Sample Point SXMN01, mouth of Saxman Run

The TMDL for sample point SXMN01 consists of a load allocation to all of the area between SXMN01 and SXMN02 (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at the point. The average flow of 10.50 MGD, measured at the 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 added suspended solids as a cause of impairment to the 2002 PA Section 303(d) list. Although pH is not listed as a cause of impairment, sample data at point SXMN01 shows pH ranging between 5.6 and 6.1; pH will be addressed as part of this TMDL because of the mining impacts.

Table C16. TMDL Calculations at Point SXMN01				
Flow = 10.50 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	25.30	2,214.6	1.01	88.6
Mn	4.06	355.4	0.81	71.1
Al	3.58	313.4	0.47	40.7
Acidity	73.92	6,470.6	16.26	1,423.5
Alkalinity	6.10	534.0		

The calculated load reductions for all the loads that enter point SXMN01 must be accounted for in the calculated reductions at the sample point shown in Table C17. A comparison of measured loads between points SXMN01 and SXMN02 shows that there is a decrease in iron loading and an increase in aluminum, manganese, and acidity loading within the segment. The percent of iron load lost within the segment is calculated and applied to the upstream allocated load entering the segment to determine the amount of the upstream load that is tracked through the segment. For aluminum, manganese, and acidity the total segment load is the sum of the upstream allocated loads plus the additional loading that enters the segment.

Table C17. Calculation of Load Reduction Necessary at Point SXMN01				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Measured Load	2,214.6	355.4	313.4	6,470.6
Difference in Measured Loads	-343.9	21.6	134.7	398.0
Load tracked from SXMN02	76.8	66.8	12.5	1943.2
Percent loss due to instream process	13	-	-	-
Percent load tracked from SXMN02	87	-	-	-
Total Load tracked between points SXMN02 & SXMN01	66.4	88.4	147.2	2,341.2
Allowable Load at SXMN01	88.6	71.1	40.7	1423.5
Load Reduction at SXMN01	0.0	17.3	106.5	917.7
% Reduction required at SXMN01	0	20	72	39

Margin of Safety

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

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

Seasonal Variation

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

Critical Conditions

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

Attachment D

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

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

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

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

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

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

Attachment E

Water Quality Data Used In TMDL Calculations

Monitoring Point	Date	Flow	pH	Alkalinity	Acidity	Fe	Mn	Al
		gpm		mg/L	mg/L	mg/L	mg/L	mg/L
SXMN01	4/9/2003	8049	5.8	24.2	63.2	23.1	3.67	4.25
Latitude:	5/15/2003	5722	5.6	20.4	88.8	26.6	4.27	4.09
40 19' 20"	6/24/2003	5891	5.7	27.2	88.6	26.3	4.23	3.42
Longitude:	7/21/2003	5081	5.7	25.6	86	28.1	4.43	3.66
79 22' 50"	8/14/2003	11701	6.1	50.2	43	22.4	3.7	2.48
Mouth of Saxman Run	Average	7288.80000	5.78000	29.52000	73.92000	25.30000	4.06000	3.58000
	St Dev	2707.78973	0.19235	11.83098	20.33352	2.43824	0.35057	0.69839
SXMN02	4/3/2003	6695	5.1	12.8	89	25.1	4.57	6.02
Latitude:	5/15/2003	5994	5.7	56	86.8	37.3	4.35	0
40 19' 26"	6/24/2003	4710	5.7	52.4	73.2	37.4	4.07	1.42
Longitude:	7/21/2003	6647	5.6	34	89.8	36.6	4.34	1.78
79 22' 41"	8/14/2003	8669	6	50.2	47.6	26.4	3.91	2.15
Downstream of	Average	6543.00000	5.62000	41.08000	77.28000	32.56000	4.24800	2.27400
Lower Saxman Discharge	St Dev	1433.09857	0.32711	17.91513	17.90452	6.24123	0.25908	2.24679
SXMN03	4/3/2003	4189	5.1	13.2	88.2	24.8	4.5	5.89
Latitude:	5/15/2003	3202	4.9	10.4	96.4	21.1	4.18	6.2
40 19' 26"	6/24/2003	3689	5.3	15.4	93.8	24.2	4.44	5.49
Longitude:	7/21/2003	3674	5.1	13	104.6	25.3	4.7	5.97
79 22' 36"	8/14/2003	4406	6.3	46	41.4	20.1	3.58	3.01
Upstream of Lower	Average	3832.00000	5.34000	19.60000	84.88000	23.10000	4.28000	5.31200
Saxman Discharge	St Dev	474.14080	0.55498	14.86405	25.01344	2.34201	0.43313	1.31211
SXMN04	4/3/2003	3123	5.1	16	92	26.6	4.28	6.12
Latitude:	5/15/2003	2603	4.9	12.2	103	22.4	3.94	6.3
40 19' 28"	6/24/2003	3007	5.3	18	92.6	26.1	4.02	5.38
Longitude:	7/21/2003	3089	5.1	14.8	101.6	26.2	4.32	6.11
79 22' 18"	8/14/2003	4321	6.3	53.4	35	22.6	3.06	3.06
Downstream of	Average	3228.60000	5.34000	22.88000	84.84000	24.78000	3.92400	5.39400
Upper Saxman Discharge	St Dev	645.06961	0.55498	17.18988	28.31162	2.09093	0.50978	1.35170
SXMN05	4/9/2003	6642	5.5	18	62.4	19.3	3.06	5.35
Latitude:	5/15/2003	4190	5	11.8	97.8	24.9	4.61	7.79
40 19' 27"	6/24/2003	3405	5.3	18.6	93.4	25.5	4.02	5.38
Longitude:	7/21/2003	156	6.2	147.8	0	32.1	4.04	0
79 22' 16"	8/14/2003	18	6.6	129.4	0	16.2	2.52	0
Upstream of Upper	Average	2882.20000	5.72000	65.12000	50.72000	23.60000	3.65000	3.70400
Saxman Discharge	St Dev	2817.60380	0.66106	67.44503	48.26895	6.14003	0.84196	3.52324

Monitoring Point	Date	Flow	pH	Alkalinity	Acidity	Fe	Mn	Al
		gpm		mg/L	mg/L	mg/L	mg/L	mg/L
SXMN06	4/3/2003	1156	4.2	5	134.6	7.15	3.01	15.6
Latitude:	5/15/2003	1484	4	2.8	149.2	9.6	3.66	18.7
40 19' 18"	6/24/2003	789	4.1	4.2	185	11.4	3.94	20.8
Longitude:	7/21/2003	683	3.7	0	201.6	7.88	4.5	22.5
79 21' 16"	8/14/2003	1594	6.4	17.4	38.2	7.76	2.15	7.07
Downstream of Unnamed	Average	1141.20000	4.48000	5.88000	141.72000	8.75800	3.45200	16.93400
Tributary 43450	St Dev	405.20081	1.08950	6.71506	63.80009	1.73506	0.90420	6.08529
SXMN07	4/3/2003	66	7.2	138.6	0	0.509	0.342	<0.5
Latitude:	5/15/2003	132	7.6	122.8	0	0.365	0.207	<0.5
40 19' 19"	6/24/2003	103	7.2	117.8	0	<0.3	0.053	<0.5
Longitude:	7/21/2003	54	7.4	131.4	0	<0.3	<0.05	<0.5
79 21' 11"	8/14/2003	374	7.6	109.6	0	<0.3	<0.05	<0.5
Mouth of Unnamed	Average	145.80000	7.40000	124.04000	0.00000	0.43700	0.20067	NA
Tributary 43450	St Dev	131.23719	0.20000	11.34848	0.00000	0.10182	0.14460	NA
SXMN08	4/9/2003	2290	3.2	0	202	24.8	4.03	22.8
Latitude:	5/15/2003	1045	3.1	0	278.4	32.2	5.42	29.8
40 19' 16"	6/24/2003	591	3	0	340.2	32.5	5.55	29.6
Longitude:	7/21/2003	597	3	0	374.4	38.5	6.87	36.6
79 19' 04"	8/14/2003	885	3.4	0	191.8	22.4	4.3	21.8
Downstream of Unnamed	Average	1081.60000	3.14000	0.00000	277.36000	30.08000	5.23400	28.12000
Tributary 43454	St Dev	702.80637	0.16733	0.00000	81.18860	6.48282	1.13280	6.02428

Attachment F
Comment and Response

A 60-day public comment period was open from September 4, 2004 to November 4, 2004. During this time, no comments on the draft TMDL for the Saxman Run Watershed were received.