FINAL

SEATON CREEK WATERSHED TMDL

Butler County

Prepared for:

Pennsylvania Department of Environmental Protection

October 20, 2004

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Seaton Creek Watershed
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Introduction

This report presents the Total Maximum Daily Loads (TMDLs) developed for the Seaton Creek segments in the upper portion of the Slippery Rock Creek Watershed, Butler County. These were done to address the impairments noted on the 1996 Pennsylvania Section 303(d) list, required under the Clean Water Act, and covers one segment on this list (located in Table 1). 4.42 miles of impairment are listed due to depressed pH and elevated metals. The impairment associated with pH and metals is the result of acid drainage from abandoned coal mines and the natural condition of the ground water associated with an absence or paucity of alkaline producing material in the flow path of the water. The TMDL addresses the three primary metals associated with acid mine drainage (iron, manganese, aluminum), and pH.

Table 1. Section 303(d) Sub-List

State Water Plan (SWP) Subbasin: 20-C Seaton Creek

Year	Miles	Segment ID	DEP Stream Code	Stream Name	Designated Use	Data Source	Source	EPA 305(b) Cause Code
1996	4.42	4571	34751	Seaton Creek	CWF	305(b) Report	RE	Metals, pH, & other inorganics
1998	No additional assessment data collected for the 1998 303(d) list.			Seaton Creek				
2000	No additional assessment data collected for the 2000 303(d) list.			Seaton Creek				
2002	4.4	4571	34751	Seaton Creek	CWF	SWMP	AMD	Metals, pH, & other inorganics

Cold Water Fishes=CWF
Resource Extraction = RE
Surface Water Monitoring Program = SWMP
See Attachment E, *Excerpts Justifying Changes Between the 1996, 1998, and Draft 2000 Section 303(d) Lists*.
The use designation for the stream segment in this TMDL can be found in PA Title 25 Chapter 93. Note: It is covered under Slippery Rock Creek basin. Almost all of the Seaton Creek drainage area has been impacted by acid mine drainage.

[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 Seaton Creek Watershed

The Seaton Creek Watershed is approximately 10 square miles in area. It is located in north central Butler County. The segment flows through the northwestern most area of the main bituminous coal region in Western Pennsylvania. It enters Slippery Rock Creek, which flows west 30 miles to Ellwood City where it meets Connoquenessing Creek and then enters the Beaver River. Seaton Creek is found on the Eau Claire, Hilliards, West Sunbury and Barkeyville $7^1/_2$ minute series topographic maps. Access to the mouth of Seaton Creek can be gained by taking Exit 4 (Clintonville) of Interstate 80. Follow PA route 308 south 5.6 miles to Goff Station Road, make a left. Go 0.2 miles to an unnamed tributary, sample point 40. This tributary enters Seation Creek below the downstream sample point 68. Sample point 68 is 0.7 mile from PA route 308 on the Goff Station Road, at a stream crossing for a junkyard. This point was chosen because the access is good and beavers have created a large wetland complex at the confluence with Slippery Rock Creek. One mile upstream of sample point 68, Seaton Creek splits with Murrin Run (local name) branching off to the north and Seaton Creek continuing to the east. Sample point 18 is on Murrin Run at this stream crossing. Sample 19 is on Seaton Creek above the mouth of Murrin Run. Sample Point 48 is upstream of 19 where McJunking Road crosses the stream. Sample points 23, 25, and 30 are upstream of 48. (Sample points 23 and 25 are stream evaluation points for the Growing Greener grants near DeSale.)

Back on Murrin Run, just upstream of sample point 18 is a Growing Greener project on the west side and the Quality Aggregates mine site on the east side of the tributary. Sample point 13 is upstream at the PA route 58 stream crossing. Sample points 4, 6, 9, 11, and 12 are upstream of 13.

Segments addressed in this TMDL

The Seaton Creek Watershed is affected by pollution from AMD. This pollution has caused high levels of metals and low pH in the mainstem of Seaton Creek.

There is one surface mine permit still in effect in the watershed. Western Hickory, SMP 10803018, coal removal is completed and treatment is ongoing for acid mining discharge. Discharges on the Growing Greener sites and all other discharges in the watershed are from abandoned mining operations and will be treated as non-point sources. The distinction between non-point and point sources in this case is determined on the basis of whether or not there is a responsible party for the discharge. Where there is no responsible party the discharge is considered to be a non-point source. 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 E for the 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 U.S. Environmental Protection Agency’s (USEPA) implementing regulations (40 CFR Part 130) require:

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

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

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

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

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

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

In the cases that have been settled to date, the consent agreements require USEPA to backstop TMDL development, track TMDL development, review state monitoring programs, and fund studies on issues of concern (e.g., AMD, implementation of nonpoint source Best Management Practices (BMPs), etc.). These TMDLs were developed in partial fulfillment of the 1996 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA*.

Section 303(d) Listing Process

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

The primary method adopted by the Pennsylvania Department of Environmental Protection (Pa. 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. Pa. DEP is now using the Unassessed Waters Protocol (UWP), a modification of the USEPA Rapid Bioassessment Protocol II (RPB-II), as the primary mechanism to assess Pennsylvania's waters. The UWP provides a more consistent approach to assessing Pennsylvania's streams.

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

After the survey is completed, the biologist determines the status of the stream segment. The decision is based on the performance of the segment using a series of biological metrics. If the stream is determined to be impaired, the source and cause of the impairment is documented. An impaired stream must be listed on the state's Section 303(d) list with the documented source and cause. A TMDL must be developed for the stream segment. A TMDL is for only one pollutant. If a stream segment is impaired by two pollutants, two TMDLs must be developed for that stream segment. In order for the process to be more effective, adjoining stream segments with the same source and cause listing are addressed collectively, and on a watershed basis.

Basic Steps for Determining a TMDL

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

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

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

Watershed History

Mining was first conducted in this area around the turn of the century with deep mines on the Brookville coal near Goff Station. Deep mining continued until 1930s. In the early 1940s strip mining was taking place removing the crop coal left in place by the deep mines. There were no regulations for mining and reclamation as there are today. In fact, the highwalls were intentionally left open so mining could resume at the higher cover if needed. These mines were abandoned with open pits; spoil piles, and abandoned highwalls that still remain.

The Sunbeam Coal Preparation Plant near the mouth of Seaton Creek started up in the early 1950s. It was in continuous operation until the mid 1990s when Sunbeam went out of business. The site was reclaimed by the fall of 1996. Due to the close proximity to their prep plant and the available reserves, Sunbeam mined the Brookville and Middle Kittanning coal seams in the watershed right up until their demise. Other mining companies, such as Adobe Minimn, Western Hickory, Lucas and Chernickey also had mining operations in the watershed.

Seaton Creek, as part of the Slippery Rock Creek Watershed, was included in the Department's Comprehensive Mine Reclamation Strategy (CMRS), which began in 1994. Slippery Rock Creek has a drainage area of almost 300 square miles. The headwaters, with a drainage area of 27 square miles, was chosen for the CMRS. The CMRS study area was selected based on the manageable size of the watershed, the degree of pollution and local support. The main stem of Slippery Rock Creek is marginally acidic and passive treatment technology has had a positive impact. Seaton Creek has a drainage area of 10 square miles. It is the most severely impaired segment in the entire watershed. Water monitoring has been conducted since 1994, but only samples collected after 1/1/1996 have been used for this TMDL.

- Western Hickory Coal Co. mined the Middle Kittanning coal in the mid 1980s under Surface Mine Permit (SMP) #10803018. A pre-existing acid discharge was degraded by mining soon after coal removal was completed. Chemical treatment with caustic soda has taken place since 1987. A passive treatment system was constructed in August 2000.
- Ben Hal Mining Co., SMP #109701014, coal removal is completed; site is backfilled and planted, no WLA needed.
- Quality Aggregates inc., SMP #10820139, coal removal is completed; site is backfilled and planted, no WLA needed. A reclamation project funded by Growing Greener is under construction near Goff Station. Two other Growing Greener projects near DeSale have been built.

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 comparison between observed instream conditions and conditions that are expected to restore designated uses. The endpoint is based on either the narrative or numeric criteria available in water quality standards.

Because of the nature of the pollution sources in the watershed, the TMDLs component makeup will be load allocations that are specified above a point in the stream segment. All allocations will be specified as long-term average daily concentrations. These long-term average daily concentrations are expected to meet water quality criteria 99 percent of the time. Pennsylvania Title 25 Chapter 93.6(c) specifies that the water quality standards must be met 99 percent of the time. The iron TMDLs are expressed as total recoverable as the iron data used for this analysis was reported as total recoverable. Table 2 shows the water quality criteria for the selected parameters.

Table 2. Applicable Water Quality Criteria

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

*The pH values shown will be used when applicable. In the case of freestone streams with little or no buffering capacity, the TMDL endpoint for pH will be the natural background water quality. These values are typically as low as 5.4 (Pennsylvania Fish and Boat Commission).

Other Inorganics

The cause of inorganic impairment as listed on the 1996 Section 303(d) list is sulfates. Due to Title 25 Chapter 96.3(d) a TMDL to address sulfates is not necessary. The nearest potable water withdrawal to Seaton Creek occurs approximately 40-50 miles downstream of the mouth at Camp Allegheny Salvation Army (#6370810). Sulfate data from WQN0922, located on Slippery Rock Creek at the SR2005 bridge at Camp Allegheny approximately 0.5-1 mile downstream of the water supply intake, shows that sulfate criteria of 250 mg/L is not exceeded. The average sulfate concentration calculated from 5 years of WQN sulfate data is 97.94 mg/L. A map of the water supply intake, WQN Station, and USGS Gage Station is located in Appendix A and sulfate and flow data for the WQN Station is located in Appendix F.

TMDL Elements (WLA, LA, MOS)

A TMDL equation consists of a wasteload allocation, load allocation and a margin of safety. The wasteload 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).

Allocation Summary

These TMDLs will focus remediation efforts on the identified numerical reduction targets for each watershed. As changes occur in the watershed, the TMDL may be re-evaluated to reflect current conditions. Table 5 presents the estimated reductions identified for all points in the watershed. Attachment F gives detailed TMDLs by segment analysis for each allocation point.

Table 3. Summary Table – Seaton Creek Watershed

Station	Parameter	Measured Sample Data		Allowable		Reduction Identified
		Conc. (mg/l)	Load (lb/day)	LTA Conc. (mg/l)	Load (lb/day)	Percent
6	Al	6.56	60.3	0.33	3.0	95
	Fe	0.79	7.3	0.79	7.3	0
	Mn	13.91	127.9	0.56	5.1	96
	Acidity	48.84	449.1	6.84	62.9	86
	Alkalinity	17.48	160.7			
9	Al	2.78	27.1	0.14	1.4	95
	Fe	0.89	8.7	0.89	8.7	0
	Mn	14.08	137.1	0.42	4.1	97
	Acidity	37.19	362.1	5.58	54.3	85
	Alkalinity	17.86	173.9			
18	Al	1.03	31.6	0.16	5.1	NA
	Fe	0.90	27.6	0.69	21.2	23
	Mn	6.08	186.4	0.43	13.0	NA
	Acidity	3.30	101.1	3.30	101.1	NA
	Alkalinity	37.90	1161.7			
23	Al	7.59	16.6	0.30	0.7	96
	Fe	9.83	21.5	0.59	1.3	94
	Mn	38.97	85.3	0.39	0.9	99
	Acidity	191.88	419.8	0.10	0.2	100
	Alkalinity	0.28	0.6			
25	Al	14.47	18.1	0.43	0.5	97
	Fe	12.88	16.1	0.39	0.5	97
	Mn	38.79	48.5	0.39	0.5	99
	Acidity	235.00	293.8	0.14	0.2	100.0
	Alkalinity	0.31	0.4			
30	Al	0.25	0.2	0.25	0.2	0
	Fe	0.15	0.1	0.15	0.1	0
	Mn	2.28	1.7	0.32	0.2	86
	Acidity	0.65	0.5	0.65	0.5	0
	Alkalinity	11.9	8.9			
48	Al	3.65	50.9	0.22	3.1	82
	Fe	0.77	10.7	0.22	3.0	NA
	Mn	13.66	190.5	0.41	5.7	90
	Acidity	48.47	675.8	2.42	33.8	NA
	Alkalinity	9.41	131.2			
68	Al	0.61	54.4	0.16	14.2	NA
	Fe	1.15	102.6	0.41	36.9	NA
	Mn	7.58	676.5	0.30	27.1	NA
	Acidity	10.79	963.0	1.08	96.3	NA
	Alkalinity	17.32	1545.8			
40	Al	7.67	15.5	0.23	0.5	97
	Fe	0.15	0.3	0.15	0.3	0
	Mn	23.96	48.4	0.24	0.5	99
	Acidity	96.25	194.4	2.89	5.8	97
	Alkalinity	8.44	17.2			

Waste load allocations are being assigned to the one permitted discharge for permit SMP 10803018 for iron and manganese. This site is upstream of sample point 6 on a tributary to Seaton Creek. Aluminum and acidity are not included in the permit so no waste load allocation is assigned for these parameters. The waste load allocations are based on measured flow data and the permit limits, which are Best Available Technology (BAT) limits. Table 4 contains the waste load allocations for the permitted discharge. Flow data used is located in Attachment F.

Table 4. Waste Load Allocations for SMP 10803018

Parameter	Allowable Average Monthly Conc. (mg/l)	Average Flow (MGD)	Allowable Load (lbs/day)
Fe	3.0	0.0103	0.258
Mn	2.0	0.0103	0.172
Al	2.0	0.0103	0.172

Recommendations

Two primary programs that provide reasonable assurance for maintenance and improvement of water quality in the watershed are in effect. The PADEP'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 PADEP'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 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 PA 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; and administers a loan program for bonding anthracite underground mines and for mine subsidence. Administers the EPA Watershed Assessment Grant Program, the Small Operator's Assistance Program (SOAP), and the Remining Operators Assistance Program (ROAP).

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.

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

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

- To encourage private and public participation in abandoned mine reclamation efforts
- To improve reclamation efficiency through better communication between reclamation partners
- To increase reclamation by reducing remining risks
- To maximize reclamation funding by expanding existing sources and exploring new sources.

Passive treatment systems installed at DeSale (Phases I and II) and Goff Station have resulted in the removal of acid, iron and aluminum, making significant improvements in the water quality in the Seaton Creek Watershed. A Passive treatment system is also under construction at Erico Bridge. Current land reclamation involving filling abandon open pits, removing/regrading refuse piles and coal ash treatment at Erico Bridge, Brookville Pit and Chernicky will also contribute to improved water quality in the watershed. Other areas of concern in the Seaton Creek watershed will be addressed in the future along with the operation and maintenance of the treatment systems already installed. As changes occur in the watershed, the TMDL may be re-evaluated to reflect current conditions.

Current projects have before and after monitoring performed to determine the remediation technique efficiency, as will future remediation projects. There is a project in progress or planned at each point where a TMDL allocation has been made.

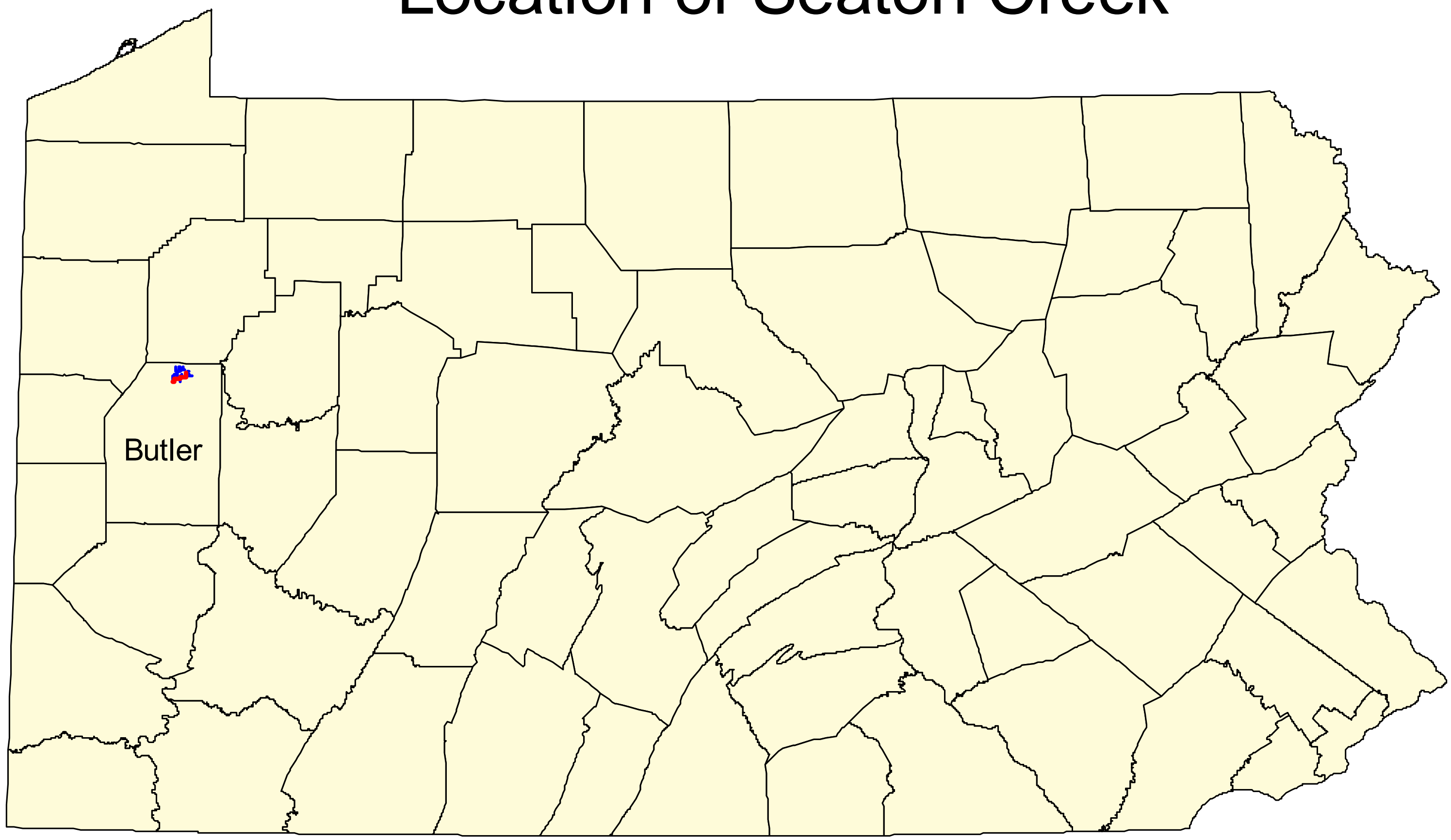
Public Participation

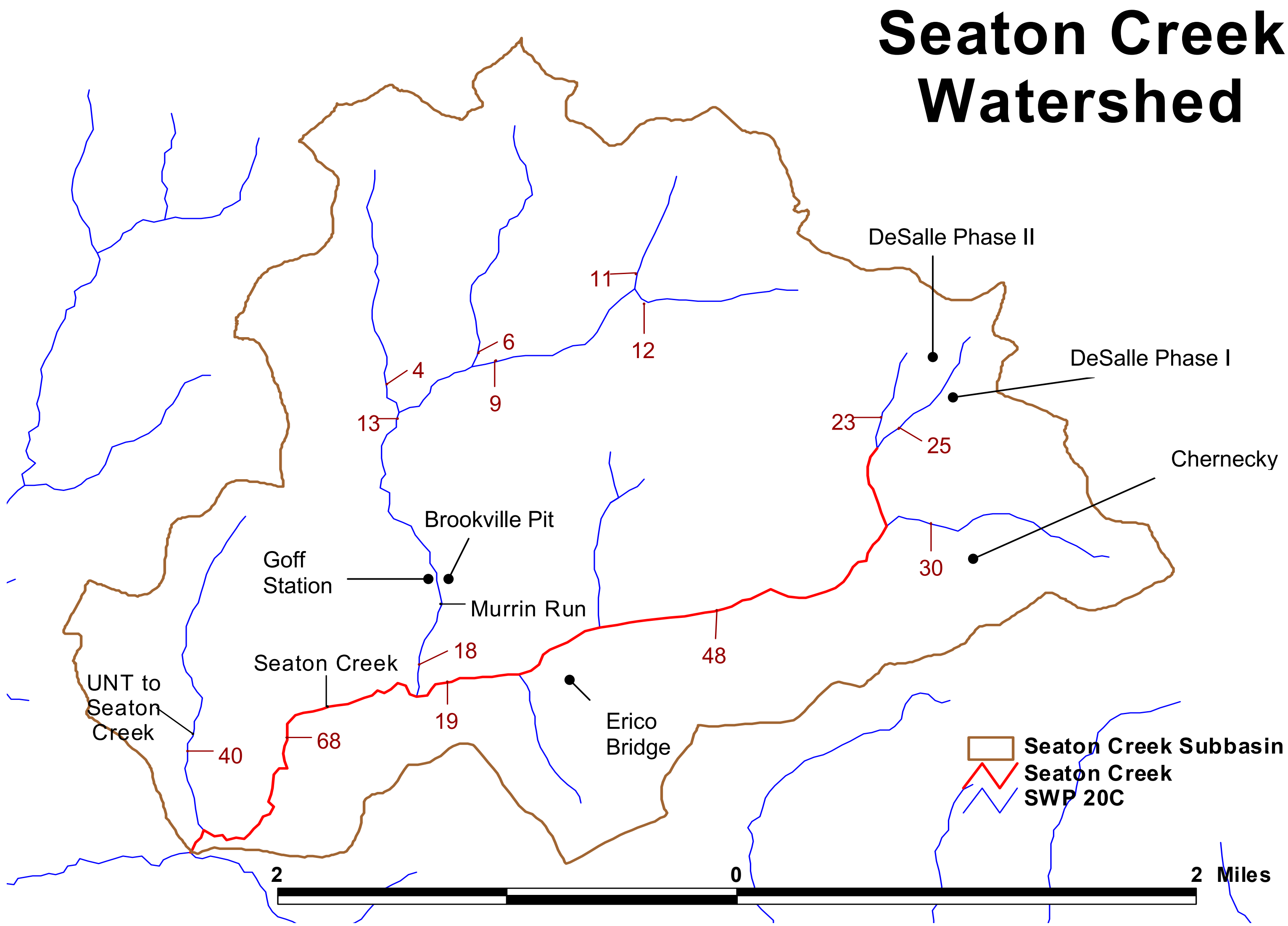
Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* and the Butler Eagle, Butler, PA on November 18,2002 to foster public comment on the allowable loads calculated. A public meeting was held on December 12, 2002, at the Jennings Environmental Ecucation Center in Butler county, PA , to discuss the proposed TMDL.

Attachment A

Seaton Creek Watershed Map

Location of Seaton Creek




Seaton Creek Watershed
DeSalle Phase II
DeSalle Phase I
Chernecky
Brookville Pit
Goff Station
Murrin Run
Seaton Creek
UNT to Seaton Creek
Erico Bridge
11
12
6
4
9
13
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30
48
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19
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2
0
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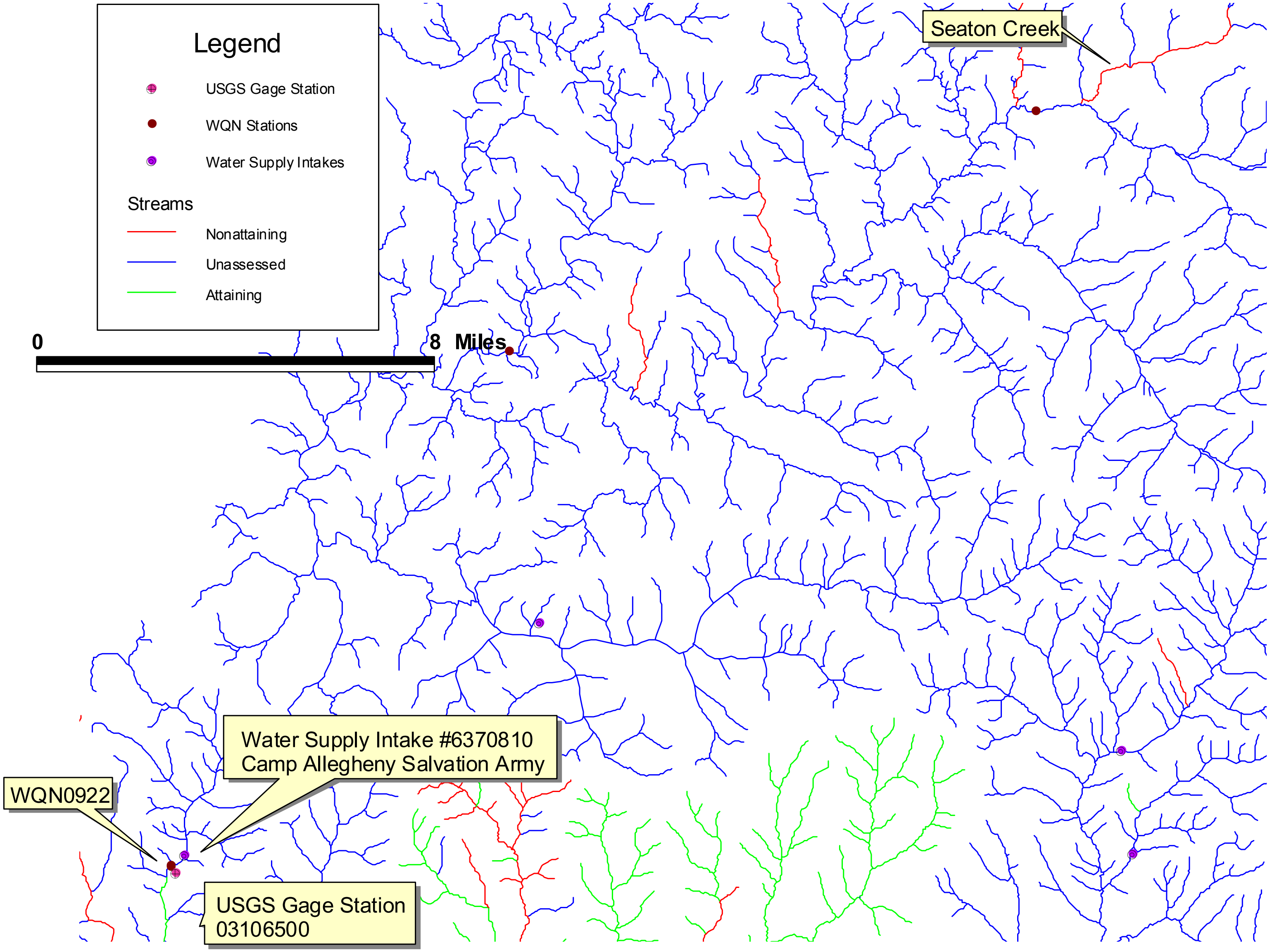
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WQN Stations
Water Supply Intakes
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Camp Allegheny Salvation Army
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USGS Gage Station
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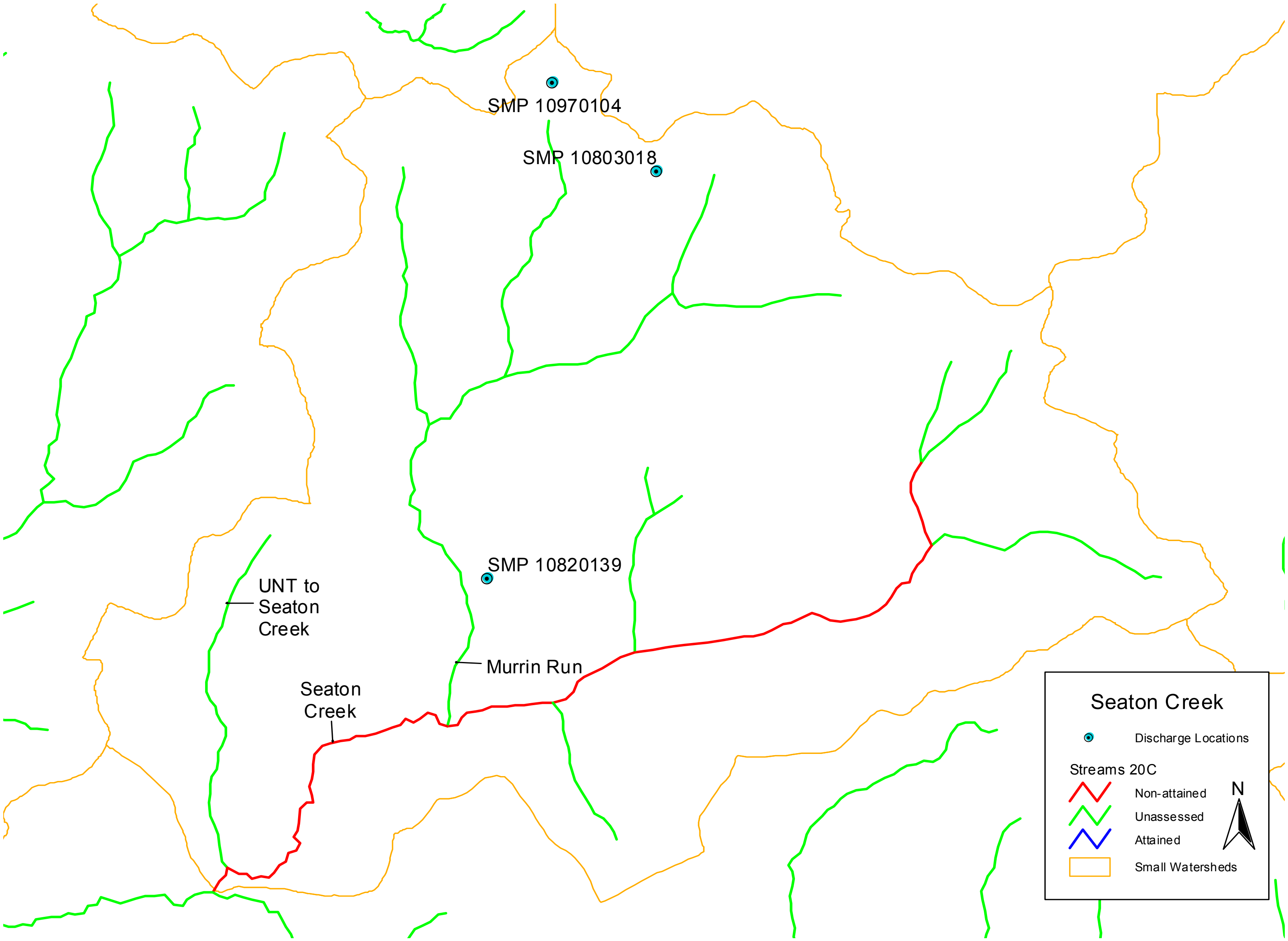
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SMP 10803018
SMP 10820139
UNT to
Seaton
Creek
Murrin Run
Seaton
Creek
Seaton Creek
Discharge Locations
Streams 20C
Non-attained
Unassessed
Attained
Small Watersheds
N

Attachment B

AMD Methodology, The pH Method, and Surface Mining Control and Reclamation Act

AMD Methodology

Two approaches are used for the TMDL analysis of AMD-affected stream segments. Both of these approaches use the same statistical method for determining the instream allowable loading rate at the point of interest. The difference between the two is based on whether the pollution sources are defined as discharges that are permitted or have a responsible party, which are considered point sources. Nonpoint sources are then any pollution sources that are not point sources.

For situations where all of the impact is due to nonpoint sources, the equations shown below are applied using data for a point in the stream. The load allocation made at that point will be for all of the watershed area that is above that point. For situations where there are only point-source impacts or a combination of point and 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.

TMDLs and load allocations for each pollutant were determined using Monte Carlo simulation. 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 any required percent reduction so that the water quality criteria 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)

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

LTA = allowable LTA source concentration in mg/l

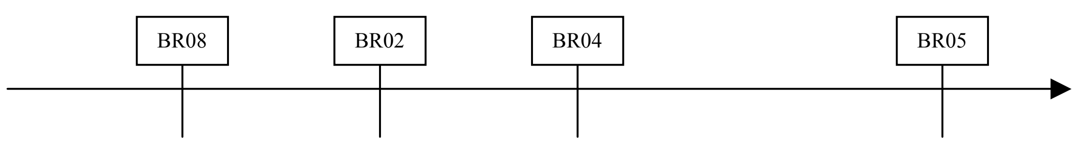
Once the required percent reduction for each pollutant source was determined, a second series of Monte Carlo simulations were performed to determine if the cumulative loads from multiple sources allow instream water quality criteria to be met at all points at least 99 percent of the time. The second series of simulations combined the flows and loads from individual sources in a step-wise fashion, so that the level of attainment could be determined immediately downstream of each source. Where available data allowed, pollutant-source flows used were the average flows. Where data were insufficient to determine a source flow frequency distribution, the average flow derived from linear regression was used.

In general, these cumulative impact evaluations indicate that, if the percent reductions determined during the first step of the analysis are achieved, water quality criteria will be achieved at all upstream points, and no further reduction in source loadings is required.

Where a stream segment is listed on the 303(d) list for pH impairment, the evaluation is the same as that discussed above; the pH method is fully explained in Attachment C. An example calculation from the Swatara Creek TMDL, including detailed tabular summaries of the Monte Carlo results, is presented for the Lorberry Creek TMDL in Attachment E. Information for the TMDL analysis performed using the methodology described above is contained in the TMDLs by segment section of this report in Attachment F.

Accounting for Upstream Reductions in AMD TMDLs

In AMD TMDLs, sample points are evaluated in headwaters (most upstream) to stream mouth (most downstream) order. As the TMDL evaluation moves downstream the impact of the previous, upstream, evaluations must be considered. The following examples are from the Beaver Run AMD TMDL (2003):



In the first example BR08 is the most upstream sample point and BR02 is the next downstream sample point. The sample data, for both sample points, are evaluated using @Risk (explained above) to calculate the existing loads, allowable loads, and a percentage reduction for aluminum, iron, manganese, and acidity (when flow and parameter data are available).

Any calculated load reductions for the upstream sample point, BR08, must be accounted for in the calculated reductions at sample point BR02. To do this (see table A) the allowable load is subtracted from the existing load, for each parameter, to determine the total load reduction.

Table A	Alum.	Iron	Mang.	Acidity
BR08	(#/day)	(#/day)	(#/day)	(#/day)
existing load=	3.8	2.9	3.5	0.0
allowable load=	3.8	2.9	3.5	0.0
TOTAL LOAD REDUCTION=	**0.0**	**0.0**	**0.0**	**0.0**

In table B the Total Load Reduction BR08 is subtracted from the Existing loads at BR02 to determine the Remaining Load. The Remaining Load at BR02 has the previously calculated Allowable Loads at BR02 subtracted to determine any load reductions at sample point BR02. This results in load reductions for aluminum, iron and manganese at sample point BR02.

Table B. Necessary Reductions at Beaver Run BR02				
	Al (#/day)	Fe (#/day)	Mn (#/day)	Acidity (#/day)
Existing Loads at BR02	13.25	38.44	21.98	6.48
Total Load Reduction BR08	0.00	0.00	0.00	0.00
Remaining Load (Existing Load at BR02 - BR08)	13.25	38.44	21.98	6.48
Allowable Loads at BR02	2.91	9.23	7.03	6.48
Percent Reduction	78.0%	76.0%	68.0%	NA
Additional Removal Required at BR02	10.33	29.21	14.95	0.00

At sample point BR05 this same procedure is also used to account for calculated reductions at sample points BR08 and BR02. As can be seen in Tables C and D this procedure results in additional load reductions for iron, manganese and acidity at sample point BR04.

At sample point BR05 (the most downstream) no additional load reductions are required, see Tables E and F.

Table C	Alum.	Iron	Mang.	Acidity
BR08 & BR02	(#/day)	(#/day)	(#/day)	(#/day)
Total Load Reduction=	**10.33**	**29.21**	**14.95**	**0.0**

Table E	Alum.	Iron	Mang.	Acidity
BR08 BR02 &BR04	(#/day)	(#/day)	(#/day)	(#/day)
Total Load Reduction=	10.3	29.2	14.9	0.0

Table D. Necessary Reductions at Beaver Run BR04

	Al (#/day)	Fe (#/day)	Mn (#/day)	Acidity (#/day)
Existing Loads at BR04	12.48	138.80	54.47	38.76
Total Load Reduction BR08 & BR02	10.33	29.21	14.95	0.00
Remaining Load (Existing Load at BBR04 - TLR Sum	2.15	109.59	39.53	38.76
Allowable Loads at BR04	8.99	19.43	19.06	38.46
Percent Reduction	NA	82.3%	51.8%	0.8%
Additional Removal Required at BR04	0.00	90.16	20.46	0.29

Table F. Necessary Reductions at Beaver Run BR05

	Al (#/day)	Fe (#/day)	Mn (#/day)	Acidity (#/day)
Existing Loads at BR05	0.0	31.9	22.9	4.1
Total Load Reduction BR08, BR02 & BR04	10.3	119.4	35.4	0.3
Remaining Load (Existing Load at BBR05 - TLR Sum	NA	NA	NA	3.8
Allowable Loads at BR05	0.0	20.4	15.1	4.1
Percent Reduction	NA	NA	NA	NA
Additional Removal Required at BR05	0.0	0.0	0.0	0.0

Although the evaluation at sample point BR05 results in no additional removal this does not mean there are no AMD problems in the stream segment BR05 to BR04. The existing and allowable loads for BR05 show that iron and manganese exceed criteria and, any abandoned mine discharges in this stream segment will be addressed.

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 USEPA'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 the 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.*

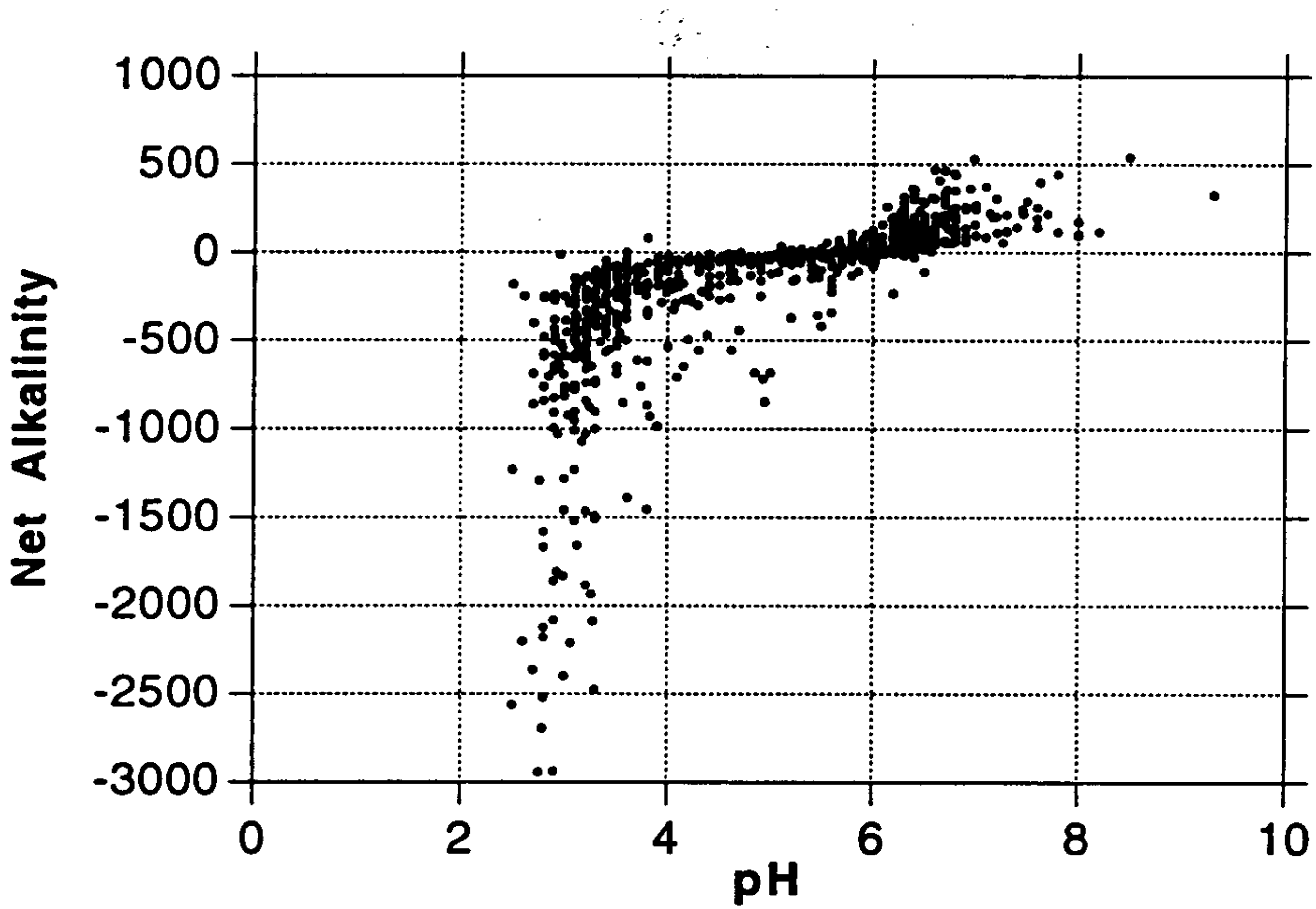


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

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

Example Calculation: Lorberry Creek

Lorberry Creek was evaluated for impairment due to high metals contents in the following manner: the analysis was completed in a stepwise manner, starting at the headwaters of the stream and moving to the mouth. The Rowe Tunnel (Swat-04) was treated as the headwaters of Lorberry Creek for the purpose of this analysis.

1. A simulation of the concentration data at point Swat-04 was completed. This estimated the necessary reduction needed for each metal to meet water quality criteria 99 percent of the time as a long-term average daily concentration. Appropriate concentration reductions were made for each metal.

2. A simulation of the concentration data at point Swat-11 was completed. It was determined that no reductions in metals concentrations are needed for Stumps Run at this time. Therefore, no TMDL for metals in Stumps Run is required at this time.

3. A mass balance of loading from Swat-04 and Swat-11 was completed to determine if there was any need for additional reductions as a result of combining the loads. No additional reductions were necessary.

4. The mass balance was expanded to include the Shadle Discharge (L-1). It was estimated that best available technology (BAT) requirements for the Shadle Discharge were adequate for iron and manganese. There is no BAT requirement for aluminum. A wasteload allocation was necessary for aluminum at point L-1.

There are no other known sources below the Shadle Discharge. However, there is additional flow from overland runoff and one unnamed tributary not impacted by mining. It is reasonable to assume that the additional flow provides assimilation capacity below point L-1, and no further analysis is needed downstream.

The calculations are detailed in the following section (Tables 1-8). Table 9 shows the allocations made on Lorberry Creek.

1. A series of four equations was used to determine if a reduction was needed at point Swat-04, and, if so the magnitude of the reduction.

Table 1. Equations Used for Rowe Tunnel Analysis (SWAT 04)

	Field Description	Equation	Explanation
1	Swat-04 Initial Concentration Value (Equation 1A)	= Risklognorm (Mean, St Dev)	This simulates the existing concentration of the sampled data.
2	Swat-04 % Reduction (from the 99th percentile of percent reduction)	= (Input a percentage based on reduction target)	This is the percent reduction for the discharge.
3	Swat-04 Final Concentration Value	= Sampled Value x (1-percent reduction)	This applies the given percent reduction to the initial concentration.
4	Swat-04 Reduction Target (PR)	= Maximum (0, 1- Cd/Cc)	This computes the necessary reduction, if needed, each time a value is sampled. The final reduction target is the 99th percentile value of this computed field.

2. The reduction target (PR) was computed taking the 99th percentile value of 5,000 iterations of the equation in row four of Table 1. The targeted percent reduction is shown, in boldface type, in the following table.

Table 2. Swat-04 Estimated Target Reductions			
Name	**Swat-04 Aluminum**	**Swat-04 Iron**	**Swat-04 Manganese**
Minimum =	0	0.4836	0
Maximum =	0.8675	0.9334	0.8762
Mean =	0.2184	0.8101	0.4750
Std. Deviation =	0.2204	0.0544	0.1719
Variance =	0.0486	0.0030	0.0296
Skewness =	0.5845	-0.8768	-0.7027
Kurtosis =	2.0895	4.3513	3.1715
Errors Calculated =	0	0	0
Targeted Reduction % =	**72.2**	**90.5**	**77.0**
Target #1 (Perc%)=	99	99	99

3. This PR value was used as the percent reduction in the equation in row three of Table 1. Testing was done to see that the water quality criterion for each metal was achieved at least 99 percent of the time. This verified the estimated percent reduction necessary for each metal. Table 3 shows, in boldface type, the percent of the time criteria for each metal was achieved during 5,000 iterations of the equation in row three of Table 1.

Table 3. Swat-04 Verification of Target Reductions			
Name	**Swat-04 Aluminum**	**Swat-04 Iron**	**Swat-04 Manganese**
Minimum =	0.0444	0.2614	0.1394
Maximum =	1.5282	2.0277	1.8575
Mean =	0.2729	0.7693	0.4871
Std Deviation =	0.1358	0.2204	0.1670
Variance =	0.0185	0.0486	0.0279
Skewness =	1.6229	0.8742	1.0996
Kurtosis =	8.0010	4.3255	5.4404
Errors Calculated =	0	0	0
Target #1 (value) (WQ Criteria)=	0.75	1.5	1
Target #1 (Perc%)=	**99.15**	**99.41**	**99.02**

4. These same four equations were applied to point Swat-11. The result was that no reduction was needed for any of the metals. Tables 4 and 5 show the reduction targets computed for, and the verification of, reduction targets for Swat-11.

Table 4. Swat-11 Estimated Target Reductions			
Name	**Swat-11 Aluminum**	**Swat-11 Iron**	**Swat-11 Manganese**
Minimum =	0.0000	0.0000	0.0000
Maximum =	0.6114	0.6426	0.0000
Mean =	0.0009	0.0009	0.0000
Std Deviation =	0.0183	0.0186	0.0000
Variance =	0.0003	0.0003	0.0000
Skewness =	24.0191	23.9120	0.0000
Kurtosis =	643.4102	641.0572	0.0000
Errors Calculated =	0	0	0
Targeted Reduction % =	**0**	**0**	**0**
Target #1 (Perc%) =	99	99	99

Table 5. Swat-11 Verification of Target Reductions			
Name	**Swat-11 Aluminum**	**Swat-11 Iron**	**Swat-11 Manganese**
Minimum =	0.0013	0.0031	0.0246
Maximum =	1.9302	4.1971	0.3234
Mean =	0.0842	0.1802	0.0941
Std Deviation =	0.1104	0.2268	0.0330
Variance =	0.0122	0.0514	0.0011
Skewness =	5.0496	4.9424	1.0893
Kurtosis =	48.9148	48.8124	5.1358
Errors Calculated =	0	0	0
WQ Criteria =	**0.75**	**1.5**	**1**
% of Time Criteria Achieved =	**99.63**	**99.60**	**100**

5. Table 6 shows variables used to express mass balance computations.

Table 6. Variable Descriptions for Lorberry Creek Calculations	
Description	**Variable Shown**
Flow from Swat-04	Q_{swat04}
Swat-04 Final Concentration	C_{swat04}
Flow from Swat-11	Q_{swat11}
Swat-11 Final Concentration	C_{swat11}
Concentration below Stumps Run	C_{stumps}
Flow from L-1 (Shadle Discharge)	Q_{L1}
Final Concentration From L-1	C_{L1}
Concentration below L-1	C_{allow}

6. Swat-04 and Swat-11 were mass balanced in the following manner:

   The majority of the sampling done at point Swat-11 was done in conjunction with point Swat-04 (20 matching sampling days). This allowed for the establishment of a significant correlation between the two flows (the R-squared value was 0.85). Swat-04 was used as the base flow, and a regression analysis on point Swat-11 provided an equation for use as the flow from Swat-11.

The flow from Swat-04 (Q_{swat04}) was set into an @RISK function so it could be used to simulate loading into the stream. The cumulative probability function was used for this random flow selection. The flow at Swat-04 is as follows (Equation 1):

$$Q_{swat04} = \text{RiskCumul(min,max,bin range, cumulative percent of occurrence)} \quad (1)$$

The RiskCumul function takes four arguments: minimum value, maximum value, the bin range from the histogram, and cumulative percent of occurrence.

The flow at Swat-11 was randomized using the equation developed through the regression analysis with point Swat-04 (Equation 2).

$$Q_{swat11} = Q_{swat}04 \text{ x } 0.142 + 0.088 \quad (2)$$

The mass balance equation is as follows (Equation 3):

$$C_{stumps} = ((Q_{swat04} * C_{swat04}) + (Q_{swat11} * C_{swat11}))/(Q_{swat04}+Q_{swat11}) \quad (3)$$

This equation was simulated through 5,000 iterations, and the 99th percentile value of the data set was compared to the water quality criteria to determine if standards had been met. The results show there is no further reduction needed for any of the metals at either point. The simulation results are shown in Table 7.

Table 7. Verification of Meeting Water Quality Standards Below Stumps Run

Name	Below Stumps Run Aluminum	Below Stumps Run Iron	Below Stumps Run Manganese
Minimum =	0.0457	0.2181	0.1362
Maximum =	1.2918	1.7553	1.2751
Mean =	0.2505	0.6995	0.4404
Std Deviation =	0.1206	0.1970	0.1470
Variance =	0.0145	0.0388	0.0216
Skewness =	1.6043	0.8681	1.0371
Kurtosis =	7.7226	4.2879	4.8121
Errors Calculated =	0	0	0
WQ Criteria =	**0.75**	**1.5**	**1**
% of Time Criteria Achieved =	**99.52**	**99.80**	**99.64**

7. The mass balance was expanded to determine if any reductions would be necessary at point L-1.

The Shadle Discharge originated in 1997, and very few data are available for it. The discharge will have to be treated or eliminated. It is the current site of a USGS test remediation project. The data that were available for the discharge were collected at a point prior to a settling pond. Currently, no data for effluent from the settling pond are available.

Modeling for iron and manganese started with the BAT-required concentration value. The current effluent variability based on limited sampling was kept at its present level. There was no BAT value for aluminum, so the starting concentration for the modeling was arbitrary. The BAT values for iron and manganese are 6 mg/l and 4 mg/l, respectively. Table 8 shows the BAT-adjusted values used for point L-1.

Table 8. L-1 Adjusted BAT Concentrations

Parameter	**Measured Value**		**BAT adjusted Value**	
	Average Conc.	*Standard Deviation*	*Average Conc.*	*Standard Deviation*
Iron	538.00	19.08	6.00	0.21
Manganese	33.93	2.14	4.00	0.25

The average flow (0.048 cfs) from the discharge will be used for modeling purposes. There were not any means to establish a correlation with point Swat-04.

The same set of four equations used for point Swat-04 was used for point L-1. The equation used for evaluation of point L-1 is as follows (Equation 4):

$$C_{allow} = ((Q_{swat04}*C_{swat04})+(Q_{swat11}*C_{swat11})+(Q_{L1}*C_{L1}))/(Q_{swat04}+Q_{swat11}+Q_{L1}) \qquad (4)$$

This equation was simulated through 5,000 iterations, and the 99th percentile value of the data set was compared to the water quality criteria to determine if standards had been met. It was estimated that an 81 percent reduction in aluminum concentration was needed for point L-1.

8. Table 9 shows the simulation results of the equation above.

Table 9. Verification of Meeting Water Quality Standards Below Point L-1			
Name	**Below L-1 Aluminum**	**Below L-1 Iron**	**Below L-1 Manganese**
Minimum =	0.0815	0.2711	0.1520
Maximum =	1.3189	2.2305	1.3689
Mean =	0.3369	0.7715	0.4888
Std Deviation =	0.1320	0.1978	0.1474
Variance =	0.0174	0.0391	0.0217
Skewness =	1.2259	0.8430	0.9635
Kurtosis =	5.8475	4.6019	4.7039
Errors Calculated =	0	0	0
WQ Criteria=	**0.75**	**1.5**	**1**
Percent of time achieved=	**99.02**	**99.68**	**99.48**

9. Table 10 presents the estimated reductions needed to meet water quality standards at all points in Lorberry Creek.

Table 10. Lorberry Creek Summary						
		Measured Sample Data		**Allowable**		**Reduction Identified**
Station	Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)	%
Swat 04						
	Al	1.01	21.45	0.27	5.79	73%
	Fe	8.55	181.45	0.77	16.33	91%
	Mn	2.12	44.95	0.49	10.34	77%
Swat 11						
	Al	0.08	0.24	0.08	0.24	0%
	Fe	0.18	0.51	0.18	0.51	00%
	Mn	0.09	0.27	0.09	0.27	00%
L-1						
	Al	34.90	9.03	6.63	1.71	81%
	Fe	6.00	1.55	6.00	1.55	0%
	Mn	4.00	1.03	4.00	1.03	0%

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

The TMDL for Lorberry Creek requires that a load allocation be made to the Rowe Tunnel Discharge (Swat-04) for the three metals listed, and that a wasteload allocation is made to the Shadle Discharge (L-1) for aluminum. There is no TMDL for metals required for Stumps Run (Swat-11) at this time.

Margin of Safety

For this study, the margin of safety is applied implicitly. 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:

- None of the data sets were filtered by taking out extreme measurements. Because the 99 percent level of protection is designed to protect for the extreme event, it was pertinent not to filter the data set.

- Effluent variability plays a major role in determining the average value that will meet water quality criteria over the long term. This analysis maintained that the variability at each point would remain the same. The general assumption can be made that a treated discharge would be less variable than an untreated discharge. This implicitly builds in another margin of safety.

Attachment D
TMDLs By Segment

There are two main contributors to the impairment of Seaton Creek, deep mining on the Brookville coal strip and strip mining on the Middle Kittanning coal. Discharges from an abandoned Brookville deep mine near Erico Bridge, at times, produce over 1000 gpm of acid mine drainage. Discharge near DeSale from abandoned strip mining on the Middle Kittanning contribute another 500 gpm of acid mine drainage more polluted than the Erico Bridge discharges.

On Murrin Run, the main contributor to the impairment is the pre-Act strip mining on the Middle Kittanning coal seam. The Vanport limestone is found in this area and is most likely responsible for the buffering capacity observed at sample point 13. Between sample points 13 and 18, abandoned Brookville deep mine discharge ~200 gpm acid mine drainage.

TMDLs for sample points 4, 11, 12, 13, and 19 were not done because only one flow (zero flows at 19) datum was available at each of these sample points. Concentration data for these points is located in Appendix F.

<u>Waste Load Allocation – Mining permit SMP 10803018</u>

The waste load allocation for mining permit SMP 10803018 was determined from measured flow data and the monthly average permit limits for iron and manganese. The following table shows the waste load allocaton.

Parameter	Allowable Average Monthly Conc. (mg/l)	Average Flow (MGD)	Allowable Load (lbs/day)
Fe	3.0	0.0103	0.258
Mn	2.0	0.0103	0.172
Al	2.0	0.0103	0.172

Murrin Run – Above Sample Point 6

<u>TMDL calculations</u>

The TMDL for this tributary to Murrin Run consists of a load allocation to all of the area above sampling point 6 (Attachment A). Addressing the mining impacts above this point addresses the impairment for the entire stream segment to its headwaters.

There is currently no entry for this segment on the Pa Section 303(d) list for impairment due to pH. However sample data at point 6 shows pH ranging between 4.6 and 6.7; pH will be addressed as part of this TMDL because of the mining impacts. The objective is to reduce acid loading to the stream, which will in turn raise the pH to the desired 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.

The load allocation for this stream segment was computed using water-quality sample data collected at point 6. The average flow measurement (1.10 mgd) was used to derive loading values for the TMDL.

An allowable long-term average in-stream concentration was determined at point 6 for 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. The following Table shows the load allocations for this stream segment. The following table shows the load allocations for this sample point.

Table D1. Murrin Run Sample Point 6

	Measured Sample Data		Allowable		Reduction Identified
Parameter	Conc (mg/l)	Load (lbs/day)	LTA conc (mg/l)	Load (lbs/day)	%
Al	6.56	60.3	0.33	3.0	95
Fe	0.79	7.3	0.79	7.3	4
Mn	13.91	127.9	0.56	5.1	96
Acidity	48.84	449.1	6.84	62.9	86
Alkalinity	17.48	160.7			

The allowable loading values shown in Table D1 represent load allocations made at point 6.

Murrin Run – Above Sample Point 9

<u>TMDL Calculations</u>

This TMDL for Murrin Run consists of a load allocation to all of the area above sample point 9 shown in Attachment A. Addressing the mining impacts above this point addresses the impairment for the entire stream segment to its headwaters.

There is currently no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point 9 shows pH ranging between 4.7 and 6.5; pH will be addressed as part of this TMDL because of the mining impacts. The objective is to reduce acid loading to the stream, which will in turn raise the pH. 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.

The load allocation for this stream segment was computed using water-quality sample data collected at sample point 9. The average flow measurement (1.17 mgd) was used to derive loading values for the TMDL.

An allowable long-term average in-stream concentration was determined at point 9 for 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. The following table shows the load allocations for this stream segment.

Table D2. Murrin Run Sample Point 9

	Measured Sample Data		Allowable		Reduction Identified
Parameter	Conc (mg/l)	Load (lbs/day)	LTA conc (mg/l)	Load (lbs/day)	%
Al	2.78	27.1	0.14	1.4	95
Fe	0.89	8.7	0.89	8.7	0
Mn	14.08	137.1	0.42	4.1	97
Acidity	37.19	362.1	5.58	54.3	85
Alkalinity	17.86	173.9			

The allowable loading values shown in Table D2 represent load allocations made at point 9.

Murrin Run – TMDL Calculations (Sample Point 18)

The TMDL for Murrin Run, sampling point 18, consists of a load allocation to all of the area between stream monitoring point 18 and 9. The load allocation for this stream segment was computed using water quality/quantity data collected for surface mine permit applications for operations in the study area. Evaluating the mining impacts at point 18, addresses the impairment for this area of Murrin Run. This was based on the sample data for this point and did not account for any load reductions already specified from upstream sources. The load reductions from points 6 and 9, were summed and represent the upstream load reductions. The upstream load reduction was subtracted from the existing load at point 18, and was compared to the allowable load at 18 for each parameter, to determine if any further reductions were needed at this point.

There is currently no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point 18 shows pH ranging between 4.3 and 6.7; pH will be addressed as part of this TMDL because of the mining impacts. The objective is to reduce acid loading to the stream, which will in turn raise the pH. Acidity at sample point 18 will be used in this analysis because the pH is lower. 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.

The load allocation for this stream segment was computed using water-quality sample data collected at point 18. The average flow (3.67 mgd) for this point was used to derive loading values for the TMDL.

An allowable long-term average in-stream concentration was determined at point 18 for iron. 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.

Table D3. Murrin Run Sample Point 18

	Measured Sample Data		Allowable	
Parameter	Conc (mg/l)	Load (lbs/day)	LTAConc (mg/l)	Load (lbs/day)
Al	1.03	31.6	0.16	5.1
Fe	0.90	27.6	0.69	21.5
Mn	6.08	186.4	0.43	13.0
Acidity	3.30	101.1	3.30	101.1
Alkalinity	37.90	1161.7		

Murrin Run upstream of 18 is adversely affected by AMD and one or more allocations may be necessary at 18. In an effort to determine if there is a need for any allocations at this point the following procedure was used.

The loading reductions for points 6 and 9, were summed to show the total load that was removed from upstream sources. This value, for each parameter, was then subtracted from the existing load at point 18. This value was then compared to the allowable load at point 18. Reductions at point 18 are necessary for any parameter that exceeded the allowable load at this point. Table D4 shows a summary of all loads that affect point 18. Table D5 illustrates the necessary reductions at point 18. The results of this analysis show that a reduction for iron is necessary at this point.

Table D4. Summary of All Loads that Affect 18				
	Al (#/day)	**Fe (#/day)**	**Mn (#/day)**	**Acidity (#/day)**
Murrin Run (6)				
load reduction=	57.3	0.0	122.8	386.2
Murrin Run (9)				
load reduction=	25.7	0.0	133.0	307.8

Table D5. Necessary Reductions at Sample Point 18				
	Al (#/day)	**Fe (#/day)**	**Mn (#/day)**	**Acidity (#/day)**
Existing Loads at 18	31.6	27.6	186.4	101.1
Total Load Reduction (Sum of 6 &9)	83.0	0.0	255.8	694.0
Remaining Load (Existing Loads at 18 – TLR Sum)	NA	27.6	NA	NA
Allowable Loads at 18	5.1	21.2	13.0	101.1
Percent Reduction	NA	23	NA	NA
Additional Removal Required at 18	NA	6.4	NA	NA

The load allocation for this sample point was computed using water-quality sample data collected at point 18 and the allowable loads from 6 and 9. The average flow, measured at sample point 18, is used for these computations. The TMDL for 18 consists of a load allocation for iron to all of the area upstream of 18 shown in Attachment A. The Percent Reduction in Table 5, above, is calculated (refer to Table D5):

$$\left[1-\left(\frac{\text{Allowable Loads at 18}}{\text{Remaining Load (Existing Loads at 18 - TLR Sum}}\right)\right]\times 100\,\%$$

No additional loading reductions were necessary for aluminum, manganese, or acidity.

Seaton Creek Unnamed Tributary – Above Sample Point 23

<u>TMDL calculations</u>

The TMDL for Seaton Creek consists of a load allocation to all of the area above the point 23 shown in Attachment A. Addressing the mining impacts above this point addresses the impairment for the entire stream segment to its headwaters.

There is currently no entry for this segment on the Pa Section 303(d) list for impairment due to pH. No sample data is available above point 23 to establish an upstream pH value. Sample data at point 23 shows pH ranging between 2.9 and 4.3; pH will be addressed as part of this TMDL because the cause of impairment for Seaton Creek is pH and metals. The objective is to reduce acid loading to the stream, which will in turn raise the pH. 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.

The load allocation for this stream segment was computed using water-quality sample data collected at point 23. The average flow measurement (0.26 MGD) for point 23 was used to derive the loading values for the TMDL.

An allowable long-term average in-stream concentration was determined at point 23 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, 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. The following table shows the load allocations for this stream segment

Table D6. Seaton Creek Sample Point 23

	Measured Sample Data		Allowable		Reduction Identified
Parameter	Conc (mg/l)	Load (lbs/day)	LTA conc (mg/l)	Load (lbs/day)	%
Al	7.59	16.6	0.30	0.7	96
Fe	9.83	21.5	0.59	1.3	94
Mn	38.97	85.3	0.39	0.9	99
Acidity	191.88	419.8	0.10	0.2	100
Alkalinity	0.28	0.6			

The allowable loading values shown in Table D6 represent load allocations made at point 23.

Seaton Creek – Above Sample Point 25

<u>TMDL Calculations</u>

The TMDL for Seaton Creek consists of a load allocation to all of the area above the point 25 shown in Attachment A. Addressing the mining impacts above this point addresses the impairment for the entire stream segment to its headwaters.

There is currently no entry for this segment on the Pa Section 303(d) list for impairment due to pH. However sample data at point 25 shows pH ranging between 3.1 and 5.2; pH will be addressed as part of this TMDL because of the mining impacts. 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.

The load allocation for this stream segment was computed using water-quality sample data collected at point 25. The average flow measurement (0.15 MGD) for point 25 was used to derive loading values for the TMDL.

An allowable long-term average in-stream concentration was determined at point 25 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, 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. The following table shows the load allocations for this stream segment.

Table D7. Seaton Creek Sample Point 25

	Measured Sample Data		Allowable		Reduction Identified
Parameter	Conc (mg/l)	Load (lbs/day)	LTA conc (mg/l)	Load (lbs/day)	%
Al	14.47	18.1	0.43	0.5	97
Fe	12.88	16.1	0.39	0.5	97
Mn	38.79	48.5	0.39	0.5	99
Acidity	235.00	293.8	0.14	0.2	100
Alkalinity	0.31	0.4			

The allowable loading values shown in Table D7 represent load allocations made at point 25.

Seaton Creek Unnamed Tributary – Above Sample Point 30

TMDL Calculations

The TMDL for Seaton Creek consists of a load allocation to all of the area above the point 30 shown in Attachment A. Addressing the mining impacts above this point addresses the impairment for the entire stream segment to its headwaters.

There is currently no entry for this segment on the Pa Section 303(d) list for impairment due to pH. However sample data at point 30 shows pH ranging between 5.8 and 6.3; pH will be addressed as part of this TMDL because of the mining impacts. 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.

The load allocation for this stream segment was computed using water-quality sample data collected at point 30. The average flow measurement (0.09MGD) for point 30 was used to derive loading values for the TMDL.

An allowable long-term average in-stream concentration was determined at point 30 for manganese. 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. The following table shows the load allocations for this stream segment.

Table D8. Seaton Creek Sample Point 30

	Measured Sample Data		Allowable		Reduction Identified
Parameter	Conc (mg/l)	Load (lbs/day)	LTA conc (mg/l)	Load (lbs/day)	%
Al	0.25	0.2	0.25	0.2	0
Fe	0.15	0.1	0.15	0.1	0
Mn	2.28	1.7	0.32	0.2	86
Acidity	0.65	0.5	0.65	0.5	0
Alkalinity	11.9	8.9			

The allowable loading values shown in Table D8 represent load allocations made at point 30.

Seaton Creek – TMDL Calculations (Sample Point 48)

The TMDL for Seaton Creek, sampling point 48, consists of a load allocation to all of the area between stream monitoring points 23, 25, and 30. The load allocation for this stream segment was computed using water quality/quantity data collected for surface mine permit applications for operations in the study area. Evaluating the mining impacts at point 48, addresses the impairment for this area of Seaton Creek. This was based on the sample data for this point and did not account for any load reductions already specified from upstream sources. The load reductions from points 23, 25, and 30, were summed and represent the upstream load reductions. The upstream load reduction was subtracted from the existing load at point 48, and was compared to the allowable load at 48 for each parameter, to determine if any further reductions were needed at this point.

There is currently an entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point 48 shows pH ranging between 4.4 and 5.8; pH will be addressed as part of this TMDL because of the mining impacts. The objective is to reduce acid loading to the stream, which will in turn raise the pH. The result of this analysis is an acid loading reduction that equates to meeting standards for pH (see TMDL Endpoints section in the report, Table 2). The method and rationale for addressing pH is contained in Attachment B.

The load allocation for this stream segment was computed using water-quality sample data collected at point 48. The average flow (1.67 mgd) for this point was used to derive loading values for the TMDL.

An allowable long-term average in-stream concentration was determined at point 48 for aluminum and manganese. 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.

Table D9. Seaton Creek Point 48				
	Measured Sample Data		Allowable	
Parameter	Conc (mg/l)	Load (lbs/day)	LTAConc (mg/l)	Load (lbs/day)
Al	3.65	50.9	0.22	3.1
Fe	0.77	10.7	0.22	3.0
Mn	13.66	190.5	0.41	5.7
Acidity	48.47	675.8	2.42	33.8
Alkalinity	9.41	131.2		

Seaton Creek upstream of 48 is adversely affected by AMD and one or more allocations may be necessary at 48. In an effort to determine if there is a need for any allocations at this point the following procedure was used.

The loading reductions for points 23, 25, and 30 were summed to show the total load that was removed from upstream sources. This value, for each parameter, was then subtracted from the existing load at point 48. This value was then compared to the allowable load at point 48. Reductions at point 48 are necessary for any parameter that exceeded the allowable load at this point. Table D10 shows a summary of all loads that affect point 48. Table D11 illustrates the necessary reductions at point 48. The results of this analysis show that reductions for aluminum and manganese are necessary at this point.

Table D10. Summary of All Loads that Affect 48				
	Al (#/day)	**Fe (#/day)**	**Mn (#/day)**	**Acidity (#/day)**
Seaton Creek (23)				
load reduction=	16.3	20.9	84.9	419.7
Seaton Creek (25)				
load reduction=	17.6	15.6	48.0	293.6
Seaton Creek (30)				
load reduction=	0.0	0.0	1.5	0.0

Table D11. Necessary Reductions at Sample Point 48				
	Al (#/day)	Fe (#/day)	Mn (#/day)	Acidity (#/day)
Existing Loads at 48	50.9	10.7	190.5	675.8
Total Load Reduction (Sum of 23, 25, & 30)	33.9	36.5	134.4	713.3
Remaining Load (Existing Loads at 48 – TLR Sum)	17.0	NA	56.1	NA
Allowable Loads at 48	3.1	3.0	5.7	33.8
Percent Reduction	82	NA	90	NA
Additional Removal Required at 48	13.9	NA	50.4	NA

The load allocation for this sample point was computed using water-quality sample data collected at point 48 and the allowable loads from 23, 25, and 30. The average flow, measured at sample point 48, is used for these computations. The TMDL for 48 consists of load allocations for aluminum and manganese to all of the area upstream of 48 shown in Attachment A. The Percent Reduction in Table 11, above, is calculated (refer to Table D11):

$$\left[1-\left(\frac{\text{Allowable Loads at 48}}{\text{Remaining Load (Existing Loads at 48 - TLR Sum}}\right)\right]\times 100\%$$

No additional loading reductions were necessary for iron and acidity.

Seaton Creek – TMDL Calculations (Sample Point 68)

The TMDL for Seaton Creek, sampling point 68, consists of a load allocation to all of the area between stream monitoring points 48 and 68. The load allocation for this stream segment was computed using water quality/quantity data collected for surface mine permit applications for operations in the study area. Evaluating the mining impacts at point 68, addresses the impairment for this area of Seaton Creek. This was based on the sample data for this point and did not account for any load reductions already specified from upstream sources. The load reductions from points 6, 9, 18, 23, 25, 30, and 48 were summed and represent the upstream load reductions. The upstream load reduction was subtracted from the existing load at point 68, and was compared to the allowable load at 68 for each parameter, to determine if any further reductions were needed at this point.

There is currently an entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point 68 shows pH ranging between 5.2 and 6.3; pH will be addressed as part of this TMDL because of the mining impacts. The objective is to reduce acid loading to the stream, which will in turn raise the pH. The result of this analysis is an acid loading reduction that equates to meeting standards for pH (see TMDL Endpoints in the report, Table 2). The method and rationale for addressing pH is contained in Attachment B.

The load allocation for this stream segment was computed using water-quality sample data collected at point 68. The average flow (6.05 mgd) for this point was used to derive loading values for the TMDL.

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.

Table D12. Seaton Creek Point 68

	Measured Sample Data		Allowable	
Parameter	Conc (mg/l)	Load (lbs/day)	LTAConc (mg/l)	Load (lbs/day)
Al	0.61	54.4	0.16	14.2
Fe	1.15	102.6	0.41	36.9
Mn	7.58	676.5	0.30	27.1
Acidity	10.79	963.0	1.08	96.3
Alkalinity	17.32	1545.8		

Seaton Creek upstream of 68 is adversely affected by AMD and one or more allocations may be necessary at 68. In an effort to determine if there is a need for any allocations at this point the following procedure was used.

The loading reductions for points 6, 9, 18, 23, 25, 30, and 48 were summed to show the total load that was removed from upstream sources. This value, for each parameter, was then subtracted from the existing load at point 68. This value was then compared to the allowable load at point 68. Reductions at point 68 are necessary for any parameter that exceeded the allowable load at this point. Table D13 shows a summary of all loads that affect point 68. Table D14 illustrates the necessary reductions at point 68. The results of this analysis show that reductions for iron and manganese are necessary at this point.

Table D13. Summary of All Loads that Affect 68				
	Al (#/day)	Fe (#/day)	Mn (#/day)	Acidity (#/day)
Murrin Run (6 & 9)				
load reduction=	83.0	0.3	256.0	694.0
Murrin Run (18)				
load reduction=	0.0	6.1	0.0	0.0
Seaton Creek (23, 25, & 30)				
load reduction=	33.9	36.5	134.4	713.3
Seaton Creek (48				
load reduction=	13.9	0.0	50.4	0.0

Table D14. Necessary Reductions at Sample Point 68				
	Al (#/day)	Fe (#/day)	Mn (#/day)	Acidity (#/day)
Existing Loads at 68	54.4	102.6	676.5	963.0
Total Load Reduction (Sum of 6, 9, 18, 23, 25, 30, & 48)	130.8	42.9	440.8	1407.3
Remaining Load (Existing Loads at 68 – TLR Sum)	NA	59.7	235.7	NA
Allowable Loads at 68	14.2	36.9	27.1	96.3
Percent Reduction	NA	38	89	NA
Additional Removal Required at 68	NA	22.8	208.6	NA

No additional loading reductions were necessary for aluminum and acidity.

Seaton Creek Unnamed Tributary – Above Sample Point 40

TMDL calculations

The TMDL for Seaton Creek consists of a load allocation to all of the area above the point 40 shown in Attachment A. Addressing the mining impacts above this point addresses the impairment for the entire stream segment to its headwaters.

There is currently no entry for this segment on the Pa Section 303(d) list for impairment due to pH. No sample data is available above point 40 to establish an upstream pH value. Sample data at point 40 shows pH ranging between 4.2 and 6.1; pH will be addressed as part of this TMDL because of the mining impacts. The objective is to reduce acid loading to the stream, which will in turn raise the pH. 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.

The load allocation for this stream segment was computed using water-quality sample data collected at point 40. The average flow measurement (0.24 MGD) for point 40 was used to derive the loading values for the TMDL.

An allowable long-term average in-stream concentration was determined at point 40 for 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. The following table shows the load allocations for this stream segment

Table D15. Seaton Creek Point 40

	Measured Sample Data		Allowable		Reduction Identified
Parameter	Conc (mg/l)	Load (lbs/day)	LTA conc (mg/l)	Load (lbs/day)	%
Al	7.67	15.5	0.23	0.5	97
Fe	0.15	0.3	0.15	0.3	0
Mn	23.96	48.4	0.24	0.5	99
Acidity	96.25	194.4	2.89	5.8	97
Alkalinity	8.44	17.2			

The allowable loading values shown in Table D15 represent load allocations made at point 40.

Margin of Safety

PADEP used an implicit MOS in these TMDLs derived from the Monte Carlo statistical analysis. The Water Quality standard states that water quality criteria must be met at least 99% of the time. All of the @Risk analyses results surpass the minimum 99% level of protection. Other margins of safety used for this TMDL analysis include the following:

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

- A MOS is also the fact that the calculations were 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 E

Excerpts Justifying Changes Between the 1996, 1998, and Draft 2000 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 draft 2000 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).

The most notable difference between the 1998 and Draft 2000 Section 303(d) lists are the listing of unnamed tributaries in 2000. In 1998, the GIS stream layer was coded to the named stream level so there was no way to identify the unnamed tributary records. As a result, the unnamed tributaries were listed as part of the first downstream named stream. The GIS stream coverage used to generate the 2000 list had the unnamed tributaries coded with the DEP's five-digit stream code. As a result, the unnamed tributary records are now split out as separate records on the 2000 Section 303(d) list. This is the reason for the change in the appearance of the list and the noticeable increase in the number of pages.

Attachment F
Water Quality Data Used In TMDL Calculations

Sample Site 6

DATE COLLECTED	FINAL FLOW	PH pH units	ALK MG/L	Hot A MG/L	FE MG/L	MN MG/L	AL MG/L	SO4 MG/L
----------	-------	--------	--------		--------	--------	--------	--------
7/10/1996		6.3	36	11.4	0.936	12.1	3.44	611
8/14/1996		6.7	46	0	1.02	11.5	2.7	615.7
9/11/1996		4.8	8.8	66	1.09	14.3	7.34	508.7
10/8/1996		5.1	10.8	58	1.37	16.2	5.65	664.7
11/19/1996		4.8	9.2	64	0.669	13.9	7.18	466.6
12/12/1996		4.7	8.8	44	0.405	8.49	5.6	277.4
1/8/1997	790	4.8	11.4	66	0.715	14.5	9.02	612.6
2/11/1997		4.9	12	52	0.667	13.7	7.29	578.1
3/11/1997		4.6	9.8	72	0.422	11.9	8.31	384.9
4/15/1997		4.7	12.2	86	0.581	17.9	10.7	823.4
5/13/1997		4.9	11.2	66	0.66	15.2	5.23	671.6
7/10/1997		6.4	38	28				677
10/9/1997		6	32	24	1.38	13.7	1.41	654.1
2/3/1998		5	12.6	36	0.662	17	9.67	523.8
4/15/1998		4.6	10.4	60	0.447	11.1	7.46	380.5
5/3/2000	740	5	10.4	48	0.784	17.1	7.45	548
Avg=	765		17.48	48.84	0.79	13.91	6.56	
Stdev=			12.57	23.49	0.31	2.58	2.59	

Sample Site 9

DATE COLLECTED	FINAL FLOW	PH pH units	ALK MG/L	Hot A MG/L	FE MG/L	MN MG/L	AL MG/L	SO4 MG/L
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7/10/1996		6.2	32	26	1.17	16.4	1	768.2
8/14/1996		6.5	44	0	1.73	16.7	0.25	839.9
9/11/1996		5.9	14.8	38	1.28	14.6	0.25	646.7
10/8/1996		6.2	19.8	34	1.02	13.3	1.74	828.7
11/19/1996		4.9	8.6	50	0.743	13.3	4.04	531.5
12/12/1996		6	13.2	9	0.406	3.65	1.71	140.3
1/8/1997	1150	4.9	11.2	50	0.714	14.3	4.62	593.6
2/11/1997		5	11.4	32	0.676	13.2	4.15	595.9
3/11/1997		4.8	9.8	56	0.412	10.1	5.23	364.1
4/15/1997		4.7	12.8	100	0.607	21.8	11	685.6
5/13/1997		5	11.6	56	0.708	15.3	2.61	632.5
7/10/1997		6.4	34	34	1.67	17.3	0.25	721.8
10/9/1997		6.2	30	26	1.11	13.1	0.25	697.3
2/3/1998		5	12	24	1.03	16.9	4.17	570.2
4/15/1998		4.9	10	26	0.442	7.18	2.17	258.9
5/3/2000	470	5.3	10.6	34	0.545	18.1	1.11	686
Avg=	810		17.86	37.19	0.89	14.08	2.78	
Stdev=			10.88	22.75	0.42	4.35	2.79	

Sample Site 18

DATE	FINAL	PH	ALK	Hot A	FE	MN	AL	SO4
COLLECTED	FLOW	pH units	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
----------	-------	--------	--------		--------	--------	--------	--------
7/10/1996		6.3	46	0	1.37	6.22	0.516	394.5
8/14/1996		6.5	52	0	0.967	5.45	0.25	487.3
9/11/1996		6.5	34	0	0.751	5.32	0.25	290.5
10/8/1996		6.7	48	0	0.747	4.66	0.62	327.1
11/19/1996		6.4	28	0.8	0.843	5.55	1.02	310.3
12/11/1996		6.3	28	28				327
1/15/1997		6.4	34	2	1.16	7.52	1.92	606.7
2/11/1997		6.4	28	0	0.805	5.81	1.7	354
3/11/1997		6.2	16.4	10.8	0.857	4.96	2.81	248.8
4/15/1997		6	16.2	12	0.721	7.41	2.44	316.6
4/24/1997		6.3	28	0	1.76	7.9	0.924	388.8
5/13/1997		6.5	34	0	0.666	6.32	0.514	459.8
7/10/1997		6.7	58	0	0.907	6.1	0.25	451.4
7/16/1997		6.5	62	0	0.697	4.69	0.25	478.2
1/30/1998		6	24	0	1.24	8.05	3.21	405.2
4/15/1998		5.7	12	6.6	0.675	4.77	1.65	228.2
6/2/1998		6.5	38	10.2	0.84	12.7	0.25	529
7/28/1998		6.5	46	0				683.9
11/5/1998		6.6	68	0				438
3/24/1999		6.3	26	0				345
6/17/1999		6.6	44	0				510
9/1/1999		6.6	54	0				512
12/21/1999		4.3	6.6	0	0.15	1.24	1.83	202
2/10/2000		6.6	66	18.6	1.39	4.87	0.531	623.9
3/30/2000	1900	6.3	34	0	0.787	3.88	0.25	367.6
5/10/2000	3200	6.6	36	0	0.782	8.25	0.25	
average	2550		37.20	3.30	0.91	6.08	1.07	
stdev			16.46	6.93	0.34	2.27	0.96	

Sample Site 23

DATE COLLECTED	FINAL FLOW	PH pH units	ALK MG/L	Hot A MG/L	FE MG/L	MN MG/L	AL MG/L	SO4 MG/L
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7/31/1996		3.1	0	262	9.81	50.8	8.64	1132
8/29/1996		3.1	0	334	13	63.2	11	1418.4
9/18/1996		3.6	0	86	3.73	16.3	2.81	399
10/24/1996		3.7	0	80	3.64	19.4	3.68	535.4
11/26/1996		4.3	6.4	46	2.3	9.88	2.04	198.2
3/21/1997		3.6	0	144	7.44	28.3	6.24	696.2
6/10/1997		3.2	0	216	9.82	39.6	7.38	897.9
7/10/1997		3.1	0	342	17.4	61.2	11	1203.3
8/12/1997		3	0	410	18.2	69.8	12.4	1577
10/9/1997		3.3	0	220	10.5	40.9	7.08	900.1
11/18/1997		3.7	0	118	8.69	23	4.45	596.6
12/23/1997	150	3.8	0	70	4.8	15.7	3.31	372.6
1/7/1998		3.6	0	112	5.89	23	4.67	549.8
2/10/1998	60	3.5	0	166	11.3	34.2	6.83	732.8
3/5/1998	450	3.6	0	128	8.21	26	5.06	650.4
3/19/1998		3.6	0	96	6.23	19.9	3.96	471.1
4/9/1998		3.8	0	110	9.05	24.3	6.82	568.1
5/19/1998		3.4	0	182	9.47	35.3	15	857.4
7/7/1998		3.2	0	230	12.8	54	9.34	1096.8
9/24/1998		2.9	0	306	20.9	69.2	12.6	1659
10/14/1998		3.2	0	294	16.3	59.1	10.6	1304.2
1/26/1999	50	4.1	3.2	28	3.53	9.96	2.31	239.9
3/23/1999		3.6	0	102	5.93	26.6	5.7	417.8
5/18/1999		3.3	0	204	8.55	47.2	8.84	973
6/24/1999		3.2	0	240	9.25	51.6	9.24	1185.4
7/8/1999		3.1	0	324	11.7	58.2	10.4	1432.4
8/20/1999		3	0	224	11.5	60.9	11.1	1526
9/9/1999		3.1	0	278	12.5	64.9	11.7	1647.5
11/12/1999		3.2	0	320	12	51.3	9.3	1153.2
1/20/2000		3.5	0	154	15.9	36	6.78	1026.6
2/10/2000		3.4	0	230	14.6	42	8.19	1153
3/8/2000		3.4	0	128	4.7	25.6	5.16	573.1
4/25/2000		3.5	0	148	6.1	32.8	7.26	769.9
5/16/2000	200	3.4	0	192	8.38	34.7	7.24	
Avg=	182		0.28	191.88	9.83	38.97	7.59	
Stdev=			1.21	96.11	4.56	17.89	3.26	

Sample Site 25

DATE COLLECTED	FINAL FLOW	PH pH units	ALK MG/L	Hot A MG/L	FE MG/L	MN MG/L	AL MG/L	SO4 MG/L
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7/31/1996		3.2	0	264	6.27	39.5	15.4	792
8/29/1996		3.2	0	304	7.81	45.9	19.2	1187.7
9/18/1996		3.2	0	222	7.17	30.7	11.5	737
10/24/1996		3.4	0	190	10.1	34.7	13	767.3
11/26/1996		5.2	11	30	1.87	6.19	2.78	147.7
1/6/1997		3.4	0	184	7.86	27.1	11.2	867.2
6/10/1997		3.1	0	276	9.19	36.8	13.8	880.4
7/10/1997		3.1	0	302	9.94	45.1	17.1	781.5
8/12/1997		3.1	0	322	8.24	46.4	18.7	946.7
10/9/1997		3.1	0	328	12.2	49	19	1043.1
11/18/1997		3.4	0	298	13.8	41.1	17.4	1008
12/23/1997	150	3.6	0	142	6.67	23.1	10.2	501.1
1/7/1998		3.3	0	226	10.7	34.2	12.9	1235.5
2/10/1998	80	3.4	0	226	11.9	32.9	13.8	721
3/5/1998	190	3.3	0	210	10.8	31.9	12.5	769.8
3/19/1998		3.3	0	160	8.56	27.7	11	724.3
4/9/1998		3.5	0	178	19.7	30.1	13.4	711.7
5/19/1998		3.3	0	186	9.13	37.5	7.02	816.7
7/7/1998		3.2	0	246	9.26	44.1	18.1	988.8
9/24/1998		3.2	0	266	8.3	48.3	21.4	1122.1
10/14/1998		3.3	0	252	9.64	52.9	24.1	1025.2
1/26/1999	50	3.5	0	142	11.4	31.6	12.7	716.8
3/23/1999		3.4	0	162	8.02	32	13.5	555.1
5/18/1999		3.3	0	184	5.34	33.2	13.7	708.2
6/24/1999		3.3	0	198	5.61	34.1	13.2	883.2
7/8/1999	50	3.2	0	274	8.12	42.2	16.3	882
8/20/1999		3.1	0	232	25.6	56.8	16.9	1354
9/9/1999		3.2	0	286	30.1	59	16	1415.7
10/13/1999		3.1	0	362				1244.3
11/12/1999		3.2	0	442	29.6	55.5	16.4	1650.7
12/28/1999		3.4	0	240	28	52.8	18.1	921.6
1/20/2000		3.4	0	216	30.7	46.4	14.1	1051.7
2/10/2000		3.4	0	296	27.2	42.9	13.2	1250
3/8/2000		3.3	0	212				839
4/25/2000		3.5	0	170	16.3	28.4	9.81	695.4
average	104		0.31	235.09	12.88	38.79	14.47	
stdev			1.86	74.91	8.16	11.13	4.11	

Sample Site 30

DATE COLLECTED	FINAL FLOW	PH pH units	ALK MG/L	Hot A MG/L	FE MG/L	MN MG/L	AL MG/L	SO4 MG/L
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2/25/1999	80	5.8	11.2	0	0.15	2	0.25	39.9
11/12/1999		5.9	11.2	2	0.15	3.98	0.25	146.5
3/8/2000		6	10.4	0.6	0.15	0.828	0.25	46
4/25/2000	45	6.3	14.8	0	0.15	2.33	0.25	88.6
average	62.5		11.90	0.65	0.15	2.28	0.25	
stdev			1.97	0.94	0.00	1.30	0.00	

Sample Site 48

DATE COLLECTED	FINAL FLOW	PH pH units	ALK MG/L	Hot A MG/L	FE MG/L	MN MG/L	AL MG/L	SO4 MG/L
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7/9/1996		4.6	9.4	76	0.741	21.6	7.05	626.8
8/15/1996		4.6	9	102	0.524	20	5.78	732.6
9/10/1996		5.8	14.8	24	0.69	8.01	0.925	110.3
11/20/1996		5.6	7.2	13.8	0.15	4.61	1.31	132.1
1/23/1997		4.6	8.8	58	0.889	11	3.6	300
2/27/1997		4.6	8	22	0.59	7.85	2.16	207
3/19/1997		4.6	10	54	0.639	11.7	4.32	401.7
5/20/1997		4.6	9	70	0.335	14.5	4.06	416.7
8/6/1997		4.4	7.4	94	4.69	26.6	7.97	703
10/9/1997		4.7	10	72	0.481	18.3	4.08	575.5
1/7/1998		4.7	9.8	24	0.15	12	3.56	331.2
5/14/1998		4.7	9	48	0.15	11.7	3.73	332.3
3/30/2000	1270	5	9.2	5.4	0.15	8.93	0.891	296.4
5/10/2000	1050	4.9	10.2	15.4	0.633	14.5	1.7	366.3
average	1160		9.41	48.47	0.77	13.66	3.65	
stdev			1.81	31.48	1.15	6.08	2.19	

Sample Site 68

DATE COLLECTED	FINAL FLOW	PH pH units	ALK MG/L	Hot A MG/L	FE MG/L	MN MG/L	AL MG/L	SO4 MG/L
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7/10/1996		6.2	13.8	24	0.515	11.8	0.25	546.5
7/31/1996		5.9	11.8	36	0.451	14.1	0.25	590.3
10/16/1996		6.3	22	15.8	0.457	10	0.25	487.6
11/15/1996		6.2	13	3.4	0.728	0.337	0.25	71.4
11/26/1996		5.8	12.4	24	1.7	7.4	1.13	267.8
1/6/1997		5.2	8.8	2.2	1.13	9.11	2.03	322.1
3/12/1997	14500	5.5	10	24	1.04	7.15	1.74	296.4
9/30/1997		6	17.8	0	0.969	0.703	0.25	180.4
1/8/1998	6800	5.4	10.8	11.2	1.29	9.42	1.29	354
3/6/1998		6.1	14	1	0.375	0.685	0.25	97.5
5/14/1998		5.5	10	24	1.06	9.38	1.08	386.7
6/9/1998		6.3	22	0	1.43	1.06	0.25	193.9
10/14/1998		6.3	22	0	0.612	10.9	0.25	518.6
12/7/1999		6.3	24	8.4	1.12	8.68	0.25	464
2/10/2000		6.3	36	17.2	4.21	11.3	0.688	872.7
3/30/2000	3200	5.7	28	0	1.26	6.27	0.25	351.8
5/10/2000	5200	6.1	15.4	2.8	1.35	10.4	0.25	394.8
6/28/2000		6.2	20	0.2	1.03	7.77	0.25	362.2
average	4200		17.32	10.79	1.15	7.58	0.61	375.48
stdev			7.29	11.56	0.85	4.21	0.58	

Sample Site 40

DATE COLLECTED	NAL FLOW	PH pH units	ALK MG/L	FE MG/L	MN MG/L	AL MG/L	SO4 MG/L
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7/10/1996	40	4.3	7	0.15	43.7	14.3	674.2
8/16/1996		4.4	7	0.15	21.3	5.58	276.6
9/11/1996		4.2	4.8	0.15	32.1	8.84	449.8
10/16/1996		4.6	11	0.15	43.5	13.7	617.9
11/20/1996		4.3	4.8	0.15	21.4	7.48	374.8
1/28/1997		4.6	9.8	0.15	12.3	4.34	221.2
2/12/1997		4.5	9	0.15	22.7	7.97	358.7
3/19/1997		4.4	8	0.15	20.7	7.98	364.1
5/20/1997		4.5	8.2	0.15	17.2	5.66	299.5
10/10/1997		4.2	5.4	0.15	47.9	13.8	745.6
1/8/1998	250	4.4	7.8	0.15	20.5	7.14	300.3
5/14/1998		4.6	9.2	0.15	19.8	7.21	323.7
10/14/1998		4.3	6.4	0.15	18.3	6.21	382.7
12/7/1999		6.1	20	0.15	1.46	0.25	165
3/30/2000	215	4.5	8.2	0.15	16.6	4.63	250.6
	168		8.44	0.15	23.96	7.67	
			3.66	0.00	12.65	3.84	

Sample Site 4

DATE COLLECTED	FINAL FLOW	PH pH units	ALK MG/L	FE MG/L	MN MG/L	AL MG/L	SO4 MG/L
----------	-------	--------	--------	--------	--------	--------	--------
7/10/1996		7.4	154	0.521	0.259	<.5	145.8
8/14/1996		7.9	152	0.528	0.33	<.5	107.4
9/11/1996		7.2	120	0.443	0.298	<.5	116.5
10/8/1996		7.9	148	0.346	0.246	<.5	105.7
11/21/1996		7.4	134	0.418	0.279	<.5	127.9
4/27/2000	800	7.9	122	0.513	0.265	<.5	189.2
Avg	800	7.62	138.33	0.46	0.28		
Stdev		0.32	15.15	0.072	0.030		

Sample Point 11

DATE	FINAL	PH	ALK	FE	MN	AL	SO4
COLLECTED	FLOW	pH units	MG/L	MG/L	MG/L	MG/L	MG/L
----------	------	--------	--------	--------	--------	--------	--------
7/11/1996		4.9	13	0.68	33	8.98	1056
8/15/1996		5.6	20	0.996	25.6	5.92	1252.9
9/11/1996		4.6	9.8	0.798	23.7	9.89	880
10/9/1996		4.9	11.6	0.644	20.8	7.02	846.9
11/20/1996		4.7	10.8	0.498	20.4	10.2	640.6
12/12/1996		4.7	11.2	0.417	12.7	6.65	291.1
1/8/1997	180	4.8	11.6	0.15	9.09	5.91	348.4
7/10/1997		4.9	10.6	0.674	31.3	7.66	934.5
10/3/1997		4.7	10	0.598	19.1	7	732.8
10/9/1997		4.6	11.4	0.64	35.9	13.1	1159.8
2/3/1998		4.7	12.4	0.509	30.9	14.5	773.8
4/15/1998		4.6	9.8	0.382	12.3	4.87	397.8
7/28/1998		4.6	9.8	0.662	39.8	4.1	1121.9
11/18/1998		5.1	12.8	1.88	26.3	2.84	1156.9
3/16/1999		4.8	10.2	0.15	10.6	5.68	588.8
5/18/1999		4.5	11	2.46	45.2	14.7	1114.6
8/27/1999		5.6	14.8	4.05	25.5	1.8	816
11/12/1999		4.9	12.2	5.07	29.1	4.27	1276.9
1/11/2000		4.7	10.4	0.609	13.8	4.13	794.3
3/8/2000		4.8	8.8	1.07	14.5	3.18	476
4/25/2000		4.7	12.4	0.829	28.4	14.6	713.9
average			11.65	1.13	24.19	7.48	
stdev				1.27	9.96	4.00	

Sample Site 12

DATE	FINAL	PH	ALK	FE	MN	AL	SO4
COLLECTED	FLOW	pH units	MG/L	MG/L	MG/L	MG/L	MG/L
----------	-------	--------	--------	--------	--------	--------	--------
7/11/1996		4.4	12	0.494	69.6	24.3	1732
8/15/1996		4.4	10.8	0.714	60.6	17.8	1392
9/11/1996		4.5	9.6	0.725	44.7	16.5	1082.5
10/9/1996		4.5	12.4	0.653	49.2	18.9	1246.2
11/20/1996		4.5	11	0.661	44.2	24.8	962.8
12/12/1996		4.5	11.4	0.715	27.9	14.3	594.1
1/8/1997	175	4.3	10.8	1.03	54.2	27.8	1167.4
2/11/1997		4.3	8.2	0.932	48.3	24.1	1106.9
3/11/1997		4.2	5.8	1.04	37.7	20.1	846.9
4/15/1997		4.1	5.8	1.09	51.9	22.4	1175.4
5/13/1997		4.2	8.4	0.849	57	23.1	1307
7/10/1997		4.4	10.4	0.768	72.4	21	1196.7
10/9/1997		4.4	10.8	0.624	48.4	14.8	1181.6
2/3/1998		4.2	6.6	1.02	58	30.9	1248.7
4/15/1998		4.1	5.8	0.849	28.9	11.5	717
7/28/1998		4.4	10.4	0.682	75.1	15.7	1713.8
11/18/1998		4.7	13.2	0.537	48.1	9.63	1439
5/18/1999		4	4.2	0.937	75.7	36.3	1582.1
8/27/1999		4.5	11.4	0.723	54.6	18.2	1338.1
3/8/2000		4.4	10.2	0.519	37.2	18.4	1124.5
average		4.35	9.46	0.78	52.19	20.53	
stdev			2.57	0.18	13.90	6.47	

Sample Site 13

DATE	FINAL	PH	ALK	FE	MN	AL	SO4
COLLECTED	FLOW	pH units	MG/L	MG/L	MG/L	MG/L	MG/L
----------	-------	--------	--------	--------	--------	--------	--------
7/10/1996		6.4	50	0.486	11.9	0.25	508.6
8/14/1996		6.5	62	0.355	8.3	0.25	510.5
9/11/1996		6.1	22	0.488	9.35	0.8	480
10/8/1996		6.6	46	0.507	9.12	0.25	428
11/20/1996		5.2	10.2	0.501	12.4	2.44	494.4
12/12/1996		5.5	12.4	0.307	5.08	2.17	221.7
1/8/1997	2400	6.5	70	0.528	3.42	0.844	244.9
2/11/1997		6.4	54	0.582	10.9	3.12	356.2
3/11/1997		6.3	26	0.401	6.3	3.33	245.1
4/15/1997		4.9	11.4	0.407	11.8	4	407.3
5/13/1997		6.2	24	0.449	12.5	1.32	487.3
7/10/1997		6.8	88	0.774	8.63	0.25	370.9
10/9/1997		6.6	124	0.682	1.93	0.25	218.2
2/3/1998		6.5	46	0.707	9.55	3.63	428.6
4/15/1998		5.4	12.4	0.607	6.1	2.91	266.5
7/28/1998		6.8	110	0.469	8.3	0.25	321.9
11/18/1998		6.9	114	0.662	2.62	0.25	310
5/18/1999		6.5	40	0.602	17	1.79	630.7
8/27/1999		6.8	56	0.83	10.5	0.25	706.6
3/8/2000		6.6	50	0.437	5.91	1.62	414
average	2400	6.275	51.42	0.54	8.58	1.50	
stdev			34.97	0.14	3.77	1.33	

Sample Site 19

DATE COLLECTED	FINAL FLOW	PH pH units	ALK MG/L	FE MG/L	MN MG/L	AL MG/L	SO4 MG/L
----------	-------	--------	--------	--------	--------	--------	--------
7/9/1996		4.2	5.6	11.9	23.9	0.764	641
8/15/1996		3.7	0	4.23	25.2	0.785	691.8
9/10/1996		4.2	4.6	0.812	12.5	0.706	364.1
10/15/1996		4.4	6.4	4.26	17	0.633	561.3
11/19/1996		5.1	8	4.17	11.4	0.869	338.9
1/23/1997		4.8	7.8	4.35	11.2	1.38	351.9
2/27/1997		4.8	8.6	2.79	9	1.3	269.5
3/19/1997		5	9.6	5.99	10.5	1.51	368.3
8/5/1997		3.5	0	4.03	29.7	1.31	755.8
10/9/1997		4.2	4.6	1.45	13.7	0.802	453.1
1/7/1998		4.7	8.2	2.12	10.7	0.954	363.8
5/14/1998		4.7	8	4.37	11.5	0.874	396.2
12/7/1999		6	14.2	1.1	9.64	0.25	399
2/10/2000		5.7	16.6	3.23	16.9	0.25	577.3
average		4.64	7.30	3.91	15.20	0.88	
stdev			4.54	2.74	6.55	0.39	

SMP 10803018	
Date	Flow (gpm,)
11/1/2000	5
12/19/2000	6
1/11/2001	0
2/15/2001	16
4/24/2001	8
10/4/2001	0
11/14/2001	1
12/4/2001	3
1/24/2002	15
4/9/2002	15
6/20/2002	20
7/11/2002	10
8/1/2002	5
11/13/2002	0.75
12/13/2002	2.6
avg=	7.16

avg (mgd)=	0.0103

WQN0922 Sulfate and Flow Data			
WQN0922~40-50 miles downstream of Seaton Creek Slippery Rock Crk-SR2005 BR at Camp Allegheny 0.5-1 mile downstream from Water Supply Intake # 63780810 (Camp Allegheny Salvation Army)			
Date	Sulfate Concentration mg/L	Mean Daily Flow cfs	Instantaneous Flow cfs
1/13/1993	80	1580	1730
2/9/1993	125	291	260
3/2/1993	107	432	395
4/5/1993	87	878	924
5/4/1993	93	623	666
6/2/1993	142	288	305
7/1/1993		144	
7/6/1993	123	139	144
8/3/1993	157	93	101
9/2/1993	144	86	86
10/5/1993	169	105	112
11/3/1993	127	339	350
12/2/1993	84	639	634
1/3/1994	124	420	420
2/8/1994	87	430	430
3/2/1994	83	725	691
4/12/1994	36	4660	6620
5/10/1994	106	395	395
6/9/1994	134	253	247
7/5/1994	105	178	174
8/1/1994	130	162	151
9/1/1994	116	291	286
10/4/1994	73	333	319
11/1/1994	108	896	882
12/1/1994	73	768	731
1/9/1995	106	210	210
2/1/1995	91	415	411
2/21/1995	80	766	
3/15/1995	78	579	579
4/13/1995	74	906	927
5/2/1995	95	841	357
6/6/1995	70	1070	1060
7/12/1995	102	199	201
8/1/1995	73	157	156
8/31/1995		65	
9/21/1995	126	66	66
10/19/1995	145	86	86
11/2/1995	124	162	158
12/4/1995	81	365	357

WQN0922 Sulfate and Flow Data

1/18/1996	93	1970	1250
2/6/1996	118	340	
3/11/1996	94	1190	689
4/11/1996	121	359	352
5/6/1996	84	1100	1080
6/4/1996	109	677	663
7/10/1996	112	177	
8/2/1996		174	
8/5/1996	79		
9/17/1996	71	357	
10/1/1996	61	890	
11/4/1996	81	352	
12/5/1996	70	1003	
1/2/1997	95	600	
2/6/1997	58	1620	
3/3/1997	34	1660	
4/1/1997	84	715	
5/5/1997	89	490	
6/2/1997	76	1220	
7/1/1997	85	219	
8/4/1997	10		64.1
9/9/1997	134		55.6
10/1/1997	118		
11/4/1997	137		
12/3/1997	71		
1/5/1998	75		
2/2/1998	96		
3/2/1998	75		
4/1/1998	96		
5/5/1998	78		
6/1/1998	128		
7/1/1998	116		
8/4/1998	153		
10/1/1998	131		
12/3/1998	64		
Avg	97.94	623.24	599.41
Stdev	29.90	700.12	1009.76

Attachment G

Comment and Response

Comment 1: Page 7 of the pre-public noticed TMDL report indicated that although surface water monitoring has been performed since 1994, only data from 1996 is used. An explanation was requested and, instead, the sentence was removed. Please provide a brief explanation as to why only water quality data since January 1996 is being used, whether or not the explanation is included in the TMDL report.

Response: The data used in this TMDL report was found in the DEP Sample Information System (SIS); this system went online 1/1/96. Water quality data collected before 1996 is on hard copy only. The additional monitoring data has been added to the Seaton Creek Excel spreadsheet.

Comment 2: According to the TMDL report, there are three surface mine permits, one with a post-mining discharge and two active operations as of October 2000. Waste Load Allocations (WLAs) are required for the three permits. In addition please provide the following information:

Response: Two, now inactive, operations have been regraded with Stage 1 bond release

Comment 3: Update the information. The TMDL report gives the status as of 10/00. Include the status of each permit by permit number and name.

Response: Western Hickory SMP#10803018 Campbell mine – operator continues to try to abate the discharges, passive treatment system was constructed but chemical treatment still required, excavation work significantly reduced flows, Quality Aggregates has proposed coal ash capping project (submitted 2/25/03).
Discharge 41 09 34, 79 51 23; stream 41 09 22, 79 51 10, upstream of sample point 11.

BenHal Mining Co. SMP#10970104 Fehl Mine – regraded with Stage 1 bond release
Sediment pond 41 09 54, 79 51 54, stream 41 09 45, 79 51 56, upstream of sample point 6.

Quality Aggregates SMP#10820139 Tiche Mine – regraded with Stage 1 bond release
Sediment pond 41 07 58, stream 79 52 10, upstream of sample point 18.

Comment 4: Provide the location of each permit including the location receiving the discharge.

Response: See Comment 3 for locations (latitude and longitude).

Comment 5: Does the permit for SMP#10970104 allow the sediment pond to discharge within the Seaton Creek watershed? If yes, a WLA is required above Point 9.

Response: This permit is has been regarded with Stage 1 bond release and does not discharge.

Comment 6: As it is assumed that SMP#10820139 near Goff Station is an active operation, it must have a WLA. The existing load at Point 18 includes the existing discharge from the mine. The allowable load at Point 18 must include the permitted load from the mine.

Response: SMP#10820139 is no longer active.

Comment 7: It is assumed that SMP#1080318, Western Hickory Coal Co., is the permit with the post-mining discharge. Its location is not identified. The permitted load must be accounted for in the downstream points allowable load and the permit must have a WLA.

Response: See Comment 3 for location.

Comment: it is assumed that the Growing Greener projects are not issued permits, in which case the are properly included in the LAs.