LACKAWANNA RIVER WATERSHED TMDL

Lackawanna, Luzerne, Susquehanna, and Wayne Counties

Prepared for:

Pennsylvania Department of Environmental Protection

March 9, 2005

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ATTACHMENTS

TMDL[1]
Lackawanna River Watershed
Lackawanna, Luzerne, Susquehanna and Wayne Counties, Pennsylvania

INTRODUCTION

This Total Maximum Daily Load (TMDL) calculation has been prepared for segments in the Lackawanna River Watershed (Attachment A). It was done to address the impairments noted on the 1996, 1998, 2002, and 2004 Pennsylvania Section 303(d) lists and required under the Clean Water Act. The TMDL covers four segments on these lists (Table 1). High levels of metals, and in some areas depressed pH, caused these impairments. All impairments resulted from abandoned mine drainage (AMD) from coal mining. The TMDL addresses the three primary metals (iron, manganese, and aluminum) associated with AMD, and pH.

Table 1. Lackawanna River Segments Addressed

State Water Plan (SWP) Subbasin: 05-A Lackawanna River								
Year	***Miles***	***Segment ID***	***DEP Stream Code***	***Stream Name***	***Designated Use***	***Data Source***	***Source***	***EPA 305(b) Cause Code***
1996	2.6	Not placed on GIS	28374	Lackawanna River	HQ-CWF, WWF	305(b) Report	RE	Metals
1998	2.57	4249	28374	Lackawanna River	HQ-CWF, WWF	SWMP	AMD	Metals
2002	2.7	20000315-0830-TTS	28374	Lackawanna River	HQ-CWF, WWF	SWAP	AMD	pH, Metals, Siltation, Flow Alterations
2002	22.1	20000315-1108-TTS	28374	Lackawanna River	HQ-CWF, WWF	SWAP	AMD	pH, Metals
2002	1.8	20010525-1245-CJD	28570	Lackawanna River	HQ-CWF, WWF	SWAP	AMD	Siltation
2002	1.4	20010621-1030-CJD	28575	Lackawanna River	HQ-CWF, WWF	SWAP	AMD	Siltation
2004	2.7	20000315-0830-TTS	28374	Lackawanna River	HQ-CWF, WWF	SWAP	AMD	pH, Metals, Siltation, Flow Alterations
2004	22.1	20000315-1108-TTS	28374	Lackawanna River	HQ-CWF, WWF	SWAP	AMD	pH, Metals
2004	1.8	20010525-1245-CJD	28570	Unt. Lackawanna River	CWF	SWAP	AMD	Siltation
2004	1.4	20010621-1030-CJD	28575	Unt. Lackawanna River	CWF	SWAP	AMD	Siltation

Attachment B includes a justification of differences between the 1996, 1998, 2002, and 2004 303(d) lists.

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

[1] Pennsylvania's 1996, 1998, 2002, and 2004 Section 303(d) lists were approved by the U.S. Environmental Protection Agency. The 1996 Section 303(d) list provides the basis for measuring progress under the 1996 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

LOCATION

The Lackawanna River Watershed is approximately 347 square miles in area. It is located mostly in Lackawanna County, but also extends into Luzerne, Susquehanna, and Wayne Counties. The mouth is located in the city of Pittston, Pennsylvania. The Lackawanna River flows 60 miles southwest from its headwaters on the border between Susquehanna and Wayne Counties, to its confluence with the Susquehanna River. The Lackawanna River can be accessed from I-81 north around Scranton and by Rt. 6 north in northern Lackawanna County.

SEGMENTS ADDRESSED IN THIS TMDL

The Lackawanna River Watershed is affected by pollution from AMD. This pollution has caused high levels of metals and low pH in the mainstem and in several tributaries such as Aylesworth Creek, Grassy Island Creek, Powderly Creek, and Wilson Creek. There are numerous mine seeps, boreholes and outfalls throughout the watershed. Mine drainage is entering the Lackawanna River either directly or via its tributaries. Abandoned mine lands (AMLs) also contribute to the degradation of the watershed.

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 130) require:

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

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

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

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

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

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

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

SECTION 303(D) LISTING PROCESS

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

The primary method adopted by the Pennsylvania Department of Environmental Protection (Pa. DEP) for evaluating waters changed between the publication of the 1996 and 1998 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 include kick-screen sampling of benthic macroinvertebrates, habitat surveys, and measurements of pH, temperature, conductivity, dissolved oxygen, and alkalinity. Benthic macroinvertebrates are identified to the family level in the field.

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 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

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

stream segment is impaired by two pollutants, two TMDLs must be developed for that stream segment. In order for the process to be more effective, adjoining stream segments with the same source and cause listing are addressed collectively, and on a watershed basis.

BASIC STEPS FOR DETERMINING A TMDL

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

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

This document will present the information used to develop the Lackawanna River Watershed TMDL.

WATERSHED BACKGROUND

The Lackawanna River Watershed lies within the Appalachian Mountain Section of the Ridge and Valley Province, and the Glaciated Low Plateau and the Glaciated Pocono Plateau Sections of the Appalachian Plateau Province. There is a decrease in elevation in the watershed of about 2,000 feet from its headwaters to its mouth. The topography of the watershed is characterized by long ridges with steep hillsides separated by valleys. The upland areas have rocky, poorly drained soils. The valley floor is mostly developed, impervious surfaces. Areas in the valley that have been mined, but not developed, have rapid permeability. The primary land uses are forested land, agriculture and developed (58 percent, 20 percent and 16 percent, respectively). It is also dotted with AMLs. Interbedded sedimentary rock and sandstone comprise the major rock types in the watershed (67 percent and 33 percent, respectively).

Underground mining of anthracite coal began in this area as early as the 1820s. Mining of the Northern Anthracite Coal field took place down the center of the watershed from Forest City to Pittston. Thirteen coal beds of the anthracite field were mined. Most deep mines were forced to close in the late 1950s when the price of mining underground exceeded the price per ton of anthracite coal. The occurrence of the Knox Mine Disaster also contributed to the closings. In 1959, the Susquehanna River broke through at Pittston and flooded all of the underground mines in the lower Lackawanna and Wyoming Valley. The last underground mine operation closed in 1966. Coal mining then shifted to surface mining in the 1960s. Since the 1960s, only minor strip mining and coal reprocessing have occurred in the watershed. (Lackawanna River Watershed Conservation Plan, 2001)

Today, there are 12 active mining operations in the watershed (see Table 2). These operations are either noncoal mining or are reprocessing old coal banks left behind by previous underground mining. Gigliello Topsoil is the only operation with an NPDES permit. The permit is for erosion and sediment control and therefore does not need a (wasteload allocation) WLA.

Table 2. Mining Permits in the Lackawanna River Watershed

Permit Number	Company	Status	NPDES Permit
35940201	APHC II	Reclamation Complete	
35970201	APHC II	Active	N/A
35773205	CJC Inc.	Inactive/Reclamation Complete	N/A
40032801	Cremard Brothers*	Active/Has Not Started	N/A
40960301	Cremard Brothers*	Active	N/A
40820305	Cremard Brothers*	Reclamation Complete	N/A
35840203	CSY Inc.	Active	N/A
40860801	Duryea Auto Parts*	Active	N/A
5376SM1	Duryea Realty*	Active	N/A
40840301	Duryea Realty*	Reclamation Complete	N/A
35870201	Fell Coal Co.	Stage I	N/A
40800304	Gigliello Topsoil*	Active	Y
35950302	Keystone Pocono Block & Supply*	Active	N/A
35940101	Loomis Development	Abandoned/Bond Forfeit	N/A
35763202	Northampton Coal Co.	Active	N/A
35860803	Robert Parry*	Active/Never Materialized	N/A
40763208	Popple Brothers	Active	N/A
35910102	Silverbrook Anthracite, Inc.	Active	N/A
35940301	Telco Coal*	Active	N/A
35860301	United Sand and Gravel Inc.*	Active	N/A

*Noncoal mining permits

The Lackawanna River Watershed has been part of numerous studies that address its water quality problems such as AMD, urban/stormwater runoff and combined sewer overflows (CSOs). This TMDL only addresses the AMD impairments to the Lackawanna River. Some of the studies include: two Scarlift reports; a Lackawanna River Priority Water Body Survey conducted by the Susquehanna River Basin Commission; two U.S Army Corps of Engineers reports: Lackawanna River Corridor Greenway Reconnaissance Report and Upper Susquehanna-Lackawanna River Watershed Section 206 Ecosystem Restoration Report (ERR); and a Lackawanna River Watershed Conservation Plan.

- The Lackawanna River Priority Water Body Survey was conducted in 1988. The Pa. Department of Environmental Resources (Pa. DER), Bureau of Water Quality Management classified the river as a priority waterbody through a screening process that determined several water quality parameters to be a concern in the watershed. Water chemistry and physical characteristic data were collected during this survey. Three sewage treatment plants and two mine discharges were found to have the greatest impacts on the water quality of the river.

- The Lackawanna River Corridor Greenway Reconnaissance Report documented all sources of pollution in the watershed, including AMD. It identified AMD sources, as well as recommended restoration solutions. The Phase I GIS Environmental Master Plan of the ERR mentioned above was conducted by the PA GIS Consortium and submitted to the USACE in 2001. The study used Geographic Information Systems (GIS) to inventory available environmental data for the watershed. Using GIS, environmental problems and their solutions were identified.

- The Lackawanna River Corridor Association developed a conservation plan for the watershed in partnership with 26 municipalities and Lackawanna County. The plan inventoried and examined environmental conditions of the watershed and offered recommendations for educational outreach, recreation and conservation projects, and watershed management. Funding and support for this project came from federal, state and local entities, as well as the community.

AMD METHODOLOGY

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

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

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

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

Protection, Chapter 93, Water Quality Standards, will be met instream at least 99 percent of the time. For each iteration, the required percent reduction is:

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

PR = required percent reduction for the current iteration

Cc = criterion in mg/l

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

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

Standard Deviation = standard deviation of observed data

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

LTA = Mean * (1 – PR99) where (2)

LTA = allowable LTA source concentration in mg/l

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

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

There are two basic rules that are applied in load tracking; rule one is that if the sum of the measured loads that directly affect the downstream sample point is less than the measured load at the downstream sample point it is indicative that there is an increase in load between the points being evaluated, and this amount (the difference between the sum of the upstream and downstream loads) shall be added to the allowable load(s) coming from the upstream points to give a total load that is coming into the downstream point from all sources. The second rule is that if the sum of the measured loads from the upstream points is greater than the measured load at the downstream point this is indicative that there is a loss of instream load between the evaluation points, and the ratio of the decrease shall be applied to the load that is being tracked (allowable load(s)) from the upstream point.

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

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

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

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 96.3(c) specifies that the water quality standards must be met 99 percent of the time. The iron TMDLs are expressed at total recoverable as the iron data used for this analysis were reported as total recoverable. Table 3 shows the water quality criteria for the selected parameters.

Table 3. Applicable Water Quality Criteria

Parameter	Criterion Value (mg/l)	Total Recoverable/Dissolved
Aluminum (Al)	0.75	Total Recoverable
Iron (Fe)	1.50 0.3	30-Day Average Total Recoverable Dissolved
Manganese (Mn)	1.00	Total Recoverable
pH *	6.0-9.0	N/A

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

TMDL ELEMENTS (WLA, LA, MOS)

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

TMDL ALLOCATIONS SUMMARY

There were not enough paired flow/parameter data to calculate correlations (fewer than 10 paired observations) in this TMDL.

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

This TMDL will focus remediation efforts on the identified numerical reduction targets for each watershed. As changes occur in the watershed, the TMDL may be reevaluated to reflect current conditions. Table 4 presents the estimated reductions identified for all points in the watershed. Attachment D gives detailed TMDLs by segment analysis for each allocation point.

Table 4. Summary Table–Lackawanna River Watershed

Station	Parameter	Existing Load (lb/day)	TMDL Allowable Load (lb/day)	WLA (lb/day)	LA (lb/day)	Load Reduction (lb/day)	Percent Reduction %
LR4		1/10 mile upstream of Route 247 bridge outside of Forest City					
	Fe	ND	NA	NA	NA	0.0	0
	Mn	ND	NA	NA	NA	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	739.9	NA	NA	NA	0.0	0
LR3		At USGS gage between Jermyn and Archbald					
	Fe	ND	NA	NA	NA	0.0	0
	Mn	140.1	140.1	NA	0.0*	0.0*	0*
	Al	ND	NA	NA	NA	0.0	0
	Acidity	0.0	NA	NA	NA	0.0*	0*

Station	Parameter	Existing Load (lb/day)	TMDL Allowable Load (lb/day)	WLA (lb/day)	LA (lb/day)	Load Reduction (lb/day)	Percent Reduction %
LR2		Downstream of Broadway Street Bridge					
	Fe	ND	NA	NA	NA	0.0	0
	Mn	240.9	240.9	NA	0.0*	0.0*	0*
	Al	ND	NA	NA	NA	0.0	0
	Acidity	0.0	NA	NA	NA	0.0*	0*
LR1		Upstream of Coxton Road bridge downstream of split channel					
	Fe	12746.2	1024.8	NA	1024.8*	11721.4*	92*
	Mn	2145.7	896.7	NA	896.7*	1489.9*	63*
	Al	ND	NA	NA	NA	0.0	0
	Acidity	NA	NA	NA	NA	0.0*	0*

ND = not detected; NA = meets water quality standards, no TMDL necessary
*Takes into account reductions from upstream points; see Tables D3, D5, and D7 for calculations

RECOMMENDATIONS

In the late 1990s, the Lackawanna River Watershed 2000 Program was developed from a USEPA water resources grant. The intent of the grant is to address AMD, AML, and CSO problems in the watershed. A working partnership was developed between state and local agencies, as well as a working group that meets to discuss current and future projects in the watershed.

The Lackawanna River will be undergoing bank stabilization in the Yucca Flats area near Forest City. The Yucca Flats is an area where the river is channelized as it flows through culm and silt banks. This project is funded through a Growing Greener Grant. There also will be a project to replace the headwall and outfall structures of the Jermyn Outfall, in the borough of Jermyn.

Grassy Island Creek, a tributary to the Lackawanna River, has undergone some reclamation. The Lackawanna County Conservation District moved part of the creek from the mouth upstream to the railroad tracks using fluvial geomorphology techniques. The purpose of the new stream channel was to move the stream away from an eroding coal mine refuse pile. In the fall of 2003, the Pa. DEP Bureau of Abandoned Mine Reclamation (BAMR) began a project upstream of the Lackawanna County Conservation District site. This project involves rehabilitating the stream channel in Jessup Borough, grading on-site coal refuse, and backfilling a mine opening. Eighty acres of AML will be reclaimed by this project. The Pa. DEP also will soon begin a project that will reclaim a dangerous highwall and 44 acres of AMLs.

Two primary programs that provide reasonable assurance for maintenance and improvements of water quality in the watershed are in effect. The Pa. DEP's efforts to reclaim AMLs, 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 Pa. DEP's BAMR, which administers and oversees the Abandoned Mine Reclamation Program in Pennsylvania, the U. S. Office of Surface Mining, the National Mine Land Reclamation Center, the National Environmental Training Laboratory, and many other agencies and individuals. Funding from USEPA's 319 Nonpoint Source 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.

Reclaim PA is Pa. 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 constitute a significant public liability–more than 250,000 acres of abandoned surface mines, 2,400 miles of stream polluted with AMD, over 7,000 orphaned and abandoned oil and gas wells, widespread subsidence problems, numerous hazardous mine openings, mine fires, abandoned structures, and affected water supplies–representing as much as one-third of the total problem nationally.

Since the 1960s, Pennsylvania has been a national leader in establishing laws and regulations to ensure mine reclamation and well plugging occur after active operation is completed. Mine reclamation and well plugging refers to the process of cleaning up environmental pollutants and safety hazards associated with a site and returning the land to a productive condition, similar to Pa. DEP's Brownfields Program. Pennsylvania is striving for complete reclamation of its abandoned mines and plugging of its orphan wells. Realizing this task is no small order, Pa. DEP has developed Reclaim PA, a collection of concepts to make abandoned mine reclamation easier. These concepts include legislative, policy, and land management initiatives designed to enhance mine operator/volunteer/Pa. 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.

The coal industry, through Pa. DEP-promoted remining efforts, can help to eliminate some sources of AMD and conduct some of the remediation through the permitting, mining, and reclamation of abandoned and disturbed mine lands. Special consideration should be given to potential remining projects within these areas as the environmental benefit versus cost ratio is generally very high.

PUBLIC PARTICIPATION

In the beginning stages of the Lackawanna River TMDL, an early notification letter was sent to inform stakeholders and interested parties that a TMDL would be completed in their watershed and offer them the opportunity to submit information for TMDL development. The PADEP considered all the information submitted and all pertinent information was included in the report.

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on January 8, 2005, and the Scranton Times on January 19, 2005 to foster public comment on the allowable loads calculated. A public meeting was held on January 25, 2005, at the Dickson City Borough Hall in Dickson City to discuss the proposed TMDL.

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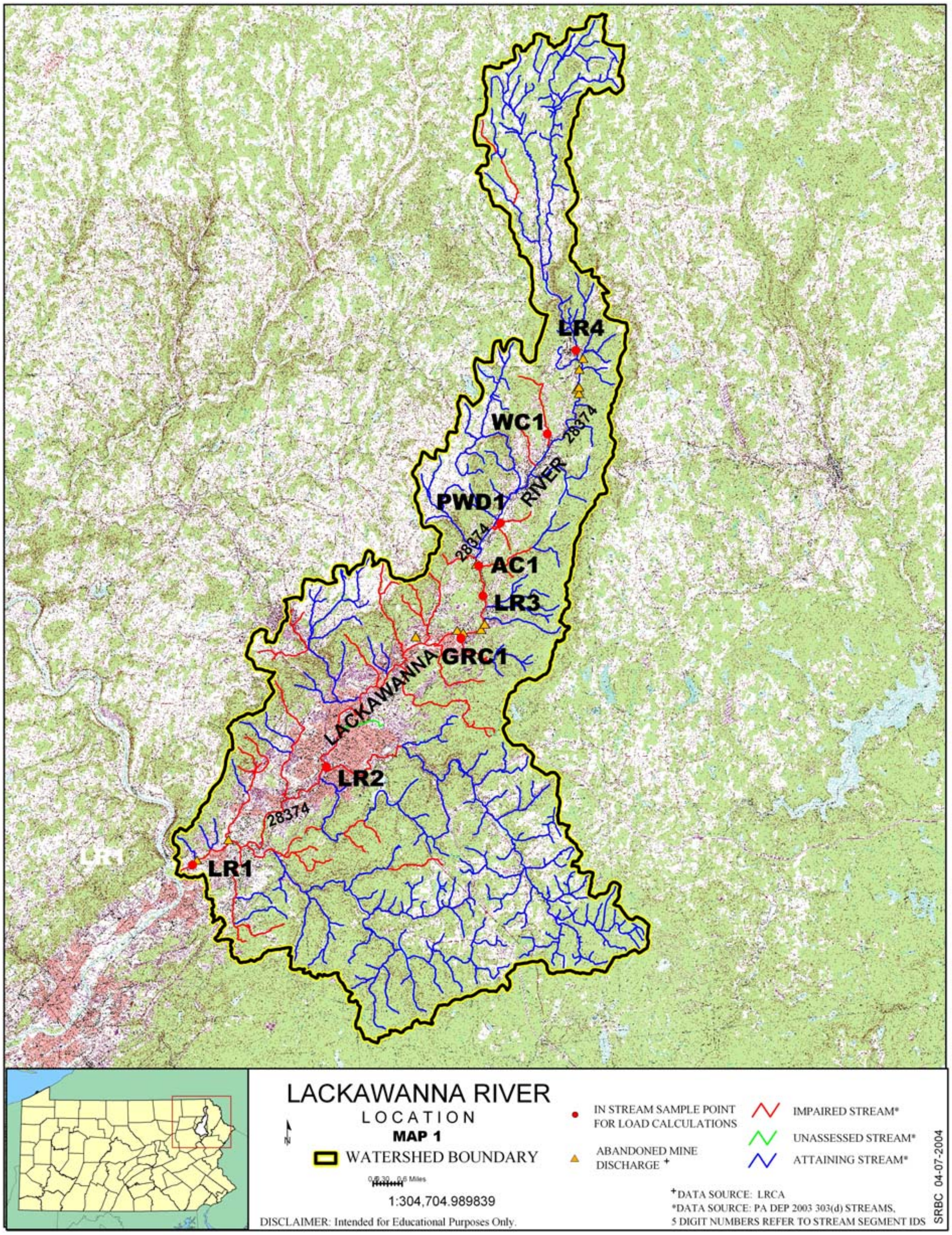
Attachment A

Lackawanna River Watershed Maps


LR4
WC1
28374
RIVER
PWD1
28374
AC1
LR3
GRC1
LACKAWANNA
LR2
28374
LR1
LACKAWANNA RIVER
LOCATION
MAP 1
WATERSHED BOUNDARY
1:304,704.989839
DISCLAIMER: Intended for Educational Purposes Only.
IN STREAM SAMPLE POINT FOR LOAD CALCULATIONS
ABANDONED MINE DISCHARGE +
IMPAIRED STREAM*
UNASSESSED STREAM*
ATTAINING STREAM*
+DATA SOURCE: LRCA
*DATA SOURCE: PA DEP 2003 303(d) STREAMS,
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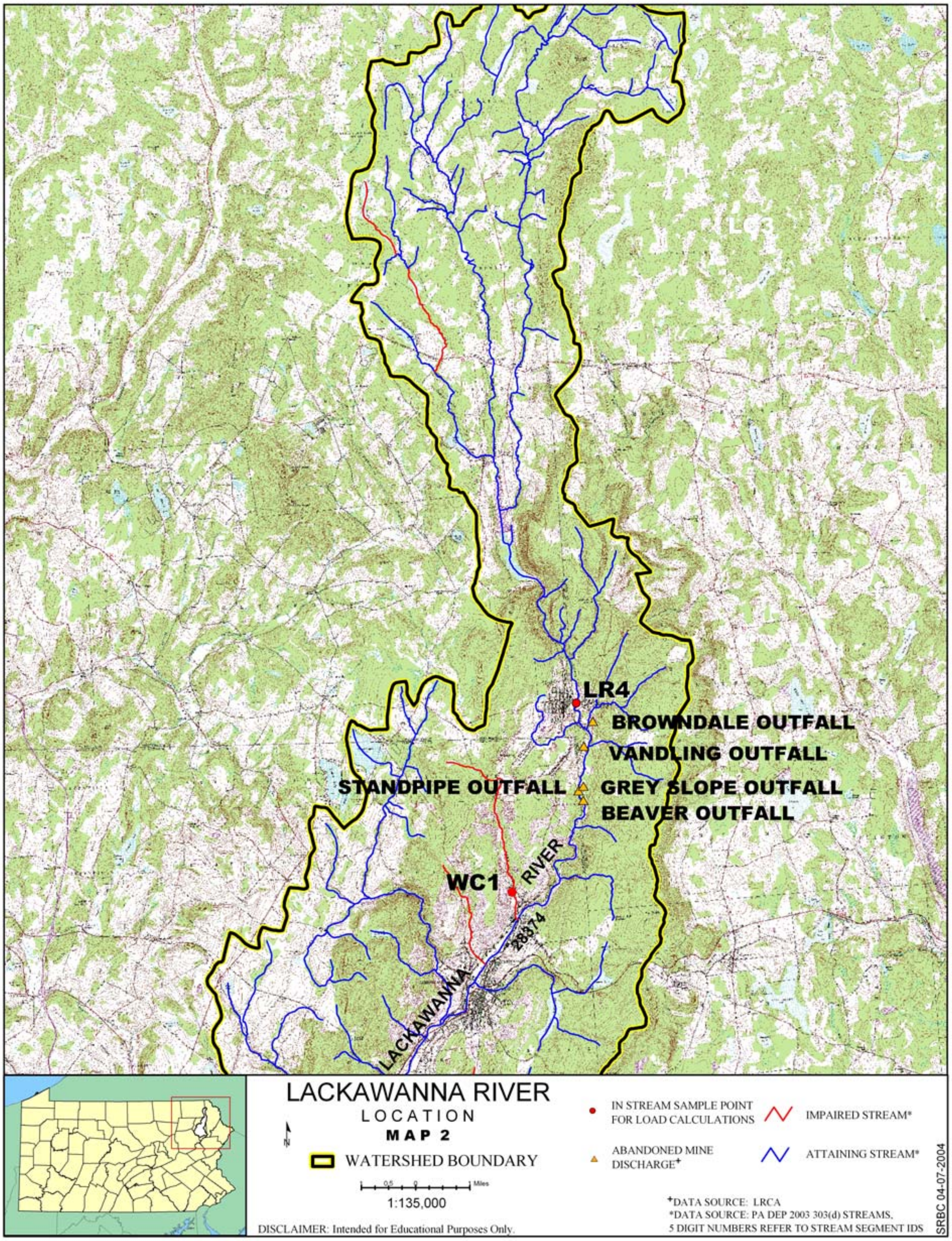
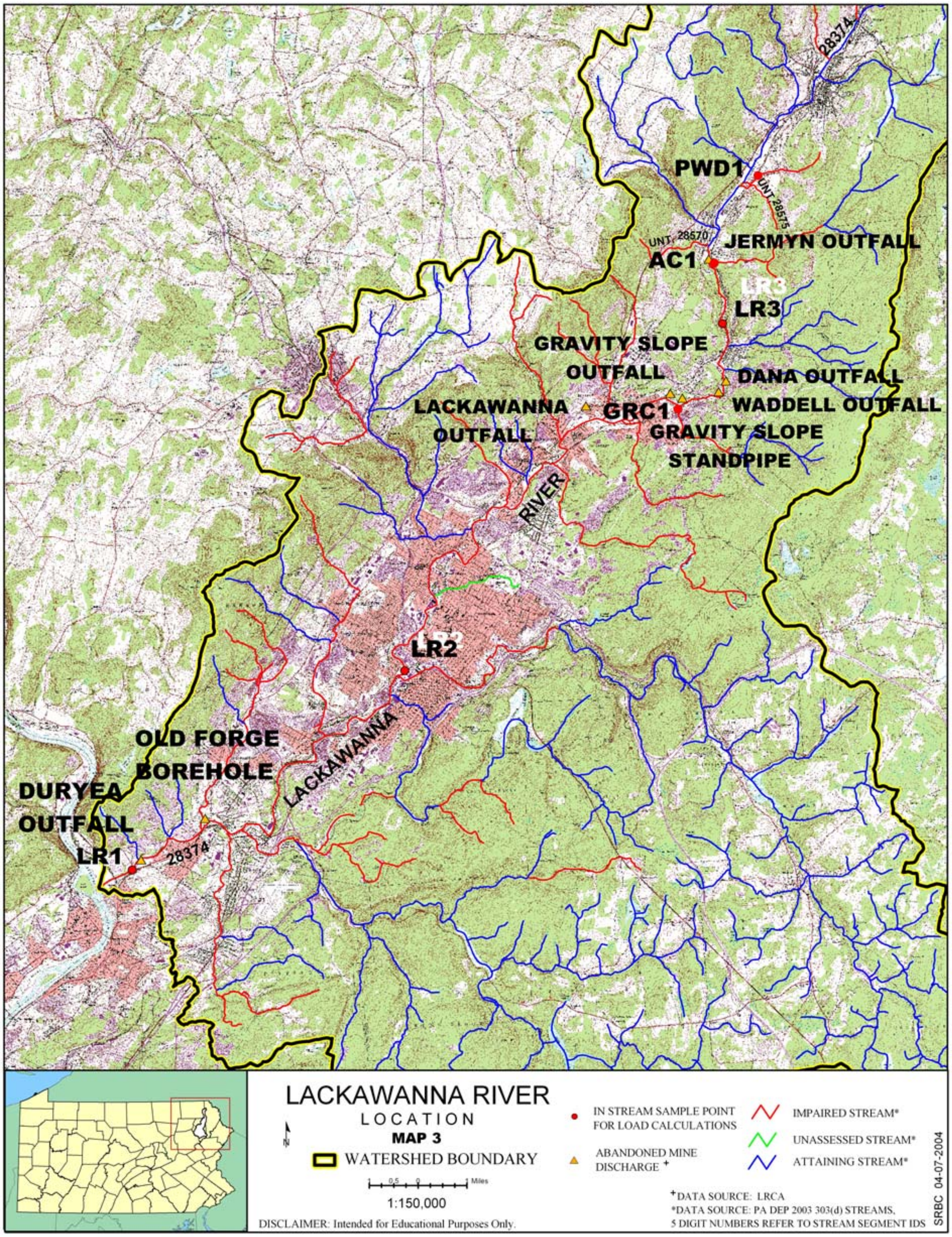
SRBC 04-07-2004


LR4
BROWNDALE OUTFALL
VANDLING OUTFALL
STANDPIPE OUTFALL
GREY SLOPE OUTFALL
BEAVER OUTFALL
RIVER
WC1
28374
LACKAWANNA
LACKAWANNA RIVER
LOCATION
MAP 2
WATERSHED BOUNDARY
1:135,000
IN STREAM SAMPLE POINT FOR LOAD CALCULATIONS
ABANDONED MINE DISCHARGE+
IMPAIRED STREAM*
ATTAINING STREAM*
+DATA SOURCE: LRCA
*DATA SOURCE: PA DEP 2003 303(d) STREAMS, 5 DIGIT NUMBERS REFER TO STREAM SEGMENT IDS
DISCLAIMER: Intended for Educational Purposes Only.
SRBC 04-07-2004


PWD1
UNT 28575
28374
UNT 28570
JERMYN OUTFALL
AC1
LR3
GRAVITY SLOPE
OUTFALL
DANA OUTFALL
WADDELL OUTFALL
LACKAWANNA
OUTFALL
GRC1
GRAVITY SLOPE
STANDPIPE
RIVER
LR2
LACKAWANNA
OLD FORGE
BOREHOLE
DURYEA
OUTFALL
LR1
28374
LACKAWANNA RIVER
LOCATION
MAP 3
WATERSHED BOUNDARY
1:150,000
Miles
IN STREAM SAMPLE POINT FOR LOAD CALCULATIONS
ABANDONED MINE DISCHARGE +
IMPAIRED STREAM*
UNASSESSED STREAM*
ATTAINING STREAM*
+DATA SOURCE: LRCA
*DATA SOURCE: PA DEP 2003 303(d) STREAMS,
5 DIGIT NUMBERS REFER TO STREAM SEGMENT IDS
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SRBC 04-07-2004

Attachment B

Excerpts Justifying Changes Between the 1996, 1998, Draft 2000, 2002, and 2004 Section 303(d) Lists

The following are excerpts from the Pennsylvania DEP 303(d) narratives that justify changes in listings between the 1996, 1998, draft 2000, 2002, and 2004 lists. The 303(d) listing process has undergone an evolution in Pennsylvania since the development of the 1996 list.

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

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

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

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

The most notable difference between the 1998 and Draft 2000 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 Pa. DEP's five-digit stream code. As a result, the unnamed tributary records are now split out as separate records on the 2000 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. After due consideration of comments from USEPA and Pa. DEP on the Draft 2000 Section 303(d) list, the 2002 Pa. Section 303(d) list was written in a manner similar to the 1998 Section 303(d) list.

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

Category 1: Waters attaining all designated uses.

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

Category 3: Waters for which there are insufficient or no data and information to determine, consistent with the state's listing methodology, if designated uses are met.

Category 4: Waters impaired for one or more designated use but not needing a TMDL. States may place these waters in one of the following three subcategories:

- TMDL has been completed.
- Expected to meet all designated uses within a reasonable timeframe.
- Not impaired by a pollutant.

Category 5: Waters impaired for one or more designated uses by any pollutant. Category 5 includes waters shown to be impaired as the result of biological assessments used to evaluate aquatic life use even if the specific pollutant is not known unless the state can demonstrate that nonpollutant stressors cause the impairment or that no pollutant(s) causes or contribute to the impairment. Category 5 constitutes the Section 303(d) list that USEPA will approve or disapprove under the Clean Water Act. Where more than one pollutant is causing the impairment, the water remains in Category 5 until all pollutants are addressed in a completed USEPA-approved TMDL or one of the delisting factors is satisfied.

Attachment C

Method for Addressing 303(d) Listings for pH

Method for Addressing 303(d) Listings for pH

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

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

Each sample point used in the analysis of pH by this method must have measurements for total alkalinity and total acidity. Net alkalinity is alkalinity minus acidity, both being in units of milligrams per liter (mg/l) $CaCO_3$. 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 303(d) list can be established from its upper unaffected regions, then the pH standard will be expanded to include this natural range. The acceptable net alkalinity of the stream after treatment/abatement in its polluted segment will be the average net alkalinity established from the stream's upper, pristine reaches. Summarized, if the pH in an unaffected portion of a stream is found to be naturally occurring below six, then the average net alkalinity for that portion of the stream will become the criterion for the polluted portion. This "natural net alkalinity level" will be the criterion to which a 99 percent confidence level will be applied. The pH range will be varied only for streams in which a natural unaffected net alkalinity level can be established. This can only be done for streams that have upper segments that are not impacted by mining activity. All other streams will be required to meet a minimum net alkalinity of zero.

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

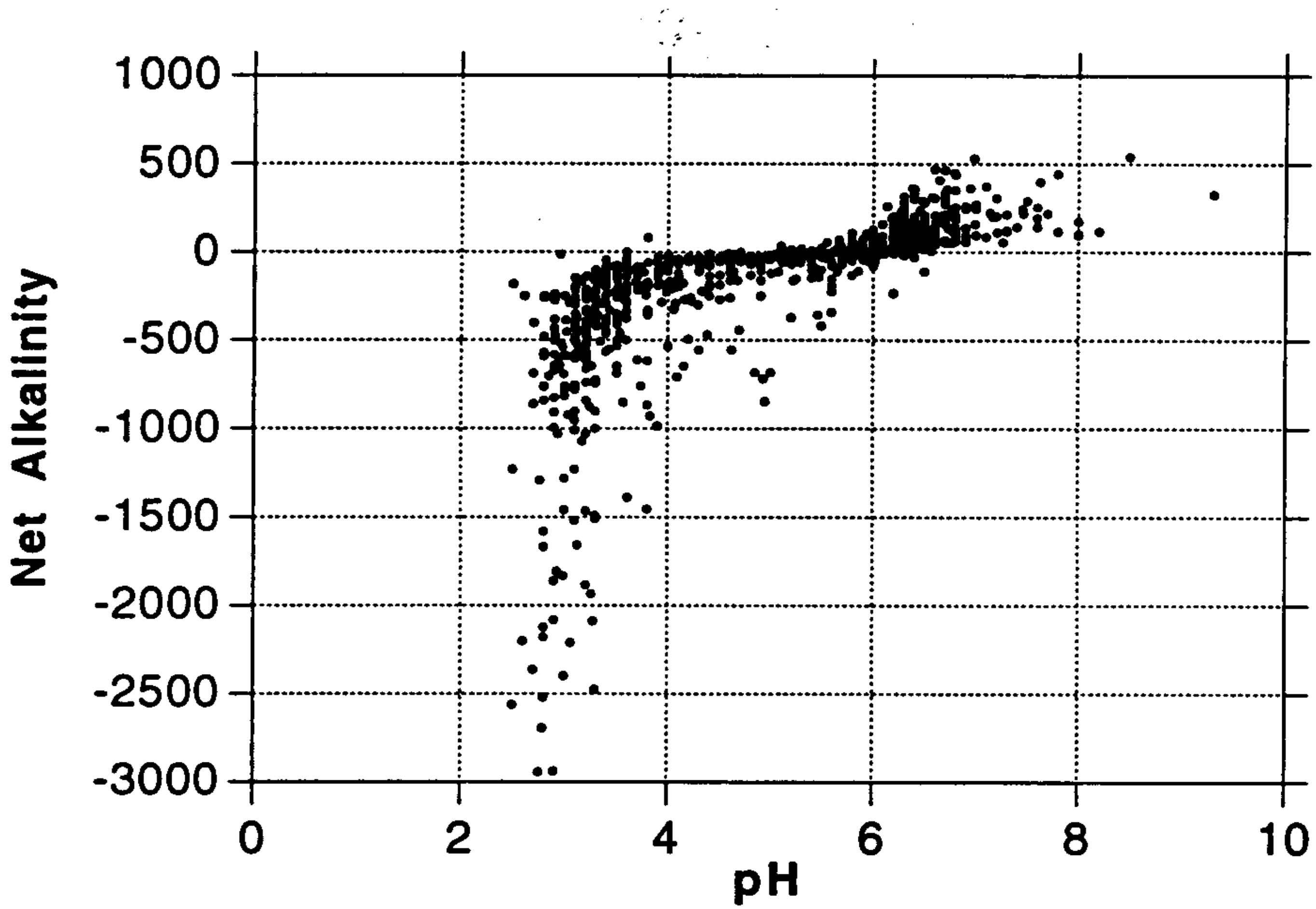

Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania.

Attachment D
TMDLs By Segment

Lackawanna River above LR4

Lackawanna River above LR4 represents the river upstream of Forest City. A section of the river at Forest City is affected by a large abandoned mine land (AML) site called Yucca Flats. It is located between an abandoned railroad and the river. This site is an area where the river is channelized as it flows through culm and silt banks.

The TMDL for this section of the Lackawanna River consists of a load allocation to all of the watershed area above LR4. Addressing the mining impacts at this point addresses the impairment for the segment. An instream flow measurement was available for point LR4 (51.28 mgd).

Sample data at this point are net alkaline with pH ranging between 6.1 and 7.4. Therefore, acidity will not be addressed in this TMDL.

Fewer than four data points with values above the detection limit for each parameter are necessary to conduct the Monte Carlo analysis necessary to produce the long-term average concentrations. All data measurements for iron were below the detection limit (0.300 mg/l); however, these values are well under water quality standards for iron (1.5 mg/l) and therefore a TMDL is not necessary to address iron. All data measurements for manganese were below water quality standards (1.0 mg/l), with three being below the detection limit; therefore, a TMDL is not necessary to address manganese. All data measurements for aluminum were below water quality standards (0.75 mg/l), with four being below the detection limit; therefore, a TMDL is not necessary to address aluminum.

The load allocations made at LR4 for this stream segment are presented in Table D1.

Table D1. Reductions for the Lackawanna River at LR4

Station LR4	***Measured Sample Data***		***Allowable***		***Reduction Identified***
	Conc. (mg/l)	***Load (lb/day)***	***LTA Conc. (mg/l)***	***Load (lb/day)***	***Percent***
Fe	ND	ND	NA	NA	0
Mn	ND	ND	NA	NA	0
Al	ND	ND	NA	NA	0
Acidity	1.73	739.9	NA	NA	0
Alkalinity	22.30	9537.2			

All values shown in this table are long-term average daily values.
ND = not detected; NA = meeting water quality standards, no TMDL necessary

The TMDL for the Lackawanna River at LR4 does not require that a load allocation be applied to the Lackawanna River above LR4 for any parameters.

Lackawanna River between LR4 and LR3

The Lackawanna River at point LR3 represents all of the watershed area between LR4 and LR3. There are AMLs and six known AMD discharges between Forest City and Jermyn. The Browndale Outfall is located on the east bank of the Lackawanna River, southeast of Forest City. This outfall drains a small area from the Hudson Coal Company's Clinton Colliery. It is not connected to any mine pool; therefore, the flow fluctuates with precipitation. The Vandling Discharge is located about 0.5 miles downstream of the Browndale Outfall, under the D & H Railroad. It drains the Hudson Coal Company's Clinton Colliery. The Grey Slope Outfall is located about 0.5 miles southeast of the borough of Vandling. This outfall was once the main haul way of the Pennsylvania Coal Company's Forest City Colliery. The Standpipe Discharge is a single cased well, located about 500 feet downstream of the Grey Slope Outfall. It is thought that this well provided water to steam locomotives. The Beaver Outfall is about 1,000 feet downstream of the Standpipe Discharge. This outfall originated from a roof collapse in a large room of the mine (Operation Scarlift, Part I, 1971). The Jermyn Outfall is located on the west bank of the Lackawanna River in the borough of Jermyn. The discharge drains directly into the river from a concrete conduit. This outfall discharges the largest volume of AMD in this section of the river, however, its effects on the river are minimal. The cold water from the discharge is thought to be beneficial to the river (http://www.lrca.org/pages/amdaml/pages/amdoutfalls.htm 2003).

There are several AMD impaired tributaries entering the river between LR4 and LR3. Wilson Creek enters the west bank of the Lackawanna River at Simpson, about 3 miles downstream of the Beaver Outfall. About 4 miles downstream of Wilson Creek, Powderly Creek enters the Lackawanna River on the east bank in Mayfield. Powderly Creek is one of the most severely degraded tributaries in the Lackawanna River Watershed. Unt. 28575 enters the river several hundred feet below Powderly Creek. About one mile below this confluence, Unt. 28570 enters the west bank of the Lackawanna River. Unt. 28575 and Unt. 28570 are being accounted for in this TMDL. Aylesworth Creek flows into the Lackawanna about 0.25-mile below the Jermyn Outfall on the east bank. TMDLs calculated at the mouth of Wilson Creek, Powderly Creek, and Aylesworth Creek will be accounted for in the mass balance calculation for point LR3. For more information on Wilson, Powderly and Aylesworth Creeks, see their individual TMDL documents (www.dep.state.pa.us keyword: TMDL).

The TMDL for this section of the Lackawanna River consists of a load allocation to all of the watershed area between LR4 and LR3. Addressing the mining impacts between these points addresses the impairment for the segment. An instream flow measurement was available for point LR3 (140.0 mgd).

Sample data at this point are net alkaline with pH ranging between 6.5 and 7.2. Therefore, acidity will not be addressed in this TMDL

Fewer than four data points with values above the detection limit for each parameter are necessary to conduct the Monte Carlo analysis necessary to produce the long-term average concentrations. All data measurements for iron were below water quality standards (1.5 mg/l), with four measurements being below detection limits; therefore, a TMDL is not necessary to address iron. All data measurements for aluminum were below water quality standards (0.75 mg/l), with four being below the detection limit; therefore, a TMDL is not necessary to address aluminum.

An allowable long-term average instream concentration for manganese was determined at point LR3. The analysis is designed to produce a long-term average value that, when met, will be protective of the water quality criterion for that parameter 99 percent of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water quality criteria 99 percent of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean and the standard deviation of the data set, 5,000 iterations of sampling were completed and compared against the water quality criterion for that parameter. For each sampling event, a percent reduction was calculated, if necessary, to meet water quality criteria. A second simulation that multiplied the percent reduction times the sampled value was run to insure that criteria were met 99 percent of the time. The mean value from this data set represents that long-term daily average concentration that needs to be met to achieve water quality standards. The load allocations made at point LR3 for this stream segment are presented in Table D2.

Table D2. Long Term Average (LTA) Concentrations for Lackawanna River Between LR4 and LR3

Station LR3	***Measured Sample Data***		***Allowable***	
	Conc. (mg/l)	***Load (lb/day)***	***LTA Conc. (mg/l)***	***Load (lb/day)***
Fe	ND	ND	NA	NA
Mn	0.12	140.1	0.12	140.1
Al	ND	ND	NA	NA
Acidity	0	0	NA	NA
Alkalinity	27.57	32,190.7		

All values shown in this table are long-term average daily values.
ND = not detected; NA = meeting water quality standards, no TMDL necessary

The calculated load reductions for all the loads that enter upstream of point LR3 (LR4, WC1, PWD1, AC1) must be accounted for in the calculated reductions at sample point LR3 shown in Table D3. A comparison of measured loads between points LR4 and LR3 shows that there is a loss in load for acidity indicated by the negative numbers in the second row of Table D3. A loss in load indicates that instream processes, such as settling, are taking place within the segment. It also indicates that no additional loading is directly entering the segment for acidity. To determine the total segment load, the percent decrease in existing loads between LR4 and LR3 is applied to the upstream loads entering the segment. For acidity, the allowable load at LR3 is less than the upstream loads entering the segment, which results in a load reduction for the segment. It is assumed that once allocations at upstream points are met, the TMDL at LR3 also will be met.

Table D3. Reductions Necessary at Point LR3				
	Iron (lb/day)	***Manganese (lb/day)***	***Aluminum (lb/day)***	***Acidity (lb/day)***
Existing Load at LR3	ND	140.1	ND	0.0
Existing load from upstream points (LR4, WC1, AC1, PWD1)	-	19.2	-	2566.1
Difference of existing load and upstream existing load	-	120.9	-	-2566.1
Percent load loss due to instream process	-	86	-	100
Allowable loads from upstream point	-	19.2	-	377.0
Percent remaining at LR3	-	14	-	0
Total Load at LR3	-	2.7	-	0.0
Allowable Loads at LR3	NA	140.1	NA	NA
Load reduction at LR3 (Total load at LR3 – Remaining load at LR3)	0.0	0.0	0.0	0.0
Percent reduction required at LR3	0	0	0	0

The TMDL for point LR3 requires that no load allocation be applied to the Lackawanna River between LR4 and LR3 for any parameters.

Lackawanna River between LR3 and LR2

The Lackawanna River at point LR2 represents all of the watershed area between LR3 and LR2. The river is minimally impacted by five discharges within this section. AMLs lie adjacent to the river around Dickson City, Olyphant, and Blakely.

The Dana Tunnel is located in the borough of Archibald downstream of Laurel Run. The discharge emerges from a drift mine opening beside the Archibald power plant. It then flows west about 75 meters through a ditch, and then under the Lackawanna River Heritage Trail on its way to the river. The Waddell Outfall is located about 0.25-mile downstream of the Dana Tunnel, in the borough of Jessup. The discharge drains under the Lackawanna River Heritage Trail from a pipe on the east bank of the river. The Gravity Slope Outfall is located in the borough of Jessup, 0.25-mile upstream of the Constitution Ave. bridge. A steady discharge emerges from a former deep mine entrance and flows through a wetland before entering the stream. The wetland, created by a beaver dam, allows most of the metals to precipitate out of the mine water before it enters the river. The Gravity Slope Standpipe discharges just upstream of the Gravity Slope Outfall. The Lackawanna Outfall is located near Lillibridge St. in the borough of Blakely. The mine water is diverted from a mine shaft to a concrete culvert and into a ditch. It flows south under Lillibridge St., then turns east and flows about 0.25-mile towards the Lackawanna River. This discharge typically goes dry during the summer (http://www.lrca.org/pages/amdaml/pages/amdoutfalls.htm 2003).

There is one AMD impaired tributary that enters the river between LR3 and LR2. Grassy Island Creek, an AMD impaired tributary, enters the river on the east bank between the Gravity Slope discharges. TMDLs calculated at the mouth of Grassy Island Creek will be accounted for in the mass balance calculation for point LR2. For more information on Grassy Island Creek, see its individual TMDL document (www.dep.state.pa.us keyword: TMDL).

The TMDL for this stream consists of a load allocation to all of the watershed area between LR3 and LR2. Addressing the mining impacts above this point addresses the impairment for the segment. An instream flow measurement was not available for point LR2. The unit area method was used based on a USGS gage station at Old Forge, slightly downstream of LR2. The average instream flow measurement for LR2 was calculated at 320.94 mgd.

Sample data at this point are net alkaline with pH ranging between 6.7 and 7.3. Therefore, acidity will not be addressed in this TMDL

Fewer than four data points with values above the detection limit for each parameter are necessary to conduct the Monte Carlo analysis necessary to produce the long-term average concentrations. All data measurements for iron were below water quality standards (1.5 mg/l), with five measurements being below detection limits; therefore, a TMDL is not necessary to address iron. All data measurements for aluminum were below water quality standards (0.75 mg/l), with four being below the detection limit; therefore, a TMDL is not necessary to address aluminum.

An allowable long-term average instream concentration for manganese was determined at point LR2. The analysis is designed to produce a long-term average value that, when met, will be protective of the water quality criterion for that parameter 99 percent of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water quality criteria 99 percent of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean and the standard deviation of the data set, 5,000 iterations of sampling were completed and compared against the water quality criterion for that parameter. For each sampling event, a percent reduction was calculated, if necessary, to meet water quality criteria. A second simulation that multiplied the percent reduction times the sampled value was run to insure that criteria were met 99 percent of the time. The mean value from this data set represents that long-term daily average concentration that needs to be met to achieve water quality standards. The load allocations made at point LR2 for this stream segment are presented in Table D4.

Table D4. Long Term Average (LTA) Concentrations for Lackawanna River at LR2

Station LR2	***Measured Sample Data***		***Allowable***	
	Conc. (mg/l)	***Load (lb/day)***	***LTA Conc. (mg/l)***	***Load (lb/day)***
Fe	ND	NA	NA	NA
Mn	0.09	240.9	0.09	240.9
Al	ND	NA	NA	NA
Acidity	0	0	NA	NA
Alkalinity	28.17	75,400.9		

All values shown in this table are long-term average daily values.
ND = not detected; NA = meeting water quality standards, no TMDL necessary

The calculated load reductions for all the loads that enter upstream of point LR2 (LR3, GR1) must be accounted for in the calculated reductions at sample point LR2 shown in Table D5. A comparison of measured loads between points LR3 and LR2 shows that there is a loss in load for acidity indicated by the negative numbers in the second row of Table D5. A loss in load indicates that instream processes, such as settling, are taking place within the segment. It also indicates that no additional loading is directly entering the segment for acidity. To determine the total segment load, the percent decrease in existing loads between LR3 and LR2 is applied to the upstream loads entering the segment. For acidity, the allowable load at LR2 is less than the upstream loads entering the segment, which results in a load reduction for the segment. It is assumed that once allocations at upstream points are met, the TMDL at LR2 also will be met.

Table D5. Reductions Necessary at Point LR2

	Iron (lb/day)	***Manganese (lb/day)***	***Aluminum (lb/day)***	***Acidity (lb/day)***
Existing Load at LR2	ND	240.9	ND	0.0
Existing load from upstream points (LR3, GRS1)	-	144.4	-	955.5
Difference of existing load and upstream existing load	-	96.5	-	-955.5
Percent load loss due to instream process	-	40	-	100
Allowable loads from upstream point	-	144.4	-	265.0
Percent remaining at LR2	-	60	-	0
Total Load at LR2	-	86.6	-	0.0
Allowable Loads at LR2	NA	240.9	NA	NA
Load reduction at LR2 (Total load at LR2 – Remaining load at LR2)	0.0	0.0	0.0	0.0
Percent reduction required at LR2	0	0	0	0

The TMDL for point LR2 does not require that a load allocation be applied to the Lackawanna River between LR3 and LR2 for any parameter.

Lackawanna River between LR2 and LR1

The Lackawanna River at LR1 represents all of the watershed area between LR2 and LR1. The source of the AMD impairment to this section of the river is from two large discharges south of Scranton. The discharges being accounted for in this TMDL include the Old Forge Borehole and the Duryea Outfall.

Mine water from the Old Forge Borehole discharges into the river upstream of the Union St. bridge in the borough of Old Forge. In the 1960s, a concrete box culvert was constructed to release rising water from the mine pool into the river. The underground mine pool runs between Blakely and Duryea. The Old Forge Borehole is the largest discharge by volume in the watershed (http://www.lrca.org/pages/amdaml/pages/amdoutfalls.htm 2003). The Duryea Outfall is located in Duryea, Luzerne County, upstream of the Coxton Rd. bridge. Mine water emerges from a hole in the ground, flows through a wetland created by a beaver dam and continues 0.25-mile down a small channel to the Lackawanna River. The Duryea Outfall and the Old Forge Borehole severely degrade the last 3 miles of the Lackawanna River (http://www.lrca.org/pages/amdaml/pages/amdoutfalls.htm 2003).

The TMDL for this section of the Lackawanna River consists of a load allocation to all of the watershed area between LR2 and LR1. Addressing the mining impacts between these points addresses the impairment for the segment. An instream flow measurement was not available for point LR1. Average flow for point LR1 was calculated by adding together the mean flow from point LR2, mean flow from the Old Forge Borehole discharge, and mean flow from the Duryea discharge. This calculated flow includes the major AMD and flow sources between LR2 and LR1. The average calculated flow for point LR1 was determined to be 383.4 mgd.

Sample data at this point are net alkaline with pH ranging between 6.4 and 6.7. Therefore, acidity will not be addressed in this TMDL

Fewer than four data points with values above the detection limit for each parameter are necessary to conduct the Monte Carlo analysis necessary to produce the long-term average concentrations. All data measurements for aluminum were below water quality standards (0.75 mg/l), with five being below the detection limit; therefore, a TMDL is not necessary to address aluminum.

An allowable long-term average instream concentration for iron and manganese was determined at point LR1. The analysis is designed to produce a long-term average value that, when met, will be protective of the water quality criterion for that parameter 99 percent of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water quality criteria 99 percent of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean and the standard deviation of the data set, 5,000 iterations of sampling were completed and compared against the water quality criterion for that parameter. For each sampling event, a percent reduction was calculated, if necessary, to meet water quality criteria. A second simulation that multiplied the percent reduction times the sampled value was run to insure that criteria were met 99 percent of the time. The mean value from this data set represents that long-term daily average concentration that needs to be met to achieve water quality standards. The load allocations made at point LR1 for this stream segment are presented in Table D6.

Table D6. Long Term Average (LTA) Concentrations for the Lackawanna River at LR1

Station LR1	***Measured Sample Data***		***Allowable***	
	Conc. (mg/l)	***Load (lb/day)***	***LTA Conc. (mg/l)***	***Load (lb/day)***
Fe	3.98	12,746.2	0.32	1,024.8
Mn	0.67	2,145.7	0.28	896.7
Al	ND	NA	NA	NA
Acidity	2.57	8,230.6	NA	NA
Alkalinity	44.67	143,058.4		

All values shown in this table are long-term average daily values.
ND = not detected; NA = meeting water quality standards, no TMDL necessary.

The calculated load reductions for all the loads that enter upstream of point LR1 (LR2) must be accounted for in the calculated reductions at sample point LR1 shown in Table D7. A comparison of measured loads between points LR2 and LR1 shows that there is a loss in load for acidity indicated by the negative numbers in the second row of Table D7. A loss in load indicates that instream processes, such as settling, are taking place within the segment. It also indicates that no additional loading is directly entering the segment for acidity. To determine the total segment load, the percent decrease in existing loads between LR2 and LR1 is applied to the upstream loads entering the segment. For acidity, the allowable load at LR1 is less than the upstream loads entering the segment, which results in a load reduction for the segment. It is assumed that once allocations at upstream points are met, the TMDL at LR1 also will be met.

Table D7. Reductions Necessary at Point LR1

	Iron (lb/day)	***Manganese (lb/day)***	***Aluminum (lb/day)***	***Acidity (lb/day)***
Existing Load at LR1	12746.2	2145.7	ND	NA
Existing load from upstream points (LR2)	NA	240.9	-	0.0
Difference of existing load and upstream existing load	12746.2	1904.8	-	-
Percent load loss due to instream process	NA	0	-	100
Allowable loads from upstream point	NA	240.9	-	0.0
Percent remaining at LR1	NA	100	-	0
Total Load at LR1	12746.2	2386.6	-	NA
Allowable Loads at LR1	1024.8	896.7	NA	NA
Load reduction at LR1 (Total load at LR1 – Remaining load at LR1)	11721.4	1489.9	0.0	0.0
Percent reduction required at LR1	92	63	0	0

The TMDL for point LR1 requires that a load allocation be applied to all areas of the Lackawanna River between LR2 and LR1 for total iron and total manganese.

Margin of Safety (MOS)

Pa. DEP used an implicit MOS in these TMDLs derived from the Monte Carlo statistical analysis. The Water Quality Standards state that water quality criteria must be met at least 99 percent of the time. All of the @Risk analyses results surpass the minimum 99 percent level of protection. Another MOS used for this TMDL analyses results from:

- 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 MOS.
- A MOS is also the fact that the calculations were performed with a daily iron average, instead of the 30-day average.

Seasonal Variation

Seasonal variation is implicitly accounted for in 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

Water Quality Data Used In TMDL Calculations

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid mg/l	Alk mg/l	Fe mg/l	Mn mg/l	Al mg/l	pH	Sulfate, mg/L
LR4	LACK4.0	SRBC-604(b) Report	*	11/26/2001	13464.94	0	32	<0.300	0.075	0.692	6.8	26.1
	LACK4.0	SRBC-604(b) Report	*	2/18/2002	36355.32	0	16.4	<0.300	<0.050	<0.500	6.8	30.7
	LACK4.0	SRBC-604(b) Report	*	3/25/2002	30969.35	10.4	22	<0.300	<0.050	<0.500	6.1	<20
	LACK4.0	SRBC-604(b) Report	*	4/29/2002	69568.83	0	16.4	<0.300	0.081	<0.500	6.6	<20
	LACK4.0	SRBC-604(b) Report	*	6/10/2002	59245.71	0	19	<0.300	0.175	<0.500	6.5	<20
	LACK4.0	SRBC-604(b) Report	*	7/15/2002	3904.83	0	28	<0.300	<0.050	0.559	7.4	<20
				Average=	35584.83	1.73333	22.3	<0.300	0.1103	0.6255	6.7	28.40
				StDev=	25414.79	4.24578	6.4371	*	0.0561	0.094	0.429	3.25

	Vandling Discharge	Fell Coal Co.	35870201	1/27/1992	*	73	0	0.3	3.76	8.62	3.71	96
	Vandling Discharge	Fell Coal Co.	35870201	3/4/1992	*	6.6	15	1.87	0.735	<0.500	6	55
	Vandling Discharge	Fell Coal Co.	35870201	3/27/1992	*	17	0	0.25	0.42	1.16	4.25	53
	Vandling Discharge	Fell Coal Co.	35870201	4/2/1992	*	15.6	12	2.44	1.01	<0.500	6.7	60
	Vandling Discharge	Fell Coal Co.	35870201	5/15/1992	*	32	0	0.18	1.81	3.58	3.85	94.2
	Vandling Discharge	Fell Coal Co.	35870201	7/24/1992	*	19	1	0.41	0.79	1.7	4.62	60
	Vandling Discharge	Fell Coal Co.	35870201	8/31/1992	*	51	0	1.19	1.76	5.3	3.66	91.6
	Vandling Discharge	Fell Coal Co.	35870201	10/30/1992	*	11	4	1.91	0.78	<0.1	4.87	76.9
	Vandling Discharge	Fell Coal Co.	35870201	11/30/1992	*	7	4	2.57	1.16	<0.1	5.38	85.7
	Vandling Discharge	Fell Coal Co.	35870201	12/30/1992	*	9	7	2.21	1.05	0.16	5.37	7
	Vandling Discharge	Fell Coal Co.	35870201	1/27/1993	*	4	9	1.45	0.93	<0.1	5.59	95.6
	Vandling Discharge	Fell Coal Co.	35870201	2/5/1993	*	7	7	2.4	1	0.68	5.51	85.7
	Vandling Discharge	Fell Coal Co.	35870201	3/26/1993	*	8	5	1.55	0.36	<0.1	5.55	54.4
	Vandling Discharge	Fell Coal Co.	35870201	4/14/1993	*	13	4	0.26	0.82	0.34	4.9	71.2
	Vandling Discharge	Fell Coal Co.	35870201	5/14/1993	*	6	4	0.41	0.78	0.21	4.8	67
	Vandling Discharge	Fell Coal Co.	35870201	6/24/1993	*	2	6	0.71	0.41	0.43	5.58	69
	Vandling Discharge	Fell Coal Co.	35870201	9/19/1996	*	10	12.2	<0.300	0.198	<0.500	5.7	42.2
	Vandling Discharge	Fell Coal Co.	35870201	12/30/1996	*	12.2	15.4	0.559	0.629	<0.500	5.6	54
	Vandling Discharge	Fell Coal Co.	35870201	1/31/1997	1070	3.97	4.88	0.54	0.68	0.1	5.99	75.3
	Vandling Discharge	Fell Coal Co.	35870201	2/13/1997	*	2.99	4.85	0.58	0.51	0.2	5.52	114
	Vandling Discharge	Fell Coal Co.	35870201	3/13/1997	*	4	14	1.13	0.641	<0.500	5.5	65.8
	Vandling Discharge	Fell Coal Co.	35870201	3/31/1997	*	1.25	4.83	1.06	0.71	0.25	5.41	90.6
	Vandling Discharge	Fell Coal Co.	35870201	4/24/1997	1912	1.21	4.83	1.05	0.71	0.2	5.21	114
	Vandling Discharge	Fell Coal Co.	35870201	6/23/1997	429.81	0.4	5.88	1.07	0.56	0.3	5.5	71.2

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid mg/l	Alk mg/l	Fe mg/l	Mn mg/l	Al mg/l	pH	Sulfate, mg/L
	Vandling Discharge	Fell Coal Co.	35870201	5/28/1998	*	1.8	13.2	1.15	0.56	<0.500	5.7	50.7
	Vandling Discharge	Fell Coal Co.	35870201	2/4/1999	*	0	11.8	0.603	0.248	<0.500	5.8	45

	Flow (gpm)	Acid mg/l	Alk mg/l	Fe mg/l	Mn mg/l	Al mg/l	pH	Sulfate, mg/L
Average=	1137.27	12.27	6.53	1.11	0.89	1.55	5.24	70.97
StDev=	743.38	16.57	4.85	0.75	0.70	2.46	0.73	23.84

	MP 001	Loomis Development Co.	35940101	3/26/1993	126	16	0	0.1	0.19	1.38	4.09	83.8
	MP 001	Loomis Development Co.	35940101	4/14/1993	72	15	0	0.03	0.14	0.64	4.01	73.7
	MP 001	Loomis Development Co.	35940101	5/14/1993	35	13	0	0.2	0.12	0.29	4.23	69.1
	MP 001	Loomis Development Co.	35940101	6/24/1993	35	11	0	0.16	0.18	1.06	4.44	88
	MP 001	Loomis Development Co.	35940101	8/20/1993	22	10	0	0.03	0.25	<0.1	4.25	84.6
	MP 001	Loomis Development Co.	35940101	9/24/1993	52	16	0	0.15	0.22	2.27	4.24	76.3
	MP 001	Loomis Development Co.	35940101	10/13/1993	35	15	0	0.2	0.19	0.86	3.98	73.8
	MP 001	Loomis Development Co.	35940101	10/29/1993	35	12	0	0.06	0.19	1.34	3.97	100.9
	MP 001	Loomis Development Co.	35940101	11/12/1993	52	10	0	0.73	0.19	0.97	4.01	69.6
	MP 001	Loomis Development Co.	35940101	11/24/1993	32	9	0	0.03	0.19	1.35	4.44	90.7
	MP 001	Loomis Development Co.	35940101	12/10/1993	52	14	0	0.07	0.13	0.97	4.44	66
	MP 001	Loomis Development Co.	35940101	12/30/1993	72	9	0	0.09	0.12	0.77	4.42	67.2
	MP 001	Loomis Development Co.	35940101	2/28/1994	35	7	0	0.05	0.13	0.66	4.41	96.5
	MP 001	Loomis Development Co.	35940101	4/26/1994	72	7	0	0.05	0.09	0.38	4.49	76.3
	MP 001	Loomis Development Co.	35940101	4/29/1994	72	6	0	0.11	0.11	0.4	4.41	79.1
	MP 001	Loomis Development Co.	35940101	5/5/1994	126	8	1	0.05	0.1	0.27	4.62	76.7
	MP 001	Loomis Development Co.	35940101	5/31/1994	22	0	8	0.03	0.11	0.27	4.43	78.7
	MP 001	Loomis Development Co.	35940101	9/27/1994	*	22	7	<0.300	0.195	0.534	4.6	96
	MP 001	Loomis Development Co.	35940101	10/27/1994	*	10	6.4	0.437	0.2	0.709	4.5	77
	MP 001	Loomis Development Co.	35940101	3/13/1995	*	19.8	6.6	<0.300	0.126	<0.500	4.6	74
	MP 001	Loomis Development Co.	35940101	4/10/1995	*	9.51	0	0.11	0.18	0.44	*	84.47
	MP 001	Loomis Development Co.	35940101	5/8/1995	*	8.58	0	0.1	0.19	0.35	*	87.4
	MP 001	Loomis Development Co.	35940101	6/8/1995	*	9.8	6.4	<0.300	0.312	<0.500	4.5	82
	MP 001	Loomis Development Co.	35940101	6/14/1995	*	8.04	0	0.45	0.45	0.51	4.48	92
	MP 001	Loomis Development Co.	35940101	8/3/1995	*	0.2	11.2	<0.300	<0.05	<0.500	6.2	22
	MP 001	Loomis Development Co.	35940101	12/10/1996	*	12.6	7.2	<0.300	0.241	<0.500	4.7	73.6
	MP 001	Loomis Development Co.	35940101	4/3/1997	*	6	3	<0.300	0.221	<0.500	4.3	75.3
	MP 001	Loomis Development Co.	35940101	9/23/1997	*	20	8.2	<0.300	0.39	0.519	4.8	105.1

Average=	55.71	10.88	2.32	0.15	0.19	0.77	4.44	79.28

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid mg/l	Alk mg/l	Fe mg/l	Mn mg/l	Al mg/l	pH	Sulfate, mg/L
				StDev=	31.59	5.22	3.56	0.18	0.08	0.49	0.42	15.15
	Jermyn Outfall	Pa. DEP - BAMR	*	3/1/1983	*	0	18	1.3	*	*	5.94	94
	Jermyn Outfall	Pa. DEP - BAMR	*	4/4/1983	*	0	14	1.2	*	*	6.88	118
	Jermyn Outfall	Pa. DEP - BAMR	*	5/2/1983	*	0	21	1.3	*	*	5.82	161
	Jermyn Outfall	Pa. DEP - BAMR	*	6/6/1983	*	0	19	0.8	*	*	5.75	238
	Jermyn Outfall	Pa. DEP - BAMR	*	7/11/1983	*	0	21	1.2	*	*	5.65	199
	Jermyn Outfall	Pa. DEP - BAMR	*	8/8/1983	*	0	20	1.1	*	*	5.78	222
	Jermyn Outfall	Pa. DEP - BAMR	*	9/7/1983	*	0	20	1.6	*	*	5.78	214
	Jermyn Outfall	Pa. DEP - BAMR	*	10/4/1983	*	0	27	8	*	*	5.69	240
	Jermyn Outfall	Pa. DEP - BAMR	*	11/1/1983	*	0	57	6.1	*	*	5.89	243
	Jermyn Outfall	Pa. DEP - BAMR	*	12/5/1983	*	1	29	4.7	*	*	5.82	253
	Jermyn Outfall	Pa. DEP - BAMR	*	1/3/1984	*	10	25	1.2	*	*	5.78	254
	Jermyn Outfall	Pa. DEP - BAMR	*	2/1/1984	*	0	115	1.6	*	*	5.86	245
	Jermyn Outfall	Pa. DEP - BAMR	*	3/6/1984	*	10	19	1	*	*	5.82	209
	Jermyn Outfall	Pa. DEP - BAMR	*	4/3/1984	*	0	19	1.2	*	*	5.72	162
	Jermyn Outfall	Pa. DEP - BAMR	*	5/7/1984	*	7	20	1.1	*	*	5.85	178
	Jermyn Outfall	Pa. DEP - BAMR	*	6/4/1984	*	0	20	1.6	*	*	5.87	139
	Jermyn Outfall	Pa. DEP - BAMR	*	7/2/1984	*	2	21	1.2	*	*	5.75	197
	Jermyn Outfall	Pa. DEP - BAMR	*	8/2/1984	*	0	20	1	*	*	5.82	209
	Jermyn Outfall	Pa. DEP - BAMR	*	9/4/1984	*	0	24	2.9	*	*	5.94	224
	Jermyn Outfall	Pa. DEP - BAMR	*	10/2/1984	*	7	37	6.8	*	*	6.13	179
	Jermyn Outfall	Pa. DEP - BAMR	*	11/2/1984	*	0	28	5.2	*	*	5.94	220
	Jermyn Outfall	Pa. DEP - BAMR	*	12/5/1984	*	0	29	3.3	*	*	5.95	202
	Jermyn Outfall	Pa. DEP - BAMR	*	1/3/1985	*	0	24	2.2	*	*	5.84	172
	Jermyn Outfall	Pa. DEP - BAMR	*	2/4/1985	*	0	22	2.1	*	*	5.81	193
	Jermyn Outfall	Pa. DEP - BAMR	*	3/4/1985	*	0	21	1.5	*	*	5.75	196
	Jermyn Outfall	Pa. DEP - BAMR	*	4/2/1985	*	0	21	1.1	*	*	5.89	195
	Jermyn Outfall	Pa. DEP - BAMR	*	5/2/1985	*	0	20	1.1	*	*	5.84	143
	Jermyn Outfall	Pa. DEP - BAMR	*	6/4/1985	*	0	23	1.5	*	*	5.83	179
	Jermyn Outfall	Pa. DEP - BAMR	*	7/1/1985	*	0	22	2.3	*	*	5.77	194
	Jermyn Outfall	Pa. DEP - BAMR	*	8/2/1985	*	0	21	1.4	*	*	5.83	186
	Jermyn Outfall	Pa. DEP - BAMR	*	9/9/1985	*	0	23	2.5	*	*	5.94	208
	Jermyn Outfall	Pa. DEP - BAMR	*	10/7/1985	*	0	19	1.9	*	*	5.86	195
	Jermyn Outfall	Pa. DEP - BAMR	*	11/1/1985	*	0	22	2.2	*	*	5.92	223

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid mg/l	Alk mg/l	Fe mg/l	Mn mg/l	Al mg/l	pH	Sulfate, mg/L
	Jermyn Outfall	Pa. DEP - BAMR	*	12/4/1985	*	0	22	1.3	*	*	6.45	177
	Jermyn Outfall	Pa. DEP - BAMR	*	1/7/1986	*	0	22	1	*	*	5.78	169
	Jermyn Outfall	Pa. DEP - BAMR	*	2/5/1986	*	0	20	*	*	*	5.75	174
	Jermyn Outfall	SRBC-Lackawanna River Priority Water Body Survey Report	*	10/18/1988	3994.6	14	26	1.68	0.856	0.118	6.2	200
	MP 3 Jermyn Outfall	Silverbrook Anthracite Inc.	35910102	2/5/1991	**8976.6**	4	10	1	0.55	0.13	6.4	150
	MP 3 Jermyn Outfall	Silverbrook Anthracite Inc.	35910102	3/1/1991	**6732.5**	6	4	0.45	0.1	0.01	6.2	150
	MP 3 Jermyn Outfall	Silverbrook Anthracite Inc.	35910102	4/10/1991	**8976.6**	16	10	0.75	0.4	0	6.2	150
	MP 3 Jermyn Outfall	Silverbrook Anthracite Inc.	35910102	5/7/1991	**6732.5**	13	10	0.19	0	0	6.1	47
	MP 3 Jermyn Outfall	Silverbrook Anthracite Inc.	35910102	6/7/1991	**6732.5**	13	11	0.18	0.01	0	6.2	51
	MP 3 Jermyn Outfall	Silverbrook Anthracite Inc.	35910102	7/2/1991	**4488.3**	14	9	1.7	0.25	0.03	5.8	150
	MP 3 Jermyn Outfall	Silverbrook Anthracite Inc.	35910102	8/22/1991	**4488.3**	15	8	1.6	0.27	0.05	5.6	150
	MP 3 Jermyn Outfall	Silverbrook Anthracite Inc.	35910102	11/7/1991	*	0	36	1.42	0.786	<0.500	6.2	185
	Jermyn Outfall Slope 1	USGS	*	11/4/1999	15170.49	43	3	0.32	0.51	0.22	6	160
				Average=	7365.82	3.80	22.87	1.93	0.37	0.06	5.93	182.54
				StDev=	3450.19	7.82	16.47	1.68	0.30	0.08	0.24	45.59

LR3	Lack 22.1, at USGS gage station in Archibald	SRBC-Lackawanna River Priority Water Body Survey Report	*	10/18/1988	3,976.60	0	38	0.794	0.16	0.4	6.5	136
	LACK3.0	SRBC-604(b) Report	*	11/26/2001	26,929.87	0	32	0.33	0.131	0.742	6.7	58.6
	LACK3.0	SRBC-604(b) Report	*	2/18/2002	89,766.23	0	24	<0.300	0.138	<0.500	6.7	54.4
	LACK3.0	SRBC-604(b) Report	*	3/25/2002	78,994.29	0	22	<0.300	0.083	<0.500	6.7	33.1
	LACK3.0	SRBC-604(b) Report	*	4/29/2002	323,158.40	0	17	0.389	0.107	<0.500	6.6	<20
	LACK3.0	SRBC-604(b) Report	*	6/10/2002	135,098.20	0	24	<0.300	0.1	<0.500	6.5	26.5
	LACK3.0	SRBC-604(b) Report	*	7/15/2002	21,992.73	0	36	<0.300	0.099	<0.500	7.2	48.7
				Average=	97,130.90	0.00	27.57	0.50	0.12	0.57	6.70	59.55
				StDev=	109669.79	0	7.8285	0.2526	0.0269	0.2418	0.238	39.45

	MD-1Dana Tunnel	Archibald Power Corp.	35940201	2/15/1995	*	5.01	2.54	0.04	0.31	0.96	5.46	177.1
	MD-1Dana Tunnel	Archibald Power Corp.	35940201	8/14/1995	*	0	10.4	0.197	0.72	*	5.92	232
	MD-1Dana Tunnel	Archibald Power Corp.	35940201	11/15/1995	*	8	2.7	0.022	0.329	*	5.84	202
	MD-1Dana Tunnel	Archibald Power Corp.	35940201	2/21/1996	*	0.67	3.7	0.083	0.234	0.78	5.89	163

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid mg/l	Alk mg/l	Fe mg/l	Mn mg/l	Al mg/l	pH	Sulfate, mg/L
	MD-1Dana Tunnel	Archibald Power Corp.	35940201	5/20/1996	*	<0.4	15.8	0.14	0.22	*	6.52	136
	MD-1Dana Tunnel	Archibald Power Corp.	35940201	2/12/1997	*	6.96	3.88	0.14	0.33	1.5	5.79	174
	MD-1Dana Tunnel	Archibald Power Corp.	35940201	5/29/1997	*	<0.4	14.3	0.27	0.24	*	6.39	159
	MD-1Dana Tunnel	Archibald Power Corp.	35940201	3/2/1998	*	7.88	1.94	0.27	0.5	2.19	4.85	175
	MD-1Dana Tunnel	Archibald Power Corp.	35940201	5/14/1998	*	<0.4	15.8	0.12	0.37	*	6.39	155
	MD-1Dana Tunnel	Archibald Power Corp.	35940201	8/12/1998	*	12.8	1.6	0.08	1	*	4.84	305
	MD-1Dana Tunnel	Archibald Power Corp.	35940201	11/18/1998	*	28	1.6	0.05	0.86	*	4.73	368
	MD-1Dana Tunnel	Archibald Power Corp.	35940201	6/1/1999	*	<0.4	20.1	0.29	0.27	*	6.18	197

	Flow	Acid	Alk	Fe	Mn	Al	pH	Sulfate
Average=	*	8.67	7.86	0.14	0.45	1.36	5.73	203.59
StDev=	*	8.84	6.91	0.09	0.27	0.63	0.63	68.18

	Gravity Slope Outfall	Pa. DEP - BAMR	*	3/1/1983	3865	3	12	1.1	*	*	5.52	156
	Gravity Slope Outfall	Pa. DEP - BAMR	*	4/4/1983	4489	3	9	1.7	*	*	5.49	171
	Gravity Slope Outfall	Pa. DEP - BAMR	*	5/2/1983	14103	4	10	1.3	*	*	5.41	169
	Gravity Slope Outfall	Pa. DEP - BAMR	*	6/6/1983	5171	5	8	0.6	*	*	5.27	181
	Gravity Slope Outfall	Pa. DEP - BAMR	*	7/11/1983	3711	12	8	0.8	*	*	5.18	160
	Gravity Slope Outfall	Pa. DEP - BAMR	*	8/8/1983	3602	6	7	0.5	*	*	5.21	188
	Gravity Slope Outfall	Pa. DEP - BAMR	*	9/7/1983	749	4	6	0.6	*	*	5.20	193
	Gravity Slope Outfall	Pa. DEP - BAMR	*	10/4/1983	541	11	4	0.6	*	*	5.07	176
	Gravity Slope Outfall	Pa. DEP - BAMR	*	11/1/1983	435	8	47	0.9	*	*	5.32	185
	Gravity Slope Outfall	Pa. DEP - BAMR	*	12/5/1983	2166	3	13	1.1	*	*	5.58	184
	Gravity Slope Outfall	Pa. DEP - BAMR	*	1/3/1984	4496	6	8	1.4	*	*	5.37	199
	Gravity Slope Outfall	Pa. DEP - BAMR	*	2/1/1984	1935	4	8	1.2	*	*	5.39	175
	Gravity Slope Outfall	Pa. DEP - BAMR	*	3/6/1984	5251	10	9	1.5	*	*	5.32	127
	Gravity Slope Outfall	Pa. DEP - BAMR	*	4/3/1984	4897	5	9	1.3	*	*	5.32	166
	Gravity Slope Outfall	Pa. DEP - BAMR	*	5/7/1984	6256	6	9	1.1	*	*	5.36	104
	Gravity Slope Outfall	Pa. DEP - BAMR	*	6/4/1984	11687	4	9	1.1	*	*	5.46	107
	Gravity Slope Outfall	Pa. DEP - BAMR	*	7/2/1984	6599	2	11	0.9	*	*	5.41	167
	Gravity Slope Outfall	Pa. DEP - BAMR	*	8/2/1984	4176	16	10	0.7	*	*	5.39	174
	Gravity Slope Outfall	Pa. DEP - BAMR	*	9/4/1984	1977	3	9	0.6	*	*	5.43	170
	Gravity Slope Outfall	Pa. DEP - BAMR	*	10/2/1984	1038	4	8	0.7	*	*	5.35	179
	Gravity Slope Outfall	Pa. DEP - BAMR	*	11/2/1984	784	4	8	0.8	*	*	5.38	160
	Gravity Slope Outfall	Pa. DEP - BAMR	*	12/5/1984	1228	13	12	0.9	*	*	5.53	141
	Gravity Slope Outfall	Pa. DEP - BAMR	*	1/3/1985	3489	13	14	1.3	*	*	5.53	176

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid mg/l	Alk mg/l	Fe mg/l	Mn mg/l	Al mg/l	pH	Sulfate, mg/L
	Gravity Slope Outfall	Pa. DEP - BAMR	*	2/4/1985	2008	0	10	0.9	*	*	5.45	159
	Gravity Slope Outfall	Pa. DEP - BAMR	*	3/4/1985	4080	5	10	1.5	*	*	5.37	169
	Gravity Slope Outfall	Pa. DEP - BAMR	*	4/2/1985	3924	7	11	1.4	*	*	5.56	146
	Gravity Slope Outfall	Pa. DEP - BAMR	*	5/2/1985	3333	0	10	1.4	*	*	5.46	143
	Gravity Slope Outfall	Pa. DEP - BAMR	*	6/4/1985	3599	0	10	1.3	*	*	5.51	147
	Gravity Slope Outfall	Pa. DEP - BAMR	*	7/1/1985	2704	0	11	1.1	*	*	5.51	137
	Gravity Slope Outfall	Pa. DEP - BAMR	*	8/2/1985	2992	0	12	1.2	*	*	5.53	126
	Gravity Slope Outfall	Pa. DEP - BAMR	*	9/9/1985	2271	0	13	0.9	*	*	5.71	136
	Gravity Slope Outfall	Pa. DEP - BAMR	*	10/7/1985	10493	0	18	0.6	*	*	5.78	140
	Gravity Slope Outfall	Pa. DEP - BAMR	*	11/1/1985	5008	6	11	0.5	*	*	5.62	151
	Gravity Slope Outfall	Pa. DEP - BAMR	*	12/4/1985	10583	0	14	0.4	*	*	6.21	137
	Gravity Slope Outfall	Pa. DEP - BAMR	*	1/7/1986	4888	12	10	0.5	*	*	5.39	174
	Gravity Slope Outfall	Pa. DEP - BAMR	*	2/5/1986	6806	0	12	*	*	*	5.59	120
	Gravity Slope Outfall	CJC Coal Co.	35773205	10/31/1984	*	80	0	0.66	1.5	0.15	5.4	216
	Gravity Slope (Peckville Shaft)	USGS	*	11/4/1999	4937.14	41	2	0.47	0.79	0.051	5.8	130
				Average=	4331.65	7.89	10.58	0.96	1.15	0.10	5.46	158.92
				StDev=	3134.92	8.03	10.54	0.96	1.15	0.10	5.46	159.00

LR2	LACK2.0	SRBC-604(b) Report	*	11/26/2001	54,308.57	0	36	0.348	0.067	0.753	6.9	54.8
	LACK2.0	SRBC-604(b) Report	*	2/18/2002	165,169.90	0	26	<0.300	0.139	0.51	7.1	50.7
	LACK2.0	SRBC-604(b) Report	*	3/26/2002	157,539.70	0	26	<0.300	0.089	<0.500	6.9	37.5
	LACK2.0	SRBC-604(b) Report	*	4/30/2002	586,397.90	0	19	<0.300	0.094	<0.500	6.7	37.2
	LACK2.0	SRBC-604(b) Report	*	6/10/2002	338,418.70	0	24	<0.300	0.092	<0.500	6.8	30.5
	LACK2.0	SRBC-604(b) Report	*	7/16/2002	34,560.00	0	38	<0.300	0.07	<0.500	7.3	66.8
				Average=	222,732.46	0.00	28.17	0.35	0.09	0.63	6.95	46.25
				StDev=	208314.61	0	7.3326	*	0.0258	0.1718	0.2168	13.58

	Lackawanna Outfall	Pa. DEP - BAMR	*	3/1/1983	385	32	16	17.6	*	*	5.60	146
	Lackawanna Outfall	Pa. DEP - BAMR	*	4/4/1983	919	37	12	17	*	*	5.45	138
	Lackawanna Outfall	Pa. DEP - BAMR	*	5/2/1983	4081	30	0	8.5	*	*	4.40	152
	Lackawanna Outfall	Pa. DEP - BAMR	*	6/6/1983	1057	24	3	9.8	*	*	4.79	158
	Lackawanna Outfall	Pa. DEP - BAMR	*	7/11/1983	513	25	6	11.2	*	*	5.12	132

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid mg/l	Alk mg/l	Fe mg/l	Mn mg/l	Al mg/l	pH	Sulfate, mg/L
	Lackawanna Outfall	Pa. DEP - BAMR	*	8/8/1983	*	*	*	*	*	*	*	*
	Lackawanna Outfall	Pa. DEP - BAMR	*	9/7/1983	*	*	*	*	*	*	*	*
	Lackawanna Outfall	Pa. DEP - BAMR	*	10/4/1983	*	*	*	*	*	*	*	*
	Lackawanna Outfall	Pa. DEP - BAMR	*	11/1/1983	*	*	*	*	*	*	*	*
	Lackawanna Outfall	Pa. DEP - BAMR	*	12/5/1983	*	*	*	*	*	*	*	*
	Lackawanna Outfall	Pa. DEP - BAMR	*	1/3/1984	382	31	10	16	*	*	5.45	137
	Lackawanna Outfall	Pa. DEP - BAMR	*	2/1/1984	227	31	11	14.8	*	*	5.44	149
	Lackawanna Outfall	Pa. DEP - BAMR	*	3/6/1984	691	28	7	10.7	*	*	5.25	129
	Lackawanna Outfall	Pa. DEP - BAMR	*	4/3/1984	2694	24	5	11.8	*	*	5.10	125
	Lackawanna Outfall	Pa. DEP - BAMR	*	5/7/1984	3099	23	0	8.8	*	*	4.07	126
	Lackawanna Outfall	Pa. DEP - BAMR	*	6/4/1984	6722	18	0	5.5	*	*	4.40	130
	Lackawanna Outfall	Pa. DEP - BAMR	*	7/2/1984	6138	30	1	7.3	*	*	4.60	162
	Lackawanna Outfall	Pa. DEP - BAMR	*	8/2/1984	1068	29	5	7.8	*	*	5.05	137
	Lackawanna Outfall	Pa. DEP - BAMR	*	9/4/1984	40	30	7	10.6	*	*	5.25	159
	Lackawanna Outfall	Pa. DEP - BAMR	*	10/2/1984	*	*	*	*	*	*	*	*
	Lackawanna Outfall	Pa. DEP - BAMR	*	11/2/1984	*	*	*	*	*	*	*	*
	Lackawanna Outfall	Pa. DEP - BAMR	*	12/5/1984	100	34	14	14.3	*	*	5.51	139
	Lackawanna Outfall	Pa. DEP - BAMR	*	1/3/1985	1568	64	10	14.1	*	*	5.32	148
	Lackawanna Outfall	Pa. DEP - BAMR	*	2/4/1985	*	*	*	*	*	*	*	*
	Lackawanna Outfall	Pa. DEP - BAMR	*	3/4/1985	1125	36	10	13	*	*	5.29	160
	Lackawanna Outfall	Pa. DEP - BAMR	*	4/2/1985	648	39	8	12.5	*	*	5.32	166
	Lackawanna Outfall	Pa. DEP - BAMR	*	5/2/1985	75	57	9	12.7	*	*	5.31	143
	Lackawanna Outfall	Pa. DEP - BAMR	*	6/4/1985	869	29	1	12.9	*	*	4.55	174
	Lackawanna Outfall	Pa. DEP - BAMR	*	7/1/1985	40	26	10	13.4	*	*	5.45	162
	Lackawanna Outfall	Pa. DEP - BAMR	*	8/2/1985	1269	39	8	14	*	*	5.20	160
	Lackawanna Outfall	Pa. DEP - BAMR	*	9/9/1985	25	24	12	13.5	*	*	5.60	156
	Lackawanna Outfall	Pa. DEP - BAMR	*	10/7/1985	2239	34	6	11.3	*	*	5.19	112
	Lackawanna Outfall	Pa. DEP - BAMR	*	11/1/1985	75	16	1	11.3	*	*	4.65	154
	Lackawanna Outfall	Pa. DEP - BAMR	*	12/4/1985	2708	24	10	10.3	*	*	5.47	157
	Lackawanna Outfall	Pa. DEP - BAMR	*	1/7/1986	330	33	10	12.6	*	*	5.31	137
	Lackawanna Outfall	Pa. DEP - BAMR	*	2/5/1986	871	22	12	*	*	*	5.45	142
				Average=	1427.07	31.04	7.29	11.97	*	*	5.13	146.07
				StDev=	1756.37	10.17	4.55	2.90	*	*	0.41	14.72

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid mg/l	Alk mg/l	Fe mg/l	Mn mg/l	Al mg/l	pH	Sulfate, mg/L
	Old Forge Discharge	Pa. DEP - BAMR	*	3/1/1983	*	3	87	37	*	*	5.95	556
	Old Forge Discharge	Pa. DEP - BAMR	*	4/4/1983	*	2	83	45	*	*	5.92	542
	Old Forge Discharge	Pa. DEP - BAMR	*	5/2/1983	*	0	76	31.2	*	*	5.92	505
	Old Forge Discharge	Pa. DEP - BAMR	*	6/6/1983	*	3	80	32.4	*	*	5.91	507
	Old Forge Discharge	Pa. DEP - BAMR	*	7/11/1983	*	1	107	31.4	*	*	5.78	430
	Old Forge Discharge	Pa. DEP - BAMR	*	8/8/1983	*	0	81	24.3	*	*	5.94	526
	Old Forge Discharge	Pa. DEP - BAMR	*	9/6/1983	*	0	87	31.1	*	*	5.98	473
	Old Forge Discharge	Pa. DEP - BAMR	*	10/4/1983	*	0	108	30.8	*	*	5.76	541
	Old Forge Discharge	Pa. DEP - BAMR	*	11/1/1983	*	0	82	32.6	*	*	5.91	427
	Old Forge Discharge	Pa. DEP - BAMR	*	12/5/1983	*	1	87	34	*	*	5.96	515
	Old Forge Discharge	Pa. DEP - BAMR	*	1/3/1984	*	0	87	32.5	*	*	6.00	560
	Old Forge Discharge	Pa. DEP - BAMR	*	2/1/1984	*	5	86	33	*	*	5.92	365
	Old Forge Discharge	Pa. DEP - BAMR	*	3/6/1984	*	1	84	30	*	*	5.97	501
	Old Forge Discharge	Pa. DEP - BAMR	*	4/3/1984	*	0	80	32	*	*	5.91	478
	Old Forge Discharge	Pa. DEP - BAMR	*	5/7/1984	*	0	73	28.2	*	*	5.93	438
	Old Forge Discharge	Pa. DEP - BAMR	*	6/4/1984	*	0	82	24	*	*	5.99	497
	Old Forge Discharge	Pa. DEP - BAMR	*	7/2/1984	*	0	78	19.4	*	*	5.93	461
	Old Forge Discharge	Pa. DEP - BAMR	*	8/2/1984	*	0	93	22.8	*	*	6.01	441
	Old Forge Discharge	Pa. DEP - BAMR	*	9/4/1984	*	0	91	24.6	*	*	6.02	471
	Old Forge Discharge	Pa. DEP - BAMR	*	10/2/1984	*	0	91	28	*	*	6.00	630
	Old Forge Discharge	Pa. DEP - BAMR	*	11/2/1984	*	0	91	27.5	*	*	6.06	633
	Old Forge Discharge	Pa. DEP - BAMR	*	12/5/1984	*	0	92	30.8	*	*	6.01	535
	Old Forge Discharge	Pa. DEP - BAMR	*	1/3/1985	*	0	102	33	*	*	5.96	620
	Old Forge Discharge	Pa. DEP - BAMR	*	2/4/1985	*	0	14	32.4	*	*	5.89	573
	Old Forge Discharge	Pa. DEP - BAMR	*	3/4/1985	*	0	89	34	*	*	5.94	603
	Old Forge Discharge	Pa. DEP - BAMR	*	4/2/1985	*	0	87	35.4	*	*	6.05	588
	Old Forge Discharge	Pa. DEP - BAMR	*	5/2/1985	*	0	85	32.2	*	*	5.89	556
	Old Forge Discharge	Pa. DEP - BAMR	*	6/4/1985	*	0	82	31	*	*	5.96	513
	Old Forge Discharge	Pa. DEP - BAMR	*	7/1/1985	*	2	89	28	*	*	5.93	555
	Old Forge Discharge	Pa. DEP - BAMR	*	8/2/1985	*	0	79	30.6	*	*	5.84	511
	Old Forge Discharge	Pa. DEP - BAMR	*	9/9/1985	*	0	85	31.4	*	*	6.03	549
	Old Forge Discharge	Pa. DEP - BAMR	*	10/7/1985	*	1	84	30.8	*	*	6.05	469
	Old Forge Discharge	Pa. DEP - BAMR	*	11/1/1985	*	12	80	28	*	*	5.99	518
	Old Forge Discharge	Pa. DEP - BAMR	*	12/4/1985	*	0	84	28.4	*	*	5.97	345
	Old Forge Discharge	Pa. DEP - BAMR	*	1/7/1986	*	0	83	28.2	*	*	5.84	404
	Old Forge Discharge	Pa. DEP - BAMR	*	2/5/1986	*	0	8	*	*	*	5.96	497

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid mg/l	Alk mg/l	Fe mg/l	Mn mg/l	Al mg/l	pH	Sulfate, mg/L
	Old Forge Discharge	SRBC-Lackawanna River Priority Water Body Survey Report	*	10/19/1988	27378.7	0	102	32.2	3.86	0.07	6	479
	Old Forge Borehole	USGS	*	11/3/1999	34919.06	9	186	18	2.5	0.015	6.1	400
				Average=	31148.88	1.05	85.39	30.17	3.18	0.04	5.95	505.58
				StDev=	5331.84	2.54	25.19	4.81	0.96	0.04	0.07	69.18

	Duryea Outfall	Pa. DEP - BAMR	*	3/1/1983	9519	5	89	43.5	*	*	5.95	399
	Duryea Outfall	Pa. DEP - BAMR	*	4/4/1983	10831	3	86	48	*	*	5.94	345
	Duryea Outfall	Pa. DEP - BAMR	*	5/2/1983	27615	6	77	37.2	*	*	5.91	389
	Duryea Outfall	Pa. DEP - BAMR	*	6/6/1983	14914	4	86	39	*	*	5.93	508
	Duryea Outfall	Pa. DEP - BAMR	*	7/11/1983	12558	9	86	40.7	*	*	5.84	356
	Duryea Outfall	Pa. DEP - BAMR	*	8/8/1983	11056	1	86	31.6	*	*	5.95	530
	Duryea Outfall	Pa. DEP - BAMR	*	9/6/1983	10077	0	89	36.2	*	*	6.02	481
	Duryea Outfall	Pa. DEP - BAMR	*	10/4/1983	9198	2	83	39	*	*	5.83	425
	Duryea Outfall	Pa. DEP - BAMR	*	11/1/1983	9047	0	89	38	*	*	5.96	456
	Duryea Outfall	Pa. DEP - BAMR	*	12/5/1983	10070	2	89	40.5	*	*	5.96	489
	Duryea Outfall	Pa. DEP - BAMR	*	1/3/1984	13231	8	86	40	*	*	6.00	535
	Duryea Outfall	Pa. DEP - BAMR	*	2/1/1984	10520	3	85	40	*	*	6.02	473
	Duryea Outfall	Pa. DEP - BAMR	*	3/6/1984	13200	5	81	37.5	*	*	5.92	451
	Duryea Outfall	Pa. DEP - BAMR	*	4/3/1984	13713	5	82	38.6	*	*	5.90	453
	Duryea Outfall	Pa. DEP - BAMR	*	5/7/1984	18175	2	76	36.4	*	*	5.92	419
	Duryea Outfall	Pa. DEP - BAMR	*	6/4/1984	26113	5	75	33	*	*	5.95	432
	Duryea Outfall	Pa. DEP - BAMR	*	7/2/1984	25481	0	87	34	*	*	5.90	474
	Duryea Outfall	Pa. DEP - BAMR	*	8/2/1984	15404	0	86	32	*	*	5.97	441
	Duryea Outfall	Pa. DEP - BAMR	*	9/4/1984	12795	0	85	29	*	*	6.03	453
	Duryea Outfall	Pa. DEP - BAMR	*	10/2/1984	10595	0	87	35.8	*	*	6.00	476
	Duryea Outfall	Pa. DEP - BAMR	*	11/2/1984	9765	0	87	36	*	*	6.08	504
	Duryea Outfall	Pa. DEP - BAMR	*	12/5/1984	9548	0	90	35	*	*	6.01	457
	Duryea Outfall	Pa. DEP - BAMR	*	1/3/1985	10609	0	89	39	*	*	5.99	492
	Duryea Outfall	Pa. DEP - BAMR	*	2/4/1985	9355	0	87	37.6	*	*	5.94	516
	Duryea Outfall	Pa. DEP - BAMR	*	3/4/1985	10357	0	89	38	*	*	5.94	526
	Duryea Outfall	Pa. DEP - BAMR	*	4/2/1985	10947	1	89	39.5	*	*	6.08	514
	Duryea Outfall	Pa. DEP - BAMR	*	5/2/1985	10104	0	89	37	*	*	5.94	498
	Duryea Outfall	Pa. DEP - BAMR	*	6/4/1985	12647	2	86	36.8	*	*	5.99	517
	Duryea Outfall	Pa. DEP - BAMR	*	7/1/1985	10471	6	89	36	*	*	5.94	532

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid mg/l	Alk mg/l	Fe mg/l	Mn mg/l	Al mg/l	pH	Sulfate, mg/L
	Duryea Outfall	Pa. DEP - BAMR	*	8/2/1985	10963	0	80	39	*	*	5.83	517
	Duryea Outfall	Pa. DEP - BAMR	*	9/9/1985	9331	0	89	35.6	*	*	6.05	517
	Duryea Outfall	Pa. DEP - BAMR	*	10/7/1985	15844	2	82	38	*	*	6.02	447
	Duryea Outfall	Pa. DEP - BAMR	*	11/1/1985	11670	2	90	35.2	*	*	5.95	464
	Duryea Outfall	Pa. DEP - BAMR	*	12/4/1985	16700	3	80	32.5	*	*	5.88	446
	Duryea Outfall	Pa. DEP - BAMR	*	1/7/1986	12820	0	87	38	*	*	5.85	463
	Duryea Outfall	Pa. DEP - BAMR	*	2/5/1986	13902	2	86	*	*	*	5.96	485
	Duryea Discharge	SRBC-Lackawanna River Priority Water Body Survey Report	*	10/19/1988	8438.03	0	94	4.19	0.087	0.102	6.4	431
	Duryea Breach Seepage	USGS	*	11/3/1999	1122.08	9	134	20	2.8	0.14	5.9	400
				Average=	12597.50	2.29	87.03	35.88	1.44	0.12	5.96	466.08
				StDev=	4995.59	2.71	8.85	6.94	1.92	0.03	0.10	48.09

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid mg/l	Alk mg/l	Fe mg/l	Mn mg/l	Al mg/l	pH	Sulfate, mg/L
LR1	LACK1.0	SRBC-604(b) Report	*	11/27/2001	calc.	0	68	10.5	1.35	0.664	6.6	221
	LACK1.0	SRBC-604(b) Report	*	2/18/2002	calc.	0	38	2.94	0.521	<0.500	6.7	77.5
	LACK1.0	SRBC-604(b) Report	*	3/26/2002	calc.	0	38	2.15	0.371	<0.500	6.6	73.9
	LACK1.0	SRBC-604(b) Report	*	4/30/2002	calc.	0	24	1.21	0.199	<0.500	6.5	30.2
	LACK1.0	SRBC-604(b) Report	*	6/10/2002	calc.	15.4	32	2.04	0.359	<0.500	6.4	40.5
	LACK1.0	SRBC-604(b) Report	*	7/16/2002	calc.	0	68	5.03	1.2	<0.500	6.7	185.6
				Average=	266,478.84	2.57	44.67	3.98	0.67	0.66	6.58	104.78
				StDev=	*	6.28702	18.79	3.4491	0.4844	*	0.1169	79.29

"*" signifies no data were collected

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

Note: Instream flow for the following points was calculated in the given manners:

LR2 = calculated using the unit area method based on a USGS gage station at Old Forge.

LR1 = calculated by adding the average flow of the Old Forge and Duryea discharges to the average flow at LR2.

Attachment F

Comment and Response

No Comments Received