FINAL

LAUREL BRANCH RUN WATERSHED TMDL

Clearfield County

For Acid Mine Drainage Affected Segments

Prepared by:

Pennsylvania Department of Environmental Protection

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TABLE OF CONTENTS

FIGURES

TABLES

ATTACHMENTS

[1]TMDL

Laurel Branch Run Watershed
Clearfield County, Pennsylvania

Table 1. 303(d) Sub-List								
State Water Plan (SWP) Subbasin: 17-D Laurel Branch Run								
Year	**Miles**	**Segment ID Assessment ID**	**DEP Stream Code**	**Stream Name**	**Designated Use**	**Data Source**	**Source**	**EPA 305(b) Cause Code**
1996	1.4	5302	48023	Laurel Branch Run	HQ-CWF	RE	AMD	pH Metals
1998	3.09	5302	48023	Laurel Branch Run	HQ-CWF	SWMP	AMD	pH Metals
2002	3.1	5302	48023	Laurel Branch Run	HQ-CWF	SWMP	AMD	pH Metals
2004	3.1	5302	48023	Laurel Branch Run	HQ-CWF	SWMP	AMD	pH Metals

Resource Extraction = RE
High Quality = HQ
Cold Water Fishery = CWF
Resource Extraction = RE
Surface Water Monitoring Program = SWMP
Abandoned Mine Drainage = AMD
See Attachment D, *Excerpts Justifying Changes Between the 1996, 1998, 2002 and 2004 Section 303(d) Lists.*
The use designations for the stream segments in this TMDL can be found in PA Title 25 Chapter 93

Introduction

This Total Maximum Daily Load (TMDL) calculation has been prepared for one segment in the Laurel Branch Run Watershed (Attachment A). It was done to address the impairments noted on the 1996 Pennsylvania 303(d) list, required under the Clean Water Act, and covers one segment on this list (shown in Table 1). High levels of metals and in some areas depressed pH caused these impairments. Impairments resulted due to acid drainage from abandoned coalmines. The TMDL addresses the three primary metals associated with acid mine drainage (iron, manganese, aluminum) and pH.

Directions to the Laurel Branch Run Watershed

The Laurel Branch Run Watershed is located in North Central Pennsylvania, occupying a northwestern portion of Clearfield County in Bell, Brady and Penn Townships. The watershed area is found on United States Geological Survey maps covering Luthersburg and Mahaffey 7.5-Minute Quadrangles. Land use within the watershed includes abandoned mine lands as well as forestlands with a few homes scattered across the watershed area.

Laurel Branch Run lies between the towns of Luthersburg and Irishtown. State Route 219 passes to the northeast of the watershed. One can access the watershed by traveling on State Route 219

[1] Pennsylvania's 1996, 1998, 2002 and 2004 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 1996 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

to Chestnut Grove. From Chestnut Grove, the watershed can be accessed by traveling south on Irishtown Road for approximately 2.5 miles. This will be near the headwaters of Laurel Branch watershed.

Hydrology of Laurel Branch Run Watershed

The area within the watershed consists of 2.89 square miles. The Laurel Branch Run Watershed consists of a main stem and five unnamed tributaries. Laurel Branch Run flows from an elevation of 1900 feet above sea level in its headwaters to an elevation of 1600 feet above sea level at its confluence with Beech Run. Laurel Branch Run flows from the east to the west. Laurel Branch Run is part of the Allegheny River watershed.

Geology of Laurel Branch Run Watershed

The Laurel Branch Run watershed lies within the Appalachian Plateaus Physiographic Province. The watershed area is comprised of Pennsylvanian aged rocks. The Chestnut Ridge Anticline crosses the watershed near its headwaters. The axial bearing of the anticline is northeast-southwest. The strata in the watershed generally have a northeast-southwest trend and dip to the southeast in the lower reaches of the watershed and to the northwest in the headwaters of the watershed.

Older Pennsylvanian rocks of the Pottsville Group are exposed in the valleys of the watershed and the younger Pennsylvanian aged rocks of the Allegheny Group are on the hilltops and ridges surrounding the watershed. The coals are confined to the Allegheny Group.

Segments addressed in this TMDL

Laurel Branch Run is affected by pollution from AMD. This pollution has caused high levels of metals in the watershed. There are no active mining operations in the watershed. 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 Table 3 for TMDL calculations and see Attachment C for TMDL explanations.

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 (EPA) implementing regulations (40 CFR Part 130) require:

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

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

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

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

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

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

In the cases that have been settled to date, the consent agreements require EPA to backstop TMDL development, track TMDL development, review state monitoring programs, and fund studies on issues of concern (e.g., AMD, implementation of non-point 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 EPA, the states have developed methods for assessing the waters within their respective jurisdictions.

The primary method adopted by the Pennsylvania Department of Environmental Protection (DEP) for evaluating waters changed between the publication of the 1996 and 1998 Section 303(d) lists. Prior to 1998, data used to list streams were in a variety of formats, collected under differing protocols. Information also was gathered through the Section 305(b)[2] reporting process. DEP is now using the Statewide Surface Waters Assessment Protocol (SSWAP), a

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

modification of the EPA's 1989 Rapid Bioassessment Protocol II (RBP-II), as the primary mechanism to assess Pennsylvania's waters. The SSWAP provides a more consistent approach to assessing Pennsylvania's streams.

The assessment method requires selecting representative stream segments based on factors such as surrounding land uses, stream characteristics, surface geology, and point source discharge locations. The biologist selects as many sites as necessary to establish an accurate assessment for a stream segment; the length of the 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 source and cause. A TMDL must be developed for the stream segment and each pollutant. In order for the process to be more effective, adjoining stream segments with the same source and cause listing are addressed collectively, and on a watershed basis.

Basic Steps for Determining a TMDL

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

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

Watershed History

Much of the Laurel Branch Run watershed has been heavily mined by pre-law operations. Underground mining was conducted from the 1800's into the early 1900's. Many of these mines were left abandoned. In the mid 1900's strip mining became the prevalent method of mining. Mining companies whose names have long ago been forgotten mined the land with little or no reclamation. All of the abandoned mines in the watershed have led to the degradation of the Laurel Branch Run watershed. Today some of these sites are being remined and reclaimed which helps reduce the amount of spoils exposed to the weather and eliminates abandoned deep mines in the watershed.

MINING

The Johnson Brothers Coal Company, McMurray Mine Operation (41-00-05/78-41-40) (SMP17860133, PA 0115606) was issued on June 17, 1987. The total permit area was 226.6 acres with 165.0 acres to be affected. The Lower Freeport (85.4 acres) and Upper Kittanning (137.2 acres) coal seams were mined. Mining was completed in the summer of 2000. This site is currently backfilled and planted.

AMD Methodology

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

The statistical analysis described below can be applied to situations where all of the pollutant loading is from non-point sources as well as those where there are both point and non-point sources. The following defines what are considered point sources and non-point sources for the purposes of our evaluation; point sources are defined as permitted discharges, non-point sources are then any pollution sources that are not point sources. For situations where all of the impact is due to non-point 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 non-point sources, the evaluation will use the point-source data and perform a mass balance with the receiving water to determine the impact of the point source.

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

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

PR = required percent reduction for the current iteration

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

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.

In low pH TMDLs, acidity is compared to alkalinity as described in Attachment B. Each sample point used in the analysis of pH by this method must have measurements for total alkalinity and total acidity. 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 may not represent 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 all of the pollution sources in the watershed are nonpoint sources, the TMDL is expressed as Load Allocations (LAs). All allocations will be specified as long-term average daily concentrations. These long-term average concentrations are expected to meet water-quality criteria 99% of the time as required in PA Title 25 Chapter 96.3(c). The following table shows the applicable water-quality criteria for the selected parameters.

Table 2. Applicable Water Quality Criteria

Parameter	***Criterion Value (mg/l)***	***Total Recoverable/Dissolved***
Aluminum (Al)	0.75	Total Recoverable
Iron (Fe)	1.50	30-day average; Total
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).

For High Quality waters, applicable water-quality criteria are determined using the unimpaired segment of the TMDL water or the 95th percentile of a reference WQN stream. For Laurel Branch Run, WQN 267 Conewago Creek is used as the reference water. The following table shows the criteria used in the Laurel Branch Run TMDL development. Attachment D explains how to select a reference stream for HQ TMDL development.

Table 3. Reference Conewago Creek Criteria

Parameter	***Criterion Value (mg/l)***
Aluminum (Al)	0.200
Iron (Fe)	0.112
Manganese (Mn)	0.011
Area	6 mi2
Alkalinity	17.0

TMDL Elements (WLA, LA, MOS)

$$TMDL = WLA + LA + MOS$$

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 non-point sources. The margin of safety is applied to account for uncertainties in the computational process. The margin of safety may be expressed implicitly (documenting conservative processes in the computations) or explicitly (setting aside a portion of the allowable load). The TMDL allocations in this report are based on available data. Other allocation schemes could also meet the TMDL. Table 4 contains the TMDL component summary for each point evaluated in the watershed. Refer to the maps in Attachment A.

Allocation Summary

These TMDLs will focus remediation efforts on the identified numerical reduction targets for each watershed. The reduction schemes in Table 4 for each segment are based on the assumption that all upstream allocations are achieved and also take into account all upstream reductions. Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. As changes occur in the watershed, the TMDLs may be re-evaluated to reflect current conditions. An implicit margin of safety (MOS) based on conservative assumptions in the analysis is included in the TMDL calculations.

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

There currently are no permitted discharges in the Laurel Branch Run Watershed. The difference between the TMDL and the WLA is the load allocation (LA) at the point. The LA at each point includes all loads entering the segment, including those from upstream allocation points. The percent reduction is calculated to show the amount of load that needs to be reduced to the area upstream of the point in order for water quality standards to be met at the point.

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

Table 4. Laurel Branch Run Watershed Summary Table

Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	% Reduction
LBR11- LBR above 5th UNT confluence						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	0.39	0.02	0	0.02	0.37	95%
Manganese(lbs/day)	1.31	0.004	0	0.004	0.1.306	99.7%
Acidity (lbs/day)	35.35	8.63	0	8.63	26.72	76%
LBR10 - 5th UNT (48028), downstream						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	3.33	0.56	0	0.56	2.77	83%
Manganese(lbs/day)	3.67	0.04	0	0.04	3.63	99%
Acidity (lbs/day)	33.47	15.35	0	15.35	18.12	54%
LBR09 - LBR above 4th UNT confluence						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	27.20	1.33	0	1.33	22.73	94%
Manganese(lbs/day)	14.71	0.11	0	0.11	9.66	99%
Acidity (lbs/day)	115.24	36.93	0	36.93	33.47	48%
LBR08 - 4th UNT (48027), downstream						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	2.38	0.15	0	0.15	2.23	94%
Manganese(lbs/day)	3.62	0.03	0	0.03	3.59	99%
Acidity (lbs/day)	19.76	9.66	0	9.66	10.10	51%
LBR07 - LBR above 3rd UNT confluence						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	20.95	1.78	0	1.78	0.00	0%*
Manganese(lbs/day)	18.19	0.12	0	0.12	0.02	14%
Acidity (lbs/day)	125.26	45.06	0	45.06	0.00	0%*
LBR06 - 3rd UNT (48026), downstream						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	0.28	0.004	0	0.004	0.276	99%
Manganese(lbs/day)	0.11	0.0004	0	0.0004	0.1096	100%
Acidity (lbs/day)	2.82	0.72	0	0.72	2.10	74%
LBR05 - LBR above 2nd UNT confluence						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	18.88	1.11	0	1.11	0.48	30%
Manganese(lbs/day)	14.64	0.11	0	0.11	0.00	0%*
Acidity (lbs/day)	135.71	38.69	0	38.69	14.72	28%
LBR04 - 2nd UNT (48025) downstream						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA

Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	% Reduction
Iron (lbs/day)	ND	NA	0	NA	NA	NA
Manganese(lbs/day)	ND	NA	0	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA
LBR03 - LBR above 1st UNT confluence						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	15.45	1.04	0	1.04	0.00	0%*
Manganese(lbs/day)	15.45	0.21	0	0.21	0.71	77%
Acidity (lbs/day)	226.09	66.92	0	66.92	62.15	48%
LBR02 - 1st UNT (48024), downstream						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	0.97	0.03	0	0.03	0.94	97%
Manganese(lbs/day)	ND	NA	0	NA	NA	NA
Acidity (lbs/day)	2.62	2.62	0	NA	NA	NA
LBR01 - LBR mouth above confluence with Beech Run						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	15.84	1.01	0	1.01	0.02	2%
Manganese(lbs/day)	12.96	0.24	0	0.24	0.00	0%*
Acidity (lbs/day)	159.02	70.83	0	70.83	0.00	0%*

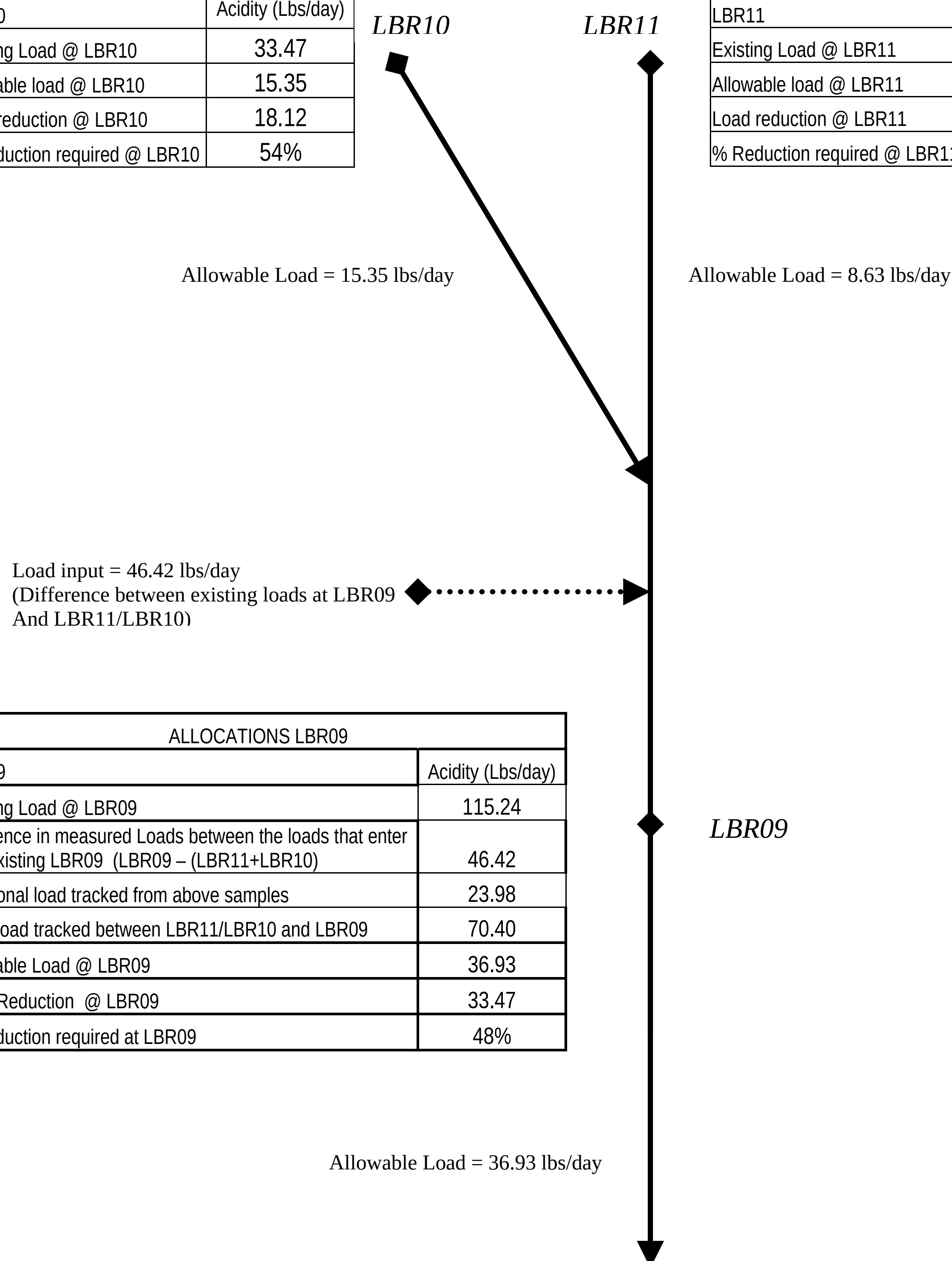
* Total of loads affecting this segment is less than the allowable load calculated at this point, therefore no reduction is necessary.
NA = not applicable

In the instance that the allowable load is equal to the measured load (e.g. acidity at LBR02, Table 4), the simulation determined that water quality standards are being met instream and therefore no TMDL is necessary for the parameter at that point. Although no TMDL is necessary, the loading at the point is considered at the next downstream point. This is denoted as "NA" in the above table.

Following is an example of how the allocations, presented in Table 4, for a stream segment are calculated. For this example, acidity allocations for LBR09 of Laurel Branch Run are shown. As demonstrated in the example, all upstream contributing loads are accounted for at each point. Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. These analyses follow the example. Attachment A contains maps of the sampling point locations for reference.

ALLOCATIONS LBR10	
LBR10	Acidity (Lbs/day)
Existing Load @ LBR10	33.47
Allowable load @ LBR10	15.35
Load reduction @ LBR10	18.12
% Reduction required @ LBR10	54%

ALLOCATIONS LBR11	
LBR11	Acidity (Lbs/day)
Existing Load @ LBR11	35.35
Allowable load @ LBR11	8.63
Load reduction @ LBR11	26.72
% Reduction required @ LBR11	76%



ALLOCATIONS LBR09	
LBR09	Acidity (Lbs/day)
Existing Load @ LBR09	115.24
Difference in measured Loads between the loads that enter and existing LBR09 (LBR09 – (LBR11+LBR10)	46.42
Additional load tracked from above samples	23.98
Total load tracked between LBR11/LBR10 and LBR09	70.40
Allowable Load @ LBR09	36.93
Load Reduction @ LBR09	33.47
% Reduction required at LBR09	48%

The allowable load tracked from LBR10 and LBR11 was 23.98 lbs/day. The existing load at LBR10 and LBR11 was subtracted from the existing load at LBR09 to show the actual measured increase of acidic load that has entered the stream between these two sample points (46.42 lbs/day). This increased value was then added to the allowable loads from LBR11 and LBR10 to calculate the total load that was tracked between LBR11 and LBR10 and LBR09 (allowable loads @ LBR11 and LBR10 + the difference in existing load between LBR11 and LBR10 and

LBR09). This total load tracked was then subtracted from the calculated allowable load at LBR09 to determine the amount of load to be reduced at LBR09. This total load value was found to be 70.40 lbs/day; it was 33.47 lbs/day greater then the LBR09 allowable load of 36.93 lbs/day. Therefore, a 48% acidic reduction at LBR09 is necessary. From this point, the allowable load at LBR09 will be tracked to the next downstream point, LBR07.

Recommendations

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

Additional opportunities for water quality improvement are both ongoing and anticipated. Historically, a great deal of research into mine drainage has been conducted by BAMR, 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 319 Grant program, and Pennsylvania's Growing Greener program have been used extensively to remedy mine drainage impacts. These many activities are expected to continue and result in water quality improvement.

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

Mine reclamation and well plugging refers to the process of cleaning up environmental pollutants and safety hazards associated with a site and returning the land to a productive condition, similar to DEP's Brownfields program. Since the 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

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.

The coal industry, through DEP-promoted remining efforts, can help to eliminate some sources of AMD and conduct some of the remediation identified in the above recommendations 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.

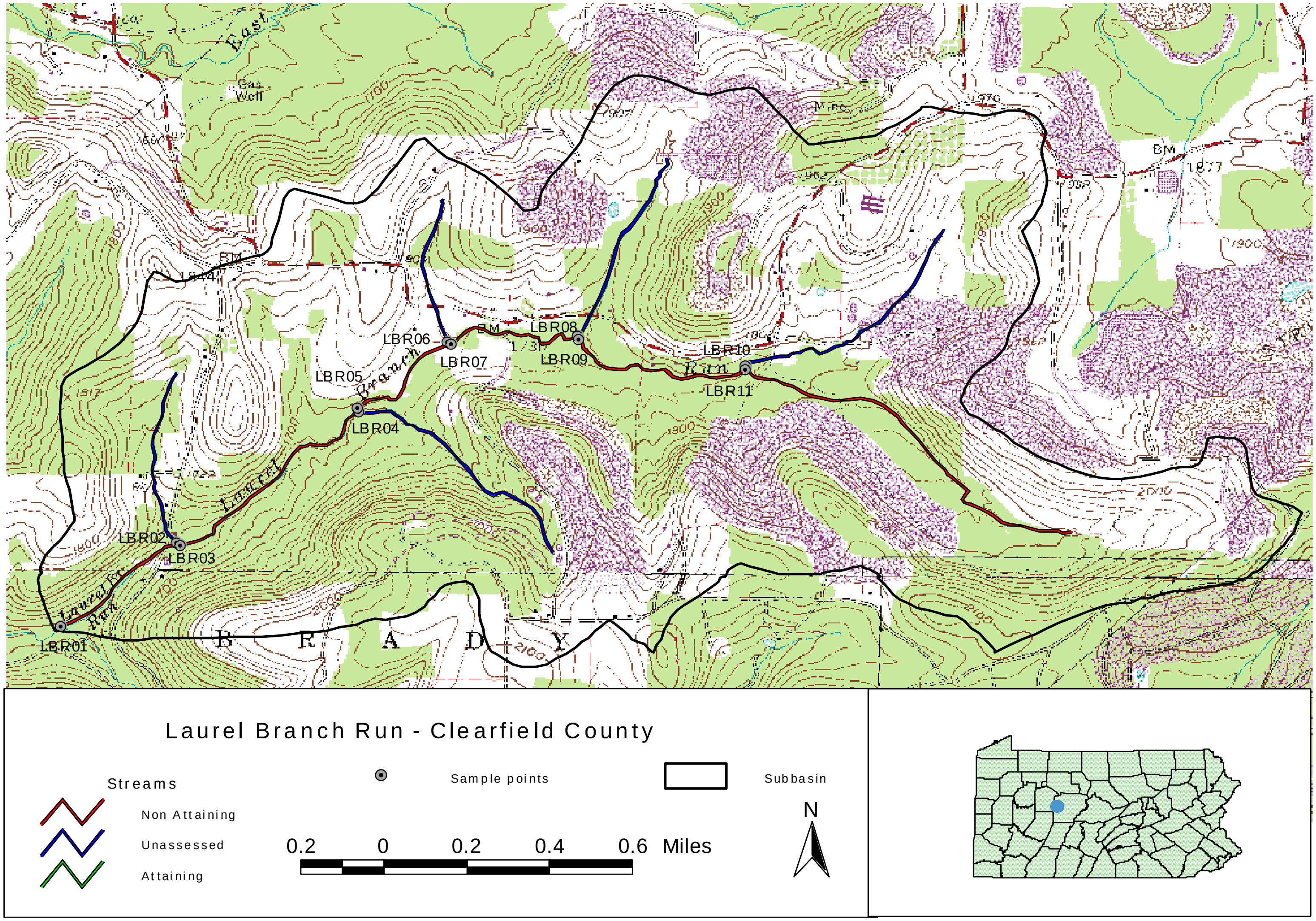
There is currently no watershed group focused on the Laurel Branch Run Watershed area. It is recommended that agencies work with local interests to form a watershed organization. This watershed organization could then work to implement projects to achieve the reductions recommended in this TMDL document.

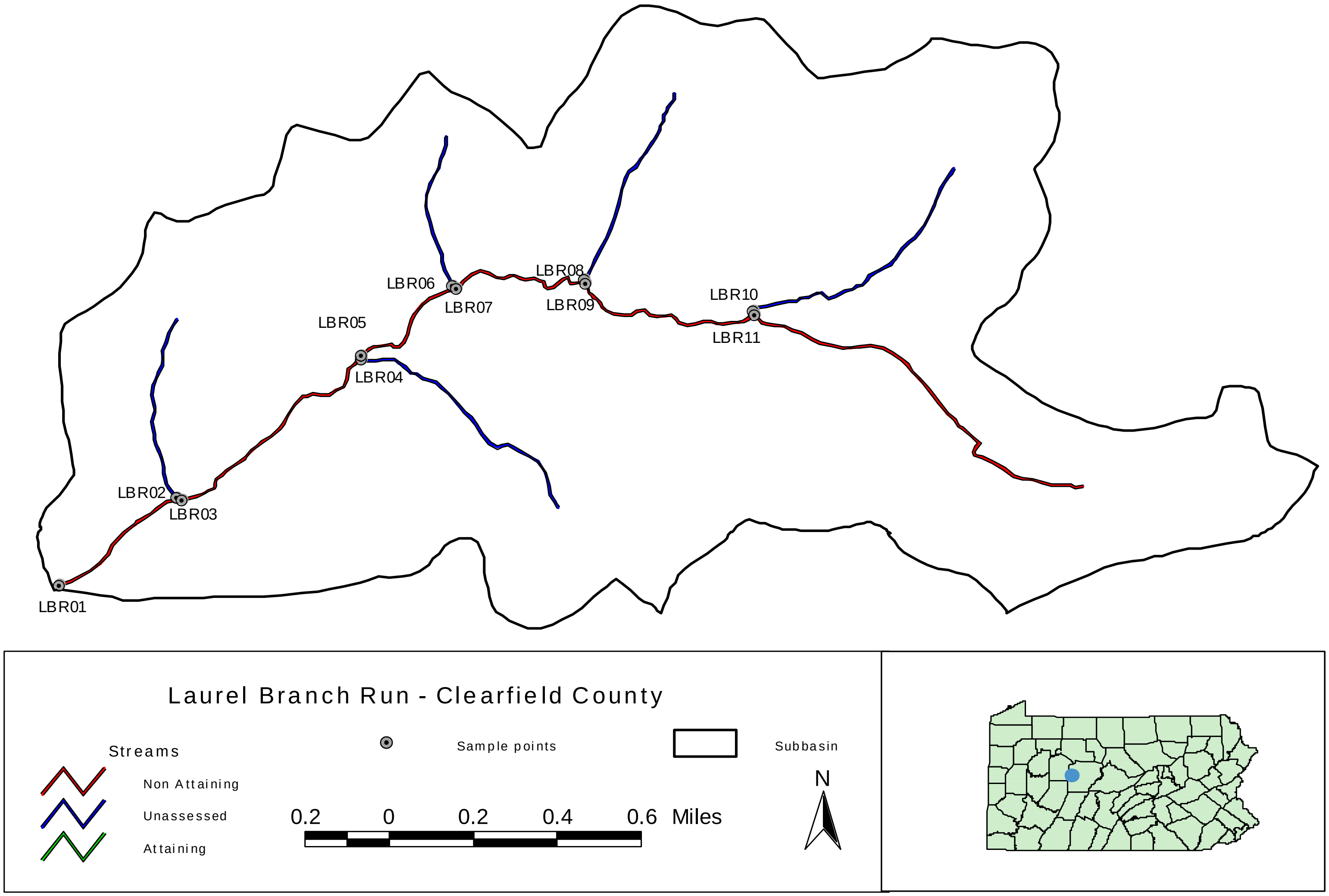
Public Participation

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* and *The Progress,* to foster public comment on the allowable loads calculated. A public meeting will be held on February 7, 2007 at the Moshannon District Mining Office, to discuss the proposed TMDL.

Attachment A

Laurel Branch Run Watershed Maps


Laurel Branch Run - Clearfield County
Streams
Non Attaining
Unassessed
Attaining
Sample points
Subbasin
0.2
0
0.2
0.4
0.6
Miles
N
LBR01
LBR02
LBR03
LBR04
LBR05
LBR06
LBR07
LBR08
LBR09
LBR10
LBR11
B R A D Y


LBR01
LBR02
LBR03
LBR04
LBR05
LBR06
LBR07
LBR08
LBR09
LBR10
LBR11
Laurel Branch Run - Clearfield County
Streams
Non Attaining
Unassessed
Attaining
Sample points
Subbasin
0.2 0 0.2 0.4 0.6 Miles
N

Attachment B

Method for Addressing Section 303(d) Listings
for pH

Method for Addressing Section 303(d) Listings for pH

There has been a great deal of research conducted on the relationship between alkalinity, acidity, and pH. Research published by the 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 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. 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. 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.

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

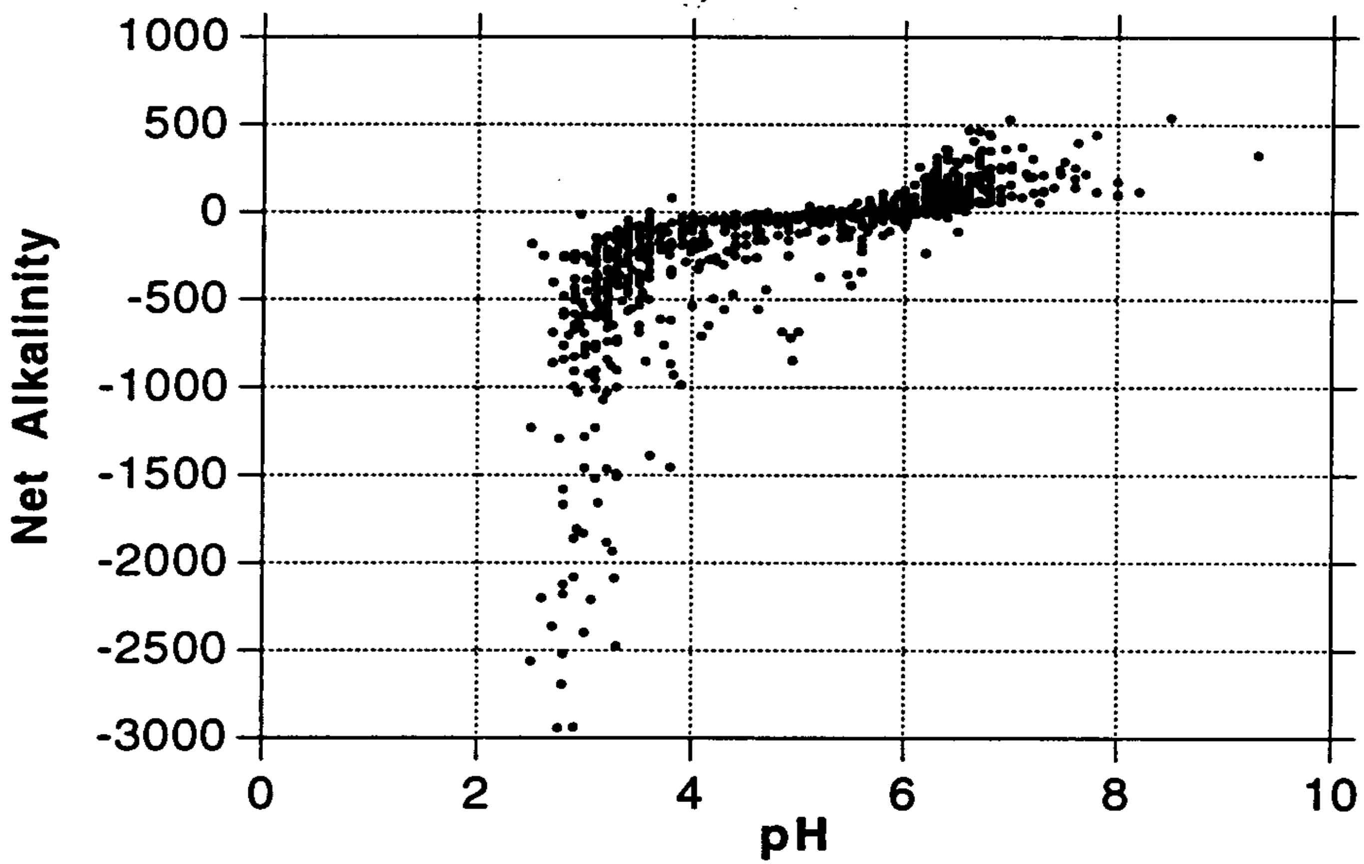


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Attachment C

TMDLs By Segment

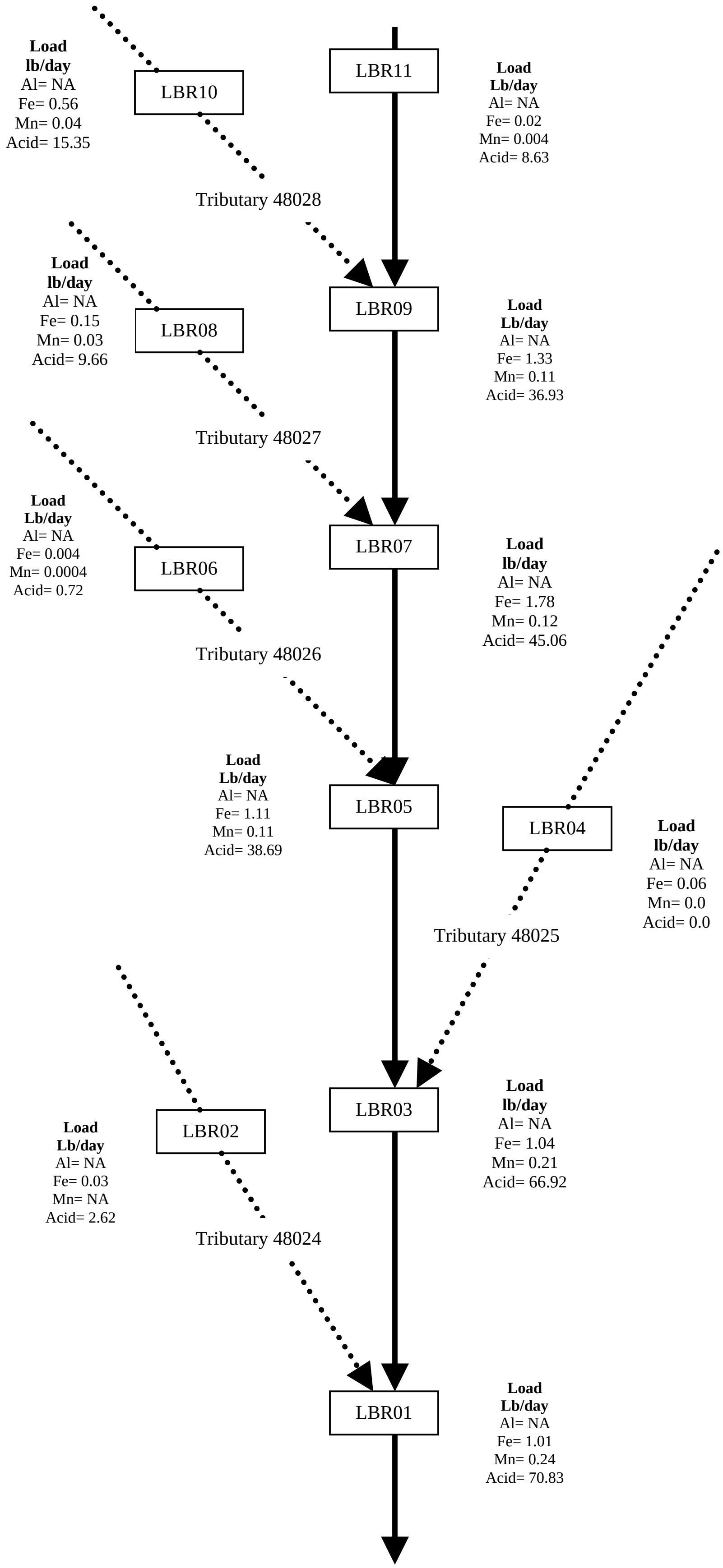
Laurel Branch Run

The TMDL for Laurel Branch Run consists of load allocations to six sampling sites along Laurel Branch Run (LBR11, LBR09, BR07, LBR05, LBR03 and LBR01) and five sampling sites on unnamed tributaries of Laurel Branch Run (LBR10, LBR08, LBR06, LBR04 and LBR02). Sample data sets were collected during 2003 and 2004. All sample points are shown on the maps included in Attachment A as well as on the loading schematic presented on the following page.

Laurel Branch Run is listed on the 1996 PA Section 303(d) list for pH and metals from AMD as being the cause of the degradation to this stream. This TMDL will focus on pH and reduced acid loading as well as metals analysis to the Laurel Branch Run watershed. The objective is to reduce acid loading to the stream, which will in turn raise the pH to the desired range and keep a net alkalinity above zero, 99% of the time. 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.

Currently, the Pennsylvania Code Title 25 lists the Laurel Branch Run Watershed as HQ-CWF. In TMDL calculations, an endpoint allows for comparison between observed instream conditions and conditions that are expected to restore designated uses. For HQ-CWF streams, a WQN stream is used as a reference. The applicable water quality criteria shown in Table 3 for WQN 267 Conewago Creek will be used as the target endpoint.

An allowable long-term average in-stream concentration was determined at each sample point for metals 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 log normally 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. Following is an explanation of the TMDL for each allocation point.



Load
lb/day
Al= NA
Fe= 0.56
Mn= 0.04
Acid= 15.35
LBR10
LBR11
Load
Lb/day
Al= NA
Fe= 0.02
Mn= 0.004
Acid= 8.63
Tributary 48028
Load
lb/day
Al= NA
Fe= 0.15
Mn= 0.03
Acid= 9.66
LBR08
LBR09
Load
Lb/day
Al= NA
Fe= 1.33
Mn= 0.11
Acid= 36.93
Tributary 48027
Load
Lb/day
Al= NA
Fe= 0.004
Mn= 0.0004
Acid= 0.72
LBR06
LBR07
Load
lb/day
Al= NA
Fe= 1.78
Mn= 0.12
Acid= 45.06
Tributary 48026
Load
Lb/day
Al= NA
Fe= 1.11
Mn= 0.11
Acid= 38.69
LBR05
LBR04
Load
lb/day
Al= NA
Fe= 0.06
Mn= 0.0
Acid= 0.0
Tributary 48025
LBR03
Load
lb/day
Al= NA
Fe= 1.04
Mn= 0.21
Acid= 66.92
Load
Lb/day
Al= NA
Fe= 0.03
Mn= NA
Acid= 2.62
LBR02
Tributary 48024
LBR01
Load
Lb/day
Al= NA
Fe= 1.01
Mn= 0.24
Acid= 70.83

TMDL calculations- LBR11- Laurel Branch Run above confluence with fifth unnamed tributary

The TMDL for sample point LBR11 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this uppermost segment of Laurel Branch Run was computed using water-quality sample data collected at point LBR11. The average flow, measured at the sampling point LBR11 (0.12 MGD), is used for these computations. This is the most upstream point of this segment and the allowable load allocations calculated at LBR11 will directly affect the downstream point LBR09.

Sample data at point LBR11 shows that this headwaters section of Laurel Branch Run has a pH ranging between 4.9 and 5.2. There currently is an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

A TMDL for iron, manganese and acidity has been calculated. The measured sample data for aluminum was below detection limits. Because water quality standards are met, a TMDL for this parameter isn't necessary and is not calculated. The existing and allowable loads for the aluminum parameter at LBR11 in Table C1 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C1 shows the measured and allowable concentrations and loads at LBR11. Table C2 shows the percent reduction for iron, manganese and acidity needed at LBR11.

Table C1		Measured		Allowable	
Flow (gpm)=	83.50	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	0.39	0.4	0.02	0.02
ND = non detection	Manganese	1.30	1.3	0.00	0.004
NA = not applicable	Acidity	35.25	35.4	8.61	8.6
	Alkalinity	7.75	7.77		

Table C2. Allocations LBR11			
LBR11	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LBR11	0.39	1.31	35.35
Allowable Load @ LBR11	0.02	0.004	8.63
Load Reduction @ LBR11	0.37	1.306	26.72
% Reduction required @ LBR11	95%	99.7%	76%

TMDL calculations- LBR10- Fifth unnamed tributary (48028) flowing from north, just before Laurel Branch Run

The TMDL for sample point LBR10 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this tributary of Laurel Branch Run was computed using water-quality sample data collected at point LBR10. The average flow, measured at the sampling point LBR10 (0.92 MGD), is used for these computations. The allowable loads calculated at LBR10 will directly affect the downstream point LBR09.

Sample data at point LBR10 shows that this tributary of Laurel Branch Run has a pH ranging between 6.7 and 7.1. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

A TMDL for acidity has been calculated. The measured sample data for aluminum was below detection limits. Because water quality standards are met, a TMDL for this parameter isn't necessary and is not calculated. The existing and allowable loads for the aluminum parameter at LBR10 in Table C3 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C3 shows the measured and allowable concentrations and loads at LBR10. Table C4 shows the percent reduction for iron, manganese and acidity needed at LBR10.

Table C3		Measured		Allowable	
Flow (gpm)=	640.75	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	0.43	3.3	0.07	0.6
ND = non detection	Manganese	0.48	3.7	0.01	0.04
NA = not applicable	Acidity	4.35	33.5	2.00	15.4
	Alkalinity	9.50	73.11		

Table C4. Allocations LBR10			
LBR10	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LBR10	3.33	3.67	33.47
Allowable Load @ LBR10	0.56	0.04	15.35
Load Reduction @ LBR10	2.77	3.63	18.12
% Reduction required @ LBR10	83%	99%	54%

TMDL calculations- LBR09- Laurel Branch Run just above confluence with fourth unnamed tributary

The TMDL for sampling point LBR09 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point LBR09. The average flow, measured at the sampling point LBR09 (2.21 MGD), is used for these computations. The allowable loads calculated at LBR09 will directly affect the downstream point LBR07.

Sample data at point LBR09 shows pH ranging between 6.6 and 6.7; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point LBR09 for aluminum, iron, manganese and acidity was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from points LBR11/ LBR10 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points LBR11/ LBR10 and LBR09 to determine a total load tracked for the segment of stream between LBR09 and LBR11/ LBR10. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at LBR09.

A TMDL for iron, manganese and acidity at LBR09 has been calculated. The measured sample data for aluminum was below detection limits. Because water quality standards are met, a TMDL for this parameter isn't necessary and is not calculated. The existing and allowable loads for the aluminum parameter at LBR09 in Table C5 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C5 shows the measured and allowable concentrations and loads at LBR09. Table C6 shows the percent reduction for iron, manganese and acidity needed at LBR09.

Table C5		Measured		Allowable	
Flow (gpm)=	1535.25	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	1.48	27.2	0.07	1.3
ND = non detection	Manganese	0.80	14.7	0.01	0.1
NA = not applicable	Acidity	6.25	115.2	2.00	36.9
	Alkalinity	20.80	383.5		

Table C6. Allocations LBR09			
LBR09	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LBR09	27.20	14.71	115.24

Difference in measured Loads between the loads that enter and existing LBR09	23.48	9.73	46.42
Additional load tracked from above samples	0.58	0.04	23.98
Total load tracked between LBR11/LBR10 and LBR09	24.06	9.77	70.40
Allowable Load @ LBR09	1.33	0.11	36.93
Load Reduction @ LBR09	22.73	9.66	33.47
% Reduction required at LBR09	94%	99%	48%

There is a 23.48 lbs/day increase of iron at this sample point compared to the sum of measured load from upstream segments. This increase entered this segment of stream between LBR11/LBR10 and LBR09. The total iron load measured was 22.73 lbs/day greater than the calculated allowable iron load of 1.33 lbs/day, resulting in a required 94% iron reduction. The manganese load reduction required at LBR09 was 9.66 lbs/day. A 99% reduction is required to achieve the calculated allowable manganese loading. A 48% acidic reduction has been calculated at LBR09 to attain the calculated allowable acidic load of 36.93 lbs/day.

TMDL calculations- LBR08- Fourth unnamed tributary (48027) flowing from north, just before Laurel Branch Run

The TMDL for sample point LBR08 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this tributary of Laurel Branch Run was computed using water-quality sample data collected at point LBR08. The average flow, measured at the sampling point LBR08 (0.58 MGD), is used for these computations. The allowable loads calculated at LBR08 will directly affect the downstream point LBR07.

Sample data at point LBR08 shows that this tributary of Laurel Branch Run has a pH ranging between 6.9 and 7.4. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

A TMDL for iron, manganese and acidity has been calculated. All measured sample data for aluminum was below detection limits. Because water quality standards are met, a TMDL for this parameter isn't necessary and is not calculated. The existing and allowable loads for the aluminum parameter at LBR08 in Table C7 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C7 shows the measured and allowable concentrations and loads at LBR08. Table C8 shows the percent reduction for iron, manganese and acidity needed at LBR08.

Table C7		Measured		Allowable	
Flow (gpm)=	401.25	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	0.49	2.4	0.03	0.2
ND = non detection	Manganese	0.75	3.6	0.01	0.03

NA = not applicable	Acidity	4.10	19.8	2.00	9.7
	Alkalinity	34.60	166.7		

Table C8. Allocations LBR08			
LBR08	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LBR08	2.38	3.62	19.76
Allowable Load @ LBR08	0.15	0.03	9.66
Load Reduction @ LBR08	2.23	3.59	10.10
% Reduction required @ LBR08	94%	99%	51%

TMDL calculations- LBR07- Laurel Branch Run just above confluence with third unnamed tributary

The TMDL for sampling point LBR07 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point LBR07. The average flow, measured at the sampling point LBR07 (2.21 MGD), is used for these computations. The allowable loads calculated at LBR07 will directly affect the downstream point LBR05.

Sample data at point LBR07 shows pH ranging between 6.6 and 6.7; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point LBR07 for aluminum, iron, manganese and acidity was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from points LBR09/ LBR08 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points LBR09/ LBR08 and LBR07 to determine a total load tracked for the segment of stream between LBR07 and LBR08/ LBR09. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at LBR07.

A TMDL for iron, manganese and acidity at LBR07 has been calculated. All measured sample data for aluminum was below detection limits. Because water quality standards are met, a TMDL for this parameter isn’t necessary and is not calculated. The existing and allowable loads for the aluminum parameter at LBR07 in Table C9 will be denoted as “NA”. The concentrations will be denoted as “ND”.

Table C9 shows the measured and allowable concentrations and loads at LBR07. Table C10 shows the percent reduction for iron, manganese and acidity needed at LBR07.

Table C9		Measured		Allowable	
Flow (gpm)=	1879.25	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	0.93	21.0	0.08	1.8
ND = non detection	Manganese	0.81	18.2	0.01	0.1
NA = not applicable	Acidity	5.55	125.3	2.00	45.1
	Alkalinity	22.20	501.0		

Table C10. Allocations LBR07			
LBR07	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LBR07	20.95	18.19	125.26
Difference in measured Loads between the loads that enter and existing LBR07	-8.63	-0.14	-9.74
Percent loss due calculated at LBR07	29.2%	0.8%	7.2%
Additional load tracked from above samples	1.48	0.14	46.59
Percentage of upstream loads that reach the LBR07	70.8%	99.2%	92.8%
Total load tracked between LBR09/LBR08 and LBR07	1.05	0.14	43.23
Allowable Load @ LBR07	1.78	0.12	45.06
Load Reduction @ LBR07	-0.73	0.02	-1.83
% Reduction required at LBR07	0%	14%	0%

There is an 8.63 lbs/day decrease of iron at LBR07 compared to the sum of measured loads from upstream segments. This decrease of iron loading in this segment of stream between LBR09/LBR08 and LBR07 can be a result of dilution or other natural stream processes. The total iron load measured was 0.73 lbs/day less than the calculated allowable iron load of 1.78 lbs/day, resulting in no iron reduction at this point. The manganese load reduction required at LBR07 was 0.02 lbs/day. A 14% reduction is required to achieve the calculated allowable manganese loading. The total acidic load tracked from upstream was 43.23 lbs/day, which was 1.83 lbs/day less than the calculated allowable acidic load. Since the total load tracked was less than the allowable load, no acidic reduction is necessary at LBR07.

TMDL calculations- LBR06- Third unnamed tributary (48026) flowing from north, just before Laurel Branch Run

The TMDL for sample point LBR06 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this tributary of Laurel Branch Run was computed using water-quality sample data collected at point LBR06. The average flow, measured at the sampling point LBR06 (0.02 MGD), is used for these computations. The allowable loads calculated at LBR06 will directly affect the downstream point LBR05.

Sample data at point LBR06 shows that this tributary of Laurel Branch Run has a pH ranging between 6.2 and 6.6. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

A TMDL for iron, manganese and acidity has been calculated. All measured sample data for aluminum was below detection limits. Because water quality standards are met, a TMDL for this parameter isn't necessary and is not calculated. The existing and allowable loads for the aluminum parameter at LBR06 in Table C11 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C11 shows the measured and allowable concentrations and loads at LBR06. Table C12 shows the percent reduction for iron, manganese and acidity needed at LBR06.

Table C11		Measured		Allowable	
Flow (gpm)=	11.25	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	2.07	0.3	0.03	0.004
ND = non detection	Manganese	0.79	0.1	0.00	0.0004
NA = not applicable	Acidity	20.90	2.8	5.31	0.7
	Alkalinity	24.55	3.3		

Table C12. Allocations LBR06			
LBR06	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LBR06	0.28	0.11	2.82
Allowable Load @ LBR06	0.004	0.0004	0.72
Load Reduction @ LBR06	0.276	0.1096	2.10
% Reduction required @ LBR06	99%	100%	74%

TMDL calculations- LBR05- Laurel Branch Run just above confluence with second unnamed tributary

The TMDL for sampling point LBR05 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point LBR05. The average flow, measured at the sampling point LBR05 (2.33 MGD), is used for these computations. The allowable loads calculated at LBR05 will directly affect the downstream point LBR03.

Sample data at point LBR05 shows pH ranging between 6.5 and 7.0; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point LBR05 for aluminum, iron, manganese and acidity was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from points LBR07/ LBR06 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points LBR07/ LBR06 and LBR05 to determine a total load tracked for the segment of stream between LBR05 and LBR06/ LBR07. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at LBR05.

A TMDL for iron, manganese and acidity at LBR05 has been calculated. The measured sample data for aluminum was below detection limits. Because water quality standards are met, a TMDL for this parameter isn't necessary and is not calculated. The existing and allowable loads for the aluminum parameter at LBR05 in Table C13 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C13 shows the measured and allowable concentrations and loads at LBR05. Table C14 shows the percent reduction for iron, manganese and acidity needed at LBR05.

Table C13		Measured		Allowable	
Flow (gpm)=	1614.25	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	0.97	18.9	0.06	1.1
ND = non detection	Manganese	0.76	14.6	0.01	0.1
NA = not applicable	Acidity	7.00	135.7	2.00	38.7
	Alkalinity	22.35	433.3		

Table C14. Allocations LBR05			
LBR05	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LBR05	18.88	14.64	135.71
Difference in measured Loads between the loads that enter and existing LBR05	-2.35	-3.66	7.63
Percent loss due calculated at LBR05	11.1%	20.0%	NA
Additional load tracked from above samples	1.78	0.12	45.78
Percentage of upstream loads that reach the LBR05	88.9%	80.0%	NA
Total load tracked between LBR07/LBR06 and LBR05	1.59	0.10	53.41
Allowable Load @ LBR05	1.11	0.11	38.69
Load Reduction @ LBR05	0.48	-0.01	14.72
% Reduction required at LBR05	30%	0%	28%

There is a 2.35 lbs/day decrease of iron at LBR05 compared to the sum of measured loads from upstream segments. This decrease of iron loading in this segment of stream between

LBR07/LBR06 and LBR05 can be a result of dilution or other natural stream processes. The total iron load measured was 0.48 lbs/day greater than the calculated allowable iron load of 1.11 lbs/day, resulting in a 30% iron reduction at this point. The total manganese load tracked at LBR05 was 0.01 lbs/day less than the calculated allowable manganese load of 0.11 lbs/day. Therefore no reduction is required to achieve the calculated allowable manganese loading. The total acidic load tracked from upstream was 53.41 lbs/day, which was 14.72 lbs/day greater than the calculated allowable acidic load. A 28% acidic reduction is necessary to meet water quality standards at LBR05.

TMDL calculations- LBR04- Second unnamed tributary (48025) flowing from south, just before Laurel Branch Run

The TMDL for sample point LBR04 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this tributary of Laurel Branch Run was computed using water-quality sample data collected at point LBR04. The average flow, measured at the sampling point LBR04 (0.30 MGD), is used for these computations. The allowable loads calculated at LBR04 will directly affect the downstream point LBR03.

Sample data at point LBR04 shows that this tributary of Laurel Branch Run has a pH ranging between 6.8 and 7.5. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

No TMDL for any parameter has been calculated. The measured sample data for aluminum, iron and manganese was below detection limits. There was no measured acidity at this sample point. Because all water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. The existing and allowable loads for the aluminum parameter at LBR04 in Table C15 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C15 shows the measured and allowable concentrations and loads at LBR04.

Table C15		Measured		Allowable	
Flow (gpm)=	210.50	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	ND	NA	ND	NA
ND = non detection	Manganese	ND	NA	ND	NA
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	31.45	79.51		

TMDL calculations- LBR03- Laurel Branch Run just above confluence with first unnamed tributary

The TMDL for sampling point LBR03 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point LBR03. The average flow, measured at the sampling point LBR03 (4.02 MGD), is used for these computations. The allowable loads calculated at LBR03 will directly affect the downstream point LBR01.

Sample data at point LBR03 shows pH ranging between 6.9 and 7.2; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point LBR03 for aluminum, iron, manganese and acidity was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from points LBR05/ LBR04 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points LBR05/ LBR04 and LBR03 to determine a total load tracked for the segment of stream between LBR03 and LBR05/ LBR04. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at LBR03.

A TMDL for iron and acidity at LBR03 has been calculated. The measured sample data for aluminum was below detection limits. Sample data for manganese was found to be above detection limits but still below water quality standards. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. The existing and allowable loads for the aluminum parameter at LBR03 in Table C16 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C16 shows the measured and allowable concentrations and loads at LBR03. Table C17 shows the percent reduction for iron, manganese and acidity needed at LBR03.

Table C16		Measured		Allowable	
Flow (gpm)=	2789.00	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	0.46	15.5	0.03	1.0
ND = non detection	Manganese	0.46	15.5	0.01	0.2
NA = not applicable	Acidity	6.75	226.1	2.00	66.9
	Alkalinity	19.80	663.2		

Table C17. Allocations LBR03			
LBR03	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LBR03	15.45	15.45	226.09
Difference in measured Loads between the loads that enter and existing LBR03	-3.43	0.81	90.38
Percent loss due calculated at LBR03	18.2%	NA	NA
Additional load tracked from above samples	1.11	0.11	38.69
Percentage of upstream loads that reach the LBR03	81.8%	NA	NA
Total load tracked between LBR05/LBR04 and LBR03	0.91	0.92	129.07

Allowable Load @ LBR03	1.04	0.21	66.92
Load Reduction @ LBR03	-0.13	0.71	62.15
% Reduction required at LBR03	0%	77%	48%

There is a 3.43 lbs/day decrease of iron at LBR03 compared to the sum of measured loads from upstream segments. This decrease of iron loading in this segment of stream between LBR07/LBR06 and LBR05 can be a result of dilution or other natural stream processes. The total iron load measured was 0.13 lbs/day less than the calculated allowable iron load of 1.04 lbs/day, resulting no iron reduction at this point. The total manganese load tracked at LBR03 was 0.71 lbs/day greater than the calculated allowable manganese load of 0.21 lbs/day. Therefore a 77% reduction is required to achieve the calculated allowable manganese loading. The total acidic load tracked from upstream was 129.07 lbs/day, which was 62.15 lbs/day greater than the calculated allowable acidic load. A 48% acidic reduction is necessary to meet water quality standards at LBR03.

TMDL calculations- LBR02- First unnamed tributary (48024) flowing from north, just before Laurel Branch Run

The TMDL for sample point LBR02 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this tributary of Laurel Branch Run was computed using water-quality sample data collected at point LBR02. The average flow, measured at the sampling point LBR02 (0.18 MGD), is used for these computations. The allowable loads calculated at LBR02 will directly affect the downstream point LBR01.

Sample data at point LBR02 shows that this tributary of Laurel Branch Run has a pH ranging between 6.8 and 7.0. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

A TMDL for iron has been calculated. All measured sample data for aluminum and manganese was below detection limits. Acidic data shows that no reductions are necessary at this site. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. The existing and allowable loads for the aluminum and manganese parameters at LBR02 in Table C18 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C18 shows the measured and allowable concentrations and loads at LBR02. Table C19 shows the percent reduction for iron needed at LBR02.

Table C18		Measured		Allowable	
Flow (gpm)=	124.75	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	0.65	0.97	0.02	0.03
ND = non detection	Manganese	ND	NA	ND	NA
NA = not applicable	Acidity	1.75	2.6	1.75	2.6

	Alkalinity	13.35	20.0		

Table C19. Allocations LBR02	
LBR02	Fe (Lbs/day)
Existing Load @ LBR02	0.97
Allowable Load @ LBR02	0.03
Load Reduction @ LBR02	0.94
% Reduction required @ LBR02	97%

TMDL calculations- LBR01- Laurel Branch Run just above confluence with Beech Run

The TMDL for sampling point LBR01 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point LBR01. The average flow, measured at the sampling point LBR01 (4.24 MGD), is used for these computations.

Sample data at point LBR01 shows pH ranging between 6.9 and 7.1; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point LBR01 for aluminum, iron, manganese and acidity was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from points LBR03/ LBR02 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points LBR02/ LBR03 and LBR01 to determine a total load tracked for the segment of stream between LBR01 and LBR02/ LBR03. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at LBR01.

A TMDL for iron, manganese and acidity at LBR01 has been calculated. The measured sample data for aluminum was below detection limits. Because water quality standards are met, a TMDL for this parameter isn't necessary and is not calculated. The existing and allowable loads for the aluminum parameter at LBR01 in Table C20 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C20 shows the measured and allowable concentrations and loads at LBR01. Table C21 shows the percent reduction for iron, manganese and acidity needed at LBR01.

Table C20		Measured		Allowable	
Flow (gpm)=	2942.50	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	0.45	15.8	0.03	1.0

ND = non detection	Manganese	0.37	13.0	0.01	0.2
NA = not applicable	Acidity	4.50	159.0	2.00	70.8
	Alkalinity	19.30	682.0		

Table C21. Allocations LBR01			
LBR01	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LBR01	15.84	12.96	159.02
Difference in measured Loads between the loads that enter and existing LBR01	-0.58	-2.49	-69.69
Percent loss due calculated at LBR01	3.5%	16.1%	30.5%
Additional load tracked from above samples	1.07	0.21	69.54
Percentage of upstream loads that reach the LBR01	96.5%	83.9%	69.5%
Total load tracked between LBR03/LBR02 and LBR01	1.03	0.18	48.35
Allowable Load @ LBR01	1.01	0.24	70.83
Load Reduction @ LBR01	0.02	-0.06	-22.48
% Reduction required at LBR01	2%	0%	0%

There is a 0.58 lbs/day decrease of iron at LBR01 compared to the sum of measured loads from upstream segments. This decrease of iron loading in this segment of stream between LBR03/LBR02 and LBR01 can be a result of dilution or other natural stream processes. The total iron load measured was 0.02 lbs/day greater than the calculated allowable iron load of 1.01 lbs/day, resulting in a 2% iron reduction at this point. The total manganese load tracked at LBR01 was 0.06 lbs/day less than the calculated allowable manganese load of 0.24 lbs/day. Therefore no reduction is required to achieve the calculated allowable manganese loading. The total acidic load tracked from upstream was 48.35 lbs/day, which was 22.48 lbs/day less than the calculated allowable acidic load. No acidic reduction is necessary to meet water quality standards at LBR01.

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. Another margin of safety used for this TMDL analysis 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 margin of safety.

Seasonal Variation

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

Critical Conditions

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

Attachment D

Use of reference stream for High Quality waters

Streams placed on the 1996 303 (d) list with a designated use of High Quality (HQ) will be subject to Pennsylvania's anti degradation policy. Therefore, DEP must establish instream goals for TMDLs that restore the waterbody to existing (pre-mining) quality.

This is accomplished by sampling an unaffected stretch of stream to use as a reference. This stretch typically is the headwaters segment of the High Quality stream in question. If an unaffected stretch isn't available, a nearby-unimpaired stream will function as a surrogate reference.

The reference stream data will be selected from statewide ambient Water Quality Network (WQN) stations. To determine which WQN station represents existing water quality appropriate for use in developing TMDLs for HQ waters, alkalinity and drainage area are considered.

1. First step is to match alkalinities of TMDL stream and WQN reference stream. If alkalinities for candidate stream are not available, use pH as a surrogate. As a last resort, if neither pH nor alkalinity are available match geologies using current geological maps.
2. The second consideration is drainage area.
3. Finally, from the subset of stations with similar alkalinity and drainage area select the station nearest the TMDL stream.

Once a reference stream is selected, the 95^{th} percentile confidence limit on the median for aluminum, iron and manganese is used as the applicable water quality criteria needed for the @Risk model.

Attachment E

Excerpts Justifying Changes Between the 1996, 1998, 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, 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 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 303(d) list were calculated automatically by the GIS (ArcInfo) using a constant projection and map units (meters) for each watershed. Segment lengths originally calculated by using a map wheel and those calculated by the GIS did not always match closely. This was the case even when physical identifiers (e.g., tributary confluence and road crossings) matching the original segment descriptions were used to define segments on digital quad maps. This occurred to some extent with all segments, but was most noticeable in segments with the greatest potential for human errors using a map wheel for calculating the original segment lengths (e.g., long stream segments or entire basins).

Attachment F

Water Quality Data Used In TMDL Calculations

LBR11 Date	Flow gpm	Lab pH	Alkalinity mg/l	Acidity mg/l	Iron mg/l	Manganese mg/l	Aluminum mg/l
3/26/2004	81	4.9	7.6	21.2	<.30	1.03	0.627
11/4/2004	30	4.9	7.4	48.8	0.318	2.13	<.5
9/10/2003	132	5.2	7.2	37.2	0.317	1.4	<.5
6/11/2003	91	5.1	8.8	33.8	0.917	0.656	0.57
average	83.5	5.025	7.75	35.25	0.388	1.304	0.29925
st dev	41.94043	0.15	0.718795	11.3565	0.383113	0.628880487	0.346327

LBR10 Date	Flow gpm	Lab pH	Alkalinity mg/l	Acidity mg/l	Iron mg/l	Manganese mg/l	Aluminum mg/l
3/26/2004	756	6.7	14.4	17.4	0.375	0.443	<.5
11/4/2004	312	7.1	36.6	0	0.443	0.492	<.5
9/10/2003	648	7.1	31.4	0	0.363	0.664	<.5
6/11/2003	847	7	26.2	0	0.551	0.307	<.5
AVERAGE	640.75	6.975	27.15	4.35	0.433	0.4765	0
ST DEV	233.7739	0.189297	9.501403	8.7	0.086194	0.147477682	0

LBR09 Date	Flow gpm	Lab pH	Alkalinity mg/l	Acidity mg/l	Iron mg/l	Manganese mg/l	Aluminum mg/l
3/26/2004	2376	6.6	6.6	25	1.15	0.59	<.5
11/4/2004	713	6.6	27.2	0	1.86	1.03	<.5
9/12/2003	1359	6.7	23.6	0	1.47	0.944	<.5
6/11/2003	1693	6.7	20.8	0	1.42	0.627	<.5
AVERAGE	1535.25	6.65	19.55	6.25	1.475	0.79775	0
ST DEV	692.5568	0.057735	9.02201	12.5	0.292632	0.221844352	0

LBR08 Date	Flow gpm	Lab pH	Alkalinity mg/l	Acidity mg/l	Iron mg/l	Manganese mg/l	Aluminum mg/l
3/26/2004	566	6.9	23	16.4	0.634	1.01	<.5
11/4/2004	135	7.1	38.6	0	<0.300	0.616	<.5
9/12/2003	140	7.4	42	0	0.48	0.926	<.5
6/11/2003	764	7.3	34.8	0	0.862	0.456	<.5
AVERAGE	401.25	7.175	34.6	4.1	0.494	0.752	0
ST DEV	315.1036	0.221736	8.273653	8.2	0.364809	0.260097418	0

LBR07 Date	Flow gpm	Lab pH	Alkalinity mg/l	Acidity mg/l	Iron mg/l	Manganese mg/l	Aluminum mg/l
3/29/2004	2438	6.8	19.8	22.2	0.994	0.597	<.5
10/9/2003	1132	6.6	24.6	0	0.711	0.931	<.5
9/12/2003	1675	6.9	25	0	1.02	1.16	<.5
6/10/2003	2272	6.9	19.4	0	0.988	0.536	<.5
AVERAGE	1879.25	6.8	22.2	5.55	0.92825	0.806	0

ST DEV	596.2535	0.141421	3.011091	11.1	0.145498	0.292985779	0

LBR06 Date	Flow gpm	Lab pH	Alkalinity mg/l	Acidity mg/l	Iron mg/l	Manganese mg/l	Aluminum mg/l
3/29/2004	19	6.6	26.4	11	0.916	0.097	<.5
10/9/2003	6	6.3	26	24.8	3.2	1.38	<.5
9/12/2003	0	6.2	33	10.2	3.53	1.34	<.5
6/10/2003	20	6.3	12.8	37.6	0.648	0.344	<.5
	bog area (9/12)						
AVERAGE	11.25	6.35	24.55	20.9	2.0735	0.79025	0
ST DEV	9.844626	0.173205	8.46542	12.99487	1.501361	0.665773923	0

LBR05 Date	Flow gpm	Lab pH	Alkalinity mg/l	Acidity mg/l	Iron mg/l	Manganese mg/l	Aluminum mg/l
3/29/2004	2094	6.8	19.4	28	0.843	0.641	<.5
10/9/2003	1177	6.5	25.2	0	0.623	0.822	<.5
9/11/2003	1362	7	25.8	0	1.09	1.07	<.5
6/10/2003	1824	6.9	19	0	1.34	0.488	<.5
AVERAGE	1614.25	6.8	22.35	7	0.974	0.75525	0
ST DEV	419.9098	0.216025	3.649201	14	0.309717	0.250332279	0

LBR04 Date	Flow gpm	Lab pH	Alkalinity mg/l	Acidity mg/l	Iron mg/l	Manganese mg/l	Aluminum mg/l
3/29/2004	273	7.3	28	0	<.300	<.05	<.5
10/9/2004	115	6.8	37.4	0	<.3	<.05	<.5
9/11/2003	134	7.5	30.8	0	<.3	<.05	<.5
6/10/2003	320	7.5	29.6	0	0.677	0.051	<.5
AVERAGE	210.5	7.275	31.45	0	0.16925	0.01275	0
ST DEV	101.438	0.330404	4.129165	0	0.3385	0.0255	0

LBR03 Date	Flow gpm	Lab pH	Alkalinity mg/l	Acidity mg/l	Iron mg/l	Manganese mg/l	Aluminum mg/l
3/29/2004	3618	6.9	16.8	27	0.675	0.471	<.5
10/8/2003	1950	7.2	22.2	0	<.3	0.558	<.5
9/11/2003	2295	7.2	22.4	0	0.454	0.53	<.5
6/10/2003	3293	7	17.8	0	0.716	0.286	<.5
AVERAGE	2789	7.075	19.8	6.75	0.46125	0.46125	0
ST DEV	793.5603	0.15	2.916619	13.5	0.328324	0.122331176	0

LBR02 Date	Flow gpm	Lab pH	Alkalinity mg/l	Acidity mg/l	Iron mg/l	Manganese mg/l	Aluminum mg/l
3/29/2004	162	6.8	11.6	7	0.311	<.05	<.5
10/8/2003	90	7	14.8	0	<.3	<.05	<.5
9/11/2003	62	7	14	0	1.47	0.07	0.757
6/10/2003	185	6.9	13	0	0.816	<.05	<.5

AVERAGE	124.75	6.925	13.35	1.75	0.64925	0.0175	0.18925
ST DEV	58.20295	0.095743	1.379613	3.5	0.642229	0.035	0.3785

LBR01 Date	**Flow gpm**	**Lab pH**	**Alkalinity mg/l**	**Acidity mg/l**	**Iron mg/l**	**Manganese mg/l**	**Aluminum mg/l**
3/29/2004	3817	6.9	17	18	0.697	0.416	<0.5
10/8/2003	1675	7.2	22.2	0	<.3	0.42	<.5
9/11/2003	2406	7.1	21	0	0.338	0.379	<.5
6/10/2003	3872	6.9	17	0	0.758	0.252	<.5
AVERAGE	2942.5	7.025	19.3	4.5	0.44825	0.36675	0
ST DEV	1083.683	0.15	2.700617	9	0.351618	0.078695087	0

Zero has been substituted for the less than detection values in the TMDL calculations

Attachment G

Comment and Response

No official comments were received.