

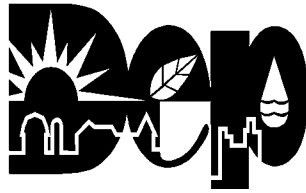
**FINAL**

**LOYALSOCK CREEK WATERSHED**

**TMDL**

**Sullivan and Lycoming Counties**

For Acid Mine Drainage Affected Segments



Prepared by the Pennsylvania Department of Environmental Protection

February 15, 2005

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# TMDL<sup>1</sup>

## Loyalsock Creek Watershed Sullivan and Lycoming Counties, Pennsylvania

### Introduction

This Total Maximum Daily Load (TMDL) calculation has been prepared for segments in the Loyalsock Creek Watershed (Attachment A). It was done to address the AMD 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. All impairments resulted from acid drainage from abandoned coal mines. The TMDL addresses the three primary metals associated with acid mine drainage (iron, manganese, aluminum) and pH.

Table 1. 303(d) Sub-List								
State Water Plan (SWP) Subbasin: 10-B West Branch Susquehanna River								
Year	Miles	Segment ID	DEP Stream Code	Stream Name	Designated Use	Data Source	Source	EPA 305(b) Cause Code
1996	13.4	7097	19804	Loyalsock Creek	TSF, CWF	305(b) Report	RE	Metals
1998	7.73	7097	19804	Loyalsock Creek	TSF, CWF	SWMP	AMD	Metals
2002*	37.45	20020111-1230-FIT	19804	Loyalsock Creek	TSF, CWF	SWMP	Unknown	Mercury
2002	6.2	990823-1330-GGM	19804	Loyalsock Creek	TSF, CWF	SWMP	AMD	Metals & Ph
2004*	37.4	20020111-1230-FIT	19804	Loyalsock Creek	TSF, CWF	SWMP	Unknown	Mercury
2004	6.2	990823-1330-GGM	19804	Loyalsock Creek	TSF, CWF	SWMP	AMD	Metals & pH

\*The 2002 listing for Source Unknown/Mercury will be addressed in a future TMDL.

Trout Stocked Fishery = TSF

Cold Water Fishery = CWF

Surface Water Monitoring Program = SWMP

Abandoned Mine Drainage = AMD

Resource Extraction = RE

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

<sup>1</sup> Pennsylvania's 1996, 1998 and 2002 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*.

## **Directions to the Loyalsock Creek Watershed**

The Loyalsock Creek Watershed study area is located in western Wyoming and northeastern Sullivan Counties and is found on the Colley, Dutch Mountain, Laporte, Lopez, and Red Rock 7.5-minute topographic quadrangle maps. This study area includes the portion of the Loyalsock Creek Watershed from Ringdale to the source, a total of 70.69 square miles. Ringdale, at the western terminus of the study area, is found by traveling north for approximately 38 miles on Route 220 from its intersection with Route 554 in Williamsport.

## **Segments addressed in this TMDL**

All of the discharges in the study area are from abandoned mines and will be treated as non-point sources. The distinction between non-point and point sources in this case is determined on the basis of whether or not there is a responsible party for the discharge. Where there is no responsible party, the discharge is considered to be a non-point source. Each segment on the Section 303(d) list will be addressed as a separate TMDL. These TMDLs will be expressed as long-term, average loadings. Due to the nature and complexity of mining effects on the watershed, expressing the TMDL as a long-term average gives a better representation of the data used for the calculations. See Attachment C for TMDL calculations.

## **Clean Water Act Requirements**

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

Additionally, the federal Clean Water Act and the U.S. Environmental Protection Agency’s (USEPA) implementing regulations (40 CFR Part 130) require:

- States to develop lists of impaired waters for which current pollution controls are not stringent enough to meet water-quality standards (the list is used to determine which streams need TMDLs);
- States to establish priority rankings for waters on the lists based on severity of pollution and the designated use of the water body; 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 non-point 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 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 water bodies there must be sufficient data available to assess which streams are impaired and should be on the Section 303(d) list. With guidance from the USEPA, the states have developed methods for assessing the waters within their respective jurisdictions.

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

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

After the survey is completed, the biologist determines the status of the stream segment. The decision is based on the performance of the segment using a series of biological metrics. If the stream is determined to be impaired, the source and cause of the impairment is documented. An impaired stream must be listed on the state's Section 303(d) list with the documented source and cause. A TMDL must be developed for the stream segment. A TMDL is for only one pollutant.

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<sup>2</sup> Section 305(b) of the Clean Water Act requires a biannual description of the water quality of the waters of the state.

If two or more pollutants impair a stream segment, 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. Collecting and summarizing pre-existing data (watershed characterization), inventorying contaminant sources, determining pollutant load, etc.);
2. Calculate TMDL for the water body 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.

### **Geologic setting**

The Loyalsock Creek Watershed study area consists of 70.69 square miles (4922 acres). Along its 12.4-mile length in the study area, Loyalsock Creek flows from an elevation of 2130 feet above sea level in its headwaters to an elevation of 1500 feet above sea level at Ringdale. Loyalsock Creek flows into the West Branch of the Susquehanna River near Williamsport. Land uses within the study area include forestland, fish and wildlife habitat, and abandoned mine lands.

This study area largely lies within the Appalachian Plateaus Physiographic Province. Surface rocks here include the Mauch Chunk Formation, Pocono Group, and the Huntley Mountain Formation of Mississippian age and the Allegheny and Pottsville Groups of Pennsylvanian age.

### **History of mining**

There has been a long history of underground and surface coal mining in the study area (Table 2). Attachment A shows locations of known coal mining operations in the study area.

Deep mining began in the late 1800's and ended in the 1940's. Of the numerous deep mines that operated here, three were the most significant: the Connell Anthracite Mining Company, the O'Boyle-Foy Anthracite Coal Company, and the Northern Anthracite or Murray Coal Company. These three operations are referred to as the Connell Deep Mine Complex, which is responsible for most of the AMD impairment to Loyalsock Creek. After demise of deep mining in the study area, surface coal mining became prevalent in the 1950's.

The coal mines listed in Table 2 are located on the maps in Attachment A. These locations are the approximate center of gravity of the permitted area and are not discharge locations.

Table 2: Coal mines in the study area						
Index no.	Date	Permit no.	Company	Seam	Type	Lat.-long.
	Unknown	Unknown	Connell Anthracite Mining Co.	A, B, C, D	Deep	Unknown
	Unknown	Unknown	O'Boyle-Foy Anthracite Coal Co.	B	Deep	Unknown
	Unknown	Unknown	Northern Anthracite or Murray Coal Co.	A, B, C D	Deep	Unknown
Gutten Coal	Late 1800's to early 1900's, 1940's	Unknown	Gutten Coal Co.	A, B	Deep	41-27-53.65 76-21-59.29
21180	3-19-50	10306 (or 10386)	Bernice White Ash Coal Co.	Misc.	Deep	41°27'41.56" 76°24'12.18"
20935	8-18-61	261M080, Bernice White Ash Deep Mine	Pastrusic Bros.	Unknown	Deep	41-27-42.44 76-21-56.78
20941	2-26-62	262M011	Bliss Bros.	B	Deep	41-27-46.84 76-23-23.69
20936	11-23-64	264M012, Connell Mine	J & K Coal Co.	Unknown	Deep	41-27-52.59 76-19-54.97
Dutch Mtn	1950's		Dutch Mountain Mine		Deep	41-28-29.92 76-14-9.33.
20931	7-1-52	13694, Connell Op.	Bernice White Ash Coal Co.	Unknown	Surface	41-28-33.65 76-19-25.42.
20938	11-1-56	16080	Bliss Bros.	B	Surface	41-27-34.62 76-23-10.48
21178	2-23-58	18150, Old Connell	William A. Monahan	Unknown	Surface	41-28-16.41 76-19-44.14
12547	7-16-58	16080	Charles Mott	B	Surface	41-27-47.36 76-23-34.4
20933	4-23-59	18460, Connell Strip Mine	Bliss Bros.	Unknown	Surface	41-28-11.95 76-19-48.7
20934	10-30-59	18750,	E & B Coal	Unknown	Surface	41-27-37.95

Table 2: Coal mines in the study area						
Index no.	Date	Permit no.	Company	Seam	Type	Lat.-long.
		Edwin Booth Op.	Sales			76-20-47.83
	Unknown	Unknown	Leroy Excavating	Unknown	Unknown	Unknown
20944	10-8-64	264M011	Meg Coal Co.	B, C	Surface	41-28-0.41 76-24-0.04
21275	4-21-67	266M025, Booth Op.	E & B Coal Sales	Unknown	Surface	41-27-50.36 76-20-35.2
21276	9-25-69 Completed	5769301, Booth Op.	Barca Coal & Land Co.	B	Surface	41-27-56.6 76-20-16.31.
5894	3-7-75	5774SM2, Fiorini-Murray Op.	John Percival	Unknown	Surface	41-28-18.66 76-19-44.48
5775SM2	Abandoned	5775SM2	East Allen Co., Inc.	Unknown	Surface	41-27-51.9 76-20-22.11
23285	5-7-84 Forfeited	57813001 (57810101), Bliss Mine	Bernice Mining (formerly York Resources)	B, C, C' D	Surface	41-27-50.83 76-23-03.3
29328	7-27-98	57970101, Barca Pit	Capitol Coal Co.	B, C	Surface	41-27-59.42 76-20-30.92

Relatively recent surface mining in the study area involves two permits by Bernice Mining and Contracting, Inc.: SMP # 57813001, the Bliss Mine, and SMP #57830101, the Lewis Mine (Table 2). A permit for the former was issued on 4-19-82 to York Resources Corporation for mining the B, C, C', and D coals on the 511-acre site. On 4-21-92 York Resources Corporation merged with Lancaster Resources, Ltd. to become the Commonwealth Resource Corporation. On 5-7-99 the Bliss Mine was transferred to Bernice Mining and Contracting, Inc. A mining permit for the Lewis Mine was issued on 3-7-84 to Lancaster Resources, Ltd. for mining the D, C, and B coals on the 880.1-acre site. On 4-21-92 York Resources Corporation merged with Lancaster Resources, Ltd. to become the Commonwealth Resource Corporation. The permit was transferred on 1-15-99 from Commonwealth Resource Corporation to Bernice Mining and Contracting, Inc. As of this report, the Bliss and Lewis permits have been forfeited.

The Capitol Coal Company, Inc.'s Barca Pit (SMP # 57970101) is a 128.4-acre site and was permitted on 7-27-98 for mining the B and C coals. As of the date of this report, mining has been completed and this site is being regraded

Within the study area, some localized deep mining occurred in the headwaters of Loysalsock Creek. One such site is the Dutch Mountain Mine. The areal extent of this mining is unknown.

Coal mining in the study area has resulted in some stream impairment. Most of the impairment is from two deep-mine discharges. Deep mining at the previously referenced Connell Deep Mine Complex resulted in the construction of two drainage tunnels known as the B and C Tunnels (Attachment A). These tunnels are the primary source of most of the AMD in the study area. Attempts in the late 1930's to seal the tunnels were unsuccessful. For a number of years, AMD from these tunnels impaired an eight-mile stretch of Loyalsock Creek. Compiled water data for these discharges are shown as Attachment E.

### Long Run sampling

One of the objectives of this study was to determine if mining had impaired Long Run and its unnamed tributary. On 5-29-03 a water sample was taken of Long Run at its confluence with Loyalsock Creek. This sample was not accompanied by flow measurements because the landowner ordered the DEP samplers off the property. For the same reason, a sample accompanied with a flow measurement was not taken at the confluence of the unnamed tributary to Long Run. Chemical results of the 5-29-03 sample show that the stream is natural background – i.e., not impaired from mining. This observation agrees with previous water sampling at the same location (Table 3).

Date	Flow, gpm	pH	Acidity		Alkalinity		Total Fe		Ferrous Fe	
			mg/l	lb/day	mg/l	lb./day	mg/l	lb/day	mg/l	lb/day
8/7/73	323.16	6.5	0	0	0	0	0.8	3.1	<0.5	<1.9
8/20/73	350.09	5.8	4.0	16.7	0	0	0.8	3.3	0.6	2.5
5/29/03	-----	6.4	45.8	-----	10	-----	0.8	-----	-----	-----

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

Allowable loads are determined for each point of interest using Monte Carlo simulation. Monte Carlo simulation is an analytical method meant to imitate real-life systems, especially when other analyses are too mathematically complex or too difficult to reproduce. Monte Carlo simulation calculates multiple scenarios of a model by repeatedly sampling values from the probability distribution of the uncertain variables and using those values to populate a larger data set. Allocations were applied uniformly for the watershed area specified for each allocation point. For each source and pollutant, it was assumed that the observed data were log-normally distributed. Each pollutant source was evaluated separately using @Risk<sup>3</sup> 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:

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

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

$$Cd = \text{RiskLognorm}(\text{Mean}, \text{Standard Deviation}) \text{ where (1a)}$$

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:

$$LTA = \text{Mean} * (1 - PR_{99}) \text{ where (2)}$$

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.

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<sup>3</sup>@Risk – Risk Analysis and Simulation Add-in for Microsoft Excel, Palisade Corporation, Newfield, NY, 1990-1997.

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. Net alkalinity is alkalinity minus acidity, both in units of milligrams per liter (mg/l) CaCO<sub>3</sub>. 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 be 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 in-stream 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 as total recoverable as the iron data used for this analysis were reported as total recoverable. The following table shows the water-quality criteria for the selected parameters.

**Table 4. Applicable Water-Quality Criteria**

Parameter	<i>Criterion Value (mg/l)</i>	<i>Total Recoverable/Dissolved</i>
Aluminum (Al)	0.75	Total Recoverable
Iron (Fe)	1.50 0.3	30-day average; Total Recoverable dissolved (PWS)
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 waste-load allocation, load allocation and a margin of safety. The waste-load allocation is the portion of the load assigned to point sources. The load allocation is the portion of the load assigned to non-point sources. The margin of safety is applied to account for uncertainties in the computational process. The margin of safety may be expressed implicitly (documenting conservative processes in the computations) or explicitly (setting aside a portion of the allowable load).

### **Allocation Summary**

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

**Table 5. Summary Table–Loyalsock Creek**

<i>Station</i>	<i>Parameter</i>	<i>Existing Load (lbs/day)</i>	<i>TMDL Allowable Load (lb/day)</i>	<i>WLA (lbs/day)</i>	<i>LA (lbs/day)</i>	<i>Load Reduction (lbs/day)</i>	<i>Percent Reduction %</i>
<b>LYSK5.0</b>							
	Al	0.0	0.0	NA	0.0	0.0	0
	Fe	0.11	15.9	NA	15.9	0.0	0
	Mn	0.0	0.0	NA	0.0	0.0	0
	Acidity	683.8	177.8	NA	177.8	903.9	74
<b>LYSK2.0</b>							
	Al	0.0	0.0	NA	0.0	0.0	0
	Fe	0.0	0.0	NA	0.0	0.0	0
	Mn	9.6	9.6	NA	9.6	0.0	0
	Acidity	1611.9	274.0	NA	274.0	831.8	75
<b>LYSK0.1</b>							
	Al	0.0	0.0	NA	0.0	0.0	0
	Fe	0.0	0.0	NA	0.0	0.0	0
	Mn	5.0	5.0	NA	5.0	0.0	0
	Acidity	1067.7	340.9	NA	340.9	0.0	0

**Recommendations**

Two primary programs that provide reasonable assurance for maintenance and improvement of water quality in the watershed are in effect. The PADEP’s efforts to reclaim abandoned mine lands, coupled with its duties and responsibilities for issuing NPDES permits, will be the focal points in water-quality improvement.

Additional opportunities for water-quality improvement are both ongoing and anticipated. Historically, a great deal of research into mine drainage has been conducted by PADEP’s Bureau of Abandoned Mine Reclamation, which administers and oversees the Abandoned Mine Reclamation Program in Pennsylvania, the United States Office of Surface Mining, the National Mine Land Reclamation Center, the National Environmental Training Laboratory, and many other agencies and individuals. Funding from EPA’s 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 PA DEP Bureau of Mining and Reclamation administers an environmental regulatory program for all mining activities, mine-subsidence regulation, mine-subsidence insurance, and coal-refuse disposal; conducts a program to ensure safe underground bituminous mining and protect certain structures from subsidence; administers a mining license and permit program; administers a regulatory program for the use, storage, and handling of explosives; provides for training, examination, and certification of applicants for blaster’s licenses; and administers a loan program for bonding anthracite underground mines and for mine subsidence. Administers the EPA Watershed Assessment Grant Program, the Small Operator’s Assistance Program (SOAP), and the Remining Operators Assistance Program (ROAP).

Reclaim PA is DEP's initiative designed to maximize reclamation of the state's quarter million acres of abandoned mineral extraction lands. Abandoned mineral extraction lands in Pennsylvania constituted a significant public liability – more than 250,000 acres of abandoned surface mines, 2,400 miles of streams polluted with mine drainage, over 7,000 orphaned and abandoned oil and gas wells, widespread subsidence problems, numerous hazardous mine openings, mine fires, abandoned structures and affected water supplies – representing as much as one-third of the total problem nationally. Mine reclamation and well plugging refers to the process of cleaning up environmental pollutants and safety hazards associated with a site and returning the land to a productive condition, similar to DEP's Brownfields program. Since the 1960's, Pennsylvania has been a national leader in establishing laws and regulations to ensure reclamation and plugging occur after active operation is completed.

Pennsylvania is striving for complete reclamation of its abandoned mines and plugging of its orphaned wells. Realizing this task is no small order, DEP 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 and volunteer DEP reclamation efforts. Reclaim PA has 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 remaining risks
- To maximize reclamation funding by expanding existing sources and exploring new sources.

### **Reclamation projects in the study area**

Two bond forfeiture projects in the study area have been coordinated by the Bureau of Abandoned Mine Reclamation (BAMR). The first, BF 164-201.1, involved 21.3 acres of surface mine reclamation of abandoned land on MDP 5775SM2, formerly operated by the East Allen Company. This project cost \$180,030.50 and was completed on 6-20-96. Highwalls and a pit were reclaimed. The reclamation resulted in an overall positive drainage for the site by eliminating low areas, as at the base of the highwalls, where water collected and came into contact with pyrite-bearing rocks to produce AMD. A second BAMR project, BF 325-201.1, involved 155 acres of surface mine reclamation of abandoned land on MDP 5774SM2, formerly operated by the John Percival Coal Company. This project cost \$1,413, 886.48 and was completed on 7-30-97. Extensive highwalls were eliminated, the site was regraded to AOC, it was revegetated, and channels were constructed to convey stormwater off the site. BAMR is also treating AMD from the previously mentioned B and C Connell tunnels. At the B tunnel there is an oxic limestone drain (OLD) and, at the C tunnel there is a vertical flow system. The seven-mile downstream stretch of Loyalsock Creek immediately downstream of the treatment now supports fish. However, macroinvertebrate populations are not reestablished at levels high enough to remove this section of stream from the impaired designation.

There is also an active watershed group, the Loyalsock Creek Watershed Association, in the study area. Major objectives of the association are identifying discharges that exhibit

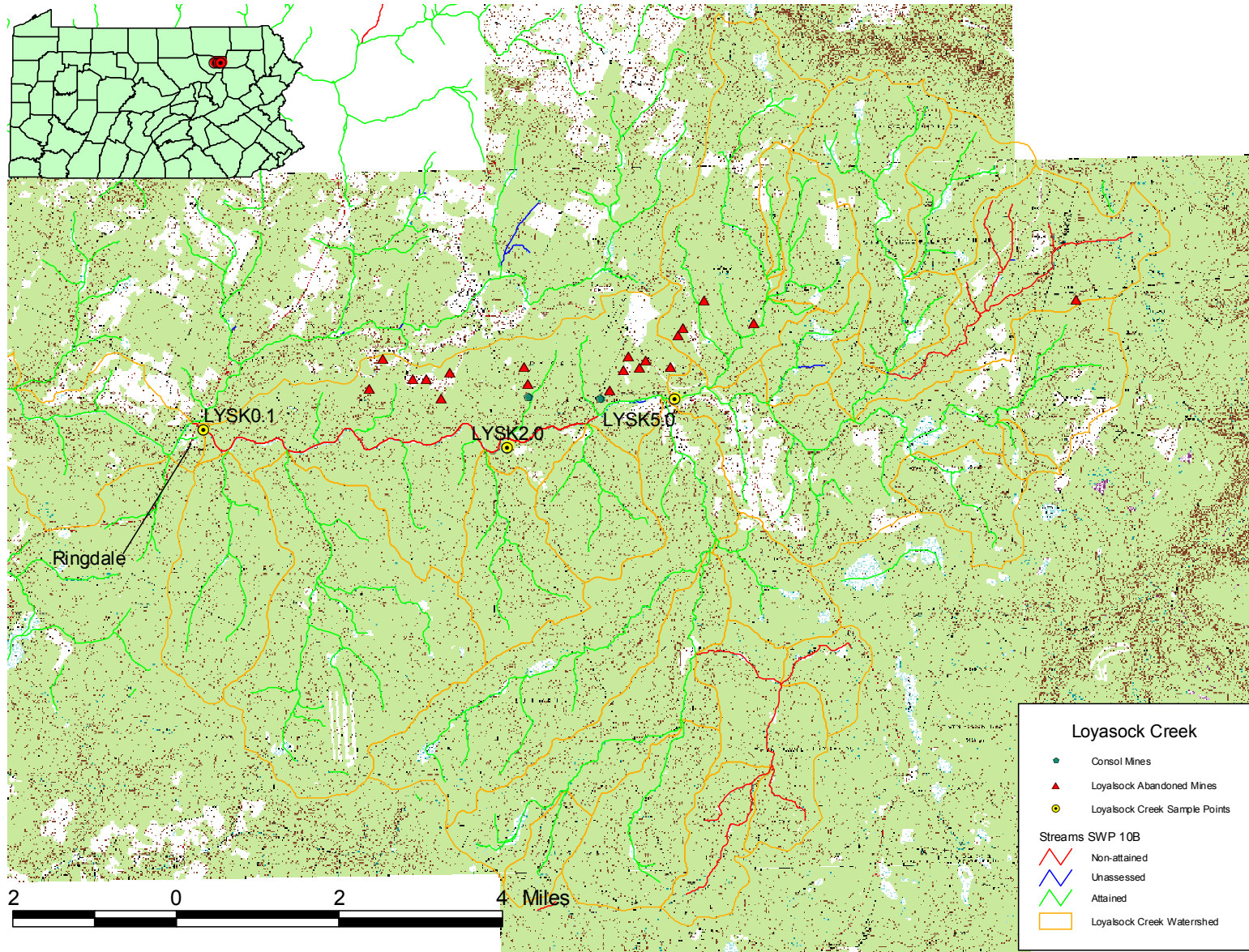
characteristics of AMD and identifying abandoned surface coal areas for possible reclamation. The association has received two Growing Greener grants to provide financial assistance with their work in the watershed. It is anticipated that additional funding will be provided.

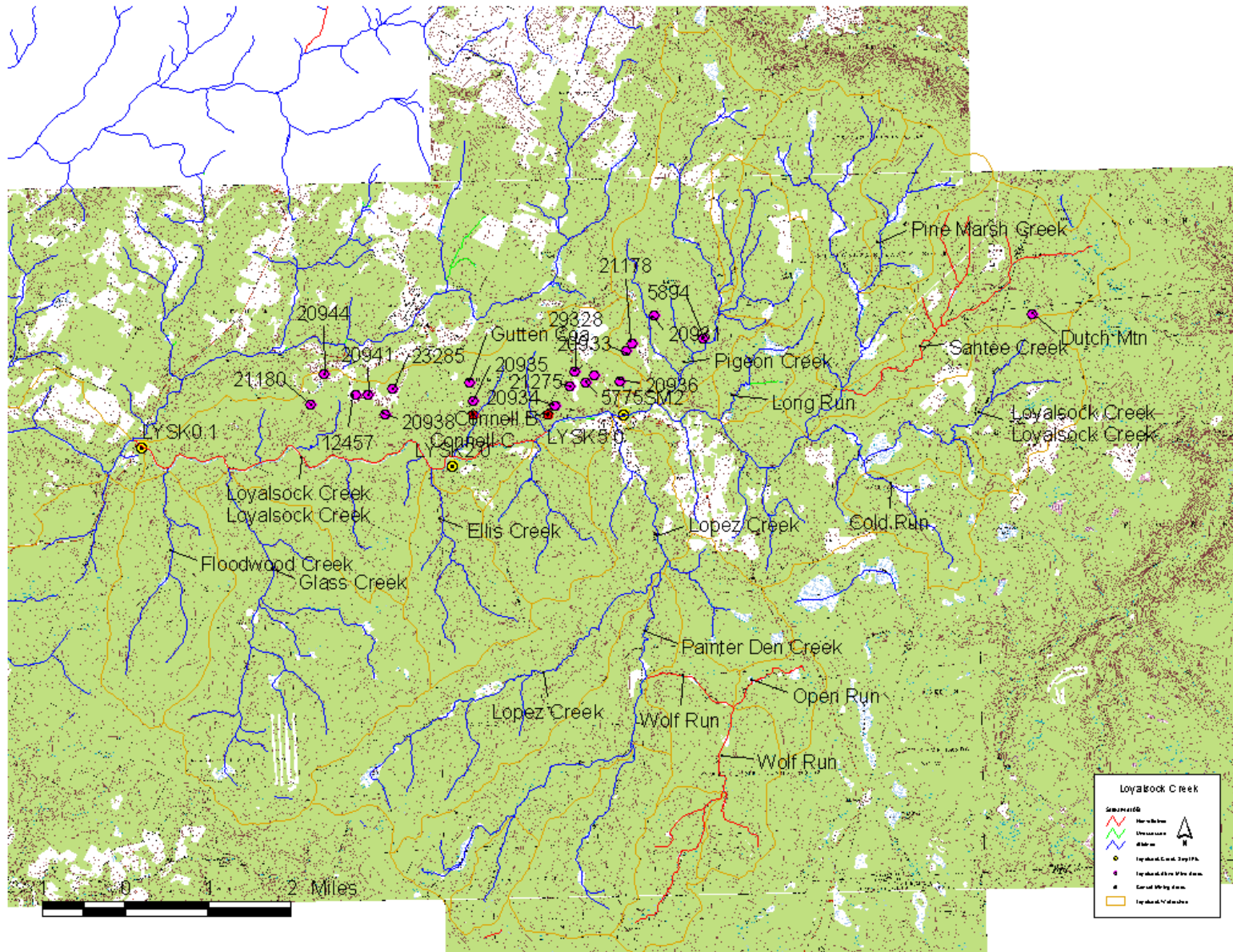
### **Public Participation**

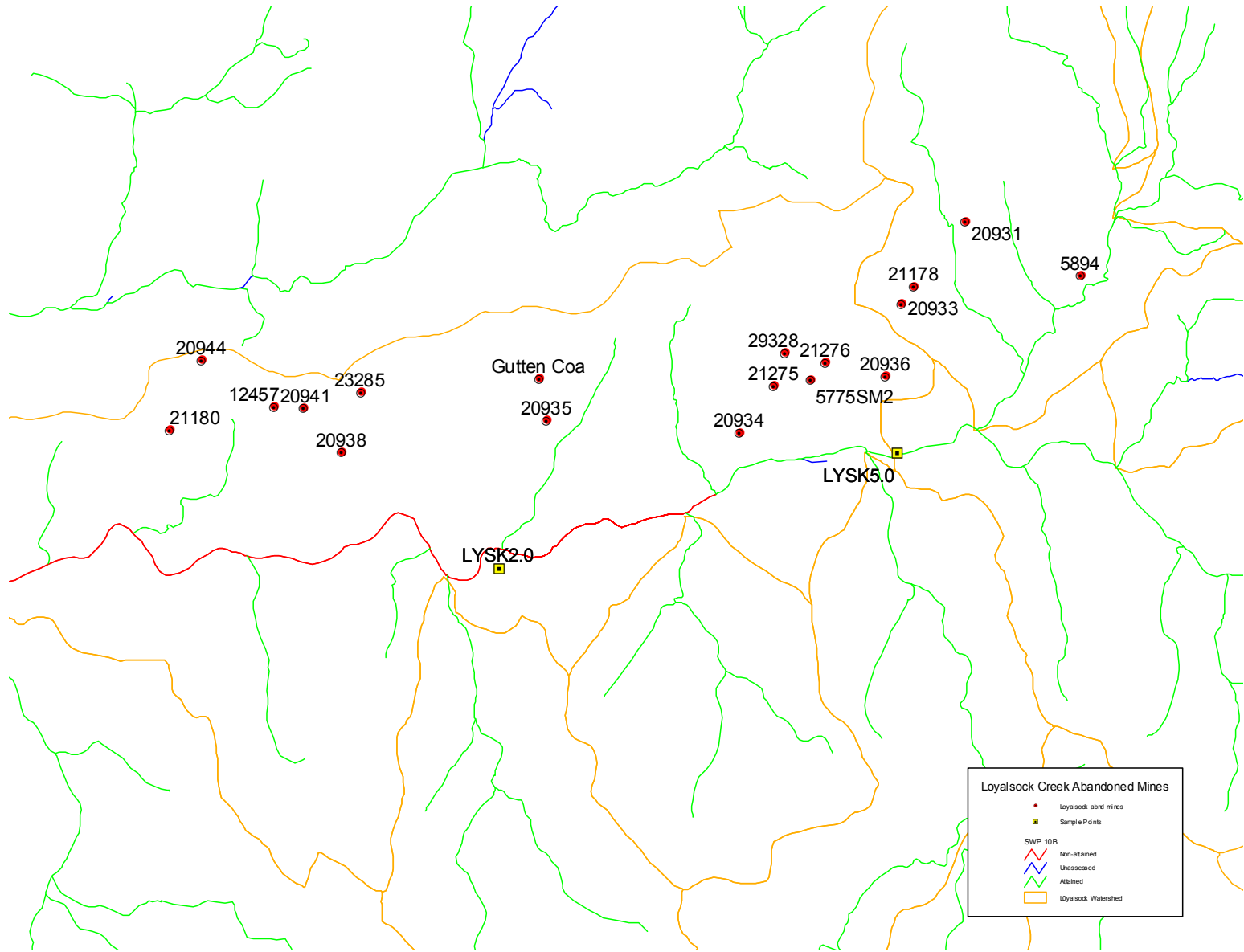
Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on November 20, 2004 and the Williamsport Sun Gazette on November 24, 2004 and December 1, 2004 to foster public comment on the allowable loads calculated. A public meeting was held on January 12, 2005 in the Blair County Courthouse in Holidaysburg, PA, to discuss the proposed TMDL.

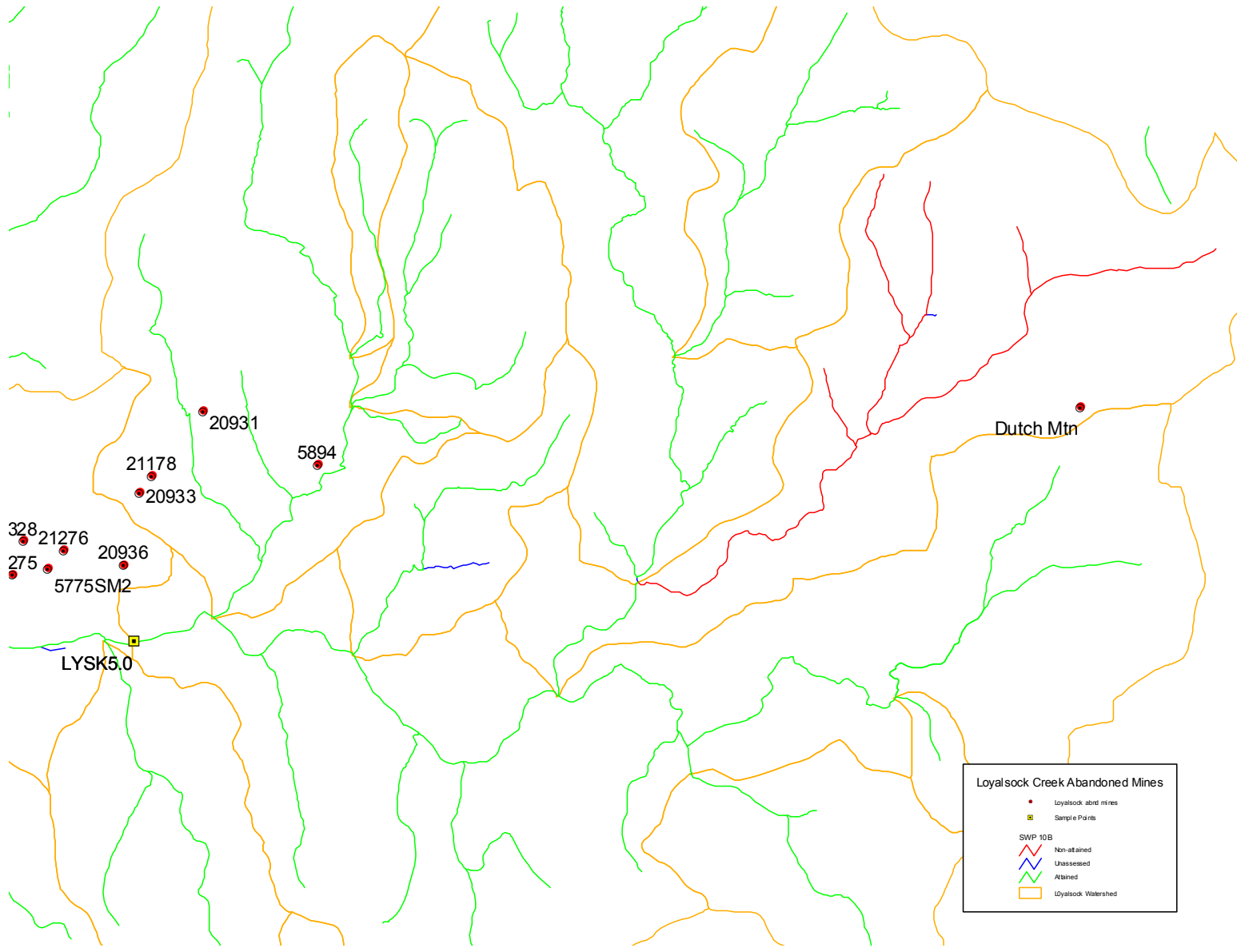
# **Attachment A**

## **Loyalsock Creek Watershed Map**









# **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 Section 303(d) list due to pH. The concentration of acidity in a stream is at least partially chemically dependent upon metals. For this reason, it is extremely difficult to predict the exact pH values, which would result from treatment of abandoned mine drainage. Therefore, net alkalinity will be used to evaluate pH in these TMDL calculations. This methodology assures that the standard for pH will be met because net alkalinity is a measure of the reduction of acidity. When acidity in a stream is neutralized or is restored to natural levels, pH will be acceptable. Therefore, the measured instream alkalinity at the point of evaluation in the stream will serve as the goal for reducing total acidity at that point. The methodology that is applied for alkalinity (and therefore pH) is the same as that used for other parameters such as iron, aluminum, and manganese that have numeric water-quality criteria.

Each sample point used in the analysis of pH by this method must have measurements for total alkalinity and total acidity. Net alkalinity is alkalinity minus acidity, both being in units of milligrams per liter (mg/l) CaCO<sub>3</sub>. The same statistical procedures that have been described for use in the evaluation of the metals is applied, using the average value for total alkalinity at that point as the target to specify a reduction in the acid concentration. By maintaining a net alkaline stream, the pH value will be in the range between six and eight. This method negates the need to specifically compute the pH value, which for mine waters is not a true reflection of acidity. This method assures that Pennsylvania's standard for pH is met when the acid concentration reduction is met.

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

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

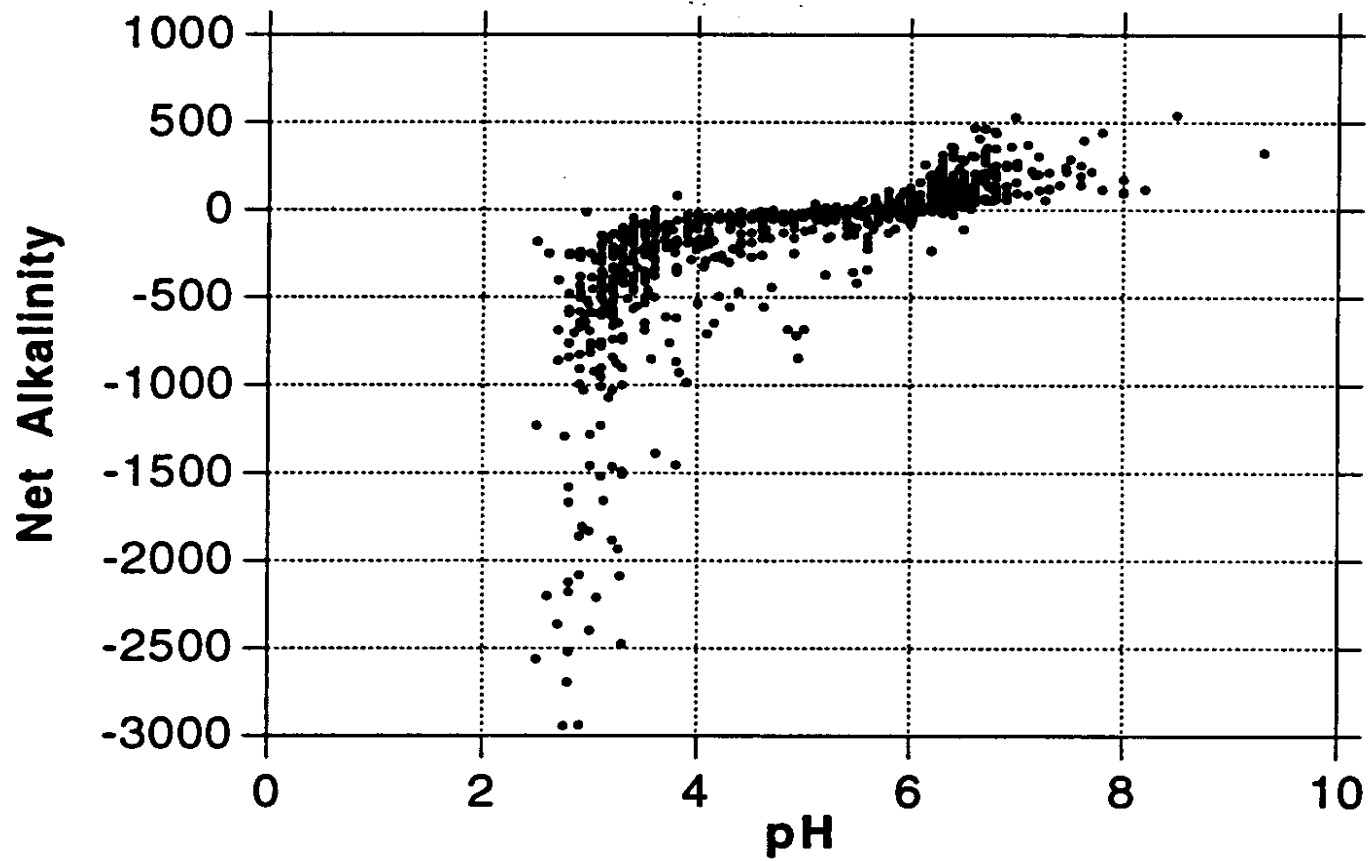


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

# **Attachment C**

## **TMDLs By Segment**

## Loyalsock Creek

The TMDL for Loyalsock Creek consists of load allocations to three sampling sites along the stream (LYSK5.0, LYSK2.0 and LYSK0.1). All sample points are shown on the map included in Attachment A. Following is an explanation of the TMDL for each allocation point.

Loyalsock Creek is listed for metals and pH from AMD as being the cause of the degradation to the stream. For pH, the objective is to reduce acid loading to the stream that will in turn raise the pH to the acceptable range. The result of this analysis is an acid loading reduction that equates to meeting standards for pH (see TMDL Endpoints section in the report, Table 2). The method and rationale for addressing pH is contained in Attachment B.

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

### TMDL calculations- LYSK5.0

The TMDL for sample point LYSK5.0 consists of a load allocation to the area above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point LYSK5.0. The average flow, measured at the sampling point LYSK5.0 (17.2 MGD), is used for these computations.

There currently is an entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point LYSK5.0 show pH ranging between 5.9 and 6.9, pH will be addressed in this TMDL.

Parameter	Measured Sample Data		Allowable		Reduction Identified
	Conc. (mg/l)	Load (lbs/day)	LTA conc. (mg/l)	Load (lbs/day)	%
Al	0.00	0.0	0.00	0.0	0
Fe	0.11	15.9	0.11	15.9	0
Mn	0.00	0.0	0.00	0.0	0
Acidity	4.77	683.8	1.24	177.8	74
Alkalinity	12.07	1731.1			

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	15.9	0.0	0.0	683.8
Allowable Load = TMDL	15.9	0.0	0.0	177.8
Load Reduction	0.0	0.0	0.0	506.0
% Reduction Segment	0%	0%	0%	74%

#### TMDL Calculation –LYSK2.0

The TMDL for sampling point LYSK2.0 consists of a load allocation to all of the area above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point LYSK2.0. The average flow (25.1 MGD), measured at LYSK02, is used for these computations.

There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH. Sample data at point LYSK2.0 show pH ranging between 5.7 and 6.8; pH will be addressed as part of this TMDL.

Parameter	Measured Sample Data		Allowable	
	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	0.00	0.0	0.00	0.0
Fe	0.00	0.0	0.00	0.0
Mn	0.046	9.6	0.046	9.6
Acidity	7.69	1611.9	1.31	274.0
Alkalinity	11.16	2338.7		

The calculated load reductions for all the loads that enter point LYSK2.0 must be accounted for in the calculated reductions at sample point LYSK2.0 shown in Table C4. A comparison of measured loads between points LYSK5.0 and LYSK2.0 shows that there is a loss in load for iron indicated by the negative numbers in the second row of Table C4. This 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. To determine the total segment load, the percent decrease in existing loads between LYSK5.0 and LYSK2.0 is applied to the upstream loads entering the segment. For iron the allowable load at LYSK2.0 is less than the upstream load entering the segment which results in a 100 percent loss due to instream processes in this segment. At sample point LYSK5.0 the iron concentration is 0.11 mg/l and there is no required reduction for iron. The iron load at LYSK5.0 is the product of this concentration, the flow of

30.7 mgd and a conversion factor. It is assumed that once allocations at upstream points are met, the TMDL at LYSK2.0 will also be met.

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	0	9.6	0	1611.9
Difference in Existing Load between LYSK5.0 & LYSK2.0	-15.9	9.6	0.0	928.1
Load tracked from LYSK5.0 (Upstream Load)	15.9	0.0	0.0	177.8
Percent lost due to instream process	100.0	-	-	-
Percent load tracked from LYSK5.0	0.0	-	-	-
Total Load tracked between points LYSK5.0 & LYSK2.0	0.0	9.6	0.0	1105.9
Allowable Load = TMDL	0	9.6	0.0	274.0
Load Reduction	0.0	0.0	0.0	831.8
% Reduction Segment	0%	0%	0%	75%

#### TMDL Calculation – LYSK0.1

The TMDL for sampling point LYSK0.1 on Loyalsock Creek consists of a load allocation of the area above point LYSK0.1 as shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point LYSK0.1. The unit area average flow (39.4 MGD), calculated at the sampling point LYSK0.1 is used for these computations. The unit area method was used to calculate this average flow because the measured flow demonstrated a flow loss in the stream segment between LYSK2.0 and LYSK0.1.

There currently is an entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point LYSK0.1 show pH ranging between 5.6 and 6.75; pH will be addressed as part of this TMDL.

Parameter	Measured Sample Data		Allowable	
	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	0.00	0.0	0.00	0.0
Fe	0.00	0.0	0.00	0.0
Mn	0.015	5.0	0.015	5.0
Acidity	3.25	1067.7	1.04	340.9
Alkalinity	10.05	3301.6		

The calculated load reductions for all the loads that enter point LYSK0.1 must be accounted for in the calculated reductions at sample point LYSK0.1 shown in Table C4. A comparison of measured loads between points LYSK2.0 and LYSK0.1 shows that there is a loss in load for

manganese and acidity indicated by the negative numbers in the second row of Table C6. This 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. To determine the total segment load, the percent decrease in existing loads between LYSK2.0 and LYSK0.1 is applied to the upstream loads entering the segment. For manganese the allowable load at LYSK0.1 is less than the upstream load entering the segment which results in a load 100 percent loss due to instream processes. At sample point LYSK2.0 the manganese concentration is 0.046 mg/l and the flow is 44.9 mgd. No reduction is required for the segment. The allowable load for acidity at this sample point (LYSK0.1) is greater than the total acid load between sample points LYSK2.0 and LYSK0.1 resulting in a negative load reduction at LYSK0.1 in Table C6. The acidity concentration (in mg/l) increases from LYSK5.0 to LYSK2.0 (4.77 to 7.69). But, from LYSK2.0 to LYSK0.1 acidity decreases (7.69 to 3.25). The alkalinity concentration only slightly decreases from sample point to sample point (12.07, 11.16, and 10.05) The alkalinity relative to the acidity at LYSK0.1 results in a lesser, comparable, acidity reduction at LYSK0.1 and an allowable acidity load that is higher than either of the upstream sample points. This results in the negative Load Reduction for acidity at LYSK0.1 and the zero percent segment reduction. It is assumed that once allocations at upstream points are met, the TMDL at LYSK0.1 will also be met.

<b>Table C6. Calculation of Load Reductions Necessary at Point LYSK0.1</b>				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	0	5.0	0	1067.7
Difference in Existing Load between LYSK2.0 & LYSK0.1	0.0	-4.6	0.0	-544.2
Load tracked from LYSK2.0 (Upstream Load)	0	17.1	0.0	489.5
Percent lost due to instream process	-	100%	-	100%
Percent load tracked from LYSK2.0	-	0%	-	0%
Total Load tracked between points LYSK2.0 & LYSK0.1	0.0	0.0	0.0	0.0
Allowable Load = TMDL	0	5.0	0.0	340.9
Load Reduction	0.0	0.0	0.0	0.0
% Reduction Segment	0%	0%	0%	0%

### Margin of Safety (MOS)

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.

- A MOS is added when 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 represent all seasons.

### **Critical Conditions**

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

# **Attachment D**

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

*The following are excerpts from the Pennsylvania DEP 303(d) narratives that justify changes in listings between the 1996, 1998, draft 2000, and Draft 2002 list. 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).

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 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 EPA and PADEP on the Draft 2000 Section 303(d) list, the Draft 2002 Pa Section 303(d) list was written in a manner similar to the 1998 Section 303(d) list.

# **Attachment E**

## **Water Quality Data Used In TMDL Calculations**

LYSK5.0

				403M	Cond	410M	70508	1105Z	1045Z	1055Z
Date	Time	Flow	Temp	pH	umhos/	Alkalinity	Acidity	TAI	TFe	TMn
		cfs	C		cm	mg/l	mg/l	mg/l	mg/l	mg/l
20010313	1050	63.22	1.8	5.9	38	10.2	0	0.5	0	0.05
20010426	930	49.08	6.4	5.9	30	8.4	0	0.5	0	0.05
20010521	1345	19.67	12	6.3	36	12.2	0	0.5	0	0.05
20010702	1200	20.776	14.9	6.3	33	11.8	28.6	0.5	0.327	0.05
20010802	1115	3.456	17.1	6.9	49	16.4	0	0.5	0	0.05
20010904	1205	3.464	15.9	6.7	12	13.4	0	0.5	0.336	0.05
<b>AVE</b>		<b>26.61</b>	<b>11.35</b>	<b>6.33</b>		<b>12.07</b>	<b>4.77</b>	<b>0.50</b>	<b>0.11</b>	<b>0.05</b>
<b>STDEV</b>							<b>11.68</b>	<b>0.00</b>	<b>0.17</b>	<b>0.00</b>

LYSK2.0

				403M	Cond	410M	70508	1105Z	1045Z	1055Z
Date	Time	Flow	Temp	PH	umhos/	Alkalinity	Acidity	TAI	TFe	TMn
		cfs	C		cm	mg/l	mg/l	mg/l	mg/l	mg/l
20010313	900	69.11	1.9	5.8	38	9	0.2	0.5	0.3	0.064
20010313	915	69.11	1.9	5.7	38	8.6	0	0.5	0.3	0.066
20010426	1050	53.89	5.9	5.8	32	7.6	1.6	0.5	0.3	0.078
20010521	1200	24.955	11.8	6.2	44	11.4	0	0.5	0.3	0
20010702	1005	53.239	13.4	6.1	35	10.4	37.2	0.5	0.3	0.075
20010702	1015	53.239	13.4	6.1	35	10.8	30.2	0.5	0.3	0.072
20010802	930	8.654	17.9	6.8	60	15	0	0.5	0.3	0
20010802	945	8.654	17.9	6.8	60	15	0	0.5	0.3	0
20010904	1400	9.128	16.3	6.7	15	12.6	0	0.5	0.3	0.057
<b>AVE</b>		<b>38.89</b>	<b>11.16</b>	<b>6.22</b>		<b>11.16</b>	<b>7.69</b>	<b>0.50</b>	<b>0.30</b>	<b>0.05</b>
<b>STDEV</b>							<b>14.86</b>	<b>0.00</b>	<b>0.00</b>	<b>0.03</b>

LYSK0.1

				403M	Cond	410M	70508	1105Z	1045Z	1055Z
Date	Time	Flow	Temp	pH	umhos/	Alkalinity	Acidity	TAI	TFe	TMn
		cfs	C		cm	mg/l	mg/l	mg/l	mg/l	mg/l
20010313	1310	79.74	2.4	5.9	39	8.2	1	0.5	0.3	0.058
20010426	1210	60.94	6.7	5.7	33	7.2	1.2	0.5	0.3	0.063
20010521	1005	29.925	12.5	6.2	43	10.6	0.4	0.5	0.3	0
20010521	1015	29.925	12.5	6.2	43	10.8	0	0.5	0.3	0
20010702	1355	66.109	15.3	6.1	35	9.4	23.4	0.5	0.3	0
20010802	1320	12.589	19.5	6.7	51	11	0	0.5	0.3	0
20010904	1030	13.17	16.9	6.6	16	11.6	0	0.5	0.3	0
20010904	1040	13.17	16.9	6.7	16	11.6	0	0.5	0.3	0
	<b>AVE</b>	<b>38.20</b>	<b>12.84</b>	<b>6.26</b>	<b>34.50</b>	<b>10.05</b>	<b>3.25</b>	<b>0.50</b>	<b>0.30</b>	<b>0.02</b>
	<b>STDEV</b>						<b>8.16</b>	<b>0.00</b>	<b>0.00</b>	<b>0.03</b>

Connell B (Before treatment)

			Spec.						
Date	Flow	pH	Cond.	Alk.	Acid.	Fe	Mn	Al	Comment
9/1/54	nr	3.30	nr	nr	nr	2.20	nr	nr	SL-188.
9/10/58	nr	3.50	nr	nr	nr	1.00	nr	nr	SL-188.
2/9/61	nr	3.60	nr	nr	nr	1.00	nr	nr	SL-188.
5/27/66	nr	3.60	nr	nr	nr	9.00	nr	nr	SL-188.
9/14/72	400	3.60	nr	0	28	0.90	nr	nr	B tunnel; SE tunnel; 5772SM2; Fld. Eng. Rept.
8/7/73	1386.89	3.50	nr	0	40	0.90	nr	nr	SL-188.
8/20/73	1665.16	3.60	nr	0	36	0.70	nr	nr	SL-188.
9/25/73	3877.9	3.50	nr	0	38	0.60	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
10/15/73	2356.36	3.00	nr	0	42	0.59	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
11/12/73	3231.58	3.80	nr	0	48	0.59	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
1/16/74	3940.7	3.80	nr	0	34	0.44	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
2/22/74	4201.1	3.20	nr	0	22	0.74	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
3/18/74	3554.7	3.10	nr	0	24	0.95	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
4/24/74	3819.6	3.80	nr	0	24	0.50	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
5/31/74	2998.2	3.60	nr	0	26	1.00	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
6/28/74	2854.6	3.50	nr	0	38	0.80	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
8/26/74	1795.3	3.80	nr	0	26	0.70	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
9/24/74	3141.8	3.70	nr	0	62	0.30	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
10/31/74	1934.46	3.30	nr	0	22	0.60	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
12/5/75	nr	3.50	nr	0	24	0.37	nr	nr	JG5, mouth of Connell tunnel; 5775SM2,
1/13/76	785.45	4.00	nr	0	40	0.60	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
1/30/76	4735.17	3.90	nr	0	34	1.20	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
2/11/76	1346.49	3.90	nr	0	38	4.70	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
2/19/76	8976.62	4.00	nr	0	34	0.40	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.

Date	Flow	pH	Spec. Cond.	Alk.	Acid.	Fe	Mn	Al	Comment
2/25/76	6508.05	4.00	nr	0	48	0.30	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
3/10/76	2244.16	4.00	nr	0	34	0.40	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
3/18/76	1526.03	4.00	nr	0	20	0.40	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
3/22/76	1436.26	4.10	nr	2	26	0.40	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
3/25/76	2244.16	3.90	nr	0	26	0.40	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
4/8/76	2019.74	4.20	nr	4	32	0.50	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
4/14/76	1391.38	4.00	nr	0	32	0.50	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
4/21/76	897.66	3.90	nr	0	24	0.60	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
5/4/76	1211.84	3.50	nr	0	64	0.60	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
8/23/77	nr	3.90	nr	0	40	0.44	nr	nr	Mouth of Connell tunnel; 500+ gpm; 5775SM2.
4/20/81	nr	3.81	nr	0	26	0.70	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
5/26/81	nr	3.86	nr	0	25	0.50	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
8/4/81	nr	3.98	nr	0	35	0.80	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
8/26/81	nr	4.06	nr	0	33	1.10	nr	nr	Smplg. sta. 8, B Connell Disch.; SL-188.
3/13/82	nr	3.40	170	0	70	0.32	0.90	nr	B tunnel; 57813001.
8/20/82	nr	4.00	nr	1	30	0.51	1.42	2.12	JG-5, deep mine disch.; 5775SM2.
8/14/89	nr	4.00	nr	1	32	0.59	1.08	1.49	"B" tunnel disch.; 57813001.
4/10/96	2511	4.00	nr	nr	18	0.24	0.56	0.77	MP8, "B" tunnel disch.; 57970101.
4/17/96	5022	4.00	nr	nr	22	0.20	0.63	0.99	MP8, "B" tunnel disch.; 57970101.
4/22/96	4064	4.00	nr	nr	20	0.20	0.62	0.84	MP8, "B" tunnel disch.; 57970101.
4/30/96	3704	4.10	nr	nr	16	0.23	0.62	0.92	MP8, "B" tunnel disch.; 57970101.
5/8/96	5022	4.00	nr	nr	20	0.20	0.59	0.90	MP8, "B" tunnel disch.; 57970101.
5/15/96	6975	4.10	nr	nr	15	0.17	0.57	0.83	MP8, "B" tunnel disch.; 57970101.
5/21/96	4837.5	4.20	nr	nr	32	2.19	0.57	0.85	MP8, "B" tunnel disch.; 57970101.
5/29/96	2673	4.00	nr	nr	26	0.30	0.56	0.81	MP8, "B" tunnel disch.; 57970101.

Date	Flow	pH	Spec. Cond.	Alk.	Acid.	Fe	Mn	Al	Comment
6/4/96	1863	4.20	nr	nr	24	0.32	0.56	0.82	MP8, "B" tunnel disch.; 57970101.
6/11/96	1498.5	4.20	nr	nr	22	0.39	0.65	0.95	MP8, "B" tunnel disch.; 57970101.
6/18/96	1143	4.10	nr	nr	34	0.38	0.58	0.87	MP8, "B" tunnel disch.; 57970101.
7/30/96	1318.5	4.20	nr	nr	26	0.35	0.67	1.02	MP8, "B" tunnel disch.; 57970101.
8/29/96	1089	4.10	nr	0	30	0.42	0.77	1.25	MP8, "B" tunnel disch.; 57970101.
8/29/96	1089	4.10	nr	nr	30	0.42	0.77	1.25	MP8, "B" tunnel disch.; 57970101.
9/30/96	1390.5	4.00	nr	0	24	0.34	0.84	1.40	MP8, "B" tunnel disch.; 57970101.
9/30/96	1390.5	4.00	nr	nr	24	0.34	0.84	1.40	MP8, "B" tunnel disch.; 57970101.
11/13/96	6066	4.00	nr	0	26	0.19	0.69	1.05	MP8, "B" tunnel disch.; 57970101.
11/13/96	6066	4.00	nr	nr	26	0.19	0.69	1.05	MP8, "B" tunnel disch.; 57970101.
12/1/96	17752.5	4.10	nr	0	24	0.18	0.02	0.14	MP8, "B" tunnel disch.; 57970101.
12/1/96	17753.5	4.10	nr	nr	24	0.18	0.02	0.14	MP8, "B" tunnel disch.; 57970101.
1/14/97	2191.5	4.10	nr	0	24	0.31	0.62	0.92	MP8, "B" tunnel disch.; 57970101.
1/14/97	2191.5	4.10	nr	nr	24	0.31	0.62	0.92	MP8, "B" tunnel disch.; 57970101.
3/3/97	2650.5	4.10	nr	0	22	0.22	0.62	0.93	MP8, "B" tunnel disch.; 57970101.
3/3/97	2650.5	4.10	nr	nr	22	0.22	0.62	0.93	MP8, "B" tunnel disch.; 57970101.
4/2/97	nr	3.94	140	0	15	0.23	0.60	<.1	MP8, "B" tunnel disch.; 57970101.
7/29/97	1020	4.21	170	0	18	0.51	0.85	1.00	MP8, "B" tunnel disch.; 57970101.
8/24/98	nr	4.20	nr	5	16	0.50	0.61	0.91	MP8; B-tunnel disch.; 57970101.
9/8/99	nr	4.20	nr	4	18	0.68	0.82	1.39	MP8; B-tunnel disch.; 57970101.
11/3/99	nr	4.20	nr	4	19	0.39	0.76	1.34	MP8, B tunnel; BAMR curr. trtg. part of flow; 57970101.
1/18/01	nr	4.20	nr	0	19	0.16	0.68	1.17	BV01; raw wat. fr. B-vein; BAMR.
2/27/01	nr	4.10	nr	0	18	0.25	0.75	1.22	BV01; raw wat. fr. B-vein; BAMR.
3/29/01	nr	4.10	nr	0	16	0.19	0.68	1.06	BV01; raw wat. fr. B-vein; BAMR.
4/24/01	nr	4.19	117	0	19	0.21	0.55	<.1	MP8; B-tunnel disch.; mon. dat.; 57970101.

			Spec.						
Date	Flow	pH	Cond.	Alk.	Acid.	Fe	Mn	Al	Comment
5/3/01	nr	4.10	nr	0	14	<0.02	0.63	1.00	BV01; raw wat. fr. B-vein; BAMR.
6/5/01	nr	4.20	nr	0	18	0.06	0.67	1.06	BV01; raw wat. fr. B-vein; BAMR.
6/25/01	nr	4.12	167	0	17	0.46	0.74	1.89	MP8; B-tunnel disch.; mon. dat.; 57970101.
7/24/01	nr	4.20	nr	0	55	0.30	0.70	1.15	BV01; raw wat. fr. B-vein; BAMR.
9/5/01	nr	4.10	nr	2	61	0.55	0.75	1.26	MP8; B-tunnel disch.; 57970101.
9/24/01	nr	4.10	170	0	18	0.52	0.83	1.00	MP8; B-tunnel disch.; mon. dat.; 57970101.
10/3/01	nr	4.10	nr	0	66	0.17	0.95	1.67	BV01; raw wat. fr. B-vein; BAMR.
11/1/01	nr	4.00	nr	0	54	0.23	0.87	1.57	BV01; raw wat. fr. B-vein; BAMR.
12/26/01	nr	4.02	132	0	18	0.19	0.70	1.00	MP8; B-tunnel disch.; mon. dat.; 57970101.
2/6/02	nr	4.00	nr	0	66	0.16	0.76	1.32	BV01; raw wat. fr. B-vein; BAMR.
2/26/02	nr	4.00	nr	2	53	0.33	0.64	1.08	MP8; B-tunnel disch.; 57970101.
3/12/02	nr	4.00	nr	0	62	0.05	0.76	1.46	BV01; raw wat. fr. B-vein; BAMR.
5/8/02	nr	4.10	nr	0	53	0.10	0.67	1.10	BV01; raw wat. fr. B-vein; BAMR.
6/4/02	nr	4.10	nr	0	52	0.13	0.70	1.12	BV01; raw wat. fr. B-vein; BAMR.
8/15/02	nr	4.40	nr	0	53	0.31	0.69	1.13	BV01; raw wat. fr. B-vein; BAMR.
10/1/02	nr	4.20	nr	0	58	<.02	0.80	1.35	BV01; raw wat. fr. B-vein; BAMR.
11/21/02	nr	4.10	nr	0	68	0.08	0.69	1.20	BV01; raw wat. fr. B-vein; BAMR.
mean=	3404.0	3.9	152.3	0.4	32.1	0.6	0.7	1.1	

Consol B (After treatment)

Date	Flow	pH	Spec. Cond.	Alk.	Acid.	Fe	Mn	Al	Comment
1/18/01	nr	6.30	nr	14	0	0.13	0.37	0.57	Cell C; trtd. wat. exiting OLD C @ B-vein disch.; BAMR.
1/18/01	nr	6.40	nr	20	0	0.12	0.30	0.44	Cell A, trtd. wat. exiting OLD A @ B-vein disch.; BAMR.
1/18/01	nr	6.30	nr	16	0	0.15	0.36	0.52	Cell B; trtd. wat. exiting OLD B @ B-vein disch.; BAMR.
2/27/01	nr	6.40	nr	20	0	0.11	0.40	0.57	Cell C; trtd. wat. exiting OLD C @ B-vein disch.; BAMR.
2/27/01	nr	6.60	nr	26	0	0.15	0.32	0.68	Cell A, trtd. wat. exiting OLD A @ B-vein disch.; BAMR.
2/27/01	nr	6.50	nr	20	0	0.10	0.41	0.58	Cell B; trtd. wat. exiting OLD B @ B-vein disch.; BAMR.
3/29/01	nr	6.20	nr	22	0	0.10	0.40	0.54	Cell C; trtd. wat. exiting OLD C @ B-vein disch.; BAMR.
3/29/01	nr	6.30	nr	26	0	0.09	0.37	0.47	Cell A, trtd. wat. exiting OLD A @ B-vein disch.; BAMR.
3/29/01	nr	6.30	nr	26	0	0.09	0.35	0.47	Cell B; trtd. wat. exiting OLD B @ B-vein disch.; BAMR.
5/3/01	nr	6.40	nr	26	0	0.10	0.35	0.48	Cell C; trtd. wat. exiting OLD C @ B-vein disch.; BAMR.
5/3/01	nr	6.50	nr	28	0	0.10	0.33	0.42	Cell A, trtd. wat. exiting OLD A @ B-vein disch.; BAMR.
5/3/01	nr	6.50	nr	30	0	0.10	0.30	0.46	Cell B; trtd. wat. exiting OLD B @ B-vein disch.; BAMR.
6/5/01	nr	6.40	nr	26	0	0.46	0.38	0.49	Cell C; trtd. wat. exiting OLD C @ B-vein disch.; BAMR.
6/5/01	nr	6.40	nr	28	0	0.17	0.39	0.56	Cell A, trtd. wat. exiting OLD A @ B-vein disch.; BAMR.
6/5/01	nr	6.40	nr	30	0	0.49	0.36	0.49	Cell B; trtd. wat. exiting OLD B @ B-vein disch.; BAMR.
7/24/01	nr	6.40	nr	30	14	0.14	0.40	0.56	Cell C; trtd. wat. exiting OLD C @ B-vein disch.; BAMR.
7/24/01	nr	6.50	nr	40	0	0.13	0.37	0.47	Cell A, trtd. wat. exiting OLD A @ B-vein disch.; BAMR.
7/24/01	nr	6.40	nr	34	12	0.14	0.38	0.49	Cell B; trtd. wat. exiting OLD B @ B-vein disch.; BAMR.
10/3/01	nr	6.40	nr	40	0	0.09	0.37	0.59	Cell C; trtd. wat. exiting OLD C @ B-vein disch.; BAMR.
10/3/01	nr	6.40	nr	40	1	0.08	0.44	0.62	Cell A, trtd. wat. exiting OLD A @ B-vein disch.; BAMR.
10/3/01	nr	6.50	nr	44	0	0.07	0.37	0.50	Cell B; trtd. wat. exiting OLD B @ B-vein disch.; BAMR.
11/1/01	nr	6.30	nr	30	10	0.08	0.35	0.45	Cell C; trtd. wat. exiting OLD C @ B-vein disch.; BAMR.
11/1/01	nr	6.40	nr	32	12	0.10	0.35	0.47	Cell A, trtd. wat. exiting OLD A @ B-vein disch.; BAMR.

11/1/01	nr	6.70	nr	64	0	0.37	0.07	0.28	Cell B; trtd. wat. exiting OLD B @ B-vein disch.; BAMR.
2/6/02	nr	6.30	nr	24	11	0.09	0.42	0.59	Cell C; trtd. wat. exiting OLD C @ B-vein disch.; BAMR.
2/6/02	nr	6.20	nr	20	25	0.09	0.46	0.64	Cell A, trtd. wat. exiting OLD A @ B-vein disch.; BAMR.
2/6/02	nr	6.50	nr	34	0	0.05	0.32	0.40	Cell B; trtd. wat. exiting OLD B @ B-vein disch.; BAMR.
3/12/02	nr	6.30	nr	28	24	0.10	0.39	0.55	Cell C; trtd. wat. exiting OLD C @ B-vein disch.; BAMR.
3/12/02	nr	6.20	nr	19	24	0.11	0.45	0.62	Cell A, trtd. wat. exiting OLD A @ B-vein disch.; BAMR.
3/12/02	nr	6.50	nr	28	0	0.06	0.30	0.40	Cell B; trtd. wat. exiting OLD B @ B-vein disch.; BAMR.
5/8/02	nr	6.60	nr	34	0	0.08	0.31	0.31	Cell C; trtd. wat. exiting OLD C @ B-vein disch.; BAMR.
5/8/02	nr	6.40	nr	28	6	0.10	0.38	0.52	Cell A, trtd. wat. exiting OLD A @ B-vein disch.; BAMR.
5/8/02	nr	6.60	nr	38	0	0.07	0.28	0.36	Cell B; trtd. wat. exiting OLD B @ B-vein disch.; BAMR.
6/4/02	nr	6.50	nr	32	0	0.10	0.33	0.44	Cell C; trtd. wat. exiting OLD C @ B-vein disch.; BAMR.
6/4/02	nr	6.40	nr	28	12	0.12	0.39	0.54	Cell A, trtd. wat. exiting OLD A @ B-vein disch.; BAMR.
6/4/02	nr	6.60	nr	38	0	0.08	0.30	0.39	Cell B; trtd. wat. exiting OLD B @ B-vein disch.; BAMR.
8/15/02	nr	6.50	nr	38	0	0.13	0.31	0.40	Cell C; trtd. wat. exiting OLD C @ B-vein disch.; BAMR.
8/15/02	nr	6.40	nr	36	17	0.18	0.38	0.49	Cell A, trtd. wat. exiting OLD A @ B-vein disch.; BAMR.
8/15/02	nr	6.60	nr	44	0	0.15	0.27	0.35	Cell B; trtd. wat. exiting OLD B @ B-vein disch.; BAMR.
10/1/02	nr	6.80	nr	32	0	0.11	0.41	0.49	Cell C; trtd. wat. exiting OLD C @ B-vein disch.; BAMR.
10/1/02	nr	6.90	nr	36	0	0.14	0.42	0.52	Cell A, trtd. wat. exiting OLD A @ B-vein disch.; BAMR.
10/1/02	nr	7.00	nr	48	0	0.12	0.28	0.36	Cell B; trtd. wat. exiting OLD B @ B-vein disch.; BAMR.
11/21/02	nr	6.60	nr	28	0	0.09	0.34	0.52	Cell C; trtd. wat. exiting OLD C @ B-vein disch.; BAMR.
11/21/02	nr	6.70	nr	36	0	0.08	0.29	0.40	Cell A, trtd. wat. exiting OLD A @ B-vein disch.; BAMR.
11/21/02	nr	6.80	nr	42	0	0.10	0.24	0.46	Cell B; trtd. wat. exiting OLD B @ B-vein disch.; BAMR.
mean=		6.47		31.18	3.75	0.13	0.35	0.49	

Connel C

			Spec.						
Date	Flow	pH	Cond.	Alk.	Acid.	Fe	Mn	Al	Comment
9/1/54	nr	3.30	nr			2.00	nr	nr	#9; C Connell tunnel; SL-188.
9/10/58	nr	3.40	nr			1.60	nr	nr	#9; C Connell tunnel; SL-188.
2/9/61	nr	3.40	nr			1.60	nr	nr	#9; C Connell tunnel; SL-188.
5/27/66	nr	3.40	nr			2.80	nr	nr	#9; C Connell tunnel; SL-188.
9/14/72	50	3.30	nr	0	58	1.60	nr	nr	C tunnel ; SW tunnel; 5772/SM2; Fld. Eng. Rept.
8/7/73	534.11	3.30	nr	0	96	1.20	nr	nr	#9; C Connell tunnel; SL-188.
8/20/73	798.92	3.40	nr	0	60	0.90	nr	nr	#9; C Connell tunnel; SL-188.
9/25/73	1243.26	3.20	nr	0	60	0.90	nr	nr	C tunnel; 57813001.
10/15/73	534.11	2.90	nr	0	62	1.05	nr	nr	C tunnel; 57813001.
11/12/73	1099.64	3.50	nr	0	62	0.89	nr	nr	C tunnel; 57813001.
1/16/74	1117.59	3.60	nr	0	38	1.05	nr	nr	C tunnel; 57813001.
2/22/74	1135.54	3.20	nr	0	32	1.20	nr	nr	C tunnel; 57813001.
3/18/74	1171.45	3.00	nr	0	34	1.19	nr	nr	C tunnel; 57813001.
4/24/74	1243.26	3.50	nr	0	42	0.60	nr	nr	C tunnel; 57813001.
5/31/74	565.53	3.30	nr	0	42	1.40	nr	nr	C tunnel; 57813001.
6/28/74	906.64	3.30	nr	0	54	1.50	nr	nr	C tunnel; 57813001.
8/26/74	520.64	3.50	nr	0	66	1.40	nr	nr	C tunnel; 57813001.
9/24/74	839.31	3.50	nr	0	70	0.80	nr	nr	C tunnel; 57813001.
10/31/74	430.88	3.10	nr	0	50	1.30	nr	nr	C tunnel; 57813001.
1/13/76	381.51	3.80	nr	0	64	1.00	nr	nr	C tunnel; 57813001.
1/30/76	1683.12	3.50	nr	0	52	2.30	nr	nr	C tunnel; 57813001.
2/11/76	412.92	3.50	nr	0	52	6.40	nr	nr	C tunnel; 57813001.
2/19/76	2692.99	3.80	nr	0	44	0.60	nr	nr	C tunnel; 57813001.

			Spec.						
Date	Flow	pH	Cond.	Alk.	Acid.	Fe	Mn	Al	Comment
2/25/76	2176.83	3.90	nr	0	42	0.50	nr	nr	C tunnel; 57813001.
3/10/76	987.43	3.70	nr	0	44	0.70	nr	nr	C tunnel; 57813001.
3/18/76	718.13	3.80	nr	0	34	0.70	nr	nr	C tunnel; 57813001.
3/22/76	861.76	3.90	nr	0	40	0.70	nr	nr	C tunnel; 57813001.
3/25/76	1009.87	3.70	nr	0	42	0.60	nr	nr	C tunnel; 57813001.
4/8/76	807.9	3.80	nr	0	44	0.70	nr	nr	C tunnel; 57813001.
4/14/76	484.74	3.80	nr	0	40	0.80	nr	nr	C tunnel; 57813001.
4/21/76	350.09	3.60	nr	0	38	1.10	nr	nr	C tunnel; 57813001.
5/4/76	269.3	3.80	nr	0	36	0.90	nr	nr	C tunnel; 57813001.
11/20/79	800	3.60	230	0	56	0.80	0.80	nr	C tunnel; 57813001.
2/16/81	2124	3.50	270	0	103	3.12	1.20	nr	C tunnel; 57813001.
4/20/81	nr	3.52	nr	0	46	2.10	nr	nr	C tunnel; Sta. 9, SL188; 57813001.
5/21/81	4,200	3.60	250	0	77	0.84	1.00	nr	C tunnel; 57813001.
5/21/81	4200	3.50	250	0	77	0.84	1.00	nr	C tunnel; 57813001.
5/26/81	nr	3.55	nr	0	43	0.90	nr	nr	C tunnel; Sta. 9, SL188; 57813001.
8/4/81	nr	3.63	nr	0	55	1.60	nr	nr	C tunnel; Sta. 9, SL188; 57813001.
8/4/81	nr	3.90	nr	0	56	0.71	1.31	2.24	Disch. wat. tunnel; S/A SP3; Fid. Eng. Rept.; 57813001.
8/26/81	nr	3.73	nr	0	56	1.9	nr	nr	C tunnel; Sta. 9, SL188; 57813001.
12/30/81	516	3.30	210	0	100	1.06	1.40	nr	C tunnel; 57813001.
3/13/82	3000	3.20	170	0	66	1.24	0.78	nr	C tunnel; 57813001.
4/5/82	2500	3.80	200	0	61	0.08	0.78	2.85	MP3, C tunnel, mon. dat.; 57813001.
4/27/82	400	3.80	210	0	65	0.08	0.78	3.30	MP3, C tunnel, mon. dat.; 57813001.
7/15/82	500	3.60	175	0	131	1.12	1.14	14.50	MP3, C tunnel, mon. dat.; 57813001.
8/27/82	115	3.40	200	0	92	2.06	1.4	3.95	MP3, C tunnel, mon. dat.; 57813001.
9/25/82	54	3.80	220	0	89	2.98	1.64	5.15	MP3, C tunnel, mon. dat.; 57813001.

			Spec.						
Date	Flow	pH	Cond.	Alk.	Acid.	Fe	Mn	Al	Comment
10/23/82	44.9	3.50	240	0	97	3.16	1.14	5.70	MP3, C tunnel, mon. dat.; 57813001.
11/20/82	204	3.40	240	0	97	1.54	1.76	3.55	MP3, C tunnel, mon. dat.; 57813001.
12/18/82	635	3.50	230	0	99	0.20	1.24	3.88	MP3, C tunnel, mon. dat.; 57813001.
1/15/83	354	3.30	220	0	79	0.49	0.99	3.78	MP3, C tunnel, mon. dat.; 57813001.
2/14/83	nr	3.50	nr	0	52	0.68	0.94	2.83	"C" tunnel deep mine disch. @ OMP3; 57813001.
2/16/83	630	3.40	170	0	69	0.23	0.65	2.44	MP3, C tunnel, mon. dat.; 57813001.
3/19/83	720	3.40	240	0	73	0.28	0.85	1.50	MP3, C tunnel, mon. dat.; 57813001.
4/23/83	1513	3.50	210	0	58	0.13	0.86	<1	MP3, C tunnel, mon. dat.; 57813001.
5/19/83	nr	3.70	nr	0	48	0.55	0.69	1.96	"C" tunnel deep mine disch. @ OMP3; 57813001.
5/21/83	556	3.50	190	0	60	0.62	0.98	2.99	MP3, C tunnel, mon. dat.; 57813001.
6/27/83	204	3.50	240	0	74	1.25	1.30	3.63	MP3, C tunnel, mon. dat.; 57813001.
7/28/83	115	3.40	230	0	104	2.48	1.60	6.87	MP3, C tunnel, mon. dat.; 57813001.
8/24/83	87.1	3.60	270	0	93	2.44	1.60	nr	MP3, C tunnel, mon. dat.; 57813001.
9/24/83	53.9	3.60	290	0	93	3.33	1.96	7.78	MP3, C tunnel, mon. dat.; 57813001.
10/22/83	75	3.60	290	0	104	2.67	2.22	nr	MP3, C tunnel, mon. dat.; 57813001.
11/25/83	1018	3.50	280	0	105	0.73	1.92	nr	MP3, C tunnel, mon. dat.; 57813001.
12/8/83	nr	3.50	nr	0	132	0.60	0.99	3.43	MP3, C tunnel @ weir; 57813001.
12/27/83	635	3.50	240	0	91	1.01	1.49	nr	MP3, C tunnel, mon. dat.; 57813001.
12/28/83	nr	3.60	nr	0	58	0.70	0.98	2.80	"C" tunnel deep mine disch @ weir; 57813001.
1/21/84	204	3.40	260	0	87	1.55	1.49	nr	MP3, C tunnel, mon. dat.; 57813001.
2/20/84	2600	3.50	310	0	85	0.60	0.94	nr	MP3, C tunnel, mon. dat.; 57813001.
3/24/84	2000	3.40	220	0	84	0.61	1.15	nr	MP3, C tunnel, mon. dat.; 57813001.
4/1/84	1360	3.70	160	0	48	0.50	0.83	nr	MP3, C tunnel, mon. dat.; 57813001.
6/1/84	284	3.70	214	0	42	1.50	1.20	nr	MP3, C tunnel, mon. dat.; 57813001.

			Spec.						
Date	Flow	pH	Cond.	Alk.	Acid.	Fe	Mn	Al	Comment
11/1/84	635	3.40	204	0	47	0.86	1.40	nr	MP3, C tunnel, mon. dat.; 57813001.
12/1/84	635	3.40	213	0	49	1.10	1.50	nr	MP3, C tunnel, mon. dat.; 57813001.
1/1/85	370	3.50	198	0	42	1.30	1.40	nr	MP3, C tunnel, mon. dat.; 57813001.
2/1/85	310	3.50	204	0	41	1.30	1.40	nr	MP3, C tunnel, mon. dat.; 57813001.
3/1/85	397	3.50	218	0	40	0.73	1.30	nr	MP3, C tunnel, mon. dat.; 57813001.
4/1/85	236	3.50	215	0	39	0.37	1.40	nr	MP3, C tunnel, mon. dat.; 57813001.
5/1/85	nr	3.40	211	0	40	1.00	1.40	nr	MP3, C tunnel, mon. dat.; 57813001.
6/1/85	nr	3.50	228	0	47	0.56	1.40	nr	MP3, C tunnel, mon. dat.; 57813001.
8/1/85	nr	3.40	228	0	60	0.75	1.90	nr	MP3, C tunnel, mon. dat.; 57813001.
9/1/85	nr	3.30	254	0	57	2.10	2.00	nr	MP3, C tunnel, mon. dat.; 57813001.
10/1/85	nr	3.50	280	0	59	0.97	1.90	nr	MP3, C tunnel, mon. dat.; 57813001.
12/1/85	nr	3.40	293	0	52	1.40	2.00	nr	MP3, C tunnel, mon. dat.; 57813001.
3/1/86	2000	3.40	220	0	83	0.60	0.83	nr	MP3, C tunnel, mon. dat.; 57813001.
5/1/86	nr	3.70	214	0	42	1.50	1.20	nr	MP3, C tunnel, mon. dat.; 57813001.
7/1/86	nr	3.50	nr	0	42	0.92	1.40	nr	MP3, C tunnel, mon. dat.; 57813001.
9/1/86	nr	3.70	nr	0	49	1.10	1.70	nr	MP3, C tunnel, mon. dat.; 57813001.
10/1/86	nr	3.60	nr	0	38	0.86	1.60	nr	MP3, C tunnel, mon. dat.; 57813001.
11/1/86	nr	3.70	nr	0	48	0.97	1.90	nr	MP3, C tunnel, mon. dat.; 57813001.
12/1/86	nr	3.40	nr	0	47	0.37	2.00	nr	MP3, C tunnel, mon. dat.; 57813001.
3/25/87	nr	3.60	nr	0	60	0.79	1.36	3.20	C-tunnel disch.; MP3; 57813001.
6/25/87	nr	3.70	nr	0	60	1.59	1.55	4.04	C-tunnel disch.; MP3; 57813001.
8/1/87	900	3.80	314	0	57	0.72	1.90	nr	MP3, C tunnel, mon. dat.; 57813001.
8/6/87	nr	3.50	nr	0	56	2.24	2.18	5.36	C-tunnel disch.; MP3; 57813001.
12/1/87	nr	3.80	185	0	48	0.62	1.20	nr	MP3, C tunnel, mon. dat.; 57813001.
3/24/88	nr	3.50	157	0	65	0.52	1.30	nr	MP3, C tunnel, mon. dat.; 57813001.
6/13/88	nr	3.80	216	0	55	0.97	1.30	nr	MP3, C tunnel, mon. dat.; 57813001.

			Spec.						
Date	Flow	pH	Cond.	Alk.	Acid.	Fe	Mn	Al	Comment
9/28/88	nr	3.70	263	0	51	0.87	1.50	nr	MP3, C tunnel, mon. dat.; 57813001.
12/30/88	nr	3.60	199	0	53	0.90	1.40	nr	MP3, C tunnel, mon. dat.; 57813001.
3/21/89	nr	3.50	264	0	80	1.00	1.60	nr	MP3, C tunnel, mon. dat.; 57813001.
8/14/89	nr	3.60	nr	0	52	1.67	1.58	3.19	C-tunnel disch.; MP3; 57813001.
3/2/90	nr	3.80	200	0	43	0.70	1.00	nr	MP3, C tunnel, mon. dat.; 57813001.
5/31/90	nr	3.90	150	0	35	0.74	<.05	nr	MP3, C tunnel, mon. dat.; 57813001.
9/19/90	nr	3.40	229	0	76	1.7	1.5	nr	MP3, C tunnel, mon. dat.; 57813001.
12/7/90	nr	4.10	177	0	38	0.77	0.99	nr	MP3, C tunnel, mon. dat.; 57813001.
1/2/91	nr	3.62	180	0	38	0.33	1.24	nr	MP3, C tunnel, mon. dat.; 57813001.
6/5/91	nr	3.70	117	18	45	0.68	0.95	nr	MP3, C tunnel, mon. dat.; 57813001.
8/27/91	nr	3.50	259	0	45	2.40	1.6	nr	MP3, C tunnel, mon. dat.; 57813001.
11/6/91	nr	3.50	nr	0	58	1.26	1.83	4.93	C-tunnel disch.; MP3; 57813001.
12/24/91	nr	3.50	234	0	42	0.63	1.1	nr	MP3, C tunnel, mon. dat.; 57813001.
2/19/92	nr	3.60	nr	0	44	1.11	1.23	3.72	C-tunnel disch.; MP3; 57813001.
3/11/92	nr	3.60	179	0	40	0.54	1.2	nr	MP3, C tunnel, mon. dat.; 57813001.
7/10/92	nr	3.20	272	0	45	0.86	1.1	nr	MP3, C tunnel, mon. dat.; 57813001.
8/4/92	nr	3.60	nr	0	56	0.98	1.53	4.56	C-tunnel disch.; MP3; 57813001.
11/5/92	nr	3.60	nr	0	42	0.88	1.27	4.38	C-tunnel disch.; MP3; 57813001.
2/4/93	nr	3.60	nr	0	34	<.3	0.30	0.85	C-tunnel disch.; MP3; 57813001.
2/26/93	nr	3.62	180	0	38	0.33	1.24	nr	MP3, C tunnel, mon. dat.; 57813001.
6/7/93	nr	3.70	nr	0	40	1.06	1.00	2.77	C-tunnel disch.; MP3; 57813001.
7/1/93	130	3.70	210	0	15	1.70	1.23	3.40	MP3, C tunnel, mon. dat.; 57813001.
11/20/93	677	3.64	220	0	43	0.52	1.39	5.42	MP3, C tunnel, mon. dat.; 57813001.
6/22/94	483	3.56	200	0	36	0.60	1.13	2.12	MP3, C tunnel, mon. dat.; 57813001.
9/15/94	273	3.61	190	0	32	0.79	0.94	0.50	MP3, C tunnel, mon. dat.; 57813001.
12/14/94	nr	4.00	nr	3	11	0.41	0.77	2.12	C-tunnel disch.; MP3; 57813001.

			Spec.						
Date	Flow	pH	Cond.	Alk.	Acid.	Fe	Mn	Al	Comment
12/19/94	635	3.66	170	0	32	0.51	0.83	2.00	MP3, C tunnel, mon. dat.; 57813001.
3/15/95	nr	3.70	nr	0	36	0.44	1.02	2.74	C-tunnel disch.; MP3; 57813001.
4/13/95	354	3.73	180	0	34	0.73	1.09	3.00	MP3, C tunnel, mon. dat.; 57813001.
7/20/95	147	3.39	240	0	38	1.41	1.49	3.50	MP3, C tunnel, mon. dat.; 57813001.
9/11/95	nr	3.60	314	0	52	2.10	1.82	4.88	C-tunnel disch.; MP3; 57813001.
10/16/95	174	3.56	270	0	54	1.27	1.89	5.00	MP3, C tunnel, mon. dat.; 57813001.
2/17/96	346	3.49	180	0	36	0.85	0.86	2.71	MP3, C tunnel, mon. dat.; 57813001.
4/22/96	1724	3.60	nr	nr	32	0.37	0.83	1.87	C vein disch.; #84; 57970101.
4/30/96	2115	3.70	nr	nr	28	0.4	0.82	2.01	C vein disch.; #84; 57970101.
5/4/96	1807	3.61	170	0	28	0.10	0.72	1.80	MP3, C tunnel, mon. dat.; 57813001.
5/8/96	1575	3.60	nr	nr	30	0.40	0.81	1.95	C vein disch.; #84; 57970101.
5/15/96	2178	3.70	nr	nr	30	0.31	0.76	1.83	C vein disch.; #84; 57970101.
5/21/96	859.5	3.80	nr	nr	44	0.45	0.81	1.97	C vein disch.; #84; 57970101.
5/29/96	504	3.70	nr	nr	38	0.67	0.85	2.03	C vein disch.; #84; 57970101.
6/4/96	322.65	3.80	nr	nr	32	0.80	0.86	2.11	C vein disch.; #84; 57970101.
6/11/96	166.5	3.80	nr	nr	32	0.98	1.01	2.39	C vein disch.; #84; 57970101.
6/18/96	63	3.70	nr	nr	46	1.06	0.99	2.33	C vein disch.; #84; 57970101.
7/1/96	126	3.59	nr	0	37	1.35	1.09	3.00	MP3, C tunnel, mon. dat.; 57813001.
<b>7/30/1996</b>	396	3.9		0	42.000	0.979	1.050	2.730	C vein
<b>8/29/1996</b>	247.5	3.7		0	50.000	1.530	1.500	3.850	C vein
<b>9/30/1996</b>	247.5	3.7		0	46.000	0.902	1.500	4.030	C vein
11/2/96	566	3.63	120	0	33	0.46	0.93	3.29	MP3, C tunnel, mon. dat.; 57813001.
<b>11/13/1996</b>	2056.5	3.7		0	36.000	0.431	1.060	2.610	C vein
<b>12/1/1996</b>	4693.5	3.7		0	36.000	0.196	0.694	1.170	C vein
12/11/96	nr	3.80	nr	0	38	0.42	0.74	1.99	MP3; C tunnel; 57813001.
<b>1/14/1997</b>	571.5	3.7		0	36.000	0.619	0.868	2.170	C vein

			Spec.						
Date	Flow	pH	Cond.	Alk.	Acid.	Fe	Mn	Al	Comment
1/23/97	142	3.69	180	0	27	0.69	0.81	1.57	MP3, C tunnel, mon. dat.; 57813001.
2/22/97	711	3.69	170	0	32	0.52	0.88	2.71	MP3, C tunnel, mon. dat.; 57813001.
3/3/1997	886.5	3.7		0	28.000	0.433	0.881	2.180	C vein
3/24/97		3.80	nr	0	32	0.47	0.77	1.99	MP3; C tunnel; 3" on weir; 57813001.
4/8/1997	1426	3.8		0	32.000	0.421	0.845	2.140	C vein
5/8/1997	464	3.8		0	36.000	0.532	0.880	2.310	C vein
6/11/1997	220	3.7		0	40.000	0.824	1.040	2.860	C vein
6/18/97	?	3.70	nr	0	42	0.86	1.06	2.88	MP3; C tunnel; 4" on weir; 57813001.
7/7/97	160	3.66	nr	0	44	1.20	1.26	3.00	MP3, C tunnel, mon. dat.; 57813001.
7/9/1997	117	3.8		0	42.000	1.230	1.130	2.910	C vein
8/12/1997	162	3.8		0	46.000	1.850	1.500	3.960	C vein
9/10/1997	536	3.7		0	52.000	1.010	1.720	4.180	C vein
9/16/97	nr	3.80	nr	0	52	0.84	1.76	4.35	MP3; "C" tunnel; 3" on weir; 57813001.
10/8/1997	168	3.6		0	54.000	1.360	1.720	4.520	C vein
11/5/1997	172	3.7		0	50.000	1.390	1.710	4.470	C vein
12/4/1997	1147	3.4		0	44.000	0.473	1.220	3.050	C vein
12/18/97	nr	3.70	nr	0	42	0.71	1.22	3.19	MP3, "C" tunnel; 57813001.
01/14/98		3.6		0	36.000	0.562	0.959	2.420	C vein
02/11/98		3.7		0	34.000	0.822	1.110	2.670	C vein
03/10/98		3.8		0	32.000	0.900	0.954	2.550	C vein
3/28/98	903	3.69	nr	0	30	0.35	0.82	2.00	MP3, C tunnel; mon. dat.; 57830101.
04/09/98		3.8		0	30.000	0.641	0.933	2.350	C vein
05/11/98		3.8		0	28.000	0.594	1.000	2.050	C vein
06/10/98		4.5		0	7.200	0.928	0.165	0.990	C vein
6/22/98	nr	3.70	nr	0	32	0.47	1.09	2.37	MP3, "C" tunnel; 57813001.
07/08/98		3.8		0	38.000	0.880	1.210	2.600	C vein

			Spec.						
Date	Flow	pH	Cond.	Alk.	Acid.	Fe	Mn	Al	Comment
7/9/98	198	3.70	nr	0	38	0.83	1.32	4.00	MP3, C tunnel; mon. dat.; 57830101.
<b>08/06/98</b>		3.7		0	40.000	1.430	1.330	2.020	C vein
8/19/98		3.70	nr	0	42	1.61	1.35	2.89	Tunnel "C"; 4" , 48' V-notch weir; 57813001.
<b>09/10/98</b>		3.7		0	42.000	1.880	1.840	3.630	C vein
<b>10/13/98</b>		3.8		0	40.000	1.350	2.430	3.350	C vein
<b>11/12/98</b>		3.7		0	3.400	2.170	0.015	4.730	C vein
12/7/98		3.70	nr	0	54	2.43	2.37	5.63	Tunnel "C"; 3.5", 48" V-notch weir; 57813001.
<b>12/10/98</b>		3.7		0	7.000	2.490	2.270	5.390	C vein
12/29/98	72	3.69	nr	0	56	1.76	2.62	5.00	MP3, C tunnel; mon. dat.; 57830101.
<b>01/26/99</b>		3.6		0	42.000	0.677	1.210	2.990	C vein
<b>02/22/99</b>		3.7		0	36.000	0.558	1.080	2.680	C vein
2/17/99	292	3.69	nr	0	38	0.56	0.98	2.00	MP3, C tunnel; mon. dat.; 57830101.
<b>03/29/99</b>		3.8		0	34.000	0.414	1.040	2.300	C vein
6/23/99	126	3.68	nr	0	43	1.39	1.48	3.00	MP3; C tunnel; mon. dat.; 57830101
9/27/99	626	3.56	nr	0	59	0.56	2.01	5.00	MP3, C tunnel; mon. dat.; 57830101.
<b>12/15/1999</b>		6.1		7.80	5.200	0.420	5.800	1.110	C Vein
<b>2/23/2000</b>	227.75	3.6		0.00	44.000	0.732	1.450	3.800	C vein
<b>3/23/2000</b>		3.7		0	32.000	0.394	1.190	2.420	C vein
3/27/00	903	3.62	nr	0	33	0.38	1.18	2.71	MP3, C tunnel, mon. dat.; 57813001.
<b>4/26/2000</b>		3.7		0	30.000	0.477	1.190	2.290	C vein
<b>5/30/2000</b>	599	3.7		0	34.000	0.401	1.060	2.280	C vein
<b>7/5/2000</b>		3.7		0	38.000	0.845	1.280	2.660	C vein
<b>7/27/2000</b>		3.7		0	40.000	0.600	1.540	3.140	C vein
<b>8/30/2000</b>		3.6		0	46.000	1.800	1.910	4.160	C vein
<b>9/28/2000</b>		3.7		0	50.000	1.180	1.900	4.590	C vein
<b>11/2/2000</b>		7.1		52	0.000	0.184	2.410	0.277	C vein

			Spec.						
Date	Flow	pH	Cond.	Alk.	Acid.	Fe	Mn	Al	Comment
12/7/2000		3.6		0	42.000	0.859	1.460	3.530	C vein
1/18/01	nr	3.70	nr	0	38	1.25	1.27	3.04	Raw mine wat. fr. C-vein; CV01; BAMR.
2/27/01	nr	3.70	nr	0	38	0.69	1.28	3.11	Raw mine wat. fr. C-vein; CV01; BAMR.
3/29/01	nr	3.70	nr	0	36	0.57	1.23	2.99	Raw mine wat. fr. C-vein; CV01; BAMR.
4/24/01	318	3.72	169	0	32	0.50	1.05	2.14	MP3, C tunnel, mon. dat.; 57813001.
5/3/01	nr	3.70	nr	0	32	0.76	1.19	2.44	Raw mine wat. fr. C-vein; CV01; BAMR.
6/5/01	nr	3.70	nr	0	42	1.45	1.37	2.79	Raw mine wat. fr. C-vein; CV01; BAMR.
6/25/01	407	3.70	236	0	36	0.61	1.83	3.22	MP3, C tunnel, mon. dat.; 57813001.
7/24/01	nr	3.70	nr	0	51	1.25	1.66	3.68	Raw mine wat. fr. C-vein; CV01; BAMR.
9/24/01	nr	3.52	293	0	54	1.48	2.40	5.00	MP3, C tunnel, mon. dat.; 57813001.
10/3/01	nr	3.60	nr	0	100	0.62	1.83	4.11	Raw mine wat. fr. C-vein; CV01; BAMR.
11/1/01	nr	3.60	nr	0	53	2.63	1.66	3.97	Raw mine wat. fr. C-vein; CV01; BAMR.
12/26/01	nr	3.56	194	0	42	0.60	1.31	3.00	MP3, C tunnel, mon. dat.; 57813001.
2/6/02	nr	3.60	nr	0	73	0.50	1.31	3.12	Raw mine wat. fr. C-vein; CV01; BAMR.
3/12/02	nr	3.60	nr	0	80	0.63	1.37	3.05	Raw mine wat. fr. C-vein; CV01; BAMR.
5/8/02	nr	3.60	nr	0	59	0.59	1.32	3.04	Raw mine wat. fr. C-vein; CV01; BAMR.
6/4/02	nr	3.70	nr	0	41	0.96	1.47	3.21	Raw mine wat. fr. C-vein; CV01; BAMR.
8/15/02	nr	3.70	nr	0	42	1.95	1.62	3.08	Raw mine wat. fr. C-vein; CV01; BAMR.
10/1/02	nr	3.70	nr	0	63	0.89	2.17	3.70	Raw mine wat. fr. C-vein; CV01; BAMR.
Avg=	800.22	3.64	219.63	0.39	49.65	1.04	1.32	3.21	

Connell C Discharge of the treatment cell

Date	Flow	pH	Cond.	Alk.	Acid.	Fe	Mn	Al	
12/15/1999		7.6		84.00	0.000	0.593	0.389	<0.20	dis trecell
2/23/2000	183	7.2		58.00	0.000	0.050	0.674	0.395	dis trecell
3/23/2000		7.4		72.00	0.000	0.371	0.690	<.200	dis trecell
4/26/2000		7.7		64.00	0.000	0.198	0.858	<.200	dis trecell
5/30/2000	532	3.7		0	32.000	0.421	1.040	2.260	dis trecell
7/5/2000		7.1		64	0.000	0.148	1.740	<.200	dis trecell
7/27/2000		3.7		0	38.000	0.660	1.500	3.080	dis trecell
8/30/2000		7.1		78	0.000	0.096	2.050	<.200	dis trecell
9/28/2000		6.7		54	0.000	0.339	2.580	0.221	dis trecell
11/2/2000		3.6		0	50.000	1.090	1.760	4.160	dis trecell
12/7/2000		6.7		38	0.000	0.118	1.690	0.505	dis trecell
1/18/2001		6.8		50.000	0.000	0.132	1.220	0.420	dis trecell
2/27/2001		7.1		46.000	0.000	0.127	1.110	0.403	dis trecell
Avg=		6.3		46.8	9.2	0.3	1.3	1.4	

Connell C Discharge of the settling pond

Date	Flow	pH	Cond.	Alk.	Acid.	Fe	Mn	Al	
12/15/1999		7.3		70.00	0.000	0.604	0.323	0.266	dis setpond
2/23/2000		7.1		54.00	0.000	0.321	0.609	0.294	dis setpond
3/23/2000		7.3		68.00	0.000	0.373	0.635	0.231	dis setpond
4/26/2000		7.5		66.00	0.000	0.222	0.865	<.200	dis setpond
5/30/2000	2573	7.6		60	0.000	0.162	1.400	<.200	dis setpond
7/5/2000		7.0		58	0.000	0.318	1.670	0.237	dis setpond
7/27/2000		7.0		78	0.000	0.140	1.780	<.200	dis setpond
8/30/2000		7.6		68	0.000	0.107	1.590	<.200	dis setpond
9/28/2000		6.7		48	0.000	0.284	2.210	0.310	dis setpond

<b>11/2/2000</b>		7.2		52	0.000	0.154	1.830	0.236	dis setpond
<b>12/7/2000</b>		6.8		40	0.000	0.117	1.620	0.514	dis setpond
<b>1/18/2001</b>		6.8		46.000	0.000	0.120	1.160	0.404	dis setpond
<b>2/27/2001</b>		7.1		46.000	0.000	0.156	1.040	0.384	dis setpond
<b>Avg=</b>		7.2		58.0	0.0	0.2	1.3	0.3	

Connell C Combined treated and untreated discharge

Date	Flow	pH	Cond.	Alk.	Acid.	Fe	Mn	Al	
<b>12/15/1999</b>		3.8		0.00	40.000	0.810	1.160	2.980	Cvein cbfl.
<b>2/23/2000</b>	649	5.3		3.20	10.200	0.491	0.983	2.080	Cvein cbfl.
<b>3/23/2000</b>		4.0		0	22.000	0.341	0.921	1.790	Cvein cbfl.
<b>4/26/2000</b>	1889.62	5.0		2.60	11.000	0.376	0.973	1.530	Cvein cbfl.
<b>5/30/2000</b>		7.4		54	0.000	0.278	1.310	<.200	Cvein cbfl.
<b>7/5/2000</b>		7.1		52	0.000	0.432	1.570	0.337	Cvein cbfl.
<b>7/27/2000</b>		7.0		64	0.000	0.270	1.080	<.200	Cvein cbfl.
<b>8/30/2000</b>		7.1		60	0.000	0.790	1.060	0.206	Cvein cbfl.
<b>9/28/2000</b>		6.7		44	0.000	0.348	1.750	<.200	Cvein cbfl.
<b>11/2/2000</b>		6.7		30.000	0.000	0.421	1.500	0.897	Cvein cbfl.
<b>12/7/2000</b>		6.7		30	0.000	0.191	1.400	0.568	C vein cbfl
<b>1/18/2001</b>		6.8		38.000	0.000	0.260	0.889	0.477	Cvein cbfl.
<b>2/27/2001</b>		5.9		5.400	8.600	0.463	1.030	1.640	Cvein cbfl.
<b>Avg=</b>		6.1		29.5	7.1	0.4	1.2	1.3	

# **Attachment F**

## **Comment and Response**