COOKS RUN WATERSHED TMDL
Cameron and Clinton Counties

Prepared for:

Pennsylvania Department of Environmental Protection

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INTRODUCTION

This report presents the Total Maximum Daily Loads (TMDLs) developed for stream segments in the Cooks Run Watershed (Attachment A). These were done to address the impairments noted on the 1996 Pennsylvania Section 303(d) lists of impaired waters. required under the Clean Water Act and covers six segments on this list (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. Cooks Run Segments Addressed

State Water Plan (SWP) Subbasin: 09-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	3.3	Not placed on GIS	23988	Cooks Run	HQ-CWF CWF	305(b) Report	RE	Metals
1998	3.3	Not placed on GIS	23988	Cooks Run	HQ-CWF CWF	305(b) Report	AMD	Metals
2000	3.35	960601-1035-TAS	23988	Cooks Run	HQ-CWF CWF	Unassessed Project	AMD	Metals, pH, Siltation
1996	6.8	Not placed on GIS	23988	Cooks Run (Basin)	EV/HQ-CWF CWF	305(b) Report	RE	Metals
1998	6.8	Not placed on GIS	23988	Cooks Run (Basin)	EV/HQ-CWF CWF	305(b) Report	AMD	Metals
1996	1.2	Not placed on GIS	23994	Rock Run	CWF	305(b) Report	RE	Metals
1998	1.2	Not placed on GIS	23994	Rock Run	CWF	305(b) Report	AMD	Metals
2000	1.82	990601-1320-TAS	23994	Rock Run	CWF	Unassessed Project	AMD	pH
1996	2.0	Not placed on GIS	23992	Camp Run	CWF	305(b) Report	RE	Metals
1998	2.0	Not placed on GIS	23992	Camp Run	CWF	305(b) Report	AMD	Metals
2000	3.85	990601-	23992	Camp	CWF	Unassessed	AMD	Metals,

[1] Pennsylvania's 1996 and 1998 Section 303(d) lists were approved by the Environmental Protection Agency (EPA). The 2000 Section 303(d) list was not required by U. S. Environmental Protection Agency. The 1996 Section 303(d) list provides the basis for measuring progress under the 1996 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

State Water Plan (SWP) Subbasin: 09-B West Branch Susquehanna River								
Year	***Miles***	***Segment ID***	***DEP Stream Code***	***Stream Name***	***Designated Use***	***Data Source***	***Source***	***EPA 305(b) Cause Code***
		1240-TAS		Run		Project		pH
1996	3.1	Not placed on GIS	23989	Crowley Hollow	CWF	305(b) Report	RE	Metals
1998	3.14	7136	23989	Crowley Hollow	CWF	SWMP	AMD	Metals
2000	3.14	990601-1140-TAS	23989	Crowley Hollow	CWF	Unassessed Project	AMD	Metals, pH, Siltation
2000	0.79	990601-1240-TAS	23993	Cow Hole	CWF	Unassessed Project	AMD	Metals, pH

See Attachment B, Excerpts Justifying Changes Between the 1996, 1998, and draft 2000 Section 303(d) lists.
The use designations for the stream segments in this TMDL can be found in PA Title 25 Chapter 93.

EV = Exceptional Value
HQ = High Quality Water
CWF = Cold Water Fishes
RE = Resource Extraction
AMD = Abandoned Mine Drainage
SWMP = Surface Water Monitoring Program

The 1999 survey added siltation as a cause of impairment to Cooks Run and Crowley Hollow. It is assumed that the siltation listing applies to coal fines washed into the creek and depositing on the streambed, therefore hindering aquatic life. Siltation due to coal fines is not a cause of impairment in the Cooks Run Watershed. Field investigations of various areas of the watershed conducted in November 2001 revealed no coal fines in Cooks Run and no basis for the siltation listing on the 2000 303(d) list. Therefore, TMDLs for siltation are not necessary.

LOCATION

The Cooks Run Watershed is approximately 26 square miles in area. It is located in northwestern Clinton County and eastern Cameron County, about 10 miles west of Renovo, Pennsylvania. Kettle Creek State Park is located 2 miles east of the watershed. Cooks Run flows 11.6 miles south/southeast from its headwaters near Jericho in Grove Township, Cameron County, to its confluence with the West Branch Susquehanna River. Approximately 91 percent of the watershed lies within the Sproul State Forest. Cooks Run can be accessed by traveling on State Highway 120 northwest from Lock Haven, Pennsylvania.

SEGMENTS ADDRESSED IN THIS TMDL

The Cooks Run Watershed is affected by pollution from AMD. This pollution has caused high levels of metals and low pH in the mainstem of Cooks Run below Rock Run, in Crowley Hollow, in Camp Run, and in Rock Run. Cooks Run, between Onion Run and Rock Run, has minor affects of AMD from discharges at Bear Hollow and a wet-weather seep at the mouth of

Onion Run. Below Rock Run, Cooks Run is likely impaired due to impaired tributaries entering the stream and seeps from an abandoned surface mine below Crowley Hollow. Crowley Hollow Run is affected by AMD discharges from underground mining. This is a result of the "up dip" mining technique, which allows water to flow freely through the mines. Rock Run and Camp Run are affected by an abandoned surface mine located on a mountaintop west of Cooks Run.

CLEAN WATER ACT REQUIREMENTS

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

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

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

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

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

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

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

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

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

SECTION 303(D) LISTING PROCESS

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

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

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

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

BASIC STEPS FOR DETERMINING A TMDL

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

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

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

5. Submit draft report for public review and comments; and
6. USEPA approval of the TMDL.

This document will present the information used to develop the Cooks Run Watershed TMDL.

WATERSHED BACKGROUND

The Cooks Run Watershed lies within the Mountainous High Plateau and Pittsburgh Low Plateau Sections of the Appalachian Plateau Province. There is a vertical drop in the watershed of 1,520 feet from its headwaters to its mouth. The average annual precipitation is 40 inches. The region is characterized by warm summers and long, cold winters. Temperatures change frequently and sometimes rapidly.

Coal mining and timber production were the primary land uses throughout the early half of the 20th century. Some timber production still occurs in the watershed. Forested land now makes up 95.7 percent of the watershed. Disturbed land (abandoned coal mines, quarries, etc.) make up four percent of the watershed. The watershed is relatively uninhabited.

Cooks Run Watershed is made up of interbedded sedimentary rock and sandstone (77 percent and 23 percent, respectively). The predominant soil association in the watershed is the Hazelton-Dekalb-Buchanan series. It accounts for 86 percent of the soil coverage. This soil association is characterized by highly permeable, well-drained soils derived from the weathering of sandstone and shale. The Hazelton-Cookport-Ernest series makes up 14 percent of the watershed. This association is moderately well drained with low permeability.

The Cooks Run Watershed was previously designated as a conservation area by the Pa. DER (Pennsylvania Department of Environmental Resources). This was changed in 1979 to various classifications due to impacts from abandoned mine drainage. Currently, from its source to Onion Run, Cooks Run is classified by the PA Code, Title 25 Chapter 93 Water Quality Standards as EV. It is classified as HQ-CWF from Onion Run to Crowley Hollow Run. From Crowley Hollow Run to its mouth, Cooks Run is listed as CWF.

Historical data shows that mining and logging began in this area in the late 19th century. Although much of the logging was completed by 1914 due to a forest fire, mining continued until the 1970's. Evidence indicates that the discharges on Cooks Run at Onion Run and Bear Hollow result from underground mining during the early 20th century (Klimkos 2001). Underground mining practices continued in the watershed until surface mining took over in the 1950's.

There have been various studies within the watershed to assess the biological community and water quality (Miller 1978, Pennsylvania Department of Environmental Resources Bureau of Water Quality Management 1989, Voykin 1978). In an aquatic investigation performed by the Pa. DER, it was acknowledged that Cooks Run upstream of Rock Run had excellent stream conditions. There was a high diversity of benthic macroinvertebrates, brook and brown trout existed, and chemically, the water quality was excellent. Below this point there was severe degradation from mine drainage in Rock Run, Camp Run, and Crowley Hollow. There were very few benthic macroinvertebrates and no fish found. Historical data indicates that Rock Run, Camp Run, and Cooks Run above the mouth of Crowley Hollow were excellent quality streams until permitted mining took place (Pa.DER BWQM 1989). A geologic investigation of the Camp, Cooks, and Rock Run areas noted that Camp Run and Rock Run are adversely being affected by acid conditions from mining (Voykin 1978). Finally, a Special Protection Evaluation Report identified portions of Rock and Camp Runs, and Cooks Run below Rock Run and Crowley Hollow Run as severely degraded by AMD from the Fran Contracting mining areas (Pa. DER BWQM 1989). It recommended that these streams be redesignated from HQ-CWF to CWF.

Currently, the Pa. DEP Bureau of Abandoned Mine Reclamation (BAMR) is conducting various projects to address the AMD problems in the Cooks Run Watershed (Klimkos 2001). The objective of this work is to create a high alkaline environment that ground or surface water will come in contact with before it reaches AMD. Most recently, part of Cooks Run between Onion Run and Rock Run has been diverted from contact with an abandoned mine discharge at Bear Hollow. If this treatment is successful it may be used elsewhere in the area. BAMR and the Allegheny Mountain Chapter of Trout Unlimited (AMCTU) are doing a pilot study to place a passive treatment system at the Fran Contracting Discharge. This project would involve using sulfate-reducing bacteria to treat the AMD. According to the AMCTU, reducing sulfate has shown to be an effective way to treat AMD that contains dissolved heavy metals. A treatment system on Rock Run is still in the planning stages. This project will involve excavating a pond upstream of the discharges on Rock Run, filling it with limestone, and then diverting Rock Run through the pond to increase the alkalinity of the stream before it contacts the AMD.

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 acceptable water quality. An instream numeric endpoint, therefore, represents the water quality goal that is to be achieved by implementing the load reductions specified in the TMDL. The endpoint allows for comparison between observed instream conditions and conditions that are expected to restore designated uses. The endpoint is based on either the narrative or numeric criteria available in water quality standards.

Because of the nature of the pollution sources in the watershed, the TMDLs component makeup will be load allocations that are specified above a point in the stream segment. All allocations will be specified as long-term average daily concentrations. These long-term average daily concentrations are expected to meet water quality criteria 99 percent of the time. Pennsylvania Title 25 Chapter 96.3(c) specifies that a minimum 99 percent level of protection is required. All metals criteria evaluated in this TMDL are specified as total recoverable. Pennsylvania does have dissolved criteria for iron; however, the data used for this analysis report iron as total recoverable. Table 2 shows the water quality criteria for the selected parameters.

Table 2. Applicable Water Quality Criteria

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

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

TMDL ELEMENTS (WLA, LA, MOS)

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

HYDROLOGY

Data used to determine flow for points CR01, CWR, CAR, and RR were only those flow values from a synchronous study conducted by the Susquehanna River Basin Commission in 2001. Data used for point FRAN were flow values from 1995 through 1997. These values were used because they were the most consistent data. All flow measurements were determined using the mean of the flow values available for that point in the stream.

Points CR02, CR03, and CR04 were not included in the 2001 monitoring program. Flow determinations were made at these points using flow data from the other instream points collected over the same period of time in 2001. ArcView v3.2 was used to delineate the watersheds and determine watershed areas upstream of the points. The flow for each point was computed by extrapolation using a linear regression equation found using Excel [flow = (0.7103 * watershed area at allocation point) – 350.67, R squared = 0.9968] (Figure 1).

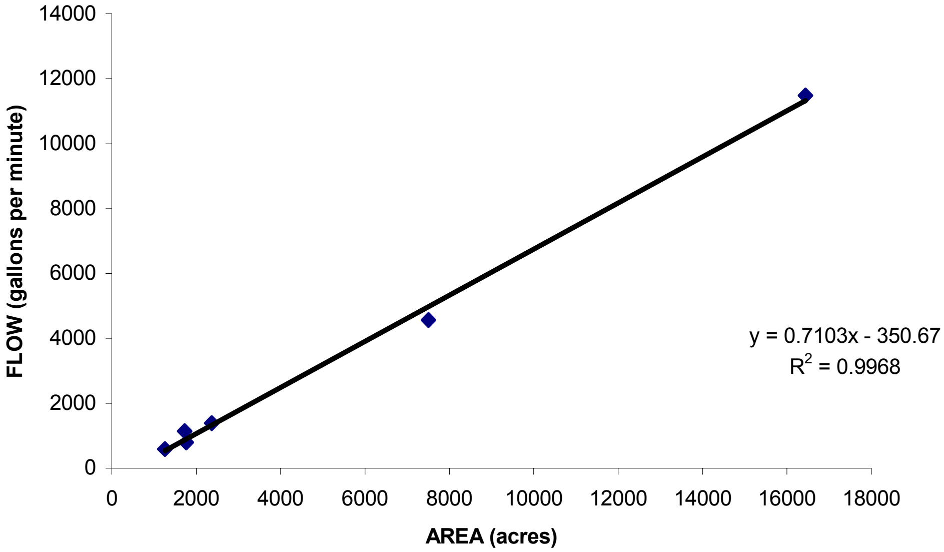


Figure 1. Flow Extrapolation for Loading Points in Cooks Run Watershed

Table 3. Flow Determination for Loading Points in Cooks Run Watershed

Point Identification	Average Flow (mgd*)	Determination Method	Number of Samples	Date Range
CR01	16.55	Average	7	3/14/01 – 9/6/01
CR02	14.18	Linear Regression		
CR03	11.09	Linear Regression		
CR04	8.55	Linear Regression		
CR05	6.57	Average	7	2/28/01 – 9/5/01
CWR	1.65	Average	7	2/28/01 – 9/5/01
CAR	1.14	Average	7	2/28/01 – 9/5/01
FRAN	0.02	Average	33	4/26/95-7/19/00
RR	2.00	Average	7	2/28/01 – 9/5/01

*mgd = million gallons per day

TMDL ALLOCATIONS SUMMARY

Analyses of data for metals for point FRAN indicated that there was no single critical flow condition for pollutant sources, and further, that there was no significant correlation between source flows and pollutant concentrations (Table 4). The other points in this TMDL did not have enough paired flow/parameter data to calculate correlations (fewer than 15 paired observations).

Table 4. Correlation Between Metals and Flow for Selected Points

Point Identification	Flow vs. Iron	Flow vs. Manganese	Flow vs. Aluminum	Number of Samples
FRAN	0.057	0.355	0.031	33

Methodology for dealing with metal and pH impairments is discussed in Attachment D. An example calculation from the Swatara Creek TMDL, including detailed tabular summaries of the Monte Carlo results, is presented for the Lorberry Creek TMDL in Attachment E. Information for the TMDL analysis using the methodology described above is contained in the TMDLs by segment section in Attachment F.

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

Table 5. Summary Table–Cooks Run Watershed

Station	Parameter	Measured Sample Data		Allowable		Reduction Identified
		Conc. (mg/l)	Load (lb/day)	LTA Conc. (mg/l)	Load (lb/day)	Percent
CR04						
	Fe	1.88	134.1	0.17	12.1	91
	Mn	0.20	14.3	0.16	11.4	19
	Al	0.95	67.7	0.01	0.7	90
	Acidity	3.97	283.1	1.67	119.1	59
	Alkalinity	12.27 (13.65)*	874.9 (973.3)*			
RR						
	Fe	0.27	4.5	0.27	4.5	0
	Mn	0.42	7.0	0.42	7.0	0
	Al	1.92	32.0	0.27	4.5	86
	Acidity	22.65	377.8	0	0	100
	Alkalinity	0	0			
CR03						
	Fe	1.27	117.5	0.17	15.7	0
	Mn	0.28	25.9	0.28	25.9	0
	Al	0.64	59.2	0.14	13.0	0
	Acidity	8.88	821.3	3.90	360.7	0
	Alkalinity	8.30 (18.56)*	767.7 (1,716.6)*			
FRAN						
	Fe	180.74	30.1	0.54	0.1	99.7
	Mn	43.48	7.3	0.43	0.1	99
	Al	200.35	33.4	0.40	0.1	99.8
	Acidity	2081.18	347.1	0	0	100
	Alkalinity	0	0			

Station	Parameter	Measured Sample Data		Allowable		Reduction Identified
		Conc. (mg/l)	Load (lb/day)	LTA Conc. (mg/l)	Load (lb/day)	Percent
CAR						
	Fe	0.29	2.8	0.29	2.8	0
	Mn	0.87	8.3	0.23	2.2	0
	Al	2.49	23.7	0.20	1.9	0
	Acidity	28.50	271.0	0	0	0
	Alkalinity	0	0			
CR02						
	Fe	3.20	378.4	0.13	15.4	93
	Mn	0.45	53.2	0.17	20.1	53
	Al	2.30	272.0	0.05	5.9	96
	Acidity	15.97	1889.0	2.56	302.7	70
	Alkalinity	6.94 (25.65)*	820.7 (3,033.4)*			
CWR						
	Fe	44.63	614.2	0.45	6.2	99
	Mn	6.77	93.2	0.41	5.6	94
	Al	20.81	286.4	0.21	2.9	99
	Acidity	363.88	5007.4	0	0	100
	Alkalinity	0.15	2.1			
CR01						
	Fe	5.14	709.5	0.16	22.1	0
	Mn	1.20	165.6	0.25	34.5	23
	Al	3.13	432.0	0.16	22.1	0
	Acidity	64.79	8942.8	14.25	1966.9	20
	Alkalinity	2.05 (74.47)*	283.0 (10,278.9)*			

*Alkalinity value used as water quality standard. (Attachment D)

RECOMMENDATIONS

There is currently no watershed group in the Cooks 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. Continuing with the current projects within the watershed is strongly recommended. These projects, although in the early stages, have shown great possibilities in treating AMD in the watershed.

Currently, the Pa. DEP Bureau of Abandoned Mine Reclamation (BAMR) is conducting various projects to address the AMD problems in the Cooks Run Watershed (Klimkos 2001). The objective of this work is to create a high alkaline environment that ground or surface water will come in contact with before it reaches AMD. Most recently, part of Cooks Run between Onion Run and Rock Run has been diverted from contact with an abandoned mine discharge at Bear Hollow. If this treatment is successful it may be used elsewhere in the area. BAMR and the Allegheny Mountain Chapter of Trout Unlimited are doing a pilot study to place a passive treatment system at the Fran Contracting Discharge. This project would involve using sulfate-reducing bacteria to treat the AMD. A treatment system on Rock Run is still in the planning stages. This project will involve excavating a pond upstream of the discharges on Rock Run, filling it with limestone, and then diverting Rock Run through the pond to increase the alkalinity of the stream before it contacts the AMD.

PUBLIC PARTICIPATION

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on December 14, 2002 and the Renovo Record on December 31, 2002 and January 29, 2003 to foster public comment on the allowable loads calculated. Public meetings were held on January 8 and February 10, 2003, at the First Christian Church in Big Run, PA and at the Renovo Borough Hall in Renovo, PA, to discuss the proposed TMDL.

REFERENCES

Klimkos, Michael J. 2001. A Plan for Addressing Acid Mine Drainage in Cooks Run Watershed, Cameron and Clinton Counties. Pennsylvania Department of Environmental Protection, Bureau of Abandoned Mine Reclamation.

Pennsylvania Department of Environmental Resources. 1995. Preliminary Hydrogeological Investigation of Completion Report #494201, from Corey Cram, Hydrogeologist Hawk Run District Office, to Terry L. Confer, Monitoring and Compliance Manager Hawk Run District Office, Mine Drainage from Avery Coal Company in Cooks Run Watershed.

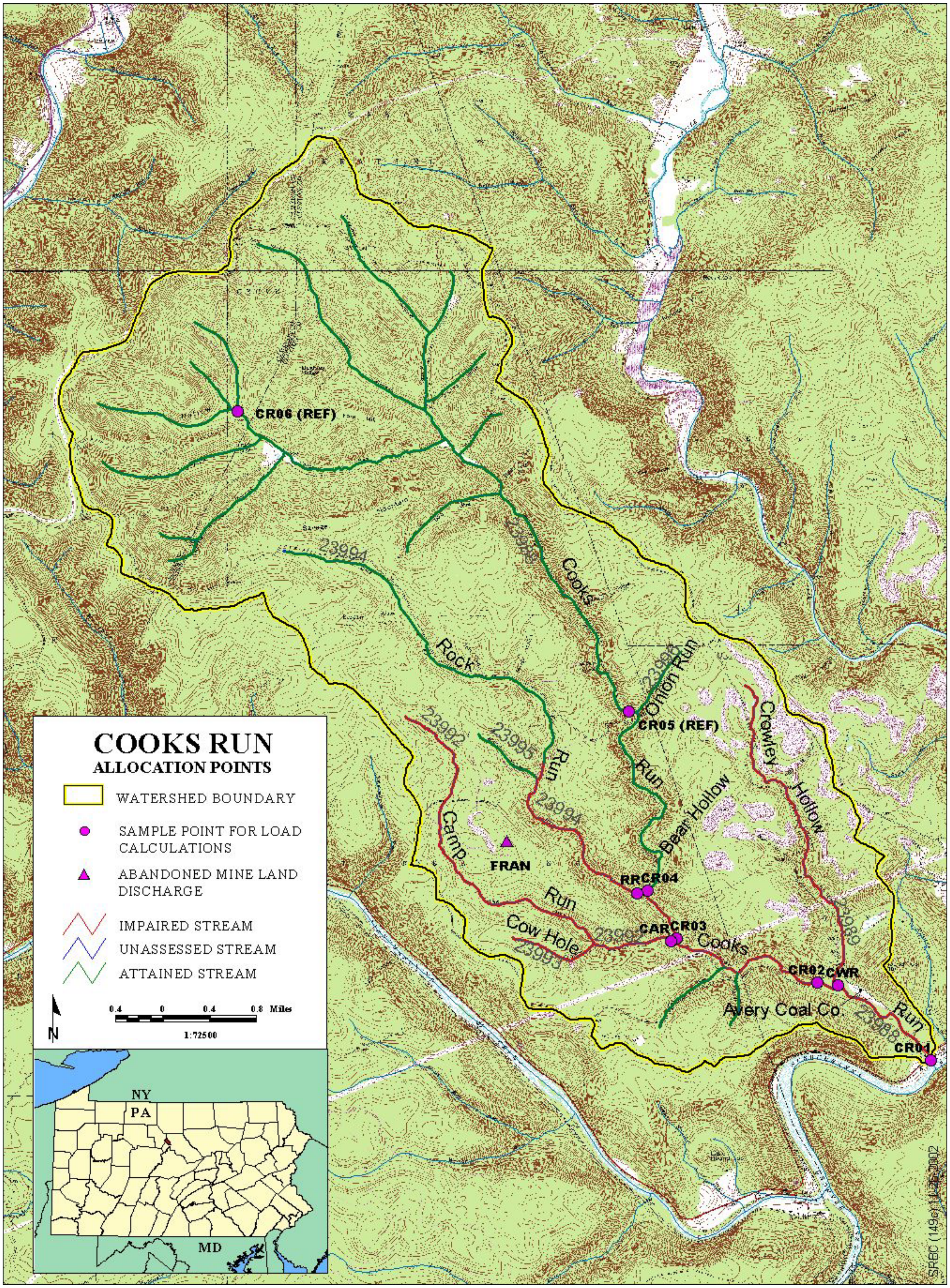
——1989. Special Protection Evaluation Report. Water Quality Standards Review. Bureau of Water Quality Management, Division of Water Quality. Cooks Run, Cameron and Clinton Counties.

——1978. Unpublished Geologic Investigation, from Dale P. Voykin, Regional Geologist Williamsport Regional Office, to Daniel L. Alters, Chief of Operations Section Bureau of Water Quality Management, on acid conditions in Cooks Run Watershed.

——1978. Unpublished Aquatic Biology Investigation, from Gerald G. Miller, Water Pollution Biologist Williamsport Regional Office, to Charles E. Gummo, Chief of Operations Section Bureau of Water Quality Management, on Mine Drainage from Fran Contracting, Inc in Cooks Run Watershed.

Attachment A

Cooks Run Watershed Map



COOKS RUN
ALLOCATION POINTS
WATERSHED BOUNDARY
SAMPLE POINT FOR LOAD CALCULATIONS
ABANDONED MINE LAND DISCHARGE
IMPAIRED STREAM
UNASSESSED STREAM
ATTAINED STREAM
0.4 0 0.4 0.8 Miles
1:72500
N
NY
PA
MD
CR06 (REF)
CR05 (REF)
RR
CR04
CAR
CR03
CR02
CWR
CR01
FRAN
Cooks Run
Rock Run
Camp Run
Cow Hole
Onion Run
Bear Hollow
Crowley Hollow
Avery Coal Co.
23994
23992
23995
23993
23988

Attachment B

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

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 C

Mining Permits in the Cooks Run Watershed

Permit Number	Company Name	Status
18841601	Avery Coal Company (Westport Tipple)	Stage II Bond Release
4674SM21	Fran Contracting, Inc.	Bond Forfeit

Attachment D

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

AMD Methodology

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

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

TMDLs and load allocations for each pollutant were determined using Monte Carlo simulation. Allocations were applied uniformly for the watershed area specified for each allocation point. For each source and pollutant, it was assumed that the observed data were log-normally distributed. Each pollutant source was evaluated separately using @Risk[3] by performing 5,000 iterations to determine any required percent reduction so that the water quality criteria will be met instream at least 99 percent of the time. For each iteration, the required percent reduction is:

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

PR = required percent reduction for the current iteration
Cc = criterion in mg/l
Cd = randomly generated pollutant source concentration in mg/l based on the observed data

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

Mean = average observed concentration
Standard Deviation = standard deviation of observed data

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

LTA = Mean * (1 – PR99)   where   (2)
LTA = allowable LTA source concentration in mg/l

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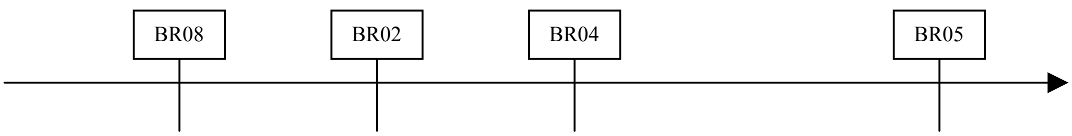
[3] @Risk – Risk Analysis and Simulation Add-in for Microsoft Excel, Palisade Corporation, Newfield, NY, 1990-1997.

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

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

Accounting for Upstream Reductions in AMD TMDLs

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



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

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

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

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

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

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

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

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

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

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

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

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

Method for Addressing 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. Therefore, net alkalinity will be used to evaluate pH in these TMDL calculations. This methodology assures that the standard for pH will be met because net alkalinity is a measure of the reduction of acidity. When acidity in a stream is neutralized or is restored to natural levels, pH will be acceptable. Therefore, the measured instream alkalinity at the point of evaluation in the stream will serve as the goal for reducing total acidity at that point. The methodology that is applied for alkalinity (and therefore pH) is the same as that used for other parameters such as iron, aluminum, and manganese that have numeric water quality criteria.

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

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

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

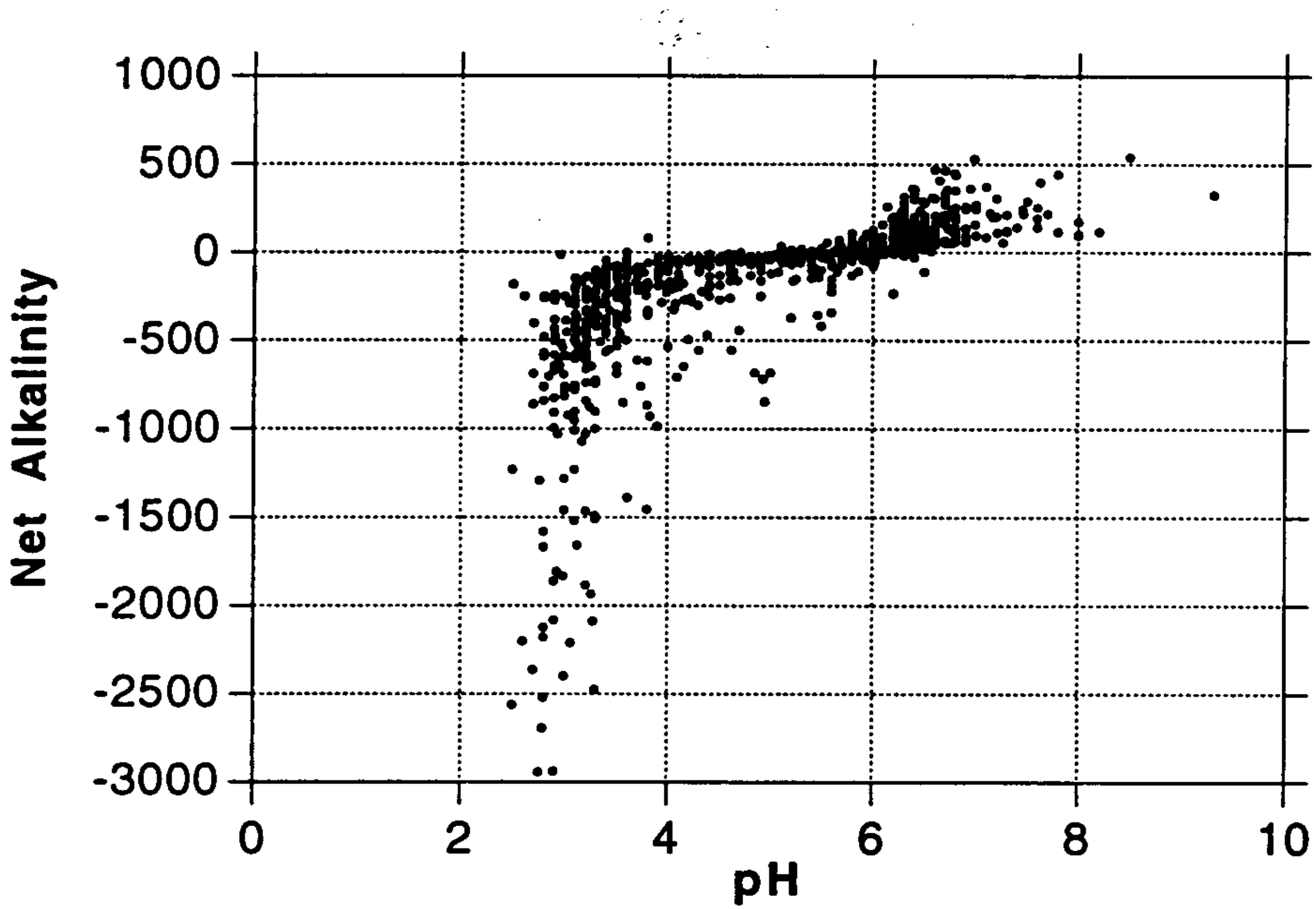


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania.

Surface Mining Control and Reclamation Act

The Surface Mining Control and Reclamation Act of 1977 (SMCRA, Public Law 95-87) and its subsequent revisions were enacted to established a nationwide program to, among other things, protect the beneficial uses of land or water resources, and pubic health and safety from the adverse effects of current surface coal mining operations, as well as promote the reclamation of mined areas left without adequate reclamation prior to August 3, 1977. SMCRA requires a permit for the development of new, previously mined, or abandoned sites for the purpose of surface mining. Permittees are required to post a performance bond that will be sufficient to ensure the completion of reclamation requirements by the regulatory authority in the event that the applicant forfeits. Mines that ceased operating by the effective date of SMCRA, (often called "pre-law" mines) are not subject to the requirements of SMCRA.

Title IV of the Act is designed to provide assistance for reclamation and restoration of abandoned mines, while Title V states that any surface coal mining operations shall be required to meet all applicable performance standards. Some general performance standards include:

- Restoring the affected land to a condition capable of supporting the uses which it was capable of supporting prior to any mining,

- Backfilling and compacting (to insure stability or to prevent leaching of toxic materials) in order to restore the approximate original contour of the land with all highwalls being eliminated, and topsoil replaced to allow revegetation, and

- Minimizing the disturbances to the hydrologic balance and to the quality and quantity of water in surface and ground water systems both during and after surface coal mining operations and during reclamation by avoiding acid or other toxic mine drainage.

For purposes of these TMDLs, point sources are identified as NPDES-permitted discharge points, and non-point sources include discharges from abandoned mine lands, including but not limited to, tunnel discharges, seeps, and surface runoff. Abandoned and reclaimed mine lands were treated in the allocations as non-point sources because there are no NPDES permits associated with these areas. In the absence of an NPDES permit, the discharges associated with these land uses were assigned load allocations.

The decision to assign load allocations to abandoned and reclaimed mine lands does not reflect any determination by EPA as to whether there are, in fact, unpermitted point source discharges within these land uses. In addition, by establishing these TMDLs with mine drainage discharges treated as load allocations, EPA is not determining that these discharges are exempt from NPDES permitting requirements.

Related Definitions

Pre-Act (Pre-Law) - Mines that ceased operating by the effective date of SMCRA and are not subject to the requirements of SMCRA.

Bond – A instrument by which a permittee assures faithful performance of the requirements of the acts, this chapter, Chapters 87-90 and the requirements of the permit and reclamation plan.

Postmining pollution discharge – A discharge of mine drainage emanating from or hydrologically connected to the permit area, which may remain after coal mining activities have been completed, and which does not comply with the applicable effluent requirements described in Chapters 87.102, 88.92, 88.187, 88.292, 89.52 or 90.102. The term includes minimal-impact postmining discharges, as defined in Section of the Surface Mining Conservation and Reclamation Act.

Forfeited Bond – Bond money collected by the regulatory authority to complete the reclamation of a mine site when a permittee defaults on his reclamation requirements.

Attachment E

Example Calculation: Lorberry Creek

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Table 8. L-1 Adjusted BAT Concentrations

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

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

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

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

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

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

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

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

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

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

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

Margin of Safety

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

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

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

Attachment F
TMDLs By Segment

Cooks Run above CR05

Cooks Run above point CR05 is attaining its designated uses and is, therefore, not included on the Section 303(d) list. It is included as a reference point for all other points downstream, on Cooks Run. Additionally, the pH criteria for points on the mainstem of Cooks Run, linked to the level of instream net alkalinity and acidity, is based on instream net alkalinity at point CR05. Point CR06 has been added as another reference point for all other points downstream of CR05. Cooks Run above CR06 also is attaining its designated uses and is, therefore, not included on the Section 303(d) list. The net alkalinity for CR05 (13.93 mg/l) is more protective then that of CR06 (11.0 mg/l), so it will be used as the alkalinity standard. Because the reach of Cooks Run containing CR05 is not listed as impaired, a TMDL will not be calculated for Cooks Run upstream of CR05.

Cooks Run between points CR05 and CR04

Cooks Run, above point CR04, has minor affects of AMD from discharges at Bear Hollow and a wet-weather seep at the mouth of Onion Run. The Onion Run seep shows some potential to be a problem, but it currently demonstrates no significant water quality affects. One discharge at Bear Hollow flows at about 0.003 or 0.004 million gallons per day (mgd) and appears to be caused by water flowing through abandoned underground coal mines. At the present time, there is a project underway to address the AMD problems of this section of Cooks Run. Phase 1 was completed in October 2001. It consisted of building two stream blocks to divert Cooks Run away from the discharge previously mentioned. Phase 2 of this project has yet to begin. It will involve adding high alkaline materials to the mine subsidence area responsible for the seep at Bear Hollow.

The TMDL for this section of Cooks Run consists of a load allocation to all of the watershed area between points CR04 and CR05. Addressing the mining impacts between these points addresses the minor impairments. An instream flow measurement was not available for point CR04; the average flow was derived using the linear regression method (8.55 mgd).

The water quality standard for acidity (13.65 mg/l) at point CR04 was determined by adding the net alkalinity at CR05 (CR05 alkalinity – CR05 acidity) to the acidity at CR04 (13.93–4.25 = 9.68; 9.68 + 3.97 = 13.65). Load reductions for acidity were calculated using this value as the water quality standard for acidity at point CR04.

An allowable long-term average instream concentration was determined at point CR04 for iron, manganese, aluminum and acidity. The analysis is designed to produce a long-term average value that, when met, will be protective of the water quality criterion for that parameter 99 percent of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water quality criteria 99 percent of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean and the standard deviation of the data set, 5,000 iterations of sampling were completed and compare against the water quality criterion for that parameter. For each sampling event a percent reduction was calculated, if necessary, to meet water quality criteria. A second simulation that multiplied the percent reduction times the sampled value was run to insure that criteria were met 99 percent of the time. The mean value from this data set represents that long-term daily average concentration that needs to be met to achieve water quality standards. The load allocations made at point CR04 for this stream segment are presented in Table F1.

Table F1. Reductions for Cooks Run Between CR05 and CR04					
	Measured Sample Data		***Allowable***		***Reduction Identified***
	Conc. (mg/l)	***Load (lb/day)***	***LTA Conc. (mg/l)***	***Load (lb/day)***	***Percent***
Fe	1.88	134.1	0.17	12.1	91
Mn	0.20	14.3	0.16	11.4	19
Al	0.95	67.7	0.10	7.1	90
Acidity	3.97	283.1	1.67	119.1	59
Alkalinity	12.27 (13.65)*	874.9 (973.3)*			

All values shown in this table are long-term average daily values.
* Alkalinity value used as water quality standard.

The TMDL for Cooks Run at point CR04 requires that a load allocation be made for all areas above CR04 for total iron, total manganese, total aluminum and total acidity.

Rock Run above RR

Rock Run is a tributary to Cooks Run that enters below CR04. There is a large abandoned surface mine discharge from Fran Contracting workings located on a mountaintop between Rock Run and Camp Run that affects both streams. The area was mined in the 1970's. Once operations ceased unsuccessful treatment systems were left behind. Now AMD seeps from the mine and flows into the lower section of Rock Run.

The TMDL for Rock Run consists of a load allocation to all of the watershed area above point RR. Addressing the mining impacts above this point addresses the impairment for the segment. An instream flow measurement was available for point RR (2.00 mgd).

An allowable long-term average instream concentration for iron, manganese, aluminum and acidity was determined at point RR. The analysis is designed to produce a long-term average value that, when met, will be protective of the water quality criterion for that parameter 99 percent of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water quality criteria 99 percent of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean and the standard deviation of the data set, 5,000 iterations of sampling were completed and compare 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 that percent reduction times that sampled value was run to insure that criteria were met 99 percent of the time. The mean value from this data set represents that long-term daily average concentration that needs to be met to achieve water quality standards. The load allocations made at point RR for this stream segment are presented in Table F2.

Table F2. Reductions for Rock Run Above RR					
	Measured Sample Data		*Allowable*		*Reduction Identified*
	Conc. (mg/l)	*Load (lb/day)*	*LTA Conc. (mg/l)*	*Load (lb/day)*	*Percent*
Fe	0.27	4.5	0.27	4.5	0
Mn	0.42	7.0	0.42	7.0	0
Al	1.92	32.0	0.27	4.5	86
Acidity	22.65	377.8	0.00	0.0	100
Alkalinity	0.00	0.0			

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

The TMDL for point RR requires that a load allocation be applied to all areas of Rock Run above RR for total aluminum and acidity.

Cooks Run Between CR04 and CR03

Cooks Run between CR04 and CR03 represents Cooks Run after receiving water from Rock Run. There are no additional sources of AMD for this segment of Cooks Run.

The TMDL for this section of Cooks Run consists of a load allocation to all of the watershed area between CR03 and CR04. Addressing the mining impacts between these points addresses the impairment for the segment. An instream flow measurement was not available for point CR03; the average flow was derived using the linear regression method (11.09 mgd).

The water quality standard for acidity (18.56 mg/l) at point CR03 was determined by adding the net alkalinity at CR05 (CR05 alkalinity – CR05 acidity) to the acidity at CR03 (13.93–4.25 = 9.68; 9.68 + 8.88 = 18.56). Load reductions for acidity were calculated using this value as the water quality standard for acidity at point CR03.

An allowable long-term average instream concentration was determined at point CR03 for iron, manganese, aluminum and acidity. The analysis is designed to produce a long-term average value that, when met, will be protective of the water quality criterion for that parameter 99 percent of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water quality criteria 99 percent of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean and the standard deviation of the data set, 5,000 iterations of sampling were completed and compare against the water quality criterion for that parameter. For each sampling event a percent reduction was calculated, if necessary, to meet water quality criteria. A second simulation that multiplied the percent reduction times the sampled value was run to insure that criteria were met 99 percent of the time. The mean value from this data set represents that long-term daily average concentration that needs to be met to achieve water quality standards. The load allocations made at CR03 for this stream segment are presented in Table F3.

Table F3. Long Term Average (LTA) for Cooks Run Between CR04 and CR03				
	Measured Sample Data		*Allowable*	
	Conc. (mg/l)	*Load (lb/day)*	*LTA Conc. (mg/l)*	*Load (lb/day)*
Fe	1.27	117.5	0.17	15.7
Mn	0.28	25.9	0.28	25.9
Al	0.64	59.2	0.14	13.0
Acidity	8.88	821.3	3.90	360.7
Alkalinity	8.30 (18.56)*	767.7 (1,716.6)*		

All values shown in this table are long-term average daily values.
* Alkalinity value used as water quality standard.

The loading reductions for points CR04 and RR were used to show the total load that was removed from upstream sources. For each parameter, the total load that was removed upstream was subtracted from the existing load at point CR03. This value was compared to the allowable load at point CR03. Reductions at point CR03 are necessary for any parameter that exceeds the allowable load at this point. A summary of all loads that affect point CR03 are shown in Table F4. Necessary reductions at point CR03 are shown in Table F5.

Table F4. Summary of Loads Affecting Point CR03				
	Iron (lb/day)	*Manganese (lb/day)*	*Aluminum (lb/day)*	*Acidity (lb/day)*
CR04				
Load Reduction	122.0	2.9	60.6	164.0
RR				
Load Reduction	0.0	0.0	27.5	377.8

Table F5. Reductions Necessary at Point CR03				
	Iron (lb/day)	*Manganese (lb/day)*	*Aluminum (lb/day)*	*Acidity (lb/day)*
Existing Loads at CR03	117.5	25.9	59.2	821.3
Total Load Reduction (CR04, RR)	122.0	2.9	88.1	541.8
Remaining Load	0	23.0	0	279.5
Allowable Loads at CR03	15.7	25.9	13.0	360.7
Percent Reduction	0	0	0	0
Load Reduction	0	0	0	0

The TMDL for Cooks Run at point CR03 does not require that a load allocation be made between CR04 and CR03.

Fran Contracting Discharge at Point FRAN

There is a large abandoned surface mine discharge located on a mountaintop between Camp Run and Rock Run. The FRAN point uses data collected from a 90-degree weir where the discharge enters the stream. The area was mined in the 1970's. Once operations ceased unsuccessful treatment systems were left behind. Now AMD seeps from the mine and flows a few hundred feet into the mid-section of Camp Run.

The TMDL for this section of Camp Run consists of a load allocation to FRAN. Addressing the mining impacts above this point addresses the impairment for the discharge. A discharge flow measurement was available for point FRAN (0.02 mgd).

An allowable long-term average instream concentration for iron, manganese, aluminum and acidity was determined at FRAN. The analysis is designed to produce a long-term average value that, when met, will be protective of the water quality criterion for that parameter 99 percent of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water quality criteria 99 percent of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean and the standard deviation of the data set, 5,000 iterations of sampling were completed and compare against the water quality criterion for that parameter. For each sampling event a percent reduction was calculated, if necessary, to meet water quality criteria. A second simulation that multiplied the percent reduction times the sampled value was run to insure that criteria were met 99 percent of the time. The mean value from this data set represents that long-term daily average concentration that needs to be met to achieve water quality standards. The load allocations made at point FRAN for this stream segment are presented in Table F6.

Table F6. Reductions for Fran Contracting Discharge at FRAN

	Measured Sample Data		***Allowable***		***Reduction Identified***
	Conc. (mg/l)	***Load (lb/day)***	***LTA Conc. (mg/l)***	***Load (lb/day)***	***Percent***
Fe	180.74	30.1	0.54	0.1	99.7
Mn	43.48	7.3	0.43	0.1	99
Al	200.35	33.4	0.40	0.1	99.8
Acidity	2081.18	347.1	0.00	0.0	100
Alkalinity	0.0	0.0			

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

The TMDL for point FRAN requires that a load allocation be applied to the Fran Discharge for total iron, total manganese, total aluminum and acidity.

Camp Run above CAR

Camp Run is a tributary to Cooks Run that enters below CR03. There is a large abandoned surface mine discharge located on a mountaintop between Camp Run and Rock Run. The area was mined in the 1970's. Once operations ceased unsuccessful treatment systems were left behind. Now AMD (Fran Discharge) seeps from the mine and flows a few hundred feet into the mid-section of Camp Run. Point CAR includes loading to Camp Run from the Fran Discharge upstream.

A stream survey was completed by the PFBC early this year on Camp Run. It determined that Camp Run above the Fran discharge, supports a natural wild brook trout population and that Camp Run is only impaired downstream of the Fran discharge. Further discussion with BAMR and the PFBC, indicated that there is no AMD impairment to Cow Hole, a tributary to Camp Run.

The TMDL for Camp Run consists of a load allocation to all of the watershed area above point CAR including the Cow Hole Subwatershed. Addressing the mining impacts above this point addresses the impairment for the segment. An instream flow measurement was available for point CAR (1.14 mgd).

An allowable long-term average instream concentration for iron, manganese, aluminum and acidity was determined at point CAR. The analysis is designed to produce a long-term average value that, when met, will be protective of the water quality criterion for that parameter 99 percent of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water quality criteria 99 percent of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean and the standard deviation of the data set, 5,000 iterations of sampling were completed and compare against the water quality criterion for that parameter. For each sampling event a percent reduction was calculated, if necessary, to meet water quality criteria. A second simulation that multiplied the percent reduction times the sampled value was run to insure that criteria were met 99 percent of the time. The mean value from this data set represents that long-term daily average concentration that needs to be met to achieve water quality standards. The load allocations made at point CAR for this stream segment are presented in Table F7.

Table F7. Long Term Average (LTA) Concentrations for Camp Run above CAR				
	Measured Sample Data		*Allowable*	
	Conc. (mg/l)	*Load (lb/day)*	*LTA Conc. (mg/l)*	*Load (lb/day)*
Fe	0.29	2.8	0.29	2.8
Mn	0.87	8.3	0.23	2.2
Al	2.49	23.7	0.20	1.9
Acidity	28.50	271.0	0.00	0.0
Alkalinity	0.00	0.0		

The loading reductions for point FRAN were used to show the total load that was removed from upstream sources. For each parameter, the total load that was removed upstream was subtracted from the existing load at point CAR. This value was compared to the allowable load at point CAR. Reductions at point CAR are necessary for any parameter that exceeds the allowable load at this point. A summary of all loads that affect point CAR is shown in Table F8. Necessary reductions at point CAR are shown in Table F9.

Table F8. Summary of Loads Affecting Point CAR				
	Iron (lb/day)	*Manganese (lb/day)*	*Aluminum (lb/day)*	*Acidity (lb/day)*
FRAN				
Load Reduction	30.0	7.2	33.3	347.1

Table F9. Reductions Necessary at Point CAR				
	Iron (lb/day)	*Manganese (lb/day)*	*Aluminum (lb/day)*	*Acidity (lb/day)*
Existing Loads at CAR	2.8	8.3	23.7	271.0
Total Load Reduction (FRAN)	30.0	7.2	33.3	347.1
Remaining Load	0.0	1.1	0.0	0.0
Allowable Loads at CAR	2.8	2.2	1.9	0.0
Percent Reduction	0	0	0	0
Load Reduction	0	0	0	0

The TMDL for point CAR does not require that load allocations be applied to Camp Run above CAR. The load allocation had been accounted for at point FRAN.

Cooks Run Between CR03 and CR02

Cooks Run between points CR03 and CR02 represents Cooks Run after receiving drainage from Camp Run. There are no additional AMD discharges in this segment.

The TMDL for this section of Cooks Run consists of a load allocation to all of the watershed area between points CR02 and CR03. Addressing the mining impacts between these points addresses the impairment for the segment. An instream flow measurement was not available for point CR02; the average flow was derived using the linear regression method (14.18 mgd).

The water quality standard for acidity (25.65 mg/l) at point CR02 was determined by adding the net alkalinity at CR05 (CR05 alkalinity – CR05 acidity) to the acidity at CR02 (13.93–4.25 = 9.68; 9.68 + 15.97 = 25.65). Load reductions for acidity were calculated using this value as the water quality standard for acidity at point CR02.

An allowable long-term average instream concentration for iron, manganese, aluminum, and acidity was determined at point CR02. The analysis is designed to produce a long-term average value that, when met, will be protective of the water quality criterion for that parameter 99 percent of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water quality criteria 99 percent of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean and the standard deviation of the data set, 5,000 iterations of sampling were completed and compare against the water quality criterion for that parameter. For each sampling event, a percent reduction was calculated, if necessary, to meet water quality criteria. A second simulation that multiplied the percent reduction times the sampled value was run to insure that criteria were met 99 percent of the time. The mean value from this data set represents that long-term daily average concentration that needs to be met to achieve water quality standards. The load allocations made at point CR02 for this stream segment are presented in Table F10.

Table F10. Long Term Average (LTA) Concentrations for Cooks Run Between CR03 and CR02

	Measured Sample Data		***Allowable***	
	Conc. (mg/l)	***Load (lb/day)***	***LTA Conc. (mg/l)***	***Load (lb/day)***
Fe	3.20	378.4	0.13	15.4
Mn	0.45	53.2	0.17	20.1
Al	2.30	272.0	0.05	5.9
Acidity	15.97	1889.0	2.56	302.7
Alkalinity	6.94 (25.65)*	820.7 (3,033.4)*		

All values shown in this table are long-term average daily values.
*Alkalinity value used as water quality standard.

The loading reductions for points CR03 and CAR were used to show the total load that was removed from upstream sources. For each parameter, the total load that was removed upstream was subtracted from the existing load at point CR02. This value was compared to the allowable load at point CR02. Reductions at point CR02 are necessary for any parameter that exceeds the allowable load at this point. A summary of all loads that affect point CR02 are shown in Table F11. Necessary reductions at point CR02 are shown in Table F12.

Table F11. Summary of Loads Affecting Point CR02				
	Iron (lb/day)	*Manganese (lb/day)*	*Aluminum (lb/day)*	*Acidity (lb/day)*
CR04, RR				
Load Reduction	122.0	2.9	88.1	541.8
CR03				
Load Reduction	0	0	0	0
FRAN				
Load Reduction	30.0	7.2	33.3	347.1
CAR				
Load Reduction	0	0	0	0

Table F12. Reductions Necessary at Point CR02				
	Iron (lb/day)	*Manganese (lb/day)*	*Aluminum (lb/day)*	*Acidity (lb/day)*
Existing Loads at CR02	378.4	53.2	272.0	1889.0
Total Load Reduction (CR04, RR, CR03, FRAN & CAR)	152.0	10.1	121.4	888.9
Remaining Load	226.4	43.1	150.6	1,000.1
Allowable Loads at CR02	15.4	20.1	5.9	302.7
Percent Reduction	93	53	96	70
Load Reduction	211.0	23.0	144.7	697.4

The TMDL for Cooks Run at point CR02 requires that a load allocation be made for all areas between CR03 and CR02 for total iron, total manganese, total aluminum and acidity.

Crowley Hollow Run above CWR

Crowley Hollow Run is a tributary to Cooks Run located just below point CR02. The source of the AMD impairment is discharges from abandoned underground mines. This site is currently being monitored by BAMR.

The TMDL for Crowley Hollow Run consists of a load allocation to all of the watershed area above point CWR. Addressing the mining impacts above this point addresses the impairment for the segment. An instream flow measurement was available for point CWR (1.65 mgd).

An allowable long-term average instream concentration for iron, manganese, aluminum and acidity was determined at point CWR. The analysis is designed to produce a long-term average value that, when met, will be protective of the water quality criterion for that parameter 99 percent of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water quality criteria 99 percent of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean and the standard deviation of the data set, 5,000 iterations of sampling were completed and compare against the water quality criterion for that parameter. For each sampling event, a percent reduction was calculated, if necessary, to meet water quality criteria. A second simulation that multiplied the percent reduction times the sampled value was run to insure that criteria were met 99 percent of the time. The mean value from this data set represents that long-term daily average concentration that needs to be met to achieve water quality standards. The load allocations made at point CWR for this stream segment are presented in Table F13.

Table F 13. Reductions for Crowley Hollow Run Point CWR					
	Measured Sample Data		***Allowable***		***Reduction Identified***
	Conc. (mg/l)	***Load (lb/day)***	***LTA Conc. (mg/l)***	***Load (lb/day)***	***Percent***
Fe	44.63	614.2	0.45	6.2	99
Mn	6.77	93.2	0.41	5.6	94
Al	20.81	286.4	0.21	2.9	99
Acidity	363.88	5007.4	0.00	0.0	100
Alkalinity	0.15	2.1			

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

The TMDL for point CWR requires that a load allocation be applied to all areas of Cooks Run above CWR for total iron, total manganese, total aluminum and acidity.

Cooks Run Between CR02 and CR01

Cooks Run between points CR02 and CR01 represents Cooks Run after receiving drainage from Crowley Hollow Run. The source of the AMD at this segment appears to be from small seeps from an abandoned surface mine on Cooks Run at the base of Round Top Mountain. CR01 represents the loadings to Cooks Run at the confluence with the West Branch Susquehanna River.

The TMDL for this section of Cooks Run consists of a load allocation to all of the watershed area between points CR01 and CR02. Addressing the mining impacts between these points addresses the impairment for the segment. An instream flow measurement was available for point CR01 (16.55 mgd).

The water quality standard for acidity (74.47 mg/l) at point CR01 was determined by adding the net alkalinity at CR05 (CR05 alkalinity – CR05 acidity) to the acidity at CR01 (13.93–4.25 = 9.68; 9.68 + 64.79 = 74.47). Load reductions for acidity were calculated using this value as the water quality standard for acidity at point CR01.

An allowable long-term average instream concentration for iron, manganese, aluminum and acidity was determined at point CR01. The analysis is designed to produce a long-term average value that, when met, will be protective of the water quality criterion for that parameter 99 percent of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water quality criteria 99 percent of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean and the standard deviation of the data set, 5,000 iterations of sampling were completed and compare against the water quality criterion for that parameter. For each sampling event, a percent reduction was calculated, if necessary, to meet water quality criteria. A second simulation that multiplied the percent reduction times the sampled value was run to insure that criteria were met 99 percent of the time. The mean value from this data set represents that long-term daily average concentration that needs to be met to achieve water quality standards. The load allocations made at point CR01 for this stream segment are presented in Table F14.

Table F14. Long Term Average (LTA) Concentrations for Cooks Run Between CR02 & CR01

	Measured Sample Data		***Allowable***	
	Conc. (mg/l)	***Load (lb/day)***	***LTA Conc. (mg/l)***	***Load (lb/day)***
Fe	5.14	709.5	0.16	22.1
Mn	1.20	165.6	0.25	34.5
Al	3.13	432.0	0.16	22.1
Acidity	64.79	8942.8	14.25	1,966.9
Alkalinity	2.05 (74.47)*	283.0 (10,278.9)*		

All values shown in this table are long-term average daily values.
*Alkalinity value used as water quality standard.

The loading reductions for points CR02 and CWR were used to show the total load that was removed from upstream sources. For each parameter, the total load that was removed upstream was subtracted from the existing load at point CR01. This value was compared to the allowable load at point CR01. Reductions at point CR01 are necessary for any parameter that exceeds the allowable load at this point. A summary of all loads that affect point CR01 are shown in Table F15. Necessary reductions at point CR01 are shown in Table F16.

Table F15. Summary of Loads Affecting Point CR01

	Iron (lb/day)	***Manganese (lb/day)***	***Aluminum (lb/day)***	***Acidity (lb/day)***
CR04, RR, CR03, FRAN, & CAR				
Load Reduction	152.0	10.1	121.4	888.9
CR02				
Load Reduction	211.0	23.0	138.3	697.4
CWR				
Load Reduction	608.0	87.6	283.5	5007.4

Table F16. Reductions Necessary at Point CR01				
	Iron (lb/day)	***Manganese (lb/day)***	***Aluminum (lb/day)***	***Acidity (lb/day)***
Existing Loads at CR01	709.5	165.6	432.0	8,942.8
Total Load Reduction (CR04, RR, CR03, FRAN, CAR, CR02, & CWR)	971.0	120.7	543.2	6,593.7
Remaining Load	0.0	44.9	0.0	2,349.1
Allowable Loads at CR01	22.1	34.5	22.1	1,966.9
Percent Reduction	0	23	0	20
Load Reduction	0	10.4	0	382.2

The TMDL for point CR01 requires that a load allocation be applied to all areas of Cooks Run between CR02 and CR01 for total manganese and acidity.

Margin of Safety

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

- Effluent variability plays a major role in determining the average value that will meet water-quality criteria over the long-term. The value that provides this variability in our analysis is the standard deviation of the dataset. The simulation results are based on this variability and the existing stream conditions (an uncontrolled system). The general assumption can be made that a controlled system (one that is controlling and stabilizing the pollution load) would be less variable than an uncontrolled system. This implicitly builds in a margin of safety.
- A MOS is also the fact that the calculation were performed with a daily Iron average instead of the 30 day average.

Seasonal Variation

Seasonal variation is implicitly accounted for in each TMDL because the data used represent all seasons.

Critical Conditions

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

Attachment G

Water Quality Data Used In TMDL Calculations

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid (mg/l)	Alk (mg/l)	Fe (mg/l)	Mn (mg/l)	Al (mg/l)	pH	Sulfate (mg/l)
CR 01	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	9/10/1985	*2800*	69	0	3.79	2.23	*	3.29	128
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	10/10/1985	*1700*	78	0	5.78	2.67	*	3.28	186
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	12/10/1985	*1400*	65	0	7.69	1.08	*	3.27	99
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	3/14/1986	*8000*	20	0	1.76	0.51	*	3.9	40
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	8/22/1986	*920*	72	0	3.27	1.54	*	3.6	220
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	10/23/1986	*350*	54	0	1.93	1.33	*	3.5	220
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	3/24/1987	*1500*	70	0	3.19	1.39	*	3.4	123
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	6/30/1987	*1257*	54	0	2.08	0.2	*	3.4	96
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	9/29/1987	*1500*	70	0	3.19	1.39	*	3.5	123
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	12/21/1987	*1500*	40	0	1.67	0.54	*	3.8	51
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	3/1/1988	*2000*	62	0	4.44	0.96	*	3.6	123
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	5/17/1988	*	30	2	1.17	0.57	*	4.1	46
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	9/27/1988	*1000*	110	0	4.17	2.04	*	3.4	220
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	11/4/1988	*	122	0	6.2	1.53	*	3.4	231
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	2/17/1989	*	60	0	1.74	0.86	*	3.8	78
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	6/26/1989	*	38	0	1.69	0.57	*	3.6	74
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	9/8/1989	*500*	126	0	6.14	1.91	*	3.1	314
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	11/20/1989	*6248*	25	0	2.1	0.88	*	3.8	52
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	3/30/1990	*8000*	32	0	2.42	0.7	*	3.8	52
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	6/13/1990	*5000*	43	0	3.07	0.87	*	3.7	75
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	9/29/1990	*5000*	35	0	3.59	0.94	*	3.75	71
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	12/27/1990	*5000*	25	2	2.35	0.42	*	3.95	39
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	3/30/1991	*5000*	30	0	3.17	0.56	*	3.9	46
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	6/13/1991	*4488*	77	0	6.67	1.46	*	3.4	143
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	9/19/1991	*2992*	140	0	12.5	3.2	*	3.15	299
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	12/13/1991	*3739*	46	0	4.34	1.51	*	3.6	115
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	3/23/1992	*4563*	36	0	3.22	0.79	*	3.85	63
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	6/29/1993	*	120	0	11.39	1.84	*	3.1	62
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	7/22/1993	*	430	0	60.8	5.4	*	2	300
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	12/31/1993	*1500*	94	0	8.99	1.12	*	3.3	220
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	3/26/1994	*	86	0	6.25	1.08	*	3.4	210
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	6/18/1994	*	22	0	1.58	0.41	*	3.7	40
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	9/17/1994	*	0	8	0.94	0.62	*	6.1	30
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	1/13/1995	*58.1*	9	28	0.77	0.28	*	6.6	20
	Monitoring Pt. 4 Cooks Run downstream	Avery Coal Company	18841601	5/15/1995	*225*	0	16	0.44	0.43	*	6.6	25
	CR1 Cooks Run at mouth	BAMR Project	*	5/31/2000	*11465.7*	46	0	4	0.64	2.75	3.5	43

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid (mg/l)	Alk (mg/l)	Fe (mg/l)	Mn (mg/l)	Al (mg/l)	pH	Sulfate (mg/l)
	Mouth of Cooks Run	604 B Report**	*	3/14/2001	18873.36	34	0	2.51	0.74	2.45	3.8	30
	Mouth of Cooks Run	604 B Report**	*	3/14/2001	18873.36	34	0	2.52	0.73	2.45	4	39.3
	Mouth of Cooks Run	604 B Report**	*	4/19/2001	31550.28	0	32	2.18	0.36	1.57	4	42
	Mouth of Cooks Run	604 B Report**	*	5/23/2001	4956.78	68	0	4.46	0.98	3.61	3.5	64.3
	Mouth of Cooks Run	604 B Report**	*	6/21/2001	3273.87	48	0	2.94	1.09	3.29	3.3	63.6
	Mouth of Cooks Run	604 B Report**	*	8/9/2001	1311.79	100	0	2.94	2.11	5.82	3.1	102.1
	Mouth of Cooks Run	604 B Report**	*	9/6/2001	1550.98	66	0	*	*	*	3.3	78.3
				Average =	11484.35	64.79	2.05	5.14	1.20	3.13	3.72	109.22
				StDev =	6532.23	66.73	6.82	9.19	0.94	1.35	0.83	82.35

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid (mg/l)	Alk (mg/l)	Fe (mg/l)	Mn (mg/l)	Al (mg/l)	pH	Sulfate (mg/l)
CR 02	Cooks Run upstream of confluence w/ Crowley Hollow	Special Prot. Eval. Rpt.	*	8/10/1983	*	*	1	0.12	0.02	0.24	4.7	25
	Cooks Run upstream of confluence w/Cole Run	Special Prot. Eval. Rpt.	*	8/10/1983	*	*	1	0.07	0.63	1.75	4.6	20
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	9/10/1985	*2600*	20	1	0.13	0.87	*	4.68	40
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	10/10/1985	*900*	13	1	0.02	0.6	*	4.82	41
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	12/10/1985	*9000*	11	1	0.14	0.29	*	4.75	25
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	3/14/1986	*5000*	6	1	0.17	0.18	*	4.94	18
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	8/22/1986	*458*	14	10	0.1	0.31	*	4.9	57
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	10/23/1986	*300*	12	8	0.01	0.25	*	5.1	70
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	3/24/1987	*1000*	18	0	0.07	0.29	*	3.9	43
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	6/30/1987	*807*	16	2	0.01	0.24	*	4	28
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	9/29/1987	*1000*	20	6	0.12	0.43	*	4.6	35
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	12/21/1987	*1200*	18	6	0.08	0.18	*	4.5	23
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	3/1/1988	*1500*	8	4	0.01	0.25	*	4.8	41
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	5/17/1988	*	4	20	0.01	0.33	*	7.1	21
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	9/27/1988	*600*	36	0	0.01	0.47	*	4	42
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	11/4/1988	*	18	6	0.01	0.54	*	4.7	38
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	2/17/1989	*	16	6	0.08	0.39	*	4.8	28
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	6/26/1989	*	16	2	0.06	0.24	*	4.1	28
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	9/8/1989	*300*	20	10	0.1	0.35	*	4	34
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	11/20/1989	*4712*	6	7	0.75	0.74	*	4.9	20
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	3/30/1990	*3500*	21	6	0.3	0.23	*	4.8	52
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	6/13/1990	*5000*	7	9	0.24	0.27	*	4.9	18
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	9/29/1990	*5000*	9	8	0.08	0.31	*	4.95	21
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	12/27/1990	*5000*	11	10	0.25	0.14	*	5.1	15
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	3/30/1991	*5000*	8	12	0.08	0.1	*	5.15	16

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid (mg/l)	Alk (mg/l)	Fe (mg/l)	Mn (mg/l)	Al (mg/l)	pH	Sulfate (mg/l)
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	6/13/1991	*2356*	7	10	0.21	0.28	*	5.05	21
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	9/19/1991	*1496*	9	9	0.14	0.57	*	4.95	38
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	12/13/1991	*2094*	10	7	0.4	0.45	*	4.85	31
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	3/23/1992	*2350*	14	10	0.39	0.33	*	3.85	26
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	3/17/1993	*	0	10	0.28	0.25	*	4.9	25
	Cooks Run below Camp Run corresponds w/CR4	BAMR	*	6/16/1993	*	34	5	0.356	0.289	1.05	4.5	25
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	6/29/1993	*	14	0	0.5	0.34	*	4	39
	Cooks Run below Camp Run corresponds w/CR4	BAMR	*	7/8/1993	*	6.6	7	0.41	0.324	0.563	4.8	29
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	7/22/1993	*	6	6	0.84	0.35	*	4.5	33
	Cooks Run below Camp Run corresponds w/CR4	BAMR	*	10/19/1993	*	7	10.4	0.86	0.59	1	5	27
	Cooks Run at Lower Bridge corresponds w/CR3	BAMR	*	10/19/1993	*	5	9.8	0.58	0.525	0.674	5	27
	Cooks Run below Camp Run corresponds w/CR4	BAMR	*	11/8/1993	*	1	9	9.11	1.03	7.97	2.8	20
	Cooks Run at Lower Bridge corresponds w/CR3	BAMR	*	11/8/1993	*	1	9.2	6.16	0.749	5.47	2.8	20
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	12/31/1993	*500*	30	8	0.13	0.22	*	4.9	36
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	3/26/1994	*	14	10	0.23	0.13	*	4.5	28
	Cooks Run below Camp Run corresponds w/CR4	BAMR	*	5/1/1994	*	24	9	0.59	0.366	2.09	4.4	20
	Cooks Run at Lower Bridge corresponds w/CR3	BAMR	*	5/1/1994	*	17	10.2	0.27	0.247	1.22	4.7	20
	Cooks Run at Lower Bridge corresponds w/CR3	BAMR	*	5/10/1994	*	9.2	8.6	0.819	0.164	0.699	5	20
	Cooks Run below Camp Run corresponds w/CR4	BAMR	*	5/11/1994	*	10.4	9	0.396	0.207	0.95	4.9	20
	Cooks Run below Camp Run corresponds w/CR4	BAMR	*	5/18/1994	*10508*	19.4	7.6	0.077	0.177	0.58	4.9	23.1
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	6/18/1994	*	0	4	0.14	0.23	*	4.7	25
	Cooks Run below Camp Run corresponds w/CR4	BAMR	*	8/17/1994	*	20	7.8	0.38	0.166	0.236	5	20
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	9/17/1994	*	0	8	0.29	0.3	*	4.9	18
	Cooks Run below Camp Run corresponds w/CR4	BAMR	*	9/20/1994	*	6	12.6	9.32	0.714	3.74	4.7	23
	Cooks Run at Lower Bridge corresponds w/CR3	BAMR	*	9/20/1994	*	3.6	8.4	6.71	0.546	2.44	4.8	22
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	10/15/1994	*	0	8	0.19	0.28	*	4.9	34
	Cooks Run below Camp Run corresponds w/CR4	BAMR	*	10/26/1994	*	1.4	9.2	0.92	0.4	0.792	5	24
	Cooks Run below Camp Run corresponds w/CR4	BAMR	*	10/26/1994	*	2.8	6.2	9.43	1.48	3.75	4.3	25
	Cooks Run at Lower Bridge corresponds w/CR3	BAMR	*	10/26/1994	*	2	9.2	11.6	1.69	4.25	5	24
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	1/13/1995	*	2	8	0.45	0.15	*	4.8	16
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	5/15/1995	*	6	6	0.12	0.32	*	4.5	22
	Cooks Run at Lower Bridge corresponds w/CR3	BAMR	*	5/22/1995	*	15.2	9	70	0.181	0.703	4.6	22
	Cooks Run at Lower Bridge corresponds w/CR3	BAMR	*	6/21/1995	*	19.6	8.6	21	0.346	2.84	5.2	15.3
	Cooks Run at Lower Bridge corresponds w/CR3	BAMR	*	7/13/1995	*	3.4	9.6	0.6	0.189	0.514	4.8	22.3
	Cooks Run at Lower Bridge corresponds w/CR3	BAMR	*	8/21/1995	*	3	8	0.423	0.291	0.51	5.1	26.7
	Monitoring Pt. 3 Cooks Run upstream of Crowley Hollow Run	Avery Coal Company	18841601	8/25/1995	*	10	2	0.01	0.24	*	4.1	26

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid (mg/l)	Alk (mg/l)	Fe (mg/l)	Mn (mg/l)	Al (mg/l)	pH	Sulfate (mg/l)
	Cooks Run at Lower Bridge corresponds w/CR3	BAMR	*	9/20/1995	*	7.6	5.2	0.941	0.359	0.538	4.5	35.9
	Cooks Run at Lower Bridge corresponds w/CR3	BAMR	*	10/18/1995	*	12.6	7.2	6.01	0.518	2.17	5	36.8
	Cooks Run at Lower Bridge corresponds w/CR3	BAMR	*	6/12/1996	*	24	9.2	0.769	0.234	0.7	4.9	1362
	Cooks Run at Lower Bridge corresponds w/CR3	BAMR	*	10/8/1996	*	19.4	9.4	6.44	0.609	2.35	4.8	20
	Cooks Run at Lower Bridge corresponds w/CR3	BAMR	*	4/7/1997	*	8.6	10.6	3.21	0.199	1.24	4.8	20
	Cooks Run at Lower Bridge corresponds w/CR3	BAMR	*	10/18/1999	*	8.2	7.2	0.078	0.892	0.863	4.7	42
	CR3 Cooks Run upstream of Crowley Run	BAMR Project	*	6/5/2000	*	322	0	46	4.19	18.6	2.8	286
	CR3 Cooks Run upstream of Crowley Run	BAMR Project	*	7/18/2000	*	6.2	2.4	0.27	0.26	0.85	5	20
				Average =	NA	15.97	6.94	3.20	0.45	2.30	4.67	50.94
				StDev =	NA	38.81	3.72	10.38	0.54	3.49	0.59	163.46

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid (mg/l)	Alk (mg/l)	Fe (mg/l)	Mn (mg/l)	Al (mg/l)	pH	Sulfate (mg/l)
CR 03	Cooks Run downstream of confluence w/ Rock Run CR5A	BAMR	*	7/16/1990	*	8	8	2.63	0.263	1.09	5.8	22
	Cooks Run downstream of confluence w/ Rock Run CR5A	BAMR	*	6/16/1993	*	36	6	0.667	0.375	1.62	4.6	28
	Cooks Run downstream of confluence w/ Rock Run CR5A	BAMR	*	7/8/1993	*	5.4	7	0.4	0.269	0.448	5.1	26
	Cooks Run downstream of confluence w/ Rock Run CR5A	BAMR	*	7/21/1993	*	12.6	7	0.5	0.281	0.323	4.9	30
	Cooks Run downstream of confluence w/ Rock Run CR5A	BAMR	*	10/19/1993	*	1.8	11	0.5	0.39	0.21	6.5	22
	Cooks Run above Camp Run corresponds w/CR5	BAMR	*	10/19/1993	*	0	12.4	0.27	0.275	0.135	6.2	27
	Cooks Run downstream of confluence w/ Rock Run CR5A	BAMR	*	11/8/1993	*	2	9.2	0.57	0.226	0.735	5.3	20
	Cooks Run above Camp Run corresponds w/CR5	BAMR	*	11/8/1993	*	2	9.8	0.41	0.16	0.286	5.8	20
	Cooks Run downstream of confluence w/ Rock Run CR5A	BAMR	*	5/1/1994	*	14.8	11	0.52	0.224	1.17	4.7	20
	Cooks Run above Camp Run corresponds w/CR5	BAMR	*	5/1/1994	*	11.4	11.2	0.181	0.139	0.255	5	20
	Cooks Run downstream of confluence w/ Rock Run CR5A	BAMR	*	5/11/1994	*	10.6	9.4	0.47	0.161	0.749	5.2	20
	Cooks Run above Camp Run corresponds w/CR5	BAMR	*	5/11/1994	*	6.6	9.4	1.33	0.153	0.581	5.5	20
	Cooks Run downstream of confluence w/ Rock Run CR5A	BAMR	*	5/18/1994	*	8.4	7.8	0.031	0.1	0.33	5.5	19.2
	Cooks Run above Camp Run corresponds w/CR5	BAMR	*	5/18/1994	*8124*	11.4	7.2	0.146	0.116	0.255	5	23.1
	Cooks Run above Camp Run corresponds w/CR5	BAMR	*	8/17/1994	*	18.8	8.6	0.43	0.129	0.135	5.7	20
	Cooks Run downstream of confluence w/Rock Run CR5A	BAMR	*	8/18/1994	*	24	1	1.03	0.199	0.544	4.9	5.37
	Cooks Run downstream of confluence w/Rock Run CR5A	BAMR	*	9/20/1994	*	3.4	7.6	0.17	0.216	0.307	4.9	20
	Cooks Run above Camp Run corresponds w/CR5	BAMR	*	9/20/1994	*	0	9.6	5.61	0.203	0.259	5	22
	Cooks Run above Camp Run corresponds w/CR5	BAMR	*	10/26/1994	*	2.4	9	0.79	0.377	0.588	5	24
	Cooks Run downstream of confluence w/Rock Run CR5A	BAMR	*	7/12/1995	*	3.8	7.4	11.6	0.565	3.55	4.3	20.3
	Cooks Run downstream of confluence w/Rock Run CR5A	BAMR	*	9/20/1995	*	7.8	6.2	0.165	0.431	0.592	4.8	43
	Cooks Run downstream of confluence w/Rock Run CR5A	BAMR	*	10/18/1995	*	10.2	7.4	0.309	0.459	0.258	5.3	34.1
	Cooks Run above Camp Run corresponds w/CR5	BAMR	*	10/18/1999	*	2.8	7.6	0.424	0.665	0.335	5.2	26

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid (mg/l)	Alk (mg/l)	Fe (mg/l)	Mn (mg/l)	Al (mg/l)	pH	Sulfate (mg/l)
				Average =	NA	8.88	8.30	1.27	0.28	0.64	5.23	23.13
				StDev =	NA	8.49	2.32	2.54	0.15	0.73	0.52	6.87
CR 04	Cooks Run upstream of confluence w/ Rock Run	Special Prot. Eval. Rpt.	*	8/10/1983	*	*	5	0.07	0.05	0.33	5.8	20
	Onion Run upstream of confluence w/Cooks Run	Special Prot. Eval. Rpt.	*	8/10/1983	*	*	5	0.08	0.03	0.07	5.9	5
	Cooks Run above Rock Run corresponds w/CR6	BAMR	*	7/16/1990	*	2	11	0.125	0.062	0.234	6.2	21
	Cooks Run above Rock Run corresponds w/CR6	BAMR	*	6/16/1993	*	28	9	9.42	0.98	4.37	5.5	24
	Cooks Run above Rock Run corresponds w/CR6	BAMR	*	7/8/1993	*	0	18	13.4	0.585	4.35	6	27
	Cooks Run above Rock Run corresponds w/CR6	BAMR	*	7/19/1993	*	0	18	0.512	0.017	0.116	6.6	26
	Cooks Run above Rock Run corresponds w/CR6	BAMR	*	10/19/1993	*	0	15.8	2.66	0.31	1.2	6.5	20
	Cooks Run above Rock Run corresponds w/CR6	BAMR	*	11/8/1993	*	0	12.6	0.43	0.067	0.216	6.1	20
	Cooks Run above Rock Run corresponds w/CR6	BAMR	*	5/1/1994	*	9	14.2	5.81	0.087	0.257	6.1	20
	Cooks Run above Rock Run corresponds w/CR6	BAMR	*	5/11/1994	*	0	13	5.81	0.67	2.66	7.4	20
	Cooks Run above Rock Run corresponds w/CR6	BAMR	*	5/18/1994	*6101*	7.2	10.4	0.052	0.05	0.135	6.1	13.3
	Cooks Run above Rock Run corresponds w/CR6	BAMR	*	8/18/1994	*	16.6	11.4	0.27	0.12	0.208	6	20
	Cooks Run above Rock Run corresponds w/CR6	BAMR	*	9/20/1994	*	0	11.8	0.17	0.067	0.135	5.7	20
	Cooks Run above Rock Run corresponds w/CR6	BAMR	*	10/26/1994	*	0	12.4	0.76	0.25	0.58	6.3	28
	Cooks Run above Rock Run corresponds w/CR6	BAMR	*	4/7/1997	*	1.2	13	0.461	0.057	0.168	5.9	20
	Cooks Run above Rock Run corresponds w/CR6	BAMR	*	10/18/1999	*	0.8	10.2	0.455	0.409	0.2	6	29
	CR6 Cooks Run upstream of Rock Run	BAMR Project	*	5/31/2000	*6849.3*	0	12.6	0.2	0.06	<.2	6.4	20
	CR6A Cooks Run at Crowley Trail	BAMR Project	*	5/31/2000	*4690.31*	0	14.4	0.11	<.01	<.2	6.5	20
	CR7 Cooks Run at Crowley Hollow Trail	BAMR Project	*	7/17/2000	*	0	14.4	0.1	<.01	<.2	6.5	*
	CR6 Cooks Run upstream of Rock Run	BAMR Project	*	8/23/2001	*	14.6	7.4	0.2	0.12	<.2	6.2	20
	BRH3 Cooks Run below junction	BAMR Project	*	8/23/2001	*	0	15	0.21	0.02	<.2	6.4	23.5
	BRH4 Mouth of new channel	BAMR Project	*	8/23/2001	*	0	15.4	0.12	0.01	<.2	6.5	20
				Average =	NA	3.97	12.27	1.88	0.20	0.95	6.21	20.80
				StDev =	NA	7.60	3.52	3.56	0.26	1.48	0.40	5.08
CR 05 (REF)	Cooks Run upstream of confluence w/Onion Run	Special Prot. Eval. Rpt.	*	8/10/1983	*	*	13	0.06	0.01	0.11	5.9	10
	CR8 Cooks Run at Three Point Hollow	BAMR Project	*	7/17/2000	*1296*	0	14.4	0.495	0.01	<.2	6.5	384
	Cooks Run .5 mile downstream of Lick Run	604 B Report**	*	2/28/2001	3744.77	2	6	0.3	0.05	0.5	6.5	20
	Cooks Run .5 mile downstream of Lick Run	604 B Report**	*	4/18/2001	12676.92	4	6	0.3	0.05	0.5	6.3	20
	Cooks Run .5 mile downstream of Lick Run	604 B Report**	*	4/18/2001	12676.92	4	6	0.3	0.05	0.5	6.3	20
	Cooks Run .5 mile downstream of Lick Run	604 B Report**	*	5/22/2001	1670.57	6	16	0.4	0.05	0.5	6.7	20
	Cooks Run .5 mile downstream of Lick Run	604 B Report**	*	6/20/2001	568.07	4	16	0.41	0.05	0.5	7	21.4

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid (mg/l)	Alk (mg/l)	Fe (mg/l)	Mn (mg/l)	Al (mg/l)	pH	Sulfate (mg/l)
	Cooks Run .5 mile downstream of Lick Run	604 B Report**	*	8/8/2001	149.49	6	24	0.3	0.05	0.5	6.9	20
	Cooks Run .5 mile downstream of Lick Run	604 B Report**	*	9/5/2001	452.21	8	24	0.31	0.05	0.5	6.5	20.3
				Average =	4562.71	4.25	13.93	0.32	0.04	0.45	6.51	59.52
				StDev =	5376.96	2.49	7.08	0.12	0.02	0.14	0.33	121.73
CR 06 (REF)	Cooks Run downstream of Cow Hollow	604 B Report**	*	3/14/2001	642.82	6	10	0.3	0.05	0.5	6.9	22.3
	Cooks Run downstream of Cow Hollow	604 B Report**	*	4/19/2001	2746.92	6	2	0.3	0.05	0.5	6.4	20
	Cooks Run downstream of Cow Hollow	604 B Report**	*	5/23/2001	512.01	8	14	0.3	0.05	0.5	6.9	20
	Cooks Run downstream of Cow Hollow	604 B Report**	*	5/23/2001	512.01	8	14	0.3	0.05	0.5	6.9	20
	Cooks Run downstream of Cow Hollow	604 B Report**	*	6/20/2001	153.23	8	12	0.3	0.05	0.5	6.75	38.7
	Cooks Run downstream of Cow Hollow	604 B Report**	*	8/9/2001	19.06	8	12	0.3	0.05	0.5	6.7	37.7
	Cooks Run downstream of Cow Hollow	604 B Report**	*	8/9/2001	19.06	8	12	0.3	0.05	0.5	6.7	20
	Cooks Run downstream of Cow Hollow	604 B Report**	*	9/5/2001	104.64	8	12	0.3	0.05	0.5	6.45	22.2
				Average =	588.72	7.50	11.00	0.30	0.05	0.50	6.71	25.11
				StDev =	905.97	0.93	3.85	0.00	0.00	0.00	0.20	8.14
CWR	CWR1 Crowley Run at mouth	BAMR Project	*	4/17/1980	*	8	4	0	*	*	6.17	24
	CWR1 Crowley Run at mouth	BAMR Project	*	5/5/1980	*	8	3	0	*	*	5.73	25
	CWR1 Crowley Run at mouth	BAMR Project	*	5/10/1980	*	27	1	0	*	*	5.15	43
	CWR1 Crowley Run at mouth	BAMR Project	*	7/7/1980	*	23	5	2	*	*	6.28	40
	Crowley Hollow Run upstream confluence w/Cooks Run	Special Prot. Eval. Rpt.	*	8/10/1983	*	*	0	65.93	11.35	32.3	2.7	510
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	9/10/1985	*1200*	260	0	21.7	7.53	*	2.8	447
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	9/10/1985	*1300*	255	0	19.4	7.19	*	2.82	432
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	10/10/1985	*600*	520	0	66	16.4	*	2.74	968
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	10/10/1985	*650*	500	0	61.3	16.1	*	2.74	950
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	12/10/1985	*4000*	440	0	68.8	6.01	*	2.65	628
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	12/10/1985	*4200*	430	0	63.5	6.27	*	2.66	614
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	3/14/1986	*1000*	212	0	25	4.56	*	2.94	353
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	3/14/1986	*1200*	212	0	24.2	4.53	*	2.95	342
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	8/22/1986	*251*	438	0	40.6	7.7	*	3	760
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	8/22/1986	*270*	430	0	37.8	7.6	*	3	720
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	10/23/1986	*150*	456	0	45.5	9.8	*	2.8	780
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	10/23/1986	*150*	441	0	40.7	9.3	*	2.8	830
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	3/24/1987	*300*	466	0	57	7	*	2.8	784

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid (mg/l)	Alk (mg/l)	Fe (mg/l)	Mn (mg/l)	Al (mg/l)	pH	Sulfate (mg/l)
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	3/24/1987	*300*	438	0	59	6.6	*	2.8	613
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	6/30/1987	*270*	344	0	36.8	7.5	*	2.9	700
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	6/30/1987	*270*	334	0	36.1	7.4	*	2.8	740
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	9/29/1987	*300*	350	0	32.4	6.5	*	2.9	314
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	9/29/1987	*300*	334	0	3.06	6.3	*	2.9	500
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	12/21/1987	*350*	250	0	18.3	5.02	*	3	526
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	12/21/1987	*350*	244	0	22.7	4.91	*	3	448
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	3/1/1988	*300*	370	0	47.6	4.98	*	3	526
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	3/1/1988	*300*	360	0	43.9	4.87	*	3	740
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	5/17/1988	*400*	250	0	19.4	4.71	*	3.1	500
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	5/17/1988	*600*	258	0	22.2	4.76	*	3.1	478
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	9/27/1988	*175*	450	0	43	10.3	*	2.9	663
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	9/27/1988	*200*	442	0	41.3	10.3	*	2.9	807
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	11/4/1988	*250*	500	0	27.3	8.1	*	3.1	526
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	11/4/1988	*275*	512	0	27.1	7.9	*	2.9	700
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	2/17/1989	*1000*	318	0	28.7	5.23	*	3	613
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	2/17/1989	*500*	296	0	25.9	5.02	*	3	720
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	6/26/1989	*400*	340	0	35.6	3.21	*	2.8	681
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	6/26/1989	*500*	320	0	35.2	3.19	*	2.8	720
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	9/8/1989	*100*	652	0	72.6	11.4	*	2.6	700
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	9/8/1989	*125*	612	0	71.4	11.7	*	2.6	960
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	11/20/1989	*1346*	355	0	52.3	8.4	*	2.85	564
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	11/20/1989	*1370*	338	0	51.8	8.17	*	2.8	580
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	3/30/1990	*1000*	231	0	24.64	4.47	*	2.95	422
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	3/30/1990	*1200*	228	0	23.24	4.34	*	2.95	378
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	6/13/1990	*2617*	343	0	50	5.94	*	2.95	556
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	6/13/1990	*2693*	343	0	44.5	5.92	*	2.85	512
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	9/29/1990	*1346*	355	0	40.7	6.73	*	2.9	450
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	9/29/1990	*1683*	345	0	42.2	6.64	*	2.9	409
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	12/27/1990	*2617*	273	0	40.5	3.92	*	3.15	434
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	12/27/1990	*3000*	253	0	30.7	3.73	*	3.15	416
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	3/30/1991	*2805*	282	0	51.1	3.8	*	3.1	407
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	3/30/1991	*3150*	228	0	23.24	4.34	*	2.95	378
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	6/13/1991	*898*	509	0	86.8	7.43	*	2.8	720
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841604	6/13/1991	*931*	482	0	86.8	7.47	*	2.8	724
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	9/19/1991	*750*	532	0	77.14	11.7	*	2.75	883

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid (mg/l)	Alk (mg/l)	Fe (mg/l)	Mn (mg/l)	Al (mg/l)	pH	Sulfate (mg/l)
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	9/19/1991	*775*	482	0	68.74	11.22	*	2.75	790
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	12/13/1991	*1010*	415	0	53.12	12.46	*	3.05	740
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	12/13/1991	*1036*	356	0	51.46	11.7	*	2.95	722
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	3/23/1992	*1047*	311	0	41.6	5.38	*	3.1	446
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	3/23/1992	*1100*	294	0	41.7	5.17	*	3.1	424
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	3/17/1993	*	220	0	26.7	4.96	*	3.2	489
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	3/17/1993	*	218	0	25.2	4.7	*	3.2	468
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	6/29/1993	*325*	728	0	103.6	9.05	*	2.7	960
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	7/22/1993	*200*	812	0	118.9	10.43	*	2.7	1400
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	7/22/1993	*225*	728	0	118	10.4	*	2.7	1162
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	12/31/1993	*280*	506	0	70.49	6.32	*	2.8	762
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	12/31/1993	*300*	478	0	63.73	6.05	*	2.8	663
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	3/26/1994	*500*	190	0	15.5	2.43	*	3.1	367
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	3/26/1994	*600*	164	0	14.5	2.46	*	3.2	321
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	6/18/1994	*	250	0	29.9	2.92	*	2.8	526
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	6/18/1994	*	234	0	27.1	2.8	*	2.9	438
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	9/17/1994	*	458	0	60.4	5.09	*	2.8	484
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	9/17/1994	*	458	0	60.4	5.09	*	2.8	484
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	10/15/1994	*	446	0	68.8	7.03	*	2.9	807
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	10/15/1994	*	446	0	68.8	7.03	*	2.9	807
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	1/13/1995	*	306	0	41.89	5.11	*	3	390
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	1/13/1995	*	306	0	41.89	5.11	*	3	390
	Monitoring Pt. 1 Crowley Hollow Run upstream	Avery Coal Company	18841601	5/15/1995	*	198	0	18.29	4.02	*	3	260
	Monitoring Pt. 2 Crowley Hollow Run at mouth	Avery Coal Company	18841601	5/15/1995	*	198	0	18.29	4.02	*	3	260
	CWR1 Crowley Run at mouth	BAMR Project	*	5/31/2000	*1229*	370	0	56.9	5.1	22.1	2.8	98
	CWR1 Crowley Run at mouth	BAMR Project	*	7/18/2000	*510*	388	0	64.3	6.35	25.4	2.8	384
	CWR7 Crowley Run downstream of Cattaraugus Rd.	BAMR Project	*	7/18/2000	*	44	0	0.48	1.35	4.53	3.7	44
	CWR1 Crowley Run at mouth	BAMR Project	*	8/1/2000	*	462	0	69.7	8.12	25.8	2.7	488
	Crowley Hollow Run upstream confluence w/Cooks Run	604 B Report**	*	2/28/2001	960.49	398	0	52.6	5.7	23.7	2.9	665.9
	Crowley Hollow Run upstream confluence w/Cooks Run	604 B Report**	*	4/19/2001	2702.07	332	0	37.2	3.9	16.3	2.9	386.6
	Crowley Hollow Run upstream confluence w/Cooks Run	604 B Report**	*	4/19/2001	2702.07	332	0	36.1	3.8	16.3	2.9	395.4
	Crowley Hollow Run upstream confluence w/Cooks Run	604 B Report**	*	5/22/2001	999.73	552	0	66.4	6.06	2.75	2.8	629.7
	Crowley Hollow Run upstream confluence w/Cooks Run	604 B Report**	*	6/21/2001	269.09	540	0	66.3	7.78	25.8	2.8	487
	Crowley Hollow Run upstream confluence w/Cooks Run	604 B Report**	*	8/8/2001	223.86	608	0	81.7	10.9	28	2.6	635.9
	Crowley Hollow Run upstream confluence w/Cooks Run	604 B Report**	*	9/5/2001	134.54	596	0	76.5	10.9	26.7	2.7	524

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid (mg/l)	Alk (mg/l)	Fe (mg/l)	Mn (mg/l)	Al (mg/l)	pH	Sulfate (mg/l)
				Average =	1141.69	363.88	0.15	44.63	6.77	20.81	3.03	556.81
				StDev =	966.19	155.66	0.75	24.93	2.96	9.20	0.64	242.42
CAR	Camp Run upstream from confluence w/Cooks Run	Special Prot. Eval. Rpt.	*	8/10/1983	*	*	0	0.13	2.77	5.66	3.9	10
	CAR1 Camp Run at mouth	BAMR	*	5/18/1994	*1568*	*	*	*	*	*	*	*
	CAR1 Camp Run at mouth	BAMR Project	*	7/18/2000	*438.17*	32	0	0.18	0.89	3.65	3.9	23
	Camp Run at confluence w/Cooks Run	604 B Report**	*	2/28/2001	1061.39	30	0	0.3	0.56	2.72	4.2	27.2
	Camp Run at confluence w/Cooks Run	604 B Report**	*	4/18/2001	3378.52	30	0	0.48	0.39	2.33	4	20.2
	Camp Run at confluence w/Cooks Run	604 B Report**	*	5/22/2001	523.22	36	0	0.3	0.63	2.74	3.9	31.7
	Camp Run at confluence w/Cooks Run	604 B Report**	*	6/20/2001	205.55	22	0	0.3	0.35	1.03	3.9	20
	Camp Run at confluence w/Cooks Run	604 B Report**	*	8/8/2001	112.12	20	0	0.3	0.54	0.8	3.9	27.4
	Camp Run at confluence w/Cooks Run	604 B Report**	*	8/8/2001	112.12	20	0	0.3	0.53	0.78	4	20
	Camp Run at confluence w/Cooks Run	604 B Report**	*	9/5/2001	153.23	38	0	0.3	1.15	2.74	3.9	20
				Average =	792.31	28.50	0.00	0.29	0.87	2.49	3.96	22.17
				StDev =	1073.47	7.07	0.00	0.10	0.76	1.56	0.10	6.23
FRAN	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	4/26/1995	10.6	1870	0	10.6	34.4	179	2.7	835
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	5/24/1995	6	1958	0	157	36	209	2.5	968
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	6/29/1995	1	1690	0	123	39	166	2.6	1034
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	7/17/1995	1	2020	0	140	50.6	187	2.4	2544
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	8/16/1995	1.5	2442	0	233	84.6	310	2.4	1834
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	9/13/1995	1	2972	0	337	94.5	245	2.4	2938
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	10/25/1995	25	1786	0	161	54.8	20.5	2.6	600
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	11/13/1995	9	1582	0	112	42.9	175	2.6	760
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	12/18/1995	6	2266	0	167	37.2	217	2.6	1200
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	1/18/1996	22	1672	0	153	43.8	194	2.8	1334
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	2/13/1996	0	2000	0	181	36.5	240	2.7	1564
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	3/12/1996	14.5	1656	0	154	27.6	198	2.6	659
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	4/9/1996	27.5	2134	0	171	27.8	199	2.6	768
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	5/15/1996	41.8	2064	0	221.5	25.6	243.5	2.6	762
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	6/18/1996	1.07	2208	0	203	51.6	227	2.5	1730
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	7/16/1996	0.19	2516	0	292	58.2	215	2.4	1340
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	8/12/1996	0.68	2590	0	257	61.7	196	2.3	1280
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	9/16/1996	6.05	1706	0	140	48.5	162	2.5	1220
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	10/29/1996	37.87	1998	0	160	32	198	2.6	1212

TMDL Site	Study Point	Company	Permit #	Date	Flow (gpm)	Acid (mg/l)	Alk (mg/l)	Fe (mg/l)	Mn (mg/l)	Al (mg/l)	pH	Sulfate (mg/l)
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	11/20/1996	37.87	2024	0	91.1	23.9	158	2.7	977
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	12/17/1996	36	1984	0	181	27.3	208	2.6	743
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	1/13/1997	8.9	2314	0	241	40.3	244	2.9	745
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	2/24/1997	81.7	1524	0	128	23.6	193	2.7	891
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	3/24/1997	49.6	2054	0	204	29.3	221	2.6	1100
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	4/14/1997	20.3	1934	0	203	33.3	223	2.7	364
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	5/12/1997	4.9	2064	0	183	42.4	220	2.7	658
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	6/16/1997	6	1926	0	127	35.2	170	2.5	1340
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	7/28/1997	2.2	3746	0	251	57.4	200	2.4	1300
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	8/18/1997	21.7	1096	0	80.9	36	107	2.6	740
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	9/24/1997	3.8	2062	0	165	65	218	2.4	585
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	10/21/1997	1.9	2486	0	211	61.2	235	2.5	1100
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	11/17/1997	24.5	1744	0	137	30	175	2.7	594
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	12/15/1997	24.5	1904	0	197	39.8	210	2.7	1100
	CAR6 Camp Run Discharge 90 Weir	BAMR Project	*	7/19/2000	*	2768	0	372	46.3	249	2.4	1740
				Average =	16.26	2081.18	0.00	180.74	43.48	200.35	2.57	1134.09
				StDev =	18.50	474.43	0.00	70.53	16.48	47.50	0.14	546.07
RR	Rock Run upstream of confluence w/ Cooks Run	Special Prot. Eval. Rpt.	*	8/10/1983	*	*	0	0.11	0.59	3.79	4.4	15
	RR1 Rock Run	BAMR Project	*	7/18/2000	*866.4*	17.2	0	0.17	0.44	2.18	4.4	20
	Rock Run at Confluence w/Cooks Run	604 B Report**	*	2/28/2001	1947.13	34	0	0.3	0.36	1.88	4.5	26.9
	Rock Run at Confluence w/Cooks Run	604 B Report**	*	4/18/2001	4794.96	24	0	0.35	0.29	1.9	4.3	21.9
	Rock Run at Confluence w/Cooks Run	604 B Report**	*	5/22/2001	960.49	28	0	0.3	0.4	2.17	4.4	21.5
	Rock Run at Confluence w/Cooks Run	604 B Report**	*	5/22/2001	960.49	28	0	0.3	0.42	2.24	4.4	20
	Rock Run at Confluence w/Cooks Run	604 B Report**	*	6/20/2001	571.81	22	0	0.3	0.38	1.42	4.3	20
	Rock Run at Confluence w/Cooks Run	604 B Report**	*	8/8/2001	325.15	16	0	0.3	0.5	0.97	4.5	20
	Rock Run at Confluence w/Cooks Run	604 B Report**	*	9/5/2001	133.8	12	0	0.3	0.42	0.71	4.7	22.7
				Average =	1384.83	22.65	0.00	0.27	0.42	1.92	4.43	20.89
				StDev =	1506.63	7.33	0.00	0.08	0.09	0.89	0.12	3.14

"*" signifies no data were collected

"**"Flow data from the 604 b Report was used to determine average flow for these points instead of the other available data shown in italics.

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

Attachment H
Comment and Response

EPA Region III Comments

Comment:
Please note that although that both "Cooks Run (Basin)" and "Cooks Run" with individual tributaries, were on the 1996 Section 303(d) list of impaired water, Cooks Run will count only once towards the Consent Decree requirements. Cooks Run Watershed provides four, not five, TMDLs toward meeting the Consent Decree requirements.

Response:
It has been noted that Cooks Run provides only four TMDLs toward meeting the Consent Decree requirements.

Comment:
The public noticed version of the Cooks Run Basin TMDL Report indicates alternate water quality standards for alkalinity, upstream unimpaired segments' alkalinity is less than 20 mg/l. It is understood that increasing instream alkalinity may be a low priority for DEP and may not be specifically addressed when implemented TMDLs for metals or acidity. Therefore, EPA expects the alkalinity to be monitored after the metals and acidity TMDLs are implemented and, if necessary, the streams will be listed for alkalinity and TMDLs developed.

Response:
Relisting will occur if monitoring, subsequent to TMDL implementation, shows a waterbody is not meeting alkalinity criteria and, is meeting criteria for previously listed parameters.

Comment:
Attachment F, although the public noticed version of the Cooks Run Watershed TMDL Report states that Cow Hole is not impaired by AMD, the 2002 Section 303(d) list of impaired waters lists Cow Hole with Camp Run as impaired for pH and metals. Please verify which document is correct.

Response:
Further investigation is needed to determine whether or not Cow Hole is actually impaired by AMD.