UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Decision Rationale
Total Maximum Daily Loads
Big Run Watershed
For Acid Mine Drainage Affected Segments
Clearfield County

Signed
Jon M. Capacasa, Director
Water Protection Division

Date: *12/13/04*

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I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those waterbodies identified as impaired by the state where technology-based and other controls will not attain water quality standards. A TMDL determines the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety, that may be discharged to a water quality-limited waterbody without violating water quality standards.

The Pennsylvania Department of the Environmental Protection (PADEP), Bureau of Watershed Conservation, submitted the *Big Run Watershed TMDL*, dated September 9, 2004, (TMDL Report), electronically to EPA for final Agency review on October 5, 2004, followed by a printed copy on October 8, 2004. This report included Total Maximum Daily Loads (TMDLs) for three metals (iron, manganese, aluminum) and pH, and addresses one segment (ID 7162) on Pennsylvania's 1996, 1998 and 2002 Section 303(d) list of impaired waters due to pH cause.

EPA's rationale is based on the TMDL Report and information contained in the attachments to the report. EPA's review determined that the TMDL meets the following eight regulatory requirements pursuant to 40 CFR Part 130.

1. The TMDLs are designed to implement the applicable water quality standards.
2. The TMDLs include a total allowable load as well as individual Wasteload Allocations (WLAs) and Load Allocations (LAs).
3. The TMDLs consider the impacts of background pollutant contributions.
4. The TMDLs consider critical environmental conditions.
5. The TMDLs consider seasonal environmental variations.
6. The TMDLs include a Margin Of Safety (MOS).
7. There is reasonable assurance that the proposed TMDLs can be met.
8. The TMDLs have been subject to public participation.

II. Summary

Table 1 presents the 1996, 1998, and 2002 Section 303(d) listing information for the water quality limited segments listed in 1996.

Table 1. 303(d) Sub-List

State Water Plan (SWP) Subbasin: 08-C Big Run

Year	Miles	Segment ID	DEP Stream Code	Stream Name	Designated Use	Data Source	Source	EPA 305(b) Cause Code
1996	1	7162	25971	Big Run	CWF	305(b) Report	RE	pH
1998	1.09	7162	25971	Big Run	CWF	SWMP	AMD	pH
2002	1.1	7162	25971	Big Run	CWF	SWMP	AMD	pH

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

The TMDL was developed using a statistical procedure to ensure that water quality criteria are met 99 percent of the time as required by Pennsylvania's water quality standards at Pennsylvania Code Title 25, Chapter 96.3(c). Tables 2 summarizes the TMDL for Big Run as determined by PADEP.

TMDL is the summation of the point source waste load allocations (WLAs) plus the summation of the nonpoint source load allocations (LAs) plus a margin of safety (MOS) and is often expressed as:

$$TMDL = \sum WLAS + \sum LAS + MOS$$

The Big Run Watershed TMDLs are shown Table 2 below.

Table 2. TMDL Summary

Big Run TMDLs	Parameter	TMDL (lbs/day)	WLA (lbs/day)	LA (lbs/day)	MOS (lbs/day)
Big Run Main Stem 25971-7162	Mn	3.21	0	3.21	implicit
	Acidity	56.58	0	56.58	implicit
Big Run Tributary 25972-7162	Acidity	7.39	0	7.39	implicit
Big Run Tributary 25973-7162	Acidity	4.75	0	4.75	implicit

The TMDL is a written plan and analysis established to ensure that a waterbody will attain and maintain water quality standards. The TMDL is a scientifically-based strategy which considers current and foreseeable conditions, the best available data, and accounts for uncertainty with the inclusion of a MOS value. Conditions, available data, and the understanding that the natural processes can change more than anticipated by the MOS. The option is always available to refine the TMDL for resubmittal to EPA for approval.

Pennsylvania's Statewide Surface Waters Assessment Protocol (SSWAP), PADEP's modified method of conducting biological assessments of Pennsylvania's waters, was used as the primary mechanism to assess Pennsylvania's waters. EPA considers this as a more consistent approach to assessing Pennsylvania's streams. However, the long-range goal is to reassess all waters on a five-year cycle. Therefore, while the TMDL should not be modified at the expense of achieving water quality standards expeditiously, the TMDL may be modified when warranted by additional data or other information.

III. Background

The Big Run Watershed is located in Graham Township, Clearfield County, Pennsylvania (see Attachment A). The area within the watershed consists of 3.10 square miles. There are two stream segments in the Big Run watershed: the main stem and an unnamed tributary. Big Run flows from an elevation of 1620 feet above sea level in its headwaters to an elevation of 930 above sea level at its confluence with the West Branch of the Susquehanna River. The flow direction of Big Run is from the south to the north.

The Big Run watershed lies within the Appalachian Plateau Physiographic Province. The Watershed area is comprised of Pennsylvanian and Mississippian aged rocks. Older Mississippian rocks of the Burgoon Sandstone are exposed in the valleys of the watershed and the younger Pennsylvanian aged rocks of the Pottsville and Allegheny Groups are on the hilltops and ridges surrounding the watershed. Strata in the watershed are oriented in a SW to NE trend and dip to the SW.

The earliest surface mining in or near the Big Run watershed area started in 1947. At least six different mining sites were mined within the watershed from this time up into the 1980s. During this time the Lower Kittanning and Clarion coal seams were mined. No extensive deep mining was done in the watershed. Several mines were "punched" into the Clarion coal, but were later removed during the surface mining. Companies that conducted mining within the watershed include: Lester G Smeal (1947), Thompson Brothers Coal (1960), Reed Jacox Coal Company (1960), Hartman and Stewart (1962), Earl M Brown (1970), Penn Coal Company (1975), T & T Clay Company (1977) and Richard Yingling (1984). Today there is no active mining within the watershed boundaries. There are currently no National Pollutant Discharge Elimination System (NPDES) permits in this watershed.

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 public 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.

These TMDLs were completed by PADEP to meet the eighth year (2005) TMDL milestone commitment under the requirements of the 1997 TMDL lawsuit settlement agreement. Eighth year milestones include the development of TMDLs for 40 percent of the waters listed on Pennsylvania's 1996 Section 303(d) list of impaired waters by the effects of Acid Mine Drainage or 40 waters since 2003, and 80 percent of waters listed impaired by non-AMD related impacts or 34 waters since 2003. Delisted waters may count for 20 percent of the requirement.

Computational Procedure

The TMDLs were developed using a statistical procedure to ensure that water quality criteria are met 99 percent of the time as required by Pennsylvania's water quality standards. The Big Run TMDL consists of load allocations of tributaries and nine sampling sites (BR01-BR09) along the stream (Attachment A). No waste load allocations are assigned because there are currently no permitted discharges in the Big Run watershed.

TMDLs are calculated for all nine sampling points. These TMDLs will focus remediation efforts on the identified numerical reduction targets for each segment (between two sampling points) and its watershed. The reduction schemes for each segment are based on the assumption that all upstream allocations are achieved and also taken into account all upstream reductions. Water quality data from four sampling events indicates low metal concentrations and pH for most of the sampling points.

An allowable long-term average instream concentration was determined at each point for iron, aluminum, manganese, and acidity. A statistical analysis, the Monte Carlo simulation, is designed to produce an average value that, when met, will be protective of the water quality criterion for that parameter 99 percent of the time.

TMDLs for each parameter were determined using a Monte Carlo simulation, @RISK,[1] with the measured, or existing, pollutant concentration data. For each source and pollutant, it was assumed that the observed data are lognormally distributed. Each pollutant was evaluated separately using @RISK.

Using the collected sample concentration parameters, mean and standard deviation, the simulation performs 5000 iterations and predicts an existing long-term average concentration and this analysis shows whether or not the existing data is from a population where water quality standards are exceeded more than one percent of the time. A second simulation of 5000 iterations is performed to calculate the percent reduction necessary to meet the criteria 99 percent of the time. Finally, using the calculated percent reductions, a final simulation is run to confirm that the target value for a long-term average concentration will result in meeting water quality criteria 99 percent of the time.

The existing and allowable long-term average loads were computed using the mean concentration from @RISK multiplied by the average flow. The TMDL Report points out that the loads are being computed based on average annual flow and should not be taken out of the context for which they are intended, which is to depict how the pollutants affect the watershed and where the sources and sinks are located spatially in the watershed.

IV. Discussions of Regulatory Requirements

EPA has determined that these TMDLs are consistent with statutory and regulatory requirements and EPA policy and guidance.

1. The TMDLs are designed to implement the applicable water quality standards.

Water quality standards are state regulations that define the water quality goals of a waterbody. Standards are comprised of three components, including: (1) designated uses, (2) criteria necessary to protect those uses, and (3) antidegradation provisions that prevent the degradation of water quality. All of the stream segments evaluated in the Big Run Watershed have been designated by Pennsylvania as Cold Water Fishes with criteria to protect the aquatic life uses. The designations for these stream segments can be found at Pennsylvania Title 25 § 93.9. To protect the designated uses, as well as the existing uses, the water quality criteria

[1]@RISK - Risk Analysis and Simulation Add-in for Microsoft Excel®, Palisade Corporation, Newfield, NY.

shown in Table 3 apply to all evaluated segments. The table includes the instream numeric criterion for each parameter and any associated specifications.

Table 3. Applicable Water Quality Criteria

Parameter	Criterion Value (mg/l)	Duration	Total Recoverable
Aluminum (Al)	0.75	Maximum	Total Recoverable
Iron (Fe)	1.5	30-day Average	Total Recoverable
Manganese (Mn)	1.0	Maximum	Total Recoverable
pH	6.0 - 9.0	Inclusive	N/A

Pennsylvania Title 25 § 96.3(c) requires that water quality criteria be achieved at least 99 percent of the time, and TMDLs expressed as long-term average concentrations, are expected to meet these requirements. That is, the statistical Monte Carlo simulation used to develop TMDLs and LAs for each parameter results in a determination that any required percent pollutant reduction assures that the water quality criteria will be met instream at least 99 percent of the time. The Monte Carlo simulation used 5000 iterations where each iteration was independent of all other iterations, and the observed data were assumed to be lognormally distributed for each source and pollutant.

EPA finds that these TMDLs will attain and maintain the applicable narrative and numerical water quality standards. For iron, the TMDL endpoint was expressed as total recoverable iron because all monitoring data was expressed as total recoverable iron.

The pH values shown in Table 3 were used as the TMDL endpoints for these TMDLs. In the case of freestone streams with little or no buffering capacity, the allowable TMDL endpoint for pH may be the natural background water quality; these values can get as low as 5.4 (Pennsylvania Fish and Boat Commission). However, PADEP chose to set the pH standard between 6.0 to 9.0, inclusive, which is presumed to be met when the net alkalinity is maintained above zero. This presumption is based on the relationship between net alkalinity and pH, on which PADEP based its methodology to addressing pH in the watershed. See the *Big Run Watershed TMDL* report, Attachment B. A summary of the methodology is presented as follows.

The parameter of pH, a measurement of hydrogen ion acidity presented as a negative logarithm of effective hydrogen ion concentration, is not conducive to standard statistics. Additionally, pH does not measure latent acidity that can be produced from the hydrolysis of

metals. PADEP is using the following approach to address the stream impairments noted on the Section 303(d) list due to pH. Because the concentration of acidity in a stream is partially dependent upon metals, it is extremely difficult to predict the exact pH values which would result from treatment of AMD. 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 able to measure the reduction of acidity. When acidity in a stream is neutralized or is restored to natural levels, pH will be acceptable ($\geq$6.0). 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 used to calculate the required 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. EPA finds this approach to pH to be reasonable.

PADEP also has an alkalinity standard. Alkalinity (of a minimum 20 mg/L as $CaCO_3$ except where natural conditions are less) is related to but not identical with pH. Alkalinity is a measure of the buffering capacity of the water. Adequate buffering prevents large swings in pH with additions of small amounts of acid. Although many of the AMD-impacted streams are naturally low in alkalinity, available monitoring data does not always include upstream waters unimpacted by AMD. As PADEP does not list waters for inadequate alkalinity, TMDLs are not being developed for alkalinity but PADEP should monitor the waters for alkalinity and if, after these TMDLs are implemented, alkalinity is less than 20 mg/L or natural conditions, PADEP should list the waters for alkalinity and develop TMDLs.

2. *The TMDLs include a total allowable load as well as individual WLAs and LAs.*

There are no permitted dischargers in the watershed. For purposes of TMDLs only, point sources are identified as permitted discharge points and nonpoint sources are identified as other discharges from abandoned mine lands which can include, but are not limited to, tunnel discharges, seeps, and surface runoff. Abandoned and reclaimed mine lands were treated in the allocations as nonpoint sources because there are no NPDES permits associated with these areas. As such, the discharges associated with these landuses were assigned LAs (as opposed to WLAs). The decision to assign LAs to abandoned and reclaimed mine lands does not reflect any determination by EPA as to whether there are unpermitted point source discharges within these landuses. In addition, by approving these TMDLs with mine drainage discharges treated as LAs, EPA is not determining that these discharges are exempt from NPDES permitting requirements.

The LA for each sampling point was computed using water-quality data collected from that point. The instream TMDLs for nine sampling points (BR01 to BR09) consist of LAs made to the area above those points. The instream TMDLs for sampling point 5 consists of a LA to the area between sample points 8 and 7; point 3 consists of a LA to the area between sample points 6 and 4; point 1 consists of a LA to the area between sample points 3 and 2. The load allocation for this stream segment was computed using water quality sample data collected at all sampling points during sampling events. The sampling points are shown on the map in Attachment A, together with a flow diagram. Big Run Watershed TMDLs, WLAs, and LAs are shown in Table 2 in Section II above.

Once PADEP determined the allowable concentration and load for each pollutant, a mass-balance accounting was performed starting at the top of the watershed and working down in sequence, see the flow diagram in Attachment A. This mass-balance or load tracking is explained below. Load tracking through the watershed utilizes the change in measured loads from sample location to sample location as a guide for expected changes in the allowable loads.

PADEP used two basic rules for the load tracking between two ends of a stream segment; (1) if the measured upstream loads are less than the downstream loads, it is indicative that there is an increase in load between the points being evaluated and no instream processes are assumed. (2) If the sum of the measured loads from the upstream points is greater than the measured load at the downstream point this is indicative that there is a loss of instream load between the points, and the ratio of the decrease is applied to the allowable load being tracked from the upstream point.

Tracking loads through the watershed provides a picture of how the pollutants are affecting the watershed, based on the available information. The analysis is done to ensure that water quality standards will be met at all points in the stream. EPA finds this approach reasonable.

Currently PADEP allocated only nonpoint sources within the watershed. If there are active mining operations or post-mining discharge treatment in the watershed, Federal regulations require that subsequent to TMDL development and approval, point sources permitted effluent limitations be water quality-based.[2] In addition, PA Title 25, Chapter 96, Section 96.4(d) requires that WLAs shall serve as the basis for determination of permit limits for point source discharges regulated under Chapter 92 (relating to NPDES permitting, monitoring and compliance). Therefore, no new mining may be permitted within the watershed without reallocation of the TMDL.

[2]It should be noted that technology-based permit limits may be converted to water quality-based limits according to EPA's *Technical Support Document For Water Quality-based Toxics Control*, March 1991, recommendations.

Table 4 Summary of the allowable loads for the Big Run Watershed.

Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	% Reduction
BR09						
Aluminum (lbs/day)	0.14	0.06	0	0.06	0.08	57%
Iron (lbs/day)	0.45	0.11	0	0.11	0.34	76%
Manganese(lbs/day)	0.28	0.07	0	0.07	0.21	75%
Acidity (lbs/day)	8.39	1.76	0	1.76	6.63	79%
BR07 (Tributary 25973 to Big Run)						
Aluminum (lbs/day)	ND	ND	0	ND	NA	NA
Iron (lbs/day)	ND	ND	0	ND	NA	NA
Manganese(lbs/day)	ND	ND	0	ND	NA	NA
Acidity (lbs/day)	8.48	4.75	0	4.75	0*	0%*
BR08						
Aluminum (lbs/day)	ND	ND	0	ND	NA	NA
Iron (lbs/day)	ND	ND	0	ND	NA	NA
Manganese(lbs/day)	ND	ND	0	ND	NA	NA
Acidity (lbs/day)	52.37	13.62	0	13.62	38.75	74%
BR05						
Aluminum (lbs/day)	ND	ND	0	ND	NA	NA
Iron (lbs/day)	2.08	2.08	0	2.1	NA	NA
Manganese(lbs/day)	0.98	0.98	0	0.98	NA	NA
Acidity (lbs/day)	52.05	17.7	0	17.7	0*	0%*
BR06						
Aluminum (lbs/day)	ND	ND	0	ND	NA	NA
Iron (lbs/day)	ND	ND	0	ND	NA	NA
Manganese(lbs/day)	0.34	0.15	0	0.15	0.19	56%
Acidity (lbs/day)	22.93	3.9	0	3.9	19.03	83%
BR04 (Tributary 25972 to Big Run)						
Aluminum (lbs/day)	ND	ND	0	ND	NA	NA
Iron (lbs/day)	ND	ND	0	ND	NA	NA
Manganese(lbs/day)	ND	ND	0	ND	NA	NA
Acidity (lbs/day)	30.81	7.39	0	7.39	4.39	37%
BR03						
Aluminum (lbs/day)	ND	ND	0	ND	NA	NA
Iron (lbs/day)	ND	ND	0	ND	NA	NA
Manganese(lbs/day)	0.97	0.97	0	0.97	NA	NA
Acidity (lbs/day)	81.11	43.8	0	43.8	0*	0%*
BR02						
Aluminum (lbs/day)	0.021	0.016	0	0.02	0.05	24%
Iron (lbs/day)	1.63	0.05	0	0.05	1.58	97%
Manganese(lbs/day)	0.15	0.03	0	0.03	0.12	80%
Acidity (lbs/day)	2.78	2.37	0	2.37	0.41	15%
BR01						
Aluminum (lbs/day)	ND	ND	0	ND	NA	NA
Iron (lbs/day)	ND	ND	0	ND	NA	NA
Manganese(lbs/day)	7.29	3.21	0	3.21	3.96	55%
Acidity (lbs/day)	269.45	56.58	0	56.58	175.15	76%

ND = Not Detected
NA = Not Applicable

3. The TMDLs consider the impacts of background pollutant contributions.

Big Run is located in an area that there was extensive mining operation in the watershed. The TMDLs were developed using instream data which account for existing background conditions.

4. The TMDLs consider critical environmental conditions.

The reductions specified in this TMDL apply at all flow conditions. A critical flow condition was not identified from the data used for this analysis. Regression and correlation analyses between flow and concentration almost always produce little or no correlation and disclose no critical condition. The average flow for each sampling site was used to derive loading values for the TMDL.

5. The TMDLs consider seasonal environmental variations.

All sample sets included data points from various seasons, which together with the lack of correlations between flow and concentration, indicate that PADEP considered seasonal variations to the extent that data was available.

6. The TMDLs include a MOS.

The CWA and Federal regulations require TMDLs to include a MOS to take into account any lack of knowledge concerning the relationship between effluent limitations and water quality. EPA guidance suggests two approaches to satisfy the MOS requirement. First, it can be met implicitly by using conservative model assumptions to develop the allocations. Alternately, it can be met explicitly by allocating a portion of the allowable load to the MOS.

PADEP used an implicit MOS in these TMDLs by assuming the treated instream concentration variability to be the same as the untreated stream's concentration variability. This is a more conservative assumption than the general assumption that a treated discharge has less variability than an untreated discharge. By retaining variability in the treated discharge, a lower average concentration is required to meet water quality criteria 99 percent of the time than if the variability of the treated discharge is reduced.

With respect to iron, PADEP identified an additional implicit MOS in the analysis and TMDL development by treating the iron water quality criterion as if the 1.50 mg/L were a maximum value instead of a thirty-day average value.

7. There is reasonable assurance that the proposed TMDLs can be met.

Though currently there is no watershed association exists for the Big Run, the *Recommendations* section of the final PADEP Big Run Watershed TMDL report highlights what can be done in the watershed to provide maintenance and improvement of water quality in the

watershed. Aside from PADEP's primary efforts to improve water quality in the Big Run Watershed through reclamation of abandoned mine lands and through the NPDES permit program, additional opportunities for reasonable assurance exist. PADEP expects activities, such as research conducted by its Bureau of Abandoned Mine Reclamation (BAMR), funding from EPA's 319 grant program, and Pennsylvania's Growing Greener program will also help remedy abandoned mine drainage impacts. PADEP also has in place an initiative that aims to maximize reclamation of Pennsylvania's abandoned mineral extraction lands. Through Reclaim PA, Pennsylvania's goal is to accomplish complete reclamation of abandoned mine lands and plugging of orphaned wells. Pennsylvania strives to achieve this objective through legislative and policy land management efforts, and activities described in the TMDL report.

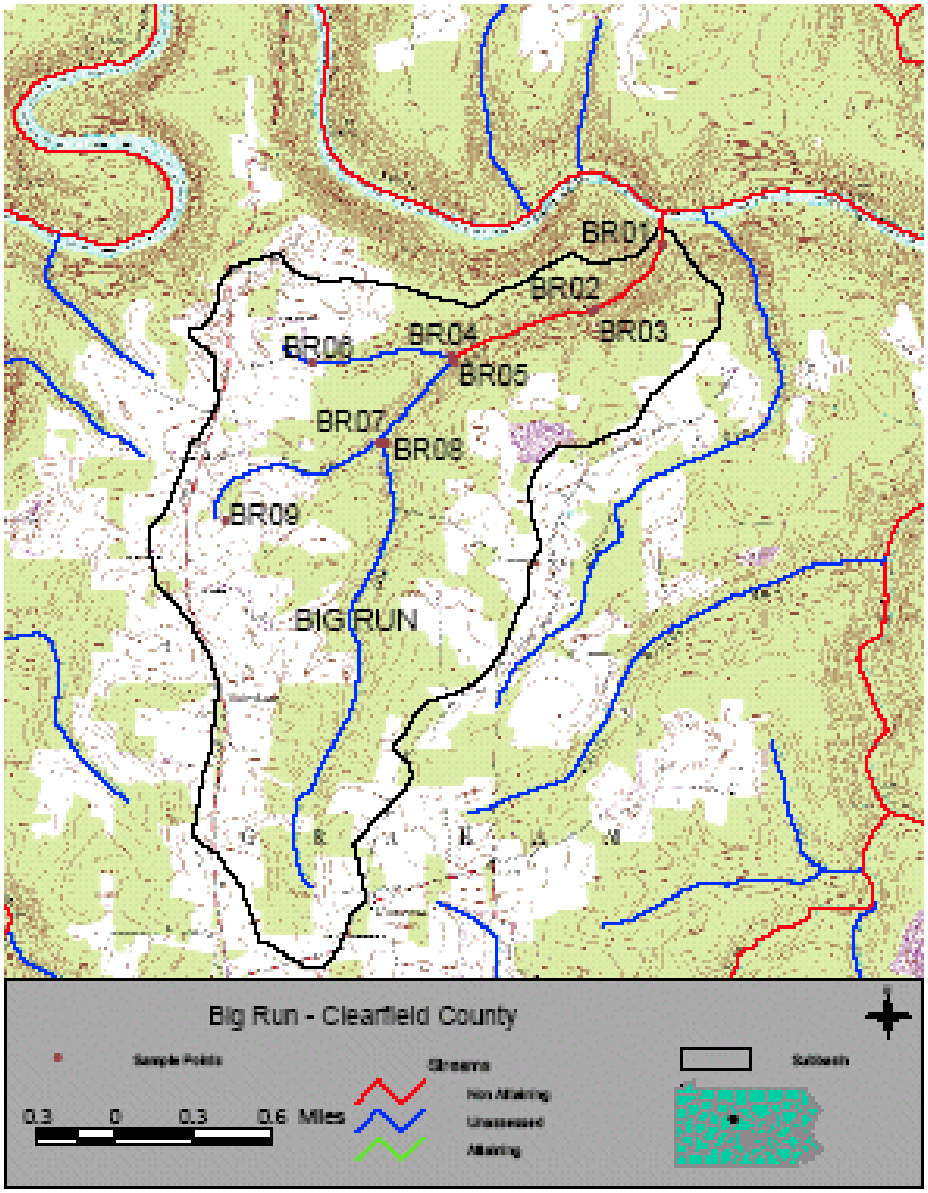
8. The TMDLs have been subject to public participation.

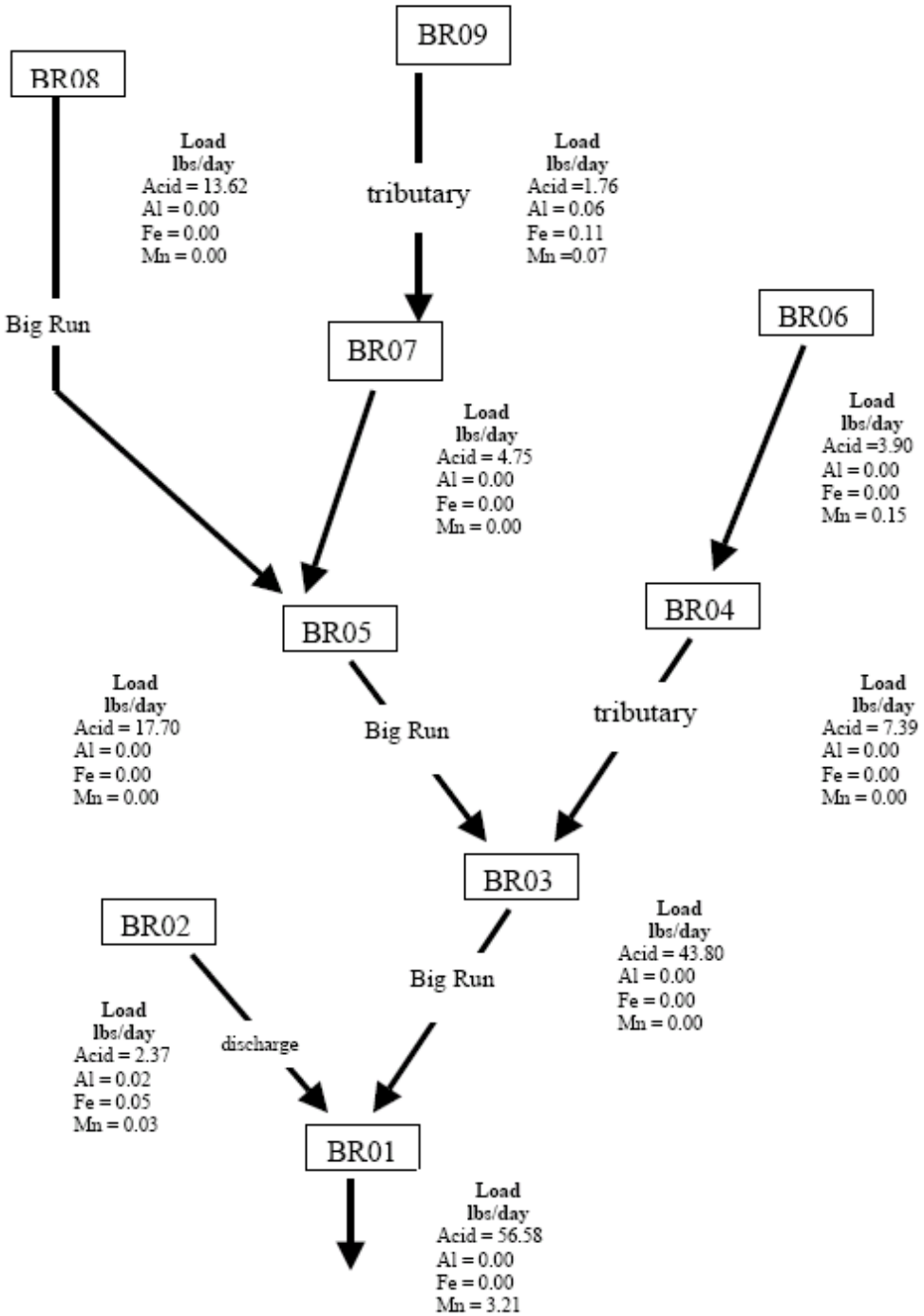
PADEP public noticed the draft TMDLs in the *Pennsylvania Bulletin* and the *Clearfield Progress* to solicit public comment on the allowable loads calculated. A public meeting was held on July 14, 2004, at the Multiservice Center in Clearfield, Pennsylvania, to discuss the proposed TMDL.

Although not specifically stated in the TMDL Report, PADEP routinely posts the approved TMDL report their web site: www.dep.state.pa.us/watermanagement_apps/tmdl/.

Attachment A

Big Run Watershed Maps


BR01
BR02
BR03
BR04
BR05
BR06
BR07
BR08
BR09
BIG RUN
Big Run - Clearfield County
Sample Points
Streams
Non Attaining
Unassessed
Attaining
Subbasin
0.3
0
0.3
0.6 Miles


BR09
BR08
Load
lbs/day
Acid = 13.62
Al = 0.00
Fe = 0.00
Mn = 0.00
tributary
Load
lbs/day
Acid =1.76
Al = 0.06
Fe = 0.11
Mn =0.07
Big Run
BR07
BR06
Load
lbs/day
Acid = 4.75
Al = 0.00
Fe = 0.00
Mn = 0.00
Load
lbs/day
Acid =3.90
Al = 0.00
Fe = 0.00
Mn = 0.15
BR05
BR04
Load
lbs/day
Acid = 17.70
Al = 0.00
Fe = 0.00
Mn = 0.00
Big Run
tributary
Load
lbs/day
Acid = 7.39
Al = 0.00
Fe = 0.00
Mn = 0.00
BR03
BR02
Load
lbs/day
Acid = 43.80
Al = 0.00
Fe = 0.00
Mn = 0.00
Big Run
Load
lbs/day
Acid = 2.37
Al = 0.02
Fe = 0.05
Mn = 0.03
discharge
BR01
Load
lbs/day
Acid = 56.58
Al = 0.00
Fe = 0.00
Mn = 3.21

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