FINAL

MONASTERY RUN WATERSHED TMDL

Westmoreland County

For Acid Mine Drainage Affected Segments

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Pennsylvania Department of Environmental Protection

December 2, 2004

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Introduction

This report presents the Total Maximum Daily Loads (TMDLs) developed for segments in the Monastery Run Watershed (Attachments A). These were done to address the impairments noted on the 1996 Pennsylvania Section 303(d) list of impaired waters, required under the Clean Water Act, and covers two segments on this list (shown in Table 1). High levels of metals and sulfates caused these impairments. All impairments resulted from acid drainage from abandoned coalmines. The TMDL addresses the three primary metals associated with acid mine drainage (iron, manganese, aluminum), sulfates, and pH.

Table 1. 303(d) Sub-List
State Water Plan (SWP) Subbasin: 18-C Loyalhanna Creek

Year	Miles	Segment ID	DEP Stream Code	Stream Name	Designated Use	Data Source	Source	EPA 305(b) Cause Code
1996	0.8	NA	43457	Monastery Run	WWF	305(b) Report	RE	Metals
1998	0.8	NA	43457	Monastery Run	WWF	SWMP	AMD	Metals
2002	2.0	New survey; new segment id. 990527-0930-ALF	43457	Monastery Run	WWF	SWAP	AMD	Metals
1996	1.0	NA	43458	Fourmile Run	WWF	305(b) Report	AMD	Metals & Other Inorganics
1998	1.0	NA	43458	Fourmile Run	WWF	SWMP	AMD	Metals & Other Inorganics
2002	1.3	New survey; new segment id. 990527-1045-ALF	43458	Fourmile Run	WWF	SWAP	AMD	Metals & Suspended Solids

Resource Extraction=RE
Warm Water Fishes = WWF
Surface Water Monitoring Program = SWMP
Surface Water Assessment Program=SWAP
Abandoned Mine Drainage = AMD

[1] Pennsylvania's 1996 and 1998 Section 303(d) lists were approved by the Environmental Protection Agency (EPA). The 1996 Section 303(d) list provides the basis for measuring progress under the 1997 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

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.

Directions to the Monastery Run Watershed

The Monastery Run and Fourmile Run Watersheds are located in South Western Pennsylvania, occupying the central portion of Westmoreland County. The watershed area is found on the Latrobe 7.5-Minute Quadrangle United States Geological Survey map. The area within the Monastery Run watershed consists of 12.1 square miles of which 8.41 is the Fourmile Run Watershed. St. Vincent Lake and Saint Vincent College are located near the confluence of Fourmile Run with Monastery Run. Approximately a mile downstream of the confluence with Fourmile Run, Monastery Run drains to Loyalhanna Creek near the town of Latrobe. Monastery Run can be accessed by taking Route 30 east from Greensburg, PA and turning left on PA 981. After approximately ½ mile, PA 981 crosses over Monastery Run near its confluence with Loyalhanna Creek. All of the treatment wetlands along Fourmile Run can be accessed near the Grist Mill on Beatty Road located on the northern part of the Saint Vincent College campus.

Segments addressed in this TMDL

There are no active mining operations in the watershed. All of the discharges in the watershed are from abandoned mines and will be treated as non-point sources. Each segment on the Section 303(d) list will be addressed as a separate TMDL. These TMDLs will be expressed as long-term, average loadings. Due to the nature and complexity of mining effects on the watershed, expressing the TMDL as a long-term average gives a better representation of the data used for the calculations. See Attachment C for TMDL calculations.

Clean Water Act Requirements

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

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

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

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

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

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

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

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

In the cases that have been settled to date, the consent agreements require EPA to backstop TMDL development, track TMDL development, review state monitoring programs, and fund studies on issues of concern (e.g., AMD, implementation of nonpoint source Best Management Practices (BMPs), etc.).

These TMDLs were developed in partial fulfillment of the 1997 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

Section 303(d) Listing Process

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

The primary method adopted by the Pennsylvania Department of Environmental Protection (DEP) for evaluating waters changed between the publication of the 1996 and 1998 Section 303(d) lists. Prior to 1998, data used to list streams were in a variety of formats, collected under differing protocols. Information also was gathered through the Section 305(b)[2] reporting process. DEP is now using the Statewide Surface Waters Assessment Protocol (SSWAP), a modification of the EPA's 1989 Rapid Bioassessment Protocol II (RBP-II), as the primary mechanism to assess Pennsylvania's waters. The SSWAP provides a more consistent approach to assessing Pennsylvania's streams.

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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.

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 assessed stream segment can vary between sites. All the biological surveys included kick-screen sampling of benthic macroinvertebrates and habitat evaluations. 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 habitat scores and a series of narrative biological statements used to evaluate the benthic macroinvertebrate community. If the stream is determined to be impaired, the source and cause of the impairment is documented. An impaired stream must be listed on the state's Section 303(d) list with the source and cause. A TMDL must be developed for the stream segment and each pollutant. In order for the process to be more effective, adjoining stream segments with the same source and cause listing are addressed collectively, and on a watershed basis.

Basic Steps for Determining a TMDL

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

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

Watershed History

The main source of pollution to Monastery Run begins at Monastery's confluence with Fourmile Run. Both watersheds are part of the Conemaugh River Basin in Westmoreland County and drain directly into Loyalhanna Creek. Fourmile Run and Monastery Run provide the first significant source of abandoned mine drainage to Loyalhanna Creek. Upstream of their confluence, Loyalhanna Creek is a very popular fishery and provides recreational benefits to surrounding residents. Downstream of their confluence, Loyalhanna Creek is severely impacted by iron precipitate coating the bottom of the stream.[3]

[3] http://facweb.stvincent.edu/EEC/lcmdcmission.htm

The watershed area is located in the Allegheny Plateau Physiographic Province, which covers much of western Pennsylvania. The plateau area consists primarily of extensively forested uplands and several major river valleys dissect the highlands. Structurally, both watersheds are located on the North Latrobe Syncline. The general strike in the area is approximately 35 degrees northeast and dipping approximately 10 degrees northwest. Chestnut Ridge is located just east of Monastery Run and Fourmile Run.

Construction and road building have altered the topography of the area. Included in the area in and around Latrobe and Derry are gently rolling hills with slopes on the order of 10 percent. The maximum elevation around the stream is about 1300 feet, while the minimum elevation is around 960 feet.

Several abandoned Pittsburgh and Upper Freeport coal seam deep mines underlie and discharge to both watershed areas. The Upper Freeport and Pittsburgh deep mines have been daylighted by strip mines in several areas within the two watersheds. There has also been strip mining on the Mahoning coal seam within the Fourmile Run Watershed and strip mining on the Redstone coal seam within the Monastery Run Watershed. There are no active or recent strip mining sites within either watershed.

The most significant unit of the strata in the area is the Pittsburgh coal seam, which has been extensively deep mined. Mining was popular in the area because the coal was close to the surface. In some areas only 20-40 feet of soil covered the coal. Coal mines in the region surrounding the watershed were in operation prior to 1889 through 1967, with the bulk of the mining occurring from 1900 to 1940. The primary companies, which operated these mines, include the Benedictine Society, Westmoreland and Fayette Coal Company, Mount Pleasant Coke Company, Latrobe Coal Company, and Mount Pleasant By-Product Coal Company. Drainage from these deep mines is the prime source of pollution to Fourmile Run and Monastery Run.[3]

Land uses within the watersheds include agriculture, abandoned mine lands, rural residential properties, areas of light industry, a college, and small communities scattered throughout the area. The Greater Latrobe Airport is located in the southeast reaches of the watershed.

AMD Methodology

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

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

Allowable loads are determined for each point of interest using Monte Carlo simulation. Monte Carlo simulation is an analytical method meant to imitate real-life systems, especially when other analyses are too mathematically complex or too difficult to reproduce. Monte Carlo simulation calculates multiple scenarios of a model by repeatedly sampling values from the probability distribution of the uncertain variables and using those values to populate a larger data set. Allocations were applied uniformly for the watershed area specified for each allocation point. For each source and pollutant, it was assumed that the observed data were log-normally distributed. Each pollutant source was evaluated separately using @Risk[4] by performing 5,000 iterations to determine the required percent reduction so that the water quality criteria, as defined in the *Pennsylvania Code. Title 25 Environmental Protection, Department of Environmental Protection, Chapter 93, Water Quality Standards,* will be met instream at least 99 percent of the time. For each iteration, the required percent reduction is:

PR = 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)

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

LTA = allowable LTA source concentration in mg/l

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

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

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

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

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

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

TMDL Endpoints

One of the major components of a TMDL is the establishment of an instream numeric endpoint, which is used to evaluate the attainment of applicable water quality. An instream numeric endpoint, therefore, represents the water quality goal that is to be achieved by implementing the load reductions specified in the TMDL. The endpoint allows for a 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 most of the pollution sources in the watershed are nonpoint sources, the largest part of the TMDL is expressed as Load Allocations (LAs). All allocations will be specified as long-term average daily concentrations. These long-term average concentrations are expected to meet water-quality criteria 99% of the time as required in PA Title 25 Chapter 96.3(c). The following table shows the applicable water-quality criteria for the selected parameters.

Table 2. Applicable Water Quality Criteria

Parameter	***Criterion Value (mg/l)***	***Total Recoverable/Dissolved***
Aluminum (Al)	0.75	Total Recoverable
Iron (Fe)	1.50	30 day average; Total Recoverable
Manganese (Mn)	1.00	Total Recoverable
pH *	6.0-9.0	N/A
Sulfates**	250	Total Recoverable

*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.
**In accordance with Pennsylvania Title 25 Chapter 96.3(d).

Other Inorganics

The cause of inorganic impairment as listed on the 1996 Section 303(d) list is sulfates. Due to Title 25 Chapter 96.3(d), which requires the criterion to be met at the point of potable water supply withdrawals, a TMDL to address sulfates is not necessary. The nearest potable water withdrawal to Fourmile Run occurs approximately 50 miles downstream of the mouth at the Buffalo Township Municipal Authority (PWSID 5030019) located on the Allegheny River. Fourmile Run is connected to the Allegheny River via the following streams (rivers): Monastery Run, Loyalhanna Creek, and the Kiskiminetas River, which drains to the Allegheny River. A map illustrating the location of the water supply intake, WQN Station, and the Fourmile Run Watershed is located in Attachment A. Because of the distance between Fourmile Run and the nearest downstream water supply intake and the assimilative capacity of the streams into which Fourmile drains, the sulfates in Fourmile Run have a negligible affect on the sulfate concentration at the water supply intake. In addition, 5 ½ years of sulfate data from WQN0812 on the Loyalhanna Creek downstream of Fourmile Run shows an average sulfate concentration of 142 mg/L. The WQN data is located in Appendix E.

TMDL Elements (WLA, LA, MOS)

$$TMDL = WLA + LA + MOS$$

A TMDL equation consists of a waste load allocation (WLA), load allocation (LA), and a margin of safety (MOS). The waste load allocation is the portion of the load assigned to point sources. The load allocation is the portion of the load assigned to non-point sources. The margin of safety is applied to account for uncertainties in the computational process. The margin of safety may be expressed implicitly (documenting conservative processes in the computations) or explicitly (setting aside a portion of the allowable load). The TMDL allocations in this report are based on available data. Other allocation schemes could also meet the TMDL.

Allocation Summary

These TMDLs will focus remediation efforts on the identified numerical reduction targets for each watershed. The reduction schemes in Table 3 for each segment are based on the assumption that all upstream allocations are achieved and take into account all upstream reductions. Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. As changes occur in the watershed, the TMDLs may be re-evaluated to reflect current conditions. An implicit MOS based on conservative assumptions in the analysis is included in the TMDL calculations.

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

Each permitted discharge in a segment is assigned a waste load allocation and the total waste load allocation for each segment is included in this table. There are currently no permitted discharges in the watershed and therefore all waste load allocations are equal to zero. The difference between the TMDL and the WLA at each point is the load allocation (LA) at the point. The LA at each point includes all loads entering the segment, including those from upstream allocation points. The percent reduction is calculated to show the amount of load that needs to be reduced within a segment in order for water quality standards to be met at the point.

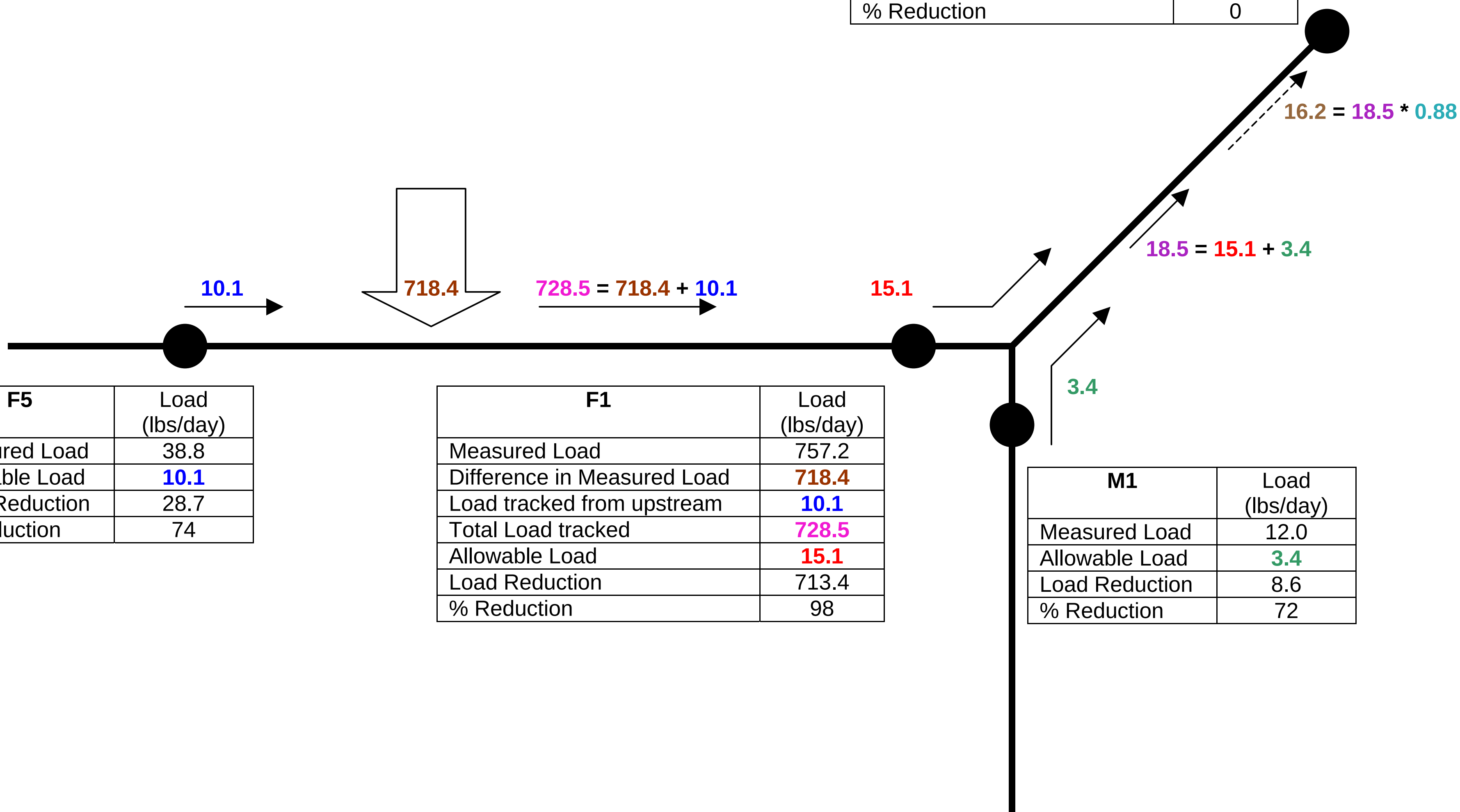
In some instances, instream processes, such as settling, are taking place within a stream segment. These processes are evidenced by a decrease in measured loading between consecutive sample points. It is appropriate to account for these losses when tracking upstream loading through a segment. The calculated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

Table 3. TMDL Component Summary for the Monastery Run Watershed

Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
F5	*Fourmile Run, upstream of treatment wetlands*						
	Fe	38.8	10.1	0.0	10.1	28.7	74
	Mn	6.0	4.4	0.0	4.4	1.6	27
	Al	13.7	8.7	0.0	8.7	5.0	37
	Acidity	0.0	0.0	NA	NA	0.0	0
F1	*Mouth of Fourmile Run*						
	Fe	757.2	15.1	0.0	15.1	713.4	98
	Mn	85.6	19.7	0.0	19.7	64.4	77
	Al	18.3	8.6	0.0	8.6	4.6	35
	Acidity	0.0	0.0	NA	NA	0.0	0
M1	*Monastery Run, upstream of Fourmile Run*						
	Fe	12.0	3.4	0.0	3.4	8.6	72
	Mn	0.6	0.6	NA	NA	0.0	0
	Al	4.8	2.9	0.0	2.9	1.9	40
	Acidity	4.8	4.8	NA	NA	0.0	0
M2	*Mouth of Monastery Run*						
	Fe	674.7	27.0	0.0	27.0	0.0	0
	Mn	86.7	27.7	0.0	27.7	0.0	0
	Al	24.5	13.2	0.0	13.2	0.0	0
	Acidity	0.0	0.0	NA	0.0	0.0	0

In the instance that the allowable load is equal to the existing load (e.g. manganese point M1, Table 3), the simulation determined that water quality standards are being met instream 99% of the time and no TMDL is necessary for the parameter at that point. Although no TMDL is necessary, the loading at the point is considered at the next downstream point.

Following is an example of how the allocations, presented in Table 3 are calculated. For this example, iron allocations are shown. As demonstrated in the example, all upstream contributing loads are accounted for at each point. Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. These analyses follow the example. Attachment A contains a map of the sampling point locations for reference.



M2	Load (lbs/day)
Measured Load	674.7
Difference in Measured Load	-94.5
Load tracked from upstream	18.5
% Load lost	12
% Load tracked	88
Total Load tracked	16.2
Allowable Load	27.0
Load Reduction	0.0
% Reduction	0

F5	Load (lbs/day)
Measured Load	38.8
Allowable Load	10.1
Load Reduction	28.7
% Reduction	74

F1	Load (lbs/day)
Measured Load	757.2
Difference in Measured Load	718.4
Load tracked from upstream	10.1
Total Load tracked	728.5
Allowable Load	15.1
Load Reduction	713.4
% Reduction	98

M1	Load (lbs/day)
Measured Load	12.0
Allowable Load	3.4
Load Reduction	8.6
% Reduction	72

Recommendations

Monastery Run has several wetlands in existence to help aid in the reduction of AMD pollution. Monastery Run upstream of the confluence with Fourmile Run is attaining its uses; however, downstream of the confluence with Fourmile Run metals concentrations are elevated and the stream is not attaining its uses. The Monastery Run Project has addressed some of these problems by the use of wetlands for a large artesian discharge associated with Fourmile Run.

The Monastery Run Project consists of five separate projects completed by the Loyalhanna Mine Drainage Coalition. The project is located 2 miles southwest of Latrobe, along State Route 1045 (Beatty Road) adjacent to Saint Vincent College. The group built 3 wetlands on 20 acres of land dedicated for this purpose by Saint Vincent College. Combined, the 3 wetlands were designed to improve 2.4 miles of Fourmile Run, resulting in improvement of Monastery Run and Loyalhanna Creek. [5]

Wetland #1 is an 8.5-acre passive treatment system. The system was designed by the PA Department of Environmental Protection's Bureau of Abandoned Mine Reclamation (BAMR) and was constructed in 1998. The system was constructed within an existing wetland area that was created by ten mine drainage discharges. The discharges enter the wetlands at various locations within the four-cell system. The largest of these discharges is an artesian flow which wells up in the western end of cell one. The average influent quality is: pH 6.1, total iron 95.7 mg/L, manganese 3.38 mg/L, and aluminum 0.33 mg/L. The average effluent quality is: pH 6.7, total iron 2.3 mg/L, manganese 2.3 mg/L, and aluminum 0.30 mg/L.

Wetland #2 is a 7.5-acre passive wetland treatment system. The system was designed by USDA Natural Resource Conservation Service and was constructed in 1998. The system was constructed within an existing wetland area that was created by mine drainage discharges. The constructed wetland consists of three cells. The discharges are alkaline with elevated iron concentrations. The average effluent quality is: pH 6.8, total iron 6.3 mg/L, manganese 2.7 mg/L, and aluminum 0.37 mg/L.

In July 1999, in order to provide more efficient treatment performance, Wetland #1 and Wetland #2 were connected together via a pipe that carries the effluent from Wetland #1 under Fourmile Run and discharges it into Wetland #2. This was done in order to handle the higher flows from Wetland #1 during the winter and spring months.

Wetland #3 is a 3.11-acre passive wetland treatment system. The system was designed by USDA Natural Resource Conservation Service and was constructed in 1997. The constructed wetland consists of five treatment cells plus a four-cell mesocosm system used for field research by Saint Vincent College. The system primarily treats water from a large artesian mine discharge, known as "The Bubbler", located just east of the wetland. The Bubbler flows from a borehole drilled down into the abandoned Pittsburgh deep mine. In 2001 the pipeline, which carries water from "The Bubbler", was extended over to Wetland #2 in order to handle high

[5] http://facweb.stvincent.edu/EEC/lcmdcmission.htm

flows. The average influent quality is: pH 6.0, total iron 95.7 mg/L, manganese 3.38 mg/L, and aluminum 0.33 mg/L. The average effluent quality is: pH 6.7, total iron 2.3 mg/L, manganese 2.3 mg/L, and aluminum 0.30 mg/L.

Wetland systems #2 and #3 discharge directly to Fourmile Run. Wetland system #1 discharges a portion of its effluent directly to Fourmile Run during high flow events in the winter and spring months.

Saint Vincent Lake, which is near the confluence of Fourmile Run and Monastery Run, is located along the north side of Fourmile Run. The lake is fed by springs located on the western end of the lake. The lake is not impacted by AMD discharges.

Since 1993, the group has been monitoring Fourmile Run, Monastery Run, Loyalhanna Creek, and the Saint Vincent passive treatment wetlands. Analyses of these samples are completed to determine the concentration of the dissolved and total iron, aluminum, and manganese in the stream as well as alkalinity and acidity. Recent monitoring data indicate that the wetlands of the Monastery Run Project capture and retain more than 260 pounds of iron oxide daily, reducing the iron content of the acid mine discharges from both Fourmile Run and Monastery Run, below Fourmile Run, by more than 90%. The wetlands have also proven to be a viable habitat for plant and animal life, as evidenced by the emergence of a diverse ecosystem. In conjunction with their functioning in acid mine drainage remediation, the wetlands are used as a field laboratory for environmental studies and educational programs.[6]

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

Additional opportunities for water quality improvement are both ongoing and anticipated. Historically, a great deal of research into mine drainage has been conducted by DEP's Bureau of Abandoned Mine Reclamation, which administers and oversees the Abandoned Mine Reclamation Program in Pennsylvania; the United States Office of Surface Mining; the National Mine Land Reclamation Center; the National Environmental Training Laboratory; and many other agencies and individuals. Funding from EPA's CWA Section 319(a) Grant program and Pennsylvania's Growing Greener program has been used extensively to remedy mine drainage impacts. These many activities are expected to continue and result in water quality improvement.

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

[6] http://facweb.stvincent.edu/EEC/lcmdcmission.htm

Watershed Assessment Grant Program, the Small Operator's Assistance Program (SOAP), and the Remining Operators Assistance Program (ROAP).

Mine reclamation and well plugging refers to the process of cleaning up environmental pollutants and safety hazards associated with a site and returning the land to a productive condition, similar to DEP's Brownfields program. Since the 1960's, Pennsylvania has been a national leader in establishing laws and regulations to ensure reclamation and plugging occur after active operation is completed.

Pennsylvania is striving for complete reclamation of its abandoned mines and plugging of its orphaned wells. Realizing this task is no small order, DEP has developed concepts to make abandoned mine reclamation easier. These concepts, collectively called Reclaim PA, include legislative, policy land management initiatives designed to enhance mine operator, volunteer land DEP reclamation efforts. Reclaim PA has the following four objectives.

- To encourage private and public participation in abandoned mine reclamation efforts
- To improve reclamation efficiency through better communication between reclamation partners
- To increase reclamation by reducing remining risks
- To maximize reclamation funding by expanding existing sources and exploring new sources.

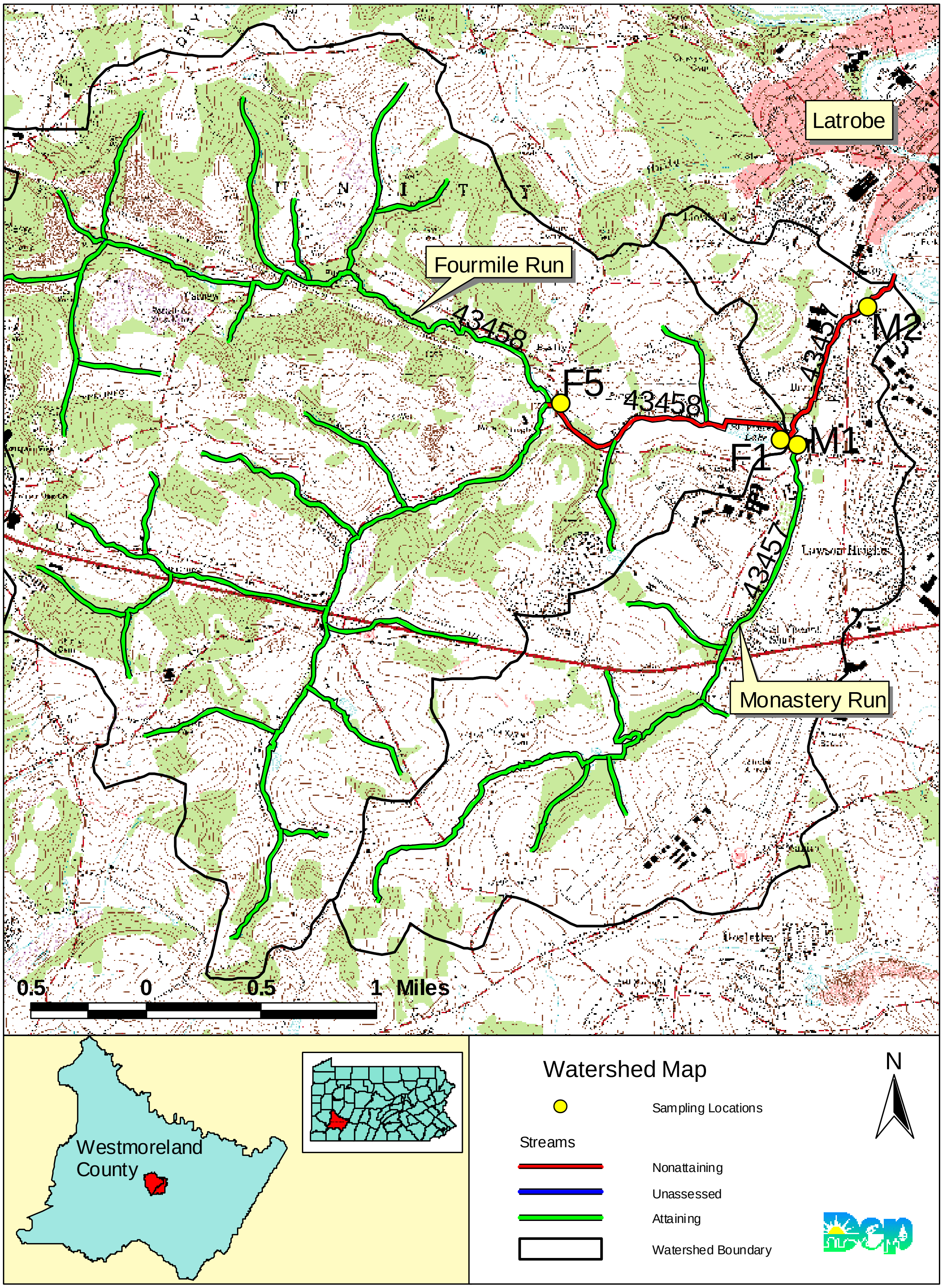
Reclaim PA is DEP's initiative designed to maximize reclamation of the state's quarter million acres of abandoned mineral extraction lands. Abandoned mineral extraction lands in Pennsylvania constituted a significant public liability – more than 250,000 acres of abandoned surface mines, 2,400 miles of streams polluted with mine drainage, over 7,000 orphaned and abandoned oil and gas wells, widespread subsidence problems, numerous hazardous mine openings, mine fires, abandoned structures and affected water supplies – representing as much as one third of the total problem nationally.

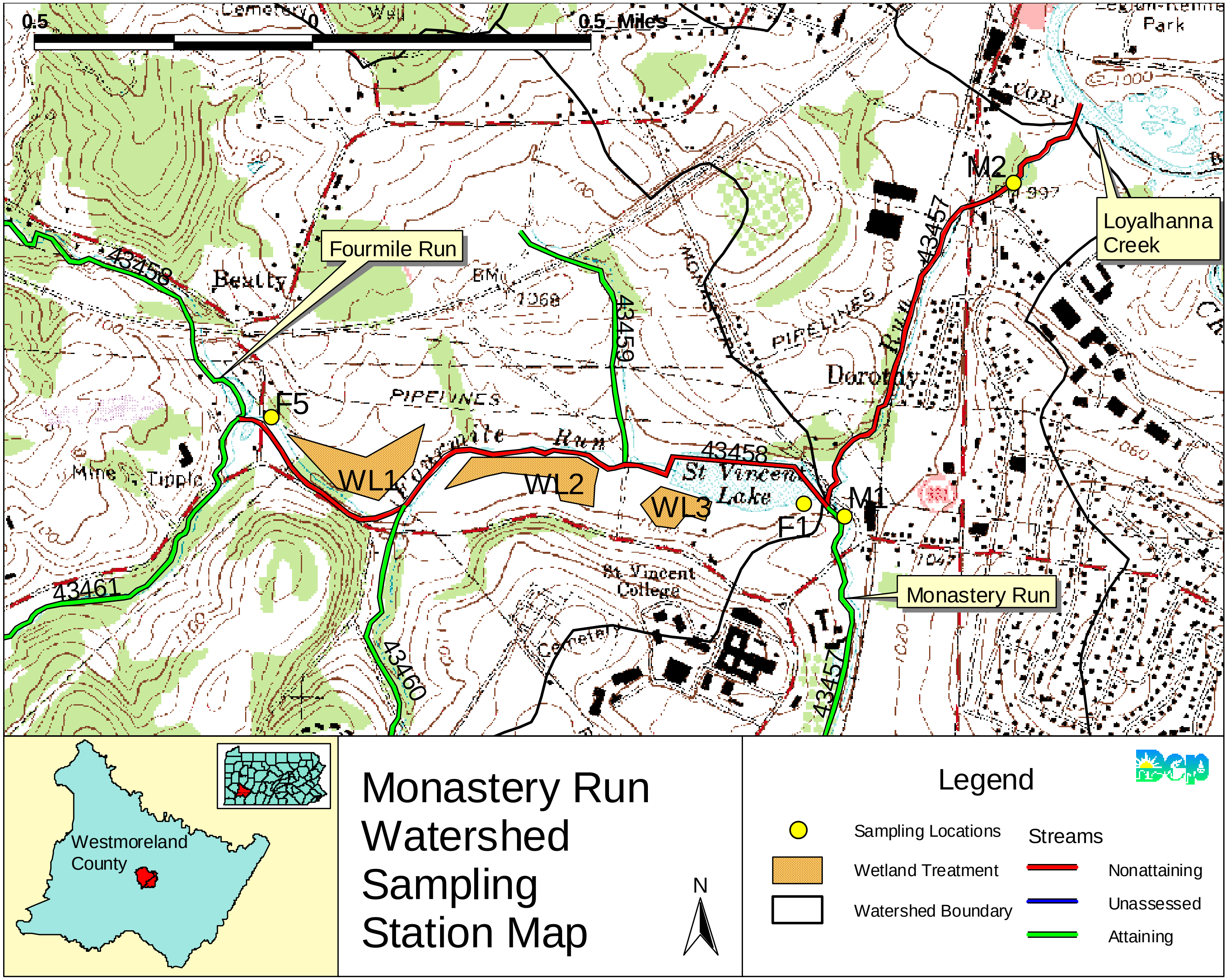
Public Participation

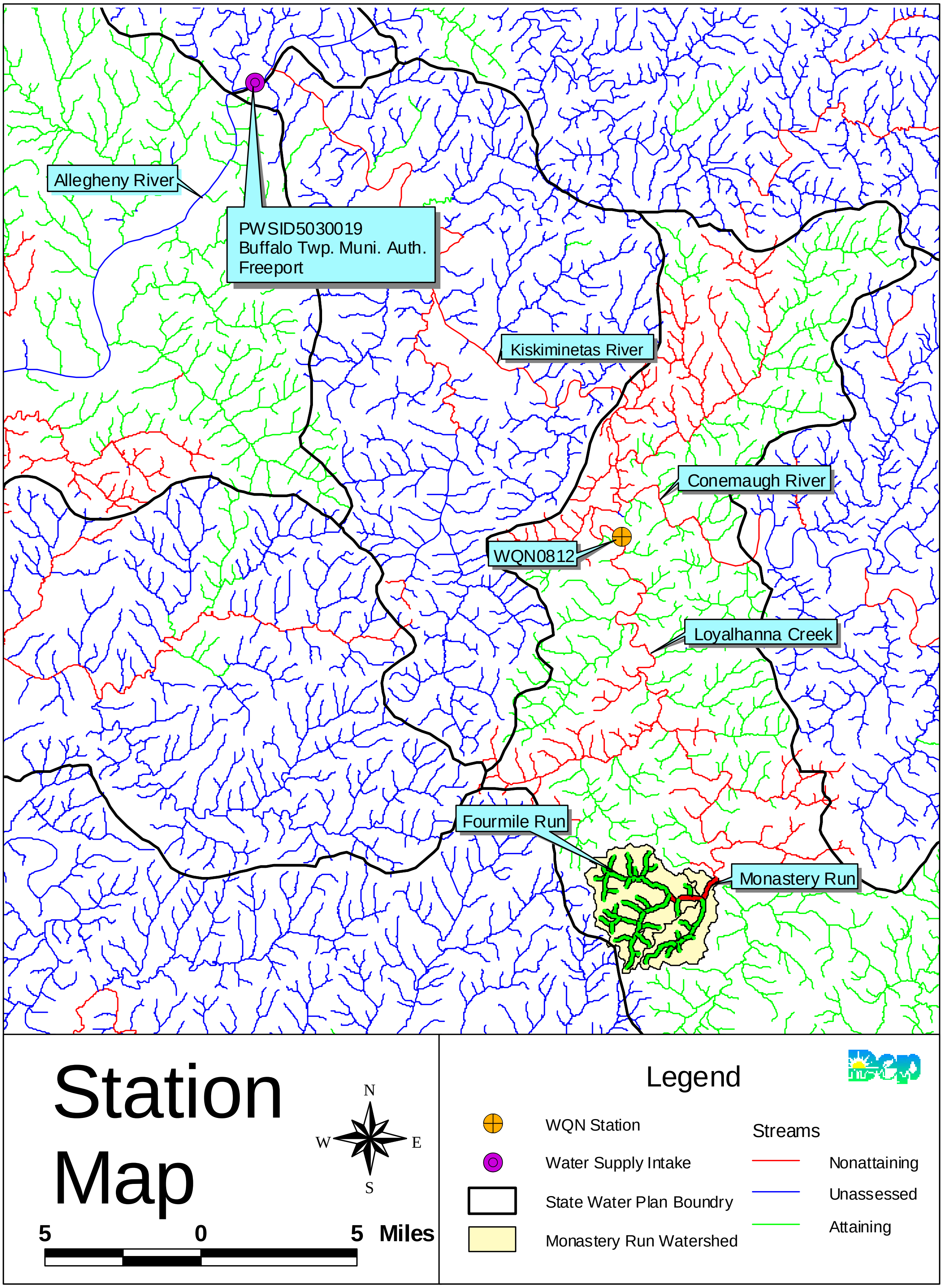
Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on September 4, 2004 and the *Latrobe Bulletin* on September 29, 2004 to foster public comment on the allowable loads calculated. The public comment period on this TMDL was open from September 4, 2004 to November 4, 2004. A public meeting was held on October 7, 2004 at the Unity Township Municipal Building to discuss the proposed TMDL.

Attachment A

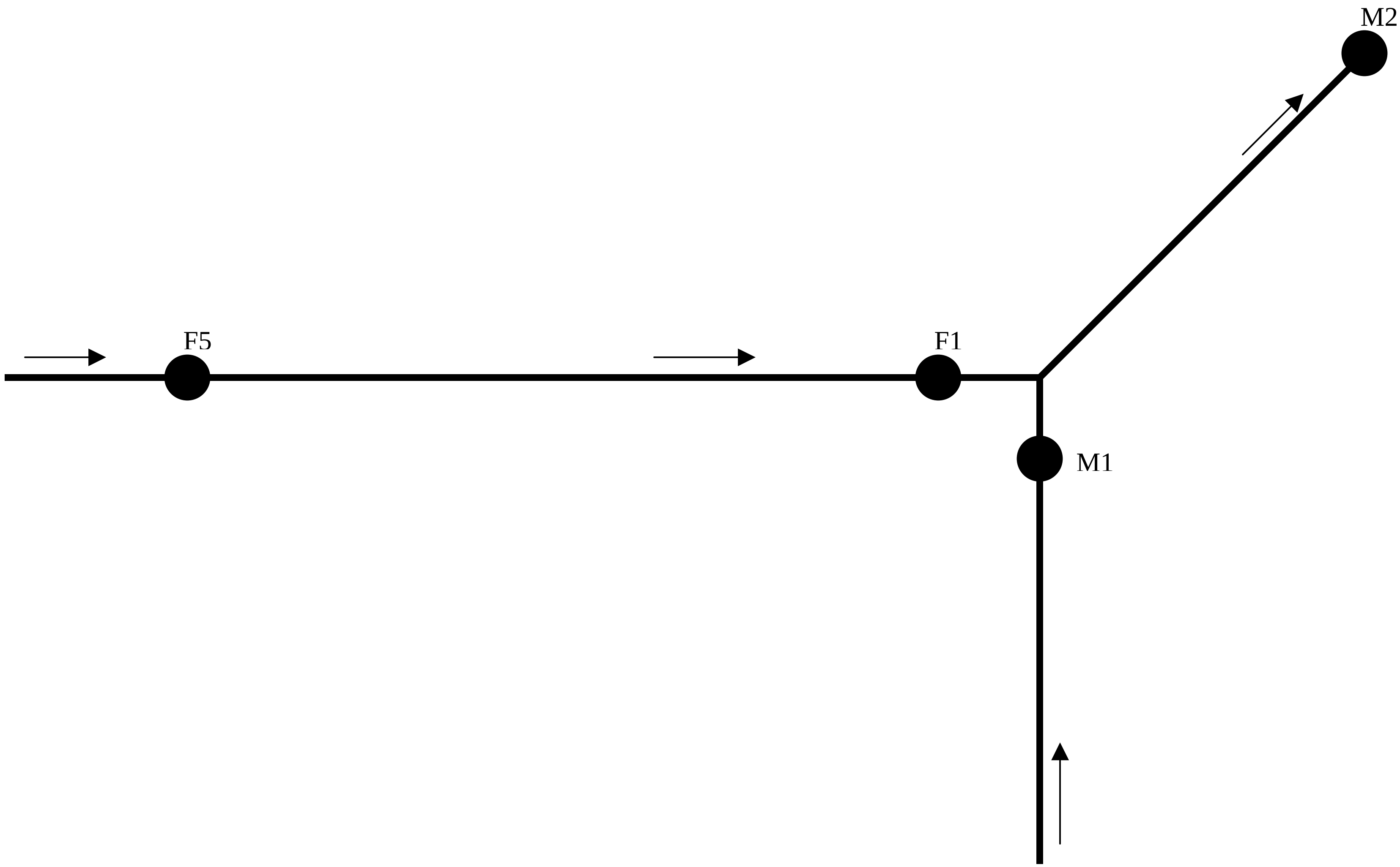
Monastery Run Watershed Maps


Latrobe
Fourmile Run
43458
F5
43458
F1
M1
M2
43457
43457
Monastery Run
0.5
0
0.5
1 Miles
Westmoreland County
Watershed Map
N
Sampling Locations
Streams
Nonattaining
Unassessed
Attaining
Watershed Boundary


0.5
0
0.5 Miles
Fourmile Run
Loyalhanna Creek
Monastery Run
F5
F1
M1
M2
WL1
WL2
WL3
43458
43459
43460
43461
43457
Beatty
St Vincent Lake
St Vincent College
Dorothy
PIPELINES
Mine Tipple
Westmoreland County
Monastery Run Watershed Sampling Station Map
N
Legend
Sampling Locations
Wetland Treatment
Watershed Boundary
Streams
Nonattaining
Unassessed
Attaining


Allegheny River
PWSID5030019
Buffalo Twp. Muni. Auth.
Freeport
Kiskiminetas River
Conemaugh River
WQN0812
Loyalhanna Creek
Fourmile Run
Monastery Run
Station Map
N
W
E
S
5
0
5
Miles
Legend
WQN Station
Water Supply Intake
State Water Plan Boundry
Monastery Run Watershed
Streams
Nonattaining
Unassessed
Attaining

Sampling Station Diagram
Diagram not to scale.
Arrows indicate direction of flow.



Attachment B

Method for Addressing Section 303(d) Listings for pH

Method for Addressing Section 303(d) Listings for pH

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

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

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

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

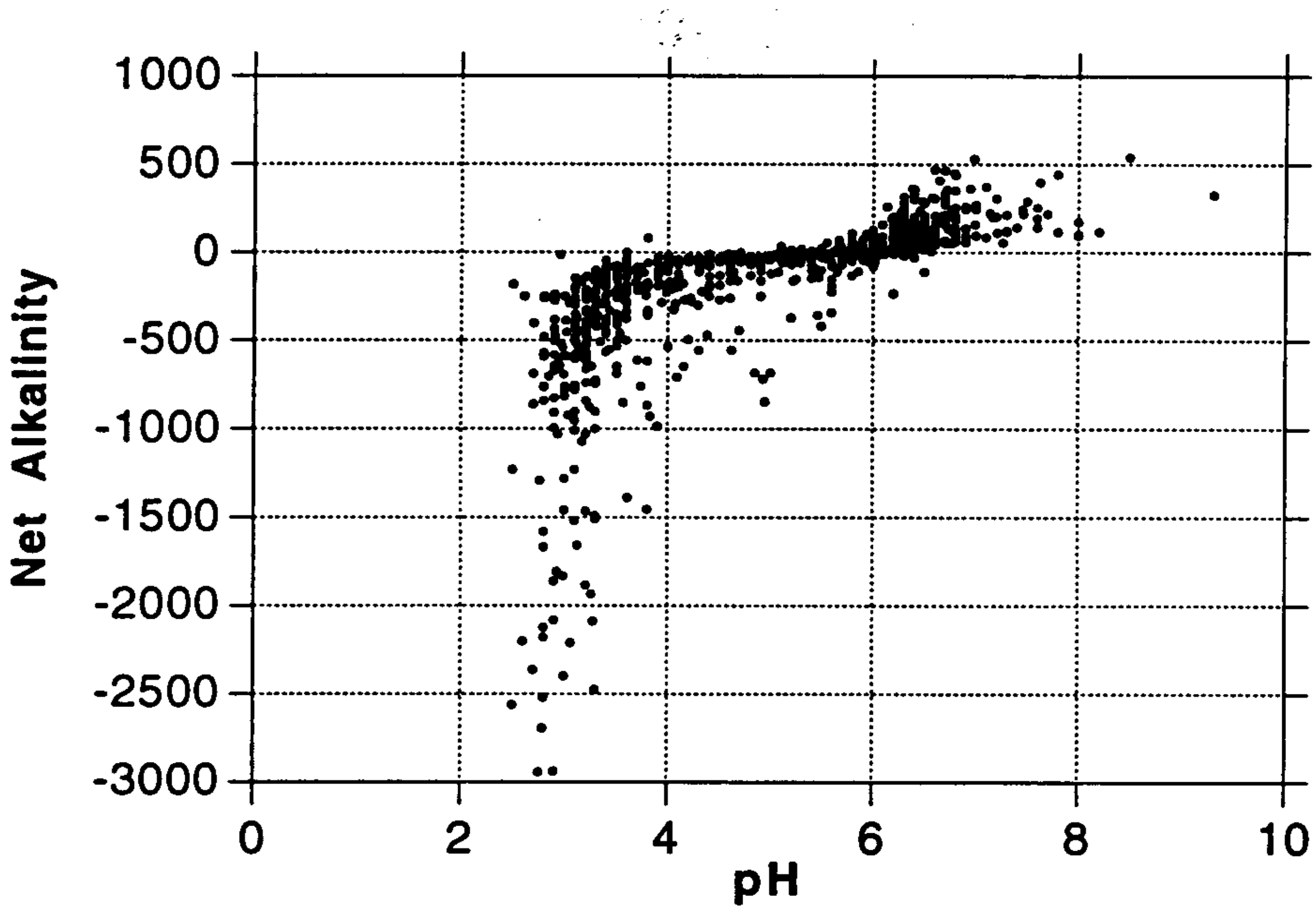


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Attachment C
TMDLs By Segment

Fourmile Run

Fourmile Run occupies a majority of the Monastery Run Watershed area. Monastery Run upstream of the confluence with Fourmile Run is attaining its uses.

The TMDL for Fourmile Run consists of load allocations to two sampling sites along the stream. Fourmile Run is listed as impaired on the PA Section 303(d) list by high metals, suspended solids, and sulfates from AMD. The suspended solids impairment is metal floc and will be removed with the effective removal of the metals impairment.

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

TMDL Calculations - Sample Point F5, downstream of Unnamed Tributary 43461 and above wetland treatment

The TMDL for Fourmile Run consists of a load allocation to all of the area above sampling point F5 (Attachment A). The load allocation for this stream segment was computed using water-quality sample data collected at point F5. Flow for this F5 was estimated using the unit-area hydrology from a known point, F1.

The watershed area above sample point F5 is 7.40 square miles. Point F1 has an average flow of 5.61 MGD, and a watershed area of 8.41 square miles. This gives a flow yield of 0.667 MGD/sq. mi. Multiplying the flow yield for the known point times the watershed area above point F5 equals the flow of 4.94 MGD at sample point F5.

Fourmile Run above F5 is attaining its uses and does not appear on the PA Section 303(d) list. Sample data at point F5 shows pH ranging between 6.8 and 8.5; pH is not addressed as part of this TMDL.

Table C1. TMDL Calculations at Point F5				
Flow = 4.94 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.94	38.8	0.24	10.1
Mn	0.14	6.0	0.11	4.4
Al	0.33	13.7	0.21	8.7
Acidity	0.00	0.0	0.00	0.0
Alkalinity	111.19	4,580.9		

Table C2. Calculation of Load Reduction Necessary at Point F5				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	38.8	6.0	13.7	0.0
Allowable Load	10.1	4.4	8.7	0.0
Load Reduction	28.7	1.6	5.0	0.0
% Reduction Segment	74	27	37	0

TMDL Calculation - Sample Point F1, mouth of Fourmile Run upstream St. Vincent Lake spillway

The TMDL for sample point F1 consists of a load allocation to all of the area between sample point F1 and F5, shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point F1. The average flow, measured at the sampling point F1 (5.61 MGD), is used for these computations.

This segment appeared on the 1996 and 1998 PA Section 303(d) lists for metals and other inorganics impairments. A reassessment of the segment in 1999 removed other inorganics and added suspended solids as a cause of impairment to the PA 2002 Section 303(d) list. There is currently no listing for this segment for pH impairments on the PA Section 303(d) list. Sample data at point F1 shows pH ranging between 6.3 and 7.6; pH is not addressed as part of this TMDL.

Table C3. TMDL Calculations at Point F1				
Flow = 5.61 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	16.19	757.2	0.32	15.1
Mn	1.83	85.6	0.42	19.7
Al	0.39	18.3	0.18	8.6
Acidity	0.00	0.0	0.00	0.0
Alkalinity	96.52	4,514.0		

The calculated load reductions for all the loads that enter point F1 must be accounted for in the calculated reductions at the sample point shown is Table C4. A comparison of measured loads between points F1 and F5 shows that there is additional loading entering the segment for iron, manganese, and aluminum. The total segment load is the sum of the upstream loads and the load directly entering the segment.

Table C4. Calculation of Load Reduction Necessary at Point F1				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Measured Load	757.2	85.6	18.3	0.0
Difference in Measured Load	718.4	79.7	4.5	0.0
Load tracked from F5	10.1	4.4	8.7	0.0
Total Load tracked between points	728.5	84.0	13.2	0.0
Allowable Load at F1	15.1	19.7	8.6	0.0
Additional Reduction at F1	713.4	64.3	4.6	0.0
% Reduction required at F1	98	77	35	0

Monastery Run

The TMDL for Monastery Run consists of load allocations to two sampling sites along the stream. Monastery Run, downstream of Fourmile Run, is listed as impaired on the CWA 303(d) list by metals from AMD.

TMDL Calculations - Sample Point M1, Monastery Run upstream of confluence with Fourmile Run

The TMDL for Monastery Run consists of a load allocation to all of the area above sampling point M1 (Attachment A). The load allocation for this stream segment was computed using water-quality sample data collected at point M1. Flow for M1 was estimated using the unit-area hydrology from a known point, F1.

The watershed area above sample point M1 is 3.00 square miles. Point F1 has an average flow of 5.61 MGD, and a watershed area of 8.41 square miles. This gives a flow yield of 0.667 MGD/sq. mi. Multiplying the flow yield for the known point times the watershed area above point M1 equals the flow of 2.00 MGD at sample point M1.

There is currently no entry for this segment on the PA Section 303(d) list. Monastery Run above M1 is attaining its uses. Sample data at point M1 shows pH ranging between 7.4 and 8.5; pH is not addressed as part of this TMDL.

Water quality analysis determined that the existing and allowable manganese loads are equal. Because the WQS is met, a TMDL for manganese is not necessary. Although a TMDL for manganese is not necessary, the load at the point is considered at the next downstream point, M2.

Table C5. TMDL Calculations at Point M1				
Flow = 2.00 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.72	12.0	0.20	3.4
Mn	0.03	0.6	0.03	0.6
Al	0.29	4.8	0.17	2.9
Acidity	0.29	4.8	0.29	4.8
Alkalinity	229.29	3,824.6		

Table C6. Calculation of Load Reduction Necessary at Point M1				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	12.0	0.6	4.8	4.8
Allowable Load	3.4	0.6	2.9	4.8
Load Reduction	8.6	0.0	1.9	0.0
% Reduction Segment	72	0	40	0

TMDL Calculation - Sample Point M2, mouth of Monastery Run

The TMDL for sample point M2 consists of a load allocation to all of the area between sample points F1, M1, and M2, shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point M2. Flow for M2 was estimated using the unit-area hydrology from a known point, F1.

The watershed area above sample point M2 is 12.10 square miles. Point F1 has an average flow of 5.61 MGD and a watershed area of 8.41 square miles. This gives a flow yield of 0.667 MGD/sq. mi. Multiplying the flow yield for the known point times the watershed area above point M2 equals the flow of 8.07 MGD at sample point M2.

This segment is currently on the PA Section 303(d) list for metals impairments. Sample data at point M2 shows pH ranging between 6.4 and 8.2; pH is not addressed as part of this TMDL.

Table C7. TMDL Calculations at Point M2				
Flow = 8.07 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	10.02	674.7	0.40	27.0
Mn	1.29	86.7	0.41	27.7
Al	0.36	24.5	0.20	13.2
Acidity	0.00	0.0	0.00	0.0
Alkalinity	123.00	8,278.5		

The calculated load reductions for all the loads that enter point M2 must be accounted for in the calculated reductions at the sample point shown is Table C8. A comparison of measured loads between points F1, M1 and M2 shows that there is additional loading entering the segment for manganese and aluminum and a loss of iron load. The total segment manganese and aluminum load is the sum of the upstream loads and the additional load entering the segment. For loss of iron load, the percent of load lost within the segment is calculated and applied to the upstream loads to determine the amount of the upstream load that is tracked through the segment.

Table C8. Calculation of Load Reduction Necessary at Point M2

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Measured Load	674.7	86.7	24.5	0.0
Difference in Measured Load	-94.5	0.4	1.4	-4.8
Load tracked from upstream	18.5	20.3	11.5	4.8
% Load lost	12	-	-	100
% Load tracked	88	-	-	0
Total Load tracked between points	16.2	20.7	12.9	0.0
Allowable Load at M2	27.0	27.7	13.2	0.0
Load Reduction at M2	0.0	0.0	0.0	0.0
% Reduction required at M2	0	0	0	0

Margin of Safety

For this study the margin of safety is applied implicitly. A MOS is implicit because 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:

- 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.
- An additional MOS is provided because the calculations were done with a daily Fe average instead of the 30-day average

Seasonal Variation

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

Critical Conditions

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

Attachment D

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

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

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

Attachment E

Water Quality Data Used In TMDL Calculations

Sampling Point	Date	Alkalinity	Acidity	pH	Fe	Mn	Al	Sulfates
		mg/L	mg/L		mg/L	mg/L	mg/L	mg/L
F5	6/26/96	no data	0.00	7.88	2.10	0.00	0.40	74.26
Latitude:	7/22/96	100.91	0.00	6.99	2.50	0.20	0.19	104.64
40 17’ 56”	8/16/96	142.78	0.00	6.84	2.40	0.10	0.40	151.10
Longitude:	9/20/96	95.54	0.00	7.00	1.30	0.10	0.30	84.26
79 25’ 03”	10/24/96	89.18	0.00	7.99	2.10	0.00	0.40	210.31
	11/14/96		0.00	7.80	2.70	0.10	0.70	144.85
	11/27/96	66.60		7.87				
	12/18/96				2.20			
	12/26/96	85.09	0.00			0.10	0.50	130.99
	1/22/97	110.72	0.00	7.54	1.40	0.10	0.50	153.67
	2/19/97	59.46	0.00	7.93	1.40	0.20	0.40	70.12
	3/11/97				0.20			
	3/20/97	85.55	0.00	8.48		0.10	0.30	92.85
	4/22/97	121.02	0.00	8.01	1.90	2.70	0.20	126.36
	5/22/97	73.03	0.00	7.97	0.70	no data	no data	81.63
	6/24/97	146.06	0.00	7.88	0.00	0.00	0.30	140.00
	8/5/97	173.43	0.00	8.11	2.30	0.00	0.10	180.40
	8/27/97	136.65	0.00	8.26	0.30	0.00	0.20	114.50
	9/29/97	78.10	0.00	7.29	0.30	0.00	0.70	189.90
	10/27/97	113.02	0.00	7.50	1.00	0.00	0.50	
	11/17/97	72.95	0.00	7.84	0.30	0.20	0.16	75.38
	12/17/97	87.85	0.00	7.70	No smp	No smp	No smp	99.81
	1/21/98	80.70	0.00	7.66	0.30	0.18	0.17	74.00
	2/10/98	76.61	0.00	7.20	1.40	0.27	0.33	62.77
	3/19/98	80.70	0.00	8.41	1.10	0.17	0.24	69.59
	4/23/98	73.90	0.00	8.44	0.30	0.08	0.43	62.72
	5/14/98	98.53	0.00	8.09	1.70	0.11	0.26	65.82
	6/9/98	134.95	0.00	7.92	0.00	0.05	0.29	99.08
	7/14/98	158.51	0.00	7.95	1.20	0.08	0.20	145.06
	7/31/98	120.01	0.00	7.60	0.60	0.10	0.39	61.98
	8/1/98							
	9/1/98							
	10/1/98							
	11/1/98							
	12/1/98	228.50	0.00	7.95	0.60	0.70	1.20	136.91
	1/1/99	64.60	0.00	7.90	6.80	0.15	0.60	180.34
	2/1/99	73.32	0.00	7.88	4.90	0.07	0.50	67.98
	3/1/99	76.82	0.00	8.33	4.80	0.38	0.40	5.14
	4/1/99	103.51	0.00	7.97		0.03	0.59	142.91
	5/1/99	174.33	0.00	8.02				31.39
	6/1/99	175.23	0.00	7.80	0.70	0.13	0.30	9.52
	7/1/99	163.53	0.00	7.81	0.50	0.06	0.57	190.82
	8/1/99							
	9/1/99							

Sampling Point	Date	Alkalinity	Acidity	pH	Fe	Mn	Al	Sulfates
		mg/L	mg/L		mg/L	mg/L	mg/L	mg/L
	10/1/99			7.55	0.30			
	10/27/99	169.59	0.00			0.08	1.23	257.89
	11/1/99	148.83	0.00	7.94	0.50	0.10	0.27	362.09
	12/1/99	82.68	0.00	7.35	0.40	0.00	0.84	362.01
	1/18/00	120.45	0.00	7.35	0.30	0.10	0.53	
	2/28/00	no data	no data	no data				no data
	3/27/00	81.11	0.00	7.90	0.10	0.09	0.27	
	4/27/00	76.00			0.30	0.10	0.07	125.22
	5/30/00	66.38	0.00	7.90	0.30	0.06		76.62
	6/22/00							
	7/27/00	173.68	0.00	7.93	0.10	0.04	0.20	625.71
	8/1/00							
	9/1/00							88.90
	9/29/00	139.00	0.00	8.01	0.10	0.04	0.06	
	10/1/00	147.00	0.00	8.08	0.52	0.08	0.02	191.79
	11/1/00							
	12/1/00	84.00	0.00	7.93	0.61	0.23	0.20	65.00
	1/1/01	113.00	0.00	7.87	0.26	0.00	0.20	112
	2/1/01	68.00	0.00	7.99	0.45	0.20	0.54	66.00
	3/1/01	90.00	0.00	8.14	0.20	0.19	0.20	88.00
	4/1/01	114.00	0.00	8.04	1.16	0.22	0.20	107.00
	5/1/01	135	0.00	8.05	0.17	0.19	0.20	125
	6/1/01	127	0.00	8.04	0.37	0.05	0.20	107
	7/1/01	172	0.00	7.99	0.47	0.14	0.20	159
	8/1/01	164	0.00	8.14	0.27	0.02	0.20	157
	9/1/01	152	0.00	8.09	0.19	0.11	0.20	127
	10/1/01	147	0.00	7.79	0.24	0.05	0.20	113
	11/1/01	109	0.00	7.98	0.20	0.04	0.20	176
	12/1/01	82	0.00	7.90	0.45	0.07	0.20	139
	1/2/02	91	0.00	7.90	0.15	0.08	0.20	88
	2/2/02	91	0.00	8.42	0.19	0.12	0.27	93
	3/2/02	55	0.00	7.83	0.21	0.11	0.21	60
	4/2/02	71	0.00	7.96	0.32	0.13	0.20	73
	5/2/02	86	0.00	7.88	0.32	0.11	0.20	99
	6/2/02	143	0.00	8.10	0.17	0.04	0.02	127
	7/2/02	154	0.00	8.06	0.14	0.04	0.02	
	9/2/02	148	0.00	8.06	1.66	0.12	0.49	6
	10/2/02	104	0.00	7.94	0.41	0.03	0.44	75
	11/1/02	71	0.00	7.64	0.27	0.084	0.21	49
	12/1/02	62	0.00	7.55	0.28	0.04	0.28	50
	1/3/03							
	Average	111.18879	0.00000	7.86926	0.94067	0.14485	0.33369	122.80346
	St Dev	38.55412	0.00000	0.32301	1.24425	0.33609	0.23421	91.94427

Sampling Point	Date	Alkalinity	Acidity	pH	Fe	Mn	Al	Sulfates	Flow
		mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	gpm
F1	6/26/96	92.27	0.00	6.41	25.00	2.00	0.70	354.91	
Latitude:	7/22/96	93.39	0.00	6.64	29.50	2.40	0.29	446.73	
40 17’ 49”	8/16/96	121.31	0.00	6.53	36.40	3.00	0.10	683.10	
Longitude:	9/20/96	107.35	0.00	6.75	24.30	1.60	0.20	496.09	
79 23’ 58”	10/24/96	84.81	0.00	6.70	15.10	1.20	0.30	223.14	
	11/14/96		0.00	6.59	21.80	1.50	0.60	467.78	
	11/27/96	98.40		6.54					
	12/18/96				35.10				
	12/26/96	102.52	0.00			2.50	0.70	63.85	
	1/22/97	134.31	0.00	6.52	44.20	3.10	0.60	812.74	
	2/19/97	82.02	0.00	6.48	24.40	1.70	0.50	285.72	
	3/11/97				22.00				
	3/20/97	100.15	0.00	6.78		1.60	0.40	377.80	
	4/22/97	121.02	0.00	6.56	40.00	2.90	0.60	608.45	
	5/22/97	104.33	0.00	6.57	18.60	no data	no data	254.36	
	6/24/97	117.89	0.00	6.42	45.90	3.30	0.60	632.70	
	8/5/97	103.16	0.00	6.41	28.30	3.80	0.30	669.20	
	8/27/97	105.83	0.00	6.54	24.00	2.50	0.30	518.10	
	9/29/97	62.70	0.00	6.28	6.00	0.60	1.60	34.80	
	10/27/97	95.55	0.00	6.90	12.60	1.10	0.40		
	11/17/97	80.14	0.00	6.95	15.40	1.30	0.30	234.33	
	12/17/97	99.09	0.00	6.87	28.50	2.21	0.59	412.65	
	1/21/98	103.17	0.00	6.54	28.10	2.18	0.64	372.20	
	2/10/98	96.02	0.00	6.53	25.00	1.92	0.67	295.95	
	3/19/98	96.02	0.00	6.77	28.50	2.17	0.56	367.03	
	4/23/98	82.74	0.00	6.84	25.40	1.86	0.86	358.38	
	5/14/98	102.82	0.00	6.62	28.50	2.09	0.56	403.74	
	6/9/98	115.67	0.00	6.53	34.50	2.80	0.53	389.82	
	7/14/98	102.82	0.00	6.55	37.60	3.18	0.44	635.21	
	7/31/98	89.96	0.00	6.77	20.70	1.87	0.68	235.42	
	8/1/98								
	9/1/98								
	10/1/98								
	11/1/98								
	12/1/98	157.09	0.00	6.79	10.70	1.69	1.40	1059.21	
	1/1/99	78.91	0.00	7.01	8.30	0.94	0.60	70.91	
	2/1/99	82.05	0.00	7.12	6.50	0.87	0.60	284.79	
	3/1/99	161.10	0.00	6.90	6.80	1.05	0.50	319.71	
	4/1/99	114.40	0.00	6.60	30.60	1.76	0.63	638.65	
	5/1/99	81.72	0.00	6.34	22.30	1.83	0.70	712.23	
	6/1/99	98.06	0.00	6.66	17.20	2.45	0.10	795.51	
	7/1/99	110.24	0.00	6.80	10.10	1.90	0.17	913.13	

Sampling Point	Date	Alkalinity	Acidity	pH	Fe	Mn	Al	Sulfates	Flow
		mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	gpm
	8/1/99	No Sample							
	9/1/99								
	10/1/99			6.35	12.10				
	10/27/99	127.88	0.00			1.57	1.23	520.45	801
	11/1/99	125.49	0.00	6.61	14.40	1.35	0.35	445.77	484
	12/1/99	84.52	0.00	6.55	9.80	2.64	1.05	24.72	
	1/18/00	95.67	0.00	6.19	11.40	3.45	0.55		
	2/28/00	67.59	0.00	6.40	10.30	0.96	0.21	1140.75	7245
	3/27/00	77.13	0.00	7.96	15.00	1.45	0.25	45.54	3855
	4/27/00	70.54	0.00	6.50	11.80	1.67	0.20	374.12	
	5/30/00	75.39	0.00	6.34	9.00	1.31	0.02	303.98	
	6/22/00	87.24	0.00	6.68	11.49	1.66	0.02	430.14	
	7/27/00	58.75	0.00	7.26	6.28	1.68	0.03	630.60	
	8/1/00	No Sample							
	9/1/00							444.06	
	9/29/00	110.00	0.00	7.07	6.87	1.08	0.02		
	10/1/00	83.00	0.00	7.07	3.72	0.85	0.14	273.90	
	11/1/00	NO Sample	NO Sample	NO Sample	NO Sample	NO Sample	NO Sample	NO Sample	
	12/1/00	100.00	0.00	6.86	13.62	2.27	0.20	413.00	
	1/1/01	107.00	0.00	6.91	16.30	2.61	0.20	461	
	2/1/01	75.00	0.00	7.04	8.30	1.46	0.51	251.00	
	3/1/01	86.00	0.00	7.07	11.50	2.20	0.29	387.00	
	4/1/01	84.00	0.00	7.60	16.93	2.79	0.20	476.00	
	5/1/01	88	0	7.05	6.11	2.64	0.20	466	
	6/1/01	90	0	6.99	6.46	2.28	0.20	457	
	7/1/01	88	0	6.87	6.94	2.42	0.20	558	
	8/1/01	87	0	6.97	6.50	1.50	0.20	579	
	9/1/01	112	0	6.98	7.86	1.65	0.20	508	
	10/1/01	113	0	6.86	5.85	2.25	0.20	472	
	11/1/01	100	0	7.12	5.42	1.50	0.20	362	
	12/1/01	90	0	7.27	4.52	0.59	0.20	192	
	1/2/02	97	0	6.86	6.04	1.12	0.20	274	1157.00
	2/2/02	95	0	7.14	5.45	0.96	0.23	303	
	3/2/02	57	0	7.20	3.26	0.71	0.26	25	
	4/2/02	78	0	6.91	6.29	1.47	0.20	289	7142.00
	5/2/02	85	0	6.78	13.47	1.11	0.20	332	9138.00
	6/2/02	83	0	7.01	10.13	2.24	0.02	20	3324.00
	7/2/02	80	0	6.91	4.02	2.29	0.02	514	
	9/2/02	113	0	7.10	6.52	1.83	0.20	543	918.00
	10/2/02	107	0	7.18	4.58	0.82	0.20	245	1922.00
	11/1/02	103	0	7.17	3.50	0.531	0.19	114	6852.00
	12/1/02	78	0	7.02	4.46	0.69	0.19	139	
	1/3/03	110	0	6.75	21.51	1.54	0.04	464	
	Average	96.51528	0.00000	6.79736	16.18889	1.83111	0.39070	412.96467	3894.36364

Sampling Point	Date	Alkalinity	Acidity	pH	Fe	Mn	Al	Sulfates	Flow
		mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	gpm
	St Dev	19.27901	0.00000	0.31349	11.00314	0.75106	0.31532	229.19821	3158.88750

Sampling Point	Date	Alkalinity	Acidity	pH	Fe	Mn	Al	Sulfates
		mg/L	mg/L		mg/L	mg/L	mg/L	mg/L
M1	6/26/96	247.33	0.00	8.10	1.20	0.00	0.30	58.96
Latitude:	7/22/96	208.26	0.00	8.17	1.30	0.20	0.19	64.57
40 17’ 47”	8/16/96	217.92	0.00	8.13	1.40	0.00	0.30	50.70
Longitude:	9/20/96	247.98	0.00	8.21	1.90	0.10	0.20	183.07
79 23’ 52”	10/24/96	201.82	0.00	8.13	2.20	0.00	0.30	57.93
	11/14/96		0.00	8.17	0.70	0.10	0.40	115.86
	11/27/96	217.30		8.27				
	12/18/96							
	12/26/96	231.70	0.00			0.00	0.20	433.81
	1/22/97	249.12	0.00	8.14	0.60	0.00	0.20	102.44
	2/19/97	219.08	0.00	8.31	1.80	0.10	0.10	49.75
	3/11/97							
	3/20/97	232.64	0.00	8.30	0.00	0.00	0.10	55.85
	4/22/97	249.34	0.00	8.15	0.40	0.00	0.20	56.08
	5/22/97	30.25	12.98	8.22	0.00	no data	no data	57.10
	6/24/97	267.07	0.00	8.13	0.90	0.00	0.40	47.90
	8/5/97	263.64	0.00	7.97	1.30	0.00	0.20	49.20
	8/27/97	274.33	0.00	8.12	0.50	0.00	0.20	58.90
	9/29/97	132.50	0.00	7.38	0.80	0.00	1.10	92.80
	10/27/97	220.90	0.00	7.71	1.10	0.00	0.20	
	11/17/97	211.65	0.00	8.18	1.80	0.00	0.16	47.35
	12/17/97	227.79	0.00	8.30	1.60	0.00	0.16	77.22
	1/21/98	224.73	0.00	8.45	0.00	0.00	0.17	56.30
	2/10/98	199.19	0.00	8.33	0.70	0.19	0.22	42.00
	3/19/98	202.26	0.00	8.62	1.00	0.11	0.17	59.78
	4/23/98	191.02	0.00	8.30	0.00	0.02	0.21	37.08
	5/14/98	244.18	0.00	8.42	1.50	0.02	0.20	no result
	6/9/98	262.40	0.00	8.33	0.00	0.00	0.20	55.48
	7/14/98	272.03	0.00	8.18	1.30	0.02	0.23	51.72
	7/31/98	225.02	0.00	8.09	0.50	0.04	0.37	46.95
	8/1/98							
	9/1/98							
	10/1/98							
	11/1/98							
	12/1/98	373.06	0.00	8.02	0.60	0.13	1.20	2.28
	1/1/99	201.64	0.00	8.10	6.90	0.04	0.60	188.62
	2/1/99							
	3/1/99	195.53	7.26	7.06	6.40	0.03	0.30	207.84
	4/1/99	234.25	0.00	8.10	0.01	0.00	0.44	49.49
	5/1/99	242.42	0.00	8.08	0.00	0.35	0.73	85.34

Sampling Point	Date	Alkalinity	Acidity	pH	Fe	Mn	Al	Sulfates
		mg/L	mg/L		mg/L	mg/L	mg/L	mg/L
	6/1/99	212.64	0.00	7.98	0.10	0.00	0.20	99.66
	7/1/99	211.30	0.00	8.17	0.20	0.03	0.22	162.38
	8/1/99							
	9/1/99							
	10/1/99			7.55	0.20			
	10/27/99	213.14	0.00			0.09	1.27	6.37
	11/1/99	209.46	0.00	8.08	0.20	0.00	0.34	68.15
	12/1/99	205.79	0.00	8.22	0.30	0.00	0.76	84.92
	1/18/00	194.99	0.00	8.20	0.30	0.00	0.50	
	2/28/00	157.20	0.00	8.09	0.40	0.02	0.17	83.86
	3/27/00	220.98	0.00	8.31	0.00	0.01	0.18	83.81
	4/27/00	211.45	0.00	8.20	0.00	0.01	0.11	51.74
	5/30/00	203.65	0.00	8.16			0.11	
	6/22/00	264.60	0.00	8.15	0.36	0.00		50.35
	7/27/00							44.40
	8/1/00							
	9/1/00							
	9/29/00	282.00	0.00	8.28	0.08	0.04	0.03	
	10/1/00	233.00	0.00	8.11	0.45	0.06	0.05	53.48
	11/1/00							
	12/1/00	239.00	0.00	8.33	0.16	0.04	0.20	54.00
	1/1/01	244.00	0.00	8.19	0.37	0.06	0.20	54
	2/1/01	219.00	0.00	8.36	0.29	0.05	0.40	53.00
	3/1/01	223.00	0.00	8.35	0.00	0.04	0.20	51.00
	4/1/01	245.00	0.00	8.02	0.54	0.02	0.20	45.00
	5/1/01	258	0.00	8.22	0.27	0.04	0.20	51
	6/1/01	272	0.00	8.14	0.31	0.01	0.20	50
	7/1/01	267	0.00	8.10	0.12	0.00	0.20	54
	8/1/01	261	0.00	not done	0.12	0.00	0.20	53
	9/1/01	256	0.00	8.22	0.12	0.03	0.20	51
	10/1/01	266	0.00	8.18	0.00	0.00	0.20	35
	11/1/01	229	0.00	8.18	0.24	0.04	0.20	60
	12/1/01	161	0.00	7.97	0.91	0.06	0.38	57
	1/2/02	231	0.00	8.28	0.14	0.03	0.20	67
	2/2/02	227	0.00	8.43	0.11	0.03	0.20	59
	3/2/02	181	0.00	8.24	0.16	0.03	0.20	52
	4/2/02	223	0.00	8.26	0.17	0.03	0.20	51
	5/2/02	224	0.00	8.23	0.00	0.03	0.02	52
	6/2/02	271	0.00	8.22	0.27	0.01	0.02	51
	7/2/02	270	0.00	8.24	0.13	0.02	0.02	
	9/2/02	281	0.00	8.22	1.70	0.00	0.64	60
	10/2/02	276	0.00	8.14	0.18	0.01	0.60	62
	11/1/02	251	0.00	8.20		0.015	0.04	72
	12/1/02	207	0.00	8.00		0.02	0.18	54

Sampling Point	Date	Alkalinity	Acidity	pH	Fe	Mn	Al	Sulfates
		mg/L	mg/L		mg/L	mg/L	mg/L	mg/L
	1/3/03	241	0.00	8.08		0.02	0.04	56
	4/9/03	218	0.00	8.20	0.30	0.05	0.50	51
	Average	229.29188	0.28510	8.15246	0.72133	0.03474	0.28594	71.01001
	St Dev	42.32692	1.76670	0.22402	1.21134	0.05737	0.25126	58.13470

Sampling Point	Date	Alkalinity	Acidity	pH	Fe	Mn	Al	Sulfates
		mg/L	mg/L		mg/L	mg/L	mg/L	mg/L
M2	6/26/96	79.44	no data		18.60	1.70	0.60	292.37
Latitude:	7/22/96	110.57	0.00	8.05	16.40	1.80	0.26	333.07
40 18’ 19”	8/16/96	120.23	0.00	8.22	18.20	2.30	0.40	506.40
Longitude:	9/20/96	142.78	0.00	8.01	16.90	1.60	0.40	366.58
79 23’ 32”	10/24/96	151.70	0.00	7.20	11.70	0.85	0.50	225.73
	11/14/96		0.00	6.85	16.90	1.00	0.70	459.56
	11/27/96	122.00		6.78				
	12/18/96							
	12/26/96	133.89	0.00			1.90	0.70	337.26
	1/22/97	147.63	0.00	6.65	29.60	2.10	0.50	443.14
	2/19/97	104.49	0.00	6.78	17.00	1.25	0.50	225.22
	3/11/97							
	3/20/97	114.76	0.00	6.72	20.70	1.60	0.30	293.91
	4/22/97	121.02	0.00	6.76	30.60	2.30	0.60	465.16
	5/22/97	113.71	0.00	7.01	12.20	no data	no data	203.92
	6/24/97	119.97	0.00	6.59	31.90	2.70	0.70	505.70
	8/5/97	94.22	0.00	6.91	17.60	3.10	0.10	560.30
	8/27/97	136.65	0.00	6.90	10.10	1.80	0.20	381.80
	9/29/97	113.50	0.00	6.85	3.50	0.50	0.70	101.80
	10/27/97	119.18	0.00	7.15	6.10	0.80	0.20	
	11/17/97	87.34	0.00	6.99	9.10	0.90	0.16	174.41
	12/17/97	120.54	0.00	6.67	19.70	1.63	0.38	306.56
	1/21/98	122.58	0.00	6.94	16.90	1.54	0.40	266.60
	2/10/98	116.45	0.00	6.65	15.00	1.39	0.46	221.19
	3/19/98	108.28	0.00	6.93	19.50	1.66	0.39	275.46
	4/23/98	106.24	0.00	7.06	15.40	1.43	0.64	246.87
	5/14/98	117.81	0.00	6.88	19.00	1.61	0.44	316.24
	6/9/98	119.95	0.00	7.22	14.50	1.51	0.26	309.64
	7/14/98	107.10	0.00	6.65	19.90	2.35	0.20	483.71
	7/31/98	129.59	0.00	7.30	7.20	1.19	0.20	219.28
	8/1/98							
	9/1/98							
	10/1/98							
	11/1/98							
	12/1/98	210.45	0.00	7.81	3.50	0.95	1.50	262.43
	1/1/99	116.97	0.00	7.16	9.10	0.95	0.70	118.40
	2/1/99							

Sampling Point	Date	Alkalinity	Acidity	pH	Fe	Mn	Al	Sulfates
		mg/L	mg/L		mg/L	mg/L	mg/L	mg/L
	3/1/99	108.24	0.00	7.06	12.40	1.08	0.40	207.84
	4/1/99	129.66	0.00	6.78	20.30	1.44	0.48	479.87
	5/1/99	127.11	0.00	6.74	12.30	1.49	0.64	24.58
	6/1/99	110.77	0.00	7.17	3.20	1.29	0.10	688.11
	7/1/99	156.18	0.00	6.78	2.40	1.64	0.53	575.71
	8/1/99							
	9/1/99							
	10/1/99			7.30	3.10			
	10/27/99	144.79	0.00			0.97	1.23	349.93
	11/1/99	140.56	0.00	7.64	3.90	0.48	0.37	194.46
	12/1/99	109.18	0.00	7.19	3.40	0.70	0.90	45.84
	1/18/00	116.12	0.00	6.76	6.70	1.64	0.54	
	2/28/00	103.99	0.00	7.00	8.30	1.02	0.19	433.00
	3/27/00	111.79	0.00	7.13	9.70	0.82	0.26	255.98
	4/27/00	103.13	0.00	6.90	7.80	1.23	0.20	6.02
	5/30/00	no data					0.10	
	6/22/00	not done						320.46
	7/27/00							
	8/1/00							
	9/1/00							455.91
	9/29/00	156.00	0.00	6.42	24.10	1.69	0.05	
	10/1/00	130.00	0.00	7.56	9.35	0.30	0.02	221.76
	11/1/00							
	12/1/00	135.00	0.00	7.29	2.88	0.46	0.20	166.00
	1/1/01	137.00	0.00	7.17	9.30	2.04	0.20	334
	2/1/01	113.00	0.00	7.39	4.67	1.04	0.48	196.00
	3/1/01	116.00	0.00	7.23	7.84	1.60	0.20	286.00
	4/1/01	113.00	0.00	6.81	8.15	1.78	0.20	366.00
	5/1/01	126	0.00	7.51	3.14	1.41	0.20	372
	6/1/01	121	0.00	7.53	3.46	1.58	0.20	430
	7/1/01	112	0.00	7.53	2.77	1.19	0.20	500
	8/1/01	111	0.00	7.61	2.56	0.96	0.20	503
	9/1/01	150	0.00	7.63	2.48	1.03	0.20	299
	10/1/01	157	0.00	7.53	1.74	0.85	0.20	283
	11/1/01	132	0.00	7.55	2.83	0.83	0.20	266
	12/1/01	96	0.00	7.67	3.02	0.28	0.20	107
	1/2/02	140	0.00	7.51	3.09	0.74	0.20	198
	2/2/02	144	0.00	7.49	3.61	0.72	0.20	226
	3/2/02	97	0.00	7.59	1.83	0.50	0.20	546
	4/2/02	111	0.00	7.29	3.56	0.99	0.20	241
	5/2/02	117	0.00	7.28	7.59	0.75	0.02	167
	6/2/02	116	0.00	7.46	5.62	1.63	0.02	485
	7/2/02	118	0.00	7.60	1.67	1.60	0.02	
	9/2/02	133	0.00	7.65	0.18	1.22	0.85	506

Sampling Point	Date	Alkalinity	Acidity	pH	Fe	Mn	Al	Sulfates
		mg/L	mg/L		mg/L	mg/L	mg/L	mg/L
	10/2/02	147	0.00	7.65	2.15	1.07	0.20	348
	11/1/02	152	0.00	7.46	2.57	0.696	detected	179
	12/1/02	112	0.00	7.54	2.66	0.50	0.28	116
	1/3/03	116	0.00	7.03	14.82	1.12	0.04	359
	4/9/2003	108	0	7.1	3.75	0.78	0.5	201
	Average	123.00182	0.00000	7.19441	10.02491	1.28768	0.36338	311.08184
	St Dev	19.98622	0.00000	0.39164	7.81031	0.57035	0.27767	143.83400

WQN0812	
Loyalhanna Creek	
SR1046 BR at Dam, Loyalhanna TWP.	
Date	**Sulfates (mg/L)**
1/4/1990	50
2/14/1990	86
3/15/1990	182
4/17/1990	84
5/17/1990	89
6/14/1990	87
7/12/1990	149
8/9/1990	183
9/12/1990	68
10/2/1990	111
11/14/1990	83
12/18/1990	77
1/10/1991	112
2/6/1991	102
3/6/1991	97
4/9/1991	147
5/9/1991	111
6/12/1991	214
7/9/1991	268
8/13/1991	278
9/5/1991	343
11/7/1991	348
12/17/1991	59
1/7/1992	100
2/11/1992	125
3/17/1992	75
4/7/1992	94
5/18/1992	94
6/8/1992	169
7/8/1992	219
8/12/1992	147
9/3/1992	171
10/7/1992	179
11/12/1992	142
12/16/1992	107
1/5/1993	59
2/17/1993	141
3/10/1993	63
4/14/1993	129
5/12/1993	175
6/8/1993	229
7/14/1993	214
8/17/1993	263
9/7/1993	263
10/5/1993	173
11/4/1993	143
12/7/1993	42
1/12/1994	86
2/14/1994	105
3/8/1994	126
4/4/1994	98
5/3/1994	163
6/6/1994	100
7/6/1994	186
8/2/1994	243
9/8/1994	118
10/18/1994	171
11/3/1994	217
12/7/1994	67
1/11/1995	130
2/9/1995	141
3/15/1995	71
4/10/1995	162
5/9/1995	100
6/7/1995	93
Average	141.86
St Dev	69.05

Attachment F

Comment and Response

A 60-day public comment period was open from September 4, 2004 to November 4, 2004. During this time, no comments on the draft TMDL for the Monastery Run Watershed were received.