FINAL

DOOLEY RUN WATERSHED TMDL
Greene County

For Acid Mine Drainage Affected Segments

Prepared by:

Pennsylvania Department of Environmental Protection

April 3, 2007

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ATTACHMENTS

TMDL[1]
Dooley Run Watershed
Greene County, Pennsylvania

Table 1. 303(d) Sub-List								
State Water Plan (SWP) Subbasin: 19-G Dooley Run								
Year	**Miles**	**Segment ID**	**DEP Stream Code**	**Stream Name**	**Designated Use**	**Data Source**	**Source**	**EPA 305(b) Cause Code**
1996	2.2	4929	41465	Dooley Run	WWF	305(b) Report	RE	metals
1998	2.28	4929	41465	Dooley Run	WWF	SWMP	AMD	metals
2002	2.3	4929	41465	Dooley Run	WWF	SWMP	AMD	metals
2004	2.3	4929	41465	Dooley Run	WWF		AMD	metals

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

Introduction

This report presents the Total Maximum Daily Loads (TMDLs) developed for a segment in the Dooley 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 one segment on this list. Dooley Run was listed as impaired for metals. All impairments resulted from acid drainage from abandoned coalmines. The TMDL addresses the three primary metals associated with acid mine drainage (iron, manganese, aluminum) and pH.

Directions to the Dooley Run Watershed

The majority of the Dooley Run Watershed is found in southwestern Pennsylvania, as it is located, for the most part, in extreme south-central Greene County. However, approximately 50 acres of the headwaters is located in Monongalia County, West Virginia. The entire watershed area can be found on the Osage 7.5-Minute Quadrangle United States Geological Survey map. The watershed is fairly small, as it only comprises about 1,200 acres. Dooley Run can be accessed by taking Exit 1 (Mt. Morris exit) off of Interstate 79 and traveling about ¾ mile east on Ellsworth Avenue where you will cross over the lower reaches of Dooley Run just prior to the intersection with T-341 and T319.

[1] Pennsylvania's 1996, 1998, and 2002 Section 303(d) lists were approved by the Environmental Protection Agency (EPA). The 1996 Section 303(d) list provides the basis for measuring progress under the 1997 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

Segments addressed in this TMDL

Dooley Run is affected by pollution from AMD. This pollution was presumed to have caused high levels of metals in the watershed. There are no active mining operations in the watershed. Each segment on the Section 303(d) list will be addressed as a separate TMDL. These TMDLs will be expressed as long-term, average loadings. Due to the nature and complexity of mining effects on the watershed, expressing the TMDL as a long-term average gives a better representation of the data used for the calculations. See Table 3 for TMDL calculations and see Attachment C for TMDL explanations.

Clean Water Act Requirements

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

Additionally, the federal Clean Water Act and the 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.

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:

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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.

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 and comment period on draft TMDL;
6. Submittal of final TMDL; and
7. EPA approval of the TMDL.

Watershed History

Dooley Run is part of the Monongahela River Basin in Greene County. Dooley Run drains to Dunkard Creek approximately 1 mile downstream from Mt. Morris, Pennsylvania. The watershed area trends south to north and is characterized by the main stem of Dooley Run and one defined tributary, however, several small intermittent tributaries enter along the way. The general topography is fairly hilly with local relief from 870 to 1519 msl.

General geology includes a northwestern dip of about 2-3 degrees toward the Whiteley Syncline, which is located about 3 ½ miles to the northwest. For the most part, the watershed is forested but does include some agricultural property located along the main stem of Dooley Run in the central area of the watershed.

In regard to mining activities, the site has been almost entirely deep mined by activities on the Pittsburgh Coal Seam (i.e. Shannopin Mining Company (Shannopin Mine) and Consolidation Coal Company (Humphrey Mine)). Two boreholes near the headwaters of Dooley Run are present and both indicate iron parameters but both are dry most of the time. Some iron staining is visible within the stream channel at times and this may be responsible for the “impaired” nature of the stream, however, stream flow is alkaline and the iron “drops out” quickly. In addition to the Pittsburgh deep mining, there are several small “punch mines” on the Waynesburg Coal Seam, most of which were located within the mining area of the recent surface mine (Patriot) referenced below. These deep mines indicated poor water quality but were fairly low flow and were intermittent in nature. These mines were eliminated by Patriot’s surface mining activities.

Two surface mines are located within the borders of the watershed. The first is MDP 3274SM23 issued to Energy Resource Corporation of America (Chocolate Drop Site) in 1974. This site is located at the extreme downstream portion of Dooley Run. Mining occurred on the Waynesburg Coal Seam from 1975-1985. This site does have poor quality discharges (~25gpm) that are being pumped to a central location and being treated via a chemical treatment system. It is important to note that the final discharge point currently flows into Dunkard Creek, however, if pumping ceased, 3 of the 5 discharges would flow into Dooley Run just upstream of it’s confluence with Dunkard Creek. This discharge point can be seen on the maps in Attachment A. If the pumping does cease, the Dooley Run TMDL will be revisited and a waste load allocation will be calculated for this permitted discharge.

The other surface mine is SMP 30010101 issued to Patriot Mining Company that is currently in the stages of bond release. About 135 acres of the Waynesburg Coal Seam was mined from 2002-2004. Subsequent to 2004, final reclamation work (to include seeding and planting) was conducted and all treatment and sedimentation ponds were removed. A few new seeps of groundwater recharge to Dooley Run (less than 10 gpm in volume) have been discovered since reclamation has ceased. These seeps are currently being monitored by the Department to determine what, if any, impact they are having on the stream. As monitoring data show (Attachments C&E), water quality standards are being met at DOOL2.0, the monitoring point on Dooley Run downstream of the seeps, with the exception of manganese. The lack of substantial surface flow in Dooley Run, especially in the summer and the fall, is a strong indication that extensive deep mining on the Pittsburgh coal seam has effectively dewatered the overlying strata, which could result in higher concentrations of instream metals due to lack of dilution capacity. Should it be determined through the current monitoring that these seeps are causing degradation of Dooley Run, the responsibility of Patriot Mining for treatment of these seeps could be enforced. If treatment of these seeps is required as the result of the current investigation, the Dooley Run TMDL will be re-evaluated and appropriate modifications (WLAs) based on watershed conditions will be implemented.

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[3] by performing 5,000 iterations to determine the required percent reduction so that the water quality criteria, as defined in the *Pennsylvania Code. Title 25 Environmental Protection, Department of Environmental Protection, Chapter 93, Water Quality Standards,* will be met instream at least 99 percent of the time. For each iteration, the required percent reduction is:

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

PR = required percent reduction for the current iteration

Cc = criterion in mg/l

Cd = randomly generated pollutant source concentration in mg/l based on the observed data

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

Mean = average observed concentration

Standard Deviation = standard deviation of observed data

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

LTA = Mean * (1 – PR99) where (2)

LTA = allowable LTA source concentration in mg/l

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

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

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. 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 be a true reflection of acidity. This method assures that Pennsylvania's standard for pH is met when the acid concentration reduction is met.

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

TMDL Endpoints

One of the major components of a TMDL is the establishment of an instream numeric endpoint, which is used to evaluate the attainment of applicable water quality. An instream numeric endpoint, therefore, represents the water quality goal that is to be achieved by implementing the load reductions specified in the TMDL. The endpoint allows for 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 TMDLs' component makeup will be 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

*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.

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.

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. Reductions apply to Pennsylvania only.

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. Dooley Run Watershed Summary Table

Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	% Reduction
DOOL02 - Headwaters segment of Dooley Run						
Aluminum (lbs/day)	0.14	0.14	0	NA	NA	NA
Iron (lbs/day)	0.87	0.87	0	NA	NA	NA
Manganese(lbs/day)	2.46	0.63	0	0.63	1.83	74%
Acidity (lbs/day)	22.85	22.85	0	NA	NA	NA
DOOL01 – mouth segment of Dooley Run						
Aluminum (lbs/day)	0.23	0.23	0	NA	NA	NA
Iron (lbs/day)	0.75	0.75	0	NA	NA	NA
Manganese(lbs/day)	0.27	0.27	0	NA	NA	NA
Acidity (lbs/day)	34.84	34.84	0	NA	NA	NA

=NA = not applicable

In the instance that the allowable load is equal to the existing load (e.g. iron point DOOL02, 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. This is denoted as “NA” in the above table.

Recommendations

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

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

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

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

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

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

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

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

The coal industry, through DEP-promoted remining efforts, can help to eliminate some sources of AMD and conduct some of the remediation identified in the above recommendations through the permitting, mining, and reclamation of abandoned and disturbed mine lands. Special consideration should be given to potential remining projects within these areas, as the environmental benefit versus cost ratio is generally very high.

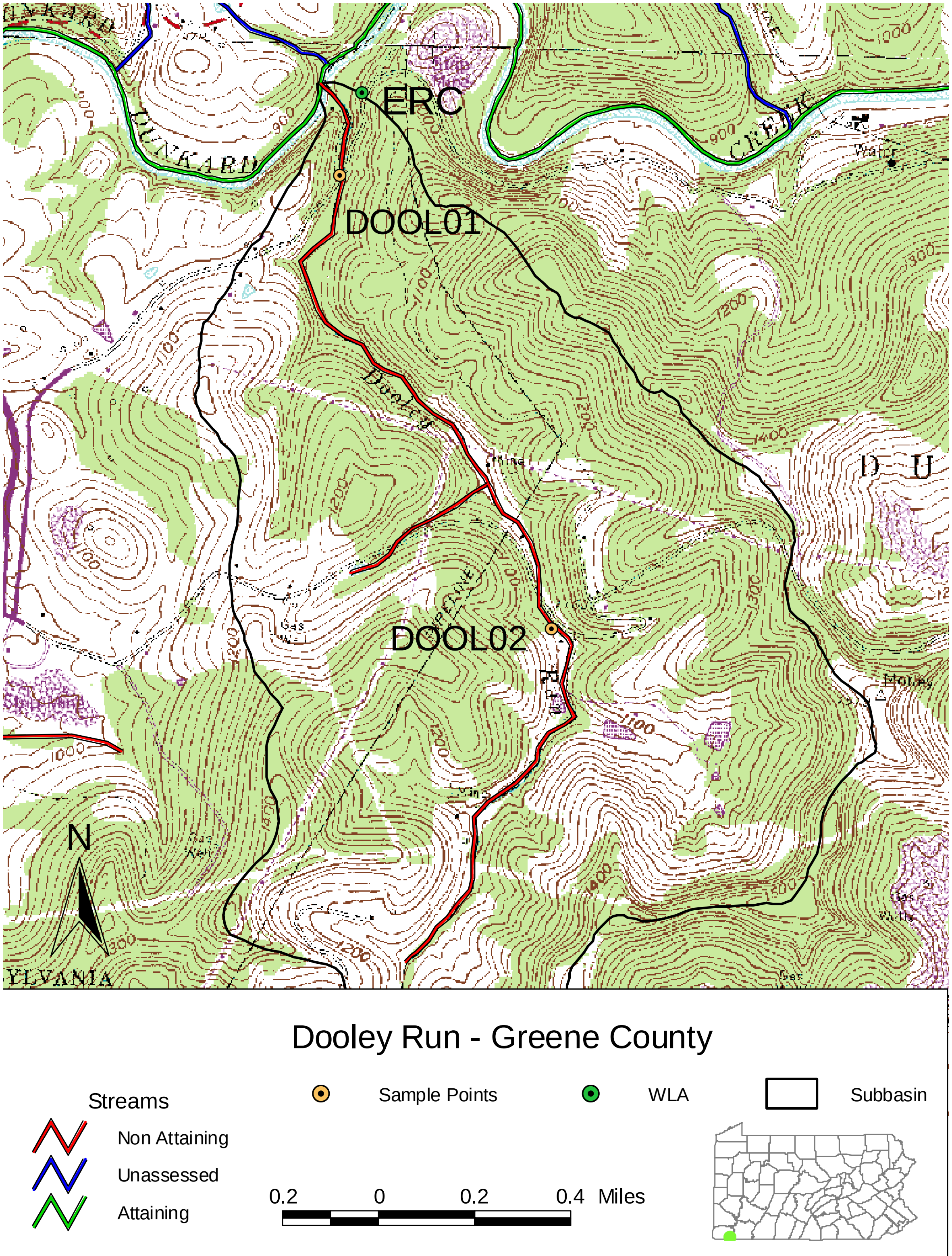
The situation with the poor quality discharges associated with the Energy Resources site is also stable as the discharges are pumped to a central point, treated and then discharged to Dunkard Creek. However, if pumping were to cease, 3 out of 5 discharges would flow into Dooley Run just upstream of its confluence with Dunkard Creek, As such, since long-term treatment of the discharges is unclear, its recommended that an overall evaluation of the current "pumping" setup and the "chemical" system to see if the water quality is conducive for a "passive" system or, at the very least, a combination "active/passive" system.

Public Participation

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* and the *Greene County Messenger* on 1/12/2007 to foster public comment on the allowable loads calculated. A public meeting was held on 1/30/2007 at the Greensburg District Mining Office, to discuss the proposed TMDL.

Attachment A

Dooley Run Watershed Maps


ERC
DOOL01
DOOL02
Dooley Run - Greene County
Streams
Non Attaining
Unassessed
Attaining
Sample Points
WLA
Subbasin
0.2 0 0.2 0.4 Miles
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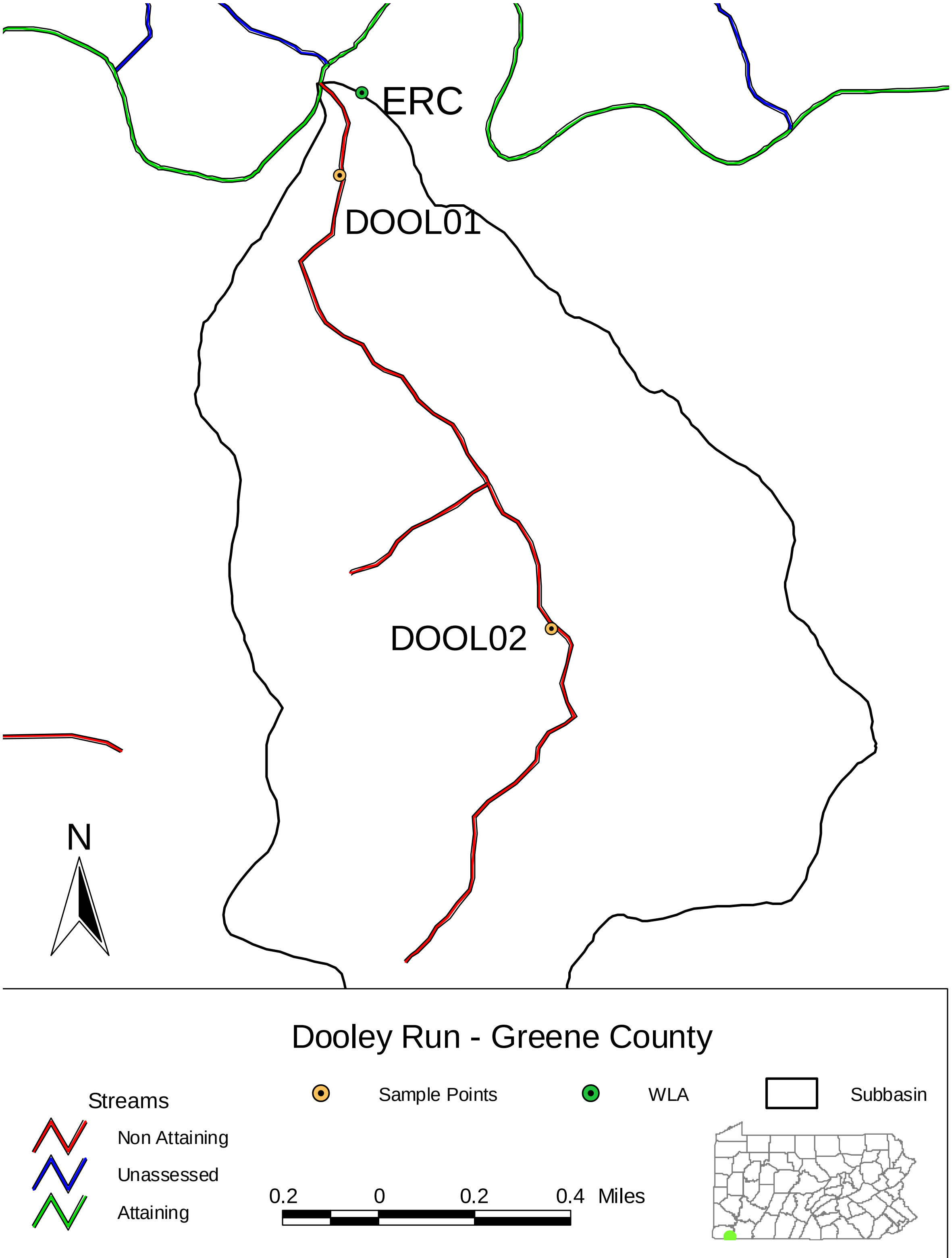
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Dooley Run - Greene County
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0.2
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0.2
0.4
Miles

Attachment B

Method for Addressing Section 303(d) Listings for pH

Method for Addressing Section 303(d) Listings for pH

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

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

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

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

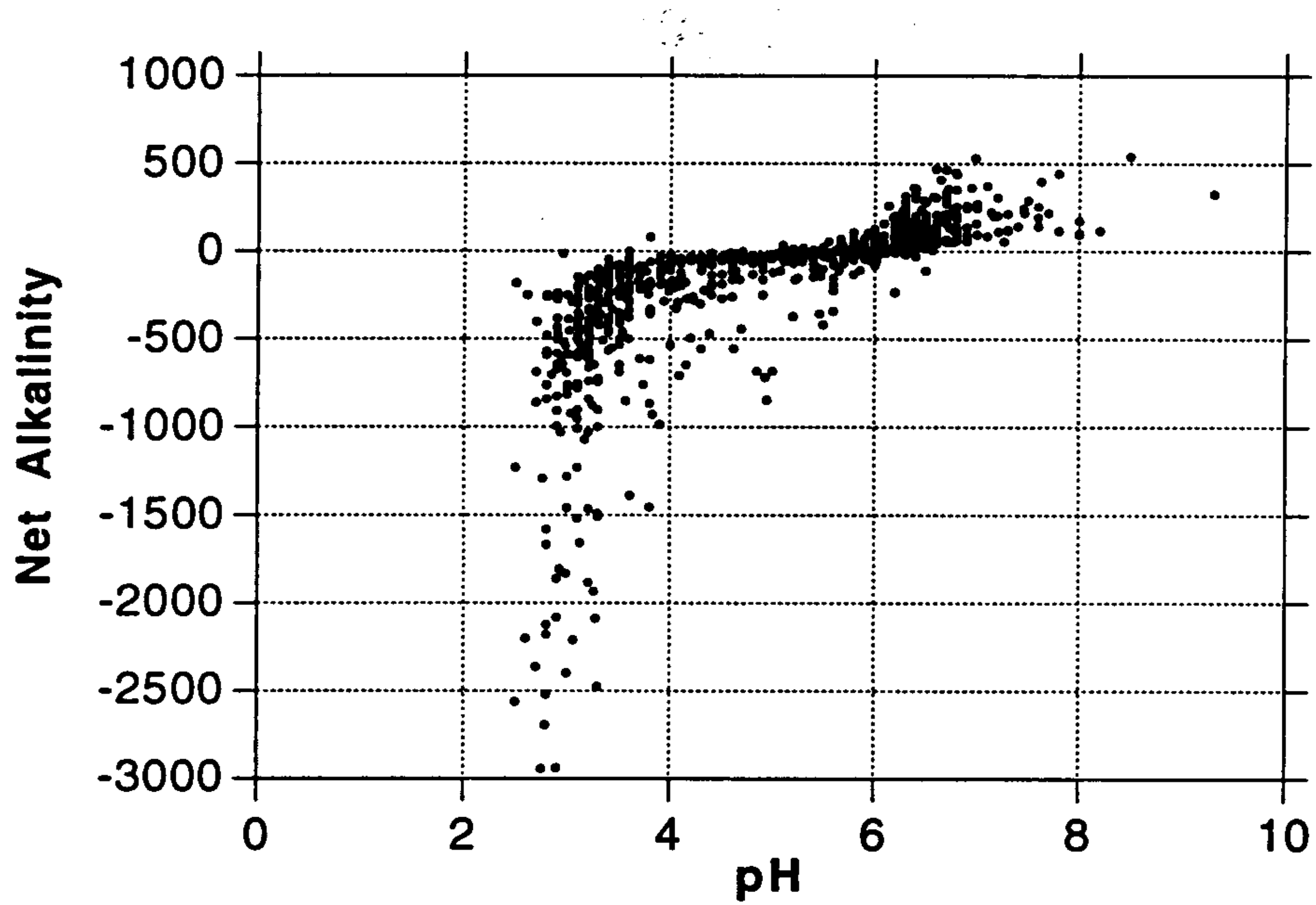


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Attachment C

TMDLs By Segment

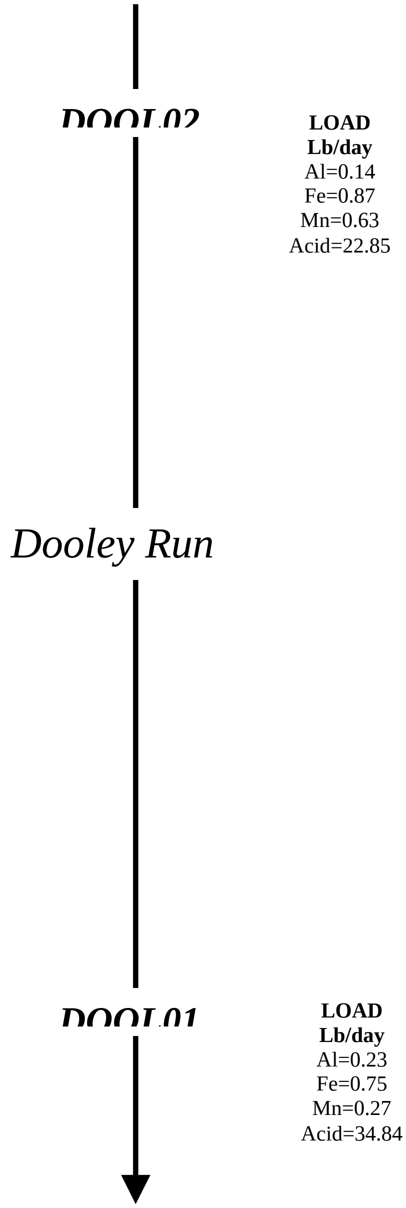
Dooley Run

The TMDL for Dooley Run consists of load allocations to two sampling sites on Dooley Run (DOOL02 and DOOL01). Sample data sets were collected during 2003 and 2004. All sample points are shown on the maps included in Attachment A as well as on the loading (allowable) schematic presented on the following page.

Dooley Run is listed on the 1996 PA Section 303(d) list for metals from AMD as being the cause of the degradation to this stream. Although this TMDL will focus primarily on metal loading to the Dooley Run watershed, reduced acid loading analysis will be performed. The objective is to reduce acid loading to the stream, which will in turn raise the pH to the desired range and keep a net alkalinity above zero, 99% of the time. The result of this analysis is an acid loading reduction that equates to meeting standards for pH (see TMDL Endpoint section in the report, Table 2). The method and rationale for addressing pH is contained in Attachment B.

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

Dooley Run Sampling Station Diagram
Arrows represent direction of flow
Diagram not to scale



TMDL calculations- DOOL02- Headwaters segment of Dooley Run

The TMDL for sample point DOOL02 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for the headwaters of Dooley Run was computed using water-quality sample data collected at point DOOL02. The average flow, measured at the sampling point DOOL02 (0.29 MGD), is used for these computations. The allowable load allocations calculated at DOOL02 will directly affect the downstream point DOOL01.

Sample data at point DOOL02 shows that the Dooley Run headwaters segment has a pH ranging between 7.8 and 8.1. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

A TMDL for manganese has been calculated at this site. Aluminum, iron and acidity were less than water quality criteria. Because water quality standards are met, a TMDL for these parameters is not necessary and is not calculated.

Table C1 shows the measured and allowable concentrations and loads at DOOL02. Table C2 shows the percent reductions for manganese.

Table C1		Measured		Allowable	
Flow (gpm)=	202.40	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.06	0.1	0.06	0.1
	Iron	0.36	0.9	0.36	0.9
ND = not determined	Manganese	1.01	2.5	0.26	0.6
NA = not applicable	Acidity	9.40	22.9	9.40	22.9
	Alkalinity	164.60	400.1		

Table C2. Allocations DOOL02	
DOOL02	Mn (Lbs/day)
Existing Load @ DOOL02	2.46
Allowable Load @ DOOL02	0.63
Load Reduction @ DOOL02	1.83
% Reduction required @ DOOL02	74%

The Patriot Mining Mount Morris Operation is in existence upstream of DOOL02 but has not been assigned a waste load allocation in this TMDL document. All mining and surface reclamation on the site is complete; the site is currently in the stages of bond release. A few new seeps of groundwater recharge to Dooley Run (less than 10 gpm in volume) have been discovered since reclamation has ceased. These seeps are currently being monitored by the Department to determine what, if any, impact they are having on the stream. As monitoring data show, water quality standards are being met at DOOL2.0, the monitoring point on Dooley Run downstream of the seeps, with the exception of manganese. Should it be determined through the current monitoring that these seeps are causing degradation of Dooley Run, the responsibility of Patriot Mining for treatment of these seeps could be enforced. If treatment of these seeps is required as the result of the current investigation, the Dooley Run TMDL will be re-evaluated and appropriate modifications (WLAs) based on watershed conditions will be implemented. If WLA becomes necessary for these seeps for manganese, it would be 0.24 lbs/day. However, until the results of the current monitoring are known, no treatment requirements are being imposed on Patriot Mining for the site and no WLAs are being assigned.

TMDL calculations- DOOL01- Downstream segment of Dooley Run

The TMDL for sampling point DOOL01 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment of Dooley Run was computed using water-quality sample data collected at point DOOL01. The average flow, measured at the sampling point DOOL01 (0.56 MGD), is used for these computations.

Sample data at point DOOL01 shows pH ranging between 7.2 and 7.9; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point DOOL01 for aluminum, iron, manganese and acidity was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from points DOOL02 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points DOOL02 and DOOL01 to determine a total load tracked for the segment of stream between DOOL01 and DOOL02. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at DOOL01.

All sample data for aluminum, iron and manganese was less than water quality criteria. Acidic data showed that no reduction was necessary due to high alkalinity and low acidic values. Because water quality standards are met for the three metals, a TMDL for these parameters isn't necessary and is not calculated.

Table C3 shows the measured and allowable concentrations and loads at DOOL02.

Table C3		Measured		Allowable	
Flow (gpm)=	392.00	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.05	0.2	0.05	0.2
	Iron	0.16	0.8	0.16	0.8
	Manganese	0.06	0.3	0.06	0.3
	Acidity	7.40	34.8	7.40	34.8
	Alkalinity	142.60	671.3		

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 that 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, 2002 and 2004 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, 2002 and 2004 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

Site	Date	Flow (gpm)	pH	Acidity (mg/L)	Alk (mg/L)	Al (mg/L)	Fe (mg/L)	Mn (mg/L)
DOOL02	5/28/2003	323	7.9	4	140	0.15	0.42	1.2
	7/2/2003	66	8.1	7	215	0.1	0.25	0.35
Latitude:	8/21/2003	16	8.0	5	203	0.04	0.13	0.07
39.73262	3/11/2004	308	7.8	17	115	<.02	0.82	1.52
Longitude:	4/22/2004	299	7.9	14	150	<.02	0.16	1.93
-80.0354								
	Average	202.40000	7.92200	9.40000	164.60000	0.09667	0.35600	1.01400
	St Dev	148.6415151	0.134425	5.770615	42.7001171	0.055076	0.282896	0.784493
Site	**Date**	**Flow (gpm)**	**pH**	**Acidity (mg/L)**	**Alk (mg/L)**	**Al (mg/L)**	**Fe (mg/L)**	**Mn (mg/L)**
DOOL01	5/28/2003	611	7.9	3	129	0.02	0.12	0.09
	7/2/2003	52	7.5	0	165	0.13	0.18	0.02
Latitude:	8/21/2003	16	7.2	2	175	0.09	0.3	0.02
39.74609	3/11/2004	715	7.8	10	112	<.02	0.18	0.16
Longitude:	4/22/2004	566	7.8	22	132	<.02	0.02	<.02
-80.04494	Average	392.00000	7.61200	7.40000	142.60000	0.08000	0.16000	0.07250
	St Dev	331.4898188	0.267713	8.988882	26.38749704	0.055678	0.10198	0.06702

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

Attachment F

Comment and Response

No written comments were received.