FINAL

RICHARDS RUN WATERSHED TMDL

Indiana County

For Acid Mine Drainage Affected Segments

Prepared by:

Pennsylvania Department of Environmental Protection

January 4, 2007

TABLE OF CONTENTS

TABLES

ATTACHMENTS

TMDL[1]
Richards Run Watershed
Indiana County, Pennsylvania

Table 1. 303(d) Sub-List								
State Water Plan (SWP) Subbasin: 18-D Richards Run								
Year	**Miles**	**Segment ID**	**DEP Stream Code**	**Stream Name**	**Designated Use**	**Data Source**	**Source**	**EPA 305(b) Cause Code**
1996	0.5		44924	Richards Run	CWF	305(b) Report	RE	Metals
1998	0.5		44924	Richards Run	CWF	SWMP	AMD	Metals
2004	1.8	20040930-1600-CLW	44924	Richards Run	CWF	SWMP	AMD	Metals

Resource Extraction=RE
Cold Water Fishes = CWF
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.
*Not listed on the 2002 Section 303 (d) list.

Introduction

This report presents the Total Maximum Daily Loads (TMDLs) developed for a segment in the Richards 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. 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 Richards Run Watershed

The Richards Run Watershed is located in Western Pennsylvania, occupying a southeastern portion of Indiana County in West Wheatfield Township. The watershed area is found on the "Bolivar" and "New Florence" United States Geological Survey 7.5-Minute Quadrangles. The area within the watershed consists of approximately 5,230 acres, or approximately 8.2 square miles. Land uses within the watershed include abandoned mine lands, forestlands, croplands, and rural residential properties with small communities scattered throughout the area.

The mouth of Richards Run is located immediately east of the town of Robinson, in Indiana County. Robinson can be reached by traveling west on State Route 22(SR22), until reaching

[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.*

State Route 259(SR259), approximately 4 miles west of the town of Armagh. Then take SR259 south into Robinson. In Robinson, turn left onto Caroline Street and travel east to its junction with Jones Street. Richards Run lies approximately 370' east of the junction of Caroline and Jones Streets. The mouth of Richards Run, where it junctions with the Conemaugh River, lies a further 530' downstream from this point along Richards Run.

Hydrology and Geology

The headwaters for Richards Run are comprised of the East and West Branches. The East Branch includes several unnamed tributaries draining the area south of SR22, approximately between the town of Clyde along SR22 and the junction of SR22 and SR259. The West Branch begins immediately south of SR22, approximately **.**75 miles west of the junction of SR22 and SR259. The east and west branches junction near SR259, approximately **.**2 miles south of the village of Germany. From this point, the stream flows south along SR259 for approximately 1**.**7 miles, before its junction with the Conemaugh River. Downstream of the junction of the east and west branches, three additional unnamed tributaries junction with Richards Run. Richards Run flows from an elevation of approximately 1740' at the highest reaches of the east branch and approximately 1680' at the highest reaches of the west branch. At its junction with the Conemaugh River, the elevation of Richards Run is approximately 1020'.

The Richards Run Watershed lies within the Appalachian Plateau Physiographic Province. The westernmost portions of the watershed, including the west branch downstream through the mouth, are located on the eastern flank of the Chestnut Ridge Anticline. The remainder of the watershed, including the east branch and its multiple unnamed tributaries are located on the western flank of the Ligonier Syncline. Strata and geologic structure within the watershed are oriented with a SW to NE trend. The prevailing direction of dip is to the southeast.

The watershed area is comprised of Pennsylvanian aged rocks, which are divided into the Pottsville and Allegheny Formations. The Casselman Formation, of the Conemaugh Group, forms the ridge tops within the eastern portion of the watershed, while the Glenshaw Formation, of the Conemaugh Group, forms the majority of the exposed geology within this portion of the watershed. This area comprises the majority of the watershed. The Casselman Formation forms the ridge tops in the western-most portion of the watershed, while rocks from the Allegheny Group form the balance of the exposed geology within this portion of the watershed. The west branch, downstream through the mouth of Richards Run, exposes rock from the Allegheny Group. The Conemaugh Group includes coal seams from the Mahoning up through the Lower Pittsburgh and Morantown. The Allegheny Group includes the Brookville, Clarion, Lower Kittanning, Middle Kittanning, Upper Kittanning, Lower Freeport and Upper Freeport coal seams.

Segments addressed in this TMDL

Richards Run is affected by pollution from AMD. This pollution has in some cases caused high levels of metals in the watershed. There is one active mining operation 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:

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;

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

6. Submittal of final TMDL; and
7. EPA approval of the TMDL.

Watershed History

The entire watershed has been extensively mined since the late 1940's. The majority of the mining taking place in the eastern portions of the watershed consisted of underground operations. This underground mining focused on the Upper and Lower Freeport Coal Seams. However, underground mining also took place on the Lower Kittanning and Brookville Coal Seams. The majority of the surface mining occurred along the west branch of Richards Run. This surface mining focused on the Upper and Lower Freeport Coal Seams. However, surface mining also took place on the Upper and Lower Kittanning Coal Seams. Much of the mining completed in the watershed was prior to enactment of the Surface Mining Conservation and Reclamation Act.

Wheatfield Operation owned by the River Hill Coal Company, Inc. SMP No. 32000108, NPDES Permit No. PA0248801 is the only active permit in the watershed.

To-date, the operator has not started any mining activities on this remining Subchapter F permit. As such, the NPDES discharge points do not yet exist. Furthermore, these discharge points coincide with the multiple phases of the mining operation. Therefore, with the possible exception of the final few years of the operation, they will not all be in-place at one time. Depending on market conditions, the operator estimates that the mining operation will take approximately 20 years to complete. Not all of the sediment and treatment ponds associated with this operation will discharge into Richards Run. Bearing this in mind, it is important to note that the above-referenced NPDES Discharge Points are associated with the final five phases of mining. Therefore, it is likely that these discharge points will not exist for several years.

As a Subchapter F permit, several pre-existing degraded ("Non-Point Source") discharges were evaluated during the permit review process. None of these Sub. F discharges flow to Richards Run, except one, denoted as WF-332, or Hydrologic Unit 6 in the issued permit. This is a Deep Mine discharge off the Lower Kittanning #3 Coal Seam. The permit indicates that it emanates from 2X air shafts and that it is the major drainage point on "Fort Hill. This discharge is located about 530' upstream of the RR6 monitoring point from the TMDL Report. Based on the flows reported for Richards Run at RR6, this discharge is being significantly diluted within Richards Run, but its high levels of mining related contamination still show up enough to be seen in the same parameters measured at RR6. Although the requisite abatement plan calls for daylighting a large amount of deep mine, as well as other reclamation work, this work is not expected to result in any significant post-mining improvement to the water quality from this discharge, nor is the work expected to impact the discharge rate.

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

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

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 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 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.

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. 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. Richards 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
RR9 - Mouth of West Branch Richards Run						
Aluminum (lbs/day)	2.43	2.43	0	NA	NA	NA
Iron (lbs/day)	6.64	6.64	0	NA	NA	NA
Manganese(lbs/day)	0.76	0.76	0	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA
RR7 - Mouth of East Branch Richards Run						
Aluminum (lbs/day)	18.58	18.34	0	18.34	0.24	1%
Iron (lbs/day)	119.42	13.84	0	13.84	105.58	88%
Manganese(lbs/day)	93.32	8.20	0	8.20	85.12	91%
Acidity (lbs/day)	ND	NA	0	NA	NA	NA
RR6 – Mouth of Richards Run						
Aluminum (lbs/day)	252.87	18.32	1.53	16.79	234.31	93%
Iron (lbs/day)	890.62	36.50	2.30	34.20	748.54	95%
Manganese(lbs/day)	12.19	12.19	1.53	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA

* Total of loads affecting this segment is less than the allowable load calculated at this point, therefore no reduction is necessary.
NA = not applicable ND = not determined

In the instance that the allowable load is equal to the existing load (e.g. iron point RR9, 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.

A waste load allocation was assigned to one permitted mine drainage discharge contained in the Richards Run watershed. The River Hill Coal Company, Inc. discharge, which used a flow value calculated from the discharge capacity from the dewatering devise is being evaluated at sample point RR6 on Richards Run. Calculated allowable loads at RR6 show that no reductions are necessary for manganese. Since this parameter is attaining, the impact from upstream sources including the waste load is negligible. Therefore, no reductions to the present waste load allocation are necessary at this time. All necessary reductions are assigned to non-point sources.

Table 4 Waste Load Allocations in Richards Run Watershed

Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
RIVER HILL COAL CO.			
Al	2	0.091728	1.53
Fe	3	0.091728	2.30
Mn	2	0.091728	1.53

Following is an example of how the allocations, presented in Table 3, for a stream segment are calculated. For this example, aluminum allocations for RR6 of Richards Run 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 maps of the sampling point locations for reference.

ALLOCATIONS RR9	
RR9	Aluminum (Lbs/day)
Existing Load @ RR9	2.43
Allowable load @ RR9	2.43

ALLOCATIONS RR7	
RR7	Aluminum (Lbs/day)
Existing Load @ RR7	18.58
Allowable load @ RR7	18.34

Allowable Load = 2.43 lbs/day

Allowable Load = 18.34 lbs/day

Load input = 231.86 lbs/day
(Difference between existing loads at RR6
And RR9/RR7)

ALLOCATIONS RR6	
RR6	Al (Lbs/day)
Existing Load @ RR6	252.87
Difference in measured Loads between the loads that enter and existing RR6 (RR6–(RR9+RR7))	231.86
Additional load tracked from above samples	20.77
Total load tracked between RR6 and RR7/RR9	252.63
Allowable Load @ RR6	18.32
Load Reduction @ RR6	234.31
% Reduction required at RR6	93%

Allowable Load = 18.32 lbs/day

The allowable aluminum load tracked from RR9+RR7 was 20.77 lbs/day. The existing load at RR9+RR7 was subtracted from the existing load at RR6 to show the actual measured increase of aluminum load that has entered the stream between these two sample points (231.86 lbs/day). This increased value was then added to the calculated allowable load from RR9+RR7 to calculate the total load that was tracked between RR9+RR7 and RR6 (allowable loads @ RR9+RR7 + the difference in existing load between RR9+RR7 and RR6). This total load tracked was then subtracted from the calculated allowable load at RR6 to determine the amount of load to be reduced at RR6. This total load value was found to be 252.63 lbs/day; it was 234.31 lbs/day greater then the RR6 allowable load of 18.32 lbs/day. Therefore, a 93% aluminum reduction at RR6 is necessary.

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.

Despite the mining that has taken place historically within the watershed, the most recent water quality results establish that the west branch of Richards Run does not exhibit any significant level of degradation from mine drainage. The pH levels are neutral or better, with significant alkalinity levels and negative acidity levels. The East Branch of Richards Run is subject to flooding. It is possible that there is some unaccounted for "non-point" source discharge that activated briefly due to a rain event, causing the higher than normal levels of metals.

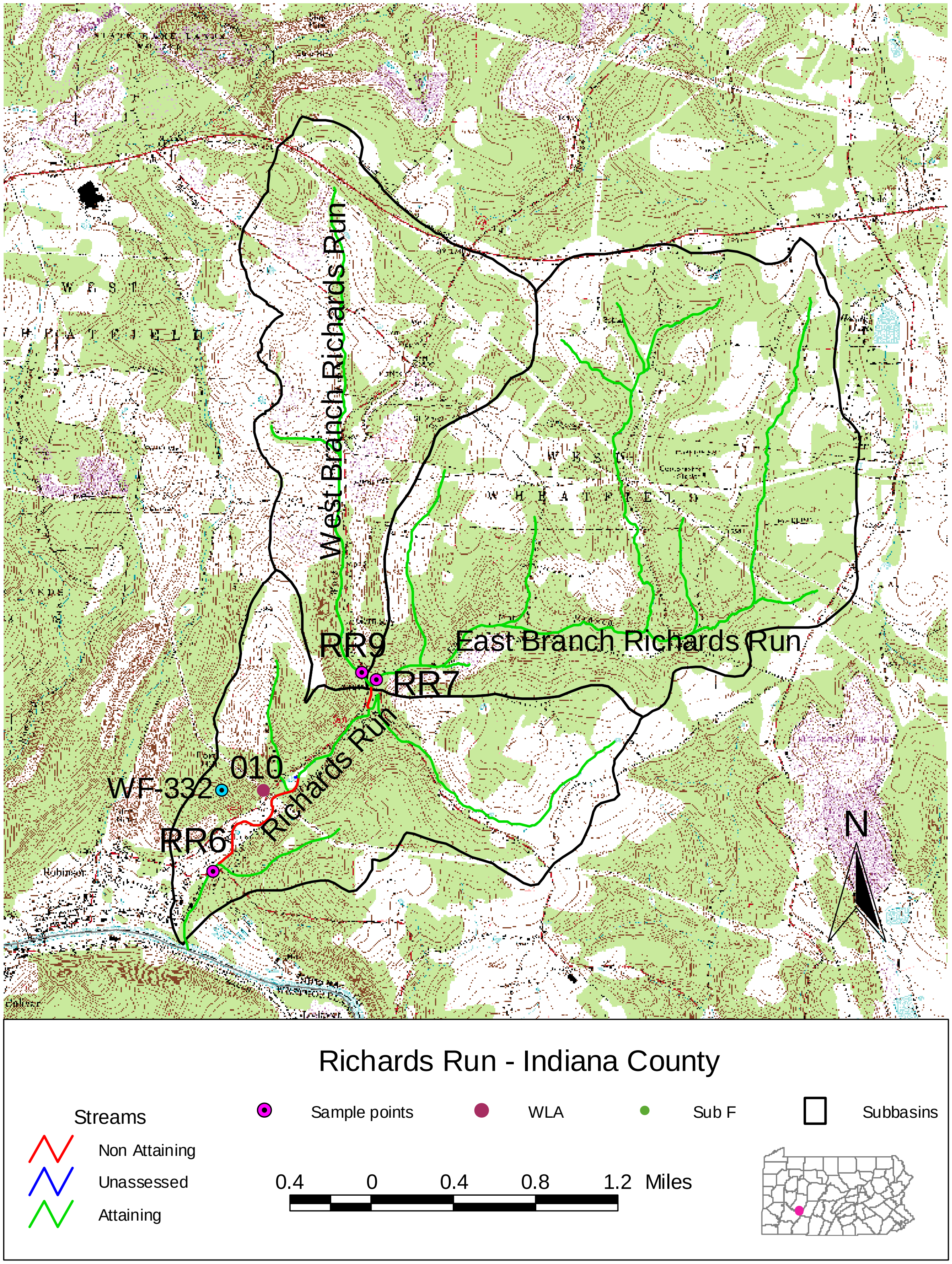
Richards Run does not have a separate watershed group. However, the stream is part of the Kiski-Conemaugh Watershed Group. The Department is not aware of any additional projects in-place to address the abandoned mine lands (AML's) within the Richards Run Watershed. The problems associated with these AML's would need to be addressed either by the BAMR, or through other programs within District Mining Operations (DMO), such as remining and Government Financed Construction Contracts (GFCC's). Any post-mining discharges of substandard quality might then be addressed through the Growing Greener Program.

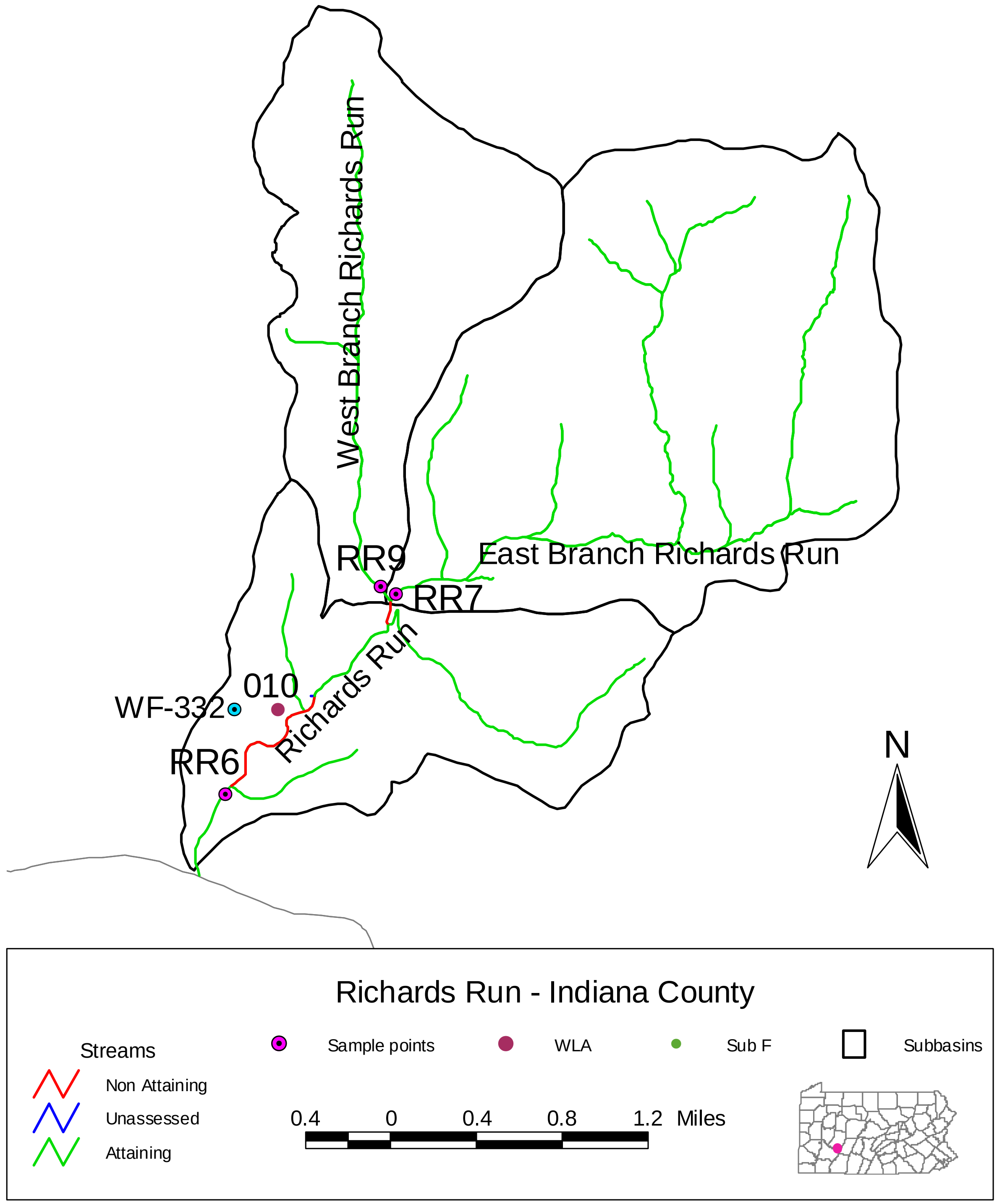
Public Participation

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* and the *Indiana Gazette* on 11/13/2006 to foster public comment on the allowable loads calculated. The public comment period on this TMDL was open from 11/4/2006 to 1/4/2007. A public meeting was held on 11/21/2006 at the Cambria District Mining Office, to discuss the proposed TMDL.

Attachment A

Richards Run Watershed Maps


West Branch Richards Run
East Branch Richards Run
Richards Run
RR9
RR7
RR6
010
WF-332
N
Richards Run - Indiana County
Streams
Non Attaining
Unassessed
Attaining
Sample points
WLA
Sub F
Subbasins
0.4 0 0.4 0.8 1.2 Miles


West Branch Richards Run
RR9
RR7
East Branch Richards Run
010
WF-332
Richards Run
RR6
N
Richards Run - Indiana County
Streams
Non Attaining
Unassessed
Attaining
Sample points
WLA
Sub F
Subbasins
0.4 0 0.4 0.8 1.2 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 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.*

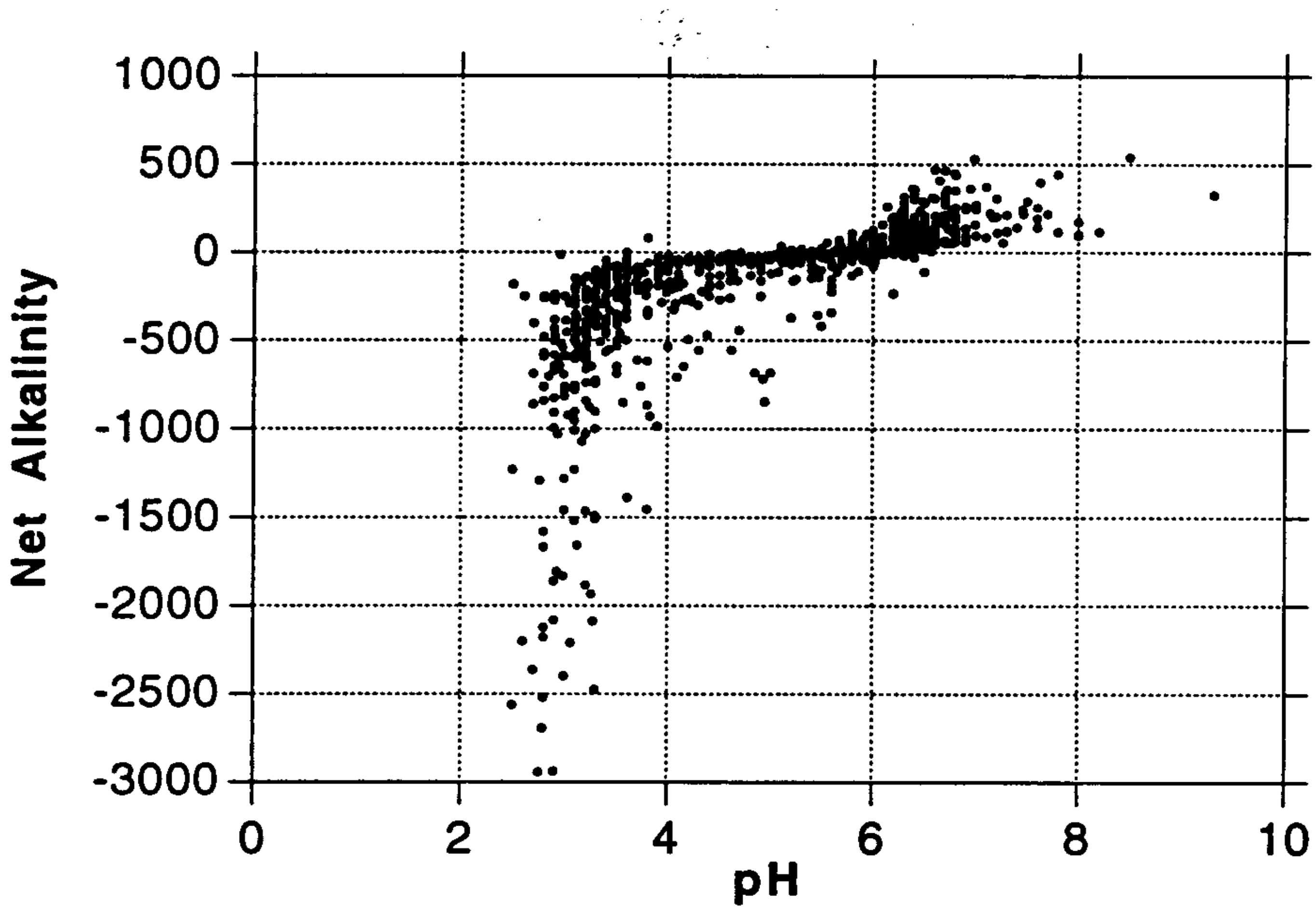


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Attachment C

TMDLs By Segment

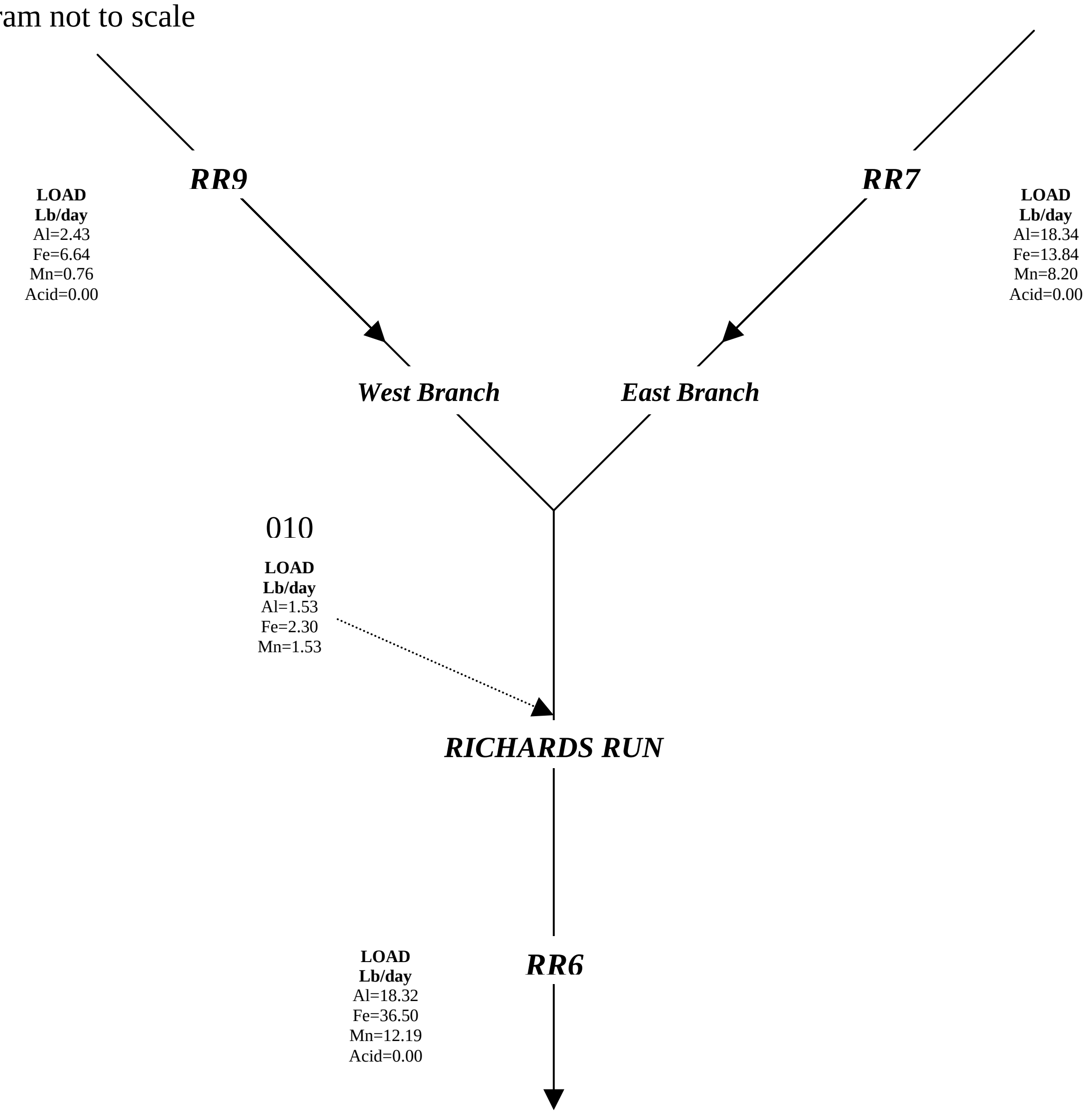
Richards Run

The TMDL for Richards Run consists of load allocations to one sampling site on Richards Run (RR6) a sample site on East Branch Richards Run (RR7) and one site on West Branch Richards Run (RR9). Sample data sets were collected during 2003 to 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.

Richards 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 Richards 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.

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



TMDL calculations- RR9- Mouth of West Branch Richards Run

The TMDL for sample point RR9 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for West Branch Richards Run was computed using water-quality sample data collected at point RR9. The average flow, measured at the sampling point RR9 (3.24 MGD), is used for these computations. The allowable load allocations calculated at RR9 will directly affect the downstream point RR6.

Sample data at point RR9 shows that West Branch Richards Run has a pH ranging between 7.6 and 8.0. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

There have been no TMDLs calculated at this site. The measured sample data for aluminum, iron and manganese was above detection limits but still less than water quality criteria. There was no acidity measured at this sample point. There are no allocations because analysis disclosed that Water Quality Standards are met 99% of the time. The existing and allowable loads for the acidic parameter at RR9 in Table C1 will be denoted as “NA”. The concentrations will be denoted as “ND”.

Table C1 shows the measured and allowable concentrations and loads at RR9.

Table C1		Measured		Allowable	
Flow (gpm)=	2247.80	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.09	2.4	0.09	2.4
	Iron	0.25	6.6	0.25	6.6
ND = non detection	Manganese	0.03	0.8	0.03	0.8
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	57.32	1547.4		

<u>TMDL calculations- RR7- Mouth of East Branch Richards Run</u>

The TMDL for sample point RR7 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for East Branch Richards Run was computed using water-quality sample data collected at point RR7. The average flow, measured at the sampling point RR7 (8.84 MGD), is used for these computations. This is the most upstream point of this segment and the allowable load allocations calculated at RR7 will directly affect the downstream point RR6.

Sample data at point RR7 shows that East Branch Richards Run has a pH ranging between 7.0 and 7.4. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

A TMDL for aluminum, iron and manganese has been calculated. There was no acidity measured at this sample point. Because water quality standards are met, a TMDL for acidity isn’t necessary and is not calculated. The existing and allowable loads for the acidity at RR7 in Table C2 will be denoted as “NA”. The concentrations will be denoted as “ND”.

Table C2 shows the measured and allowable concentrations and loads at RR7. Table C3 shows the percent reduction for aluminum, iron and manganese needed at RR7.

Table C2		Measured		Allowable	
Flow (gpm)=	6138.00	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.25	18.6	0.25	18.3

	Iron	1.62	119.4	0.19	13.8
ND = non detection	Manganese	1.27	93.3	0.11	8.2
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	16.62	1225.0		

Table C3. Allocations RR7			
RR7	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)
Existing Load @ RR7	18.58	119.42	93.32
Allowable Load @ RR7	18.34	13.84	8.20
Load Reduction @ RR7	0.24	105.58	85.12
% Reduction required @ RR7	1%	88%	91%

Waste Load Allocation – River Hill Coal Company Inc., Wheatfield Operations

The River Hill Coal Company, Inc., SMP 32000108, NPDES permit no. PA 0248801 has a permitted discharge that is evaluated in the calculated allowable loads at RR6. This permitted site has not yet been started. Even when it begins, this pond is not proposed for construction until the latter phases of the operation. This means it most likely won't be constructed for at least 15 years. After construction, it is relatively "short lived". The treatment pond is only in-place to serve the pits assigned to it and is removed when the pits are reclaimed. The following table shows the waste load allocation for this discharge.

Table C7. Waste Load Allocations at Sky Haven			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
River Hill Company, Co.			
Al	2	0.091728	1.53
Fe	3	0.091728	2.30
Mn	2	0.091728	1.53

TMDL calculations- RR6- Mouth of Richards Run

The TMDL for sampling point RR6 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 Richards Run was computed using water-quality sample data collected at point RR6. The average flow, measured at the sampling point RR6 (15.89 MGD), is used for these computations.

Sample data at point RR6 shows pH ranging between 5.0 and 7.0; 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 RR6 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 RR9/RR7 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points RR9/RR7 and RR6 to determine a total load tracked for the segment of stream between RR6 and RR9/RR7. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at RR6.

A TMDL for aluminum and iron at RR6 has been calculated. Sample data for manganese was above detection limits but still under water quality standards. There was no acidity measured at this sample point. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. The existing and allowable loads for the acidic parameter at RR6 in Table C4 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C4 shows the measured and allowable concentrations and loads at RR6. Table C5 shows the percent reduction for acidity needed at RR6.

Table C4		Measured		Allowable	
Flow (gpm)=	11035.60	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	1.91	252.9	0.14	18.3
	Iron	6.72	890.6	0.28	36.5
ND = non detection	Manganese	0.09	12.2	0.09	12.2
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	13.78	1826.0		

Table C5. Allocations RR6		
RR6	Al (Lbs/day)	Fe (Lbs/day)
Existing Load @ RR6	252.87	890.62
Difference in measured Loads between the loads that enter and existing RR6	231.86	764.56
Additional load tracked from above samples	20.77	20.48
Total load tracked between RR9/RR7 and RR6	252.63	785.04
Allowable Load @ RR6	18.32	36.50
Load Reduction @ RR6	234.31	748.54
% Reduction required at RR6	93%	95%

231.86 lbs/day of aluminum entered the stream between RR9/RR7 and RR6. The total aluminum load tracked was 252.63 lbs/day. The calculated allowable load was 18.32 lbs/day. 93% of the total aluminum load needs to be reduced to reach the calculated allowable load. There is a 764.56 lbs/day increase of iron at this sample point compared to the sum of measured loads from upstream segments. This increase entered this segment of stream between RR9/RR7 and RR6. The total iron load measured was 748.54 lbs/day greater than the calculated allowable iron load of 36.50 lbs/day, resulting in a 95% required iron reduction necessary.

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, 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

Site	Date	Flow (gpm)	pH	Acidity (mg/L)	Alkalinity (mg/L)	Al (mg/L)	Fe (mg/L)	Mn (mg/L)
RR9	5/22/2003	698	7.83	-53.7	56.7	0.17	0.23	0.03
Latitude:	6/5/2003	3641	7.65	-34.5	38.2	0.03	0.3	0.04
40.41700	7/25/2003	1826	7.63	-52.2	55.2	0.19	0.35	0.03
Longitude:	8/5/2004	4818	7.56	-34.4	39.5	0.02	0.22	0.02
-79.11592	10/3/2004	256	7.95	-92.6	97.0	0.04	0.13	0.02
Mouth of West Branch Richards Run								
AVERAGE		2247.8	7.724	-53.48	57.322	0.09	0.246	0.028
ST DEV		1942.55	0.160873	23.75052	23.78104	0.082765	0.083845	0.008367

Site	Date	Flow (gpm)	pH	Acidity (mg/L)	Alkalinity (mg/L)	Al (mg/L)	Fe (mg/L)	Mn (mg/L)
RR7	5/22/2003	1987	7.32	-12.0	15.8	0.25	0.19	0.02
Latitude:	6/5/2003	11197	7.00	-5.7	9.9	0.41	0.52	0.06
40.41602	7/25/2003	2840	7.37	-13.5	18.3	0.33	0.37	0.03
Longitude:	8/5/2004	13966	7.09	-4.4	12.1	0.02	6.9	6.2
-79.11437	10/3/2004	700	7.27	-22.0	27.0	0.25	0.12	0.02
Mouth of East Branch Richards Run								
AVERAGE		6138.000	7.21	-11.514	16.618	0.252	1.62	1.266
ST DEV		6011.458	0.157956	7.034201	6.650535	0.145671	2.955749	2.758239

Site	Date	Flow (gpm)	pH	Acidity (mg/L)	Alkalinity (mg/L)	Al (mg/L)	Fe (mg/L)	Mn (mg/L)
RR6	5/22/2003	3717	6.43	-4.8	12.1	1.4	5.3	0.07
Latitude:	6/5/2003	19844	7.02	-9.7	15.2	0.54	1.3	0.06
40.40281	7/25/2003	5112	6.78	-14.1	21.9	1.1	4.0	0.06
Longitude:	8/5/2004	25208	6.74	-8.5	16.5	0.8	3.0	0.04
-79.12933	10/3/2004	1297	5.00	35.2	3.2	5.7	20.0	0.23
Mouth of Richards Run								
AVERAGE		11035.60	6.394000	-0.372000	13.77800	1.908000	6.720000	0.09200
ST DEV		10746.35	0.807019	20.16098	6.892998	2.144136	7.566175	0.07791

Attachment F

Comment and Response

No official comments were received for this TMDL.