FINAL

PLUM CREEK WATERSHED TMDL

Allegheny County

For Acid Mine Drainage Affected Segments

Prepared by:

Pennsylvania Department of Environmental Protection

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Introduction

This report presents the Total Maximum Daily Loads (TMDLs) developed for segments in the Plum Creek Watershed (Attachments A). These were done to address the impairments noted on the 1996 Pennsylvania Section 303(d) list of impaired waters, required under the Clean Water Act, and covers two segments on this list (shown in Table 1). In 1999 the watershed was resurveyed and the old segments assigned new ids. In addition, two new segments were added to the list. High levels of metals, and in some areas depressed pH, caused these impairments. The TMDL addresses the three primary metals associated with acid mine drainage (iron, manganese, aluminum) and pH.

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

Year	Miles	Segment ID	DEP Stream Code	Stream Name	Designated Use	Data Source	Source	EPA 305(b) Cause Code
1996	3.1	4960	42246	Plum Creek	WWF	305(b) Report	RE	Metals
1998	8.98	4960	42246	Plum Creek	WWF	SWMP	AMD	Metals
2002	4.4	New survey, new segment id 990706-1530-TVP	42246	Plum Creek	WWF	SWAP	AMD	Metals
1996	4	4961	42256	Little Plum Creek	WWF	305(b) Report	RE	Metals
1998	5.15	4961	42256	Little Plum Creek	WWF	SWMP	AMD	Metals
2002	2.7	New survey; new id 990608-1000-TVP	42256	Little Plum Creek	WWF	SWAP	AMD	Metals
2002	4.2	New survey; new id 990712-1100-TVP	42256	Little Plum Creek	WWF	SWAP	AMD	Metals
1996	Not on List							
1998	Not on List							
2002	3.9	990609-1330-TVP	42256	Little Plum Creek	WWF	SWAP	AMD	Metals & pH

[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.*

Table 1. 303(d) Sub-List								
State Water Plan (SWP) Subbasin: 18-A Deer Creek								
Year	**Miles**	**Segment ID**	**DEP Stream Code**	**Stream Name**	**Designated Use**	**Data Source**	**Source**	**EPA 305(b) Cause Code**
1996	Not on List							
1998	Not on List							
2002	1.6	990609-1245-TVP	42256	Little Plum Creek	WWF	SWAP	AMD	Metals
Plum Creek Non-AMD Segments								
2002	4.4	990706-1530-TVP	42246	Plum Creek	WWF	SWAP	URSS	Other Inorganics & Oil and Grease
2002	7.3	990615-1200-TVP	42246	Plum Creek	WWF	SWAP	URSS	Nutrients & Siltation
2002	2.3	990615-1215-TVP	42246	Plum Creek	WWF	SWAP	URSS	Nutrients
2002	2.5	990706-1500-TVP	42246	Plum Creek	WWF	SWAP	URSS	Nutrients & Oil and Grease
2002	1.4	990712-0945-TVP	42246	Plum Creek	WWF	SWAP	URSS	Nutrients
Little Plum Creek Non-AMD Segments								
2002	2.7	990608-1000-TVP	42256	Little Plum Creek	WWF	SWAP	Petroleum Activities	pH
2002	4.2	990712-1100-TVP	42256	Little Plum Creek	WWF	SWAP	CSO URSS	Nutrients Nutrients & Oil and Grease

Resource Extraction=RE
Warm Water Fishes = WWF
Surface Water Monitoring Program = SWMP
Surface Water Assessment Program = SWAP
Abandoned Mine Drainage = AMD
Urban Runoff/Storm Sewers = URSS
Combined Sewer Overflow = CSO

Plum Creek and Little Plum Creek are also included on the PA Section 303(d) list for nutrient, oil and grease, and siltation impairments resulting from Urban Runoff/Storm Sewers and Combined Sewer Overflow. These impairments are not addressed in this TMDL, but will be addressed at a later date.

See Attachment D, *Excerpts Justifying Changes Between the 1996, 1998, and 2002 Section 303(d) Lists.*

The use designations for the stream segments in this TMDL can be found in PA Title 25 Chapter 93.

Directions to the Plum Creek Watershed

The Plum Creek Watershed is located in southwestern Pennsylvania, occupying the east central portion of Allegheny County. The watershed area is found on the Braddock, Murrysville, New Kensington East and New Kensington West 7.5-Minute Quadrangle United States Geological Survey maps. The area within the watershed consists of approximately 20.6 square miles with Little Plum Creek constituting 8.06 square miles of the total watershed area. Plum Creek drains to Allegheny River approximately 2.5 miles south of the PA Turnpike Bridge. The lower end of Plum Creek divides the communities of Oakmont and Verona.

The stream can be reached by taking Exit 48, also known as the Allegheny Valley Exit of the PA Turnpike. From the exit, proceed south on Freeport Road for approximately 1.5 miles to the Hulton Bridge, which crosses the Allegheny River to Oakmont. In Oakmont, turn right onto Allegheny River Boulevard and proceed south towards Verona. Turn left at Plum Street. This street parallels the lower end of Plum Creek.

Little Plum Creek is a tributary of Plum Creek, which it joins near the community of Unity. To reach the stream, from the Hulton Bridge, mentioned above, proceed on Hulton Road for approximately 3 miles to Unity Road. Follow Unity Road approximately 1 mile to Leechburg Road, which parallels the lower end of the stream.

Geology and Hydrology

The Plum Creek Watershed is set in the Conemaugh and Allegheny Groups of Pennsylvania age rocks. Plum Creek generally flows from the southeast to the northwest. The headwaters are located on the northern flank of the Duquesne Syncline and the stream intersects the Amity Anticline near its confluence with the Allegheny River. The surface elevation of the stream ranges from approximately 1300 feet at the headwaters to 721 feet at the river. The watershed has a variety of land uses. The major land use is suburban residential development. Other land uses include undeveloped forestland on the steeper slopes to commercial/industrial development on the stream valley areas.

Little Plum Creek generally flows from east to west. The stream is located on the northwestern flank of the Duquesne Syncline. The surface elevation of the stream ranges from approximately 1300 feet at the headwaters to 960 feet where it joins Plum Creek near the community of Unity. The major land uses in the Little Plum Creek Watershed are undeveloped farmland and forestland. Minor land uses include residential areas and reclaimed mine sites.

Segments addressed in this TMDL

There are two active mining operations in the watershed. The Consolidation Coal Company, Renton AMD Plant, Mining Activity Permit No. 02733702 (no NPDES number) has a treated mine pool discharge that discharges to Little Plum Creek. The treatment discharge is assigned a waste load allocation. The Robindale Energy Services, Inc. Renton Pile, SMP Number

02020201 NPDES PA0250121, is a refuse reprocessing operation. Included in the permit is a mine drainage treatment facility discharge; however, because it is a refuse reprocessing operation there is no pit water to be treated and therefore no discharge. No waste load allocation is assigned to the Renton pile operation. In addition, the preexisting seeps from the Renton pile are collected and flow into the Renton deep mine pool, which is pumped and treated by Consolidation Coal Company.

All of the remaining discharges in the watershed are from abandoned mines and will be treated as non-point sources. Each segment on the PA Section 303(d) list will be addressed as a separate TMDL. These TMDLs will be expressed as long-term, average loadings. Due to the nature and complexity of mining effects on the watershed, expressing the TMDL as a long-term average gives a better representation of the data used for the calculations. See Attachment C for TMDL calculations.

Clean Water Act Requirements

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

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

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

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

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

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

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

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

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

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

Section 303(d) Listing Process

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

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

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.

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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.

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 TMDL for the waterbody using EPA approved methods and computer models;
3. Allocating pollutant loads to various sources;
4. Determining critical and seasonal conditions;
5. Public review and comment period on draft TMDL;
6. Submittal of final TMDL; and
7. EPA approval of the TMDL.

Watershed History

The Pittsburgh Coal seam outcrops in the higher elevations of the Plum Creek and Little Plum Creek Watersheds and has been extensively mined by both surface and deep mining since the early 1900's. The underlying Upper Freeport Coal seam has also been extensively deep mined. The Villa Coal Co. operated the Renton Mine in this coal seam in the Little Plum Creek Watershed.

A large coal refuse pile is located near the community of Renton. The Consolidation Coal Company operated a coal preparation plant there and built the refuse pile under Coal Refuse Disposal Permit No. 02733702. Seeps from the refuse pile are collected and flow to the Renton mine pool. Consul is currently pumping and treating the Renton mine pool.

In the past year, a remining permit was issued to Coal Valley Sales Corp. to remove coal refuse from the site. The refuse is being trucked to a fluidized bed power generating plant to be burned and alkaline ash from the plant is being returned to the site. This permit was transferred in September of 2003 to Robindale Energy Services, Inc. It is expected that replacing the acidic coal refuse with alkaline ash will reduce or eventually eliminate acidic drainage from the site.

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

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:

$$PR = \text{maximum } \{0, (1-Cc/Cd)\} \text{ where} \tag{1}$$

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

$$Cd = \text{RiskLognorm(Mean, Standard Deviation) where} \tag{1a}$$

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:

$$LTA = Mean * (1 - PR99) \text{ where} \tag{2}$$

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

LTA = allowable LTA source concentration in mg/l

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

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

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

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

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

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

TMDL Endpoints

One of the major components of a TMDL is the establishment of an instream numeric endpoint, which is used to evaluate the attainment of applicable water quality. An instream numeric endpoint, therefore, represents the water quality goal that is to be achieved by implementing the load reductions specified in the TMDL. The endpoint allows for a comparison between observed instream conditions and conditions that are expected to restore designated uses. The endpoint is based on either the narrative or numeric criteria available in water quality standards.

Because most of the pollution sources in the watershed are nonpoint sources, the larges part of the TMDL is expressed as Load Allocations (LAs). All allocations will be specified as long-term average daily concentrations. These long-term average concentrations are expected to meet water-quality criteria 99% of the time as required in PA Title 25 Chapter 96.3(c). The following table shows the applicable water-quality criteria for the selected parameters.

Table 2. Applicable Water Quality Criteria

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

*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. There is currently one permit in the watershed with a treatment discharge. The difference between the TMDL and the WLA at each point is the load allocation (LA) at the point. The LA at each point includes all loads entering the segment, including those from upstream allocation points. The percent reduction is calculated to show the amount of load that needs to be reduced within a segment in order for water quality standards to be met at the point.

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

Table 3. TMDL Component Summary for the Plum Creek Watershed

Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
PLUM17	*Mouth of Unnamed Tributary 42284*						
	Fe	4.3	0.9	0.0	0.9	3.4	79
	Mn	2.9	0.8	0.0	0.8	2.1	73
	Al	25.9	0.3	0.0	0.3	25.6	99
	Acidity	273.3	1.4	0.0	1.4	271.9	99
PLUM15	*Mouth of Unnamed Tributary 42282*						
	Fe	6.2	0.2	0.0	0.2	6.0	96
	Mn	3.5	0.3	0.0	0.3	3.2	92
	Al	14.5	0.3	0.0	0.3	14.2	98
	Acidity	138.3	2.8	0.0	2.8	135.5	98
PLUM13	*Plum Creek downstream of Unnamed Tributary 42281*						
	Fe	10.9	1.5	0.0	1.5	0.0	0
	Mn	3.5	1.3	0.0	1.3	0.0	0
	Al	25.3	1.0	0.0	1.0	0.0	0
	Acidity	61.6	40.6	0.0	40.6	0.0	0
PLUM10	*Mouth of Unnamed Tributary 42279*						
	Fe	1.7	1.1	0.0	1.1	0.6	36
	Mn	0.4	0.4	NA	NA	0.0	0
	Al	3.4	0.8	0.0	0.8	2.6	77
	Acidity	0.0	0.0	NA	NA	0.0	0

Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
PLUM09	*Mouth of Unnamed Tributary 42276*						
	Fe	1.2	0.5	0.0	0.5	0.7	58
	Mn	0.5	0.3	0.0	0.3	0.1	28
	Al	6.2	0.2	0.0	0.2	6.0	97
	Acidity	0.0	0.0	NA	NA	0.0	0
PLUM08	*Plum Creek upstream of Little Plum Creek*						
	Fe	<0.3	NA	NA	NA	0.0	0
	Mn	5.1	4.9	0.0	4.9	0.0	0
	Al	10.6	6.9	0.0	6.9	0.0	0
	Acidity	0.0	0.0	NA	NA	0.0	0
LPLM08	*Little Plum Creek downstream of Unnamed Tributary 42274*						
	Fe	10.5	3.6	0.0	3.6	6.9	66
	Mn	7.4	1.5	0.0	1.5	5.9	80
	Al	25.0	1.7	0.0	1.7	23.3	93
	Acidity	41.9	23.0	0.0	23.0	18.8	45
LPLM07	*Mouth of Unnamed Tributary 42273*						
	Fe	10.6	0.6	0.0	0.6	10.0	94
	Mn	3.5	0.5	0.0	0.5	3.0	85
	Al	26.9	0.5	0.0	0.5	26.4	98
	Acidity	251.0	0.0	0.0	0.0	251.0	100
LPLM05	*Unnamed Tributary 42260 downstream of Mouth of Unnamed Tributary 42266*						
	Fe	5.7	2.1	0.0	2.1	3.6	64
	Mn	8.2	1.9	0.0	1.9	6.3	77
	Al	23.2	1.2	0.0	1.2	22.0	95
	Acidity	63.4	33.0	0.0	33.0	30.4	48
LPLM04	*Mouth of Unnamed Tributary 42260*						
	Fe	10.7	9.3	0.0	9.3	0.0	0
	Mn	14.4	6.5	0.0	6.5	1.6	20
	Al	46.0	2.3	0.0	2.3	21.7	90
	Acidity	0.0	0.0	NA	NA	0.0	0
LPLM03	*Little Plum Creek downstream of Unnamed Tributary 42260*						
	Fe	34.7	19.8	18.0	1.8	12.5	88
	Mn	25.6	20.7	12.0	8.7	0.1	1
	Al	85.0	6.4	6.0	0.4	3.6	91
	Acidity	0.0	0.0	NA	NA	0.0	0
LPLM02	*Little Plum Creek downstream of Unnamed Tributary 42257*						
	Fe	37.9	21.2	0.0	21.2	1.7	8
	Mn	29.6	8.6	0.0	8.6	16.1	65
	Al	136.4	16.4	0.0	16.4	41.4	72
	Acidity	0.0	0.0	NA	NA	0.0	0

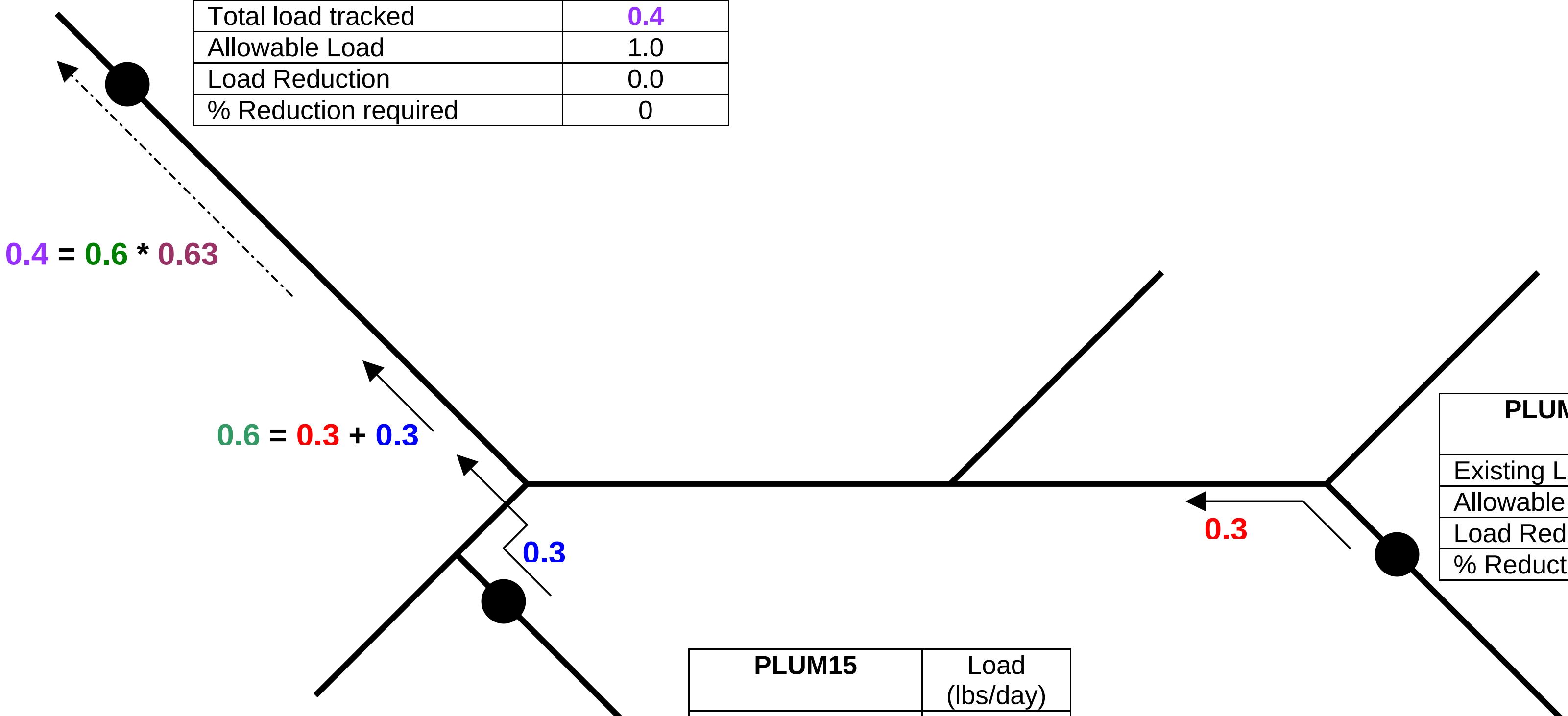
Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
LPLM01	*Mouth of Little Plum Creek*						
	Fe	32.2	29.0	0.0	29.0	0.0	0
	Mn	20.1	12.4	0.0	12.4	0.0	0
	Al	95.5	10.5	0.0	10.5	1.0	9
	Acidity	0.0	0.0	NA	NA	0.0	0
PLUM05	*Plum Creek upstream of Unnamed Tributary 42253*						
	Fe	28.6	28.6	NA	NA	0.0	0
	Mn	20.7	17.1	0.0	17.1	0.0	0
	Al	108.9	19.6	0.0	19.6	0.0	0
	Acidity	0.0	0.0	NA	NA	0.0	0
PLUM03	*Plum Creek upstream of Unnamed Tributary 42247*						
	Fe	<0.3	NA	NA	NA	0.0	0
	Mn	12.3	12.3	NA	NA	0.0	0
	Al	<0.5	NA	NA	NA	0.0	0
	Acidity	0.0	0.0	NA	NA	0.0	0
PLUM02	*Mouth of Unnamed Tributary 42247*						
	Fe	<0.3	NA	NA	NA	0.0	0
	Mn	<0.05	NA	NA	NA	0.0	0
	Al	<0.5	NA	NA	NA	0.0	0
	Acidity	0.0	0.0	NA	NA	0.0	0
PLUM01	*Mouth of Plum Creek*						
	Fe	<0.3	NA	NA	NA	0.0	0
	Mn	17.8	17.8	NA	NA	0.0	0
	Al	<0.5	NA	NA	NA	0.0	0
	Acidity	0.0	0.0	NA	NA	0.0	0

NA meets WQS. No TMDL necessary.

In the instance that the allowable load is equal to the measured load (e.g. manganese PLUM10, Table 3), the simulation determined that water quality standards are being met instream and therefore 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. In addition, when all measured values are below the method detection limit (e.g. iron point PLUM08, Table 3), no TMDL is necessary. In this case the accounting for upstream loads is not carried through to the next downstream point. Rather, there is a disconnect noted and the allowable load is considered to start over because the water quality standard is satisfied.

Following is an example of how the allocations, presented in Table 3, for a stream segment are calculated. For this example, aluminum allocations for PLUM17, PLUM15 and PLUM13 are shown. As demonstrated in the example, all upstream contributing loads are accounted for at each point. Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. These analyses follow the example. Attachment A contains a map of the sampling point locations for reference.

PLUM13	Load (lbs/day)
Existing Load	25.3
Difference in Existing Loads	-15.1
Load tracked from upstream	0.6
Percent load lost	37
Percent load tracked	63
Total load tracked	0.4
Allowable Load	1.0
Load Reduction	0.0
% Reduction required	0



PLUM17	Load (lbs/day)
Existing Load	25.9
Allowable Load	0.3
Load Reduction	25.6
% Reduction	99

PLUM15	Load (lbs/day)
Existing Load	14.5
Allowable Load	0.3
Load Reduction	14.2
% Reduction	98

A waste load allocation is assigned to the permitted mine drainage treatment plant discharge for the Consolidated Coal Company permit, Mining Activity Permit No. 02733702. The waste load allocation is calculated by multiplying the average flow from the plant by the permit limits. Discharge from the plant is consistently 0.72 MGD. Aluminum is not included in the permit; however a waste load allocation is calculated to allow for the discharge of aluminum. A value of 1.0 mg/L is used in the calculation, which is stricter than the standard BAT limit of 2.0 mg/L. The WLA for 001 is being evaluated at sample point LPLM03.

No required reductions of permit limits are required at this time. All necessary reductions are assigned to non-point sources.

Table 4 below contains the WLA for the mine drainage treatment plant discharge located on the Consolidation site.

Table 4. Waste Load Allocation of Permitted Discharge

Parameter	Allowable Average Monthly Conc. (mg/L)	Measured Average Flow (MGD)	WLA (lbs/day)
Consolidation Coal Company, Mining Activity Permit No. 02733702			
001			
Fe	3.0	0.72	18.0
Mn	2.0	0.72	12.0
Al	1.0	0.72	6.0

Recommendations

The Plum Creek Watershed Association was formed in 2001. The Association is a non-profit, public/private partnership conservation organization. The purpose of the Organization is to protect and improve the water quality and recreation benefits of the watershed while educating the public on the necessity of water conservation and other natural and recreational resources of the Plum and Little Plum Creek Watershed. The Watershed Association received a Round 6 Growing Greener Grant (November 2004) to conduct a watershed assessment and to develop a watershed restoration and protection plan. This study and plan will lay the groundwork for future remediation projects in the watershed.

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

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

The DEP Bureau of Mining and Reclamation administers an environmental regulatory program for all mining activities, mine subsidence regulation, mine subsidence insurance, and coal refuse disposal; conducts a program to ensure safe underground bituminous mining and protect certain structures form subsidence; administers a mining license and permit program; administers a regulatory program for the use, storage, and handling of explosives; provides for training, examination, and certification of applicants for blaster's licenses; administers a loan program for bonding anthracite underground mines and for mine subsidence; and administers the EPA 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 1960s, Pennsylvania has been a national leader in establishing laws and regulations to ensure reclamation and plugging occur after active operation is completed.

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

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

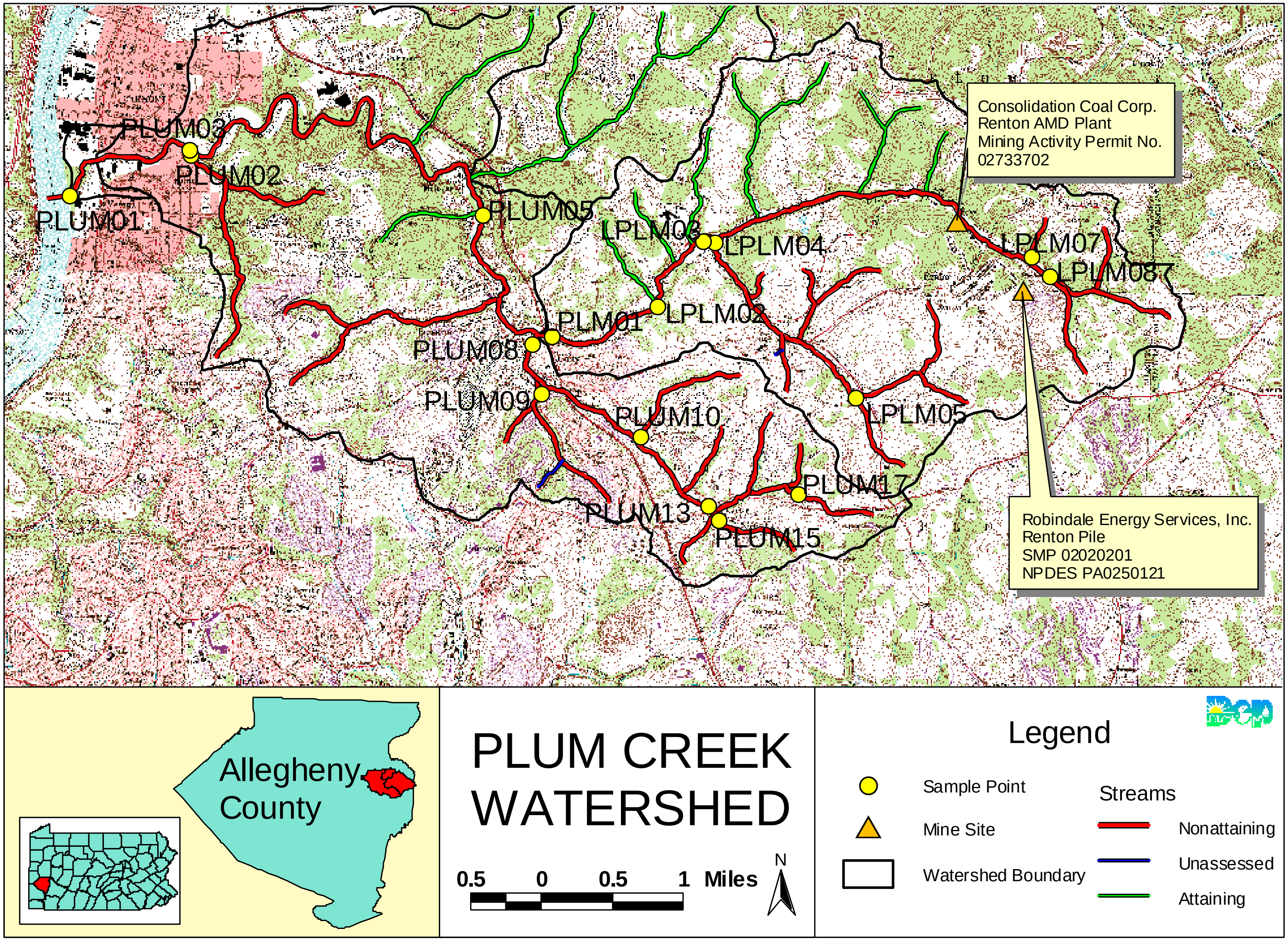
Reclaim PA is DEP's initiative designed to maximize reclamation of the state's quarter million acres of abandoned mineral extraction lands. Abandoned mineral extraction lands in Pennsylvania constituted a significant public liability – more than 250,000 acres of abandoned surface mines, 2,400 miles of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

Public Participation

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on November 6, 2004 and the *Pittsburgh Post-Gazette* on November 18, 2004 to foster public comment on the allowable loads calculated. The public comment period on this TMDL was open from November 6, 2004 to January 5, 2005. A public meeting was held on December 2, 2004 at the Plum Borough Municipal Building in Plum, PA to discuss the proposed TMDL.

Attachment A

Plum Creek Watershed Maps



PLUM01
PLUM02
PLUM03
PLUM05
PLUM08
PLUM09
PLUM10
PLUM13
PLUM15
PLUM17
PLM01
LPLM02
LPLM03
LPLM04
LPLM05
LPLM07
LPLM087
Consolidation Coal Corp.
Renton AMD Plant
Mining Activity Permit No.
02733702
Robindale Energy Services, Inc.
Renton Pile
SMP 02020201
NPDES PA0250121
Allegheny County
PLUM CREEK WATERSHED
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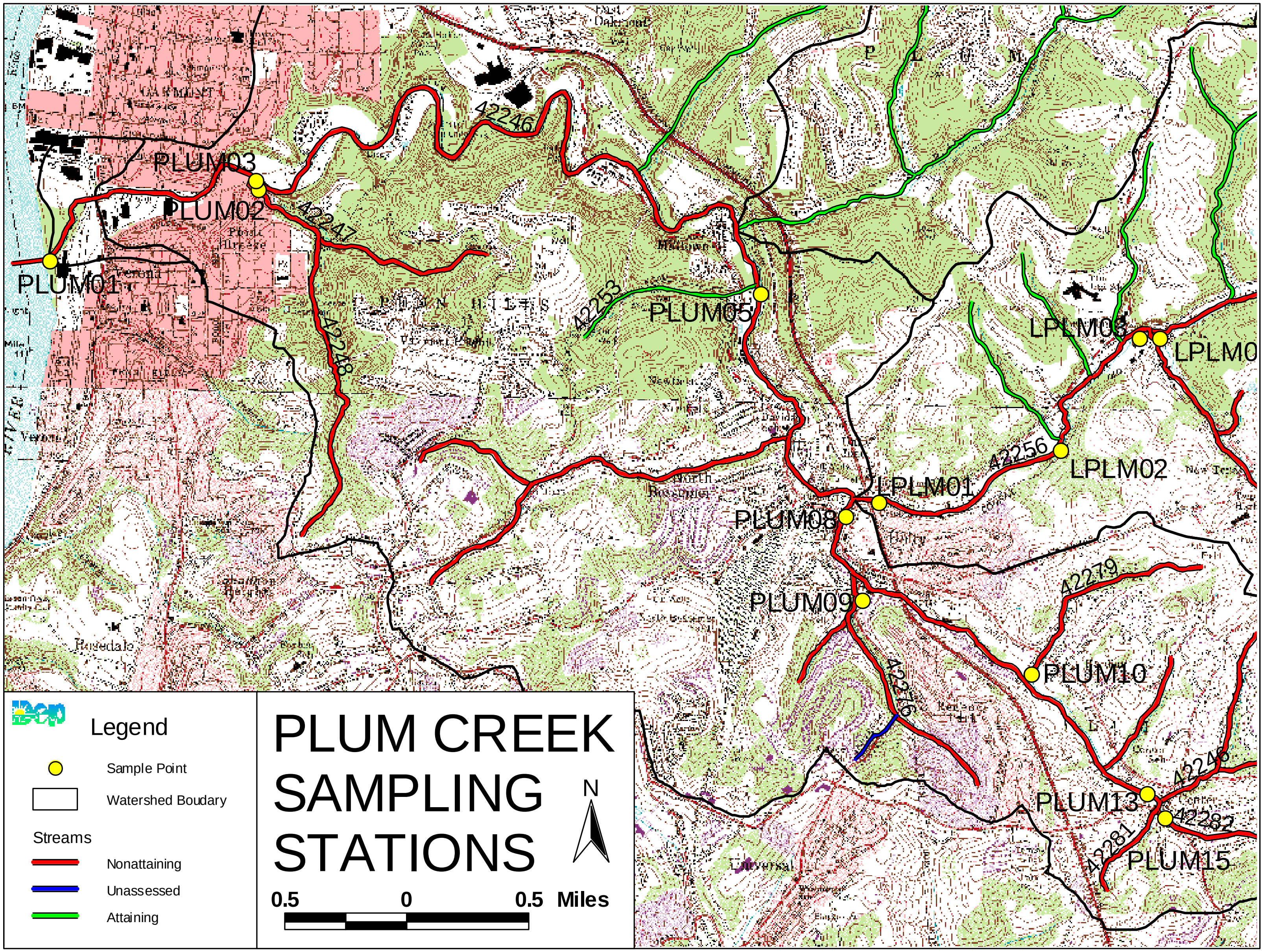
Legend
Sample Point
Mine Site
Watershed Boundary
Streams
Nonattaining
Unassessed
Attaining


PLUM CREEK
SAMPLING
STATIONS
Legend
Sample Point
Watershed Boudary
Streams
Nonattaining
Unassessed
Attaining
N
0.5
0
0.5
Miles
PLUM01
PLUM02
PLUM03
PLUM05
PLUM08
PLUM09
PLUM10
PLUM13
PLUM15
LPLM01
LPLM02
LPLM03
LPLM0
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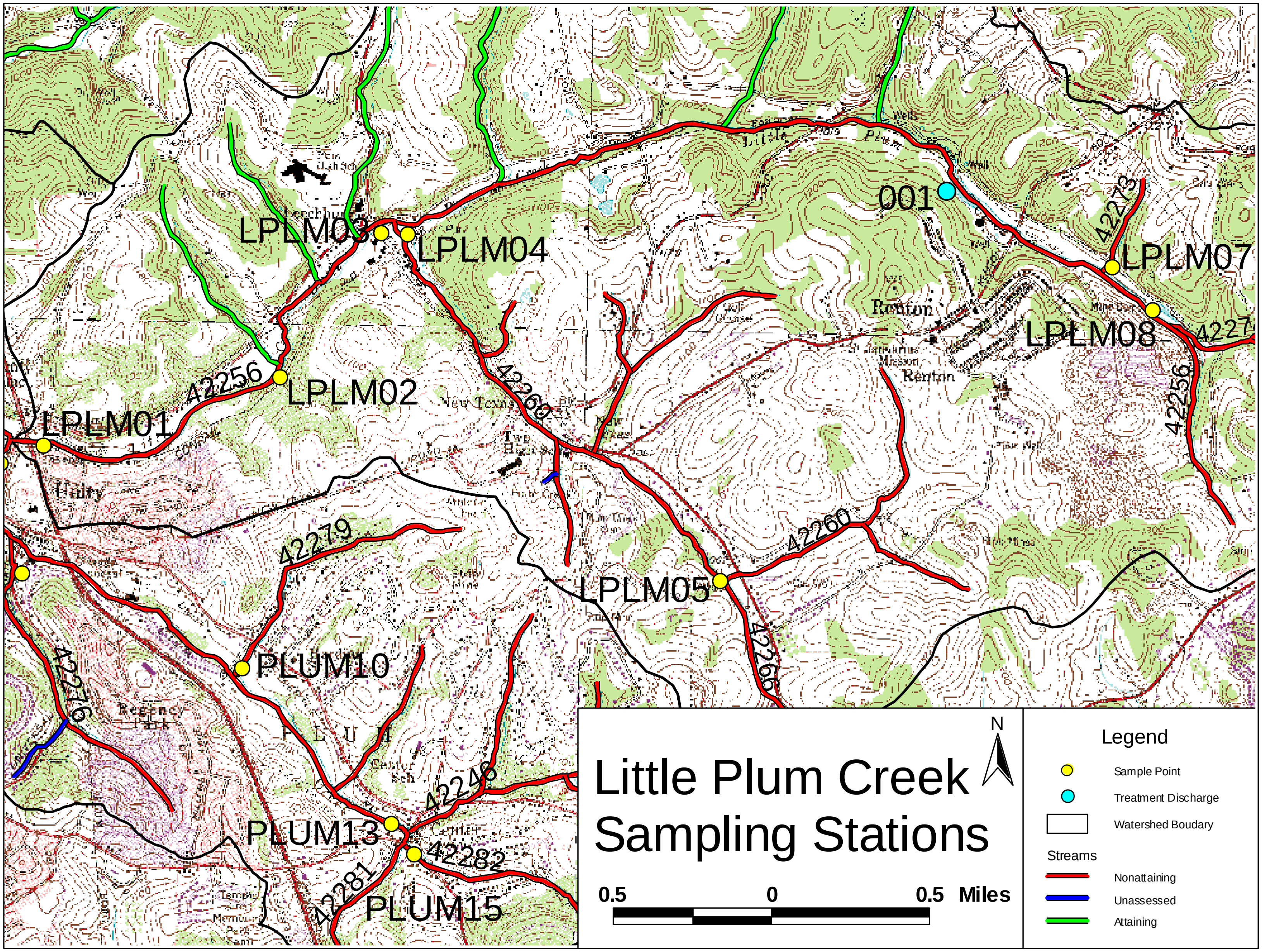
42279
42276
42281
42282


Little Plum Creek
Sampling Stations
Legend
Sample Point
Treatment Discharge
Watershed Boudary
Streams
Nonattaining
Unassessed
Attaining
N
0.5
0
0.5 Miles
LPLM01
LPLM02
LPLM03
LPLM04
LPLM05
LPLM07
LPLM08
PLUM10
PLUM13
PLUM15
001
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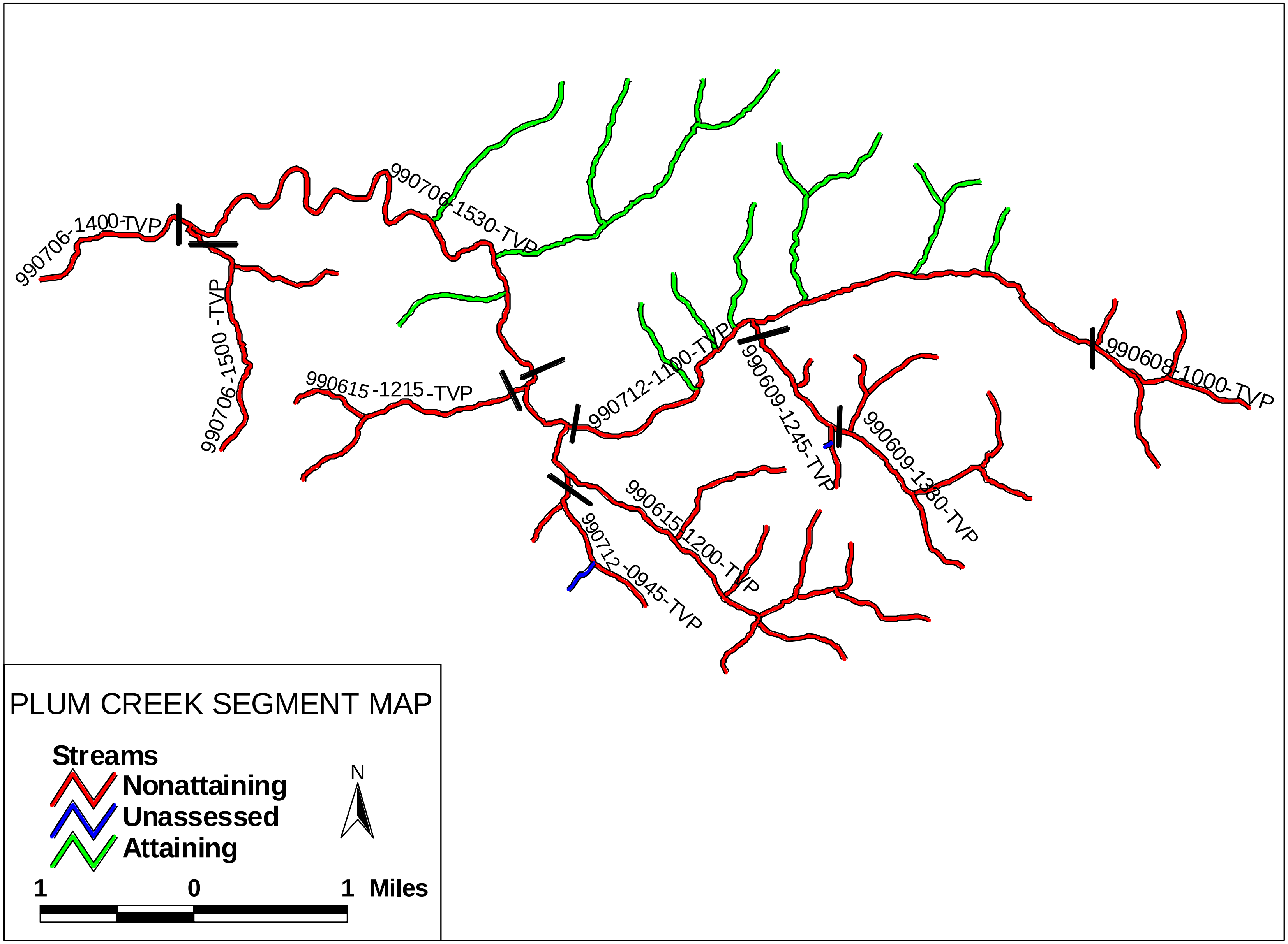
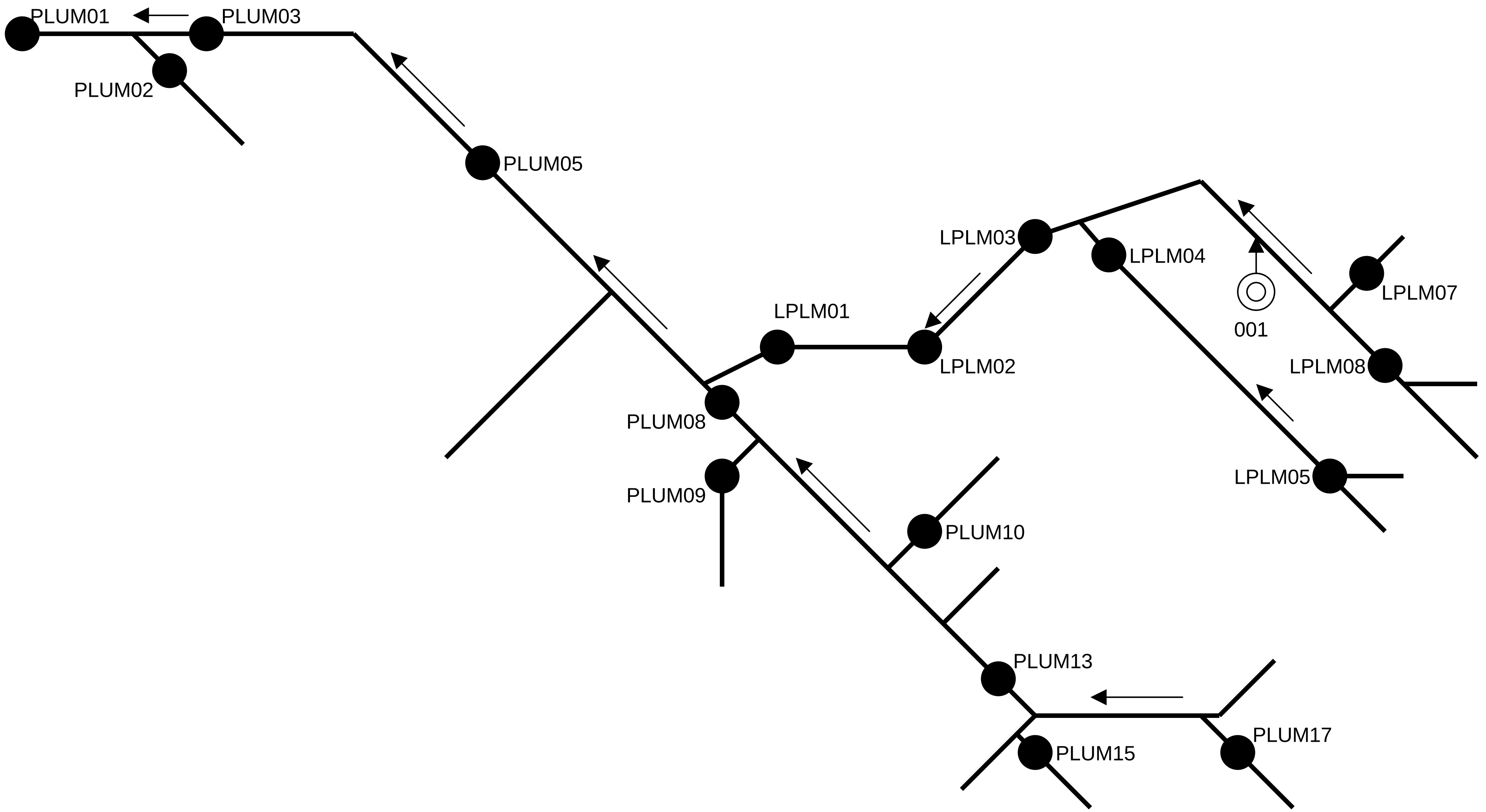
42260
42273
42279
42276
42248
42282
42281
Renton


990706-1400-TVP
990706-1530-TVP
990706-1500-TVP
990615-1215-TVP
990712-1100-TVP
990609-1245-TVP
990608-1000-TVP
990609-1330-TVP
990615-1200-TVP
990712-0945-TVP
PLUM CREEK SEGMENT MAP
Streams
Nonattaining
Unassessed
Attaining
N
1
0
1
Miles

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



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.*

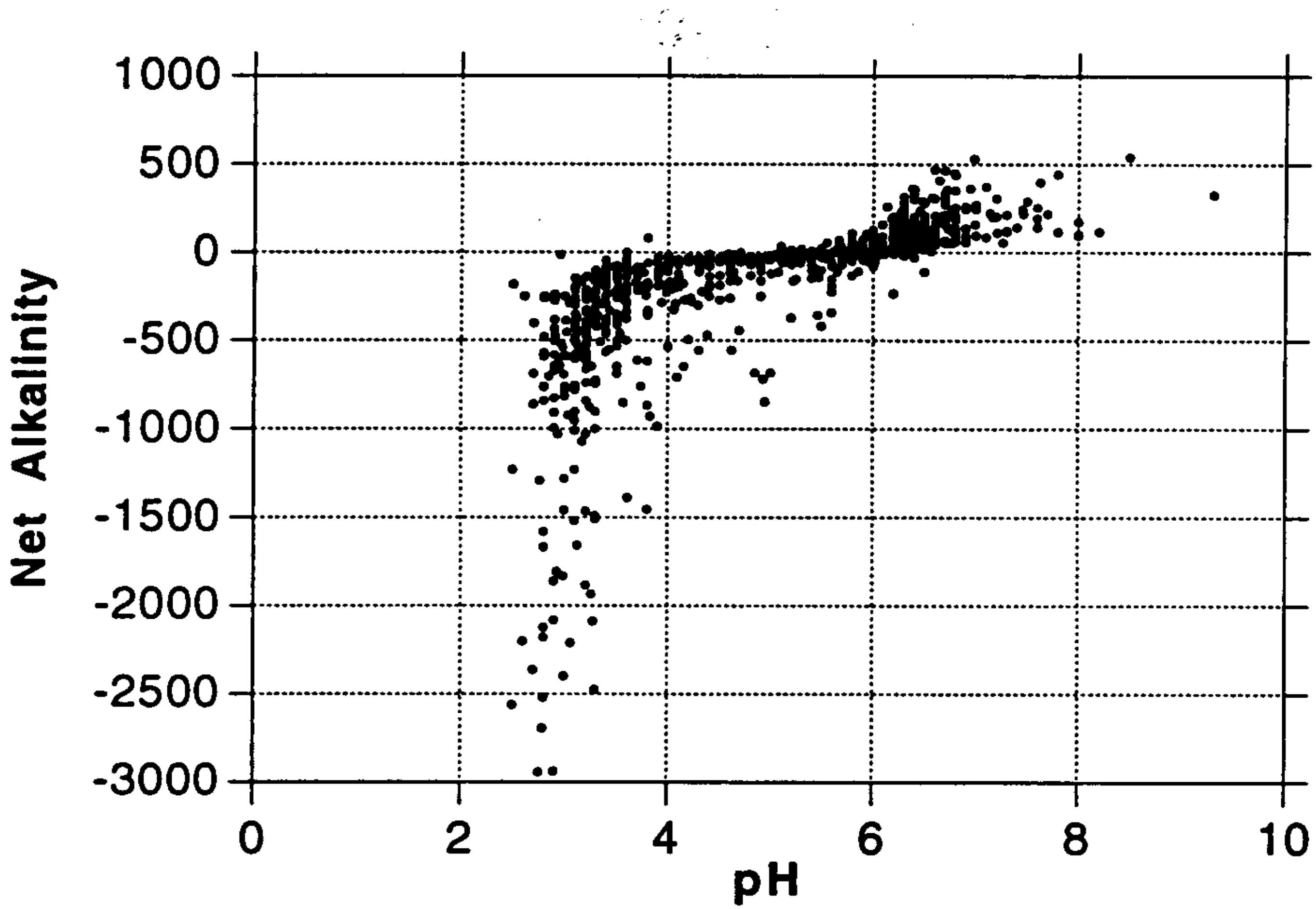


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Attachment C

TMDLs By Segment

Plum Creek and Little Plum Creek

The TMDL for Plum Creek consists of load allocations of six tributaries, including Little Plum Creek, and five sampling sites along the stream. The TMDL for Little Plum Creek consists of load allocations of two tributaries and four sampling sites along the stream. A waste load allocation is assigned to the Consolidation Coal Company Renton AMD Plant, Mining Activity Permit No. 02733702, which discharges to Little Plum Creek.

Plum Creek is listed as impaired on the PA Section 303(d) List by high metals from AMD as being the cause of the degradation to the stream. Little Plum Creek is listed as impaired on the PA Section 303(d) List by both high metals and in some areas depressed pH as being the cause of degradation to the stream. For pH, the objective is to reduce acid loading to the stream that will in turn raise the pH to the acceptable range. 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 aluminum, iron, manganese, and acidity. The analysis is designed to produce an average value that, when met, will be protective of the water-quality criterion for that parameter 99% of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water-quality criteria 99% of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean and standard deviation of the data set, 5000 iterations of sampling were completed, and compared against the water-quality criterion for that parameter. For each sampling event a percent reduction was calculated, if necessary, to meet water-quality criteria. A second simulation that multiplied the percent reduction times the sampled value was run to insure that criteria were met 99% of the time. The mean value from this data set represents the long-term average concentration that needs to be met to achieve water-quality standards.

TMDL Calculations - Sample Point PLUM17, mouth of Unnamed Tributary 42284

The TMDL for sample point PLUM17 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point PLUM17. The average flow of 0.15 MGD, measured at the point, is used for these computations.

This segment is not included on the PA Section 303(d) lists for impairments from AMD. In 1999 an assessment was completed on the segment and nutrients and siltation from Urban Runoff and Storm Sewers were added as causes of impairment. Sample data at point PLUM17 shows pH ranging between 3.5 and 5.6; pH is addressed as part of this TMDL.

Table C1. TMDL Calculations at Point PLUM17				
Flow = 0.15 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	3.54	4.3	0.74	0.9
Mn	2.41	2.9	0.65	0.8
Al	21.23	25.9	0.21	0.3
Acidity	223.87	273.3	1.12	1.4
Alkalinity	7.13	8.7		

Table C2. Calculation of Load Reduction Necessary at Point PLUM17				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	4.3	2.9	25.9	273.3
Allowable Load	0.9	0.8	0.3	1.4
Load Reduction	3.4	2.1	25.6	271.9
Total % Reduction	79	73	99	99.5

TMDL Calculations - Sample Point PLUM15, mouth of Unnamed Tributary 42282

The TMDL for sample point PLUM15 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point PLUM15. The average flow of 0.10 MGD, measured at the point, is used for these computations.

This segment is not included on the PA Section 303(d) lists for impairments from AMD. In 1999 an assessment was completed on the segment and nutrients and siltation from Urban Runoff and Storm Sewers were added as causes of impairment. Sample data at point PLUM15 shows pH ranging between 3.2 and 7.1; pH is addressed as part of this TMDL.

Table C3. TMDL Calculations at Point PLUM15				
Flow = 0.10 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	7.52	6.2	0.30	0.2
Mn	4.25	3.5	0.34	0.3
Al	17.54	14.5	0.35	0.3
Acidity	167.73	138.3	3.35	2.8
Alkalinity	15.37	12.7		

Table C4. Calculation of Load Reduction Necessary at Point PLUM15				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	6.2	3.5	14.5	138.3
Allowable Load	0.2	0.3	0.3	2.8
Load Reduction	6.0	3.2	14.2	135.5
Total % Reduction	96	92	98	98

TMDL Calculations - Sampling Point PLUM13, Plum Creek downstream of Unnamed Tributary 42281

The TMDL for sampling point PLUM13 consists of a load allocation to the area between sample points PLUM13, PLUM15 and PLUM17. The load allocation for this stream segment was computed using water-quality sample data collected at point PLUM13. The average flow of 0.45 MGD, measured at the point, is used for these computations.

This segment is not included on the PA Section 303(d) lists for impairments from AMD. In 1999 an assessment was completed on the segment and nutrients and siltation from Urban Runoff and Storm Sewers were added as causes of impairment. Sample data at point PLUM13 shows pH ranging between 5.6 and 7.8; pH is addressed as part of this TMDL.

Table C5. TMDL Calculations at Point PLUM13				
Flow = 0.45 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	2.92	10.9	0.41	1.5
Mn	0.94	3.5	0.34	1.3
Al	6.79	25.3	0.27	1.0
Acidity	16.53	61.6	10.91	40.6
Alkalinity	77.57	288.8		

The calculated load reductions for all the loads that enter point PLUM13 must be accounted for in the calculated reductions at the sample point shown in Table C6. A comparison of measured loads between points PLUM13, PLUM15 and PLUM17 shows that there is a loss of manganese, aluminum, and acidity loading and an additional iron loading entering the segment. The total segment iron load is the sum of the upstream allocated-loads and any additional loading within the segment. For loss of manganese, aluminum and acidity loading, the percent of load lost within the segment is calculated and applied to the upstream-allocated loads to determine the amount of load that is tracked through the segment.

Table C6. Calculation of Load Reduction Necessary at Point PLUM13				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	10.9	3.5	25.3	61.6
Difference in Existing Load between PLUM13, PLUM15 & PLUM17	0.3	-2.9	-15.1	-350.1
Load tracked from PLUM15 & PLUM17	1.2	1.1	0.6	4.2
Percent loss due to instream process	-	46	37	85
Percent of loads tracked through segment	-	54	63	15
Total Load tracked between points PLUM13, PLUM15 & PLUM17	1.5	0.6	0.4	0.6
Allowable Load at PLUM13	1.5	1.3	1.0	40.6
Load Reduction at PLUM13	0.0	0.0	0.0	0.0
% Reduction required at PLUM13	0	0	0	0

TMDL Calculations - Sample Point PLUM10, mouth of Unnamed Tributary 42279

The TMDL for sample point PLUM10 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point PLUM10. The average flow of 0.20 MGD, measured at the point, is used for these computations.

This segment is not included on the PA Section 303(d) lists for impairments from AMD. In 1999 an assessment was completed on the segment and nutrients and siltation from Urban Runoff and Storm Sewers were added as causes of impairment. Sample data at point PLUM10 shows pH ranging between 7.7 and 7.9; pH is not addressed as part of this TMDL.

Water quality analysis determined that the existing and allowable manganese loads are equal. Because the WQS is met, a TMDL for manganese is not necessary. Although a TMDL is not necessary for manganese, the existing load is considered at the next downstream point PLUM08.

Table C7. TMDL Calculations at Point PLUM10				
Flow = 0.20 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	1.01	1.7	0.64	1.1
Mn	0.24	0.4	0.24	0.4
Al	2.03	3.4	0.47	0.8
Acidity	0.00	0.0	0.00	0.0
Alkalinity	118.30	200.8		

Table C8. Calculation of Load Reduction Necessary at Point PLUM10				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	1.7	0.4	3.4	0.0
Allowable Load	1.1	0.4	0.8	0.0
Load Reduction	0.6	0.0	2.6	0.0
Total % Reduction	36	0	77	0

TMDL Calculations - Sample Point PLUM09, mouth of Unnamed Tributary 42276

The TMDL for sample point PLUM09 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point PLUM09. The average flow of 0.13 MGD, measured at the point, is used for these computations.

This segment is not included on the PA Section 303(d) lists for impairments from AMD. In 1999 an assessment was completed on the segment and nutrients from Urban Runoff and Storm Sewers was added as causes of impairment. Sample data at point PLUM09 shows pH ranging between 6.7 and 8.3; pH is not addressed as part of this TMDL.

Table C9. TMDL Calculations at Point PLUM09				
Flow = 0.13GD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	1.17	1.2	0.49	0.5
Mn	0.43	0.5	0.31	0.3
Al	5.86	6.2	0.18	0.2
Acidity	0.00	0.0	0.00	0.0
Alkalinity	98.30	104.3		

Table C10. Calculation of Load Reduction Necessary at Point PLUM09				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	1.2	0.45	6.2	0.0
Allowable Load	0.5	0.32	0.2	0.0
Load Reduction	0.7	0.13	6.0	0.0
Total % Reduction	58	28	97	0

TMDL Calculations - Sampling Point PLUM08, Plum Creek upstream of Little Plum Creek

The TMDL for sampling point PLUM08 consists of a load allocation to the area between sample points PLUM08, PLUM09, PLUM10 and PLUM13. The load allocation for this stream segment was computed using water-quality sample data collected at point PLUM08. The average flow of 1.98 MGD, measured at the point, is used for these computations.

This segment is not included on the PA Section 303(d) lists for impairments from AMD. In 1999 an assessment was completed on the segment and nutrients and siltation from Urban Runoff and Storm Sewers were added as causes of impairment. Sample data at point PLUM08 shows pH ranging between 8.0 and 8.2; pH is not addressed as part of this TMDL.

All values for iron are below the method detection limit. Because the WQS is met, a TMDL for iron is not necessary. In addition, upstream iron loading at PLUM08 is not considered because values are below the detection limits under the current conditions.

Table C11. TMDL Calculations at Point PLUM08

Flow = 1.98 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	<0.3	NA	NA	NA
Mn	0.31	5.1	0.30	4.9
Al	0.64	10.6	0.42	6.9
Acidity	0.00	0.0	0.00	0.0
Alkalinity	120.13	1,987.9		

The calculated load reductions for all the loads that enter point PLUM08 must be accounted for in the calculated reductions at the sample point shown in Table C12. A comparison of measured loads between points PLUM08, PLUM09, PLUM10 and PLUM13 shows that there is a loss of aluminum and acidity loading and additional manganese loading entering the segment. The total segment manganese load is the sum of the upstream loads and the additional loading within the segment. For loss of aluminum and acidity loading, the percent of load lost within the segment is calculated and applied to the upstream loads to determine the amount of load that is tracked through the segment.

Table C12. Calculation of Load Reduction Necessary at Point PLUM08

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	ND	5.1	10.6	0.0
Difference in Existing Load between PLUM08, PLUM09, PLUM10 & PLUM13	-	0.8	-24.4	-61.6
Load tracked from PLUM09, PLUM10 & PLUM13	-	1.3	1.4	0.6
Percent loss due to instream process	-	-	70	100
Percent of loads tracked through segment	-	-	30	0
Total Load tracked between points PLUM08, PLUM09, PLUM10 & PLUM13	-	2.1	0.4	0.0
Allowable Load at PLUM08	NA	4.9	6.9	0.0
Load Reduction at PLUM08	0.0	0.0	0.0	0.0
% Reduction required at PLUM08	0	0	0	0

TMDL Calculations - Sample Point LPLM08, Little Plum Creek downstream of the mouth of Unnamed Tributary 42274

The TMDL for sample point LPLM08 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point LPLM08. The average flow of 0.50 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. In 1999 a reassessment was completed on the segment and pH from petroleum activities was added as a cause of impairment. Sample data at point LPLM08 shows pH ranging between 6.1 and 6.6; pH is addressed as part of this TMDL.

Table C13. TMDL Calculations at Point LPLM08				
Flow = 0.50 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	2.49	10.5	0.85	3.6
Mn	1.77	7.4	0.35	1.5
Al	5.94	25.0	0.42	1.7
Acidity	9.96	41.9	5.48	23.0
Alkalinity	27.76	116.7		

Table C14. Calculation of Load Reduction Necessary at Point LPLM08				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	10.5	7.4	25.0	41.9
Allowable Load	3.6	1.5	1.7	23.0
Load Reduction	6.9	5.9	23.3	18.8
Total % Reduction	66	80	93	45

TMDL Calculations - Sample Point LPLM07, mouth of Unnamed Tributary 42273

The TMDL for sample point LPLM07 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point LPLM07. The average flow of 0.19 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. In 1999 a reassessment was completed on the segment and pH from petroleum activities was added as a cause of impairment. Sample data at point LPLM07 shows pH ranging between 3.2 and 4.4; pH is addressed as part of this TMDL.

Table C15. TMDL Calculations at Point LPLM07				
Flow = 0.19 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	6.66	10.6	0.40	0.6
Mn	2.19	3.5	0.33	0.5
Al	17.00	26.9	0.34	0.5
Acidity	158.36	251.0	0.00	0.0
Alkalinity	1.48	2.3		

Table C16. Calculation of Load Reduction Necessary at Point LPLM07				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	10.6	3.5	26.9	251.0
Allowable Load	0.6	0.5	0.5	0.0
Load Reduction	10.0	3.0	26.4	251.0
Total % Reduction	94	85	98	100

TMDL Calculations - Sample Point LPLM05, Unnamed Tributary 42260 downstream of 42266

The TMDL for sample point LPLM05 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point LPLM05. The average flow of 0.58 MGD, measured at the point, is used for these computations.

This segment was included on the 2002 PA Section 303(d) list for impairments metals and pH from AMD. Sample data at point LPLM05 shows pH ranging between 6.2 and 7.8; pH is addressed as part of this TMDL.

Table C17. TMDL Calculations at Point LPLM05				
Flow = 0.58 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	1.19	5.7	0.43	2.1
Mn	1.70	8.2	0.39	1.9
Al	4.82	23.2	0.24	1.2
Acidity	13.16	63.4	6.84	33.0
Alkalinity	43.00	207.1		

Table C18. Calculation of Load Reduction Necessary at Point LPLM05				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	5.7	8.2	23.2	63.4
Allowable Load	2.1	1.9	1.2	33.0
Load Reduction	3.6	6.3	22.0	30.4
Total % Reduction	64	77	95	48

TMDL Calculations - Sampling Point LPLM04, mouth of Unnamed Tributary 42260

The TMDL for sampling point LPLM04 consists of a load allocation to the area between sample points LPLM04 and LPLM05. The load allocation for this stream segment was computed using water-quality sample data collected at point LPLM04. The average flow of 1.71 MGD, measured at the point, is used for these computations.

This segment was included on the 2002 PA Section 303(d) list for impairments metals and pH from AMD. Sample data at point LPLM04 shows pH ranging between 6.7 and 7.6; pH is not addressed as part of this TMDL.

Table C19. TMDL Calculations at Point LPLM04				
Flow = 1.71 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.75	10.7	0.65	9.3
Mn	1.01	14.4	0.45	6.5
Al	3.22	46.0	0.16	2.3
Acidity	0.00	0.0	0.00	0.0
Alkalinity	69.48	991.3		

The calculated load reductions for all the loads that enter point LPLM04 must be accounted for in the calculated reductions at the sample point shown in Table C20. A comparison of measured loads between points LPLM04 and LPLM05 shows that there is a loss of acidity loading and additional iron, aluminum, and manganese loading entering the segment. The total segment iron, aluminum, and manganese load is the sum of the upstream loads and the additional loading within the segment. For loss of acidity loading, the percent of load lost within the segment is calculated and applied to the upstream loads to determine the amount of load that is tracked through the segment.

Table C20. Calculation of Load Reduction Necessary at Point LPLM04				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	10.7	14.4	46.0	0.0
Difference in Existing Load between LPLM04 & LPLM05	5.0	6.2	22.8	-63.4
Load tracked from LPLM05	2.1	1.9	1.2	33.0
Percent loss due to instream process	-	-	-	100.0
Percent of loads tracked through segment	-	-	-	0.0
Total Load tracked between points LPLM04 & LPLM05	7.1	8.1	24.0	0.0
Allowable Load at LPLM04	9.3	6.5	2.3	0.0
Load Reduction at LPLM04	0.0	1.6	21.7	0.0
% Reduction required at LPLM04	0	20	90	0

Waste Load Allocation – Consolidation Coal Company, Renton AMD Plant, 001

The Consolidation Coal Company Mining Activity Permit No. 02733702, has one treatment plant discharge. 001, located on the map in Attachment A, discharges to Little Plum Creek upstream of LPLM03. The waste load allocation for 001 was calculated using permit limits and the average measured flow. Aluminum is not included in the permit; however, a waste load allocation is included for aluminum. A value of 1.0 mg/L is used in calculating the allocation. The following table shows the waste load allocation for the discharge.

Table C21. Waste Load Allocation			
Parameter	**Monthly Avg. Allowable Conc. (mg/L)**	**Average Flow (MGD)**	**Allowable Load (lbs/day)**
001			
Fe	3.0	0.72	18.0
Mn	2.0	0.72	12.0
Al	1.0	0.72	6.0

TMDL Calculations - Sampling Point LPLM03, Little Plum Creek downstream of Unnamed Tributary 42260

The TMDL for sampling point LPLM03 consists of a waste load allocation to an AMD treatment discharge and a load allocation to the area between sample points LPLM03, LPLM04, LPLM07 and LPLM08. The load allocation for this stream segment was computed using water-quality sample data collected at point LPLM03. The average flow of 3.42 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. In 1999 a reassessment of the segment added nutrient impairments from combined sewer overflow and urban runoff and storm sewers and oil and grease impairments from urban runoff and storm sewers. Sample data at point LPLM03 shows pH ranging between 6.7 and 7.6; pH is not addressed as part of this TMDL.

Table C22. TMDL Calculations at Point LPLM03				
Flow = 3.42 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	1.22	34.7	0.69	19.8
Mn	0.90	25.6	0.73	20.7
Al	2.98	85.0	0.22	6.4
Acidity	0.00	0.0	0.00	0.0
Alkalinity	71.44	2,040.2		

The calculated load reductions for all the loads that enter point LPLM03 must be accounted for in the calculated reductions at the sample point shown in Table C23. A comparison of measured loads between points LPLM03, LPLM04, LPLM07 and LPLM08 shows that there is a loss of aluminum and acidity loading and additional iron and manganese loading entering the segment. The total segment iron and manganese load is the sum of the upstream loads and the additional loading within the segment. For loss of aluminum and acidity loading, the percent of load lost within the segment is calculated and applied to the upstream loads to determine the amount of load that is tracked through the segment.

Table C23. Calculation of Load Reduction Necessary at Point LPLM03				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	34.7	25.6	85.0	0.0
Difference in Existing Load between LPLM03, LPLM07, LPLM08 & LPLM04	3.0	0.3	-12.8	-292.9
Load tracked from LPLM04, LPLM07 & LPLM08	11.3	8.5	4.6	23.0
Percent loss due to instream process	-	-	13	100
Percent of loads tracked through segment	-	-	87	0
Load tracked between points LPLM03, LPLM07, LPLM08 & LPLM04	14.3	8.8	4.0	0.0
Allowable Load at LPLM03	19.8	20.7	6.4	0.0
Allowable Load assigned to WLA	18.0	12.0	6.0	-
Allowable Load assigned to LA	1.8	8.7	0.4	-
Total Load = Load between points + WLA	32.3	20.8	10.0	0.0
Load Reduction at LPLM03	12.5	0.1	3.6	0.0

TMDL Calculations - Sampling Point LPLM02, Little Plum Creek downstream of Unnamed Tributary 42257

The TMDL for sampling point LPLM02 consists of a load allocation to the area between sample points LPLM02 and LPLM03. The load allocation for this stream segment was computed using water-quality sample data collected at point LPLM02. The average flow of 4.23 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. In 1999 a reassessment of the segment added nutrient impairments from combined sewer overflow and urban runoff and storm sewers and oil and grease impairments from urban runoff and storm sewers. Sample data at point LPLM03 shows pH ranging between 6.9 and 7.7; pH is not addressed as part of this TMDL.

Table C24. TMDL Calculations at Point LPLM02				
Flow = 4.23 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	1.07	37.9	0.60	21.2
Mn	0.84	29.6	0.24	8.6
Al	3.86	136.4	0.46	16.4
Acidity	0.00	0.0	0.00	0.0
Alkalinity	62.96	2,223.0		

The calculated load reductions for all the loads that enter point LPLM02 must be accounted for in the calculated reductions at the sample point shown in Table C25. A comparison of measured loads between points LPLM02 and LPLM03 shows that there is a additional metals loading entering the segment. The total segment metals loads are the sum of the upstream loads and the additional loading within the segment.

Table C25. Calculation of Load Reduction Necessary at Point LPLM02				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	37.9	29.6	136.4	0.0
Difference in Existing Load between LPLM02 & LPLM03	3.1	4.0	51.4	0.0
Load tracked from LPLM03	19.8	20.7	6.4	0.0
Total Load tracked between points LPLM02 & LPLM03	22.9	24.7	57.8	0.0
Allowable Load at LPLM02	21.2	8.6	16.4	0.0
Load Reduction at LPLM02	1.7	16.1	41.4	0.0
% Reduction required at LPLM02	8	65	72	0

TMDL Calculations - Sampling Point LPLM01, mouth of Little Plum Creek

The TMDL for sampling point LPLM01 consists of a load allocation to the area between sample points LPLM02 and LPLM01. The load allocation for this stream segment was computed using water-quality sample data collected at point LPLM01. The average flow of 4.58 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. In 1999 a reassessment of the segment added nutrient impairments from combined sewer overflow and urban runoff and storm sewers and oil and grease impairments from urban runoff and storm sewers. Sample data at point LPLM03 shows pH ranging between 7.5 and 7.8; pH is not addressed as part of this TMDL.

Table C26. TMDL Calculations at Point LPLM01				
Flow = 4.58 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.84	32.2	0.76	29.0
Mn	0.53	20.1	0.33	12.4
Al	2.50	95.5	0.28	10.5
Acidity	0.00	0.0	0.00	0.0
Alkalinity	72.80	2,780.3		

The calculated load reductions for all the loads that enter point LPLM01 must be accounted for in the calculated reductions at the sample point shown in Table C27. A comparison of measured loads between points LPLM01 and LPLM02 shows that there is a loss of loading for all metals within the segment. For loss of loading, the percent of load lost within the segment is calculated and applied to the upstream loads to determine the amount of load that is tracked through the segment. The upstream aluminum load entering the segment is greater than the allowable load at LPLM01. This is due to data variability and it is assumed that when the upstream reductions are achieved, the standard will be met at LPLM01 without any further reductions.

Table C27. Calculation of Load Reduction Necessary at Point LPLM01				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	32.2	20.1	95.5	0.0
Difference in Existing Load between LPLM01 & LPLM02	-5.7	-9.5	-40.9	0.0
Load tracked from LPLM02	21.2	8.6	16.4	0.0
Percent loss due to instream process	15	32	30	-
Percent of loads tracked through segment	85	68	70	-
Total Load tracked between points LPLM01 & LPLM02	18.0	5.8	11.5	0.0
Allowable Load at LPLM01	29.0	12.4	10.5	0.0
Load Reduction at LPLM01	0.0	0.0	1.0	0.0
% Reduction required at LPLM01	0	0	9	0

TMDL Calculations - Sample Point PLUM05, Plum Creek upstream of Unnamed Tributary 42253

The TMDL for sampling point PLUM05 consists of a load allocation to the area between sample points PLUM05, LPLM01 and PLUM08. The load allocation for this stream segment was computed using water-quality sample data collected at point PLUM05. The average flow of 5.99 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. In 1999 a reassessment of the segment added nutrient, siltation, oil and grease, and other inorganic impairments from urban runoff and storm sewers. Sample data at point PLUM05 shows pH ranging between 7.6 and 8.2; pH is not addressed as part of this TMDL.

Water quality analysis determined that the measured iron load is equal to the allowable iron load. Because the WQS is met, a TMDL for iron is not necessary. Although a TMDL is not necessary, the measured load is considered at the next downstream point, PLUM03.

Table C28. TMDL Calculations at Point PLUM05				
Flow = 5.99 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.57	28.6	0.57	28.6
Mn	0.41	20.7	0.34	17.1
Al	2.18	108.9	0.39	19.6
Acidity	0.00	0.0	0.00	0.0
Alkalinity	107.93	5,390.2		

The calculated load reductions for all the loads that enter point PLUM05 must be accounted for in the calculated reductions at the sample point shown in Table C29. A comparison of measured loads between points PLUM05, LPLM01 and PLUM08 shows that there is a loss of loading for iron and manganese and an increase in aluminum. For loss of loading, the percent of load lost within the segment is calculated and applied to the upstream loads to determine the amount of load that is tracked through the segment. For increased aluminum load, the total segment load is the sum of the upstream loads and the additional load entering within the segment.

Table C29. Calculation of Load Reduction Necessary at Point PLUM05				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	28.6	20.7	108.9	0.0
Difference in Existing Load between PLUM05, PLUM08 & LPLM01	-3.6	-4.5	2.8	0.0
Load tracked from PLUM08 & LPLM01	18.0	7.9	10.9	0.0
Percent loss due to instream process	11	18	-	-
Percent of loads tracked through segment	89	82	-	-
Total Load tracked between points PLUM05, PLUM08 & LPLM01	16.0	6.5	13.7	0.0
Allowable Load at PLUM05	28.6	17.1	19.6	0.0
Load Reduction at PLUM05	0.0	0.0	0.0	0.0
% Reduction required at PLUM05	0	0	0	0

TMDL Calculations - Sample Point PLUM03, Plum Creek upstream of Unnamed Tributary 42247

The TMDL for sampling point PLUM03 consists of a load allocation to the area between sample points PLUM03 and PLUM05. The load allocation for this stream segment was computed using water-quality sample data collected at point PLUM03. The average flow of 8.76 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. In 1999 a reassessment of the segment added oil and grease and other inorganic impairments from urban runoff and storm sewers. Sample data at point PLUM03 shows pH ranging between 7.8 and 8.3; pH is not addressed as part of this TMDL.

All values for iron and aluminum are below the method detection limits. Water quality analysis determined that the measured manganese load is equal to the allowable manganese load. Because WQS are met, TMDLs for iron, aluminum, and manganese are not necessary. Although a TMDL for manganese is not necessary, the measured load is considered at the next downstream point, PLUM01.

Table C30. TMDL Calculations at Point PLUM03

Flow = 8.76 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	<0.3	NA	NA	NA
Mn	0.17	12.3	0.17	12.3
Al	<0.5	NA	NA	NA
Acidity	0.00	0.0	0.00	0.0
Alkalinity	109.97	8,037.3		

The calculated load reductions for all the loads that enter point PLUM03 must be accounted for in the calculated reductions at the sample point shown in Table C31. A comparison of measured loads between points PLUM03 and PLUM05 shows that there is a loss of manganese loading. For loss of loading, the percent of load lost within the segment is calculated and applied to the upstream loads to determine the amount of load that is tracked through the segment.

Table C31. Calculation of Load Reduction Necessary at Point PLUM03

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	<0.3	12.3	<0.5	0.0
Difference in Existing Load between PLUM05 & PLUM03	-	-8.4	-	0.0
Load tracked from PLUM05	-	6.5	-	0.0
Percent loss due to instream process	-	41	-	-
Percent of loads tracked through segment	-	59	-	-
Total Load tracked between points PLUM05 & PLUM03	-	3.9	-	0.0
Allowable Load at PLUM03	NA	12.3	NA	0.0
Load Reduction at PLUM03	0.0	0.0	0.0	0.0
% Reduction required at PLUM03	0	0	0	0

TMDL Calculations - Sample Point PLUM02, mouth of Unnamed Tributary 42246

TMDLs at PLUM02 for iron, manganese, aluminum and acidity are not necessary because WQS are met. All metals concentrations are below the method detection limits and sample data at point PLUM02 shows pH ranging between 8.0 and 9.0.

This segment is not included on the PA Section 303(d) lists for impairments from AMD. In 1999 an assessment was completed on the segment and nutrients and oil and grease from Urban Runoff and Storm Sewers were added as causes of impairment.

TMDL Calculations - Sample Point PLUM01, mouth of Plum Creek

The TMDL for sampling point PLUM01 consists of a load allocation to the area between sample points PLUM01, PLUM02 and PLUM03. The load allocation for this stream segment was computed using water-quality sample data collected at point PLUM01. The average flow of 9.35 MGD, measured at the point, is used for these computations.

This segment is was included on the 1996 PA Section 303(d) list for metals impairments from AMD. In 1999 a reassessment of the segment added oil and grease and other inorganic impairments from urban runoff and storm sewers. Sample data at point PLUM01 shows pH ranging between 7.8 and 8.3; pH is not addressed as part of this TMDL.

All values for iron and aluminum are below the method detection limits. Water quality analysis determined that the measured manganese load is equal to the allowable manganese load. Because WQS are met, TMDLs for iron, aluminum, and manganese are not necessary.

Table C32. TMDL Calculations at Point PLUM01

Flow = 9.35 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	<0.3	NA	NA	NA
Mn	0.23	17.8	0.23	17.8
Al	<0.5	NA	NA	NA
Acidity	0.00	0.0	0.00	0.0
Alkalinity	107.84	8,405.3		

The calculated load reductions for all the loads that enter point PLUM01 must be accounted for in the calculated reductions at the sample point shown in Table C33. A comparison of measured loads between points PLUM01, PLUM02 and PLUM03 shows that there is an increase of manganese loading. The total segment manganese load is the sum of the upstream loads and the additional load within the segment.

Table C33. Calculation of Load Reduction Necessary at Point PLUM01				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	<0.3	17.8	<0.5	0.0
Difference in Existing Load between PLUM01, PLUM02 & PLUM03	-	5.5	-	0.0
Load tracked from PLUM02 & PLUM03	-	3.9	-	0.0
Total Load tracked between points PLUM01, PLUM02 & PLUM03	-	9.4	-	0.0
Allowable Load at PLUM01	NA	17.8	NA	0.0
Load Reduction at PLUM01	0.0	0.0	0.0	0.0
% Reduction required at PLUM01	0	0	0	0

Margin of Safety

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

- Effluent variability plays a major role in determining the average value that will meet water-quality criteria over the long-term. The value that provides this variability in our analysis is the standard deviation of the dataset. The simulation results are based on this variability and the existing stream conditions (an uncontrolled system). The general assumption can be made that a controlled system (one that is controlling and stabilizing the pollution load) would be less variable than an uncontrolled system. This implicitly builds in a margin of safety.
- An additional MOS is provided because the calculations were done with a daily Fe average instead of the 30-day average
- The method used to calculate a flow for a WLA using the area of the pit and ungraded portions is conservative and an implicit margin of safety.

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 lists. 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

Monitoring Point	Sampling Date	Flow	Lab pH	Alkalinity	Acidity	Iron	Manganese	Aluminum
		gpm		mg/L	mg/L	mg/L	mg/L	mg/L
PLUM01	7/11/2002	5000	7.8	111.0	0.0	<0.3	<0.05	<0.5
Latitude:	8/9/2002	2400	8.0	124.0	0.0	<0.3	<0.05	<0.5
40-30-27	3/27/2003	7050	8.3	80.8	0.0	<0.3	0.243	<0.5
Longitude:	4/14/2003	15000	8.1	94.0	0.0	<0.3	0.214	<0.5
79-50-49	7/17/2003	3000	8.3	129.4	0.0	<0.3	<0.05	<0.5
Mouth of Plum Creek	Average	6490.00000	8.10000	107.84000	0.00000	<0.3	0.22850	<0.5
	St Dev	5095.63539	0.21213	20.36340	0.00000	NA	0.02051	NA
PLUM02	7/11/2002	30	8.0	158.0	0.0	<0.3	<0.05	<0.5
Latitude:	8/9/2002	15	8.2	170.0	0.0	<0.3	<0.05	<0.5
40-30-43	3/27/2003	250	9.0	105.0	0.0	<0.3	<0.05	<0.5
Longitude:	4/14/2003	675	8.2	115.8	0.0	<0.3	<0.05	<0.5
79-49-51	5/29/2003	235	8.4	137.6	0.0	<0.3	<0.05	<0.5
	7/17/2003	30	8.2	148.0	0.0	<0.3	<0.05	<0.5
Plum Creek upstream of	Average	205.83333	8.33333	139.06667	0.00000	<0.3	<0.05	<0.5
Mouth of Unnamed Trib 42247	St Dev	253.44460	0.35024	24.89648	0.00000	NA	NA	NA
PLUM03	7/11/2002	4950	7.8	122.0	0.0	<0.3	0.070	<0.5
Latitude:	8/9/2002	2365	8.1	136.0	0.0	<0.3	0.127	<0.5
40-30-45	3/27/2003	6800	8.1	80.2	0.0	<0.3	0.298	<0.5
Longitude:	4/14/2003	14000	8.1	94.2	0.0	<0.3	0.252	<0.5
79-49-52	5/29/2003	5500	7.9	101.2	0.0	<0.3	0.092	<0.5
	7/17/2003	2900	8.3	126.2	0.0	<0.3	<0.05	<0.5
Plum Creek upstream of	Average	6085.83333	8.05000	109.96667	0.00000	<0.3	0.16780	<0.5
Mouth of Unnamed Trib 42247	St Dev	4213.58567	0.17607	21.43620	0.00000	NA	0.10126	NA

Monitoring Point	Sampling Date	Flow	Lab pH	Alkalinity	Acidity	Iron	Manganese	Aluminum
		gpm		mg/L	mg/L	mg/L	mg/L	mg/L
PLUM05	7/11/2002	4025	8.2	178.0	0.0	<0.3	<0.05	<0.5
Latitude:	8/9/2002	2050	8.2	118.0	0.0	<0.3	<0.05	<0.5
40-30-23	3/27/2003	3550	7.6	66.6	0.0	0.573	0.649	2.650
Longitude:	4/14/2003	10200	7.8	80.2	0.0	0.573	0.497	1.710
79-47-30	5/29/2003	3475	7.8	88.2	0.0	<0.3	0.402	<0.5
	7/17/2003	1650	8.2	116.6	0.0	<0.3	0.107	<0.5
Plum Creek upstream	Average	4158.33333	7.96667	107.93333	0.00000	0.57300	0.41375	2.18000
of Unnamed Trib 42253	St Dev	3101.39753	0.26583	39.88176	0.00000	0.00000	0.22841	0.66468
LPLM01	7/2/2002	1800	7.5	84.0	0.0	<0.3	0.233	<0.5
Latitude:	8/1/2002	1350	7.6	88.0	0.0	<0.3	0.155	<0.5
40-29-39	3/19/2003	3650	7.5	52.6	0.0	1.13	0.774	3.890
Longitude:	4/14/2003	6000	7.7	71.4	0.0	0.801	0.642	2.400
79-46-56	5/9/2003	3100	7.8	68.0	0.0	0.599	0.821	1.210
Mouth of Little Plum Creek	Average	3180.00000	7.62000	72.80000	0.00000	0.84333	0.52500	2.50000
	St Dev	1832.55286	0.13038	14.04920	0.00000	0.26802	0.31043	1.34280
LPLM02	7/2/2002	1500	7.4	76.0	0.0	<0.3	0.378	<0.5
Latitude:	8/1/2002	1200	7.5	82.0	0.0	0.359	0.257	<0.5
40-29-51	3/19/2003	3600	6.9	49.0	0.0	1.32	0.863	4.640
Longitude:	4/14/2003	5500	7.7	63.8	0.0	1.14	0.702	3.680
79-46-05	5/9/2003	2900	7.0	44.0	0.0	1.47	1.990	3.270
Little Plum Creek downstream	Average	2940.00000	7.30000	62.96000	0.00000	1.07225	0.83800	3.86333
of Unnamed Trib 42257	St Dev	1738.67766	0.33912	16.48963	0.00000	0.49427	0.68837	0.70316

Monitoring Point	Sampling Date	Flow	Lab pH	Alkalinity	Acidity	Iron	Manganese	Aluminum
		gpm		mg/L	mg/L	mg/L	mg/L	mg/L
LPLM03	7/2/2002	500	7.3	60.0	0.0	<0.3	0.980	0.732
Latitude:	8/1/2002	1050	7.6	82.0	0.0	<0.3	0.701	<0.5
40-30-15	3/19/2003	3490	6.7	41.0	0.0	1.63	1.010	5.420
Longitude:	4/14/2003	4350	7.4	112.2	0.0	1.28	0.827	3.850
79-45-44	5/9/2003	2500	7.4	62.0	0.0	0.737	0.959	1.910
Little Plum Creek downstream	Average	2378.00000	7.28000	71.44000	0.00000	1.21567	0.89540	2.97800
of Unnamed Trib 42260	St Dev	1614.82816	0.34205	27.01607	0.00000	0.44996	0.12923	2.07436
LPLM04	7/2/2002	675	7.3	72.0	0.0	<0.3	1.280	1.030
Latitude:	8/1/2002	260	7.6	106.0	0.0	0.32	0.373	<0.5
40-30-15	3/19/2003	1680	6.7	41.2	0.0	1.04	1.310	6.710
Longitude:	4/14/2003	2500	7.6	65.0	0.0	0.831	0.918	3.470
79-45-38	5/9/2003	825	7.5	63.2	0.0	0.801	1.150	1.680
Mouth of Unnamed Trib 42260	Average	1188.00000	7.34000	69.48000	0.00000	0.74800	1.00620	3.22250
	St Dev	897.15244	0.37815	23.44850	0.00000	0.30449	0.38622	2.54364
LPLM05	7/2/2002	150	6.4	18.2	38.0	0.589	2.860	4.730
Latitude:	8/1/2002	200	7.5	72.0	0.0	<0.3	1.930	<0.5
40-29-19	3/19/2003	1005	6.2	18.4	27.8	2.11	1.510	7.820
Longitude:	4/14/2003	200	6.8	34.8	0.0	1.66	1.470	6.110
79-44-29	5/9/2003	450	7.8	71.6	0.0	0.403	0.733	0.634
Unnamed Trib 42260 downstream	Average	401.00000	6.94000	43.00000	13.16000	1.19050	1.70060	4.82350
of Unnamed Trib 42266	St Dev	357.42831	0.69138	27.14038	18.37738	0.82621	0.77823	3.06566

Monitoring Point	Sampling Date	Flow	Lab pH	Alkalinity	Acidity	Iron	Manganese	Aluminum
		gpm		mg/L	mg/L	mg/L	mg/L	mg/L
LPLM07	7/2/2002	50	3.3	0.0	229.4	<0.3	<0.05	<0.5
Latitude:	8/1/2002	55	4.4	7.4	94.6	1.41	4.140	10.100
40-30-12	3/19/2003	230	3.2	0.0	183.2	13.2	1.320	21.900
Longitude:	4/14/2003	225	3.5	0.0	151.8	7.98	1.440	18.500
79-43-06	5/9/2003	100	3.7	0.0	132.8	4.06	1.850	17.500
	Average	132.00000	3.62000	1.48000	158.36000	6.66250	2.18750	17.00000
Mouth of Unnamed Trib 42273	St Dev	89.34484	0.47645	3.30938	51.05240	5.12629	1.32130	4.97058
LPLM08	7/2/2002	75	6.6	40.0	0.0	2.51	1.730	6.680
Latitude:	8/1/2002	35	6.3	22.0	30.8	3.61	3.490	8.450
40-30-05	3/19/2003	540	6.1	16.8	19.0	1.75	1.240	5.890
Longitude:	4/14/2003	600	6.5	29.6	0.0	1.92	1.030	4.730
79-42-57	5/9/2003	500	6.5	30.4	0.0	2.68	1.350	3.940
Little Plum Crk downstream of	Average	350.00000	6.40000	27.76000	9.96000	2.49400	1.76800	5.93800
Unnamed Trib 42274	St Dev	272.00643	0.20000	8.85257	14.26212	0.73541	0.99560	1.75459
PLUM08	7/11/2002	1800	8.2	132.0	0.0	<0.3	<0.05	<0.5
Latitude:	8/9/2002	1027	8.1	150.0	0.0	<0.3	<0.05	<0.5
40-29-36	3/27/2003	1200	8.0	84.4	0.0	<0.3	0.416	0.516
Longitude:	4/14/2003	2550	8.1	100.8	0.0	<0.3	0.440	0.764
79-47-05	5/29/2003	965	8.0	116.4	0.0	<0.3	0.075	<0.5
	7/17/2003	725	8.1	137.2	0.0	<0.3	<0.05	<0.5
Mouth of Unnamed Trib 42276	Average	1377.83333	8.08333	120.13333	0.00000	<0.3	0.31033	0.64000
	St Dev	678.75339	0.07528	24.44869	0.00000	NA	0.20416	0.17536

Monitoring Point	Sampling Date	Flow	Lab pH	Alkalinity	Acidity	Iron	Manganese	Aluminum
		gpm		mg/L	mg/L	mg/L	mg/L	mg/L
PLUM09	7/11/2002	75	8.3	100.0	0.0	<0.3	0.106	<0.5
Latitude:	8/9/2002	40	7.8	102.0	0.0	<0.3	<0.05	<0.5
40-29-18	3/27/2003	100	6.7	27.0	0.0	1.71	0.750	9.790
Longitude:	4/14/2003	150	7.5	78.0	0.0	1.41	0.507	6.200
79-47-00	5/29/2003	90	7.8	108.2	0.0	0.402	0.338	1.590
	7/17/2003	75	8.1	174.6	0.0	<0.3	<0.05	<0.5
Mouth of Unnamed Trib 42276	Average	88.33333	7.70000	98.30000	0.00000	1.17400	0.42525	5.86000
	St Dev	36.42344	0.56214	47.81644	0.00000	0.68519	0.27183	4.11056
PLUM10	7/11/2002	40	7.7	214.0	0.0	1.56	0.163	1.990
Latitude:	8/9/2002	3	7.8	100.0	0.0	0.645	0.095	<0.5
40-29-03	3/27/2003	50	7.9	88.0	0.0	1.09	0.259	2.490
Longitude:	4/14/2003	75	7.8	104.0	0.0	0.728	0.192	1.610
79-46-12	5/29/2003	645	7.8	87.0	0.0	<0.3	0.587	<0.5
	7/17/2003	35	7.9	116.8	0.0	<0.3	0.127	<0.5
Mouth of Unnamed Trib 42279	Average	141.33333	7.81667	118.30000	0.00000	1.00575	0.23717	2.03000
	St Dev	247.84404	0.07528	48.16202	0.00000	0.41696	0.18042	0.44136
PLUM13	7/11/2002	300	7.0	62.0	0.0	1.74	1.350	5.810
Latitude:	8/9/2002		7.7	118.0	0.0	0.743	0.642	1.740
40-28-38	3/27/2003	300	5.8	16.6	52.2	3.4	1.330	9.840
Longitude:	4/14/2003	350	5.6	13.6	47.0	6.33	0.134	10.100
79-45-39	5/29/2003	450	6.7	52.2	0.0	2.39	1.240	6.460
	7/17/2003	150	7.8	203.0	0.0	<0.3	<0.05	<0.5
Plum Creek downstream of	Average	310.00000	6.76667	77.56667	16.53333	2.92060	0.93920	6.79000
Unnamed Trib 42281	St Dev	108.39742	0.92664	72.19811	25.66606	2.13724	0.53587	3.42164

Monitoring Point	Sampling Date	Flow	Lab pH	Alkalinity	Acidity	Iron	Manganese	Aluminum
		gpm		mg/L	mg/L	mg/L	mg/L	mg/L
PLUM15	7/11/2002	30	4.5	9.4	321.2	0.349	9.190	13.600
Latitude:	8/9/2002	2	7.1	64.0	0.0	0.523	4.020	<0.5
40-28-33	3/27/2003	100	3.4	0.0	227.4	10.6	3.130	21.500
Longitude:	4/14/2003	125	3.2	0.0	231.2	18.6	3.330	24.400
79-45-34	5/29/2003	110	4.5	9.0	118.0	6.68	2.510	13.200
	7/17/2003	45	4.5	9.8	108.6	8.36	3.340	15.000
Mouth of Unnamed Trib 42822	Average	68.66667	4.53333	15.36667	167.73333	7.51867	4.25333	17.54000
	St Dev	49.72592	1.38948	24.26765	114.23202	6.84171	2.46629	5.08803
PLUM17	7/11/2002	200	3.5	0.0	719.2	3.91	3.020	37.300
Latitude:	8/9/2002	35	4.0	3.0	204.8	2.02	3.000	25.800
40-28-43	3/27/2003	75	4.3	8.4	169.8	3.55	2.040	22.000
Longitude:	4/14/2003	75	4.4	8.6	117.2	5.26	2.010	17.900
79-44-56	5/29/2003	200	4.6	9.6	97.6	4.19	2.100	16.800
	7/17/2003	25	5.6	13.2	34.6	2.33	2.270	7.600
Mouth of Unnamed Trib 42824	Average	101.66667	4.40000	7.13333	223.86667	3.54333	2.40667	21.23333
	St Dev	78.84584	0.70143	4.78776	249.71375	1.20767	0.47597	9.96206

Attachment F

Comment and Response

Comments/Responses on the Plum Creek Watershed TMDL

A 60-day public comment period was open on the Plum Creek Watershed Draft TMDL from November 6, 2004 until January 5, 2005. During this time, no comments were received.