LITTLE MILL CREEK WATERSHED TMDL

Clarion and Jefferson Counties, Pennsylvania

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Introduction

This Total Maximum Daily Load (TMDL) calculation has been prepared for a segment in the Little Mill Creek Watershed (Attachment A). It was done to address the impairments noted on the 1996 Pennsylvania 303(d) list, required under the Clean Water Act, and covers the one listed segment shown in Table 1. Metals in acidic discharge water from abandoned coalmines causes the impairment. The TMDL addresses the three primary metals associated with acid mine drainage (iron, manganese, aluminum), and pH.

Table 1. 303(d) Sub-List Clarion River

State Water Plan (SWP) Subbasin: 17B

Year	SWP	Miles	Segment ID	DEP Stream Code	Stream Name	Desig-nated Use	Data Source	Source	EPA 305(b) Cause Code
1996	17-B	20	5392	49727	Little Mill Creek	CWF	303 (d) List	Resource Extraction	Metals
1998	17-B	23.55	5392	49727	Little Mill Creek	CWF	SWMP	AMD	Metals
2002	17-B	23.5	5392	49727	Little Mill Creek	CWF	SWMP	AMD	Metals
2004	17-B	7.8	5392	49727	Little Mill Creek	CWF	SWMP	AMD	Metals
2004	17-B	1.4	5392	49728	Unt Little Mill Creek	CWF	SWMP	AMD	Metals
2004	17-B	1.2	5392	49729	Unt Little Mill Creek	CWF	SWMP	AMD	Metals
2004	17-B	1.2	5392	49730	Unt Little Mill Creek	CWF	SWMP	AMD	Metals
2004	17-B	0.3	5392	49731	Unt Little Mill Creek	CWF	SWMP	AMD	Metals
2004	17-B	0.4	5392	49732	Unt Little Mill Creek	CWF	SWMP	AMD	Metals
2004	17-B	0.4	5392	49733	Unt Little Mill Creek	CWF	SWMP	AMD	Metals
2004	17-B	1.4	5392	49734	Unt Little Mill Creek	CWF	SWMP	AMD	Metals
2004	17-B	1.4	5392	49737	Unt Little Mill Creek	CWF	SWMP	AMD	Metals
2004	17-B	0.4	5392	49739	Unt Little Mill Creek	CWF	SWMP	AMD	Metals

2004	17-B	0.9	5392	49740	Unt Little Mill Creek	CWF	SWMP	AMD	Metals
2004	17-B	0.7	5392	49741	Unt Little Mill Creek	CWF	SWMP	AMD	Metals
2004	17-B	0.9	5392	49742	Unt Little Mill Creek	CWF	SWMP	AMD	Metals
2004	17-B	0.6	5392	49743	Unt Little Mill Creek	CWF	SWMP	AMD	Metals
2004	17-B	1.9	5392	49744	Unt Little Mill Creek	CWF	SWMP	AMD	Metals
2004	17-B	1.2	5392	49745	Unt Little Mill Creek	CWF	SWMP	AMD	Metals
2004	17-B	0.6	5392	49746	Unt Little Mill Creek	CWF	SWMP	AMD	Metals
2004	17-B	0.5	5392	49747	Unt Little Mill Creek	CWF	SWMP	AMD	Metals
2004	17-B	0.2	5392	49748	Unt Little Mill Creek	CWF	SWMP	AMD	Metals
2004	17-B	0.5	5392	49749	Unt Little Mill Creek	CWF	SWMP	AMD	Metals
2004	17-B	0.1	5392	49750	Unt Little Mill Creek	CWF	SWMP	AMD	Metals

Cold Water Fishes=CWF
Surface Water Monitoring Program = SWMP
Abandoned Mine Drainage = AMD

Directions to the Little Mill Creek Watershed

The Little Mill Creek Watershed is approximately 13.7 square miles in area. It is located in Eastern Clarion County and Western Jefferson County, about 6.4 miles East of the town of Clarion and approximately 4.0 miles northwest of the town of Brookville. Little Mill Creek flows approximately 6.9 miles west from its headwaters in Jefferson County to its confluence with Mill Creek in Clarion County and can be found on the Strattanville and Corsica 7-1/2 minute quadrangles.

Little Mill Creek can be accessed by taking Exit 73 (Corsica, Route 949) of Interstate 80 (I-80). From Exit 73, take Rt. 949 South approximately 1.8 miles to a bridge. Little Mill Creek (LMC01) flows under Rt. 949 and the headwaters are upstream from this point. The mouth of Little Mill Creek empties into Mill Creek on State Game Lands No. 74 and cannot be accessed by vehicle.

Segments addressed in this TMDL

The Little Mill Creek Watershed is affected by pollution from AMD. This pollution has caused high levels of metals and low pH in the main stem of Little Mill Creek and in a majority of its tributaries. The sources of the AMD are seeps and discharges from areas disturbed by surface mining. Most of the discharges originate from mining on the Lower Kittanning and

Clarion coal seams or refuse piles associated with them. All but one of the discharges are considered to be nonpoint sources of pollution because they are from abandoned Pre-Act mining operations or from coal companies that have settled their bond forfeitures with the Pennsylvania Department of Environmental Protection (PADEP). C&K Coal Company (SMP No. 3776SM6) is actively treating a post mining discharge on their Wishart site located on an unnamed tributary to Little Mill Creek (UNT07). The discharge is being treated with both caustic soda and soda ash briquettes and is sampled and inspected on a monthly basis by a Knox DMO Surface Mine Compliance Inspector. Since liability exists for this discharge, it is considered to be point-source discharge and will be assigned a waste load allocation (WLA).

There are five permitted bituminous coal surface mining permits and one small non-coal (industrial minerals) surface mining permit in the Little Mill Creek Watershed. Active mining has been completed on two of the coal surface mining permits (TDK Coal Sales, SMP No.339601009 & Ben Hal Mining Company, SMP No. 33030103) and they are both in Stage 1 of bond release; therefore, these operations do not produce a discharge and do not require a WLA. Three of the permits are actively mining coal (MSM Mining Company, Inc. SMP No. 33020106 & SMP No. 33040102, & Sky Haven Coal Inc. SMP No. 16990105). Although the MSM Mining Company, Inc SMP No. 33020106 operation lies within the Little Mill Creek Watershed, treated water from this site flows into an unnamed tributary to Coder Run, outside the Little Mill Creek Watershed, therefore a WLA was not assigned to this permit. MSM Mining Company, Inc. SMP No. 33040102 flows into Little Mill Creek and a WLA has been assigned to this mining permit. Sky Haven Coal Inc. SMP No.16990105 was issued under DEPs Subchapter-F regulations, which provide that the permittee's effluent limits are based on baseline pollution conditions rather than standard coal mining BAT standards, due to the fact that the site had polluting discharges that pre-date the Sky Haven permit. The subchapter F discharges on these sites have been treated as nonpoint source for the purpose of doing this TMDL however, since water is being pumped from the active pit, treated and discharged, a WLA has been assigned to this permit. The small non-coal permit (Calvin Gray, SMP No. 33990810) does not produce any discharges and a WLA is not necessary.

There are three Bureau of Abandoned Mine Reclamation (BAMR) projects in the watershed and eleven passive treatment systems in the watershed on sites where there is no liability by a surface mine operator. All of the remaining discharges in the watershed are from abandoned mines and will be treated as non-point sources. The distinction between non-point and point sources in this case is determined on the basis of whether or not there is a responsible party for the discharge. 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.

The designation for this stream segment can be found in PA Title 25 Chapter 93.

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 U.S. Environmental Protection Agency's (USEPA) implementing regulations (40 CFR 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 USEPA 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

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

Despite these requirements, states, territories, authorized tribes, and USEPA had not developed many TMDLs since 1972. Beginning in 1986, organizations in many states filed lawsuits against the USEPA for failing to meet the TMDL requirements contained in the federal Clean Water Act and its implementing regulations. While USEPA has entered into consent agreements with the plaintiffs in several states, many lawsuits still are pending across the country.

In the cases that have been settled to date, the consent agreements require USEPA 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.).

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 USEPA, the states have developed methods for assessing the waters within their respective jurisdictions.

The primary method adopted by the Pennsylvania Department of Environmental Protection (Pa. DEP) for evaluating waters changed between the publication of the 1996 and 1998 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 305(b) reporting process. Pa. DEP is now using the Unassessed Waters Protocol (UWP), a modification of the USEPA Rapid Bioassessment Protocol II (RPB-II), as the primary mechanism to assess Pennsylvania's waters. The UWP 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 stream segment can vary between sites. All the biological surveys included kick-screen sampling of benthic macroinvertebrates, habitat surveys, and measurements of pH, temperature, conductivity, dissolved oxygen, and alkalinity. 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 the performance of the segment using a series of biological metrics. 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 303(d) list with the documented source and cause. A TMDL must be developed for the stream segment. A TMDL is for only one pollutant. If a stream segment is impaired by two pollutants, two TMDLs must be developed for that stream segment. 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. Calculate TMDL for the waterbody using USEPA approved methods and computer models;
3. Allocate pollutant loads to various sources;
4. Determine critical and seasonal conditions;
5. Submit draft report for public review and comments; and
6. USEPA approval of the TMDL.

This document will present the information used to develop the Daguscahonda Run Watershed TMDL.

Watershed History

The Little Mill Creek Watershed flows through the north central most area of the main bituminous coal region in northwestern Pennsylvania. Very little coal was mined prior to the 1870's in the Little Mill Creek Watershed. The development of railroads along with the need for fuel for the industrial revolution was the impetus for increased coal mining in Pennsylvania. Deep mining (small drift mines for household use) was the principal mining method in Clarion and Jefferson Counties until the 1920's when the prominent mining process started to shift towards strip mining. The surface mining of coal in the Little Mill Creek watershed and the initiation of the production of AMD from surface mining probably peaked from the mid 1960's through the late 1970's. The permitting of coal mining at that time was done without the benefits of today's techniques for the prediction and prevention of AMD. Several of the more prolific mining companies during that time period included W.P. Stahlman Coal Co., Inc. (later acquired by C & K Coal Company), Mauersburg Coal Company, Zacherl Coal Company, R.E.M. Coal Company, W. Paul Glen, H & G Coal Company, James Kerle Coal Co., Midway Resources, Inc., J.A. Mays (deep mine) and Bracken Construction Co.

Since the middle 1970's, various government, industry and local organizations have collected data and developed plans to characterize the pollution sources and develop remediation plans for the Mill Creek and other impaired watersheds. The Mill Creek Coalition (MCC), the Department of Environmental Protection's Knox District Mining Office and Bureau of Abandoned Mine Reclamation, the Clarion and Jefferson County Conservation Districts and the National Resource Conservation Service have been among the most active organizations working towards restoration of this watershed. Improved permitting and mining technologies, nationally recognized passive treatment development through the MCC and over $1.5 million in state, federal and private funds and services have improved some stream reaches, but there is still much to be done.

In 1975, the Department of Environmental Resources contracted with the EADS group to perform an acid mine drainage abatement study on the Mill Creek Watershed. The ensuing report, called the Mill Creek ScarLift Report SL-133-5, established 17 sampling and flow measurement stations in the Little Mill Creek Watershed. 43 discharges were identified in 19 project areas of Little Mill Creek and its tributaries. For the location of the sampling points and project areas refer to the map contained in the ScarLift SL-133-5 Report.

The Knox District Mining Office started a comprehensive monitoring program to assess the quality of the Little Mill Creek Watershed and Acid Mine Drainage (AMD) discharges to the Little Mill Creek watershed. Monitoring of numerous stream stations and discharges in the watershed started in 1981 and continues to the present. Water quality data from this effort has been included in this TMDL.

In the mid 1980's, BAMR contracted with Earth Satellite Corp. to complete a statewide abandoned mine lands inventory. This comprehensive photo interpretive inventory known as NALIS identified 5290 "Problem Areas" statewide with a total of 16 of these "Problem Areas" within the Little Mill Creek Watershed. Knox District staff reassessed all of the "Problem

Areas" within the Little Mill Creek Watershed and the NALIS inventory was updated to reflect current conditions.

Starting in late 1980, any new surface mine permit applications in the Little Mill Creek Watershed required overburden analysis (OBA) and were carefully scrutinized to determine the potential for the production of AMD. On July 31, 1982, Pennsylvania was granted primacy for its coal mining regulatory program under the federal Surface Mining Control and Reclamation Act of 1977 (SMCRA). As part of SMCRA's implementation, any surface mine permit issued prior to June 1980 was required to go through a "re-permitting" process if the operator planned to continue coal mining after March 31, 1983. Based on overburden analysis results conducted as part of that re-permitting process, many of the permits in the Little Mill Creek watershed were either cancelled or reduced in size or scope to eliminate mining of potentially acid forming overburden.

In March 1999 the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) with the cooperative sponsorship by the Clarion County Commissioners, Jefferson County Commissioners, Clarion Conservation District, Jefferson Conservation District, the Headwaters Resource Conservation and Development and the Mill Creek Coalition submitted the "Mill Creek Watershed Plan and Environmental Assessment, PL 83-566 Report." This plan identified twenty-seven mine drain discharges in the Little Mill Creek Watershed and recommended the construction of twenty-two passive mine water treatment systems at a cost of $2,194,000. The plan indicated that the sponsors would incur about forty-eight percent (48%) of the total project cost in the Little Mill Creek Watershed. The report projects the plan will improve water quality and will either restore or enhance the aquatic habitat of 32.8 miles of the Mill Creek Watershed.

Utilizing a variety of funding sources and partnering with various organizations, the Mill Creek Coalition has been responsible for the installation of fourteen treatment systems in the Little Mill Creek watershed, some of which have been treating AMD for over 10 years. Working with Headwaters Charitable Trust as its sponsor, the Mill Creek Coalition received a Growing Greener Grant in 2004 to develop a comprehensive Operation, Maintenance, and Replacement (OM&R) plan for treatment systems in the entire Mill Creek watershed. Existing information on the aging treatment systems along with water quality data will be combined with a Geographical Information System (GIS) database for data management and system assessment that will allow the Coalition to make OM&R decisions and system evaluations. PL566 and DEP Landowner Reclamation funds were received by the Mill Creek Coalition to complete the land reclamation and passive treatment system installation at the REM (Smail/Orcutt) site. Natural Resource and Conservation Services (NRCS) performed the required engineering work and Mano Construction was awarded the contract and completed the land reclamation on the Smail property during the winter of 2003. The site was seeded in the spring of 2004 and construction of the passive treatment systems, consisting of Anoxic Limestone Drains (ALDs), Successive Alkalinity Producing Systems (SAPS) and settling basins to treat two separate discharges, was completed during the winter of 2004. This treatment system is expected to effectively treat discharges that are causing degraded water quality on the UNT05 tributary. The Mill Creek Coalition applied for two Growing Greener grants in 2005 to remediate discharges associated with two Abandoned Mine Land (AML) sites (PA1173 and PA3482) in the Little Mill Creek Watershed.

AMD Methodology

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

The statistical analysis describes 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, 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[1] 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)

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

Mean = average observed concentration

Standard Deviation = standard deviation of observed data

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

LTA = Mean * (1 – PR99) where (2)

LTA = allowable LTA source concentration in mg/l

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

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

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

In Low 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 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.

Method to Quantify Treatment Pond Pollutant Load

Surface Coal Mines remove soil and overburden materials to expose the underground coal seams for removal. After removal of the coal, the overburden is replaced as mine spoil and the soil is replaced for revegetation. In a Typical surface mining operation the overburden materials are removed and placed in the previous cut where the coal has been removed. In this fashion, an active mining operation has a pit that progresses through the mining site during the life of the mine. The pit may have water reporting to it, as it is a low spot in the local area. Pit water can be the result of limited shallow groundwater seepage, direct precipitation into the pit, and surface runoff from partially regarded areas that have been backfilled but not yet revegated. Pit water is pumped to nearby treatment ponds where it is treated to the required treatment pond effluent limits. The standard effluent limits are as follows, although stricter effluent limits may be applied to a mining permit's effluent limits to insure that the discharge of treated water does not cause instream limits to be exceeded.

Standard Treatment Pond Effluent Limits:
Alkalinity > Acidity
6.0 <= pH <= 9.0
Fe < 3.0 mg/l
Mn < 2.0 mg/l
Al < 2.0

When a treatment plant has an NPDES permit a Waste Load Allocation (WLA) must be calculated. When there is flow data available this is used along with the permit Best Available Technology (BAT) limits for one or more of the following: aluminum, iron, and manganese. The following formula is used:

Flow (MGD) X BAT limit (mg/l) X 8.34 = lbs/day

When site specific flow data is unavailable to determine a waste load allocation for an active mining operation, an average flow rate must be determined. This is done by investigating and quantifying the hydrology of a surface mine site. The following is an explanation of the quantification of the potential pollution load reporting to the stream from permitted pit water treatment ponds that discharge water at established effluent limits when site specific flow data is unavailable.

The total water volume reporting to ponds for treatment can come from two primary sources: direct precipitation to the pit and runoff from the unregraded area following the pit's progression through the site. Groundwater seepage reporting to the pit is considered negligible compared to the flow rates resulting from precipitation.

In an active mining scenario, a mine operator pumps pit water to the ponds for chemical treatment. Pit water is often acidic with dissolved metals in nature. At the treatment ponds, alkaline chemicals are added to increase the pH and encourage dissolved metals to precipitate and settle. Pennsylvania averages 40 inches of precipitation per year. A maximum pit dimension without special permit approval is 1500 feet long by 300 feet wide. Assuming 100 percent runoff of the precipitation to be pumped to the treatment ponds results in the following equation and average flow rates for the pit area.

40 in. precip./yr x 1 ft/12/in. x 1500'x 300'/pit x 7.48 gal/ft3 x 1yr/365days x 1day/24hr. x 1hr/60mins. =

21.3 gal/min average discharge from direct precipitation into the open mining pit area.

Pit water can also result from runoff from the unregraded and revegetated area following the pit. DEP compliance efforts encourage that backfilling, topsoiling, and revegetation be as prompt and concurrent as mining conditions and weather conditions allow. Generally the revegatation follows about three pit widths behind the active mining area.

In the case of roughly backfilled land highly porous spoil; there is very little surface runoff. It is estimated that 80 percent of precipitation on the roughly regraded mine spoil infiltrates, 5 percent evaporates, and 15 percent may run off to the pit for pumping and potential treatment. The following equation represents the average flow reporting to the pit from the unregraded and unrevegatated spoil area.

40 in. precip./yr x 3 pit areas x 1 ft/12/in. x 1500'x 300'/pit x 7.48 gal/ft3 x 1yr/365days x 1day/24hr. x 1hr/60mins. x 15 in. runoff/100 in. precipitation =

= 9.6 gal/min average discharge from spoil runoff into the pit area.

The total average flow to the pit is represented by the sum of the direct pit precipitation and the water flowing to the pit from the spoil area as follows:

Total Average Flow = Direct Pit Precipitation + Spoil Runoff

Total Average Flow = 21.3 gal./min. + 9.6 gal./min. = 30.9 gal./min.

The resulting average load from a permitted treatment pond area as follows.

Allowable Iron Waste Load Allocation:
30.9 gal./min. x 3 mg/l x 0.01202 = 1.1 lbs./day

Allowable Manganese Waste Load Allocation:
30.9 gal./min. x 2 mg/l x 0.01202 = 0.7 lbs./day

Allowable Aluminum Waste Load Allocation:
30.9 gal./min. x 2 mg/l x 0.01202 = 0.7 lbs./day

(Note: 0.01202 is a conversion factor to convert from a flow rate in gal./min. and a concentration in mg/l to a load in units of lbs./day.)

Field experience shows that the average flow rate of 30.9 gal./min. is excessively high. It is common for many mining sites to have very "dry" pits that rarely accumulate water that would require pumping and treatment. Also, it is the goal of DEP's permit review process to not issue mining permits that would cause negative impacts to the enviroment. As a step to insure that a mine site does not produce acid drainage, it is common to require the addition of alkaline materials (limestone, alkaline shale or other rocks) may produce alkaline pit water with very low metals concentrations that does not require treatment. Also, while most mining operations are permitted to have a standard, 1500' x 300' pit, most are well below that size and have a corresponding decreased flow and load. Where pit dimensions are greater that the standard size is present, the calculations to define the potential pollution load are adjusted accordingly. Hence, the above calculated Waste Load Allocation is very generous and likely high compared to actual conditions that are generally encountered.

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 acceptable 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 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 of the nature of the pollution sources in the watershed, the TMDLs component makeup will be load allocations that are specified above a point in the stream segment. All allocations will be specified as long-term average daily concentrations. These long-term average daily concentrations are expected to meet water quality criteria 99 percent of the time. Pennsylvania Title 25 Chapter 96.3(c) specifies that a minimum 99 percent level of protection is required. All metals criteria evaluated in this TMDL are specified as total recoverable. Pennsylvania does have dissolved criteria for iron; however, the data used for this analysis report iron as total recoverable. Table 2 shows the 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 0.3	Total Recoverable Dissolved
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. These values are typically as low as 5.4 (Pennsylvania Fish and Boat Commission).

TMDL Elements (WLA, LA, MOS)

A TMDL equation consists of a wasteload allocation, load allocation and a margin of safety. The wasteload allocation is the portion of the load assigned to point sources. The load allocation is the portion of the load assigned to nonpoint 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).

TMDL Allocations Summary

Analyses of data for metals for points LMC02 and UNT07 indicate that there is no single critical flow condition for pollutant sources, and further, that there was no significant correlation between source flows and pollutant concentrations (Table 3). The other points in this TMDL and aluminum at LMC02 and UNT07 did not have enough paired flow/parameter data to calculate correlations (fewer than 15 paired observations).

Table 3 Correlation Between Metals and Flow for Selected Points

Point Identification	*Flow vs.*			*Number of Samples*
	Iron	*Manganese*	*Aluminum*	
LMC02	0.049	0.046	*	13
UNT07	0.016	0.001	*	Fe = 67 Mn = 56

*Not enough paired data available.

Allocation Summary

This TMDL will focus remediation efforts on the identified numerical reduction targets for each watershed. As changes occur in the watershed, the TMDL may be re-evaluated to reflect current conditions. Table 5 presents the estimated reductions identified for all points in the watershed. Attachment F gives detailed TMDLs by segment analysis for each allocation point.

Table 4. Summary Table–Little Mill 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 %*
UNT01	UNT01 (49727) Headwaters of Little Mill Creek						
	Al	ND	NA	-	-	0.0	0
	Fe	0.2	0.2	0.0	0.0	0.0	0
	Mn	ND	NA	-	-	0.0	0
	Acidity	5.0	1.6	0.0	1.6	3.4	68
HWLMC	HWLMC Unnamed Tributary (49749) of Little Mill Creek						
	Al	ND	NA	-	-	0.0	0
	Fe	ND	NA	-	-	0.0	0
	Mn	0.7	0.2	0.0	0.2	0.51	63
	Acidity	9.9	3.8	0.0	3.8	6.1	62
UNT01A	UNT01A Low Flow Unnamed Tributary (49750) to Little Mill Creek Downstream of UNT01						
	Al	ND	NA	-	-	0.0	0
	Fe	ND	NA	-	-	0.0	0
	Mn	0.01	0.01	0.0	0.01	0.0	0
	Acidity	1.6	0.4	0.0	0.4	0.1	25
LMC01AE	LMC01AE (49727)Little Mill Creek						
	Al	ND	NA	-	-	0.0	0
	Fe	ND	NA	-	-	0.0	0
	Mn	0.4	0.4	0.0	0.4	0.0	0
	Acidity	31.3	13.1	0.0	13.1	17.0	56
LMC01ASA2	LMC01ASA2 Eastern Unnamed Tributary (49745) Upstream of LMC01ASA						
	Al	6.2	0.9	0.0	0.9	5.3	85
	Fe	ND	NA	-	-	0.0	0
	Mn	70.8	2.8	0.0	2.8	68.0	96
	Acidity	251.0	17.6	0.0	17.6	233.4	93
LMC01ASA1	LMC01ASA1 Southern Unnamed Tributary (49746) Upstream of LMC01ASA						
	Al	ND	NA	-	-	0.0	0
	Fe	ND	NA	-	-	0.0	0
	Mn	15.2	0.9	0.0	0.9	14.3	94
	Acidity	44.1	5.7	0.0	5.7	38.4	87
LMC01ASA	LMC01ASA Unnamed Tributary (49745) to Unnamed Tributary (49744) to Little Mill Creek						
	Al	9.0	1.3	0.0	1.3	1.6	57
	Fe	ND	NA	-	-	0.0	0
	Mn	110.2	5.5	0.0	5.5	22.4	80
	Acidity	327.8	29.5	0.0	29.5	26.4	47
UNT02A	UNT02A Unnamed Tributary (49743) to Little Mill Creek Upstream of LMC01						
	Al	ND	NA	*0.03	-	0.0	0
	Fe	ND	NA	*0.05	-	0.0	0
	Mn	13.2	3.6	*0.03	3.57	9.6	73
	Acidity	ND	NA	-	-	0.0	0
UNT03	UNT03 Unnamed Tributary (49743) to Little Mill Creek Upstream of LMC01						
	Al	0.1	0.02	0.0	0.02	0.08	83
	Fe	2.5	0.02	0.0	0.02	2.48	99
	Mn	2.3	0.05	0.0	0.05	2.25	98
	Acidity	7.8	1.8	0.0	1.8	6.0	77
LMC01	Little Mill Creek						
	Al	8.6	3.2	*0.03	3.17	0.0	0
	Fe	47.7	9.5	*0.05	9.45	38.2	79

Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
	Mn	143.9	8.6	*0.03	8.57	18.7	68
	Acidity	525.4	68.3	0.0	68.3	134.7	66
UNT05	UNT05 Unnamed Tributary (49742) to Little Mill Creek Upstream of LMC02						
	Al	1.7	0.3	0.0	0.27	1.4	84
	Fe	29.5	0.3	0.0	0.25	29.2	99
	Mn	30.8	0.6	0.0	0.57	30.2	98
	Acidity	176.6	0.5	0.0	0.5	176.1	99.7
LMC02	Little Mill Creek						
	Al	8.3	2.1	0.0	2.1	0.7	26
	Fe	42.9	7.3	0.0	7.3	0.0	0
	Mn	138.9	6.9	0.0	6.9	0.4	6
	Acidity	702.9	21.1	0.0	21.1	48.8	70
UNT06	UNT06 Unnamed Tributary (49741) to Little Mill Creek Downstream of LMC02						
	Al	ND	NA	*0.03	-	0.0	0
	Fe	3.0	1.0	*0.05	0.95	2.0	67
	Mn	4.0	0.4	*0.03	0.37	3.6	89
	Acidity	18.8	4.7	0.0	4.7	14.1	75
UNT07	UNT07 Unnamed Tributary (49740) to Little Mill Creek Upstream of LMC03						
	Al	8.8	0.9	0.22	0.68	7.9	90
	Fe	25.3	0.8	0.33	0.47	24.5	97
	Mn	25.9	0.8	0.22	0.58	25.1	97
	Acidity	197.5	3.9	0.0	3.9	193.6	98
LMC03	Little Mill Creek						
	Al	12.9	4.5	0.0	4.5	0.0	0
	Fe	47.2	19.4	0.0	19.4	0.0	0
	Mn	218.0	10.9	0.0	10.9	46.5	81
	Acidity	1077.0	86.2	0.0	86.2	101.3	54
UNT08C	UNT08C Southern Unnamed Tributary (49737) to Little Mill Creek						
	Al	2.6	1.1	0.001	1.099	1.5	56
	Fe	3.0	3.0	0.06	2.94	0.0	0
	Mn	74.9	4.5	0.04	4.46	70.4	94
	Acidity	334.6	33.5	0.0	33.5	301.1	86
UNT08B	UNT08B Eastern Unnamed Tributary (49739) to Unnamed Tributary (49737) Upstream of UNT08						
	Al	ND	NA	-	-	0.0	0
	Fe	ND	NA	-	-	0.0	0
	Mn	0.4	0.2	0.0	0.2	0.2	58
	Acidity	9.1	1.5	0.0	1.5	7.6	84
UNT08	UNT08 Unnamed Tributary (49737) to Little Mill Creek, Downstream from LMC03						
	Al	3.8	1.2	0.0	1.2	1.1	48
	Fe	3.1	3.1	0.0	3.1	0.0	0
	Mn	62.1	3.1	0.0	3.1	3.1	19
	Acidity	279.1	25.14	0.0	25.1	3.2	11
UNT09	UNT09 Unnamed Tributary (49736) to Little Mill Creek, Downstream of UNT08						
	Al	2.7	0.1	0.0	0.1	2.6	95
	Fe	0.05	0.05	0.0	0.05	0.0	0
	Mn	4.2	0.1	0.0	0.1	4.1	97
	Acidity	35.6	1.4	0.0	1.4	34.2	96
LMC04	Little Mill Creek						
	Al	36.0	13.3	0.0	13.3	9.2	41

Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
	Fe	44.4	29.3	0.0	29.3	0.0	0
	Mn	406.4	20.3	0.0	20.3	115.8	85
	Acidity	1794.7	107.7	0.0	107.7	408.1	79
UNT10	UNT10 Unnamed Tributary (49734) to Little Mill Creek Downstream of LMC04						
	Al	36.9	1.5	0.14	1.36	34.4	96
	Fe	39.6	1.2	0.21	0.99	38.4	97
	Mn	53.6	2.1	0.14	1.96	51.5	96
	Acidity	488.5	4.9	0.0	4.9	483.6	99
LMC05	Little Mill Creek						
	Al	78.3	14.1	0.0	14.1	6.1	30
	Fe	188.4	17.0	0.0	17.0	118.0	87
	Mn	425.5	21.3	0.0	21.3	0.0	0
	Acidity	2227.1	111.4	0.0	111.4	0.0	0
UNT12	UNT12 Unnamed Tributary (49733) to Little Mill Creek Downstream of LMC05						
	Al	3.7	0.1	0.0	0.1	3.6	96
	Fe	0.4	0.1	0.0	0.1	0.3	60
	Mn	2.0	0.2	0.0	0.2	1.8	90
	Acidity	33.9	0.0	0.0	0.0	33.9	100
UNT12B	UNT12B Unnamed Tributary to Little Mill Creek Downstream of UNT12						
	Al	2.8	0.08	0.0	0.08	2.72	97
	Fe	0.2	0.1	0.0	0.1	0.1	56
	Mn	1.7	0.14	0.0	0.14	1.56	92
	Acidity	29.6	0.0	0.0	0.0	29.6	100
UNT13	UNT13 Unnamed Tributary (49732) to Little Mill Creek Downstream of UNT12B						
	Al	ND	NA	-	-	0.0	0
	Fe	4.8	0.2	0.0	0.2	4.6	95
	Mn	3.6	0.17	0.0	0.17	3.43	95
	Acidity	36.2	0.0	0.0	0.0	36.2	100
LMC06	Little Mill Creek at Confluence with Mill Creek						
	Al	79.1	14.2	0.0	14.2	0.0	0
	Fe	202.8	26.4	0.0	26.4	0.1	0.004
	Mn	471.4	23.6	0.0	23.6	36.8	61
	Acidity	3041.7	60.8	0.0	60.8	765.4	93

*The MSM Mining Co. treatment systems MSMT1, MSMT2 and MSMT3 are not all in operation at the same time. As mining proceeds treatment system are built, used and removed. By fall of 2005 treatment system MSMT1 is no longer used and has been removed. The MSMT2 is now built and ready for use. MSMT3 will be used in the future. As these treatment systems are built and used the WLA moves from one treatment system to another and one of three sample points are affected by the WLA in turn. MSMT1 affected a UNT that is not on our GIS system but is upstream of UNT06. The MSMT2 treatment system also discharges to a UNT that is not on our GIS system but is upstream of sample point LMC01. Treatment system MSMT3 will discharge upstream of sample point UNT02A. See Table on page 20 for the sample point affected by the WLAs.

All waste load allocations were calculated using the methodology explained previously in the Method to Quantify Treatment Pond Pollutant Load section of the report.

Waste allocations for the existing mining operation were incorporated into the calculations at UNT02A, LMC01, LMC02, UNT07, UNT08C, and UNT10. These are the first downstream monitoring points that receive all the potential flow of treated water from the five treatment sites MSMT3, MSMT2, MSMT1, C&KD7, SHC006 and SHC005. No required reductions of these permits are necessary at this time because there are upstream non-point sources that when reduced will met the TMDL or there is available assimilation capacity. All necessary reductions are assigned to non-point sources.

Although a TMDL for aluminum is not necessary at LMC01 because the water quality standard is met, WLAs are assigned to the MSMT2 discharge of the MSM Coal Co. permit. Because the standard is met for aluminum at LMC01, the actual allowed load is the water quality standard times the flow and a conversion factor at the points. For LMC01 this equals 32.69 lbs/day for aluminum. The aluminum WLAs of 0.03 lbs/day for the above segment is acceptable and will not have a negative impact on water quality within the segments.

The MSM Coal Co., Inc Songer Monks Mine (SMP#33040102, NPDES No. PA 0242519) has a non-standard pit size of 100 feet in length and a width of 200 feet. This pit size was used in the Method to Quantify Treatment Pond Pollutant Load calculation as shown below:

40 in. precip./yr x 1 ft/12/in. x 100'x 200'/pit x 7.48 gal/ft3 x 1yr/365days x 1day/24hr. x 1hr/60mins. = 0.95 gal/min average discharge from direct precipitation into the open mining pit area.

40 in. precip./yr x 3 pit areas x 1 ft/12/in. x 100'x 200'/pit x 7.48 gal/ft3 x 1yr/365days x 1day/24hr. x 1hr/60mins. x 15 in. runoff/100 in. precipitation = 0.43 gal/min average discharge from spoil runoff into the pit area.

The total average flow to the pit is represented by the sum of the direct pit precipitation and the water flowing to the pit from the spoil area as follows:

Total Average Flow = Direct Pit Precipitation + Spoil Runoff

Total Average Flow = 0.95 gal./min. + 0.43 gal./min. = 1.38 gal./min.

The resulting average load from a permitted treatment pond area as follows.

Allowable Iron Waste Load Allocation:
1.38 gal./min. x 3 mg/l x 0.01202 = 0.05 lbs./day

Allowable Manganese Waste Load Allocation:
1.38 gal./min. x 2 mg/l x 0.01202 = 0.03 lbs./day

Allowable Aluminum Waste Load Allocation:
1.38 gal./min. x 2 mg/l x 0.01202 = 0.03 lbs./day

The C&K Coal Co. is treating a post mining discharge that is noted as D7, (C&KD7 on the map) flow data from 1996 to 2005 was available (average flow at D7 is 9.28 gpm). This flow data is available at the end of Attachment F. This flow data was used to calculate the WLAs for iron, manganese and aluminum. See table 5 below.

The Sky Haven Co., Inc Corsica Mine (a Subchapter F remining permit SMP#16990105, NPDES No. PA 0241661) has two non-standard pit sizes Pit 1 is 250 feet in length and a width of 100 feet and Pit 2 is 835 feet in length with a width of 100 feet. Treatment plant SHC006 is associated with Pit 1 and treatment plant SHC005 is associated with Pit 2. These pit sizes were used in the Method to Quantify Treatment Pond Pollutant Load calculation and the results are shown in Table 5. For aluminum the instream concentration was 0.55 mg/l exceeded the instream criteria, so in order to protect this unnamed tributary from aluminum degradation, treatment facility SHC1 had been assigned an effluent limit of 0.6 mg/l. This treatment facility still exists, however, mining has been completed on this part of the site. Mining on the part of the site that discharges to SHC2 is expected to be completed by fall of 2005.

Table 5. Waste Load Allocation of Permitted Discharges

Parameter	Allowable Average Monthly Conc. (mg/l)	Calculated Average Flow (MGD)	WLA (lbs/day)
MSMT1	UNT not on GIS, upstream of UNT06		
Al	2.0	0.0019	0.03
Fe	3.0	0.0019	0.05
Mn	2.0	0.0019	0.03
MSMT2	UNT not on GIS, upstream of LMC01		
Al	2.0	0.0019	0.03
Fe	3.0	0.0019	0.05
Mn	2.0	0.0019	0.03
MSMT3	UNT02A		
Al	2.0	0.0019	0.03
Fe	3.0	0.0019	0.05
Mn	2.0	0.0019	0.03
C&KD7	UNT07		
Al	2.0	0.013	0.22
Fe	3.0	0.013	0.33
Mn	2.0	0.013	0.22
SHC006	UNT08C		
Al	0.6	0.0024	0.001
Fe	3.0	0.0024	0.06
Mn	2.0	0.0024	0.04
SHC005	UNT10		
Al	2.0	0.0083	0.14
Fe	3.0	0.0083	0.21
Mn	2.0	0.0083	0.14

The MSM Mining Co. treatment systems MSMT1, MSMT2 and MSMT3 are not all in operation at the same time. As mining proceeds treatment system are built, used and removed. By fall of 2005 treatment system MSMT1 is no longer used and has been removed. The MSMT2 is now built and ready for use. MSMT3 will be used in the future. As these treatment systems are built and used the WLA moves from one treatment system to another and one of three sample points are affected by the WLA in turn. MSMT1 affected a UNT that is not on our GIS system but is upstream of UNT06. The MSMT2 treatment system also discharges to a UNT that is not on our GIS system but is upstream of sample point LMC01. Treatment system MSMT3 will discharge upstream of sample point UNT02A

Note for the two treatment plants that are part of the Sky Haven Coal permit number 16990105. The SHC006 treatment plant is still in place but not in operation because mining has been completed on this part of the site. Mining is expected to be completed on the remaining part of the site that is treated by SHC 005 by fall of 2005.

Recommendations

Two primary programs that provide reasonable assurance for maintenance and improvement of water quality in the watershed are in effect. The PADEP'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 PADEP'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 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 PA 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. 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.

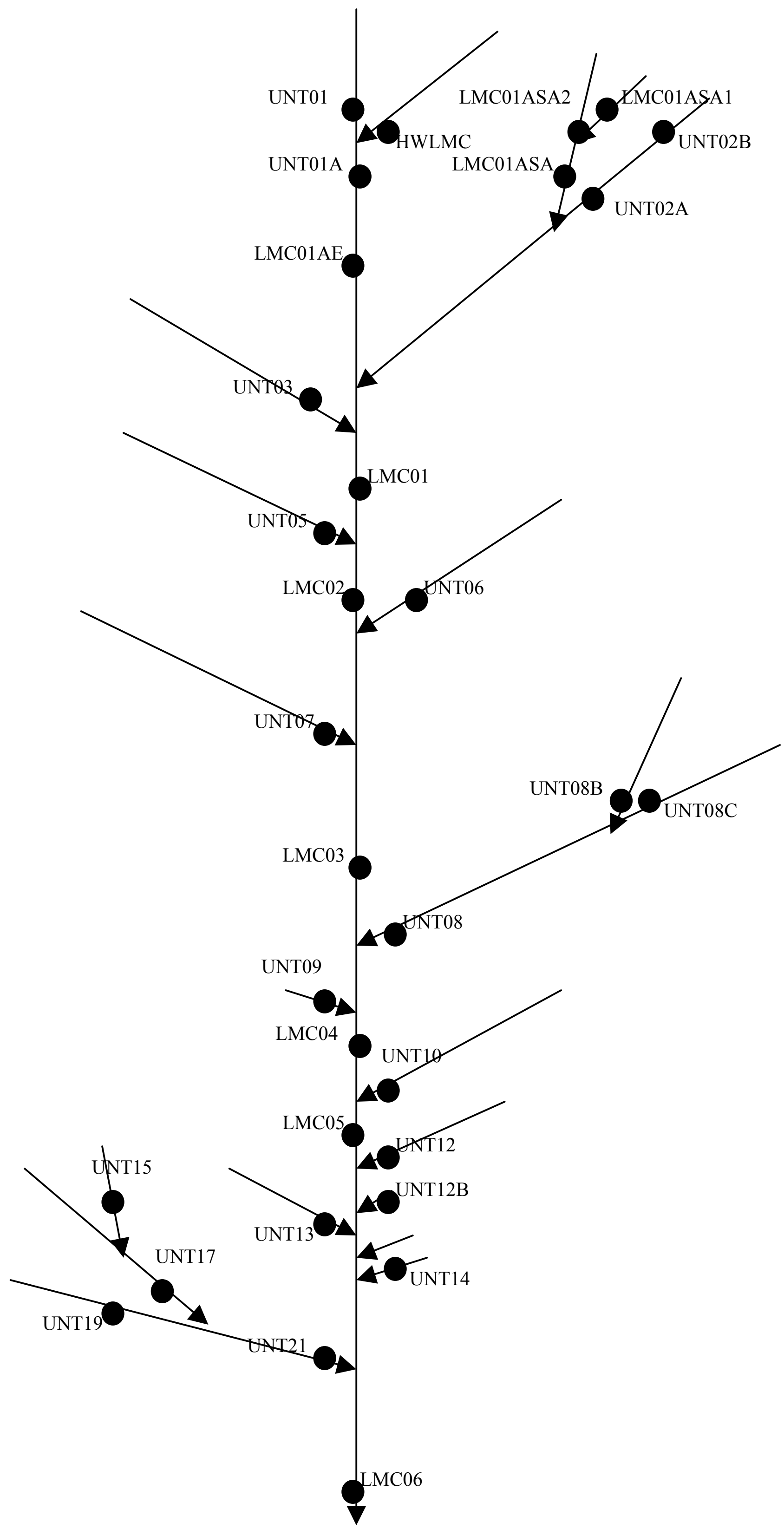
Pennsylvania is striving for complete reclamation of its abandoned mines and plugging of its orphaned wells. Realizing this task is no small order, DEP has developed concepts to make abandoned mine reclamation easier. These concepts, collectively called Reclaim PA, include legislative, policy land management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

Since 1990, the Mill Creek Coalition has been active in assessing the water quality and completing AMD remediation projects in the Mill Creek Watershed. Working with local partnerships and local, state and federal agencies, the Mill Creek Coalition has been responsible for the installation of approximately 20 passive treatment systems; 16 of which are located in the Little Mill Creek Watershed. The Coalition is currently working with The EADS Group to create a GIS based Operation, Maintenance and Replacement (OM&R) Plan for all of the treatment systems in the watershed and has also applied for Growing Greener funds to remediate discharges on two AML sites in 2005.

Public Participation

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on July 9, 2005 and the Clarion News on July 26, 2005 to foster public comment on the allowable loads calculated. A public meeting was held on August 10, 2005 beginning at 7:00 p.m., at Clarion University in the Peirce Science Center Building, Room 225, in Clarion, Pennsylvania, to discuss the proposed TMDL.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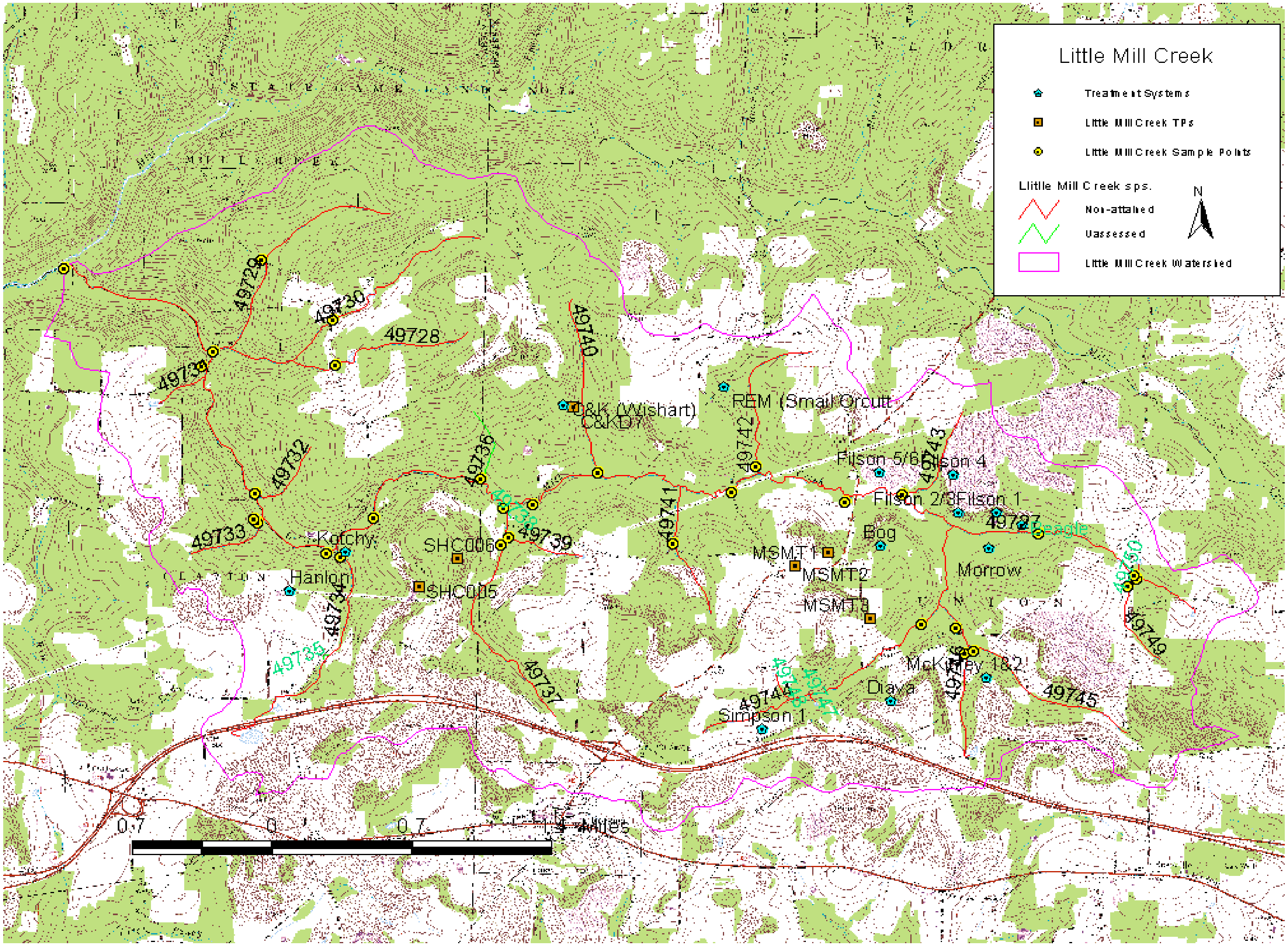
Attachment A

Little Mill Creek Watershed Maps


Little Mill Creek
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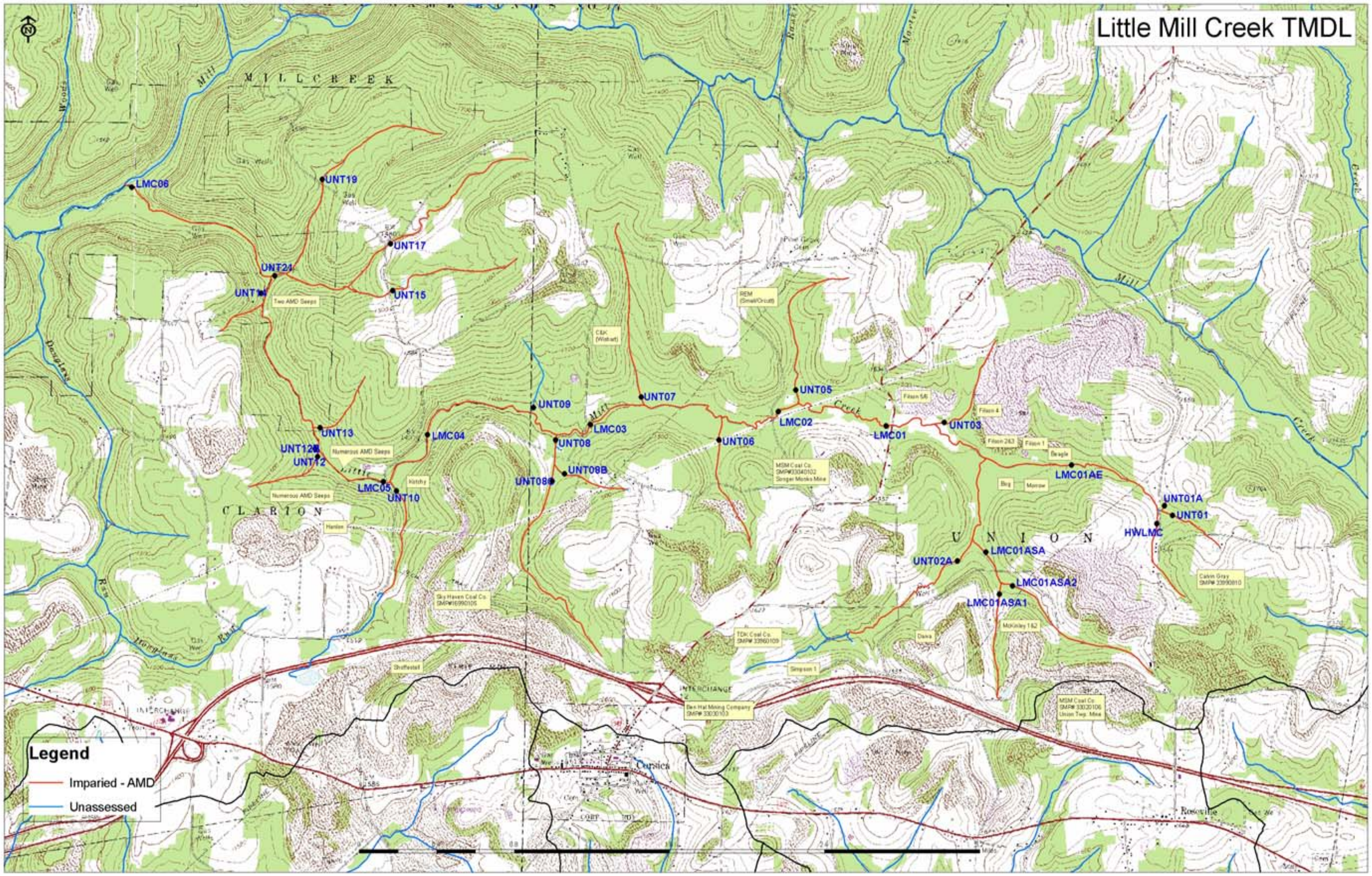
Little Mill Creek TMDL
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UNT15
Two AMD Seeps
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Numerous AMD Seeps
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UNT08B
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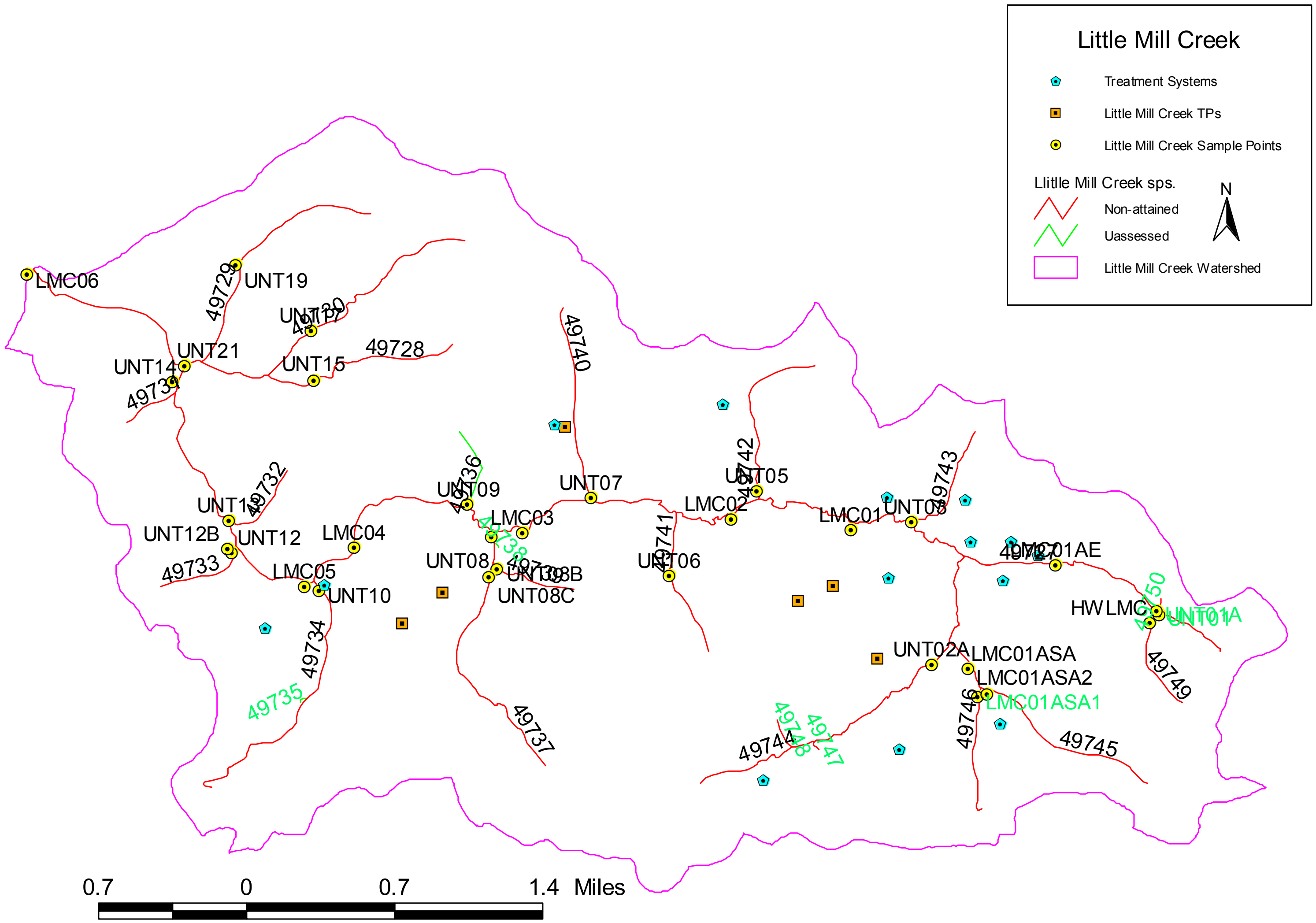
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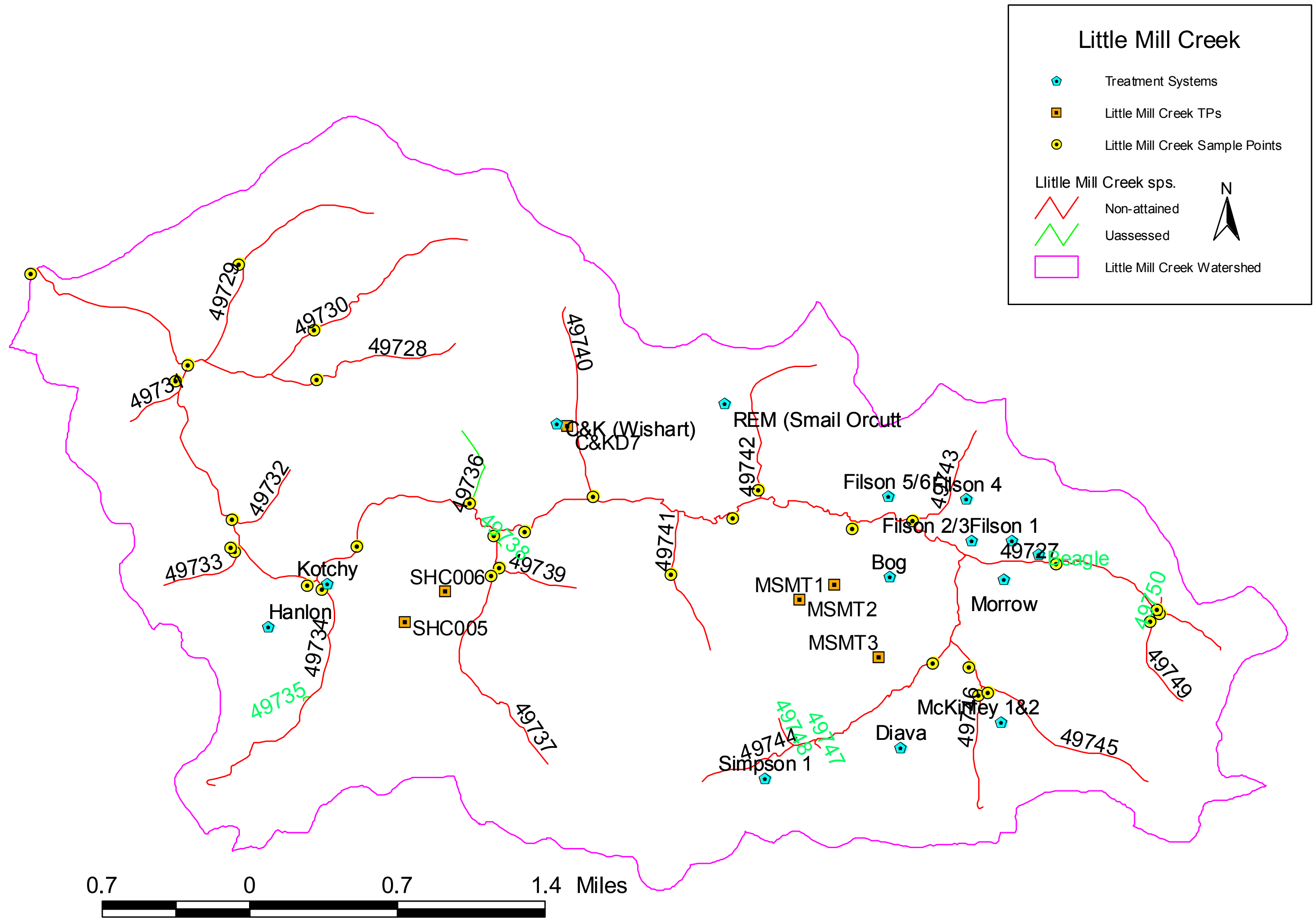
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Hanlon
SHC006
SHC005
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49735
49737
49741
Filson 5/6
Filson 4
49743
Filson 2/3
Filson 1
49727
Beagle
Bog
MSMT1
MSMT2
MSMT3
Morrow
49750
49749
McKinney 1&2
Diava
49744
Simpson 1
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Attachment B

Method for Addressing Section 303(d) Listings for pH

Method for Addressing 303(d) Listings for pH

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

The pH, a measurement of hydrogen ion acidity presented as a negative logarithm, is not conducive to standard statistics. Additionally, pH does not measure latent acidity. For this reason, and based on the above information, Pennsylvania is using the following approach to address the stream impairments noted on the 303(d) list due to pH. The concentration of acidity in a stream is at least partially chemically dependent upon metals. For this reason, it is extremely difficult to predict the exact pH values, which would result from treatment of abandoned mine drainage. 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 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.*

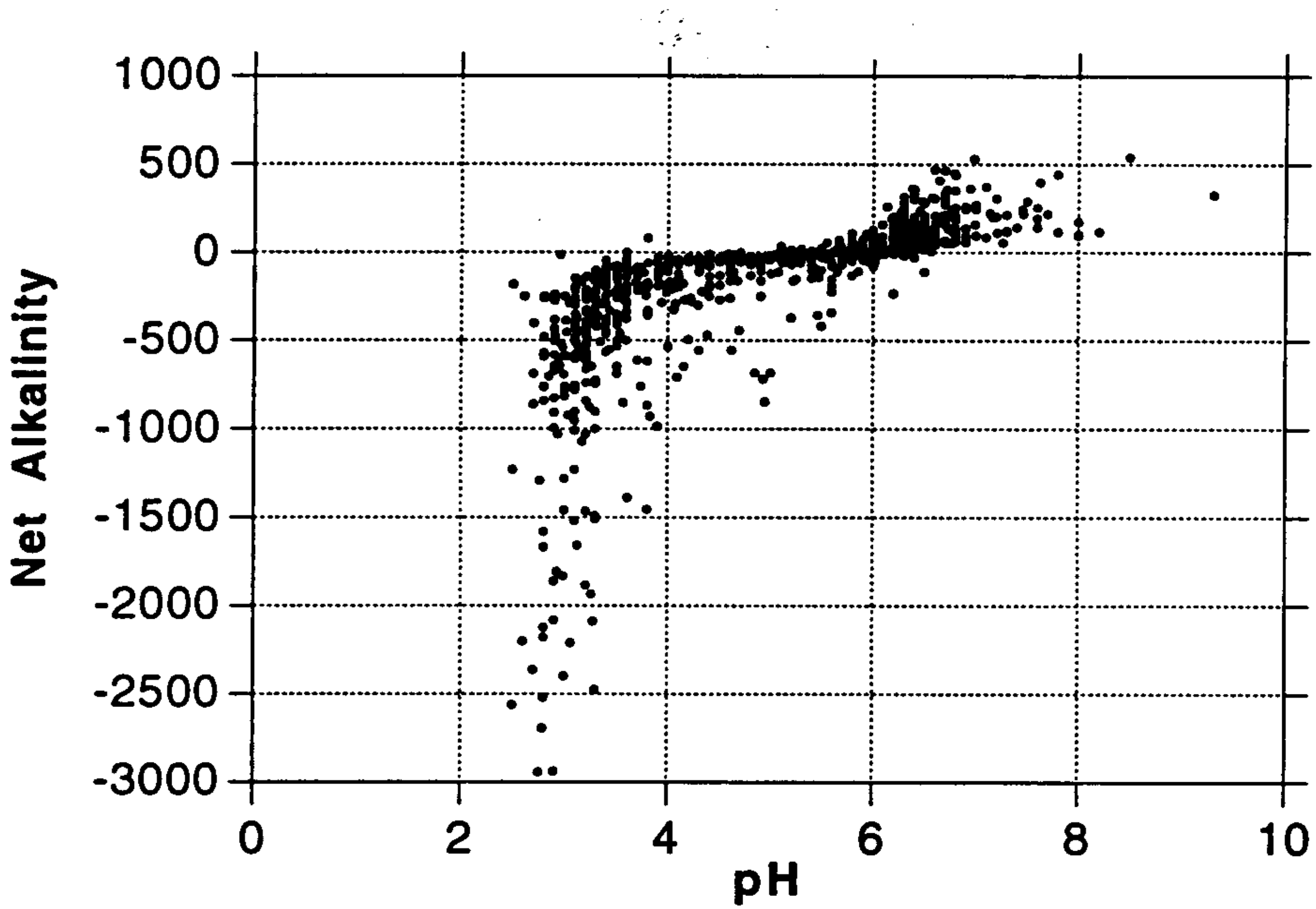

Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Attachment C

TMDLs By Segment

Little Mill Creek

The TMDL for Little Mill Creek consists of load allocations for thirty sampling sites along Little Mill Creek and various unnamed tributaries.

Little Mill Creek is listed for metals from AMD as being the cause of the degradation to the stream. The method and rationale for addressing pH is contained in Attachment B.

An allowable long-term average in-stream concentration was determined at the points below 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.

UNT01 (49727) Headwaters of Little Mill Creek

The TMDL for this sample point on Little Mill Creek consists of a load allocation to the segment upstream. The load allocation for this segment was computed using water-quality sample data collected at point UNT01. The average flow, measured at the sampling point UNT01 (0.07 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point UNT01 shows pH ranging between 6.6 and 7.2, pH will be addressed in this TMDL because of the mining impacts. 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.

Allocations were not calculated for aluminum and manganese because all of the aluminum data were less than detection and two of four manganese data points were also less than detection.

Table C1. Load Allocations for Point UNT01				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. mg/l	Load Lbs/day
Aluminum	ND	ND	NA	NA
Iron	0.28	0.2	0.28	0.2
Manganese	ND	ND	NA	NA
Acid	9.05	5.0	2.90	1.6
Alkalinity	16.80	9.2		

Table C2. Calculation of Load Reduction Necessary at Point UNT01				
	Al	Fe	Mn	Acidity
	(lbs/day)	(lbs/day)	(lbs/day)	(lbs/day)
Existing Load	ND	0.2	ND	5.0
Allowable Load=TMDL	NA	0.2	NA	1.6
Load Reduction	0.0	0.0	0.0	3.4
Total % Reduction	0	0	0	68

HWLMC Unnamed Tributary (49749) of Little Mill Creek

The TMDL for this unnamed tributary of Little Mill Creek consists of a load allocation to all of the watershed area upstream of sample point HWLMC. The load allocation for this segment was computed using water-quality sample data collected at point HWLMC. The average flow, measured at the sampling point HWLMC (0.09 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point HWLMC shows pH ranging between 6.1 and 6.8, pH will be addressed in this TMDL because of the mining impacts. 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.

Allocations were not calculated for aluminum and iron because all of the aluminum data were less than detection and three of five iron data points were also less than detection.

Table C3. Load Allocations at Point HWLMC				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	ND	ND	NA	NA
Iron	ND	ND	NA	NA
Manganese	0.91	0.7	0.34	0.2
Acid	13.64	9.9	5.18	3.8
Alkalinity	24.88	18.1		

Table C4. Calculation of Load Reduction Necessary at Point HWLMC				
	Al	Fe	Mn	Acidity
	(#/day)	(#/day)	(#/day)	(#/day)
Existing Load	ND	ND	0.7	9.9
Allowable Load=TMDL	NA	NA	0.2	3.8
Load Reduction	0.0	0.0	0.5	6.2
Total % Reduction	0	0	63	62

UNT01A Low Flow Unnamed Tributary (49750) to Little Mill Creek Downstream of UNT01

The TMDL for sampling point UNT01A consists of a load allocation to the area upstream of point UNT01A. The load allocation for this tributary was computed using water-quality sample data collected at point UNT01A. The average flow, measured at the sampling point UNT01A (0.01 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point UNT01A shows pH ranging between 6.1 and 6.6, pH will be addressed in this TMDL because of the mining impacts. 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.

Allocations were not calculated for aluminum and iron because all of the aluminum data were less than detection and three of five iron data points were also less than detection.

Table C5. Load Allocations at Point UNT01A				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	ND	ND	NA	NA
Iron	ND	ND	NA	NA
Manganese	0.15	0.01	0.15	0.01
Acid	29.75	1.6	8.03	0.4
Alkalinity	13.70	0.7		

Table C6. Calculation of Load Reduction Necessary at Point UNT01A				
	Al	Fe	Mn	Acidity
	(#/day)	(#/day)	(#/day)	(#/day)
Existing Load	ND	ND	0.01	1.6
Allowable Load=TMDL	NA	NA	0.01	0.4
Load Reduction	0.0	0.0	0.00	1.2
Total % Reduction	0	0	0	73

LMC01AE Little Mill Creek

The TMDL for this segment of Little Mill Creek consists of a load allocation to the area between sample points UNT01, HWLMC, UNT01A and LMC01AE. The load allocation for this segment was computed using water-quality sample data collected at point LMC01AE. The average flow, measured at the sampling point LMC01AE (0.33 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point LMC01AE shows pH ranging between 6.5 and 7.3, pH will be addressed in this TMDL because of the mining impacts. 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.

Allocations were not calculated for aluminum and iron because all of the aluminum data were less than detection and four of five iron data points were also less than detection.

Table C7. Load Allocations for Point LMC01AE				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	ND	ND	NA	NA
Iron	ND	ND	NA	NA
Manganese	0.14	0.4	0.14	0.4
Acid	11.40	31.3	4.79	13.1
Alkalinity	22.92	62.9		

The calculated load reductions for all the loads that enter point LMC01AE must be accounted for in the calculated reductions at sample point LM01AE shown in Table C8. A comparison of measured loads between points UNT01, HWLMC, UNT0IA, and LMC01AE shows that there is no additional loading entering the segment for aluminum, iron and manganese. For aluminum, iron and manganese the percent decrease in existing load is applied to the allowable upstream load entering the segment. There is an increase in acidity loading within the segment. The total segment load for acidity is the sum on the upstream allocated loads and any additional loading within the segment.

Table C8. Calculation of Load Reduction at Point LMC01AE				
	Al	Fe	Mn	Acidity
Existing Load	0	0.18	0.4	31.3
Difference in Existing Load between UNT01, HWLMC, UNT01A & LMC01AE	0.0	-0.1	-0.3	14.8
Load tracked from UNT01, HWLMC & UNT01A	0.0	0.26	0.27	5.8
Percent loss due to instream process	-	35	43	-
Percent load tracked from UNT01, HWLMC & UNT01A	-	65	57	-
Total Load tracked from UNT01, HWLMC & UNT01A	0.0	0.17	0.15	20.6
Allowable Load at LCM01AE	0.0	0.18	0.39	13.1
Load Reduction at LMC01AE	0.0	0.0	0.0	7.5
% Reduction required at LMC01AE	0	0	0	36

LMC01ASA2 Eastern Unt (49745) Upstream of LMC01ASA

The TMDL for this unnamed tributary of Little Mill Creek consists of a load allocation to all of the watershed area upstream of sample point LMC01ASA2. The load allocation for this segment was computed using water-quality sample data collected at point LMC01ASA2. The average flow, measured at the sampling point LMC01ASA2 (0.45 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point LMC01ASA2 shows pH ranging between 4.7 and 5.5, pH will be addressed in this TMDL because of the mining impacts. 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.

Allocations were not calculated for iron because four of five iron data points were also than detection.

Table C9. Load Allocations at Point LMC01ASA2

	Measured Sample Data		**Allowable**	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	1.63	6.2	0.25	0.9
Iron	ND	ND	NA	NA
Manganese	18.72	70.8	0.75	2.8
Acid	66.36	251.0	4.65	17.6
Alkalinity	8.52	32.2		

Table C10. Calculation of Load Reduction Necessary at Point LMC01ASA2

	Al	Fe	Mn	Acidity
	(#/day)	(#/day)	(#/day)	(#/day)
Existing Load	6.2	ND	70.8	251.0
Allowable Load=TMDL	0.9	NA	2.8	17.6
Load Reduction	5.3	0.0	68.0	233.5
Total % Reduction	85	0	96	93

LMC01ASA1 Southern Unnamed Tributary (49746) Upstream of LMC01ASA

The TMDL for sampling point LMC01ASA1 consists of a load allocation of the area upstream of sample point LMC01ASA1. The load allocation for this tributary was computed using water-quality sample data collected at point LMC01ASA1. The average flow, measured at the sampling point LMC01ASA1 (0.14 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point LMC01ASA1 shows pH ranging between 4.9 and 6.5, pH will be addressed in this TMDL because of the mining impacts. 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.

Allocations were not calculated for aluminum and iron because three of five of the aluminum data were less than detection and all of the iron data points were also less than detection.

Table C11. Load Allocations at Point LMC01ASA1

	Measured Sample Data		**Allowable**	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	ND	ND	NA	NA
Iron	ND	ND	NA	NA
Manganese	13.0	15.2	0.78	0.9
Acid	37.72	44.1	4.90	5.7
Alkalinity	11.24	13.1		

Table C12. Calculation of Load Reduction Necessary at Point LMC01ASA1

	Al	Fe	Mn	Acidity
	(#/day)	(#/day)	(#/day)	(#/day)
Existing Load	ND	ND	15.2	44.1
Allowable Load=TMDL	NA	NA	0.9	5.7
Load Reduction	0.0	0.0	14.3	38.4
Total % Reduction	0	0	94	87

LMC01ASA Unnamed Tributary (49745) to Unnamed Tributary (49744) to Little Mill Creek

The TMDL for sampling point LMC01ASA consists of a load allocation of the area between sample points LMC01ASA2, LMC01ASA1 and LMC01ASA. The load allocation for this tributary was computed using water-quality sample data collected at point LMC01ASA. The average flow, measured at the sampling point LMC01ASA (0.81 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point LMC01ASA shows pH ranging between 4.8 and 5.6, pH will be addressed in this TMDL because of the mining impacts. 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.

Table C13. Load Allocations for Point LMC01ASA				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	1.34	9.0	0.19	1.3
Iron	0.14	1.0	0.14	1.0
Manganese	16.38	110.2	0.82	5.5
Acid	48.72	327.8	4.38	29.5
Alkalinity	8.68	58.4		

The calculated load reductions for all the loads that enter point LMC01ASA must be accounted for in the calculated reductions at sample point LMC01ASA shown in Table C14. A comparison of measured loads between points LMC01ASA2, LMC01ASA1 and LMC01ASA shows that there is no additional loading entering the segment for iron. For iron the percent decrease in existing loads are applied to the allowable upstream loads entering the segment. There is an increase in aluminum, manganese and acidity loading within the segment. The total segment aluminum, manganese and acidity loads are the sum of the upstream allocated loads and any additional loading within the segment.

Table C14. Calculation of Load Reduction at Point LMC01ASA				
	Al	Fe	Mn	Acidity
Existing Load	9.0	1.0	110.2	327.8
Difference in Existing Load between LMC01ASA2, LMC01ASA1 & LMC01ASA	1.8	0.7	24.2	32.6
Load tracked from LMC01ASA2 & LMC01ASA1	1.1	0.3	3.7	23.3
Total Load tracked between points LMC01ASA2, LMC01ASA1 & LMC01ASA	2.9	1.0	27.9	55.9
Allowable Load at LMC01ASA	1.3	1.0	5.5	29.5
Load Reduction at LMC01ASA	1.6	0.0	22.4	26.4
% Reduction required at LCM01ASA	57	0	80	47

Waste Load Allocation – MSM Coal Co., Inc.

The MSM Coal Co., Songer Monks Mine Permit has three permitted treatment facilities. One, MSMT3 is upstream of Sample Point UNT02A. The waste load allocation was calculated as described in the Method to Quantify Treatment Pond Pollutant Loading section of the report and is incorporated into the calculations at UNT02A. This is the first downstream monitoring point that receives all the potential flow of treated water. The following table shows the waste load allocation.

Table C15. Waste Load Allocation			
Parameter	Allowable Average Monthly Conc. (mg/l)	Calculated Average Flow (MGD)	WLA (lbs/day)
MSMT3			
Al	2.0	0.0019	0.03
Fe	3.0	0.0019	0.05
Mn	2.0	0.0019	0.03

UNT02A Unnamed Tributary (49743) to Little Mill Creek Upstream of LMC01

The TMDL for this segment of the Unnamed Tributary to Little Mill Creek consists of a load allocation to all of the watershed area upstream of sample point UNT02A. The load allocation for this segment was computed using water-quality sample data collected at point UNT02A. The average flow, measured at the sampling point UNT02A (0.98 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point UNT02A shows pH ranging between 6.2 and 7.6, pH will not be addressed in this TMDL because this unnamed tributary s net alkaline. The method and rationale for addressing pH is contained in Attachment B.

Table C16. Load Allocations for Point UNT02A				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Al	ND	ND	NA	NA
Fe	ND	ND	NA	NA
Mn	1.61	13.2	0.44	3.6
Acid	ND	ND	NA	NA
Alk	31.59	259.3		

Table C17. Calculation of Load Reduction Necessary at Point UNT02A				
	Al	Fe	Mn	Acidity
	(#/day)	(#/day)	(#/day)	(#/day)
Existing Load	ND	ND	13.2	ND
Allowable Load=TMDL	NA	NA	3.6	NA
Load Reduction	0.0	0.0	9.7	0.0
Total % Reduction	0	0	73	0

UNT03 Unnamed Tributary (49743) to Little Mill Creek Upstream of LMC01

The TMDL for this unnamed tributary to Little Mill Creek consists of a load allocation to all of the watershed area upstream of sample point UNT03. The load allocation for this segment was computed using water-quality sample data collected at point UNT03. The average flow, measured at the sampling point UNT03 (0.01 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point UNT03 shows pH ranging between 4.2 and 6.4, pH will be addressed in this TMDL because of the mining impacts. 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.

Table C18. Load Allocations for Point UNT03

	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	0.78	0.1	0.13	0.02
Iron	20.59	2.5	0.21	0.02
Manganese	18.98	2.3	0.38	0.05
Acid	64.56	7.8	14.85	1.8
Alkalinity	24.16	2.9		

Table C19. Calculation of Load Reduction Necessary at Point UNT03

	Al	Fe	Mn	Acidity
	(#/day)	(#/day)	(#/day)	(#/day)
Existing Load	0.09	2.47	2.28	7.8
Allowable Load=TMDL	0.02	0.02	0.05	1.8
Load Reduction	0.07	2.45	2.23	6.0
Total % Reduction	83	99	98	77

Waste Load Allocation – MSM Coal Co., Inc.

The MSM Coal Co., Songer Monks Mine Permit has three permitted treatment facilities. One, MSMT2 discharges to a UNT that is not on our GIS. This UNT is upstream of Sample Point LMC01. The waste load allocation was calculated as described in the Method to Quantify Treatment Pond Pollutant Loading section of the report and is incorporated into the calculations at LMC01. This is the first downstream monitoring point that receives all the potential flow of treated water. The following table shows the waste load allocation.

Table C20. Waste Load Allocation			
Parameter	Allowable Average Monthly Conc. (mg/l)	Calculated Average Flow (MGD)	WLA (lbs/day)
MSMT2			
Al	2.0	0.0019	0.03
Fe	3.0	0.0019	0.05
Mn	2.0	0.0019	0.03

LMC01 Little Mill Creek

The TMDL for this segment of Little Mill Creek consists of a load allocation to all of the watershed area between sample points LMC01AE, LMC01ASA, UNT02A, UNT03, & LMC01. The load allocation for this segment was computed using water-quality sample data collected at point LMC01. The average flow, measured at the sampling point LMC01 (1.96 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point LMC01 shows pH ranging between 4.5 and 6.2, pH will be addressed in this TMDL because of the mining impacts. 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.

Table C21. Load Allocation at Point LMC01				
	Measured Sample Data		**Allowable**	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	0.52	8.6	0.19	3.2
Iron	2.91	47.7	0.58	9.5
Manganese	8.78	143.9	0.53	8.6
Acid	32.06	525.4	4.17	68.3
Alkalinity	11.03	180.7		

The calculated load reductions for all the loads that enter point LMC01 must be accounted for in the calculated reductions at sample point LMC01 shown in Table C22. A comparison of measured loads between points LMC01AE, LMC01ASA, UNT02A, UNT03 and LMC01 shows that there is no additional loading entering the segment for aluminum. For aluminum the percent decrease in existing loads are applied to the allowable upstream loads entering the segment. There is additional loading entering the segment for iron, manganese and acidity. The total segment iron, manganese, and acidity loads are the sum of the upstream allocated loads and any additional loading within the segment.

Table C22. Calculation of Load Reduction at Point LMC01				
	Al	Fe	Mn	Acidity
Existing Load	8.6	47.7	143.9	525.4
Difference in Existing Load between LMC01AE, LMC01ASA, UNT02A, UNT03 & LMC01	-1.2	43.0	17.8	152.0
Load tracked from LMC01AE, LMC01ASA, UNT02A & UNT03	1.9	2.3	9.5	51.0
Percent loss due to instream process	12	-	-	-
Percent load tracked from LMC01AE, LMC01ASA, UNT02A & UNT03	88	-	-	-
Total Load tracked between points LMC01AE, LMC01ASA, UNT02A & UNT03	1.7	45.3	27.3	203.0
Allowable Load at LMC01	3.2	9.5	8.6	68.3
Load Reduction at LMC01	0.0	35.7	18.7	134.7
% Reduction required at LMC01	0	79	68	66

UNT05 Unnamed Tributary (49742) to Little Mill Creek Upstream of LMC02

The TMDL for this unnamed tributary to Little Mill Creek consists of a load allocation to all of the watershed area upstream of sample point UNT05. The load allocation for this segment was computed using water-quality sample data collected at point UNT05. The average flow, measured at the sampling point UNT05 (0.15 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point UNT05 shows pH ranging between 3.0 and 4.2, pH will be addressed in this TMDL because of the mining impacts. 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.

Table C23. Load Allocations for Point UNT05				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	1.36	1.7	0.22	0.3
Iron	24.17	29.5	0.24	0.3
Manganese	25.20	30.8	0.50	0.6
Acid	144.50	176.6	0.43	0.5
Alkalinity	1.10	1.3		

Table C24. Calculation of Load Reduction Necessary at Point UNT05				
	Al	Fe	Mn	Acidity
	(#/day)	(#/day)	(#/day)	(#/day)
Existing Load	1.7	29.5	30.8	176.6
Allowable Load=TMDL	0.3	0.3	0.6	0.5
Load Reduction	1.4	29.2	30.2	176.1
Total % Reduction	84	99	98	99.7

LMC02 Little Mill Creek

The TMDL for this segment of Little Mill Creek consists of a load allocation to all of the watershed area between sample points LMC01, UNT05, & LMC02. The load allocation for this segment was computed using water-quality sample data collected at point LMC02. The average flow, measured at the sampling point LMC02 (1.88 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point LMC02 shows pH ranging between 3.0 and 6.6, pH will be addressed in this TMDL because of the mining impacts. 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.

Table C25. Load Allocations at Point LMC02				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	0.53	8.3	0.13	2.1
Iron	2.74	42.9	0.47	7.3
Manganese	8.88	138.9	0.44	6.9
Acid	44.91	702.9	1.35	21.1
Alkalinity	5.24	82.0		

The calculated load reductions for all the loads that enter point LMC02 must be accounted for in the calculated reductions at sample point LMC02 shown in Table C26. A comparison of measured loads between points LMC01, UNT05 and LMC02 shows that there is no additional loading entering the segment for iron. For iron the percent decrease in existing loads are applied to the allowable upstream loads entering the segment. There is an increase in aluminum, manganese and acidity loading within the segment. The total segment aluminum, manganese and acidity loads are the sum of the upstream allocated loads and any additional loading within the segment.

Table C26. Calculation of Load Reduction at Point LMC02				
	Al	Fe	Mn	Acidity
Existing Load	8.3	42.9	138.9	702.9
Difference in Existing Load between LMC01, UNT05 & LMC02	-1.9	-34.4	-35.7	1.0
Load tracked from LMC01 & UNT05	3.4	9.8	9.2	68.8
Percent loss due to instream process	18	44	20	-
Percent load tracked from LMC01, & UNT05	82	56	80	-
Total Load tracked between points LMC01, UNT05 & LMC02	2.8	5.5	7.4	69.8
Allowable Load at LMC02	2.1	7.3	6.9	21.1
Load Reduction at LMC02	0.7	0.0	0.4	48.8
% Reduction required at LMC02	26	0	6	70

Waste Load Allocation – MSM Coal Co., Inc.

The MSM Coal Co., Songer Monks Mine Permit has three permitted treatment facilities. One MSMT1 discharges to a UNT that is not on our GIS. This UNT is upstream of Sample Point UNT06. The waste load allocation was calculated as described in the Method to Quantify Treatment Pond Pollutant Loading section of the report and is incorporated into the calculations at UNT06. This is the first downstream monitoring point that receives all the potential flow of treated water. The following table shows the waste load allocation.

Table C27. Waste Load Allocation			
Parameter	Allowable Average Monthly Conc. (mg/l)	Calculated Average Flow (MGD)	WLA (lbs/day)
MSMT1			
Al	2.0	0.0019	0.03
Fe	3.0	0.0019	0.05
Mn	2.0	0.0019	0.03

UNT06 Unnamed Tributary (49741) to Little Mill Creek Downstream of LMC02

The TMDL for this unnamed tributary to Little Mill Creek consists of a load allocation to all of the watershed area upstream of sample point UNT06. The load allocation for this segment was computed using water-quality sample data collected at point UNT06. The average flow, measured at the sampling point UNT06 (0.24 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point UNT06 shows pH ranging between 4.2 and 7.3, pH will be addressed in this TMDL because of the mining impacts. 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.

Table C28. Load Allocations for Point UNT06				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	0.11	0.2	0.08	0.2
Iron	1.47	3.0	0.49	1.0
Manganese	1.96	4.0	0.22	0.4
Acid	9.28	18.8	2.32	4.7
Alkalinity	21.75	44.0		

Table C29. Calculation of Load Reduction Necessary at Point UNT06				
	Al	Fe	Mn	Acidity
	(#/day)	(#/day)	(#/day)	(#/day)
Existing Load	0.21	3.0	4.0	18.8
Allowable Load=TMDL	0.17	1.0	0.4	4.7
Load Reduction	0.05	2.0	3.5	14.1
Total % Reduction	22	67	89	75

Waste Load Allocation – C&K Coal Co.

The C&K Coal Co. Mine Permit(3776SM6) is a treatment facility for a post mining discharge. The D7 treated discharge is upstream of Sample Point UNT07. The waste load allocation was calculated as described in the Method to Quantify Treatment Pond Pollutant Loading section of the report and is incorporated into the calculations at UNT07. This is the first downstream monitoring point that receives all the potential flow of treated water. The following table shows the waste load allocation.

Table C30. Waste Load Allocation			
Parameter	Allowable Average Monthly Conc. (mg/l)	Calculated Average Flow (MGD)	WLA (lbs/day)
C&KD7			
Al	2.0	0.013	0.22
Fe	3.0	0.013	0.33
Mn	2.0	0.013	0.22

UNT07 Unnamed Tributary (49740) to Little Mill Creek Upstream of LMC03

The TMDL for this unnamed tributary to Little Mill Creek consists of a load allocation to all of the watershed area upstream of sample point UNT07. The load allocation for this segment was computed using water-quality sample data collected at point UNT07. The average flow, measured at the sampling point UNT07 (0.48 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point UNT07 shows pH ranging between 2.8 and 7.5, pH will be addressed in this TMDL because of the mining impacts. 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.

Table C31. Load Allocations for Point UNT07				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	2.21	8.8	0.22	0.9
Iron	6.36	25.3	0.19	0.8
Manganese	6.51	25.9	0.20	0.8
Acid	49.66	197.5	0.99	3.9
Alkalinity	5.11	20.3		

Table C32. Calculation of Load Reduction Necessary at Point UNT07				
	Al	Fe	Mn	Acidity
	(#/day)	(#/day)	(#/day)	(#/day)
Existing Load	8.8	25.3	25.9	197.5
Allowable Load=TMDL	0.9	0.7	0.8	3.9
Load Reduction	7.9	24.5	25.1	193.5
Total % Reduction	90	97	97	98

LMC03 Little Mill Creek

The TMDL for sampling point LMC03 consists of a load allocation of the area between sample points LMC02, UNT06, UNT07 and LMC03. The load allocation for this segment was computed using water-quality sample data collected at point LMC03. The average flow, measured at the sampling point LMC03 (3.54 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point LMC03 shows pH ranging between 3.7 and 7.1, pH will be addressed in this TMDL because of the mining impacts. 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.

Table C33. Load Allocations at Point LMC03

	Measured Sample Data		**Allowable**	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	0.44	12.9	0.15	4.5
Iron	1.60	47.2	0.66	19.4
Manganese	7.39	218.0	0.37	10.9
Acid	36.51	1077.0	2.92	86.2
Alkalinity	8.59	253.3		

The calculated load reductions for all the loads that enter point LMC03 must be accounted for in the calculated reductions at sample point LMC03 shown in Table C34. A comparison of measured loads between points LMC02, UNT06, UNT07 and LMC03 shows that there is no additional loading entering the segment for aluminum and iron. For aluminum and iron the percent decrease in existing load is applied to the allowable upstream load entering the segment. There is an increase in loading entering the segment for manganese and acidity. To determine the total segment manganese and acidity loads is the sum of the upstream allocated loads and any additional loading within the segment.

Table C34. Calculation of Load Reduction at Point LMC03				
	Al	Fe	Mn	Acidity
Existing Load	12.9	47.2	218.0	1077.0
Difference in Existing Load between LMC02, UNT06, UNT07 & LMC03	-4.5	-23.9	49.2	157.8
Load tracked from LMC02, UNT06 & UNT07	3.1	9.0	8.2	29.7
Percent loss due to instream process	26	34	-	-
Percent load tracked from LMC02, UNT06 & UNT07	74	66	-	-
Total Load tracked between points LMC02, UNT06 & UNT07	2.3	6.0	57.4	187.5
Allowable Load at LMC03	4.50	19.4	10.9	86.2
Load Reduction at LMC03	0.0	0.0	46.5	101.3
% Reduction required at LMC03	0	0	81	54

Waste Load Allocation – Sky Haven Coal, Inc.

The Sky Haven Coal Co., Corsica Mine Permit has two permitted treatment facilities. One SHC006 is upstream of Sample Point UNT08C. The waste load allocation was calculated as described in the Method to Quantify Treatment Pond Pollutant Loading section of the report and is incorporated into the calculations at UNT08C. This is the first downstream monitoring point that receives all the potential flow of treated water. The following table shows the waste load allocation.

For aluminum the instream concentration of 0.55 mg/l exceeded the instream criteria, so in order to protect this unnamed tributary from aluminum degradation, treatment facility SHC006 had been assigned an effluent limit of 0.6 mg/l. This treatment facility still exists; however, mining has been completed on this part of the site.

Table C35. Waste Load Allocation			
Parameter	Allowable Average Monthly Conc. (mg/l)	Calculated Average Flow (MGD)	WLA (lbs/day)
SHC1			
Al	0.6	0.0024	0.001
Fe	3.0	0.0024	0.06
Mn	2.0	0.0024	0.04

UNT08C Southern Unnamed Tributary (49737) to Little Mill Creek

The TMDL for sampling point UNT08C consists of a load allocation to the area upstream of sample point UNT08C. The load allocation for this tributary was computed using water-quality sample data collected at point UNT08C. The average flow, measured at the sampling point UNT08C (0.84 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point UNT08C shows pH ranging between 5.4 and 5.8, pH will be addressed in this TMDL because of the mining impacts. 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.

Table C36. Load Allocations at Point UNT08C

	Measured Sample Data		**Allowable**	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	0.37	2.6	0.16	1.1
Iron	0.42	3.0	0.42	3.0
Manganese	10.72	74.9	0.64	4.5
Acid	47.92	334.6	4.79	33.5
Alkalinity	9.04	63.1		

Table C37. Calculation of Load Reduction Necessary at Point UNT08C

	Al	Fe	Mn	Acidity
	(#/day)	(#/day)	(#/day)	(#/day)
Existing Load	2.6	3.0	74.9	334.6
Allowable Load=TMDL	1.1	3.0	4.5	33.5
Load Reduction	1.4	0.0	70.4	301.1
Total % Reduction	56	0	94	90

UNT08B Eastern Unnamed Tributary (49739) to Unnamed Tributary (49737) Upstream of UNT08

The TMDL for sampling point UNT08B consists of a load allocation to the area upstream of sample point UNT08B. The load allocation for this tributary was computed using water-quality sample data collected at point UNT08B. The average flow, measured at the sampling point UNT08B (0.04 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point UNT08B shows pH ranging between 5.2 and 5.9, pH will be addressed in this TMDL because of the mining impacts. 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.

Table C38. Load Allocations at Point UNT08B				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	ND	ND	NA	NA
Iron	ND	ND	NA	NA
Manganese	1.26	0.4	0.53	0.2
Acid	29.00	9.1	4.64	1.5
Alkalinity	7.40	2.3		

Table C39. Calculation of Load Reduction Necessary at Point UNT08B				
	Al	Fe	Mn	Acidity
	(#/day)	(#/day)	(#/day)	(#/day)
Existing Load	ND	ND	0.4	9.1
Allowable Load=TMDL	NA	NA	0.2	1.5
Load Reduction	0.0	0.0	0.2	7.6
Total % Reduction	0	0	58	84

UNT08 Unnamed Tributary (49737) to Little Mill Creek Downstream from LMC03

The TMDL for sampling point UNT08 consists of a load allocation to the area between sample points UNT08C, UNT08B & UNT08. The load allocation for this tributary was computed using water-quality sample data collected at point UNT08. The average flow, measured at the sampling point UNT08 (0.93 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point UNT08 shows pH ranging between 5.1 and 5.9, pH will be addressed in this TMDL because of the mining impacts. 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.

Table C40. Load Allocations at Point UNT08				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	0.48	3.8	0.15	1.2
Iron	0.40	3.1	0.40	3.1
Manganese	7.98	62.1	0.40	3.1
Acid	35.83	279.1	3.22	25.1
Alkalinity	9.66	75.3		

The calculated load reductions for all the loads that enter point UNT08 must be accounted for in the calculated reductions at sample point UNT08 shown in Table C41. A comparison of measured loads between points UNT08C, UNT08B and UNT08 shows that there is no additional loading entering the segment for iron. For iron the percent decrease in existing load is applied to the allowable upstream load entering the segment. There is an increase in loading entering the segment for aluminum, manganese, and acidity. To determine the total segment aluminum, manganese, and acidity load is the sum of the upstream allocated load and any additional loading within the segment.

Table C41. Calculation of Load Reduction at Point UNT08				
	Al	Fe	Mn	Acidity
Existing Load	3.8	3.1	62.1	279.1
Difference in Existing Load between UNT08C, UNT08B & UNT08	1.2	0.2	-13.2	-64.6
Load tracked from UNT08C & UNT08B	1.1	3.0	4.7	34.9
Percent loss due to instream process	-	-	17	19
Percent load tracked from UNT08C & UNT08B	-	-	83	81
Total Load tracked between points UNT08C, UNT08B & UNT08	2.3	3.1	3.8	28.4
Allowable Load at UNT08	1.21	3.1	3.1	25.1
Load Reduction at UNT08	1.1	0.0	0.7	3.2
% Reduction required at UNT08	48	0	19	11

UNT09 Unnamed Tributary (49736) of Little Mill Creek Downstream of UNT08

The TMDL for sampling point UNT09 consists of a load allocation to the area upstream of sample point UNT09. The load allocation for this tributary was computed using water-quality sample data collected at point UNT09. The average flow, measured at the sampling point UNT09 (0.05 MGD), is used for these computations.

There currently is no entry for this segment on the Section Pa 303(d) list for impairment due to pH. Sample data at point UNT09 shows pH ranging between 3.4 and 4.6; pH will be addressed as part of this TMDL because of the mining impacts. The objective is to reduce acid loading to the stream, which will in turn raise the pH 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.

Table C42. Load Allocations at Point UNT09

	Measured Sample Data		**Allowable**	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	6.11	2.7	0.31	0.13
Iron	0.12	0.05	0.12	0.05
Manganese	9.55	4.2	0.29	0.13
Acid	80.52	35.6	3.22	1.4
Alkalinity	6.08	2.7		

Table C43. Calculation of Load Reduction Necessary at Point UNT09

	Al	Fe	Mn	Acidity
	(#/day)	(#/day)	(#/day)	(#/day)
Existing Load	2.7	0.05	4.2	35.6
Allowable Load=TMDL	0.1	0.05	0.1	1.4
Load Reduction	2.6	0.0	4.1	34.2
Total % Reduction	95	0	97	96

LMC04 Little Mill Creek

The TMDL for sampling point LMC04 consists of a load allocation of the area between sample points LMC03, UNT08, UNT09 and LMC04. The load allocation for this segment was computed using water-quality sample data collected at point LMC04. The average flow, measured at the sampling point LMC04 (5.62 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point LMC04 shows pH ranging between 3.6 and 6.5, pH will be addressed in this TMDL because of the mining impacts. 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.

Table C44. Load Allocations at Point LMC04				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	0.77	36.0	0.28	13.3
Iron	0.95	44.4	0.62	29.3
Manganese	8.67	406.4	0.43	20.3
Acid	38.27	1794.7	2.30	107.7
Alkalinity	6.95	325.9		

The calculated load reductions for all the loads that enter point LMC04 must be accounted for in the calculated reductions at sample point LMC04 shown in Table C45. A comparison of measured loads between points LMC03, UNT084, UNT09 and LMC04 shows that there is no additional loading entering the segment for iron. For iron the percent decrease in existing load is applied to the allowable upstream load entering the segment. There is an increase in loading entering the segment for aluminum, manganese and acidity. To determine the total segment aluminum, manganese and acidity load is the sum of the upstream allocated load and any additional loading within the segment.

Table C45. Calculation of Load Reduction at Point LMC04				
	Al	Fe	Mn	Acidity
Existing Load	36.0	44.4	406.4	1794.7
Difference in Existing Load between LMC03, UNT08, UNT09 & LMC04	16.6	-6.0	122.0	403.1
Load tracked from LMC03, UNT08 & UNT09	5.8	22.5	14.1	112.7
Percent loss due to instream process	-	12	-	-
Percent load tracked from LMC03, UNT08 & UNT09	-	88	-	-
Total Load tracked between points LMC03, UNT08, UNT09 & LMC04	22.5	19.8	136.1	515.8
Allowable Load at LMC04	13.3	29.3	20.3	107.7
Load Reduction at LMC04	9.2	0.0	115.8	408.1
% Reduction required at LMC04	41	0	85	79

Waste Load Allocation – Sky Haven Coal Co., Inc.

The Sky Haven Coal Co., Corsica Mine Permit has two permitted treatment facilities. One SHC005 is upstream of Sample Point UNT10. The waste load allocation was calculated as described in the Method to Quantify Treatment Pond Pollutant Loading section of the report and is incorporated into the calculations at UNT10. This is the first downstream monitoring point that receives all the potential flow of treated water. The following table shows the waste load allocation. Mining on the part of the site that discharges to SHC005 is expected to be completed by fall of 2005.

Table C46. Waste Load Allocation			
Parameter	Allowable Average Monthly Conc. (mg/l)	Calculated Average Flow (MGD)	WLA (lbs/day)
SHC2			
Al	2.0	0.0083	0.14
Fe	3.0	0.0083	0.21
Mn	2.0	0.0083	0.14

UNT10 Unnamed Tributary (49734) to Little Mill Creek Downstream of LMC04

The TMDL for this unnamed tributary consists of a load allocation to all of the watershed area upstream of sample point UNT10. The load allocation for this segment was computed using water-quality sample data collected at point UNT10. The average flow, measured at the sampling point UNT10 (0.72 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point UNT10 shows pH ranging between 3.6 and 5.4, pH will be addressed in this TMDL because of the mining impacts. 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.

Table C47. Load Allocations at Point UNT10				
	Measured Sample Data		**Allowable**	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	6.13	36.9	0.25	1.5
Iron	6.56	39.6	0.20	1.2
Manganese	8.89	53.6	0.36	2.1
Acid	81.03	488.5	0.81	4.9
Alkalinity	2.47	14.9		

Table C48. Calculation of Load Reduction Necessary at Point UNT10				
	Al	Fe	Mn	Acidity
	(#/day)	(#/day)	(#/day)	(#/day)
Existing Load	36.9	39.6	53.6	488.5
Allowable Load=TMDL	1.5	1.2	2.1	4.9
Load Reduction	35.4	38.4	51.5	483.6
Total % Reduction	96	97	96	99

LMC05 Little Mill Creek

The TMDL for this segment of Little Mill Creek consists of a load allocation to all of the watershed area between sample points LMC04, UNT10, and LMC05. The load allocation for this segment was computed using water-quality sample data collected at point LMC05. The average flow, measured at the sampling point LMC05 (5.74 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point LMC05 shows pH ranging between 3.7 and 5.8, pH will be addressed in this TMDL because of the mining impacts. 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.

Table C49. Load Allocations at Point LMC05				
	Measured Sample Data		**Allowable**	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	1.64	78.3	0.29	14.1
Iron	3.94	188.4	0.35	17.0
Manganese	8.89	425.5	0.44	21.3
Acid	46.52	2227.1	2.33	111.4
Alkalinity	5.71	273.4		

The calculated load reductions for all the loads that enter point LMC05 must be accounted for in the calculated reductions at sample point LMC05 shown in Table C50. A comparison of measured loads between points LMC04, UNT10, and LMCO5 shows that there is no additional manganese and acidity loading entering the segment. For manganese and acidity the percent decrease in existing load is applied to the allowable upstream load entering the segment. There is additional loading entering the segment for aluminum and iron. The total segment aluminum and iron load is the sum of the upstream allocated loads and any additional loading within the segment.

Table C50. Calculation of Load Reduction at Point LMC05				
	Al	Fe	Mn	Acidity
Existing Load	78.3	188.4	425.5	2227.1
Difference in Existing Load between LMC04, UNT10 & LMC05	5.4	104.5	-34.5	-56.1
Load tracked from LMC04 & UNT10	14.8	30.5	22.5	112.6
Percent loss due to instream process	-	-	7	2
Percent load tracked from LMC04 & UNT10	-	-	93	98
Total Load tracked between points LMC04, UNT10 & LMC05	20.2	134.9	20.8	109.8
Allowable Load at LMC05	14.1	17.0	21.3	111.4
Load Reduction at LMC05	6.1	118.0	0.0	0.0
% Reduction required at LMC05	30	87	0	0

UNT12 Unnamed Tributary (49733) to Little Mill Creek Downstream of LMC05

The TMDL for this unnamed tributary consists of a load allocation to all of the watershed area upstream of sample point UNT12. The load allocation for this segment was computed using water-quality sample data collected at point UNT12. The average flow, measured at the sampling point UNT12 (0.03 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point UNT12 shows pH ranging between 3.4 and 3.6, pH will be addressed in this TMDL because of the mining impacts. 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.

Table C51. Load Allocations at Point UNT12				
	Measured Sample Data		**Allowable**	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	13.44	3.7	0.54	0.1
Iron	1.29	0.4	0.52	0.1
Manganese	7.34	2.0	0.73	0.2
Acid	123.88	33.9	0.00	0.0
Alkalinity	0.00	0.0		

Table C52. Calculation of Load Reduction Necessary at Point UNT12				
	Al	Fe	Mn	Acidity
	(#/day)	(#/day)	(#/day)	(#/day)
Existing Load	3.7	0.4	2.0	33.9
Allowable Load=TMDL	0.1	0.1	0.2	0.0
Load Reduction	3.6	0.3	1.8	33.9
Total % Reduction	96	60	90	100

UNT12B Unnamed Tributary to Little Mill Creek Downstream of UNT12

The TMDL for this unnamed tributary consists of a load allocation to all of the watershed area upstream of sample point UNT12B. The load allocation for this segment was computed using water-quality sample data collected at point UNT12B. The average flow, measured at the sampling point UNT12B (0.03 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point UNT12B shows pH ranging between 3.7 and 4.0, pH will be addressed in this TMDL because of the mining impacts. 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.

Table C53. Load Allocations at Point UNT12B				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	10.38	2.8	0.31	0.09
Iron	0.81	0.2	0.36	0.10
Manganese	6.38	1.7	0.51	0.14
Acid	108.35	29.6	0.00	0.0
Alkalinity	0.00	0.0		

Table C54. Calculation of Load Reduction Necessary at Point UNT12B				
	Al	Fe	Mn	Acidity
	(#/day)	(#/day)	(#/day)	(#/day)
Existing Load	2.8	0.2	1.7	29.6
Allowable Load=TMDL	0.09	0.1	0.1	0.00
Load Reduction	2.7	0.1	1.6	29.6
Total % Reduction	97	56	92	100

UNT13 Unnamed Tributary (49732) to Little Mill Creek Downstream of UNT12B

The TMDL for this unnamed tributary consists of a load allocation to all of the watershed area upstream of sample point UNT13. The load allocation for this segment was computed using water-quality sample data collected at point UNT13. The average flow, measured at the sampling point UNT13 (0.05 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point UNT13 shows pH ranging between 3.0 and 3.3, pH will be addressed in this TMDL because of the mining impacts. 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.

Table C55. Load Allocations at Point UNT13				
	Measured Sample Data		**Allowable**	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	ND	ND	NA	NA
Iron	12.47	4.8	0.62	0.24
Manganese	9.26	3.6	0.46	0.18
Acid	94.44	36.2	0.00	0.0
Alkalinity	0.00	0.0		

Table C56. Calculation of Load Reduction Necessary at Point UNT13				
	Al	Fe	Mn	Acidity
	(#/day)	(#/day)	(#/day)	(#/day)
Existing Load	ND	4.8	3.6	36.2
Allowable Load=TMDL	NA	0.24	0.18	0.00
Load Reduction	0.0	4.56	3.38	36.2
Total % Reduction	0	95	95	100

There are no load allocations for sample points UNT15, UNT17, UNT19 and UNT21 because there were only two samples available for these sample points and the metals meet water quality standards and no TMDL is required. The affects of these sample points are considered at the next downstream sample point.

LMC06 Little Mill Creek at Confluence with Mill Creek

The TMDL for this segment of Little Mill Creek consists of a load allocation to all of the watershed area between sample points LMC05 UNT12, UNT12B, UNT13, and LMC06. The load allocation for this segment was computed using water-quality sample data collected at point

LMC06. The average flow, measured at the sampling point LMC06 (6.90 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point LMC06 shows pH ranging between 3.4 and 5.2, pH will be addressed in this TMDL because of the mining impacts. 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.

Table C57. Load Allocations at Point LMC06

	Measured Sample Data		**Allowable**	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	1.37	79.1	0.25	14.2
Iron	3.52	202.8	0.46	26.4
Manganese	8.19	471.4	0.41	23.6
Acid	52.84	3041.7	1.06	60.8
Alkalinity	2.65	152.7		

The calculated load reductions for all the loads that enter point LMC06 must be accounted for in the calculated reductions at sample point LMC06 shown in Table C58. A comparison of measured loads between points LMC05, UNT12, UNT12B, UNT13, and LMC06 shows that there is no additional aluminum loading entering the segment. For aluminum the percent decrease in existing load is applied to the allowable upstream load entering the segment. There is additional loading entering the segment for iron, manganese and acidity. The total segment iron, manganese and acidity loading is the sum of the upstream allocated loads and any additional loading within the segment.

Table C58. Calculation of Load Reduction at Point LMC06				
	Al	Fe	Mn	Acidity
Existing Load	79.1	202.8	471.4	3041.7
Difference in Existing Load between LMC05, UNT12, UNT12B, UNT13 & LMC06	-5.7	9.0	38.6	714.9
Load tracked from LMC05, UNT12, UNT12B & UNT13	14.3	17.4	21.8	111.4
Percent loss due to instream process	7	-	-	-
Percent load tracked from LMC05, UNT12, UNT12B & UNT13	93	-	-	-
Total Load tracked between points LMC05, UNT12, UNT12B, UNT13 & LMC06	13.4	26.5	60.4	826.2
Allowable Load at LMC06	14.2	26.4	23.6	60.8
Load Reduction at LMC06	0.0	0.1	36.8	765.4
% Reduction required at LMC06	0	0.4	61	93

Margin of Safety (MOS)

PADEP used an implicit MOS in these TMDLs derived from the Monte Carlo statistical analysis. The Water-Quality standard states that water-quality criteria must be met at least 99% of the time. All of the @Risk analyses results surpass the minimum 99% level of protection. Another margin of safety used for this TMDL analysis results from:

- 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.

- A MOS is added when the calculations were performed with a daily iron average instead of the 30-day average.

Seasonal Variation

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

Critical Conditions

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

Attachment D

Excerpts Justifying Changes Between the 1996, 1998, 2002, and 2004 Section 303(d) Lists

The following are excerpts from the Pennsylvania DEP 303(d) narratives that justify changes in listings between the 1996, 1998, 2002, and 2004 list. The 303(d) listing process has undergone an evolution in Pennsylvania since the development of the 1996 list.

In the 1996 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 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 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

UNT01	Unt to Little Mill Creek Below HWLMC						
Date	Initial	pH	ALK	HOT A	FE	MN	AL
Collected	Flow	pH units	MG/L	MG/L	MG/L	MG/L	MG/L
7/16/2003	40	7.2	17.6	0	0.429	0.056	0
9/18/2003	59	6.9	14	0	0.339	0	0
8/17/2004	45	7	18.8	22.8	0.349	0.063	0
10/7/2004	39	6.6	16.8	13.4	0	0	0
avg=	45.75	6.925	16.8	9.05	0.28	0.03	0
stdev=				11.13	0.19	0.03	0.00

HWLMC	Headwaters of Little Mill Creek						
Date	Initial	pH	ALK	HOT A	FE	MN	AL
Collected	Flow	pH units	MG/L	MG/L	MG/L	MG/L	MG/L
7/16/2003	34	6.8	39.4	0	0	1.63	0
9/18/2003	36	6.3	26	16	0.357	0.565	0
5/6/2004	156	6.2	14.6	35.2	0.325	0.792	0
8/17/2004	40	6.5	24	6.2	0	0.343	0
10/7/2004	37	6.1	20.4	10.8	0	1.23	0
avg=	60.60	6.38	24.88	13.64	0.14	0.91	0.00
stdev=				13.42	0.19	0.52	0.00

UNT01A	Low Flow Tributary Downstream UNT01						
Date	Initial	pH	ALK	HOT A	FE	MN	AL
Collected	Flow	pH units	MG/L	MG/L	MG/L	MG/L	MG/L
9/18/2003	0.5	6.1	10.2	36.6	1.5	0.252	0
5/6/2004	15	6.2	12	35.2	0	0.086	0
8/17/2004	1.5	6.6	17.2	24.4	0.412	0.161	0
10/7/2004	0.75	6.4	15.4	22.8	0	0.09	0
AVG=	4.44	6.33	13.70	29.75	0.48	0.15	0.00
stdev=				7.15	0.71	0.08	0.00

LMC01AE	Little Mill Creek						
Date	Initial	pH	ALK	HOT A	FE	MN	AL
Collected	Flow	pH units	MG/L	MG/L	MG/L	MG/L	MG/L
7/16/2003	112	7.3	28	0	0	0.101	0
9/18/2003	270	6.8	21.2	0	0	0.081	0
5/6/2004	535	6.5	16	24.2	0	0.21	0
8/17/2004	75	6.7	27.2	12	0.328	0.173	0
10/7/2004	151	6.5	22.2	20.8	0	0.152	0
avg=	228.60	6.76	22.92	11.40	0.07	0.14	0.00
stdev=				11.32	0.15	0.05	0.00

LMC01ASA2	Eastern Trib Upstream LMC01ASA						
Date	Initial	pH	ALK	HOT A	FE	MN	AL
Collected	Flow	pH units	MG/L	MG/L	MG/L	MG/L	MG/L
7/16/2003	206	5	7.8	88.8	0	18.5	1.42
9/23/2003	414	5.5	8.4	48.2	0.385	15.7	0.679
5/6/2004	425	4.7	8.2	81	0	17.7	2.89
8/17/2004	159	5.2	9	63.6	0	20.8	0.813
10/7/2004	371	4.7	9.2	50.2	0	20.9	2.37
avg=	315.00	5.02	8.52	66.36	0.08	18.72	1.63
stdev=				18.14	0.17	2.20	0.97

LMC01ASA1	Southern Trib Upstream LMC01ASA						
Date	Initial	pH	ALK	HOT A	FE	MN	AL
Collected	Flow	pH units	MG/L	MG/L	MG/L	MG/L	MG/L
7/16/2003	50	6.3	11.4	52.6	0	13.2	0
9/23/2003	244	6	10.4	21.8	0	10.6	0
5/6/2004	100	4.9	8.4	49.8	0	13.9	2.37
8/17/2004	36	6.5	16	20.2	0	12	0
10/7/2004	57	5	10	44.2	0	15.2	1.83
avg=	97.40	5.74	11.24	37.72	0.00	12.98	0.84
stdev=				15.57	0.00	1.76	1.17

LMC01ASA	Little Mill Creek						
Date	**Initial**	**pH**	**ALK**	**HOT A**	**FE**	**MN**	**AL**
Collected	**Flow**	**pH units**	**MG/L**	**MG/L**	**MG/L**	**MG/L**	**MG/L**
7/15/2003	210	5.2	8.6	51.4	0.707	15.6	1.34
9/23/2003	727	5.6	8.4	35	0	13.6	0
5/6/2004	1084	4.8	8.2	72.2	0	16.2	2.63
8/17/2004	206	5.5	9.6	46.8	0	18	0.615
10/7/2004	574	4.8	8.6	38.2	0	18.5	2.11
avg=	560.20	5.18	8.68	48.72	0.14	16.38	1.34
stdev=				14.67	0.32	1.97	1.07

UNT02A	Unnamed Tributary to Little Mill Creek Below LMC01AS						
Date	**Initial**	**pH**	**ALK**	**HOT A**	**FE**	**MN**	**AL**
Collected	**Flow**	**pH units**	**MG/L**	**MG/L**	**MG/L**	**MG/L**	**MG/L**
1/9/1997		6.2	16.2	4.2	0	1.02	0
9/15/1998		6.4	20	0	0	0.626	0
12/2/1998		6.3	24	0	0.07	2.05	0
3/3/1999		6.5	14.2	0	0.418	1.26	0.36
8/23/1999		6.4	24	0	0.089	1.75	0
11/8/1999		6.5	22	0	0.107	1.41	0
1/13/2000		6.7	34	0	0.227	1.5	0.264
4/19/2000		6.4	26	2.6	0.258	1.21	0.306
8/11/2000		6.6	52	0	0.972	1.49	0.817
10/24/2000		7.1	60	0	0.199	1.96	0.213
5/11/2001		6.8	42	0	0	1.92	0
8/16/2001		7.6	66	0	0	2.73	0
10/16/2001		7.3	58	0	0	2.24	0
3/19/2002		6.8	26	0	0	1.54	0
8/27/2002		7.2	42	0	0.363	2.96	0
10/9/2002		7.4	46	0	0	3.23	0
3/19/2003		6.5	19.2	0	0.462	0.871	<.5
5/16/2003		6.8	24.2	0	0	1.14	0
1/7/2004		6.6	18.8	0	0	1.02	0
7/14/2004		6.9	37	0	0	1.75	0
10/22/2004		6.8	25.4	8	0	2.03	0
7/15/2003		7	23.2	0	0	1.04	0
9/23/2003	1311	7.1	26.6	0	0.438	0.81	0
5/6/2004	835	6.6	20.4	6	0	1.33	0
8/17/2004	190	6.8	31	0	0	1.34	0
10/7/2004	398	6.6	23.2	0	0	1.68	0
avg=	683.50	6.77	31.59	0.80	0.14	1.61	0.08
stdev=				2.08	0.23	0.65	0.19

UNT03	Unt to Little Mill Creek above Filson 5/6 Treatment System						
Date	Initial	pH	ALK	HOT A	FE	MN	AL
Collected	Flow	pH units	MG/L	MG/L	MG/L	MG/L	MG/L
7/16/2003		6.4	76.6	84.4	74.6	21.7	0
9/18/2003	6	5.9	17.6	58.2	10.5	9.91	0
5/6/2004	27	4.8	8.8	70.6	2.54	12.2	2.15
8/16/2004	1	4.2	5.6	64.6	7.78	28.7	0.518
10/7/2004	6	5.5	12.2	45	7.51	22.4	1.21
avg=	10.00	5.36	24.16	64.56	20.59	18.98	0.78
stdev=				14.60	30.33	7.78	0.91

LMC01	**Little Mill Creek at RT 949**						
Date	**Initial**	**pH**	**ALK**	**HOT A**	**FE**	**MN**	**AL**
Collected	**Flow**	**pH units**	**MG/L**	**MG/L**	**MG/L**	**MG/L**	**MG/L**
9/30/1996		5.6	10.2	17.8	1.9	6.23	0.192
10/9/1996		5.3	12.6	54	6.71	15.3	1.31
11/14/1996		5.7	11.4	14.6	3.16	7.84	0.4
12/9/1996		5.5	9.6	16	2.77	8.99	0.984
1/6/1997		5.4	11.4	12.4	2.57	7.97	0.644
2/6/1997		5.3	10.2	34	2.18	5.12	0.534
3/5/1997		5.2	10	15.2	2.04	6.23	0.795
4/16/1997		5.3	11.4	24	3.54	9.1	0.906
5/19/1997		4.5	7.8	44	4.08	10.6	0.93
6/9/1997		5.5	11.2	18.8	3.1	8.64	0.452
4/14/2000		5.4	10.6	22	1.38	7.23	0.669
9/13/1995		5.9	19	70	15.30	24.60	0
10/12/1995		5.8	15.8	44	5.58	16.70	0
11/21/1995		5.5	8.4	26	2.08	6.67	0
12/6/1995		5.5	10	28	1.28	6.56	0
4/3/1996		5.1	8	40	1.93	10.50	1.05
5/7/1996		5.1	7	26	2.52	8.06	0.60
6/6/1996		4.9	7.6	44	2.08	13.70	1.160
7/10/1996		5.6	11.2	44	2.98	16.50	0.70
8/6/1996		4.9	8.2	60	2.34	18.60	1.74
9/30/1996		5.6	10.2	17.8	1.9	6.23	0.192
10/9/1996		5.3	12.6	54	6.71	15.3	1.31
11/14/1996		5.7	11.4	14.6	3.16	7.84	0.4
12/9/1996		5.5	9.6	16	2.77	8.99	0.984
1/6/1997		5.4	11.4	12.4	2.57	7.97	0.644
2/6/1997		5.3	10.2	34	2.18	5.12	0.534
3/5/1997		5.2	10	15.2	2.04	6.23	0.795
4/16/1997		5.3	11.4	24	3.54	9.1	0.906
5/19/1997		4.5	7.8	44	4.08	10.6	0.93
6/9/1997		5.5	11.2	18.8	3.1	8.64	0.452
4/14/2002		5.4	10.6	22	1.38	7.23	0.669
7/15/2003	902	6	13.2	45.8	1.39	8.91	0
9/18/2003	1259	6.1	16.2	43.6	2.45	8.89	0
5/5/2004	2464	5.2	7.6	55.6	1.35	9.87	0.567
8/16/2004	763	6.2	18.2	29.6	2.79	10.4	0
10/7/2004	1434	5.8	13.8	52	3.82	12.5	0
avg=	1364.40	5.42	11.03	32.06	2.91	8.78	0.52
stdev=				15.94	1.36	2.56	0.41

UNT05	Unt to Little Mill Creek @ 800 ft upstream from LMC02						
Date	Initial	pH	ALK	HOT A	FE	MN	AL
Collected	Flow	pH units	MG/L	MG/L	MG/L	MG/L	MG/L
7/15/2003	115	3	0	207.8	18.1	30.4	2.02
9/18/2003	99	3.1	0	148.4	12.7	22.2	1.75
8/16/2004	84	4.2	4.4	46.4	7.46	13.6	0
10/7/2004	109	3.3	0	175.4	58.4	34.6	1.66
avg=	101.75	3.4	1.1	144.5	24.165	25.2	1.3575
stdev=				69.76	23.23	9.29	0.92

LMC02	Little Mill Creek at TWP Road 342						
Date	Initial	pH	ALK	HOT A	FE	MN	AL
Collected	Flow	pH units	MG/L	MG/L	MG/L	MG/L	MG/L
8/27/1981	623	4.2	0	24	0.72	11.54	
12/29/1981	1200	6.3	7	5	1.34	4.44	
5/13/1982	2500	6.6	7	9	0.63	7	
11/18/1981	400	5.9	4	9	0.85	6.6	
8/20/1982		6.55	12.02		0.53	3.53	
11/21/1982	780	6.05	3.55	2.47	0.25	1.18	
2/1/1983	982	6.05	5.19	5.16	1.95	6.59	
9/11/1985		3.8	0	50	3.5	4.9	0.95
2/10/1986		4.1	2	20	4.51	10.4	2.3
6/25/1986		3.6	0	74	3.81	14	0
8/11/1986		3	0	60	3.03	9.84	0.789
11/4/1986		3.8	0	28	2.77	10.8	0.949
11/12/1986	625	4.14		25.01	2.52	4.92	
1/16/1987		3.8	0	33	6.09	13.7	1.84
2/4/1987	700	3.66		53.06	0.55	14.25	
5/1/1987		3.83		40.9	2.9	7.59	
5/6/1987		3.9	0	52	3.88	9.19	1.1
7/10/1996		3.8	0	64	0	0	0
8/6/1996		0.38	0	70	2.34	18.8	1.49
9/30/1996		4.8	7.8	17	1.62	5.88	0.613
10/9/1996		4.3	7.4	52	3.19	13.1	1.06
11/14/1996		4.5	6.8	13.8	2.1	7.22	0.415
12/9/1996		4.4	6	22	2.27	8.31	0.737
1/6/1997		4.3	7.4	14.6	1.4	8.09	0.773
2/6/1997		4.5	7.2	34	1.54	4.82	0.475
3/5/1997		4.4	6.8	15	1.25	5.64	0.728
4/16/1997		4.3	6.6	26	2.29	9.08	0.827
5/19/1997		4.1	3.6	38	1.72	10	0.843
6/9/1997		4	2.4	24	2.16	9.84	0.605
10/17/2001		3.7	0	82.8	2.39	14.4	2

1/4/2002		4.1	9.4	49.6	3.91	8.18	0
4/26/2002		4.3	5.6	69.6	1.53	8.02	0
7/31/2002		3.8	0	63.4	2.77	11.9	0
10/18/2002		3.6	0	90.4	6.75	16.2	0.837
1/9/2003		4.8	6.4	49.6	2.78	7.45	0.532
4/25/2003		4	1.8	55.4	2.39	11.4	0.714
7/11/2003		3.2	0	210.2	5.92	16.5	2
7/14/2003	1371	4.1	2.8	52.6	1.28	7.73	0
7/31/2003		5.8	9.6	47.2	0.677	4.33	0
8/11/2003		5.6	9.4	51.6	1.18	8.29	0
9/18/2003	1686	5.2	8.4	53	1.58	9.15	0
10/8/2003		8	6.8	42.6	2.13	8.61	0
11/24/2003		6	9.8	45.8	1.95	4.14	0
12/23/2003		5.6	8.2	38.4	4.01	5.15	0.683
1/9/2004		5.5	8.8	27.2	3.16	7.13	0.732
4/27/2004		5.6	8.2	58.4	2.06	4.68	0
5/4/2004	3258	4.5	6.8	63.4	4.07	9.9	0
6/3/2004		5.7	9.2	64.8	2.27	8.1	0
7/7/2004		4.3	5	39.4	4.2	13.8	0
8/16/2004	999	4.2	4.4	45.2	7.8	13.7	0
8/25/2004		6.2	12.4	37	3.93	5.69	0
9/16/2004		6.1	11.8	70	3.6	7.43	0
10/7/2004	1820	4.8	7.8	43	6.43	14.6	0
10/22/2004		5.5	9.4	44.8	4.76	9.77	0
11/2/2004		4.8	7.6	48.6	5.47	10.7	0
avg=	1303.38	4.66	5.24	44.91	2.74	8.88	0.53
stdev=				30.99	1.75	3.90	0.63

UNT06	**Unnamed Tributary to Little Mill Creek Downstream from UNT02B**						
Date	**Initial**	**pH**	**ALK**	**HOT A**	**FE**	**MN**	**AL**
Collected	**Flow**	**pH units**	**MG/L**	**MG/L**	**MG/L**	**MG/L**	**MG/L**
8/27/1981	151	4.2	0	15	2.09	5.49	
12/29/1981	150	5.7	4	12	3.01	2.81	
5/13/1982	200	4.7	1	10	0.86	3.4	
7/14/2003	114	6.9	30.6	0	1.09	0.661	0
9/18/2003	146	6.8	32.6	0	0.386	0.628	0
5/5/2004	339	7.3	34.4	22.2	0.868	0.618	0.525
8/16/2004	63	6.7	32	13.4	2.11	1.19	0
10/7/2004	184	6.8	39.4	1.6	1.37	0.919	0
avg=	168.38	6.14	21.75	9.28	1.47	1.96	0.11
stdev=				8.07	0.86	1.78	0.23

UNT07	Unt to Little Mill Creek Upstream LMC03						
Date	**Initial**	**pH**	**ALK**	**HOT A**	**FE**	**MN**	**AL**
Collected	**Flow**	**pH units**	**MG/L**	**MG/L**	**MG/L**	**MG/L**	**MG/L**
4/8/1975	846	4.2	0	6	0		
7/17/1975	219	5.5	4	4	0.12		
8/20/1975	79	6	10	2	0.24		
9/22/1975	549	5.7	24	4	0.38		
10/15/1975	923	5.1	20	8	0.3		
11/12/1975	663	4.5	6	12	0.1		
12/10/1975	721	5.5	8	4	0.1		
1/22/1976	384	7.5	10	6	0.1		
2/18/1976	10754	5.4	8	10	0.3		
3/22/1976	2346	6.3	10	4	0.1		
4/21/1976	323	4.7	10	6	0.3		
9/1/1976		6.5	5	0	0.07		
9/10/1986		3.4	0	134	4.57	18	5.38
10/2/1986		3.7	0	74	1.93	7.4	2.42
12/8/1986		4.5	5	42	4.19	3.69	1.73
3/24/1987		3.9	0	46	5.3	7.28	2.15
5/19/1987		3.7	0	39	2.14	8.1	
6/10/1987		3.7	0	100	13.5	13.4	3.23
2/2/1988		4.6	6	16	3.65	2.45	3.93
4/21/1988		5	8	26	6.58	6.84	1.92
6/14/1988		4.7	7	56	8.13	13.2	3.13
10/4/1988	1.0	4.2	0	17	0.81	4.84	
1/5/1989	5	4.2		24	1.68	1.44	
1/5/1989		4.2	0	24	1.68	1.44	
4/17/1989	5	4.2		23	1.48	1.2	
4/17/1989		4.2	0	23	1.48	1.2	
8/3/1989	5	3.3		31	6.29	3.86	
8/3/1989		3.3	0	31	6.29	3.86	
10/10/1989	1	3		36	5.47	5.72	
10/10/1989		3	0	36	5.47	5.72	
1/11/1990	10	3.8		19	2.27	1.65	
1/11/1990		3.8	0	19	2.27	1.65	
4/9/1990	10	3.8		23	1.75	1.41	
4/9/1990		3.8	0	23	1.75	1.41	
7/24/1990	3	3.6		24	3.78	2.0	
7/24/1990		3.6	0	24	3.78	2.03	
10/15/1990	15	4		16	0.47	1.87	
10/15/1990		4	0	16	0.47	1.87	
1/18/1991	25	4.1		35	1.44	1.16	
2/12/1991		5.2	8	17.4	3.84	4.97	1.51
4/23/1991	15.0	3.8		26	2.35	1.55	
7/24/1991	1.0	2.9		106	11.79	9.44	
10/21/1991	1.0	3		124	21.6	10.37	

1/28/1992	2.0	3.8		35	1.37	1.98	
4/8/1992	5.0	3.9		23	1.03	1.57	
7/13/1992	5.0	3.5		35	2.06	2.07	
10/6/1992	1.0	3.5		38	3.25	2.96	
2/8/1993	2.0	3.6		49	6.07	2.32	
4/20/1993	5.0	3.9		25	0.49	1.51	
7/20/1993	1.0	2.9		122	21.33	9.63	
12/2/1993	5.0	4.2		16	2.49	1.9	
2/9/1994	2.0	3.6		36	7.03	2.49	
5/19/1994	1.0	3.6		31	2.32	1.98	
8/4/1994	1.0	3		51	19.2	7.04	
11/3/1994	1.0	3.8		24	1.33	2.38	
1/11/1995	5.0	3.3		48	10.83	3.83	
5/23/1995	50.0	3.6		36	2.84	2.56	
8/15/1995	1.0	2.8		191	45.7	11.09	
11/8/1995	4.0	3		85	22.2	7.3	
1/24/1996	20	3.8		38	5.12	2.32	
5/9/1996	30	3.6		37	1.59	2.47	
7/25/1996	50	3.7		35	3.08	3.26	
10/17/1996	5	3		85	17.34	4.34	
1/14/1997	5	3.4		45	9.04	3.12	
5/16/1997	5	3.3		71	8.13	3.9	
7/31/1997	2	2.8		198	46	12.21	
12/9/1997	5	3.5		94	7.02	3.23	
1/16/1998	7	4.1		34	0.78	1.91	
5/13/1998	75	3.7		48	4.37	2.28	
8/13/1998	1	2.9		184	62.5	12.02	
10/14/1998	2	2.8		229	47.6	12.25	
1/26/1999	10	4.1		33	1.88	2.28	
5/4/1999	5	3.6		44	1.58	3.03	
7/28/1999	50	3.3		100	4.28	18.8	
10/18/1999	50	3.3		97	4.34	18.3	
2/10/2000	50	3.6		62	6.83	12.39	
4/20/2000	500	4.1		19	2.43	4.4	
8/17/2000	50	3.3		111	5.36	20.9	
12/13/2000	500	3.8		22	2.34	4.73	
3/12/2001	300	3.7		47	8.34	10.32	
4/19/2001	1500	4.2		19	2.55	3.5	
8/8/2001	75	3.3		138	3.16	29.13	
10/11/2001	25	3.2		142	5.06	28.4	
1/16/2002		3.4		54	2.34	8.25	
4/10/2002		5	7	52.2	4.05	3.9	0.799
4/10/2002	750	4.4		24	2.85	4.05	
7/16/2002	100	3.5		94	4.38	29.1	
10/8/2002	50	3.3		100	5.21	23.1	
1/9/2003	300	4.4		22	3.29	5.35	
4/10/2002		5	7	52.2	4.05	3.9	0.799

10/15/2003		4.6	5.8	37.8	2.39	3.48	0.671
4/6/2004		5.6	10	39.2	5.74	6.57	1.09
avg=	331.13	3.98	5.11	49.66	6.36	6.51	2.21
stdev=				46.842	10.67	6.661	1.395

LMC03	**Little Mill Creek at TWP Road 350, Flemming Spring**						
Date	**Initial**	**pH**	**ALK**	**HOT A**	**FE**	**MN**	**AL**
Collected	**Flow**	**pH units**	**MG/L**	**MG/L**	**MG/L**	**MG/L**	**MG/L**
1/7/2000		5.3	9.2	9	1.15	3.89	0
10/18/2000		5.6	11.4	7.4	1.61	6.49	0
2/14/2001		5.5	8.8	8.2	1.06	2.8	0
8/16/2001		3.8	0	81.2	2.37	18.5	0.975
5/21/2002		5	9	46.4	1.02	5.86	0.758
12/18/2002		5	6.6	38.4	1.63	4.81	0
10/7/2003		5.8	9.4	30	1.51	6.79	0
7/10/1996		3.9	0	44	1.11	12.5	0.734
8/6/1996		3.9	0	54	0.936	14.7	1.31
9/30/1996		5.2	8.4	13.8	1.32	4.52	0.338
10/9/1996		4.6	9.8	40	1.98	10.5	0.869
11/14/1996		5	8.4	8.4	1.76	5.7	0.397
12/9/1996		5.1	8.4	18	1.92	6.53	0.742
1/6/1997		4.6	9	11.8	1.49	6.8	0.946
2/6/1997		4.8	8.4	30	1.18	3.77	0.519
3/5/1997		4.8	8	11.2	1.18	4.6	0.729
4/16/1997		4.6	9	16.8	1.32	6.6	0.809
5/19/1997		4.1	5.8	40	1.33	8.8	0.997
6/9/1997		4.3	5.6	17.2	1.08	7.85	0.72
10/17/2001		3.7	0	78.4	2.08	13.8	1.69
1/4/2002		4.2	11.2	33.4	2.53	7.39	0.569
4/26/2002		4.7	7.6	61.6	0.808	7.61	0.583
7/31/2002		4	2.2	56.8	1.06	9.85	0.566
10/18/2002		3.8	0	69	1.83	13.9	0.884
1/9/2003		5.2	7	34.8	2.17	6.04	0.597
4/22/2003		4.2	4.2	53.8	3.44	9.34	1.19
7/11/2003		7.1	57.2	0	0.362	0	0
7/31/2003		5.9	9.4	43	0.765	3.52	0
8/11/2003		5.9	10	46	1.12	6.94	0
9/18/2003	2034	5.7	9.8	50.2	1.22	7.56	0
10/8/2003		5.6	8	34.8	1.47	6.76	0
11/24/2003		5.8	9	31.4	1.24	3.1	0
12/23/2003		5.8	11.2	35	2.92	4.52	0.607
1/9/2004		5.8	9.6	22.4	2.23	5.48	0.524
4/27/2004		5.6	8	48	1.43	3.83	0
5/4/2004	4098	4.7	7.4	60	2.01	7.53	0.533
6/3/2004		5.7	8.6	48.4	1.4	6.52	0

7/7/2004		4.6	6.6	36	0.956	9.9	0
8/16/2004	1445	4.5	6.4	35.8	1.94	10.9	0.595
8/25/2004		6.2	11	26.4	1.53	4.49	0
9/16/2004		6.1	11	52.2	1.34	5.64	0
10/7/2004	2248	5.5	9.2	39.2	2.62	11.8	0
10/22/2004		5.5	9.2	49.6	2.58	8.03	0
11/2/2004		5.3	8.8	34.4	2.43	8.74	0
avg=	2456.25	5.05	8.59	36.51	1.60	7.39	0.44
stdev=				19.31	0.64	3.59	0.45

UNT08C	**Southern Unt to Little Mill Creek above UNT08**						
Date	**Initial**	**pH**	**ALK**	**HOT A**	**FE**	**MN**	**AL**
Collected	**Flow**	**pH units**	**MG/L**	**MG/L**	**MG/L**	**MG/L**	**MG/L**
7/16/2003	327	5.6	8.4	65.8	0	10.3	0
9/17/2003	606	5.7	8.2	58	0.388	9.53	0
5/5/2004	1025	5.8	9	47.4	0.548	8.79	0.73
8/16/2004	260	5.4	9.2	41	0.471	11.7	0.513
10/7/2004	689	5.7	10.4	27.4	0.712	13.3	0.596
avg=	581.40	5.64	9.04	47.92	0.42	10.72	0.37
stdev=				14.92	0.27	1.80	0.34

UNT08B	**Eastern Unt to Little Mill Creek above UNT08**						
Date	**Initial**	**pH**	**ALK**	**HOT A**	**FE**	**MN**	**AL**
Collected	**Flow**	**pH units**	**MG/L**	**MG/L**	**MG/L**	**MG/L**	**MG/L**
7/16/2003	17	5.9	7.6	24.4	0	0.878	0
9/17/2003	26	5.4	6.2	27.4	0	1.2	0
5/5/2004	43	5.2	6.6	38.8	0	1.03	0
8/16/2004	23	5.7	8	23.8	0	1.37	0
10/7/2004	22	5.6	8.6	30.6	0	1.84	0
avg=	26.20	5.56	7.40	29.00	0.00	1.26	0.00
stdev=				6.11	0.00	0.37	0.00

UNT08	Unnamed Tributary to Little Mill Creek Downstream from LMC03						
Date	**Initial**	**pH**	**ALK**	**HOT A**	**FE**	**MN**	**AL**
Collected	**Flow**	**pH units**	**MG/L**	**MG/L**	**MG/L**	**MG/L**	**MG/L**
7/14/2003	397	5.5	8.4	47.2	0.382	7.73	0
9/17/2003	692	5.6	7.6	52	0.492	8.79	0
5/5/2004	1152	5.8	10	50.8	0.447	7.99	0.645
8/16/2004	283	5.5	9.2	41.6	0.436	11.3	0.513
10/7/2004	719	5.7	10.4	28.6	0.806	13.2	0.626
1/7/2000		5.4	9.6	6.4	0.469	3.59	0.519
6/7/2000		5.1	10.4	15.4	0	13.2	0.662
10/18/2000		5.8	11.4	5.4	0.326	6.47	0
2/14/2001		5.3	9	7.2	0.455	3.52	0.694
8/16/2001		4.8	10	70.6	0	2.8	1.04
5/21/2002		5.1	10	48.4	0.336	5.11	1.59
11/4/2002		5.9	10.2	58.2	0.613	12.1	0
10/7/2003		5.8	9.4	34	0.457	7.88	0
avg=	648.60	5.48	9.66	35.83	0.40	7.98	0.48
stdev=				21.60	0.22	3.65	0.49

UNT09	Unt to Little Mill Creek @ 1000 ft downstream UNT08						
Date	**Initial**	**pH**	**ALK**	**HOT A**	**FE**	**MN**	**AL**
Collected	**Flow**	**pH units**	**MG/L**	**MG/L**	**MG/L**	**MG/L**	**MG/L**
7/14/2003	32	3.4	0	117.4	0.61	20.3	3.94
9/18/2003	29	4.6	7.2	48.8	0	4.42	3.47
5/5/2004	66	4.4	7.8	91	0	7.84	10
8/16/2004	17	4.4	7	72.8	0	7.63	6.82
10/7/2004	40	4.6	8.4	72.6	0	7.57	6.3
avg=	36.80	4.28	6.08	80.52	0.12	9.55	6.11
stdev=				25.49	0.27	6.17	2.61

LMC04	Little Mill Creek at Red Bridge on T-562						
Date	**Initial**	**pH**	**ALK**	**HOT A**	**FE**	**MN**	**AL**
Collected	**Flow**	**pH units**	**MG/L**	**MG/L**	**MG/L**	**MG/L**	**MG/L**
8/7/1995		3.6	0	36	0.92	16.50	0.78
10/12/1995		3.6	0	64	3.35	16.50	1.04
4/5/1996		4.3	7.4	30	0.82	9.32	1.12
5/23/1996		4.3	6.2	52	0.60	9.15	1.02
6/24/1996		4.8	9.6	22	2.20	5.00	1.72
7/8/1996		4.1	4.6	34	0.469	12	0.815
8/8/1996		4	2.4	50	0.587	16.6	1.35
9/4/1996		3.9	0	46	1.21	11.9	0.732
10/9/1996		4.6	8	40	1.66	10.2	0.967
11/14/1996		5	9.8	10.4	1.44	5.7	0.53
12/9/1996		5	8.6	15.4	1.58	6.52	0.815
1/6/1997		4.8	13	20	0.776	5.44	0.635
3/5/1997		5.1	10.2	16	0.997	4.8	0.781
4/16/1997		4.7	9.6	15.4	1.13	6.15	0.958
5/19/1997		4.3	5.8	30	1.14	7.82	1.25
6/9/1997		4.3	6	15	0.737	7.42	0.761
7/19/1999		6.5	32	0	1.07	0.689	0
11/1/2001		4.1	2.8	44	0.922	10.3	0.909
4/24/2002		4.8	7.8	41.8	0.682	5.59	0.589
5/29/2002		4.5	6.4	61.2	0.414	8.85	1.38
8/6/2002		3.7	0	69.8	0.567	16.4	1.11
10/3/2002		3.8	0	91.6	0.693	14	0.947
5/15/2003		4.3	6.6	53.4	0.412	5.95	0.61
9/9/2003	3518	5.5	7.4	32.4	0.867	6.61	0
4/22/2004		4.6	7	58.8	0.779	7.08	0.994
5/4/2004	6959	4.7	7.4	51	1.01	7.69	0.832
8/16/2004	2004	4.4	6.2	33.2	0.705	10.7	0.675
10/6/2004	3138	5.2	9.8	38.2	1.91	10.9	0
avg=	3904.75	4.52	6.95	38.27	0.95	8.67	0.77
stdev=				20.56	0.41	3.83	0.38

UNT10	Unnamed Tributary to Little Mill Creek Below LMC05						
Date	Initial	pH	ALK	HOT A	FE	MN	AL
Collected	Flow	pH units	MG/L	MG/L	MG/L	MG/L	MG/L
7/14/2003	197	3.6	0	82	3.17	8.18	6.18
9/17/2003	306	3.7	0	73	1.49	6.9	4.9
8/16/2004	158	3.7	0	65.4	1.99	9.37	5.99
5/4/2004	975	3.9	0	77.6	1.72	8.23	8.24
10/7/2004	426	3.9	0	82.8	2.62	11.4	9.62
1/7/2000		5.2	10.4	13.2	0.829	3.8	0
10/18/2000	950	3.7	0	62	4.73	6.64	6.03
2/14/2001		4.1	4	32	1.91	3.27	3
8/16/2001		3.2	0	167.8	6.1	20.4	9.35
5/21/2002		4.1	3.8	121	1.02	6	13.6
11/4/2002		5.4	11.4	142.6	51.2	15.8	1.38
10/7/2003		3.8	0	53	1.95	6.7	5.21
avg=	502.00	4.03	2.47	81.03	6.56	8.89	6.13
stdev=				44.10	14.14	4.93	3.76

LMC05							
Date	Initial	pH	ALK	HOT A	FE	MN	AL
Collected	Flow	pH units	MG/L	MG/L	MG/L	MG/L	MG/L
1/7/2000		4.7	8.8	22	3.31	4.36	0.758
12/18/2002		5.2	7.6	36.6	3.28	5.01	0.729
8/7/1995		3.5	0	64	4.25	17.00	2.18
4/5/1996		4	2	44	1.66	9.52	2.56
5/23/1996		4.1	3.6	66	1.36	8.82	2.29
6/24/1996		4.5	8	30	2.30	4.85	2.38
7/8/1996		3.9	0	50	1.33	12	2.16
8/8/1996		3.7	0	76	1.34	16.4	4.03
9/4/1996		3.7	0	74	2.64	13.4	2.76
10/9/1996		4.2	5.2	54	2.13	10.4	1.86
11/14/1996		4.6	8.4	14	2.23	6.09	1.4
12/9/1996		4.4	6.6	28	2.46	6.67	2.01
1/6/1997		4.5	13	28	1.46	5.93	1.39
2/6/1997		4.5	7.4	36	1.57	3.89	1.17
3/5/1997		4.5	7.6	24	1.51	4.91	1.51
4/16/1997		4.4	7.6	28	2	6.38	1.88
5/19/1997		4.1	4.2	34	1.72	8.11	1.73
6/9/1997		4	2.8	28	1.38	8.01	1.35
11/1/2001		4	1.2	64	9.55	11.1	1.04
4/24/2002		4.5	7.2	38.6	2.8	6.17	1.54
5/29/2002		4.3	4.6	47.8	2.6	10.1	3.17

8/6/2002	1638	3.8	0	74	7.33	16.1	1.81
10/3/2002	1574	3.9	0.4	105.8	16.4	15.6	1.31
5/15/2003	5393	4.8	8.8	46.8	3.23	6.57	1.02
9/9/2003	5348	5.6	9.2	42.6	3.84	6.86	0.562
4/22/2004		5	8.8	52	4	7.37	1.6
5/4/2004	7482	5	8.4	58.4	3.51	7.88	1.35
8/16/2004	2453	5.8	12.4	37.4	8.58	11.4	1.09
10/6/2004	4014	5.6	11.8	45.2	8.18	11.5	1.67
avg=	3986.00	4.44	5.71	46.52	3.94	8.89	1.64
stdev=				20.24	3.53	3.71	0.77

UNT12	**Unt to Little Mill Creek @ 1300 ft downstream LMC05**						
Date	**Initial**	**pH**	**ALK**	**HOT A**	**FE**	**MN**	**AL**
Collected	**Flow**	**pH units**	**MG/L**	**MG/L**	**MG/L**	**MG/L**	**MG/L**
7/14/2003	4	3.4	0	117	2.43	8.3	11.5
9/17/2003	23	3.4	0	123.6	1.49	6.53	11
5/5/2004	66	3.6	0	131.6	0.948	5.72	15.5
8/16/2004	5	3.5	0	120.4	0.596	8.4	13.3
10/7/2004	16	3.6	0	126.8	0.982	7.73	15.9
avg=	22.80	3.50	0.00	123.88	1.29	7.34	13.44
stdev=				5.65	0.71	1.17	2.24

UNT12B	**Unt to Little Mill Creek @ 10 ft downstream UNT12**						
Date	**Initial**	**pH**	**ALK**	**HOT A**	**FE**	**MN**	**AL**
Collected	**Flow**	**pH units**	**MG/L**	**MG/L**	**MG/L**	**MG/L**	**MG/L**
9/17/2003	23	3.8	0	97.8	0.498	5.2	5.7
5/5/2004	30	3.8	0	102.6	0	4.21	6.32
8/16/2004	26	4	0	118.4	1.51	8.82	14.9
10/7/2004	12	3.7	0	114.6	1.22	7.3	14.6
avg=	22.75	3.825	0	108.35	0.807	6.3825	10.38
stdev=				9.74	0.69	2.07	5.05

UNT13	**Unt to Little Mill Creek 650 ft downstream UNT12**						
Date	**Initial**	**pH**	**ALK**	**HOT A**	**FE**	**MN**	**AL**
Collected	**Flow**	**pH units**	**MG/L**	**MG/L**	**MG/L**	**MG/L**	**MG/L**
7/14/2003	28	3	0	123	16	11.3	0
9/17/2003	0.75	3.3	0	60.6	5.57	4.81	0
5/5/2004	91	3.3	0	85.8	7.36	6.81	0
8/16/2004	19	3.1	0	111.6	17	11.9	0
10/7/2004	21	3.3	0	91.2	16.4	11.5	0
avg=	31.95	3.2	0	94.44	12.466	9.264	0
stdev=				24.19	5.53	3.24	0.00

UNT15	Unt to Little Mill Creek						
Date	Initial	pH	ALK	HOT A	FE	MN	AL
Collected	Flow	pH units	MG/L	MG/L	MG/L	MG/L	MG/L
7/14/2003	27	5.5	6.8	39.8	0.802	0.219	<.5
9/17/2003	66	5.7	6	32.2	<.3	0.205	<.5

UNT17	Unt to Little Mill Creek						
Date	Initial	pH	ALK	HOT A	FE	MN	AL
Collected	Flow	pH units	MG/L	MG/L	MG/L	MG/L	MG/L
7/14/2003	30	6.4	12.6	36.8	0.967	0.23	<.5
9/17/2003	77	6.5	0	9.6	0.799	0.055	<.5

UNT19	Unt to Little Mill Creek						
Date	Initial	pH	ALK	HOT A	FE	MN	AL
Collected	Flow	pH units	MG/L	MG/L	MG/L	MG/L	MG/L
7/14/2003	105	5.4	6.6	24.4	<.3	0.156	<.5
9/17/2003	155	5.6	5.8	14	<.3	0.133	<.5

UNT21	UNT to Little Mill Creek, 650ft downstream UNT12						
Date	Initial	pH	ALK	HOT A	FE	MN	AL
Collected	Flow	pH units	MG/L	MG/L	MG/L	MG/L	MG/L
7/15/2003	189	6.4	9.4	22.2	<.3	0.055	<.5
9/17/2003	374	6.4	8.8	38	<.3	<.05	<.5

UNT14	Unt to LMC Upstream UNT21						
Date	Initial	pH	ALK	HOT A	FE	MN	AL
Collected	Flow	pH units	MG/L	MG/L	MG/L	MG/L	MG/L
9/17/2003	20	6.8	14.8	0	<.3	<.05	<.5
5/5/2004	74	6.6	12.2	4	<.3	<.05	<.5

LMC06	Mouth of Little Mill Creek (at Confluence with Mill Creek)						
Date	Initial	pH	ALK	HOT A	FE	MN	AL
Collected	Flow	pH units	MG/L	MG/L	MG/L	MG/L	MG/L
8/7/1995		3.5	0	48	2.10	11.60	1.52
4/5/1996		3.9	0	38	1.83	8.13	1.92
4/24/1996		3.9	0	34	1.48	5.92	1.37
8/13/1996		3.8	0	36	1.15	9.99	2.86
10/9/1996		4	3.2	46	1.55	8.95	1.99
9/19/2001	1300	3.4	0	97.2	6.44	13.9	1.39
11/1/2001	1330	3.5	0	64	7.06	10.9	1.13
4/24/2002	9287	4.3	5.8	39.2	2.91	4.93	0.971
5/29/2002	8444	4	1.4	43.2	1.78	8.19	2.4
8/6/2002	2750	3.4	0	69.6	3.61	13.6	1.9
10/3/2002	2191	3.4	0	84.2	0	0	0
5/15/2003	7036	4.2	5.4	45.6	3.17	5.8	1.09
9/9/2003	7556	5.2	6.8	48.8	4.87	6.16	0.522
4/22/2004	7985	4.8	7.6	53.8	3.54	6	1.24
10/6/2004	4847	5	9.6	45	6.19	9.85	0.997
avg=	5272.6	4.02	2.65	52.84	3.52	8.19	1.37
stdev=				18.31	2.24	3.91	0.80

C&K post mining discharge D7	
Date Collected	Flow (gpm)
10/2/1996	20.00
9/10/1997	2.50
7/28/1998	3.00
9/10/1998	1.00
1/26/1999	2.50
6/16/1999	4.00
7/7/1999	3.00
9/10/1999	0.75
10/12/1999	0.75
.11/12/1999	0.75
6/7/2001	6.00
12/26/2001	1.00
2/7/2002	4.00
4/10/2002	10.00
7/10/2002	0.25
8/6/2002	10.00
11/5/2002	2.00
1/16/2003	12.00
4/24/2003	15.00
7/24/2003	20.00

9/12/2003	15.00
10/15/2003	20.00
11/6/2003	15.00
12/4/2003	15.00
1/21/2004	10.00
2/11/2004	10.00
4/6/2004	20.00
7/14/2004	15.00
10/22/2004	20.00
2/2/2005	20
avg=	9.28
mgd=	0.013

Attachment F

Comment and Response