Final

LITTLE SCHUYLKILL RIVER WATERSHED TMDL

Schuylkill County

For Acid Mine Drainage Affected Segments

Prepared by:

Pennsylvania Department of Environmental Protection

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TMDL[1]

Little Schuylkill River Watershed
Schuylkill County, Pennsylvania

Table 1. 303(d) Sub-List								
State Water Plan (SWP) Subbasin: 03-A								
Year	**SWP**	**Miles**	**Segment ID**	**DEP Stream Code**	**Stream Name**	**Designated Use**	**Data Source**	**EPA 305(b) Cause Code**
1996	03-A	2.5	6189	02202	Little Schuylkill River	CWF	Resource Extraction	Metals
1996	03-A	3.2	6189	02202	Little Schuylkill River	CWF	Resource Extraction	Susp. Solids
1996	03-A	2.4	6189	02202	Little Schuylkill River	CWF	Resource Extraction	pH
1998	03-A	31.47	6189	02202	Little Schuylkill River	CWF	SWMP	pH Susp. Solids Metals
2002	03-A	16	20000815-0815-CJD	02202	Little Schuylkill River	CWF	SWAP	Metals pH Susp. Solids Siltation Water/Flow Variability Other Habitat Alterations
2004	03-A	22.8	20000815-0815-CJD	02202	Little Schuylkill River	CWF	SWAP	Metals pH Susp. Solids Siltation
2004	03-A	1.7	20000815-0816-CJD	02233	Unt Little Schuylkill River	CWF	SWAP	Metals pH Susp. Solids
2004	03-A	0.1	20000815-0816-CJD	02244	Unt Little Schuylkill River	CWF	SWAP	Metals pH Susp. Solids
2004	03-A	0.1	20000815-0816-CJD	02245	Unt Little Schuylkill River	CWF	SWAP	Metals pH Susp. Solids

CWF=Cold Water Fishery
SWMP= Surface Water Monitoring Program
SWAP= Surface Water Assessment Program
See Attachment D, *Excerpts Justifying Changes Between the 1996, 1998, 2002, and 2004 Section 303(d) Lists.*
The use designations for the stream segments in this TMDL can be found in PA Title 25 Chapter 93.

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

Introduction

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

Directions to the Little Schuylkill River Watershed

The Little Schuylkill River Watershed is approximately 53.4 square miles in area. It is located in eastern Schuylkill County, about a mile south of Haddock, Pennsylvania. The Little Schuylkill River flows 31.44 miles south from its headwaters near Haddock in Kline Township, Schuylkill County to its confluence with the Schuylkill River at Port Clinton in West Brunswick Township, Schuylkill County. The Little Schuylkill River can be accessed by traveling on Interstate 81 to State Route 309 in Hazleton, Pennsylvania.

Segments addressed in this TMDL

The Little Schuylkill River Watershed is affected by pollution from AMD. This pollution has caused high levels of metals and low pH in the mainstem of the Little Schuylkill River at numerous sources as well as from two tributaries, the Wabash and Panther Creeks. AMD begins near the headwaters from the Silverbrook Discharge. Sources of AMD are nonexistent once the Little Schuylkill River flows south of Sharp Mountain and out of the Southern Anthracite coalfield.

There are active mining operations with NPDES permits in the watershed (Table 2). All of the discharges in the watershed are from abandoned mines and will be treated as non-point sources, except for one large discharge (NPDES permit # PA0012360). Each segment on the Section 303(d) list will be addressed as a separate TMDL. These TMDLs will be expressed as long-term, average loadings. Due to the nature and complexity of mining effects on the watershed, expressing the TMDL as a long-term average gives a better representation of the data used for the calculations. See Attachment C for TMDL calculations.

Clean Water Act Requirements

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

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

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

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

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

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

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

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

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

These TMDLs were developed in partial fulfillment of the 1996 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA*.

Section 303(d) Listing Process

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

The primary method adopted by the Pennsylvania Department of Environmental Protection (DEP) for evaluating waters changed between the publication of the 1996 and 1998 Section 303(d) lists. Prior to 1998, data used to list streams were in a variety of formats, collected under differing protocols. Information also was gathered through the Section 305(b)[2] reporting process. DEP is now using the Statewide Surface Waters Assessment Protocol (SSWAP), a

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

modification of the EPA's 1989 Rapid Bioassessment Protocol II (RBP-II), as the primary mechanism to assess Pennsylvania's waters. The SSWAP provides a more consistent approach to assessing Pennsylvania's streams.

The assessment method requires selecting representative stream segments based on factors such as surrounding land uses, stream characteristics, surface geology, and point source discharge locations. The biologist selects as many sites as necessary to establish an accurate assessment for a stream segment; the length of the 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 Section 303(d) list with the source and cause. A TMDL must be developed for the stream segment and each pollutant. In order for the process to be more effective, adjoining stream segments with the same source and cause listing are addressed collectively, and on a watershed basis.

Basic Steps for Determining a TMDL

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

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

Watershed History

The Little Schuylkill Watershed drains approximately 53.4 square miles, with approximately 31.44 miles of stream. Abandoned mine areas are dominant in the northern portion of the watershed. Besides the AMD from Wabash and Panther Creeks, the watershed receives sources of AMD from two topographical basins known as the Silverbrook and Tamaqua Basins. The Silverbrook Basin contains less than a mile of the stream. The Tamaqua Basin, which begins approximately 7.2 miles downstream from the Silverbrook Basin, contains a 1.5-mile reach of stream.

AMD into the watershed is primarily from deep mine pools, both abandoned and active mines. The largest of these pools is the Silverbrook Mine pool, which underlies most of the Silverbrook Basin. Smaller deep mine pools are situated on the west side of the Little Schuylkill River at the water gaps north and south of Tamaqua Borough. All five pools extend for some distance into the Wabash Valley and, therefore, drain a portion of the groundwater from this valley.

The surface in the Silverbrook Basin has been almost completely destroyed by surface and deep mining. Similar activities on both sides of the water gaps at Tamaqua have destroyed the surface in these areas as well. The Silverbrook Basin has been an area of very extensive deep mining below present water level. As a result of abandonment, 80 to 90% of the deep mine workings are now inundated, forming a huge pool of acid mine water underlying much of the basin.

The headwaters of the Little Schuylkill River are in the Silverbrook Basin and the overflow (Silverbrook Discharge) from the mine pool is a large part of the flow for the River at this point. The point of discharge is on the bank of the stream 200 feet east of State Route 309. The mine flow emanates from the base of a refuse bank, which conceals a possible portal.

Immediately adjacent to the east of the Silverbrook Discharge is an active surface mining permit issued to Northeastern Power Company (NEPCO). The surface mining permit covers 876 acres and consists mainly of loading and transporting existing supplies of coal refuse as fuel for the onsite fluidized bed cogeneration plant. Also, included with the operations is the reclamation of existing onsite abandoned mining areas with placement of coal ash. Also immediately adjacent to the west of the Silverbrook Discharge along the bank of the Little Schuylkill River are two (2) limestone diversion wells constructed by PADEP; the majority of the water from discharge is redirected to these wells. The first well was placed in the spring of 1996 and the second in the fall of 1998. The wells are maintained by NEPCO.

Within the Tamaqua Basin, a large AMD discharge, Rt. 309 Buck Drift Discharge, flows from a buried deep mine opening south of Tamaqua, on the east side of State Route 309 along the north side of Pisqah Mountain (one mile south of the intersection of SR 209 and SR 309 in Tamaqua). The discharge is believed to drain four (4) deep mine pools, named Tamaqua, Greenwood, Rahn and Coaldale, extending from Tamaqua westward to Coaldale (Taylor 1988). On the surface the discharge is routed into a buried 30-inch pipe before entering the Little Schuylkill River. Initially, this discharge was being treated using a wetland adjacent to Route 309 constructed by the Bureau of Abandoned Mine Reclamation for passive treatment of the mine drainage. However, during 2003, the Lehigh Coal & Navigation Wadesville P-33 operation ceased pumping groundwater from an active pit being mined on this complex. Because the operation is hydrologically connected to the discharge, when groundwater pumping ceased, local groundwater levels in the connected deep mine pool began to rise. This created pressure with the deep mine that resulted in a blow out and an increase in drainage volume. Additionally, a severe storm in June 2006 caused further pressure and another subsequent blow out with increased volume at the Route 309 discharge. Due to the hydrologic connection to the deep mine complex, LCN is in the process of negotiating a consent agreement for the long-term treatment of this discharge with the Department. The Department has renewed their NPDES permit for this discharge that will include water quality based effluent limits (WQBELs) more stringent than current best available technology (BAT) effluent limits.

There are currently five (5) active coalmining permits in the watershed (see Table 2). All the active mining sites are remining permits since they are reclaiming piles of previously unusable reprocessing refuse (culm) bank material by turning it into a fuel source. For the mining sites that do not hold NPDES permits, no waste load allocation is necessary due to the lack of a discharge. Only Outfall 005 on the LCN permit is actively discharging, therefore a WLA (Waste Load Allocation) has been calculated. Premium Fine Coal, Inc. (NPDES #PA0593486) and South Tamaqua Coal Pockets, Inc. (NPDES #PA0613631) have NPDES permits for erosion and sedimentation only. The sedimentation ponds have no recorded discharges and have not been assigned waste load allocations. It has been determined that effects from sedimentation ponds are negligible because their potential discharges are based on infrequent and temporary events and the ponds should rarely discharge if reclamation and revegetation is concurrent. In addition, sedimentation ponds are designed in accordance with PA Code Title 25 Chapter 87.108 (h) to at minimum contain runoff from a 10-year 24-hour precipitation event.

Table 2. Mining Permits in the Little Schuylkill Watershed

Permittee	*Permit Number*	*Status*	*NPDES*
Mazaika Coal Company	54840209	Coal preparation plant on site. No NPDES permit	N/A
Premium Fine Coal, Inc.	54860204	Coal preparation plant on site. NPDES permit for a sedimentation pond. No reported discharge.	PA0593486
Vito J. Rodino, Inc.	54921601	Coal preparation plant on site. No NPDES permit.	N/A
Northeastern Power Company	54920201	No NPDES permit. Cogeneration plant, refuse reprocessing, and coal ash placement are active on this site.	N/A
South Tamaqua Coal Pockets, Inc.	54830209	Coal preparation plant on site. NPDES permit for a sedimentation pond. No reported discharge.	PA0613631
Lehigh Coal & Navigation Company	54733020	NPDES permit for Outfall 005.	PA0012360

A recent biological survey conducted by DEP's Water Management Program (Daley 2003) for the Little Schuylkill River in the Tamaqua area showed moderate impairment. The stations below Panther Creek, Wabash Creek, and the Rt. 309 Buck Drift Discharge showed a reduction of abundance and diversity of benthic organisms compared to the station above these influences, attributed to the effects of AMD. However, overall improvement was noted, since no populations were found during a survey in 1984. The construction of treatment facilities and reclamation projects was stated as a reason for the gradual improvement in the water quality over the years.

AMD Methodology

A two-step approach is used for the TMDL analysis of 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 unless otherwise indicated.

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

Allowable loads are determined for each point (NPS) of interest using Monte Carlo simulation. Monte Carlo simulation is an analytical method meant to imitate real-life systems, especially when other analyses are too mathematically complex or too difficult to reproduce. Monte Carlo simulation calculates multiple scenarios of a model by repeatedly sampling values from the probability distribution of the uncertain variables and using those values to populate a larger data set. Allocations were applied uniformly for the watershed area specified for each allocation point. For each source and pollutant, it was assumed that the observed data were log-normally distributed. Each pollutant source was evaluated separately using @Risk[3] by performing 5,000 iterations to determine the required percent reduction so that the water quality criteria, as defined in the *Pennsylvania Code. Title 25 Environmental Protection, Department of Environmental Protection, Chapter 93, Water Quality Standards,* will be met instream at least 99 percent of the time. For each iteration, the required percent reduction is:

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

PR = required percent reduction for the current iteration

Cc = criterion in mg/l

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

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

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

Mean = average observed concentration

Standard Deviation = standard deviation of observed data

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

$$LTA = Mean * (1 – PR99) \text{ where} \quad (2)$$

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 pH TMDLs, hot 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 hot acidity. Net alkalinity is alkalinity minus hot 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 represent a true reflection of acidity. This method assures that Pennsylvania's standard for pH is met when the acid concentration reduction is met.

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

TMDL Endpoints

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

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

Table 3. Applicable Water Quality Criteria

Parameter	***Criterion Value (mg/l)***	***Total Recoverable/Dissolved***
Aluminum (Al)	0.75	Total Recoverable
Iron (Fe)	1.50	30-day average; Total
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).

Impairment due to suspended solids/siltation

The suspended solids, or siltation, impairment noted in Little Schuylkill River is due to runoff from large refuse piles (culm banks) from historic mining and croplands located throughout the watershed. Refuse piles are also abundant along Panther Creek and Wabash Creek, two large tributaries to Little Schuylkill River. An existing sediment load was computed using the Generalized Watershed Loading Function (GWLF) model. This model is being used by the Department to address sedimentation/siltation/suspended solids problems in other watersheds throughout the Commonwealth.

The "Reference Watershed Approach" is used to determine the sediment load reduction needed for this watershed. The Reference Watershed Approach compares two watersheds, one attaining its designated uses and one that is impaired based on biological assessments. Both watersheds must have similar land use/cover distributions. Other features such as base geologic formation should be matched to the extent possible; however, most variations can be adjusted in the model. The objective of the process is to reduce the loading rate of pollutants in the impaired stream segment to a level equivalent to, or slightly lower than, the loading rate in the non-impaired, reference segment. This load reduction will result in conditions favorable to the return of a healthy biological community to the impaired stream segments.

In general, three factors are considered when selecting a suitable reference watershed. The first factor is to use a watershed that the Department has assessed and determined to be attaining water quality standards. The second factor is to find a watershed that closely resembles the impaired watershed in physical properties such as land cover/land use, physiographic province, and geology. Finally, the size of the reference watershed should be within 20-30% of the impaired watershed area. The search for a reference watershed for Little Schuylkill River that would satisfy the above characteristics was done by means of a desktop screening using several GIS coverages, including the Multi-Resolution Land Characteristics (MRLC), Landsat-derived land cover/use grid, the Pennsylvania's 305(b) assessed streams database, and geologic rock types.

Meshoppen Creek Watershed was selected for use as the reference watershed. The watershed is located in State Water Plan subbasin 4G; the protected use is aquatic life. Meshoppen Creek Basin is designated as Cold Water Fishes (CWF) under §93.9t in Title 25 of the Pa. Code (Commonwealth of Pennsylvania, 2002). Based on the Department's 305(b) report database, Meshoppen Creek Watershed is currently attaining its designated uses. The attainment of designated uses is based on sampling done by the Department in 2000, using the Unassessed Waters Program protocol. A map of the Meshoppen Creek Watershed is located in Attachment A.

Drainage area, location, land use and other physical characteristics such as geology and rock types of the Little Schuylkill River Watershed were compared to the Meshoppen Creek Watershed. An analysis of the available characteristics revealed that while land cover/use distributions are not an exact match, the watersheds are similar.

A suspended solids/siltation TMDL for the Little Schuylkill River Watershed was developed using the ArcView Generalized Watershed Loading Function (AVGWLF) model as described in Attachment E. The AVGWLF model was used to establish existing loading conditions for the Little Schuylkill River Watershed and the Meshoppen Creek Reference Watershed. All modeling outputs have been included in Attachment G.

The sediment reduction goal for the TMDL is based on setting the watershed-loading rate of the impaired Little Schuylkill River equal to the watershed-loading rate in the un-impaired Meshoppen Creek Watershed. The load reduction for suspended solids in Little Schuylkill River was assigned to the land use categories coal mines/quarry and croplands.

The TMDL for sediment results in a 34% reduction in loading from croplands and 39% from coal mine/quarry. A more detailed explanation of sediment calculations is contained in Attachment D. The individual components of the TMDL are summarized in Table 4 and the load allocation summary is given in Table 5.

Table 4. TMDL, WLA, MOS, LA, LNR, and ALA for Little Schuylkill River Watershed	
Component	Sediment (lbs/yr.)
TMDL (Total Maximum Daily Load)	96205299
WLA (Waste Load Allocation)	705434
MOS (Margin of Safety)	9620529.9
LA (Load Allocation)	85879334
LNR (Loads Not Reduced)	16497140
ALA (Adjusted Load Allocation)	69382193.6

Table 5. Sediment Source Load Allocation Summary for Little Schuylkill River Watershed			
Source	Current Loading (lbs/yr.)	Allowable Loading (lbs/yr.)	Percent Reduction (%)
CROPLAND	35847600	23635750	34%
COAL_MINES/QUARRY	74456180	45746443	39%
NPS Loads Not Reduced	16497140	16497140	-
Total	126800920	85879334	37%

TMDL Elements (WLA, LA, MOS)

$$TMDL = WLA + LA + MOS$$

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 non-point sources. The margin of safety is applied to account for uncertainties in the computational process. The margin of safety may be expressed implicitly (documenting conservative processes in the computations) or explicitly (setting aside a portion of the allowable load). The TMDL allocations in this report are based on available data. Other allocation schemes could also meet the TMDL. Table 6 contains the TMDL component summary for each point evaluated in the watershed. Refer to the maps in Attachment A.

Allocation Summary

These TMDLs will focus remediation efforts on the identified numerical reduction targets for each watershed. The reduction schemes in Table 6 for each segment are based on the assumption that all upstream allocations are achieved and also take into account all upstream reductions. Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. As changes occur in the watershed, the TMDLs may be re-evaluated to reflect current conditions. An implicit margin of safety (MOS) based on conservative assumptions in the analysis is included in the TMDL calculations.

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

Each permitted discharge in a segment is assigned a waste load allocation and the total waste load allocation for each segment is included in this table. There is currently one necessary waste load allocation (WLA) in the Little Schuylkill River Watershed. The difference between the TMDL and the WLA is the load allocation (LA) at the point. The LA at each point includes all loads entering the segment, including those from upstream allocation points. The percent reduction is calculated to show the amount of load that needs to be reduced to the area upstream of the point in order for water quality standards to be met at the point.

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

Table 6. Little Schuylkill River Watershed Summary Table

Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	% Reduction
LS1 – Little Schuylkill River at notched weir upstream of diversion wells						
Aluminum (lbs/day)	89.63	6.99	0	6.99	82.64	92%
Iron (lbs/day)	111.85	7.16	0	7.16	104.69	94%
Manganese(lbs/day)	22.98	9.24	0	9.24	13.74	60%
Acidity (lbs/day)	1176.94	5.36	0	5.36	1171.58	99.5%
LS2 – Silverbrook Outfall at weir upstream of diversion wells						
Aluminum (lbs/day)	107.86	6.54	0	6.54	101.32	94%
Iron (lbs/day)	307.30	19.98	0	19.98	287.32	94%
Manganese(lbs/day)	28.26	13.73	0	13.73	14.53	52%
Acidity (lbs/day)	2033.44	40.33	0	40.33	1993.11	98%
LS3 – Little Schuylkill River downstream of diversion wells and unnamed tributary						
Aluminum (lbs/day)	235.15	22.82	0	22.82	28.37	56%*
Iron (lbs/day)	488.71	26.78	0	26.78	69.92	73%*
Manganese(lbs/day)	62.27	31.87	0	31.87	2.13	7%*
Acidity (lbs/day)	3112.52	159.77	0	159.77	0	0%*
LS4 – Lofty Creek near confluence with Little Schuylkill River						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	ND	NA	0	NA	NA	NA

Manganese(lbs/day)	3.83	3.83	0	NA	NA	NA
Acidity (lbs/day)	1126.42	161.76	0	161.76	924.66	86%
LS5 – Little Schuylkill River upstream of Northeastern Power Company						
Aluminum (lbs/day)	214.64	26.88	0	26.88	0	0%*
Iron (lbs/day)	338.14	38.88	0	38.88	0	0%*
Manganese(lbs/day)	59.84	35.87	0	35.87	0	0%*
Acidity (lbs/day)	4507.39	332.33	0	332.33	0	0%*
LS6 – Little Schuylkill River downstream of Northeastern Power Company						
Aluminum (lbs/day)	396.66	61.93	0	61.93	148.97	71%*
Iron (lbs/day)	522.21	104.84	0	104.84	118.11	53%*
Manganese(lbs/day)	116.76	81.49	0	81.49	11.30	13%*
Acidity (lbs/day)	9397.50	751.74	0	751.74	4470.70	86%*
LS7 – Little Schuylkill River west of Hometown						
Aluminum (lbs/day)	102.75	33.65	0	33.65	0	0%*
Iron (lbs/day)	135.13	135.13	0	NA	NA	NA
Manganese(lbs/day)	73.30	73.30	0	NA	NA	NA
Acidity (lbs/day)	12259.86	1359.95	0	1359.95	2254.15	63%*
LS8 – Little Schuylkill River downstream of Locust Creek						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	103.21	103.21	0	NA	NA	NA
Manganese(lbs/day)	70.31	70.31	0	NA	NA	NA
Acidity (lbs/day)	6585.65	889.82	0	889.82	0	0%*
LS9 – Little Schuylkill River at USGS gaging station at Tamaqua						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	195.72	195.72	0	NA	NA	NA
Manganese(lbs/day)	41.57	41.57	0	NA	NA	NA
Acidity (lbs/day)	2012.40	664.09	0	664.09	0	0%*
Panther Creek						
Aluminum (lbs/day)	46.3	6.5	0	6.5	---	---
Iron (lbs/day)	57.6	15.0	0	15.0	---	---
Manganese(lbs/day)	74.2	8.9	0	8.9	---	---
Acidity (lbs/day)	119.9	119.9	0	NA	---	---
Wabash Creek						
Aluminum (lbs/day)	46.3	6.0	0	6.0	---	---
Iron (lbs/day)	9.8	9.8	0	NA	---	---
Manganese(lbs/day)	18.6	9.7	0	9.7	---	---
Acidity (lbs/day)	368.2	11.0	0	11.0	---	---
LS11 – Little Schuylkill River 1.2 miles downstream from Lehigh Coal & Navigation Route 309 Discharge						
Aluminum (lbs/day)	440.38	251.02	41.41	209.61	109.26	31%*

Iron (lbs/day)	1610.09	395.66	82.83	312.83	1171.83	75%*
Manganese(lbs/day)	977.26	222.55	55.22	167.33	680.51	76%*
Acidity (lbs/day)	12785.74	2119.72	-	2119.72	8960.51	81%*
LSNR – Little Schuylkill River downstream of Route 443 bridge in New Ringold						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	671.56	496.95	0	496.95	129.49	21%*
Manganese(lbs/day)	867.79	555.39	0	555.39	0	0%*
Acidity (lbs/day)	2992.38	329.16	0	329.16	158.38	33%*
LS13 – Little Schuylkill River at mouth						
Aluminum (lbs/day)	864.65	510.15	0	510.15	354.50	40%*
Iron (lbs/day)	774.39	518.84	0	518.84	77.50	13%*
Manganese(lbs/day)	501.59	476.51	0	476.51	0	0%*
Acidity (lbs/day)	11528.71	2651.60	0	2651.60	6213.89	79%*

* Total of loads affecting this segment is less than the allowable load calculated at this point based on mass balance of upstream loading, therefore no reduction is necessary.
ND = non detection NA = not applicable

In the instance that the allowable load is equal to the measured load (e.g. manganese LS4, Table 4), the simulation determined that water quality standards are being met instream and therefore no TMDL is necessary for the parameter at that point. Although no TMDL is necessary, the loading at the point is considered at the next downstream point. This is denoted as "NA" in the above table. "ND" was used to represent sample data which was found to be below detection levels or where no data was measured at a sample point.

A Waste Load Allocation was assigned to one permitted mine drainage discharge contained in Lehigh Coal and Navigation Company (SMP54733020, NPDES PA0012360). Waste Load Allocations are calculated using the average flow and monthly average permit limits for iron and manganese (calculated as water quality-based effluent limits). The WLA for Outfall 005 is being evaluated at sample point LS11.

Table 7. Waste Load Allocations at Outfall 005			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
Outfall 005			
Al	0.75	6.621	41.41
Fe	1.5	6.621	82.83
Mn	1.0	6.621	55.22

Following is an example of how the allocations, presented in Table 6, for a stream segment are calculated. For this example, acidity allocations for LS7 of Little Schuylkill River are shown. As demonstrated in the example, all upstream contributing loads are accounted for at each point. Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. These analyses follow the example. Attachment A contains maps of the sampling point locations for reference.

LS6	Acidity (Lbs/day)
Existing Load @ LS6	9397.50
Difference in measured Loads between upstream loads and existing LS6	4890.11
Percent loss due calculated at LS6	0%
Additional load tracked from above samples	332.33
Percentage of upstream loads that reach the LS6	100%
Total load tracked between LS5 and LS6	5222.44
Allowable Load @ LS6	751.74
Load Reduction @ LS6	4470.70
% Reduction required at LS6	86%

Load = 751.74lbs/day

Load input = 2862.36lb/day
(Difference between existing loads at LS7 and LS6)

LS7	Acidity (Lbs/day)
Existing Load @ LS7	12259.86
Difference in measured Loads between upstream loads and existing LS7	2862.36
Additional load tracked from above samples	751.74
Total load tracked between LS6 and LS7	3614.10
Allowable Load @ LS7	1359.95
Load Reduction @ LS7	2254.15
% Reduction required at LS7	63%

Load = 1359.95 lbs/day

The allowable load tracked from LS6 was 751.74 lbs/day. The existing load at LS6 was subtracted from the existing load at LS7 to show the actual measured increase of acidity load that has entered the stream between these two sample points (2862.36 lbs/day). This increased value was then added to the allowable load at LS6 to calculate the total load that was tracked between LS6 and LS7 (allowable load @ LS6 + the difference in existing load between LS6 and LS7). This total load tracked was then subtracted from the calculated allowable load at LS7 to determine the amount of load to be reduced at LS7. This value was found to be 3614.10 lbs/day; it was 2254.15 lbs/day greater than the LS7 allowable load of 1359.45 lbs/day. Therefore, a 63% reduction at LS7 is necessary. From this point, the allowable acidic load at LS7 will be tracked to the next downstream point, LS8.

Recommendations

Various methods to eliminate or treat pollutant sources and to provide a reasonable assurance that the proposed TMDLs can be met exist in Pennsylvania. These methods include PADEP's primary efforts to improve water quality through reclamation of abandoned mine lands (for abandoned mining) and through the National Pollution Discharge Elimination System (NPDES) permit program (for active mining). Funding sources available that are currently being used for projects designed to achieve TMDL reductions include the Environmental Protection Agency (EPA) 319 grant program and Pennsylvania's Growing Greener Program (which has awarded almost $37 M since 1999 for watershed restoration and protection in mine-drainage impacted watersheds and abandoned mine reclamation). In 2006 alone, federal funding through the Office of Surface Mining (OSM) contributed $949 K for reclamation and mine drainage treatment through the Appalachian Clean Streams Initiative and another $298 K through Watershed Cooperative Agreements. According to the Department of the Interior, Office of Surface Mining (www.osmre.gov/annualreports/05SMCRA2AbandMineLandReclam.pdf), during 2005, Pennsylvania reclaimed 54 acres of gob piles, 73 acres of pits, 2,500 acres of spoil areas, 7,658 feet of highwall, and treated 94,465 gallons of mine drainage under their environmental (Priority 3) program only (priorities 1&2 are for reclaiming features threatening public health and safety with much larger number of features reclaimed).

OSM reports that nationally, of the $8.5 billion of high priority (defined as priority 1&2 features or those that threaten public health and safety) coal related AML problems in the AML inventory, $6.6 billion (78%)have yet to be reclaimed; $3.6 billion of this total is attributable to Pennsylvania watershed costs. Almost 83 percent of the $2.3 billion of coal related environmental problems (priority 3) in the AML inventory are not reclaimed. The Bureau of Abandoned Mine Reclamation, the Department's primary bureau in dealing with abandoned mine reclamation (AMR) issues, has established a comprehensive plan for abandoned mine reclamation throughout the Commonwealth to prioritize and guide reclamation efforts for throughout the state to make the best use of valuable funds (www.dep.state.pa.us/dep/deputate/minres/bamr/complan1.htm). In developing and implementing a comprehensive plan for abandoned mine reclamation, the resources (both human and financial) of the participants must be coordinated to insure cost-effective results. The following set of principles is intended to guide this decision making process:

- Partnerships between the DEP, watershed associations, local governments, environmental groups, other state agencies, federal agencies and other groups organized to reclaim abandoned mine lands are essential to achieving reclamation and abating acid mine drainage in an efficient and effective manner.

- Partnerships between AML interests and active mine operators are important and essential in reclaiming abandoned mine lands.

- Preferential consideration for the development of AML reclamation or AMD abatement projects will be given to watersheds or areas for which there is an approved rehabilitation plan. (guidance is given in Appendix B to the Comprehensive Plan).

- Preferential consideration for the use of designated reclamation moneys will be given to projects that have obtained other sources or means to partially fund the project or to projects that need the funds to match other sources of funds.

- Preferential consideration for the use of available moneys from federal and other sources will be given to projects where there are institutional arrangements for any necessary long-term operation and maintenance costs.

- Preferential consideration for the use of available moneys from federal and other sources will be given to projects that have the greatest worth.

- Preferential consideration for the development of AML projects will be given to AML problems that impact people over those that impact property.

- No plan is an absolute; occasional deviations are to be expected.

A detailed decision framework is included in the plan that outlines the basis for judging projects for funding, giving high priority to those projects whose cost/benefit ratios are most favorable and those in which stakeholder and landowner involvement is high and secure.

In addition to the abandoned mine reclamation program, regulatory programs also are assisting in the reclamation and restoration of Pennsylvania's land and water. PADEP has been effective in implementing the NPDES program for mining operations throughout the Commonwealth. During 2006, District Mining Offices issued 31 new remining permits with the potential for reclaiming 1,058 acres of abandoned mine lands; an additional 328 acres were reclaimed during 2006 from existing remining permits. This reclamation was done at no cost to the Commonwealth or the federal government. Long-term treatment agreements were initialized for 109 facilities/operators who need to assure treatment of post-mining discharges or discharges they degraded which will provide for long-term treatment of 211 discharges. Of the 109 agreements, 34 have been finalized with 17 conventional bonding agreements totaling $75 M and 17 with treatment trusts totaling $73 M. According to OSM, "PADEP is conducting a program where active mining sites are, with very few exceptions, in compliance with the approved regulatory program". In addition, the Commonwealth dedicates 359 full-time equivalents (staff) to its regulatory and AML programs.

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

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

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

Reclaim PA is DEP's initiative designed to maximize reclamation of the state's quarter million acres of abandoned mineral extraction lands. Abandoned mineral extraction lands in Pennsylvania constituted a significant public liability – more than 250,000 acres of abandoned surface mines, 2,400 miles of streams polluted with mine drainage, over 7,000 orphaned and abandoned oil and gas wells, widespread subsidence problems, numerous hazardous mine openings, mine fires, abandoned structures and affected water supplies – representing as much as one third of the total problem nationally. The coal industry, through DEP-promoted remining efforts, can help to eliminate some sources of AMD and conduct some of the remediation identified in the above recommendations through the permitting, mining, and reclamation of abandoned and disturbed mine lands. Special consideration should be given to potential remining projects within these areas, as the environmental benefit versus cost ratio is generally very high.

The Commonwealth is exploring all options to address its abandoned mine problem. During 2000-2006, many new approaches to mine reclamation and mine drainage remediation have been explored and projects funded to address problems in innovative ways. These include:

- Project XL - The Pennsylvania Department of Environmental Protection ("PADEP"), has proposed this XL Project to explore a new approach to encourage the remining and reclamation of abandoned coal mine sites. The approach would be based on compliance with in-stream pollutant concentration limits and implementation of best management practices ("BMPs"), instead of National Pollutant Discharge Elimination System ("NPDES") numeric effluent limitations measured at individual discharge points. This XL project would provide for a test of this approach in up to eight watersheds with significant acid mine drainage ("AMD") pollution. The project will collect data to compare in-stream pollutant concentrations versus the loading from individual discharge points and provide for the evaluation of the performance of BMPs and this alternate strategy in PADEP's efforts to address AMD.

- Awards of grants for 1) proposals with economic development or industrial application as their primary goal and which rely on recycled mine water and/or a site that has been made suitable for the location of a facility through the elimination of existing Priority 1 or 2 hazards, and 2) new and innovative mine drainage treatment technologies that will provide waters of higher purity that may be needed by a particular industry at costs below conventional treatment costs as in common use today or reduce the costs of water treatment below those of conventional lime treatment plants. Eight contracts totaling $4.075 M were awarded in 2006 under this program.
- Projects using water from mine pools in an innovative fashion, such as the Shannopin Deep Mine Pool (in southwestern Pennsylvania), the Barnes & Tucker Deep Mine Pool (the Susquehanna River Basin Commission into the Upper West Branch Susquehanna River), and the Wadesville Deep Mine Pool (Excelon Generation in Schuylkill County).

Citizen and stakeholder involvement is critical to watershed reclamation in Pennsylvania and is strongly encouraged through the TMDL program and process. The Schuylkill Headwaters Association, Inc. (SHA) is a watershed group in the Little Schuylkill River Watershed. SHA maintains active membership with monthly work sessions, regular public meetings and implementation of group projects. Specifically, SHA participated in the construction of the diversion wells near the Silverbrook Discharge. Efforts should be made to prioritize funding for reclamation projects in the Little Schuylkill River Watershed to restore those waters, in addition to providing increased benefit to the Schuylkill River. Each DEP Regional Office (6) and each District Mining Office (5) have watershed managers to assist stakeholder groups interested in restoration in their watershed. Most Pennsylvania county conservation districts have a watershed specialist who can also provide assistance to stakeholders (www.pacd.org). Potential funding sources for AMR projects can be found at www.dep.state.pa.us/dep/subject/pubs/water/wc/FS2205.pdf.

Public Participation

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* and the Pottsville Republican to foster public comment on the allowable loads calculated. A public meeting was held on November 16, 2004, at Schuylkill County Agricultural Center in Pottsville, PA, to discuss the proposed TMDL. A second public meeting was held on February 20, 2007, at the Pa. DEP Pottsville District Office to discuss the revised TMDL.

References

A.W. Martin Associates, Inc. for Pennsylvania Department of Environmental Resources. 1973. Little Schuylkill mine Drainage Pollution Abatement Project. Operation Scarlift.

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Daley, Timothy L. Unpublished. Cause/Effect Survey Panther Creek/Little Schuylkill River. Pennsylvania Department of Environmental Protection.

L. Robert Kimball & Associates for Schuylkill Conservation District. 2001. Little Schuylkill River Assessment Report.

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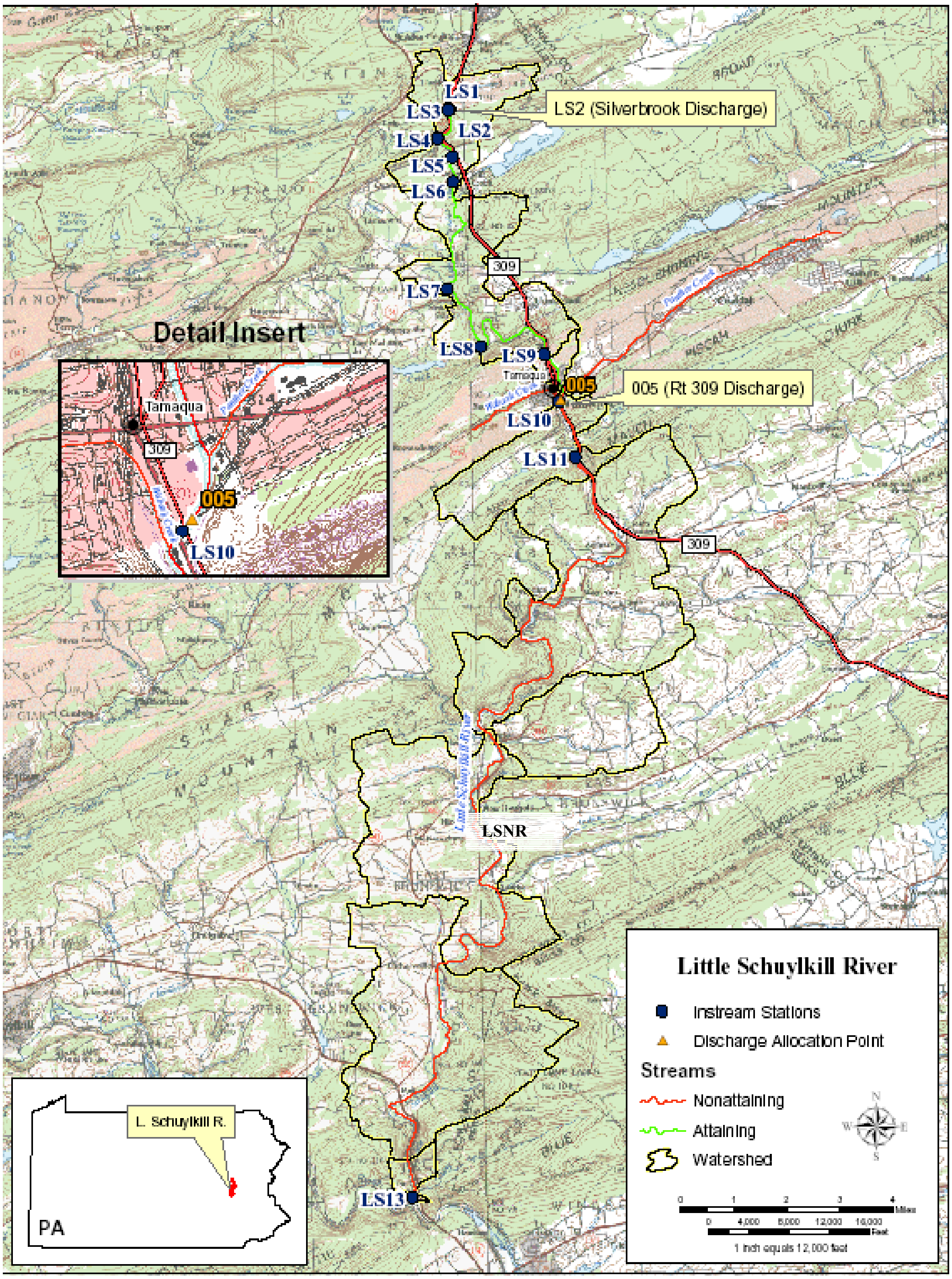
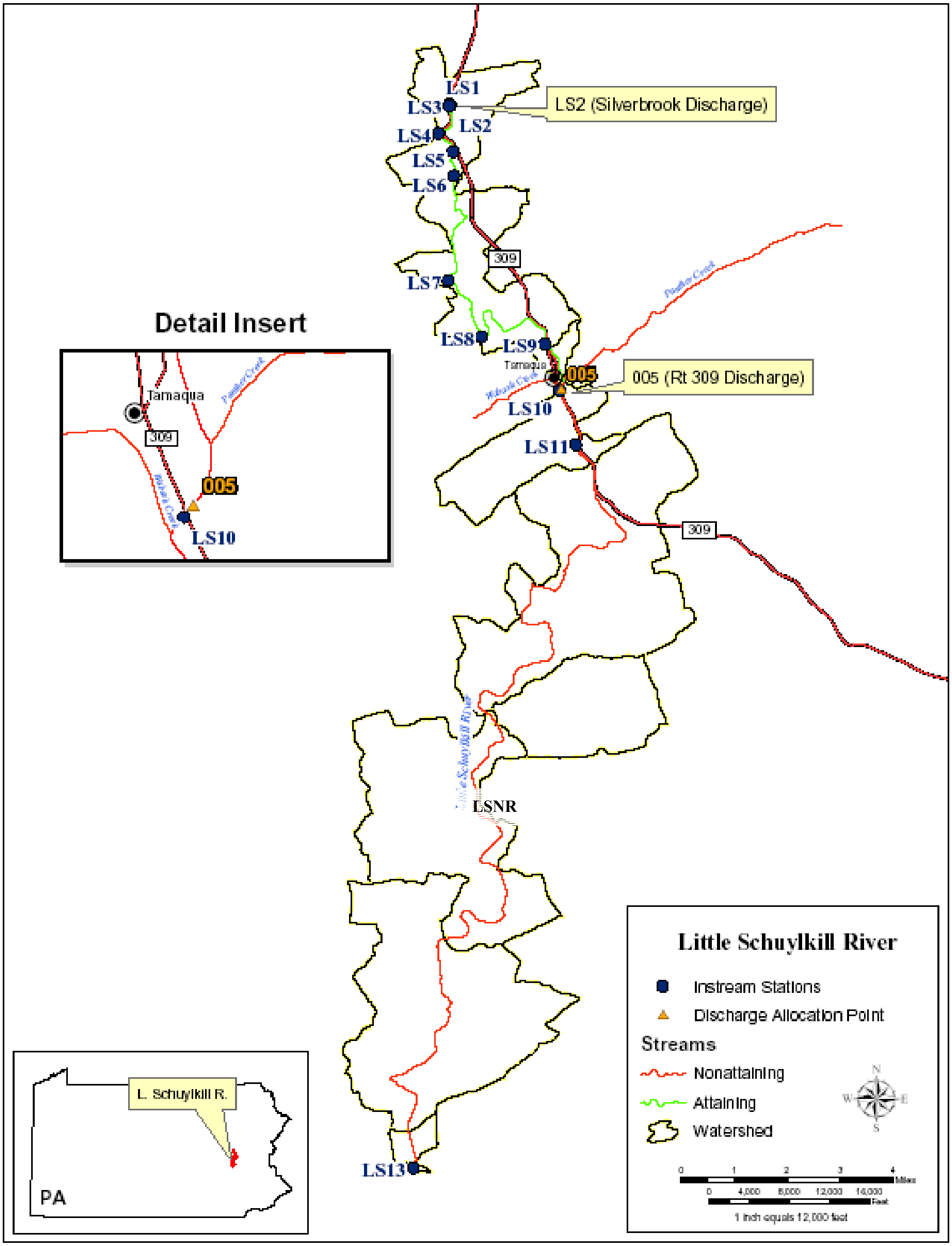
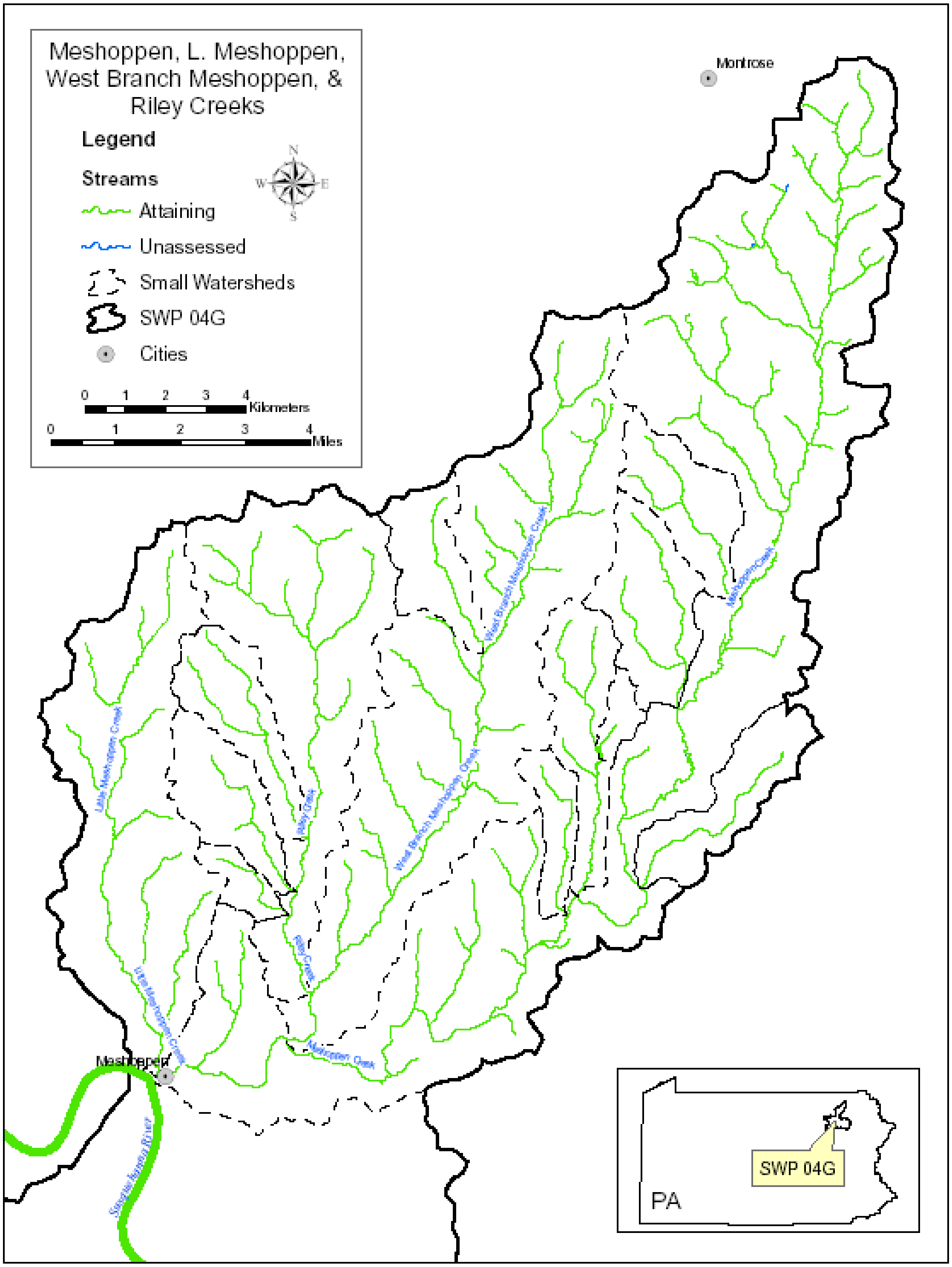
Attachment A

Little Schuylkill River Watershed Map


LS1
LS2 (Silverbrook Discharge)
LS3
LS2
LS4
LS5
LS6
309
LS7
Detail Insert
Tamaqua
309
005
LS10
LS8
LS9
Tamaqua
005
005 (Rt 309 Discharge)
LS10
LS11
309
LSNR
Little Schuylkill River
L. Schuylkill R.
PA
LS13
Little Schuylkill River
Instream Stations
Discharge Allocation Point
Streams
Nonattaining
Attaining
Watershed
1 inch equals 12,000 feet



LS1
LS3
LS2 (Silverbrook Discharge)
LS2
LS4
LS5
LS6
309
LS7
LS8
LS9
Tamaqua
005
005 (Rt 309 Discharge)
LS10
LS11
309
LSNR
LS13
Detail Insert
Tamaqua
309
005
LS10
L. Schuylkill R.
PA
Little Schuylkill River
Instream Stations
Discharge Allocation Point
Streams
Nonattaining
Attaining
Watershed
1 inch equals 12,000 feet



Meshoppen, L. Meshoppen, West Branch Meshoppen, & Riley Creeks
Legend
Streams
Attaining
Unassessed
Small Watersheds
SWP 04G
Cities
0 1 2 3 4 Kilometers
0 1 2 3 4 Miles
N
S
E
W
Montrose
Meshoppen
West Branch Meshoppen Creek
Meshoppen Creek
Little Meshoppen Creek
Riley Creek
Susquehanna River
SWP 04G
PA

Attachment B

Method for Addressing Section 303(d) Listings for pH and *Surface Mining Control and Reclamation Act*

Method for Addressing Section 303(d) Listings for pH

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

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

Each sample point used in the analysis of pH by this method must have measurements for total alkalinity and total acidity. Net alkalinity is alkalinity minus acidity, both being in units of milligrams per liter (mg/l) $CaCO_3$. The same statistical procedures that have been described for use in the evaluation of the metals is applied, using the average value for total alkalinity at that point as the target to specify a reduction in the acid concentration. By maintaining a net alkaline stream, the pH value will be in the range between six and eight. This method negates the need to specifically compute the pH value, which for mine waters is not a true reflection of acidity. This method assures that Pennsylvania's standard for pH is met when the acid concentration reduction is met.

There are several documented cases of streams in Pennsylvania having a natural background pH below six. If the natural pH of a stream on the Section 303(d) list can be established from its upper unaffected regions, then the pH standard will be expanded to include this natural range. The acceptable net alkalinity of the stream after treatment/abatement in its polluted segment will be the average net alkalinity established from the stream's upper, pristine reaches added to the acidity of the polluted portion in question. Summarized, if the pH in an unaffected portion of a stream is found to be naturally occurring below six, then the average net alkalinity for that portion (added to the acidity of the polluted portion) of the stream will become the criterion for the polluted portion. This "natural net alkalinity level" will be the criterion to which a 99 percent confidence level will be applied. The pH range will be varied only for streams in which a natural unaffected net alkalinity level can be established. This can only be done for streams that have upper segments that are not impacted by mining activity. All other streams will be required to reduce the acid load so the net alkalinity is greater than zero 99% of time.

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

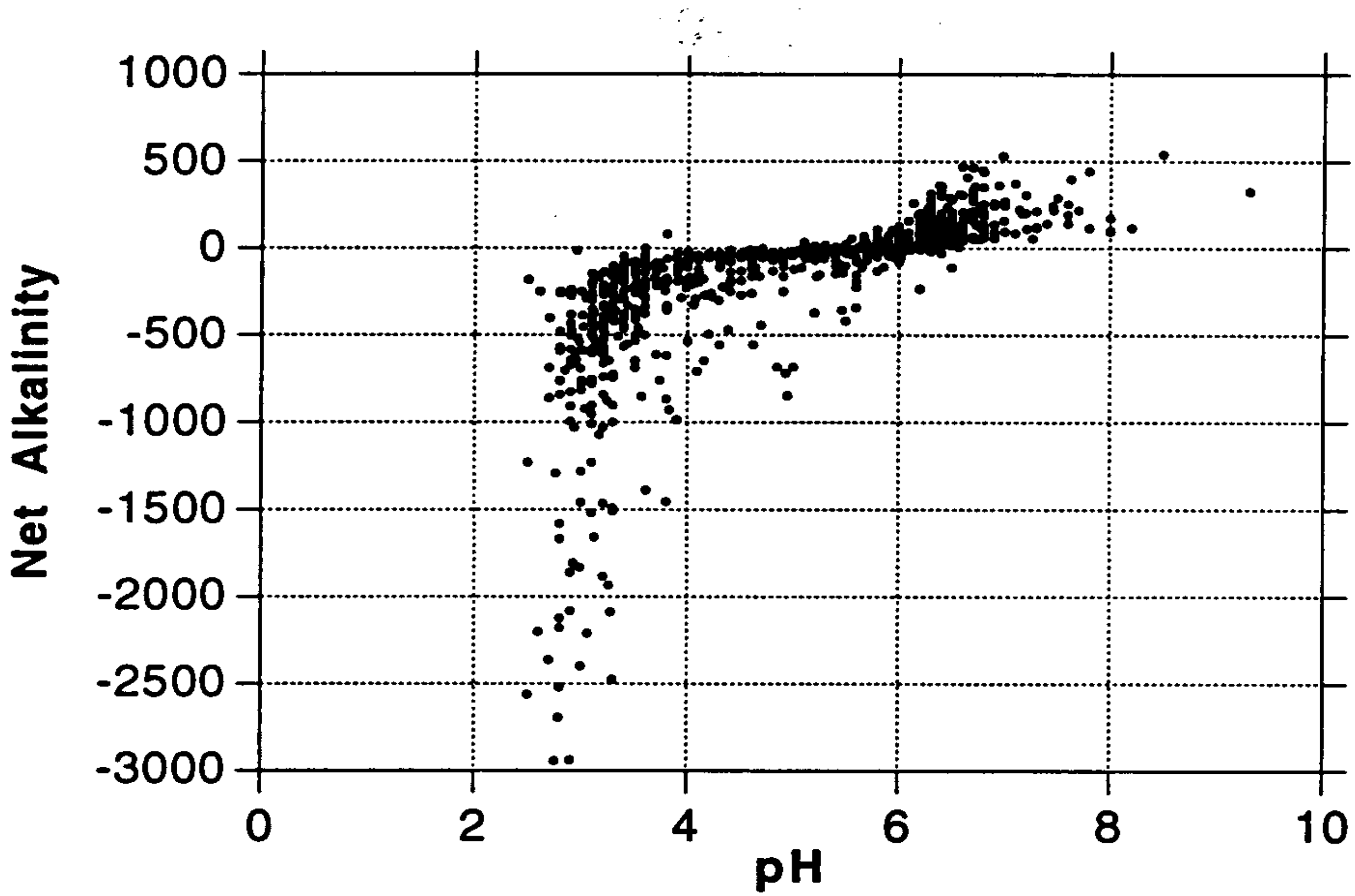


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Attachment C
TMDLs By Segment

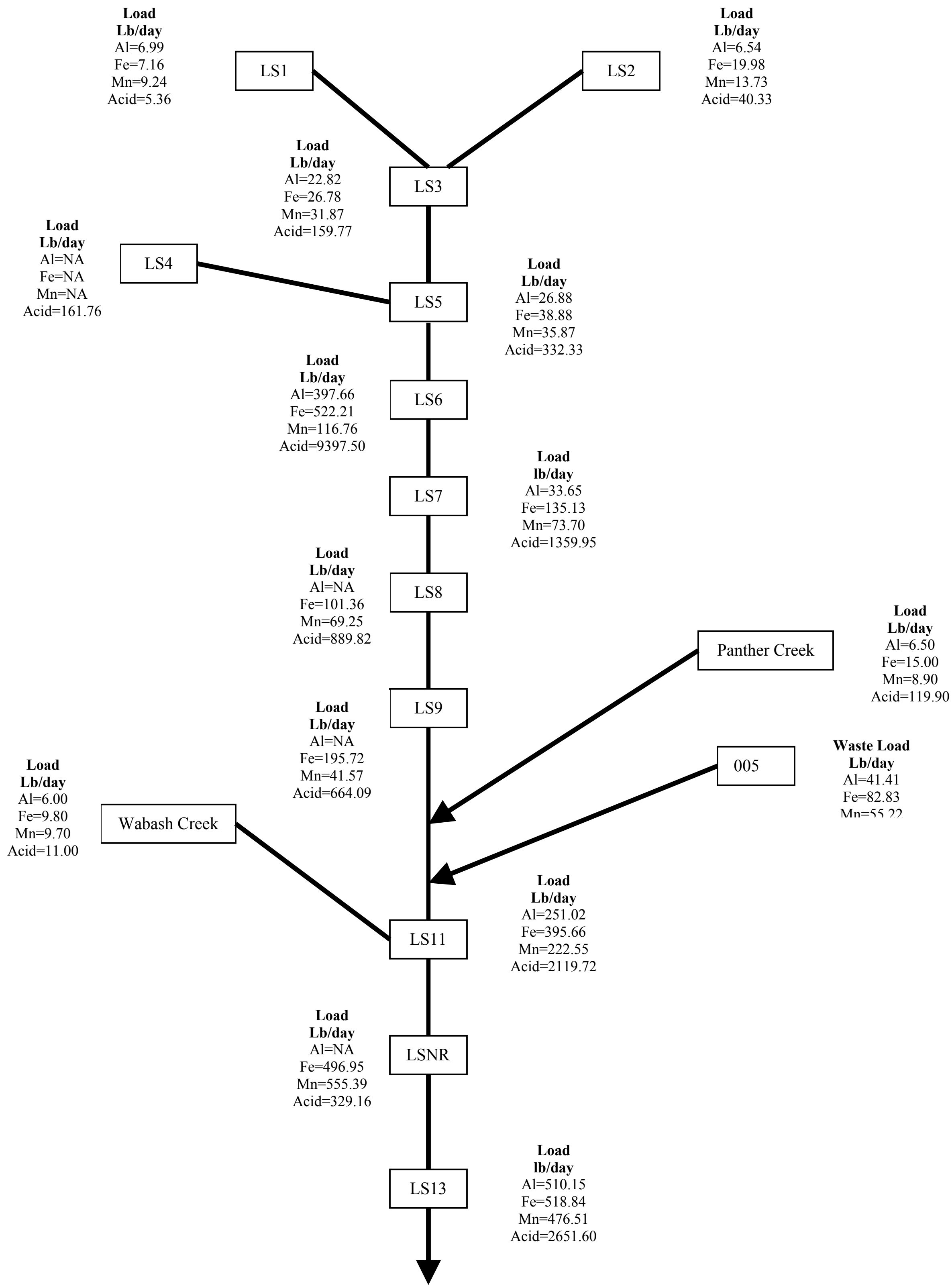
Little Schuylkill River

The Little Schuylkill River is a cold-water fishery (CWF) that flows into the Schuylkill River. Little Schuylkill River (stream code 02202) is identified as Segment 6189 under State Water Plan 3-A. A total of 12 sample locations (LS1 – LS9, LS11, LSNR, LS13) were identified in the initial assessment of the Little Schuylkill River. Eleven sampling sites on the Little Schuylkill, one site on Lofty Creek (LS4), one discharge (LS2) and two previous TMDLs (Panther and Wabash Creeks) were included in Little Schuylkill calculations.

Data sets include multiple rounds of water quality sampling. The Little Schuylkill River is too large of a waterway to correctly and safely collect flow measurements at the most downstream points. The available flow data did not correctly represent the existing flow dynamics of the Little Schuylkill River. In order to achieve a relative representation of the true flow characteristics, the unit area method was used based on watershed area and flow at the U.S. Geological Survey stream gauge on the Little Schuylkill River at Tamaqua (#01469500). All sample points are shown on the maps included in Attachment A as well as on the loading schematic on the following page.

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

An allowable long-term average in-stream concentration was determined at each sample point for metals and acidity. The analysis is designed to produce an average value that, when met, will be protective of the water-quality criterion for that parameter 99% of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water-quality criteria 99% of the time. The simulation was run assuming the data set was 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. Following is an explanation of the TMDL for each allocation point.



Load
Lb/day
Al=6.99
Fe=7.16
Mn=9.24
Acid=5.36
LS1
LS2
Load
Lb/day
Al=6.54
Fe=19.98
Mn=13.73
Acid=40.33
Load
Lb/day
Al=22.82
Fe=26.78
Mn=31.87
Acid=159.77
LS3
Load
Lb/day
Al=NA
Fe=NA
Mn=NA
Acid=161.76
LS4
LS5
Load
Lb/day
Al=26.88
Fe=38.88
Mn=35.87
Acid=332.33
Load
Lb/day
Al=397.66
Fe=522.21
Mn=116.76
Acid=9397.50
LS6
LS7
Load
lb/day
Al=33.65
Fe=135.13
Mn=73.70
Acid=1359.95
Load
Lb/day
Al=NA
Fe=101.36
Mn=69.25
Acid=889.82
LS8
Panther Creek
Load
Lb/day
Al=6.50
Fe=15.00
Mn=8.90
Acid=119.90
LS9
Load
Lb/day
Al=NA
Fe=195.72
Mn=41.57
Acid=664.09
005
Waste Load
Lb/day
Al=41.41
Fe=82.83
Mn=55.22
Load
Lb/day
Al=6.00
Fe=9.80
Mn=9.70
Acid=11.00
Wabash Creek
LS11
Load
Lb/day
Al=251.02
Fe=395.66
Mn=222.55
Acid=2119.72
Load
Lb/day
Al=NA
Fe=496.95
Mn=555.39
Acid=329.16
LSNR
LS13
Load
lb/day
Al=510.15
Fe=518.84
Mn=476.51
Acid=2651.60

TMDL calculations- LS1 – notched weir on Little Schuylkill River, upstream of diversion wells

The TMDL for sample point LS1 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this headwaters segment of the Little Schuylkill River was computed using water-quality sample data collected at point LS1. The average flow, calculated using the unit method at sampling point LS1 (2.16 MGD), is used for these computations. Because this is the most upstream point of this segment, the allowable load allocations calculated at LS1 is equal to the actual load that will directly affect the downstream point LS3.

Sample data at point LS1 shows that the headwaters segment has a pH ranging between 3.7 and 4.2. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

A TMDL for aluminum, iron, manganese and acidity at LS1 has been calculated. Table C1 shows the measured and allowable concentrations and loads at LS1. Table C2 shows percent reductions for aluminum, iron, manganese and acidity required at this point.

Table C1		Measured		Allowable	
Flow (gpm)=	1500	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	4.98	89.63	0.39	6.99
	Iron	6.21	111.85	0.40	7.16
	Manganese	1.28	22.98	0.51	9.24
	Acidity	65.33	1176.94	0.30	5.36
	Alkalinity	0.51	9.21		

TABLE C2. ALLOCATIONS LS1				
LS1	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LS1	89.63	111.85	22.98	1176.94
Allowable Load @ LS1	6.99	7.16	9.24	5.36
Load Reduction @ LS1	82.64	104.69	13.74	1171.58
% Reduction required @ LS1	92%	94%	60%	99.5%

TMDL Calculation – LS2 – notched weir @ Silverbrook outflow, upstream of diversion wells

The TMDL for sample point LS2 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this upper segment of Little Schuylkill River was computed using water-quality sample data collected at point LS2. The average flow, calculated using the unit area method at sampling point LS2 (2.16 MGD), is used for these computations. Because this an upstream point of this segment, the allowable load allocations calculated at LS2 is equal to the actual load that will directly affect the downstream point LS3.

Sample data at point LS2 shows a pH ranging between 3.7 and 4.4. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

A TMDL for aluminum, iron, manganese and acidity at LS2 have been calculated. Table C3 shows the measured and allowable concentrations and loads at LS2. Table C4 shows percent reductions for aluminum, iron, manganese and acidity required at this point.

Table C3		Measured		Allowable	
Flow (gpm)=	1500	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	5.99	107.86	0.36	6.54
	Iron	17.06	307.30	1.11	19.98
	Manganese	1.57	28.26	0.76	13.73
	Acidity	112.88	2033.44	2.24	40.33
	Alkalinity	0.96	17.25		

Table C4. Allocations LS2				
LS2	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LS2	107.86	307.30	28.26	2033.44
Allowable Load @ LS2	6.54	19.98	13.73	40.33
Load Reduction @ LS2	101.32	287.32	14.53	1993.11
% Reduction required @ LS2	94%	94%	52%	98%

TMDL Calculation – LS3 – downstream of diversion wells and a small-unnamed tributary

The TMDL for sampling point LS3 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point LS3. The average flow, calculated using the unit area method at sampling point LS3 (5.76 MGD), is used for these computations. The allowable loads calculated at LS3 will directly affect the downstream point LS5.

Sample data at point LS3 shows pH ranging between 3.9 and 6.0; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point LS3 for aluminum, iron, manganese and acidity was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from points LS1 and LS2 show the total load that was permitted from upstream sources. This value was added to the difference in existing loads between point LS1/LS2 and LS3 to determine a total load tracked for the segment of stream between LS3 and LS2/LS1. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at LS3.

A TMDL for aluminum, iron, manganese and acidity at LS3 has been calculated. Table C5 shows the measured and allowable concentrations and loads at LS3. Table C6 shows the percent reduction needed for these parameters at this point.

Table C5		Measured		Allowable	
Flow (gpm)=	3999.53	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	4.90	235.15	0.48	22.82
	Iron	10.17	488.71	0.56	26.78
	Manganese	1.30	62.27	0.66	31.87
	Acidity	64.80	3112.52	3.33	159.77
	Alkalinity	5.31	255.11		

Table C6. Allocations LS3				
LS3	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LS3	235.15	488.71	62.27	3112.52
Difference in measured Loads between upstream loads and existing LS3	37.66	69.56	11.03	-97.86
Percent loss calculated at LS3	0%	0%	0%	3%
Additional load tracked from above samples	13.53	27.14	22.97	45.69
Percentage of upstream loads that reach LS3	100%	100%	100%	97%
Total load tracked between LS2/LS1 and LS3	51.19	96.70	34.00	44.32
Allowable Load @ LS3	22.82	26.78	31.87	159.77
Load Reduction @ LS3	28.37	69.92	2.13	0
% Reduction required at LS3	56%	73%	7%	0%

The existing aluminum load at LS3 was measured to be 235.15 lbs/day. This was 37.66 lbs/day greater than the upstream contributing loads. This increase in aluminum load in this segment can be attributed to aluminum entering the river in this segment. The total aluminum load tracked was 28.37 lbs/day greater than the calculated allowable aluminum load of 22.82 lbs/day; therefore a 56% reduction for aluminum is necessary. The existing iron load was reported to be 488.71 lbs/day. An increase of 69.56 lbs/day of iron has entered the Little Schuylkill River between LS1/LS2 and LS3. The total iron load tracked was found to be 96.70 lbs/day greater than the calculated allowable iron load of 26.78 lbs. A 73% reduction is required for iron. The Little Schuylkill River has gained 11.03 lbs/day of manganese by the time it reaches sample point LS3. The total load tracked was 2.13 lbs/day greater than the allowable load of 31.87 lbs/day; therefore a 7% manganese reduction is necessary. The acidic load at LS3 of 44.32 lbs/day was less is than the allowable acidic load at LS3 of 159.77 lbs/day; therefore, no reduction in acidity at LS3 is necessary.

TMDL Calculation – LS4 – Lofty Creek, just upstream of confluence with Little Schuylkill

The TMDL for sample point LS4 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this tributary of the Little Schuylkill River was computed using water-quality sample data collected at point LS4. The average flow, calculated using the unit area method at sampling point LS4 (6.47 MGD), is used for these computations. Because this a tributary point, the allowable load allocations calculated at LS4 is equal to the actual load that will directly affect the downstream point LS5.

Sample data at point LS4 shows a pH ranging between 4.8 and 5.8. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

A TMDL for acidity at LS4 have been calculated. All measured sample data for aluminum and iron fell below the detection limits. The measured sample data at manganese was above detection limits but fell below applicable water quality criteria limits. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. The existing load for aluminum and iron values at LS4 in Table C7 will be denoted as "NA".

Table C7 shows the measured and allowable concentrations and loads at LS4. Table C8 shows percent reductions for acidity required at this point.

Table C7		Measured		Allowable	
Flow (gpm)=	4494.88	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA		
	Iron	ND	NA		
	Manganese	0.07	3.83	0.07	3.83
ND = non detection	Acidity	20.87	1126.42	3.00	161.76
NA = not applicable	Alkalinity	6.69	361.08		

Table C8. Allocations LS4	
LS4	Acidity (Lbs/day)
Existing Load @ LS4	1126.42
Allowable Load @ LS4	161.76
Load Reduction @ LS4	964.66
% Reduction required @ LS4	86%

TMDL Calculation – LS5 – upstream of Northeast Power Company

The TMDL for sampling point LS5 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point LS5. The average flow, calculated using the unit area method for LS5 (11.56 MGD), is used for these computations. The allowable loads calculated at LS5 will directly affect the downstream point LS6.

Sample data at point LS5 shows pH ranging between 4.3 and 4.8; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point LS5 for aluminum, iron, manganese and acidity was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from points LS3 and LS4 show the total load that was permitted from upstream sources. This value was added to the difference in existing loads between point LS3/LS4 and LS5 to determine a total load tracked for the segment of stream between LS5 and LS3/LS4. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at LS5.

A TMDL for aluminum, iron, manganese and acidity at LS5 has been calculated. Table C9 shows the measured and allowable concentrations and loads at LS5. Table C10 shows the percent reduction needed for these parameters at this point.

Table C9		Measured		Allowable	
Flow (gpm)=	8028.14	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	2.22	213.64	0.28	26.88
	Iron	3.51	338.14	0.40	38.88
	Manganese	0.62	59.84	0.37	35.87
	Acidity	46.75	4507.39	3.45	332.33
	Alkalinity	5.75	554.38		

Table C10. Allocations LS5				
LS5	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LS5	213.64	338.14	59.84	4507.39
Difference in measured Loads between upstream loads and existing LS5	-21.51	-150.57	-6.26	268.45
Percent loss due calculated at LS5	10%	31%	10%	0%
Additional load tracked from above samples	22.82	26.78	35.70	321.53
Percentage of upstream loads that reach the LS5	90%	69%	90%	100%
Total load tracked between LS3/LS4 and LS5	20.54	18.48	32.13	321.53
Allowable Load @ LS5	26.88	38.88	35.87	332.33
Load Reduction @ LS5	0	0	0	0
% Reduction required at LS5	0%	0%	0%	0%

Sample data for aluminum, iron, manganese and acid all show that the load tracked from upstream points (LS3/LS4) is lower than the allowable load at LS5; therefore, no reductions are necessary at LS5.

TMDL Calculation – LS6– Little Schuylkill River downstream of Northeast Power Company

The TMDL for sampling point LS6 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point LS6. The average flow, calculated using the unit area method for LS6 (24.66 MGD), is used for these computations. The allowable load allocations calculated at LS6 will directly affect the downstream point LS7.

Sample data at point LS6 shows pH ranging between 4.4 and 4.8; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point LS6 for all parameters was computed using water-quality sample data collected at this point. This was based on the sample data for this point and did not account for any loads already specified from upstream sources. The existing load for each parameter from point LS5 was subtracted from the actual load at point LS6 to determine a remaining load that was added to the allowable load from LS5 to determine the total load for the segment of stream between LS5 and LS6. This total load will be compared to the calculated allowable load at LS6 to determine if further reductions are needed to meet the calculated TMDL at LS6.

A TMDL for aluminum, iron, manganese and acidity at LS6 have been calculated. Table C11 shows the measured and allowable concentrations and loads at LS6. Table C12 shows the percent reduction for aluminum, iron, manganese and acidity needed at LS6.

Table C11		Measured		Allowable	
Flow (gpm)=	17126.68	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	1.93	397.66	0.30	61.93
	Iron	2.54	522.21	0.51	104.84
	Manganese	0.57	116.76	0.40	81.49
	Acidity	45.69	9397.50	3.65	751.74
	Alkalinity	5.93	1220.40		

Table C12. Allocations LS6				
LS6	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LS6	397.66	522.21	116.76	9397.50
Difference in measured Loads between upstream loads and existing LS6	184.02	184.07	56.92	4890.11
Percent loss due calculated at LS6	0%	0%	0%	0%
Additional load tracked from above samples	26.88	38.88	35.87	332.33
Percentage of upstream loads that reach the LS6	100%	100%	100%	100%
Total load tracked between LS5 and LS6	210.90	222.95	92.79	5222.44
Allowable Load @ LS6	61.93	104.84	81.49	751.74
Load Reduction @ LS6	148.97	118.11	11.30	4470.70
% Reduction required at LS6	71%	53%	13%	86%

The existing aluminum load at LS6 was measured to be 397.66 lbs/day. This was 184.02 lbs/day greater than the upstream contributing loads. This increase in aluminum load in this segment can be attributed to aluminum entering the river in this segment. The total aluminum load tracked was 148.97 lbs/day greater than the calculated allowable aluminum load of 61.93 lbs/day; therefore a 71% reduction for aluminum is necessary. The existing iron load was reported to be 522.21 lbs/day. An increase of 184.07 lbs/day of iron has entered the Little Schuylkill River between LS5 and LS6. The total iron load tracked was found to be 222.95 lbs/day greater than the calculated allowable iron load of 104.84 lbs. A 53% reduction is required for iron. The Little Schuylkill River has gained 56.92 lbs/day of manganese by the time it reaches sample point LS6. The total load tracked was 11.30 lbs/day greater than the allowable load of 81.49 lbs/day; therefore a 13% manganese reduction is necessary. The Little Schuylkill River has gained 4890.11 lbs/day of acidity by the time it reaches sample point LS6. The total load tracked was 4470.70 lbs/day greater than the allowable load of 751.74 lbs/day; therefore an 86% acidity reduction is necessary.

TMDL Calculation – LS7 – Little Schuylkill River west of Hometown

The TMDL for sampling point LS7 on the Little Schuylkill River consists of a load allocation of the entire area above point LS7 as shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point LS7. The average flow, using a ratio method at LS7 (31.37 MGD), is used for these computations. The allowable load calculated at LS7 will directly affect the downstream point LS8.

There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point LS7 shows pH ranging between 5.0 and 6.1; pH will be addressed as part of this TMDL.

The measured and allowable loading for point LS7 for all parameters was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The existing load for each parameter from point LS6 was subtracted from the actual load at point LS7 to determine a remaining load that was added to the allowable load from LS6 to calculate the total load for the segment of stream between LS6 and LS7. This total load will be compared to the calculated allowable load at LS7 to determine if further reductions are needed to meet the calculated TMDL at LS7.

A TMDL for aluminum and acidity at LS7 has been calculated. The measured sample data for iron and manganese were above detection limits but fell below applicable water quality criteria limits. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated.

Table C13 shows the measured and allowable concentrations and loads at LS7. Table C14 shows the percent reductions required for aluminum and acidity at sample point LS7.

Table C13		Measured		Allowable	
Flow (gpm)=	21781.75	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.39	102.75	0.13	33.65
	Iron	0.52	135.13	0.52	135.13
	Manganese	0.28	73.30	0.28	73.70
	Acidity	46.87	12259.86	5.20	1359.95
	Alkalinity	8.11	2121.79		

Table C14. Allocations LS7		
LS7	Al (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LS7	102.75	12259.86
Difference in measured Loads between upstream loads and existing LS7	-294.91	2862.36
Percent loss due calculated at LS7	75%	0%
Additional load tracked from above samples	61.93	751.74
Percentage of upstream loads that reach the LS7	25%	100%
Total load tracked between LS6 and LS7	15.48	3614.10
Allowable Load @ LS7	33.65	1359.95
Load Reduction @ LS7	0	2254.15
% Reduction required at LS7	0%	63%

The sample data collected at LS7 show water quality standards for iron and manganese are being met; therefore, no reductions are necessary for these pollutants at LS7. No reductions in aluminum are necessary because the total load tracked between LS6 and LS7 is lower than the allowable load of 33.65 lbs/day at LS7. The sample data show an increase in acidity load between LS6 and LS7 of 2862.36 lbs/day which results in the acid load at LS7 being greater than the allowable load of 1359.95 lbs/day by 2254.15 lbs/day, requiring a 63% reduction in acidity.

TMDL Calculation – LS8 – downstream of Locust Creek

The TMDL for sampling point LS8 on the Little Schuylkill River consists of a load allocation of the entire area above point LS8 as shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point LS8. The average flow, using the unit area method at LS8 (56.20 MGD), is used for these computations. The allowable loads calculated at LS8 will directly affect the downstream point LS9.

There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point LS8 shows pH ranging between 5.8 and 7.1; pH will be addressed as part of this TMDL.

The measured and allowable loading for point LS8 for all parameters was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The existing load for each parameter from point LS7 was subtracted from the existing load at point LS8 to determine a remaining load that was then added to the allowable load from LS7 to calculate the total load for the segment of stream between LS7 and LS8. This total load will be compared to the calculated allowable load at LS8 to determine if further reductions are needed to meet the calculated TMDL at LS8.

A TMDL for acidity at LS8 has been calculated. All measured sample data for aluminum fell below detection limits. The measured sample data for iron and manganese were above detection limits but fell below applicable water quality criteria limits. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. The existing load for aluminum values at LS8 in Table C15 will be denoted as "NA".

Table C15 shows the measured and allowable concentrations and loads at LS8. Table C16 shows the percent reduction required for acidity at sample point LS8.

Table C15		Measured		Allowable	
Flow (gpm)=	39029.57	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA		
	Iron	0.22	101.36	0.22	101.36
	Manganese	0.15	69.25	0.15	69.25
ND = non detection	Acidity	14.05	6585.65	1.90	889.82
NA = not applicable	Alkalinity	12.30	5765.37		

Table C16. Allocations LS8	
LS8	Acidity (Lbs/day)
Existing Load @ LS8	6585.65
Difference in measured Loads between upstream loads and existing LS8	-5674.21
Percent loss due calculated at LS8	47%
Additional load tracked from above samples	1359.95
Percentage of upstream loads that reach the LS8	53%
Total load tracked between LS7 and LS8	720.77
Allowable Load @ LS8	889.82
Load Reduction @ LS8	0
% Reduction required at LS8	0%

The existing acidic load was measured at 6585.65 lbs/day. This was less then the existing load of the upstream point LS7, meaning that 5674.21 lbs/day, or 47%, had been lost to instream processes in the segment between upstream point LS7 and LS8. The total acidic load tracked between LS7 and LS8 was found to be 169.05 lbs/day less then the calculated acidic allowable load of 889.82 lbs/day at LS8. Therefore, no acidic reduction at sample point LS8 is necessary. Water quality standards for aluminum, iron, and manganese are being met at LS8 and therefore no reductions are necessary.

<u>TMDL Calculation – LS9 – USGS gauging station on Little Schuylkill River at Tamaqua</u>

The TMDL for sampling point LS9 on the Little Schuylkill River consists of a load allocation of the entire area above point LS9 as shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point LS9. The average flow, measured at the sampling point LS9 (56.74 MGD) using the U.S. Geological Survey stream gauge (#01469500), is used for these computations. The loads calculated at LS9 will directly affect the downstream point LS10.

There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point LS9 shows pH ranging between 6.0 and 7.2; pH will be addressed as part of this TMDL.

The measured and allowable loading for point LS9 for all parameters was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The existing load for each parameter from point LS8 was subtracted from the existing load at point LS9 to determine a remaining load that was then added to the allowable load from LS8 to calculate the total load for the segment of stream between LS8 and LS9. This total load will be compared to the calculated allowable load at LS9 to determine if further reductions are needed to meet the calculated TMDL at LS9.

A TMDL for acidity at LS9 has been calculated. All measured sample data for aluminum fell below detection limits. The measured sample data for iron and manganese were above detection limits but fell below applicable water quality criteria limits. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. The existing and allowable load for aluminum values at LS9 in Table C17 will be denoted as "NA".

Table C17 shows the measured and allowable concentrations and loads at LS9. Table C18 shows the percent reduction required for acidity at sample point LS9.

Table C17		Measured		Allowable	
Flow (gpm)=	39402.89	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA		
	Iron	0.41	195.72	0.41	195.72
	Manganese	0.09	41.57	0.09	41.57
ND = non detection	Acidity	4.25	2012.40	1.40	664.09
NA = not applicable	Alkalinity	14.19	6714.64		

Table C18. Allocations LS9	
LS9	Acidity (Lbs/day)
Existing Load @ LS9	2012.40
Difference in measured Loads between upstream loads and existing LS9	-4573.25
Percent loss due calculated at LS9	70%
Additional load tracked from above samples	889.82
Percentage of upstream loads that reach the LS9	30%
Total load tracked between LS8 and LS9	266.95
Allowable Load @ LS9	664.09
Load Reduction @ LS9	0
% Reduction required at LS9	0%

Sample data for acid show that the load tracked from LS8 is lower than the allowable load at LS9; therefore, no reduction is necessary at LS9. Sample data show water quality standards are being met for iron, manganese, and aluminum at LS9; therefore, no reductions are necessary.

Panther Creek TMDL Calculation

A TMDL was completed on the Panther Creek watershed. Panther Creek enters the Little Schuylkill River above sample point LS11. The allowable loads from the last sample point (003) for Panther Creek are used in the calculation of the Little Schuylkill TMDL.

Table C19. Panther Creek Contributions				
Sample 003	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ 003	46.30	57.60	74.20	119.9
Allowable Load @ 003	6.50	15.00	8.90	119.9

Waste Load Allocation – Outfall 005, LCN Route 309 discharge

The Lehigh Coal and Navigation Company (SMP 54733020R2 & R3CB, PA0012360) has Outfall 005 into the Little Schuylkill River Watershed. The Waste Load Allocation for Outfall 005 is determined from measured flow data and the monthly average permit limits for aluminum, iron and manganese; the permit limits were calculated as WQBELs using PennToxSD. The following table shows the waste load allocation for this discharge.

Table C20. Waste Load Allocations at Outfall 005			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
Outfall 005			
Al	0.75	6.621	41.41
Fe	1.5	6.621	82.83
Mn	1.0	6.621	55.22

Wabash Creek TMDL Calculation

A TMDL was completed on the Wabash Creek watershed. Wabash Creek enters the Little Schuylkill River above sample point LS11. The allowable loads for Wabash Creek most downstream point (11WB) are used in the calculation of the Little Schuylkill TMDL.

Table C21. Wabash Creek Contributions				
Sample 11WB	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ 11WB	46.3	9.8	18.6	368.2
Allowable Load @ 11WB	6.0	9.8	9.7	11.0

TMDL Calculation – LS11 – Little Schuylkill River 1.2 miles downstream of Rt. 309 discharge

The TMDL for sampling point LS11 on the Little Schuylkill River consists of a load allocation of the entire area above point LS11 as shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point LS11. The average flow, calculated using the unit area method at the sampling point LS11 (91.12 MGD), is used for these computations. The allowable loads calculated at LS11 will directly affect the downstream point LS13.

There currently is an entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point LS11 shows pH ranging between 6.3 and 6.7; pH will be addressed as part of this TMDL.

The measured and allowable loading for point LS11 for all parameters was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The existing load for each parameter from points LS9, Panther and Wabash Creek (LS/Pan/Wab) was subtracted from the existing load at point LS11 to determine a remaining load that was then added to the allowable loads from LS/Pan/Wab/11WB to calculate the total load for the segment of stream between LS/Pan/Wab and LS11. This total load will be compared to the calculated allowable load at LS11 to determine if further reductions are needed to meet the calculated TMDL at LS11.

A TMDL for each parameter at LS11 has been calculated. Table C24 shows the measured and allowable concentrations and loads at LS11. Table C25 shows the percent reduction required for aluminum, iron, manganese and acidity at sample point LS11.

Table C22		Measured		Allowable	
Flow (gpm)=	63276.48	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.58	440.38	0.33	251.02
	Iron	2.12	1610.09	0.52	395.66
	Manganese	1.29	977.26	0.29	222.55
	Acidity	16.83	12785.74	2.79	2119.72
	Alkalinity	17.60	13374.68		

Table C23. Allocations LS11				
LS11	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LS11	440.38	1610.09	977.26	12785.74
Difference in measured loads between upstream loads and existing LS11	237.34	1181.31	732.45	10285.24
Percent loss due calculated at LS11	0%	0%	0%	0%
Additional load tracked from above samples	122.94	386.18	170.61	794.99
Percentage of upstream loads that reach the LS11	100%	100%	100%	100%
Total load tracked between LS9/Pan/Wab and LS11	360.28	1567.49	903.06	11080.23
Allowable Load @ LS11	251.02	395.66	222.55	2119.72
Load Reduction @ LS11	109.26	1171.83	680.51	8960.51
% Reduction required at LS11	31%	75%	76%	81%

Sample data show 237.34 lbs/day of aluminum entered the Little Schuylkill River at this segment resulting in an existing load of 440.38 lbs/day. The total aluminum load tracked between

LS9/Panther/Wabash and LS11 was shown to be 360.28 lbs/day. This was 109.29 lbs/day more than the calculated allowable load of 251.02 lbs/day; therefore, a 31% aluminum reduction is necessary at LS11. Calculations showed an increase of 1181.31 lbs/day iron loading in the segment of stream between LS9/Panther/Wabash and LS11. A total iron load tracked through this segment showed that it was 1181.31 lbs/day more than the calculated allowable LS11 load of 395.66 lbs/day. Therefore, a 75% iron loading reduction is necessary at LS11. The existing manganese load was measured to be 977.26 lbs/day, with an increase of manganese loads between LS9/Panther/Wabash of 732.45 lbs/day. The total load tracked was 680.51 lbs/day more than the calculated LS11 allowable load of 222.55 lbs/day. A 76% reduction is necessary in manganese loads at LS11. The existing acidic load was measured at 12785.74 lbs/day. This was 10285.24 lbs/day more than the sum of upstream points LS9/Panther/Wabash. The total load tracked between LS9/Panther/Wabash and LS11 was found to be 8960.51 lbs/day greater than the calculated acidic allowable load of 2119.72 lbs/day at LS11. Therefore, an 81% acidic reduction is necessary.

TMDL Calculation – LSNR – downstream of Route 443 bridge in New Ringold

The TMDL for sampling point LSNR on the Little Schuylkill River consists of a load allocation of the entire area above point LSNR as shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point LSNR. The average flow, using the unit area method at the sampling point LSNR (138.00 MGD), is used for these computations. The allowable loads calculated at LSNR will directly affect the downstream point LS13.

There currently is an entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point LSNR shows pH ranging between 7.0 and 7.4. pH will be addressed as part of this TMDL.

The measured and allowable loading for point LSNR for all parameters was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The existing load for each parameter from point LS11 was subtracted from the existing load at point LSNR to determine a remaining load that was added to the allowable load from LS11 to calculate the total load for the segment of stream between LS11 and LSNR. This total load will be compared to the calculated allowable load at LSNR to determine if further reductions are needed to meet the calculated TMDL at LSNR.

Table C21 shows the measured and allowable concentrations and loads at LSNR. Table C22 shows the percent reduction required for aluminum, iron, manganese and acidity at sample point LSNR.

Table C24		Measured		Allowable	
Flow (gpm)=	95832.98	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA		
	Iron	0.58	671.56	0.43	496.95
	Manganese	0.75	867.79	0.48	555.39
	Acidity	2.60	2992.38	0.29	329.16
	Alkalinity	21.15	24341.87		

Table C23. Allocations LSNR			
LSNR	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LSNR	671.56	867.79	2992.38
Difference in measured loads between upstream loads and existing LSNR	230.78	-742.30	-9793.36
Percent loss due calculated at LSNR	0%	46%	77%
Additional load tracked from above samples	395.66	222.55	2119.72
Percentage of upstream loads that reach the LSNR	100%	54%	23%
Total load tracked between LS11 and LSNR	626.44	120.18	487.54
Allowable Load @ LSNR	496.95	555.39	329.16
Load Reduction @ LSNR	129.49	0	158.38
% Reduction required at LSNR	21%	0%	33%

The existing iron load was measured to be 671.56 lbs/day. This existing load was 230.78 lbs/day greater than the upstream loads. The total load tracked was 129.49 lbs/day greater than the calculated LSNR allowable load of 496.95 lbs/day. A 21% iron reduction is necessary. The existing acidic load was measured at 2992.38 lbs/day. This was 9793.36 lbs/day less than the existing upstream load, resulting from a 77% loss due to instream processes. The total load tracked between LS11 and LSNR was found to be 158.38 lbs/day greater then the calculated acidic allowable load of 329.16 lbs/day at LSNR. Therefore, a 33% acidic reduction is necessary. The total manganese load tracked is less than the allowable load; therefore, no reduction in manganese is required.

TMDL Calculation – LS13 – mouth of Little Schuylkill River

The TMDL for sampling point LS13 consists of a load allocation of the entire area above point LS13 as shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point LS13. The average flow, calculated using a ratio method at sampling point LS13 (184.88 MGD), is used for these computations.

There currently is an entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point LS13 shows pH ranging between 6.3 and 7.6; pH will be addressed as part of this TMDL.

The measured and allowable loading for point LS13 for all parameters was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The existing load for each parameter from point LSNR was subtracted from the actual load at point LS13 to determine a remaining load that was added to the allowable load from LSNR to calculate the total load for the segment of stream between LSNR and LS13. This total load will be compared to the calculated allowable load at LS13 to determine if further reductions are needed to meet the calculated TMDL at LS13.

A TMDL for aluminum, iron, manganese and acidity at LS13 have been calculated. Table C26 shows the measured and allowable concentrations and loads at LS13. Table C27 shows the percent reduction required for aluminum, iron and acidity at sample point LS13.

Table C26		Measured		Allowable	
Flow (gpm)=	128389.48	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.56	864.65	0.33	510.15
	Iron	0.50	774.39	0.34	518.84
	Manganese	0.33	501.59	0.31	476.51
	Acidity	7.48	11528.71	1.72	2651.60
	Alkalinity	16.85	25975.19		

Table C27. Allocations LS13				
LS13	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LS13	864.65	774.39	501.59	11528.71
Difference in measured Loads between upstream loads and existing LS13	NA	99.39	-366.20	8536.33
Percent loss due calculated at LS13	0%	0%	43%	0%
Additional load tracked from above samples	NA	496.95	555.39	329.16
Percentage of upstream loads that reach LS13	100%	100%	57%	100%
Total load tracked between LSNR and LS13	864.65	596.34	316.57	8865.49
Allowable Load @ LS13	510.15	518.84	476.51	2651.60
Load Reduction @ LS13	354.50	77.50	0	6213.89
% Reduction required at LS13	40%	13%	0%	71%

The existing aluminum load is 864.65 lbs/day. The total aluminum load tracked at this segment of river was 354.50 lbs/day greater than the calculated aluminum allowable load of 510.15 lbs/day; therefore a 40% aluminum reduction is necessary. The existing aluminum load is 864.65 lbs/day. The total aluminum load tracked at this segment of river was 354.50 lbs/day greater than the calculated aluminum allowable load of 510.15 lbs/day; therefore a 40%

aluminum reduction is necessary. The existing iron load is 774.39 lbs/day, which is 99.39 lbs/day greater than the upstream load. The total iron load tracked at this segment of river was 77.50 lbs/day greater than the calculated iron allowable load of 518.84 lbs/day; therefore a 13% aluminum reduction is necessary. The existing acid load is 11528.71 lbs/day, which is 8536.33 lbs/day greater than the upstream load. The total acid load tracked at this segment of river was 6213.89 lbs/day greater than the calculated acid allowable load of 2651.60 lbs/day; therefore a 71% aluminum reduction is necessary. Calculations show that the total loads tracked from LSNR are below the allowable loads for manganese; therefore, no reductions are necessary for this pollutant at LS13.

Margin of Safety

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 also the fact that 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 represents all seasons.

Critical Conditions

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

Attachment D
Little Schuylkill River Sediment Calculations

Little Schuylkill River Sediment TMDL Calculations

The AVGWLF model produced information on watershed size, land use, and sediment loading. The sediment loads represent an annual average over the 23 years simulated by the model (1975 to 1998). This information was then used to calculate existing unit area loading rates for the Little Schuylkill River and Meshoppen Creek Watersheds.

Table A. Existing Loading Values for Little Schuylkill River (impaired)			
Source	Area (ac)	Sediment (lbs.)	Unit Area Load (lb/ac/yr)
Hay/Past	5725.4	1186520	207.24
Cropland	9390	35847600	3817.64
Conif_for	5162	57380	11.12
Mixed_for	3123.4	35640	11.41
decid_for	56512.9	2055560	36.37
unpaved_rd	66.7	820220	12297.15
coal_mine/quarry	2742.8	74456180	27146.05
transition	96.4	1360360	14111.62
lo_int_dev	766	71220	92.98
hi_int_dev	1146.6	161780	141.10
stream bank	****	10748460	
total	84732.2	126,800,920.00	1496.49

Table B. Existing Loading Values for Meshoppen Creek Watershed (reference)			
Source	Area (ac)	Sediment (lbs.)	Unit Area Load (lb/ac/yr)
Hay/Past	5646.3	1101080	195.01
Cropland	20455.4	69723320	3408.55
Conif_for	4265	35520	8.33
Mixed_for	5918	104180	17.60
decid_for	35118.6	760440	21.65
unpaved_rd	355.8	2643700	7430.30
transition	7.4	125360	16940.54
lo_int_dev	106.3	2760	25.96
hi_int_dev	108.7	4200	38.64
stream bank	****	7227540	
total	71981.5	81728100	1135.40

The TMDL target sediment load for Little Schuylkill River is the product of the unit area sediment-loading rate in the reference watershed (Meshoppen Creek) and the total area of the impaired watershed (Little Schuylkill River). These numbers and the resulting TMDL target load are shown in Table C on the following page.

Table C. TMDL Total Load Computation			
Pollutant	Unit Area Loading Rate in Meshoppen Creek Watershed (lbs/acre/yr)	Total Watershed Area in Little Schuylkill River (acres)	TMDL Total Load (lbs/year)
Sediment	1135.4	84732.2	96,205,298.79

Targeted TMDL values were used as the basis for load allocations and reductions in the Little Schuylkill River Watershed, using the following equation

1. TMDL = LA+WLA+MOS
2. LA = ALA-LNR

Where:

TMDL = Total Maximum Daily Load
LA = Load Allocation
ALA = Adjusted Load Allocation
LNR = Loads Not Reduced
WLA = Waste Load Allocation
MOS = Margin of Safety

Waste Load Allocation

There is an NPDES permit at Lehigh Coal and Navigation (SMP54733020, NPDES PA0012360) Outfall 005 (Route 309 discharge) with suspended solids effluent limits to discharge into the Little Schuylkill River. The WLA was calculated as 1932.7 lbs/day or 705,435.5 lbs/year:

Suspended Solids Waste Load Allocations at Outfall 005			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
Outfall 005			
Suspended solids (total)	35.0	6.621	1932.7

Margin of Safety

The margin of safety (MOS) is that portion of the pollution loading that is reserved to account for any uncertainty in the data and computational methodology used for the analysis. The Margin of Safety (MOS) for this analysis is explicit. Ten percent of the TMDL was reserved as the MOS.

MOS = 0.1 * 96,205,299

MOS = 9,620,529.9 lbs/yr

Load Allocation

The Load Allocation (LA), the portion of the load consisting of all nonpoint sources in the watershed, was computed by subtracting the Margin of Safety from the TMDL total load.

LA = TMDL – MOS - WLA

LA = 96,205,299 – 9,620,529.9 – 705,435.5

LA = 85,879,334 lbs/year

Adjusted Load Allocation

The adjusted load allocation (ALA) is the actual portion of the LA distributed among those non-point sources receiving reductions. It is computed by subtracting those non-point source loads that are not being considered for reductions (loads not reduced or LNR) from the LA. Reductions in the Little Schuylkill River Watershed were applied to COAL_MINES/QUARRY and CROPLAND sources for sediment. Those land uses/sources for which existing loads were not reduced (HAY/PAST, CONIF_FOR, MIXED_FOR, DECID_FOR, UNPAVED_RD, TRANSITION, LO_INT_DEV, HI_INT_DEV and Stream bank) kept their current loading values, Table D. The ALA for sediment is 69,382,194 lbs/yr.

Table D. Load Allocation, Loads Not Reduced and Adjusted Load Allocations for the Little Schuylkill River Sediment TMDL

	Sediment (lbs./yr)
Load Allocation	85879334
Loads Not Reduced	16497140
Hay/Past	1186520
Conif_for	57380
Mixed_for	35640
decid_for	2055560
unpaved_rd	820220
transition	1360360
lo_int_dev	71220
hi_int_dev	161780
stream bank	10748460
Adjusted load allocation	69382194

TMDL

The sediment TMDL for the Little Schuylkill River Watershed consists of a Load Allocation and a Margin of Safety (MOS). The individual components of the TMDL are summarized in Table E.

Table E. TMDL, WLA, MOS, LA, LNR and ALA for Little Schuylkill River Sediment TMDL	
Component	Sediment (lbs/year)
TMDL (Total Maximum Daily Load)	96205299
WLA (Waste Load Allocation)	705435.5
MOS (Margin of Safety)	9620529.9
LA (Load Allocation)	85879334
LNR (Loads Not Reduced)	16497140
ALA (Adjusted Load Allocation)	69382194

Calculation of Sediment Load Reductions

Adjusted Load Allocations established in the previous section represents the sediment load that is available for allocation between contributing sources in the Little Schuylkill River Watershed. Data needed for load reduction analysis, including land use distribution, were obtained by GIS analysis. The Equal Marginal Percent Reduction (EMPR) allocation method (Attachment F) was used to distribute the ALA between the appropriate contributing land uses.

Table F contains the results of the sediment EMPR analysis for the appropriate contributing land uses in the Little Schuylkill River Watershed. The load allocation for each land use is shown, along with the percent reduction of current loads necessary.

Table F. Sediment Load Allocations & Reductions for the Little Schuylkill River Watershed						
Pollutant Source	Acres	Unit Area Loading Rate (lbs/ac/yr)		Pollutant Loading (lbs/yr)		Percent Reduction
		Current	Allowable	Current	Allowable	
COAL_MINE/QUARRY	2743	27146.05	16678.74	74456180	45746443	39%
CROPLAND	9390	3817.64	2517.12	35847600	23635750	34%
TOTAL				110303780	69382194	37%

Consideration of Critical Conditions

The AVGWLF model is a continuous simulation model, which uses daily time steps for weather data and water balance calculations. Monthly calculations are made for sediment loads based on the daily water balance accumulated to monthly values. Therefore, all flow conditions are taken into account for loading calculations. Because there is generally a significant lag time between the introduction of sediment to a waterbody and the resulting impact on beneficial uses, establishing these TMDLs using average annual conditions is protective of the waterbody.

Consideration of Seasonal Variations

The continuous simulation model used for this analysis considers seasonal variation through a number of mechanisms. Daily time steps are used for weather data and water balance calculations. The model requires specification of the growing season and hours of daylight for each month. The model also considers the months of the year when manure is applied to the land. The combination of these actions by the model accounts for seasonal variability.

Attachment E

AVGWLF Model Overview & GIS-Based Derivation of Input Data

TMDLs for the Little Schuylkill River Watershed were developed using the Generalized Watershed Loading Function or GWLF model. The GWLF model provides the ability to simulate runoff, sediment, and nutrient (N and P) loadings from watershed given variable-size source areas (e.g., agricultural, forested, and developed land). It also has algorithms for calculating septic system loads, and allows for the inclusion of point source discharge data. It is a continuous simulation model, which uses daily time steps for weather data and water balance calculations. Monthly calculations are made for sediment and nutrient loads, based on the daily water balance accumulated to monthly values.

GWLF is a combined distributed/lumped parameter watershed model. For surface loading, it is distributed in the sense that it allows multiple land use/cover scenarios. Each area is assumed to be homogenous in regard to various attributes considered by the model. Additionally, the model does not spatially distribute the source areas, but aggregates the loads from each area into a watershed total. In other words, there is no spatial routing. For sub-surface loading, the model acts as a lumped parameter model using a water balance approach. No distinctly separate areas are considered for sub-surface flow contributions. Daily water balances are computed for an unsaturated zone as well as a saturated sub-surface zone, where infiltration is computed as the difference between precipitation and snowmelt minus surface runoff plus evapotranspiration.

GWLF models surface runoff using the Soil Conservation Service Curve Number (SCS-CN) approach with daily weather (temperature and precipitation) inputs. Erosion and sediment yield are estimated using monthly erosion calculations based on the Universal Soil Loss Equation (USLE) algorithm (with monthly rainfall-runoff coefficients) and a monthly composite of KLSCP values for each source area (e.g., land cover/soil type combination). The KLSCP factors are variables used in the calculations to depict changes in soil loss erosion (K), the length slope factor (LS) the vegetation cover factor (C) and conservation practices factor (P). A sediment delivery ratio based on watershed size and transport capacities based on average daily runoff are applied to the calculated erosion to determine sediment yield for each source area. Surface nutrient losses are determined by applying dissolved N and P coefficients to surface runoff and a sediment coefficient to the yield portion for each agricultural source area. Point source discharges can also contribute to dissolved losses to the stream and are specified in terms of kilograms per month. Manured areas, as well as septic systems, can also be considered. Urban nutrient inputs are all assumed to be solid-phase, and the model uses an exponential accumulation and washoff function for these loadings. Sub-surface losses are calculated using dissolved N and P coefficients for shallow groundwater contributions to stream nutrient loads, and the sub-surface sub-model only considers a single, lumped-parameter contributing area. Evapotranspiration is determined using daily weather data and a cover factor dependent upon land use/cover type. Finally, a water balance is performed daily using supplied or computed precipitation, snowmelt, initial unsaturated zone storage, maximum available zone storage, and evapotranspiration values. All of the equations used by the model can be viewed in GWLF Users Manuel, available from the Department's Bureau of Water Supply and Wastewater Management, Division of Water Quality Assessment and Standards.

For execution, the model requires three separate input files containing transport-, nutrient-, and weather-related data. The transport (TRANSPRT.DAT) file defines the necessary parameters for each source area to be considered (e.g., area size, curve number, etc.) as well as global parameters (e.g., initial storage, sediment delivery ratio, etc.) that apply to all source areas. The nutrient (NUTRIENT.DAT) file specifies the various loading parameters for the different source areas identified (e.g., number of septic systems, urban source area accumulation rates, manure concentrations, etc.). The weather (WEATHER.DAT) file contains daily average temperature and total precipitation values for each year simulated.

The primary sources of data for this analysis were geographic information system (GIS) formatted databases. A specially designed interface was prepared by the Environmental Resources Research Institute of the Pennsylvania State University in ArcView (GIS software) to generate the data needed to run the GWLF model, which was developed by Cornell University. The new version of this model has been named AVGWLF (ArcView Version of the Generalized Watershed Loading Function).

In using this interface, the user is prompted to identify required GIS files and to provide other information related to "non-spatial" model parameters (e.g., beginning and end of the growing season, the months during which manure is spread on agricultural land and the names of nearby weather stations). This information is subsequently used to automatically derive values for required model input parameters, which are then written to the TRANSPRT.DAT, NUTRIENT.DAT and WEATHER.DAT input files needed to execute the GWLF model. For use in Pennsylvania, AVGWLF has been linked with statewide GIS data layers such as land use/cover, soils, topography, and physiography; and includes location-specific default information such as background N and P concentrations and cropping practices. Complete GWLF-formatted weather files are also included for eighty weather stations around the state. The following table lists the statewide GIS data sets and provides an explanation of how they were used for development of the input files for the GWLF model.

GIS Data Sets	
DATASET	DESCRIPTION
Censustr	Coverage of Census data including information on individual homes septic systems. The attribute *usew_sept* includes data on conventional systems, and *sew_other* provides data on short-circuiting and other systems.
County	The County boundaries coverage lists data on conservation practices, which provides C and P values in the Universal Soil Loss Equation (USLE).
Gwnback	A grid of background concentrations of N in groundwater derived from water well sampling.
Landuse5	Grid of the MRLC that has been reclassified into five categories. This is used primarily as a background.
Majored	Coverage of major roads. Used for reconnaissance of a watershed.
MCD	Minor civil divisions (boroughs, townships and cities).
Npdespts	A coverage of permitted point discharges. Provides background information and cross check for the point source coverage.
Padem	100-meter digital elevation model. This used to calculate landslope and slope length.
Palumrlc	A satellite image derived land cover grid that is classified into 15 different landcover categories. This dataset provides landcover loading rate for the different categories in the model.
Pasingle	The 1:24,000 scale single line stream coverage of Pennsylvania. Provides a complete network of streams with coded stream segments.
Physprov	A shapefile of physiographic provinces. Attributes *rain_cool* and *rain_warm* are used to set recession coefficient
Pointsrc	Major point source discharges with permitted N and P loads.
Refwater	Shapefile of reference watersheds for which nutrient and sediment loads have been calculated.
Soilphos	A grid of soil phosphorous loads, which has been generated from soil sample data. Used to help set phosphorus and sediment values.
Smallsheds	A coverage of watersheds derived at 1:24,000 scale. This coverage is used with the stream network to delineate the desired level watershed.
Statsgo	A shapefile of generalized soil boundaries. The attribute *mu_k* sets the k factor in the USLE. The attribute *mu_awc* is the unsaturated available capacity., and the *muhsg_dom* is used with landuse cover to derive curve numbers.
Strm305	A coverage of stream water quality as reported in the Pennsylvania's 305(b) report. Current status of assessed streams.
Surfgeol	A shapefile of the surface geology used to compare watersheds of similar qualities.
T9sheds	Data derived from a DEP study conducted at PSU with N and P loads.
Zipcode	A coverage of animal densities. Attribute *aeu_acre* helps estimate N & P concentrations in runoff in agricultural lands and over manured areas.
Weather Files	Historical weather files for stations around Pennsylvania to simulate flow.

Attachment F

Equal Marginal Percent Reduction (EMPR)

Equal Marginal Percent Reduction (EMPR) (An Allocation Strategy)

The Equal Marginal Percent Reduction (EMPR) allocation method was used to distribute Adjusted Load Allocations (ALAs) between the appropriate contributing nonpoint sources. The load allocation and EMPR procedures were performed using a MS Excel spreadsheet. The 5 major steps identified in the spreadsheet are summarized below:

Step 1: Calculation of the TMDL based on impaired watershed size and unit area loading rate of reference watershed.

Step 2: Calculation of Adjusted Load Allocation based on TMDL, Margin of Safety, and existing loads not reduced.

Step 3: Actual EMPR Process:

a. Each land use/source load is compared with the total ALA to determine if any contributor would exceed the ALA by itself. The evaluation is carried out as if each source is the only contributor to the pollutant load of the receiving waterbody. If the contributor exceeds the ALA, that contributor would be reduced to the ALA. If a contributor is less than the ALA, it is set at the existing load. This is the baseline portion of EMPR.

b. After any necessary reductions have been made in the baseline, the multiple analyses are run. The multiple analyses will sum all of the baseline loads and compare them to the ALA. If the ALA is exceeded, an equal percent reduction will be made to all contributors' baseline values. After any necessary reductions in the multiple analyses, the final reduction percentage for each contributor can be computed.

Step 4: Calculation of total loading rate of all sources receiving reductions.

Step 5: Summary of existing loads, final load allocations, and % reduction for each pollutant source.

Equal Marginal Percent Reduction Calculations in Lbs. for Little Schuylkill River

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Step 1:	TMDL Total Load				Step 2:	Adjusted LA = (TMDL total load - MOS) - uncontrollable						
2		Load = TP loading rate in ref. * Acres in Impaired					69382194	69382194					
3		96205299											
6			Annual Average					% reduction				Allowable	
7	Step 3:		Load	Load Sum	Check	Initial Adjust	Recheck	allocation	Load Reduction	Initial LA	Acres	Loading Rate	% Reduction
8		Coal/Quarr	74456180.0	110303780.0	bad	69382194	ADJUST	0.66	23635750	45746443	2743	16678.74	38.6%
9							35847600						
10		Cropland	35847600.0		good	35847600		0.34	12211850	23635750	9390	2517.12	34.1%
13						105229794		1.00		69382194			
15	Step 4:	All Ag. Loac	5718.56										
17				Allowable (Target)		Current							
18	Step 5:		Acres	loading rate	Final LA	Loading Rates	Current Load	% Red.					
19		Coal	2743	16678.74	45746443	27146.05	74456180	39%					
21		Cropland	9390	2517.12	23635750	3817.64	35847600	34%					
24					69382194		110303780	37%					

Equal Marginal Percent Reduction Calculations in tons for Little Schuylkill River

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Step 1:	TMDL Total Load				Step 2:	Adjusted LA = (TMDL total load - MOS) - uncontrollable						
2		Load = TP loading rate in ref. * Acres in Impaired					34691	34691					
3		48103											
7	Step 3:		Annual Ave	Load Sum	Check	Initial Adjus	Recheck	% reductior	Load Reduction	Initial LA	Acres	Allowable L	% Reduction
8		Coal/Quarry	37228.1	55151.9	bad	34691	ADJUST	0.66	11818	22873	2743	8.34	38.6%
9							17924						
10		Cropland	17923.8		good	17924		0.34	6106	11818	9390	1.26	34.1%
13						52615		1.00		34691			
15	Step 4:	All Ag. Loadin	2.86										
18	Step 5:		Acres	Allowable (	Final LA	Current Lo	Current Loa	% Red.					
19		Coal	2743	8.34	22873	13.57	37228	39%					
21		Cropland	9390	1.26	11818	1.91	17924	34%					
24					34691		55152	37%					

Attachment G
AVGWLF OUTPUT

AVGWLF Transport File and Model Output for Little Schuylkill River

Edit Transport File

Rural LU	Area (ha)	CN	K	LS	C	P
HAY/PAST	2317	75	0.22481	2.75367	0.03	0.45
CROPLAND	3800	82	0.22066	3.69139	0.42	0.45
CONIF_FOR	2089	73	0.21046	2.36646	0.002	0.45
MIXED_FOR	1264	73	0.21618	2.36443	0.002	0.45
DECID_FOR	22870	73	0.20758	6.79451	0.002	0.52
UNPAVED_RD	27	87	0.20840	2.97363	0.8	1
QUARRY	407	91	0.18149	12.3975	0.8	0.8
COAL_MINES	703	89	0.17561	7.96047	0.8	0.8

Urban LU	Area (ha)	CN	K	LS	C	P
LO_INT_DEV	310	83	0.20141	1.16338	0.08	0.2
HI_INT_DEV	464	93	0.18788	1.89287	0.08	0.2

Month	Ket	Day Hrs	Season	Eros Coef
APR	0.6866	13	1	0.300
MAY	0.9312	14	1	0.300
JUN	1.0731	15	1	0.300
JUL	1.1554	15	1	0.300
AUG	1.2032	14	1	0.300
SEP	1.2309	12	1	0.300
OCT	1.2469	11	1	0.120
NOV	0.8407	10	0	0.120
DEC	0.6051	9	0	0.120
JAN	0.2350	9	0	0.120
FEB	0.2538	10	0	0.120
MAR	0.2648	12	0	0.120

Antecedent Moisture Condition

Day -1	Day -2	Day -3	Day -4	Day -5
0	0	0	0	0

Init Unsat Stor (cm)	10	Initial Snow (cm)	0
Init Sat Stor (cm)	0	Sed Delivery Ratio	0.078
Recess Coef (l/day)	0.10021	Sediment A Factor	4.784E-05
Seepage Coef (l/day)	0	Unsat Avail Wat (cm)	12.8838

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Average Loads by Source

GWLF Total Loads for imp1

Period of analysis: 23 years, from Apr 1975 to Mar 1998

Source	(Acres) Area	(in) Runoff	(Tons) Erosion	Sediment	Total Loads (Pounds) Dis. Nitr.	Tot. Nitr.	Dis. Phos.	Tot. Phos.
HAY/PAST	5725.4	3.78	7605.92	593.26	13048.39	16607.96	1446.91	1946.44
CROPLAND	9390.0	6.11	229792.29	17923.80	34529.45	142072.24	3838.91	18930.75
CONIF_FOR	5162.0	3.31	367.81	28.69	736.28	908.41	23.25	47.41
MIXED_FOR	3123.4	3.31	228.40	17.82	445.50	552.40	14.07	29.07
DECID_FOR	56512.9	3.31	13176.70	1027.78	8060.68	14227.38	254.55	1119.94
UNPAVED_RD	66.7	8.90	5257.82	410.11	390.43	2851.09	26.93	372.24
QUARRY	1005.7	12.61	230220.99	17957.24	34.50	107777.92	5.46	15125.46
COAL_MINES	1737.1	10.52	247062.17	19270.85	49.72	115674.81	7.87	16233.93
TRANSITION	96.4	8.90	8720.30	680.18	563.95	4645.05	38.89	611.61
LO_INT_DEV	766.0	6.56	456.53	35.61	0.00	106.33	0.00	14.18
HI_INT_DEV	1146.6	15.40	1037.10	80.89	0.00	5149.76	0.00	571.06
Stream Bank				5374.23		537.42		236.47
Groundwater					227697.13	227697.13	5909.22	5909.22
Point Sources					186808.48	186808.48	4214.70	4214.70
Septic Syst.					28996.44	28996.44	268.19	268.19
Totals	84732.3	4.10	743926.0	63400.4	501360.93	854612.80	16048.96	65630.65

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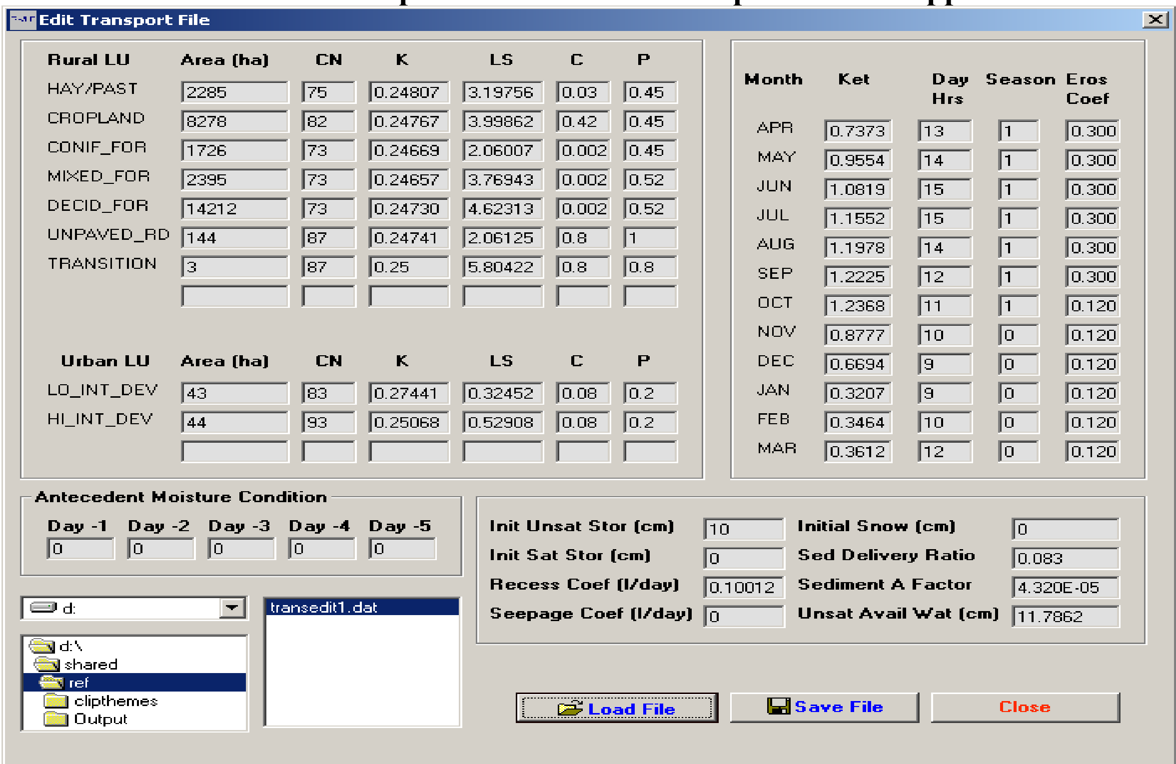
AVGWLF Transport File and Model Output for Meshoppen Creek



Edit Transport File

Rural LU	Area (ha)	CN	K	LS	C	P
HAY/PAST	2285	75	0.24807	3.19756	0.03	0.45
CROPLAND	8278	82	0.24767	3.99862	0.42	0.45
CONIF_FOR	1726	73	0.24669	2.06007	0.002	0.45
MIXED_FOR	2395	73	0.24657	3.76943	0.002	0.52
DECID_FOR	14212	73	0.24730	4.62313	0.002	0.52
UNPAVED_RD	144	87	0.24741	2.06125	0.8	1
TRANSITION	3	87	0.25	5.80422	0.8	0.8

Urban LU	Area (ha)	CN	K	LS	C	P
LO_INT_DEV	43	83	0.27441	0.32452	0.08	0.2
HI_INT_DEV	44	93	0.25068	0.52908	0.08	0.2

Month	Ket	Day Hrs	Season	Eros Coef
APR	0.7373	13	1	0.300
MAY	0.9554	14	1	0.300
JUN	1.0819	15	1	0.300
JUL	1.1552	15	1	0.300
AUG	1.1978	14	1	0.300
SEP	1.2225	12	1	0.300
OCT	1.2368	11	1	0.120
NOV	0.8777	10	0	0.120
DEC	0.6694	9	0	0.120
JAN	0.3207	9	0	0.120
FEB	0.3464	10	0	0.120
MAR	0.3612	12	0	0.120

Antecedent Moisture Condition

Day -1	Day -2	Day -3	Day -4	Day -5
0	0	0	0	0

Init Unsat Stor (cm)	10	Initial Snow (cm)	0
Init Sat Stor (cm)	0	Sed Delivery Ratio	0.083
Recess Coef (l/day)	0.10012	Sediment A Factor	4.320E-05
Seepage Coef (l/day)	0	Unsat Avail Wat (cm)	11.7862

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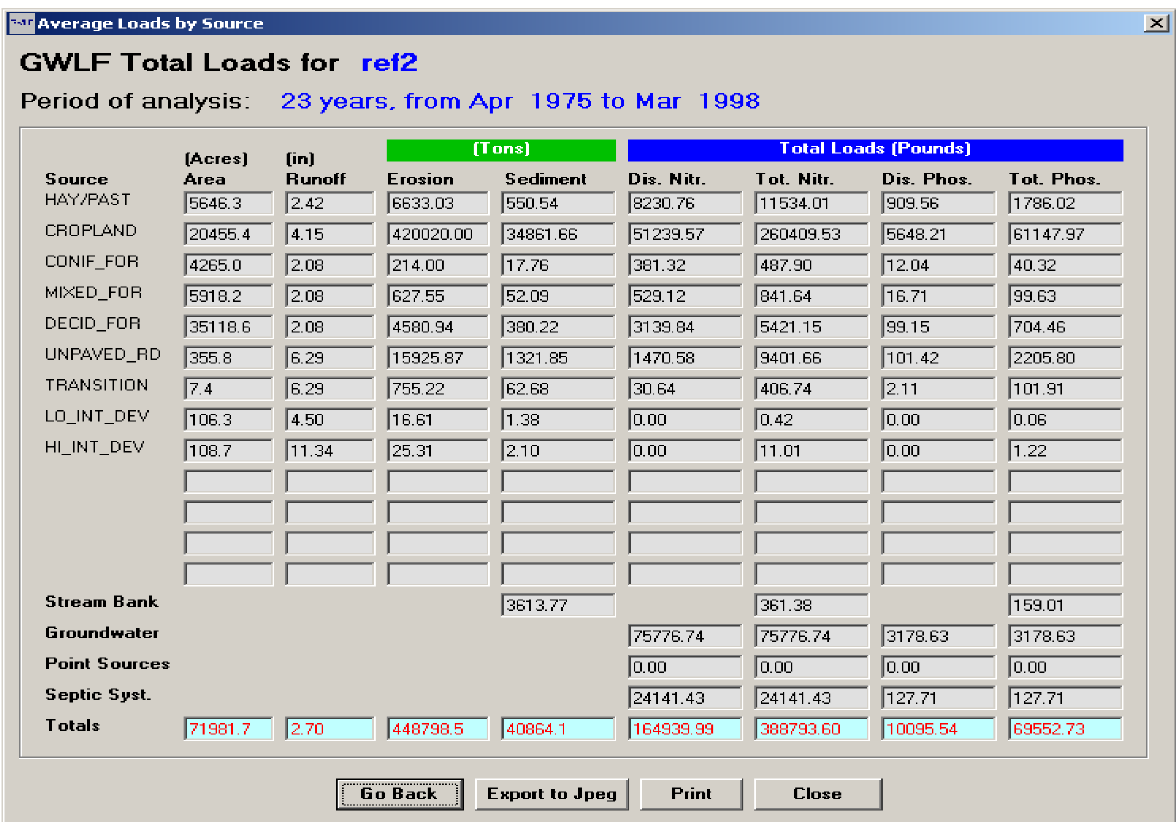

Average Loads by Source

GWLF Total Loads for ref2

Period of analysis: 23 years, from Apr 1975 to Mar 1998

Source	(Acres) Area	(in) Runoff	(Tons) Erosion	(Tons) Sediment	Total Loads (Pounds) Dis. Nitr.	Tot. Nitr.	Dis. Phos.	Tot. Phos.
HAY/PAST	5646.3	2.42	6633.03	550.54	8230.76	11534.01	909.56	1786.02
CROPLAND	20455.4	4.15	420020.00	34861.66	51239.57	260409.53	5648.21	61147.97
CONIF_FOR	4265.0	2.08	214.00	17.76	381.32	487.90	12.04	40.32
MIXED_FOR	5918.2	2.08	627.55	52.09	529.12	841.64	16.71	99.63
DECID_FOR	35118.6	2.08	4580.94	380.22	3139.84	5421.15	99.15	704.46
UNPAVED_RD	355.8	6.29	15925.87	1321.85	1470.58	9401.66	101.42	2205.80
TRANSITION	7.4	6.29	755.22	62.68	30.64	406.74	2.11	101.91
LO_INT_DEV	106.3	4.50	16.61	1.38	0.00	0.42	0.00	0.06
HI_INT_DEV	108.7	11.34	25.31	2.10	0.00	11.01	0.00	1.22
Stream Bank				3613.77		361.38		159.01
Groundwater					75776.74	75776.74	3178.63	3178.63
Point Sources					0.00	0.00	0.00	0.00
Septic Syst.					24141.43	24141.43	127.71	127.71
Totals	71981.7	2.70	448798.5	40864.1	164939.99	388793.60	10095.54	69552.73

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Attachment H

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 lists. 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 I

Water Quality Data Used In TMDL Calculations

DATE_COLECTED	Project MP	pH (pH units)	AL (UG/L)	ALK (MG/L)	FE (UG/L)	HOT A (MG/L)	MN (UG/L)	TSS (MG/L)
6/25/2002	LS1	3.7	4990.00	0.0	7770.00	73.60	1410.00	4
7/25/2002	LS1	3.9	7000.00	0.0	13900.00	84.40	1800.00	<3
8/19/2002	LS1	4.0	7190.00	2.0	13600.00	86.80	1780.00	<3
11/26/2002	LS1	3.7	4780.00	0.0	5100.00	58.00	1170.00	<3
1/6/2003	LS1	3.8	3710.00	0.0	2740.00	52.20	950.00	8
3/24/2003	LS1	4.0	4130.00	0.0	2240.00	52.40	965.00	<3
4/30/2003	LS1	3.7	5490.00	0.0	4370.00	75.20	1410.00	<3
6/2/2003	LS1	4.2	2250.00	2.6	1580.00	38.00	578.00	<3
5/26/2004	LS1	3.7	5240.00	0.0	4580.00	67.40	1420.00	<3
AVG		**3.9**	**4975.6**	**0.5**	**6208.9**	**65.3**	**1275.9**	
4/18/1972	LS2*	3.8			10000.00			
11/1/1991	LS2*	4.3			19000.00		1900.00	
1/3/2000	LS2*	3.9		0.0	19700.00	110.00	1800.00	0
2/2/2000	LS2*	4.0		0.0	18200.00	110.00	1600.00	0
3/11/2000	LS2*	3.8		0.0	16700.00	110.00	1800.00	1
4/15/2000	LS2*	3.9		0.0	14000.00	100.00	1500.00	0
5/1/2000	LS2*	3.7		0.0	13600.00	95.00	1500.00	0
6/2/2000	LS2*	4.0		0.0	11600.00	95.00	1900.00	1
7/3/2000	LS2*	3.8		0.0	10800.00	90.00	1400.00	0
8/2/2000	LS2*	3.7		0.0	11200.00	90.00	1600.00	0
9/5/2000	LS2*	3.8		0.0	15400.00	115.00	1500.00	0
11/8/2000	LS2*	4.2	10600.00	7.0	23000.00	102.00	1950.00	<2
1/3/2001	LS2*	4.2		0.0	22300.00	140.00	2000.00	0
2/1/2001	LS2*	4.0		0.0	20100.00	137.00	1800.00	1
3/1/2001	LS2*	4.1		0.0	20400.00	118.00	1800.00	0
4/4/2001	LS2*	4.0		0.0	15600.00	105.00	1600.00	0
5/1/2001	LS2*	3.9		0.0	16000.00	110.00	1600.00	0
6/24/2001	LS2*	3.8		0.0	16200.00	125.00	1500.00	1
10/1/2001	LS2*	4.4		0.0	20700.00	150.00	1600.00	1
11/2/2001	LS2*	4.1		0.0	21900.00	155.00	1600.00	0
12/3/2001	LS2*	4.2		0.0	21000.00	150.00	1400.00	1
1/2/2002	LS2*	4.2		0.0	25000.00	140.00	1700.00	0
2/5/2002	LS2*	4.2		0.0	21200.00	150.00	1400.00	0
3/4/2002	LS2*	4.3		0.0	21600.00	140.00	1300.00	0
4/1/2002	LS2*	4.1		0.0	19900.00	130.00	2000.00	2
5/3/2002	LS2*	4.1		0.0	17400.00	150.00	860.00	0
6/3/2002	LS2*	3.9		0.0	17000.00	130.00	920.00	1
6/25/2002	LS2*	4.2	3970.00	5.2	15400.00	82.20	1360.00	<3
7/25/2002	LS2*	4.1	6690.00	3.0	18400.00	89.00	1640.00	12
8/19/2002	LS2*	3.9	7560.00	1.4	16900.00	86.40	1640.00	<3
11/26/2002	LS2*	4.2	5900.00	4.0	17800.00	101.60	1720.00	<3
1/6/2003	LS2*	4.0	4470.00	1.4	14400.00	84.80	1390.00	10
4/30/2003	LS2*	4.2	<500.00	3.0	12000.00	68.60	1370.00	<3
6/2/2003	LS2*	3.9	4970.00	0.8	9650.00	79.00	1320.00	<3
5/26/2004	LS2*	4.2	3740.00	5.8	13000.00	86.40	1370.00	<3
AVG		**4.0**	**5987.5**	**1.0**	**17058.6**	**112.9**	**1568.8**	
6/25/2002	LS3	4.7	4390.00	8.4	10400.00	64.60	1330.00	44

7/25/2002	LS3	6.0	6100.00	17.6	13600.00	41.80	1620.00	42
8/19/2002	LS3	4.9	6620.00	9.6	14800.00	68.80	1530.00	16
11/26/2002	LS3	4.0	4930.00	2.0	8570.00	81.20	1310.00	<3
1/6/2003	LS3	4.0	4010.00	1.4	7170.00	66.20	1100.00	
3/24/2003	LS3	4.1	4100.00	0.2	4170.00	56.60	1030.00	<3
4/30/2003	LS3	3.9	4860.00	0.2	8680.00	64.00	1340.00	<3
6/2/2003	LS3	4.0	3550.00	1.8	4380.00	52.80	908.00	4
5/26/2004	LS3	4.3	5500.00	6.6	19800.00	87.20	1500.00	52
AVG		**4.4**	**4895.6**	**5.3**	**10174.4**	**64.8**	**1296.4**	
6/25/2002	LS4	5.5	<500.00	7.6	<300.00	14.20	58.00	<3
7/25/2002	LS4	5.8	<500.00	7.4	<300.00	8.60	50.00	12
8/19/2002	LS4	5.5	<500.00	7.6	<300.00	14.00	50.00	<3
11/26/2002	LS4	5.0	<500.00	5.8	<300.00	28.60	79.00	<3
1/6/2003	LS4	5.0	<500.00	6.0	<300.00	19.00	74.00	16
3/24/2003	LS4	4.8	<500.00	6.6	<300.00	23.40	78.00	<3
4/30/2003	LS4	5.1	<500.00	6.6	<300.00	18.20	81.00	<3
6/2/2003	LS4	4.7	<500.00	5.2	<300.00	28.80	80.00	8
5/26/2004	LS4	5.1	<500.00	7.4	<300.00	33.00	88.00	<3
AVG		**5.2**	**<0.5**	**6.7**	**<0.3**	**20.9**	**70.9**	
6/25/2002	LS5	4.5	2170.00	6.8	3930.00	46.60	719.00	<3
7/25/2002	LS5	4.6	3530.00	6.0	6590.00	49.40	999.00	4
8/19/2002	LS5	4.8	4230.00	8.2	8220.00	68.20	1130.00	6
11/26/2002	LS5	4.5	1710.00	5.0	2260.00	44.80	456.00	<3
1/6/2003	LS5	4.5	1550.00	5.2	2090.00	44.20	441.00	12
3/24/2003	LS5	4.5	1510.00	5.2	1630.00	28.00	388.00	4
4/30/2003	LS5	4.3	2100.00	4.6	2420.00	49.40	602.00	<3
6/2/2003	LS5	4.6	927.00	5.0	917.00	43.40	230.00	6
5/26/2004	LS5							
AVG		**4.5**	**2215.9**	**5.8**	**3507.1**	**46.8**	**620.6**	**6.4**
6/25/2002	LS6	4.4	1920.00	6.2	2700.00	40.40	660.00	<3
7/25/2002	LS6	4.4	3510.00	5.0	4880.00	41.20	1000.00	4
8/19/2002	LS6	4.7	3330.00	8.0	4960.00	55.40	982.00	<3
11/26/2002	LS6	4.5	1670.00	5.2	1960.00	39.80	455.00	<3
1/6/2003	LS6	4.6	1420.00	5.4	1760.00	35.00	415.00	6
3/24/2003	LS6	4.6	1520.00	5.8	1570.00	32.40	380.00	4
4/30/2003	LS6	4.4	1690.00	5.2	1740.00	60.40	522.00	<3
6/3/2003	LS6	4.8	1040.00	6.0	1000.00	56.60	266.00	<3
5/26/2004	LS6	4.6	1300.00	6.6	2280.00	50.00	429.00	4
AVG		**4.6**	**1933.33**	**5.93**	**2538.89**	**45.69**	**567.67**	
6/26/2002	LS7	5.7	887.00	7.8	651.00	47.40	354.00	<3
7/25/2002	LS7	5.2	1070.00	6.6	304.00	39.40	522.00	10
8/19/2002	LS7	5.0	931.00	7.8	<300.00	31.80	556.00	
11/25/2002	LS7	5.7	647.00	9.0	643.00	56.20	229.00	8
1/6/2003	LS7	5.9	<500.00	7.2	514.00	45.00	164.00	8
3/27/2003	LS7	6.0	<500.00	9.2	553.00	52.60	155.00	6
4/30/2003	LS7	5.6	<500.00	7.8	478.00	48.00	198.00	<3
6/3/2003	LS7	6.1	<500.00	8.4	884.00	38.80	144.00	<3
5/27/2004	LS7	5.6	<500.00	9.2	622.00	62.60	200.00	<3

AVG		**5.6**		**8.11**	**581.13**	**46.87**	**280.22**	
6/26/2002	LS8	6.9	<500.00	12.4	329.00	0.00	179.00	<3
7/26/2002	LS8	7.1	<500.00	13.4	<300.00	0.00	240.00	<3
8/19/2002	LS8	6.6	<500.00	13.6	<300.00	0.00	304.00	<3
11/25/2002	LS8	6.9	<500.00	13.8	<300.00	0.00	92.00	6
3/27/2003	LS8	6.5	<500.00	11.2	315.00	37.40	82.00	<3
4/30/2003	LS8	6.4	<500.00	10.6	310.00	39.20	113.00	<3
6/3/2003	LS8	6.7	<500.00	11.0	430.00	0.00	73.00	4
5/27/2004	LS8	5.8	<500.00	12.4	346.00	35.80	99.00	<3
AVG		**6.6**	**<0.5**	**12.3**	**346.0**	**14.1**	**147.8**	
6/26/2002	LS9	7.1	<500.00	13.0	<300.00	0.00	94.00	<3
7/26/2002	LS9	7.2	<500.00	14.4	<300.00	0.00	73.00	<3
8/20/2002	LS9	6.6	<500.00	14.6	<300.00	0.00	50.00	6
11/25/2002	LS9	7.0	<500.00	13.8	<300.00	0.00	91.00	
1/7/2003	LS9	6.8	<500.00	10.4	366.00	0.00	95.00	4
3/27/2003	LS9	6.5	<500.00	11.2	<300.00	37.60	84.00	4
4/30/2003	LS9	6.5	<500.00	10.6	<300.00	0.00	105.00	<3
6/3/2003	LS9	6.7	<500.00	11.0	447.00	0.00	83.00	6
5/27/2004	LS9	6.0	<500.00	12.8	476.00	31.60	97.00	<3
5/31/2006	LS9	6.8	<500	12.4	380.00	11.60	89.00	<3
7/24/2006	LS9	7.1	<500	13.6	<300	0.00	90.00	4
8/28/2006	LS9	7.1	<500	15.6	399.00	0.00	124.00	<3
9/7/2006	LS9	7.1	<500	16.0	<300	0.00	74.00	<3
9/11/2006	LS9	6.7	<500	16.4	<300	0.00	63.00	<3
9/18/2006	LS9	6.7	<500	17.4	<300	0.00	64.00	<3
9/25/2006	LS9	6.7	<500	18.0	<300	0.00	79.00	<3
10/2/2006	LS9	7.0	<500	16.4	<300	0.00	95.00	<3
10/10/2006	LS9	6.5	<500	17.0	<300	0.00	111.00	<3
10/25/2006	LS9	7.0	<500	15.0	<300	0.00	108.00	<3
AVG		**6.8**	**<0.5**	**12.5**	**417.3**	**4.3**	**86.5**	
6/26/2002	LS11	6.6	743.00	19.4	3120.00	0.00	1920.00	<3
7/26/2002	LS11	6.7	684.00	28.0	3560.00	0.00	2400.00	6
8/20/2002	LS11	6.6	<500.00	24.0	4380.00	0.00	2930.00	22
11/25/2002	LS11	6.5	645.00	15.2	1570.00	0.00	816.00	
1/7/2003	LS11	6.7	558.00	12.8	1390.00	0.00	778.00	6
3/27/2003	LS11	6.6	668.00	13.2	1230.00	44.20	614.00	10
4/30/2003	LS11	6.4	686.00	16.8	1960.00	38.60	1320.00	<3
6/3/2003	LS11	6.5	749.00	12.8	1200.00	0.00	543.00	8
5/27/2004	LS11	6.3	646.00	18.0	1660.00	51.80	887.00	<3
AVG		**6.5**	**672.4**	**17.8**	**2230.0**	**15.0**	**1356.4**	
5/31/2006	LSNR	7.0	<500	20.8	567.00	10.40	508.00	<3
7/24/2006	LSNR	7.4	<500	23.2	317.00	0.00	1110.00	12
8/28/2006	LSNR	7.2	<500	23.0	1150.00	0.00	766.00	<3
10/26/2006	LSNR	7.1	<500	17.6	<300	0.00	632.00	<3
AVG		**7.2**		**21.2**	**678.0**	**2.6**	**754.0**	
6/26/2002	LS13	7.0	<500.00	16.6	300.00	0.00	114.00	<3
7/26/2002	LS13	7.6	<500.00	17.6	300.00	0.00	50.00	<3
8/20/2002	LS13	6.8	<500.00	16.8	300.00	0.00	50.00	4

11/25/2002	LS13	7.1	<500.00	15.6	300.00	0.00	320.00	8
1/7/2003	LS13	7.1	<500.00	12.8	300.00	0.00	338.00	<3
3/27/2003	LS13	6.5	<500.00	13.6	335.00	48.60	320.00	<3
4/30/2003	LS13	6.6	<500.00	13.0	300.00	0.00	453.00	<3
6/3/2003	LS13	6.8	<500.00	13.4	635.00	0.00	280.00	16
5/27/2004	LS13	6.6	1290.00	18.6	1920.00	48.60	376.00	8
5/31/2006	LS13	7.0	<500	19.6	559.00	0.00	498.00	<3
7/24/2006	LS13	6.3	<500	22.6	<300	0.00	601.00	4
8/28/2006	LS13	7.2	<500	22.4	680.00	0.00	680.00	4
10/26/2006	LS13	7.1	<500	16.4	<300	0.00	149.00	<3
AVG		**6.9**		**16.8**	**524.9**	**7.5**	**325.3**	

*Less than detects are calculated at the detection limit in the data sets.

Calculated flow using the unit area ratio method

Sampling Point	Area (unitless)	Adjusted flow, GPM	Adjusted flow, MGD
LS1		1500	2.16
LS2		1500	2.16
LS3	2832114.23030	3999.524755	5.759315647
LS4	4235677.92020	4494.877887	6.472624157
LS5	14247037.27596	8028.139859	11.5605214
LS6	40027387.14130	17126.67749	24.66241558
LS7	53217364.23738	21781.75407	31.36572586
LS8	110588753.68956	39029.56871	56.20257895
LS9	111646547.89294	39402.89105	56.74016311
LS11	170791045.05994	63276.48026	91.11813158
LSNR	263038607.59031	95832.97864	137.9994892
LS13	355286170.12067	128389.477	184.8808469

Flow data for points LS1 and LS2 were estimated based on their relative contributions to the Little Schuylkill River at LS3.

Attachment J
Comment and Response

Comments/Responses on Little Schuylkill River TMDL on Proposed Final TMDL (January 10, 2007)

Comment received from EPA Region III on March 2, 2007:

Comment: Table 6 should identify sample locations.

Response: Sample location descriptions have been added to Table 6.

Comments received from Penn Future on February 23, 2007:

Comment: Inadequate Public Comment Period

Given that PADEP invited the public to present comments on the Revised TMDL at a public hearing and to submit comments in writing, 37 Pa. Bull. 578, it clearly considers the document to be a revised draft that may be changed based on this additional public input. The governing regulation is clear that "[d]raft TMDL notices shall be subject to a minimum 30-day comment period." 25 Pa. Code § 96.7(b). The 20-day public comment period being offered for the Revised TMDL obviously falls short of satisfying this requirement and is clearly unlawful.

In addition to objecting to the unreasonably short comment period provided for the particular TMDL, PennFuture objects to the blitz of fully two dozen proposed or revised PADEP TMDLs coming out in the span of just six weeks (December 23, 2006 through February 3, 2007), sixteen of which have the same comment deadline of February 23, 2007, with two more having a deadline of February 27. Adding to this onslaught, the Environmental Protection Agency (EPA) recently released four draft Pennsylvania TMDLs with mid-March comment deadlines, including the complex Proposed Schuylkill River PCB TMDL. This intensely concentrated release of so many draft TMDLs with convergent comment deadlines indisputably impairs the public's ability to provide meaningful input on the proposed drafts or revisions, particularly those members of the public having an interest in the process of TMDL development and implementation generally, as well as interests in waters all across Pennsylvania. Cf. 40 C.F.R.§§ 130.5(b)(3), 130.7(a), (c)(1)(ii). For example, someone who is interested in commenting on the recently-noticed revised TMDLs for Mahanoy Creek, the Schuylkill River, and the Little Schuylkill River (all three of which have a comment deadline of February 23, 2007), as well as the 124-page proposed TMDL for the 6,992 square mile West Branch Susquehanna River Watershed (due March 5, 2007), faces a challenging task unnecessarily made more difficult by the tight, convergent deadlines.

PADEP had exacerbated these problems by the manner in which it has made certain TMDLs available. The public notice for the revised Mahanoy Creek TMDL appeared in the Pennsylvania Bulletin on January 27, 2007 (37 Pa. Bull. 472-73), but the revised document itself is dated February 2, 2007, and the first time it was available during business hours on PADEP's web page was the morning of February 5, 2007, just 18 days before the comment deadline. As with the Little Schuylkill River TMDL at issue here, PADEP unlawfully provided only a 20-day comment period for the "Revised Final Total Maximum Daily Load (TMDL) for the Schuylkill River Watershed". 37 Pa. Bull. 578-79 (February 3, 2007). As explained in PennFuture's separate comments on that TMDL, PADEP made that particular unlawfully short deadline worse by failing to indicate in the public notice that the "Schuylkill River Watershed TMDL" would appear in the alphabetized list of TMDLs on PADEP's website under "U" for "Upper Schuylkill River TMDL".

EPA, PADEP, and their contractors work on some of these TMDLs for years before they are released to the public. It took four years from the close of the comment period on the original draft of the Mahanoy Creek TMDL in February 2003 for PADEP to release the revised version. Revising the TMDL for the Little Schuylkill River took two years, even though PADEP failed to perform the hardest and most important part of that process (see Comment 1, below). Given the complexity of the various models employed, changes in methodologies, the volume of data to review, the number of applicable guidance documents and regulations, and the difficulty of fettering out all the changes made, even a full twenty days would be an insufficient period for the public to review, analyze, and comment on the revised TMDL like the one at issue here. The that so many proposed or revised Pennsylvania TMDLs are pending at once and have essentially the same comment deadline deprives the public of a meaningful opportunity to participate in the process, and deprives agencies of input from which they and the ultimate product might benefit.

There is no valid reason why so many TMDLs pile up against essentially the same deadline. PADEP and EPA should prevent a similar tsunami from occurring tin the future. Given some of the fundamental errors PennFuture has uncovered in the pending wave of TMDLs, the time pressure seems to be impairing the quality of the TMDLs produced in ways that are wasteful for all concerned. We turn to one of those fundamental errors presently.

Response: PennFuture comments specifically find fault with two items in the proposed final Little Schuylkill River TMDL public comment period:

1) 20-day versus 30-day comment period
2) Large number of TMDLs issued concurrently presenting difficulties to those who would like to provide public comment on more than one TMDL concurrently

Each item will be addressed individually below.

1) The Department will extend the public notice period for an additional 10 days to allow for the full 30-day comment period according to regulation. Notice of the extension of the comment period will be published in the Pennsylvania Bulletin.
2) The Department will work to address this problem in the future as it recognizes that those members of the public who would like to comment on multiple TMDL

documents are presented with a significant difficulty when many documents are released for comment concurrently.

Comment: The TMDL must include water quality-based WLAs for the Route 309 discharge.

The Revised TMDL gets one point exactly backwards. It provides that a TMDL may include technology-based wasteload allocations (WLAs) until PADEP develops water quality-based effluent limitations (WQBELs) for the relevant point source discharge. In fact, the opposite is true: the law makes it clear that PADEP must first develop the more stringent, water quality-based WLAs, and then use those WLAs as the basis for WQBELs.

PennFuture's comment on the Original Draft TMDL focused on Lehigh Coal & Navigation Company's (LCN's) "Route 309 discharge". PennFuture offered a number of alternatives for deriving more-stringent-then-technology-based WLAs for the Route 309 Discharge, and also translated those water quality-based WLAs into proposed WQBELs. Although PADEP agrees with PennFuture that WQBELs must be developed for the Route 309 discharge, the Revised TMDL rejects the notion that PADEP should first develop water quality-based WLAs, and then base the WQBELs in LCN's National Pollution Discharge Elimination System (NPDES) permit on those WLAs. According to PADEP, precisely the opposite should happen: first finalize the NPDES permit, then revise the TMDL accordingly.

The Revised TMDL explains that PADEP is "in the process of negotiating a consent agreement": with LCN concerning long-term treatment of the Route 309 Discharge, which recently has increased in volume. "Concurrently the Department is in the process of renewing [LCN's] NPDES permit for this discharge that will include water quality-based effluent limits (WQBELs) more stringent than current best available technology (BAT) effluent limits. However, as the permit is in the process of being renewed and is not final, BAT limits will be used to calculate a waste load allocation (WLA) for the Route 309 Discharge." (Revised TMDL, pp.8-9)

This position fundamentally misconceives the TMDL process and is plainly contrary to law. The Pennsylvania water quality standards implementation regulation entitled "TMDLs and WQBELs" makes it crystal clear that one essential purpose of TMDLs is to provide the basis for WQBELs: "WLAs developed in accordance with this chapter shall serve as the basis for the determination of WQBELs for point source discharges regulated under Chapter 92 (relating to National Pollution Discharge Elimination System permitting, monitoring and compliance). 25 Pa. Code § 96.4(d). That is, WLAs must precede – "serve as the basis for" – WQBELs. See also U.S. EPA, Guidance for Water Quality-Based Decisions: The TMDL Process, EPA 440/4-91-001 (April 1991), p. 23 ("Once allowable loadings have been developed through WLAs for specific pollution sources, limits are incorporated into NPDES permits."). The Pennsylvania regulation on "TMDLs and WQBELs" goes on to provide that WLAs shall be the more stringent of loadings determined using technology-based requirements and those necessary to satisfy water quality protection requirements. 25 Pa. Code § 96.4(f)(1).

PADEP has the process exactly backwards, and it completely overlooks the mandate to adopt WLAs that are more stringent than technology-based requirements where necessary to achieve water quality standards. WLAs determined scientifically during the TMDL process are supposed to provide the foundation for including WQBELs in NPDES permits. See 25 Pa. Code § 96.4(d); 40 C.F.R. § 122.44(d)(1)(vii)(B). PADEP would not only turn this process on its head, but also would supplant what is supposed to be a scientific process of first determining maximum pollutant daily loads and then deriving the WQBELs necessary to achieve them with a bargaining process in which so-called WQBELs are negotiated as part of a consent agreement, and then the "allowable" loads are calculated using those bargained-for results.

One basic purpose of a TMDL is to identify waters in which the application of technology based effluent standards to the point sources has failed to prevent the violations of one or more water quality standards (as at point LS10 in the Little Schuylkill River), and to determine, through the development of WLAs, how much the existing pollutant loading from those point sources must improve to ensure attainment and maintenance of water quality standards. Sadly, the Revised TMDL is no closer to fulfilling that basic goal than the Original Draft TMDL was two years ago. Before the TMDL is made final, however, PADEP must scientifically determine, and include in the TMDL, water quality-based WLAs for the Route 309 Discharge. See 25 Pa. Code § 96.4(d), (f)(1).

Response: The final TMDL replaces the technology-based waste load allocations with water-quality based waste load allocations for the LC&N Route 309 Discharge. The waste load allocations were calculated using water-quality based effluent limits (WQBELs). The WLA will be incorporated into the revised LC&N NPDES permit with a 6-month compliance period.

Comment: The exercise of discretion must be explained, and Pa. DEP has no discretion to omit water quality-based WLAs for the Route 309 discharge from the TMDL.

The Revised TMDL rejects, in an officious manner, the several alternatives advanced by PennFuture that would apply PADEP's Equal Marginal Percent Reduction (EMPR) method to derive water quality-based WLAs for the Route 309 Discharge. The presentation of those alternatives in PennFuture's comments on the Original Draft TMDL covered about a dozen pages, which contained both narrative explanations and a number of tables presenting the outcome of many calculations. (Revised TMDL, pp.78-90) After presenting that information, PennFuture asserted that "any version of the EMPR method Is fairer and more accurate than the [technology-based] allocation at LS10 presented in the Proposed TMDL…and would require significant reductions in the effluent limits applicable the LCN Route 309 Discharge." (Revised TMDL, p.90)

The Revised TMDL does not express any disagreement with PennFuture's assertion that the EMPR method is "fairer and more accurate" than the technology-based method used in both the Original Draft TMDL and the Revised TMDL, but it does not explain why PADEP failed to apply to the metals impairment of the Little Schuylkill River the EMPR method it did apply to the river's sediment impairment. PADEP's entire "Response" to PennFuture's extensive and detailed comments on this point states: "EMPR is an allocation method that is used by the Department. It is not required to be used in all cases nor is there any set requirements for performing allocations. The setting of allocations is at the discretion of the Department." (Revised TMDL, p.90)

Well, of course you have some discretion. If every step of the process were mandatory or ministerial, public comment would be circumscribed and relatively unimportant. A basic purpose of a public comment process is to inform and influence the exercise of discretion, and the whole point of a comment/response process is supposed to be to explain why the agency exercised its discretion in a particular manner. Indeed, one of the hallmarks of an abuse of discretion is the agency's inability or refusal to explain why it exercised its discretion in the manner chosen. E.g. Motor Vehicle Mfrs. Ass'n, Inc. v. State Farm Mut. Auto. Ins. Co., 463 U.S. 29, 48-49 (1983) (United States Supreme Court has "frequently reiterated that an agency must cogently explain why it has exercised its discretion in a given manner") (citations omitted). If "we have discretion" were considered an adequate "response" for every one of PADEP's many discretionary decisions, the comment/response process would be a meaningless farce. (PADEP undoubtedly would not be satisfied if EPA explained its disapproval of a TMDL by saying, "The approval of TMDLs is at the discretion of EPA.")

In addition to misconceptualizing the comment/response process, PADEP's response mistakenly assumes that it has absolute and unfettered discretion over this particular decision. In fact, there are two clear legal limits on PADEP's discretion that PADEP violated in this instance. As explained in Comment 2, above, PADEP does not have the discretion to delay the development of water quality-based WLAs for the Route 309 Discharge pending the completion of its negotiating an enforcement agreement with LCN and related revision of LCN's NPDES permit. Pennsylvania's water quality implementation regulations make clear that WLAs "shall serve as the basis for the determination of WQBELs," not the other way around. 25 Pa. Code § 96.4(d). PADEP also does not have the discretion to adopt technology-based WLAs where more stringent WLAs are needed to satisfy water quality requirements. Again, the regulations leave no doubt that PADEP must adopt the more stringent of the technology-based and water quality-based WLAs. 25 Pa. Code § 96.4(f)(1).

PADEP is bound by the regulations it implements. E.g., Harriman Coal Corp. v. DEP, 2000 EHB 1008, 1012 n. 1 (citing Al Hamilton Contracting v. Department of Environmental Protection, 680 A.2d 1209, 1212-1213 (Pa. Cmwlth. 1996)). Unless and until the Environmental Quality Board amends 25 Pa. Code § 96.4(d) and (f)(1), PADEP is required to include water quality-based WLAs in TMDLs when point source loading limits more stringent than technology-based requirements are necessary to alleviate the identified stream impairment, and it may not delay the determination of those WLAs pending it negotiations of revisions to the relevant NPDES permits(s). With respect to the impaired Little Schuylkill River, PADEP should finally get around to doing what it should have done in the Original Draft TMDL in 2004: determine water quality-baased WLAs for the Route 309 Discharge.

Response: The Department has adopted WLAs for the LC&N Route 309 Discharge and the WLAs will be translated into WQBELs for the permit. PennFuture did supply a technically sound method for calculating WQBELs for the Route 309 Discharge using the EMPR method and supporting rationale. The Department decided not to use the EMPR method in the calculation of WQBELs for LC&N to maintain consistency in methodology when calculating WQBELs for toxic substances. The NPDES program, as administered through both the Water and Mining Deputates, uses mixing scenarios and receiving water models (often PennToxSD as was used in this case, or other similar toxic modeling applications) to calculate effluent limits for inclusion in NPDES permits. To maintain consistency with these programs, which will be implementing the WLAs included in TMDLs, the Department decided not to use the EMPR method in this instance. The EMPR method is an acceptable method of allocation that is used routinely in TMDLs for some non-toxic pollutants, such as sediment and nutrients. It was for consistency with other methods used within the Department regarding toxics that the discretionary decision was made to use methods other then EMPR to develop WQBELs for the LC&N Route 309 Discharge.

Comments/Responses on original draft of the Little Schuylkill River TMDL (June 21, 2004)

EPA Region III comments:

Comment:
The Little Schuylkill River's 1996 Section 303(d) listing included suspended solids from resource extraction and the 2002 Section 303(d) listing added siltation. This TMDL Report addresses sediment in Attachments D and E, however, the Report's main body does not mention suspended solids/siltation except in Table 1, 303(d) Sub-List. Please add a description of the sediment TMDL procedure, including a *TMDL Endpoint* section description, and the sediment/siltation TMDLs summary table.

Response:
Added to the report's main body are sections titled, "Impairments due to suspended solids/sedimentation" and "Selection of Reference Watershed". These additions add a description of the sediment TMDL procedure including how a reference watershed is selected. A suspended solids/siltation TMDL summary table has also been included. In Attachment A, a map of the reference watershed, Meshoppen Creek, has been added. The sediment/suspended solids Attachments have been expanded and are now Attachments D through G.

Comment:
It appears that EPA did not receive the final @RISK spreadsheet, and did not receive the EMPR spreadsheet. Please provide all final calculations/spreadsheets to EPA.

Response:
These will be provided and sent with the final TMDL report.

PennFuture Comments:

Comment:

Table C20 on page 36 of the proposed TMDL, entitled "Waste Load Allocations at Discharge 005," lists a monthly average allowable concentration of 2.0 mg/l for aluminum. In fact, LCN's NPDES permit does not contain any effluent limits for aluminum. As renewed on October 10, 2002, LCN's NPDES Permit No. PA0012360 contains effluent limits applicable to outfall 005 that are the same as those set forth at 25 Pa. Code § 88.92(a).

NPDES permit effluent limits must be "consistent with the assumptions and requirements of any available wasteload allocation for the discharge prepared by the State and approved by EPA pursuant to 40 CFR 130.7." 40 C.F.R. § 122.44(d)(1)(vii)(B) (incorporated into Pennsylvania law by 25 Pa. Code § 92.2(b)(14)). Therefore, at a minimum, the Proposed TMDL's assumption of a monthly average concentration limit of 2.0 mg/l for aluminum would require DEP to amend LCN's NPDES permit to include that limit, plus a related daily maximum limit of 4.0 mg/l and an instantaneous maximum limit of 5.0 mg/l. PennFuture shows in Sections 4 and 5, however, that more stringent, water quality based effluent limits are required to assure that the instream water quality criterion for aluminum is satisfied at LS10.

The TMDL assumes that the Route 309 Discharge is subject to the standard, technology-based effluent limits for iron, manganese, and total suspended solids that are set forth in 25 Pa. Code § 88.92(a). Those limits were incorporated into the October 10, 2002 renewal of the NPDES permit. PennFuture notes, however, that according to the attached letter from DEP to LCN dated May 5, 2003, no iron, manganese, or total suspended solids effluent limits have been in effect for the Route 309 Discharge at Outfall 005 since May 5, 2003. That letter, entitled "Notice of Permit Correction," purports to eliminate those parameters temporarily "until the BAMR Project has been completed and Lehigh Coal and Navigation Company (LCN) has constructed the permanent treatment facilities" required under a 2002 Consent Order and Agreement with DEP. The letter would: 1) leave in place the existing NPDES effluent limit requiring that alkalinity exceed acidity at all times; 2) require that the pH remain between 6.2 and 9.0 standard units (inclusive) at all times, which is a slight tightening of the permissible range under the October 2002 permit (6.0 to 9.0), and 3) require that the treatment be "designed for a target pH of 6.4 standard units." But because a modification of the applicable effluent limits does not constitute a "minor modification" under 40 C.F.R. § 122.63, it may not take effect until the permit modification procedures of 40 C.F.R. §§ 122.62, 124.5(c), 124.6, including public notice and an opportunity to comment on a draft permit, are completed. See 25 Pa. Code § 92.2(b)(18) (incorporating 40 C.F.R. §§ 122.62, 122.63); Pennsylvania PIRG v. P.H. Glatfelter Co., 128 F. Supp. 2d 747, 759-61 (M.D. Pa. 2001) (1989 consent adjudication that would have applied more lenient requirements than color effluent limits established in 1984 NPDES permit had no effect on permit limits because DEP did not follow the NPDES permit modification procedures required by federal law).

No public notice of the May 5, 2003 "Notice of Permit Correction" appeared in the Pennsylvania Bulletin. Therefore, as in Glatfelter, because DEP did not follow the procedures required to validly modify a NPDES permit, the "Notice of Permit Correction" has no effect on the final and unappealed effluent limits in the October 10, 2002 renewal of LCN's NPDES permit. Moreover, even if DEP had followed the proper procedures, the "Notice of Permit

Correction" would violate the "Anti-backsliding" provision of the federal Clean Water Act, 33 U.S.C. § 1342(*o*). Under that provision, effluent limits in a NPDES permit never may be made less stringent than the current effluent limit guidelines. See id. § 1342(*o*)(3). The current effluent limit guidelines for the coal mining point source category are the same as the total suspended solids, iron, and manganese limits that appear in the October 10, 2002 renewal of LCN's NPDES permit. See 40 C.F.R. § 434.35. In addition, under the Anti-backsliding provision, the relaxation of an effluent limit may never result in the violation of a water quality standard. 33 U.S.C. § 1342(*o*)(3). In Section 4, PennFuture shows that the daily load of iron discharged at outfall 005 from March 2003 through September 2004 was roughly 950 lb/day, and the daily load of manganese was roughly 550 lb/day. These loadings exceed the allowable loads at LS10 of 441.5 lb/day of iron and 334.1 lb/day of manganese (Table C21, p. 37). Thus, by itself, the LCN Route 309 Discharge has caused the exceedance of the allowable loads at LS10 and the violation of water quality standards.

In any event, PennFuture shows in Sections 4 and 5 of these comments that DEP must establish water quality based effluent limits for iron and manganese that are more stringent than the technology-based limits appearing in the October 10, 2002 permit renewal.

Response:
The Department (DEP) includes a monthly average allowable concentration of 2.0 mg/l for aluminum in Table C20 entitled "Waste Load Allocations at Discharge 005." When the permit is renewed, it should be consistent with the TMDL, therefore, the next permit issued for this discharge will require effluent limitations on aluminum. It is understood that the LCN NPDES permit at discharge 005 currently does not have an aluminum limitation, but future permits in conjunction with the TMDL will have aluminum effluent limitations.

Comment:
The fifth row of figures in Table C22 on page 37 of the Proposed TMDL is labeled "Allowable Load @LS10 (LS10-WLA)." For the three metals, however, the figures in that row do not represent the overall allowable loads (which appear in the immediately preceding table, C21), but rather the portion of the allowable load at LS10 PADEP is assigning to all of the sources other than LCN's Route 309 discharge. In other words, it is the total allowable load (Table C21) minus the Waste Load Allocation to the Route 309 Discharge. (For acidity, the figure presented in Row 5 of Table C22 is the same as the overall allowable load in Table C21 because there is zero allowable load from the Route 309 discharge, which has a NPDES permit requirement that alkalinity exceed acidity. In essence, Row 5 of Table C22 represents the Load Allocation @LS10, which is the label PennFuture suggests.

The sixth row of figures in Table C22 is supposed to present the required load reductions at LS10. For the metals, however, this row overstates the amount of the actual load reductions required because PADEP subtracted the wrong values from the "Total loads tracked between LS9/Panther and LS10" that appear in Row 4 of Table C22. Those total loads include the waste loads coming from the LCN Route 309 discharge.

As a result, when calculating the overall load reductions required at LS10, one must subtract the total allowable concentrations listed in Table C21[1] – not the figures listed in Row 5 of Table C22 – from the "Total loads tracked" that appear in Row 4 of Table C22. Again, for the three metals, using the correct figures reduces considerably both the "Load Reduction @LS10" and the "% Reduction required at LS10" in the final two rows of Table C22. The correct figures appear in the portion of the table presented immediately below.

In the excerpt from Table C22 appearing below, PennFuture has added a row showing the Waste Load Allocation to the LCN Route 309 Discharge (005). Starting with the fourth row of figures ("Total load tracked between LS9/Panther and LS10"), Table C22 would appear as follows:

LS10	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Total loads tracked between LS9/Panther and LS10	547.93	2926.58	1552.00	22512.84
Waste Load Allocation @005	165.97	248.96	165.97	0.00
Load Allocation @LS10	93.81	192.50	168.16	4539.55
Load Reduction @LS10	288.15	2485.12	1217.87	17973.29
% Reduction required at LS10	52.59%	84.92%	78.47%	80%

Note that the "Total load tracked" equals the sum of the next three rows: Waste Load Allocation plus Load Allocation plus required Load Reduction. Because of how the "Total loads tracked" are determined, the figures presented above take into account the load reductions required by the finalized TMDL for the Panther Creek Watershed by assuming that all of the load reductions required by that TMDL will be successfully achieved. Because all of the load reductions in the Panther Creek watershed are allocated to nonpoint sources and are dependent on future funding of unspecified projects to treat abandoned mine discharges or to reclaim abandoned mine lands, that assumption is unrealistic.

Finally, note that the figures presented above are not based on application of the "AMD Methodology" discussed in Section 3, immediately below, or the Equal Marginal Percent Reduction (EMPR) allocation strategy in Attachment E of the Proposed TMDL, which is discussed in Section 4 of these comments. As shown in Section 4, application of the EMPR method results in reductions in the Waste Load Allocation to the LCN Route 309 Discharge (005), which in turn will necessitate the establishment of more stringent, water quality based effluent limits. Near the end of Section 4, PennFuture presents a different version of Table C22 based on the application of the EMPR allocation method.

Response:
The loads shown in Table C22 are those that can still be reduced under our allocation scenario. To help clarify, row 5 of Table C22 has been relabeled to show that the allowable load is indeed non point source (NPS) only.

1 The total allowable load figures in Table C21 only go to one decimal place. Because Table C22 uses figures that go to two decimal places, PennFuture's calculations use total allowable load figures that likewise go to two decimal places

Comment:

The Proposed TMDL includes a summary of a two-step “AMD Methodology” (pp. 9-11) that often appears as an attachment in the mine drainage TMDLs approved through 2003. The Proposed TMDL states that “[f]or situations where there are point-source impacts alone, or in combination with non-point sources, the evaluation will use the point-source data and perform a mass balance with the receiving water to determine the impact of the point source.” (p. 9) More than two dozen of Pennsylvania’s approved TMDLs for streams impaired by mine drainage include as an attachment a set of calculations for Lorberry Creek in Schuylkill County that was first approved as part of the Upper Swatara Creek TMDL in April 1999. That attachment appears most recently in the March 2004 Final TMDL for Limestone Run in Armstrong County.

The segment of the Little Schuylkill River between LS9 and LS10 is affected by both a point source discharge (the LCN Route 309) and nonpoint sources. But despite the statement from page 9 of the Proposed TMDL quoted above, the Proposed TMDL does not apply a mass balance methodology. What makes DEP’s failure to follow the Lorberry Creek model so striking here is how closely the situation at Little Schuylkill segment LS10 parallels the situation encountered at Lorberry Creek. The upstream sampling point (LS9) corresponds to point Swat-04 on Lorberry Creek. The tributary here (Panther Creek) corresponds to Stumps Run/Swat-11. And finally, the point source discharge here (LCN Route 309 (005)) corresponds to the Shadle Discharge (L-1) into Lorberry Creek.

Applying the Lorberry Creek model, the AMD Methodology would require the following steps here:

1. A simulation of the concentration data at LS9. This step is done in the Proposed TMDL.

2. A simulation of the concentration data at Panther Creek (003). This step was done as part of the approved Panther Creek TMDL.

3. A mass balance of the loadings from LS9 and Panther Creek (003) using an equation paralleling Equation 3 in the Lorberry Creek calculation:

   $$C_{\text{below Panther}} = ((Q_{LS9} \times C_{LS9}) + (Q_{PC003} \times C_{PC003}))/(Q_{LS9} + Q_{PC003})$$

   This equation would be simulated through 5,000 iterations using the modeling software. A comparison of the 99^{th} percentile value for the resulting data set would be compared to the water quality criterion for each of the metals to determine whether further reductions are required.

   No such mass balance analysis appears in the Proposed TMDL.

4. The mass balance would be expanded to include the LCN Route 309 Discharge using an equation paralleling Equation 4 in the Lorberry Creek calculation:

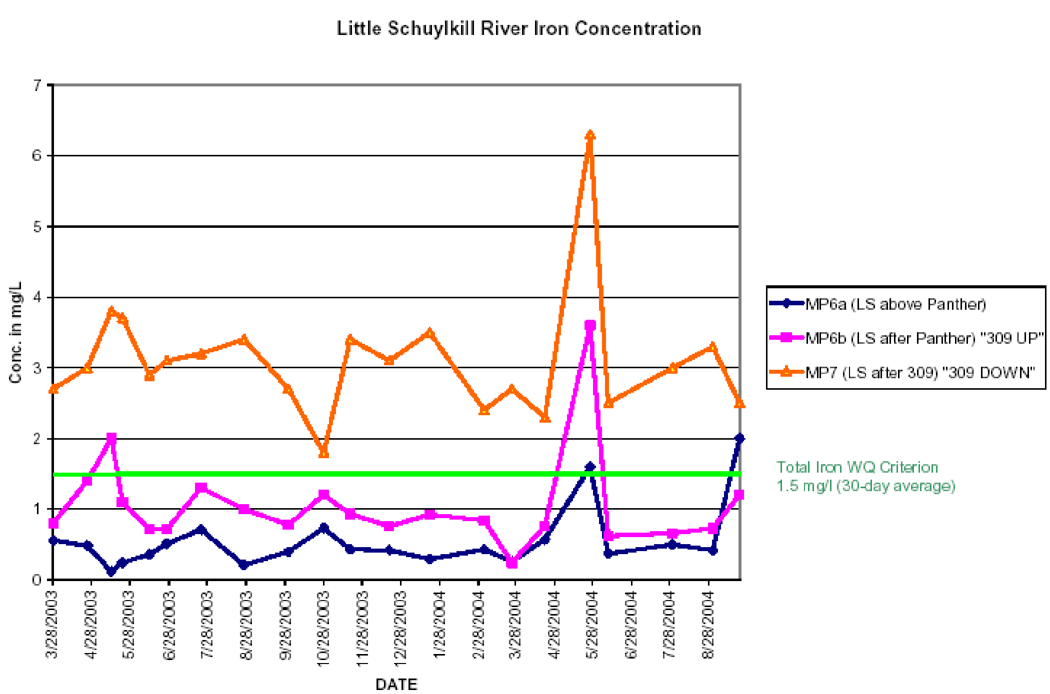
$C_{below\ LCN} = ((Q_{LS9} \times C_{LS9}) + (Q_{PC003} \times C_{PC003}) + (Q_{LCN} \times C_{LCN}))/(Q_{LS9} + Q_{PC003} + Q_{LCN})$

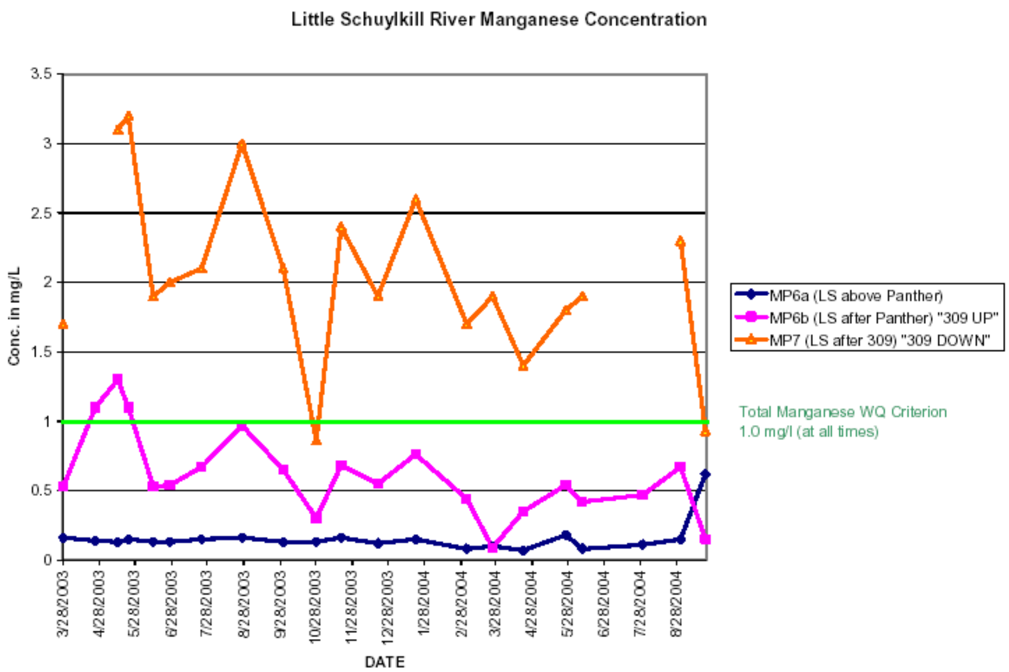
As was true for the Shadle Discharge, there is no effluent limit for aluminum, so the starting concentration (C_{LCN}) used in the modeling would be arbitrarily selected based on any historical monitoring data for aluminum. For the other metals, the Lorberry Creek model uses the daily concentration limits of 6 mg/l for iron and 4 mg/l for manganese. This expanded mass balance would be simulated through 5,000 iterations to determine whether further reductions are required.

Again, no such mass balance analysis appears in the Proposed TMDL.

The Proposed TMDL does not explain why DEP did not follow this stepwise, mass balance methodology for the segment of the Little Schuylkill River between LS9 and LS10. If DEP did, in fact, follow this methodology, then it should present the kinds of tables that appear in the Lorberry Creek calculation. If not, it should explain why it did not follow the "AMD Methodology" it nevertheless saw reason to summarize in the Proposed TMDL document.

The attached charts show LCN's monitoring data for three monitoring points in the Little Schuylkill River during the period March 2003 through September 2004. Discontinuities in the chart for manganese result from two outlier values above 100 mg/l. The three monitoring points are located above Panther Creek (MP6a), below Panther Creek and above the Route 309 Discharge (MP6b), and below the Route 309 Discharge (MP7). These charts suggest that a mass balance approach would require considerable load reductions from the Route 309 Discharge.





Response:
The methods used to complete the allocations presented in this TMDL are clearly explained in the AMD Methodology section. In the past year we have changed our method for computing the TMDLs in AMD impacted waters. This is a dynamic process and we are constantly evaluating our procedures to ensure we are making the best use of the information available. The load tracking method that we employed for these calculations is a significant step forward in describing how the pollutant loads affect the watershed. The data used in these computations was not equivalent to the very large, robust data set that was available in the Upper Swatara Creek TMDL. Therefore, the same mass balance technique was not applied here. The method used for these allocations has changed since the March 2004 TMDL that was cited in this comment. The department is now tracking loads through the watershed instead of tracking reductions. This is a major step forward in showing how water quality is affected by pollutant contributions.

Comment:
The Proposed TMDL would assign all of the necessary load reductions to nonpoint sources and none of them to the LCN Route 309 Discharge, which would only be required to meet the existing (or for aluminum, assumed) technology-based effluent limits rather than the more stringent water quality based effluent limits (WQBELs). The Proposed TMDL does not explain why the allocation of the load reductions fails to more closely approximate the percentage load contributions. The Proposed TMDL also provides no explanation for its failure to apply the Equal Marginal Percent Reduction (EMPR) allocation strategy in Attachment E when allocating the allowable loads of metals at point LS10.

As stated above, the only monitoring data for the LCN Route 309 Discharge presented in the Proposed TMDL are flow readings. (pp. 59-60) The "Allowable Load" numbers in the last column of Table C20 on page 36 of the Proposed TMDL are based on these measured flows and the "Monthly Average Allowable Concentration" figures in Table C20 (which include an assumed effluent limit for aluminum). In reality, LCN has exceeded its permit limits for iron and manganese in every month from at least March 2003 through September 2004. LCN generally samples the Route 309 discharge once per month, with that single grab sample monitoring LCN's compliance with both its average monthly and daily maximum effluent limits. Because it does not have an aluminum effluent limit, LCN does not monitor for aluminum. Using LCN's self-monitoring data (Module 8.1(A)), from March 2003 through September 2004, the monthly samples of the Route 309 discharge ranged from 8.0 mg/l to 13.6 mg/l of iron, with a mean of 11.5 mg/l. For manganese, the range was 6.1-7.3 mg/l, with a mean of 6.7 mg/l.

Notwithstanding LCN's history of violating its NPDES permit limits, the calculations performed to produce the tables presented below assume that the existing pollutant loads coming from the LCN Route 309 Discharge are equal to the "Allowable Loads" in Table C20. In fact, LCN's monitoring data for iron and manganese indicate that during the period considered in the development of the Proposed TMDL, the daily loading the Route 309 Discharge actually contributed to the Little Schuylkill was more than triple the allowable loads that appear in Table C20. For iron, the Table C20 allowable load from the Route 309 Discharge is 248.96 lb/day (8.51% of the existing load tracked at LS10), but the actual load using the concentration figures presented in the preceding paragraph and the average flow of 9.9504 mgd[2] used in the Proposed TMDL is 954.34 lb/day (33% of the existing load tracked at LS10). For manganese, the allowable load is 165.97 lb/day (10.7% of the existing load tracked at LS10), but the actual load is 556.01 lb/day (35.8% of the existing load tracked at LS10).

The upshot is that during the period considered in the development of the Proposed TMDL, the LCN Route 309 has been contributing a much greater share of the metals contaminant loading than the Proposed TMDL would lead one to believe. The reason it has done so is that the discharge has violated the effluent limits in the NPDES permit throughout this period. But by falsely attributing 24.5% of the existing iron load and 25% of the manganese load at LS10 to nonpoint sources, the TMDL overstates the significance of nonpoint sources in this segment while understating the impact of the Route 309 Discharge on instream water quality. PennFuture shows below that in order to attain the instream water quality criteria here, the new treatment system for the Route 309 Discharge must be capable of consistently achieving compliance with water quality based effluent limits that are more stringent than the "Monthly Average Allowable Concentration" figures in Table C20.

There are four sources or groups of sources contributing loads to point LS10:

1) LS9

The upstream sources in the Little Schuylkill River Watershed, represented by sampling point LS9. For aluminum, the existing wasteload is treated a zero because all samples were below the detection limit.

2 Based on the flow monitoring data for 2003 available in the LCN file and the amount of precipitation received in the region during 2004, the average flow from the Route 309 Discharge during March 2003 through September 2004 probably exceeded this level considerably.

For iron and manganese, the existing wasteloads of 98.18 pounds per day and 63.11 pounds per day,[3] respectively, are considered allowable in the Proposed TMDL because there is no exceedance of the instream water quality standardsat sampling point LS9.

2) Panther Creek
The sources in the Panther Creek Watershed, represented by the allowable TMDL loads at the Panther Creek TMDL's point 003. Using the allowable loads gives effect to the approved Panther Creek TMDL by assuming that all of the load reductions it identifies as necessary will be achieved.

3) LS10 Nonpoint Sources – all nonpoint sources between LS9 and LS10.

4) LCN (005) – the permitted LCN Route 309 Discharge.

The Proposed TMDL essentially lumps together all of the sources except the LCN Route 309 Discharge. It assigns the Route 309 Discharge a Waste Load Allocation at the technology-based monthly average effluent limitations listed in Table C20, and it assigns the remaining allowable load and all of the necessary load reductions to the three remaining source categories collectively. Although the Proposed TMDL does not differentiate between the three other groups of sources when addressing the required load reductions at LS10, it is apparent from its discussion of LS9 and Panther Creek that the Proposed TMDL assigns all of the required load reductions at LS10 to the LS10 Nonpoint Sources.

In the three subsections that follow, PennFuture provides tables showing the results of three slightly different variations on the application of the EMPR allocation method to the loadings of aluminum, iron, and manganese at point LS10. In Subsection A, PennFuture groups the pollutant sources in the same way as the Proposed TMDL, applying the EMPR method to two sources: the LCN point source discharge versus all other sources. Subsection B breaks down the "all other sources" category into its three component parts (LS9, Panther Creek, and LS10 Nonpoint), but does not require any additional load reductions at LS9 or Panther Creek. This is, Subsection B treats the allowable loads at LS9 in the Proposed TMDL and at Panther Creek 003 in the Final Panther Creek TMDL as not being subject to further reduction in order to satisfy water quality standards at LS10. Although we do not advocate this approach, the finer detail it provides is an improvement over Subsection A because it helps to illustrate the sources of the loading at LS10, and it results in slightly more accurate allocation of the required load reductions between the LCN Route 309 Discharge and the LS10 Nonpoint Sources.

In Subsection C, PennFuture presents what it believes is the proper way to apply the EMPR method to the allocation at LS10, or in any similar situation in which points upstream of, or tributaries to, the segment in question either satisfy water quality standards (as at LS9) or are subject to a final TMDL, the implementation of which would result in attainment of water

3 These figures were determined using the average flow and concentration values reported on page 58 of the Proposed TMDL. Note that the chart for LS9 on page 13 and Table C17 on page 35 of the Proposed TMDL incorrectly indicate that iron and manganese were not detected ("ND") at LS9. Similarly, the stick diagram on page 24 incorrectly indicates that there is no loading of iron or manganese at LS9. In fact, both iron and manganese were detected at LS9, and there is a loading of those two contaminants at that point, but no reductions of those loadings are required in order to meet water quality standards at LS9.

quality standards (as at Panther Creek 003). Subsection C treats all four of the source categories as being available for further load reductions. PennFuture believes this approach properly recognizes that even if no load reductions are necessary at an upstream point like LS9 in order to satisfy water quality standards in that segment: a) they may be necessary in order to satisfy water quality standards at a downstream point like LS10; and b) it is proper to require the upstream sources to contribute their fair share (as determined through the EMPR method) to the load

reductions needed at the downstream point.[4] Similarly, even if a TMDL has established the load reductions necessary to satisfy water quality criteria in a tributary like Panther Creek, it is fair to require additional reductions when that tributary contributes pollutant loads to another stream that is listed as impaired for those pollutants. Although it is not the situation presented in Little Schuylkill segment LS10, the clearest illustration of the need for such an approach comes when the upstream point barely satisfies water quality standards, and lesser load additions in the downstream segment make the stream violate a water quality criterion. In that situation, it clearly would be unfair to require that all the load reductions come from the (lesser) sources in the downstream segment.

The most important point in this section, however, is that any of the three alternatives illustrated in the three subsections is better than the approach taken in the Proposed TMDL. That is to say, the EMPR method is better and more equitable than DEP's approach of automatically assigning all of the required load reductions to the sources other than the LCN Route 309 Discharge and requiring no load reductions from the only permitted point source of mine drainage in the watershed. Given that LCN contributes to the pollutant loads that are impairing the river, it should be required to contribute to the pollutant load reductions that are necessary to satisfy the instream water quality criteria for the three metals at LS10.

All three of the allocations presented below would require the inclusion of WQBELs in the NPDES permit for the LCN Route 309 Discharge. Here again, their similarity in requiring WQBELs is more significant than the distinctions between the specific WQBELs each would require.[5]

4 It also may be appropriate to revise the allocations for segments further upstream (e.g., LS8) in light of any reductions that might be required at LS9 in order to satisfy water quality standards at LS10. All of the sources upstream from LS9 are nonpoint sources, however, so there are no NPDES permits that such a reallocation might affect.

5 The "Required WQBEL" in each applicable chart is simply the allowable load from the LCN (005)
Discharge – the "Multiple Value" in the chart – divided by 82.99, which was derived by multiplying a conversion factor of 0.00000834 by the average daily flow from the LCN discharge of 9,950,400 gallons.

Application of the EMRP Method to the Load Allocations at LS10

A. LCN (005) Point Source Versus All Other Sources

i. Results of EMPR calculations

ALUMINUM (Total)						
Source	Total Load Tracked (lbs/day)	Baseline Value (lbs/day)	Multiple Value (lbs/day)	Final % Reduction	Assumed Mo. Avg. Allowable Conc.	**Required WQBEL** (mo. avg. conc.)
Point: LCN (005)	165.97	165.97	101.27	38.98%	2.0 mg/l	**1.22 mg/l**
All Other: LS9 + Panther Creek + LS10 Nonpoint	381.96	259.78	158.51	58.50%		
TOTAL	**547.93**	**425.75**	**259.79**	**52.59%**		

IRON (Total)						
Source	Total Load Tracked (lbs/day)	Baseline Value (lbs/day)	Multiple Value (lbs/day)	Final % Reduction	Tech-based Effluent Limit (mo. avg. conc.)	**Required WQBEL** (mo. avg. conc.)
Point: LCN (005)	248.96	248.96	159.19	36.06%	3.0 mg/l	**1.92 mg/l**
All Other: LS9 + Panther Creek + LS10 Nonpoint	2677.62	441.46	282.27	89.46%		
TOTAL	**2926.58**	**690.42**	**441.46**	**84.92%**		

MANGANESE (Total)						
Source	Total Load Tracked (lbs/day)	Baseline Value (lbs/day)	Multiple Value (lbs/day)	Final % Reduction	Tech-based Effluent Limit (mo. avg. conc.)	**Required WQBEL** (mo. avg. conc.)
Point: LCN (005)	165.97	165.97	110.89	33.19%	2.0 mg/l	**1.34 mg/l**
All Other: LS9 + Panther Creek + LS10 Nonpoint	1386.03	334.13	223.24	83.89%		
TOTAL	**1552.00**	**500.10**	**334.13**	**78.47%**		

ii. Allocation of load reductions

ALLOCATION OF LOAD REDUCTIONS (As Proposed by PADEP, p. 37)				
Parameter	LCN (005)		All Other Sources	
	lbs/day	% of Total	lbs/day	% of Total
Aluminum	0	0%	454.12	100%
Iron	0	0%	2734.08	100%
Manganese	0	0%	1383.84	100%

ALLOCATION OF LOAD REDUCTIONS (As Proposed by PADEP, but corrected to account for LCN (005) point source load in total load tracked between LS9 and LS10)				
Parameter	LCN (005)		All Other Sources	
	lbs/day	% of Total	lbs/day	% of Total
Aluminum	0	0%	288.15	100%
Iron	0	0%	2485.12	100%
Manganese	0	0%	1217.87	100%

EMPR ALLOCATION OF LOAD REDUCTIONS AT LS10 (Applying Equal Marginal Percent Reduction and corrected to account for LCN (005) point source load in total load tracked between LS9 and LS10)				
Parameter	LCN (005)		All Other Sources	
	lbs/day	% of Total	lbs/day	% of Total
Aluminum	64.70	22.45%	223.45	77.55%
Iron	89.77	3.61%	2395.35	96.39%
Manganese	55.09	4.52%	1162.80	95.48%

iii. Comparison between existing load contributions and required load reductions

EXISTING LOADS tracked between LS9/Panther and LS10 (based on assumption of compliance with Table C20 monthly average allowable concentration limits at point 005)				
Parameter	LCN (005)		All Other Sources	
	lbs/day	% of Total	lbs/day	% of Total
Aluminum	165.97	30.29%	381.96	69.71%
Iron	248.96	8.51%	2677.62	91.49%
Manganese	165.97	10.70%	1386.03	89.30%

PERCENTAGE OF EXISTING LOAD versus PERCENTAGE OF LOAD REDUCTION AT LS10 under PADEP'S PROPOSED ALLOCATION				
Parameter	LCN (005)		All Other Sources	
	% Existing Load	% Load Reduction	% Existing Load	% Load Reduction
Aluminum	30.29%	0%	69.71%	100%
Iron	8.51%	0%	91.49%	100%
Manganese	10.70%	0%	89.30%	100%

PERCENTAGE OF EXISTING LOAD versus PERCENTAGE OF LOAD REDUCTION AT LS10 under EMPR ALLOCATION				
Parameter	LCN (005)		All Other Sources	
	% Existing Load	% Load Reduction	% Existing Load	% Load Reduction
Aluminum	30.29%	22.45%	69.71%	77.55%
Iron	8.51%	3.61%	91.49%	96.39%
Manganese	10.70%	4.52%	89.30%	95.48%

B. Separating the four source categories, but requiring no further reductions at LS9 or Panther Creek

This set of calculations expressly recognizes that some of the loads at LS10 come from LS9 and Panther Creek, but expressly declines to require any load reductions at those points beyond those already required by the Panther Creek TMDL. This approach places a greater share of the load reduction burden on the LCN Route 309 Discharge than in the first set of calculations.

i. Results of EMPR calculations

ALUMINUM (Total)						
Source	Total Load Tracked (lbs/day)	Baseline Value (lbs/day)	Multiple Value (lbs/day)	Final % Reduction	Assumed Mo. Avg. Allowable Conc.	**Required WQBEL** (mo. avg. conc.)
Point: LCN (005)	165.97	165.97	100.26	39.59%	2.0 mg/l	**1.21 mg/l**
LS10 Nonpoint	375.46	253.28	153.02	59.24%		
Subtotal LS10	**541.43**	**419.25**	**253.28**	**53.22%**		
LS9	0.00		0.00	N/A		
Panther Creek	6.50		6.50	No more		
TOTAL	**547.93**		**259.78**	**52.59%**		

IRON (Total)						
Source	Total Load Tracked (lbs/day)	Baseline Value (lbs/day)	Multiple Value (lbs/day)	Final % Reduction	Tech-based Effluent Limit (mo. avg. conc.)	**Required WQBEL** (mo. avg. conc.)
Point: LCN (005)	248.96	248.96	141.59	43.13%	3.0 mg/l	**1.71 mg/l**
LS10 Nonpoint	2564.44	328.28	186.69	92.72%		
Subtotal LS10	**2813.40**	**577.24**	**328.28**	**88.33%**		
LS9	98.18		98.18	None		
Panther Creek	15.00		15.00	No more		
TOTAL	**2926.58**		**441.46**	**84.92%**		

MANGANESE (Total)						
Source	Total Load Tracked (lbs/day)	Baseline Value (lbs/day)	Multiple Value (lbs/day)	Final % Reduction	Tech-based Effluent Limit (mo. avg. conc.)	**Required WQBEL** (mo. avg. conc.)
Point: LCN (005)	165.97	165.97	101.62	38.77%	2.0 mg/l	**1.22 mg/l**
All Nonpoint LS10	1314.02	262.12	160.50	87.79%		
Subtotal LS10	**1479.99**	**428.09**	**262.12**	**82.29%**		
LS9	63.11		63.11	None		
Panther Creek	8.90		8.90	No more		
TOTAL	**1552.00**		**334.13**	**78.47%**		

ii. Allocation of load reductions

ALLOCATION OF LOAD REDUCTIONS (As Proposed by PADEP, p. 37)				
Parameter	LCN (005)		All Other Sources	
	lbs/day	% of Total	lbs/day	% of Total
Aluminum	0	0%	454.12	100%
Iron	0	0%	2734.08	100%
Manganese	0	0%	1383.84	100%

ALLOCATION OF LOAD REDUCTIONS (As Proposed by PADEP, but corrected to account for LCN (005) point source load in total load tracked between LS9 and LS10)				
Parameter	LCN (005)		All Other Sources	
	lbs/day	% of Total	lbs/day	% of Total
Aluminum	0	0%	288.15	100%
Iron	0	0%	2485.12	100%
Manganese	0	0%	1217.87	100%

EMPR ALLOCATION OF LOAD REDUCTIONS AT LS10 (Applying Equal Marginal Percent Reduction and corrected to account for LCN (005) point source load in total load tracked between LS9 and LS10)				
Parameter	LCN (005)		All Other Sources	
	lbs/day	% of Total	lbs/day	% of Total
Aluminum	64.70	22.45%	223.45	77.55%
Iron	89.77	3.61%	2395.35	96.39%
Manganese	55.09	4.52%	1162.80	95.48%

*Reductions in addition to those required under Panther Creek Watershed TMDL

iii. Comparison between existing load contributions and required load reductions

EXISTING LOADS tracked between LS9/Panther and LS10 (based on assumption of compliance with Table C20 monthly average allowable concentration limits at point 005)								
Parameter	LCN (005)		LS10 Nonpoint		LS9		Panther Creek	
	lbs/day	% of Total	lbs/day	% of Total	lbs/day	% of Total	lbs/day	% of Total
Aluminum	165.97	30.29%	375.46	68.52%	0.00	0.00%	6.50	1.19%
Iron	248.96	8.51%	2564.44	87.63%	98.18	3.35%	15.00	0.51%
Manganese	165.97	10.70%	1314.02	84.66%	63.11	4.07%	8.90	0.57%

PERCENTAGE OF EXISTING LOAD versus PERCENTAGE OF LOAD REDUCTION AT LS10 under PADEP'S PROPOSED ALLOCATION				
Parameter	LCN (005)		All Other Sources	
	% Existing Load	% Load Reduction	% Existing Load	% Load Reduction
Aluminum	30.29%	0%	69.71%	100%
Iron	8.51%	0%	91.49%	100%
Manganese	10.70%	0%	89.30%	100%

PERCENTAGE OF EXISTING LOAD versus PERCENTAGE OF LOAD REDUCTION AT LS10 under EMPR ALLOCATION								
Parameter	LCN (005)		LS10 Nonpoint		LS9		Panther Creek	
	% Existing Load	% Load Reduct.	% Existing Load	% Load Reduct.	% Existing Load	% Load Reduct.	% Existing Load	% Load Reduct.
Aluminum	30.29%	22.80%	68.52%	77.20%	0.00%	0%	1.19%	0%
Iron	8.51%	4.32%	87.63%	95.68%	3.35%	0%	0.51%	0%
Manganese	10.70%	5.28%	84.66%	94.72%	4.07%	0%	0.57%	0%

C. Separating and requiring load reductions from all four source categories
Because it treats the loads from every source category contributing to the impairment of segment LS10 as being available for reduction, PennFuture believes this set of calculations best applies the EMPR method.

i. Results of EMPR calculations

ALUMINUM (Total)						
Source	Total Load Tracked (lbs/day)	Baseline Value (lbs/day)	Multiple Value (lbs/day)	Final % Reduction	Assumed Mo. Avg. Allowable Conc.	**Required WQBEL** (mo. avg. conc.)
Point: LCN (005)	165.97	165.97	99.75	39.90%	2.0 mg/l	**1.20 mg/l**
LS10Nonpoint	375.46	259.78	156.13	58.42%		
LS9	0.00	0.00	0.00	0.00%		
Panther Creek	6.50	6.50	3.90	40.00%		
TOTAL	**547.93**	**432.25**	**259.78**	**52.59%**		

IRON (Total)						
Source	Total Load Tracked (lbs/day)	Baseline Value (lbs/day)	Multiple Value (lbs/day)	Final % Reduction	Tech-based Effluent Limit (mo. avg. conc.)	**Required WQBEL** (mo. avg. conc.)
Point: LCN (005)	248.96	248.96	136.77	45.06%	3.0 mg/l	**1.65 mg/l**
LS10Nonpoint	2564.44	441.46	242.53	90.54%		
LS9	98.18	98.18	53.93	45.07%		
Panther Creek	15.00	15.00	8.23	45.14%		
TOTAL	**2926.58**	**803.60**	**441.46**	**84.92%**		

MANGANESE (Total)						
Source	Total Load Tracked (lbs/day)	Baseline Value (lbs/day)	Multiple Value (lbs/day)	Final % Reduction	Tech-based Effluent Limit (mo. avg. conc.)	**Required WQBEL** (mo. avg. conc.)
Point: LCN (005)	165.97	165.97	96.93	41.60%	2.0 mg/l	**1.17 mg/l**
LS10 Nonpoint	1314.02	334.13	195.13	85.15%		
LS9	63.11	63.11	36.87	41.58%		
Panther Creek	8.90	8.90	5.20	41.57%		
TOTAL	**1552.00**	**572.11**	**334.13**	**78.47%**		

ii. Allocation of load reductions

ALLOCATION OF LOAD REDUCTIONS (As Proposed by PADEP, p. 37)				
Parameter	LCN (005)		All Other Sources	
	lbs/day	% of Total	lbs/day	% of Total
Aluminum	0	0%	454.12	100%
Iron	0	0%	2734.08	100%
Manganese	0	0%	1383.84	100%

ALLOCATION OF LOAD REDUCTIONS (As Proposed by PADEP, but corrected to account for LCN (005) point source load in total load tracked between LS9 and LS10)				
Parameter	LCN (005)		All Other Sources	
	lbs/day	% of Total	lbs/day	% of Total
Aluminum	0	0%	288.15	100%
Iron	0	0%	2485.12	100%
Manganese	0	0%	1217.87	100%

PENNFUTURE'S PROPOSED ALLOCATION OF LOAD REDUCTIONS AT LS10 (Applying Equal Marginal Percent Reduction and corrected to account for LCN (005) point source load in total load tracked between LS9 and LS10)								
Parameter	LCN (005)		LS10 Nonpoint		LS9		Panther Creek (additional)*	
	lbs/day	% of Total	lbs/day	% of Total	lbs/day	% of Total	lbs/day	% of Total
Aluminum	66.22	22.98%	219.33	76.12%	0.00	0.00%	2.60	0.90%
Iron	112.19	4.52%	2321.91	93.43%	44.25	1.78%	6.77	0.27%
Manganese	69.04	5.67%	1118.89	91.87%	26.24	2.16%	3.70	0.30%

*Reductions in addition to those required under Panther Creek Watershed TMDL

iii. Comparison between existing load contributions and required load reductions

EXISTING LOADS tracked between LS9/Panther and LS10 (based on assumption of compliance with Table C20 monthly average allowable concentration limits at point 005)								
Parameter	LCN (005)		LS10 Nonpoint		LS9		Panther Creek	
	lbs/day	% of Total	lbs/day	% of Total	lbs/day	% of Total	lbs/day	% of Total
Aluminum	165.97	30.29%	375.46	68.52%	0.00	0.00%	6.50	1.19%
Iron	248.96	8.51%	2564.44	87.63%	98.18	3.35%	15.00	0.51%
Manganese	165.97	10.70%	1314.02	84.66%	63.11	4.07%	8.90	0.57%

PERCENTAGE OF EXISTING LOAD versus PERCENTAGE OF LOAD REDUCTION AT LS10 under PADEP'S PROPOSED ALLOCATION				
Parameter	LCN (005)		All Other Sources	
	% Existing Load	% Load Reduction	% Existing Load	% Load Reduction
Aluminum	30.29%	0%	69.71%	100%
Iron	8.51%	0%	91.49%	100%
Manganese	10.70%	0%	89.30%	100%

PERCENTAGE OF EXISTING LOAD versus PERCENTAGE OF LOAD REDUCTION AT LS10 under PENNFUTURE'S PROPOSED ALLOCATION								
Parameter	LCN (005)		LS10 Nonpoint		LS9		Panther Creek	
	% Existing Load	% Load Reduct.	% Existing Load	% Load Reduct.	% Existing Load	% Load Reduct.	% Existing Load	% Load Reduct.
Aluminum	30.29%	22.98%	68.52%	76.12%	0.00%	0.00%	1.19%	0.90%
Iron	8.51%	4.52%	87.63%	93.43%	3.35%	1.78%	0.51%	0.27%
Manganese	10.70%	5.67%	84.66%	91.87%	4.07%	2.16%	0.57%	0.30%

D. Summary: Implications of Applying the EMPR Method

Under PennFuture's proposed allocation in Subsection C, the portion of Table C22 addressed in Section 2 of these comments would be expanded further by adding rows for the Load Allocations to LS9 and Panther Creek in order to differentiate the load allocations among the four source categories. In full, that table would read:

Table C22. Allocations LS10				
LS10	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LS10	587.73	2969.18	1617.30	26881.61
Difference in measured loads between upstream loads and existing LS10	541.43	2911.58	1543.10	21369.79
Additional load tracked from above samples (Allowable @LS9 plus Allowable @ Panther Creek)	6.50	15.00	8.90	1143.05
Total loads tracked between LS9/Panther and LS10	547.93	2926.58	1552.00	22512.84
Waste Load Allocation @005	99.75	136.77	96.93	0.00
Load Allocation @ LS9	0.00	53.93	36.87	
Load Allocation @ Panther Creek	3.90	8.23	5.20	
Load Allocation @LS10 (Nonpoint)	156.13	242.53	195.13	4539.55
Overall Load Reduction @LS10	288.15	2485.12	1217.87	17973.29
% Reduction required at LS10	52.59%	84.92%	78.47%	80%

The most immediate effect of applying the EMPR load allocation method at LS10 is to require the application of WQBELs to the LCN Route 309 Discharge. The following table compares the existing technology-based effluent limits for iron and manganese in LCN's NPDES permit (which would be retained under DEP's proposed TMDL), plus the allowable limit for aluminum used by DEP in determining the WLA for the LCN Route 309, against the WQBELs that would be required under the three variations of the EMPR allocation method presented above. Contrary to the statement in the Proposed TMDL's "Allocation Summary" (p. 14), reductions in LCN's effluent limits are necessary at this time.

EFFLUENT LIMITS AT LCN (005) (Monthly average concentrations, in milligrams per liter)			
Parameter	Aluminum	Iron	Manganese
PADEP Allocation (Table C20 Allowable)	2.0	3.0	2.0
EMPR Option A	1.22	1.92	1.34
EMPR Option B	1.21	1.71	1.22
EMPR Option C (recommended)	1.20	1.65	1.17

PennFuture recommends the version of the EMPR method presented in Subsection C, above, because it requires each source category to make load reductions roughly commensurate with the loads it contributes to LS10. But any version of the EMPR method is fairer and more accurate than the allocation at LS10 presented in the Proposed TMDL, and as shown in the table immediately above, any version of the EMPR method would require significant reductions in the effluent limits applicable to the LCN Route 309 Discharge. But the EMPR-driven WQBELs are just a start. PennFuture shows in the next section why DEP must apply even more stringent WQBELs than those summarized above.

Response:
EMPR is an allocation method that is used by the Department. It is not required to be used in all cases nor is there any set requirements for performing allocations. The setting of allocations is at the discretion of the Department.

Comment:
As in most Pennsylvania TMDLs for streams impaired by mine drainage, the "Recommendations" section of the Proposed TMDL for the Little Schuylkill River Watershed cites "[t]wo primary programs that provide reasonable assurance for maintenance and improvements of the water quality in the watershed": the NPDES permitting program, and DEP's "efforts to reclaim abandoned mine lands." (p. 16) But something more is required here. For watersheds like this one that include both Load Allocations to nonpoint sources and Wasteload Allocations to point sources, EPA's TMDL guidance states that "the TMDL should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions in order for the TMDL to be approvable." (EPA May 20, 2002 Guidelines, p. 4) (emphasis added) The idea behind this requirement is that because there are no permitting or

enforcement mechanisms available for nonpoint sources, if the agency cannot provide "reasonable assurances" that load reductions assigned to nonpoint sources actually will be realized, it must ensure that the necessary reductions occur by further reducing the WLA(s) and tightening the effluent limits on the point source(s).

In order to provide the required "reasonable assurances," the agency must do more than list programs that might, at some unspecified time in the future, support projects that might reduce the loadings from nonpoint sources. Instead, it must identify specific projects, provide reason to believe that those projects will occur, and provide reasonable estimates of the loading reduction benefits of those specific projects. The Proposed TMDL falls far short of providing this kind of reasonable assurance that the required load reductions from nonpoint sources in the LS10 segment will be realized.

The NPDES permitting program is limited to point source discharges. See 25 Pa. Code § 92.3. The Proposed TMDL identifies only one point source discharge of mine drainage, but it requires no loading reductions from that discharge. It is plainly disingenuous for DEP to say it is "relying on" the point source NPDES program for the purpose of achieving reductions in loads from sources DEP has classified in the same document as exclusively nonpoint sources. Cf. EPA May 20, 2002 Guidelines, p. 4 ("When a TMDL is developed for waters impaired by point sources only, the issuance of a National Pollutant Discharge Elimination System (NPDES) permit(s) provides the reasonable assurance that the wasteload allocations contained in the TMDL will be achieved.")(emphasis added).

The second "primary program" on which the Proposed TMDL says it will rely to achieve the required loading reductions is the state's efforts to reclaim abandoned mine lands. Although the Proposed TMDL describes efforts to reclaim abandoned mine lands and treat abandoned mine discharges in the headwaters area of the Little Schuylkill Watershed, as well as one completed or largely completed BAMR project near Tamaqua (p. 7), it provides no details about any specific future projects. It also offers no estimates of loading reductions that such projects reasonably might achieve, or any implementation plan that demonstrates how and when the specific projects will occur and when the load reductions needed to attain water quality standards will be achieved. The Proposed TMDL therefore provides no assurance that the second "primary program" on which DEP intends to rely will attain the necessary load reductions.

Given this inability to provide reasonable assurance that the necessary load reductions from the nonpoint sources will be achieved, DEP must evaluate further waste load reductions – beyond those required under the EMPR method – from the only point source in the watershed, the LCN Route 309 Discharge. For example, assigning the LCN Discharge a proportion of the allowable load equal to the discharge's percentage of the existing load tracked at LS10 would result in the following allowable waste loads and WQBELs:

Parameter	Total Allowable Load at LS10 (lbs/day)	LCN (005) % of Existing Load Tracked at LS10	Proportion of Allowable Load based on pct. of Existing Load (lbs/day)	WQBEL (monthly average concentration)
Aluminum	259.78	30.29%	78.69	0.95 mg/l
Iron	441.46	8.51%	37.57	0.45 mg/l
Manganese	334.13	10.70%	35.75	0.43 mg/l

Regardless of whether DEP adopts these specific waste load allocations and WQBELs, given that there is only one permitted point source of mine drainage in this watershed, it must at a minimum evaluate whether waste load reductions beyond those required by the EMPR method are attainable here. Under no circumstances, however, should DEP follow the Proposed TMDL's suggestion that "[n]o required reductions of [LCN's existing, technology-based] permit limits [or the assumed limit for aluminum] are needed at this time" (p. 14), nor should DEP take the easy but unsupportable path of assigning all of the necessary load reductions to nonpoint sources. The EMPR allocations presented above and the WQBELs associated with them represent the minimum waste load reductions that DEP must require from the LCN Route 309 Discharge.

PennFuture believes that the Proposed Little Schuylkill River Watershed TMDL has significant implications not only for the allocation of loads within this watershed, and in particular to the LCN Route 309 Discharge, but also statewide as a precedent for handling the allocation of pollutant loads in the kind of situation confronted at point LS10.

Response:
The TMDL is designed to achieve water quality standards at all points in the stream. To perform this type of analysis it is necessary to start at the most upstream segment of the watershed and work downward toward the mouth, fixing each problem encountered along the way. It is not the responsibility of any discharger to fix problems that they are not contributing to. The TMDL outlines a plan that is reasonable (capable of being achieved); it does not guarantee that funding is available to address every problem in the watershed.