UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
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Decision Rationale
Total Maximum Daily Loads
Aylesworth Creek Watershed
For Acid Mine Drainage Affected Segments
Lackawanna County

Signed
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Water Protection Division

Date: *4/1/05*

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I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those waterbodies identified as impaired by the state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS), that may be discharged to a water quality-limited waterbody without violating water quality standards.

The Pennsylvania Department of Environmental Protection (PADEP), Bureau of Watershed Conservation, submitted the *Aylesworth Creek Watershed TMDL*, dated March 9, 2005 (TMDL Report), electronically to the U.S. Environmental Protection Agency (EPA) for final Agency review on March 9, 2005. This report included TMDLs for three metals (aluminum, iron, and manganese) and pH. It addresses one segment on Pennsylvania's 1996 Section 303(d) list of impaired waters, Aylesworth Creek. The TMDL Report does not address the subsequent 2002 Integrated Report listing of flow alteration as that listing was contained in Category 4C (and therefore a TMDL is not required).

EPA's rationale is based on the TMDL Report and information contained in the attachments to the report. EPA's review determined that the TMDL meets the following eight regulatory requirements pursuant to 40 CFR Part 130.

1. The TMDLs are designed to implement the applicable water quality standards.
2. The TMDLs include a total allowable load as well as individual wasteload allocations (WLAs) and load allocations (LAs).
3. The TMDLs consider the impacts of background pollutant contributions.
4. The TMDLs consider critical environmental conditions.
5. The TMDLs consider seasonal environmental variations.
6. The TMDLs include a MOS.
7. There is reasonable assurance that the proposed TMDLs can be met.
8. The TMDLs have been subject to public participation.

II. Summary

Table 1 presents the 1996, 1998, 2002, and proposed 2004 Section 303(d) and Integrated Report listing information for the water quality limited segments listed in 1996.

State Water Plan (SWP) Subbasin: 05-A Lackawanna River								
Year	*Miles*	*Segment ID*	*DEP Stream Code*	*Stream Name*	*Designated Use*	*Data Source*	*Source*	*EPA 305(b) Cause Code*
1996	0.5	Not placed on GIS	28566	Aylesworth Creek	CWF	305(b) Report	RE	pH, Metals
1998	1.03	6219	28566	Aylesworth Creek	CWF	SWMP	AMD	pH, Metals
2002	2.1	19990716-1407-CJD	28566	Aylesworth Creek	CWF	SWAP	AMD	Flow Alterations
2002	1.4	990716-1407-TTS	28566	Aylesworth Creek	CWF	SWAP	AMD	pH, Metals
2004	1.4	990716-1407-TTS	28566	Aylesworth Creek	CWF	SWAP	AMD	pH, Metals
2004	1.5	19990716-1407-CJD	28566	Aylesworth Creek	CWF	SWAP	AMD	Flow Alterations
2004	0.6	19990716-1407-CJD	28567	Unt. Aylesworth Creek	CWF	SWAP	AMD	Flow Alterations

Attachment B includes a justification of differences between the 1996, 1998, 2002, and 2004 303(d) lists.

CWF = Cold Water Fishes
RE = Resource Extraction
AMD = Abandoned Mine Drainage
SWMP = Surface Water Monitoring Program
SWAP = Surface Water Assessment Program

The TMDLs were developed using a statistical procedure to ensure that water quality criteria are met 99 percent of the time as required by Pennsylvania's water quality standards at Pennsylvania Code Title 25, Chapter 96.3(c).

TMDLs are defined as the summation of the point source WLAs plus the summation of the nonpoint source LAs plus a MOS and are often shown as:

$$TMDL = \sum WLAs + \sum LAs + MOS$$

The TMDL is a written plan and analysis established to ensure that a waterbody will attain and maintain water quality standards. The TMDL is a scientifically-based strategy which considers current and foreseeable conditions, the best available data, and accounts for uncertainty with the inclusion of a MOS value. Conditions, available data, and the understanding of the natural processes can change more than anticipated by the MOS. The option is always available to refine the TMDL for resubmittal to EPA for approval.

Pennsylvania's Surface Water Assessment Program (formerly the Unassessed Waters Protocol) is PADEP's method of conducting biological assessments of Pennsylvania's waters, was developed in 1996 and implementation began in 1997. PADEP's goal is a statewide assessment of surface waters in Pennsylvania. After completion of the initial assessments, the long-range goal is to reassess all waters on a five-year cycle. Therefore, while the TMDL should not be modified at the expense of achieving water quality standards expeditiously, the TMDL may be modified when warranted by additional data or other information.

III. Background

The Aylesworth Creek Watershed is located in Lackawanna County, Pennsylvania, and is approximately 6.7 square miles in area. The stream originates from a small wetland on Moosic Mountain and empties into the Lackawanna River in the town of Jermyn. Aylesworth Creek flows about five miles west from its headwaters in Carbondale Township, near the border between Lackawanna and Wayne Counties, to its confluence with the Lackawanna River. The watershed is primarily forested (89 percent) with remaining areas being comprised of a mixture of
residential development, recreational development, and abandoned mine lands.

The Aylesworth Creek Watershed is affected by pollution from acid mine drainage (AMD), which has caused high levels of metals and low pH in a section of the mainstem below the Aylesworth Reservoir and in an unnamed tributary entering the stream above the reservoir. Impacts from abandoned mining are also the source of flow alterations on a section of the mainstem above the reservoir and on the same unnamed tributary. Mine drainage in this watershed is found in the form of two seeps along the unnamed tributary to Aylesworth Creek, as well as a seep on the south shore of the Aylesworth Reservoir.

Underground mining of anthracite coal began in the Lackawanna River Watershed, which includes Aylesworth Creek, in the 1820s. Thirteen coal beds of the anthracite field were mined, but most of the deep mines were forced to close in the late 1950s due to decreasing profit margins and the Knox Mine Disaster. In 1959, the Susquehanna River broke through at Pittston and flooded all of the underground mines in the lower Lackawanna and Wyoming Valley, and the last underground mine operation closed in 1966. In the 1960s, coal mining shifted to surface mining; since that time, only minor strip mining and coal reprocessing activities have occurred.

The Lackawanna River Watershed has been part of numerous studies on water quality problems pertaining to AMD, urban/stormwater runoff, and combined sewer overflows (CSOs). See the TMDL Report for reference to the various studies conducted in this area and a brief summary of some of the reports.

In the early 1980s, the PADEP Bureau of Abandoned Mine Reclamation (BAMR) constructed a limestone barrel treatment system on the unnamed tributary to Aylesworth Creek upstream of Aylesworth Reservoir (not shown on Attachment A map). Unfortunately, the system is no longer working due to vandalism and lack of upkeep.

Within the Aylesworth Creek Watershed, there is one active surface mining operation, Silverbrook Anthracite Inc. #35910102. This operation does not have an National Pollutant Discharge Elimination System (NPDES) discharge permit. All of the remaining discharges in the watershed are from abandoned mines and were treated as nonpoint sources. For purposes of these TMDLs only, point sources are identified as permitted discharge points and nonpoint sources are identified as other discharges from abandoned mine lands which can include tunnel discharges, seeps and surface runoff. Abandoned and reclaimed mine lands were treated in the allocations as nonpoint sources because there are no NPDES permits associated with these areas. As such, the discharges associated with these landuses were assigned LAs (as opposed to WLAs). The decision to assign LAs to abandoned and reclaimed mine lands does not reflect any determination by EPA as to whether there are unpermitted point source discharges within these landuses. In addition, by approving these TMDLs with mine drainage discharges treated as LAs, EPA is not determining that these discharges are exempt from NPDES permitting requirements.

PADEP treats each segment on the Section 303(d) list as a separate TMDL while EPA, for purposes of EPA's national tracking system, sums the loads for a watershed TMDL. The TMDLs are expressed as long-term averages (see the *Aylesworth Creek Watershed TMDL* Report, Attachment D, for TMDL calculations).

The Surface Mining Control and Reclamation Act of 1977 (SMCRA, Public Law 95-87) and its subsequent revisions were enacted to establish a nationwide program to, among other things, protect the beneficial uses of land or water resources, and public health and safety from the adverse effects of current surface coal mining operations, as well as promote the reclamation of mined areas left without adequate reclamation prior to August 3, 1977. SMCRA requires a permit for the development of new, previously mined, or abandoned sites for the purpose of surface mining. Permittees are required to post a performance bond that will be sufficient to ensure the completion of reclamation requirements by the regulatory authority in the event that the applicant forfeits. Mines that ceased operating by the effective date of SMCRA (often called "pre-law" mines), are not subject to the requirements of SMCRA.

These TMDLs were completed by PADEP to meet the eighth year (2005) TMDL milestone commitment under the requirements of the 1997 TMDL lawsuit settlement agreement. Eighth year milestones include the development of TMDLs for 20% of the waters listed on Pennsylvania's 1996 Section 303(d) list of impaired waters by the effects of acid mine drainage (AMD) or 81 waters since 2003, and 20% of waters listed as impaired by non-AMD related impacts or 33 waters since 2003. Delisted waters may count for 20% of the requirement.

Computational Procedure

The TMDLs were developed using a statistical procedure to ensure that water quality criteria are met 99 percent of the time as required by Pennsylvania's water quality standards. The Aylesworth Creek TMDL assigns LAs to two sampling points along Aylesworth Creek and to one unnamed tributary. To support the TMDL development, five to six samples were collected in the Aylesworth Creek Watershed at each of the sampling points between December

2001 and July 2002. PADEP's BAMR and the Susquehanna River Basin Commission also collected a great amount of data, dating back from April 1993 to July 2003, for sampling point AC2. In addition, a wealth of data pertaining to one of the seeps has been collected from June 1992 to August 2003 by Silverbrook Anthracite, Inc.

A critical flow was not identified, and the reductions specified in this TMDL apply at all flow conditions. Regression and correlation analyses between flow and concentration almost always produce little or no correlation and disclose no critical condition.

TMDLs for each parameter were determined using a Monte Carlo simulation, @RISK,[1] with the measured, or existing, pollutant concentration data. For each source and pollutant, it was assumed that the observed data are lognormally distributed. Each pollutant was evaluated separately using @RISK.

Using the collected sample concentration parameters, mean and standard deviation, the simulation performs 5000 iterations and predicts an existing long-term average concentration and this analysis shows whether or not the existing data is from a population where water quality standards are exceeded more than one percent of the time. A second simulation of 5000 iterations is performed to calculate the percent reduction necessary to meet the criteria 99 percent of the time. Finally, using the calculated percent reductions, a final simulation is run to confirm that the target value for a long-term average concentration will result in meeting water quality criteria 99 percent of the time.

The existing and allowable long-term average loads were computed using the mean concentration from @RISK multiplied by the average flow. The loads were 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.

IV. Discussions of Regulatory Requirements

EPA has determined that these TMDLs are consistent with statutory and regulatory requirements and EPA policy and guidance.

1. The TMDLs are designed to implement the applicable water quality standards.

Water quality standards are state regulations that define the water quality goals of a waterbody. Standards are comprised of three components, including: (1) designated uses, (2) criteria necessary to protect those uses, and (3) antidegradation provisions that prevent the degradation of water quality. All of the stream segments evaluated in the Aylesworth Creek

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

Watershed have been designated by Pennsylvania as Cold Water Fishes with criteria to protect the aquatic life uses. The designations for these stream segments can be found at Pennsylvania Title 25 § 93.9(i). To protect the designated uses, as well as the existing uses, the water quality criteria shown in Table 2 apply to all evaluated segments. The table includes the instream numeric criterion for each parameter and any associated specifications.

Table 2. Applicable Water Quality Criteria

Parameter	Criterion Value (mg/l)	Duration	Total Recoverable/ Dissolved
Aluminum (Al)	0.75	Maximum	Total Recoverable
Iron (Fe)	1.5 0.3	30-day Average Maximum	Total Recoverable Dissolved
Manganese (Mn)	1.0	Maximum	Total Recoverable
pH	6.0 - 9.0	Inclusive	N/A

Pennsylvania Title 25 § 96.3(c) requires that water quality criteria be achieved at least 99 percent of the time, and TMDLs expressed as long-term average concentrations, are expected to meet these requirements. That is, the statistical Monte Carlo simulation used to develop TMDLs and LAs for each parameter results in a determination that any required percent pollutant reduction assures that the water quality criteria will be met instream at least 99 percent of the time. The Monte Carlo simulation used 5000 iterations where each iteration was independent of all other iterations, and the observed data were assumed to be lognormally distributed for each source and pollutant.

EPA finds that these TMDLs will attain and maintain the applicable narrative and numerical water quality standards. For iron, the TMDL endpoint was expressed as total recoverable iron because all monitoring data was expressed as total recoverable iron.

The pH values shown in Table 3 were used as the TMDL endpoints for these TMDLs. In the case of freestone streams with little or no buffering capacity, the allowable TMDL endpoint for pH may be the natural background water quality; these values can get as low as 5.4 (Pennsylvania Fish and Boat Commission). However, PADEP chose to set the pH standard between 6.0 to 9.0, inclusive, which is presumed to be met when the net alkalinity is maintained above zero. This presumption is based on the relationship between net alkalinity and pH, on which PADEP based its methodology to addressing pH in the watershed (see the *Aylesworth Creek Watershed TMDL* Report, Attachment C). A summary of the methodology is presented as follows.

The parameter of pH, a measurement of hydrogen ion acidity presented as a negative logarithm of effective hydrogen ion concentration, is not conducive to standard statistics. Additionally, pH does not measure latent acidity that can be produced from the hydrolysis of metals. PADEP is using the following approach to address the stream impairments noted on the Section 303(d) list due to pH. Because the concentration of acidity in a stream is partially dependent upon metals, it is extremely difficult to predict the exact pH values which would result from treatment of AMD. 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 able to measure the reduction of acidity. When acidity in a stream is neutralized or is restored to natural levels, pH will be acceptable ($\geq$6.0). 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 used to calculate the required 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. EPA finds this approach to pH to be reasonable.

PADEP also has an alkalinity standard. Alkalinity (of a minimum 20 mg/l calcium carbonate except where natural conditions are less) is related to but not identical with pH. Alkalinity is a measure of the buffering capacity of the water. Adequate buffering prevents large swings in pH with additions of small amounts of acid. Although many of the AMD-impacted streams are naturally low in alkalinity, available monitoring data does not always include upstream waters unimpacted by AMD. As PADEP does not list waters for inadequate alkalinity, TMDLs are not being developed for alkalinity but PADEP should monitor the waters for alkalinity and if, after these TMDLs are implemented, alkalinity is less than 20 mg/l or natural conditions, PADEP should list the waters for alkalinity and develop TMDLs.

2. *The TMDLs include a total allowable load as well as individual WLAs and LAs.*

There is one active surface mine in the watershed (Silverbrook Anthracite, Inc.), but this operation does not have a permitted discharge. Therefore, the allocations are to nonpoint sources only, and an absence of a WLA for the Silverbrook mining operation is interpreted as a zero allocation. For purposes of these TMDLs only, point sources are identified as permitted discharge points and nonpoint sources are identified as other discharges from abandoned mine lands which can include, but are not limited to, tunnel discharges, seeps, and surface runoff. Abandoned and reclaimed mine lands were treated in the allocations as nonpoint sources because there are no NPDES permits associated with these areas. As such, the discharges associated with these landuses were assigned LAs (as opposed to WLAs). The decision to assign LAs to abandoned and reclaimed mine lands does not reflect any determination by EPA as to whether

there are unpermitted point source discharges within these landuses. In addition, by approving these TMDLs with mine drainage discharges treated as LAs, EPA is not determining that these discharges are exempt from NPDES permitting requirements.

The LA for each sampling point was computed using water-quality data collected from that point. The instream TMDLs for sampling points AC2 and ATR1 consist of LAs made to the area above those points. The instream TMDLs for sampling point AC1 consists of a LA to the area between sample points AC2, ATR1, and AC1. The sampling points are shown on the map in Attachment A.

Once PADEP determined the allowable concentration and load for each pollutant, a mass-balance accounting was 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 a guide for expected changes in the allowable loads.

PADEP used two basic rules for the load tracking between two ends of a stream segment; (1) if the measured upstream loads are less than the downstream loads, it is indicative that there is an increase in load between the points being evaluated and no instream processes are assumed. (2) 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 points, and the ratio of the decrease shall be applied to the allowable load being tracked from the upstream point.

Tracking loads through the watershed provides a picture of how the pollutants are affecting the watershed, based on the available information. The analysis is done to insure that water quality standards will be met at all points in the stream. EPA finds this approach reasonable.

Table 3 presents a summary of the allowable loads for the Aylesworth Creek Watershed. Note the reduction identified for sampling point AC1 is the reduction necessary after upstream reductions have been made.

For Table 3, PADEP defined LA to be the sum of the loads entering the stream segment including loads from the upstream segment.

Table 3. Summary Table for Aylesworth Creek Watershed

Station	Parameter	Measured Sample Data		Allowable		LA (lbs/day)	Reduction Identified %
		Conc. (mg/L)	Load (lbs/day)	LTA Conc. (mg/L)	Load (lbs/day)		
AC2 Aylesworth Creek headwaters	Fe	0.07	5.3	0.07	5.3	5.3	0
	Mn	0.15	11.4	0.15	11.4	11.4	0
	Al	0.26	19.8	0.26	19.8	19.8	0
	Acidity	16.89	1283.3	1.35	102.6	102.6	92
	Alkalinity	3.89	295.6				
ATR1 UNT Aylesworth Creek headwaters	Fe	ND	ND				
	Mn	0.16	1.5	0.16	1.5	1.5	0
	Al	ND	ND				
	Acidity	20.84	198.1	3.75	35.7	35.7	82
	Alkalinity	12.44	118.3				
AC1 Aylesworth Creek mouth	Fe	ND	ND				
	Mn	0.11	11.6	0.11	11.6	11.6	0
	Al	ND	ND				
	Acidity	12.60	1325.1	2.52	265.0	265.0	0
	Alkalinity	9.23	970.7				

LTA = Long Term Average
ND = not detected
LA = total loads entering segment, including any upstream loads

PADEP allocated only to nonpoint sources as there are no mining operations with permitted discharges within the watershed. Where there are active mining operations or post-mining discharge treatment in the watershed, Federal regulations require that subsequent to TMDL development and approval, point source permitted effluent limitations be water quality-based.[2] In addition, PA Title 25, Chapter 96, Section 96.4(d) requires that WLAs shall serve as the basis for determination of permit limits for point source discharges regulated under Chapter 92 (relating to NPDES permitting, monitoring and compliance). Therefore, no new mining may be permitted within the watershed without reallocation of the TMDL.

3. The TMDLs consider the impacts of background pollutant contributions.

Aylesworth Creek is located in an area that was extensively mined. The TMDLs were developed using instream data which account for existing background conditions.

4. The TMDLs consider critical environmental conditions.

[2]It should be noted that technology-based permit limits may be converted to water quality-based limits according to EPA's *Technical Support Document For Water Quality-based Toxics Control,* March 1991, recommendations.

The reductions specified in this TMDL apply at all flow conditions. A critical flow condition was not identified from the data used for this analysis. The average flow for each sampling site was used to derive loading values for the TMDL.

5. The TMDLs consider seasonal environmental variations.

All sample sets included data points from various seasons, which together with the lack of correlations between flow and concentration, indicate that PADEP considered seasonal variations to the extent that data was available.

6. The TMDLs include a MOS.

The CWA and Federal regulations require TMDLs to include a MOS to take into account any lack of knowledge concerning the relationship between effluent limitations and water quality. EPA guidance suggests two approaches to satisfy the MOS requirement. First, it can be met implicitly by using conservative model assumptions to develop the allocations. Alternately, it can be met explicitly by allocating a portion of the allowable load to the MOS.

PADEP used an implicit MOS in these TMDLs by assuming the treated instream concentration variability to be the same as the untreated stream's concentration variability. This is a more conservative assumption than the general assumption that a treated discharge has less variability than an untreated discharge. By retaining variability in the treated discharge, a lower average concentration is required to meet water quality criteria 99 percent of the time than if the variability of the treated discharge is reduced.

With respect to iron, PADEP identified an additional implicit MOS in the analysis and TMDL development by treating the iron water quality criterion as if the 1.50 mg/l were a maximum value instead of a thirty-day average value.

7. There is reasonable assurance that the proposed TMDLs can be met.

The *Recommendations* section highlights what can be done in the watershed to eliminate or treat pollutant sources. Aside from PADEP's primary efforts to improve water quality in the Aylesworth Creek Watershed through reclamation of abandoned mine lands and through the NPDES permit program, additional opportunities for reasonable assurance exist. PADEP expects activities, such as research conducted by its Bureau of Abandoned Mine Reclamation, funding from EPA's § 319 grant program, and Pennsylvania's Growing Greener program will also help remedy abandoned mine drainage impacts. PADEP also has in place an initiative that aims to maximize reclamation of Pennsylvania's abandoned mineral extraction lands. Through Reclaim PA, Pennsylvania's goal is to accomplish complete reclamation of abandoned mine lands and plugging of orphaned wells. Pennsylvania strives to achieve this objective through legislative and policy land management efforts, and activities described in the TMDL Report.

In the late 1990s, the Lackawanna River Watershed 2000 Program was developed with an EPA water resources grant. The intent of the grant was to address AMD, abandoned mine lands, and CSO problems in the watershed. A working partnership was developed between state and local agencies, as well as a working group that meets to discuss current and future projects in the watershed. In the early 1980s, the PADEP's BAMR constructed a limestone barrel treatment system on the unnamed tributary to Aylesworth Creek upstream of Aylesworth Reservoir. Water from the stream was piped to the system, where it came in contact with rotating drums filled with crushed limestone, neutralized, discharged. Unfortunately, the system is no longer working due to vandalism, lack of upkeep and will be removed in 2005. There are plans to build anoxic limestone drains to replace the limestone barrels system through the Watershed 2000 program, and construction is anticipated to being in 2005.

8. The TMDLs have been subject to public participation.

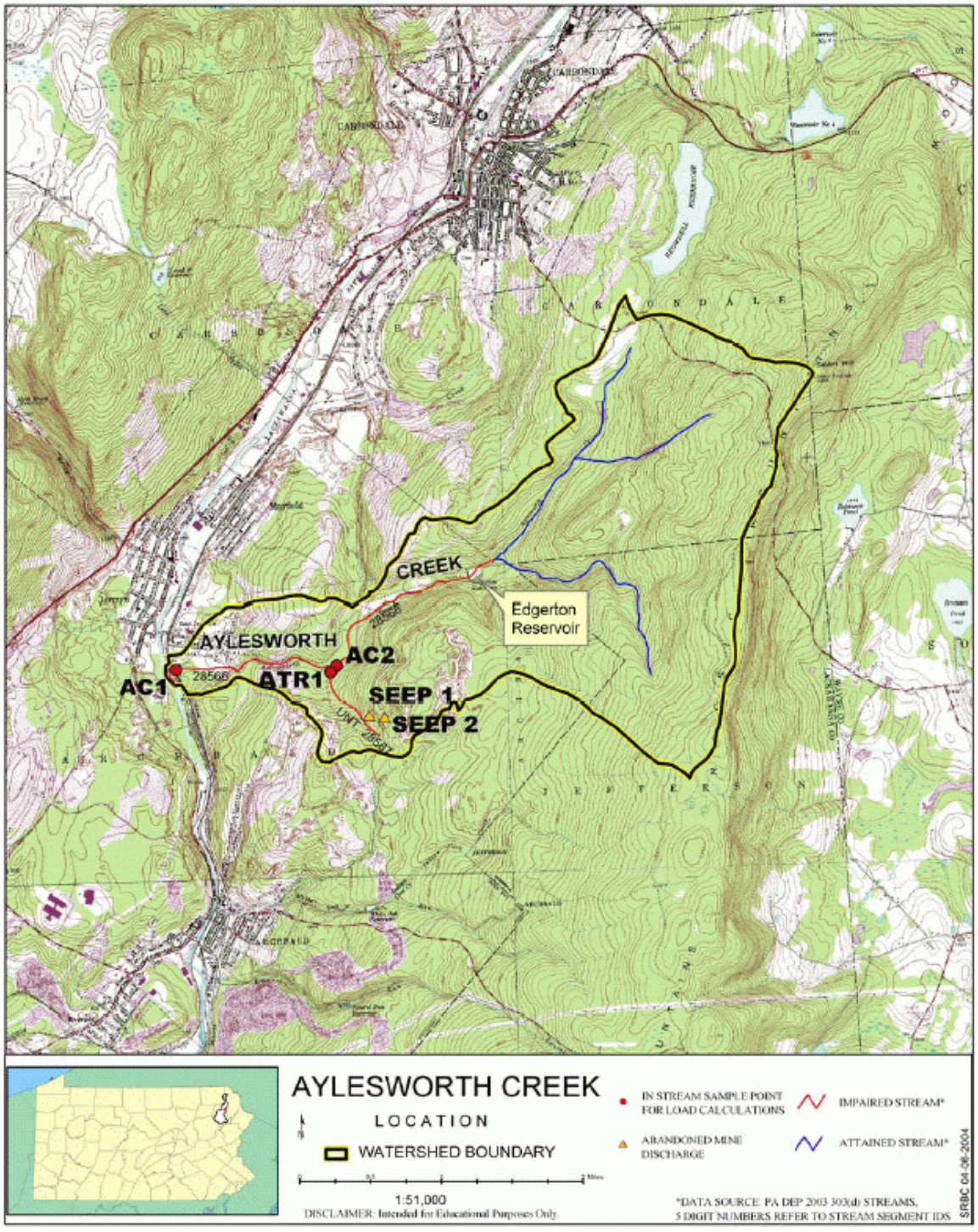
In the beginning stages of the Aylesworth Creek Watershed TMDL, an early notification letter was sent to inform stakeholders and interested parties that a TMDL would be completed in their watershed and offer them the opportunity to submit information for TMDL development. PADEP considered all information submitted, and all pertinent information was included in the report.

PADEP public noticed the draft TMDLs in the *Pennsylvania Bulletin* on February 7, 2004 and in the *Scranton Times* on January 19, 2005. A public meeting was held on January 25, 2005 at the Dickson City Borough Hall in Dickson City, Pennsylvania, to discuss the proposed TMDLs.

Although not specifically stated in the TMDL Report, PADEP routinely posts the approved TMDL report on their web site: www.dep.state.pa.us/watermanagement_apps/tmdl/.

Attachment A

Aylesworth Creek Watershed Map


CREEK
Edgerton
Reservoir
AYLESWORTH
AC2
AC1
28568
ATR1
SEEP 1
SEEP 2
UNT 28567
AYLESWORTH CREEK
LOCATION
WATERSHED BOUNDARY
1:51,000
DISCLAIMER: Intended for Educational Purposes Only.
IN STREAM SAMPLE POINT FOR LOAD CALCULATIONS
ABANDONED MINE DISCHARGE
IMPAIRED STREAM*
ATTAINED STREAM*
*DATA SOURCE: PA DEP 2003 303(d) STREAMS, 5 DIGIT NUMBERS REFER TO STREAM SEGMENT IDS
SRBC 04-06-2004