UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
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Decision Rationale
Total Maximum Daily Loads
Little Juniata River Watershed
For Nutrients and Sediment
Blair County, Pennsylvania

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Water Protection Division

Date: _____

Decision Rationale

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I. Introduction

This document will set forth the Environmental Protection Agency's (EPA) rationale for approving the Total Maximum Daily Load (TMDL) for nutrients (phosphorus) and sediment for the Little Juniata River Watershed in Blair County, Pennsylvania. The Pennsylvania Department of Environmental Protection (PADEP) submitted the *Little Juniata River Watershed TMDL*, dated March 2005, (TMDL Report) electronically to EPA for final Agency review on March 17, 2005. EPA's rationale is based on the TMDL Report and supporting information contained in the appendices to the report. EPA's review determined that the TMDL meets the following eight regulatory requirements pursuant to 40 CFR §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 margin of safety (MOS).
7. There is reasonable assurance that the proposed TMDLs can be met.
8. The TMDLs have been subject to public participation.

II. Summary

The Little Juniata River is located within and north of the City of Altoona in Blair County, Pennsylvania. Little Juniata River is approximately 30 miles in length, and the watershed is approximately 24,100 acres in area. Land use in the watershed is about 18% developed, 17% agriculture, 63% wooded, and 2% transitional, with approximately 73 miles of streams. As designated under Chapter 93 in Title 25 of the Pennsylvania Code, streams in this watershed are protected for aquatic life uses including Trout Stocking (mainstem of Little Juniata River), Warm Water Fishes (Homer Gap Run, Kettle Creek, Spring Run, and unnamed tributaries), and Cold Water Fishes (Riggles Gap Run and Sandy Run).

Pennsylvania's 1996 Section 303(d) list identified 1.2 miles of the Little Juniata River as having aquatic life use impairments. PADEP attributed the impairments to organic enrichment/low dissolved oxygen from municipal point sources and unknown causes from urban runoff/storm sewers. Approximately 23% of the watershed area falls in a designated Municipal Separate Storm Sewer System (MS4) area for the City of Altoona. The impairments on the Little Juniata River begin at the headwaters in Altoona and terminate at the downstream end of the study reach. In addition to the impairments on the Little Juniata, portions of Spring Creek and Kettle Creek tributaries were identified on Pennsylvania's 2002 Section 303(d) list due to siltation from urban runoff and storm sewers. Table 1 presents the 1996, 1998, 2002, and proposed 2004 Section 303(d) listing information for the water quality limited segments addressed in the Little Juniata River Watershed TMDL.

TABLE 1. SECTION 303(D) LISTINGS FOR THE LITTLE JUNIATA RIVER WATERSHED (SWP 11-A)

Date Listed	*Miles Impaired*	*Segment ID*	*PADEP Stream Code*	*Stream Name*	*Source*	*Cause*
1996	1.2	6555	15664	Little Juniata River	Municipal Point Sources	Organic Enrichment/DO
					Urban Runoff/ Storm Sewers	Other
1998	4.82	6555	15664	Little Juniata River	Municipal Point Source	Organic Enrichment/ Low DO
					Urban Runoff/ Storm Sewers	Cause Unknown
2002	4.8	6555	15664	Little Juniata River	Municipal Point Source	Organic Enrichment/ Low DO
					Urban Runoff/ Storm Sewers	Cause Unknown
2004	0.8	9337	15664	Little Juniata River	Municipal Point Source	Organic Enrichment/ Low DO
					Urban Runoff/ Storm Sewers	Cause Unknown
2004	4.8	6555	15664	Little Juniata River	Municipal Point Source	Organic Enrichment/ Low DO
					Urban Runoff/ Storm Sewers	Cause Unknown
2002	1.6	20000317-1001-TAS	16052	Spring Run	Urban Runoff/ Storm Sewers	Siltation
					Small Residential Runoff	Siltation
2004	1.65	20000317-1001-TAS	16052	Spring Run	Urban Runoff/ Storm Sewers	Siltation
					Small Residential Runoff	Siltation
2002	1	20000314-1246-TAS	16049	Kettle Creek	Urban Runoff/ Storm Sewers	Siltation
2004	0.97	20000314-	16049	Kettle	Urban Runoff/	Siltation

Date Listed	*Miles Impaired*	*Segment ID*	*PADEP Stream Code*	*Stream Name*	*Source*	*Cause*
		1246-TAS		Creek	Storm Sewers	

Section 303(d) of the Clean Water Act (CWA) and its implementing regulations require a TMDL to be developed for those waterbodies identified as impaired by the state where technology-based and other controls will not provide for the 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 MOS, that may be discharged to a water quality-limited waterbody without violating water quality standards. These TMDLs were developed to address the impairments caused by excess nutrients and sediment in waters of the Little Juniata River Watershed.

According to Federal regulations at 40 CFR §130.2(g), LAs are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading. Table 2 summarizes the elements of the TMDLs for sediment developed by PADEP. Despite the fact that EPA believes that annual loads are an appropriate measure for these TMDLs, for the sake of consistency, we are breaking the annual TMDL loads down into daily loads.

TABLE 2. SUMMARY OF SEDIMENT TMDLS FOR THE LITTLE JUNIATA RIVER WATERSHED

WLA	*LA*	*MOS*	*TMDL*		*Existing Load*	*% Reduction*
tons/yr	tons/yr	tons/yr	tons/yr	tons/day	tons/yr	
4,656	3,957	957	9,570	26.22	15,494	46%

To address nutrients, PADEP employed a phase TMDL approach to address nutrient-enrichment problems caused by municipal point source discharges. The TMDL Report notes that, although original impairment listings for the Little Juniata River were identified to be "organic enrichment/low DO," the more appropriate cause for impairment should have been identified as "nutrients" due to the relationship between high level of nutrients and excess algal growth.

PADEP is currently developing numeric phosphorus criteria for the Commonwealth. As part of this criteria development process, PADEP is investigating how periphyton (attached algae) growth is affected by phosphorus. The primary pigment in algae is chlorophyll-a, which is used as an indicator for nutrient enrichment. In the absence of numeric criteria at this time, PADEP intends to apply the underlying basis for phosphorus criteria development to identifying an appropriate endpoint for the Little Juniata River Watershed over the course of two NPDES permit cycles. For the first phase, point sources will be assigned WLAs based on the more stringent of either: (1) technology-based limits required for discharges of phosphorus where a nutrient impairment exists (per PA Title 25 Chapter 96.5), or (2) Chesapeake Bay tributary strategy allocations for the treatment plants within the Little Juniata River Watershed. A similar

type of approach to determining a phosphorus endpoint was used in the Skippack Creek Watershed TMDL. As part of the Skippack TMDL process, a relationship between periphyton and phosphorus concentration was established, and a range of phosphorus concentration values was determined through a regression analysis[1]. The resulting instream phosphorus concentration values identified for the Skippack Creek Watershed are 70 and 240 ug/l. At this time, PADEP does not have sufficient information to either confirm that the values developed in the Skippack study would be appropriate for use in the Little Juniata River, or to perform an equivalent analysis. As such, PADEP will collect site-specific monitoring data in 2005 to support a planned revision to the TMDL by December 2005.

Nonpoint source contributions of phosphorus were addressed through the sediment TMDL. Since instream phosphorus is often bound to sediment eroded from upland areas and streambanks, PADEP expects that decreases in phosphorus loads from nonpoint sources will also be realized on a mean annual basis due to best management practices (BMPs) implemented to reduce sediment loss in the watershed.

Section 303(d) listings for the Little Juniata River include low dissolved oxygen as a cause of aquatic life use impairments. However, as explained in Appendix H of the TMDL Report, monitoring conducted in the summer of 2004 showed no dissolved oxygen violations. Dissolved oxygen levels will continued to be monitored as part of the second phase of the TMDL. Algae will also be monitored as part of Phase 2 efforts to ensure that dissolved oxygen levels are meeting, or will meet water quality standards. In the context of this TMDL, PADEP does expect that reductions in phosphorus will decrease algae growth and the respiration induced-oxygen depletion.

A 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. If this occurs, the option is always available to refine the TMDL for resubmittal to EPA for approval. The Surface Waters Assessment Program (formerly the Unassessed Waters Protocol), a method of conducting biological assessments of Pennsylvania's waters, was developed in 1996 and implementation began in 1997. PADEP's goal is to achieve a comprehensive, 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

[1] A range of acceptable phosphorus concentration values was based on maintaining a standing crop of periphyton between 50 and 100 mg/m^2 measured as chlorophyll-a. This range for benthic chlorophyll-a is established in literature as the level above which nuisance algae conditions exist. The phosphorus concentration values that result in this chlorophyll-a range in the Skippack Creek Watershed are 70 and 240 ug/l.

not be modified at the expense of achieving water quality standards expeditiously, the TMDL may be modified when warranted.

III. Discussion of Regulatory Conditions

EPA finds that Pennsylvania has provided sufficient information to meet all of the eight basic requirements for establishing phosphorus and sediment TMDLs for the Little Juniata River Watershed. EPA therefore approves the TMDLs and information contained in the appendices. EPA's rationale for approval is set forth according to the regulatory requirements listed below.

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. The designated use for the mainstem of Little Junitata River is Trout Stocking. Homer Gap Run, Kettle Creek, Spring Run, and unnamed tributaries is Warm Water Fishes. Riggles Gap Run and Sandy Run is Cold Water Fishes. The designations for these stream segments can be found under Chapter 93 in Title 25 of the Pennsylvania Code.

Pennsylvania does not currently have specific numeric water quality criteria for nutrients (nitrogen or phosphorus) or sediment, the cause of impairments identified on Pennsylvania's 303(d) list. However, general water quality criteria under PA Code, Title 25, Chapter 93 provide for the interpretation of an acceptable water quality endpoint. Therefore, Pennsylvania utilized its general water quality criteria, which states that: *(a) Water may not contain substances attributable to point or nonpoint source waste discharges in concentrations or amounts sufficient to be inimical or harmful to the water uses to be protected or to human, animal, plant, or aquatic life; and (b) In addition to other substances limited to, floating materials, oil, grease, scum and substances which produce color, tastes, odors, turbidity or settle to form deposits*,[2] to establish a water quality endpoint for phosphorus and sediment such that the designated uses of the Little Juniata River Watershed are attained and maintained.

Although nutrients (phosphorus and nitrogen) are listed as the causes of impairment and are subsequently modeled, only a TMDL for phosphorus was established to help restore the designated uses of the Little Juniata River Watershed. This is due to PADEP's finding that phosphorus is the limiting nutrient in all waters of the watershed. A common N:P ratio is 10:1, and an increase in this ratio indicates a limitation of phosphorus[3]. The ratio for this watershed was determined to be near 20:1 above the point source influences, indicating that this watershed is phosphorus-limited. Phosphorus is often the major nutrient in shortest supply and is

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[2] Pennsylvania Code, Title 25., Environmental Protection, Chapter 93. Water Quality Standards, Section 93.6.

[3] Horne, A.J. and C.R. Goldman. 1994. Limnology (2nd Edition). McGraw-Hill Inc., New York, New York.

frequently a prime determinant of the total biomass[4]. It is also the most effectively controlled using existing engineering technology and landuse management. EPA finds this to be a reasonable determination.

The approach used to develop nutrient TMDLs for point sources is based on PADEP's interpretation of Pennsylvania's narrative criteria. During critical low-flow periods, the Little Juniata River is effluent dominated; therefore, PADEP believes that by reducing permitted concentrations of phosphorus from dischargers, PADEP is effectually limiting the amount of phosphorus input into the watershed during critical conditions. Two evaluation points were identified for the purposes of evaluating instream phosphorus concentrations and responses. PADEP will employ a two-phased approach in evaluating the low-flow phosphorus endpoint in the Little Juniata River and the reduction necessary from point sources to achieve that endpoint (once determined). The two phases represent two NPDES permit cycles.

The first phase for the Little Juniata River Watershed TMDL is based on the requirements contained in PA Title 25 Chapter 96 as amended, which allows for technology-based requirements to be applied to dischargers of phosphorus where a nutrient problem has been identified, or the allocations prescribed by PADEP's Tributary Strategy for the Chesapeake Bay to meet standards set forth by the state of Maryland. PA Title 25 Chapter 96.5 states that a maximum value of 2 mg/l be applied as an effluent limit where nutrient impairment has been identified. During the first permit cycle, the more stringent of 2 mg/l effluent total phosphorus limits or Chesapeake Bay tributary strategy allocations for the two point sources will be applied.

The second phase is based on the implementation of a water quality based solution, which will be determined after an appropriate instream phosphorus objective is determined for the stream. For the second phase, the water quality based effluent limits (WQBELs) for the point sources will be determined using the models that are described in the TMDL Report. EPA finds this approach reasonable, noting that PADEP plans to collect site-specific data for the Little Juniata River Watershed this year (2005) to support a planned revision to the TMDL (second phase) by December 2007. The types of data to be collected will closely mirror the monitoring plan for periphyton conducted in the Skippack Creek Watershed. The TMDL refers to current efforts in the Skippack Creek Watershed, which has resulted in a selection of 0.24 mg/l as the instream objective for phosphorus. This endpoint was based on meeting a target value of 100 mg/m^2 chlorophyll-a, a benchmark defined in literature as the upper bound for a healthy ecosystem, in the streambed. PADEP expects that a similar endpoint will be determined from the site-specific data that will be collected in the Little Juniata River Watershed.

Computational Procedure

[4] U.S. EPA. 1980. Modeling Phosphorus Loading and Lake Response under Uncertainty: A Manual and Compilation of Export Coefficients. EPA 440/5-80-011.

The TMDLs within the Little Juniata River Watershed were primarily developed using the ArcView Generalized Watershed Loading Function (AVGWLF)[5] and STREAMPLAN models. Overview information on both models are provided in Appendices B and C of the TMDL Report, and AVGWLF model outputs are contained in Appendices D and E. The AVGWLF model was used to develop the sediment TMDL and indirectly addresses the nonpoint source contributions of phosphorus. Both the AVGWLF and STREAMPLAN models were used to predict instream phosphorus concentrations under various pollution reduction schemes for this phase of the nutrient TMDL that impacts point sources.

In order to numerically express nutrient and sediment endpoints consistent with the general water quality criteria for sources other than municipal point sources, PADEP used a Reference Watershed Approach in combination with the AVGWLF loading model. The basis for this method is that achieving nutrient and sediment loadings in the impaired watershed similar to those loadings of the reference watershed will ensure that the impaired watershed will attain and maintain its designated uses and general water quality criteria.

[5] Arcview Generalized Watershed Loading Function model, the Environmental Resources Research Institute of Pennsylvania State University's Arcview based version of the GWLF model developed by Cornell Univeristy, Dec. 15, 1992.

The reference watershed chosen is representative of the conditions required for the impaired watershed to meet its designated uses. This representative condition is analyzed to determine an appropriate level of nutrient and sediment loading to the waterbody. The Reference Watershed Approach consists of comparing the biologically-impaired watershed with a reference watershed that is meeting its designated uses for aquatic life in order to determine an appropriate level of nutrient and sediment loading to the waterbody. This approach is based on comparing the impaired watershed to one with similar designated uses, geology, land uses, physiographic province, land area, soils, and meteorological patterns. The AVGWLF model provides a means of estimating the dissolved and total nutrient loadings to a stream from a complex watershed with added GIS capabilities. The model provides monthly streamflow, soil erosion, and sediment yield values and includes both surface runoff and groundwater sources as well as nutrient loads from point sources and onsite wastewater disposal (septic) systems.[6] Calibration of this model is not required. However, it has been applied and validated to an 85,000 hectare watershed in upstate New York.

The Blair Gap Run Watershed was used as the reference watershed for comparison with the Little Juniata River Watershed to develop the nonpoint source phosphorus and sediment TMDLs. Blair Gap Run Watershed is located in Allegheny and Juniata Townships, approximately 17 miles southwest of the Little Juniata River, and is currently attaining its designated uses, Trout Stocking, Warm Water Fishes, and Cold Water Fishes. Table 2 in the TMDL Report compares various attributes of these watersheds. Although both the impaired and reference watersheds are similar in terms of physical characteristics, location, size, and precipitation, they have different stormwater management practices in place to control runoff. Stormwater management in Blair Gap Run includes surface water detention basins, that collect runoff and release it slowly. The retention and slow release of stormwater allows for the settling of sediment in these basins, less severe impacts to streambank erosion as a result of the reducing peak streamflows, and less sedimentation deposition in the stream channel of Blair Gap Run. EPA finds the use of the Blair Gap Run Watershed as a reference watershed to be reasonable for these TMDLs.

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[6] Haith, D.A., R. Mandel and R.S. Wu, Generalized Watershed Loading Functions, Version 2.0, Cornell University, Dec. 15, 1992.

Using the continuous simulation AVGWLF model, PADEP modeled the nutrient and sediment loads originating from nonpoint sources in the reference watershed. In order to make these estimates, AVGWLF requires daily precipitation and temperature data, runoff sources and transport and chemical parameters. The AVGWLF model is a combined distributed/lumped parameter watershed model. In terms of surface loading, this means that the model allows the user to distribute multiple land use/cover scenarios in the watershed. However, the loads originating from the watershed are lumped, and spatial routing of nutrient and sediment loads is not available. In terms of sub-surface loading, the load contributions from sub-surface areas are not distinct and are considered lumped using a water balance approach. The AVGWLF model relies on the Soil Conservation Service Curve Number (SCS-CN) to estimate surface runoff and the Revised Universal Soil Loss Equation (RUSLE) to estimate erosion and sediment yield. Monthly estimates of nutrient and sediment loadings, applicable to each watershed, are generated by using watershed-specific local daily weather inputs and RUSLE factors.[7] The following average existing load values for sediment, illustrated in Table 3, were determined for the Blair Gap Run and Little Juniata River Watersheds using watershed-specific data.

TABLE 3. EXISTING SEDIMENT LOADING VALUES FOR THE IMPAIRED AND REFERENCE WATERSHEDS

Watershed	Area (Acres)	Sediment Load (tons/yr)	Unit Area Sediment Loading Rate (tons/acre/yr)
Little Juniata River	24,105.2	15,494	0.64
Blair Gap Run	17,744.6	7039.05	0.397

As previously mentioned, the AVGWLF modeling approach was used to support TMDL development in the Little Juniata River to address stream segments that were listed as impaired due to nonpoint sources (*e.g.*, urban runoff, storm sewers, small residential runoff). However, in situations where streams were listed for nutrient impairments due to point sources (e.g., municipal wastewater treatment plants), both the AVGWLF and STREAMPLAN models were used. In this case, AVGWLF was first used to estimate nonpoint source loads to affected segments, and then STREAMPLAN was subsequently used to combine these loads with point source discharge data to estimate instream nutrient concentrations.

PADEP modeled the instream phosphorus concentration of Little Juniata River to include a range of values from 0.1 mg/l to 1.8 mg/l. And, to establish compliance with these instream phosphorus objective concentration criteria, PADEP first set point source discharges at the plant design flow. Point source effluent concentrations were then evaluated at the two instream points identified by PADEP as evaluation points; both instream evaluation points are located on the mainstem of the Little Juniata River, with one location approximately 0.1 miles below the Altoona City Authority - East sewage treatment facility, and the other approximately 0.1 miles downstream of the Logan Township - Greenwood sewage treatment facility. PADEP made iterative STREAMPLAN model runs to determine the range of instream nutrient targets and the subsequent reductions necessary from point sources discharges to achieve the nutrient targets. The overall objective of this modeling exercise was to determine the point source phosphorus load values that would satisfy each of the instream phosphorus values. Table 11 of the TMDL

[7] Local daily weather inputs include temperature and precipitation. The USLE factors are KLSCP; K=changes in soil loss erosion, LS=length slope factor, C=vegetation cover factor, P=conservation practices factor.

Report and the table in Appendix G show the wide range of instream phosphorus values and associated discharge loads and concentrations, respectively.

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

Table 2 indicates the total allowable loads for sediment as determined using the Reference Watershed Approach and AVGWLF model.

A. Wasteload Allocations (WLAs)

The TMDL includes WLAs for those portions of the Little Juniata River Watershed that are contained within a designated MS4 area. Small MS4s are now considered point sources under EPA's Phase II NPDES Stormwater Regulations and therefore are addressed by the WLA portion of the TMDL. PADEP indicates that 23% of the watershed falls within an MS4 area of the City of Altoona. The WLAs for sediment were distributed by land use category within the City of Altoona and are listed in Table 4.

TABLE 4. MS4 AND SEDIMENT WLAS BY LANDUSE

MS4	Land Use	Existing Load (tons/yr)	Allowable Load (tons/yr)	Percent Reduction