Chest Creek Watershed Sediment TMDL
West Branch Susquehanna River

Cambria County, Pennsylvania

Prepared by:

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

August 2011

TABLE OF CONTENTS

Chest Creek Watershed Sediment TMDL,
West Branch Susquehanna River
Cambria County, Pennsylvania

Executive Summary

A Total Maximum Daily Load (TMDL) for sediment was developed to address impairments in the Chest Creek Watershed (Ashcraft Run, Brubaker Run, Duclos Run, the mainstem of Chest Creek (headwaters), and a headwaters tributary of Chest Creek) as noted in Pennsylvania's 303(d) List and the Pennsylvania Integrated Water Quality Monitoring and Assessment Report (Integrated List). Chest Creek is a tributary of the West Branch Susquehanna River, Cambria and Clearfield Counties (figure 1., page 19.). The impairments were documented during biological surveys of the aquatic life present in the watershed (1998 and 2003). Excessive siltation resulting from abandoned mine land use was listed as the source of non-point source pollution for Ashcraft Run and Brubaker Run. In addition, the removal of vegetation contributed to siltation in the Brubaker Run watershed. Grazing-related agricultural activities and erosion from derelict land has been identified as the cause of these impairments in Duclos Run. Agricultural activities in the headwaters of Chest Creek (mainstem and a headwaters tributary) have also created habitat impairment due to siltation. Because Pennsylvania does not currently have water quality criteria for sediment, a TMDL endpoint for sediment was identified using a reference watershed approach. Based on a comparison to similar, unimpaired watersheds, the headwaters of Blair Run (reference for Ashcraft Run), South Poplar Run (reference for Brubaker Run, Pavia Run (reference for Duclos Run), headwaters of Bobs Creek (reference for the mainstem of Chest Creek), and Wallacks Branch (reference for the headwater tributary), the maximum sediment loading that should still allow water quality objectives to be met in the sediment-impaired segments of Chest Creek (topography maps, figure 1.-5., page 19.-23., aerial maps, figure17.-20., page 56.-59., specific topo. and aerial maps, and field photography in Appendix A.). Allocation of the sediment TMDL is summarized below:

Table 1a. Summary of TMDL for Ashcraft Run in lbs./yr. & lbs./day						
Summary of TMDL for Ashcraft Run (lbs./yr.)						
Pollutant	TMDL	WLA	MOS	LA	LNR	ALA
Sediment	100,144.0	1,001.4	10,014.4	89,128.1	6,600.0	82,528.1
Summary of TMDL for Ashcraft Run (lbs./day)						
Pollutant	TMDL	WLA	MOS	LA	LNR	ALA
Sediment	274.4	2.74	27.4	244.2	18.1	226.1

Table 1b. Summary of TMDL for Brubaker Run in lbs./yr. & lbs./day						
Summary of TMDL for Brubaker Run (lbs./yr.)						
Pollutant	TMDL	WLA	MOS	LA	LNR	ALA
Sediment	9,565,874.0	95,658.7	956,587.4	8,513,627.8	446,600.0	8,067,027.8
Summary of TMDL for Brubaker Run (lbs./day)						
Pollutant	TMDL	WLA	MOS	LA	LNR	ALA
Sediment	26,207.9	262.1	2,620.8	23,325.0	1,223.6	22,101.4

Table 1c. Summary of TMDL for Duclos Run in lbs./yr. & lbs./day						
Summary of TMDL for Duclos Run (lbs./yr.)						
Pollutant	TMDL	WLA	MOS	LA	LNR	ALA
Sediment	1,130,294.9	11,302.9	113,029.5	1,005,962.5	66,800.0	939,162.5
Summary of TMDL for Duclos Run (lbs./day)						
Pollutant	TMDL	WLA	MOS	LA	LNR	ALA
Sediment	3,097.7	31.0	309.7	2,756.1	183	2,573.0

Table 1d. Summary of TMDL for the mainstem of Chest Creek in lbs./yr. & lbs./day						
Summary of TMDL for the mainstem of Chest Creek (lbs./yr.)						
Pollutant	TMDL	WLA	MOS	LA	LNR	ALA
Sediment	10,484,841.0	123,124.0	1,048,484.1	9,313,232.9	239,000.0	9,074,232.9
Summary of TMDL for the mainstem of Chest Creek (lbs./day)						
Pollutant	TMDL	WLA	MOS	LA	LNR	ALA
Sediment	28,725.6	337.3	2872.6	25,515.7	654.8	24,860.9

Table 1e. Summary of TMDL for the headwaters tributary of Chest Cr. in lbs./yr. & lbs./day						
Summary of TMDL for the headwaters tributary of Chest Creek (lbs./yr.)						
Pollutant	TMDL	WLA	MOS	LA	LNR	ALA
Sediment	2,219,395.9	22,194.0	221,939.6	1,975,262.3	35,400.0	1,939,862.3
Summary of TMDL for the headwaters tributary of Chest Creek (lbs./day)						
Pollutant	TMDL	WLA	MOS	LA	LNR	ALA
Sediment	6,080.5	60.8	608	5,411.7	97.0	5,314.7

The Chest Creek Sediment TMDL is allocated to nonpoint sources, with 10% of the TMDL reserved explicitly as a margin of safety (MOS). The wasteload allocation (WLA) is that portion of the total load assigned to National Pollutant Discharge Elimination System (NPDES) permitted point source discharges. A search of the Pennsylvania Department of Environmental Protection's (Department) efacts permit database identified one point source discharge entering Laurel Lick Run, tributary to the headwaters of Chest Creek. The WLA was adjusted based on permit information. An additional allocation of 1% of the TMDL was incorporated into the WLA as a bulk reserve to take in account the dynamic nature of future permit activity. The load allocation (LA) is that portion of the total load assigned to nonpoint sources, all sources other than NPDES permitted point sources. Loads not reduced (LNR) are the portion of the LA associated with nonpoint sources other than agricultural (croplands, hay/pasture), transitional land, and stream bank and is equal to the sum of forested, wetland and low intensity development loadings. The adjusted load allocation (ALA) represents the remaining portion of the LA to be distributed among agricultural, transitional land and stream bank uses receiving load reductions. The TMDL developed for the sediment-impaired segments of Chest Creek established a reduction in the current sediment loading in Ashcraft Run to 27.4%, Brubaker Run 46.5%, Duclos Run to 20.2 %, the mainstem of Chest Creek (headwaters) to 24.9%, and a headwaters tributary of Chest Creek to 23.9%.

Introduction

The majority of the Chest Creek Watershed is currently designated as a Cold Water Fishery (CWF) from the mouth, near the town of Mahaffey, Clearfield County, upstream to the town of Patton, Clearfield County. The headwaters of Chest Creek are currently designated as a High Quality, Cold Water Fishery (HQ-CWF), (PA Code 25 § 93.9o), from the town of Patton to the headwaters to the south, near the town of Lorretto, Cambria County (Figure 1., Page 19.). The waters qualify for Special Protection status described and implemented according multiple Pennsylvania codes including the Antidegradation Requirements of PA Code 25 § 93.4a and 93.4c specifically, 93.4c.(b)(2) *Nonpoint source control.* The Department will assure that cost-effective and reasonable best management practices for nonpoint source control are achieved. High Quality Cold Water Fishery by definition states: HQ - Surface waters having quality which exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water by satisfying § 93.4b(a). CWF – Maintenance or propagation, or both, of fish species including the family Salmonidae and additional flora and fauna which are indigenous to a cold water habitat.

This Total Maximum Daily Load (TMDL) calculation has been prepared for all sediment-impaired segments in the Chest Creek Watershed (Figure 1., Page 19.). The headwaters are located in East Carroll, Clearfield, and Allegheny Townships, southwest Cambria County. Chest Creek, including all its tributaries, makes up approximately 264 stream miles downstream to the confluence of West Branch Susquehanna River, located near the town of Mahaffey. The entire watershed basin is approximately 129.22 square miles (82,700.47 acres).

Ashcraft Run encompasses approximately 5.54 stream miles and an area 2.75 square miles (1759.40 acres). Land use in this watershed is composed of agriculture (22%), including croplands and hay/pasture, forestland (76%), and other (2% low intensity development, wetland, and coal mines). Brubaker Run encompasses approximately 18.80 stream miles and an area 12.75 square miles (8156.9 acres). Land use in this watershed is composed of agriculture (40%), including croplands and hay/pasture, and forestland (52%), and other (2% low intensity development, wetland, transitional land, and coal mines). Duclos Run encompasses approximately 7.89 stream miles and an area 3.32 square miles (2124.79 acres). Land use in this watershed is composed of agriculture (61%), including croplands and hay/pasture, forestland (32%), and other (6% low intensity development, wetland, and transition). The mainstem of Chest Creek encompasses approximately 67.70 stream miles and an area 22.63 square miles (14,483.14 acres). Land use in this watershed is composed of forestland (57%), agriculture (37%), including croplands and hay/pasture, and other (6% low intensity development, wetland, transition, coal mines, and turf grass). The headwaters tributary of Chest Creek encompasses approximately 18.70 stream miles and an area 5.72 square miles (3660.79 acres). Land use in this watershed is composed of forestland (51%), agriculture (44%), including croplands and hay/pasture, and other (5% low intensity development, wetland, and transition).

The impaired watersheds are located in State Water Plan (SWP) Subbasin 08B and within Hydrologic Unit Code (HUC) 02050201- Upper West Branch Susquehanna (topography maps, Figure 2. and 4., Pages 20. and 22., aerial maps, Figure 17. and 19., Pages 56. and 58., specific topo. and aerial maps, and field photography in Appendix A.). The Chest Creek Watershed is within the Appalachian Plateaus physiographic province with an elevation range of over 2339 feet to less than 1280 feet. The sediment-impaired segments of Chest Creek Watershed have the following elevation ranges: Ashcraft Run, 1646' to 1361', Brubaker Run, 2280' to 1420', Duclos Run, 2000' to 1760', mainstem of Chest Creek, 2339' to 1770', and headwater tributary, 2131' to 1780'. This steep terrain in conjunction with intensive agriculture in the headwaters creates high velocity silt laden runoff during precipitation events, thus degrading habitat to the point of impairment. The TMDL was completed to address the impairments noted in the Integrated Water Quality Monitoring and Assessment Report ((2010)(complete list of impaired segments are in Attachement D), pages 135-1430, required under the Clean Water Act, and covers the listed segments shown in Table 2a., 2b., 2c., and 2d. Siltation from erosion from derelict land and agriculture has been listed as causing the impairment. The TMDL addresses siltation from croplands, hay/pasture lands, and transitional lands.

Table 2a. Integrated Water Quality Monitoring and Assessment Report Listed Segments				
State Water Plan (SWP) Subbasin: 08B				
HUC: 02050201 – Upper West Branch Susquehanna				
Watershed – Ashcraft Run (Chest Creek)				
Source	EPA 305(b) Cause Code	Miles	Designated Use	Use Designation
Abandoned Mine Drainage	Siltation	0.66	CWF	Aquatic Life

Table 2b. Integrated Water Quality Monitoring and Assessment Report Listed Segments				
State Water Plan (SWP) Subbasin: 08B				
HUC: 02050201 – Upper West Branch Susquehanna				
Watershed – Brubaker Run (Chest Creek)				
Source	EPA 305(b) Cause Code	Miles	Designated Use	Use Designation
Abandoned Mine Drainage	Siltation	6.38	CWF	Aquatic Life
Removal of Vegetation	Siltation	11.03	CWF	Aquatic Life

Table 2c. Integrated Water Quality Monitoring and Assessment Report Listed Segments				
State Water Plan (SWP) Subbasin: 08B				
HUC: 02050201 – Upper West Branch Susquehanna				
Watershed – Duclos Run (Chest Creek)				
Source	EPA 305(b) Cause Code	Miles	Designated Use	Use Designation
Erosion from Derelict Land	Siltation	2.50	HQ-CWF	Aquatic Life
Grazing Related Agriculture	Siltation	5.40	HQ-CWF	Aquatic Life

Table 2d. Integrated Water Quality Monitoring and Assessment Report Listed Segments				
State Water Plan (SWP) Subbasin: 08B				
HUC: 02050201 – Upper West Branch Susquehanna				
Watershed – Chest Creek (Mainstem (headwaters) and Headwaters Tributary))				
Source	EPA 305(b) Cause Code	Miles	Designated Use	Use Designation
Agriculture	Siltation	20.29	HQ-CWF	Aquatic Life

HUC= Hydrologic Unit Code
CWF= Cold Water Fishes
HQ-CWF= High Quality - Cold Water Fishes
The use designations for the stream segments in this TMDL can be found in PA Title 25 Chapter 93.
See Attachments D & E, for more information on the listings and listing process.

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 United States Environmental Protection Agency’s (EPA) implementing regulations (40 CFR 130) require:

- States to develop lists of impaired waters for which current pollution controls are not stringent enough to meet water quality standards (the list is used to determine which streams need TMDLs);
- States to establish priority rankings for waters on the lists based on severity of pollution and the designated use of the waterbody; states must also identify those waters for which TMDLs will be developed and a schedule for development;
- States to submit the list of waters to EPA every two years (April 1 of the even numbered years);
- States to develop TMDLs, specifying a pollutant budget that meets state water quality standards and allocate pollutant loads among pollution sources in a watershed, e.g., point and nonpoint sources; and
- EPA to approve or disapprove state lists and TMDLs within 30 days of final submission.

Despite these requirements, states, territories, authorized tribes, and EPA have not developed many TMDLs since 1972. Beginning in 1986, organizations in many states filed lawsuits against 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., Abandoned Mine Drainage (AMD), implementation of nonpoint source Best Management Practices (BMPs), etc.).

Pennsylvania Clean Streams Law Requirements and Agricultural Operations

All Pennsylvania farmers are subject to the water quality regulations authorized under the Pennsylvania Clean Streams Law, Title 25 Environmental Protection, and found within Chapters 91-93, 96, 102 and 105. These regulations include topics such as manure management, Concentrated Animal Operations (CAOs), Concentrated Animal Feeding Operations (CAFOs), Pollution Control and Prevention at Agricultural Operations, Water Quality Standards, Water Quality Standards Implementation, Erosion and Sediment Control Requirements, and Dam Safety and Waterway Management. To review these regulations, please refer to http://pacode.com/ or the Pennsylvania Water Quality Action Packet for Agriculture which is supplied by the County Conservation Districts. To find your County Conservation District’s contact information, please refer to http://pacd.org/ or call any DEP office or the Pennsylvania Conservation Districts Headquarters at 717-238-7223.

Integrated Water Quality Monitoring and Assessment Report, List 5, 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 listed in the Integrated Water Quality Monitoring and Assessment Report. Prior to 2004 the impaired waters were found on the 303(d) List; from 2004 to present, the 303(d) List was incorporated into the Integrated Water Quality Monitoring and Assessment Report and found on List 5. Please see Table 3 below for a breakdown of the changes to listing documents and assessment methods through time.

With guidance from EPA, the states have developed methods for assessing the waters within their respective jurisdictions. From 1996-2006, the primary method adopted by the Pennsylvania Department of Environmental Protection for evaluating waters found on the 303(d) lists (1998-2002) or in the Integrated Water Quality Monitoring and Assessment Report (2004-2006) was the Statewide Surface Waters Assessment Protocol (SSWAP). SSWAP was a modification of the EPA Rapid Bioassessment Protocol II (RPB-II) and provided a more consistent approach to assessing Pennsylvania's streams.

The assessment method required selecting representative stream segments based on factors such as surrounding land uses, stream characteristics, surface geology, and point source discharge locations. The biologist selected as many sites as necessary to establish an accurate assessment for a stream segment; the length of the stream segment could 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 were identified to the family level in the field.

The listings found in the Integrated Water Quality Monitoring and Assessment Reports from 2008 to present were derived based on the Instream Comprehensive Evaluation protocol (ICE). Like the SSWAP protocol that preceded the ICE protocol, the method requires selecting representative 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 could vary between sites. All the biological surveys include D-frame kicknet sampling of benthic macroinvertebrates, habitat surveys, and measurements of pH, temperature, conductivity, dissolved oxygen, and alkalinity. Collected samples are returned to the laboratory where the samples are then subsampled to obtain a benthic macroinvertebrate sample of 200 + or – 20% (160 to 240). The benthic macroinvertebrates in this subsample were then identified to the generic level. The ICE protocol is a modification of the EPA Rapid Bioassessment Protocol III (RPB-III) and provides a more rigorous and consistent approach to assessing Pennsylvania's streams than the SSWAP.

After these surveys (SSWAP, 1998-2006 lists or ICE, 2008-present lists) were completed, the biologist determined the status of the stream segment. The decision was based on the performance of the segment using a series of biological metrics. If the stream segment was classified as impaired, it was then listed on the state's 303(d) List or presently the Integrated Water Quality Monitoring and Assessment Report with the source and cause documented.

Once a stream segment is listed as impaired, a TMDL must be developed for it. A TMDL addresses only one pollutant. If a stream segment is impaired by multiple pollutants, all of those pollutants receive separate and specific TMDLs within that stream segment. In order for the TMDL process to be most effective, adjoining stream segments with the same source and cause listing are addressed collectively on a watershed basis.

Table 3. Impairment Documentation and Assessment Chronology		
Listing Date	Listing Document	Assessment Method
1998	303(d) List	SSWAP
2002	303(d) List	SSWAP
2004	Integrated List	SSWAP
2006	Integrated List	SSWAP
2008-Present	Integrated List	ICE

Integrated List= Integrated Water Quality Monitoring and Assessment Report
SSWAP= Statewide Surface Waters Assessment Protocol   ICE= Instream Comprehensive Evaluation Protocol

Basic Steps for Determining a TMDL

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

1. Collection and summarization of pre-existing data (watershed characterization, inventory contaminant sources, determination of pollutant loads, etc.);
2. Calculate TMDL for the waterbody using EPA approved methods and computer models;
3. Allocate pollutant loads to various sources;
4. Determine critical and seasonal conditions;
5. Submit draft report for public review and comments; and
6. EPA approval of the TMDL.

TMDL Elements (WLA, LA, MOS)

A TMDL equation consists of a wasteload allocation, load allocation and a margin of safety. The wasteload allocation (WLA) is the portion of the load assigned to point sources (National Pollutant Discharge Elimination System (NPDES) permitted discharges). The load allocation (LA) is the portion of the load assigned to nonpoint sources (non-permitted). The margin of safety (MOS) is applied to account for uncertainties in the computational process. The MOS may be expressed implicitly (documenting conservative processes in the computations) or explicitly (setting aside a portion of the allowable load).

Future TMDL Modifications

In the future, the Department may adjust the load and/or wasteload allocations in this TMDL to account for new information or circumstances that are developed or discovered during the implementation of the TMDL when a review of the new information or circumstances indicate that such adjustments are appropriate. Adjustment between the load and wasteload allocation will only be made following an opportunity for public participation. A wasteload allocation adjustment will be made consistent and simultaneous with associated permit(s) revision(s)/reissuances (i.e., permits for revision/reissuance in association with a TMDL revision will be made available for public comment concurrent with the related TMDLs availability for public comment). New information generated during TMDL implementation may include among other things, monitoring data, BMP effectiveness information, and land use information. All changes in the TMDL will be tallied and once the total changes exceed 1% of the total original TMDL allowable load, the TMDL will be revised. The adjusted TMDL, including its LAs and WLAs, will be set at a level necessary to implement the applicable water quality standards (WQS) and any adjustment increasing a WLA will be supported by reasonable assurance demonstration that load allocations will be met. The Department will notify EPA of any adjustments to the TMDL within 30 days of its adoption and will maintain current tracking mechanisms that contain accurate loading data for TMDL waters.

Changes in TMDLs That May Require EPA Approval

- Increase in total load capacity.
- Transfer of load between point (WLA) and nonpoint (LA) sources.
- Modification of the margin of safety (MOS).
- Change in water quality standards (WQS).
- Non-attainment of WQS with implementation of the TMDL.
- Allocation transfers in trading programs.

Changes in TMDLs That May Not Require EPA Approval

- Total loading shift less than or equal to 1% of the total load.
- Increase of WLA results in greater LA reductions provided reasonable assurance of implementation is demonstrated (a compliance/implementation plan and schedule).
- Changes among WLAs with no other changes; TMDL public notice concurrent with permit public notice.
- Removal of a pollutant source that will not be reallocated.
- Reallocation between LAs.
- Changes in land use.

TMDL Approach

The TMDL developed for the Chest Creek Watershed addresses sediment. Because neither Pennsylvania nor EPA has water quality criteria for sediment, a method was developed to determine water quality objectives for this pollutant that should result in the impaired stream segments attaining their designated uses. The method employed for this TMDL is termed the “Reference Watershed Approach”.

Selection of the Reference Watershed

The reference watershed approach was used to estimate the appropriate sediment loading reduction necessary to restore healthy aquatic communities to the Chest Creek Watershed. This approach is based on selecting a non-impaired, or reference, watershed and estimating its current loading rates for the pollutants of interest. The objective of the process is to reduce loading rates of those pollutants identified as causing impairment to a level equivalent to or lower than the loading rates in the reference watershed. Achieving the appropriate load reductions should allow the return of a healthy biological community to affected stream segments.

First, there are three factors that should be considered when selecting a suitable reference watershed: impairment status, similarity of physical properties, and size of the watershed. A watershed that the Department has assessed and determined to be attaining water quality standards should be used as the reference. Second, a watershed that closely resembles the impaired watershed

in physical properties such as land use/land cover, physiographic province, elevation, slope and geology should be chosen. Finally, the size of the reference watershed should be within 20-30% of the impaired watershed area.
The search for a reference watershed that would satisfy the above characteristics was done by means of a desktop screening using several GIS shapefiles, including a watershed layer, geologic formations layer, physiographic province layer, soils layer, Landsat-derived land cover/use grid, and the stream assessment information found on the Department's Instream Comprehensive Evaluation Protocol (ICE) GIS-based website. The suitability of the chosen watershed was confirmed through discussions with Department staff as well as through field verification of conditions.

The headwaters of Blair Run, South Poplar Run, Pavia Run, the headwaters of Bobs Creek, and Wallacks Branch were selected as the reference watersheds for developing the Chest Creek Watershed Sediment TMDL (topography maps, Figure 3. and 5., Pages 21. and 23., aerial maps, Figure 18. and 20., Pages 57. and 59., specific topo. and aerial maps, and field photography in Appendix A.). Blair Run and South Poplar Run flow east near the town of Hollidaysburg, Blair County, and eventually to the Upper Juniata River, HUC: 02050302, State Water Plan (SWP): sub-basin 11A. Both are designated as Cold Water Fisheries (CWF), like the majority of Chest Creek Watershed (from the town of Patton, north to the mouth). Pavia Run, the headwaters of Bobs Creek, and Wallacks Branch confluence near the town of Pavia, Bedford County, and flow eventually to the Raystown Branch of the Suquehanna River, HUC: 02050303, SWP: sub-basin 11C. They are all designated as High Quality, Cold Water Fisheries (HQ-CWF), like the headwaters of Chest Creek (south to the town of Patton), before becoming a Cold Water Fishery (CWF) downstream from Pavia to the mouth of Bobs Creek. The watersheds are located in the Appalachian Plateaus physiographic province and were identified in ICE as attaining its designated uses (HQ-CWF). The attainment of designated uses is based on biological sampling done by the Department.

The headwaters of Blair Run were compared to the impaired Ashcraft Run and flow within Juniata Township, Blair County. South Poplar Run was compared with the impaired Brubaker Run and flows within Greenfield Township, Blair County. Pavia Run was compared to the impaired Duclos Run and flow within Union Township, Bedford County. The headwaters of Bobs Creek were compared to the impaired mainstem of Chest Creek (headwaters) and primarily flow within Greenfield Township, Blair County and Union Township, Bedford County. Wallacks Branch was compared to the impaired headwaters tributary of Chest Creek and flow within Union and Lincoln Townships, Bedford County. Table 4a., 4b., 4c., 4d., and 4e. compare the respective impaired and reference watersheds in terms of size, location, and other physical characteristics.

Table 4a. Comparison of Ashcraft Run (impaired) and headwaters of Blair Run (reference)

	Ashcraft Run	headwaters of Blair Run
Physiographic Province	Appalachian Plateaus	Appalachian Plateaus
Area (acres)	1,759.3	1,349.2
Land Use Distribution % Agriculture % Forest % Other	 22 76 2	 8 92 0
Dominant Soils: Group C	100	100
Surface Geology: Interbedded Sedimentary	100	100
Average Rainfall (in.)	46.04, 19 years	46.12, 23 years
Average Runoff (in.)	3.25, 19 years	2.77, 23 years

Table 4b. Comparison of Brubaker Run (impaired) and South Poplar Run (reference)		
	Brubaker Run	South Poplar Run
Physiographic Province	Appalachian Plateaus	Appalachian Plateaus
Area (acres)	8156.9	7,430.0
Land Use Distribution % Agriculture % Forest % Other	 40 52 8	 20 77 3
Dominant Soils: Group C	100	100
Surface Geology: Interbedded Sedimentary	100	100
Average Rainfall (in.)	46.12, 23 years	46.12, 23 years
Average Runoff (in.)	3.52, 23 years	3.01, 23 years

Table 4c. Comparison of Duclos Run (impaired) and Pavia Run (reference)		
	Duclos Run	Pavia Run
Physiographic Province	Appalachian Plateaus	Appalachian Plateaus
Area (acres)	2,122	1,797
Land Use Distribution % Agriculture % Forest % Other	 61 32 7	 10 88 2
Dominant Soils: Group C	100	100
Surface Geology: Interbedded Sedimentary	100	100
Average Rainfall (in.)	46.12, 23 years	46.12, 23 years
Average Runoff (in.)	4.23, 23 years	2.86, 23 years

Table 4d. Comparison of the mainstem of Chest C. (imp.) and headwaters of Bobs C. (ref.)		
	mainstem of Chest Creek	headwaters of Bobs Creek
Physiographic Province	Appalachian Plateaus	Appalachian Plateaus
Area (acres)	14,448	14,268
Land Use Distribution % Agriculture % Forest % Other	 37 57 6	 15 82 3
Dominant Soils: Group C	100	100
Surface Geology: Interbedded Sedimentary	100	100
Average Rainfall (in.)	46.12, 23 years	46.12, 23 years
Average Runoff (in.)	3.53, 23 years	2.98, 23 years

Table 4e. Comparison of the headwaters trib. to Chest C. (imp.) and Wallacks Branch (ref.)		
	headwaters tributary	Wallacks Branch
Physiographic Province	Appalachian Plateaus	Appalachian Plateaus
Area (acres)	3,655	3,188
Land Use Distribution % Agriculture % Forest % Other	 44 51 5	 14 84 2
Dominant Soils: Group C	100	100
Surface Geology: Interbedded Sedimentary	100	100
Average Rainfall (in.)	46.12, 23 years	47.46, 18 years
Average Runoff (in.)	3.60, 23 years	2.75, 18 years

The analysis of value counts for each pixel of the Multi-Resolution Land Characterization (MRLC) grid revealed that land cover/use distributions are relatively similar and forest is the most dominant land cover type. All watersheds lie within the Appalachian Plateaus. Surface geology in the watershed consists mainly of interbedded sedimentary.

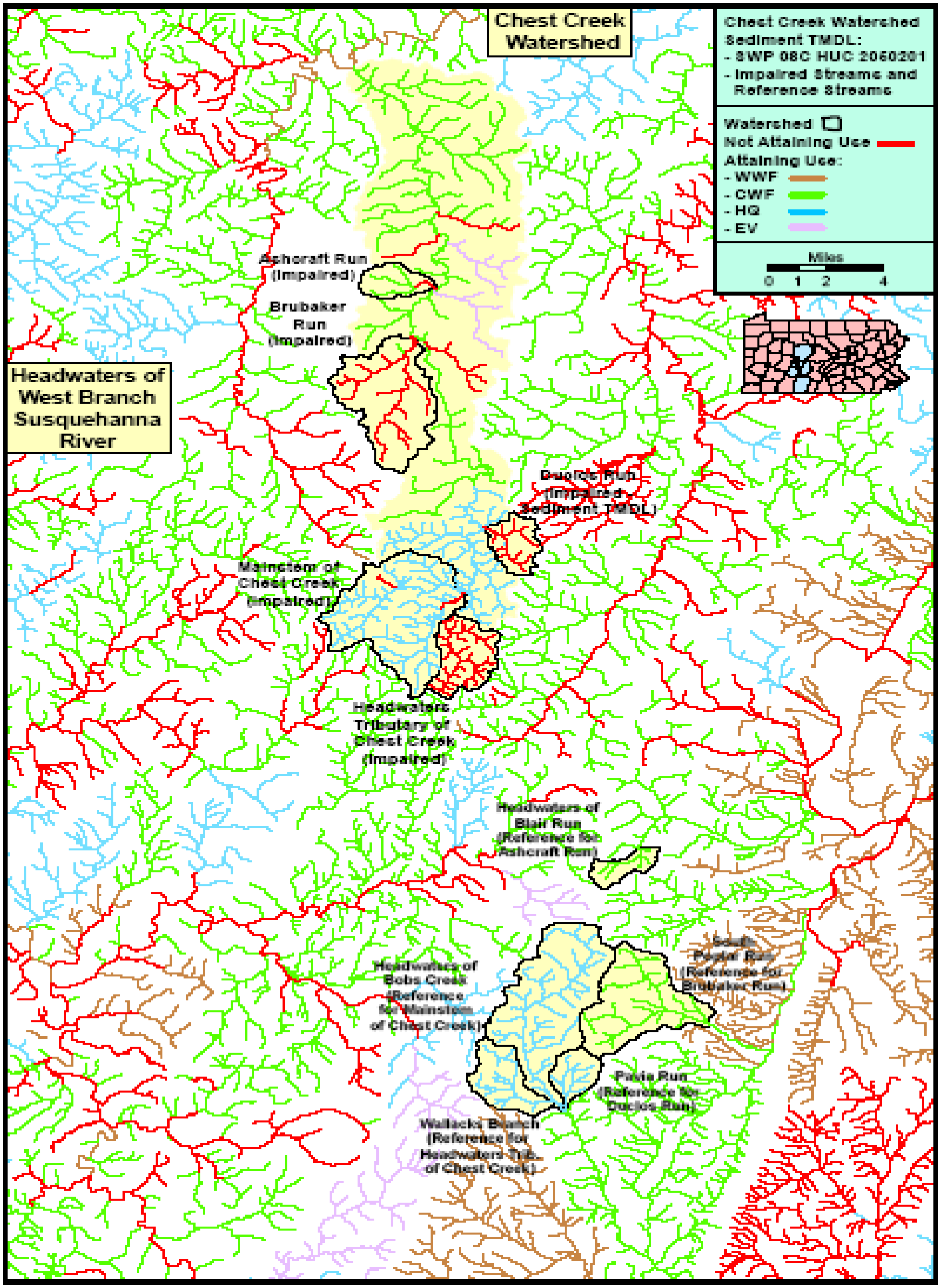


Figure 1. – Overview map of the Chest Creek Watershed with sediment-impaired streams (Ashcraft Run, Brubaker Run, Duclos Run, mainstem segment of Chest Creek, & headwater trib.) and corresponding non-impaired, reference streams (headwaters of Blair Run, South Poplar Run, Pavia Run, headwaters of Bob Creek, & Wallacks Branch)

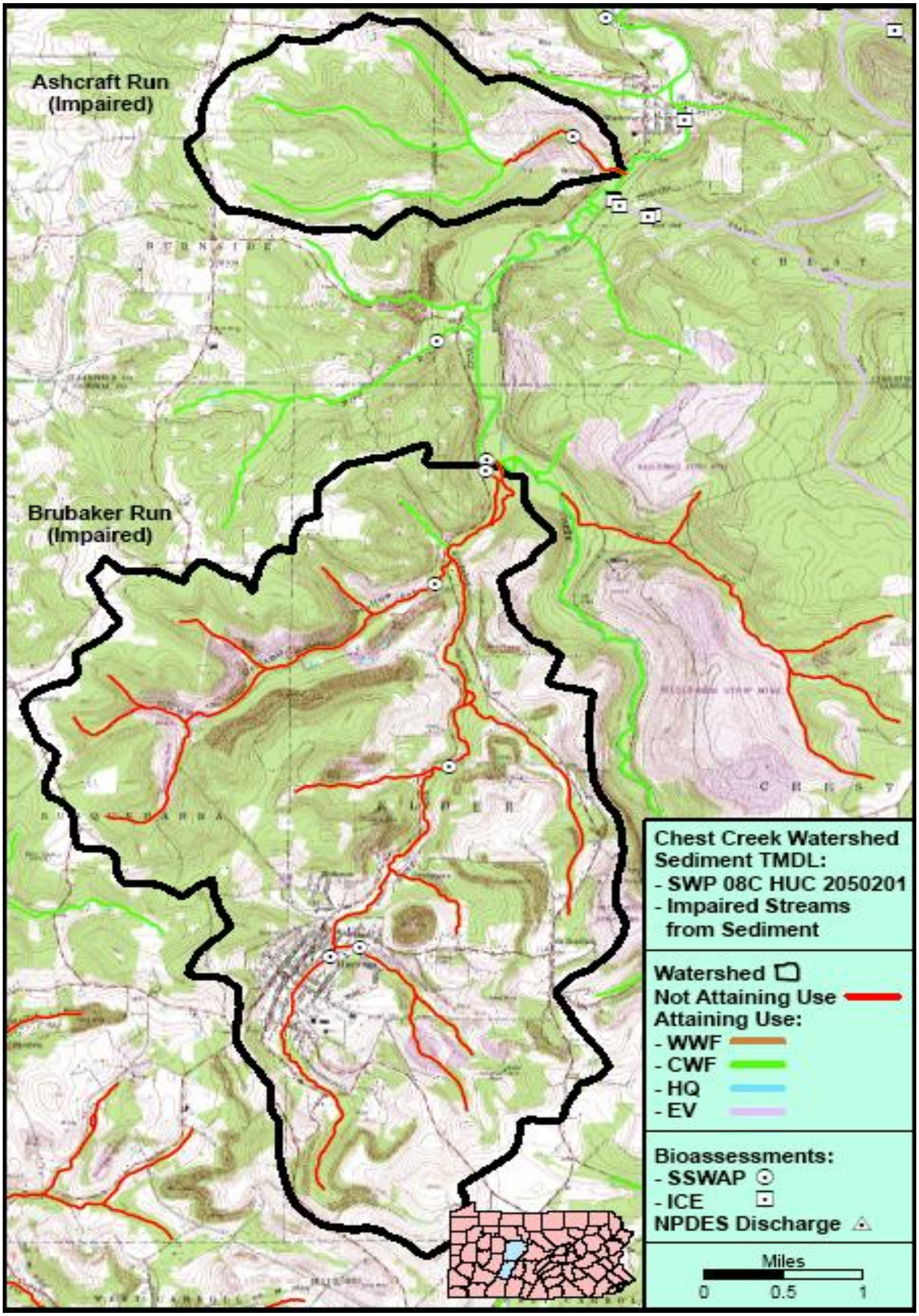


Figure 2. – Topography map of sediment-impaired streams, downstream Chest Creek (Ashcraft Run & Brubaker Run)

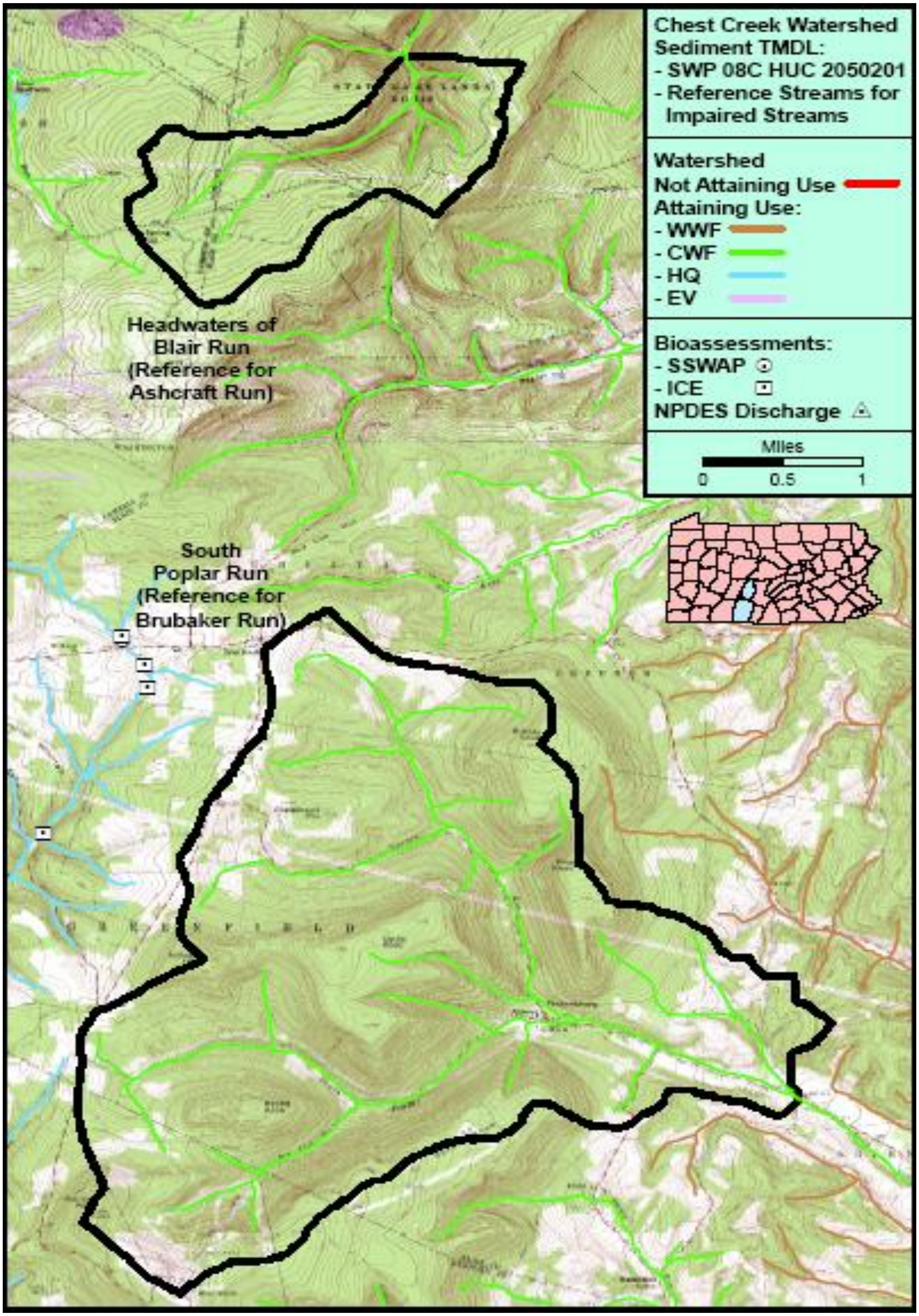


Figure 3. – Topography map of reference streams for impaired streams, downstream Chest Creek (headwaters of Blair Run and South Poplar Run)

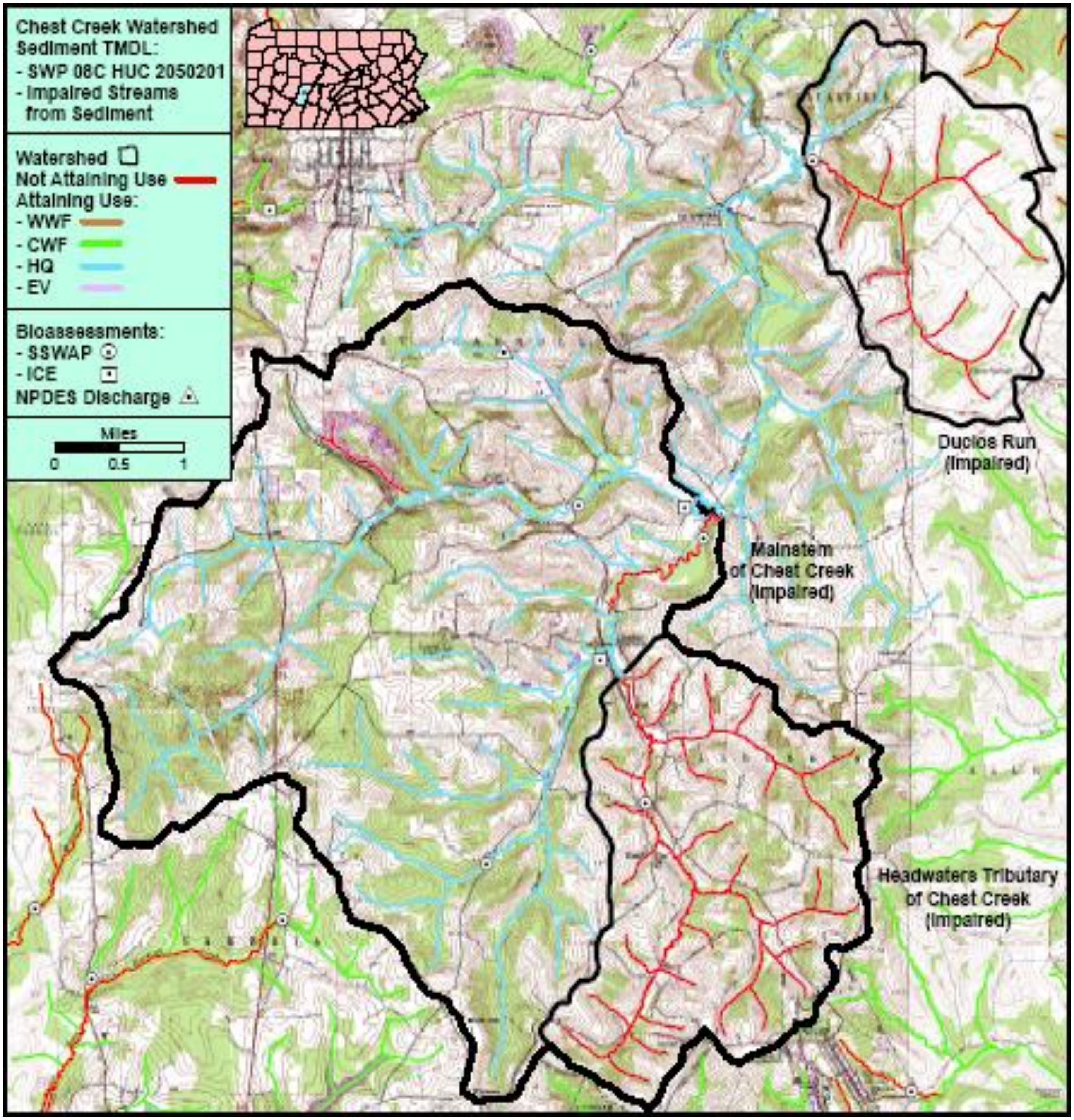


Figure 4. – Topography map of sediment-impaired streams, upstream Chest Creek (Duclos Run, mainstem segment of Chest Creek, & headwaters tributary)

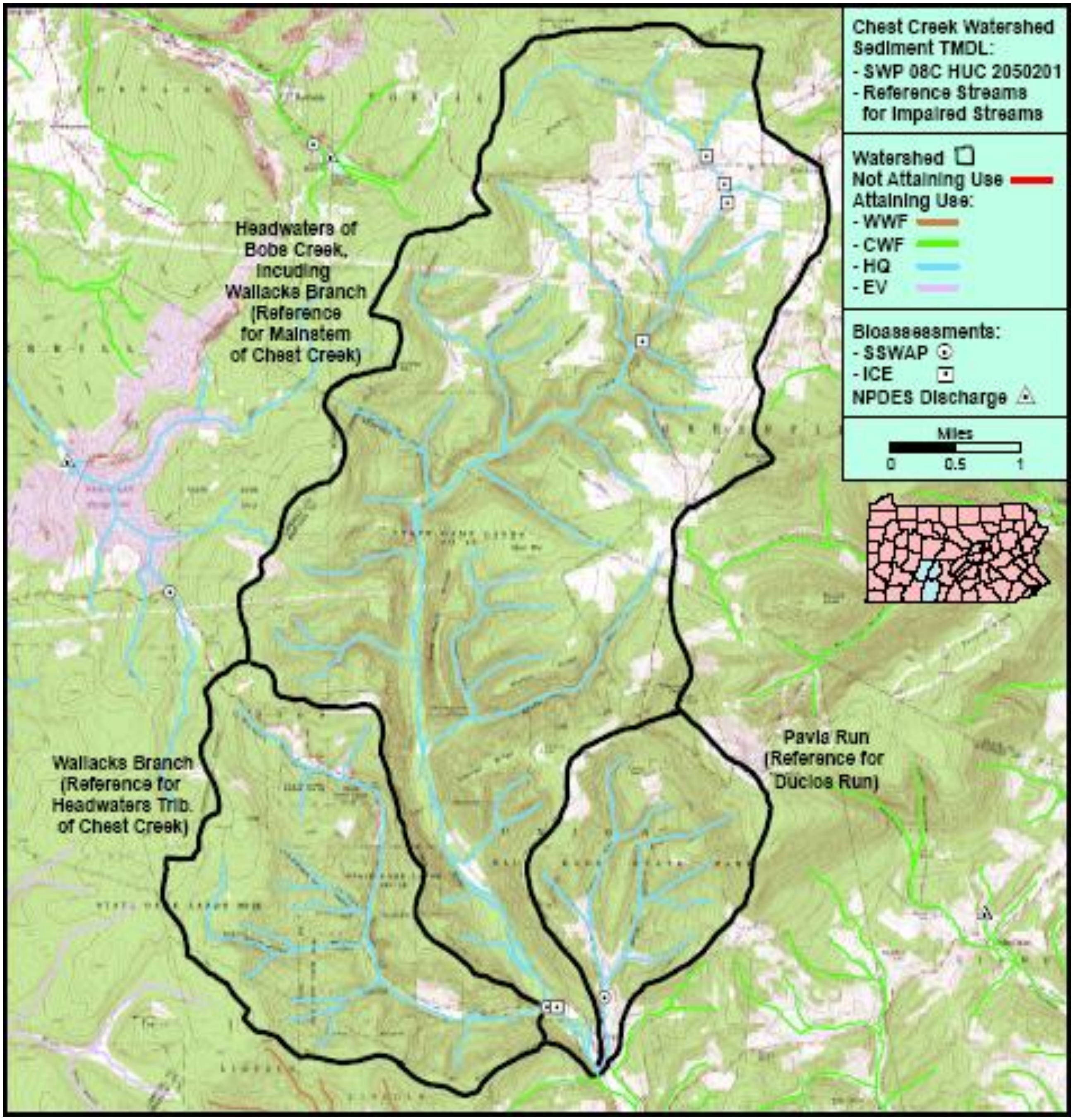


Figure 5. – Topography map of reference streams for impaired streams, upstream Chest Creek (Pavia Run, headwaters of Bobs Creek, & Wallacks Branch)

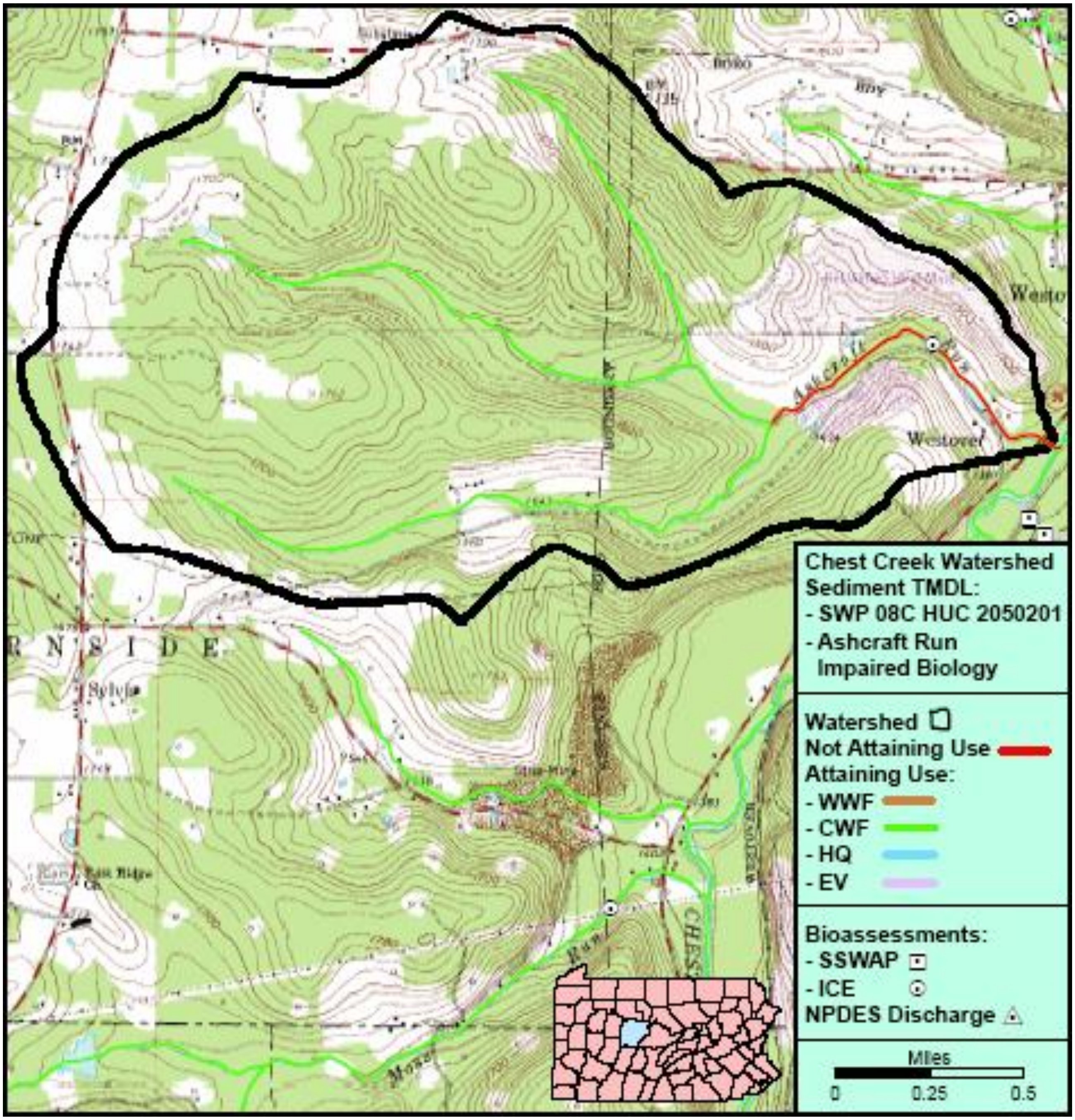


Figure 6. – Topography map of Ashcraft Run (impaired)

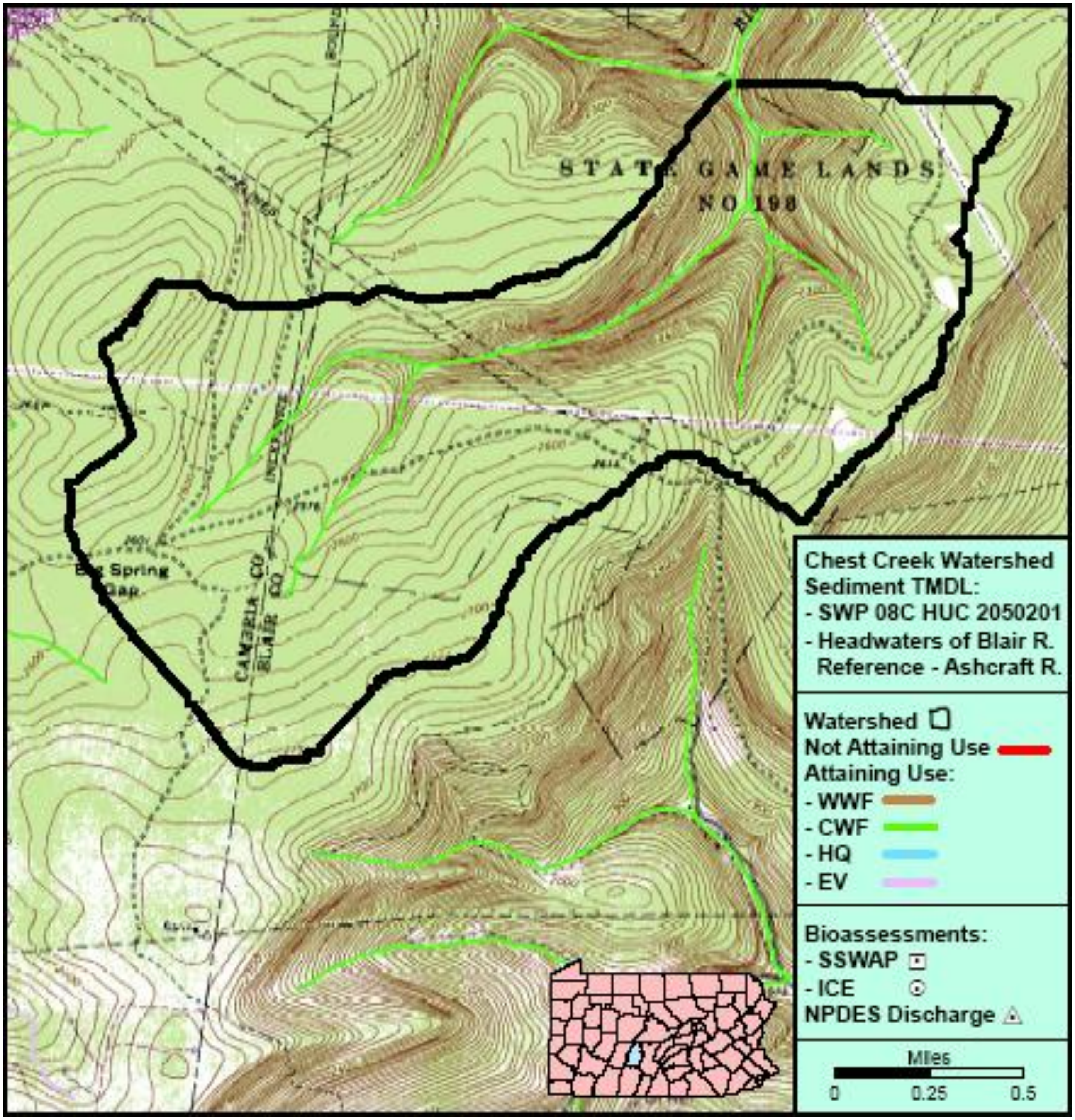


Figure 7. – Topography map of the headwaters of Blair Run (reference for Ashcraft Run)

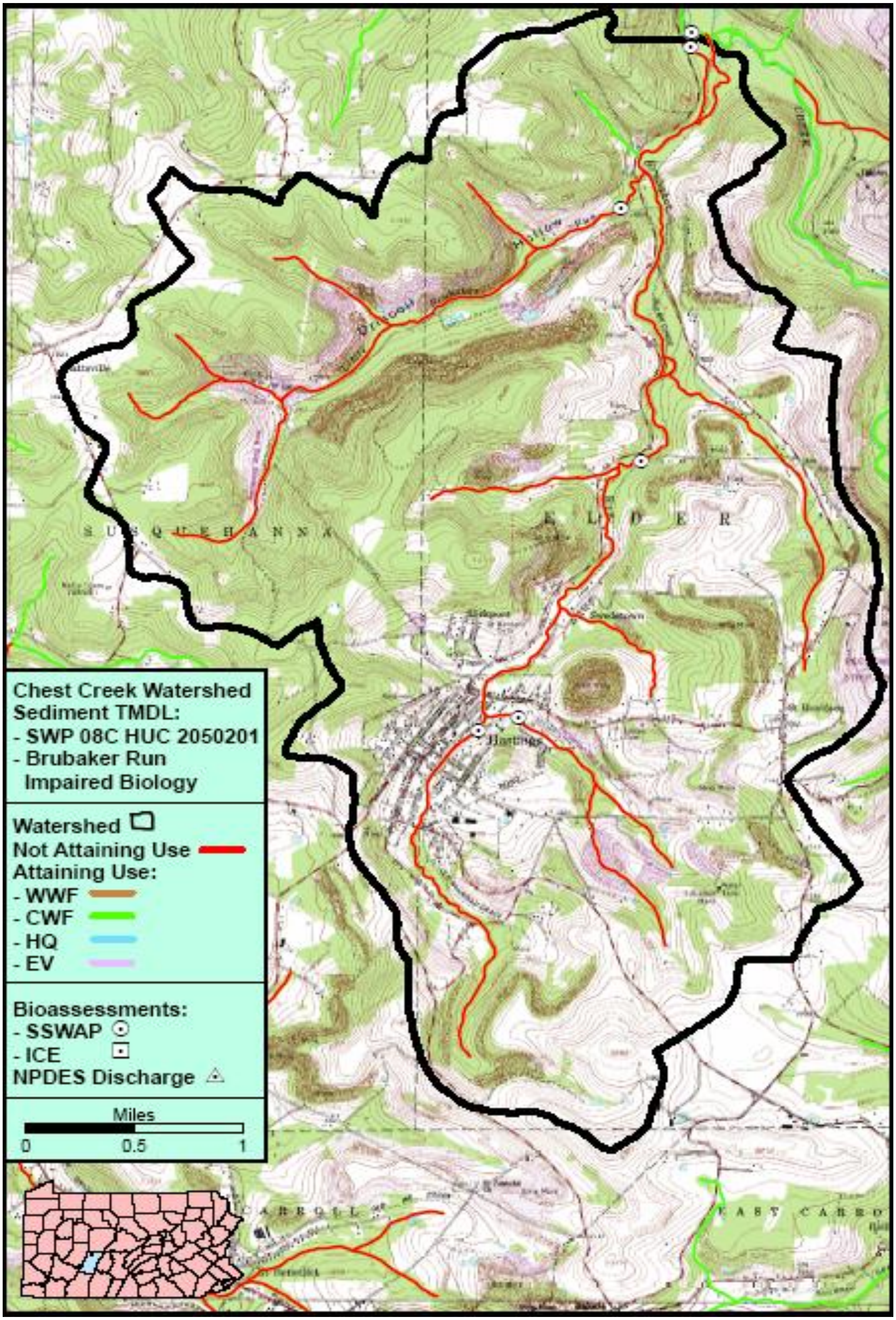


Figure 8. – Topography map of Brubaker Run (impaired)

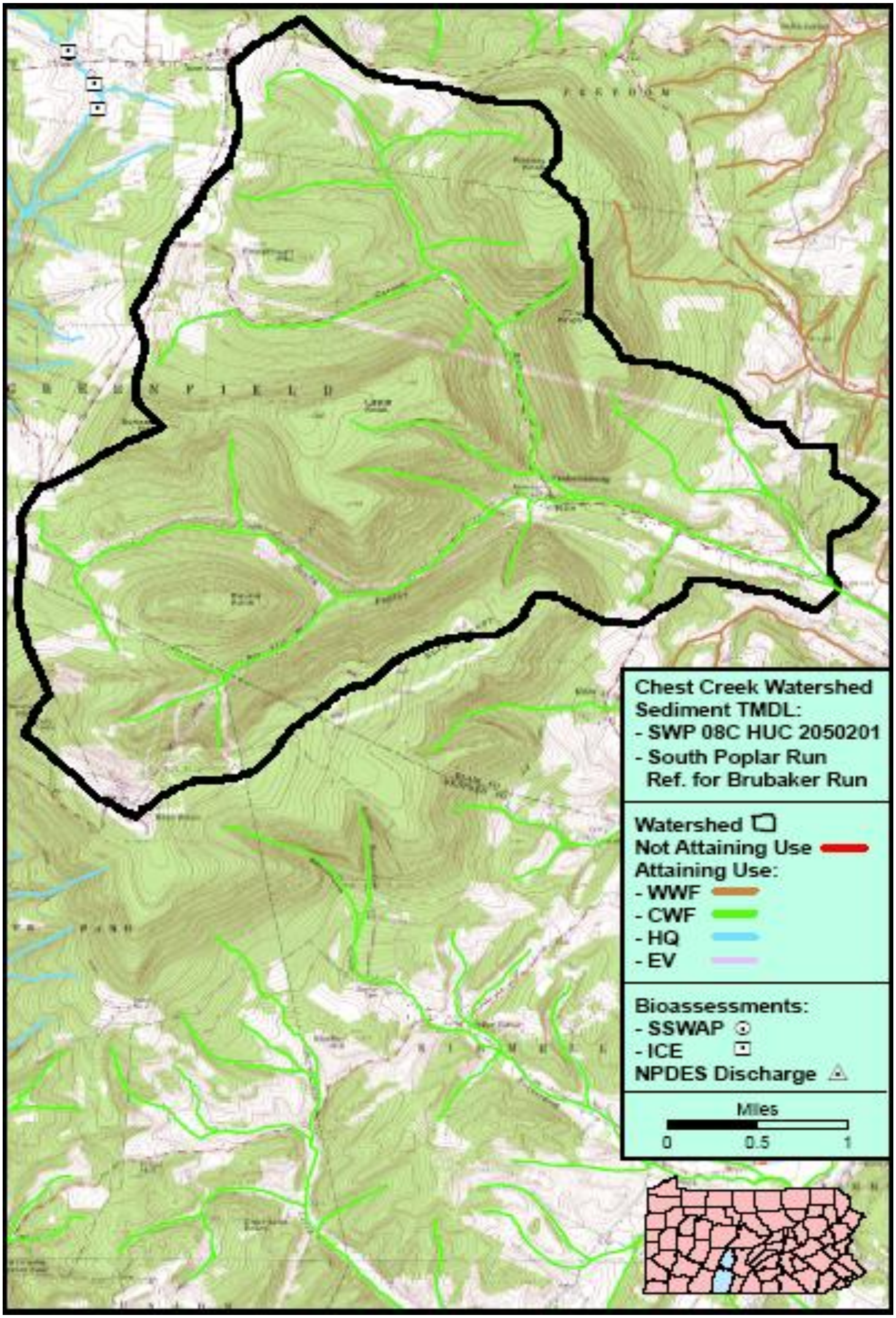


Figure 9. – Topography map of the South Poplar Run (reference for Brubaker Run)

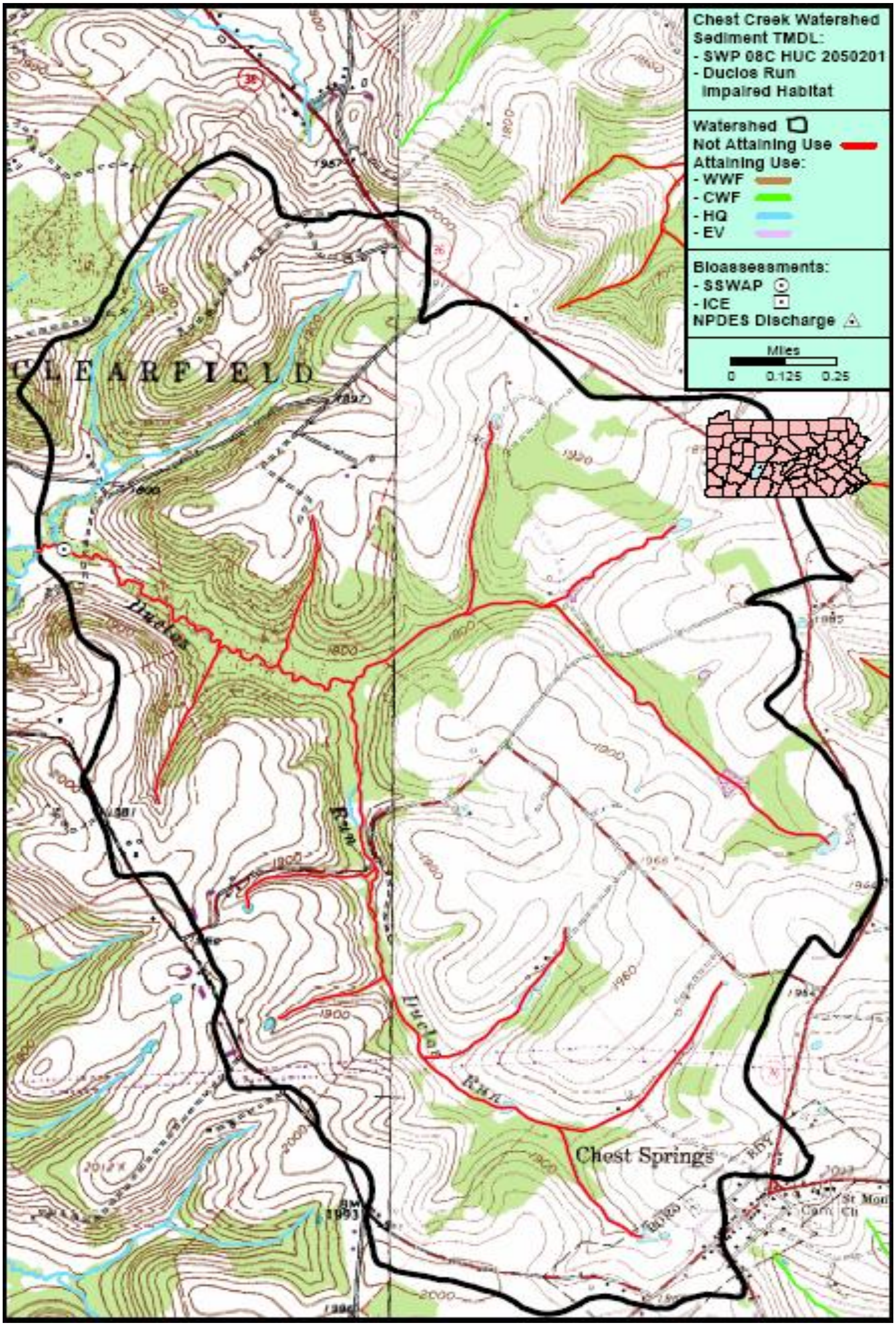


Figure 10. – Topography map of Duclos Run (impaired)

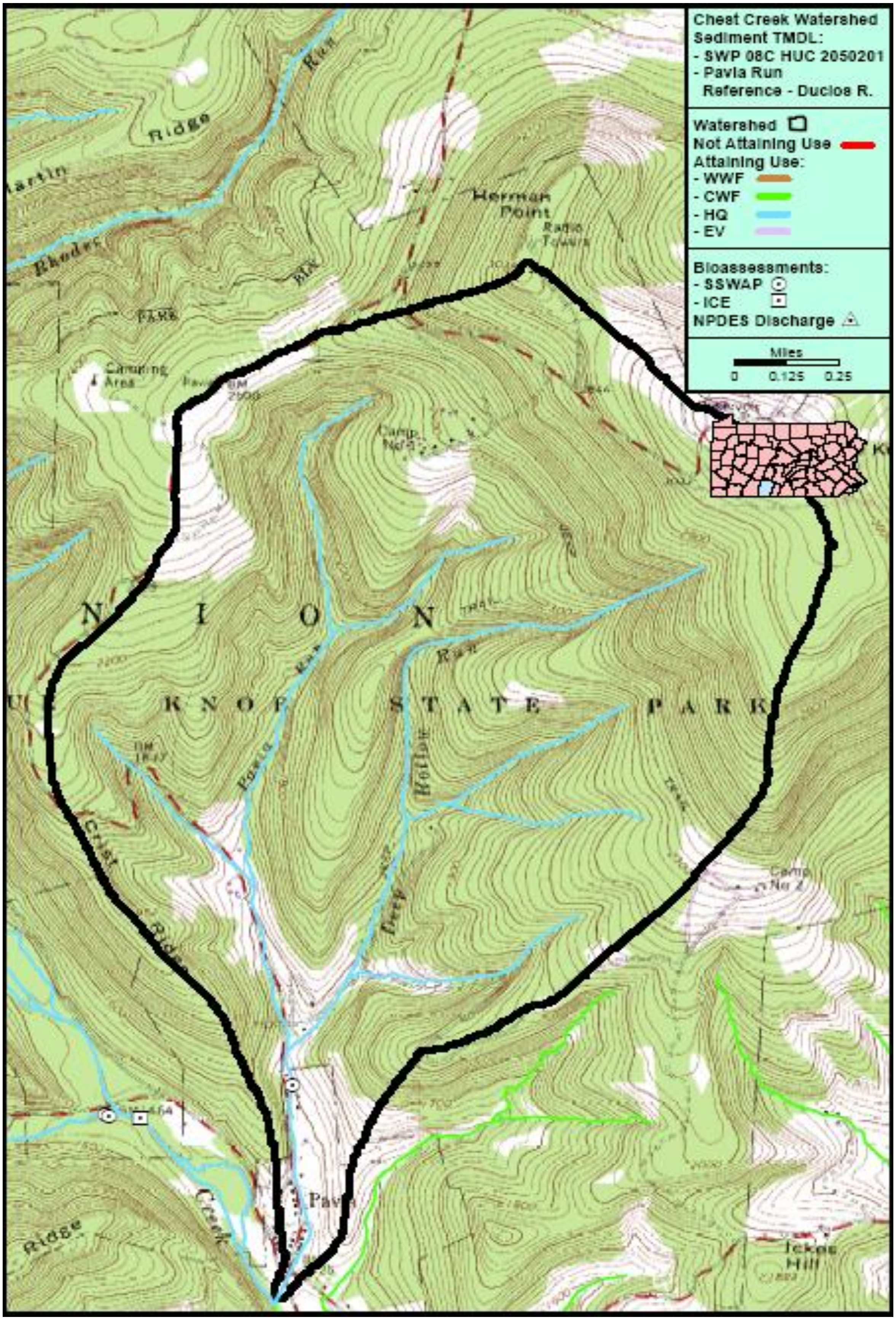


Figure 11. – Topography map Pavia Run (reference for Duclos Run)

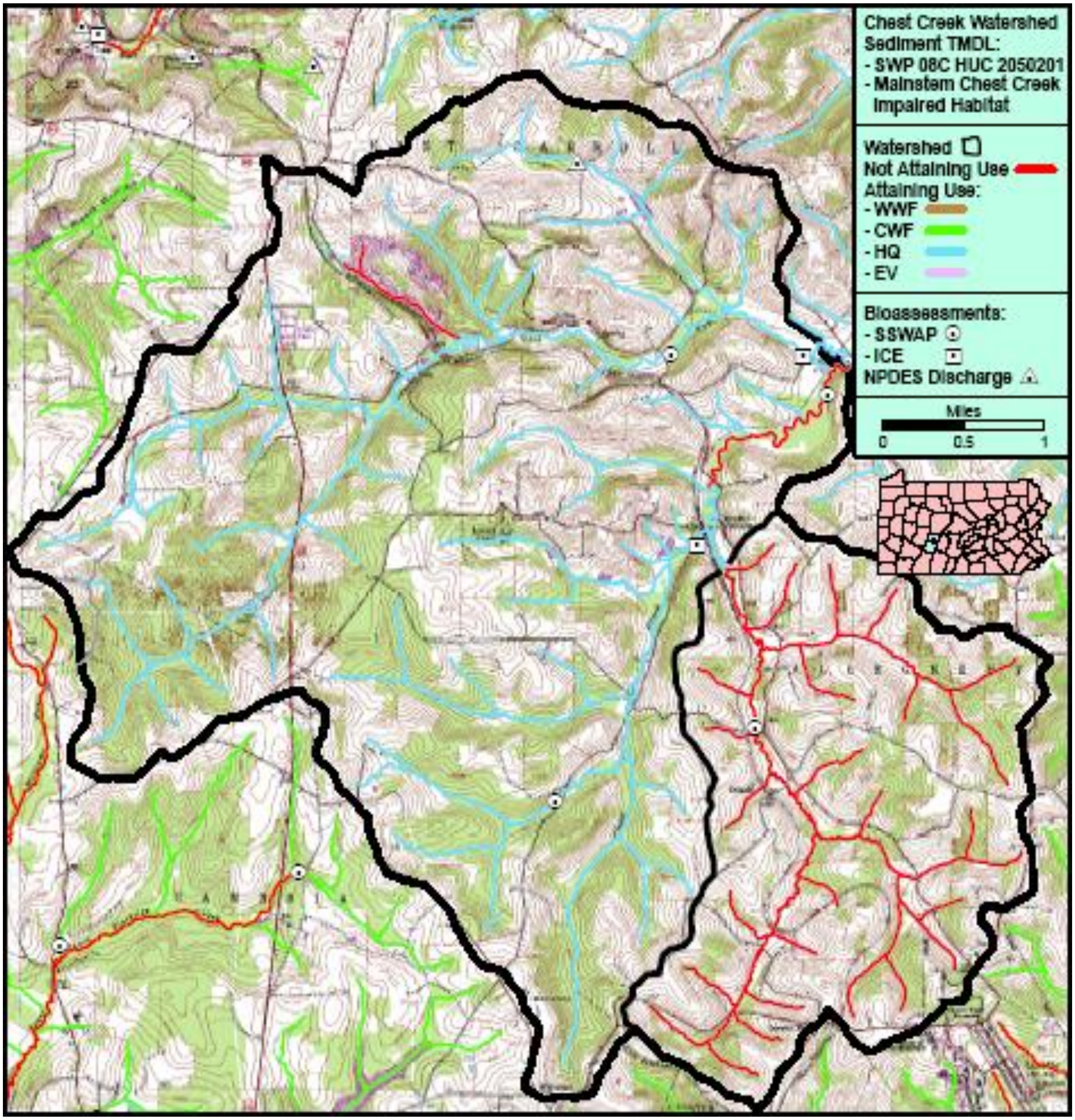


Figure 12. – Topography map of the mainstem of Chest Creek (impaired)

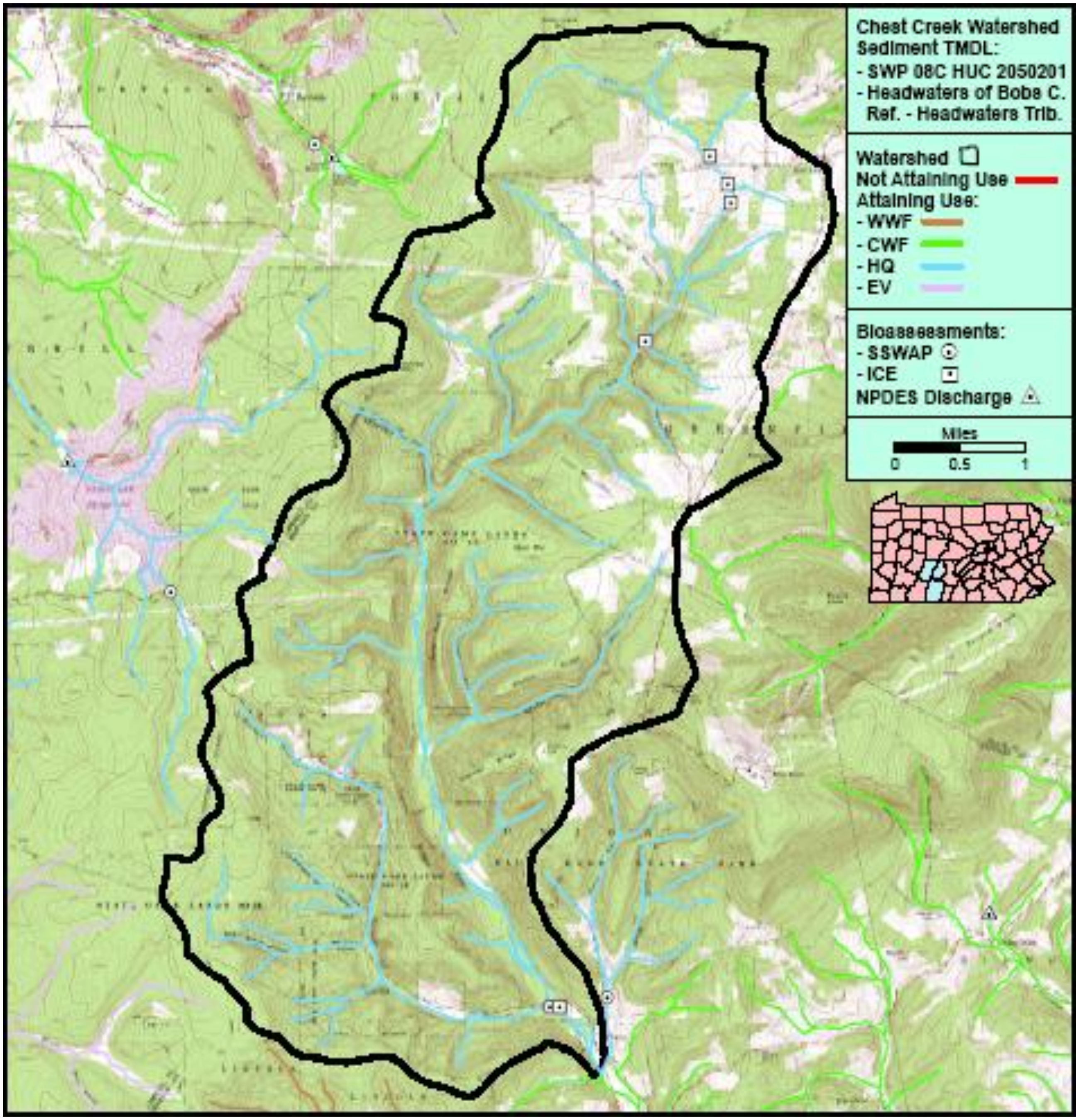


Figure 13. – Topography map of the headwaters of Bobs Creek
(reference for the mainstem of Chest Creek)

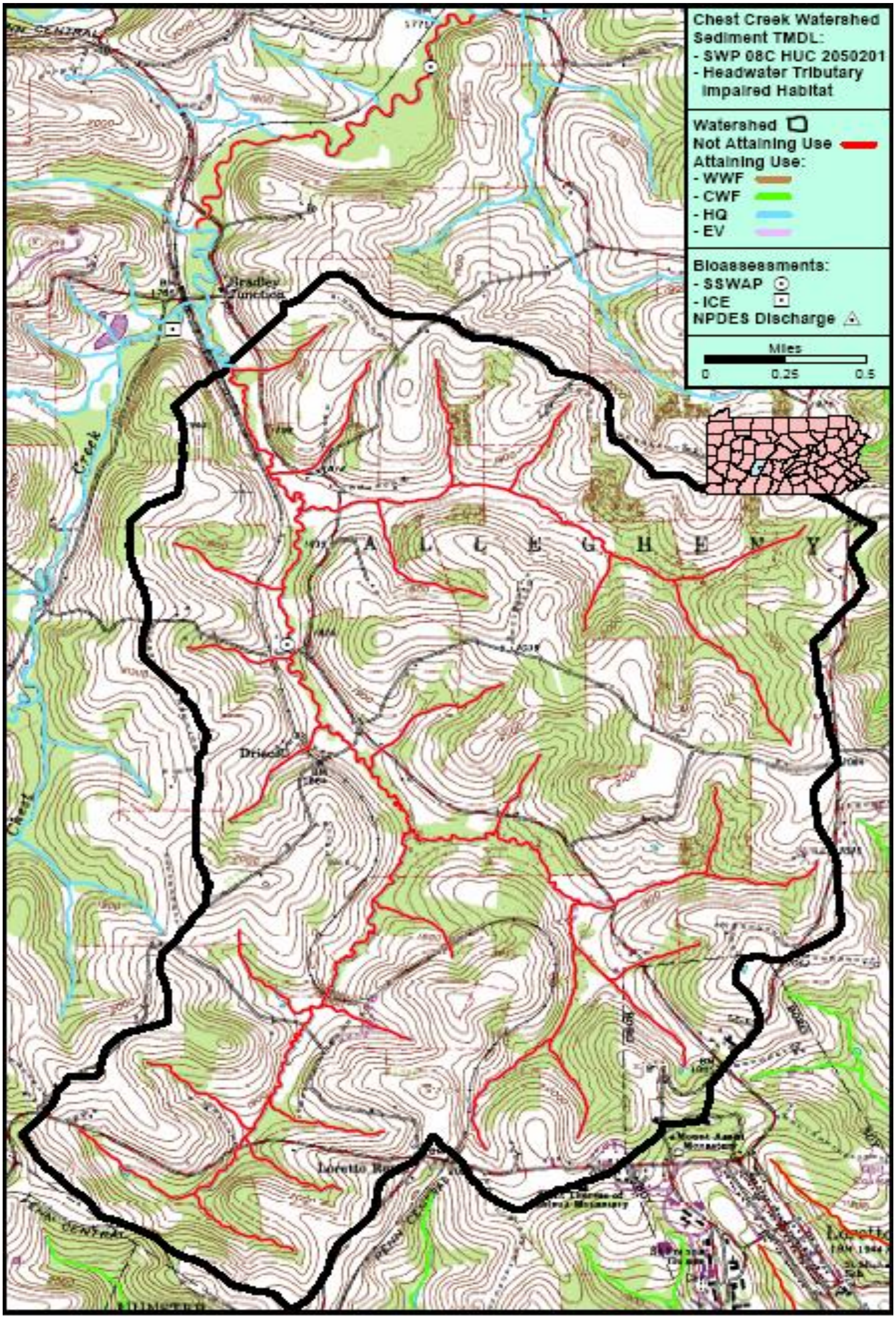


Figure 14. – Topography map of the headwaters tributary of Chest Creek (impaired)

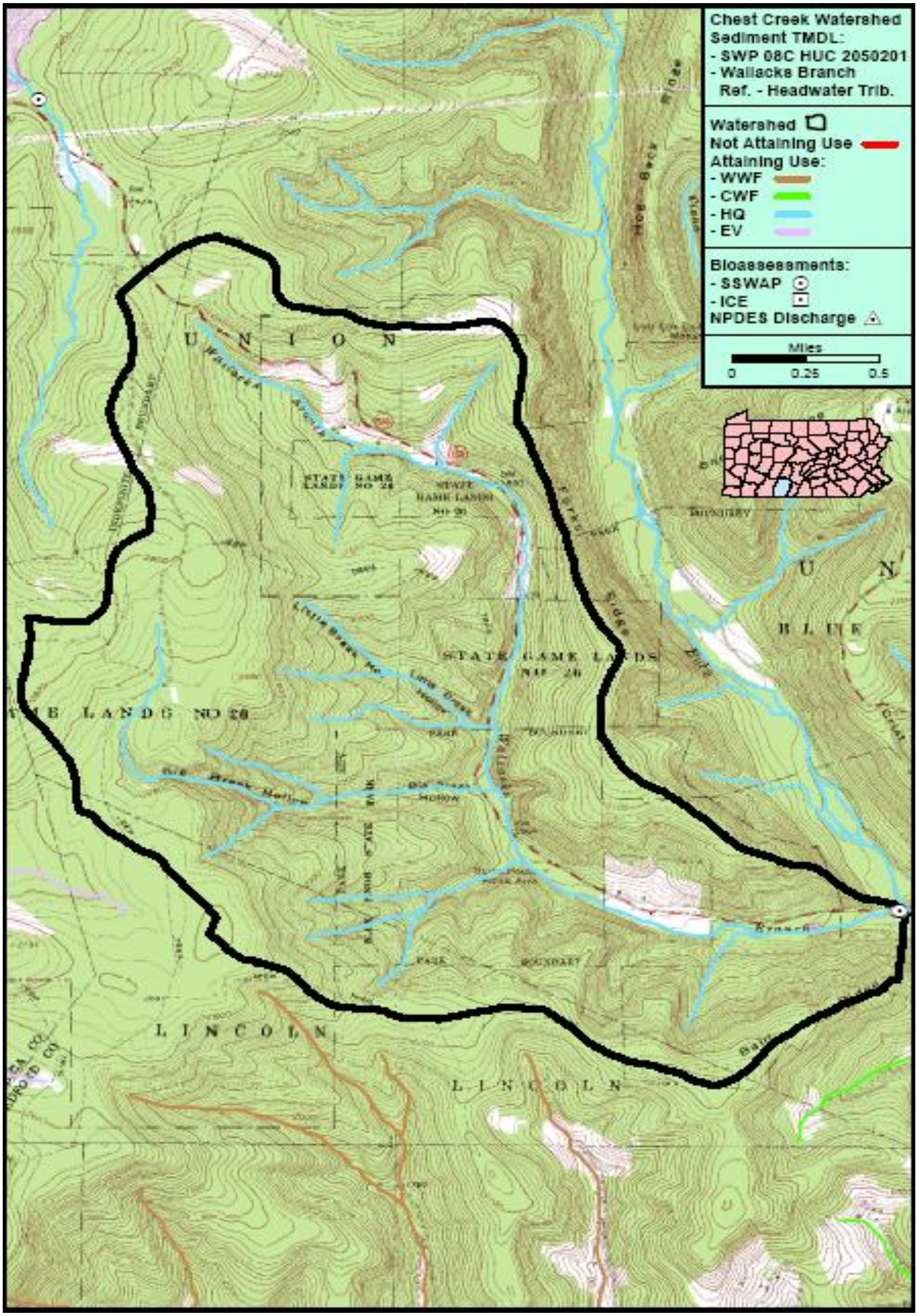


Figure 15. – Topography map of Wallacks Branch
(reference for the headwaters tributary of Chest Creek)

Hydrologic / Water Quality Modeling

Part 1. Model Overview & Data Compilation

The TMDL for this watershed was calculated using the ArcView Generalized Watershed Loading Function (AVGWLF) Interface for Windows, version 7.2.3. The remaining paragraphs in this section are excerpts from the GWLF User's Manual (Haith et al., 1992).

The core watershed simulation model for the AVGWLF software application is the GWLF (Generalized Watershed Loading Function) model developed by Haith and Shoemaker. The original DOS version of the model was re-written in Visual Basic by Evans et al. (2002) to facilitate integration with ArcView, and tested extensively in the U.S. and elsewhere.

The GWLF model provides the ability to simulate runoff and sediment load from a watershed given variable-size source areas (i.e., agricultural, forested, and developed land). It is a continuous simulation model that 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.

GWLF is considered to be a combined distributed/lumped parameter watershed model. For surface loading, it is distributed in the sense that it allows multiple land use/cover scenarios, but 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 simply aggregates the loads from each source 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 simply computed as the difference between precipitation and snowmelt minus surface runoff plus evapotranspiration.

With respect to the major processes simulated, GWLF models surface runoff using the Soil Conservation Service Curve Number, or 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 (i.e., 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 the conservation practices factor (P). A sediment delivery ratio based on watershed size and transport capacity, which is based on average daily runoff, is then applied to the calculated erosion to determine sediment yield for each source 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.

For execution, the model requires two separate input files containing transport and weather-related data. The transport (transport.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 weather (weather.dat) file contains daily average temperature and total precipitation values for each year simulated.

Since its initial incorporation into AVGWLF, the GWLF model has been revised to include a number of routines and functions not found in the original model. For example, a significant revision in one of the earlier versions of AVGWLF was the inclusion of a streambank erosion routine. This routine is based on an approach often used in the field of geomorphology in which monthly streambank erosion is estimated by first calculating a watershed-specific lateral erosion rate (LER). After a value for LER has been computed, the total sediment load generated via streambank erosion is then calculated by multiplying the above erosion rate by the total length of streams in the watershed (in meters), the average streambank height (in meters), and the average soil bulk density (in kg/m3).

The inclusion of the various model enhancements mentioned above has necessitated the need for several more input files than required by the original GWLF model, including a "scenario" (*.scn) file, an animal data (animal.dat) file. Also, given all of the new and recent revisions to the model, it has been renamed "GWLF-E" to differentiate it from the original model.

As alluded to previously, the use of GIS software for deriving input data for watershed simulation models such as GWLF is becoming fairly standard practice due to the inherent advantages of using GIS for manipulating spatial data. In this case, a customized interface developed by Penn State University for ArcView GIS software (versions 3.2 or 3.3) is used to parameterize input data for the GWLF-E model. In utilizing this interface, the user is prompted to load required GIS files and to provide other information related to various "non-spatial" model parameters (e.g., beginning and end of the growing season; the months during which manure is spread on agricultural land, etc.). This information is subsequently used to automatically derive values for required model input parameters which are then written to the appropriate input files needed to execute the GWLF-E model. Also accessed through the interface are Excel-formatted weather files containing daily temperature and precipitation information. (In the version of AVGWLF used in Pennsylvania, a statewide weather database was developed that contains about twenty-five (25) years of temperature and precipitation data for seventy-eight (78) weather stations around the state). This information is used to create the necessary weather.dat input file for a given watershed simulation.

Part 2. GIS Based Derivation of Input Data

The primary sources of data for this analysis were geographic information system (GIS) formatted databases and shapefiles. In using the AVGWLF 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 growing season, manure spreading period, etc.). This information is subsequently used to automatically derive values for required model input parameters, which are then written to the TRANSPRT.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 cropping practices. Complete GWLF-formatted weather files are also included for the seventy-eight weather stations around the state.

Table 5. lists GIS datasets and shapefiles used for the Chest Creek Watershed Sediment TMDL calculations via AVGWLF and provides explanations of how they were used for development of the input files for the GWLF model.

Table 5. GIS Datasets	
DATASET	**DESCRIPTION**
county.shp	The county boundaries coverage lists data on conservation practices which provides C and P values in the Universal Soil Loss Equation (USLE).
padem	100 meter digital elevation model; this is used to calculate landslope and slope length.
palumrlc	A satellite image derived land cover grid which is classified into 15 different landcover categories. This dataset provides landcover loading rates for the different categories in the model.
physprov.shp	A shapefile of physiographic provinces. This is used in rainfall erosivity calculations.
smallsheds.shp	A coverage of watersheds derived at 1:24,000 scale. This coverage is used with the stream network to delineate the desired level watershed.
streams.shp	The 1:24,000 scale single line stream coverage of Pennsylvania. Provides a complete network of streams with coded stream segments.
PAgeo	A shapefile of the surface geology used to compare watersheds of similar qualities.
weathersta.shp	Historical weather files for stations around Pennsylvania to simulate flow.
soils.shp	A shapefile providing soil characteristics data. This is used in multiple calculations.
zipcodes.shp	This shapefile provides animal density numbers used in the LER calculation.

In the GWLF model, the nonpoint source load calculated is affected by terrain conditions such as amount of agricultural land, land slope, and inherent soil erodibility. It is also affected by farming practices utilized in the area. Various parameters are included in the model to account for these conditions and practices. Some of the more important parameters are summarized below:

Areal extent of different land use/cover categories: This is calculated directly from a GIS layer of land use/cover.

Curve number: This determines the amount of precipitation that infiltrates into the ground or enters surface water as runoff. It is based on specified combinations of land use/cover and hydrologic soil type, and is calculated directly using digital land use/cover and soils layers.

K factor: This factor relates to inherent soil erodibility, and affects the amount of soil erosion taking place on a given unit of land.

LS factor: This factor signifies the steepness and length of slopes in an area and directly affects the amount of soil erosion.

C factor: This factor is related to the amount of vegetative cover in an area. In agricultural areas, the crops grown and the cultivation practices utilized largely control this factor. Values range from 0 to 1.0, with larger values indicating greater potential for erosion.
P factor: This factor is directly related to the conservation practices utilized in agricultural areas. Values range from 0 to 1.0, with larger values indicating greater potential for erosion.

Sediment delivery ratio: This parameter specifies the percentage of eroded sediment that is delivered to surface water and is empirically based on watershed size.

Unsaturated available water-holding capacity: This relates to the amount of water that can be stored in the soil and affects runoff and infiltration. It is calculated using a digital soils layer.

Other less important factors that can affect sediment loads in a watershed are also included in the model.

The above parameter descriptions were taken from the *AVGWLF Version 7.1 Users Guide* (Evans et al., 2007).

Watershed Assessment and Modeling

The AVGWLF model was used to establish existing loading conditions for the sediment-impaired segments of the Chest Creek Watershed (Ashcraft Run, Brubaker Run, Duclos Run, the mainstem of Chest Creek (headwaters), and a headwaters tributary of Chest Creek) and their corresponding reference watersheds (headwaters of Blair Run, headwaters of Poplar Run, Pavia Run, headwaters of Bobs Creek, and Wallacks Branch). All AVGWLF data and outputs have been attached to this TMDL as Attachment B. Department staff visited the listed watersheds to get a better understanding of existing conditions that might influence the AVGWLF model. The following summarizes details noted in the field, aerial maps, and field photographs, (specific topo. and aerial maps, and field photography in Appendix A.).

General observations of the individual watershed characteristics of Ashcraft Run and the headwaters of Blair Run included:

Ashcraft Run (impaired)

- Abandoned mine land with runoff cutting on dirt roads and slopes to stream
- Wetland/sediment build up behind in-stream empoundment

Headwaters of Blair Run (reference)

- Stable banks, variety of substrate and forested riparian buffering

Based on field observations adjustments may be made to specific parameters used in the AVGWLF model. These adjustments were as follows:

Ashcraft Run

- No changes to the model were necessary for the Ashcraft Run.

Headwaters of Blair Run

- No changes to the model were necessary for the headwaters of Blair Run.

General observations of the individual watershed characteristics of Brubaker Run and the South Poplar Run included:

Brubaker Run (impaired)

- Abandoned mine land a top surrounding slopes
- In-stream sediment/wetland build up near banks and bridges/culverts
- Turbid water coming from AML surface mines

- AML precipitation, particulate settling, and concretion of substrate

South Poplar Run (reference)

- Stable banks, variety of substrate and forested riparian buffering
- Well-developed riffle/run substrate
- No accumulation of sediment in pools
- Steep slopes forested to stream

Based on field observations adjustments may be made to specific parameters used in the AVGWLF model. These adjustments were as follows:

Brubaker Run (impaired)

- No changes to the model were necessary for the Brubaker Run.

South Poplar Run (reference)

- No changes to the model were necessary for the Pavia Run.

General observations of the individual watershed characteristics of Duclos Run and Pavia Run included:

Duclos Run (impaired)

- Minimally vegetated, old fields, sloping to stream
- Banks vulnerable to sediment build up during low flow
- High prone erosion with incised and slumping banks

Pavia Run (reference)

- Stable banks, variety of substrate and forested riparian buffering
- Well-developed riffle/run substrate
- Forested slopes to stream

Based on field observations adjustments may be made to specific parameters used in the AVGWLF model. These adjustments were as follows:

Duclos Run

- No changes to the model were necessary for the Duclos Run.

Pavia Run

- No changes to the model were necessary for the Pavia Run.

General observations of the individual watershed characteristics of mainstem of Chest Creek and the headwaters of Bobs Creek included:

Mainstem of Chest Creek (impaired)

- Sediment build up and substrate inundation
- Slumping banks, pooling, and a decrease in unproductive benthic substrate
- Minimized sediment transport

Headwaters of Bob Creek (reference)

- Well-developed riparian buffering
- Stable banks
- Fenced-off pastureland and tree plantings
- Extensive willow tree riparian buffering
- Clear water and a variety of substrate material, including gravel/cobble
- Forested slopes to stream
- Forested barrier from adjacent agriculture on slope to stream

Based on field observations adjustments may be made to specific parameters used in the AVGWLF model. These adjustments were as follows:

Mainstem of Chest Creek (impaired)

- The following changes to the model were necessary for the mainstem of Chest Creek: Cropland landuse, Cover factor of 0.42 was adjusted to 0.5

Headwaters of Bob Creek (reference)

- No changes to the model were necessary for the Bobs Creek.

General observations of the individual watershed characteristics of the headwaters tributary of Chest Creek and Wallacks Branch included:

Headwaters tributary of Chest Creek (impaired)

- Mature trees and other vegetation amongst slumping banks
- Alder and willow trees growing out of sediment hummocks
- Telephone pole amongst incised banks
- Minimal riparian buffering
- High prone erosion and slumping banks

Wallacks Branch (reference)

- Stable banks and well-developed riparian buffering
- Clear water and well-developed riffle/run substrate
- contour cropping

Based on field observations adjustments may be made to specific parameters used in the AVGWLF model. These adjustments were as follows:

Headwaters tributary of Chest Creek (impaired)

- The following changes to the model were necessary for the headwaters tributary to Chest Creek: Cropland landuse, Cover factor of 0.42 was adjusted to 0.6

Wallacks Branch (reference)

- No changes to the model were necessary for the Wallacks Branch.

The AVGWLF model produced area information and sediment loading based on land use (6a., 6b., 6c., 6d., and 6e. for impaired streams and 7a., 7b., 7c., 7d., and 7e. for references (Attachment B.)

Table 6a. Existing Loading Values for Ashcraft Run (impaired)			
Source	Area (ac)	Sediment (lbs)	Unit Area Load (lbs/ac/yr)
HAY/PAST	348.4	35,200.0	101.0
CROPLAND	39.5	38,200.0	967.1
FOREST	1,344.3	5,400.0	4.0
WETLAND	4.9	0.0	0.0
TRANSITION	0.0	0.0	0.0
LO_INT_DEV	22.2	1,200.0	54.1
Stream Bank		40,200.0	
Total	1,759.3	120,200.0	68.3

Table 7a. Existing Loading Values for headwaters of Blair R. (reference)			
Source	Area (ac)	Sediment (lbs)	Unit Area Load (lbs/ac/yr)
HAY/PAST	93.9	30,000.0	319.5
CROPLAND	9.9	12,400.0	1,252.5
FOREST	1,245.4	22,600.0	18.1
WETLAND	0.0	0.0	0.0
TRANSITION	0.0	0.0	0.0
LO_INT_DEV	0.0	0.0	0.0
Stream Bank		11,800.0	
Total	1,349.2	76,800.0	56.9

Table 6b. Existing Loading Values for Brubaker Run (impaired)			
Source	Area (ac)	Sediment (lbs)	Unit Area Load (lbs/ac/yr)
HAY/PAST	2,181.9	1,905,200.0	873.2
CROPLAND	1,047.7	12,170,200.0	11,616.1
FOREST	4,235.4	152,800.0	36.1
WETLAND	14.8	0.0	0.0
TRANSITION	27.2	339,800.0	12,492.6
LO_INT_DEV	642.5	252,600.0	393.2
COAL MINES	7.4	4,200.0	567.6
Stream Bank		676,600.0	
Total	8,156.9	15,501,400.0	1,900.4

Table 7b. Existing Loading Values for South Poplar Run (reference)			
Source	Area (ac)	Sediment (lbs)	Unit Area Load (lbs/ac/yr)
HAY/PAST	1,213.3	3,376,000.0	2,782.5
CROPLAND	306.4	3,764,200.0	4,152.9
FOREST	5,700.7	870,000.0	152.6
WETLAND	0.0	0.0	0.0
TRANSITION	9.9	219,800.0	22,202.0
LO_INT_DEV	200.2	56,400.0	281.7
Stream Bank		427,600.0	
Total	7,430.5	8,714,000.0	1,172.7

Table 6c. Existing Loading Values for Duclos Run (impaired)			
Source	Area (ac)	Sediment (lbs)	Unit Area Load (lbs/ac/yr)
HAY/PAST	437.4	39,200.0	89.6
CROPLAND	857.5	1,117,600.0	1,303.3
FOREST	689.4	2,800.0	4.1
WETLAND	7.4	0.0	0.0
TRANSITION	9.9	15,800.0	1,596.0
LO_INT_DEV	121.1	64,000.0	528.5
Stream Bank		3,800.0	
Total	2122.7	1,243,200.0	585.7

Table 7c. Existing Loading Values for the Pavia Run (reference)			
Source	Area (ac)	Sediment (lbs)	Unit Area Load (lbs/ac/yr)
HAY/PAST	160.6	463,400.0	2,885.4
CROPLAND	27.2	251,200.0	9,235.3
FOREST	1,576.5	182,600.0	115.8
WETLAND	0.0	0.0	0.0
TRANSITION	2.5	9,000.0	3,600.0
LO_INT_DEV	29.7	3,000.0	101.0
Stream Bank		47,400.0	
Total	1,796.5	956,600.0	532.5

Table 6d. Existing Loading Values for the mainstem Chest Cr. (impaired)			
Source	Area (ac)	Sediment (lbs)	Unit Area Load (lbs/ac/yr)
HAY/PAST	2,903.5	830,200.0	285.9
CROPLAND	2,510.6	8,531,600.0	3,398.2
FOREST	8,184.1	91,400.0	11.2
WETLAND	111.2	400.0	3.6
TRANSITION	7.4	9,000.0	1,216.2
LO_INT_DEV	622.7	106,000.0	170.2
COAL MINES	44.5	4,200.0	94.4
TURF GRASS	64.2	41,200.0	641.7
Stream Bank		2,707,800.0	
Total	14,448.2	12,340,075.6	854.1

Table 7d. Existing Loading Values for the headwaters of Bobs Creek (ref.)			
Source	Area (ac)	Sediment (lbs.)	Unit Area Load (lb/ac/yr)
HAY/PAST	1,650.7	1,313,200.0	795.5
CROPLAND	558.5	6,804,600.0	12,183.7
FOREST	11,641.1	716,200.0	61.5
WETLAND	17.3	0.0	0.0
TRANSITION	9.9	43,800.0	4,424.2
LO_INT_DEV	390.4	149,200.0	382.2
Stream Bank		1,327,000.0	
Total	14,267.9	10,354,000.0	725.7

Table 6e. Existing Loading Values for the headwaters tributary (imp.)			
Source	Area (ac)	Sediment (lbs)	Unit Area Load (lbs/ac/yr)
HAY/PAST	889.6	118,600.0	133.3
CROPLAND	719.1	2,089,400.0	2,905.6
FOREST	1,855.8	16,200.0	8.7
WETLAND	24.7	0.0	0.0
TRANSITION	4.9	5,000.0	1,020.4
LO_INT_DEV	160.6	19,200.0	119.6
Stream Bank		335,000.0	
Total	3,654.7	2,583,400.0	706.9

Table 7e. Existing Loading Values for Wallacks Branch (reference)			
Source	Area (ac)	Sediment (lbs)	Unit Area Load (lbs/ac/yr)
HAY/PAST	392.9	496,000.0	1,262.4
CROPLAND	56.8	990,800.0	17,443.7
FOREST	2,666.3	269,800.0	101.2
WETLAND	0.0	0.0	0.0
TRANSITION	0.0	0.0	0.0
LO_INT_DEV	71.7	66,800.0	931.7
Stream Bank		112,400.0	
Total	3,187.7	1,935,800.0	607.3

For Tables 6 and 7 the "stream bank" sediment loads are calculated by AVGWLF's stream bank routine. This routine uses stream bank (linear) miles rather than area.

Development of Sediment TMDL

The target TMDL value for the sediment-impaired segments of Chest Creek (Ashcraft Run, Brubaker Run, Duclos Run, the mainstem of Chest Creek (headwaters), and a headwaters tributary of Chest Creek) was established based on current loading rates for sediment in their corresponding reference watersheds (headwaters of Blair Run, South Poplar Run, Pavia Run, headwaters of Bobs Creek, and Wallacks Branch). See topography maps, figure 1.-5., page 19.-23., aerial maps, figure17.-20., page 56.-59., specific topo. and aerial maps, and field photography in Attachment A.). Reducing the loading rates of sediment in the headwaters of the Chest Creek Watershed to levels equal to, or less than, the reference watershed should allow for the reversal of current use impairments and maintain its CWF and HQ-CWF value.

As described in the previous section, sediment loading rates were computed for the reference watersheds using the AVGWLF model (Attachment B.). The target TMDL value for sediment was determined by multiplying the unit area loading rates for the reference watersheds by the total watershed area of impaired segments (Table 8a., 8b., 8c., 8d., and 8e).

Table 8a. TMDL Values for Ashcraft Run				
Pollutant	Loading Rate in Reference (lb/ac-yr)	Total Area Impaired Watershed (ac)	Target TMDL Value (lb/yr)	Target TMDL Value (lb/day)
Sediment	56.9	1,759.3	100,144.0*	274.4

Table 8b. TMDL Values for Brubaker Run				
Pollutant	Loading Rate in Reference (lb/ac-yr)	Total Area Impaired Watershed (ac)	Target TMDL Value (lb/yr)	Target TMDL Value (lb/day)
Sediment	1,172.7	8,156.9	9,565,874.0*	26,207.9

Table 8c. TMDL Values for Duclos Run				
Pollutant	Loading Rate in Reference (lb/ac-yr)	Total Area Impaired Watershed (ac)	Target TMDL Value (lb/yr)	Target TMDL Value (lb/day)
Sediment	532.5	2,122.7	1,130,294.9*	3,096.7

Table 8d. TMDL Values for the mainstem of Chest Creek				
Pollutant	Loading Rate in Reference (lb/ac-yr)	Total Area Impaired Watershed (ac)	Target TMDL Value (lb/yr)	Target TMDL Value (lb/day)
Sediment	725.7	14,448.2	10,484,841.0*	28,725.6

Table 8e. TMDL Values for the headwaters tributary of Chest Creek				
Pollutant	Loading Rate in Reference (lb/ac-yr)	Total Area Impaired Watershed (ac)	Target TMDL Value (lb/yr)	Target TMDL Value (lb/day)
Sediment	607.3	3,654.7	2,219,395.9*	6,080.5

* takes into account rounding in previous calculations

The target TMDL value was then used as the basis for load allocations and reductions in Ashcraft Run, Brubaker Run, Duclos Run, the mainstem of Chest Creek (headwaters), and the headwaters tributary of Chest Creek, using the following two equations:

1. TMDL = WLA + LA + MOS and LA = ALA + LNR

    where:

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

Waste Load Allocation

The waste load allocation (WLA) portion of the TMDL equation is the total loading of a pollutant that is assigned to point sources. A search of the Pennsylvania Department of Environmental Protection's (Department) efacts permit database identified one point source discharge within the sediment-impaired segments of the Chest Creek Watershed. An additional allocation of 1% of the TMDL (10,484,841.0 lbs./yr. for the mainstem of Chest Creek (headwaters)) was incorporated as a bulk reserve (104,848.4 lbs./yr.) for the dynamic nature of future permit activity. The WLA for NPDES permit number PA0111201 with one effluent into Laurel Lick (tributary to the headwaters of Chest Creek) is derived from the permit limit of a total suspended solids (TSS) concentration of 30 mg/L (monthly average) and the design flow for 0.2 million gallons per day (mgd). The WLA for the NPDES permit was adjusted at 18,275.6 lbs./yr. This permitted facility along with the bulk reserve account for a waste load allocation for sediment loading in the mainstem of Chest Creek (headwaters) at 123,124.0 lbs./yr.

WLA for NPDES = 0.2 mgd Flow * 30 mg/L monthly average concentration* 8.34* 365 = 18,275.6 lbs./yr.

WLA = 18,275.6 lbs./yr. or 50.1 lbs./day (WLA for NPDES permits) +
104,848.4 lbs./yr. or 287.3 lbs./day (1% Bulk Reserve)

WLA = 123,124.0 lbs./yr. or 337.3 lbs./day for the mainstem of Chest Creek (headwaters)

<u>Ashcraft Run:</u>
WLA = 1,001.4 lbs./yr. (1% Bulk Reserve of 100,144.0 lbs./yr. TMDL)
or
WLA = 2.7 lbs./day (TMDL) * 0.1 = 274.4 lbs./day

<u>Brubaker Run:</u>
WLA = 95,658.7 lbs./yr. (1% Bulk Reserve of 9,565,874.0 lbs./yr. TMDL)
or
WLA = 262.1 lbs./day (TMDL) * 0.1 = 26,207.9 lbs./day

<u>Duclos Run:</u>
WLA = 11,302.9 lbs./yr. (1% Bulk Reserve of 1,130,294.9 lbs./yr. TMDL)
or
WLA = 31.0 lbs./day (TMDL) * 0.1 = 3,096.7 lbs./day

<u>Mainstem of Chest Creek (headwaters):</u>
WLA = 123,124.0 lbs./yr. (1% Bulk Reserve of 10,484,841 lbs./yr. TMDL)
or
WLA = 337.3 lbs./day (TMDL) * 0.1 = 28,725.6 lbs./day

<u>Headwaters Tributary of Chest Creek:</u>
WLA = 22,194.0 lbs./yr. (1% Bulk Reserve of 2,219,395.9 lbs./yr. TMDL)
or
WLA = 60.8 lbs./day (TMDL) * 0.1 = 6,080.5 lbs./day

Margin of Safety

The margin of safety (MOS) is that portion of the pollutant loading that is reserved to account for any uncertainty in the data and computational methodology used for the analysis. For this analysis, the MOS is explicit. Ten percent of the targeted TMDL for sediment was reserved as the MOS. Using 10% of the TMDL load is based on professional judgment and will provide an additional level of protection to the designated uses of the sediment-impaired segments of Chest Creek. The MOS used for the sediment TMDL was set at 10,014.4 lbs./yr. for Ashcraft Run, 956, 587.4 lbs./yr., 113,029.5 lbs./yr for Duclos Run, 1,048,484.1 lbs./yr for the mainstem of Chest Creek, and 221,939.6 lbs./yr for the headwaters of Chest Creek.

<u>Ashcraft Run:</u>
MOS = 100,144.0 lbs./yr. (TMDL) * 0.1 = 10,014.4 lbs./yr.
or
MOS = 274.4 lbs./day (TMDL) * 0.1 = 27.4 lbs./day

Brubaker Run:
MOS = 9,565,874.0 lbs./yr. (TMDL) * 0.1 = 956,587.4 lbs./yr.
or
MOS = 26,207.9 lbs./day (TMDL) * 0.1 = 2,620.8 lbs./day
Duclos Run:
MOS = 1,130,294.9 lbs./yr. (TMDL) * 0.1 = 113,029.5 lbs./yr.
or
MOS = 3,096.7 lbs./day (TMDL) * 0.1 = 309.7 lbs./day

Mainstem of Chest Creek:
MOS = 10,484,841.0 lbs./yr. (TMDL) * 0.1 = 1,048,484.1 lbs./yr.
or
MOS = 28,725.6 lbs./day (TMDL) * 0.1 = 2,872.6 lbs./day

Headwaters Tributary of Chest Creek:
MOS = 2,219,395.9 lbs./yr. (TMDL) * 0.1 = 221,939.6 lbs./yr.
or
MOS = 6,080.5 lbs./day (TMDL) * 0.1 = 608.1 lbs./day

Load Allocation

The load allocation (LA) is that portion of the TMDL that is assigned to nonpoint sources. The LA for sediment was computed by subtracting the MOS value and the WLA from the TMDL value. The LA for sediment was 89,128.1 lbs./yr. for Ashcraft Run, 8,513,627.8 for Brubaker Run, 1,005,962.5 lbs./yr for Duclos Run, 9,313,232.9 lbs./yr for the mainstem of Chest Creek, and 1,975,262.3 lbs./yr for the headwaters of Chest Creek.

Ashcraft Run:
LA = 100,144.0 lbs./yr. (TMDL) – 10,014.4 lbs./yr. (MOS) – 1,001.4 lbs./yr. (WLA)= 89,128.1 lbs./yr.
or
LA = 274.4 lbs./day (TMDL) – 27.4 lbs./day (MOS) – 2.7 lbs./day (WLA)= 244.2 lbs./day

Brubaker Run:
LA = 9,565,874.0 lbs./yr. (TMDL) – 956,587.4 lbs./yr. (MOS) – 95,658.7 lbs./yr. (WLA)= 8,513,627.8 lbs./yr.
or
LA = 26,207.9 lbs./day (TMDL) – 2,620.8 lbs./day (MOS) – 262.1 lbs./day (WLA)= 23,325.0 lbs./day

Duclos Run:
LA = 1,130,294.9 lbs./yr. (TMDL) – 113,029.5 lbs./yr. (MOS) – 11,302.9 lbs./yr. (WLA)= 1,005,962.5 lbs./yr.
or
LA = 3,096.7 lbs./day (TMDL) – 309.7 lbs./day (MOS) – 0 lbs./day (WLA)= 2,756.1 lbs./day

Mainstem of Chest Creek:
LA = 10,484,841.0 lbs./yr. (TMDL) – 1,048,484.1 lbs./yr. (MOS) – 123,124.0 lbs./yr. (WLA)= 9,313,232.9 lbs./yr.
or
LA = 28,725.6 lbs./day (TMDL) – 2,872.6 lbs./day (MOS) – 337.3 lbs./day (WLA)= 25,515.7 lbs./day

Headwaters Tributary of Chest Creek:
LA = 2,219,395.9 lbs./yr. (TMDL) – 221,939.6 lbs./yr. (MOS) – 22,194.0 lbs./yr. (WLA)= 1,975,262.3 lbs./yr.
or
LA = 6,080.5 lbs./day (TMDL) – 608.1 lbs./day (MOS) – 60.8 lbs./day (WLA)= 5,411.7 lbs./day

Adjusted Load Allocation

The adjusted load allocation (ALA) is the actual portion of the LA distributed among those nonpoint sources receiving reductions. It is computed by subtracting those nonpoint source loads that are not being considered for reductions (loads not reduced (LNR)) from the LA. While the Chest Creek Watershed Sediment TMDL was developed to address impairments caused by agricultural activities including, hay/pastureland and cropland, they were not the only land uses considered for reductions. Transitional land and stream banks noted in the Chest Creek Watershed were believed to also be a contributor to the sediment load in the watershed. Land uses/source loads not reduced (LNR) were carried through at their existing loading (Table 9a., 9b., 9c., 9d., and 9e.).

Table 9a. Load Allocations, Loads Not Reduced and Adjusted Load Allocations (Ashcraft Run)

	Sediment (lbs./yr.)	Sediment (lbs./day)
Load Allocation	89,128.1	244.2
Loads Not Reduced:	6,600.0	18.1
Forest	5,400.0	14.8
Wetland	0.0	0.0
Low Intensity Development	1,200.0	3.3
Adjusted Load Allocation	82,528.1	226.1

Table 9b. Load Allocations, Loads Not Reduced and Adjusted Load Allocations (Brubaker Run)

	Sediment (lbs./yr.)	Sediment (lbs./day)
Load Allocation	8,513,627.8	23,325.0
Loads Not Reduced:	446,600.0	1,223.6
Forest	152,800.0	418.6
Wetland	0.0	0.0
Turf Grass	41,200.0	112.9
Low Intensity Development	252,600.0	692.1
Adjusted Load Allocation	8,067,027.8	22,101.4

Table 9c. Load Allocations, Loads Not Reduced and Adjusted Load Allocations (Duclos Run)

	Sediment (lbs./yr.)	Sediment (lbs./day)
Load Allocation	1,005,962.5	2,756.1
Loads Not Reduced:	66,800.0	183.0
Forest	2,800.0	7.7
Wetland	0.0	0
Low Intensity Development	64,000	175.3
Adjusted Load Allocation	939,162.5	2,573.0

Table 9d. Load Allocations, Loads Not Reduced and Adjusted Load Allocations (Mainstem of Chest Creek)

	Sediment (lbs./yr.)	Sediment (lbs./day)
Load Allocation	9,313,232.9	25,515.7

Loads Not Reduced: Forest Wetland Turf Grass Low Intensity Development	239,000.0 91,400.0 400.0 41,200.0 106,000.0	654.8 250.4 1.1 112.9 290.4
Adjusted Load Allocation	9,074,232.9	24,860.9

Table 9e. Load Allocations, Loads Not Reduced and Adjusted Load Allocations (Headwaters Tributary of Chest Creek)		
	Sediment (lbs./yr.)	Sediment (lbs./day)
Load Allocation	1,975,262.3	5,411.7
Loads Not Reduced: Forest Wetland Low Intensity Development	35,400.0 16,200.0 0 19,200.0	97.0 44.4 0 52.6
Adjusted Load Allocation	1,939,862.3	5,314.7

TMDL Summary

The sediment TMDL established for the Chest Creek Watershed consists of a Load Allocation (LA) and a Margin of Safety (MOS). The individual components of the Chest Creek Watershed TMDL are summarized in Table 10a., 10b., 10c., 10d., and 10e..

Table 10a. TMDL Components for Ashcraft Run		
Component	Sediment (lbs./yr.)	Sediment (lbs./day)
TMDL (Total Maximum Daily Load)	100,144.0	274.4
WLA (Waste Load Allocation)	1,001.4	2.7
MOS (Margin of Safety)	10,014.4	27.4
LA (Load Allocation)	89,128.1	244.2
LNR Loads Not Reduced)	6,600.0	18.1
ALA (Adjusted Load Allocation)	82,528.1	226.1

Table 10b. TMDL Components for Brubaker Run		
Component	Sediment (lbs./yr.)	Sediment (lbs./day)
TMDL (Total Maximum Daily Load)	9,565,874.0	26,207.9
WLA (Waste Load Allocation)	95,658.7	262.1
MOS (Margin of Safety)	956,587.4	2,620.8
LA (Load Allocation)	8,513,627.8	23,325.0
LNR Loads Not Reduced)	446,600.0	1,223.6
ALA (Adjusted Load Allocation)	8,067,027.8	22,101.4

Table 10c. TMDL Components for Duclos Run		
Component	Sediment (lbs./yr.)	Sediment (lbs./day)
TMDL (Total Maximum Daily Load)	1,130,294.9	3096.7
WLA (Waste Load Allocation)	11,302.9	31.0

MOS (Margin of Safety)	113,029.5	309.7
LA (Load Allocation)	1,005,962.5	2,756.1
LNR Loads Not Reduced)	66,800.0	183.0
ALA (Adjusted Load Allocation)	939,162.5	2,573.0

Table 10d. TMDL Components for the mainstem of Chest Creek		
Component	Sediment (lbs./yr.)	Sediment (lbs./day)
TMDL (Total Maximum Daily Load)	10,484,841.0	28,725.6
WLA (Waste Load Allocation)	123,124.0	337.3
MOS (Margin of Safety)	1,048,484.1	2,872.6
LA (Load Allocation)	9,313,232.9	25,515.7
LNR Loads Not Reduced)	239,000.0	654.8
ALA (Adjusted Load Allocation)	9,074,232.9	24,860.9

Table 10e. TMDL Components for the headwaters tributary of Chest Creek		
Component	Sediment (lbs./yr.)	Sediment (lbs./day)
TMDL (Total Maximum Daily Load)	2,219,395.9	6,080.5
WLA (Waste Load Allocation)	22,194.0	60.8
MOS (Margin of Safety)	221,939.6	608.1
LA (Load Allocation)	1,975,262.3	5,411.7
LNR Loads Not Reduced)	35,400.0	97.0
ALA (Adjusted Load Allocation)	1,939,862.3	5,314.7

Calculation of Sediment Load Reductions

The adjusted load allocation established in the previous section represents the sediment load that is available for allocation between Hay/Pasture, Cropland, transitional lands and stream banks in the UNT 07251 Watershed. Data needed for load reduction analyses, including land use distribution, were obtained by GIS analysis. The Equal Marginal Percent Reduction (EMPR) allocation method, Attachment B, was used to distribute the ALA between the three land use types and stream banks. The process is summarized below:

1. Each land use/source load is compared with the total allocable load to determine if any contributor would exceed the allocable load by itself. The evaluation is carried out as if each source is the only contributor to the pollutant load to the receiving waterbody. If the contributor exceeds the allocable load, that contributor would be reduced to the allocable load. This is the baseline portion of EMPR. For this evaluation Cropland was in excess of the adjusted load allocation (ALA).

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 total allocable load. If the allocable load 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. For this evaluation the allocable load was exceeded. The equal percent reduction, i.e., the ALA divided by the summation of the baselines, worked out to specific reductions for the following sediment-impaired segments of Chest Creek: Ashcraft Run to 27.4%, Brubaker Run 46.5%, Duclos Run to 20.2 %, the mainstem of Chest Creek (headwaters) to 24.9%, and a headwaters tributary of Chest Creek to 23.9%.

Tables 11a., 11b., 11c., 11d., and 11e. (Annual Values) and 12a., 12b., 12c., 12d., and 12e. (Daily Values) contain the results of the EMPR for hay/pasture, cropland, transitional land, stream banks, and coal mines in the sediment-impaired segments of the Chest Creek Watershed (Attachment B.). The load allocation for each land use is shown along with the percent reduction of current loads necessary to reach the targeted LA.

Table 11a. Sediment Load Allocations/Reductions for Land Uses and Stream Banks in the Ashcraft Run (Annual Values)

		Current Loading	Allowable Loading	Current Load	Load Allocation	
Land Use	Acres	(lbs./acre/yr.)	(lbs./acre/yr.)	(lbs./yr.)	(lbs./yr.)	% Reduction
Cropland	39.5	967.1	702.6	38,200.0	27,751.5	27.4
Hay/Pasture	348.4	101.0	73.4	35,200.0	25,572.1	27.4
Stream bank				40,200.0	29,204.5	27.4

Table 12a. Sediment Load Allocations/Reductions for Land Uses and Stream Banks in the Ashcraft Run (Daily Values)

		Current Loading	Allowable Loading	Current Load	Load Allocation	
Land Use	Acres	(lbs./acre/day)	(lbs./acre/day)	(lbs./day)	(lbs./day)	% Reduction
Cropland	39.5	2.6	1.9	104.7	76.0	27.4
Hay/Pasture	348.4	0.3	0.2	96.4	70.1	27.4
Stream bank				110.1	80.0	27.4

Table 11b. Sediment Load Allocations/Reductions for Land Uses and Stream Banks in the Brubaker Run (Annual Values)

		Current Loading	Allowable Loading	Current Load	Load Allocation	
Land Use	Acres	(lbs./acre/yr.)	(lbs./acre/yr.)	(lbs./yr.)	(lbs./yr.)	% Reduction
Cropland	1,047.7	11,616.1	5,650.4	12,170,200.0	5,919,945.2	51.4
Hay/Pasture	2,181.9	873.2	640.8	1,905,200.0	1,398,120.8	26.6
Transitional Land	27.2	12,492.6	9,167.7	339,800.0	249,360.4	26.6
Coal Mines	7.0	567.57	416.5	4,200.0	3,082.1	26.6
Stream bank				676,600.0	496,519.3	26.6

Table 12b. Sediment Load Allocations/Reductions for Land Uses and Stream Banks in the Brubaker Run (Daily Values)

		Current Loading	Allowable Loading	Current Load	Load Allocation	
Land Use	Acres	(lbs./acre/day)	(lbs./acre/day)	(lbs./day)	(lbs./day)	% Reduction
Cropland	1,047.7	31.8	15.5	33,343.0	16,219.0	51.4
Hay/Pasture	2,181.9	2.4	1.8	5,219.7	3,830.5	26.6

Transitional Land	27.2	34.2	25.1	931.0	683.2	26.6
Coal Mines	7.0	1.6	1.1	11.5	8.4	26.6
Stream bank				1,853.7	1,360.3	26.6

Table 11c. Sediment Load Allocations/Reductions for Land Uses and Stream Banks in the Duclos Run (Annual Values)

Land Use	Acres	Current Loading (lbs./acre/yr.)	Allowable Loading (lbs./acre/yr.)	Current Load (lbs./yr.)	Load Allocation (lbs./yr.)	% Reduction
Cropland	857.5	1,303.3	1,030.7	1,117,600.0	883,827.0	20.9
Hay/Pasture	437.4	89.6	84.3	39,200.0	36,890.3	5.9
Transitional Land	9.9	1,596.0	1,501.9	15,800.0	14,869.1	5.9
Stream bank				3,800.0	3,576.0	5.9

Table 12c. Sediment Load Allocations/Reductions for Land Uses and Stream Banks in the Duclos Run (Daily Values)

Land Use	Acres	Current Loading (lbs./acre/day)	Allowable Loading (lbs./acre/day)	Current Load (lbs./day)	Load Allocation (lbs./day)	% Reduction
Cropland	857.5	3.6	2.9	3,061.9	2,421.4	20.9
Hay/Pasture	437.4	0.2	0.2	107.4	101.1	5.9
Transitional Land	9.9	4.4	4.1	43.3	40.7	5.9
Stream bank				10.4	9.80	5.9

Table 11d. Sediment Load Allocations/Reductions for Land Uses and Stream Banks in the mainstem of Chest Creek (Annual Values)

Land Use	Acres	Current Loading (lbs./acre/yr.)	Allowable Loading (lbs./acre/yr.)	Current Load (lbs./yr.)	Load Allocation (lbs./yr.)	% Reduction
Cropland	2,510.6	3,398.2	2,552.1	8,531,600.0	6,407,267.0	24.9
Hay/Pasture	2,903.5	285.9	214.7	830,200.0	623,483.6	24.9
Transitional Land	7.4	1216.2	913.4	9,000.0	6,759.0	24.9
Coal Mines	44.5	94.4	70.9	4,200.0	3154.2	24.9
Stream bank				2,707,800.0	2,033,569.0	24.9

Table 12d. Sediment Load Allocations/Reductions for Land Uses and Stream Banks in the mainstem of Chest Creek (Daily Values)

Land Use	Acres	Current Loading (lbs./acre/day)	Allowable Loading (lbs./acre/day)	Current Load (lbs./day)	Load Allocation (lbs./day)	% Reduction
Cropland	2,510.6	9.3	7.0	23,374.2	17,554.2	25.1
Hay/Pasture	2,903.5	0.8	0.6	2,274.5	1,708.7	25.1

Transitional Land	7.4	3.3	2.5	24.7	18.5	25.1
Coal Mines	44.5	0.3	0.2	11.5	8.6	25.1
Stream bank				7,418.6	5,571.4	25.1

Table 11e. Sediment Load Allocations/Reductions for Land Uses and Stream Banks in the headwaters tributary of Chest Creek (Annual Values)

		Current Loading	Allowable Loading	Current Load	Load Allocation	
Land Use	Acres	(lbs./acre/yr.)	(lbs./acre/yr.)	(lbs./yr.)	(lbs./yr.)	% Reduction
Cropland	719.1	2,905.6	2,281.8	2,089,400.0	1,568,949.3	24.9
Hay/Pasture	889.6	133.3	107.8	118,600.0	95,923.0	19.1
Transitional Land	4.9	1,020.4	825.3	5,000.0	4,044.0	19.1
Stream banks				335,000.0	270,946.0	19.1

Table 12e. Sediment Load Allocations/Reductions for Land Uses and Stream Banks in the headwaters tributary of Chest Creek (Daily Values)

		Current Loading	Allowable Loading	Current Load	Load Allocation	
Land Use	Acres	(lbs./acre/day)	(lbs./acre/day)	(lbs./day)	(lbs./day)	% Reduction
Cropland	719.1	8.0	6.3	5,724.4	4,298.5	24.9
Hay/Pasture	889.6	0.4	0.3	324.9	262.8	19.1
Transitional	4.9	2.8	2.3	13.7	11.1	19.1
Stream banks				917.8	742.3	19.1

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 daily water balance accumulated in 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 this TMDL 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.

Consideration of Background Contributions

The AVGWLF model accounts for all landuses within the watershed and their respective contributions to the sediment load. The only background sources of sediment within the watershed would be from forested areas. There are no additional “upstream” sources of sediment to this watershed. The remaining landuses are anthropogenic sources of sediment to the watershed, thus will not be considered background.

Recommendations

Sediment reduction in the TMDL is allocated to nonpoint sources in the watershed including: agricultural activities, transitional lands and stream banks. Implementation of best management practices (BMPs) in these affected areas are called for according to this TMDL document. The proper implementation of these BMPs should achieve the loading reduction goals established in the TMDL.

From an agricultural perspective, reductions in the amount of sediment reaching the streams in the watershed can be made through the right combination of BMPs including, but not limited to: establishment of cover crops, strip cropping, residue management, no till, crop rotation, contour farming, terracing, stabilizing heavy use areas and proper management of storm water. Vegetated or forested buffers are acceptable BMPs to intercept any runoff from farm fields. For the pasturing of farm animals and animal heavy use areas, acceptable BMPs may include: manure storage, rotational grazing, livestock exclusion fencing and forested riparian buffers. Some of these BMPs were observed in the sediment-impaired segments of the Chest Creek Watershed (Ashcraft Run, Brubaker Run, Duclos Run, mainstem (headwaters), and headwaters tributary); however, they were more extensively used in the unimpaired, reference watersheds (headwaters of Blair Run, South Poplar Run, Pavia Run, headwaters of Bobs Creek, and Wallacks Branch), with forested riparian buffers being the predominant BMP in use. Since most watersheds have a considerable amount of agricultural activities, it is apparent that the greater use of BMPs, especially forested riparian buffers, in the reference streams have contributed to there ability to maintain there attainment status as a Cold Waters Fishery (CWF) and High Quality Waters-Cold Waters Fishery (HQ-CWF).

Stream banks contribute to the sediment load in the sediment-impaired segments of the Chest Creek Watershed. Stream bank stabilization projects would be acceptable BMPs for the eroded stream banks in the area. However, the establishment of forested riparian buffers is the most economical and effective BMP at providing stream bank stabilization and protection of the banks from freeze/thaw erosion and scouring flows. Forested riparian buffers are also essential to maintaining the biologically rich yet sensitive CWF and HQ-CWF habitat. Forested riparian buffers also provide important natural and durable connectivity of land and water. This connectivity is necessary to provide cover, nesting and nursery sites, shade and stable temperatures, and viable substrate for aquatic organisms of all layers of the food web protected under the CWF and HQ-CWF use designation.

Important to TMDLs, established forested riparian buffers act as nutrient and sediment sinks. This is because the highly active and concentrated biological communities they maintain will assimilate and remove nutrients and sediment from the water column instead of allowing them to pass downstream, thus forested riparian buffers work directly toward attaining the goals of the TMDL by reducing pollutant loads. These forested riparian buffers also provide the essential conditions necessary to meet the CWF and HQ-CWF designated use of the waterway. Forested riparian buffers also provide critical habitat to rare and sensitive amphibious and terrestrial organisms as well as migratory species. While forested riparian buffers are considered the most effective BMP, other possibilities for attaining the desired reductions may exist for the agricultural usages, as well as for the stream banks.

For both the agricultural landuses, further ground truthing should be performed in order to assess both the extent of existing BMPs, and to determine the most cost effective and environmentally protective combination of BMPs required for meeting the sediment reductions outlined in this report. A combined effort involving key personnel from the regional DEP office, the Cambria County Conservation District, Susquehanna River Basin Commission (SRBC) and other state and local agencies and/or watershed groups would be the most effective in accomplishing any ground truthing exercises. Development of a more detailed watershed implementation plan is recommended.

Public Participation

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on May 28, 2011 to foster public comment on the allowable loads calculated. No comments affecting this TMDL were offered.

Literature Cited

Haith, D. A.; Mandel, R.; Wu, R. S. for Cornell University *Generalized Watershed Loading Functions Version 2.0 User's Manual*; Ithaca, NY, 1992.

Evans, B. M.; Lehning, D. W.; Corradini, K. J. for The Pennsylvania State University *AVGWLF Version 7.1 Users Guide*; University Park, PA, 2007

Attachment A
Aerial Maps and Field Photographs

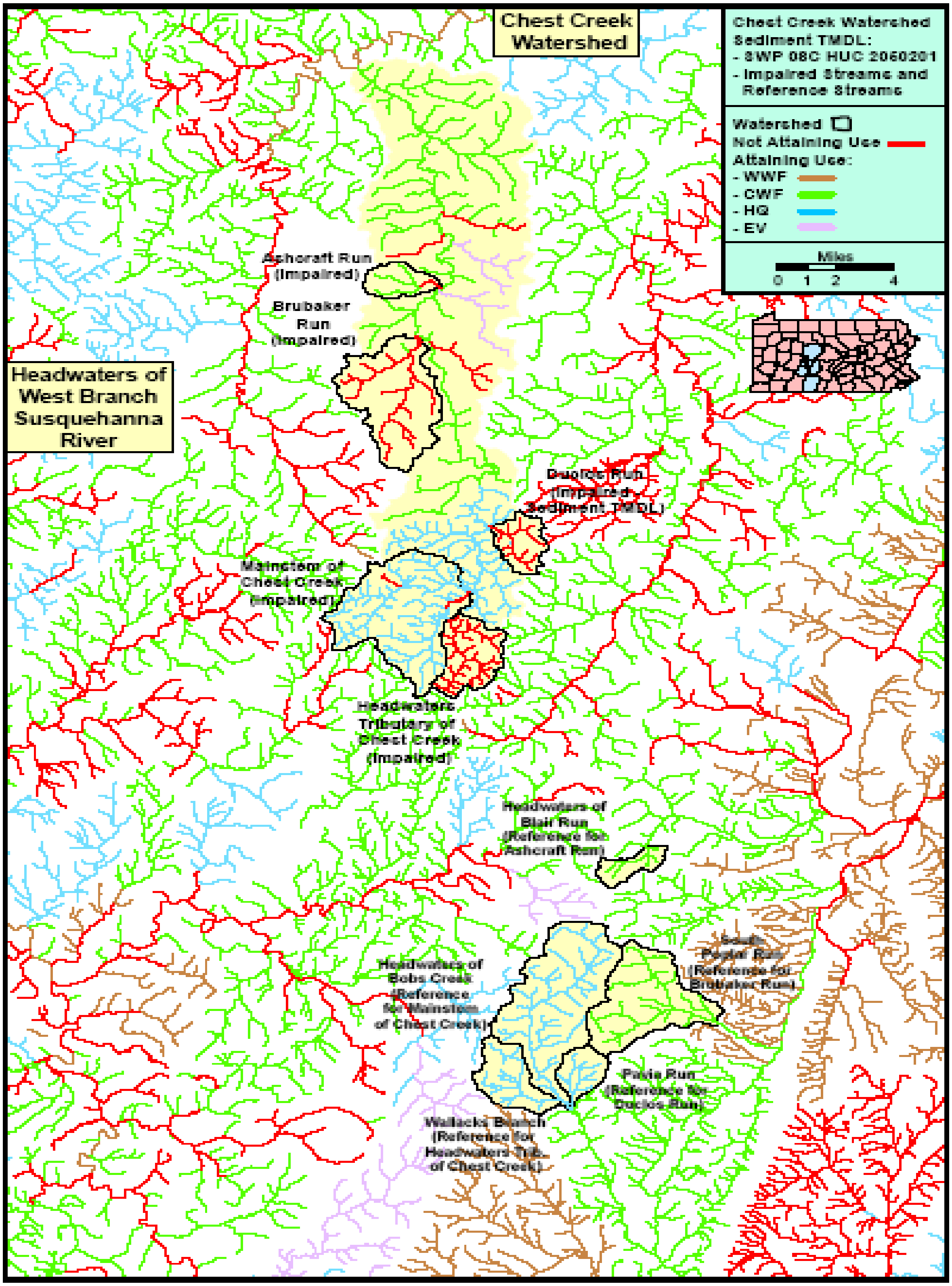


Figure 16. – Overview map of the Chest Creek Watershed with sediment-impaired streams (Ashcraft Run, Brubaker Run, Duclos Run, mainstem segment of Chest Creek, & headwaters trib.) and corresponding non-impaired, reference streams (headwaters of Blair Run, South Poplar Run, Pavia Run, headwaters of Bob Creek, & Wallacks Branch)

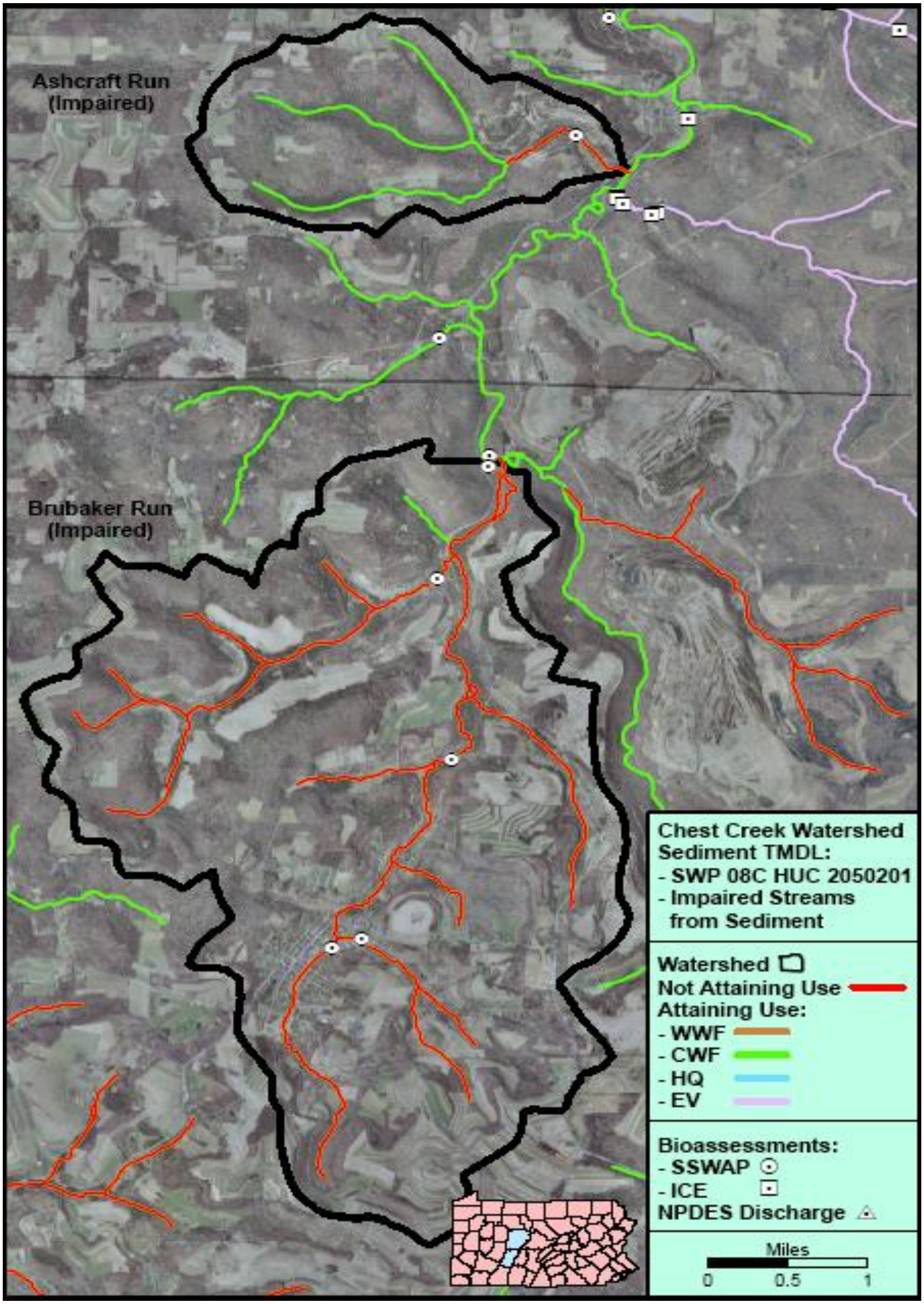


Figure 17. – Aerial map of sediment-impaired streams, downstream Chest Creek (Ashcraft Run & Brubaker Run)

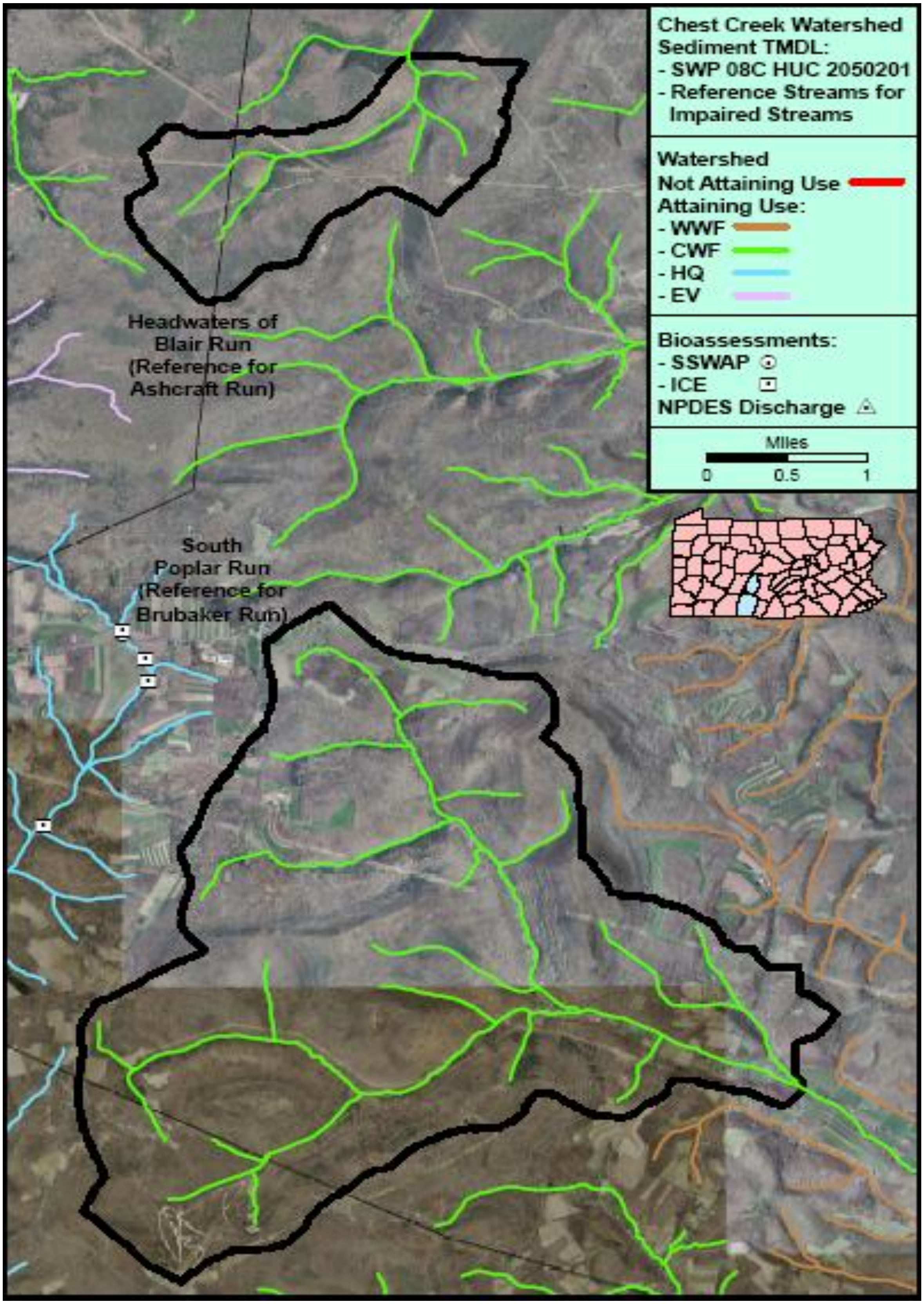


Figure 18. –Aerial map of reference streams for impaired streams, downstream Chest Creek (headwaters of Blair Run and South Poplar Run)

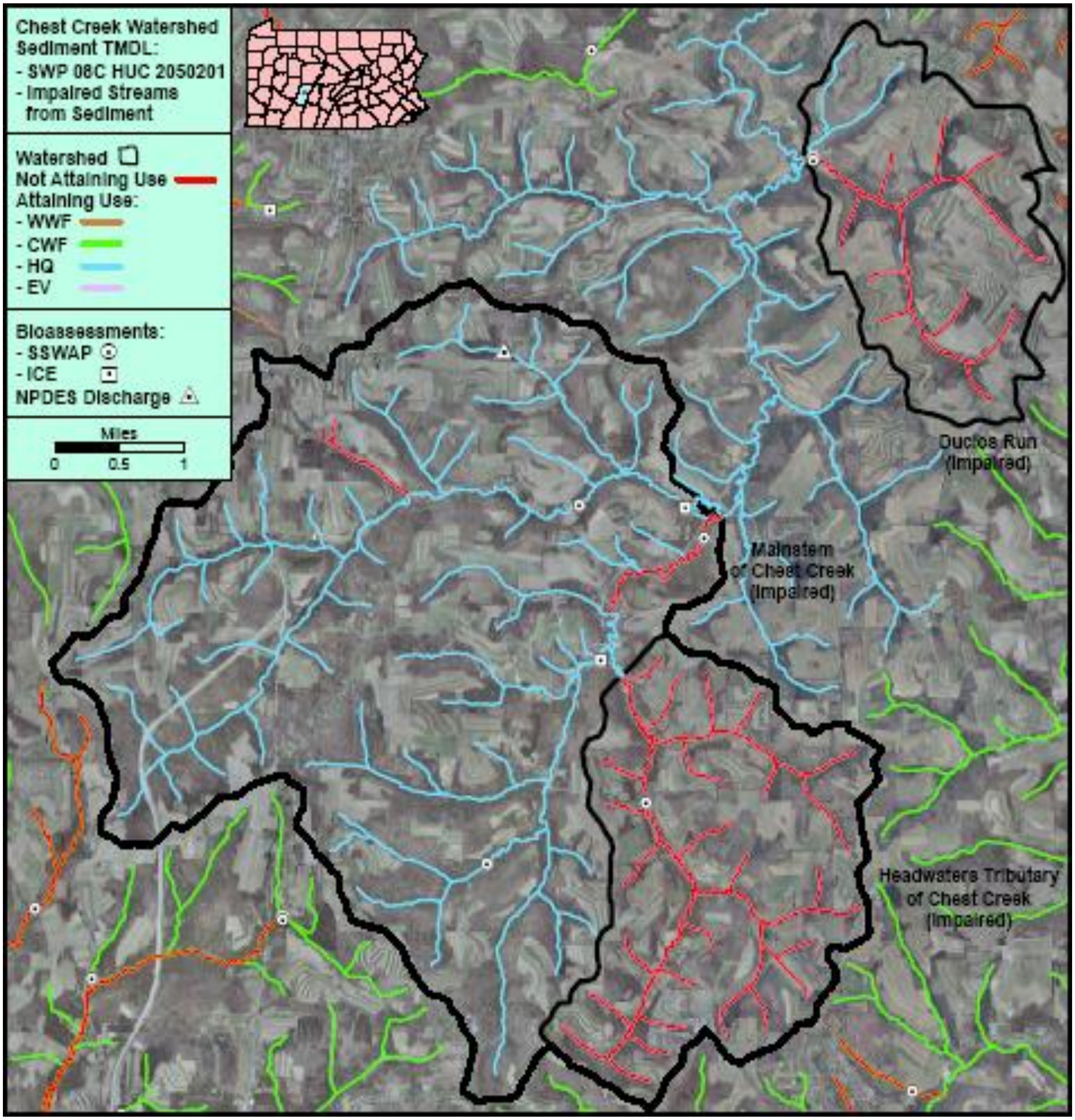


Figure 19. – Aerial map of sediment-impaired streams, upstream Chest Creek
(Duclos Run, mainstem segment of Chest Creek, & headwater tributary)

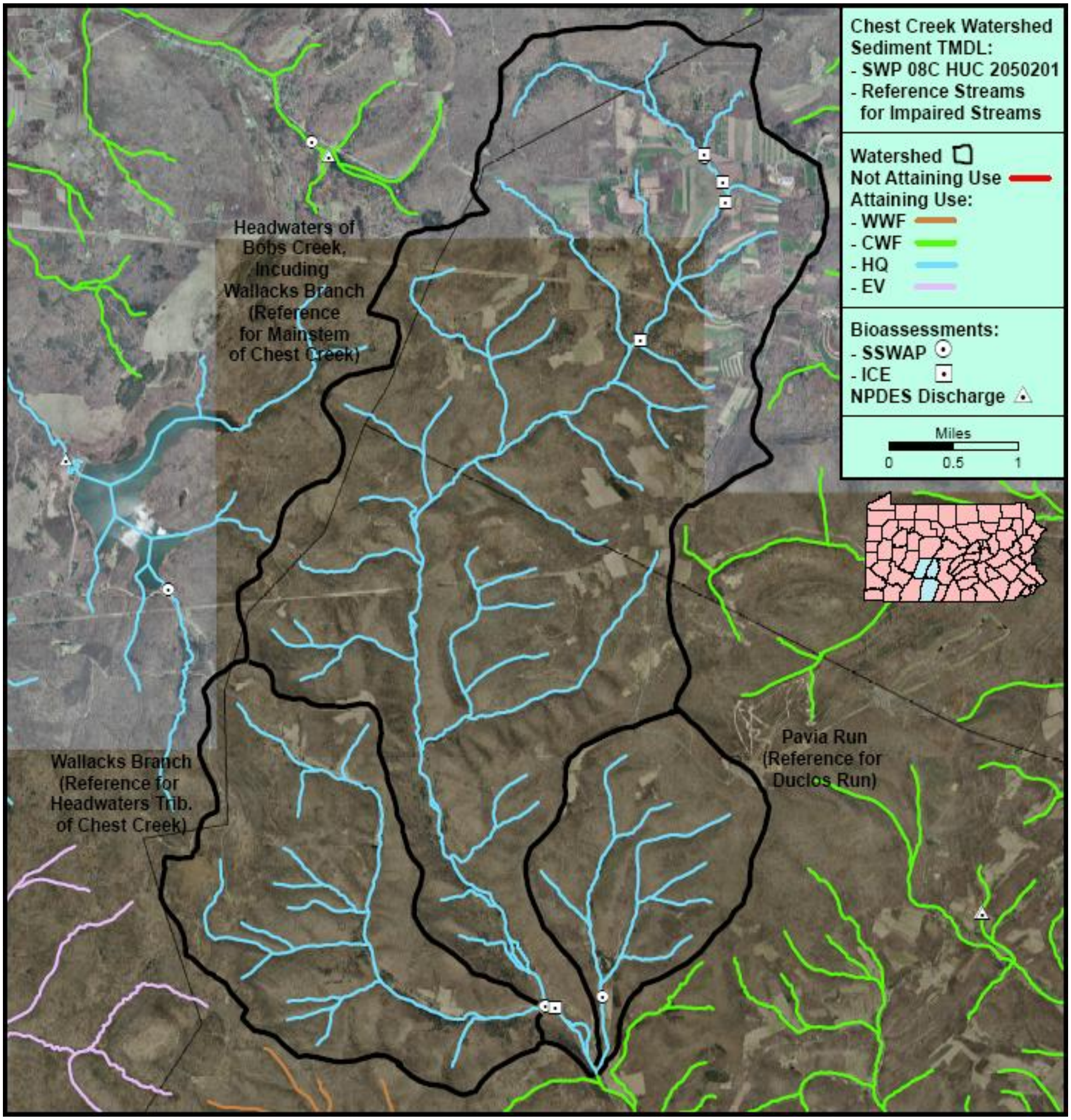


Figure 20. – Aerial map of non-impaired, reference streams, upstream Chest Creek (Pavia Run, headwaters of Bob Creek, & Wallacks Branch)

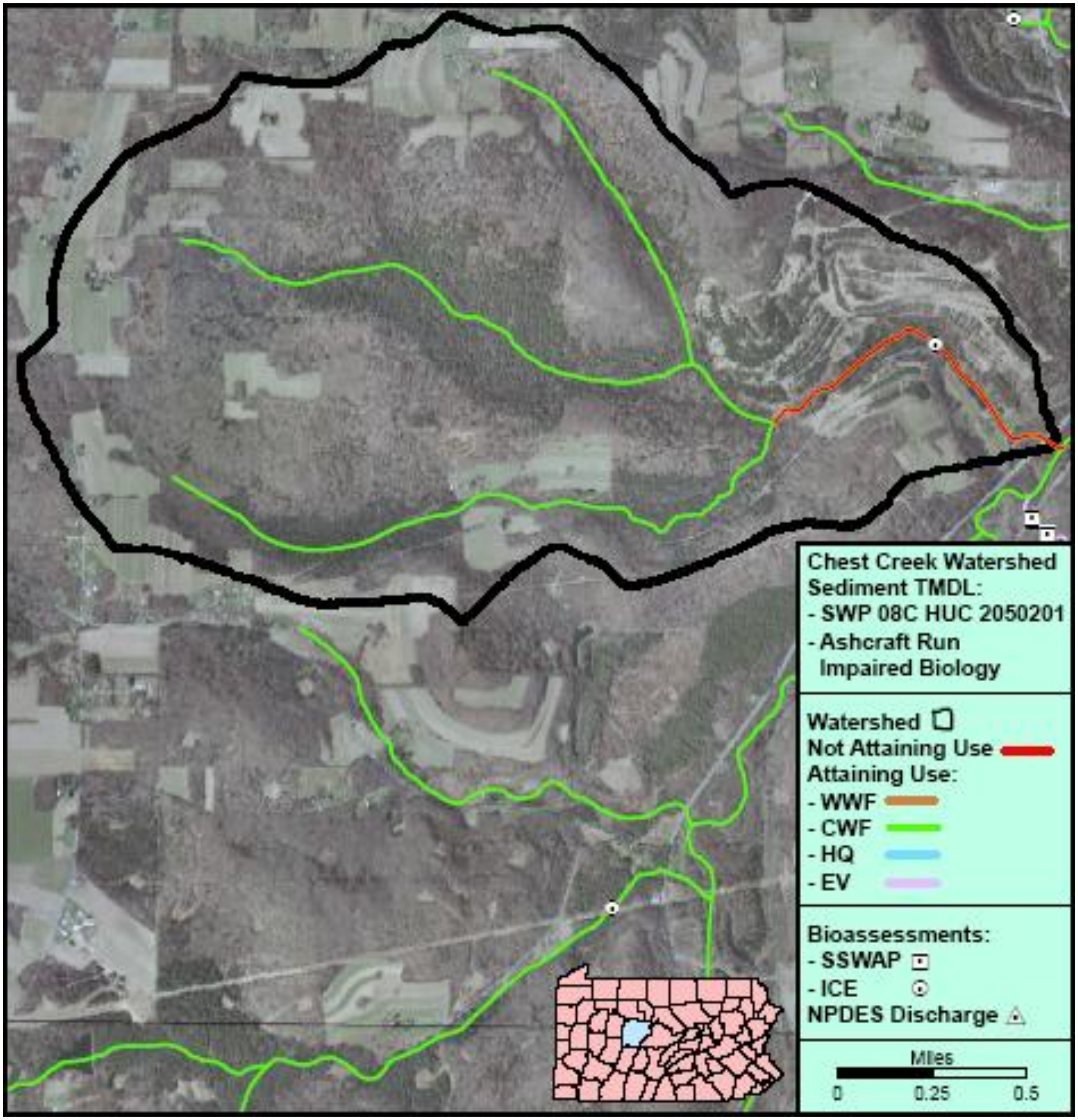


Figure 21. – Aerial map of Ashcraft Run (impaired)

Figure 22. – Abandoned mine land (AML) with runoff cutting on dirt roads, upstream of impaired segment, Ashcraft Run (looking adjacent)

Figure 23. – AML sloping to dirt roads (overburden) and consecutively to stream, upstream of impaired segment, Ashcraft Run

Figure 24. – Wetland/sediment build up behind empoundment,
downstream of impaired segment, Ashcraft Run (looking adjacent)

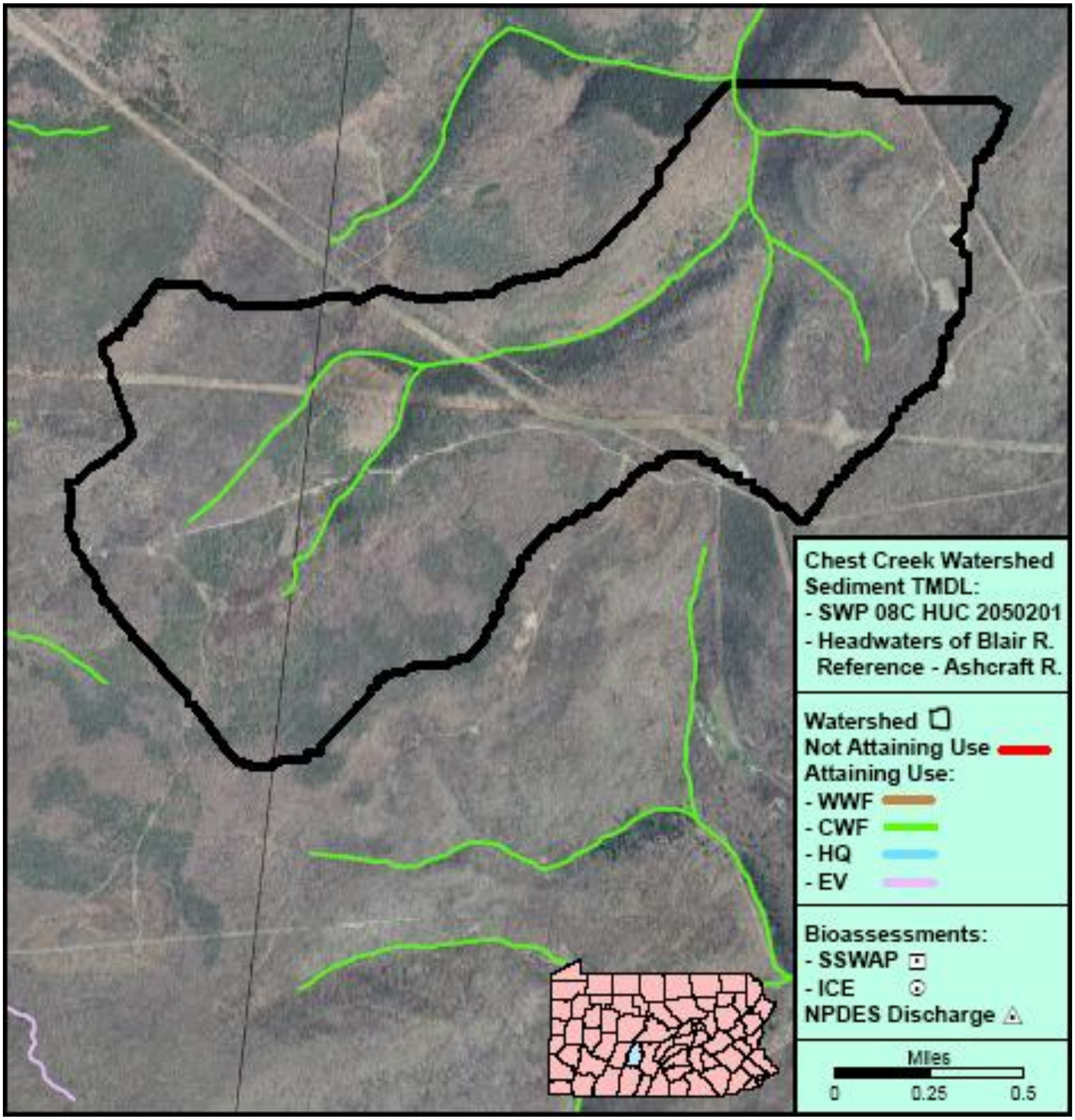


Figure 25. – Aerial map of the headwaters of Blair Run (reference for Ashcraft Run)

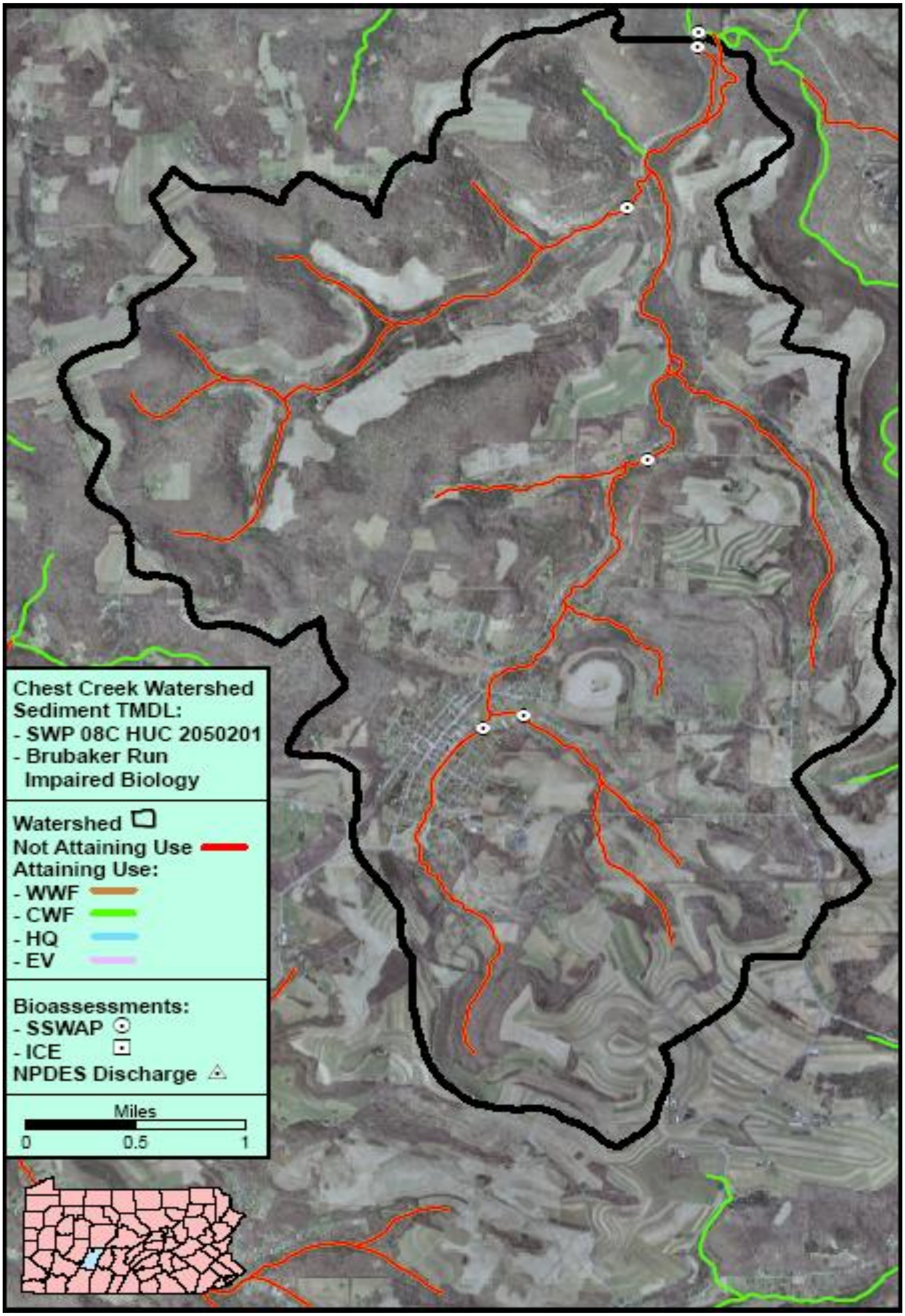


Figure 26. – Aerial map of Brubaker Run (impaired)

Figure 27. – Abandoned mine land a top surrounding slopes,
in-stream sediment buildup, headwaters of Brubaker Run (looking upstream)

Figure 28. – Close up of in-stream sediment build up during,
headwaters of Brubaker Run (looking upstream)

Figure 29. – Sediment and gravel layering during high flow events,
headwaters of Brubaker Run (looking downstream)

Figure 30. – Turbid water coming from stream running through AML,
headwaters tributary of Brubaker Run (looking upstream)

Figure 31. – Close up of turbid water; aluminum precipitating on substrate, headwaters tributary of Brubaker Run (looking upstream)

Figure 32. – Turbid water, sediment and wetland build up, headwaters tributary of Brubaker Run (looking downstream)


Figure 33. – Mainstem of Brubaker Run, downstream of headwaters (looking upstream)


Figure 34. – Mainstem of Brubaker Run, downstream of headwaters (looking downstream)

Figure 35. – Mainstem of Brubaker Run, upstream of east tributary, (along SR 36), (looking downstream)

Figure 36. – Excess siltation on benthic substrate, mainstem of Brubaker Run, upstream of east tributary, (along SR 36), (looking downstream)

Figure 37. – East tributary of Brubaker Run, along SR 36 (looking upstream)

Figure 38. – Abandoned mine land (AML) drainage and particulate settling,
Little Brubaker Run (looking upstream)

Figure 39. – Close up view of AML particulate settling and benthic concretion,
Little Brubaker Run (looking upstream)

Figure 40. – AML particulate settling and benthic concretion,
mouth of Little Brubaker Run (looking upstream)

Figure 41. – Close up view of AML particulate settling and benthic concretion, mouth of Little Brubaker Run (looking upstream)

Figure 42. – Confluence of Little Brubaker and Brubaker Run, mouth of Little Brubaker Run (looking downstream)

Figure 43. – Brubaker Run, upstream of Little Brubaker Run (looking adjacent)

Figure 44. – Mouth of Brubaker Run (looking upstream)


Figure 45. – Mouth of Brubaker Run (looking downstream)

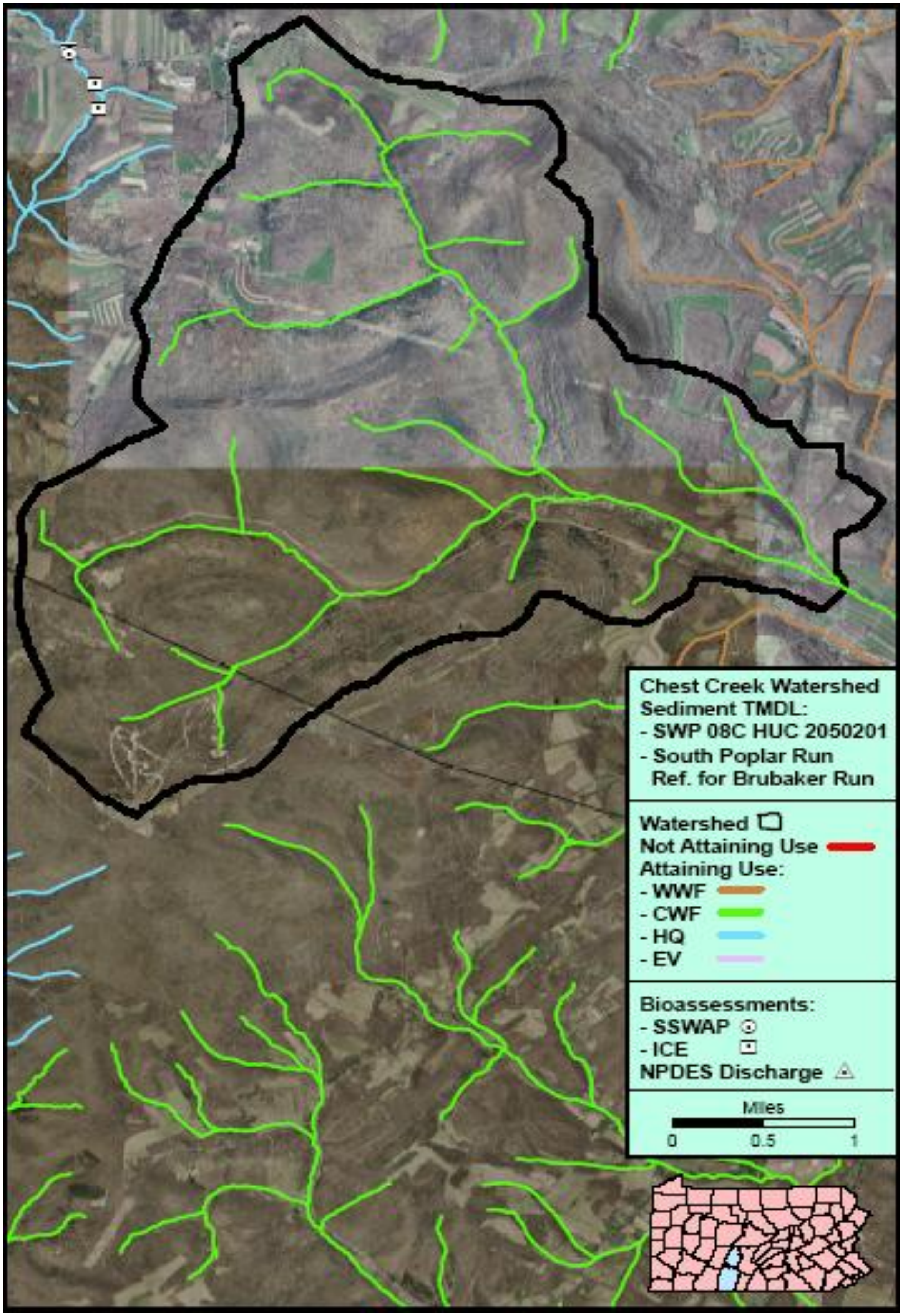


Figure 46. – Aerial map of the South Poplar Run (reference for Brubaker Run)


Figure 47. – Well-developed forested slopes of Carson Run,
tributary of South Poplar Run (looking adjacent)


Figure 48. – Well-developed forested slopes and riffle/run habitat of Carson Run,
tributary of South Poplar Run (looking adjacent)

Figure 49. – Variety of substrate without an accumulation of sediment,
Carson Run, tributary of South Poplar Run (looking upstream)

Figure 50. – Forested slopes, good riffle/run substrate, no accumulation of sediment in pools,
mainstem of South Poplar Run (looking upstream)

Figure 51. – Well-developed forested slopes and riffle/run substrate,
mainstem of South Poplar Run (looking upstream)

Figure 52. – Well-developed forested slopes and riffle/run substrate,
upstream of Carson Run, mainstem South Poplar Run (looking upstream)

Figure 53. – Well-developed forested slopes and riffle/run substrate,
downstream of the confluence of Carson Run and South Poplar Run (looking upstream)

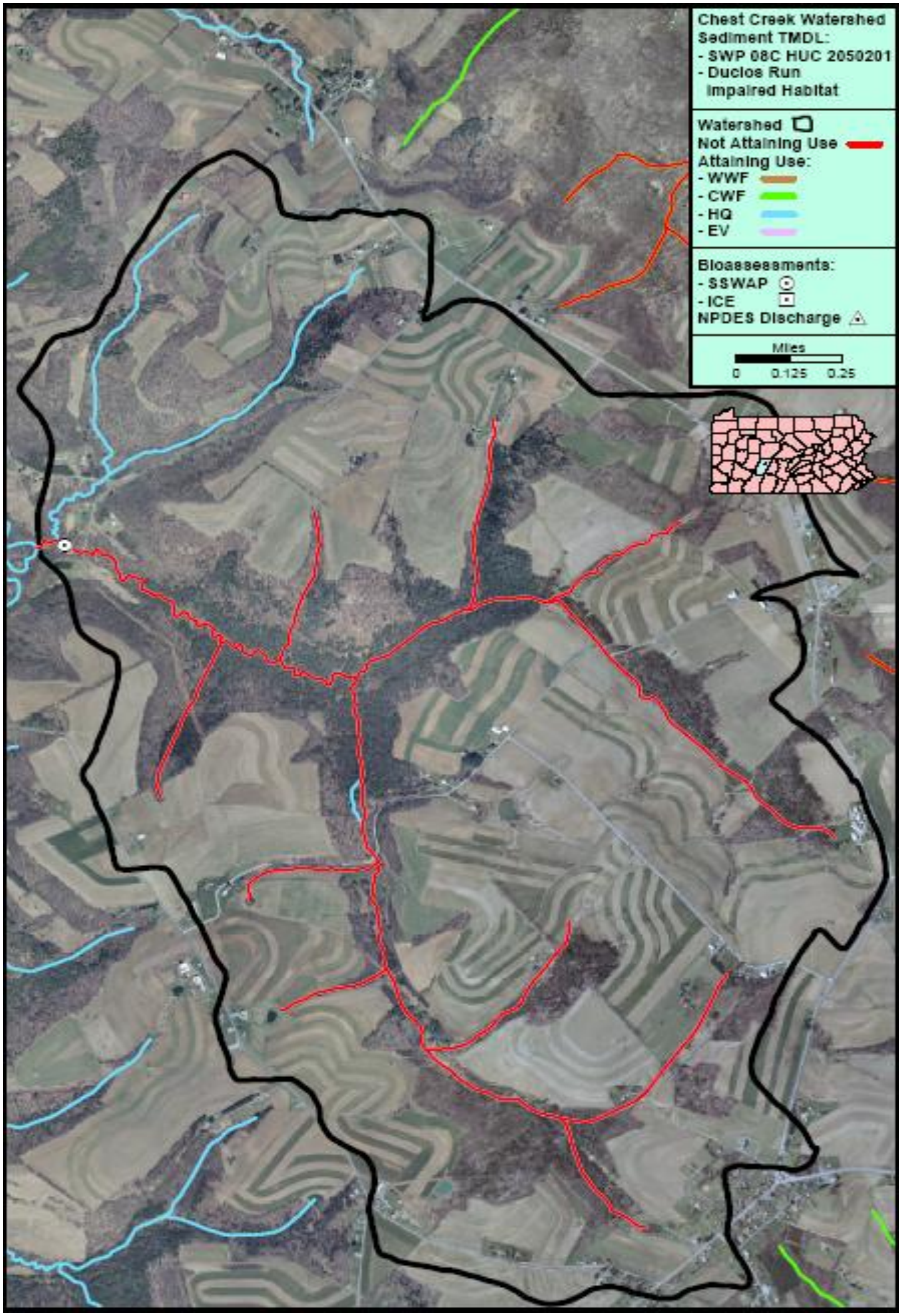


Figure 54. – Aerial map of Duclos Run (impaired)

Figure 55. – Minimally vegetated, old fields, sloping to stream,
headwaters of Duclos Run (looking upstream)

Figure 56. – Banks vulnerable to sediment build up during low flow,
headwaters of Duclos Run (looking downstream)

Figure 57. – Incised and slumping banks,
near mouth of Duclos Run (looking upstream)

Figure 58. – High prone erosion with incised banks,
near mouth of Duclos Run (looking downstream)

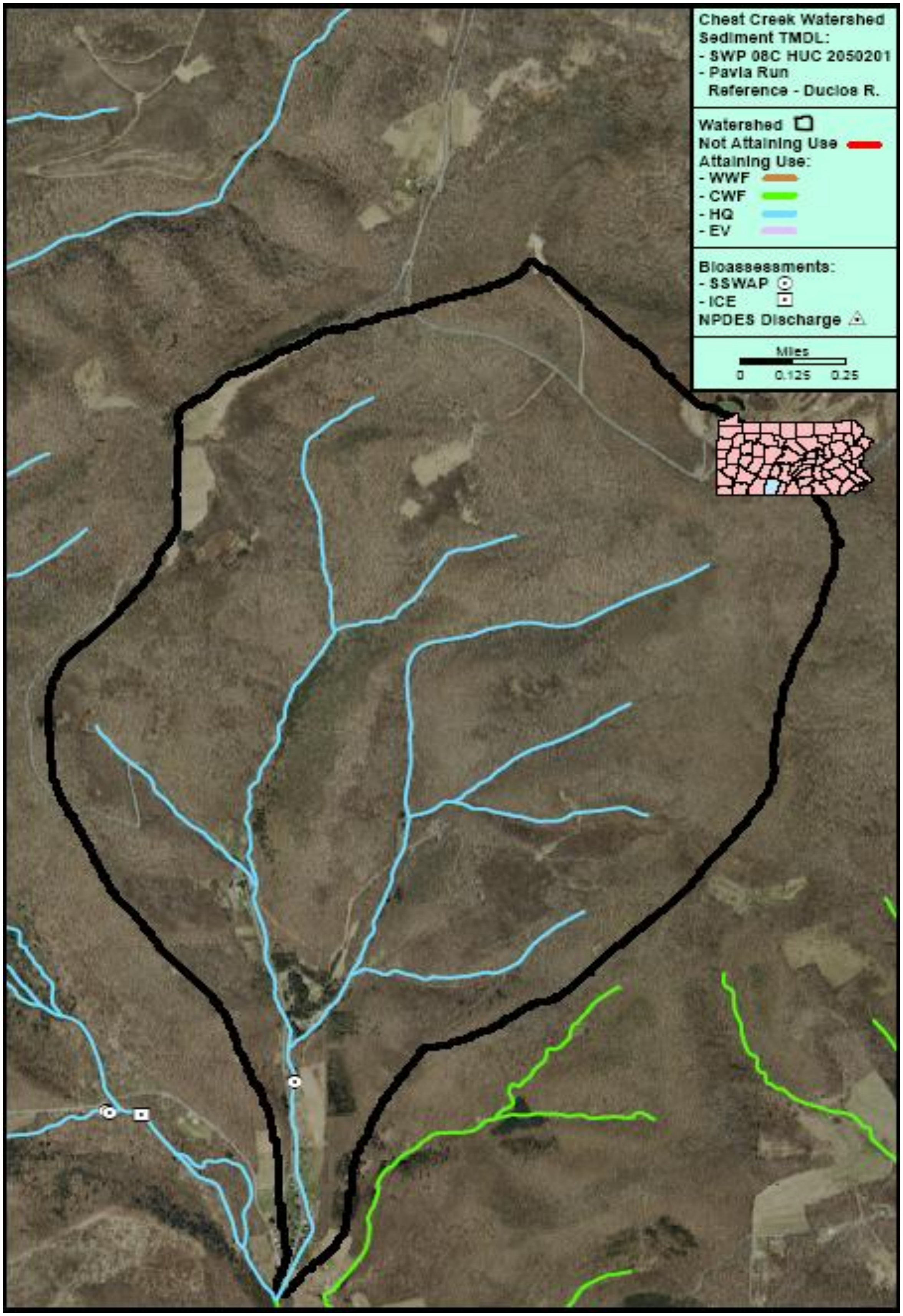


Figure 59. – Aerial map of Pavia Run (reference for Duclos Run)

Figure 60. – Stable banks, variety of substate and forested riparian buffering, headwaters of Pavia Run (looking downstream)

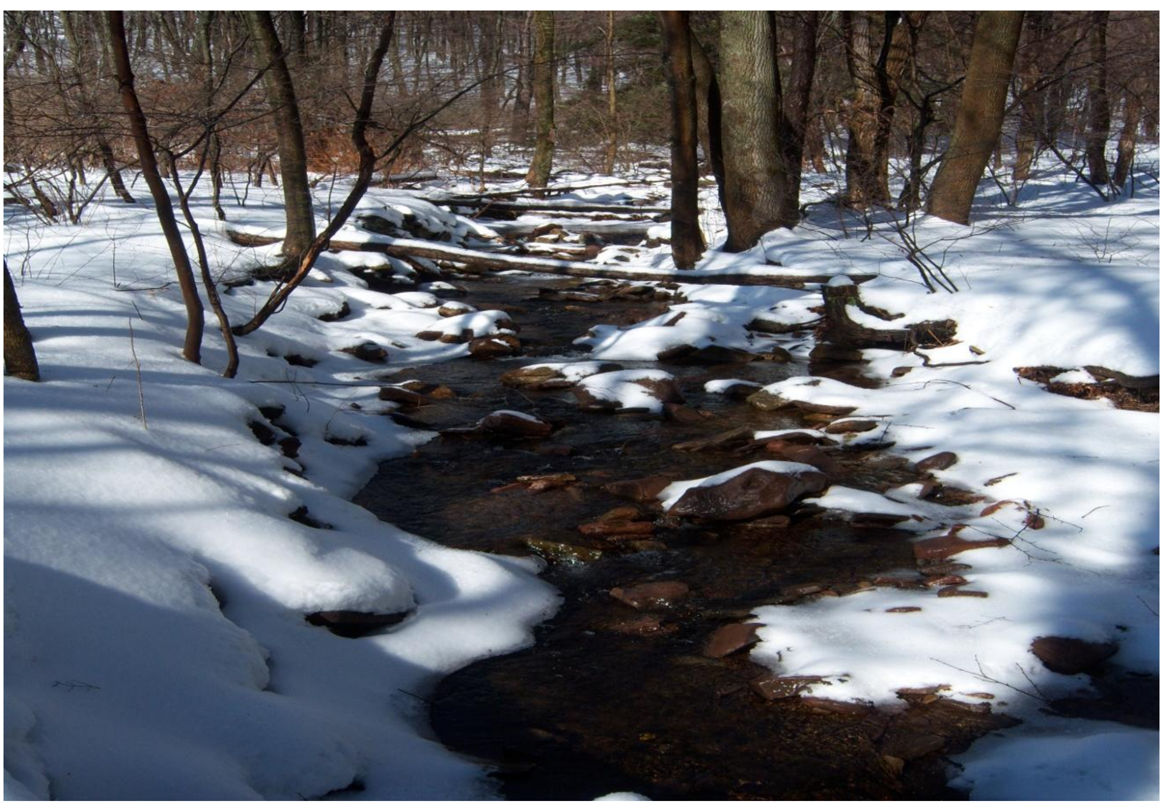


Figure 61. – Well-developed riffle/run substate and forested riparian buffering, headwaters of Pavia Run (looking upstream)

Figure 62. – Well-developed riffle/run substate and forested riparian buffering, headwaters of Pavia Run (looking upstream)

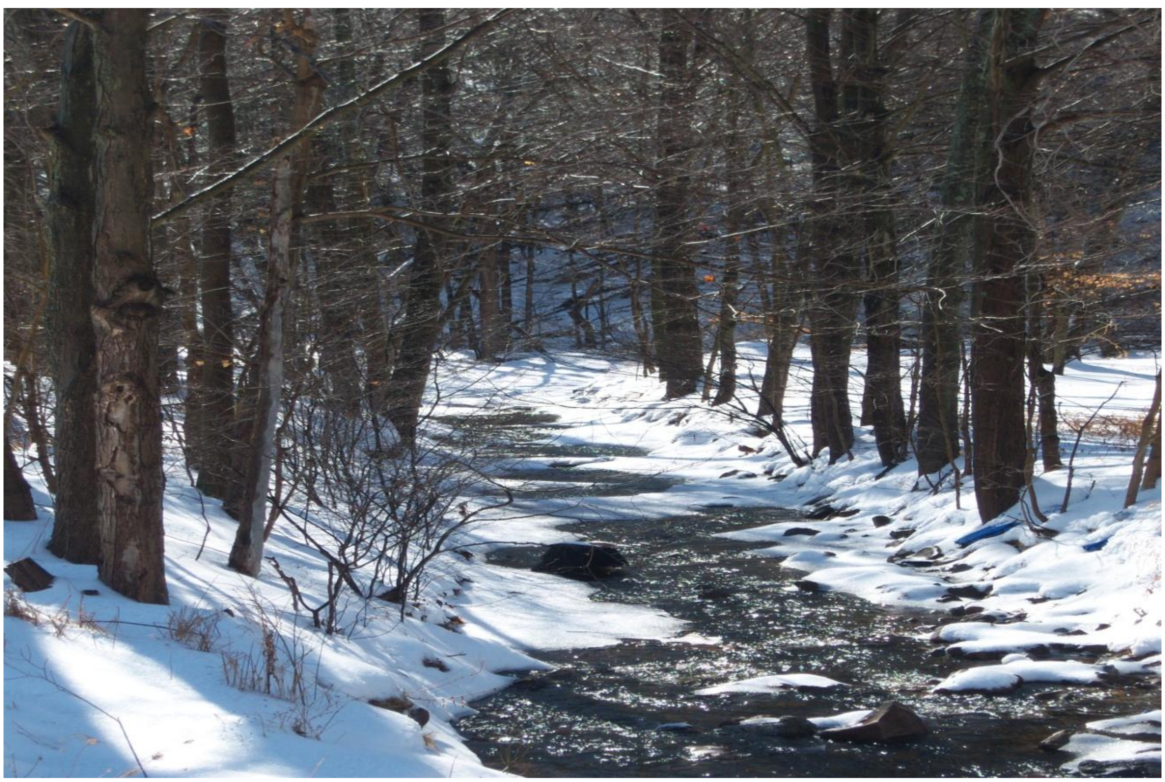


Figure 63. – Well-developed riffle/run substate and forested riparian buffering, mouth of Pavia Run (looking downstream)

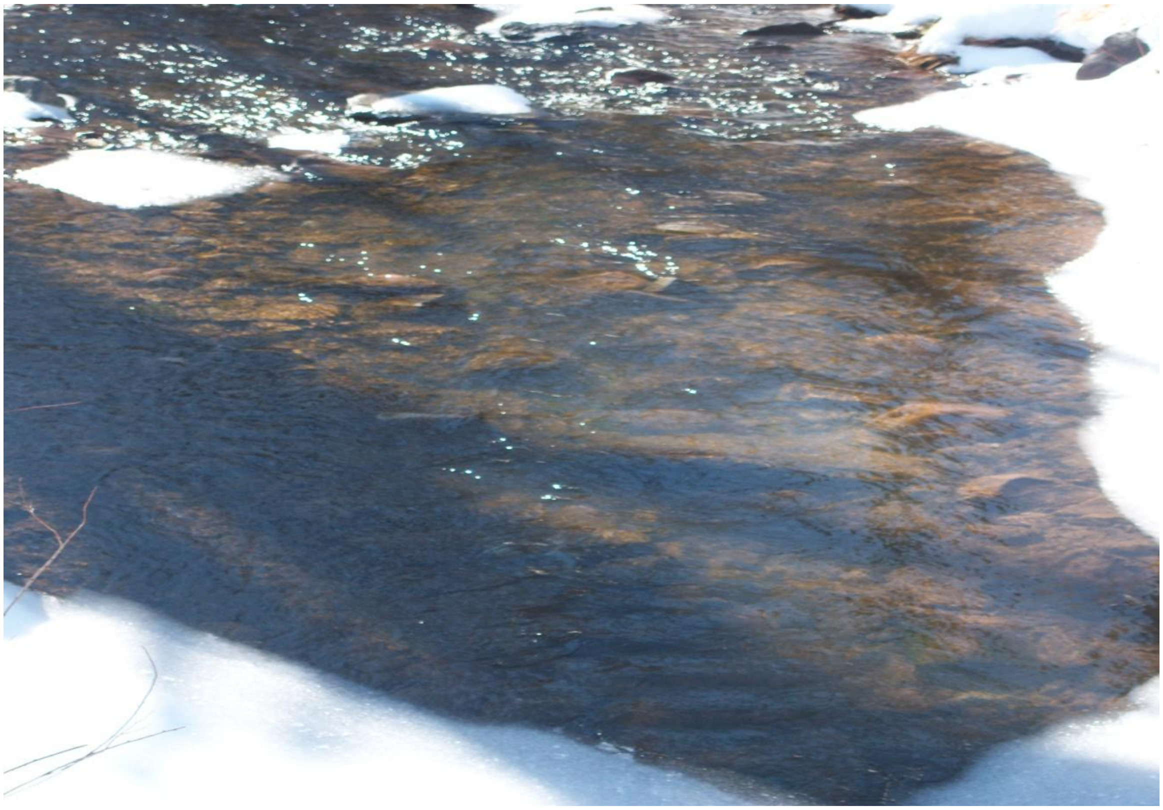


Figure 64. – Forested riparian buffering on west bank slope and on right bank, mouth of Pavia Run (looking downstream)

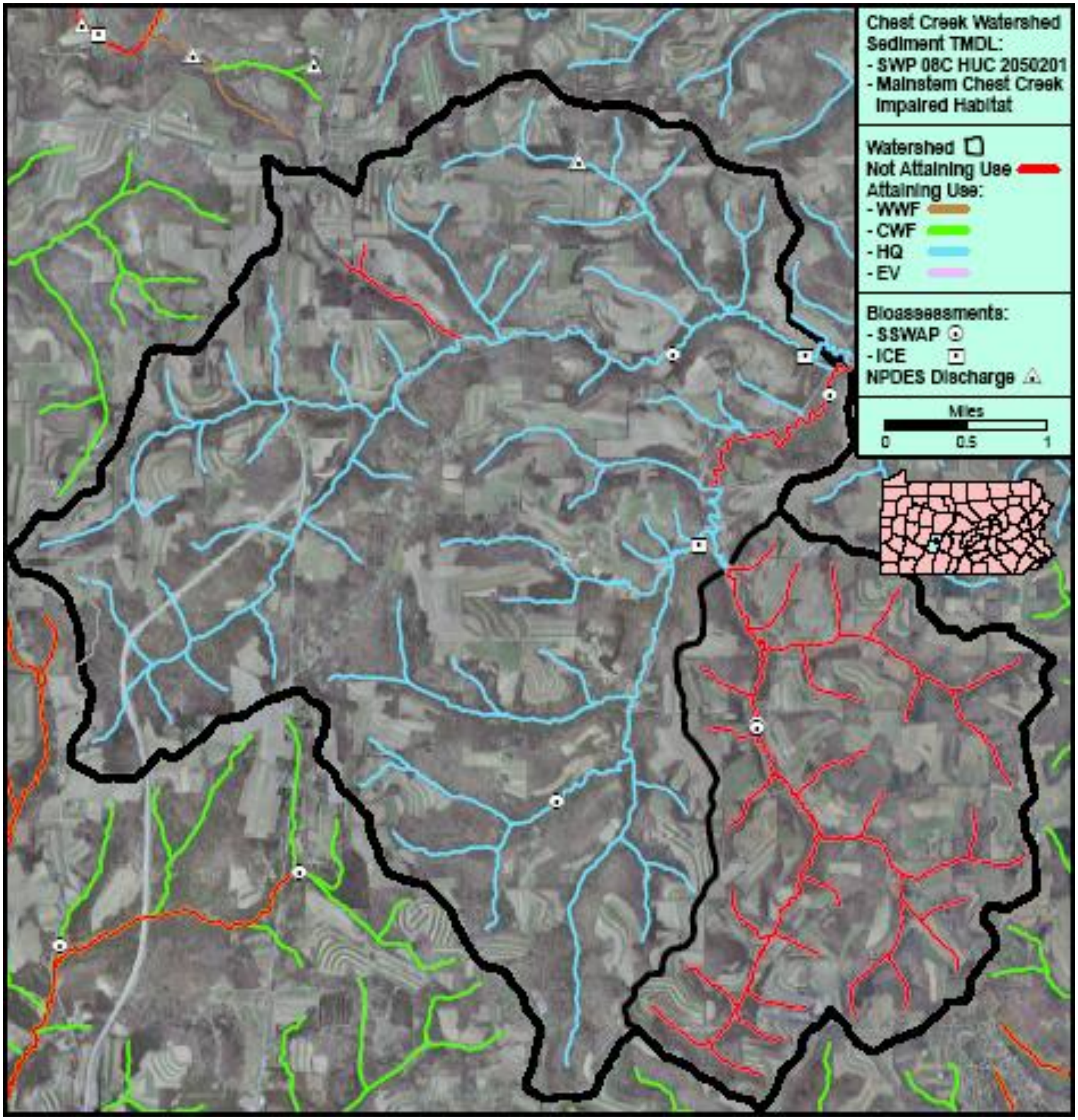


Figure 65. – Aerial map of the mainstem of Chest Creek (headwaters)

Figure 66. – Sediment build up and substrate inundation,
upper end of impaired segment, mainstem of Chest Creek (looking upstream)

Figure 67. – Slumping banks, pooling, and a decrease in unproductive benthic substrate
upper end of impaired segment, mainstem of Chest Creek (looking downstream)

Figure 68. – Minimized sediment transport,
lower end of impaired segment, mainstem of Chest Creek (looking upstream)

Figure 69. – Area prone to substrate inundation,
lower end of impaired segment, mainstem of Chest Creek (looking downstream)

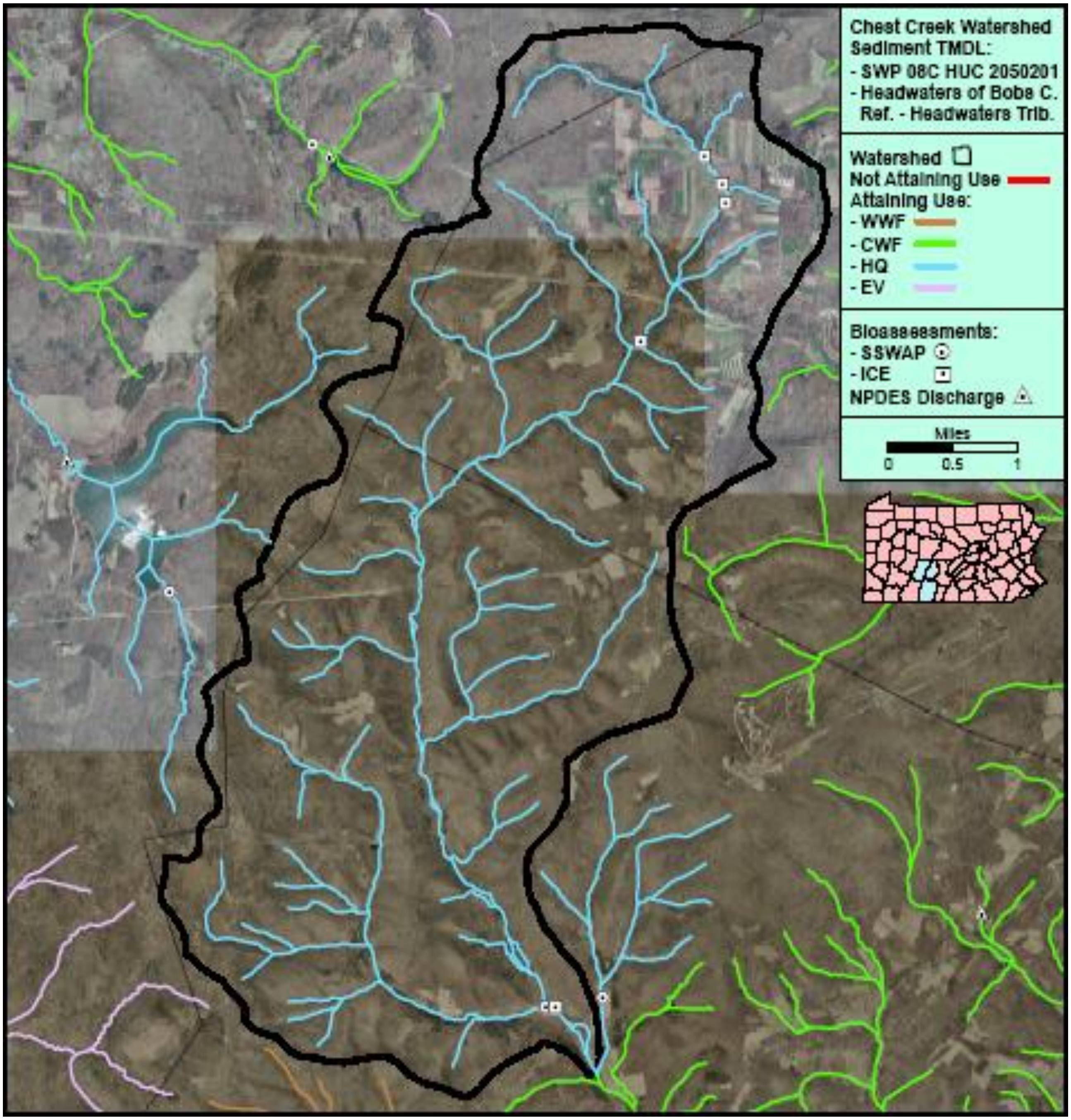


Figure 70. – Aerial map of the headwaters of Bobs Creek
(reference for the mainstem of Chest Creek (headwaters))


Figure 71. – Well-developed riparian buffering, mid-section Bobs Creek (looking upstream)


Figure 72. – Stable banks with well-developed riparian buffering,
mid section Bobs Creek (looking downstream)

Figure 73. – Fenced-off pastureland, upper-section of Bobs Creek (looking adjacent)

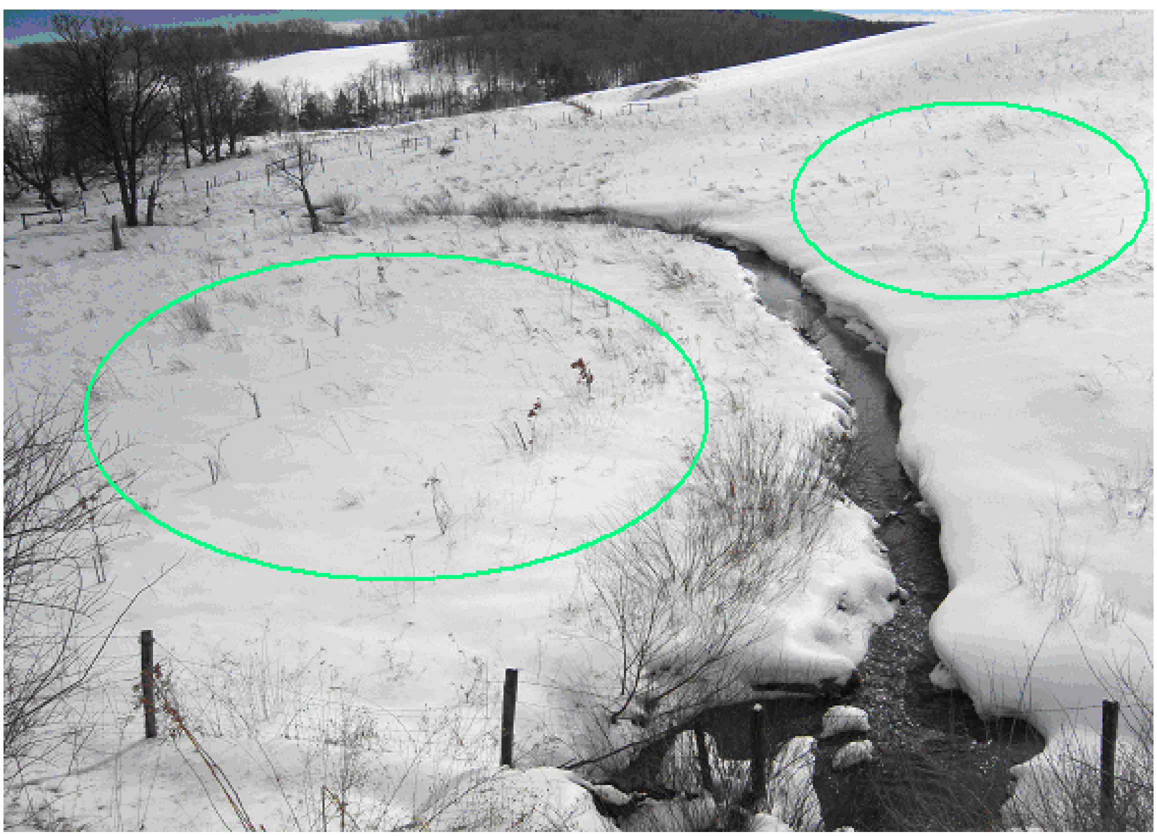


Figure 74. – Tree plantings on same pastureland, upper-section Bobs Creek (looking upstream)


Figure 75. – Willow tree riparian buffering, upper-section Bobs Creek (looking downstream)


Figure 76. – Bobs Creek upstream from confluence of Wallacks Branch (looking upstream)

Figure 77. – Bobs Creek upstream from confluence of Wallacks Branch (from right) (looking downstream)

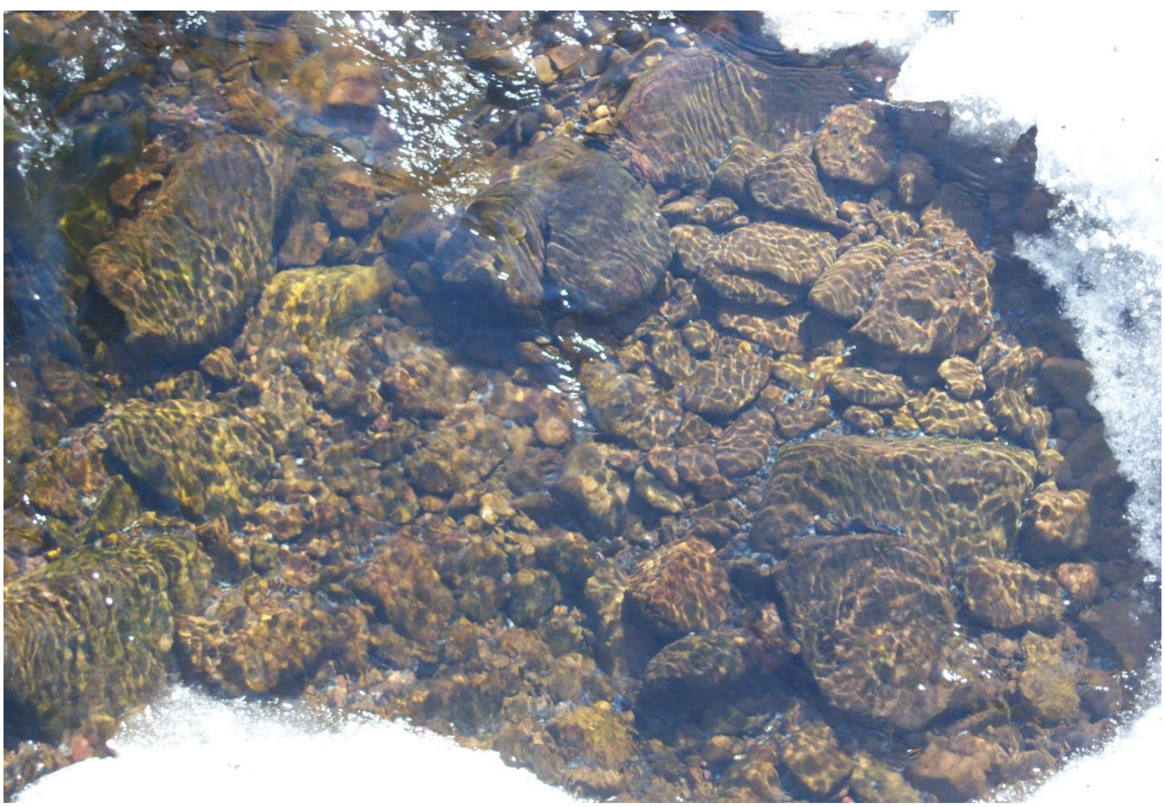


Figure 78. – Clear water and a variety of substrate material, including gravel/cobble, Bobs Creek upstream from confluence of Wallacks Branch (looking downstream)

Figure 79. – Forested riparian buffering on west bank slope and on right bank,
Bobs Creek below confluence of Pavia Run (looking upstream)

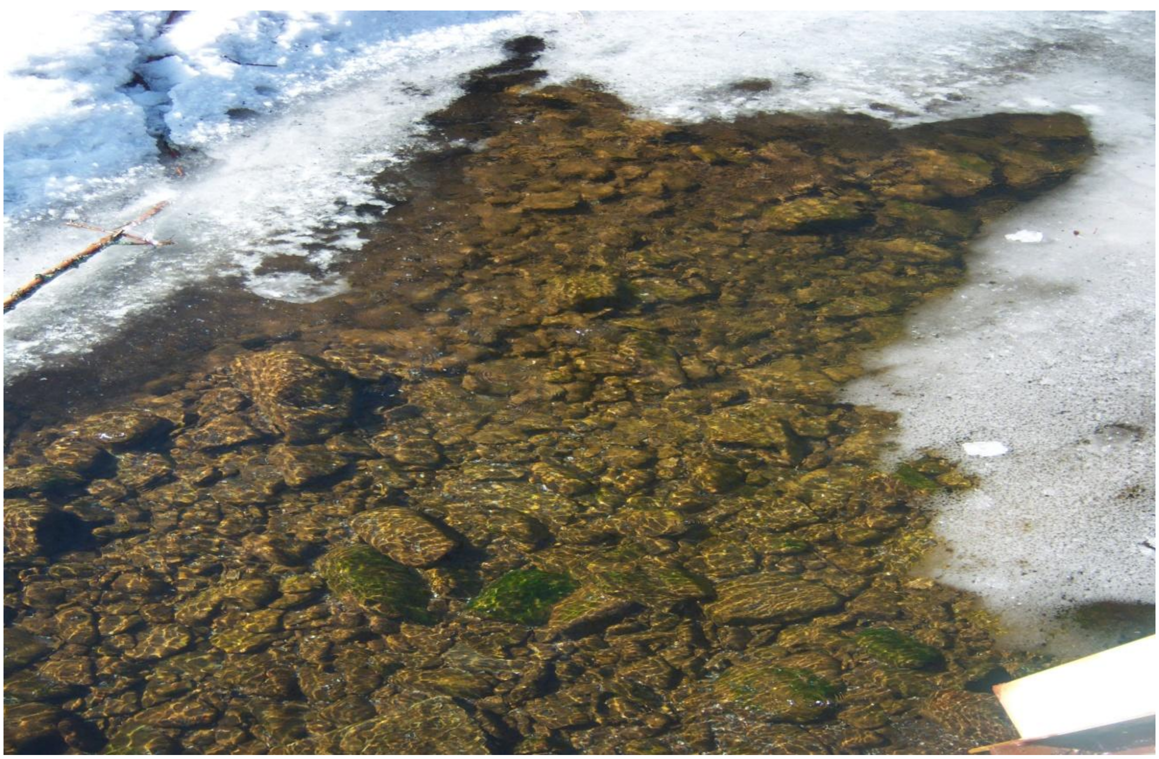


Figure 80. – Clear water and variety of substrate,
Bobs Creek below confluence of Pavia Run (looking upstream)

Figure 81. – Forested barrier from slope agriculture,
Bobs Creek below confluence of Pavia Run (looking downstream)

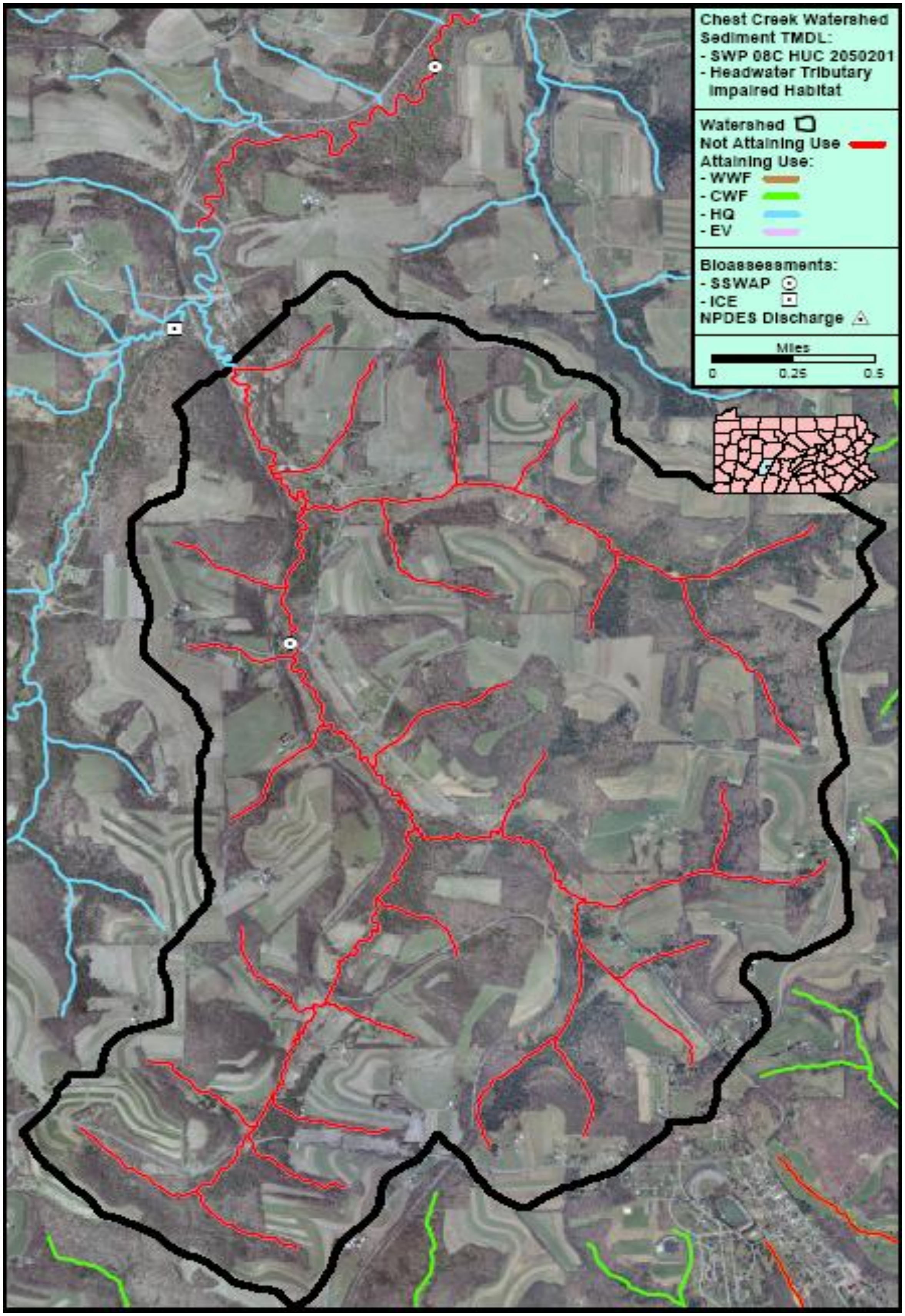


Figure 82. – Aerial map of the headwaters tributary to Chest Creek

Figure 83. – Mature tree amongst slumping banks
upper-section headwaters tributary to Chest Creek (looking upstream)

Figure 84. – Alder and willow trees growing out of sediment hummocks
upper-section headwaters tributary to Chest Creek (looking upstream)

Figure 85. – Telephone pole among incised banks; minimal riparian buffering, mid section headwaters tributary to Chest Creek (looking upstream)

Figure 86. – Slumping banks; alder growing out of sediment hummocks, mid section of the headwaters tributary of Chest Creek (looking upstream)

Figure 87. – Close up view of slumping bank; alder growing out of sediment hummocks, mid section of the headwaters tributary of Chest Creek (looking upstream)

Figure 88. – Alder growing out of sediment hummocks, mid section of the headwaters tributary of Chest Creek (looking downstream)

Figure 89. – High prone erosion and slumping banks (with trees)
lower section of the headwaters tributary of Chest Creek (looking upstream)

Figure 90. – Close up view of slumping banks,
lower section of headwaters tributary of Chest Creek (looking upstream)

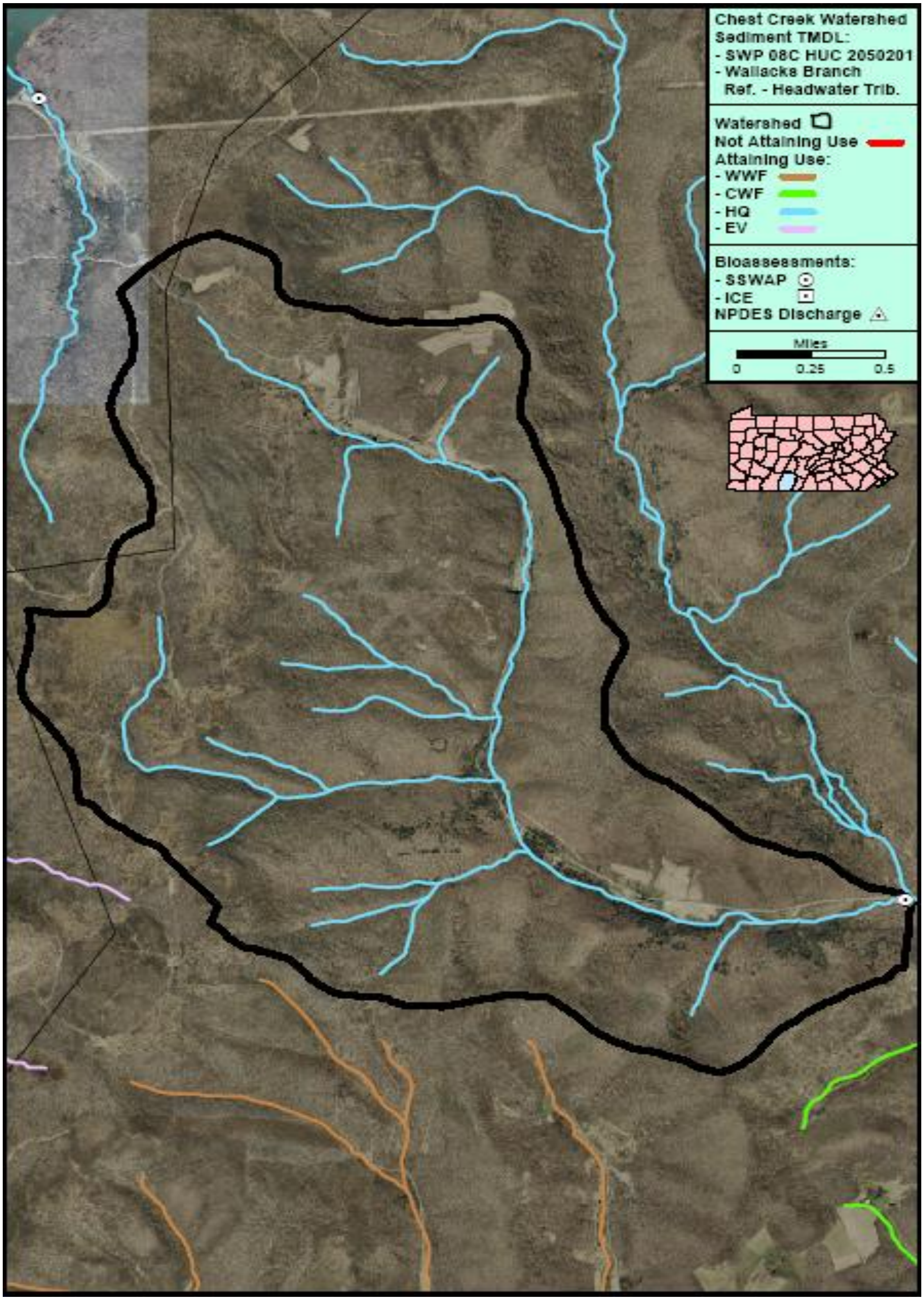


Figure 91. – Aerial map of Wallacks Branch
(reference the headwaters tributary to Chest Creek)

Figure 92. – Stable banks and well-developed riparian buffering,
headwaters of Wallacks Branch (looking upstream)

Figure 93. – Clear water and well-developed riffle/run substrate,
headwaters of Wallacks Branch (looking upstream)

Figure 94. – Well-developed forested riparian buffering,
headwaters of Wallacks Branch (looking downstream)

Figure 95. – Well-developed forested riparian buffering,
mid section Wallacks Branch (looking upstream)


Figure 96. – Clear water and well-developed riffle/run substrate,
mid section Wallacks Branch (looking upstream)


Figure 97. – Mature, forested riparian buffering and stable banks,
mid section of Wallacks Branch (looking downstream)

Figure 98. – Well-developed riffle/run and forest riparian buffering,
upstream mouth of Wallacks Branch (looking adjacent)

Figure 99. – Bobs Creek upstream from the
confluence of Wallacks Branch ((from right) (looking downstream))

Attachment B
Equal Marginal Percent Reduction Method

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.

1	TMDL				2	Adjusted LA = TMDL total load - ((MOS) - loads not reduced)						
	TMDL = Sediment loading rate in ref. * Impaired Acres					82528.1	82528.1					
	100144.0											
		Annual				Recheck	% reduction	Load			Allowable	%
3		Avg. Load	Load Sum	Check	Initial Adjust	Adjust	allocation	Reduction	Initial LA	Acres	Loading Rate	Reduction
	CROPLAND	38200.0	113600.0	good	38200.0		0.3	10448.5	27751.5	39.5	702.6	27.4%
	HAY/PASTURE	35200.0		good	35200.0	31071.9	0.3	9627.9	25572.1	348.4	73.4	27.4%
	TRANSITIONAL	0.0		good	0.0		0.0	0.0	0.0	0.0	#DIV/0!	#DIV/0!
	STREAMBANK	40200.0		good	40200.0		0.4	10995.5	29204.5			27.4%
					113600.0		1.0		82528.1			
4	All Ag. Loading Rate	137.47										
			Allowable		Current	Current						
		Acres	loading rate	Final LA	Loading Rate	Load	% Red.		CURRENT LOAD		FINAL LA	
5	CROPLAND	39.5	702.6	27751.5	967.1	38200.0	27.4%		CROPLAND	38,200	27,752	
	HAY/PASTURE	348.4	73.4	25572.1	101.0	35200.0	27.4%		HAY/PASTURE	35,200	25,572	
	TRANSITIONAL	0.0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		TRANSITIONAL	#DIV/0!	#DIV/0!	
	STREAMBANK			29204.5		40200.0	27.4%		STREAMBANK	40,200	29,204	
				#DIV/0!		#DIV/0!	#DIV/0!					

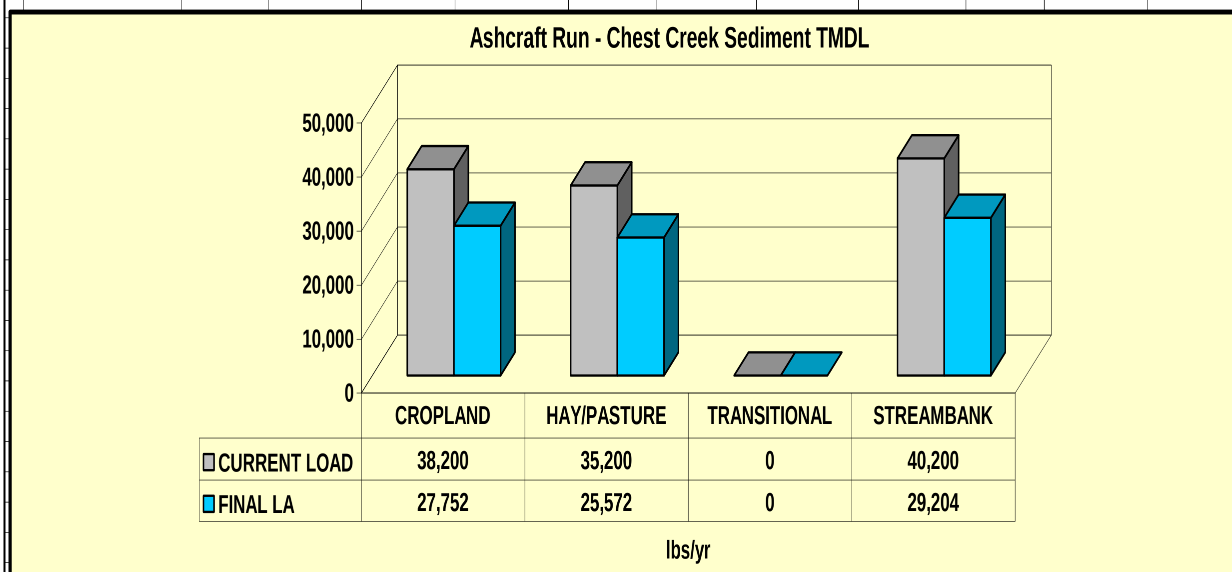


Table B1. Equal Marginal Percent Reduction calculations for Ashcraft Run

1	TMDL				2	Adjusted LA = TMDL total load - ((MOS) - loads not reduced)						
	TMDL = Sediment loading rate in ref. * Impaired Acres					8067027.8	8067027.8					
	9565874.0											
		Annual				Recheck	% reduction	Load			Allowable	%
3		Avg. Load	Load Sum	Check	Initial Adjust	Adjust	allocation	Reduction	Initial LA	Acres	Loading Rate	Reduction
	CROPLAND	12170200.0	15091800.0	bad	8067027.8		0.7	2147082.7	5919945.2	1047.7	5650.4	51.4%
	HAY/PASTURE	1905200.0		good	1905200.0	2925800.0	0.2	507079.2	1398120.8	2181.9	640.8	26.6%
	TRANSITIONAL	339800.0		good	339800.0		0.0	90439.6	249360.4	27.2	9167.7	26.6%
	STREAMBANK	676600.0		good	676600.0		0.1	180080.7	496519.3			26.6%
	COAL MINES	4200.0		good	4200.0		0.0	1117.9	3082.1	7.4	416.5	26.6%
					10992827.8		1.0		8067027.8			
4	All Ag. Loading Rate	2323.58										
			Allowable		Current	Current						
		Acres	loading rate	Final LA	Loading Rate	Load	% Red.			CURRENT LOAD	FINAL LA	
5	CROPLAND	1047.7	5650.4	5919945.2	11616.1	12170200.0	51.4%		CROPLAND	12,170,200	5,919,945	
	HAY/PASTURE	2181.9	640.8	1398120.8	873.2	1905200.0	26.6%		HAY/PASTURE	1,905,200	1,398,121	
	TRANSITIONAL	27.2	9167.7	249360.4	12492.6	339800.0	26.6%		TRANSITIONAL	339,800	249,360	
	STREAMBANK			496519.3		676600.0	26.6%		STREAMBANK	676,600	496,519	
	COAL MINES	7	416.5	3082.1	567.57	4200.0	26.6%		COAL MINES	4,200	3,082	
				8067027.8		15091800.0	46.5%					

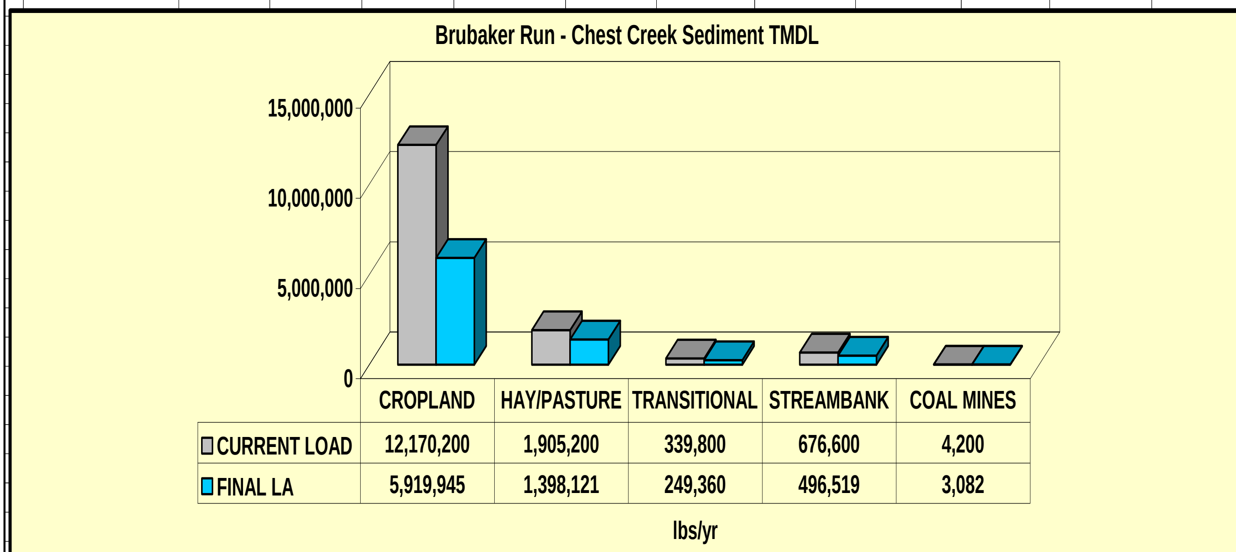


Table B2. Equal Marginal Percent Reduction calculations for Brubaker Run

1	TMDL				2	Adjusted LA = TMDL total load - ((MOS) - loads not reduced)						
	TMDL = Sediment loading rate in ref. * Impaired Acres					939162.5	939162.5					
	1130294.9											
		Annual				Recheck	% reduction	Load			Allowable	%
3		Avg. Load	Load Sum	Check	Initial Adjust	Adjust	allocation	Reduction	Initial LA	Acres	Loading Rate	Reduction
	CROPLAND	1117600.0	1176400.0	bad	939162.5		0.9	55335.5	883827.0	857.5	1030.7	20.9%
	HAY/PASTURE	39200.0		good	39200.0	58800.0	0.0	2309.7	36890.3	437.4	84.3	5.9%
	TRANSITIONAL	15800.0		good	15800.0		0.0	930.9	14869.1	9.9	1501.9	5.9%
	STREAMBANK	3800.0		good	3800.0		0.0	223.9	3576.1			5.9%
					997962.5		1.0		939162.5			
4	All Ag. Loading Rate	717.03										
			Allowable		Current	Current						
		Acres	loading rate	Final LA	Loading Rate	Load	% Red.			CURRENT LOAD	FINAL LA	
5	CROPLAND	857.5	1030.7	883827.0	1303.3	1117600.0	20.9%		CROPLAND	1,117,600	883,827	
	HAY/PASTURE	437.4	84.3	36890.3	89.6	39200.0	5.9%		HAY/PASTURE	39,200	36,890	
	TRANSITIONAL	9.9	1501.9	14869.1	1596.0	15800.0	5.9%		TRANSITIONAL	15,800	14,869	
	STREAMBANK			3576.1		3800.0	5.9%		STREAMBANK	3,800	3,576	
				939162.5		1176400.0	20.2%					

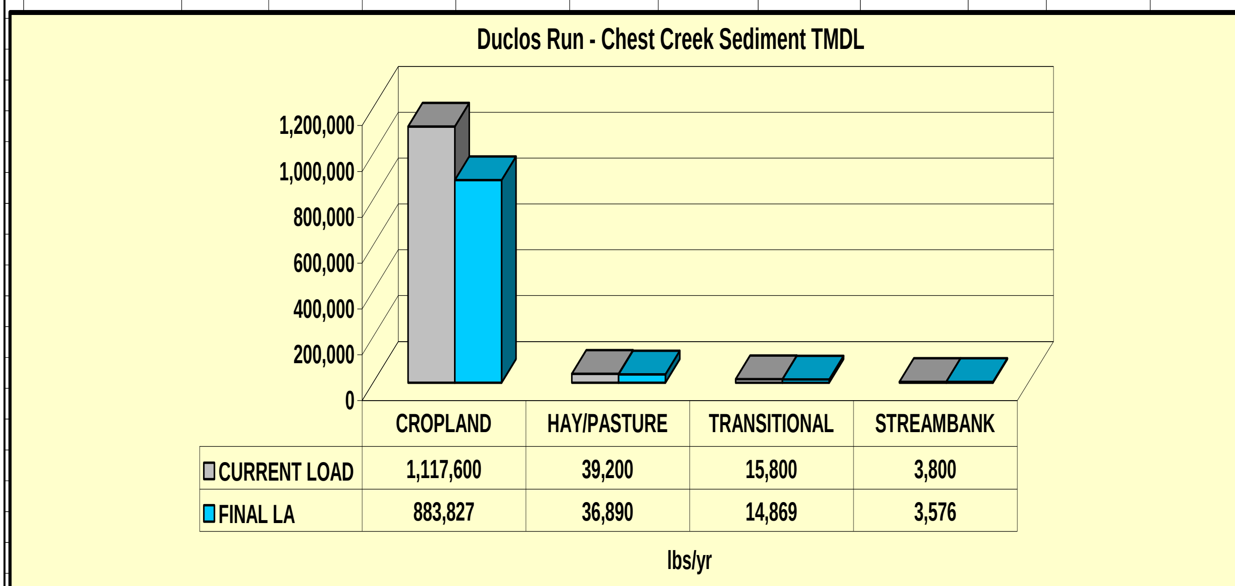


Table B3. Equal Marginal Percent Reduction calculations for Duclos Run

1	TMDL				2	Adjusted LA = TMDL total load - ((MOS) - loads not reduced)						
	TMDL = Sediment loading rate in ref. * Impaired Acres					9055957.3	9055957.3					
	10484841.0											
		Annual				Recheck	% reduction	Load			Allowable	%
3		Avg. Load	Load Sum	Check	Initial Adjust	Adjust	allocation	Reduction	Initial LA	Acres	Loading Rate	Reduction
	CROPLAND	8531600.0	12078600.0	good	8531600.0		0.7	2137237.3	6394362.7	2510.6	2546.9	25.1%
	HAY/PASTURE	830200.0		good	830200.0	3026842.7	0.1	207972.1	622227.9	2903.5	214.3	25.1%
	TRANSITIONAL	9000.0		good	9000.0		0.0	2254.6	6745.4	7.4	911.5	25.1%
	STREAMBANK	2707800.0		good	2707800.0		0.2	678326.6	2029473.4			25.1%
	COAL MINES	4200.0		good	4200.0		0.0	1052.1	3147.9	44.5	70.7	25.1%
					12082800.0		1.0		9055957.3			
4	All Ag. Loading Rate	1295.46										
			Allowable		Current	Current						
		Acres	loading rate	Final LA	Loading Rate	Load	% Red.			CURRENT LOAD	FINAL LA	
5	CROPLAND	2510.6	2546.9	6394362.7	3398.2	8531600.0	25.1%		CROPLAND	8,531,600	6,394,363	
	HAY/PASTURE	2903.5	214.3	622227.9	285.9	830200.0	25.1%		HAY/PASTURE	830,200	622,228	
	TRANSITIONAL	7.4	911.5	6745.4	1216.2	9000.0	25.1%		TRANSITIONAL	9,000	6,745	
	STREAMBANK			2029473.4		2707800.0	25.1%		STREAMBANK	2,707,800	2,029,473	
	COAL MINES	45	70.7	3147.9	94.38	4200.0	25.1%		COAL MINES	4,200	3,148	
				9055957.3		12078600.0	25.0%					

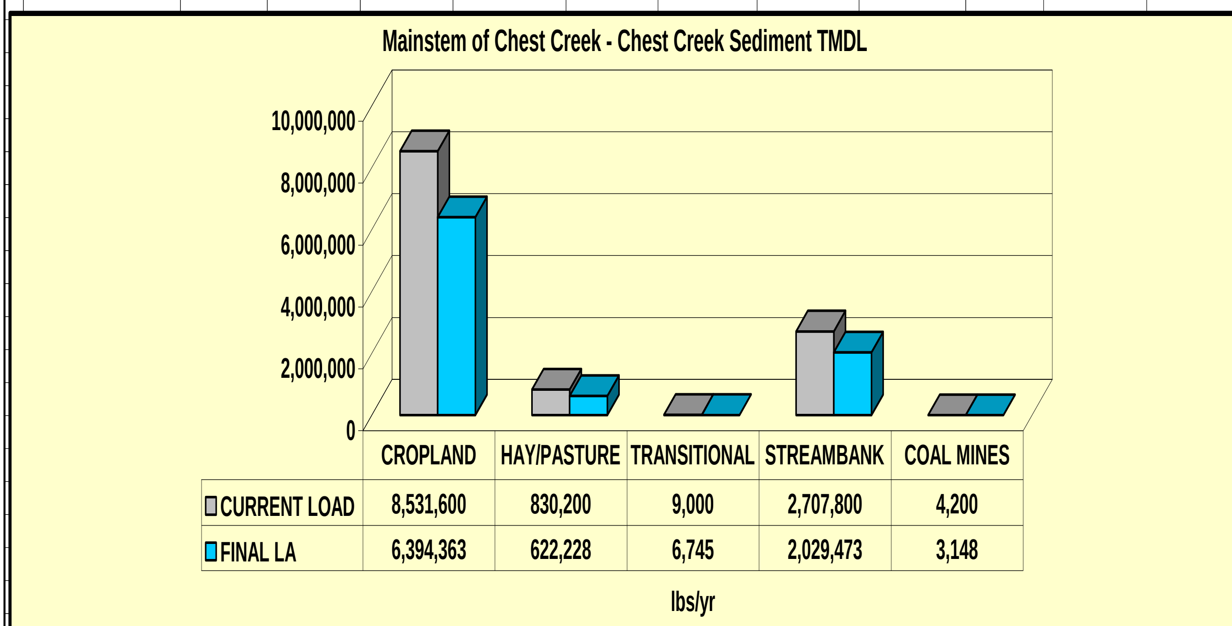


Table B4. Equal Marginal Percent Reduction calculations for the mainstem of Chest Creek

1	TMDL				2	Adjusted LA = TMDL total load - ((MOS) - loads not reduced)						
	TMDL = Sediment loading rate in ref. * Impaired Acres					1939862.3	1939862.3					
	2219395.9											
		Annual				Recheck	% reduction	Load			Allowable	%
3		Avg. Load	Load Sum	Check	Initial Adjust	Adjust	allocation	Reduction	Initial LA	Acres	Loading Rate	Reduction
	CROPLAND	2089400.0	2548000.0	bad	1939862.3		0.8	370913.0	1568949.3	719.1	2181.8	24.9%
	HAY/PASTURE	118600.0		good	118600.0	458600.0	0.0	22677.0	95923.0	889.6	107.8	19.1%
	TRANSITIONAL	5000.0		good	5000.0		0.0	956.0	4044.0	4.9	825.3	19.1%
	STREAMBANK	335000.0		good	335000.0		0.1	64054.0	270946.0			19.1%
					2398462.3		1.0		1939862.3			
4	All Ag. Loading Rate	1034.28										
			Allowable		Current	Current						
		Acres	loading rate	Final LA	Loading Rate	Load	% Red.			CURRENT LOAD	FINAL LA	
5	CROPLAND	719.1	2181.8	1568949.3	2905.6	2089400.0	24.9%		CROPLAND	2,089,400	1,568,949	
	HAY/PASTURE	889.6	107.8	95923.0	133.3	118600.0	19.1%		HAY/PASTURE	118,600	95,923	
	TRANSITIONAL	4.9	825.3	4044.0	1020.4	5000.0	19.1%		TRANSITIONAL	5,000	4,044	
	STREAMBANK			270946.0		335000.0	19.1%		STREAMBANK	335,000	270,946	
				1939862.3		2548000.0	23.9%					

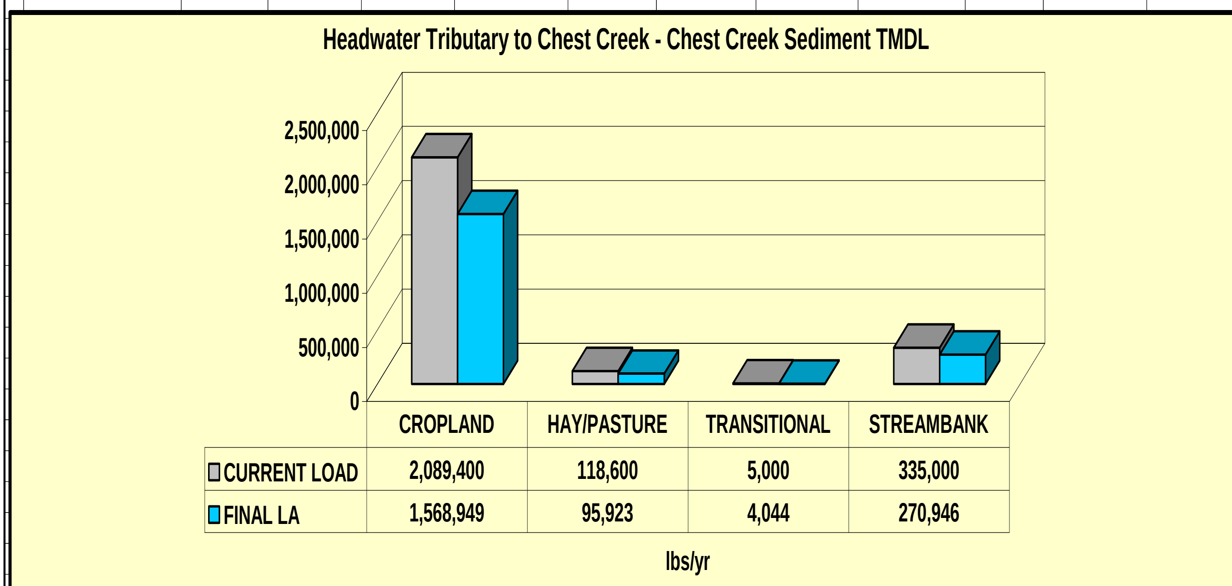


Table B5. Equal Marginal Percent Reduction calculations for headwaters tributary of Chest Creek

Attachment C
AVGWLF Generated Data Tables

Rural LU	Area (ha)	CN	K	LS	C	P
Hay/Past	141	75	0.25	0.712	0.03	0.45
Cropland	16	82	0.285	0.369	0.42	0.52
Forest	544	73	0.216	0.492	0.002	0.45
Wetland	2	87	0.291	0.148	0.01	0.1
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
Bare Land	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
	0	0	0	0	0	0
	0	0	0	0	0	0
Urban LU	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
Lo_Int_Dev	9	83	0.284	0.294	0.08	0.2
	0	0	0	0	0	0

Month	Ket	Day Hours	Season	Eros Coef	Stream Extract	Ground Extract
Jan	0.66	9.4	0	0.08	0	0
Feb	0.72	10.4	0	0.08	0	0
Mar	0.75	11.8	0	0.08	0	0
Apr	0.76	13.2	0	0.26	0	0
May	0.92	14.4	1	0.26	0	0
Jun	1.01	14.9	1	0.26	0	0
Jul	1.06	14.6	1	0.26	0	0
Aug	1.09	13.6	1	0.26	0	0
Sep	1.11	12.2	1	0.08	0	0
Oct	0.97	10.8	0	0.08	0	0
Nov	0.9	9.6	0	0.08	0	0
Dec	0.85	9.1	0	0.08	0	0

Init Unsat Stor (cm)	10	Initial Snow (cm)	0	Recess Coefficient	0.1
Init Sat Stor (cm)	0	Sed Delivery Ratio	0.188	Seepage Coefficient	0
Unsat Avail Wat (cm)	14.4115	Tile Drain Ratio	0.5	Sediment A Factor	2.5992E-04
		Tile Drain Density	0	Sed A Adjustment Factor	1

Load File | Save File | Export to JPEG | Close

Table C1(a). GWLF model data inputs for the Ashcraft Run

GWLF Total Loads for file: ashcraftrun-0

Period of analysis: 19 years from 1975 to 1993

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dis N	Total N	Dis P	Total P
Hay/Past	348.4	3.5	93.4	17.6	727.5	832.9	78.6	95.4
Cropland	39.5	6.2	101.4	19.1	145.4	259.9	15.6	33.8
Forest	1344.3	3.0	14.4	2.7	174.1	190.3	5.5	8.1
Wetland	4.9	9.5	0.0	0.0	2.0	2.1	0.1	0.1
Lo_Int_Dev	22.2	6.8	3.3	0.6	0.0	13.2	0.0	1.8
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				20.1		2.0		0.9
Groundwater					4962.8	4962.8	152.7	152.7
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					15.2	15.2	1.9	1.9
Totals	1759.4	3.30	212.6	60.1	6027.1	6278.4	254.4	294.7

Go Back | Pathogen Loads | Export to JPEG | Print | Close

Table C1(b). GWLF model data outputs for Ashcraft Run

Rural LU	Area (ha)	CN	K	LS	C	P
Hay/Past	38	75	0.18	3.14	0.03	0.45
Cropland	4	82	0.18	0.884	0.42	0.45
Forest	504	73	0.18	2.674	0.002	0.45
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
Bare Land	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
	0	0	0	0	0	0
	0	0	0	0	0	0
Urban LU	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
	0	0	0	0	0	0
	0	0	0	0	0	0

Month	Ket	Day Hours	Season	Eros Coef	Stream Extract	Ground Extract
Jan	0.63	9.4	0	0.080	0	0
Feb	0.68	10.4	0	0.080	0	0
Mar	0.71	11.8	0	0.080	0	0
Apr	0.72	13.2	0	0.260	0	0
May	0.88	14.4	1	0.260	0	0
Jun	0.98	14.9	1	0.260	0	0
Jul	1.03	14.6	1	0.260	0	0
Aug	1.06	13.6	1	0.260	0	0
Sep	1.08	12.2	1	0.080	0	0
Oct	0.94	10.8	0	0.080	0	0
Nov	0.86	9.6	0	0.080	0	0
Dec	0.81	9.1	0	0.080	0	0

Init Unsat Stor (cm)	10	Initial Snow (cm)	0	Recess Coefficient	0.1
Init Sat Stor (cm)	0	Sed Delivery Ratio	0.191	Seepage Coefficient	0
Unsat Avail Wat (cm)	13.31	Tile Drain Ratio	0.5	Sediment A Factor	1.2621E-04
		Tile Drain Density	0	Sed A Adjustment Factor	1

Load File | Save File | Export to JPEG | Close

Table C2(a). GWLF model data inputs for Blair Run (reference for Ashcraft Run)

GWLF Total Loads for file: headwatersofblairrun-0

Period of analysis: 23 years from 1975 to 1997

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dis N	Total N	Dis P	Total P
Hay/Past	93.9	3.2	78.3	15.0	173.9	263.7	20.7	35.8
Cropland	9.9	5.6	32.5	6.2	32.5	69.7	3.8	10.0
Forest	1245.4	2.7	59.0	11.3	145.4	213.0	4.6	16.0
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				5.9		0.6		0.3
Groundwater					2242.3	2242.3	92.9	92.9
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					20.2	20.2	1.9	1.9
Totals	1349.2	2.80	169.8	38.3	2614.3	2809.5	123.8	156.8

Go Back | Pathogen Loads | Export to JPEG | Print | Close

Table C2(b). GWLF model data outputs for Blair Run (reference for Ashcraft Run)

Rural LU	Area (ha)	CN	K	LS	C	P
Hay/Past	883	75	0.286	5.72	0.03	0.52
Cropland	424	82	0.325	5.527	0.42	0.45
Forest	1714	73	0.265	3.826	0.002	0.52
Wetland	6	87	0.263	0.272	0.01	0.1
Coal_Mines	3	87	0.34	0.706	0.8	0.1
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
Bare Land	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
	0	0	0	0	0	0
Transition	11	87	0.338	1.689	0.8	0.8
Urban LU	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
Lo_Int_Dev	260	83	0.341	2.106	0.08	0.2
	0	0	0	0	0	0

Month	Ket	Day Hours	Season	Eros Coef	Stream Extract	Ground Extract
Jan	0.67	9.4	0	0.08	0	0
Feb	0.72	10.4	0	0.08	0	0
Mar	0.75	11.8	0	0.08	0	0
Apr	0.77	13.2	0	0.26	0	0
May	0.93	14.4	1	0.26	0	0
Jun	1.02	14.9	1	0.26	0	0
Jul	1.07	14.6	1	0.26	0	0
Aug	1.1	13.6	1	0.26	0	0
Sep	1.12	12.2	1	0.08	0	0
Oct	0.99	10.8	0	0.08	0	0
Nov	0.91	9.6	0	0.08	0	0
Dec	0.86	9.1	0	0.08	0	0

Init Unsat Stor (cm)	10	**Initial Snow (cm)**	0	**Recess Coefficient**	0.1
Init Sat Stor (cm)	0	**Sed Delivery Ratio**	0.157	**Seepage Coefficient**	0
Unsat Avail Wat (cm)	15.7545	**Tile Drain Ratio**	0.5	**Sediment A Factor**	5.9588E-04
		Tile Drain Density	0	**Sed A Adjustment Factor**	1

Load File | Save File | Export to JPEG | Close

Table C3(a). GWLF model data inputs for Brubaker Run

GWLF Total Loads for file: brubakerrun-0

Period of analysis: 23 years from 1975 to 1997

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dis N	Total N	Dis P	Total P
Hay/Past	2181.9	3.2	6067.3	952.6	4042.0	9757.4	475.8	1016.9
Cropland	1047.7	5.6	38758.7	6085.1	3440.2	39950.9	394.8	3851.2
Forest	4235.4	2.7	486.7	76.4	494.6	953.0	15.6	59.0
Wetland	14.8	8.6	0.1	0.0	5.5	5.6	0.2	0.2
Coal_Mines	7.4	8.6	15.5	2.4	0.2	14.8	0.0	1.4
Transition	27.2	8.6	1082.4	169.9	154.4	1174.0	10.6	107.2
Lo_Int_Dev	642.5	6.1	804.2	126.3	0.0	353.4	0.0	47.1
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				338.3		33.8		14.9
Groundwater					19232.1	19232.1	596.5	596.5
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					230.4	230.4	39.4	39.4
Totals	8156.9	3.50	47214.9	7751.1	27599.4	71705.4	1533.0	5733.7

Go Back | Pathogen Loads | Export to JPEG | Print | Close

Table C3(b). GWLF model data outputs for Brubaker Run

Rural LU	Area (ha)	CN	K	LS	C	P
Hay/Past	491	75	0.195	16.926	0.03	0.66
Cropland	124	82	0.215	6.177	0.42	0.52
Forest	2307	73	0.192	12.613	0.002	0.74
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
Bare Land	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
	0	0	0	0	0	0
Transition	4	87	0.211	3.869	0.8	0.8
Urban LU	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
Lo_Int_Dev	81	83	0.226	1.832	0.08	0.2
	0	0	0	0	0	0

Month	Ket	Day Hours	Season	Eros Coef	Stream Extract	Ground Extract
Jan	0.64	9.4	0	0.12	0	0
Feb	0.7	10.4	0	0.12	0	0
Mar	0.73	11.8	0	0.12	0	0
Apr	0.74	13.2	0	0.3	0	0
May	0.9	14.4	1	0.3	0	0
Jun	0.99	14.9	1	0.3	0	0
Jul	1.04	14.6	1	0.3	0	0
Aug	1.07	13.6	1	0.3	0	0
Sep	1.09	12.2	1	0.12	0	0
Oct	0.96	10.8	0	0.12	0	0
Nov	0.88	9.6	0	0.12	0	0
Dec	0.83	9.1	0	0.12	0	0

Init Unsat Stor (cm)	10	Initial Snow (cm)	0	Recess Coefficient	0.1
Init Sat Stor (cm)	0	Sed Delivery Ratio	0.16	Seepage Coefficient	0
Unsat Avail Wat (cm)	12.7699	Tile Drain Ratio	0.5	Sediment A Factor	3.0037E-04
		Tile Drain Density	0	Sed A Adjustment Factor	1

Load File | Save File | Export to JPEG | Close

Table C4(a). GWLF model data inputs for South Poplar Run (reference for Brubaker Run)

GWLF Total Loads for file: southpoplarrun-0

Period of analysis: 23 years from 1975 to 1997

Source	Area (Acres)	Runoff (in)	Tons: Erosion	Tons: Sediment	Total Loads (Pounds): Dis N	Total N	Dis P	Total P
Hay/Past	1213.3	3.2	10550.0	1688.0	2247.6	12375.6	265.9	1677.1
Cropland	306.4	5.6	11825.8	1892.1	1006.1	12358.8	116.1	1698.0
Forest	5700.7	2.7	2718.6	435.0	665.7	3275.5	21.0	384.7
Transition	9.9	8.6	687.2	109.9	56.2	715.8	3.9	95.8
Lo_Int_Dev	200.2	6.1	176.4	28.2	0.0	110.1	0.0	14.7
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				213.8		21.4		9.4
Groundwater					13791.7	13791.7	551.8	551.8
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					186.8	186.8	26.3	26.3
Totals	7430.4	3.00	25957.9	4367.1	17954.0	42835.7	985.0	4457.6

Go Back | Pathogen Loads | Export to JPEG | Print | Close

Table C4(b). GWLF model data outputs for South Poplar Run (reference for Brubaker Run)

Rural LU	Area (ha)	CN	K	LS	C	P
Hay/Past	177	75	0.255	0.642	0.03	0.45
Cropland	347	82	0.264	0.644	0.42	0.45
Forest	279	73	0.239	0.48	0.002	0.45
Wetland	3	87	0.294	0.343	0.01	0.1
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
Bare Land	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
	0	0	0	0	0	0
Transition	4	87	0.298	0.208	0.8	0.8
Urban LU	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
Lo_Int_Dev	49	83	0.242	0.201	0.08	0.2
	0	0	0	0	0	0

Month	Ket	Day Hours	Season	Eros Coef	Stream Extract	Ground Extract
Jan	0.58	9.4	0	0.08	0	0
Feb	0.63	10.4	0	0.08	0	0
Mar	0.66	11.8	0	0.08	0	0
Apr	0.67	13.2	0	0.26	0	0
May	0.87	14.4	1	0.26	0	0
Jun	0.99	14.9	1	0.26	0	0
Jul	1.05	14.6	1	0.26	0	0
Aug	1.09	13.6	1	0.26	0	0
Sep	1.11	12.2	1	0.08	0	0
Oct	0.94	10.8	0	0.08	0	0
Nov	0.83	9.6	0	0.08	0	0
Dec	0.77	9.1	0	0.08	0	0

Init Unsat Stor (cm)	10	Initial Snow (cm)	0	Recess Coefficient	0.1
Init Sat Stor (cm)	0	Sed Delivery Ratio	0.186	Seepage Coefficient	0
Unsat Avail Wat (cm)	15.1484	Tile Drain Ratio	0.5	Sediment A Factor	4.5784E-04
		Tile Drain Density	0	Sed A Adjustment Factor	1

Load File | Save File | Export to JPEG | Close

Table C5(a). GWLF model data inputs for the Duclos Run

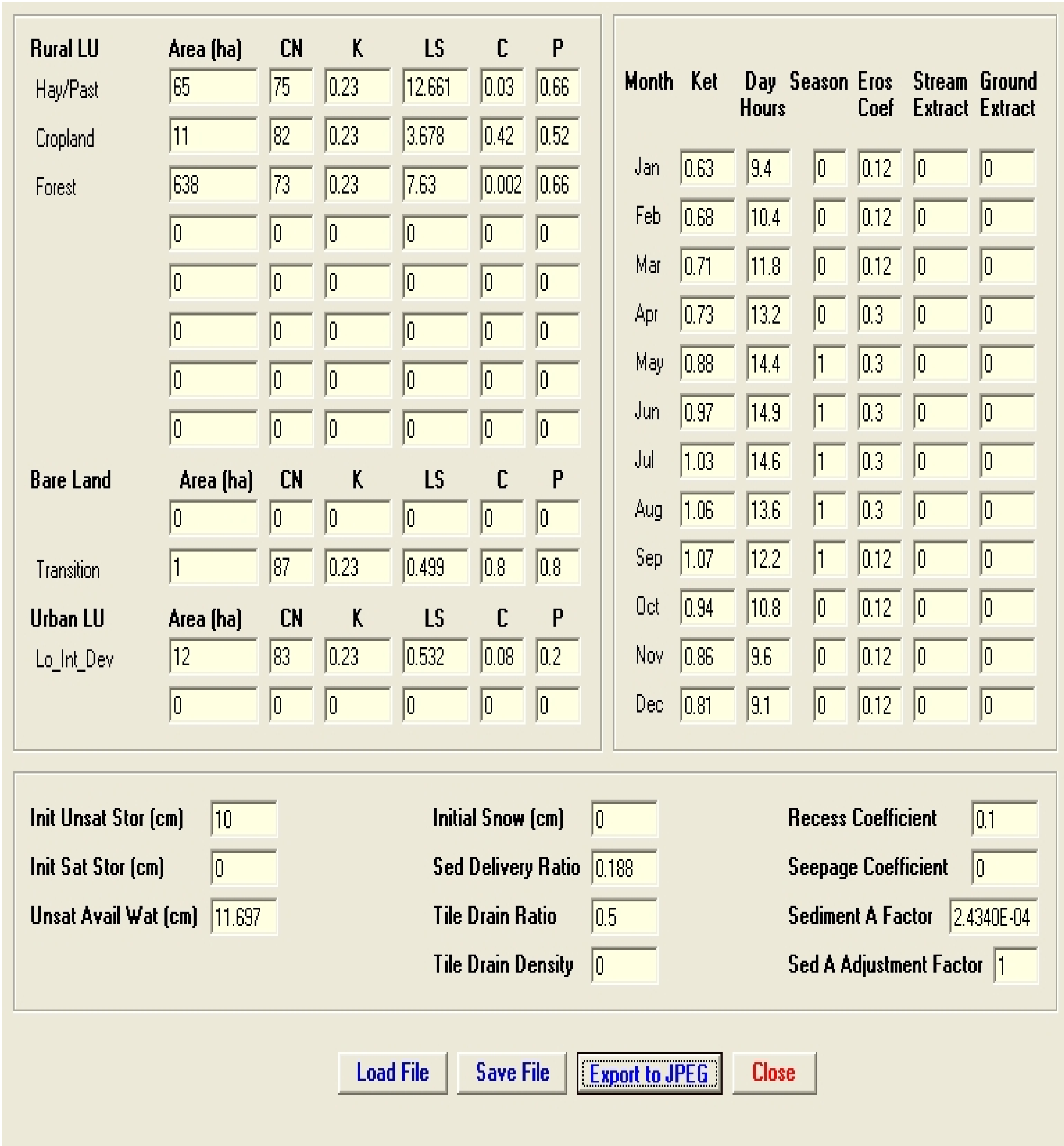
GWLF Total Loads for file: DuclosRunOutput-0

Period of analysis: 23 years from 1975 to 1997

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dis N	Total N	Dis P	Total P
Hay/Past	437.4	3.2	105.3	19.6	810.2	927.7	95.2	104.9
Cropland	857.5	5.6	3004.4	558.8	2815.4	6168.3	322.6	598.7
Forest	689.4	2.7	7.8	1.4	80.5	89.2	2.5	3.3
Wetland	7.4	8.6	0.1	0.0	2.8	2.8	0.1	0.1
Transition	9.9	8.6	42.7	7.9	56.2	103.7	3.9	7.8
Lo_Int_Dev	121.1	6.1	10.3	1.9	0.0	66.6	0.0	8.9
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				52.9		5.3		2.3
Groundwater					20954.0	20954.0	254.4	254.4
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					44.9	44.9	7.5	7.5
Totals	2122.6	4.20	3170.4	642.6	24764.0	28362.6	686.3	987.9

Go Back | Pathogen Loads | Export to JPEG | Print | Close

Table C5(b). GWLF model data outputs for Duclos Run

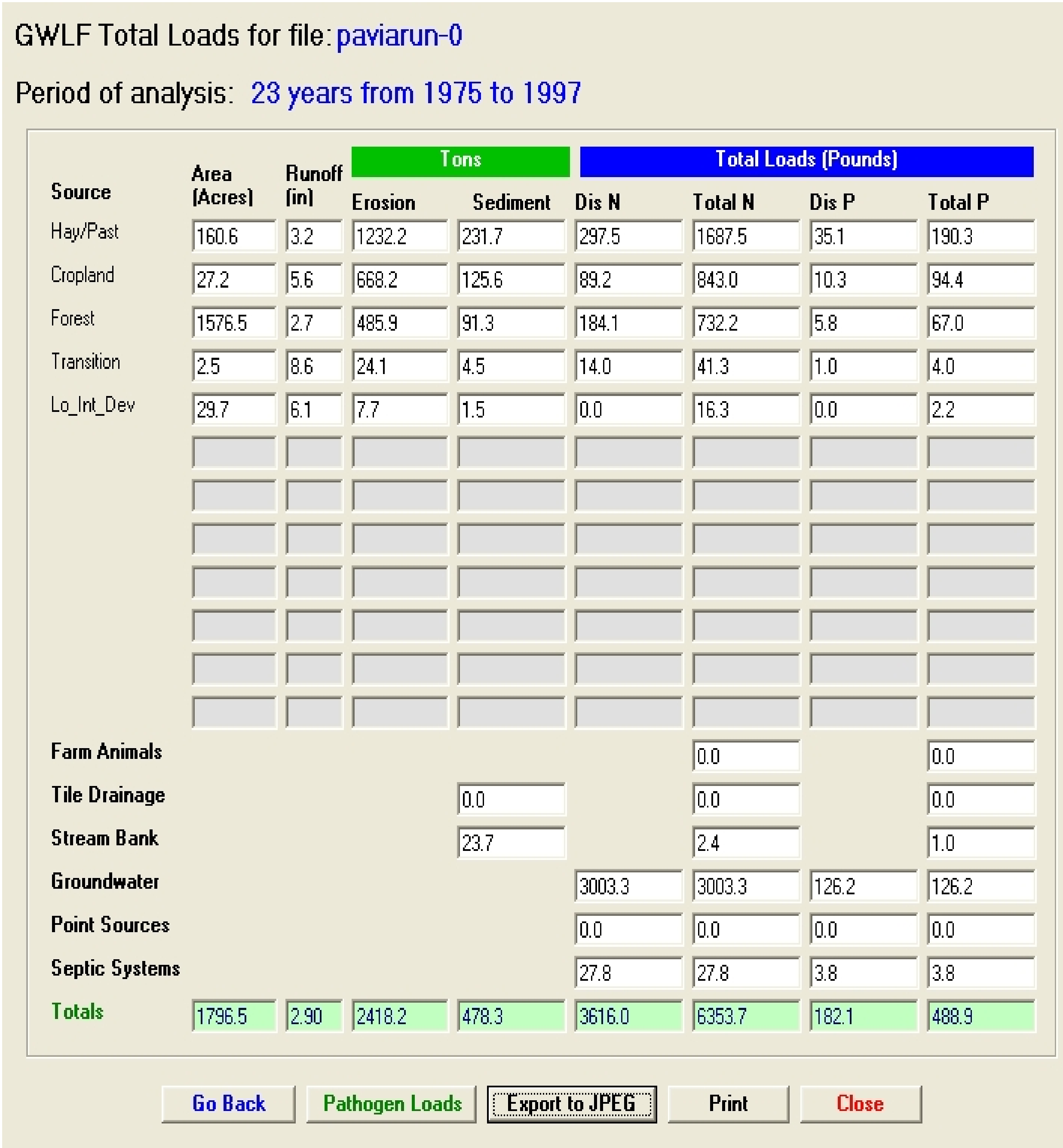


Rural LU	Area (ha)	CN	K	LS	C	P
Hay/Past	65	75	0.23	12.661	0.03	0.66
Cropland	11	82	0.23	3.678	0.42	0.52
Forest	638	73	0.23	7.63	0.002	0.66
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
Bare Land	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
	0	0	0	0	0	0
Transition	1	87	0.23	0.499	0.8	0.8
Urban LU	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
Lo_Int_Dev	12	83	0.23	0.532	0.08	0.2
	0	0	0	0	0	0

Month	Ket	Day Hours	Season	Eros Coef	Stream Extract	Ground Extract
Jan	0.63	9.4	0	0.12	0	0
Feb	0.68	10.4	0	0.12	0	0
Mar	0.71	11.8	0	0.12	0	0
Apr	0.73	13.2	0	0.3	0	0
May	0.88	14.4	1	0.3	0	0
Jun	0.97	14.9	1	0.3	0	0
Jul	1.03	14.6	1	0.3	0	0
Aug	1.06	13.6	1	0.3	0	0
Sep	1.07	12.2	1	0.12	0	0
Oct	0.94	10.8	0	0.12	0	0
Nov	0.86	9.6	0	0.12	0	0
Dec	0.81	9.1	0	0.12	0	0

Init Unsat Stor (cm)	10	Initial Snow (cm)	0	Recess Coefficient	0.1
Init Sat Stor (cm)	0	Sed Delivery Ratio	0.188	Seepage Coefficient	0
Unsat Avail Wat (cm)	11.697	Tile Drain Ratio	0.5	Sediment A Factor	2.4340E-04
		Tile Drain Density	0	Sed A Adjustment Factor	1

Table C6(a). GWLF model data inputs for Pavia Run (reference for Duclos Run)



GWLF Total Loads for file: paviarun-0

Period of analysis: 23 years from 1975 to 1997

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dis N	Total N	Dis P	Total P
Hay/Past	160.6	3.2	1232.2	231.7	297.5	1687.5	35.1	190.3
Cropland	27.2	5.6	668.2	125.6	89.2	843.0	10.3	94.4
Forest	1576.5	2.7	485.9	91.3	184.1	732.2	5.8	67.0
Transition	2.5	8.6	24.1	4.5	14.0	41.3	1.0	4.0
Lo_Int_Dev	29.7	6.1	7.7	1.5	0.0	16.3	0.0	2.2
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				23.7		2.4		1.0
Groundwater					3003.3	3003.3	126.2	126.2
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					27.8	27.8	3.8	3.8
Totals	1796.5	2.90	2418.2	478.3	3616.0	6353.7	182.1	488.9

Table C6(b). GWLF model data outputs for Pavia Run (reference for Duclos Run)

Rural LU	Area (ha)	CN	K	LS	C	P
Hay/Past	1175	75	0.332	2.185	0.03	0.45
Cropland	1016	82	0.329	1.572	0.5	0.45
Forest	3312	73	0.335	1.269	0.002	0.45
Wetland	45	87	0.351	0.296	0.01	0.1
Coal_Mines	18	87	0.34	0.117	0.8	0.1
Turf_Grass	26	71	0.37	3.717	0.08	0.2
	0	0	0	0	0	0
	0	0	0	0	0	0
Bare Land	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
	0	0	0	0	0	0
Transition	3	87	0.335	0.194	0.8	0.8
Urban LU	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
Lo_Int_Dev	252	83	0.338	1.077	0.08	0.2
	0	0	0	0	0	0

Month	Ket	Day Hours	Season	Eros Coef	Stream Extract	Ground Extract
Jan	0.63	9.4	0	0.08	0	0
Feb	0.68	10.4	0	0.08	0	0
Mar	0.71	11.8	0	0.08	0	0
Apr	0.73	13.2	0	0.26	0	0
May	0.89	14.4	1	0.26	0	0
Jun	0.99	14.9	1	0.26	0	0
Jul	1.05	14.6	1	0.26	0	0
Aug	1.08	13.6	1	0.26	0	0
Sep	1.1	12.2	1	0.08	0	0
Oct	0.95	10.8	0	0.08	0	0
Nov	0.87	9.6	0	0.08	0	0
Dec	0.82	9.1	0	0.08	0	0

Init Unsat Stor (cm)	10	Initial Snow (cm)	0	Recess Coefficient	0.1
Init Sat Stor (cm)	0	Sed Delivery Ratio	0.134	Seepage Coefficient	0
Unsat Avail Wat (cm)	16.7522	Tile Drain Ratio	0.5	Sediment A Factor	4.4857E-04
		Tile Drain Density	0	Sed A Adjustment Factor	1

Load File | Save File | Export to JPEG | Close

Table C7(a). GWLF model data inputs for the mainstem of Chest Creek

GWLF Total Loads for file: mainstemchestcreekpostfield-0

Period of analysis: 23 years from 1975 to 1997

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dis N	Total N	Dis P	Total P
Hay/Past	2903.5	3.2	3098.4	415.2	5378.7	7869.7	632.4	841.7
Cropland	2510.6	5.6	31834.4	4265.8	8243.4	33838.3	944.9	3094.8
Forest	8184.1	2.7	341.2	45.7	955.6	1230.0	30.2	53.2
Wetland	111.2	8.6	1.3	0.2	41.4	42.4	1.3	1.4
Coal_Mines	44.5	8.6	15.4	2.1	1.0	13.4	0.2	1.2
Turf_Grass	64.2	2.3	154.0	20.6	83.9	207.7	2.8	13.2
Transition	7.4	8.6	33.6	4.5	42.1	69.1	2.9	5.2
Lo_Int_Dev	622.7	6.1	395.2	53.0	0.0	342.5	0.0	45.7
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				1354.5		135.5		59.6
Groundwater					88087.4	88087.4	1412.1	1412.1
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					632.6	632.6	110.8	110.8
Totals	14448.2	3.50	35873.5	6161.5	103466.0	132468.5	3137.6	5638.9

Go Back | Pathogen Loads | Export to JPEG | Print | Close

Table C7(b). GWLF model data outputs for the mainstem of Chest Creek

Rural LU	Area (ha)	CN	K	LS	C	P
Hay/Past	668	75	0.21	6.98	0.03	0.52
Cropland	226	82	0.214	7.493	0.42	0.52
Forest	4711	73	0.215	6.231	0.002	0.66
Wetland	7	87	0.23	0.083	0.01	0.1
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
Bare Land	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
	0	0	0	0	0	0
Transition	4	87	0.218	0.912	0.8	0.8
Urban LU	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
Lo_Int_Dev	158	83	0.217	3.165	0.08	0.2
	0	0	0	0	0	0

Month	Ket	Day Hours	Season	Eros Coef	Stream Extract	Ground Extract
Jan	0.63	9.4	0	0.113	0	0
Feb	0.68	10.4	0	0.113	0	0
Mar	0.71	11.8	0	0.113	0	0
Apr	0.72	13.2	0	0.293	0	0
May	0.88	14.4	1	0.293	0	0
Jun	0.97	14.9	1	0.293	0	0
Jul	1.03	14.6	1	0.293	0	0
Aug	1.06	13.6	1	0.293	0	0
Sep	1.07	12.2	1	0.113	0	0
Oct	0.94	10.8	0	0.113	0	0
Nov	0.86	9.6	0	0.113	0	0
Dec	0.81	9.1	0	0.113	0	0

Init Unsat Stor (cm)	10	Initial Snow (cm)	0	Recess Coefficient	0.1
Init Sat Stor (cm)	0	Sed Delivery Ratio	0.135	Seepage Coefficient	0
Unsat Avail Wat (cm)	12.1938	Tile Drain Ratio	0.5	Sediment A Factor	2.9176E-04
		Tile Drain Density	0	Sed A Adjustment Factor	1

Load File | Save File | Export to JPEG | Close

Table C8(a). GWLF model data inputs for the headwaters of Bobs Creek
(reference for the mainstem of Chest Creek)

GWLF Total Loads for file: headwatersofbobscreek-0

Period of analysis: 23 years from 1975 to 1997

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dis N	Total N	Dis P	Total P
Hay/Past	1650.7	3.2	4863.9	656.6	3057.8	6997.6	361.0	832.5
Cropland	558.5	5.6	25202.4	3402.3	1833.7	22247.6	211.1	2654.0
Forest	11641.1	2.7	2652.7	358.1	1359.3	3508.0	42.9	300.0
Wetland	17.3	8.6	0.0	0.0	6.4	6.5	0.2	0.2
Transition	9.9	8.6	162.1	21.9	56.2	187.4	3.9	19.6
Lo_Int_Dev	390.4	6.1	552.9	74.6	0.0	214.8	0.0	28.6
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				663.5		66.4		29.2
Groundwater					23656.3	23656.3	1052.7	1052.7
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					162.8	162.8	22.5	22.5
Totals	14267.8	3.00	33434.1	5177.1	30132.5	57047.3	1694.4	4939.4

Go Back | Pathogen Loads | Export to JPEG | Print | Close

Table C8(b). GWLF model data outputs for the headwaters of Bobs Creek (reference for the mainstem of Chest Creek)

Rural LU	Area (ha)	CN	K	LS	C	P
Hay/Past	360	75	0.327	0.779	0.03	0.45
Cropland	291	82	0.328	0.725	0.6	0.45
Forest	751	73	0.328	0.765	0.002	0.45
Wetland	10	87	0.32	0.194	0.01	0.1
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
Bare Land	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
	0	0	0	0	0	0
Transition	2	87	0.34	0.118	0.8	0.8
Urban LU	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
Lo_Int_Dev	65	83	0.329	0.585	0.08	0.2
	0	0	0	0	0	0

Month	Ket	Day Hours	Season	Eros Coef	Stream Extract	Ground Extract
Jan	0.64	9.4	0	0.08	0	0
Feb	0.69	10.4	0	0.08	0	0
Mar	0.72	11.8	0	0.08	0	0
Apr	0.74	13.2	0	0.26	0	0
May	0.91	14.4	1	0.26	0	0
Jun	1.01	14.9	1	0.26	0	0
Jul	1.07	14.6	1	0.26	0	0
Aug	1.1	13.6	1	0.26	0	0
Sep	1.12	12.2	1	0.08	0	0
Oct	0.97	10.8	0	0.08	0	0
Nov	0.88	9.6	0	0.08	0	0
Dec	0.83	9.1	0	0.08	0	0

Init Unsat Stor (cm)	10	Initial Snow (cm)	0	Recess Coefficient	0.1
Init Sat Stor (cm)	0	Sed Delivery Ratio	0.178	Seepage Coefficient	0
Unsat Avail Wat (cm)	16.7784	Tile Drain Ratio	0.5	Sediment A Factor	4.6931E-04
		Tile Drain Density	0	Sed A Adjustment Factor	1

Load File Save File Export to JPEG Close

Table C9(a). GWLF model data inputs for the headwaters tributary of Chest Creek

GWLF Total Loads for file: HeadwaterTribtoChestCreekPostField-0

Period of analysis: 23 years from 1975 to 1997

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dis N	Total N	Dis P	Total P
Hay/Past	889.6	3.2	333.3	59.3	1647.9	2003.9	193.9	226.3
Cropland	719.1	5.6	5869.3	1044.7	2361.1	8629.5	270.9	841.3
Forest	1855.8	2.7	45.7	8.1	216.7	265.5	6.8	11.3
Wetland	24.7	8.6	0.2	0.0	9.2	9.4	0.3	0.3
Transition	4.9	8.6	13.8	2.5	28.1	42.8	1.9	3.3
Lo_Int_Dev	160.6	6.1	53.9	9.6	0.0	88.3	0.0	11.8
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				167.5		16.8		7.4
Groundwater					25429.2	25429.2	371.5	371.5
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					30.2	30.2	1.9	1.9
Totals	3654.7	3.60	6316.2	1291.8	29722.3	36515.6	847.3	1475.0

Go Back | Pathogen Loads | Export to JPEG | Print | Close

Table C9(b). GWLF model data outputs for the headwaters tributary of Chest Creek

Rural LU	Area (ha)	CN	K	LS	C	P
Hay/Past	159	75	0.2	8.879	0.03	0.52
Cropland	23	82	0.218	6.331	0.42	0.66
Forest	1079	73	0.217	7.756	0.002	0.66
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0

Bare Land	Area (ha)	CN	K	LS	C	P
	0	0	0	0	0	0
	0	0	0	0	0	0

Urban LU	Area (ha)	CN	K	LS	C	P
Lo_Int_Dev	29	83	0.223	5.741	0.08	0.2
	0	0	0	0	0	0

Month	Ket	Day Hours	Season	Eros Coef	Stream Extract	Ground Extract
Jan	0.64	9.4	0	0.112	0	0
Feb	0.69	10.4	0	0.112	0	0
Mar	0.72	11.8	0	0.112	0	0
Apr	0.73	13.2	0	0.292	0	0
May	0.89	14.3	1	0.292	0	0
Jun	0.98	14.9	1	0.292	0	0
Jul	1.03	14.6	1	0.292	0	0
Aug	1.06	13.6	1	0.292	0	0
Sep	1.08	12.2	1	0.112	0	0
Oct	0.94	10.8	0	0.112	0	0
Nov	0.87	9.7	0	0.112	0	0
Dec	0.82	9.1	0	0.112	0	0

Init Unsat Stor (cm)	10	Initial Snow (cm)	0	Recess Coefficient	0.1
Init Sat Stor (cm)	0	Sed Delivery Ratio	0.181	Seepage Coefficient	0
Unsat Avail Wat (cm)	12.1826	Tile Drain Ratio	0.5	Sediment A Factor	2.5775E-04
		Tile Drain Density	0	Sed A Adjustment Factor	1

Load File | Save File | Export to JPEG | Close

Table C10(a). GWLF model data inputs for Wallacks Branch (reference for the headwaters tributary of Chest Creek)

GWLF Total Loads for file: wallacksbranch-0

Period of analysis: 18 years from 1975 to 1992

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dis N	Total N	Dis P	Total P
Hay/Past	392.9	3.0	1370.0	248.0	703.8	2191.6	74.6	230.3
Cropland	56.8	5.4	2736.7	495.4	181.5	3153.6	19.0	330.1
Forest	2666.3	2.6	745.6	134.9	295.0	1104.6	9.3	94.1
Lo_Int_Dev	71.7	5.9	184.8	33.4	0.0	40.3	0.0	5.4
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				56.2		5.6		2.5
Groundwater					5266.0	5266.0	215.6	215.6
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					44.6	44.6	5.6	5.6
Totals	3187.7	2.80	5037.0	967.9	6490.8	11806.3	324.2	883.6

Go Back | Pathogen Loads | Export to JPEG | Print | Close

Table C10(b). GWLF model data outputs for Wallacks Branch
(reference for the headwaters tributary of Chest Creek)

Attachment D
Pennsylvania Integrated Water Quality Monitoring and Assessment Report: Streams, Category 5 Waterbodies, Pollutants Requiring a TMDL

Stream Name Use Designation (Assessment ID) Source	Cause	Date Listed	TMDL Date

Hydrologic Unit Code: 02050201 - Upper West Branch Susquehanna

Ashcraft Run
HUC: 02050201

Aquatic Life (9969) - 0.66 miles; 1 Segment(s)*

Source	Cause	Date Listed	TMDL Date
Abandoned Mine Drainage	Metals	2002	2015
Abandoned Mine Drainage	Siltation	2002	2015

Report Summary

Watershed Summary

	Stream Miles	Assessment Units	Segments (COMIDs)
Watershed Characteristics	5.22	1	6

Impairment Summary

Source	Cause	Miles	Assessment Units	Segments (COMIDs)
Abandoned Mine Drainage	Metals	.66	1	1
Abandoned Mine Drainage	Siltation	.66	1	1
		.66**	1**	1**

**Totals reflect actual miles of impaired stream. Each stream segment may have multiple impairments (different sources or causes contributing to the impairment), so the sum of individual impairment numbers may not add up to the totals shown.

Use Designation Summary

	Miles	Assessment Units	Segments (COMIDs)
Aquatic Life	.66	1	1

*Segments are defined as individual COM IDs.

Stream Name / Use Designation (Assessment ID) / Source	Cause	Date Listed	TMDL Date

Hydrologic Unit Code: 02050201 - Upper West Branch Susquehanna

Brubaker Run
HUC: 02050201

Use Designation / Source	Cause	Date Listed	TMDL Date
Aquatic Life (4185) - 5.66 miles; 9 Segment(s)*			
Abandoned Mine Drainage	Metals	2004	2017
Removal of Vegetation	Siltation	2004	2017
Aquatic Life (9971) - 1.59 miles; 4 Segment(s)*			
Abandoned Mine Drainage	Metals	2002	2015
Abandoned Mine Drainage	Siltation	2002	2015
Potable Water Supply (15409) - 0.57 miles; 2 Segment(s)*			
Source Unknown	Other Inorganics	2010	2023

Brubaker Run (Unt 26866)
HUC: 02050201

Use Designation / Source	Cause	Date Listed	TMDL Date
Aquatic Life (4185) - 1.84 miles; 4 Segment(s)*			
Abandoned Mine Drainage	Metals	2004	2017
Removal of Vegetation	Siltation	2004	2017

Brubaker Run (Unt 26867)
HUC: 02050201

Use Designation / Source	Cause	Date Listed	TMDL Date
Aquatic Life (4185) - 0.91 miles; 1 Segment(s)*			
Abandoned Mine Drainage	Metals	2004	2017
Removal of Vegetation	Siltation	2004	2017

Brubaker Run (Unt 26868)
HUC: 02050201

Use Designation / Source	Cause	Date Listed	TMDL Date
Aquatic Life (4185) - 0.74 miles; 2 Segment(s)*			
Abandoned Mine Drainage	Metals	2004	2017
Removal of Vegetation	Siltation	2004	2017

Brubaker Run (Unt 26870)
HUC: 02050201

Use Designation / Source	Cause	Date Listed	TMDL Date
Aquatic Life (4185) - 0.95 miles; 2 Segment(s)*			
Abandoned Mine Drainage	Metals	2004	2017
Removal of Vegetation	Siltation	2004	2017

Little Brubaker Run
HUC: 02050201

Use Designation / Source	Cause	Date Listed	TMDL Date
Aquatic Life (4185) - 0.58 miles; 4 Segment(s)*			
Abandoned Mine Drainage	Metals	2004	2017
Removal of Vegetation	Siltation	2004	2017
Aquatic Life (9971) - 3.56 miles; 9 Segment(s)*			
Abandoned Mine Drainage	Metals	2002	2015
Abandoned Mine Drainage	Siltation	2002	2015

*Segments are defined as individual COM IDs.

Stream Name Use Designation (Assessment ID) Source	Cause	Date Listed	TMDL Date
Little Brubaker Run (Unt 26862) HUC: 02050201			
Aquatic Life (9971) - 0.47 miles; 1 Segment(s)*			
Abandoned Mine Drainage	Metals	2002	2015
Abandoned Mine Drainage	Siltation	2002	2015
Little Brubaker Run (Unt 26863) HUC: 02050201			
Aquatic Life (9971) - 0.67 miles; 1 Segment(s)*			
Abandoned Mine Drainage	Metals	2002	2015
Abandoned Mine Drainage	Siltation	2002	2015
Little Brubaker Run (Unt 26865) HUC: 02050201			
Aquatic Life (4185) - 0.34 miles; 1 Segment(s)*			
Abandoned Mine Drainage	Metals	2004	2017
Removal of Vegetation	Siltation	2004	2017
zz Unknown NHD Name: 02050201002498 HUC: 02050201			
Aquatic Life (9971) - 0.11 miles; 1 Segment(s)*			
Abandoned Mine Drainage	Metals	2002	2015
Abandoned Mine Drainage	Siltation	2002	2015

Report Summary

Watershed Summary

	Stream Miles	Assessment Units	Segments (COMIDs)
Watershed Characteristics	17.87	3	41

Impairment Summary

Source	Cause	Miles	Assessment Units	Segments (COMIDs)
Abandoned Mine Drainage	Metals	17.41	2	39
Abandoned Mine Drainage	Siltation	6.38	1	16
Removal of Vegetation	Siltation	11.03	1	23
Source Unknown	Other Inorganics	.57	1	2
		17.41**	3**	39**

**Totals reflect actual miles of impaired stream. Each stream segment may have multiple impairments (different sources or causes contributing to the impairment), so the sum of individual impairment numbers may not add up to the totals shown.

Use Designation Summary

	Miles	Assessment Units	Segments (COMIDs)
Aquatic Life	17.41	2	39
Potable Water Supply	.57	1	2

*Segments are defined as individual COM IDs.

Stream Name / Use Designation (Assessment ID) / Source	Cause	Date Listed	TMDL Date

Hydrologic Unit Code: 02050201 - Upper West Branch Susquehanna

Duclos Run
HUC: 02050201

Aquatic Life (5971) - 0.96 miles; 8 Segment(s)*			
Grazing Related Agric	Siltation	2004	2017
Aquatic Life (9974) - 2.50 miles; 11 Segment(s)*			
Erosion from Derelict Land	Siltation	2002	2015

Duclos Run (Unt 26894)
HUC: 02050201

Aquatic Life (5971) - 0.44 miles; 1 Segment(s)*			
Grazing Related Agric	Siltation	2004	2017

Duclos Run (Unt 26895)
HUC: 02050201

Aquatic Life (5971) - 0.41 miles; 1 Segment(s)*			
Grazing Related Agric	Siltation	2004	2017

Duclos Run (Unt 26896)
HUC: 02050201

Aquatic Life (5971) - 1.91 miles; 10 Segment(s)*			
Grazing Related Agric	Siltation	2004	2017

Duclos Run (Unt 26897)
HUC: 02050201

Aquatic Life (5971) - 0.52 miles; 2 Segment(s)*			
Grazing Related Agric	Siltation	2004	2017

Duclos Run (Unt 26899)
HUC: 02050201

Aquatic Life (5971) - 0.38 miles; 2 Segment(s)*			
Grazing Related Agric	Siltation	2004	2017

Duclos Run (Unt 26900)
HUC: 02050201

Aquatic Life (5971) - 0.28 miles; 3 Segment(s)*			
Grazing Related Agric	Siltation	2004	2017

Duclos Run (Unt 26901)
HUC: 02050201

Aquatic Life (5971) - 0.52 miles; 6 Segment(s)*			
Grazing Related Agric	Siltation	2004	2017

*Segments are defined as individual COM IDs.

Stream Name / Use Designation (Assessment ID) / Source	Cause	Date Listed	TMDL Date

Report Summary

Watershed Summary

	Stream Miles	Assessment Units	Segments (COMIDs)
Watershed Characteristics	8.03	2	45

Impairment Summary

Source	Cause	Miles	Assessment Units	Segments (COMIDs)
Erosion from Derelict Land	Siltation	2.50	1	11
Grazing Related Agric	Siltation	5.40	1	33
		7.90 **	**2 ****	**44 ****

**Totals reflect actual miles of impaired stream. Each stream segment may have multiple impairments (different sources or causes contributing to the impairment), so the sum of individual impairment numbers may not add up to the totals shown.

Use Designation Summary

	Miles	Assessment Units	Segments (COMIDs)
Aquatic Life	7.90	2	44

*Segments are defined as individual COM IDs.

Stream Name Use Designation (Assessment ID) Source	Cause	Date Listed	TMDL Date

Hydrologic Unit Code: 02050201 - Upper West Branch Susquehanna

Chest Creek
HUC: 02050201

Aquatic Life (9985) - 1.60 miles; 3 Segment(s)*			
Agriculture	Siltation	2002	2015

Chest Creek (Unt 26976)
HUC: 02050201

Aquatic Life (5970) - 2.60 miles; 11 Segment(s)*			
Agriculture	Siltation	2004	2017
Aquatic Life (9985) - 2.36 miles; 7 Segment(s)*			
Agriculture	Siltation	2002	2015

Chest Creek (Unt 26977)
HUC: 02050201

Aquatic Life (5970) - 0.35 miles; 1 Segment(s)*			
Agriculture	Siltation	2004	2017

Chest Creek (Unt 26978)
HUC: 02050201

Aquatic Life (5970) - 0.56 miles; 1 Segment(s)*			
Agriculture	Siltation	2004	2017

Chest Creek (Unt 26979)
HUC: 02050201

Aquatic Life (5970) - 2.28 miles; 6 Segment(s)*			
Agriculture	Siltation	2004	2017
Aquatic Life (9985) - 0.26 miles; 1 Segment(s)*			
Agriculture	Siltation	2002	2015

Chest Creek (Unt 26980)
HUC: 02050201

Aquatic Life (5970) - 0.55 miles; 1 Segment(s)*			
Agriculture	Siltation	2004	2017

Chest Creek (Unt 26981)
HUC: 02050201

Aquatic Life (5970) - 0.45 miles; 1 Segment(s)*			
Agriculture	Siltation	2004	2017

Chest Creek (Unt 26982)
HUC: 02050201

Aquatic Life (5970) - 0.36 miles; 1 Segment(s)*			
Agriculture	Siltation	2004	2017

*Segments are defined as individual COM IDs.

Stream Name Use Designation (Assessment ID) Source	Cause	Date Listed	TMDL Date
Chest Creek (Unt 26983) HUC: 02050201			
Aquatic Life (5970) - 0.29 miles; 1 Segment(s)*			
Agriculture	Siltation	2004	2017
Chest Creek (Unt 26985) HUC: 02050201			
Aquatic Life (5970) - 0.39 miles; 1 Segment(s)*			
Agriculture	Siltation	2004	2017
Chest Creek (Unt 26986) HUC: 02050201			
Aquatic Life (5970) - 0.35 miles; 1 Segment(s)*			
Agriculture	Siltation	2004	2017
Chest Creek (Unt 26987) HUC: 02050201			
Aquatic Life (5970) - 0.45 miles; 1 Segment(s)*			
Agriculture	Siltation	2004	2017
Chest Creek (Unt 26988) HUC: 02050201			
Aquatic Life (5970) - 0.56 miles; 1 Segment(s)*			
Agriculture	Siltation	2004	2017
Chest Creek (Unt 26989) HUC: 02050201			
Aquatic Life (5970) - 1.84 miles; 5 Segment(s)*			
Agriculture	Siltation	2004	2017
Chest Creek (Unt 26990) HUC: 02050201			
Aquatic Life (5970) - 0.31 miles; 1 Segment(s)*			
Agriculture	Siltation	2004	2017
Chest Creek (Unt 26991) HUC: 02050201			
Aquatic Life (5970) - 0.84 miles; 3 Segment(s)*			
Agriculture	Siltation	2004	2017
Chest Creek (Unt 26992) HUC: 02050201			
Aquatic Life (5970) - 0.31 miles; 1 Segment(s)*			
Agriculture	Siltation	2004	2017

*Segments are defined as individual COM IDs.

Stream Name Use Designation (Assessment ID) Source	Cause	Date Listed	TMDL Date
Chest Creek (Unt 26993) HUC: 02050201			
Aquatic Life (5970) - 0.56 miles; 3 Segment(s)*			
Agriculture	Siltation	2004	2017
Chest Creek (Unt 26994) HUC: 02050201			
Aquatic Life (5970) - 0.32 miles; 1 Segment(s)*			
Agriculture	Siltation	2004	2017
Chest Creek (Unt 26995) HUC: 02050201			
Aquatic Life (5970) - 0.38 miles; 1 Segment(s)*			
Agriculture	Siltation	2004	2017
Chest Creek (Unt 26996) HUC: 02050201			
Aquatic Life (5970) - 0.35 miles; 1 Segment(s)*			
Agriculture	Siltation	2004	2017
Chest Creek (Unt 26997) HUC: 02050201			
Aquatic Life (5970) - 0.42 miles; 3 Segment(s)*			
Agriculture	Siltation	2004	2017
Chest Creek (Unt 26998) HUC: 02050201			
Aquatic Life (5970) - 0.32 miles; 3 Segment(s)*			
Agriculture	Siltation	2004	2017
Chest Creek (Unt 26999) HUC: 02050201			
Aquatic Life (5970) - 0.42 miles; 1 Segment(s)*			
Agriculture	Siltation	2004	2017
Chest Creek (Unt 27000) HUC: 02050201			
Aquatic Life (5970) - 0.44 miles; 1 Segment(s)*			
Agriculture	Siltation	2004	2017
Chest Creek (Unt 27001) HUC: 02050201			
Aquatic Life (5970) - 0.40 miles; 1 Segment(s)*			
Agriculture	Siltation	2004	2017

*Segments are defined as individual COM IDs.

Stream Name Use Designation (Assessment ID) Source	Cause	Date Listed	TMDL Date

Report Summary

Watershed Summary

	Stream Miles	Assessment Units	Segments (COMIDs)
Watershed Characteristics	40.89	2	127

Impairment Summary

Source	Cause	Miles	Assessment Units	Segments (COMIDs)
Agriculture	Siltation	20.29	2	63
		20.29 **	**2 ****	**63 ****

**Totals reflect actual miles of impaired stream. Each stream segment may have multiple impairments (different sources or causes contributing to the impairment), so the sum of individual impairment numbers may not add up to the totals shown.

Use Designation Summary

	Miles	Assessment Units	Segments (COMIDs)
Aquatic Life	20.29	2	63

Attachment E
Excerpts Justifying Changes between the 1998-2002 Section 303(d) Lists and the 2004 to present Integrated Water Quality Monitoring and Assessment Reports

The following are excerpts from the Pennsylvania DEP Section 303(d) narratives that justify changes in listings between the 1996-2002 303(d) Lists and the 2004 to present Integrated Water Quality Monitoring and Assessment Reports. The Section 303(d) listing process has undergone an evolution in Pennsylvania since the development of the 1996 list.

In the 1996 Section 303(d) narrative, strategies were outlined for changes to the listing process. Suggestions included, but were not limited to, a migration to a Global Information System (GIS), improved monitoring and assessment, and greater public input.

The migration to a GIS was implemented prior to the development of the 1998 Section 303(d) list. As a result of additional sampling and the migration to the GIS some of the information appearing on the 1996 list differed from the 1998 list. Most common changes included:

1. mileage differences due to recalculation of segment length by the GIS;
2. slight changes in source(s)/cause(s) due to new EPA codes;
3. changes to source(s)/cause(s), and/or miles due to revised assessments;
4. corrections of misnamed streams or streams placed in inappropriate SWP subbasins; and
5. unnamed tributaries no longer identified as such and placed under the named watershed listing.

Prior to 1998, segment lengths were computed using a map wheel and calculator. The segment lengths listed on the 1998 Section 303(d) list were calculated automatically by the GIS (ArcInfo) using a constant projection and map units (meters) for each watershed. Segment lengths originally calculated by using a map wheel and those calculated by the GIS did not always match closely. This was the case even when physical identifiers (e.g., tributary confluence and road crossings) matching the original segment descriptions were used to define segments on digital quad maps. This occurred to some extent with all segments, but was most noticeable in segments with the greatest potential for human errors using a map wheel for calculating the original segment lengths (e.g., long stream segments or entire basins).

Migration to National Hydrography Data (NHD)

New to the 2006 report is use of the 1/24,000 National Hydrography Data (NHD) streams GIS layer. Up until 2006 the Department relied upon its own internally developed stream layer. Subsequently, the United States Geologic Survey (USGS) developed 1/24,000 NHD streams layer for the Commonwealth based upon national geodatabase standards. In 2005, DEP contracted with USGS to add missing streams and correct any errors in the NHD. A GIS contractor transferred the old DEP stream assessment information to the improved NHD and the old DEP streams layer was archived. Overall, this marked an improvement in the quality of the streams layer and made the stream assessment data compatible with national standards but it necessitated a change in the Integrated Listing format. The NHD is not attributed with the old DEP five digit stream codes so segments can no longer be listed by stream code but rather only by stream name or a fixed combination of NHD fields known as reachcode and ComID. The NHD is aggregated by Hydrologic Unit Code (HUC) watersheds so HUCs rather than the old State Water Plan (SWP) watersheds are now used to group streams together. A more basic change was the shift in data management philosophy from one of “dynamic segmentation” to “fixed segments”. The dynamic segmentation records were proving too difficult to mange from an historical tracking perspective. The fixed segment methods will remedy that problem. The stream assessment data management has gone through many changes over the years as system requirements and software changed. It is hoped that with the shift to the NHD and OIT's (Office of Information Technology) fulltime staff to manage and maintain SLIMS the systems and formats will now remain stable over many Integrated Listing cycles.

Attachment F
Comment and Response

No public comments were received for the Chest Creek Sediment TMDL.