UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029
4/4/2007

Ms. Cathy Curran Myers
Deputy Secretary for Water Management
Pennsylvania Department of Environmental Protection
Rachel Carson State Office Building
P.O. Box 2063
Harrisburg, PA 17105-2063

Dear Ms. Myers:

The U.S. Environmental Protection Agency (EPA) Region III is establishing Total Maximum Daily Loads (TMDLs) for metals, pH, and sediment for the Sawmill Run Watershed. These TMDLs were established in accordance with Section 303(d)(1)(c) and (2) of the Clean Water Act to address impairments of water quality as identified on Pennsylvania's 1996 and 2002 Section 303(d) lists. These segments were listed for their failure to attain the aquatic life use.

In accordance with Federal regulations at 40 CFR §130.7, a TMDL must comply with the following requirements: (1) designed to attain and maintain the applicable water quality standards, (2) include a total allowable loading and as appropriate, wasteload allocations (WLAs) for point sources and load allocations for nonpoint sources, (3) consider the impacts of background pollutant contributions, (4) take critical stream conditions into account (the conditions when water quality is most likely to be violated), (5) consider seasonal variations, (6) include a margin of safety (which accounts for uncertainties in the relationship between pollutant loads and instream water quality), (7) consider reasonable assurance that the TMDL can be met and (8) be subject to public participation. The TMDLs for the Sawmill Run Watershed satisfied each of these requirements. A copy of the TMDL Report has been included with this letter.

Following the establishment of these TMDLs, Pennsylvania is required to incorporate these TMDLs into Pennsylvania's Water Quality Management Plan pursuant to 40 CFR § 130.7(d)(2). As you know, all new or revised National Pollutant Discharge Elimination System permits must be consistent with the TMDL WLA pursuant to 40 CFR §122.44 (d)(1)(vii)(B). Please submit all such permits to EPA for review as per EPA's letter dated October 1, 1998.

If you have any questions or comments concerning this letter, please do not hesitate to contact Mr. Thomas Henry, EPA Region III TMDL Program Manager, at (215) 814-5752.

Sincerely,

Signed

Jon M. Capacasa, Director
Water Protection Division

Enclosures

cc: Mr. Glenn Rider, PADEP
Mr. Bill Brown, PADEP
Mr. Steve Balta, PADEP SWRO
Ms. Rita Coleman, PADEP SWRO

United States Environmental Protection Agency - Region III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Total Maximum Daily Load for Sawmill Run Allegheny County, Pennsylvania

Established on:__April 4, 2007______

_________/s/______________________
Jon M. Capacasa, Director
Water Protection Division
EPA, Region III

United States Environmental Protection Agency-Region III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

AMD and Sediment Total Maximum Daily Loads for the Sawmill Run Watershed, Pennsylvania

Prepared by

THE Louis Berger Group, INC.
2300 N Street, NW
Washington, DC 20037

April 9, 2007

Final Report

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1.0 Introduction

1.1 Regulatory Guidance

Section 303(d) of the Clean Water Act and the Environmental Protection Agency (EPA)'s Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies that are exceeding water quality standards. TMDLs represent the total pollutant loading that a waterbody can receive without violating water quality standards. The TMDL process establishes the allowable loadings of pollutants for a waterbody based on the relationship between pollution sources and instream water quality conditions. By following the TMDL process, states can establish water quality based controls to reduce pollution from both point and non-point sources to restore and maintain the quality of their water resources (EPA, 2001).

The state regulatory agency for Pennsylvania is the Department of Environmental Protection (PADEP). As required by the Clean Water Act, PADEP develops and maintains a listing of all impaired waters in the state that details the pollutant(s) exceeding water quality standards and the potential source(s) of each pollutant. This list is referred to as the 303(d) list. As part of the settlement of a TMDL lawsuit in Pennsylvania[1], EPA agreed to develop or approve TMDLs for waters included on Pennsylvania's 1996 303(d) List of Impaired Waters under a specified timeframe. The TMDLs in this report were developed in partial fulfillment of that lawsuit and address 14 segments impaired by acid mine drainage (AMD) and/or sediment on Pennsylvania's 1996 and 2002 Section 303(d) list within the Sawmill Run watershed, located in Allegheny County.

1.2 Impairment Listing

The Sawmill Run watershed is located entirely within Allegheny County in western Pennsylvania. The watershed contains only one major named stream, Sawmill Run. This stream accounts for 46% of the watershed's total stream mileage with the remainder

[1] *American Littoral Society and Public Interest Research Group of Pennsylvania v. EPA*

accounted for in unnamed tributaries. The main stem of Sawmill Run begins in the southwestern tip of the watershed and flows northward. Stream orders 1 and 2, account for nearly 72% of the watershed's stream mileage. (**Figure 1-1**).

Stream segments in the Sawmill Run watershed (located in Pennsylvania State Water Plan 20F) were first reported as impaired on Pennsylvania's 1996 303(d) List of Impaired Waters. Additional segments and impairment sources were subsequently added on Pennsylvania's 2002 303(d) lists. Each stream segment in these watersheds is identified by a unique code, referred to as a stream code. The stream codes for each stream segment in Sawmill Run are presented in **Figure 1-1**, and will be used to describe the impairment listings for these streams.

The full impairment listings for Sawmill Run are discussed below in Section 1.2.1. Stream segments in the watersheds are listed as impaired for nutrients and organic enrichment, metals, and siltation. However, the analyses and results presented in this report establish TMDLs for sediment and AMD-related (i.e., metals) causes for Sawmill Run. The other impairments will be addressed in a separate TMDL at a later time.

1.2.1 Impaired Segment Listings

One segment (stream code 37164) with 6 individual listings was listed on Pennsylvania's 1996 section 303(d) list for BOD/DO, organic enrichment, nutrients and metals. Eight additional stream segments of the Sawmill Run watershed (stream codes: 37166, 37167, 37168, 37169, 37170, 37171, 37172, 37174) were reported on Pennsylvania's 2002 section 303(d) list as impaired due to organic enrichment and low dissolved oxygen from combined sewer overflow. Two segments in the watershed have been listed in 2002 for siltation caused by urban runoff and storm sewers. **Table 1.1** shows the section 303(d) impairment listings for segments within the Sawmill Run watershed.

As stated above, this report addresses only the AMD and sediment impairment present in Sawmill Run watershed and establishes such TMDLs for these streams.

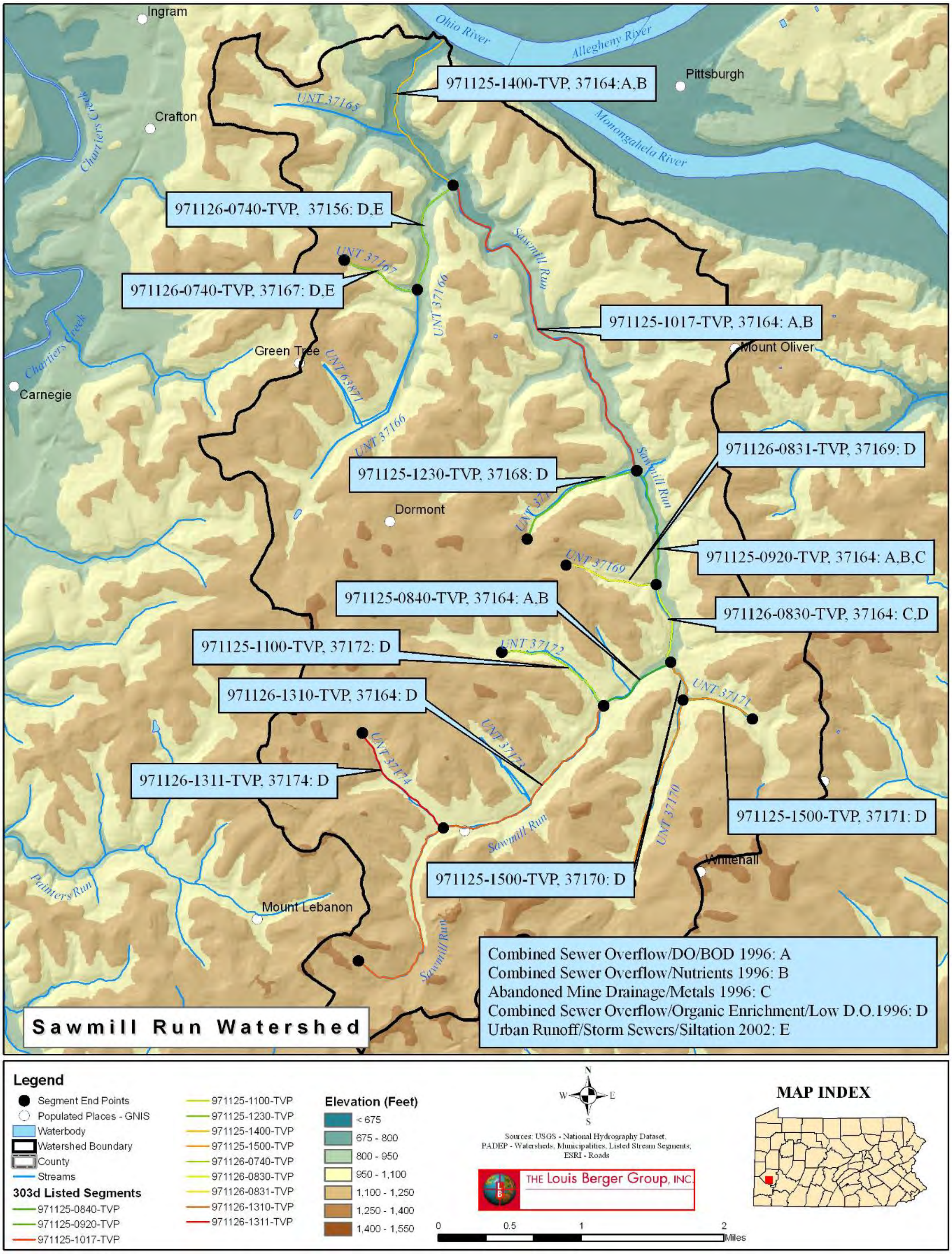


Figure 1-1: Impaired Segments in the Sawmill Run Watershed

1.3 Applicable Water Quality Standard

Water quality standards consist of designated uses for a waterbody and water quality criteria necessary to support those designated uses. Water quality standards consist of designated uses for a waterbody and water quality criteria necessary to support those designated uses, as well as an antidegradation section. According to Pennsylvania Water Quality Standards, the term *water quality criteria* are defined as “numeric concentrations, levels or surface water conditions that need to be maintained or attained to protect existing and designated uses.”

1.3.1 Designated Uses

Pennsylvania Water Quality Standards (§ 93.3 of the Code of Pennsylvania) designate water uses which shall be protected, and upon which the development of water quality criteria shall be based. These include the protection of potable water supplies as defined by the Federal Safe Drinking Water Act (42 U.S.C.A. § 300F), or by other water users that require a permit from the Department under the Pennsylvania Safe Drinking Water Act (35 P. S. § 721.1—721.18), as well as water supply for wildlife, industry, livestock, and irrigation. The maintenance and propagation of aquatic life, including coldwater and warmwater fisheries, and anadromous and catadromous fishes which ascend into flowing waters to complete their life cycle, are also protected as designated uses of Pennsylvania’s waters. Pennsylvania Water Quality Standards also serve to designate waters in the state for primary contact recreation, fishing, boating, esthetics, and navigation. **Table 1.1** shows the designated uses for the 303(d) listed segments.

Table 1-1: Designated Water Uses and 303(d) Impairment Listings for Sawmill Run watershed Segments

Original Listing Date	303(d) Listed Segment (AssessmentID, Stream Code)	Stream Name	Designated Water Uses	303(d) Impairment (Source/Cause)
1996	971125-1400-TVP, 37164	Sawmill Run	WWF	CSO/BOD, CSO/Nutrients
1996	971125-1017-TVP, 37164	Sawmill Run	WWF	CSO/BOD, CSO/Nutrients
1996	971125-0920-TVP, 37164	Sawmill Run	WWF	*AMD/Metals, CSO/BOD, CSO/Nutrients
1996	971126-0830-TVP, 37164	Sawmill Run	WWF	*AMD/Metals, CSO/Org Enrichment/Low DO
1996	971125-0840-TVP, 37164	Sawmill Run	WWF	CSO/Nutrients, CSO/DO/BOD
1996	971126-1310-TVP, 37164	Sawmill Run	WWF	CSO/Org Enrichment/Low DO
2002	971126-0740-TVP, 37166	Sawmill Run UNT 37166	WWF	CSO/Org Enrichment/Low DO, *Urban Runoff/Storm Sewer/Siltation
2002	971126-0740-TVP, 37167	Sawmill Run UNT 37167	WWF	CSO/Org Enrichment/Low DO, *Urban Runoff/Storm Sewer/Siltation
2002	971125-1230-TVP, 37168	Sawmill Run UNT 37168	WWF	CSO/Org Enrichment/Low DO
2002	971126-0831-TVP, 37169	Sawmill Run UNT 37169	WWF	CSO/Org Enrichment/Low DO
2002	971125-1500-TVP, 37170	Sawmill Run UNT 37170	WWF	CSO/Org Enrichment/Low DO
2002	971125-1500-TVP, 37171	Sawmill Run UNT 37171	WWF	CSO/Org Enrichment/Low DO
2002	971125-1100-TVP, 37172	Sawmill Run UNT 37172	WWF	CSO/Org Enrichment/Low DO
2002	971126-1311-TVP, 37174	Sawmill Run UNT 37174	WWF	CSO/Org Enrichment/Low DO

UNT: Unnamed tributary to Sawmill Run
WWF: Warm Water Fishes
Pennsylvania State Water Plan 20F
* denotes impairments listings addressed under this TMDL

1.3.2 Water Quality Criteria

General Criteria

The General Criteria defined in Pennsylvania's Water Quality Standards (§ 93.6 of the Code of Pennsylvania) provides general, narrative criteria for the protection of designated uses from substances that may interfere with attainment of such uses. The general water quality criteria state:

"Water may not contain substances attributable to point or non-point source discharges in concentration or amounts sufficient to be inimical or harmful to the water uses to be protected or to human, animal, plant or aquatic life. In addition to other substances listed within or addressed by this chapter, specific substances to be controlled include, but are not limited to, floating materials, oil, grease, scum and substances which produce color, tastes, orders, turbidity or settle to form deposits."

Table 1.2 shows the specific water criteria for each of designated uses in Sawmill Run.

Table 1-2: Pennsylvania "Specific Water Quality Standards" for Sawmill Run*

Parameter	Critical Use	Criteria
Alkalinity	WWF	Minimum of 20 mg/L as $CaCO_3$
Chloride	PWS	Maximum 250 mg/L
Color	PWS	Maximum 75 units on the platinum-cobalt scale; no other colors perceptible to the human eye
DO	WWF	Minimum of 4.0 mg/L
Total Fe	WWF	30 day average 1.5 mg/L
Dissolved Fe	PWS	Maximum 0.3 mg/L
Fluoride	PWS	Daily average 2.0 mg/L
Total Manganese	PWS	Maximum 1.0 mg/L
NO_x-N (NO_3-N+NO_2-N)	PWS	Maximum 10 mg/L
Phenolics	PWS	Maximum 0.005 mg/L
pH	WWF	From 6.0 to 9.0 inclusive
Total Dissolved Solids	PWS	500 mg/L as a monthly average value; maximum 750 mg/L
Sulfate	PWS	Maximum 250 mg/L
Temperature	TSF	Depending on month of sampling
Tot. Res. Chlorine	WWF	1-hour average of 0.019 mg/L

* Department of Environmental Protection (May 14, 2005). Commonwealth of Pennsylvania, Pennsylvania Code, Title 25. Environmental Protection.

Sediment Criteria

Sediment was listed as a cause of impairment in Sawmill Creek. However, Pennsylvania has not currently established numeric water quality criteria for sediment. In the absence of specific water quality criteria, the General Criteria defined by Pennsylvania provides a narrative criteria for the protection of a waterbodies designated uses.

Metals Criteria

Pennsylvania had developed a criteria for metals in § 16.24 of the Pennsylvania Code. The aquatic life criteria for metals can be expressed as either dissolved or total recoverable, depending on the available data. The dissolved criteria can be found in Appendix A, Table 1 in Chapter 16 of the Pennsylvania code. The dissolved criteria was developed by Pennsylvania using the most current EPA conversion factors to the total recoverable criteria. **Table 1-3** provides the criteria for AMD pollutants.

Table 1-3: PA Water Quality Criteria for AMD pollutants*

Parameter	Criteria
Total Aluminum	0.75 mg/L
Total Iron	30 day average of 1.5 mg/L
Total Manganese	1.0 mg/L
pH	6 - 9

* Department of Environmental Protection (May 14, 2005). Commonwealth of Pennsylvania, Pennsylvania Code, Title 25. Environmental Protection.

1.4 TMDL Development for Sawmill Run

TMDL development requires a methodology to confirm impairment causes identified in the 303(d) list and to determine pollutant reductions that will allow the streams to attain their designated uses. Sediment, nutrients, and metals were identified as the cause of the impairment in Sawmill Run. This report addresses the siltation and AMD impairments and establishes sediment and AMD TMDLs for Sawmill Run.

In the subsequent sections of this report, watershed and environmental monitoring data used in TMDL development for Sawmill Run is discussed and analyzed. Sources of the sediment and AMD impairments in the watershed are also described and analyzed. After reviewing the available watershed and environmental monitoring data, a technical approach was developed and used to estimate loading rates from sediment, nutrients, and AMD and to quantify the load reductions necessary to obtain designated uses for Sawmill Run.

An AMD TMDL, a statistical analysis using Monte Carlo simulation was used to determine the necessary load reductions for AMD. Approaches, calculations, and TMDL allocations are presented in Section 4.0 of this TMDL report.

For the sediment TMDL, a reference watershed approach was used to determine the necessary load reductions for sediment. Approaches, calculations, and TMDL allocations are presented in Section 5.0 of this TMDL report.

Finally, reasonable assurance and the public participation process for these TMDLs are discussed in Section 7.0, and references are discussed in Section 8.0.

2.0 Watershed Characterization

The purpose of the watershed characterization is to provide an overview of conditions in the watershed as they relate to the impairment listings. In particular, watershed physical features such as topography, soil types, and land uses are inventoried and assessed. In addition, any permitted discharge facilities or water quality monitoring stations present in the watersheds are documented. Information obtained from the watershed characterization is then used in identifying potential pollutant(s) causing the impairment, as well as for the subsequent TMDL development.

2.1 Physical Characteristics

Important physical characteristics of the Sawmill Run watershed were analyzed using GIS coverages and other ancillary information describing its physical condition. GIS coverages of the watershed boundary, stream network, topography, soils, land use, and ecoregion were compiled and analyzed from the following primary sources:

- BASINS Database - EPA
- National Land Cover Dataset (NLCD) – USGS
- National Hydrography Dataset (NHD) – USGS
- State Soil Geographic Database (STATSGO)– NRCS
- Pennsylvania Spatial Data Access (PASDA) – PA Bureau of Geospatial Technologies and Penn State Institutes of the Environment

2.1.1 Watershed Location and Boundary

The Sawmill Run drainage area is approximately 12,432 acres, or 19 square miles, and is located entirely within Allegheny County in western Pennsylvania **(Figure 2-1)**. The main stem of Sawmill Run begins in the southern tip of the watershed, flows north through the boroughs of Bethel Park, Castle Shannon, Mount Oliver, and the city of Pittsburgh. At the northern end of the watershed, Sawmill Run flows into the Ohio River, downstream of the confluence of the Allegheny and Monongahela Rivers.

Major transportation routes in the vicinity of the watershed include: Interstate 279 and State Route 60, which follow an east to west orientation through the upper third of the watershed; State Route 51, which enters from the southern portion of the watershed and follows the main stem of Sawmill Run until it joins US Highway 19; US Highway 19, which splits upon entering the watershed and merges again to follow the tailwaters of the main stem; State Route 88, which follows headwaters of Sawmill Run before joining State Route 51; and State Route 121 which follows a path roughly parallel to the western border of the watershed before joining Interstate 279 **(Figure 2-1).**

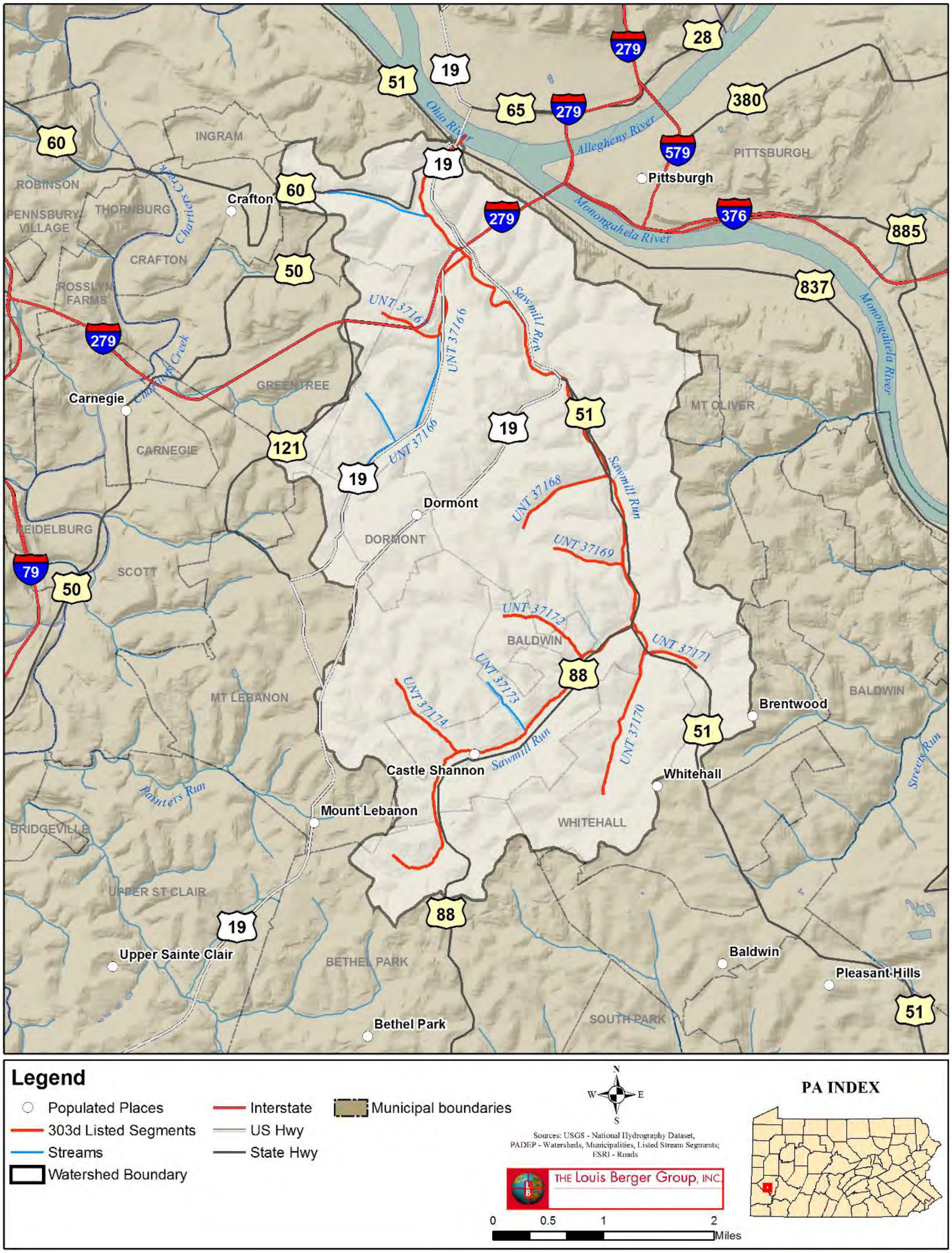


Figure 2-1. Sawmill Run Vicinity Map

2.1.2 Stream Network

The stream network for Sawmill Run was mapped and analyzed using GIS data provided by PADEP (**Figure 2-2**). Based on this data, there are 20 miles of stream in the watershed, approximately 16.3 miles of which were identified on the Section 303(d) list of impaired waters in 1996, 1998, or 2002. The listed segments consist of the mainstem of Sawmill Run and 8 of the 11 unnamed tributaries.

The Sawmill Run watershed contains only one major named stream, Sawmill Run. This stream accounts for 46% of the watershed's total stream mileage with the remainder accounted for in unnamed tributaries **(Table 2-1)**. The main stem of Sawmill Run begins in the southwestern tip of the watershed and flows northward. Stream orders 1 and 2, account for nearly 72% of the watershed's stream mileage **(Table 2-2)**.

Table 2-1: Streams Mileage by Stream Order in the Sawmill Run Watershed

Stream Order	Length (miles)
1	10.0
2	4.4
3	5.6
Total	**20.0**

Table 2-2: Major Tributaries in Sawmill Watershed

Name	Length (miles)
Sawmill Run	9.3
UNT 37165	1.0
UNT 37166	2.5
UNT 37167	0.6
UNT 37168	1.0
UNT 37169	0.7
UNT 37170	1.7
UNT 37171	0.5
UNT 37172	0.9
UNT 37173	0.6
UNT 37174	0.9
UNT 63871	0.5
Total	**26.7**

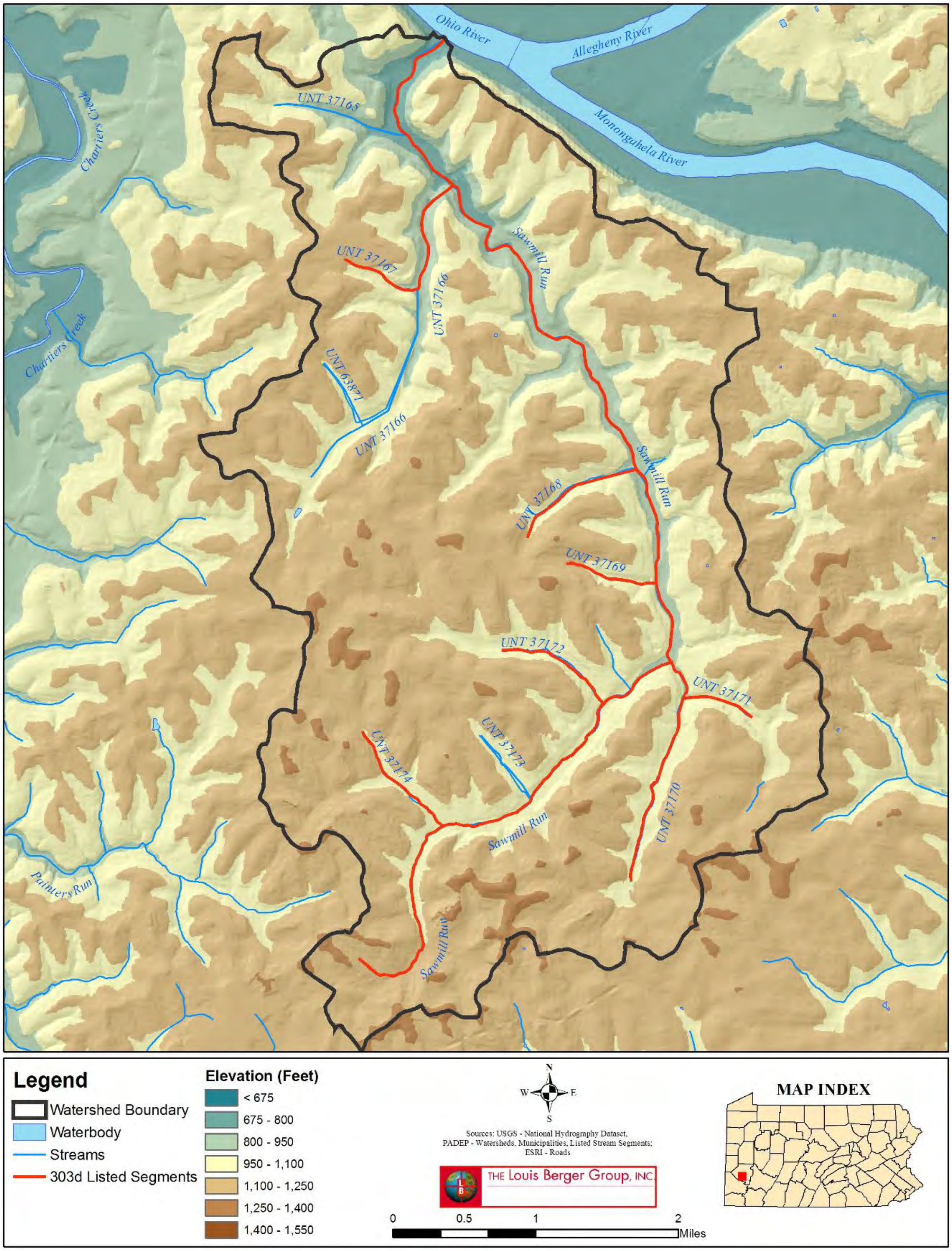


Figure 2-2. Stream Network and Topography of the Sawmill Run Watershed

2.1.3 Topography

A 10-meter digital elevation model (DEM) was used to characterize topography in the watershed. Elevations in the watershed ranged from 714 to 1,316 feet above mean sea level with an average elevation of 1,112 feet.

Table 2-3: Percent Slope Classes in the Sawmill Run Watershed by Proportion

Slope Classes	Acres	Proportion of Watershed
0-5%	1,011	8.1%
5-10%	2,585	20.8%
10-25%	6,509	52.4%
25-50%	2,051	16.5%
50-100%	272	2.2%
>100%	5	<0.1%
TOTAL	12,432	100.0%

The steepness and distribution of slopes in the watershed has a significant effect on the hydrologic character of a given watershed. In general, in the absence of the effects of urban development, watersheds with a high proportion of their area in low slope classes tend to have a greater proportion of rainfall reabsorbed into the soil before becoming surface runoff. In contrast, watersheds with a significant portion of their area in higher slope classes tend to have more rapid conversion of rainfall to runoff and more flashy flow characteristics. Based on slope calculations modeled from the DEM, slopes in the watershed (calculated as percent slope) were as high as 150%, with the average slope in the watershed approximately 17%. Slope classes in the watershed are presented below in **Table 2-3**.

2.1.4 Soils

There was no detailed county level soil survey data for Allegheny County available at the time of this characterization. As a result, state level soil characterization data, the State Soil Geographic (STATSGO) dataset, was used in the following characterization of soil conditions. STATSGO data is prepared by delineating generalized map unit areas that show similar combinations of soil types in reasonably predictable proportions.

Four STATSGO soil map units were found in the Sawmill Run watershed (Figure 2-3). The first, is dominated by the Dormont, Culleoka, and Guermsey soil series which are all considered very deep, well drained, moderately slow permeable soils. This map unit is only found in a small portion of the southern tip of the watershed. The second soil map unit is dominated by the Gilpin, Dormont, and Culleoka series. The Gilpin soil series are moderately deep, well drained soils formed from nearly horizontal interbedded shale, siltstone, and some sandstone. This map unit occurs primarily in the upper third of the watershed. The third soil map unit in the watershed is only found in a northern edge of the watershed, and is comprised predominately of areas delineated as urban, i.e. areas of disturbed or highly modified soils. The soil series of next highest proportion in this map unit include the Monongahela soil series, which consists of very deep, moderately well drained soils formed in old alluvium derived from acid sandstone and shale, and the Rainsboro soil series, which are very deep, moderately well drained soils that formed in loess. The fourth map unit, which is the most dominant in the watershed, consists of areas delineated as urban and the Culleoka and Guernsey soils series. Table 2-4 lists the STATSGO soil map units found in the watershed.

Table 2-4: STATSGO Soil Map Units in the Sawmill Run Watershed

Map Unit ID	Soil Associations	Hydrologic Groups	Acres	Proportion of Watershed
PA040	Dormont/Culleoka/Guernsey	B/C	63	< 1%
PA041	Gilpin/Dormont/Culleoka	C	2118	17%
PA045	Urban Land/Monongahela/Rainsboro	C	364	3%
PA047	Urban Land/Culleoka/Guernsey	B/C	9,887	80%
Totals			**12,432**	**100%**

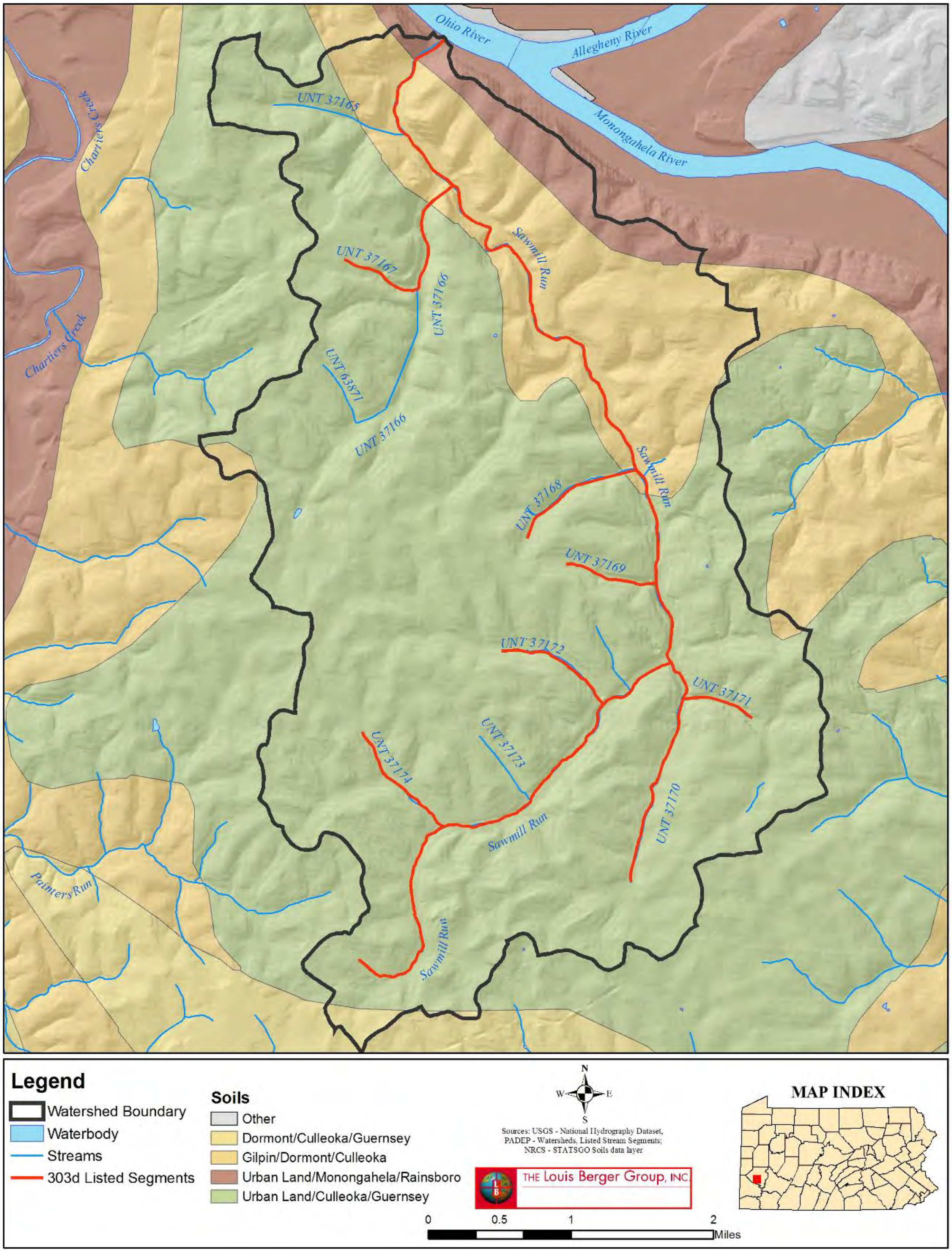


Figure 2-3. STATSGO Soil Map Units in the Sawmill Run Watershed

The hydrologic soil groups represent different levels of infiltration capacity of the soils as described in **Table 2-5**. Hydrologic soil group "A" designates soils that are well to excessively well drained, whereas hydrologic soil group "D" designates soils that are poorly drained. This means that soils in hydrologic group "A" allow a larger portion of the rainfall to infiltrate and become part of the ground water system. Conversely, soils in hydrologic group "D" allow a smaller portion of the rainfall to infiltrate and become part of the ground water. Consequently, more rainfall becomes part of the surface water runoff in hydrologic group D.

Table 2-5: Descriptions of Hydrologic Soil Groups

Hydrologic Soil Group	Description
A	High infiltration rates. Soils are deep, well drained to excessively drained sand and gravels.
B	Moderate infiltration rates. Deep and moderately deep, moderately well and well-drained soils with moderately coarse textures.
C	Moderate to slow infiltration rates. Soils with layers impeding downward movement of water or soils with moderately fine or fine textures.
D	Very slow infiltration rates. Soils are clayey, have high water table, or shallow to an impervious cover
B/C	Combination of Soil Group B and C

2.1.5 Land Use

Land use characterization was based on 1992 National Land Cover Data (NLCD) developed by USGS. The distribution of land uses in the Sawmill Run watershed, by land area and percentage, is presented in **Table 2-6**. Developed areas cover the majority of the watershed (63%). The majority of the remaining watershed area is dominated by deciduous forest (26.1%). **Figure 2-4** displays a map of the land uses within the Sawmill Run watershed. Brief descriptions of land use categories are presented in **Table 2-7.**

Table 2-6. Sawmill Run Watershed Land Use Distribution

General Land Use Category	NLCD Land Use Type	Acres	Percent of Watershed	Total Percent
Water/Wetlands	Open Water	1	< 0.1%	< 0.1%
	Emergent Herbaceous Wetlands	< 1	< 0.1%	
Developed	Low Intensity Residential	6875	55.3%	63.3%
	High Intensity Residential	306	2.5%	
	Commercial/Industrial/Transportation	689	5.5%	
Agriculture	Urban/Recreational Grasses	483	3.9%	3.9%
Forest	Deciduous Forest	3,244	26.1%	32.8%
	Evergreen Forest	48	0.4%	
	Mixed Forest	786	6.3%	
Other	Transitional	< 1	< 0.1%	< 0.1%
Total		12,432	100%	100.0%

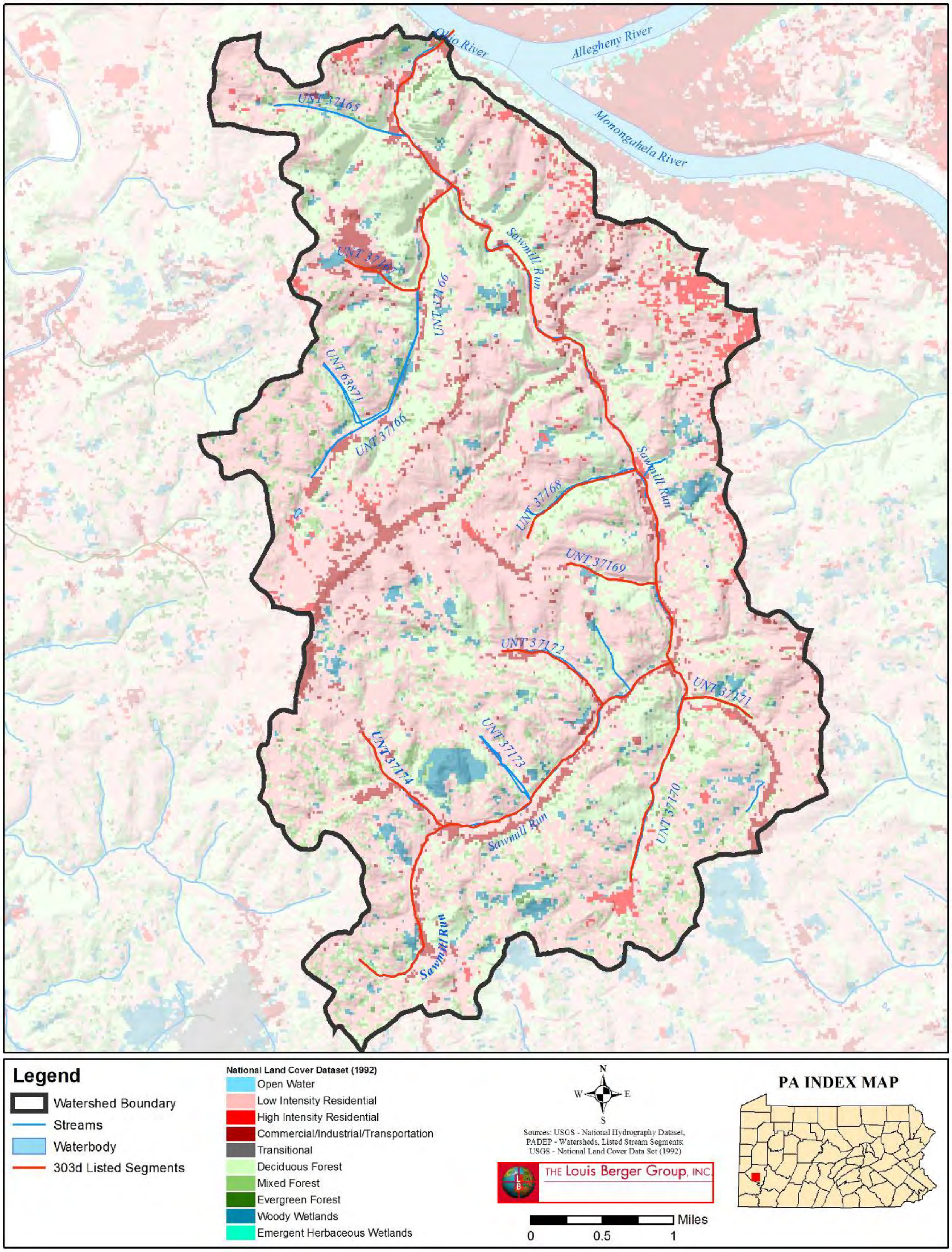


Figure 2-4. Land Use in the Sawmill Run Watershed

Table 2-7: Descriptions of NLCD Land Use Types

Land Use Type	Description
Open Water	All areas of open water, generally with less than 25% cover of vegetation or soil.
Low Intensity Residential	Includes areas with a mixture of constructed materials and vegetation. Constructed materials account for 30-80 percent of the cover. Vegetation may account for 20 to 70 percent of the cover. These areas most commonly include single-family housing units. Population densities will be lower than in high intensity residential areas.
High Intensity Residential	Includes heavily built up urban centers where people reside in high numbers. Examples include apartment complexes and row houses. Vegetation accounts for less than 20 percent of the cover. Constructed materials account for 80-100 percent of the cover.
Commercial/Industrial /Transportation	Includes infrastructure (e.g. roads, railroads, etc.) and all highways and all developed areas not classified as High Intensity Residential.
Transitional	Areas of sparse vegetative cover (less than 25 percent of cover) that are dynamically changing from one land cover to another, often because of land use activities. Examples include forest clearcuts, a transition phase between forest and agricultural land, the temporary clearing of vegetation, and changes due to natural causes (e.g. fire, flood, etc.).
Deciduous Forest	Areas dominated by trees where 75 percent or more of the tree species shed foliage simultaneously in response to seasonal change.
Evergreen Forest	Areas characterized by trees where 75 percent or more of the tree species maintain their leaves all year. Canopy is never without green foliage.
Mixed Forest	Areas dominated by trees where neither deciduous nor evergreen species represent more than 75 percent of the cover present.
Pasture/Hay	Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops.
Row Crops	Areas used for the production of crops, such as corn, soybeans, vegetables, tobacco, and cotton.
Urban/Recreational Grasses	Vegetation (primarily grasses) planted in developed settings for recreation, erosion control, or aesthetic purposes. Examples include parks, lawns, golf courses, airport grasses, and industrial site grasses.
Woody Wetlands	Areas where forest or shrubland vegetation accounts for 25-100 percent of the cover and the soil or substrate is periodically saturated with or covered with water.
Emergent Herbaceous Wetlands	Areas where perennial herbaceous vegetation accounts for 75-100 percent of the cover and the soil or substrate is periodically saturated with or covered with water.

Source: National Land Cover Data (NLCD) (http://www.mrlc.gov/nlcd_definitions.asp)

2.1.6 Ecoregions

The Sawmill Run watershed is located within the Monongahela Transition Zone and Pittsburgh Low Plateau ecoregions (**Figure 2.5**) (Level IV Ecoregions, classification numbers 70b and 70c respectfully; Woods et al., 1999). About 99% of the watershed located in the Monongahela Transition Zone ecoregion (12,246 acres), with the remaining area in the Pittsburgh Low Plateau ecoregion (186 acres). The following ecoregion descriptions are taken from Woods, Omernik, and Brown (1999).

The Monongahela Transition Zone ecoregion is made up of unglaciated hills, knobs, and ridges which are typically underlain by interbedded limestone, shale, sandstone, and coal of the Monongahela Group. There is are occurrences of entrenched rivers, gently dipping strata, and land slips in this ecoregion. Today, forests are extensive and urban, suburban, and industrial activities are found in the river valleys that also serve as transportation corridors. Bituminous coal mining is common and some oil production occurs. The boundary between ecoregions 70b and 70c generally follows the geologic division between the limestone-bearing Monongahela Group and the noncarbonate Conemaugh Group.

The Pittsburgh Low Plateau ecoregion is unglaciated and has rounded hills, narrow valleys, fluvial terraces, entrenched rivers, general farming, land slides, and bituminous coal mining. Hilltop elevations commonly range from 1,100 to 1,400 feet (366-396 m). Generally, the ecoregion is is both lower and less forested than neighboring ecoregions. The average annual growing season varies inversely with elevation. General farming and dairy operations predominate but are often handicapped by sloping terrain, soil wetness, low soil fertility, and a short growing season. There are oil wells in the west and gas fields in the east. Industry and population are concentrated in the Beaver, lower Allegheny, and Ohio valleys. Widespread coal mining has left some land barren or reverting to woodland. Other areas have been reclaimed and releveled but their soils are not always satisfactory for cultivation. Extensive acidic mine drainage and industrial pollution have degraded stream habitat and caused the loss of at least 16 fish species from the Ohio River drainage.

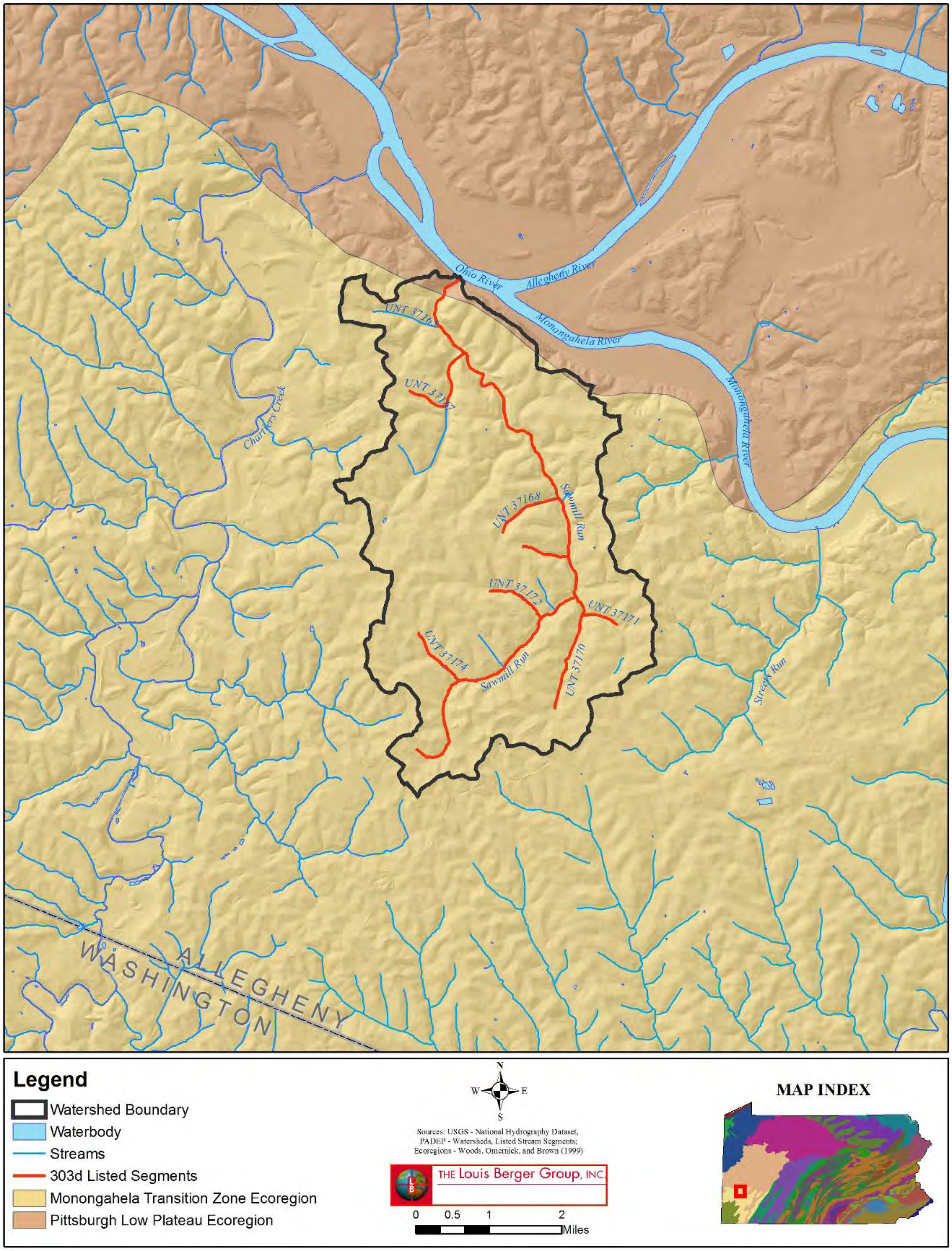


Figure 2-5. Ecoregions in the Sawmill Run Watershed

2.2 Monitoring Data

Before 2006, there was no available ambient or biological water quality monitoring data for the watershed from either the PADEP or the United States Geological Survey (USGS). EPA's BASINS database listed one monitoring station established by the Allegheny County Department of Health (Station ID ACHDNET938). However, the data for this station could not be located. Some water quality monitoring has been conducted by the 3 Rivers 2nd Nature project.

2.2.1 Pennsylvania Department of Environmental Protection

In 2006, PADEP collected water quality data in the Sawmill Run watershed to identify the nutrient load under baseflow conditions and to characterize the impact of AMD on the stream under different flow regimes. A total of seven instream sampling stations were selected in the Sawmill Run watershed (**Figure 2-6**). Six of these stations are located at the mainstem of Sawmill Run and one at UNT 37170, an AMD impacted tributary. The stations were selected based on the impaired segments, a review of potential pollutant sources and their spatial distribution.

To characterize the impact of AMD, water quality data were collected on five occasions (four times in August 2006 and once in September 2006) at four stations under base, low flow, and high flow conditions. **Table 2-8** provides a description of the four stations selected.

Table 2-8: Water Quality Sampling Stations for AMD

Sample Station	Waterbody	Description
SMR_03	Sawmill Run	Upstream of confluence with UNT 37168; downstream boundary of the 303(d) listed segment for AMD
SMR_04	Sawnmill Run	Upstream of confluence with UNT 37168 at the Park
SMR_05	UNT 37170	Upstream of confluence with Saw Mill Run; behind Eckerd Pharmacy
SMR_06	Sawmill Run	Upstream of confluence with UNT 37170

Table 2-9: Instream Water Quality Sampling Stations for Nutrient/Low DO		
Sample Station	**Waterbody**	**Description**
SMR_01	Sawmill Run	Upstream of confluence with Ohio River
SMR_02	Sawmill Run	Downstream of UNT 37168 at the Armory
SMR_05	UNT 37170	Upstream of confluence with Saw Mill Run; behind Pharmacy Eckerd
SMR_06	Sawmill Run	Upstream of confluence with UNT 3717
SMR_07	Sawmill Run	Upstream of confluence with UNT 37173 at Aruba Tan

In addition, continuous diurnal DO, temperature, specific conductivity, and pH measurements were taken at SMR_01, SMR_02, SMR_06, and SMR_07 between August 8 and 10, 2006 and at SMR_01, SMR_03, SMR_06, and SMR_07 between September 18 and 20, 2006.

Section 3 provides a more detailed description and results of these sampling events. Appendix A provides the complete data set used for completing the AMD and Sediment TMDLs.

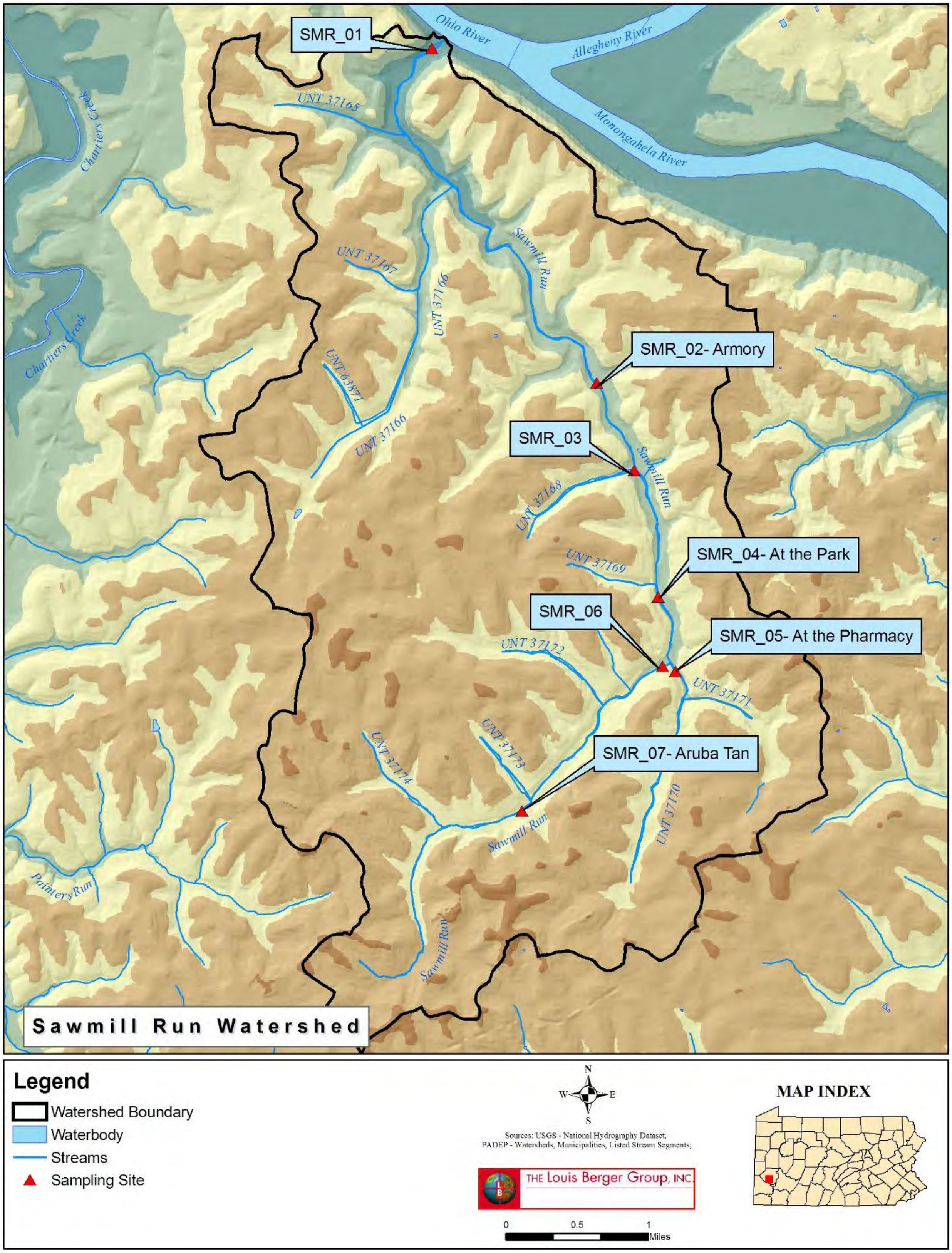


Figure 2-6. Location of PADEP Sampling Sites

Supplementary Data Sources

The 3 Rivers 2nd Nature project conducted various field studies in the region surrounding Pittsburgh, with a focus on the major rivers (the Ohio, Allegheny, and Monongahela) and the 53 streams that flow into and through Allegheny County. The project examined water quality and urban riverbanks. **Table 2-10** presents the available water quality data from the 3 Rivers 2nd Nature project.

Table 2-10: 3 Rivers 2nd Nature Project Monitoring Sites

Station	Location	Type	Parameters Tested	Collection Period(s)	Number of Samples
SM01	Sawmill Run	Ambient and Biological	Temp, pH, DO Conductivity, Turbidity, Iron, Total Coliform, E. Coli, Enterococci, Fecal Coliform, Ammonia, Total Dissolved Solids, Alkalinity, Hardness,	6/2000, 7/2000, 8/2000, 10/2000 5/2001*	5

- Biological sampling only

2.2.2 Permitted Discharge Facilities

Based on data obtained from the EPA's online PCS database and DMR records from PADEP, there are currently six discharge permits in the Sawmill Run watershed. These discharge permits are associated with construction or stormwater. The permit number, type, permitted flow, receiving waterbody, and status of each permit is presented in **Table 2-11**. Permitted discharge locations are presented in **Figure 2-7**.

Table 2-11: Facilities Holding Individual Permits in the Sawmill Run Watershed

Permit Number	Discharger Name	Category	Design Flow (gpd)	Receiving Waterbody	Status
PAR806118	Laid Law Transit Services	-	-	Sawmill Run	Active
PAR236126	Parker Plastics Corporation	-	-	-	Active
PAG056102	Cumberland Farms Inc	-	-	Sawmill Run	Active
PAR226108	Lozier Corporation	-	-	Sawmill Run - Tri Ohio & Monongahela	Active
PAG056204	Pit Stop Express	-	-	-	Active
PAR806194	PA National Guard	-	-	-	-

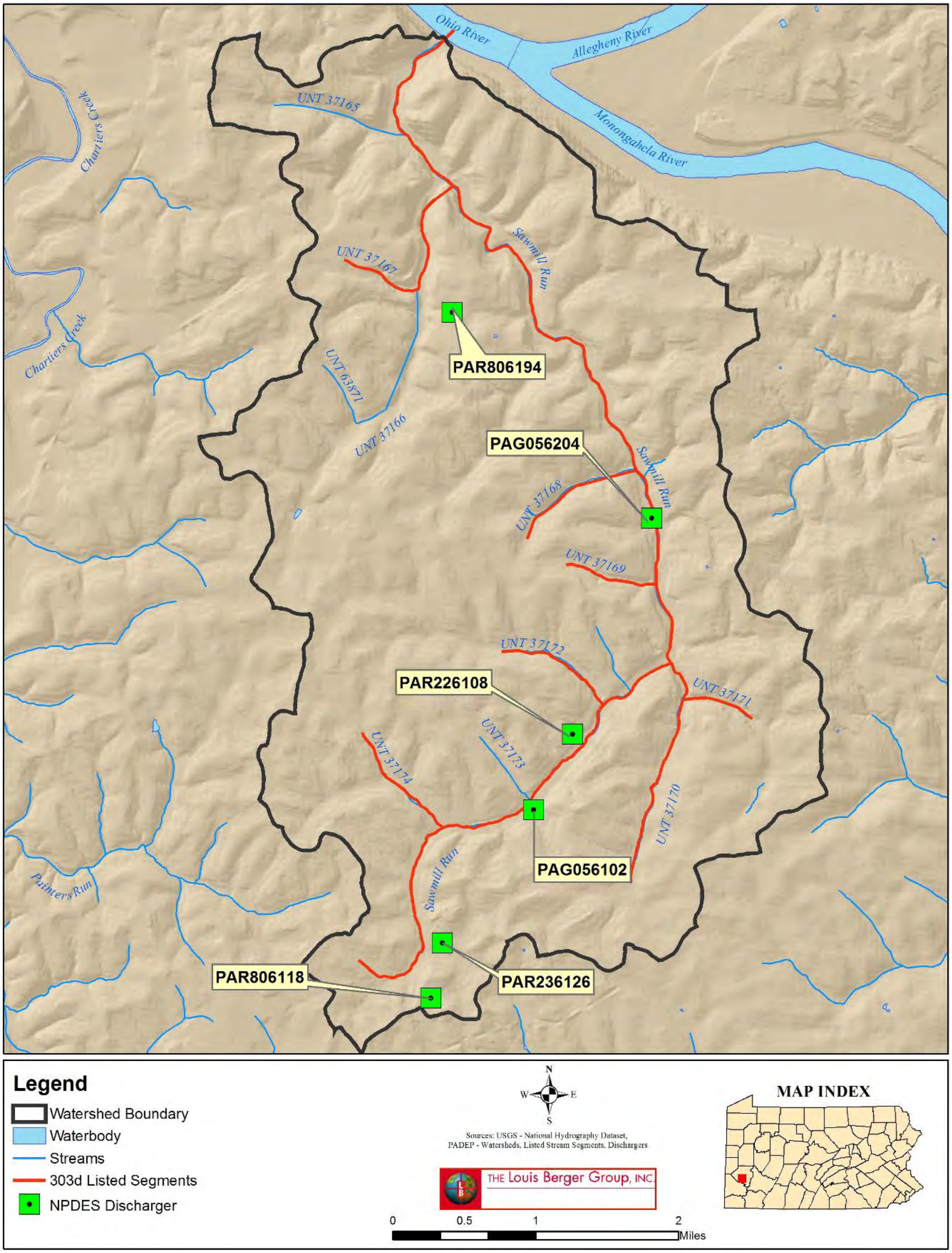


Figure 2-7. Discharge Locations in the Sawmill Run Watershed

In addition to the individual and general permits presented above, there are fourteen (14) municipalities or Municipal Separate Storm Sewers (MS4s) that should be covered under Pennsylvania's Stormwater Phase II NPDES general permit within the Sawmill Run Watershed. **Table 2-12** lists all the MS4 areas with the area covered by each individual MS4. The MS4 areas were calculated using the US Census Urban Areas (2000). Combined, these MS4 permits cover the entire Sawmill Run watershed. **Figure 2-8** presents the major MS4 areas located within the Sawmill Run watershed. It should be noted that the entire area of the Sawmill Run watershed is encompassed by MS4 permit holders.

Table 2-12. MS4 Permits located within the Sawmill Run Watershed

MS4 Permit Holder	Acres
Baldwin Borough	6
Baldwin Township	318
Bethel Park Borough	612
Brentwood Borough	378
Castle Shannon Borough	1,003
Crafton Borough	2
Dormont Borough	491
Green Tree Borough	292
Ingram Borough	2
Mt. Lebanon Township	1,483
Mt. Oliver Borough	29
Pittsburgh City	6,663
Scott Township	39
Whitehall Borough	1,114
Total	**12,432**

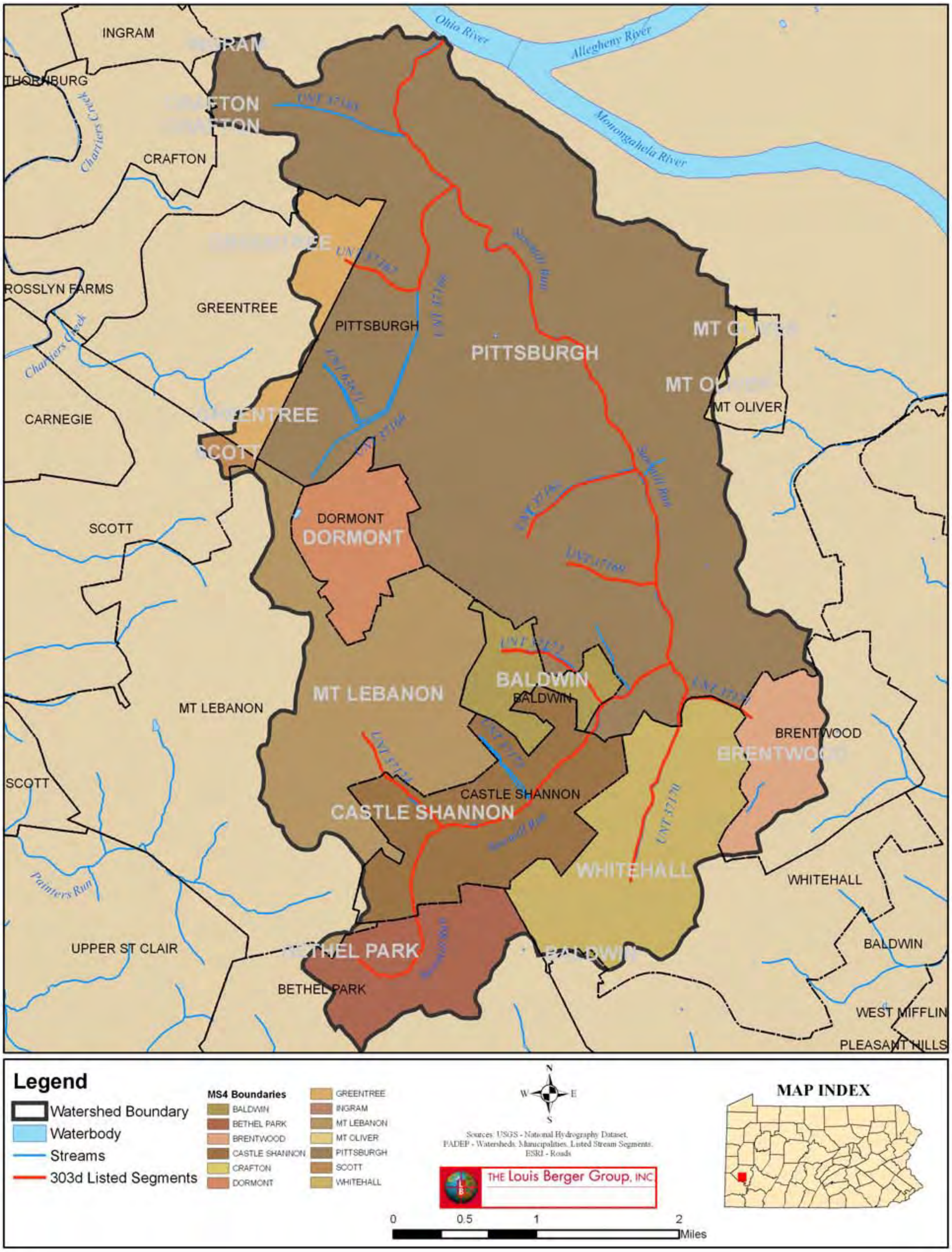


Figure 2-8. MS4 Boundaries in the Sawmill Run watershed

2.3 Natural Resource Extraction

Based on data obtained from the Pennsylvania Spatial Data Access (PASDA) database, there is one mining operation within the Sawmill Run watershed that is now inactive and 10 identified abandoned mine lands (**Figure 2-8**). The inactive mining operation was managed by the Port Authority of Allegheny County and was permitted for LRT coal removal. Reclamation of the mine has been completed, though there was no record of when this occurred.

There are currently 7 oil/gas wells in the watershed, 4 of which are considered active. The remainder of the wells are plugged/inactive wells (**Figure 2-9)**.

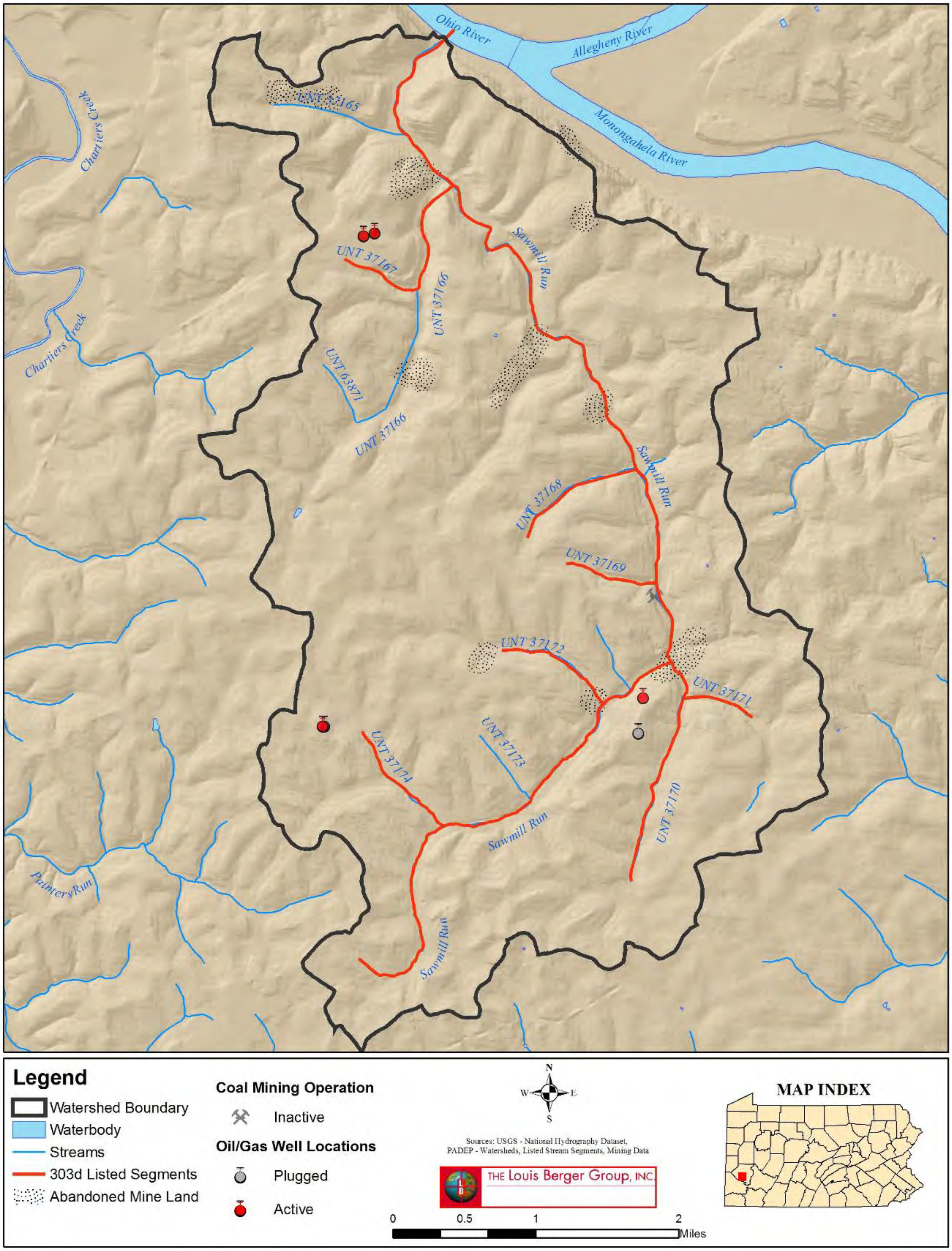


Figure 2-9. Mining/Drilling Activities in the Sawmill Run Watershed

2.4 Combined Sewer Overflows

Based on data provided by the Pittsburgh Water and Sanitation, there are a total of 47 combined sewer overflow (CSO) outfalls in the Sawmill Run watershed. 28 of these CSO outfalls are associated with the Allegheny County Sanitary Authority (ALCOSAN), while the remaining 19 outfalls are associated with the Pittsburgh Water and Sanitation Authority.

Currently, there is no information characterizing the volume or concentrations from these outfalls.

Figure 2-9 provides the location of these CSO outfalls in the watershed.

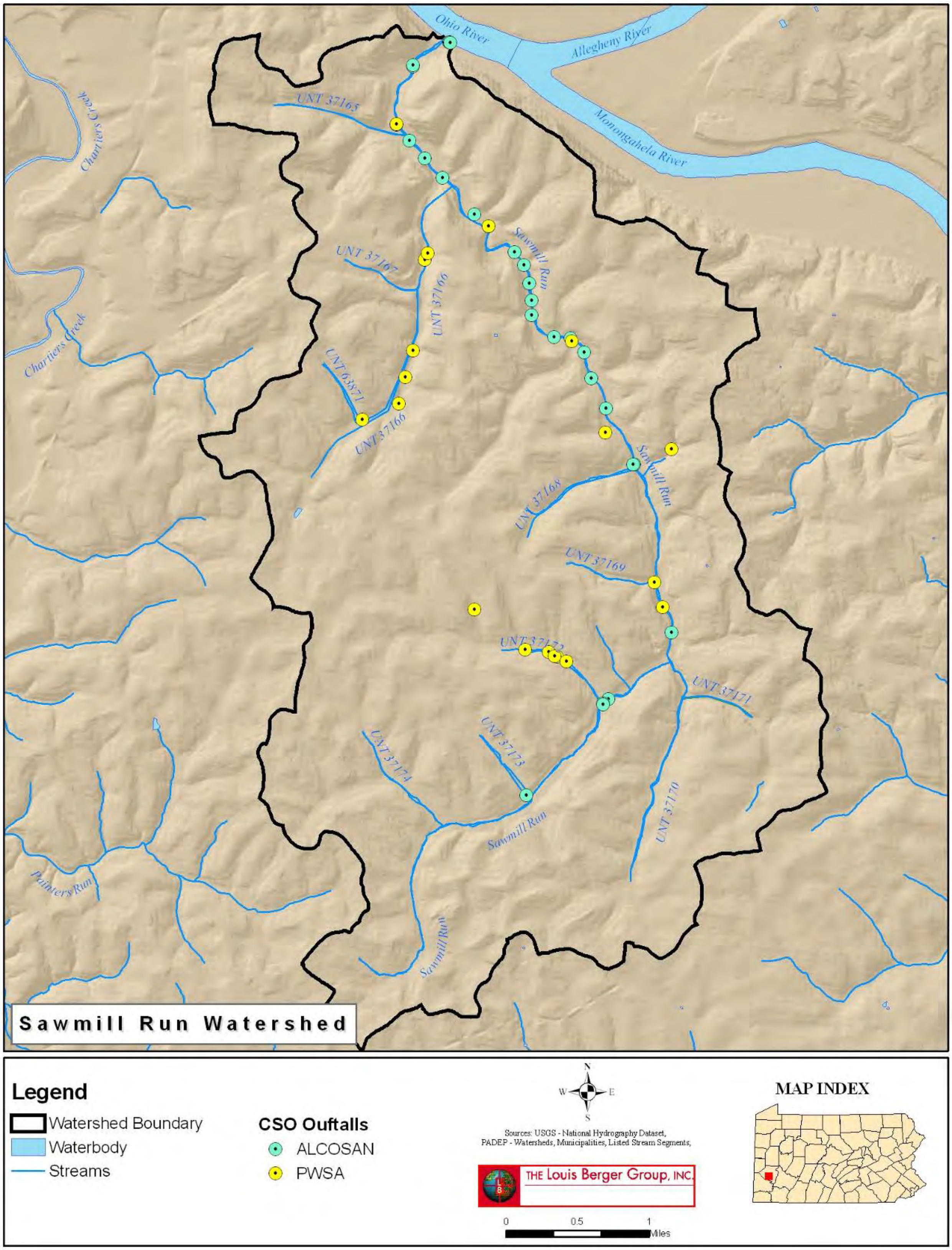


Figure 2-10. CSO Outfall Locations in the Sawmill Run Watershed

3.0 Environmental Monitoring

Environmental monitoring efforts in the Sawmill Run watershed include ambient water quality and biological sampling. Monitoring efforts within the watershed have been conducted by PADEP and 3 Rivers 2nd Nature. The following sections will summarize and present the available monitoring data used in TMDL development.

3.1 Pennsylvania Department of Environmental Quality Data

3.1.1 Ambient Water Quality Monitoring under Dry Weather Conditions

To determine the impact of AMD on Sawmill Run, PADEP collected water quality data on five occasions (four times in August 2006 and once in September 2006) at four stations under base, low flow, and high flow conditions. Samples were assessed for the following field and chemical water quality parameters: temperature, DO, pH, specific conductivity, total alkalinity, total hardness, alkalinity, sulfate, total dissolved solids (TDS), total suspended solids (TSS), carbonaceous biochemical oxygen demand over five and 20 days ($CBOD_5$ and $CBOD_{20}$), total organic carbon (TOC), ammonia, nitrite, nitrate, total nitrogen (TN), dissolved ortho-phosphorus, total ortho-phosphorus, dissolved phosphorus, total calcium, and total phosphorus (TP). In addition, samples were also analyzed for total metals (aluminum, magnesium, iron, and manganese). All sample measurements were assessed relative to Pennsylvania's established water quality standards.

A bulleted summary of the data derived from all in-stream monitoring data collected by PADEP within the Sawmill Run watershed is listed below. It should be noted that the unnamed tributary 37170 observed at station SMR_05 showed generally significantly different results in comparison to samples collected on the Sawmill Run mainstem.

- TDS concentrations sampled at the majority of stations violated the maximum criteria of 750 mg/L (average: 858; range: between 1.05 and 1208 mg/L). The highest concentration was found at SMR_05 located on UNT 37170.
- TSS concentrations were on average 8.9 mg/L in the mainstem (range: 1.0 – 22 mg/L) and 36 mg/L in UNT 37170.
- Carbonaceous BOD_5 and BOD_{20} were on average 1.95 and 1.79 mg/L in the mainstem (range: 1.2 – 2.8 mg/L and 0.1 – 5.0 mg/L) and 10.8 and 13.1 mg/L in UNT 37170.
- TN and NO_3-N concentrations measured within the mainstem were on average at 1.06 and 0.71 mg/L and in UNT 37170 at 2.11 and 0.27 mg/L (**Figure 3-1**).

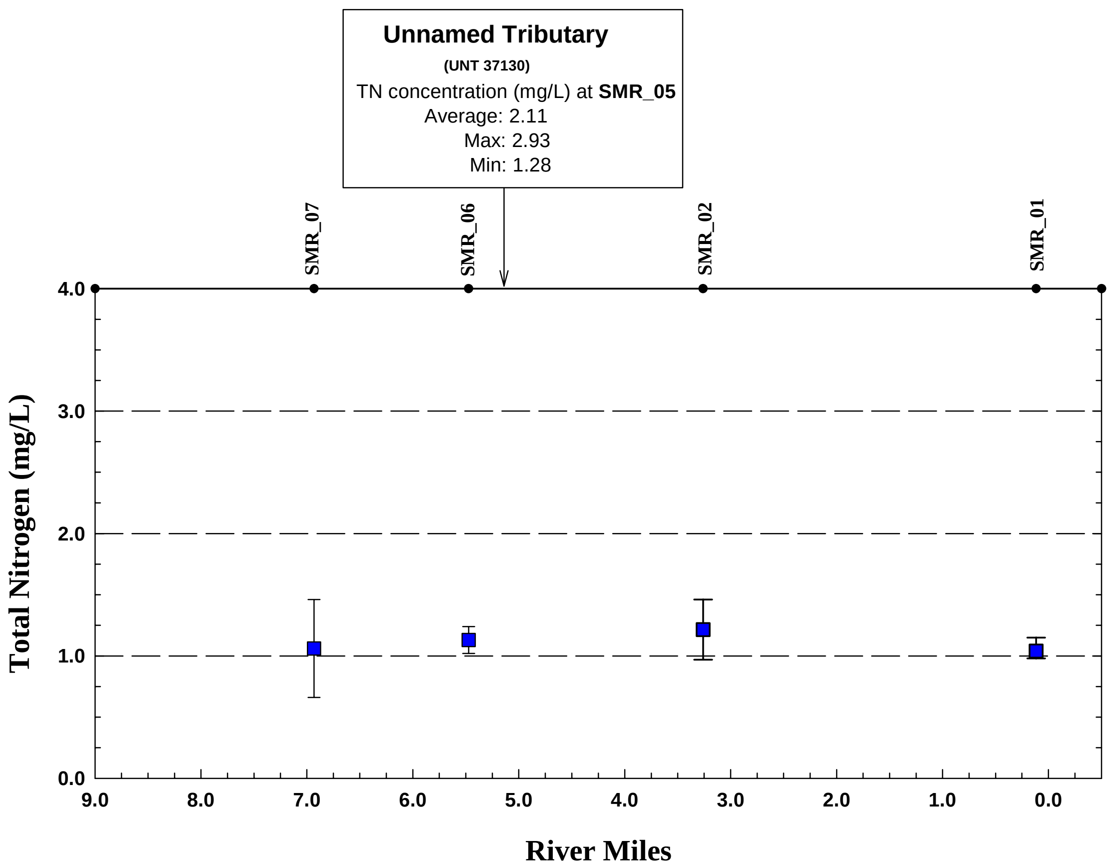


Figure 3-1 Maximum, Average, and Minimum Concentration for Total Nitrogen at Nutrient Stations.

- TP and dissolved PO_4-P concentrations measured within the mainstem were on average at 0.04 and 0.03 mg/L and in UNT 37170 at 0.119 and 0.01 mg/L (**Figure 3-2**).

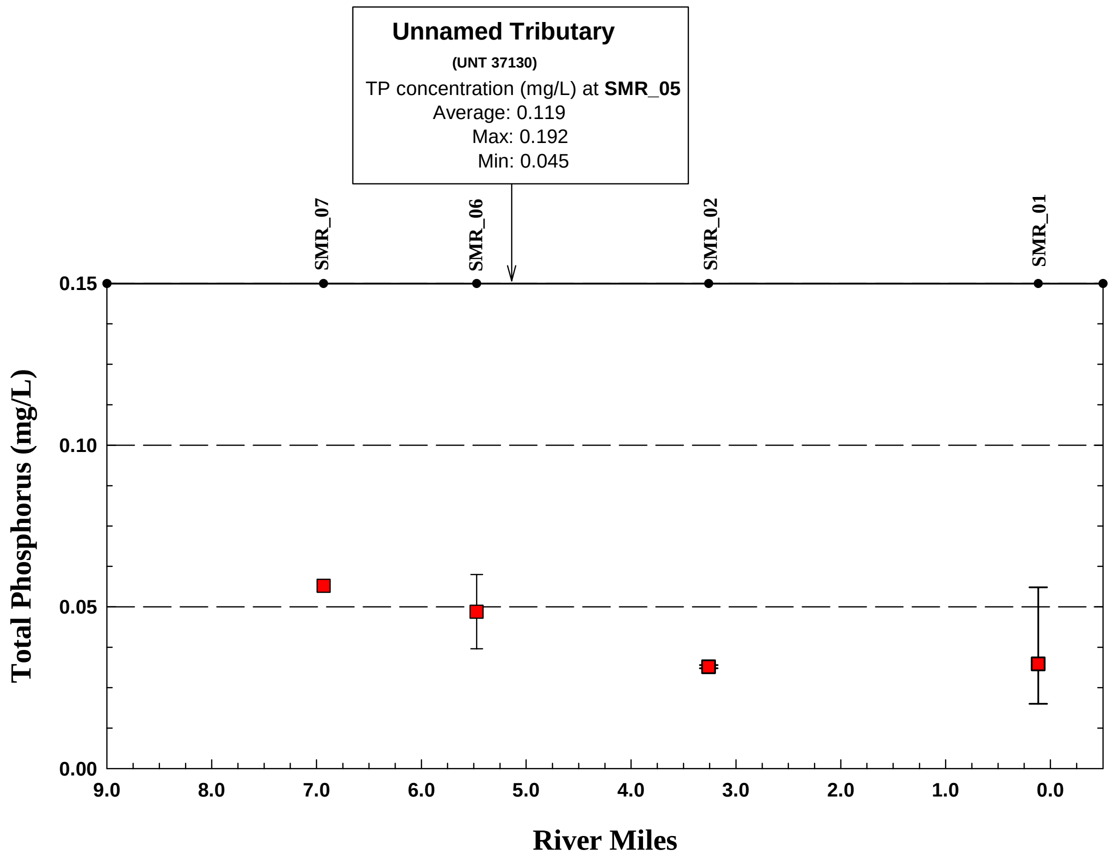


Figure 3-2 Maximum, Average, and Minimum Concentration for Total Phosphorus at Nutrient Stations.

- Alkalinity concentrations were on average 85.8 mg/L in the mainstem and never violated the PA standard of 20 mg/L. In contrast, the PA standard for alkalinity was violated six out of seven sampling events at SMR_05 (average: 9.6 mg/L; range: 0.0 - 37.4 mg/L)

- Sulfate levels violated the maximum standard of 250 mg/L on eight occasions (twice at SMR04 and SMR03, respectively, and four times at SMR_05 on UNT 37170). No violations were found at the most upstream station for AMD (SMR06). The maximum, average, and minimum concentration for sulfate at each AMD station is shown in **Figure 3-3**.

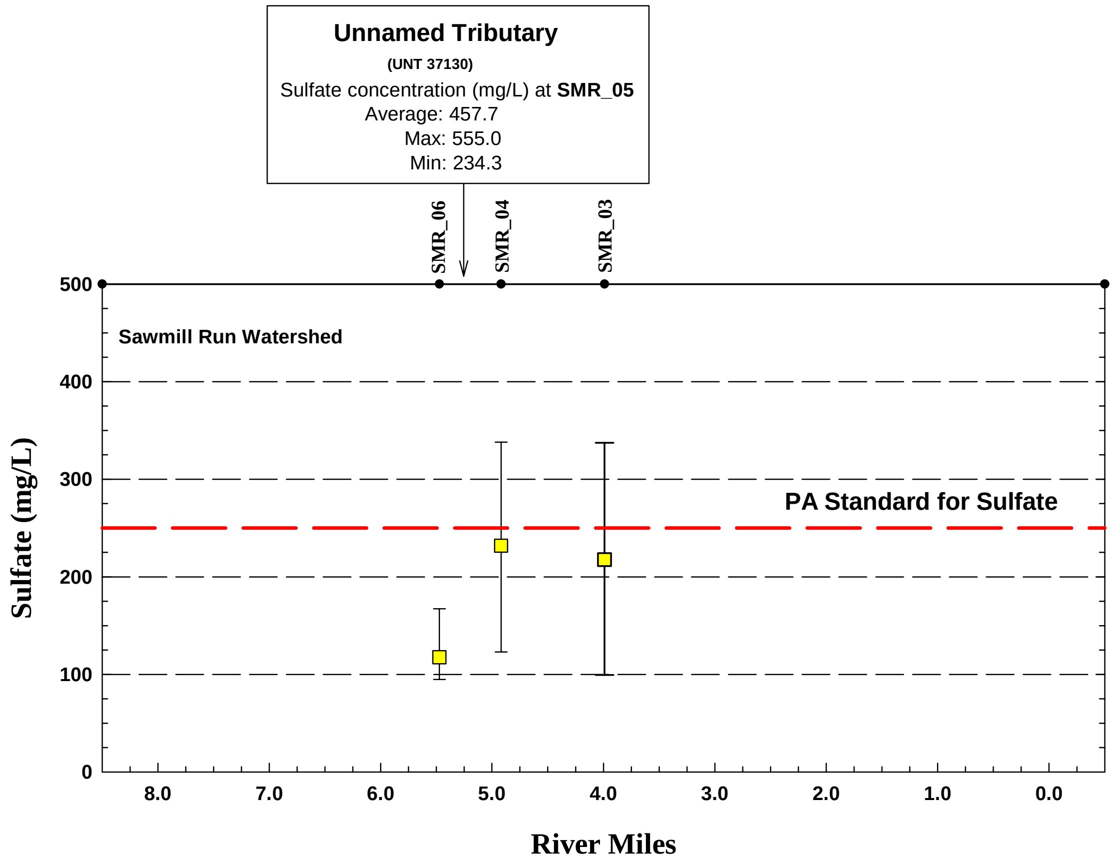


Figure 3-3 Maximum, Average, and Minimum Concentration for Sulfate at AMD Stations.

- pH and net-alkalinity (total alkalinity minus total acidity) levels were in compliance with PA standard on the mainstem. In contrast, station SMR_05 (UNT 37170) violated on three occasions the PA standard for pH (average: 4.86, range: between 3.6 and 6.8) and on four occasions the PA standard of 0 mg/L for net-alkalinity (**Figure 3-4**).

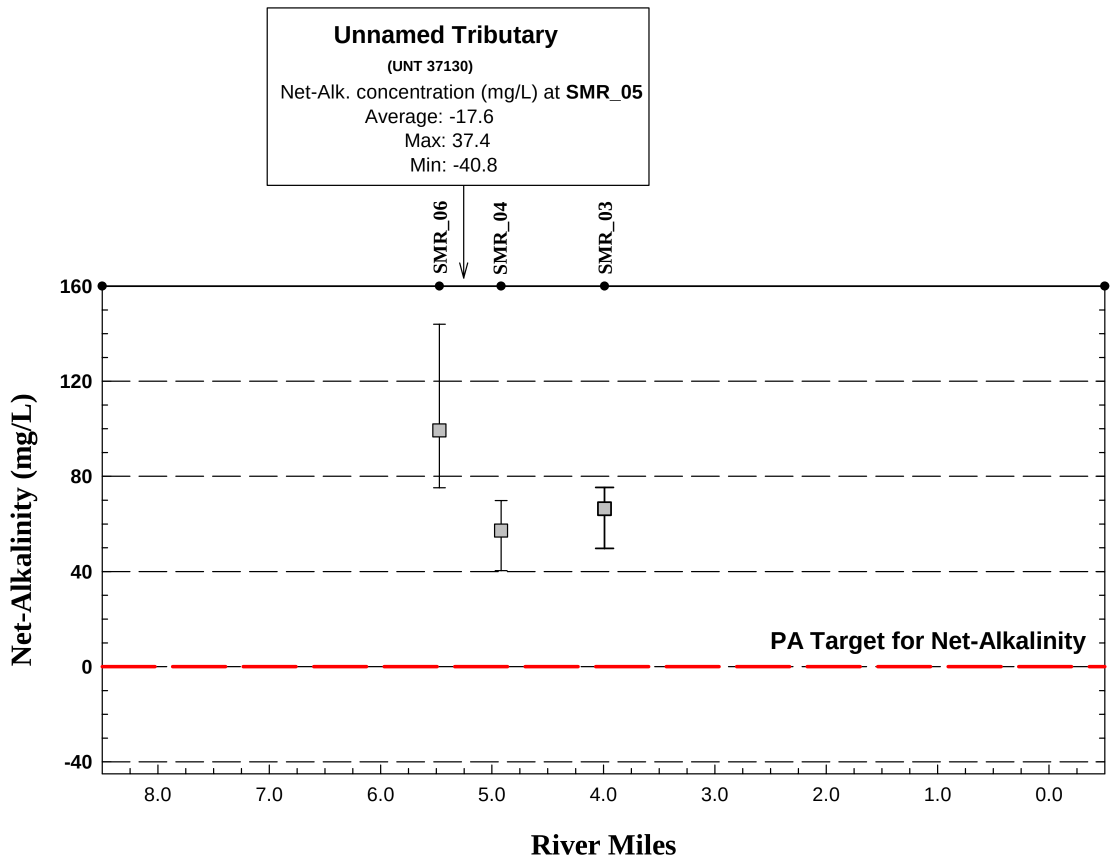


Figure 3-4 Maximum, Average, and Minimum Concentration for Net-Alkalinity at AMD Stations.

- Total iron levels violated the maximum standard of 1.5 mg/L on nine occasions (four times at SMR04 and five times at SMR_05). No violations were found at the most upstream (SMR06) and downstream (SMR03) stations for AMD. The maximum, average, and minimum concentration for total iron at each AMD station is shown in **Figure 3-5.**

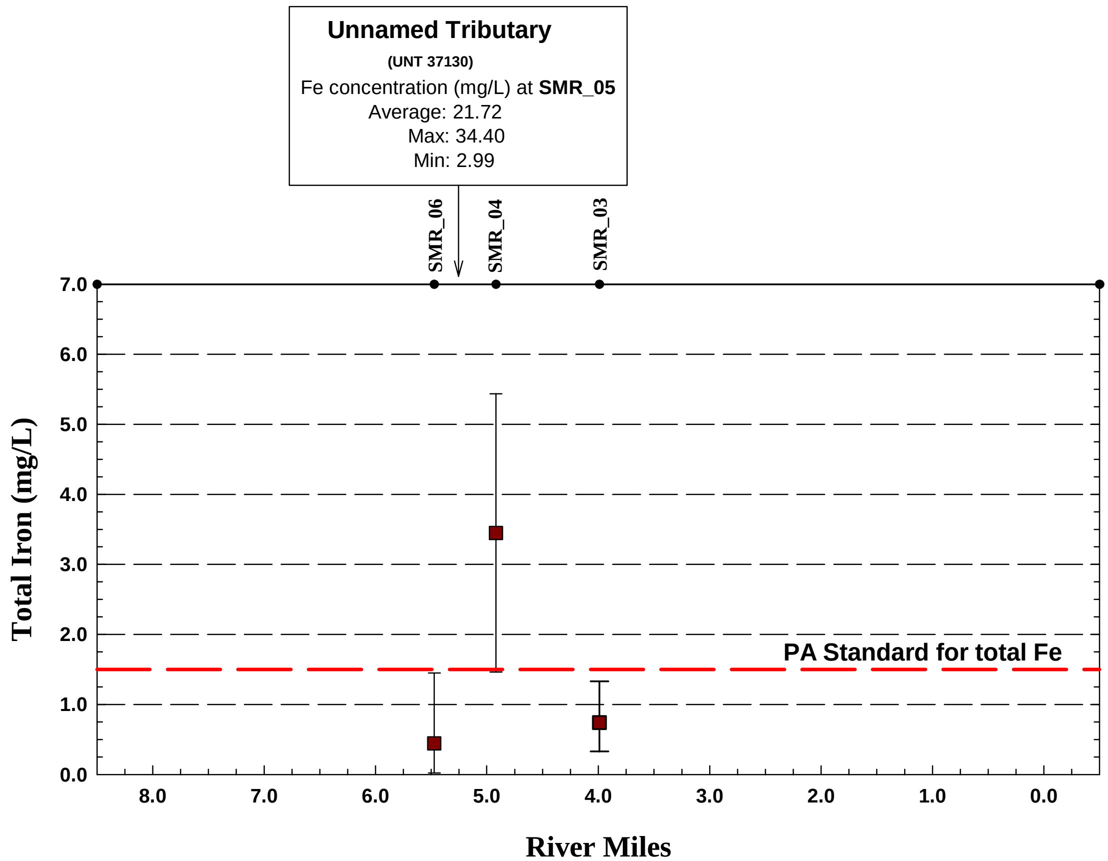


Figure 3-5 Maximum, Average, and Minimum Concentration for Total Iron at AMD Stations.

- Total manganese levels were in compliance with PA standard of 1.0 mg/L. The maximum, average, and minimum concentration for total manganese at each AMD station is shown in **Figure 3-6.**

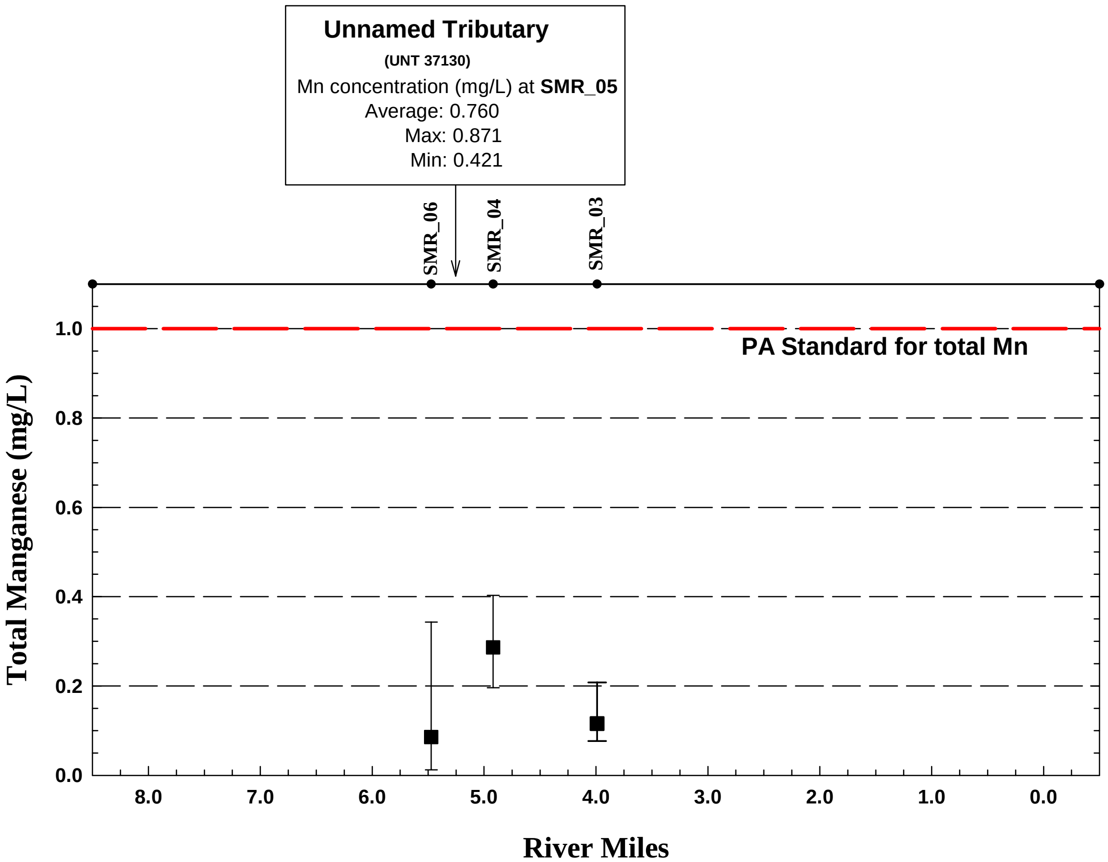


Figure 3-6 Maximum, Average, and Minimum Concentration for Total Iron at AMD Stations.

- Total aluminum levels violated the maximum standard of 0.75 mg/L on four occasions (twice at SMR06 and SMR04, respectively). No violations were found at the downstream stations (SMR04) and (SMR03) and in the unnamed tributary 37170. The maximum, average, and minimum concentration for total aluminum at each AMD station is shown in **Figure 3-7.**

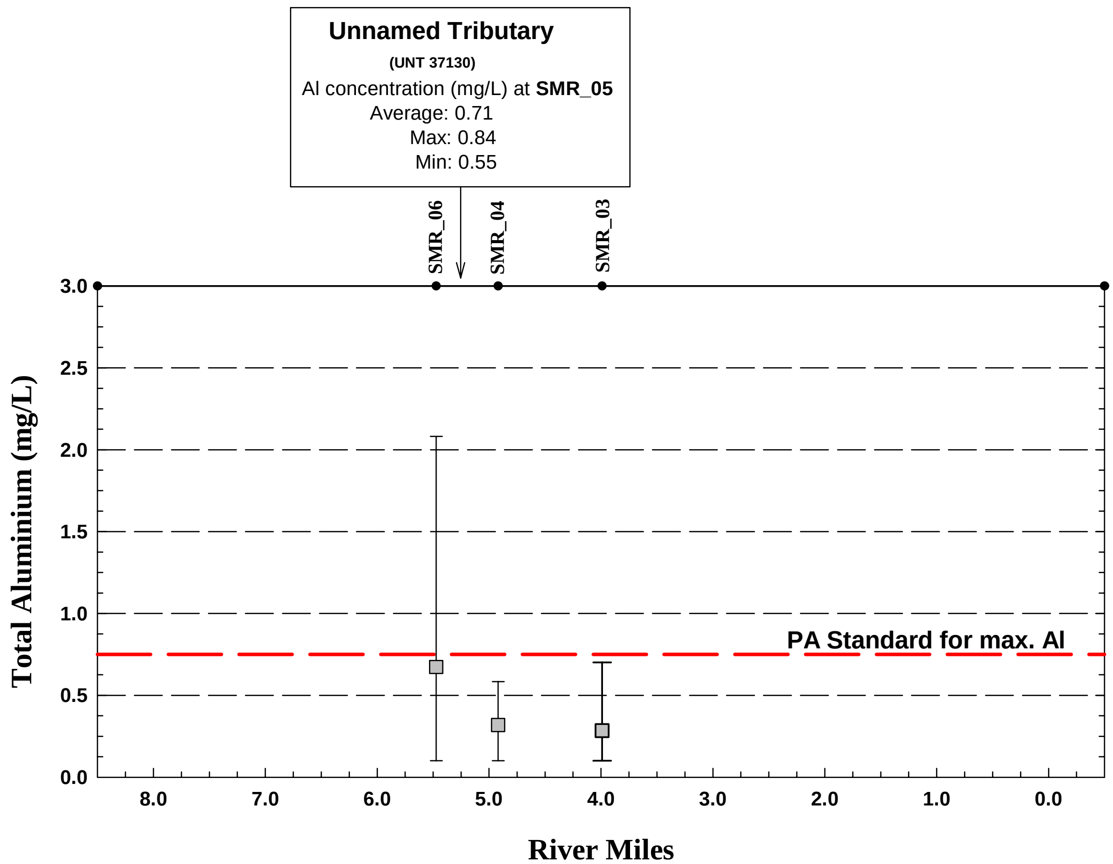


Figure 3-7 Maximum, Average, and Minimum Concentration for Total Aluminum at AMD Stations.

3.1.2 Continuous Measurements under Dry Weather Conditions

Over four stations in the mainstem of Sawmill Run over approximately two days in August and September 2006, PADEP conducted continuous instream measurements for temperature, dissolved oxygen (DO), specific conductivity, and pH. The following summarizes the results of all continuous monitoring data:

- Measurements for DO did not violate the Pennsylvania standard for a minimum DO concentration of 4 mg/L. The lowest DO level measured during the DO sonde deployments was 4.54 mg/L.
- Dissolved oxygen swings in Sawmill Run changed both spatially and temporally (**Table 3-1**). At the headwater stations in Sawmill Run (SMR_7 and SMR_6) large DO swings were recorded in August (13.52 mg/L for SMR_7 and 6.28 mg/L for SMR_6) and also in September for SMR_7 (6.27 mg/L). Downstream of the headwater stations at the center and mouth of Sawmill Run (SMR_3, SMR_2, and SMR_1), DO swings were in the middle, ranging between 1.70 and 3.26 mg/L.
- Measurements for pH complied with the state standard except measurements recorded in September at station SMR_06. pH fluctuated on average between 0.7 and 0.9 (**Table 3-1**).
- Temperature levels were on average 23 °C in August and 19 °C in September and fluctuated on average between 5 and 7 °C (**Table 3-1**).
- Specific conductivity levels for all measurements were on average 1257 (range: 860 – 1487 µS/cm) for both surveys.

Table 3-1: Comparison of DO, Temperature, and pH Swing to Date and Station

	DO Swing		Temperature Swing		pH Swing	
Station	Aug-06	Sep-06	Aug-06	Sep-06	Aug-06	Sep-06
SMR_07	13.52	6.27	9.52	6.13	1.19	0.85
SMR_06	6.28	2.12	6.41	5.41	0.94	1.16
SMR_03	-	1.7	-	3.74	-	0.48
SMR_02	3.26	-	4.26	-	0.69	-
SMR_01	2.30	2.17	6.95	5.05	0.78	0.48

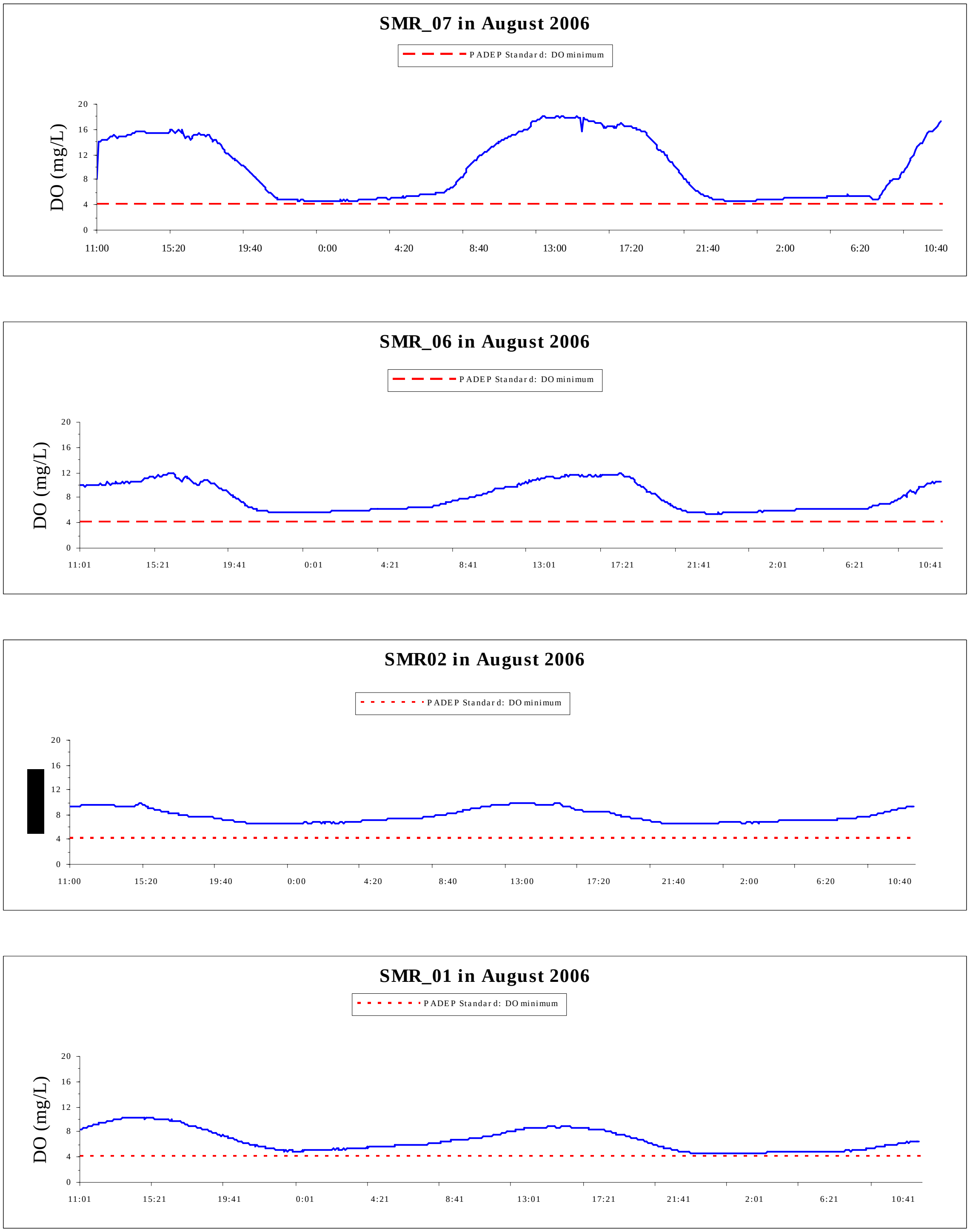


Figure 3-8 Continuous Dissolved Oxygen Measurements in the mainstem of Sawmill Run in August 2006.

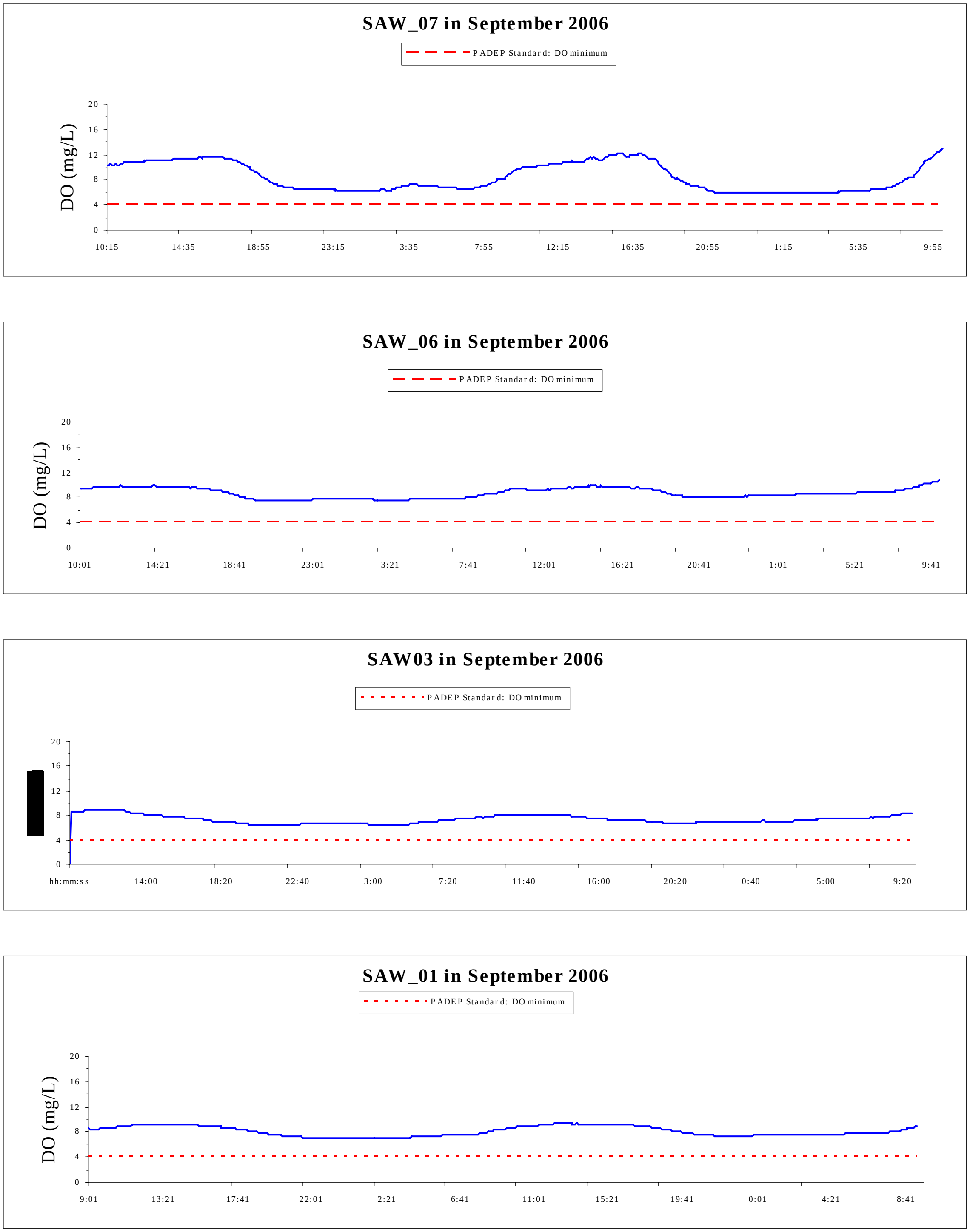


Figure 3-9 Continuous Dissolved Oxygen Measurements in the mainstem of Sawmill Run in September 2006.

3.1.3 Ambient Water Quality Monitoring under Wet Weather Conditions

Water quality data was collected once on October 17, 2006 during wet weather conditions at the mouth of Sawmill Run. The water quality sample was collected at the end of the rain event at 12:30 PM. The total rain depth was 1.52 inch over 12 hours. During the rain event, water quality samples were collected for TDS (total dissolved solids), TSS (total suspended solids), TOC (total organic carbon), total ammonia, nitrite, nitrate, TN, diss. PO_4-P, total PO_4-P, TP, $CBOD_5$ (carbonaceous BOD incubated over five days), and $CBOD_{20}$ (carbonaceous BOD incubated over 20 days). Some of these results are shown in **Table 3-2** and compared to a total average of all dry weather measurements. From this comparison, the results show that, in general, sediment concentrations increased significantly under wet weather conditions. (Note that results may not reflect maximum concentrations in Sawmill Run, since sampling occurred at the end of the rain event. Therefore, the first flush may not be captured.)

Table 3-2: Comparison of water quality measurements under dry and wet weather conditions		
Parameter	**Dry Weather at the Mouth[4]**	**Wet Weather at the Mouth[5]**
	mg/L	**mg/L**
Alkalinity	97.53	49.80
TDS	929.33	228.00
TSS	6.00	192.00
TOC	2.23	6.30
$CBOD_5$[1]	1.83	9.77
TN	1.04	1.92
Total Ammonia	0.06	0.17
DIN (Diss. Inorg. Nitrogen)	0.83	1.28
Organic N[2]	0.21	0.64
TP	0.032	0.253
Diss. PO_4-P	0.021	0.030
Organic P[3]	0.012	0.223

[1] Carbonaceous BOD incubated over 5 days

[2] Organic N = TN - DIN

[3] Organic P = TP - Diss PO_4-P

[4] Based on 2 measurement in August and September 2006

[5] Based on 1 measurement in October 2006

3.2 3 Rivers 2nd Nature Data

3.2.1 Biological Monitoring Data

Biological sampling was conducted within the Sawmill Run watershed on May 31, 2001 as part of a study conducted by the 3 Rivers 2nd Nature entitled, “Biological Assessment of Aquatic Invertebrate Communities of Streams Tributary to the Emsworth Dam Pool (Pittsburgh Pool) on the Ohio, Allegheny, and Monongahela Rivers.” Benthic macroinvertebrate samples were collected at Station Number 0012 on Sawmill Run in the west end in Pittsburgh. Out of 35 streams sampled within the entire three rivers (Ohio, Alleghany, and Monongahela) watershed, Sawmill Run was ranked 25th due to a low percentage of sensitive organisms present within the sample. In addition, Sawmill Run received a Family Biotic Index (FBI) score which indicated that sewage pollution was impacting the benthic community in Sawmill Run more profoundly in comparison to other watersheds sampled in this study. In addition, biological sampling notes added that a sewage odor was present and a large carp was observed in the creek.

3.2.2 Ambient Water Quality Monitoring

There is one ambient water quality monitoring station by 3 Rivers 2nd Nature project located in the Sawmill Run watershed (**Table 3-3**). The station was sampled five times between June and October 2004 and included general water quality parameters (alkalinity, ammonia, conductivity, DO, Escherichia Coli, fecal coliform, hardness, pH, temperature, total coliform, total dissolved solids, and turbidity) and one metal (iron).

Table 3-3: Ambient Water Quality Monitoring Stations

Station	Description
SM01	River Mile 0.8 on Sawmill Run

A bulleted summary of the general water quality parameter including iron derived from the 3 Rivers 2nd Nature project data is listed below (**Table 3-4**):

- Alkalinity, dissolved oxygen, pH, and ammonia levels have been in compliance with the criteria.

- Four out of five temperature measurements violated the standard for Cold Water Fish (CWF).
- Four out of five total dissolved solid (TDS) concentrations violated both the monthly average and the maximum standard.
- Hardness concentrations ranged between 237 and 299 mg/L (average: 273 mg/L).
- Conductivity levels ranged between 140 and 1,400 µmMhos/cm (average: 818 µmMhos/cm) with 60% of the measurements greater than 1000 µmMhos/cm.
- Bacteria levels ranged between 85 and 14,000 col/100ml (Geometric mean for total coliform: 2,420 col /100ml, for escherichia coli: 1,711 col /100ml, for entero- cocci: 286 col /100ml, and fecal coliform: 2580 col /100ml.
- Iron concentrations once exceeded the standard for dissolved iron (range: 0.073 - 0.336 mg/L, average: 0.142).

Table 3-4: Water Quality Data sampled by 3 Rivers 2nd Nature project

Sample ID	Date	Temp.	DO	pH	Cond.	Tot. Alk.	Tot. Hard.	NH_3	TDS	Turb.	Fe	Tot. Col.	EColi	Ent.-coc.	Fec. Col.
		ºC	mg/L		µmMhos/cm	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	col/100mL	col/100mL	col/100mL	col/100mL
SM01-1	6/1/2000	18.6	8.16	7.7	1400							2420	1300	178	
SM01-2	7/10/2000	21.3	7.55	7.6	220	81	237	0.01	779	1.2	0.336	2420	2420	2420	14000
SM01-3	7/25/2000	17.9	8.79	7.5	150	90	280	0.05	918	0.39	0.082				3100
SM01-4	8/22/2000	17.1	9.24	7.7	1000	99	299	0.01	967	0.44	0.073	2420	2419	184	1300
SM01-5	10/16/2000	13.2	8.74	7.8	1320	110	279	0.02	866	0.38	0.078	2420	1414	85	785
Count		5	5	5	5	4	4	4	4	4	4	4	4	4	4
Ave		17.62	8.50	7.66	818	95	274	0.02	883	0.60	0.14				
Geom. Mean												2420	1811	286	2580
Min		13.20	7.55	7.48	150	81	237	0.01	779	0.38	0.07	2420	1300	85	785
Max		21.30	9.24	7.76	1400	110	299	0.05	967	1.20	0.34	2420	2420	2420	14000

Cond.: Specific Conductivity, Tot. Alk.: Total Alkalinity, Tot. Hard.: Total Hardness, TDS: Total Dissolved Solids, Turb.: Turbidity,

Tot. Col.: Total Coliform, Ecoli: Echia Coli, Ent.-cocc.: Entero-cocci, Fec. Col.: Fecal Coliform.

4.0 AMD TMDL Development

4.1 AMD TMDL Approach

This section describes the modeling approach used in the TMDL development. The primary focus within this section is on the assumptions used and the model set-up.

4.1.1 TMDL Endpoints

One of the important steps in TMDL development is determining the numeric endpoints, or water quality targets. Water quality targets compare the current stream conditions to the expected restored stream conditions after TMDL load reductions are implemented. The endpoint is based on either the narrative or numeric criteria available in water quality standards.

The TMDL endpoints for AMD in the Sawmill Run watershed are based on the water quality criteria, as defined in *the Pennsylvania Code. Title 25 Environmental Protection, Department of Environmental Protection, Chapter 93, Water Quality Standard* for total aluminum, total iron, total manganese, and pH. **Table 4-1** presents the criterion value for each pollutant.

Table 4-1:PA Water Quality Criteria for AMD pollutants in the Sawmill Run watershed*

Parameter	Criteria
Total Aluminum	0.75 mg/L
Total Iron	30 day average of 1.5 mg/L
Total Manganese	1.0 mg/L
pH	6 - 9

* Department of Environmental Protection (May 14, 2005). Commonwealth of Pennsylvania, Pennsylvania Code, Title 25. Environmental Protection.

Much of the sources of pollution in the watershed are nonpoint sources which are expressed as Load Allocations (LAs) in a TMDL. All allocations are specified as long-term average daily concentrations. These long-term average concentrations are expected to meet water-quality criteria 99% of the time as required in *PA Title 25 Chapter 96.3(c)*.

4.1.2 TMDL Methodology

The Sawmill Run AMD TMDL was developed using a two-step process that is used regularly by PADEP for AMD TMDLs. The first step determines the maximum allowable instream concentrations of the pollutants at each location of interest. The second step performs a load tracking using a mass balance approach for each pollutant (aluminum, iron, manganese, acidity) at each point of interest to compute the TMDL allocations. The mass balance approach tracks the pollutant loads along the stream and ensures that the Pennsylvania water quality standards are attained at all locations.

4.1.2.1. Statistical Approach

The allowable instream concentration of each pollutant is determined by statistically analyzing instream water quality data and finding a concentration that has a 99 percent probability of meeting the water quality criteria, as defined in the *Pennsylvania Code. Title 25 Environmental Protection, Department of Environmental Protection, Chapter 93, Water Quality Standard*. Since the statistical analysis requires a large number of instream water quality measurements, the Monte Carlo simulation was used to generate 5000 data points at each location. The Monte Carlo simulation was performed using the @RISK software (Palisade Corporation, 2005).

The Monte Carlo simulation randomly generates a larger data set based on the mean and the standard deviation of observed concentrations of the pollutants at each sampling site and a lognormal distribution. The @Risk software also computes the pollutant concentration corresponding to a specified probability of exceedence. Thus the pollutant concentration that will not be exceeded 99 percent of time (Cd) was determined and compared with the water quality criterion (Cc) to compute the required percent reduction (PR). For each iteration, the required percent reduction can be expresses as:

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

The allowable long-term average concentration (LTA Conc) can be computed using:

$$LTA\ Conc = Mean\ Conc \cdot (1 - PR)$$

In order to compute the mean and the standard deviation as input to the Monte Carlo simulation, five base flow and non-base flow samples were collected at each specified monitoring site to improve the sample population statistics.

Figure 4-1 provides a graphical representation of the steps needed to develop the maximum allowable instream concentrations.

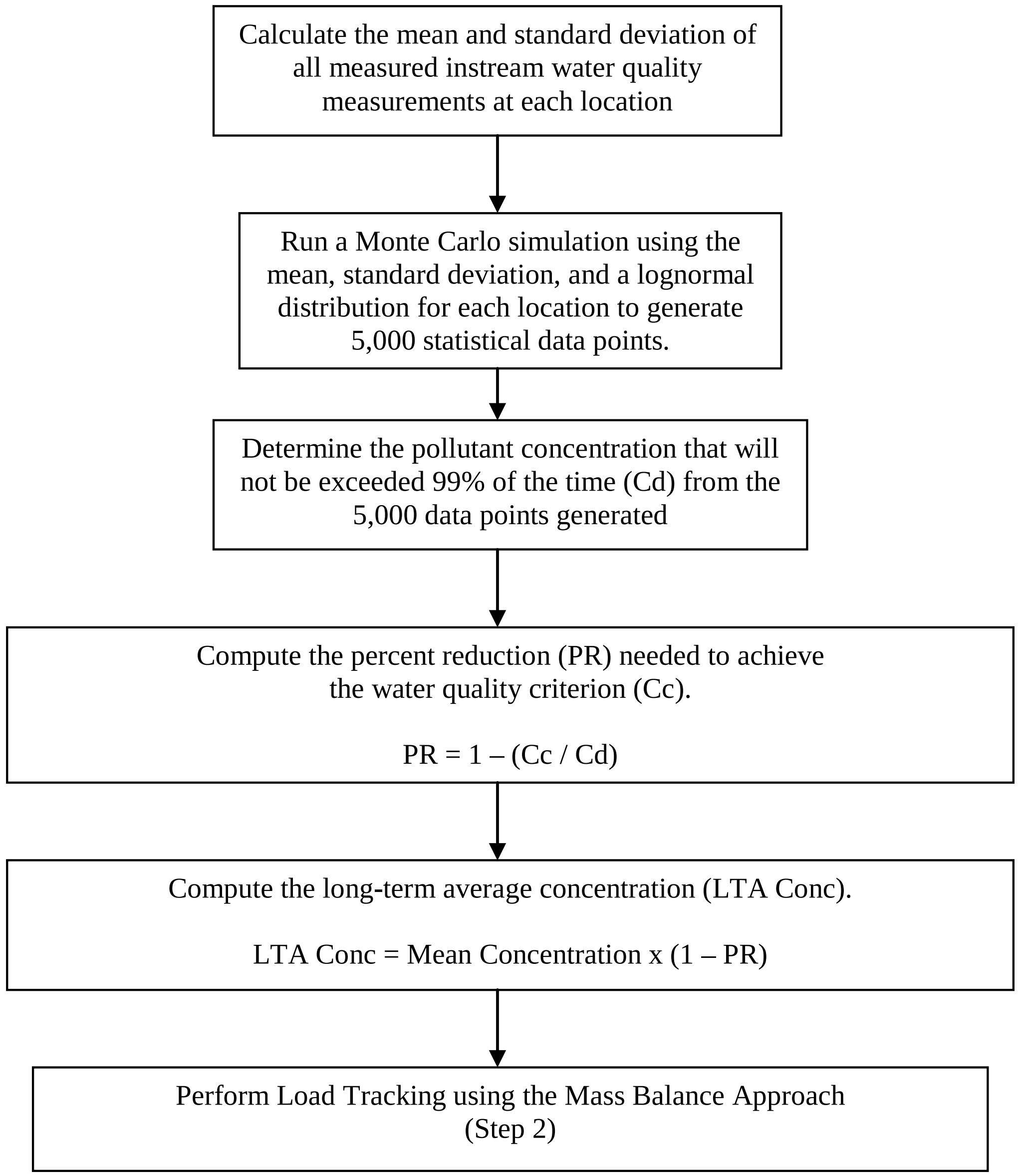


Figure 4-1: Flow Diagram of Step 1 – Calculation of the Maximum Allowable Instream Concentration

4.1.2.2. Mass Balance Analysis

Using the change in measured loads between sampling locations and the calculated allowable load, the mass analysis provides a picture of how AMD is impacting each sampling location. This analysis is done to ensure that all water quality standards will be met all points of the impaired stream.

For each sample site, mass balances were computed based on upstream and downstream loads and the allowable LTA load determined from the Monte Carlo simulation. The loads were calculated using the allowable LTA concentration and the average stream flow. The mass balance was computed following two basic rules to establish TMDL load:

1. If the sum of the load received from upstream is less than the load at the downstream site, the difference between the downstream and upstream loads will be added to the allowable LTA load as a contribution from groundwater/diffuse sources.

2. If the sum of the load received from upstream is greater than the load at the downstream site, the ratio of the decrease will be applied to the allowable LTA load at the upstream site. This will account for any in-stream processes, such as settling, taking place within the stream segment.

Figures 4.2 provide a graphical representation of the mass balance approach used to track the pollutant loads.

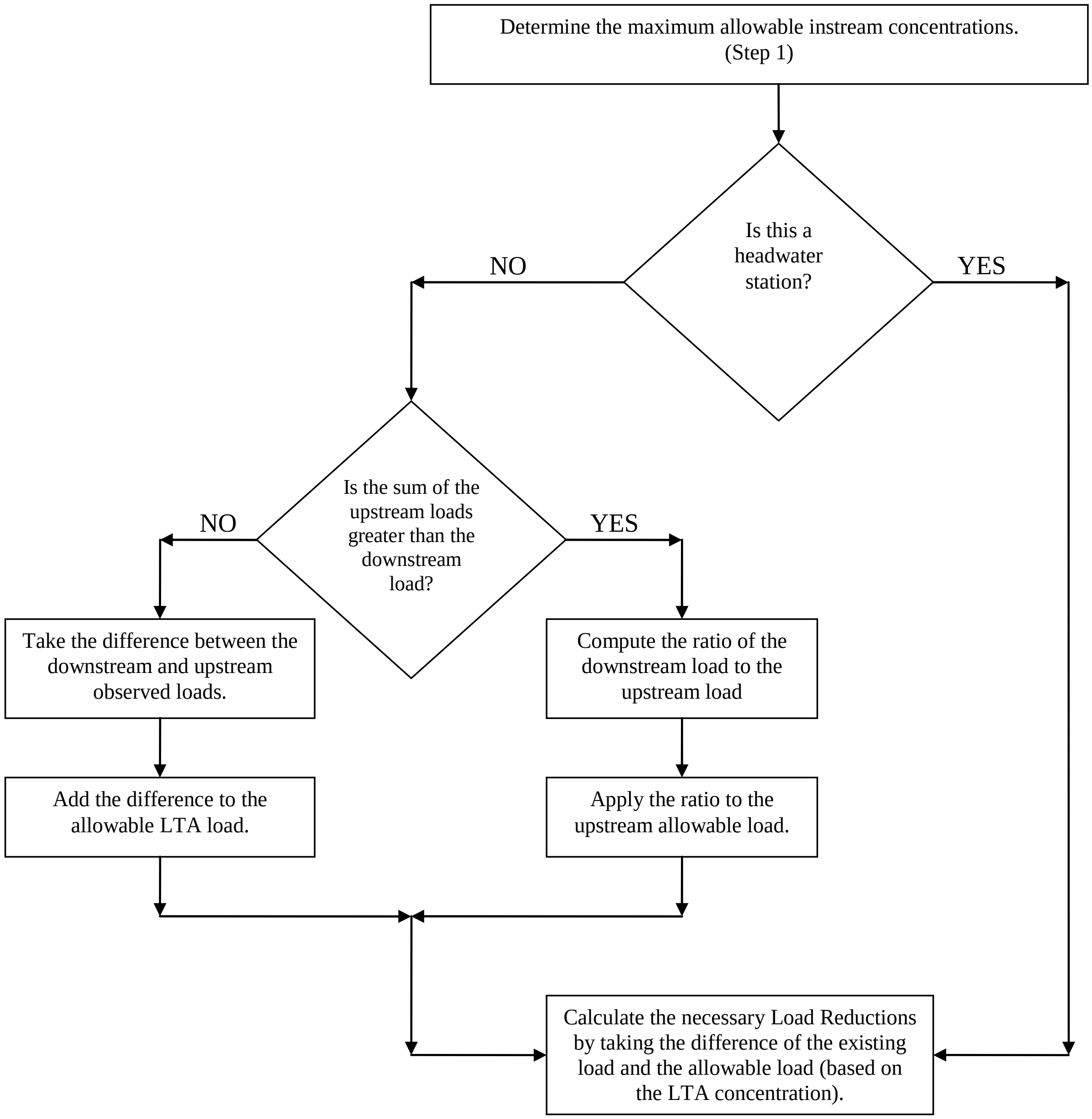


Figure 4-2: Flow Diagram of Step 2– Mass Balance Analysis

The development of the allocations for point sources and nonpoint sources was based on the allocation approach performed in previously EPA-approved TMDLs for AMD such as for the Brubaker Run watershed (PADEP, 2004) and Raccoon Creek watershed (PADEP, 2005).

The TMDL load is allocated to point sources (waste load allocation) and to non-point sources (load allocation) at each sample site. The waste load allocations (WLA) are applied to permitted discharges. Because the facilities in the watershed do not have permitted discharges, no waste load allocation was applied. The load allocations (LAs) were calculated as the difference between the TMDLs (allowable LTA) and the WLAs. The LAs at each sample site incorporated the allowable loads from upstream and loads from tributaries. The percent reductions were computed for each sample site.

4.1.2.3. Method for the pH TMDL Development

Extensive research on geochemistry of acid mine drainage provided the basis for development of pH TMDLs in Pennsylvania and established the relationship between alkalinity, acidity and pH under the special circumstances. Research by Department of Environmental Protection revealed that for positive (greater than or equal to zero) net alkalinity, alkalinity minus acidity (both in units of milligrams per liter (mg/L) CaCO3), the pH is commonly between six to eight, which also lies within the acceptable pH criteria range specified in PA Title 25 Chapter 96.3(c). The pH, a measurement of hydrogen ion acidity presented as a negative logarithm, is not conducive to standard statistics and pH does not measure latent acidity. Since acidity in a stream is partially chemically dependent upon dissolved metals and it is extremely difficult to predict the exact pH in water in acid mine drainage areas, Pennsylvania uses net alkalinity (= – net acidity) allocations to address the pH impairments included in the Section 303(d) list. This methodology assures that the standard for pH will be met when acidity in a stream is neutralized or a net alkaline stream is maintained. This method eliminates the need to specifically compute the pH value, which for mine waters is not a true reflection of acidity.

The procedure for development of the acidity allocations at the sampling sites involves the following steps.

1. Compute acidity from measured hot acidity and alkalinity of each sample at a sampling site
2. Perform Monte Carlo simulation to generate 5,000 data points using the mean and the standard deviation of all acidity values, and based on a log-normal distribution as described in Section 4.1.2.1
3. Determine the percent reduction needed to make the 99^{th} percentile acidity equivalent to the mean alkalinity as described in Section 4.1.2.1
4. Apply the percent reduction to determine long-term average (LTA) acidity (i.e. desired target for mean acidity) at the sampling site as described in Section 4.1.2.1
5. Perform a mass-balance analysis to determine TMDL allocations for acidity at each site as described in Section 4.1.2.2

4.1.2.4. Existing AMD Loads

In summary, average AMD loads for the Sawmill Run watershed were determined as follows (**Table 4-2**):

- Existing loads were calculated using the average stream flow and average concentration measured at each sampling site.
- Allowable LTA concentrations were determined by Monte Carlo simulation using a lognormal distribution, mean, and standard deviation.
- The allowable load was calculated using LTA concentration and the average stream flow measured at each sampling site.

Table 4-2: AMD Concentrations and Loads in the Sawmill Run watershed

Station	Average Stream Flow (cfs)	Parameter	Existing		Allowable	
			Concentration (mg/L)	Load (Ib/day)	Concentration (mg/L)	Load (Ib/day)
SMR-06	12.01	Iron	0.44	28.70	0.22	14.29
		Manganese	0.09	5.54	0.13	8.28
		Aluminum	1.53	99.17	0.29	18.62
		Acidity	12.24	792.34	70.22	4,545.50
SMR-05	9.89	Iron	21.72	1,157.72	0.47	24.90
		Manganese	0.76	40.49	0.57	30.50
		Aluminum	0.71	37.60	0.55	29.07
		Acidity	38.69	2,062.19	10.36	555.05
SMR-04	16.24	Iron	3.45	301.80	0.61	53.68
		Manganese	0.28	25.09	0.53	46.28
		Aluminum	0.37	32.69	0.30	26.16
		Acidity	10.28	899.85	52.53	4,598.39
SMR-03	14.83	Iron	0.74	59.33	0.55	43.58
		Manganese	0.12	9.26	0.38	30.62
		Aluminum	0.56	44.92	0.37	29.26
		Acidity	8.84	706.61	51.67	4,130.27

4.2 AMD TMDL Allocation

The purpose of TMDL allocation is to identify the pollutant load reductions required from each source to achieve water quality standards. Reduction of AMD loads from each non-point source in the impaired watershed to cumulatively meet the TMDL endpoint load is expected to ensure that Sawmill Run meets water quality standards and restore its designated uses.

4.2.1 Basis for TMDL Allocations

AMD TMDL allocations for Sawmill Run were based on the following equation:

$$TMDL = WLA + LA + MOS$$

Where:
TMDL= Endpoint AMD Load
WLA = Wasteload Allocation
LA = Load Allocation
MOS = Margin of Safety

The wasteload allocation (WLA) represents the total AMD loading allocated to point sources. However, since there are no point sources of AMD-related pollutants located within the Sawmill Run watershed, a wasteload allocation was not assigned. The load allocation (LA) represents the total AMD loading allocated to non-point sources. The margin of safety (MOS) is a required TMDL element designed to account for uncertainties in the calculation of the TMDL.

4.2.1.1. Margin of Safety

For this TMDL, the margin of safety was applied implicitly by simulating concentrations and loadings with a Monte Carlo simulation. Another margin of safety used for this TMDL analysis included the consideration of effluent variability. The standard deviation of the dataset was the value that best provides this variability for this analysis. The simulation results are based on this variability and the existing stream conditions, an uncontrolled system. The general assumption can be made that a controlled system, one that is controlling and stabilizing the pollution load, would be less variable than an uncontrolled system. This implicitly builds in a margin of safety.

4.2.1.2. Wasteload Allocation

The point sources as described in Chapter 2 do not have permitted limits for any the AMD parameters and are associated with construction or stormwater. Therefore, no wasteload allocations are needed for this TMDL.

4.2.1.3. Load Allocation

The TMDL for Sawmill Run consists of load allocations to all of the areas upstream of and between each of the sampling sites used. The load allocation for each stream segment was computed using the data collected at each sampling station. In addition, flow measurements gathered with each sampling event had been used.

The TMDL for SMR-06 consists of a load allocation to all the area upstream of the sampling site. Upstream of confluence with the UNT 37170, SMR-06 is located on the mainstem of Sawmill Run. **Table 3-3** provides the calculation for the SMR-06.

Table 4-3: TMDL Calculations for SMR-06

	Iron (Ibs/day)	Manganese (Ibs/day)	Aluminum (Ibs/day)	Acidity (lbs/day)
Existing Load	28.70	5.54	99.17	792.34
Allocated Load	14.29	8.28	18.62	4,545.50
Load Reduction	14.41	0.00	80.56	0.00
Percent Reduction	50.20	0.00	81.23	0.00

The TMDL for SMR-05 consists of a load allocation to the area that drains into UNT 37170. This station is located upstream of the confluence with Sawmill Run. A local landmark near this station is an Eckerd Pharmacy. **Table 4-4** provides the calculation for the SMR-05.

Table 4-4: TMDL Calculations for SMR-05				
	Iron (Ibs/day)	**Manganese (Ibs/day)**	**Aluminum (Ibs/day)**	**Acidity (lbs/day)**
Existing Load	1,157.72	40.49	37.60	2,062.19
Allocated Load	24.90	30.50	29.07	555.05
Load Reduction	1,132.82	9.99	8.53	1510.14
Percent Reduction	97.85	24.68	22.70	73.23

The TMDL for SMR-04 consists of a load allocation includes the area between SMR-06 and this station. SMR-04 is located upstream of the confluence with UNT 37168 in the Park. **Table 4-5** provides the calculation for the SMR-04.

Table 4-5: TMDL Calculations for SMR-04				
	Iron (Ibs/day)	**Manganese (Ibs/day)**	**Aluminum (Ibs/day)**	**Acidity (lbs/day)**
Existing Load	301.80	25.09	32.69	899.85
Existing Load From Upstream	1186.43	46.03	136.78	2,854.53
Difference with Upstream Existing Load	-884.63	-20.95	-104.08	-1,954.69
Ratio of difference	0.25	0.54	0.24	0.44
Allowable load from Upstream	39.19	38.78	47.69	5,097.55
Total Upstream Load Tracked	9.97	21.13	11.40	2,224.34
Allocated Load	53.68	46.28	26.16	4,598.39
Load Reduction	0	0	0	0.0
Percent Reduction	0	0	0	0.0

The TMDL for SMR-03 consists of the load allocation of the area between SMR-04 and this station. Located upstream of the confluence with UNT 37168, SMR-03 is the station that represents the downstream boundary of the 303(d) listed segment for AMD. **Table 4-6** provides the calculation for the SMR-03.

Table 4-6: TMDL Calculations for SMR-03

	Iron (Ibs/day)	Manganese (Ibs/day)	Aluminum (Ibs/day)	Acidity (lbs/day)
Existing Load	59.33	9.26	44.92	706.61
Existing Load From Upstream	301.80	25.09	32.69	899.85
Difference with Upstream Existing Load	-242.47	-15.83	12.23	-193.23
Ratio of difference	0.20	0.37	-	0.79
Allowable load from Upstream	53.68	46.28	26.16	4,598.39
Total Upstream Load Tracked	10.55	17.08	23.63	3,610.94
Allocated Load	43.58	30.62	29.26	4,130.27
Load Reduction	0	0	0	0.0
Percent Reduction	0	0	0	0.0

Table 4-7 provides load reductions needed for water quality criteria to be met in the Sawmill Run watershed.

Table 4-7: Allowable Loads and Necessary Load Reductions for the Sawmill Run watershed

Station	Parameter	Existing Load (Ib/day)	Allocated Load (Ib/day)	Load Reduction (Ib/day)	Reduction (%)
SMR-06	Iron	28.70	14.29	14.41	50.20
	Manganese	5.54	8.28	0.00	0.00
	Aluminum	99.17	18.62	80.56	81.23
	Acidity	792.34	4,545.50	0.00	0.00
SMR-05	Iron	1,157.72	24.90	1,132.82	97.85
	Manganese	40.49	30.50	9.99	24.68
	Aluminum	37.60	29.07	8.53	22.70
	Acidity	2,062.19	555.05	1,510.14	73.23
SMR-04	Iron	301.80	53.68	0.00	0.00
	Manganese	25.09	46.28	0.00	0.00
	Aluminum	32.69	26.16	0.00	0.00
	Acidity	899.85	4,598.39	0.00	0.00
SMR-03	Iron	59.33	43.58	0.00	0.00
	Manganese	9.26	30.62	0.00	0.00
	Aluminum	44.92	29.26	0.00	0.00
	Acidity	706.61	4,130.27	0.00	0.00

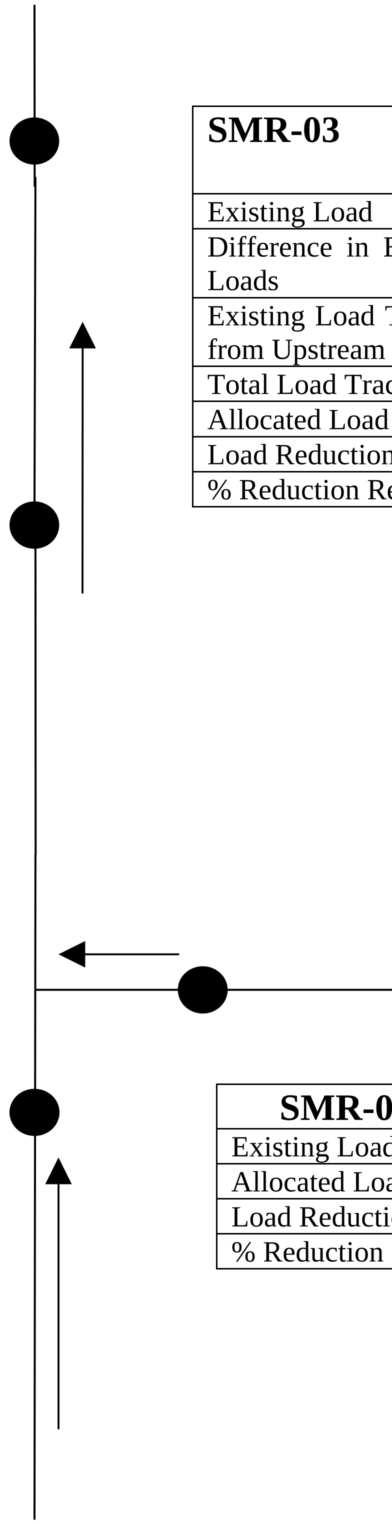
4.2.2 Overall Recommended TMDL Allocations

The load allocations for the Sawmill Run AMD TMDL are summarized in **Table 4-8**.

Figures 4-3 through 4-6 provide a graphical representation of the allocations required for the Sawmill Run watershed to meet water quality criteria.

Table 4-8: AMD TMDL for the Sawmill Run watershed

Station	Parameter	Existing Load (lbs/day)	Reduction (%)	TMDL (lbs/day)	WLA (lbs/day)	LA (lbs/day)
SMR-06	Iron	28.70	50.20	14.29	0.00	14.29
	Manganese	5.54	0.00	8.28	0.00	8.28
	Aluminum	99.17	81.23	18.62	0.00	18.62
	Acidity	792.34	0.00	4,545.50	0.00	4,545.50
SMR-05	Iron	1,157.72	97.85	24.90	0.00	24.90
	Manganese	40.49	24.68	30.50	0.00	30.50
	Aluminum	37.60	22.70	29.07	0.00	29.07
	Acidity	2,062.19	73.23	555.05	0.00	555.05
SMR-04	Iron	301.80	0.00	53.68	0.00	53.68
	Manganese	25.09	0.00	46.28	0.00	46.28
	Aluminum	32.69	0.00	26.16	0.00	26.16
	Acidity	899.85	0.00	4,598.39	0.00	4,598.39
SMR-03	Iron	59.33	0.00	43.58	0.00	43.58
	Manganese	9.26	0.00	30.62	0.00	30.62
	Aluminum	44.92	0.00	29.26	0.00	29.26
	Acidity	706.61	0.00	4,130.27	0.00	4,130.27



SMR-03	Load lbs/day
Existing Load	59.33
Difference in Existing Loads	-242.47
Existing Load Tracked from Upstream	301.80
Total Load Tracked	10.55
Allocated Load	43.58
Load Reduction	0
% Reduction Required	0

SMR-04	Load lbs/day
Existing Load	301.80
Difference in Existing Loads	-884.63
Existing Load Tracked from Upstream	1186.43
Total Load Tracked	9.97
Allocated Load	53.68
Load Reduction	0
% Reduction Required	0

SMR-06	Load lbs/day
Existing Load	28.70
Allocated Load	14.29
Load Reduction	14.41
% Reduction	50.20

SMR-05	Load lbs/day
Existing Load	1,157.72
Allocated Load	24.90
Load Reduction	1,132.82
% Reduction	97.85

Figure 4-3. Allowable and Existing Iron Loads

SMR-03	Load lbs/day
Existing Load	9.26
Difference in Existing Loads	-15.83
Existing Load Tracked from Upstream	25.09
Total Load Tracked	17.08
Allocated Load	30.62
Load Reduction	0
% Reduction Required	0

SMR-04	Load lbs/day
Existing Load	25.09
Difference in Existing Loads	-20.95
Existing Load Tracked from Upstream	46.00
Total Load Tracked	21.13
Allocated Load	46.28
Load Reduction	0
% Reduction Required	0

SMR-05	Load lbs/day
Existing Load	40.49
Allocated Load	30.50
Load Reduction	9.99
% Reduction	24.68

SMR-06	Load lbs/day
Existing Load	5.54
Allocated Load	8.28
Load Reduction	0
% Reduction	0

Figure 4-4. Allowable and Existing Manganese Loads

12.23 = 44.92 – 32.69

SMR-03	Load lbs/day
Existing Load	44.92
Difference in Existing Loads	12.23
Existing Load Tracked from Upstream	32.69
Total Load Tracked	23.63
Allocated Load	29.26
Load Reduction	0
% Reduction Required	0

SMR-04	Load lbs/day
Existing Load	32.69
Difference in Existing Loads	-104.08
Existing Load Tracked from Upstream	136.78
Total Load Tracked	11.40
Allocated Load	26.16
Load Reduction	0
% Reduction Required	0

SMR-06	Load lbs/day
Existing Load	99.17
Allocated Load	18.62
Load Reduction	80.56
% Reduction	81.23

SMR-05	Load lbs/day
Existing Load	37.60
Allocated Load	29.07
Load Reduction	8.53
% Reduction	22.70

Figure 4-5. Allowable and Existing Aluminum Loads

SMR-03	Load lbs/day
Existing Load	706.61
Difference in Existing Loads	-193.23
Existing Load Tracked from Upstream	899.85
Total Load Tracked	3,610.94
Allocated Load	4,130.27
Load Reduction	0.00
% Reduction Required	0.00

SMR-04	Load lbs/day
Existing Load	899.85
Difference in Existing Loads	-1,954.69
Existing Load Tracked from Upstream	2,854.53
Total Load Tracked	2,224.34
Allocated Load	4,598.39
Load Reduction	0.00
% Reduction Required	0.00

SMR-05	Load lbs/day
Existing Load	2,062.19
Allocated Load	552.05
Load Reduction	1,510.13
% Reduction	73.23

SMR-06	Load lbs/day
Existing Load	792.34
Allocated Load	4,545.50
Load Reduction	0.00
% Reduction	0.00

Figure 4-6. Allowable and Existing Acidity Loads

4.3 Consideration of Critical Conditions

EPA regulations at 40 CFR 130.7 (c) (1) require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. The reductions specified in this TMDL apply at all flow conditions. A critical flow condition could not be identified from the data used for this analysis.

4.4 Consideration of Seasonal Variability

Seasonal variations involve changes in stream flow and AMD loading as a result of hydrologic and climatological patterns. Since the model was based on observed data collected during different flow regimes, seasonal variations were explicitly incorporated in the modeling approach for these TMDLs.

5.0 Sediment TMDL Development

TMDL development requires determination of endpoints, or water quality goals/targets, for the impaired waterbody. TMDL endpoints represent the stream conditions at which a given stream would meet water quality standards. Endpoints are normally expressed as the numeric water quality criteria for the pollutant causing the impairment. Compliance with numeric water quality criteria, such as a maximum allowable pollutant concentration, is expected to achieve full use support for the waterbody. However, not all pollutants have established numeric water quality criteria. In these cases, alternative approaches may be used to define the TMDL endpoint. As discussed in Section 1.0, Pennsylvania currently has not established numeric criteria for sediment. Therefore, an alternate approach for determining the sediment TMDL endpoint was utilized.

5.1 TMDL Approach

A reference watershed approach was used to develop a sediment TMDL for Sawmill Run. This approach is used regularly by PADEP to develop sediment TMDLs across the Commonwealth. The annual sediment load calculated for the reference watershed defines the numeric TMDL endpoint for the impaired watershed. Therefore, sediment loads were determined for the reference watershed and the impaired watershed in order to quantify load reductions necessary to achieve the designated uses for the Sawmill Run watershed.

The methodology used in the selection of the reference watershed and the quantification of the sediment sources for the TMDL development is presented in the subsequent sections

5.1.1 Selected Reference Watershed

The numeric sediment targets for the Sawmill Run watershed were determined using the reference watershed approach. Under this approach, the TMDL endpoint for an impaired watershed is established based on conditions in a similar, but non-impaired or ‘reference condition’ watershed. For sediment, the TMDL endpoint is the sediment load in the reference watershed. Reduction of the sediment load in the impaired watershed to levels comparable to that in the reference watershed is assumed to be sufficient for the impaired stream to attain its designated uses. Selection of an appropriate reference watershed is based on similarities in watershed characteristics such as soils, topography, land uses, and ecology.

The reference watershed selected for the Sawmill Run sediment TMDL is the Little Pine Creek watershed, located in Allegheny County, Pennsylvania. The Little Pine Creek watershed was recommended for use as a reference by the PADEP due to its similar land use breakdown and character.

In the Little Pine Creek watershed, there is one listed segment – UNT 42138 to Little Pine Creek. This segment was listed in 2002 as impaired due to nutrients caused by urban runoff and storm sewers. For the Sawmill Run TMDL, only the portion above this impaired segment was used as the reference watershed, as was done for two similar Pennsylvania TMDLs for Marsh Run and McCarthy Run. It should also be noted that PADEP is currently conducting a pathogens study in the Little Pine Creek watershed. However, a potential pathogen impairment has no effect on sediment.

Table 5-1 summarizes important criteria considered in the selection of a reference watershed. Comparisons of key watershed characteristics are provided in the following sections.

Table 5-1: Criteria Used in Reference Watershed Selection

Criteria	Relevance
Watershed Size	The reference watershed should be similar in size to the impaired watershed since watershed area influences pollutant loading rates to the stream. In cases where there is a size difference, the reference watershed size must be adjusted.
Location	Close proximity to the impaired watershed generally improves overall watershed similarity.
Ecoregion	The reference and impaired watersheds should belong to the same ecoregion to help ensure similarities in stream ecology.

Table 5-1: Criteria Used in Reference Watershed Selection	
Criteria	**Relevance**
Land Uses	The selected reference watersheds should reflect similar land use distributions. The water quality of streams in a watershed is greatly influenced by land use. Similar land use distributions help to establish achievable TMDL endpoints.
Soils	Soil composition influences watershed runoff, erosion, and stream ecology.

Watershed Size

The Little Pine Creek watershed drains an area of approximately 1,525 acres, or 2 square miles. In comparison, the Sawmill Run Watershed drains 12,432 acres, or 19 square miles. Because the impaired watershed is over 8 times larger than the reference watershed, the reference watershed loads were area adjusted to be comparable to the Sawmill Run watershed (See Section 5.1.5).

Watershed Location

The reference watershed is located 11 miles north of Sawmill Run (**Figure 5-1**).

Ecoregion

Both the reference and impaired watersheds are located Western Allegheny Plateau ecoregion (Level III Ecoregion, classification 70) **(Figure 5-1)**.

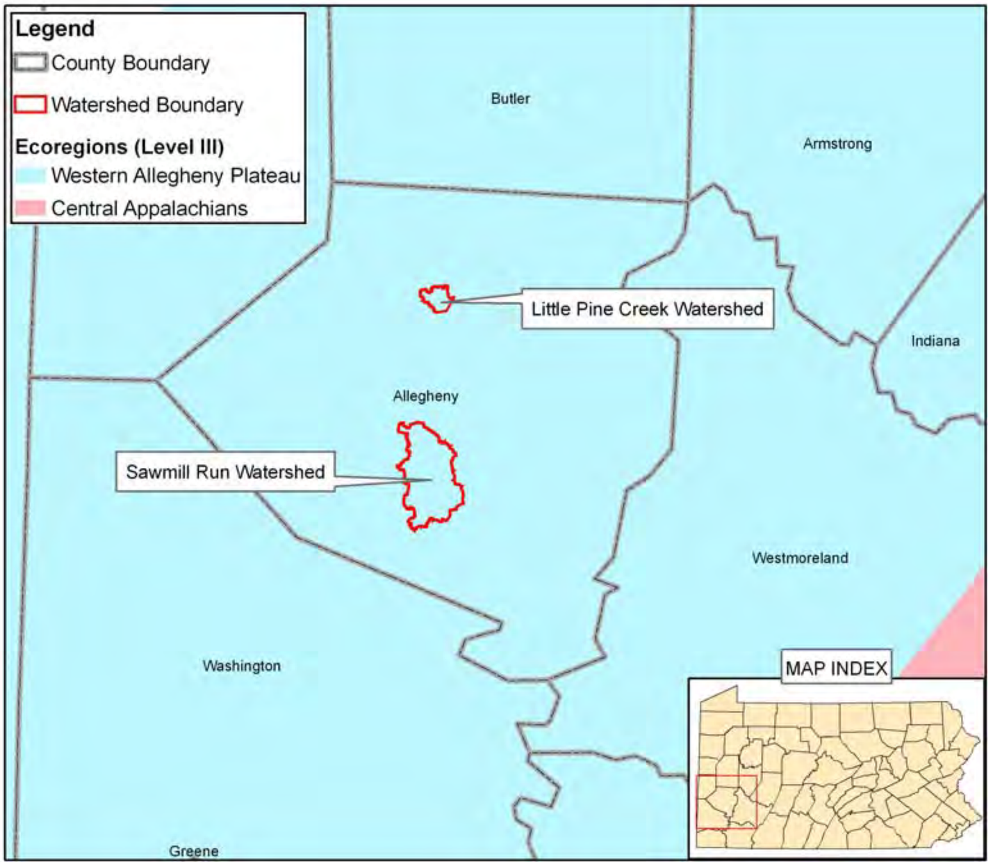


Figure 5-1: Location of the Sawmill Run and Little Pine Creek Watersheds

Land Use

Land-use distribution influences the hydrologic regime and amount of direct runoff in the watershed. **Table 5-2** shows the land use distributions in the Sawmill Run watershed and in the two proposed reference watersheds. The following observations can be made:

- The Little Pine Creek watershed has a large and comparable percentage of developed lands (41%) to the one in Sawmill Run (63%)
- The agricultural land proportions are comparable in Sawmill Run and Little Pine Creek (4% and 1% respectively).
- The forested land proportions are comparable in Sawmill Run and Little Pine Creek (33% and 44% respectively).

Table 5-2: Land-use Distributions in the Sawmill Run and Little Pine Creek Watersheds (Based on NLCD 1992)		
Land Use Category	**% of Total Watershed**	
	Sawmill Run (Impaired Watershed)	**Little Pine Creek (Reference Watershed)**
Forest	33	10
Agricultural	4	40
Developed	63	41
Water/Wetlands	< 1	< 1
Other	< 1	8
Total	**100**	**100**

Soil Distribution

Soil composition influences watershed runoff, erosion, and stream ecology. The soil types in the Little Pine Creek watershed consist of soils in hydrologic soil group C, which have moderate infiltration rates. In contrast, the majority of the soil types in the Sawmill Run watershed mostly consist of soils in hydrologic soil group B/C, which have moderate to slow infiltration rates that would allow for slightly more surface runoff (**Table 5-3**).

Table 5-3: Hydrologic Groups in Sawmill Run and Little Pine Creek		
Hydrologic Group	**% of Total Watershed**	
	Sawmill Run	**Little Pine Creek**
A	0 %	0 %
B	0 %	0%
B/C	80 %	0%
C	20 %	100 %
D	0 %	0 %

5.1.2 Sediment Source Assessment

Sediment can be delivered to a stream from point sources in the watershed and can be carried in the form of non-point source pollution in runoff generated from various sediment producing land uses. In addition, sediment can be generated within the stream as a result of channel scour and deposition processes. These processes are primarily a function of stream flow volumes and velocities, with higher flows and velocities producing greater levels of in-stream erosion and associated sediment. The eroded material is then deposited downstream as stream flow velocities decrease in larger slower stream reaches. These processes adversely impact water quality and degrade aquatic habitats.

Non-Point Sources

The erosion of land is dependent upon many factors including land use type and cover, soil type, and topography. The rate of delivery of this eroded material to streams (i.e. conversion of eroded material to sediment) can be directly correlated to the size of the watershed.

The land use types in the Sawmill Run watershed were characterized using NLCD (1992) data, while soil types were characterized using the STATSGO database. Erosion and associated sediment production from generalized land use types present in the Sawmill Run watershed are discussed below.

Forested Lands
Erosion and sediment production from forested lands is typically low due to extensive root systems and vegetative cover that serves to stabilize soils. In addition, forest canopies intercept rainfall and limit rainfall induced erosion and sediment production.

Agricultural lands
Erosion and sediment production from agricultural lands tend to be elevated due to the exposure of soil that occurs as a result of agricultural practices. Cropland and pastureland are two sources of elevated sediment loads.

Developed Lands
Developed lands consist of both pervious and impervious surfaces. Impervious surfaces are not subject to soil erosion, but sediment may be created through the washoff of solids deposited on impervious surfaces. In addition, elevated levels of uncontrolled stormwater runoff from developed lands contribute to stream bank erosion as discussed below.

Point Sources

Sediment loads attributed to point sources are derived from suspended solids that are present in discharge effluent. There are six permitted NPDES dischargers present in the Sawmill Run watershed. In addition, there are about 15 CSO outfalls associated with ALCOSAN.

Instream Bank Erosion

Sediment derived from instream bank erosion is also dependent upon numerous watershed characteristics. Land use types present in the watershed may affect hydrology of the watershed. In particular, developed lands may lead to increased stream flows that erode the stream channel and banks. Likewise, watersheds defined by steep topography may experience high levels of runoff that cause instream erosion. The level of instream erosion is also dependent on the erodibility of the soil, normally defined as the soil K factor.

5.1.3 Technical Approach for Estimating Sediment Loads

AVGWLF Model Description

For the purpose of TMDL development, annual sediment loads from land erosion were determined using the ArcView Generalized Watershed Loading Functions (AVGWLF) model. AVGWLF was developed by the Environmental Resources Research Institute of the Pennsylvania State University (Evans et al., 2006), and facilitates the use of the Generalized Watershed Loading Function (GWLF) model developed by Haith and Shoemaker (1987) via a GIS software interface.

GWLF is a time variable simulation model that simulates hydrology and sediment loads on a watershed basis. Observed daily precipitation data is required in GWLF as the basis for water budget calculations. Surface runoff, evapotranspiration, and groundwater flows are calculated based on user specified parameters. Stream flow is the sum of surface runoff and groundwater discharge. Surface runoff is computed using the Soil Conservation Service Curve Number Equation. Curve numbers are a function of soils and land use type. Evapotranspiration is dependent upon temperature, daylight hours, saturated water vapor pressure, and a cover coefficient. Groundwater discharge to the stream is described by a lumped parameter watershed water balance for unsaturated and shallow saturated water zones. Infiltration to the unsaturated zone occurs when precipitation exceeds surface runoff and evapotranspiration. Percolation to the shallow saturated zone occurs when the unsaturated zone capacity is exceeded. The shallow saturated zone is modeled as a linear reservoir to calculate groundwater discharge. In addition, the model allows for seepage to a deep saturated zone.

Erosion and sediment loading is a function of the land source areas present in the watershed. Multiple source areas may be defined based on land use type, the underlying soils type, and the management practices applied to the lands. The Universal Soil Loss Equation (USLE) is used to compute erosion for each source area and a sediment delivery ratio is applied to determine the sediment loadings to the stream. Sediment loadings from each source area are summed to obtain a watershed total.

Instream Erosion

Instream erosion was calculated in the AVGWLF model using an algorithm developed by Evans et al. (2006) that estimates stream bank erosion based on watershed characteristics. Using this method, a watershed-specific lateral erosion rate is calculated as follows:

$$LER = aQ^{0.6}$$

Where:
LER = an estimated lateral erosion rate, expressed as meters per month
a = an empirically-derived "erosion potential factor"
Q = monthly stream flow, expressed as cubic meters per second.

The 'a' factor is computed based on a wide variety of watershed parameters including the fraction of developed area in the watershed, average field slope, mean soil erodibility (K factor), average curve number value, and the mean livestock density for the watershed.

$$a = (0.00467*PD) + (0.000863*AD) - (0.000001*CN) + (0.000425*KF) + (0.000001*MS) - 0.000036$$

Where:
PD = fraction developed land
AD = animal density measured in animal equivalent units/acre
CN = area-weighted runoff curve number value
KF = area-weighted K factor
MS = mean field slope

The fraction of developed land in the impaired and reference watersheds was obtained from NLCD data (1992). All other input parameters were calculated in AVGWLF based on GIS data layers for Pennsylvania that were provided with the model. The mean soil erodibility K factor and mean field slope of the watersheds were computed from the STATSGO database contained in AVGWLF. The average watershed curve number was developed based on curve numbers applied in the model. Livestock densities for the watersheds were based on county livestock inventories. The ‘a’ factors for both the impaired and reference watersheds were computed.

LER values were calculated in AVGWLF using predicted stream flow from the model. Monthly sediment loads from stream bank erosion (kg/month) were then calculated as the product of the LER (meters/month), total stream length (meters), average stream bank height (meters), and average soil bulk density (kg/m^3). Total stream lengths for the impaired and reference watersheds were obtained from the 1:24,000 streams dataset contained in the AVGWLF model. The default model input of 1.5 m was used as the average stream bank height, and the default model value of 1500 kg/m^3 was used as the mean soil bulk density. Annual sediment loads from stream bank erosion were computed as the summation of monthly loads.

Point Source Load

Six permitted facilities are present in the Sawmill Run watershed, as shown in **Table 4-4**. For the purpose of TMDL development, the existing point source loads were computed by averaging monthly loading rates for TSS loads from recent (generally within the last 5 years) available discharge monitoring reports. All of the facilities have permits that are associated with stormwater and do not have reported design flows.

In addition, there are 47 combined sewer overflows that flow directly into Sawmill Run. At this time, there is no available data characterizing the flows and concentrations from these outfalls.

Table 5-4: Point Sources in the Sawmill Run Watershed

Permit Number	Discharger Name	Receiving Waterbody	TSS Load (Lbs/day)	TSS Load (ton/year)
PAR806118	Laid Law Transit Services	Sawmill Run	-	-
PAR236126	Parker Plastics Corporation	-	-	-
PAG056102	Cumberland Farms Inc	Sawmill Run	-	-
PAR226108	Lozier Corporation	Sawmill Run - Tri Ohio & Monongahela	-	-
PAG056204	Pit Stop Express	-	-	-
PAR806194	PA National Guard	-	-	-
Total			-	-

Municipal Separate Storm Sewer Systems (MS4 Permit Areas)

There are 14 Municipal Separate Storm Sewer Systems (MS4s) in the Sawmill Run watershed. These systems collect stormwater runoff and transfer this runoff and its associated sediment loads to streams. Although the loads associated with the storm sewer system inputs to the stream are primarily non-point source in origin, each MS4 area is covered under the NPDES Stormwater Phase II general permit and is therefore considered as a point source. However, there are currently no specific limits for TSS that each municipality is required to meet within the general permit. The sediment loads associated with MS4s were estimated using the AVGWLF model based on the sediment unit loads for each land use in the MS4 area. The sediment loads allocated to each MS4 area were included in the wasteload allocation component of the TMDL. **Table 4-5** reports the acreage and distribution of land uses in all 14 MS4 areas.

Table 5-5: Land Use Distribution in all Sawmill Run Creek MS4 Areas

Land Use Class	Sawmill Run Acreage	Acreage associated with MS4 areas
Hay/Pasture	541	541
Turf Grass	106	106
Low Intensity Residential	11,315	11,315
High Intensity Residential	440	440
Total	**12,402**	**12,402**

5.1.4 AVGWLF Model Development and Calibration

AVGWLF model simulations were performed for a 10-year period to account for both seasonal and annual variations in hydrology and sediment loading. AVGWLF was set up using the available rainfall data for the period of 1994 to 2004, and the existing watershed conditions. Models were developed for both the reference and impaired watersheds. Input parameters were computed from statewide datasets for Pennsylvania that were included with the AVGWLF model, as well as additional datasets such as the NLCD (2001) land use dataset. A complete list of the datasets used in the AVGWLF model is presented in **Table 5-6**.

Table 5-6: Description of Datasets Used to Generate Model Input Parameters

AVGWLF Dataset	Description
Animal densities	Mean livestock densities in Pennsylvania
Census data	Dataset providing U.S. Census data, including information on septic systems used to compute nutrient loading.
County	Contains county soils information, including conservation practices and input values for the Universal Soil Loss Equation (USLE).
Digital elevation model	100 meter DEM used to characterize topography.
Groundwater nitrogen	Grid of background nitrogen concentrations present in groundwater.
Land use	National Land Cover Data (NLCD).
Point sources	Coverage of permitted point source dischargers. Updated based on more detailed point source information provided by DEP.
Physiographic providences	Physiographic providences in Pennsylvania.
Roads	Major roads in watershed.
Soils	Generalized soils from the STATSGO database.
Soil phosphorus	Grid of phosphorus loads generated from soil sample data.
Streams	1:24,000 stream coverage for Pennsylvania.
Surface geology	Dataset of surface geology types.
Weather	Long-term weather data for 80 stations in Pennsylvania

Model Input Parameters

The AVGWLF model requires specification of input parameters relating to climate, hydrology, erosion, and sediment yield. These parameters are automatically computed in AVGWLF using the input datasets described above.

Runoff curve numbers and USLE erosion factors are specified by AVGWLF as an average value for a given source area. These source areas are defined by the land use types present in the impaired and reference watersheds. Land use data from the Multi-Resolution Land Characteristic (MRLC) dataset (1992) is provided along with the AVGWLF model and is automatically used for the identification and tabulation of different source areas.

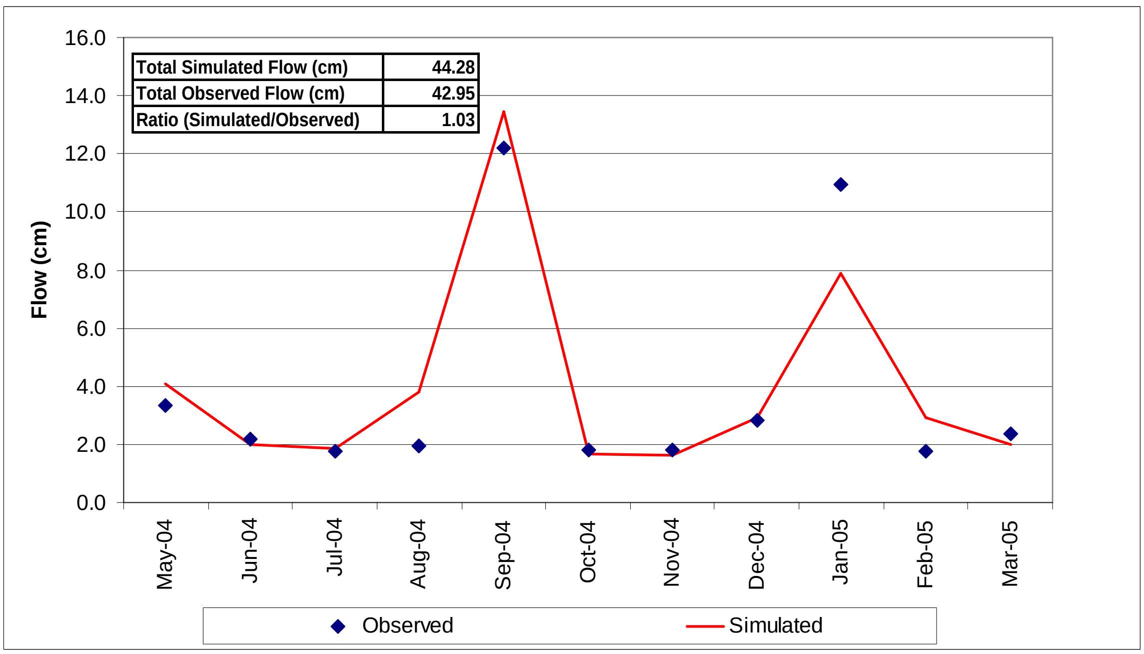
The GWLF model was originally developed as a planning tool for estimating nutrient and sediment loadings on a watershed basis. Designers of the model intended it to be implemented without calibration. Precipitation data from the National Climate Data Center weather station, PITTSBURGH WSCOM 2 AP, for the period of 1995 to 2005 was used in the model. Area-weighted evapotranspiration cover coefficients were developed for each model source area in the AVGWLF model based on values suggested in Evans *et al.* (2006).

The STATSGO soils dataset was used by AVGWLF to examine soil properties for each model source area. USLE factors for soil erodibility (K), length-slope (LS), cover and management (C), and supporting practice (P) were derived from multiple data sources contained in the AVGWLF model, such as the STATSGO soil database, digital elevation models, and county-specific information. The sediment delivery ratio was applied directly by AVGWLF, and was based on the sizes of the watersheds.

5.1.5 Hydrology Calibration

GWLF was originally developed as a planning tool for estimating nutrient and sediment loadings on a watershed basis. Although the designers of the model did not intend the model to be calibrated for use, comparisons should be made between predicted and observed stream flow to ensure an adequate hydrologic simulation in Sawmill Run.

USGS Station 03085213 located at the outlet of the watershed was selected for the hydrology calibration. This station is currently active and has been recording discharge measurements in Sawmill Run since May 2004; therefore flow from May 2004 to March 2005; the most recent observed flow data; was used as a calibration period for the hydrology simulation in Sawmill Run. GWLF parameters relating to hydrology were calibrated based on the flow data collected at station 03085213. The groundwater seepage coefficient and the unsaturated zone available water capacity were adjusted to obtain a best fit with observed data. A visual comparison between observed and predicted flow (May 2004 – March 2005) is shown for Sawmill Run (**Figure 5-2**). The results of the hydrology calibration indicate a good fit between observed and simulated values. In



addition, the **Figure 5-2: Hydrology Calibration Results for Sawmill Run (May 2004 to March 2004)**

total simulated streamflow volume is within 3 percent of total observed annual streamflow (**Figure 5-2**). In addition, the robustness of the calibration is verified by a coefficient of determination (R^2) value of 0.758 (**Figure 5-3**).

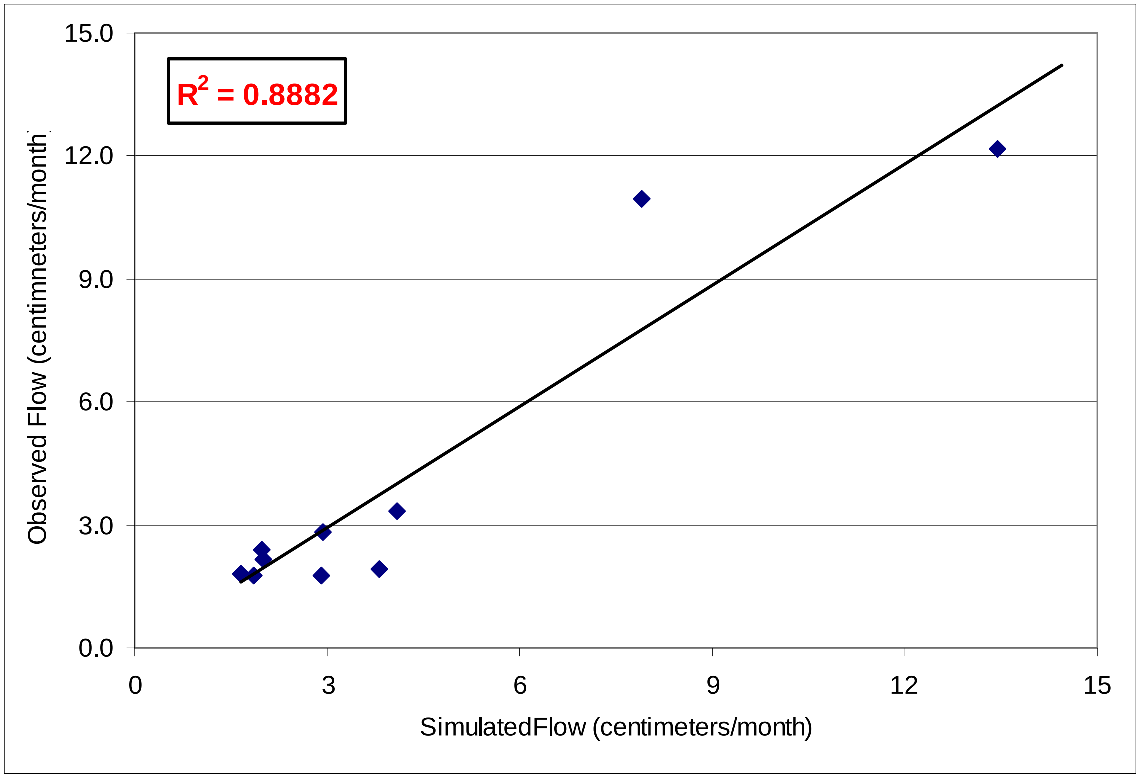


Figure 5-3: Regression between Monthly Observed and Simulated Flows (May 2004 to March 2005)

5.1.6 Sediment Load Estimates

Sediment Loads from Non-point Sources

The AVGWLF model was used to estimate sediment loadings from each source area (land use type) in the impaired and reference watersheds. Based on a 10-year simulation period, average annual sediment loads were computed for each land source in each watershed.

Because of size differences between the impaired and reference watersheds, source area acreages and associated sediment loads were proportionately adjusted to allow for comparability between the two watersheds **Table 5-7**. The size adjustment required increasing the reference watershed area by roughly 8 times while preserving the land use distribution in the watershed.

Table 5-7: Modeled Sediment Loading from Land Sources in the Sawmill Run and Little Pine Creek (Area Adjusted) watersheds

Land Use Class	Sawmill Run Acreage	Sawmill Run Existing Loads (tons/yr)	Little Pine Creek Acreage	Little Pine Creek Existing Load (tons/yr)	Little Pine Creek Adjusted Acreage	Little Pine Creek (Area-adjusted) Existing Load (tons/yr)
Hay/Pasture	541	52.5	195	6.2	1,601	50.6
Turf Grass	106	14.3	-	-	-	-
Low Intensity Development	11,315	499.5	1,295	35.4	10,618	290.2
High Intensity Development	440	2.1	22	0.4	183	3.6
Total	**12,402**	**568.4**	**1,512**	**42.0**	**12,402**	**344.4**

Sediment Loads from Instream Erosion

Instream erosion was estimated in AVGWLF based on the stream bank lateral erosion rate equation introduced by Evans et al. (2003), as described in Section 4.1.3. Instream erosion estimates generated by the AVGWLF model are largely influenced by stream flow. To generate accurate instream erosion estimates, the AVGWLF model was setup and run for the entire Sawmill Run basin. In this way, the total stream flow flowing through Sawmill Run was considered, and accurate instream sediment loading estimates were developed for the watershed.

Annual sediment loads from stream bank erosion are presented in **Table 5-8**.

Table 5-8: Annual Instream Erosion Estimates for the Sawmill Run and Little Pine Creek watersheds

Watershed	Instream Erosion (tons/year)
Sawmill Run	1,859.3
Little Pine Creek	129.4
Little Pine Creek (Area Adjusted)	461.4

5.1.7 Existing Sediment Loadings – All Sources

In summary, average annual sediment loads for the Sawmill Run and Little Pine Creek (reference) watersheds were determined as follows:

- Erosion and sediment yield from land sources were modeled using AVGWLF.
- Instream bank erosion was computed in AVGWLF based on the method described by Evans et al. (2003).
- Sediment loads from point sources were calculated based on the permitted total suspended solids loading rate for each facility.

Results for all sources are summarized in **Table 5-9**. The total existing sediment load in the Sawmill Run watershed is 2,536.5 tons per year, compared to the reference watershed's load of 805.8 tons per year. The majority of the sediment load in the Sawmill Run watershed is derived from instream erosion, which is primarily a function of stream flow.

Table 5-9: Existing Sediment Loads in the Sawmill Run and Little Pine Creek Watersheds

Source	Land Use Class	Sawmill Run Existing Load (ton/yr)	TMDL Endpoint Load (ton/yr)
Land Sources	Hay/Pasture	2.19	1.095
	Turf Grass	499.68	258.42
	Low Intensity Development	52.56	27.01
	High Intensity Development	14.23	7.3
CSOs	-	108.9	56.21
Instream Erosion	-	1,859.3	374.86
Total		**2,536.5**	**725.26**

5.2 Sediment TMDL Allocation

The purpose of allocating the TMDL load is to identify the pollutant load reductions required from each source to achieve water quality standards. Reduction of sediment loads from each source in the impaired watershed to cumulatively meet the TMDL endpoint load is expected to ensure that Sawmill Run meets water quality standards and restore its designated uses.

5.2.1 Basis for TMDL Allocations

Sediment TMDL allocations for Sawmill Run were based on the following equation:

$$TMDL = WLA + LA + MOS$$

Where:
TMDL= Endpoint Sediment Load Based on Reference Watershed
WLA = Wasteload Allocation
LA = Load Allocation
MOS = Margin of Safety

The wasteload allocation (WLA) represents the total sediment loading allocated to point sources. The load allocation (LA) represents the total sediment loading allocated to non-point sources. The margin of safety (MOS) is a required TMDL element designed to account for uncertainties in the calculation of the TMDL.

5.2.1.1. Margin of Safety

An explicit MOS of 10% was used in the TMDL allocation for Sawmill Run to account for uncertainties associated with calculation of the TMDL sediment load. The use of a 10% MOS is consistent with previous TMDLs developed in Pennsylvania, and is appropriate to account for uncertainties associated with planning level water quality models such as AVGWLF. Based on this rationale, a total of 80.6 tons/year were allocated as a MOS for the Sawmill Run TMDL.

5.2.1.2. Wasteload Allocation

The wasteload allocated to a point source was determined based on each facility's permitted TSS discharge limit and its reported design flow (**Table 5-10)**. Wasteload allocations calculated in this manner ensure that the sediment load that facilities are legally allowed to discharge to Sawmill Run are taken into account for TMDL allocation.

At this time, there is no available data characterizing the flow and concentrations from the combined sewer overflows (CSOs). In order to simulate the CSO overflow in Sawmill Run, a specific CSO land-use was added to the AVGWLF input file. The drainage area covered by the CSO was taken proportionally from the low and high intensity development land uses, and iteratively adjusted until the total average CSO runoff volume was approximately 30% of the total runoff volume from low and high intensity development (Novonoty, 2003).

Table 5-10: Wasteload Allocation for Permitted Facilities on Sawmill Run

Facility Name	NPDES Permit Number	Receiving Waters	Allocated Load (tons/yr)
Laid Law Transit Services	PAR806118	Sawmill Run	-
Parker Plastics Corporation	PAR236126	-	-
Cumberland Farms Inc	PAG056102	Sawmill Run	-
Lozier Corporation	PAR226108	Sawmill Run - Tri Ohio & Monongahela	-
Pit Stop Express	PAG056204	-	-
PA National Guard	PAR806194	-	-
Combined Sewer Overflows*	-	Sawmill Run	56.3
Total			**56.3**

* No data available for Combined Sewer Overflows

5.2.1.3. Load Allocation

Because the watershed is entirely within MS4 areas and MS4 areas are permitted, there is no load allocation for this TMDL.

Municipal Separate Storm Sewer Systems (MS4)

As shown in Section 2, there are fourteen (14) MS4 areas in the Sawmill Run watershed. Sediment load from these MS4 areas originates from both non-point sources and instream erosion processes. Because MS4 areas are permitted, the sediment loads associated with these areas are formally considered within the TMDL allocation under the WLA component of the TMDL.

To allocate the portions of the TMDL load to the MS4 areas and associated instream erosion processes, loads were calculated based on the proportion of the watershed occupied by each MS4 area (see below).

$$\frac{\textit{MS4 Area in the Watershed}}{\textit{Total Watershed Area}} \times \textit{Sediment Load}$$

Once the sediment load associated with each MS4 area was calculated, the reductions determined by the Equal Marginal Percent Reduction (EMPR) method was used to distribute the WLA to each source area within each MS4 area. **Figure 5-4** provides a graphical representation of the entire EMPR method. A more detailed explanation of the EMPR method can be found in Appendix C.

A reduction of the sediment load from land sources by 48.3% and instream sources by 79.8% in all MS4 areas would be needed to meet the TMDL. Appendix D shows the sediment load allocation for each individual MS4 area. **Table 5-11** and **Table 5-12** shows the total MS4 sediment load allocations for each of the land sources and the municipalities.

Table 5-11: Sawmill Run MS4 Wasteload Allocation Summary

Land Source	Existing Load (tons/yr)	Allocated Load (tons/yr)	Reduction (%)
Hay/Pasture	2.19	1.095	48.3%
Turf Grass	499.68	258.42	48.3%
Low Intensity Development	52.56	27.01	48.3%
High Intensity Development	14.23	7.3	48.3%
Instream Erosion	1,859.3	374.86	79.8%
TOTAL	**2,427.6**	**668.9**	71.4%

Table 5-12: Sawmill Run MS4 Wasteload Allocation Summary			
Municipality	**Existing Load (tons/yr)**	**Allocated Load (tons/yr)**	**Percent Reduction**
Baldwin Borough	1.1	0.3	72.1%
Baldwin Township	62.5	17.3	72.4%
Bethel Park Borough	119.0	32.6	72.6%
Brentwood Borough	73.7	20.3	72.5%
Castle Shannon Borough	191.8	51.9	73.0%
Crafton Borough	0.3	0.1	72.7%
Dormont Borough	92.2	24.5	73.4%
Green Tree Borough	55.4	14.8	73.2%
Ingram Borough	0.3	0.1	72.7%
Mt. Lebanon Township	297.8	84.1	71.8%
Mt. Oliver Borough	5.6	1.5	72.7%
Pittsburgh City	1,299.6	357.8	72.5%
Scott Township	7.7	2.1	72.6%
Whitehall Borough	220.6	61.4	72.2%
TOTAL	**2,427.6**	**668.9**	**72.4%**

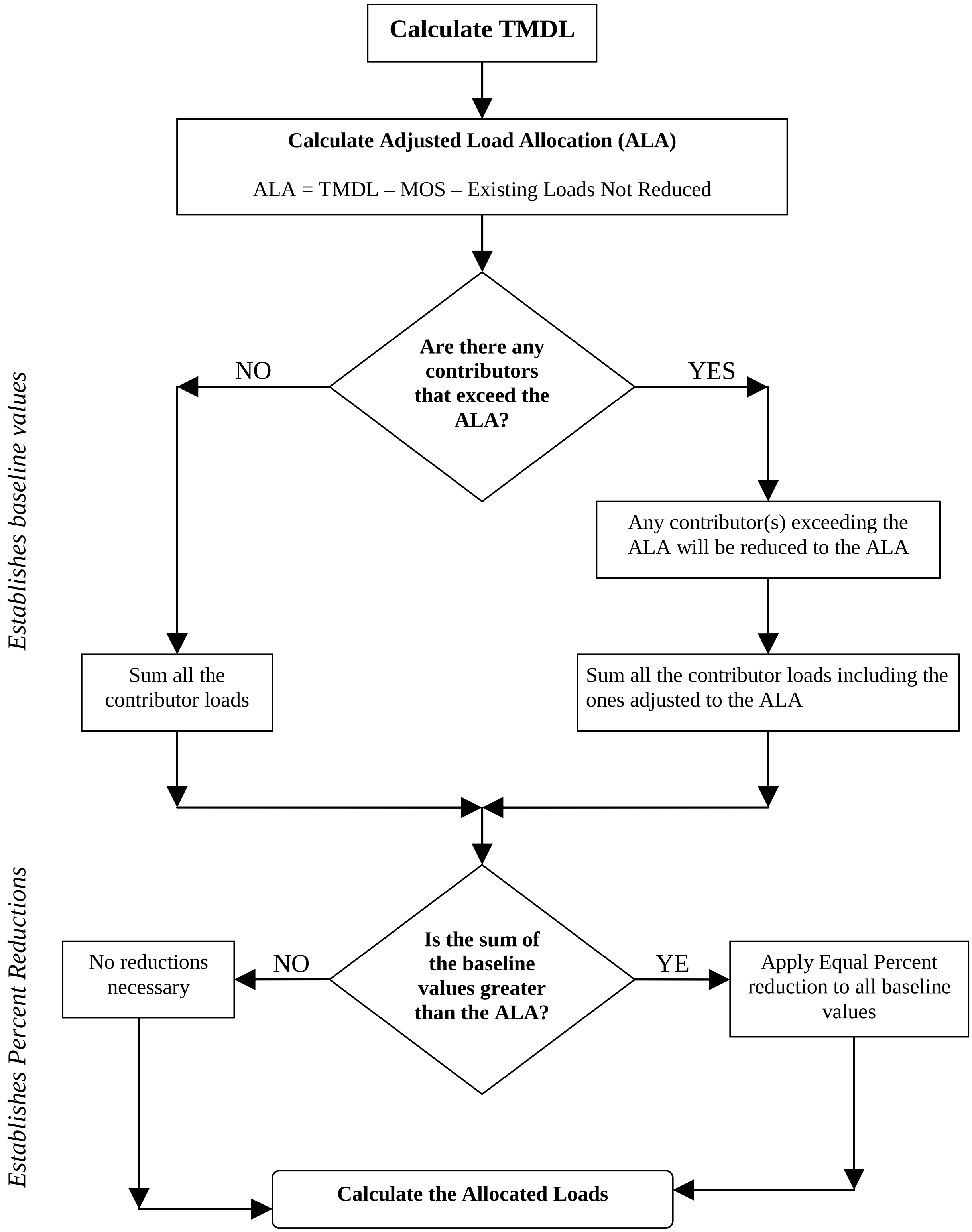


Figure 5-4: Flow Chart of the EMPR Method

5.2.2 Overall Recommended TMDL Allocations

The load and wasteload allocations and margin of safety for the Sawmill Run sediment TMDL are summarized in **Table 5-13**. The recommended daily allocations (tons/day) for each source in the Sawmill Run watershed are provided in **Table 5-14**. Overall, the sediment loads in Sawmill Run must be reduced by 69.8% to meet the sediment TMDL endpoints.

Table 5-13: Sediment TMDL for Sawmill Run (tons/year)

TMDL	Load Allocation	Wasteload Allocation *(Includes permitted facilities and MS4 areas)*	Margin of Safety (10%)
805.8	0	725.2	80.6

Table 5-14: Recommended TMDL Allocations for Sawmill Run

Source	Land Use Type	Average Annual Sediment Load (tons/day)		Reduction (%)
		Existing	Allocated	
Nonpoint sources	Low Intensity Development	0	0	0
	High Intensity Development	0	0	0
	Turf Grass	0	0	0
	Hay/Pasture	0	0	0
	Instream Erosion	0	0	0
MS4	Low Intensity Development	0.144	0.074	48.3%
	High Intensity Development	0.039	0.020	48.3%
	Turf Grass	1.369	0.708	48.3%
	Hay/Pasture	0.006	0.003	48.3%
	Instream Erosion	5.094	1.027	79.8%
CSOs	-	0.298	0.154	48.3%
Total		**6.949**	**1.987**	**69.8%**

5.2.3 Consideration of Critical Conditions

EPA regulations at 40 CFR 130.7 (c) (1) requires TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that designated uses are protected throughout the year, including vulnerable periods.

In the case of Sawmill Run, a primary stressor pollutant in the streams is excessive sediment loading. Since sediment loading occurs throughout the year and its impacts are often a function of cumulative loading rather than particular events, it is appropriate to consider sediment loading an annual basis. Therefore, TMDL allocations were developed based on average annual loads determined from the 10-year simulation period used in the AVGWLF model.

5.2.4 Consideration of Seasonal Variability

Seasonal variations involve changes in stream flow and sediment loading as a result of hydrologic and climatologically patterns. Seasonal variations were explicitly incorporated in the modeling approach for these TMDLs. AVGWLF is a continuous simulation model that incorporates seasonal variations in hydrology and sediment loading by using a daily time-step for water balance calculations. Therefore, the 10-year simulation performed with AVGWLF adequately captures seasonal variations.

6.0 Reasonable Assurance and Public Participation

There is reasonable assurance that the goals of these TMDLs can be met with proper watershed planning, implementation of pollution reduction best management practices (BMPs), and strong political and financial mechanisms. Reasonable assurance that the TMDLs established will require a comprehensive, adaptive approach that addresses:

- non-point source pollution and stream bank erosion,
- existing and future sources,
- regulatory and voluntary approaches.

TMDLs represent an attempt to quantify the pollutant load that may be present in a waterbody and still ensure attainment and maintenance of water quality standards. The Sawmill Run TMDLs identify the necessary overall load reductions for AMD, sediment, and nutrients currently causing use impairments and distributes those reduction goals to the appropriate sources. Reaching the reduction goals established by these TMDLs will only occur through changes in current land use practices, including the incorporation of best management practices (BMPs). Additionally, federal regulations at 40 CFR 122.44 require NPDES permit effluent limits to be consistent with the assumptions and requirements of the approved WLA.

6.1 *Best Management Practices*

Best management practices (BMPs) are methods and practices for preventing or reducing non-point source pollution to a level compatible with water quality goals. BMPs can be classified as structural, vegetative, or management, and each class is somewhat more effective in controlling certain types of diffuse pollution than others (Novotny and Olem, 1994). BMPs can be selected either to control a known type of pollution, or to prevent pollution from certain land use activities. The following approach has been suggested by Novotny and Olem (1994) when selecting BMPs to address water quality problems:

- Identify the water quality problem
- Identify the pollutants contributing to the problem and their probable sources
- Determine the dominant method of pollutant delivery to the water
- Set a reasonable water quality goal and determine the level of treatment needed to meet that goal
- Evaluate feasible BMPs for water quality effectiveness, effect on groundwater, economic feasibility, and site suitability.

6.1.1 AMD Best Management Practices

Implementation of the AMD TMDL will contribute to PADEP's on-going water quality improvement efforts aimed at resorting areas effected by acid mine drainage through efforts to reclaim abandoned mine lands along with the issuing NPDES permits. In addition, the PADEP Bureau of Mining and Reclamation administers an environmental regulatory program for all mining activities, mine subsidence regulation, mine subsidence insurance, and coal refuse disposal. The responsibilities of PADEP Bureau of Mining and Reclamation's regulation program include administration of a mining license and permit program, a loan program for bonding anthracite underground mines, and the EPA watershed Assessment Grant Program as well as other programs.

By instituting mine reclamation and well plugging efforts, the effects on water quality can be reduced and the land can be returned to a productive condition. Since the 1960s, Pennsylvania has been a national leading in establishing laws and regulations to ensure reclamation and plugging occurs after mining operations are completed. In order to make reclamation easier, PADEP has developed concepts collectively entitled Reclaim PA and includes legislation and policy land management initiatives. Reclaim PA has the following objectives: encourage private and public participation in abandoned mine reclamation efforts, improve reclamation efficiency through improved communication between reclamation partners, increase reclamation by reducing remining risks, and maximize reclamation funding by expanding existing sources and finding new sources.

6.1.2 Sediment Best Management Practices

By developing a sediment TMDL for the Sawmill Run watershed, the stage has been set for local citizens to design and implement watershed restoration plans based on the reduction goals specified in the TMDLs. Individuals and/or local watershed groups interested in helping to solve the identified problems in the Sawmill Run watershed are strongly encouraged to avail themselves of funding sources available through PADEP and other state and federal agencies.

The relative contribution of sediment varies throughout the watershed according to the distribution of land use sources such as row crop and pasture lands. Implementation of best management practices in the watershed should reduce the non-point source loads of sediment to levels that achieve the loading reduction goals established in the TMDL. Efforts must also be taken to control future potential sources of sediment as new construction and redevelopment occurs. Because of the complexity of the problem and the potential solutions, an adaptive approach will be needed to achieve the TMDL.

The analyses discussed previously in this report have served to identify the sediment sources present in Sawmill Run. The water quality goals for sediment have also been established for this stream, as have the load reductions necessary for Sawmill Run to attain its designated uses. There are many BMPs that may be considered in the implementation phase of the Sawmill Run Sediment TMDL in order to achieve the TMDL water quality goals. **Table 7-1** provides examples of common BMPs for sediment.

Table 6-1: Examples of Common Best Management Practices for Sediment

Pollutant	Best Management Practices		
	Structural	**Vegetative**	**Management**
Sediment	Terraces	Crop cover	Contour farming
	Stream bank protection	Crop rotation	Riparian area protection
	Stream bank stabilization	Conservation tillage	Livestock management

	Sediment basins	Filter strips	Range management
		Grassed waterways	
		Field borders	

6.2 *Implementation of Best Management Practices*

Implementation of best management practices (BMPs) should eventually achieve the loading reduction goals established in these TMDLs. Further ground-truthing should be performed in order to determine the most cost-effective and environmentally protective combination of BMPs required for meeting the reductions outlined in this report.

6.3 *Implementation Funding Sources*

Potential funding mechanisms for implementation include federal grants (i.e., CWA Section 104(b)(3), CWA Section 319, State Revolving Fund), and state grants (i.e., Growing Greener, PENNVEST). EPA funds are available through Pennsylvania under CWA Section 319 or the Non-point Source Program to fund some projects. Also the PA DEP's Bureau of Mining offers grant programs to fund mine reclamation efforts.

Public Participation

Federal regulations require that there is a public participation process as part of the TMDL development process. The public comment period for this TMDL began on February 8, 2007 and closed March 9, 2007. A public notice was published in *The Pittsburgh-Post Gazette* on February 2, 2007.

During this time, EPA welcomed input from interested parties and the general public on the proposed TMDL document. The TMDL report was available at the EPA Region III office or website (http://www.epa.gov/reg3wapd/tmdl). EPA received no comments.

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Appendix A. Water Quality Data

Appendix A provides the following data used for completing the AMD, sediment, and nutrient TMDL for the Sawmill Run watershed:

- Flow observed by USGS
- Water Quality observed by PADEP (Dry and wet weather, sonde measurements)
- AMD Measurements collected by PADEP

Table A-1 Flow at USGS Gage 03085213 at Sawmill Run, PA between May 2004 and March

Date	Flow (cfs)	Date	Flow (cfs)	Date	Flow (cfs)	Date	Flow (cfs)	Date	Flow (cfs)	Date	Flow (cfs)
1-May	13.0	1-Jul	7.1	1-Sep	7.4	1-Nov	6.7	1-Jan	11.0	1-Mar	20.0
2-May	16.0	2-Jul	8.8	2-Sep	7.0	2-Nov	25.0	2-Jan	10.0	2-Mar	14.0
3-May	12.0	3-Jul	8.2	3-Sep	7.3	3-Nov	15.0	3-Jan	124.0	3-Mar	12.0
4-May	11.0	4-Jul	7.8	4-Sep	11.0	4-Nov	14.0	4-Jan	34.0	4-Mar	13.0
5-May	11.0	5-Jul	8.7	5-Sep	7.3	5-Nov	10.0	5-Jan	628.0	5-Mar	13.0
6-May	11.0	6-Jul	6.6	6-Sep	7.0	6-Nov	7.1	6-Jan	674.0	6-Mar	17.0
7-May	30.0	7-Jul	9.1	7-Sep	48.0	7-Nov	7.4	7-Jan	122.0	7-Mar	27.0
8-May	11.0	8-Jul	7.6	8-Sep	573.0	8-Nov	7.6	8-Jan	169.0	8-Mar	47.0
9-May	9.7	9-Jul	7.5	9-Sep	166.0	9-Nov	6.9	9-Jan	187.0	9-Mar	17.0
10-May	9.1	10-Jul	6.3	10-Sep	20.0	10-Nov	6.3	10-Jan	204.0	10-Mar	15.0
11-May	8.7	11-Jul	7.3	11-Sep	16.0	11-Nov	6.0	11-Jan	239.0	11-Mar	23.0
12-May	8.5	12-Jul	20.0	12-Sep	12.0	12-Nov	39.0	12-Jan	165.0	12-Mar	21.0
13-May	9.5	13-Jul	20.0	13-Sep	10.0	13-Nov	9.4	13-Jan	69.0	13-Mar	15.0
14-May	12.0	14-Jul	13.0	14-Sep	9.5	14-Nov	8.5	14-Jan	168.0	14-Mar	13.0
15-May	15.0	15-Jul	7.5	15-Sep	8.8	15-Nov	8.3	15-Jan	48.0	15-Mar	12.0
16-May	9.8	16-Jul	6.9	16-Sep	9.3	16-Nov	8.2	16-Jan	38.0	16-Mar	11.0
17-May	8.7	17-Jul	9.7	17-Sep	1740.0	17-Nov	9.1	17-Jan	28.0	17-Mar	8.9
18-May	113.0	18-Jul	15.0	18-Sep	532.0	18-Nov	11.0	18-Jan	23.0	18-Mar	9.4
19-May	102.0	19-Jul	8.4	19-Sep	99.0	19-Nov	108.0	19-Jan	25.0	19-Mar	9.8
20-May	18.0	20-Jul	5.8	20-Sep	48.0	20-Nov	26.0	20-Jan	19.0	20-Mar	14.0
21-May	210.0	21-Jul	4.2	21-Sep	24.0	21-Nov	11.0	21-Jan	16.0	21-Mar	8.9
22-May	103.0	22-Jul	6.7	22-Sep	20.0	22-Nov	12.0	22-Jan	14.0	22-Mar	8.2
23-May	24.0	23-Jul	8.7	23-Sep	17.0	23-Nov	9.3	23-Jan	10.0	23-Mar	44.0
24-May	17.0	24-Jul	5.8	24-Sep	14.0	24-Nov	41.0	24-Jan	9.5	24-Mar	17.0
25-May	16.0	25-Jul	6.9	25-Sep	13.0	25-Nov	17.0	25-Jan	13.0	25-Mar	14.0
26-May	36.0	26-Jul	198.0	26-Sep	11.0	26-Nov	10.0	26-Jan	15.0	26-Mar	11.0
27-May	17.0	27-Jul	27.0	27-Sep	9.4	27-Nov	13.0	27-Jan	9.3	27-Mar	19.0
28-May	38.0	28-Jul	13.0	28-Sep	9.6	28-Nov	33.0	28-Jan	9.4	28-Mar	143.0
29-May	14.0	29-Jul	11.0	29-Sep	7.6	29-Nov	15.0	29-Jan	11.0	29-Mar	46.0
30-May	13.0	30-Jul	9.6	30-Sep	6.5	30-Nov	17.0	30-Jan	14.0	30-Mar	20.0
31-May	28.0	31-Jul	26.0	1-Oct	6.4	1-Dec	211.0	31-Jan	11.0	31-Mar	16.0
1-Jun	17.0	1-Aug	11.0	2-Oct	6.8	2-Dec	19.0	1-Feb	11.0		
2-Jun	16.0	2-Aug	11.0	3-Oct	5.4	3-Dec	14.0	2-Feb	9.8		
3-Jun	20.0	3-Aug	9.9	4-Oct	4.7	4-Dec	11.0	3-Feb	7.7		
4-Jun	11.0	4-Aug	23.0	5-Oct	3.5	5-Dec	9.9	4-Feb	8.1		
5-Jun	24.0	5-Aug	17.0	6-Oct	2.1	6-Dec	9.7	5-Feb	8.3		
6-Jun	13.0	6-Aug	9.5	7-Oct	2.2	7-Dec	32.0	6-Feb	9.2		
7-Jun	12.0	7-Aug	9.5	8-Oct	2.6	8-Dec	12.0	7-Feb	9.9		
8-Jun	11.0	8-Aug	8.7	9-Oct	2.5	9-Dec	79.0	8-Feb	14.0		
9-Jun	12.0	9-Aug	6.4	10-Oct	2.3	10-Dec	33.0	9-Feb	43.0		
10-Jun	13.0	10-Aug	6.3	11-Oct	2.2	11-Dec	19.0	10-Feb	19.0		
11-Jun	70.0	11-Aug	7.7	12-Oct	2.9	12-Dec	15.0	11-Feb	8.1		
12-Jun	15.0	12-Aug	13.0	13-Oct	27.0	13-Dec	13.0	12-Feb	5.6		
13-Jun	12.0	13-Aug	9.0	14-Oct	8.5	14-Dec	11.0	13-Feb	4.6		
14-Jun	87.0	14-Aug	8.7	15-Oct	36.0	15-Dec	12.0	14-Feb	109.0		
15-Jun	43.0	15-Aug	7.3	16-Oct	10.0	16-Dec	12.0	15-Feb	22.0		

Table A-1 Flow at USGS Gage 03085213 at Sawmill Run, PA between May 2004 and March											
16-Jun	20.0	16-Aug	8.3	17-Oct	5.2	17-Dec	11.0	16-Feb	19.0		
17-Jun	26.0	17-Aug	7.6	18-Oct	122.0	18-Dec	11.0	17-Feb	7.8		
18-Jun	23.0	18-Aug	10.0	19-Oct	40.0	19-Dec	14.0	18-Feb	5.8		
19-Jun	14.0	19-Aug	93.0	20-Oct	14.0	20-Dec	11.0	19-Feb	4.9		
20-Jun	13.0	20-Aug	82.0	21-Oct	7.1	21-Dec	12.0	20-Feb	27.0		
21-Jun	12.0	21-Aug	53.0	22-Oct	6.6	22-Dec	13.0	21-Feb	35.0		
22-Jun	43.0	22-Aug	10.0	23-Oct	6.3	23-Dec	113.0	22-Feb	16.0		
23-Jun	11.0	23-Aug	8.5	24-Oct	30.0	24-Dec	18.0	23-Feb	13.0		
24-Jun	11.0	24-Aug	7.8	25-Oct	6.8	25-Dec	15.0	24-Feb	17.0		
25-Jun	11.0	25-Aug	7.5	26-Oct	6.1	26-Dec	14.0	25-Feb	17.0		
26-Jun	9.8	26-Aug	23.0	27-Oct	5.7	27-Dec	12.0	26-Feb	13.0		
27-Jun	9.0	27-Aug	15.0	28-Oct	5.4	28-Dec	11.0	27-Feb	11.0		
28-Jun	18.0	28-Aug	17.0	29-Oct	107.0	29-Dec	11.0	28-Feb	30.0		
29-Jun	11.0	29-Aug	24.0	30-Oct	17.0	30-Dec	11.0				
30-Jun	9.4	30-Aug	17.0	31-Oct	9.6	31-Dec	11.0				
		31-Aug	7.8								

Table A-2 PADEP: Water Quality Measurements for Nutrient TMDL in Sawmill Run collected on August 8, 2006

Station	Alk	TDS	TOC	TSS	$CBOD_5$	$CBOD_{20}$	NO_2-N	NO_3-N	NH_3-N	TN	TP	Diss PO_4-P	Diss P	Tot PO_4-P
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
SMR_01	85.4	978	-	16	1.7	5	0.01	0.66	0.15	1.15	0.056	0.033	0.042	0.037
SMR_02	61.8	862	-	20	1.2	2.1	<0.01	0.77	0.04	0.97	0.032	0.016	0.019	0.017
SMR_05		1208	-	56	18	23	0.04	0.21	1.73	2.93	0.192	0.010	<0.01	<0.01
SMR_06	118.6	834	-	16	1.4	1.7	0.07	0.72	0.06	1.02	0.060	0.032	0.044	0.037
SMR_07	175.8	994	-	22	2.1	3.4	0.01	0.35	0.05	0.66	0.058	0.025	0.034	0.024

Table A-3 PADEP: Water Quality Measurements for Nutrient TMDL in Sawmill Run collected on September 18, 2006

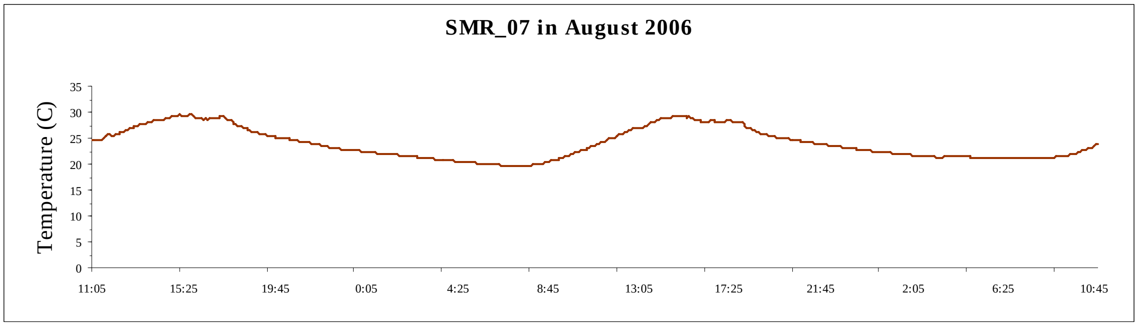
Station	Alk	TDS	TOC	TSS	$CBOD_5$	$CBOD_{20}$	NO_2-N	NO_3-N	NH_3-N	TN	TP	Diss PO_4-P	Diss P	Tot PO_4-P
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
SMR_01	103	888	2.23	<0.5	1.8	1.4	<0.01	0.82	<0.02	0.99	0.02	0.014	0.019	0.016
SMR_01[1]	104.2	922	-	<0.5	2	<0.5	<0.01	0.81	<0.02	0.98	0.021	0.015	0.019	0.017
SMR_02	81.2	812	2.13	<0.5	2.2	1.2	0.02	0.99	0.03	1.28	0.031	0.013	0.02	0.019
SMR_05	5.4	978	1.61	16	3.6	3.2	0.02	0.32	0.91	1.46	0.045	<0.01	<0.01	<0.01
SMR_06	152.8	1.05	1.24	0.98	2.35	<0.5	0.051	0.04	0.01	922	0.037	0.039	<0.01	2
SMR_07	202	956	2.57	2	2.8	1.1	<0.01	1.24	<0.02	1.46	0.055	0.048	0.056	0.048

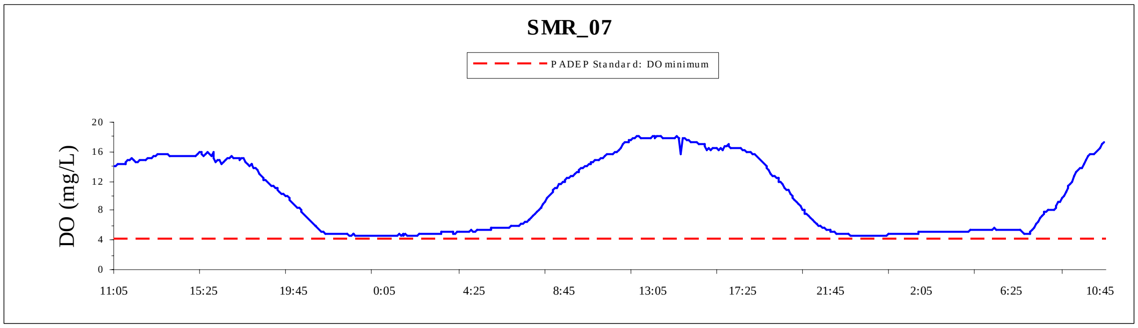
Alk Alkalinity; TDS Total Dissolved Solids; TOC Total Organic Carbon; TSS Total Suspended Solids;

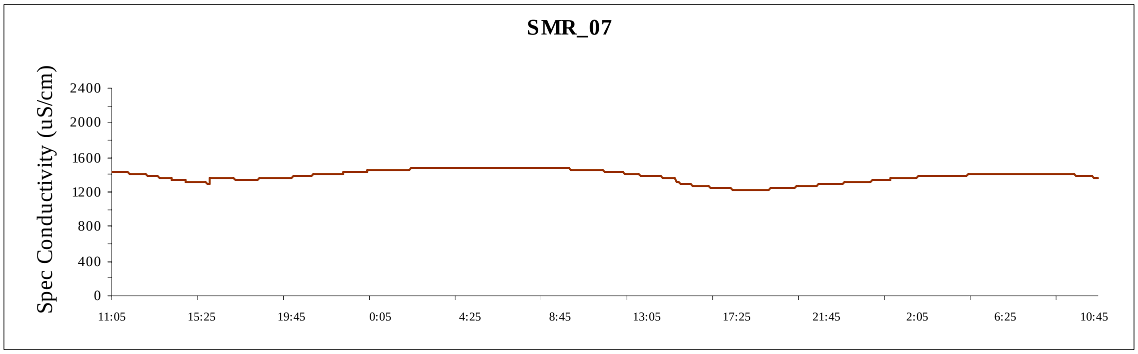
$CBOD_5$ and $CBOD_{20}$ Carbonaceous BOD incubated over 5 and 20 days

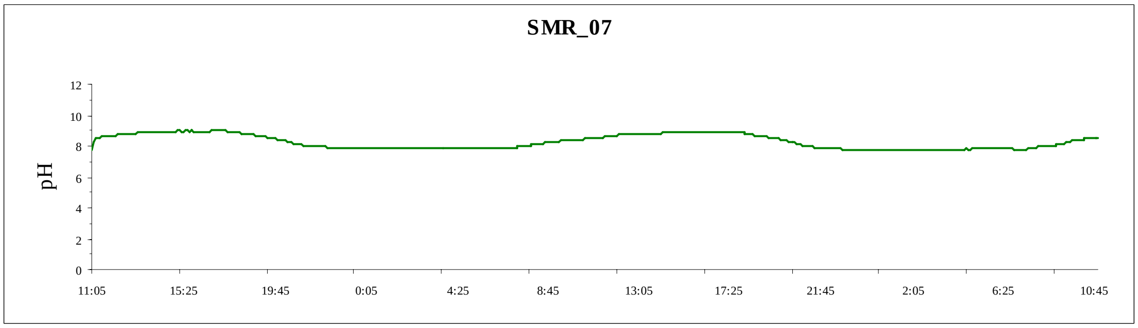
[1] Duplicate

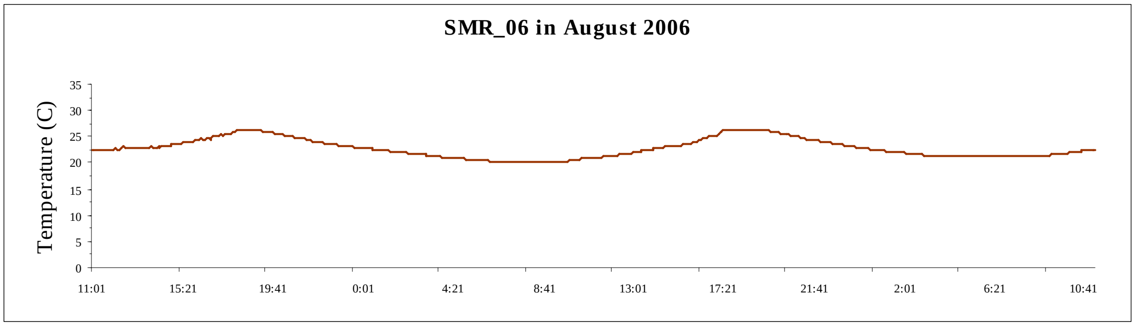
Table A-4: PADEP Wet Weather Water Quality Measurements in the Sawmill Run Watershed collected at the mouth on 10.17.06	
Parameter	**Conc. (mg/L)**
TN	1.92
TP	0.253
CBOD51	9.77
CBOD202	39.7
NO2-N	0.03
NO3-N	1.08
Tot NH3-N	0.17
Diss. P	0.099
Tot PO4	0.106
Diss. PO4	0.03
TOC	6.3
TSS	192
TDS	228
ALKALINITY	49.8
CBOD5 and CBOD20 = Carbonaceous BOD incubated over 5 and 20 days	
TOC = Total organic carbon; TSS = Total suspended solids; TDS = Total dissolved solids	

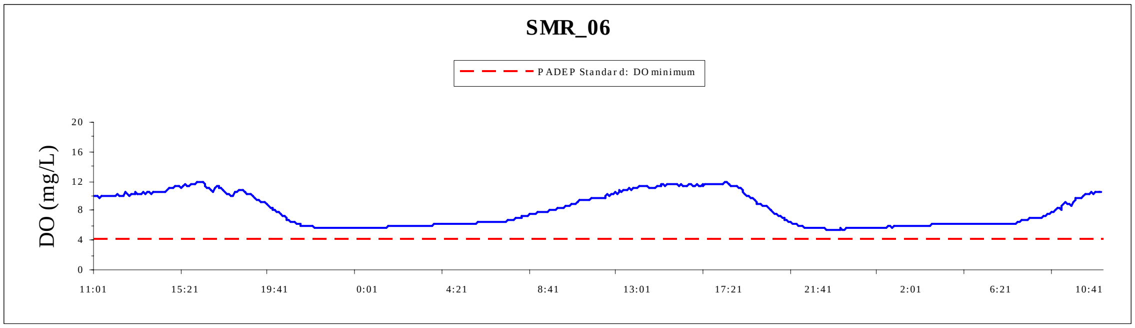

SMR_07 in August 2006
Temperature (C)
0
5
10
15
20
25
30
35
11:05
15:25
19:45
0:05
4:25
8:45
13:05
17:25
21:45
2:05
6:25
10:45

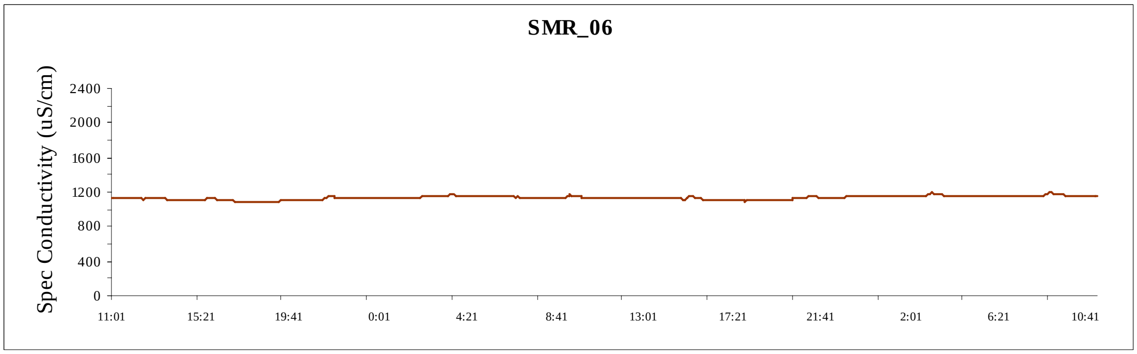

SMR_07
PADEP Standard: DO minimum
DO (mg/L)
0
4
8
12
16
20
11:05
15:25
19:45
0:05
4:25
8:45
13:05
17:25
21:45
2:05
6:25
10:45

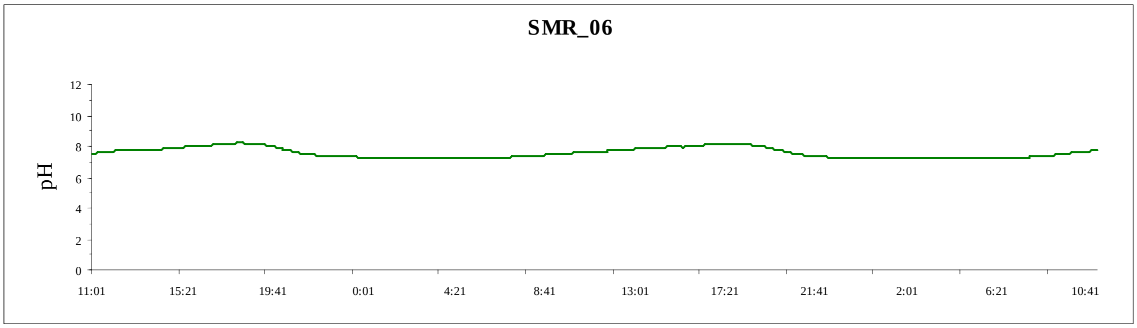

SMR_07
Spec Conductivity (uS/cm)
0
400
800
1200
1600
2000
2400
11:05
15:25
19:45
0:05
4:25
8:45
13:05
17:25
21:45
2:05
6:25
10:45

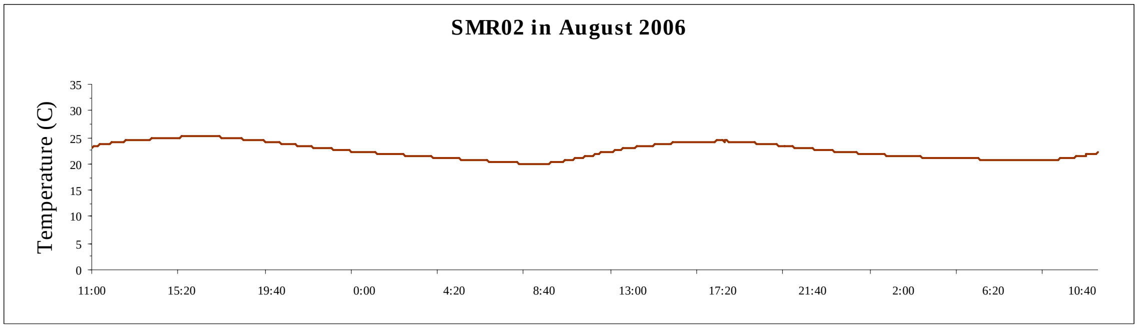

SMR_07
pH
0
2
4
6
8
10
12
11:05
15:25
19:45
0:05
4:25
8:45
13:05
17:25
21:45
2:05
6:25
10:45

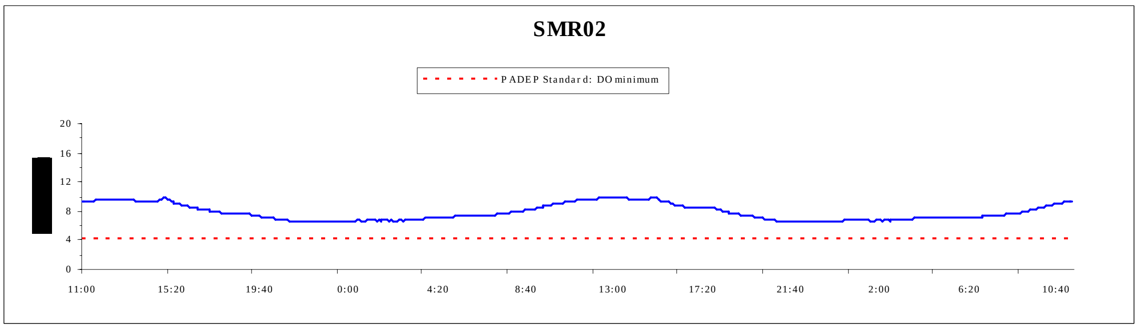

SMR_06 in August 2006
Temperature (C)
35
30
25
20
15
10
5
0
11:01
15:21
19:41
0:01
4:21
8:41
13:01
17:21
21:41
2:01
6:21
10:41

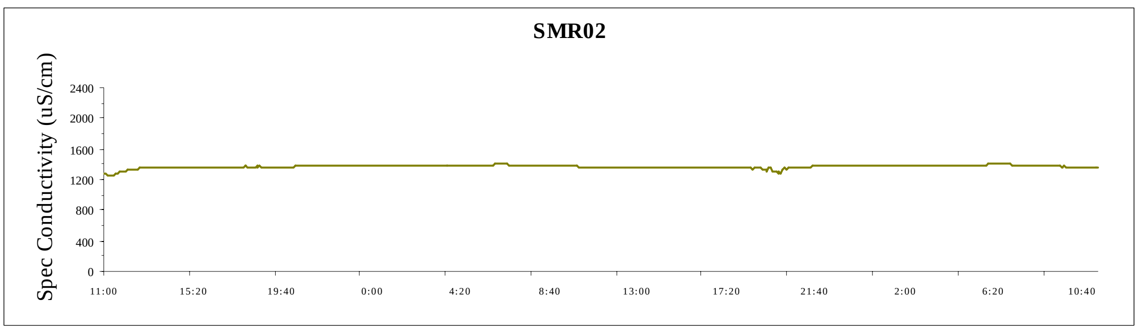

SMR_06
PADEP Standard: DO minimum
DO (mg/L)
20
16
12
8
4
0
11:01
15:21
19:41
0:01
4:21
8:41
13:01
17:21
21:41
2:01
6:21
10:41

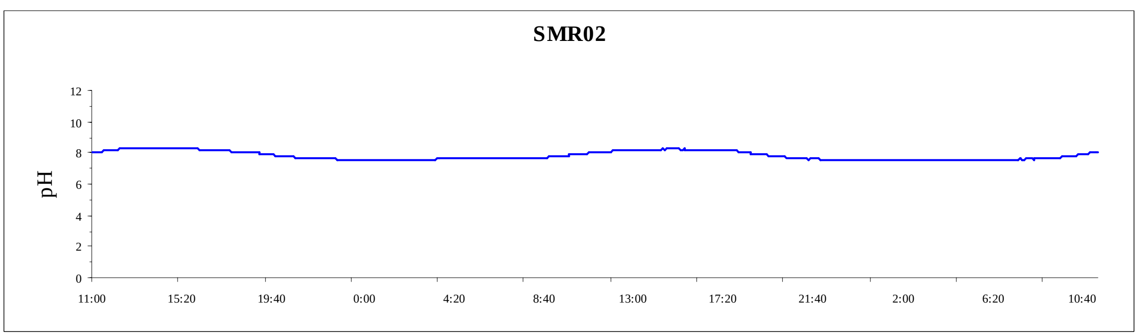

SMR_06
Spec Conductivity (uS/cm)
2400
2000
1600
1200
800
400
0
11:01
15:21
19:41
0:01
4:21
8:41
13:01
17:21
21:41
2:01
6:21
10:41


SMR_06
pH
12
10
8
6
4
2
0
11:01
15:21
19:41
0:01
4:21
8:41
13:01
17:21
21:41
2:01
6:21
10:41


SMR02 in August 2006
Temperature (C)
35
30
25
20
15
10
5
0
11:00
15:20
19:40
0:00
4:20
8:40
13:00
17:20
21:40
2:00
6:20
10:40


SMR02
PADEP Standard: DO minimum
[redacted]
20
16
12
8
4
0
11:00
15:20
19:40
0:00
4:20
8:40
13:00
17:20
21:40
2:00
6:20
10:40


SMR02
Spec Conductivity (uS/cm)
2400
2000
1600
1200
800
400
0
11:00
15:20
19:40
0:00
4:20
8:40
13:00
17:20
21:40
2:00
6:20
10:40


SMR02
pH
12
10
8
6
4
2
0
11:00
15:20
19:40
0:00
4:20
8:40
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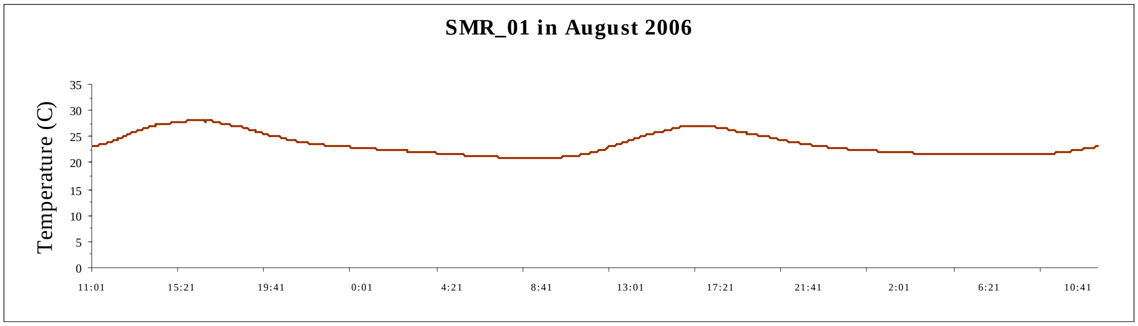
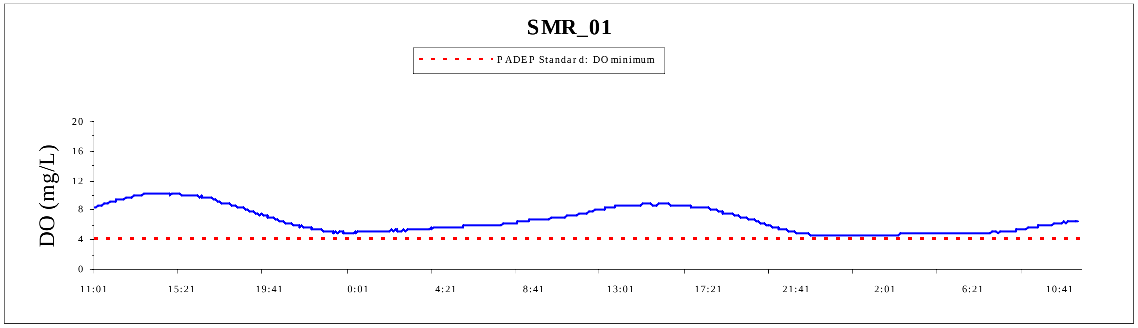
2:00
6:20
10:40


SMR_01 in August 2006
Temperature (C)
0
5
10
15
20
25
30
35
11:01
15:21
19:41
0:01
4:21
8:41
13:01
17:21
21:41
2:01
6:21
10:41


SMR_01
PADEP Standard: DO minimum
DO (mg/L)
0
4
8
12
16
20
11:01
15:21
19:41
0:01
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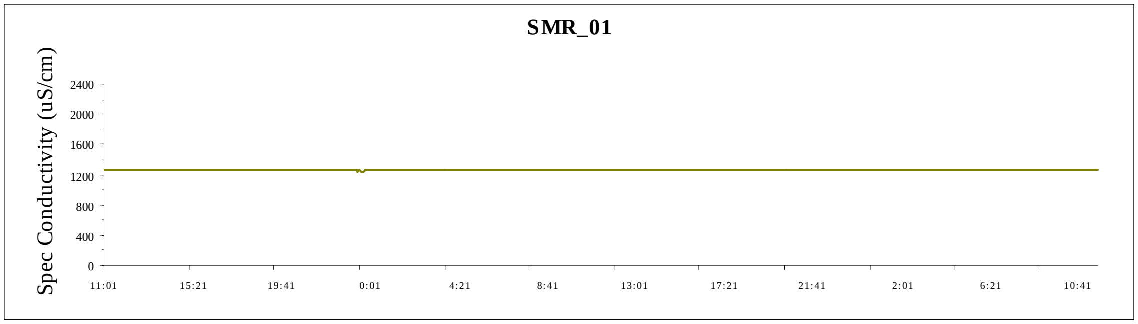
2:01
6:21
10:41


SMR_01
Spec Conductivity (uS/cm)
0
400
800
1200
1600
2000
2400
11:01
15:21
19:41
0:01
4:21
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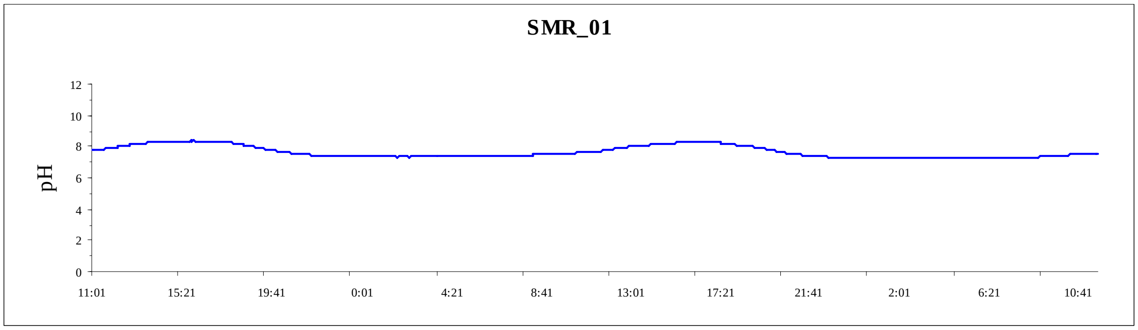
2:01
6:21
10:41


SMR_01
pH
0
2
4
6
8
10
12
11:01
15:21
19:41
0:01
4:21
8:41
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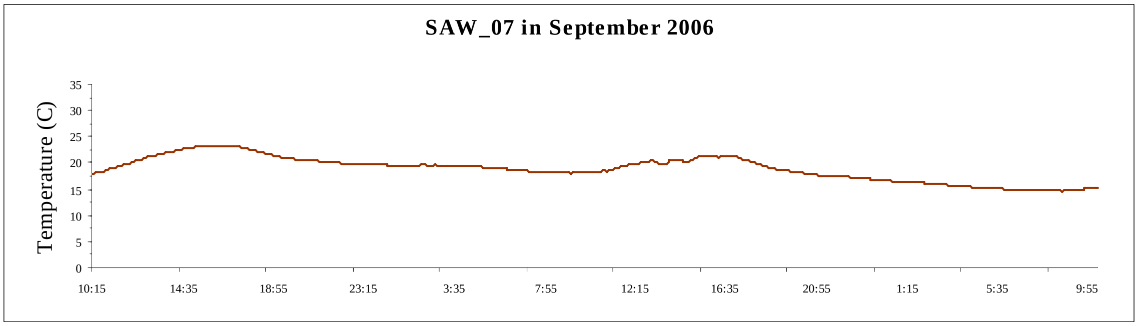
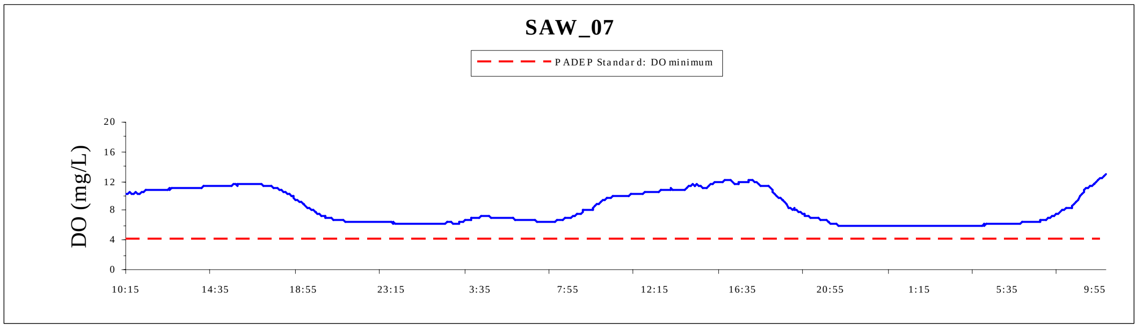
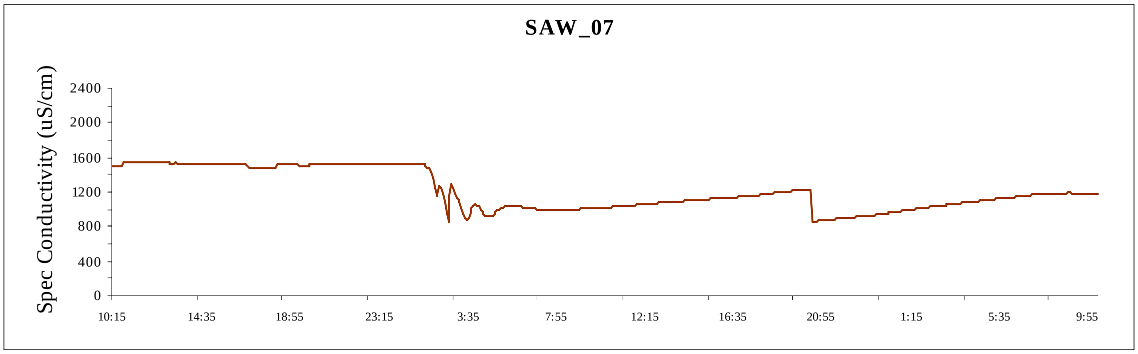
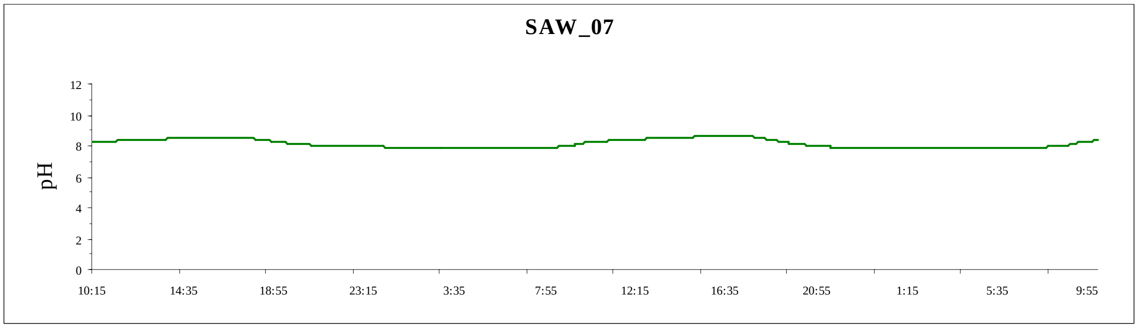
2:01
6:21
10:41


SAW_07 in September 2006
Temperature (C)
35
30
25
20
15
10
5
0
10:15
14:35
18:55
23:15
3:35
7:55
12:15
16:35
20:55
1:15
5:35
9:55


SAW_07
PADEP Standard: DO minimum
DO (mg/L)
20
16
12
8
4
0
10:15
14:35
18:55
23:15
3:35
7:55
12:15
16:35
20:55
1:15
5:35
9:55


SAW_07
Spec Conductivity (uS/cm)
2400
2000
1600
1200
800
400
0
10:15
14:35
18:55
23:15
3:35
7:55
12:15
16:35
20:55
1:15
5:35
9:55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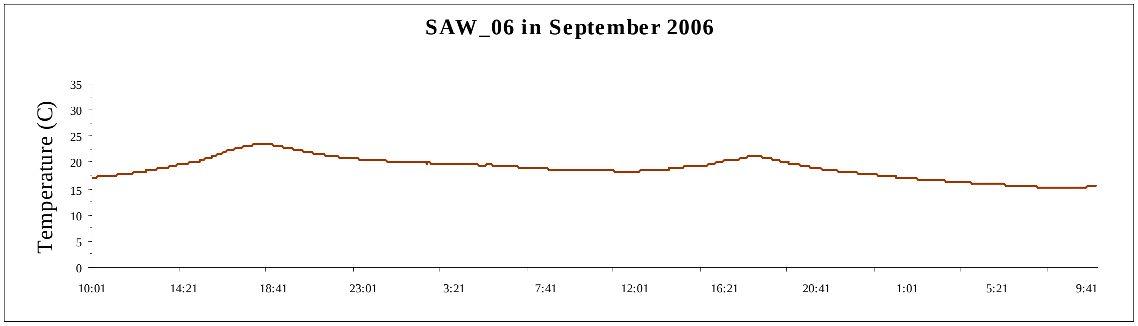
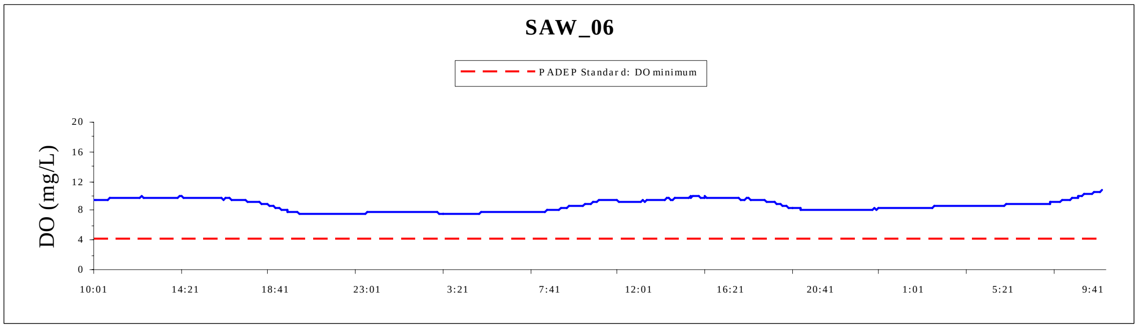
pH
12
10
8
6
4
2
0
10:15
14:35
18:55
23:15
3:35
7:55
12:15
16:35
20:55
1:15
5:35
9:55


SAW_06 in September 2006
Temperature (C)
35
30
25
20
15
10
5
0
10:01
14:21
18:41
23:01
3:21
7:41
12:01
16:21
20:41
1:01
5:21
9:41


SAW_06
PADEP Standard: DO minimum
DO (mg/L)
20
16
12
8
4
0
10:01
14:21
18:41
23:01
3:21
7:41
12:01
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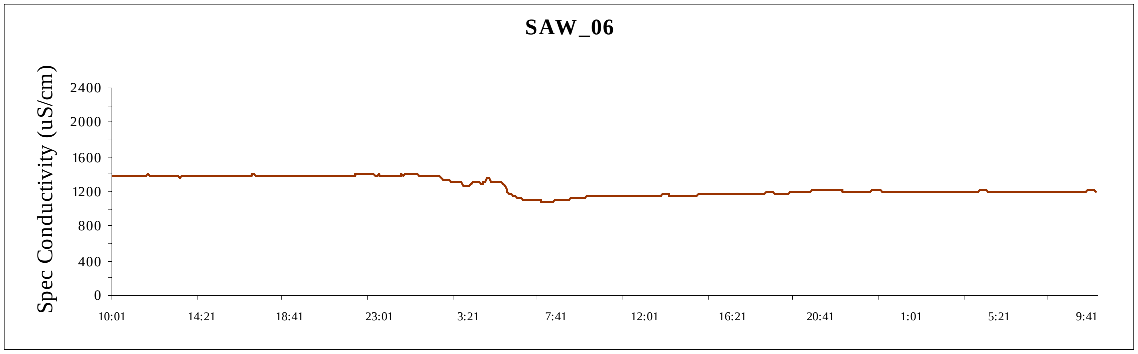
20:41
1:01
5:21
9:41


SAW_06
Spec Conductivity (uS/cm)
2400
2000
1600
1200
800
400
0
10:01
14:21
18:41
23:01
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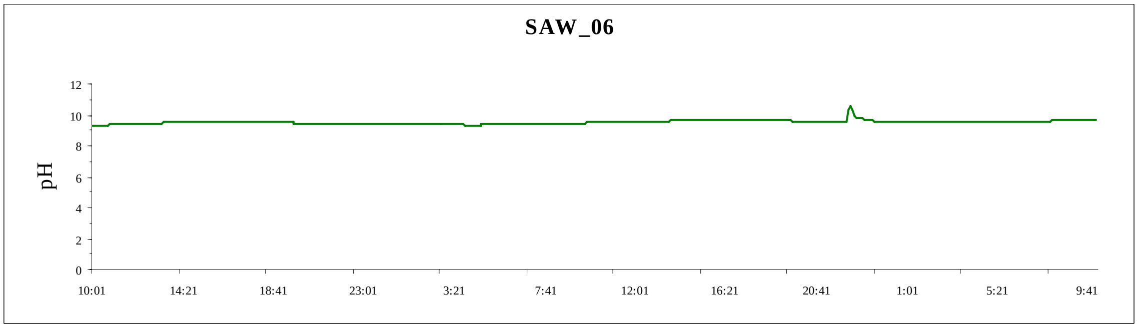
20:41
1:01
5:21
9:41


SAW_06
pH
12
10
8
6
4
2
0
10:01
14:21
18:41
23:01
3:21
7:41
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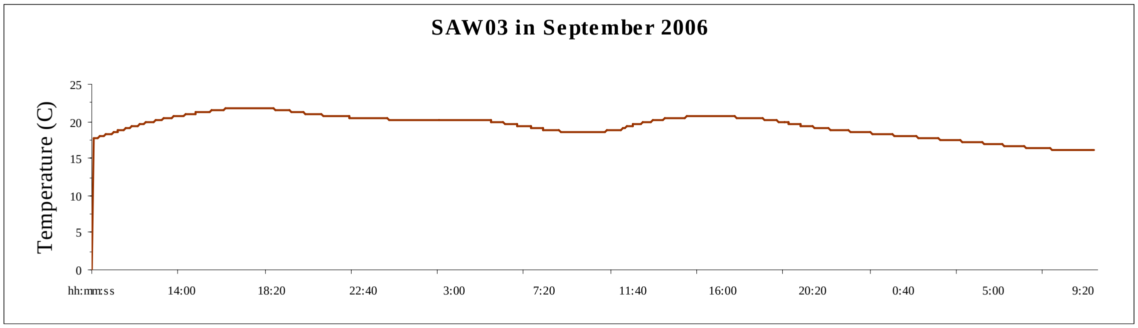
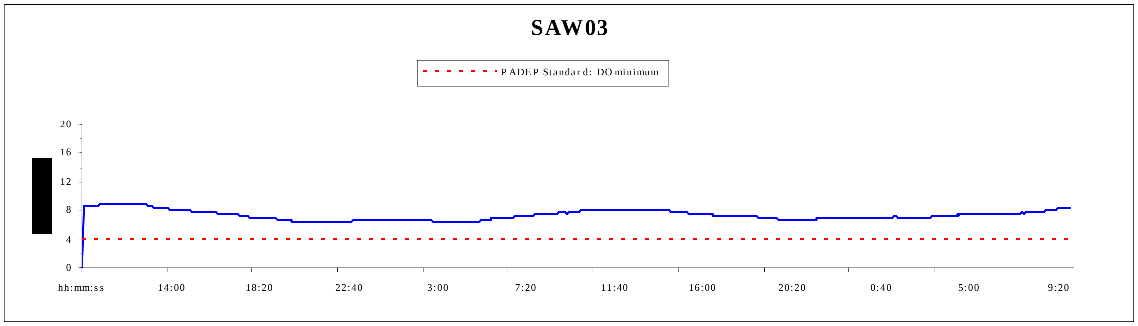
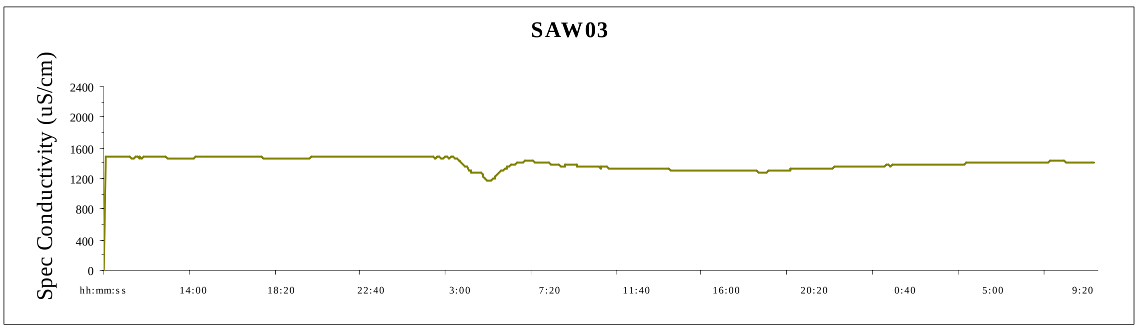
1:01
5:21
9:41


SAW03 in September 2006
Temperature (C)
25
20
15
10
5
0
hh:mm:ss
14:00
18:20
22:40
3:00
7:20
11:40
16:00
20:20
0:40
5:00
9:20


SAW03
PADEP Standard: DO minimum
[redacted]
20
16
12
8
4
0
hh:mm:ss
14:00
18:20
22:40
3:00
7:20
11:40
16:00
20:20
0:40
5:00
9:20


SAW03
Spec Conductivity (uS/cm)
2400
2000
1600
1200
800
400
0
hh:mm:ss
14:00
18:20
22:40
3:00
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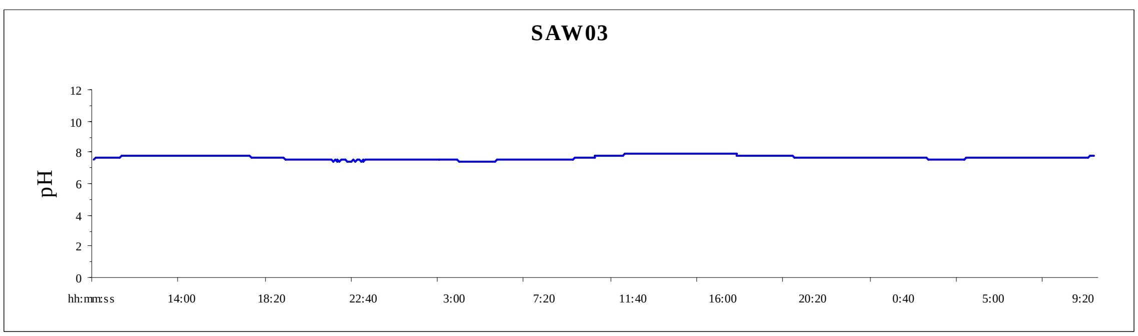
0:40
5:00
9:20


SAW03
pH
12
10
8
6
4
2
0
hh:mm:ss
14:00
18:20
22:40
3:00
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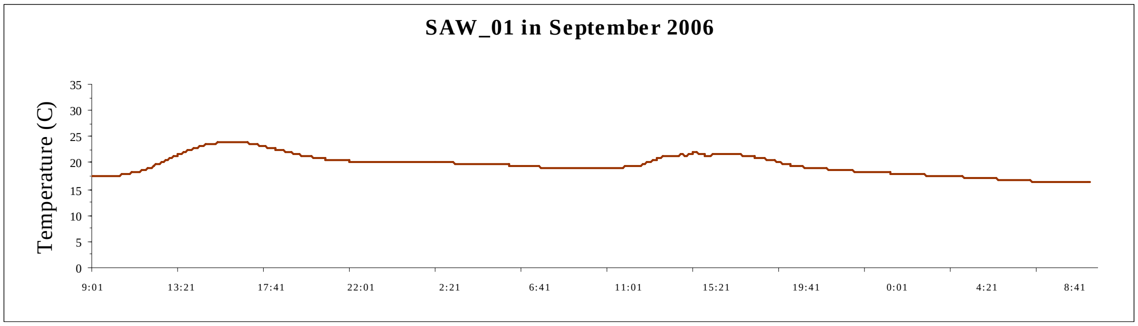
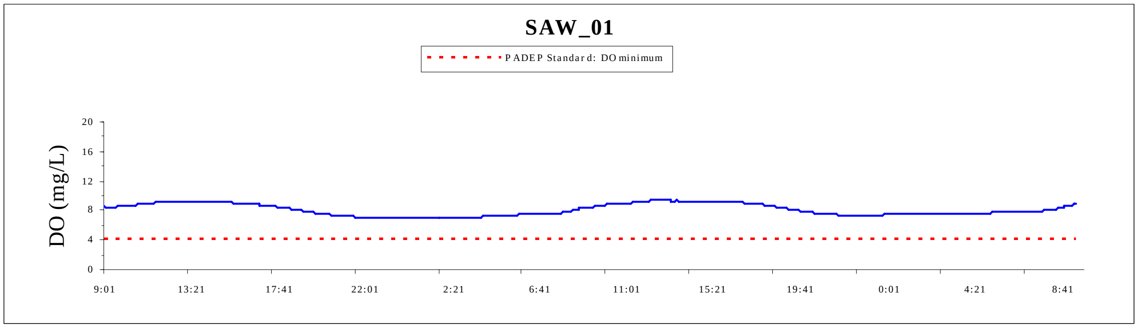
0:40
5:00
9:20


SAW_01 in September 2006
Temperature (C)
35
30
25
20
15
10
5
0
9:01
13:21
17:41
22:01
2:21
6:41
11:01
15:21
19:41
0:01
4:21
8:41


SAW_01
PADEP Standard: DO minimum
DO (mg/L)
20
16
12
8
4
0
9:01
13:21
17:41
22:01
2:21
6:41
11:01
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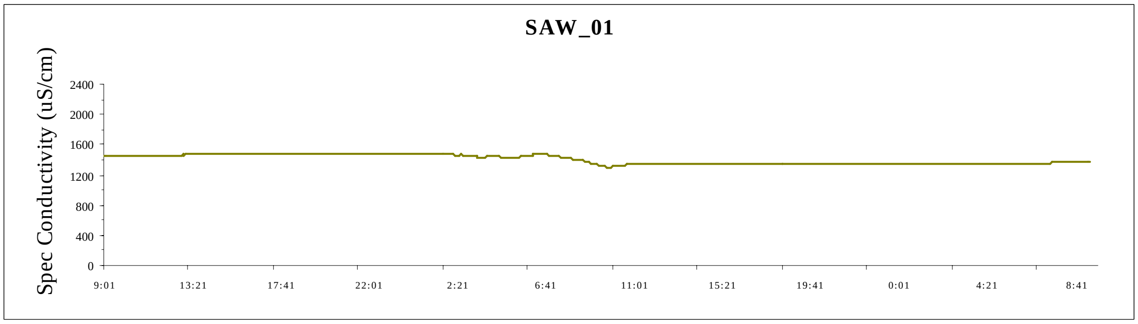
19:41
0:01
4:21
8:41


SAW_01
Spec Conductivity (uS/cm)
2400
2000
1600
1200
800
400
0
9:01
13:21
17:41
22:01
2:21
6:41
11:01
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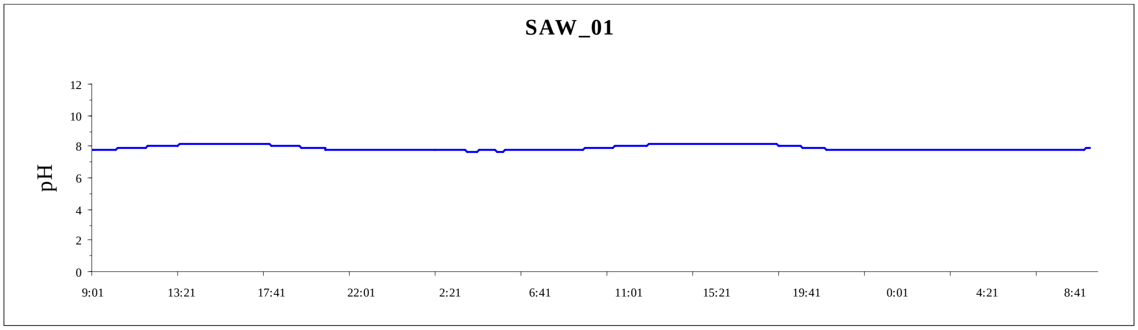
19:41
0:01
4:21
8:41


SAW_01
pH
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10
8
6
4
2
0
9:01
13:21
17:41
22:01
2:21
6:41
11:01
15:21
19:41
0:01
4:21
8:41

Table A-5: AMD Water Quality Data from SMR_03

Sampling Round	Date	Time	Flow m^3/s	Hardness T mg/L	MAGNESIUM T mg/L	T SUSP SOLID mg/L	MANGANESE T ug/L	pH SU	HOT ACIDITYTY mg/L	CALCIUM T mg/L	SULFATE T mg/L	ALKALINITY mg/L	IRON T ug/L	ALUMINUM T ug/L
1	8/2/2006	1130	0.40	432	32.7	<2	122	7.9	-66.4	119	337.3	75	699	100
2	8/9/2006	930	0.20	428	34.6	<2	208	7.8	-41	114	311.1	49.8	467	100
3	8/29/2006	905	0.50	212	15.7	16	77	7.8	-57.2	58.8	137.5	68.6	1330	701
4	8/28/2006	850	0.50	282	21.4	6	84	7.9	-54.4	77.6	202.7	63.4	329	100
5	9/13/2006	840	0.50	167	11.3	6	88	8	-69	48	99.4	75.4	886	423

Table A-6: AMD Water Quality Data from SMR_04

Sampling Round	Date	Time	Flow m^3/s	Hardness T mg/L	MAGNESIUM T mg/L	T SUSP SOLID mg/L	MANGANESE T ug/L	pH SU	HOT ACIDITYTY mg/L	CALCIUM T mg/L	SULFATE T mg/L	ALKALINIT Y mg/L	IRON T ug/L	ALUMINUM T ug/L
1	8/2/2006	1050	0.40	433	33.5	10	298	7.4	-62	118	294	69.6	4481	235
2	8/9/2006	1000	0.40	415	34	18	403	7.2	-29.6	110	338	40.4	5437	231
3	8/28/2006	925	0.50	251	19	18	208	7.5	-44.6	68.9	182.5	54.8	2670	445
4	8/29/2006	920	0.50	319	25	10	328	7.6	-42.6	86.3	221.6	51.6	3190	100
5	9/13/2006	905	0.50	203	13.8	18	196	8	-56	58.3	123	69.8	1461	583

Table A-7: AMD Water Quality Data from SMR_05

Sampling Round	Date	Time	Flow m^3/s	Hardness T mg/L	MAGNESIUM T mg/L	T SUSP SOLID mg/L	MANGANESE T ug/L	pH SU	HOT ACIDITYTY mg/L	CALCIUM T mg/L	SULFATE T mg/L	ALKALINITY mg/L	IRON T ug/L	ALUMINUM T ug/L
1	8/2/2006	900	0.30	517	42.35	18	871	3.7	34	137	524.8	0	34400	736
2	8/9/2006	1025	0.20	508	45.5	12 M	865	3.6	40.8	128	555	0	2990	760
3	8/28/2006	950	0.30	432	35.8	20	778	6.3	28	114	507.7	15.2	27900	811
4	8/29/2006	945	0.30	457	37.6	18	863	3.9	37.8	121	466.9	0	30200	551
5	9/13/2006	930	0.30	284	22.3	30	421	6.8	0	76.8	234.3	37.4	13100	669

Table A-8: AMD Water Quality Data from SMR_06

Sampling Round	Date	Time	Flow m^3/s	Hardness T mg/L	MAGNESIUM T mg/L	T SUSP SOLID mg/L	MANGANESE T ug/L	pH SU	HOT ACIDITYTY mg/L	CALCIUM T mg/L	SULFATE T mg/L	ALKALINITY mg/L	IRON T ug/L	ALUMINUM T ug/L
1	8/2/2006	0940	0.3	355	26.6	<2	15	8.2	-132.6	98.1	123	144	44	100
2	8/9/2006	1050	0.2	340	27.2	<2	22	8.1	-104.4	91	167.3	117.4	21	100
3	8/28/2006	1015	0.3	168	11.9	26	36	7.9	-64	47.4	97.1	75.2	1450	983
4	8/29/2006	1005	0.4	176	12.8	<2	12	8	-75.8	49.5	105.5	82.2	60	100
5	9/13/2006	1015	0.5	196	12.7	26	343	8.3	-58.6	57.3	94.9	77.8	642	2081

Appendix B: Equal Marginal Percent Reduction Method

The Equal Marginal Percent Reduction (EMPR) allocation method was used to distribute Adjusted Load Allocations (ALAs) between the appropriate contributing non-point sources. The load allocation and EMPR procedures were performed using MS Excel. The 4 major steps identified in the spreadsheet are summarized below:

- **Step 1**: Calculation of the TMDL based on a reference watershed area adjusted to the size of the impaired watershed.

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

  ALA = TMDL – MOS – WLA – (Existing Loads not reduced, i.e. Forest)

- **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 water-body. 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 of all sources receiving reductions.

Appendix C: MS4 Sediment Allocations

Table C-1: Baldwin Borough MS4 Area Allocation				
Land Source	**Acreage within Area**	**Existing Load (tons/day)**	**Allocated Load (tons/day)**	**Percent Reduction**
Low Intensity Development	5	0.0006	0.0003	48.3%
High Intensity Development	0	0.0000	0.0000	0.0%
Hay/Past	0	0.0001	0.0001	48.3%
Turf Grass	0	0.0000	0.0000	0.0%
Instream Erosion	-	0.0023	0.0005	79.8%
Total	**6**	**0.0030**	**0.0008**	**72.1%**

Table C-2: Baldwin Township MS4 Area Allocation				
Land Source	**Acreage within Area**	**Existing Load (tons/day)**	**Allocated Load (tons/day)**	**Percent Reduction**
Low Intensity Development	304	0.037	0.019	48.3%
High Intensity Development	0	0.000	0.000	0.0%
Hay/Past	14	0.004	0.002	48.3%
Turf Grass	0	0.000	0.000	0.0%
Instream Erosion	-	0.131	0.026	79.8%
Total	**318**	0.171	0.047	72.4%

Table C-3: Bethel Park Borough MS4 Area Allocation				
Land Source	**Acreage within Area**	**Existing Load (tons/day)**	**Allocated Load (tons/day)**	**Percent Reduction**
Low Intensity Development	502	0.0607	0.0314	48.3%
High Intensity Development	57	0.0007	0.0004	48.3%
Hay/Past	52	0.0137	0.0071	48.3%
Turf Grass	0	0.0000	0.0000	0.0%
Instream Erosion	-	0.2508	0.0506	79.8%
Total	**612**	**0.3259**	**0.0894**	**72.6%**

Table C-4: Brentwood Borough MS4 Area Allocation				
Land Source	**Acreage within Area**	**Existing Load (tons/day)**	**Allocated Load (tons/day)**	**Percent Reduction**
Low Intensity Development	367	0.044	0.023	48.3%
High Intensity Development	0	0.000	0.000	0.0%
Hay/Past	7	0.002	0.001	48.3%
Turf Grass	3	0.001	0.001	48.3%
Instream Erosion	-	0.155	0.031	79.8%
Total	**378**	**0.202**	**0.056**	**72.5%**

Table C-5: Castle Shannon Borough MS4 Area Allocation				
Land Source	**Acreage within Area**	**Existing Load (tons/day)**	**Allocated Load (tons/day)**	**Percent Reduction**
Low Intensity Development	827	0.100	0.052	48.3%
High Intensity Development	126	0.002	0.001	48.3%
Hay/Past	43	0.011	0.006	48.3%
Turf Grass	4	0.001	0.001	48.3%
Instream Erosion	-	0.411	0.083	79.8%
Total	**1,002**	**0.526**	**0.142**	**73.0%**

Table C-6: Crafton Borough Area MS4 Allocation				
Land Source	**Acreage within Area**	**Existing Load (tons/day)**	**Allocated Load (tons/day)**	**Percent Reduction**
Low Intensity Development	2	0.0002	0.0001	48.3%
High Intensity Development	0	0.0000	0.0000	0.0%
Hay/Past	0	0.0000	0.0000	0.0%
Turf Grass	0	0.0000	0.0000	0.0%
Instream Erosion	-	0.0007	0.0001	79.8%
Total	**2**	**0.0009**	**0.0002**	**72.7%**

Table C-7: Dormont Borough MS4 Area Allocation				
Land Source	**Acreage within Area**	**Existing Load (tons/day)**	**Allocated Load (tons/day)**	**Percent Reduction**
Low Intensity Development	408	0.0493	0.0255	48.3%
High Intensity Development	77	0.0010	0.0005	48.3%
Hay/Past	5	0.0013	0.0007	48.3%
Turf Grass	0	0.0000	0.0000	0.0%
Instream Erosion	-	0.2011	0.0406	79.8%
Total	**491**	**0.2526**	**0.0672**	**73.4%**

Table C-8: Green Tree Borough MS4 Area Allocation				
Land Source	**Acreage within Area**	**Existing Load (tons/day)**	**Allocated Load (tons/day)**	**Percent Reduction**
Low Intensity Development	222	0.027	0.014	48.3%
High Intensity Development	53	0.001	0.000	48.3%
Hay/Past	17	0.004	0.002	48.3%
Turf Grass	0	0.000	0.000	0.0%
Instream Erosion	-	0.120	0.024	79.8%
Total	**292**	**0.152**	**0.041**	**73.2%**

Table C-9: Ingram Borough MS4 Area Allocation				
Land Source	**Acreage within Area**	**Existing Load (tons/day)**	**Allocated Load (tons/day)**	**Percent Reduction**
Low Intensity Development	2	0.000	0.000	48.3%
High Intensity Development	0	0.000	0.000	0.0%
Hay/Past	0	0.000	0.000	0.0%
Turf Grass	0	0.000	0.000	0.0%
Instream Erosion	-	0.001	0.000	79.8%
Total	**2**	**0.001**	**0.000**	**72.7%**

Table C-10: Mt. Lebanon Township MS4 Area Allocation				
Land Source	**Acreage within Area**	**Existing Load (tons/day)**	**Allocated Load (tons/day)**	**Percent Reduction**
Low Intensity Development	1,291	0.156	0.081	48.3%
High Intensity Development	30	0.000	0.000	48.3%
Hay/Past	64	0.017	0.009	48.3%
Turf Grass	94	0.035	0.018	48.3%
Instream Erosion	-	0.607	0.123	79.8%
Total	**1,483**	**0.816**	**0.230**	**71.8%**

Table C-11: Mt. Oliver Borough MS4 Area Allocation				
Land Source	**Acreage within Area**	**Existing Load (tons/day)**	**Allocated Load (tons/day)**	**Percent Reduction**
Low Intensity Development	29	0.004	0.002	48.3%
High Intensity Development	0	0.000	0.000	0.0%
Hay/Past	0	0.000	0.000	0.0%
Turf Grass	0	0.000	0.000	0.0%
Instream Erosion	-	0.012	0.002	79.8%
Total	**29**	**0.015**	**0.004**	**72.7%**

Table C-12: Pittsburgh City MS4 Area Allocation				
Land Source	**Acreage within Area**	**Existing Load (tons/day)**	**Allocated Load (tons/day)**	**Percent Reduction**
Low Intensity Development	6,286	0.760	0.393	48.3%
High Intensity Development	96	0.001	0.001	48.3%
Hay/Past	263	0.070	0.036	48.3%
Turf Grass	0	0.000	0.000	0.0%
Instream Erosion	-	2.729	0.550	79.8%
Total	**6,663**	**3.560**	**0.980**	**72.5%**

Table C-13: Scott Township MS4 Area Allocation				
Land Source	**Acreage within Area**	**Existing Load (tons/day)**	**Allocated Load (tons/day)**	**Percent Reduction**
Low Intensity Development	39	0.00	0.00	48.3%
High Intensity Development	0	0.00	0.00	0.0%
Hay/Past	0	0.00	0.00	48.3%
Turf Grass	0	0.00	0.00	0.0%
Instream Erosion	-	0.02	0.00	79.8%
Total	**39**	**0.02**	**0.01**	**72.6%**

Table C-14: Whitehall Borough MS4 Area Allocation				
Land Source	**Acreage within Area**	**Existing Load (tons/day)**	**Allocated Load (tons/day)**	**Percent Reduction**
Low Intensity Development	1,032	0.125	0.065	48.3%
High Intensity Development	0	0.000	0.000	0.0%
Hay/Past	77	0.020	0.011	48.3%
Turf Grass	5	0.002	0.001	48.3%
Instream Erosion	-	0.457	0.092	79.8%
Total	**1,114**	**0.604**	**0.168**	**72.2%**