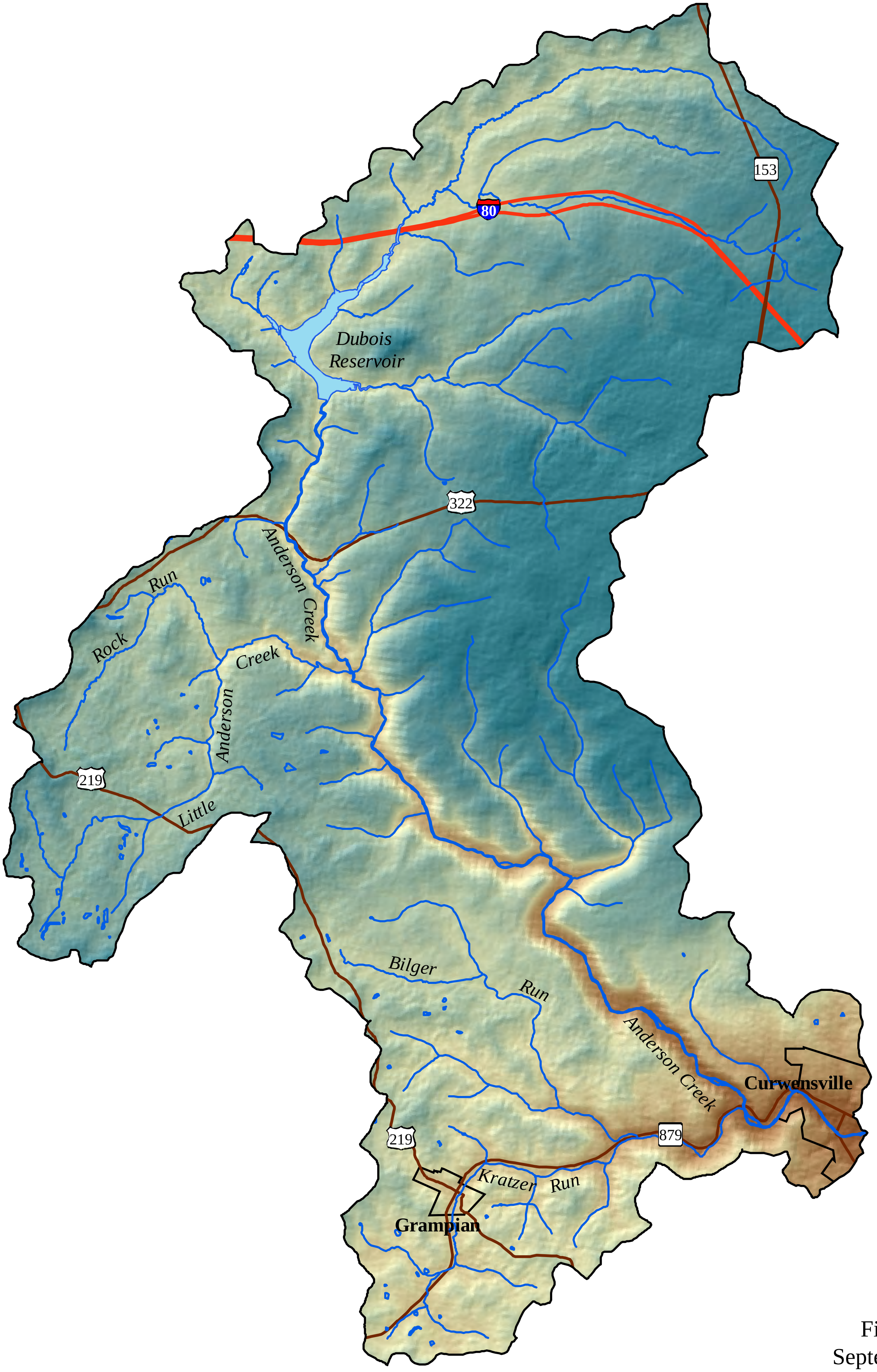
Anderson Creek Watershed

Assessment, Restoration and Implementation Plan



Final Plan
September 2006

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and
U.S. Environmental Protection Agency Section 319 Nonpoint Source Management Program

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I. Introduction

Overview

The Anderson Creek Watershed Assessment, Restoration, and Implementation Plan was developed as a key component in the effort to address pollution problems affecting Anderson Creek and its tributaries. Anderson Creek Watershed Association (ACWA), a local, nonprofit, volunteer organization, in cooperation with numerous partners, has created this plan to provide users with valuable information that will help guide future restoration and implementation activities within the watershed. ACWA contracted with Western Pennsylvania Conservancy (WPC) to gather available data, perform the field assessment, develop a monitoring plan and coordinate monitoring activities with ACWA volunteers and the DEP Bureau of Watershed Management Nonpoint Source Pollution (NPS) program, initiate landowner contact, assist in coordinating initial restoration efforts with landowners, local, county, state, and federal agencies, and develop the implementation plan. In addition, WPC has provided technical assistance to ACWA on matters outside the specific scope of the Anderson Creek Watershed Assessment, Restoration, and Implementation Plan.

The restoration of the Anderson Creek watershed presents many challenges and users of this plan should understand that the recommendations identified within are based on the best information on restoration technologies available at the time of its creation. Due to the evolving techniques and technologies used in watershed restoration, changing priorities of government agency programs, and the availability of various funding sources used in restoration activities, a periodic review and updating of the plan is highly recommended.

Prior to the development of this restoration and implementation plan, ACWA and its various partners focused their restoration efforts on the most obvious pollution problem in the watershed, abandoned mine drainage (AMD). Several prior studies have cataloged the negative impacts mineral resource extraction activities have had on the watershed. None have recorded stream and riparian conditions as part of the study. The Anderson Creek Watershed Assessment, Restoration, and Implementation Plan is designed to include a comprehensive assessment of the watershed’s stream conditions, along with an updated assessment of the AMD problems.

Because this assessment is funded through Pennsylvania Department of Environmental Protection, Bureau of Watershed Management’s Section 319 Nonpoint Source Pollution program, the study is also developed to consider requirements of the U.S. Environmental Protection Agency (EPA) Section 319 program. In addition, the study will also help develop a new AMD restoration model, created in cooperation with a consulting firm, DEP, and Penn State University.

Public Information and Participation

Because long-term local support is necessary if Anderson Creek is to be restored, ACWA made every effort to create the partnerships necessary to sustain their cleanup efforts. ACWA has teamed with local citizens, nonprofit groups, local and county government, state, and federal government agencies. They are working with local mining companies to promote remining of problem abandoned mine sites. ACWA has joined with the Clearfield County Conservation District and the Environmental Alliance for Senior Involvement (EASI) to install flow-monitoring weirs on critical AMD sites throughout the watershed. They also assisted in gathering water quality data during the monitoring period of the assessment. ACWA partnered with Pike Township to develop grants and monitor water quality. Another important partner has been the Pike Township Water Authority, which draws water from Anderson Creek during critical drought conditions and provided valuable resource data. ACWA is also working with other organizations with similar goals in a much larger effort to clean up the West Branch of the Susquehanna River, into which Anderson Creek flows.

ACWA usually holds monthly public meetings and encourages all of their partners and interested local citizens to attend, assuring an open line of communication within their community. During this assessment, the group has asked WPC to make regular updates on the progress of the project at the monthly meetings. In addition, as the assessment proceeded, initiating personal contact with landowners to gain their support was a priority.

The group also developed and initiated a public outreach effort to assure local citizens are aware of the cleanup activities taking place. As part of their outreach, a display board that highlights their efforts within the watershed was created and prominently displayed at various community businesses. Local businesses have been a willing and supportive partner. As an effort to reach as many people in the community as possible, the group had several articles published in the local newspaper. They have also made presentations to local community groups.

All of these efforts have paid off in strong community support. Every landowner approached during this assessment that has an abandoned mine issue on their property indicated their willingness to work with the watershed group. Numerous landowners indicated they will allow work to take place on their properties and would permit treatment systems to be built in order to clean up the stream. ACWA is confident their outreach efforts have played a key role in developing such support.

Assessment Methodology

At the initial time of development of the Anderson Creek Watershed Assessment, Restoration, and Implementation Plan, Pennsylvania had no required methods or standards for completing a watershed assessment and restoration plan. The Pennsylvania DEP developed some methodologies for properly assessing AMD-impaired watersheds during the mid to late 1990s but none had become a standard for watershed groups to follow.

One such effort, called “A Model Plan for Watershed Restoration,” was developed by DEP in cooperation with Natural Resources Conservation Service, U.S. Army Corps of Engineers, Office of Surface Mining, Eastern and Western Pennsylvania Coalitions for Abandoned Mine Reclamation and PA Department of Conservation and Natural Resources. This plan outline was an attempt to develop a universal method that could be used by all of the different agencies, with some tweaking for their individual programs. Thus, one plan could serve several funding sources.

Prior to the “Model Plan” was a plan called “Pennsylvania’s Comprehensive Plan for Abandoned Mine Reclamation,” developed by DEP’s Bureau of Abandoned Mine Reclamation (BAMR). Its methodology was primarily developed to meet the guidelines set by the Surface Mining Control and Reclamation Act, the federal law governing mining and reclamation, under which BAMR’s reclamation program operates.

A number of assessments and restoration plans had been completed under the state’s Growing Greener program, but no required format was set because of the variety of watersheds and the problems affecting them. More recently, DEP Watershed Managers, created under the Growing Greener program, developed a guide for watershed assessments called “Recommended Key Components of an Effective Watershed Assessment and Restoration Plan.” This outline identifies the types of information that should be assembled to develop a good assessment and proper restoration plan. It identifies critical steps that should be completed as information is gathered, the physical assessment proceeds, and the plan is developed.

Most importantly for the Anderson Creek assessment, DEP’s Bureau of Watershed Management, in accordance with EPA Section 319 guidelines, recently developed their “Elements of a Watershed Implementation Plan in Pennsylvania’s Non-Point Source Management Plan” guidelines for those receiving funding through the EPA program. The outline focuses on addressing non-point source impairments identified in the Total Maximum Daily Load (TMDL) assessments, such as that recently completed for the Anderson Creek watershed.

One of the most important factors in development of the assessment and restoration and implementation plan is properly balancing the time, effort, and money necessary to complete the suggested restoration and implementation approach. Within each suggested method there are limits to the type and amount of information that can be gathered based on the goals, objectives, priorities, and the level of funding available for its development. The goals and objectives in themselves are driven by different and sometimes competing priorities, established first by the organization for which the plan is developed and secondly, but often just as important, the funding source, which usually carries its own requirements or priorities.

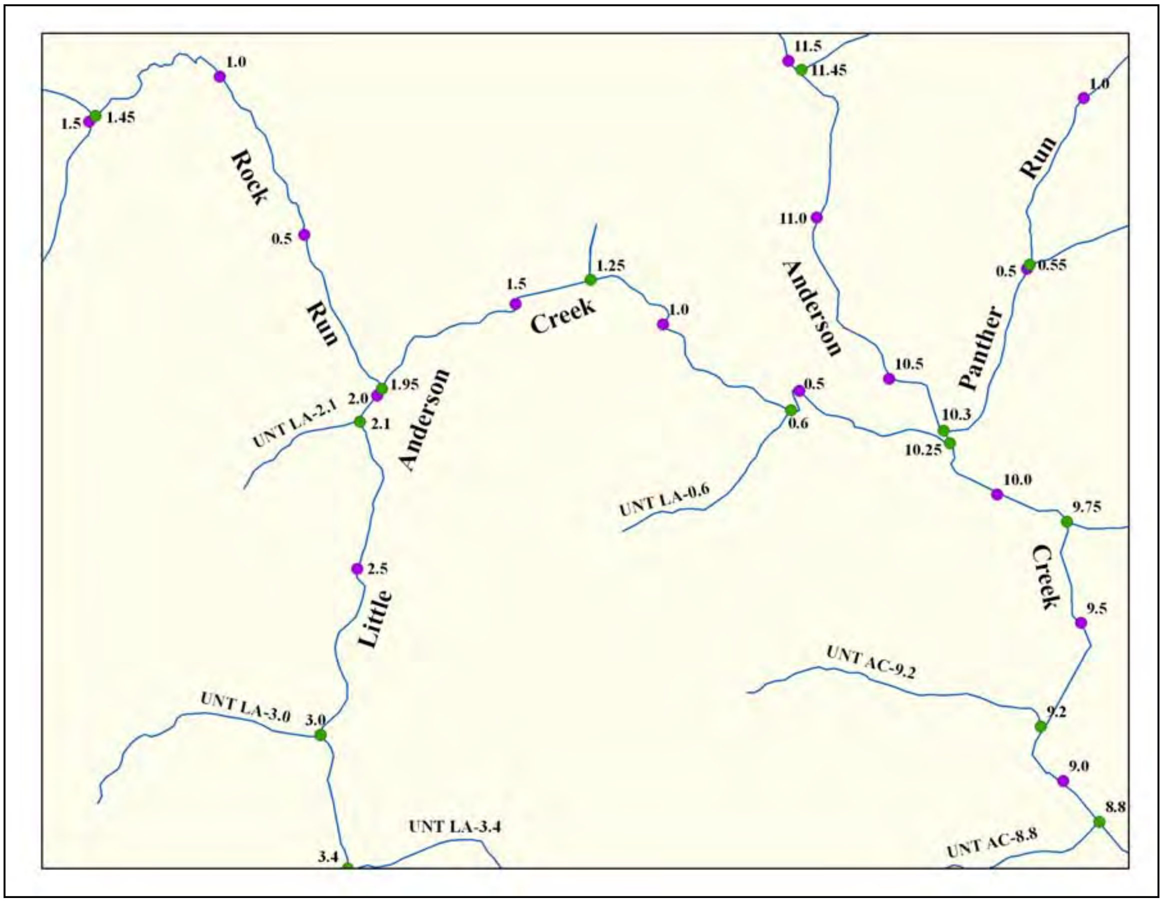
The comprehensive assessment approach taken for Anderson Creek under this study was primarily based on the needs and desires of ACWA, DEP's Section 319 program priorities, DEP Bureaus of Mining and Reclamation and Abandoned Mine Reclamation, and the cooperative effort between DEP Bureau of Watershed Management and Penn State University to create a restoration model for AMD-impaired watersheds. It also attempts to blend aspects of the other previously mentioned assessment plan outlines in an effort to make the plan as useful as possible.

To fully assess the physical condition of the stream channels and streamside areas, all named streams and their tributaries below the Dubois Reservoir were walked. Each tributary was visually assessed as stream segments with similar characteristics. Stream segments varied in length, depending on them maintaining similar characteristics. When the in-stream or riparian area of a tributary changed noticeably, a new segment was created. For example, if the gradient of the stream changed from flat or low to something more moderate, the steeper section was considered a new segment. Similarly, if the streamside vegetation changed significantly, for example, from forested to residential, a new segment was created.

In order to have a consistent way to compare stream segments and quantify conditions within and among them, a modified version of the USDA Stream Assessment Protocol was used during the development of the Anderson Creek Watershed Assessment, Restoration, and Implementation Plan. The USDA protocol assigns a numerical value to each of the stream characteristics, or "assessment elements," equating to overall stream quality. The assigned assessment score, which is usually between 1 and 10, with 10 being highest in quality, is based on specific conditions associated with each assessment element. An example of the assessment form used can be found in the Appendices. All of the individual visual assessment scores on each segment were combined to create an overall visual assessment score. A GIS-based map was created based on those overall scores to help quickly identify the quality rating of each stream segment and is included within the report.

Anderson Creek was divided into subwatersheds for the purpose of this assessment. To identify individual tributaries within the main stem of Anderson Creek and its subwatersheds, numerical values were assigned to tributaries based on their distance, in miles, from the mouth of each named stream. ArcGIS 9.0 was used to measure the distances on electronic versions of USGS 1:24,000 scale topographic maps. The streams were traced using the ArcGIS 9.0 measuring tool set in miles and an identifier was placed on the map at each half-mile increment, beginning at the mouth of Anderson Creek. Each tributary entering the stream was then easily identified by where it fell along the continuum of the distance from the mouth to the headwaters. An alphabetic prefix was also assigned, based on the stream the tributary entered. For example, if an unnamed tributary entered Little Anderson Creek 3.4 miles upstream of its mouth, its designation would be UNT-LA 3.40 (UNT for "unnamed tributary," LA for "Little Anderson," and 3.40 for the distance in miles measured from the mouth of the stream). Using this system, it is unnecessary to designate which side of the stream a tributary entered from when using the map. No tributaries entered a stream directly across the stream from another. Each has an individual designation based on the distance it enters upstream from the mouth of the receiving stream.

Stream monitoring points were labeled differently. Again, letters were used as a prefix to designate the type of monitoring, in this case, SMP for "stream monitoring point," the stream name, such as AC for Anderson Creek, but the numeric designation only indicated the monitoring point's relative position along the stream starting at the mouth and moving upstream. For instance, SMP-AC1 indicated the first monitoring point upstream of the mouth of Anderson Creek, and, in this instance, SMP-AC4 indicated the uppermost monitoring station. No mileage designation was assigned to the in-stream monitoring point.



Tributary identification system is based on distance in miles from the mouth of the receiving stream.

In addition to stream monitoring stations, individual AMD discharges and groups of AMD discharges were monitored. Individual AMD discharges were labeled using the prefix DMP, which represents "discharge monitoring point." Some discharges were identified with the stream it impacted and distance from the mouth, such as DMP-BR 4.5, which indicated a monitoring point located on a discharge entering Bilger Run 4.5 miles upstream from its mouth. Others were identified by names familiar to watershed group members, such as DMP-Drauker1, for a discharge draining from the Drauker Mine #1 in the Little Anderson Creek subwatershed.

In some instances, it was impossible to monitor each individual AMD source at a site because they were too numerous or because of difficult site conditions. In such cases, a monitoring point that captured all of the AMD discharges was chosen. Such areas were termed “problem areas,” and the monitoring point was labeled PAMP, indicating it was a “problem area monitoring point.” These sites were also given an identifier that indicated the stream or unnamed tributary on which it was located. For example, PAMP KR-1.45 indicated a monitoring point for a collection of discharges from a problem area located on Kratzer Run 1.45 miles upstream from the mouth of the stream.

Monitoring sites were chosen based on the best possible location to measure both pollution source loads and their effects on streams. Water samples were taken on a monthly basis for a period of twelve months to allow for a full evaluation of changes that occur throughout the seasons. In accordance with standard methods, field measurements were performed for temperature and pH using electronic meters. AMD discharge water samples were collected as grab samples, to limit the possibility of cross contamination, and transported to Mahaffey Laboratory, in Grampian. Samples were tested in the lab only. Lab samples were tested for hot acidity, alkalinity, total iron, total aluminum, total manganese, and total sulfates. Flow-measuring devices were installed by ACWA partners and volunteers on AMD discharges and included notched weirs or collection pipes that were measured using a bucket and stopwatch to determine flow. Stream flow measurements, along with associated sampling, were performed monthly and coordinated with the sampling of AMD discharges. Stream samples were collected as grab samples to limit the possibility of cross contamination. Samples were transported and analyzed by Mahaffey Laboratory. Stream lab samples were tested for hot acidity, total iron, total aluminum, total manganese, and total sulfates. Stream flows were taken using a Marsh-McBirney, Inc. Model 201 portable flow meter and used the cross-sectional area and velocity measurement and recorded in gallons per minute.

To help identify on which side of the stream pollution sources are located, a designation of “river left” or “river right” is used, which is the standard practice used by the American Canoe Association when describing locations on a stream. It is very important to understand these directions are given in relation to the observer always facing “downstream.” In this way, north, south, east, and west directions are minimized, as streams are constantly shifting the direction in which they flow.

ACWA Restoration Priorities

The ACWA’s priorities are to:

- improve water quality enough to re-establish a fishery in the main stem of Anderson Creek from the confluence with Little Anderson Creek to the mouth of the stream;
- re-establish a fishery in the Kratzer Run/Bilger Run subwatershed main stems;

- identify all AMD discharges and abandoned mine areas directly affecting the quality of the stream;
- identify remediation projects that will assist the group in meeting water quality improvement goals;
- identify remediation projects that will help the group sustain local interest and support for restoration efforts over the long-term;
- monitor changes in water quality and stream biology as restoration proceeds; and
- educate the public about the mission of ACWA, its ongoing involvement in restoration activities, and the importance of conserving the watershed's unique natural and cultural assets through sound land-use practices.

II. Watershed Description

Overview

The Anderson Creek watershed is located in central Pennsylvania, Clearfield County. Anderson Creek encompasses parts of Bloom, Brady, Penn, Pike, Pine, and Union townships, and lies approximately seven miles west of Clearfield Borough and five miles east of the City of Dubois. The watershed is mostly rural, with a few small communities located in the northern portion and several more densely populated communities in the southern portion. The communities of Chestnut Grove, Laborde, Anderson Station, Rockton, and Anderson Creek lie to the north, while the boroughs of Curwensville, Grampian, and Hepburnia, along with the community of Stronach, are in the southern part of the watershed.

Anderson Creek drains approximately 78 square miles. From its headwaters located in Pine Township, it flows in a southward arc, first to the west, and then back to the east, before its confluence with the West Branch of the Susquehanna River in the borough of Curwensville.

The watershed is primarily forested (83.9 percent) with minimal developed lands (1.3 percent). Agriculture, mainly croplands and hay fields, account for 11.7 percent of the land use. Surface coal and clay mines have impacted approximately 2.6 percent of the watershed. Waterbodies and wetlands account for the remaining area (SRBC 2002).

The highest elevations in the watershed lie on its eastern edge, approximately 2,400 feet above sea level. The mouth of Anderson Creek is about 1,100 feet above sea level.

The major tributaries of Anderson Creek are Whitney Run, Stony Run, Montgomery Run, and Coupler Run in the northern portion of the watershed; Little Anderson Creek, Rock Run, Panther Run, Irvin Branch, and Bear Run in the central area; and Bilger Run, Hughey Run, Fenton Run, Kratzer Run, and Roaring Run in the southern portion.

Interstate 80 intersects the watershed in an east-west direction to the north, just above the reservoir. PA Route 322 also dissects the watershed in an east-west direction, but approximately two miles south of the Dubois Reservoir. PA Route 219 traverses the eastern edge of the watershed in a mostly north-south direction. PA Route 879 parallels Kratzer Run in a mostly east-west direction for much of its length in the southern portion of the watershed. On the eastern side, Greenwood Road closely follows the watershed boundary of the study area between Curwensville and PA Route 322, which traverses the northern boundary east to west.

Dubois Reservoir, a key water feature located in the northwestern part of the watershed—and impounding water from only the main stem's upper reaches—covers approximately 210 acres. The reservoir serves as the water supply for the city of Dubois.

In 1999, the City of Dubois Watershed Commission received a comprehensive planning grant to complete a management plan for the upper part of the watershed (headwaters to Dubois Reservoir). The study indicates that the drainage area above the Dubois Reservoir is relatively unimpacted by NPS pollution, although acid rain appears to be having an increasingly negative effect over time, due to the geology of the area and its lack of buffering capability. This section of Anderson Creek is classified as a high-quality coldwater fishery (HQ-CWF). The area above the Dubois Reservoir was not included in this assessment report.

The Anderson Creek watershed could be described as having two distinctly different characters. To the north and east, the watershed is mostly forested, with relatively little disturbance. To the west and south, mainly below the Dubois Reservoir, the geology and the character of the watershed change significantly. Coal and clay deposits, located primarily within the western and southern portions of the watershed, have led to extensive mining of these important natural resources. Unregulated and under-regulated mining practices of the past have seriously degraded the land and water resources within this region of the watershed where most of mining has occurred. It is within this area of the watershed where most of this study has ultimately concentrated.

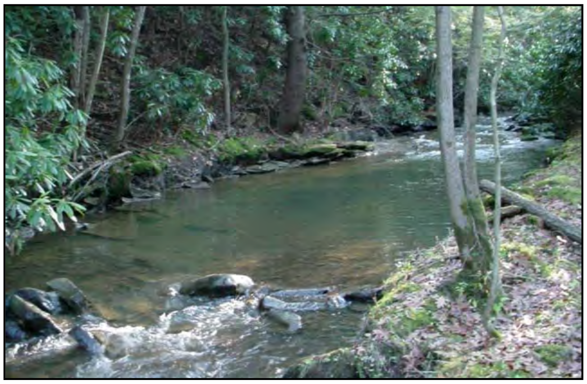
Except for slight acid rain impacts, naturally occurring acidic conditions, and minor flows of polluted mine drainage from a few old mine sites, the main stem of Anderson Creek remains relatively unpolluted for approximately 3.5 miles below the Dubois Reservoir, until its confluence with Little Anderson Creek. Little Anderson Creek drains much of the west-central portion of the watershed, which contains the coal and clay. It severely degrades Anderson Creek with acid and metals from numerous abandoned coal and clay mines for the remainder of its course to the confluence with the West Branch of the Susquehanna River at Curwensville. Several subwatersheds add acid and metals pollution directly to the main stem below the confluence with Little Anderson Creek, the more severely degraded caused chiefly by coal and clay mining, but some also caused by acid precipitation. Additionally, pollution from Kratzer Run and its sub-basins adds to the impairments of Anderson Creek when it joins the stream approximately two miles upstream of the mouth near Curwensville.

The Dubois Reservoir, located in the northern portion of Anderson Creek, serves as a water supply for the City of Dubois.

The different types of mining common throughout the region have compounded Anderson Creek's mining-related problems. Historically throughout Pennsylvania, coal mining has accounted for most resource extraction non-point source pollution. However, in Anderson Creek, abandoned clay mines may be an even more significant problem than coalmines in some instances. Clay mines account for mine discharges containing high levels of aluminum, known for its toxicity to aquatic life, and are prevalent throughout the watershed. High levels of aluminum are also more difficult to treat using passive treatment technologies and usually require more complex and expensive treatment methods.

In the southern portion of the watershed is Kratzer Run, another major tributary to Anderson Creek, which flows west to east and parallels Route 879 for most of its length from Grampian to Curwensville. Bilger Run, which includes the tributaries of Hughey Run and Fenton Run, flows from the northwest and is Kratzer Run’s largest tributary. Kratzer Run and Bilger Run have both have been identified as streams not meeting their designated use due to water quality impairments. Kratzer Run is polluted with metals, most of which come from Bilger Run, but it does contain alkalinity, which helps to neutralize some of the acidity in Anderson Creek.

Below the confluence of Kratzer Run and Anderson Creek, Roaring Run, a small tributary that is perhaps the highest quality stream within the watershed, joins Anderson Creek. Roaring Run drains from the southeastern portion of the watershed. Unlike most streams on the eastern side of the watershed, which are pH depressed and acidic, Roaring Run maintains a fairly consistent neutral pH and contains more alkalinity. Roaring Run provides additional alkalinity and good water quality to Anderson Creek, but it is not enough to neutralize the acidic conditions of Anderson Creek, and the stream remains polluted for the remainder of its course.



Roaring Run, a high-quality stream that enters Anderson Creek near Curwensville.

Near its confluence with the West Branch of the Susquehanna River, Anderson Creek flows through the borough of Curwensville. Anderson Creek becomes much wider and shallower near Curwensville and exhibits evidence of being channelized, very likely for flood-control purposes. Within Curwensville, another small tributary that drains the area just north of the borough enters the stream. This small tributary goes unnoticed for most of its course through Curwensville because it is a buried stream, only emerging in a flood-control channel as it nears the main stem.

Although many stream segments within the study area are impaired, the Anderson Creek watershed remains an important regional asset. Pike Township Water Authority (PTWA) relies on Anderson Creek for a water supply in times when its main water source is diminished during drought conditions. Approximately 4,500 area residents are served by PTWA, and assuring a clean, reliable water supply is critical to homeowners and local industry alike. Farming, although on the decline here as in other areas throughout Pennsylvania, remains an important industry within the watershed and depends on good water sources and fertile land. Surface mining has affected much of the historic farmland within the watershed as diminishing profits prompted many farmers to take advantage of the value of coal lying beneath their fields. Recreation, which is becoming an increasingly valuable economic resource, could become a major source of revenue within the region once degraded areas within the watershed are addressed and water quality improves. Local citizens look optimistically at Anderson Creek as a major recreational draw for the region.

Geography

Anderson Creek is located within the Appalachian Plateau Province. The Appalachian Plateau is sometimes known in Pennsylvania as the Allegheny Plateau. The plateau is oriented in a northeast-southwest direction, covering much of northern and western Pennsylvania—nearly half of the state. Its topography is characterized by ridges of relatively similar elevations, downcut by streams into narrow valleys. Streams have developed into dendritic drainage patterns, characteristic of an area underlain by relatively horizontal sedimentary rocks of similar erosion resistance, in this case, shales, sandstone, and conglomerates. Many of the hilltops contain deposits of erosion-resistant sandstone, which prevented them from being significantly downcut. The maximum elevation of approximately 2,380 feet is found in the headwaters of Bear Run, and the minimum elevation of approximately 1,140 feet at the mouth of Anderson Creek (SRBC 2002).

Geology of Anderson Creek

The following information is published in the Anderson Creek Mine Drainage Abatement Project, Operation Scarlift. Project No. SL-1-17: 1-102.6. 1974. It provides a very good description of the geologic features found within the watershed.

> ### Structural Features
>
> The surface formations in the area, which includes the Anderson Creek watershed, are entirely of sedimentary origin. These rocks are primarily of the Allegheny and Pottsville Formations of Middle Pennsylvanian age.
>
> Some higher locations in the southern part of the watershed, particularly around Grampian, have exposures of the Conemaugh Formation, which immediately overlies the Allegheny Formation and is also of Pennsylvanian age. The rocks of the Mauch Chunk and Pocono Formations of Mississippian age are present along Anderson Creek. The Mauch Chunk Formation is present along Bear Run as well, and it is also present to a lesser extent along several of the major tributaries of Anderson Creek. In some locations, but to a very limited extent, rocks of the upper Devonian, particularly those of the Oswayo Formation, are found. This is the case along Anderson Creek at some locations, particularly south of its confluence with Little Anderson Creek.

A pronounced structural feature in this area is the Chestnut Ridge Anticline. This Anticline was known as the Driftwood Anticline in many of the works of the earlier Pennsylvania Geological Surveys, but was later associated with the Chestnut Ridge Anticline of southwestern Pennsylvania and became known as such. The Anticline trends southwest-northeast across Clearfield and Elk counties. The Anticline enters the watershed about three miles southwest of Chestnut Grove and proceeds across the watershed in a northeasterly direction. It plunges at both ends with a dome centered two to three miles northwest of the watershed.

The dome is approximately 18 miles long with an average width of three miles. This surface structural closure is determined by the lowest closing contour of 2100 feet. The configuration of the contour closure suggests that there may be a saddle present just west of the Pine Township line. If so, then there would be "twin highs" on the dome.

Dips are relatively steep on the south flank of the Anticline and gentler to the north. Dips on the southern flank reach 350 feet to 400 feet to the mile. Topographically, this Anticline produces the highest ground in the watershed, in some places over 2,300 feet. This anticline exposes the pre-Pennsylvanian, uppermost Devonian strata where cut by streams. (See PLATE 4 taken from the Anderson Creek Mine Drainage Abatement Project, Operation Scarlift. Project No. SL-1-17: 1-102.6. 1974.)

In the area west of the Allegheny Front, the folding is quite gentle in contrast to the close folding and faulting to be found in the Appalachian Valley and eastward. In those portions of the project area divorced from the Chestnut Ridge Anticline, particularly to the south and northwest, the strata lie nearly flat or are only slightly folded. Faults are of no major consequence in this area and are present only of as light magnitude locally.

(For geologic cross sections showing regional structure see Exhibit No. 1 taken from the Anderson Creek Mine Drainage Abatement Project, Operation Scarlift. Project No. SL-1-17: 1-102.6. 1974.)

Geologic Column

The surface formations in the project area are sedimentary strata, primarily of Pennsylvanian age of the Allegheny and Pottsville Formations. Very limited exposures of Conemaugh Formation rocks are evident, and some Mississippian and Devonian age rocks also occur.

Coals and clays in the watershed usually occur in beds less than five feet thick. The sandstones and shales in the watershed are quite variable with some beds reaching 50 feet to 75 feet thick. The sandstones and shales frequently grade into each other vertically and horizontally with no distinct delineation between beds. The sandstones are often massive and are very abundant.

Limestone beds in the watershed are limited, and those beds encountered are usually thin and impure. The underclays are perhaps the most persistent beds in the watershed, even more so than the coals. The clays range from one foot to 18 feet thick, with an average thickness of from two feet to four feet.

Only the lowermost members of the Conemaugh Formation are present in the project area. The lower beds of the Mahoning member are present primarily on hilltops in the synclines. The Conemaugh Group extends from the top of the Upper Freeport coal to the floor of the Pittsburgh coal underclay.

Below the Conemaugh Group end covering the greater part of the watershed is the Allegheny Formation. This formation has a vertical thickness of approximately 300 feet. One must remember that the thickness of most of the strata in this area is very variable and lateral extent of the beds are at best inconsistent, so that in talking about a geologic column for an area such as this one, only a generalized and theoretical column can be considered, as the column would probably not be the same at any two locations in the area.

The uppermost bed of the Allegheny Formation is the Upper Freeport coal, which is among the most persistent and workable beds in the area. It is usually present as a single bed, occasionally reaching a thickness of six feet, but usually is less then four feet thick. The Upper Freeport coal is overlain by fine-grained shales of an olive or yellowish-green cast which grade into a flinty shale. Limestone is found underlying this seam more so than any other.

The Upper Freeport clay almost invariably underlies the coal. With an average thickness of two feet to four feet, it is the thickest regular clay in the group. Underneath is the Upper Freeport limestone, which is present only locally. This limestone, when present, ranges from less than a foot to five feet in thickness.

Often occurring with, and underlying, this limestone is the Boliver fireclay. This clay is second only to the Mercer clay of the Pottsville Formation in economic significance in this area. Underlying the Bolivar fire clay is a dark gray to purple shale often containing layers of sandstone. The shale ranges from 20 feet to 60 feet thick and overlies the Lower Freeport coal. The Lower Freeport seam generally produces a coal of high quality and may appear as one bed or as two separate seams ranging from 1½ foot to six feet thick. The Lower Freeport clay and limestone are often absent.

The Freeport sandstone separates the Lower Freeport coal from the Kittanning coals and is generally around 40 feet thick. The Upper Kittanning seam is usually quite thin compared to the other coals of the area, often less than a foot thick. The Upper Kittanning coal is underlain by approximately 50 feet of shales and some local sandstones. The Middle Kittanning coal seam is also thin and is often absent. Drab shales with rider coal and local sandstones underlie this seam. The Lower Kittanning coal is perhaps the most valuable seam in the area. The Lower Kittanning coal is very persistent and ranges from two feet to 4 ½ feet in thickness with an average thickness of two feet to 2 ½ feet. It is underlain everywhere by clay two feet to 20 feet in thickness and averaging six feet to eight feet thick. The VanPort limestone, which is usually a key bed, is almost entirely absent in this area.

Below the VanPort limestone lays the Clarion coal seam, another thin seam mined locally. The Clarion coal overlies the Clarion sandstone, which is very massive, and the Clarion flint clay. At the base of the Allegheny Formation are the Brookville coal and its clay underlier. The Brookville coal ranges from thin to four feet thick.

The Pottsville Formation is from 150 feet to 200 feet thick in this area. Its uppermost member is the Homewood sandstone. The Homewood sandstone is the most massive member of the group, being coarse-grained and often conglomeratic. The Homewood sandstone is generally light brown and often streaked with iron oxide. It may contain quartz pebbles an inch in diameter. The sandstone ranges from 20 feet to 80 feet thick and is economically important having been quarried extensively near Curwensville.

Underlying the Homewood sandstone is a thin layer of shale and Mercer coal. The Mercer coal seam is usually less than two feet thick and overlies the Mercer clay. The Mercer clay is the most economically significant clay in the area. It is usually eight feet to 10 feet thick and may reach a thickness of 18 feet.

The bottom member of the Pottsville Formation, locally, is the Connoquenessing sandstone. It is fine-grained and quite shaly in places, often nearly entirely replaced by sandy shale.

The Mauch Chunk and Pocono Formations of Mississippian age appear in some of the deeper stream valleys. In some deep stream valleys crossing the Chestnut Ridge Anticline, rocks of the Upper Devonian Oswayo or Catskill Formations may outcrop.

(For a generalized geologic column of the rocks of the watershed, see Exhibit No. 2 from the Anderson Creek Scarlift report, 1974.)

Coal Seams

Practically all of the coal mined in the project area is that of the Allegheny Group, originally known as the Lower Productive Coal Measures. The only possible exception might be the Mercer coal seam, which may be mined locally on a very limited scope. In general, this group increases in thickness from west to east and the number of coal beds increases in the same direction. Fixed carbon increases from west to east also. There may be as many as 15 or more coal beds in this area, four of which are quite widely workable and many more mined locally. These beds are on the average a little thinner in the project area than elsewhere in the county. Workable beds range from slightly less than two feet in thickness to about 52 feet thick. The coal beds in this area are generally quite shallow, none being over 1,000 feet deep, and, as a rule, most are considerably less than 400 feet deep.

Over part of the area, particularly in the lower-lying portions along the Chestnut Ridge Anticline, some or all of the Allegheny coals have been removed by erosion. The beds are underlain practically everywhere by clay.

The principal coals of the Anderson Creek watershed area are as follows:

Upper Freeport – Also known as E or cap seam. The Upper Freeport coal is one of the most valuable and persistent beds of the group. In this area, it may reach a thickness of six feet, but is most commonly less than four feet thick. The Upper Freeport coal is usually found as a single bed. The Upper Freeport in this area is overlain by olive or yellow green, fine-grained shales that may grade into a flinty shale. Limestone frequently underlies the underclay of the Upper Freeport, and often a layer of flint clay is present.

Lower Freeport – Also known as D or Moshannon seam. The Lower Freeport generally lies 20 feet to 60 feet below the Upper Freeport coal, with the average being about 40 feet. The Lower Freeport is a very variable bed and in some parts of the county, particularly to the southeast of the watershed, it splits into two seams, which are separated by as much as 55 feet. The Lower Freeport coal seam is generally of high quality averaging about two feet to 2 ½ feet thick, but reaching a thickness of five feet near Grampian.

Upper Kittanning – Also known as C′. The Upper Kittanning coal is of only minor importance. It is usually quite thin compared to other coals, and commonly averages around a foot thick. Most of the cannel coal in the state appears to occur at this horizon.

Middle Kittanning – Also known as C. Several coals occur between the Upper and Lower Kittanning seams. In the watershed there are at least three horizons in this interval, and perhaps as many as five in some parts of the county. It has been suggested that the variable vertical position of coals in this space may be due to the occurrence of non-persistent coals at several distinct horizons. The seams in the watershed are generally a foot or less thick. As a rule, these coals are of little value commercially, but in some locations it is thick enough to attract commercial exploitation.

Lower Kittanning – Also known as B seam. The Lower Kittanning is probably the most important coal in Clearfield County, and is the most persistent coal of the Allegheny Group. It is not a very thick bed, but is generally a bed of fine quality. It ranges from one foot eight inches to about five feet in thickness, and averages about two feet to 2 ½ feet thick. It is underlain everywhere by clay ranging in thickness from two feet to 20 feet, but generally being six feet to eight feet thick.

Clarion – Also known as A'. The Clarion coals are commonly quite thin and of little commercial value, but like the other minor coals of the Allegheny Group, they thicken locally so as to be of value. Generally, in this area they are a foot or less in thickness.

Brookville – Also known as A. This is the bottom coal of the Allegheny Group. This is generally not of too much importance in Pennsylvania. In the project area it is approximately a foot thick and has a tendency to carry a high percentage of ash.

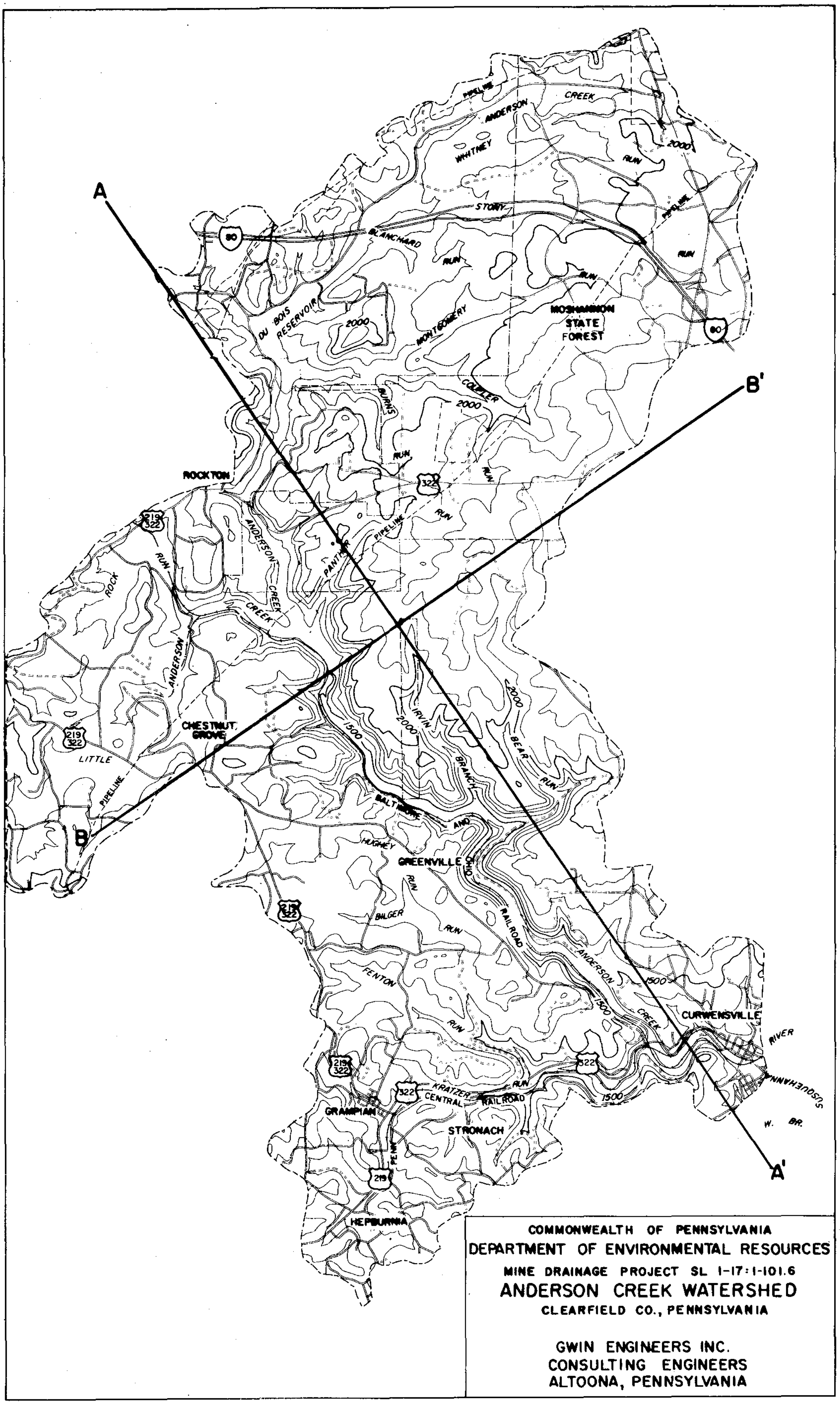
Mercer – This is the uppermost coal of the Pottsville Series, but is not of much consequence economically in the project area. It is usually about a foot thick. At some places there are as many as four or five seams at this horizon. Generally of more interest than the coal is the Mercer clay, which underlies it. This clay has been both deep mined and strip mined quite extensively throughout the watershed, with many of the inactive clay operations being among the chief acid producers.

Watershed Impairments

Historic data shows many areas within the watershed are heavily impacted by past resource extraction activities, particularly mining. The various types of mineral resources common throughout the region have compounded Anderson Creek’s mining-related problems. Historically in Pennsylvania, coal mining has accounted for most resource

Exhibit No. 1
Page 1 of 2

GEOLOGIC CROSS SECTIONS



COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
MINE DRAINAGE PROJECT SL 1-17:1-101.6
ANDERSON CREEK WATERSHED
CLEARFIELD CO., PENNSYLVANIA

GWIN ENGINEERS INC.
CONSULTING ENGINEERS
ALTOONA, PENNSYLVANIA

Exhibit No. 1
Page 2 of 2

GENERALIZED STRATIGRAPHY OF THE ANDERSON CREEK WATERSHED

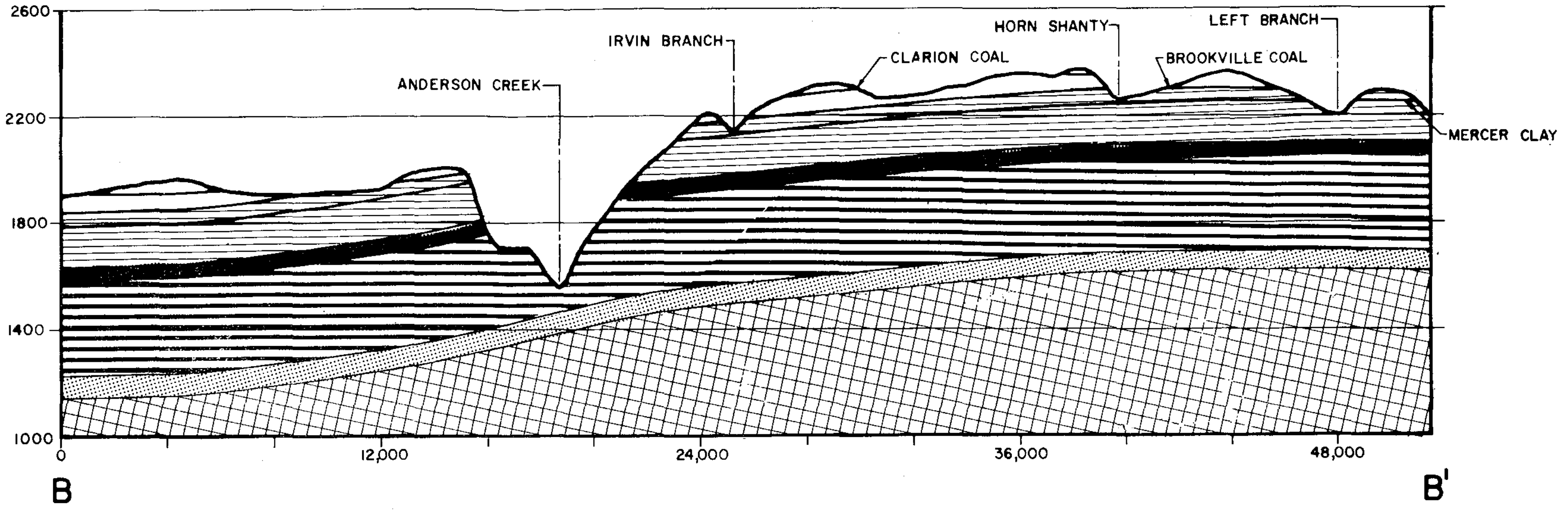
FORMATION	MEMBER	COLUMNAR SECTION	APPROXIMATE THICKNESS	ROCK TYPE
CONEMAUGH	BUFFALO	▥	70'	SANDY SHALES SANDSTONES CONGLOMERATES COAL
	MAHONING	▥	70'	
ALLEGHENY	FREEPORT	▤	300'	COAL CLAYS SHALES SANDSTONES
	KITTANNING	▤		
	CLARION	▤		
	BROOKVILLE	▤		
POTTSVILLE	MERCER	▤	200'	COAL CLAYS SHALES SANDSTONES CONGLOMERATES
	CONNEQUE-NESSING	▤		
MAUCH CHUNK	UPPER	▤		
	LOWER	■	50'	SHALES
POCONO	BURGOON	▤	350'	SANDSTONES CONGLOMERATES
	PATTON	░	25'	RED SHALES
	SUB-BURGOON	▩	650'	SHALES SANDSTONES

NOTES:

THE STRATA OF THE LOWER POTTSVILLE AND UPPER MAUCH CHUNK ARE SO SIMILAR THAT THEY CANNOT BE READILY DIFFERENTIATED.

GEOLOGIC INTERPRETATION OF WATERSHED CROSS-SECTIONS IS BASED ON THE BEST INFORMATION CURRENTLY AVAILABLE.

HORIZONTAL AND VERTICAL DISTANCES ON CROSS-SECTIONS ARE GIVEN IN FEET.



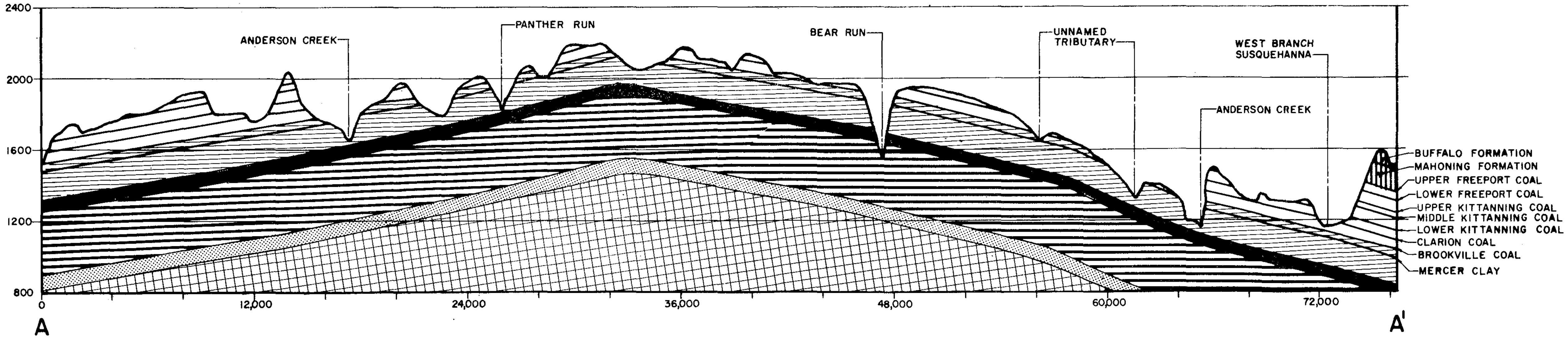
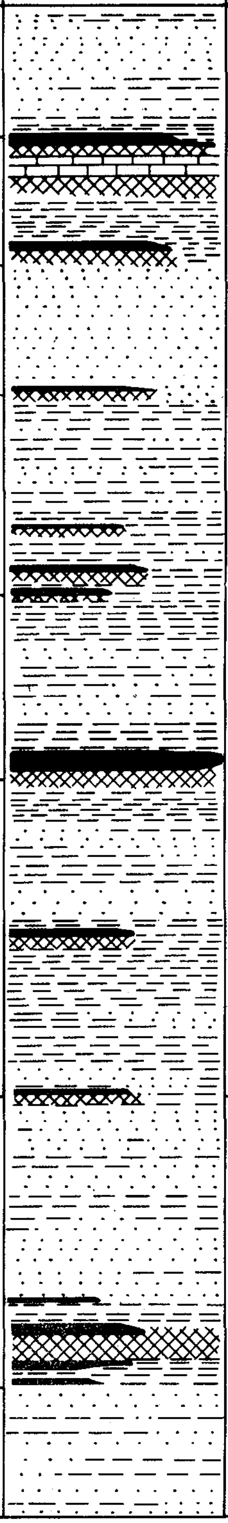
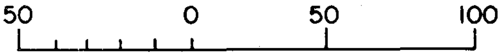


Exhibit No. 2
Page 1 of 1

GENERALIZED COLUMNAR SECTION OF EXPOSED ROCKS

System	Group	Formation	Member	Section	Character of Member	General Character of Formation
PENNSYLVANIAN	CONEMAUGH		Lower Mahoning sandstone		Sandstone and sandy shale sometimes separated by thin lenses of coal Red shale occurs -40' above Upper Freeport	Only the lower part of the formation is present - about 40'.
	ALLEGHENY	Glen Richey Fm.	Upper Freeport coal		Widely persistent average thickness 3' to 3½'.	A variable sequence of shale, sandstone, limestone, clay, and valuable beds of coal. Average thickness is about 300'.
			Lower Freeport coal		Variable, average 2' to 2½' thick.	
		Laurel Run Fm.	Freeport s.s. Upper Kittanning coal		Thin, about 1' to 1½' thick.	
		Mineral Springs Fm.	Middle Kittanning coal		About 3 seams present at this horizon. Usually 1' to 1½' thick.	
		Millstone Fm.	Lower Kittanning coal		Very persistent. Average thickness 2' to 2½'	
		Clearfield Fm.	Clarion coal		Thin, variable, about one foot thick.	
			Brookville coal		Thin, variable.	
	POTTSVILLE	Curwensville Fm.	Homewood s.s.		Massive s.s. often separated by shale.	Only the upper part of the formation is shown here - about 140'
			Mercer coal		Variable, often several thin beds present at this horizon.	
			Mercer clay			
		Elliott Park Fm.	Connoquenessing s.s.		Fine grained, quite shaly in places almost completely replaced by sandy shale.	



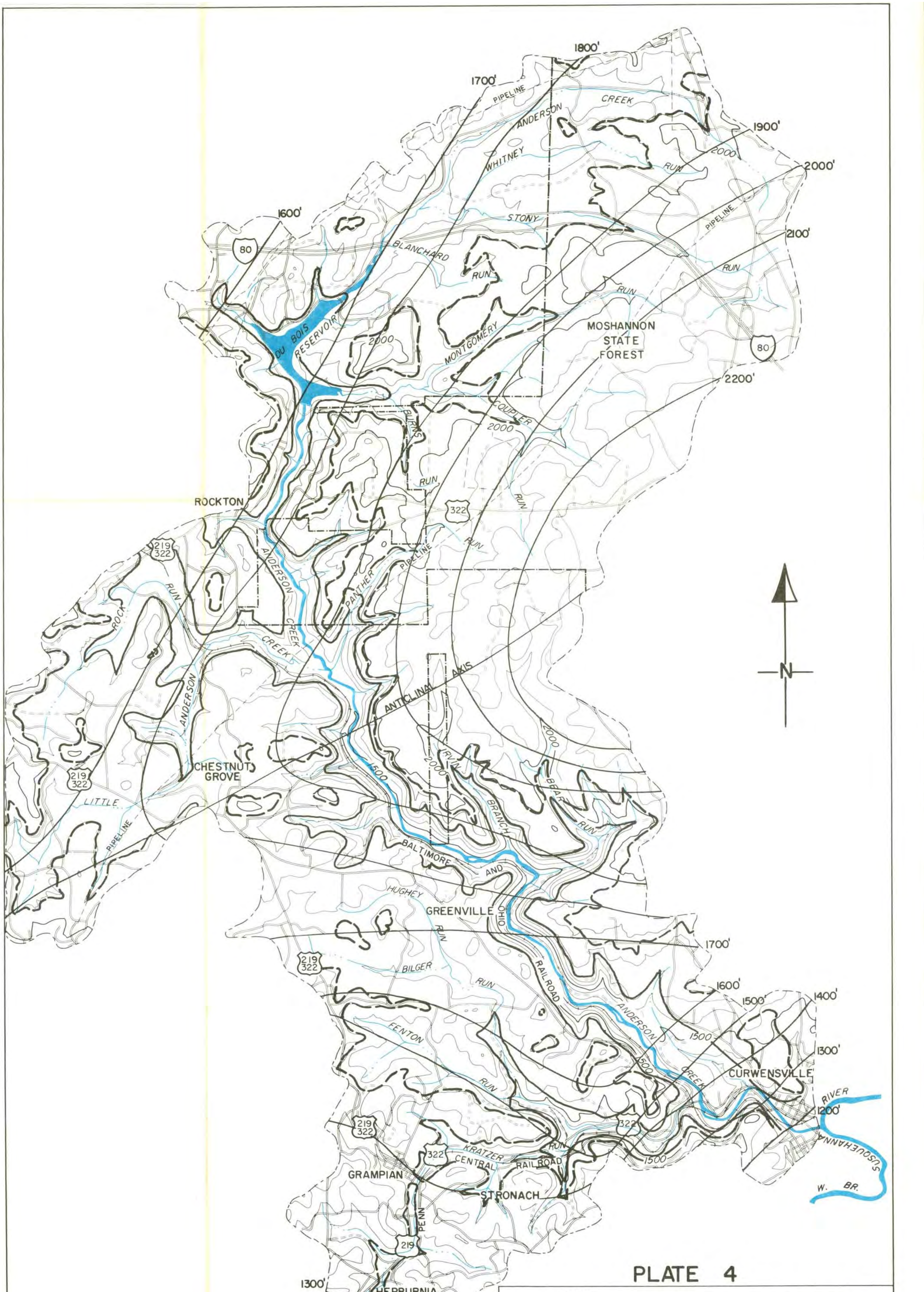


PLATE 4

LEGEND

- - - TOWNSHIP LINE
— — WATERSHED BOUNDARY
MERCER CLAY OUTCROP
LOWER KITTANNING COAL OUTCROP
1500 SURFACE CONTOURS
— · — STATE FOREST LAND
STRUCTURE CONTOURS BASE OF MERCER CLAY

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
MINE DRAINAGE PROJECT SL 1-17: 1-101.6

COAL SEAM OUTCROP
OF THE
ANDERSON CREEK WATERSHED

CLEARFIELD CO., PENNSYLVANIA

1000 0 2000
SCALE
1974

PREPARED BY
GWIN ENGINEERS, INC.
CONSULTING ENGINEERS
ALTOONA, PENNSYLVANIA

extraction non-point source pollution. In Anderson Creek, abandoned clay mines may be an even more significant problem than coalmines, in some instances. Extraction of natural gas has also been common throughout many areas within the Anderson Creek watershed, and has led to some erosion problems and forest fragmentation. Those problems are minor in comparison to those caused by the mining of clay and coal.

Clay mines account for mine discharges containing high levels of acidity and aluminum, known for its toxicity to aquatic life. Several high-flow discharges from abandoned underground clay mines account for a significant portion of the pollution entering Anderson Creek. In some instances, because the clay seams that were mined were relatively thick and often close to the surface, significant areas of subsidence have occurred. The subsidence not only creates surface depressions that develop flow paths of surface water into the mine voids, it also increases the opportunity for oxygen to enter the mine, which accelerates the chemical reactions that produce AMD. Furthermore, coal often lies above the clay. When subsidence occurs, the coal and surrounding materials, which contain the pyrite that produces AMD, collapses into the clay mine, increases acid production, and helps leach the aluminum from the clay. Eventually, the toxic AMD escapes from the mine and enters surface water streams where it has a devastating effect on all aquatic life.

Subsidence area above the Spencer clay mine. Note the numerous depressions. Such areas direct rain and surface water directly into the underground mine, which increases pollution. Subsidence areas are extremely hazardous to nearby residents.

Problems associated with unreclaimed surface mining also severely degrade the stream. Again, the problem is compounded by the fact that clay was surface mined and coal seams above the clay were regarded as an insignificant resource compared to the clay. Most often this coal and its associated shales were intermixed and “spoiled” on site, often left in un-vegetated, haphazard piles without proper drainage. Several of these areas exist throughout the watershed. Some do not show significant surface water impairments on-site, but can be associated with AMD discharges at lower elevations, where they often appear next to the stream. Others create AMD on-site and pollute adjacent watercourses.

Poorly vegetated mine spoil on an abandoned surface mine.

Pollution from resource extraction is not the only problems affecting the stream.

Agricultural practices in some areas of the watershed add nutrients and sediment loads to the streams as well. Some stream segments in headwater areas are directly accessible to cattle, which can trample streambanks and expose the water to animal waste. Direct runoff from barnyards can also impair receiving streams with the same pollution sources. Other sources of non-point source pollution also affect areas of the watershed. Poorly functioning or non-existent septic systems, uncontrolled stormwater, sediment from dirt and gravel roads, poor forest harvesting practices, and poor streamside vegetation cover all affect the watershed. Several stream segments have severe erosion and sedimentation problems related to land-use activities in the more residential areas of the watershed. Acid deposition affects many of the watershed's streams. However, none are as widespread or destructive as the problem caused by poorly regulated coal and clay mining and their associated AMD.

Studies of Anderson Creek

Several studies have identified the pollution problems on Anderson Creek. A study completed in 1974 under the state's Scarlift program, initiated by the Pennsylvania Department of Environmental Resources (DER), identified specific areas where abandoned mine problems, both land and water, existed within the watershed. The locations of abandoned underground and surface mine areas were noted, problems associated with the areas identified, and recommendations for the reclamation of the areas affected were developed.

The Scarlift study, along with later studies by Pennsylvania's Bureau of Abandoned Mine Reclamation (BAMR), identified Little Anderson Creek and Rock Run, its major tributary, as severely impacted by AMD. Anderson Creek was essentially devoid of fish life from the confluence of Little Anderson Creek to the mouth of the stream. The studies noted Kratzer Run and its tributaries as severely degraded as well. Recent water monitoring done by DEP, Clearfield County Conservation District, Susquehanna River Basin Commission, and ACW members tend to confirm the findings of those older studies, and show that many stream segments still contain toxic levels of metals and acidity. Many areas identified in the 1974 Scarlift study have never been addressed and remain significant sources of pollution today. Some water quality improvements have been made, mostly due to remining of previously affected areas and the incorporation of modern reclamation techniques. Significant areas of disturbed lands, which also affect surface waters, remain unreclaimed.

Other studies performed under the auspices of the local, state, and federal agencies and other organizations have noted the problems in the watershed. The most recent study, completed by the Susquehanna River Basin Commission in 2004 under the requirements of the federal Clean Water Act, identified the following studies as having been completed in the watershed:

- In 1990, the U.S. Army Corps of Engineers completed a hydrological study on Tanners Run. A control channel was constructed to reduce the flooding impacts in Curwensville from this tributary to Anderson Creek.

- The Pike Township Municipal Authority manages a public water supply reservoir on Bear Run. In 1991, the DER completed a special protection evaluation report and water quality standards review on Bear Run and the Irvin Branch. They recommended that Bear Run's designation be changed to a HQ-CWF to further protect its use as a public water supply. The designation change on Bear Run, from its source to the Pike Township Municipal Authority Dam, occurred shortly thereafter. Bear Run remains classified as a coldwater fishery (CWF) below the dam. Irvin Branch was recommended to remain a CWF because of elevated levels of metals and a lowered pH. Conflicting reports concerning Irvin Branch debate whether or not it is impaired by AMD. In the spring of 2002, an aquatic biology survey using the DEP SSWAP method was completed. Irvin Branch has excellent biological fauna and was determined to be meeting its designated use. In fact, the biologist recommended it be used as a reference for the aquatic life that should be found in the area streams. Irvin Branch has been recommended for de-listing.
- In 1998 and 1999, DEP's SSWAP surveyed the macroinvertebrate communities in most of the watershed to determine if the streams were meeting their designated uses.
- The Clearfield County Conservation District received a 104(b) 3 grant for an assessment of the Upper West Branch of the Susquehanna River, which includes the Anderson Creek watershed. The project report was completed in 1999.
- The Cambria County Conservation and Recreation Authority also received funding in 1999 from a Department of Conservation and Natural Resources (DCNR) Rivers Conservation Grant to conduct a study of the Upper West Branch of the Susquehanna River. Their final report was published in 2001 (WRAS 2000).
- In 2000, the Clearfield County Commissioners contacted the USDA NRCS to begin the process for a PL-566 study of Anderson Creek on behalf of the ACWA. A preliminary assessment was completed through the Headwaters Resource Conservation and Development Council and the Clearfield County Conservation District.
- In April 2000, the City of DuBois was awarded a Growing Greener Grant to identify the sources of metals, low pH, and other pollutants in order to develop a remediation plan for their drinking water supply. Most of the streams that flow into their reservoir have at least one water quality parameter that does not meet DEP drinking water standards. The parameters most often violated are pH, iron, manganese, sodium, and aluminum. The final report, entitled the DuBois Reservoir Watershed Water Quality Assessment Project, was completed in 2001. The water quality violations are due to natural conditions and, therefore, will not be addressed in this document because they are not caused by AMD. Anderson Creek and its tributaries above the DuBois Reservoir are meeting their designated uses for aquatic life according to the DEP SSWAP despite these chemical violations (SRBC 2004).

In addition to those studies, in July 1999 Headwaters Charitable Trust, in cooperation with the Pennsylvania Fish and Boat Commission, Canaan Valley Institute, and DEP performed a biological survey of Anderson Creek and several of its major tributaries. The study found several of the relatively unimpaired sub-basins contained naturally reproducing brook trout populations. Little Anderson Creek only contained fish in its headwaters. No fish were found at the station sampled in Bilger Run. And the main stem of Anderson Creek only contained fish above the confluence with Little Anderson Creek.

Restoration: A Priority

Several studies have identified the restoration of Anderson Creek as a priority. The Upper West Branch Susquehanna River Conservation Plan identified the restoration of the Anderson Creek watershed as a priority in its management recommendations. The newly completed TMDL study has also identified the watershed as severely impacted and a priority for restoration. In addition, preliminary work on the NRCS PL-566 Small Watershed Protection Plan has indicated AMD as the main impairment to the watershed and a priority for cleanup.

Although many stream segments within the study area are impaired, Anderson Creek remains an important regional asset. Pike Township Water Authority (PTWA) relies on Anderson Creek for its water supply during drought conditions and must incur additional treatment costs to make the stream water potable during those times. Assuring a clean, reliable water supply is critical to PTWA homeowners and local industry alike.

Farming, although on the decline as in other areas throughout Pennsylvania, remains an important industry within the watershed and depends on good quality water sources and fertile land. As farm profits diminished, many farmers were prompted to take advantage of the value of coal lying beneath their fields by having it surface mined. Old surface-mining techniques often led to less-productive land and many fields are no longer considered as quality cropland. Restoration of abandoned mine land into productive agricultural or forest land is therefore also a priority

Recreation, which is becoming an increasingly valuable economic resource, could become a major source of revenue within the region once degraded areas within the watershed are addressed and water quality improves. Much of the streamside land remains wooded and riparian conditions and in-stream habitat are generally of high quality throughout most of the watershed. Restoration of degraded stream water quality would likely lead to higher recreational use for recreational fishing and other activities. There appears to be good potential to improve Anderson Creek enough to support fish below its confluence with Little Anderson Creek if several AMD-producing sites in the sub-basin are improved. Water quality monitoring indicated that with some improvement, Anderson Creek could recover.

Improvements in water quality would provide recreational stream users with a high-quality experience. Recognizing this, local citizens look optimistically at the

Anderson Creek gorge as a major recreational draw for the region. An abandoned railroad traverses much of the Anderson Creek gorge and development of a Rail-to-Trail using this rail line would connect nicely with the trail along Kratzer Run and the West Branch of the Susquehanna River. Additionally, other nearby rail trails could be connected to an Anderson Creek rail trail. Improving the water resource will be a key to developing any additional recreational and economic value within the watershed. Recreational boaters also consider Anderson Creek a challenging whitewater stream. Its numerous rapids and remote character make it an appealing whitewater run. Only its poor water quality degrades what could be a premier boating experience.

Whitewater rapids within the Anderson Creek gorge

III. Problem Identification

Overview

Several types of non-point source (NPS) pollution impair the Anderson Creek watershed. NPS gets its name from the way the pollution is produced and/or how it is transported to waterways. NPS pollution is usually created over a broad area and often pollutes in the same manner, emanating from many individual sources within that area. For example, within the borough of Curwensville are significant areas paved with asphalt or concrete and used as parking areas. As cars and trucks are parked on the paved areas, oil, grease, and other various materials collect on the pavement. When it rains, those materials are washed from all of the paved surfaces and transported to drains that eventually lead to nearby drainage ways and streams. The pollution comes from a broad area and reaches the stream from many sources that collectively can have substantial negative impacts on the stream. NPS pollution can come from many different sources. It is usually classified under one of the following categories: agriculture, silviculture (forestry-related), nutrients, construction and urban runoff, mineral resource extraction, and hydromodification.

Impairment from mining-related resource extraction has been identified as the number one NPS problem in Anderson Creek. The TMDL study and numerous studies before it have identified the problems associated with mining. Although resource extraction has had the largest impact on the watershed, significantly degrading both land and water resources, the other sources of NPS pollution also affect the watershed, but to a much lesser extent. The TMDL study specifically identifies impairments from sediment on the Rock Run/Little Anderson Creek sub-basin and nutrients on the Bilger Run/Kratzer Run sub-basin.

Silviculture

The lumber industry likely began the first major environmental changes in the watershed. Early forestry practices gave little or no consideration to impacts the industry had on ecological systems. Clearcutting removed trees throughout the entire watershed and logs were hauled to nearby streams, where they were eventually floated downstream to area lumber mills. Once trees were removed, many of the steep slopes likely experienced severe soil erosion during periods of heavy rainfall. One can only imagine the devastating effects hundreds or even thousands of logs had on the watershed’s streams as dams were built to impound them and then floated in massive quantities to the mills downstream. On their way downstream, it is very likely the logs impacted the original conditions of the streambed. Such destructive forestry practices have long since vanished and new, more environmentally friendly logging methods have been developed over time.

The lumber industry is very active within the watershed. New methods and machinery have eliminated the need to transport logs in-stream, and logging can be done at a much faster rate. However, with modern forestry methods come new challenges. Logs are now removed using equipment that requires the construction of numerous roads within the areas being logged. Staging areas, which are used to store and load logs onto trucks for transportation to saw mills, are also constructed as part of a logging operation. They require additional clearing and grading. Excessive erosion and sediment can be generated if those roads and staging areas are not properly constructed using “best management practices.” These practices, or BMPs as they are called, were developed to limit erosion and sediment pollution.

Logging operations also often necessitate the crossing of streams. To assure minimal impacts, the construction of stabilized stream crossings is necessary. Proper construction of those crossings is critical in limiting erosion and sediment and protecting in-stream habitats. Logging roads should be constructed in a manner that limits erosion. Techniques that prevent water from flowing long distances down steep slopes, such as following the natural contour of the land and the frequent use of road cross drains, such as water bars, dips, or culverts, can limit erosion problems. Such areas should be drained to undisturbed areas and never directly to a stream. Disturbance within the streamside habitat should be limited or excluded. These methods help prevent silt from reaching the stream and impairing aquatic habitat.

Improperly constructed logging road with poor drainage allows water to collect and sediment to enter the nearby stream.

Agriculture

The original forest clearing, usually done by first “ringing” tree trunks (cutting a ring of bark from the trunk to kill the tree) allowed many areas of the land to be opened up for farming. Early farming was also closely tied to the lumbering industry as farmers turned to lumbering during the times when fieldwork was impractical. Lumbering offered a source of cash income that supplemented the subsistence farming usually practiced at that time. As more trees were cleared and land opened up, the farming industry flourished and the population grew. Farming became a key industry within the watershed.

Farming remains viable within the Anderson Creek watershed, but many factors have contributed to a decline in

Unlimited cattle access to streams can cause sedimentation, erosion, and nutrient pollution.

full-time farming operations. Economics has long been the determining factor in the viability of family farms. Throughout Pennsylvania and much of the nation, there has been a trend to move away from "family farms" and toward larger-scale operations because of the improved economics. No large-scale, industrial-type farming operations exist within the watershed.

Family farming has generally been a low-profit industry and when faced with the possibility of earning extra income from other resources, many farmers in the Anderson Creek watershed took advantage of the opportunity. Many farmers leased their minerals rights to coal mining companies, which used surface-mining techniques to extract the coal. Such operations gave many farmers much needed income, but eventually many of those farms went out of production. Many of those farms were reclaimed but are comprised mainly of fallow fields. Some have been restored to productive use, while others are left unreclaimed and remain sources of mining-related NPS pollution.

Today, there are a few working farms within the Anderson Creek watershed. Most farms contain areas where the implementation of BMPs could help reduce agricultural NPS pollution sources reaching the stream. Riparian fencing and planting, in-pasture watering systems, barnyard stabilization and runoff control, stabilized stream crossings, alternative watering sources, and various other techniques that minimize soil erosion are just a few of the practices that could be installed to reduce farm impacts to streams.

Construction and Urban Runoff

Construction and urban runoff and hydrologic/habitat modification appear to be having minimal overall impacts in the watershed. Curwensville is the largest urban area within the watershed and is the area mostly associated with these types of pollution sources. As discussed previously, pollution is generated on paved surfaces within the town and is washed into the stream during periods of rain or snow.

Some stream segments of tributaries within Curwensville have been channelized with hard structures (concrete channels) for flood control because homes and businesses within the town have been built within the floodplain. Although the structures control water during periods of high flow, they are detrimental to natural stream conditions and functions. However, it is unlikely the concrete-lined stream segments will be returned to anything resembling natural conditions. Therefore, for this assessment, the areas are just noted as impacted.

Tanners Run, a tributary to Anderson Creek, is enclosed in a concrete channel in Curwensville.

The main stem of Anderson Creek, as it flows through Curwensville, has been previously channelized. It appears that channelization has occurred from approximately one-quarter mile upstream of the confluence with Kratzer Run down to the confluence with the West Branch of the Susquehanna River. The stream channel is very wide and shallow compared with upstream sections. This section does not provide the high-quality stream habitat that exists elsewhere in the watershed.

Anderson Creek braids into two distinct channels just below the State Route 879 Bridge, near the Pike Township Municipal building. The gradient remains steep enough through this segment that no significant sediment bars have appeared within the channel. Curwensville Borough has reported the formation of a large gravel bar below the mouth of the stream in the West Branch of the Susquehanna River. It was reported that during high-flow conditions, the gravel bar is causing water to be diverted towards homes and businesses located along the West Branch of the Susquehanna River. Borough officials planned to apply for a grant through the Growing Greener program in the winter of 2005 to address the problem. It is recommended that natural stream channel design techniques be incorporated into any proposed remediation effort for the gravel bar. A more detailed study of the entire lower main stem of Anderson Creek, from the bridge on Route 879 to the mouth, would likely provide additional opportunities to install natural stream channel design structures that would greatly improve in-stream habitat.

Gravel bar, which has formed in the West Branch of the Susquehanna River at the mouth of Anderson Creek, is causing erosion along the streambank in the background.

Stormwater Runoff

The watershed’s steep topography makes flooding steams more destructive. Water velocities can become quite high during periods of very high flow and some areas of the watershed show signs of flood damage. Much of that disturbance is located in areas near roads or places where the stream has been modified. Kratzer Run, in particular, has several areas apparently affected by erosion, and downcutting is actively taking place. The areas are invariably associated with stream modification or stream encroachment, such as at road crossings or near residences.

The Dubois Reservoir provides some flood protection for the main stem of Anderson Creek, though it was not specifically designed for that purpose. The area above the reservoir accounts for only approximately one-third of the entire watershed. Much of the watershed is free flowing and therefore more prone to flooding. In addition, significant areas of forest were removed during surface mining, causing increased stormwater runoff. Implementing BMPs to reduce stormwater runoff from headwater areas may help reduce the possibility of future flooding.

The Grampian/Stronach area is the watershed's second largest urban area, but has seen little recent development pressure. Streams in the area have not been channelized to any major extent, but some has occurred. The Grampian and Stronach areas have experienced little growth over recent years and therefore pollution from construction activities is not a large limiting factor for the stream.

Erosion of streambank due to stream encroachment and poor streamside vegetation

Closely related to stormwater flow is streambank stabilization. When stormwater is released to a stream too quickly, which usually occurs because of an inability of rainwater to soak slowly into the ground, the natural balance of the stream can be quickly upset and its ability to dissipate the energy created within the water during high flows is overwhelmed.

Under normal, unaltered conditions, a stream operates within a state of equilibrium or "balance" that has been created during the formation of the stream over a very long period of time. If this balance is upset by some outside forces, such as the activities of humans that increases runoff, the stream will try to return to its natural state of balance by changing its character. Those changes might include widening of the channel, cutting wider bends, downcutting of the streambed, and so on. These changes often affect the streambanks, causing them to erode at higher rates than normal (it is important to remember that streams do erode their banks naturally, but not excessively). Eroding streambanks cause sediment to be deposited in the stream, which can degrade the habitat for aquatic animals that live in the stream. Eroding banks can eventually encroach on structures located too close to the stream channel and compromise their integrity.

Urban runoff is concentrated in the Curwensville, Grampian, and Stronach areas, but because the areas comprise such a small portion of the watershed, it appears they have little overall impact to the stream compared with other impairments. There is evidence of downcutting and streambank erosion on Kratzer Run and some of its tributaries. Since some of the headwater area has been cleared of trees for agriculture or mining activities, stormwater runoff there is likely to have higher velocities than in forested areas. Also, because many homes have encroached on Kratzer Run in Grampian and Stronach, the erosion problem has been often compounded by the clearing streamside vegetation, which usually serves to stabilize the streambanks.

Dirt and Gravel Roads

In 1997, when the gas tax legislation was amended, Pennsylvania enacted a Dirt and Gravel Roads Program (DGRP). This innovative effort funds environmentally sound maintenance of unpaved roadway sections identified as sources of dust and sediment pollution through Section 9106 of the PA Vehicle Code (PACD website).

The DGRP program is a cooperative effort between local township municipalities and the conservation districts, which assists townships in identifying problem roads and implementing BMPs that reduce or eliminate sediment from road runoff. The Clearfield County Conservation District, in cooperation with Trout Unlimited, has identified several segments of unpaved roads within the assessment area, which are causing sedimentation problems in tributaries of Anderson Creek. The townships have addressed no sites thus far. Information on locations and the status of identified problem sites can be obtained at the Clearfield County Conservation District.

Nutrient Pollution

Nutrient pollution is the presence of unnaturally high concentrations of nutrients, primarily nitrogen and phosphorous, in surface or groundwater. Sources of nutrient pollution include agriculture runoff from fields and pastures, feedlots, and barnyards, discharges from septic tanks and sewage treatment systems, atmospheric deposition from combustion sources, like coal and oil-fired power plants, urban runoff, and runoff from golf courses. Nutrient pollution can cause excessive algal growth, which causes oxygen depletion, and in more extreme cases, may lead to fish kills. The main source of nitrogen pollution is atmospheric deposition, with agriculture being the second-leading source. The chief source of phosphorous pollution comes from agricultural activities, with septic systems contributing the next greatest proportion.

Only Kratzer Run and Bilger Run were identified by the TMDL study as having a nutrient problem. The source of the nutrients was indicated to be failing septic systems in the more developed areas as well as agricultural areas. Recently the Grampian and Stronach areas along Kratzer Run were the focus of a sewage treatment system project that addressed a major portion of the nutrient problem on that tributary of Anderson Creek. Failing on-lot sewage systems or non-existent systems that pipe sewage directly to the stream are likely the cause of some localized problems remaining in the watershed.

A more detailed study of the nutrient problems in the watershed should be conducted. One of the difficulties with identifying nutrient problems in the watershed is the AMD problem, which can mask the problem by overwhelming it. Once some of the AMD-impacted stream segments are addressed, it is likely that nutrient problems will become an issue. Identifying those areas prior to AMD cleanup is very difficult and beyond the scope of this study.

Sedimentation/Siltation Pollution

Sedimentation/siltation pollution can come from activities related to all of the NPS categories. It is the number one pollutant by volume in Pennsylvania. In the Anderson Creek TMDL study, sedimentation/siltation problems were identified and calculated within the Little Anderson Creek and Rock Run watersheds. This was primarily due to sparsely vegetated abandoned mine lands and agricultural areas where livestock have access to the stream and no riparian buffers exist. These watersheds were the only basins identified by the TMDL study as impaired. Subsequent visual assessments performed under this study in other sub-basins identified many areas likely causing sedimentation/siltation problems. As mentioned in the TMDL study, sources were often associated with abandoned mine and agricultural areas, but many sites were also associated with a variety of other human activities within or near riparian zones. Of particular note was Kratzer Run, where significant erosion was taking place in several areas.

Acid Deposition

The following information was obtained from the website of Pennsylvania Fish and Boat Commission and is an excellent description of the airborne pollution most affecting Anderson Creek watershed.

> ### Acid Precipitation
>
> *Note: This is a text-only file of a Fish and Boat Commission publication that includes graphics and a map. Contact the PFBC if you would like a free copy of the complete publication.*
>
> Pennsylvania is blessed with thousands of miles of freshwater streams ranging from high mountain headwater tributaries to the slower-moving lowland varieties. All are affected to some degree by acid deposition. The purpose of this brochure is to acquaint the reader with the causes, effects and the need to reduce its effect on our aquatic environment. "The creek is a symbol of our greatest resource; as the creek flows, so flows mankind."
>
> During the past couple of decades, thousands of scientific reports have documented the serious effects of acid deposition in North America and Europe. The control of the air pollutants that cause acid rain and deposition has become a battle cry for conservation-minded citizens in many industrialized countries. Because Pennsylvania waters receive the highest amount of acid deposition of any state in the nation, the Pennsylvania Fish and Boat Commission is particularly concerned about this problem.

Acid deposition is primarily the result of human-made emissions from burning fossil fuel, automotive exhausts and other industrial processes, which emit sulfur dioxide (SO_2) and nitrogen oxide (NO_x) gases. These pollutants are transported in the atmosphere, chemically transformed, and deposited either as wet deposition (such as rain, sleet or snow) or in the form of sulfuric and nitric acids, or as dry deposition in the form of sulfate and nitrate particles. This deposition has been shown to have adverse effects on streams, lakes, forests, buildings, drinking water and human health.

Pennsylvania receives the most acid deposition of any state in the nation because, in addition to being the third highest producer of the gases that cause acid deposition, we are also located downwind from the highest concentration of air pollution emitters. Monitoring stations located throughout the Commonwealth reveal that the pH of our rainfall averages an incredible 4.0 to 4.1, which is many times more acidic than unpolluted rain.

Different areas of the state may respond differently to acid deposition, depending on the region's natural ability to "buffer" or neutralize the incoming acidity. This ability of a body of water to neutralize acids is called its "acid neutralizing capacity," and depends on the dissolved mineral content in the water, which, in turn, depends on the composition of the soils and bedrock in the watershed. If sandstone or igneous rocks such as granite or basalt primarily underlie the watershed, then the streams and lakes in the region will have low acid-neutralizing capacity. If soils and waters of an area continually receive acid deposition, their neutralizing capacity will decrease. With little or no neutralizing capacity, the water will gradually acidify and fish and other aquatic life forms will be adversely affected.

The acid-neutralizing capacity of a waterway is measured by a test called alkalinity, which can be expressed as milligrams per liter (mg/l), or parts per million (ppm) of calcium carbonate. According to international standards, streams and lakes are considered vulnerable to acid deposition if base flow alkalinity values are 10 mg/l or less. These waters are especially susceptible to effects of the continued influx of atmospheric acids. Using this criterion, about one-third of the 4,800+ miles of stocked trout streams in Pennsylvania are considered vulnerable. These streams are indicated on the accompanying map and county lists. In addition to the stocked trout streams on the map, there are even more miles of unstocked waters throughout the Commonwealth that are vulnerable to acid deposition. Some of these vulnerable waters in Pennsylvania are lakes, but most are high-quality small, mountain streams that support naturally reproducing trout populations.

What is the effect of acidification on vulnerable streams and lakes? As a waterway becomes acidified, algae and rooted aquatic plants die off, reducing the available food supply for aquatic insects and fish. Healthy aquatic insect communities are replaced by acid-tolerant individuals, which are not as desirable or abundant a food supply for higher organisms such as certain species of fish. More tolerant fish species may begin to replace the original populations, or the fish may disappear entirely from a waterway.

Fish populations can also be directly affected in several ways. Acidity can stress a fish's basic body function, because it upsets the fish's ability to regulate its blood chemistry. Toxic metals, such as aluminum, can be leached from the soils and delivered to the lakes and streams by acidic rainfall. For example, small amounts of dissolved aluminum can cause mortality in fish by damaging their gills and decreasing sodium in their bloodstream. Finally, fish eggs and fry are very susceptible to high acidity and toxic metals. Partial or entire year classes can perish, leaving older, more resistant individuals to maintain a remnant population.

Over the years, the Fish and Boat Commission has been forced to change many of its stocking patterns on streams receiving increased acidity from acid deposition. In the beginning stages of acidification, it might be possible to change a stocking pattern simply by using a different species of fish. For example, one pattern change may be to change from the stocking of acid-sensitive rainbow trout to the more acid-tolerant brook trout. Another strategy is to change stocking schedules, so that the sensitive fish are not stocked preseason, when the heavy spring rains and winter snowmelt increase the acid and aluminum content of the streams.

Finally, the Fish and Boat Commission may be forced to discontinue stocking altogether when even the brook trout cannot live in the acid runoff. A review of the stocking records in Pennsylvania indicates that since the late 1950s, more than 90 streams have been subject to trout stocking management changes as a result of increasing acidity. Since 1969, the Fish and Boat Commission has had to remove 18 waterways from the trout-stocking list, because of degraded water quality caused by increasing acidity and toxic aluminum.

Currently Fish and Boat Commission managers test water samples from known vulnerable streams every year during March and April. To make future management decisions, fisheries management personnel have also conducted studies on the chemical characteristics and survivability of trout stocked in sensitive water.

Numerous government and university studies have also been conducted in Pennsylvania. Studies conducted by the U.S. Environmental

Protection Agency indicate that the Pocono lakes region is the second most negatively affected lakes region in the country. A Lehigh University study determined that out of 160 lakes in the Pocono region for which there were data, 70 percent were sensitive to acid deposition and 8 percent were already acidified. Scientists from the Pennsylvania State University and from California University of Pennsylvania conducted many watershed studies on the Laurel Hill Ridge, which contains the majority of the natural trout streams in southwestern Pennsylvania. One of their studies revealed that 10 of the 61 watershed samples were fishless and concluded "26 percent of the headwater streams on the Laurel Hill are severely impacted by acidification episodes." The National Academy of Science has stated that protection or recovery would occur on 80 percent of the nation's affected waters if sulfate deposition were reduced to 17 kg/ha/year (15 pounds/acre/year). In Pennsylvania, sulfate deposition ranges from 25 to 45 kg/ha/year (23 to 41 pounds/acre/year), so a reduction of approximately 50 percent would be required.

The Pennsylvania Fish and Boat Commission has actively sought legislation to control acid deposition since 1978. Our 1986 "Policy on Acid Precipitation" urged the federal and state governments to reduce SO_2 and NO_x emissions by 50 percent. After 13 years of study, deliberation and hearings, Congress approved the Clean Air Act Amendments of 1990. Many provisions including acid deposition were new to the Clean Air Act. One of the goals of the acid deposition provision is to reduce annual SO_2 emissions by 10 million tons/year from the 1980 emission levels and cap the annual utility SO_2 emission rate at approximately 8.9 million tons by the year 2010. Another important goal of the provision is to reduce annual NO_x levels by two million tons from the 1980 levels, but unfortunately no caps were put in place. The Congressional findings and passage of the Clean Air Act Amendments were historic in a sense that the long debate about the cause and effect of acid rain was ended.

The Pennsylvania Fish and Boat Commission was pleased that Congress finally passed the necessary legislation that will hopefully end the acid rain crisis. Scientists are optimistic that the 1990 Amendments will benefit Pennsylvania's affected waterways. A National Acid Precipitation Assessment Program (NAPAP) report speculates that because the major emission sources are located along the Ohio River Valley, Pennsylvania should experience a reduction of SO_2 emissions by greater than 50 percent and a SO_2 deposition rate of less than 17 kg/ha/year. Although NAPAP will continue to monitor deposition rates and test water quality, we will not know the final results of the Clean Air Act Amendments until the year 2010.

The passage of the 1990 Amendments is a credit to all the concerned anglers, citizens and scientists who took the time to voice their

> opinions for cleaner air. However, our work is not done. Attempts will continuously be made to weaken the current legislation. We all must remind our Congressional leaders that acid deposition is still a major concern and that complete enforcement of the 1990 regulations is a must. We can also do our part to limit air pollution by conserving energy, promoting mass transit and supporting strict automobile emission inspections. Future generations of Pennsylvanians are counting on us to protect, conserve and enhance the water resources of our state.
>
> Acid Activity
>
> Many people not familiar with chemistry have a hard time understanding the pH scale. The scale represents the potential hydrogen ion activity of a water environment and therefore its relative corroding action. Although the scale contains 15 numbers (0 to 14), the acid activity at a pH of 7 and above is not very significant. Numbers below a pH of 7 represent increased acid activity and potential harm to the environment. Most organisms live in environments where the pH ranges between 6 and 9. At pH levels below 4.5, the acid activity is too toxic for most organisms to survive.
>
> A pH number is a negative logarithm, so the number is a decimal part of a whole number. A change from one whole pH number to another represents a tenfold increase or decrease in the acid potential of a water environment. The chart above shows several ways to present the concept of acid potential (pH) and some pH levels for common liquids in our environment. [Note: Chart is omitted in this “text only” version.]
>
> Although all Pennsylvania waters receive acid deposition, the locations of the most vulnerable streams are directly related to the geology and physical features of the state. By comparing the larger map above with the smaller one to the right, it becomes apparent that most of our vulnerable streams are located in the sandstone mountainous regions of Pennsylvania. [Note: Maps are omitted in this “text only” version.]

As mentioned above, acid precipitation affects all of Pennsylvania. The assessment area is particularly vulnerable to the effects of acid precipitation because of its geologic makeup, which provides very little, if any, neutralizing ability against acid deposition. During field reconnaissance, very few stream segments had pH values of 7 or above. Surface or deep mining affects much of the watershed. Some stream segments clearly suffered from depressed pH and elevated aluminum levels due to acid precipitation, because there was either very limited or no mining done near the area of the reconnaissance. The previous study performed on the area of the watershed draining to the Dubois Reservoir indicated the same.

AMD

The most prevalent pollution problem within the Anderson Creek watershed stems from past mineral resource extraction activities. There are a number of significant coal and clay layers, or "seams," located throughout the watershed. The combination of valuable coal and clay resources being located within a large portion of the watershed led to a substantial amount of both underground and surface mining. Past unregulated and under-regulated mining of those resources led to significant pollution problems for many areas within the Anderson Creek watershed. Problems affecting land and water are associated with both surface and underground mining.

Abandoned mine drainage, or AMD, is a term given to water that has been polluted due to mining activities. A mineral called pyrite, which is often contained within coal and shale layers usually associated with coal, produces sulfuric acid through a series of complex chemical reactions when it is exposed to oxygen and water. Under normal or undisturbed conditions, little or no chemical reactions occur. After mining, whether underground or on the surface, oxygen and water comes in contact with pyrite and begins the chemical reaction. Depending on the chemical makeup of the rock layers, highly acidic water can be produced. This acidic water often leaches toxic metals from the rock layers it contacts. The metals often discolor the water or the streambed as they are deposited in the stream channel. Metal precipitation in AMD is highly dependent on pH. At very low pH, AMD-polluted water can look clear and unpolluted because the metals are completely dissolved in the water. As a general rule, as pH rises and acidity decreases the metals will begin to precipitate. At pH 4.5, aluminum will usually begin to precipitate

Iron from AMD pollution sources deposited on the streambed of Little Anderson Creek.

from AMD and will impart a white cast to the water or the rocks that it contacts. Approaching pH 6, iron begins to precipitate and will color the water or stain the streambed orange. This orange color is usually associated with AMD-impaired streams.

In the Anderson Creek watershed, extensive coal and clay mining have occurred. The highest area of concentration of mining occurs in the Little Anderson Creek and Rock Run sub-basins of Anderson Creek, which are identified in the Scarlift and TMDL reports as heavily polluted by metals and acid. AMD also pollutes numerous other stream segments within the watershed. Kratzer Run and all of its major tributaries, which include Bilger Run, Fenton Run, and Hughey Run, are also impacted to varying degrees.

In some instances, because the clay seams that were mined were relatively thick and often close to the surface, significant areas of subsidence have occurred. The subsidence not only creates surface depressions that create flow paths of surface water into the mine voids, it also increases the opportunity for oxygen to enter the mine, which accelerates the chemical reactions that produce AMD. Furthermore, a coal seam often lies above the clay. When subsidence occurs, the coal and surrounding materials, which contain the pyrite that produces AMD, collapses into the clay mine, increases acid production, and helps leach the aluminum from the clay. Eventually, the toxic AMD discharges from the mine and enters surface water streams where it has a devastating effect on all aquatic life.

Many areas throughout the watershed have been remined since the completion of the Scarlift reports and the development of the BAMR Problem Area maps. Remining is the process by which areas that have been previously mined, and often left unreclaimed, are mined once again. Using modern equipment and methods it is often possible to extract additional coal, and in the case of the Anderson Creek watershed, sometimes clay, that has economic value. In the process of remining, the land is reclaimed to a condition much improved over what was there prior to remining. The approval of modern-day mining permits relies heavily on evaluating the soils and rock that lie above the coal to contain a net positive balance of alkalinity over acidity. Often, when conditions are such that the balance is net acidic, additional alkaline material is incorporated into the remining and reclamation process to gain the net alkaline balance. These techniques have thus far been very successful in the reclamation and restoration of many areas previously degraded by mining within the Anderson Creek watershed. However, there are areas within the watershed where site conditions are such that remining is impractical because of the extremely acidic rock layers. Remining continues within the watershed. If improved conditions hold over time, it can be expected that additional improvements in water quality will be realized through additional remining in the future.

Impairment of Water Quality and Aquatic Life

NPS pollution has its most profound impact on the plant and animal life that live in the streams. AMD and acid deposition are the main pollution sources affecting life in the streams of the Anderson Creek watershed, often causing them to be virtually devoid of fish and other aquatic life. The primary pollutants from AMD are metals, most often iron, aluminum, manganese, and acidity. Pennsylvania established in-stream water quality standards for iron and manganese, which are published in the Pennsylvania Code, Chapter 93 Water Quality Standards. The standards set the limits as follows: Iron – 30 day average 1.5 mg/L as total recoverable, Manganese – Maximum 1.0 mg/L as total recoverable, and pH - 6.0 – 9.0 inclusive. Water quality standards for aluminum are identified in the Pennsylvania Code, Chapter 16 as 750 ug/L (0.75 mg/L) in Appendix A, Table 1, Water Quality Criteria for Toxic Substances. In-stream water quality below the standards can be considered as impaired.

A search of available information on existing best management practices implemented within the watershed to address identified NPS pollution turned up very little specific information. Several remining operations that have reclaimed abandoned surface mines have apparently improved water quality in some stream segments, however those improvements are based on empirical information. Any future remining and reclamation of abandoned mine sites or implementation of BMP’s within the watershed, particularly those which will successfully address AMD sources, should be coupled with instream chemical and biological monitoring to quantify improvements on affected stream segments.

1979, the Pennsylvania Fish and Boat Commission (PFBC) performed a stream survey on Anderson Creek. The study divided Anderson Creek into five sections. Two sections were located in the headwaters above the Dubois Reservoir, two sections between the reservoir and Little Anderson Creek, and the final section covering from the confluence of Little Anderson Creek to the mouth of the stream in Curwensville. The study found conditions much the same as they were during this study. The upper sections to Little Anderson Creek were impaired by acid deposition but contained life, although in depressed numbers. From Little Anderson Creek to the mouth, the stream was severely degraded. PFBC found one pumpkinseed sunfish at the confluence with Kratzer Run, likely where some alkalinity entered the stream. Otherwise, very little aquatic life was noted. The recommendation from the study suggested that a trout-stocked fishery be maintained in section three, from the Dubois Reservoir to one kilometer downstream of the Route 322 Bridge. Section four below that to the confluence with Little Anderson Creek was considered too inaccessible to be stocked. Those recommendations were still in effect at the time of this study.

In July 1999, Headwaters Charitable Trust, in cooperation with the PFBC, Canaan Valley Institute, and DEP performed a biological survey of Anderson Creek and several of its major tributaries. Four stations were sampled along Anderson Creek from below the Dubois Reservoir to the mouth of the stream. Only the first station recorded fish species (seven species), indicating good water quality, though no trout were captured. The remaining three downstream sites recorded no fish, indicating the degraded nature of the stream due to AMD. Three stations were located along Little Anderson Creek, from its headwaters above SR 219 to the mouth of the stream. Only the uppermost station produced fish (three species), indicating moderate stream quality. The remaining two stations showed a complete absence of fish due to AMD. Five additional tributaries of

Anderson Creek were sampled—Panther Run, Bear Run, Kratzer Run, Fenton Run, and Bilger Run. Panther Run, Bear Run, and Fenton Run all contained naturally reproducing brook trout. Bear Run scored the highest for habitat of all streams and contained the most trout, with Panther Run and Fenton Run successively fewer. Kratzer Run also contained trout, but they were identified as hatchery trout, very likely those stocked by ACWA during the limestone sand-dosing project. Bilger Run contained no fish as a result of its AMD impacts. Macroinvertebrates were also sampled during the assessment, but no data on the results was available.

DEP's Unassessed Stream Program, which is required to assess all of the waters of Pennsylvania, recently performed a biological assessment of the Anderson Creek watershed. The findings of this assessment generally confirmed the findings of the PFBC study and this assessment. The stream segments on Anderson Creek above the confluence with Little Anderson Creek were considered relatively unimpaired, though populations were noted as depressed because of acid deposition. Much of the remainder of the watershed was impaired biologically, due to AMD, with some of those segments also containing impaired habitat, mostly due to precipitate from AMD or sediment from surface mining.

IV. Problem Definition

Overview

This section addresses the specific AMD problems found during the assessment. Problems defined under this section are written specifically to address the TMDLs developed and approved in the 2004 publication, *Anderson Creek Watershed TMDL*, by the Susquehanna River Basin Commission (SRBC). Although many of the problems identified during this assessment were also identified by the TMDL study, a great many others exist that were not specifically mentioned in the TMDL study. This assessment attempts to identify as many of the other problem sites as possible, but does not capture them all. To do so would require an effort far beyond the scope of this assessment. As in the TMDL study, the watershed is divided into sub-basins, which are then divided into manageable stream segments. Each segment is identified with the type and relative location of impairment affecting that portion of the stream. Anderson Creek is listed for both metals and low pH as being the cause of degradation to the stream (SRBC 2002).

TMDLs for all of Anderson Creek consist of load allocations for AMD constituents, primarily pH, metals, and acidity. Individual TMDLs identify the specific types of pollutants requiring reduction, such as iron, aluminum, and manganese. Not all AMD constituents were included in every required TMDL load reduction. Often there were not enough samples to measure the individual constituent to accurately develop a proper load reduction. Often in those instances, reducing one pollutant, such as iron, will assure aluminum will be removed as well.

Because AMD is the chief impairment on most segments, descriptions of the discharge locations are given for areas directly affecting the stream segment. Since many areas have been extensively deep mined and surface mined for both coal and clay, often on numerous occasions, pollution sources can be very difficult to pinpoint as they occur over large and diffuse areas. Present on-the-ground conditions also create problems in developing reasonable solutions for remediating impaired areas, for often site conditions and water quality varies considerably within relatively small areas. In some instances, the water quality of pollution sources can change drastically in very short distances; or it can be of different water quality. In one particular instance, four AMD discharge points, located within a 20-foot radius, had distinctly different water quality characteristics. In some instances, land activities or disturbances cause problems in areas much lower in elevation than the disturbance site itself. As will be seen, all of these varying conditions have often led to conditions that necessitate detailed studies beyond the scope of this watershed assessment. In those instances, such recommendations will be identified.

For the TMDL, SRBC identified 10 AMD discharges, load allocations for six tributaries, and one sampling point along the stream as the focal points of the study. The method used to label TMDL stream segments used a “headwaters to mouth” approach, for lack of a better term. Beginning in the headwater areas of Anderson Creek and its tributaries, segments were labeled with alphabetic letters that are consistent with the stream's name and a descending numeric value as points were located further downstream. For example, the designation given to the most upstream reach in Little Anderson Creek was LA1 and it represents the segment of Little Anderson Creek before the confluence with the first unnamed tributary. The next monitoring point downstream is labeled LA2, and so on. Similarly, the designation given to the first unnamed tributary in the uppermost reach of Little Anderson Creek was designated UNT (unnamed tributary) LA1 and it accounts for the entire reach of the uppermost unnamed tributary. The next unnamed tributary downstream was labeled UNT LA2 with point LA2 being just upstream of the unnamed tributary. Not all unnamed tributaries were given labels or in-stream points located at the mouths of the named tributaries. It is necessary to use the map developed by SRBC to clearly identify segments used by the TMDL study.

Tributary Reports:

Little Anderson Creek

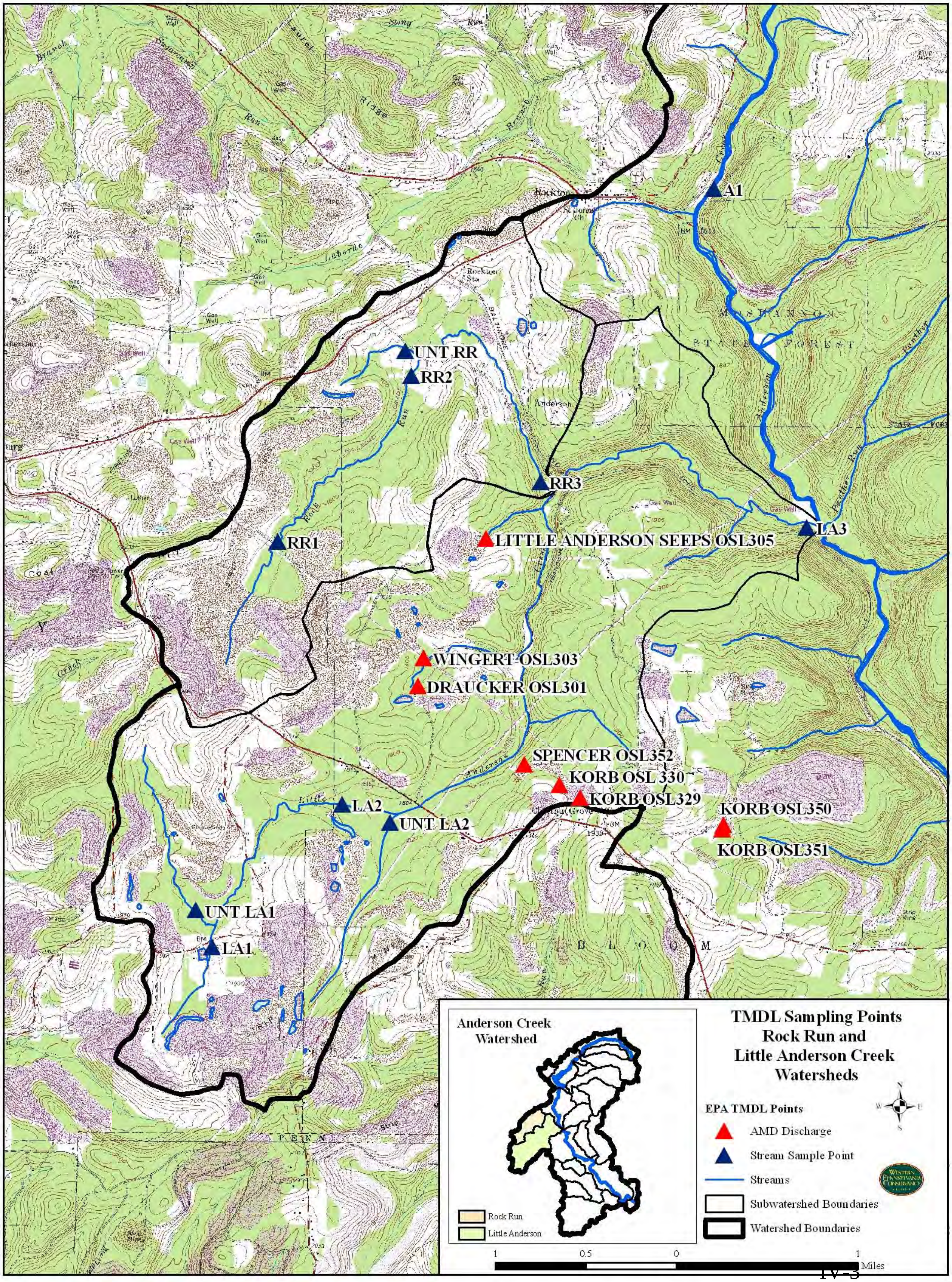
The headwaters of Little Anderson Creek are located approximately two miles west of Chestnut Grove and two miles southeast of Luthersburg. The headwater area begins in Brady Township, just northwest of the juncture of Brady, Penn, and Bloom townships, and is practically surrounded by areas previously disturbed by surface mining. Some of the surface mines have remained unreclaimed since the 1940s and 1950s. The surface mines have had a significant impact on the water quality of the stream at many of its highest reaches.

The headwaters area drains the western portion of the watershed. Little Anderson Creek flows in a northeasterly direction, crossing PA Route 219 just west of Chestnut Grove, and joins with Rock Run two miles downstream. From its confluence with Rock Run, Little Anderson Creek flows in a southeasterly arc, through a steep valley for another two miles, to its confluence with Anderson Creek.

Much of Little Anderson Creek is severely degraded from mineral resource extraction activities, more so than any other sub-basin in the entire watershed. Several abandoned underground clay mines are associated with high-flow AMD discharges, which pollute Little Anderson Creek. These discharges are especially damaging to aquatic life because of their high levels of acidity and aluminum. Additionally, extensive areas have been surface mined for clay and coal throughout the watershed. Many of those surface mines, both reclaimed and unreclaimed, are also associated with AMD discharges.

Little Anderson above TMDL point LA1

This stream segment represents the absolute headwaters of Little Anderson Creek. It is located approximately six miles upstream from the mouth of Little Anderson Creek and is about 4,000 feet in length. The stream is low gradient and is characterized by very large wetland areas surrounding the entire segment.


TMDL Sampling Points
Rock Run and
Little Anderson Creek
Watersheds
Anderson Creek
Watershed
Rock Run
Little Anderson
EPA TMDL Points
AMD Discharge
Stream Sample Point
Streams
Subwatershed Boundaries
Watershed Boundaries
1
0.5
0
1
Miles
A1
UNT RR
RR2
RR3
RR1
LA3
LITTLE ANDERSON SEEPS OSL305
WINGERT OSL303
DRAUCKER OSL301
SPENCER OSL352
KORB OSL 330
KORB OSL329
KORB OSL350
KORB OSL351
LA2
UNT LA2
UNT LA1
LA1

Most of the area above the segment, which is located south of the bridge on State Route (SR) 4010, has been surface mined and reclaimed, though some unreclaimed or poorly reclaimed land is present. Some of the areas have been remined. A very large wetland area is located within this section of the stream. According to the landowner (Mr. Peterman) where the segment is located, the wetland area was once farmed but is now saturated with groundwater, rendering farming impossible. There is one area in the upper end, below Shaffer Road and above the Peterman farm along SR 4010 that had low field pH readings, indicating acidic conditions. Vegetation in the area was obviously affected by the acidic water. The seep zone was visually estimated to have a total flow of approximately 15 gallons per minute (gpm). An accurate measured reading could not be collected due to the diffuse nature of the seeps. This site clearly had negative impacts locally, but there was enough net alkaline groundwater (albeit polluted with iron) that it was neutralized after a fairly short distance. Because it is an acidic discharge, neutralization of the acidic discharge would likely improve the water quality in the stream.

A possibility exists that other low-pH seeps in the area are impacting the stream. The riparian area is generally saturated by groundwater and distinct sources of low-pH water were unable to be identified.

Most of the surface water within this section of the stream has a field pH above 6.0, but is polluted by iron. Elevated levels of iron also likely pollute groundwater, as iron staining is visible throughout the wetland in many areas where no flowing surface water exists. Iron was also observed being mobilized while walking in the wetlands, during the visual assessment.

The small valley south of the Peterman farm was not completely assessed because the land was posted, though a majority of it was completed. As with the area surrounding the Peterman farm portion of this segment, extensive wetlands existed adjacent to the small stream channel and iron stained the water in the channel. Field readings of 6.0 pH were found in this reach. The upper portion of the valley was marked with “No Trespassing” signs and the property owner was not identified. Based on the observations to that point, it is likely the area is very much like that near the Peterman farm.

Elevated levels of iron were observed throughout the entire wetland area during the assessment of this segment. Several areas were marked by remnants of old beaver ponds. Field readings showed that most of the water had a field pH reading of 6.0 or higher.

TMDL for Above LA1

A load allocation reduction for total iron, total manganese, total aluminum, and acidity is required for all areas above LA1 (SRBC 2004). Table G1, taken from the TMDL study, shows the load reductions required for Little Anderson Creek above TMDL point LA1.

Table G1. Reductions for Little Anderson Creek Above LA1

Station	*Parameter*	*Measured Sample Data*		*Allowable*		*Reduction Identified*
		Conc. (mg/l)	*Load (lbs/day)*	*LTA Conc. (mg/l)*	*Load (lbs/day)*	*Percent*
LA1	Fe	3.73	4.67	0.15	0.19	96
	Mn	5.09	6.37	0.15	0.19	97
	Al	0.25	0.31	0.21	0.26	16
	Acidity	24.91	31.16	1.49	1.86	94
	Alkalinity	10.87	13.60			

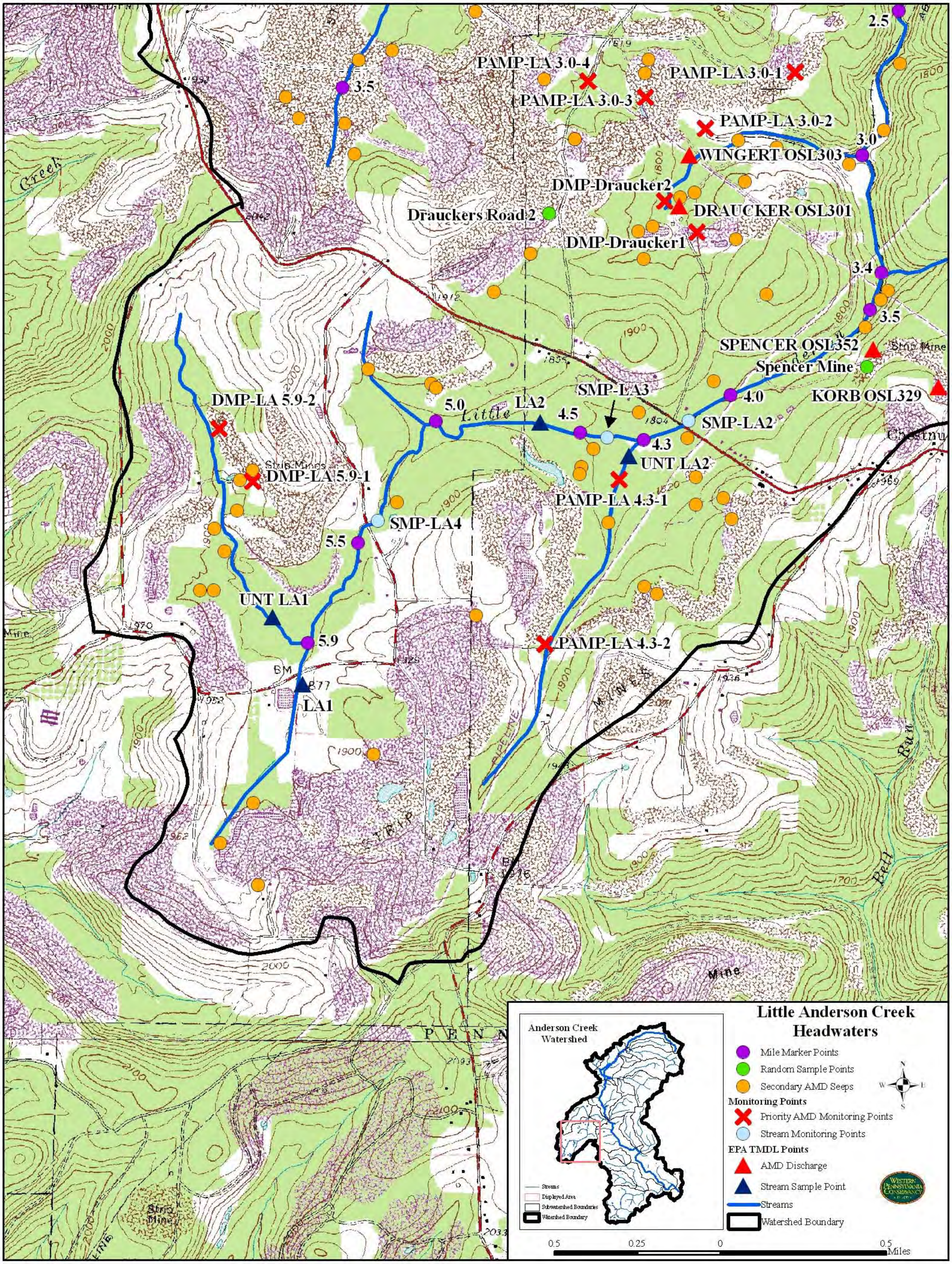
All values shown in this table are long-term average daily values.

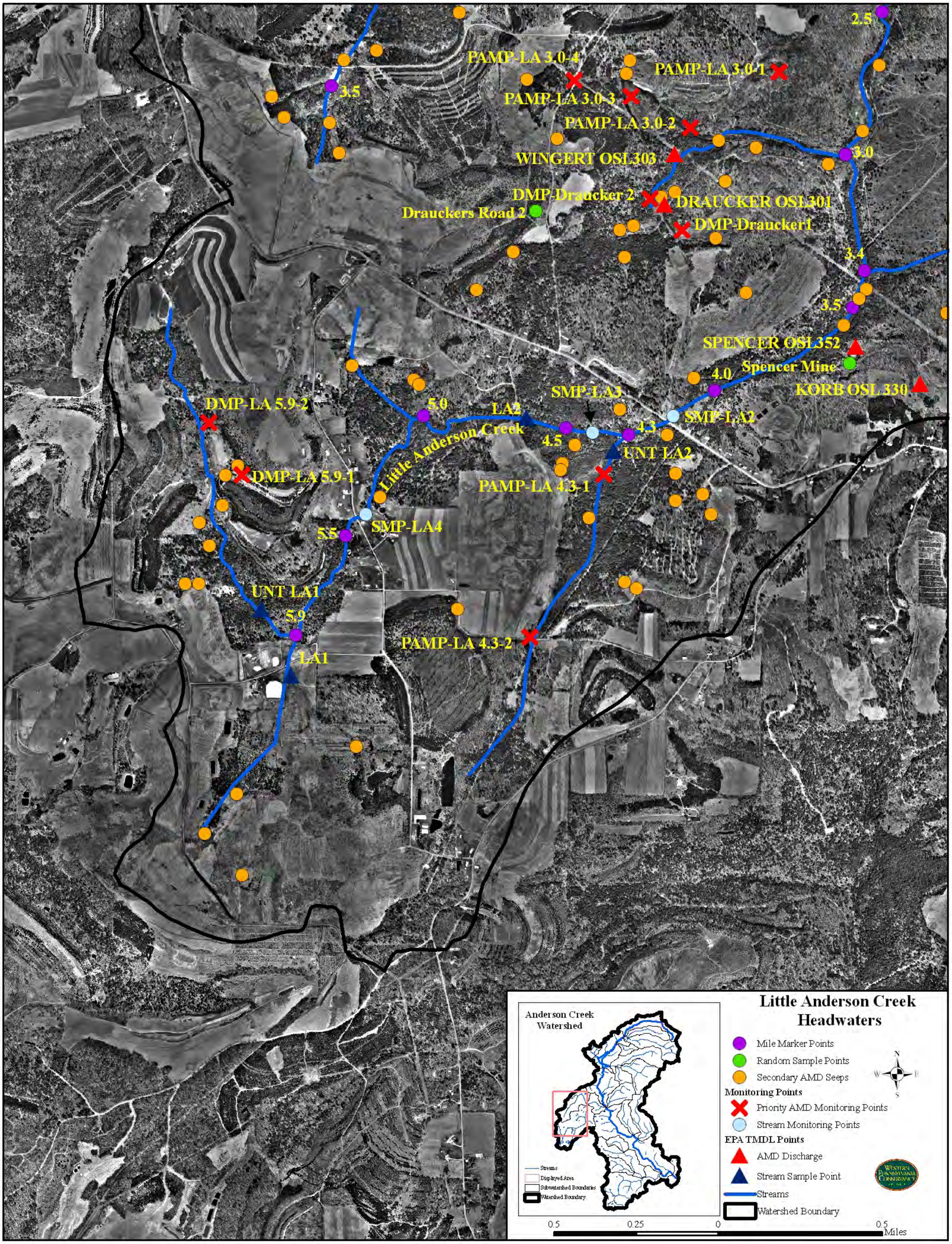
Recommendations for Little Anderson Creek above TMDL point LA1

Realistically, it would be extremely difficult to prevent this segment from becoming polluted or reducing pollutants to required reduction levels. Most of the land area surrounding the segment has been surfaced mined and reclaimed, and likely adds to the iron polluting the stream through groundwater sources that surface within the extensive wetlands. Remediating such conditions would be nearly impossible.

Because much of the polluted area appears to have net alkaline water (containing enough alkalinity to remain net alkaline once metals are removed), one way to improve in-stream water quality would be to increase retention time within the wetlands. A simple solution could be the installation of a low-impact dike system throughout the wetland area, similar to silt fencing constructed for erosion and sediment control. Such a system could break up direct flow paths to the stream and improve retention time within the wetland, affording more of an opportunity for metals to be removed from the water. Such a system would be extensive but could be installed by unskilled labor using hand tools. Because there is a large drainage area above the wetlands, surface runoff during heavy storms could be a problem with a lightweight dike system. Using mechanical equipment within the wetland area would be very difficult. Of course, permitting requirements to install such a system within a wetland would require careful evaluation.

The acidic discharge located within this segment could be treated to remove acidity and metals using a passive treatment technique. It appears that ample area exists on site for construction of the required treatment cells. Presently, there is not sufficient water quality and flow data about this particular discharge to develop a conceptual treatment plan. Such data usually requires the installation of a flow measurement device, such as a V-notch weir, and collection of monthly chemistry and flow data for 12 months, or a sufficient time to assure measurement of high- and low-flow situations. Installation of a flow measuring device and 12 continuous months of chemistry and flow data is recommended before any treatment plan is developed.


Little Anderson Creek Headwaters
Anderson Creek Watershed
Streams
Displayed Area
Subwatershed Boundaries
Watershed Boundary
Mile Marker Points
Random Sample Points
Secondary AMD Seeps
Monitoring Points
Priority AMD Monitoring Points
Stream Monitoring Points
EPA TMDL Points
AMD Discharge
Stream Sample Point
Streams
Watershed Boundary
N
E
S
W
0.5
0.25
0
0.5
Miles
PAMP-LA 3.0-4
PAMP-LA 3.0-1
PAMP-LA 3.0-3
PAMP-LA 3.0-2
2.5
3.5
3.0
WINGERT OSL303
DMP-Draucker2
DRAUCKER OSL301
Drauckers Road 2
DMP-Draucker1
3.4
3.5
SPENCER OSL352
Spencer Mine
KORB OSL329
DMP-LA 5.9-2
DMP-LA 5.9-1
5.0
LA2
4.5
SMP-LA3
4.0
SMP-LA2
4.3
UNT LA2
PAMP-LA 4.3-1
SMP-LA4
5.5
UNT LA1
5.9
PAMP-LA 4.3-2
LA1
Little
Creek
Strip Mines
Strip Mine
Mine
Bell Run


2.5
PAMP-LA 3.0-4
PAMP-LA 3.0-1
3.5
PAMP-LA 3.0-3
PAMP-LA 3.0-2
WINGERT OSL303
3.0
DMP-Draucker 2
DRAUCKER OSL301
Draucker Road 2
DMP-Draucker1
3.4
3.5
SPENCER OSL352
Spencer Mine
KORB OSL 330
4.0
SMP-LA3
SMP-LA2
DMP-LA 5.9-2
5.0
LA2
4.5
4.3
Little Anderson Creek
UNT LA2
DMP-LA 5.9-1
PAMP-LA 4.3-1
SMP-LA4
5.5
UNT LA1
5.9
LA1
PAMP-LA 4.3-2
Little Anderson Creek Headwaters
Anderson Creek Watershed
Streams
Displayed Area
Subwatershed Boundaries
Watershed Boundary
Mile Marker Points
Random Sample Points
Secondary AMD Seeps
Monitoring Points
Priority AMD Monitoring Points
Stream Monitoring Points
EPA TMDL Points
AMD Discharge
Stream Sample Point
Streams
Watershed Boundary
N
W
E
S
Western Pennsylvania Conservancy
0.5
0.25
0
0.5
Miles

Due to the close proximity of the stream channel and wetland area and the relatively flat topography at the location of the discharges, passive treatment options will be limited. Even though this discharge lowers the pH of the upper reaches of this segment, it is not significant enough to degrade the entire segment. Small fish were observed in the stream at the uppermost bridge on SR 4010, at the lower end of the segment. Any reduction of acidity will be beneficial to the stream because the stream will be able to maintain its alkalinity further downstream and help buffer more significant acidic discharges that enter the stream.

Based on the present site conditions, a small passive alkalinity generating system could be employed. Additional sampling would be necessary to determine the appropriate type. Because there are significant wetlands in this segment, construction of settling ponds may be difficult to permit or even unnecessary. Neutralized water could be simply discharged into the wetland area and allowed to filter through them, where iron would be deposited, as is presently occurring.

TMDL point UNT LA1 (UNT LA 5.9)

This segment could also be called the very headwaters of Little Anderson Creek. It flows in a southerly direction from SR 4008, just off of Route 219 near Coal Hill, and joins with the previously described segment just above the second SR 4010 Bridge. The uppermost portion of this headwater segment is free from surface mining and the water quality in-stream is quite good. A short distance downstream, water quality becomes impaired from discharges emanating from areas of unreclaimed, poorly reclaimed, and reclaimed surface mines. A large wetland exists in the upper one-third of the tributary. Just downstream from the wetland, a major portion of the stream now flows through a nearly half-mile long strip-cut, apparently dug in preparation for surface mining activities, according to a local miner who worked at the site. Mining at that particular operation never commenced and the diversion was abandoned. Some time after the site was abandoned, the stream broke into the cut and began flowing through it, exiting near SR 4010 and into Little Anderson Creek after the confluence of LA1 and UNT LA1 (LA-5.9 and UNT-LA 5.9). Spoil is placed downslope of the cut and it appears some of the water is filtering through the spoil and into both UNT LA1 and Little Anderson Creek.

The first mine drainage of any significance comes from an area that was previously surface-mined east of the tributary and above the strip cut. An acidic seep (DMP-LA5.9-2) flows from the base of a small ravine. An old V-notch weir was found already installed at the discharge and appears to have been placed during the Scarlift assessment in 1973. It appears to be monitoring point 345. Flows measured during Scarlift were significantly higher during the same time of the year than those measured presently, even with the wet conditions experienced during this assessment. (It may be possible that surface contours above the site were significantly altered sometime after 1973.) No discharge is indicated at the location on the latest BAMR Problem Area maps.

A second significant discharge was located south of DMP-LA5.9-2. DMP-LA5.9-1 has water quality somewhat similar to DMP-LA5.9-2. Each is low iron and aluminum and relatively low manganese. DMP-LA5.9-1 has nearly twice the acidity, iron, aluminum, and manganese as that of DMP-LA5.9-2. It also flows into a very large depression of standing water created during mining. This area appears to serve as a significant recharge area as there is no outlet to the pond. It is very likely the polluted water in the pond eventually enters the stream as polluted groundwater.

Downstream of both of the sites is the half-mile long strip-cut area previously described. As mentioned, sometime in the past, the stream broke into the cut and now flows through it. Additional water also flows in the original channel, with more flow entering the channel as it flows southward. It is impacted by iron pollution, but it maintains enough alkalinity to support life. Minnows were observed throughout the reach of the tributary.

Seeps containing high levels of iron appear adjacent and within a large wetland area about 2,000 feet upstream of the confluence of the unnamed tributary with Little Anderson Creek. The seeps, which seem to emanate from a reclaimed strip mine just west (river right) of the lower portion of UNT LA1 (UNT-LA 5.9), do not appear to be very acidic, according to pH readings taken in the field. The seeps are diffuse and appear as polluted groundwater, similar to those in the adjacent tributary, LA1 (LA 5.9). This area also contains a significant forested wetland and floodplain area, which is also impacted by iron-polluted groundwater. Throughout the entire area, iron staining was noted in practically every area of standing water or saturated soil conditions.

TMDL for Above UNT LA1

A load allocation reduction for total iron and total manganese is required for all areas above LA1 (SRBC 2004). Table G2, taken from the TMDL study, identifies the load reductions required for UNT LA1.

Table G2. Reductions for Little Anderson Creek Above UNT LA1

Station	***Parameter***	***Measured Sample Data***		***Allowable***		***Reduction Identified***
		Conc. (mg/l)	***Load (lbs/day)***	***LTA Conc. (mg/l)***	***Load (lbs/day)***	***Percent***
UNT LA1	Fe	2.02	2.53	0.36	0.45	82
	Mn	3.54	4.43	0.18	0.23	95
	Al	0.11	0.14	0.11	0.14	0
	Acidity	0.43	0.54	0.44	0.55	0
	Alkalinity	27.52	34.43			

All values shown in this table are long-term average daily values.

Recommendations for TMDL point UNT LA1 (UNT-LA5.9)

The significant amount of surface-mined areas within the higher elevations of this tributary, make it very difficult to prevent pollution from occurring or to eliminate pollutants altogether. Several projects can be undertaken that would reduce the amount of pollution entering the stream.

Clearly, the first action taken on this segment should be to return the stream to its natural channel where it enters the long open channel dug in preparation for surface mining adjacent to the stream. Doing so will prevent the stream from coming into contact with the materials placed downslope of the dug channel. In addition, the dug channel should be refilled and, if necessary, combined with additional alkaline material to neutralize the effects of acidic spoil that may be present. A permit to mine the area near the open channel was approved years ago, according to the property owner. The company never began the mining operation. Perhaps a Government Financed Construction Contract (GFCC) could be developed for the area, which would allow for reclamation of the site in exchange for taking additional coal from the site.

The two acidic discharges east of the stream channel should then be addressed. The water quality samples for both discharges indicate relatively low levels of metals, in particular aluminum, which means that it is likely anoxic limestone drains (ALD) could be used to eliminate acidity and substantially increase the alkalinity of the discharges. Settling ponds and polishing wetlands would be included as part of the treatment system for each discharge. For DMP-LA5.9-1, the outflow of the system would be redirected away from the large surface depression, into which it presently flows. Open limestone channels could be used at the outfall of the treatment system to improve manganese reduction or perhaps small, buried limestone beds could be used, which would also reduce the temperature of the water leaving the system.

As part of the restoration efforts, the large surface depression, into which DMP LA5.9-1 flows, should be filled and positive surface drainage established where possible throughout the entire reach, to prevent water from infiltrating into the disturbed soils and becoming polluted.

The iron seeps located west of the stream channel in the lower one-third of the stream segment could possibly benefit from the installation of a low-impact dike system, as described for section LA1. Improving detention time within the present wetland should help remove some of the iron entering the stream.

Water quality was not specifically monitored on UNT-LA 5.9 during this assessment. A monitoring point was established downstream of the confluence of UNT-LA 5.9 and the headwaters of Little Anderson Creek just downstream of SR 4010 nearest to Route 219 and was designated SMP-LA4. This monitoring site would include all of the pollution sources on the very headwaters of Little Anderson Creek identified by TMDL points LA1 and UNT LA1.

Average water quality measured at SMP-LA4

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
SMP-LA4	**0.70**	**4.8**	**6.61**	**23.5**	**0.19**	**0.8**	**4.50**	**-6.9**	**12**	**90.5**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

TMDL LA1 to LA2 (SMP-LA3)

TMDL point LA2 represents the combination of TMDL points LA1 and UNT LA1 to the point just above the confluence with TMDL UNT LA2. LA2 is also represented by SMP-LA3, monitored under this assessment. As mentioned previously, the flow from the long surface mine cut enters near the beginning of this section, upstream of SR 4010. Throughout this segment downstream of SR 4010 and the Cramer farm, a number of small seeps enter the stream, mostly from two areas on either side of the stream.

Several seeps and numerous wet areas containing standing water with noticeable iron staining were located on the river-right of the stream channel. The area is wooded and could likely be classified as a wooded wetland. It appears similar to the wooded wetland area of UNT LA1, and is likely impacted by polluted groundwater emanating from previously surface mined areas at higher elevations surrounding the tributary.

Further downstream, additional polluted seeps enter the stream from the river-left side of the stream. A reclaimed surface mine is located on that side of the stream and, similar to many areas within the watershed, an unnaturally steep, high slope exists along the lower end of the mined area. At the base of this steep slope or toe-of-spoil, as they are sometimes called, numerous AMD discharges appear. Some appear as diffuse discharges while others are more distinct. One discharge, behind a relatively newly built log house, had a field pH of 3.9 and had a higher flow. Another discharge, which is likely the poorest quality discharge appearing in this section, based on initial field testing, was identified in a steep ravine slightly further east**.** It appears to be associated with another poorly reclaimed surface mine just south of the area, which has sparse vegetation and likely serves as a recharge area into the reclaimed mine spoil during rain events. The discharge flows through a wooded area, eventually entering Little Anderson Creek above UNT-LA 4.3. It is not bad enough to seriously degrade Little Anderson Creek where it enters the stream. Although its low field pH reading and apparent high iron concentration made it worth noting, the discharge was considered a low priority based on the impacts from other discharges in the watershed. None of the discharges in this section downstream of SR 4010 appear to have been identified by the TMDL study.

Beyond the above-mentioned surface mines and their associated discharges and to the confluence of the next major unnamed tributary on the river-right, UNT-LA 4.3, no mine discharges of significance enter the stream. With the entry of UNT-LA 4.3-the worst pollution source on Little Anderson Creek upstream of Route 219-the main stem of the stream becomes severely degraded and is essentially dead below.

TMDL for LA2

The TMDL for Little Anderson Creek consists of a load allocation to Little Anderson Creek between point LA1 and point LA2. Addressing the mining impacts above this point addresses the impairment for the segment. An in-stream flow measurement was not available for LA2; therefore, the flow was determined using the

AVGWLF model (1.55 mgd) (SRBC 2004). Table G3, taken from the TMDL study, identifies pollution loads for Little Anderson Creek above TMDL monitoring point LA2.

Table G3. Long Term Average (LTA) Concentrations for Little Anderson Creek Above LA2

Station	***Parameter***	***Measured Sample Data***		***Allowable***	
		Conc. (mg/l)	***Load (lbs/day)***	***LTA Conc. (mg/l)***	***Load (lbs/day)***
LA2	Fe	0.52	6.72	0.34	4.40
	Mn	3.56	46.02	0.25	3.23
	Al	0.32	4.14	0.21	2.71
	Acidity	2.66	34.39	1.38	17.84
	Alkalinity	12.61	163.01		

All values shown in this table are long-term average daily values.

The TMDL for Little Anderson Creek at point LA2 requires that a load allocation be made for total manganese and total aluminum. The TMDL for Little Anderson Creek at point LA2 does not require a load allocation to be made for total iron and acidity (SRBC 2004). Tables G4 and G5, taken from the TMDL study, identifies the summary of loads and the reductions necessary at TMDL monitoring point LA2.

Table G4. Summary of Loads Affecting Point LA2

	Iron (lbs/day)	***Manganese (lbs/day)***	***Aluminum (lbs/day)***	***Acidity (lbs/day)***
LA1				
Existing Load	4.67	6.37	0.31	31.16
Allowable Load	0.19	0.19	0.26	1.86
Load Reduction	4.48	6.18	0.05	29.30
UNT LA1				
Existing Load	2.53	4.43	0.14	0.54
Allowable Load	0.45	0.23	0.14	0.55
Load Reduction	2.08	4.20	0	0

Table G5. Reductions Necessary at Point LA2

	Iron (lbs/day)	***Manganese (lbs/day)***	***Aluminum (lbs/day)***	***Acidity (lbs/day)***
Existing Loads at LA2	6.72	46.02	4.14	34.39
Total Load Reduction (LA1 and UNT LA1)	6.56	10.38	0.05	29.30
Remaining Load	0.16	35.64	4.09	5.09
Allowable Loads at LA2	4.40	3.23	2.71	17.84
Percent Reduction	0	91	34	0

The TMDL for the unnamed tributary to Little Anderson Creek at point UNT LA2 requires that a load allocation be made for all areas above UNT LA2 for total iron, total manganese, total aluminum, and acidity (SRBC 2004).

Recommendations for TMDL LA1 to LA2 (SMP-LA3)

Additional pollution enters Little Anderson Creek from several sources between TMDL points LA1 and LA2. Some will be very difficult to remediate because it appears that AMD enters through polluted groundwater sources over a diffuse area. Iron staining was observed in standing water in the forested area immediately below the SR 4010 Bridge on the river-right side of the stream. It is assumed the pollution is migrating to the area from higher elevations previously surface mined and hydrologically connected. It appears, through field pH sampling, the sources were net alkaline or nearly so. A more detailed study of the area is required to determine both the source of the pollution and the water chemistry associated with it. Because the area is likely considered a forested wetland, obtaining proper permitting for the construction of a treatment system at the site may be difficult. If the pollution source(s) is net alkaline, it may be possible to install a low-impact dike system to improve retention of the pollution within the existing wetland area.

An area associated with a poorly reclaimed surface mine, located approximately one-half mile on the river-left below the SR 4010 Bridge, was noted as a pollution source. Seeps appear at the toe of the spoil from several areas. This area of pollution appears to be having the most impact to Little Anderson Creek in this segment of the stream. At least two areas appear to be candidates for remediation. Neither of the sites is having a significant impact on Little Anderson Creek, and should be considered a medium- to low-priority situation. Developing treatment systems for the sites would likely improve the water quality in Little Anderson Creek, in this segment, by removing acidity, metals, and adding alkalinity to the stream. There has not been sufficient water quality data collected to determine the proper treatment system for either of the areas. Additional detailed studies of the sites, that would include both water quality and flow data in a sufficient amount to characterize both the low-flow and high-flow conditions of the discharges, are recommended.

Numerous small fish were observed in Little Anderson Creek at SMP-LA3, even though metals and acidity from AMD sources upstream degrade it. Addressing the abandoned mine problems associated with DMP-5.9-1, DMP-5.9-2, redirecting the stream into its original channel on UNT LA5.9, and remining and/or re-contouring and re-vegetating abandoned mine lands to promote proper drainage and limit water contact with disturbed soils, should significantly reduce pollutant loads and improve water quality in Little Anderson Creek at SMP-LA3.

Average water quality measured at SMP-LA3

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
SMP-LA3	**0.82**	**1.8**	**3.47**	**9.5**	**0.25**	**0.6**	**6.20**	**23.2**	**9**	**26.8**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

TMDL for UNT LA2 (UNT-LA4.3)

TMDL UNT LA2 (UNT-LA4.3) is the worst polluted tributary upstream of Route 219. Upon entering Little Anderson Creek, approximately 600 feet upstream of Route 219, this tributary essentially kills the stream. Similar to the other tributaries, much of the higher elevations surrounding the tributary have been surface mined and reclaimed with varying degrees of success. Conditions indicate that some remining of previously-mined areas has occurred.

The stream above Cramer Road, which connects SR 3011 with SR 4010, is impaired but not significantly. Below Cramer Road, the tributary becomes highly polluted from a reclaimed surface mine on the river-right side of the stream, termed by DEP as the Smouse strip mine. Numerous discharges emanate from the reclaimed surface mine, mostly near the toe of the mine spoil. Two large, interconnected detention ponds, which were part of the mining operation, remain at the lower end of the reclaimed mine site. The one at the higher elevation appears to hold water only in very wet conditions, while the lower and larger of the two had a small pool of standing water present at the time of investigation. Many of the discharges appear to be associated with the locations of the ponds, because they appear directly downslope of the ponds.

Similar to many other reclaimed sites within the Anderson Creek watershed, a large steep slope, estimated to be 20 feet high or more, was created at the downslope edges of the surface mine. Discharges appear at or near the original surface level, and, in this particular instance, also at elevations lower than original surface level and within a large, degraded wetland downslope of the mine. These may be more related to the actual depth of the mining that occurred or at the level of the coal seam. The elevation of the discharges may also be related to the presence of an aquatard or aquaclude, such as a clay layer, which prevents the water from penetrating deeper below the surface, and has been observed elsewhere in the watershed. No detailed site investigations were performed to make that determination.

Vegetation appeared to be impaired by acidic groundwater conditions at numerous areas leading to the detention basins and can be observed as areas of dead, withered, or nonexistent plant life. A very large kill zone developed where there are AMD discharges on the adjacent property, creating a severely degraded wetland. Green and brown filamentous algae abounds. It is very difficult to estimate how much water is being produced within the degraded wetland. It appears that most of the AMD surfaces are near the toe of the mine spoil. There is also a large pond of AMD-polluted water located at the toe of the spoil. The depth of

Large "kill zone" caused by AMD seeping out immediately downslope of a large surface mine known as the Smouse Strip, located on UNT-LA 4.3.

the pond was not measured and is unknown.

Another discharge associated with the same surface mine is located in the wooded area south of the mine site and is the first very acidic AMD discharge to enter UNT LA2 (UNT LA4.3) from the mine site. The unnamed tributary becomes seriously degraded at this point. As the tributary flows towards Little Anderson Creek it mixes with the discharges draining into the wetland and those surfacing within the wetland. Combined, these pollution sources account for the major portion of the pollution in UNT LA2 (UNT-LA4.3) and Little Anderson Creek above Route 219.

TMDL for Above UNT LA2 (PAMP LA-4.3)

Table G6, taken from the TMDL study, identifies the load reductions required at TMDL point UNT LA2. It is very important to note that loading values for the tributary do not include the specific amounts attributed to the Smouse surface mine. There was not sufficient flow data to develop the calculations so they were not included in the estimates. The loadings are included in the TMDL point Little Anderson 3 (LA3).

Table G6. Reductions for Unnamed Tributary for Little Anderson Creek above UNT LA2

Station	***Parameter***	***Measured Sample Data***		***Allowable***		***Reduction Identified***
		Conc. (mg/l)	***Load (lbs/day)***	***LTA Conc. (mg/l)***	***Load (lbs/day)***	***Percent***
UNT LA2	Fe	0.63	0.47	0.25	0.19	60
	Mn	2.27	1.70	0.16	0.12	93
	Al	1.48	1.11	0.07	0.05	95
	Acidity	10.44	7.84	1.35	1.01	87
	Alkalinity	11.93	8.95			

All values shown in this table are long-term average daily values.

The TMDL for the unnamed tributary to Little Anderson Creek at point UNT LA2 [LA-UNT 4.3] requires that a load allocation be made for all areas above UNT LA2 for total iron, total manganese, total aluminum, and acidity (SRBC 2004).

The water quality for monitoring point PAMP-LA 4.3-1 measured by this study represents the same location as TMDL monitoring point UNT LA2. A weir was installed on the unnamed tributary to gather accurate flow data. During the assessment, a flood event rendered the weir unusable. Following the flood event, flow measurements were taken using a flow meter. During periods of very low flow, volumes could only be visually estimated.

In order to determine the total loading attributed to the Smouse surface mine, two monitoring points were established on UNT-LA4.3, one above and one below the Smouse surface mine. The pollution load from the monitoring point above the site was subtracted from the monitoring point pollution load below the site to determine the total loads created at the site. The following chart identifies the total pollution load attributed to the Smouse surface mine.

Average water quality measured at PAMP-LA4.3

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
PAMP-LA4.3	**8.80**	**11.73**	**9.98**	**15.48**	**9.28**	**14.56**	**115**	**167.29**	**0**	**0.00**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

Recommendations for PAMP LA-4.3 (Smouse surface mine)

Remediating the AMD from this tributary is a key to reducing pollution to UNT-LA 4.3, upper Little Anderson Creek, and Anderson Creek. In particular, the Smouse surface mine discharges must be remediated to bring the tributary back to a point where it will support life and meet the TMDL goal. These discharges were not included in the TMDL because of a lack of proper flow and chemistry data. The loadings from the Smouse strip mine were included in the next downstream TMDL site, LA3. For the purpose of this study, recommendations for UNT LA2 (UNT-LA 4.3) will include the Smouse surface mine site discharges.

Monitoring performed under this assessment measured the total amounts of flow and concentrations of pollutants in-stream at points above the Smouse surface mine and at the mouth of UNT-LA4.3. Because there are so many individual discharges emanating from the Smouse strip mine, and there were no significant other sources entering the tributary, the entire site was considered as a “problem area.” By monitoring pollution loads at the mouth of the stream and subtracting the amount of pollution in the tributary above the site, the difference was considered to be the pollution loads from all the discharges at the Smouse strip mine. This would also account for pollution entering directly into the streambed through polluted groundwater sources. That amount will likely be much less in comparison to the amount entering from the visible discharges. It should be noted that during this study, high flows rendered the weir installed on the tributary unusable. In-stream flows were then determined using a flow meter. Readings at low flow levels on such a small tributary become less accurate when a flow meter is used. Flow readings measured using a flow meter for such periods should not be considered highly accurate. At very low flow periods, volumes were visually estimated for this monitoring point.

Reducing or eliminating pollution from the Smouse strip mine will be very difficult for several reasons, including: the exact locations of the areas on the mine site responsible for producing the pollution have not been identified specifically; the number of discharges coming from the site is extensive and diffuse; the numerous discharges coming from the site vary in chemical makeup and flow quantities and would require collecting or channeling flows in order to measure each; individual passive treatment systems would likely have to be designed for each individual discharge, unless some are combined or active treatment is used; the excessive height of the spoil at the perimeter of the surface mine will make it difficult to treat the water on the property associated with the actual mining activities; and much of the reclaimed land is in use as pasture land, and the property owners may not be open to the idea of disturbing it or using it for treatment.

Two large settling/detention ponds remain on the lower end of the reclaimed surface mine. A large portion of the surface is graded to drain to the area where the detention ponds are located. It appears from the vegetation on the surface that acidic groundwater is affecting the vegetation at numerous locations up gradient of the ponds. Several of the discharges appear to be directly related to the detention pond areas and appear at the toe of the spoil down gradient of them. This study did not determine whether the pit floor of the reclaimed surface mine coincides with the contour of the surface and also dips to the pond areas at the lower end of the site. Further investigation of the permit information is recommended to help determine the subsurface flow paths. The ponds did not appear to retain much water. Only the pond lowest in elevation contained any standing water when inspected in early May 2005, after a relatively wet winter and spring.

A third pond exists below the spoil terminus at the southeastern corner of the reclaimed property. This pond is of unknown depth and retains AMD. It flows into the large kill zone created below the reclaimed mine site. The assessment identified it as one of five main sources of pollution from the site, although other small flow discharges are present. In addition, another main source of AMD to UNT-LA 4.3 emanates from the base of the spoil along the southeasterly portion of the mine site. It is the first discharge to seriously degrade the tributary. It appears to follow what may be an old drift mine entry that disappears under the spoil, but that was not confirmed.

Treatment options for the site might include:

- Subsurface electromagnetic mapping and characterization of the reclaimed mine site to determine locations of “hot spots,” which could be targeted for in-situ remediation to reduce or eliminate acid production. High-alkaline materials could be injected into the hot spots to help neutralize acidic material or encapsulate acid-producing materials.
- Excavation of acidic hot spot materials to segregate or encapsulate it in order to reduce or eliminate contact with water.
- Strategic placement of steel slag (or other high-alkaline material) surface ponds, which would catch runoff, increase its alkalinity, and then allow infiltration of the alkaline water into subsurface hotspots.
- Subsurface Sulfate Reducing Bioreactors located along water flow paths determined by the electromagnetic mapping.
- Surface Sulfate Reducing Bioreactors located at discharge points or at a combination of discharge points.
- Installation of J-channels, which are six-foot-deep channels dug along the toe of the mine spoil filled with lime kiln dust or other high-alkaline material that are used to collect and control acid water and impart alkalinity to it.
- Open limestone channels (OLC), used to increase alkalinity to surface waters. OLCs have been successfully used to add alkalinity to surface water with low iron content. They have also been reported to work on AMD, but lose efficiency when the limestone becomes coated with iron. Some studies have shown OLCs can still provide some alkaline addition when coated with iron, but others have been shown to become non-effective.

- Passive AMD treatment systems that utilize methods that can handle high aluminum discharges, such as Sulfate Reducing Bacteria Bioreactors, SAPS, Upflow Limestone Ponds, and other such systems.
- Low-cost active treatment technology merely to treat the discharges to eliminate acidity, allowing metals to leave the site.
- Standard active treatment technology that would treat the discharges, collect the metals on site, and discharge effluent water meeting water quality standards. Such a system would require an operator to periodically remove the collected metals from the treatment system and properly dispose of them. Such a system would likely require substantial annual operating costs, but may be the only viable solution for this site.

TMDL for LA2 to LA3 (SMP-LA 4.3 to the mouth of Little Anderson Creek)

This segment is the most heavily polluted portion of Little Anderson Creek and represents nearly seventy percent of the main stem’s length. It receives AMD discharges from many surface mines, both reclaimed and unreclaimed, and several deep mines. This segment also receives AMD from all of the sources on Rock Run as well. The water quality of Rock Run is not quite as bad as that of Little Anderson Creek.

AMD from two sources enters Little Anderson Creek just downstream of UNT LA 4.3 from river-right. The first is a larger source and is located in a gully at the toe of a reclaimed surface mine site on the opposite side of the tributary from the Smouse discharges. It may be the site of an old deep mine entry, but that could not be confirmed during the study. No water samples were taken of the discharge, but field pH readings of 4.5 were taken. There appeared to be ample room for passive treatment and this site would likely be a good candidate for remediation in the future. Both flow and chemistry monitoring would have to be performed prior to any treatment design recommendations. It was not identified for monitoring under this study because of its lower flows and better water quality in comparison to many other sites within this stream segment.

The second discharge enters Little Anderson Creek just upstream of Route 219 from river-right. It also appears from a gully at the toe of the spoil. In this case, the AMD emanates from a plastic corrugated pipe, which may have been part of a reclamation project. This is the uppermost discharge of several in the watershed that display unique characteristics. The water exits the pipe at what appears to be a chemically net alkaline condition, as indicated by its field pH of 6.1. In a very short distance the discharge quickly turns acidic with a field pH of 3.5. Apparently, another AMD discharge source, likely from a slightly lower coal seam or clay seam discharges in the very same location. This second source is much more acidic, and completely changes the chemistry of the water in a very short distance. Once the two AMD sources mix, the water remains acidic for the remainder of its flow into Little Anderson Creek. Several other small flows also enter this drainage. They are insignificant in comparison to the flows at the source and are not believed to add significant additional pollution to the drainage. Further investigation of the area’s geology and prior mining would need to be performed to determine the exact cause of the drastic change in water quality near the source.

Little Anderson Creek continues to pick up metals and acidity from many different sources, some very significant, some much less so, once crossing under Route 219. Just downstream of the bridge a small flow of acidic water enters from river-left. This flow is associated with a large surface mine and deep mine, part of which drains to Little Anderson Creek at this point. At an estimated flow of about 5 gpm, the discharge was significant enough to be noted, but not large enough to be considered for monitoring under this study. The discharge likely does affect the stream, even if to a smaller extent than other discharges entering Little Anderson Creek further downstream. It appeared there was ample room for treatment of the discharge at this site. Like the two mentioned above, it would likely be a good candidate for remediation some time in the future. Further monitoring of flow and chemistry would be necessary to properly characterize the discharge for treatment. Also, in the same area but on the opposite side of the stream (river-right), smaller iron seeps were identified in a low-lying area along the stream. The seeps were insignificant and did not appear to be significantly impacting the stream, though they were discharging some iron into the stream.

Discharge from main entry of the Spencer mine at low-flow conditions.

TMDL for Spencer Mine Discharges - OSL 352 and OSL 330 (DMP Spencer)

The next AMD source to enter the stream is from the Spencer mine. The Spencer mine was an underground clay mine located adjacent to the Korb mine in Chestnut Grove. The mine is located just north of Route 219 and west of Viaduct Road. Presently, some of the mine has been surface mined and mostly reclaimed, but with pine tree plantings and little ground cover. Surface drainage is fair. A portion of a highwall exists and the area near the former mine opening remains unreclaimed. Immediately above the highwall area and below a pasture field, there is a significant area of mine subsidence with dangerous depressions, especially since there are homes with young children nearby. AMD is draining out of what appears to be the former main mine entrance nearby. Un-vegetated spoil piles are also located in the mine entry area.

The TMDL study identified two discharges associated with the Spencer mine. They are identified as discharge OSL 352 and OSL 330 in the Scarlift report and the TMDL report (SRBC 2004).

Tables G7 and G9, taken from the TMDL report, identify the load reductions required for the Spencer discharges (OSL 352 and OSL 330).

Table G7. Reductions for Spencer Discharge (OSL 352)

Station	Parameter	Measured Sample Data		Allowable		Reduction Identified
		Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)	Percent
OSL 352	Fe	78.80	26.29	0.63	0.21	99.2
	Acidity	860.00	286.90	0	0	100
	Alkalinity	0	0			

All values shown in this table are long-term average daily values.

The TMDL for the Spencer 352 Discharge requires that a load allocation be made for OSL 352 for total iron and acidity (SRBC 2004).

Table G9. Reductions for the Spencer Discharge (OSL 330)

Station	Parameter	Measured Sample Data		Allowable		Reduction Identified
		Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)	Percent
OSL330	Fe	1.82	0.15	0.42	0.04	77
	Acidity	201.40	16.80	0	0	100
	Alkalinity	0	0			

All values shown in this table are long-term average daily values.

The TMDL for the Spencer 330 Discharge requires that a load allocation be made for OSL 330 for total iron and acidity (SRBC 2004).

During the visual assessment, water was flowing out of the mine opening, but not at a high flow rate. Site conditions indicated that flows might be more significant at other times. A significant portion of the AMD from the mine appears to be infiltrating into the groundwater table and entering the Little Anderson Creek at stream level below the site. Several seep areas were located directly adjacent to the stream, at what appears to be the top of a clay layer located at that elevation. Field readings of 2.7 pH were noted during the assessment.

The Spencer mine discharge was not regularly sampled as part of this study. It was determined that it would be very difficult to accurately measure the actual flow volumes coming from the mine because of the various diffuse seep areas along Little Anderson Creek. Two samples were taken at low flow at the mine opening to determine the AMD chemistry at its most concentrated form. It would be extremely difficult to measure flow or even impact to Little Anderson Creek because of the locations of the seeps near the stream and in relation to where the next major source of AMD, DMP Korb 4, enters just downstream of the seeps. Taking upstream samples on Little Anderson Creek and then downstream samples would not likely give an accurate measurement of the flows coming from the Spencer mine because the Korb 4 and Spencer mine AMD sources are too close. The Spencer mine discharge seeps do not have time to mix in the stream before the Korb 4 discharge enters, thus making it nearly impossible to differentiate the impacts to Little Anderson Creek between the two.

Recommendations for Spencer Mine

The Spencer mine is likely having a severe negative effect on Little Anderson Creek. How much so is very difficult to determine at this time. The discharge from the mine opening flows on the surface only at high groundwater periods. There appears to be a significant amount of water that also enters the groundwater table and appears as severely polluted seeps adjacent to Little Anderson Creek, downslope of the Spencer mine. During low flows, the AMD infiltrates completely into the ground and appears as a series of seeps directly adjacent to the stream. Locations of the seeps make it nearly impossible to accurately measure the total actual flows entering Little Anderson Creek.

Numerous, very low-pH seeps appear just above the streambed of Little Anderson Creek far below the elevation of the Spencer mine.

Contact was made with the property owner of the Spencer mine site. The property owner is very interested in reclaiming as much of his property as possible. He indicated that he would be open to remining the site and would donate a portion of his property for the development of an AMD treatment system and supports the efforts of the Anderson Creek Watershed Association (ACWA) to clean up the stream.

There are several things that could be done to improve the impacts from the Spencer mine:

- Land reclamation should be undertaken to remove the highwall, eliminate the unreclaimed spoil piles, limit contact of acid materials and water, and promote positive surface drainage. The large area of dangerous subsidence holes should be remined and reclaimed if possible. It is not known whether the pasture area above the subsidence area contains enough coal to be economical for remining or if the landowner would be willing to remine the area if it does. Negotiations with the landowner about reclamation should be initiated. Adding high amounts of alkaline material when reclaiming the site would very likely improve groundwater quality.
- Removal of clay layer and special handling of acid material to remove from contact with groundwater to reduce the amount of aluminum leached into the groundwater.
- Installation of an impermeable alkaline barrier on the pit floor to prevent acid water from infiltrating into the groundwater.
- Re-grading other areas upslope of the mine to improve surface runoff and addition of high-alkaline materials to buffer acidity in this area as well.
- Installation of open limestone trenches to impart alkalinity to surface runoff.

- Re-vegetate areas above the mine to develop a thick groundcover and reduce groundwater infiltration. Incorporate high-alkaline material or biosolids to enhance growth, improve water quality, and reduce surface water infiltration.
- Reduce the production of AMD at the source. In addition to incorporating high-alkaline material into the backfill, subsurface limestone drains should be incorporated into the highwall area to capture groundwater, increase alkalinity, and perhaps redirect it to a specific area for passive treatment, if necessary.
- Install high-alkaline surface trenches to intercept surface water and redirect into the groundwater.
- Close monitoring of AMD seeps at the stream elevation of Little Anderson Creek to determine success of reclamation measures. Installation of alkaline drains at seep zone, if necessary.
- Passive treatment of remaining AMD at the surface mine elevation once other reclamation measures are performed.
- Active treatment of the mine opening discharge if water chemistry indicates it is the best option.

The #2 priority Korb 4 discharge, draining from the abandoned Korb mine in Chestnut Grove.

TMDL for the Korb Mine Discharge OSL 329 (DMP Korb4)

This Korb mine discharge is located north of Route 219 and just west of Viaduct Road, in the village of Chestnut Grove. This is a major contributor of AMD to Little Anderson Creek and is being monitored under this assessment. It was identified in the Anderson Creek Scarlift Report and the TMDL report as OSL 329. This study identifies it as DMP Korb4.

Korb mine is an underground clay mine (Scarlift Project Area XXXIX, Project Map 13), which is overlain by a coal seam. Some of the Korb mine underground clay mine has been remined by surface mining, but never reclaimed. Much of the clay mine workings remain. Of special concern is the fact that coal seams lie above the clay mines and in much of the area have subsided into the clay mine. This has created an especially troublesome condition because the coal and its overburden collapsed into the clay mine are known to produce high levels of acid and aluminum in their AMD. The Korb 4 discharge emanates from a deep ravine that is connected to the underground Korb mine workings, and was part of the reclamation effort after surface mining. This site was identified as priority #3 by the TMDL study. Collectively, all the discharges from the Korb mine were ranked as priority #4 by the Scarlift study. Korb 4 is identified as priority #2 by this study.

The TMDL for the Korb Discharge OSL 329 used data available from the Scarlift Report. There were fewer manganese and aluminum data than necessary for this discharge to conduct a proper analysis, therefore, they were not evaluated for this TMDL. However, observations for manganese and aluminum in the downstream segments of Little Anderson Creek indicate that they also may be violating water quality standards. It is assumed that BMPs used to reduce iron loads in this reach also would reduce the amount of manganese and aluminum (SRBC 2004).

Table G8, taken from the TMDL report, identifies the load reductions required for the Korb Discharge (OSL 329).

Table G8. Reductions for the Korb Discharge (OSL 329)

Station	***Parameter***	***Measured Sample Data***		***Allowable***		***Reduction Identified***
		Conc. (mg/l)	***Load (lbs/day)***	***LTA Conc. (mg/l)***	***Load (lbs/day)***	***Percent***
OSL 329	Fe	143.02	143.13	0.57	0.57	99.6
	Acidity	760.00	760.61	0	0	100
	Alkalinity	0	0			

All values shown in this table are long-term average daily values.

The TMDL for the Korb 329 Discharge requires that a load allocation be made for OSL 329 for total iron and acidity (SRBC 2004).

Average water quality measured at DMP-Korb4

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
DMP-KORB4	**43.96**	**37.59**	**8.76**	**7.43**	**30.95**	**20.47**	**382**	**338.51**	**0**	**0.00**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

Recommendations for DMP-Korb4

The Korb mine is an underground clay mine and is identified in the Scarlift Report as Project Area XLVI, Project Map 13. The mine is located in the Chestnut Grove area adjacent to the Spencer mine and is noted as being interconnected to it. The Korb mine complex is uniquely situated on the axis of the Chestnut Ridge Anticline, an elongated, dome-like geologic structure. AMD from the Korb mine drains from opposite sides of the dome (anticline). One large discharge, TMDL OSL 329, drains to the west [DMP-Korb4] and three discharges [DMP-Korb1, DMP-Korb2 and DMP-Korb3] drain to the east (Scarlift Report 1974).

The Korb mine discharges are identified as priority discharges under both the Scarlift study and the TMDL study. DMP-Korb4 drains into a valley that empties into Little Anderson Creek. The other Korb discharges drain the other side of the anticline to the east and into the main stem of Anderson Creek via UNT-AC 8.2. This tributary also receives discharges from two other large surface mines, one reclaimed, one unreclaimed, located on either side of the stream. The discharges appear very near and on opposite sides of the stream approximately one-half mile below the Korb Mine Road. The combination of the discharges from the Korb mine and the seeps from surface mines into UNT-AC 8.2 likely causes it to carry the highest pollution load into Anderson Creek after Little Anderson Creek enters. The total pollution load at the mouth of UNT-AC 8.2 was not measured regularly under this study but is recommended for further study. Remediating the discharges entering the stream will likely result in significant improvements to water quality in the main stem of Anderson Creek. Remediation of the Korb discharges, along with the Spencer mine discharges, would make a significant improvement to the water quality of Anderson Creek. The two mines account for two of the top five priorities identified by the Scarlift report and five of the top ten priorities identified in the TMDL study.

At the time of this assessment, a mining company has proposed to remine a portion of the Korb mine in Chestnut Grove as a reclamation project. The company proposed to unearth a hilltop that is underlain by the underground mine workings and containing significant subsidence areas, remove the remaining clay mine workings and associated overlying coal, place additional alkaline materials on-site, and replace and re-grade the overburden materials to promote positive surface water drainage off-site. The mining company, in cooperation with DEP, performed preliminary drilling and overburden analysis of a portion of the site. An analysis of the findings has shown that because of the very acidic nature of the materials above the clay mine, remining would be very costly and may not be successful at reducing or eliminating the acid being produced at the site. Therefore, remining is presently not being viewed as an option.

Because of the location and the water chemistry of the DMP-Korb4 discharge, one option may be a self-flushing limestone pond. This technology has recently been successfully demonstrated as a possible treatment option for AMD containing aluminum. This system is similar to an Upflow Limestone Pond but differs in it that automatically drains itself after imparting alkalinity to the acidic water and before aluminum has an opportunity to precipitate in the limestone. Other passive AMD treatment system options that utilize methods that can handle high aluminum discharges, such as Sulfate Reducing Bacteria Bioreactors, SAPS, Upflow Limestone Ponds, and other such systems, might also be

Combined Korb2 and Korb3 discharges draining into an unnamed tributary to Anderson Creek (UNT AC8.2).

incorporated. These systems have limitations and must be closely evaluated before a treatment option is chosen. Lastly, active chemical treatment is an option. High operation and maintenance costs are often a limiting factor when this option is chosen.

Another polluted unnamed tributary enters Little Anderson Creek from river-right, just downstream from where the Spencer mine and DMP-Korb4 enter the stream. This AMD emanates from an area adjacent to the Korb mine and is likely associated with poorly reclaimed surface mines located further north and west of Viaduct Road. At the time of this assessment, a mining company was remining a portion of the area adjacent to the affected tributary. No suggestion for remediation of the tributary area is recommended until further investigations are made once the remining project is completed.

Little Anderson Unnamed Tributary 3.0 (UNT-LA 3.0)

The next polluted unnamed tributary to enter Little Anderson Creek is the most polluted in the entire subwatershed, Little Anderson Unnamed Tributary 3.0 (UNT LA 3.0). Several reclaimed and unreclaimed surface mines, as well as deep-mined areas, drain to this tributary.

Drauckers Bottom Road near Route 219

Beginning in the uppermost reaches of the tributary, upslope from Drauckers Bottom Road and very near Route 219, unreclaimed surface mines have created many discharges, which eventually drain to UNT-LA 3.0. This area is also the ridgeline boundary between Rock Run and Little Anderson Creek. Just north of the intersection of Drauckers Bottom Road with Route 219, the unreclaimed surface mines collect water behind spoil piles and cause the water to filter beneath and through the spoil, eventually polluting the surface water draining the area. Two small intermittent streams drain the area towards the east and cross under Drauckers Bottom Road in culverts a short distance from Route 219. Eventually, the two small streams lead to an area where two discharge monitoring points have been established as part this study. DMP-Drauckers 1 and DMP-Drauckers 2, are two very significant pollution sources being sampled under this study that eventually combine and drain into UNT-LA3.0.

Although the unreclaimed surface mine area upslope of Drauckers Bottom Road near the Route 219 intersection is causing AMD, it is not being monitored because it was not considered a significant pollution source in comparison to other sources entering UNT-LA 3.0 further downstream. The area should be further investigated and considered for restoration activities some time in the future.

Recommendations for Drauckers Bottom Road near Route 219

This area is considered a low priority at this time. It is recommended the area be studied for possible remining or reclamation. During such activities, the area should be re-graded to eliminate any possibility of surface and groundwater pooling behind the mine spoil.

Reclamation should be done to promote positive surface water drainage from the area and replanted with a heavy vegetative cover to reduce infiltration into the subsurface. Any alkaline addition that could be incorporated into the reclamation would also be very beneficial. It may be possible to incorporate open limestone channels or subsurface limestone drains into the reclamation effort as well to increase alkalinity in surface and groundwater. Any additional alkalinity would help improve the water quality in UNT-LA 3.0.

The Drauckers Discharges

TMDL for OSL 301 (DMP-Drauckers1)

The Drauckers discharges are associated with two distinct abandoned underground clay mines, which drain into UNT-LA 3.0. TMDL point OSL 301 is identified as the largest single contributor of pollution to Little Anderson Creek. This assessment has also identified this discharge, DMP-Drauckers1, as being the highest priority for restoration.

The TMDL for the Drauckers Discharge consists of a load allocation to OSL 301. Addressing the mining impacts for this drainage addresses impairment for the discharge. An in-stream flow measurement was available for OSL 301 (0.20 mgd) (SRBC 2004).

There were fewer manganese and aluminum data than necessary for this discharge to conduct Monte Carlo analysis; therefore, they were not evaluated for this TMDL. However, the observations for manganese and aluminum in the downstream segments of Little Anderson Creek indicate that they also may be violating water quality standards. It is assumed that BMPs used to reduce iron loads in this reach also would reduce the amount of manganese and aluminum (SRBC 2004).

Table G10, taken from the TMDL report, identifies the load reductions required for the Drauckers Discharge (OSL 301).

Table G10. Reductions for the Drauckers Discharge (OSL 301)

Station	***Parameter***	***Measured Sample Data***		***Allowable***		***Reduction Identified***
		Conc. (mg/l)	***Load (lbs/day)***	***LTA Conc. (mg/l)***	***Load (lbs/day)***	***Percent***
OSL 301	Fe	153.13	255.42	0.61	1.02	99.6
	Mn	19.79	33.01	-	-	-
	Al	46.67	77.85	-	-	-
	Acidity	929.33	1,550.12	0	0	100
	Alkalinity	0.47	0.78			

All values shown in this table are long-term average daily values.

The TMDL for the Drauckers Discharge requires that a load allocation be made for OSL 301 for total iron and acidity (SRBC 2004).

As previously mentioned, DMP Drauckers1 and DMP Drauckers2, which are being monitored for water quality and flow under this study, also drain into UNT-LA 3.0. These two distinct and significant discharge areas severely degrade Little Anderson Creek.

DMP-Drauckers1 emanates from an underground clay mine, which has also been partially surface mined (Scarlift Project Area XXIII & XXV, Project Map 15). DMP-Drauckers1 is the most significant source of pollution to Little Anderson Creek and the Anderson Creek watershed. Because there is a significant area of unreclaimed mine spoil associated with the discharge, it is also a significant source of runoff pollution. Typical for this area draining into UNT-LA 3.0, a coal seam overlies the clay seam. When the clay was surface mined, the coal was not considered valuable and was intermixed with the excavated material, adding to the pollution problem created by the unreclaimed spoil.

Large flows of very acidic AMD and unreclaimed mine lands make reclamation very challenging for Drauckers1—the highest priority site in the Anderson Creek watershed.

DMP-Drauckers1 flows through an unreclaimed area of mine spoil. It joins with the two previously mentioned intermittent streams draining the area near the intersection of Drauckers Bottom Road and Route 219 before combining with DMP-Drauckers2 in a large wetland area. The polluted water eventually combines with several other AMD sources and additional surface water to form UNT-LA 3.0, which eventually joins Little Anderson Creek.

Average water quality measured at DMP-Drauckers1

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
DMP-Drauckers1	**78.63**	**89.34**	**21.43**	**24.95**	**57.06**	**71.68**	**624**	**781.71**	**0**	**0.00**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

Recommendations for DMP-Drauckers 1

Many options for addressing the problems associated with DMP-Drauckers1 exist. Perhaps the best option is to explore the feasibility of remining the site and incorporating alkaline addition into the reclamation of the land area during the remining. As with other unreclaimed areas associated with UNT-LA 3.0, conditions at the site are not conducive to easy remining, otherwise the sites would have likely already been remined. According to one nearby property owner, strata associated with the coal seam contain nodules of high sulfur and iron. These nodules can be seen throughout the spoil and within associated strata at the remaining highwall. Such conditions cause concerns for mining companies because they reduce the desirability of the coal and increase the likelihood of creating AMD discharges. A detailed drilling and overburden analysis of the site is recommended to determine the feasibility of remining.

DEP has embarked on a program, in association with EPA, to address such issues. The original program was given the name “Project XL.” The program would allow remining and reclamation of such areas by cooperatively developing a reclamation plan between DEP and the mining company that would use the best available techniques to reduce the possibility of creating additional pollution sources. Remining would be performed by strictly following the agreed-upon plan. If the remining were performed according to the plan, the mining company would not be liable for any unforeseen circumstances that would make the pollution worse. Presently, DEP is testing the program. DMP Drauckers1 should be seriously considered for the program.

Another issue associated with remining a site is willingness of the property owner to support the idea. Presently, the property owner has indicated a willingness to entertain the idea of remining the site. The property owner is an avid sportsman and considers the wooded area near the abandoned mine site as prime habitat for wildlife. It may be possible to incorporate the “reforestation initiative,” recently developed between the Office of Surface Mining and DEP, as part of the reclamation. That initiative uses alternative reclamation techniques that promote the cultivation of valuable hardwoods. Such techniques reduce the costs of reclamation and eventually produce trees that can be harvested for profit. The property owner may be even more inclined to support a reclamation project if he knows the area would be planted in hardwoods afterwards. Presently, most reclamation is done using techniques that inhibit the growth of trees, but that promote grass cover. A cooperative agreement with the mining company to use the reforestation initiative techniques would need to be developed, and the new techniques closely followed in order to ensure successful implementation of the program.

Barring remining the site, several reclamation techniques could be considered for the site. Land reclamation at the site is highly desirable, considering that present conditions are causing the formation of AMD and sedimentation because of the lack of proper surface drainage and vegetation. In addition, treatment of DMP-Drauckers1 would greatly reduce the metals and acidity load entering UNT-LA3.0. There appears to be ample area for passive treatment. Because of the high acidity and high levels of aluminum in the discharge, passive treatment would likely necessitate the use of treatment systems able to handle those levels without the likelihood of premature failure. Modified Vertical Flow Systems, Sulfate Reducing Bioreactors, and

Drauckers2 discharge prior to mixing with acidic groundwater.

Upflow Limestone Ponds are some possibilities. Active treatment of the discharge using chemicals might also be desirable or the only viable treatment option.

DMP-Drauckers2

DMP-Drauckers2 also emanates from an underground mine and associated surface mines (Scarlift Project Area XXIV, project map 15). This discharge was not specifically addressed by the TMDL study but should be included in TMDL point LA3, which includes all of the AMD sources in the Little Anderson Creek watershed.

DMP-Drauckers2 is also a significant source of pollution to Little Anderson Creek. It is similar in characteristics to the previously mentioned discharges located upstream of Route 219, in that the chemistry of the discharge changes dramatically in a relatively short distance. Similar to the previously mentioned discharge, this discharge appears as net alkaline water in a defined channel. After the discharge travels a short distance, the water becomes acidic and picks up volume from numerous, undefined seeps. Trees and plants adjacent to the acidic discharges are noticeably impacted and many have died. As with the similar discharges upstream of Route 219, it is presently unknown what is causing the chemical change of the discharge and additional study of the site is necessary to determine the exact causes. Based on other acid discharges in the area, it is very likely connected to the abandoned Drauckers #2 underground clay mine.

Average water quality measured at DMP-Drauckers2

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
DMP-Drauckers2	**2.41**	**3.43**	**4.24**	**9.50**	**1.01**	**3.36**	**29**	**69.03**	**1**	**3.13**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

Recommendations for DMP-Drauckers2

As noted previously, the DMP-Drauckers2 discharge exhibits peculiar characteristics, in that it first appears as a net alkaline discharge but very quickly turns acidic as it reaches a slightly lower elevation. A detailed investigation of the site-specific conditions is necessary to fully understand why this happens. Such an investigation was beyond the scope of this assessment. It is recommended that further studies be performed to better understand conditions at this site and other similar sites in the watershed.

First segregating the alkaline water from the acidic water and then treating them separately could address AMD from DMP Drauckers2. Since the alkaline water appears at a higher elevation and from a more distinct source, it should be possible to capture the water prior to it reaching the area where the acidic water appears and then degrades the discharge. A significant issue will be finding area to treat passively the net alkaline discharge. Although passive treatment of net alkaline water is easier than acidic discharges, it still requires significant space for passive aeration, a settling pond, and polishing wetlands. Site conditions limit the area for treatment. The area is constricted by the location of an intermittent stream on one side, and the location of the acidic discharges down slope. It may be possible to build a small settling pond near its present location and then gain additional treatment area by diverting the discharge under the intermittent stream and to the opposite side of the stream. Wetland issues will be a consideration whatever the treatment design will be.

Once the net alkaline water is segregated from the acidic water, the acidic water could likely be treated using the same methods identified in the DMP Drauckers1 recommendations (SAPS, Vertical Flow Systems, Sulfate Reducing Bioreactors, Upflow Limestone Ponds, etc., as well as active chemical treatment). Wetlands will also be an issue, since there is a large wetland just downslope of the acidic discharges. It is recommended to pursue the use of a Wetlands Waiver 16, which is an agreement between BAMR and the U.S. Army Corps of Engineers that limits mitigation requirements in wetlands impaired by AMD. The waiver was successfully used in the past, but recent efforts to take advantage of the waiver have not been very successful. It is very likely that any impacts to the present wetlands will require wetland mitigation on at least a 1:1 basis and the development of a wetland mitigation plan.

Other UNT-LA 3.0 Problem Areas

Three other significant problem areas impact UNT-LA 3.0. The problems again begin within the upper reaches of the tributary, west of Drauckers Bottom Road and just north of the previously mentioned unreclaimed surface mine area near the Route 219 intersection. This area was also heavily surface mined and its highest elevations continue to form the boundary between Rock Run and Little Anderson Creek. This area is much more significant than that further south and was identified as a site for monthly monitoring by this assessment. It is designated PAMP-LA 3.0-4.

PAMP-LA 3.0 - 4

Because there are several discharge areas located in the area, the entire area above Drauckers Bottom Road was considered as a whole and designated Problem Area LA 3.0 - 4. A monitoring point for this study was established where all the drainage from the area crosses beneath Drauckers Bottom Road and given the designation PAMP-LA 3.0 - 4. The uppermost discharges appear in a deep ravine at the toe of the spoil of a reclaimed surface mine and near a power line, which bisects the area. Once again, the discharges exhibit an interesting and similar pattern to that described before. In this case, there are four distinct discharges, which appear at the head of the deep ravine within approximately 25 feet of one another. Each had a distinctly different field pH, with a range that would indicate a net alkaline condition to one of net acidic, although no individual lab samples of the discharges were taken to verify their chemistry makeup. The field pH of the combined discharges was 5.2 . Once

Combined discharges at PAMP-LA 3.0-4.

again, as the water traveled down gradient, and a relatively short distance, it gathered significantly more water and the field pH dropped to 3.3. Just upstream of the road, additional mine drainage enters from a surface-mined area to the south. Monitoring point PAMP-LA 3.0 - 4 is a combination of all the discharges upslope of the site.

Average water quality measured at PAMP-LA3.0-4

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
PAMP-LA3.0-4	**11.95**	**11.55**	**10.89**	**10.66**	**0.56**	**0.78**	**62**	**55.45**	**0**	**0.00**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

Recommendations for PAMP-LA 3.0 - 4

Because of the nature of the varied discharges and the changes that take place in the chemistry of the discharges, a more detailed investigation of the site is recommended. Once again, the changes in chemistry are similar to other impacted areas within the Little Anderson Creek subwatershed and conclusions drawn from a more detailed study of this site or the other sites might be common to all.

As a result of the different areas that contribute AMD, the number of discharges, the differing chemistry of the individual discharges, wetland issues, site constraints, and the likelihood that polluted groundwater also adds to the pollution load, it will be very difficult to treat passively the individual discharges associated with this problem area. It is recommended to chemically treat the combined flows of the discharges at their convergence point at or near the culvert conveying them under Drauckers Bottom Road. Doing so will provide the most economic and feasible way to address this area. A number of different types of active treatment systems are available and each has their advantages and disadvantages. A system that operated without electricity and required little maintenance would be best. These systems are available commercially and could be set up with minimal construction costs. They usually incorporate some type of silo in which the chemical is stored on-site to reduce operation and maintenance costs.

Ideally, the treated water would enter a settling pond to collect the metals as they precipitate. Usually, active treatment generates high volumes of precipitate and requires the settling ponds to be cleaned out fairly often, leading to high operation and maintenance (O&M) costs. There have also been cases where, due to the magnitude of the problem and the limited amount of funding available for O&M, the precipitates have been allowed to settle out in the stream. In essence, a tributary is somewhat sacrificed for the greater good of the main stem of the stream. Presently, this may be the best option for PAMP-LA 3.0 - 4 because the tributary is essentially dead for its entire reach. Treating in the headwater area allows more opportunities for metals to settle out, excess alkalinity generated to affect areas downstream, and there are other areas of higher priority that will require a substantial amount of funding to reclaim.

The Wingert Site

Downstream of the headwaters area of PAMP-LA 3.0 - 4 is a very large area of abandoned deep mines, and unreclaimed surface mines that contains numerous large, un-vegetated spoil piles, water-filled pits, and dangerous highwalls. It is known locally as the Wingert site. It is perhaps the worst unreclaimed site in the entire Anderson Creek watershed. UNT-LA 3.0 actually flows directly off of a highwall and into the unreclaimed surface mine. Numerous AMD discharges exist throughout the site. Deep, dangerous, water-filled pits likely pollute the groundwater and also discharge into surface waters. The site is identified in the Scarlift Report as Problem Areas XXVI and XXVII.

TMDL for the Wingert Discharge (OSL 303)

The Wingert Discharge originates from two ponds formed in the strip cuts left behind after extensive strip mining of the area. The headwaters of an unnamed tributary to Little Anderson Creek add a continual recharge to the system by flowing over the highwall and into the ponds. A small deep mine, known as Wingert mine, also is present, though dry (Lincoln 1999). The ACWA considers this site a reclamation priority (Smeal 2001; SRBC 2004).

The TMDL for the Wingert Discharge consists of a load allocation to OSL 303. Addressing the mining impacts for this drainage addresses the impairment for the discharge. An in-stream flow measurement was available for OSL 303 (0.38 mgd) (SRBC 2004).

There were fewer manganese and aluminum data than necessary for this discharge to conduct Monte Carlo analysis; therefore, they were not evaluated for this TMDL. However, the observations for manganese and aluminum in the downstream segments of Little Anderson Creek indicate that they also may be violating water quality standards. It is assumed that BMPs used to reduce iron loads in this reach also would reduce the amount of manganese and aluminum (SRBC 2004).

Table G11, taken from the TMDL report, identifies the load reductions required for the Wingert Discharge (OSL 303).

Table G11. Reductions for the Wingert Discharge (OSL 303)

Station	***Parameter***	***Measured Sample Data***		***Allowable***		***Reduction Identified***
		Conc. (mg/l)	***Load (lbs/day)***	***LTA Conc. (mg/l)***	***Load (lbs/day)***	***Percent***
OSL 303	Fe	20.66	65.48	0.41	1.30	98
	Mn	8.00	25.35	-	-	-
	Al	7.48	23.71	-	-	-
	Acidity	232.62	737.22	0	0	100
	Alkalinity	0	0			

All values shown in this table are long-term average daily values.

The TMDL for Wingert Discharge requires that a load allocation be made for OSL 303 for total iron and acidity (SRBC 2004).

Once again, rather than attempt to collect water samples at each individual discharge, monitoring points were established to determine the pollution load generated by the entire site. Two monitoring points were established, one above the point where the tributary drops off the highwall, identified as PAMP-LA 3.0 - 3, and one at a point where all of the water from the site enters the main flow of the tributary, labeled PAMP-LA 3.0 - 2.

The Wingert site is similar to DMP- Drauckers1 in that the area was deep mined for clay and then was surface mined. The coal, which is located above the clay, was not removed during surface mining and was just mixed in with the spoiled overburden. Highwalls, large un-vegetated spoil piles, and poorly vegetated mounds of unreclaimed overburden remain. Water quality is not quite as acidic and does not contain as high of a concentration of metals as DMP-Drauckers1. This site is much more extensive and will require considerable land reclamation.

Average water quality measured at PAMP-LA3.0

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
PAMP-LA3.0	**3.43**	**2.82**	**1.57**	**2.22**	**3.61**	**9.84**	**24**	**99.83**	**0**	**0.00**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

Recommendations for Wingert Site

The Wingert site is perhaps the worst abandoned surface mine site in the Anderson Creek watershed. Here an unnamed tributary flows off the highwall into the open pit.

As with DMP- Drauckers1, perhaps the best option for the Wingert site is to explore the feasibility of remining the site and incorporating the reclamation of the land area during the remining. Conditions at this site are not conducive to remining, otherwise it would have likely already been remined as well. The strata associated with the coal seam also contain nodules of high sulfur and iron. These nodules can be seen throughout the spoil and within associated strata at the exposed highwalls. Like DMP-Drauckers1, remining and reclamation by cooperatively developing a reclamation plan between DEP and the mining company, using the best available techniques to reduce the possibility of creating additional pollution sources, would be the best option. Remining would strictly follow the agreed upon plan and the mining company would not be liable for any unforeseen circumstances should the pollution become worse. DEP would then assume responsibility for treating the water. The landowner is very interested in any proposal that would reclaim the land, eliminate the water-filled pits and highwalls, re-vegetate the site, and treat the AMD. Before any remining option is pursued, a detailed drilling and overburden analysis of the area must be performed to determine the feasibility of successful remining.

Again, barring remining of the site, several reclamation techniques could be considered. Land reclamation is an absolute necessity, considering the extent of the deplorable conditions on the site. The site is extremely dangerous with its water-filled pits and numerous vertical highwalls. The addition of alkaline materials during reclamation is highly recommended. With the construction of the new waste-coal-fired cogeneration plant being planned for the Karthus area, a ready supply of high-alkaline ash should be available for use on the site. Mine spoils containing highly acidic materials could be encapsulated in alkaline ash, which can harden and prevent infiltration of water into the acidic material. Reclaiming and re-grading the site to promote surface water runoff, rather than allowing the water to infiltrate into the mine spoil, would also greatly reduce AMD production. The combination of encapsulation of acidic mine spoil combined with proper control of surface waters would greatly reduce the metals and acidity load entering into UNT-LA 3.0 from the Wingert site. Any remaining discharges would likely contain much less metals and acidity.

There appears to be ample area for passive treatment, should that option be viable. Because of the high acidity and high levels of aluminum in the present discharges, passive treatment would likely necessitate the use of treatment systems able to handle that type of water. Modified Vertical Flow Systems, Sulfate Reducing Bioreactors, and Upflow Limestone Ponds are again some possibilities. Active treatment of the discharges or the entire amount of water draining from the site using chemicals might also be an option, especially if remining is not viable. Excess alkalinity could be generated from active treatment, which would provide additional benefits downstream. Operation and maintenance would again be a consideration if active treatment was employed, and a system that would not use electricity would be very desirable.

PAMP-LA 3.0-1

Just east of the Wingert site is another, which contains abandoned clay mines, both underground and surface. The site is similar to the Wingert mine, but smaller in size and without the significant water problems of the Wingert site. One monitoring point was established on the site as part of this study, PAMP-LA 3.0-1. During periods when the water table is high, a consistent flow of AMD discharges from the site. As the water table drops and the weather dries, the

Lack of proper surface drainage allows water to seep through poorly vegetated and un-reclaimed mine spoil.

discharge disappears. A significant area of high, steep, un-vegetated mine spoil piles exists on the site. An open pit and highwall remain as well. As with DMP-Drauckers 1 and the Wingert site, a coal seam lies above the clay seam. Once again, the coal was simply discarded on site and mixed with the overburden material lying above the clay. And, like the other sites, the sulfur and iron nodules are present, and are visible in the highwall and mixed in with the spoil. During periods of high water, the pit of the surface mine collects water, allowing some of it to filter through the mine spoils, creating AMD that eventually reaches the stream. The monitoring point is located to measure the water that flows from the pit and into UNT-LA 3.0.

Average water quality measured at PAMP-LA3.0-1

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
PAMP-LA3.0-1	**1.29**	**0.13**	**3.50**	**0.39**	**16.30**	**1.88**	**124**	**14.39**	**0**	**0.00**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

Recommendations for PAMP-LA 3.0 -1

Similar to Drauckers1 and the Wingert site, the best possible solution to the problems on the site is remining and reclamation, perhaps as a government-financed construction contract (GFCC). It is also recommended to perform on-site alkaline addition, acidic material encapsulation with cogen flyash, and passive treatment of any remaining AMD during the remining process. Once again, conditions at this site are not conducive to remining, otherwise it would have likely already been remined, so developing or using economic incentives to remine and reclaim the site are recommended. Barring remining, a land reclamation project that is combined with alkaline addition, acidic material encapsulation, and passive treatment of remaining discharges are recommended. Modified Vertical Flow Systems, Sulfate Reducing Bioreactors, and Upflow Limestone Ponds are again some possibilities. Active treatment of the discharges for the entire amount of water draining from the site using chemicals might also be an option, especially if remining is not viable. Excess alkalinity could be generated from active treatment, which would provide additional benefits downstream. Operation and maintenance would again be a consideration if active treatment was employed and a system that would not use electricity would be very desirable.

PAMP-LA 2.10

Downstream of UNT-LA 3.00 approximately .9 miles, UNT-LA 2.10 enters from river-left. This unnamed tributary drains an area previously surface mined and poorly reclaimed. A large area of mine spoil is placed in such a way that it prevents positive surface water draining and backs up water behind the spoil. This area serves as a groundwater recharge zone that likely produces AMD as it flows through the spoil material. Several areas of AMD seeps were noted. Vegetation growing on the site is sparse and probably increases the amount of AMD being produced. The Scarlift Report identified the site as being controversial because it was not known whether a recent surface mine operation, at the time, would be held liable for the discharges. Apparently, that was not the case or perhaps the company has since gone out of business, because there is no evidence of prior treatment activities at the site. No recommendations were given for the site in the Scarlift Report because of the question of liability.

For much of the assessment, this site was not monitored. Several samples and flows were recorded toward the end of the study (PAMP-LA 2.10). Additional samples and flows should be collected during periods of high groundwater to better determine this problem area's contribution of pollution to Little Anderson Creek at high flows. Based on the data collected, it may be a moderate pollution source.

Average water quality measured at PAMP-LA 2.10

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
PAMP-LA2.10	**1.63**	**0.26**	**7.19**	**1.70**	**6.46**	**1.63**	**70**	**16.44**	**0**	**0.00**

All values represent short-term averages for samples taken during the monitoring period of the assessment. (It should also be noted that this site was not sampled during the time when flows would be their highest. This site likely accounts for higher pollution loads than identified by this chart.)

Recommendations for PAMP-LA 2.10

This problem area is recommended for land reclamation and AMD treatment. It is recommended that land reclamation take place first, in order to reduce the amount of AMD being produced by the site. It is not known at this time whether remining is an option at this site, and investigation of that possibility should be pursued. If it is feasible, it may be possible to reclaim the site under a government financed construction contract (GFCC), which would reduce the cost of reclamation. As previously mentioned, re-contouring of the land to promote proper draining of surface water will help prevent that water from infiltrating into the mine spoil and creating higher volumes of AMD. In addition, the vegetation on the poorly reclaimed surface mine is very sparse and developing a thick mat of vegetation will also help to reduce water infiltration into the mine spoil, further reducing the flows of AMD. The addition of alkaline material into the spoil during reclamation will also serve to limit the production of AMD. Treatment of the AMD seeps is not recommended until land reclamation takes place.

Large abandoned mine site at headwaters of UNT-LA2.10 appears to serve as a major source for AMD during wet periods.

Rock Run TMDL Sites

TMDL for Rock Run 1 and above (RR1)

TMDL point RR1 is located at the point where Rock Run crosses in a pipe beneath a gated road, approximately three miles upstream from its mouth. The TMDL for Rock Run above R1 identifies the mining impacts in the headwaters area as the cause of impairment, which is pH and metals impairment. Table G13, taken from the TMDL report, identifies the load reductions required for Rock Run above RR1.

Table G13. Reductions for Rock Run above RR1

Station	*Parameter*	*Measured Sample Data*		*Allowable*		*Reduction Identified*
		Conc. (mg/l)	*Load (lbs/day)*	*LTA Conc. (mg/l)*	*Load (lbs/day)*	*Percent*
RR1	Fe	2.17	15.02	0.54	3.74	75
	Mn	18.86	130.55	0.38	2.63	98
	Al	2.70	18.69	0.32	2.22	88
	Acidity	82.54	571.36	0.25	1.73	99.7
	Alkalinity	0.69	4.78			

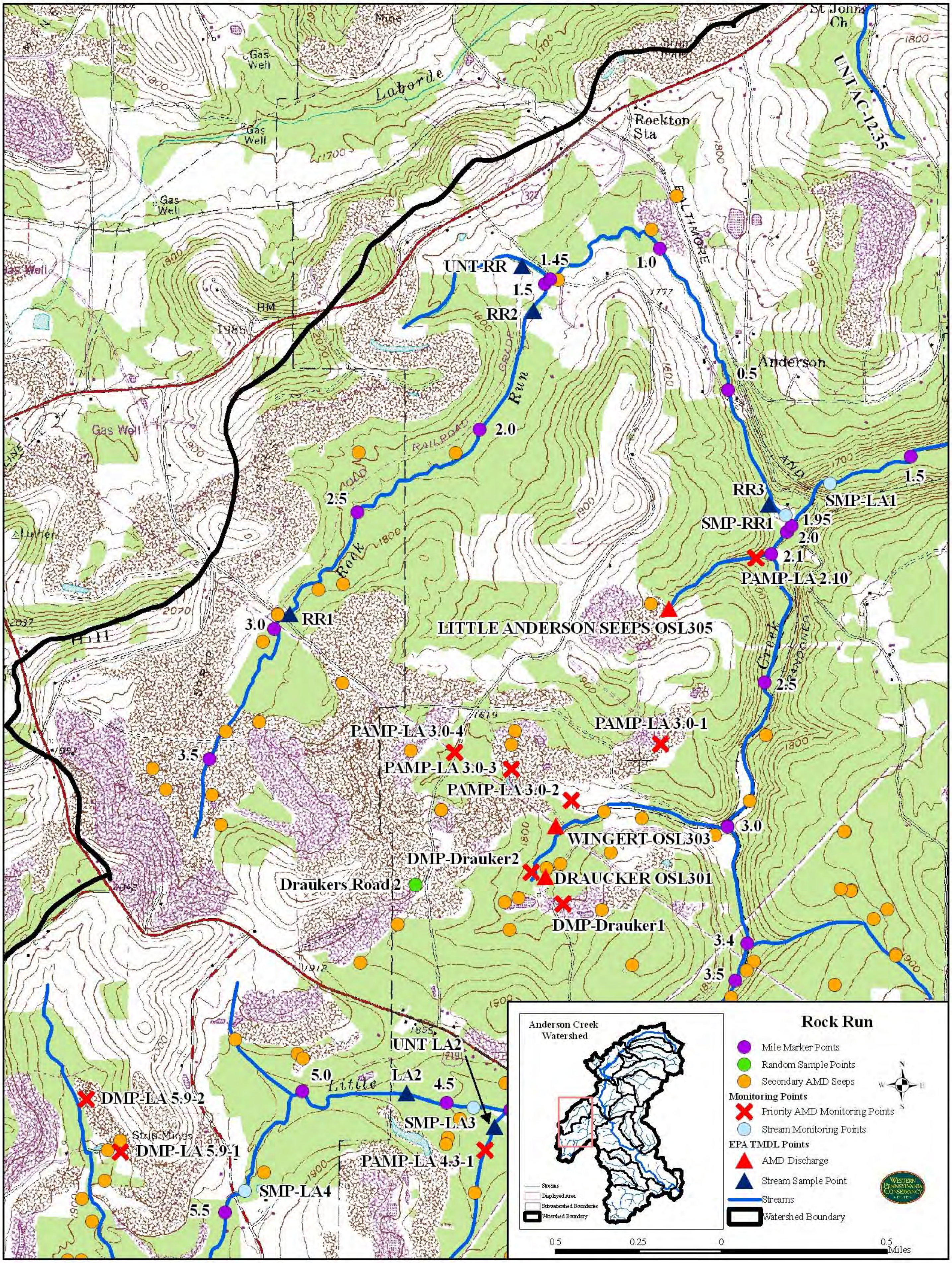
All values shown in this table are long-term average daily values.

The TMDL for Rock Run at point RR1 requires that a load allocation be made for all areas above RR1 for total iron, total manganese, total aluminum, and acidity.

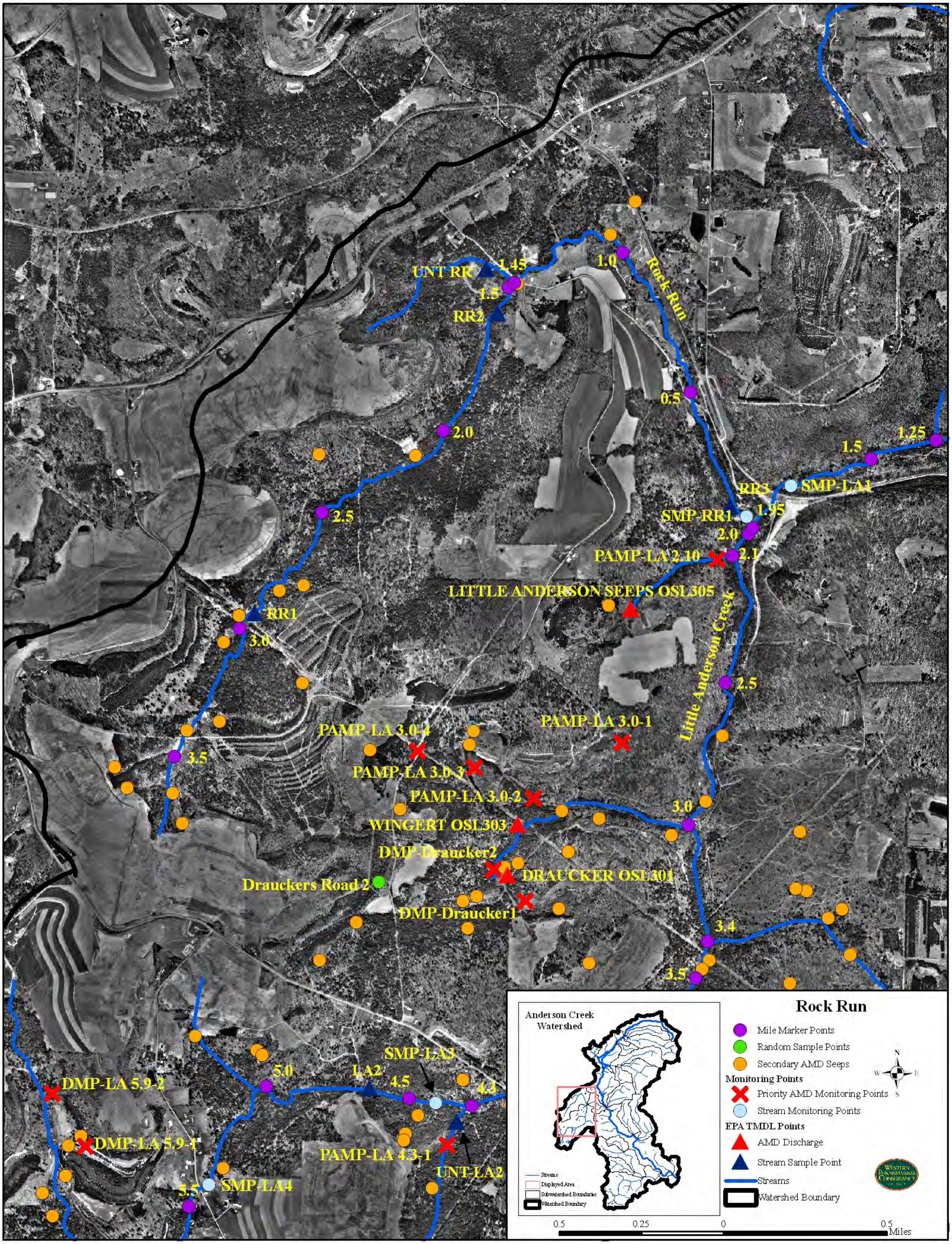
Recommendations for TMDL Rock Run above RR1

As mentioned above, a large reclaimed surface mine is associated with numerous seeps discharging from the toe of the spoil. Because the toe of the spoil is not at the original contour, but is much higher in elevation, it will be extremely difficult to address the discharges on the mine site. A large wetland exists immediately below the surface mine and all of the discharges above RR1 eventually flow into the wetland. By creating a series of low dikes that control the flow of the discharges, it may be possible to gain additional detention time in order to remove some of the metals before they enter the wetland. It should be noted that it will likely be difficult to obtain permits for working within the wetland area to treat the discharges. As was indicated for the headwaters area of Little Anderson Creek, a simple solution could be the installation of a low-impact dike system throughout the wetland area, similar to silt fencing constructed for erosion and sediment control. Again, because there is a large drainage area above the wetlands, surface runoff during heavy storms could be a problem with a lightweight dike system.

There is one discharge, which enters the wetland from the north, on what may be a pipeline right-of-way. This discharge could be a priority for remediation efforts in this segment. It was not considered as an overall priority in the context of assessing the entire Anderson Creek watershed. The discharge emanates from the toe of spoil below the surface mine, and is one of the more significant discharges on the headwaters of Rock Run. Sufficient area exists for creating settling ponds and treatment wetlands. Once



Rock Run
Anderson Creek Watershed
Mile Marker Points
Random Sample Points
Secondary AMD Seeps
Monitoring Points
Priority AMD Monitoring Points
Stream Monitoring Points
EPA TMDL Points
AMD Discharge
Stream Sample Point
Streams
Watershed Boundary
Streams
Displayed Area
Subwatershed Boundaries
Watershed Boundary
0.5
0.25
0
0.5
Miles
UNT-RR
1.45
1.5
RR2
1.0
0.5
Anderson
2.0
2.5
RR1
3.0
3.5
RR3
SMP-RR1
SMP-LA1
1.95
2.0
2.1
1.5
PAMP-LA 2.10
LITTLE ANDERSON SEEPS OSL305
2.5
PAMP-LA 3.0-1
PAMP-LA 3.0-4
PAMP-LA 3.0-3
PAMP-LA 3.0-2
WINGERT-OSL303
3.0
DMP-Draucker2
DRAUCKER OSL301
Draukers Road 2
DMP-Drauker1
3.4
3.5
UNT LA2
LA2
4.5
5.0
Little
SMP-LA3
PAMP-LA 4.3-1
DMP-LA 5.9-2
DMP-LA 5.9-1
SMP-LA4
5.5
UNTAC-12.35
Rockton Sta
Laborde
Rock
Run
Creek
Gas Well
BALTIMORE
RAILROAD
St Johns Ch
Strip Mines
Luthers
Mine


UNT RR
1.45
1.5
RR2
1.0
Rock Run
0.5
2.0
2.5
RR1
3.0
3.5
1.25
1.5
RR3
SMP-LA1
SMP-RR1
1.95
2.0
PAMP-LA 2.10
2.1
LITTLE ANDERSON SEEPS OSL305
Little Anderson Creek
2.5
PAMP-LA 3.0-4
PAMP-LA 3.0-1
PAMP-LA 3.0-3
PAMP-LA 3.0-2
3.0
WINGERT OSL303
DMP-Draucker2
DRAUCKER OSL301
Drauckers Road 2
DMP-Draucker1
3.4
3.5
DMP-LA 5.9-2
5.0
LA2
SMP-LA3
4.5
4.3
DMP-LA 5.9-1
PAMP-LA 4.3-1
UNT-LA2
5.5
SMP-LA4
Anderson Creek Watershed
Streams
Displayed Area
Subwatershed Boundaries
Watershed Boundary
Rock Run
Mile Marker Points
Random Sample Points
Secondary AMD Seeps
Monitoring Points
Priority AMD Monitoring Points
Stream Monitoring Points
EPA TMDL Points
AMD Discharge
Stream Sample Point
Streams
Watershed Boundary
N
W
E
S
Western Pennsylvania Conservancy
0.5
0.25
0
0.5
Miles

again, wetland-permitting issues will be a concern because the discharge flows through wetlands before entering Rock Run.

TMDL for Rock Run at RR2 (RR1 to RR2)

TMDL point RR2 is located at a bridge crossing on Rock Run Road, approximately .3 miles south of Route 322 and just upstream of UNT-RR 1.45. Reductions at point RR2 are necessary for any parameter that exceeds the allowable load at this point. A summary of all loads that affect point RR2 are shown in Table G15. Necessary reductions at point RR2 are shown in Table G16 [both tables are taken from the TMDL report] (SRBC 2004).

Table G15. Summary of Loads Affecting Point RR2

	Iron (lbs/day)	***Manganese (lbs/day)***	***Aluminum (lbs/day)***	***Acidity (lbs/day)***
RR1				
Existing Load	15.02	130.55	18.69	571.36
Allowable Load	3.74	2.63	2.22	1.73
Load Reduction	11.28	127.92	16.47	569.63

Table G16. Reductions Necessary at Point RR2

	Iron (lbs/day)	***Manganese (lbs/day)***	***Aluminum (lbs/day)***	***Acidity (lbs/day)***
Existing Loads at RR2	17.70	191.09	30.15	686.99
Total Load Reduction (RR1)	11.28	127.92	16.47	569.63
Remaining Load	6.42	63.17	13.68	117.36
Allowable Loads at RR2	3.39	1.86	3.06	41.19
Percent Reduction	47	97	78	65

The TMDL for Rock Run at point RR2 requires that a load allocation be made for total iron, total manganese, total aluminum, and acidity (SRBC 2004).

Recommendations for TMDL RR1 to RR2

This segment of Rock Run is rather secluded, flowing through an undeveloped, mostly forested area. Several previously mined areas discharge AMD into the stream along this segment.

A few hundred feet downstream of the bridge, a series of acid seeps enter from the right and are associated with an old, poorly reclaimed surface mine located immediately to the east. Field testing noted a drop in the pH of the stream after the discharges entered, and thus the seeps are considered a significant source of impairment to this segment. The seeps are located in the woods, downslope from the poorly reclaimed spoil piles of the mine.

Reclamation of the poorly reclaimed surface mine will be necessary to reduce the impacts from the discharges. It is likely that substantial alkaline addition will be necessary during reclamation of the area in order to reduce or eliminate the acidic conditions of the discharges. Based on discharges associated with other reclaimed surface mine areas in the watershed, it may be possible to eliminate the acidity, but it is unlikely that the metal loadings associated with the discharges will be eliminated once the surface mine is reclaimed. Metal loadings will likely be reduced. Once the area is reclaimed, or remined, if possible, further testing of the discharges should be performed. Only then will it be possible to determine the proper method of remediation. In any case, wetlands permitting will again be an issue. This is especially true for this site, since some of the seeps appear in wooded bogs, and wooded bogs or wetlands are usually accorded a heightened status for protection by the regulatory agencies.

Additionally, the higher elevations of the entire left side of this stream segment were surface mined. AMD enters the stream from numerous points but most appear to be net alkaline. There is one area about midway along the segment that had seeps with pH readings in the mid-three range. Flow volume was low and access to the site would be very difficult due to its remote location, so the seeps were given a low priority for restoration.

Unnamed Tributary to Rock Run - UNT RR (UNT-RR 1.45)

TMDL point UNT RR is located at the mouth of a tributary entering Rock Run from river-left, just downstream from TMDL point RR2. This tributary is impaired by AMD from several seeps in its headwaters. The seeps emanate from reclaimed surface mines just south of Route 322.

Necessary reductions at TMDL point UNT RR are shown in Table G17 [taken from the TMDL report]. The TMDL for the unnamed tributary to Rock Run at point UNT RR requires that a load allocation be made for all areas above UNT RR for total iron, total manganese, and acidity (SRBC 2004).

Table G17. Reductions for the Unnamed Tributary to Rock Run above UNT RR

Station	*Parameter*	*Measured Sample Data*		*Allowable*		*Reduction Identified*
		Conc. (mg/l)	*Load (lbs/day)*	*LTA Conc. (mg/l)*	*Load (lbs/day)*	*Percent*
UNT RR	Fe	0.62	0.62	0.30	0.30	52
	Mn	22.03	22.05	0.20	0.20	99.1
	Al	0.80	0.80	-	-	-
	Acidity	59.38	59.43	1.19	1.19	98
	Alkalinity	5.99	5.99			

All values shown in this table are long-term average daily values.

There was not enough data to properly develop a TMDL for aluminum at point UNT RR so a reduction percentage was not identified. The observations for aluminum in the downstream segments of Rock Run indicate that it also may be violating water quality standards. It is assumed that BMPs used to reduce iron loads in this reach also would reduce the amount of aluminum (SRBC 2004).

Recommendations for TMDL point UNT RR

Similar to TMDL point RR1, the AMD entering this tributary appears in a wooded area, downslope of a large reclaimed surface mine located at the very headwaters of the tributary. Again, the reclaimed site has a very high and steep embankment at the toe of the spoil and does not follow the approximate original contour of the undisturbed land below it. These conditions would make it very difficult to address the discharges on the reclaimed mine site.

Field testing indicated that most of the AMD discharges are not very acidic, with pH readings ranging from 5.4 to 6.1. Based on the field testing, it may be possible to remove some of the polluting metals by capturing the discharges and directing them through a passive settling pond and wetland treatment system to improve retention time and promote precipitation of the metals. Most of the discharges flow into a large wetland area located west of Rock Run Road, which is likely removing some of the metals. It is difficult to determine whether additional AMD enters the wetland through polluted groundwater. A more detailed study of the wetland area would be necessary to make that determination. Such a study was beyond the scope of this assessment but is recommended as a future activity.

The wooded area below the surface mine where the discharges are located is apparently being used for hunting purposes, as there were several tree stands located in the area. It is unknown whether the property owner would be willing to use the wooded area for the construction of a treatment system. Communication with the property owner has not occurred and would be necessary to determine if the area would be available for treatment.

TMDL point Rock Run 3 (RR3) [SMP RR1]

The TMDL point for RR3 is located near the mouth of Rock Run and includes all of the pollution sources on Rock Run, including UNT RR. Necessary reductions at TMDL point UNT RR are shown in Table G20 [taken from the TMDL report]. The TMDL for Rock Run at point RR3 requires that a load allocation be made for total iron, total manganese, and acidity. The TMDL for Rock Run at point RR3 does not require a load allocation to be made for total aluminum. [It assumes] all necessary reductions have been made upstream from this point (SRBC 2004).

Table G20. Reductions Necessary at Point RR3

	Iron (lbs/day)	***Manganese (lbs/day)***	***Aluminum (lbs/day)***	***Acidity (lbs/day)***
Existing Loads at RR3	65.74	508.77	23.17	1,935.61
Total Load Reduction (RR1, RR2, and UNT RR)	25.91	339.00	43.56	1,273.67
Remaining Load	39.83	169.77	0	661.94
Allowable Loads at RR3	6.71	4.34	4.09	116.11
Percent Reduction	83	97	0	82

TMDL monitoring point RR3 is also represented by this assessment as monitoring point SMP-RR1, which was located slightly upstream from Rock Run's confluence with Little Anderson Creek. The following averages were developed using the data collected during this assessment and represents the average pollution load in all of Rock Run during that time period

Average water quality measured at SMP-RR1

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
SMP-RR1	**2.15**	**20.9**	**7.19**	**96.0**	**0.91**	**19.4**	**15.44**	**217.7**	**5**	**96.5**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

Recommendations for TMDL RR 3

One area of significance was identified downstream of UNT RR (UNT RR 1.45) that adds to the metals pollution load entering Rock Run. The site is an abandoned coal tipple adjacent to the abandoned Baltimore and Ohio rail line approximately .75 miles south of Rockton Station. The site contains a large area of mine spoil that is un-vegetated and has an erosion problem. Based on field tests and visual observations during the assessment, rain and surface water runoff become polluted when they come in contact with the mine spoil. It is unknown whether the site pollutes the groundwater in the area, although it is likely to have some negative effect. One small discharge was identified near Rock Run below the site and is assumed to be hydrologically connected. A definitive determination was beyond the scope of this assessment.

Reclamation of the abandoned tipple site is recommended. Removal of the spoil or re-grading and re-vegetation of the site, along with some type of alkaline addition would likely improve the quality of the water associated with the site. Because restoration of Rock Run is not considered a high priority in the overall restoration of Anderson Creek at this time, it is recommended that this site be included in a more detailed study of Rock Run sometime in the future.

TMDL for Little Anderson at LA3 (SMP-LA1)

The TMDL point for LA3 is identified as the mouth of Little Anderson Creek near the confluence with Anderson Creek. Basically, LA3 captures the entire pollution load entering Little Anderson Creek. The TMDL for LA3 was developed by subtracting the required TMDL load reductions for all of the discharges above LA3, assuming they will be addressed at those points, from the existing loads at LA3. The results show a required load reduction only for aluminum at LA3. Table G23, taken from the TMDL study, shows the required load reductions at LA3.

Table G23. Reductions Necessary at Point LA3

	Iron (lbs/day)	*Manganese (lbs/day)*	*Aluminum (lbs/day)*	*Acidity (lbs/day)*
Existing Loads at LA3	439.73	411.92	475.36	6,778.42
Total Load Reduction (Sum of OSL Discharges, La1, UNT LA1, LA2, UNT LA2, RR1, RR2, UNT RR, and RR3)	634.20	898.18	65.18	7,017.02
Remaining Load	0	0	410.18	0
Allowable Loads at LA3	47.57	44.49	32.32	0
Percent Reduction	0	0	92	0

The TMDL for point LA3 requires that a load allocation be made for all areas above LA3 for total aluminum. The TMDL for Little Anderson Creek at point LA3 does not require a load allocation to be made for total iron, total manganese, and acidity. All necessary reductions have been made upstream from this point (SRBC 2004).

TMDL point LA3 is also represented by this assessment by SMP-LA1, which is located slightly upstream from the TMDL monitoring point. The following averages were developed using the data collected during this assessment and represents the average pollution load in all of Little Anderson Creek during that period.

Average water quality measured at SMP-LA1

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
SMP-LA1	**6.2**	**140.1**	**5.2**	**192.6**	**3.6**	**134.7**	**49.9**	**1559.6**	**0.8**	**87.3**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

Recommendations for TMDL LA3

Below Rock Run, no identifiably significant AMD source enters Little Anderson Creek. Some minor seeps were observed at the base of the viaduct below the railroad, but none were significant enough to warrant a priority status. The first unnamed tributaries entering Little Anderson Creek below the viaduct from river-left, UNT-LA 1.25, was influenced by lower pH seeps but none were significant enough to cause concern. It is clear that the previously identified AMD discharges to Little Anderson Creek above Rock Run are the major contributors of metals and acid pollution to the subwatershed. It is recommended to focus efforts to reduce pollution loads on those discharges.

The Main Stem of Anderson Creek

The main stem of Anderson Creek flows for approximately 23.5 miles, from its headwaters above Interstate 80 to its confluence with the West Branch of the Susquehanna River in Curwensville. This study only covered the portion of Anderson Creek from the outflow of the Dubois Reservoir to the confluence with the West Branch, a distance of 14 miles. Between the Dubois Reservoir and Little Anderson Creek, Anderson Creek supports a trout-stocked fishery and is relatively unimpaired by AMD. It is influenced by acid rain, which is compounded by a general lack of buffering capabilities, as is the case throughout most of the watershed. Although the acidic conditions in the upper watershed affect its quality, the stream remains net alkaline and has the lowest levels of metals for all sampling points.

For this assessment, the main stem was monitored at four points. Stream Monitoring Point AC1 (SMP-AC1) is located just upstream of the State Route 153 Bridge in Curwensville. Stream Monitoring Point AC2 (SMP-AC2) is located just above the old State Route 879 Bridge (now abandoned), which is located approximately two miles upstream from the mouth. Stream Monitoring Point AC3 is located about .5 miles below the Pike Township Municipal Authority dam on Anderson Creek and approximately 5.25 miles upstream from the mouth. The uppermost monitoring point, Stream Monitoring Point AC4 (SMP-AC4) is located just downstream from the State Route 322 Bridge, west of Rockton. It is approximately 12.25 miles upstream from the mouth.

The water quality of Anderson Creek becomes severely degraded at the confluence with Little Anderson Creek. The pollution load from Little Anderson Creek essentially kills the stream when it enters. Although Little Anderson Creek is the main source of metals and acid pollution to Anderson Creek, other unnamed tributaries and AMD discharges also degrade the stream. In addition, discharges entering Kratzer Run, and its subwatershed Bilger Run, also add to the metals and acid pollution load of Anderson Creek.

Anderson Creek also receives relatively good water, which is sometimes net acidic but low in metals, from several named tributaries which enter from the eastern side of the watershed. Panther Run, Irvin Branch, and Bear Run all provide water that helps Anderson Creek hold its pH in the mid to upper four range for most of year. During base flow conditions, Anderson Creek below Kratzer Run actually increases its level of alkalinity and receives lower levels of metals because several of the more severe AMD discharges on Little Anderson Creek, Bilger Run, and Kratzer Run cease to flow. During the August 2005 monitoring event, minnows were observed for the first time at SMP-AC1 and at SMP-BR2 on Bilger Run. It is assumed the fish migrated into these sites from refuges on the West Branch of the Susquehanna River and other tributaries in the lower watershed with water quality good enough to support fish. These positive indicators point to the significance of addressing the worst discharges on Little Anderson Creek, Bilger Run, and Kratzer Run and give hope for the restoration of Anderson Creek.

TMDL for Main Stem of Anderson Creek - A1

The reach of Anderson Creek above TMDL point A1 is the area of Anderson Creek located above and just below the DuBois Reservoir. Anderson Creek above point A1 is not listed on the Section 303(d) list as being impaired by AMD, and a TMDL will not be developed for this point. The DuBois Reservoir is used by the City of DuBois as a public water supply. Up to 3.00 mgd is allocated to DuBois from the reservoir (Runkle 2000). A conservation release of 1.52 mgd must be maintained at all times over the reservoir to sustain downstream uses (Runkle 2000). This release becomes especially important in times of low flow, as a backup public water supply intake for the Pike Township Municipal Authority, which is located a few miles downstream on Anderson Creek.

Other potential problems exist in areas of the watershed above point A1, which is not degraded by AMD. Interstate 80 transects the watershed in its upper reaches less than one mile upstream of the DuBois Reservoir. The City of DuBois applied for and received a Growing Greener Grant through the Commonwealth of Pennsylvania to investigate sources of pollution to the upper reaches of the watershed. The City of DuBois Watershed Commission is concerned that a spill on Interstate 80, the spraying of overpasses during the winter months by the Pennsylvania Department of Transportation (PennDOT), and the possibility of malfunctioning gas wells present risks to the water supply. The EADS Group of Clarion, Pa., completed the study in July 2001. It concluded that the pollution is from natural sources, such as acid rain leaching metals from the bedrock (DuBois Reservoir Watershed Water Quality Assessment Project 2001; SRBC 2004).

Monitoring point SMP-AC4 coincides with the TMDL sampling point A1. The following averages were developed using the data collected during this assessment.

Average water quality measured at SMP-AC4

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
SMP-AC4	**0.14**	**25.0**	**0.06**	**13.3**	**0.09**	**19.7**	**1.40**	**480.7**	**10.2**	**1201.2**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

TMDL for Main Stem of Anderson Creek - A1 to A2 (SMP-AC3)

Anderson Creek between A1 and A2 represents Anderson Creek and its unnamed tributaries from just above Route 322 to the mouth of Anderson Creek. This includes the main-stem segment and its named and unnamed tributaries from below the DuBois Reservoir to the West Branch of the Susquehanna River in Curwensville.

The TMDL for Anderson Creek at point A2 consists of a wasteload allocation to one future mining operation and a load allocation to all of the watershed area between A1 and A2. Addressing the mining impacts above this point addresses the pH and metal impairment for the segment. An in-stream flow measurement was not available for A2; therefore, the flow was determined using the AVGWLF model (74.19 mgd) (SRBC 2004).

The water quality standard for acidity (17.85 mg/l) at point A2 was determined by adding the net alkalinity at A1 (A1 alkalinity - A1 acidity) to the acidity at A2 (9.97 -4.70

= 5.27; 5.27 + 12.58 = 17.85). Load reductions for acidity were calculated using this value as the water quality standard for acidity at point A2 (SRBC 2004).

There were fewer manganese and aluminum data than necessary for this discharge to conduct Monte Carlo analysis; therefore, they were not evaluated for this TMDL. However, the observations for manganese and aluminum in these segments of Anderson Creek indicate that they also may be violating water quality standards. It is assumed that BMPs used to reduce iron loads in this reach also would reduce the amount of manganese and aluminum (SRBC 2004).

Tables G38 and G40, taken from the TMDL report, show the long-term concentrations and the load reductions established for Anderson Creek at TMDL point A2.

Table G38. Long-Term Average (LTA) Concentrations for Anderson Creek Between A1 and A2

Station	***Parameter***	***Measured Sample Data***		***Allowable***	
		Conc. (mg/l)	***Load (lbs/day)***	***LTA Conc. (mg/l)***	***Load (lbs/day)***
A2	Fe	0.28	173.25	0.28	172.15
	Mn	0.92	569.25	-	-
	Al	0.79	488.81	-	-
	Acidity	12.58	7,783.81	8.55	5,290.27
	Alkalinity	1.63 (17.85)*	1,008.55 (11,044.59)*		

All values shown in this table are long-term average daily values.
*Alkalinity value used as water quality standard.

Table G40. Reductions Necessary at Point A2

	Iron (lbs/day)	***Manganese (lbs/day)***	***Aluminum (lbs/day)***	***Acidity (lbs/day)***
Existing Loads at A2	173.25	569.25	488.81	7,783.81
Total Load Reduction (LA1, UNT LA1, LA2, UNT LA2; OSL 352, 329, 330, 301, 303, 305; RR1, RR2, UNTRR, RR3, LA3, OSL 350, OSL 351, HR1, OSL 211-214, BR1, BR2, FR1, KR1, OSL 220)	1,263.25	1,572.95	598.95	18,282.89
Remaining Load	0	0	0	0
Allowable Loads at A2	172.15	-	-	5,290.27
Percent Reduction	0	0	0	0

The TMDL for Anderson Creek at point A2 does not require a load allocation to be made for total iron, total manganese, total aluminum, and acidity. All necessary reductions have been made upstream from this point (SRBC 2004).

Monitoring point SMP-AC1 coincides with the TMDL sampling point A2. The following averages were developed using the data collected during this assessment.

Average water quality measured at SMP-AC1

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
SMP-AC1	**0.31**	**138.2**	**0.82**	**260.5**	**0.46**	**206.4**	**5**	**2000.2**	**9**	**2060.4**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

Problem Areas on the Main Stem of Anderson Creek

Dubois Reservoir to Little Anderson Creek

The study area of this assessment begins at the outflow of the Dubois Reservoir. Between the outflow of the reservoir and Little Anderson Creek, Anderson Creek is relatively unimpaired by non-point source pollution. Tributaries entering the main stem are generally affected by acid deposition and are afflicted with depressed pH readings. Although some surface mining has taken place in this area of the watershed, AMD is not a problem in this 3.75-mile long section of Anderson Creek. The Pennsylvania Fish and Boat Commission manages this stream segment as a trout-stocked fishery. It is likely that Anderson Creek occasionally receives a significant amount of salt runoff from Route 322 during winter weather. The stream flows at higher volume during that time and likely is able to assimilate such conditions without significant impacts. The stream is also susceptible to toxic spills from vehicles traveling Route 322, which is a concern but beyond the scope of this study.

Panther Run

Panther Run is the largest tributary entering Anderson Creek between the DuBois Reservoir and the confluence with Little Anderson Creek, which enters just downstream of Panther Run. The headwaters of Panther Run are located south of Route 322 and east of the Anderson Creek main stem. The area is forested and contains a very dense and nearly impenetrable population of rhododendron along the stream. The upper reaches along Route 322 are receiving some development pressure as several new residences have been built in recent years. No specific problems were noted related to the development. A gas line traverses the subwatershed in a northeast/southwest orientation. Some erosion problems, caused by ATV use, were identified along the pipeline.

When field sampled during the assessment, Panther Run exhibited symptoms of an acidified stream, with depressed pH (4.7) and depressed macroinvertebrate life observed in the stream. A lab sample showed that Panther Run was net acidic with low metal content and contained aluminum levels identified as being toxic to some fish species. Panther Run is similar, in such respects, to many of the other streams draining the eastern part of Anderson Creek. The acidic geology of Panther Run, combined with chronic acid deposition, causes the stream to mainly support acid-tolerant aquatic insects. In the 1999 assessment performed by Headwaters Charitable Trust, a good population of brook trout was noted at the sample site. Brook trout are the most acid-tolerant species of trout in Pennsylvania.

Unnamed Tributaries below Little Anderson Creek

Below the confluence of Anderson Creek and Little Anderson Creek, several impaired tributaries enter the main stem of the stream. The first three tributaries entering from river-right, UNT-AC 9.20, UNT-AC 8.80, and UNT-AC 8.20 are impaired by AMD to varying degrees. Each is affected by abandoned surface mines and underground mines located in the higher elevations of the sub-basins on the western side of Anderson Creek.

Immediately below these impaired tributaries, two very large net acidic tributaries enter Anderson Creek from river-left, Irvin Branch (AC-6.45) and Bear Run (AC- 6.05). Although neither is heavily impacted with AMD, each suffers from acid deposition and had depressed pH and slightly elevated levels of aluminum. Both Bear Run and Irvin Branch were identified by the Headwaters Charitable Trust study as containing good populations of brook trout. Data for the macroinvertebrate sampling was not available at the time of the assessment. Based on empirical observations taken during the assessment and the water quality of the streams, it is likely macroinvertebrates will tend to be of the acid-tolerant type.

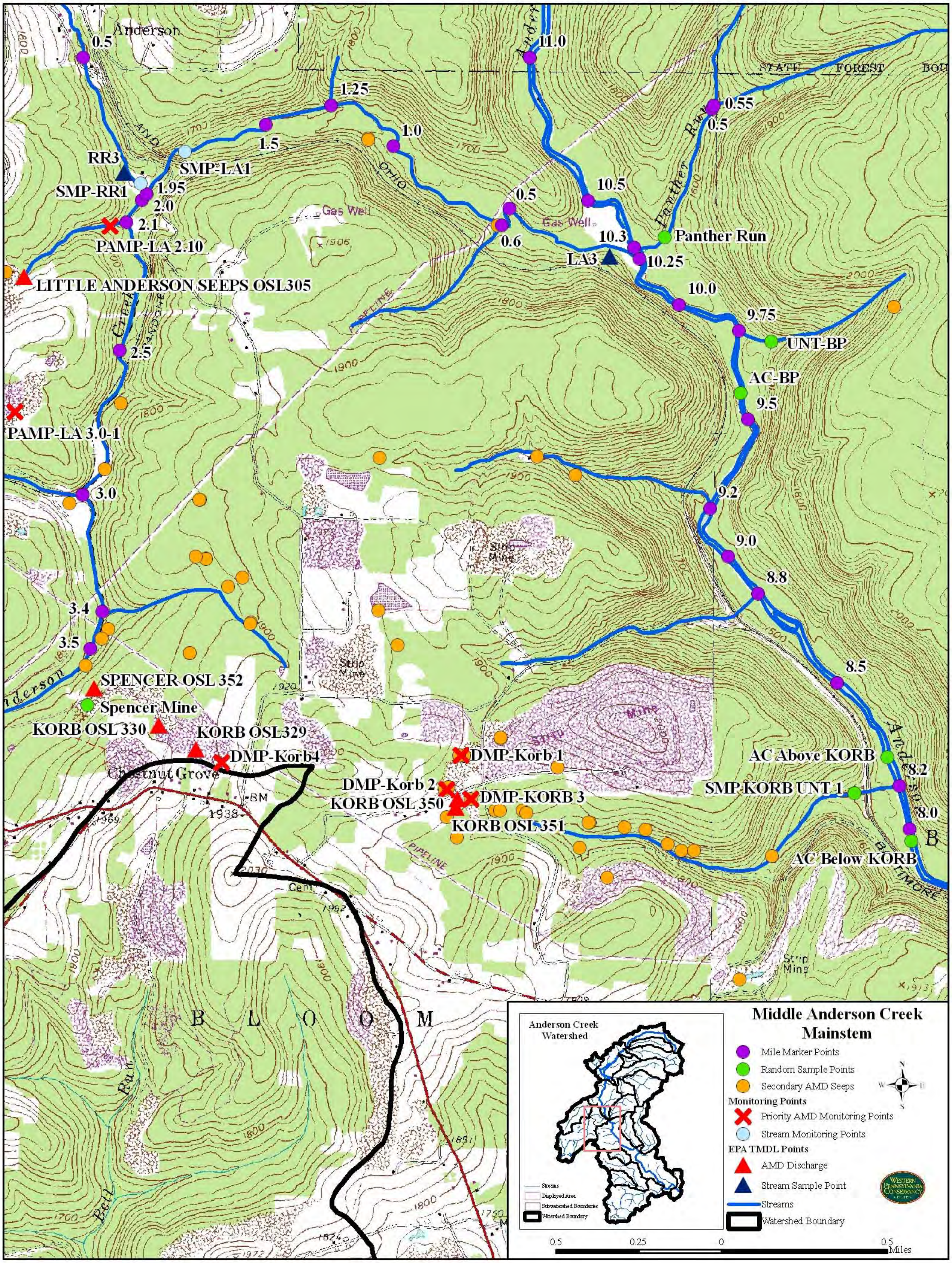
The combined flows of Bear Run and Irvin Branch are large enough to add significant amounts of alkalinity and acidity to Anderson Creek. Some AMD does enter the streams from abandoned surface and deep mines, but the main source of their acidity appears to be from atmospheric deposition or acid rain and the geology of the area. The geology of the eastern side of the Anderson Creek watershed provides little or no buffering capacity for acid rain and most of the streams draining the eastern side are often net acidic with low metals.

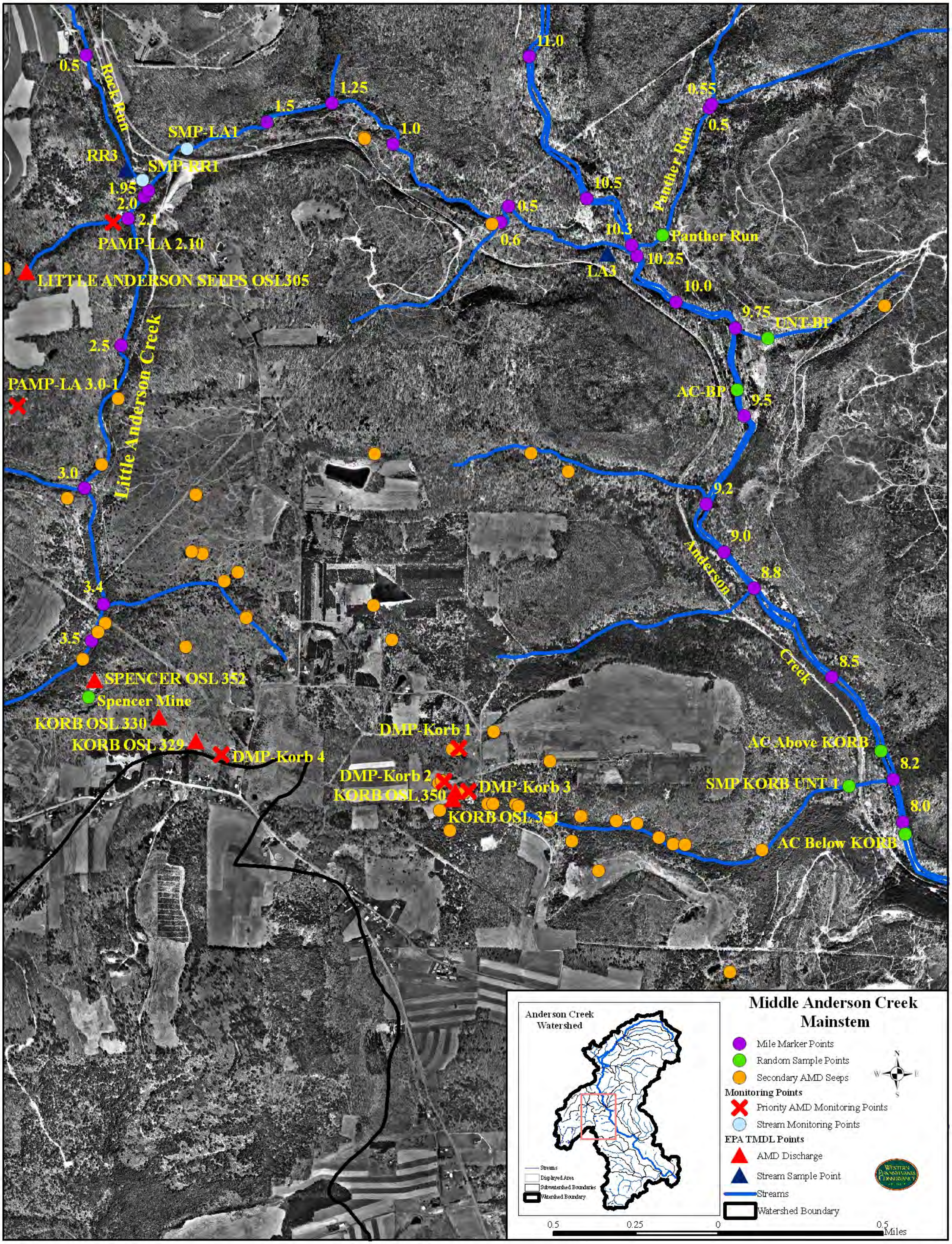
Just below Bear Run, a small, unnamed tributary enters from river-left (UNT-AC 5.8). For most of its length, the stream quality is decent, but as it approaches Anderson Creek several low-pH AMD seeps enter the stream almost unnoticed. The seeps are likely springs, which have been polluted from an abandoned mine located in higher elevations. Known locally as Laurel Swamp, the site was apparently deep mined and then surface mined for the Mercer clay. An area of unreclaimed mine spoil remains at the site. No restoration recommendations were identified within the Scarlift study, but the site was identified on mining maps. Perhaps it was an oversight. The pH of the stream steadily drops as additional low-pH seeps enter, very near to the streambed, and reduce the pH of the tributary considerably. This low-pH condition was noted by an ACWA volunteer who monitored the mouths of many of the small tributaries entering Anderson Creek for pH several years prior to this assessment.

Approximately two miles further downstream, Anderson Creek receives additional AMD from an abandoned clay mine located several hundred feet above the stream on the eastern flank of the gorge. Similar to the situation on UNT-AC 5.8 at Laurel Swamp, the clay mine, known locally as Bloom mine, was deep mined and later surface mined. This site is much larger and produces AMD from two distinct areas located on either side of UNT-AC 3.75. Both areas were monitored as part of this assessment and are identified as DMP-AC 3.75-1 and DMP-AC 3.75-2. DMP-AC 3.75-1 flows from a collapsed mine tunnel at an elevation of about 1,700 feet above the gorge. DMP-AC 3.75-2 once again, does not appear at the abandoned mine site but hundreds of feet below the mine on the very steep hillside within the gorge. This discharge is being sampled along the Pike Township Water Authority access road, located along the eastern side of the Anderson Creek gorge. Another drainage site associated with this tributary was also sampled for a short time during this assessment, DMP-AC 3.75-3. It is located near DMP-AC 3.75-1. It was determined that the drainage was likely more associated with acidic mine spoil runoff and was dropped from the sampling schedule.

From UNT-AC 3.75 to the confluence with Kratzer Run, no significant discharges were identified. Downstream of Kratzer Run, two additional sources of AMD were identified. The first enters Anderson Creek just above the North American Refractory from the river-right side of the stream. This discharge actually emanates from an abandoned underground mine located just outside of Curwensville along Windy Hill Road. The discharge emerges in a very steep ravine north of Windy Hill Road and drops approximately 200 feet in elevation before entering a wetland located upstream and on the opposite side of Anderson Creek from the refractory (AC-1.5). The discharge apparently encounters alkaline material near the refractory as the pH rises before it enters Anderson Creek. The discharge was not monitored as part of the assessment. A single water sample was gathered at the discharge site to determine the water quality as it discharges from the mine.

One additional area of AMD was noted entering the main stem of Anderson Creek, which emanates from an area along an unnamed tributary flowing through Curwensville, UNT-AC 0.3, which enters Anderson Creek in a concrete flood-control channel from the river-left side near the confluence with the West Branch of the Susquehanna River. Iron-stained seeps were located along the tributary prior to it entering buried pipe just east of Oak Hill Cemetery, which carries the stream underground through most of Curwensville. It re-emerges from underground in the above-mentioned concrete channel once past Route 879 and before entering Anderson Creek. Because field sampling did not indicate the seeps were of very poor water quality or of high flow and did not have a significant impact to Anderson Creek, they were not sampled as part of the assessment. There may be a possibility of improving the water quality of this unnamed tributary by removing some of the metals through passive treatment or other methods. Finding ample room to construct a passive treatment system might be difficult because of the location of the seeps near the stream or residences.


Middle Anderson Creek Mainstem
● Mile Marker Points
● Random Sample Points
● Secondary AMD Seeps
Monitoring Points
✕ Priority AMD Monitoring Points
○ Stream Monitoring Points
EPA TMDL Points
▲ AMD Discharge
▲ Stream Sample Point
Streams
Watershed Boundary
Anderson Creek Watershed
Streams
Displayed Area
Subwatershed Boundaries
Watershed Boundary
0.5
0.25
0
0.5
Miles
N
W
E
S
Anderson
0.5
11.0
1.25
1.5
1.0
0.55
0.5
RR3
SMP-LA1
SMP-RR1
1.95
2.0
2.1
PAMP-LA 2.10
0.5
0.6
10.5
10.3
10.25
LA3
Panther Run
LITTLE ANDERSON SEEPS OSL305
10.0
9.75
UNT-BP
AC-BP
9.5
2.5
PAMP-LA 3.0-1
3.0
9.2
9.0
8.8
3.4
3.5
8.5
SPENCER OSL 352
Spencer Mine
KORB OSL 330
KORB OSL329
DMP-Korb4
DMP-Korb 1
AC Above KORB
8.2
SMP-KORB UNT 1
DMP-Korb 2
DMP-KORB 3
KORB OSL 350
KORB OSL 351
8.0
AC Below KORB
Chestnut Grove
Strip Mine
Strip Mine
Strip Mine
Gas Well
Gas Well
PIPELINE
STATE FOREST
Panther Run
Anderson
Little Anderson Creek
Bell Run
B L O O M
1700
1800
1900
2000
1938
1969
2030
1992
1906
1920
1972
1824
1851


Middle Anderson Creek Mainstem
Rock Run
0.5
RR3
SMP-LA1
SMP-RR1
1.95
2.0
2.1
PAMP-LA 2.10
LITTLE ANDERSON SEEPS OSL305
1.5
1.25
1.0
0.5
0.6
11.0
10.5
10.3
10.25
LA3
0.55
0.5
Panther Run
Panther Run
10.0
9.75
UNT-BP
AC-BP
9.5
9.2
9.0
8.8
Anderson
Creek
8.5
AC Above KORB
8.2
SMP KORB UNT 1
8.0
AC Below KORB
2.5
PAMP-LA 3.0-1
Little Anderson Creek
3.0
3.4
3.5
SPENCER OSL 352
Spencer Mine
KORB OSL 330
KORB OSL 329
DMP-Korb 4
DMP-Korb 1
DMP-Korb 2
KORB OSL 350
DMP-Korb 3
KORB OSL 351
Anderson Creek Watershed
Streams
Displayed Area
Subwatershed Boundaries
Watershed Boundary
Mile Marker Points
Random Sample Points
Secondary AMD Seeps
Monitoring Points
Priority AMD Monitoring Points
Stream Monitoring Points
EPA TMDL Points
AMD Discharge
Stream Sample Point
Streams
Watershed Boundary
N
W
E
S
Western Pennsylvania Conservancy
0.5
0.25
0
0.5
Miles

Recommendations for the Problem Areas on the Main Stem of Anderson Creek

Recommendations for Panther Run

Panther Run is essentially unimpaired by AMD. As is the case with all of the streams draining the northeasterly portion of the watershed, the lack of alkaline material, acidic rock formations, and acid precipitation cause its waters to be pH depressed and likely to have populations of acid-tolerant aquatic macroinvertebrates. No fish were observed in the stream during this assessment, although no electro-fishing study was performed. The 1999 Headwaters Charitable Trust study did find the stream contained a population of reproducing brook trout. Because AMD was not an issue with Panther Run it was not sampled as part of this assessment. Panther Run would be a prime candidate for some type of alkaline addition treatment, such as limestone sand addition, which performs well on high-gradient streams such as Panther Run. Its inaccessibility and remoteness would make such treatment very difficult. Another option would be the use of automated lime dosers to raise the pH of the stream and neutralize episodic acidic events. Such treatments are costly and require regular operation and maintenance. It is likely that only a reduction of atmospheric acid deposition would be of the most long-term benefit to the depressed pH conditions of Panther Run.

UNT-AC 9.20

Surface mines located along Viaduct Road, on property owned by Anderson Creek Sportsmen, affect the first tributary, UNT-AC 9.20. A portion of the headwaters area of the tributary was surface mined and reclaimed, but present vegetation is sparse, consisting mostly of a pine tree forest with very little groundcover vegetation. The area likely serves as a groundwater recharge area. Several minor seeps appear adjacent to the stream at elevations that appear to be about 200 feet lower in elevation than the reclaimed surface mine area. None of the seeps had significant flow at the time of assessment. Field tests showed that some had depressed pH and obviously contained elevated concentrations of metals. None were identified as a single significant source. Collectively they reduce the quality of the stream significantly. A large pond, located on Anderson Creek Sportsmen property also field-tested as having a depressed pH. Although the stream is impaired, it was considered a low priority for remediation at this time.

Recommendation for UNT-AC 9.20

UNT-AC 9.20 is AMD impaired and its water quality could likely be improved though a combination of land reclamation and passive AMD remediation techniques. The headwaters area, which is sparsely vegetated with pine trees and contains poor soil conditions, could be improved by the addition of alkalinity and nutrients into the soil. Replacing the pine trees with either a thick vegetative mat, which would reduce rain infiltration into the mine spoil, or replanting with high-value deciduous trees after proper soil and subsoil enhancements would be beneficial as well.

The water quality of the large pond on the sportsmen's property appeared to contain low concentrations of metals and might be improved though methods used in passive AMD treatment, such as anoxic limestone drains, Upflow Limestone Ponds, or self-flushing limestone ponds. Because the stream is very steep, limestone sand dosing would likely be very successful in neutralizing acidic water. Any neutralization of acidic conditions and additional alkalinity would have a positive effect not only on the tributary, but on Anderson Creek as well.

UNT-AC 8.80

The second AMD-impaired unnamed tributary entering Anderson Creek below Little Anderson Creek again flows from the west, or river-right, side. Because field sampling indicated this tributary was not severely degraded, it was not regularly monitored under this assessment. Mostly old, poorly reclaimed surface mines in its headwaters affect UNT-AC 8.80. These poorly reclaimed mines surround the headwaters area.

A large pond exists on the main flow of the tributary on private property in its very headwaters. The pond is impaired by AMD, mainly by acid and aluminum. Sampling measured acidity at 27mg/L of acidity and 1.87 mg/L aluminum and very little iron (Franke sample). The property owner indicated that a discharge upwelling occurs at the northeastern side of the pond, under water. No visible areas of discharge were identified surrounding the pond. Immediately below the pond is a large wetland area where additional AMD with higher levels of iron enter the tributary, indicated by a change in the color of water. Field testing indicated pH increased below the pond area. Communication with the landowner indicated a willingness to address the polluted water leaving the pond. The landowner was uncertain whether he would be willing to address the pollution within the pond.

Recommendations for UNT-AC 8.80

A passive treatment system, which would address the outflow of the pond, would likely make significant improvements to UNT-AC 8.80. Because of low iron concentrations, it may be possible to treat the pond discharge using a self-flushing, open limestone pond-type system. Such a system is basically a large basin filled with limestone, which is used to neutralize acidity, combined with a self-flushing device that allows the pond to fill and then drain out at a rapid rate. The system is designed to minimize plugging problems associated with aluminum. As described above, the area below the pond contains wetlands, so permitting would be an issue.

In addition, significant benefits could be achieved by a much more dense blanket of vegetation over the entire area now covered by pine trees. Dense vegetation along with the addition of alkaline material would likely further improve any water draining through the mine spoil on the abandoned mine sites. This would likely be very costly unless it was part of another mitigation project.

UNT-AC 8.20

The third AMD-impaired unnamed tributary to enter the main stem downstream of Little Anderson Creek also flows in from the west, or the river-right, side. UNT-AC 8.20 appears to be the most impaired of the three streams entering the gorge below Little Anderson Creek from the west. Like its two other adjacent streams, its problems stem from abandoned mines in its headwaters. This tributary also receives significant discharges from the abandoned Korb underground clay mine located in Chestnut Grove.

Three areas of discharges drain from the Korb mine into UNT-AC 8.20 and account for one of the top three acid, iron, and pollution loads in Anderson Creek. Addressing the Korb mine discharges would, as discussed previously, make significant improvements to this tributary. It would not address all of the pollution sources.

Several seeps appear on either side of the stream lower in elevation. Those seeps appear to be directly associated with two large surface mines located on the hills, on either side, above the stream. Combined, these discharges account for a significant amount of pollution entering UNT-AC 8.20. During dry periods, when the Korb discharges were flowing little water, over 50 gpm of AMD-impaired water was observed still flowing at the mouth of the stream. Therefore, other measures should be taken to address the pollution generated at those mines.

Recommendations for UNT-AC 8.20

UNT-AC 8.20 is associated with two of the highest priority discharges for remediation identified by this assessment. Those discharges drain from the abandoned Korb underground clay mine located in the headwaters area of tributary near Chestnut Grove. A recommendation for addressing those discharges involved remining of the Korb mine in combination with the addition of alkaline material and was discussed previously.

In addition to the Korb mine discharges, there are several AMD seeps that impact UNT-AC 8.20 lower in elevation along the stream. These discharges are associated with surface mines located on either side of the stream at higher elevations. Consistent with other areas of the watershed, the seeps appear well below the actual area that was mined. Some were also located nearer to the surface mine.

Because the seeps are located very near the stream, and the stream is in a remote, steep valley, it will be very difficult to address them where they appear. A better approach would be to determine whether remining and enhanced reclamation techniques, using significant alkaline addition, could be utilized on the abandoned mine site to improve the quality of the seeps. The abandoned mine located on the southern side of the tributary contains areas with un-vegetated or poorly vegetated spoil and a pond of water in one area. This site is the most likely to have some possibility of remining. The surface mine to the north is reclaimed and covers the entire hilltop. It is probably less likely to have any possibility of remining.

The surface-mined headwater areas of Anderson Creek unnamed tributaries 9.20, 8.80, and 8.20 may also be responsible for several low-pH seeps entering Little Anderson Creek from the area west of Viaduct Road. The seeps appear 60 to 100 feet lower in elevation than the surface mines. A hydrologic study making a connection to the seeps was beyond the scope of this study, but would be useful in making a definitive determination.

Irvin Branch (AC-6.45)

Irvin Branch is a remote, forested stream draining from the eastern side of the Anderson Creek watershed. Access to the stream is very limited. It flows in a southeasterly direction and is situated between the main stem of Anderson Creek and Bear Run, which enters .4 miles downstream. Irvin Branch is essentially unimpaired by AMD, although some surface mining was done in the headwaters area. As is the case with all of the streams draining the northeasterly portion of the watershed, the lack of alkaline material, naturally occurring acidic rock formations, and acid precipitation cause its waters to be pH depressed and likely have low populations of acid-tolerant aquatic macroinvertebrates. No fish were observed in the stream during the assessment. The 1999 Headwaters Charitable Trust study did find the stream contained a population of reproducing brook trout. Because AMD was not an issue with Irvin Branch, it was not sampled regularly as part of this assessment

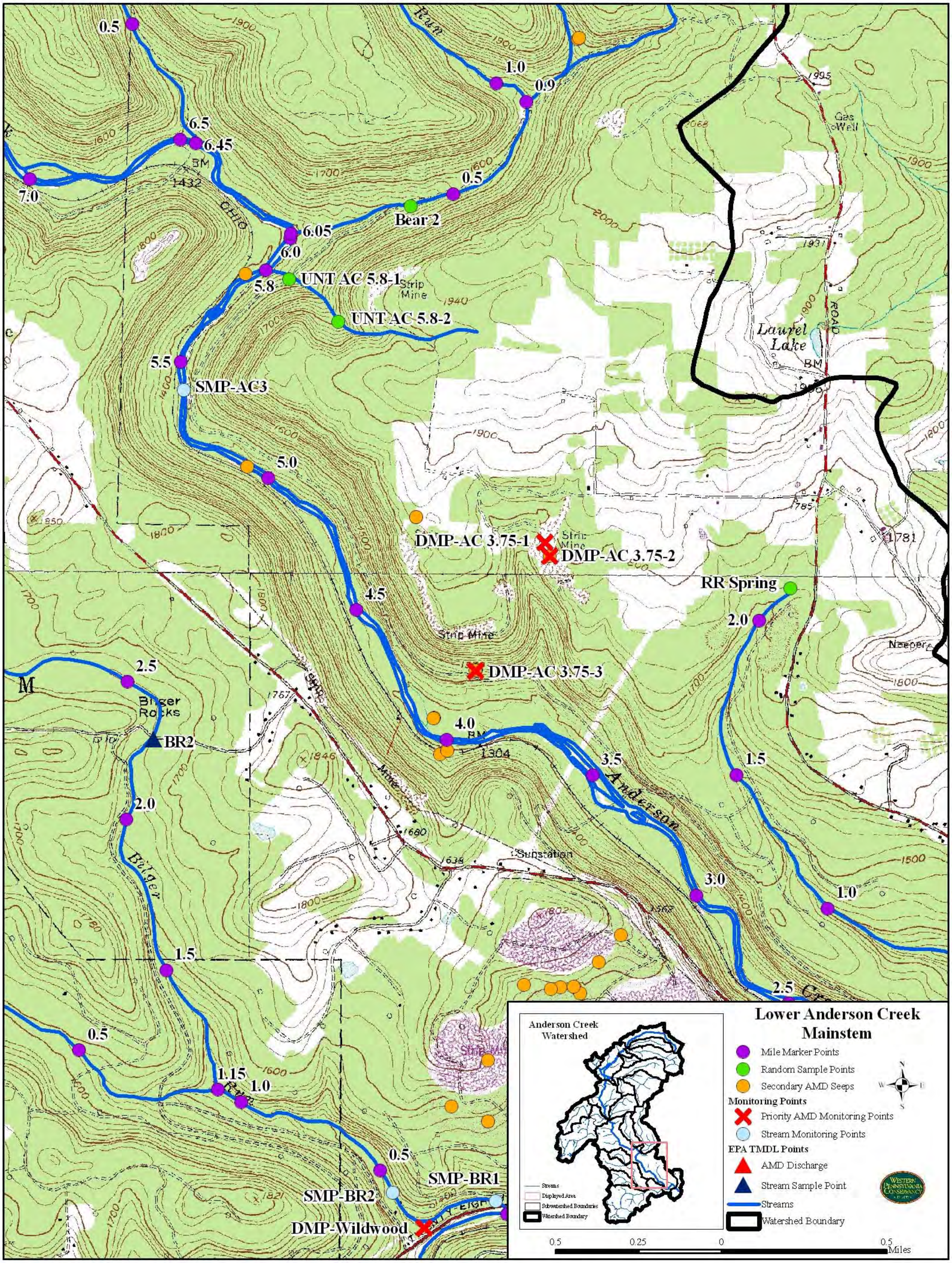
Recommendations for Irvin Branch (AC-6.45)

The water quality problems of Irvin Branch are mainly acidification primarily due to acid precipitation. Irvin Branch would be a prime candidate for some type of alkaline addition treatment, such as limestone sand addition, which performs well on high-gradient streams such as Irvin Branch, strategically placed anoxic or open limestone drains or limestone ponds, diversion wells, or other passive types of alkaline addition. Its inaccessibility and remoteness would make such treatment very difficult. It is likely that a reduction of atmospheric acid deposition would be very beneficial and the most long-term benefit to the depressed pH conditions of Irvin Branch.

Bear Run (AC- 6.05)

Bear Run is the largest subwatershed draining the eastern portion of Anderson Creek within the gorge. Three first order headwater tributaries flow in a southeasterly direction and meet a fourth tributary that flows in a westerly direction. The four tributaries are impounded in a reservoir approximately .9 miles upstream from the confluence of Bear Run with Anderson Creek. Exiting the reservoir, Bear Run flows in a westerly direction to its junction with Anderson Creek.

It is very remote but accessible via a road maintained by the Pike Township Municipal Authority. The road follows the eastern side of Anderson Creek in a northwesterly direction through the gorge to Bear Run. There it turns east to follow Bear


Lower Anderson Creek Mainstem
Anderson Creek Watershed
Streams
Displayed Area
Subwatershed Boundaries
Watershed Boundary
Mile Marker Points
Random Sample Points
Secondary AMD Seeps
Monitoring Points
Priority AMD Monitoring Points
Stream Monitoring Points
EPA TMDL Points
AMD Discharge
Stream Sample Point
Streams
Watershed Boundary
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Miles
Western Pennsylvania Conservancy
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Bear 2
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5.8
UNT AC 5.8-1
UNT AC 5.8-2
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SMP-AC3
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DMP-AC 3.75-1
DMP-AC 3.75-2
RR Spring
2.0
4.5
DMP-AC 3.75-3
2.5
Bilger Rocks
BR2
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Anderson
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1.15
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Run
0.5
SMP-BR1
SMP-BR2
DMP-Wildwood
Strip Mine
Laurel Lake
Gas Well
ROAD
Substation
Neepers
OHIO
BM
1432
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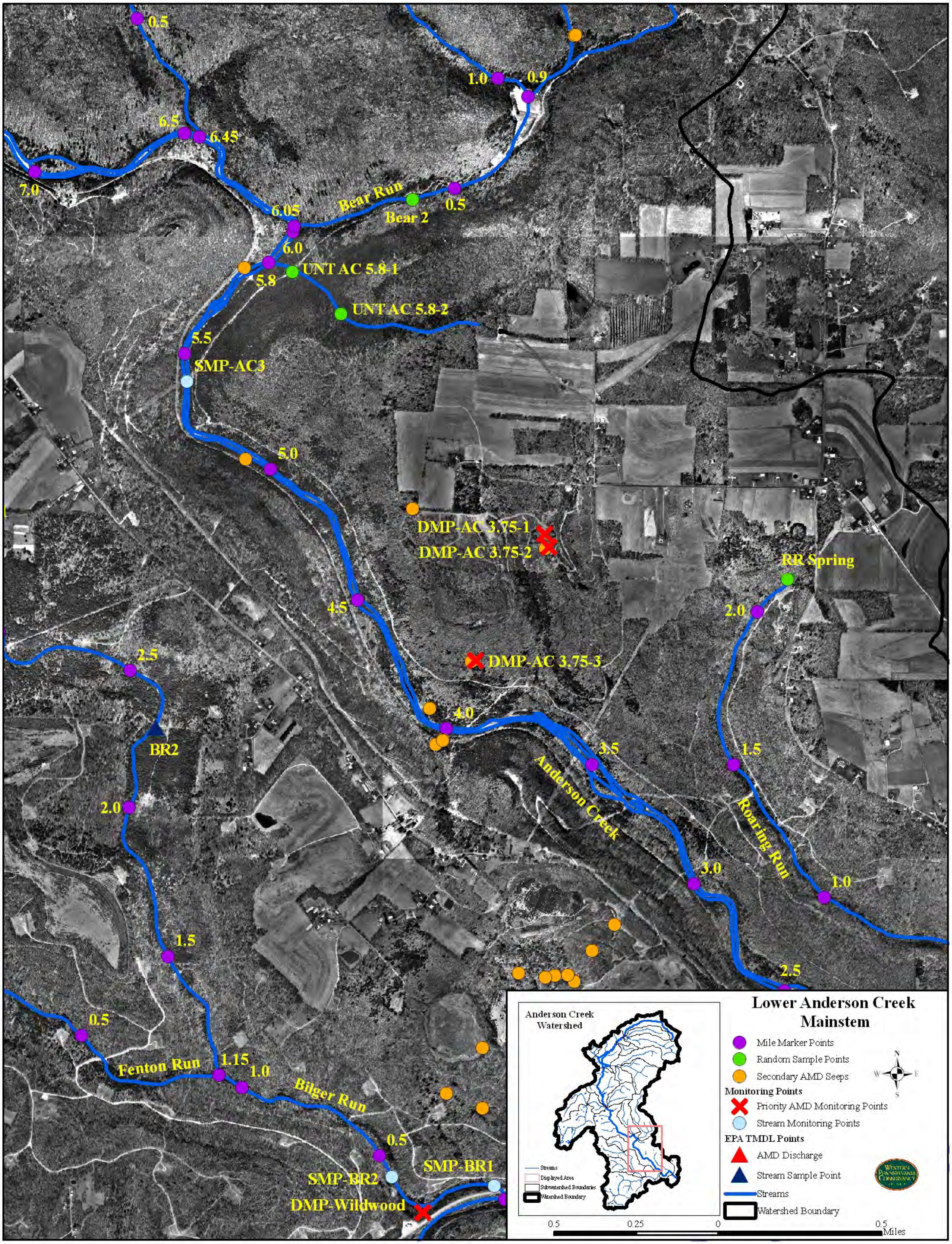
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Anderson Creek
Bear Run
Roaring Run
Fenton Run
Bilger Run
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Bear 2
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UNT AC 5.8-1
UNT AC 5.8-2
5.5
SMP-AC3
5.0
DMP-AC 3.75-1
DMP-AC 3.75-2
RR Spring
2.0
4.5
2.5
DMP-AC 3.75-3
BR2
4.0
3.5
1.5
2.0
3.0
1.0
1.5
2.5
0.5
1.15
1.0
0.5
SMP-BR1
SMP-BR2
DMP-Wildwood

Run to the reservoir previously mentions, which is maintained by the Pike Township Water Authority.

The headwaters of Bear Run lie just west of Greenwood Road, which connects State Route 322, east of the Dubois Reservoir, to State Route 879 in Curwensville, and is roughly the eastern boundary of the Anderson Creek watershed. Bear Run, like the adjacent Irvin Branch, is partially impaired due to atmospheric acid deposition. Its geology consists of acidic rock formation and little alkaline material so it is very susceptible to acid rain. Like Irvin Branch, it suffers from depressed pH and likely contains acid-tolerant macroinvertebrates. Very few macroinvertebrates and no fish were observed in the stream. Again, no electro-fishing survey was performed as part of this study. The 1999 Headwaters Charitable Trust study did find the stream contained a good population of reproducing brook trout.

Bear Run near its confluence with Anderson Creek.

Bear Run is a steep, mostly wooded watershed. Some underground and surface mining for clay has occurred south of the reservoir, at the higher elevations. This same area also contains some farming activity. Both recent and past logging activity is apparent.

Two abandoned mines are located southeast of the Bear Run's confluence with Anderson Creek. A third is located south and east of Bear Run Reservoir. The pH of Bear Run is depressed (field measured pH 5.3), but the previously mentioned small, unnamed tributary south of Bear Run, AC UNT 5.8, is more impaired. Several AMD seeps were identified draining from the slope west of the abandoned mine at an elevation of approximately 1,500 feet. The drainage caused the pH of the stream to dip from 5.3 to 4.1 near its mouth at high flow, and even lower at low flow. The area is also indicated as the site of a Mercer coal seam. References indicate an underseam of medium hard clay. No apparent AMD discharges were identified during the initial investigation of the site, but the abandoned pit did contain a pool of water.

Large erosion site on Bear Run, immediately below the water-supply reservoir.

Inspection of the most easterly and smaller unreclaimed surface mine, known locally as the Stadtmiller mine, revealed an AMD problem along with the unreclaimed land issues. The lack of surface water controls above the site allows water runoff to enter the abandoned pit. Water is captured in the pit in two areas. Additional water is entering the pit through a groundwater source, and is indicated by a larger volume of water exiting the southwestern end of the pit than the amount entering from the runoff above the site. After exiting the pit, the AMD travels several yards before disappearing into the ground. Field testing indicated an influx of acidic groundwater flow entering into the stream several hundred feet below the mine, but no distinct discharge could be located. It is assumed that the AMD, like in many other areas in the watershed, percolates through the ground until hitting an impervious layer which prevents it from flowing deeper underground and forces it out, in this case as stream base flow in Bear Run, far below the actual mine site.

The main stem of Bear Run is relatively unimpaired by non-point source pollution from visible sources. Immediately below the Bear Run Reservoir outflow, the stream appears channelized against a steep hillside where moderate erosion is occurring.

The streambed itself appears scoured from that point downstream to the mouth. Also, at the time of the assessment there was a considerable amount of earth disturbance along the road, which parallels Bear Run in its local reaches. It appears that it was part of an effort to widen and re-grade the road. Numerous trees were pushed over and into the stream channel, sometimes blocking it.

Recommendations for Bear Run (AC-6.05)

Similar to the adjacent Irvin Branch, much of Bear Run’s non-point source pollution problems stem mostly from acid precipitation/deposition. Little alkaline material occurs naturally in the subwatershed and, therefore, is unavailable to neutralize inputs of acidity. Reducing acid deposition is the best long-term solution to the acidification of the stream. A very good rate of success has been achieved by artificially introducing limestone into a watershed, mainly through direct application to the stream. Significant improvements have been achieved in other watersheds by using limestone sand dosing, which places sand-sized (and slightly larger) limestone in the stream and on the streambank in such a way that it will wash into the stream during high-flow events. The technique adds more limestone when it is most necessary, at high stream flows, which are times of high acid conditions. Other watersheds using this technique have returned naturally reproducing brook trout to streams that were essentially devoid of fish life.

As describe above, Bear Run is also impacted by a small surface mine located in its southeastern headwaters area. The abandoned, unreclaimed mine produces AMD, which pools at the highwall area and flows away from the site into the nearby forest and disappears into the ground. Eventually this water reappears in Bear Run as base flow, depressing its pH and likely adding some aluminum.

Reclaiming the mine site and incorporating excess alkaline material during reclamation would very likely be beneficial to Bear Run by reducing the acid presently being produced at the mine site. It is extremely difficult to determine just how much improvement could be achieved. The mine is relatively small and it is likely the overall benefits would be as well.

UNT-AC 5.8

UNT-AC 5.8 drains a small area of Anderson Creek just south of Bear Run. The tributary begins high on the plateau above the eastern side of the gorge and flows in a westerly direction into Anderson Creek. The water quality of the tributary is relatively unimpaired for much of its length, but does become impaired by AMD as it nears Anderson Creek. As with several other areas in the watershed, it appears that the discharges are associated with an abandoned mine, in this case, a clay mine, known locally as Laurel Swamp, located several hundred feet higher on the slope above the stream. The clay mine was first deep mined and then surface mined. Presently, unreclaimed mine spoil and a highwall remain at the site. No AMD was identified at the abandoned mine site itself. As is apparent elsewhere in the watershed, the AMD percolates through the subsurface material below the mine until reaching an impermeable layer which forces it to the surface at what appear to be springs. It is likely that prior to mining the springs were unpolluted, although no historic data exists that would confirm this assumption. Once this series of seeps, which field tested 3.2 pH, enters the tributary, its pH quickly drops. At the time of the sampling in April, in-stream pH was 3.9 and the aluminum concentration spiked to over 2 mg/L.

In addition to the seeps located along UNT-AC 5.8 an additional discharge was located very near the pumping station located at the emergency water intake dam on Anderson Creek located just downstream of the mouth of UNT-AC 5.8. The discharge had an estimated flow of less than 5gpm when field-tested and the pH of 3.3 was worth noting. In relative comparison to other discharges impacting Anderson Creek, the site was not recommended for inclusion as a monitoring point. Further investigation and analysis of UNT-AC 5.8 should be performed once other more significant sources of AMD are addressed within the watershed.

Recommendation for UNT-AC 5.8

UNT-AC 5.8 was not identified as a priority for restoration and was not regularly sampled as part of this assessment. The stream is impaired by the abandoned mine on the north side above the stream. This was an underground clay mine that was later surface mined. Acidic water from the mined area percolates through the ground and appears as acid seeps or springs along the tributary just above the municipal authority road in the Anderson Creek gorge below Bear Run. Due to their location, the seeps will be difficult to treat where they appear. Also, no discharge was identified at the actual mine site. Presently, it is unlikely that there is a possibility to remine the abandoned mine site and reclaim the area using additional alkaline material to improve the quality of the seeps. The most practical way to address the polluted stream is to neutralize the acidity in the stream near the municipal authority road. The distance from that point to Anderson Creek is too short to allow for alkaline sand treatment because there would not be sufficient time for the limestone to react. Either an automated lime doser or a limestone diversion well could be used to increase the alkalinity of the stream. Either of these treatment technologies would require significant operation and maintenance commitments. The small discharge located adjacent to the municipal authority pumping station may be able to be treated with a small self-flushing open limestone system. No water samples were taken because UNT-AC 5.8 was not considered a priority under this assessment. The tributary definitely should be further investigated once other higher priority sites are addressed.

UNT-AC 3.75

UNT-AC 3.75 is a small tributary that flows into the lower Anderson Creek gorge from the east, or river-left. This unnamed tributary is impacted by AMD from a large abandoned clay mine site, known locally as the Bloom mine, located in the headwaters area of the stream. The mined area surrounds the upper reaches of the stream. The mining consisted of both underground mines and surface mines. A large area of disturbed land is present, including un-vegetated spoil piles, abandoned highwalls, water-filled pits, and subsidence areas.

Polluted water flows from an open mine tunnel, mine spoil areas, and from the hillside in the Anderson Creek gorge below the mine site. Three locations were monitored as part of this assessment and given the designations DMP-AC 3.75-1, DMP-AC 3.75-2, and DMP-AC 3.75-3. One monitoring site, DMP-AC 3.75-1, was discontinued because it was determined that the water quality at that point was not impaired sufficiently to warrant continued monitoring. Some additional seeps were identified near the mouth of the tributary but were not considered significant.

Recommendation for DMP-AC 3.75-2

Discharge monitoring point DMP-AC 3.75-2 emanates from an underground abandoned clay mine opening just east of the headwaters of the tributary. The discharge flows through the site and into the tributary. A highwall also exists at the site and surface water collects and forms a pond at the site. The water quality in the pond was not impaired, as small fish were observed in the pond.

This discharge contains less than one part iron and low levels of aluminum so it should be very easily treated using passive treatment technology. A vertical flow system would likely be very successful at treating the discharge. With the low levels of iron, it may also be possible to treat the water using a self-flushing limestone pond system. Using these types of systems should remove all the acidity and provide additional alkalinity to the stream, which would be beneficial to Anderson Creek. The aluminum can be easily collected in a small settling basin/wetland.

Average water quality measured at DMP-AC 3.75-2

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
DMP-AC3.75-2	**0.9**	**0.4**	**0.4**	**0.2**	**2.8**	**1.2**	**42.8**	**17.91**	**0.0**	**0.0**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

Recommendation for DMP-AC 3.75-3

Discharge Monitoring Point-AC 3.75-3 is located along the Pike Township Municipal Authority road adjacent to Anderson Creek. The discharge actually flows from the hillside high above the road to the east. The monitoring point was chosen as the most practical point to monitor the discharge. As with many other discharges in the watershed, the discharge appears well below the mine site that produces the AMD. As previously mentioned, this discharge is associated with the Bloom mine. This discharge drains from the large surface-mined and subsidence area west of UNT-AC 3.75, and its water quality is significantly worse than DMP-AC 3.75-2.

Remining the abandoned mine area associated with this site is likely impractical. The area causing the AMD is a former clay mine that was deep mined and then surface mined. Because there is little demand for clay, there are no significant coal seams at the site and it does not qualify for federal reclamation funding, it is likely it will remain unreclaimed. It is beyond the scope of this study to determine if other techniques could be employed at the mine site in order to lessen or eliminate the severity of the AMD at its source.

This discharge will require the construction of a passive treatment system capable of treating high levels of aluminum or active treatment. Area does appear to exist below the monitoring point along Anderson Creek to install a treatment system. The discharge actually appears quite a distance higher in elevation than the monitoring point along the road, which means it could be taken even further upstream along Anderson Creek, possibly allowing for more treatment area. It will be impossible to treat the discharge at the point where it first appears high on the hillside.

Average water quality measured at DMP-AC 3.75-3

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
DMP-AC3.75-3	**3.1**	**0.3**	**3.2**	**0.5**	**23.4**	**4.8**	**195.3**	**38.84**	**0.0**	**0.0**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

Windy Hill Discharge

The Windy Hill discharge emanates from an abandoned underground mine located just outside of Curwensville along Windy Hill Road. The discharge emerges in a very steep ravine north of Windy Hill Road and drops approximately 200 feet in elevation before entering a wetland located upstream and on the opposite side of Anderson Creek from the North American Refractory Company operation located along State Route 879, at stream mile point AC-1.5. The discharge apparently encounters alkaline material near the refractory because the pH rises before it enters Anderson Creek. The discharge was not monitored as part of the assessment. A single water sample was gathered at the discharge site to determine the water quality as it discharges from the mine. Acidity measured 96mg/L, iron and manganese, less than one mg/L, and aluminum 13.4 mg/L.

Recommendation for the Windy Hill Discharge

Because this discharge picks up alkalinity near the North American Refractory, its impacts to Anderson Creek are minor. It contains high levels of aluminum and acidity and essentially no iron so it could very well be treated passively, using a self-flushing limestone pond. Such a treatment system could produce excess alkalinity and remove all the aluminum in the discharge. Further investigation of property ownership, their willingness to cooperate, water quality and flows, and site conditions will be necessary in order to properly determine how to best address the discharge.

UNT-AC 0.30

UNT-AC 0.30, or Tanner Run, as it is known locally, drains the area directly north of Curwensville along Naulton Road and essentially flows through, and for the most part, beneath the town, entering Anderson Creek in a concrete flood-control channel from river-left very near the confluence with the West Branch of the Susquehanna River. AMD was identified draining from an area along the stream just outside of Curwensville. Iron-stained seeps were located along the tributary prior to entering a buried pipe just east of Oak Hill Cemetery, which carries the stream underground through most of Curwensville. It re-emerges from underground in the above-mentioned concrete channel once past Route 879 and before entering Anderson Creek. It appears the discharges may be associated with some surface mining that was done in the headwaters.

Recommendations for UNT-AC 0.30

Because field sampling did not indicate the seeps were of very poor water quality or of high flow and they did not have a significant impact to Anderson Creek, they were not considered a priority or sampled as part of this assessment. There may be a possibility of improving the water quality of this unnamed tributary by removing some of the metals through passive treatment or other methods. Further study of the area should be conducted to determine the exact source(s) of the discharges. Finding ample room to construct a passive treatment system might be difficult because of the location of the seeps near the stream and several residences located in the area. Landowner cooperation will be essential.

Kratzer Run

Kratzer Run is the largest tributary to Anderson Creek, consisting of 15.4 square miles. Beginning in its headwaters just west of Hepburnia, Kratzer Run flows in a northeasterly direction for approximately four miles before its largest tributary, Bilger Run, joins it. Kratzer Run then flows approximately 1.5 additional miles to its confluence with Anderson Creek near the Pike Township municipal building in Bridgeport.

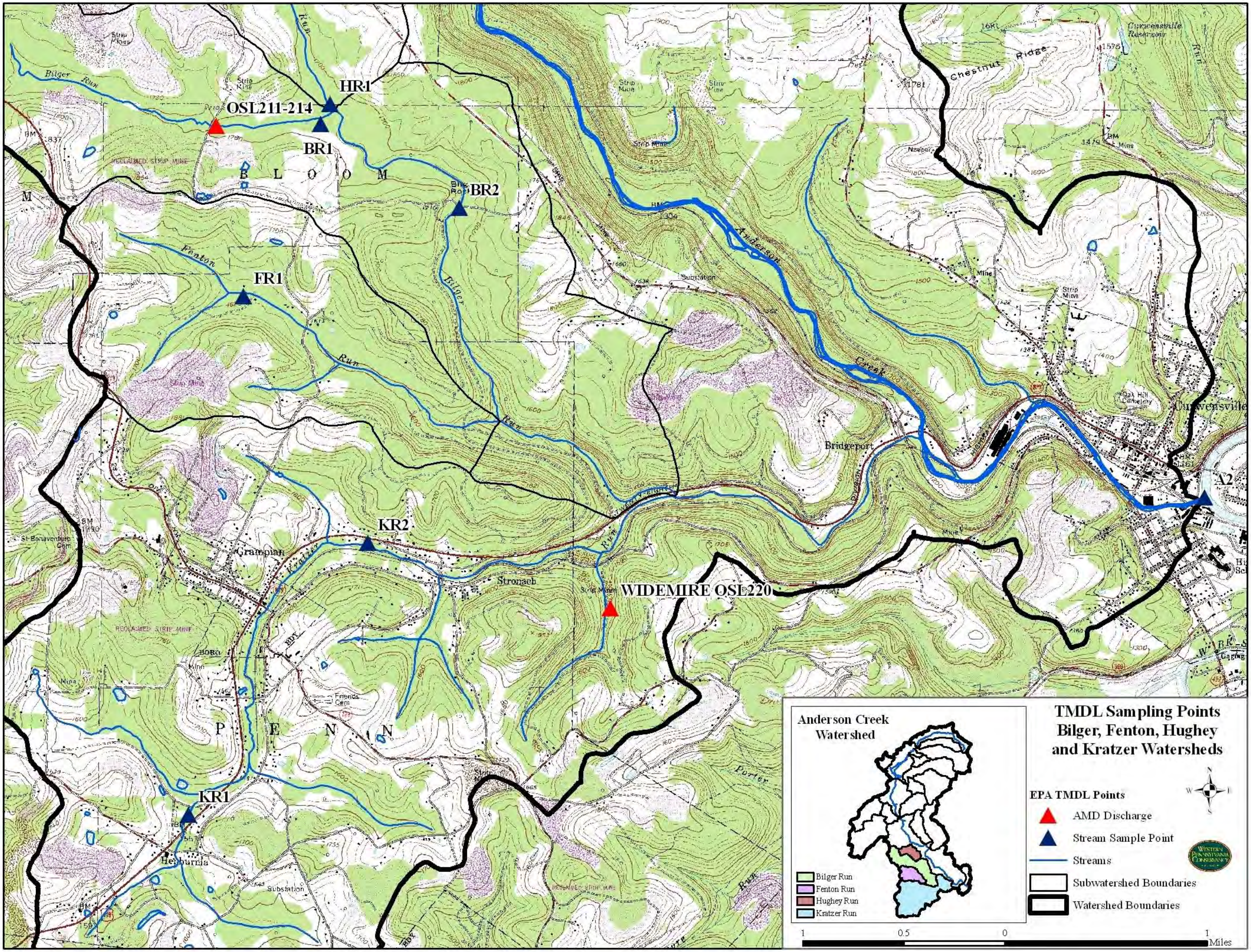
The headwaters of Kratzer Run are comprised mostly of farmland of moderately steep, rolling hills, previously farmed areas that have now been surfaced mined for coal, and wooded stream corridors. Some unreclaimed mines remain, but most have been reclaimed and are classified as pastureland, although little of it appears used for that purpose. The stream valleys mostly contain wooded riparian areas with good vegetative cover, even near surface-mined areas.

Flowing from west to east, the Kratzer Run headwaters closely follows Route 219 past Hepburnia until reaching the town of Grampian. In Grampian, it begins to parallel State Route 879, following it past the nearby community of Stronach and on to its confluence with Anderson Creek.

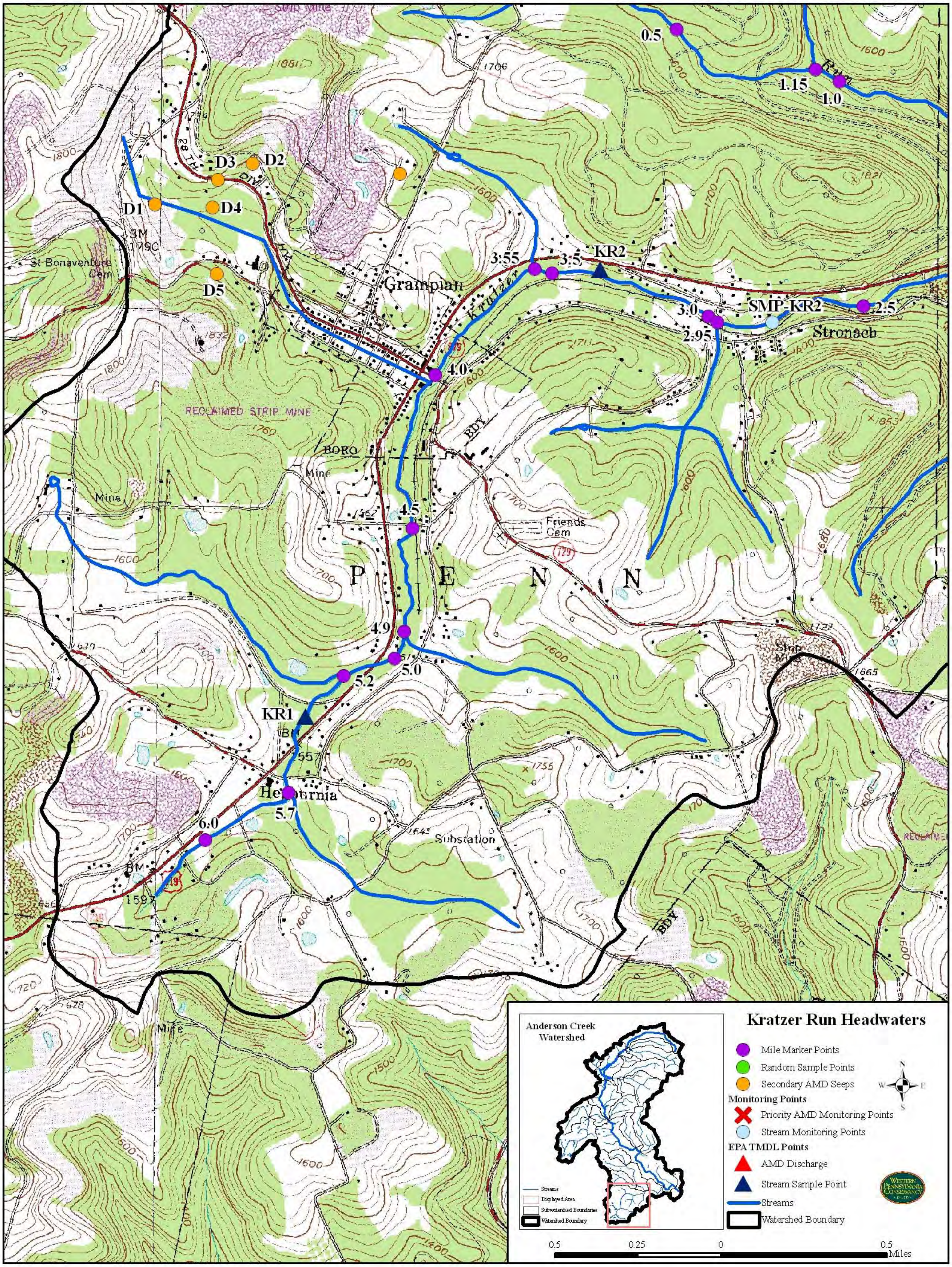
From the headwaters above Hepburnia and to just downstream of the town of Stronach, the stream has a low gradient and many homes and business are located adjacent to Kratzer Run or its unnamed tributaries. As expected, the stream has been affected by the development that occurred along this segment. Some channelization has occurred. In addition, farming in the headwaters area is having some impacts, as sediment was noted in the stream. On the headwaters of Kratzer Run, unnamed tributary KR-5.2, a farm operation was noted as a problem area. Cattle had direct access to the stream and little vegetation was present in the riparian corridor. The site was noted in the visual assessment. Just downstream of that area, on the river-right side of the stream, an unreclaimed surface mine was causing erosion problems. Most of the drainage from the site ended in a sediment pond. During the assessment, some measures were taken to help stabilize the slopes below the open pit. As of this writing, the open pit remained but the sediment problem was under control. An unreclaimed surface mine along TR 463 also drains to this stream segment. No significant pollution was noted coming from the site. An open pit and vegetated spoil piles remain.

The most heavily impaired stream in Kratzer Run’s headwaters (above Stream Monitoring Point KR2) is UNT-KR-4.0, which enters the main stem in Grampian and flows from the north, roughly following Route 219 South. The stream is not identified on the USGS topography map. It flowed even during the driest period of the year. Five main sources of mine drainage enter the stream. It appears that four of the five are net alkaline. All of the net alkaline discharges enter the tributary upstream of the community park located along the stream in Grampian. Iron stained the water, but small fish were observed living in the stream segment above the park.

The uppermost discharge flows from below the toe of a reclaimed surface mine, located east of TR 462 and west of Route 219, and appears to be net alkaline. The next discharge flows from a gully below a reclaimed surface mine north of Grampian and east of Route 219. It appears to be associated with the surface mine. Two seep areas discharging AMD to the stream were located downslope of this area closer to the stream and west of Route 219. All these areas are located on the river-left of the tributary. The worst of the five discharges, water quality wise, flows from an abandoned mine site located west of Grampian. It is unclear whether this discharge is associated with an underground mine, a surface mine, or both. The Scarlift Report identifies it as surface



TMDL Sampling Points
Bilger, Fenton, Hughey
and Kratzer Watersheds


Kratzer Run Headwaters
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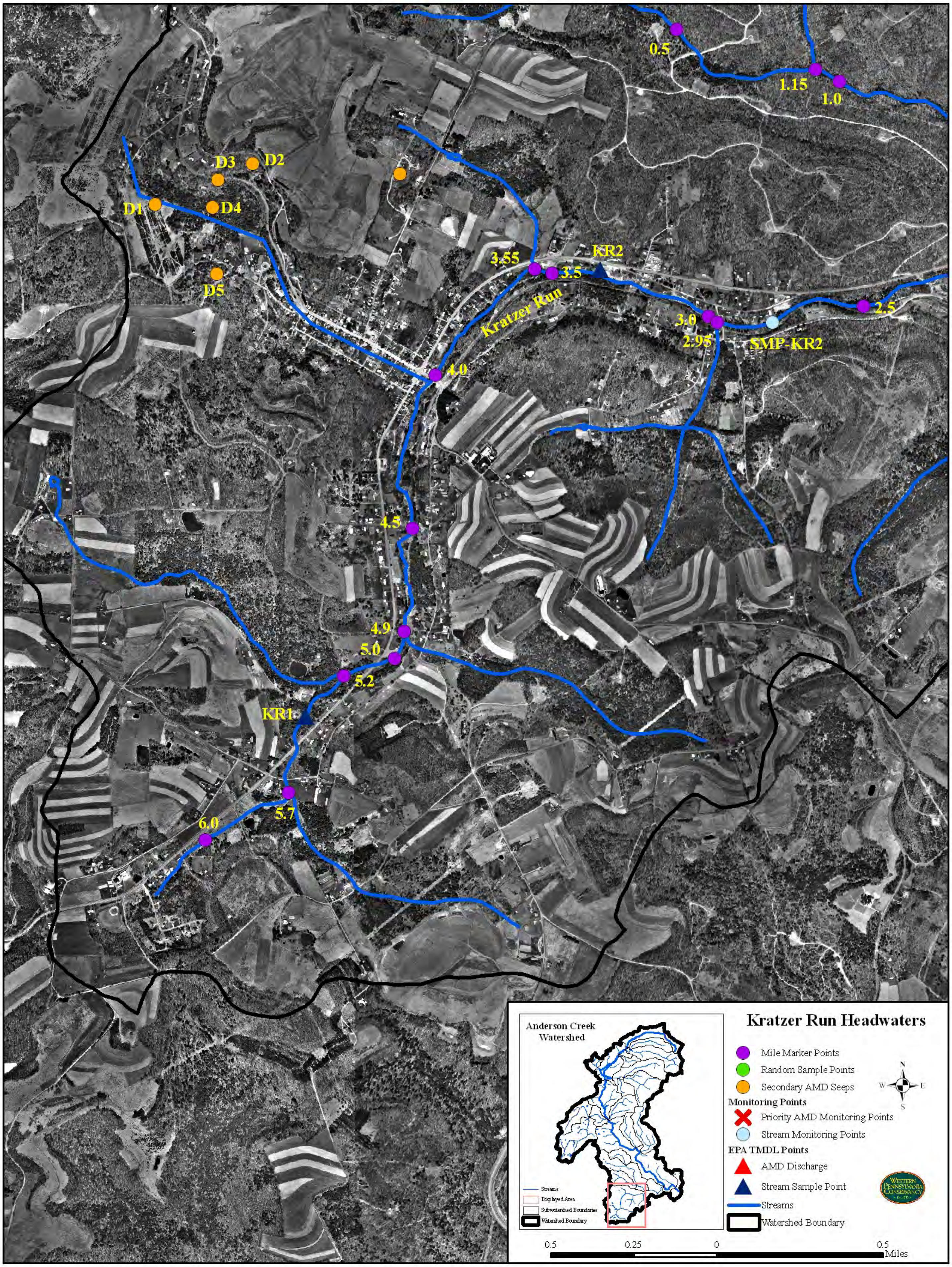
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mine related. Belfast Number 2 Mine (underground) was located nearby and may also be associated with the discharge. The discharge is acidic and contains aluminum (white precipitate observed). It flows from a hillside on the left side of the road and is located just past the school heading west on SR 3011. This discharge was not sampled during this assessment because of its low flow and relatively minor impacts in relation to Kratzer Run. This discharge enters UNT-KR 4.0 within the community of Grampian, below the community park. At that point, the stream is channelized, moved, and degraded by the urban setting. Below the park, the stream habitat and riparian zone is poor.

Although UNT-KR 4.0 is impaired, it does not have a significant impact on Kratzer Run. Remediation of the discharges is classified as low priority. Any reductions in pollution loading to the tributary through remediation would be beneficial.

From UNT-KR 4.0 downstream to TMDL monitoring points KR2, and SMP-KR2, no significant sources of AMD enter the stream. Minor sources of impairments were observed on some of the unnamed tributaries, but none were significant enough to warrant concern.

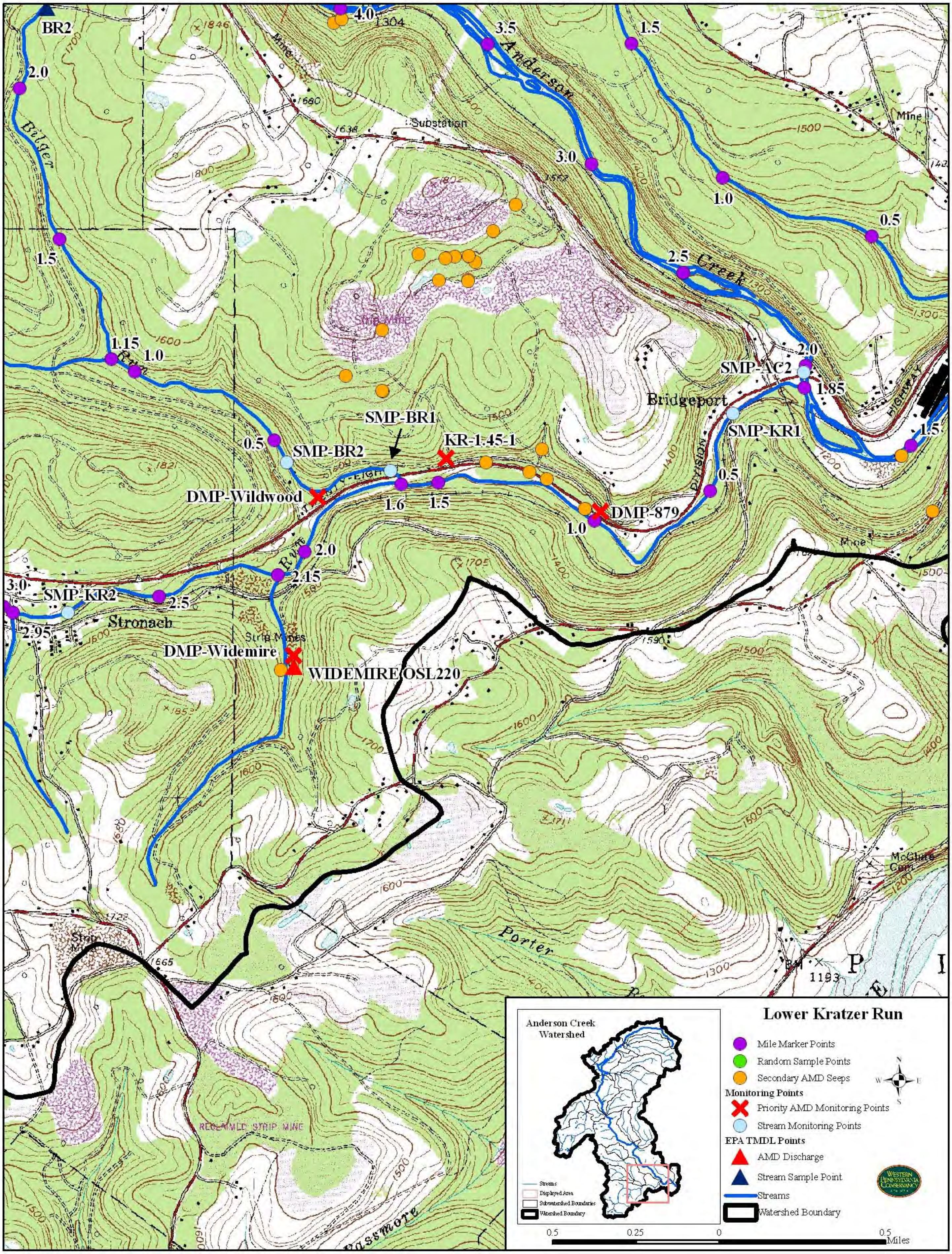
Lower Kratzer Run

For this assessment, Kratzer Run below Stronach is being designated as lower Kratzer Run. Not only does the character of the stream change significantly, but the amount of AMD pollution changes significantly as well. Just below the sewage treatment plant in Stronach, the stream gradient becomes much steeper, increasing stream velocity significantly. Many boulders in the channel create numerous rapids and small waterfalls. It is in this section of the stream that numerous AMD sources enter and degrade Kratzer Run's water quality. As more AMD sources enter Kratzer Run as it flows along Route 879 to its confluence with Anderson Creek, the effects become more apparent as the streambed is stained orange.

Widemire Discharge

Below SMP-KR2 significant degradation of Kratzer Run water quality from AMD occurs. Just east of Stronach, two underground mines (Widemire and Irvin) and associated surface mines severely impact the stream. The worst impacts from the two mines come from the Widemire mine located south of State Route 879 along UNT-KR 2.15. Two significant sources discharge from the mine. Only one was sampled because of its significantly higher volume and lower water quality, DMP-Widemire. This source discharges net acid water with relatively low iron, aluminum, and manganese levels.

The Widemire Discharge pollutes an unnamed tributary to Kratzer Run (UNT-KR2.15) with acid and aluminum.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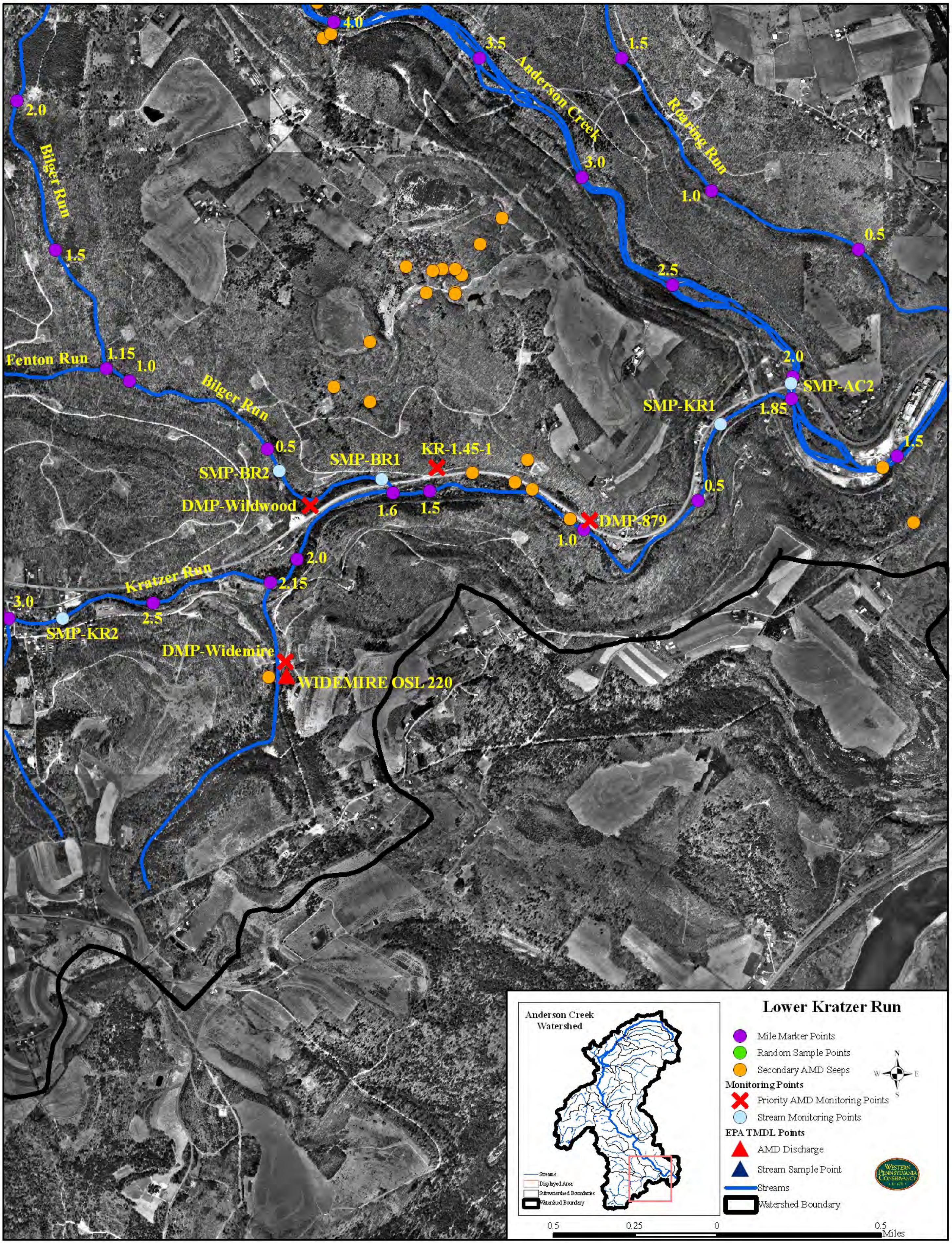
Stream Sample Point
Streams
Watershed Boundary
N
S
E
W
0.5
0.25
0
0.5
Miles
BR2
2.0
1.5
1.15
1.0
0.5
SMP-BR2
SMP-BR1
KR-1.45-1
DMP-Wildwood
1.6
1.5
DMP-879
1.0
0.5
SMP-KR1
Bridgeport
SMP-AC2
2.0
1.85
1.5
2.0
2.15
2.5
3.0
SMP-KR2
2.95
Stronach
DMP-Widemire
WIDEMIRE OSL220
Strip Mines
Strip Mine
RECLAIMED STRIP MINE
4.0
3.5
3.0
2.5
1.5
1.0
0.5
Anderson
Creek
Bilger
Run
Run
Porter
Passmore
Substation
Mine
McClure
Highway
Division
1193


4.0
3.5
Anderson Creek
1.5
Roaring Run
2.0
Bilger Run
3.0
1.0
0.5
1.5
2.5
Fenton Run
1.15
1.0
2.0
SMP-AC2
SMP-KR1
1.85
Bilger Run
1.5
0.5
KR-1.45-1
SMP-BR1
SMP-BR2
DMP-Wildwood
1.6
1.5
0.5
DMP-879
1.0
2.0
Kratzer Run
2.15
3.0
2.5
SMP-KR2
DMP-Widemire
WIDEMIRE OSL 220
Lower Kratzer Run
Anderson Creek Watershed
Streams
Displayed Area
Subwatershed Boundaries
Watershed Boundary
Mile Marker Points
Random Sample Points
Secondary AMD Seeps
Monitoring Points
Priority AMD Monitoring Points
Stream Monitoring Points
EPA TMDL Points
AMD Discharge
Stream Sample Point
Streams
Watershed Boundary
N
W
E
S
Western Pennsylvania Conservancy
0.5
0.25
0
0.5
Miles

Aluminum and acidity levels are of most concern. During the study period, its flows fluctuated between 50 and 250 gpm. The TMDL for Widemire Discharge requires that a load allocation be made for OSL 220 [DMP-Widemire] for total iron and acidity (SRBC 2004).

There were fewer manganese and aluminum data than necessary for this discharge to conduct Monte Carlo analysis; therefore, they were not evaluated for this TMDL. However, the observations for manganese and aluminum in the downstream segments of an unnamed tributary to Kratzer Run indicate that they also may be violating water quality standards. It is assumed that BMPs used to reduce iron loads in this reach also would reduce the amount of manganese and aluminum (SRBC 2004).

Table G37, taken from the TMDL report, identifies the load reductions required for the Widemire Discharge (OSL 220).

Table G37. Reductions for the Widemire Discharge (OSL 220)

Station	*Parameter*	*Measured Sample Data*		*Allowable*		*Reduction Identified*
		Conc. (mg/l)	*Load (lbs/day)*	*LTA Conc. (mg/l)*	*Load (lbs/day)*	*Percent*
OSL 220	Fe	10.17	129.77	0.51	6.51	95
	Acidity	86.83	1,107.97	0	0	100
	Alkalinity	0	0			

The Widemire Discharge was also sampled as a priority during this assessment and is identified as DMP-Widemire. The discharge is the second highest priority for restoration in Kratzer Run. The following averages were developed using the data collected during this assessment.

Average water quality measured at DMP-Widemire

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
DMP-Widemire	**5.84**	**6.30**	**2.24**	**2.57**	**4.94**	**6.21**	**48**	**55.06**	**0**	**0.12**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

Recommendation for Widemire Discharge

The discharge is very close to the stream and in a steep stream valley, making passive treatment difficult. Because of its location, this discharge may necessitate using active treatment or alternative passive treatment. A slight boost in alkalinity should allow the aluminum to precipitate quickly. Perhaps a self-flushing limestone pond would be sufficient to reduce or remove the acid and aluminum levels. Little room exists for settling ponds, so it may only be possible to treat for acidity and allow the metals to settle in the streambed, with those metals being flushed at periods of very high flows when they should have less effect on the stream. Otherwise, it will be extremely difficult to collect the metals. Fish were observed in Kratzer Run at assessment monitoring point SMP-KR1 and the watershed group reported trout surviving in Kratzer Run above SMP-KR1. Because the Widemire Discharge does not appear to degrade the stream enough to kill fish near SMP-KR1, it is being given a moderate rating for restoration. It does add acidity and metals to the stream, increasing its pollution load, and any effort to reduce or eliminate the pollution would be beneficial.

Kratzer Run Below Stronach

Immediately below UNT-KR 2.15, on which the Widemire Discharge is located, the water quality of Kratzer Run changes. It is in this area that the first iron staining begins to appear in the stream. Several discharge areas are located along Kratzer Run, from this point to the confluence with Anderson Creek, including a major discharge near the mouth of Bilger Run, the largest tributary of Kratzer Run. Bilger Run will be addressed later in this report.

Field investigations and monitoring indicate that most of the discharges are net alkaline in this section, which means there is enough alkalinity in the discharge to neutralize the acidity produced. It is assumed that the alkaline discharges are associated with the surface mines located on the hilltops just north of Route 879. A more detailed study would be required to determine the exact source, but the geology dips to the south and discharges have been noted at lower elevations beneath hilltop surface mines in other areas of the watershed. Another possibility might be an association with a clay mine identified in the Scarlift Report as being west and north of the area along Route 879. Usually, clay mines are associated with acid discharges and these are net alkaline, so they likely come from another source.

Kratzer Run does support fish and other aquatic life below Stronach because most of the discharges are net alkaline or nearly net alkaline. The diversity and numbers of aquatic organisms living in the stream are usually reduced because of the degraded stream habitat, due to iron deposition. In addition, there are other discharges entering the stream that are net acidic and further degrade the stream.

Problem Area KR 1.45

The next major pollution source entering Kratzer Run actually comes from Bilger Run. The discharges associated with Bilger Run will be described separately. Just below the mouth of Bilger Run, a significant source of AMD enters from river-left at mile KR 1.45. It can be easily identified because it flows from a concrete pipe, high on the northern roadside bank and is visible from Route 879. At periods of high flow it looks like a waterfall. The monitoring point, which is actually located upslope of the pipe, was given the name “falls” by the watershed group for obvious reasons.

The discharge actually emanates from a large abandoned mine site north of the monitoring point, at the top of the hill. The Scarlift Report identified the site as Project

Area XI. The description given in the report does not accurately match existing conditions.

Because the site contains numerous unreclaimed areas and numerous sources of polluted water, the monitoring point was chosen to collectively account for all of the polluted surface water draining from the site. The monitoring point was given the designation PAMP-KR 1.45 by WPC to indicate it is a collection of sources. ACWA and Mahaffey Labs identified the monitoring point as “Falls.”

Reclamation of the abandoned mine site responsible for PAMP-KR 1.45 discharge is the highest priority for restoration in Kratzer Run. The following averages were developed using the data collected during the time of this assessment.

Average water quality measured at PAMP-KR 1.45

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
PAMP-KR 1.45-1	**0.26**	**0.30**	**5.50**	**5.82**	**7.95**	**8.61**	**72**	**70.19**	**.33**	**0.98**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

It is assumed that groundwater associated with the site is also likely polluted. Several discharges located along Route 879 below the mouth of Bilger Run may very well be associated with Problem Area KR 1.45, since the rock strata dips in that direction. One of the more significant discharges in that area (DMP-879) is being monitored under this assessment and will be addressed separately.

Recommendations for PAMP KR-1.45

This Problem Area is a very large site with numerous abandoned mine problems. In order to remediate the water problems associated with the site, significant land reclamation is recommended. All of the previously mentioned recommendations associated with land reclamation apply to this site as well. It is unknown at this time whether remining of the site is possible, but that option should be investigated and is highly recommended. Most of the large hilltop at the western end of the site has been remined and reclaimed. There are several remaining areas with dangerous highwalls, open pits, un-vegetated mine spoil, standing water, and poor surface drainage. As recommended for other areas, remining combined with traditional and innovative reclamation techniques would likely be a good option. Some recommendations include:

- Negotiations with the landowner about reclamation and remining should be initiated.
- Land reclamation to remove the highwalls, eliminate the unreclaimed spoil piles, limit or eliminate contact of acid materials with water, and promote positive surface drainage. Adding high amounts of alkaline material when reclaiming the site would very likely improve groundwater quality.

- Installation of an impermeable alkaline barrier on the pit floor to prevent acid water from infiltrating into the groundwater.
- Re-grading other areas upslope of the mine to improve surface runoff and addition of high alkaline materials to buffer acidity in this area as well.
- Installation of open limestone trenches to impart alkalinity to surface runoff.
- Re-vegetate areas above the mine to develop a thick groundcover and reduce groundwater infiltration. Incorporate high-alkaline material or biosolids to enhance growth, improve water quality, and reduce surface water infiltration.
- Reduce the production of AMD at the source. In addition to incorporating high-alkaline material into the backfill, subsurface limestone drains should be incorporated into the highwall area to capture groundwater, increase alkalinity, and perhaps redirect it to a specific area for passive treatment if necessary.
- Install high-alkaline surface trenches to intercept surface water and redirect into the groundwater.
- Monitoring of remaining AMD after reclamation and development of appropriate passive treatment system based on final chemistry and flow data.
- Close monitoring of AMD s

Abandoned mine located above monitoring point PAMP-KR 1.45.

Perhaps the best option for the Problem Area Monitoring Point KR 1.45 site is to explore the feasibility of remining the site and incorporating the reclamation of the land area during the remining. Conditions at this site are not likely conducive to remining, otherwise it would have already been remined. Implementing remining and reclamation by cooperatively developing a reclamation plan between DEP and the mining company, using the best available techniques to reduce the possibility of creating additional pollution sources, would be the best option. Remining would strictly follow the agreed-upon plan and the mining company would not be liable for any unforeseen circumstances should the pollution become worse. DEP would then assume responsibility for treating the water.

Again, barring remining of the site, several reclamation techniques could be considered. Land reclamation is an absolute necessity, considering the extent of the conditions on the site. The site is dangerous with its water-filled pits, vertical highwalls, and steep spoil piles. The addition of alkaline materials during reclamation is highly recommended.

With the construction of the new waste-coal-fired cogeneration plant being planned for the Karthus area, a ready supply of high-alkaline ash should be available for use on the site. Mine spoils containing highly acidic materials could be encapsulated in alkaline ash mixed with cement or bottom ash, which can harden and prevent infiltration of water into the acidic material.

Reclaiming and re-grading the site to promote surface water runoff rather than allowing the water to infiltrate into the mine spoil would also greatly reduce AMD production. The combination of encapsulation of acidic mine spoil combined with proper control of surface and subsurface waters would greatly reduce the metals and acidity load presently produced at the site. Any remaining discharges would likely contain much less metals and acidity.

There appears to be ample area for passive treatment, should that option be viable. Because of the high acidity and high levels of aluminum in the present discharges, passive treatment would likely necessitate the use of treatment systems able to handle that type of water. SAPS, Vertical Flow Systems, Sulfate Reducing Bioreactors, and Upflow Limestone Ponds are again some possibilities.

Active treatment of the entire amount of water draining from the site using chemicals might also be an option, especially if remining is not viable. Excess alkalinity could be generated from active treatment, which would provide additional benefits downstream. Operation and maintenance would again be a consideration if active treatment was employed and a system that would not use electricity would be very desirable.

Route 879 Discharges

Approximately .5 miles downstream from the inflow of the acidic discharges of Problem Area KR 1.45, an alkaline discharge seeps from a roadside gully located on the north side of Route 879. The monitoring point is identified as DMP-879. The discharge flows in the gully, parallel to Route 879 before crossing underneath the road and entering Kratzer Run. This discharge, along with several other more diffuse discharges located in the floodplain of the stream along Route 879, is barely net acid and does not have a killing effect on the stream. It does add iron loading and stains the stream orange. Because of the chemical makeup, it would be fairly easy to treat and there appears to be some area for settling prior to discharging into the stream.

DMP-879 is located adjacent to Route 879 below the mouth of Bilger Run on the north-side berm of the road.

In addition to DMP-879, there are several other similar discharges impacting Kratzer Run. One of the most intriguing is actually coming from the base of the Route 879 Bridge over Bilger Run, at its confluence with Kratzer Run. The discharge comes from a large crack in the bridge pier. At the time it was assessed, the discharge caused the stream to become noticeably more orange. It appears that PennDOT is monitoring the crack in the bridge pier, which seems to be widening. It can be assumed that eventually the bridge will need to be stabilized or replaced. Every effort should be made to work with PennDOT to address the bridge discharge while they are working in the area. At the time of the assessment, no contact had been made with PennDOT.

Because Route 879 is located adjacent to the stream in a fairly steep valley, room for passive treatment of any of the discharges will be minimal. Many of the discharges are associated with wetland areas adjacent to the stream and treatment options would likely require considerable efforts to acquire wetland permits.

The DMP-879 discharge is the third highest priority site in Kratzer Run. The following monitoring data averages were developed using the samples collected during the time of this assessment.

Average water quality measured at DMP-879

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
DMP-879	**17.13**	**1.89**	**2.21**	**0.24**	**0.10**	**0.01**	**5.08**	**.90**	**13.17**	**1.65**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

Recommendations for the Route 879 Discharge

As previously mentioned, because of the chemical makeup of this discharge it would be fairly easy to treat passively, using a wetland treatment system. Because of its location along the road, it would also make an excellent spot for a demonstration and education area for passive treatment. Because its location is confined along Route 879, it may be difficult to treat the discharge enough to remove all of its iron without using area on the opposite side of the road near the stream. This area is an AMD-impacted wetland and would require proper permits in order to use the area. Such sites have often been problematic and may require wetland mitigation even though it is already degraded.

The iron in the discharge is its main problem. There are elevated levels of manganese but they are not high enough to cause concern. Aluminum is not a concern. An anoxic limestone drain (ALD) followed by a wetland/settling basin is recommended for the site. It is doubtful that enough area is available for total treatment at periods of high flow, but the additional alkalinity generated would help settle the iron faster at those levels. At low flows, concentration levels rise significantly, but with the reduced flow, a wetland treatment system should be able to reduce iron loadings significantly. Also, the additional alkalinity generated by an ALD would be beneficial to Kratzer Run and Anderson Creek. As mentioned earlier, another issue associated with this site is the degraded wetland, which the discharge has created. Permitting issues might arise and mitigation be required if the project is not considered for its overall benefit to the watershed.

Additional seeps, with what appears to be similar water chemistry, are located within the floodplain along both sides of Kratzer Run and Route 879 for nearly the remainder of its course to its confluence with Anderson Creek near Bridgeport. Although these seeps also add to the metals pollution load to Kratzer Run, they did not appear as easy to treat as the Route 879 discharge because of their location and more difficult accessibility. They were not sampled as part of this study. It is recommended that the additional seeps along Route 879 be investigated in the future, once the higher priority sites in the watershed are addressed.

Bilger Run

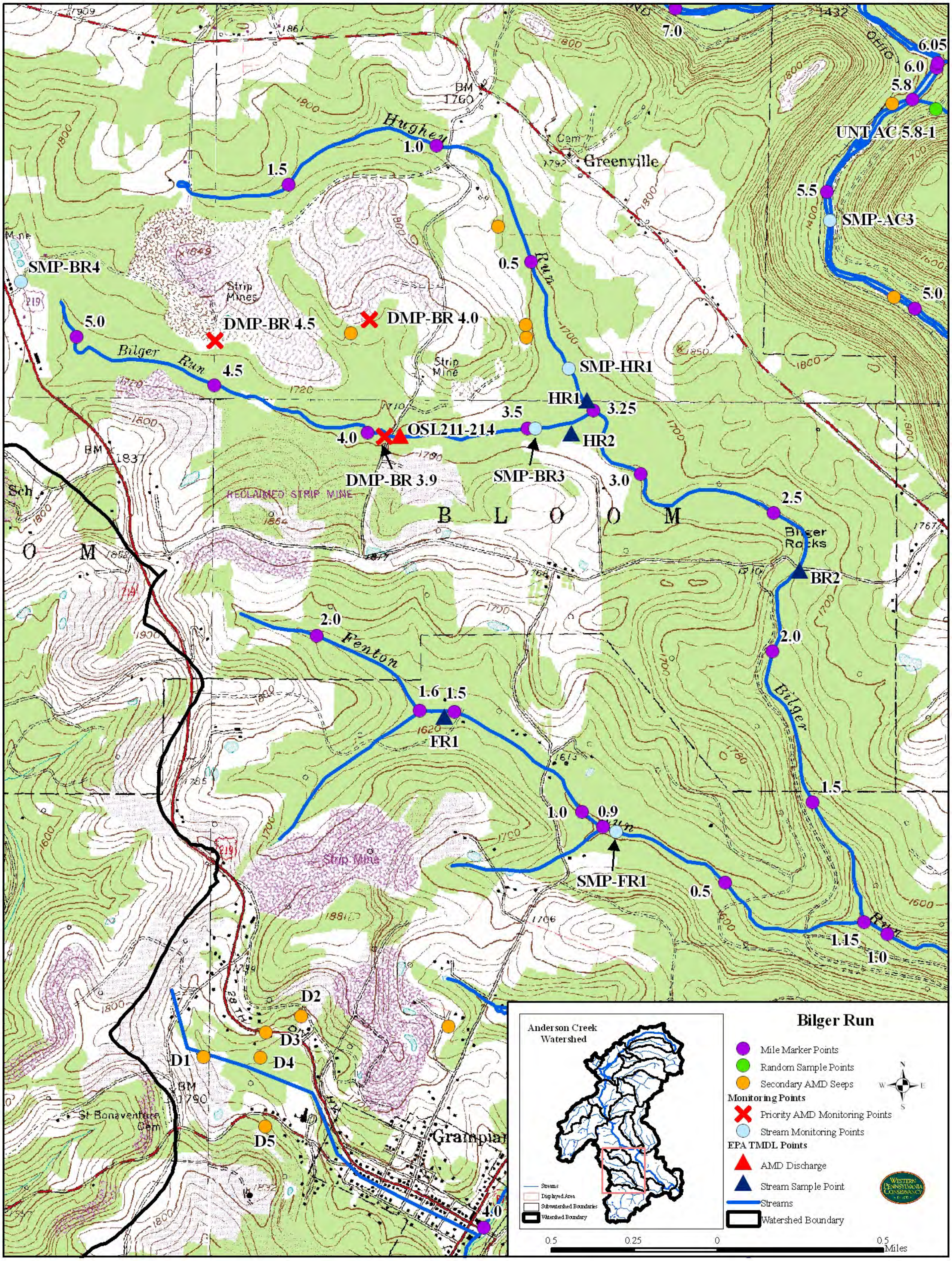
Bilger Run and its two named tributaries, Fenton Run and Hughey Run, account for almost half (47 percent) of the Kratzer Run watershed. Nearly all of the headwaters of Bilger Run are located just east of Route 219, when traveling north out of Grampian. Of the total area of Bilger Run, Fenton Run accounts for 27 percent and Hughey Run 17 percent.

The upper reaches of Bilger Run are low gradient and contain very large wetland areas. Many areas within the headwaters of Bilger Run have been surface mined. Two deep mines were located there as well. As can be expected, impacts from abandoned mines affect Bilger Run and its tributaries. Unreclaimed land, poorly reclaimed land, and AMD degrade each of the streams. However, the main stem of Bilger Run is the most impacted.

Two major tributaries to Bilger Run are Fenton Run and Hughey Run. Over the last thirty years, the water quality in Fenton Run has been vastly improved through remining. Water quality sampling from the early 1970s Scarlift Report indicates Fenton Run having a pH of about 4.5. Today, the pH is often in the low sevens. Most of that change can be attributed to remining and the application of alkaline addition during reclamation of the previously degraded areas. Hughey Run has improved since that time as well, while water in Bilger Run has less acidity but still contains unacceptable levels of acid, iron, and aluminum. Aluminum was not measured during the Scarlift studies.

ACWA decided to focus their efforts on Bilger Run because it had the most potential to recover enough to support trout stocking. In 2000 and 2001, ACWA used alkaline sand addition to help neutralize in-stream acidity in the stream segment below Bilgers Rocks. The project was successful in reducing acidity. The group stocked trout in the stream and the trout survived over the life of the project. In the following years, ACWA was not able to secure funding to continue the in-stream alkaline sand dosing and conditions returned to pre-dosing levels.

Bilger Run has two distinctly different areas of AMD impacts. The upper watershed, located above Bilger Rocks and TMDL monitoring point BR1, is impaired by poorly reclaimed or unreclaimed land areas and high acidity discharges containing low levels of iron and moderate levels of aluminum, which is deadly to aquatic life. Near its mouth in the lower watershed, Bilger Run is polluted by low-acidity discharges that


Bilger Run
Mile Marker Points
Random Sample Points
Secondary AMD Seeps
Monitoring Points
Priority AMD Monitoring Points
Stream Monitoring Points
EPA TMDL Points
AMD Discharge
Stream Sample Point
Streams
Watershed Boundary
Anderson Creek Watershed
Streams
Displayed Area
Subwatershed Boundaries
Watershed Boundary
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OSL211-214
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SMP-FR1
SMP-AC3
UNT AC 5.8-1
D1
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Hughey Run
Bilger Run
Fenton Run
Greenville
Bilger Rocks
Grampian
St Bonaventure Cem
Strip Mines
Strip Mine
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Reclaimed Strip Mine
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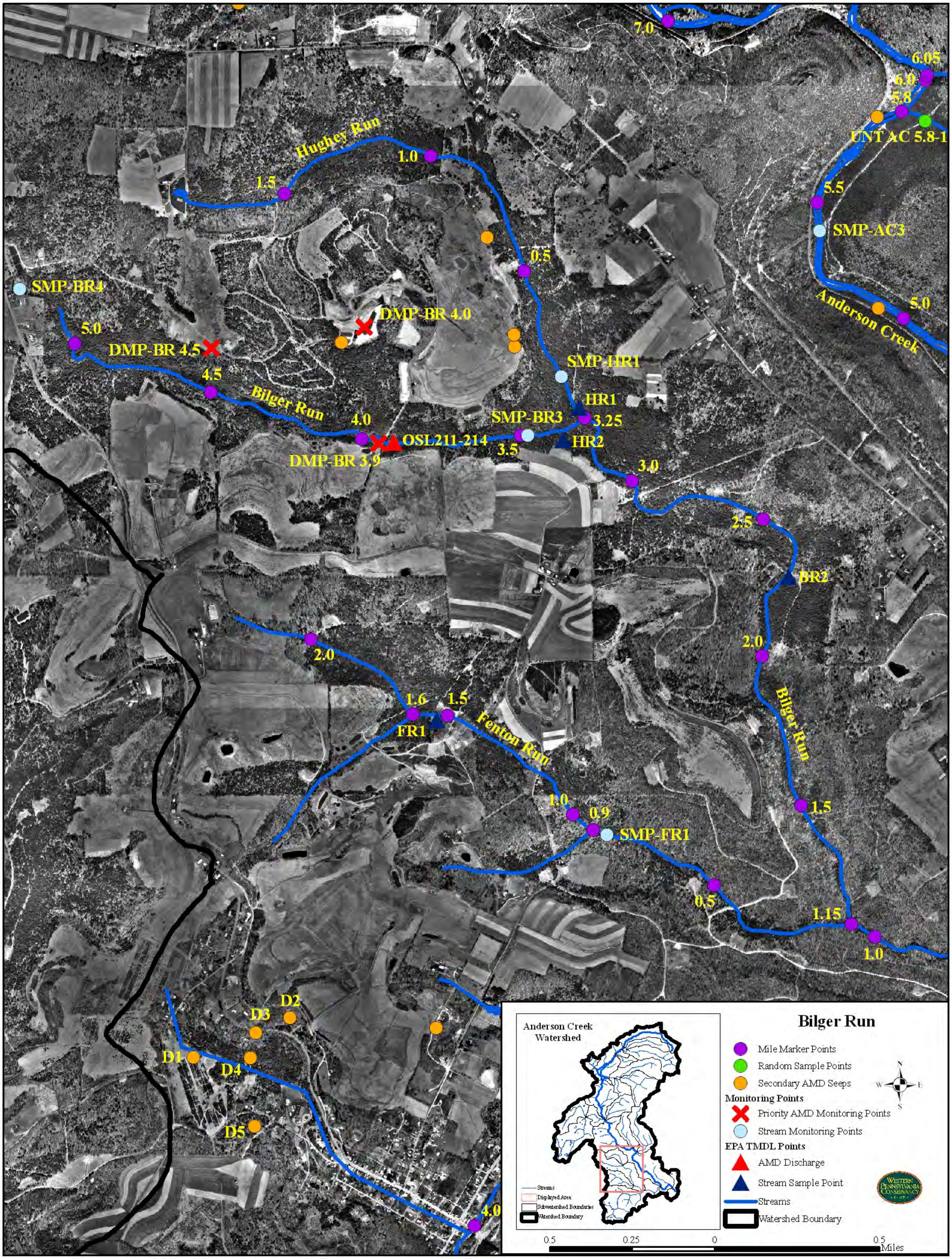

Bilger Run
Hughey Run
Fenton Run
Anderson Creek
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UNT AC 5.8-1
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SMP-AC3
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SMP-BR4
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DMP-BR 4.0
DMP-BR 4.5
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OSL211-214
DMP-BR 3.9
SMP-HR1
HR1
SMP-BR3
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HR2
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BR2
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FR1
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SMP-FR1
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Anderson Creek Watershed
Streams
Displayed Area
Subwatershed Boundaries
Watershed Boundary
Mile Marker Points
Random Sample Points
Secondary AMD Seeps
Monitoring Points
Priority AMD Monitoring Points
Stream Monitoring Points
EPA TMDL Points
AMD Discharge
Stream Sample Point
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contain low levels of iron and virtually no aluminum. Each area was identified as a priority by this study.

Bilger Run TMDLs

Bilger Run above BR1

This stream segment represents the headwaters of Bilger Run before any major tributaries enter the stream. The stream begins near Route 219 and flows southeast for approximately two miles to its confluence with Hughey Run. Rankin mine, an abandoned underground clay mine is located just west of Route 219 on the headwaters and drains some AMD into Bilger Run. The entry to the mine crosses under Route 219 from the eastern side of the roadway but all of the Rankin mine workings are located on the western side. The entry has subsided numerous times and the location can be easily identified on Route 219 by a road-wide patch located in a dip of the road just before reaching Chestnut Grove when traveling north from Grampian. The discharge from the mine is small and field tests did not indicate severely degraded water quality, although the stream is clearly degraded.

In addition to the deep mine discharge, there are other abandoned mine problems near the site. Reclaimed surface mines lie to the west of Route 219 that may be degrading the groundwater in the area but most of the area appears to drain to the west toward adjacent Bell Run. To the east of Route 219 and just south of the old mine entry and a short distance downstream is an area of unreclaimed, poorly vegetated mine spoil. It is assumed the spoil is associated with the old deep mine workings. Also, there are three ponds located opposite the spoil piles that ACWA members thought were polluted, but that turned out to support fish. The ponds become hypereutrophic in the summer, which may be due to septic systems from nearby residences.

Below the Rankin mine area, Bilger Run flows through a very large wetland area that is very difficult to traverse. Many of the hills surrounding the stream segment were surface mined and reclaimed. Most have been re-designated as pastureland and now contain few trees. Several areas along the wetland were identified as having depressed field pH but only one small discharge entered from river-right that measured in the lower 3-pH range. It was not considered as a priority for restoration.

A large, poorly reclaimed surface mine is located to the north of the stream along the segment between Route 219 and Evergreen Road (Township Road 484). The main sources of acidity and aluminum in upper Bilger Run come from this area. The area has been the site of several previous surface-mining operations and, at the time of this assessment, was being surface mined again. Two main sources of AMD and a few other minor discharges drain off the site. The two main pollution sources associated with the site were monitored under this assessment. Another less severe discharge located just south of the bridge on Evergreen Road was also monitored. This less severe site was chosen because treatment could provide additional alkalinity to Bilger Run. Because it is very likely that addressing the three discharge points on this problem area would likely result in significant improvements to Bilger Run, monitoring of the three discharges was a high priority under this assessment.

TMDL for Bilger Run above BR1

The TMDL for Bilger Run above point BR1 requires that a load allocation be made for total iron, total manganese, and total aluminum. The TMDL does not require a load allocation be made for acidity. All necessary reductions have been upstream from this point. Table G28 below, taken from the TMDL report, establishes the long-term averages for monitoring station BR1. Table G30, also taken from the Anderson Creek TMDL report, identifies the necessary reductions.

Table G28. Long Term Average (LTA) Concentrations for Bilger Run Above BR1

Station	*Parameter*	*Measured Sample Data*		*Allowable*	
		Conc. (mg/l)	*Load (lbs/day)*	*LTA Conc. (mg/l)*	*Load (lbs/day)*
BR1	Fe	1.66	25.47	0.20	2.97
	Mn	6.01	92.23	0.24	3.58
	Al	2.44	37.44	0.15	2.30
	Acidity	43.05	660.63	0.86	13.20
	Alkalinity	4.76	73.05		

All values shown in this table are long-term average daily values.

Table G30. Reductions Necessary at Point BR1

	Iron (lbs/day)	*Manganese (lbs/day)*	*Aluminum (lbs/day)*	*Acidity (lbs/day)*
Existing Loads at BR1	25.47	92.23	37.44	660.63
Total Load Reduction (OSL 211-214)	18.33	-	-	679.39
Remaining Load	7.14	92.23	37.44	0
Allowable Loads at BR1	2.97	3.58	2.30	13.20
Percent Reduction	58	96	94	0

Based on the watershed assessment performed under this study, it appears that a major source of AMD was not identified by the TMDL. The discharge, identified in the Scarlift Report as OSL 215, is very likely the same discharge identified by this study as DMP-BR4.5 or Bilger 3, although the discharge point has likely been moved slightly because of subsequent surface mining. This significant pollution source discharges from a pond located downslope from a reclaimed surface mine and adjacent to the large wetland. The TMDL monitoring point BR1 should still account for its pollution load.

TMDL monitoring point BR1 was also represented by a monitoring point established for this assessment, SMP-BR3. SMP-BR3 was established to measure what was determined to be the worst polluted stream segment of Bilger Run. The three discharges identified on this segment are the highest in priority for restoration on Bilger Run. The following monitoring data averages for SMP-BR3 were developed using the samples collected during the time of this assessment.

Average water quality measured at SMP-BR3

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
SMP-BR3	**1.29**	**4.7**	**7.17**	**52.5**	**1.4**	**16.8**	**20.50**	**188.5**	**6.7**	**28.1**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

Recommendations for TMDL above BR1

This section of Bilger Run contains the worst polluting discharges that enter the stream. In its upper reaches, Bilger Run is polluted from water draining from the Rankin mine, which is located west of Route 219. That source does not severely degrade the stream. Several reclaimed surface mines are also located in the area, but no significant discharges appear to be draining from the sites into Bilger Run. Just east of Route 219, several large, poorly vegetated spoil piles are located directly adjacent to the stream. The piles should be reclaimed, but they do not appear to be significantly degrading the stream with AMD. They do, however, provide a significant source of sediment.

Downstream of this area is the large area of poorly reclaimed surface and deep mines discharging AMD into Bilger Run, which was mentioned previously. Three discharges-two containing high levels of acidity and high levels of metals and one with moderate acidity and low levels of metals-are being monitored. All are ranked as priorities for restoration. DMP-BR 4.5 and DMP-BR 4.0 are ranked priority one and two respectively for Bilger Run.

Assessment monitoring point DMP-BR 4.5 is the highest priority discharge for restoration in Bilger Run. The following monitoring data averages for DMP-BR 4.5 were developed using the samples collected during the time of this assessment.

Average water quality measured at DMP-BR 4.5

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
DMP-BR4.5	**13.63**	**13.95**	**21.32**	**19.19**	**8.17**	**7.35**	**115**	**103.76**	**0**	**0.18**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

Assessment monitoring point DMP-BR 4.0 is the second-highest priority discharge for restoration in Bilger Run. The following monitoring data averages for DMP-BR 4.5 were developed using the samples collected during the time of this assessment.

Average water quality measured at DMP-BR 4.0

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
DMP-BR4.0	**8.22**	**2.38**	**18.82**	**6.10**	**10.09**	**3.30**	**101.27**	**33.20**	**0**	**0.00**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

DMP-BR 4.5 and DMP-BR 4.0 are presently part of a restoration effort being directed by the Pennsylvania DEP Moshannon District Mining Office and the DEP Bureau of Abandoned Mine Reclamation. The preliminary plans call for an active treatment plant using chemicals. When completed, the treatment plant should eliminate the metals and acid load of the discharges.

A third discharge, emanating from an area on the opposite side of Bilger Run and to the south, contains low metals and lower acidity. This discharge can be easily treated using passive treatment technology. In March 2005, ACWA applied to Pennsylvania's Growing Greener grant program to design and construct an anoxic limestone drain to treat the discharge. Expected results include eliminating all the present metals and acidity and producing an additional 150 mg/L of alkalinity to be discharged into the stream to help neutralize acidity in Bilgers Run. It is estimated that over 50 lbs/day of alkalinity can be introduced into the stream at average flow.

Assessment monitoring point DMP-BR 3.9 is the third-highest priority discharge for restoration in Bilger Run. The following monitoring data averages for DMP-BR 3.9 were developed using the samples collected during the time of this assessment.

Average water quality measured at DMP-BR 3.9

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
DMP-BR3.9	**1.78**	**0.41**	**3.08**	**.86**	**0.64**	**0.29**	**12.86**	**4.61**	**6**	**2.16**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

Bilger Run between BR1 and BR2

This stream segment of Bilger Run is identified by the TMDL as being located between the bridge on TR 484 and the confluence with Fenton Run. The TMDL for BR2 consists of a load allocation to all of the watershed area between BR1 and BR2, including that of Hughey Run. The TMDL for Bilger Run at point BR2 requires that a load allocation be made for total manganese, total aluminum, and acidity. The TMDL for Bilger Run at point BR2 does not require a load allocation to be made for total iron. All necessary reductions have been made upstream from this point (SRBC 2004).

A summary of all loads that affect point BR2 are shown in Table G32, taken from the TMDL report. Note: As mentioned above, a significant pollution source on this stream segment, OSL 215 or DMP-BR 4.5 as designated by this study, appears to have been omitted from the TMDL report.

Table G32. Summary of Loads Affecting Point BR2

	Iron (lbs/day)	*Manganese (lbs/day)*	*Aluminum (lbs/day)*	*Acidity (lbs/day)*
HR1				
Existing Load	3.41	1.05	1.16	45.74
Allowable Load	1.38	1.05	1.16	6.39
Load Reduction	2.03	0	0	39.35
OSL 211-214				
Existing Load	18.51	-	-	679.39
Allowable Load	0.18	-	-	0
Load Reduction	18.33	-	-	679.39
BR1				
Existing Load	25.47	92.23	37.44	660.63
Allowable Load	2.97	3.58	2.30	13.20
Load Reduction	22.50	88.65	35.14	647.43

Necessary load reductions at point BR2 are shown in Table G33, taken from the TMDL report.

Table G33. Reductions Necessary at Point BR2

	Iron (lbs/day)	*Manganese (lbs/day)*	*Aluminum (lbs/day)*	*Acidity (lbs/day)*
Existing Loads at BR2	30.04	224.77	59.73	1,574.11
Total Load Reduction (OSL 211-214, BR1, and HR1)	42.86	88.65	35.14	1,366.17
Remaining Load	0	136.12	24.59	207.94
Allowable Loads at BR2	13.81	10.70	4.14	31.42
Percent Reduction	0	92	83	85

Assessment Recommendations for BR1 to BR2

This assessment differed from the TMDL in that it established stream monitoring points near the mouth of Bilger Run rather than at the mid-point where TMDL BR2 is located. The TMDL used the monitoring point at the mouth of Anderson Creek (A2) to measure the remaining pollution sources on Bilger Run. Because AMD sources with a different general chemical makeup (net alkaline rather than net acid) enter Bilgers Run in its lower reaches, two monitoring points (one above the area of the net alkaline AMD discharges and one below) were established as monitoring points. In addition, monitoring point SMP-KR1 on Kratzer Run measures the total pollution loads received from Bilger Run before it joins Anderson Creek. Recommendations for the discharges near the mouth of Bilger Run will be addressed later in the “Lower Bilger Run” section.

Between TMDL point BR2 and the net alkaline discharges on lower Bilger Run, Hughey Run and Fenton Run enter the stream. These subwatersheds of Bilger Run are described separately below. Since no other significant pollution sources enter the Bilger

Run main stem above the net alkaline discharges, no recommendations for restoration are given.

Hughey Run

Hughey Run drains the northernmost area of the Bilger Run watershed. It is a low-gradient stream that joins the main stem of Bilger Run about .75 miles downstream of the TR 484 Bridge that crosses Bilger Run. Several areas draining into Hughey Run have been surface mined. Most have been properly reclaimed. The uppermost reaches are also associated with the previously mentioned problem area containing acidic discharges on Bilger Run. The stream is not severely degraded by those mines, however.

Hughey Run was visually assessed during the period of high groundwater. Water draining from several drainage ditches, located on reclaimed mines and wet areas down gradient of the mine sites, were noted as having depressed field pH readings. The stream itself maintained a field pH reading near 6.0. Small fish were observed in the stream as well. Hughey Run consistently maintained pH readings near 6.0 throughout the assessment monitoring period and is considered a low priority for restoration. Hughey Run would likely benefit from the installation of high calcium carbonate limestone in the surface water diversions draining the reclaimed mine sites, as well as the wet areas below the mine sites. Doing so would likely reduce the acidity in Hughey Run and have beneficial impacts to Bilger Run as well.

Hughey Run TMDL

The TMDL for Hughey Run was included in the reductions required for TMDL point BR2, which included all of the pollution sources in the upper Bilger Run watershed. Table G32, taken from the TMDL report, identifies the load reductions specifically for HR1 and is presented below.

Table G32. Summary of Loads Affecting Point BR2 Repeated Table

	Iron (lbs/day)	*Manganese (lbs/day)*	*Aluminum (lbs/day)*	*Acidity (lbs/day)*
HR1				
Existing Load	3.41	1.05	1.16	45.74
Allowable Load	1.38	1.05	1.16	6.39
Load Reduction	2.03	0	0	39.35
OSL 211-214				
Existing Load	18.51	-	-	679.39
Allowable Load	0.18	-	-	0
Load Reduction	18.33	-	-	679.39
BR1				
Existing Load	25.47	92.23	37.44	660.63
Allowable Load	2.97	3.58	2.30	13.20
Load Reduction	22.50	88.65	35.14	647.43

The TMDL for Hughey Run consists of a load allocation to all of the watershed area above point HR1. Addressing the mining impacts above this point addresses the impairment for the segment (SRBC 2004).

The load reductions required for Hughey Run above HR1 are identified in Table G26, taken from the TMDL report. Reductions of iron and acid are required.

Table G26. Reductions for Hughey Run Above HR1

Station	*Parameter*	*Measured Sample Data*		*Allowable*		*Reduction Identified*
		Conc. (mg/l)	*Load (lbs/day)*	*LTA Conc. (mg/l)*	*Load (lbs/day)*	*Percent*
HR1	Fe	0.62	3.41	0.25	1.38	59
	Mn	0.19	1.05	0.19	1.05	0
	Al	0.21	1.16	0.21	1.16	0
	Acid	8.31	45.74	1.16	6.39	86
	Alkalinity	9.58	52.73			

All values shown in this table are long-term average daily values.

The TMDL for Hughey Run at point HR1 requires that a load allocation be made for all areas above HR1 for total iron and acidity. The TMDL for Hughey Run at point HR1 does not require a load allocation to be made for total manganese and total aluminum. This assessment also established a monitoring point representative of TMDL HR1 (SRBC 2004).

TMDL monitoring point HR1 was also represented by a monitoring point established for this assessment, SMP-HR1. The following monitoring data averages for SMP-HR1 were developed using the samples collected during the time of this assessment.

Average water quality measured at SMP-HR1

Sample ID	**Fe mg/L**	**Fe Loading lbs/day**	**Mn mg/L**	**Mn Loading lbs/day**	**Al mg/L**	**Al Loading lbs/day**	**Acidity mg/L**	**Acidity Loading lbs/day**	**Alkalinity mg/L**	**Alkalinity Loading lbs/day**
SMP-HR1	**0.24**	**0.9**	**0.32**	**1.2**	**0.17**	**0.9**	**5.20**	**24.3**	**8.4**	**37.1**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

Recommendations for Hughey Run above TMDL point HR1

The TMDL recommends load reductions of 2.03 lbs/day of iron and 39.35 lbs/day of acidity for the entire Hughey Run watershed. Hughey Run would likely benefit from the installation of high calcium carbonate limestone in the surface water diversions draining the reclaimed mine sites as well as the wet areas below the mine sites, some of which may be impaired springs. It may also be possible to install small anoxic limestone drains in the depressed-pH wet areas to increase alkalinity at these specific points. Doing so would likely reduce the acidity and metals in Hughey Run and have beneficial impacts to Bilger Run as well.

Fenton Run

The Fenton Run headwaters begin just south of Bilger Rocks Road, which is located about two miles north of Grampian along Route 219. Fenton Run is a low-gradient stream that flows southeast for 1.5 miles before it begins its steep decline to its confluence with Bilger Run. In the steep section, Fenton Run becomes boulder-choked and contains several small waterfalls. Once it reaches Bilger Run, the alkalinity in Fenton Run causes Bilger Run to precipitate much of its aluminum load. The stream takes on a milky appearance and the rocks on the substrate become coated with aluminum precipitate.

TMDL for Fenton Run

The TMDL for Fenton Run consists of a load allocation to all of the watershed area above point FR1. The TMDL for Fenton Run at point FR1 requires that a load allocation be made for all areas above FR1 for total iron, total manganese, and acidity (SRBC 2004). Table G34, taken from the TMDL report, identifies the reductions required to meet in-stream TMDL requirements.

Table G34. Reductions for Fenton Run Above FR1

Station	*Parameter*	*Measured Sample Data*		*Allowable*		*Reduction Identified*
		Conc. (mg/l)	*Load (lbs/day)*	*LTA Conc. (mg/l)*	*Load (lbs/day)*	*Percent*
FR1	Fe	0.51	1.32	0.19	0.49	63
	Mn	1.92	4.96	0.13	0.34	93
	Al	1.56	4.03	-	-	-
	Acid	5.50	14.22	3.24	8.38	41
	Alkalinity	22.72	58.74			

All values shown in this table are long-term average daily values.

A monitoring point for this assessment was established on Fenton Run. It was located approximately .5 miles downstream of the TMDL station and below the confluence of an unnamed tributary and identified as SMP-HR1. The following monitoring data averages for SMP-HR1 were developed using the samples collected during the time of this assessment.

Average water quality measured at SMP-FR1

Sample ID	**Fe mg/L**	**Fe Loading lbs/day**	**Mn mg/L**	**Mn Loading lbs/day**	**Al mg/L**	**Al Loading lbs/day**	**Acidity mg/L**	**Acidity Loading lbs/day**	**Alkalinity mg/L**	**Alkalinity Loading lbs/day**
SMP-FR1	**0.74**	**2.4**	**0.80**	**6.1**	**0.22**	**1.9**	**-29.00**	**-146.3**	**49**	**272.6**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

Recommendations for Fenton Run

The water quality in Fenton Run is good enough to support fish and aquatic insects. The upper reaches show some signs of iron precipitation, particularly at low flows, but the impacts to Fenton Run are minor. Fenton Run is considered a low priority and is not recommended for restoration activities at this time.

DMP-Wildwood is located just upstream of Route 879 on Bilger Run.

Lower Bilger Run

Near the mouth of Bilger Run at Route 879, the water quality of the stream is again degraded by additional sources of AMD. The AMD in this area is much different from that in the upper watershed. The upper watershed discharges have high acidity and high concentrations of metals. Here discharges have low acidity, lower iron, and are nearly balanced between acidity and alkalinity.

The Wildwood Discharge, named for a nearby local establishment, is located adjacent to the stream and forms a large, degraded wetland before discharging into the stream. There are some additional AMD seeps on the opposite side of the stream from the Wildwood Discharge. The seeps are smaller flows but do appear to have elevated levels of iron. Because the seeps were lower in flow, they were not considered a high priority and were not sampled during the monitoring period. Because of the steep topography on that side of the stream, it does not appear it would be feasible to treat the seeps without relocating them. They were considered a low priority for monitoring.

AMD discharges from crack in Route 879 Bridge pier on Bilger Run.

Located slightly downstream, at the Route 879 Bridge over Bilger Run, are additional AMD discharges. These discharges appear at the base of the Route 879 Bridge piers. One of the piers has a large crack in it and is being monitored by PennDOT. At the base of the crack, AMD can be observed bubbling out. The discharge is substantial enough to stain the stream with iron. It appears that PennDOT will eventually address the bridge pier situation. Coordination with PennDOT will be critical if any possible action can be taken to address these discharges.

Recommendations for Lower Bilger Run - Wildwood Discharge

Although there may be permitting issues with the location of the discharge next to the stream and the wetland area it has created, based on water quality, the Wildwood

Discharge should be easily treated using passive treatment. An anoxic limestone drain (ALD) and pond/wetland treatment system should work well. The discharge is net acidic but does already contain some alkalinity. The biggest issue will be working in or near the stream and wetland, especially with heavy equipment. Access is somewhat difficult. It may also be possible to enhance the present wetland to improve the treatment efficiency without significant impacts to the wetland by using materials other than earthen dikes to improve detention time in the wetland. ACWA made application to the Growing Greener grant program in 2003 to remediate the discharge, but the application was denied. It is recommended that ACWA again make application for funding to address this discharge.

Average water quality measured at DMP-Wildwood

Sample ID	Fe mg/L	Fe Loading lbs/day	Mn mg/L	Mn Loading lbs/day	Al mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day
DMP-Wildwood	**8.91**	**9.28**	**2.71**	**2.55**	**0.05**	**0.06**	**17**	**15.95**	**9**	**10.75**

All values represent short-term averages for samples taken during the monitoring period of the assessment.

As mentioned in the Kratzer Run section, AMD is discharging into Bilger Run from the base of the Route 879 Bridge pier. Because of the location, it will be very difficult to address the discharge. Efforts must be coordinated with PennDOT and treatment system engineers well in advance of any repairs to the bridge piers to determine the best approach to remediation.

Sediment and Nutrient TMDLS

Pollutants and Sources

Nutrients and siltation have been identified as the pollutants causing designated-use impairments in the Anderson Creek watershed. Sub-basin 1 represents the portion of the watershed affected by siltation. The watersheds in Sub-basin 1 are comprised of Little Anderson Creek and Rock Run. Sub-basin 2 represents the portion of the watershed affected by nutrient impairment. Kratzer Run and Bilger Run are the two streams in Sub-basin 2. There are no known permitted wastewater discharges present within the two sub-basins. Based on the assessment data and visual observations, abandoned mine and agricultural lands are the sources of the siltation in Sub-basin 1. Some areas are sparsely vegetated where acid conditions exist, contributing to significant sediment runoff. There also are portions of the watershed where livestock have unlimited access to the stream, and no riparian buffer exists. For Sub-basin 2, the assessment data states the source of the nutrients to be septic systems in the more developed areas, however, there is a significant amount of disturbed and agricultural lands present as well (SRBC 2004).

Reference Watershed Approach

The TMDL developed for Anderson Creek Sub-basins 1 and 2 addresses sediment and phosphorus, respectively. Because neither Pennsylvania nor the EPA has numeric water quality criteria for these pollutants, a method was developed to determine water quality objectives that would result in the impaired stream segments attaining their designated uses. The method employed for these TMDLs is termed the "Reference Watershed Approach" (SRBC 2004).

The Reference Watershed Approach compares two watersheds, one attaining its uses and one that is impaired based on biological assessments. Both watersheds must have similar land use/cover distributions. Other features, such as base geologic formation, should be matched to the extent possible; however, most variations can be adjusted for in the model. The objective of the process is to reduce the loading rate of pollutants in the impaired stream segment to a level equivalent to the loading rate in the non-impaired, reference stream segment. This load reduction will result in conditions favorable to the return of a healthy biological community to the impaired stream segments (SRBC 2004).

Curry Creek, stream code 26760, was selected as the reference watershed for developing the Anderson Creek Sub-basin TMDLs. The Curry Creek watershed is located just west of Anderson Creek in Clearfield County, Pennsylvania. The watershed is located in State Water Plan Sub-basin 8B, and protected uses include aquatic life and recreation. The entire basin is currently designated as CWF under §93.9z in Title 25 of the Pa. Code (Commonwealth of Pennsylvania 2001). Based on DEP's 305(b) report database, Curry Creek is currently attaining its designated uses. The attainment of designated uses is based on sampling done by DEP in 1999 (SRBC 2004).

TMDLs

Targeted TMDL values for the Anderson Creek watershed were established based on current loading rates for sediment and phosphorus in the Curry Creek reference watershed. Biological assessments have determined that Curry Creek is currently attaining its designated uses. Reducing the loading rate of sediment and phosphorus in the Anderson Creek watershed to levels equivalent to those in the Curry Creek watershed will provide conditions favorable for the reversal of current use impairments (SRBC 2004).

Targeted TMDLs

Targeted TMDL values for sediment and phosphorus were determined by multiplying the total area of Sub-basins 1 and 2 of the Anderson Creek watershed (6,626.31 and 9,779.61 acres, respectively) by the appropriate unit-area loading rate for the Curry Creek watershed. The existing mean annual loading of sediment to Sub-basin 1 (1,588,248.60 lbs/yr) will need to be reduced by 57 percent to meet the targeted TMDL of 686,684.51 lbs/yr. Meeting the targeted phosphorus TMDL of 1,564.74 lbs/yr for Sub-basin 2 will require a 29 percent reduction in the current mean annual loading (2,212.10 lbs/yr) (SRBC 2004).

Recommendations for Implementation

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 Anderson Creek sediment and phosphorus TMDLs identify the necessary overall load reductions and distribute those reduction goals to the appropriate non-point sources. Reaching the reduction goals established by these TMDLs will only occur through changes in current land-use practices and reclamation of abandoned mine lands, including the incorporation of BMPs. BMPs that would be helpful in lowering the amount of sediment and nutrients reaching Anderson Creek include streambank fencing and riparian buffer strips, among many others (SRBC 2004).

The required level of detail is outside the scope of this TMDL document and is an activity best accomplished at the local level. Successful implementation of the activities necessary to address current use impairments to Anderson Creek will require local citizens taking an active interest in the watershed and the enthusiastic cooperation of local landowners. Some of the work needed is actively being pursued through efforts targeting the abandoned mine lands (SRBC 2004).

Assessment Recommendations for Sub-basin 1

Meeting TMDL sediment reduction goals for Sub-basin 1, as established by the Anderson Creek watershed TMDL, will require significant amounts of land restoration on many of the AMD TMDL sites previously identified for Little Anderson Creek. These sites include areas associated with PAMP-LA2.10, PAMP-LA 3.0-1, PAMP-LA 3.0-2, DMP-Drauckers 1, Spencer mine, and PAMP-LA4.3-1. No agricultural sites were identified as significant sediment sources on Little Anderson Creek. In addition to the identified sites, other poorly vegetated sites within the sub-basin may also be contributing to the sediment load, but to a lesser degree. Also contributing to the problem is the flocculent associated with metals deposition from AMD onto the streambed.

Two sites in the Rock Run subwatershed, one abandoned mine site and one agriculture site, were also noted during the visual assessment as likely sources of sediment. Both sites are located in the lower reaches of Rock Run. An abandoned coal tipple, located east of Rock Run Road, contains large piles of un-vegetated coal waste that are severely eroding. Although it is not located adjacent to the stream, coal waste fines were observed in a drainage way leading to the stream. The agriculture site is also located in the vicinity, approximately .5 miles downstream. At this site, livestock have direct access to the stream and the pasture field is poorly vegetated.

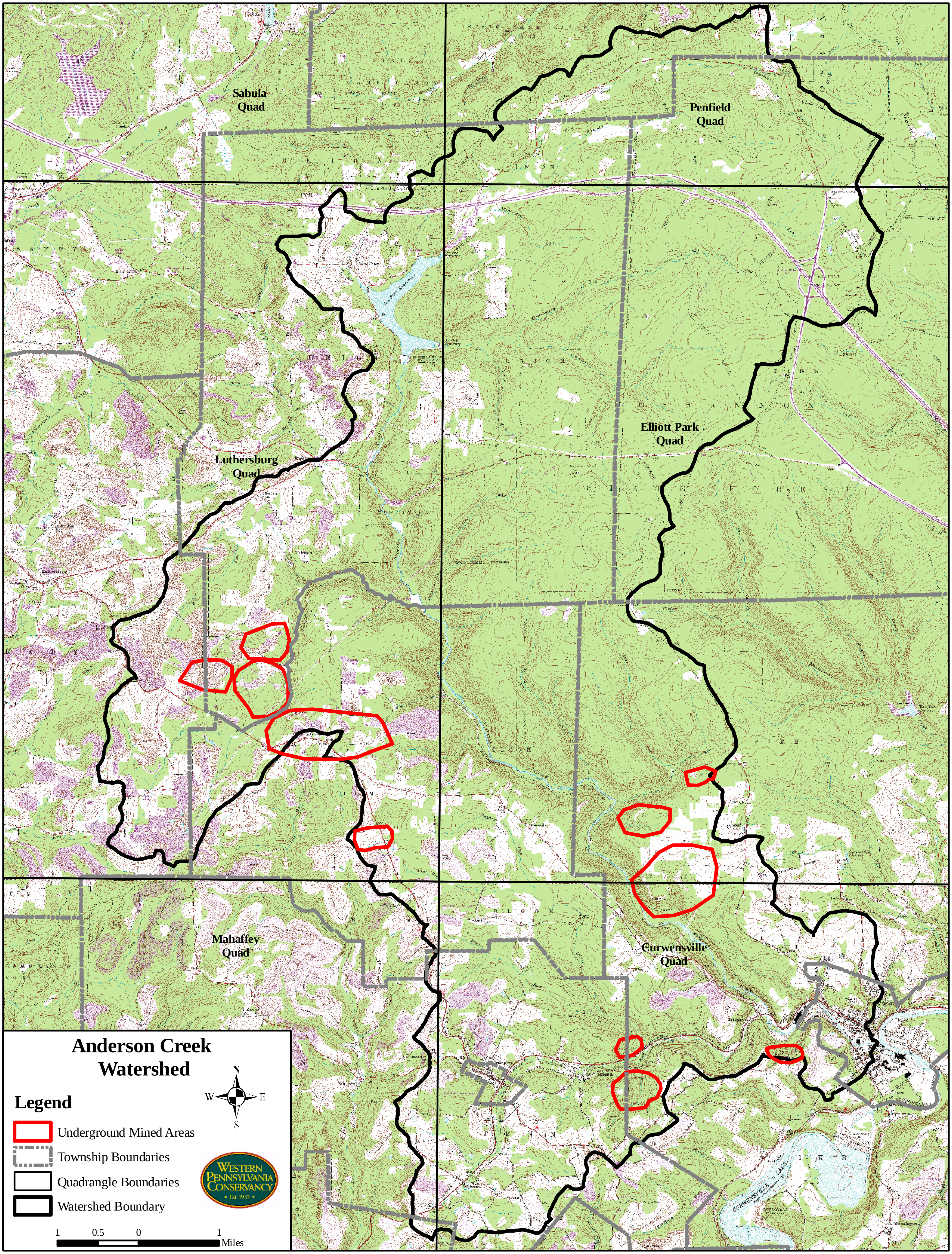
Assessment Recommendations for Sub-basin 2

The TMDL report identified Sub-basin 2, Kratzer Run and Bilger Run, as impaired by nutrients and requiring a 23 percent reduction of phosphorous. The visual assessment conducted during this study appeared to support these findings. Two possible agricultural sources were identified in the headwaters area during the assessment. The worst of the two is located on the headwaters of UNT-KR 5.2, north of Hepburnia, where a barnyard and adjoining pasture permit uncontrolled livestock access to the stream. Streamside vegetation is sparse and streambanks are eroding. It is recommended that contact be made with the landowner and efforts be made to initiate proper agricultural BMPs on the site.

The TMDL study also noted failing septic systems as another source of nutrients in the watershed. Although sewage discharges into Sub-basin 2 were noted, they did not appear to be widespread. Kratzer Run, in particular, visually appeared to be affected by nutrients. However, no tests were performed to confirm these suspicions. The towns of Grampian and Stronach, both located in Sub-basin 2 on Kratzer Run, had a sewage treatment plant installed to serve their residents. The plant was operational prior to the assessment, which indicates agricultural areas and remaining on-lot septic systems are likely still affecting the stream.

Although not identified specifically by the TMDL, Kratzer Run also has a sediment problem. Because the stream flows through the communities of Grampian and Stronach and parallels Route 879, it is clearly affected by human encroachment. It is also affected by many areas in the headwaters that have been surface mined and contain few trees, leading to accelerated rates of precipitation runoff during storm events. The visual assessment identified several areas of moderate to severe streambank erosion along Kratzer Run. Several are associated with poor streamside vegetation, some due to lawns being mowed to the edge of the stream. The area between Grampian and Stronach is particularly notable.

The worst area of streambank instability is below Stronach. The gradient of the stream becomes steeper in this section, which can increase erosion rates when problems occur. Between Stronach and the mouth of Bilger Run, a road crossing the stream has been removed without proper streambank stabilization being employed. At this site, significant siltation is occurring from the downcutting of in-stream sediment remaining above the former road crossing. Additionally, severe bank erosion is taking place at the site of the former road and immediately below it. Heavy sediment deposits were noted in the stream channel below the site for a considerable distance. This area is considered the number one priority for erosion and sedimentation in the entire Anderson Creek watershed. It is recommended that a more detailed study of the entire Kratzer Run area below Stronach be undertaken to determine the proper natural stream channel stabilization techniques to be implemented throughout the stream segment.


Sabula Quad
Penfield Quad
Luthersburg Quad
Elliott Park Quad
Mahaffey Quad
Curwensville Quad
Anderson Creek Watershed
Legend
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Quadrangle Boundaries
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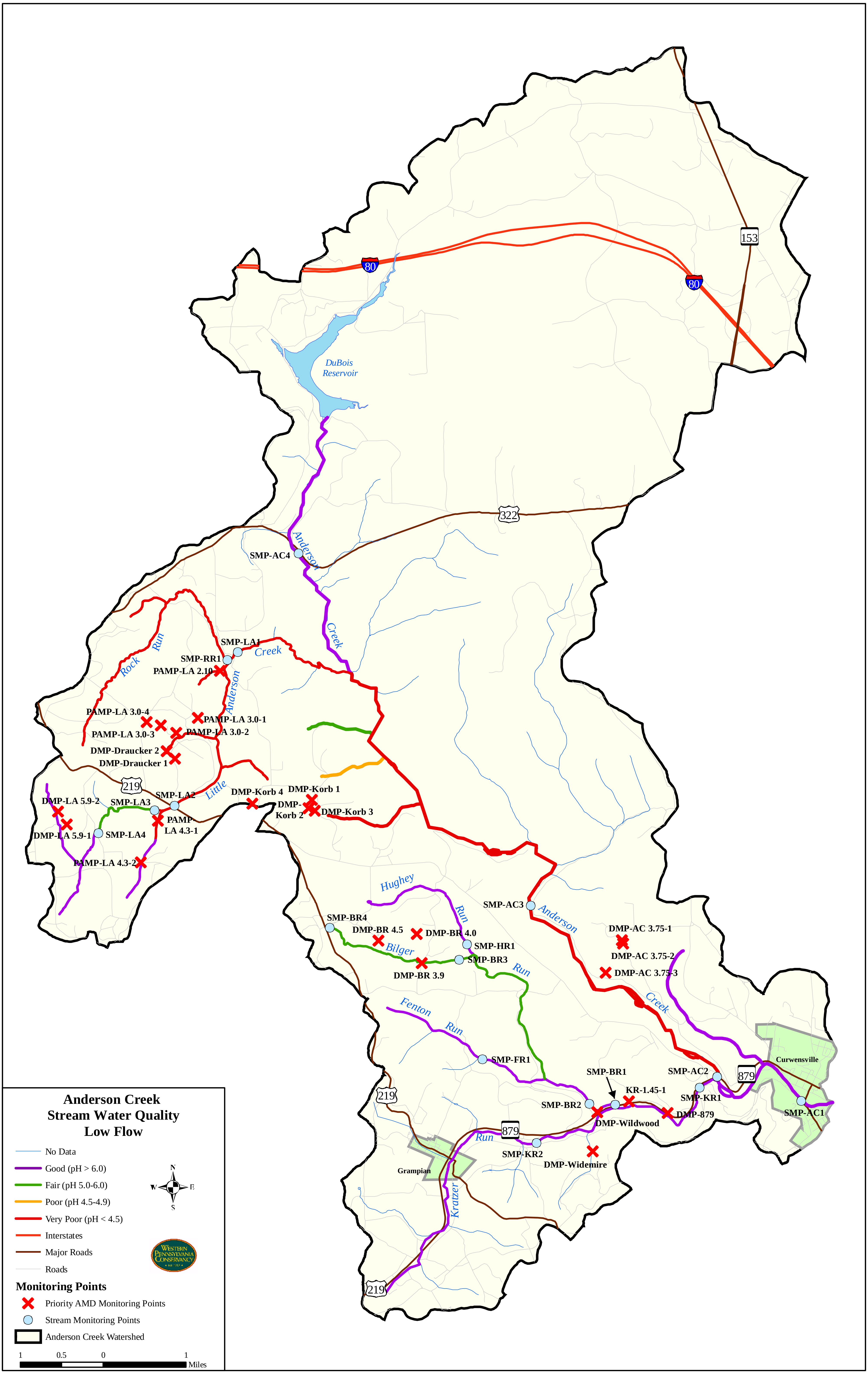
Anderson Creek
Stream Water Quality
Low Flow
No Data
Good (pH > 6.0)
Fair (pH 5.0-6.0)
Poor (pH 4.5-4.9)
Very Poor (pH < 4.5)
Interstates
Major Roads
Roads
Monitoring Points
Priority AMD Monitoring Points
Stream Monitoring Points
Anderson Creek Watershed
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Western Pennsylvania Conservancy
DuBois Reservoir
80
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322
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879
879
Anderson Creek
Little Anderson Creek
Rock Run
Hughey Run
Bilger Run
Fenton Run
Kratzer Run
SMP-AC4
SMP-LA1
SMP-RR1
PAMP-LA 2.10
PAMP-LA 3.0-4
PAMP-LA 3.0-1
PAMP-LA 3.0-3
PAMP-LA 3.0-2
DMP-Draucker 2
DMP-Draucker 1
SMP-LA2
DMP-Korb 4
DMP-Korb 1
DMP-Korb 2
DMP-Korb 3
DMP-LA 5.9-2
SMP-LA3
DMP-LA 5.9-1
SMP-LA4
PAMP-LA 4.3-1
PAMP-LA 4.3-2
SMP-AC3
SMP-BR4
DMP-BR 4.5
DMP-BR 4.0
SMP-HR1
SMP-BR3
DMP-BR 3.9
DMP-AC 3.75-1
DMP-AC 3.75-2
DMP-AC 3.75-3
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SMP-BR1
KR-1.45-1
SMP-AC2
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Curwensville
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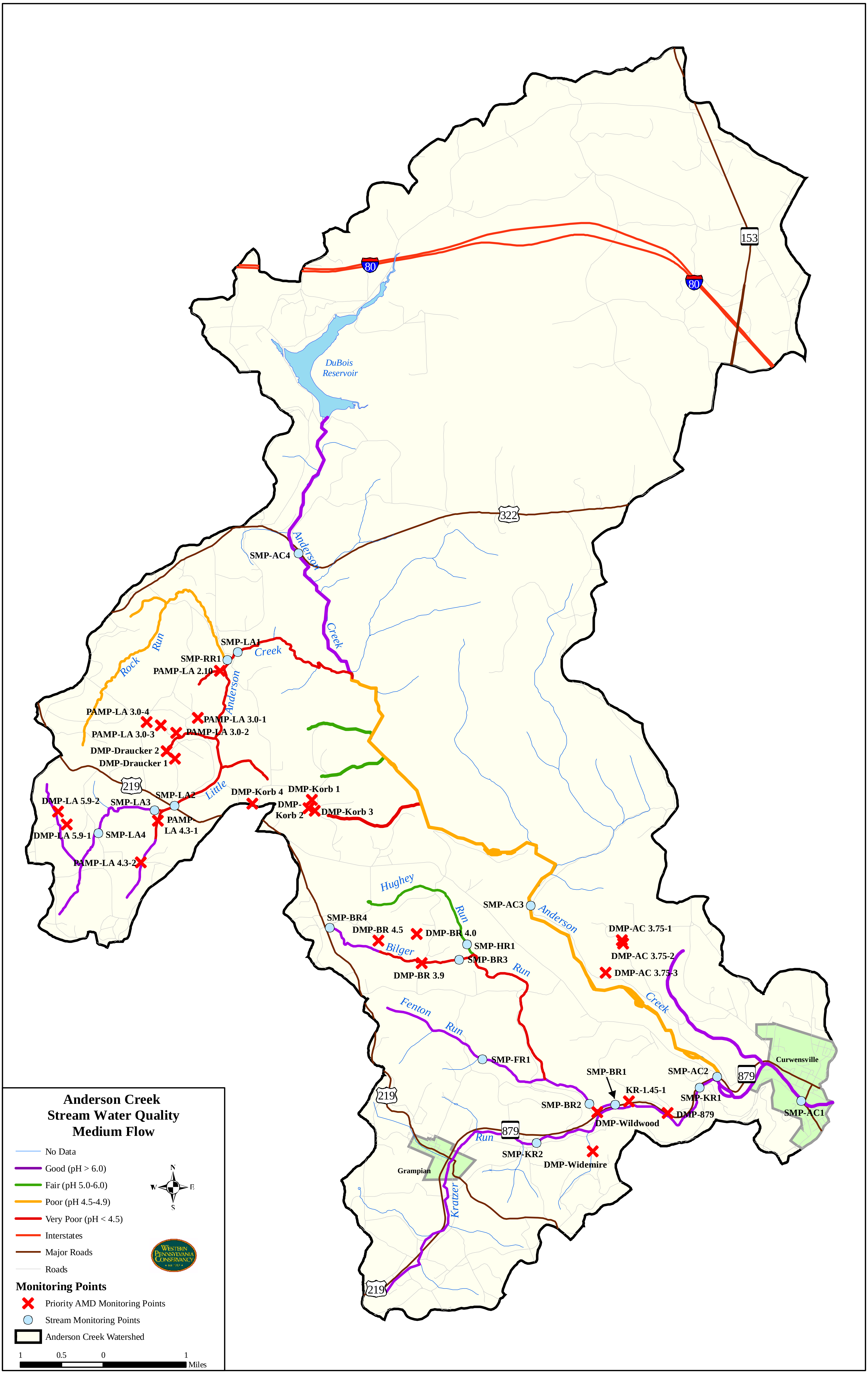
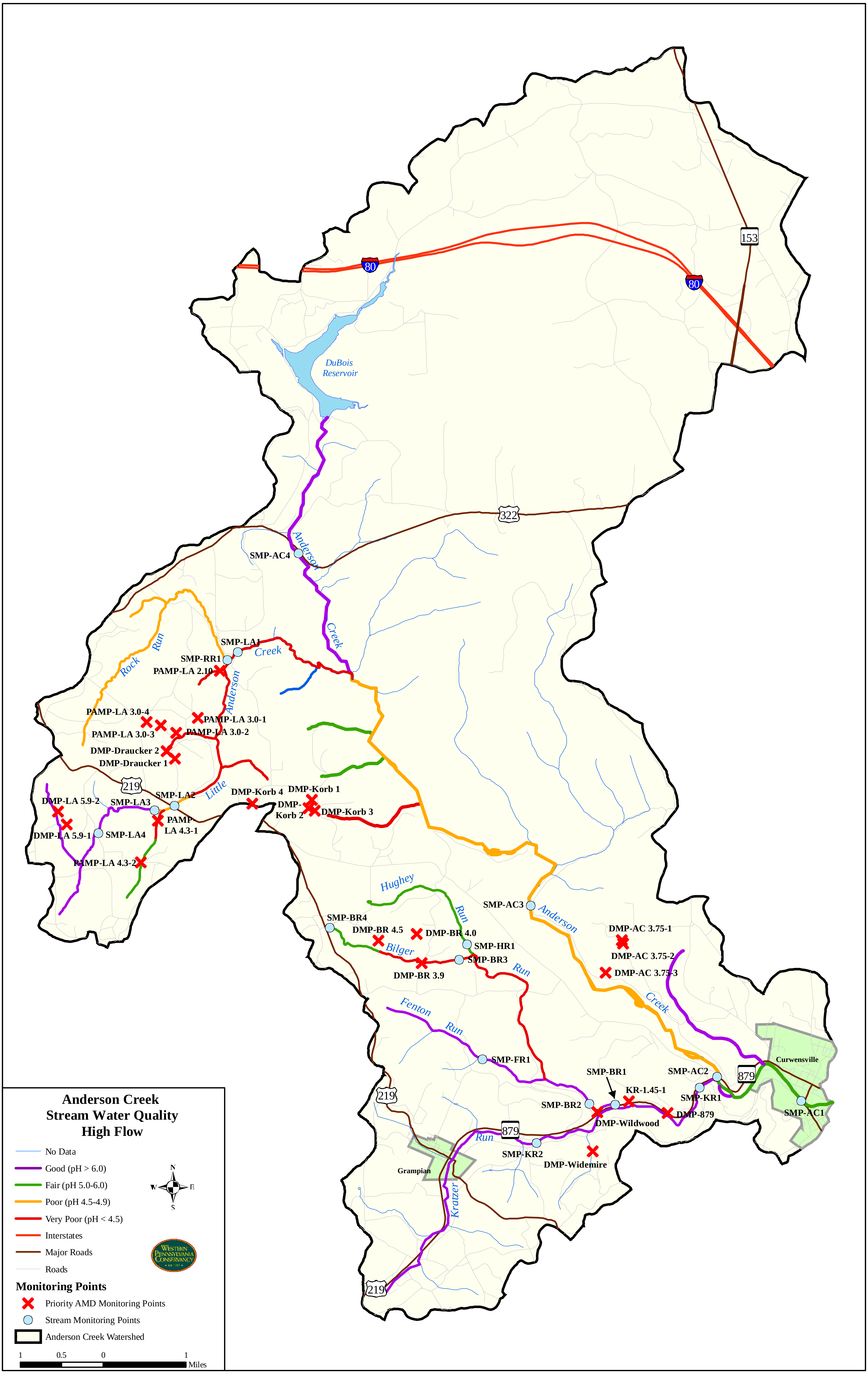
DMP-Widemire
Grampian



Anderson Creek
Stream Water Quality
Medium Flow



Anderson Creek Stream Water Quality High Flow

V. Priorities for Restoration

The best approach to the restoration of an impaired watershed is to establish a set of priorities for the necessary work. Usually, restoration priorities first determine which sites are causing the most impairment to the watershed based on pollution loads. Most often, because acidity in AMD is a good indicator of its severity, it has been used as a key factor in determining priority. Acidity levels in an AMD discharge alone, however, do not tell the whole story. The volume of flow must be coupled with the amount of pollutant in the water to determine the total amount of pollution being produced by a discharge, usually measured in pounds per day. Flow is determined by using techniques that will assure reasonably accurate measurement. Most often, discharge flows are measured using a weir, such as a V-notch or rectangular weir, a flume, a piped discharge and using a bucket and stopwatch, or a flow meter, if the discharge is very large. Once a flow measurement is matched with the amount of pollutant in the water, a total load of pollutant in pounds per day can be calculated. These are the basic methods that were used in this assessment.

Many other factors can play a role in determining a final restoration prioritization scheme. These factors may include site conditions, landowner cooperation, site location or access to the site, cost of treatment (both initial and long-term), ease of construction, likelihood of success, expected environmental results, operation and maintenance requirements, funding availability, remining potential, local priorities and support, and many others. Often the initial prioritization is based on pollution load and then is refined based on the other factors. Flexibility is the key to successful restoration efforts. Often the worst discharges cannot be tackled immediately, so other factors help determine what to do and when.

In the case of Anderson Creek, the watershed was long thought to be a lost cause, just too degraded to be worth the effort. However, Anderson Creek Watershed Association (ACWA) saw hope in making small advances, and continued working toward restoration of the watershed despite doubts. Bilger Run is one such area where the initial focus was to stock trout in the lower sections by reducing acidity through limestone sand dosing. That successful project inspired a continued effort toward the cleanup of the entire watershed. Bilger Run continues to be a top local priority because of the possibility to return four miles of stream to a trout fishery with construction of a few remediation projects. Cleaning up Bilger Run will also have a positive effect on the experience visitors have when visiting Bilgers Rocks, through which the stream flows. Additionally, restoration of the main stem of Anderson Creek remains another achievable priority for ACWA. As major sites on Little Anderson Creek are cleaned up, it is very likely that water quality will significantly improve on the main stem of Anderson Creek.

Scarlift Priorities

The first prioritization of AMD problems in Anderson Creek were done during the Scarlift project. Under that study, problem areas were prioritized based on the relative acid load, cost of reclamation, relative benefit to the receiving stream, effectiveness of the proposed reclamation measures, and the possibility of future mining activity in the area. Reclamation focused primarily on AMD treatment projects. At the time, it was felt that by flooding underground mine pools, AMD pollution would be reduced. Many restoration projects focused on installing clay mine seals at the entrances of the mines in order to flood them. Subsequent studies found the technique was not always successful. Project costs were also fairly low because the technique was relatively simple.

Based on the Scarlift study restoration priorities, the 20 problem areas listed in the table below were ranked as priorities in 1974.

Scarlift Study Priorities

Priority	Scarlift ID#	Assessment Discharge ID	Description/Note
1	301-302	DMP-Draucker1	Drauckers and Pearce mine
2	303	PAMP LA3.0-1, 2	Wingert Site
3	220-221	DMP-Widemire	Kratzer Run tipple
4	329, 350, 351	Korb4, Korb2, Korb3	Little Anderson/Anderson
5	330, 352	DMP - Spencer	Little Anderson
6	204	PAMP KR1.45-1	Falls
7	211-214	DMP-BR 4.0	Bilger Run pipe discharge
8	341-343	PAMP-LA 4.3	Tepke property
9	215-216	DMP-BR 4.5	Bilger Run pond
10	304-304A-304B	PAMP-LA3.0	Wingert
11	334-337	SMP-LA 4.3	Southern discharges – not sampled
12	301A	DMP-Draucker2	Little Anderson
13	103-105	DMP-AC 3.75 -1&2	Bloom Mine
14	322-324		Rock Run Headwaters
15	209		Bilger Run east of twp. road – eliminated
16	313-313A-315		Rock Run headwaters – acid seep area
17	113		Greenville Pike area
18	106	AC-UNT 5.8	Bear Run – Laurel Swamp
19	309		Rock Run headwaters
20	345	DMP-LA5.9-1	Assessment site

TMDL Study Priorities

In 2004, the Susquehanna River Basin Commission completed a Total Maximum Daily Load report for Anderson Creek. The following list identifies the top ten restoration priorities developed for the TMDL. It differs slightly from the priority ranking developed by the Scarlift study.

TMDL Priorities

Priority	Site Name	Scarlift #	Sub-basin	Assessment Designation
1	Drauckers Discharges	OSL 301	Little Anderson Creek	DMP-Drauckers 1
2	Widemire Discharge	OSL 220	Kratzer Run	DMP-Widemire
3	Korb Discharge	OSL 329	Little Anderson Creek	DMP-Korb 4
4	Wingert Discharge	OSL 303	Little Anderson	PAMP-LA3.0-1,2
5	Stronach Discharges	OSL 211–214	Bilger Run	DMP-BR4
6	Little Anderson Seeps	OSL305	Little Anderson Creek	PAMP-LA 2.10
7	Korb Discharge	OSL 350	Anderson Creek	DMP-Korb 2
8	Spencer Discharge	OSL 352	Little Anderson Creek	DMP-Spencer
9	Korb Discharge	OSL 351	Anderson Creek	DMP-Korb 3
10	Spencer Discharge	OSL 330	Little Anderson Creek	DMP-Spencer

ACWA Assessment Priorities

The overall ACWA prioritization for restoration of pollution sources developed for this study is based on acid and metals loadings, measured as existing average load in pounds per day during the 12-month monitoring period. The following charts identify priorities for restoration based on acid, aluminum, iron, and manganese. Because acid and aluminum are the deadliest pollutant sources to aquatic life, they were chosen as the primary indicators of priority for restoration. Although the load rankings change depending on the pollutant, the top-priority discharges remain relatively the same and are strikingly similar to the priorities of the previous studies, which indicate that not much has changed in Anderson Creek in over 30 years.

Ranking by Acidity Loading

Monitoring Point ID	Acidity Loading lbs/day	Rank
DMP-Drauckers1	743.1	1
DMP-Korb4	338.5	2
DMP-Korb2	246.0	3
PAMP-LA4.3	173.6	4
PAMP-LA3.0	97.8	5
DMP-BR4.5	84.9	6
PA-KR1.45-1	70.2	7
DMP-Drauckers2	66.4	8
DMP-Widemire	55.1	9
PAMP-LA3.0-4	54.0	10
DMP-BR4.0	35.5	11
DMP-AC3.75-3	28.7	12
PAMP-LA2.10	16.4	13
DMP-Wildwood	15.9	14
PAMP-LA3.0-1	14.4	15
DMP-AC3.75-2	13.4	16
DMP-Korb1	10.4	17
DMP-AC3.75-1	9.2	18
DMP-LA5.9-1	8.0	19
DMP-LA5.9-2	7.0	20
DMP-Korb3	5.5	21
DMP-BR3.9	5.4	22
DMP-879	-0.3	23

Ranking by Aluminum Loading

Monitoring Point ID	Al Loading lbs/day	Rank
DMP-Drauckers1	67.9	1
DMP-Korb2	21.4	2
DMP-Korb4	20.5	3
PAMP-LA4.3	15.0	4
PAMP-LA3.0	9.7	5
PA-KR1.45-1	8.6	6
DMP-BR4.5	8.2	7
DMP-Widemire	6.2	8
DMP-AC3.75-3	4.3	9
DMP-BR4.0	4.3	10
DMP-Drauckers2	3.3	11
PAMP-LA3.0-1	1.9	12
PAMP-LA2.10	1.6	13
DMP-AC3.75-2	0.9	14
DMP-AC3.75-1	0.9	15
PAMP-LA3.0-4	0.8	16
DMP-LA5.9-2	0.6	17
DMP-BR3.9	0.5	18
DMP-Korb3	0.5	19
DMP-LA5.9-1	0.4	20
DMP-Korb1	0.2	21
DMP-Wildwood	0.1	22
DMP-879	0.0	23

Ranking by Iron Loading

Monitoring Point ID	Fe Loading lbs/day	Rank
DMP-Drauckers1	83.4	1
DMP-Korb4	37.6	2
DMP-Korb2	20.5	3
DMP-BR4.5	13.9	4
PAMP-LA4.3	12.1	5
PAMP-LA3.0-4	11.3	6
DMP-Wildwood	9.3	7
DMP-Widemire	6.3	8
DMP-Drauckers2	3.0	9
DMP-BR4.0	2.8	10
PAMP-LA3.0	2.6	11
DMP-879	1.9	12
DMP-LA5.9-2	0.6	13
DMP-Korb1	0.5	14
DMP-BR3.9	0.5	15
DMP-AC3.75-2	0.3	16
PA-KR1.45-1	0.3	17
DMP-AC3.75-3	0.3	18
PAMP-LA2.10	0.3	19
DMP-Korb3	0.2	20
DMP-AC3.75-1	0.2	21
PAMP-LA3.0-1	0.1	22
DMP-LA5.9-1	0.1	23

Ranking by Manganese Loading

Monitoring Point ID	Mn Loading lbs/day	Rank
DMP-Drauckers1	23.3	1
DMP-BR4.5	21.3	2
PAMP-LA4.3	16.0	3
PAMP-LA3.0-4	10.5	4
DMP-Drauckers2	9.1	5
DMP-BR4.0	7.9	6
DMP-Korb4	7.4	7
PA-KR1.45-1	5.8	8
DMP-Widemire	2.6	9
DMP-Wildwood	2.6	10
DMP-LA5.9-2	2.5	11
DMP-LA5.9-1	2.3	12
PAMP-LA3.0	2.1	13
PAMP-LA2.10	1.7	14
DMP-Korb2	1.5	15
DMP-BR3.9	1.3	16
DMP-AC3.75-3	0.5	17
PAMP-LA3.0-1	0.4	18
DMP-879	0.2	19
DMP-AC3.75-2	0.1	20
DMP-AC3.75-1	0.1	21
DMP-Korb3	0.1	22
DMP-Korb1	0.0	23

Sub-Basin Priorities

The priority restoration sites were also categorized according to the sub-basins into which they drained. The sub-basins included: Anderson Creek, Little Anderson Creek, Kratzer Run, and Bilger Run. Rock Run was not considered a priority sub-basin at this time because of the significant pollution sources elsewhere in the watershed. Priorities were primarily based on measured existing load in pounds per day of acid and aluminum, with iron and manganese measured existing loads being the bigger determinant on discharges approaching a net-alkaline condition.

Little Anderson Creek Sub-basin

Little Anderson Creek Priorities

Monitoring Point	Priority
DMP- Drauckers 1	1
DMP-Korb 4	2
PAMP-LA 4.3	3
PAMP-LA 3.0	4
DMP-Drauckers 2	5
PAMP-LA 3.0-4	6
PAMP-LA 2.1	7
PAMP-LA 3.0-1	8
PAMP-LA 5.9-2	9
PAMP-LA 5.9-1	10

Anderson Creek Sub-basin

Anderson Creek Priorities

Monitoring Point	Priority
DMP-Korb 2	1
DMP-AC 3.75-3	2
DMP-AC 3.75-2	3
DMP-Korb 1	4
DMP-AC 3.75-1	5
DMP-Korb 3	6

Bilger Run Sub-basin

Bilger Run Priorities

Monitoring Point	Priority
DMP- BR 4.5	1
DMP- BR 4.0	2
DMP-BR 3.9	3
DMP-Wildwood	4

Kratzer Run Sub-basin

Kratzer Run Priorities

Monitoring Point	Priority
PAMP KR 1.45-1	1
DMP-Widemire	2
DMP-879	3

Technical and Financial Assistance Needs

Estimates of Remediation Costs

Estimates of costs to construct AMD treatment systems are given for the top fifteen (15) priority sites for restoration. The sites are listed under the sub-basin that they affect. Three methods were used in developing cost estimates—two for passive treatment systems and one for active treatment systems.

One of the methods used to estimate costs for passive treatment systems used the Watershed Restoration Analysis Model (WRAM). WRAM is a loading-based tool that predicts the downstream benefits of treating AMD discharges within a watershed. The Microsoft Excel-based spreadsheet program also generates conceptual passive treatment system component sequences and sizing requirements, cost estimates, and construction area requirements. The user can select one or more AMD sources to treat, then evaluate the predicted downstream water quality improvements in comparison to potential costs. This allows for rapid screening to prioritize AMD abatement projects by cost/benefit ratios (DEP/PSU).

The Penn State ArcView Generalized Watershed Loading Function (AVGWLF) program is an ArcView GIS-based system that also is used for modeling of pollutant loading in streams. A component of AVGWLF is capable of predicting stream flow statistics using historic weather records and watershed-specific factors such as size, slope, surface cover, and soils. This approach has proven effective for estimating long-term flow characteristics for watersheds that do not have continuous flow records (DEP/PSU).

WRAM and AVGWLF were combined to create the WRAM/AVGWLF program, which combined the modeling capabilities of both programs in order to predict the type and costs of constructing passive AMD treatment systems and model in-stream load reductions simultaneously. It uses data from the 12-month assessment sampling, coupled with WRAM software to recommend a passive treatment type. Each AMD discharge monitoring point and its unique water chemistry help define the treatment system components and their costs. AVGWLF is used to help better predict what chemical changes will occur in-stream as a result of treating each of the priority discharges and removing the pollution loading. Long-term flows, produced by AVGWLF, provide a more accurate depiction of what can be expected.

WRAM/AVGWLF was developed in cooperation between DEP, Bureau of Watershed Management’s Section 319 program, Penn State University, and a private consulting firm, and is primarily used as a water quality modeling tool. Because several AMD discharge sites contained water quality that pushes the limits of passive treatment technology, cost estimates are also given for active chemical treatment and annual operation and maintenance as a comparison. Estimated treatment costs for either passive or active treatment must be viewed with the understanding that reliable estimates can only be developed by performing thorough on-site investigations and developing detailed design-engineering estimates, which are beyond the scope of this assessment. The estimates given are based on the WRAM model and discussions with experienced AMD treatment system designers.

Land reclamation estimates associated with the priority sites are unavailable and were not developed during this assessment. A very general ranking of the amount of land reclamation associated for each priority site is given if applicable. As with the AMD remediation project estimates, reliable land restoration estimates can only be developed with thorough on-site investigations and engineering estimates, which are beyond the scope of this assessment.

Little Anderson Creek Priorities – System Type/Estimated Costs

Little Anderson Creek Projects - Estimated AMD Treatment Costs

Monitoring Site	Treatment Type	System Type	Estimated Cost of Construction	Operation, Maintenance & Replacement*	**Land Reclamation
DMP-Draucker1	WRAM Passive	VFW, settling basin, wetland, manganese bed	$2,700,000	$108,000/yr over 20yr life of system*	**Significant**
	Active	Chemicals, settling basin	$250,000	Chemical costs $80,000 over 20yrs	
DMP-Korb 4	WRAM Passive	VFW, settling basin, wetland, manganese bed	$1,133,000	$906,000 over 20yr life of system*	**Minimal**
	Active	Chemicals, settling basin	$250,000	Chemical costs $80,000 over 20yrs	
PAMP-LA 4.3	Passive	VFP/SAPS, settling basin, wetland	$1,000,000	$800,000 over 20yr life of system*	**Moderate**
	WRAM Passive	VFW, settling basin, wetland, manganese bed	$1,402,500	$1,120,000 over 20yr life of system*	
	Active	Chemicals, settling basin	$250,000	Chemical costs $50,000 over 20yrs.	
PAMP-LA 3.0	Passive	VFP/SAPS, settling basin, wetland	$200,000	$160,000 over 20yr life of system*	**Significant**
	WRAM Passive	VFW, wetland	$1,000,000	$800,000 over 20yr life of system*	
	Active	Chemicals, settling basin	250,000	Chemical costs $80,000 over 20yrs	
DMP-Draucker2	Passive	ALD, settling pond, wetland	$150,000	$120,000 over 20yr life of system*	**Minimal**
	WRAM Passive	VFW, wetland	$1,348,200	$1,078,000 over 20yr life of system*	
Subtotals	Passive		$5,183,000 to $7,583,700	$1,986,000 to $3,904,000 over 20yr life	
	Active & Passive		$1,150,000	$410,000 to $1,288,000 over 20yrs	

***Note: One-time system replacement cost included in estimate**

****Note: Land reclamation costs not included in cost estimations**

Bilger Run Priorities - System Type/Estimated Costs

Bilger Run Projects - Estimated AMD Treatment Costs

Monitoring Site	Treatment Type	System Type	Estimated Cost of Construction	Operation, Maintenance & Replacement*	**Land Reclamation
DMP- BR 4.5	WRAM Passive	VFW, settling basin, wetland, manganese bed	$1,495,687	$1,196,000 over 20yr life of system*	**Moderate**
	Active	Chemicals, settling basin	$200,000	Chemical costs $60,000 over 20yrs	
DMP-BR 4.0	Passive	VFP/SAPS, settling basin, wetland	$225,000	$180,000 over 20yr life of system*	**N/A**
	WRAM Passive	VFW, settling basin, wetland, manganese bed	$565,901	$452,000 over 20yr life of system*	
	Active	Chemicals, settling basin	$250,000	Chemical costs $80,000 over 20yrs	
DMP-BR 3.9	Passive	ALD, settling pond	$115,000	$40,000 over 20yr life of system*	**N/A**
	WRAM Passive	VFW, wetland	$114,632	$40,000 over 20yr life of system*	
DMP-Wildwood	Passive	ALD, settling pond	$350,000	$280,000 over 20yr life of system*	**N/A**
	WRAM Passive	VFW, settling basin, wetland, manganese bed	$636,855	$510,000 over 20yr life of system*	
Subtotals	Passive		$2,185,687 to $2,813,075	$1,696,000 to $2,198,000 over 20yr life	
	Active & Passive		$915,000 to $1,201,855	$460,000 to $690,000 over 20yrs	

***Note: One-time system replacement cost included in estimate**

****Note: Land reclamation costs not included in cost estimations**

Kratzer Run Priorities - System Type/Estimated Costs

Kratzer Run Projects - Estimated AMD Treatment Costs					
Monitoring Site	**Treatment Type**	**System Type**	**Estimated Cost of Construction**	**Operation, Maintenance & Replacement***	****Land Reclamation**
PAMP-KR 1.45-1	Passive	Flushing limestone pond, settling basin, wetland	$150,000	$120,000 over 20yr life of system*	**Significant**
	WRAM Passive	VFW, settling basin, wetland, manganese bed	$741,000	$600,000 over 20yr life of system*	
DMP-Widemire	Passive	Flushing limestone pond, settling basin, wetland	$250,000	$200,000 over 20yr life of system*	**N/A**
	WRAM Passive	VFW, settling basin, wetland	$418,698	$334,000 over 20yr life of system*	
DMP-879	Passive	Aeration, settling pond	$30,000	$24,000 over 20yr life of system*	**N/A**
	WRAM Passive	Settling pond, wetland	$20,558	$16,400 over 20yr life of system*	
Subtotals	Passive		$430,000 to $1,180,256	$336,400 to $958,000 over 20 yrs	

***Note: One-time system replacement cost included in estimate**

****Note: Land reclamation costs not included in cost estimations**

Anderson Creek Main Stem Priorities - System Type/Estimated Costs

Anderson Creek Mainstem Projects - Estimated AMD Treatment Costs

Monitoring Site	Treatment Type	System Type	Estimated Cost of Construction	Operation, Maintenance & Replacement*	**Land Reclamation
DMP- Korb2	WRAM Passive	VFW, settling basin, wetland	$871,451	$696,000 over 20yr life of system*	**Moderate**
	Active	Chemicals, settling basin	$250,000	Chemical costs $100,000 over 20yrs	
DMP-AC 3.75-3	Passive	Flushing limestone pond, settling basin, wetland	$150,000	$120,000 over 20yr life of system*	**N/A**
	WRAM Passive	VFW, settling basin, wetland	$453,255	$362,600 over 20yr life of system*	
DMP-AC 3.75-2	Passive	Flushing limestone pond, settling pond, wetland	$50,000	$40,000 over 20yr life of system*	**Moderate**
	WRAM Passive	VFW, wetland	$116,000	$92,800 over 20yr life of system*	
Subtotals	Passive		$1,071,451 to $1,440,706	$856,000 to $1,151,400 over 20yr life	
	Active & Passive		$450,000 to $819,255	$260,000 to $555,400 over 20yrs	

***Note: One-time system replacement cost included in estimate**

****Note: Land reclamation costs not included in cost estimations**

Combined Subbasin Priorities – Total Estimated

Combined Anderson Creek Projects - Total Estimated AMD Treatment Costs					
Subwatershed	**Treatment Type**	**System Type**	**Estimated Cost of Construction Subtotal**	**Operation, Maintenance & Replacement***	****Land Reclamation**
Little Anderson Creek	Passive	Various Passive Treatment Types	$5,183,000 to $7,583,700	$97,000 to $195,200 over 20yr life	**Significant**
	Active & Passive	Quick lime doser	$1,150,000	$3,625,000 over 20yrs	
Bilger Run	Passive	Various Passive Treatment Types	$2,185,687 to $2,813,075	$84,800 to $109,900 over 20yr life	**Moderate**
	Active & Passive	Quick lime doser	$915,000 to $1,201,855	$175,000 over 20yrs	
Anderson Creek Mainstem	Passive	Various Passive Treatment Types	$1,071,451 to $1,440,706	$42,800 to $57,570 over 20yr life	**Moderate**
	Active & Passive	Quick lime doser	$450,000	$125,000 over 20yrs	
Kratzer Run	Passive	Various Passive Treatment Types	$430,000 to $1,180,256	$336,400 to $958,000 over 20 yrs	**N/A**
Totals for all Restoration	Passive		$8,870,138 to $13,017,737	$241,800 to $410,190 over 20 yrs	
	Active & Passive		$2,945,000 to $3,982,111	$3,784,700 to $3,972,520 over 20yrs	

***Note: One-time system replacement cost included in estimate**

****Note: Land reclamation costs not included in cost estimations**

Funding and Support Sources

No restoration/implementation funding was totally secured for any of the identified priority sites in any of the sub-basins at the time of the completion of the assessment report. However, funding to implement restoration projects on three priority sites in the Bilger Run sub-basin was being pursued. As mentioned earlier, the two highest priority sites are being targeted for treatment by DEP. Preliminary negotiations have been initiated with a local energy producer to set up a trust fund for the operation and maintenance of an active treatment system at the highest priority site, DMP-BR 4.5. Pennsylvania's Bureau of Abandoned Mine Reclamation (BAMR) has agreed to fund the construction of the active treatment system and the energy producer has agreed in principle to fund the operation and maintenance of the system. In addition, BAMR is planning to address the #2 priority site, DMP-BR 4.0, by constructing another treatment system at that site. The type of treatment system had not been determined as of the completion of the assessment report, but water quality indicates active treatment may be the best option. In addition, ACWA made application to the Pennsylvania Growing Greener Grant Program to design and construct a passive AMD treatment system on the #3 priority site in Bilger Run, DMP-3.9. Additional financial support, through in-kind services, will be provided by the ACWA, Clearfield County Conservation District, and the PA Senior Environmental Corps, through operation and maintenance and monitoring. The design consultant is offering in-kind support through discounted service fees. The property owner is also providing in-kind support through the use of his land.

Additional sources of funding and support for restoration efforts associated with the remaining priority sites have been identified and include:

- EPA non-point source pollution funding, targeted watershed grants, state revolving funds, Brownfields Initiative, and environmental education grants
- OSM Appalachian Clean Streams Initiative, summer internships, and Title IV AML programs
- DEP Growing Greener Environmental Stewardship/Watershed Protection and Technical Assistance Grant (TAG) program
- DEP Moshannon District Mining Office technical assistance and support
- DEP Bureau of Abandoned Mine Reclamation technical assistance and financial support
- DEP Bureau of Dams & Waterways Engineering technical assistance with permitting and wetlands issues
- DEP Bureau of Mining and Reclamation through reclamation planning, remining, and alkaline addition initiatives
- Western Pennsylvania Conservancy technical assistance
- USDA Natural Resources Conservation Service PL-566 Watershed Protection and Flood Prevention Act funding and technical services center assistance
- Canaan Valley Institute technical and financial assistance

- Headwaters Resource Conservation and Development Area technical assistance and support
- Headwaters Charitable Trust financial support
- Clearfield County Conservation District technical support and monitoring
- PA Senior Environmental Corps technical support and monitoring
- Pike Township administrative and technical assistance
- Pike Township Water Authority monitoring site access
- Western Pennsylvania Watershed Program financial support
- Western Pennsylvania Coalition for Abandoned Mine Reclamation technical support
- PA Fish and Boat Commission technical assistance
- PA Trout Unlimited technical assistance
- Mining industry support through cooperative remining initiatives
- Private industry support through cooperative financial and technology initiatives

VI. Implementation Schedule and Milestones

Overview

Implementation of the restoration priorities is dependent on many factors. A primary factor will be the support of the owner of the property on which restoration activities will take place. Initial contacts have been made with most of the property owners at the priority sites and all have been initially supportive of implementing restoration activities. It is expected that issues will arise regarding property owner concerns as more details of the type and size of the proposed treatment systems are developed. Liability issues are usually of a primary concern. Pennsylvania has initiated a “Good Samaritan” statute, in response to concerns, which protects cooperative property owners from a number of liability issues. This law is expected to be used extensively as restoration activities progress in Anderson Creek.

Funding is also a major factor in implementing restoration activities. As identified previously, many different sources of support are available to support restoration efforts. As priority projects are developed, individual funding sources should be evaluated for their appropriateness to each project. Every effort should be made to use a variety of funding sources in order to provide for matching funds, which are always viewed favorably.

Because Anderson Creek Watershed Association (ACWA) is a totally volunteer organization, it will be difficult for them to administer multiple projects, which in many cases will have large budgets. If ACWA implements one project per year they will likely be managing several projects concurrently, as restoration projects usually are multi-year undertakings. Currently, they depend on Pike Township to serve as fiscal sponsors for their grants. ACWA and Pike Township should carefully evaluate how much effort will be required to manage multiple projects. In addition, consideration must be given to how implementation projects will be managed on-site to assure work is performed as designed. It will likely be necessary for ACWA to partner with additional organizations to serve as fiscal sponsors and others to serve as on-site project managers.

Remining may play a major role in restoration activities within the watershed and reclamation projects will likely be implemented outside the scope of ACWA activities. Such projects would help speed the rate of restoration. Coordination between ACWA, DEP, the mining industry, and property owners could help focus restoration efforts on priority sites. Remining should be investigated as a possible approach on all sites requiring land reclamation.

Because restoration activities will likely be implemented by ACWA, state agencies, and the mining industry concurrently, reclamation projects will be spread throughout the watershed. A strictly regimented implementation schedule will be very difficult to initiate and follow. Planning an implementation schedule by sub-basins and based on the assessment priorities should help to make restoration activities more manageable. The implementation schedule must be flexible enough to account for variability in funding priorities and availability, agency priorities, market conditions affecting industry efforts, and ACWA and partner management capabilities.

Based on the sub-basin approach and their priorities for restoration, the following implementation schedule should result in measurable load reductions of metals and acidity and an increase in pH values within the individual basins and to Anderson Creek itself.

Bilger Run Sub-basin

Bilger Run Sub-basin Implementation Schedule

		Project Implementation Milestones			
Priority Site	**Responsible Party**	**Preliminary Planning**	**Design Phase**	**Build Phase**	**Monitoring Phase**
DMP- BR 4.5	DEP	Dec-05	Sep-06	Sep-07	Jan-08
DMP-BR 4.0	DEP	Dec-05	Sep-06	Sep-07	Jan-08
DMP-BR 3.9	ACWA	Jan-07	Apr-07	Jul-07	Jan-08
DMP-Wildwood	ACWA	Jan-08	Apr-09	Apr-10	Jan-11

Little Anderson Creek Sub-basin

Little Anderson Creek Sub-basin Implementation Schedule

		Project Implementation Milestones			
Priority Site	**Responsible Party**	**Preliminary Planning**	**Design Phase**	**Build Phase**	**Monitoring Phase**
DMP-Drauckers 1	Industry	Jun-07	Jun-08	Jan-09	Jan-11
DMP-Korb 4	ACWA	Jun-07	Dec-07	Jun-08	Jun-10
PAMP-LA 4.3	DEP	Jun-08	Sep-08	Mar-09	Jan-11
PAMP-LA 3.0	Industry	Jun-08	Jun-09	Jun-10	Jun-12
DMP-Drauckers 2	ACWA	Sep-09	Mar-10	Sep-10	Jan-13

Anderson Creek Main Stem

Anderson Creek Main Stem Implementation Schedule

		Project Implementation Milestones			
Priority Site	**Responsible Party**	**Preliminary Planning**	**Design Phase**	**Build Phase**	**Monitoring Phase**
DMP-Korb 2	DEP	Mar-07	Sep-07	Sep-08	Mar-10
DMP-AC 3.75-3	ACWA	Jun-07	Jan-08	Jan-09	Jun-10
DMP-AC 3.75-2	Industry	Jun-07	Dec-07	Jun-09	Sep-11

Kratzer Run Sub-basin

Kratzer Run Sub-basin Implementation Schedule

		Project Implementation Milestones			
Priority Site	**Responsible Party**	**Preliminary Planning**	**Design Phase**	**Build Phase**	**Monitoring Phase**
PAMP-KR 1.45	Industry	Sep-06	Sep-07	Sep-08	Sep-10
DMP-Widemire	DEP	Jun-09	Jan-10	Jan-11	Sep-13
DMP-879	ACWA	Sep-10	Apr-11	Jan-12	Jan-13

VII. Load Reduction and Water Quality Evaluation

Water Quality and Monitoring Objectives

The main objective of the restoration-monitoring plan is to measure and assess changes in water quality, based on required TMDL load reductions within Anderson Creek and its impaired sub-basins, as restoration projects are implemented and then progress long-term. Water quality and monitoring criteria established in the QA/QC plan for measuring pollution loads for this assessment should, at a minimum, be maintained for future monitoring. Because in-stream monitoring points for the assessment were established based on identifying impacts to the main stem of Anderson Creek and within its sub-basins, those established points will also serve well for future restoration work. In addition to the established monitoring points, other monitoring points may also be required to better measure load reductions from the implementation of individual restoration projects.

Often, when treating AMD using passive methods, monitoring points are also established within the treatment system itself in order to measure the functionality of the individual treatment system components. Such monitoring protocol will be established for each treatment system constructed.

Depending on the location of the restoration project, varying numbers of in-stream monitoring locations will be necessary to properly determine load reductions. The number and locations of monitoring points will be established during the process of developing a restoration project. Each project will, at a minimum, establish an upstream and downstream monitoring point on the effected tributary and also a point or points on the next larger receiving stream or streams, depending on expected environmental results. A final point should also be established at the mouth of Anderson Creek, and perhaps additional points along the main stem, to assess overall load reductions to the stream system.

Because DEP has identified WRAM as a developmental tool that will likely be used to help predict water quality changes over time, it is recommended that the modeling work begun on this project continue for the life of the restoration activities on the watershed. Such long-term use of the model will help to assess its effectiveness and make necessary adjustments to improve its accuracy. Because the model is presently based only on passive treatment system options, a further recommendation is to also include active treatment as a restoration option within the model. This could be developed within the ongoing restoration-monitoring program.

Because treatment of AMD using either passive treatment or active treatment methods often generate varying but often significant amounts of excess alkalinity, it will be important that the model will be able to be modified to account for the varying amounts of additional alkalinity produced. Presently, the model is limited to a constant amount of alkalinity that is produced by the treatment scenario. In reality, alkalinity generation can vary greatly, depending on numerous factors, which include, but are not limited to, the water chemistry of the discharge, flow rates (which can change drastically throughout the year), detentions times within a treatment system, and the treatment system type, to name a few. For instance, active (chemical) treatment systems can easily be adjusted to discharge high amounts of excess alkalinity in order to neutralize untreated acidic inputs from other areas of the watershed. Passive AMD treatment systems also often provide additional alkalinity beyond the amount needed to neutralize acidity in a particular discharge. To accurately predict in-stream results from the installation of all types of AMD treatment systems, the model's effluent concentrations should be adjustable through a wide range that includes all possible results to depict accurately what may be occurring.

The focus of the monitoring plan for Anderson Creek will be two-fold. The primary short-term focus will be to remediate AMD impacts to Bilger Run and its receiving stream, Kratzer Run, and monitor water quality changes over time. The long-term focus will be to address the discharges affecting Little Anderson Creek (which, in turn, affects the Anderson Creek main stem) and to monitor changes that take place over time.

Because of the sheer number of AMD discharges on Little Anderson Creek, beneficial results will, in reality, be noticed first on the water quality within the main stem of Anderson Creek. Water quality within the main stem above Little Anderson Creek is meeting its designated use, although it is not optimal. Once Little Anderson Creek merges with Anderson Creek, water quality becomes seriously degraded. In addition to impacts from Little Anderson Creek, several discharges enter the main stem directly, via unnamed tributaries to Anderson Creek. Because of the dilution effects from Anderson Creek upstream of Little Anderson Creek, it is likely that load reductions achieved through treating the major discharges affecting Little Anderson Creek and the unnamed tributaries to Anderson Creek will result in enough improvement to Anderson Creek's water quality that some pollution-tolerant aquatic species will return to the stream. Therefore, initial measurable environmental results will most likely have their biggest impacts within the Anderson Creek main stem and monitoring should be focused there. This will be especially true for biological changes. As mentioned earlier, monitoring points to measure improvements will vary depending on the location of the implementation projects within the watershed.

A major component of the overall approach for this restoration-monitoring plan will be a proposal to develop creative approaches to the AMD associated with the abandoned clay mines on Little Anderson Creek. The best approach will be to work with both DEP and EPA to use programs such as Government Financed Construction Contracts, Project XL, or perhaps the Brownfields program to address the worst sites within the watershed. Part of the problem with monitoring large unreclaimed areas is the fact that there are usually many discharges associated with one abandoned site. A program like Brownfields or Project XL might be able to address such sites by using a combined monitoring approach, which considers the entire site as one pollution source and establishes a monitoring point downstream of the entire problem area. Otherwise, it will be necessary to monitor numerous points per site and may be beyond the scope of this assessment, restoration, and implementation plan.

Using WRAM as a predictive model in association with the EPA-certified monitoring plan originally developed for the assessment should provide sufficient accuracy and precision within the monitoring program to assure the quality of data while allowing for adaptations to the program over time. In addition, because projects will likely be implemented on a sub-basin approach, but also be part of an overall watershed restoration program, an adaptive management approach should be used to allow the focus of the restoration work within the watershed to shift as load reductions are achieved and biologic conditions improve.

Determining Success

Either in-stream numeric load reduction or biological “trigger points” could be established to indicate success and when it would be appropriate to shift focus to other areas of impairments within the system. Such an approach should maximize restoration efforts by focusing activities where they will provide the most benefit.

To better determine the success of restoration efforts, both chemical and biological sampling should be performed in-stream at selected monitoring points, based on the location of implementation projects. Chemical sampling will clearly indicate load reductions. The goal for chemical sampling should be to achieve water quality standards set forth in the Pennsylvania Code its for each pollution constituent. However, it may be impossible or unnecessary to reach the set chemical standard in order claim success at restoring a stream segment to the point that it supports its designated use. Biologic conditions should also be considered.

Arguably, the biologic health of the stream is a better indicator of its true condition because macroinvertebrates and fish will populate a stream prior to it meeting in-stream chemical standards. In the case of Anderson Creek, the watershed is designated a cold water fishery (CWF) and should support fish species and other aquatic life that are indigenous to such streams.

To measure the health of recovering stream segments of Anderson Creek, a biologic “trigger point”, which indicates that a stream segment contains macroinvertebrates and fish populations of a similar healthy stream, or reference stream, should be used. Because Curry Creek was the reference stream used in establishing the sediment and nutrient TMDL on Anderson Creek, its index of biologic integrity, or IBI, should be used as the standard by which to measure Anderson Creek’s recovery. Because Curry Creek is relatively unimpaired, a measure of recovery to within 90% or greater of an IBI used for Curry Creek, such as the Hilsenhoff biological index (HBI) for macroinvertebrates, would be a reasonable trigger point for Anderson Creek and therefore should be adopted. In addition, meeting a standard of 95% or greater for the in-stream chemical constituents (metals, acidity, pH, sediment, and nutrients, as identified by the TMDL) designated by the Pennsylvania Code would also constitute a trigger point that indicates a reasonable level of successful restoration.

The frequency and location of monitoring will vary, depending on its purpose. In-stream chemical and biologic monitoring should be performed a minimum of every two years once restoration efforts have begun. Monitoring point locations should be dictated by the location of the BMP's being implemented. When possible, monitoring points established during this assessment should be used. However, locations that best measure the beneficial effects of the project being implemented should be chosen.

If the monitoring program indicates that environmental improvements are not occurring as expected, then a reevaluation of the assessment, restoration, and implementation plan should be conducted and adjustments made to improve beneficial results. Modifications to the program might include: reprioritization of projects to better insure positive results, alteration of the previously implemented projects to make them more efficient, implementation of additional projects, installation of new technologies or techniques, and reconsideration of the established TMDL, which may be incorrect and need revised.

It will be important that Anderson Creek Watershed Association and its partners commit to a long-term monitoring program to assure beneficial environmental results will be recorded over time. Assistance and financial support for the monitoring program should be provided by local, state, federal and private programs.

Overall Program Objectives

A key component of long-term success toward restoring impaired watersheds is to build local support for restoration efforts. One way to strengthen local support is through the implementation of restoration projects, and by actively creating public relations "success stories" related to those projects. ACWA has been very active in providing information about their activities by publishing information in local news media, displaying information in local businesses, and attending local events that are related to their watershed work. It is expected that such activities will continue and increase as implementation work proceeds.

Measuring local buy-in can be accomplished in many ways, including the number of articles regarding watershed activities appearing in news print, newsletters produced, new members joining the group, new partners supporting their efforts, new sponsors for group activities, public or government agencies actively engaged in watershed group-related work, number of promotional events held, and others. It will be important for ACWA to keep an accurate record of such accomplishments in order to show success beyond environmental pollution reduction. Doing so will assure long-term support for their watershed work.

TMDLs and Expected Load Reductions

Measuring pollution load reductions will be a key component to indicating progress toward the goals established by the TMDL. Using the data gathered during the TMDL study and this assessment should provide a sound baseline for measuring progress. However, because of program limitations and the lack of sufficient recent water quality data, the TMDL developed for Anderson Creek was generated primarily from pre-existing data, some of which dates back to the 1974 Scar Lift Report. Scar Lift was a state initiated program that identified all of the abandoned mine related problems throughout Pennsylvania. Although the reports are excellent resources and are still excellent resources, extensive reclamation and restoration performed since that time has changed runoff and recharge patterns dramatically. Therefore, the TMDLs developed for Anderson Creek appear to indicate much worse water quality than actually presently exists. In that regard, EPA Region III has approved the use of the calculated loads measured during the monitoring period of this assessment as appropriate targets or goals for pollution load reduction. Those calculated loads, based on measured samples, have been used to determine expected load reduction.

Performing water quality testing at site-specific implementation projects will provide accurate load reduction measurements for individual pollution sources, while in-stream monitoring at established or new monitoring points will measure load reductions to the overall system.

Based on the restoration priorities established for the watershed’s sub-basins and the suggested treatment type, the following load reductions can be expected. Again, all load reductions are based on the pollution loads measured during this assessment rather than those developed through the TMDL process.

Little Anderson Creek Expected Load Reductions - Code10332

Implementation Date - Planning to Construction	Pollution Source	Preferred Treatment Type	Measured Existing Load Lbs./Day	Expected Load Reduction Lbs./Day	Expected Load Reduction Percentage
Jun-06 to Jan-10	**DMP- Drauckers 1**				
	Iron	Active Treatment	89.34	89.34	100
	Manganese		24.95	24.95	100
	Aluminum		71.68	71.68	100
	Acidity		781.71	781.71	100
Jun-07 to Jun-10	**DMP-Korb 4**				
	Iron	Active Treatment	37.59	37.59	100
	Manganese		7.43	7.43	100
	Aluminum		20.47	20.47	100
	Acidity		338.51	338.51	100
Jun-08 to Jan-11	**PAMP-LA 4.3**				
	Iron	Active Treatment	11.73	11.73	100
	Manganese		15.48	15.48	100
	Aluminum		14.56	14.56	100
	Acidity		167.29	167.29	100
Jun-08 to Jun-12	**PAMP-LA 3.0**				
	Iron	Passive Treatment	2.82	2.68	95
	Manganese		2.22	0.67	30
	Aluminum		9.84	9.35	95
	Acidity		99.83	99.83	100
Sep-09 to Jan-13	**DMP-Drauckers 2**				
	Iron	Passive Treatment	3.43	3.26	95
	Manganese		9.50	2.85	30
	Aluminum		3.36	3.19	95
	Acidity		69.03	69.03	100

Anderson Creek Expected Load Reductions - Code 9938

Implementation Date - Planning to Construction	Pollution Source	Preferred Treatment Type	Measured Existing Load Lbs./Day	Expected Load Reduction Lbs./Day	Expected Load Reduction Percentage
Mar-07 to Mar-10	**DMP-Korb 2**				
	Iron	Active Treatment	20.52	20.52	100
	Manganese		1.45	1.45	100
	Aluminum		21.44	21.44	100
	Acidity		295.21	295.21	100
Jun-07 to Jun-10	**DMP-AC 3.75-3**				
	Iron	Passive Treatment	0.30	0.29	95
	Manganese		0.50	0.15	30
	Aluminum		4.80	4.56	95
	Acidity		38.84	38.84	100
Jun-07 to Sep-11	**DMP-AC 3.75-2**				
	Iron	Passive Treatment	0.40	0.38	95
	Manganese		0.20	0.06	30
	Aluminum		1.20	1.14	95
	Acidity		17.91	17.91	100

Bilger Run Expected Load Reductions - Code 5661

Implementation Date - Planning to Construction	Pollution Source	Preferred Treatment Type	Measured Existing Load Lbs./Day	Expected Load Reduction Lbs./Day	Expected Load Reduction Percentage
Dec-05 to Jan-08	**DMP- BR 4.5**				
	Iron	Active Treatment	13.95	13.95	100
	Manganese		19.19	19.19	100
	Aluminum		7.35	7.35	100
	Acidity		103.76	103.76	100
Dec-05 to Jan-08	**DMP-BR 4.0**				
	Iron	Active Treatment	2.38	2.38	100
	Manganese		6.10	6.10	100
	Aluminum		3.30	3.30	100
	Acidity		33.20	33.20	100
Jan-07 to Jan-08	**DMP-BR 3.9**				
	Iron	Passive Treatment	0.41	0.39	95
	Manganese		0.86	0.26	30
	Aluminum		0.29	0.28	95
	Acidity		4.61	4.61	100
Jan-08 to Jan-11	**DMP-Wildwood**				
	Iron	Passive Treatment	9.28	8.82	95
	Manganese		2.55	0.77	30
	Aluminum		0.06	0.06	95
	Acidity		15.95	15.95	100

Kratzer Run Expected Load Reductions - Code 10355

Implementation Date - Planning to Construction	Pollution Source	Preferred Treatment Type	Measured Existing Load Lbs./Day	Expected Load Reduction Lbs./Day	Expected Load Reduction Percentage
Sep-06 to Sep-10	**PAMP-KR 1.45**				
	Iron	Passive Treatment	0.30	0.29	95
	Manganese		5.82	1.75	30
	Aluminum		8.61	8.18	95
	Acidity		70.19	70.19	100
Jun-09 to Sep-13	**DMP-Widemire**				
	Iron	Passive Treatment	6.30	5.99	95
	Manganese		2.57	0.77	30
	Aluminum		6.21	5.90	95
	Acidity		55.06	55.06	100
Sep-10 to Jan-13	**DMP-879**				
	Iron	Passive Treatment	1.89	1.80	95
	Manganese		0.24	0.07	30
	Aluminum		0.01	0.01	95
	Acidity		0.90	0.90	100

VIII. Visual Assessment

As part of the overall watershed assessment, a visual assessment of the in-stream and riparian conditions was performed. The visual assessment used a modified version of the USDA Stream Assessment Protocol to quantify the conditions of the watershed's streams below the DuBois Reservoir. No streams were visually assessed above the reservoir. As mentioned earlier, streams were divided into segments with similar physical characteristics. Segment lengths varied in accordance with their maintenance of similar physical characteristics. When the character of the stream changed noticeably, a new segment was created. For example, some of the characteristics which triggered the creation of a new segment included changes in gradient, changes in streamside land use, changes in streamside vegetation, and changes in the composition of the stream bottom itself.

In accordance with the methods of the overall assessment, the visual assessment of the watershed was divided into sub-basins. Segments of streams within the sub-basins were numbered according to their general order, beginning at the mouth of the stream. For example, the segment of Anderson Creek from the mouth to a point where the physical character of the stream noticeably changed was designated AC-Section 1. The next segment was then identified as AC-Section 2 and continued for as long as the physical characteristics of the stream or the riparian zone remained similar. (See enclosed map for specific stream segment designations.) Segment length varied according to the distance the stream segment retained its similar physical characteristics.

Results of the visual assessment show that, overall, the physical characteristics of the watershed's in-stream and riparian area conditions are relatively good. Some significant problem areas exist, particularly on Kratzer Run, where there are significant anthropogenic impacts from homes and roads. The main sources of the problems identified in this sub-basin were previously identified in Chapter IV – Problem Definition. Recommendations for those sites are also identified there.

Because the focus of this assessment was on non-point pollution sources identified in the TMDL study, primarily those caused by mineral resource extraction, a general overview of the results from the visual assessment will be given. As identified in the TMDL report, poorly reclaimed surface mines have led to some segments of stream being degraded by sediment.

Anderson Creek

The main stem of Anderson Creek generally has good to excellent streamside and channel conditions from the outlet of the DuBois Reservoir to Route 879 near Curwensville. Some channelization has occurred near Route 322, primarily for the construction of the highway bridge. Throughout most of this reach, Anderson Creek is very remote and its riparian area has seen little alteration. An abandoned railroad bed follows the western side of the stream from the confluence of Little Anderson Creek to

Route 879. A dirt road parallels the stream on the eastern side for much of this segment as well. Although the railroad and road parallel the stream on either side, their impacts appear minor. Some minor braiding of the stream channel occurs and may be the result of the significant surface coal mining that has occurred in the watershed.

Aluminum staining in Anderson Creek, near its confluence with the West Branch of the Susquehanna.

Near Route 879, Anderson Creek appears to become channelized for the remainder of its course to its confluence with the West Branch of the Susquehanna River. This section of the main stem received a poor rating because of its altered condition. As Anderson Creek receives some alkalinity from Kratzer Run, rocks in the stream are stained white from aluminum in the water. This segment below Route 879 would benefit from natural stream channel design improvements when water quality problems are addressed.

Bear Run

Much of Bear Run is a remote mountain stream with very little human impacts and very good in-stream and riparian conditions within its headwaters. Pike Township Water Authority maintains a reservoir, located approximately one mile upstream from its mouth. Immediately below the reservoir, Bear Run is impaired by severely eroding streambanks and the access road running parallel to it. Efforts should be made to stabilize the eroding streambanks and limit sedimentation from the road. The stream is also slightly impaired by AMD from two abandoned clay mines just south of the stream.

Irvin Branch

Irvin Branch is a remote mountain stream draining a portion of the eastern side of the watershed. Irvin Branch exhibited very good in-stream and riparian conditions. No significant problems were observed.

Panther Run

Panther Run drains a portion of the eastern side of Anderson Creek just south of Route 322. Some homes are located within the headwaters of the stream, but none seem to impact it negatively. A pipeline runs through the sub-basin and off-road riders have created erosion problems in several areas. However, the stream contains a nearly impenetrable rhododendron thicket, which protects the stream for most of its length.

Little Anderson Creek

Little Anderson Creek has been seriously degraded by surface and underground mining throughout much of it course. In its headwaters, UNT LA-5.9 has been diverted from its stream bed and should be restored to its original channel. Despite a majority of its headwaters area being surface mined, Little Anderson Creek maintains a reasonably good riparian area and supports life in its headwaters. Significant water quality degradation begins just upstream of Route 219 and continues for several miles as numerous mine discharges enter the stream. Below Route 219 the stream is essentially dead. Several unreclaimed and poorly reclaimed surface mines deposit sediment in the stream in addition to the AMD. Below the railroad tunnel on Aqueduct Road, the stream becomes relatively inaccessible as it enters a deep valley on its way to Anderson Creek. Some streambank stabilization problems do occur throughout the entire length of Little Anderson Creek, but none were significant in scope. Little Anderson Creek maintains good riparian cover and in-stream habitat for most of its course. Reclamation of abandoned surface mines and AMD sources are necessary to reduce impacts to the stream. AMD is the chief pollutant, and erosion/siltation from poorly reclaimed surface mines is the second-leading problem.

Anderson Creek stream banks remain well vegetated within the gorge.

Rock Run

Surface mining within the higher elevations of the sub-basin has impaired much of Rock Run. Numerous AMD discharges enter the stream, beginning in the uppermost reaches and continuing throughout much of its length. Although the stream's water quality is impaired, it maintained a pH near or above 5.0 during the assessment-monitoring period.

Large wetland areas, surrounded by surface mines, characterize the headwaters area. A good riparian zone exists throughout much of the stream's course through the upper reaches. Below Rock Run Road, an abandoned coal tipple and a farming operation degrade the quality of in-stream and riparian conditions. Reclamation of the coal tipple area and the installation of agricultural BMPs at the farming operation are recommended to reduce impacts to the stream.

Kratzer Run

The physical condition of Kratzer Run is the most degraded within the entire Anderson Creek watershed. The impaired condition of the riparian area of Kratzer Run can be attributed to several factors, but the chief sources are the two major highways that parallel the stream for most of its length, the concentration of communities, residences and businesses within the basin and adjacent to the stream, and, to a lesser extent, the amount of mined lands and farmland in its upper reaches. Combined, these factors have led to many areas along the stream suffering from unstable streambanks and degraded in-stream habitat. The stream also receives AMD from several sources throughout its length, which have been previously described.

Two significant areas that were identified as priorities for restoration are located between Stronach and the mouth of the stream. The uppermost site is located at a former road crossing downstream of Stronach approximately 0.3 miles. Severely eroding streambanks, located at the former crossing and just downstream from it, are producing a significant amount of sediment that is being deposited in the stream. Several large gravel bars have formed along the stream segment and are causing the stream to alter its course. The lower site, which is located just upstream from the bridge in Bridgeport, is beginning to create a condition that will soon force the stream to flow onto Route 879 during flooding events. A very large gravel bar that has forced the stream to erode the bank nearest the road is diverting the stream. In addition to the gravel bar, a large amount of debris is also serving to block the stream flow at the site. In combination, the conditions have created a problem that should be addressed as soon as possible.

Large gravel bar deposited in lower Kratzer Run.

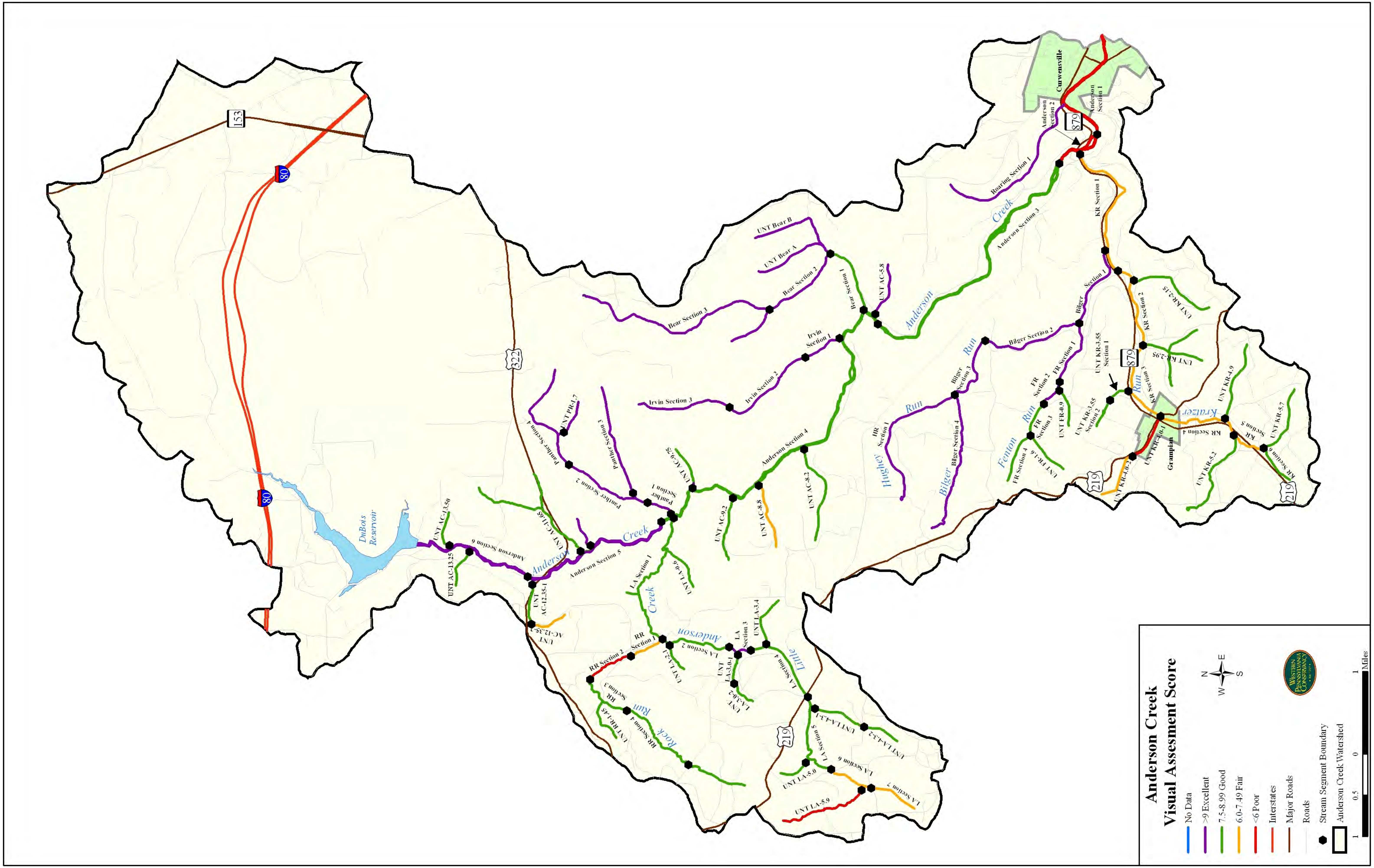
It is recommended that a more detailed survey be conducted of the entire stream reach, and that properly engineered natural stream design techniques be employed to address these two sites. In addition, other recommendations and natural stream channel design structures should be constructed along Kratzer Run to further improve in-stream conditions and limit the possibility of additional stream degradation.

Bilger Run

Bilger Run is in stable physical condition. No riparian or in-stream restoration efforts are recommended beyond those previously identified regarding AMD treatment.

Hughey Run

Hughey Run is in very stable physical condition. No riparian or in-stream restoration efforts are recommended at this time.


Anderson Creek
Visual Assesment Score
No Data
>9 Excellent
7.5-8.99 Good
6.0-7.49 Fair
<6 Poor
Interstates
Major Roads
Roads
Stream Segment Boundary
Anderson Creek Watershed
N
E
S
W
Western Pennsylvania Conservancy
1
0.5
0
1
Miles
Curwensville
Grampian
DuBois Reservoir
80
153
322
879
219
Anderson Creek
Little Anderson Creek
Bilger Run
Hughey Run
Fenton Run
Kratzer Run
Rock Run
Anderson Section 1
Anderson Section 2
Anderson Section 3
Anderson Section 4
Anderson Section 5
Anderson Section 6
Roaring Section 1
KR Section 1
KR Section 2
KR Section 3
KR Section 4
KR Section 5
KR Section 6
UNT KR-2.15
UNT KR-2.95
UNT KR-3.55 Section 1
UNT KR-3.55 Section 2
UNT KR-4.9
UNT KR-5.2
UNT KR-5.7
UNT KR-4.0
UNT KR-4.05
Bilger Section 1
Bilger Section 2
Bilger Section 3
Bilger Section 4
FR Section 1
FR Section 2
FR Section 3
FR Section 4
UNT FR-0.9
UNT FR-1.6
HR Section 1
UNT Bear B
UNT Bear A
Bear Section 1
Bear Section 2
Bear Section 3
UNT AC-5.8
Irvin Section 1
Irvin Section 2
Irvin Section 3
UNT AC-8.2
UNT AC-8.8
UNT AC-9.2
UNT AC-9.75
Panther Section 1
Panther Section 2
Panther Section 3
Panther Section 4
UNT PR-1.7
UNT AC-11.65
UNT AC-13.50
UNT AC-13.25
UNT AC-12.35-1
UNT AC-12.35-2
LA Section 1
LA Section 2
LA Section 3
LA Section 4
LA Section 5
LA Section 6
LA Section 7
UNT LA-0.6
UNT LA-2.1
UNT LA-3.0-1
UNT LA-3.0-2
UNT LA-3.4
UNT LA-4.4-1
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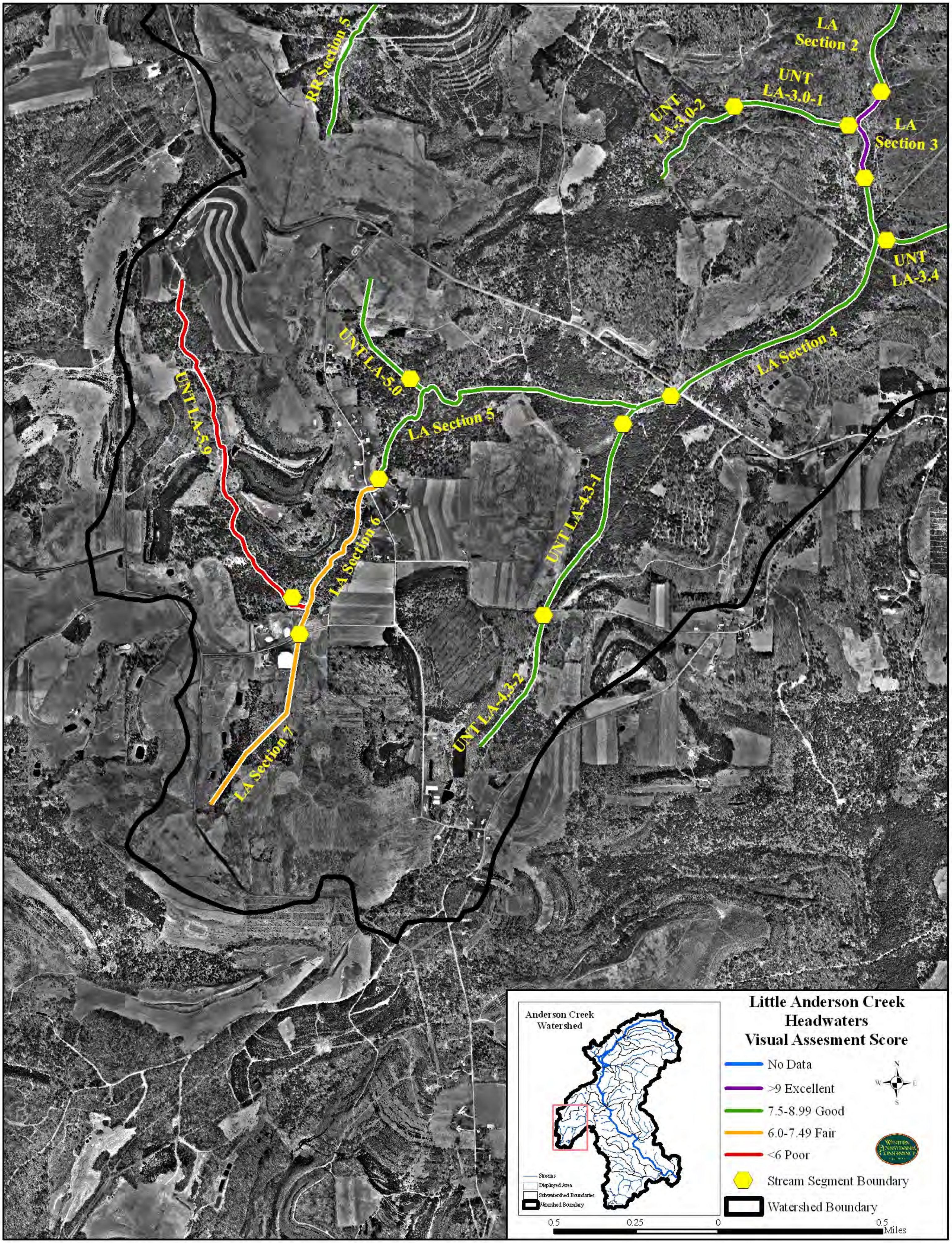
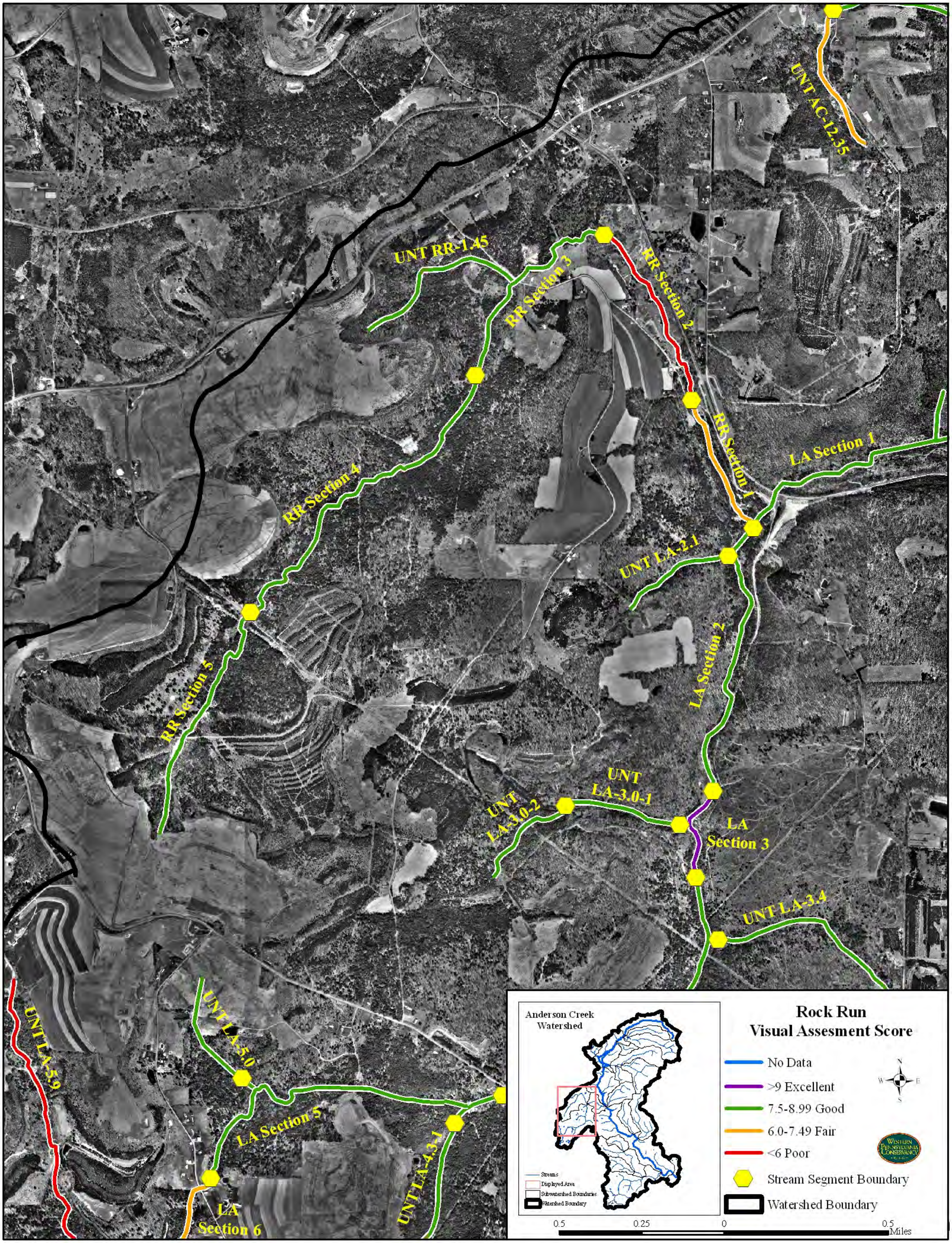
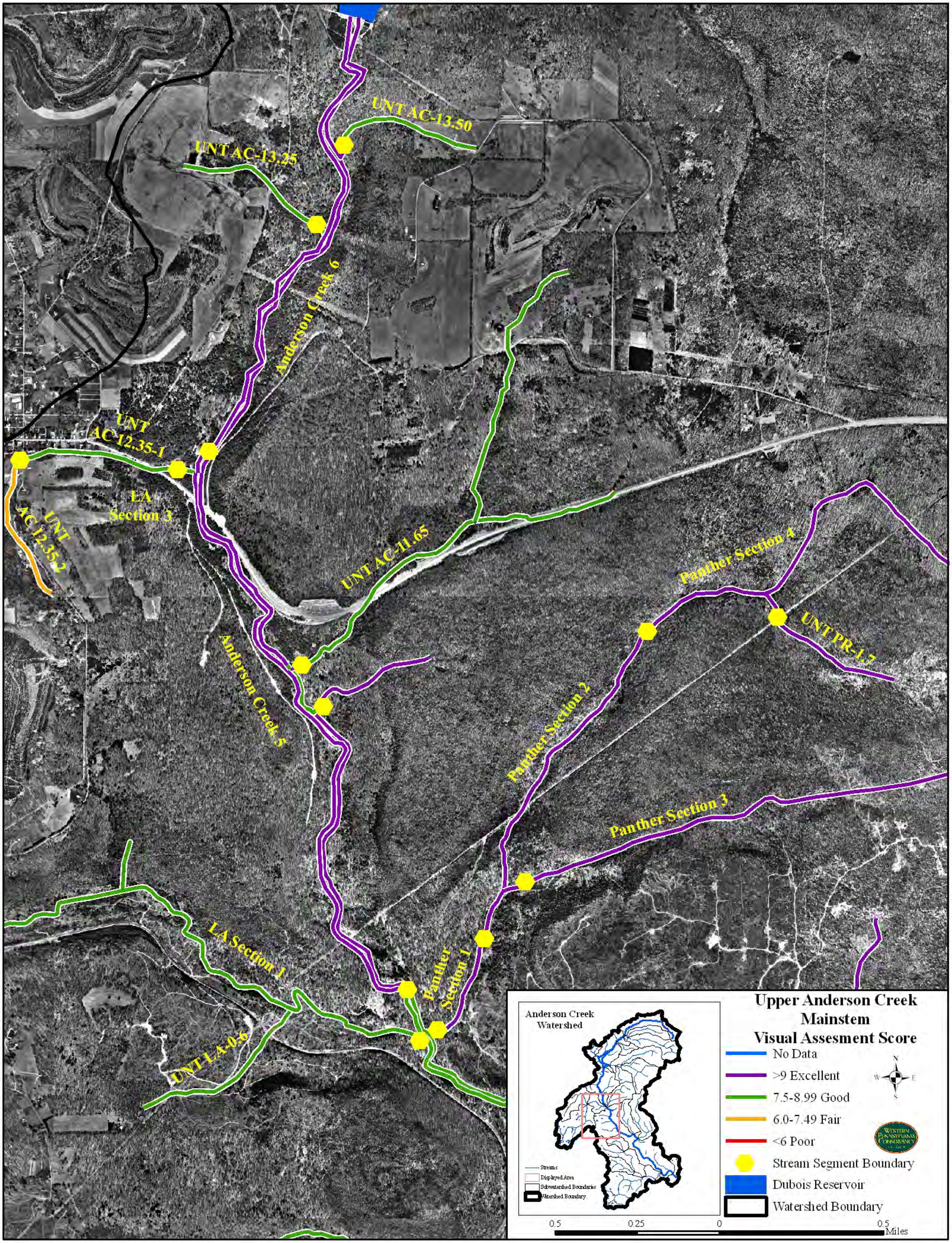
RR Section 1
RR Section 2
RR Section 3
RR Section 4
UNT RR-1.45

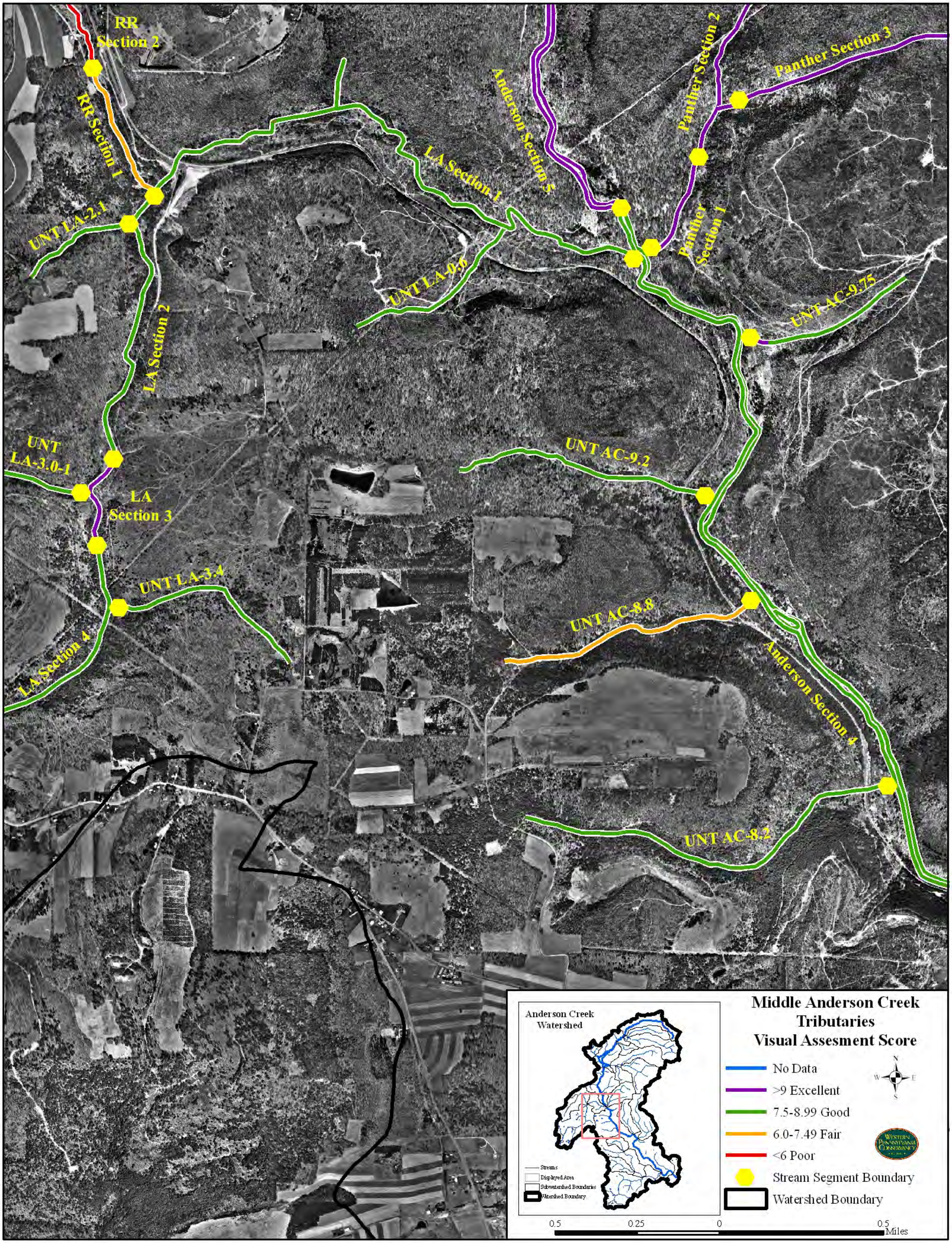


Little Anderson Creek Headwaters Visual Assesment Score



Rock Run
Visual Assesment Score


UNT AC-13.50
UNT AC-13.25
Anderson Creek 6
UNT AC-12.35-1
LA Section 3
UNT AC 12.35-2
UNT AC-11.65
Panther Section 4
UNT PR-1.7
Anderson Creek 5
Panther Section 2
Panther Section 3
LA Section 1
Panther Section 1
UNT LA-0.6
Anderson Creek Watershed
Streams
Displayed Area
Subwatershed Boundaries
Watershed Boundary
Upper Anderson Creek Mainstem Visual Assesment Score
No Data
>9 Excellent
7.5-8.99 Good
6.0-7.49 Fair
<6 Poor
Stream Segment Boundary
Dubois Reservoir
Watershed Boundary
N
W
E
S
0.5
0.25
0
0.5
Miles


RR Section 2
RR Section 1
UNT LA-2.1
LA Section 1
Anderson Section 5
Panther Section 2
Panther Section 3
Panther Section 1
UNT LA-0.6
UNT AC-9.75
LA Section 2
UNT LA-3.0-1
LA Section 3
UNT AC-9.2
UNT LA-3.4
LA Section 4
UNT AC-8.8
Anderson Section 4
UNT AC-8.2
Anderson Creek Watershed
Streams
Displayed Area
Subwatershed Boundaries
Watershed Boundary
Middle Anderson Creek Tributaries
Visual Assesment Score
No Data
>9 Excellent
7.5-8.99 Good
6.0-7.49 Fair
<6 Poor
Stream Segment Boundary
Watershed Boundary
N
W
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S
Western Pennsylvania Conservancy
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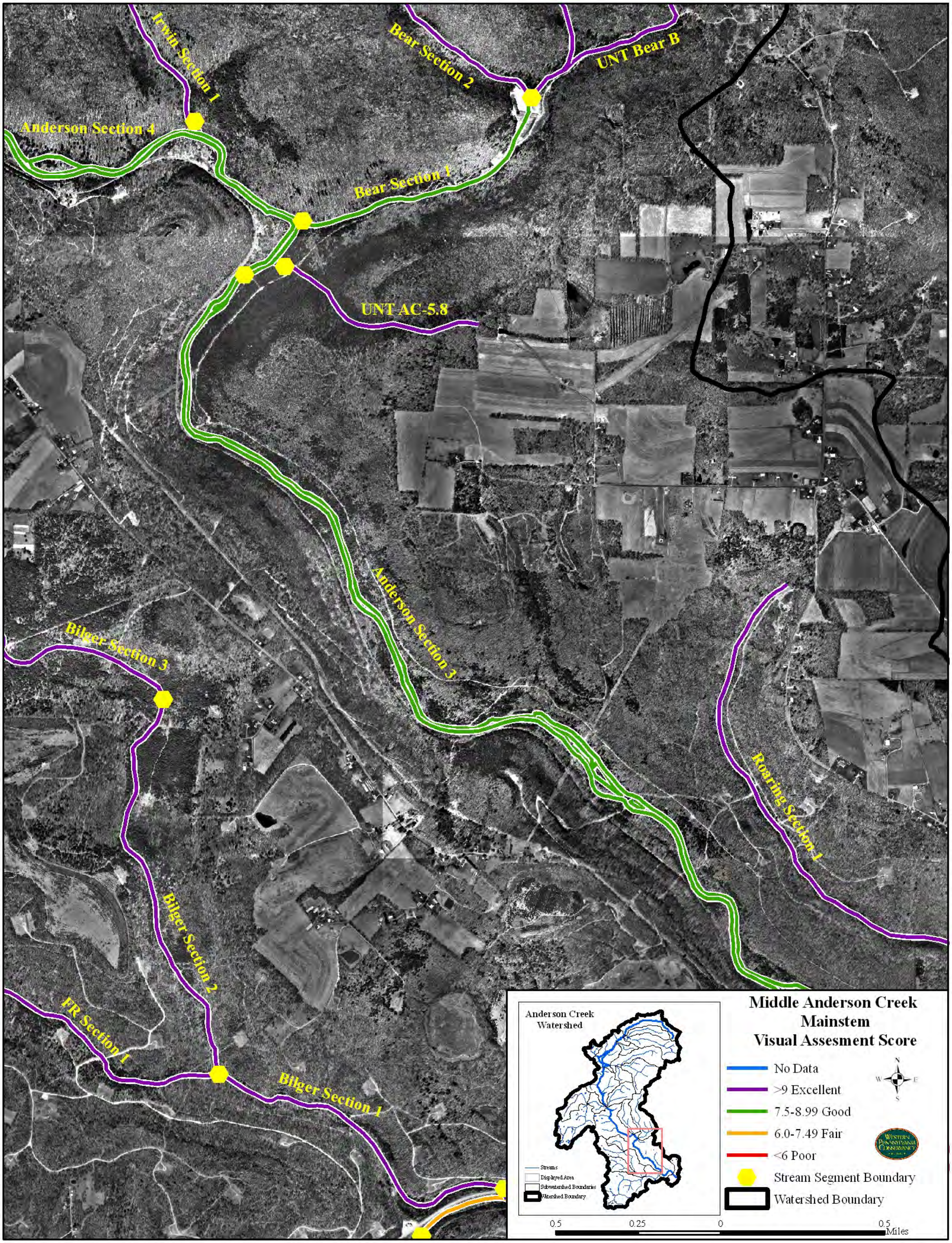
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Anderson Section 3
Bilger Section 3
Roaring Section 1
Bilger Section 2
FR Section 1
Bilger Section 1
Anderson Creek Watershed
Streams
Displayed Area
Subwatershed Boundaries
Watershed Boundary
Middle Anderson Creek
Mainstem
Visual Assesment Score
No Data
>9 Excellent
7.5-8.99 Good
6.0-7.49 Fair
<6 Poor
Stream Segment Boundary
Watershed Boundary
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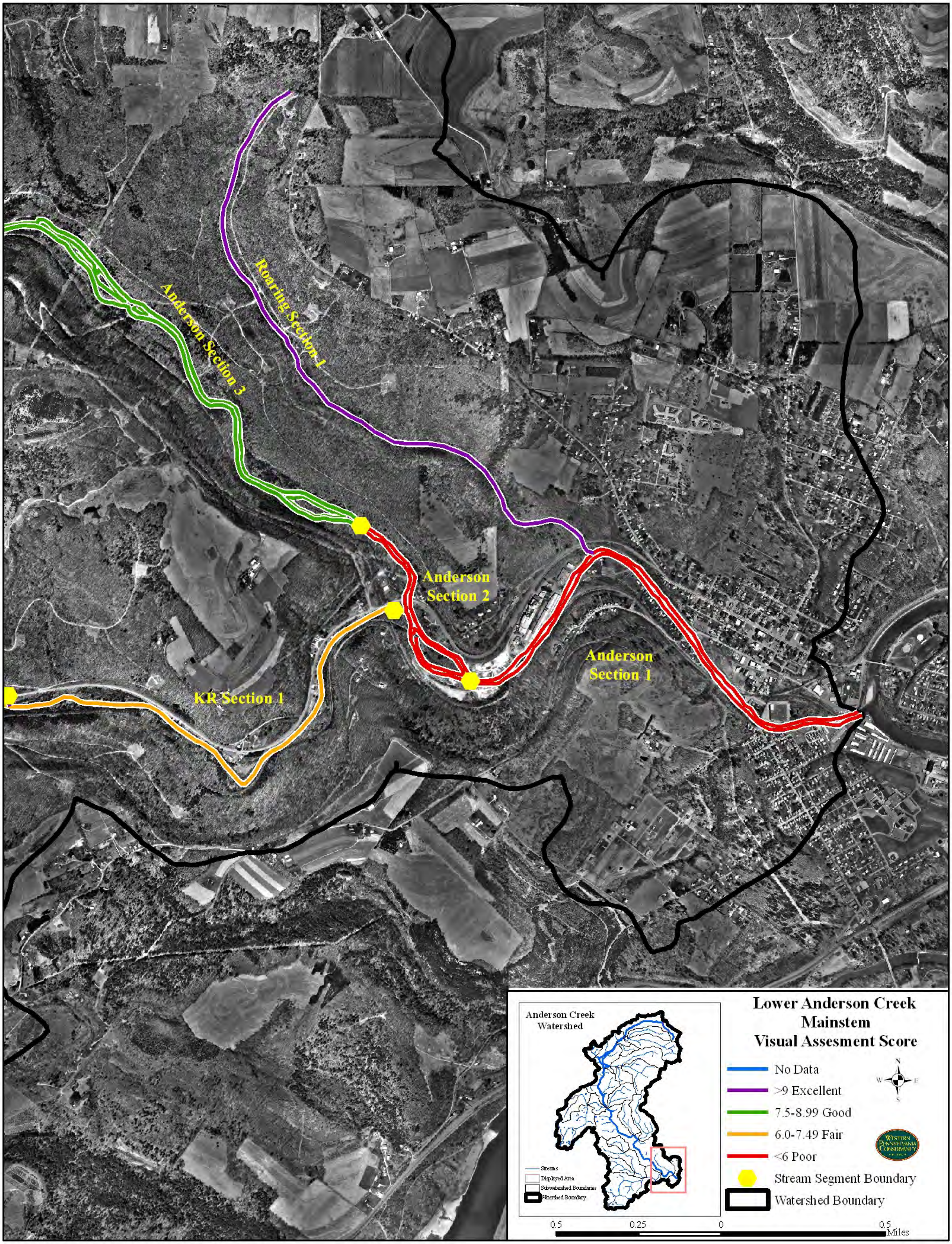
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Anderson Section 1
KR Section 1
Lower Anderson Creek Mainstem Visual Assesment Score
Anderson Creek Watershed
Streams
Displayed Area
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Watershed Boundary
No Data
>9 Excellent
7.5-8.99 Good
6.0-7.49 Fair
<6 Poor
Stream Segment Boundary
Watershed Boundary
N
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Western Pennsylvania Conservancy
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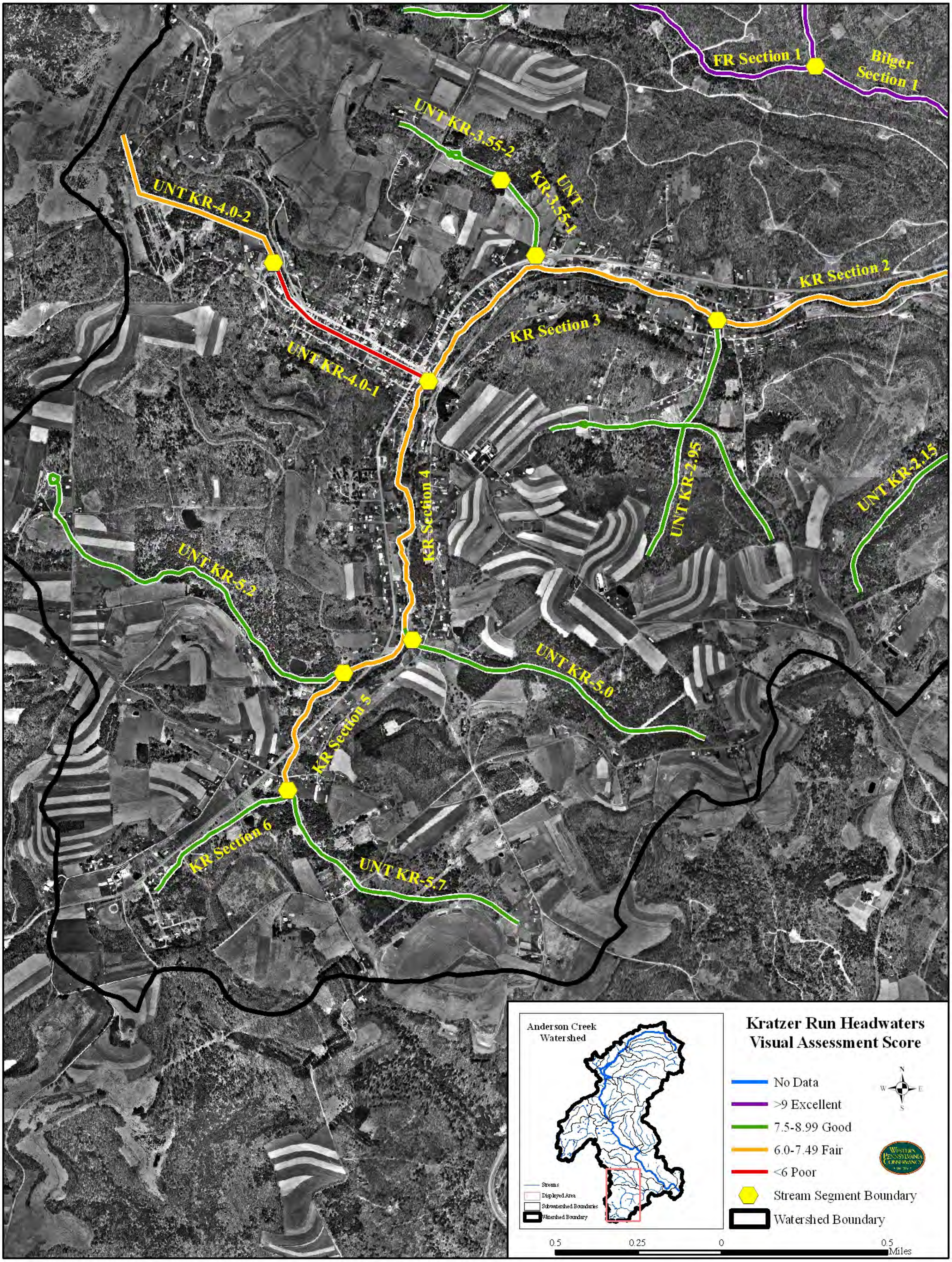
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UNT KR-3.55-1
UNT KR-4.0-2
KR Section 2
KR Section 3
UNT KR-4.0-1
KR Section 4
UNT KR-2.95
UNT KR-2.15
UNT KR-5.2
UNT KR-5.0
KR Section 5
KR Section 6
UNT KR-5.7
Anderson Creek Watershed
Streams
Displayed Area
Subwatershed Boundaries
Watershed Boundary
Kratzer Run Headwaters Visual Assessment Score
No Data
>9 Excellent
7.5-8.99 Good
6.0-7.49 Fair
<6 Poor
Stream Segment Boundary
Watershed Boundary
N
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Western Pennsylvania Conservancy
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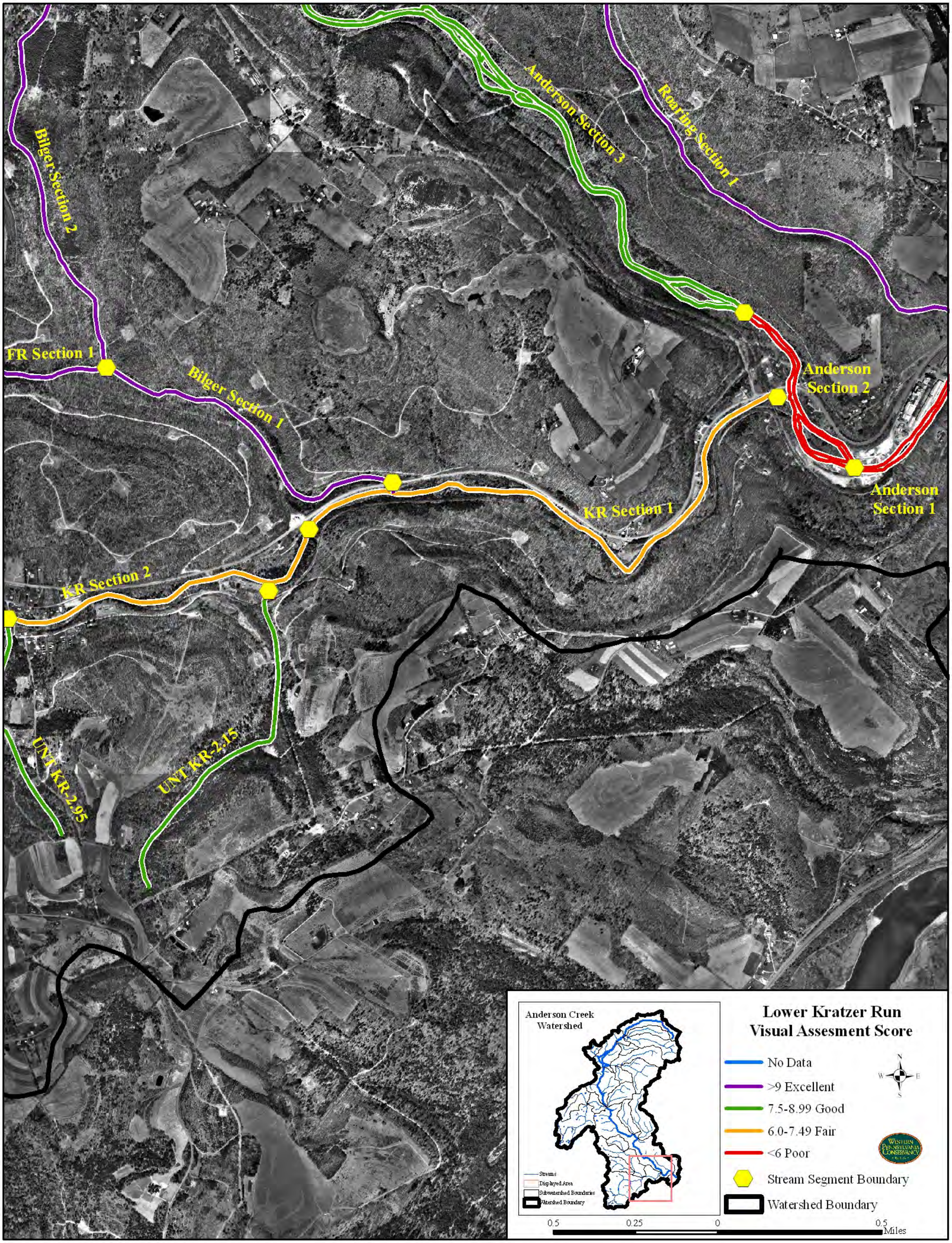
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Anderson Section 2
Anderson Section 1
KR Section 1
KR Section 2
UNT KR-2.95
UNT KR-2.15
Anderson Creek Watershed
Streams
Displayed Area
Subwatershed Boundaries
Watershed Boundary
Lower Kratzer Run Visual Assesment Score
No Data
>9 Excellent
7.5-8.99 Good
6.0-7.49 Fair
<6 Poor
Stream Segment Boundary
Watershed Boundary
N
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Western Pennsylvania Conservancy
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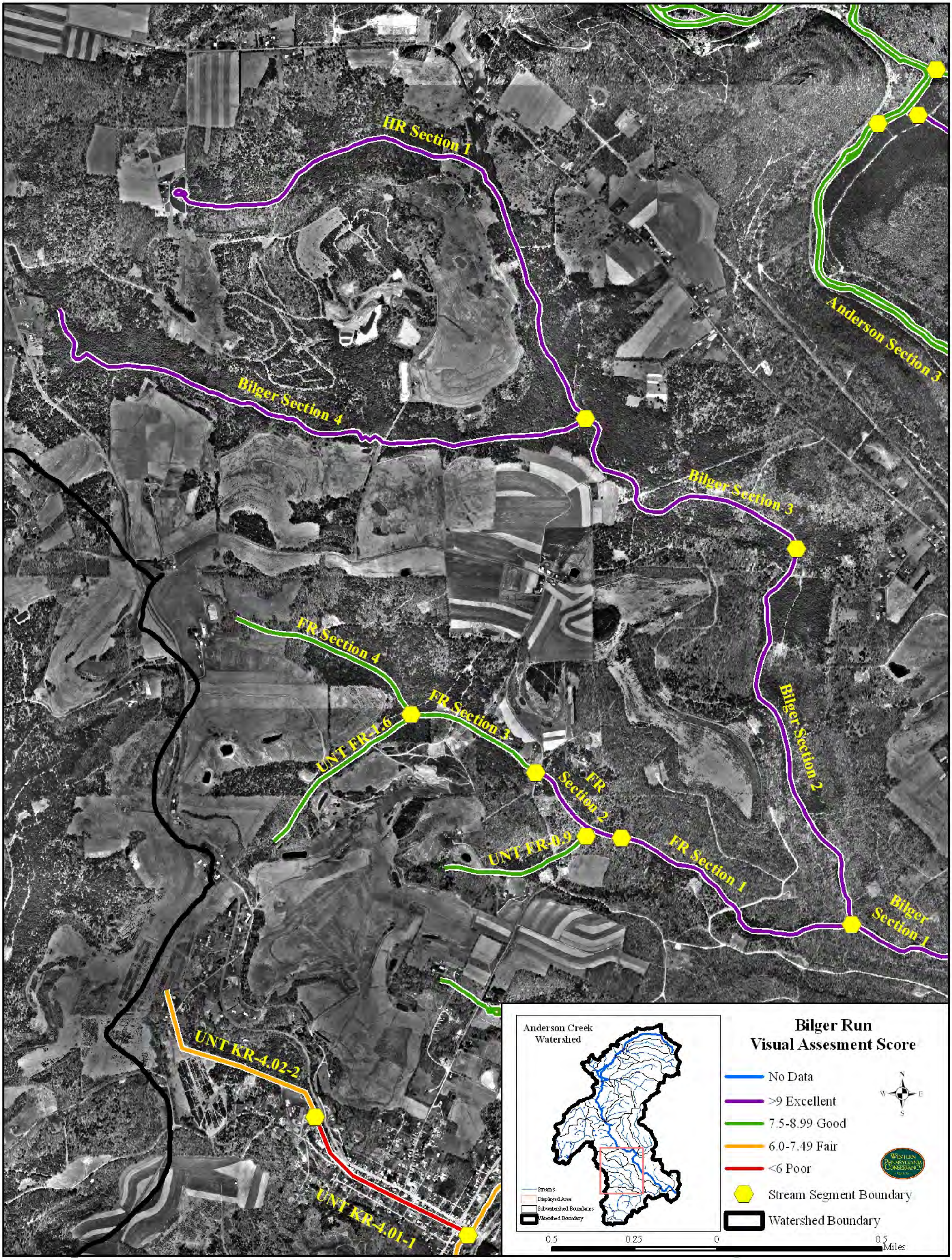
Miles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FR Section 2
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FR Section 1
Bilger Section 2
Bilger Section 1
UNT KR-4.02-2
UNT KR-4.01-1
Anderson Creek Watershed
Streams
Displayed Area
Subwatershed Boundaries
Watershed Boundary
Bilger Run
Visual Assesment Score
No Data
>9 Excellent
7.5-8.99 Good
6.0-7.49 Fair
<6 Poor
Stream Segment Boundary
Watershed Boundary
N
W
E
S
Western Pennsylvania Conservancy
0.5
0.25
0
0.5
Miles

Stream Visual Assessment Protocol

Owners name ____________________________ Evaluator's name_________________________ Date ____________

Stream name _____________________________________ Waterbody ID number ____________________________

Reach location ____

____

Ecoregion ____________________________ Drainage area ___________________ Gradient_____________________

Applicable reference site ____

Land use within drainage (%): row crop _____ hayland _____ grazing/pasture ______ forest _____ residential ______

confined animal feeding operations _____ Cons. Reserve _______ industrial ______ Other: ______________

Weather conditions-today ______________________________ Past 2-5 days __________________________________

Active channel width __________________ Dominant substrate: boulder _____ gravel _____ sand _____ silt _____ mud _____

Site Diagram

Assessment Scores

Channel condition	☐	Pools	☐
Hydrologic alteration	☐	Invertebrate habitat	☐
Riparian zone	☐	***Score only if applicable***	
Bank stability	☐	Canopy cover	☐
Water appearance	☐	Manure presence	☐
Nutrient enrichment	☐	Salinity	☐
Barriers to fish movement	☐	Riffle embeddedness	☐
Instream fish cover	☐	Marcroinvertebrates Observed (optional)	☐

Overall score
(Total divided by number scored) ___________

<6.0	**Poor**
6.1-7.4	**Fair**
7.5-8.9	**Good**
>9.0	**Excellent**

Suspected causes of observed problems____

____

____

____

Recommendations____

____

____

____

____

____

____

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____

Stream Name	Reach Location	Gradient	Land Use	Active Channel Width	Dominant Substrate	Channel condition	Hydrologic alteration	Riparian zone	Bank stability	Water appearance	Nutrient enrichment	Fish barriers	Instream fish cover	Pools	Invertebrate habitat	Canopy cover	Riffle embeddedness	Manure Presence	Macros observed	Total	Score		Comments	Reccommendations
Anderson Creek Mainstem																								
Anderson Creek	Anderson Section 1-West Branch to upstream of NARCO plant	moderate	residential, industrial, forest	40'-70'	cobble	6	3	5	8	3	9	4	3	3	4	8	6		0	62	**5.17**	**Poor**	Channel appears altered for flood control, wide and shallow. AMD impaired. Flows through Curwensville.	Natural Stream Design improvements to channel
Anderson Creek	Anderson Section 2-Narco plant to .25 miles upstream of Route 879	moderate	forest, residential, industrial	40'-50'	gravel, boulder	8	4	6	9	4	7	10	3	3	5	8	4		0	71	**5.92**	**Poor**	Channel of Anderson splits immediately below confluence of Kratzer with Anderson at trail bridge, flows on both sides of trail. Raw sewage from houses below confluence with Kratzer. Anderson Creek is severely impaired by AMD. Riparian zone impacted by trail (RR bed) and houses. Looks like flow channel altered (shallow, wide). Tree lined for most of the reach.	Address sewage issue. Natural Stream design imporvements to channel
Anderson Creek	Anderson Section 3-upstream of Rt.879 to water intake below Bear Run	moderate	forest,agriculture	45'-50'	gravel	9	9	10	10	2	9	10	9	9	9	9	8		0	103	**8.58**	**Good**	Anderson Creek severely impaired by AMD throughout this section, pH@4.5. Lower reach channelized near 879.	Natural Stream Design improvements to channel
Anderson Creek	Unnamed tributary just below Bear Run (UNT AC-5.8); from mouth to upstream .5 mile	high	forest	5'-8'	boulder, gravel	10	10	10	10	8	10	10	10	9	10	10	9		2	116	**9.67**	**Excellent**	Stream pH at mouth <4.1, pH increases upstream. Area of low pH seeps/springs between 2.9 and 3.7. Lower end impaired by AMD. AMD adjacent to pump station; pH =3.6.	
Anderson Creek	first unnamed tributary below confluence with Little Anderson (UNT AC-9.75)	high	forest	8'-10'	boulder, gravel,sand	10	9	9	9	10	10	3	10	10	10	10	5		8	105	**8.75**	**Good**	Area logged, but responsibly	
Anderson Creek	second unnamed tributary below confluence with Little Anderson (UNT AC-9.2)	high	forest, mining, residential	10'	boulder, gravel, sand, cobble	7	5	8	9	5	10	9	8	8	10	9	8		0	96	**8.00**	**Good**	Roadside discharge=3.8; estimated flow=10-15gpm. Stream above=4.1, stream below=4.0. At powerline pH=4.3, iron staining. Sediment from road and powerline crossing.	
Anderson Creek	third tributary below confluence with Little Anderson (UNT AC-8.8)	high	forest, mining, residential	6'-8'	boulder, gravel, cobble, sand	6	8	6	7	5	7	9	8	8	9	9	6		0	88	**7.33**	**Fair**	Road parallels the stream for much of its lower reach. Several residences located adjacent to the stream. Degraded water quality.	Stabilization needed along road paralleling the stream
Anderson Creek	fourth unnamed tributary below confluence with Little Anderson (UNT AC-8.2); above road	low	forest, mining	7'	sand, silt, gravel	8	9	10	9	7	9	9	9	9	9	10	3		0	101	**8.42**	**Good**	Some logging, riffles embedded	
Anderson Creek	fourth unnamed tributary below confluence with Little Anderson (UNT AC-8.2), lower end.	high	forest, mining, residential	12'-15'	boulder, gravel, sand	8	9	10	8.5	4	10	9	10	10	10	10	6		9	104.5	**8.71**	**Good**	Timbered to and across stream, bank erosion above railroad. pH=3.2 above split. Area of 3.0 seeps on southwest side of stream	
Anderson Creek	Anderson Section 4-Above Pike Township Water Authority dam to above Little Anderson	moderate	forest, mining	30'-40'	boulder, cobble	9	10	9.5	10	8	10	2	10	9	9	9	9		0	104.5	**8.71**	**Good**	Water authority dam. Iron staining, some silt.	
Anderson Creek	Anderson Section 5-Above Little Anderson Creek to above Rt. 322	moderate	forest	20'-30'	boulder, cobble	9	9	9.5	7	8	10	10	10	9	9	9	9		8	108.5	**9.04**	**Excellent**	Stream widened at Rt. 322. Bank erosion below Rt.322 at camp. Iron staining, some silt.	
Anderson Creek	UNT AC 11.65Unnamed tributary just above Route 322	high	forest	8'-10'	boulder, gravel, sand	8	5	6	8	8	10	9	9	8	9	8	8		7	96	**8.00**	**Good**	Stream channelized along Route 322 with typical problems usually associated with nearby highway.	
Anderson Creek	UNT AC 12.35- Along Route 322 to Rockton	high	forest, residential		boulder, gravel, sand	7	6	8	7	8	8	9	9	8	5	8	7		7	90	**7.50**	**Good**	Runoff from route 322. Likely channelized along 322; gravel, sediment deposited in lower section; slight braiding at deposits.	
Anderson Creek	UNT AC-12.35-Above Rockton	ow/moderat	forest, residential	3'-5'	sand, silt	6	7	8	8	9	9	9	7	7	6	8	4		5	88	**7.33**	**Fair**	Seep zone below old strip (pH=3.7 to 4.1). Didn't affect tributary; no noticeable metals. Some channelization near homes at Rockton; some braiding at silt deposits.	Siltation from roads. High runoff likely.
Anderson Creek	Anderson Section 6- Route 322 to Dubois reservoir	moderate	forest, residential	15'-25'	boulder, gravel, sand	9	9	10	9	9	8	10	10	10	9	10	9		9	112	**9.33**	**Excellent**	One area of streambank erosion. Some pipes from summer homes. Overall, section had few observed problems.	
Roaring Run																								
Roaring Run	Roaring Section 2-Above Rt. 879 to headwaters	moderate/ high	forest	5'-8'	boulder, gravel, sand	10	10	10	10	9	10	10	10	10	10	10	9		3	118	**9.83**	**Excellent**	Low alkalinity, all sandstone in streambed. Extremely dense mountain laurel and rhododendron.	
Roaring Run	Roaring Section 2 - 879 to confluence with Anderson	moderate/ high	forest	5'-8'	boulder, gravel, sand	6	8	9	7	9	10	7	8	8	10	10	8		3	100	**8.33**	**Good**	Stream channelized near camp. Bank erosion near Rt. 879. Piped under Rt.879.	
Bear Run Subbasin																								
Bear Run	Section 1-mouth to resevoir	high	forest	20'	cobble, boulder, gravel	6	8	8	6	8	10	10	10	10	8	8	8		6	100	**8.33**	**Good**	Stream pH at mouth=5.3; pH at upper end also 5.3. Some macroinvertebrates observed. Streambed appeared somewhat scoured. Some erosion, especially below resevoir. Road construction actually pushed trees into stream. Road to pump station discharge=3.1. pH=4.5 in stream in valley. Bank erosion just below reservoir outlet.	
Bear Run	Section 2-above reservoir to first unt	high	forest	10'-15'	boulder, gravel	10	10	10	10	8	10	10	10	10	10	10	9			117	**9.75**	**Excellent**	No major problems observed.	
Bear Run	Section 3-above first unnamed tributary to headwaters	moderate	forest	10'-12'	boulder, gravel	9	10	9	10	10	10	10	10	10	10	10	8		6	116	**9.67**	**Excellent**	Very few macroinvertebrates, appeared to be only stoneflies.	
Bear Run	UNT Bear A	oderate/hig	forest	4'-5'	cobble, boulder, sand	9	10	10	9	10	10	7	10	9	10	10	9		8	113	**9.42**	**Excellent**	Quad trails crossing stream. Stream disappeared underground at headwaters. Some caddisflies and stoneflies present. pH at head of stream=4.9.	
Bear Run	UNT Bear B	high	forest	4'-5'	cobble, boulder, sand	9	10	9	9	10	10	7	10	9	10	10	9		8	112	**9.33**	**Excellent**	Iron spring, pH=5.8 to 5.3 near stream. Large zone of springs immediately south. Evidence of past logging; stream is recovered. Stream disappears underground. Caddis, mayflies and stoneflies observed.	
Irvin Branch Subbasin																								
Irvin Branch	Section 1-mouth to trail crossing	high	forest	10'-12'	boulder, gravel	10	10	10	10	10	10	10	10	10	10	10	9		6	119	**9.92**	**Excellent**	Stream pH=5.1 at top. A few macroinvertebrates found.	
Irvin Branch	Section 2-trail crossing to cabin	moderate	forest, residential	6'-8'	cobble, gravel, sand	9	9	8	10	10	10	9	10	10	10	10	9		3	114	**9.50**	**Excellent**	pH=4.4, may be affected by surface minining in headwaters and/or acid rain.	
Panther Run Subbasin																								
Panther Run	Section 1-Lower	moderate/ high	forest	10'-12'	boulder, gravel, sand	10	10	10	10	10	10	10	10	9	10	10	9		3	118	**9.83**	**Excellent**	Low alkalinity, all sandstone in streambed. Extremely dense mountain laurel and rhododendron.	
Panther Run	Section 2-Middle	moderate/ high	forest	6'-19'	boulder, gravel, sand	10	10	10	10	10	10	10	10	9	10	10	9		3	118	**9.83**	**Excellent**	Low alkalinity, all sandstone in streambed. Extremely dense mountain laurel and rhododendron.	
Panther Run	Section 3-cabin to headwaters	moderate	forest, residential	4'-6'	cobble, gravel, sand	8	9	10	9	10	10	9	10	10	9	9	9		6	112	**9.33**	**Excellent**		
Panther Run	Section 3-Unnamed tributary to East	moderate/ high	forest	6'-19'	boulder, gravel, sand	10	10	10	10	10	10	10	10	9	10	10	9		3	118	**9.83**	**Excellent**	Low alkalinity, all sandstone in streambed. Extremely dense mountain laurel and rhododendron.	
Little Anderson Creek Subbasin																								
Little Anderson	LA Section 1-mouth to confluence of Rock Run	moderate/ high	forest	20'-30'	boulder, cobble, silt	9	9	9	8	3	10	9	9	8	10	8	6		0	98	**8.17**	**Good**	iron floc on stream bottom. Some areas bank erosion.	
Little Anderson	LA Section 2-Rock Run to below UNT-LA 3.0	moderate	forest	20'	boulder, cobble, silt	9	10	9	9	3	10	7	9	9	10	9	8		0	102	**8.50**	**Good**		
Little Anderson	UNT-LA 3.0 - tributary to Vrobel property	ow/moderat	forest, bog at bottom	12'	boulder, cobble, silt, gravel	9	9	9	10	4	10	9	10	9	10	9	8		0	106	**8.83**	**Good**	Iron staining present. Railroad moved stream. pH starts to drop below hemlock within channel. pH=3.2, acid seems to kill trees	
Little Anderson	LA Section 3 - 0.5 miles below 219 to UNT-LA 3.0	high	forest	25'	boulder	9	9	10	8	7	10	10	10	9	10	9	9		0	110	**9.17**	**Excellent**	Logging near unstabilized stream crossing. Poor logging road construction, no drainage.	
Little Anderson	UNT LA 3.0 - Vrobel tributary left branch north of camp	low	forest	6'	boulder, sand, silt	9	9	10	9	8	8	8	9	9	10	10	3		0	102	**8.50**	**Good**	Some logging	
Little Anderson	LA Section 4 - below RT. 219	low	agricultural, residential, forest, surface mine	20'	boulder, gravel, silt	8	10	9	8	7	9	10	10	9	9	10	8		0	107	**8.92**	**Good**	Small riparian area open above 219, some iron staining.	
Little Anderson	UNT-LA 4.3-1, mouth to upper road	moderate	agricultural, forest, strip mine	8'-10'	grave, sand, silt, mud	8	8	10	9	8	9	7	8	8	8	9	8		0	100	**8.33**	**Good**	Heavy sand and silt in stream, likely attributed to prior surface mining. Tributary pH=4.2 just below site. Apparent seepage below pond all around, but not flowing on this date.	Good area for treatment
Little Anderson	UNT-LA 4.3-2, above Cramer Road	ow/moderat	agricultural, residential, forest	5'-10'	silt, sand, gravel	5	9	7	8	8	10	7	7	6	8	8	8			91	**7.58**	**Good**	Previous channel downcutting, silt deposition, likely association with surface mining in headwaters. Light iron color, some areas near road not good riparian.	
Little Anderson	LA Section 5- confluence of UNT-LA 4.3 to SR 4010.	ow/moderat	agricultural, residential, forest, surface mine	10'-15'	boulder, gravel, silt	7.5	9	10	8	7	9	10	10	9	10	10	6		2	105.5	**8.79**	**Good**	Good habitat but degraded water quality	
Little Anderson	LA Section 6-upstream of SR 4010 to UNT LA 5.9	low	forest, strip mine	8'	silt, mud	8	8	9	8	1	9	10	8	9	4	8	1		5	83	**6.92**	**Fair**	Acid seep, pH=4.1. Downstream of seep, pH=6.1	Associated with upstream channel diversion
Little Anderson	LA Section 7- LA above confluence of UNT-LA 5.9	low	agricultural-hay/pasture	3'-5'	silt, mud	6	4	8	10	2	10	7	7	7	7	6	7			81	**6.75**	**Fair**	This section characterized by a large wetland are in open fields (that were prior farmland according to the landowner). Some portions were tree lined. Some areas near the farm were channelized. Small fish observed in stream channel at stream crossing below barn on SR 4010.	This section is affected by nearby surface mines. It appears most of the wetland area is affected by iron levels exceeding state standards' iron staining is apparent. One area below the reclaimed strip mine is discharging low pH, acidic water. Groundwater otherwise appears alkaline. Wetland conditions limit treatment. Baffling in wetland may help retain more iron in the wetland area. Alkaline addition atacid seeps could also speed iron settling.
Little Anderson	UNT-LA 5.9 above SR 4010	low	forest, strip mine	5'	silt, mud	1	1	10	9	1	9	8	7	5	2	5	7		1	65	**5.42**	**Poor**	Stream diverted into pit. Channel may be old highwall of strip mine. pH=6.2 just above channel diversion at bottom end of wetland.	Divert stream into original channel. Reclaim strip mine cut.

Stream Name	Reach Location	Gradient	Land Use	Active Channel Width	Dominant Substrate	Channel condition	Hydrologic alteration	Riparian zone	Bank stability	Water appearance	Nutrient enrichment	Fish barriers	Instream fish cover	Pools	Invertebrate habitat	Canopy cover	Riffle embeddedness	Manure Presence	Macros observed	Total	Score		Comments	Reccommendations
Rock Run Subbasin																								
Rock Run	Section1-below quarry to mouth	high	forest	12'	boulder, gravel	9	9	10	10	10	10	10	10	9	10	10	9		10	116	**9.67**	**Excellent**	Steep mountain stream in very nice condition. Old quarry at headwaters has little noticeable effect. Did not go entire way to quarry. Slight channelization at cabin near mouth.	
Rock Run	Section 1-mouth to railroad bridge	ow/moderat	hayland, grazing/pasture, forest, residential	5'-10'	gravel, sand, silt	7	7	6	8	6	9	9	10	9	8	7	7	7	0	93	**7.75**	**Good**	Trash observed in stream, homes adjacent to stream, farmer fenced across the stream. Coal tipple area.	
Rock Run	Section 3-Upstream from railroad bridge	low	forest	10'-15'	gravel, sand, silt	9	10	9	9	6	10	9	10	9	8	10	7		0	106	**8.83**	**Good**	Iron staining, slow moving, meandering stream. Beaver in lower areas. Area consists of hemlock and beech forest	
Kratzer Run Subbasin																								
Kratzer Run	KR Section 1-below confluence with Bilger Run to confluence with Anderson Creek	oderate/hig	forest, residential, industrial	25'	gravel, boulder	7	5	8	8	4	7	10	9	9	8	9	7			91	**7.58**	**Good**	Kratzer Run below the confluence with Bilger Run becomes impaired with mine drainage. Mine water appears somewhat alkaline and drops iron before reaching stream. Proximity to road (Rt.879) impacts riparian zone and channel condition. Otherwise riparian area is mostly wooded.	
Kratzer Run	KR Section 2-Grampian to mouth of Bilger Run	high	forest	20'	boulder, gravel	6	6	10	5	8	7	9	10	9	10	10	8		7	98	**8.17**	**Good**	Character of stream changes below Grampian near sewage plant. Gradient much steeper (drop/pool); rhododendron along stream; some trash in stream; erosion at and below washed-out road; mayflies observed. Odor from sewage plant; state highway near stream; small mine seep (at 10gpm) immediately behind red & yellow house on route 879, doesn't seem to affect stream.	
UNT KR	KR Section 3-Grampian to Stronach	low	residential, industrial	10'-15'	gravel, sand, silt	6	6	6	7	7	9	10	7	7	6	6	6			83	**6.92**	**Fair**	Light streambank erosion on outside bends. Very light iron staining. Homes located on left side of stream, often mowed very close to stream. Right side typically tree lined. Bike trail on right side. Quad tracks in stream at very lower end of Kratzer Run Road running in stream. Also appears somewhat channeled at lower end.	Stream stabilization, riparian improvements
Kratzer Run	UNT KR- 2.95-Joins Kratzer at Stronach from south	high	forest	8'	gravel, sand	8	9	9	9	9	8	9	8	7	9	10	9		7	104	**8.67**	**Good**	Small tributary meeting Kratzer Run at Stronach (from south). Minimal sediment, little embeddedness, good canopy (90%), active farm in western headwater tributary. Mayflies observed.	
Kratzer Run	KR Section 4-Hepburnia to Grampian	ow/moderat	residential, industrial	10'-15'	gravel, silt	6	6	9	9	7	7	6	9	7	5	10	6		4	87	**7.25**	**Fair**	Moderate to heavy silt in pools, slight bank erosion, some trash in stream, very nice canopy, old hemlocks, site of old lowhead dam (breached), old beaver dams, slight iron staining on eastern side of stream (below old coal tipple?) Reach appears to be impaired by residential areas of Grampian and Hepburnia. Character of riparian area unique considering close proximity to residential areas.	Natural Stream Design restoration
Kratzer Run	KR Section 5-Hepburnia downstream 1/4 miles	low	pasture, forest, residential	8'	silt, mud, gravel	7	7	9	7	8	5	10	7	8	4	7	7			86	**7.17**	**Fair**	Some sewage odor, silt is heavy in pools. Some hydrologic modification occurs near road crossings*i.e.* slow moving water, pools. Some fish(forage)observed. Few macroinvertebrates. Just below Hepburnia, one landowner has lined the streambank with Jersey Barriers.	Natural Stream Design restoration
Kratzer Run	UNT KR- 5.2-upstream Hepburnia bridge	low	row crop, hayland, pasture, forest, residential	10'	silt, mud, gravel	6	7	10	7	9	8	10	10	8	9	10	7			101	**8.42**	**Good**	Heavy silt in pools, riffles decent, some past downcutting. Good forest canopy, lots of hemlocks. Stream bottom mainly silt and clay. Open strip cut in headwaters with two adjacent sediment ponds. Sediment from old strip-mine & roadway. Active farm with degraded pasture in very headwaters.	
Kratzer Run	KR Section 6-headwaters above Hepburnia, along Route 219	low	row crop, hayland, pasture, forest residential, industrial	6'	silt, mud	8	9	8	9	9	7	10	8	6	5	7	7			93	**7.75**	**Good**	Characterized by non-working farms with a few working farms interspersed. Many hilltops have been strip-mined. Stream riparian areas are generally forested, usually with conifers. Open areas generally have good riparian cover with some areas being covered in brush. Numerous minnows. Homes presently without sewage.	
Kratzer Run	UNT KR 4.0-1-Grampian tributary	ow/moderat	residential	10'	sand, silt, gravel, boulder	1.5	2	4	4	6	10	7	4	4	6	4	2			54.5	**4.54**	**Poor**	This section runs through town of Grampian. A lot of channelization and sedimentation.	Stream stabilization, riparian improvements
Kratzer Run	UNT KR 4.0-2-Grampian tributary, left branch	ow/moderat	forest, strip mine, residential	7-8'	sand, silt, gravel, cobble	4	9	10	6	3	10	5	7	7	8	10	2		2	81	**6.75**	**Fair**	This section has a lot of downcutting. Stream becomes more orange upstream. The only impact above the old strip mine is erosion and sedimentation.	Stream stabilization, riparian improvements
Kratzer Run	UNT KR 5.7-First unnamed tributary south of Hepburnia	low	residential, field, forest	2'-4'	silt, mud	6	9	8	7	9	9	9	7	7		7	5			83	**7.55**	**Good**	Stream characterized by mud bottom, heavily silted and some downcutting. In-stream pH=6.2.	
Kratzer Run	UNT KR 5.0 -Second unnamed tributary south of Hepburnia	ow/moderat	grazing/pasture, forest	8'	cobble, gravel, silt, mud	7	9	9	8	9	10	10	7	8	8	9	7		7	101	**8.42**	**Good**	Some downcutting of channel, minnows and mayflies were observed. In-stream pH=6.2.	
Kratzer Run	UNT KR 3.55-1-First tributary to north below Grampian	oderate/hig	hayland, grazing/pasture	3'-4'	gravel, sand, silt	7	7	6	7	7	10	9	8	8	8	8	7		7	92	**7.67**	**Good**	Stream appears squeezed in on each side, possibly from previous surface mining. Small riparian zone fields beyond on either side. Some macroinvertebrates observed, one big stonefly.	
Kratzer Run	UNT KR 3.55-2-Headwaters, first tributary to north below Grampian	oderate/hig	forest	6'-8'	gravel, silt	6	9	10	8	9	10	8	8	7	8	10	6		5	99	**8.25**	**Good**	Some trash in stream, somewhat silted. Gravel appeared to be from surface mine. Some downcutting. Fish were observed.	
Bilger Run Subbasin																								
Bilger Run	Bilger Section 1- confluence with Kratzer Run to Fenton Run	high	forest	25'	boulder, gravel	10	10	10	10	6	10	10	10	10	10	10	9		0	115	**9.58**	**Excellent**	Stream has very high quality riparian and in-stream habitat. Severely impaired by AMD from abandoned strip mines upstream. Other smaller AMD seeps have limited impacts.	
Bilger Run	Bilger Section 2- Fenton Run to Bilger Run Road	oderate/hig	forest	25'	boulder, gravel	10	10	10	9	7	9	10	10	10	10	10	9			114	**9.50**	**Excellent**	This section is degraded by AMD. Known acid discharges to stream. Stream has a milky cast. However, riparian area and stream habitat are excellent. Some logging nearby; selective cutting.	
Bilger Run	Bilger Section 3 -Bilger Rocks to Hughey Run	low/mod	forest	20'	gravel, sand	10	10	10	9	7	9	10	10	9	9	10	8			111	**9.25**	**Excellent**	AMD present in headwaters, water slightly discolored. First of alkaline sand addition sites. Except for AMD, overall very good condition.	
Fenton Run Subbasin																								
Fenton Run	FR Section 1-confluence with Bilger Run to 0.5 miles downstream of Grampian Road	high	forest	20'	boulder, gravel	10	10	10	10	8	8	10	10	10	10	10	9			115	**9.58**	**Excellent**	Appears to be several old breached dams. Typical high gradient mountain stream.	
Fenton Run	FR Section 2-Grampian Road to 1/2 mile downstream	low	forest, residential	10'	sand, gravel	9	10	10	10	8	8	10	9	8	10	10	8			110	**9.17**	**Excellent**	This section is low gradient with meanders. Very sandy soils. Excellent cover, bank condition and riparian area. Probably affected by cleared areas in headwaters during high flows. There is little downcutting observed. Small fish observed.	
Fenton Run	UNT FR-0.9-Smaller tributary further south on Sixth St.	low		4'	gravel, sand, mud	7	9	10	9	9	9	8	8	8	7	10	8			102	**8.50**	**Good**	Recent logging in area	
Fenton Run	FR Section 3-Above 6th St. to split of headwaters	low	forest, residential	6'-8'	gravel, sand, mud	8	10	10	8	8	10	8	7.5	8	7					84.5	**8.45**	**Good**	Some downcutting, cloudy in pools. Section just below road similar, channel width widens near homes.	
Fenton Run	FR Section 4 -Above where headwaters splits (north)	low	forest, residential	4'	silt, mud, clay	7	9	10	9	9	9	8	8	8	7	10	8			102	**8.50**	**Good**	pH=6.6 at 6th St. Crossing. Fish observed, signs of beaver in lower section near road. Many downed trees in stream. Previously logged.	
Fenton Run	UNT FR 1.6 -Above where headwaters splits (south)	low	forest, residential	4'	silt, mud, clay	7	9	10	9	9	9	8	8	8	7	10	8			102	**8.50**	**Good**	pH=6.6 at 6th St. Crossing. Fish observed, signs of beaver in lower section near road. Many downed trees in stream. Previously logged.	
Hughey Run Subbasin																								
Hughey Run	HR Section 1-above confluence with Bilger Run	low	pasture, forest	10'-15'	sand, gravel, silt	10	10	10	9	8	10	9	10	10	10	10	8			114	**9.50**	**Excellent**	Slow sinnous stream segment. Sandy soils. Stoneflies observed. Stream pH = 5.8.	

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Appendix X-A

Chemistry and Flow Data

Problem Area and discharge data - Raw

Sample ID	ACWA ID	Sample Date	Flow GPM	pH Field	pH Lab	Cond. Umhos	Temp C	Alkalinity mg/L	Acidity mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Susp. Solids mg/L	TDS mg/L	Notes	Fe Loading lbs/day	Al Loading lbs/day	Mn Loading lbs/day	Acidity Loading lbs/day	Alkalinity Loading lbs/day
PAMP-LA2.10		5/19/2005	41.4	3.9	3.6	362	9.0	0	64	0.87	7.36	6.86	92.00	5.69			0.43	3.41	3.66	31.83	0.00
PAMP-LA2.10		7/13/2005	15.0	3.8	3.4	486	18.0	0	73	0.71	4.23	6.47	119.00	6.19		est flow	0.13	1.17	0.76	13.16	0.00
PAMP-LA2.10		8/23/2005	5.0	3.5	3.4	793	15.0	0	72	3.75	11.30	5.09	287.00	6.19		est flow	0.23	0.31	0.68	4.33	0.00
PAMP-LA2.10		9/15/2005	3.0	3.5	3.4	490	15.0	0	72	1.20	5.88	7.42	178.00	7.10		est flow	0.04	0.27	0.21	2.60	0.00
Average			**16.1**		**3.5**				**70**	**1.63**	**7.19**	**6.46**	**169.00**				**0.21**	**1.29**	**1.33**	**12.98**	**0.00**
DMP-879	ROAD	10/23/2004	8.9	6.9	6.1	377	5.6	13	11	6.84	1.93	0.05	142.00	11.40			0.73	0.01	0.21	1.18	1.39
DMP-879	ROAD	11/18/2004	16.7	5.9	5.7	406	6.7	10	9	10.10	2.46	0.05	179.00	5.69	276		2.03	0.01	0.49	1.81	2.01
DMP-879	ROAD	12/18/2004	16.7	6.6	5.9	308	-1.1	11	-12	5.34	0.84	0.05	115.00	7.10	259		1.07	0.01	0.17	-2.41	2.21
DMP-879	ROAD	1/19/2005	21.7	6.8	6.2	285	-2.2	12	9	8.40	1.39	0.06	105.00	17.10	199		2.19	0.02	0.36	2.35	3.13
DMP-879	ROAD	2/16/2005	16.7	5.9	6.1	225	3.9	10	7	6.72	1.00	0.05	74.00	10.00	133		1.35	0.01	0.20	1.41	2.01
DMP-879	ROAD	3/22/2005	27.5	6.9	6.3	297	3.3	11	9	18.60	1.39	0.18	104.00	7.10	163		6.15	0.06	0.46	2.97	3.64
DMP-879	ROAD	4/20/2005	8.9	6.9	6.1	386	8.9	13	-16	25.80	2.01	0.28	147.00	28.60	247		2.76	0.03	0.22	-1.71	1.39
DMP-879	ROAD	5/18/2005	7.5	6.9	5.9	428	9.4	10	16	21.70	2.44	0.22	162.00	12.90	286		1.96	0.02	0.22	1.44	0.90
DMP-879	ROAD	6/22/2005	0.4	6.7	6.1	485	13.3	13	11	15.30	2.71	0.05	178.00	6.19	343		0.08	0.00	0.01	0.06	0.07
DMP-879	ROAD	7/20/2005	2.2	5.9	6.1	512	15.6	14	13	32.60	3.76	0.13	208.00	18.60	349		0.86	0.00	0.10	0.34	0.37
DMP-879	ROAD	8/24/2005	8.4	6.5	6.1	564	12.8	18	49	23.40	3.40	0.05	218.00	10.00	404		2.36	0.00	0.34	4.94	1.82
DMP-879	ROAD	9/14/2005	3.0	6.7	6.0	447	12.2	23	45	30.80	3.21	0.06	220.00	28.60	394		1.11	0.00	0.12	1.63	0.83
Average			**11.6**		**6.1**			**13**	**13**	**17.13**	**2.21**	**0.10**	**154.33**				**1.89**	**0.01**	**0.24**	**1.17**	**1.65**
DMP-AC3.75-1	NEEP 1	10/23/2004	6.7	5.0	4.6	108	7.8	5	11	0.19	0.09	0.39	28.00	8.60	60		0.02	0.03	0.01	0.88	0.40
DMP-AC3.75-1	NEEP 1	12/5/2004	12.0	6.6	5.1	103	5.0	6	10	0.07	0.07	0.45	29.00	5.69	69		0.01	0.06	0.01	1.44	0.87
DMP-AC3.75-1	NEEP 1	12/23/2004	41.8	3.4	3.3	299	3.3	0	50	1.24	0.37	3.07	42.00	11.40	86		0.62	1.54	0.19	25.12	0.00
DMP-AC3.75-1	NEEP 1	1/15/2005	12.0	5.0	4.8	98	3.0	5	11	0.06	0.06	0.45	27.00	5.69	74		0.01	0.06	0.01	1.59	0.72
DMP-AC3.75-1	NEEP 1	2/12/2005	6.3	4.9	5.3	87		6	6	0.05	0.05	0.22	24.00	5.69	40		0.00	0.02	0.00	0.46	0.46
DMP-AC3.75-1	NEEP 1	3/16/2005	16.0	3.1	3.0	716	0.6	0	177	1.34	2.45	22.00	169.00	5.69	351	Sampled in	0.26	4.23	0.47	34.04	0.00
DMP-AC3.75-1	NEEP 1	5/21/2005	12.0	4.2	5.0	90	6.7	7	6	1.00	0.09	0.40	25.00	8.60	54		0.14	0.06	0.01	0.87	1.01
Average			**15.3**		**4.4**			**4**	**39**	**0.56**	**0.45**	**3.85**	**49.14**				**0.15**	**0.86**	**0.10**	**9.20**	**0.49**
DMP-AC3.75-2	NEEP 2	10/23/2004	12.0	3.3	3.4	339	8.9	0	51	1.98	0.49	3.34	39.00	7.00	90		0.29	0.48	0.07	7.36	0.00
DMP-AC3.75-2	NEEP 2	12/5/2004	60.0	5.4	3.4	303	7.2	0	45	1.06	0.45	3.28	36.00	5.69	96		0.76	2.37	0.32	32.45	0.00
DMP-AC3.75-2	NEEP 2	12/23/2004	41.8	3.4	3.3	299	5.0	0	50	1.24	0.37	3.07	42.00	11.40	86		0.62	1.54	0.19	25.12	0.00
DMP-AC3.75-2	NEEP 2	1/15/2005	70.2	3.2	3.3	310	9.0	0	51	1.42	0.46	3.38	39.00	5.69	90		1.20	2.85	0.39	43.03	0.00
DMP-AC3.75-2	NEEP 2	2/12/2005	34.2	3.4	3.5	259	5.6	0	39	0.63	0.37	2.47	34.00	5.70	69		0.26	1.02	0.15	16.03	0.00
DMP-AC3.75-2	NEEP 2	3/17/2005	34.2	3.2	3.5	254	5.6	0	36	0.57	0.34	2.16	35.00	0.57	91		0.23	0.89	0.14	14.80	0.00
DMP-AC3.75-2	NEEP 2	4/15/2005	34.2	3.2	3.4	303	8.9	0	41	0.79	0.36	2.74	37.00	5.69	210		0.32	1.13	0.15	16.85	0.00
DMP-AC3.75-2	NEEP 2	5/21/2005	12.4	3.1	3.6	225	10.0	0	32	0.29	0.29	1.86	30.00	5.69	74		0.04	0.28	0.04	4.77	0.00
DMP-AC3.75-2	NEEP 2	6/20/2005	2.2	3.3	3.5	231	11.1	0	28	0.14	0.26	1.41	32.00	6.19	70		0.00	0.04	0.01	0.74	0.00
DMP-AC3.75-2	NEEP 2	8/22/2005		3.3	3.3	369	12.0	0	55	0.97	0.58	4.56	49.00	6.19	137		0.00	0.00	0.00	0.00	0.00
Average			**33.5**		**3.4**				**43**	**0.91**	**0.40**	**2.83**	**37.30**				**0.37**	**1.06**	**0.15**	**16.12**	**0.00**

Problem Area and discharge data - Raw

Sample ID	ACWA ID	Sample Date	Flow GPM	pH Field	pH Lab	Cond. Umhos	Temp C	Alkalinity mg/L	Acidity mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Susp. Solids mg/L	TDS mg/L	Notes	Fe Loading lbs/day	Al Loading lbs/day	Mn Loading lbs/day	Acidity Loading lbs/day	Alkalinity Loading lbs/day
DMP-AC3.75-3	PWR	10/23/2004	7.5	3.1	3.1	748	8.9	0	208	1.68	3.34	23.60	217.00	8.60	366		0.15	2.13	0.30	18.75	0.00
DMP-AC3.75-3	PWR	12/5/2004	15.0	5.3	3.1	789	5.6	0	193	1.37	2.08	22.10	192.00	5.69	320		0.25	3.98	0.38	34.80	0.00
DMP-AC3.75-3	PWR	12/23/2004														Sample taken in wrong place.					
DMP-AC3.75-3	PWR	1/15/2005	55.0	3.1	3.1	648	4.0	0	163	1.26	1.91	21.80	151.00	5.69	274		0.83	14.41	1.26	107.76	0.00
DMP-AC3.75-3	PWR	2/11/2005	15.0	3.1	3.1	693	2.8	0	182	1.55	2.73	23.60	174.00	5.69	310		0.28	4.26	0.49	32.81	0.00
DMP-AC3.75-3	PWR	4/15/2005	24.0	3.0	3.0	758	7.2	0	172	1.06	1.95	18.80	165.00	5.69	273		0.31	5.42	0.56	49.62	0.00
DMP-AC3.75-3	PWR	5/21/2005	8.6	2.8	3.2	705	12.2	0	172	1.33	3.06	22.40	173.00	5.69	324		0.14	2.31	0.32	17.72	0.00
DMP-AC3.75-3	PWR	6/20/2005	4.3	3.1	3.0	878	17.8	0	201	2.70	3.45	21.70	244.00	6.19	393		0.14	1.12	0.18	10.39	0.00
DMP-AC3.75-3	PWR	8/22/2005		3.0	3.0	927	18.0	0	271	13.50	7.41	33.20	405.00	6.19	577		0.00	0.00	0.00	0.00	0.00
Average			**18.5**		**3.1**			**0**	**195**	**3.06**	**3.24**	**23.40**					**0.26**	**4.20**	**0.44**	**33.98**	**0.00**

Sample ID	ACWA ID	Sample Date	Flow GPM	pH Field	pH Lab	Cond. Umhos	Temp C	Alkalinity mg/L	Acidity mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Susp. Solids mg/L	TDS mg/L	Notes	Fe Loading lbs/day	Al Loading lbs/day	Mn Loading lbs/day	Acidity Loading lbs/day	Alkalinity Loading lbs/day
DMP-BR3.9	BILG 1	10/23/2004	12.0	4.3	4.3	437	8.9	3	15	0.44	3.96	0.71	175.00	10.00	279		0.06	0.10	0.57	2.16	0.43
DMP-BR3.9	BILG 1	12/5/2004	60.0	6.0	4.5	376	4.4	5	17	0.51	2.88	1.02	163.00	5.69	246		0.37	0.74	2.08	12.26	3.61
DMP-BR3.9	BILG 1	12/24/2004	20.0	4.5	4.6	365	3.3	5	12	0.93	3.32	0.95	162.00	8.60	256		0.22	0.23	0.80	2.88	1.20
DMP-BR3.9	BILG 1	1/18/2005														Resampled 1/20					
DMP-BR3.9	BILG 1	1/20/2005	30.0	4.5	4.5	394	0.0	5	16	0.65	2.37	1.19	173.00	5.69			0.23	0.43	0.85	5.77	1.80
DMP-BR3.9	BILG 1	2/13/2005	20.0	4.7	4.8	359	0.0	6	16	1.66	3.08	1.00	163.00	5.69			0.40	0.24	0.74	3.85	1.44
DMP-BR3.9	BILG 1	3/17/2005	20.0	5.2	5.4	344	1.1	9	13	4.35	3.34	0.58	143.00	5.69			1.05	0.14	0.80	3.13	2.16
DMP-BR3.9	BILG 1	4/14/2005	60.0	4.9	4.8	367	6.0	5	15	1.64	2.32	0.95	142.00	5.69			1.18	0.69	1.67	10.82	3.61
DMP-BR3.9	BILG 1	5/23/2005	4.2	5.2	6.1	354	12.0	9	10	2.41	3.01	0.12	145.00	10.00			0.12	0.01	0.15	0.50	0.45
DMP-BR3.9	BILG 1	6/20/2005	1.3	4.7	4.6	363	13.0	4	10	1.00	3.76	0.30	130.00	6.19			0.02	0.00	0.06	0.16	0.06
DMP-BR3.9	BILG 1	9/20/2005		4.5	4.6	381	18.0	4	10	0.75	3.70	0.31	141.00	6.19			0.00	0.00	0.00	0.00	0.00
Average			**25.3**		**4.8**			**6**	**13**	**1.43**	**3.17**	**0.71**	**153.70**				**0.37**	**0.26**	**0.77**	**4.15**	**1.48**

Sample ID	ACWA ID	Sample Date	Flow GPM	pH Field	pH Lab	Cond. Umhos	Temp C	Alkalinity mg/L	Acidity mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Susp. Solids mg/L	TDS mg/L	Notes	Fe Loading lbs/day	Al Loading lbs/day	Mn Loading lbs/day	Acidity Loading lbs/day	Alkalinity Loading lbs/day
DMP-BR4.0	BILG 2	10/23/2004	20.0	3.9	3.8	1390	10.0	0	144	18.90	27.10	12.50	611.00	10.00	1166		4.54	3.01	6.51	34.62	0.00
DMP-BR4.0	BILG 2	12/5/2004	60.0	5.6	3.9	1220	7.8	0	116	7.34	20.80	11.40	615.00	5.69	959		5.29	8.22	15.00	83.66	0.00
DMP-BR4.0	BILG 2	12/24/2004	20.0	4.0	3.6	1170	5.6	0	97	10.10	21.20	10.30	593.00	81.40	819		2.43	2.48	5.10	23.32	0.00
DMP-BR4.0	BILG 2	1/18/2005														Resampled 1/20					
DMP-BR4.0	BILG 2	1/20/2005	60.0	3.9	3.6	1220	5.0	0	122	6.01	21.20	11.60	602.00	5.69			4.33	8.37	15.29	87.99	0.00
DMP-BR4.0	BILG 2	2/13/2005	30.0	3.9	3.8	1160	5.6	0	104	8.83	19.20	10.30	573.00	5.69			3.18	3.71	6.92	37.50	0.00
DMP-BR4.0	BILG 2	3/17/2005	30.0	3.8	3.8	1110	5.6	0	80	6.36	17.90	9.46	552.00	8.60			2.29	3.41	6.45	28.85	0.00
DMP-BR4.0	BILG 2	4/14/2005	20.0	3.8	3.7	1080	5.0	0	87	2.14	13.20	9.38	518.00	6.40			0.51	2.25	3.17	20.91	0.00
DMP-BR4.0	BILG 2	5/23/2005	8.5	3.9	3.8	1130	5.0	0	100	7.81	16.60	10.30	579.00	11.40			0.80	1.05	1.70	10.22	0.00
DMP-BR4.0	BILG 2	6/20/2005	3.0	3.9	3.8	1160	6.0	0	96	7.60	15.80	10.20	593.00	6.19			0.27	0.37	0.57	3.46	0.00
DMP-BR4.0	BILG 2	7/18/2005	1.3	3.8	3.6	1150	7.0	0	96	12.40	17.70	9.96	667.00	18.60			0.19	0.15	0.27	1.44	0.00
DMP-BR4.0	BILG 2	9/20/2005		3.1	3.5	1180	17.0	0	72	2.91	16.30	5.61	577.00	6.19			0.00	0.00	0.00	0.00	0.00
Average			**25.3**		**3.7**			**0**	**101**	**8.22**	**18.82**	**10.09**	**589.09**				**2.17**	**3.00**	**5.54**	**30.18**	**0.00**

Sample ID	ACWA ID	Sample Date	Flow GPM	pH Field	pH Lab	Cond. Umhos	Temp C	Alkalinity mg/L	Acidity mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Susp. Solids mg/L	TDS mg/L	Notes	Fe Loading lbs/day	Al Loading lbs/day	Mn Loading lbs/day	Acidity Loading lbs/day	Alkalinity Loading lbs/day
DMP-BR4.5	BILG 3	10/23/2004	20.0	3.8	3.7	1300	8.3	0	116	11.50	24.80	9.04	528.00	10.00	1026		2.76	2.17	5.96	27.89	0.00
DMP-BR4.5	BILG 3	12/5/2004	20.0	5.8	3.8	1240	3.3	0	119	19.00	25.10	8.34	597.00	5.69	970		4.57	2.00	6.03	28.61	0.00
DMP-BR4.5	BILG 3	12/27/2004	150.0	3.9	4.0	1260	4.0	1	146	24.90	24.10	7.65	646.00	22.90	1081	Estimated fl	44.89	13.79	43.45	263.24	1.80
DMP-BR4.5	BILG 3	1/18/2005	250.0	3.9	3.8	1140	4.0	0	97	8.68	22.90	9.05	563.00	18.60	950	Estimated fl	26.08	27.20	68.81	291.49	0.00
DMP-BR4.5	BILG 3	2/13/2005	25.0	3.8	3.7	1200	-2.2	0	119	17.90	29.90	11.50	572.00	5.69			5.38	3.46	8.98	35.76	0.00
DMP-BR4.5	BILG 3	3/17/2005	60.0	3.9	3.9	1140	1.1	0	104	22.80	24.00	9.09	557.00	5.70			16.44	6.56	17.31	75.00	0.00
DMP-BR4.5	BILG 3	4/14/2005	120.0	3.9	3.9	1150	7.0	0	107	15.60	21.10	9.85	514.00	7.00			22.50	14.21	30.43	154.34	0.00
DMP-BR4.5	BILG 3	5/23/2005	50.0	3.5	3.6	1250	6.0	0	118	14.20	21.90	8.97	611.00	11.40		Estimated fl	8.53	5.39	13.16	70.92	0.00
DMP-BR4.5	BILG 3	6/20/2005	26.0	3.3	3.3	1330	20.0	0	117	7.39	22.30	8.45	614.00	6.19			2.31	2.64	6.97	36.56	0.00
DMP-BR4.5	BILG 3	7/18/2005	16.0	3.2	3.1	1190	20.0	0	109	3.08	20.30	7.70	572.00	6.19			0.59	1.48	3.90	20.96	0.00
DMP-BR4.5	BILG 3	9/20/2005		2.9	3.3	1360	20.0	0	110	4.83	23.10	8.22	627.00	6.19			0.00	0.00	0.00	0.00	0.00
Average			**73.7**		**3.6**			**0**	**115**	**13.63**	**23.59**	**8.90**					**12.19**	**7.17**	**18.64**	**91.34**	**0.16**

Problem Area and discharge data - Raw

Sample ID	ACWA ID	Sample Date	Flow GPM	pH Field	pH Lab	Cond. Umhos	Temp C	Alkalinity mg/L	Acidity mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Susp. Solids mg/L	TDS mg/L	Notes	Fe Loading lbs/day	Al Loading lbs/day	Mn Loading lbs/day	Acidity Loading lbs/day	Alkalinity Loading lbs/day
DMP-KORB1	KORB I	12/18/2004	0.0	3.3	3.1	653		0	189	6.05	1.40	23.80	153.00	5.69			0.00	0.01	0.00	0.09	0.00
DMP-KORB1	KORB I	1/15/2005	12.0	3.0	2.9	890	4.4	0	251	12.80	1.02		242.00	5.69			1.85	0.00	0.15	36.20	0.00
DMP-KORB1	KORB I	2/13/2005	1.3	3.1	3.0	874	-1.7	0	277	12.60	1.51	32.20	275.00	5.69			0.20	0.52	0.02	4.44	0.00
DMP-KORB1	KORB I	4/14/2005	0.5	3.0	3.1	643	16.0	0	162	3.10	1.30	20.30	124.00	7.00			0.02	0.12	0.01	0.97	0.00
Average			**3.5**		**3.0**			**0**	**220**	**8.64**	**1.31**	**26.25**					**0.52**	**0.16**	**0.04**	**10.43**	**0.00**
DMP-KORB2	KORB II	10/23/2004	20.4	2.8	2.6	1680	6.7	0	498	36.30	2.44	51.50	438.00	8.60			8.90	12.63	0.60	122.11	0.00
DMP-KORB2	KORB II	11/21/2004	10.2	2.8	2.7	1550	4.4	0	480	38.50	2.60	54.50	522.00	10.00			4.72	6.68	0.32	58.85	0.00
DMP-KORB2	KORB II	12/18/2004	71.5	2.9	2.7	1470	5.0	0	411	33.50	2.25	46.50	410.00	5.69			28.77	39.94	1.93	352.98	0.00
DMP-KORB2	KORB II	1/15/2005	259.0	2.8	2.8	1200	5.6	0	301	18.40	1.21		295.00	5.69			57.28	0.00	3.77	937.07	0.00
DMP-KORB2	KORB II	2/13/2005	125.5	2.8	2.7	1330	5.0	0	353	25.00	1.88	37.40	350.00	5.69			37.71	56.42	2.84	532.50	0.00
DMP-KORB2	KORB II	3/17/2005	71.5	2.7	2.7	1350	5.6	0	389	25.00	1.91	36.20	403.00	5.70			21.47	31.09	1.64	334.08	0.00
DMP-KORB2	KORB II	4/14/2005	71.5	2.7	2.7	1390	10.0	0	344	24.10	1.80	35.20	387.00	7.60			20.70	30.23	1.55	295.44	0.00
DMP-KORB2	KORB II	5/23/2005	20.4	2.6	2.7	1580	6.0	0	461	29.70	2.28	46.70	471.00	10.00			7.28	11.45	0.56	113.04	0.00
DMP-KORB2	KORB II	6/20/2005	10.2	2.5	2.6	1790	12.0	0	537	36.50	2.74	53.40	557.00	6.19			4.48	6.55	0.34	65.84	0.00
DMP-KORB2	KORB II	7/18/2005	20.0	2.5	2.7	1680	18.0	0	583	57.80	4.17	80.60	616.00	6.19			13.90	19.38	1.00	140.15	0.00
Average			**68.0**		**2.7**			**0**	**436**	**32.48**	**2.33**	**48.25**					**20.52**	**21.44**	**1.45**	**295.21**	**0.00**
DMP-KORB3	KORB III	10/23/2004	N/A	3.1	3.1	646	6.7	0	131	5.13	1.35	13.40	116.00	7.10							
DMP-KORB3	KORB III	11/21/2004	1.0	3.2	3.0	640	4.4	0	142	6.64	1.45	12.90	149.00	5.69			0.08	0.16	0.02	1.71	0.00
DMP-KORB3	KORB III	12/18/2004	4.0	3.1	3.0	717	3.9	0	181	4.59	1.66	21.80	146.00	5.69			0.22	1.05	0.08	8.70	0.00
DMP-KORB3	KORB III	1/15/2005	12.0	3.2	3.1	577	40.0	0	141	2.89	1.19		114.00	5.69			0.42	0.00	0.17	20.34	0.00
DMP-KORB3	KORB III	2/13/2005	7.5	3.1	3.1	573	4.4	0	140	3.93	1.32	15.60	120.00	5.69			0.35	1.41	0.12	12.62	0.00
DMP-KORB3	KORB III	3/17/2005	3.0	3.1	3.1	638	3.3	0	143	8.63	1.48	16.40	143.00	5.69			0.31	0.59	0.05	5.16	0.00
DMP-KORB3	KORB III	4/14/2005	4.0	3.1	3.1	679	7.0	0	158	4.78	1.63	19.00	134.00	8.30			0.23	0.91	0.08	7.60	0.00
DMP-KORB3	KORB III	5/23/2005	1.3	3.1	3.1	661	8.0	0	140	5.51	1.67	15.60	147.00	8.60			0.09	0.25	0.03	2.24	0.00
DMP-KORB3	KORB III	6/20/2005	0.5	2.9	3.0	822	18.0	0	160	5.90	1.95	15.00	211.00	6.19			0.04	0.09	0.01	0.96	0.00
DMP-KORB3	KORB III	7/18/2005	0.5	2.9	3.0	714	21.0	0	134	3.90	1.31	10.30	134.00	6.19			0.02	0.06	0.01	0.81	0.00
Average			**3.8**		**3.1**			**0**	**147**	**5.19**	**1.50**	**15.32**					**0.20**	**0.50**	**0.06**	**6.68**	**0.00**
DMP-LA5.9-1	LAH 1	10/23/2004	8.9	4.4	3.6	564	5.6	0	45	3.63	4.67	2.99	202.00	10.00			0.39	0.32	0.50	4.81	0.00
DMP-LA5.9-1	Cramer2	12/18/2004	16.7	4.3	4.3	911	6.1	3	36	0.05	8.62	2.50	430.00	5.69			0.01	0.50	1.73	7.23	0.60
DMP-LA5.9-1	Cramer2	1/15/2005	50.3	4.2	4.3	939	6.7	3	32	0.05	10.80		447.00	5.69			0.03	0.00	6.53	19.35	1.81
DMP-LA5.9-1	Cramer2	2/13/2005	14.6	4.3	4.3	856	6.1	7	30	0.05	8.66	2.62	399.00	5.69			0.01	0.46	1.52	5.26	1.23
DMP-LA5.9-1	Cramer2	3/17/2005	8.9	4.2	4.3	842	6.7	5	25	0.42	8.27	2.41	387.00	5.69			0.04	0.26	0.88	2.67	0.53
DMP-LA5.9-1	Cramer2	4/14/2005	27.5	4.1	4.3	875	11.0	3	26	0.05	8.64	2.44	427.00	18.60			0.02	0.81	2.86	8.59	0.99
Average			**21.1**		**4.2**			**4**	**32**	**0.71**	**8.28**	**2.49**					**0.08**	**0.39**	**2.34**	**7.99**	**0.86**
DMP-LA5.9-2	Cramer1	11/21/2004	2.2	4.5	4.3	520	5.6	6	18	0.15	4.16	1.00	240.00	10.00			0.00	0.03	0.11	0.48	0.16
DMP-LA5.9-2	Cramer1	12/18/2004	21.7	4.3	4.4	571	5.6	4	24	0.05	4.64	1.27	275.00	5.69			0.01	0.33	1.21	6.26	1.04
DMP-LA5.9-2	Cramer1	1/15/2005	85.8	4.3	4.5	605	5.6	5	17	1.03	4.81		299.00	5.69			1.06	0.00	4.96	17.53	5.16
DMP-LA5.9-2	Cramer1	2/13/2005	8.9	4.5	4.4	522	6.1	4	19	0.06	4.83	1.25	245.00	5.69			0.01	0.13	0.52	2.03	0.43
DMP-LA5.9-2	Cramer1	3/17/2005	16.7	4.4	4.6	527	6.1	7	16	0.05	4.29	1.02	230.00	5.69			0.01	0.20	0.86	3.21	1.41
DMP-LA5.9-2	Cramer1	4/14/2005	26.7	4.4	4.5	540	8.0	5	14	1.44	4.40	1.31	219.00	8.80			0.46	0.42	1.41	4.49	1.60
DMP-LA5.9-2	Cramer1	5/23/2005	6.1	4.7	4.5	513	6.0	4	16	0.06	3.96	1.03	213.00	8.60			0.00	0.08	0.29	1.17	0.29
DMP-LA5.9-2	Cramer1	6/20/2005	3.8	4.5	4.4	510	9.0	4	16	1.02	4.19	1.18	207.00	25.70			0.05	0.05	0.19	0.74	0.18
DMP-LA5.9-2	Cramer1	7/18/2005	2.2	4.3	4.4	492	12.0	4	17	0.17	4.30	0.86	199.00	6.19			0.00	0.02	0.11	0.45	0.11
DMP-LA5.9-2	Cramer1	8/19/2005	0.4	2.6	4.5	500	13.0	5	14	0.27	5.22	0.82	227.00	6.19			0.00	0.00	0.03	0.07	0.03
Average			**17.5**		**4.5**			**5**	**17**	**0.43**	**4.48**	**1.07**					**0.16**	**0.13**	**0.97**	**3.64**	**1.04**

Problem Area and discharge data - Raw

Sample ID	ACWA ID	Sample Date	Flow GPM	pH Field	pH Lab	Cond. Umhos	Temp C	Alkalinity mg/L	Acidity mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Susp. Solids mg/L	TDS mg/L	Notes	Fe Loading lbs/day	Al Loading lbs/day	Mn Loading lbs/day	Acidity Loading lbs/day	Alkalinity Loading lbs/day
DMP-Korb4	SPEN	10/23/2004	35.4	2.8	2.7	1570	6.1	0	398	54.30	11.30	34.40	466.00	10.00			23.11	14.64	4.81	169.35	0.00
DMP-Korb4	SPEN	11/21/2004	29.4	2.9	2.7	1510	5.6	0	428	53.09	9.78	32.40	575.00	5.70			18.76	11.45	3.46	151.25	0.00
DMP-Korb4	SPEN	12/18/2004	136.0	2.9	2.7	1530	5.6	0	394	48.60	8.33	31.10	524.00	5.69			79.45	50.84	13.62	644.08	0.00
DMP-Korb4	SPEN	1/15/2005	233.5	2.9	2.8	1350	5.6	0	327	31.80	6.12		428.00	5.69			89.25	0.00	17.18	917.78	0.00
DMP-Korb4	SPEN	2/13/2005	57.2	2.8	2.8	1370	5.6	0	344	36.20	7.05	25.50	460.00	5.69			24.89	17.53	4.85	236.52	0.00
DMP-Korb4	SPEN	3/17/2005	157.0	2.7	2.8	1460	5.0	0	343	38.40	7.90	25.60	487.00	5.69			72.47	48.31	14.91	647.29	0.00
DMP-Korb4	SPEN	4/14/2005	117.0	2.8	2.8	1400	9.0	0	307	32.90	7.20	23.50	454.00	5.69			46.27	33.05	10.13	431.75	0.00
DMP-Korb4	SPEN	5/23/2005	64.9	2.8	2.8	1530	7.0	0	359	36.70	8.09	26.40	498.00	10.00			28.63	20.59	6.31	280.06	0.00
DMP-Korb4	SPEN	6/20/2005	49.5	2.6	2.7	1640	13.0	0	388	47.30	9.89	34.10	528.00	6.19			28.14	20.29	5.88	230.86	0.00
DMP-Korb4	SPEN	7/18/2005	35.4	2.6	2.7	1550	12.0	0	413	45.60	9.09	32.30	582.00	6.19			19.40	13.74	3.87	175.73	0.00
DMP-Korb4	SPEN	8/19/2005	12.8	2.5	2.7	1600	12.0	0	436	49.10	9.81	35.70	622.00	6.19			7.55	5.49	1.51	67.08	0.00
DMP-Korb4	SPEN	9/20/2005	20.4	2.3	2.7	1800	14.0	0	450	53.50	10.60	39.40	656.00	6.19			13.12	9.66	2.60	110.34	0.00
Average			**79.0**		**2.7**			**0**	**382**	**43.96**	**8.76**	**30.31**					**37.59**	**20.47**	**7.43**	**338.51**	**0.00**
DMP-Widemire	tipple	10/23/2004	98.5	4.2	3.8	397	6.1	0	41	6.70	2.38	5.07	137.00	15.70			7.93	6.00	2.82	48.54	0.00
DMP-Widemire	tipple	11/18/2004	98.5	4.3	3.9	352	7.2	0	35	7.44	2.36	4.01	144.00	14.30	230		8.81	4.75	2.79	41.44	0.00
DMP-Widemire	tipple	12/18/2004	136.0	3.6	3.9	398	6.7	0	47	6.01	2.10	5.13	141.00	7.10	230		9.82	8.39	3.43	76.83	0.00
DMP-Widemire	tipple	1/19/2005	245.0	3.9	3.7	404	1.1	0	53	6.39	2.33	6.58	154.00	31.40	261		18.82	19.38	6.86	156.08	0.00
DMP-Widemire	tipple	2/16/2005	117.0	3.8	4.1	354	6.1	1	50	2.54	1.98	5.41	141.00	8.60	209		3.57	7.61	2.78	70.32	1.41
DMP-Widemire	tipple	3/22/2005	98.5	3.8	4.0	383	8.3	0	44	3.42	2.36	6.32	150.00	5.69	214		4.05	7.48	2.79	52.09	0.00
DMP-Widemire	tipple	4/20/2005	98.5	3.5	3.9	403	8.9	0	53	3.12	2.15	6.48	150.00	12.90	259		3.69	7.67	2.55	62.75	0.00
DMP-Widemire	tipple	5/18/2005	81.0	2.9	4.0	372	8.9	0	45	3.01	2.15	5.50	137.00	5.69	241		2.93	5.35	2.09	43.81	0.00
DMP-Widemire	tipple	6/22/2005	49.5	3.1	3.9	389	14.4	0	38	4.56	2.12	4.89	132.00	8.60	237		2.71	2.91	1.26	22.61	0.00
DMP-Widemire	tipple	7/20/2005	47.0	3.3	3.9	368	10.0	0	64	7.38	2.33	3.87	135.00	6.19	233		4.17	2.19	1.32	36.16	0.00
DMP-Widemire	tipple	8/24/2005	35.4	3.6	4.0	373	8.9	0	71	9.35	2.35	3.19	131.00	12.90	249		3.98	1.36	1.00	30.21	0.00
DMP-Widemire	tipple	9/14/2005	42.5	3.8	3.8	286	8.3	0	39	10.10	2.26	2.81	130.00	8.60	264		5.16	1.44	1.15	19.92	0.00
Average			**95.6**		**3.9**			**0**	**48**	**5.84**	**2.24**	**4.94**					**6.30**	**6.21**	**2.57**	**55.06**	**0.12**
DMP-Wildwood	WILD	10/23/2004	117.0	6.0	5.6	402	6.7	10	16	10.70	2.37	0.05	154.00	15.70			15.05	0.07	3.33	22.50	14.06
DMP-Wildwood	WILD	11/18/2004	136.0	6.3	5.5	420	6.1	9	12	10.30	2.56	0.05	185.00	10.00	296		16.84	0.08	4.18	19.62	14.71
DMP-Wildwood	WILD	12/18/2004	81.0	6.2	6.1	332	3.3	12	14	9.29	1.69	0.05	125.00	7.10	207		9.04	0.05	1.65	13.63	11.68
DMP-Wildwood	WILD	1/19/2005	178.0	6.1	6.2	288	-1.1	10	11	7.86	1.57	0.05	101.00	24.30	193		16.82	0.11	3.36	23.54	21.40
DMP-Wildwood	WILD	2/16/2005	189.0	6.1	6.2	246	5.0	10	7	4.68	0.93	0.06	69.00	8.60	137		10.63	0.14	2.11	15.90	22.72
DMP-Wildwood	WILD	3/22/2005	127.0	5.9	5.8	336	5.6	7	8	3.96	1.69	0.05	116.00	5.69	187		6.05	0.07	2.58	12.21	10.69
DMP-Wildwood	WILD	4/20/2005	81.0	5.6	5.4	425	8.9	7	14	4.30	2.38	0.05	163.00	8.60	284		4.19	0.05	2.32	13.63	6.82
DMP-Wildwood	WILD	5/18/2005	49.5	5.9	5.1	463	10.6	6	13	5.82	2.87	0.05	182.00	5.69	291		3.46	0.03	1.71	7.73	3.57
DMP-Wildwood	WILD	6/22/2005	42.4	5.9	5.9	526	12.2	9	15	9.67	3.52	0.05	204.00	7.10	354		4.93	0.02	1.79	7.64	4.59
DMP-Wildwood	WILD	7/20/2005	64.9	5.9	5.9	545	14.4	11	22	13.80	3.69	0.05	235.00	6.19	389		10.77	0.04	2.88	17.16	8.58
DMP-Wildwood	WILD	8/24/2005	42.5	5.9	5.5	592	8.9	9	50	13.80	4.67	0.05	246.00	8.60	421		7.05	0.03	2.39	25.54	4.60
DMP-Wildwood	WILD	9/14/2005	42.5	5.9	5.5	467	11.1	11	24	12.70	4.60	0.05	240.00	6.19	430		6.49	0.03	2.35	12.26	5.62
Average			**95.9**		**5.7**			**9**	**17**	**8.91**	**2.71**	**0.05**					**9.28**	**0.06**	**2.55**	**15.95**	**10.75**

Problem Area and discharge data - Raw

Sample ID	ACWA ID	Sample Date	Flow GPM	pH Field	pH Lab	Cond. Umhos	Temp C	Alkalinity mg/L	Acidity mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Susp. Solids mg/L	TDS mg/L	Notes	Fe Loading lbs/day	Al Loading lbs/day	Mn Loading lbs/day	Acidity Loading lbs/day	Alkalinity Loading lbs/day
DMP-Drauker1	DRAUK1	10/22/2004	35.4	2.9	2.8	223	11.0	0	645	75.30	20.80	48.50	837.00	5.69	1504		32.04	20.64	8.85	274.45	0.00
DMP-Draucker1	DRAUK1	11/18/2004	64.9	2.7	2.7	2160	12.0	0	677	103.00	24.30	59.40	1018.00	5.69	1511		80.35	46.34	18.96	528.13	0.00
DMP-Draucker1	DRAUK1	12/17/2004	178.0	2.8	2.7	2030	12.0	0	652	59.00	15.60	58.40	808.00	5.69	1217		126.23	124.95	33.38	1394.99	0.00
DMP-Draucker1	DRAUK1	1/19/2005	294.0	2.9	2.7	1870	10.0	0	519	52.90	15.60	49.40	714.00	21.40	1117		186.94	174.57	55.13	1834.08	0.00
DMP-Draucker1	DRAUK1	2/16/2005	178.0	3.1	2.7	1840	10.0	0	591	62.10	18.50	56.30	775.00	7.10	1214		132.87	120.46	39.58	1264.48	0.00
DMP-Draucker1	DRAUK1	3/18/2005	136.0	2.7	2.7	1870	11.0	0	574	67.70	20.20	52.70	832.00	10.00	1454		110.67	86.15	33.02	938.33	0.00
DMP-Draucker1	DRAUK1	4/18/2005	136.0	2.8	2.8	1830	10.0	0	546	62.30	18.50	49.80	753.00	17.10	1197		101.84	81.41	30.24	892.56	0.00
DMP-Draucker1	DRAUK1	5/23/2005	98.5	2.8	2.8	1940	11.0	0	634	70.00	18.50	49.40	875.00	7.10	1336		82.88	58.49	21.90	750.64	0.00
DMP-Draucker1	DRAUK1	6/17/2005	64.9	2.8	2.8	1990	10.0	0	650	94.00	24.60	60.80	890.00	6.19	1580		73.33	47.43	19.19	507.06	0.00
DMP-Draucker1	DRAUK1	7/15/2005	64.9	2.8	2.8	2010	9.0	0	682	94.40	25.30	69.40	984.00	6.19	1636		73.64	54.14	19.74	532.03	0.00
DMP-Draucker1	DRAUK1	8/22/2005	35.4	2.8	2.8	2030	9.0	0	647	98.80	27.10	61.80	1059.00	6.19	1533		42.04	26.30	11.53	275.30	0.00
DMP-Draucker1	DRAUK1	9/19/2005	23.4	2.8	2.8	2000	10.6	0	670	104.00	28.10	68.80	1021.00	6.19	1556		29.25	19.35	7.90	188.45	0.95
Average			**109.1**		**2.8**			**0**	**624**	**78.63**	**21.43**	**57.06**					**89.34**	**71.68**	**24.95**	**781.71**	**0.08**
DMP-Draucker2	DRAUK2	10/22/2004	178.0	4.1	4.1	505	10.0	2	21	1.76	4.36	1.01	180.00	7.10	293		3.77	2.16	9.33	44.93	4.28
DMP-Draucker2	DRAUK2	11/18/2004	136.0	3.9	3.9	490	9.0	0	26	2.19	4.34	0.92	191.00	5.69	297		3.58	1.50	7.09	42.50	0.00
DMP-Draucker2	DRAUK2	1/19/2005	370.0	4.3	4.3	509	1.0	3	18	0.76	3.40	1.31	209.00	22.90	321		3.38	5.83	15.12	80.05	13.34
DMP-Draucker2	DRAUK2A	12/17/2004	870.2	4.1	4.0	429	3.0	1	27	0.95	3.04	1.23	161.00	5.69	250		9.94	12.87	31.80	282.41	10.46
DMP-Draucker2	DRAUK2A	2/16/2005	324.0	4.2	4.1	439	2.0	1	28	1.09	3.32	1.60	164.00	11.40	247		4.24	6.23	12.93	109.05	3.89
DMP-Draucker2	DRAUK2A	3/18/2005	209.6	4.1	4.1	525	3.0	1	25	0.80	3.47	1.52	194.00	8.60	355		2.02	3.83	8.74	62.98	2.52
DMP-Draucker2	DRAUK2	4/18/2005	258.1	4.0	4.0	547	12.0	1	27	0.68	3.33	1.67	183.00	14.30	343		2.11	5.18	10.33	83.76	3.10
DMP-Draucker2	DRAUK2	5/23/2005	106.4	3.8	3.8	511	11.0	0	25	1.07	3.52	1.00	165.00	14.30	296		1.37	1.28	4.50	31.97	0.00
DMP-Draucker2	DRAUK2	6/17/2005	98.5	3.7	3.7	627	14.4	0	28	2.21	5.03	0.82	189.00	6.19	346		2.62	0.97	5.96	33.15	0.00
DMP-Draucker2	DRAUK2A	7/15/2005	49.5	3.4	3.5	685	17.0	0	43	4.42	5.07	0.47	214.00	6.19	390		2.63	0.28	3.02	25.58	0.00
DMP-Draucker2	DRAUK2A	8/22/2005	35.4	3.4	3.5	671	17.0	0	38	6.95	6.35	0.23	208.00	7.10	361		2.96	0.10	2.70	16.17	0.00
DMP-Draucker2	DRAUK2A	9/19/2005	35.4	3.4	3.5	634	15.6	0	37	5.99	5.69	0.29	225.00	6.19	357		2.55	0.12	2.42	15.74	0.24
Average			**222.6**		**3.9**			**1**	**29**	**2.41**	**4.24**	**1.01**					**3.43**	**3.36**	**9.50**	**69.03**	**3.15**
PAMP-LA3.0-3	OWENS1	10/22/2004	117.0	3.5	3.5	663	10.0	0	33	2.17	7.33	0.77	253.00	8.60	390		3.05	1.08	10.31	46.41	0.00
PAMP-LA3.0-3	OWENS1	11/18/2004	64.9	3.4	3.5	760	9.0	0	45	2.82	8.67	0.68	315.00	5.69	464		2.20	0.53	6.76	35.10	0.00
PAMP-LA3.0-3	OWENS1	12/17/2004	157.0	3.7	3.7	603	3.0	0	41	2.80	6.97	1.12	249.00	5.69	356		5.28	2.11	13.15	77.37	0.00
PAMP-LA3.0-3	OWENS1	1/19/2005	370.0	3.7	3.7	542	1.0	0	29	1.55	5.69	1.46	237.00	18.60	349		6.89	6.49	25.31	128.97	0.00
PAMP-LA3.0-3	OWENS1	2/16/2005	294.0	3.9	3.7	459	2.0	0	27	1.79	5.69	1.08	180.00	5.70	269		6.33	3.82	20.11	95.41	0.00
PAMP-LA3.0-3	OWENS1	3/18/2005	157.0	3.6	3.6	617	5.0	0	33	2.21	7.71	1.10	254.00	10.00	436		4.17	2.08	14.55	62.28	0.00
PAMP-LA3.0-3	OWENS1	4/18/2005	200.0	3.5	3.6	653	11.0	0	34	1.47	7.58	1.42	227.00	14.30	410		3.53	3.41	18.22	81.74	0.00
PAMP-LA3.0-3	OWENS1	5/23/2005	136.0	3.4	3.4	690	12.0	0	42	1.67	7.78	0.81	274.00	10.00	423		2.73	1.32	12.72	68.66	0.00
PAMP-LA3.0-3	OWENS1	6/17/2005	64.9	3.3	3.4	817	14.4	0	47	2.70	8.10	0.57	298.00	6.19	461		2.11	0.44	6.32	36.66	0.00
PAMP-LA3.0-3	OWENS1	7/15/2005	35.4	3.2	3.2	1080	19.0	0	72	5.08	12.10	0.50	399.00	6.19	614		2.16	0.21	5.15	30.64	0.00
PAMP-LA3.0-3	OWENS1	8/22/2005	23.4	3.2	3.2	1070	18.0	0	77	7.90	13.40	0.44	494.00	7.10	670		2.22	0.12	3.77	21.66	0.00
PAMP-LA3.0-3	OWENS1	9/19/2005	12.8	3.1	3.2	1220	15.6	0	76	8.23	13.70	0.45	464.00	6.19	721		1.27	0.07	2.11	11.69	0.53
Average			**136.0**		**3.5**			**0**	**46**	**3.37**	**8.73**	**0.87**					**3.50**	**1.81**	**11.54**	**58.05**	**0.04**

Problem Area and discharge data - Raw

Sample ID	ACWA ID	Sample Date	Flow GPM	pH Field	pH Lab	Cond. Umhos	Temp C	Alkalinity mg/L	Acidity mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Susp. Solids mg/L	TDS mg/L	Notes	Fe Loading lbs/day	Al Loading lbs/day	Mn Loading lbs/day	Acidity Loading lbs/day	Alkalinity Loading lbs/day
PAMP-LA3.0-2	OWENS2	10/22/2004	117.0	3.5	3.4	671	10.0	0	67	2.38	5.24	4.38	243.00	5.69	394		3.35	6.16	7.37	94.22	0.00
PAMP-LA3.0-2	OWENS2	11/18/2004	98.5	3.3	3.4	755	9.0	0	69	3.46	7.20	4.78	290.00	5.69	454		4.10	5.66	8.52	81.69	0.00
PAMP-LA3.0-2	OWENS2	12/17/2004	245.0	3.5	3.3	648	3.0	0	86	2.81	5.04	6.51	216.00	5.69	344	Estimated fl	8.28	19.17	14.84	253.26	0.00
PAMP-LA3.0-2	OWENS2	1/19/2005	543.0	3.5	3.5	583	2.0	0	61	1.84	4.84	5.02	220.00	18.60	331	Estimated fl	12.01	32.76	31.59	398.14	0.00
PAMP-LA3.0-2	OWENS2	2/16/2005	448.8	3.6	3.5	532	4.0	0	59	2.11	5.17	4.64	197.00	5.69	283		11.38	25.03	27.89	318.28	0.00
PAMP-LA3.0-2	OWENS2	3/18/2005	235.5	3.4	3.4	626	4.0	0	70	2.41	5.78	4.91	212.00	7.10	391		6.82	13.90	16.36	198.15	0.00
PAMP-LA3.0-2	OWENS2	4/18/2005	300.0	3.4	3.4	664	18.0	0	62	2.59	5.64	5.34	210.00	11.40	387		9.34	19.26	20.34	223.57	0.00
PAMP-LA3.0-2	OWENS2	5/23/2005	178.0	3.3	3.4	691	13.0	0	61	2.13	6.13	3.66	255.00	8.60	387		4.56	7.83	13.12	130.51	0.00
PAMP-LA3.0-2	OWENS2	6/17/2005	117.0	3.3	3.3	734	15.6	0	64	5.39	7.86	3.65	234.00	6.19	417		7.58	5.13	11.05	90.01	0.00
PAMP-LA3.0-2	OWENS2	7/15/2005	49.5	3.1	3.3	942	22.0	0	82	4.76	10.40	4.52	362.00	6.19	551		2.83	2.69	6.19	48.79	0.00
PAMP-LA3.0-2	OWENS2	8/22/2005	35.4	3.2	3.2	969	23.0	0	82	6.92	10.60	3.37	356.00	6.19	591		2.94	1.43	4.51	34.89	0.00
PAMP-LA3.0-2	OWENS2	9/19/2005	23.4	3.2	3.3	1020	18.9	0	82	9.53	12.00	2.93	406.00	6.19	697		2.68	0.82	3.38	23.06	0.00
Average			**199.3**		**3.4**			**0**	**70**	**3.86**	**7.16**	**4.48**					**6.32**	**11.65**	**13.76**	**157.88**	**0.00**
PAMP-KR1.45-1	FALL	10/23/2004	81.0	3.8	4.0	460	6.1	0	57	0.26	5.70	7.00	192.00	10.00			0.25	6.82	5.55	55.50	0.00
PAMP-KR1.45-1	FALLS	11/18/2004	81.0	3.9	4.0	407	7.2	0	47	0.20	5.53	6.31	175.00	5.69	269		0.19	6.14	5.38	45.76	0.00
PAMP-KR1.45-1	FALLS	12/18/2004	222.0	3.1	4.0	424	0.6	0	59	0.21	3.74	5.90	173.00	5.69	277		0.56	15.74	9.98	157.44	0.00
PAMP-KR1.45-1	FALLS	1/19/2005	245.0	4.1	4.0	387	0.0	0	52	0.23	4.28	6.67	167.00	17.10	266		0.68	19.64	12.60	153.13	0.00
PAMP-KR1.45-1	FALLS	2/16/2005	245.0	3.9	4.2	307	3.3	2	36	0.17	2.98	4.42	121.00	5.70	174		0.50	13.02	8.78	106.02	5.89
PAMP-KR1.45-1	FALLS	3/22/2005	245.0	3.9	4.1	366	2.8	2	45	0.27	4.10	6.43	146.00	5.69	211		0.80	18.94	12.07	132.52	5.89
PAMP-KR1.45-1	FALLS	4/20/2005	90.0	3.5	4.0	445	10.0	0	56	0.16	4.97	7.51	181.00	5.70	287		0.17	8.12	5.38	60.58	0.00
PAMP-KR1.45-1	FALLS	5/18/2005	35.4	2.7	4.0	417	9.4	0	53	0.15	4.74	6.45	159.00	5.69	277		0.06	2.74	2.02	22.55	0.00
PAMP-KR1.45-1	FALLS	6/22/2005	12.8	2.6	3.9	465	13.9	0	56	0.20	5.79	8.51	173.00	6.19	300		0.03	1.31	0.89	8.62	0.00
PAMP-KR1.45-1	FALLS	7/20/2005	23.4	2.4	3.9	439	16.7	0	57	0.31	5.19	6.52	164.00	6.19	277		0.09	1.83	1.46	16.03	0.00
PAMP-KR1.45-1	FALLS	8/24/2005	4.5	2.5	3.8	682	8.9	0	216	0.44	9.33	14.50	311.00	6.19	534		0.02	0.78	0.50	11.68	0.00
PAMP-KR1.45-1	FALLS	9/14/2005	45.0	2.3	3.8	731	13.3	0	134	0.50	9.65	15.20	324.00	6.19	593		0.27	8.22	5.22	72.48	0.00
Average			**110.8**		**4.0**			**0**	**72**	**0.26**	**5.50**	**7.95**					**0.30**	**8.61**	**5.82**	**70.19**	**0.98**
PAMP-LA4.3-1		10/23/2004	262.0	3.6	3.5	626	8.0	0	91	8.11	8.10	7.42	221.00	14.30			25.54	23.37	25.51	286.58	0.00
PAMP-LA4.3-1		11/22/2004	262.0	3.7	3.6	555	6.0	0	80	7.16	8.02	7.33	224.00	11.40			22.55	23.09	25.26	251.96	0.00
PAMP-LA4.3-1		2/9/2005		3.9	3.8	381	2.0	0	49	3.77	5.08	5.02	136.00	5.69		no flow taken-too high					
PAMP-LA4.3-1		3/16/2005		4.1	3.6	461	0.0	0	64	3.65	5.89	6.12	194.00	5.69		Ice prevented flow reading					
PAMP-LA4.3-1		4/14/2005	426.8	3.6	3.6	521	10.0	0	53	2.86	5.92	5.87	181.00	5.69			14.67	30.11	30.37	271.90	0.00
PAMP-LA4.3-1		5/18/2005	130.0	3.5	3.5	604	12.5	0	90	4.09	7.48	6.91	217.00	5.69		Flow adjust	6.39	10.80	11.69	140.63	0.00
PAMP-LA4.3-1		6/15/2005	100.0	3.0	3.2	962	19.0	0	137	8.90	11.10	9.43	339.00	6.19		Flow adjust	10.70	11.33	13.34	164.67	0.00
PAMP-LA4.3-1		7/13/2005	30.0	3.2	3.1	1210	21.0	0	183	12.60	16.20	13.10	466.00	6.19		both dischar	4.54	4.72	5.84	65.99	0.00
PAMP-LA4.3-1		8/22/2005	9.6	3.0	3.0	1300	18.0	0	234	18.60	21.30	16.80	638.00	6.19		estimated fl	2.16	1.95	2.47	27.11	0.00
PAMP-LA4.3-1		9/14/2005	10.0	3.1	3.0	1420	16.0	0	220	18.30	22.20	17.50	576.00	6.19			2.20	2.10	2.67	26.44	0.00
Average			**153.8**		**3.4**			**0**	**120**	**8.80**	**11.13**	**9.55**					**11.09**	**13.43**	**14.64**	**154.41**	**0.00**
PAMP-LA4.3-2		10/23/2004	112.0	6.1	5.9	178	9.0	8	4	0.70	0.87	0.11	43.00	12.90			0.94	0.15	1.17	5.38	10.77
PAMP-LA4.3-2		11/22/2004	91.2	6.0	6.0	153	7.0	10	4	0.62	0.69	0.09	39.00	10.00			0.68	0.10	0.76	4.38	10.96
PAMP-LA4.3-2		2/9/2005		5.9	6.0	142	3.0	8	5	9.95	0.70	1.38	36.00	22.90		No flow taken-too high					
PAMP-LA4.3-2		3/16/2005	136.2	5.8	5.5	158	3.0	8	10	0.32	0.59	0.15	41.00	5.69		Flow read w	0.52	0.25	0.97	16.37	13.10
PAMP-LA4.3-2		4/14/2005	136.2	5.5	6.0	176	11.0	6	4	0.45	0.55	0.24	45.00	5.69			0.74	0.39	0.90	6.55	9.82
PAMP-LA4.3-2		5/18/2005	64.4	5.9	5.9	167	15.0	8	7	0.41	0.74	0.14	37.00	5.69			0.32	0.11	0.57	5.42	6.19
PAMP-LA4.3-2		6/15/2005	30.2	5.8	6.3	194	18.5	9	3	0.72	1.38	0.20	49.00	6.19			0.26	0.07	0.50	1.09	3.27
PAMP-LA4.3-2		7/13/2005	15.0	5.8	6.0	242	21.0	9	6	0.50	1.99	0.12	71.00	6.19			0.09	0.02	0.36	1.08	1.63
PAMP-LA4.3-2		8/22/2005	3.0	6.0	6.2	272	20.0	9	6	1.03	2.41	0.15	75.00	6.19		estimated fl	0.04	0.01	0.09	0.22	0.32
PAMP-LA4.3-2		9/14/2005	3.0	5.8	6.3	207	21.0	11	1	1.09	1.56	0.13	67.00	6.19		estimated fl	0.04	0.00	0.06	0.04	0.40
Average			**65.7**		**6.0**			**9**	**5**	**1.58**	**1.15**	**0.27**					**0.40**	**0.12**	**0.60**	**4.50**	**4.96**

Problem Area and discharge data - Raw

Sample ID	ACWA ID	Sample Date	Flow GPM	pH Field	pH Lab	Cond. Umhos	Temp C	Alkalinity mg/L	Acidity mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Susp. Solids mg/L	TDS mg/L	Notes	Fe Loading lbs/day	Al Loading lbs/day	Mn Loading lbs/day	Acidity Loading lbs/day	Alkalinity Loading lbs/day
PAMP-LA3.0-4	REAS	10/22/2004	35.4	3.5	3.5	777	11.0	0	48	11.00	9.50	0.51	323.00	15.70	496		4.68	0.22	4.04	20.42	0.00
PAMP-LA3.0-4	REAS	11/18/2004	64.9	3.5	3.5	859	10.0	0	63	15.40	11.30	0.44	387.00	5.69	587		12.01	0.34	8.82	49.15	0.00
PAMP-LA3.0-4	REAS	12/17/2004	98.5	3.9	3.6	805	3.0	0	64	19.00	11.70	0.69	386.00	10.00	544		22.50	0.82	13.85	75.77	0.00
PAMP-LA3.0-4	REAS	1/19/2005	178.0	3.7	3.5	648	5.0	0	38	4.72	8.01	0.92	271.00	30.00	407		10.10	1.97	17.14	81.30	0.00
PAMP-LA3.0-4	REAS	2/16/2005	178.0	3.8	3.8	607	4.0	0	40	8.49	8.02	0.70	284.00	7.10	409		18.16	1.50	17.16	85.58	0.00
PAMP-LA3.0-4	REAS	3/18/2005	136.0	3.6	3.8	688	3.0	0	45	12.10	9.42	0.69	322.00	10.00	578		19.78	1.13	15.40	73.56	0.00
PAMP-LA3.0-4	REAS	4/18/2005	136.0	3.5	3.6	717	11.0	0	42	7.97	9.11	0.85	292.00	14.30	467		13.03	1.39	14.89	68.66	0.00
PAMP-LA3.0-4	REAS	5/23/2005	136.0	3.5	3.5	738	10.0	0	55	9.38	8.77	0.52	322.00	11.40	491		15.33	0.85	14.34	89.91	0.00
PAMP-LA3.0-4	REAS	6/17/2005	35.4	3.4	3.4	873	13.3	0	62	13.90	13.10	0.44	362.00	10.00	593		5.91	0.19	5.57	26.38	0.00
PAMP-LA3.0-4	REAS	7/15/2005	23.4	3.2	3.3	1110	18.0	0	84	11.60	13.50	0.35	437.00	6.19	670		3.26	0.10	3.80	23.63	0.00
PAMP-LA3.0-4	REAS	8/22/2005	12.8	3.2	3.2	1140	20.0	0	96	15.20	13.20	0.28	597.00	6.19	734		2.34	0.04	2.03	14.77	0.00
PAMP-LA3.0-4	REAS	9/19/2005	12.8	3.1	3.2	1250	18.9	0	101	14.60	15.00	0.31	501.00	6.19	777		2.25	0.05	2.31	15.54	0.00
Average			**87.3**		**3.5**			**0**	**62**	**11.95**	**10.89**	**0.56**					**10.78**	**0.72**	**9.95**	**52.06**	**0.00**

PAMP-LA3.0-1	SLT	12/17/2004	6.0	3.4	3.3	566	2.0	0	115	0.90	3.27	13.80	139.00	5.69	267		0.06	1.00	0.24	8.29	0.00
PAMP-LA3.0-1	SLT	1/19/2005	12.0	3.4	3.2	674	2.0	0	142	1.38	3.80	19.10	197.00	22.90	357		0.20	2.75	0.55	20.48	0.00
PAMP-LA3.0-1	SLT	2/16/2005	13.3	3.6	3.3	511	1.0	0	115	1.58	3.43	16.00	145.00	8.60	260		0.25	2.56	0.55	18.38	0.00
Average			**10.4**		**3.3**				**124**	**1.29**	**3.50**	**16.30**					**0.17**	**2.10**	**0.44**	**15.72**	**0.00**

Stream Monitoring Data - Raw

SMP-AC1		10/23/2004	20169.0	6.2	6.2	198	9.0	9	4	0.21	0.78	0.43	57.00	12.90			50.91	104.25	189.10	969.73	2181.88
SMP-AC1		11/22/2004	21764.3	6.3	6.2	188	7.0	8	8	0.26	0.90	0.52	62.00	10.00			68.02	136.04	235.45	2092.86	2092.86
SMP-AC1		2/9/2005	60343.9	6.4	5.8	246	1.0	7	7	1.00	1.43	1.15	74.00	8.60			725.33	834.13	1037.23	5077.34	5077.34
SMP-AC1		3/16/2005	35763.1	6.2	4.9	186	0.0	8	10	0.51	0.77	0.86	46.00	5.69			219.23	369.69	331.00	4298.72	3438.98
SMP-AC1		4/14/2005	52725.0	5.5	5.2	175	7.0	5	8	0.35	0.66	0.71	43.00	5.69			221.81	449.97	418.28	5070.04	3168.77
SMP-AC1		5/18/2005	21743.0	5.8	5.6	199	11.0	6	7	0.20	0.77	0.53	50.00	5.69		Al staining	52.27	138.52	201.24	1829.46	1568.11
SMP-AC1		6/15/2005	13705.8	6.5	6.5	181	21.0	9	2	0.16	0.56	0.13	40.00	6.19			26.36	21.42	92.26	329.49	1482.69
SMP-AC1		7/13/2005	4409.6	7.1	5.7	385	22.0	10	10	0.11	0.85	0.07	73.00	7.10			5.83	3.71	45.05	530.03	530.03
SMP-AC1		8/22/2005	2656.9	6.9	6.8	292	20.0	14	-2	0.07	0.74	0.06	69.00	7.10			2.24	1.92	23.63	-63.87	447.11
SMP-AC1		9/14/2005	3660.0	6.0	6.9	298	16.0	14	-3	0.22	0.73	0.09	96.00	7.10			9.68	3.96	32.11	-131.98	615.90
Average			**23694.1**		**6.0**			**9.0**	**5.1**	**0.3**	**0.8**	**0.5**					**138.2**	**206.4**	**260.5**	**2000.2**	**2060.4**

SMP-AC2		10/23/2004	18029.0	4.8	4.6	173	9.0	5	12	0.12	1.01	0.78	48.00	8.60			26.01	169.03	218.88	2600.50	1083.54
SMP-AC2		11/22/2004	17101.6	5.2	4.8	165	7.0	6	11	0.12	1.04	0.79	55.00	5.69			24.67	162.39	213.78	2261.17	1233.37
SMP-AC2		2/9/2005	52041.1	5.1	4.7	219	2.0	5	12	0.63	1.34	1.00	67.00	5.69			394.09	625.53	838.22	7506.41	3127.67
SMP-AC2		3/16/2005	32916.8	5.0	4.6	153	1.0	6	14	0.38	0.68	0.87	40.00	5.69			150.35	344.22	269.05	5539.24	2373.96
SMP-AC2		4/14/2005	43021.1	4.5	4.7	155	8.0	5	10	0.29	0.67	0.84	36.00	5.69			149.96	434.38	346.47	5171.14	2585.57
SMP-AC2		5/18/2005	14932.0	4.6	4.6	171	11.5	5	13	0.09	0.88	0.80	40.00	5.69		moved upst	16.15	143.59	157.94	2333.27	897.41
SMP-AC2		6/10/2005		4.5	4.5	153	25.0	8	5	0.09	0.74	0.50	33.00	6.19		no flow taken					
SMP-AC2		6/15/2005	10000.0	4.3	4.7	154	20.5	5	8	0.40	0.68	0.48	32.00	6.19			48.08	57.70	81.74	961.60	601.00
SMP-AC2		7/13/2005	4499.0	4.5	4.4	248	22.0	4	15	0.11	1.20	0.82	52.00	6.19			5.95	44.34	64.89	811.17	216.31
SMP-AC2		8/22/2005	2276.1	4.4	4.4	230	19.5	4	13	0.09	1.17	0.76	53.00	7.10			2.46	20.79	32.01	355.66	109.43
SMP-AC2		9/14/2005	2220.5	4.3	4.4	234	15.0	4	12	0.07	1.22	0.95	68.00	6.19			1.87	25.36	32.56	320.28	106.76
Average			**19703.7**		**4.6**			**5.2**	**11.4**	**0.2**	**1.0**	**0.8**					**82.0**	**202.7**	**225.6**	**2786.0**	**1233.5**

Stream Monitoring Data - Raw

Sample ID	ACWA ID	Sample Date	Flow GPM	pH Field	pH Lab	Cond. Umhos	Temp C	Alkalinity mg/L	Acidity mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Susp. Solids mg/L	TDS mg/L	Notes	Fe Loading lbs/day	Al Loading lbs/day	Mn Loading lbs/day	Acidity Loading lbs/day	Alkalinity Loading lbs/day
SMP-AC3		10/23/2004	16492.0	4.7	4.7	177	8.0	5	11	0.20	1.02	0.73	50.00	8.60			39.65	144.71	202.20	2180.57	991.17
SMP-AC3		11/23/2004	15146.4	4.9	4.9	166	5.0	5	10	0.23	1.08	0.77	52.00	5.69			41.87	140.19	196.62	1820.60	910.30
SMP-AC3		2/10/2005		5.2	5.1	117	1.5	6	8	0.63	0.75	0.66	31.00	18.60			0.00	0.00	0.00	0.00	0.00
SMP-AC3		3/16/2005	32652.9	4.6	4.8	156	1.0	5	12	0.48	0.76	0.84	41.00	5.69			188.39	329.69	298.29	4709.85	1962.44
SMP-AC3		4/15/2005	43364.4	4.5	4.7	153	7.5	5	9	0.43	0.70	0.84	38.00	10.00			224.13	437.84	364.87	4691.16	2606.20
SMP-AC3		5/19/2005	15682.9	4.7	4.7	167	10.0	5	12	0.10	0.83	0.72	42.00	5.69			18.85	135.73	156.46	2262.10	942.54
SMP-AC3		6/16/2005	22817.4	4.6	4.8	185	18.0	5	9	0.29	0.79	0.42	41.00	8.60			79.54	115.19	216.67	2468.39	1371.33
SMP-AC3		7/13/2005	4568.3	4.4	4.4	223	25.0	4	15	0.10	1.30	0.81	54.00	6.19		when comin	5.49	44.48	71.38	823.67	219.65
SMP-AC3		8/22/2005	2584.9	4.3	4.4	245	22.0	3	13	0.13	1.62	0.92	63.00	6.19			4.04	28.58	50.33	403.92	93.21
SMP-AC3		9/15/2005	1397.1	4.4	4.4	230	18.0	4	12	0.05	1.25	0.80	65.00	6.19			0.84	13.43	20.99	201.52	67.17
Average			**17189.60**		**4.69**			**4.70**	**11.10**	**0.26**	**1.01**	**0.75**					**60.28**	**138.98**	**157.78**	**1956.18**	**916.40**

Sample ID	ACWA ID	Sample Date	Flow GPM	pH Field	pH Lab	Cond. Umhos	Temp C	Alkalinity mg/L	Acidity mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Susp. Solids mg/L	TDS mg/L	Notes	Fe Loading lbs/day	Al Loading lbs/day	Mn Loading lbs/day	Acidity Loading lbs/day	Alkalinity Loading lbs/day
SMP-AC4		10/23/2004	6898.0	6.7	6.4	102	10.0	10	2	0.17	0.04	0.05	22.00	10.00			14.10	4.06	3.32	165.83	829.14
SMP-AC4		11/23/2004	8026.8	6.6	6.5	99	7.0	10	2	0.19	0.04	0.05	22.00	5.70			18.33	4.73	3.86	192.96	964.82
SMP-AC4		2/9/2005	41749.2	6.1	6.1	85	2.0	8	6	0.20	0.15	0.23	19.00	11.40			100.37	115.42	75.27	3010.95	4014.60
SMP-AC4		3/16/2005	12060.4	6.1	6.3	112	0.3	7	4	0.18	0.14	0.15	21.00	5.69			26.09	21.74	20.30	579.86	1014.76
SMP-AC4		4/15/2005	16950.5	6.3	6.5	118	14.0	8	2	0.20	0.08	0.16	19.00	8.60			40.75	32.60	16.30	407.49	1629.96
SMP-AC4		5/19/2005	6057.0	6.7	6.4	112	14.0	9	4	0.12	0.03	0.05	19.00	5.69			8.74	3.57	2.18	291.22	655.25
SMP-AC4		6/16/2005	21327.0	6.5	6.7	125	21.0	9	1	0.15	0.04	0.05	17.00	10.00			38.45	12.56	10.25	256.35	2307.15
SMP-AC4		7/14/2005	1382.9	6.4	6.9	132	21.0	13	-1	0.08	0.03	0.05	20.00	6.19			1.33	0.81	0.50	-16.62	216.09
SMP-AC4		8/23/2005	1139.1	6.7	6.9	138	17.0	14	-2	0.07	0.02	0.05	18.00	6.19			0.96	0.67	0.27	-27.38	191.69
SMP-AC4		9/15/2005	1117.9	6.4	7.0	130	19.0	14	-4	0.05	0.02	0.05	18.00	6.19			0.67	0.66	0.27	-53.75	188.11
Average			**11670.9**		**6.6**			**10.2**	**1.4**	**0.1**	**0.1**	**0.1**					**25.0**	**19.7**	**13.3**	**480.7**	**1201.2**

Sample ID	ACWA ID	Sample Date	Flow GPM	pH Field	pH Lab	Cond. Umhos	Temp C	Alkalinity mg/L	Acidity mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Susp. Solids mg/L	TDS mg/L	Notes	Fe Loading lbs/day	Al Loading lbs/day	Mn Loading lbs/day	Acidity Loading lbs/day	Alkalinity Loading lbs/day
SMP-BR1		10/22/2004	3630.0	6.7	6.6	298	10.0	12	0	0.91	1.36	0.28	108.00	10.00			39.71	12.22	59.34	0.00	523.59
SMP-BR1		11/22/2004	1775.8	6.9	6.4	328	7.0	14	1	1.31	1.49	0.14	133.00	7.10			27.96	2.99	31.80	21.34	298.83
SMP-BR1		2/9/2005	7195.2	5.9	6.4	393	2.0	15	2	1.28	3.07	1.40	153.00	5.69			110.70	121.08	265.51	172.97	1297.29
SMP-BR1		3/16/2005	4638.4	6.3	6.2	310	0.0	16	2	0.84	1.27	0.81	111.00	5.69			46.83	45.16	70.81	111.51	892.05
SMP-BR1		4/14/2005	4167.7	6.0	6.6	345	8.0	10	2	1.00	1.76	0.63	117.00	5.69			50.10	31.56	88.17	100.19	500.95
SMP-BR1		5/18/2005	1271.0	6.7	6.3	389	9.5	14	2	1.64	1.32	0.29	132.00	5.69			25.05	4.43	20.17	30.55	213.88
SMP-BR1		6/15/2005	1060.6	6.1	6.7	348	17.0	14	-1	1.59	0.72	0.08	112.00	6.19			20.27	1.02	9.18	-12.75	178.48
SMP-BR1		7/13/2005	512.6	6.2	6.6	431	17.5	18	-4	2.46	1.05	0.05	148.00	6.19			15.16	0.30	6.47	-24.64	110.90
SMP-BR1		8/22/2005	328.6	6.6	6.5	447	16.0	19	-6	3.82	1.47	0.05	162.00	6.19			15.09	0.19	5.81	-23.70	75.05
SMP-BR1		9/14/2005	258.6	6.2	6.5	490	13.0	19	-5	5.27	1.77	0.05	210.00	8.60			16.38	0.15	5.50	-15.54	59.05
Average			**2483.83**		**6.48**			**15.10**	**-0.70**	**2.01**	**1.53**	**0.38**					**36.72**	**21.91**	**56.28**	**35.99**	**415.01**

Sample ID	ACWA ID	Sample Date	Flow GPM	pH Field	pH Lab	Cond. Umhos	Temp C	Alkalinity mg/L	Acidity mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Susp. Solids mg/L	TDS mg/L	Notes	Fe Loading lbs/day	Al Loading lbs/day	Mn Loading lbs/day	Acidity Loading lbs/day	Alkalinity Loading lbs/day
SMP-BR2		10/22/2004	2869.0	6.5	6.6	288	9.0	12	0	0.26	1.22	0.24	105.00	8.60			8.97	8.28	42.07	0.00	413.82
SMP-BR2		11/22/2004	1637.8	6.9	6.4	319	7.0	13	2	0.22	1.30	0.15	130.00	7.10		no visible ir	4.33	2.95	25.59	39.37	255.92
SMP-BR2		2/9/2005	5491.5	6.1	6.4	384	2.0	13	1	0.36	2.53	1.00	159.00	5.69			23.76	66.01	167.00	66.01	858.10
SMP-BR2		3/16/2005	5431.8	6.5	6.4	323	0.0	16	2	0.43	1.47	0.86	127.00	5.69			28.07	56.15	95.98	130.58	1044.65
SMP-BR2		4/14/2005	4039.2	6.3	6.7	343	9.0	10	2	0.40	1.89	0.70	126.00	5.69			19.42	33.99	91.76	97.10	485.51
SMP-BR2		5/18/2005	1195.4	6.8	6.4	372	10.5	12	3	0.51	1.25	0.38	128.00	5.70			7.33	5.46	17.96	43.11	172.42
SMP-BR2		6/15/2005	732.6	6.3	6.8	313	18.0	11	1	0.22	0.31	0.19	97.00	6.19			1.94	1.67	2.73	8.81	96.87
SMP-BR2		7/13/2005	563.9	6.5	6.8	377	18.0	14	1	0.13	0.25	0.07	126.00	6.19			0.88	0.47	1.69	6.78	94.89
SMP-BR2		8/22/2005	124.8	6.6	6.5	347	17.0	10	3	0.14	0.20	0.07	118.00	6.19			0.21	0.10	0.30	4.50	15.00
SMP-BR2		9/14/2005	131.7	6.2	6.5	399	14.0	9	2	0.06	0.08	0.05	164.00	6.19			0.09	0.08	0.13	3.17	14.25
Average			**2221.8**		**6.6**			**12.0**	**1.7**	**0.3**	**1.1**	**0.4**					**9.5**	**17.5**	**44.5**	**39.9**	**345.1**

Stream Monitoring Data - Raw

Sample ID	ACWA ID	Sample Date	Flow GPM	pH Field	pH Lab	Cond. Umhos	Temp C	Alkalinity mg/L	Acidity mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Susp. Solids mg/L	TDS mg/L	Notes	Fe Loading lbs/day	Al Loading lbs/day	Mn Loading lbs/day	Acidity Loading lbs/day	Alkalinity Loading lbs/day
SMP-BR3		10/22/2004	675.0	4.4	4.5	434	10.0	4	20	0.41	5.45	1.29	178.00	8.60			3.33	10.47	44.22	162.27	32.45
SMP-BR3		11/22/2004	529.1	5.5	4.7	438	7.0	6	16	0.36	5.68	1.18	198.00	5.70		very silty	2.29	7.51	36.13	101.76	38.16
SMP-BR3		2/9/2005	2150.0	4.5	4.4	549	0.0	3	30	0.73	8.75	3.18	270.00	5.69			18.87	82.18	226.12	775.28	77.53
SMP-BR3		3/16/2005	829.4	4.7	4.4	453	0.0	6	24	0.39	5.34	2.32	201.00	5.69			3.89	23.13	53.24	239.26	59.82
SMP-BR3		4/14/2005	901.6	4.1	4.3	551	14.0	3	26	0.34	6.04	2.40	234.00	5.69		trees down	3.68	26.01	65.46	281.78	32.51
SMP-BR3		5/18/2005	519.5	4.1	4.1	599	13.0	2	35	0.57	9.77	2.67	289.00	5.69			3.56	16.67	61.00	218.54	12.49
SMP-BR3		6/15/2005	241.4	4.0	4.0	552	23.0	1	27	1.41	8.15	0.74	217.00	6.19			4.09	2.15	23.65	78.34	2.90
SMP-BR3		7/13/2005	104.3	5.4	4.7	515	26.0	6	20	3.72	6.97	0.16	195.00	14.30			4.67	0.20	8.74	25.08	7.53
SMP-BR3		8/22/2005	43.6	6.5	6.5	5.2	20.0	26	1	3.95	6.07	0.05	190.00	8.60			2.07	0.03	3.18	0.52	13.63
SMP-BR3		9/14/2005	29.3	6.4	5.9	656	16.0	10	6	1.00	9.46	0.11	312.00	6.19			0.35	0.04	3.33	2.11	3.52
Average			**602.32**		**4.75**			**6.70**	**20.50**	**1.29**	**7.17**	**1.41**					**4.68**	**16.84**	**52.51**	**188.50**	**28.05**
SMP-BR4		11/22/2004	175.0	6.1	5.7	218	7.5	8	7	1.19	1.23	0.36	62.00	7.10		estimated fl	2.50	0.76	2.59	14.72	16.83
SMP-BR4		2/9/2005		5.5	5.5	288	4.0	7	10	2.05	1.59	2.21	95.00	27.10			0.00	0.00	0.00	0.00	0.00
SMP-BR4		3/16/2005	326.4	5.6	4.9	238	4.0	6	14	0.53	1.05	1.00	70.00	5.69			2.08	3.92	4.12	54.93	23.54
SMP-BR4		4/14/2005	255.1	5.0	5.0	279	12.0	6	12	0.51	1.30	1.37	78.00	5.69			1.56	4.20	3.99	36.80	18.40
SMP-BR4		5/18/2005	55.9	5.8	5.7	191	15.0	6	8	0.55	0.76	0.25	37.00	5.69			0.37	0.17	0.51	5.38	4.03
SMP-BR4		6/15/2005	76.7	5.6	6.8	176	17.0	9	3	0.71	0.68	0.14	32.00	6.19			0.65	0.13	0.63	2.77	8.30
SMP-BR4		7/13/2005	16.2	6.2	6.1	220	23.5	10	4	1.26	0.80	0.14	34.00	6.19			0.24	0.03	0.16	0.78	1.94
SMP-BR4		8/22/2005	10.0	6.0	6.4	198	24.0	13	0	3.47	0.75	1.03	26.00	7.10		estimated fl	0.42	0.12	0.09	0.00	1.56
SMP-BR4		9/14/2005	12.0	6.4	6.4	205	23.0	13	0	1.47	0.68	0.08	31.00	6.19		estimated fl	0.21	0.01	0.10	0.00	1.88
Average			**115.9**		**5.8**			**8.7**	**6.4**	**1.3**	**1.0**	**0.7**					**0.9**	**1.0**	**1.4**	**12.8**	**8.5**
SMP-FR1		10/22/2004	631.0	7.1	7.3	521	10.0	44	0	0.35	1.15	0.26	200.00	8.60			2.65	1.97	8.72	0.00	333.72
SMP-FR1		11/22/2004	433.8	7.1	6.9	529	7.0	45	0	0.24	1.00	0.17	222.00	7.10			1.25	0.89	5.21	0.00	234.65
SMP-FR1		2/9/2005	1909.2	6.6	6.9	402	2.0	33	-20	0.39	0.88	0.39	154.00	5.69			8.95	8.95	20.19	-458.97	757.30
SMP-FR1		3/16/2005	726.9	7.1	7.2	511	0.5	54	-40	0.29	1.07	0.31	220.00	5.69			2.53	2.71	9.35	-349.51	471.84
SMP-FR1		4/14/2005	845.5	6.6	7.5	539	10.0	43	-29	0.28	1.06	0.33	6.00	5.69			2.85	3.35	10.77	-294.74	437.03
SMP-FR1		5/18/2005	289.0	7.3	6.9	604	13.0	51	-37	0.31	1.08	0.19	229.00	5.69			1.08	0.66	3.75	-128.54	177.18
SMP-FR1		6/15/2005	204.6	6.8	7.5	595	19.0	49	-36	0.27	0.66	0.13	219.00	6.19			0.66	0.32	1.62	-88.53	120.50
SMP-FR1		7/13/2005	147.6	7.0	7.4	600	20.0	57	-41	0.60	0.47	0.12	222.00	6.19			1.06	0.21	0.83	-72.72	101.10
SMP-FR1		8/22/2005	77.4	7.2	7.4	529	18.5	60	-45	0.69	0.26	0.05	179.00	6.19			0.64	0.05	0.24	-41.84	55.79
SMP-FR1		9/14/2005	55.9	7.1	7.3	506	14.0	55	-42	4.00	0.32	0.25	181.00	6.19			2.69	0.17	0.21	-28.21	36.94
Average			**532.09**		**7.23**			**49.10**	**-29.00**	**0.74**	**0.80**	**0.22**					**2.44**	**1.93**	**6.09**	**-146.31**	**272.61**
SMP-HR1		10/22/2004	413.0	5.8	6.0	122	10.0	8	4	0.26	0.33	0.20	30.00	14.30			1.29	0.99	1.64	19.86	39.71
SMP-HR1		11/22/2004	345.8	5.8	5.9	120	7.0	9	5	0.30	0.30	0.16	28.00	7.10			1.25	0.67	1.25	20.78	37.41
SMP-HR1		2/9/2005	857.2	5.6	5.9	117	3.0	8	4	0.26	0.25	0.26	25.00	5.69			2.68	2.68	2.58	41.21	82.43
SMP-HR1		3/16/2005	798.1	6.1	5.8	124	2.0	10	8	0.15	0.24	0.20	28.00	5.69			1.44	1.92	2.30	76.75	95.94
SMP-HR1		4/14/2005	775.3	5.4	5.9	127	8.0	7	5	0.10	0.24	0.15	25.00	5.69			0.93	1.40	2.24	46.60	65.23
SMP-HR1		5/18/2005	279.4	5.7	5.7	144	10.0	7	7	0.10	0.37	0.16	32.00	5.69			0.34	0.54	1.24	23.51	23.51
SMP-HR1		6/15/2005	151.9	5.6	5.9	151	15.5	9	4	0.19	0.38	0.16	29.00	6.19			0.35	0.29	0.69	7.30	16.43
SMP-HR1		7/13/2005	51.6	6.1	6.0	160	19.0	8	6	0.30	0.35	0.15	28.00	6.19			0.19	0.09	0.22	3.72	4.96
SMP-HR1		8/22/2005	28.6	6.5	6.1	159	17.0	9	6	0.51	0.42	0.18	28.00	6.19			0.18	0.06	0.14	2.06	3.10
SMP-HR1		9/14/2005	23.7	6.6	6.3	152	14.0	9	3	0.24	0.36	0.11	32.00	6.19			0.07	0.03	0.10	0.85	2.56
Average			**372.5**		**6.0**			**8.4**	**5.2**	**0.2**	**0.3**	**0.2**					**0.9**	**0.9**	**1.2**	**24.3**	**37.1**

Stream Monitoring Data - Raw

Sample ID	ACWA ID	Sample Date	Flow GPM	pH Field	pH Lab	Cond. Umhos	Temp C	Alkalinity mg/L	Acidity mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Susp. Solids mg/L	TDS mg/L	Notes	Fe Loading lbs/day	Al Loading lbs/day	Mn Loading lbs/day	Acidity Loading lbs/day	Alkalinity Loading lbs/day
SMP-KR1		10/22/2004	6802.0	6.5	7.1	279	9.0	26	0	0.50	0.65	0.16	82.00	11.40			40.88	13.08	53.14	0.00	2125.76
SMP-KR1		11/22/2004	3853.6	7.0	6.6	309	7.0	27	0	0.71	0.72	0.09	103.00	8.60		heavy iron s	32.89	4.17	33.35	0.00	1250.64
SMP-KR1		2/9/2005	11416.4	6.6	6.6	346	1.0	22	-7	0.95	1.24	0.71	101.00	8.60			130.36	97.43	170.16	-960.58	3018.95
SMP-KR1		3/16/2005	7561.4	7.1	6.5	298	0.0	18	0	1.65	1.09	0.83	85.00	5.70			149.96	75.44	99.07	0.00	1635.98
SMP-KR1		4/14/2005	7293.0	5.9	6.9	320	7.5	17	-5	0.90	1.05	0.46	98.00	5.69			78.90	40.32	92.04	-438.31	1490.25
SMP-KR1		5/18/2005	2308.7	6.8	6.7	374	9.5	25	-10	0.76	0.78	0.08	114.00	5.69			21.09	2.22	21.65	-277.51	693.78
SMP-KR1		6/15/2005	1847.0	5.9	7.3	380	18.5	34	-23	0.74	0.35	0.05	104.00	6.19			16.43	1.11	7.77	-510.62	754.83
SMP-KR1		7/13/2005	1055.9	6.1	7.2	482	19.0	42	-28	1.21	0.27	0.06	129.00	10.00			15.36	0.76	3.43	-355.36	533.04
SMP-KR1		8/22/2005	863.3	6.4	7.1	473	17.5	47	-33	1.53	0.24	0.05	141.00	6.19			15.88	0.51	2.49	-342.44	487.72
SMP-KR1		9/14/2005	833.6	6.2	7.2	509	14.0	46	-35	1.70	0.30	0.05	176.00	7.10			17.03	0.49	3.01	-350.71	460.93
Average			**4383.5**		**6.9**			**30.4**	**-14.1**	**1.1**	**0.7**	**0.3**					**51.9**	**23.6**	**48.6**	**-323.6**	**1245.2**
SMP-KR2		10/22/2004	1923.0	7.0	7.2	251	10.0	36	0	0.33	0.09	0.06	52.00	8.60			7.63	1.39	2.08	0.00	832.12
SMP-KR2		11/22/2004	1079.4	7.1	6.8	273	7.0	42	0	0.40	0.10	0.05	63.00	5.70			5.19	0.64	1.30	0.00	544.90
SMP-KR2		2/9/2005	4992.0	6.3	6.7	265	2.0	29	-14	0.82	0.18	0.38	42.00	5.69			49.20	22.80	10.80	-840.05	1740.11
SMP-KR2		3/16/2005	2030.4	6.9	6.8	349	1.5	34	-20	0.38	0.16	0.12	70.00	5.69			9.27	2.93	3.90	-488.10	829.77
SMP-KR2		4/14/2005	1834.9	6.4	7.4	311	9.5	31	-20	0.32	0.11	0.11	71.00	5.69		algae	7.06	2.43	2.43	-441.11	683.73
SMP-KR2		5/18/2005	504.2	7.4	6.9	360	13.0	49	-33	0.43	0.10	0.06	75.00	5.69			2.61	0.36	0.61	-200.01	296.98
SMP-KR2		6/15/2005	370.3	6.7	7.6	439	20.0	60	-48	0.47	0.20	0.06	87.00	6.19			2.09	0.27	0.89	-213.63	267.03
SMP-KR2		7/13/2005	168.9	6.9	7.6	537	21.5	70	-56	0.49	0.15	0.08	99.00	6.19		several sma	0.99	0.16	0.30	-113.71	142.14
SMP-KR2		8/22/2005	83.9	7.4	7.7	490	19.0	82	-64	0.41	0.10	0.07	83.00	7.10			0.41	0.07	0.10	-64.52	82.67
SMP-KR2		9/14/2005	105.2	6.9	7.7	520	16.0	91	-73	0.40	0.07	0.08	96.00	6.19			0.51	0.10	0.09	-92.33	115.09
Average			**1309.22**		**7.24**			**52.40**	**-32.80**	**0.45**	**0.13**	**0.11**					**8.50**	**3.11**	**2.25**	**-245.35**	**553.45**
SMP-LA1		10/23/2004	4061.0	3.9	4.6	571	9.0	5	18	0.27	4.80	1.18	259.00	8.60			13.18	57.60	234.30	878.64	244.07
SMP-LA1		11/23/2004	2299.7	3.9	3.8	554	5.0	0	42	4.34	4.84	3.11	237.00	5.69			119.97	85.97	133.79	1160.96	0.00
SMP-LA1		2/10/2005	19858.5	4.5	4.3	273	1.0	3	19	1.98	2.73	1.88	90.00	14.30			472.62	448.75	651.65	4535.28	716.10
SMP-LA1		3/16/2005	4960.1	3.8	3.8	567	1.0	0	42	4.24	5.44	4.18	250.00	5.69			252.79	249.22	324.34	2504.08	0.00
SMP-LA1		4/15/2005	4974.5	3.5	3.7	554	10.0	0	46	3.89	4.57	4.12	209.00	5.70			232.60	246.35	273.26	2750.50	0.00
SMP-LA1		5/19/2005	2149.2	3.7	3.7	543	9.5	0	48	0.10	0.80	3.83	195.00	5.69			2.58	98.94	20.67	1240.01	0.00
SMP-LA1		6/16/2005	2250.1	3.6	3.5	701	17.0	0	49	4.18	6.54	3.13	262.00	11.40			113.05	84.65	176.88	1325.26	0.00
SMP-LA1		7/13/2005	706.5	3.8	3.4	746	18.5	0	71	8.21	6.11	4.39	264.00	7.10			69.72	37.28	51.89	602.96	0.00
SMP-LA1		8/23/2005	240.3	3.6	3.4	724	14.0	0	81	17.50	8.76	5.13	284.00	8.60			50.55	14.82	25.31	233.99	0.00
SMP-LA1		9/15/2005	365.1	3.5	3.3	731	14.5	0	83	16.90	7.65	5.22	335.00	10.00			74.16	22.91	33.57	364.20	0.00
Average			**4186.5**		**3.8**			**0.8**	**49.9**	**6.2**	**5.2**	**3.6**					**140.1**	**134.6**	**192.6**	**1559.6**	**96.0**
SMP-LA2		10/23/2004	847.0	4.5	4.3	403	8.0	3	27	2.41	3.25	2.26	155.00	14.30			24.54	23.01	33.09	274.89	30.54
SMP-LA2		11/22/2004	888.1	4.7	4.5	378	6.8	5	25	2.58	3.36	2.42	164.00	10.00			27.54	25.83	35.87	266.87	53.37
SMP-LA2		2/9/2005	4556.2	5.1	4.8	325	1.0	5	21	2.38	3.74	2.36	111.00	5.69			130.34	129.25	204.82	1150.08	273.83
SMP-LA2		3/16/2005		4.6	4.1	399	0.0	4	34	1.90	4.27	2.87	158.00	5.69		Ice prevented flow reading					
SMP-LA2		4/14/2005	1530.9	4.3	4.2	428	10.0	2	23	1.19	3.84	2.24	160.00	5.69			21.90	41.22	70.66	423.22	36.80
SMP-LA2		5/18/2005	626.1	4.4	4.1	411	14.0	1	34	1.74	3.55	2.32	155.00	5.69			13.09	17.46	26.72	255.86	7.53
SMP-LA2		6/15/2005	289.5	3.6	3.6	616	19.0	0	49	3.34	5.13	3.86	230.00	6.19			11.62	13.43	17.85	170.50	0.00
SMP-LA2		7/13/2005	102.5	3.7	3.6	733	20.0	0	56	2.79	7.19	4.41	281.00	6.19			3.44	5.43	8.86	69.00	0.00
SMP-LA2		8/22/2005	28.9	3.5	3.4	429	19.0	0	70	0.94	4.96	6.45	121.00	6.19			0.33	2.24	1.72	24.32	0.00
SMP-LA2		9/14/2005	26.8	3.5	3.5	873	16.0	0	73	3.77	14.00	5.93	370.00	6.19			1.22	1.91	4.51	23.53	0.00
Average			**988**		**4**			**2**	**41**	**2**	**5**	**4**					**26**	**29**	**45**	**295**	**45**

Stream Monitoring Data - Raw

Sample ID	ACWA ID	Sample Date	Flow GPM	pH Field	pH Lab	Cond. Umhos	Temp C	Alkalinity mg/L	Acidity mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Susp. Solids mg/L	TDS mg/L	Notes	Fe Loading lbs/day	Al Loading lbs/day	Mn Loading lbs/day	Acidity Loading lbs/day	Alkalinity Loading lbs/day
SMP-LA3	LA4.3	10/23/2004	N/A	6.3	6.3	349	8.0	10	3	0.45	1.56	0.10	123.00	7.10		no flow taken					
SMP-LA3	LA4.3	11/22/2004		6.4	6.3	336	6.0	12	3	0.49	0.84	0.07	138.00	5.70		no flow taken					
SMP-LA3	LA4.3	2/9/2005		5.9	6.2	298	0.0	10	3	1.89	2.40	1.00	96.00	14.30		no flow taken					
SMP-LA3	LA4.3	3/16/2005		6.3	5.8	351	0.0	12	6	0.33	2.35	0.15	140.00	5.69		Ice prevented flow reading					
SMP-LA3	LA4.3	4/14/2005	1016.5	5.5	6.1	401	10.0	7	6	0.46	2.98	0.21	151.00	5.69			5.62	2.57	36.41	73.31	85.53
SMP-LA3	LA4.3	5/18/2005	490.2	6.0	5.9	346	13.0	8	8	0.48	1.74	0.13	118.00	5.69			2.83	0.77	10.25	47.13	47.13
SMP-LA3	LA4.3	6/15/2005	166.1	5.6	6.2	441	19.0	8	4	0.50	0.93	0.10	171.00	6.19			1.00	0.20	1.86	7.98	15.97
SMP-LA3	LA4.3	7/13/2005	69.4	5.6	5.8	543	20.0	8	8	0.55	2.31	0.09	223.00	6.19		fish observe	0.46	0.08	1.93	6.68	6.68
SMP-LA3	LA4.3	8/22/2005	15.6	5.9	6.2	473	18.0	10	5	1.18	7.37	0.16	183.00	6.19			0.22	0.03	1.38	0.93	1.87
SMP-LA3	LA4.3	9/14/2005	15.0	5.5	5.6	655	16.0	8	16	1.90	12.20	0.51	316.00	6.19		estimated fl	0.34	0.09	2.20	2.88	1.44
Average			**295.5**		**6.0**			**9.3**	**6.2**	**0.8**	**3.5**	**0.3**					**1.7**	**0.6**	**9.0**	**23.2**	**26.4**
SMP-LA4	SMP-LASR40	4/14/2005	686.1	5.9	6.2	453	13.0	8	4	0.67	3.92	0.19	190.00	5.69			5.53	1.57	32.33	32.99	65.98
SMP-LA4	SMP-LASR40	5/18/2005	349.3	6.4	6.3	402	16.5	12	4	0.77	3.21	0.08	157.00	5.69			3.23	0.34	13.48	16.80	50.39
SMP-LA4	SMP-LASR40	6/15/2005	150.0	6.2	7.0	522	21.0	22	-10	0.80	3.51	0.07	206.00	6.19		flow adjuste	1.44	0.13	6.33	-18.03	39.67
SMP-LA4	SMP-LASR40	9/14/2005	14.0	5.3	5.1	720	18.0	7	20	0.56	15.80	0.42	360.00	6.19		estimated fl	0.09	0.07	2.66	3.37	1.18
Average			**299.86**		**6.15**			**12.25**	**4.50**	**0.70**	**6.61**	**0.19**					**2.57**	**0.52**	**13.70**	**8.78**	**39.30**
SMP-RR1		11/23/2004	794.3	5.2	4.7	748	6.0	5	17	1.00	8.70	1.11	376.00	5.69			9.55	10.60	83.07	162.31	47.74
SMP-RR1		2/9/2005	6428.1	5.4	5.1	364	1.0	6	11	1.09	4.21	1.10	156.00	12.90			84.22	84.99	325.29	849.92	463.59
SMP-RR1		3/16/2005	1943.1	5.4	4.9	704	1.0	6	15	1.09	7.15	1.45	344.00	5.69			25.46	33.87	167.00	350.34	140.14
SMP-RR1		4/15/2005	1570.4	4.9	4.8	692	12.0	6	14	0.76	6.36	1.47	328.00	5.69			14.35	27.75	120.05	264.26	113.25
SMP-RR1		5/19/2005	488.7	5.1	4.7	705	11.0	5	18	5.04	4.88	1.17	323.00	5.69			29.61	6.87	28.67	105.74	29.37
SMP-RR1		6/16/2005	900.5	4.9	4.6	839	21.0	5	14	1.16	9.55	0.77	343.00	8.60			12.56	8.33	103.37	151.53	54.12
SMP-RR1		7/13/2005	182.0	5.0	4.3	798	21.0	4	15	1.51	7.88	0.54	349.00	6.19		noticable iro	3.30	1.18	17.24	32.82	8.75
SMP-RR1		8/23/2005	113.5	5.4	4.5	810	15.0	7	23	3.68	9.25	0.32	456.00	7.10			5.02	0.44	12.62	31.38	9.55
SMP-RR1		9/15/2005	78.5	5.5	4.2	758	16.0	2	12	4.01	6.74	0.29	364.00	7.10			3.79	0.27	6.36	11.33	1.89
Average			**1388.8**		**4.6**			**5.1**	**15.4**	**2.1**	**7.2**	**0.9**					**20.9**	**19.4**	**96.0**	**217.7**	**96.5**
Random Samples																					
Roaring Run		4/15/2005		7.0	6.8	113	7.0	11	-1	0.11	0.04	0.10	17.00	5.69		Roaring Run					0.00
UNT-AC5.8-1		4/15/2005		3.7	3.9	125	7.0	0	22	0.39	0.23	2.06	26.00	5.69		UNTAC before Bear Run					0.00
Bear2		4/15/2005		5.0	5.3	35	8.0	5	6	0.06	0.07	0.15	11.00	5.69		Bear Run					0.00
UNT-AC5.8-2		4/15/2005		5.2	5.7	37	7.5	6	5	0.34	0.05	0.19	12.00	5.69		UNTAC before Bear Run					0.00
FRANKE		*2/10/2005*			*4.1*	*103*		*2*	*24*	*0.26*	*1.12*	*1.87*	*30.00*	*10.00*							0.00
Panther Run		*1/13/2005*		*4.6*	*4.7*	*48*		*5*	*9*	*0.06*	*0.16*	*0.41*	*12.00*	*5.69*							0.00

Stream Monitoring Data - Raw

Sample ID	ACWA ID	Sample Date	Flow GPM	pH Field	pH Lab	Cond. Umhos	Temp C	Alkalinity mg/L	Acidity mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Susp. Solids mg/L	TDS mg/L	Notes	Fe Loading lbs/day	Al Loading lbs/day	Mn Loading lbs/day	Acidity Loading lbs/day	Alkalinity Loading lbs/day
RRspring	spring	4/15/2005		4.5	5.4	164	7.2	9	1	0.05	0.06	0.16	15.00	5.69	69						0.00
Panther		6/10/2005		5.0	4.7	46	15.0	8	2	0.05	0.08	0.14	6.00	6.19		mouth					0.00
UNT BP		6/10/2005		5.9	6.0	28	14.0	8	3	0.09	0.02	0.06	6.00	6.19		mouth					0.00
AC-BP		6/10/2005		5.0	5.0	173	22.0	8	7	0.22	0.79	0.55	42.00	6.19		below Panther					0.00
SMP-AC2		6/10/2005		4.5	4.5	153	25.0	8	5	0.09	0.74	0.50	33.00	6.19		no flow taken					
SMP-KORBunt-1		7/13/2005	103.9	3.5	3.3	561	17.5	0	75	1.58	5.17	5.33	103.00	6.19							0.00
AC-above KORB		7/13/2005		4.3	4.4	266	25.0	0	20	0.14	1.69	1.02	70.00	6.19							0.00
AC-below KORB		7/13/2005		4.2	4.3	272	25.0	8	19	0.18	1.71	1.12	72.00	6.19							0.00
Spencer Mine	Mine opening	7/26/2005	0.9	2.6	2.6	1920	24.0	0	721	19.70	4.45	49.00	615.00	6.19							0.00
Draukers Road	2nd pipe	7/26/2005	5.0	3.7	3.6	1000	19.0	0	56	1.63	7.45	3.50	449.00	6.19		estimated flow					0.00
Rock Run	TR499	7/26/2005	50.0	5.0	5.3	1220	25.0	7	40	0.47	17.40	0.14	601.00	6.19		estimated flow					4.21
AC-UNT5.8-1		*2/10/2005*		*4.8*	*4.9*	*44*	*1.0*	*5*	*6*	*0.47*	*0.11*	*0.41*	*14.00*	*8.60*							0.00
Windy Hill Mine		8/23/2005	3.0	3.7	3.6	731	13.5	0	96	0.06	0.97	13.40	242.00	6.19							0.00
AC untBK		9/15/2005	61.4	3.3	3.2	625	15.0	0	86	1.37	6.72	6.12	191.00	6.19							0.00

Discharge Chemistry by Flow

Sample ID	Flow GPM	Iron mg/L	Fe Loading lbs/day	Manganese mg/L	Mn Loading lbs/day	Aluminum mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day	Relative Flow
DMP-879	0.42	15.30	0.08	2.71	0.01	0.05	0.00	11	0.06	13	0.07	Low
DMP-879	2.19	32.60	0.86	3.76	0.10	0.13	0.00	13	0.34	14	0.37	Low
DMP-879	3.01	30.80	1.11	3.21	0.12	0.06	0.00	-45	-1.64	23	0.83	Low
DMP-879	7.50	21.70	1.96	2.44	0.22	0.22	0.02	16	1.44	10	0.90	Low
DMP-879	8.39	23.40	2.36	3.40	0.34	0.049	0.00	49	4.94	18	1.82	Medium
DMP-879	8.89	6.84	0.73	1.93	0.21	0.049	0.01	11	1.18	13	1.39	Medium
DMP-879	8.90	25.80	2.76	2.01	0.22	0.28	0.03	-16	-1.71	13	1.39	Medium
DMP-879	16.70	10.10	2.03	2.46	0.49	0.049	0.01	9	1.81	10	2.01	Medium
DMP-879	16.70	5.34	1.07	0.84	0.17	0.049	0.01	-12	-2.41	11	2.21	Medium
DMP-879	16.70	6.72	1.35	1.00	0.20	0.049	0.01	7	1.41	10	2.01	Medium
DMP-879	21.70	8.40	2.19	1.39	0.36	0.06	0.02	9	2.35	12	3.13	High
DMP-879	27.50	18.60	6.15	1.39	0.46	0.18	0.06	9	2.97	11	3.64	High
DMP-AC3.75-1	6.32	0.05	0.00	0.05	0.00	0.22	0.02	6	0.46	6	0.46	Low
DMP-AC3.75-1	6.67	0.19	0.02	0.09	0.01	0.39	0.03	11	0.88	5	0.40	Low
DMP-AC3.75-1	12.00	0.07	0.01	0.07	0.01	0.45	0.06	10	1.44	6	0.87	Medium
DMP-AC3.75-1	12.00	0.06	0.01	0.06	0.01	0.45	0.06	11	1.59	5	0.72	Medium
DMP-AC3.75-1	12.00	1.00	0.14	0.09	0.01	0.4	0.06	6	0.87	7	1.01	Medium
DMP-AC3.75-1	16.00	1.34	0.26	2.45	0.47	22	4.23	18	3.40	0	0.00	High
DMP-AC3.75-1	41.80	1.24	0.62	0.37	0.19	3.07	1.54	50	25.12	0	0.00	High
DMP-AC3.75-2	2.20	0.14	0.00	0.26	0.01	1.41	0.04	28	0.74	0	0.00	Low
DMP-AC3.75-2	12.00	1.98	0.29	0.49	0.07	3.34	0.48	51	7.36	0	0.00	Low
DMP-AC3.75-2	12.40	0.29	0.04	0.29	0.04	1.86	0.28	32	4.77	0	0.00	Low
DMP-AC3.75-2	34.20	0.63	0.26	0.37	0.15	2.47	1.02	39	16.03	0	0.00	Medium
DMP-AC3.75-2	34.20	0.57	0.23	0.34	0.14	2.16	0.89	36	14.80	0	0.00	Medium
DMP-AC3.75-2	34.20	0.79	0.32	0.36	0.15	2.74	1.13	41	16.85	0	0.00	Medium
DMP-AC3.75-2	41.80	1.24	0.62	0.37	0.19	3.07	1.54	50	25.12	0	0.00	High
DMP-AC3.75-2	60.00	1.06	0.76	0.45	0.32	3.28	2.37	45	32.45	0	0.00	High
DMP-AC3.75-2	70.20	1.42	1.20	0.46	0.39	3.38	2.85	51	43.03	0	0.00	High
DMP-AC3.75-2		0.97		0.58		4.56		55		0		No flow

Discharge Chemistry by Flow

Sample ID	Flow GPM	Iron mg/L	Fe Loading lbs/day	Manganese mg/L	Mn Loading lbs/day	Aluminum mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day	Relative Flow
DMP-AC3.75-3	4.30	2.70	0.14	3.45	0.18	21.7	1.12	201	10.39	0	0.00	Low
DMP-AC3.75-3	7.50	1.68	0.15	3.34	0.30	23.6	2.13	208	18.75	0	0.00	Low
DMP-AC3.75-3	8.57	1.33	0.14	3.06	0.32	22.4	2.31	172	17.72	0	0.00	Medium
DMP-AC3.75-3	15.00	1.37	0.25	2.08	0.38	22.1	3.98	193	34.80	0	0.00	Medium
DMP-AC3.75-3	15.00	1.55	0.28	2.73	0.49	23.6	4.26	182	32.81	0	0.00	Medium
DMP-AC3.75-3	24.00	1.06	0.31	1.95	0.56	18.8	5.42	172	49.62	0	0.00	High
DMP-AC3.75-3	55.00	1.26	0.83	1.91	1.26	21.8	14.41	163	107.76	0	0.00	High
DMP-AC3.75-3		13.50		7.41		33.2		271		0		No flow
DMP-BR3.9	1.33	1.00	0.02	3.76	0.06	0.3	0.00	10	0.16	4	0.06	Low
DMP-BR3.9	4.20	2.41	0.12	3.01	0.15	0.12	0.01	10	0.50	9	0.45	Low
DMP-BR3.9	12.00	0.44	0.06	3.96	0.57	0.71	0.10	15	2.16	3	0.43	Low
DMP-BR3.9	20.00	0.93	0.22	3.32	0.80	0.95	0.23	12	2.88	5	1.20	Medium
DMP-BR3.9	20.00	1.66	0.40	3.08	0.74	1	0.24	16	3.85	6	1.44	Medium
DMP-BR3.9	20.00	4.35	1.05	3.34	0.80	0.58	0.14	13	3.13	9	2.16	Medium
DMP-BR3.9	30.00	0.65	0.23	2.37	0.85	1.19	0.43	16	5.77	5	1.80	Medium
DMP-BR3.9	60.00	0.51	0.37	2.88	2.08	1.02	0.74	17	12.26	5	3.61	High
DMP-BR3.9	60.00	0.56	0.40	2.67	1.93	1.46	1.05	16	11.54	5	3.61	High
DMP-BR3.9	60.00	1.64	1.18	2.32	1.67	0.95	0.69	15	10.82	5	3.61	High
DMP-BR3.9		0.75		3.70		0.31		10		4		No flow
DMP-BR4.0	1.25	12.40	0.19	17.70	0.27	9.96	0.15	96	1.44	0	0.00	Low
DMP-BR4.0	3.00	7.60	0.27	15.80	0.57	10.2	0.37	96	3.46	0	0.00	Low
DMP-BR4.0	8.50	7.81	0.80	16.60	1.70	10.3	1.05	100	10.22	0	0.00	Low
DMP-BR4.0	20.00	18.90	4.54	27.10	6.51	12.5	3.01	144	34.62	0	0.00	Low
DMP-BR4.0	20.00	10.10	2.43	21.20	5.10	10.3	2.48	97	23.32	0	0.00	Low
DMP-BR4.0	20.00	2.14	0.51	13.20	3.17	9.38	2.25	87	20.91	0	0.00	Low
DMP-BR4.0	30.00	8.83	3.18	19.20	6.92	10.3	3.71	104	37.50	0	0.00	Medium
DMP-BR4.0	30.00	6.36	2.29	17.90	6.45	9.46	3.41	80	28.85	0	0.00	Medium
DMP-BR4.0	60.00	7.34	5.29	20.80	15.00	11.4	8.22	116	83.66	0	0.00	High
DMP-BR4.0	60.00	6.01	4.33	21.20	15.29	11.6	8.37	122	87.99	0	0.00	High
DMP-BR4.0	100.00	5.64	6.78	21.90	26.32	12.2	14.66	108	129.82	0	0.00	High
DMP-BR4.0		2.91		16.30		5.61		72		0		No flow

Discharge Chemistry by Flow

Sample ID	Flow GPM	Iron mg/L	Fe Loading lbs/day	Manganese mg/L	Mn Loading lbs/day	Aluminum mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day	Relative Flow
DMP-BR4.5	16.00	3.08	0.59	20.30	3.90	7.7	1.48	109	20.96	0	0.00	Low
DMP-BR4.5	20.00	11.50	2.76	24.80	5.96	9.04	2.17	116	27.89	0	0.00	Low
DMP-BR4.5	20.00	19.00	4.57	25.10	6.03	8.34	2.00	119	28.61	0	0.00	Low
DMP-BR4.5	25.00	17.90	5.38	29.90	8.98	11.5	3.46	119	35.76	0	0.00	Medium
DMP-BR4.5	26.00	7.39	2.31	22.30	6.97	8.45	2.64	117	36.56	0	0.00	Medium
DMP-BR4.5	60.00	22.80	16.44	24.00	17.31	9.09	6.56	104	75.00	0	0.00	Medium
DMP-BR4.5	120.00	15.60	22.50	21.10	30.43	9.85	14.21	107	154.34	0	0.00	High
DMP-BR4.5	150.00	24.90	44.89	24.10	43.45	7.65	13.79	146	263.24	1	1.80	High
DMP-BR4.5	250.00	8.68	26.08	22.90	68.81	9.05	27.20	97	291.49	0	0.00	High
DMP-BR4.5		14.20		21.90		8.97		118		0		No flow
DMP-BR4.5		4.83		23.10		8.22		110		0		No flow
DMP-KORB1	0.04	6.05	0.00	1.40	0.00	23.8	0.01	189	0.09	0	0.00	Low
DMP-KORB1	0.50	3.10	0.02	1.30	0.01	20.3	0.12	162	0.97	0	0.00	Medium
DMP-KORB1	1.33	12.60	0.20	1.51	0.02	32.2	0.52	277	4.44	0	0.00	Medium
DMP-KORB1	12.00	12.80	1.85	1.02	0.15		0.00	251	36.20	0	0.00	High
DMP-KORB2	10.20	38.50	4.72	2.60	0.32	54.5	6.68	480	58.85	0	0.00	Low
DMP-KORB2	10.20	36.50	4.48	2.74	0.34	53.4	6.55	537	65.84	0	0.00	Low
DMP-KORB2	20.00	57.80	13.90	4.17	1.00	80.6	19.38	583	140.15	0	0.00	Low
DMP-KORB2	20.40	36.30	8.90	2.44	0.60	51.5	12.63	498	122.11	0	0.00	Medium
DMP-KORB2	20.40	29.70	7.28	2.28	0.56	46.7	11.45	461	113.04	0	0.00	Medium
DMP-KORB2	71.45	33.50	28.77	2.25	1.93	46.5	39.94	411	352.98	0	0.00	Medium
DMP-KORB2	71.45	25.00	21.47	1.91	1.64	36.2	31.09	389	334.08	0	0.00	Medium
DMP-KORB2	71.45	24.10	20.70	1.80	1.55	35.2	30.23	344	295.44	0	0.00	Medium
DMP-KORB2	125.50	25.00	37.71	1.88	2.84	37.4	56.42	353	532.50	0	0.00	High
DMP-KORB2	259.00	18.40	57.28	1.21	3.77		0.00	301	937.07	0	0.00	High

Discharge Chemistry by Flow

Sample ID	Flow GPM	Iron mg/L	Fe Loading lbs/day	Manganese mg/L	Mn Loading lbs/day	Aluminum mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day	Relative Flow
DMP-KORB3	0.50	5.90	0.04	1.95	0.01	15	0.09	160	0.96	0	0.00	Low
DMP-KORB3	0.50	3.90	0.02	1.31	0.01	10.3	0.06	134	0.81	0	0.00	Low
DMP-KORB3	1.00	6.64	0.08	1.45	0.02	12.9	0.16	142	1.71	0	0.00	Low
DMP-KORB3	1.33	5.51	0.09	1.67	0.03	15.6	0.25	140	2.24	0	0.00	Medium
DMP-KORB3	3.00	8.63	0.31	1.48	0.05	16.4	0.59	143	5.16	0	0.00	Medium
DMP-KORB3	4.00	4.59	0.22	1.66	0.08	21.8	1.05	181	8.70	0	0.00	Medium
DMP-KORB3	4.00	4.78	0.23	1.63	0.08	19	0.91	158	7.60	0	0.00	Medium
DMP-KORB3	7.50	3.93	0.35	1.32	0.12	15.6	1.41	140	12.62	0	0.00	High
DMP-KORB3	12.00	2.89	0.42	1.19	0.17			141	20.34	0	0.00	High
DMP-KORB3	N/A	5.13		1.35		13.4		131		0		No flow

DMP-LA5.9-1	8.89	3.63	0.39	4.67	0.50	2.99	0.32	45	4.81	0	0.00	Low
DMP-LA5.9-1	8.89	0.42	0.04	8.27	0.88	2.41	0.26	25	2.67	5	0.53	Low
DMP-LA5.9-1	14.60	0.05	0.01	8.66	1.52	2.62	0.46	30	5.26	7	1.23	Medium
DMP-LA5.9-1	16.70	0.05	0.01	8.62	1.73	2.5	0.50	36	7.23	3	0.60	Medium
DMP-LA5.9-1	27.50	0.05	0.02	8.64	2.86	2.44	0.81	26	8.59	3	0.99	High
DMP-LA5.9-1	50.30	0.05	0.03	10.80	6.53			32	19.35	3	1.81	High

DMP-LA5.9-2	0.42	0.27	0.00	5.22	0.03	0.82	0.00	14	0.07	5	0.03	Low
DMP-LA5.9-2	2.19	0.17	0.00	4.30	0.11	0.86	0.02	17	0.45	4	0.11	Low
DMP-LA5.9-2	2.20	0.15	0.00	4.16	0.11	1	0.03	18	0.48	6	0.16	Low
DMP-LA5.9-2	3.83	1.02	0.05	4.19	0.19	1.18	0.05	16	0.74	4	0.18	Medium
DMP-LA5.9-2	6.10	0.06	0.00	3.96	0.29	1.03	0.08	16	1.17	4	0.29	Medium
DMP-LA5.9-2	8.89	0.06	0.01	4.83	0.52	1.25	0.13	19	2.03	4	0.43	Medium
DMP-LA5.9-2	16.70	0.05	0.01	4.29	0.86	1.02	0.20	16	3.21	7	1.41	Medium
DMP-LA5.9-2	21.70	0.05	0.01	4.64	1.21	1.27	0.33	24	6.26	4	1.04	High
DMP-LA5.9-2	85.80	1.03	1.06	4.81	4.96			17	17.53	5	5.16	High
DMP-LA5.9-2	267.00	1.44	4.62	4.40	14.12	1.31	4.20	14	44.93	5	16.05	High

Discharge Chemistry by Flow

Sample ID	Flow GPM	Iron mg/L	Fe Loading lbs/day	Manganese mg/L	Mn Loading lbs/day	Aluminum mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day	Relative Flow
DMP-KORB4	12.80	49.10	7.55	9.81	1.51	35.7	5.49	436	67.08	0	0.00	Low
DMP-KORB4	20.40	53.50	13.12	10.60	2.60	39.4	9.66	450	110.34	0	0.00	Low
DMP-KORB4	29.40	53.09	18.76	9.78	3.46	32.4	11.45	428	151.25	0	0.00	Low
DMP-KORB4	35.40	54.30	23.11	11.30	4.81	34.4	14.64	398	169.35	0	0.00	Low
DMP-KORB4	35.40	45.60	19.40	9.09	3.87	32.3	13.74	413	175.73	0	0.00	Low
DMP-KORB4	49.50	47.30	28.14	9.89	5.88	34.1	20.29	388	230.86	0	0.00	Medium
DMP-KORB4	57.20	36.20	24.89	7.05	4.85	25.5	17.53	344	236.52	0	0.00	Medium
DMP-KORB4	64.90	36.70	28.63	8.09	6.31	26.4	20.59	359	280.06	0	0.00	Medium
DMP-KORB4	117.00	32.90	46.27	7.20	10.13	23.5	33.05	307	431.75	0	0.00	High
DMP-KORB4	136.00	48.60	79.45	8.33	13.62	31.1	50.84	394	644.08	0	0.00	High
DMP-KORB4	157.00	38.40	72.47	7.90	14.91	25.6	48.31	343	647.29	0	0.00	High
DMP-KORB4	233.50	31.80	89.25	6.12	17.18			327	917.78	0	0.00	High
DMP-Widemire	35.40	9.35	3.98	2.35	1.00	3.19	1.36	71	30.21	0	0.00	Low
DMP-Widemire	42.50	10.10	5.16	2.26	1.15	2.81	1.44	39	19.92	0	0.00	Low
DMP-Widemire	47.00	7.38	4.17	2.33	1.32	3.87	2.19	64	36.16	0	0.00	Low
DMP-Widemire	49.50	4.56	2.71	2.12	1.26	4.89	2.91	38	22.61	0	0.00	Low
DMP-Widemire	81.00	3.01	2.93	2.15	2.09	5.5	5.35	45	43.81	0	0.00	Medium
DMP-Widemire	98.50	6.70	7.93	2.38	2.82	5.07	6.00	41	48.54	0	0.00	Medium
DMP-Widemire	98.50	7.44	8.81	2.36	2.79	4.01	4.75	35	41.44	0	0.00	Medium
DMP-Widemire	98.50	3.42	4.05	2.36	2.79	6.32	7.48	44	52.09	0	0.00	Medium
DMP-Widemire	98.50	3.12	3.69	2.15	2.55	6.48	7.67	53	62.75	0	0.00	Medium
DMP-Widemire	117.00	2.54	3.57	1.98	2.78	5.41	7.61	50	70.32	1	1.41	High
DMP-Widemire	136.00	6.01	9.82	2.10	3.43	5.13	8.39	47	76.83	0	0.00	High
DMP-Widemire	245.00	6.39	18.82	2.33	6.86	6.58	19.38	53	156.08	0	0.00	High

Discharge Chemistry by Flow

Sample ID	Flow GPM	Iron mg/L	Fe Loading lbs/day	Manganese mg/L	Mn Loading lbs/day	Aluminum mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day	Relative Flow
DMP-Wildwood	42.40	9.67	4.93	3.52	1.79	0.049	0.02	15	7.64	9	4.59	Low
DMP-Wildwood	42.50	13.80	7.05	4.67	2.39	0.05	0.03	50	25.54	9	4.60	Low
DMP-Wildwood	42.50	12.70	6.49	4.60	2.35	0.049	0.03	24	12.26	11	5.62	Low
DMP-Wildwood	49.50	5.82	3.46	2.87	1.71	0.049	0.03	13	7.73	6	3.57	Low
DMP-Wildwood	64.90	13.80	10.77	3.69	2.88	0.049	0.04	22	17.16	11	8.58	Medium
DMP-Wildwood	81.00	9.29	9.04	1.69	1.65	0.049	0.05	14	13.63	12	11.68	Medium
DMP-Wildwood	81.00	4.30	4.19	2.38	2.32	0.049	0.05	14	13.63	7	6.82	Medium
DMP-Wildwood	117.00	10.70	15.05	2.37	3.33	0.049	0.07	16	22.50	10	14.06	Medium
DMP-Wildwood	127.00	3.96	6.05	1.69	2.58	0.049	0.07	8	12.21	7	10.69	High
DMP-Wildwood	136.00	10.30	16.84	2.56	4.18	0.049	0.08	12	19.62	9	14.71	High
DMP-Wildwood	178.00	7.86	16.82	1.57	3.36	0.05	0.11	11	23.54	10	21.40	High
DMP-Wildwood	189.00	4.68	10.63	0.93	2.11	0.06	0.14	7	15.90	10	22.72	High

DMP-Draucker1	23.40	104.00	29.25	28.10	7.90	68.8	19.35	670	188.45	0	0.00	Low
DMP-Draucker1	35.40	75.30	32.04	20.80	8.85	48.5	20.64	645	274.45	0	0.00	Low
DMP-Draucker1	35.40	98.80	42.04	27.10	11.53	61.8	26.30	647	275.30	0	0.00	Low
DMP-Draucker1	64.90	103.00	80.35	24.30	18.96	59.4	46.34	677	528.13	0	0.00	Low
DMP-Draucker1	64.90	94.00	73.33	24.60	19.19	60.8	47.43	650	507.06	0	0.00	Low
DMP-Draucker1	64.90	94.40	73.64	25.30	19.74	69.4	54.14	682	532.03	0	0.00	Low
DMP-Draucker1	98.50	70.00	82.88	18.50	21.90	49.4	58.49	634	750.64	0	0.00	Medium
DMP-Draucker1	136.00	67.70	110.67	20.20	33.02	52.7	86.15	574	938.33	0	0.00	Medium
DMP-Draucker1	136.00	62.30	101.84	18.50	30.24	49.8	81.41	546	892.56	0	0.00	Medium
DMP-Draucker1	178.00	59.00	126.23	15.60	33.38	58.4	124.95	652	1394.99	0	0.00	High
DMP-Draucker1	178.00	62.10	132.87	18.50	39.58	56.3	120.46	591	1264.48	0	0.00	High
DMP-Draucker1	294.00	52.90	186.94	15.60	55.13	49.4	174.57	519	1834.08	0	0.00	High

Discharge Chemistry by Flow

Sample ID	Flow GPM	Iron mg/L	Fe Loading lbs/day	Manganese mg/L	Mn Loading lbs/day	Aluminum mg/L	Al Loading lbs/day	Acidity mg/L	Acidity Loading lbs/day	Alkalinity mg/L	Alkalinity Loading lbs/day	Relative Flow
DMP-Draucker2	35.40	6.95	2.96	6.35	2.70	0.23	0.10	38	16.17	0	0.00	Low
DMP-Draucker2	35.40	5.99	2.55	5.69	2.42	0.29	0.12	37	15.74	0	0.00	Low
DMP-Draucker2	49.50	4.42	2.63	5.07	3.02	0.47	0.28	43	25.58	0	0.00	Low
DMP-Draucker2	98.50	2.21	2.62	5.03	5.96	0.82	0.97	28	33.15	0	0.00	Low
DMP-Draucker2	106.40	1.07	1.37	3.52	4.50	1	1.28	25	31.97	0	0.00	Medium
DMP-Draucker2	136.00	2.19	3.58	4.34	7.09	0.92	1.50	26	42.50	0	0.00	Medium
DMP-Draucker2	178.00	1.76	3.77	4.36	9.33	1.01	2.16	21	44.93	2	4.28	Medium
DMP-Draucker2	209.60	0.80	2.02	3.47	8.74	1.52	3.83	25	62.98	1	2.52	Medium
DMP-Draucker2	258.10	0.68	2.11	3.33	10.33	1.67	5.18	27	83.76	1	3.10	High
DMP-Draucker2	324.00	1.09	4.24	3.32	12.93	1.6	6.23	28	109.05	1	3.89	High
DMP-Draucker2	370.00	0.76	3.38	3.40	15.12	1.31	5.83	18	80.05	3	13.34	High
DMP-Draucker2	870.20	0.95	9.94	3.04	31.80	1.23	12.87	27	282.41	1	10.46	High
PAMP-LA3.0-3	23.40	8.23	2.31	13.70	3.85	0.45	0.13	76	21.38	0	0.00	Low
PAMP-LA3.0-3	35.40	7.90	3.36	13.40	5.70	0.44	0.19	77	32.76	0	0.00	Low
PAMP-LA3.0-3	49.50	5.08	3.02	12.10	7.20	0.5	0.30	72	42.84	0	0.00	Low
PAMP-LA3.0-3	98.50	2.82	3.34	8.67	10.27	0.68	0.81	45	53.28	0	0.00	Low
PAMP-LA3.0-3	98.50	2.70	3.20	8.10	9.59	0.57	0.67	47	55.65	0	0.00	Low
PAMP-LA3.0-3	106.40	1.67	2.14	7.78	9.95	0.81	1.04	42	53.71	0	0.00	Medium
PAMP-LA3.0-3	117.00	2.17	3.05	7.33	10.31	0.77	1.08	33	46.41	0	0.00	Medium
PAMP-LA3.0-3	209.60	2.21	5.57	7.71	19.42	1.1	2.77	33	83.14	0	0.00	Medium
PAMP-LA3.0-3	245.00	2.80	8.25	6.97	20.53	1.12	3.30	41	120.74	0	0.00	High
PAMP-LA3.0-3	258.10	1.47	4.56	7.58	23.52	1.42	4.41	34	105.48	0	0.00	High
PAMP-LA3.0-3	324.00	1.79	6.97	5.69	22.16	1.08	4.21	27	105.15	0	0.00	High
PAMP-LA3.0-3	370.00	1.55	6.89	5.69	25.31	1.46	6.49	29	128.97	0	0.00	High

Discharge Loadings in Pounds per Day at Low, Medium, and High Flow

Monitoring Point	Fe Load Low	Fe Load Med	Fe Load High	Mn Load Low	Mn Load Med	Mn Load High	Al Load Low	Al Load Med	Al Load High	Acidity Load Low	Acidity Load Med	Acidity Load High
DMP-879	1.0	1.7	4.2	0.1	0.3	0.4	0.0	0.0	0.0	-3.6	0.9	2.7
DMP-AC3.75-1	0.0	0.1	0.4	0.0	0.0	0.3	0.0	0.1	2.9	0.7	1.3	29.6
DMP-AC3.75-2	0.1	0.3	0.9	0.0	0.1	0.3	0.3	1.0	2.3	4.3	15.9	33.5
DMP-AC3.75-3	0.1	0.2	0.6	0.2	0.4	0.9	1.6	3.5	9.9	14.6	28.4	78.7
DMP-BR3.9	0.1	0.5	0.7	0.3	0.8	1.9	0.0	0.3	0.8	0.9	3.9	11.5
DMP-BR4.0	1.5	2.7	5.5	2.9	6.7	18.9	1.6	3.6	10.4	15.7	33.2	100.5
DMP-BR4.5	2.6	8.0	31.2	5.3	11.1	47.6	1.9	4.2	18.4	25.8	49.1	236.4
DMP-KORB1	0.0	0.1	1.8	0.0	0.0	0.1	0.0	0.3	0.0	0.1	2.7	36.2
DMP-Korb2	7.7	17.4	47.5	0.6	1.3	3.3	10.9	25.1	28.2	88.3	243.5	734.8
DMP-Korb3	0.0	0.2	0.4	0.0	0.1	0.1	0.1	0.7	1.4	1.2	5.9	16.5
DMP-LA5.9-1	0.2	0.0	0.0	0.7	1.6	4.7	0.3	0.5	0.8	3.7	6.2	14.0
DMP-LA5.9-2	0.0	0.0	1.9	0.1	0.5	6.8	0.0	0.1	2.3	0.3	1.8	22.9
DMP-KORB4	16.4	27.2	71.9	3.2	5.7	14.0	11.0	19.5	44.1	134.8	249.1	660.2
DMP-Widemire	4.0	5.5	10.7	1.2	2.6	4.4	2.0	6.3	11.8	27.2	49.7	101.1
DMP-Wildwood	5.5	9.8	12.6	2.1	2.5	3.1	0.0	0.1	0.1	13.3	16.7	17.8
DMP-Draucker1	55.1	98.5	148.7	14.4	28.4	42.7	35.7	75.3	140.0	384.2	860.5	1497.9
DMP-Draucker2	2.7	2.7	4.9	3.5	7.4	17.5	0.4	2.2	7.5	22.7	45.6	138.8
PAMP-LA3.0-3	3.0	3.6	6.7	7.3	13.2	22.9	0.4	1.6	4.6	41.2	61.1	115.1
PAMP-LA3.0-2	4.4	5.5	15.5	6.7	13.1	33.1	2.6	9.7	36.3	52.1	146.2	459.8
PA-KR1.45-1	0.1	0.2	0.6	1.2	5.4	10.9	1.7	7.3	16.8	14.7	58.6	137.3
PMP-LA4.3-1	4.6	11.9	20.9	5.7	17.2	27.0	4.5	15.2	25.5	61.0	210.3	270.1
PMP-LA4.3-2	4.4	0.4	0.7	6.7	0.6	1.0	2.6	0.1	0.3	52.1	3.6	9.4
PAMP-LA3.0-4	3.7	16.5	14.1	3.6	13.5	17.1	0.1	0.9	1.7	20.1	71.4	83.4
PAMP-LA3.0-1	0.1	0.2	0.3	0.2	0.5	0.5	1.0	2.8	2.6	8.3	20.5	18.4
PAMP-LA2.10	0.0	0.2	0.4	0.2	0.7	3.7	0.3	0.7	3.4	2.6	8.7	31.8

Iron Loading at Low, Medium, and High Flow

	Fe Load lbs/day Low Flow		Fe Load lbs/day Med Flow		Fe Load lbs/day High Flow
DMP-Drauker1	55.1	DMP-Drauker1	98.5	DMP-Drauker1	148.7
DMP-KORB4	16.4	DMP-KORB4	27.2	DMP-KORB4	71.9
DMP-Korb2	7.7	DMP-Korb2	17.4	DMP-Korb2	47.5
DMP-Wildwood	5.5	PAMP-LA3.0-4	16.5	DMP-BR4.5	31.2
PMP-LA4.3-1	4.6	PMP-LA4.3-1	11.9	PMP-LA4.3-1	20.9
PAMP-LA3.0-2	4.4	DMP-Wildwood	9.8	PAMP-LA3.0-2	15.5
PMP-LA4.3-2	4.4	DMP-BR4.5	8.0	PAMP-LA3.0-4	14.1
DMP-Widemire	4.0	PAMP-LA3.0-2	5.5	DMP-Wildwood	12.6
PAMP-LA3.0-4	3.7	DMP-Widemire	5.5	DMP-Widemire	10.7
PAMP-LA3.0-3	3.0	PAMP-LA3.0-3	3.6	PAMP-LA3.0-3	6.7
DMP-Drauker2	2.7	DMP-BR4.0	2.7	DMP-BR4.0	5.5
DMP-BR4.5	2.6	DMP-Drauker2	2.7	DMP-Drauker2	4.9
DMP-BR4.0	1.5	DMP-879	1.7	DMP-879	4.2
DMP-879	1.0	DMP-BR3.9	0.5	DMP-LA5.9-2	1.9
DMP-LA5.9-1	0.2	PMP-LA4.3-2	0.4	DMP-KORB1	1.8
DMP-AC3.75-3	0.1	DMP-AC3.75-2	0.3	DMP-AC3.75-2	0.9
DMP-AC3.75-2	0.1	PA-KR1.45-1	0.2	PMP-LA4.3-2	0.7
DMP-BR3.9	0.1	DMP-AC3.75-3	0.2	DMP-BR3.9	0.7
PAMP-LA3.0-1	0.1	DMP-Korb3	0.2	PA-KR1.45-1	0.6
PA-KR1.45-1	0.1	PAMP-LA3.0-1	0.2	DMP-AC3.75-3	0.6
DMP-Korb3	0.0	PAMP-LA2.10	0.2	DMP-AC3.75-1	0.4
DMP-AC3.75-1	0.0	DMP-KORB1	0.1	PAMP-LA2.10	0.4
DMP-LA5.9-2	0.0	DMP-AC3.75-1	0.1	DMP-Korb3	0.4
DMP-KORB1	0.0	DMP-LA5.9-2	0.0	PAMP-LA3.0-1	0.3
PAMP-LA2.10	0.0	DMP-LA5.9-1	0.0	DMP-LA5.9-1	0.0

Aluminum Loading at Low, Medium, and High Flow

	Al Load lbs/day Low Flow		**Al Load lbs/day Med Flow**		**Al Load lbs/day High Flow**
DMP-Drauker1	35.7	DMP-Drauker1	75.3	DMP-Drauker1	140.0
DMP-KORB4	11.0	DMP-Korb2	25.1	DMP-KORB4	44.1
DMP-Korb2	10.9	DMP-KORB4	19.5	PAMP-LA3.0-2	36.3
PMP-LA4.3-1	4.5	PMP-LA4.3-1	15.2	DMP-Korb2	28.2
PAMP-LA3.0-2	2.6	PAMP-LA3.0-2	9.7	PMP-LA4.3-1	25.5
PMP-LA4.3-2	2.6	PA-KR1.45-1	7.3	DMP-BR4.5	18.4
DMP-Widemire	2.0	DMP-Widemire	6.3	PA-KR1.45-1	16.8
DMP-BR4.5	1.9	DMP-BR4.5	4.2	DMP-Widemire	11.8
PA-KR1.45-1	1.7	DMP-BR4.0	3.6	DMP-BR4.0	10.4
DMP-AC3.75-3	1.6	DMP-AC3.75-3	3.5	DMP-AC3.75-3	9.9
DMP-BR4.0	1.6	PAMP-LA3.0-1	2.8	DMP-Drauker2	7.5
PAMP-LA3.0-1	1.0	DMP-Drauker2	2.2	PAMP-LA3.0-3	4.6
PAMP-LA3.0-3	0.4	PAMP-LA3.0-3	1.6	PAMP-LA2.10	3.4
DMP-Drauker2	0.4	DMP-AC3.75-2	1.0	DMP-AC3.75-1	2.9
DMP-LA5.9-1	0.3	PAMP-LA3.0-4	0.9	PAMP-LA3.0-1	2.6
PAMP-LA2.10	0.3	PAMP-LA2.10	0.7	DMP-LA5.9-2	2.3
DMP-AC3.75-2	0.3	DMP-Korb3	0.7	DMP-AC3.75-2	2.3
PAMP-LA3.0-4	0.1	DMP-LA5.9-1	0.5	PAMP-LA3.0-4	1.7
DMP-Korb3	0.1	DMP-KORB1	0.3	DMP-Korb3	1.4
DMP-BR3.9	0.0	DMP-BR3.9	0.3	DMP-BR3.9	0.8
DMP-Wildwood	0.0	DMP-LA5.9-2	0.1	DMP-LA5.9-1	0.8
DMP-AC3.75-1	0.0	PMP-LA4.3-2	0.1	PMP-LA4.3-2	0.3
DMP-LA5.9-2	0.0	DMP-AC3.75-1	0.1	DMP-Wildwood	0.1
DMP-KORB1	0.0	DMP-Wildwood	0.1	DMP-879	0.0
DMP-879	0.0	DMP-879	0.0	DMP-KORB1	0.0

Acidity Loading at Low, Medium, and High Flow

	Acidity Load lbs/day Low Flow		Acidity Load lbs/day Med Flow		Acidity Load lbs/day High Flow
DMP-Drauker1	384.2	DMP-Drauker1	860.5	DMP-Drauker1	1497.9
DMP-KORB4	134.8	DMP-KORB4	249.1	DMP-Korb2	734.8
DMP-Korb2	88.3	DMP-Korb2	243.5	DMP-KORB4	660.2
PMP-LA4.3-1	61.0	PMP-LA4.3-1	210.3	PAMP-LA3.0-2	459.8
PAMP-LA3.0-2	52.1	PAMP-LA3.0-2	146.2	PMP-LA4.3-1	270.1
PMP-LA4.3-2	52.1	PAMP-LA3.0-4	71.4	DMP-BR4.5	236.4
PAMP-LA3.0-3	41.2	PAMP-LA3.0-3	61.1	DMP-Drauker2	138.8
DMP-Widemire	27.2	PA-KR1.45-1	58.6	PA-KR1.45-1	137.3
DMP-BR4.5	25.8	DMP-Widemire	49.7	PAMP-LA3.0-3	115.1
DMP-Drauker2	22.7	DMP-BR4.5	49.1	DMP-Widemire	101.1
PAMP-LA3.0-4	20.1	DMP-Drauker2	45.6	DMP-BR4.0	100.5
DMP-BR4.0	15.7	DMP-BR4.0	33.2	PAMP-LA3.0-4	83.4
PA-KR1.45-1	14.7	DMP-AC3.75-3	28.4	DMP-AC3.75-3	78.7
DMP-AC3.75-3	14.6	PAMP-LA3.0-1	20.5	DMP-KORB1	36.2
DMP-Wildwood	13.3	DMP-Wildwood	16.7	DMP-AC3.75-2	33.5
PAMP-LA3.0-1	8.3	DMP-AC3.75-2	15.9	PAMP-LA2.10	31.8
DMP-AC3.75-2	4.3	PAMP-LA2.10	8.7	DMP-AC3.75-1	29.6
DMP-LA5.9-1	3.7	DMP-LA5.9-1	6.2	DMP-LA5.9-2	22.9
PAMP-LA2.10	2.6	DMP-Korb3	5.9	PAMP-LA3.0-1	18.4
DMP-Korb3	1.2	DMP-BR3.9	3.9	DMP-Wildwood	17.8
DMP-BR3.9	0.9	PMP-LA4.3-2	3.6	DMP-Korb3	16.5
DMP-AC3.75-1	0.7	DMP-KORB1	2.7	DMP-LA5.9-1	14.0
DMP-LA5.9-2	0.3	DMP-LA5.9-2	1.8	DMP-BR3.9	11.5
DMP-KORB1	0.1	DMP-AC3.75-1	1.3	PMP-LA4.3-2	9.4
DMP-879	-3.6	DMP-879	0.9	DMP-879	2.7

Manganese Loading at Low, Medium, and High Flow

	Mn Load lb/day Low Flow		**Mn Load lb/day Med Flow**		**Mn Load lb/day High Flow**
DMP-Drauker1	14.4	DMP-Drauker1	28.4	DMP-BR4.5	47.6
PAMP-LA3.0-3	7.3	PMP-LA4.3-1	17.2	DMP-Drauker1	42.7
PAMP-LA3.0-2	6.7	PAMP-LA3.0-4	13.5	PAMP-LA3.0-2	33.1
PMP-LA4.3-2	6.7	PAMP-LA3.0-3	13.2	PMP-LA4.3-1	27.0
PMP-LA4.3-1	5.7	PAMP-LA3.0-2	13.1	PAMP-LA3.0-3	22.9
DMP-BR4.5	5.3	DMP-BR4.5	11.1	DMP-BR4.0	18.9
PAMP-LA3.0-4	3.6	DMP-Drauker2	7.4	DMP-Drauker2	17.5
DMP-Drauker2	3.5	DMP-BR4.0	6.7	PAMP-LA3.0-4	17.1
DMP-KORB4	3.2	DMP-KORB4	5.7	DMP-KORB4	14.0
DMP-BR4.0	2.9	PA-KR1.45-1	5.4	PA-KR1.45-1	10.9
DMP-Wildwood	2.1	DMP-Widemire	2.6	DMP-LA5.9-2	6.8
PA-KR1.45-1	1.2	DMP-Wildwood	2.5	DMP-LA5.9-1	4.69
DMP-Widemire	1.2	DMP-LA5.9-1	1.6	DMP-Widemire	4.4
DMP-LA5.9-1	0.7	DMP-Korb2	1.3	PAMP-LA2.10	3.66
DMP-Korb2	0.6	DMP-BR3.9	0.8	DMP-Korb2	3.3
DMP-BR3.9	0.3	PAMP-LA2.10	0.72	DMP-Wildwood	3.1
DMP-AC3.75-3	0.2	PMP-LA4.3-2	0.6	DMP-BR3.9	1.9
PAMP-LA3.0-1	0.24	PAMP-LA3.0-1	0.5	PMP-LA4.3-2	1.0
PAMP-LA2.10	0.21	DMP-LA5.9-2	0.5	DMP-AC3.75-3	0.9
DMP-879	0.1	DMP-AC3.75-3	0.4	PAMP-LA3.0-1	0.55
DMP-LA5.9-2	0.08	DMP-879	0.3	DMP-879	0.4
DMP-AC3.75-2	0.0	DMP-AC3.75-2	0.1	DMP-AC3.75-1	0.3
DMP-Korb3	0.0	DMP-Korb3	0.1	DMP-AC3.75-2	0.3
DMP-AC3.75-1	0.0	DMP-KORB1	0.0	DMP-KORB1	0.1
DMP-KORB1	0.0	DMP-AC3.75-1	0.0	DMP-Korb3	0.1

Load Rankings for Discharge Points

Ranking by Iron Loading

	Fe Loading lbs/day	*Rank*
DMP-Drauker1	89.34	1
DMP-KORB4	37.59	2
DMP-KORB2	20.52	3
DMP-BR4.5	13.95	4
PAMP-LA4.3	12.24	5
PAMP-LA3.0-4	10.78	6
DMP-Wildwood	9.28	7
DMP-Widemire	6.30	8
PAMP-LA3.0	4.08	9
DMP-Drauker2	3.43	10
DMP-BR4.0	2.78	11
DMP-879	1.89	12
DMP-LA5.9-2	0.58	13
DMP-KORB1	0.52	14
DMP-AC3.75-2	0.42	15
DMP-BR3.9	0.41	16
PAMP-KR1.45-1	0.30	17
DMP-AC3.75-3	0.30	18
PAMP-LA2.10	0.21	19
DMP-KORB3	0.20	20
PAMP-LA3.0-1	0.17	21
DMP-AC3.75-1	0.15	22
DMP-LA5.9-1	0.08	23

Ranking by Aluminum Loading

	Al Loading lbs/day	*Rank*
DMP-Drauker1	71.68	1
DMP-KORB4	22.33	2
DMP-KORB2	21.44	3
PAMP-LA4.3	14.95	4
PAMP-LA3.0	14.10	5
PAMP-KR1.45-1	8.61	6
DMP-BR4.5	8.17	7
DMP-Widemire	6.21	8
DMP-AC3.75-3	4.80	9
DMP-BR4.0	4.33	10
DMP-Drauker2	3.36	11
PAMP-LA3.0-1	2.10	12
PAMP-LA2.10	1.29	13
DMP-AC3.75-2	1.18	14
DMP-AC3.75-1	0.86	15
PAMP-LA3.0-4	0.72	16
DMP-KORB3	0.56	17
DMP-LA5.9-2	0.56	18
DMP-LA5.9-1	0.47	19
DMP-BR3.9	0.36	20
DMP-KORB1	0.16	21
DMP-Wildwood	0.06	22
DMP-879	0.01	23

Ranking by Manganese Loading

	Mn Loading lbs/day	*Rank*
DMP-Drauker1	24.95	1
DMP-BR4.5	21.32	2
PAMP-LA4.3	16.07	3
PAMP-LA3.0-4	9.95	4
DMP-Drauker2	9.50	5
DMP-BR4.0	7.94	6
DMP-KORB4	7.43	7
PAMP-KR1.45-1	5.82	8
PAMP-LA3.0	3.67	9
DMP-Widemire	2.57	10
DMP-Wildwood	2.55	11
DMP-LA5.9-1	2.34	12
DMP-LA5.9-2	2.24	13
DMP-KORB2	1.45	14
PAMP-LA2.10	1.33	15
DMP-BR3.9	0.97	16
DMP-AC3.75-3	0.50	17
PAMP-LA3.0-1	0.44	18
DMP-879	0.24	19
DMP-AC3.75-2	0.16	20
DMP-AC3.75-1	0.10	21
DMP-KORB3	0.06	22
DMP-KORB1	0.04	23

Ranking by Acidity Loading

	Acidity Loading lbs/day	*Rank*
DMP-Drauker1	781.71	1
DMP-KORB4	338.51	2
DMP-KORB2	295.21	3
PAMP-LA4.3	172.32	4
PAMP-LA3.0	148.60	5
DMP-BR4.5	103.76	6
PAMP-KR1.45-1	70.19	7
DMP-Drauker2	69.03	8
DMP-Widemire	55.06	9
PAMP-LA3.0-4	52.06	10
DMP-BR4.0	41.98	11
DMP-AC3.75-3	38.84	12
DMP-AC3.75-2	17.91	13
DMP-Wildwood	15.95	14
PAMP-LA3.0-1	15.72	15
PAMP-LA2.10	12.98	16
DMP-KORB1	10.43	17
DMP-AC3.75-1	9.20	18
DMP-LA5.9-1	7.99	19
DMP-LA5.9-2	7.69	20
DMP-KORB3	6.68	21
DMP-BR3.9	5.31	22
DMP-879	-0.33	23

Ranking by Alkalinity Loading

	Alkalinity Loading lbs/day	*Rank*
DMP-Wildwood	10.75	1
DMP-Drauker2	3.13	2
DMP-LA5.9-2	2.48	3
DMP-BR3.9	1.84	4
DMP-879	1.65	5
PAMP-KR1.45-1	0.98	6
DMP-LA5.9-1	0.86	7
DMP-AC3.75-1	0.49	8
DMP-BR4.5	0.20	9
DMP-Widemire	0.12	10
DMP-AC3.75-2	0.00	11
DMP-AC3.75-3	0.00	11
DMP-BR4.0	0.00	11
DMP-KORB2	0.00	11
DMP-KORB3	0.00	11
DMP-KORB4	0.00	11
DMP-Drauker1	0.00	11
PAMP-LA3.0	0.00	11
PAMP-LA4.3	0.00	11
PAMP-LA3.0-4	0.00	11
PAMP-LA3.0-1	0.00	11
PAMP-LA2.10	0.00	11
DMP-KORB1	0.00	11

Stream Flow Loading

Sample ID	Sample Date	Flow GPM	pH Field	pH Lab	Cond. Umhos	Temp C	Alkalinity mg/L	Acidity mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Susp. Solids mg/L	TDS mg/L	Fe Loading lbs/day	Al Loading lbs/day	Mn Loading lbs/day	Acidity Loading lbs/day	Flow Category
SMP-AC1	10/23/2004	20169.0	6.2	6.2	198	9.0	9	4	0.21	0.78	0.43	57	12.90		50.91	104.25	189.10	969.73	Medium
SMP-AC1	11/22/2004	21764.3	6.3	6.2	188	7.0	8	8	0.26	0.90	0.52	62	10.00		68.02	136.04	235.45	2092.86	Medium
SMP-AC1	2/9/2005	60343.9	6.4	5.8	246	1.0	7	7	1.00	1.43	1.15	74	8.60		725.33	834.13	1037.23	5077.34	High
SMP-AC1	3/16/2005	35763.1	6.2	4.9	186	0.0	8	10	0.51	0.77	0.86	46	5.69		219.23	369.69	331.00	4298.72	High
SMP-AC1	4/14/2005	52725.0	5.5	5.2	175	7.0	5	8	0.35	0.66	0.71	43	5.69		221.81	449.97	418.28	5070.04	High
SMP-AC1	5/18/2005	21743.0	5.8	5.6	199	11.0	6	7	0.20	0.77	0.53	50	5.69		52.27	138.52	201.24	1829.46	Medium
SMP-AC1	6/15/2005	13705.8	6.5	6.5	181	21.0	9	2	0.16	0.56	0.13	40	6.19		26.36	21.42	92.26	329.49	Medium
SMP-AC1	7/13/2005	4409.6	7.1	5.7	385	22.0	10	10	0.11	0.85	0.07	73	7.10		5.83	3.71	45.05	530.03	Low
SMP-AC1	8/22/2005	2656.9	6.9	6.8	292	20.0	14	-2	0.07	0.74	0.06	69	7.10		2.24	1.92	23.63	-63.87	Low
SMP-AC1	9/14/2005	3660.0	6.0	6.9	298	16.0	14	-3	0.22	0.73	0.09	96	7.10		9.68	3.96	32.11	-131.98	Low
SMP-AC2	10/23/2004	18029.0	4.8	4.6	173	9.0	5	12	0.12	1.01	0.78	48	8.60		26.01	169.03	218.88	2600.50	Medium
SMP-AC2	11/22/2004	17101.6	5.2	4.8	165	7.0	6	11	0.12	1.04	0.79	55	5.69		24.67	162.39	213.78	2261.17	Medium
SMP-AC2	2/9/2005	52041.1	5.1	4.7	219	2.0	5	12	0.63	1.34	1	67	5.69		394.09	625.53	838.22	7506.41	High
SMP-AC2	3/16/2005	32916.8	5.0	4.6	153	1.0	6	14	0.38	0.68	0.87	40	5.69		150.35	344.22	269.05	5539.24	High
SMP-AC2	4/14/2005	43021.1	4.5	4.7	155	8.0	5	10	0.29	0.67	0.84	36	5.69		149.96	434.38	346.47	5171.14	High
SMP-AC2	5/18/2005	14932.0	4.6	4.6	171	11.5	5	13	0.09	0.88	0.8	40	5.69		16.15	143.59	157.94	2333.27	Medium
SMP-AC2	6/15/2005	10000.0	4.3	4.7	154	20.5	5	8	0.40	0.68	0.48	32	6.19		48.08	57.70	81.74	961.60	Medium
SMP-AC2	7/13/2005	4499.0	4.5	4.4	248	22.0	4	15	0.11	1.20	0.82	52	6.19		5.95	44.34	64.89	811.17	Low
SMP-AC2	8/22/2005	2276.1	4.4	4.4	230	19.5	4	13	0.09	1.17	0.76	53	7.10		2.46	20.79	32.01	355.66	Low
SMP-AC2	9/14/2005	2220.5	4.3	4.4	234	15.0	4	12	0.07	1.22	0.95	68	6.19		1.87	25.36	32.56	320.28	Low
SMP-AC3	10/23/2004	16492.0	4.7	4.7	177	8.0	5	11	0.20	1.02	0.73	50	8.60		39.65	144.71	202.20	2180.57	Medium
SMP-AC3	11/23/2004	15146.4	4.9	4.9	166	5.0	5	10	0.23	1.08	0.77	52	5.69		41.87	140.19	196.62	1820.60	Medium
SMP-AC3	2/10/2005		5.2	5.1	117	1.5	6	8	0.63	0.75	0.66	31	18.60						
SMP-AC3	3/16/2005	32652.9	4.6	4.8	156	1.0	5	12	0.48	0.76	0.84	41	5.69		188.39	329.69	298.29	4709.85	High
SMP-AC3	4/15/2005	43364.4	4.5	4.7	153	7.5	5	9	0.43	0.70	0.84	38	10.00		224.13	437.84	364.87	4691.16	High
SMP-AC3	5/19/2005	15682.9	4.7	4.7	167	10.0	5	12	0.10	0.83	0.72	42	5.69		18.85	135.73	156.46	2262.10	Medium
SMP-AC3	6/16/2005	22817.4	4.6	4.8	185	18.0	5	9	0.29	0.79	0.42	41	8.60		79.54	115.19	216.67	2468.39	High
SMP-AC3	7/13/2005	4568.3	4.4	4.4	223	25.0	4	15	0.10	1.30	0.81	54	6.19		5.49	44.48	71.38	823.67	Low
SMP-AC3	8/22/2005	2584.9	4.3	4.4	245	22.0	3	13	0.13	1.62	0.92	63	6.19		4.04	28.58	50.33	403.92	Low
SMP-AC3	9/15/2005	1397.1	4.4	4.4	230	18.0	4	12	0.05	1.25	0.8	65	6.19		0.84	13.43	20.99	201.52	Low
SMP-AC4	10/23/2004	6898.0	6.7	6.4	102	10.0	10	2	0.17	0.04	0.049	22	10.00		14.10	4.06	3.32	165.83	Medium
SMP-AC4	11/23/2004	8026.8	6.6	6.5	99	7.0	10	2	0.19	0.04	0.049	22	5.70		18.33	4.73	3.86	192.96	Medium
SMP-AC4	2/9/2005	41749.2	6.1	6.1	85	2.0	8	6	0.20	0.15	0.23	19	11.40		100.37	115.42	75.27	3010.95	High
SMP-AC4	3/16/2005	12060.4	6.1	6.3	112	0.3	7	4	0.18	0.14	0.15	21	5.69		26.09	21.74	20.30	579.86	Medium
SMP-AC4	4/15/2005	16950.5	6.3	6.5	118	14.0	8	2	0.20	0.08	0.16	19	8.60		40.75	32.60	16.30	407.49	High
SMP-AC4	5/19/2005	6057.0	6.7	6.4	112	14.0	9	4	0.12	0.03	0.049	19	5.69		8.74	3.57	2.18	291.22	Medium
SMP-AC4	6/16/2005	21327.0	6.5	6.7	125	21.0	9	1	0.15	0.04	0.049	17	10.00		38.45	12.56	10.25	256.35	High
SMP-AC4	7/14/2005	1382.9	6.4	6.9	132	21.0	13	-1	0.08	0.03	0.049	20	6.19		1.33	0.81	0.50	-16.62	Low
SMP-AC4	8/23/2005	1139.1	6.7	6.9	138	17.0	14	-2	0.07	0.02	0.049	18	6.19		0.96	0.67	0.27	-27.38	Low
SMP-AC4	9/15/2005	1117.9	6.4	7.0	130	19.0	14	-4	0.05	0.02	0.049	18	6.19		0.67	0.66	0.27	-53.75	Low

Stream Flow Loading

Sample ID	Sample Date	Flow GPM	pH Field	pH Lab	Cond. Umhos	Temp C	Alkalinity mg/L	Acidity mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Susp. Solids mg/L	TDS mg/L	Fe Loading lbs/day	Al Loading lbs/day	Mn Loading lbs/day	Acidity Loading lbs/day	Flow Category
SMP-BR1	10/22/2004	3630.0	6.7	6.6	298	10.0	12	0	0.91	1.36	0.28	108	10.00		39.71	12.22	59.34	0.00	Medium
SMP-BR1	11/22/2004	1775.8	6.9	6.4	328	7.0	14	1	1.31	1.49	0.14	133	7.10		27.96	2.99	31.80	21.34	Medium
SMP-BR1	2/9/2005	7195.2	5.9	6.4	393	2.0	15	2	1.28	3.07	1.4	153	5.69		110.70	121.08	265.51	172.97	High
SMP-BR1	3/16/2005	4638.4	6.3	6.2	310	0.0	16	2	0.84	1.27	0.81	111	5.69		46.83	45.16	70.81	111.51	High
SMP-BR1	4/14/2005	4167.7	6.0	6.6	345	8.0	10	2	1.00	1.76	0.63	117	5.69		50.10	31.56	88.17	100.19	High
SMP-BR1	5/18/2005	1271.0	6.7	6.3	389	9.5	14	2	1.64	1.32	0.29	132	5.69		25.05	4.43	20.17	30.55	Medium
SMP-BR1	6/15/2005	1060.6	6.1	6.7	348	17.0	14	-1	1.59	0.72	0.08	112	6.19		20.27	1.02	9.18	-12.75	Medium
SMP-BR1	7/13/2005	512.6	6.2	6.6	431	17.5	18	-4	2.46	1.05	0.049	148	6.19		15.16	0.30	6.47	-24.64	Low
SMP-BR1	8/22/2005	328.6	6.6	6.5	447	16.0	19	-6	3.82	1.47	0.049	162	6.19		15.09	0.19	5.81	-23.70	Low
SMP-BR1	9/14/2005	258.6	6.2	6.5	490	13.0	19	-5	5.27	1.77	0.049	210	8.60		16.38	0.15	5.50	-15.54	Low
SMP-BR2	10/22/2004	2869.0	6.5	6.6	288	9.0	12	0	0.26	1.22	0.2	105	8.60		8.97	8.28	42.07	0.00	Medium
SMP-BR2	11/22/2004	1637.8	6.9	6.4	319	7.0	13	2	0.22	1.30	0.15	130	7.10		4.33	2.95	25.59	39.37	Medium
SMP-BR2	2/9/2005	5491.5	6.1	6.4	384	2.0	13	1	0.36	2.53	1	159	5.69		23.76	66.01	167.00	66.01	High
SMP-BR2	3/16/2005	5431.8	6.5	6.4	323	0.0	16	2	0.43	1.47	0.86	127	5.69		28.07	56.15	95.98	130.58	High
SMP-BR2	4/14/2005	4039.2	6.3	6.7	343	9.0	10	2	0.40	1.89	0.7	126	5.69		19.42	33.99	91.76	97.10	High
SMP-BR2	5/18/2005	1195.4	6.8	6.4	372	10.5	12	3	0.51	1.25	0.38	128	5.70		7.33	5.46	17.96	43.11	Medium
SMP-BR2	6/15/2005	732.6	6.3	6.8	313	18.0	11	1	0.22	0.31	0.19	97	6.19		1.94	1.67	2.73	8.81	Medium
SMP-BR2	7/13/2005	563.9	6.5	6.8	377	18.0	14	1	0.13	0.25	0.07	126	6.19		0.88	0.47	1.69	6.78	Low
SMP-BR2	8/22/2005	124.8	6.6	6.5	347	17.0	10	3	0.14	0.20	0.07	118	6.19		0.21	0.10	0.30	4.50	Low
SMP-BR2	9/14/2005	131.7	6.2	6.5	399	14.0	9	2	0.06	0.08	0.049	164	6.19		0.09	0.08	0.13	3.17	Low
SMP-BR3	10/22/2004	675.0	4.4	4.5	434	10.0	4	20	0.41	5.45	1.29	178	8.60		3.33	10.47	44.22	162.27	Medium
SMP-BR3	11/22/2004	529.1	5.5	4.7	438	7.0	6	16	0.36	5.68	1.18	198	5.70		2.29	7.51	36.13	101.76	Medium
SMP-BR3	2/9/2005	2150.0	4.5	4.4	549	0.0	3	30	0.73	8.75	3.18	270	5.69		18.87	82.18	226.12	775.28	High
SMP-BR3	3/16/2005	829.4	4.7	4.4	453	0.0	6	24	0.39	5.34	2.32	201	5.69		3.89	23.13	53.24	239.26	High
SMP-BR3	4/14/2005	901.6	4.1	4.3	551	14.0	3	26	0.34	6.04	2.4	234	5.69		3.68	26.01	65.46	281.78	High
SMP-BR3	5/18/2005	519.5	4.1	4.1	599	13.0	2	35	0.57	9.77	2.67	289	5.69		3.56	16.67	61.00	218.54	Medium
SMP-BR3	6/15/2005	241.4	4.0	4.0	552	23.0	1	27	1.41	8.15	0.74	217	6.19		4.09	2.15	23.65	78.34	Medium
SMP-BR3	7/13/2005	104.3	5.4	4.7	515	26.0	6	20	3.72	6.97	0.16	195	14.30		4.67	0.20	8.74	25.08	Low
SMP-BR3	8/22/2005	43.6	6.5	6.5	5.2	20.0	26	1	3.95	6.07	0.05	190	8.60		2.07	0.03	3.18	0.52	Low
SMP-BR3	9/14/2005	29.3	6.4	5.9	656	16.0	10	6	1.00	9.46	0.11	312	6.19		0.35	0.04	3.33	2.11	Low
SMP-BR4	11/22/2004	175.0	6.1	5.7	218	7.5	8	7	1.19	1.23	0.36	62	7.10		2.50	0.76	2.59	14.72	High
SMP-BR4	2/9/2005		5.5	5.5	288	4.0	7	10	2.05	1.59	2.21	95	27.10		0.00	0.00	0.00	0.00	
SMP-BR4	3/16/2005	326.4	5.6	4.9	238	4.0	6	14	0.53	1.05	1	70	5.69		2.08	3.92	4.12	54.93	High
SMP-BR4	4/14/2005	255.1	5.0	5.0	279	12.0	6	12	0.51	1.30	1.37	78	5.69		1.56	4.20	3.99	36.80	High
SMP-BR4	5/18/2005	55.9	5.8	5.7	191	15.0	6	8	0.55	0.76	0.25	37	5.69		0.37	0.17	0.51	5.38	Medium
SMP-BR4	6/15/2005	76.7	5.6	6.8	176	17.0	9	3	0.71	0.68	0.14	32	6.19		0.65	0.13	0.63	2.77	Medium
SMP-BR4	7/13/2005	16.2	6.2	6.1	220	23.5	10	4	1.26	0.80	0.14	34	6.19		0.24	0.03	0.16	0.78	Low
SMP-BR4	8/22/2005	10.0	6.0	6.4	198	24.0	13	0	3.47	0.75	1.03	26	7.10		0.42	0.12	0.09	0.00	Low
SMP-BR4	9/14/2005	12.0	6.4	6.4	205	23.0	13	0	1.47	0.68	0.08	31	6.19		0.21	0.01	0.10	0.00	Low

Stream Flow Loading

Sample ID	Sample Date	Flow GPM	pH Field	pH Lab	Cond. Umhos	Temp C	Alkalinity mg/L	Acidity mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Susp. Solids mg/L	TDS mg/L	Fe Loading lbs/day	Al Loading lbs/day	Mn Loading lbs/day	Acidity Loading lbs/day	Flow Category
SMP-FR1	10/22/2004	631.0	7.1	7.3	521	10.0	44	0	0.35	1.15	0.26	200	8.60		2.65	1.97	8.72	0.00	Medium
SMP-FR1	11/22/2004	433.8	7.1	6.9	529	7.0	45	0	0.24	1.00	0.17	222	7.10		1.25	0.89	5.21	0.00	Medium
SMP-FR1	2/9/2005	1909.2	6.6	6.9	402	2.0	33	-20	0.39	0.88	0.39	154	5.69		8.95	8.95	20.19	-458.97	High
SMP-FR1	3/16/2005	726.9	7.1	7.2	511	0.5	54	-40	0.29	1.07	0.31	220	5.69		2.53	2.71	9.35	-349.51	High
SMP-FR1	4/14/2005	845.5	6.6	7.5	539	10.0	43	-29	0.28	1.06	0.33	6	5.69		2.85	3.35	10.77	-294.74	High
SMP-FR1	5/18/2005	289.0	7.3	6.9	604	13.0	51	-37	0.31	1.08	0.19	229	5.69		1.08	0.66	3.75	-128.54	Medium
SMP-FR1	6/15/2005	204.6	6.8	7.5	595	19.0	49	-36	0.27	0.66	0.13	219	6.19		0.66	0.32	1.62	-88.53	Medium
SMP-FR1	7/13/2005	147.6	7.0	7.4	600	20.0	57	-41	0.60	0.47	0.12	222	6.19		1.06	0.21	0.83	-72.72	Low
SMP-FR1	8/22/2005	77.4	7.2	7.4	529	18.5	60	-45	0.69	0.26	0.05	179	6.19		0.64	0.05	0.24	-41.84	Low
SMP-FR1	9/14/2005	55.9	7.1	7.3	506	14.0	55	-42	4.00	0.32	0.25	181	6.19		2.69	0.17	0.21	-28.21	Low
SMP-HR1	10/22/2004	413.0	5.8	6.0	122	10.0	8	4	0.26	0.33	0.2	30	14.30		1.29	0.99	1.64	19.86	Medium
SMP-HR1	11/22/2004	345.8	5.8	5.9	120	7.0	9	5	0.30	0.30	0.16	28	7.10		1.25	0.67	1.25	20.78	Medium
SMP-HR1	2/9/2005	857.2	5.6	5.9	117	3.0	8	4	0.26	0.25	0.26	25	5.69		2.68	2.68	2.58	41.21	High
SMP-HR1	3/16/2005	798.1	6.1	5.8	124	2.0	10	8	0.15	0.24	0.2	28	5.69		1.44	1.92	2.30	76.75	High
SMP-HR1	4/14/2005	775.3	5.4	5.9	127	8.0	7	5	0.10	0.24	0.15	25	5.69		0.93	1.40	2.24	46.60	High
SMP-HR1	5/18/2005	279.4	5.7	5.7	144	10.0	7	7	0.10	0.37	0.16	32	5.69		0.34	0.54	1.24	23.51	Medium
SMP-HR1	6/15/2005	151.9	5.6	5.9	151	15.5	9	4	0.19	0.38	0.16	29	6.19		0.35	0.29	0.69	7.30	Medium
SMP-HR1	7/13/2005	51.6	6.1	6.0	160	19.0	8	6	0.30	0.35	0.15	28	6.19		0.19	0.09	0.22	3.72	Low
SMP-HR1	8/22/2005	28.6	6.5	6.1	159	17.0	9	6	0.51	0.42	0.18	28	6.19		0.18	0.06	0.14	2.06	Low
SMP-HR1	9/14/2005	23.7	6.6	6.3	152	14.0	9	3	0.24	0.36	0.11	32	6.19		0.07	0.03	0.10	0.85	Low
SMP-KR1	10/22/2004	6802.0	6.5	7.1	279	9.0	26	0	0.50	0.65	0.2	82	11.40		40.88	13.08	53.14	0.00	Medium
SMP-KR1	11/22/2004	3853.6	7.0	6.6	309	7.0	27	0	0.71	0.72	0.09	103	8.60		32.89	4.17	33.35	0.00	Medium
SMP-KR1	2/9/2005	11416.4	6.6	6.6	346	1.0	22	-7	0.95	1.24	0.71	101	8.60		130.36	97.43	170.16	-960.58	High
SMP-KR1	3/16/2005	7561.4	7.1	6.5	298	0.0	18	0	1.65	1.09	0.83	85	5.70		149.96	75.44	99.07	0.00	High
SMP-KR1	4/14/2005	7293.0	5.9	6.9	320	7.5	17	-5	0.90	1.05	0.46	98	5.69		78.90	40.32	92.04	-438.31	High
SMP-KR1	5/18/2005	2308.7	6.8	6.7	374	9.5	25	-10	0.76	0.78	0.08	114	5.69		21.09	2.22	21.65	-277.51	Medium
SMP-KR1	6/15/2005	1847.0	5.9	7.3	380	18.5	34	-23	0.74	0.35	0.05	104	6.19		16.43	1.11	7.77	-510.62	Medium
SMP-KR1	7/13/2005	1055.9	6.1	7.2	482	19.0	42	-28	1.21	0.27	0.06	129	10.00		15.36	0.76	3.43	-355.36	Low
SMP-KR1	8/22/2005	863.3	6.4	7.1	473	17.5	47	-33	1.53	0.24	0.049	141	6.19		15.88	0.51	2.49	-342.44	Low
SMP-KR1	9/14/2005	833.6	6.2	7.2	509	14.0	46	-35	1.70	0.30	0.049	176	7.10		17.03	0.49	3.01	-350.71	Low
SMP-KR2	10/22/2004	1923.0	7.0	7.2	251	10.0	36	0	0.33	0.09	0.06	52	8.60		7.63	1.39	2.08	0.00	High
SMP-KR2	11/22/2004	1079.4	7.1	6.8	273	7.0	42	0	0.40	0.10	0.049	63	5.70		5.19	0.64	1.30	0.00	Medium
SMP-KR2	2/9/2005	4992.0	6.3	6.7	265	2.0	29	-14	0.82	0.18	0.38	42	5.69		49.20	22.80	10.80	-840.05	High
SMP-KR2	3/16/2005	2030.4	6.9	6.8	349	1.5	34	-20	0.38	0.16	0.12	70	5.69		9.27	2.93	3.90	-488.10	High
SMP-KR2	4/14/2005	1834.9	6.4	7.4	311	9.5	31	-20	0.32	0.11	0.11	71	5.69		7.06	2.43	2.43	-441.11	Medium
SMP-KR2	5/18/2005	504.2	7.4	6.9	360	13.0	49	-33	0.43	0.10	0.06	75	5.69		2.61	0.36	0.61	-200.01	Medium
SMP-KR2	6/15/2005	370.3	6.7	7.6	439	20.0	60	-48	0.47	0.20	0.06	87	6.19		2.09	0.27	0.89	-213.63	Medium
SMP-KR2	7/13/2005	168.9	6.9	7.6	537	21.5	70	-56	0.49	0.15	0.08	99	6.19		0.99	0.16	0.30	-113.71	Low
SMP-KR2	8/22/2005	83.9	7.4	7.7	490	19.0	82	-64	0.41	0.10	0.07	83	7.10		0.41	0.07	0.10	-64.52	Low
SMP-KR2	9/14/2005	105.2	6.9	7.7	520	16.0	91	-73	0.40	0.07	0.08	96	6.19		0.51	0.10	0.09	-92.33	Low

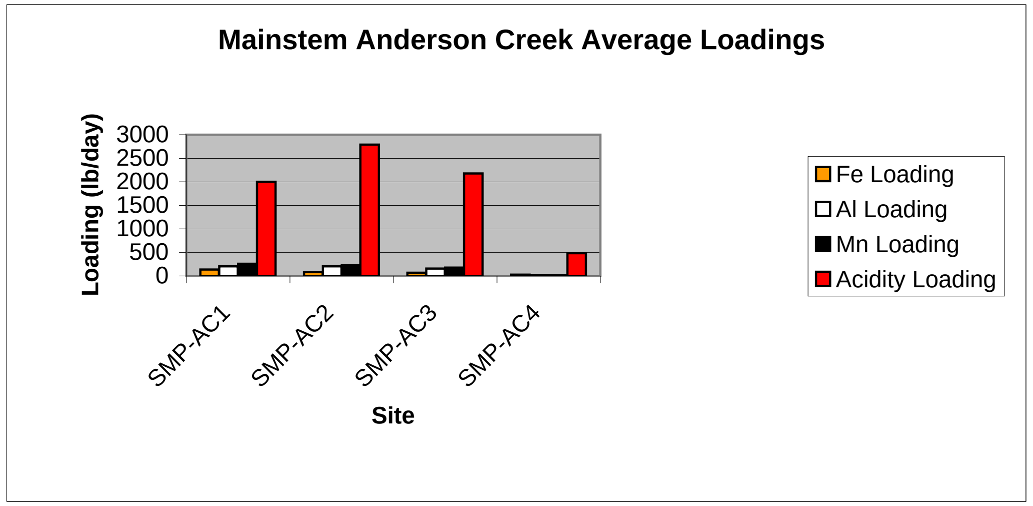
Stream Flow Loading

Sample ID	Sample Date	Flow GPM	pH Field	pH Lab	Cond. Umhos	Temp C	Alkalinity mg/L	Acidity mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Susp. Solids mg/L	TDS mg/L	Fe Loading lbs/day	Al Loading lbs/day	Mn Loading lbs/day	Acidity Loading lbs/day	Flow Category
SMP-LA1	10/23/2004	4061.0	3.9	4.6	571	9.0	5	18	0.27	4.80	1.18	259	8.60		13.18	57.60	234.30	878.64	Medium
SMP-LA1	11/23/2004	2299.7	3.9	3.8	554	5.0	0	42	4.34	4.84	3.11	237	5.69		119.97	85.97	133.79	1160.96	Medium
SMP-LA1	2/10/2005	19858.5	4.5	4.3	273	1.0	3	19	1.98	2.73	1.88	90	14.30		472.62	448.75	651.65	4535.28	High
SMP-LA1	3/16/2005	4960.1	3.8	3.8	567	1.0	0	42	4.24	5.44	4.18	250	5.69		252.79	249.22	324.34	2504.08	High
SMP-LA1	4/15/2005	4974.5	3.5	3.7	554	10.0	0	46	3.89	4.57	4.12	209	5.70		232.60	246.35	273.26	2750.50	High
SMP-LA1	5/19/2005	2149.2	3.7	3.7	543	9.5	0	48	0.10	0.80	3.83	195	5.69		2.58	98.94	20.67	1240.01	Medium
SMP-LA1	6/16/2005	2250.1	3.6	3.5	701	17.0	0	49	4.18	6.54	3.13	262	11.40		113.05	84.65	176.88	1325.26	Medium
SMP-LA1	7/13/2005	706.5	3.8	3.4	746	18.5	0	71	8.21	6.11	4.39	264	7.10		69.72	37.28	51.89	602.96	Low
SMP-LA1	8/23/2005	240.3	3.6	3.4	724	14.0	0	81	17.50	8.76	5.13	284	8.60		50.55	14.82	25.31	233.99	Low
SMP-LA1	9/15/2005	365.1	3.5	3.3	731	14.5	0	83	16.90	7.65	5.22	335	10.00		74.16	22.91	33.57	364.20	Low
SMP-LA2	10/23/2004	847.0	4.5	4.3	403	8.0	3	27	2.41	3.25	2.26	155	14.30		24.54	23.01	33.09	274.89	Medium
SMP-LA2	11/22/2004	888.1	4.7	4.5	378	6.8	5	25	2.58	3.36	2.42	164	10.00		27.54	25.83	35.87	266.87	High
SMP-LA2	2/9/2005	4556.2	5.1	4.8	325	1.0	5	21	2.38	3.74	2.36	111	5.69		130.34	129.25	204.82	1150.08	High
SMP-LA2	3/16/2005		4.6	4.1	399	0.0	4	34	1.90	4.27	2.87	158	5.69						
SMP-LA2	4/14/2005	1530.9	4.3	4.2	428	10.0	2	23	1.19	3.84	2.24	160	5.69		21.90	41.22	70.66	423.22	High
SMP-LA2	5/18/2005	626.1	4.4	4.1	411	14.0	1	34	1.74	3.55	2.32	155	5.69		13.09	17.46	26.72	255.86	Medium
SMP-LA2	6/15/2005	289.5	3.6	3.6	616	19.0	0	49	3.34	5.13	3.86	230	6.19		11.62	13.43	17.85	170.50	Medium
SMP-LA2	7/13/2005	102.5	3.7	3.6	733	20.0	0	56	2.79	7.19	4.41	281	6.19		3.44	5.43	8.86	69.00	Low
SMP-LA2	8/22/2005	28.9	3.5	3.4	429	19.0	0	70	0.94	4.96	6.45	121	6.19		0.33	2.24	1.72	24.32	Low
SMP-LA2	9/14/2005	26.8	3.5	3.5	873	16.0	0	73	3.77	14.00	5.93	370	6.19		1.22	1.91	4.51	23.53	Low
SMP-LA3	10/23/2004	N/A	6.3	6.3	349	8.0	10	3	0.45	1.56	0.1	123	7.10						
SMP-LA3	11/22/2004		6.4	6.3	336	6.0	12	3	0.49	0.84	0.07	138	5.70						
SMP-LA3	2/9/2005		5.9	6.2	298	0.0	10	3	1.89	2.40	1	96	14.30						
SMP-LA3	3/16/2005		6.3	5.8	351	0.0	12	6	0.33	2.35	0.15	140	5.69						
SMP-LA3	4/14/2005	1016.5	5.5	6.1	401	10.0	7	6	0.46	2.98	0.21	151	5.69		5.62	2.57	36.41	73.31	High
SMP-LA3	5/18/2005	490.2	6.0	5.9	346	13.0	8	8	0.48	1.74	0.13	118	5.69		2.83	0.77	10.25	47.13	High
SMP-LA3	6/15/2005	166.1	5.6	6.2	441	19.0	8	4	0.50	0.93	0.1	171	6.19		1.00	0.20	1.86	7.98	Medium
SMP-LA3	7/13/2005	69.4	5.6	5.8	543	20.0	8	8	0.55	2.31	0.09	223	6.19		0.46	0.08	1.93	6.68	Medium
SMP-LA3	8/22/2005	15.6	5.9	6.2	473	18.0	10	5	1.18	7.37	0.16	183	6.19		0.22	0.03	1.38	0.93	Low
SMP-LA3	9/14/2005	35.0	5.5	5.6	655	16.0	8	16	1.90	12.20	0.51	316	6.19		0.80	0.21	5.13	6.73	Low
SMP-LA4	4/14/2005	686.1	5.9	6.2	453	13.0	8	4	0.67	3.92	0.19	190	5.69		5.53	1.57	32.33	32.99	High
SMP-LA4	5/18/2005	349.3	6.4	6.3	402	16.5	12	4	0.77	3.21	0.08	157	5.69		3.23	0.34	13.48	16.80	Medium
SMP-LA4	6/15/2005	587.1	6.2	7.0	522	21.0	22	-10	0.80	3.51	0.07	206	6.19		5.65	0.49	24.77	-70.57	Low
SMP-LA4	9/14/2005	30.0	5.3	5.1	720	18.0	7	20	0.56	15.80	0.42	360	6.19		0.20	0.15	5.70	7.21	Low
SMP-RR1	11/23/2004	794.3	5.2	4.7	748	6.0	5	17	1.00	8.70	1.11	376	5.69		9.55	10.60	83.07	162.31	Medium
SMP-RR1	2/9/2005	6428.1	5.4	5.1	364	1.0	6	11	1.09	4.21	1.1	156	12.90		84.22	84.99	325.29	849.92	High
SMP-RR1	3/16/2005	1943.1	5.4	4.9	704	1.0	6	15	1.09	7.15	1.45	344	5.69		25.46	33.87	167.00	350.34	High
SMP-RR1	4/15/2005	1570.4	4.9	4.8	692	12.0	6	14	0.76	6.36	1.47	328	5.69		14.35	27.75	120.05	264.26	High
SMP-RR1	5/19/2005	488.7	5.1	4.7	705	11.0	5	18	5.04	4.88	1.17	323	5.69		29.61	6.87	28.67	105.74	Medium
SMP-RR1	6/16/2005	900.5	4.9	4.6	839	21.0	5	14	1.16	9.55	0.77	343	8.60		12.56	8.33	103.37	151.53	Medium
SMP-RR1	7/13/2005	182.0	5.0	4.3	798	21.0	4	15	1.51	7.88	0.54	349	6.19		3.30	1.18	17.24	32.82	Low
SMP-RR1	8/23/2005	113.5	5.4	4.5	810	15.0	7	23	3.68	9.25	0.32	456	7.10		5.02	0.44	12.62	31.38	Low
SMP-RR1	9/15/2005	78.5	5.5	4.2	758	16.0	2	12	4.01	6.74	0.29	364	7.10		3.79	0.27	6.36	11.33	Low

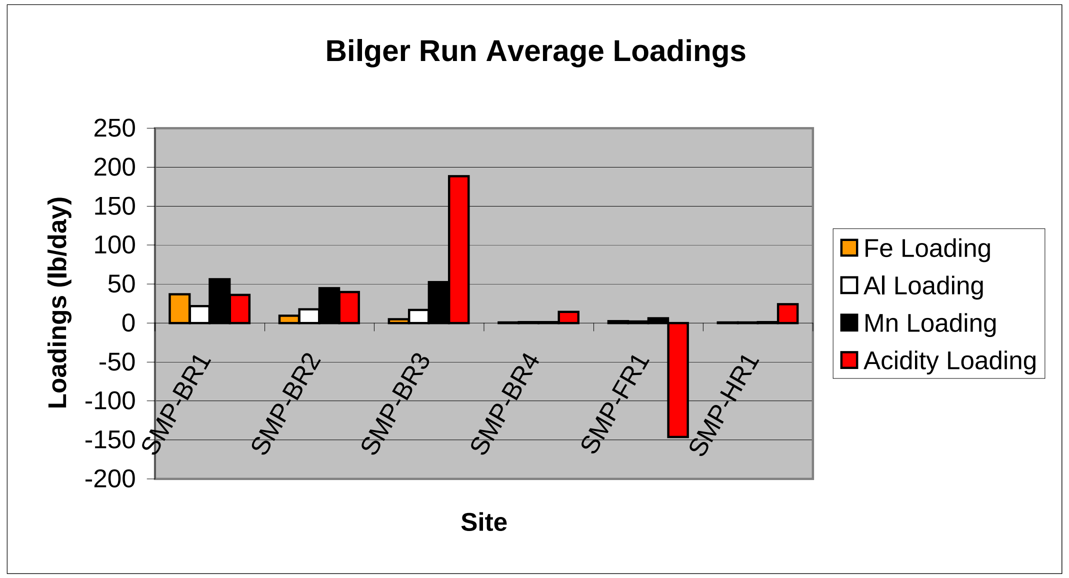
Stream Pollution Loadings at Low, Medium, and High Flow

Monitoring Point	pH Low	pH Medium	pH High	Fe Load Low	Fe Load Med	Fe Load High	Al Load Low	Al Load Med	Al Load High	Mn Load Low	Mn Load Med	Mn Load High	Acidity Load Low	Acidity Load Med	Acidity Load High
SMP-AC1	6.5	6.1	5.3	5.9	49.4	388.8	3.2	100.1	551.3	33.6	179.5	595.5	111.4	1305.4	4815.4
SMP-AC2	4.4	4.7	4.7	3.4	28.7	231.5	30.2	133.2	468.0	43.2	168.1	484.6	495.7	2039.1	6072.3
SMP-AC3	4.4	4.8	4.8	3.5	33.5	164.0	28.8	140.2	294.2	47.6	185.1	293.3	476.4	2087.8	3956.5
SMP-AC4	6.9	6.4	6.4	1.0	16.8	59.9	0.7	8.5	33.9	0.3	7.4	33.9	-32.6	307.5	1224.9
SMP-BR1	6.5	6.5	6.4	15.5	28.2	69.2	0.2	5.2	65.9	5.9	30.1	141.5	-21.3	9.8	128.2
SMP-BR2	6.6	6.6	6.5	0.4	5.6	23.8	0.2	4.6	52.0	0.7	22.1	118.2	4.8	22.8	97.9
SMP-BR3	5.7	4.3	4.4	2.4	3.3	8.8	0.1	9.2	43.8	5.1	41.2	114.9	9.2	140.2	432.1
SMP-BR4	5.7	6.3	5.2	0.3	0.5	2.0	0.1	0.1	3.0	0.1	0.6	3.6	0.3	4.1	35.5
SMP-FR1	7.4	7.2	7.2	1.5	1.4	4.8	0.1	1.0	5.0	0.4	4.8	13.4	-47.6	-54.3	-367.7
SMP-HR1	6.1	5.9	5.9	0.1	0.8	1.7	0.1	0.6	2.0	0.2	1.2	2.4	2.2	17.9	54.9
SMP-KR1	7.2	6.9	6.7	16.1	27.8	119.7	0.6	5.1	71.1	3.0	29.0	120.4	-349.5	-197.0	-466.3
SMP-KR2	7.7	7.2	6.9	0.6	4.2	22.0	0.1	0.9	9.0	0.2	1.3	5.6	-90.2	-213.7	-442.7
SMP-LA1	3.4	3.9	3.9	64.8	62.2	319.3	25.0	81.8	314.8	36.9	141.4	416.4	400.4	1151.2	3263.3
SMP-LA2	3.5	4.0	4.5	1.7	16.4	59.9	3.2	18.0	65.4	5.0	25.9	103.8	39.0	233.7	613.4
SMP-LA3	5.9	6.0	6.0	0.5	0.7	4.2	0.1	0.1	1.7	3.3	1.9	23.3	3.8	7.3	60.2
SMP-LA4	6.1	6.3	6.2	2.9	3.2	5.5	0.3	0.3	1.6	15.2	13.5	32.3	-31.7	16.8	33.0
SMP-RR1	4.3	4.7	4.9	4.0	17.2	41.3	0.6	8.6	48.9	12.1	71.7	204.1	25.2	139.9	488.2

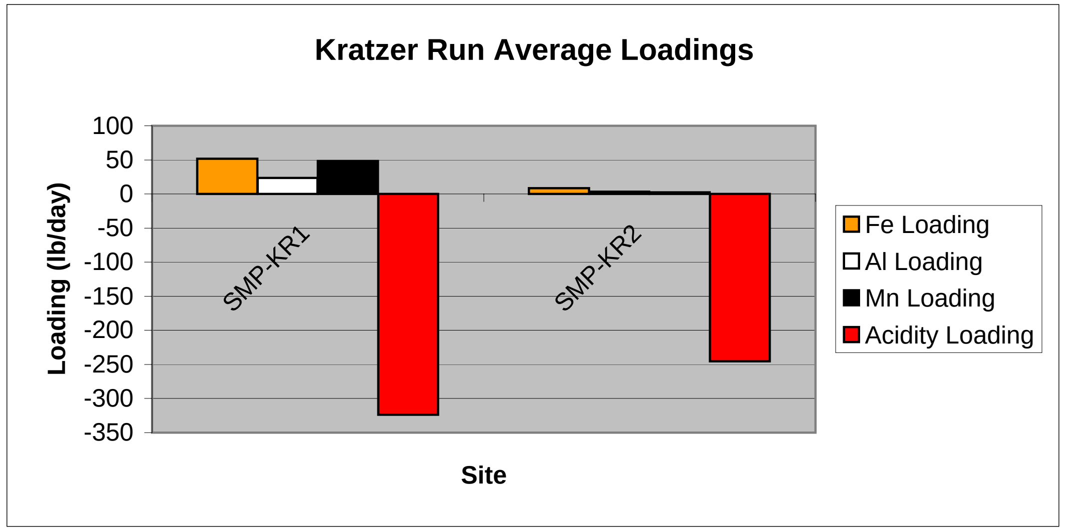
Monitoring Pt.	Fe Loading	Al Loading	Mn Loading	Acidity Loading
SMP-AC1	138.17	206.36	260.53	2000.18
SMP-AC2	81.96	202.73	225.55	2786.04
SMP-AC3	66.98	154.43	175.31	2173.53
SMP-AC4	24.98	19.68	13.25	480.69



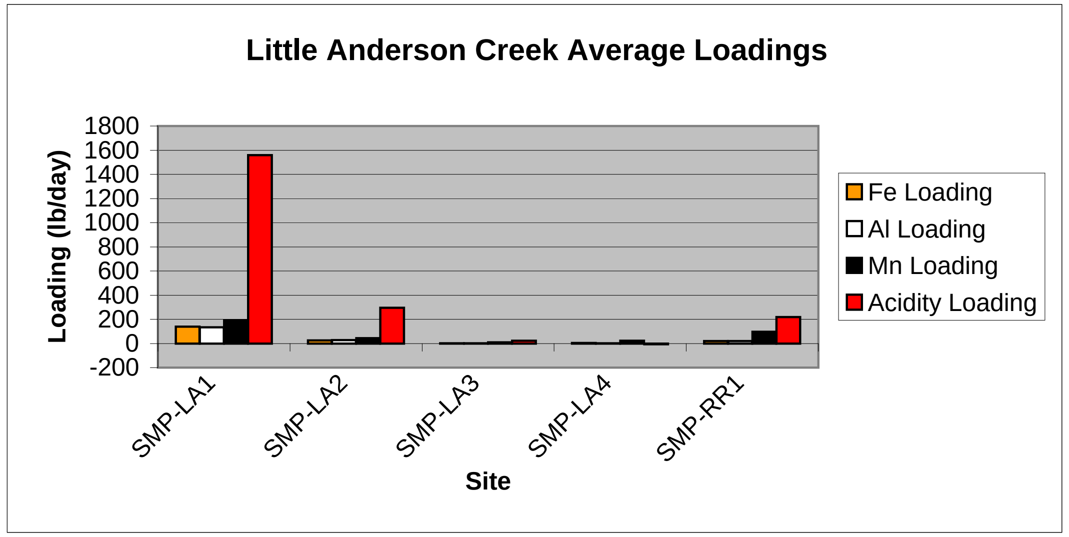
Monitoring Pt.	Fe Loading	Al Loading	Mn Loading	Acidity Loading
SMP-BR1	36.72	21.91	56.28	35.99
SMP-BR2	9.68	3.96	32.11	-131.98
SMP-BR3	2.46	20.79	32.01	355.66
SMP-BR4	4.04	28.58	50.33	403.92
SMP-FR1	0.96	0.67	0.27	-27.38
SMP-HR1	15.09	0.19	5.81	-23.70



Monitoring Pt.	Fe Loading	Al Loading	Mn Loading	Acidity Loading
SMP-KR1	100.37	115.42	75.27	3010.95
SMP-KR2	110.70	121.08	265.51	172.97



Monitoring Pt.	Fe Loading	Al Loading	Mn Loading	Acidity Loading
SMP-LA1	18.85	135.73	156.46	2262.10
SMP-LA2	8.74	3.57	2.18	291.22
SMP-LA3	25.05	4.43	20.17	30.55
SMP-LA4	0.00	0.00	0.00	0.00
SMP-RR1	9.50	17.52	44.52	39.94



Column1	
Mean	1262.73502
Standard Error	720.692232
Median	165.803868
Mode	0
Standard Deviation	2279.028945
Sample Variance	5193972.933
Kurtosis	6.195523617
Skewness	2.417051943
Range	7253.33678
Minimum	0
Maximum	7253.33678
Sum	12627.3502
Count	10

Appendix X-B

Watershed Restoration Analysis Model (WRAM) Data

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: SMP-AC1 **Description:** Anderson Creek, above bridge near carwash **Lat:** 40.97267

Downstream Point: **Type:** In-Stream **Long:** -78.52695

				Field Parameters				**Laboratory Analyses**						
(1) **Smp No.**	(2) **Sample Note**	(3) **Sample Date**	(4) **Sampler**	(5) **Flow** (gpm)	(6) **pH** (SU)	(7) **Temp.** (oC)	(8) **Cond.** uS	(9) **pH** (SU)	(10) **Acid.** (mg/L)	(11) **Alk.** (mg/L)	(12) **Al** (mg/L)	(13) **Fe** (mg/L)	(14) **Mn** (mg/L)	(15) **SO_4** (mg/L)
	Cloudy, light	10/23/04	MK, EL	20196	6.2	9	198	6.20	4	9	0.43	0.21	0.78	57
	cloudy, cool,	11/22/04	MK, EL	21764	7.3	7	188	6.20	8	8	0.52	0.26	0.90	62
	heavy rain	2/9/05	HB, MK	60344	6.4	1	246	5.80	7	7	1.15	1.00	1.43	74
	partly cloudy,	3/16/05	AT, MK	35763	6.2	0	186	4.90	10	8	0.86	0.51	0.77	46
	warm, sunny	4/14/05	JB, MK	52725	5.5	7	175	5.20	8	5	0.71	0.35	0.66	43
	cool, sunny	5/18/05	JB, MK	21743	5.8	11	199	5.60	7	6	0.53	0.20	0.77	50
	hot, cloudy	6/15/05	HB, MK	13706	6.5	21	181	6.50	2	9	0.13	0.16	0.56	40
	sunny, humic	7/13/05	AT, MK	4410	7.1	22	385	5.70	10	10	0.07	0.11	0.85	73
	sunny, warm	8/22/05	GS, MK	2657	6.9	20	292	6.80	-2	14	0.06	0.07	0.74	69
	sunny, warm	9/14/05	GS, MK	3660	6.0	16	298	6.90	-3	14	0.09	0.22	0.73	96

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: SMP-KR1 **Description:** Kratzer/Bilger **Lat:** 40.97567

Downstream Point: SMP-AC1 **Type:** In-Stream **Long:** -78.55078

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
	Overcast, co	10/22/04	MK, EL	6802	6.5	9	279	7.10	0	26	0.16	0.50	0.65	82
	Cloudy, cool,	11/22/04	MK, EL	3854	7.0	7	309	6.60	0	27	0.09	0.71	0.72	103
	heavy rain	2/9/05	HB, MK	11416	6.6	1	346	6.60	-7	22	0.71	0.95	1.24	101
	partly cloudy,	3/16/05	AT, MK	7561	7.1	0	298	6.50	0	18	0.83	1.65	1.09	85
	warm, sunny	4/14/05	JB, MK	7293	5.9	7.5	320	6.90	-5	17	0.46	0.90	1.05	98
	cool, sunny	5/18/05	JB, MK	2309	6.8	9.5	374	6.70	-10	25	0.08	0.76	0.78	114
	hot, cloudy	6/15/05	HB, MK	1847	5.9	18.5	380	7.30	-23	34	0.05	0.74	0.35	104
	sunny, humi	7/13/05	AT, MK	1056	6.1	19	482	7.20	-28	42	0.06	1.21	0.27	129
	warm, sunny	8/22/05	GS, MK	863	6.4	17.5	473	7.10	-33	47	0.05	1.53	0.24	6.19
	warm, sunny	9/14/05	GS, MK	834	6.2	14	509	7.20	-35	46	0.05	1.70	0.30	176

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: DMP-879 **Description:** Discharge into Kratzer Run near Rt. 879 **Lat:** 40.97177

Downstream Point: SMP-KR1 **Type:** Point Source **Long:** -78.56007

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
		10/23/04	CCCD	9	6.9	5.556	377	6.10	11	13	0.049	6.84	1.93	142
		11/20/04	CCCD	17	5.9	6.667	406	5.70	9	10	0.049	10.10	2.46	179
		12/18/04	CCCD	17	6.6	-1.1	308	5.90	-12	11	0.049	5.34	0.84	115
		1/19/05	CCCD	22	6.8	-2.222	285	6.20	9	12	0.06	8.40	1.39	105
		2/16/05	CCCD	17	5.9	3.889	225	6.10	7	10	0.049	6.72	1.00	74
		3/22/05	CCCD	28	6.9	3.333	297	6.30	9	11	0.18	18.60	1.39	104
		4/20/05	CCCD	9	6.9	8.889	386	6.10	-16	13	0.28	25.80	2.01	147
		5/18/05	CCCD	8	6.9	9.444	428	5.90	16	10	0.22	21.70	2.44	162
		6/22/05	CCCD	0	6.7	13.33	485	6.10	11	13	0.05	15.30	2.71	178
		7/20/05	CCCD	2	5.9	15.56	512	6.10	13	14	0.13	32.60	3.76	208
		8/24/05	CCCD	8	6.5	12.78	564	6.10	49	18	0.05	23.40	3.40	218
		9/14/05	CCCD	3	6.7	12.22	447	6.00	-452	23	0.06	30.80	3.21	220

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: PA-KR1.45 **Description:** Discharge into Kratzer Run from problem area **Lat:** 40.97282

Downstream Point: SMP-KR1 **Type:** Point Source **Long:** -78.5756

				Field Parameters				Laboratory Analyses						
(1) **Smp No.**	(2) **Sample Note**	(3) **Sample Date**	(4) **Sampler**	(5) **Flow** (gpm)	(6) **pH** (SU)	(7) **Temp.** (oC)	(8) **Cond.** uS	(9) **pH** (SU)	(10) **Acid.** (mg/L)	(11) **Alk.** (mg/L)	(12) **Al** (mg/L)	(13) **Fe** (mg/L)	(14) **Mn** (mg/L)	(15) **SO_4** (mg/L)
		10/23/04	CCCD	81	3.8	6.111	460	3.80	57	0	7	0.26	5.70	192
		11/20/04	CCCD	81	3.9	7.222	407	4.00	47	0	6.31	0.20	5.53	175
		12/18/04	CCCD	222	3.1	0.6	424	4.00	59	0	5.9	0.21	3.74	173
		1/19/05	CCCD	245	4.1	0	387	4.00	52	0	6.67	0.23	4.28	167
		2/16/05	CCCD	245	3.9	3.333	307	4.20	36	2	4.42	0.17	2.98	121
		3/22/05	CCCD	245	3.9	2.778	366	4.10	45	2	6.43	0.27	4.10	146
		4/20/05	CCCD	90	3.5	10	445	4.00	56	0	7.51	0.16	4.97	181
		5/18/05	CCCD	35	2.7	9.444	417	4.00	53	0	6.45	0.15	4.74	277
		6/22/05	CCCD	13	2.6	13.89	465	3.90	56	0	8.51	0.20	5.79	173
		7/20/05	CCCD	23	2.4	16.67	439	3.90	57	0	6.52	0.31	5.19	164
		8/24/05	CCCD	43	5.9	8.889	592	5.50	50	9	0.05	13.80	4.67	246
		9/14/05	CCCD	45	2.3	13.33	731	3.80	134	0	15.2	0.50	9.65	324

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: DMP-Wide **Description:** Widemire discharge point **Lat:** 40.96743

Downstream Point: SMP-KR1 **Type:** Point Source **Long:** -78.5758

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
		10/23/04	CCCD	99	4.2	6.111	397	3.80	41	0	5.07	6.70	2.38	137
		11/20/04	CCCD	99	4.3	7.222	352	3.90	35	0	4.01	7.44	2.36	144
		12/18/04	CCCD	136	3.6	6.7	398	3.90	47	0	5.13	6.01	2.10	141
		1/19/05	CCCD	245	3.9	1.111	404	3.70	53	0	6.58	6.39	2.33	154
		2/16/05	CCCD	117	3.8	6.111	354	4.10	50	1	5.41	2.54	1.98	141
		3/22/05	CCCD	99	3.8	8.333	383	4.00	44	0	6.32	3.42	2.36	150
		4/20/05	CCCD	99	3.5	8.889	403	3.90	53	0	6.48	3.12	2.15	150
		5/18/05	CCCD	81	2.9	8.889	372	4.00	45	0	5.50	3.01	2.15	137
		6/22/05	CCCD	50	3.1	14.44	389	3.90	38	0	4.89	4.56	2.12	237
		7/20/05	CCCD	47	3.3	10	368	3.90	64	0	3.87	7.38	2.33	135
		8/24/05	CCCD	35	3.6	8.889	373	4.00	71	0	3.19	9.35	2.35	131
		9/14/05	CCCD	43	3.8	8.333	286	3.80	39	0	2.81	10.10	2.26	130

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: SMP-BR1 **Description:** Bilger Run North 879 Bridge **Lat:** 40.97315

Downstream Point: SMP-KR1 **Type:** In-Stream **Long:** -78.57065

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
	Cool, overca	10/22/04	MK, EL	3630	6.7	10	198	6.60	0	12	0.28	0.91	1.36	108
	Cloudy, light	11/22/04	MK, EL	1776	6.9	7	328	6.40	1	14	0.14	1.31	1.49	133
	heavy rain	2/9/05	HB, MK	7195	5.9	2	393	6.40	2	15	1.4	1.28	3.07	153
	partly cloudy	3/16/05	AT, MK	4638	6.3	0	310	6.20	2	16	0.81	0.84	1.27	111
	warm, sunny	4/14/05	JB, MK	4168	6.0	8	345	6.60	2	10	0.63	1.00	1.76	117
	cool, sunny	5/18/05	JB, MK	1271	6.7	9.5	389	6.30	2	14	0.29	1.64	1.32	132
	hot, cloudy	6/15/05	HB, MK	1061	6.1	17	348	6.70	-1	14	0.08	1.59	0.72	112
	sunny, humic	7/13/05	AT, MK	513	6.2	17.5	431	6.60	-4	18	0.05	2.46	1.05	148
	sunny, warm	8/22/05	GS, MK	329	6.6	16	447	6.50	-6	19	0.05	3.82	1.47	162
	sunny, warm	9/14/05	GS, MK	259	6.2	13	490	6.50	-5	19	0.05	5.27	1.77	210

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: DMP-Wildv **Description:** Discharge into Bilger Run near Wildwoods **Lat:** 40.97208

Downstream Point: SMP-BR1 **Type:** Point Source **Long:** -78.5756

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
		10/23/04	CCCD	117	6.0	6.667	402	5.60	16	10	0.049	10.70	2.37	154
		11/20/04	CCCD	136	6.3	6.111	420	5.50	12	9	0.049	10.30	2.56	185
		12/18/04	CCCD	81	6.2	3.3	332	6.10	14	12	0.049	9.29	1.69	125
		1/19/05	CCCD	178	6.1	-1.111	288	6.20	11	10	0.05	7.86	1.57	101
		2/16/05	CCCD	189	6.1	5	246	6.20	7	10	0.06	4.68	0.93	69
		3/22/05	CCCD	127	5.9	5.556	336	5.80	8	7	0.049	3.96	1.69	116
		4/20/05	CCCD	81	5.6	8.889	425	5.40	14	7	0.049	4.30	2.38	163
		5/18/05	CCCD	50	5.9	10.56	463	5.10	13	6	0.05	5.82	2.87	291
		6/22/05	CCCD	42	5.9	12.22	526	5.90	15	9	0.05	9.67	3.52	204
		7/20/05	CCCD	65	5.9	14.44	545	5.90	22	11	0.05	13.80	3.69	235
		8/24/05	CCCD	43	5.9	8.889	592	5.50	50	9	0.05	13.80	4.67	246
		9/14/05	CCCD	43	5.9	11.11	467	5.50	24	11	0.049	12.70	4.60	240

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: SMP-BR2 **Description:** Bilger Run behind Wildwoods **Lat:** 40.9734

Downstream Point: SMP-BR1 **Type:** In-Stream **Long:** -78.5764

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
	Cool, overca	10/22/04	MK, EL	2869	6.5	9	288	6.60	0	12	0.24	0.26	1.22	105
	Cloudy, cool,	11/22/04	MK, EL	1638	6.9	7	319	6.40	2	13	0.15	0.22	1.30	130
	heavy rain	2/9/05	HB, MK	5492	6.1	1.5	384	6.40	1	13	1	0.36	2.53	159
	partly cloudy	3/16/05	AT, MK	5432	6.5	0	323	6.40	16	2	0.86	0.43	1.47	127
	warm, sunny	4/14/05	JB, MK	4039	6.3	9	343	6.70	2	10	0.7	0.40	1.89	126
	cool, sunny	5/18/05	JB, MK	1195	6.8	10.5	372	6.40	3	12	0.38	0.51	1.25	128
	hot, cloudy	6/15/05	HB, MK	733	6.3	18	313	6.80	1	11	0.19	0.22	0.31	97
	sunny, humi	7/13/05	AT, MK	564	6.5	18	377	6.80	1	14	0.07	0.13	0.25	126
	warm, sunny	8/22/05	GS, MK	125	6.6	17	347	6.50	3	10	0.07	0.14	0.20	118
	warm, sunny	9/14/05	GS, MK	132	6.2	14	399	6.50	2	9	0.05	0.06	0.08	164

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: SMP-FR1 **Description:** Fenton Run off of 6th St. Ext. **Lat:** 40.98692

Downstream Point: SMP-BR2 **Type:** In-Stream **Long:** -78.61187

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
	Cool, overca	10/22/04	MK, EL	631	7.1	9.5	521	7.30	0	44	0.26	0.35	1.15	200
	Cloudy, cool,	11/22/04	MK, EL	434	7.1	7	529	6.90	0	45	0.17	0.24	1.00	222
	heavy rain	2/9/05	HB, MK	1909	6.6	2	402	6.90	-20	33	0.39	0.39	0.88	154
	partly cloudy	3/16/05	AT, MK	727	7.1	0.5	511	7.20	-40	54	0.31	0.29	1.07	220
	warm, sunny	4/14/05	JB, MK	846	6.6	10	539	7.50	-29	43	0.33	0.28	1.06	6
	cool, sunny	5/18/05	JB, MK	289	7.3	13	604	6.90	-37	51	0.19	0.31	1.08	229
	hot, cloudy	6/15/05	HB, MK	205	6.8	19	595	7.50	-36	49	0.13	0.27	0.66	219
	sunny, humi	7/13/05	AT, MK	148	7.0	20	600	7.40	-41	57	0.12	0.60	0.47	222
	warm, sunny	8/22/05	GS, MK	77	7.2	18.5	529	7.40	-45	60	0.05	0.69	0.26	179
	warm, sunny	9/14/05	GS, MK	56	7.1	14	506	7.30	-42	55	0.25	4.00	0.32	181

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: SMP-HR1 **Description:** Hughey Run above Confluence with Bilger Run **Lat:** 41.00053

Downstream Point: SMP-BR2 **Type:** In-Stream **Long:** -78.60292

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
	Cool, overca	10/22/04	MK, EL	413	5.8	9.5	122	6.00	4	8	0.2	0.26	0.33	30
	Cloudy, cool,	11/22/04	MK, EL	346	5.8	7	120	5.90	5	9	0.16	0.30	0.30	28
	heavy rain	2/9/05	HB, MK	857	5.6	3	117	5.90	4	8	0.26	0.26	0.25	25
	partly cloudy	3/16/05	AT, MK	798	6.1	2	124	5.80	8	10	0.2	0.15	0.24	28
	warm, sunny	4/14/05	JB, MK	775	5.4	8	127	5.90	5	7	0.15	0.10	0.24	25
	cool, sunny	5/18/05	JB, MK	279	5.7	10	144	5.70	7	7	0.16	0.10	0.37	32
	hot, cloudy	6/15/05	HB, MK	152	5.6	15.5	151	5.90	4	9	0.16	0.19	0.38	29
	sunny, humi	7/13/05	AT, MK	52	6.1	19	160	6.00	6	8	0.15	0.30	0.35	28
	warm, sunny	8/22/05	GS, MK	29	6.5	17	159	6.10	6	9	0.18	0.51	0.42	28
	warm, sunny	9/14/05	GS, MK	24	6.6	14	152	6.30	3	9	0.11	0.24	0.36	32

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: SMP-BR3 **Description:** Bilger Run above confluence **Lat:** 40.99932

Downstream Point: SMP-BR2 **Type:** In-Stream **Long:** -78.6044

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
	Cool, overca	10/22/04	MK, EL	675	4.4	9.5	434	4.50	20	4	1.29	0.41	5.45	178
	Cloudy, cool,	11/22/04	MK, EL	529	5.5	7	438	4.70	16	6	1.18	0.36	5.68	198
	heavy rain	2/9/05	HB, MK	2150	4.5	0	549	4.40	30	3	3.18	0.73	8.75	270
	partly cloudy	3/16/05	AT, MK	829	4.7	0	453	4.40	24	6	2.32	0.39	5.34	201
	warm, sunny	4/14/05	JB, MK	902	4.1	14	551	4.30	26	3	2.4	0.34	6.04	234
	cool, sunny	5/18/05	JB, MK	519	4.1	13	599	4.10	35	2	2.67	0.57	9.77	289
	hot, cloudy	6/15/05	HB, MK	241	4.0	23	552	4.00	27	1	0.74	1.41	8.15	217
	sunny, humid	7/13/05	AT, MK	104	5.4	26	515	4.70	20	6	0.16	3.72	6.97	195
	warm, sunny	8/22/05	GS, MK	44	6.6	17	502	6.50	1	26	0.05	3.95	6.07	190
	warm, sunny	9/14/05	GS, MK	29	6.4	16	656	5.90	6	10	0.11	1.00	9.46	312

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: DMP-BR3. **Description:** BILG1-pond road **Lat:** 40.99665

Downstream Point: SMP-BR3 **Type:** Point Source **Long:** -78.61457

				Field Parameters				**Laboratory Analyses**						
(1) **Smp No.**	(2) **Sample Note**	(3) **Sample Date**	(4) **Sampler**	(5) **Flow** (gpm)	(6) **pH** (SU)	(7) **Temp.** (oC)	(8) **Cond.** uS	(9) **pH** (SU)	(10) **Acid.** (mg/L)	(11) **Alk.** (mg/L)	(12) **Al** (mg/L)	(13) **Fe** (mg/L)	(14) **Mn** (mg/L)	(15) **SO_4** (mg/L)
		10/23/04	CCCD	12	4.3	8.9	437	4.30	15	3	0.71	0.44	3.96	175
		12/5/04	CCCD	60	6.0	4.444	376	4.50	17	5	1.02	0.51	2.88	163
		12/24/04	CCCD	20	4.5	3.333	365	4.60	12	5	0.95	0.93	3.32	162
	estimated flo	1/18/05	CCCD	150	4.5	5	395	4.60	16	5	1.46	0.56	2.67	174
		1/20/05	CCCD	30	4.5	0	394	4.60	16	5	1.19	0.65	2.37	173
		2/13/05	CCCD	20	4.7	0	359	4.80	16	6	1	1.66	3.08	163
		3/17/05	CCCD	20	5.2	1.111	344	5.40	13	9	0.58	4.35	3.34	143
		4/14/05	CCCD	60	4.9	6	367	4.80	15	5	0.95	1.64	2.32	142
		5/23/05	CCCD	4	5.2	12	354	6.10	10	9	0.12	2.41	3.01	145
		6/20/05	CCCD	1	4.7	13	363	4.60	10	4	0.30	1.00	3.76	130
	No flow	9/20/05	CCCD		4.5	18	381	4.60	10	4	0.31	0.75	3.70	141

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: DMP-BR4. **Description:** BILG2-discharge **Lat:** 41.0068

Downstream Point: SMP-BR3 **Type:** Point Source **Long:** -78.61978

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
		10/23/04	CCCD	20	3.9	10	1390	3.80	144	0	12.5	18.90	27.10	611
		12/5/04	CCCD	60	5.6	7.778	1220	3.90	116	0	11.4	7.34	20.80	615
		12/24/04	CCCD	20	4.0	5.556	1170	3.60	97	0	10.3	10.10	21.20	593
	estimated flo	1/18/05	CCCD	100	3.8	10	395	3.70	108	0	12.2	5.64	21.90	609
		1/20/05	CCCD	60	3.9	5	1220	3.60	122	0	11.6	6.01	21.20	602
		2/13/05	CCCD	30	3.9	5.556	1160	3.80	104	0	10.3	8.83	19.20	573
		3/17/05	CCCD	30	3.8	5.556	1110	3.80	80	0	9.46	6.36	17.90	552
		4/14/05	CCCD	20	3.8	5	1080	3.70	87	0	9.38	2.14	13.20	518
		5/23/05	CCCD	9	3.9	5	1130	3.80	100	0	10.30	7.81	16.60	579
		620/05	CCCD	3	3.9	6	1160	3.80	96	0	10.20	7.60	15.80	593
		7/18/05	CCCD	1	3.8	7	1150	3.60	96	0	9.96	12.40	17.70	667
	No flow	9/20/05	CCCD		3.1	17	1180	3.50	72	0	5.61	2.91	16.30	577

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: DMP-BR4. **Description:** BILG3-at wetland **Lat:** 41.00282

Downstream Point: SMP-BR3 **Type:** Point Source **Long:** -78.62427

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
		10/23/04	CCCD	20	3.8	8.3	1300	3.70	116	0	9.04	11.50	24.80	528
		12/5/04	CCCD	20	5.8	3.333	1240	3.80	119	0	8.34	19.00	25.10	597
	estimated flo	12/27/04	CCCD	150	3.9	4	1260	4.00	146	1	7.65	24.90	24.10	646
	estimated flo	1/18/05	CCCD	250	3.9	4	1140	3.80	97	0	9.05	8.68	22.90	563
		2/13/05	CCCD	25	3.9	-2.222	1200	3.70	119	0	11.5	17.90	29.90	572
		3/17/05	CCCD	60	3.9	1.111	1140	3.90	104	0	9.09	22.80	24.00	557
		4/14/05	CCCD	120	3.9	7	1150	3.90	107	0	9.85	15.60	21.10	514
		5/23/05	CCCD		3.5	6	1250	3.60	118	0	8.97	14.20	21.90	611
		6/20/05	CCCD	26	3.3	20	1330	3.30	117	0	8.45	7.39	22.30	614
		7/18/05	CCCD	16	3.2	20	1190	3.10	109	0	7.70	3.08	20.30	572
	No flow	9/20/05	CCCD		2.9	20	1360	3.30	110	0	8.22	4.83	23.10	627

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: SMP-BR4 **Description:** Bilger headwaters near 3 ponds **Lat:** 41.00605

Downstream Point: SMP-BR3 **Type:** In-Stream **Long:** -78.63525

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. *u*S	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
	cloudy, cool	11/22/04	MK, EL		6.1	7.5	218	5.70	7	8	0.36	1.19	1.23	62
	estimated flo	2/9/05	HB, MK		5.5	3.5	288	5.50	10	7	2.21	2.05	1.59	95
	partly cloudy	3/16/05	AT, MK	326	5.6	4	238	4.90	14	6	1	0.53	1.05	70
	warm, sunny	4/14/05	JB, MK	255	5.0	12	279	5.00	12	6	1.37	0.51	1.30	78
	cool, sunny	5/18/05	JB, MK	56	5.8	15	191	5.70	8	6	0.25	0.55	0.76	37
	hot, cloudy	6/15/05	HB, MK	77	5.6	17	176	6.80	3	9	0.14	0.71	0.68	32
	sunny, humic	7/13/05	AT, MK	16	6.2	23.5	220	6.10	4	10	0.14	1.26	0.80	34
	warm, sunny	8/22/05	GS, MK	10	6.0	24	198	6.40	0	13	1.03	2.47	0.75	26
	estimated flo	9/14/05	GS, MK	12	6.4	23	205	6.40	0	13	0.08	1.47	0.68	31

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: SMP-KR2 **Description:** Below Stronach Rd. Bridge **Lat:** 40.96653

Downstream Point: SMP-KR1 **Type:** In-Stream **Long:** -78.58967

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
	Cool, overca	10/22/04	MK, EL	1923	7.0	10	251	7.20	0	36	0.06	0.33	0.09	52
	Cloudy, cool,	11/22/04	MK, EL	1079	7.1	7	273	6.80	0	42	0.049	0.40	0.10	63
	heavy rain	2/9/05	HB, MK	4992	6.3	2	265	6.70	-14	29	0.38	0.82	0.18	42
	partly cloudy	3/16/05	AT, MK	2030	6.9	1.5	349	6.80	-20	34	0.12	0.38	0.16	70
	warm, sunny	4/14/05	JB, MK	1835	6.4	9.5	311	7.40	-20	31	0.11	0.32	0.11	71
	cool, sunny	5/18/05	JB, MK	504	7.4	13	360	6.90	-33	49	0.06	0.43	0.10	75
	hot, cloudy	6/15/05	HB, MK	370	6.7	20	439	7.60	-48	60	0.06	0.47	0.20	87
	sunny, humic	7/13/05	AT, MK	169	6.9	21.5	537	7.60	-56	70	0.08	0.49	0.15	99
	warm, sunny	8/22/05	GS, MK	84	7.4	19	490	7.70	-64	82	0.07	0.41	0.10	83
	warm, sunny	9/14/05	GS, MK	105	6.9	16	520	7.70	-73	91	0.08	0.40	0.07	96

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: SMP-AC2 **Description:** Anderson Creek, 100 ft above old closed bridge **Lat:** 40.97817

Downstream Point: SMP-AC1 **Type:** In-Stream **Long:** -78.54647

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
	Cloudy, light	10/23/04	MK, EL	18029	4.8	9	173	4.60	12	5	0.78	0.12	1.01	48
	Cloudy, cool,	11/22/04	MK, EL	17102	5.2	7	165	4.80	11	6	0.79	0.12	1.04	55
	heavy rain	2/9/05	HB, MK	52041	5.1	1.5	219	4.70	12	5	1	0.63	1.34	67
	partly cloudy	3/16/05	AT, MK	32917	5.0	1	153	4.60	14	6	0.87	0.38	0.68	40
	warm, sunny	4/14/05	JB, MK	43021	4.5	8	155	4.70	10	5	0.84	0.29	0.67	36
	cool, sunny	5/18/05	JB, MK	14932	4.6	11.5	171	4.60	13	5	0.8	0.09	0.88	40
	sunny, hot	6/10/05	MK, EL		4.5	25	153	4.50	5	8	0.5	0.09	0.74	33
	hot, cloudy	6/15/05	HB, MK	10000	4.3	20.5	154	4.70	8	5	0.48	0.40	0.68	32
	sunny, humic	7/13/05	AT, MK	4499	4.5	21.5	248	4.40	15	4	0.82	0.11	1.20	52
	sunny, warm	8/22/05	GS, MK	2276	4.4	19.5	230	4.40	13	4	0.76	0.09	1.17	53
	sunny, warm	9/14/05	GS, MK	2,220	4.3	15	234	4.40	12	4	0.95	0.07	1.22	68

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: SMP-AC3 **Description:** Anderson Creek, 25-30 ft above dam **Lat:** 41.01322

Downstream Point: SMP-AC2 **Type:** In-Stream **Long:** -78.58527

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
	Cloudy, light	10/23/04	MK, EL	16492	4.7	8	177	4.70	11	5	0.73	0.20	1.02	50
	Cloudy, cool,	11/23/04	MK, EL	15146	4.9	5	166	4.90	10	5	0.77	0.23	1.08	52
	heavy rain	2/10/05	HB, MK		5.2	1.5	117	5.10	8	6	0.66	0.63	0.75	31
	sunny	3/17/05	AT, MK	32653	4.6	1	156	4.80	12	5	0.84	0.48	0.76	41
	warm, sunny	4/15/05	JB, MK	43364	4.5	7.5	153	4.70	9	5	0.84	0.43	0.70	38
	cool, sunny	5/19/05	JB, MK	15683	4.7	10	167	4.70	12	5	0.72	0.10	0.83	42
	hot, rain	6/16/05	HB, MK	22817	4.6	18	185	4.80	9	5	0.42	0.29	0.79	41
	sunny, humic	7/13/05	AT, MK	4568	4.4	25	223	4.40	15	4	0.81	0.10	1.30	54
	warm, sunny	8/22/05	GS, MK	2585	4.3	22	245	4.40	13	3	0.92	0.13	1.62	63
	warm, sunny	9/15/05	GS, MK	1397	4.4	18	230	4.40	12	4	0.80	0.05	1.25	65

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: DMP-AC3. **Description:** PWR-Anderson Gorge **Lat:** 40.99475

Downstream Point: SMP-AC2 **Type:** Point Source **Long:** -78.57042

				Field Parameters				Laboratory Analyses						
(1) **Smp No.**	(2) **Sample Note**	(3) **Sample Date**	(4) **Sampler**	(5) **Flow** (gpm)	(6) **pH** (SU)	(7) **Temp.** (oC)	(8) **Cond.** uS	(9) **pH** (SU)	(10) **Acid.** (mg/L)	(11) **Alk.** (mg/L)	(12) **Al** (mg/L)	(13) **Fe** (mg/L)	(14) **Mn** (mg/L)	(15) **SO_4** (mg/L)
		10/23/04	CCCD	8	3.1	8.9	748	3.10	208	0	23.6	1.68	3.34	217
		12/5/04	CCCD	15	5.3	5.556	789	3.10	193	0	22.1	1.37	2.08	192
	Sample taker	12/23/04	CCCD	126	4.5	3.3	83	4.50	10	6	0.7	0.16	0.49	23
		1/15/05	CCCD	55	3.1	4	648	3.10	163	0	21.8	1.26	1.91	151
		2/11/05	CCCD	15	3.1	2.778	693	3.10	182	0	23.6	1.55	2.73	174
		4/15/05	CCCD	24	3.0	7.222	758	3.00	172	0	18.8	1.06	1.95	165
		5/21/05	CCCD	9	2.8	12.22	705	3.20	172	0	22.4	1.33	3.06	173
		6/20/05	CCCD	4	3.1	17.78	878	3.00	201	0	21.70	2.70	3.45	244
		8/22/05	CCCD		3.0	18	927	3.00	271	0	33.20	13.50	7.41	405

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: DMP-AC3. **Description:** NEEP2 **Lat:** 41.99665

Downstream Point: SMP-AC2 **Type:** Point Source **Long:** -78.61457

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
		10/23/04	CCCD	12	3.3	8.9	339	3.40	51	0	3.34	1.98	0.49	39
		12/5/04	CCCD	60	5.4	7.222	303	3.40	45	0	3.28	1.06	0.45	36
		12/23/04	CCCD	42	3.4	5	299	3..3	50	0	3.07	1.24	0.37	86
		1/15/05	CCCD	70	3.2	9	310	3.30	51	0	3.38	1.42	0.46	39
		2/12/05	CCCD	34	3.4	5.556	259	3.50	39	0	2.47	0.63	0.37	34
		3/17/05	CCCD	34	3.2	5.556	254	3.50	36	0	2.16	0.57	0.34	35
		4/15/05	CCCD	34	3.2	8.889	303	3.40	41	0	2.74	0.79	0.36	37
		5/21/05	CCCD	12	3.1	10	225	3.60	32	0	1.86	0.29	0.29	30
		6/20/05	CCCD	2	3.3	11.11	231	3.50	28	0	1.41	0.14	0.26	32
		8/22/05	CCCD		3.3	12	369	3.30	55	0	4.56	0.97	0.58	49

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: DMP-AC3. **Description:** NEEP1 **Lat:** 41.00197

Downstream Point: SMP-AC2 **Type:** Point Source **Long:** -78.5679

				Field Parameters				Laboratory Analyses						
(1) **Smp No.**	(2) **Sample Note**	(3) **Sample Date**	(4) **Sampler**	(5) **Flow** (gpm)	(6) **pH** (SU)	(7) **Temp.** (oC)	(8) **Cond.** uS	(9) **pH** (SU)	(10) **Acid.** (mg/L)	(11) **Alk.** (mg/L)	(12) **Al** (mg/L)	(13) **Fe** (mg/L)	(14) **Mn** (mg/L)	(15) **SO_4** (mg/L)
		10/23/04	CCCD	7	5.0	7.8	108	4.60	11	5	0.39	0.19	0.09	28
		12/5/04	CCCD	12	6.6	5	103	5.10	10	6	0.45	0.07	0.07	29
		12/23/04	CCCD	126	5.2	3.3	92	4.90	10	6	0.63	0.09	0.08	27
		1/15/05	CCCD	12	5.0	3	98	4.80	11	5	0.45	0.06	0.06	74
		2/12/05	CCCD	6	4.9		87	5.30	6	6	0.22	0.05	0.05	24
	PNR Neep1	3/16/05	CCCD	16	3.1	0.5556	716	3.00	177	0	22	1.34	2.45	169
		5/21/05	CCCD	12	4.2	6.667	90	5.00	6	7	0.4	1.00	0.09	25

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: DMP-KORI **Description:** Korb 1 discharge **Lat:** 41.0277

Downstream Point: SMP-AC3 **Type:** Point Source **Long:** -78.63587

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
		12/18/04	CCCD	0	3.3		653	3.10	189	0	23.8	6.05	1.40	153
		1/15/05	CCCD	12	3.0	4.444	890	2.90	251	0		12.80	1.02	242
		2/13/05	CCCD	1	3.1	-1.667	874	3.00	277	0	32.2	12.60	1.51	275
		4/14/05	CCCD	1	3.0	16	643	3.10	162	0	20.3	3.10	1.30	124
	dry	9/20/05	CCCD											

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: DMP-KORI **Description:** KORB2 weir below road **Lat:** 41.02607

Downstream Point: SMP-AC3 **Type:** Point Source **Long:** -78.63808

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
		10/23/04	CCCD	20	2.8	6.667	1680	2.60	498	0	51.5	36.30	2.44	438
		11/21/04	CCCD	10	2.8	4.444	1550	2.70	480	0	54.5	38.50	2.60	522
		12/18/04	CCCD	71	2.9	5	1470	2.70	411	0	46.5	33.50	2.25	410
		1/15/05	CCCD	259	2.8	5.556	1200	2.80	301	0		18.40	1.21	295
		2/13/05	CCCD	126	2.8	5	1330	2.70	353	0	37.4	25.00	1.88	350
		3/17/05	CCCD	71	2.7	5.556	1350	2.70	389	0	36.2	25.00	1.91	403
		4/14/05	CCCD	71	2.7	10	1390	2.70	344	0	35.2	24.10	1.80	387
		5/23/05	CCCD	20	2.6	6	1580	2.70	461	0	46.70	29.70	2.28	471
		6/20/05	CCCD	10	2.5	12	1790	2.60	537	0	53.40	36.50	2.74	557
		7/18/05	CCCD	20	2.5	18	1680	2.70	583	0	80.60	57.80	4.17	616
	dry	9/20/05	CCCD											

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: DMP-KORI **Description:** KORB3 at crossroads **Lat:**

Downstream Point: SMP-AC3 **Type:** Point Source **Long:**

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
		10/23/04	CCCD		3.1	6.667	646	3.10	131	0	13.4	5.13	1.35	116
		11/21/04	CCCD	1	3.2	4.444	640	3.00	142	0	12.9	6.64	1.45	149
		12/18/04	CCCD	4	3.1	3.9	717	3.00	181	0	21.8	4.59	1.66	146
		1/15/05	CCCD	12	3.2	4.444	577	3.10	141	0		2.89	1.19	114
		2/3/05	CCCD	8	3.1	4.444	573	3.10	140	0	15.6	3.93	1.32	120
		3/17/05	CCCD	3	3.1	3.333	638	3.10	143	0	16.4	8.63	1.48	143
		4/14/05	CCCD	4	3.1	7	679	3.10	158	0	19	4.78	1.63	134
		5/23/05	CCCD	1	3.1	8	661	3.10	140	0	15.60	5.51	1.67	147
		6/20/05	CCCD	1	2.9	18	822	3.00	160	0	15.00	5.90	1.95	211
		7/18/05	CCCD	1	2.9	21	714	3.00	134	0	10.30	3.90	1.31	134
	dry	9/20/05	CCCD											

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: SMP-LA1 **Description:** Little Anderson, below train tunnel **Lat:** 41.05407

Downstream Point: SMP-AC3 **Type:** In-Stream **Long:** -78.65567

				Field Parameters				Laboratory Analyses						
(1) **Smp No.**	(2) **Sample Note**	(3) **Sample Date**	(4) **Sampler**	(5) **Flow** (gpm)	(6) **pH** (SU)	(7) **Temp.** (oC)	(8) **Cond.** uS	(9) **pH** (SU)	(10) **Acid.** (mg/L)	(11) **Alk.** (mg/L)	(12) **Al** (mg/L)	(13) **Fe** (mg/L)	(14) **Mn** (mg/L)	(15) **SO_4** (mg/L)
	Cloudy, ligh	10/23/04	MK, EL	4061	3.9	8.5	571	4.60	18	5	1.18	0.27	4.80	259
	Cloudy, cool,	11/23/04	MK, EL	2300	3.9	5	554	3.80	42	0	3.11	4.34	4.84	237
	heavy rain	2/10/05	HB, MK	19859	4.5	1	273	4.30	19	3	1.88	1.98	2.73	90
	sunny	3/17/05	AT, MK	4960	3.8	1	567	3.80	42	0	4.18	4.24	5.44	250
	warm, sunny	4/15/05	JB, MK	4974	3.5	10	554	3.70	46	0	4.12	3.89	4.57	209
	cool, sunny	5/19/05	JB, MK	21492	3.7	9.5	543	3.70	48	0	3.83	0.10	0.80	195
	hot, rain	6/16/05	HB, MK	2250	3.6	17	701	3.50	49	0	3.13	4.18	6.54	262
	partly sun, hu	7/14/05	AT, MK	707	3.8	18.5	746	3.40	71	0	4.39	8.21	6.11	264
	cloudy, warm	8/23/05	GS, MK	240	3.6	14	724	3.40	81	0	5.13	17.50	8.76	284
	warm, sunny	9/15/05	GS, MK	365	3.5	14.5	731	3.30	83	0	5.22	16.90	7.65	335

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: SMP-RR1 **Description:** Rock Run above confluence with Little Anderson **Lat:** 41.05268

Downstream Point: SMP-LA1 **Type:** In-Stream **Long:** -78.65825

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
	cloudy, cool,	11/23/04	MK, EL	794	5.2	7	748	4.70	17	5	1.11	1.00	8.70	376
	heavy rain	2/9/05	HB, MK	6428	5.4	1	364	5.10	11	6	1.1	1.09	4.21	156
	sunny	3/16/05	AT, MK	1943	5.4	1	704	4.90	15	6	1.45	1.09	7.15	344
	warm, sunny	4/15/05	JB, MK	1570	7.0	7	692	4.80	14	6	1.47	0.76	6.36	328
	cool, sunny	5/19/05	JB, MK	489	5.1	11	705	4.70	18	5	1.17	5.04	4.88	323
	rain, hot	6/16/05	HB, MK	900	4.9	18	839	4.60	14	5	0.77	1.16	9.55	343
	cloudy, humi	7/14/05	AT, MK	182	5.0	21	798	4.30	15	4	0.54	1.51	7.88	349
	cloudy, warm	8/23/05	GS, MK	113	5.4	15	810	4.50	23	7	0.32	3.68	9.25	456
	warm, sunny	9/15/05	GS, MK	79	5.5	16	758	4.20	12	2	0.29	4.01	6.74	364

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: PAMP-LA3 **Description:**

Lat: 41.04153

Downstream Point: SMP-LA1 **Type:** Point Source

Long: -78.66758

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
		12/17/04	CCCD	6	3.4	2	566	3.30	115	0	13.8	0.90	3.27	139
		1/19/05	CCCD	12	3.4	2	674	3.20	142	0	19.1	1.38	3.80	197
		2/16/05	CCCD	13	3.6	1	511	3.30	115	0	16	1.58	3.43	145

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: DMP-Drau **Description:** Draucker mine discharge **Lat:** 41.03678

Downstream Point: SMP-LA1 **Type:** Point Source **Long:** -78.67203

				Field Parameters				Laboratory Analyses						
(1) **Smp No.**	(2) **Sample Note**	(3) **Sample Date**	(4) **Sampler**	(5) **Flow** (gpm)	(6) **pH** (SU)	(7) **Temp.** (oC)	(8) **Cond.** uS	(9) **pH** (SU)	(10) **Acid.** (mg/L)	(11) **Alk.** (mg/L)	(12) **Al** (mg/L)	(13) **Fe** (mg/L)	(14) **Mn** (mg/L)	(15) **SO_4** (mg/L)
		10/22/04	CCCD	178	4.1	10	505	4.10	21	2	1.01	1.76	4.36	180
		11/18/04	CCCD	136	3.9	9	490	3.90	26	0	0.92	2.19	4.34	191
		12/17/04	CCCD	370	4.1	3	429	4.00	27	1	1.23	0.95	3.04	161
		1/19/05	CCCD	870	4.3	1	509	4.30	18	3	1.31	0.76	3.40	209
		2/16/05	CCCD	324	4.2	2	439	4.10	28	1	1.6	1.09	3.32	164
		3/18/05	CCCD	210	4.1	3	525	3.40	25	1	1.52	0.80	3.47	194
		4/18/05	CCCD	258	4.0	12	547	4.00	27	1	1.67	0.68	3.33	183
		5/23/05	CCCD	106	3.8	11	511	3.80	25	0	1.00	1.07	3.52	165
		6/17/05	CCCD	99	3.7	14.44	627	3.70	28	0	0.82	2.21	5.03	189
		7/15/05	CCCD	50	3.4	17	685	3.50	43	0	0.47	4.42	5.07	214
		8/22/05	CCCD	35	3.4	17	671	3.50	38	0	0.23	6.95	6.35	208
		9/19/05	CCCD	35	3.4	15.56	634	3.50	37	0	0.29	5.99	5.69	225

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: DMP-Drau **Description:** Dracker Mine discharge **Lat:** 41.03478

Downstream Point: SMP-LA1 **Type:** Point Source **Long:** -78.67058

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
		10/22/04	CCCD	35	2.9	11	2230	2.80	645	0	48.5	75.30	20.80	837
		11/18/04	CCCD	65	2.7	12	2160	2.70	677	0	59.4	103.00	24.30	191
		12/17/04	CCCD	178	2.8	12	2030	2.70	652	0	58.4	59.00	15.60	808
		1/19/05	CCCD	294	2.9	10	1870	2.70	519	0	49.4	52.90	15.60	714
		2/16/05	CCCD	178	3.1	10	1840	2.70	591	0	56.3	62.10	18.50	775
		3/18/05	CCCD	136	2.7	11	1870	2.70	574	0	52.7	67.70	20.20	832
		4/18/05	CCCD	136	2.8	10	1830	2.80	546	0	49.8	62.30	18.50	753
		5/23/05	CCCD	99	2.8	11	1940	2.80	634	0	49.40	70.00	18.50	875
		6/17/05	CCCD	65	2.8	10	1990	2.80	650	0	60.80	94.00	24.60	890
		7/15/05	CCCD	65	2.8	9	2010	2.80	682	0	69.40	98.40	25.30	984
		8/22/05	CCCD	35	2.8	9	2030	2.80	647	0	61.80	98.80	27.10	1059
		9/19/05	CCCD	23	2.8	10.56	2000	2.80	670	0	68.8	104.00	28.10	1556

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: PAMP-LA3 **Description:** Point above highwall **Lat:** 41.04142

Downstream Point: SMP-LA1 **Type:** Point Source **Long:** -78.6745

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO$_4$ (mg/L)
		10/22/04	CCCD	117	3.5	10	663	3.50	33	0	0.77	2.17	7.33	253
		11/18/04	CCCD	65	3.4	9	760	3.50	45	0	0.68	2.82	8.67	315
		12/17/04	CCCD	157	3.7	3	603	3.70	41	0	1.12	2.80	6.97	249
		1/19/05	CCCD	370	3.7	1	542	3.70	29	0	1.46	1.55	5.69	237
		2/16/05	CCCD	294	3.9	2	459	3.70	27	0	1.08	1.79	5.69	269
		3/18/05	CCCD	157	3.6	5	617	3.60	33	0	1.1	2.21	9.42	322
		4/18/05	CCCD	200	3.5	11	653	3.60	34	0	1.42	1.47	7.58	227
		5/23/05	CCCD	136	3.4	12	690	3.40	42	0	0.81	1.67	7.78	274
		6/17/05	CCCD	65	3.3	14.44	817	3.40	47	0	0.57	2.70	8.10	298
		7/15/05	CCCD	35	3.2	19	1080	3.20	72	0	0.50	5.08	12.10	399
		8/22/05	CCCD	23	3.2	18	1070	3.20	77	0	0.44	7.90	13.40	494
		9/19/05	CCCD	13	3.1	15.56	1220	3.20	76	0	0.45	8.23	13.70	464

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: PAMO-LA3 **Description:** Point below trench **Lat:** 41.04097

Downstream Point: SMP-LA1 **Type:** Point Source **Long:** -78.67197

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
		10/22/04	CCCD	117	3.5	10	671	3.40	67	0	4.38	2.38	5.24	243
		11/18/04	CCCD	99	3.3	9	755	3.40	69	0	4.78	3.46	7.20	290
	estimated flo	12/17/04	CCCD	245	3.5	3	648	3.30	86	0	6.51	2.81	5.04	216
	estimated flo	1/9/05	CCCD	543	3.5	2	583	3.50	61	0	5.02	1.84	4.84	220
		2/16/05	CCCD	449	3.6	4	532	3.50	59	0	4.64	2.11	5.17	197
		3/18/05	CCCD	236	3.4	4	626	3.40	70	0	4.91	2.41	5.78	212
		4/18/05	CCCD	300	3.4	18	664	3.40	62	0	5.34	2.59	5.64	210
		5/23/05	CCCD	178	3.3	13	691	3.40	61	0	3.66	2.13	6.13	255
		6/17/05	CCCD	117	3.3	15.56	734	3.30	64	0	3.65	5.39	7.86	234
		7/15/05	CCCD	50	3.1	22	942	3.30	82	0	4.52	4.76	10.40	362
		8/22/05	CCCD	35	3.2	23	969	3.20	82	0	3.37	6.92	10.60	356
		9/19/05	CCCD	23	3.2	18.89	1020	3.30	82	0	2.93	9.53	12.00	406

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: PAMP-LA3 **Description:** Reasinger property **Lat:** 41.04175

Downstream Point: SMP-LA1 **Type:** Point Source **Long:** -78.67725

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
		10/22/04	CCCD	35	3.5	11	777	3.50	48	0	0.51	11.00	9.50	323
		11/18/04	CCCD	65	3.5	10	859	3.50	63	0	0.44	15.40	11.30	387
		12/17/04	CCCD	99	3.9	3	805	3.60	64	0	0.69	19.00	11.70	386
		1/19/05	CCCD	178	3.7	5	648	3.50	38	0	0.92	4.72	8.01	271
		2/16/05	CCCD	178	3.8	4	607	3.80	40	0	0.7	8.49	8.02	284
		3/18/05	CCCD	136	3.6	3	688	3.80	45	0	0.69	12.10	9.42	322
		4/18/05	CCCD	136	3.5	11	717	3.60	42	0	0.85	7.97	9.11	292
		5/23/05	CCCD	136	3.5	10	738	3.50	55	0	0.52	9.38	8.77	322
		6/17/05	CCCD	35	3.4	13.33	873	3.40	62	0	0.44	13.90	13.10	362
		7/15/05	CCCD	23	3.2	18	1110	3.30	84	0	0.35	11.60	13.50	437
		8/22/05	CCCD	13	3.2	20	1140	3.20	96	0	0.28	15.20	13.20	597
		9/19/05	CCCD	13	3.1	18.89	1250	3.20	101	0	0.31	14.60	15.00	777

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: DMP-KORI **Description:** Spencer Mine Discharge **Lat:** 41.02708

Downstream Point: SMP-LA1 **Type:** Point Source **Long:** -78.6517

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. *u*S	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
		10/23/04	CCCD	35	2.8	6.111	1570	2.70	398	0	34.4	54.30	11.30	466
		11/21/04	CCCD	29	2.9	5.556	1510	2.70	428	0	32.4	53.09	9.78	575
		12/18/04	CCCD	136	2.9	5.6	1530	2.70	394	0	31.1	48.60	8.33	524
		1/15/05	CCCD	234	2.9	5.556	1350	2.80	327	0		31.80	6.12	428
		2/13/05	CCCD	57	2.8	5.556	1370	2.80	344	0	25.5	36.20	7.05	460
		3/17/05	CCCD	157	2.7	5	1460	2.80	343	0	25.6	38.40	7.90	487
		4/14/05	CCCD	117	2.8	9	1400	2.80	307	0	23.5	32.90	7.20	454
		5/23/05	CCCD	65	2.8	7	1530	2.80	359	0	26.40	36.70	8.09	498
		6/20/05	CCCD	50	2.6	13	1640	2.70	388	0	34.10	47.30	9.89	528
		7/18/05	CCCD	35	2.6	12	1550	2.70	413	0	32.30	45.60	9.09	582
		8/19/05	CCCD	13	2.5	12	1600	2.70	436	0	35.70	49.10	9.81	622
		9/20/05	CCCD	20	2.3	14	1800	2.70	450	0	39.4	53.50	10.60	656

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: SMP-LA2 **Description:** Just downstream of Rt. 219 bridge **Lat:** 41.02718

Downstream Point: SMP-LA1 **Type:** In-Stream **Long:** -78.67117

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. *u*S	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
	Cloudy, light	10/23/04	MK, EL	847	4.5	8	403	4.30	27	3	2.26	2.41	3.25	155
	Cloudy, cool,	11/22/04	MK, EL	888	4.7	6.75	378	4.50	25	5	2.42	2.58	3.36	164
	heavy rain	2/9/05	HB, MK	4556	5.1	1	325	4.80	21	5	2.36	2.38	3.74	111
	partly cloudy	3/16/05	AT, MK		4.6	0	399	4.10	34	4	2.87	1.90	4.27	158
	warm, sunny	4/14/05	JB, MK	1531	4.3	10	428	4.20	23	2	2.24	1.19	3.84	160
	cool, sunny	5/18/05	JB, MK	626	4.4	14	411	4.10	34	1	2.32	1.74	3.55	155
	hot, cloudy	6/15/05	HB, MK	289	3.6	19	616	3.60	49	0	3.86	3.34	5.13	230
	sunny, humic	7/13/05	AT, MK	103	3.7	20	733	3.60	56	0	4.41	2.79	7.19	281
	warm, sunny	8/22/05	GS, MK	29	3.5	19	429	3.40	70	0	6.45	0.94	4.96	121
	warm, sunny	9/14/05	GS, MK	27	3.5	16	873	3.50	73	0	5.93	3.77	14.00	370

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: SMP-LA3 **Description:** Little Anderson, 10 ft upstream of impact; old LA4.3 **Lat:** 41.02647

Downstream Point: SMP-LA2 **Type:** In-Stream **Long:** -78.67398

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
	Cloudy, light	10/23/04	MK, EL		6.3	8	349	6.30	3	10	0.1	0.45	1.56	123
	Cloudy, cool,	11/22/04	MK, EL		6.4	6	336	6.30	3	12	0.07	0.49	0.84	138
	heavy rain	2/9/05	HB, MK		5.9	0	298	6.20	3	10	1	1.89	2.40	96
	partly cloudy	3/16/05	AT, MK		6.3	0	351	5.80	6	12	0.15	0.33	2.35	140
	warm, sunny	4/14/05	JB, MK	1017	5.5	10	401	6.10	6	7	0.21	0.46	2.98	151
	cool, sunny	5/18/05	JB, MK	490	6.0	12.5	346	5.90	8	8	0.13	0.48	1.74	118
	hot, cloudy	6/15/05	HB, MK	166	5.6	19	441	6.20	4	8	0.1	0.50	0.93	171
	sunny, humic	7/13/05	AT, MK	69	5.6	20	543	5.80	8	8	0.09	0.55	2.31	223
	warm, sunny	8/22/05	GS, MK	16	5.9	18	473	6.20	5	10	0.16	1.18	7.37	183
	estimated flo	9/14/05	GS, MK	35	5.5	16	655	5.60	16	8	0.51	1.90	12.20	316

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: SMP-LA4 **Description:** SR4010 crosses LA **Lat:**

Downstream Point: **Type:** In-Stream **Long:**

				Field Parameters				Laboratory Analyses						
(1) **Smp No.**	(2) **Sample Note**	(3) **Sample Date**	(4) **Sampler**	(5) **Flow** (gpm)	(6) **pH** (SU)	(7) **Temp.** (oC)	(8) **Cond.** *u* S	(9) **pH** (SU)	(10) **Acid.** (mg/L)	(11) **Alk.** (mg/L)	(12) **Al** (mg/L)	(13) **Fe** (mg/L)	(14) **Mn** (mg/L)	(15) **SO_4** (mg/L)
	warm, sunny	4/14/05	JB, MK	686	5.9	13	401	6.10	6	7	0.21	0.46	2.98	151
	cool, sunny	5/18/05	JB, MK	349	6.4	16.5	402	6.30	4	12	0.08	0.77	0.08	157
	hot, cloudy	6/15/05	HB, MK	587	6.2	21	522	7.00	-10	22	0.07	0.80	3.51	206
	estimated flo	9/14/05	GS, MK	30	5.3	18	720	5.10	20	7	0.42	0.56	15.80	360

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: PMP-LA2.1 **Description:** ______ **Lat:** ______

Downstream Point: ______ **Type:** In-Stream **Long:** ______

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
	warm, sun	5/19/05	JB, MK	171	3.9	9	362	3.60	64	0	6.86	0.87	7.36	92
	sunny, humic	7/14/05	AT, MK	15	3.8	18	486	3.40	73	0	6.47	0.71	4.23	119
	warm, cloudy	8/23/05	GS, MK	5	3.5	15	793	3.40	72	0	5.09	3.75	11.30	287
	estimated flo	9/15/05	GS, MK	3	3.5	15	490	3.40	72	0	7.42	1.20	5.88	178

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: PA-LA4.3- **Description:** 10 ft from mouth of stream discharge into LA **Lat:** 41.0262

Downstream Point: SMP-LA2 **Type:** In-Stream **Long:** -78.67395

				Field Parameters				Laboratory Analyses						
(1) **Smp No.**	(2) **Sample Note**	(3) **Sample Date**	(4) **Sampler**	(5) **Flow** (gpm)	(6) **pH** (SU)	(7) **Temp.** (oC)	(8) **Cond.** uS	(9) **pH** (SU)	(10) **Acid.** (mg/L)	(11) **Alk.** (mg/L)	(12) **Al** (mg/L)	(13) **Fe** (mg/L)	(14) **Mn** (mg/L)	(15) **SO_4** (mg/L)
	Cloudy, over	10/23/04	MK, EL	262	3.6	8	626	3.50	91	0	7.42	8.11	8.10	221
	Cloudy, cool,	11/22/04	MK, EL	262	3.7	6	555	3.60	80	0	7.33	7.16	8.02	224
	estimated 30	2/9/05	HB, MK		3.4	1.5	381	3.80	49	0	5.02	3.77	5.08	136
	partly cloudy	3/16/05	AT, MK		4.1	0	461	3.60	64	0	6.12	3.65	5.89	194
	warm, sunny	4/14/05	JB, MK	427	3.6	10	521	3.60	53	0	5.87	2.86	5.92	181
	cool, sunny	5/18/05	JB, MK	41	3.5	12.5	604	3.50	90	0	6.91	4.09	7.48	217
	hot, cloudy	6/15/05	HB, MK	143	3.0	19	962	3.20	137	0	9.43	8.90	11.10	339
	sunny, humi	7/13/05	AT, MK	41	3.2	21	1210	3.10	183	0	13.10	12.60	16.20	466
	warm, sunny	8/22/05	GS, MK	10	3.0	18	1300	3.00	234	0	16.80	18.60	21.30	638
	estimted flow	9/14/05	GS, MK	25	3.1	16	1420	3.00	220	0	17.50	18.30	22.20	576

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: PA-LA4.3- **Description:** Downstream Cramer Road bridge, 300 yds. **Lat:** 41.01815

Downstream Point: PA-LA4.3- **Type:** In-Stream **Long:** -78.67825

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
	Cloudy, light	10/23/04	MK, EL	112	6.1	9	178	5.90	4	8	0.11	0.70	0.87	43
	Cloudy, cool,	11/22/04	MK, EL	91	6.0	7	153	6.00	4	10	0.09	0.62	0.69	39
	Weir blown o	2/9/05	HB, MK		5.9	2.5	142	6.00	5	8	1.38	9.95	0.70	36
	partly cloudy	3/16/05	AT, MK	136	5.8	3	158	5.50	10	8	0.15	0.32	0.59	41
	warm, sunny	4/14/05	JB, MK	136	5.5	11	176	6.00	4	6	0.24	0.45	0.55	45
	cool, sunny	5/18/05	JB, MK	64	5.9	15	167	5.90	7	8	0.14	0.41	0.74	37
	hot, cloudy	6/15/05	HB, MK	30	5.8	18.5	194	6.30	3	9	0.2	0.72	1.38	49
	cloudy, humi	7/13/05	AT, MK	15	5.8	21	242	6.00	6	9	0.12	0.50	1.99	71
	warm, sunny	8/22/05	GS, MK	10	6.0	20	272	6.20	6	9	0.15	1.03	2.41	75
	estimated flo	9/14/05	GS, MK	10	5.8	21	207	6.30	1	11	0.13	1.09	1.56	67

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: DMP-LA5. **Description:** Cramer1, LAH2 **Lat:** 41.02663

Downstream Point: SMP-LA2 **Type:** Point Source **Long:** -78.69743

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
		11/21/04	CCCD	2	4.5	5.556	520	4.30	18	0	1	0.15	4.16	240
		12/18/04	CCCD	22	4.3	5.6	571	4.40	24	4	1.27	0.05	4.64	275
		1/15/05	CCCD	86	4.3	5.556	605	4.50	17	5		1.03	4.81	299
		2/13/05	CCCD	9	4.5	6.111	522	4.40	19	4	1.25	0.06	4.83	245
		3/17/05	CCCD	17	4.4	6.111	527	4.60	16	7	1.02	0.05	4.29	230
		4/14/05	CCCD	267	4.4	8	540	4.50	14	5	1.31	1.44	4.40	219
		5/23/05	CCCD	6	4.7	6	513	4.50	16	4	1.03	0.06	3.96	213
		6/20/05	CCCD	4	4.5	9	510	4.40	16	4	1.18	1.02	4.19	207
		7/18/05	CCCD	2	4.3	12	492	4.40	17	4	0.86	0.17	4.30	199
		8/19/05	CCCD	0	2.6	13	500	4.50	14	5	0.82	0.27	5.22	227
	dry	9/20/05	CCCD											

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: DMP-LA5.9 **Description:** LAH-1, CRAMER#2 **Lat:** 41.02453

Downstream Point: SMP-LA2 **Type:** Point Source **Long:** -78.69618

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
		10/23/04	CCCD	9	4.4	5.556	564	3.60	45	0	2.99	3.63	4.67	202
		12/18/04	CCCD	17	4.3	6.111	911	4.30	36	3	2.5	0.05	8.62	430
		1/15/05	CCCD	50	4.2	6.667	939	4.30	32	3		0.05	10.80	447
		2/13/05	CCCD	15	4.3	6.111	856	4.30	30	7	2.62	0.05	8.66	399
		3/17/05	CCCD	9	4.2	6.667	842	4.30	25	5	2.41	0.42	8.27	387
		4/14/05	CCCD	28	4.1	11	875	4.30	26	3	2.44	0.05	8.64	427
	dry	9/20/05	CCCD											

WRAM v2.0 - Sample Point Data

Project Name: Anderson Creek

Sample ID: SMP-AC4 **Description:**

Lat: 41.96653

Downstream Point: SMP-AC3 **Type:** In-Stream

Long: -78.58967

				Field Parameters				Laboratory Analyses						
(1) Smp No.	(2) Sample Note	(3) Sample Date	(4) Sampler	(5) Flow (gpm)	(6) pH (SU)	(7) Temp. (oC)	(8) Cond. uS	(9) pH (SU)	(10) Acid. (mg/L)	(11) Alk. (mg/L)	(12) Al (mg/L)	(13) Fe (mg/L)	(14) Mn (mg/L)	(15) SO_4 (mg/L)
	Cloudy, light	10/23/04	MK, EL	6898	6.7	10	102	6.40	2	10	0.049	0.17	0.04	22
	Cloudy, cool,	11/23/04	MK, EL	8027	6.6	7	99	6.50	2	10	0.049	0.19	0.04	22
	Heavy rain	2/10/05	HB, MK	41749	6.1	2	85	6.10	6	8	0.23	0.20	0.15	19
	sunny	3/17/05	AT, MK	12060	6.1	0.25	112	6.30	4	7	0.15	0.18	0.14	21
	warm, sunny	4/15/05	JB, MK	16951	6.3	14	118	6.50	2	8	0.16	0.20	0.08	19
	cool, sunny	5/19/05	JB, MK	6057	6.7	14	112	6.40	4	9	0.049	0.12	0.03	19
	rain, hot	6/16/05	HB, MK	21327	6.5	21	125	6.70	1	9	0.049	0.15	0.04	17
	cloudy, humi	7/14/05	AT, MK	1383	6.4	21	132	6.90	-1	13	0.05	0.08	0.03	20
	warm, cloudy	8/23/05	GS, MK	1139	6.7	17	138	6.90	-2	14	0.05	0.07	0.02	18
	warm, sunny	9/15/05	GS, MK	1118	6.4	19	130	7.00	-4	14	0.05	0.05	0.02	18

Appendix X-C

DEP Assessment and PA Fish & Boat Commission Data

Appendix C. Pennsylvania Department of Environmental Protection, Pennsylvania Fish and Boat Commission, and Headwaters Resource Conservation and Development Council Data

Creek Status
U=Not Impaired
B=Impaired Biology
H=Impaired Habitat

DEP Unassessed Data

Station ID		Code	Name	Abundance	Range	Hilsenhoff Score
19990503-1100-JLR	**Location**	25	Cambaridae	P	3-9	6
	Upstream of Bridge on Rt. 153 (Penfield Quad)	30	Ephemerellidae	P	3-9	2
Anderson Creek Headwaters		50	Chloroperlidae	A	25-100	0
Creek Status= **U**		53	Peltoperlidae	P	3-9	2
Section 01 PA Fish Commission	**Impairment**	57	Taeniopterygidae	P	3-9	2
	Possible acid deposition impact; No mining activity	60	Elmidae	R	<3	5
Water Chemistry		67	Nigronia	R	<3	2
pH: 3.5		68	Sialidae	R	<3	6
Temp ©: 10.3		70	Brachycentridae	P	3-9	1
Cond (umhos)= 67	**Land Use**	73	Hydropsychidae	P	3-9	5
DO (mg/l): 6.37	80% forest; 10% Other; 5% residential; 5% fields	77	Limnehilidae	R	<3	4
		80	Philopotamidae	R	3-9	3
Stream Assessment Total Score: 175		84	Rhyacophilidae	C	10-24	1
		96	Simuliidae	A	25-100	6
		98	Tipulidae	P	3-9	4

1990503-1210-JLR	**Location**	5	Oligochaeta	R	<3	10
Whitney Run	On Whitney Run downstream of bridge on Gordon Road (Penfield	25	Cambaridae	P	3-9	6
Creek Status= B		32	Heptageniidae	R	<3	3
Section 02 of PA Fish Commission		50	Chloroperlidae	A	25-100	0
	Land Use	57	Taeniopterygidae	C	10-25	2
Water Chemistry	90% forest; 5% residential; 5% Fields	67	Nigronia	P	3-9	2
pH: 4.55		68	Sialidae	R	<3	6
Temp (Celcius): 10.3	**Impairment**	73	Hydropsychidae	R	<3	5
Cond (umhos): 38	Low pH due to acid deposition/headwater stream	80	Philopotamidae	R	<3	3
DO (mg/l): 6.01		84	Rhyacophilidae	P	3-9	1
		89	Certatopogonidae	R	<3	6
Stream Assessment Total Score: 187		96	Simuliidae	A	25-100	6

Appendix C. Pennsylvania Department of Environmental Protection, Pennsylvania Fish and Boat Commission, and Headwaters Resource Conservation and Development Council Data

Creek Status
U=Not Impaired
B=Impaired Biology
H=Impaired Habitat

DEP Unassessed Data

Station ID		Code	Name	Abundance	Range	Hilsenhoff Score
19990503-1300-JLR	**Location**	5	Oligochaeta	R	<3	10
Stony Run	Downstream of bridge on Access Rd. along I-80	50	Chloroperlidae	C	10-24	0
Creek Status= **U**		54	Perlidae	P	3-9	3
Section 02 of PA Fish Commission		57	Taeniopterygidae	C	10-24	2
	Land Use	73	Hydropsychidae	C	10-24	5
Water Chemistry	70% forest; 20% roadways; 5% residential; 5% fields	80	Philopotamidae	P	3-9	3
pH: 5.7		89	Certatopogonidae	P	3-9	6
Temp ©: 14.4		96	Simuliidae	C	10-24	6
Cond (umhos)=212						
DO (mg/l): 5.41						
Stream Assessment Total Score: 169						
19990503-1415-JLR	**Location**	25	Cambaridae	P	3-9	6
Mongomery R @ Access Rd	Montgomery Run @ end of Access Road off of Gordon Road (Elliot Park Quad)	30	Ephemerellidae	R	<3	2
Creek Status= U		40	Aeshnidae	R	<3	3
Section 02 of PA Fish Commission		50	Chloroperlidae	A	25-100	0
		53	Peltoperlidae	R	<3	2
Water Chemistry	**Land Use**	54	Perlidae	C	10-24	3
pH: 3.6	90% forest; 5% residential; 5% fields	57	Taenopterygidae	C	10-24	2
Temp (celcius): 10.7		67	Nigronia	P	3-9	2
Cond (umhos): 29	**Impairment**	73	Hydropsychidae	P	3-9	5
DO (mg/l): 5.96	Naturally Acidic	80	Philopostamidae	P	3-9	3
		84	Rhyacophilidae	C	10-24	1
Total Stream Assessment Total: 190		96	Simuliidae	C	10-24	6
19981019-1315-JLR	**Location**	25	Cambaridae	R	<3	6
Anderson Ck. Rt. 322	Main Stem of Anderson Ck.; downstream of Rt. 322	32	Heptageniidae	A	25-100	3
Creek Status: U		40	Aeshnidae	R	<3	3
Section 03 of PA Fish Commission		50	Chloroperlidae	R	<3	0
Water Chemistry	**Land Use**	54	Perlidae	C	10-24	3
pH: 6.8	65% Forest; 10% residential; 5% mining; 5% cropland; 5% pasture; 5% other	67	Nigronia	R	<3	2
Temp (celcius): 6.8		68	Sialidae	R	<3	6
Cond (umhos):125		73	Hydropsychidae	C	10-24	5
DO (mg/l): 5.47		80	Philopotamidae	C	10-24	3
Stream Assessment Total Score: 144		83	Psychomyiidae	R	<3	2

Appendix C. Pennsylvania Department of Environmental Protection, Pennsylvania Fish and Boat Commission, and Headwaters Resource Conservation and Development Council Data

Creek Status
U=Not Impaired
B=Impaired Biology
H=Impaired Habitat

DEP Unassessed Data

Station ID		Code	Name	Abundance	Range	Hilsenhoff Score
19981029-0900-JLR		4	Hydracarina	R	<3	7
Anderson Ck. Junction with L. Anderson Ck.		27	Baetidae	R	<3	6
Creek Status= U		32	Heptageniidae	A	25-100	3
Section 04 of PA Fish Commission		33	Isonychiidae	P	3-9	3
Water Chemistry	**Location**	50	Chloroperlidae	R	<3	0
pH: 7	Upstream of confluence w/Little Anderson Creek; Downstream of pipeline (Luthersburg Quad)	54	Perlidae	A	25-100	3
Temp (celcius): 8		60	Elmidae	R	<3	5
Cond (umhos):120		66	Corydalus	P	3-9	4
DO (mg/l): 6.09		67	Nigronia	C	10-24	2
Stream Assessment Total Score: 170		68	Sialidae	R	<3	6
	Land Use	73	Hydropsychidae	A	25-100	5
	65% forest; 10% residential; 10% Abd. Mining; 10% fields; 5% other	80	Philospotamidae	A	25-100	3
		96	Simuliidae	R	<3	6
		98	Tipulidae	R	<3	4
19981029-1030-JLR	**Location**	40	Aeshnidae	R	<3	3
	Downstream of confluence; along railroad tracks; Forest Service Rd (Elliot Park Quad)					
Downstream of Little Anderson		54	Perlidae	R	<3	3
Creek Status= B,H		67	Nigronia	P	3-9	2
Section 05 of PA Fish Commission		68	Sialidae	R	<3	6
Water Chemistry	**Land Use**	73	Hydropsyscidae	P	3-9	5
pH: 3.9	70% forest; 10% residential; 10% Abd. Mining; 10% Fields					
Temp (celcius): 8.6						
Cond (umhos):299	**Impairment**					
DO (mg/l): 6.37	AMD; Orange Deposit					
Stream Assessment Total Score: 155						
19981027-1330-JLR	**Location**	73	Hydropsyscidae	C	10-24	5
Anderson downstream of Refactory Co.	Anderson Ck. Downstream of N. Amer. Refactory Co.; Upstream of Grampian Rd. (Curwensville Quad)					
Creek Status= B,H						
Section 05 of PA Fish Commission	**Land Use**					
Water Chemistry	50% residential; 10% Abd. Mining; 10% Industrial; 10% fields; 15% Cropland; 10% forest					
pH: 5.5						
Temp (celcius): 14.2						
Cond (umhos):323	**Impairment**					
DO (mg/l): 6.17	Sediment Deposition; iron/grey precipitate on rocks; AMD					
Stream Assessment Total Score: 115						

Appendix C. Pennsylvania Department of Environmental Protection, Pennsylvania Fish and Boat Commission, and Headwaters Resource Conservation and Development Council Data

Creek Status
U=Not Impaired
B=Impaired Biology
H=Impaired Habitat

DEP Unassessed Data

Station ID		Code	Name	Abundance	Range	Hilsenhoff Score
19981019-1125-JRL	**Location**	50	Chloroperlidae	R	<3	0
Anderson Ck. @ Mouth	Anderson Creek Upstream of bridge on Rt. 879 (Curwensville Quad)	55	Perlodidae	R	<3	2
Creek Status= B		67	Nigronia	P	3-9	2
Section 05 of PA Fish Commission		68	Sialidae	P	3-9	6
	Land Use	73	Hydropsychidae	P	3-9	5
Water Chemistry	75% forest; 10% residential; 5% Industrial; 5% Commercial; 5% fields	83	Pshychomyiidae	R	<3	2
pH: 4						
Temp (celcius): 13.4						
Cond (umhos):291	**Impairment**					
DO (mg/l): 5.82	AMD					
Stream Assessment Total Score: 148						
19990504-1455-JLR	**Location**		Chloroperlidae	R	<3	0
Rock Run above Bridge	Upstream of Rt. 219 Bridge (Luthersburg Quad)		Nigronia	P	3-9	2
Creek Status= B,H			Sialidae	P	3-9	6
	Land Use		Empididae	R	<3	6
Water Chemistry	50% forest; 20% Residential;25% Abd. Mining: Fields 5%		Tipulidae	R	<3	4
pH: 2.65						
Temp (celcius): 15.9	**Impairment**					
Cond (umhos):457	Iron preciptation; abandoned strip mines					
DO (mg/l): 5.22						
Stream Assessment Total Score: 159						
19990505-0850-JLR		68	Sialidae	P	3-9	6
L. Anderson Ck. Upstream of bridge						
Creek Status= B	**Location**					
	Bridge near B & O railroad					
Water Chemistry						
pH: 2.15	**Land Use**					
Temp (celcius): 11.6	45% forest; 15% residential; 30% Abd. Mining; 10% fields					
Cond (umhos):630						
DO (mg/l): 5.67	**Impairment**					
Stream Assessment Total Score: 167						
	AMD					

Appendix C. Pennsylvania Department of Environmental Protection, Pennsylvania Fish and Boat Commission, and Headwaters Resource Conservation and Development Council Data

Creek Status
U=Not Impaired
B=Impaired Biology
H=Impaired Habitat

DEP Unassessed Data

Station ID		Code	Name	Abundance	Range	Hilsenhoff Score
19981029-1200-JLR	**Location**	68	Sialidae	P	3-9	6
L. Anderson Ck. @ Rt. 219	Upstream of Rock Run Rd. (Luthersburg Quad)	73	Hydropsychidae	C	10-24	5
Creek Status= B						
	Land Use					
Water Chemistry	35% forest; 15% Residential; 15% Abd. Mining; Fields 10%;					
pH: 3.9						
Temp (celcius): 9	**Impairment**					
Cond (umhos):1060	High embeddedness, siltation; impact from strip mining					
DO (mg/l): 6.16						
Stream Assessment Total Score: 138						
19990506-0945-JLR	**Location**	5	Oligochaeta	A	25-100	10
Kratzer Run ds Rt. 729	Kratzer Run ds of Rt. 729 bridge (Curwensville Quad)	30	Ephemerellidae	R	<3	2
Creek Status= B		32	Heptageniidae	R	<3	3
**Also refer to results KR01	**Land Use**	68	Sialidae	R	<3	6
	65% Residential; 5% Abd. Mining; 10% commercial; 5% fields; 5% croplands					
Water Chemistry		73	Hydropsychidae	A	25-100	5
pH: 4.43	**Impairment**	98	Tipulidae	R	<3	4
Temp (celcius): 19	excessive growth of algae; nutrient problems					
Cond (umhos):425						
DO (mg/l): 8.61						
Stream Assessment Total Score: 176						
19990506-0830-JLR	**Location**	51	Leuctridae	R	<3	0
Kratzer Run near Mouth	Kratzer run near confluence w/Anderson Ck	54	Perlidae	R	<3	3
Creek Status= B		73	Hydropsychidae	P	3-9	5
**Also refer to results KR01						
Water Chemistry	**Land Use**					
pH: 6.5	50% forest; 15% residential; 25% Abd. Mining; 10% fields					
Temp (celcius):13.1						
Cond (umhos):299	**Impairment**					
DO (mg/l): 5.71	AMD					
Stream Assessment Total Score: 149						

Appendix C. Pennsylvania Department of Environmental Protection, Pennsylvania Fish and Boat Commission, and Headwaters Resource Conservation and Development Council Data

Creek Status
U=Not Impaired
B=Impaired Biology
H=Impaired Habitat

DEP Unassessed Data

Station ID		Code	Name	Abundance	Range	Hilsenhoff Score
20030827-1200-JCO	**Location**	51	Leuctridae	R	<3	0
	Bilger Run 1/8 mile upstream of T461 (Bilgers Rocks Rd); Curwensville Quad					
Bilger Run @ Bilger Rock		67	Nigronia	C	10-24	2
Creek Status= B		68	Sialidae	R	<3	6
**Also refer to results BGR	**Land Use**	73	Hydropsychidae	A	25-100	5
Water Chemistry	45% forest; 10% residential; 30% Abd. Mining; 10% fields; 5% cropland					
pH: 4.43						
Temp (celcius):19	**Impairment**					
Cond (umhos): 425	AMD; Yellowboy covering rocks					
DO (mg/l): 8.61						
Stream Assessment Total Score: 176						

19990506-0900-JLR	**Location**	25	Cambaridae	R	<3	6
	On Bilger Run @ mouth; Upstream of Rt. 870 bridge (Curwensville Quad)					
Bilger Run @ mouth		68	Sialidae	P	3-9	6
Creek Status= B						
**Also refer to results BGR	**Land Use**					
Water Chemistry	80% forest; 5% residential; 15% Abd. Mining					
pH: 6.1						
Temp (celcius):13.1	**Impairment**					
Cond (umhos): 321	AMD; Yellowboy covering rocks					
DO (mg/l): 5.68						
Stream Assessment Total Score: 142						

Appendix C. Pennsylvania Department of Environmental Protection, Pennsylvania Fish and Boat Commission, and Headwaters Resource Conservation and Development Council Data

Fish and Boat Commission Report

Section 01 (0.5 upstream from Rt. 322 bridge near Rockton)

Chemiclal Data	Biological Data	Physical Data
Air temp. = 22	Invertebrate data	Flow = Norm (2)
pH = 4.6	Peltoperlidae	Bnk. Ersn. = Lite (3)
Total Alk.=1	Hydropsychidae	Shade = Dense (1)
Tot. Hard. = 14	Limnephilidae	Bank Veg. = Trees (4)
D.O. = 99.9	Chironomidae	Sub. Comp. = Grvl, Sand (4, 5)
Conductivity = 85	Corydalidae	
	Cambaridae	
	Fish Data	
	Salvelinus fontinalis	
	(Brook Trout)	

Section 02 (0.8 km downstream from Gordon Road bridge)

Chemical Data	Biological Data	Physical Data
Air temp. = 23	Invertebrate data	Flow = Norm (2)
pH = 5.8	Leuctridae	Bnk. Ersn. = Hvy. (1)
Total Alk. = 4	Chironomidae	Shade = Dens (1)
Tot. Hard. = 19	Culicidae	Bank Veg. = Tree (4)
D.O. = 7.9	Rhigionidae	Sub. Comp. = Sand, Silt (5,6)
Conductivity = 65	Tipulidae	
	Corydaliade	
	Cambaridae	
	Oligochaeta	
	Fish Data	
	Rhinichythys cataractae	
	(Blacknose Dace)	
	Semotilus atromaculatus	
	(Creek Chub)	
	Catostomus commersoni	
	(White Sucker)	
	Lepomis gibbosus	
	(Pumpkinseed, Kiver)	
	Etheostoma olmstedi	
	(tessellated darter)	

Appendix C. Pennsylvania Department of Environmental Protection, Pennsylvania Fish and Boat Commission, and Headwaters Resource Conservation and Development Council Data

Fish and Boat Commission Report

Section 02 (1.3 km upstream of I-80)

Chemical Data	Biological Data	Physical Data
Air temp. = 23	Invertebrate data	Flow = Norm (2)
pH = 6.1	Ephemeridae	Bnk. Ersn. = Mod. (2)
Total Alk. = 8	Heptageniidae	Shade = Prtl (2)
Tot. Hard. = 22	Hydropsychidae	Bank Veg. = GsLd (2)
D.O. = 7.5	Odontoceridae	Sub. Comp. = Sand, Silt (5,6)
Conductivity = 60	Odontoceridae	
	Philopotamidae	
	Chironomidae	
	Rhigionidae	
	Corydalidae	
	Oligochaeta	
	Fish Data	
	Salmo trutta	
	(Brown Trout)	
	Notropis cornutus	
	(Red-sided Minnow)	
	Pimephales notatus	
	(Bluntnose Dace)	
	Rhinichythys atratulus	
	(Blacknose Dace)	
	Semotilus atromaculatus	
	(Creek Chub)	
	Catostomus commersoni	
	(White sucker)	
	Ictalurus nebulousus	
	(Brown Bullhead)	
	Lemomis gibbosus	
	(Pumpkinseed, kiver)	
	Micropterus salmonides	
	(Largemouth Bass)	
	Etheostoma olmstedi	
	(Tessellated Darter)	
	Etheostoma nigrum	
	(Fantail darter)	

Section 03 (downstream from Rt. 153 bridge)

Chemical Data	Biological Data	Physical Data
Air temp. = 23	Invertebrate data	Flow = Norm (2)
pH = 6.8	Heptageniidae	Bnk. Ersn. = Lite (3)
Total Alk. = 8	Siphlonuridae	Shade = Prtl (2)
Tot. Hard. = 17	Perlidae	Bank Veg. = Tree (4)
D.O. = 8.0	Gomphidae	Sub. Comp. = Rubl, Grvl (3,4)
Conductivity = 78	Chironomidae	
	Oligochaeta	
	Fish Data	
	Salmo trutta	
	(Brown Trout)	
	Salvelinus fontinalis	
	(Brook Trout)	
	Pimephales notatus	
	(Bluntnose Minnow)	
	Rhinishythys atratulus	
	(Longnose Dace)	
	Semotilus atromaculatus	
	(Creek Chub)	
	Catostomus commersoni	
	(White Sucker)	
	Noturus insignis	
	(Margined Madtom)	

Section 04 (2.0 km extension of Section 03)

Section in very close to proximity to Section 03; therefore refer to those results

Appendix C. Pennsylvania Department of Environmental Protection, Pennsylvania Fish and Boat Commission, and Headwaters Resource Conservation and Development Council Data

Fish and Boat Commission Report

Section 05 (2.2 km downstream from confluence with Little

Chemical Data	Biological Data	Physical Data
Air temp. = 26	Peltoperlidae	Flow = Norm (2)
pH = 4.7	Chironomidae	Bnk. Ersn. = Mod (2)
Total Alk.=1	Sialidae	Shade = Prtl (2)
Tot. Hard. = 40		Bank Veg. = Tree (4)
D.O. = 99.9		Sub. Comp. = Rubl, Grvl (3,4)
Conductivity = 198		

Section 05 (at confluence with Kratzer Rn. Near Curwensville)

Chemical Data	Biological Data	Physical Data
Air temp. = 25	Invertebrate Data	Flow = Norm (2)
pH = 4.4	Peltoperlidae	Bnk. Ersn. = Lite (3)
Total Alk.=0	Chironomidae	Shade = Open (3)
Tot. Hard. = 42	Sialidae	Bank Veg. = Tree (4)
D.O. = 99.9		Sub. Comp. = Rubl, Grvl (3,4)
Conductivity = 146	Fish Data	
	Lepomis gibbosus	
	(Pumpkinseed, Kiver)	

Appendix C. Pennsylvania Department of Environmental Protection, Pennsylvania Fish and Boat Commisison, and Headwaters Resource Conservation and Development Council Data

Headwaters RC & D Assessment

Habitat Parameter	ACO1	ACO2	AC03	AC04	LA01	LA02	LA03	PR01	BR01	KR01	FR01	BR01
Epifaunal Substrate/Available Cover	14	14	12	8	11	11	7	11	18	12	13	14
Riffle Quality	9	9	12	7	8	7	9	8	14	10	9	9
Embeddedness	13	13	18	13	12	7	14	12	17	9	14	13
Channel Alteration	19	19	16	8	18	19	14	18	19	14	18	18
Sediment Deposition	12	12	17	11	13	8	18	13	18	13	14	16
Frequency of Riffles	11	11	11	8	9	12	14	9	14	12	11	11
Channel Flow Status	13	13	7	10	8	12	8	8	11	8	7	8
Bank Vegetative Protection	18	18	16	11	14	8	8	14	18	15	15	18
Bank Stability	18	16	15	17	14	8	7	14	18	15	15	18
Riparian Vegetative Zone Width	18	17	12	2	16	18	10	16	18	14	17	18
Totals	**145**	**142**	**136**	**95**	**123**	**110**	**109**	**123**	**165**	**122**	**133**	**143**

Parameters based on a scale ranging from 1-20

Additional Assessment

Station 01 Anderson Creek (beginning below the reservoir) AC01

Figure 3, PA Quadrangle

Habitat Evaluation:145 (suboptimal)

Areas of Concern: Riffle Quality

Average Stream Width: 30 ft

Station 02 Anderson Creek AC02

Figure 02, PA Quadrangle

Habitat Evaluation: 142 (suboptimal)

Area of Concern: Riffle Quality

Average Stream Width: 30 ft

Station 03, Anderson Creek AC03

Figure 03, PA Quadrangle

Habitat Evaluation: 136 (suboptimal)

Area of Concern: channel flow status

Average Stream Width: 50 ft

Station 03, Anderson Creek AC03

Figure 03, PA Quadrangle

Habitat Evaluation: 136 (suboptimal)

Area of Concern: channel flow status

Average Stream Width: 50 ft

Station 04, Anderson Creek AC04

Figure 04, PA Quadrangle

Habitat Evaluation: 95 (marginal)

Area of Concern: Epifunal substrate, riffle quality, channel alterations, riparian vegetative zone

Average Stream Width: 45

Station 01, Little Anderson Creek LA01

Figure 01, PA Quadrangle

Habitat Evaluation: 123 (suboptimal)

Areas of Concern: riffle quality, frequency of riffles, channel flow status

Average Stream Width: 5 ft

Appendix C. Pennsylvania Department of Environmental Protection, Pennsylvania Fish and Boat Commisison, and Headwaters Resource Conservation and Development Council Data

Headwaters RC & D Assessment

Station 02, Little Anderson Creek LA02

Figure 02, PA Quadrangle

Habitat Evaluation: 110 (low suboptimal range)

Areas of concern: riffle quality, embeddedness, sediment deposition, vegetative protection, bank stability

Average Stream Width: 8 ft

Station 03, Little Anderson Creek LA03

Figure 03, PA Quadrangle

Habitat Evaluation: 109 (low suboptimal range)

Areas of concern: riffle quality, channel flow status, bank vegetative protection, bank stability, riparian vegetative zone width

Average Stream Width: 25 ft

Tributaries of Anderson Creek

Station 01: Panther Run PR01

Figure 3, PA Quadrangles

Habitat Evaluation: 123 (suboptimal range)

Areas of Concern: riffle quality, frequency of riffles, channel flow status

Average Stream Width: 5 ft

Station 01: Bear Run BR01

Figure 5, PA Quadrangle

Habitat Evaluation: 165 (Optimal)

Areas of Concern: channel flow status

Average Stream Width: 12 ft

Station 01: Kratzer Run KR01

Figure 1, PA Quadrangle

Habitat Evaluation: 122 (suboptimal)

Areas of Concern: embeddedness, channel flow status

Average Stream Width: 10 ft.

Station 01: Fenton Run FR01

Figure 2, PA Quadrangle

Habitat Evaluation: 133 (suboptimal)

Areas of Concern: Riffle quality, channel flow status

Average Stream Width: 10 ft

Station 01: Bilger Run BR01

Figure 2, PA Quadrangle

Habitat Evaluation: 143 (high suboptimal range)

Areas of Concern: Riffle quality, channel flow

Average Stream Width: 8 ft

Appendix X-D

USDA Visual Assessment Protocol

United States
Department of
Agriculture

Natural
Resources
Conservation
Service

National Water and Climate Center
Technical Note 99–1

Stream Visual Assessment Protocol

Issued December 1998

Cover photo: Stream in Clayton County, Iowa, exhibiting an impaired riparian zone.

Preface

This document presents an easy-to-use assessment protocol to evaluate the condition of aquatic ecosystems associated with streams. The protocol does not require expertise in aquatic biology or extensive training. Least-impacted reference sites are used to provide a standard of comparison. The use of reference sites is variable depending on how the state chooses to implement the protocol. The state may modify the protocol based on a system of stream classification and a series of reference sites. Instructions for modifying the protocol are provided in the technical information section. Aternatively, a user may use reference sites in a less structured manner as a point of reference when applying the protocol.

The Stream Visual Assessment Protocol is the first level in a hierarchy of ecological assessment protocols. More sophisticated assessment methods may be found in the Stream Ecological Assessment Field Handbook. The field handbook also contains background information on basic stream ecology. Information on chemical monitoring of surface water and groundwater may be found in the National Handbook of Water Quality Monitoring.

The protocol is designed to be conducted with the landowner. Educational material is incorporated into the protocol. The document is structured so that the protocol (pp. 7–20) can be duplicated to provide a copy to the landowner after completion of an assessment. The assessment is recorded on a single sheet of paper (copied front and back).

Acknowledgments

This protocol was developed by the Natural Resources Conservation Service (NRCS) Aquatic Assessment Workgroup. The principal authors were **Bruce Newton**, limnologist, National Water and Climate Center, NRCS, Portland, OR; **Dr. Catherine Pringle**, associate professor of Aquatic Ecology, University of Georgia, Athens, GA; and **Ronald Bjorkland**, University of Georgia, Athens, GA. The NRCS Aquatic Assessment Workgroup members provided substantial assistance in development, field evaluation, and critical review of the document. These members were:

Tim Dunne, biologist, NRCS, Annandale, NJ
Ray Erickson, area biologist, NRCS, Texarkana, AR
Chris Faulkner, aquatic biologist, USEPA, Washington, DC
Howard Hankin, aquatic ecologist, Ecological Sciences Division, NRCS, Washington, DC
Louis Justice, state biologist, NRCS, Athens, GA
Betty McQuaid, soil ecologist, Watershed Science Institute, NRCS, Raleigh, NC
Marcus Miller, wetlands specialist, Northern Plains Riparian Team, NRCS, Bozeman, MT
Lyn Sampson, state biologist, NRCS, East Lansing, MI
Terri Skadeland, state biologist, NRCS, Lakewood, CO
Kathryn Staley, fisheries biologist, Wildlife Habitat Management Institute, NRCS, Corvallis, OR
Bianca Streif, state biologist, NRCS, Portland, OR
Billy Teels, director, Wetlands Science Institute, NRCS, Laurel, MD

Additional assistance was provided by **Janine Castro,** geomorphologist, NRCS, Portland, OR; **Mark Schuller,** fisheries biologist, NRCS, Spokane, WA; **Lyle Steffen,** geologist, NRCS, Lincoln, NE; and **Lyn Townsend,** forest ecologist, NRCS, Seattle, WA.

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Stream Visual Assessment Protocol

Introduction

This assessment protocol provides a basic level of stream health evaluation. It can be successfully applied by conservationists with little biological or hydrological training. It is intended to be conducted with the landowner and incorporates talking points for the conservationist to use during the assessment. This protocol is the first level in a four-part hierarchy of assessment protocols. Tier 2 is the NRCS Water Quality Indicators Guide, Tier 3 is the NRCS Stream Ecological Assessment Field Handbook, and Tier 4 is the intensive bioassessment protocol used by your State water quality agency.

This protocol provides an assessment based primarily on physical conditions within the assessment area. It may not detect some resource problems caused by factors located beyond the area being assessed. The use of higher tier methods is required to more fully assess the ecological condition and to detect problems originating elsewhere in the watershed. However, most landowners are mainly interested in evaluating conditions on their land, and this protocol is well suited to supporting that objective.

What makes for a healthy stream?

A stream is a complex ecosystem in which several biological, physical, and chemical processes interact. Changes in any one characteristic or process have cascading effects throughout the system and result in changes to many aspects of the system.

Some of the factors that influence and determine the integrity of streams are shown in figure 1. Often several factors can combine to cause profound changes. For example, increased nutrient loads alone might not cause a change to a forested stream. But when combined with tree removal and channel widening, the result is to shift the energy dynamics from an aquatic biological community based on leaf litter inputs to one based on algae and macrophytes. The resulting chemical changes caused by algal photosynthesis and respiration and elevated temperatures may further contribute to a completely different biological community.

Many stream processes are in a delicate balance. For example, stream power, sediment load, and channel roughness must be in balance. Hydrologic changes that increase stream power, if not balanced by greater channel complexity and roughness, result in "hungry" water that erodes banks or the stream bottom. Increases in sediment load beyond the transport capacity of the stream leads to deposition, lateral channel movement into streambanks, and channel widening.

Most systems would benefit from increased complexity and diversity in physical structure. Structural complexity is provided by trees fallen into the channel, overhanging banks, roots extending into the flow, pools and riffles, overhanging vegetation, and a variety of bottom materials. This complexity enhances habitat for organisms and also restores hydrologic properties that often have been lost.

Chemical pollution is a factor in most streams. The major categories of chemical pollutants are oxygen depleting substances, such as manure, ammonia, and organic wastes; the nutrients nitrogen and phosphorus; acids, such as from mining or industrial activities; and toxic materials, such as pesticides and salts or metals contained in some drain water. It is important to note that the effects of many chemicals depend on several factors. For example, an increase in the pH caused by excessive algal and aquatic plant growth may cause an otherwise safe concentration of ammonia to become toxic. This is because the equilibrium concentrations of nontoxic ammonium ion and toxic un-ionized ammonia are pH-dependent.

Finally, it is important to recognize that streams and flood plains need to operate as a connected system. Flooding is necessary to maintain the flood plain biological community and to relieve the erosive force of flood discharges by reducing the velocity of the water. Flooding and bankfull flows are also essential for maintaining the instream physical structure. These events scour out pools, clean coarser substrates (gravel, cobbles, and boulders) of fine sediment, and redistribute or introduce woody debris.

What's the stream type?

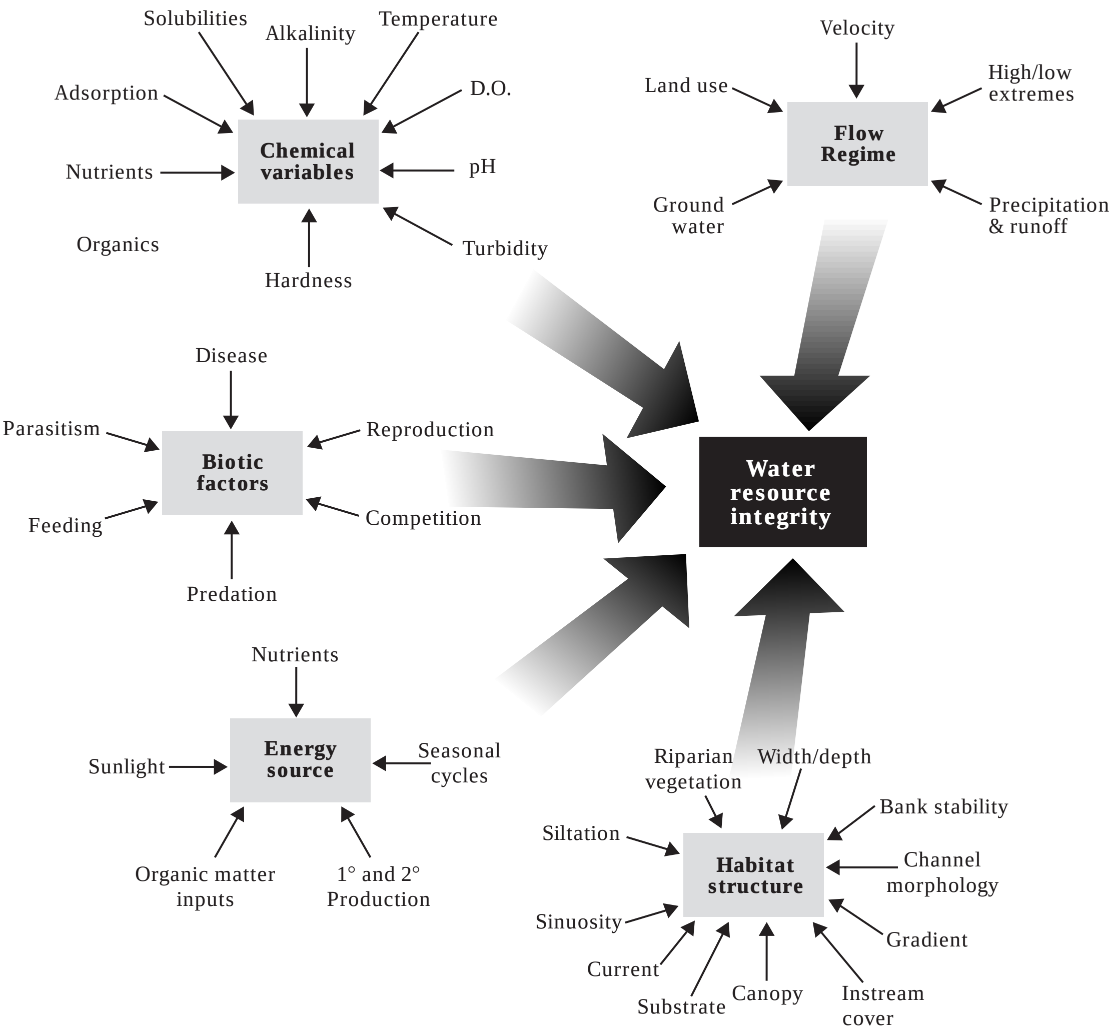
A healthy stream will look and function differently in different parts of the country and in different parts of the landscape. A mountain stream in a shale bedrock is different from a valley stream in alluvial deposits. Coastal streams are different from piedmont streams. Figuring out the different types of streams is called stream classification. Determining what types of streams are in your area is important to assessing the health of a particular stream.

There are many stream classification systems. For the purpose of a general assessment based on biology and habitat, you should think in terms of a three-level classification system based on ecoregion, drainage area, and gradient. *Ecoregions* are geographic areas in which ecosystems are expected to be similar. A national-level ecoregion map is available, and many states are working to develop maps at a higher level of resolution. *Drainage area* is the next most important factor to defining stream type. Finally, the slope or *gradient* of the reach you are assessing will help you determine the stream type. If you are familiar with another classification system, such as Rosgen or Montgomery/Buffington, you should use that system. This protocol may have been adjusted by your state office to reflect stream types common in your area.

Reference sites

One of the most difficult issues associated with stream ecosystems is the question of historic and potential conditions. To assess stream health, we need a benchmark of what the healthy condition is. We can usually assume that historic conditions were healthy. But in areas where streams have been degraded for 150 years or more, knowledge of historic conditions may have been lost. Moreover, in many areas returning to historic conditions is impossible or the historic conditions would not be stable under the current hydrology. Therefore, the question becomes what is the best we can expect for a particular stream. Scientists have grappled with this question for a long time, and the

Figure 1 Factors that influence the integrity of streams (modified from Karr 1986)



consensus that has emerged is to use reference sites within a classification system.

Reference sites represent the best conditions attainable within a particular stream class. The identification and characterization of reference sites is an ongoing effort led in most states by the water quality agency. You should determine whether your state has identified reference sites for the streams in your area. Such reference sites could be in another county or in another state. Unless your state office has provided photographs and other descriptive information, you should visit some reference sites to learn what healthy streams look like as part of your skills development. Visiting reference sites should also be part of your orientation after a move to a new field office.

Using this protocol

This protocol is intended for use in the field with the landowner. Conducting the assessment with the landowner gives you the opportunity to discuss natural resource concerns and conservation opportunities.

Before conducting the assessment, you should determine the following information in the field office:

- ecoregion (if in use in your State)
- drainage area
- stream gradients on the property
- overall position on the landscape

Your opening discussion with landowners should start by acknowledging that they own the land and that you understand that they know their operation best. Point out that streams, from small creeks to large rivers, are a resource that runs throughout the landscape—how they manage their part of the stream affects the entire system. Talk about the benefits of healthy streams and watersheds (improved baseflow, forage, fish, waterfowl, wildlife, aesthetics, reduced flooding downstream, and reduced water pollution). Talk about how restoring streams to a healthy condition is now a national priority.

Explain what will happen during the assessment and what you expect from them. An example follows:

This assessment will tell us how your stream is doing. We'll need to look at sections of the stream that are representative of different conditions. As we do the assessment we'll discuss how the functioning of different aspects of the stream work to keep the system healthy. After we're done, we can talk about the results of the assessment. I may recommend further assessment work to better understand what's going on. Once we understand what is happening, we can explore what you would like to accomplish with your stream and ideas for improving its condition, if necessary.

You need to assess one or more representative reaches. A reach is a length of stream. For this protocol, the length of the assessment reach is 12 times the active channel width. The reach should be representative of the stream through that area. If conditions change dramatically along the stream, you should identify additional assessment reaches and conduct separate assessments for each.

As you evaluate each element, try to work the talking points contained in the scoring descriptions into the conversation. If possible, involve the owner by asking him or her to help record the scores.

The assessment is recorded on a two-page worksheet. A completed worksheet is shown in figure 2. (A worksheet suitable for copying is at the end of this note.) The stream visual assessment protocol worksheet consists of two principal sections: reach identification and assessment. The identification section records basic information about the reach, such as name, location, and land uses. Space is provided for a diagram of the reach, which may be useful to locate the reach or illustrate problem areas. On this diagram draw all tributaries, drainage ditches, and irrigation ditches; note springs and ponds that drain to the stream; include road crossings and note whether they are fords, culverts, or bridges; note the direction of flow; and draw in any large woody debris, pools, and riffles.

The assessment section is used to record the scores for up to 15 assessment elements. Not all assessment elements will be applicable or useful for your site. Do not score elements that are not applicable. Score an element by comparing your observations to the descriptions provided. If you have difficulty matching descriptions, try to compare what you are observing to the conditions at reference sites for your area.

The overall assessment score is determined by adding the values for each element and dividing by the number of elements assessed. For example, if your scores add up to 76 and you used 12 assessment elements, you would have an overall assessment value of 6.3, which is classified as *fair*. This value provides a numerical assessment of the environmental condition of the stream reach. This value can be used as a general statement about the "state of the environment" of the stream or (over time) as an indicator of trends in condition.

Figure 2 Stream visual assessment protocol worksheet

Stream Visual Assessment Protocol

Owners name Elmer Smith Evaluator's name Mary Soylkahn Date 6-20-99

Stream name Camp Creek Waterbody ID number ______

Reach location About 2,000 feet upstream of equipment shed

Ecoregion ______ Drainage area 2,200 acres Gradient 1.2 % (map)

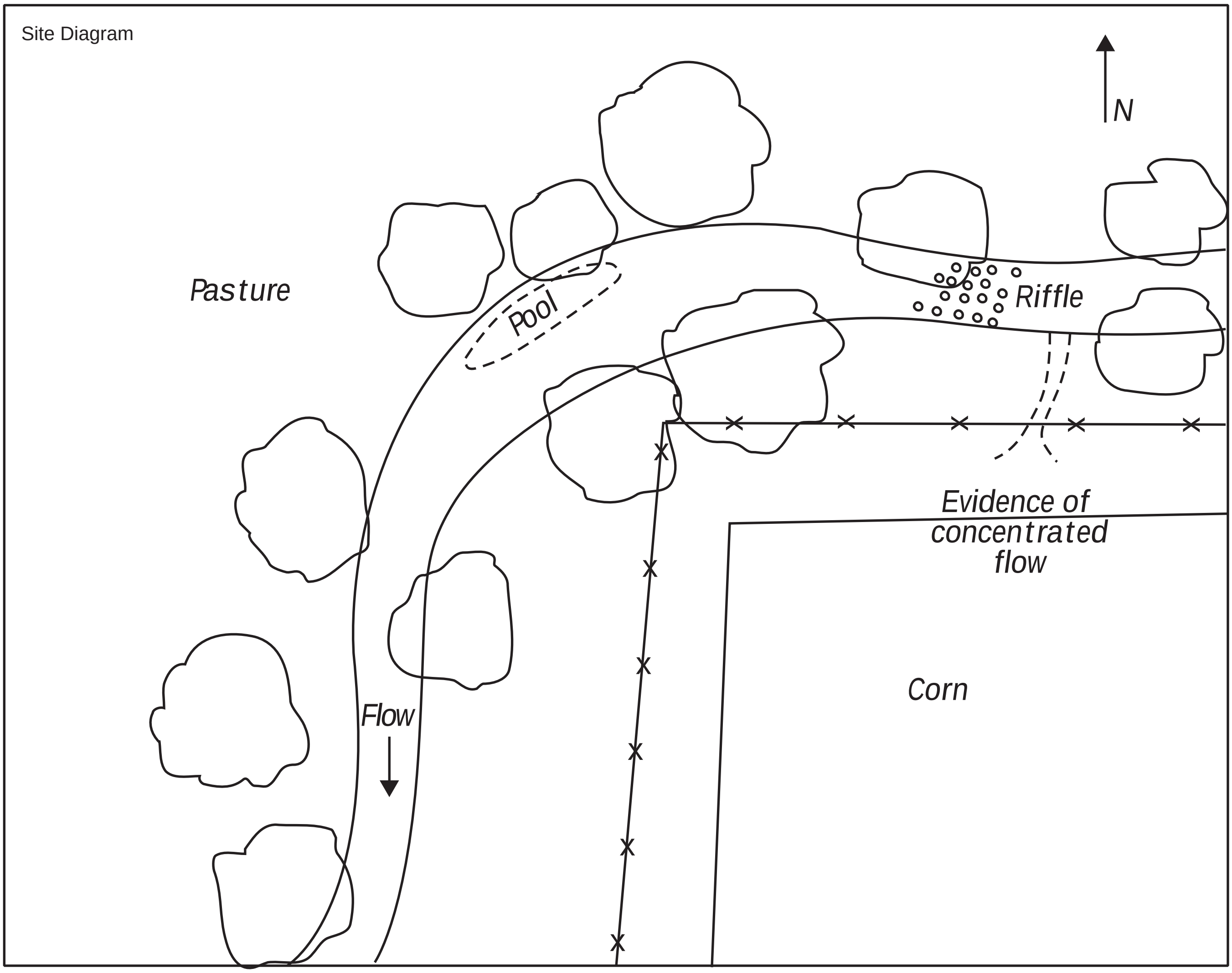
Applicable reference site Cherry Creek north of the Rt 310 bridge

Land use within drainage (%): row crop 40 hayland 30 grazing/pasture 20 forest 10 residential ______

confined animal feeding operations ______ Cons. Reserve ______ industrial ______ Other: ______

Weather conditions-today clear Past 2-5 days clear

Active channel width 15 feet Dominant substrate: boulder ______ gravel X sand X silt ______ mud ______



Assessment Scores

Channel condition	8
Hydrologic alteration	10
Riparian zone	1
Bank stability	5
Water appearance	3
Nutrient enrichment	7
Barriers to fish movement	10
Instream fish cover	3
Pools	3
Invertebrate habitat	7

Score only if applicable

Canopy cover	3
Manure presence	1
Salinity	
Riffle embeddedness	5
Marcroinvertebrates Observed (optional)	10

Overall score
(Total divided by number scored)
76/14 5.4

<6.0	[✓ **Poor**]
6.1-7.4	**Fair**
7.5-8.9	**Good**
>9.0	**Excellent**

Suspected causes of observed problems *This reach is typical of the reaches on the property. Severely degraded riparian zones lack brush, small trees. Some bank problems from livestock access. Channel may be widening due to high sediment load. Does not appear to be downcutting.*

Recommendations *Install 391-Riparian Forest Buffer. Need to encourage livestock away from stream using water sources and shade or exclude livestock. Concentrated flows off fields need to be spread out in zone 3 of buffer. Relocate fallen trees if they deflect current into bank–use as stream barbs to deflect current to maintain channel.*

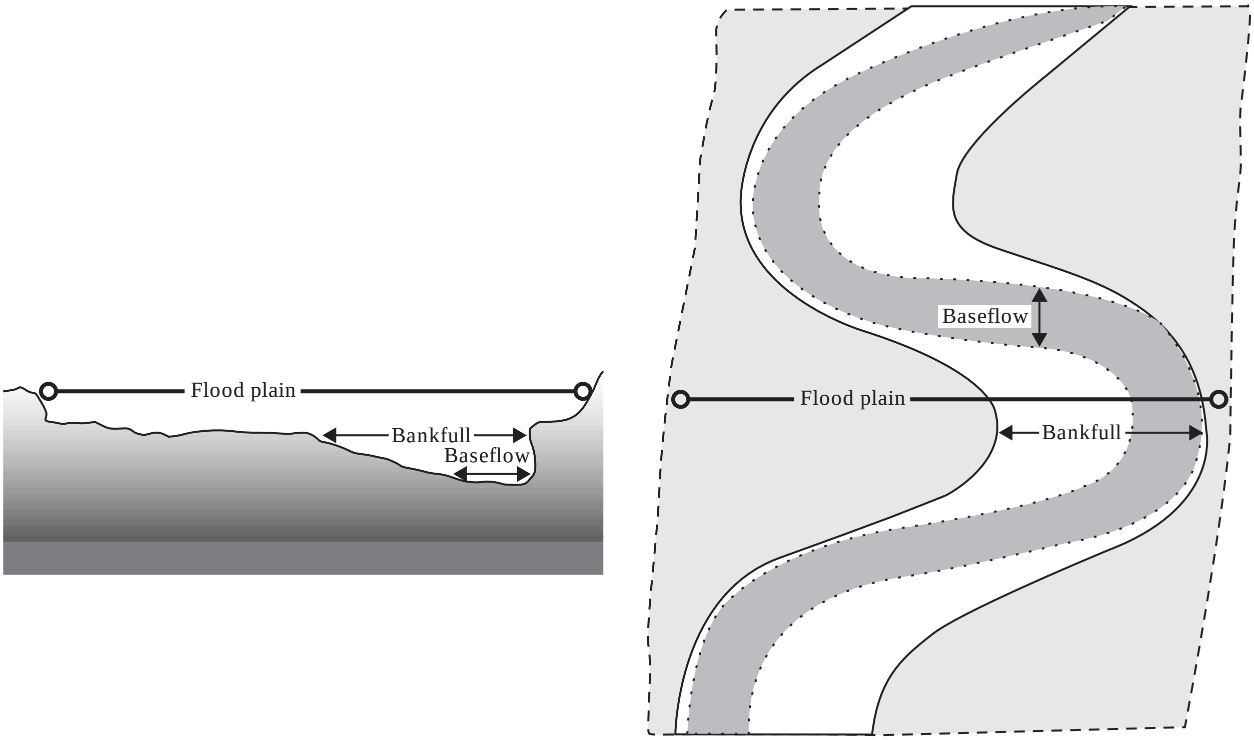
Reach description

The first page of the assessment worksheet records the identity and location of the stream reach. Most entries are self-explanatory. Waterbody ID and ecoregion should be filled out only if these identification and classification aids are used in your state.

Active channel width can be difficult to determine. However, active channel width helps to characterize the stream. It is also an important aspect of more advanced assessment protocols; therefore, it is worth becoming familiar with the concept and field determination. For this protocol you do not need to measure active channel width accurately — a visual estimate of the average width is adequate.

Active channel width is the stream width at the bankfull discharge. Bankfull discharge is the flow rate that forms and controls the shape and size of the active channel. It is approximately the flow rate at which the stream begins to move onto its flood plain if the stream has an active flood plain. The bankfull discharge is expected to occur every 1.5 years on average. Figure 3 illustrates the relationship between baseflow, bankfull flow, and the flood plain. Active channel width is best determined by locating the first flat depositional surface occurring above the bed of the stream (i.e., an active flood plain). The lowest elevation at which the bankfull surface could occur is at the top of the point bars or other sediment deposits in the channel bed. Other indicators of the bankfull surface include a break in slope on the bank, vegetation change, substrate, and debris. If you are not trained in locating the bankfull stage, ask the landowner how high the water gets every year and observe the location of permanent vegetation.

Figure 3 Baseflow, bankfull, and flood plain locations (Rosgen 1996)



Scoring descriptions

Each assessment element is rated with a value of 1 to 10. Rate only those elements appropriate to the stream. Using the Stream Visual Assessment Protocol worksheet, record the score that best fits the observations you make based on the narrative descriptions provided. Unless otherwise directed, assign the lowest score that applies. For example, if a reach has aspects of several narrative descriptions, assign a score based on the lowest scoring description that contains indicators present within the reach. You may record values intermediate to those listed. Some background information is provided for each assessment element, as well as a description of what to look for. The length of the assessment reach should be 12 times the active channel width.

Channel condition

Natural channel; no structures, dikes. No evidence of downcutting or excessive lateral cutting.	Evidence of past channel alteration, but with significant recovery of channel and banks. Any dikes or levies are set back to provide access to an adequate flood plain.	Altered channel; <50% of the reach with riprap and/or channelization. Excess aggradation; braided channel. Dikes or levees restrict flood plain width.	Channel is actively downcutting or widening. >50% of the reach with riprap or channelization. Dikes or levees prevent access to the flood plain.
10	7	3	1

Stream meandering generally increases as the gradient of the surrounding valley decreases. Often, development in the area results in changes to this meandering pattern and the flow of a stream. These changes in turn may affect the way a stream naturally does its work, such as the transport of sediment and the development and maintenance of habitat for fish, aquatic insects, and aquatic plants. Some modifications to stream channels have more impact on stream health than others. For example, channelization and dams affect a stream more than the presence of pilings or other supports for road crossings.

Active downcutting and excessive lateral cutting are serious impairments to stream function. Both conditions are indicative of an unstable stream channel. Usually, this instability must be addressed before committing time and money toward improving other stream problems. For example, restoring the woody vegetation within the riparian zone becomes increasingly difficult when a channel is downcutting because banks continue to be undermined and the water table drops below the root zone of the plants during their growing season. In this situation or when a channel is fairly stable, but already incised from previous downcutting or mechanical dredging, it is usually necessary to plant upland species, rather than hydrophytic, or to apply irrigation for several growing seasons, or both. Extensive bank-armoring of channels to stop lateral cutting usually leads to more problems (especially downstream). Often stability can be obtained by using a series of structures (barbs, groins, jetties, deflectors, weirs, vortex weirs) that reduce water velocity, deflect currents, or act as gradient controls. These structures are used in conjunction with large woody debris and woody vegetation plantings. Hydrologic alterations are described next.

What to look for: Signs of channelization or straightening of the stream may include an unnaturally straight section of the stream, high banks, dikes or berms, lack of flow diversity (e.g., few point bars and deep pools), and uniform-sized bed materials (e.g., all cobbles where there should be mixes of gravel and cobble). In newly channelized reaches, vegetation may be missing or appear very different (different species, not as well developed) from the bank vegetation of areas that were not channelized. Older channelized reaches may also have little or no vegetation or have grasses instead of woody vegetation. Drop structures (such as check dams), irrigation diversions, culverts, bridge abutments, and riprap also indicate changes to the stream channel.

Indicators of downcutting in the stream channel include nickpoints associated with headcuts in the stream bottom and exposure of cultural features, such as pipelines that were initially buried under the stream. Exposed footings in bridges and culvert outlets that are higher than the water surface during low flows are other examples. A lack of sediment depositional features, such as regularly-spaced point bars, is normally an indicator of incision. A low vertical scarp at the toe of the streambank may indicate downcutting, especially if the scarp occurs on the inside of a meander. Another visual indicator of current or past downcutting is high streambanks with woody vegetation growing well below the top of the bank (as a channel incises the bankfull flow line moves downward within the former bankfull channel). Excessive bank erosion is indicated by raw banks in areas of the stream where they are not normally found, such as straight sections between meanders or on the inside of curves.

Hydrologic alteration

Flooding every 1.5 to 2 years. No dams, no water withdrawals, no dikes or other structures limiting the stream's access to the flood plain. Channel is not incised.	Flooding occurs only once every 3 to 5 years; limited channel incision. or Withdrawals, although present, do not affect available habitat for biota.	Flooding occurs only once every 6 to 10 years; channel deeply incised. or Withdrawals significantly affect available low flow habitat for biota.	No flooding; channel deeply incised or structures prevent access to flood plain or dam operations prevent flood flows. or Withdrawals have caused severe loss of low flow habitat. or Flooding occurs on a 1-year rain event or less.
10	7	3	1

Bankfull flows, as well as flooding, are important to maintaining channel shape and function (e.g., sediment transport) and maintaining the physical habitat for animals and plants. High flows scour fine sediment to keep gravel areas clean for fish and other aquatic organisms. These flows also redistribute larger sediment, such as gravel, cobbles, and boulders, as well as large woody debris, to form pool and riffle habitat important to stream biota. The river channel and flood plain exist in dynamic equilibrium, having evolved in the present climatic regime and geomorphic setting. The relationship of water and sediment is the basis for the dynamic equilibrium that maintains the form and function of the river channel. The energy of the river (water velocity and depth) should be in balance with the bedload (volume and particle size of the sediment). Any change in the flow regime alters this balance.

If a river is not incised and has access to its flood plain, decreases in the frequency of bankfull and out-of-bank flows decrease the river's ability to transport sediment. This can result in excess sediment deposition, channel widening and shallowing, and, ultimately, in *braiding* of the channel. Rosgen (1996) defines braiding as a stream with three or more smaller channels. These smaller channels are extremely unstable, rarely have woody vegetation along their banks, and provide poor habitat for stream biota. A *split channel*, however, has two or more smaller channels (called side channels) that are usually very stable, have woody vegetation along their banks, and provide excellent habitat.

Conversely, an increase in flood flows or the confinement of the river away from its flood plain (from either incision or levees) increases the energy available to transport sediment and can result in bank and channel erosion.

The low flow or baseflow during the dry periods of summer or fall usually comes from groundwater entering the stream through the stream banks and bottom. A decrease in the low-flow rate will result in a smaller portion of the channel suitable for aquatic organisms. The withdrawal of water from streams for irrigation or industry and the placement of dams often change the normal low-flow pattern. Baseflow can also be affected by management and land use within the watershed — less infiltration of precipitation reduces baseflow and increases the frequency and severity of high flow events. For example, urbanization increases runoff and can increase the frequency of flooding to every year or more often and also reduce low flows. Overgrazing and clearcutting can have similar, although typically less severe, effects. The last description in the last box refers to the increased flood frequency that occurs with the above watershed changes.

What to look for: Ask the landowner about the frequency of flooding and about summer low-flow conditions. A flood plain should be inundated during flows that equal or exceed the 1.5- to 2.0-year flow event (2 out of 3 years or every other year). Be cautious because water in an adjacent field does not necessarily indicate natural flooding. The water may have flowed overland from a low spot in the bank outside the assessment reach.

Evidence of flooding includes high water marks (such as water lines), sediment deposits, or stream debris. Look for these on the banks, on the bankside trees or rocks, or on other structures (such as road pilings or culverts).

Excess sediment deposits and wide, shallow channels could indicate a loss of sediment transport capacity. The loss of transport capacity can result in a stream with three or more channels (braiding).

Riparian zone

Natural vegetation extends at least two active channel widths on each side.	Natural vegetation extends one active channel width on each side. or If less than one width, covers entire flood plain.	Natural vegetation extends half of the active channel width on each side.	Natural vegetation extends a third of the active channel width on each side. or Filtering function moderately compromised.	Natural vegetation less than a third of the active channel width on each side. or Lack of regeneration. or Filtering function severely compromised.
10	8	5	3	1

This element is the width of the natural vegetation zone from the edge of the active channel out onto the flood plain. For this element, the word *natural* means plant communities with (1) all appropriate structural components and (2) species native to the site or introduced species that function similar to native species at reference sites.

A healthy riparian vegetation zone is one of the most important elements for a healthy stream ecosystem. The quality of the riparian zone increases with the width and the complexity of the woody vegetation within it. This zone:

- Reduces the amount of pollutants that reach the stream in surface runoff.
- Helps control erosion.
- Provides a microclimate that is cooler during the summer providing cooler water for aquatic organisms.
- Provides large woody debris from fallen trees and limbs that form instream cover, create pools, stabilize the streambed, and provide habitat for stream biota.
- Provides fish habitat in the form of undercut banks with the "ceiling" held together by roots of woody vegetation.
- Provides organic material for stream biota that, among other functions, is the base of the food chain in lower order streams.
- Provides habitat for terrestrial insects that drop in the stream and become food for fish, and habitat and travel corridors for terrestrial animals.
- Dissipates energy during flood events.
- Often provides the only refuge areas for fish during out-of-bank flows (behind trees, stumps, and logs).

The type, timing, intensity, and extent of activity in riparian zones are critical in determining the impact on these areas. Narrow riparian zones and/or riparian zones that have roads, agricultural activities, residential or commercial structures, or significant areas of bare soils have reduced functional value for the stream. The filtering function of riparian zones can be compromised by concentrated flows. No evidence of concentrated flows through the zone should occur or, if concentrated flows are evident, they should be from land areas appropriately buffered with vegetated strips.

What to look for: Compare the width of the riparian zone to the active channel width. In steep, V-shaped valleys there may not be enough room for a flood plain riparian zone to extend as far as one or two active channel widths. In this case, observe how much of the flood plain is covered by riparian zone. The vegetation must be natural and consist of all of the structural components (aquatic plants, sedges or rushes, grasses, forbs, shrubs, understory trees, and overstory trees) appropriate for the area. A common problem is lack of shrubs and understory trees. Another common problem is lack of regeneration. The presence of only mature vegetation and few seedlings indicates lack of regeneration. Do not consider incomplete plant communities as natural. Healthy riparian zones on both sides of the stream are important for the health of the entire system. If one side is lacking the protective vegetative cover, the entire reach of the stream will be affected. In doing the assessment, examine both sides of the stream and note on the diagram which side of the stream has problems. There should be no evidence of concentrated flows through the riparian zone that are not adequately buffered before entering the riparian zone.

Bank stability

Banks are stable; banks are low (at elevation of active flood plain); 33% or more of eroding surface area of banks in outside bends is protected by roots that extend to the base-flow elevation.	Moderately stable; banks are low (at elevation of active flood plain); less than 33% of eroding surface area of banks in outside bends is protected by roots that extend to the baseflow elevation.	Moderately unstable; banks may be low, but typically are high (flooding occurs 1 year out of 5 or less frequently); outside bends are actively eroding (overhanging vegetation at top of bank, some mature trees falling into steam annually, some slope failures apparent).	Unstable; banks may be low, but typically are high; some straight reaches and inside edges of bends are actively eroding as well as outside bends (overhanging vegetation at top of bare bank, numerous mature trees falling into stream annually, numerous slope failures apparent).
10	7	3	1

This element is the existence of or the potential for detachment of soil from the upper and lower stream banks and its movement into the stream. Some bank erosion is normal in a healthy stream. Excessive bank erosion occurs where riparian zones are degraded or where the stream is unstable because of changes in hydrology, sediment load, or isolation from the flood plain. High and steep banks are more susceptible to erosion or collapse. All outside bends of streams erode, so even a stable stream may have 50 percent of its banks bare and eroding. A healthy riparian corridor with a vegetated flood plain contributes to bank stability. The roots of perennial grasses or woody vegetation typically extend to the baseflow elevation of water in streams that have bank heights of 6 feet or less. The root masses help hold the bank soils together and physically protect the bank from scour during bankfull and flooding events. Vegetation seldom becomes established below the elevation of the bankfull surface because of the frequency of inundation and the unstable bottom conditions as the stream moves its bedload.

The type of vegetation is important. For example, trees, shrubs, sedges, and rushes have the type of root masses capable of withstanding high streamflow events, while Kentucky bluegrass does not. Soil type at the surface and below the surface also influences bank stability. For example, banks with a thin soil cover over gravel or sand are more prone to collapse than are banks with a deep soil layer.

What to look for: Signs of erosion include unvegetated stretches, exposed tree roots, or scalloped edges. Evidence of construction, vehicular, or animal paths near banks or grazing areas leading directly to the water's edge suggest conditions that may lead to the collapse of banks. Estimate the size or area of the bank affected relative to the total bank area. This element may be difficult to score during high water.

Water appearance

Very clear, or clear but tea-colored; objects visible at depth 3 to 6 ft (less if slightly colored); no oil sheen on surface; no noticeable film on submerged objects or rocks.	Occasionally cloudy, especially after storm event, but clears rapidly; objects visible at depth 1.5 to 3 ft; may have slightly green color; no oil sheen on water surface.	Considerable cloudiness most of the time; objects visible to depth 0.5 to 1.5 ft; slow sections may appear pea-green; bottom rocks or submerged objects covered with heavy green or olive-green film. or Moderate odor of ammonia or rotten eggs.	Very turbid or muddy appearance most of the time; objects visible to depth < 0.5 ft; slow moving water may be bright-green; other obvious water pollutants; floating algal mats, surface scum, sheen or heavy coat of foam on surface. or Strong odor of chemicals, oil, sewage, other pollutants.
10	7	3	1

This element compares turbidity, color, and other visual characteristics with a healthy or reference stream. The depth to which an object can be clearly seen is a measure of turbidity. Turbidity is caused mostly by particles of soil and organic matter suspended in the water column. Water often shows some turbidity after a storm event because of soil and organic particles carried by runoff into the stream or suspended by turbulence. The water in some streams may be naturally tea-colored. This is particularly true in watersheds with extensive bog and wetland areas. Water that has slight nutrient enrichment may support communities of algae, which provide a greenish color to the water. Streams with heavy loads of nutrients have thick coatings of algae attached to the rocks and other submerged objects. In degraded streams, floating algal mats, surface scum, or pollutants, such as dyes and oil, may be visible.

What to look for: Clarity of the water is an obvious and easy feature to assess. The deeper an object in the water can be seen, the lower the amount of turbidity. Use the depth that objects are visible only if the stream is deep enough to evaluate turbidity using this approach. For example, if the water is clear, but only 1 foot deep, do not rate it as if an object became obscured at a depth of 1 foot. This measure should be taken after a stream has had the opportunity to "settle" following a storm event. A pea-green color indicates nutrient enrichment beyond what the stream can naturally absorb.

Nutrient enrichment

Clear water along entire reach; diverse aquatic plant community includes low quantities of many species of macrophytes; little algal growth present.	Fairly clear or slightly greenish water along entire reach; moderate algal growth on stream substrates.	Greenish water along entire reach; overabundance of lush green macrophytes; abundant algal growth, especially during warmer months.	Pea green, gray, or brown water along entire reach; dense stands of macrophytes clog stream; severe algal blooms create thick algal mats in stream.
10	7	3	1

Nutrient enrichment is often reflected by the types and amounts of aquatic vegetation in the water. High levels of nutrients (especially phosphorus and nitrogen) promote an overabundance of algae and floating and rooted macrophytes. The presence of some aquatic vegetation is normal in streams. Algae and macrophytes provide habitat and food for all stream animals. However, an excessive amount of aquatic vegetation is not beneficial to most stream life. Plant respiration and decomposition of dead vegetation consume dissolved oxygen in the water. Lack of dissolved oxygen creates stress for all aquatic organisms and can cause fish kills. A landowner may have seen fish gulping for air at the water surface during warm weather, indicating a lack of dissolved oxygen.

What to look for: Some aquatic vegetation (rooted macrophytes, floating plants, and algae attached to substrates) is normal and indicates a healthy stream. Excess nutrients cause excess growth of algae and macrophytes, which can create greenish color to the water. As nutrient loads increase the green becomes more intense and macrophytes become more lush and deep green. Intense algal blooms, thick mats of algae, or dense stands of macrophytes degrade water quality and habitat. Clear water and a diverse aquatic plant community without dense plant populations are optimal for this characteristic.

Barriers to fish movement

No barriers	Seasonal water withdrawals inhibit movement within the reach	Drop structures, culverts, dams, or diversions (< 1 foot drop) within the reach	Drop structures, culverts, dams, or diversions (> 1 foot drop) within 3 miles of the reach	Drop structures, culverts, dams, or diversions (> 1 foot drop) within the reach
10	8	5	3	1

Barriers that block the movement of fish or other aquatic organisms, such as fresh water mussels, must be considered as part of the overall stream assessment. If sufficiently high, these barriers may prevent the movement or migration of fish, deny access to important breeding and foraging habitats, and isolate populations of fish and other aquatic animals.

What to look for: Some barriers are natural, such as waterfalls and boulder dams, and some are developed by humans. Note the presence of such barriers along the reach of the stream you are assessing, their size, and whether provisions have been made for the passage of fish. Ask the landowner about any dams or other barriers that may be present 3 to 5 miles upstream or downstream. Larger dams are often noted on maps, so you may find some information even before going out into the field. Beaver dams generally do not prevent fish migration. Look for structures that may not involve a drop, but still present a hydraulic barrier. Single, large culverts with no slope and sufficient water depth usually do not constitute a barrier. Small culverts or culverts with slopes may cause high water velocities that prevent passage.

Instream fish cover

>7 cover types available	6 to 7 cover types available	4 to 5 cover types available	2 to 3 cover types available	None to 1 cover type available
10	8	5	3	1

Cover types: Logs/large woody debris, deep pools, overhanging vegetation, boulders/cobble, riffles, undercut banks, thick root mats, dense macrophyte beds, isolated/backwater pools, other: ________________________________.

This assessment element measures availability of physical habitat for fish. The potential for the maintenance of a healthy fish community and its ability to recover from disturbance is dependent on the variety and abundance of suitable habitat and cover available.

What to look for: Observe the number of different habitat and cover types *within a representative subsection of the assessment* reach that is equivalent in length to *five times* the active channel width. Each cover type must be present in appreciable amounts to score. Cover types are described below.

Logs/large woody debris—Fallen trees or parts of trees that provide structure and attachment for aquatic macroinvertebrates and hiding places for fish.

Deep pools—Areas characterized by a smooth undisturbed surface, generally slow current, and deep enough to provide protective cover for fish (75 to 100% deeper than the prevailing stream depth).

Overhanging vegetation—Trees, shrubs, vines, or perennial herbaceous vegetation that hangs immediately over the stream surface, providing shade and cover.

Boulders/cobble—Boulders are rounded stones more than 10 inches in diameter or large slabs more than 10 inches in length; cobbles are stones between 2.5 and 10 inches in diameter.

Undercut banks—Eroded areas extending horizontally beneath the surface of the bank forming underwater pockets used by fish for hiding and protection.

Thick root mats—Dense mats of roots and rootlets (generally from trees) at or beneath the water surface forming structure for invertebrate attachment and fish cover.

Dense macrophyte beds—Beds of emergent (e.g., water willow), floating leaf (e.g., water lily), or submerged (e.g., riverweed) aquatic vegetation thick enough to provide invertebrate attachment and fish cover.

Riffles—Area characterized by broken water surface, rocky or firm substrate, moderate or swift current, and relatively shallow depth (usually less than 18 inches).

Isolated/backwater pools—Areas disconnected from the main channel or connected as a "blind" side channel, characterized by a lack of flow except in periods of high water.

Pools

Deep and shallow pools abundant; greater than 30% of the pool bottom is obscure due to depth, or the pools are at least 5 feet deep.	Pools present, but not abundant; from 10 to 30% of the pool bottom is obscure due to depth, or the pools are at least 3 feet deep.	Pools present, but shallow; from 5 to 10% of the pool bottom is obscure due to depth, or the pools are less than 3 feet deep.	Pools absent, or the entire bottom is discernible.
10	7	3	1

Pools are important resting and feeding sites for fish. A healthy stream has a mix of shallow and deep pools. A *deep* pool is 1.6 to 2 times deeper than the prevailing depth, while a *shallow* pool is less than 1.5 times deeper than the prevailing depth. Pools are abundant if a deep pool is in each of the meander bends in the reach being assessed. To determine if pools are abundant, look at a longer sample length than one that is 12 active channel widths in length. Generally, only 1 or 2 pools would typically form within a reach as long as 12 active channel widths. In low order, high gradient streams, pools are abundant if there is more than one pool every 4 channel widths.

What to look for: Pool diversity and abundance are estimated based on walking the stream or probing from the streambank with a stick or length of rebar. You should find deep pools on the outside of meander bends. In shallow, clear streams a visual inspection may provide an accurate estimate. In deep streams or streams with low visibility, this assessment characteristic may be difficult to determine and should not be scored.

Insect/invertebrate habitat

At least 5 types of habitat available. Habitat is at a stage to allow full insect colonization (woody debris and logs not freshly fallen).	3 to 4 types of habitat. Some potential habitat exists, such as overhanging trees, which will provide habitat, but have not yet entered the stream.	1 to 2 types of habitat. The substrate is often disturbed, covered, or removed by high stream velocities and scour or by sediment deposition.	None to 1 type of habitat.
10	7	3	1

Cover types: Fine woody debris, submerged logs, leaf packs, undercut banks, cobble, boulders, coarse gravel, other: ____.

Stable substrate is important for insect/invertebrate colonization. *Substrate* refers to the stream bottom, woody debris, or other surfaces on which invertebrates can live. Optimal conditions include a variety of substrate types within a relatively small area of the stream (5 times the active channel width). Stream and substrate stability are also important. High stream velocities, high sediment loads, and frequent flooding may cause substrate instability even if substrate is present.

What to look for: Observe the number of different types of habitat and cover within a representative subsection of the assessment reach that is equivalent in length to five times the active channel width. Each cover type must be present in appreciable amounts to score.

Score the following assessment elements
only if applicable

Canopy cover (if applicable)

Coldwater fishery

> 75% of water surface shaded and upstream 2 to 3 miles generally well shaded.	>50% shaded in reach. or >75% in reach, but upstream 2 to 3 miles poorly shaded.	20 to 50% shaded.	< 20% of water surface in reach shaded.
10	7	3	1

Warmwater fishery

25 to 90% of water surface shaded; mixture of conditions.	> 90% shaded; full canopy; same shading condition throughout the reach.	(intentionally blank)	< 25% water surface shaded in reach.
10	7		1

Do not assess this element if active channel width is greater than 50 feet. Do not assess this element if woody vegetation is naturally absent (e.g., wet meadows).

Shading of the stream is important because it keeps water cool and limits algal growth. Cool water has a greater oxygen holding capacity than does warm water. When streamside trees are removed, the stream is exposed to the warming effects of the sun causing the water temperature to increase for longer periods during the daylight hours and for more days during the year. This shift in light intensity and temperature causes a decline in the numbers of certain species of fish, insects, and other invertebrates and some aquatic plants. They may be replaced altogether by other species that are more tolerant of increased light intensity, low dissolved oxygen, and warmer water temperature. For example, trout and salmon require cool, oxygen-rich water. Loss of streamside vegetation (and also channel widening) that cause increased water temperature and decreased oxygen levels are major contributing factors to the decrease in abundance of trout and salmon from many streams that historically supported these species. Increased light and the warmer water also promote excessive growth of submerged macrophytes and algae that compromises the biotic community of the stream. The temperature at the reach you are assessing will be affected by the amount of shading 2 to 3 miles upstream.

What to look for: Try to estimate the portion of the water surface area for the whole reach that is shaded by estimating areas with no shade, poor shade, and shade. Time of the year, time of the day, and weather can affect your observation of shading. Therefore, the relative amount of shade is estimated by assuming that the sun is directly overhead and the vegetation is in full leaf-out. First evaluate the shading conditions for the reach; then determine (by talking with the landowner) shading conditions 2 to 3 miles upstream. Alternatively, use aerial photographs taken during full leaf out. The following rough guidelines for percent shade may be used:

stream surface not visible	>90
surface slightly visible or visible only in patches	70 – 90
surface visible, but banks not visible	40 – 70
surface visible and banks visible at times	20 – 40
surface and banks visible	<20

Manure presence (if applicable)

(Intentionally blank)	Evidence of livestock access to riparian zone.	Occasional manure in stream or waste storage structure located on the flood plain.	Extensive amount of manure on banks or in stream. or Untreated human waste discharge pipes present.
	5	3	1

Do not score this element unless livestock operations or human waste discharges are present.

Manure from livestock may enter the water if livestock have access to the stream or from runoff of grazing land adjacent to the stream. In some communities untreated human waste may also empty directly into streams. Manure and human waste increase biochemical oxygen demand, increase the loading of nutrients, and alter the trophic state of the aquatic biological community. Untreated human waste is a health risk.

What to look for: Do not score this element unless livestock operations or human waste discharges are present. Look for evidence of animal droppings in or around streams, on the streambank, or in the adjacent riparian zone. Well-worn livestock paths leading to or near streams also suggest the probability of manure in the stream. Areas with stagnant or slow-moving water may have moderate to dense amounts of vegetation or algal blooms, indicating localized enrichment from manure.

Salinity (if applicable)

(Intentionally blank)	Minimal wilting, bleaching, leaf burn, or stunting of aquatic vegetation; some salt-tolerant streamside vegetation.	Aquatic vegetation may show significant wilting, bleaching, leaf burn, or stunting; dominance of salt-tolerant streamside vegetation.	Severe wilting, bleaching, leaf burn, or stunting; presence of only salt-tolerant aquatic vegetation; most streamside vegetation salt tolerant.
	5	3	1

Do not assess this element unless elevated salinity from anthropogenic sources is known to occur in the stream.

High salinity levels most often occur in arid areas and in areas that have high irrigation requirements. High salinity can also result from oil and gas well operations. Salt accumulation in soil causes a breakdown of soil structure, decreased infiltration of water, and potential toxicity. High salinity in streams affects aquatic vegetation, macroinvertebrates, and fish. Salts are a product of natural weathering processes of soil and geologic material.

What to look for: High salinity levels cause a "burning" or "bleaching" of aquatic vegetation. Wilting, loss of plant color, decreased productivity, and stunted growth are readily visible signs. Other indicators include whitish salt encrustments on the streambanks and the displacement of native vegetation by salt-tolerant aquatic plants and riparian vegetation (such as tamarix or salt cedar).

Riffle embeddedness (if applicable)

Gravel or cobble particles are < 20% embedded.	Gravel or cobble particles are 20 to 30% embedded.	Gravel or cobble particles are 30 to 40% embedded.	Gravel or cobble particles are >40% embedded.	Riffle is completely embedded.
10	8	5	3	1

Do not assess this element unless riffles are present or they are a natural feature that should be present.

Riffles are areas, often downstream of a pool, where the water is breaking over rocks or other debris causing surface agitation. In coastal areas riffles can be created by shoals and submerged objects. (This element is sensitive to regional differences and should be related to reference conditions.) Riffles are critical for maintaining high species diversity and abundance of insects for most streams and for serving as spawning and feeding grounds for some fish species. Embeddedness measures the degree to which gravel and cobble substrate are surrounded by fine sediment. It relates directly to the suitability of the stream substrate as habitat for macroinvertebrates, fish spawning, and egg incubation.

What to look for: This assessment characteristic should be used only in riffle areas and in streams where this is a natural feature. The measure is the depth to which objects are buried by sediment. This assessment is made by picking up particles of gravel or cobble with your fingertips at the fine sediment layer. Pull the particle out of the bed and estimate what percent of the particle was buried. Some streams have been so smothered by fine sediment that the original stream bottom is not visible. Test for complete burial of a streambed by probing with a length of rebar.

Macroinvertebrates observed

Community dominated by Group I or intolerant species with good species diversity. Examples include caddisflies, mayflies, stoneflies, hellgrammites.	Community dominated by Group II or facultative species, such as damselflies, dragonflies, aquatic sowbugs, blackflies, crayfish.	Community dominated by Group III or tolerant species, such as midges, craneflies, horseflies, leeches, aquatic earthworms, tubificid worms.	Very reduced number of species or near absence of all macroinvertebrates.
15	6	2	– 3

This important characteristic reflects the ability of the stream to support aquatic invertebrate animals. However, successful assessment requires knowledge of the life cycles of some aquatic insects and other macroinvertebrates and the ability to identify them. For this reason, this is an optional element. The presence of intolerant insect species (cannot survive in polluted water) indicates healthy stream conditions. Some kinds of macroinvertebrates, such as stoneflies, mayflies, and caddisflies, are sensitive to pollution and do not live in polluted water; they are considered Group I. Another group of macroinvertebrates, known as Group II or facultative macroinvertebrates, can tolerate limited pollution. This group includes damselflies, aquatic sowbugs, and crayfish. The presence of Group III macroinvertebrates, including midges, craneflies and leeches, suggests the water is significantly polluted. The presence of a single Group I species in a community does not constitute good diversity and should generally not be given a score of 15.

What to look for: You can collect macroinvertebrates by picking up cobbles and other submerged objects in the water. Look carefully for the insects; they are often well camouflaged and may appear as part of the stone or object. Note the kinds of insects, number of species, and relative abundance of each group of insects/macroinvertebrates. Each of the three classes of macroinvertebrates are illustrated on pages 19 and 20. ***Note that the scoring values for this element range from – 3 to 15.***

Stream Invertebrates

Group One Taxa

Pollution sensitive organisms found in good quality water.

1 **Stonefly Order Plecoptera.** 1/2" to 1 1/2", 6 legs with hooked tips, antennae, 2 hair-line tails. Smooth (no gills) on lower half of body (see arrow).

2 **Caddisfly: Order Trichoptera.** Up to 1", 6 hooked legs on upper third of body, 2 hooks at back end. May be in a stick, rock, or leaf case with its head sticking out. May have fluffy gill tufts on underside.

3 **Water Penny: Order Coleoptera.** 1/4", flat saucer-shaped body with a raised bump on one side and 6 tiny legs and fluffy gills on the other side. Immature beetle.

4 **Riffle Beetle: Order Coleoptera.** 1/4", oval body covered with tiny hairs, 6 legs, antennae. Walks slowly underwater. Does not swim on surface.

5 **Mayfly: Order Ephemeroptera.** 1/4" to 1", brown, moving, plate-like or feathery gills on the sides of lower body (see arrow), 6 large hooked legs, antennae, 2 or 3 long hair-like tails. Tails may be webbed together.

6 **Gilled Snail: Class Gastropoda.** Shell opening covered by thin plate called operculum. When opening is facing you, shell usually opens on right.

7 **Dobsonfly (Hellgrammite): Family Corydalidae.** 3/4" to 4", dark-colored, 6 legs, large pinching jaws, eight pairs feelers on lower half of body with paired cotton-like gill tufts along underside, short antennae, 2 tails, and 2 pairs of hooks at back end.

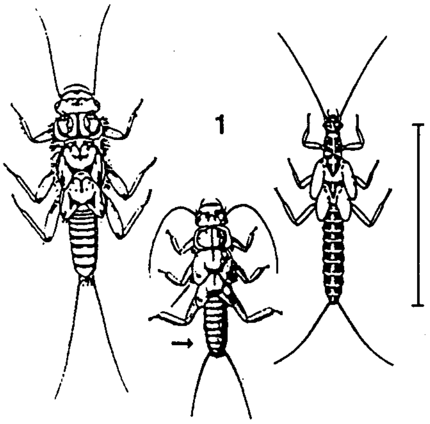
Group Two Taxa

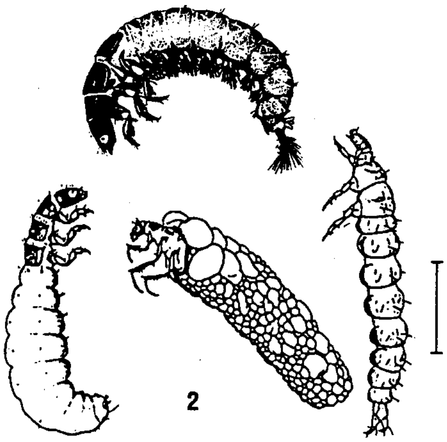
Somewhat pollution tolerant organisms can be in good or fair quality water.

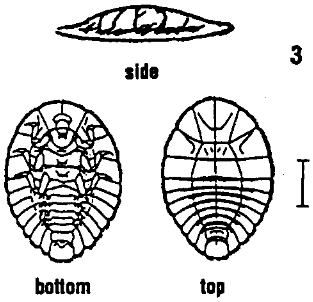
8 **Crayfish: Order Decapoda.** Up to 6", 2 large claws, 8 legs, resembles small lobster.

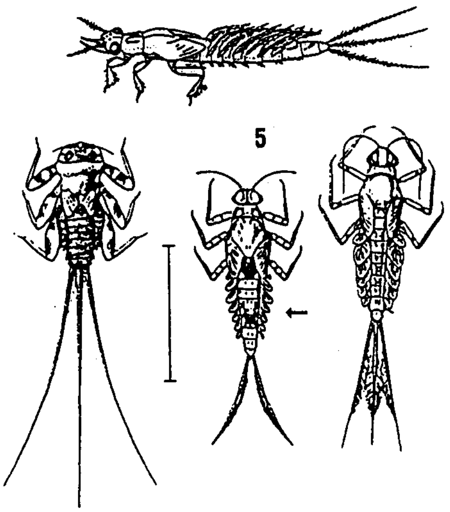
9 **Sowbug: Order Isopoda.** 1/4" to 3/4", gray oblong body wider than it is high, more than 6 legs, long antennae.

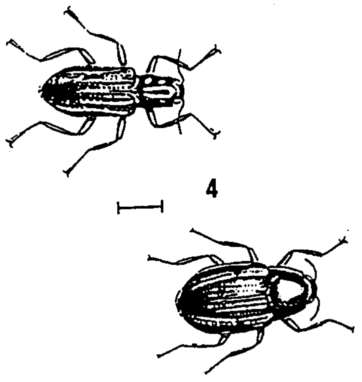
Source: Izaak Walton League of America, 707 Conservation Lane, Gaithersburg, MD 20878-2983. (800) BUG-IWLA

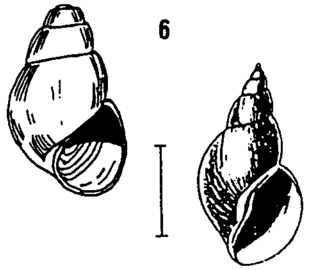


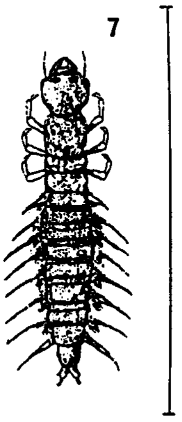


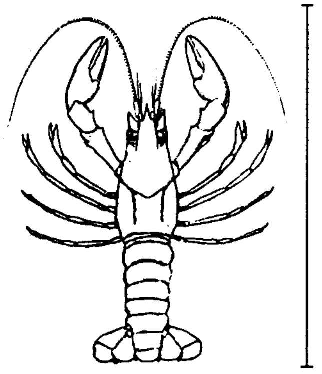


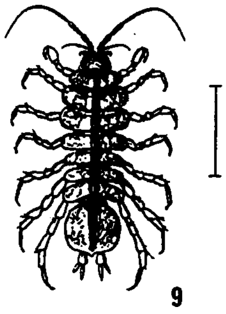












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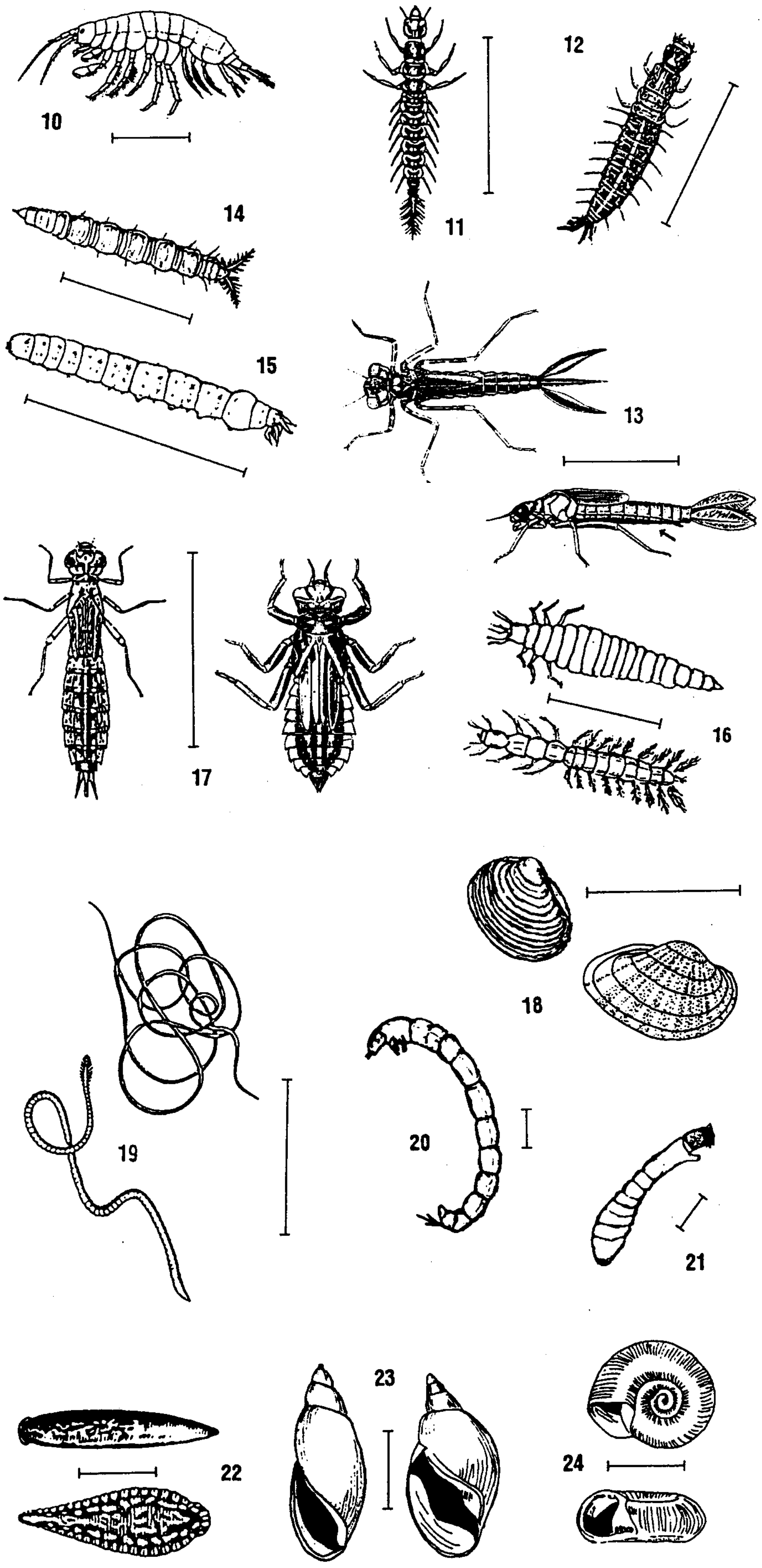


Bar line indicate relative size

Group Two Taxa

Somewhat pollution tolerant organisms can be in good or fair quality water.

10 **Scud: Order Amphipoda.** 1/4", white to gray, body higher than it is wide, swims sideways, more than 6 legs, resembles small shrimp.

11 **Alderfly Larva: Family Sialedae.** 1" long. Looks like small Hellgramite but has long, thin, branched tail at back end (no hooks). No gill tufts underneath.

12 **Fishfly Larva: Family Cordalidae.** Up to 1 1/2" long. Looks like small hellgramite but often a lighter reddish-tan color, or with yellowish streaks. No gill tufts underneath.

13 **Damselfly: Suborder Zygoptera.** 1/2" to 1", large eyes, 6 thin hooked legs, 3 broad oar-shaped tails, positioned like a tripod. Smooth (no gills) on sides of lower half of body. (See arrow.)

14 **Watersnipe Fly Larva: Family Athericidae (Atherix).** 1/4" to 1", pale to green, tapered body, many caterpillar-like legs, conical head, feathery "horns" at back end.

15 **Crane Fly: Suborder Nematocera.** 1/3" to 2", milky, green, or light brown, plump caterpillar-like segmented body, 4 finger-like lobes at back end.

16 **Beetle Larva: Order Coleoptera.** 1/4" to 1", light-colored, 6 legs on upper half of body, feelers, antennae.

17 **Dragon Fly: Suborder Anisoptera.** 1/2" to 2", large eyes, 6 hooked legs. Wide oval to round abdomen.

18 **Clam: Class Bivalvia.**

Group Three Taxa

Pollution tolerant organisms can be in any quality of water.

19 **Aquatic Worm: Class Oligochaeta.** 1/4" to 2", can be very tiny, thin worm-like body.

20 **Midge Fly Larva: Suborder Nematocera.** Up to 1/4", dark head, worm-like segmented body, 2 tiny legs on each side.

21 **Blackfly Larva: Family Simulidae.** Up to 1/4", one end of body wider. Black head, suction pad on other end.

22 **Leech: Order Hirudinea.** 1/4" to 2", brown, slimy body, ends with suction pads.

23 **Pouch Snail and Pond Snails: Class Gastropoda.** No operculum. Breath air. When opening is facing you, shell usually open to left.

24 **Other Snails: Class Gastropoda.** No operculum.Breath air. Snail shell coils in one plane.

Technical information to support implementation

Introduction

This section provides a guide for implementation of the Stream Visual Assessment Protocol (SVAP). The topics covered in this section include the origin of the protocol, development history, context for use in relation to other methods of stream assessment, instructions for modifying the protocol, and references.

Origin of the protocol

In 1996 the NRCS National Water and Climate Center surveyed the NRCS state biologists to determine the extent of activity in stream ecological assessment and the need for technical support. The survey indicated that less than a third of the NRCS states were active in supporting stream assessment within their state. Most respondents said they believed they should be more active and requested additional support from the National Centers and Institutes. In response to these findings, the NRCS Aquatic Assessment Workgroup was formed. In their first meeting the workgroup determined that a simple assessment protocol was needed. The Water Quality Indicators Guide (WQIG) had been available for 8 years, but was not being used extensively. The workgroup felt a simpler and more streamlined method was needed as an initial protocol for field office use.

The workgroup developed a plan for a tiered progression of methods that could be used in the field as conservationists became more skilled in stream assessment. These methods would also serve different assessment objectives. The first tier is a simple 2-page assessment — the Stream Visual Assessment Protocol (SVAP). The second tier is the existing WQIG. The third tier is a series of simple assessment methods that could be conducted by conservationists in the field. An example of a third tier method would be macroinvertibrate sampling and identification to the taxonomic level of Order. The fourth tier is fairly sophisticated methods used in special projects. Examples of fourth tier methods would be fish community sampling and quantitative sampling of macroinvertebrates with shipment of samples to a lab for identification.

The workgroup also found that introductory training and a field handbook that would serve as a comprehensive reference and guidance manual are needed. These projects are under development as of this writing.

Context for use

The Stream Visual Assessment Protocol is intended to be a simple, comprehensive assessment of stream condition that maximizes ease of use. It is suitable as a basic first approximation of stream condition. It can also be used to identify the need for more accurate assessment methods that focus on a particular aspect of the aquatic system.

The relationship of the SVAP to other assessment methods is shown in figure 4. In this figure a specific reference to a guidance document is provided for some methods. The horizontal bars indicate which aspects of stream condition (chemical, physical, or biological) are addressed by the method. The SVAP is the simplest method and covers all three aspects of stream condition. As you move upwards in figure 4 the methods provide more accuracy, but also become more focused on one or two aspects of stream condition and require more expertise or resources to conduct.

The SVAP is intended to be applicable nationwide. It has been designed to utilize factors that are least sensitive to regional differences. However, regional differences are a significant aspect of stream assessment, and the protocol can be enhanced by tailoring the assessment elements to regional conditions. The national SVAP can be viewed as a framework that can evolve over time to better reflect State or within-State regional differences. Instructions for modification are provided later in this document.

Development

The SVAP was developed by combining parts of several existing assessment procedures. Many of these sources are listed in the references section. Three drafts were developed and reviewed by the workgroup and others between the fall of 1996 and the spring of 1997. During the summer of 1997, the workgroup conducted a field trial evaluation of the third draft. Further field trials were conducted with the fourth draft in 1998. A report on the field trial results is appendix A of this document.

The field trials involved approximately 60 individuals and 182 assessment sites. The field trial consisted of a combination of replication studies (in which several individuals independently assessed the same sites) and accuracy studies (in which SVAP scores were compared to the results from other assessment methods). The average coefficient of variation in the replication studies was 10.5 percent. The accuracy results indicated that SVAP version 3 scores correlated well with other methods for moderately impacted and high quality sites, but that low quality sites were not scoring correspondingly low in the SVAP. Conservationists in the field who participated in the trial were surveyed on the usability and value of the protocol. The participants indicated that they found it easy to use and thought it would be valuable for their clients.

Revisions were made to the draft to address the deficiencies identified in the field trial, and some reassessments were made during the winter of 1998 to see how the revisions affected performance. Performance was improved. Additional revisions were made, and the fifth draft was sent to all NRCS state offices, selected Federal agencies, and other partners for review and comment during the spring of 1998.

Comments were received from eight NRCS state offices, the Bureau of Land Management, and several NRCS national specialists. Comments were uniformly supportive of the need for the guidance and for the document as drafted. Many commenters provided improved explanatory text for the supporting descriptions accompanying the assessment elements. Most of the suggested revisions were incorporated.

Implementation

The SVAP is issued as a national product. States are encouraged to incorporate it within the Field Office Technical Guide. The document may be modified by States. The electronic file for the document may be downloaded from the National Water and Climate Center web site at http://www.wcc.nrcs.usda.gov.

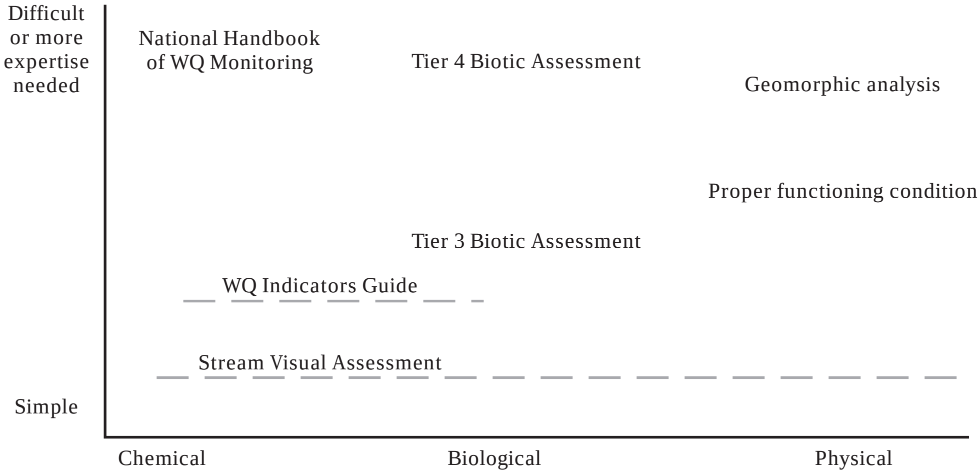
A training course for conservationists in the field suitable for use at the state or area level has been developed to facilitate implementation of the SVAP. It is designed as either a 1-day or 2-day session. The first day covers basic stream ecology and use of the SVAP. The second day includes an overview of several stream assessment methods, instruction on a macroinvertebrate survey method, and field exercises to apply the SVAP and macroinvertibrate protocols. The training materials consist of an instructor's guide, slides, video, a macroinvertebrate assessment training kit, and a student workbook. Training materials have been provided to each NRCS state office.

Instructions for modification

The national version of the Stream Visual Assessment Protocol may be used without modification. It has been designed to use assessment elements that are least sensitive to regional differences. Nonetheless, it can be modified to better reflect conditions within a geographic area. Modifying the protocol would have the following benefits:

- The protocol can be made easier to use with narrative descriptions that are closer to the conditions users will encounter.
- The protocol can be made more responsive to differences in stream condition.
- Precision can be improved by modifying elements that users have trouble evaluating.
- The rating scale can be calibrated to regionally-based criteria for excellent, good, fair, and poor condition.

Figure 4 Relationship of various stream condition assessment methods in terms of complexity or expertise required and the aspects of stream condition addressed



Two parts of the SVAP may be modified—the individual elements and their narrative descriptions, and the rating scale for assigning an overall condition rating of excellent, good, fair, or poor.

The simplest approach to modifying the SVAP is based on professional experience and judgment. Under this approach an interdisciplinary team should be assembled to develop proposed revisions. Revisions should then be evaluated by conducting comparison assessments at sites representing a range of conditions and evaluating accuracy (correlation between different assessment methods), precision (reproducibility among different users), and ease of use.

A second, more scientifically rigorous method for modifying the protocol is described below. This approach is based on a classification system for stream type and the use of reference sites.

Step 1 Decide on tentative number of versions.
Do you want to develop a revised version for your state, for each ecoregion within your state, or for several stream classes within each ecoregion?

Step 2 Develop tentative stream classification.
If you are developing protocols by stream class, you need to develop a tentative classification system. (If you are interested in a statewide or ecoregion protocol, go to step 3.) You might develop a classification system based on stream order, elevation, or landscape character. Do not create too many categories. The greater the number of categories, the more assessment work will be needed to modify the protocol and the more you will be accommodating degradation within the evaluation system. As an extreme example of the latter problem, you would not want to create a stream class consisting of those streams that have bank-to-bank cropping and at least one sewage outfall.

Step 3 Assess sites.
Assess a series of sites representing a range of conditions from highly impacted sites to least impacted sites. Try to have at least 10 sites in each of your tentative classes. Those sites should include several potential “least impacted reference sites.” Try to use sites that have been assessed by other assessment methods (such as sites assessed by state agencies or universities). As part of the assessments, be sure to record information on potential classification factors and if any particular elements are difficult to score. Take notes so that future revisions of the elements can be rescored without another site visit.

Step 4 Rank the sites.
Begin your data analysis by ranking all the sites from most impacted to least impacted. Rank sites according to the independent assessment results (preferred) or by the SVAP scores. Initially, rank all of the sites in the state data set. You will test classifications in subsequent iterations.

Step 5 Display scoring data.
Prepare a chart of the data from all sites in your state. The columns are the sites arranged by the ranking. The rows are the assessment elements, the overall numerical score, and the narrative rating. If you have independent assessment data, create a second chart by plotting the overall SVAP scores against the independent scores.

Step 6 Evaluate responsiveness.
Does the SVAP score change in response to the condition gradient represented by the different sites? Are the individual element scores responding to key resource problems? Were users comfortable with all elements? If the answers are yes, do not change the elements and proceed to step 7. If the answers are no, isolate which elements are not responsive. Revise the narrative descriptions for those elements to better respond to the observable conditions. Conduct a "desktop" reassessment of the sites with the new descriptions, and return to step 4.

Step 7 Evaluate the narrative rating breakpoints.
Do the breakpoints for the narrative rating correspond to other assessment results? The excellent range should encompass only reference sites. If not, you should reset the narrative rating breakpoints. Set the excellent breakpoint based on the least impacted reference sites. You must use judgment to set the other breakpoints.

Step 8 Evaluate tentative classification system.
Go back to step 4 and display your data this time by the tentative classes (ecoregions or stream classes). In other words, analyze sites from each ecoregion or each stream class separately. Repeat steps 5 through 7. If the responsiveness is significantly different from the responsiveness of the statewide data set or the breakpoints appear to be significantly different, adopt the classification system and revise the protocol for each ecoregion or stream class. If not, a single statewide protocol is adequate.

After the initial modification of the SVAP, the state may want to set up a process to consider future revisions. Field offices should be encouraged to locate and assess least impacted reference sites to build the data base for interpretation and future revisions. Ancillary data should be collected to help evaluate whether a potential reference site should be considered a reference site.

Caution should be exercised when considering future revisions. Revisions complicate comparing SVAP scores determined before and after the implementation of conservation practices if the protocol is substantially revised in the intervening period. Developing information to support refining the SVAP can be carried out by graduate students working cooperatively with NRCS. The Aquatic Assessment Workgroup has been conducting a pilot Graduate Student Fellowship program to evaluate whether students would be willing to work cooperatively for a small stipend. Early results indicate that students can provide valuable assistance. However, student response to advertisements has varied among states. If the pilot is successful, the program will be expanded.

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Glossary

Active channel width	The width of the stream at the bankfull discharge. Permanent vegetation generally does not become established in the active channel.
Aggradation	Geologic process by which a stream bottom or flood plain is raised in elevation by the deposition of material.
Bankfull discharge	The stream discharge (flow rate, such as cubic feet per second) that forms and controls the shape and size of the active channel and creates the flood plain. This discharge generally occurs once every 1.5 years on average.
Bankfull stage	The stage at which water starts to flow over the flood plain; the elevation of the water surface at bankfull discharge.
Baseflow	The portion of streamflow that is derived from natural storage; average stream discharge during low flow conditions.
Benthos	Bottom-dwelling or substrate-oriented organisms.
Boulders	Large rocks measuring more than 10 inches across.
Channel	A natural or artificial waterway of perceptible extent that periodically or continuously contains moving water. It has a definite bed and banks that serve to confine the water.
Channel roughness	Physical elements of a stream channel upon which flow energy is expended including coarseness and texture of bed material, the curvature of the channel, and variation in the longitudinal profile.
Channelization	Straightening of a stream channel to make water move faster.
Cobbles	Medium-sized rocks which measure 2.5 to 10 inches across.
Confined channel	A channel that does not have access to a flood plain.
Degradation	Geologic process by which a stream bottom is lowered in elevation due to the net loss of substrate material. Often called downcutting.
Downcutting	See Degradation.
Ecoregion	A geographic area defined by similarity of climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variables.
Embeddedness	The degree to which an object is buried in steam sediment.
Emergent plants	Aquatic plants that extend out of the water.
Flood plain	The flat area of land adjacent to a stream that is formed by current flood processes.
Forb	Any broad-leaved herbaceous plant other than those in the Gramineae (Poceae), Cyperacea, and Juncaceae families (Society for Range Management, 1989).

Gabions	A wire basket filled with rocks; used to stabilize streambanks and to control erosion.
Geomorphology	The study of the evolution and configuration of landforms.
Glide	A fast water habitat type that has low to moderate velocities, no surface agitation, no defined thalweg, and a U-shaped, smooth, wide bottom.
Gradient	Slope calculated as the amount of vertical rise over horizontal run expressed as ft/ft or as percent (ft/ft * 100).
Grass	An annual to perennial herb, generally with round erect stems and swollen nodes; leaves are alternate and two-ranked; flowers are in spikelets each subtended by two bracts.
Gravel	Small rocks measuring 0.25 to 2.5 inches across.
Habitat	The area or environment in which an organism lives.
Herbaceous	Plants with nonwoody stems.
Hydrology	The study of the properties, distribution, and effects of water on the Earth's surface, soil, and atmosphere.
Incised channel	A channel with a streambed lower in elevation than its historic elevation in relation to the flood plain.
Intermittent stream	A stream in contact with the ground water table that flows only certain times of the year, such as when the ground water table is high or when it receives water from surface sources.
Macrophyte bed	A section of stream covered by a dense mat of aquatic plants.
Meander	A winding section of stream with many bends that is at least 1.2 times longer, following the channel, than its straight-line distance. A single meander generally comprises two complete opposing bends, starting from the relatively straight section of the channel just before the first bend to the relatively straight section just after the second bend.
Macroinvertebrate	A spineless animal visible to the naked eye or larger than 0.5 millimeters.
Nickpoint	The point where a stream is actively eroding (downcutting) to a new base elevation. Nickpoints migrate upstream (through a process called headcutting).
Perennial stream	A steam that flows continuously throughout the year.
Point bar	A gravel or sand deposit on the inside of a meander; an actively mobile river feature.
Pool	Deeper area of a stream with slow-moving water.
Reach	A section of stream (defined in a variety of ways, such as the section between tributaries or a section with consistent characteristics).
Riffle	A shallow section in a stream where water is breaking over rocks, wood, or other partly submerged debris and producing surface agitation.

Riparian	The zone adjacent to a stream or any other waterbody (from the Latin word ripa, pertaining to the bank of a river, pond, or lake).
Riprap	Rock material of varying size used to stabilize streambanks and other slopes.
Run	A fast-moving section of a stream with a defined thalweg and little surface agitation.
Scouring	The erosive removal of material from the stream bottom and banks.
Sedge	A grasslike, fibrous-rooted herb with a triangular to round stem and leaves that are mostly three-ranked and with close sheaths; flowers are in spikes or spikelets, axillary to single bracts.
Substrate	The mineral or organic material that forms the bed of the stream; the surface on which aquatic organisms live.
Surface fines	That portion of streambed surface consisting of sand/silt (less than 6 mm).
Thalweg	The line followed by the majority of the streamflow. The line connecting the lowest or deepest points along the streambed.
Turbidity	Murkiness or cloudiness of water caused by particles, such as fine sediment (silts, clays) and algae.
Watershed	A ridge of high land dividing two areas that are drained by different river systems. The land area draining to a waterbody or point in a river system; catchment area, drainage basin, drainage area.

Appendix A—1997 and 1998 Field Trial Results

Purpose and methods

The purpose of the field trials was to evaluate the accuracy, precision, and usability of the draft Steam Visual Assessment Protocol. The draft protocols evaluated were the third draft dated May 1997 and the fourth draft dated October 1997. A field trial workplan was developed with study guidelines and a survey form to solicit feedback from users. Accuracy was evaluated by comparison to other stream assessment methods. Precision was evaluated by replicate assessments conduced by different individuals at the same sites. In all studies an attempt was made to utilize sites ranging from high quality to degraded. Results consisted of the scoring data and the user feedback form for each site.

Results

Overall, 182 sites were assessed, and approximately 60 individuals participated in the field trials. The individual studies are summarized in table A–1.

Precision could be evaluated using data from the Colorado, New Jersey, Oregon, Virginia, and Georgia studies. Results are summarized in table A–2. The New Jersey sites had coefficients of variation of 9.0 (n=8), 14.4 (n=5), and 5.7 (n=4) percent. The Oregon site with three replicates was part of a course and had a coefficient of variation of 11.1 percent. One Georgia site was assessed using the fourth draft during a pilot of the training course. There were 11 replicates, and the coefficient of variation was 8.8 percent. In May 1998 the workgroup conducted replicate assessments of two sites in Virginia using the fifth draft of the protocol. Coefficients of variation were 14.7 and 3.6 percent. The average coefficient of variation of all studies in table A–2 is 10.5 percent.

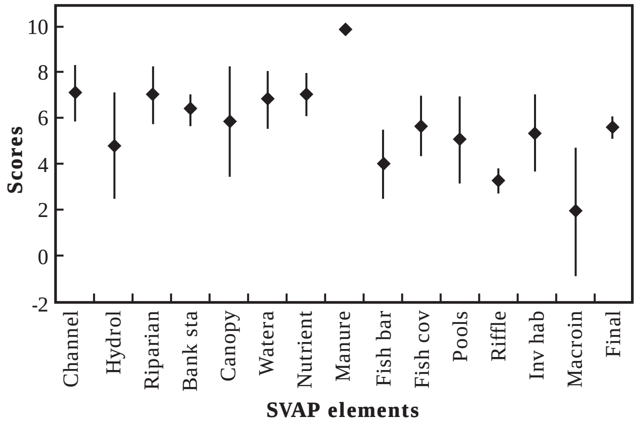
Variability within the individual elements of the SVAP was evaluated using the Georgia site with 11 replicates. The results of the individual element scores are presented in figure A–1. It should be noted that two individuals erroneously rated the "presence of manure" element.

Accuracy was evaluated by comparing the SVAP rating to other methods as noted in table A–1. Some of the comparisons involved professional judgment. In others the SVAP score could be compared with a quantitative evaluation. Figures A–2 through A–5 present data from the two studies that had larger numbers of sites. The Pearson's Correlation Coefficient is presented for these data. The results from other sites are presented in table A–3.

Table A–1 Summary of studies in the field trial

Location	Number of sites	Number of replicates	SVAP compared to	SVAP conducted by
VA	56	3, 5	IBI (fish) and Ohio QHEI	FO personnel
NC/SC	90	none	IBI, EPT	Soil scientists
MI	5	none	professional judgment	State biologist
NJ	3	4, 5, 8	NJDEP ratings	FO personnel
OR	3	none	IBI	NWCC scientist
CO	1	3	professional judgment	FO personnel
WA	3	none	professional judgment	State biologist
OR	2	3	no comparisons	FO personnel
GA	8	4-5	macroinvertebrates	FO personnel
GA	2	12, none	IBI, macroinvertebrate	FO personnel

Figure A–1 Means and standard deviations from the Parker's Mill Creek site in Americus, GA (n=11) (mean plus and minus one standard deviation is shown; SVAP version 4 used)



The SVAP version 3 scores correlated extremely well with the Ohio Qualitative Habitat Index and reasonably well with the fish community IBI in the Virginia study (fig. A–2 and A–3). However, the SVAP version 3 scores in the Carolinas study did not correlate well with either IBI or EPT Taxa (fig. A–4 and A–5). These results may reflect the fact that the SVAP primarily assesses physical habitat within the assessment reach whereas IBI and EPT Taxa are influenced by both physical habitat within the assessment reach and conditions within the watershed. Onsite physical habitat may have been a relatively more important factor at the Virginia sites than at the Carolina sites.

Overall, the field trial results for the third draft seemed to indicate that SVAP scores reflected conditions for sites in good to moderate condition. However, SVAP scores tended to be too high for poor quality sites.

Both the user questionnaires and verbal feedback indicated that users found the SVAP easy to use. Users reported that they thought it would be an effective tool to use with landowners. The majority indicated that they would recommend it to landowners.

Table A–2 Summary of replication results (version refers to the SVAP draft used; mean for overall score reported)

Site	SVAP version	No. replicates	Mean [1/]	Standard deviation	Coefficient of variation
Alloway Cr. NJ	3	5	3.6 F	0.52	14.4
Manasquan R. NJ	3	4	5.1 G	0.29	5.7
S. Br. Raritan R. NJ	3	8	5.9 G	0.53	9.0
Gales Cr. OR	3	3	5.5 G	0.61	11.1
Clear Cr. CO	3	3	5.4 G	0.74	13.7
Piscola Cr. GA #1	4	5	9.2 E	0.77	8.4
Piscola Cr. GA #2	4	5	9.0 E	0.85	9.4
Piscola Cr. GA #3	4	4	4.7 F	1.10	23.4
Piscola Cr. GA #4	4	4	7.4 G	0.96	13.0
Little R. GA # 1	4	4	8.3 E	0.73	8.8
Little R. GA # 2	4	4	7.4 E	0.83	11.2
Little R. GA # 3	4	4	8.1 E	0.41	5.1
Little R. GA # 4	4	4	7.3 G	0.60	8.2
Parker's Mill Cr. GA	4	11	5.7 F	0.50	8.8
Cedar Run (up), VA	5	5	7.7 G	1.1	14.7
Cedar R. (down), VA	5	5	6.6 F	.2	3.6

[1/] Includes SVAP narrative ratings (P = poor, F = fair, G = good, E = excellent)

Table A–3 Accuracy comparison data from studies with too few sites to determine a correlation coefficient

Site	SVAP version	SVAP score and rating	Comparative rating	Comparative method
Alloway Cr. NJ	3	3.6* — fair	12 — mod. impaired	NJIS (macro.)
Manasquan R. NJ	3	5.1* — good	12 — mod. impaired	NJIS (macro.)
S. Br. Raritan R. NJ	3	5.9* — good	30 — not impaired	NJIS (macro.)
Site 1 OR	3	2.7 — fair	12 — very poor	IBI (fish)
Site 2 OR	3	4.6 — good	22 — poor	IBI (fish)
Site 3 OR	3	7.0 — excellent	44 — good	IBI (fish)
Muckalee Cr. GA	4	8.6 — good	good to excellent	mussel taxa

* Mean value of replicates

Figure A–2 Correlation between SVAP and IBI values in the Virginia study (n=56)

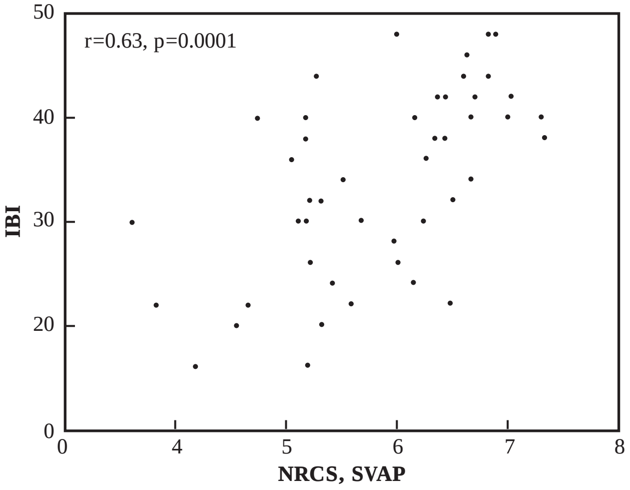


Figure A–3 Correlation between SVAP and Ohio Qualitative Habitat Evaluation Index values in the Virginia study (n=56)

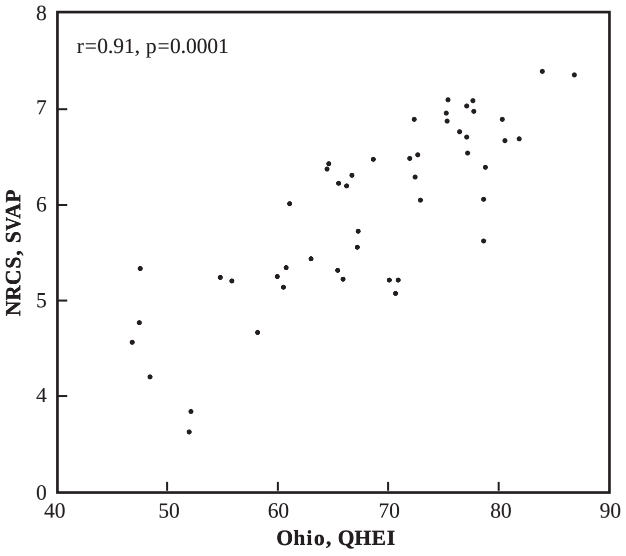


Figure A–4 Correlation between SVAP and IBI values in the Carolinas study (n=90)

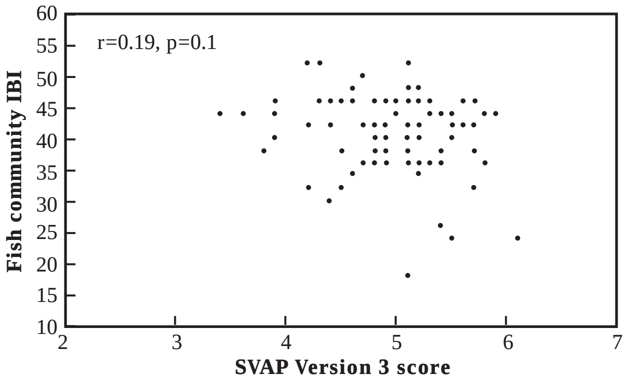
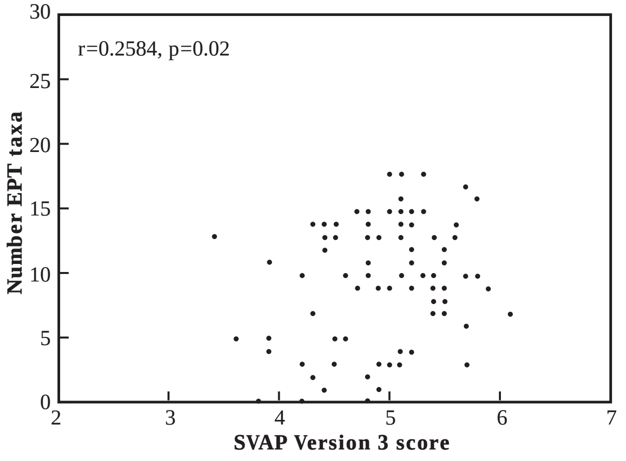


Figure A–5 Correlation between SVAP and macroinvertebrate index values in Carolinas study (n=90)



Discussion

Overall, the workgroup concluded from the first field trial that the SVAP could be used by conservationists in the field with reasonable reproducibility and a level of accuracy commensurate with its objective of providing a basic assessment of ecological condition provided the poor response to degraded streams could be corrected.

Several potential causes for the lack of accuracy with degraded sites were identified by the workgroup as follows:

- Because the overall score is an average of all assessed elements, the effect of low scoring elements can be damped out by averaging if the degradation is not picked up by many of the other assessed elements.
- Some of the elements needed to be adjusted to give lower scores for problems.
- The numerical breakpoints for the narrative ratings of poor/fair and fair/good were set too low.

To correct these problems the number of assessment elements was reduced and the instructions were modified so that certain elements are not scored if they do not apply. For example, the "presence of manure" element is not scored unless there are animal operations present. These changes reduced the potential for low scores to be damped out by the averaging process.

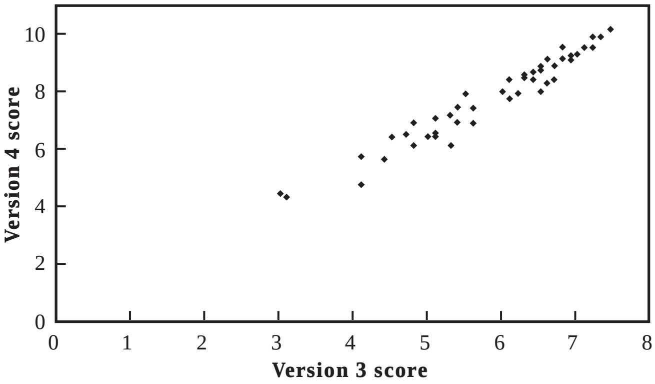
Several elements were also rewritten to reduce ambiguity at the low end of the rating scale. Additionally, several elements were rewritten to have five narrative descriptions instead of four to address a concern that users might err on the high side. The scoring scale was changed from a scale of 1 to 7 to a scale of 1 to 10 because it was felt that most people have a tendency to think in terms of a decimal scale.

The revisions were incorporated into a fourth draft and evaluated by the workgroup. Sites from the first field trial were rescored using the new draft. Response seemed to have improved as indicated by the greater separation of sites at lower scores in figure A–6.

During pilot testing of the training materials in March 1998, the fourth draft was used by 12 students independently at one site and collectively at another site. The coefficient of variation at the replication site was 8.8 percent. One of the sites had been previously assessed using other methods, and the SVAP rating corresponded well to the previous assessments.

After the evaluation of the fourth draft, minor revisions were made for the fifth draft. The breakpoints for the narrative rating of excellent, good, fair, and poor for the fifth draft were set using the Virginia data set. These breakpoints may be adjusted by the NRCS state office as explained in this document.

Figure A–6 Version 4 scores for VA plotted against version 3 scores (n=56)



Stream Visual Assessment Protocol

Owners name ____________________________________ Evaluator's name________________________________ Date ________________

Stream name ____ Waterbody ID number ____________________________________

Reach location ____

____

Ecoregion ____________________________________ Drainage area _______________________ Gradient__________________________

Applicable reference site ____

Land use within drainage (%): row crop ______ hayland ______ grazing/pasture _______ forest ______ residential _______

confined animal feeding operations ______ Cons. Reserve ________ industrial _______ Other: _________________

Weather conditions-today _______________________________________ Past 2-5 days ____

Active channel width ______________________ Dominant substrate: boulder ______ gravel ______ sand ______ silt ______ mud ______

Site Diagram

Assessment Scores

Channel condition ☐

Hydrologic alteration ☐

Riparian zone ☐

Bank stability ☐

Water appearance ☐

Nutrient enrichment ☐

Barriers to fish movement ☐

Instream fish cover ☐

Pools ☐

Invertebrate habitat ☐

Score only if applicable

Canopy cover ☐

Manure presence ☐

Salinity ☐

Riffle embeddedness ☐

Marcroinvertebrates Observed (optional) ☐

Overall score
(Total divided by number scored) ___________

<6.0	**Poor**
6.1-7.4	**Fair**
7.5-8.9	**Good**
>9.0	**Excellent**

Suspected causes of observed problems____

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Recommendations____

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Appendix X-E

Acronyms

Acronyms

AC	Anderson Creek
ACOE	Army Corps of Engineers
ACWA	Anderson Creek Watershed Association
AMD	Abandoned Mine Drainage, Acid Mine Drainage
ArcGIS	ArcView Geographic Information System
AVGWLF	ArcView Generalized Watershed Loading Function
BAMR	Bureau of Abandoned Mine Reclamation
BMR	Bureau of Mining and Reclamation
BR	Bilger Run
CCCD	Clearfield County Conservation District
DEP	Department of Environmental Protection
DER	Department of Environmental Resources
DGRP	Dirt and Gravel Road Program
DMP	Discharge Monitoring Point
EASI	Environmental Alliance for Senior Involvement
EPA	Environmental Protection Agency
FR	Fenton Run
GFCC	Government Financed Construction Contract
KR	Kratzer Run
LA	Little Anderson
NPS	Nonpoint Source Pollution
NRCS	Natural Resources Conservation Service
OLC	Open Limestone Channel
OSL	Operation Scar Lift
PACD	Pennsylvania Association of Conservation District
PAMP	Problem Area Monitoring Point
PF&BC	Pennsylvania Fish and Boat Commission
PL566	Public Law 566
PTWA	Pike Township Water Authority
RR	Rock Run
SAPS	Successive Alkalinity Producing System
SMP	Stream Monitoring Point
SR	State Route
SRBC	Susquehanna River Basin Commission
SSWAP	State Source Water Assessment Program
TAG	Technical Assistance Grant
TMDL	Total Maximum Daily Load
UNT	Unnamed Tributary
USDA	United States Department of Agriculture
WPC	Western Pennsylvania Conservancy
WRAM	Watershed Restoration Analysis Model
WRAS	Watershed Restoration Action Strategies


Anderson Creek Watershed
Mile Marker Points
Random Sample Points
Secondary AMD Seeps
Monitoring Points
Priority AMD Monitoring Points
Stream Monitoring Points
EPA TMDL Points
AMD Discharge
Sample Point
Streams
Watershed Boundary
0.5 0.25 0 0.5 1
Miles
N
S
E
W
Western Pennsylvania Conservancy
Est. 1932
Panther Run
Rockton
Luthersburg
Grampian
Curwensville
Curwensville Lake
Bridgeport
Roaring Run
Moshannon State Forest
Union
Bloom
Penn
Pike
Pine
State Game Lands No 93
Du Bois Reservoir
Little Anderson Seeps OSL 305
Spencer Mine
SMP-AC1
SMP-AC2
SMP-AC3
SMP-AC4
SMP-KR1
SMP-KR2
SMP-BR1
SMP-BR2
SMP-BR3
SMP-BR4
SMP-FR1
SMP-HR1
SMP-LA1
SMP-LA2
SMP-LA3
SMP-LA4
SMP-RR1
DMP-Widemire
Widemire OSL 220
DMP-Wildwood
DMP-Korb 1
DMP-Korb 2
DMP-Korb 3
DMP-Korb 4
DMP-Draucker 1
DMP-Draucker 2
DMP-AC 3.75-1
DMP-AC 3.75-2
DMP-AC 3.75-3
DMP-BR 3.9
DMP-BR 4.0
DMP-BR 4.5
DMP-LA 5.9-1
DMP-LA 5.9-2
PAMP-LA 2.10
PAMP-LA 3.0-1
PAMP-LA 3.0-2
PAMP-LA 3.0-3
PAMP-LA 3.0-4
PAMP-LA 4.3-1
PAMP-LA 4.3-2
Korb OSL 329
Korb OSL 330
Korb OSL 350
Korb OSL 351
Spencer OSL 352
Draucker OSL 301
Wingert OSL 303
OSL 211-214
AC Above KORB
AC Below KORB
SMP KORB UNT 1
UNT AC 5.8-1
UNT AC 5.8-2
RR Spring
KR-1.45-1
DMP-879