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Stonycreek River Watershed Reassessment

"The Point" in Johnstown where the Stonycreek River (left) joins with the Little Conemaugh River (right)to form the Conemaugh River.

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Somerset Conservation District

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Foundation for Pennsylvania Watersheds

Photos by Len Lichvar unless otherwise noted.

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FORWARD

The comeback of water quality in the Stonycreek River watershed is one of Pennsylvania's greatest conservation success stories. The effort has taken nearly two decades, millions of dollars, and untold numbers of hours from professionals and volunteers alike to restore significant portions of the 486 square mile watershed. The public-private partnerships established to accomplish the task stand as a testimonial to innovation and determination in the broad field of resource conservation.

However, the work required is not only not complete, but not even assured. The Stonycreek Reassessment effort is both a reality check and a call to further action in regard to continuing and maintaining the accomplishments of the past. The reassessment is the foundation upon which the always fragile condition of water quality will rest.

What yet needs to build upon this foundation is contained and documented within the reassessment. The past commitment that has been clearly evident by all the partners within and outside the watershed must be renewed and strengthened as well as kept ever vigilant until the goals of renewed health and life of the Stonycreek River watershed are completed, maintained, and sustained.

That is what the Stonycreek River watershed reassessment is all about.

Len Lichvar
"On the Stonycreek"

Len Lichvar
District Manager
Somerset Conservation District

ACKNOWLEDGEMENTS

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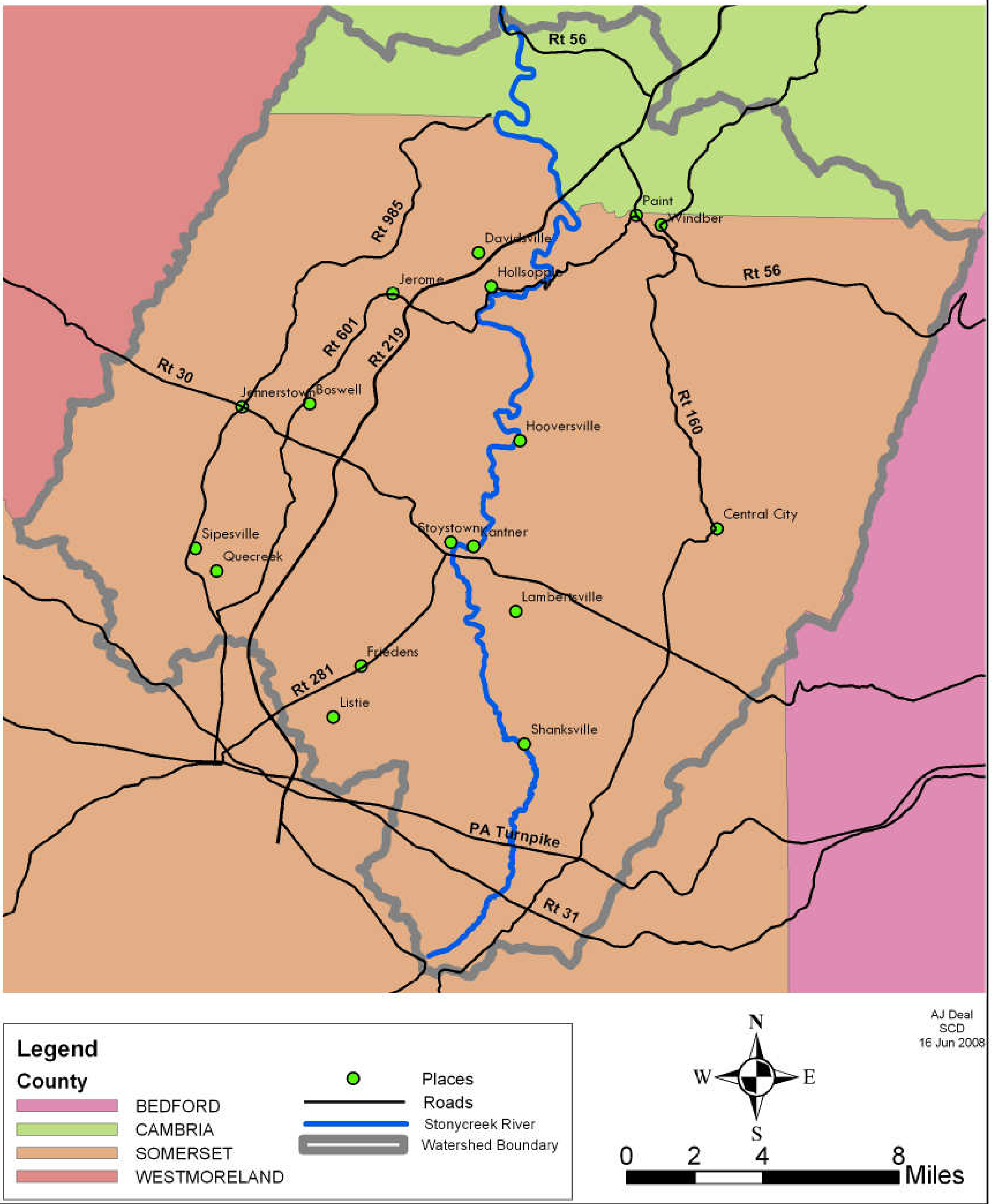
A thank you to one and all.

Stonycreek River Watershed



Abstract

The Stonycreek River watershed, which encompasses northern Somerset County and a small portion of southern Cambria County, is approximately 470 mi^2 in area and flows for 46 miles from its source near Berlin to its mouth at Johnstown. Additionally, the watershed has a long history of mineral extraction with abandoned mine sites leaving a legacy of abandoned mine drainage (AMD) impairment. The current project, funded through a grant provided by the Foundation for Pennsylvania Watersheds, is labeled as a reassessment because this project will measure the effects of nearly $10 million in project funding that was allocated after the initial 1997 USGS assessment of AMD discharges within the watershed. As a result of project implementation water chemistry in the Stonycreek River was reversed from net acidic to net alkaline and over fifteen miles of fisheries were restored. The purpose of the current reassessment is to develop a baseline data set and extend the previous study area. Ultimately the goal of the project is to quantify water quality changes, identify new projects, and complete the restoration efforts that began over fifteen years ago. Objectives of the reassessment were to: survey water quality throughout the watershed, implement a bioassessment and biomonitoring program, create a master database complete with GIS layers, and generate a full report and executive summary. Thirty-five sites—seventeen on the main stem of the Stonycreek River and eighteen on major tributaries, were evaluated for physical habitat, water chemistry, and benthic macroinvertebrates. The Somerset Conservation District (SCD) worked in cooperation with many local watershed groups and the PA Fish and Boat Commission (PFBC) Bureau of Habitat Management to sample fishes at eighteen sites for use both in the reassessment (for the SCD) and for management purposes (by the PFBC). A stream quality index (SQI) was developed specifically for the reassessment and was used to identify areas of the watershed in greatest need of restoration. Although results suggest that the quality of the Stonycreek River and its tributaries has improved since initial sampling, 18 of the 35 sites sampled were considered severely impacted based on SQI results. Impacted sites in the headwaters were generally poor because of organic and sediment loading and sites further downstream were generally impacted by AMD and physical habitat impairment. Four sites on tributaries had exceptional SQI scores. The results of the reassessment will also be provided to watershed groups as justification for funding requests to implement restoration projects.

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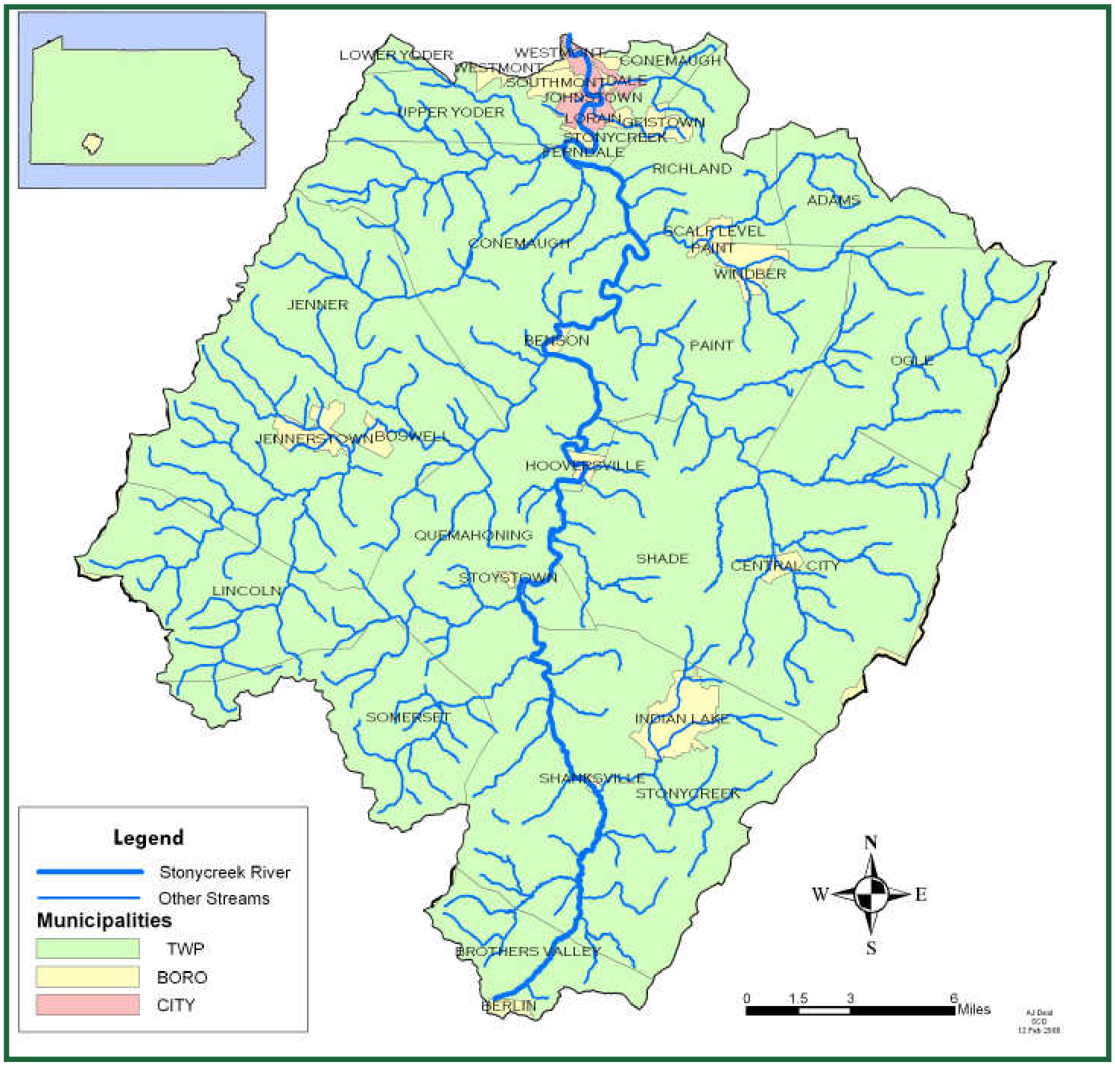
Introduction

Southwestern Pennsylvania is an area that is rich in history and natural resources. The best known and most economically viable of these resources is bituminous coal. Since the late 1800's, coal has been extracted from Somerset and Cambria Counties by way of deep shaft mining and surface strip mining. While coal fueled the industrial revolution, it also left behind detrimental impacts to the land and water that were located around the resource. These impacts can be readily seen within the Stonycreek River watershed.

The Stonycreek River watershed is located in western Pennsylvania in northern Somerset County and part of southern Cambria County (Figure 1). The watershed encompasses 467 mi^2 (298,920 acres) and contains 538 perennial stream miles, 519 miles

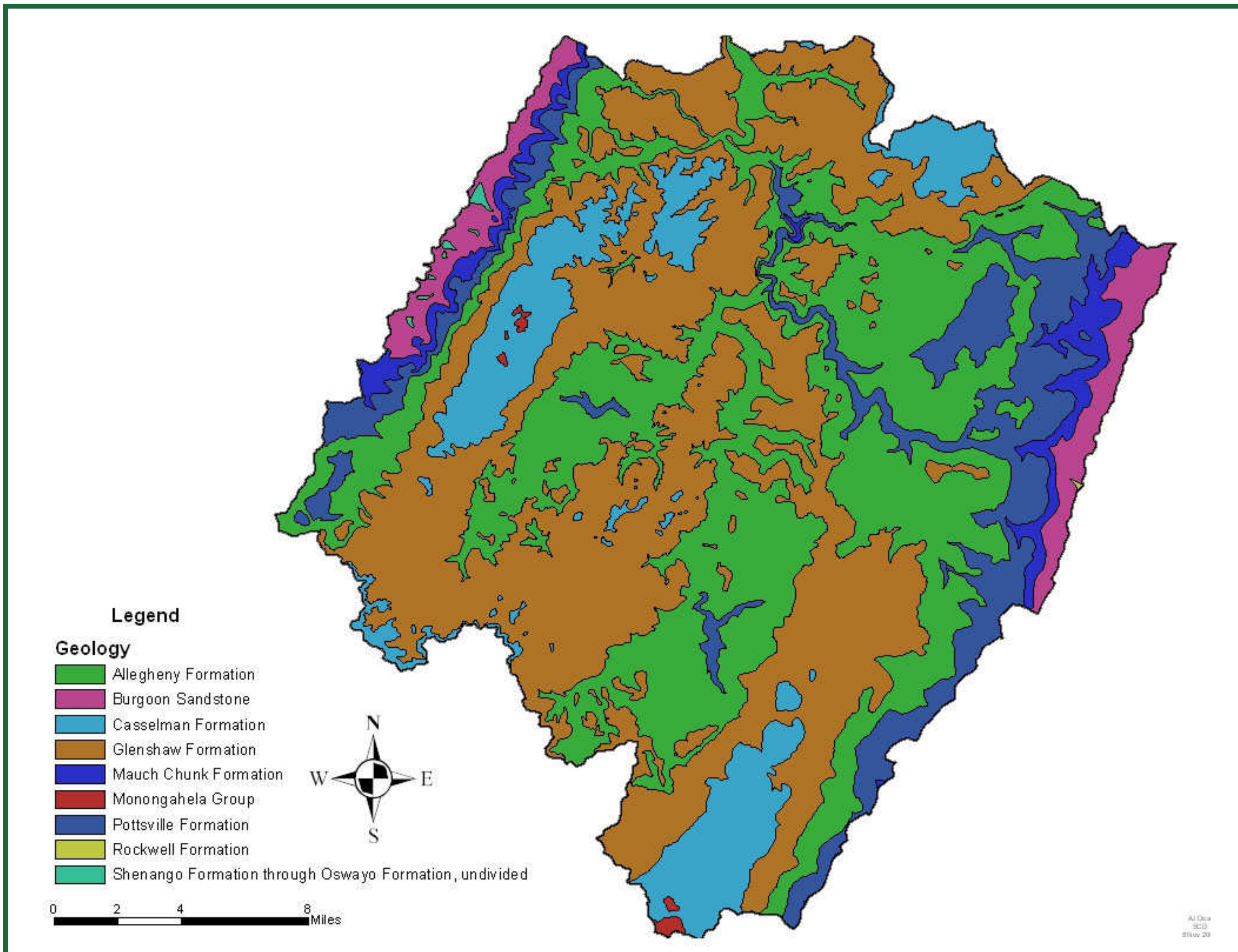
Figure 1. Stonycreek River watershed location and municipaliteis.



of which are natural stream or river paths and 19 miles consisting of man-made, artificial channels. The mainstem of the Stonycreek River gets its beginnings from Pious Springs in the borough of Berlin then flows north through fields, forests, and city before joining the Little Conemaugh River near Johnstown to form the Conemaugh River. Along its course the Stonycreek River and its tributaries also flow through historic landmarks such as the Quecreek Mine Rescue Site and the Flight 93 Memorial. The Stonycreek River is a fifth order tributary to the Conemaugh River. The headwaters of the Stonycreek River are designated as a Cold Water Fishery (CWF) by the Pennsylvania Code Chapter 93 (PA93). In its middle reaches it is designated as a Trout Stocked Fishery (TSF) and its lower reaches are a Warm Water Fishery (WWF). Eight named streams within the watershed received a designation of Exceptional Value by PA93. The remaining tributaries of the Stonycreek River are designated predominantly as CWF (Pennsylvania Code 2001). Ten major sub-basins make up the Stonycreek River watershed and include Quemahoning Creek (63,700 acres), Shade Creek (62,528 acres), Bens Creek (30,319 acres) Paint Creek (23,328 acres), Rhoads Creek (16,824 acres), Beaverdam Creek (11,886 acres), Wells Creek (10,933 acres), Glades Creek (6,703 acres), Solomon Run (5,406 acres), and Oven Run (4,751 acres).

The entire Stonycreek River watershed is located in the Allegheny Mountain Section of the Allegheny Plateau physiographic province. Elevation within the watershed ranges from 896 ft to 3,121ft. The watershed is comprised of nine groups of rock formations: Monongahela Group, Allegheny Formation, Casselman Formation, Glenshaw Formation, Pottsville Formation, Burgoon Sandstone, Mauch Chunk Formation, Rockwell Formation,

Figure 2. Geology of Stonycreek River watershed.



and the Shenango Formation (Bedrock Geology of Pennsylvania 2001) (Figure 2). Several of the rock formations, such as the Allegheny Groups, contain large quantities of bituminous coal. The large quantity coal contained in these formations and their relative proximity to the surface caused the Stonycreek River watershed to be mined extensively.

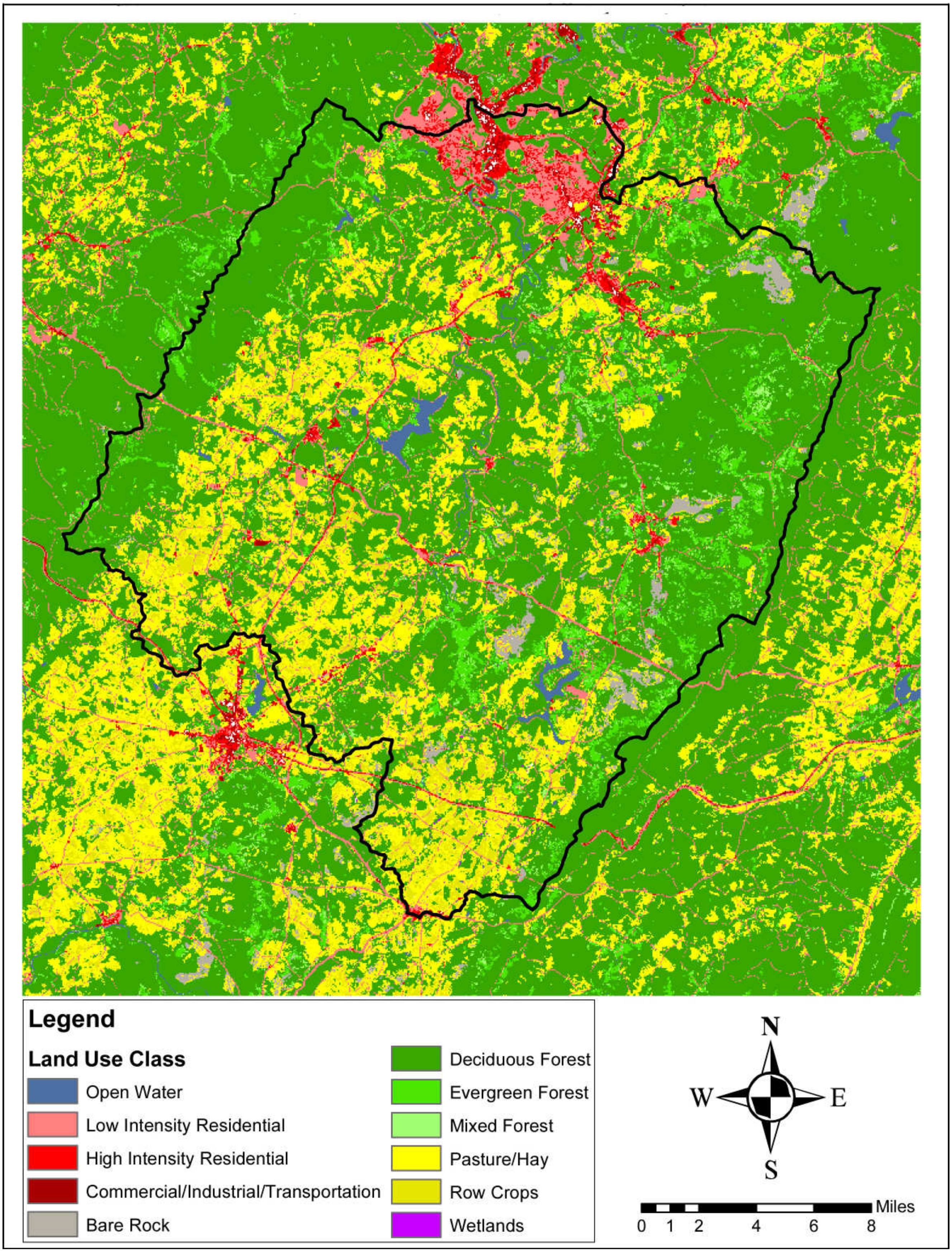
Climate within the watershed is highly affected by its elevation and is described as humid continental, with cold winters and warm summers being the norm. The watershed receives 40 to 48 inches of precipitation yearly and average annual temperatures range from 45° to 50°F.

Land use in the watershed varies spatially (Figure 3). Overall, forested land comprises 64% of the land area, while agriculture makes up 24%, and 9% is considered urban. Urban land use occurs primarily near the mouth of the Stonycreek River around Johnstown. Other population centers within the watershed are Windber, Berlin, and Boswell Boroughs.

Agriculture occurs throughout the watershed, but is concentrated near the headwaters and found frequently in the western part of the watershed. Forested land cover is found in patches across the watershed, and makes up the majority of the eastern part of the watershed. Approximately 10% (43.5mi2) of land within the watershed is publicly owned in the form of state parks, state forests, or state game lands. Public lands are found along the western boundary and north eastern portion of the watershed. Barren land cover, principally strip mined areas, account for an additional ~2% of the land cover and water and wetlands make up just over 1%.

The orange coloration on rocks in the Stonycreek River at Krings shows the visible effects of abandoned mine drainage.

Figure 3. Land use within Stonycreek River watershed.



Project Rationale

There are many ways to learn about the health of a stream or watershed. Just by looking at a stream and its surroundings we can get clues about the stream's health. Is the stream surrounded by trees or out in the open? Is the water clear and are the rocks in the stream clean or covered with sediment or orange slime? We can test water chemistry to determine if chemical measures are within given standards to ensure safety for drinking or wildlife. We can get an idea of the health of a stream by the organisms we see or don't see, like the presence or absence of certain fish species.

A mine seep along Bens Creek.

Although all of the above mentioned methods give us clues about a stream's health, they do not give us clear answers about how healthy or how unhealthy a stream is. In order to fully assess stream quality, we must look quantitatively at all aspects of stream integrity, including physical habitat, water chemistry, and biota. All of these aspects interact to tell the entire story of stream health.

From 1991 to 1994 the United States Geological Survey (USGS) conducted an assessment of mine discharges within the Stonycreek River watershed. A total of 270 coal mine discharges within the watershed were identified. Discharges from 193 mines exceeded United States Environmental Protection Agency (EPA) effluent standards for pH, 141 exceeded EPA standards for total manganese concentrations, and 122 exceeded total iron standards. Only forty of the sampled discharges met EPA standards (Williams et al. 1996). This assessment was the first performed in the Stonycreek River watershed and utilized chemical analysis to determine detrimental mine drainages. The Pennsylvania Fish and Boat Commission (PFBC) assessed areas of the watershed using electrofishing surveys to analyze fish biotic integrity and species richness in the watershed. Initial findings for the surveys indicated depressed fish communities at several locations.

Over $10 million were invested in on the ground projects to improve stream quality within the watershed based on results and recommendations of the initial USGS mine discharges study from 1991 to 1994. Consequently, the Stonycreek River was reversed from a net acidic to a net alkaline stream, as a result of increased alkaline inputs from passive treatment systems. Because of the changes in water chemistry, over fifteen miles of fisheries in the middle and lower have recovered. The initial study also caused a proliferation of

Photo by Oblique Photography for PA DEP

An aerial view of the Boswell Passive Treatment System.

watershed groups and grassroots interests in improving local streams. New watershed associations have been created in the Wells Creek, Shade Creek, and Paint Creek watersheds since the completion of the initial USGS study. Another important development since the initial study was the creation of the Stonycreek-Conemaugh River Improvement Project (SCRIP). SCRIP is a coalition of grassroots groups and local resource agencies working together to restore and promote the upper Conemaugh watersheds. SCRIP initiated the public-private partherships that have empowered local citizen groups to implement various AMD abatement projects, leading to further remediation within the watershed.

Since the USGS mine discharges study, no systematic sampling regime was implemented and only sporadic data have been collected within the watershed. Occasionally water chemistry testing is conducted by various groups throughout the watershed. Comprehensive macroinvertebrate data is sparse and rather inaccessible. Fish data have been collected throughout the watershed by the PFBC, but have not since 1998. SCRIP and newly formed watershed groups along with their state, federal, and private partners, have helped to construct passive treatment systems and AMD abatement projects. Pre- and post-construction monitoring has been minimal because funding for these activities has also been minimal or non-existent.

In 2007, thirteen years after the completion of the original chemical assessment, the Somerset Conservation District (SCD) along with various partners within the watershed acquired funding from the Foundation for Pennsylvania Watersheds to reassess the Stonycreek River watershed utilizing chemical, biological, and physical components. The goal of this reassessment was to incorporate sampling data from all three components of aquatic resource integrity to develop a baseline data set and an index that will allow tracking of pollution abatement progress within the Stonycreek River watershed. The baseline data set will also fill in data gaps and provide leverage of funding for new conservation or remediation projects.

Objectives

The main objective of the Stonycreek Reassessment was to develop a more comprehensive data set that includes, physical, chemical, and biological components complete with GIS data layers. In developing a current baseline data set, our aim was to fill in data gaps and to use this data set to provide the necessary background information and support for additional project funding. The assessment will allow for the quantitative analysis of already in place abatement and conservation projects and use data collected to identify other remediation needs. A long term goal is to use data collected from the reassessment to complete the restoration efforts that began over fifteen years ago.

Sampling Points

Sampling locations for the reassessment were selected by a group made up of SCD Staff and individuals from various cooperating partners. Site selection was based on the availability of historic data, while at the same time seeking to cover then entire watershed. The location of passive treatment systems was also taken into consideration and some sites were specifically selected because of their location upstream and downstream of these systems. Site locations are shown in Figure 4 and descriptions are shown in Table 1 with additional site information listed in Appendix 2.

Figure 4. Stonycreek River reassessment sampling locations.

Table 1. Sampling site numbers and locations.

Site #	StreamName	Location	Upstream Acreage
1	Stonycreek River	Haynes Street Bridge	298707.62
2	Stonycreek River	Ferndale downstream of Bens Creek	288298.34
3	Stonycreek River	Bridge by St. Andrews	30293.55
4	Stonycreek River	Bridge at Krings	252654.46
5	Stonycreek River	below mouth of Paint Creek	247890.88
6	Stonycreek River	Carpenter's Bridge	224548.59
7	Shade Creek	Rt. 601 Bridge	62484.39
8	Stonycreek River	Blough Bridge	90351.70
9	Quemahoning Creek	219 Bridge	46317.45
10	Stonycreek River	downstream of Oven Run	86158.41
11	Stonycreek River	Turkeyfoot Bridge near school	74999.86
12	Stonycreek River	above Beaverdam Creek	62049.52
13	Wells Creek	Wells Creek Mouth	10934.22
14	Stonycreek River	Mouth of Lamberts Run	49778.32
15	Stonycreek River	Glessner Covered Bridge	41600.00
16	Stonycreek River	Baltzer Bridge	20795.26
17	Stonycreek River	Shanksville	38130.59
18	Stonycreek River	Yonai Bridge	17163.41
19	Glades Creek	Rt. 31 Bridge	3647.48
19B	Stonycreek River	Rt. 31 Bridge	2464.33
20	Quemahoning Creek	4023 bridge	11950.84
21	Lamberts Run	Lamberts Run mouth	2373.24
22	Stonycreek River	Hollsopple Bridge	158574.84
23	Stonycreek River	below confluence with Shade Creek	232778.98
24	Fallen Timber Run	at Hooversville	3787.78
25	Beaverdam Creek	at Stoystown	19909.76
26	Pokeytown Run	at Wilbur	7966.04
27	Oven Run	at Rowena	18531.98
28	Shade Creek	at Central City	58831.17
29	Shade Creek	near Hillsboro	119361.79
30	Clear Shade Creek	below Fly Fishing Only Project	39055.41
31	South Fork Bens Creek	at 985 bridge	25686.35
32	Miller Run	mouth of Miller Run	35109.78
33	South Fork Bens Creek	upstream from sportsmen's club	54460.94
34	Rhoads Creek	near Shanksville	46211.84

Stream Quality Index

Although there are many ways to describe stream health, a full assessment requires that we look quantitatively at all aspects of stream integrity, including physical habitat, water chemistry, and biota. All of these aspects interact to show the big picture of stream health.

The purpose of the Stonycreek River watershed reassessment was to conduct a full evaluation of the entire watershed and compile a current baseline data set to provide a means of pollution abatement monitoring. The data set will also be used to monitor other impacts to the watershed such as organic loading, erosion, and sedimentation. Prior to this assessment no compiled, baseline data were available within the Stonycreek River watershed. Various watershed groups and organizations have installed treatment systems throughout the watershed to abate abandoned mine drainage (AMD). These projects were constructed on individual mine seeps and the influent and effluent of the seeps have been measured with various chemical and physical parameters to determine the efficiency of the treatment system (Williams et al. 1996). However, little water chemistry, biological, and physical habitat data had been evaluated as a whole from the Stonycreek River and its major tributaries.

The primary method of ranking and assessing sites within the watershed was with the use of a stream quality index (SQI). Sampling sites used for creation of the SQI are the same sites where benthic macroinvertebrates, water chemistry, and physical habitat were measured. As mentioned previously, the total components of biological integrity include biological, physical and chemical factors within the watershed (Barbour et al. 1999). With this concept in mind, development of a measurement tool was needed to identify the changes in water chemistry and physical habitat and their relation to the stability of biological communities within the watershed. The SQI can be viewed as a Stonycreek River watershed specific tool that will detect changes in the overall health of the stream by weighting biological, physical and chemical factors.

Water chemistry, biological data, and physical habitat measures in the SQI each consisted of multiple metrics. Each metric was scored on a scale from zero to five, with zero indicating poor quality and five indicating exceptional quality (Barbour et al. 1999, Stribling et al. 1998). The scores for all metrics that comprise each assessment category were added together to obtain a final score for that assessment category. The final score identifies whether impacts have occurred in chemistry and/or physical habitat. Chemical variables measured were used to detect organic and AMD impacts. Physical habitat focused on quantifying the actual physical structure and physical integrity of the stream area. The biological assessment focused on benthic macroinvertebrates, which can reflect the impacts on a community from degraded physical or chemical conditions. All three assessment scores were totaled and one overall SQI score was obtained for each site. The overall score provides the information necessary to assess the Stonycreek River watershed into the future and to track biotic community reestablishment. Future sampling will reflect even minor changes in water quality. The total score will increase with the improvement of the integrity of the stream. That is, water chemistry and physical habitat improvements will lead to biological improvements.

The final SQI scores are broken down into three categories: impacted, moderately impacted, and excellent quality. The score range of these categories will be determined by comparing the final SQI score to a preset score range. If a site score is 60% or below the total possible SQI score, the site will receive a rating of "Impacted." A site scoring between 61-80% will be rated as "Moderately Impacted" and a site scoring 81% and above will be deemed "Excellent Quality." Sites that receive an impacted rating will be designated as target sites for future reclamation projects. SQI development is discussed further in Appendix 1.

SQI scores for sites sampled during the Stonycreek River watershed reassessment are contained in Table 2. Eighteen sites sampled during the reassessment fell within the impacted criteria of the SQI. These sites have been severely degraded by some combination of acidification, organic loading, and physical habitat degradation. Seventeen sites were moderately impacted. Four sites exhibited an excellent SQI score, and will be recommended for preservation of their pristine ecosystems. More specific, detailed recommendations will be discussed later in the report.

Table 2. Stream quality index scores.

Site Number	SQI Score
1	74
2	78
3	110
4	73
5	81
6	96
7	47
8	100
9	95
10	81
11	112
12	99
13	85
14	123
15	93
16	103
17	90

Site Number	SQI Score
18	66
19	70
19B	96
20	57
21	94
22	99
23	96
24	88
25	126
26	79
27	89
28	81
29	69
30	130
31	112
32	125
33	138
34	80

Physical Habitat

Physical habitat is made up of many components. One of the most important aspects of optimal habitat is variety; a mix of substrates and available cover, a range of stream flow conditions, including fast deep, fast shallow, slow deep and slow shallow, and relatively frequent occurrences of riffles all contribute to good habitat. Other characteristics of favorable physical habitat include riparian buffers, stable stream banks, and clean stream bed gravel, cobble, or boulders.

Activities that occur within the watershed—not necessarily in the stream directly can have a considerable effect on physical habitat characteristics. For example, type of land use surrounding a stream can contribute either beneficial or detrimental impacts to a stream. Additionally, the presence or absence of a riparian buffer—the area along the bank of a stream—has a considerable impact on stream quality and physical in-stream habitat for many reasons. A buffer can act as a filtering tool to reduce runoff pollution; it can provide shade to help maintain low stream temperatures; and a good stream buffer can provide needed energy and nutrients to the stream food chain. All of these factors together help to enhance the overall quality of the stream.

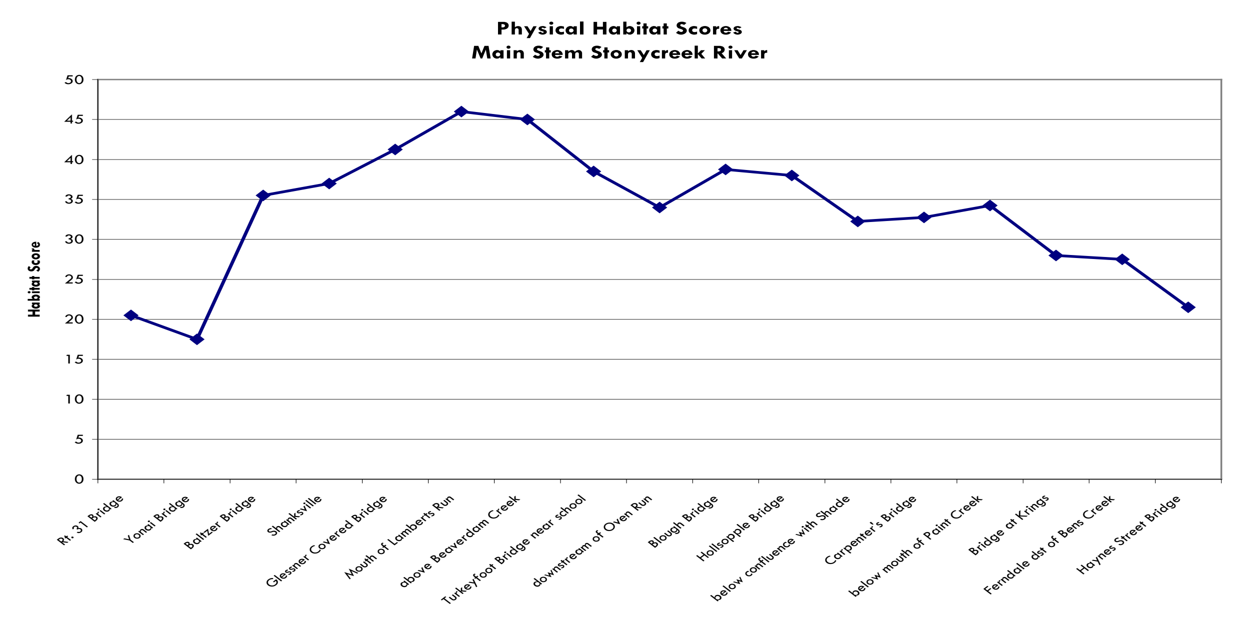
Physical habitat assessment in the current study consisted of measuring characteristics of instream features and the riparian zone. Evaluation protocols followed EPA's Rapid Bioassessment Protocols for Habitat Assessment (Barbour et al. 1999). According to the protocols, ten habitat attributes (Table 3) were evaluated by assigning a score from zero to twenty for each category, with zero representing poor condition and twenty being optimal. The scores from all categories were totaled and produced a physical habit score ranging from zero to 200. A sample physical habitat scoring sheet can be found in Appendix 1. The scores were adapted to fit a zero to five scoring system to ensure equality with other SQI components' scores. The total possible score that an individual site could attain was fifty. A stream with a score below thirty was considered severely impacted, a score of 31-40 was moderately impacted, and a stream with a score of 41-50 was considered excellent quality.

Table 3. Habitat parameters included in physical habitat assessment.

Epifaunal Substrate	Includes the relative quantity and variety of natural structures in the stream
Embeddedness	Refers to the extent to which rocks (gravel, cobble, and boulders) and snags are covered or sunken into the silt, sand, or mud of the stream bottom
Velocity/Depth Regime	A measure of habitat diversity
Sediment Deposition	Measures the amount of sediment that has accumulated in pools and the changes that have occurred to the stream bottom as a result of deposition.
Channel Flow Status	The degree to which the channel is filled with water
Channel Alteration	A measure of large-scale changes in the shape of the stream channel
Frequency of Riffles	A measure of the heterogeneity occurring in a stream
Bank Stability	Measures whether the stream banks are eroded (or have the potential for erosion)
Vegetative Protection	Measures the amount of vegetative protection afforded to the stream bank and the near-stream portion of the riparian zone
Riparian Vegetation Zone Width	Measures the width of natural vegetation from the edge of the stream bank out through the riparian zone

Physical habitat scores on the main stem of the Stonycreek River ranged from 9 to 47. The highest scores were found in the middle reaches and the lowest scores were found in the headwaters and near the mouth (Figure 5). The average habitat score for main stem sites was 32.

Figure 5. Physical habitat scores on the mainstem Stonycreek River.

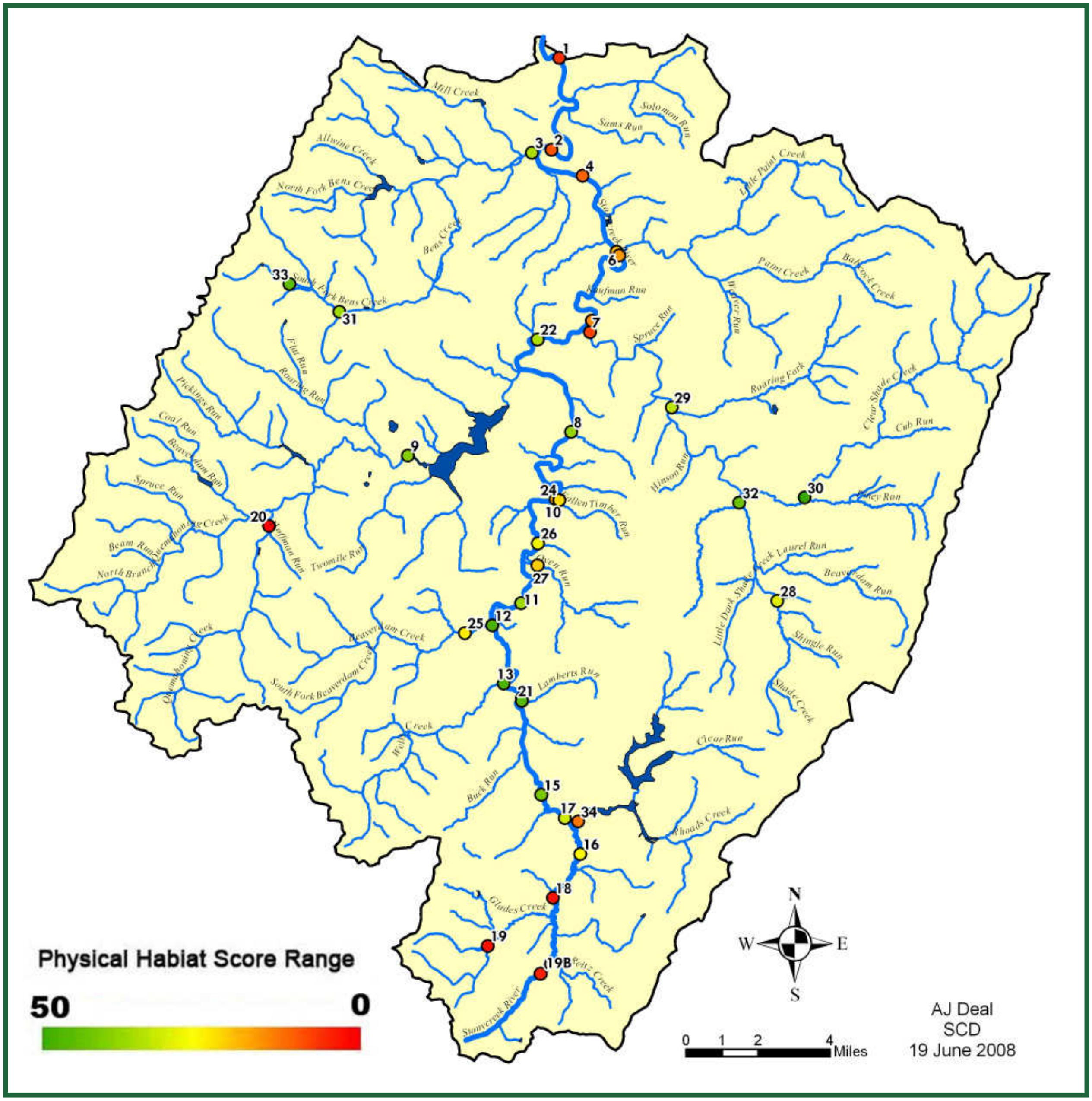


Habitat scores on tributaries varied greatly both spatially and in value. The highest and lowest habitat scores in the reassessment were located on tributaries. The highest score (50) was recorded on Clear Shade Creek (Site #30). The lowest score (9) in the reassessment was found on Quemahoning Creek near Hoffman Run (Site #20). The average habitat score for tributary sites was 35. Figure 6 shows the spatial distribution of all habitat scores.

The greatest detriment to physical habitat in the Stonycreek River watershed is a narrow or non-existent vegetated riparian zone. Approximately 50% (17 sites) of the surveyed areas exhibited marginal or poor condition when it came to the width of the riparian vegetative zone. In marginal or poor conditions, the width of the riparian zone is less than 12 m (39 ft) and human activities have impacted the zone a great deal. Headwater sites exhibited narrow vegetated riparian zones because of agricultural influences. In some cases, hay or row crops were harvested the entire way to the stream banks. In the lower reaches of the watershed, vegetated riparian buffers were lacking due to urbanization. Residential, commercial, or industrial influences were found within extremely close distances to the stream.

The degree of embeddedness is another habitat factor that is poor at numerous sites throughout the watershed. Embeddedness is the degree to which rocks in the stream are covered or surrounded by fine sediment (Platts et al. 1983; Fitzpatrick et al. 1998). At sites where embeddedness is a problem, gravel, cobble, and boulders are 50-70% surrounded by fine sediment. By filling in spaces between rocks, the suitable habitat for many macroinvertebrates is greatly reduced and diversity of niche space is lost, thus the stream reach can only support less diverse and lower quality macroinvertebrate assemblages. In

Figure 6. Spatial distribution of physical habitat scores.



the case of the Stonycreek River watershed, embeddedness is a concern in many of the same sites where a vegetative riparian buffer was lacking. The presence of a riparian buffer helps to filter runoff and trap sediment before flowing into the stream. Riparian buffer is lacking at the headwater sites because of agriculture and the sites in the lowest reaches have urban influences, allowing runoff to enter the stream unfiltered, and depositing everything contained in the runoff—including sediment, into the stream.

Twelve sites (34%) in the reassessment had optimal habitat conditions. The majority of the sites with the best habitat were located in the middle reaches (also known as the "Upper Gorge") of the main stem Stonycreek River. The Upper Gorge is highly forested and mostly unimpacted directly by adjacent land uses. Stream banks in this area generally have wide, forested riparian buffers and very few impacts from human activities. Other areas in the watershed with optimal habitat were found in mostly pristine, second or third order tributaries. Stream reaches such as those sampled in Clear Shade Creek and South Fork Bens Creek, represent mostly forested, undisturbed sub-watersheds.

Overall, only 5 sites (14%) sampled had marginal or poor physical habitat. These sites were mostly located in the headwaters and near the mouth. Headwater sites have poor habitat quality because of the large degree of agricultural activities within their sub-watersheds and in close proximity to the streams. For reasons mentioned previously (i.e. embeddedness, lack of riparian buffers, etc.), these sites experience degraded physical habitat quality. Near the mouth of the Stonycreek River, habitat is marginal because of urban influences and the presence of flood walls. The Johnstown area has historically experienced large, devastating floods and flood walls were constructed to help protect the city from future flooding. As a result, large concrete structures line the banks of the Stonycreek River and a vegetated riparian buffer is completely lacking.

(Left) Beaverdam Creek had one of the highest physical habitat scores in the reassessment.

(Right) The Upper reaches of the Stonycreek River had some of the lowest physical habitat scores.

Water Chemistry

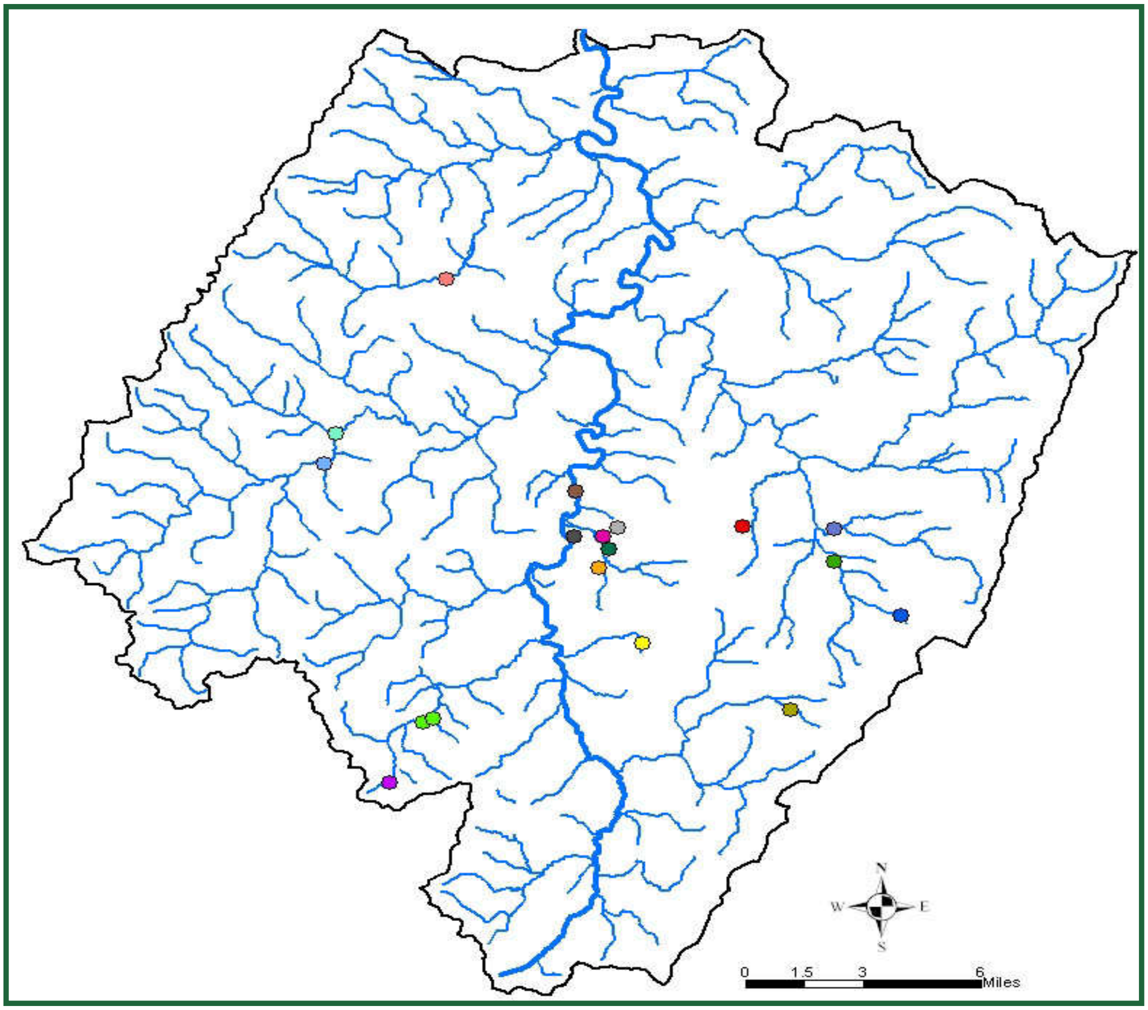
The chemical make-up of water in a stream can directly affect the organisms that reside within that stream. Aquatic organisms are surrounded by water for a significant portion or all of their lives, making water chemistry a vital determinant of biological health. If water in a stream is too warm, too acidic, or too turbid, the stream's biota may be unable to survive. Numerous factors can impact in-stream water chemistry. The physical and geologic setting plays a large role in influencing water chemistry parameters. Because of underlying bedrock or surrounding soil types, some streams have natural influences that generate a certain set of conditions that could be considered atypical or unhealthy in a different location or situation. In addition to natural influences, water chemistry is affected by human activities. Because water runs over land and carries substances with it that may eventually be deposited in the stream, activities that occur anywhere in the watershed can have an impact on in-stream water chemistry.

Water chemistry in the Stonycreek River watershed is largely impacted by AMD and agriculture. One of the most damaging pollutants from mining operations is the acid generated from the exposure of iron sulfides contained in coal and the overburden. Water running over the exposed material results in the production of ferrous iron and sulfuric acid (Hill and Bates 1979). AMD is a major environmental concern because the impacts of mining and generation of acid and influence of heavy metals occur long after mining activities have ended.

Pokeytown Run shows the effects of AMD.

One way to combat the influence of AMD is through construction of passive treatment systems. Passive treatment systems consist of a series of ponds that act to reduce the harmful effects of mine drainage by increasing alkalinity and pH and by reducing the amounts of heavy metals present in the effluent. Numerous groups have installed passive treatment systems at various locations throughout the watershed (Figure 7).

Figure 7. AMD treatment systems in the Stonycreek River watershed.



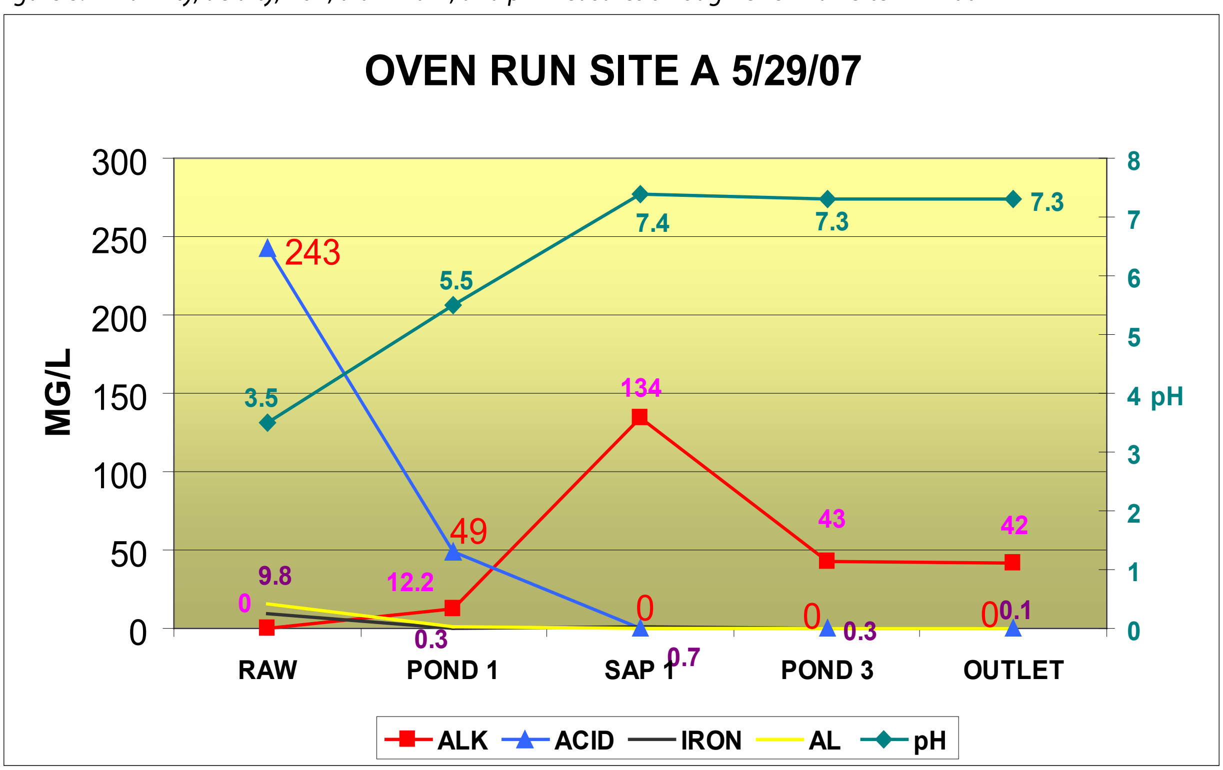
MAP SYMBOL	NAME	DATE COMPLETED
●	Adams Passive Treatment System	2003
●	Boswell Passive Treatment System	2005
●	Cottagetown Passive Treatment System	1998
●	Jenners Passive Treatment System	1997
●	Lamberts Run AMD Passive Treatment System	1999
●	Oven Run Site A Passive Treatment System	2002
●	Oven Run Site B Passive Treatment System	1998
●	Oven Run Site C Passive Treatment System	1998
●	Oven Run Site D Passive Treatment System	1995
●	Oven Run Site E Passive Treatment System	1997
●	Oven Run Site F Passive Treatment System	2000
●	Pleasant Hill Passive Treatment System	2004
●	Reitz 1 Laurel Run Passive Treatment Facility VFP & Bioreactor	2007
●	Reitz 4 AML Reclamation	2001
●	Rock Tunnel Passive Treatment System	2002
●	Shingle Run Active Lime Dosing System	2003
●	Swallow Farm Passive Treatment System	2006

Aerial photograph courtesy of PAMAP

(Left) Site D of the six-site Oven Run Passive Treatment system as seen from an aerial photograph.

One of the most high-profile systems is the six-site, $5 million, Oven Run Passive Treatment System. The systems were installed from 1995-2004 because of recommendations from the initial 1996 USGS study. The graph (Figure 8) below shows water chemistry as it moves through the system, and clearly illustrates that iron, aluminum, and acidity are drastically reduced and pH and alkalinity increase considerably.

Figure 8. Alkalinity, acidity, iron, aluminum, and pH measures through Oven Run Site A in 2007

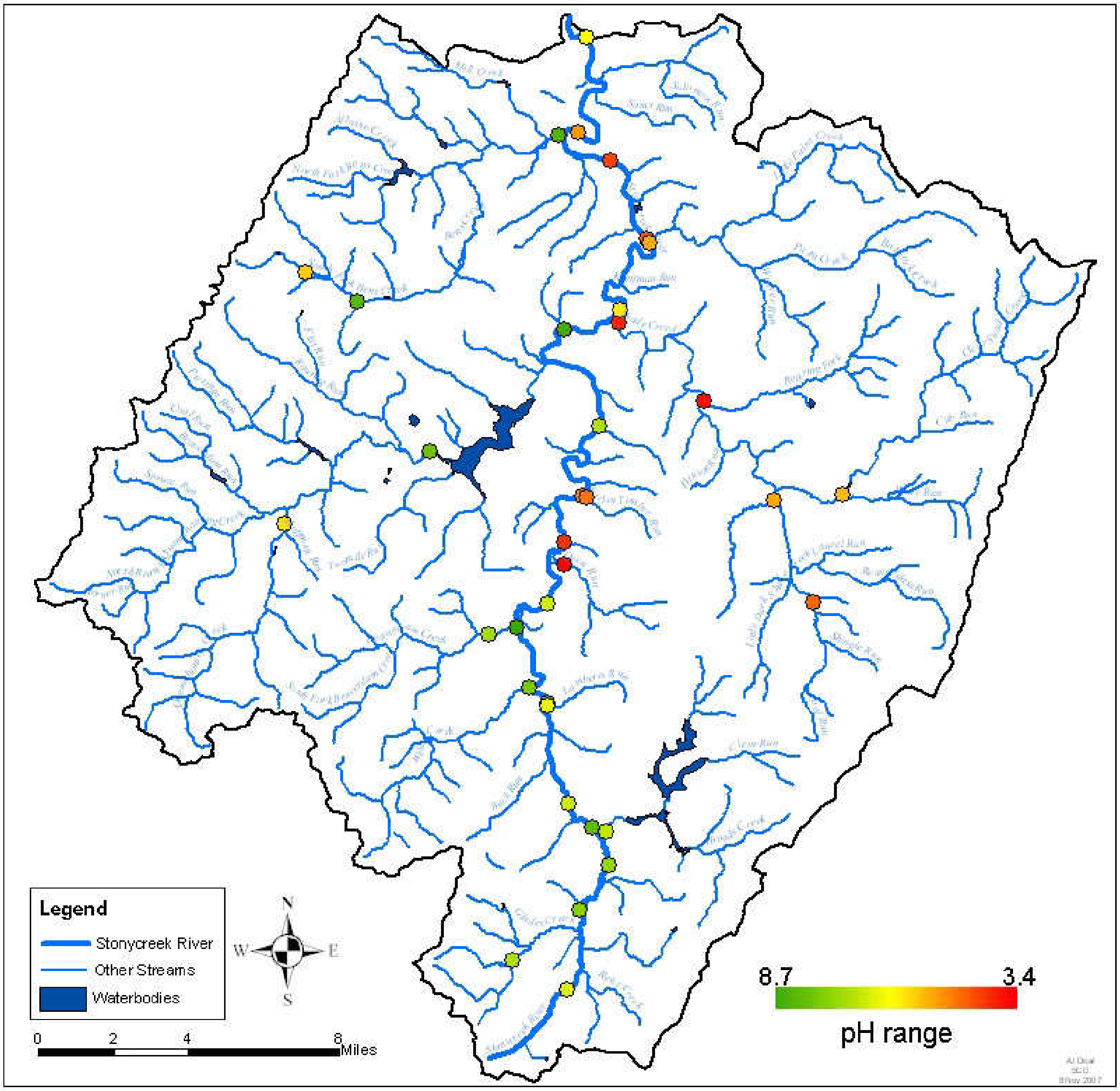


Agriculture affects stream quality because substances on the land are carried by overland flow and enter the stream through runoff. Sediment is a common stream pollutant originating from agricultural sources as a result of destabilization of the ground due to tillage. Nutrients, like phosphates and nitrates from fertilizers and manure are carried by water and enter the stream, especially if a vegetated riparian buffer is absent. In many agricultural settings, properly vegetated riparian buffers are absent and the stream lacks natural shading and is exposed to direct sunlight. As a result, the stream temperature can increase rapidly, reducing the capacity of the water to carry dissolved gases, like oxygen, and making conditions intolerable to some organisms.

Currently a relatively minor problem in the Stonycreek River watershed, but one that has potential for considerable effects in the future is the influence of urban areas and development. Development has the potential to have extremely detrimental effects on a stream for a number of reasons. The physical act of development has the potential to degrade a stream through erosion and sedimentation. Exposing bare soil makes it vulnerable to erosion through runoff that occurs during a rain event. Urban development also has secondary effects on a stream, due to the increase in impervious surface area (ISA). ISA is simply any surface that is unable to be penetrated by water, such as rooftops, sidewalks, and parking lots. An increase in ISA drastically affects the physical composition of a stream. With increased ISA in a watershed, runoff will enter a stream much quicker and at a higher temperature because it is not infiltrating into the ground and entering the stream as baseflow. Therefore, the stream will exhibit higher high peak and lower baseflows, resulting in less stable stream banks and stream communities.

The Stonycreek River as it flows through the City of Johnstown.

Figure 9. Spatial distribution of pH values.



Several watershed groups as well as the Kiski-Conemaugh Stream Team, have collected sporadic water chemistry data from various stream locations throughout the watershed. The goal of the water chemistry sampling portion of this reassessment was to develop a baseline data set, collected over the same period with consistent sampling and testing methods. Historic data collected by watershed groups will be examined and loosely compared with the new data set to determine changes that have occurred in stream chemistry as a result of construction of AMD passive treatment systems.

In the reassessment, various water chemistry parameters were measured when the stream was at base flow. A hand-held multi-meter was used to measure stream temperature, pH, total dissolved solids (TDS), and conductivity. The meter was calibrated daily with pH 7.01 and 4.01 solutions and 1431µS conductivity solution. Three independent meter readings were taken for temperature, pH, TDS, and conductivity and the average value for each metric was recorded. Dissolved oxygen was measured in the field with a Hanna Instruments Dissolved Oxygen specific meter. A water sample was taken at each site at midstream mid-depth and iron, sulfates, nitrates, and phosphates were measured in the lab with ion specific test kits.

Impacts of AMD were prominent throughout parts of the watershed. The pH values ranged from 3.4-8.7 across the entire watershed (Figure 9). The lowest values were found on Shade Creek and other small tributaries in areas highly impacted by AMD. On the main stem the lowest scores were found below the confluence with Paint Creek. These same sites also had the highest concentrations of iron present.


Testing for conductivity.

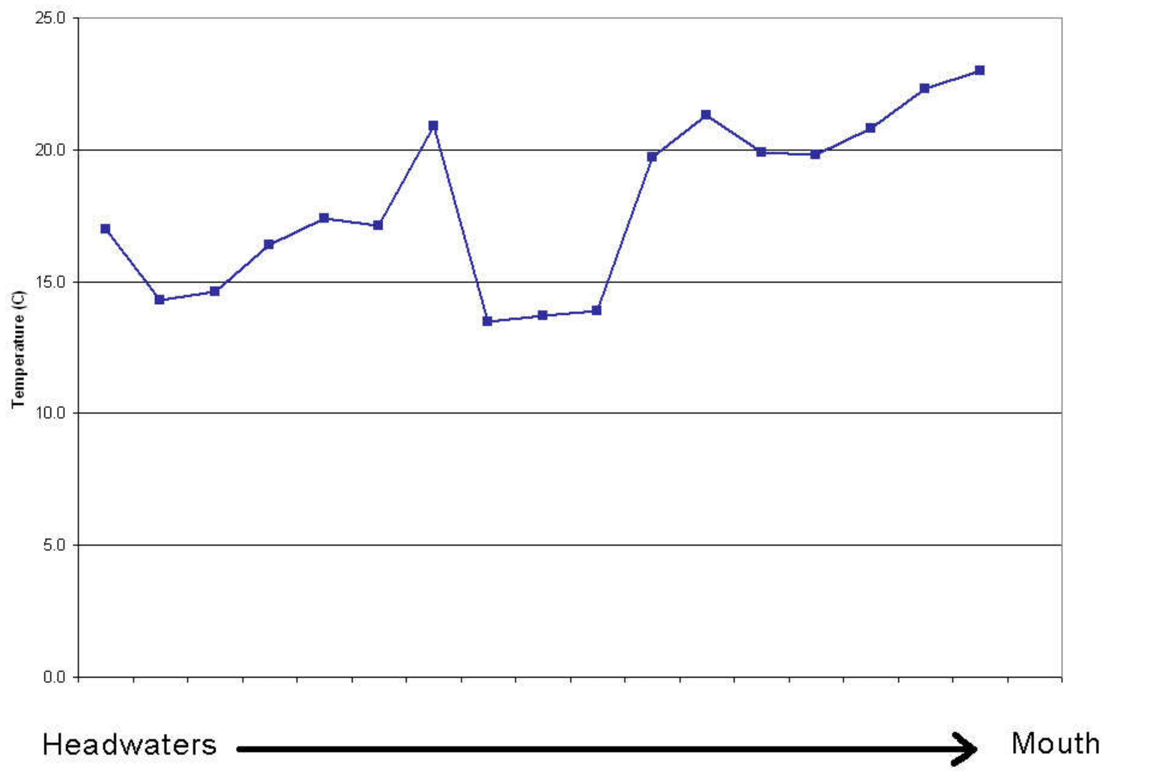
Conductivity is a measure of the ability of water to convey an electrical current and is related to the number of charged ions in water. Pure distilled water has a conductivity value of 1µS. On the main stem of the Stonycreek River conductivity values ranged from 479 µS to 932 µS with an average of 601 µS. On the tributaries, conductivity values varied extensively with values ranging from 43 µS to 2200 µS. The highest conductivity measurements were generally taken on tributaries that are highly impacted by AMD, due to the high levels of metals present in AMD water and limestone used in treatment.

The highest nutrient levels were found in the watershed's upper reaches and near Hoffman Run on Quemahoning Creek, as nitrate levels at those sites were elevated. Phosphate measurements were generally low and sulfate values were generally high throughout the entire watershed. High sulfur concentrations are likely the result of iron pyrite that has been left behind following coal mining. TDS measurements on the main stem ranged from 201 ppm to 457 ppm with an average of 298 ppm. On the tributaries the values had a much wider span with measurements ranging from 21 ppm to 1100 ppm.

Temperature measurements throughout the watershed show a general pattern of what would be expected—cooler temperatures in the forested headwater reaches and warmer temperatures in the lower reaches as the river increases in size and has a more open canopy (Figure 10). The upper sixteen miles of the Stonycreek River are classified as coldwater fisheries, the middle reaches are classified as trout stocked fisheries, and the lower sixteen miles are classified as warmwater fisheries. A few sites in the coldwater reaches showed higher than expected temperatures. On the main stem higher than expected temperatures were found at the upper most sampling site (site 19B), Glessner's Covered Bridge (site 15), below the mouth of Lamberts Run (site 14) and below Beaverdam Creek (site 12).


Testing for nitrate levels in the stream.

Figure 10. Temperature values on mainstem Stonycreek River.



Four water chemistry parameters were measured in both the reassessment and in the initial USGS study, which will be the basis of historical comparisons. These variables include pH, stream temperature, specific conductance, and iron. The following figures show comparisons between values during the USGS study from 1992-1994 and the current reassessment.

Generally speaking, pH was higher and iron levels were lower during the reassessment than during previous sampling years (Figures 11, 14). Only one site, site 11 in Kantner, had a lower pH value in the reassessment than in the USGS study, and the difference in pH values was negligible. Values of pH for sites 5 and 15 were consistently higher than at other sites sampled throughout all study years. Iron levels were generally lowest during the reassessment as compared with previous USGS samples (Figure 14). The occurrence of higher pH values and lower iron levels may suggest that on the ground passive treatment systems are indeed effective in combating negative influences of AMD.

Water temperature and conductivity values varied widely throughout sampling years. USGS water chemistry sampling during 1992 took place in September; 1993 sampling occurred during July; and USGS sampling in 1994 was conducted in May. Water temperature was higher during the 1993 sampling year, but other years varied considerably (Figure 12). Fluctuations in temperature are likely the result of varied ambient air temperatures, but could also be the result of increased or decreased canopy shading. Conductivity values varied widely throughout locations and sampling years and no clear pattern was exhibited (Figure 13).

Figure 11. pH values for mainstem sites sampled during USGS study and reassessment.

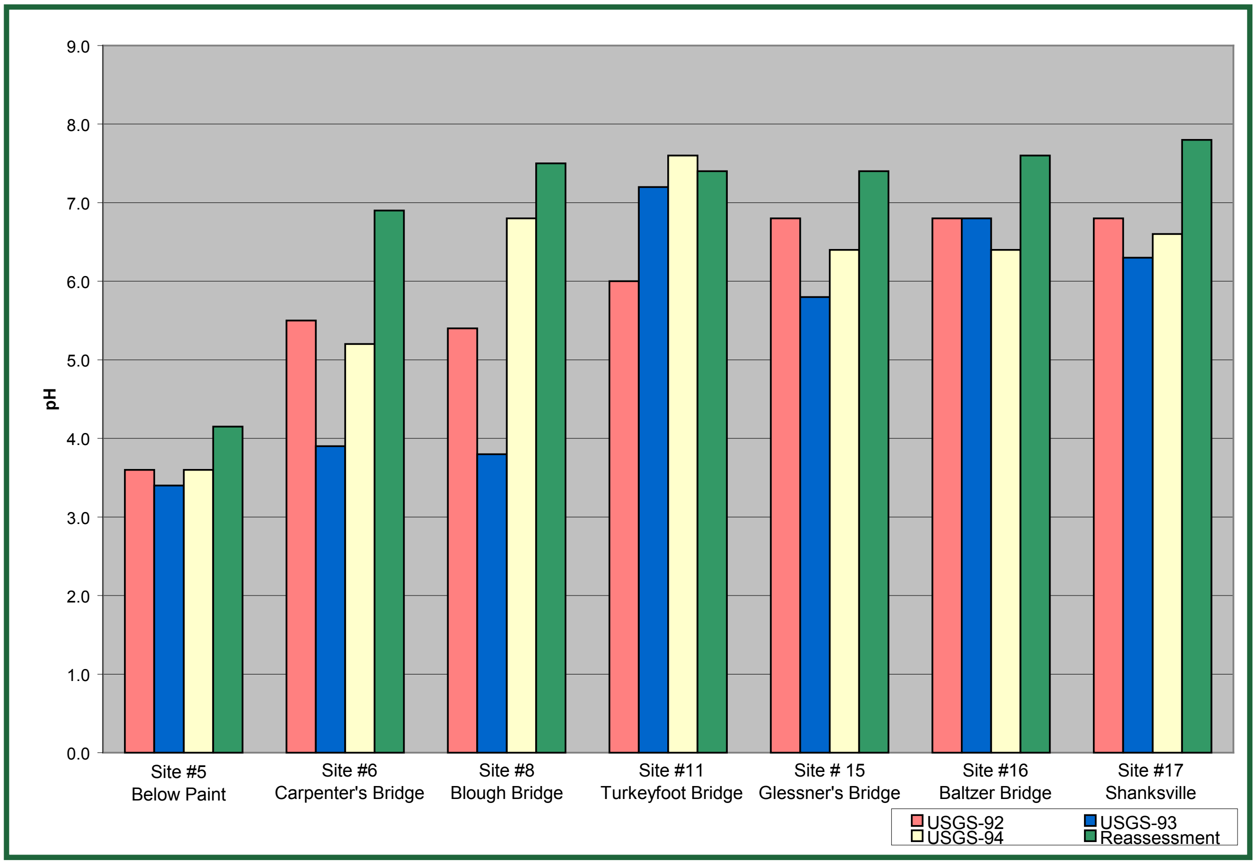


Figure 12. Temperature values for mainstem sites sampled during USGS study and reassessment.

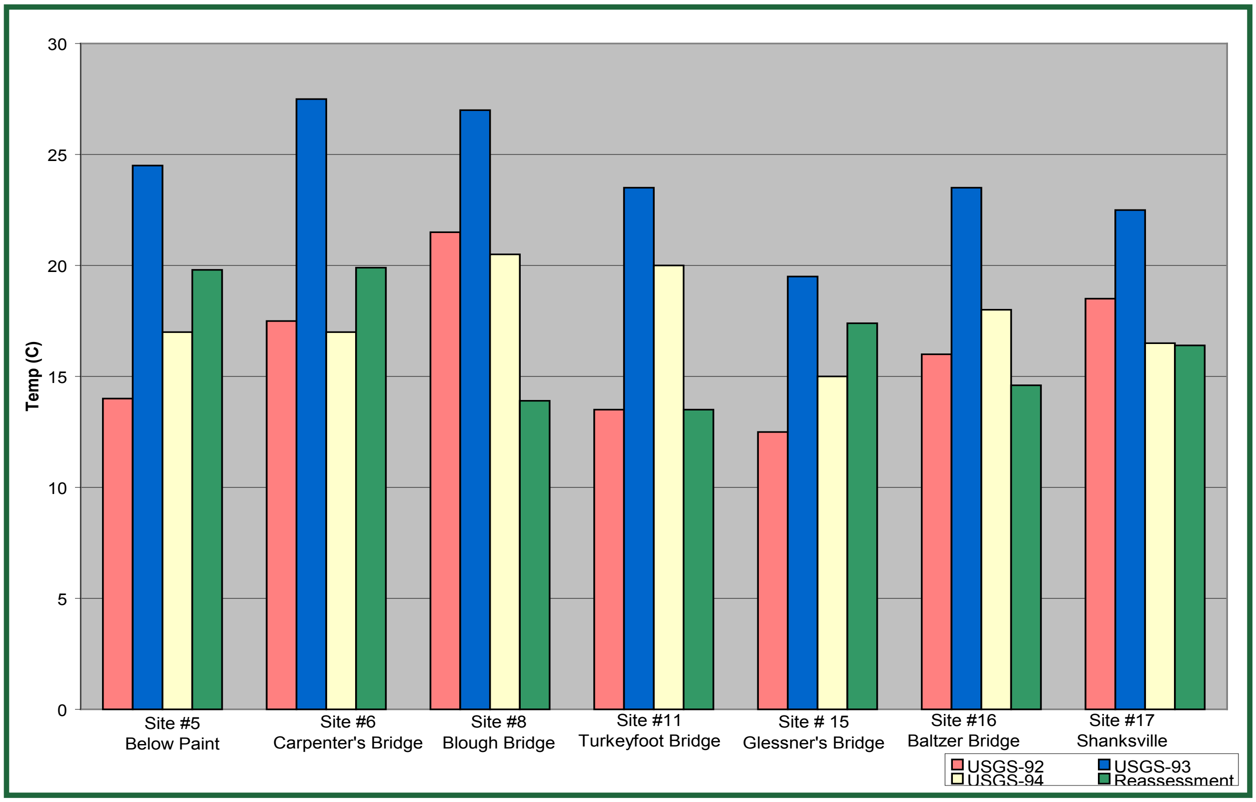


Figure 13. Conductivity values for mainstem sites sampled during USGS study and reassessment.

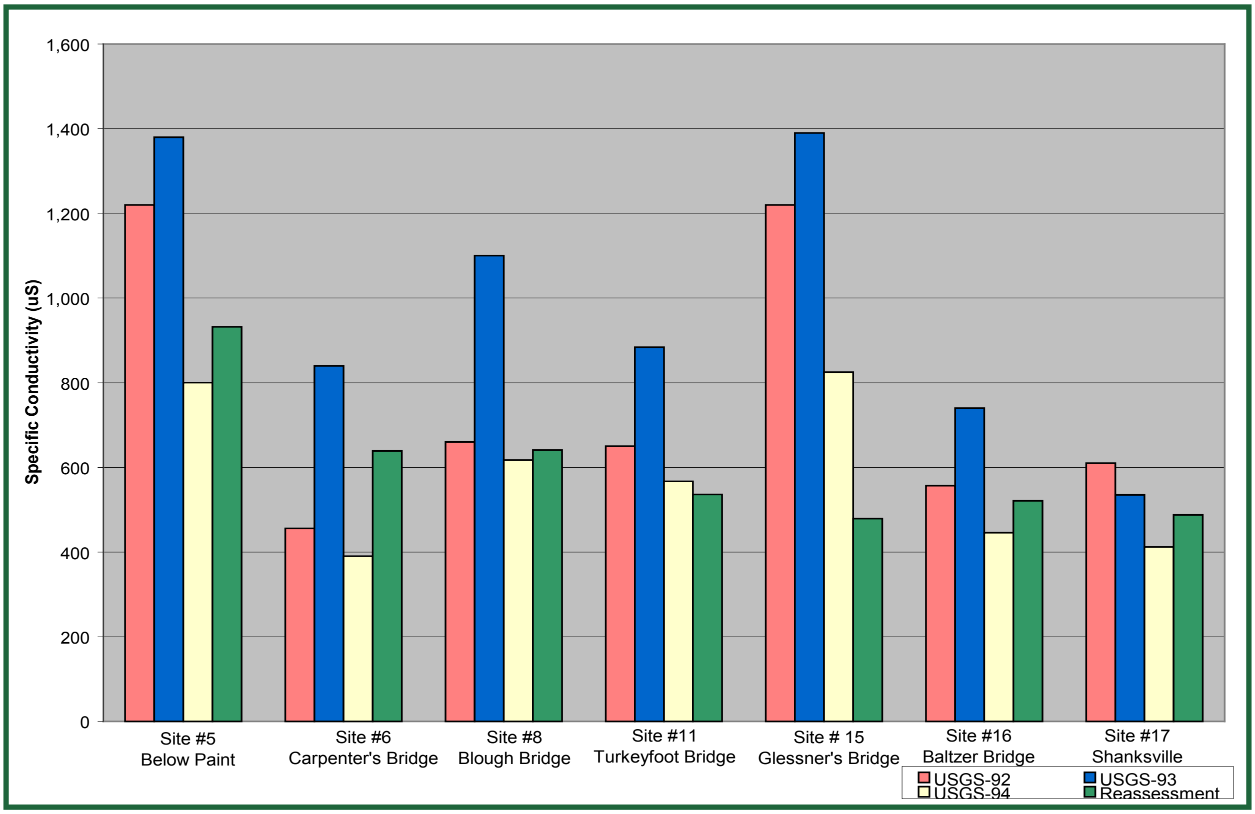
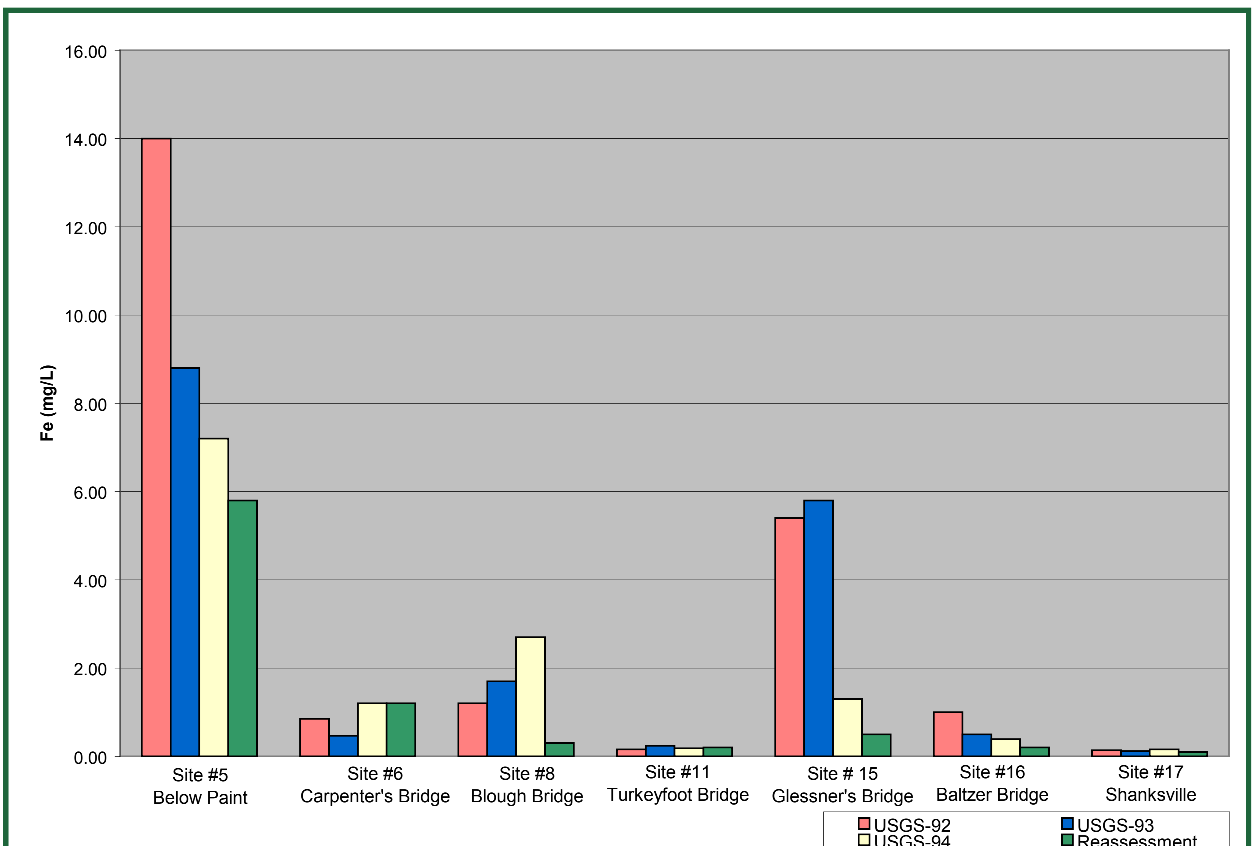


Figure 14. Iron values for mainstem sites sampled during USGS study and reassessment.



The Pennsylvania Code 93 (PA93) sets the standards that a stream must meet for its designated use. Designated uses of streams in the reassessment include coldwater fishery, warmwater fishery, trout stocked fishery, high quality stream, and exceptional value stream (Figure 15). Seven parameters measured during this survey were compared to the PA93 designated use standards for each stream. Standards used for these comparisons included pH, total dissolved solids, nitrates, dissolved oxygen, total iron, total sulfates, and temperature. Site numbers and PA93 violations are shown in Table 4. Chemical testing revealed that twenty of the sampled sites were in violation of one or more criteria of their designated use as assigned by PA93. The most common violation was temperature, with nine sites having a higher than acceptable temperature allowed by their designated use. Eight sites exceeded pH standards, and six of these same sites also exceeded designated iron values. As expected, sites that exceeded standards for pH and iron were located in areas highly influenced by AMD.

Figure 15. Chapter 93 designated uses for streams in Stonycreek River watershed.

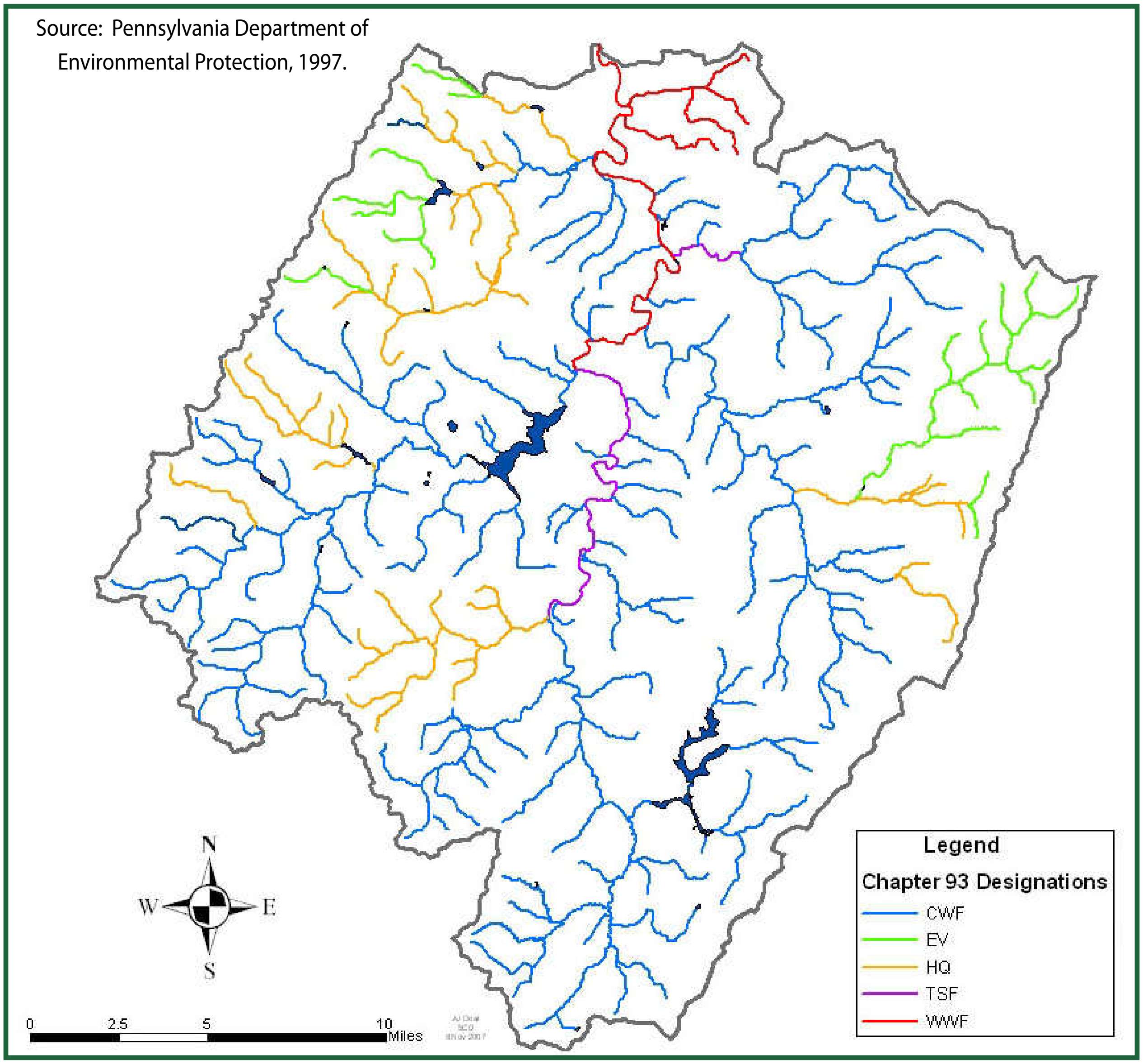


Table 4. Water chemistry PA93 violations.

Site Number	Stream	Location	PA Code 93 Violation
1	Stonycreek River	Haynes Street Bridge	None
2	Stonycreek River	Ferndale downstream of Bens Creek	None
3	Bens Creek	Bridge by St. Andrews	Temperature
4	Stonycreek River	Bridge at Krings	pH, Iron
5	Stonycreek River	below mouth of Paint Creek	pH, Iron
6	Stonycreek River	Carpenter's Bridge	None
7	Shade Creek	Rt. 601 Bridge	pH, Iron
8	Stonycreek River	Blough Bridge	None
9	Quemahoning Creek	219 Bridge	Temperature
10	Stonycreek River	downstream of Oven Run	None
11	Stonycreek River	Turkeyfoot Bridge	None
12	Stonycreek River	Upstream of Beaverdam Creek	Temperature
13	Wells Creek	Wells Creek Mouth	Temperature
14	Stonycreek River	Mouth of Lamberts Run	Temperature
15	Stonycreek River	Glessner Covered Bridge	Temperature
16	Stonycreek River	Baltzer Bridge	None
17	Stonycreek River	Shanksville	Temperature
18	Stonycreek River	Yonai Bridge	None
19	Glades Creek	Rt. 31 Bridge	None
19B	Stonycreek River	Rt. 31 Bridge	Temperature
20	Quemahoning Creek	4023 bridge	Nitrates
21	Lamberts Run	Lamberts Run mouth	TDS
22	Stonycreek River	Hollsopple Bridge	None
23	Stonycreek River	below confluence with Shade	None
24	Fallen Timber Run	at Hooversville	pH, DO
25	Beaverdam Creek	at Stoystown	None
26	Pokeytown Run	at Wilbur	pH
27	Oven Run	at Rowena	pH, Iron
28	Shade Creek	at Central City	pH
29	Shade Creek	near Hillsboro	pH, Iron
30	Clear Shade Creek	below project	None
31	South Fork Bens Creek	at 985 bridge	pH, Iron
32	Miller Run	mouth of Miller Run	None
33	South Fork Bens Creek	upstream from sportsmen's club	None
34	Rhoads Creek	near Shanksville	Temperature

Overall, the results of chemical testing suggest that a large amount of AMD influences are being addressed, but many locations throughout the watershed still have significant water chemistry impairments that need to be confronted. AMD is still the main limiting factor throughout the watershed, but agricultural influences are also becoming apparent, especially in the upper reaches.

Benthic Macroinvertebrates

Benthic macroinvertebrates are animals without backbones that are visible to the naked eye and live on or beneath the substrate of aquatic environments. Common benthic macroinvertebrates include aquatic insects, crayfish, snails, and aquatic worms. These organisms live on rocks, logs, leaves, aquatic plants or sediment within the stream. Benthic macroinvertebrates are good indicators of stream health for numerous reasons. They are fairly immobile and are unlikely to escape the effects of local sedimentation and other pollutants that degrade water quality. Benthic macroinvertebrates are extremely diverse and have a wide range of tolerances to various pollutants. Some species are sensitive to pollution and will not be present where environmental conditions are degraded, while some species proliferate in polluted systems. Many macroinvertebrates spend several years in the stream as larvae, so they can potentially be used to detect past environmental problems.

The reassessment is the first time that systematic biological sampling has taken place throughout the Stonycreek River watershed. Although watershed-wide sampling up to this point has been lacking, various groups have collected macroinvertebrates on specific reaches or tributaries. Higgins Run, a tributary to Quemahoning Creek, was sampled at six locations and results showed decreasing macroinvertebrate diversity from 2003 to 2005 (Macri 2004, Macri 2005). Herb et al. (1981) sampled macroinvertebrates on six Stonycreek River tributaries and found extremely low diversity and total numbers. Other groups have sporadically sampled macroinvertebrates throughout the years, but no formal analyses have been performed and no cumulative database exists.

Photo courtesy of Eric Null

A Perlid stonefly.

The purpose of sampling macroinvertebrates as a component of the reassessment was to develop current watershed-wide biological data and also develop the protocols by which future assessment should take place within the watershed. By using one set of assessment protocols, all data collected within the watershed—even data collected by different groups, will be able to be formally compared and more complete evaluations can be carried out.

In the reassessment, macroinvertebrates were sampled at 35 sites from May 2007 through August 2007. Seventeen sampling sites were on the main stem of the Stonycreek River and eighteen sites were on tributaries. Five sub-samples were taken from across riffle areas with a D-frame kicknet according to EPA Rapid Bioassessment Protocols (Barbour et al. 1999). All sub-samples were pooled into one sample, organisms were preserved, and returned to the lab for enumeration and identification to the lowest practical taxonomic level (usually genus level). Identifications were completed in house by the SCD's taxonomist, who has eight years of supervised taxonomic experience. Voucher specimens for each site were obtained and are stored at the SCD's office.

Photo by Dave Kemp

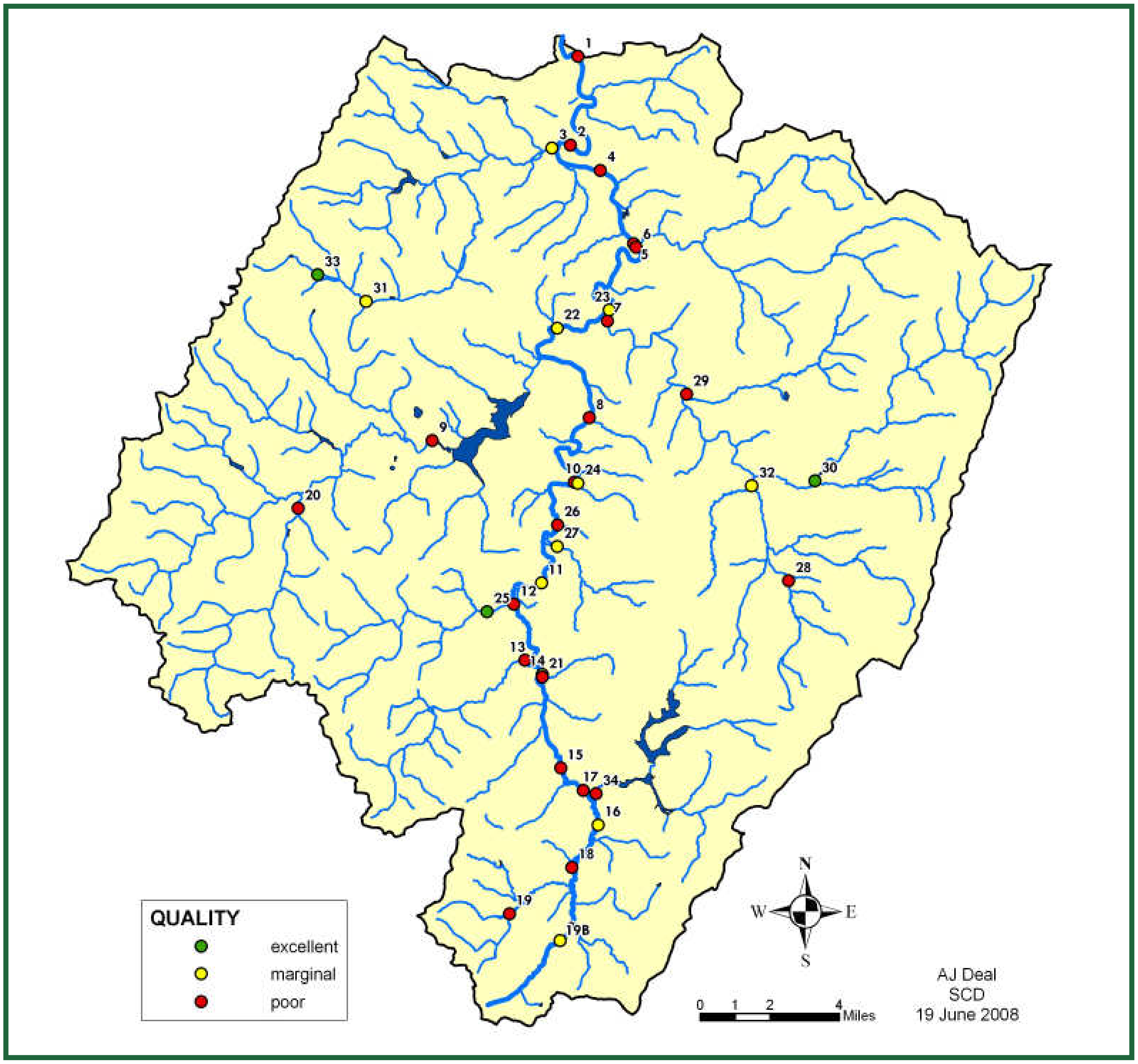
Sampling macroinvertebrates with a D-frame kicknet.

There are many different methods of assessing biological data. For example, one can look at the total number of organisms, the diversity of organisms, the relative abundance of different classes of organisms, or the presence or absence of sensitive species. One method of combining multiple measures is through an index of biotic integrity (IBI). An IBI incorporates several categories of stream community health into a single score that can be used to describe overall stream health. Each category has multiple metrics that identify specific taxa or attributes of groups of taxa to more specifically assess pollution impacts

In the reassessment benthic macroinvertebrate IBIs were calculated using two different methods. First, IBI scores were calculated according to PA DEP's statewide protocol, which includes six different metrics. Second, an IBI was developed specifically for the Stonycreek River watershed based on five categories (Barbour et al. 1999, Stribling et al. 1998). The Stonycreek specific IBI will be used for incorporation into the Stream Quality Index (SQI). Results of the PA DEP's IBI calculations will not be specifically discussed in this report because they are not comparable to the IBI scores developed specifically for the Stonycreek. The IBI specific to the Stonycreek River watershed will be discussed in further detail and a map showing results of the Stonycreek IBI is shown in Figure 16.

In the Stonycreek IBI, three sites (9%) had excellent benthic IBI scores. These sites were located on Clear Shade Creek below the fly fishing only section, on South Fork Bens Creek above the Ferndale Sportsmen's Club, and near the mouth of Beaverdam Creek near Stoystown. All three of these sites are mostly forested upstream and have minimal agricultural, AMD, and urban influences. Eleven sites (31%) scored marginal and 21 (60%) scored poor. Sites with poor IBI scores are scattered throughout the watershed. In the upper reaches of the watershed, sites are heavily impacted by agriculture and its effects are having a negative impact on the macroinvertebrate communities. In the middle reaches, AMD is prevalent and most macroinvertebrate species collected in this section are pollution and acid tolerant. In the lower-most stretch, the stream is heavily impacted by urban effects, as the banks consist of concrete floodwalls, and instream habitat for macroinvertebrates is limited.

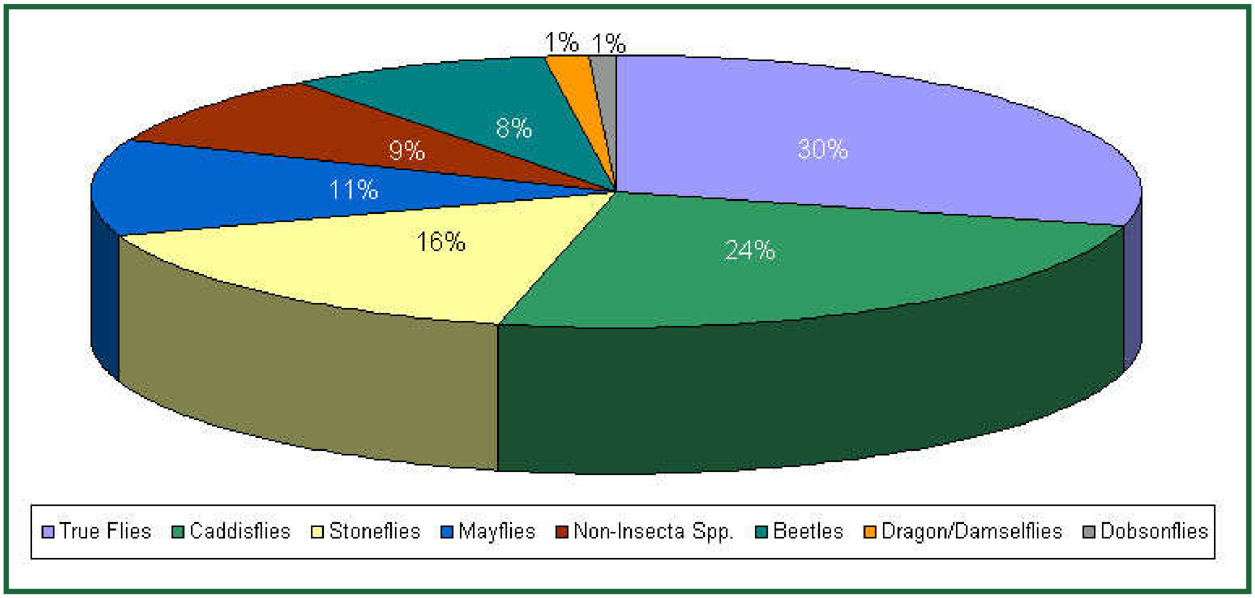
Figure 16. Benthic Index of Biotic Integrity (IBI) scores.



Throughout the reassessment over 2,000 macroinvertebrates were collected and identified, and 57 families and 91 genera were represented. The most common macroinvertebrate family collected was True Flies (Diptera), mostly non-biting midges (Chironomids) (Figure 17). Midges are two-winged insects as adults, but spend their larval stage in the water where they are an important food source for other aquatic organisms.

Caddisflies (Tricoptera), Stoneflies (Plecoptera), and Mayflies (Ephemeroptera) were collected in the next highest numbers throughout the watershed. These macroinvertebrate families, collectively referred to as EPT, have many member species that are sensitive to pollution. As a result, the number of EPT can provide some indication of water quality or pollution impacts. In the reassessment, the three sites with the highest IBI scores also had the greatest percentages of EPT. In contrast, the sites with the lowest IBI scores were dominated by pollution-tolerant species—mainly midges. The number of EPT taxa collected at each site is shown in Figure 18.

Figure 17. Percentages of macroinvertebrate families collected during the reassessment.



Diversity and number of macroinvertebrates collected at each site varied widely (Figure 19). Site 25 on Beaverdam Creek had the greatest diversity of taxa (29 genera) and also the greatest number of macroinvertebrates (356 individuals) collected. Fewer than ten total individuals were collected at eleven sites. Five sites had two or fewer taxa collected. On the Stonycreek River below Paint Creek, site 7, no macroinvertebrates were collected at all. At site 29 on Shade Creek only one organism, a midge larva, was collected.

Figure 18. Number of EPT taxa collected during reassessment.

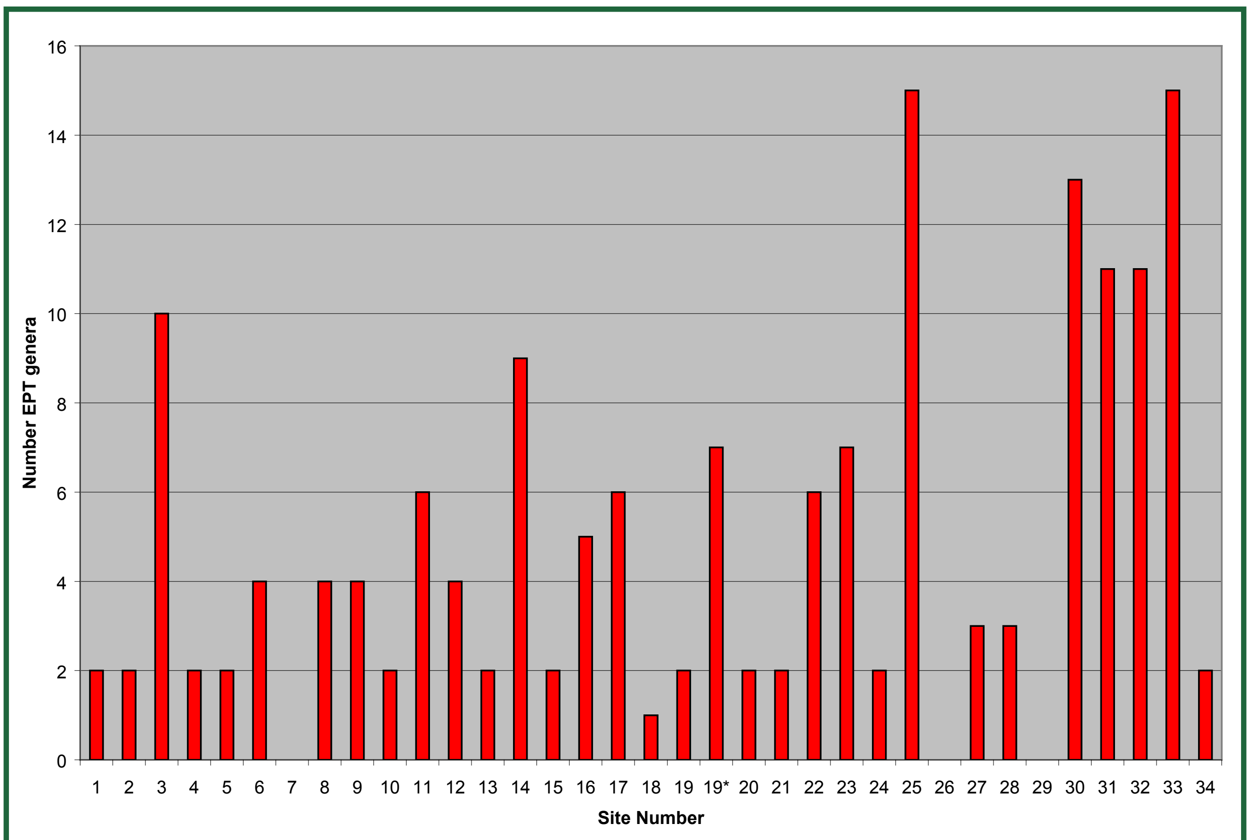
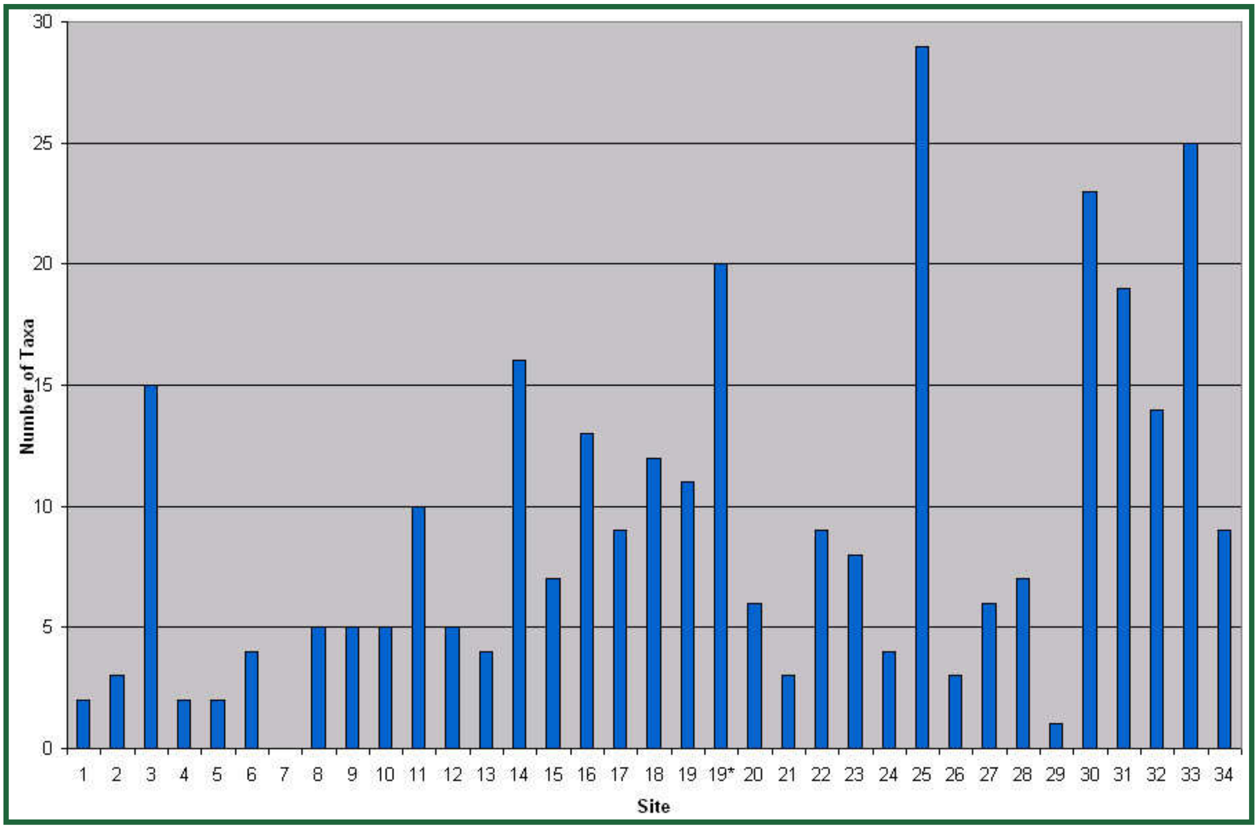


Figure 19. Total number of macroinvertebrate taxa collected at each site during reassessment.



Limiting factors to macroinvertebrate diversity are not just caused by the depressed pH in AMD. The low pH causes heavy metals to become dissolved in water. These metals are then absorbed by organisms, leading to respiratory and organ failure. The most limiting metal in AMD is aluminum; it can remain in solution with pH values as high as 5.7. As long as aluminum is in solution it can be absorbed by macroinvertebrates. Other metals in AMD are also limiting factors to diversity, and include mercury, arsenic, strontium, and iron. Iron is usually a limiting factor not because of its toxicity, but due to the blanket of metal it leaves on the bottom of the stream. This precipitate smothers most intolerant macroinvertebrates eggs, and only the most tolerant macroinvertebrates can flourish in an iron laden stream. The pH of water in a stream is usually higher where iron precipitates out of solution. Even if stream pH is potentially good, the blanket of iron will still cause a reduction in diversity of macroinvertebrates.

Organic loading is another limiting factor to macroinvertebrates. Organic compounds that are discharged into the stream cause an oxygen sink. Organics promote the growth of plants, which will deprive the stream of oxygen in the daytime. Through chemical reactions, some organic compounds can react with oxygen to form bonds, thus depleting the stream's oxygen level. The sources of organic pollutants are usually agriculture runoff, industrial facility discharge, and livestock. Macroinvertebrate numbers in an oxygen depleted environment are generally high because extremely tolerant species of midges, worms and leaches can live in very low oxygen environments. Therefore, when the stream is degraded with oxygen demanding waste, these organisms proliferate due to the lack of competition between other intolerant species.

Fishes

Fishes are perhaps the most familiar stream organisms and they make up a key component of healthy aquatic ecosystems. They feed on macroinvertebrates, detritus, or aquatic plants and are themselves a source of food for larger fish and terrestrial organisms. Like benthic macroinvertebrates, different fish species have varying degrees of tolerance to stressors, and therefore, provide an indication of stream water quality based on the presence or absence of certain species. Fish size structure also indicates water quality in that the presence of juvenile fish can indicate a reproducing population.

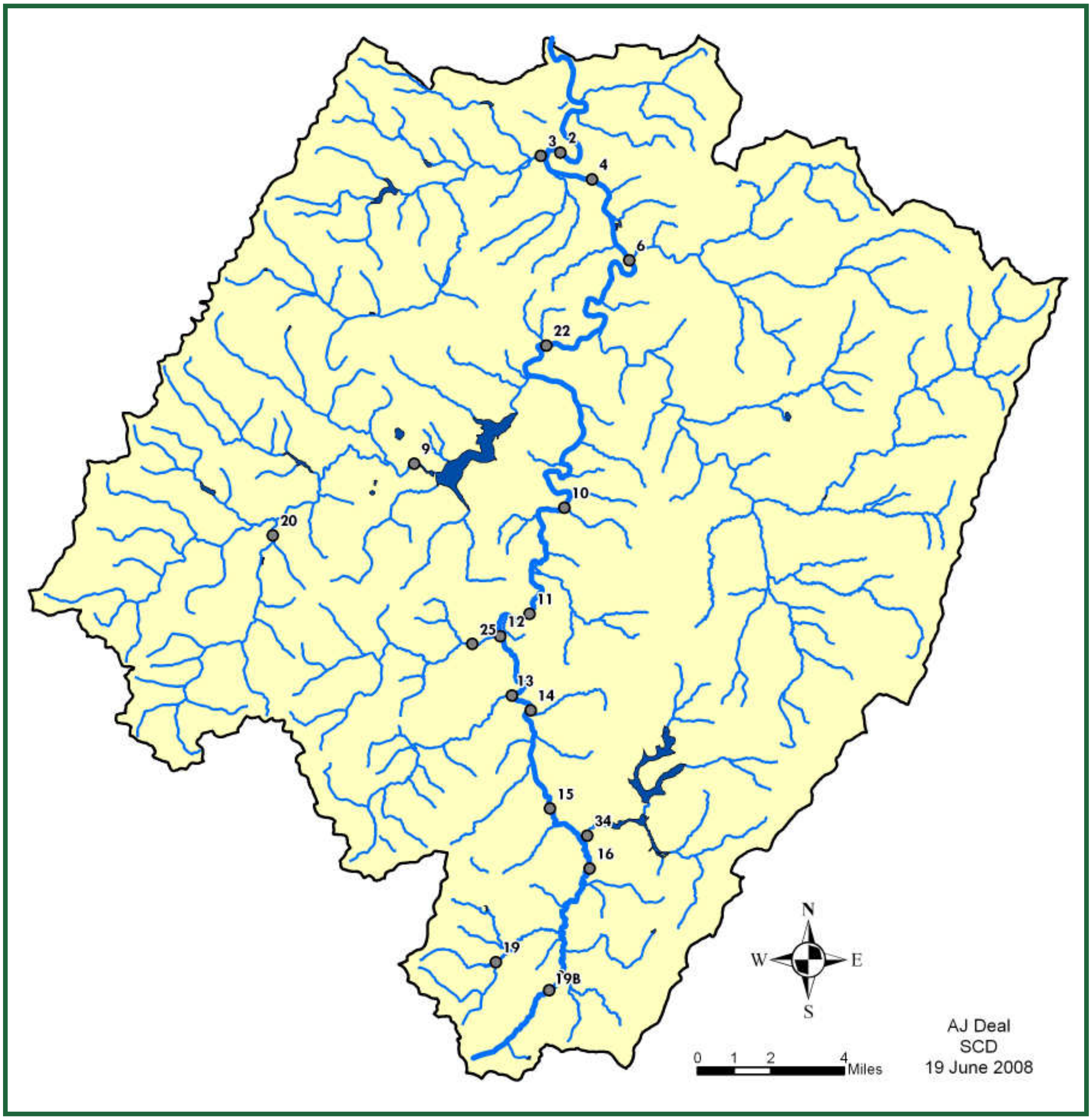
A rock bass and smallmouth bass captured by electrofishing during the reassessment.

Electrofishing during the reassessment.

Fishes have been sampled at several locations throughout the Stonycreek River watershed by the Pennsylvania Fish and Boat Commission (PFBC). The reassessment is the first time multiple sites from both the mainstem and major tributaries have been sampled during the same sampling season. Other sporadic fish sampling has been conducted by US EPA and PA DEP, but availability of these data is limited.

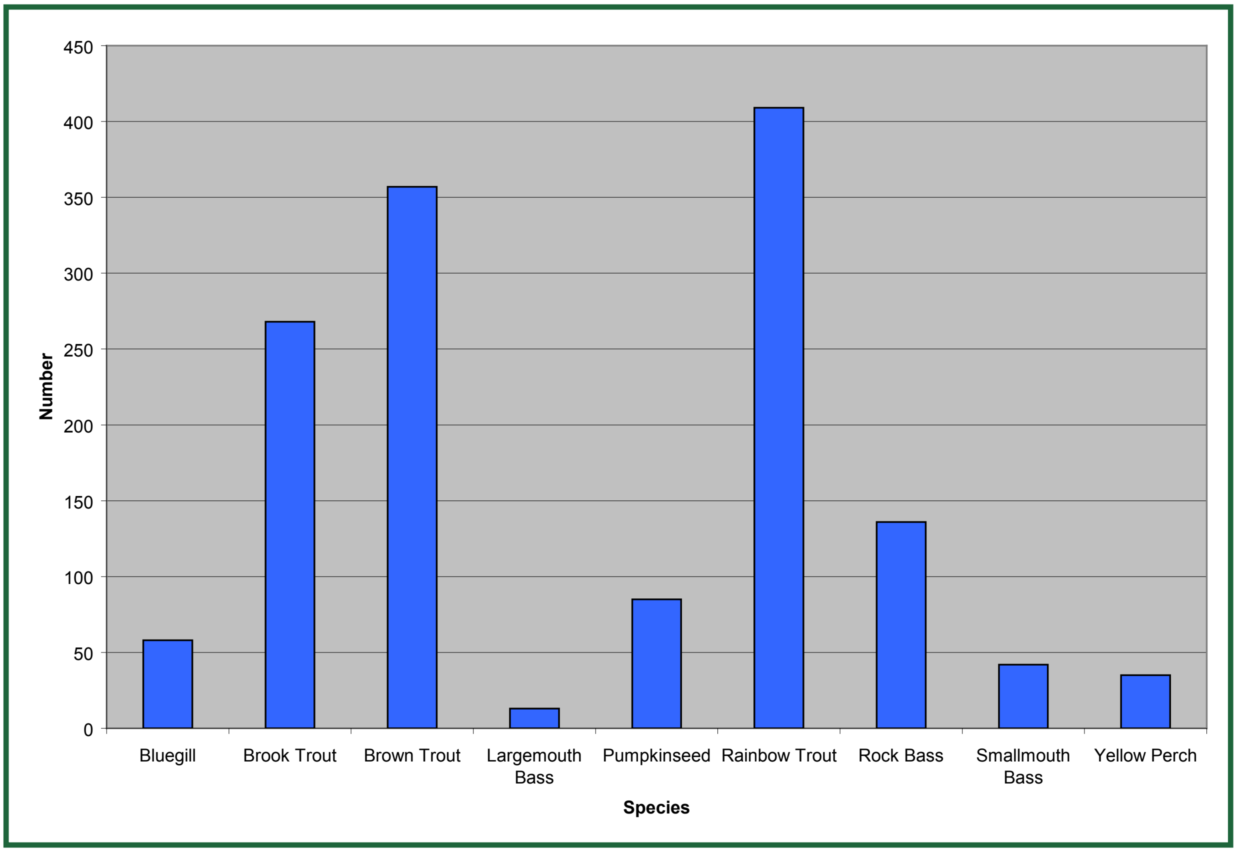
In the reassessment, fishes were sampled at 18 sites (Figure 20) using PFBC protocols. A backpack electrofishing unit was used to sample 200 m of stream and all fishes were collected, identified to species level and released. Some fish specimens were preserved and returned to the lab for positive identification.

Figure 20. Fish sampling locations.

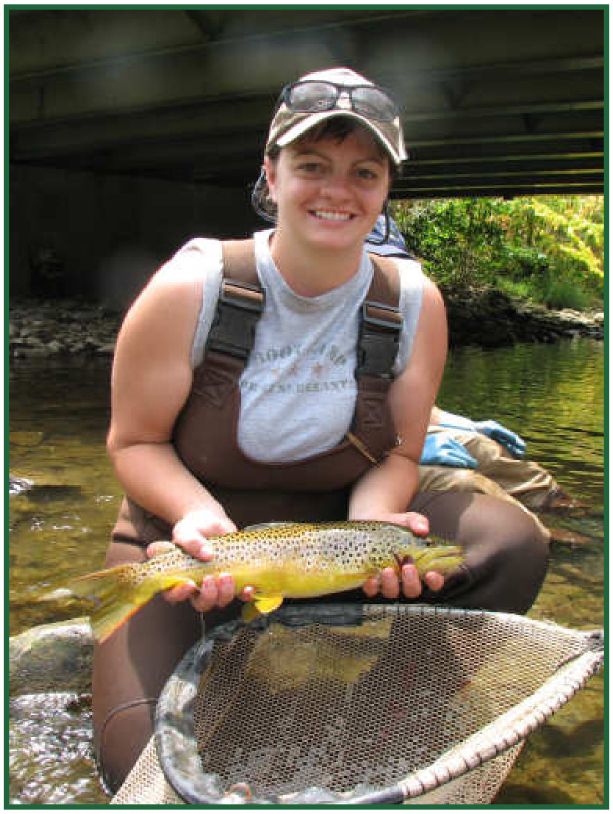


Over 6,000 individual fishes and thirty species were collected in the Stonycreek River watershed. Seven of the thirty species collected were game species and their numbers are shown in Figure 21. Of the game species, all three species of trout (rainbow, brown, and brook) were present and were more abundant than other species. The large majority of trout collected were hatchery fish and the large numbers are the result of the PFBC's stocking program.

Figure 21. Number of game fish species collected during reassessment.



A brook trout (left) and rainbow trout (right) collected during the reassessment.



(Above left) A brown trout captured on a tributary to the Stonycreek River during the reassessment. (Above right) A smallmouth bass collected on the Stonycreek River. (Below) A net full of suckers and blacknose dase, all of which are common to the Stonycreek River watershed.

However, most fishes caught on the survey were not game species. The most common species was the pollution-tolerant blacknose dace, which made up 18% of all fishes caught. mottled sculpin (15%) and white suckers (14%) were also present in high numbers. Of the seven fish families represented, minnows were the most abundant (Figure 22).

Abundance and diversity varied greatly throughout the watershed. The greatest diversity was recorded at Turkeyfoot Bridge in Kantner (Site 11) where nineteen different species were captured. The most fish (929) were caught near the mouth of Bens Creek (Site 3). Site 20 on Quemahoning Creek had the fewest number (41) of fishes collected and the lowest diversity (6 species).

An IBI was also developed to assess the fish community at the eighteen sites. The IBI utilized metrics and theory from the Maryland DNR (Roth et al. 2005) and US EPA (Barbour et al. 1999). The IBI incorporated six categories (number of benthic species; percent generalists,

Small, common, non-game fishes collected during the reassessment. (L to R) blunt-nose minnow, Johnny darter, and fantail darter.

ominivores, and insectivores; percent insertivores; percent dominant taxa; percent tolerant taxa; and percent simple lithotrophic spawners) to determine the quality of the fish community. Each metric was scored from 0-5 with zero indicating severely impacted and five indicating excellent quality. The total maximum score that could be received by a site was thirty. Sites with score ranges of 21-30 were considered excellent; sites with ranges 11-20 were considered impacted; and sites with a total score of ten or below were considered severely impacted. These scores will not be added to the SQI because not all 35 sites were sampled for fish. Fish IBI scores are shown in Table 5.

Figure 22. Abundance of fish families collected during reassessment.

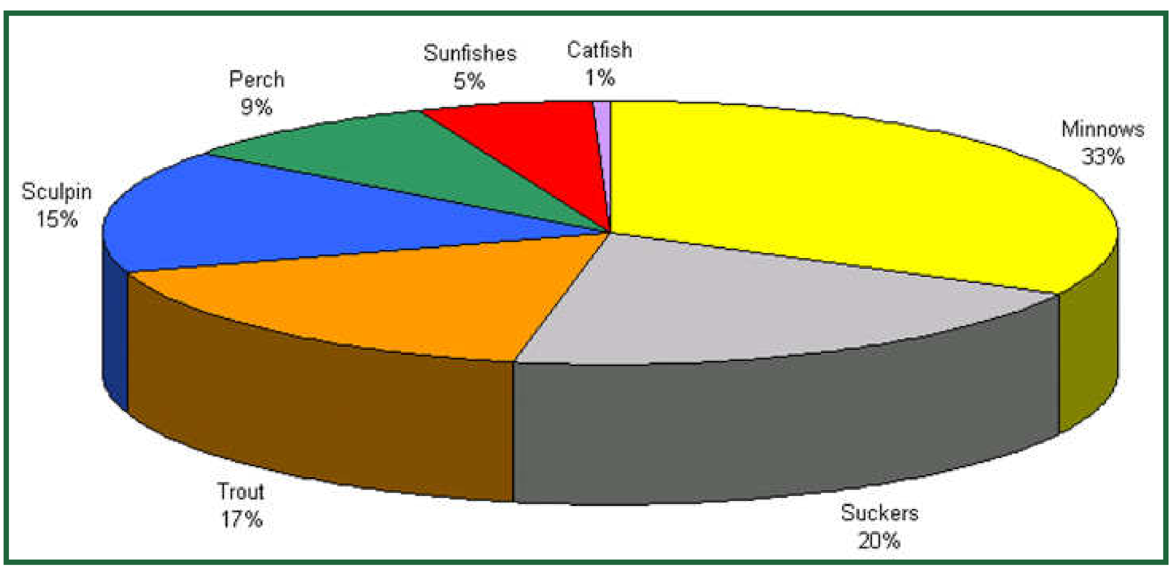


Table 5. Stonycreek River watershed fish IBI scores.

Site Number	Site Location	Score
2	Stonycreek at Ferndale	19
19	Glade Creek	14
34	Rhoads Creek	24
13	Wells Creek	17
25	Beaverdam Creek	19
20	Quemahoning Creek at SR4023	14
3	Bens Creek	23
19B	Stonycreek at Rt. 31	8
16	Stonycreek at Baltzer Bridge	20
15	Stonycreek at Glessner Covered Bridge	20
14	Stonycreek upstream of Wells Creek	17
12	Stonycreek upstream of Beaverdam Creek	17
11	Stonycreek at Turkeyfoot Bridge	19
10	Stonycreek downstream of Oven Run	19
22	Stonycreek at Hollsopple	21
6	Stonycreek at Carpenters Park	11
4	Stonycreek at Krings	15
1	Stonycreek at Haynes Street Bridge	19

Based on fish IBI scores, three sites had excellent fish communities. Two of these sites were on tributaries (Rhodes Creek Site 34 and Bens Creek Site 3) and one was on the main stem of the Stonycreek River (at Hollsopple Site 22). Only one site (Site 19B Stonycreek at Rt. 31) had an IBI score under ten and was considered severely impacted. The remaining 15 sites had fish IBI scores in the moderately impacted range.

Even though the IBIs for fishes and benthic macroinvertebrates describe a measure of biotic integrity, the benthic IBI score may not always agree with the fish IBI score. Fish and macroinvertebrates react differently to pollution stressors. Macroinvertebrates move by drifting downstream, while fish can move throughout the stream both upstream and downstream. For example, Rhoads Creek (Site 34) had an excellent fish IBI score, but was rated poor when considering the benthic macroinvertebrate IBI. Rhoads Creek forms from the outflow of Lake Stonycreek, and although some species like rock bass have locally reproducing populations, some of the fish collected were likely escapees from the reservoir and not permanent residents of Rhoads Creek.

Historic data was available for eight sites that were sampled in the reassessment. In general, more fishes were collected and a greater diversity was present in the Stonycreek River watershed when comparing data from the reassessment with historic data. All eight sites had more species present now than in historic records (Figure 23) and all sites with the exception of Site 22 had more total fish collected (Figure 24). Site 22 had greater species richness in the reassessment, but fewer total fish. In the current assessment the river at Site 22 was experiencing episodes of turbidity, which may have reduced the visibility of fish in the water, thus reducing the catch rate and being responsible for the lower number of fishes collected when compared with historic data.

Figure 23. Comparison of number of fish species collected during reassessment and previous sampling efforts.

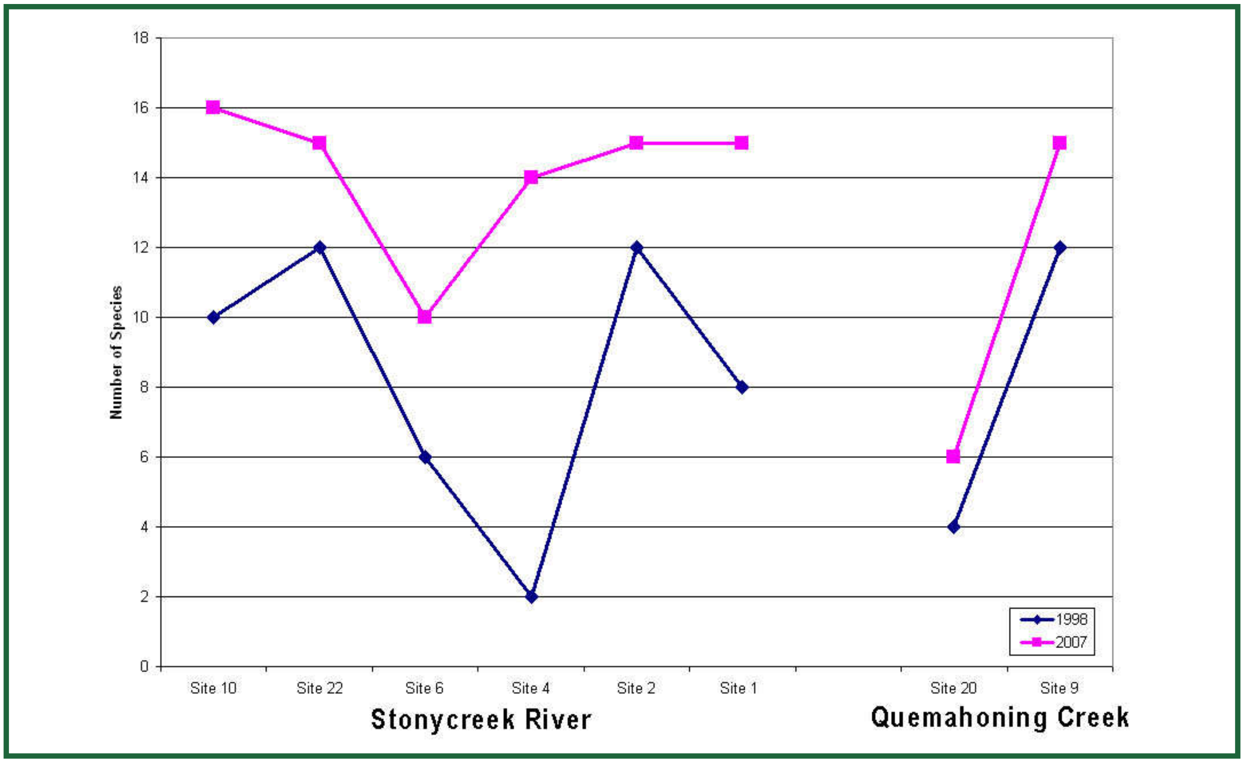
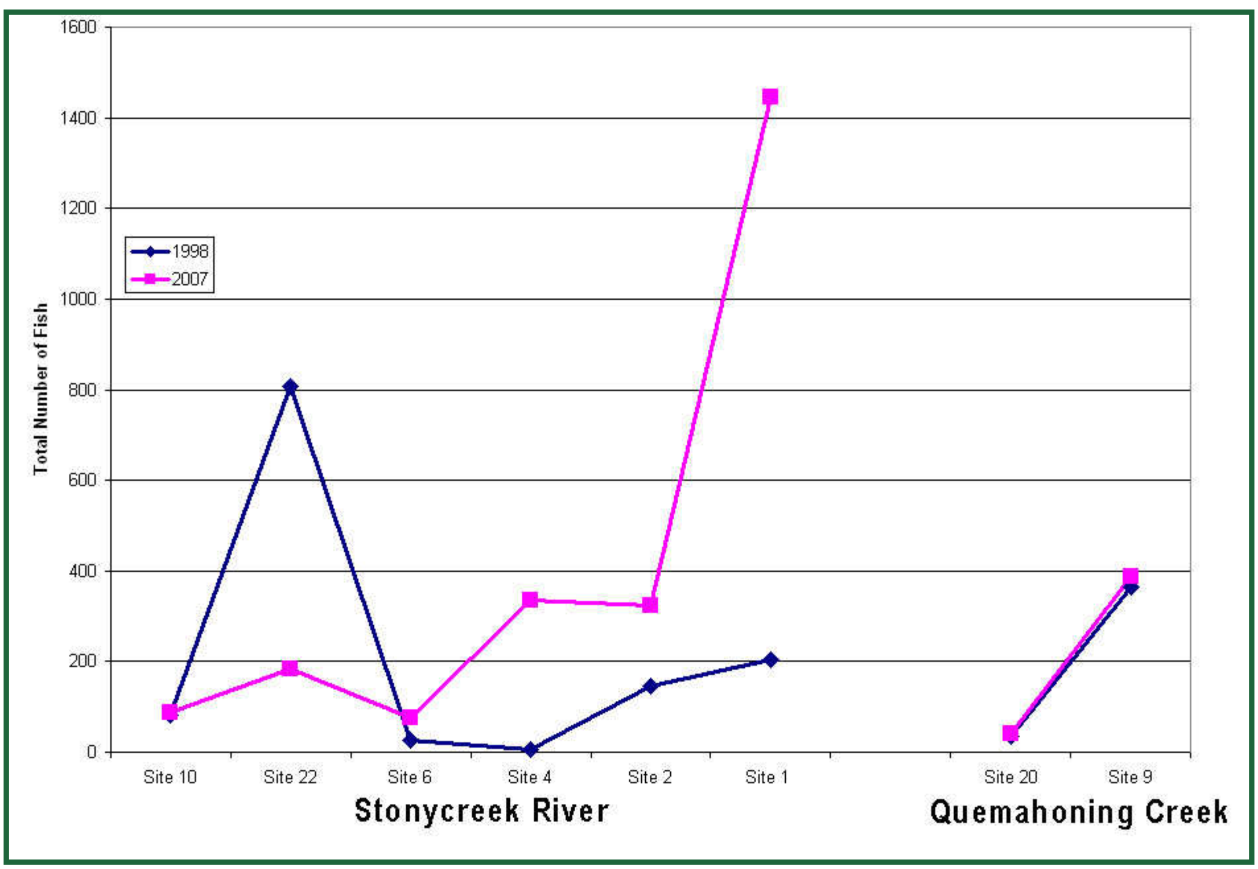


Figure 24. Comparison of total number of fishes collected during reassessment and previous sampling efforts.



Site 4, Stonycreek River at Krings, showed a drastic increase in both diversity and total number of fish. In 1998, only five total fish representing two species were collected. In the reassessment, 334 total fish representing fourteen species were collected. This is a dramatic improvement in the fish community and suggests that conditions are improving. However, most species collected in the reassessment at Krings are considered pollution tolerant and abundant, suggesting that the water quality is not yet as good as it can be.

Fallfish had been thought to be absent from the Ohio River drainage (Cooper 1983). However, recent surveys on the Monongahela River and angler reports of catching fallfish in the Stonycreek River suggested otherwise and results of the reassessment support these findings. During the fish survey portion of the reassessment, 47 fallfish were collected, suggesting that the species has moved into the Ohio River basin and has established healthy, naturally reproducing populations.

(Right) A fallfish caught on the Stonycreek River.

(Below left) A young smallmouth bass and (below right) a shield darter collected during the reassessment.

Recommendations

The Stonycreek River watershed has sustained many impacts to chemical, physical and biological integrity. Though the Stonycreek River has improved dramatically in the thirteen years since mine drainages were sampled in the initial USGS study, remediation efforts are still in order. This survey has determined that there are still large acid impacts within the watershed, but the limiting factors to the upper Stonycreek River are organic and sediment loading, along with physical habitat impacts. For discussion purposes, the watershed will be broken down into their designated uses as defined by DEP Chapter 93—cold water fisheries, trout stocked fisheries, and warm water fisheries. The sites sampled within the watershed have been further broken down into three categories:

1.) Severely Impacted: areas where reclamation and remediation need to take place and should be the first areas considered for future pollution abatement projects.

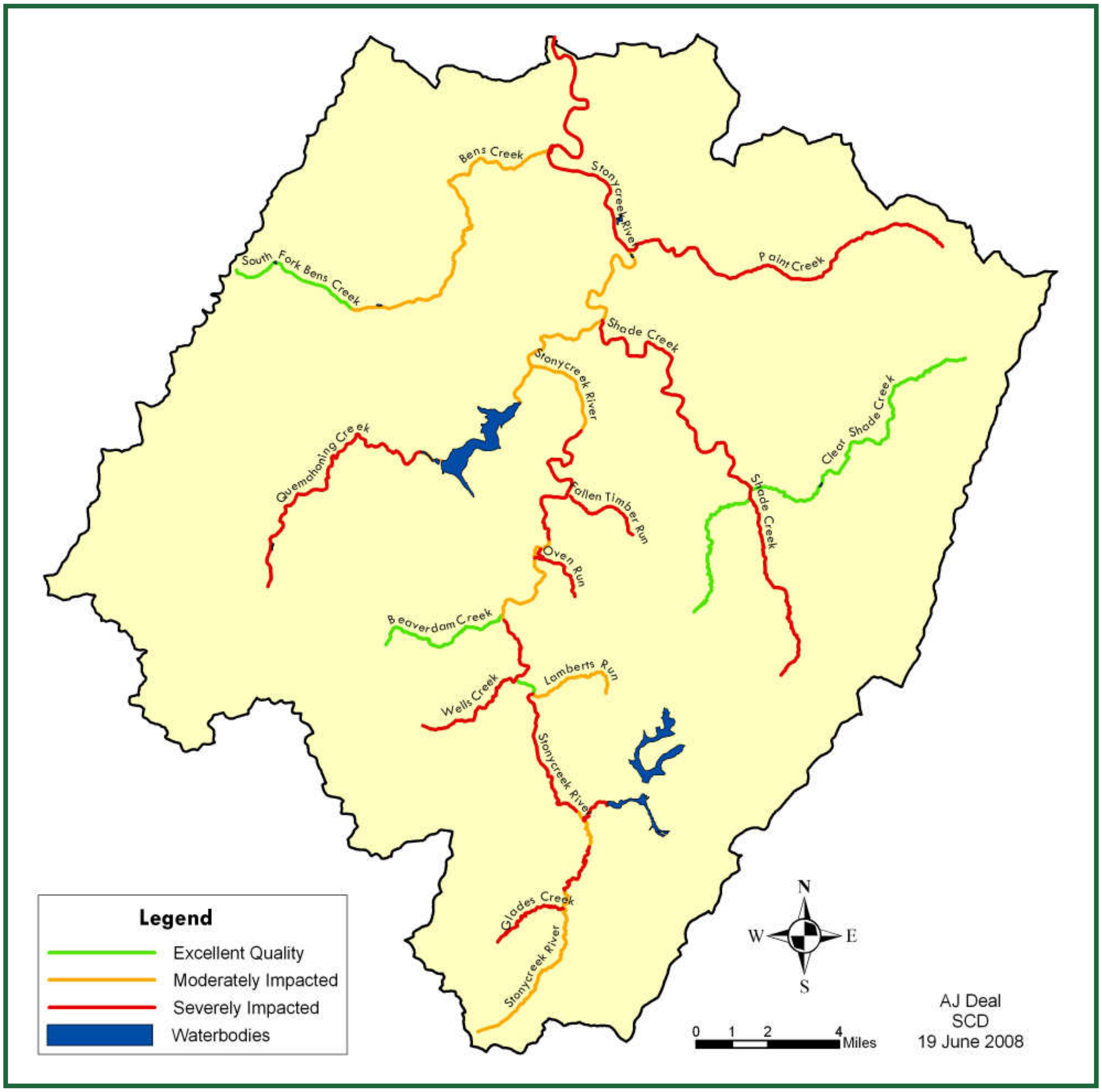
2.) Marginally Impacted: reaches that have impacts to their ecosystems but are not severely degraded. The most likely course of improving these stream segments is the reclamation of severely impacted areas, which will contribute better water quality to the overall watershed.

3) Excellent Condition: the most pristine sites in the watershed. Efforts and future development protocols should be focused on maintaining this condition.

The results of the SQI are depicted in Figure 25, a GIS map of the watershed.

Amanda Deal monitors an unabated mine discharge that flows into Hoffman Run, a tributary of Quemahoning Creek.

Figure 25. Impacted areas of the Stonycreek River watershed as determined by the stream quality index.



Severely Impacted Sites

Cold Water Fisheries

In the CWF portion of the watershed there are three severely impacted sites on the mainstem of the Stonycreek River and three severely impacted tributaries.

Site 15 Glessner Covered Bridge

This site is the location of one of the premier stocked trout fisheries in the watershed, but has a depressed macroinvertebrate community and a higher than allotted temperature. According to fish survey data the diversity of fish in the area is good, but the macroinvertebrate community suggests otherwise. The limiting factor to this site's macroinvertebrate community is likely organic loading. A seasonal sampling regime must be instated to monitor the episodic impacts to this stream reach.

Site 17 Stonycreek River at Shanksville

This site has high in-stream water temperature and degraded physical habitat (particularly due to siltation and lack of riparian buffer), which are adversely affecting the macroinvertebrate community. The physical habitat evaluation should be consulted and best management practices (BMPs) for runoff and riparian buffer establishment need to be implemented.

Site 18 Yonai Bridge

The Yonai Bridge area is upstream from Shanksville and could be the major contributor to physical impairments downstream. Yonai Bridge has severely degraded physical habitat due to erosion, no riparian buffer, and intense siltation. Implementation of educational outreach to the farming community is a must in this area. The agricultural fields surrounding this area limit beneficial physical characteristics.
Impacted Tributaries

Site 13 Wells Creek

Historically the Wells Creek watershed has been impacted by AMD. In recent years various AMD abatement projects have taken place in the Wells Creek sub-watershed and address the bulk of the AMD problems. It appears that Wells Creek is now suffering from organic loading and physical habitat impairments in the upper reaches of the sub-watershed. Wells Creek was sampled at its mouth and the severely depressed macroinvertebrate community suggests that these impacts are taking place in the upper reaches of the sub-watershed. The fish survey yielded ten species, which is low diversity when compared to other sampling locations. Wells Creek has an established watershed association which can sample the needed areas. Wells Creek must be sampled seasonally at both peak and base flows to determine the source of any organic loading. A full physical habitat survey must be performed throughout the watershed to determine the extent of physical impairments. Also, sampling for episodic or chronic acidification from the various mine sites within the watershed is recommended.

Site 19 Glades Creek

Glades Creek is the first major tributary to the Stonycreek River. It is also heavily impacted by agricultural land use. The macroinvertebrate assemblage signifies a community that lives in organic and sediment loaded water. The physical habitat score is the second lowest in the study. The fish survey did yield twelve species but, the majority of fish species caught are very organic or pollution tolerant. This sub-watershed has a heavy concentration of non-traditional Mennonite and Amish farms. These farmers need to participate in educational programs and have BMPs installed on their farms to not only improve Glades Creek, but also to improve their farmland by eliminating the loss of land due to erosion.

Agriculture is prevalent in the Glades Creek watershed.

Site 34 Rhoades Creek

Rhoades Creek is a small tributary that forms from the outflow of Lake Stonycreek. This creek shows impacts of siltation and episodic acidification. The releases from Lake Stonycreek and Indian Lake must also be considered. Since little is known about this tributary a more thorough evaluation of this watershed must be performed to address its depressed macroinvertebrate community.

Sites 9 and 20 Quemahoning Creek

Quemahoning Creek watershed is one of the largest sub-basins within the Stonycreek River watershed and has reaches of extremely poor stream integrity, but also shows signs of stream recovery downstream. Site 20 was the most severely impacted site sampled in the entire reassessment. Evaluation of this site shows that instream habitat is severely lacking; iron and nitrate levels are notably elevated; and biota present are minimal, pollution tolerant, and lacking diversity. The portion of the watershed upstream of site 20 is heavily impacted by both AMD and poor agricultural practices, as is confirmed with the high levels of iron and nitrate. In order for this stream segment to recover, agricultural BMPs should be implemented and AMD abatement should be considered beginning with headwater discharges.

Lower reaches of Quemahoning Creek.

The second sample site on Quemahoning Creek (Site 9) improves from severely impacted to moderately impacted and displays the positive effects of AMD abatement projects. Two passive treatment systems—Boswell Passive Treatment System and Jenners Passive Treatment System, are in place between the two sampling points on Quemahoning Creek and have a notable impact on reduction of iron and conductivity. The Boswell Passive Treatment System alone is responsible for removing 141 tons of iron each year. Also, a limestone streambank enhancement project has further improved both water quality and physical habitat. Continued maintenance of these passive treatment systems and additional streambank and habitat enhancement projects will further enhance the stream integrity of this stream reach.

Site 21 Lamberts Run

Lamberts Run is a tributary to the Stonycreek River that has had many ups and downs. Results of the reassessment identified the stream as moderately impacted at the present time. However, the presence of extremely high levels of iron and other metals result in exceptionally high conductivity levels and a poor macroinvertebrate community comprised mainly of tolerant taxa. The headwaters of Lamberts Run are within the boundaries of the proposed Flight

Lamberts Run

93 National Memorial a Trout Unlimited funded remediation plan has been developed and may be implemented as a component of the overall National Memorial creation.

Trout Stocked Fisheries

The TSF portion of the Stonycreek River has one site on the mainstem that is severely impacted and three tributaries that are severely impacted—Oven Run, Fallen Timber Run and Pokeytown Run. All sites within this area of the river are impacted by AMD in some form. Projects are in place and more are being planned for this area. The mainstem of the Stonycreek River improves somewhat below Oven Run due to an increased buffering capacity that is supplied by the Oven Run Passive Treatment System and other nearby treatment systems. As for the impacted sites in this area, treatment options should be explored for Fallen Timber and Pokeytown Runs due to their small size and direct input into the river.

Warm Water Fisheries

The WWF section of the Stonycreek River contains the most ecologically unaltered areas of the watershed as well as the most impacted areas. There are four mainstem sites severely impacted in this stream reach and three tributaries that are impacted.

Paint Creek just before it enters the Stonycreek River.

Site 5 Stonycreek River below Paint Creek

Paint Creek is the limiting factor for this entire stretch of the Stonycreek River. There were no samples taken from Paint Creek itself on this survey, but the sample below the mouth shows the transition from a recovery zone, which is signified by Site 6 Carpenters Bridge to a stream severely impacted by AMD. Carpenters Bridge is directly above the mouth of Paint Creek and has recovering fish and macroinvertebrate communities. The major limiting factor at the bridge is heavy metals precipitating out from the large Shade Creek discharge. Shade Creek does not impact the Stonycreek River biota to the point of decimation, but does remove the river's buffering capacity. When Paint Creek flows into the Stonycreek River there is a limited buffer. Therefore, Paint Creek is detrimental to the water chemistry and biota of the Stonycreek River all the way to its confluence with the Little Conemaugh River. The high amount of heavy metals that Paint Creek supplies the Stonycreek River can be seen for upwards of 1 mile downstream from its mouth as iron, aluminum, and manganese deposits can be seen on all rocks in this area. The sites below Paint Creek (Site 1, Site 2, and Site 4) have somewhat better fish populations than they did in previous PFBC samplings, but the macroinvertebrate communities, and physical habitat at all sites are severely degraded due to high volumes of heavy metals. There are other mine seeps that flow into the Stonycreek River between Paint Creek and the Conemaugh River, but none of them carry as many heavy metals as Paint Creek itself. Paint Creek has its own watershed group, which must take action and implement their already completed watershed restoration plan if the Stonycreek River has any chance of improving below Paint Creek.

The specific recommendations for projects in the watershed include the Jandy site, upstream of Mine 40 and the remaining Mine 40 refuse pile. Seese Run and its tributary, Weaver Run, require five discharge treatment systems between them to restore a fishery. The Cooney Brothers active treatment site on Big Paint Creek must also be completed and the removal of Mine 42 and Mine 37 coal refuse piles are also essential. A limestone doser is recommended on Babcock Creek for treatment of the Mine 42 discharge that would restore much of the Paint Creek headwaters. The UPCDO2 discharge site should be put on the DEP's PI or PII reclamation list and if implemented would also improve the headwaters of Paint Creek.

Sites 7, 28, and 29 Shade Creek

The other major input of AMD into the Stonycreek River is Shade Creek. Shade Creek confluences with the Stonycreek River below the town of Hollsopple in Conemaugh Township. As stated previously Shade does not kill the river at its confluence, but neutralizes any buffer that is present in the river, leaving the river even more vulnerable to the influence of Paint Creek. Three sites were sampled on Shade Creek and all sites violated the PA93 standard for pH with values ranging between 3.5-3.9. The main limiting factor to Shade Creek is an extremely large (largest in the entire Stonycreek River watershed) AMD discharge in Central City Borough. Shade Creek also has an active watershed organization with a watershed restoration plan. Shade and Paint Creeks must be improved if the lower portion of the Stonycreek River is to fully recover.

Exceptional Sites

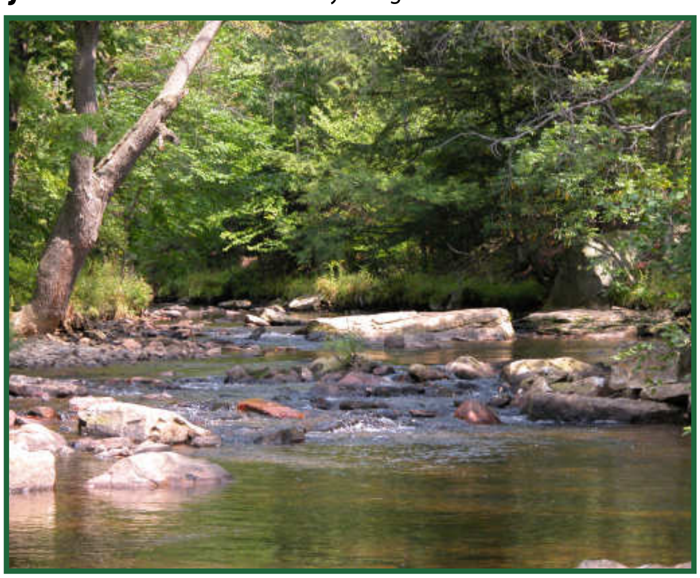
Site 26 Beaverdam Creek near Stoystown

Beaverdam Creek is rated as a High Quality Cold Water Fishery by PA93 and has increased alkalinity because of rich limestone deposits in its watershed. If the PA93 code designated use is to be upheld then this area should be preserved in its current state.

Site 30 Clear Shade below Fly Fishing Project

Clear Shade Creek is another HQ-CWF. Clear Shade Creek is a tributary to Shade Creek, but unlike Shade Creek, Clear Shade is a quality trout fishery and in contrast to Beaverdam Creek, Clear Shade is an infertile stream. It naturally has no buffering capacity and is surrounded by thick, undisturbed canopy that keeps temperatures cold and sediment out of the stream. Clear Shade Creek is the most fragile of the tributaries to the Stonycreek River. Clear Shade Creek has two named tributaries that are also of excellent quality. Cub Run is designated as an exceptional value stream and most of Piney Run is listed

Photo by Doug Beri



Clear Shade Creek below the Fly Fishing Only section.

as high quality, with its headwaters designated exceptional value. These two streams were not sampled specifically as part of the reassessment, but were sampled in 2007 for a different project. Water chemistry results suggest that these tributaries are in fact excellent tributaries with healthy macroinvertebrate populations.

New development should be limited in this entire sub-watershed. The sub-watershed is balanced perfectly, but the removal of even a few trees can expose the stream to more siltation, temperature increases and the full effects of acidified precipitation. Preservation measures must be taken for this sub-watershed.

Site 33 South Fork of Bens Creek

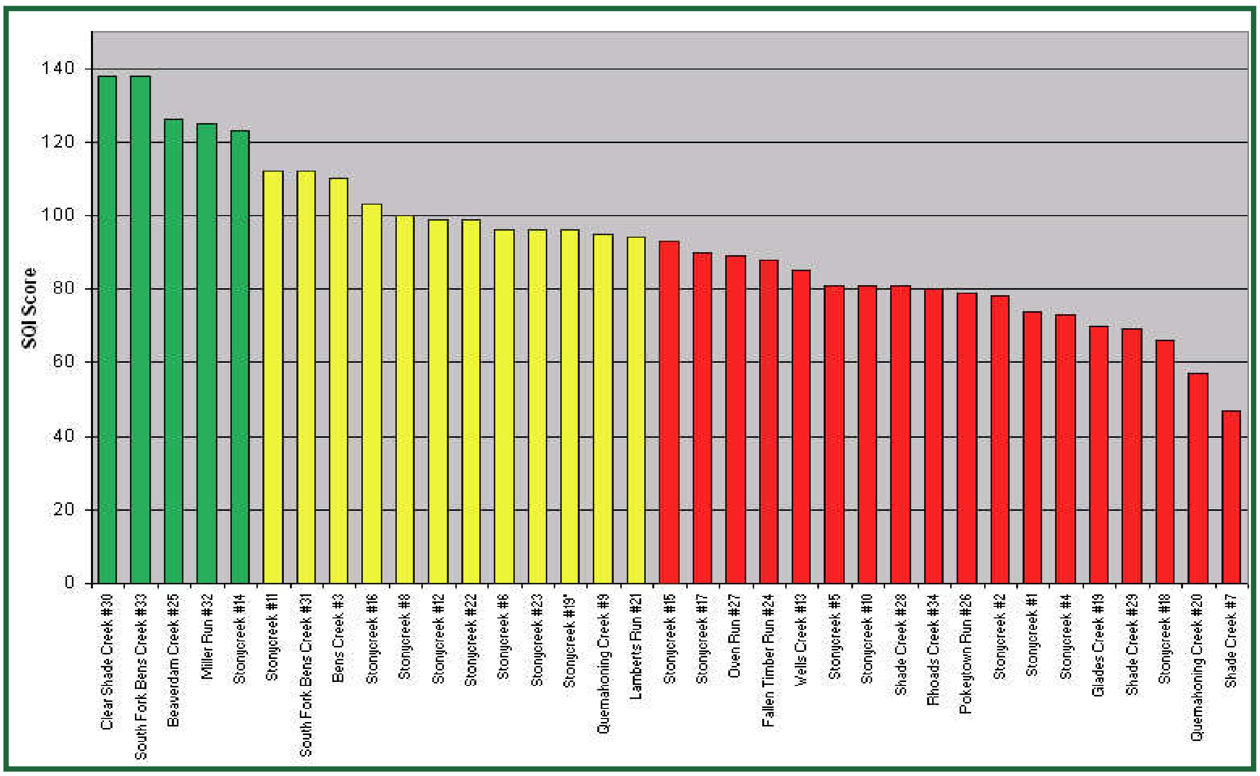
Bens Creek has faced AMD problems in the past including large treatment system failure, but with the help of various watershed and non-profit organizations as well as monitoring and enforcement from the PFBC and DEP, Bens Creek is on its way to a full recovery. The macroinvertebrate community has fully recovered as evidenced by the presence of acid intolerant two and three year old Pteronarcyd stoneflies. The headwaters of the stream above these impacts is considered an Exceptional Value Stream by PA93 and continued preservation of current land and water resources is essential to maintaining the recovery of this watershed.

South Fork Bens Creek

Conclusions

The bar graph below (Figure 26) shows SQI scores for each site sampled during the reassessment. Green bars represent sites with exceptional scores; yellow bars represent moderately impacted sites; and red bars represent sites that are severely impacted. Rather than look at individual scores for each site, the more important aspect of the graph is the amount of grey space above the bars. At some point in history, all sites were unimpacted by man and were of excellent quality—no grey space in the graph existed. The grey space represents degradation from a pristine state. As activities such as mining and agriculture in the watershed took place, they affected the stream and greatly reduced stream quality. The amount of grey space present will be reduced by achieving the goal of restoring the quality of streams within the Stonycreek River watershed.

Figure 26. SQI scores for sites sampled during reassessment.



The Stonycreek River has seen its dose of pollution impacts from AMD discharges that flowed unabated into the river, to the outright degrading of land from abandoned mining operations and unplanned development. The future of the Stonycreek River watershed holds more AMD abatement, but now also a second component—the reclaiming of physical habitat and the cooperation with local farmers to decrease the amount of nutrients and sediment being washed into the Stonycreek from agricultural operations. With cooperation from farmers and a better, more structured relationship with all the watershed groups in the Stonycreek River watershed, the Somerset Conservation District is poised to assist and empower local watershed groups and assist state and federal agencies in implementing the now clearly defined additional restoration projects and efforts required to complement and complete the task of a full watershed recovery.

Literature Cited

Barbour, M.T., J. Gerritsen, B.D. Snyder and J.B. Stribling. 1999. Rapid bioassessment Protocols for use in wadeable streams and rivers: Periphyton, benthic macroinvertebrates and fish. 2nd ed. EPA 841-B-99-002. US Environmental Protection Agency, Office of Water. Washington, D.C.

Bedrock Geology of Pennsylvania. 2001. 1st ed. Pennsylvania Bureau of Topographic and Geologic Survey, Department of Conservation and Natural Resources. Harrisburg, Pennsylvania. http://www.dcnr.state.pa.us/topogeo/map1/bedmap.htm.

Cooper, E.L. 1983. Fishes of Pennsylvania and the Northeastern United States. The Pennsylvania State University Press. University Park and London.

Fitzpatrick, F.A., I.R. Waite, P.J. D'Arconte, M.R. Meador, M.A. Maupin and M.E. Gurtz. 1998. Revised methods for characterizing stream habitat in the national water-quality assessment program. Water-Resources Investigations Report 98-4052. U.S. Geological Survey. Raleigh, NC.

Herb, W.J., L.C. Shaw, and D.E. Brown. 1981. Hydrology of Area 3, Eastern Coal Province, PA. USGS Water-Resources Investigations 81-537. United States Department of the Interior Geological Survey. Harrisburg, Pennsylvania.

Hill, R.D. and E.R. Bates. 1979. Acid mine drainage and subsidence: Effects of increased coal utilization. Environmental Health Perspectives. v33. pp177-190.

Marcri, Jr., E.P. 2005. Higgins Run Environmental Analysis. Macri International. Waynesboro, Pennsylvania.

Macri, Jr., E. P. 2004. Comparison Benthic Analysis. Macri International. Waynesboro, Pennsylvania.

Platts, W.S., W.F. Megahan and W.G. Minshall. 1983. Methods for evaluating stream riparian and biotic conditions. General Technical Report INT-138 USDA Forest Service, Rocky Mountain Research Station, Ogden, UT.

Pennsylvania Code. 2001. Commonwealth of Pennsylvania. Title 25 Environmental Protection. Department of Environmental Protection, Bureau of Water Supply and Wastewater Management, Division of Water Quality Assessment and Standards. Harrisburg, Pennsylvania, Chapter 93.

Roth, N., J. Volstad, L. Erb, E. Weber, P. Kazyak, S. Stranko and D. Boward. 2005. Maryland Biological Stream Survey 2000-2004 Laboratory, Field, and Analytical Methods. vol 6. CBWP-MANTA-EA-05-3. Maryland Department of Natural Resources Monitoring and Non-tidal Assessment Division. Annapolis, Maryland.

Stribling, J., B. Jessup and J. White. 1998. Development of a benthic index of biological integrity for Maryland. CBWP-EA-98-3. Tetra Tech Inc. Owings Mills, Maryland.

Williams, D.R., J.I. Sams and M.E. Mulkerrin. 1996. Effects of coal-mined discharges on the quality of the Stonycreek River and its tributaries, Somerset and Cambria counties, Pennsylvania. WRIR 96-4133. US Geological Survey. Lemoyne, Pennsylvania.

Appendices

Technical Appendix 1—Stream Quality Index Development

Sampling for the reassessment began in May 2007 and ended in August 2007. Thirty five sites were chosen throughout the watershed to assess chemical, biological, and physical integrity. Sixteen of these sites were chosen because of the ability to attain fish data through the PFBC's electrofishing surveys that were conducted in July of 2007. The remaining sites were selected because they were either areas of concern addressed by the 1996 USGS survey or were areas lacking any data. With these criteria for choosing sampling sites, data were obtained throughout the mainstream of the Stonycreek River as well as all major sub-watersheds and small tributaries. For reporting purposes the Stonycreek River has been divided into three areas that correspond with its designated uses as stated in PA93 (CWF, TSF, or WWF).

The mainstem and tributaries that were sampled in each of these areas were separated for the purpose of comparing individual mainstem sites to other mainstem sites in the designated area, and comparing the tributaries of the designated areas to other tributaries within the designated area. The chemical, benthic macroinvertebrate and physical habitat data were compiled into a stream quality index (SQI) developed specifically for the Stonycreek River watershed to assess pollution impacts and recovery over time within the watershed. The fish data were not incorporated into the SQI because fishes were sampled at eighteen sites rather than all 35 sites where other parameters were assessed. A fish IBI was developed and evaluated separately from other data.

Stream Quality Index

The Stonycreek River watershed reassessment provided the means to compile baseline data for further monitoring of pollution abatement within the Stonycreek River watershed. Prior to this assessment no complete and compiled data set was available within the Stonycreek River watershed. Various watershed groups and organizations have installed treatment systems throughout the watershed to abate abandoned mine drainage (AMD). These projects were constructed on individual mine seeps. The influent and effluent of the seeps have been measured with various chemical and physical parameters to determine the efficiency of the treatment system (Williams et al. 1996), but little water chemistry, biological, and physical habitat data had been obtained from the Stonycreek River and its major tributaries. There had been only scattered and sporadic macroinvertebrate data obtained throughout the watershed prior to this study. The objective of this assessment is to develop baseline data that can be used to identify areas in need of remediation and monitor the entire watershed's progress as more pollution abatement takes place. Also, this baseline data set will be used to monitor other impacts to the watershed such as organic loading, erosion, and sedimentation.

The fundamental way that monitoring will take place is with the development of a stream quality index (SQI). As stated in the EPA State of Maryland's Freshwater Streams Assessment, the components of biological integrity include physical and chemical factors within the watershed (Barbour et al. 1999). With this concept in mind, development of an index was needed to measure the changes in water chemistry and physical habitat and their relation to the stability of the biological communities within the watershed. Unlike an IBI that relies on the presence or absence of conditions or organisms, the SQI will rely on the interaction of biota with physical and chemical factors. The SQI can be viewed as a watershed specific IBI that will detect slight changes in the overall health of the stream by weighting the biological characteristics of the specific watershed. The biological component will be assessed based on a benthic macroinvertebrate IBI developed from the Maryland Biological Stream Survey (Stribling et al. 1998).

Macroinvertebrate data will be the basis for biological assessment because they were sampled at all sites within the watershed during this assessment. The macroinvertebrate communities also yield an accurate measure of the biological integrity of the stream because of their specific community structure after a pollution episode has occurred (Merrit and Cummings 1996). Macroinvertebrates can not move freely both up and down stream as fish can to escape pollution impacts. Due to their body structures macroinvertebrates can typically only move downstream when a pollution event occurs, which is known as catastrophic drift. For these reasons, this assessment will focus primarily on the relationship of physical and chemical factors to the structure of the macroinvertebrate communities.

At 18 sites within the watershed fish data were also collected in collaboration with the Area 8 Fisheries Management Office and Habitat Management Division of the PFBC. An additional SQI will be developed, which will incorporate the fish data. These sites will be sampled by the PFBC every few years according to their sampling rotation. This second SQI will provide a comparison of the entire mainstem of the Stonycreek River's biological integrity. The SQI that incorporates fish data will provide the blueprint for monitoring biotic integrity at additional sites throughout the watershed as funding becomes available for such surveys. Until funding and manpower becomes available for these intense biological surveys, small watershed groups will be able to utilize the SQI that is based on knowledge of macroinvertebrate communities to accurately assess and monitor their respective sub-watersheds.

Water chemistry, biological data, and physical habitat will each consist of multiple metrics. Each metric will be scored on a scale from 0-5, with 0 indicating poor quality and 5 indicating exceptional quality (Barbour et al. 1999, Stribling et al. 1998). The scores for all metrics that comprise each assessment category will be added together to attain a final score for that assessment category. The final score will reflect whether impacts have occurred in chemistry and/or physical habitat. The biological assessment will be in the form of a benthic IBI, which will reflect the impacts on a community from degraded physical or chemical conditions. All three assessment scores will be totaled and one overall SQI score will be assigned to each site. This initial SQI score represents the baseline data index needed to assess the Stonycreek River watershed into the future and to track community reestablishment. The final score will reflect even minor changes in water quality through future sampling by measuring the increase or decrease in biological scores and relating them to the increase or decrease in physical and chemical scores. Therefore, the final SQI score will not only reflect the change in biology, but the change in water quality that caused the biotic change. The total score will increase with improving water quality, but will also increase as higher quality macroinvertebrate communities are collected. Therefore, the index will show a directly proportional relationship between water quality and biology.

The final SQI score will determine the influence that physical habitat and water chemistry have over the biota of the Stonycreek River watershed. This influence can now be tracked using the SQI to determine the success of pollution abatement projects that local watershed groups will implement. The final SQI score will be broken down into three categories: impacted, moderately impacted, and excellent quality. The score range of these categories will be determined by comparing the final SQI score to a preset score range. The range that will be used for comparison will be 60-20-20 (Barbour et al. 1999, Stribling et al. 1998). If a site score is 60% or below the total possible SQI score, the site will receive a rating of "Impacted." A site scoring between 61-80% will be rated as "Moderately Impacted" and a site scoring 81% and above will be deemed "Excellent Quality." Sites that receive an impacted rating will be designated as target sites for future reclamation projects.

Appendix 2 - Sampling Site Locations

Site #	USGS_ID	StreamName	Location	Lat	Lon
1		Stonycreek River	Haynes Street Bridge	40.3225	-78.9167
2		Stonycreek River	Ferndale downstream of Bens Creek	40.2856	-78.9201
3	USGS834	Bens Creek River	Bridge by St. Andrews	40.2843	-78.9301
4		Stonycreek River	Bridge at Krings	40.2752	-78.9036
5	USGS830	Stonycreek River	below mouth of Paint Creek	40.2449	-78.8851
6	USGS804	Stonycreek River	Carpenter's Bridge	40.2434	-78.8838
7	USGS836	Shade Creek River	Rt. 601 Bridge	40.2124	-78.8987
8	USGS803	Stonycreek River	Blough Bridge	40.1722	-78.9079
9		Quemahoning Creek	219 Bridge	40.1617	-78.9931
10		Stonycreek River	downstream of Oven Run	40.1452	-78.9155
11	USGS802	Stonycreek River	Turkeyfoot Bridge near school	40.1031	-78.9328
12		Stonycreek River	above Beaverdam Creek	40.0940	-78.9477
13	USGS813	Wells Creek	Wells Creek Mouth	40.0706	-78.9413
14		Stonycreek River	Mouth of Lamberts Run	40.0649	-78.9316
15	USGS811	Stonycreek River	Glessner Covered Bridge	40.0261	-78.9208
16	USGS801	Stonycreek River	Baltzer Bridge	40.0026	-78.9001
17	USGS810	Stonycreek River	Shanksville	40.0170	-78.9084
18		Stonycreek River	Yonai Bridge	39.9848	-78.9141
19		Glades Creek	Rt. 31 Bridge	39.9651	-78.9477
19B		Stonycreek River	Rt. 31 Bridge	39.9542	-78.9200
20		Quemahoning Creek	4023 bridge	40.1326	-79.0655
21		Lamberts Run	Lamberts Run mouth	40.0638	-78.9316
22		Stonycreek River	Hollsopple Bridge	40.2092	-78.9260
23		Stonycreek River	below confluence with Shade	40.2170	-78.8976
24	USGS816	Fallen Timber Run	at Hooversville	40.1448	-78.9135
25	USGS814	Beaverdam Creek	at Stoystown	40.0908	-78.9620
26	USGS837	Pokeytown Run	at Wilbur	40.1273	-78.9244
27	USGS815	Oven Run	at Rowena	40.1184	-78.9244
28	USGS824	Shade Creek	at Central City	40.1053	-78.7985
29		Shade Creek	near Hillsboro	40.1825	-78.8552
30		Clear Shade Creek	below project	40.1470	-78.7849
31		South Fork Bens Creek	at 985 bridge	40.2192	-79.0302
32		Miller Run	mouth of Miller Run	40.1446	-78.8191
33		South Fork Bens Creek	upstream from sportsmen's club	40.2301	-79.0566
34		Rhoads Creek	near Shanksville	40.0156	-78.9015

Appendix 3. Field Water Chemistry Data

Site #	Date	Air Temp	Water Temp	K	DO	pH	TDS	Fe	SO4	NO3	PO4
		oC	oC	us	mg/L		ppm	mg/L	mg/L	ppm	ppm
1	5/22/2007	83	23.0	599	10.0	7.26	301	0.3	>100	2.2	<1
2	5/22/2007	83	22.3	570	9.2	6.73	283	0.3	>100	1.1	<1
3	5/24/2007	80	20.0	664	9.8	8.26	331	0.4	98	1.1	<1
4	5/22/2007	85	20.8	620	8.1	3.96	313	2.3	>100	2.2	<1
5	5/24/2007	81	19.8	932	7.1	4.15	457	5.8	>100	1.1	<1
6	5/24/2007	81	19.9	639	10.0	6.90	312	1.2	>100	1.1	<1
7	5/24/2007	78	16.7	487	10.0	3.64	242	3.0	>100	1.1	<1
8	5/17/2007	55	13.9	641	10.0	7.50	320	0.3	>100	2.2	2
9	5/22/2007	77	17.8	391	9.7	7.74	196	0.9	90	2.2	<1
10	5/17/2007	50	13.7	631	10.0	6.57	315	0.3	>100	1.1	<1
11	5/17/2007	50	13.5	536	9.6	7.40	281	0.2	>100	2.2	<1
12	5/15/2007	80	20.9	636	9.4	8.69	316	0.4	>100	1.1	<1
13	5/15/2007	77	17.8	461	9.1	7.72	230	0.6	100	4.4	<1
14	5/15/2007	75	17.1	644	5.4	7.80	319	1.0	>100	1.1	0
15	5/9/2007	75	17.4	479	9.4	7.40	246	<1	>100	2.2	0
16	5/9/2007	70	14.6	521	8.8	7.60	262	<1	100	4.4	0
17	5/9/2007	72	16.4	488	10.0	7.80	242	<1	85	0.4	0
18	5/3/2007	60	14.3	520	10.0	7.70	201	1.0	95	2.2	0
19	5/3/2007	58	12.9	400	10.0	7.50	196	<1	90	6.6	<1
19B	5/25/2007	68	17.0	596	7.0	7.39	296	0.6	70	8.8	<1
20	5/17/2007	56	13.4	508	7.7	7.13	253	1.2	90	13.2	<1
21	5/15/2007	73	13.3	2200	9.6	7.30	1100	1.4	>100	1.1	0
22	5/22/2007	78	19.7	596	9.6	8.44	297	0.3	>100	1.1	<1
23	5/24/2007	80	21.3	568	7.7	7.20	296	1.2	>100	2.2	<1
24	6/21/2007	70	12.5	530	5.5	5.81	265	0.6	100	0.4	0
25	6/21/2007	70	15.7	493	8.4	7.56	246	0.7	80	0.0	0
26	6/21/2007	68	15.0	1297	8.3	3.67	650	0.8	>100	0.0	0
27	6/21/2007	65	15.2	1344	9.0	3.39	675	1.8	>100	0.0	0
28	6/19/2007	81	15.2	97	8.6	4.61	48	1.0	28	0.0	0
29	6/19/2007	83	18.3	583	7.8	3.43	291	4.2	>100	1.3	0
30	6/21/2007	65	17.6	72	9.0	6.93	35	1.2	0	0.4	0
31	6/21/2007	66	17.2	1322	9.1	7.84	661	0.5	>100	1.1	0
32	6/19/2007	85	16.8	303	9.0	6.90	151	0.9	85	1.1	0
33	6/21/2007	66	15.6	43	7.9	7.07	21	0.1	5	0.4	0
34	6/22/2007	70	21.9	575	7.0	7.46	287	0.2	>100	0.0	0

Appendix 4. List of macroinvertebrates collected at each site during the Stonycreek River Watershed Reassessment.

Order	Family	Genus	Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Amphipoda	Gammaridae	*Gammarus*												2				1			10
Coleoptera	Dryopidae																				
Coleoptera	Dytiscidae	*Agabus*																			
Coleoptera	Dytiscidae												1								
Coleoptera	Elmidae	*Microcylloepus*																	3		
Coleoptera	Elmidae	*Promoresia*																			
Coleoptera	Elmidae	*Stenelmis*				7					1						3		6	4	
Coleoptera	Halipidae	*Halipus*																			
Coleoptera	Hydrophilidae	*Hydrochus*																			
Coleoptera	Hydrophylidae																				
Coleoptera	Psephenidae	*Dicranopselaphus*																			
Coleoptera	Psephenidae	*Psephenus*																			
Crustacea	Sphaeriidae	*Pisidum*																			1
Crustacea	Sphaeriidae	*Sphaerium*																	1		
Decapoda	Cambaridae																				1
Diptera	Anthericidae	*Antherix*															1		1		
Diptera	Ceratopogonidae	*Probezzia*																			
Diptera	Chironomidae	*Blood Midge*																			
Diptera	Chironomidae				1	20						11	1	8	47	38	12	13	11	9	23
Diptera	Psychodidae	*Pericoma*																			
Diptera	Simulidae	*Simulium*															1	2	79	17	
Diptera	Tabanidae	*Tabanus*																			
Diptera	Tanyderidae	*Protoplasa*				4															
Diptera	Tipulidae	*Antocha*				11								1			2		1		
Diptera	Tipulidae	*Hexatoma*																			
Diptera	Tipulidae	*Tipula*																			

Appendix 4 continued.

Order	Family	Genus	Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Ephemeroptera	Baetidae	*Baetis*				4						1		3	23		2				
Ephemeroptera	Baetidae	*Centroptilum*																			
Ephemeroptera	Baetidae	*Cloeon*																			1
Ephemeroptera	Caenidae	*Caenis*																6		2	
Ephemeroptera	Ephemerellidae	*Ephemerella*																			
Ephemeroptera	Ephemeridae	*Ephemera*																			
Ephemeroptera	Heptageniidae	*Stenacron*																			
Ephemeroptera	Heptageniidae	*Stenonema*				1						1		1			1		1		
Ephemeroptera	Leptophlebiidae	*Paraleptophlebia*																			
Ephemeroptera	Oligoneuriidae	*Isonychia*				1								1					4		
Gastropoda	Lymnaeidae																	1			
Gastopoda	Physidae	*Physella*																			
Gastopoda	Physidae																				5
Gastopoda	Planorbidae	*Planorbella*																			
Gastopoda	Planorbidae	*Planorbella trivolvis*																			
Hirudinea	Erpobdellidae																				
Isoptera	Asellidae	*Caecidotea*																			8
Isoptera	Asellidae	*Liceus*																			1
Megaloptera	Corydalidae	*Neohermes*															1	1	1		
Megaloptera	Corydalidae	*Nigronia*																			
Megaloptera	Sialidae	*Sialis*																			
Odonata	Calopterigidae	*Calopteryx*																			
Odonata	Coenagrionidae	*Anomalagrion*																			1
Odonata	Coenagrionidae	*Argia*																			
Odonata	Gomphidae	*Gomphus*																			
Odonata	Gomphidae	*Hagenis*																			
Odonata	Gomphidae	*Lanthus*				1										2					

Appendix 4 continued.

Order	Family	*Genus*	*Site*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*
Plecoptera	Capniidae	*Capnia*				2					1						41				
Plecoptera	Capniidae	*Utcapina*																			
Plecoptera	Chloroperlidae	*Alloperla*																			
Plecoptera	Chloroperlidae					1															
Plecoptera	Chloroperlidae	*Suwallia*																			
Plecoptera	Chloroperlidae	*Utaperla*																			
Plecoptera	Leuctricidae	*Leuctra*									3						21				
Plecoptera	Leuctricidae	*Paraleuctra*							2												
Plecoptera	Leuctridae	*Zealeuctra*																			
Plecoptera	Nemouridae	*Amphinemura*																			
Plecoptera	Peltoperlidae	*Peltoperla*																			
Plecoptera	Perlidae	*Acroneuria*												2			1		2		
Plecoptera	Perlidae	*Agnetina*																			
Plecoptera	Perlidae	*Eccoptura*																			
Plecoptera	Perlidae	*Neoperla*																			
Plecoptera	Perlodidae	*Isoperla*				1					1					2				1	
Plecoptera	Pteronarcyidae	*Pteronarcys*																			
Plecoptera		Capniidae						1													
Rhynchobdellida	Glossiphoniidae	*Theromyzon*																			2

Appendix 4 continued.

Order	Family	Genus	Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Trichoptera	Glossosomatidae	*Glossosoma*																			
Trichoptera	Hydropsychidae	*Cheumatopsyche*		2	2	20		2	1			3	1	13	3	2	2	2	2	1	
Trichoptera	Hydropsychidae	*Diplectrona*				2														1	
Trichoptera	Hydropsychidae	*Hydropsyche*		6	4	42					3	11	1	7	4		14		2	1	
Trichoptera	Hydropsychidae	*Macrostenum*																			
Trichoptera	Hydroptilidae	*Leucotrichia*																			
Trichoptera	Hydroptilinae	*Agraylea*																			
Trichoptera	Lepidostomatidae	*Lepidostoma*							1												
Trichoptera	Lepidostomatidae	Leptostoma																			
Trichoptera	Limnephilidae	*Anabolia*																			
Trichoptera	Limnephilidae	*Limnephilus*																			
Trichoptera	Limnephilidae	*Pycnopsyche*													1						
Trichoptera	Odontoceridae	*Psilotreta*																			
Trichoptera	Philopotamidae	*Chimarra*				1															
Trichoptera	Philopotamidae	*Wormalidia*																			
Trichoptera	Polycentropodidae	*Cyrnelleus*																		1	
Trichoptera	Polycentropodidae	*Nyctiophylax*							1												
Trichoptera	Polycentropodidae	*Polycentropus*															5				
Trichoptera	Rhyacophilidae	*Rhyacophila*					1														
Trichoptera	Uenoidae	*Neophylax*															1				
Tubificida	Tubificidae												1	6			1				4

Order	Family	*Genus*	*Site*	*19*	*19B*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
Amphipoda	Gammaridae	*Gammarus*		3													1			1
Coleoptera	Dryopidae			1																
Coleoptera	Dytiscidae	*Agabus*												1						
Coleoptera	Dytiscidae																			
Coleoptera	Elmidae	*Microcylloepus*									16					2				
Coleoptera	Elmidae	*Promoresia*														37			1	
Coleoptera	Elmidae	*Stenelmis*			16						8					10			1	
Coleoptera	Halipidae	*Halipus*			17						2									4
Coleoptera	Hydrophilidae	*Hydrochus*									1									
Coleoptera	Hydrophylidae				15															
Coleoptera	Psephenidae	*Dicranopselaphus*																	3	
Coleoptera	Psephenidae	*Psephenus*									6									
Crustacea	Sphaeriidae	*Pisidum*		2	2															
Crustacea	Sphaeriidae	*Sphaerium*																		
Decapoda	Cambaridae				1					3	6					2	3	1	10	4
Diptera	Anthericidae	*Antherix*									1					1				
Diptera	Ceratopogonidae	*Probezzia*																	1	
Diptera	Chironomidae	*Blood Midge*				13														
Diptera	Chironomidae			13		9	26	5	9		59	4		30	1	24	8	1	17	4
Diptera	Psychodidae	*Pericoma*																	1	
Diptera	Simulidae	*Simulium*			5						11									1
Diptera	Tabanidae	*Tabanus*														1	1			
Diptera	Tanyderidae	*Protoplasa*																		
Diptera	Tipulidae	*Antocha*				1										2	6	1	5	
Diptera	Tipulidae	*Hexatoma*														5	8		1	
Diptera	Tipulidae	*Tipula*			3						1						1			

Appendix 4 continued.

Order	Family	*Genus*	*Site*	*19*	*19B*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
Ephemeroptera	Baetidae	*Baetis*					4				31					7	5	10	16	
Ephemeroptera	Baetidae	*Centroptilum*		3																
Ephemeroptera	Baetidae	*Cloeon*																		
Ephemeroptera	Caenidae	*Caenis*																		
Ephemeroptera	Ephemerellidae	*Ephemerella*																		
Ephemeroptera	Ephemeridae	*Ephemera*									1								27	
Ephemeroptera	Heptageniidae	*Stenacron*														1			1	
Ephemeroptera	Heptageniidae	*Stenonema*						2			10					29		1	7	
Ephemeroptera	Leptophlebiidae	*Paraleptophlebia*									1								3	
Ephemeroptera	Oligoneuriidae	*Isonychia*									22									
Gastropoda	Lymnaeidae			23																1
Gastopoda	Physidae	*Physella*			3															
Gastopoda	Physidae			23																
Gastopoda	Planorbidae	*Planorbella*		6				1												11
Gastopoda	Planorbidae	*Planorbella trivolvis*			4															
Hirudinea	Erpobdellidae				2															
Isoptera	Asellidae	*Caecidotea*			3															
Isoptera	Asellidae	*Liceus*																		
Megaloptera	Corydalidae	*Neohermes*									4									
Megaloptera	Corydalidae	*Nigronia*								1	1	1		1						
Megaloptera	Sialidae	*Sialis*										2	1	1						
Odonata	Calopterigidae	*Calopteryx*			1															
Odonata	Coenagrionidae	*Anomalagrion*		12																
Odonata	Coenagrionidae	*Argia*			1															
Odonata	Gomphidae	*Gomphus*															1			1
Odonata	Gomphidae	*Hagenis*									1								2	
Odonata	Gomphidae	*Lanthus*														6				

Appendix 4 continued.

Order	Family	*Genus*	*Site*	*19*	*19B*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
Plecoptera	Capniidae	*Capnia*									2		1			61		6		
Plecoptera	Capniidae	*Utcapina*								1								1		
Plecoptera	Chloroperlidae	*Alloperla*									1								3	
Plecoptera	Chloroperlidae																			
Plecoptera	Chloroperlidae	*Suwallia*																	4	
Plecoptera	Chloroperlidae	*Utaperla*															11			
Plecoptera	Leuctricidae	*Leuctra*				4				9	15		1	3		56		20	7	
Plecoptera	Leuctricidae	*Paraleuctra*																		
Plecoptera	Leuctridae	*Zealeuctra*														3				
Plecoptera	Nemouridae	*Amphinemura*							1											
Plecoptera	Peltoperlidae	*Peltoperla*																	1	
Plecoptera	Perlidae	*Acroneuria*			2											3		2		
Plecoptera	Perlidae	*Agnetina*			2											1				
Plecoptera	Perlidae	*Eccoptura*			2				1		1									
Plecoptera	Perlidae	*Neoperla*									3									1
Plecoptera	Perlodidae	*Isoperla*															4		8	
Plecoptera	Pteronarcyidae	*Pteronarcys*															1		2	
Plecoptera		Capniidae												2						
Rhynchobdellida	Glossiphoniidae	*Theromyzon*		1																

Appendix 4 continued.

Order	Family	*Genus*	*Site*	*19*	*19B*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*
Trichoptera	Glossosomatidae	*Glossosoma*									5									
Trichoptera	Hydropsychidae	*Cheumatopsyche*			1		4	2	1		27		1	1		3	3	5	29	
Trichoptera	Hydropsychidae	*Diplectrona*															1			
Trichoptera	Hydropsychidae	*Hydropsyche*				5		11	6		112		1			2	24		18	
Trichoptera	Hydropsychidae	*Macrostenum*																1		
Trichoptera	Hydroptilidae	*Leucotrichia*			19															
Trichoptera	Hydroptilinae	*Agraylea*															1			
Trichoptera	Lepidostomatidae	*Lepidostoma*																		
Trichoptera	Lepidostomatidae	Leptostoma																	5	
Trichoptera	Limnephilidae	*Anabolia*			2															
Trichoptera	Limnephilidae	*Limnephilus*			1															
Trichoptera	Limnephilidae	*Pycnopsyche*						1												
Trichoptera	Odontoceridae	*Psilotreta*		1																
Trichoptera	Philopotamidae	*Chimarra*							1				1			2	1	1		
Trichoptera	Philopotamidae	*Wormalidia*														2	1	7		
Trichoptera	Polycentropodidae	*Cyrnelleus*														1	2	2	1	
Trichoptera	Polycentropodidae	*Nyctiophylax*						1	1											
Trichoptera	Polycentropodidae	*Polycentropus*									1									
Trichoptera	Rhyacophilidae	*Rhyacophila*							2											
Trichoptera	Uenoidae	*Neophylax*						1			3									

Tubificida	Tubificidae					11		1			4									

Appendix 5. Fishes collected at each site during the Stonycreek River Watershed Reassessment.

		Site 2	Site 3	Site 4	Site 6	Site 9	Site 10	Site 11	Site 12	Site 13
Sampling Date		7/13/2007	7/13/2007	7/12/2007	7/12/2007	7/5/2007	7/3/2007	7/9/2007	7/10/2007	7/9/2007
Site Length (m)		200	200	200	200	200	200	200	200	200
Mean Site Width (m)		26.9	8.2	42.7	24.8	15.6	22.3	27.4	16.7	8.2
Effort (min)		60	62	79	70	50	34	65	66	42
Banded Darter	*Etheostoma zonale*	15	2	1			1	23		
Blacknose Dace	*Rhinichthys atratulus*	193	370	143	1	86	1	114	8	97
Blackside Darter	*Percina maculata*	2		1	2	2				
Bluegill	*Lepomis macrochirus*					44		2		
Bluntnose Minnow	*Pimephales notatus*	5	3	12	1	76	12	2		1
Brook Trout - Hatchery	*Salvelinus fontinalis*		1					4	32	6
Brown Bullhead	*Ameiurus nebulosus*					8	1			
Brown Trout	*Salmo trutta*	1								
Brown Trout - Hatchery	*Salmo trutta*		30			4		22	51	18
Central Stoneroller	*Campostoma anomalum*		54	15			1	12		
Creek Chub	*Semotilus atromaculatus*	2	8	13	12		5	4		16
Fallfish	*Semotilus corporalis*						12	20		
Fathead Minnow	*Pimephales promelas*									
Fantail Darter	*Etheostoma flabellare*	5	3			49	3	3	2	
Golden Shiner	*Notemigonus crysoleucas*									
Greenside Darter	*Etheostoma blennioides*	1	5				4	5	9	
Johnny Darter	*Etheostoma nigrum*	7	3	2			2			
Largemouth Bass	*Micropterus salmoides*					2				
Longnose Dace	*Rhinichthys cataractae*	47	67	14						
Mimic shiner	*Notropis volucellus*	1		1	13	3				
Mottled Sculpin	*Cottus bairdi*	4	163	2		18		291	225	104
Northern Hog Sucker	*Hypentelium nigricans*		95	1			31	84	52	8
Pumpkinseed	*Lepomis gibbosus*	3	1		1			2		
Rainbow Trout	*Oncorhynchus mykiss*		7				2	68	161	20
Rock Bass	*Ambloplites rupestris*	22	11	4	8	25	1	12		
Smallmouth Bass	*Micropterus dolomieu*				3	3	1	4	3	
Stonecat	*Noturus flavus*									
Striped Shiner	*Luxilus chrysocephalus*									
White Sucker	*Catostomus commersoni*	15	106	124	34	47	9	23	19	56
Yellow Bullhead	*Ameiurus natalis*					19				
Yellow Perch	*Perca flavescens*			1	1	2	1	2	5	2
Species Total:		15	17	14	10	15	16	19	11	10
Total number of fish:		323	929	334	76	388	87	697	567	328

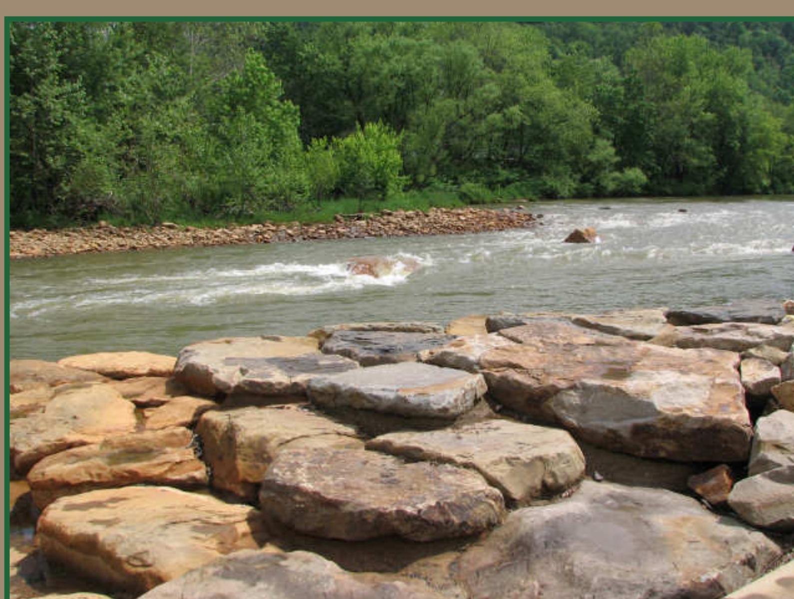
		Site 14	Site 15	Site 16	Site 19	Site 19B	Site 20	Site 22	Site 25	Site 34
Sampling Date		7/10/2007	7/11/2007	7/2/2007	7/2/2007	7/2/2007	7/6/2007	7/5/2007	7/9/2007	7/3/2007
Site Length (m)		200	200	200	190	200	200	200	200	200
Mean Site Width (m)		17.4	13.4	9.9	4.4	5.0	6.8	27.1	7.0	10.5
Effort (min)		75	76	60	40	37	41	45	57	47
Banded Darter	*Etheostoma zonale*		72	1	1			20		5
Blacknose Dace	*Rhinichthys atratulus*	8	8			53			60	
Blackside Darter	*Percina maculata*		1	6			1		3	1
Bluegill	*Lepomis macrochirus*			1	2				5	4
Bluntnose Minnow	*Pimephales notatus*			41	7	45		3	59	
Brook Trout - Hatchery	*Salvelinus fontinalis*	162	42	19					2	
Brown Bullhead	*Ameiurus nebulosus*					2				
Brown Trout	*Salmo trutta*									
Brown Trout - Hatchery	*Salmo trutta*	56	155	3				4	10	3
Central Stoneroller	*Campostoma anomalum*	2						8		
Creek Chub	*Semotilus atromaculatus*	3		12	7	199	8	4	23	
Fallfish	*Semotilus corporalis*				1			5	9	
Fathead Minnow	*Pimephales promelas*			2		10				
Fantail Darter	*Etheostoma flabellare*	4	11	5	1	26	1	11	8	1
Golden Shiner	*Notemigonus crysoleucas*					1				
Greenside Darter	*Etheostoma blennioides*	1	79	24	2			3	7	20
Johnny Darter	*Etheostoma nigrum*		1	7	2	16	6		7	
Largemouth Bass	*Micropterus salmoides*	1	5			1				4
Longnose Dace	*Rhinichthys cataractae*									
Mimic shiner	*Notropis volucellus*									
Mottled Sculpin	*Cottus bairdi*	35	1						105	
Northern Hog Sucker	*Hypentelium nigricans*	23	27	18				47	10	29
Pumpkinseed	*Lepomis gibbosus*			1	13	20	1		12	31
Rainbow Trout	*Oncorhynchus mykiss*	45	94	3				6	2	1
Rock Bass	*Ambloplites rupestris*	3	7	12	4	1		10	2	14
Smallmouth Bass	*Micropterus dolomieu*	4		1				14	2	7
Stonecat	*Noturus flavus*							1		
Striped Shiner	*Luxilus chrysocephalus*					2				
White Sucker	*Catostomus commersoni*	13	10	4	68	109	24	46	115	17
Yellow Bullhead	*Ameiurus natalis*							1		6
Yellow Perch	*Perca flavescens*	10				1				10
Species Total:		15	14	17	11	14	6	15	18	15
Total number of fish:		370	513	160	108	486	41	183	441	153

Amanda Deal "On the Stonycreek."

Eric Null records data.

Survey captured largemouth bass.

Electrofishing on Rhoades Creek.



Survey captured reptile.