Monday Creek Watershed Management Plan

September 2006

Prepared by:

Mike Steinmaus
Watershed Coordinator

and

Rebecca Black
Assistant Watershed Coordinator

115 West Main Street
New Straitsville, OH 43766

Phone – (740) 394-2047
Email - mcrp@mondaycreek.org

Acknowledgments

We would like to thank the following individuals who have spent time researching, writing, collecting and analyzing data, and assisting with public outreach activities:

The Staff of the Monday Creek Restoration Project

Matt Miller: VISTA – Education and Outreach (2005-2006)

Tim Braun: VISTA - Education and Outreach (2004-2005)

Joshua Long: Office of Surface Mining Summer Intern (Survey)

Acronyms Used In This Document

ACSI	Appalachian Clean Streams Initiative
AMD	Acid Mine Drainage
AMDAT	Acid Mine Drainage Abatement and Treatment Plan
AML	Abandoned Mine Lands
AWS	Agricultural Water Supply
BMPs	Best Management Practices
CCC	Civilian Conservation Corps
CWH	Cold Water Habitat
DMRM	Division of Mineral Resources Management
DNAP	Division of Natural Areas and Preserves
DSWC	Division of Soil and Water Conservation
EWH	Exceptional Warmwater Habitat
FSA	Farm Service Agency
FWPCA	Federal Water Pollution Control Administration
GPM	Gallons Per Minute
HUC	Hydrologic Unit Code
IBI	Index of Biological Integrity
ICI	Invertebrate Community Index
ILGARD	Institute for Local Government Administration and Rural Development
IWS	Industrial Water Supply
LRW	Limited Resource Water
LTM	Long Term Monitoring
LRW	Limited Resource Water
Miwb	Modified Index of Well Being
MWH	Modified Warmwater Habitat
MCRP	Monday Creek Restoration Project
NPDES	National Pollutant Discharge Elimination System
NRI	National Resources Inventory
NRCS	Natural Resources Conservation Service
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
OSMRE	Office of Surface Mining and Reclamation Enforcement
OU	Ohio University
PCR	Primary Contact Recreation
PWS	Public Water Supply
QHEI	Qualitative Habitat Evaluation Index
RM	River Mile
SWCD	Soil and Water Conservation District
TAMDL	Total Acid Mine Drainage Loading Model
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture

USEPA	United States Environmental Protection Agency
USGS	United States Geologic Survey
WAP	Watershed Action Plan
WVU	West Virginia University
WWH	Warmwater Habitat
WWTP	Waste Water Treatment Plant

Table of Contents:

List of Tables:

List of Figures:

List of Appendices:

List of Maps:

Executive Summary

This Monday Creek Management Plan is a comprehensive document describing the problems, priorities and activities associated with water quality and ecological integrity of the watershed. Through the process of stakeholder involvement and inventorying existing watershed conditions and features, water quality problems were identified. In addition, water resource quality data from Ohio EPA were incorporated into the plan.

The specific focus of this management plan is the goals and objectives that lead to restoration. Specific management strategies were developed for each of the four major subwatersheds that comprise the Monday Creek Watershed. Based upon water quality impairments, action plans were developed to clarify how the objectives will be achieved. Each plan identifies possible tasks, resources required to achieve the objectives, the time frame for its completion and the indicators of successful accomplishment of the task. The ultimate evaluation indicator will be in having non-attaining or partially attaining steams move into full attainment.

Methodologies and priorities identified in this plan may likely evolve with time. Agency commitments and funding strategies can modify the project implementation. However, Monday Creek Restoration Project will strive to achieve the goals outlined in this plan through a community and ecosystem-based approach toward watershed restoration.

I. Introduction

Watershed Description

Monday Creek Watershed, located in the unglaciated portion of the Allegheny Plateau region of southeastern Ohio, is a 116 square mile (74,240 acres) area encompassing Monday Creek and its associated tributaries. The main stem of Monday Creek runs 27 miles before emptying into the Hocking River. The watershed drains roughly 10 percent of the Hocking River system, which itself is part of the Greater Ohio River Watershed. Map 1 illustrates the Monday Creek Watershed.

Monday Creek Watershed encompasses portions of three counties in southeast Ohio: Perry, Hocking and Athens Counties. The majority of the watershed is rural with several incorporated and unincorporated villages located throughout.

Monday Creek has two major tributaries, Little Monday Creek (14.3 mi.) and Snow Fork (10.7 mi.). Little Monday Creek originates in the northern portion of the watershed, with headwaters in southern Perry County. Snow Fork originates as three smaller tributary streams located in the east-central portion of the watershed, combining north of Murray City and flowing south through the town of Buchtel and ultimately discharging into Monday Creek.

Geographic Locators

Monday Creek's USGS Hydrologic Unit Code (HUC) is 05030204-060. Monday Creek originates in southern Perry County (latitude 39°38'24", longitude -82°13'02") and flows in a southerly direction through eastern Hocking County and northern Athens County. The creek enters the Hocking River approximately 2 ½ miles southeast of Nelsonville (latitude 39°24'57", longitude –82°11'35").

Monday Creek Watershed has four distinct 14-digit HUCs. The 14-digit HUCs are identified on Table 1. Map 2 illustrates the subwatersheds that comprise Monday Creek Watershed.

Monday Creek is listed in Ohio EPA's Water Resource Inventory 305(b) 2005 report. The mainstem of Monday Creek has an aquatic life use designation of "Limited Resource Water" and a recreational use designation of "Primary Contact". The 305(b) Report identifies "pH," and "metals" as the causes of impairment and "acid mine drainage" as the source of the impairment. It lists the entire 27 miles of the mainstem as having very poor quality.

Table 1- Fourteen Digit Hydrologic Unit Codes for Monday Creek Watershed

14 Digit HUC Code	Location	Size (acres)
05030204060010	Monday Creek Headwaters to above Little Monday Creek	23,405
05030204060020	Little Monday Creek	16,070
05030204060030	Monday Creek below Little Monday Creek to Hocking River	17,306
05030204060040	Snow Fork	17,428

Monday Creek Restoration Project

Monday Creek Restoration Project (MCRP) was formed in 1994 by a group of individuals from agencies and institutions and local watershed residents who realized that by working together on watershed issues improvements could occur. As a non-profit organization involved in the organization of Monday Creek Restoration Project, Rural Action took on the sponsorship of MCRP. Rural Action provided a VISTA volunteer for project coordination, non-profit (501(c)3) status for grant management and staff support for media and community outreach. In early 1995, the first newsletter was printed. Monthly meetings were held and plans were made for community activities. In 1996, a Section 319 Nonpoint Source Grant was awarded to the Partnership for the restoration of the Rock Run Gob Pile. An Appalachian Clean Streams Initiative (ACSI) grant was awarded for the same site later that year. Between 1995 and 1997, the U.S. Geological Survey, along with volunteers and interns, collected water samples throughout the watershed. The results enabled the Partners to prioritize streams for future reclamation projects. In 1997, a second Section 319 grant was awarded for subsidence closure at Majestic Mine and another ACSI grant was awarded for acid mine drainage treatment at a pond in Happy Hollow. In January 1999, MCRP opened an office within the watershed. At the same time, a new watershed coordinator began work. Later that year, an Assistant Watershed Coordinator was hired to aid in project management. A VISTA volunteer has served MCRP each year since its inception.

Over the past eleven years, MCRP (through Rural Action) has been awarded four Section 319 grants; two grants, one involving the installation of treatment cells and the contouring and capping of a coal refuse pile and the second involving the contouring and capping of another coal refuse pile, installing J-trenches and constructing open limestone channels, have been completed. Another grant, involving the installation of a doser, was completed in 2006. The third grant, involving limestone leach beds, slag leach beds and open limestone channels, is

scheduled for completion in 2007. In addition, MCRP has received several ACSI grants for reclamation projects, including a project completed in 2004 involving the installation of a doser in the headwaters of Monday Creek.

Another Section 319 grant, obtained through Ohio University, resulted in the closure of a subsidence, rerouting of a small stream that emptied into the subsidence and introduction of limestone dosing to a tributary of Snow Fork. This project was completed in 2001.

Between 2001 and 2004, MCRP also received the services of summer interns through a program offered by the Office of Surface Mining,. These interns have involved local residents in project concepts, designed projects, worked on youth programs and conducted surveys of watershed residents' concerns.

Management Plan and Mission Statement

In 1999, Monday Creek Restoration Project completed its first management plan, entitled "A Comprehensive Plan for the Monday Creek Watershed". This plan identified thirteen issues affecting the watershed. Among those issues were acid mine drainage, erosion and sedimentation, flooding, forest disturbance, sewage treatment and recreational opportunities. This plan has served the Partnership in planning over the past six years.

In developing the management plan, the Partners adopted a mission statement, which is ***"The Monday Creek Restoration Project is a partnership committed to improving watershed health and water quality for the benefit of the community."*** Project partners felt that this statement accurately and concisely represented their deep-seated commitment to water quality and quality-of-life improvements in the watershed.

Activities

The MCRP Partners hold bi-monthly meetings on the second Thursday of the month. If necessary, additional meetings are scheduled to facilitate planning. Meeting minutes, upcoming agendas and other current information about the partnership can be found at www.mondaycreek.org. The Partners do not operate under a set of by-laws. Decisions are made based on general agreement of the partners.

The "Friends of Monday Creek" is a citizen support group that meets bimonthly to discuss topics of interest, such as local history, wildlife and geology. This group meets the second Thursday of alternate months compared to the Partners meetings. Meetings start at 6 p.m. with a potluck dinner followed by a program.

MCRP holds litter pick ups, stream clean ups, tree planting events, and other activities. Annual events include an annual watershed tour, held in mid-October. A canoe float is held in late spring or early summer depending upon weather conditions and water depths. A summer camp for youngsters between the ages of 9 and 13 was held for the first time in 2005. Additional summer camps are scheduled for 2006 and 2007. Activities that have been included in the summer camp are Enviroscape demonstrations, electro-fishing demonstrations, water chemistry testing and QHEI education. The MCRP staff holds tours upon request.

The staff attends fairs and festivals to display the partnership's accomplishments. A tabletop display board features photographs of watershed issues and improvements.

There are also many other ways that the group informs the public of their activities. A bi-annual newsletter is distributed to local residents and interested parties. MCRP has an active webpage (www.mondaycreek.org). Event flyers are posted on bulletin boards in post offices, libraries and convenience stores throughout the watershed. A listserve exists (mc_list@mondaycreek.org) as a useful place for event announcements, discussions, questions, and quotes from news sources among staff, members, partners, VISTA volunteers, teachers, watershed residents and interested website visitors.

Stakeholders

Many agencies and institutions are interested in the restoration of Monday Creek Watershed. Table 2 lists current stakeholders and their roles. This list continues to change as new stakeholders are identified.

Partners' Meeting

Table 2 - Partners and Their Roles in Watershed Restoration

Stakeholder	Individuals/ Groups Involved with MCRP	Role
Army Corps of Engineers	Huntington District	Reconnaissance and feasibility studies for ecological restoration
County Commissioners	Athens, Hocking and	Knowledge of local Perry Counties resources and support
County Health Departments	Athens, Hocking and Perry Counties solutions	Input based on nuisance complaints, knowledge of available resources, support for developing .
Friends of Monday Creek	Landowners and watershed residents . .	Help in gathering input on local issues, knowledge of available resources, support in developing solutions
Hocking College	School of Natural Resources, National Environmental Training Cooperative	Student reclamation training
ILGARD, Ohio University	Voinovich Center . .	Conduct studies in the watershed, provide staff and intern support, GIS database management
USDA, Natural Resource Conservation Service	Athens, Hocking and Perry Counties	Technical expertise and information on programs to landowners
Ohio Dept. of Natural Resources . .	Division of Mineral Resources Management	Developing solutions to Acid Mine Drainage-related problems, engineering designs, funding. land reclamation, water quality improvement and water quality lab work
Ohio Dept. of Natural Resources	Div. of Soil and Water Conservation	Funding, administration, water quality expertise
Ohio Environmental Protection Agency	Div. of Surface Water	Funding, environmental expertise
Office of Surface Mining	Abandoned Mine Land Program	Funding, technical expertise
OSU Extension	Ohio Watershed Network	Training, watershed planning expertise, environmental education

Table 2 (Continued). Partners and Their Roles in Watershed Restoration

Stakeholder	Individuals/ Groups Involved with MCRP	Role
Recycling and Litter Prevention	Athens, Hocking and Perry Counties	Environmental education
Rural Action	Environments Section	Sponsors grants, provides financial recordkeeping and reporting. Provides community interface
Soil & Water Conservation Districts	Athens, Hocking and Perry Counties	Technical expertise and information on programs to landowners
Township Trustees	Jackson, Monday Creek, Salt Lick, Pike, Coal, Falls ,Gore Green, Ward, Trimble, York and Dover Townships	Input from local citizens and knowledge of available resources
US Geological Survey	Water Resources Division	Manages a stream gauging station
Village Councils	Buchtel, Murray City, New Straitsville, and Shawnee	Local resource data

Source: Monday Creek Restoration Project

Community-based Citizens' Groups

Numerous community-based groups are active in the Monday Creek Watershed. Several organizations that work with the Monday Creek Restoration Project to improve water quality and promote environmental stewardship among area residents are described below.

Rural Action is the sponsoring organization for MCRP. Rural Action's mission is to promote economic, social, and environmental justice in Appalachian Ohio. Rural Action has projects in 14 counties and makes an impact on most of the 29 counties of Ohio Appalachia. Rural Action has been working with the people of Appalachian Ohio to build healthy, sustainable communities since 1982.

Sunday Creek Associates is a non-profit community development organization located in rural Southern Perry County, Ohio. Sunday Creek Associates provides community organizing in many areas, including local history and culture, youth support through recreation and the arts, building restoration, environmental stewardship, and community organization and initiatives support.

The New Straitsville History Group meets monthly to preserve the history and heritage of the unique village of New Straitsville. The group has built a meeting / display center and is restoring the historic Robinson's Cave.

The New Straitsville Improvement Committee has built a picnic shelter, installed playground equipment, built a walking trail, placed planters in the downtown area and planted trees

The Murray City Improvement Committee has refurbished the old depot building, restored the loading dock area and placed a caboose on the village park site.

II. Defining Monday Creek Watershed

History

Native Americans

The earliest known inhabitants of the Monday Creek Watershed were an ancient mound building culture, known as the Adena, who settled in the area around 1000 B.C. The Adena were one of the first groups of Native Americans east of the Mississippi to cultivate maize; they also grew squash and gourds. In addition to the study of agricultural practices, archaeologists have examined the physical evidence of Adena ceremonial burial rites in the watershed, namely the Lehman Mound near Gore and the Martzolff Mound northeast of Maxville. Following the Adena, other Native American cultures also flourished in this region of Ohio including the Delaware, Shawnee, and Wyandot Indian nations.

European Settlers

The Monday Creek Watershed was originally part of the Northwest Territory, a region that Great Britain ceded to the United States in the Treaty of Paris (1783). The Northwest Ordinance, which the Continental Congress passed on July 17, 1787, allowed the sale of newly-acquired territories in the West, instituted the laws under which they would be governed, and established conditions for statehood.

In 1787, the Ohio Company, a group of investors made up of Revolutionary War heroes, contracted to purchase one and a half million acres in southeast Ohio. By 1792, investors had paid for 918,833 acres; this first purchase included all of Athens County. The Company purchased a second tract of land in 1792 that included eastern Hocking and southern Perry Counties. These two land purchases contained the whole of the Monday Creek Watershed. The Northwest Ordinance mandated a system of townships as the local government, and this system is still in place with no major revisions.

Political boundaries within the watershed were delineated by 1818. After the creation of Ohio University in the City of Athens, Governor Edward Tiffin proposed that a county be formed to foster development and prosperity in the area. On March 1, 1805, Athens County was established. Both Hocking and Perry Counties were created on March 1, 1818. The only revision to the county boundaries within the watershed was the transfer of Ward Township, originally part of Athens County, to Hocking County in 1851. None of the county seats are located within the Monday Creek Watershed.

In the late eighteenth and early nineteenth centuries, early European settlers crossed the region on their way to better agricultural lands in western Ohio and beyond. Some of these travelers did settle in the fertile bottomlands of Monday Creek. Evidence of pioneer settlement in the area dates back to 1774. In the wake of this influx of people, soldiers were sent to disband white settlements on what was then Native American lands. Some soldiers settled in the area after finding the valleys fertile. Settlers generally lived by hunting, fishing, trading and

farming. Travelers and local inhabitants reported that the agriculture of the Hocking River Basin included fruit orchards, corn, wheat, tobacco, and maple sugar. Native Americans and early European settlers were also attracted by the abundance of salt and wild game. For example, Perry County's Saltlick Township was renowned for its deer, bear, and turkeys.

Transportation

With the creation of the Hocking Canal in 1843, connecting Athens to Columbus, the area was opened up for greater commercial activity. The canal facilitated the transportation of large quantities of wool, coal, packed meat, salt, tobacco, and lumber. Canals remained the dominant mode of transport of coal from 1843 until 1869.

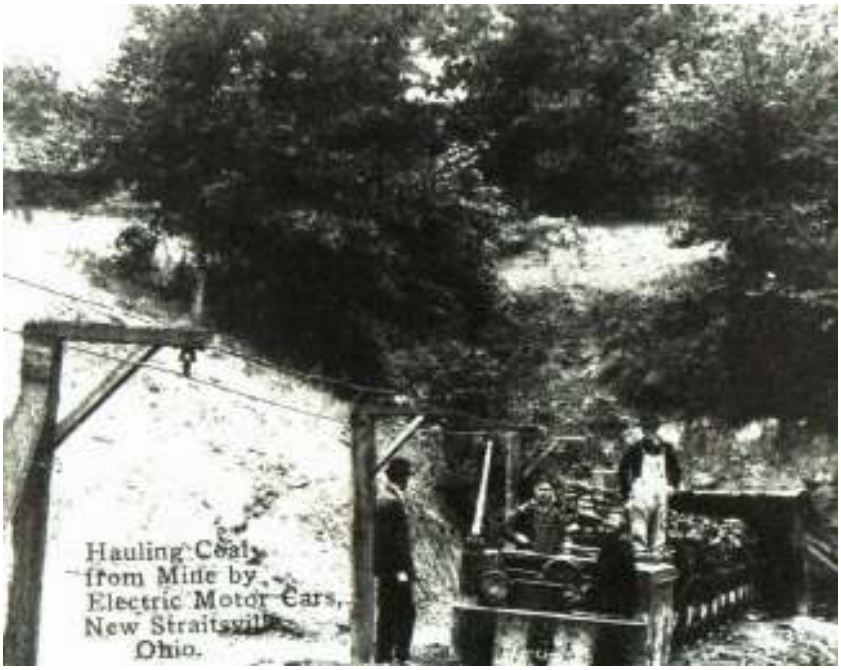
Although the Monday Creek area was in fairly close proximity to the Hocking Canal, the watershed did not experience any appreciable economic boom because of the isolation created by the rugged topography. The extension of the railroad into the area in the 1870s triggered a boom in economic and population growth. The Columbus and Hocking Valley Railroad was the first to complete tracks to Athens in 1870. This line paralleled the Hocking Canal, thus making transport on the canal outmoded. When the Columbus and Hocking line reached Logan in 1869, it prompted the immediate planning for a rail line to Straitsville. On January 2, 1871, a branch of the Columbus and Hocking Valley Railroad running through Gore to New Straitsville was completed. The following year, the Newark, Somerset and Straitsville Railroad Company finished tracks from Newark to Shawnee. A second branch of the Columbus and Hocking line was completed in 1878. It extended from Nelsonville to New Straitsville with a spur running to Murray City. Besides contributing to the region’s commercial needs, the railroads were also coal consumers, since trains used coal to stoke their engines. These steam-powered trains remained the most prominent mode of transportation in the watershed until the 1940s when diesel and electric trains became widespread. Highway transportation surpassed rail in the 1930s and 1940s with the invention of diesel trucks and improvements to the road systems.

Resource Extraction

Monday Creek Watershed contains substantial resource deposits. Advances in transportation in the mid-nineteenth century led to large-scale resource extraction. Together, these emerging technologies created an unsustainable, even if robust, economic engine that led the area into a series of “boom-to-bust” industrial cycles.

Coal was first discovered in 1755, but because of the abundance of timber as a source for heat, coal was not mined much until after 1800. The primary type of coal in the watershed is the Middle Kittanning #6, which is very high in sulfur. In the first half of the nineteenth century, coal began to replace wood as a fuel for salt and iron production. Most of the early mining was done underground, a labor-intensive process especially before the use of mechanized equipment. Early mining consisted of cutting and loading coal by hand, and then transporting it by animal-drawn carts or flatboats. In the mid 1800s, the industrial boom transformed

the Hocking Valley Coalfields of southeastern Ohio into one of the most important coal producing regions in the nation.



Coal Mining in Monday Creek Watershed

Underground mining continued until World War I. Most deep mines in the Monday Creek Watershed were closed by 1922 after a post-war economic slowdown in coal production. Eventually, underground methods became less profitable as labor costs grew and the watershed's coal became more expensive. Underground mining operations ceased in 1972 in Athens and Hocking Counties and, in 1991, in Perry County. Map 3 shows the extent of underground and surface mining that occurred in the Monday Creek Watershed.

After World War II, another coal boom arose because of increased surface mining. Surface mining has been the principal coal extraction method in Ohio for the past fifty years. Machine-aided surface excavation began in the 1880s, but Ohio did not begin keeping official records of surface mining until 1910. Recorded activity of surface mining in the watershed began in 1917. Coal mining reached its peak in Ohio in 1970. It declined sharply in 1972 in response to regulatory pressures concerned with health, safety, air quality, and land reclamation.

Prior to 1947, there were no laws regarding gob pile or mine reclamation, and early laws only regulated surface mining. The Ohio General Assembly passed Ohio's first surface mining law in 1947, but this and other successive reform efforts failed to enforce the reclamation laws. Truly effective reclamation laws for operating mines have only been in effect since 1972. The most important law to regulate mining was the Surface Mining Control and Reclamation Act (SMCRA), passed in 1977.

Perhaps the most infamous and enduring legacies of the watershed's coal industry are the mine fires. During the 1880s, labor strikes nearly crippled the mining industry in the region. Hocking Valley miners, determined to unionize for better working conditions and wages, struck against the Columbus and Hocking Valley Coal and Iron Company, better known as the Syndicate, in June 1884. This strike caused most of the mines in the watershed to shut down for weeks. In response, the Syndicate brought in replacement workers, an act that enraged the striking miners. Several months into the strike, disgruntled miners set fire to seven mines in the watershed, including five near New Straitsville and Sand Run, forcing the Syndicate to seal the mines. The long-term effects of the mine fires were devastating. Closing the mines virtually ended New Straitsville's rapid growth. The mine fires continued to burn, at times breaking the surface and causing structural damage to buildings and roadways. In 1968, the Ohio Department of Transportation closed and rerouted a portion of State Route 216 because of damage from a subsidence caused by the mine fires.

Along with coal production, iron was another product that contributed to the economic boom in the Monday Creek Watershed. The iron industry grew rapidly during the Civil War when southeast Ohio provided much of the iron the North needed. There were over a dozen coal-fired furnaces in the watershed by the early 1880s. As clear-cutting around smelting furnaces and coal mines made timber for charcoal scarcer, the companies relied increasingly on coal. Coal mined in the Monday Creek Watershed produced only a marginal grade of iron because it contained too many impurities and lacked sufficient carbon content.

Timber was essential to many other watershed industries, especially coal and iron production. Charcoal was used in ore production, while timber was used as support beams in underground mining, as well as for houses and tipples (a structure where coal was sorted before being transported). Demand for timber prompted the first wholesale clear-cut of the region. One estimate claims that 89 percent of the forested land in the region was cleared by 1885, approximately thirty years after clear-cutting began. Reforestation did not start until the creation of a national forest in southeastern Ohio in 1934.

The extraction of oil and natural gas in the Monday Creek Watershed began in 1909 near New Straitsville. That year alone prospectors drilled more than 100 wells in the vicinity of New Straitsville. There are still many active oil and gas wells in the Monday Creek Watershed. Wayne National Forest owns the mineral rights to most of its land holdings in the watershed and allows bidders to compete for the rights to drill.

Salt mining was the main industry in southeastern Ohio in the early 1800s. Salt was mined by pumping the salt brine from the earth, boiling off the liquid, and then removing the impurities to allow the salt to crystallize. One salt-works near present-day McCuneville operated from 1829 to 1877. Many of the salt factories were short-lived in the Monday Creek Watershed. There are currently no salt mines in the watershed. An abandoned salt brine well on State Route 78 north of Murray City continues to spill brine on the ground.

Brick production, drawing on the vast clay and coal deposits in the Monday Creek Watershed, peaked in the early twentieth century. There were three factories in the watershed: Greendale Brick, Ohio Mining and Manufacturing (later Claycraft), and Straitsville Impervious Brick (later Straitsville Brick and Columbus Clay). Coal-fired kilns were used until natural gas replaced them in the second half of the twentieth century. Brick production outlasted coal mining. It remained one of the watershed's most profitable industries until the 1960s. Greendale Brick closed permanently in 1930, but Claycraft and Straitsville Brick both reopened after World War II, and then finally closed in the 1970s. Bricks from the region were often transported across Ohio and to other regions.

Cultural Resources

Significant Historic Sites

Most of the structures associated with coal mining and brick manufacturing that were predominant in the watershed have been razed. The significant historic features that remain in the watershed are:

Stone Church Ruins and Cemetery - The Stone Church Ruins and Cemetery found along Stone Church Hollow Road, about 2 miles northwest of Shawnee, Ohio (Salt Lick Township, Perry County). This was the site of St. Peter's Catholic Church.

Robinson's Cave –In this cave (located in a hill above Main Street in New Straitsville), coal miners, with the leadership of Christopher Evans, a union organizer from Pennsylvania, formed the United Mine Workers. The cave later was a famous spot for picnicking families, housed a carousel, and local high school graduates would often have their pictures taken there.

Shawnee Lookout Tower – The lookout tower was built to protect the developing Wayne National Forest from wildfire. The Shawnee Lookout Tower was one of four lookout towers that were built in the 1930s. This particular tower was built in 1939 by the Civilian Conservation Corps (CCC). It is the only one of the four that remains standing today. Shawnee Lookout Tower was manned and used for fire detection until sometime in the 1970s. The tower is made of steel with wooden steps, is 100 feet tall, and the cabin at the top is seven feet square. Originally there was a cabin, restroom, and garage at the site, but they have all been razed.

Tinkers Cave – This cave is a large rock-shelter carved by an ancient creek beneath the overhanging rocks. Since it's formation, many humans and animals have taken shelter under the rock roof. It was said that the cave was large enough to hold two dozen horses, which is exactly what Seth Tinker used it for. In the 1850s, Seth began "borrowing" unattended horses and taking them to the cave. He kept the horses hidden, letting them graze in a nearby field until he herded them 175 miles north to Sandusky to the horse auctions. On his way back, Seth

"borrowed" horses in northern Ohio to sell them to farmers in the southern counties, in the Athens and Hocking regions.

Greendale Brick Plant - Established during the brick making days of southeastern Ohio, Greendale Brick Plant was one of three brick furnaces in this region.

Greendale - Greendale was once populated by workers' families from the brick plant located nearby. Now all that remains of Greendale is a few standing houses, a few ruminants of the plant, and the old school house.

Shawnee Historic District – The buildings on both sides of Main Street from 2nd Street to Walnut Street in this former mining village were placed on the National Register of Historic Places in 1976. The district includes 45 buildings and one additional structure.

Bristol Tunnel – This is a brick-faced tunnel for the Baltimore and Ohio Railroad that ran between Shawnee and Junction City. The rail line has been abandoned. The tunnel is located at the boundary of the watershed in Pike Township, Perry County.

Protected Lands

Wayne National Forest - Forty percent of the watershed is owned and managed by the Wayne National Forest (WNF). The WNF is administered by USDA and managed according to the Multiple Use Sustained Act of 1960. WNF was established in 1934 as a result of the United States Forest Service (USFS) policy to purchase and improve abandoned farm tracts and other heavily degraded lands. Much of the WNF land within the Monday Creek Watershed had been intensively mined (underground / surface) prior to purchase.

Significant Cultural Sites

There are three sites of cultural significance in the Monday Creek Watershed. They relate to the mining history of the area.

The Murray City Depot is a restored depot structure located in the north village park. Housed in the depot are memorabilia related to the coal mining that took place in the vicinity of Murray City. A restored caboose is located just outside the depot.

The Shawnee Mining Museum – This museum preserves historical items from the coal-mining era of the region.

New Straitsville History Museum – This museum holds historical pictures, equipment, clothing and literature of historical importance. The museum is unique and interesting is its reproduction of a coal mine located in the basement.

Significant Recreational Sites

Recreational opportunities are addressed in a following section of this plan. The sites of recreational significance are:

- Stone Church Horse Trail
- Stone Church Trailhead and Campground
- Monday Creek ORV Trails
- New Straitsville ATV Trailhead
- Monday ATV Trailhead
- Long Ridge ATV Trailhead
- North Country National Scenic Trail
- Buckeye Trail
- Sand Run Park
- Williams Campground (Private)
- Camp Ohio (Private)
- Begley's ATV Campground (Private)

Socio-Economics

Population

Although evidence of European settlement in southeastern Ohio dates back to 1774, communities did not take root until adequate transportation routes were established. Clearly, the most significant population expansion in the Monday Creek Watershed came in response to the extension of the railroad in the 1870s. With the introduction of this effective and economical means of transportation came a subsequent increase in industrialization. Population analyses show that thousands of Irish, Welsh, Italian, Dutch, Hungarian, Polish and German immigrants flocked to the Monday Creek area during times of economic prosperity. These immigrants settled in "company towns" with colorful names such as Buchtel, Jobs, and New Pittsburg, which were exclusively owned by mining companies and provided housing, food, and work for the people who lived there (Zanski 1997). When "coal was king" in the 1880s, some of the villages in the Monday Creek Watershed were actually small cities that boasted populations of between 3,000 and 4,000 (Graham 1883).

Between 1910 and 1950, the population of the watershed declined by more than half. A post-World War II population decline resulted from increased mechanization. Decreased demand for coal, coupled with better paying jobs in

steel factories, oil fields, and airplane factories in northern Ohio and Michigan (Zanski 1997), resulted in the loss of another one-third of the population (Davison 1996).

Table 3 - Watershed Population by Village, 1900-2000

Village	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000
Buchtel		1,180	1,178	799	755	569	499	592	585	640	574
Murray City	1,118	1,386	1,493	1,048	1,009	752	717	562	579	499	452
New Straitsville	2,302	2,242	2,208	1,718	1,473	1,122	1,019	947	937	865	774
Shawnee	2,966	2,280	1,918	1,457	1,475	1,145	1,000	914	924	742	608
TOTAL	**6,386**	**7,088**	**6,797**	**5,022**	**4,712**	**3,588**	**3,235**	**3,015**	**3,025**	**2,746**	**2,408**

Source: U.S. Bureau of Census, 1900-2000.

Though not apparent in the above statistics, some growth has occurred in the unincorporated areas since the 1980s. However, most of the watershed villages have continued to experience a gradual population decline.

The gradual out-migration of young people from Athens, Hocking, and Perry Counties has left these areas with a slightly larger percentage of elderly in comparison to 1940 statistics.

Table 4 - Percent Population of Athens, Hocking, and Perry Counties by Age Group

Age Group	1940	1950	1960	1970	1980	1990	2000
65+	9.2%	11.3%	10.5%	11.8%	11.1%	12.0%	11.5%
18-64	57.9%	56.4%	46.7%	52.1%	60.2%	62.7%	60.1%
0-17	32.9%	32.2%	34.2%	36.1%	28.7%	25.3%	28.4%

Source: U.S. Bureau of Census, 1940-2000.

In terms of racial demographics, the Monday Creek Watershed is made up largely of Caucasians, with small minority populations located in specific pocket areas. The comparatively large population of minority groups in York Township can be attributed to the presence of Hocking College in Nelsonville, which maintains a sizeable population of minority and foreign students.

Table 5 - Demographic Population of Townships by Race

Township	Total Population	White	Black	American Indian	Asian	Hispanic	Other
York	7740	7446	131	36	25	76	102
Ward	1937	1746	166	2	1	5	22
Coal	1106	1085	4	0	0	18	17
Monday Creek	671	659	2	4	2	9	4
Salt Lick	1200	1184	0	0	5	6	11
Falls/ Falls Gore	11409	11192	55	35	10	117	69

Source: U.S. Bureau of Census, 2000.

Poverty Statistics

Reflective of the Monday Creek Watershed's locality in Ohio's Appalachian region, almost 18 percent of the watershed's residents live below the poverty level. In 2003, Athens County had 18.3 percent of the county population living below the poverty level; likewise, Hocking County had 12.1 percent living below the poverty level and Perry County had 12.3 percent. These rates were 1 to 8 percentage points higher than the state average of 10.6 percent (U.S. Bureau of Census 2000). The 1998 Ohio Department of Development (ODOD) trends (based on 1990 Census) estimated poverty rates of 18 percent for Athens County, 13 percent for Hocking County, and 14 percent for Perry County. These figures represent a poverty rate 2 to 7 points higher than the state average of 11 percent.

The per capita income of watershed residents ($15,313 in 1999) is $5,690 per year less than the average in the state of Ohio ($21,003 in 1999) (U.S. Bureau of Census 2000).

Table 6 - Percent of Individuals below Poverty by County, 1970-1999

	1970	1980	1990	1995	1999
Athens	16.40%	21.60%	28.70%	32.50%	27.40%
Hocking	18.10%	12.40%	15.70%	14.50%	13.50%
Perry	16.80%	12.50%	19.10%	21.00%	11.80%
State of Ohio	9.78%	11.10%	13.60%	14.90%	10.60%
United States	13.70%	12.40%	13.10%	13.80%	12.40%

Source: US Bureau of Census, 1969, 1979, 1989, 1995, and 2000

Table 7 - Per Capita Income by County, 1969-1999

	1969	1979	1989	1999
Athens	$7,213	$8,531	$9,170	$14,171
Hocking	$7,342	$9, 493	$10,265	$16,095
Perry	$6,575	$9,109	$9,247	$15,674
State of Ohio	$10,068	$12,207	$13,461	$21,003
United States	$9,816	$12,229	$14,420	$21,587

Source: U.S. Department of Commerce, 1969, 1979, 1989, and 2000.

Employment Statistics

The coal mining industry, which historically served as the region's primary source of employment, suffered a drastic decline in the 1970s and a dramatic loss of jobs in the watershed. Today, only 1.9 percent of the population remains involved in coal mining in the Ohio Appalachian region (U.S. Census 1990). The 1990 Census indicates that only 11 percent of the employed residents (in the four largest villages) in the Monday Creek Watershed worked locally. In contrast, 29 percent of Ohio workers and 17 percent of Ohio Appalachian workers were employed close to home. Most residents were forced to commute to Logan, Nelsonville, and Columbus for employment or chose to leave the area altogether to find work.

Monday Creek Watershed experienced a dramatic increase in unemployment in the 1980s. The unemployment rate in Athens County was at 7.3 percent, Hocking County was at 13.7, and Perry County was at 12.1 percent unemployment (Labor Market Information 2002). This trend was taking place statewide as unemployment in Ohio rose 3.0 points from 1970 levels to 8.4 percent in 1980 *(Ibi*d). The 1990 Census showed marked decreases in unemployment, while the 2000 Census indicates the lowest unemployment rates since 1970. The 2000 Census listed 4.7 percent unemployment in Athens County, 7.4 percent in Perry County and 8.7 percent in Hocking County. In relation to the state of Ohio's unemployment rate of 4.0 percent, the Ohio Department of Development ranked Athens County thirty-ninth, Perry County twelfth, and Hocking County seventh highest in unemployment among Ohio's 88 counties. As of December 2002, the unemployment rate in Ohio was 5.3 percent, as compared to 6.0 percent in the U.S (Ohio Department of Development 2002).

Educational Attainment

Residents of the watershed tend to have lower educational attainment than the State average. In 2000, between 45 and 62 percent of the watershed's population held a high school diploma as the highest level of educational attainment, while 36 percent of Ohio residents held a similar level of educational attainment. Only 0.6 to 1.8 percent of the watershed residents have obtained a post-secondary degree, compared with the state of Ohio's rate of 7.5 percent (U.S. Bureau of Census 2000).

For K-12 education, the Monday Creek Watershed is serviced by the Nelsonville-York City School District, the Logan-Hocking School District, and the Southern Local School District.

The watershed contains no colleges or universities. However, Ohio University and Hocking College, both located in Athens County, are within close proximity to the watershed boundaries.

Table 8 illustrates the educational attainment of individuals from communities within the Monday Creek Watershed. These percentages are compared to statistics from Appalachian Ohio, the State of Ohio and the entire United States.

Table 8 - Educational Attainment for Persons 25 Years and Over

EDUCATION LEVEL	Buchtel	Murray City	New Straitsville	Shawnee	Appalachia Ohio*	State of Ohio	United States
Less than 9th grade	8.0%	7.9%	6.5%	4.7%	6.2%	4.5%	7.5%
9-12th Grade, no diploma	15.2%	23.3%	21.1%	11.7%	14.9%	12.6%	12.1%
High school graduate	45.6%	49.0%	52.8%	62.0%	43.7%	36.1%	28.6%
Some college, no degree	15.7%	10.3%	12.3%	14.8%	16.6%	19.9%	21.0%
Associate's degree	9.0%	5.5%	3.2%	5.0%	5.6%	5.9%	6.3%
Bachelor's degree	4.6%	3.4%	2.6%	1.1%	7.9%	13.7%	15.5%
Graduate or professional	1.8%	0.7%	1.6%	0.6%	4.4%	7.4%	8.9%

Source: U.S.Bureau of Census, 2000

*Source of Appalachia Ohio: ILGARD Data Services – Census 2000 Reports

Land Use Characteristics

Land Cover

Primary land cover categories consist of forest (87 percent), mining (in the form of current sand/gravel/limestone operations, 5 percent), crop land (3 percent), pasture (1 percent), wetlands (2 percent), grazing (1 percent), and urban (1 percent) (ODNR 1994).

Land Ownership

Forty percent of the watershed is owned and managed by the Wayne National Forest (WNF). WNF was established in 1934 as a result of the United States Forest Service (USFS) policy to purchase and improve abandoned farm tracts and other heavily degraded lands. Currently, no logging is taking place in Wayne National Forest.

Sunday Creek Coal Company is the watershed's second largest landowner. Currently Sunday Creek Coal owns and manages 8.5 percent of the watershed. Combined, the Forest Service and Sunday Creek Coal Company manage almost half (48 percent) of the Monday Creek Watershed. Although logging does not take place on property owned by the Forest Service, some logging may be taking place in parts of the watershed owned by Sunday Creek Coal Company. While exact figures are unavailable, timber logging may be taking place in parts of Salem Hollow, Sycamore Hollow, Spencer Hollow, Brush Fork, Sand Run and Snow Fork. There are no current surface mining operations in the watershed on Sunday Creek Coal Company properties.

The remainder of the watershed is primarily under private ownership. Most landholdings in the watershed are relatively small (less than 200 acres).

Agricultural Land

Although three percent of the watershed is identified as cropland, the majority of this land has been reverting to pasture and shrub/scrub land. There are no known large (40 acres or greater) row crop fields in the watershed. Several small corn fields are found scattered throughout the non-forested lands.

Pasture and grazing land in the watershed is found primarily in the western third of the watershed. The majority of the pastures are used for hay production. A few pastures are used for livestock grazing.

There are very few livestock found in the Monday Creek Watershed. Other than pastures with less than 10 cattle or horses in portions of Falls Gore, Green and York Townships, the majority of the livestock is concentrated in Monday Creek Township. Approximately 50 head of cattle, owned by four individuals, are found in Monday Creek Township.

Urban Land

The urban areas in the watershed consist of four incorporated villages: Shawnee and New Straitsville in Perry County, Murray City in Hocking County and Buchtel in Athens County. A portion of the city of Nelsonville, in Athens County, is also located within the watershed.

A number of small, unincorporated communities also exist in the watershed. They include Maxville and McCuneville in Perry County; Oreville, Gore, Longstreth and Carbon Hill in Hocking County; and Doanville and Bessemer in Athens County. Other small settlements that have a few scattered houses include Dixie, Sand Run, Monday, New Town and Orbiston.

Industrial Land

There is one manufacturing industry in the watershed (Superior Fibers, formerly Hollinee Corporation/Nicofibers). The plant, located in Shawnee, manufactures fiberglass items for the automotive industry.

There is one logging company, Tri County Tree Specialists, located at Maxville. This company specializes is logging on private landholdings.

There are two quarries in the watershed. Maxville Quarries is located immediately south of the community of Maxville. This limestone quarry ceased mining operations in 2005 and presently sells limestone and landscaping materials brought in from locations outside the watershed. BT Materials is a sand and gravel quarry located south of Doanville. This quarry is actively extracting sand and gravel from deposits between Monday Creek and the Hocking River.

There are no active coal mining operations within the watershed. Small piles of coal refuse material (gob piles) are found in scattered locations throughout the eastern two thirds of the watershed. These relatively small piles result in the only barren land within the watershed.

Transportation

U.S. Highway 33 runs north-south through the lower reaches of the watershed south of Nelsonville. The highway is a four-lane divided highway throughout the portion of the watershed that it crosses.

U.S. Highway 33, between Columbus, Ohio and Ravenswood, West Virginia, is important to local, regional, and statewide transportation. In addition, U.S. Highway 33 is a transportation corridor that is significant to Ohio ’s economy. Existing U.S. Highway 33 through the city of Nelsonville is the last remaining section of the highway within southeast Ohio that has not been upgraded to a modern limited access highway. A bypass around Nelsonville is planned for construction to begin in 2007. The bypass will traverse a portion of Snake Hollow and Coe Hollow along the lower reaches of Monday Creek.

Several state highways serve as transportation routes through the watershed. State Route 93 runs east from Logan (Hocking County) through New Straitsville and Shawnee before turning north toward New Lexington (Perry County). State Route 312 runs north from State Route 93 toward Bremen (Fairfield County). State Route 668 runs north from State Route 93 toward Junction City (Perry County).

State Route 216 connects New Straitsville and Murray City.

State Route 78 runs east from Nelsonville (Athens County) through Buchtel, turns north to Murray City and then turns east toward Glouster (Athens County). State Route 685 runs east from State Route 78 toward State Route 13 south of Jacksonville.

State Route 595 runs from New Straitsville southwest to connect with U.S. Highway 33 west of Nelsonville. State Route 278 runs north from Nelsonville to Carbon Hill and then connects with State Route 595.

Recreation

The primary recreational uses in the watershed are Off Road Vehicle (ORV) trail use and hunting. Other uses include hiking, biking, camping and firewood, mushroom and ginseng collecting. A portion of the Monday Creek ORV area traverses the watershed. Of the 65 miles of ORV trails maintained by the U.S. Forest Service, 50 miles are within the boundaries of the watershed. Use of the ORV trails is often heavy, peaking around the holidays and weekends. However use by ORV and bike riders is not allowed between December 14 and April 16. Hiking and biking are also allowed on Monday Creek ORV trails.

The Stone Church Horse Trail, named for the ruins of an old stone church nearby, is a trail system providing 21 miles of scenic riding trails. The horse trail winds through the rolling hills of Wayne National Forest. A trailhead campground offers camping for horseback riders with facilities designed for horses and horse trailers. Eight campsites are provided, each with a 45-foot long by 15-foot wide parking space. Two sites are fully accessible for people with disabilities. Each site has a covered paddock, fire pit, grill, and tent pad. Drinking water and vault toilets are available. The former Stone Church Trailhead, located nearby, is also open for camping and day use. The campgrounds are open for camping from April 14 through December 15.

The North Country National Scenic Trail (on the same path as the Buckeye Trail) crosses through approximately 19 miles of the Monday Creek Watershed. The majority of the trail traverses back-country (off road) areas. MCRP maintains two trail segments of the Buckeye Trail between Tecumseh Lake and Salem Hollow Road (4.7 miles).

Two privately-owned campgrounds (Williams Campground and Camp Ohio) are located in the watershed. Both campgrounds offer electrical hookups and access to ORV trails.

Primitive camping is allowed within the Wayne National Forest.

The U.S. Forest Service also maintains a picnic area (Sand Run Picnic Area) located north of Carbon Hill. In addition to picnic sites, the area has restroom facilities and a pond for fishing.

The villages of New Straitsville, Shawnee, Murray City and Buchtel have community parks. These parks offer a range of amenities, including playground equipment, skateboard facilities, picnic shelters, basketball and tennis courts and gazebos.

Game species, primarily deer, wild turkey, ruffed grouse and squirrel are hunted seasonally. Deer, ruffed grouse, and squirrel hunting occur during the fall months, whereas wild turkey hunting occurs in the fall and spring. Spring turkey season usually begins around the last week of April and continues to the end of the third week in May.

Zoning

There is no zoning within the Monday Creek Watershed.

Physical Attributes

Monday Creek Watershed retains a rural character common to southeast Ohio. There has been no channelization of Monday Creek or its tributaries during recent history. There have been no levies constructed nor dams built on Monday Creek or its major tributaries. Table 9 summarizes the physical features of the watershed.

Table 9 – Watershed Features

Subwatershed	River Mile	Length (Miles)	Rip. Buffer Present (Miles)	Rip. Buffer Needed (Miles)	Locations Rip.Buffer Needed (RM)	Unrestricted Livestock Access	New Homes (No.)	Bridges /Culverts (No.)
Monday Creek Headwaters to Little Monday	14.5	12.5	9.4	3.1	18.3-18.6 19.6-21.1 25.4-26.5	Yes	2	16
Dixie Hollow	25.6	2.9	2.0	0.9	1.75-2.5	Yes	0	7
Shawnee Creek	24.1	2.0	0.3	1.7	0.3-2.0	Yes	3	8
Rock Run	23.4	2.0	1.45	0.55	----	No	0	3
Stone Church Hollow	22.85	1.6	1.0	0.6	----	Yes	2	5
Salt Run	21.45	1.8	1.55	1.25	----	No	0	3
Dan's Run	19.93	3.9	1.8	2.1	----	Yes	3	5
Lost Run	16.08	2.4	1.9	0.5	1.1-2.1 2.6-3.5	No	0	4
Little Monday Creek	10.0	14.3	10.0	4.3	3.5-4 9.1-11.0 12.2-13.2	Yes	1	18
Temperance Hollow	7.08	3.6	0.9	2.7	Nearly all, up to 3.3	Yes	5	7
Monday Creek below Little Monday Creek	0.0	14.5	11.3	3.2	0.0-0.65 1.3-1.75 10.2-10.7 11.75-12.5	Yes	3	15
Kitchen Run	14.0	2.7	2.2	0.5	----	Yes	1	3
Sand Run	12.4	3.0	2.3	0.7	----	Yes	0	9
Monkey Hollow	11.09	1.8	1.35	0.45	----	Yes	0	3
Snow Fork	3.45	10.7	6.4	4.3	0.9-1.7 1.75-2.6 5.3-6.45	Yes	6	19
Salem Hollow	6.82	3.9	2.85	1.05	----	Yes	2	4
Sycamore Hollow	6.7	4.8	3.2	1.6	1.1-2.4	Yes	0	7
Spencer Hollow	6.7	2.9	2.75	0.15	----	Yes	0	3
Brush Fork	4.8	5.0	4.2	0.8	----	Yes	0	7
Long Hollow	3.35	2.4	2.3	1.0	----	Yes	0	1

Source: MCRP 2006

Development Trends

Population

U.S Census Bureau estimates indicate the state of Ohio will have the slowest population growth of the five states in the East North-central area of the Midwest (Ohio, Illinois, Indiana, Michigan and Wisconsin). The total statewide population is expected to rise from 11,151,000 in 1995 to 11,744,000 in 2025, an increase of 5 percent.

It is likely the population in the watershed will follow this trend.

Poverty and Employment

With limited industrial and commercial growth anticipated in the watershed, the high level of poverty and lack of jobs is expected to continue for the next 5 to 10 years. The majority of the employed watershed residents will work outside the watershed.

Education

Primary and secondary education will continue to be obtained at consolidated schools in or near the watershed. With a limited industrial and commercial base, the education levels in the watershed are expected to remain at or near current levels.

Land Cover

Terrain and past land uses in the Monday Creek Watershed influence trends in land cover. Land cover will remain primary as woodland for the foreseeable future.

Ownership

There is a trend toward the purchase of small lots (five acres or less) with highway/roadway access. Both year-round homes and weekend cottages are being constructed on parcels throughout the watershed. This trend is expected to continue with improved access from Columbus with the Lancaster Bypass and the Nelsonville Bypass.

Agricultural Land

Commodity prices for row crops and the trend toward larger fields and farms will continue to diminish the acreage of cropland and increase the acreage in pasture/grazing, scrub/shrub fields and forestland.

Urban Land

With limited jobs in the villages throughout the watershed, little growth or expansion is anticipated. The Village of New Straitsville has obtained land adjacent to the village boundary (formerly the land was managed as part of Wayne National Forest) for housing development. Only a few lots have been sold over the past two years.

Transportation

The only transportation project planned (and currently in the initial construction stages) is the Nelsonville Bypass on U.S. Highway 33 . This bypass, when completed, will connect the existing four lane highway west of Nelsonville with the existing four lane facility southeast of Nelsonville. This connection, estimated to cost $110 million, will allow for more efficient and safer travel between Columbus and Ravenswood, West Virginia. In addition, the Nelsonville Bypass will enhance regional economic development opportunities.

Recreation

Recreational use of the resources within the Monday Creek Watershed will continue. Recent improvements to off-road vehicle trails on Wayne National Forest and establishment of a new private campground in New Straitsville will attract riders. A potential exists for more horse trails and campgrounds suitable for horse trailer use. Hunting will remain a major seasonal pursuit in the watershed.

III. Watershed Inventory

Glacial History

Monday Creek is located in an unglaciated portion of Ohio. However, glaciers influenced the geologic history of the watershed.

Approximately two million years ago, the southern two thirds of Ohio was drained by an ancient drainage system known as the Teays River. As glaciers of the Pleistocene Ice Age pushed southward across Ohio, they formed a massive dam that blocked the northward flow of the Teays River and created a major lake in southern Ohio. Eventually, the waters of this lake breached the drainage divides and created new drainage channels marking the beginning of the modern Ohio River drainage system (Ohio DNR, Div. of Geological Survey 1995).

Today, Monday Creek flows south over lake and stream sediments deposited by the ancient lake. The creek joins the Hocking River on glacial outwash deposited on an erosional surface at the top of the Pottsville formation (USACOE 2005).

Geology and Topography

Monday Creek Watershed lies in the unglaciated portion of the Appalachian Plateau physiographic province. Bedrock is Pennsylvanian in age and consists primarily of sandstones, shale, coal, and limestone. The Allegheny and Conemaugh formations comprise the primary stratigraphic sections found in the watershed. Coal has been mined from the Middle Kittanning coal and the Upper Freeport coal seams.

Monday Creek headwaters begin in the northeast section of the watershed in the Upper Freeport sandstone and shale at elevation of 990 feet above Mean Sea Level (msl). Little Monday Creek, which drains the northwest portion of the watershed, has its headwaters in the Upper Freeport sandstone at an elevation 1000 feet above msl. Snow Fork, which drains the eastern portion of the watershed, originates in Brush Creek limestone at an elevation 1000 feet above msl (USACOE 2005).

The composition of slope and soil has a significant effect on the Monday Creek Watershed. Glaciation to the north and west of the watershed cut and filled the topography. In the Monday Creek area, however, the old, deeply dissected, steep terrain persists. Wind-blown glacial loess accumulated on the ridge tops and now constitutes a layer of soil several feet thick. Slopes in the Monday Creek Watershed are characterized by steep hillsides along narrow ridges. In general, level land can only be found in floodplains along streams. Hillsides with a slope of greater than 4 to 1 are unsuitable for farming or construction (ILGARD and Rural Action, 1999).

An abundance of shale in the Monday Creek Watershed is also significant because when shale weathers it forms clay soils. Soil with a high clay content is less permeable to water and, therefore, increases the volume of runoff from precipitation. This impermeability, coupled with the steep slopes, contributes to flood conditions along the streams in the Monday Creek Watershed. In addition, because of the presence of clayey, slip-prone soils on steep hillsides, most human settlement in the watershed exists along the flat valley bottoms that are prone to flooding (ILGARD and Rural Action, 1999).

The U.S. Geological Survey provides topographic coverage of the watershed on 7.5 minute (1:24,000) maps. All or portions of the following maps are required for full coverage:

- Junction City
- New Lexington
- Gore
- New Straitsville
- Union Furnace
- Nelsonville

Soils

Soil associations of the Monday Creek Watershed have distinct patterns of soil composition, local topography, and drainage structure. Taken from the General Soils maps from the county soil surveys and the NRCS Soils Website, major soil associations in the Monday Creek Watershed include the Westmoreland-Guernsey-Coshocton-Bethesda, Westmoreland-Guernsey-Dekalb, Wharton-Shelocta-Latham-Brownsville, and the Wheeling-Otwell-Glenford-Euclid-Chagrin. Map 4 shows the location of the major soil associations in the watershed.

Westmoreland-Guernsey-Coshocton-Bethesda soils are commonly found on ridgetops and dissected hillsides that are often benched. Westmoreland soils lie on steeper hillsides and ridgetops. They are moderately steep to very steep, well-drained, medium-textured soils formed from siltstone, sandstone, and shale. Their slowest permeability is moderate and available water capacity is low or moderate. They have a low shrink-swell potential. Guernsey soils are on flatter ridgetops, hillsides, and benches. They are moderately well drained, medium textured soils derived from shale or siltstone. Their slowest permeability is slow and available water capacity is moderate. The top of the seasonal high water table is at 33 inches during winter, early spring, and other extended wet periods. They have a high shrink-swell potential. Coshocton soils are more common in the gentle sloping and strongly sloping areas. It is a deep or very deep, moderately well drained soil. The slowest permeability is slow. They have a moderate available water capacity and a moderate shrink swell potential. Bethesda soils are found on side slopes, ridges and benches that formerly were surface mined for coal. Bethesda is a strongly sloping to moderately steep, very deep, well drained soil. The slowest permeability is moderately slow. It has a low available water capacity and a low shrink swell potential. The main use of these soils in this association is

forestland. Sometimes Westmoreland-Guernsey soils can be used as farmland and cropland. These soils are very limited for septic system absorption fields. They are moderately well suited for row crops and building sites except when on very steep hillsides where slope failures are more common (USDA 1989).

The Westmoreland-Guernsey-Dekalb Soil Association is commonly found on ridgetops, hillsides and knolls in the uplands throughout a large part of the Monday Creek Watershed. These soils are well-drained, medium textured soils. Westmoreland soils lie on steeper hillsides and ridgetops. They are moderately steep to very steep, well-drained, medium-textured soils formed from siltstone, sandstone, and shale. Their slowest permeability is moderate and available water capacity is low or moderate. They have a low shrink-swell potential. Guernsey soils are on flatter ridgetops, hillsides, and benches. They are moderately well drained, medium textured soils derived from shale or siltstone. Their slowest permeability is slow and available water capacity is moderate. The top of the seasonal high water table is at 33 inches during winter, early spring, and other extended wet periods. They have a high shrink-swell potential. Dekalb soils were formed in residuum and colluvium derived from medium- and coarse-grained sandstone. Dekalb is a moderately deep, well drained soil. The slowest permeability is moderately rapid. It has a low available water capacity and a low shrink swell potential. The main use of these soils in this association is forestland. Sometimes Westmoreland-Guernsey soils can be used as farmland and cropland. These soils are very limited for septic system absorption fields. Dekalb soils encounter bedrock at a depth of 20 to 40 inches, making these areas very limited for home construction and placement of underground utilities (USDA 1988).

The Wharton-Shelocta-Latham-Brownsville Soil Association is comprised of upland soils found on gently sloping to steep hillsides. Wharton soils are deep, moderately well drained soils formed in residuum from interbedded clay shale, siltstone and fine-grained sandstone. The slowest permeability is slow. It has a low available water capacity and a moderate shrink swell potential. The top of the seasonal high water table is at 27 inches. Shelocta soils are found on the steeper parts of hillsides and the higher points and shoulders of ridgetops. They are strongly sloping to very steep, well-drained, medium textured soils formed in colluvium and residuum derived from siltstone, sandstone and shale. They are deep and very deep, moderately permeable soils. Latham soils occur on ridgetops and side slopes. They are moderately deep, moderately well drained soils formed in residuum from acid shale and interbedded siltstone in some places on uplands. They have a slow permeability. Brownsville soils consist of deep, well-drained soils with moderate or moderately rapid permeability formed in colluvium and residuum weathered from fractured siltstone and very fine grained sandstone. Most of the soils in this association developed under mixed mesophytic and mixed oak forest (USDA 1989).

The Wheeling-Otwell-Glenford-Euclid-Chagrin Soil Association is commonly found on terraces and floodplains in valleys. .Wheeling soils, commonly found on

stream terraces, were formed in glacial outwash. The Wheeling series consists of very deep, well drained soils with moderate permeability. These soils formed in silty or loamy alluvial materials on river terraces. The seasonal high water table is at a depth of more than 6 feet. Otwell soils are gently sloping to moderately steep, well to moderately-well drained, and have a medium texture. They form in loess and lacustrine environments. They have a moderate available water capacity. The slowest permeability is impermeable. Available water capacity is moderate. The top of the seasonal high water table is at 33 inches. Depth to a root restrictive fragipan is at a depth of 20 to 40 inches. Glenford soils are found on slight rises on floodplains. The Glenford series consists of very deep, moderately well drained soils formed in stratified Wisconsinan age glaciolacustrine or stream sediments on lake plains, stream terraces, and outwash plains and terraces. Permeability is moderate or moderately slow in the upper part of the subsoil and moderately slow in the lower part of the subsoil and the substratum. The top of the seasonal high water table is at 33 inches. Euclid soils consist of very deep, somewhat poorly drained, moderately slow permeable soils formed in silty deposits on low stream terraces. This soil is rarely flooded and is not ponded. It has a high available water capacity. The top of the seasonal high water table is at 21 inches. Chagrin soils are found on floodplains. They are nearly level, well-drained, medium textured soils. Permeability and available water capacity are both moderate. This soil is frequently flooded and is not ponded. The top of the seasonal high water table is at 60 inches (USDA 1989).

Table 10 - Dominant Soil Associations, Locations, Uses and Management Concerns Within the Monday Creek Watershed

Dominant Soil Association	Location	Common Uses	Major Management Concerns
Westmoreland – Guernsey-Coshocton-Bethesda	Ridgetops, hillsides	Woodland, cropland, pasture	Erosion, droughtiness
Westmoreland - Guernsey – Dekalb	Hillsides	Woodland	Erosion, slippage
Wharton-Shelocta-Latham-Brownsville	Ridgetops, hillsides	Woodland	Erosion: droughtiness
Wharton-Otwell-Glenford-Euclid-Chagrin	Floodplains, Terraces	Woodland, cropland, pasture	Flooding, erosion, Seasonal high water table

Sources: USDA, Soil Conservation Service, *Soil Survey of Athens County, Ohio*, 1985
USDA, Soil Conservation Service, *Soil Survey of Hocking County, Ohio*, 1989
USDA, Soil Conservation Service, *Soil Survey of Perry County, Ohio*, 1988

Soil characteristics of interest within the Monday Creek Watershed are the areas of prime farmland and areas with highly erodible soils. Table 11 shows these characteristics by county within the Monday Creek Watershed. The bottom row indicates the approximate land area of Monday Creek Watershed in each county. A significant acreage within the Monday Creek Watershed is highly erodible.

Table 11 – Soil Characteristics

	Athens County	Hocking County	Perry County	Monday Creek Watershed
Prime Farmland (Acres)	628	2,808	4,184	7,620
Highly Erodible Soils (Acres)	6,322	20,339	27,793	54,454
Total Land Acreage	7,730	31,855	32,035	71,620

Source: Computerized Soils Information (SSURGO) 2006

Mineral Resources

The primary geologic ore of economic interest in the Monday Creek Watershed is coal. Coal found in the Monday Creek Watershed is primarily Middle Kittanning #6. The Ohio EPA has ranked this coal seam as having high potential for pollution based on the following factors: the content of sulfur and iron sulfide found in the coal and overburden; the method for extracting the coal; the extent of mining; and the present conditions of abandoned mines.

Approximately 15,000 acres of abandoned underground mines exist in the Monday Creek Watershed, in addition to 4,000 acres of surface-mined lands located primarily in the northern half of the region. There are no current underground or surface coal mining operations in the Monday Creek Watershed.

Besides coal, other resource extraction industries in the region found temporary success. They included salt, iron and clay. There are no operations currently extracting these resources from the watershed.

There are numerous active oil and gas wells throughout the watershed.

There is currently no limestone mining taking place in the watershed.

One sand and gravel quarry is operating south of Doanville near the mouth of Monday Creek.

Water Resources

Climate and Precipitation

Based upon data from the National Climatic Center in Asheville, North Carolina, Monday Creek Watershed is characterized by temperate, humid conditions with well-defined winter and summer seasons. In winter, the average temperature is 32 degrees Fahrenheit (^{o}F) and the average daily minimum temperature is 21 ^{o}F. The lowest temperature on record, which occurred on January 28, 1963, is –27 ^{o}F. In summer, the average temperature is 71 ^{o}F and the average maximum daily temperature is 85 ^{o}F. The highest temperature on record, which occurred on July 14, 1954, is 104 ^{o}F.

The total annual precipitation is about 39 inches. Of this, about 21 inches, or about 55 percent, falls in April through September. The heaviest 1-day rainfall recorded was 3.70 inches on January 14, 1968. Thunderstorms occur on about 45 days each year, with most occurring in summer.

The average seasonal snowfall varies greatly from the northern portion of the watershed, with an average yearly snowfall of 29 inches, to the southern portion, with an average yearly snowfall of 14 inches. The number of days with snow on the ground also varies considerably from year to year.

The average relative humidity in mid-afternoon is about 55 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines about 60 percent of the time in summer and 40 percent in winter.

Surface Water

Monday Creek drains 116 square miles in the unglaciated portion of the Allegheny Plateau region of southeastern Ohio. The watershed originates in the southern portion of Perry County and flows in a southerly direction into Hocking and Athens Counties. Monday Creek Watershed drains 10 percent of the Hocking River system, which itself is part of the Ohio River Watershed.

Streams

Of the 270 stream miles in the Monday Creek Watershed, the total of perennial streams totals 75.9 miles. The two main tributaries to Monday Creek are Little Monday Creek (14.3 miles in length) and Snow Fork (10.7 miles in length). Little Monday Creek drains an area of 25.1 square miles. Snow Fork drains 27.3 square miles.

Information about stream length, gradient, drainage area and elevations can be found in the Gazetteer of Ohio Streams, published by the Ohio Department of Natural Resources (ODNR 2001). Stream information for Monday Creek and its major tributaries is presented in Table 12.

Table 12 - Monday Creek and its Major Tributaries

Stream Name . .	Flows into	County (at mouth)	Length (miles)	Ave. Fall (ft./mile)	Drains (sq. miles)
Monday Creek	Hocking River	Athens	27	10.4	116
Snow Fork	Monday Creek	Athens	10.7	17.3	27.3
Brush Fork	Snow Fork	Hocking	4.2	34.5	4.5
Middle Fork	Snow Fork	Hocking	5.1	34.7	4.8
Sand Run	Monday Creek	Hocking	3.1	37.1	5.91
Kitchen Run	Monday Creek	Hocking	3.2	63.7	5.35
Little Monday Creek	Monday Creek	Hocking	14.3	17	25.1
Lost Run	Monday Creek	Hocking	1.2	37.5	3.14
Salt Run	Monday Creek	Perry	2.8	96.5	2.54
Shawnee Creek	Monday Creek	Perry	1.6	34.4	4.4

Source: Gazeteer of Ohio Streams, ODNR 2001

The table below identifies each of the 31 subwatersheds in the Monday Creek drainage basin. Subwatersheds are grouped by the main tributary into which they discharge and ordered from headwaters to mouth. Statistics including drainage area, mean annual flow and use designation for each subwatershed and major tributary in the Monday Creek basin. Refer to Map 2 (Sub-Watershed Locations Map).

Table 13 - Subwatersheds in the Monday Creek Basin

Subwatershed	Drains (acres)	Sq miles	Mean Annual Flow (cfs)	Aquatic Life Use Designation	Attainment
JOBS HOLLOW	2,267	3.54	3.6	LRW	NON
DIXIE HOLLOW	2,199	3.44	3.5	LRW	NON
IRONPOINT / UNNAMED 6	817	1.28	1.3	WWH	NON
SHAWNEE CREEK*	2,816	4.40	4.4	WWH	NON
ROCK RUN	1,283	2.00	2.0	LRW	NON
STONE CHURCH	2,094	3.27	3.3	WWH	NON
SALT RUN*	1,626	2.54	2.6	WWH	NON
NEW STRAITSVILLE / UNNAMED 2	2,397	3.75	3.8	WWH	NON
DANS RUN	1,930	3.02	3.0	WWH	PARTIAL
LOST RUN*	2,010	3.14	3.2	LRW	NON
LITTLE MONDAY CREEK*	16,070	25.10	25.4	WWH	F, P, N
KITCHEN RUN*	3,424	5.35	5.4	WWH	P, N
SAND RUN*	3,782	5.91	6.0	WWH	NON
MONKEY HOLLOW	1,790	2.80	2.8	LRW	NON
BIG 4 HOLLOW	605	0.95	1.0	LRW	NON
SNAKE HOLLOW	781	1.22	1.2	LRW	NON
BESSEMER HOLLOW	330	0.52	0.5	LRW	NON
SNOW FORK*	17,428	27.23	27.5	LRW	NON
COE HOLLOW	131	0.20	0.2	LRW	NON
MONDAY CREEK SUB-1	10,461	16.35	16.5	LRW	F, P, N
Monday Creek Total	**74,240**	**116.00**	**117.2**	**LRW**	**F, P, N**
TEMPERANCE HOLLOW	1,886	2.95	3.0	WWH	FULL
FELLOWSHIP / UNNAMED 3	1,414	2.21	2.2	WWH	FULL
GORE/ UNNAMED 5	1,227	1.92	1.9	Not evaluated	Not evaluated
T-403/ UNNAMED 4	955	1.49	1.5	WWH	FULL
LITTLE MONDAY CREEK SUB-1	10,588	16.54	16.7	WWH	F,P,N
Little Monday Creek Total	**16,070**	**25.10**	**25.4**	**WWH**	**F, P, N**
MIDDLE FORK / SYCAMORE HOLLOW	3,154	4.93	5.0	LRW	NON
SALEM HOLLOW	3,481	5.44	5.5	WWH	PARTIAL
SPENCER HOLLOW	1,063	1.66	1.7	LRW	NON
BRUSH FORK*	2,880	4.50	4.5	LRW	NON
GOOSE RUN	628	0.98	1.0	Not evaluated	Not evaluated
LONG HOLLOW	929	1.45	1.5	LRW	NON
WHITMORE / UNNAMED 1	775	1.21	1.2	LRW	NON
SNOW FORK SUB-1	4,518	7.06	7.1	LRW	NON
Snow Fork Total	**17,428**	**27.23**	**27.5**	**LRW**	**NON**

Source: Black 2005

USGS Gage Stations

The U.S. Geological Survey maintains and operates a streamflow gage station at Doanville (USGS 03158200) in the Monday Creek Watershed. The gage site is 1.75 miles above the mouth of Monday Creek. The gage was installed in 1997 and continues to measure gage height, discharge, water temperature, specific conductance and pH. The gage is operated in cooperation with the Ohio DNR. Based on seven years of record, the annual daily mean flow is shown in Table 14.

Table 14 - Annual Daily Mean Flow – Monday Creek at Doanville, Ohio (USGS 03158200)

Calendar Year	Discharge, cubic feet per second
1998	130.8
1999	84.2
2000	93.5
2001	88.3
2002	96.1
2003	158.3
2004	205.1

Source: USGS 2006

A second gage (USGS 03158195) was located on a bridge abutment on State Route 685 at the corporation limits of the Village of Buchtel. This gage collected water discharge measurements from Snow Fork. The gage operated from April 1981 to September 1981and from May 1997 to September 1997.

Floodplain Areas

There is no current information available on floodplain condition or connectivity for the watershed. This item will be addressed in a future WAP update.

Sinuosity and Entrenchment Indices

Sinuosity and entrenchment studies have not been completed for the watershed. Stream locations exhibiting impacts in the future will be evaluated on a case by case basis. Currently, there is no evidence to suggest that entrenchment is a source of impairment to surface water within the watershed.

Wetlands

Hundreds of small, inland wetlands that lack flowing water (Palustrine systems) are identified within the watershed by the National Wetlands Inventory (USDI, Fish and Wildlife Service). These wetlands were mapped using stereoscopic analysis of high altitude aerial photographs based on vegetation, visible hydrology and geography in accordance with Classification of Wetlands and Deepwater Habitats of the United States (USFWS 1979). Detailed on the ground and historical analysis of sites may result in revisions to these sites.

Wetlands that offer aquatic and terrestrial habitats include:

Rutherford Wetland – Rutherford Wetland occupies a tract of National Forest property along a more than half-mile stretch of railroad grade. The railroad was originally constructed and operated by Hocking Valley Railroad, and later by C&O Railroad. Rutherford Wetland includes approximately 15 acres of buttonbush swamp with standing water, and at least 5 acres of wet meadow habitat. The wetland is accessible by foot along the railroad grade, and is located 1.8 miles west of Carbon Hill on State Route 278.

Payne Wetland – This shallow pond and associated marshes are the result of an impoundment of water created by a railroad grade that blocks the natural drainage of surface runoff and a small tributary. Beavers have furthered the impoundment by damming up culverts through the grade. This impoundment presently consists of approximately 30 acres of open water and 10 acres of bog/wet meadow. It is notable for having a large great blue heron (*Ardea herodias*) rookery. Payne Wetland is located 1 mile north of Greendale along State Route 595, west and southwest of the Payne Cemetery.

Greendale Wetland – Greendale wetland is an approximately 20-acre wetland consisting of open water, wet meadow, bottomland hardwood and buttonbush swamp habitat. An abandoned railroad bed traverses the middle of the wetland that provides for easy hiking and viewing of wildlife. Greendale Wetland is located on the Wayne National Forest, adjacent to State Route 595, approximately 5 miles north of the intersection of State Route 595 and U.S. Highway 33 in Hocking County (New Straitsville/Haydenville exit) or one mile south of the Hocking/Perry County line on State Route 595.

Tansky's Marsh – Tansky's Marsh is one of the newest additions to the Wayne National Forest. This 13-acre wetland is located in Hocking County at the intersection of State Route 93 and Falls Gore Township Road 382 (between the communities of Gore and Oreville).

Greendale Wetland

Little Monday Creek Wetland – Little is known of this bottomland swamp. It begins at the junction of Township Roads 227 and 131, about two miles northeast of Maxville, and continues for over three-eighths of a mile north along T-131. The main channel of Little Monday Creek carves through approximately 20 acres of swamp and wet meadow, punctuated at intervals by small areas of open water that are likely the result of beaver activity.

Maple-ash-oak swamp – A large bottomland swamp of 80 acres, this wetland is also associated with blocked drainage resulting from the C&O Railroad grade. It follows the grade and the Monday Creek mainstem immediately downstream of Payne Wetland.

Mixed emergent marsh – A 2-acre wetland located near Longstreth.

OEPA High Quality Wetlands – Ohio EPA has designated two wetlands along the Monday Creek mainstem as being of high quality. These wetlands are:

C&O Buttonbush Swamp – An 8-acre wetland is located along Monday Creek, just north of County Road 1A in Athens County, approximately one-half mile southeast of Buchtel.

Odenthal Pond/Monday Creek Marsh – This 70-acre wetland is located immediately to the south of C&O Buttonbush Swamp across County Road 1A in Athens County.

Lakes

There are no natural lakes within the Monday Creek Watershed.

The only man-made lake within the watershed is Tecumseh Lake, a small (approximately 5 acres) reservoir located just off State Route 93 at Shawnee, Ohio. The reservoir was constructed by the village in 1952. It is used for recreational pursuits such as fishing and swimming.

Groundwater

Aquifers

Aquifers in the Monday Creek Watershed consist of interbedded sandstone, shales, siltstones, limestones and coals of the Pennsylvanian System or shales and sandstones of the Mississippian System. Multiple aquifers are typically present. In addition, sand and gravel lenses interbedded with finer-grained alluvium may occur.

Depth to water is generally moderate to deep, ranging from 40 to 70 feet. Some shallower, perched zones overlie low permeability shales, limestones, or mudstones.

Groundwater flow in deeper aquifers follows the bedrock formations and is generally a flow to the southeast. The flow regime of shallow aquifers generally follows the topography and leads to water channels.

Groundwater yields range from 10 to 25 gallons per minute (gpm) for the Mississippian System aquifers; 3 to 10 gpm for the lower Pennsylvanian System (Pottsville and Allegheny Groups) aquifers; and less than 3 gpm for the upper Pennsylvanian System (Conemaugh and Monongahela Groups) aquifers. With these low yields, groundwater is primarily used in supplying water for domestic use.

Aquifers in close proximity to Monday Creek and its tributary valleys have a depth to water that is usually shallow to moderate, averaging from 10 to 35 feet. Ground water yields in these aquifers average in the 5 to 25 gpm range.

Recharge rates of 7 to 10 inches per year occur on floodplains of Monday Creek and its tributaries. These areas contain highly permeable soils, flatter topography and shallow depths to water. Moderate recharge rates of 4 to 7 inches occur in the headwaters of smaller tributaries. These areas tend to have moderately shallow depths to water and moderate to lower permeability soils. Upland areas have recharge values of 2 to 4 inches per year. These areas are characterized by greater depths to water, lower permeability soils and steeper slopes.

Ground Water Pollution Potential

The Ohio Department of Natural Resources, Division of Water, Ground Water Resources Section is creating Ground Water Pollution Potential Maps utilizing the DRASTIC system for all 88 counties in Ohio. The DRASTIC method evaluates the hydrogeologic sensitivity of an aquifer to contamination. It uses a relative ranking scheme, called the DRASTIC index, to help prioritize ground water resources with respect to their vulnerability to ground water contamination. Seven parameters are used to calculate the DRASTIC index: Depth to water, Recharge to the aquifer, Aquifer media, Soil media, Topography, Impact of vadose zone media, and Conductivity of the aquifer. Aquifers with scores greater than or equal to 140 are considered “highly sensitive”; those scoring less than 100 are categorized as “low sensitivity”; and those between 101-139 are “moderately sensitive” (Ohio EPA 2003).

The Ohio DNR has identified areas in Hocking County along Little Monday Creek and the mainstem of Monday Creek as highly sensitive areas for ground water pollution potential, while areas along Little Monday Creek, other tributaries and the mainstem of Monday Creek in Perry County are classified as moderately sensitive. Areas outside the floodplains of these streams are considered to have a low sensitivity for ground water pollution potential. DRASTIC mapping is not available for Athens County.

A special version of DRASTIC was developed for use where the application of pesticides is a concern. The weights assigned to the DRASTIC factors were changed to reflect the processes that affect pesticide movement into the subsurface with particular emphasis on soils. The process for calculating the Pesticide DRASTIC index is identical to the process used for calculating the general DRASTIC index. However, Pesticide DRASTIC numbers vary from the general DRASTIC index because the conceptual basis in factor weighting and evaluation differs significantly. The Pesticide DRASTIC index identifies Little Monday Creek and the mainstem of Monday Creek in Hocking County as highly sensitive areas for ground water pollution potential, while areas along Little Monday Creek, other tributaries and the mainstem of Monday Creek in Perry County are classified as moderately sensitive. Areas outside the floodplains of these streams are considered to have a low sensitivity for ground water pesticide potential.

Oil and gas wells are the most abundant potential sources of contamination within the Monday Creek Watershed. They are found throughout the watershed, with the highest concentrations occurring in and near the villages of Shawnee, New Straitsville and Murray City.

Source Water Assessment Plans

Monday Creek Watershed residents are served by community and regional public water systems as shown in Table 15. The sources of water to the communities or water associations are the City of Nelsonville (ground water) and the Burr Oak Regional Water District (surface water). The Source Water Assessment Plans for both water sources identify Drinking Water Source Protection Areas outside the Monday Creek Watershed.

Table 15 - Community Public Water Systems

Public Water System.	Drinking Water Source	Pop. Served	Ohio EPA ID	Purchases From
Athens Co. Buchtel Water	Ground Water	840	0501812	City of Nelsonville
Carbon Hill Water Assn.	Surface Water	980	3700103	Burr Oak Regional Water District
Murray City Village	Surface Water	525	3700803	Burr Oak Regional Water District
Nelsonville City	Ground Water	9160	0501214	
New Straitsville Sys #1	Surface Water	774	6400503	Burr Oak Regional Water District
Old Straitsville Water Assn.	Surface Water	2400	6401403	Burr Oak Regional Water District
Shawnee Village	Surface Water	750	6401003	Burr Oak Regional Water District

Source: Ohio EPA 2006

Biological Features

Aquatic Biota

As part of the TMDL process, an intensive ambient assessment of the Monday Creek watershed was conducted by the Ohio EPA during the 2001 field sampling season. The study area included the entire length of Monday Creek, principal tributaries, and all remaining minor conveyances possessing a drainage area greater than 1.0 square mile. A total of 92 stations were sampled throughout the catchment, evaluating 30 named and unnamed streams. Ambient biology, macrohabitat quality, water column chemistry, and bacteriological data were gathered from nearly every sampling station. Diel water quality (DO, pH, conductivity, and temperature) and sediment chemistry (metals, organics, and

particle size) were evaluated at selected stations. Cumulatively, 77.6 linear stream miles of the watershed were surveyed and assessed.

A total of 26.5 miles of the Monday Creek mainstem were surveyed and assessed. Eighteen stations were deployed to evaluate the reach extending from the extreme headwaters in southern Perry County to the Hocking River confluence, near US Highway 33. The entire length of Monday Creek was found impaired. Conditions were uniformly degraded, as poor to very poor aquatic communities were commonly observed. Similarly, surface water quality was equally degraded throughout. The extent and magnitude of the impacts to both chemical water quality and the resident biota were indicative of severe and systemic mine drainage problems.

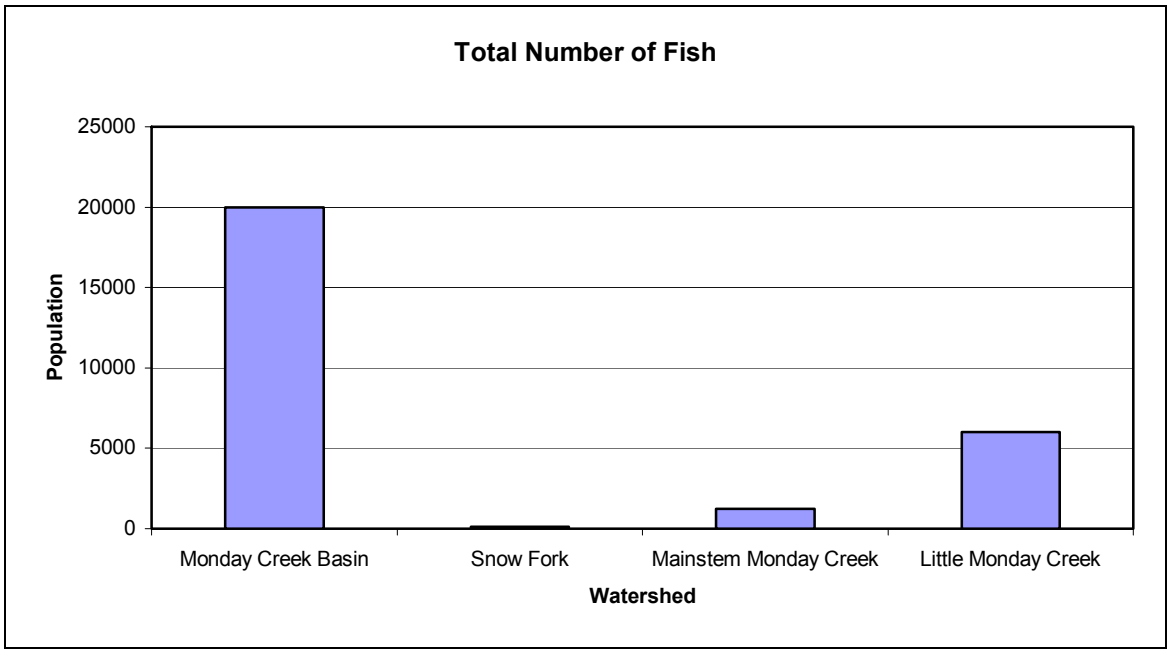
Fish

As part of the Total Maximum Daily Load (TMDL) field investigations, the Ohio Environmental Protection Agency, Division of Surface Water, Ecological Assessment Unit, conducted a fish survey in 2001 of the entire Monday Creek Watershed. A total of 26 species and 4 hybrids were identified. Figure 1 displays the total number of fish caught for the Monday Creek Basin, Snow Fork, mainstem Monday Creek and Little Monday Creek. Figure 2 shows the species diversity including hybrids found in Monday Creek Basin, Snow Fork, mainstem Monday Creek and Little Monday Creek. Pollution tolerant species made up approximately 70 percent of the fish caught in mainstem Monday Creek during the sampling period. These include yellow bullhead (*Ameriurus natalis*), bluegill (*Lepomis macroshiros*), green sunfish (*Lepomis cyanellus*), and creek chubs (*Semotilus atromacculatus*).

A total of 1,081 fish comprising 20 species and three hybrids was collected from Monday Creek between June and August 2001. The fish sampling effort included 23 sampling events, at 14 stations, evaluating 26.5 miles of the mainstem, between RM 26.5 (Portie Flamingo Rd.) and RM 0.7 (TR 36, Elm Rock Rd.).

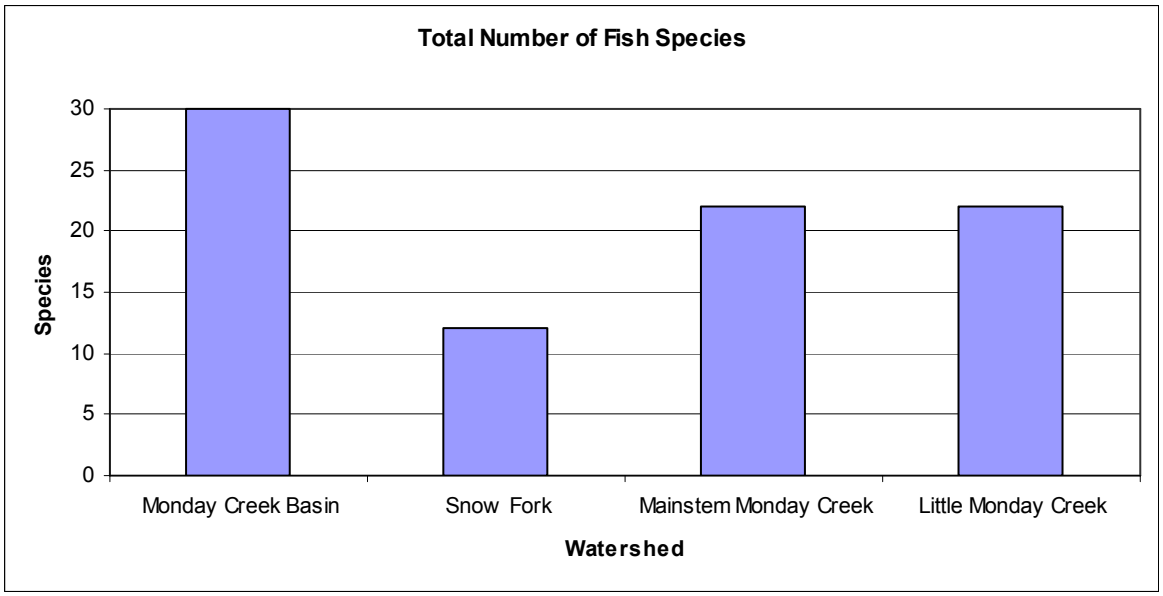
Based on aggregated catch statistics, numerically predominant species included northern creek chub (42.0%), green sunfish (16.0%), bluegill (10.1%), yellow bullhead (7.6%), grass pickerel (6.7%), and striped shiner (5.2%). In terms of relative biomass, dominate species were: northern creek chub (47.3%), yellow bullhead (18.6%), grass pickerel (10.3%), green sunfish (7.3%), bluegill (6.3%), and white sucker (4.2%). No fish species classified as rare, threatened, endangered, or otherwise recognized as a special conservation unit by the Ohio DNR (1997), were collected from the Monday Creek mainstem.

Figure 1 - Total Number of Fish Caught During TMDL Field Activities



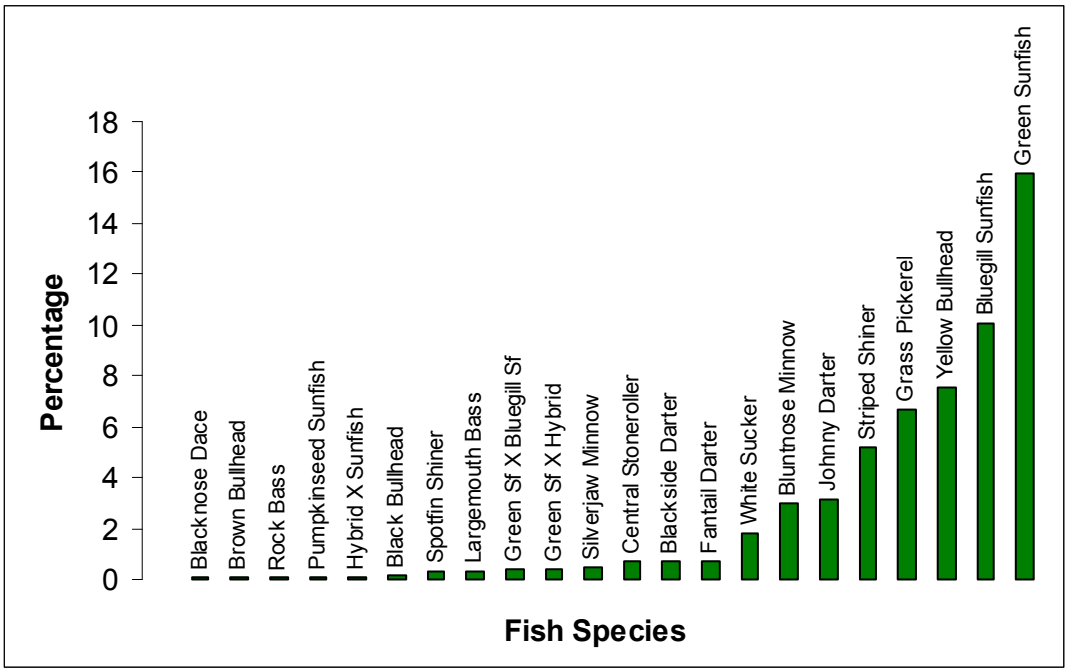
Source: Ohio EPA 2002

Figure 2 - Total Number Fish Species Caught During TMDL Field Activities



Source: Ohio EPA 2002

Figure 3 - Main Stem Monday Creek Fish Populations by Percentage



Source: U.S. Army Corps of Engineers 2005

In terms of both relative abundance and biomass, the majority of the fish assemblage was composed of highly adaptable, environmentally tolerant species (northern creek chub, green sunfish, yellow bullhead, and white sucker). Dietary plasticity, generalized reproductive habits, and observed tolerance of degraded water quality are characteristic common among all of these taxa. As such, these species tend to dominate chemically and physically disturbed waterways. Fish species classified as intolerant or otherwise environmentally sensitive, were not observed at any location on the mainstem.

The upper Monday Creek tributaries (from the headwaters to Little Monday Creek) consist of nine direct tributaries and indirect tributaries that form the principal upper drainage network of Monday Creek. In the 2001 survey, three of the evaluated tributaries were found devoid of fish life, and by all field indications appeared profoundly impacted by Acid Mine Drainage (AMD). These streams included Dixie Hollow, Rock Run, and Lost Run. The environmental conditions of these three tributaries were clearly toxic.

A total 497 fish comprising ten species was collected from the Shawnee Run watershed. Numerically predominant species were: northern creek chub (67.6%) and bluegill. In terms of relative biomass, the same two species were also dominant.

In Stone Church Run, a total of 544 fish, comprised of six species and one hybrid was collected. A single species, northern creek chub (89.0%), was numerically predominant. In terms of biomass, the same species was overwhelmingly dominant. Despite adequate macrohabitat quality, the condition of the fish community in this tributary was found universally poor. Associated causes and sources of this impairment appeared a result of the influence of modest AMD.

A total of 87 fish, comprised of six species, was collected from Salt Run. As observed throughout the Monday Creek Watershed, the fish community of Salt Run was dominated by environmentally tolerant species. The cause and source of these low numbers appeared a result of AMD.

Stations situated downstream from the Village of New Straitsville on an unnamed tributary (Monday Creek II) were found to have a fish community ranked poor to very poor. Catches from the creek yielded a total 170 fish, comprised of eight species. A single taxa, northern creek chub (91.5%), was numerically predominant. In terms of biomass, the same species was overwhelmingly dominant (95.3%).

A total of 272 fish, comprised of ten species, was collected from Dans Run. Like most other Monday Creek tributaries, the community was dominated by tolerant species, in terms of both relative abundance and biomass. However, Dans Run, along with the Shawnee Creek tributary, ranked among the best communities found among the upper Monday Creek tributaries.

6,196 fish, comprising 20 species and three hybrids, were collected from the Little Monday Creek mainstem between June and August 2001. Numerically predominant species included northern creek chub (29.5%), striped shiner (11.1%), bluntnose minnow (10.5%), central stoneroller (10.4%), southern redbelly dace (6.7%), and blacknose dace (4.6%). In terms of relative biomass, dominate species were: northern creek chub (39.3%), white sucker (17.2%), striped shiner (10.7%), central stoneroller (5.9%), yellow bullhead (5.7%), and bluntnose minnow (4.5%).

In terms of both relative abundance and biomass, by far, the majority of the fish assemblage of Little Monday Creek was composed of highly adaptable, environmentally tolerant species (northern creek chub, bluntnose minnow, yellow bullhead, blacknose dace, and white sucker). These species tend to dominate chemically and physically disturbed waterways.

Among the lower Monday Creek tributaries (Kitchen Run, Sand Run, Monkey Hollow, Snake Hollow, Big Four Hollow, Bessemer Hollow and Coe Hollow), fish assessments were conducted on Kitchen Hollow, Sand Run and Monkey Hollow. Due to unforeseen difficulties in gaining

access, fish assessments were not performed on Snake Hollow. The remaining tributaries were considered minor conveyances due to drainage areas of less than 1.0 square mile.

In total, 1,674 fish, comprising 15 species and one hybrid, were collected from the Kitchen Run sub-basin. Numerically predominant species were: northern creek chub (46.0%), southern redbelly dace (12.5%), blacknose dace (11.5%), and bluegill (11.4%). In terms of relative biomass (kg/0.3km), dominate species were: northern creek chub (33.0%), white sucker (20.8%), yellow bullhead (15.4%), and bluegill (8.3%).

In terms of both relative abundance and biomass, by far, the majority of the fish assemblage of the Kitchen Run sub-basin was composed of highly adaptable, environmentally tolerant species (northern creek chub, yellow bullhead, blacknose dace, and white sucker).

853 fish, comprising 15 species and one hybrid, were collected from the Sand Run sub-basin. Numerically predominant species were northern creek chub (52.6%), white sucker (16.0%), southern redbelly dace (8.0%) and green sunfish (7.1%). In terms of relative biomass, the same suite of species were dominant. As observed for other Monday Creek tributaries, in terms of both relative abundance and biomass, by far, the majority of the fish assemblage was composed of highly adaptable, environmentally tolerant species (northern creek chub, white sucker, and green sunfish).

No fish were collected within the Monkey Hollow sub-basin. The absence of fish clearly reflects acutely toxic condition resulting from AMD that characterizes this catchment.

A total of six individual fish, comprised of two species and one hybrid, was collected from Snow Fork between June and August 2001. The fish sampling effort involved evaluating 6.2 miles of the mainstem, between RM 6.2 (Murray City) and RM 1.0 (foot bridge at Buchtel).

Mussels

There are no reported findings of mussels in streams of the Monday Creek Watershed.

Reptiles and Amphibians

Formal surveys of reptiles and amphibians have not been conducted in the Monday Creek Watershed.

Terrestrial Biota

Birds

The extensive forest and smaller riparian and wetlands areas of the Monday Creek Watershed provide nesting and foraging habitat for a variety of bird species, such as the northern cardinal (*Cardinalis cardinalis*), pileated woodpecker (*Dryocopus pileatus*), blue jay (*Cyanocitta cristata*), American crow (*Corvus brachyrhynchos*), eastern phoebe (*Sayornis phoebe*), white breasted nuthatch (*Sitta carolinensis*), Carolina chickadee (*Poecile carolinensis*), brown creeper (*Certhia familiarus*), and various flycatchers and warblers. The forest also provides habitat for a variety of terrestrial insects and invertebrates, which serve as a food source for songbirds and other animals. Waterfowl such as the wood duck (*Aix sponsa*) and wading birds such as the great blue heron (*Ardea herodias*) probably use the wetlands and ponds more for resting than foraging due to the lack of aquatic plant and animal foods present as a result of AMD.

Mammals

The watershed supports several types of terrestrial habitats including upland forests, shrub and open areas and scrub-shrub and emergent wetland areas. However, the majority of the watershed supports mature to mid-successional forested uplands associated with small drainages and/or ponds. Common wildlife species in the watershed include popular games species such as the white-tailed deer (*Odocoileus virginianus*), wild turkey (*Meleagris gallopavo),* eastern cottontail (*Sylvilagus floridanus*), and gray squirrel (*Scirurus carolinensis*). Raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), coyote (*Canis latrans*), gray fox (*Urocyon cineroeargenteus*), and the white-footed mouse (*Peromyscus leucopus*), are common transient or resident mammal species. The beaver (*Castor canadensis*) has been very active within several subwatersheds. Several mine portals in the watershed provide entranceways to suitable hibernacula for bat species such as the big brown bat (Espesicus fuscus). In addition, the mature nature and species compositions (i.e. shagbark hickory) of forests in the watershed may provide suitable roost trees for bats.

Vegetation

Monday Creek Watershed is part of the mixed mesophytic forest region. Mesophytic forests are woody plant communities that exist on deep, well drained soils that are rich in nutrients and are characterized by a diverse dominant and codominant canopy and subcanopy. Vegetation is typical of the Ecoregion Humid Temperature Domain, Hot Continental Division, Eastern Broadleaf Forest (Oceanic) Province, Southern Unglaciated Allegheny Plateau (USFWS, 1999). The watershed supports mature or maturing second-growth forest with areas of upland brush and emergent and scrub-shrub wetlands.

The most common tree species include yellow poplar (*Liriodendron tulipifera*), shortleaf pine (*Pinus echinata*), white pine (*Pinus strobus*), white oak (*Quercus alba*), and sweetgum (*Liquidambar styraciflua*). Other common tree species include red oak (*Q. rubra*), black oak (*Q. velutina*), chestnut oak (*Q. prinus*), sugar

maple (*Acer saccharum*), red maple (*A. rubrum*), American beech (*Fagus grandifolia*), shagbark hickory (*Carya ovata*), mockernut hickory (*C. tomentosa*), bitternut hickory (*C. cordiformis*), sycamore (*Platanus occidentalis*), and white ash (*Fraxinus americana*).

Common understory tree and shrub species found in the watershed include young maples and beech, black cherry (*Prunus serotina*), dogwood (*Cornus florida*), ironwood (*Carpinus caroliniana*), hornbeam (*Ostrya virginiana*), hackberry (*Celtis occidentalis*), spicebush (*Lindera benzoin*), and blueberry (*Vaccinium* spp.). Edge type habitats are occupied by redbud (*Ceris canadensis*), greenbrier (*Smilax* spp.), and blackberry (*Rubus* spp.).

Common herbaceous species include trout lily (*Erythonium americanum*), Christmas fern (*Polystichum acrostichoides*), various species of violets (*Viola* spp.) and mints (*Dicerandra* spp.). Roadsides and more open canopy habitats include panic grass (*Pancium* spp.), common milkweed (*Asclepias syriaca*), clover (*Trifolium* spp.), aster (*Aster* spp.), and goldenrod (*Solidago* spp.).

An exotic specie documented by the Forest Service in the Monday Creek Watershed is multiflora rose (*Rosa multiflora*).

Rare, Threatened or Endangered Species

Federally Listed Animals

The U.S. Fish and Wildlife Service provided a list of federally listed endangered and threatened species pursuant to the Endangered Species Act (ESA) that have part of their range within or near Wayne National Forest. The species list included the Indiana bat (*Myotis sodalist),* American burying beetle (*Nicrophorus americanus),* and the bald eagle (*Haliaeetus leucocephalus*). Plants that may be found within Monday Creek Watershed include northern monkshood (*Aconitum noveboracense)* and small whorled pogonia (*Isotria medeoloides)*. Their range and status are listed below.

Indiana bat (Myotis sodalist)

Monday Creek Restoration Project lies within the range of the Indiana bat (Myotis sodalis), a federally listed endangered species. Summer habitat requirements for the species are not well defined; however, the U.S. Fish and Wildlife Service (Service) provided the following observations that are potentially critical habitat:

1. Dead or live trees that have snags with peeling or exfoliating bark, split tree trunk and/or branches, or cavities, which may be used as maternity roost areas.

2. Live trees (such as shagbark hickory) with exfoliating bark.

3. Stream corridors, riparian areas, and upland woodlots that provide forage sites.

Should a proposed project site contain trees with any of the characteristics listed above, the U.S. Fish and Wildlife Service recommends that those trees and surrounding trees be saved wherever possible. If they must be cut, they should not be cut between April 15 and September 15.

If desirable trees are present and if the above time restriction is unacceptable, mist net or other surveys should be conducted to determine if bats are present. The survey should be designed and conducted in coordination with the Endangered Species Coordinator with the U. S. Fish and Wildlife Service. The survey should be conducted in June or July, since the bats would only be expected in the project area from approximately April 15 to September 15.

American burying beetle (Nicrophorus americanus)

The downstream portion of Monday Creek lies within the range of the American burying beetle, a federally listed endangered species. This insect is a "generalist" as far as habitat preference is concerned, with a slight preference for grasslands, open woodlands and brushlands. Once extirpated in Ohio, it has been reintroduced to the Waterloo Wildlife Area in Hocking County, and plans for their reintroduction to the Wayne National Forest are under consideration.

Bald Eagle (Haliaeetus leucocephalus)

Monday Creek Watershed lies within the range of the bald eagle, a federally listed threatened species. Bald eagles have been observed in the lower portion of Monday Creek Watershed, primarily during migration and when overwintering in southeast Ohio. Since this species began making a comeback in Ohio, it has not been known to nest in the watershed or surrounding area, and thus is not considered to be a resident species of the watershed. Regionally, the nearest active nest is located near Stockport.

Federally Listed Plant Species

Northern Monkshood (Aconitum noveboracense)

The watershed lies within the range of the federally listed threatened northern monkshood. The plant is found on cool, moist, talus slopes or shaded cliff faces in wooded ravines. It is found in two locations in Ohio, one of them being Crane Hollow State Nature Preserve in Hocking County.

Small Whorled Pogonia (Isotria medeoloides)

The small whorled pogonia, a rare orchid and federally listed threatened species, has only two known populations in Ohio, one being in Hocking County at Camp Oty'Okwa. In 2005, part of Camp Oty'Okwa was acquired by Ohio DNR to protect this remnant population. Small whorled pogonia occurs both in fairly young forests and in maturing stands of mixed-deciduous or mixed-deciduous/coniferous forests. The majority of small whorled pogonia sites share several common characteristics. These may include sparse to moderate ground cover in the microhabitat (except when among ferns), a relatively open understory canopy, and proximity to old logging roads, streams, or other features that create long-

persisting breaks in the forest canopy. The soil in which the shallow-rooted small whorled pogonia grows is usually covered with leaf litter and decaying material. The spectrum of habitats includes dry, rocky, wooded slopes to moist slopes or slope bases crisscrossed by vernal streams.

Species With a Conservation Plan

Timber Rattlesnake (Crotalus horridus horridus)

Athens and Hocking Counties lie within the range of the timber rattlesnake, a large, shy rattlesnake that is declining throughout its national range. No federal listing status has been assigned to this species. Instead, the U.S. Fish and Wildlife Service has initiated a pre-listing Conservation Action Plan to support state and local conservation efforts. The timber rattlesnake is protected throughout much of its range and is listed as endangered by the State of Ohio. Due to its rarity and reclusive nature, the USFWS encourages early project coordination to avoid potential impacts to the timber rattlesnake and its habitat.

In Ohio, the timber rattlesnake is restricted to the un-glaciated Allegheny Plateau and utilizes specific habitat types depending upon the season. Winters are spent in dens usually associated with high, dry ridges. These dens may face any direction, but southeast to southwest are most common. Such dens usually consist of narrow crevices in the bedrock. Rocks may or may not be present on the surface. From these dens, timber rattlesnakes radiate throughout the surrounding hills and move distances as great as 4.5 miles. In the fall, timber rattlesnakes return to the same den. Intensive efforts to transplant timber rattlesnakes have not been successful.

Regional Forester's Sensitive Species

Regional Forester's Sensitive (RFS) species are those species that occur within the proclamation boundaries of the Wayne National Forest and are either candidates for federal listing under the ESA, species delisted under the ESA in the last five years, globally or nationally ranked 1-3 by The Nature Conservancy and Association for Biodiversity Information or considered sensitive on Wayne National Forest based on risk evaluations.

The list is relevant in watershed planning, as it encompasses not only species that have Federal or State listings, but also those whose reliance on watershed habitat makes them vulnerable to changes in the local landscape. This includes birds like the cerulean warbler *(Dendroica cerulea)*, declining throughout its range, which resides in the watershed during breeding season and utilizes the habitat during migration. Its inclusion on the list, among the other regionally sensitive species, pays attention to the local importance of Monday Creek Watershed in the protection of species that may or may not have State listing, but are nonetheless considered to be in decline.
A total of 42 plant and animal RFS species are currently identified for Wayne National Forest. These species are listed in Table 16.

Table 16 - Regional Forester's Sensitive Species for Wayne National Forest

Species	Common Name	State Listing
Plants		
Botrychium biternatum	Sparse-lobed grape fern	
Carex abolutescens	Pale Straw sedge	
Carex juniperorum	Juniper sedge	T
Carex striatula	Lined sedge	
Cirsium carolinianum	Carolina thistle	
Clitoria mariana	Butterfly pea	
Gentiana alba	Yellow gentian	T
Gentiana villosa	Striped gentian	E
Iris verna	Dwarf Iris	
Juglans cinerea	Butternut	P
Magnolia tripetala	Umbrella magnolia	P
Penstemon laevigatus	Smooth beardtongue	
Phacelia ranunculacea	Blue scorpionweed	E
Platanthera ciliaris	Yellow fringed orchid	T
Rhododendron nudiflorum	Pinxter flower	
Scutellaria saxatilis	Rock skullcap	P
Scleria oligantha	Tubercled nutrush	
Scleria triglomerata	Tall nutrush	
Stenanthium gramineum	Featherbells	
Triadenum tubulosum	Lesser Marsh St. John's wort	
Verbesina occidentalis	Yellow crownbeard	
Vitis cinerea	Pigeon grape	P

Species	Common Name	State Listing
Mollusks		
Obovaria subrotunda	Round hickorynut	
Plethobasus cyphyus	Sheepnose	E
Simponaias ambigua	Salamander mussel	SC
Toxolasma parvus	Liliput	
Villosa lienosa	Little spectaclecase	E
Insects		
Gomphus quadricolor	Rapids clubtail	
Pyrgus wyandot	Southern grizzled skipper	SI
Fish		
Ammocrypta pellucida	Eastern sand darter	SC
Erimyzon sucetta	Lake chubsucker	T
Ichthyomyzon bdellium	Ohio lamprey	E
Reptiles		
Crotalus horridus	Timber rattlesnake	E
Amphibians		
Acris crepitans blachardii	Blanchard's cricket frog	
Aneides aeneus	Green salamander	E
Cryptobranchus allegheniensis	Eastern hellbender	E,M
Hemidactylium sculatum	Four-toed salamander	SC
Pseudotriton montans	Mud Salamander	T
Birds		
Ammodramus henslowii	Henslow's sparrow	SC,M
Dendroica cerulea	Cerulean warbler	SC,M

Species	Common Name	State Listing
Mammals		
Lynx rufus	Bobcat	E
Ursus americanus	Black bear	E

E=Endangered, T=Threatened, SC= Species of Concern SI=Special Interest, M=Monitored, P=Potential Threatened

Source: US Forest Service, 2004

Invasive Species

Invasive plants have the ability to form monocultures—areas where there is just one kind of plant, much like a cornfield or a lawn. In wild areas, however, monocultures crowd out native plants, causing the loss of habitat not only for the native plants, but also for our native animals that depend on them. Table 17 lists the invasive non-native species that are found in the Monday Creek Watershed, and why these species are dangerous to our native flora.

Table 17 - Invasive Non-native Plants of the Monday Creek Watershed

Common Name	Scientific Name	Danger to Native Flora
Autumn -Olive	Elaeagnus umbellate	Autumn olive re-sprouts vigourously after cutting or burning. It grows rapidly, and its seeds are dispersed by birds.
Canada thistle	Cirsium arvense	An extensive root system allows Canada thistle to create monocultures covering large areas. Wind-dispersed seeds are viable for 20 years or more.
Common teasel	Dipsacus fullonum (sylvestris)	Teasels produce massive amounts of seed that remain viable for several years and have germination rates higher than 85%. Dying teasels leave behind a “nursery” for young teasels, which allows them to form monoculture and out-compete native plants for water and space.
Curly pondweed	Potamogeton crispus	This aggressive aquatic weed grows quickly early in the season and shades out and inhibits native plant growth.
Eurasian water-milfoil	Myriophyllum spicatum	Dense canopies of Eurasian water-milfoil shade out native vegetation, alter the species composition of aquatic invertebrates, and may impair the ability of some fish species to spawn. If water-milfoil plants are shredded, each fragment has the capability to become a new plant.

Common Name	Scientific Name	Danger to Native Flora
Garlic Mustard	Alliaria petiolata	Garlic mustard begins growth earlier in the Spring than native flowers, and shades them out. It also forms extremely dense clusters and a few plants can completely displace native plants within 10 years. Garlic mustard produces large quantities of seed, which remains viable for up to 7 years.
Japanese Honeysuckle & Asian Bittersweet	Lonicera japonica & Celastrus orbiculatus	These aggressive growers damages native populations by limiting sunlight, constricting nutrient flow in stems, and overweighting tree-tops, contributing to wind damage. Prolific seed producers, they also reproduce by suckers and plants regenerate quickly after cutting.
Japanese Knotweed	Polygonum cuspidatum	This quick and aggressive grower forms dense thickets that exclude native vegetation and reduce wildlife habitat. This species represents a significant threat to riparian areas where it can spread easily as small pieces of rhizome are washed downstream and deposited to create new colonies.
Lesser naiad	Najas minor	This aggressive aquatic weed grows quickly early in the season and shades out and inhibits native plant growth.
Multiflora rose	Rosa multiflora	A dense, thorny plant introduced as “living fence,” multiflora rose reproduces from seed and by cane rooting. An average plant produces over a million seeds a year, and these seeds can remain viable for up to 20 years.
Narrow-leaved cattail	Typha angustifolia	These plants establish dense monocultures that enable them to shade out other vegetation. They also produce allelopathic compounds which discourage the growth of other plants. They reproduce by rhizome and seed.
Reed Canary Grass	Phalaris arundinacea	This grass reproduces vegetatively as well as by seed. It can easily displace native vegetation to form monoculture. The grass has little wildlife value, and the seeds are easily dispersed.
Russian-Olive	Elaeagnus angustifolia	Russian olive re-sprouts vigorously after cutting or burning. It grows rapidly, and its seeds are dispersed by birds.
Tatarian Honeysuckle	Lonicera tatarica	These vigorous shrubs out-compete native wildflowers by greening up earlier in the spring than native plants and shading them out. Honeysuckles will re-grow from even small roots left in the soil.

Common Name	Scientific Name	Danger to Native Flora
Tree-of-Heaven	Ailanthus altissima	One mature tree-of-heaven can produce 350,000 seeds a year. They also reproduce by runners and suckers. Sapling growth can reach 4 feet a year. The roots give off a toxin that acts as an herbicide to kill nearby plants. Tree-of-heaven is shade tolerant, and can outgrow nearly any native tree. It rapidly takes over wherever there are gaps in the forest canopy.
White sweet-clover	Melilotus alba	The seeds of white sweet clover remain viable for over 30 years. The plant is drought-tolerant and winter-hardy, and their large size causes them to shade out native plants.
Yellow sweet-clover	Melilotus officinalis	The seeds of yellow sweet clover remain viable for over 30 years. The plant is drought-tolerant and winter-hardy, and their large size causes them to shade out native plants.

Source: Ohio DNR, 2000

IV. Water Resource Quality

Ohio EPA Beneficial Use Designations: Overview

Beneficial use designations describe existing or potential uses of water bodies. They take into consideration the use of water for public water supplies, protection and propagation of aquatic life, recreation, agricultural, industrial and other purposes. Ohio EPA assigns beneficial use designations to water bodies in the state. Examples of beneficial use designations include: public water supply, primary contact recreation, and aquatic life uses (www.epa.state.oh.us).

Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1) are used to determine which use designations should be applied to a water body. Rivers and streams in Ohio receive "use designations" that reflect how the water is used and consider the aquatic habitat the stream can support. Use designations are comprised of two categories, aquatic life and non-aquatic life uses. Non-aquatic life uses are further divided into recreation and water supply designations. Each water body in Ohio is assigned one or more aquatic use designations, one or more water supply designations, and/or one recreation designation.

Non-Aquatic Life Designations

Recreation Uses

Recreation use designations in Monday Creek Watershed are in effect from May 1 to October 15. The mainstem and all major tributaries of Monday Creek are designated for Primary Contact Recreation (PCR). Waters designated PCR are suitable for full-body contact recreation activities such as swimming and canoeing.

Water Supply Uses

Water supply designations are subdivided into three categories: Public Water Supply (PWS), Agricultural Water Supply (AWS), and Industrial Water Supply (IWS). PWS designates those streams or rivers located within 500 yards of a public water supply or food-processing intake, including those streams that are used as emergency water supplies. AWS designated waters suitable for irrigation and livestock watering without treatment, while streams and rivers designated IWS are suitable for commercial and industrial uses, with or without treatment. Monday Creek and its major tributaries are designated for AWS and IWS uses. None of the streams within the Monday Creek Watershed are designated for PWS uses.

Aquatic Life Uses

Generally, emphasis on protecting aquatic life results in attaining water quality suitable for all uses, hence the emphasis of aquatic life uses in water quality reports and planning. Ohio is divided into five eco-regions due to the difference in topography, land use, vegetative cover and soil types, which vary significantly across the state. Monday Creek Watershed is located in the Western Allegheny Plateau (WAP) and is more diverse biologically than most other eco-regions in Ohio. The aquatic life uses that could occur in the Monday Creek Watershed are described as follows:

Exceptional Warmwater Habitat (EWH)

This designation is for waters capable of supporting and maintaining an exceptional or unusual community of warmwater aquatic organisms. These assemblages of organisms are characterized by a high diversity of species, particularly those that are highly intolerant, rare, threatened, endangered, or special status species. Biological criteria for EWH apply uniformly across Ohio. The EWH designation represents a protection goal for water resource management efforts dealing with Ohio's best water resources.

Warmwater Habitat (WWH)

This designation defines the typical warmwater assemblage of aquatic organisms in Ohio's rivers and streams. Waters designated as WWH are capable of maintaining a balanced, integrated, and adaptive community of warmwater aquatic organisms. This aquatic use designation represents the principal restoration target for the majority of water resource management planning in Ohio.

Cold Water Habitat (CWH)

This designation applies to waters that are capable of supporting populations of native coldwater fish and associated vertebrate and invertebrate organisms and plants on an annual basis.

Modified Warmwater Habitat (MWH)

This designation applies to streams and rivers that have been found incapable of maintaining a balanced, integrated, and adaptive community of warmwater organisms. Streams and rivers designated MWH have been subjected to extensive and essentially permanent hydrological modifications. Modifications may include: extensive stream channel modification activities, extensive sedimentation resulting from abandoned mine land runoff, and extensive permanent impoundment of free-flowing water bodies. Aquatic assemblages in these streams generally comprise species that are tolerant of low dissolved oxygen, silt, and high nutrient concentrations.

Limited Resource Water (LRW)

This designation applies to waters that have been found lacking the capacity to support any appreciable assemblage of aquatic organisms. Use attainability analysis has demonstrated that extant organisms are substantially degraded, and that the potential for recovery to levels characteristic of any other aquatic designation is precluded. Causative factors for the LRW designation include extensive channel modifications, acid mine drainage, and other factors relating to extensive urbanization. No formal biological criteria exist for the LRW aquatic use designation.

Use Designations

Ohio's Water Quality Standards rely on biological criteria to ascertain the appropriate use designation for streams and rivers. To determine a stream use designation, biologic and water quality sampling is conducted. Stream features are evaluated and metric scores are recorded for four indices. The Qualitative Habitat Evaluation Index (QHEI) evaluates habitat quality. The measure of fish species diversity and populations are recorded as Index of Biologic Integrity (IBI) and Modified Index of Well Being (Miwb) indices. The measure of macro-invertebrate populations are recorded as Invertebrate Community Index (ICI). The presence of pollution tolerant species and the absence of sensitive species give indications of stream health. When these indices are coupled with water quality data, Ohio EPA can identify stressors to the stream system. Index scores will determine a stream's use designation. Table 18 indicates biocriteria established for the four indices.

Table 18 - Biocriteria for streams in the WAP region

WAP – Use Designation	ICI	IBI	QHEI	Mlwb
EWH	46+	50+	75+	9.4
WWH	36-45	44-49	60-74	8.4
MWH	31-35	25-43	45-59	6.2/5.5
LRW	<30	12-24	<45	4.5

Source: Black 2005

Habitat Quality

The Qualitative Habitat Evaluation Index (QHEI) represents habitat data for the study. The QHEI is a physical habitat index designed to provide an empirical, quantified evaluation of the general habitat characteristics of a stream that are important to fish communities. It consists of six principal metrics that are scored individually and summed to provide the total QHEI site score. The maximum QHEI site score is 100. The six principal metric categories are: substrate, instream cover, channel morphology, riparian zone and bank erosion, pool/glide and riffle/run quality, and gradient. The higher the score for each individual metric,

the closer that metric is to having characteristics present that are important to fish communities (OEPA).

Biological Quality

Aquatic Macroinvertebrates

Aquatic macroinvertebrates are organisms that lack a backbone and are visible to the naked eye. In fresh water streams, they include the insects, crustaceans (crayfish and others), mollusks (clams and mussels), gastropods (snails), oligochaetes (worms) and others. In most streams and rivers, the larval insects dominate the macroinvertebrate community.

These organisms provide an excellent tool for stream assessment. Because some species are less tolerant of pollution than others, the types of species present serve as indicators of long-term water quality. Thus, when assessing water quality, the total number of individuals within a species is recorded (density) along with the number of different species present (diversity).

The Invertebrate Community Index (ICI) was used to assess the aquatic macro invertebrate community of Monday Creek and it tributaries. The ICI uses artificial substrate samplers which are then populated by existing macroinvertebrates. Measurements on the total taxa which include percentages of mayflies, caddisflies, dipterans and non-insects, Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) or EPT taxa and tolerant species are utilized in the assessment.

Fish

The Index of Biological Integrity (IBI) is an approach used to assess and evaluate the biological conditions of a stream through the collection of fish. The IBI is a measure of fish species diversity and species populations. The IBI is based on a comparison of a sample site to an ecoregion reference reach site. Five ecoregions have been identified in Ohio. Characteristics reflecting the biological performance exhibited by natural or least impacted aquatic habitats have been identified and quantified. The IBI uses three broad categorical groupings to determine biological integrity: species richness and composition, trophic composition, and fish abundance and condition. These three groupings are broken down into twelve principal metrics, each of which is scored individually and then summed to provide the total IBI score.

Each metric is scored based on whether its own specific characteristics approximate, partially deviate, or strongly deviate from what is expected in a least impacted stream. The minimum possible IBI score is 12. The maximum possible IBI score is 60. The higher the score, the healthier the aquatic ecosystem (OEPA).

Causes and Sources of Water Quality Impairment

Point source - pollution that enters a water system from a single point such as pipes, ditches, or vessels.

Permitted Discharges -The communities of Buchtel, Nelsonville, Shawnee and New Straitsville dispose of sewage by means of wastewater treatment plants. Wastewater treatment plants maintain National Pollutant Discharge Elimination System (NPDES) permits. Treated water discharging from the plants is not a source of impairment to Monday Creek.

Spills and illicit discharges - A review of the Ohio EPA Division of Emergency and Remedial Response (DERR) Release Reporting System (RRS) database indicates no spills have been documented in Monday Creek Watershed from 1998 to 2002.

Non-Point Source (NPS) - Indirect or scattered sources of pollution that enter a water system such as drainage or runoff.

Impairments documented in the Monday Creek Watershed are due to NPS pollution generally related to mining.

NPS Impairments attributed to AMD

pH

Most organisms have a well-defined range of pH tolerance. If the pH falls below this range, death will occur due to respiratory or osmoregulatory failure. Low pH causes a loss of sodium ions from the blood and a loss of oxygen in the tissues. Low pH also increases the permeability of fish gills to water, which adversely affects gill function. Studies have indicated that a pH of 4.5 and a total acidity of 15 mg/L have accounted for complete loss of fish in 90 percent of streams studied Concentrations of metals were not taken into account during these studies with respect to lethal toxicity levels. Studies have indicated that a combination of pH less than 5.5 and dissolved aluminum greater than 0.5 mg/L will generally eliminate all fish and most macroinvertebrates (Earle, 1998).

Heavy Metals

Elevated aluminum and iron concentrations can affect both water quality and suitability of habitat. Aluminum and iron can either be found in a dissolved form or in a precipitated form. In the dissolved form, the metals can act as metabolic poisons, mainly by reducing aquatic life pH tolerance levels, increasing carbon dioxide tensions and osmotic pressure, causing synergistic effects, and decreasing oxygen availability as they form precipitates. Once in the precipitated form, they may coat gills and body surfaces (further reducing oxygen transfer), smother eggs, and cover the stream bottom, filling in crevices and rocks (Earle, 1998).

Of the two major metals present in mine drainage, aluminum has the most severe adverse effects on stream aquatic life. Aluminum rarely occurs naturally in water at concentrations greater than a few tenths of a milligram per liter. The addition of aluminum ions compounds the effect of low pH by interacting with hydrogen ions, further decreasing sodium uptake, and increasing sodium loss in blood and tissues. Precipitated aluminum coats the stream substrate, causing slippery surfaces and making it difficult for insects to maintain position in the current. The deposition of aluminum hydroxide particles on macroinvertebrates blocks surfaces important for respiratory or osmoregulatory exchange. Precipitated aluminum can accumulate on fish gills and interfere with their breathing. Aluminum precipitate also eliminates most of the filter feeders, which normally comprise a major portion of total stream macroinvertebrates (Earle, 1998).

Aluminum in Essex Mine Discharge

Iron precipitates at a pH greater than 3.5. Because iron can form precipitates at a low pH, it is difficult to separate the effect of iron in solution from the effect of low pH. The precipitation of iron hydroxide, however, is a discernible problem. It can clog the gills of fish and cause a complete blanketing of the stream bottom. Iron precipitate particles often cover the bodies of macroinvertebrates which otherwise appear healthy. This allows the assumption that the iron precipitate is less toxic than aluminum precipitate (Earle, 1998).

Siltation / Sediment

Acid mine drainage creates sedimentation problems when metals in surface water begin to precipitate out of solution. This results in flocculent settling in the streambed and interferes with macro-invertebrate habitat and fish reproduction. Sediments can also affect aquatic biology due to toxicity. The amounts of flocculent deposited in a streambed are dependent upon the discharge amount and metal concentration of AMD sources, as well as the pH of the receiving stream. In general, iron begins to precipitate at a pH value of 3.5, aluminum at 4.5, and manganese at 10. A comprehensive sediment analysis in Monday Creek is not available at this time.

Sediment in Monday Creek Tributary

Potential NPS Impairments

Bacteria

The most common indicator of sewage influences on water quality is the presence of bacteria, specifically total coliform and E. coli. Coliform bacteria are a natural part of the microbiology of the intestinal tract of warm-blooded mammals, including man and livestock. Coliform bacteria can also be found in soils, other animals and insects. The total coliform group is relatively easy to culture in the lab and therefore is usually used as a preliminary test before E. coli is tested. E. coli comes from the intestines of warm-blooded animals and is the direct result of fecal contamination. In other words, it could originate from human waste (i.e., malfunctioning septic or sewer systems) or from other animal sources (i.e., livestock access to surface waters). A positive test for E. coli is a stronger indicator of the presence of disease-causing bacteria and organisms than the detection of total coliform.

Coliform bacteria are not pathogenic (disease-causing) organisms, and are only mildly infectious. If large numbers of coliform are found in water, there is a high probability that pathogenic bacteria and organisms are present. In addition, less than 10% of the 140+ stereotypes of E. coli bacteria cause gastroenteritis in humans and even if a pathogenic strain is present, a dose of 100,000 bacteria may be required to cause the disease that indicates a problem. During biological studies conducted for the TMDL, Ohio EPA did not do a bacteria model because the overwhelming cause of impairment was mining impacts.

A single sampling event for fecal coliform concentrations was completed during the 2001 TMDL Study. Sites in the basin with elevated fecal coliform bacterial counts above the average and maximum Primary Contact Recreation (PCR) criteria include Monday Creek at RM 9.3, Little Monday at RMs 11.1 and 9.6, as well as Salem Hollow at RM 1. It should be understood that results from the 2001 sampling event give only an indication of where bacteria levels may potentially be a problem. Exceedence of primary contact recreation (PCR) criteria is based on a mean value of not less than five samples within a thirty-day period. A sampling event that meets these criteria has not been conducted. The Department of Health in each county was contacted to determine any bacteria sampling in Monday Creek. No sampling has been performed by any of the counties.

Table 19 - Fecal Coliform Sample Results - 2001

Date	Sample Location	Fecal Coliform # organisms per100 ml
Aug-01	Monday Creek @ RM 25.3	120
Aug-01	Monday Creek @ RM 19.7	390
Aug-01	Monday Creek @ RM 18.5	280
Aug-01	Monday Creek @ RM 15.8	10
Aug-01	Monday Creek @ RM 14.3	260
Aug-01	Monday Creek @ RM 10.5	260
Aug-01	Monday Creek @ RM 9.3	**1500**
Aug-01	Monday Creek @ RM 3.0	10
Aug-01	Monday Creek @ RM 4.3	250
Aug-01	Monday Creek @ RM 1.7	100
Aug-01	Monday Creek @ RM 0.7	10
Aug-01	Snow Fork @ RM 1.0	10
Aug-01	Salem Hollow Rn @ RM 0.1	**50000**
Aug-01	Little Monday Creek @ RM 11.1	**3100**
Aug-01	Little Monday Creek @ RM 9.6	**1300**
Aug-01	Little Monday Creek @ RM 3.3	360
Aug-01	Trib. to Shawnee Creek @ RM 0.1	315
Aug-01	Shawnee Creek @ RM 0.1	280

PCR criteria - average = colonies > 1000/100 ml, maximum = colonies 2000/100 ml)
Maximum criteria for all waters of the state- colonies > 5000/100 ml (OAC 3745-1)

Source: OEPA TMDL Sampling, 2001

Use Designations in the Monday Creek Watershed

The current aquatic use designations for Monday Creek are "Warmwater Habitat" as well as "Limited Resource Water" due to acid mine drainage (LRW–AMD). The major source of impairment to the Monday Creek Watershed is Acid Mine Drainage created by pre-law mining.

Table 20 - Watershed Assessment Unit Results Summary

HUC 11 - 050300204 060 Monday Creek					
Aquatic Life Use Assessment					
Subcategories of ALU: WWH.LRW					
Impairment: Yes					
Sampling Year: 2001					
	Raw Data		**% Attainment**		
Stream Size Category	**Data Available**	**No. Attaining**	**Full**	**Partial**	**Non**
Small (Spatial)					
<5 mi^2	39 Sites	6			
5-20 mi^2	9 Sites	1	6.6	12.2	81.2
20-50 mi^2	9 Sites	0			
Large (Linear)	7 Sites				
50-500 mi^2	14.3 Miles	0	0	0	100
High Magnitude Causes		**High Magnitude Sources**			
Metals		Surface Mining			
pH		Acid Mine Drainage			
Siltation					
Flow Alteration					
Recreation Use Assessment					
Subcategory of Use: Primary Contact					
Impairment: No					

Source: OEPA 2006

The beneficial use designations in Monday Creek Watershed are defined as follows:

Warm Water Habitat: Surface waters which are capable of maintaining a balanced, integrated, and adaptive community of warmwater aquatic organisms.

Limited Resource Water: Surface waters with sustained pH values below 4.1 standard units (s.u.) or with intermittently acidic conditions combined with severe streambed siltation, and have a demonstrated biological performance below that of the modified warm water habitat biological criteria. (OEPA 2002a)

Primary Contact: Suitable for full body contact recreation. Water body with a depth of greater than three feet over a 100 square feet area.

Chemical water quality has been severely impacted by the discharge of acid mine drainage from unreclaimed mine areas and from deep mined areas. Long term monitoring in the basin verifies the surface water quality of Monday Creek has a characteristically low pH, high specific conductance and high concentrations of total and dissolved iron, manganese, and aluminum. These water quality characteristics are indicative of water affected by mine runoff.

AMD has degraded the habitat of Monday Creek and impaired its aquatic ecosystem functions to the point that the warm water habitat community has essentially been eliminated in most of the streams within the watershed. Components of the ecosystem include physical, biological, ecological and chemical. AMD negatively affects all of these components, including both aquatic and terrestrial ecosystems.

Species diversity and abundance have been identified as problems in the aquatic and terrestrial ecosystems of the Monday Creek Watershed. Pollution-tolerant aquatic species of fish and macroinvertebrate populations are dominant in the ecosystem and are generally found in the mainstems of Monday Creek and Snow Fork. Pollution-sensitive species such as bass and darters, stoneflies and caddisflies, are found only in subwatersheds where little to no mining occurred. Because of the lack of biodiversity, the aquatic and terrestrial habitats are not as complex as a self-sustaining ecosystem.

AMD and Water Quality Standards

Ohio Water Quality Standards, developed by Ohio EPA, do not specifically address chemical parameters for AMD-impacted waters (i.e. specific conductivity, metals, sulfates, etc). Currently, U.S. EPA Water Quality Standards address only two AMD parameters, these include pH (6.5 to 9 su) and TDS (1,500 mg/l). However, criteria indicating AMD impacts were published in the Federal Water Pollution Control Act (FWPCA) in 1968.

Table 21 - Water Quality Criteria Limits

Parameter	Criteria Limit
pH	< 6
Alkalinity	< 20 mg/L
Sulfate	>74 mg/L
Conductivity	> 800 uS/cm
Iron	>.5 mg/L
Manganese	>.5 mg/L
Aluminum	>.3 mg/L
Zinc	> 5 mg/L

Source: Federal Water Pollution Control Administration 1968

Besides criteria limits that show the presence of AMD, criteria limits exist for the effects of heavy metals associated with AMD on aquatic life. These criteria limits, shown on Table 22, are based on literary research and suggest that once parameters reach the limit, aquatic life will be affected. Aquatic species are affected by contaminates in various ways, so criteria limits do not suggest that all aquatic life will be affected, but that some species will be negatively affected (McCament, 2003).

Table 22 - Guidelines for Analysis of Mine Drainage Systems

Parameter	Limit (mg/L)
Iron- total	1
Aluminum	0.5
Manganese	0.1

Source: Ohio EPA, 1979

Acid Mine Drainage Formation

Prolonged contact of pyritic rocks with air and water, and increased surface area for acid-producing materials, were created by mining. This has resulted in physical and chemical pollution to streams. Physical pollution includes sediment, silt, and mine refuse. Chemical pollution contains acidity and metals from mine drainage. In general, the worst water quality (lowest pH, highest metal concentrations, and large amounts of acid loading) is associated with deep mines. Deep mines with horizontal adits contribute the highest discharges and heaviest acidity loading, which have the greatest impact on the watershed. In the years since the early room-and-pillar mining in the Monday Creek Watershed, there have been frequent documented subsidences of underground mines. Subsidences close to the surface capture streams and runoff, allowing surface water to enter the mine complex. Fresh water dissolves oxidized pyritic material to form acid mine drainage which discharges from mine portals or is discharged from seeps, contaminating streams and groundwater. The most prevalent sources of AMD are abandoned openings to deep mines in the Middle Kittanning coal, exacerbated by sulfur-rich mine wastes in or near the mine opening, with flow increased in many cases by stream capture into subsided areas (Borch et al, 1997). Based on a 2001 Ohio EPA Total Maximum Daily Load (TMDL) study, approximately 82 of the 107 miles (77%) of streams assessed in the Monday Creek Watershed are impaired due to AMD (USACE, 2005).

Water Quality Restoration Targets

A goal of the Monday Creek Restoration Project is to restore Monday Creek mainstem to Warmwater Habitat (WWH) use designation by constructing AMD remediation projects within the most severely impacted drainage basins in the watershed. To accomplish this goal, the Water Research Institute at West Virginia University (WVU) used the Total Acid Mine Drainage Loading (TAMDL) model, a

hydrologic model, to calculate the degree of remediation necessary and to design passive and active treatment structures for AMD-affected subwatersheds. The computer program based TAMDL model was designed to simulate the evolution of stream water quality in watersheds affected by AMD and its treatment. The feasibility of designed structures was tested by incorporating them into a Monday Creek model and comparing the simulated stream pH, aluminum, and iron remediation endpoints (Stiles and Ziemkiewicz, 2003).

Water quality data collected by MCRP, OEPA, and the USGS were provided to WVU - Water Research Institute and incorporated into the TAMDL model for use as baseline information or “observed data” which was utilized for calibration. For the model, Monday Creek mainstem was divided into seventeen sections and Snow Fork tributary was divided into three sections. Drainage areas were calculated and “finite nodes” were created for each stream section.

The TAMDL model simulated the transport and reaction of aluminum, iron, and the resulting changes of pH. Due to the likelihood of error associated with modeling, margins of safety were specified for the calculated remediation endpoints. Remediation endpoints were determined by comparing associated ambient chemistry at sample locations that met the Warmwater Habitat use designations within the Monday Creek and Sunday Creek watersheds. Ohio EPA provided a range of remediation endpoint targets.

Table 23 - Monday Creek Chemistry Targets for meeting the WAP-WWH Biocriteria

Descriptive Statistics	TDS (mg/l)	AL (mg/l)	Fe (mg/l)	pH (field)	Acidity (mg/l)	Alk (mg/l)	Net Acidity (mg/l)	Drainage (miles2)	IBI Score	QHEI Score	ICI Score
95th (5th pH)	609	1.12	1.49	6.82	10.5	201.0	-30.0	9.16	48	79	47
90th (10th pH)	568	0.65	1.30	7.03	7.7	169.5	-36.4	6.30	48	75	47
75th (25th pH)	443	0.22	0.56	7.27	6.1	142.0	-46.6	4.50	46	71	36
50th	288	0.20	0.35	7.58	2.9	94.9	-90.0	2.00	44	64	32
25th (75th pH)	194	0.20	0.25	7.78	2.0	50.9	-140.0	1.70	42	57	32
Mean	332	0.32	0.54	7.58	4.2	99.6	-95.4	3.18	44	64	35
Min.	112	0.02	0.05	6.41	1.3	31.0	-252.6	1.00	42	45	32
Max.	1,240	1.47	2.07	8.29	16.0	255.0	-15.0	11.00	50	82	48
Number of Samples	51	51	51	51	51	52	51	17	17	17	16

Associated ambient chemistry for sites meeting the WAP WWH Biocriteria within Monday and Sunday Creek basins.

2001 (Chuck Boucher)

Source: OEPA 2001

Endpoints listed below express the minimum allowable 5th percentile for stream pH and the maximum allowable 95th percentile for aluminum and iron concentrations for the entire length of the Monday Creek mainstem. Margins of safety were designed to force the model to overestimate the amount of AMD treatment required to meet remediation endpoints (Stiles and Ziemkiewicz, 2003). However, the alkalinity target was set at the minimum value of 30 mg/l for Monday Creek mainstem to avoid undue expense caused by over-designing AMD treatment systems.

Table 24 - Remediation Endpoints and Margins of Safety for the TAMDL Model

Parameter	Remediation Endpoint	Margin of Safety	Remediation Endpoint plus Margin of Safety
pH	6.82 standard units	+0.25 standard units	7.07 standard units
Aluminum	1.12 mg/l	-0.4 mg/l	0.72 mg/l
Iron	1.49 mg/l	-0.4 mg/l	1.09 mg/l
Alkalinity	30 mg/l	NA	NA

Source: Stiles and Ziemkiewicz, 2003

The TAMDL model calculated load reductions necessary for Monday Creek mainstem to meet the restoration target and provide water chemistry suitable to support or sustain fish and macro-invertebrate communities. To meet the restoration target, a total load reduction of 2,740 tons per year of acidity is required.

Water Quality and Biological Information

Monitoring History

Monday Creek Restoration Project was formed in 1994. At that time, intensive efforts were made to compile historic water quality data collected within the basin. Sources of historic data included the Ohio EPA, U.S. Geologic Survey, U.S. Forest Service, U.S. Bureau of Mines and Ohio University. In 1997, MCRP initiated a Long Term Monitoring (LTM) program at ten sites in Monday Creek and Snow Fork tributary. Water quality samples and flow data were collected quarterly at the sites for a period of 5 years. Monitoring continues on a semi-annual basis with funding secured through June 2007.

In 2000, the U.S Army Corps of Engineers began a feasibility study in the watershed to evaluate the condition of the stream ecosystem and recommend ecosystem restoration projects that would reduce the impact of previous resource extraction activities performed in the watershed. The restoration objective was to restore Monday Creek to conditions consistent with the Warm Water Habitat use designation.

In 2000-2001, an abandoned mine land inventory was undertaken by cooperating agencies including the Ohio Department of Natural Resources (ODNR), Monday Creek Restoration Project, U.S. Forest Service, and the U.S. Army Corps of Engineers. Field reconnaissance was performed in “priority subwatersheds” as well as all USFS property. Mining features having a negative impact on water quality were identified, GPS coordinates and field measures were collected where possible. Within the selected subwatersheds, a total of 566 features were located. Features included: subsidence holes, stream captures, ponds and seeps discharging AMD.

To complement MCRP and ODNR efforts to identify degraded basins and quantify acid loads, a Total Maximum Daily Load (TMDL) study was initiated in the watershed by the Ohio Environmental Protection Agency (OEPA) in 2001. With the cooperation of state and federal agencies, as well as MCRP, a robust data set was produced which included all water quality monitoring conducted in the basin (1995-2002) and TMDL biological data collected June thru September of 2001 (OEPA). The data set was provided to West Virginia University (WVU) Water Research Institute, for inclusion into the TAMDL model, which simulated effects

and projected improvements resulting from various AMD treatments on the water quality in Monday Creek.

In May 2005, the Army Corps of Engineers published the Monday Creek Subbasin Ecosystem Restoration Project Draft Feasibility Report and Environmental Assessment / OEPA TMDL Report. The report documented conditions of Monday Creek ecosystem and produced initial technical designs and economic evaluations of the treatment systems recommended to ameliorate AMD impacts in Monday Creek.

Water Quality Sampling Efforts

In 2001, OEPA collected chemical, biological and physical data in 77.6 linear stream miles of the Monday Creek Watershed. The study area included a total of 92 sampling stations overall, with 13 stations located in Monday Creek, 4 stations in Snow Fork and 6 stations in Little Monday Creek. The remaining sites were located in tributaries geographically dispersed throughout the watershed. MCRP has performed Long Term Monitoring (LTM) at 10 stations in the watershed (1997-2006) and short term monitoring within AMD impacted subwatersheds. Table 25 provides LTM site descriptions. Maps 5 (LTM Locations) and 6 (TMDL Site Locations) show the sampling locations. Data collected in the Monday Creek watershed can be viewed online at http://132.235.241.242/mondaydb/ .

Table 25 - LTM Sites in Monday Creek and Snow Fork

River Mile	Site Name	Map Id	Stream	Location
26.5	LTM 148	JH00500	Monday Creek	Monday Creek-Downstream of Jobs Hollow/upstream of Dixie Hollow tributary
23.1	LTM 127	MC00800	Monday Creek	Monday Creek-Downstream of Rock Run tributary
19.8	LTM 103	MC00580	Monday Creek	Monday Creek-at Monday Cr. Junction, downstream of Dans Run tributary
16	LTM 131	MC00500	Monday Creek	Monday Creek- Downstream of Lost Run tributary, Adj. SR 595
10.5	LTM 153	MC00300	Monday Creek	Monday Creek- Upstream of Monkey Hollow tributary, SR 278
4.3	LTM 151	MC00180	Monday Creek	Monday Creek- Downstream of Snake Hollow tributary Woodlane Drive, Buchtel
1.7	LTM 108	MC00060	Monday Creek	Monday Creek- Doanville at USGS gage station
6.2	LTM 106	SF00940	Snow Fork	Snow Fork- Bridge downstream of Murray City Seeps, SR 216
4.3	LTM 107	SF00630	Snow Fork	Snow Fork- Downstream of Brush Fork, upstream of Goose Run, SR 78
2.4	LTM 109	SF00290	Snow Fork	Snow Fork- Upstream of Whitmore Hollow at historic Buchtel gage station, SR 685

Source: MCRP 2006

V. Monday Creek Pollutant Loading (HUC 05030204 – 060)

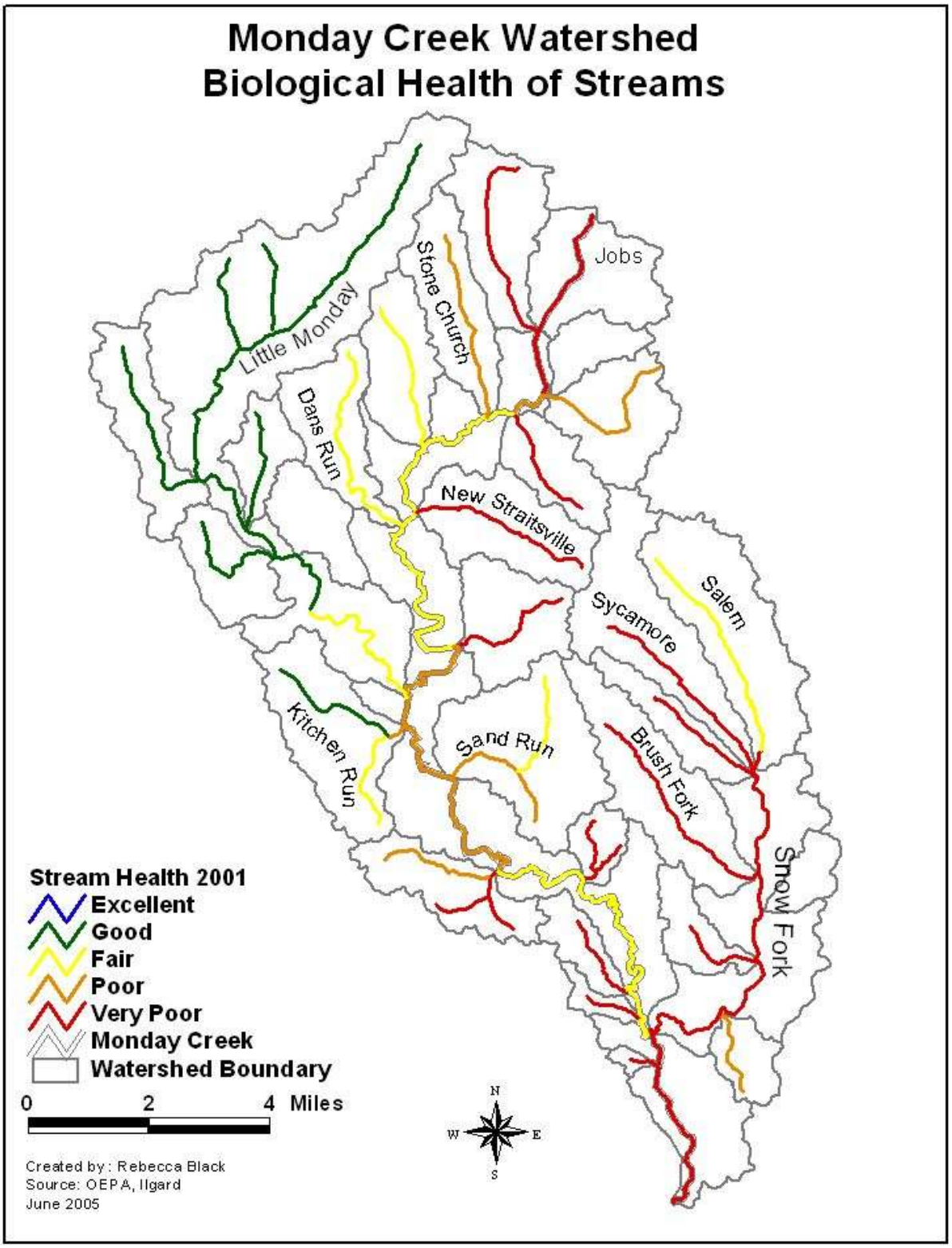
Background

The main stem of Monday Creek is 27 miles in length and flows through Perry (RM 27 to 18.1), Hocking (RM 18 to 4.9), and Athens Counties (RM 4.8 to mouth). Mining occurred throughout the watershed from the mid-1800s to the early 1970s, and continued in Perry County until the 1990s. Mine complexes often encompassed entire valleys and frequently extended into adjacent drainage basins. Drift mine entries and AMD seeps from the Middle Kittanning coal discharge into streams throughout the watershed. A total of 31 subwatersheds have been delineated within the watershed boundary. Coal mining occurred in all but two of the basins (Temperance Hollow and unnamed #3), located in the northwest section of the watershed. Drainages located in this area of the watershed are generally unimpacted or marginally impacted by acid mine drainage problems. However, the remaining northern, eastern and southern sections of the watershed are moderately to severely impacted by AMD.

TMDL Data

During the 2001 OEPA TMDL study conducted in the watershed, a vigorous sampling effort was undertaken by OEPA, MCRP and ODNR-DMRM. Samples were collected in known AMD impaired (“priority”) streams as well as streams exhibiting little to no impairment. The sampling effort provided both biological and chemical data resulting in a more comprehensive data set. Figure 4 is a map illustrating stream health of the watershed was created based on the 2001 sampling results. Data collected during the TMDL Study is included in Appendix B.

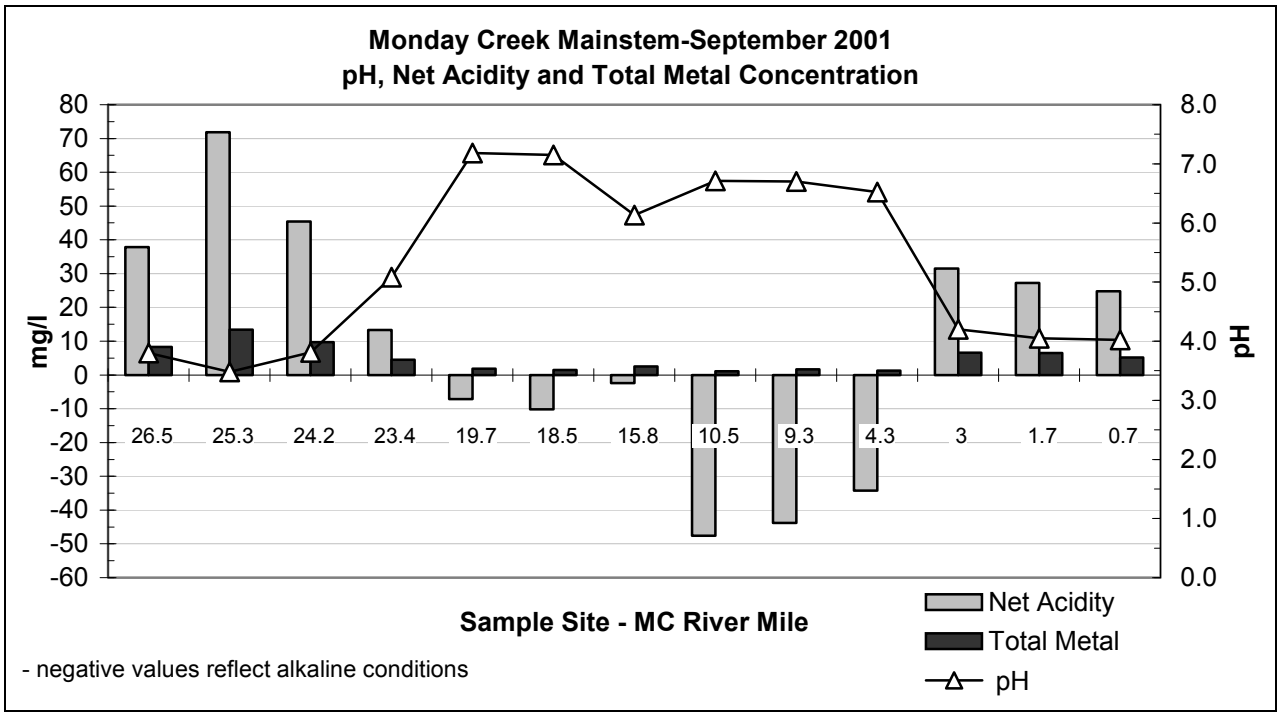
Figure 4 - Stream Health- Fall 2001



Water Chemistry - Monday Creek

Water quality sampling results collected in September 2001 during the TMDL study confirm the headwaters of Monday Creek (RM 26.5 / Jobs Hollow) are severely degraded with high acidity (>35 mg/l), elevated metal concentrations (>8 mg/l) and low pH values (< 4). This trend continues downstream for approximately three river miles to a point where marginally-impacted tributaries begin to join with Monday Creek and dilute acid and metal concentrations. At River Mile 16, an AMD impacted tributary (Lost Run) joins with Monday Creek resulting in decreased pH and increased metal concentrations. At RM 14.5, Monday Creek is joined by Little Monday Creek resulting in increased alkalinity (46 mg/l) and pH values, which are sustained for six river miles. At River Mile 3.45, Snow Fork discharges into Monday Creek. Measured pH values decline dramatically (2 s.u.) and acidity and metals increase to >25 mg/l. This trend continues to the mouth of Monday Creek where it joins with the Hocking River.

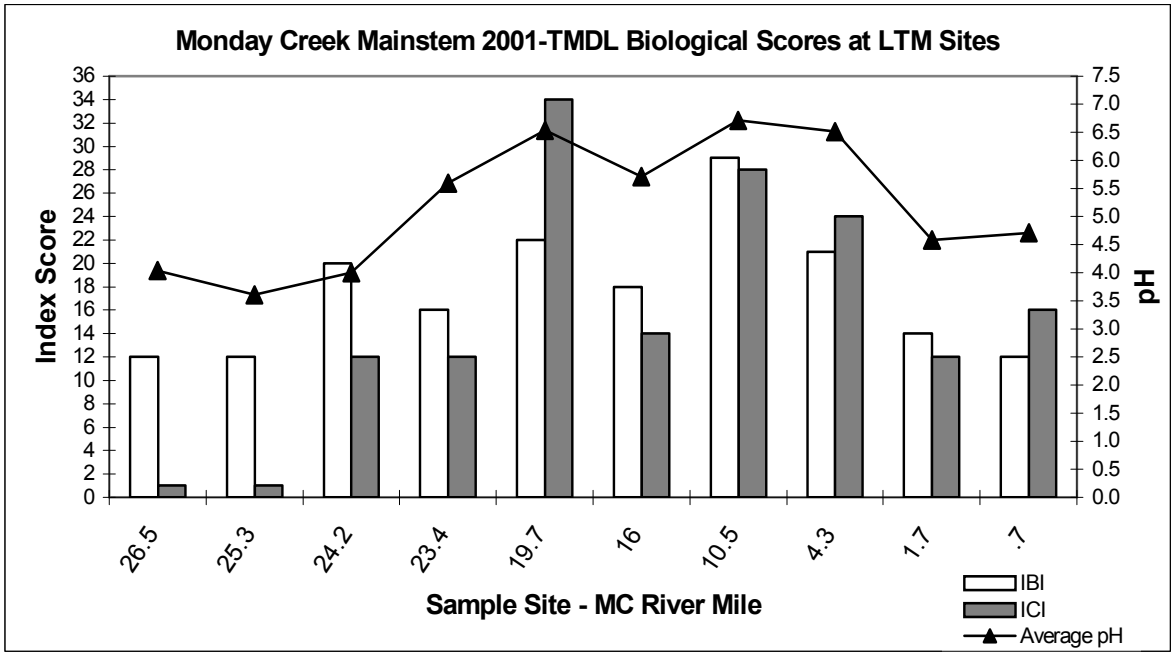
Figure 5 - Monday Creek pH, Net Acidity/Alkalinity and Total Metal Concentration- Fall 2001



Biology - Monday Creek

The headwaters of Monday Creek (RM 26.5 / Jobs Hollow) received an IBI score of 12 (lowest score possible), and an ICI score of "Very Poor". This trend continues downstream for approximately two river miles before biological scores begin to increase. In general, biological indices correlate with water chemistry data and illustrate a decline in biological diversity and abundance where AMD stressors occur in Monday Creek mainstem. At River Mile 3.45, Snow Fork discharges into Monday Creek, biological scores and pH values decline dramatically, with an IBI score of 13 and ICI score of "Poor". This trend continues to the mouth of Monday Creek where it joins with the Hocking River.

Figure 6 - Monday Creek Biological Index Scores



LTM Data - 2004

Acid and Metal Loading

At higher flow regimes, the acid concentrations in Monday Creek main stem, RM 23.1 to 1.7, generally exceed acid concentrations measured at low or base flows. This data suggests that at higher flows, deep mine discharges have a more severe impact on water quality than at low flows. Higher acidity concentrations and low pH values, resulting from deep mine flushing, impair the upper four miles (headwaters) and lower three miles (downstream of Snow Fork confluence) of Monday Creek causing water quality conditions toxic to aquatic biology (acidity

>15 mg/l, pH <4.5). Figures 7 and 8 illustrate net acidity and metals concentrations based on 2004 sampling.

Figure 7 - Net Acidity Concentration and Load in Monday Creek - 2004

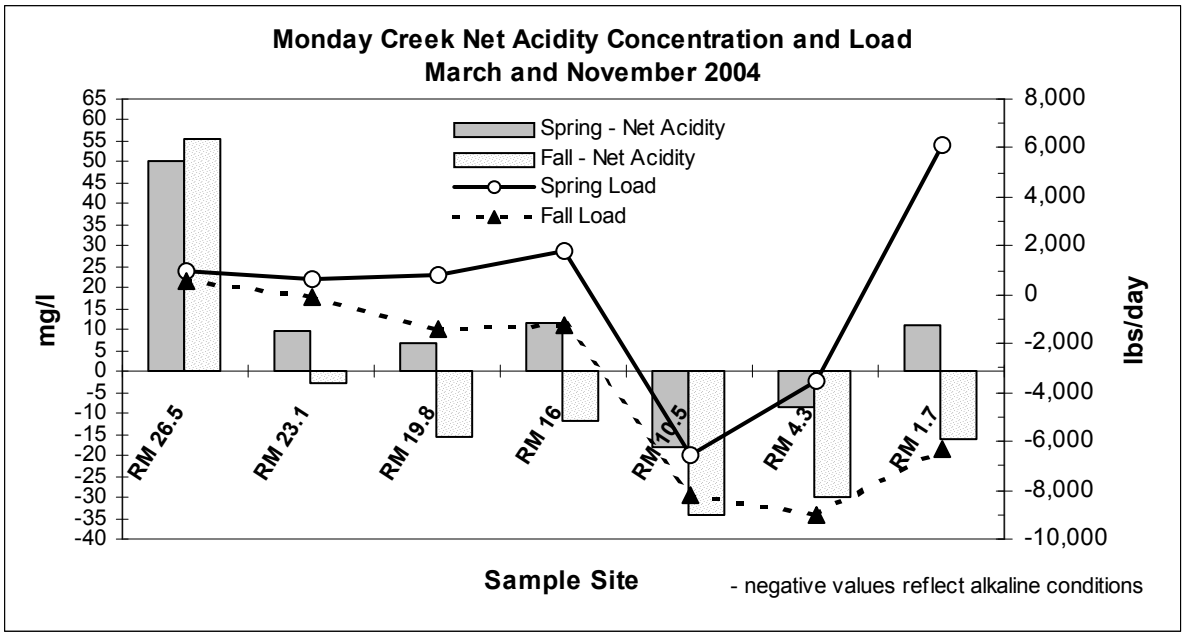
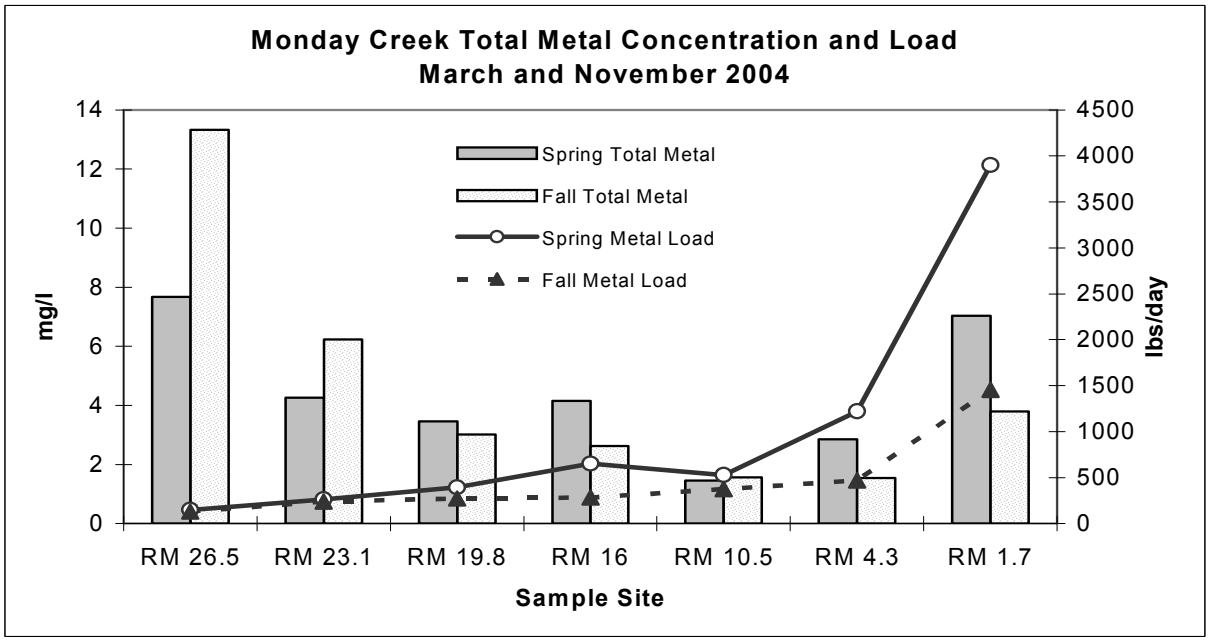


Figure 8 - Total Metal Concentration and Load in Monday Creek - 2004



Sediment

In 2004, OEPA collected sediment samples at LTM monitoring sites in the watershed. Sediment data was evaluated by OEPA, using guidelines established in *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems* (MacDonald *et. al.* 2000). The consensus-based sediment guidelines define two levels of ecotoxic effects. A *Threshold Effect Concentration* (TEC) is a level of sediment chemical quality below which harmful effects are unlikely to be observed. A *Probably Effect Concentration* (PEC) indicates a level above which harmful effects are likely to be observed. Sediment data was also evaluated using the sediment reference values (SRV) developed by Ohio EPA (Ohio EPA 2003).

Arsenic values above the TEC were found in the mainstem of Monday Creek and Snow Fork at all sample sites except RM 10.5 in Monday Creek. Exceedances in the TEC levels for chromium, nickel and zinc were documented at various locations in both Monday Creek and Snow Fork. Other Exceedances in the PEC levels for nickel were documented at RM 16 and 4.3 in Monday Creek. However, eight of the ten sites sampled exhibited disproportionate amounts of sand in the sample. OEPA indicated these sites need to be re-sampled in the future. Table 26 provides data pertaining to the sediment analyses conducted in 2004.

Table 26 - Sediment Analysis, 2004

Chemical compounds detected in sediment samples collected by Ohio EPA from the Monday Creek watershed, 2004 (mg/kg). Measurements in **bold** exceed the TEC as detailed in MacDonald *et al*. 2000. Parameters exceeding the PEC are indicated by underlined **bold** numbers. Measurements in *italics* exceed the sediment reference values (SRV) developed by Ohio EPA (Ohio EPA 2003).

River/Stream Sample																		
River Mile	Location	K*	Na*	As	Ca*	Mg*	Fe*	Mn*	Zn	Cd	Pb	Ni	Se*	Ba*	Al*	Cu	Sr	Cr
Monday Creek																		
26.5 ~	Portie Flamingo Road	13500	<DL	***20.6***	<DL	6160	*76500*	1240	***450***	<DL	<DL	<DL	<DL	316	*99500*	*43*	151	<DL
23.1	Dst Rock Run	<DL	<DL	**16.8**	<DL	<DL	1170	10.2	<DL	0.127	<DL	<DL	2.26	<DL	770	<DL	<DL	< DL
19.7	At Mon. Cr. Junction	6360	<DL	**15.8**	1900	3160	39700	526	**145**	0.241	<DL	<DL	1.99	173	45200	23	73	36
16 ~	Adj SR 595*	9980	<DL	**15.0**	2460	4510	46800	963	***241***	0.361	<DL	**49**	*3.44*	256	*64100*	28.4	99	***60***
10.5 ~	SR 278	1920	<DL	7.26	<1120	1160	19200	423	73.7	0.219	34	27	1.37	40.7	18600	5.9	22	<DL
4.3 ~	Loop Rd dst McKnight seep	8730	<DL	**14.2**	2760	4370	40300	2510	***193***	0.452	<DL	**52**	<DL	242	48300	22.4	72	**44**
1.7 ~	TR 1042/569 dst Coe Hollow	4770	<DL	**10.8**	<DL	2280	36200	321	**133**	<DL	<DL	<DL	<DL	146	44500	21.2	53	<DL

River/Stream Sample																		
River Mile	Location	K*	Na*	As	Ca*	Mg*	Fe*	Mn*	Zn	Cd	Pb	Ni	Se*	Ba*	Al*	Cu	Sr	Cr
6.2 ~	dst Murray City Seeps	4110	<DL	**11.6**	<DL	2660	*52400*	*264*	91.6	<DL	<DL	<DL	<DL	110	27200	14.2	40	<DL
4.3 ~	Dst Snow Fk Mainstem Seep	9930	<DL	***20.8***	3920	4660	*56900*	953	**146**	0.308	<DL	<DL	<DL	266	2470	30.2	84	***57***
2.4 ~	SR 685 dst Orbisten Seep	7050	<DL	**15.8**	<DL	3520	48800	509	107	<DL	<DL	<DL	<DL	200	48500	25.1	60	42

DL = Detection limit,

* Parameters do not have review guidelines established in MacDonald *et al*. 2000,

~ Locations had too much sand in the sample and should be re-sampled

VI. Subwatershed Impairments and Action Strategies

As is common throughout the coal-bearing region of southeast Ohio, abandoned surface and subsurface mines are the source of long-term impacts to surface water resources. These sources result in adverse impacts to water quality, such as low pH, increased sedimentation and habitat alteration. This chapter addresses pollutant sources, associated water quality impairments and the actions necessary to restore streams in the watershed. The impairments were identified through extensive water quality monitoring and biological studies conducted by Ohio EPA and the MCRP staff in preparing a TMDL report and AMDAT plan.

Table 27 summarizes the relationship between causes and sources of water quality impairments in the Monday Creek Watershed.

Table 27 - Watershed Impairment Summary for Monday Creek Watershed

Monday Creek Headwaters to above Little Monday Creek Subwatershed 05030204-060-010		
Causes of Impairment	**Sources of Impairment**	**Target Areas**
Acid Mine Drainage (pH and Sedimentation)	Past mining activity	Rock Run and Lost Run
Subsidences .	Past mining activity	New Straitsville area, Rock Run and Lost Run
Litter and Illegal Trash Dumping .	Roadside dumping	Old Town Road (Perry Co. Rd. 38)
Lack of Riparian Habitat	Agriculture and residential uses	RM 10.3-10.6 RM 19.6-21.1 RM 25.4-26.5
Little Monday Creek Subwatershed 05030204-060-020		
Causes of Impairment	**Sources of Impairment**	**Target Areas**
Sewage (Nutrient enrichment and pathogens)	Livestock and HSTS	Unnamed Trib. North of Maxville, Community of Maxville
Lack of Riparian Habitat . .	Agriculture and residential uses	RM 3.5-4.0 RM 9.1-11.0 RM 12.2-13.2

Monday Creek below Little Monday Creek to Hocking River Subwatershed 05030204-060-030		
Causes of Impairment	**Sources of Impairment**	**Target Areas**
Acid Mine Drainage (pH and Sedimentation)	Past mining activity	Monkey Hollow, Bessemer Hollow and Coe Hollow
Subsidences	Past mining activity	Sand Run, Monkey Hollow, Bessemer Hollow, Coe Hollow
Sewage (Nutrient enrichment and pathogens)	HSTS	Downstream from Carbon Hill
Lack of Riparian Habitat	Agriculture, sand and gravel operations residential . .	RM 0.0-0.65 RM 1.3-1.75 RM 10.2-10.7 RM 11.75-12.5
Snow Fork Subwatershed 05030204-060-040		
Causes of Impairment	**Sources of Impairment**	**Target Areas**
Acid Mine Drainage (pH and Sedimentation) .	Past mining activity	Snow Fork, Brush Fork, Long Hollow and Spencer Hollow
Subsidences .	Past mining activity	Brush Fork, Long Hollow, Goose Run
Litter and Illegal Trash Dumps .	Roadside Littering	S.R. 78 between Buchtel and Murray City
Sewage	Agriculture and HSTS	Salem Hollow (RM 0.1)
Loss of Riparian Habitat	Residential . .	RM 0.9-1.7 RM 1.75-2.6 RM 5.3-6.45

Sources: USACOE 2005, Black 2005, MCRP Field Studies

Monday Creek Headwaters to above Little Monday Creek
Subwatershed 05030204-060-010

Land Use

The Upper Monday Creek subwatershed is the area upstream of the confluence of Monday Creek and Little Monday Creek. In land area, it is the largest of the four HUC 14 subwatersheds that comprise Monday Creek, at 23,405 acres. As with the watershed as a whole, forest (deciduous, coniferous, and mixed forest) is the dominant land cover type, at 81.9 percent. 14.3 percent is classified as open (agricultural and non-impervious urban) lands, 1.6 percent is shrub/scrub type cover, and 1.7 percent is urban (impervious surfaces) and barren lands. Less than 1 percent of cover is open water or non-forested wetlands. Of the 26.6 total stream miles in this subwatershed, 3.1 miles, all on the mainstem, do not have adequate riparian habitat. According to US Census Bureau data from 2000, approximately 2,570 people live in Upper Monday Creek. This includes two incorporated villages: New Straitsville (774) and Shawnee (608).

Water Quality

Extensive abandoned underground and surface mines are located in the upper reaches of the watershed. In the upstream section of Monday Creek, coal mining generally occurred north and east of the main stem. The upstream segment of Monday Creek is severely degraded with high acidity, elevated metal concentrations and low pH values. This segment of Monday Creek drains a total of ten subwatersheds. Three of the subwatersheds (Jobs, Rock Run and Lost Run) are severely impaired by AMD and two (Dixie and New Straitsville) are moderately impaired.

Acid mine drainage discharges from Jobs Hollow (RM 27) and Dixie Hollow (RM 25.2) subwatersheds, creating toxic conditions in Monday Creek headwaters. At RM 26.5, the average net acidity concentration is 80 mg/l, with an average net acid load of 600 lbs/day, average total metal load of 107 lbs/day and average measured pH value of 3.4. The upper three miles of Monday Creek does not support aquatic life. Downstream at RM 24.2, Shawnee Creek, Stone Church tributary, and other unnamed tributaries begin to join with Monday Creek and dilute acid and metal concentrations. From RM 24.2 to 18.5, biological scores improve and the average measured pH value increases to 5.7 s.u.. Monday Creek is in full attainment of the LRW classification at RM 24.2 and 19.8. However, downstream at RM 16, an AMD-impacted tributary (Lost Run) joins with Monday Creek and discharges significant amounts of AMD, thus increasing acid and metal concentrations in Monday Creek. At RM 16, the average net acid load is 1,268 pounds per day, with an average total metal load of 560 pounds per day and average measured pH value of 5.5. Monday Creek then flows 1.5 miles southeast, where it is joined by Little Monday Creek.

Lime Dosing – Headwaters of Monday Creek

In 2004, a lime doser was installed in Jobs Hollow, along an unnamed tributary that discharges into Monday Creek at RM 26.8. The doser is a water-powered machine that distributes lime to the stream in regular increments. The lime neutralizes acidity and raises pH. The doser has been in constant operation since October 2005. Currently, the doser is dispensing less than one ton of material per day, at both low and high flow.

Jobs Doser - Headwaters of Monday Creek

Water Quality Improvements

The headwaters of Monday Creek has maintained a net alkaline status documented in all sampling events in 2006. Water quality samples collected during high flow (April 2006) confirm pH values greater than 6.5 and net alkaline conditions from RM 26.5 to RM 1.7 at Doanville. At low flow, Monday Creek maintains net alkaline conditions to RM 4.3 (upstream of Snow Fork tributary confluence). At high flow, net alkalinity concentrations present in the headwaters of Monday Creek are generally lower than concentrations documented at lower flows. This is likely due to deep mine flushing, drainage area (less surface runoff)

and tributaries such as Dixie Hollow that are net acidic at high flows. In August 2006, biological sampling was performed in Monday Creek downstream of the doser. Findings based on this sampling event are not yet available. Refer to the charts below for pH and net acidity values based on pre- and post-doser operation.

Figure 9 – Net Acidity in Monday Creek Low Flow 2005 - Post Doser

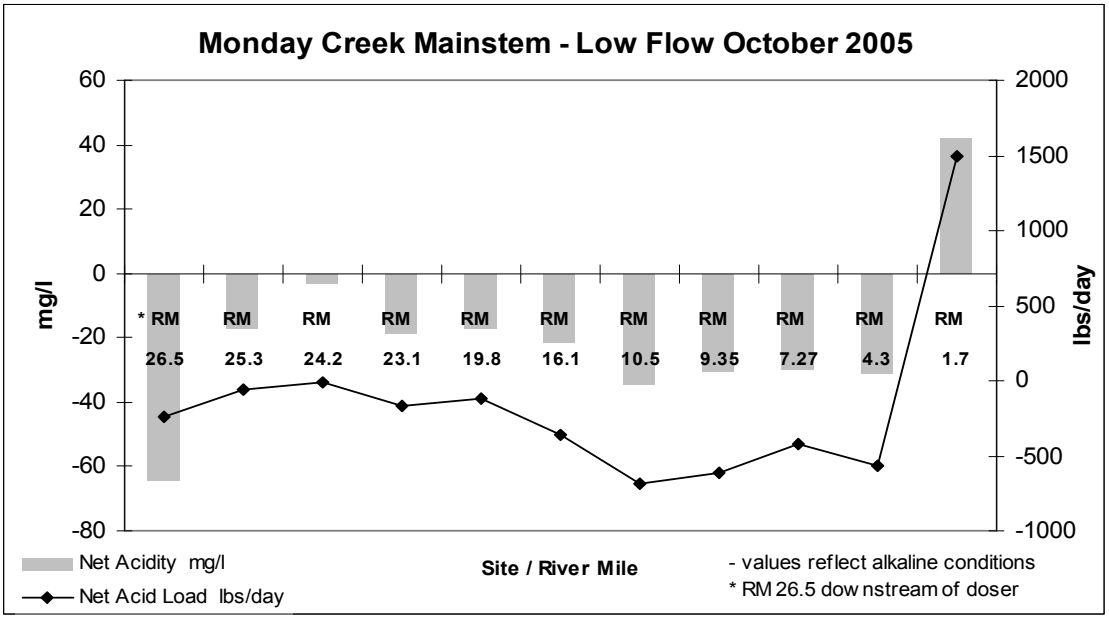


Figure 10 – pH in Monday Creek Low Flow 2005 - Post Doser

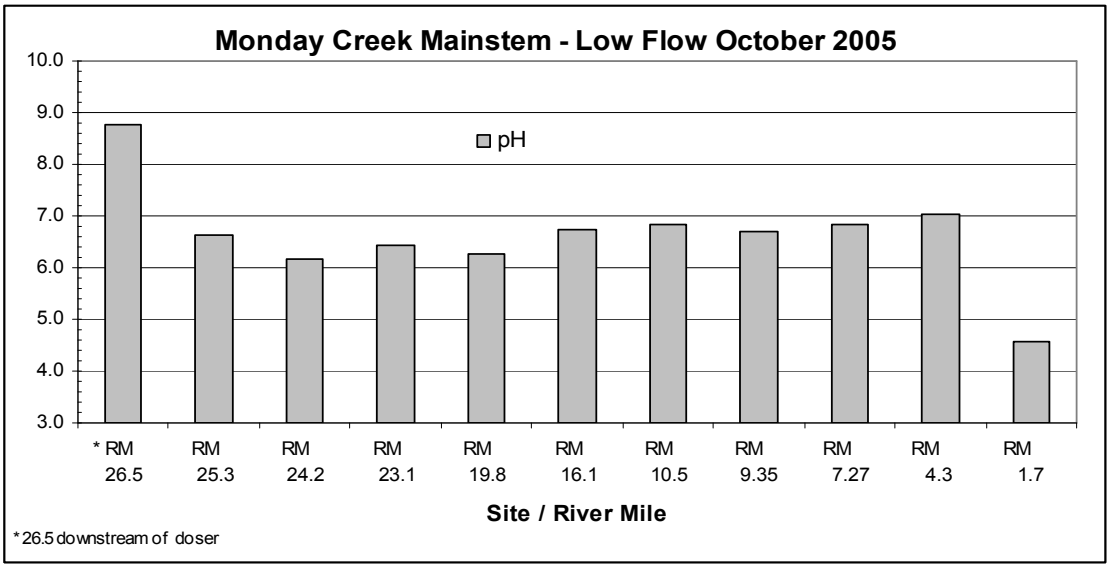


Figure 11 – Net Acidity in Monday Creek High Flow 2006 - Post Doser

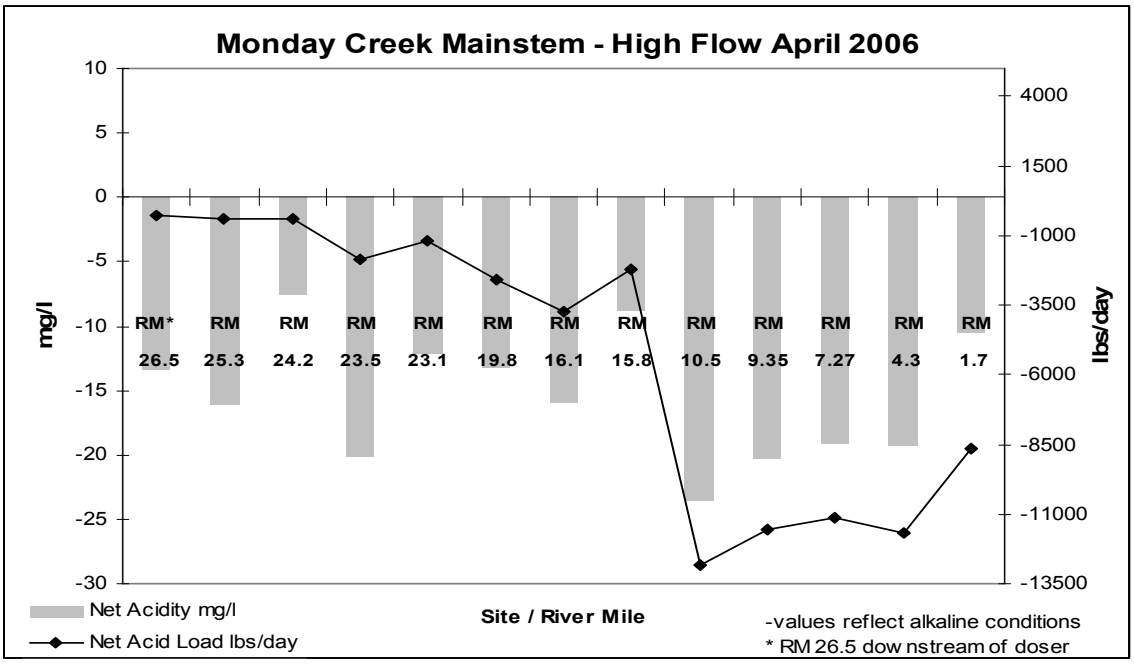
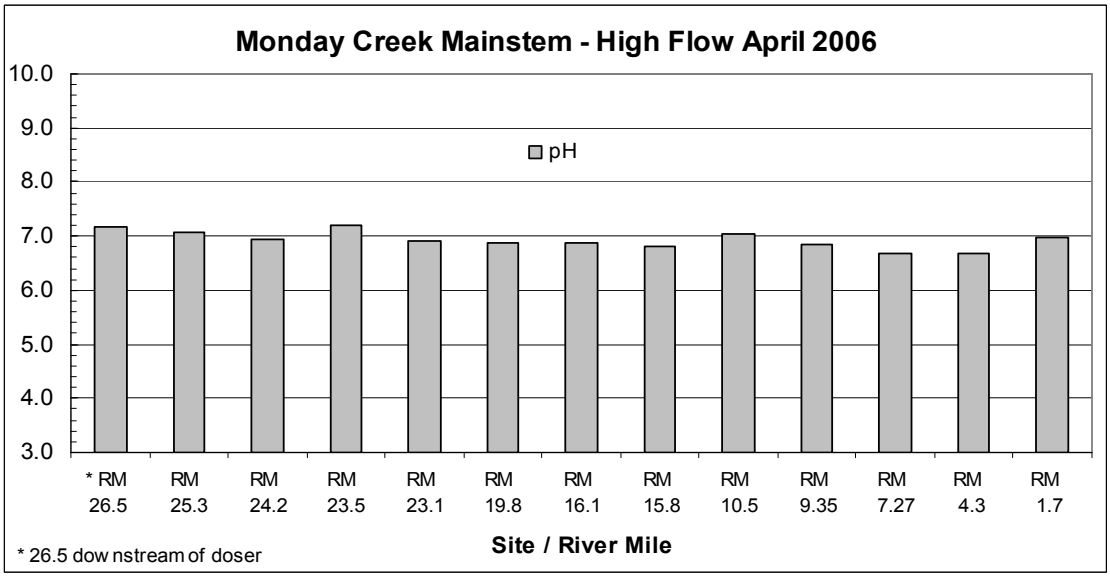


Figure 12 – pH in Monday Creek High Flow 2006 - Post Doser



Biology

Biological sampling was performed in Monday Creek at seven locations in the upstream section of Monday Creek. Due to the toxic AMD conditions present at RM 26.5 and RM 25.3, no fish were collected at these locations. Downstream at RM 24 and RM 23, only pollutant tolerant fish species were collected, mainly creek chub

and green sunfish. As Monday Creek is diluted by less impacted tributaries, the biology scores begin to increase. At RM 19.8 the highest scores in this reach are achieved, however the recovery is limited to three miles, due to the AMD contribution from the Lost Run tributary at RM 16. While biologic recovery is apparent in confined stream reaches, improvement in Monday Creek mainstem is repeatedly disrupted by AMD impacted tributaries, which are ubiquitous throughout the watershed.

Table 28 – IBI, ICI, QHEI Scores – Upper Monday Creek

Stream	River Mile	HUC # 05030 204060	IBI	ICI Qualitative	ICI Quantitative	QHEI	Attainment Status	Use Designation	Year
Monday Creek	26.5	10	12	Very Poor	1	64	Non	LRW	2001
Monday Creek	25.3	10	12	Very Poor	1	52.5	Non	LRW	2001
Monday Creek	24.2	10	20	Poor	12	77.5	Full	LRW	2001
Monday Creek	23.4	10	16	Poor	12	74.5	Non	LRW	2001
Monday Creek	19.7 / 19.8	10	22	-	34	65	Full	LRW	2001
Monday Creek	18.5	10	18	-	26	81.5	Non	LRW	2001
Monday Creek	16 / 15.8	10	18	-	14	61.5	Non	LRW	2001

Source: OEPA 2002

Problem Statement 1 of 4 - Acid Mine Drainage

Based on the October 2000 mass balance in Monday Creek, it is estimated that Rock Run contributes 2 percent (87 lbs/day) of the acid load to Monday Creek at base flow. In 2001, MCRP monitored the mouth of Rock Run tributary quarterly for one year. Based on that data, the average pH at the mouth is 4.9 and the average acid load is 200 lbs/day.

Based on the October 2000 mass balance, it is estimated that Lost Run contributes 9 percent (346 lbs/day) of the acid load to Monday Creek at base flow. Data collected at the LTM site 131, located downstream of the Lost Run tributary, indicates an average pH of 5.5 and an average alkalinity value of 5.8 mg/l. In sampling over the past eight years, the highest pH value recorded at the mouth of Lost Run is 3.6. The Lost Run subwatershed is classified as a priority subwatershed.

Action Plan

Goals:
• Reduce acidity loading by 78 tons/year and the metal loading by 65 tons/ year
•Create water quality conditions in the Monday Creek mainstem that are suitable for aquatic life.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Construct treatment systems to lessen the effect of AMD in Rock Run and Lost Run (see AMDAT Plan for list of projects, remediation strategy, cost, and load reductions.)	Construct projects in Rock Run and Lost Run during the next 10 years to reduce acidity and metal loading.	$437,000 in Rock Run and $4,000,000 in Lost Run (without Doser)	Funding through inactment of the Water Resources Development Act	Years 2-10	Projects constructed and acidity reduced by 78 tons/yr.and metal loadings reduced by 65 tons/yr.

Acid Mine Drainage - Majestic Mine

Problem Statement 2 of 4 - Subsidence

Subsidence impacts occur in the watershed when underground mine voids that are close to the surface collapse. The collapsed overburden captures surface water into the mine voids, allowing contact with sulfide minerals and oxygen, thus generating AMD within the watershed. Subsidences can take the form of large gaping holes in the streambed or hidden underground cracks that allow surface water to dissipate into the underground mine workings, thus continuing the generation of AMD. Subsidence features have been identified in the vicinity of New Straitsville, the upper reaches of Rock Run and the upper reaches of Lost Run.

Subsidence - New Straitsville

Action Plan

Goals:

- Restore positive drainage to the stream
- Reduce AMD generation by preventing contact between stream water and pyritic minerals located within the underground mines

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Construct treatment systems to restore positive drainage to tributaries in the vicinity of New Straitsville, Rock Run and Lost Run	Construct projects in tributaries of New Straitsville, Rock Run and Lost Run during the next 4 years to reduce acidity and metal loading.	$550,000 in Rock Run; $350,000 in New Straitsville; and $300,000 in Lost Run	Funding through Abandoned Mine Land funds through the US Forest Service	Years – Present - 4	Projects constructed with positive drainage to streams and Acidity reduced by 78 tons/yr. and metal loadings reduced by 65 tons/yr.(in combination with acid mine drainage objective)

Problem Statement 3 of 4 - Litter and Illegal Trash Dumping

An illegal dump site located adjacent to Old Town Road (Perry County) is an unsightly nuisance and health risk near the Buckeye Trail and Monday Creek. The dump site is in a ravine, approximately 700 feet from Monday Creek at River Mile 23.0. Some health risks include: injury due to sharp objects, increase in rodents and the potential spread of diseases (West Nile Virus, encephalitis and Dengue Fever) from mosquito breeding in scrap tires.

Illegal Trash Cleanup

Action Plan

Goal:

- Remove an illegal dump site located adjacent to Old Town Road, the Buckeye Trail and Monday Creek

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Remove discarded household goods to improve aesthetic quality and health conditions	Conduct a trash cleanup of the illegal dump site	In-kind services provided by volunteers from the community, US Forest Service and Buckeye Trail Association	Watershed Coordinator will request funding for trash disposal from the Perry County Litter Prevention office	Year 1	- Number of participants (10 estimated) involved in the cleanup events - Removal of estimated 2 tons of trash

Problem Statement 4 of 4 – Lack of Riparian Habitat

Loss of riparian habitat in this subwatershed is the result of past clearing of plots used for agricultural purposes (pastures or grazing land) or clearing for residential use (lawns). The loss of riparian habitat occurs in three locations: downstream from Tansky's Marsh (RM 10.3-10.6); in the Tucker Road / Keota Road area (RM 19.6-21.1); and in the vicinity of McCuneville (RM 25.4-26.5)

Lack of Riparian Habitat

Action Plan

Goal:

- Improve the current QHEI scores along those segments with poor riparian habitat

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Improve the riparian vegetation	Work with landowners to plant tree species compatible with existing riparian habitats	In-kind services provided by landowners and volunteers from the community	- Get approval from landowners for tree planting - Work through the Soil & Water Conservation Districts to obtain trees	Year 1-3	- Three landowners willing to create a riparian buffer -Plant 1 linear mile of riparian habitat

Little Monday Creek
Subwatershed 05030204-060-020

Land Use

The smallest of the HUC 14 units of the Monday Creek Watershed, Little Monday Creek occupies the northwest corner of the watershed and has an area of 16,070 acres. Forested and open areas make up 61.2 percent and 35.3 percent of total land area, respectively. 1.8 percent of the area is shrub/scrub, and all other land cover types occupy less than 1 percent each. 4.3 stream miles on the Little Monday Creek mainstem, out of 17.8 total miles, do not have adequate riparian habitat, primarily due to residential and pasture land use. According to US Census Bureau data from 2000, an estimated 888 people live in the Little Monday Creek subwatershed, all residents of unincorporated areas (townships).

Water Quality

Little Monday Creek is located in the western portion of the watershed. It is currently designated as Warm Water Habitat (WWH). Coal mining occurred in the lower section of the drainage, with a total of three documented underground mines, encompassing only 130 acres. The upper reaches of Little Monday Creek are in full attainment of WWH. Alkalinity is provided to Little Monday Creek from the Freeport Limestone. The Allegheny Formation beneath the western side of the Monday Creek Watershed generally contributes an average of 40 mg/L alkalinity. At the mouth of Little Monday Creek, the average net alkaline load is 3,400 lbs/day, with an average total metal load of 63 lbs/day and average measured pH value of 7.2.

Biology

Little Monday Creek represents the only refugium within the greater Monday Creek Basin. Free from significant sources of AMD, nearly half of the Little Monday Creek mainstem and four of the five tributaries fully meet WWH biocriteria. Areas of impairment are limited to the lower 6.8 miles of the mainstem. Although impacted, biologic community performance remains largely in the fair range. Departures from the WWH biocriteria are associated with moderate AMD (OEPA 2002).

Table 29 – IBI, ICI, QHEI Scores – Little Monday Creek

Stream	River Mile	HUC # 05030 204060	IBI	ICI Qualitative	ICI Quantitative	QHEI	Attainment Status	Use Designation	Year
Little Monday	13.7	20	42	Marginally Good	32	73	Full	WWH	2001
Little Monday	11.1	20	42	Marginally Good	32	79	Full	WWH	2001
Little Monday	9.5	20	44	Good	36	64.5	Full	WWH	2001
Little Monday	6.9	20	32	Good	36	69	Partial	WWH	2001
Little Monday	3.3	20	34	-	56	62.5	Partial	WWH	2001
Little Monday	0.1	20	36	Marginally Good	32	56.5	Partial	WWH	2001

Source: OEPA 2002

Problem Statement 1 of 2 - Sewage

During TMDL sampling, elevated fecal coliform levels were found in the mainstem of Little Monday Creek at RM 11.1 and RM 9.6 and are most likely the result of unrestricted livestock access to the creek as well as failing septic systems from the unsewered community of Maxville.

Action Plan

Goals:

- Work with the Perry County Health Department to increase the number of properly working home sewage systems by 20 percent within this subwatershed. The community of Maxville has approximately 15 residences. Rural housing units occur throughout the remainder of the subwatershed.

- Work with the Perry County Soil and Water Conservation District and Natural Resource Conservation Service to install practices at farming operations on Little Monday Creek and its tributaries to reduce fecal coliform counts to meet Ohio EPA standards

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Decrease the number of failing home sewage treatment systems by 20% and reduce the level of fecal coliform to below Ohio EPA standards	Work with Perry County Health Dept. to conduct fecal coliform sampling which will help identify specific target areas and provide baseline data to compare future results	Time for staff of Perry Co. Health Dept. and MCRP to conduct water quality monitoring	Staff of Perry Co. Health Dept. and MCRP will conduct sampling throughout watershed targeted areas downstream of potential problem areas. Technical assistance provided by ONDR and OEPA	Years 1-2	Database of water quality sampling results
	Work with Perry County Health Dept. to determine households with failing systems	Health Dept. inspectors inspect systems	Health Dept. will inspect approximately 15 systems	Years 3-5	Identification of the failing on-site systems with addresses generated
	Work with Perry County Health Dept. to replace/upgrade 5 failing systems	Apply for approximately $40,000 in funds to repair 5 systems at $8,000 per system	Seek funding from grants and DEFA low interest loan program to cost share on-site HSTS repair or replacement	Years 5-8	Decreased fecal coliform levels to below 2000 counts/100mL in Little Monday Creek with upgraded septic systems at 5 residences
Reduce fecal coliform counts from agricultural lands to meet OEPA standards	Work with Perry County SWCD and NRCS to identify EQIP practices relevant to grazing practices in Little Monday Creek	Time for SWCD staff, district conservationist and MCRP to work with landowners	SWCD staff, district conservationist and MCRP to encourage and support EQIP practices	Years 1-2	Present information to 4 landowners
	Conduct monitoring to determine fecal coliform counts over time	Time for SWCD and MCRP staff to conduct sampling	Staff of SWCD and MCRP will conduct sampling throughout watershed targeted areas downstream of potential problem areas. Technical assistance provided by ONDR and OEPA	Years 1-2	Database of water quality sampling results
	Provide information to landowners about cost-share programs for exclusion of livestock from waterways	Time for SWCD staff, district conservationist and MCRP to visit landowners	To inform landowners of financial and ecological benefits of livestock exclusion. Sign up willing landowners for CRP and EQIP cost-share programs	Years2-5	Two landowners enrolled in cost-share programs for livestock exclusion from waterways

Problem Statement 2 of 2 – Lack of Riparian Habitat

Loss of riparian habitat in this subwatershed is the result of past clearing of plots used for agricultural purposes (pastures or grazing land) or clearing for residential use (lawns). The loss of riparian habitat occurs in three locations: in the vicinity of County Road 18 (Hocking County) (RM 3.5-4); through the community of Maxville (RM 9.1-11.0); and adjacent to Township Road 131 (Monday Creek Township, Perry County).

Action Plan

Goal:

- Improve the current QHEI scores along those segments with poor riparian habitat

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Improve the riparian vegetation	Work with 3 landowners to plant a buffer zone with tree species compatible with existing riparian habitats	In-kind services provided by landowners and volunteers from the community	- Get approval from landowners for tree planting - Work through the Soil & Water Conservation Districts to obtain trees	Year 1-3	- 3 landowners willing to create a riparian buffer -1.5 linear miles of riparian habitat planted

Monday Creek below Little Monday Creek to Hocking River

Subwatershed 05030204-060-030

Land Use

The lower reaches of Monday Creek (downstream of the confluence with Little Monday Creek), comprise an area of 17,306 acres. Forests cover 78.1 percent of the land area and open areas occupy 18.3 percent. Urban areas make up 1 percent of the land area, and all other land use types occupy less than 1 percent of the subwatershed each. This segment of the Monday Creek has a total of 23.3 stream miles, of which 3.7 have inadequate riparian habitat due to residential and industrial settings. According to US Census Bureau data from 2000, approximately 1,355 people live in this area, all in unincorporated areas.

Water Quality

Extensive abandoned underground and surface mines are located in the downstream reaches of the watershed. Coal mining in general, occurred within tributaries located both east and west of the main stem of Monday Creek.

This downstream segment of Monday Creek is degraded by moderately acidic conditions, elevated metal concentrations and is subject to low pH excursions. This segment of Monday Creek drains a total of ten subwatersheds. Six of the subwatersheds (Monkey Hollow, Big Four Hollow, Snake Hollow, Bessemer Hollow, Snow Fork and Coe Hollow) are severely impaired by AMD. Water quality conditions in Snow Fork are addressed as a separate subwatershed. Reclamation projects have recently been completed in Big Four Hollow and Snake Hollow.

Biology

Lower Monday Creek's biological scores improve immediately downstream from the point at which Little Monday Creek joins the mainstem. Mainstem AMD impacts in Monday Creek are diluted by Little Monday Creek tributaries draining from the western portion of the watershed. The upper four miles of the reach document improvement in both the IBI and ICI scores to RM 9.3. At RM 10.5 the highest scores in this reach are achieved. However, biologic recovery is adversely influenced by AMD contributions from tributaries joining Monday Creek below RM 10.5, the largest contribution occurring at RM 3.45, where Snow Fork tributary flows into Monday Creek. IBI and ICI scores decline significantly below the confluence with Snow Fork. A total of 127 fish were collected at RM 4.3 upstream of Snow Fork, while only 17 fish were collected at RM 3. Species collected downstream from RM 3 to RM .7 were pollutation-tolerant species including various types of sucker, bullhead, sunfish and creek chub. While biologic recovery is apparent in a confined upstream reach, improvement in Monday Creek mainstem is continually disrupted by AMD-impacted tributaries, which are ubiquitous throughout the watershed.

Table 30 – IBI, ICI, QHEI Scores – Lower Monday Creek

Stream	River Mile	HUC # 05030 204060	IBI	ICI Qualitative	ICI Quantitative	QHEI	Attainment Status	Use Designation	Year
Monday Creek	14.3	30	23	Fair	4	54	Full	LRW	2001
Monday Creek	10.5	30	29	-	28	62	Full	LRW	2001
Monday Creek	9.3	30	22	-	18	63	Full	LRW	2001
Monday Creek	4.3	30	21	-	24	66	Non	LRW	2001
Monday Creek	3	30	13	Poor	12	73.5	Non	LRW	2001
Monday Creek	1.7	30	14	-	12	54.5	Non	LRW	2001
Monday Creek	0.7	30	12	-	16	68.5	Non	LRW	2001

Source: OEPA 2002

Problem Statement 1 of 4 - Acid Mine Drainage

Based on the October 2000 mass balance in Monday Creek, it is estimated that Monkey Hollow contributes 4 percent (165 lbs/day) of the acid load to Monday Creek at base flow. In the summer of 2001, OEPA performed biological and water quality sampling for a TMDL study in the Monday Creek Watershed. Study results confirm that the Monkey Hollow subwatershed is severely impacted by AMD and only meets requirements for classification as Limited Resource Water (LRW).

Based on the October 2000 mass balance, it is estimated that Bessemer Hollow also contributes 4 percent (169 lbs/day) of the acid load to Monday Creek at base flow. It is difficult to quantify the negative impact Bessemer Hollow has on Monday Creek's riparian habitat and biological performance due to the cumulative effect of the downstream Coe Hollow discharge and the close proximity of Snow Fork mouth. Over a water year, this tributary contributes between 30 to 1,095 lbs/day of acid to Monday Creek mainstem. This subwatershed is also severely impacted by AMD and only meets requirements for classification as Limited Resource Water (LRW).

The October 2000 mass balance study also identified Coe Hollow as an AMD-affected tributary. Based on the October 2000 sampling event, it is estimated that Coe Hollow contributes 10 percent (359 lbs/day) of the acid load to Monday Creek at base flow. The highest pH value recorded at the mouth of Coe Hollow to date is 3.0. Coe Hollow tributary is severely impacted by AMD and meets requirements for classification as Limited Resource Water (LRW).

Action Plan

Goals:
• Reduce acidity loading by 126 tons/year and the metal loading by 38 tons/ year
•Create water quality conditions in the Monday Creek mainstem that are suitable for aquatic life.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Construct treatment systems to lessen the effect of AMD in Monkey Hollow, Bessemer Hollow and Coe Hollow (see AMDAT Plan for list of projects, remediation strategy, cost, and load reductions.)	Construct projects in Monkey, Bessemer, and Coe Hollows during the next 10 years to reduce acidity by 126 tons/yr. and metal loading by 38 tons/yr.	$2,100,000 in Monkey Hollow; $435,000 in Bessemer Hollow; and $477,000 in Coe Hollow	Funding through inactment of the Water Resources Development Act	Years 2-10	Projects constructed and Acidity reduced by 126 tons/yr. and metal loadings reduced by 38 tons/yr..

Problem Statement 2 of 4 - Subsidence

Subsidence impacts occur in the watershed when underground mine voids that are close to the surface collapse. The collapsed overburden captures surface water into the mine voids, allowing contact with sulfide minerals and oxygen, thus generating AMD within the watershed. Subsidences can take the form of large gaping holes in the streambed or of hidden underground cracks that allow surface water to dissipate into the underground mine workings, thus continuing the generation of AMD. Subsidence features have been identified in the Sand Run subwatershed and the Valley Junk area.

Action Plan

Goals:

- Restore positive drainage to the stream
- Reduce AMD generation by preventing contact between stream water and pyritic minerals located within the underground mines

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Construct treatment systems to restore positive drainage to tributaries in the Sand Run Subwatershed and the Valley Junk area	Construct projects in tributaries of Sand Run and the Valley Junk area to restore positive drainage and reduce acidity by 126 tons/yr. and metal loading by 38 tons/yr.	$275,000 in Sand Run and $425,000 in the Valley Junk area	Funding through Abandoned Mine Land funds through the US Forest Service	Years 2 - 4	Projects constructed with positive drainage to streams and acidity by 126 tons/yr. and metal loading by 38 tons/yr. (in conjunction with the Acid Mine Drainage objective)

Problem Statement 3 of 4 - Sewage

During TMDL sampling, elevated fecal coliform levels were found in the mainstem of Monday Creek at RM 9.3. Because Carbon Hill is an unsewered community, failing and/or non-existent septic systems are the most likely cause of elevated fecal coliform numbers. There are approximately 25 residences in the Carbon Hill community.

Action Plan

Goals:

- Work with the Hocking County Health Department to increase the number of properly working home sewage systems by 20 percent within this subwatershed

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Decrease the number of failing home sewage treatment systems by 20% and reduce the level of fecal coliform to below Ohio EPA standards	Work with Hocking County Health Dept. to conduct fecal coliform sampling which will help identify specific target areas and provide baseline data to compare future results	Time for staff of Hocking Co. Health Dept. and MCRP to conduct water quality monitoring	Staff of Hocking Co. Health Dept. and MCRP will conduct sampling throughout watershed targeted areas downstream of potential problem areas. Technical assistance provided by ONDR and OEPA	Years 1-2	Database of water quality sampling results
	Work with Hocking County Health Dept. to determine households with failing systems	Health Dept. inspectors inspect systems	Health Dept. will inspect approximately 15 systems	Years 3-5	Identification of the failing on-site systems with addresses generated
	Work with Hocking County Health Dept. to replace/upgrade 5 failing systems	Apply for approximately $40,000 in funds to repair 5 systems at $8,000 per system	Seek funding from grants and DEFA low interest loan program to cost share on-site HSTS repair or replacement	Years 5-8	Decreased fecal coliform levels to below 2000 counts/100mL in Monday Creek

Problem Statement 4 of 4 – Lack of Riparian Habitat

Loss of riparian habitat in this subwatershed is the result of past clearing of plots used for agricultural purposes (row cropland), clearing for residential use (lawns) and sand and gravel operations. The loss of riparian habitat occurs in four locations: just above the confluence with the Hocking River (RM 0.0-0.65), in the vicinity of Doanville (RM 1.3-1.75), in the vicinity of Carbon Hill (RM 10.2-10.7) and downstream from the confluence of Sand Run (RM 11.75-12.5).

Action Plan

Goal:

- Improve the current QHEI scores along those segments with poor riparian habitat

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Improve the riparian vegetation	Work with 2 landowners to plant tree species compatible with existing riparian habitats One linear mile of riparian vegetation planted	In-kind services provided by landowners and volunteers from the community	- Get approval from 2 landowners for tree planting - Work through the Soil & Water Conservation Districts to obtain trees	Year 1-3	- Number of landowners willing to create a riparian buffer -llinear mile of riparian habitat planted

Snow Fork

Subwatershed 05030204-060-040

Land Use

The Snow Fork subwatershed occupies the eastern side of Monday Creek Watershed, and has an area of 17,428 acres. 80.8 percent of Snow Fork is forested land, and 14.3 percent is open land. Shrub/scrub and urban lands are 2.5 and 1.6 percent respectively, and all other land use types are less than 1 percent each. Out of 27.7 stream miles, 7.1 miles have poor riparian habitat, due to residential areas and roadcuts paralleling the streams. According to US Census Bureau data from 2000, an estimated 2,124 people live in Snow Fork subwatershed, including the villages of Buchtel (574) and Murray City (452).

Water Quality

Snow Fork is located in the earstern portion of the watershed. It is the second largest of the Monday Creek subwatersheds and is currently designated as Limited Resource Water (LRW). Approximately 67% of the Snow Fork subwatershed contains underground and/or surface mined areas. Snow Fork drains a total of seven subwatersheds. Four of the subwatersheds (Sycamore / Middle Fork, Spencer, Brush Fork and Long Hollow) are severely impaired by AMD and two are moderately impaired (Whitmore and Goose Run). Nearly all tributaries evaluated in the subwatershed, were profoundly and systemically impaired. Mine drainage was identified as the principal associated source of impairment (Boucher, 2001). The entire mainstem is severely degraded with high acidity, elevated metal concentrations and low pH values.

MCRP data collected in Snow Fork, at RM 6.2 (LTM 106) exhibit an average pH value of 4.6 and average acidity value of 46 mg/l. Data collected downstream at RM 4.3 (LTM 107) and RM 2.4 (LTM 109) record an average pH value of 3.7 and average acidity value between 85-87 mg/l. Water quality data collected since 1997 documents Snow Fork's extremely degraded status from RM 6.2 to the confluence with Monday Creek (near Buchtel). Brush Fork tributary is the largest AMD source, contributing to the decline in water quality. Over a water year, Brush Fork contributes between 595 to 5,000 lbs of acid per day to Snow Fork mainstem. Snow Fork LTM sampling results for 2004 are represented in Figures 13 and 14.

Figure 13 - Net Acidity Concentration and Load in Snow Fork - 2004

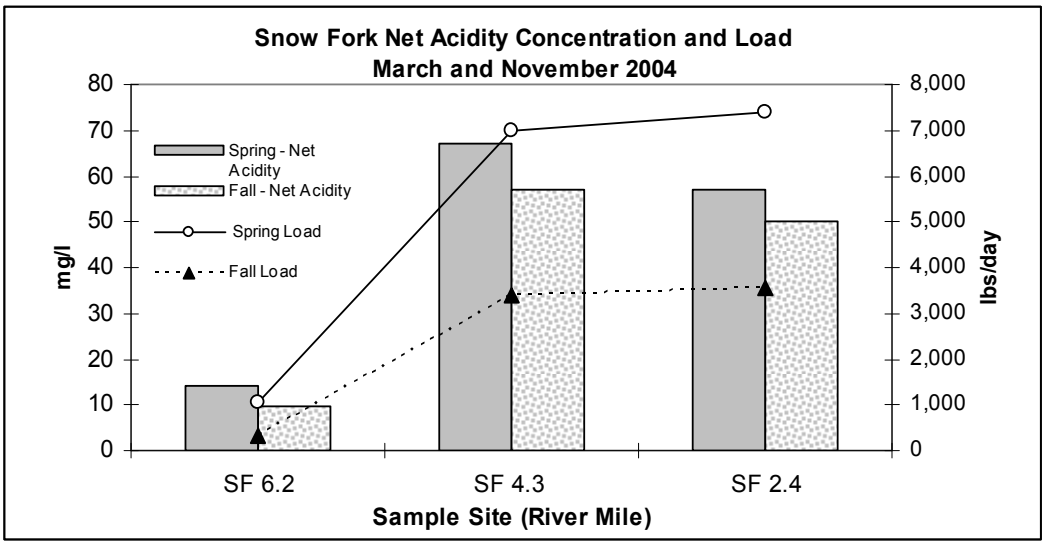
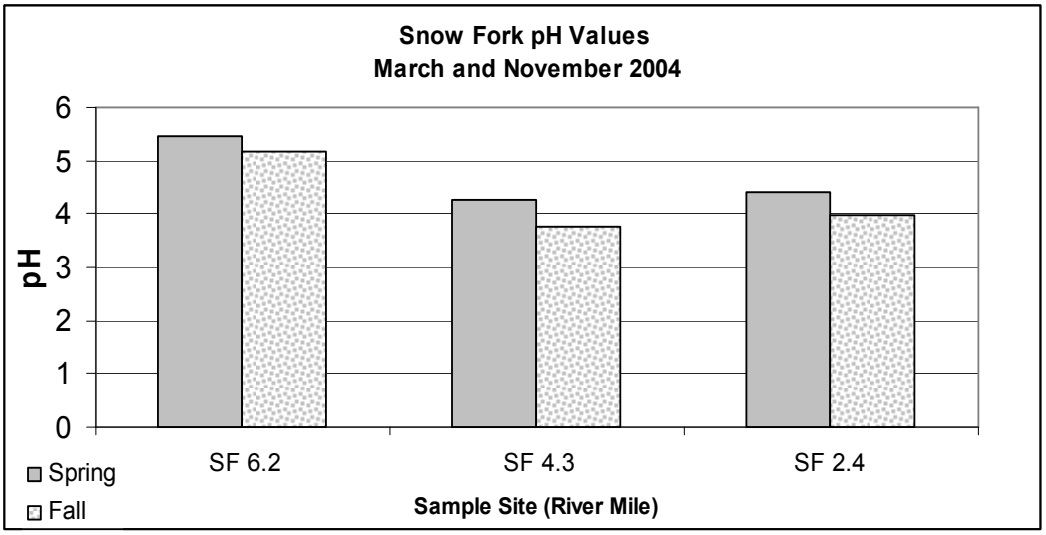


Figure 14 - pH in Snow Fork - 2004



Biology

Biological sampling was performed at four locations in Snow Fork mainstem. A total of six fish (yellow bullhead and green sunfish) were collected at sampling sites in the mainstem of Snow Fork. No fish were collected at sampling stations located at RM 4.5 and RM .1. Due to consistently low pH values and high acid and metal concentrations, Snow Fork generates water chemistry conditions acutely toxic to aquatic organisms.

Table 31 – IBI, ICI, QHEI Scores – Snow Fork

Stream	River Mile	HUC # 05030 204060	IBI	ICI Qualitative	ICI Quantitative	QHEI	Attainment Status	Use Designation	Year
Snow Fork	6.2	40	12	Very Poor	1	43	Non	LRW	2001
Snow Fork	4.5	40	12	Very Poor	1	64.5	Non	LRW	2001
Snow Fork	2.4	40	12	Very Poor	1	58.5	Non	LRW	2001
Snow Fork	1	40	12	-	6	57.5	Non	LRW	2001

Source: OEPA 2002

Problem Statement 1 of 5 - Acid Mine Drainage

At low flow conditions, Snow Fork discharges 28 percent of the flow and can account for approximately 40 percent of the acid load at the mouth of Monday Creek. At high flow conditions, Snow Fork discharges 28 percent of the flow and can account for approximately 60 percent of the acid load at the mouth of Monday Creek (Shimala, 1999).

Action Plan

Goals:
• Reduce acidity loading by 504 tons/year and the metal loading by 108 tons/ year
•Create water quality conditions in the Snow Fork mainstem that are suitable for aquatic life.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Construct treatment systems to lessen the effect of AMD in Brush Fork, Long Hollow, Orbiston, Salem Hollow, Spencer Hollow and Sycamore Hollow (see AMDAT Plan for list of projects, remediation strategy, cost, and load reductions.)	Construct projects in Brush Fork, Long Hollow, Orbiston, Salem Hollow, Spencer Hollow and Sycamore Hollow during the next 10 years to reduce acidity by 504 tons/yr and metal loading by 108 tons/yr.	$1,676,000 in Brush Fork; $849,000 in Long Hollow; $623,000 in Orbiston; $119,000 in Salem Hollow; $215,000 in Spencer Hollow; and $1,020,000 in Sycamore Hollow	Funding through inactment of the Water Resources Development Act	Years 2-10	Projects constructed and acidity by 504 tons/yr and metal loading by 108 tons/yr.

Problem Statement 2 of 5 - Subsidence

Subsidence impacts occur in the watershed when underground mine voids that are close to the surface collapse. The collapsed overburden captures surface water into the mine voids, allowing contact with sulfide minerals and oxygen, thus generating AMD within the watershed. Subsidences can take the form of large gaping holes in the stream bed or of hidden underground cracks that allow surface water to dissipate into the underground mine workings, thus continuing the generation of AMD. Subsidence features have been identified in Brush Fork, Long Hollow and Goose Run.

Action Plan

Goals:

- Restore positive drainage to the stream
- Reduce AMD generation by preventing contact between stream water and pyritic minerals located within the underground mines

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Construct treatment systems to restore positive drainage to tributaries in Brush Fork and Long Hollow	Construct projects in tributaries of Brush Fork and Long Hollow to restore positive drainage and reduce acidity by 504 tons/yr and metal loading by 108 tons/yr.	$272,000 in Brush Fork and $35,000 in Long Hollow	Funding through inactment of the Water Resources Development Act	Years 2 - 10	Projects constructed with positive drainage to streams and acidity by 504 tons/yr and metal loading by 108 tons/yr. (in conjunction with the AMD objective)

Problem Statement 3 of 5 – Litter and Illegal Trash Dumping

Littering along State Route 78 between Buchtel and Murray City, adjacent to the mainstem of Snow Fork, has been a problem for many years. Fast food containers, wrappers, bottles and cans litter this portion of roadway more than any other within the watershed. With Snow Fork ranging between 100 and 500 feet from the highway, the litter can blow into the creek or present an unsightly view to motorists.

Action Plan

Goals:

- Work with the Ohio Department of Transportation and local volunteers to remove litter and improve the aesthetic quality along a 3 mile segment of Snow Fork

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Plan community events and recruit volunteers to conduct clean-ups and remove litter	Conduct an annual cleanup of State Route 78 between Buchtel and Murray City (Snow Fork RM 2.6-5.2)	In-kind services by Nelsonville Boy Scout Troop 60 (clean-up) and Ohio Department of Transportation (litter disposal)	Funding by Ohio Highway funds	Annual springtime event	Number of participants involved in cleanup event Amount of litter removed

Problem Statement 4 of 5 - Sewage

During TMDL sampling, elevated fecal coliform levels were found near the mouth of Salem Hollow (RM 0.1). The elevated reading may be the result of unsewered or failing septic systems upstream on Salem Hollow or unfenced livestock in the stream. The closest residence to the mouth of Salem Hollow is a distance of 1.5 miles upstream. There are no areas of livestock grazing within 1.5 miles of the mouth of Salem Hollow.

Action Plan

Goals:

- Work with the Hocking County Health Department to increase the number of properly working home sewage systems by 25 percent within this subwatershed. There are only four residences along Salem Hollow.

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Decrease the number of failing home sewage treatment systems by 25% and reduce the level of fecal coliform to below Ohio EPA standards	Work with Hocking County Health Dept. to conduct fecal coliform sampling which will help identify specific target areas and provide baseline data to compare future results	Time for staff of Hocking Co. Health Dept. and MCRP to conduct water quality monitoring	Staff of Hocking Co. Health Dept. and MCRP will conduct sampling throughout watershed targeted areas downstream of potential problem areas. Technical assistance provided by ONDR and OEPA	Years 1-2	Database of water quality sampling results
	Work with Hocking County Health Dept. to determine households with failing systems	Health Dept. inspectors inspect systems	Health Dept. will inspect approximately 4 systems	Years 3-5	Identification of the failing on-site systems with addresses generated
	Work with Hocking County Health Dept. to replace/upgrade 1 failing systems	Apply for approximately $8,000 in funds to repair 1 system at $8,000 per system	Seek funding from grants and DEFA low interest loan program to cost share on-site HSTS repair or replacement	Years 5-8	Decreased fecal coliform levels to below 2000 counts/100mL in Salem Hollow
		Time for SWCD staff, district conservationist and MCRP to work with landowners	SWCD staff, district conservationist and MCRP to encourage and support EQIP practices	Years 1-2	Present information to 4 landowners

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Reduce fecal coliform counts from agricultural lands to meet OEPA standards	Work with Hocking County SWCD and NRCS to identify EQIP practices relevant to grazing practices in Salem Hollow	Time for SWCD and MCRP staff to conduct sampling	Staff of SWCD and MCRP will conduct sampling throughout watershed targeted areas downstream of potential problem areas. Technical assistance provided by ONDR and OEPA	Years 1-2	Database of water quality sampling results
	Conduct monitoring to determine fecal coliform counts over time	Time for SWCD staff, district conservationist and MCRP to visit landowners	To inform landowners of financial and ecological benefits of livestock exclusion. Sign up willing landowners for CRP and EQIP cost-share programs	Years2-5	Number of landowners enrolled in cost-share programs for livestock exclusion from waterways
	Provide information to landowners about cost-share programs for exclusion of livestock from waterways				

Problem Statement 5 of 5 – Lack of Riparian Habitat

Loss of riparian habitat in this subwatershed is the result of past clearing of plots for residential use (lawns) in communities adjacent to Snow Fork. The loss of riparian habitat occurs in three locations: two segments in the village of Buchtel (RM 0.9-1.7 and RM 1.75-2.6) and in the village of Murray City (RM 5.3-6.45).

Action Plan

Goal:

- Improve the current QHEI scores along those segments with poor riparian habitat

Overall Objective	Possible Tasks	Resources	How	Time Frame	Performance Indicators
Improve the riparian vegetation	Work with 3 landowners to plant tree species compatible with existing riparian habitats Establish 1 linear mile of riparian habitat	In-kind services provided by landowners and volunteers from the community	- Get approval from landowners for tree planting - Work through the Soil & Water Conservation Districts to obtain trees	Year 1-3	- Number of landowners willing to create a riparian buffer - Linear miles of riparian habitat planted

Table 32 - Summary Timeframe for Proposed Activities

Task	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10
Reduce Acid Mine Drainage										
Rock Run										
Lost Run										
Monkey Hollow										
Bessemer Hollow										
Coe Hollow										
Brush Fork										
Long Hollow										
Orbiston										
Salem Hollow										
Sycamore Hollow										
Spencer Hollow										
Close Subsidences										
Rock Run										
New Straitsville										
Lost Run										
Sand Run										
Valley Junk Area										
Brush Fork										
Long Hollow										

Task	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10
Remove Litter and Trash										
Old Town Road										
State Route 78										
Reduce Nutrient Enrichment / Pathogens										
Livestock										
Maxville vicinity										
Carbon Hill vicinity										
Salem Hollow										
Establish Riparian Habitat										

VII. Implementation

Priorities

Water quality in the mainstem of Monday Creek and Snow Fork subwatershed has been adversely impacted by past mining activities that continue to discharge acid and metals into the creeks. The resultant low pH and sedimentation will not improve significantly without the removal or neutralization of AMD. This is the priority implementation parameter of the watershed. Likewise, subsidences result in the contamination of stream water that enters mine voids and discharges as acid water. Likewise, other concerns such as litter and illegal trash dumps and loss of riparian habitat are certainly important issues, but AMD is a priority in the restoration of Monday Creek. Although public perceptions, as indicated in survey results, rank pollution from sewage as the primary concern of watershed residents

AMD Project Implementation

In July 2005, the U.S. Army Corps of Engineers issued a final feasibility report and environmental assessment for an ecosystem restoration project in the Monday Creek Watershed. This report addresses alternative plans for the restoration of Monday Creek through the improvement of water quality. The recommended plan would result in construction of project features in each of the eight subwatersheds significantly affected by the AMD in Monday Creek. Features such as dissipating streams, stream blockages, and subsidences would be constructed to prevent surface water from flowing into underground mine workings and thus preventing the generation of AMD within the Monday Creek Watershed and in adjacent watersheds.

The AMD restoration sites would best contribute to the ecological restoration objective to restore Monday Creek ecosystem by keeping the surface water from entering the mines and producing AMD. These restoration sites would reduce the production of AMD and help dilute other sources of AMD. This would allow the existing pockets of diverse fish and macroinvertebrate populations to repopulate areas currently impacted by AMD and thus restore both the structural and functional components of the ecosystem to a less degraded state. The recommended plan is expected to result in significant benefits to the aquatic ecosystem from the headwaters to Monday Creek's confluence with the Hocking River.

The plan includes the following features:

Table 33 - Proposed Subwatershed Reclamation Plan

Subwatershed	Proposed Reclamation
Jobs Hollow	1 doser, 3 SLB* and 1 OLC*
Dixie Run	1 SLB, 2 OLC and 1 LLB*
Rock Run	3 LHD* and 1 wetland
Lost Run	30 sites + 16 spoil blocks and 12 subsidences features
Monkey Hollow	1 doser + 9 spoil blocks and 6 subsidences features
Snow Fork	6 SLB, 19 OLC, 20 LLB, 8 dissipating streams, 9 spoil blocks, 7 subsidences, and 2 wetlands
Coe Hollow	2 SLB, 1 OLC, 4 LLB, 3 dissipating streams and 1 subsidence feature

*SLB – slag leach bed; LLB – limestone leach bed;
OLC open limestone channel; LHD – low head dam

AMD Project Timeline and Budget

The proposed projects are currently scheduled for construction over a four-year period between 2007 and 2010. The projects will be conducted in phases, with construction commencing with Phase 1 in the northern portion (upper reaches; Jobs Hollow, Dixie Run and Rock Run) of the watershed, continuing with Phase 2 in the middle portion (Lost Run and Monkey Hollow) of the watershed, and then beginning Phase 3 on the lower reaches (Snow Fork and Coe Hollow) of the watershed. All three phases are scheduled to begin in 2007.

Construction startup will depend upon federal and state funding. Although the project may be included in the 2007 federal budget, it is more likely that it will be introduced in the 2008 budget. The federal portion of construction costs is 65 percent. The remaining 35 percent is the responsibility of the State of Ohio.

Other AMD Projects

Monday Creek Restoration Project has one Section 319 Non Point Source Implementation program project underway and has submitted an application for an additional project. The projects are described in Table 34.

Table 34 - Current and Proposed AMD Projects

Project Name / Number	Start Date	Completion D	Description
Monday Creek Restoration Project – Phase 5 (Lost Run) 04(h)EPA-09	7/1/2004	12/31/2007	Construction of 1 subsidence closure, opening 1 blocked spoil drainage, installing 8 limestone leach beds, 14 open limestone channels, 2 steel slag
Shawnee Steel Slag Leach Bed Project (Proposed)	5/1/2007 (Proposed)	112/31/09 (Proposed)	Construct a steel slag leach bed in the headwaters of Monday Creek

Source: MCRP 2006

Education and Information Strategy

Monday Creek Restoration Project has a history of providing education and outreach activities to residents of the watershed. Since its beginning in 1994, MCRP has conducted annual watershed tours and sponsored informational meetings (Friends of Monday Creek) four to six times during the year. MCRP has always had an Americorps/VISTA working with the group to organize tours and meetings, edit newsletters and educate students in local schools about issues affecting Monday Creek.

Monday Creek Restoration Project will continue to keep watershed residents informed of restoration projects through newspaper articles, radio and television reports and watershed newsletters. Public meetings will be held (as necessary) to inform residents living downstream of proposed projects, and other interested citizens, of project plans and resultant conditions.

Funding Strategy

Monday Creek Restoration Project is one of four watersheds identified as part of the Healthy Environments programs of Rural Action. Rural Action has held planning meetings with watershed partners in 2002 and 2003 to find funding sources and establish a funding strategy. Additional funding strategy meetings will be held following a determination by state agencies as to the level of funding planned for the watershed coordinator program beyond 2006. Also, Rural Action will be looking at watershed coordinator funding as it develops a rural renewal strategy over the next two years.

Resources

Resources needed to complete the goals identified for the major action items are summarized in Table 35.

Table 35 - Resources Needed to Meet Goals

Resources	Action Items
Acid Mine Drainage	
Ohio Department of Natural Resources, Div. Of Mineral Resources Management	AMD restoration project match funding; Project design; bid management; site inspection during construction
Ohio Environmental Protection Agency	AMD restoration project funding (Section 319 Non Point Source Implementation Grants)
US Environmental Protection Agency	AMD restoration project funding (Targeted Watershed Grants)
Office of Surface Mining	AMD restoration project funding (Appalachian Clean Stream Initiative / Watershed Cooperative Agreements
US Forest Service	Challenge Cost-Share Agreements
Pollution from Sewage	
Perry, Hocking and Athens County Health Depts.	Inspection of home septic systems; planning for updating systems
Perry, Hocking and Athens SWCDs	Planning and engineering for fences and alternative water sources, relationships with landowners
Landowner/farmer cooperation	Agreement to use alternative water sources and fencing
NRCS	Funding for fences, alternative water sources
Litter and Illegal Trash Dumps	
Athens, Hocking and Perry County Recycling and Litter Prevention Offices	Aid in illegal dump clean ups
Citizens' volunteer time	Aid in cleaning up smaller dump sites; roadside litter cleanup events; stream cleanups
Prevention Offices	Aid in organizing litter pick up events, information about dump removal
US Forest Service	Personnel for trash cleanups on Wayne National Forest
Buckeye Trail Association	Identification of off-road dump sites; volunteers for trash cleanups
Loss of Healthy Wildlife / Riparian Habitat	
Landowners	Plant buffers on their property
Natural Resource Conservation Service	Funding for buffer plantings
Ohio Department of Natural Resources, Div. of Forestry	Funding for trees for buffers
Citizens' volunteer time	Help plant buffers
Subsidences	
US Forest Service	Closure of subsidences on Wayne National Forest
Ohio Department of Natural Resources, Div. Of Mineral Resources Management	AMD restoration project match funding; Project design; bid management; site inspection during construction
Ohio Environmental Protection Agency	AMD restoration project funding (Section 319 Non Point Source Implementation Grants)
Office of Surface Mining	AMD restoration project funding (Appalachian Clean Stream Initiative / Watershed Cooperative Agreements

VIII. Evaluation

Measuring Progress

Monday Creek Restoration project will measure its progress by the improvement of water quality. MCRP will continue semi-annual water monitoring at established monitoring sites to chart its efforts.

Future Monitoring Plan

The long-term monitoring plan will consist of water chemical and biologic monitoring. Long-term monitoring will take place in the mainstem of Monday Creek and Snow Fork at established monitoring sites. EPA's TMDL monitoring sites correspond to these locations.

Parameters	
Specific conductance	Us/cm
pH and Temp	SU and C
Total Dissolved Solids	mg/L
Acidity (total hot)	mg/L
Alkalinity (total)	mg/L
Sulfate (total)	mg/L
Aluminum (total and dissolved)	mg/L
Manganese (total and dissolved)	mg/L
Iron (total and dissolved)	mg/L

Frequency of collection

For the long-term monitoring, the chemistry and hydrologic data will be collected two times a year at low flow and high flow prior to initiation of restoration work, during construction, and for at least five years after restoration work is complete. The timeline for completion of reclamation work is an unknown and is dependent on funding.

Tributary monitoring for pre- and post-construction

Tributary level monitoring for construction projects will begin one year prior to reclamation construction and for one year after completion. The water chemistry sampling will be conducted based funding availability.

Biological Monitoring

The Macroinvertebrate Aggregate Index for Streams (MAIS) method will also be used for a rapid assessment of macroinvertebrates. Baseline data has been collected using this methodology so that trends can be documented. Biological sampling locations will be conducted at LTM sampling locations. The biological sampling will be conducted based on documented water chemistry improvements and as funding allows.

Evaluation Process

The watershed plan will be revisited every two years in conjunction with our two-year work plan. At that point, MCRP will access progress in addressing priority issues and determine if goals are being met. The re-evaluation would give insight into changes that need to be made to reach the goal. At this point, MCRP could raise or lower its goals.

The following table will be used to evaluate the success of Monday Creek Restoration Project in implementing this Management Plan. The ultimate evaluation indicator will be if non-attaining or partial attaining streams will move into full attainment. However, other efforts such as addressing sewage, illegal trash dumps, riparian habitat and subsidences will also be evaluated to determine the overall effectiveness and success of the watershed project.

Table 36 - Project Evaluation

Issue to Address	Evaluation Activity	Who	When
AMD	Pre and post monitoring at each project	Watershed Staff ODNR/MRM Lab	Six months before and a year following each project
AMD	Long-term monitoring at 11 sites on the main stem of Monday Creek and Snow Fork	Watershed Staff ODNR/MRM Lab	Semi-annually for the duration of the project
Sewage	Identification of septic systems	County Health Departments, Ohio EPA	2006 -2007
Sewage	Funding and upgrading of septic systems	County Health Departments, Ohio EPA	Unknown
Livestock	Identify livestock in streams	NRCS	2007-2008
Illegal dump clean up	Sites cleaned up	Watershed Staff, County Litter Prevention Offices, US Forest Service, Buckeye Trail Association	Annual report
Riparian Habitat	Restore and maintain riparian habitat	Watershed Staff, NCRS, SWCD	Annual Report
Subsidences	Close subsidences	Watershed Staff, US Forest Service, OSM	2006-2009

Project Activities

Monday Creek Restoration Project has conducted numerous projects. Using lessons learned from successful projects will aid in future restoration efforts. Table 35 identifies AMD and subsidence projects and the level of success obtained in reducing the impacts of AMD.

Plan Distribution

The plan will be distributed to all stakeholders listed in Table 2. The Monday Creek website will also have a downloadable version of the plan available to any interested party.

Plan Update and Revision

The Monday Creek Watershed Management Plan is intended to be updated and revised as new data is collected and projects are implemented. The plan will be reevaluated every two years and all necessary revisions will be made by the watershed coordinator.

The management plan should be reassessed at the end of the sixth year to reflect changes in land use and socio-economics within the watershed, as well as policy changes and other factors on a regional and statewide level. The revised plan will reevaluate and prioritize issues impacting the watershed.

Table 37 - Projects Completed in the Monday Creek Watershed

Sub-basin	Site	Reclamation Project	Agencies / Funding
Jobs Hollow	Jobs 13 Tributary	Installed Boxholm style doser unit. Regraded and vegetated a 2 acre	MCRP, ODNR, OSM, USFS
Jobs Hollow	Grimmett Tributary	Installed OLC's, J-trenches with LKD, moved gob pile out of stream channel, re-	MCRP, 319-EPA, ODNR
Rock Run	Gob Pile & Seep	Regraded, capped and vegetated a 17 acre gob pile, constructed a Successive Alkalinity Production System	MCRP, 319-EPA, ODNR, USFS
Rock Run	RR-24 Seep	OLC- open limestone channel (2001)	MCRP, ODNR, OSM, USFS
Big Four Hollow	Seeps & Tributary	LLB's (limestone leach bed), OLC's, rock	MCRP, ODNR, USFS
Snake Hollow	Seeps & Tributary	LLB's (limestone leach bed), SLB's (slag beds), OLC's, rock dams, subsidence filling and creation of	ODNR, USFS
Happy Hollow	Seep & Pond	Diverted AMD discharge away from	ODNR, USFS
Monday Creek	Majestic Mine (Subsidence)	Subsidence closure & OLC (1999)	ODNR
Sycamore	Subsidence	Subsidence closure x	USFS
Salem Hollow	Subsidence	Subsidence closure & OLC (2000)	ODNR
Murray City	Subsidence	Subsidence closure x	ODNR
Goose Run	Subsidence	Subsidence closure (captured 506 acres)	ODNR
Orbiston	Subsidence	Subsidence closure & OLC (2003)	USFS
Long Hollow	Subsidence	Subsidence closure x	USFS
Snow Fork	Subsidence	Subsidence closure (captured 140 acres)	ODNR

References

Black, R., 2005. Monday Creek Acid Mine Drainage Abatement and Treatment Plan

Borch, M.A., Rice, C., Stoertz, M., 1997. Monday Creek Acid Mine Drainage Abatement and Treatment Plan

Boucher, C., 2005. / Ohio EPA, 2001. Total Maximum Daily Load Study of the Monday Creek Watershed -Summary

Brocksen, R.W., M.D. Marcus and H. Olem, 1992. Practical Guide to managing acid surface waters and their fisheries. Lewis Publishers

Flint, N.K., 1951. Geology of Perry County. Geological Survey of Ohio

Cappuzzi, K., 2005. Personal communication, map contribution, technical support documents.

Crowell, D.L., 1995. History of the Coal-Mining Industry in Ohio. Bulletin 72, Ohio Division of Geological Survey, 204 pages

Earle J. and Callaghan T., 1998. Impacts of Mine Drainage on Aquatic Life, Water Uses and Man-Made Structures, Chapter 4. Pennsylvania Department of Environmental Protection

Farley, M., 2001-2005. Personal communication. Bessemer Hollow costs.

Hartke, E. 1974. Sources of Acid Mine Drainage in the Monday Creek Drainage Basin of Southeast Ohio, Ohio University masters thesis.

ILGARD at Ohio University, 2005. Acid Mine Drainage Abatement and Treatment Plan for the Moxahala Creek Watershed

Katz, M 1969. The biological and ecological effects of AMD with particular emphasis to the waters of the Appalachian region. Appalachian Regional Commission, Washington, D.C. 65 pages

McCament, B., 2003. Acid Mine Drainage Abatement and Treatment Plan for the Sunday Creek Watershed

National Park Service, 1992. Economic Impacts of Protecting Rivers, Trails and Greenway Corridors. Prepared by: Rivers, Trails and Conservation Assistance

Ohio Department of Natural Resources, Division of Mines and Reclamation, 1997 - 2004.

Ohio EPA*, A Guide to Developing Local Watershed Action Plans in Ohio*, Division of Surface Water

Ohio EPA, 1991. Biological and Water Quality Study of the Hocking River Mainstem and Selected Tributaries, Report Number EAS/1991-10-6

Ohio EPA, *Ohio Water Quality Standards*, Chapter 3745-1 of the Administrative Code, Division of Surface Water, Adopted July 21, 1999, Effective July 31, 1999

Ohio EPA, 2001. Total Maximum Daily Load Study of the Monday Creek Watershed

Ohio EPA, 2002. Biological and Water Quality Study of Monday Creek and Selected Tributaries. Draft TSD.

Ohio EPA www.epa.state.oh.us

Pfaff, C.L., Helsel, D.R., Johnson, D.P. and Angelo, C.G., 1981. Assessment of water quality in streams draining coal-producing areas in Ohio: U.S. Geological Survey Water-Resources Investigations OFR81-409, 98 pages

Rose, A.W. and Cravotta C.A., 1998. Geochemistry of Coal Mine Drainage, Chapter 1. Pennsylvania Department of Environmental Protection

Sedam and Francy, 1993. Geologic setting and water quality of selected basins in the active coal-mining areas of Ohio. 1989-91, with a summary of water quality for 1985-91. USGS WRI Report 93-4094, 133 pages

Shimala, J., 1999. Monday Creek Acid Mine Drainage Abatement and Treatment Plan II

Skousen, J.G. and Ziemkiewicz, P.F., 1995. Acid Mine Drainage Control and Treatment, Published by West Virginia University and National Mine Land Reclamation Center

Stumm,W., and Morgan, J.J.,1996. Aquatic Chemistry: An Introduction Emphasizing Chemical Equilibria in Natural Waters. 3rd Edition. John Wiley and Sons. New York.

Stiles, J.M. and Ziemkiewicz, P.F., 2003. Cost Effective Ecosystem Restoration of the Monday Creek Ohio Watershed. West Virginia Water Resource Institute, West Virginia University, Morgantown, West Virginia

Stoertz, M. and Burling, H., 1996. Water Quality and Biological Restoration Goal for an Ohio Watershed Damaged by Coal Mining. Watershed Restoration

Management: Physical, Chemical and Biological Considerations. American Water Resources Association.

Sturgeon, M.T., 1958. The Geology and Mineral Resources of Athens County, Ohio, Ohio Division of Geological Survey Bulletin 57

United States Army Corps of Engineers, 2005. Hocking River Basin, Ohio, Monday Creek Subbasin Ecosystem Restoration Project - Draft Feasibility Report and Environmental Assessment. U.S. Army Corps of Engineers Huntington District, Huntington, West Virginia

U.S. Army Corps of Engineers, "Ecosystem Restoration in the Civil Works Program," Circular No. 1105-2-210, June 1, 1995.

United States Department of Agriculture, 1985. Assessment and Treatment of Areas in Ohio Impacted by Abandoned Mines, Columbus, Ohio

United States Department of Agriculture, *Soil Survey of Athens County, Ohio*, Soil Conservation Service, April 1985

United States Department of Agriculture, *Soil Survey of Hocking County, Ohio*, Soil Conservation Service, Sept 1989

United States Department of Agriculture, *Soil Survey of Perry County, Ohio*, Soil Conservation Service, July 1988

United States Department of Agriculture (USDA) www.usda.gov

United States Department of the Interior and the U.S. Fish and Wildlife Service, 1991. Net Economic Values for Bass and Trout Fishing, Deer Hunting and Wildlife Watching, Report 91-1, October, 1994

Wise, M., 2005. Huff Run Watershed Plan, 2nd Edition

Ziemkiewicz, P.F. and J.G. Skousen. "Overview of Acid Mine Drainage At-Source Control Strategies." Greenlands, Vol. 26, No. 1, 1996.

Plan Endorsement

We, the supporters of the Monday Creek Watershed conservation efforts do hereby approve and agree to pursue implementation of this Watershed Action Plan prepared and written by the Monday Creek Restoration Project.

The Monday Creek Restoration Project has strived to develop a watershed action plan that is reflective of the public input gathered. The development strategies were designed to create a plan adaptable, flexible and usable by the community in the process of continuing the success of the Monday Creek Restoration Project.

Appendix A – Long Term Monitoring Data 2000 to 2005

River Mile	Sample Site	Map ID 2005	Site Type	Sample Date	Discharge ft³/sec.	Acidity lab mg/l	Alkalinity lab mg/l	pH lab	Conductivity µS/cm lab	Total FE mg/l	Total Mn mg/l	Total AL mg/l	Sulfate mg/l	TDS mg/l	LAT	LONG
26.5	MC-148-LTM	JH00500	Monday Creek Main stem	Feb-00	7.9	33.2	0.0	3.8	479	2.3	1.5	2.3	176	274	39.63836	-82.22459
26.5	MC-148-LTM	JH00500	Monday Creek Main stem	Apr-00	3.5	44.7	0.0	3.6	707	2.9	2.7	6.9	269	409	39.63836	-82.22459
26.5	MC-148-LTM	JH00500	Monday Creek Main stem	Jul-00	3.9	43.3	0.8	4.7	747	1.7	2.5	6.1	334	550	39.63836	-82.22459
26.5	MC-148-LTM	JH00500	Monday Creek Main stem	Oct-00	1.0	87.3	0.0	3.2	1150	3.4	4.3	11.1	532	728	39.63836	-82.22459
26.5	MC-148-LTM	JH00500	Monday Creek Main stem	Feb-01	1.8	51.7	0.0	3.3	838	2.8	2.6	13.1	299	512	39.63836	-82.22459
26.5	MC-148-LTM	JH00500	Monday Creek Main stem	Apr-01	2.1	57.6	0.0	3.5	730	3.5	2.3	3.8	309	532	39.63836	-82.22459
26.5	MC-148-LTM	JH00500	Monday Creek Main stem	Aug-01	0.7	53.9	0.0	NM	869	1.1	3.2	3.2	336	585	39.63836	-82.22459
26.5	MC-148-LTM	JH00500	Monday Creek Main stem	Oct-01	0.8	132.0	0.0	2.7	1490	3.6	4.7	8.9	614	911	39.63836	-82.22459
26.5	MC-148-LTM	JH00500	Monday Creek Main stem	Dec-01	1.1	63.2	0.0	3.3	864	3.6	3.8	5.2	413	678	39.63836	-82.22459
26.5	MC-148-LTM	JH00500	Monday Creek Main stem	Jun-02	1.4	84.1	0.0	2.9	968	2.8	3.1	6.1	402	638	39.63836	-82.22459
26.5	MC-148-LTM	JH00500	Monday Creek Main stem	Oct-02	0.3	101.0	0.0	3.4	1240	4.3	4.6	8.9	562	831	39.63836	-82.22459
26.5	MC-148-LTM	JH00500	Monday Creek Main stem	Dec-02	0.8	102.0	0.0	3.4	1330	6.0	4.7	8.8	564	835	39.63836	-82.22459
26.5	MC-148-LTM	JH00500	Monday Creek Main stem	Mar-03	3.9	44.3	0.0	3.7	639	3.1	2.1	3.4	231	382	39.63836	-82.22459
26.5	MC-148-LTM	JH00500	Monday Creek Main stem	Jun-03	1.7	55.0	0.0	3.6	848	0.2	2.9	4.2	333	530	39.63836	-82.22459
26.5	MC-148-LTM	JH00500	Monday Creek Main stem	Sep-03	3.1	42.1	0.0	4.3	633	3.9	3.2	2.5	226	359	39.63836	-82.22459
26.5	MC-148-LTM	JH00500	Monday Creek Main stem	Mar-04	3.6	50.2	0.0	3.8	764	2.2	2.0	3.6	334	478	39.63836	-82.22459
26.5	MC-148-LTM	JH00500	Monday Creek Main stem	Nov-04	1.8	55.5	0.0	3.3	949	4.8	2.9	5.6	396	623	39.63836	-82.22459
26.5	MC-148-Ca Ox	JH00500	Monday Creek Main stem	May-05	3.7	0.0	188.0	10.9	919	0.6	0.1	0.4	290	568	39.63836	-82.22459
26.5	MC-148-Ca Ox	JH00500	Monday Creek Main stem	Sep-05	0.7	0.0	66.4	8.1	1150	NM	NM	NM	594	904	39.63836	-82.22459
26.5	MC-148-Ca Ox	JH00500	Monday Creek Main stem	Apr-06	3.6	5.6	18.9	7.2	621	NM	NM	NM	261	403	39.63836	-82.22459
23.1	MC-127-LTM	MC00800	Monday Creek Main stem	Feb-00	2.6	37.8	2.8	4.8	1070	2.1	2.6	5.9	396	732	39.60776	-82.24409
23.1	MC-127-LTM	MC00800	Monday Creek Main stem	Apr-00	22.3	14.3	2.9	5.6	639	1.1	2.1	2.9	248	417	39.60776	-82.24409
23.1	MC-127-LTM	MC00800	Monday Creek Main stem	Jul-00	24.2	16.2	6.3	5.7	669	1.0	1.7	2.7	273	493	39.60776	-82.24409
23.1	MC-127-LTM	MC00800	Monday Creek Main stem	Oct-00	4.5	15.8	8.6	5.9	836	1.6	2.6	1.0	354	618	39.60776	-82.24409
23.1	MC-127-LTM	MC00800	Monday Creek Main stem	Feb-01	9.7	19.7	7.9	5.4	714	1.8	1.8	2.7	246	459	39.60776	-82.24409
23.1	MC-127-LTM	MC00800	Monday Creek Main stem	Apr-01	8.9	19.0	5.9	5.8	645	1.7	1.7	1.7	284	506	39.60776	-82.24409
23.1	MC-127-LTM	MC00800	Monday Creek Main stem	Aug-01	2.0	15.7	6.2	NM	1050	2.1	2.0	1.1	407	744	39.60776	-82.24409
23.1	MC-127-LTM	MC00800	Monday Creek Main stem	Oct-01	0.8	44.5	0.0	4.1	1240	1.8	2.6	0.7	459	848	39.60776	-82.24409
23.1	MC-127-LTM	MC00800	Monday Creek Main stem	Oct-01	0.8	44.5	0.0	4.1	1240	1.8	2.6	0.7	459	848	39.60776	-82.24409

River Mile	Sample Site	Map ID 2005	Site Type	Sample Date	Discharge ft³/sec.	Acidity lab mg/l	Alkalinity lab mg/l	pH lab	Conductivity µS/cm lab	Total FE mg/l	Total Mn mg/l	Total AL mg/l	Sulfate mg/l	TDS mg/l	LAT	LONG
23.1	MC-127-LTM	MC00800	Monday Creek Main stem	Dec-01	4.7	9.9	9.9	6.0	585	2.4	2.4	1.8	310	595	39.60776	-82.24409
23.1	MC-127-LTM	MC00800	Monday Creek Main stem	Dec-01	4.7	9.9	9.9	6.0	585	2.4	2.4	1.8	310	595	39.60776	-82.24409
23.1	MC-127-LTM	MC00800	Monday Creek Main stem	Jun-02	6.9	15.8	14.1	5.6	749	1.1	1.8	1.6	328	580	39.60776	-82.24409
23.1	MC-127-LTM	MC00800	Monday Creek Main stem	Oct-02	1.9	11.5	19.1	6.4	1090	1.7	2.6	1.6	442	782	39.60776	-82.24409
23.1	MC-127-LTM	MC00800	Monday Creek Main stem	Dec-02	2.3	20.3	15.9	6.1	1090	2.6	3.0	3.1	434	748	39.60776	-82.24409
23.1	MC-127-LTM	MC00800	Monday Creek Main stem	Mar-03	22.8	9.0	6.2	5.9	598	1.2	1.3	0.3	215	435	39.60776	-82.24409
23.1	MC-127-LTM	MC00800	Monday Creek Main stem	Jun-03	7.7	7.7	17.6	6.4	766	1.3	1.5	1.1	280	523	39.60776	-82.24409
23.1	MC-127-LTM	MC00800	Monday Creek Main stem	Sep-03	19.1	10.1	22.0	6.5	623	1.2	1.2	0.8	201	399	39.60776	-82.24409
23.1	MC-127-LTM	MC00800	Monday Creek Main stem	Mar-04	11.4	14.7	5.0	5.7	729	1.0	1.4	1.9	311	510	39.60776	-82.24409
23.1	MC-127-LTM	MC00800	Monday Creek Main stem	Nov-04	7.1	9.3	12.2	5.7	788	2.4	1.9	1.9	310	540	39.60776	-82.24409
23.1	MC-127-LTM	MC00800	Monday Creek Main stem	May-05	16.1	8.7	29.2	6.7	701	3.3	1.5	2.6	291	504	39.60776	-82.24409
23.1	MC-127-LTM	MC00800	Monday Creek Main stem	Sep-05	1.4	11.4	24.1	6.2	1160	1.6	1.0	1.3	468	836	39.60776	-82.24409
23.1	MC-127-LTM	MC00800	Monday Creek Main stem	Apr-06	15.3	8.0	20.1	6.9	657	1.7	1.0	1.3	249	419	39.60776	-82.24409
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	Feb-00	82.8	26.6	8.4	5.6	457	1.4	1.1	0.6	151	283	39.57953	-82.27588
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	Apr-00	33.5	13.6	2.8	5.7	606	0.8	2.2	4.5	238	400	39.57953	-82.27588
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	Jul-00	32.9	11.1	11.6	6.2	734	1.3	1.3	2.5	286	537	39.57953	-82.27588
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	Oct-00	10.3	10.3	24.9	6.6	760	0.7	1.8	0.3	272	534	39.57953	-82.27588
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	Feb-01	21.3	9.8	14.6	6.1	618	1.1	1.5	0.9	207	384	39.57953	-82.27588
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	Apr-01	21.7	10.9	8.5	6.1	557	1.1	1.5	1.0	222	422	39.57953	-82.27588
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	Aug-01	2.4	14.5	9.7	NM	921	3.8	1.7	0.2	342	650	39.57953	-82.27588
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	Oct-01	1.4	13.4	10.0	6.2	1020	0.5	1.3	<1.	388	711	39.57953	-82.27588
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	Dec-01	12.2	4.6	21.9	6.5	636	0.8	1.5	0.2	239	463	39.57953	-82.27588
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	Jun-02	10.9	2.7	14.5	6.4	678	0.4	1.6	0.3	286	508	39.57953	-82.27588
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	Oct-02	3.2	8.7	17.6	6.7	962	0.3	1.5	<.250	402	708	39.57953	-82.27588
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	Dec-02	4.1	8.2	19.0	6.5	986	1.2	2.0	0.4	352	630	39.57953	-82.27588
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	Mar-03	48.4	6.0	7.4	6.2	521	1.2	1.2	1.4	195	364	39.57953	-82.27588
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	Jun-03	23.1	4.7	21.8	6.8	628	0.4	1.2	0.3	198	423	39.57953	-82.27588
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	Sep-03	41.4	11.0	24.6	6.8	558	0.6	1.1	0.5	171	360	39.57953	-82.27588
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	Mar-04	21.2	13.3	6.4	6.0	652	0.6	1.5	1.4	273	459	39.57953	-82.27588
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	Nov-04	16.9	4.2	20.1	6.0	649	0.9	1.5	0.6	252	432	39.57953	-82.27588

Source: Monday Creek Restoration Project

River Mile	Sample Site	Map ID 2005	Site Type	Sample Date	Discharge ft³/sec.	Acidity lab mg/l	Alkalinity lab mg/l	pH lab	Conductivity µS/cm lab	Total FE mg/l	Total Mn mg/l	Total AL mg/l	Sulfate mg/l	TDS mg/l	LAT	LONG
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	May-05	26.0	7.3	20.3	6.5	638	1.8	1.6	2.1	277	468	39.57953	-82.27588
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	Sep-05	2.3	7.0	22.3	7.1	1060	0.3	0.9	0.1	412	736	39.57953	-82.27588
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	Apr-06	31.7	6.6	19.8	6.9	565	0.7	0.9	0.7	209	339	39.57953	-82.27588
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Feb-00	7.3	37.5	2.6	4.7	893	1.2	2.4	5.0	328	610	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Apr-00	43.0	25.6	0.0	4.9	600	1.2	2.4	5.4	237	388	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Jul-00	18.3	13.3	13.5	6.2	660	0.5	1.1	2.5	243	462	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Oct-00	13.3	8.9	17.1	6.1	778	0.4	1.3	1.2	289	540	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Feb-01	21.0	11.2	10.0	5.6	594	1.0	1.7	1.3	202	372	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Apr-01	19.3	14.6	4.0	5.6	528	0.7	1.6	1.3	196	406	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Aug-01	3.2	17.7	5.9	NM	822	4.6	1.6	0.4	310	572	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Oct-01	2.7	13.8	9.4	6.0	876	1.0	1.2	0.4	340	620	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Dec-01	9.5	9.4	12.7	6.1	716	0.6	1.9	0.7	258	472	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Jun-02	13.6	25.0	3.0	5.1	586	0.8	1.7	1.9	310	487	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Oct-02	2.7	11.0	8.7	6.0	918	0.9	1.4	1.4	397	670	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Dec-02	5.6	12.6	7.8	5.8	848	0.8	2.1	1.6	363	606	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Mar-03	52.4	9.3	4.1	5.7	506	1.2	1.3	1.7	185	338	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Jun-03	22.0	6.5	6.2	5.8	621	0.8	1.6	1.7	195	434	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Sep-03	51.6	10.2	16.6	6.5	511	0.9	1.2	1.5	167	331	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Mar-04	29.1	14.6	3.0	5.3	616	0.9	1.4	1.9	265	432	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Nov-04	20.0	4.4	16.3	6.0	620	0.5	1.5	0.6	242	411	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	May-05	39.1	11.3	5.5	5.8	603	1.2	1.6	2.5	258	427	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Sep-05	1.8	7.1	17.8	7.1	923	0.6	1.2	0.5	366	656	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Apr-06	57.5	7.0	15.7	6.8	527	0.6	1.0	1.0	190	350	39.54929	-82.2594
10.5	MC-153-LTM	MC00300	Monday Creek Main stem	Feb-00	9.8	0.0	35.2	5.7	867	1.0	1.7	4.0	274	564	39.50053	-82.24665
10.5	MC-153-LTM	MC00300	Monday Creek Main stem	Apr-00	98.6	0.0	17.0	6.4	501	0.6	1.7	4.7	165	315	39.50053	-82.24665
10.5	MC-153-LTM	MC00300	Monday Creek Main stem	Jul-00	31.9	8.0	35.0	6.7	748	0.3	0.7	2.1	244	526	39.50053	-82.24665
10.5	MC-153-LTM	MC00300	Monday Creek Main stem	Oct-00	16.6	10.6	58.8	6.6	820	0.2	0.4	0.5	220	526	39.50053	-82.24665
10.5	MC-153-LTM	MC00300	Monday Creek Main stem	Feb-01	45.9	6.2	29.6	6.7	548	0.8	1.1	0.6	157	312	39.50053	-82.24665
10.5	MC-153-LTM	MC00300	Monday Creek Main stem	Apr-01	32.5	5.8	28.4	6.9	470	0.7	1.0	0.1	169	358	39.50053	-82.24665
10.5	MC-153-LTM	MC00300	Monday Creek Main stem	Aug-01	4.9	17.3	36.8	NM	717	5.9	0.8	0.0	237	478	39.50053	-82.24665

Source: Monday Creek Restoration Project

River Mile	Sample Site	Map ID 2005	Site Type	Sample Date	Discharge ft³/sec.	Acidity lab mg/l	Alkalinity lab mg/l	pH lab	Conductivity µS/cm lab	Total FE mg/l	Total Mn mg/l	Total AL mg/l	Sulfate mg/l	TDS mg/l	LAT	LONG
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	May-05	26.0	7.3	20.3	6.5	638	1.8	1.6	2.1	277	468	39.57953	-82.27588
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	Sep-05	2.3	7.0	22.3	7.1	1060	0.3	0.9	0.1	412	736	39.57953	-82.27588
19.8	MC-103-LTM	MC00580	Monday Creek Main stem	Apr-06	31.7	6.6	19.8	6.9	565	0.7	0.9	0.7	209	339	39.57953	-82.27588
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Feb-00	7.3	37.5	2.6	4.7	893	1.2	2.4	5.0	328	610	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Apr-00	43.0	25.6	0.0	4.9	600	1.2	2.4	5.4	237	388	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Jul-00	18.3	13.3	13.5	6.2	660	0.5	1.1	2.5	243	462	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Oct-00	13.3	8.9	17.1	6.1	778	0.4	1.3	1.2	289	540	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Feb-01	21.0	11.2	10.0	5.6	594	1.0	1.7	1.3	202	372	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Apr-01	19.3	14.6	4.0	5.6	528	0.7	1.6	1.3	196	406	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Aug-01	3.2	17.7	5.9	NM	822	4.6	1.6	0.4	310	572	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Oct-01	2.7	13.8	9.4	6.0	876	1.0	1.2	0.4	340	620	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Dec-01	9.5	9.4	12.7	6.1	716	0.6	1.9	0.7	258	472	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Jun-02	13.6	25.0	3.0	5.1	586	0.8	1.7	1.9	310	487	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Oct-02	2.7	11.0	8.7	6.0	918	0.9	1.4	1.4	397	670	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Dec-02	5.6	12.6	7.8	5.8	848	0.8	2.1	1.6	363	606	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Mar-03	52.4	9.3	4.1	5.7	506	1.2	1.3	1.7	185	338	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Jun-03	22.0	6.5	6.2	5.8	621	0.8	1.6	1.7	195	434	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Sep-03	51.6	10.2	16.6	6.5	511	0.9	1.2	1.5	167	331	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Mar-04	29.1	14.6	3.0	5.3	616	0.9	1.4	1.9	265	432	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Nov-04	20.0	4.4	16.3	6.0	620	0.5	1.5	0.6	242	411	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	May-05	39.1	11.3	5.5	5.8	603	1.2	1.6	2.5	258	427	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Sep-05	1.8	7.1	17.8	7.1	923	0.6	1.2	0.5	366	656	39.54929	-82.2594
15.8	MC-131-LTM	MC00500	Monday Creek Main stem	Apr-06	57.5	7.0	15.7	6.8	527	0.6	1.0	1.0	190	350	39.54929	-82.2594
10.5	MC-153-LTM	MC00300	Monday Creek Main stem	Feb-00	9.8	0.0	35.2	5.7	867	1.0	1.7	4.0	274	564	39.50053	-82.24665
10.5	MC-153-LTM	MC00300	Monday Creek Main stem	Apr-00	98.6	0.0	17.0	6.4	501	0.6	1.7	4.7	165	315	39.50053	-82.24665
10.5	MC-153-LTM	MC00300	Monday Creek Main stem	Jul-00	31.9	8.0	35.0	6.7	748	0.3	0.7	2.1	244	526	39.50053	-82.24665
10.5	MC-153-LTM	MC00300	Monday Creek Main stem	Oct-00	16.6	10.6	58.8	6.6	820	0.2	0.4	0.5	220	526	39.50053	-82.24665
10.5	MC-153-LTM	MC00300	Monday Creek Main stem	Feb-01	45.9	6.2	29.6	6.7	548	0.8	1.1	0.6	157	312	39.50053	-82.24665
10.5	MC-153-LTM	MC00300	Monday Creek Main stem	Apr-01	32.5	5.8	28.4	6.9	470	0.7	1.0	0.1	169	358	39.50053	-82.24665
10.5	MC-153-LTM	MC00300	Monday Creek Main stem	Aug-01	4.9	17.3	36.8	NM	717	5.9	0.8	0.0	237	478	39.50053	-82.24665

River Mile	Sample Site	Map ID 2005	Site Type	Sample Date	Discharge ft³/sec.	Acidity lab mg/l	Alkalinity lab mg/l	pH lab	Conductivity µS/cm lab	Total FE mg/l	Total Mn mg/l	Total AL mg/l	Sulfate mg/l	TDS mg/l	LAT	LONG
4.3	MC-151-LTM	MC00180	Monday Creek Main stem	Dec-02	12.2	7.7	28.7	6.7	873	0.7	1.4	0.4	309	545	39.46372	-82.20353
4.3	MC-151-LTM	MC00180	Monday Creek Main stem	Mar-03	92.2	6.4	11.0	6.4	467	0.8	1.0	1.3	172	311	39.46372	-82.20353
4.3	MC-151-LTM	MC00180	Monday Creek Main stem	Jun-03	52.5	6.3	21.9	6.8	508	0.6	1.1	0.8	168	360	39.46372	-82.20353
4.3	MC-151-LTM	MC00180	Monday Creek Main stem	Sep-03	83.8	9.9	31.6	6.9	470	0.5	0.8	0.7	128	282	39.46372	-82.20353
4.3	MC-151-LTM	MC00180	Monday Creek Main stem	Mar-04	53.3	7.3	15.6	6.4	553	0.7	1.0	1.2	216	366	39.46372	-82.20353
4.3	MC-151-LTM	MC00180	Monday Creek Main stem	Nov-04	56.3	3.9	33.7	6.2	552	0.4	0.9	0.3	185	336	39.46372	-82.20353
4.3	MC-151-LTM	MC00180	Monday Creek Main stem	May-05	52.2	7.0	17.6	6.4	530	0.7	1.1	1.5	221	362	39.46372	-82.20353
4.3	MC-151-LTM	MC00180	Monday Creek Main stem	Sep-05	3.7	5.3	30.6	6.8	763	0.4	0.7	0.2	310	513	39.46372	-82.20353
4.3	MC-151-LTM	MC00180	Monday Creek Main stem	Apr-06	154.0	4.9	24.1	6.7	409	0.7	0.7	0.9	125	252	39.46372	-82.20353
1.7	MC-108-LTM	MC00060	Monday Creek Main stem	Oct-97	12.0	65.0	0.0	3.7	942	0.7	2.1	6.3	412	788	39.43524	-82.19161
1.7	MC-108-LTM	MC00060	Monday Creek Main stem	Feb-00	18.0	39.8	3.0	4.7	854	2.5	2.1	8.3	314	578	39.43524	-82.19161
1.7	MC-108-LTM	MC00060	Monday Creek Main stem	Apr-00	116.0	15.3	1.3	5.1	560	0.4	2.1	3.9	222	362	39.43524	-82.19161
1.7	MC-108-LTM	MC00060	Monday Creek Main stem	Jul-00	39.0	8.0	8.1	6.2	695	0.5	0.8	1.2	282	504	39.43524	-82.19161
1.7	MC-108-LTM	MC00060	Monday Creek Main stem	Oct-00	35.0	11.7	21.5	6.3	721	0.2	1.2	0.9	258	493	39.43524	-82.19161
1.7	MC-108-LTM	MC00060	Monday Creek Main stem	Feb-01	71.7	8.2	18.9	6.3	405	1.5	1.2	1.5	171	327	39.43524	-82.19161
1.7	MC-108-LTM	MC00060	Monday Creek Main stem	Apr-01	59.8	24.7	3.0	5.4	529	1.4	1.3	2.8	230	410	39.43524	-82.19161
1.7	MC-108-LTM	MC00060	Monday Creek Main stem	Aug-01	12.9	25.0	0.0	NM	759	0.6	1.9	3.4	311	536	39.43524	-82.19161
1.7	MC-108-LTM	MC00060	Monday Creek Main stem	Oct-01	7.9	62.0	0.0	4.5	915	0.8	2.3	5.9	407	647	39.43524	-82.19161
1.7	MC-108-LTM	MC00060	Monday Creek Main stem	Dec-01	32.9	5.9	28.7	6.7	686	0.5	1.4	1.0	213	462	39.43524	-82.19161
1.7	MC-108-LTM	MC00060	Monday Creek Main stem	Jun-02	34.1	49.6	0.9	4.6	716	0.8	1.8	3.9	309	499	39.43524	-82.19161
1.7	MC-108-LTM	MC00060	Monday Creek Main stem	Oct-02	11.5	33.8	2.2	4.9	938	0.8	1.9	3.1	396	633	39.43524	-82.19161
1.7	MC-108-LTM	MC00060	Monday Creek Main stem	Dec-02	22.4	11.6	12.3	6.1	799	1.5	1.7	2.4	325	563	39.43524	-82.19161
1.7	MC-108-LTM	MC00060	Monday Creek Main stem	Mar-03	155.0	13.3	2.3	5.3	456	1.7	1.1	2.7	212	339	39.43524	-82.19161
1.7	MC-108-LTM	MC00060	Monday Creek Main stem	Jun-03	79.2	7.6	6.6	6.0	576	1.2	1.4	2.2	215	392	39.43524	-82.19161
1.7	MC-108-LTM	MC00060	Monday Creek Main stem	Sep-03	112.0	9.1	24.9	6.7	473	1.1	0.9	1.2	137	304	39.43524	-82.19161
1.7	MC-108-LTM	MC00060	Monday Creek Main stem	Mar-04	103.0	15.8	4.5	5.5	578	0.4	1.3	0.3	240	403	39.43524	-82.19161
1.7	MC-108-LTM	MC00060	Monday Creek Main stem	Nov-04	50.0	4.6	20.5	6.2	581	1.0	1.2	1.6	223	372	39.43524	-82.19161
1.7	MC-108-LTM	MC00060	Monday Creek Main stem	May-05	99.0	15.9	2.6	5.3	567	1.1	1.3	3.0	240	387	39.43524	-82.19161
1.7	MC-108-LTM	MC00060	Monday Creek Main stem	Sep-05	8.5	46.3	1.3	4.6	858	0.5	1.8	3.5	401	623	39.43524	-82.19161
1.7	MC-108-LTM	MC00060	Monday Creek Main stem	Apr-06	208.6	6.6	17.1	7.0	448	1.0	0.8	1.1	150	269	39.43524	-82.19161

Source: Monday Creek Restoration Project

River Mile	Sample Site	Map ID 2005	Site Type	Sample Date	Discharge ft³/sec.	Acidity lab mg/l	Alkalinity lab mg/l	pH lab	Conductivity µS/cm lab	Total FE mg/l	Total Mn mg/l	Total AL mg/l	Sulfate mg/l	TDS mg/l	LAT	LONG
6.2	SF-106-LTM	SF00940	Snow Fork Main stem	Feb-00	2.8	61.8	0.0	4.4	838	8.0	2.3	10.0	364	593	39.51417	-82.16527
6.2	SF-106-LTM	SF00940	Snow Fork Main stem	Apr-00	9.8	16.1	1.2	5.2	533	4.2	2.0	7.2	221	339	39.51417	-82.16527
6.2	SF-106-LTM	SF00940	Snow Fork Main stem	Jul-00	2.9	46.9	0.0	4.2	705	3.1	1.6	3.7	344	525	39.51417	-82.16527
6.2	SF-106-LTM	SF00940	Snow Fork Main stem	Oct-00	0.8	83.4	0.0	3.2	1020	7.1	3.1	9.0	487	801	39.51417	-82.16527
6.2	SF-106-LTM	SF00940	Snow Fork Main stem	Feb-01	8.2	13.5	11.9	6.1	516	4.6	1.4	3.8	209	380	39.51417	-82.16527
6.2	SF-106-LTM	SF00940	Snow Fork Main stem	Apr-01	5.0	47.0	1.2	4.7	609	6.9	1.8	4.6	300	486	39.51417	-82.16527
6.2	SF-106-LTM	SF00940	Snow Fork Main stem	Aug-01	2.0	81.1	0.0	NM	1060	8.5	2.9	7.4	430	694	39.51417	-82.16527
6.2	SF-106-LTM	SF00940	Snow Fork Main stem	Oct-01	0.6	137.0	0.0	3.3	1040	12.3	3.2	9.6	545	829	39.51417	-82.16527
6.2	SF-106-LTM	SF00940	Snow Fork Main stem	Dec-01	2.3	23.6	3.0	5.2	682	5.4	2.0	2.2	322	525	39.51417	-82.16527
6.2	SF-106-LTM	SF00940	Snow Fork Main stem	Jun-02	3.9	61.9	0.0	3.7	886	8.8	2.3	5.9	394	586	39.51417	-82.16527
6.2	SF-106-LTM	SF00940	Snow Fork Main stem	Oct-02	1.2	65.8	0.0	3.8	983	5.9	2.9	6.4	461	675	39.51417	-82.16527
6.2	SF-106-LTM	SF00940	Snow Fork Main stem	Dec-02	1.7	38.5	2.0	4.8	875	7.5	2.3	4.1	386	593	39.51417	-82.16527
6.2	SF-106-LTM	SF00940	Snow Fork Main stem	Mar-03	16.4	30.2	1.9	5.0	516	5.0	1.2	3.2	228	357	39.51417	-82.16527
6.2	SF-106-LTM	SF00940	Snow Fork Main stem	Jun-03	9.1	29.3	1.4	4.9	643	5.4	1.8	3.9	256	446	39.51417	-82.16527
6.2	SF-106-LTM	SF00940	Snow Fork Main stem	Sep-03	12.3	13.9	16.5	6.4	548	4.1	1.3	2.7	193	364	39.51417	-82.16527
6.2	SF-106-LTM	SF00940	Snow Fork Main stem	Mar-04	14.0	19.9	5.9	5.5	541	5.3	1.0	3.0	229	373	39.51417	-82.16527
6.2	SF-106-LTM	SF00940	Snow Fork Main stem	Nov-04	6.1	15.2	5.3	5.2	624	6.6	1.6	3.0	282	426	39.51417	-82.16527
6.2	SF-106-LTM	SF00940	Snow Fork Main stem	May-05	10.0	33.6	0.6	4.6	654	8.5	1.5	5.2	303	475	39.51417	-82.16527
6.2	SF-106-LTM	SF00940	Snow Fork Main stem	Sep-05	1.4	65.9	0.0	3.6	979	7.3	2.2	5.8	484	702	39.51417	-82.16527
6.2	SF-106-LTM	SF00940	Snow Fork Main stem	Apr-06	22.1	7.8	20.0	6.8	466	3.2	0.8	2.2	176	290	39.51417	-82.16527
4.3	SF-107-LTM	SF00630	Snow Fork Main stem	Feb-00	5.4	102.0	0.0	3.1	1010	6.9	2.9	13.8	451	678	39.48806	-82.16593
4.3	SF-107-LTM	SF00630	Snow Fork Main stem	Apr-00	25.4	61.1	0.0	3.9	718	4.3	2.6	9.7	295	476	39.48806	-82.16593
4.3	SF-107-LTM	SF00630	Snow Fork Main stem	Jul-00	6.4	65.6	0.0	4.1	829	1.7	2.3	7.4	412	624	39.48806	-82.16593
4.3	SF-107-LTM	SF00630	Snow Fork Main stem	Oct-00	2.7	87.4	0.0	3.2	1040	1.3	3.5	17.7	519	786	39.48806	-82.16593
4.3	SF-107-LTM	SF00630	Snow Fork Main stem	Feb-01	14.6	53.4	1.3	4.7	622	5.0	2.1	5.4	3	464	39.48806	-82.16593
4.3	SF-107-LTM	SF00630	Snow Fork Main stem	Apr-01	13.5	82.7	0.0	3.6	760	5.2	2.0	9.0	397	583	39.48806	-82.16593
4.3	SF-107-LTM	SF00630	Snow Fork Main stem	Aug-01	2.22	91.8	0.0	NM	1110	2.2	3.5	11.6	423	740	39.48806	-82.16593
4.3	SF-107-LTM	SF00630	Snow Fork Main stem	Oct-01	2.2	151.0	0.0	3.3	1180	3.8	3.8	14.3	570	854	39.48806	-82.16593
4.3	SF-107-LTM	SF00630	Snow Fork Main stem	Dec-01	4.0	54.1	0.0	3.9	805	3.6	2.8	5.7	383	603	39.48806	-82.16593
4.3	SF-107-LTM	SF00630	Snow Fork Main stem	Jun-02	9.6	109.0	0.0	3.1	966	3.1	2.9	11.1	425	660	39.48806	-82.16593

Source: Monday Creek Restoration Project

River Mile	Sample Site	Map ID 2005	Site Type	Sample Date	Discharge ft³/sec.	Acidity lab mg/l	Alkalinity lab mg/l	pH lab	Conductivity µS/cm lab	Total FE mg/l	Total Mn mg/l	Total AL mg/l	Sulfate mg/l	TDS mg/l	LAT	LONG
4.3	SF-107-LTM	SF00630	Snow Fork Main stem	Oct-02	3.0	107.0	0.0	3.5	1060	2.7	3.7	11.9	528	745	39.48806	-82.16593
4.3	SF-107-LTM	SF00630	Snow Fork Main stem	Dec-02	2.9	94.2	0.0	3.7	1080	7.0	3.4	10.1	483	707	39.48806	-82.16593
4.3	SF-107-LTM	SF00630	Snow Fork Main stem	Mar-03	29.3	61.5	0.0	3.9	639	5.1	1.8	7.5	292	457	39.48806	-82.16593
4.3	SF-107-LTM	SF00630	Snow Fork Main stem	Jun-03	20.0	62.0	0.0	3.9	728	4.5	2.4	7.6	314	522	39.48806	-82.16593
4.3	SF-107-LTM	SF00630	Snow Fork Main stem	Sep-03	20.0	35.4	2.5	4.7	615	3.7	1.8	5.2	263	428	39.48806	-82.16593
4.3	SF-107-LTM	SF00630	Snow Fork Main stem	Mar-04	19.3	67.0	0.0	4.3	676	4.3	1.7	6.9	324	489	39.48806	-82.16593
4.3	SF-107-LTM	SF00630	Snow Fork Main stem	Nov-04	11.1	57.1	0.0	3.8	750	7.1	2.4	8.4	366	505	39.48806	-82.16593
4.3	SF-107-LTM	SF00630	Snow Fork Main stem	May-05	18.6	115.0	0.0	3.6	840	6.7	2.7	13.5	428	620	39.48806	-82.16593
4.3	SF-107-LTM	SF00630	Snow Fork Main stem	Sep-05	2.9	123.0	0.0	3.4	1130	2.7	3.6	14.5	581	825	39.48806	-82.16593
4.3	SF-107-LTM	SF00630	Snow Fork Main stem	Apr-06	31.2	40.7	0.7	4.7	545	3.6	1.3	5.6	239	362	39.48806	-82.16593
2.4	SF-109-LTM	SF00290	Snow Fork Main stem	Feb-00	6.2	102.0	0.0	3.2	1010	6.2	2.7	14.0	445	679	39.46419	-82.17113
2.4	SF-109-LTM	SF00290	Snow Fork Main stem	Apr-00	29.0	54.9	0.0	4.0	694	3.5	2.5	10.2	287	455	39.46419	-82.17113
2.4	SF-109-LTM	SF00290	Snow Fork Main stem	Jul-00	6.8	67.7	0.0	3.8	872	2.8	2.1	7.9	413	633	39.46419	-82.17113
2.4	SF-109-LTM	SF00290	Snow Fork Main stem	Oct-00	5.2	97.7	0.0	3.5	1030	3.1	3.8	14.2	494	814	39.46419	-82.17113
2.4	SF-109-LTM	SF00290	Snow Fork Main stem	Feb-01	16.2	48.3	1.8	4.7	596	3.9	2.0	3.7	274	442	39.46419	-82.17113
2.4	SF-109-LTM	SF00290	Snow Fork Main stem	Apr-01	10.2	79.3	0.0	3.6	718	4.1	1.6	8.6	389	563	39.46419	-82.17113
2.4	SF-109-LTM	SF00290	Snow Fork Main stem	Aug-01	4.8	91.8	0.0	NM	1100	3.1	3.2	11.1	421	654	39.46419	-82.17113
2.4	SF-109-LTM	SF00290	Snow Fork Main stem	Oct-01	2.9	147.0	0.0	3.3	1160	5.4	3.9	13.1	561	802	39.46419	-82.17113
2.4	SF-109-LTM	SF00290	Snow Fork Main stem	Dec-01	3.7	56.2	0.0	3.8	820	2.1	2.8	5.9	413	593	39.46419	-82.17113
2.4	SF-109-LTM	SF00290	Snow Fork Main stem	Jun-02	10.3	104.0	0.0	3.4	949	3.1	2.6	10.4	422	640	39.46419	-82.17113
2.4	SF-109-LTM	SF00290	Snow Fork Main stem	Oct-02	3.4	109.0	0.0	3.5	1070	4.3	3.4	11.2	515	739	39.46419	-82.17113
2.4	SF-109-LTM	SF00290	Snow Fork Main stem	Dec-02	4.7	87.8	0.0	3.7	978	6.1	3.2	9.1	468	685	39.46419	-82.17113
2.4	SF-109-LTM	SF00290	Snow Fork Main stem	Mar-03	36.1	57.5	0.0	4.0	662	5.0	1.7	6.8	263	435	39.46419	-82.17113
2.4	SF-109-LTM	SF00290	Snow Fork Main stem	Jun-03	23.3	58.9	0.0	3.9	698	2.9	2.2	6.8	319	508	39.46419	-82.17113
2.4	SF-109-LTM	SF00290	Snow Fork Main stem	Sep-03	21.2	36.6	1.0	4.8	614	6.7	2.7	4.7	232	406	39.46419	-82.17113
2.4	SF-109-LTM	SF00290	Snow Fork Main stem	Mar-04	24.2	57.0	0.0	4.4	655	3.9	1.5	6.1	310	460	39.46419	-82.17113
2.4	SF-109-LTM	SF00290	Snow Fork Main stem	Nov-04	13.1	50.3	0.0	4.0	699	5.6	2.2	7.4	344	489	39.46419	-82.17113
2.4	SF-109-LTM	SF00290	Snow Fork Main stem	May-05	20.6	110.0	0.0	3.6	845	5.4	2.5	12.5	412	596	39.46419	-82.17113
2.4	SF-109-LTM	SF00290	Snow Fork Main stem	Sep-05	3.7	118.0	0.0	3.4	1100	2.7	3.3	13.0	565	793	39.46419	-82.17113
2.4	SF-109-LTM	SF00290	Snow Fork Main stem	Apr-06	43.6	44.2	1.4	4.9	498	3.3	1.1	4.5	217	334	39.46419	-82.17113

Appendix B - TMDL Biology Data

Appendix B - TMDL Biology Data

Table I: List of TMDL sampling locations [Fish Community-F, Benthic Macro-invertebrates-B, Water column Chemistry (including fecal coliform counts)-C, and Sediment Analysis (organics and metals)-S] in the 2001 Monday Creek study area.

Stream River Mile	Sample Type	Drain Area (mi^2)	Latitude/Longitude	Landmarks	USGS 7.5' Quad.
***Monday Creek* (01-300)**					
26.5	(F,B,C,S)	2.9	39E38'18"/82E13'29	Portie Flamingo Rd.(DNR-148)	New Lexington
25.3	(F,B,C)	3.7	39E37'42"/82E13'58	At McCuneville, TR 224	New Lexington
24.2	(B,C)	7.3	39E36'49"/82E13'53	Ust. Shawnee Cr., SR 93	New Straitsville
24.0	(F)	7.3	39E37'01"/82E13'58	Ust. Shawnee Cr., SR 93	New Straitsville
23.4	(B,C)	14.5	39E36'27"/82E14'34	Dst. Rock Run	New Straitsville
23.1	(F,S)	14.5	39E36'28"/82E14'51	Dst. Rock Run (DNR -127)	New Staitsville
19.8	(F,S)	26.0	39E34'46"/82E16'32	Monday Creek Junction (DNR-103)	Gore
19.7	(B,C)	26.0	39E34'47"/82E16'33	Monday Creek Junction	Gore
18.5	(F,B,C)	32.0	39E34'03"/82E16'16	Private Dr. (sec. 36)	Gore
16.0	(B,S)	36.0	39E33'00"/82E15'32	Dst. Lost Run, SR 595 (DNR-131)	Gore
15.8	(F,C)	36.0	39E32'49"/82E15'37	Dst. Lost Run, SR 595	Gore
14.3	(F,B)	62.0	39E32'09"/82E16'29	Dowley Rd.	Gore
10.5	(F,B,C,S)	77.0	39E30'02"/82E14'48	SR 278 (DNR LT-153)	New Straitsville
9.3	(F,B,C)	81.0	39E29'51"/82E14'11	Carbon Hill Rd., dst Monkey Hollow	Nelsonville
4.3	(F,B,C,S)	84.0	39E27'49"/82E12'13	Dst. McKnight seep, Loop Rd. (DNR-151)	Nelsonville
3.0	(F,B,C)	112.0	39E27'02"/82E11'50	Dst. Bessemer Hollow, Hollow Rd.	Nelsonville
1.7	(F,B,C,S)	114.0	39E26'07"/82E11'30	Dst. Coe Hollow, TR1042/569 (DNR-108)	Nelsonville
0.7	(F,B,C)	116.0	39E25'20"/82E11'15	Ust. US 33, Elm Rock Rd./TR 36	Nelsonville
***Dixie Hollow Tributary* (01-308)**					
2.0	(F,B,C)	1.9	39E39'07"/82E14'59	TR 224, at Dixie	New Lexington
0.1	(F,B,C)	3.3	39E37'40"/82E14'06	SR 93	New Lexington
***Shawnee Creek* (01-370)**					
1.3	(F,B,C)	1.7	39E36'09"/82E12'45	At Shawnee, SR 93	New Straitsville
0.3	(C)	2.0	39E36'41"/82E13'40	Adj. SR 93	New Straitsville
0.1	(F,B)	4.4	39E36'43"/82E13'53	Adj. SR 93	New Straitsville
Shawnee Creek Tributary @ RM 1.25					
0.1	(C)		39E36'06"/82E12'48	SR 93	New Straitsville
***Shawnee Creek Tributary @* RM 0.59 (01-371)**					
0.1	(F,B)	1.4	39E36'45"/82E13'39	Tecumsey Rd.	New Straitsville

Stream River Mile	Sample Type	Drain Area (mi^2)	Latitude/Longitude	Landmarks	USGS 7.5' Quad.
***Monday Creek Tributary I @ RM 23.4, Rock Run* (01-307)**					
(F,B,C,S)	1.8		39E36'24"/82E14'27	Adj. Rock Run Rd.	New Straitsville
***Stone Church Run* (01-302)**					
(C)	1.8		39E37'40"/82E15'14	Adj. Stone Church Hollow Rd.	Junction City
(F,B)	2.0		39E37'41"/82E15'15	Adj. Stone Church Hollow Rd.	Junction City
(F,B,C)	3.4		39E36'28"/82E14'57	Old Town Rd.	New Straitsville
***Salt Run* (01-360)**					
(F,B,C)	1.3		39E36'53"/82E16'21	TR 190	Gore
***Monday Creek Tributary II @ RM 20.3, New Straitsville Trib.* (01-306)**					
1.5	(F,B,C)	2.1	39E34'50"/82E14'42	TR 255	New Straitsville
0.1	(F,B,C)	3.7	39E35'03"/82E16'07	Crossing at Oreville	Gore
***Monday Creek III @ 19.73, Dans Run* (01-301)**					
0.2	(F,B,C)	3.0	39E34'51"/82E16'37	SR 93	Gore
***Lost Run* (01-350)**					
1.3	(F,B,C)	1.0	39E33'16"/82E14'28	Brandy Rd.	New Straitsville
0.1	(F,B,C,S)	3.1	39E33'06"/82E15'30	SR 595	Gore
***Little Monday Creek* (01-340)**					
13.7	(F,C)	1.8	39E39'21'/82E16'48"	Adj. TR 131	Junction City
13.6	(B)	1.8	39E39'13"/82E16'54	Adj. TR 131	Junction City
11.1	(F,B,C)	4.7	39E37'43"/82E18'35	Dutch Ridge Rd.	Junction City
9.6	(B,C)	8.7	39E37'03"/82E19'57	At Maxville, Griggs Rd.	Gore
9.5	(F)	8.7	39E37'02"/82E19'58	At Maxville, Griggs Rd.	Gore
6.9	(F,B,C)	15.4	39E35'32"/82E20'06	Adj. SR 93	Gore
3.8	(B)	22.0	39E34'02"/82E18'08	Price Rd.	Gore
3.3	(F,C)	23.0	39E33'37"/82E18'17	Price Rd	Gore
3.2	(F)	24.0	39E33'34"/82E18'17	Price Rd.	Gore
0.1	(F,B,C,S)	24.5	39E32'26"/82E16'34	SR 595 (DNR-PT Site)	Gore
***Coal Brook* (01-345)**					
0.1	(F,B,C)	1.0	39E37'43"/82E18'57	TR 131	Junction City
***Little Monday Creek Tributary I @ RM 10.15* (01-344)**					
0.1	(F,B,C)	1.1	39E37'28"/82E19'36	SR 668	Gore
***Temperance Hollow Tributary* (01-341)**					
1.3	(F,B,C)	2.0	39E35'57"/82E21'04	SR 312	Gore
***Little Monday Creek Tributary II @ RM 5.69* (01-343)**					
0.1	(F,B,C)	1.7	39E34'50"/82E19'24	SR 93	Gore
***Little Monday Creek Tributary III @ RM 4.85* (01-342)**					
0.9	(F,B,C)	1.6	39E34'08"/82E19'41	Lane East of CR 17	Gore

Stream River Mile	Sample Type	Drain Area (mi^2)	Latitude/Longitude	Landmarks	USGS 7.5' Quad.
***Kitchen Run* (01-330)**					
1.6	(F,B,C)	1.9	39E32'07"/82E17'57	Stout Guess Rd.	Gore
0.5	(B)	5.3	39E31'47"/82E16'52	Ust. Trib. at RM 0.37, SR 595	Gore
0.4	(F,C)	5.3	39E31'45"/82E16'49	Ust. Trib. at RM 0.37, SR 595	Gore
***Kitchen Run Tributary @ RM 0.37* (01-331)**					
0.1	(F,B,C)	1.8	39E31'45"/82E16'52	SR 595	Gore
***Sand Run* (01-320)**					
1.7	(F,B,C)	1.7	39E31'06"/82E14'18	Dawley-New Pittsburg Rd.	New Straitsville
0.2	(F,B,C)	5.9	39E31'15"/82E15'34	Dawley Rd.	Gore
***Sand Run Tributary @ RM 1.44* (01-321)**					
0.4	(F,B)	1.5	39E31'28"/82E14'06	Adj. New Straitsville Rd.	New Straitsville
0.2	(C)		39E31'17"/82E14'14	Adj. New Straitsville Rd.	New Straitsville
***Monday Creek Tributary IV @ RM 9.88, Monkey Hollow* (01-304)**					
0.2	(F,B,C)	1.1	39E29'43"/82E14'58	Ust. Monday Cr. Trib. IV@RM 9.88/0.12	Nelsonville
0.1	(F,B,C,S)	2.8	39E29'47"/82E14'51	At Mouth (DNR-PT Site)	Nelsonville
***Tributary of Monday Creek Trib. IV @ RM 9.88/0.12* (01-305)**					
0.4	(F,B,C)	1.7	39E29'26"/82E14'59	SR 278	Nelsonville
Big Four Hollow					
0.47	(S,C)	-	39E29'53"/82E13'03	Carbon Hill-Buchtel Rd. (ODNR-PT Site)	Nelsonville
Trib to Big Four Hollow					
0.12	(C)	-	39E29'51"/82E12'55	Carbon Hill-Buchtel Rd.	Nelsonville
***Snake Hollow Tributary* (01-309)**					
0.1	(B,C,S)	1.2	39E28'02"/82E12'23	At Mouth (ODNR-PT Site)	Nelsonville
Bessemer Hollow					
0.1	(C,S)	-	39E27'39"/82E12'12	At Mouth (ODNR-PT Site)	Nelsonville
***Snow Fork* (01-310)**					
6.2	(F,B,C,S)	12.2	39E30'51"/82E09'55	Murray City, dst. Murray City Seeps 1&2 (DNR-	New Straitsville
4.5	(F)	18.2	39E29'17"/82E09'58	Goose Run Rd., dst. Mainstem Seep	Nelsonville
4.3	(B,C,S)	18.2	39E29'18"/82E09'57	Goose Run Rd., dst. Mainstem seep (DNR-107)	Nelsonville
2.4	(F,B,C,S)	24.5	39E27'51"/82E10'16	Dst. Orbiston seep, SR 685 (DNR-109)	Nelsonville
1.0	(F,B,C,S)	26.7	39E27'25"/82E11'18	Foot Bridge at Buchtel, dst. Whitmore Hollow	Nelsonville
***Salem Hollow Tributary* (01-313)**					
3.1	(F,B,C)	1.7	39E33'36"/82E10'54	Adj. Black Gold Rd.	New Straitsville
2.2	(F,B,C)	3.4	39E32'45"/82E10'22	Salem Hollow Rd.	New Straitsville
0.1	(F,B,C)	5.7	39E31'18"/82E10'02	SR 216	New Straitsville

Stream River Mile	Sample Type	Drain Area (mi^2)	Latitude/Longitude	Landmarks	USGS 7.5' Quad.
***Middle Fork, Sycamore Hollow* (01-312)**					
3.2	(F)	2.4	39E33'08"/82E12'10	SR 216	New Straitsville
3.0	(B,C)	2.4	39E33'08"/82E12'08	SR 216	New Straitsville
0.1	(F,B,C)	4.9	39E31'16"/82E10'06	Private Dr.	New Straitsville
***Spencer Hollow* (01-314)**					
0.3	(F,B,C)	1.4	39E31'16"/82E10'15	Spencer Hollow Rd.	New Straistville
***Brush Fork* (01-311)**					
3.4	(F,B,C)	1.1	39E32'01"/82E12'56	Adj. Brush Fork Rd.	New Straitsville
2.3	(F,B,C)	2.0	39E30'52"/82E11'45	Dawley-New Pittsburg Rd.	New Straitsville
0.1	(F,B,C)	4.5	39E29'45"/82E10'01	SR 78 (DNR-PT Site)	Nelsonville
Goose Run					
0.1	(C)	1.1	39E29'19"/82E09'41	Adj. Goose Run Rd.	Nelsonville
***Long Hollow Run* (01-315)**					
0.1	(F,B,C)	1.3	39E28'27"/82E10'01	SR 78 (DNR-PT Site)	Nelsonville
***Whitmore Hollow Tributary* (01-316)**					
0.2	(C)	-	39E27'37"/82E10'33	Crossing South East of Buchtel	Nelsonville
0.1	(B)	-	39E27'41"/82E10'42	Crossing South East of Buchtel	Nelsonville
Coe Hollow					
0.1	(C)	0.2	39E26'59"/82E11'55	At Mouth (ODNR-PT Site)	Nelsonville
Majestic Mine					
0.1	(S)	-	39E25'26"/82E11'12	At Mouth	Nelsonville

Table II: Total list of fish species collected in the Monday Creek basin by the Ohio EPA in 2001.

Total list of fish species collected in the Monday Creek basin by the Ohio EPA in 2001								Grand Total of All Streams Date Range: 06/28/2001 Thru: 08/14/2001		
Dist Fished: 13.01 km		No of Streams: 28				No of Passes: 75				
Species Name / ODNR Status	IBI Group	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave (gm) Weight
Grass Pickerel		P	M	P	186	4.09	0.85	0.11	3.70	27.23
Golden Redhorse	R	I	S	M	1	0.02	0.00	0.01	0.22	312.00
Northern Hog Sucker	R	I	S	M	1	0.02	0.00	0.00	0.09	126.00
White Sucker	W	O	S	T	988	22.78	4.72	0.28	9.82	13.10
Blacknose Dace	N	G	S	T	1,450	37.66	7.80	0.05	1.81	1.39
Creek Chub	N	G	N	T	7,907	196.20	40.63	1.46	50.57	7.81
South. Redbelly Dace	N	H	S		2,599	67.47	13.97	0.08	2.93	1.26
Redfin Shiner	N	I	N		27	0.57	0.12	0.00	0.02	1.11
Striped Shiner	N	I	S		832	16.91	3.50	0.11	3.77	6.47
Spotfin Shiner	N	I	M		3	0.06	0.01	0.00	0.01	3.33
Silverjaw Minnow	N	I	M		78	1.60	0.33	0.00	0.12	2.21
Fathead Minnow	N	O	C	T	12	0.32	0.07	0.00	0.02	1.75
Bluntnose Minnow	N	O	C	T	1,158	25.90	5.36	0.07	2.37	2.66
Central Stoneroller	N	H	N		1,507	36.36	7.53	0.12	4.06	3.28
Cr Chub X S. Redbelly D					3	0.06	0.01	0.00	0.01	2.67
Yellow Bullhead		I	C	T	211	4.89	1.01	0.25	8.57	50.72
Brown Bullhead		I	C	T	1	0.02	0.00	0.00	0.05	66.00
Black Bullhead		I	C	P	4	0.09	0.02	0.00	0.09	28.75
Rock Bass	S	C	C		1	0.02	0.00	0.00	0.09	134.00
Largemouth Bass	F	C	C		51	1.14	0.24	0.01	0.29	7.86
Green Sunfish	S	I	C	T	904	21.32	4.42	0.18	6.11	8.31
Bluegill Sunfish	S	I	C	P	836	20.44	4.23	0.10	3.46	5.13
Redear Sunfish	E	I	C		1	0.02	0.00	0.00	0.01	8.00
Pumpkinseed Sunfish	S	I	C	P	11	0.29	0.06	0.00	0.05	5.36
Green Sf X Bluegill Sf					12	0.25	0.05	0.01	0.27	32.17
Green Sf X Hybrid					20	0.46	0.10	0.01	0.39	25.70
Hybrid X Sunfish					2	0.05	0.01	0.00	0.14	84.50
Blackside Darter	D	I	S		10	0.20	0.04	0.00	0.01	1.90
Johnny Darter	D	I	C		557	12.42	2.57	0.01	0.39	0.89
Fantail Darter	D	I	C		504	11.21	2.32	0.02	0.58	1.46
No Fish					0	0.00	0.00			
		Grand Total			19,877	482.83		2.90		
		Number of Species			26					
		Number of Hybrids			4					

Table III: Summary of acid mine drainage (AMD) associated macro-invertebrate taxa found within the Monday Creek basin in 2001.

Numbers in **bold** meet the criteria for highly degraded AMD streams which generally include number of qualitative sample taxa $\leq$ 11, qualitative EPT $\leq$ 1, and percent of total number of taxa that are AMD indicators $\geq$ 33%.

Stream River Mile	Qual Taxa	Qual EPT[a]	% AMD Taxa	Acid Mine Drainage (AMD) Macroinvertebrate Taxa
Monday Creek				
26.5	**8**	**1**	**75%**	*Sigara sp, Sialis sp, Nigronia serricornis, Hydroporus sp, Chironomus (C.) decorus group, Polypedilum (P.) Illinoense*
25.3	12	**1**	**58%**	*Sialis sp, Nigronia sp, Hydroporus sp, Laccophilus sp, Ceratopogonidae, Chironomus (C.) decorus group, Polypedilum (P.) sp 2*
24.2	**10**	2	**40%**	*Sialis sp, Nigronia serricornis, Hydroporus sp, Polypedilum (Pentapedilum) tritum var. I*
23.4	**8**	3	13%	*Sialis sp*
19.7	23	9	9%	*Sialis sp, Nigronia serricornis, Ceratopogonidae, Polypedilum (P.) Illinoense*
18.5	20	6	15%	*Coenagrionidae, Sialis sp, Nigronia serricornis, Hydroporus sp, Ceratopogonidae, Polypedilum (P.) Illinoense*
16.0	13	2	23%	*Coenagrionidae, Sialis sp, Nigronia serricornis, Ceratopogonidae, Chironomus (C.) decorus group, Polypedilum (Pentapedilum) tritum var. I, Polypedilum (P.) sp 2*
14.3	13	5	10%	*Sialis sp, Nigronia serricornis*
10.5	17	3	8%	*Sialis sp, Nigronia serricornis, Ceratopogonidae*
9.3	12	2	11%	*Sialis sp, Nigronia serricornis, Ceratopogonidae, Chironomus (C.) sp*
4.3	**11**	5	13%	*Sialis sp, Nigronia serricornis, Ceratopogonidae*
3.0	**8**	3	**38%**	*Sigara sp, Sialis sp, Chironomus (C.) decorus group*
1.7	**8**	2	18%	*Sialis sp, Nigronia serricornis, Polypedilum (Pentapedilum) tritum var. I, Polypedilum (P.) sp 2*
0.7	**6**	**1**	30%	*Notonecta sp, Sialis sp, Nigronia serricornis,*

Source: Ohio EPA

Stream River Mile	Qual Taxa	Qual EPT[a]	% AMD Taxa	Acid Mine Drainage (AMD) Macroinvertebrate Taxa
				Chironomus (C.) decorus group, Polypedilum (Pentapedilum) tritum var. I, Polypedilum (P.) Illinoense
Dixie Hollow Creek				
2.0	9	4	**44%**	*Sigara sp, Sialis sp, Nigronia serricornis, Hydroporus sp*
0.1	10	5	**50%**	*Sigara sp, Sialis sp, Laccophilus sp, Hydroporus sp, Chironomus (C.) decorus group*
Shawnee Creek				
1.3	15	2	7%	*Sialis sp*
0.1	15	4	7%	*Nigronia serricornis*
Trib. to Shawnee Creek (RM 0.14)				
0.1	**6**	**0**	0%	
Rock Run				
0.1	**4**	**0**	**50%**	*Sialis sp, Hydroporus sp*
Stone Church Run				
1.9	18	9	17%	*Sialis sp, Hydroporus sp, Polypedilum (P.) Illinoense*
0.1	15	2	20%	*Sialis sp, Nigronia serricornis, Ceratopogonidae*
Salt Run				
1.1	21	5	9%	*Ceratopogonidae, Polypedilum (P.) Illinoense*
Trib. to Monday Creek (RM 20.03)				
1.5	**9**	**1**	**44%**	*Cambarus thomai, Hydroporus sp, Laccophilus sp, Polypedilum (P.) Illinoense*
0.1	**1**	**0**	0%	
Trib. to Monday Creek (RM 19.73)				
0.2	23	7	9%	*Sialis sp, Nigronia serricornis*
Lost Run				

Stream River Mile	Qual Taxa	Qual EPT[a]	% AMD Taxa	Acid Mine Drainage (AMD) Macroinvertebrate Taxa
1.3	**3**	**0**	**33%**	*Sialis sp*
0.1	**9**	**1**	**44%**	*Notonecta sp, Sialis sp, Nigronia serricornis, Hydroporus sp*
Little Monday Creek				
13.6	18	6	11%	*Coenagrionidae, Sialis sp*
11.1	22	8	9%	*Sialis sp, Ceratopogonidae*
9.6	25	12	4%	*Hydroporus sp*
6.9	23	9	12%	*Sialis sp, Chironomus (C.) decorus group*
3.8	29	12	4%	*Sialis sp, Nigronia serricornis*
0.1	19	7	6%	*Sialis sp, Nigronia serricornis*
Coal Brook				
0.1	20	6	10%	*Sialis sp, Chironomus (C.) decorus group*
Trib. I to Little Monday Creek (RM 10.15)				
0.1	21	6	29%	*Coenagrionidae, Sigara sp, Sialis sp, Hydroporus sp, Ceratopogonidae, Chironomus (C.) decorus group*
Temperance Hollow Creek				
1.3	27	10	7%	*Sialis sp, Hydroporus sp*
Trib. II to Little Monday Creek (RM 5.69)				
0.1	22	7	9%	*Sialis sp, Hydroporus sp*
Trib. III to Little Monday Creek (RM 4.85)				
0.9	23	6	4%	*Hydroporus sp*
Kitchen Run				
1.6	29	7	7%	*Hydroporus sp, Chironomus (C.) decorus group*
0.5	**7**	**1**	0%	
Trib. to Kitchen Run (RM 0.37)				
0.1	19	3	11%	*Coenagrionidae, Ceratopogonidae*
Sand Run				

Source: Ohio EPA

Stream River Mile	Qual Taxa	Qual EPT[a]	% AMD Taxa	Acid Mine Drainage (AMD) Macroinvertebrate Taxa
1.7	**11**	2	**45%**	*Coenagrionidae, Sialis sp, Ceratopogonidae, Chironomus (C.) decorus group, Polypedilum (Pentapedilum) tritum var. I*
0.2	**8**	**1**	12%	*Sialis sp*
Trib. to Sand Run (RM 1.44)				
0.2	17	4	18%	*Nigronia serricornis, Ceratopogonidae, Chironomus (C.) sp*
Trib. to Monday Creek/ Monkey Hollow (RM 9.88)				
0.2	**10**	**1**	**60%**	*Notonecta sp, Sialis sp, Nigronia serricornis, Hydroporus sp, Chironomus (C.) sp, Polypedilum (P.) Illinoense*
0.1	**8**	**0**	**88%**	*Sigara sp, Sialis sp, Nigronia serricornis, Hydroporus sp, Ceratopogonidae, Chironomus (C.) sp, Polypedilum (P.) Illinoense*
Trib. to Monday Creek (RM 9.88/0.1) / Trib. to Monkey Hollow				
0.4	**6**	**0**	**83%**	*Sialis sp, Nigronia serricornis, Hydroporus sp, Chironomus (C.) decorus group, Polypedilum (P.) Illinoense*
Snake Hollow				
0.1	**3**	**1**	**67%**	*Sialis sp, Nigronia serricornis,*
Snow Fork				
6.2	**5**	**0**	**60%**	*Sialis sp, Ceratopogonidae, Chironomus (C.) decorus group*
4.3	**8**	**0**	**75%**	*Nigronia serricornis, Hydroporus sp, Laccophilus sp, Chironomus (C.) decorus group, Polypedilum (Pentapedilum) tritum var. I, Polypedilum (P.) sp 2*
2.4	**6**	**0**	**83%**	*Sialis sp, Nigronia serricornis, Hydroporus sp, Chironomus (C.) decorus group, Polypedilum (Pentapedilum) tritum var. I*
1.0	**5**	**1**	**50%**	*Sialis sp, Nigronia serricornis, Chironomus (C.) decorus group, Polypedilum (Pentapedilum) tritum var. I, Polypedilum (P.) sp 2*
Salem Hollow Creek				

Stream River Mile	Qual Taxa	Qual EPT[a]	% AMD Taxa	Acid Mine Drainage (AMD) Macroinvertebrate Taxa
3.1	26	7	19%	*Sialis sp, Nigronia serricornis, Hydroporus sp, Ceratopogonidae, Chironomus (C.) decorus group*
2.2	31	9	13%	*Sialis* sp, *Hydroporus sp, Ceratopogonidae, Chironomus (C.) decorus group*
0.1	13	3	25%	*Sialis* sp, *Ceratopogonidae, Chironomus (C.) decorus group, Polypedilum (P.) Illinoense*
Sycamore Hollow Creek				
3.4	**2**	**1**	0%	
0.1	**5**	**1**	20%	*Sialis sp*
Spencer Hollow Creek				
0.3	17	2	**59%**	*Coenagrionidae, Sigara sp, Notonecta sp, Sialis sp, Nigronia serricornis, Hydroporus sp, Laccophilus sp, Ceratopogonidae, Chironomus (C.) decorus group, Polypedilum (Pentapedilum) tritum var. I*
Brush Fork				
3.4	15	**1**	**33%**	*Coenagrionidae, Sigara sp, Sialis sp, Hydroporus sp, Chironomus (C.) decorus group*
2.3	**10**	**1**	**50%**	*Sigara sp, Sialis sp, Nigronia serricornis, Hydroporus sp, Chironomus (C.) decorus group*
0.1	**6**	**1**	**67%**	*Sialis sp, Nigronia serricornis, Hydroporus sp, Polypedilum (Pentapedilum) tritum var. I*
Long Hollow Creek				
0.1	**9**	**0**	22%	*Hydroporus sp, Ceratopogonidae, Chironomus (C.) decorus group*
Whitmore Hollow - Trib to Snow Fork (RM 1.8)				
0.1	13	2	23%	*Sialis sp, Nigronia serricornis, Chironomus (C.) decorus group*
Trib. to Monday Creek (RM 2.41)				
0.4	**6**	**0**	0%	

Source: Ohio EPA

a EPT = total Ephemeroptera (mayflies), Plecoptera (stoneflies), & Trichoptera (caddisflies) taxa richness.

Table IV: TMDL sample locations IBI, QHEI, and ICI scores within the Monday Creek basin in 2001. A total of 2 to 6 water quality samples were collected at sites and utilized to determine station mean.

Stream (Rivercode)	River Mile (RM)	Mean pH	Mean Acid (mg/l) (Measured and/or Calculated)	Mean Alkalinity (mg/l) (Measured and/or Calculated)	IBI	QHEI	ICI
Monday Creek (01-300)	26.5	4.0	31	5	12	64	1
Monday Creek (01-300)	25.3	3.6	56	5	12	52.5	1
Monday Creek (01-300)	24	4.1	116	5	20	77.5	12
Monday Creek (01-300)	23.4	5.6	13	10	16	74.5	12
Monday Creek (01-300)	19.8	6.5	13	12	22	65	34
Monday Creek (01-300)	18.5	6.7	5	13	18	81.5	26
Monday Creek (01-300)	15.8	5.7	13	7	18	61.5	14
Monday Creek (01-300) (fish/bug only)	14.3	NA	NA	NA	23	54	4
Monday Creek (01-300)	10.5	6.7	4	38	29	62	28
Monday Creek (01-300)	9.3	6.6	6	81	22	63	18
Monday Creek (01-300)	4.3	6.5	6	24	21	66	24
Monday Creek (01-300)	3	4.6	28	5	13	73.5	12
Monday Creek (01-300)	1.7	4.6	27	5	14	54.5	12
Monday Creek (01-300)	0.7	4.7	26	5	12	68.5	16
Dixie Hollow Trib (01-308)	2	5.4	24	5	12	77	1
Dixie Hollow Trib (01-308)	0.1	5.5	9	5	12	59	1
Shawnee Creek (01-370)	1.3	7.1	3	123	22	54.5	12
Shawnee Creek (01-370)	0.1	7.0	3	71	22	44	13
Shawnee Cr. Trib @ RM 1.25	0.1	7.2	7	88	34	45.5	1
Rock Run (01-307)(MC Trib I @ RM 20.3)	0.1	4.2	92	5	12	56	1
Stone Church Run (01-302)	1.9	6.8	6	39	22	62	32
Stone Church Run (01-302)	0.1	6.6	4	31	20	62.5	12
Salt Run (01-360)	1.1	6.7	4	46	26	67	32
New Straitsville Trib (01-306)(MC Trib II @ RM 20.3)	1.5	7.4	7	52	16	55	1
Dans Run (03-301)(MC Trib III @ RM 19.73)	0.2	7.3	4	61	34	65	32
Lost Run (01-350)	1.3	2.6	262	5	12	65	1
Lost Run (01-350)	0.1	3.1	166	5	12	61	1

Stream (Rivercode)	River Mile (RM)	Mean pH	Mean Acid (mg/l) (Measured and/or Calculated)	Mean Alkalinity (mg/l) (Measured and/or Calculated)	IBI	QHEI	ICI
Little Monday Creek (01-340)	13.7	7.2	9	44	42	73	32
Little Monday Creek (01-340)	11.1	7.4	4	36	42	79	32
Little Monday Creek (01-340)	9.5	7.5	3	155	44	64.5	36
Little Monday Creek (01-340)	6.9	7.5	3	130	32	69	36
Little Monday Creek (01-340)	3.3	7.2	3	116	34	68.5	56
Little Monday Creek (01-340)	0.1	7.1	3	100	36	56.5	32
Coal Brook (01-345)	0.1	7.3	2	46	42	63	32
L. Monday Cr. Trib I (01-344)(@ RM 10.15)	0.1	7.5	5	428	46	59.5	31
Temperance Hollow (01-341)	1.3	7.4	2	93	42	67	36
L. Monday Creek Trib II (01-343)(@ RM 5.69)	0.1	7.5	3	52	42	56.5	32
L Monday Cr Trib III (01-342)(@ RM 4.85)	0.9	7.6	2	43	46	64	32
Kitchen Run (01-330)	1.6	7.0	3	80	34	48.5	32
Kitchen Run (01-330)	0.4	7.0	7	69	34	55.5	1
Kitchen Run Trib (01-331)(@ RM 0.37)	0.1	7.1	6	53	38	42	13
Sand Run (01-320)	1.7	6.2	13	9	30	65.5	12
Sand Run (01-320)	0.2	7.1	8	70	30	59.5	1
Sand Run Trib (01-321)(@ RM 1.44)	0.4	7.4	2	61	40	57.5	31
Monkey Hollow Trib (01-304)(Monday Cr Trib IV @ 9.88)	0.2	4.9	26	6	12	68.5	1
Monkey Hollow Trib (01-304)(Monday Cr Trib IV @ 9.88)	0.1	3.3	117	5	12	42.5	1
Trib of Monkey Hollow Trib (01-305)	0.4	4.6	142	5	12	60	1
Snake Hollow (01-309) (no fish)	0.1	3.0	212	14	NA	NA	1
Bessemer Hollow (Chem only)	0.1	3.1	189	5	NA	NA	NA
Coe Hollow (Chem Only)	0.1	2.4	311	5	NA	NA	NA

Stream (Rivercode)	River Mile (RM)	Mean pH	Mean Acid (mg/l) (Measured and/or Calculated)	Mean Alkalinity (mg/l) (Measured and/or Calculated)	IBI	QHEI	ICI
Snow Fork (01-310)	6.2	3.4	92	5	12	43	1
Snow Fork (01-310)	4.5	3.4	109	5	12	64.5	1
Snow Fork (01-310)	2.4	3.3	109	5	12	58.5	1
Snow Fork (01-310)	1	3.7	77	5	12	57.5	6
Salem Hollow (01-313)	3.1	6.8	9	67	38	78.5	32
Salem Hollow (01-313)	2.2	7.0	6	58	28	56	36
Salem Hollow (01-313)	0.1	6.6	16	28	26	73	16
Sycamore Hollow (01-312)(Middle Fork)	3.2	4.8	52	5	30	67	1
Sycamore Hollow (01-312)(Middle Fork)	0.1	4.5	23	5	12	69.5	1
Spencer Hollow (01-314)	0.3	4.1	57	5	12	76	12
Brush Fork (01-311)	3.4	6.9	20	110	12	59	1
Brush Fork (01-311)	2.3	3.2	117	5	12	55	1
Brush Fork (01-311)	0.1	3.3	106	5	12	73	1
Long Hollow Run (01-315)	0.1	3.3	62	5	12	72	1
Whitmore Hollow (01-316)(no fish)	0.1	6.5	15	63	NA	NA	12

Monday Creek Watershed

Map 1. Locator Map

PERRY CO.

HOCKING CO.

ATHENS CO.

Little Monday Creek
Salt Run
Monday Creek
Shawnee Creek
Lost Run
Kitchen Run
Brush Fork
Snow Fork
Goose Run

Jobs Doser
Grimmett Hollow
Rock Run
Rock Run 24
Lost Run
Essex Doser
Salem Hollow
Big Four
Snow Fork
Snow Fork
Goose Run
Snake Hollow
Majestic

Mc Cuneville
Maxville
Shawnee
Oreville
Gore
New Straitsville
Greendale
Carbon Hill
Murray City
Nelsonville
Buchtel
Doanville

668
93
13
312
155
595
33
328
278
685
78
691
328

Map Features

- Reclamation Sites
- Cities/Villages
- Major Roads
- Streams
- Townships
- County Boundary
- Watershed Boundary

N
W E
S

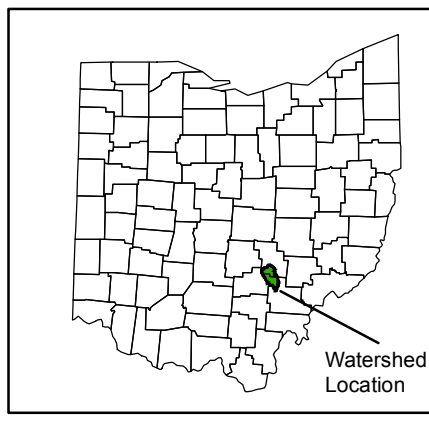
7,000 3,500 0 7,000

1 inch = 7000 Feet

ILGARD
Institute for Local Government Administration and Rural Development
OHIO UNIVERSITY

Map created for Monday Creek Restoration Project. Not for legal use. Cartography by Matt Trainer- ILGARD, Ohio University. January 12, 2007. Data Sources: Monday Creek Restoration Project, ODNR, ODOT.

GIS NET



Monday Creek Watershed

Map 2. Sub-Watershed Locations

PERRY CO.

HOCKING CO.

ATHENS CO.

DIXIE HOLLOW
JOBS HOLLOW
LITTLE MONDAY CREEK
STONE CHURCH
SALT RUN
UNNAMED 6
SHAWNEE CREEK
TEMPERANCE HOLLOW
DANS RUN
ROCK RUN
UNNAMED3
LOST RUN
SYCAMORE HOLLOW
SALEM HOLLOW
KITCHEN RUN
SAND RUN
SPENCER HOLLOW
BRUSH FORK
BIG 4 HOLLOW
GOOSE RUN
MONKEY HOLLOW
SNOW FORK
LONG HOLLOW
SNAKE HOLLOW
BESSEMER HOLLOW
COE HOLLOW
WHITMORE CEMETERY
MONDAY CREEK

Monday Creek

McCuneville
Maxville
Shawnee
Oreville
Gore
New Straitsville
Greendale
Carbon Hill
Murray City
Nelsonville
Buchtel
Doanville

668 13 93 312 155 595 33 78 328 278 685 691

Map Features

- Cities/Villages
- Major Roads
- Streams
- Townships
- County Boundary
- Subsheds

N W E S

7,000 3,500 0 7,000

1 inch = 7000 feet

Map created for Monday Creek Restoration Project. Not for legal use. Cartography by Matt Trainer- ILGARD, Ohio University. January 12, 2007. Data Sources: Monday Creek Restoration Project, ODNR, ODOT.

ILGARD
Institute for Local Government Administration and Rural Development
OHIO UNIVERSITY

GIS NET

Monday Creek Watershed

Map 3. Underground/Surface Mine Areas

PERRY CO.

HOCKING CO.

ATHENS CO.

Mc Cuneville
Maxville
Shawnee
Oreville
Gore
New Straitsville
Greendale
Carbon Hill
Murray City
Nelsonville
Buchtel
Doanville

Monday Creek

668 13 93 312 155 595 216 78 33 328 278 685 691

Map Features

- Cities/Villages
- Townships
- County Boundary
- Watershed Boundary
- Underground Mines
- Surface Mines

N W E S

7,000 3,500 0 7,000

1 inch = 7000 feet

ILGARD
Institute for Local Government Administration and Rural Development
OHIO UNIVERSITY

Map created for Monday Creek Restoration Project. Not for legal use. Cartography by Matt Trainer- ILGARD, Ohio University. January 12, 2007. Data Sources: Monday Creek Watershed Restoration Project, ODNR, ODOT.

GIS NET

Watershed Location

Monday Creek Watershed

Map 4. Soil Associations

PERRY CO.

HOCKING CO.

ATHENS CO.

668 93 13 312 155 595 216 33 328 278 78 685 691

Maxville
Mc Cuneville
Shawnee
Oreville
Gore
New Straitsville
Murray City
Carbon Hill
Nelsonville
Buchtel
Doanville

Little Monday Creek
Salt Run
Shawnee Creek
Monday Creek
Snow Fork
Lost Run
Brush Fork
Sand Run
Goose Run

Map Features

- Cities/Villages
- Major Roads
- Streams
- Townships
- County Boundary
- Watershed Boundary

Soils

- Westmoreland-Guernsey-Coshocton-Bethesda
- Westmoreland-Guernsey-Dekalb
- Wharton-Shelocta-Latham-Brownsville
- Wheeling-Otwell-Glenford-Euclid-Chagrin

N W E S

7,000 3,500 0 7,000

1 inch = 7000 Feet

Watershed Location

ILGARD Institute for Local Government Administration and Rural Development OHIO UNIVERSITY

GIS NET

Map created for Monday Creek Restoration Project. Not for legal use. Cartography by Matt Trainer- ILGARD, Ohio University. January 12, 2007. Data Sources: Monday Creek Restoration Project, ODNR, ODOT.

Monday Creek Watershed

Map 5. Long Term Monitoring Locations

PERRY CO.

HOCKING CO.

ATHENS CO.

Little Monday Creek
Salt Run
Lost Run
Kitchen Run
Brush Fork
Snow Fork
Sand Run
Monday Creek

DIXIE HOLLOW
JOBS HOLLOW
STONE CHURCH
LITTLE MONDAY CREEK
SALT RUN
DANS RUN
TEMPERANCE HOLLOW
SHAWNEE CREEK
ROCK RUN
UNNAMED3
LOST RUN
SYCAMORE HOLLOW
SALEM HOLLOW
KITCHEN RUN
SPENCER HOLLOW
SAND RUN 2
MONDAY CREEK
BRUSH FORK
BIG 4 HOLLOW
GOOSE RUN
MONKEY HOLLOW
SNOW FORK
SNAKE HOLLOW
LONG HOLLOW
BESSEMER HOLLOW
WHITMORE CEMETERY
COE HOLLOW

MC-148
MC-127
MC-103
MC-131
MC-153
MC-154
MC-151
MC-108
SF-106
SF-107
SF-109

Maxville
Mc Cuneville
Shawnee
Oreville
Gore
New Straitsville
Greendale
Carbon Hill
Murray City
Nelsonville
Buchtel
Doanville

Map Features

- EPA River Miles
- LTM_Sites
- Cities/Villages
- Townships
- County Boundary
- Subsheds
- Watershed Boundary

N
W E
S

7,000 3,500 0 7,000

1 inch = 7000 feet

Map created for Monday Creek Restoration Project. Not for legal use. Cartography by Matt Trainer- ILGARD, Ohio University. October 12, 2005. Data Sources: Monday Creek Restoration Project, ODNR, ODOT.

ILGARD
Institute for Local Government Administration and Rural Development
OHIO UNIVERSITY

GIS NET

Watershed Location

Monday Creek Watershed

Map 6. TMDL Site Locations

PERRY CO.

HOCKING CO.

ATHENS CO.

Little Monday Creek
13.6
DIXIE HOLLOW
2
JOBS HOLLOW
26.5
LITTLE MONDAY CREEK
0.1
11.1
0.1
STONE CHURCH
1.9
Mc Cuneville
25.3
0.1
Salt Run
Maxville
9.6
SALT RUN
1.1H
24.2
0.1H
23.1H
0.1H
0.1
SHAWNEE CREEK
1.3H
Shawnee
0.1
TEMPERANCE HOLLOW
1.3H
DANS RUN
Monday Creek
ROCK RUN
6.9
Oreville
0.2H
0.1
Gore
0.1
New Straitsville
1.5
19.7
Snow Fork
0.9
UNNAMED3
18.5
3.3H
LOST RUN
1.3
Lost Run
0.1
15.8
3.1
SYCAMORE HOLLOW
3.4H
SALEM HOLLOW
2.2
Greendale
0.1H
Kitchen Run
1.6
Brush Fork
3.4
SPENCER HOLLOW
KITCHEN RUN
0.4H
0.1
SAND RUN 2
0.3H
14.3
0.2
0.2
0.1H
1.7H
Mud Run
BRUSH FORK
2.3
0.1H
6.2
Murray City
Carbon Hill
BIG 4 HOLLOW
10.5H
9.3
0.47
0.1
GOOSE RUN
MONKEY HOLLOW
0.4
0.1
MONDAY CREEK
0.12
4.5
0.2
SNAKE HOLLOW
SNOW FORK
LONG HOLLOW
0.1
0.1
4.3
BESSEMER HOLLOW
Nelsonville
Buchtel
2.4
0.1
1
0.2
3.0H
COE HOLLOW
WHITMORE CEMETERY
0.1
1.7H
Doanville
0.7

Map Features

- Cities/Villages
- TMDL Sample Points- River Miles
- Major Roads
- Townships
- County Boundary
- Subsheds
- Watershed Boundary

N
W
E
S

7,000 3,500 0 7,000

1 inch = 7000 feet

ILGARD
Institute for Local Government Administration and Rural Development
OHIO UNIVERSITY

Map created for Monday Creek Restoration Project. Not for legal use. Cartography by Matt Trainer- ILGARD, Ohio University. January 12, 2007. Data Sources: Monday Creek Restoration Project, ODNR, ODOT.

GIS NET

Watershed Location