The Federal Valley Watershed Action Plan

As of April 12, 2006

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SECTION I. ACKNOWLEDGMENTS, PARTNERS, AND ACRONYMS

The Federal Valley Watershed Comprehensive Management Plan is the result of the hard work and collaboration of many agency partners and individuals.

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COMMUNITY BUILDING USE

Special thanks to the hosts of our community meetings

Amesville Grange

Kilvert Community Center

Bern Township Trustee Building

Rural Action Trimble Office

Federal Hocking School District

COLLABORATORS AND COMMUNITY PARTNERS

Amesville Grange Ames and Bern Township Trustees Appalachian Clean Streams Athens Litter Prevention Athens, Morgan and Washington Soil and Water Conservation Districts Athens, County Commissioners Athens County Health Department Athens-Hocking Solid Waste District Bartlett Local School Buckeye Hills RC&D Federal Hocking School District Federal Valley Residents Federal Valley Resource Center Hocking College ILGARD (O.U. Institute for Local Government Administration and Rural Development) Kilvert Community Center The Nature Conservancy Gifford State Forest Morgan County Schools Rural Community Assistance Program	Rural Action • Environmental Learning Program • Sustainable Forestry Program • Sustainable Agriculture Program Ohio Department of Natural Resources • Division of Soil & Water Conservation • Division of Wildlife • Division of Mineral Resources Mgt • Division of Forestry Office of Surface Mining Ohio Department of Transportation Ohio Environmental Protection Agency OSU Extension in Athens, Washington Counties Ohio University • Department of Geological Sciences • Environmental & Plant Biology Dpt • Environmental Studies Department • Geography Department • Biology Department USDA Natural Resources Conservation Service US Environmental Protection Agency (EPA) US Forest Service US Geological Service US Office of Surface Mining Village of Amesville

ACRONYM REFERENCE LIST

AMD-Acid Mine Drainage

AMDAT-Acid Mine Drainage Abatement and Treatment

BMPs-Best Management Practices

BOD-Biological Oxygen Demand

COD-Chemical Oxygen Demand

CSO-Combined Sewer Overflow

CWH-Coldwater Habitat

DBH-Diameter Breast Height

DO-Dissolved Oxygen

EPT-Ephemeroptera (mayfly), Plecoptera (stonefly), Tricoptera (caddisfly)

EWH-Exceptional Warmwater Habitat

FEMA-Federal Emergency Management Agency

FSA- Farm Service Agency

FVWG- Federal Valley Watershed Group

FVW- Federal Valley Watershed

FWPCA- Federal Water Pollution Control Administration

GIS-Geographical Information Systems

HUC- Hydrologic Unit Code

Ohio EPA-Ohio Environmental Protection Agency
- **-SEP-**Supp. Environ. Projects
- **-OEEF-** Ohio Environmental Education Fund

IBI-Index of Biological Integrity

ICI-Invertebrate Community Index

ILGARD-Institute for Local Government Admin. & Rural Dev.

LRW-Limited Resource Water

LTM-Long-term Monitoring

MRM-Mineral Resources Management

MS-Master's of Science

MWH-Modified Warmwater Habitat

NLTTB-Nothing Less Than The Best

NPDES-National Pollutant Discharge Elimination System

NPS-Non-point Source Pollution

NRCS-Natural Resources Conservation Services

NTU-National Turbidity Unit

OAC-Ohio Administrative Code

ODNR-Ohio Department of Natural Resources
- **-ACSI-**Appalachian Clean Streams Initiative
- **-AML-**Abandoned Mine Land
- **-MRM-**Mineral Resources Mgt.

ODOT- Ohio Department of Transportation

SSH-Seasonal Salmoid Habitat

STORET-Storage and Retrieval

SWCD-Soil and Water Conservation District

OES-Order of the Eastern Star

ORV-Off Road Vehicle

OSM-Offices of Surface Mining
-ACSI-Appalachian Clean Streams Initiative

OSU-Ohio State University

OU-Ohio University

PCR-Primary Contact Recreation

POTW-Publicly Owned Treatment Works

PWS-Public Water Supply

QHEI-Qualitative Habitat Evaluation Index

RCAP- Rural Community Assisstance Program

RC&D-Resource Conservation & Development

RM-River Mile

RT&E-Rare Threatened & Endangered

SCR-Secondary Contact Recreation

SEPTA-South-Eastern Probation Treatment Alternative

TAC-Technical Advisory Committee

TDS-Total Dissolved Solids

TMDL-Total Maximum Daily Load

TOC-Total Organic Carbon

TSS-Total Suspended Solids

USDA-United States Department of Agriculture

USFWS-United States Fish and Wildlife Service

UWA- Unified Watershed Assessment

VISTA-Volunteers in Service to America

WET-Whole Effluent Toxicity

WLA-Waste Load Allocation

WNF-Wayne National Forest

WPCLF-Water Pollution Control Loan Fund

WQPSDs-Water Quality Permit Support Documents

WQS-Water Quality Standards

WWH-Warm Water Habitat

SECTION II WATERSHED PLAN DEVELOPMENT

HISTORY OF THE FEDERAL VALLEY WATERSHED GROUP

After the unusually high floods in 1997 and 1998, the Village of Amesville began the process of writing a Federal Emergency management Agency grant to buy many of the homes that had been flooded. As a part of that planning process, the village created multiple committees, one of those being a watershed committee. The purpose of the watershed committee was to ensure that the entire watershed was considered in the planning process that took place after the flooding. At that time, Lisa King was appointed the chair of the watershed group. Other committee members were Pat and Jim Lochary, Marshall and Betty Lowe, Anne Bonner, Candace Facine, and Matt Glass. This committee researched watershed topics, mapped the watershed, and organized trash clean ups. In 2000, The Federal Valley Watershed Group became project of Rural Action, allowing the group a 501c3 status, and applied for an Ohio EPA 319 grant to develop a management plan. The group conducted surveys, staffed a booth at local fairs and festivals, hosted many meetings related to watershed issues, and hosted trash clean ups.

The Federal Valley Watershed Group was awarded a 319 Planning Grant in spring 2002. This grant also funded the development of an Acid Mine Drainage Abatement and Treatment (AMDAT) Plan with the ODNR, Division of Mineral Resource Management. Financial partners for this grant were Ohio EPA, Rural Action, Ohio University ILGARD, and ODNR DMRM. As a first step of this grant, the watershed group rented an office in Amesville, a village in the center of the watershed. In addition to developing this physical presence in the community, the watershed group bought a domain name and developed a website. The group's next step was to form a citizens' board and develop a mission statement. The board was made up of many local people; farmers, township trustees, health department employees, OU professors, artists, and landowners.

The watershed group developed a database with 2000 households. There is also a database with all landowners and all registered voters in the watershed. Additionally we have several databases by area i.e. own land adjacent to Federal Creek, and by category i.e. Owns abandoned mine lands, owns agricultural land, or is interested in youth programs. These databases do not print well but are available digitally if there is a need. See appendix 6 for a table of community groups, churches and businesses.

In addition to the citizen-based committee, a Technical Advisory Committee (TAC) was formed. The TAC group consists of state and local government officials, professors, an Ohio State University (OSU) Extension watershed agent, an Ohio Environmental Protection Agency (Ohio EPA) representative, NRCS personnel, ILGARD project coordinators, and geographical information system (GIS) personnel.

Currently our contact information is PO Box 151 Amesville, OH 45711 (740) 448-1012 http://www.federalcreek.org email is lisaking@federalcreek.org. If the watershed office cannot be

reached then call Rural Action 740-767-4938 http://www.ruralaction.org. Federal Valley is a project of Rural Action and operations under Rural Action organizational procedures, policies and bylaws.

MISSION STATEMENT & GOALS

The Federal Valley Watershed Group is working to restore and preserve water quality, environmental health, and recreation in the watershed. Concerned citizens and partners seek to gain a better understanding of and help raise watershed awareness.

Goals

To raise watershed awareness through education and outreach.

To restore and preserve water quality in the watershed.

To encourage preservation of natural and historically significant areas.

To gain a better understanding of problems like erosion, trash, and acid mine drainage.

To develop partnerships and seek funding to continue our efforts.

To promote good land use planning and healthy agricultural and forestry practices to improve water quality.

The group designed and printed a brochure and began to amass a database of property owners and registered voters in the watershed. An inventory of the local resource management offices, businesses, organizations, groups, churches, and schools within the area was conducted. With this database, the group started a comprehensive outreach plan. Contacts were made with the above-mentioned organizations to find out their needs related to water quality and identify interaction possibilities. The group then mailed 2000 copies of the Federal Valley Watershed Group brochure, with an invitation to a series of public meetings, and a survey asking for participants to vote on their top concerns. This mailing went out to landowners and registered voters and was also given out at local fairs and e-mailed to people who had given us e-mail addresses.

LOCAL CITIZEN WATER QUALITY CONCERNS

Federal Valley Watershed Group hosted 4 public meetings at various locations around the watershed to introduce the organization, identify water quality issues, and find out what could be done for the local stakeholders. The survey produced these statistics on the resident's concerns regarding water quality. Of the stakeholders polled, both at meetings, fairs, and emails, the following is the percentage that believed the listed source of water impairment was a top concern.

Table 1 Results of poll regarding water quality concerns

Erosion	27%
Trash	17%
Human sewage and wastewater	12%
Lack of streamside forests along the creeks	10%
Acid mine drainage	7%
Excessive use of pesticides and herbicides	5%
Livestock in the creek	4%
Improper gas and brine storage	4%
Log Jams	3%
Flooding	2%
Clean drinking water resources	2%
Vehicles driving in the creek	1%
Unregulated car junk yards	1%
Need for community cohesiveness/recreation	1%
Development along streams	1%
Lack of education regarding watershed concepts	1%

As FVWG assessed the concerns of watershed residents, inventoried physical characteristics of the creeks, gathered GIS data on sources of the above stated issues. Additionally, FVWG planned and implemented an education and outreach strategy that involved internships, school visits, bus tours, canoe floats, newsletters, placemats, watershed day camps, press releases, and public meetings with presentations.

STAKEHOLDERS

Table 2. Stakeholders involved in the development of the Management Plan.

Stakeholder Group	**What are their interests in the watershed plan?**	**These individuals and groups are represented in the watershed group.**	**How do they participate in the planning process?**
FVWG board members	Action plan will address their concerns and their land	Approximately 10-20 core members	Gathering input from local citizens and developing solutions
Village Councils and Community Groups	Addresses issues within their villages where they have the authority to implement changes	Amesville, Kilvert, Sharpsburg	Gathering input from local citizens, knowledge of available resources, and developing solutions
Ohio University	Research opportunities for students and interesting volunteer activities	Dina Lopez, Kelly Johnson, James Dyer	Editors, reviewers and advisors on technical issues
Township Trustees	Townships could benefit from improvements to watershed	Bern Twp (Richard Brown, Alan Gilchrist), Ames Twp (Gene Hines, Phil Kessler),	Knowledge of possible solutions and raise local awareness about watershed issues (i.e. litter clean-ups)
Soil and	Their best management	Mary Ann Hawk (Athens	Technical expertise,

Water Conservation District / NRCS	practices (BMP) and incentive programs could be used in part of the action strategies	Co), Cathy Bobo, partial support (Athens Co), Gail Doyle; Morgan County and Washington County (Jon Bordon)	help form solutions, and information on potential programs to offer to landowners
ODNR – Div. Wildlife	Protecting streams from soil loss	Mike Greenlee	Technical assistance on stream morphology and restoration practices
ODNR- Div. MRM	Restoring streams damaged by acid mine drainage (AMD)	Mitch Farley, Harry Payne, Mary Ann Borch,	Developing solutions to AMD related problems, engineering designs, funding, and expertise in land reclamation
ODNR- Div. Soil and Water Conservation	Restoring streams damaged by erosion	Constance White, Rosida Porter	Developing solutions to issues and concerns, engineering designs, technical assistance, and experience in conservation practices
County Health Departments	Action plan will include on-site wastewater treatment projects	Chuck Hammer	Resources and data, develop solutions and technical assistance
Rural Action	Fiscal agent and management plan grant recipient- Dedicated to environmental equity in SE Ohio.	Jane Redfern	Financial management, personnel management, VISTAs, equipment, mentoring, editing, media
Recycling and Litter Prevention	Action plan will address litter problems	Tom O'Grady	Technical assistance, resources, education, and expertise in controlling litter and degradation of stream quality
ILGARD	Plan development and GIS experts	Scott Miller, Rachael Hoy, JB Hoy, Matt Trainer	Expertise in mapping, planning, writing and editing,

LOCAL GOVERNMENT

Federal valley watershed has worked with Athens, Morgan and Washington county government as well as the township governments of Ames, Bern, Rome, Dover, Trimble, and Canaan in Athens County; Homer, Marion, Fairfield, and Union in Morgan County; and Wesley, and Decatur in Washington County. The only incorporated village in federal valley is Amesville.

PURPOSE OF THE MANAGMENT PLAN

This plan serves as an inventory of environmental conditions of the region and the blueprint for improving the overall health of the watershed. It includes a water quality and natural resources inventory, causes and sources of impairments, prioritized goals, objectives, actions, measurable indicators, timelines, and a list of resources to help meet these goals. This plan answers these questions: What are the impairments? Where are the sources of impairment? What actions need to be taken in order to restore water quality in the Federal Valley Watershed to meet Warm Water Habitat for aquatic life uses? Most importantly, it is a guide for meeting these goals.

ORGANIZATION AND DECISION MAKING STRUCTURE

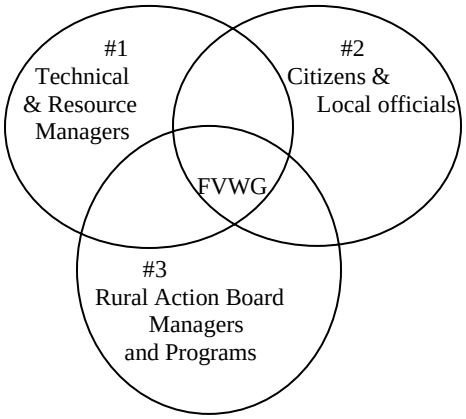
Figure 1 shows a diagram of the Federal Valley Watershed Group decision-making process. The watershed group is placed in the middle of three intersecting circles:

Circle one represents state and federal government agencies and other technical experts

Circle two represents local citizens and local government officials (i.e. trustees, mayors, commissioners, our citizen board, land owners, members, local groups, clubs, volunteers…etc.)

Circle three represents Rural Action, their management structure, their board of directors, and staff from their programs.

Figure 1. Federal Valley Watershed Group organizational structure



The Rural Action Board of Directors governs Federal Valley Watershed group as a project of Rural Action. Rural Action has 15 board members who are elected by the members of Rural Action at the Rural Action annual meeting. Rural Action does all of the financial, legal, human resources and management services for Federal Valley Watershed. Any activity that Federal Valley undertakes must agree with the overall Rural Action Mission.

An Executive Director hired by the Rural Action Board of Directors manages Rural Action. The Executive Director hires all Rural Action staff and has a management team that is made up of the Directors of Finance, Human Resources, and the Economies, Communities and Environments programs.

Each program director manages staff within their program area. The Director of Environments oversees all watershed coordinators. The Environments Director oversees, directs, and mentors all watershed coordinators within Rural Action.

The Rural Action Watershed coordinators coordinate activities within their watershed. This work includes: planning, grant writing, water monitoring, community outreach, fundraising and developing programs and projects to improve their watershed.

The coordinators work with advisory groups that work to advise and assist in the implementation of water quality improvement programs.

The decision-making within a watershed begins with the watershed coordinator. The coordinator seeks advice and support from the technical advisory and advisory boards and the Rural Action Director of Environments. The Executive Director of Rural Action must approve Grant approval, major decision-making, major expenditures, and employment, changes.

All activities undertaken by the watershed group must be appropriate with regard to the Federal Valley Watershed Group mission and goals. This mission was written by, and is overseen by, the Federal Valley Board, a group of local concerned stakeholders. Currently there are nine board members.

An action committee then directs any project that the group decides to do. This action committee ideally is made up of interested board members, other interested local citizens, and appropriate technical personnel. An appropriate technical personnel refers to experts in a relevant field to the proposed project and personnel from local, state and federal agencies. If it is not possible to get appropriate technical personnel to attend action committee meetings then they will be invited to review our proposed actions and give comments. The action committee will always base their actions on the advice of technical advisors, and whenever possible will try to get a minimum of one to three additional opinions.

The action committee will always consider the local stakeholders' needs in their actions. Educational outreach and a public meeting to allow local stakeholders to ask questions and share their thoughts regarding a proposed project will precede any action.

The role of the Federal Valley Watershed Group is to educate, motivate, organize and focus the goals of the different groups represented by these three intersecting circles (citizens, local officials, and state and federal technical agencies), to acquire needed resources, and ultimately take action. Long-term planning is possible as long as a core group of people remain focused and motivated, otherwise many good ideas would be wasted. Local communities want clean water and they need the assistance of the watershed group to direct them. In order for a watershed group to be effective and begin to take action, this core group of motivators and organizers is essential.

EDUCATION PLAN

The Federal Valley Watershed citizen's board has identified the need to increase awareness of basic watershed concepts among watershed residents. It is the group's policy to have this vision as a part of every project. This vision will be enacted with school and youth programs, adult educational presentations, media, and individual consultations. Whenever one of these activities occurs basic watershed concepts and watershed geography will be a part of that activity. Two of the goals of the Federal Valley watershed are to raise watershed awareness through education and outreach, and to promote good land use planning and healthy agricultural and forestry practices. The watershed group has a stated directive to include education in every project they undertake. The watershed group will use the goal of promoting good land use planning and healthy agricultural and forestry practices to build all of their education and outreach programs. The group will also develop individual outreach and education plans for each identified water quality problem.

SECTION III. DESCRIBE THE WATERSHED

The Federal Valley watershed is in the Hocking River Basin in Southeastern Ohio. Map 2 is a graphic representation of this information. Map 3 depicts the subwatersheds of Federal Valley. Table 2 provides the statistics on all the streams and subwatersheds in the Federal Valley.

FLOW AND SINUOSITY

The measurement of flow is the volume of water that flows past a point in a stream. For flow information see appendix 7. Sinuosity is the amount that a stream meanders; this would be from straight to having a lot of curves. Sinuosity index is measured by dividing the actual length of a stream (with the curves) by the length of a stream valley. It is a measure of how much the stream meanders back and forth. Sinuosity Index (SI) = Stream Length / Valley Length. A sinuosity index was taken for some of the streams in the watershed.

Pronounced Meanders: SI > 1.5
Moderate Meanders: 1.5 > SI > 1.26
Relatively Straight: 1.25 > SI > 1.0

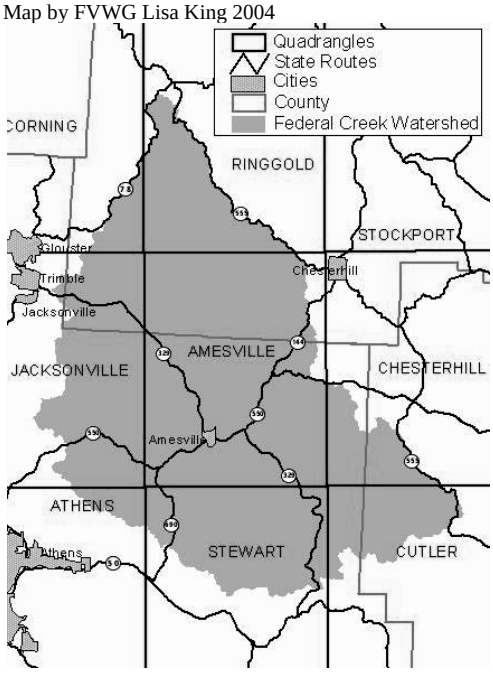
Federal Creek had a sinuosity measurement of 1.5. McDougall Branch had a sinuosity measurement of 1.4 and Sharps Fork was 1.3. Big Run has an index of 1.1, Marietta Run 1.5, Opossum Run 1.2, Wyatt Run 1.3, Bryson Branch 1.2, Mush Run 1.2.

USGS 7.5' QUADRANGLES

The Federal Valley Watershed is on 8 USGS 7.5' quadrangles they are Ringgold, Corning, Chesterhill, Amesville, Jacksonville, Cutler, Stewart, and Athens.

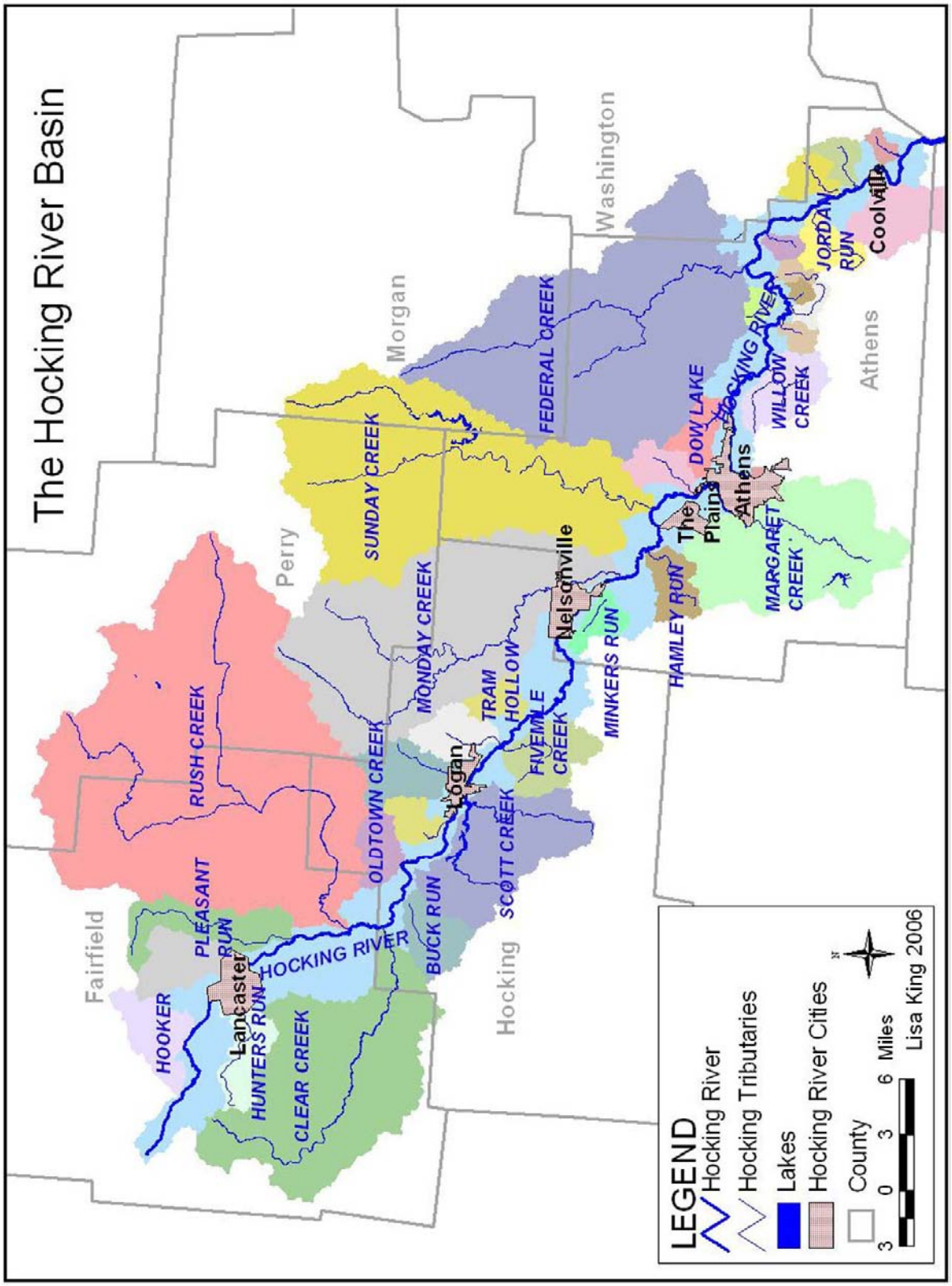
Map 1 Federal Valley and USGS 7.5' Quadrangles

Map by FVWG Lisa King 2004



Picture Page

Map 2 of the Hocking Basin



Map 2 of the Federal Valley Watershed and Subwatersheds

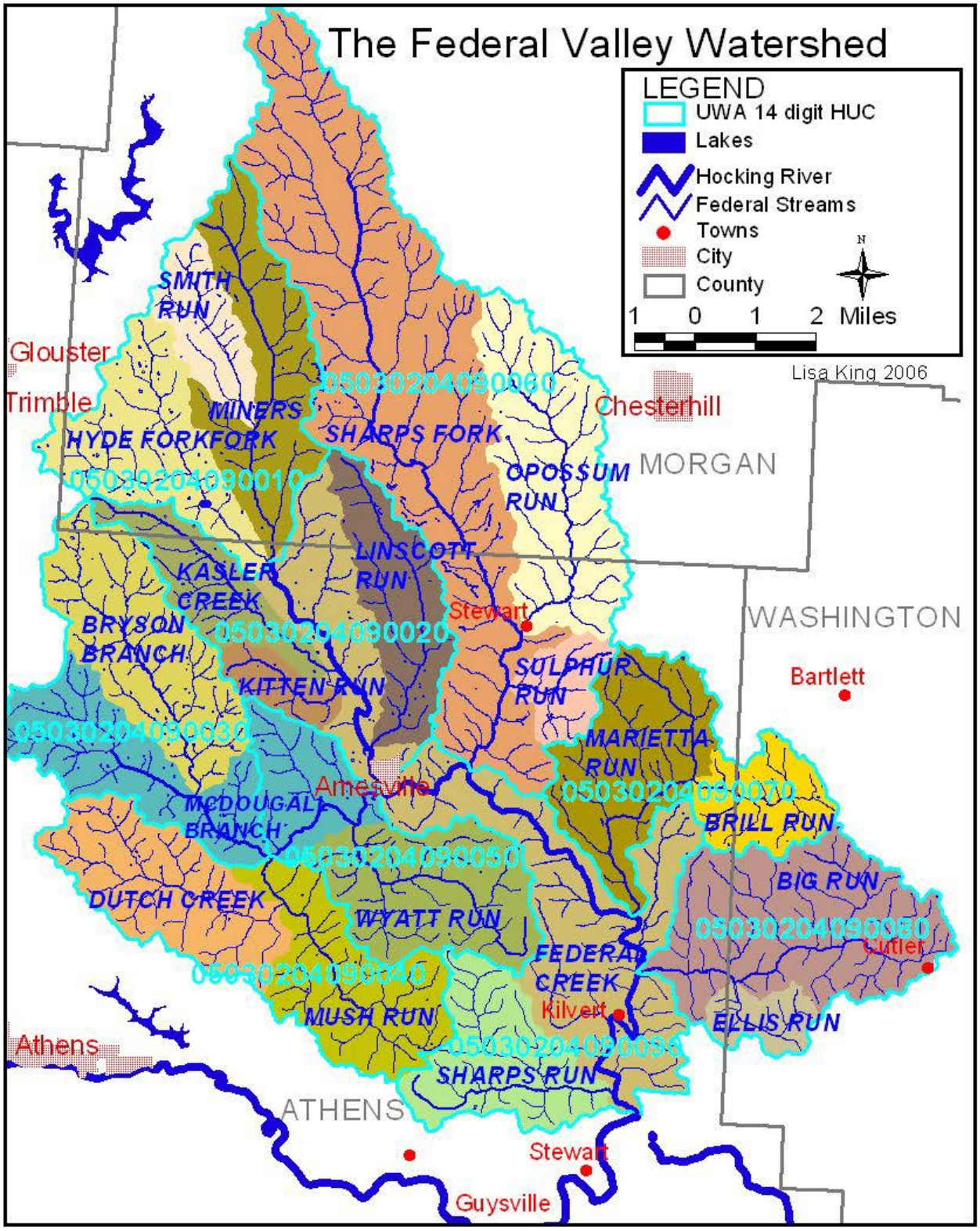


Table 3 Geography Statistics

Table 3 Subwatershed Geography

Subshed Name	Flow Direction	Stream Flows Into:	River Mile Stream Flows Into:	Morgan/ Athens/ Washington County	Homer/Rome/ Ames/Bern/ Marion/ Wesley/ Decatur/ Cannan/Dover Union/Trimble Township	Proximity to Towns	Latitude	Longitude	Corning, Ringold, Chesterhill, Jacksonville, Amesville, Cutler, Stewart, Athens Quadranagle	Area Sq. Mile	Stream Length (miles)	Elevation (source)	Elevation (mouth)	Average Fall (ft/mi)	Sq Mi of Under ground Mines	% coverage of under ground mines in shed	Sq. Mile of strip mines	% coverage of strip mines in shed
Federal Creek	South/ SE	Hocking	15.29	M,A,W	H,R,A,B,M,W, DE,C,DO,U,T	Amesville: 0.0 miles, Joy: 1 mile S-SE	39.330082	-81.887753	Co,R,Cu,J,A,Ch,S,A	144.73	23.80	1040	585	19.12	2.25	1.55%	2.09	1.44%
Sharps Run	East	Federal	0.59	A	R/Ca	Stewart: 0.8 miles S			S	5.60	3.60	760	585	48.61		0.00%		0.00%
Big Run	West	Federal	3.79	W,A	R,De,W,B	Kilvert: 1 mile E	39.3552	-81.8783	Cu,Ch,S	11.90	5.50	860	595	48.18	0.03	0.24%	0.00	0.00%
Joe's Run	South	Big Run	0.83	A	R,B	Kilvert			Ch,Cu	0.90	1.90	920	612	162.11		0.00%		0.00%
Ellis Run	North	Big Run	1.60	W,A	De,R	Kilvert: 1.3 miles E,	39.3534459	-81.8510756	Cu	1.60	2.62	755	610	55.39	0.00	0.00%	0.00	0.00%
Wildcat Run	South	Big Run	4.00	W	W	Cutler	39.3604142	-81.8155449	Cu	1.75	2.20	880	650	104.55		0.00%		0.00%
Spruce Run	South	Federal	3.79	A	R,B	BROADWELL			S,Ch,Cu		2.17	900	600	138.25	0.00			
Marrietta Run	South	Federal	4.26	A	B	Amesville: 2.5 miles E	39.368019	-81.8800396	A,Ch,S	10.10	5.80	890	604	49.31	0.32	3.12%	0.12	1.19%
Brill Run	West	Marietta Run	3.50	A,W	W,B	1 mile Bartlett			Ch,Cu	3.24	2.6	880	670	80.77		0.00%		0.00%
Sharps Fork	South	Federal	5.14	M,A	U,H,M,B	Joy in Sharps	39.4025964	-81.9296528	R,A	35.70	14.50	1040	621	28.90	1.15	3.22%	1.09	3.05%
Opossum Run	South	Sharp's Fork	2.83	M,A	M,B	Chesterhill, 0.8 miles E	39.4361753	-81.9123637	A,R	8.95	5.70	908	638	47.37	0.09	1.03%	0.85	9.50%
Starling Run	South	Opposum Run	3.94	M	M	Wrightstown			A		1.16	890	740	129.31				
Sulphur Run	West	Sharp's Fork	2.90	A	B	Sharpsburg: 0.3 miles NW			A	1.98	2.29	900	640	113.54	0.89	44.85%	0.13	6.52%
Joy Run	South	Sharp's Fork	6.37	M	M,H	Joy			A	1.12	1.50	820	675	96.67		0.00%		0.00%
McElfresh Run	South	Sharp's Fork	7.23	M	H,M	Joy			R,A	1.75	2.50	860	679	72.40		0.00%		0.00%
McDougall Branch	East	Federal	9.30	A	Do,A	Amesville: 0.3 miles W,	39.396629	-81.9625751	J,A,A/S	37.60	7.90	900	630	34.18	0.58	1.55%	0.08	0.20%
Wyatt Run	North	McDougall	0.50	A	A,R,C,B	New England in subshed	39.3842379	-81.9648203	S,A	6.78	4.90	895	634	53.27		0.00%		0.00%
Bryson Branch	South	McDougall	4.71	A	A,H,Do	Amesville: 2.0 miles E-SE	39.3959302	-82.0132625	J,A	7.77	6.48	900	660	37.04	0.00	0.01%		0.00%
Mush Run	North	McDougall	3.00	A	C,R,A	New England in subshed	39.3825448	-81.9897863	S,J,A	13.20	5.30	880	638	45.66	0.00	0.00%	0.00	0.00%
Dutch Creek	East	Mush Run	1.00	Athens	A,C	Athens: 2 miles S	39.3714707	-81.9871663	A,J,S	5.88	4.3	900	660	55.81		0.00%		0.00%
Linscott Run	South	Federal	11.93	M/A	H,A,B	Amesville: 0.4 miles S,	39.4027	-81.9602	A	5.04	5.50	910	634	50.18	0.01	0.14%	0.12	2.46%
Ewing Run	South	Linscott Run	1.76	M/A	A,H	Writestown			A	1.32	2.40	920	665	106.25		0.00%		0.00%
Kitten Run	East	Federal Creek	13.94	A	A	Amesville: 1.7 miles NW			J,A	1.55	2.85	900	640	91.23		0.00%		0.00%
Kasler Creek	South	Federal	14.13	M/A	H,A	Amesville .5 miles S			J,A	3.75	5.01	940	660	55.89		0.00%		0.00%
Draper's Run	South	Federal	15.99	M/A	H,A				A		2.34	900	660	102.56				
Hyde Branch	South	Federal	16.21	M	H,T,A	Trimble: 0.5 miles	39.4528746	-81.9904667	Co,J,A,R	6.53	4.60	893	634	56.30	0.00	0.00%	0.63	9.65%
Miners Fork	South	Federal	16.21	M/A	H,A	Joy: 1.3 miles W	39.4528746	-81.9904667	M, A	9.92	6.59	893	660	35.37	0.02	0.15%	0.36	3.61%
Smith Run	South	Miner's Fork	2.40	M	H	Bishopville	39.4815914	-81.995267	C,J,A	2.93	2.21	940	760	81.45		0.00%	0.19	6.44%

WATERSHED GEOGRAPHY NARRATIVE

The following is a narrative description of geographic features of each of the subwatersheds. This information is also presented in the table on the preceding page. This information may seem redundant but the FVWG felt that the narrative description is important for future investigations and grants that may apply to a subwatershed. The group also considers that this document should be offered as a stand-alone investigation of each subwatershed, in which case the narrative description would be important. This is organized by HUCs so that it is easy to find all of the information for a given HUC.

The Federal Valley watershed is identified as UWA 11 digit HUC 05030204090 and is located within three counties: Athens 88 mi^2, Morgan 45 mi^2, and Washington12 mi^2, a total of 145 square miles. This watershed has been subdivided into 9 14-digit subwatersheds, which has been subdivided into 13 main catchment basins and a total of 20 different basins. There are twelve townships whose boundaries cross into the watershed: Rome, Ames, Bern, Dover, Trimble, and Canaan in Athens County; Homer, Marion, Fairfield, and Union in Morgan County; and Wesley, and Decatur in Washington County (see map 2). The largest village in the watershed is Amesville with a population of approximately 250. Smaller towns in the watershed include Sharpsburg, Joy, Kilvert, New England, Broadwell, Utley, Lathrop, Phillipsburg and Mountville. On the edge of the watershed are the towns of Cutler, Chesterhill, Bishopville, Trimble and Stewart. Federal Creek can be found on the Corning, Ringold, Chesterhill, Jacksonville, Amesville, Cutler, Stewart, and Athens USGS quad sheets.

Federal Creek is a tributary of the Hocking River in southeastern Ohio. (See map of the Hocking River Basin.) The Hocking River Watershed contains approximately 1,199 square miles. Federal Valley Watershed is one of the four largest watersheds in the basin, representing approximately twelve percent of the Hocking River Watershed. Federal Valley Watershed originates in west- central Morgan County and flows in a southeasterly direction into Athens County. The river's confluence with the Hocking River is approximately twelve miles east of Athens, Ohio. The watershed covers an area of approximately 145 square miles, it is 16 miles wide and 18 miles long and the main stem is 23.8 miles long. The latitude ranges from 39°18'00" to 39°35'00" and the longitude ranges from 81°47'30" to 82°2'30".

The Subwatershed Descriptions by 14 digit UWA HUC
05030204090010 (Miners, Hyde, Smith)

Federal Creek headwater's 14 digit HUC is 5030204090010, which has an area of 16.518 mi^2. The Federal Creek headwater watershed has 0.859 mi^2, 5.2%, in Athens County and 15.659 mi^2, 94.8%, in Morgan County. This watershed contains Hyde Fork, Miners Fork, and Smith Run.

Hyde Fork occupies the northeast headwaters of the watershed, flows in a southeast direction, entering Federal Creek at 16.21 river miles. It is located in Morgan and Athens counties, crossing Homer, Trimble, and Ames townships and is near 0.50 miles east of Trimble. This subwatershed can be found on

Corning, Jacksonville, Ringold and Amesville USGS quad sheets. Hyde Fork has a drainage area of 6.53 sq. miles, and a stream length of 4.6 miles.

Miners Fork flows in a south/southeast direction, entering Federal Creek at 16.21 river miles. It is located in Athens and Morgan counties, crossing Homer and Ames townships and is near 1.3 miles west of Joy. This subwatershed can be found on Corning, Ringold, Amesville, and Jacksonville USGS quad sheets. Miners Fork has a drainage area of 9.92 sq. miles, and a stream length of 6.59 miles.

Smith Run flows in a southeast direction, entering Miners Fork at 2.4 river miles. It is located in Morgan County, crossing Homer Township and is near 2 miles east of Glouster. This subwatershed can be found on Corning, Ringgold, Amesville, and Jacksonville USGS quad sheets. Smith Run has a drainage area of 2.93 sq. miles, and a stream length of 2.21 miles.

5030204090020 (Upper Federal, Kasler, Kitten, Linscott)

Federal Creek below Miners Fork is identified as the 14 digit HUC, 503020490020, which has an area of 17.278 mi^2. This subwatershed is entirely in Athens County. Federal Creek below Miners Fork contains the subwatersheds Kasler Creek, Kitten Run, and Linscott Run.

Kasler Creek flows in a southeast direction, entering Federal Creek at 14.13 river miles. It is located in Athens and Morgan counties, crossing Homer and Ames townships and is near 2 miles NE of Amesville. This subwatershed can be found on Jacksonville and Amesville USGS quad sheets. Kasler Creek has a drainage area of 3.75 sq. miles, and a stream length of 5.01 miles.

Kitten Run flows in an east/southeast direction, entering Federal Creek at 13.94 river miles. It is located in Athens County, crossing Ames Township and is 1.7 miles NE of Amesville. This subwatershed can be found on Amesville and Jacksonville USGS quad sheets. Kitten Run has a drainage area of 1.60 sq. miles, and a stream length of 2.85 miles.

Linscott Run occupies flows in a southern direction, entering Federal Creek at 11.93 river miles. It is located in Athens and Morgan counties, crossing Homer, Bern, and Ames townships and is near 0.4 miles N of Amesville and 1.3 miles W of Sharpsburg. This subwatershed can be found on Amesville USGS quad sheets. Linscott Run has a drainage area of 5.06 sq. miles, and a stream length of 5.50 miles.

05030204090030 (Upper McDougall, Bryson)

McDougall Branch above Mush Run is known as the 14 digit HUC, 503020490030, which has an area of 13.983 mi^2. This subwatershed is comprised of 13.676 mi^2, 97.804% of Athens County and 0.32 mi^2, 2.288% of Morgan County. McDougall Branch below Mush Run contains McDougall Branch main stem subwatershed.

Our group does not split McDougall Branch up and we work with the area that is the entire main stem of McDougall branch, both above and below Mush Run. McDougall Branch flows in an east/southeast direction, entering Federal Creek at 9.3 river miles. It is located in Athens County,

crossing Dover and Ames townships and is 0.3 miles W of Amesville and 2.3 miles E of Chauncey. This subwatershed can be found on Jacksonville, Athens, Stewart, and Amesville USGS quad sheets. McDougall Branch has a drainage area of 37.60 sq. miles, and a stream length of 7.90 miles.

Bryson Branch flows in a south/southeast direction, entering McDougall Branch at 4.71 river miles. It is located in Morgan (4%) and Athens (96%) counties, crossing Ames, Homer and Dover townships. The town of Amesville is 2 miles to the east of Bryson branch. This subwatershed can be found on Jacksonville and Amesville USGS quad sheets. Bryson Branch has a drainage area of 7.77 sq. miles, and a stream length of 6.48 miles.

05030204090040 (Mush, Dutch)

The Mush Run watershed's 14 digit HUC is 5030204090040, which has an area of 13.13 mi^2, 100% of Athens County. The Mush Run watershed contains the subwatersheds Mush Run and Dutch Creek.

Mush Run flows in a northwest direction, entering McDougall Branch at 3 river miles. It is located in Athens County, crossing Canaan, Rome, and Ames townships and is 1.7 miles SW of Amesville. This subwatershed can be found on Stewart, Jacksonville, and Amesville USGS quad sheets. Mush Run has a drainage area of 7.4 sq. miles, and a stream length of 12.14 miles.

Dutch Creek, sometimes referred to as Sugar Creek, flows in an east direction, entering Mush Run at 1.00 river miles. It is located in Athens County, crossing Ames and Canaan townships. The City of Athens is 2 mile south of the subwatershed. This subwatershed can be found on Athens, Jacksonville and Stewart USGS quad sheets. Dutch Creek has a drainage area of 5.88 sq. miles, and a stream length of 4.3 miles.

05030204090050 (Lower McDougall, Wyatt)

McDougall Branch below Mush Run is identified as the HUC, 503020490050, which has an area of 10.402 mi^2, 100% of Athens County. This watershed contains the subwatersheds Wyatt Run and McDougall Branch and the stream of Brawley Run.

Wyatt Run flows in a northwest direction, entering McDougall Branch at .5 river miles. It is located in Athens County, crossing Ames, Bern, Rome, and Canaan townships and is 1 mile west of Amesville. This subwatershed can be found on Stewart and Amesville USGS quad sheets. Wyatt Run has a drainage area of 6.78 sq. miles, and a stream length of 4.90 miles.

05030204090060 (Sharps, Opossum, Sulphur)

The Sharps Fork watershed's 14 digit HUC is 5030204090060, which has an area of 35.581 mi^2. This subwatershed is comprised of 9.64 mi^2, 27.093%, of Athens County and 25.941 mi^2, 72.907% of Morgan County. The Sharps Fork watershed contains the subwatersheds Opossum Run, Sharps Fork, and Sulphur Run and the streams called McElfresh Run and Joy Run.

Sharps Fork flows in a south/southeast direction, entering Federal Creek at 5.14 river miles. It is located in Morgan and Athens counties, crossing Union, Homer, Marion and Bern townships. The town of Joy and Sharpsburg are in the Sharps Fork subwatershed. This subwatershed can be found on Ringgold and Amesville USGS quad sheets. Sharps Fork has a drainage area of 35.70 sq. miles, and a stream length of 14.50 miles.

Opossum Run flows in a southern direction, entering Sharps Fork at 2.83 river miles. It is located in Morgan and Athens counties, crossing Marion and Bern townships and is near Sharpsburg at it mouth, and Chesterhill in the headwaters. This subwatershed can be found on Amesville and Ringgold USGS quad sheets. Opossum Run has a drainage area of 8.95 sq. miles, and a stream length of 5.70 miles.

Sulphur Run flows in a west/southwest direction, entering Sharps Fork at 2.9 river miles. It is located in Athens County, crossing Bern Township and is near 0.3 miles SW of Sharpsburg, the historic town known as Lathrop is in this watershed. This subwatershed can be found on Amesville USGS quad sheets. Sulphur Run has a drainage area of 1.98 sq. miles, and a stream length of 2.29 miles.

05030204090070 (Marietta, Brill)

Marietta Run is identified as the 14 digit HUC, 5030204090070, which has an area of 10.123 mi^2. The Marietta Run watershed is comprised of 7.624 mi^2, 75.314%, of Athens County and 2.499 mi^2, 24.686% of Washington County. This subwatershed contains Brill Run and Marietta Run.

Marietta Run flows in a south/southwest direction, entering Federal Creek at 4.26 river miles. It is located in Athens and Washington counties, crossing Bern and Wesley townships and at its mouth are the towns of Phillipsburg and Broadwell. This subwatershed can be found on Amesville, Chesterhill and Stewart USGS quad sheets. Marietta Run has a drainage area of 10.10 sq. miles, and a stream length of 5.8 miles.

Brill Run flows in a west direction, entering Marietta Run at 3.50 river miles. It is located in Washington and Athens counties, crossing Wesley and Bern townships. The town of Bartlett is 1 mile north of the subwatershed. This subwatershed can be found on Chesterhill USGS quad sheets. Brill Run has a drainage area of 3.24 sq. miles, and a stream length of 2.6 miles.

05030204090080 (Big, Ellis)

The 14 digit HUC is 5030204090080 is called Big Run, which has an area of 11.866 mi^2. This watershed constitutes 2.494 mi^2, 21.018%, in Athens County and 9.372 mi^2, 78.982%, in Washington County. This watershed contains the subwatersheds Big Run and Ellis Run. Additionally there are three named tributaries that have been studied by the EPA in Big Run; Wildcat Hollow, Hatch Fork, and Joe's Run

Big Run flows in a westward direction, entering Federal Creek at 3.79 river miles. It is located in Washington and Athens counties, crossing Wesley, Bern, Decatur, and Rome townships and is one mile

east of Kilvert; the village of Cutler is at the headwater. This subwatershed can be found on Stewart, Cutler, and Chesterhill USGS quad sheets. Big Run has a drainage area of 11.90 sq. miles, and a stream length of 5.50 miles.

Ellis Run flows in a north/northwest direction, entering Big Run at 1.60 river miles. It is located in Washington and Athens counties, crossing Decatur and Rome townships and is 1.3 miles east of Kilvert. This subwatershed can be found on Cutler USGS quad sheets. Ellis Run has a drainage area of 1.59 sq. miles, and a stream length of 2.62 miles.

05030204090090 (Lower Federal, Sharps Run)

Federal Creek below McDougall is identified as the 14 digit HUC, 503020490090, which has an area of 15.505 mi^2. This subwatershed is entirely in Athens County. Federal Creek below McDougall refers to an area that contains the Federal Creek main stem and subwatersheds Sharps Run, Spruce Run and Herold Run.

Sharps Run flows in an east/southeast direction, entering Federal Creek at 0.59 river miles. It is located in Athens County, crossing Rome and Canaan townships and is 0.80 miles North of Stewart. This subwatershed can be found on Stewart's USGS quad sheets. Sharp's Run has a drainage area of 5.51 sq. miles, and a stream length of 3.60 miles.

The lower main stem of Federal Creek flows in a South/Southeast direction, entering the Hocking River at 15.29 river miles. It is located in Athens County, crossing Rome, Ames, Bern, and townships. The towns in the lower Federal Creek main stem watershed are Amesville, Kilvert, Broadwell and Phillipsburg. This subwatershed can be found on the Chesterhill, Amesville, Cutler, and Stewart USGS quad sheets. Federal Creek has a drainage area of 144 square miles.

NATURAL RESOURCE INVENTORY

Vegetation

Forests of the Federal Valley Watershed are part of the mixed mesophytic forest region (Braun 1950, Barnes 1991). Gordon (1969) described the original (natural) vegetation types of the area as mixed oak (*Quercus*), mixed mesophytic, and beech (*Fagus grandifolia*) forests. Rypma (1961) presented a similar but more detailed classification of forest types for Athens and Washington Counties. Presently, the two major forest type groups are "upland oaks" and "cove hardwoods" (Eyre 1980). Associated species are red oaks, sugar maple, yellow poplar, white oak, black locust, ash, elm and red maple. The watershed also supports Virginia, pitch, and short leaf pines. (USDA 1967).

Most forest stands in southeastern Ohio are not pre-settlement in origin, meaning they have been harvested, and then possibly cultivated or grazed one or more times since settlement by European immigrants in the late 1700s (Gordon 1969). Although over 95% of the study area was forested two hundred years ago (Williams 1989), only about 64% remains dominated by primarily second-growth forests (Griffith et al. 1993).

An interview with local resident Alice Stobart (January 1998) confirmed that there was employment in the area between 1937 and 1945 to clear scrubby woody secondary growth from areas of the Federal Valley Watershed to provide pasture for livestock. Most of the large-scale clear-cutting took place before 1955. Since that time, there has been a trend toward reforestation of farmed, mined, cleared and pastured lands.

Climate

The climate of the Federal Valley Watershed is classified as continental with moderate extremes of temperature and precipitation, based upon 1961-1990 data (Owenby and Ezell 1992). Summers are generally hot and humid with some days exceeding temperatures of 90 degrees. Winters are mostly cold and cloudy having a small number of days of subzero temperatures (EPA 1979). The average length of the freeze-free period is approximately 160 days for the Athens Unit of the Wayne National Forest (McCoy 1988).

Approximately equal amounts of precipitation are commonly received during the spring and summer, compared with the autumn and winter (McCoy 1988). Athens County receives an average precipitation of approximately 40 inches per year. The average monthly precipitation is 3.3 inches, based on a thirty-year record (1961-1990). January is typically the driest month with an average 2.5 inches of rainfall: whereas, July is generally the wettest with 4.4 inches per month (Ohio State University Extension, water fact sheet). The average precipitation for Athens County is approximately two inches above the state's average. This is most likely a result of the characteristic rough terrain of the watershed, which causes uplift and turbulence as air masses go across the hills (EPA 1979).

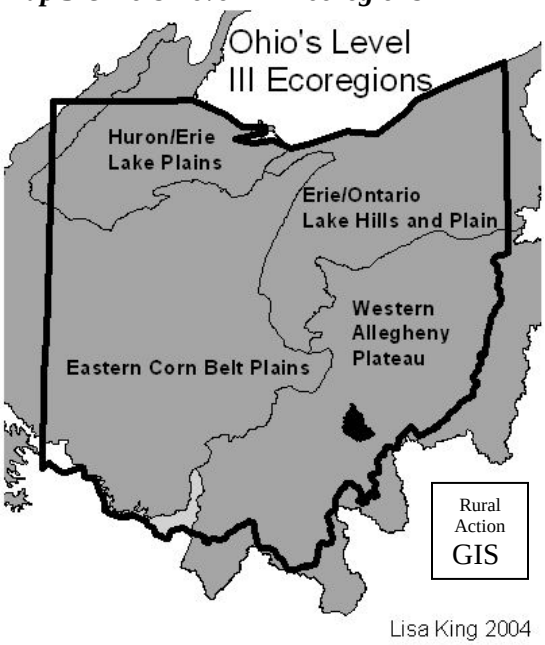
Groundwater

According to the underground water resources map of the lower Hocking River Basin, Federal Creek lies in an area in which generally less than 5 gallons per minute could be generated from wells. The rocks of the area are of two major types: consolidated sedimentary layers of shale, sandstone, limestone, and coal which form the bedrock and; unconsolidated deposits of clay, silt, sand and gravel laid down in stream valleys. There are no Drastic Maps for our area.

Around 30 feet of fine sand and silt, containing some gravel, are present along some of the tributaries of Federal Creek in the vicinity of Amesville. These tributaries include Mush Run, McDougall Branch, Hyde Fork, Miners Fork, Opossum Run, and Sharps Fork. Wells located in valley fill containing coarse material along some of the tributaries to Federal Creek may yield supplies of 5 to 10 gallons per minute. Otherwise, wells must be drilled in the bedrock, which yield supplies of less than 5 gallons per minute. However, many drilled wells are inadequate even for domestic supplies because underground water supplies are confined mainly to areas underlain by porous sandstone, which are discontinuous. In some locations, where the shale is broken or jointed, small supplies may be obtained. Wells drilled over 100 feet deep are likely to obtain salt water. Dug wells and cisterns are common water sources (Walker, 1958).

Level III Ecoregion

Map 3 Ohio's Level III Ecoregions



According to the ecological classification developed by the United States Forest Service, the Federal Valley watershed lies within the Southern Western Allegheny Plateau Section (221), in the Eastern Broadleaf Forest Province, and in the Western Hocking Plateau Subsection (221Ef) (Keys et al. 1995).

The Western Allegheny Plateau (Section 221E), a maturely dissected plateau characterized by high hills and sharp ridges, is partly comprised of the Appalachian Plateaus geomorphic province. Elevation ranges from 650 to 1,300 feet, and local relief is typically 160 to 325 feet. Bedrock is overlain by Quaternary residuum on the ridges and hilltops, colluvium on the slopes, and Pleistocene lacustrine and/or alluvium materials in the valleys. The soil is dominated by the presence of Udalfs, Udults, and Ochrepts. It is also characterized as having an udic soil moisture regime and a mesic soil temperature regime (USDA 1992).

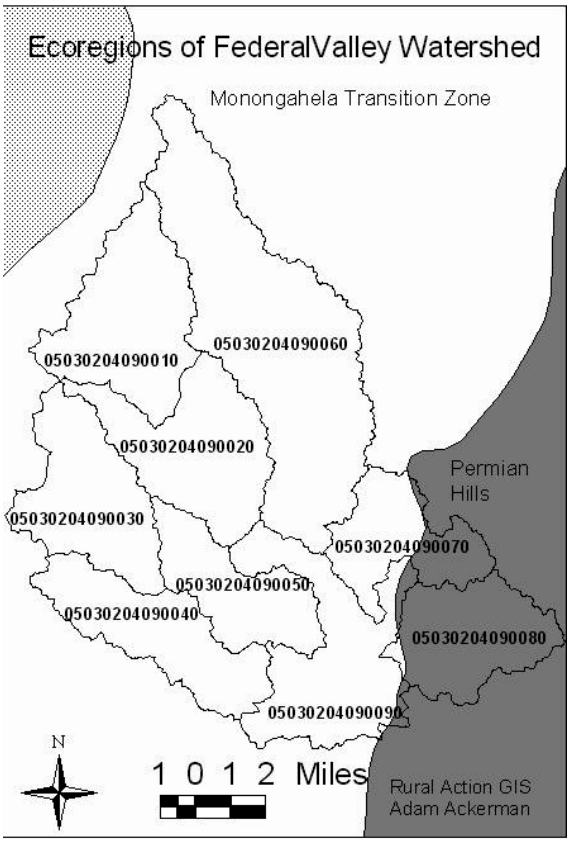
The Southern Unglaciated Allegheny Plateau (Section 221E) has unique vegetation and fauna characteristics. Potential vegetation is mixed mesophytic and Appalachian oak forests. Further recognized forest communities include oak-hickory-chestnut, oak-pine, hemlock, beech, mixed oak, floodplain, and swamp. Typical mammal populations include the white-tailed deer, gray squirrel, gray fox, opossum, white-footed mouse, and woodchuck. Fish such as the muskellunge, sturgeon, catfish, buffalo, drum, walleye, and sauger are typical in the headwater streams and rivers, while southern redbelly dace, creek chub, barred fantail darter, and greenside darter are common in smaller streams (USDA 1992).

Characteristic of this region is the dramatic impact of glaciers. The drainage system is a result of intricate drainage re-arrangements over long periods of time. This section has a high number of streams, which have gradients ranging from high, steep headwater streams to low gradient rivers. Although most are ephemeral, small streams are abundant. Some streams are underlain by shallow silt, gravel, or sand alluvium and others in the valleys are full of thick glacial deposits. Stream flow and water quality have been greatly modified by gas, coal, and oil extraction activities. Other disturbances on streams in this region include channelization, and the input of sewage and mining (USDA 1992).

Roughly half of this section is forested; however, since the time of settlement, level lands have been cleared for agriculture, and most slopes have been repeatedly logged. Areas with poor soils and/or severe erosion have been left to natural succession or planted with trees. The land use of the Western Allegheny Plateau is also characterized by the increasing urban expansion along the Ohio River and its main tributaries (USDA 1992).

Level IV Ecoregions

Map 4 Level IV Ecoregions



The Federal Valley Watershed is divided into two physiographic ecoregions; the Permian Hills (70a) and the Monongahela Transition Zone (70b). The Monongahela Transition Zone (70b) is characterized by rounded hills and ridges, which generally tend to be less rugged than the Permian Hills Ecoregion. On the coal bearing strata, clay- containing unstable regolith has developed. Forests reside in steeper regions of this Ecoregion, and livestock, dairy, and general farms are also common. Stream degradation associated with the locally extensive gas wells, coal mining, and reclaimed land regularly occurs. The Permian Hills Ecoregion is characterized as rugged, forested, and generally too steep to be farmed. On the underlying Permian shale, sandstone, and coal, high gradient streams have developed. These streams lack acidity problems, and on shale, they are frequently ephemeral and devoid of large riffle-inhabiting fish populations (Ecoregions of Indiana and Ohio, 1998).

As shown in Map 2, the majority of the watershed is within the Monongahela Transition Zone, whereas a lesser amount is within the Permian Hills Ecoregion. The Monongahela Ecoregion contains the Sharps Fork, and Mush Run subwatersheds. It also contains the areas of McDougall Branch below Mush Run to Federal Creek, McDougall Branch above Mush Run, Federal Creek headwaters to below Hyde Fork and Miners Fork confluence, Federal Creek below Miners Fork to above McDougall Branch, and the Federal Creek below McDougall Branch to the Hocking River. The Monongahela Ecoregion also contains the majority of the Marietta Run subwatershed. The Permian Hills Ecoregion contains the Big Run subwatershed and a small portion of the Marietta Run subwatershed (Ecoregions of Indiana and Ohio, 1998).

Soils

Soil associations are areas that have distinctive patterns of soils, relief, and drainage in common. Each soil association has a unique natural landscape. Typically, an association consists of one or more major soils, from which the name is derived, and some minor soil types (USDA, 1981).

The Athens County portion of Federal Valley Watershed consists of five soil associations. The Brookside-Westmoreland-Vandalia Association covers most of Ames Township, the western portion of Bern Township, a small portion of the northeastern corner of Canaan Township, and the eastern fringe of Dover Township. This association consists of soils on long narrow ridges, side slopes, and broad, uneven foot slopes. The side slopes are commonly benched or broken. Slopes range from 15 to 70 percent. Streams are typically small, and valleys are relatively narrow. The soils are characterized as deep, moderately well drained and well drained, and moderately steep to steep. Major land use limitations include the steep slopes, erosion hazard, slow permeability, seasonal wetness, high shrink-swell potential, and susceptibility of the Brookside and Vandalia soils to hillside slippage.

The Steinsburg-Westmoreland-Vandalia Association covers much of Bern Township as well the eastern portion of Rome Township. This association also consists of ridge tops and side slopes that are occasionally broken by narrow benches. Slopes are uneven and range from 25 to 70 percent. As with the previous association, streams are small with relatively narrow valleys, and the soil is characterized as deep, well drained, and steep. Major limitations for land uses are the steep slopes, erosion hazard, slow permeability, and the high shrink-swell potential and susceptibility of the Vandalia soils to hillside slippage.

The Westmoreland-Guernsey-Upshur Association covers much of Canaan and Rome Townships, and parts of Ames, Bern, and Dover Townships. This association consists of high hills and ridges. Most areas are drained by small drainage ways. Slopes range from 8 to 70 percent, but are dominantly 15 to 40 percent. This association is characterized as deep, strongly sloping to very steep, and well drained. While slope and erosion hazard are the major land use concerns, slow permeability and susceptibility to hillside slippage are also limitations.

The Omulga-Licking Association is found in a small area in the southwestern portion of the watershed in parts of Rome and Canaan Townships. This association consists of soils in preglacial valleys and on terraces. Soils are dominantly on smooth, uniform areas that are interspersed with drainage ways. Slopes range from 3 to 15 percent. Most areas of this association are farmed; they are poorly suited to septic tank absorption fields. The major land use limitations are slow permeability, seasonal wetness, erosion hazard, the high shrink-swell potential of the Licking soils, and the frangipan of the Omulga soils.

The Chagrin-Nolin Association is found on flood plains along the major streams that are subject to rare or frequent flooding. These are deep, nearly level, well-drained soils formed in alluvium. Permeability is moderate, and runoff is slow. Most areas of this association are farmed. They are well

suited to corn, soybeans, hay, and pasture, as well as woodland. Flooding is the major limitation for most uses.

The Lowell Gilpin Guernsey Association is the sole soil association found in the Morgan County portion of the Federal Valley Watershed. This association is on narrow ridge tops, hillsides, and benches. A few narrow benches break some hillsides. Broader benches are undulating and dissected by narrow stream flood plains. Slope ranges from 12 to 70 percent. The soils are deep, steep, and well drained. The major management concerns on ridge tops, broad benches, and hillsides are slope, restricted permeability, shrink-swell potential, and erosion. Additional management problems on broad benches are seasonal wetness and slippage, and on hillsides are depth to bedrock and doughtiness.

The Gilpin Dekalb Woodsfield Association is the sole soil association present in the Washington County portion of the Federal Valley Watershed. This association is on steep and very steep side slopes and wide, gently sloping and sloping ridge tops. Brownish loamy soils predominate. These soils are deep and well-drained. The slope and moderate depth over bedrock are limitations for many nonfarm uses.

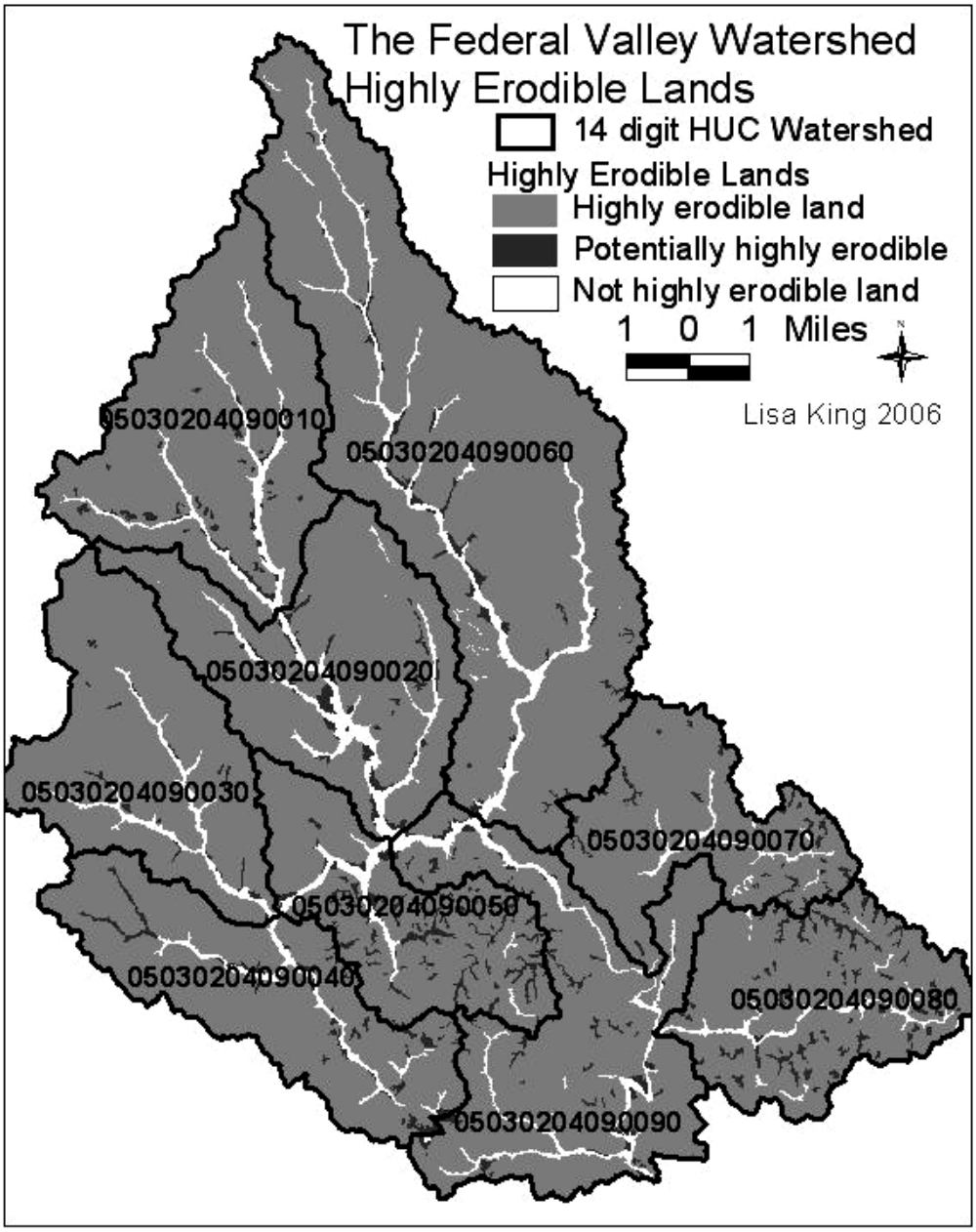
Local Soil Ratings

This section will discuss local soil ratings based on the following categories: Highly Erodible Land; Drainage Class; Prime Farmland. These are defined below.

Table 4 Soil Categories by drainage basin

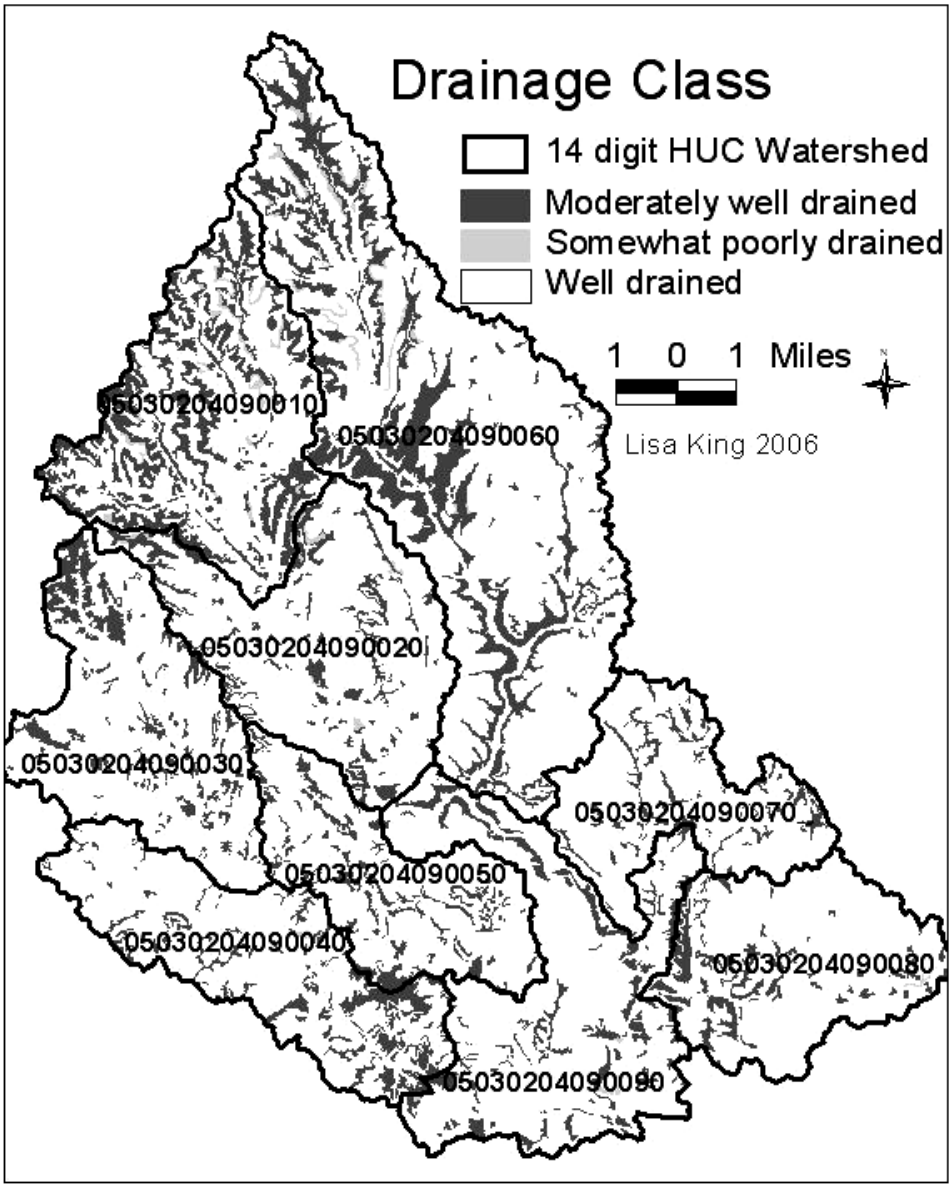
ALL UNITS ARE IN SQUARE MILES												
Subwatershed	total square miles	County	highly erodible land	potentially highly erodible	not highly erodible	well drained	moderately well drained	some what poorly drained	poorly drained	prime farmland	farmland local importance	Not prime farmland
05030204090010 (Miners, Hyde, Smith)	15.83	Morgan	14.59	0.39	0.85	10.75	4.67	0.39		0.63	6.35	8.24
05030204090010 (Miners, Hyde, Smith)	0.68	Athens	0.58	0.02	0.08	0.47	0.22				0.38	0.22
05030204090020 (Upper Federal, Kasler, Kitten, Linscott)	3.07	Morgan	3.04	0.01	0.02	2.35	0.61	0.12		0.03	1.12	1.84
05030204090020 (Upper Federal, Kasler, Kitten, Linscott)	12.43	Athens	10.68	0.56	1.20	11.02	1.38	0.03		0.10	6.94	4.17
05030204090030 (Upper McDougall, Bryson)	0.29	Morgan	0.29			0.18	0.10				0.16	0.13
05030204090030 (Upper McDougall, Bryson)	13.70	Athens	12.90	0.17	0.63	11.63	2.10			0.09	8.08	4.90
05030204090040 (Mush, Dutch)	13.13	Athens	11.96	0.60	0.56	10.94	2.16	0.02		0.21	6.91	5.43
05030204090050 (Lower McDougall, Wyatt)	10.40	Athens	8.79	1.10	0.53	8.83	1.56			0.15	5.51	4.22
05030204090060 (Sharps, Opossum, Sulphur)	26.27	Morgan	24.74	0.40	1.13	20.05	5.72	0.50		0.86	8.27	16.47
05030204090060 (Sharps, Opossum, Sulphur)	9.31	Athens	8.37	0.27	0.64	7.52	1.76			0.07	3.33	5.27
05030204090070 (Marietta, Brill)	7.83	Athens	7.30	0.26	0.22	7.04	0.76			0.03	2.16	5.41
05030204090070 (Marietta, Brill)	2.35	Washington	2.02	0.23	0.09	2.04	0.30			0.31		2.03
05030204090080 (Big, Ellis)	2.84	Athens	2.61	0.10	0.11	2.00	0.83				0.82	1.90
05030204090080 (Big, Ellis)	9.03	Washington	7.82	0.86	0.35	8.34	0.66	0.02		1.17		7.83
05030204090090 (Lower Federal, Sharps R)	17.28	Athens	15.21	0.78	1.28	14.88	2.36	0.05		0.02	6.06	9.88

Map 5 Highly Erodible Lands



The overall Highly Erodible Lands (HEL) classification for the map unit based on the rating of its components for wind and water HEL classification. Highly erodible lands are areas on which erosion control efforts should be concentrated. The indexes are the quotient of tons of soil loss by erosion predicted for bare ground divided by the sustainable soil loss (T factor). It seems that the majority of Federal Valley is classified as highly erodible land, except immediately along each mainstem.

Map 6 Drainage Class



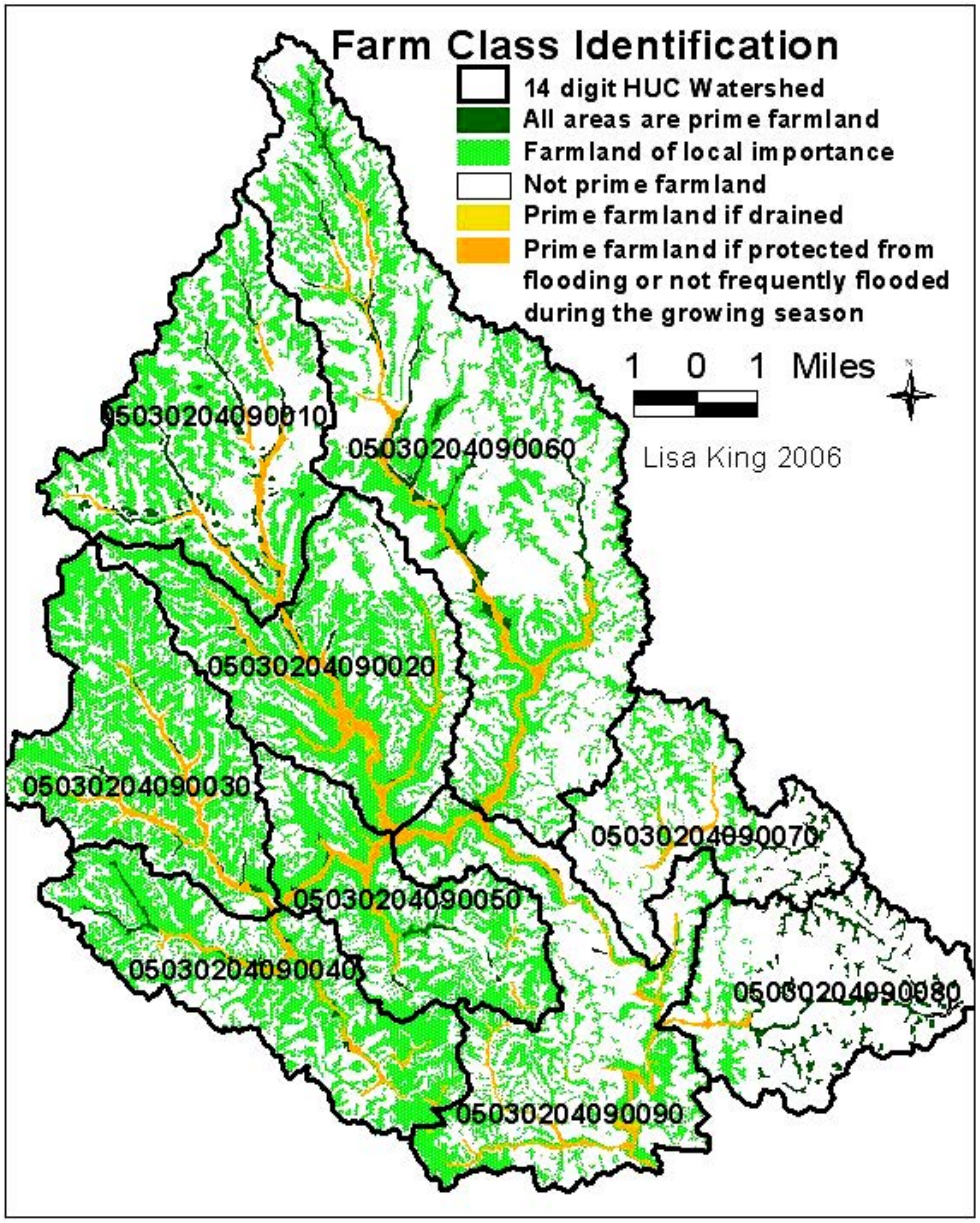
Soil drainage classes are codes identifying the natural drainage condition of the soil and refer to the frequency and duration of periods when the soil is free of saturation. The map shows that most of the watershed is well drained, and moderately well drained. There are very few places that are somewhat poorly drained.

Well Drained Water is removed from the soil readily, but not rapidly

Moderately well drained water is removed from the soil somewhat slowly during some periods. Soils are wet for only a short time during the growing season.

Somewhat poorly drained Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness restricts growth of mesophytic crops.

Map 7 Farmland Classification



Farm Class is the identification of map units as prime farmland, farmland of statewide importance, or farmland of local importance. In this map one can see that there is a difference in the classification system for each of our three counties.

Prime farmland is land that has the best combination of physical and chemical characteristics for producing food (the land could be cropland, pastureland, rangeland, forest land, or other land but not urban or built-up land or water areas).

Farmland of local importance is land that does not have the characteristics to be considered 'prime farmland', however it is locally important based on local farmland conditions.

Glacial

The Federal Valley Watershed lies in the unglaciated portion of the state. However, glaciation is evident in the sand and gravel outwash that was carried down the Hocking Valley by glacial melt water. The Marietta Plateau contains Minford clay, which was deposited by the glacial damming of the northwardly flowing preglacial Teays River system, a result of the first glacial advance into Ohio. Further glacial evidence is seen in terraces composed of clay, silt, and sand, which occur in some of the lower portions of Federal Creek. These deposits appear to have accumulated in lakes formed when gravel outwash in the Hocking Valley dammed their mouths, and are known as the Wisconsin lake silts (Kempton 1958).

Geology

Specifically, the watershed lies within the Marietta Plateau, characterized as dissected and high relief. The Marietta Plateau mostly contains fine-grained rocks and commonly contains red shale and soils. Landslides and ancient remnants of the lacustrine clay-filled Teays drainage system are also common (ODNR, Division of Natural Resources 1998). An early land system inventory for the nearby Wayne National Forest indicated that the majority of the landscape could be mapped as maturely dissected uplands; the remainder consists of broad river valleys and floodplains (Wester 1977). Typical side slopes have a steepness gradient of 12 to over 40 percent (USDA 1967). The common lithologic types are sandstone, shale, siltstone, limestone, and coal (Cusick and Silberhorn 1977).

The Federal Valley Watershed lies within the Permian and Pennsylvanian geologic systems. Within these two systems, three distinct rock units make up the strata underlying the watershed. These include the Dunkard Group of the Permian system and the Monongahela Group and Conemaugh Group of the Pennsylvanian system (ODNR, Division of Geological Survey 2001).

The Dunkard Group's lithology or rock composition consists of sandstone, siltstone, shale, and slight amounts of limestone and coal (ODNR, Division of Geological Survey 2001). Permian rocks, which follow immediately above the Pennsylvanian sequence, are the youngest of the coal-bearing rocks in Ohio (Sturgeon 1958). Color for this group tends to be shades of brown, gray, green, and red. The Dunkard Group also typically has a thickness of 600 or more feet and thin to massive bedding. This group features a dominance of siltstone, shale, and sandstone, and has an occurrence of non-marine limestone. It also features quick vertical and horizontal change in rock type (ODNR, Division of Geological Survey 2001).

The Monongahela Group, the youngest of the Pennsylvania rocks, has a lithology consisting of shale, siltstone, sandstone, limestone, and coal (Sturgeon 1958; ODNR, Division of Geological Survey 2001). The highest alkalinities are associated with the thick freshwater limestone sequences of this group in the Vanport limestone of the lower Allegheny Group and in the southwestern corner of Pennsylvania

(Brady, Hornberger, and Fleeger 2003). Color for this group tends to be shades of gray, green, and uncommonly red. The Monongahela Group also has a thickness of 350 or more feet and nonbedded to massive bedding. This group features laterally extensive non-marine limestone layers and economic coal beds, such as the Pittsburgh (No. 8) coal bed, a mineable reserve located at the base of the formation (Sturgeon 1958; ODNR, Division of Geological Survey 2001). Although the overlying strata of the Pittsburgh (No. 8) coal bed contain nine other coal beds, it is the only one that is of a moderate extent (Sturgeon 1958).

The Conemaugh Group consists of layers of shale, sandstone, siltstone, and mudstone (ODNR, Division of Geological Survey 2001). Where marine limestones are present, significant alkalinity concentrations occur in this group (Brady, Hornberger, and Fleeger 2003). The Conemaugh Group also contains many layers of coal beds; however, none of these are sufficiently thick or extensive to be considered a mineable resource. Only small amounts of coal are still mined occasionally for local or household use (Sturgeon 1958). This group typically is gray, green, brown, red, and black. The Conemaugh Group also has a thickness anywhere from 350 to 490 feet and nonbedded to massive bedding. This group is characterized by multicolored mudstones, thin to thick marine limestone, and shale in the lower two-thirds of the unit. It also features quick vertical and horizontal change in rock type, and it is not common to find coal beds in this group (ODNR, Division of Geological Survey 2001).

Coal Resources

The Pittsburgh (No. 8) coal is one of the most extensive and valuable beds in the eastern United States and is the primary coal bed of economic importance in Athens County. Athens County has the richest Pittsburgh coal deposits in Ohio, except for the Belmont field. Two main regions in Athens County have a great extent of the resource: the Federal Creek field in northeastern Athens County and the Shade Creek field in the south-central region of the county. Although production from the Federal Creek field has declined in recent years, it contains the greatest coal reserves of the two economically important areas (Delong 1955). It is for this reason that the Federal Creek field has made the Pittsburgh coal bed famous in Athens County (Sturgeon 1958).

The Federal Creek field is most extensive in Bern Township of Athens County and contains large reserves in Rome and Ames Townships of Athens County (Sturgeon 1958). This field, which terminates in Decatur Township of Washington County, also includes parts of Homer and Marion Townships of Morgan County. Although the Pittsburgh coal exists in almost every township in Morgan County, the extension of the Federal Creek field accounts for all of Morgan County's reserves. Approximately 60% of Morgan County's estimated original reserves are within the Federal Creek field in Marion and Homer Townships. Washington County does not contain any parts of the Federal Creek field, however, it does

contain two areas of mineable Pittsburgh coal: the Eastern Washington field in Aurelius and an area in Decatur Township where the Federal Creek field ends (Delong 1955).

In the Federal Creek field the coal is thin, represented by a carbonaceous shale or limestone, and is overlain by heavy sandstone (Delong 1955). It is also characterized by a double-benched, (lower and upper bench) structure that is divided by clay, several inches to one foot in thickness. The lower bench, more uniform in its thickness, contains slender partings of a pyritic nature. The upper bench is generally superior in quality and also contains slender irregular partings of clay, bone, and pyrite. At Sharpsburg within Bern Township, the Pittsburgh coal thickness has changed laterally from eight feet to a zone of nonbedded, mottled yellow, maroon, and tan clay shale deposited during the Pittsburgh coal forming period (Sturgeon 1958).

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HUMAN HISTORY

Before European Settlement

The Archaic period is the classification for the time 12,000 to 3,000 ybp (years before present). At this time the boreal forest of the glacial period was replaced by oak-hardwood forest and for some parts of this time period water levels and precipitation were lower than present. The archaic of this area are thought of exclusively as hunter-gatherers, primarily small bands moving to follow game, nuts and fruits. In the winters they would live in south facing rock overhangs near ridge tops (Cowan 1977).

The Woodland period, 3,000 to 950 ybp is regarded as an era of humans moving toward a sedentary lifestyle, while still foraging much of their food. Cultivated plants were becoming prominent in their diet. The villages became more permanent and were more often present in the floodplain. This period is also marked by large ceremonial earthworks and expansive cross continent trade networks. (Cowan 1993) Woodland people had habitation sites composed of domestic structures and small garden plots. Adjacent to the community were larger fields of crops, interlaced with old fields lying fallow. In the fallow fields were perennial plants, which bore fruit, nuts, and valuable “weeds” (Hammette 1993).

The early woodland period 2950 to 1950 ybp was marked by the Adena culture. These people are primarily known for mounds built on ridge tops. The Adena mainly focused on food production from trees, shrubs, and a hunting-gathering regime. They also had a complex gardening regime including cucubita, sumpweed, chenopod, sunflower, bottle gourd, maygrass, and knotweed (Cowan 1993) and trade goods from all over the continent.

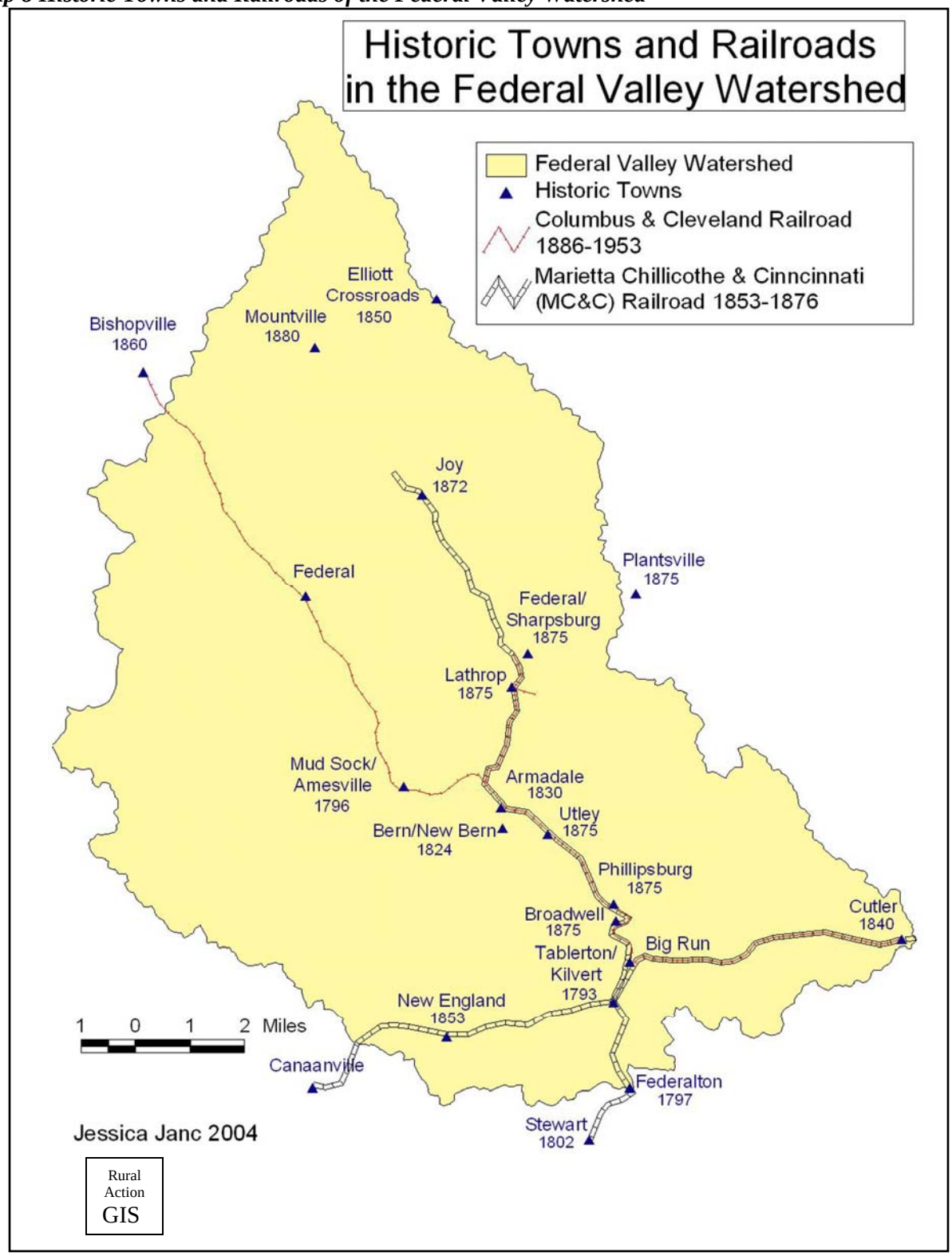
The middle woodland period, 1950 to 1250 ybp was marked by the Hopewell culture. These people are primarily known for mounds built in the floodplains. The Hopewell exhibited three forms of settlement pattern. In the first pattern were central base camps where regular but discontinuous activities took place. In a second pattern, there were permanent base camps occupied by groups ranging from nuclear families to local bands. Thirdly, there were seasonal base camps occupied by nuclear and extended families (Crites 1987). This group is also well known for earthwork-mound complexes but there do not seem to be any large sedentary villages (Pacheco 1996).

The Late Woodland period, 1250 to 950 ybp, residency of the highlands was restricted to short visits in the fall to hunt (Cowan 1993). The winter months were spent in large nucleated settlements located on the floodplain. These people can truly be called farmers in that they depended almost entirely on stored cultivated crops (Johannessen 1993). Maize was adopted as their main diet. (Cowan 1996).

Stockade towns of several hundred people mark the Fort Ancient people, from 1000 to 250 ybp. Generally these villages were confined to large stream and river valleys and located adjacent to soils that could be cultivated (Nass 1988). These people had large tracts of fields in monocrops (Cowan 1987). Progress of this group was terminated by European movement and disease introduction around 350 ybp.

European Settlement History

Map 8 Historic Towns and Railroads of the Federal Valley Watershed



Europeans first arrived in the area in 1650 AD. The Shawnee, Cherokee, Miami, Delaware and Wyandotte cultures lived in this area and co-existed with large mammals such as bison, panther, bear, wolf and cougar. Although most of those species were extinct to the area by 1800, it remained a rich trapping ground for European settlers.

The first European settlers in the Federal Valley Watershed were a group of federal army veterans living in Marietta in 1792 and working as hunters and trappers. They sought to live in the Federal Valley Watershed because of the rich hunting. These soldiers named the creek Federal because of the lucky thirteen tributaries that made up the watershed (Big Run, Sharps Run, Marietta Run, Bryson Branch, Mush Run, Wyatt Run, Sharps Fork, Opossum Run, Hyde Fork, Miners Fork, McDougall Branch, Linscott Run, Sugar Run). The number thirteen represented the thirteen original colonies of the United States (Lake, 1875).

In 1774, Lord Dunmore fought a battle at the confluence of Federal Creek and Hocking River. Some say that in 1797 Federalton was established by the soldiers who stayed behind (Smith, 19). This would be the first major port traveling up the Hocking after leaving the Ohio River.

In 1793, Barrows Mill opened. This mill was the first in the area to produce white flour. (Smith). In 1802, the founder of Stewart arrived and began farming slightly up the Hocking River from Federalton. Michael Tabler bought Barrows Mill and most of the land from the mill to Federalton in 1835. He had been a slaveholder from the south who moved here to emancipate his slaves. Subsequently he married one of his ex-slaves. By 1875, Tablertown had a post office. Big Run, Broadwell, Phillipsburg and Utley were neighboring towns. In 1937, Tablertown was destroyed by a tornado and Kilvert was erected in its place. In 1969, the people of Kilvert formed the Kilvert Community Center, which is still in operation.

In 1796, the settlement known as Mud Sock, now Amesville, was established. In 1800, a mail route was created from Zanesville to Cincinnati, by way of Marietta, Amesville, Athens and Chillicothe. In 1804, the first library in the Northwest Territory opened in Amesville, it was called the Western Library Association, but it was commonly known as “Coon-skin Library”. Local settlers selling the pelts of animals paid for the books in the library. Originally this library had 51 books and by 1830 there were 250 books. In 1810 Amesville established a post office. In 1828, the first brick church was built (Unto these Hills, 1975). Amesville continued to grow until the 1950’s when the railroad shut down. In 1997 and 1998 the village was devastated by two extremely large floods, and at that time many homes near the river had to be torn down, which greatly reduced the population of the village. Other early towns in the area were Bern, established in 1824, and New Bern established in1857. A town called Federal was platted by 1875 and became Sharpsburg by 1900. This town became very large due primarily to coal mining.

Armadale had a mill in 1830. Phillipsburg, Broadwell, Utley, and Lathrop sprouted up in 1875. Cutler was being settled by 1840. Plantsville was settled around 1875.

New England was settled in 1853 when the Marietta, Chillicothe, and Cincinnati railroad went through it. The railroad also went through Canaanville, Kilvert, Big Run and Cutler. In 1874, the railroad was abandoned (Smith). The railroad from Columbus to Marietta, by way of Glouster, Amesville, Big Run and Cutler was established in 1886. The major coal mining towns of Utley, Lathrop and Broadwell grew during this era. The railroad shut down in 1957.

Ethnic groups in Federal Valley were varied. As early as 1830 a distinct ethnic group was present in the area. This multicultural group claimed European, Native American and African American heritage. There were also a large number of Quakers, African Americans and European immigrants. (Bern Story).

There were many places in the Federal Valley Watershed that had stops on the underground railroad. This is probably due to the fact that Federal Creek is the first major north moving tributary on the Hocking River and is near the Ohio River. It is also probably related to the already present multicultural heritage of the area.

The first industries in the valley were trapping and farming. By the 1830's mills were present near Federalton, Armadale, and Amesville. In 1898 there was a mill in Sharpsburg. There was a sawmill in Broadwell in 1875. In the 1890's coal mining in the watershed became a major source of employment. The town of Utley had about 250 coke ovens in operation near the banks of Federal Creek. Armdale also had approximately 100 coke ovens at the same time. By 1957, the railroad shut down and the major coal mining towns of Utley, Lathrop and Broadwell were no longer the boomtowns they had been in the early part of the century.

The major coal operations in the watershed were the Black Diamond and the Jennings Mine (Hartzband, 1981). There has been a steady decline of coal extraction since that time. In 1966, coal strip mines within the watershed yielded 30,000 tons of coal (USDA 1967). Most of this strip mining took place in Sharps Fork. During the 1970's, as high sulphur coal became less valuable and transport became more expensive (i.e. no railroad), this land use declined. Since 1998, no coal was extracted from the watershed and most of the land owned by coal companies has been parceled out and sold.

In the Big Run/ Cutler area, Cleveland Stone Co. had four sandstone quarries in 1900. These stones, 3 to 7 feet in diameter and 1 to 2- feet thick, were milled on the Karl Mayle farm. These quarries and millstones were created with access to the MC&C Railroad. The stones were used for making files, saws, machine knives and edge tools. These stones were used throughout the U.S. around the turn of the century (OHI 1977).

The towns of Mountville and Joy were growing during these times. Businesses in Mountville included the following: a general merchandise shop with dry goods, groceries, hats, caps, boots, and shoes; an attorney at law; a carpenter, joiner and contractor; a coal bank-(coal for sale at the bank or delivered to any part of the country); a Justice of the Peace; a general gunsmith. Joy businesses included: a stock dealer, a wood dealer, a general merchandise shop, a resident farmer, a miner and dealer in coal, the Superintendent of Mansfield Petroleum Company, and the Superintendent of Vose Oil Company. Business directories from the 1875 period indicate similar occupational activities in Bern Township. Some of these activities included breeders and stock dealers of cattle, hog, sheep and horses, a manufacturer of cut shingles, a fruit dealer, a tobacco grower and several farmers.

The Amesville business directory during this same time indicates there were breeders of fine sheep and blooded horses; an agricultural implements and general merchandising store; a blacksmith and wagon maker; a manufacturer of wagons, carriages and buggies; a dealer in dry goods, groceries, yankee notions, books, shoes, queenswear, hats and caps; a blacksmith with horseshoeing as a specialty, a physician and surgeon, a manufacturer and dealer in furniture and undertaker; and several dealers in stock

Although the farm economy has been in decline for some time, farming has historically been a major industry in Federal Valley. There are still some successful orchards and small farms, and there seems to be some revitalization in farming with the idea of organic agriculture. There was employment in the area between 1937 and 1945 clearing scrubby, woody, secondary growth from many areas of the Federal Valley watershed to convert these areas to pasture for livestock. (Alice Stobart, 1998) Most of the area's large-scale clear-cutting took place before 1955. Since that time there has been a trend toward reforestation of farmed, mined, cleared and pastured land use. Timber currently is an important industry, especially in the Big Run area.

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DEMOGRAPHICS

Population

The Federal Valley Watershed lies within Morgan, Washington and Athens counties. Washington County has the largest population of the three, with 63,251 people in 2000. Both Washington and Athens Counties have had slight increases in population since 1900. In contrast, the village of Amesville in Athens County has decreased in population, from 298 residents in 1930 to 184 in 2000. Morgan County has also decreased in population in the last century, from 17,905 residents in 1900 to 14,897 in 2000. As Table 1 illustrates, the state population has nearly tripled in the last century, while the three counties in the watershed have had little or no population increases.

Block groups, which are portions or blocks of land smaller than counties, were used to better estimate the actual total population in the watershed. It is important to note that, although using block groups results in more accurate data, it is still an estimate. Block groups still cross over watershed boundaries, and are therefore not completely contained within the watershed. In the table below, the total population in the watershed was found by summing the individual block groups in each of the three counties. The total population in the watershed was estimated to be 8,202.

Table 5. Historical Population Growth 1900-2000

	Population in 1900	Population in 1930	Population in 1970	Population in 2000
Athens Co.	38,730	44,175	54,889	62,223
Amesville Village	---	298	295	184
Block Group	---	---	---	3,466
Washington Co.	48,245	42,437	57,160	63,251
Block Group	---	---	---	2,109
Morgan Co.	17,905	13,583	12,375	14,897
Block Group	---	---	---	2,627
*Federal Valley Watershed	---	---	---	8,202
Appalachia	971,844	1,075,512	1,237,660	1,455,313
Ohio	4,157,545	6,646,697	10,652,017	11,353,140

Source: U.S. Census Bureau 2000 http://ilgard.ohiou.edu/data/index.asp
Amesville data: http://factfinder.census.gov/servlet/BasicFactsServlet
* This was calculated by summing the individual block groups within each of the three counties.

Age and Gender Ratios

According to the U.S. Census Bureau (2000), Athens County has a median age of 25.7 years. Washington County has a median age of 39.1 years and Morgan County 38.9 years. Individuals within Amesville village have an average age of 36.4 years, given most people in the village are 35-44 years of age (22.3 % of total population).

There are slightly higher percentages of females in Athens, Washington and Morgan Counties than there are males. Athens County has 48.8% males and 51.2% females. Washington County has 48.5% males and 51.5% females. Morgan County has 49.1% males and 50.9% females. In Amesville village, 47.8 % are males and 52.2% are females.

Educational Attainment

Overall educational attainment levels in Appalachian Ohio and in the watershed are significantly lower than in other areas in the state. The exception to this is the high school graduate percentage for Washington County, Morgan County and Appalachia, which are higher than the state's. Fewer people in the watershed have gone on to higher education, such as a bachelor's degree. The exception to this is Athens County, influenced by Ohio University, which follows the state pattern and outranks it significantly in the number of residents who complete graduate school.

For the most part, educational attainment for Federal Valley Watershed follows the same pattern as the other counties. The percentage of high school graduates is 45%, higher than the state level and that of all of Appalachia. In contrast, the percentages of those individuals with some college, Associate degrees, Bachelor's degree or graduate school are lower for the watershed than for the state.

Table 6. Educational Attainment for Adults 25 and Older, 2000

	High School Graduate	Some College	Associate's Degree	Bachelor's Degree	Graduate School
Athens Co. Block Group	34.2% 39.8%	16.5% 13.9%	6.5% 7.5%	12.6% 11.8%	13.2% 8.3%
Washington Block Group	43.0% 44.6%	19.4% 18.1%	7.1% 8.0%	9.4% 6.4%	5.6% 4.9%
Morgan Co. Block Group	50.5% 51.8%	15.8% 16.9%	5.3% 5.1%	5.1% 6.0%	4.0% 1.8%
Federal Valley Watershed*	45.0%	16.0%	5.9%	8.5%	5.3%
Appalachia	43.7%	16.6%	5.6%	7.9%	4.4%
Ohio	36.1%	19.9%	5.9%	13.7%	7.5%

Source: U.S. Bureau Census 2000 http://ilgard.ohiou.edu/data/index.asp

* This was calculated by summing the individual block groups within each of the three counties.

Economic Characteristics

The Appalachian region is the most economically depressed section of the state, and that is reflected in the poverty rate of the Federal Valley Watershed and its counties. The percent of Ohioans in poverty is 10.6%, but those figures are higher for the counties in the watershed. Athens County has the highest poverty level with 27.4% and Morgan County with the next highest, 18.4%. The table below shows how the percent unemployed correlates with the percent in poverty. Athens County with the highest percent in poverty has the highest percent unemployed at 11.1%. This unemployment percent is significantly more than the less poverty- stricken counties of Washington (7.4% unemployed) and Morgan (8.4% unemployed). In the Federal Valley Watershed, 15.1 % of all individuals live below the poverty level (1999 census). The civilian labor force unemployment percentage is 9.3 % in the watershed; almost double the state's percentage.

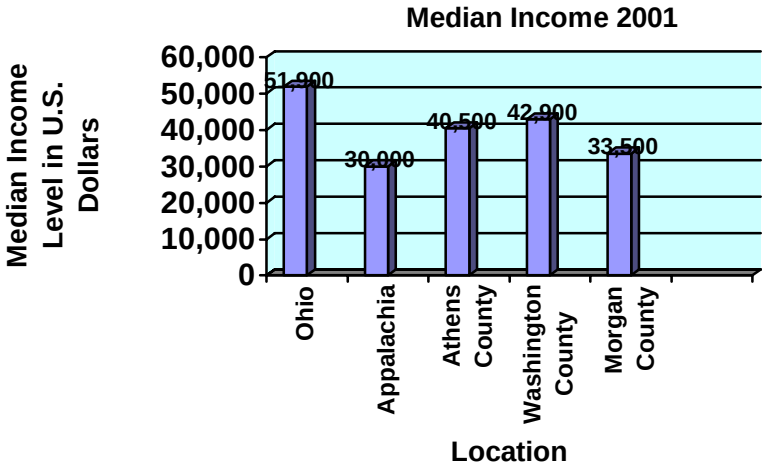
Table 7. Poverty Rates 1999

	Percent of all in Poverty 1999	Civilian Labor Force-Percent Unemployed
Athens Co. Block Group	27.4 15.9	11.1 6.2
Washington Co. Block Group	11.4 12.4	7.4 11.9
Morgan Co. Block Group	18.4 16.2	8.4 11.7
Federal Valley Watershed*	15.1	9.3
Ohio	10.6	5.0

Source: U.S. Census Bureau, 2000 http://factfinder.census.gov/servlet/BasicFactsServlet
* This was calculated by summing the individual block groups within each of the counties.

The annual median income for these counties tells a similar story (Figure 2). For the year 2001, the U.S. Department of Housing and Urban Development estimated the median household income for the state of Ohio to be $51,900. Figure 1 compares the median household incomes of the watershed counties, Ohio and Appalachia. Appalachia has the lowest median household income of $30,000, with Morgan County contributing to that figure, having a value of $33,500. Athens County likely has a higher median household income due to the college and industry there.

Figure 2. Median Household Income, 2001



Source: U.S. Dept. of Housing and Urban Development. http://www.huduser.org/datasets/il/fmr00/hud00oh.txt

Occupations and Industry

The most prevalent employment industries across the state are the service, trade and manufacturing sectors. In Athens County, there are a total employment of 18,423 individuals. The government sector claims the largest portion of this total with 6,835 individuals, equivalent to 37.1%. In Morgan County, the total employment was 3,444. The manufacturing sector claims the largest portion of this total with 734 individuals, or 21.3%. Washington County has the largest total employment in the watershed with 24,330 individuals employed. The wholesale and retail trade contributes the most to this total with 6,088, or 25%.

The state of Ohio has a total employment of 5,460,117. Unlike the counties in the Federal Valley Watershed, the service sector claims the largest portion of the state's total employment with 1,507,591 individuals, equivalent to 27.6%

Table 8. Employment by Industry, 2000

	Manufacturing	Government	Services	Finance	Trade	Construction	Other
Athens	1,160	6,835	3,098	669	4,734	607	510
Morgan	734	700	383	104	657	239	593
Washington	5,553	3,142	5,714	843	6,088	1,603	1,389
Ohio	1,082,145	657,744	1,507,591	298,934	1,366,254	247,533	300,113

Source: Ohio Department of Development, County Profiles, 2000
http://www.odod.state.oh.us/research/ProductListing.html#S0

In the table above, the 'Other' category for Athens County includes mining (24 individuals), agriculture, forestry, and fishing (128 individuals) and transportation and utilities (358 individuals). For Morgan County the 'Other' category consists of mining (221), agriculture (22) and transportation and utilities (350). In Washington County, the 'Other' category consists of mining (262), agriculture (272) and transportation and utilities (855).

Unemployment

According to estimates available through the Ohio Department of Job and Family Services, average unemployment rates are higher in Morgan and Washington Counties in comparison with the state's average. Morgan County has the highest rate of 18.5%, whereas Athens County has the lowest unemployment rate of 5.4%.

Table 9. Unemployment Rate, January 2003

	Athens Co.	Morgan Co.	Washington Co.	Ohio
Unemployment Rate 2002	5.4%	18.5%	6.6%	6.3%

Source: Ohio Department of Job and Family Services, bases on Bureau of Labor Market Information http://lmi.state.oh.us/LAUS/ColorRateMap.pdf

Housing and Infrastructure

About 69.8 percent of residents within the watershed counties own their own home, while the remaining 30.2 percent rent. In Amesville, about 79 percent of the residents own their own home. Ohio University student population boosts Athens County's rental units, though the township containing the university does not lie in the Federal Valley Watershed. Therefore, the estimate for Amesville is most likely closer to the actual percentage of those that own a home in the watershed. Table 8 shows the population and number of occupied housing units for the three counties in the watershed and for Ohio. This data reveals that on average there are two or three people per household.

For the state of Ohio, only 0.4% of the housing units lack complete plumbing. As Table 9 shows, all counties within the Federal Valley Watershed have a much higher percentage of households lacking complete plumbing. Morgan County is more than six times higher than the state level, with 2.5 percent of households lacking complete plumbing. Athens County has 1.2% of the housing units lacking complete plumbing, triple the state level.

Table 10. Housing Ownership in 2000

	Occupied Housing Units	Owned	Rented
Athens Co. Amesville village	22,501 70	13,596 55	8,905 15
Morgan Co.	5,890	4,607	1,283
Washington Co.	25,137	19,165	5,972
Ohio	4,087,546	2,758,131	1,329,415

Source: U.S. Bureau of the Census, 2000 http://ilgard.ohiou.edu/data/index.asp
Amesville Data: http://factfinder.census.gov/servlet/BasicFactsServlet

Table 11. People per Household

	Population	Number of Occupied Housing Units	Average Number of People per Household
Athens Co. Amesville	62,223 184	22,501 70	2.8 2.63
Morgan Co.	14,897	5,890	2.5
Washington Co.	63,251	25,137	2.5
Ohio	11,353,140	4,087,546	2.8

Source: U.S. Bureau of the Census, 2000 http://ilgard.ohiou.edu/data/index.asp
Amesville Data: http://factfinder.census.gov/servlet/BasicFactsServlet

Table 12. Occupied Housing Units Lacking Complete Plumbing

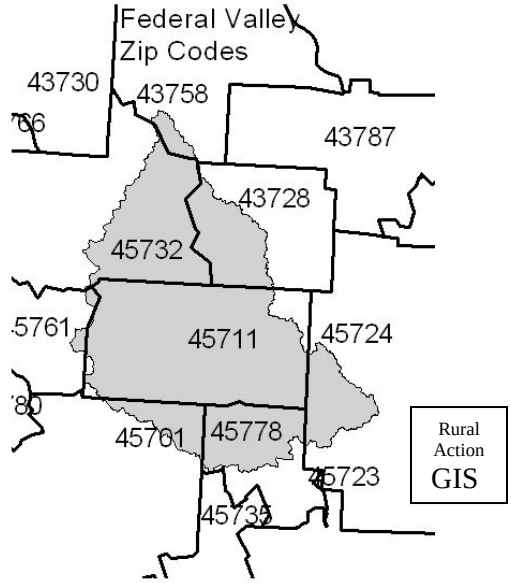
	Owner Occupied	Renter Occupied	Total # Lacking Complete Plumbing	Total Percent Lacking Complete Plumbing
Athens Co.	182	92	274	1.2%
Morgan Co.	107	40	147	2.5%
Washington Co.	110	74	184	0.7%

Source: U.S. Bureau of the Census, 2000 http://ilgard.ohiou.edu/data/index.asp

DISTRICTS

Zip Codes of the area

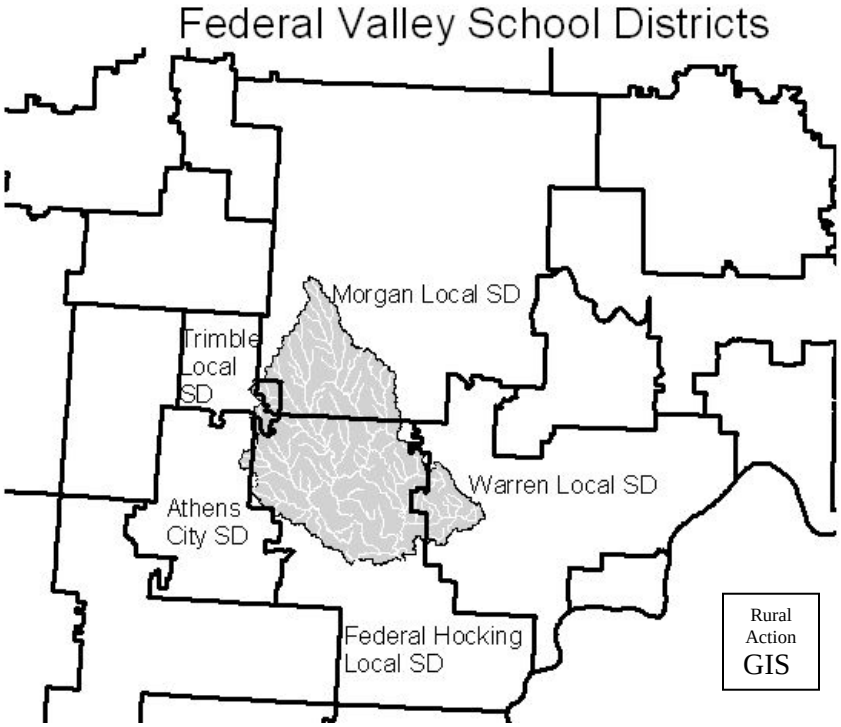
Map 9 zip codes



School Districts

Map 10 school districts that Federal Valley crosses into

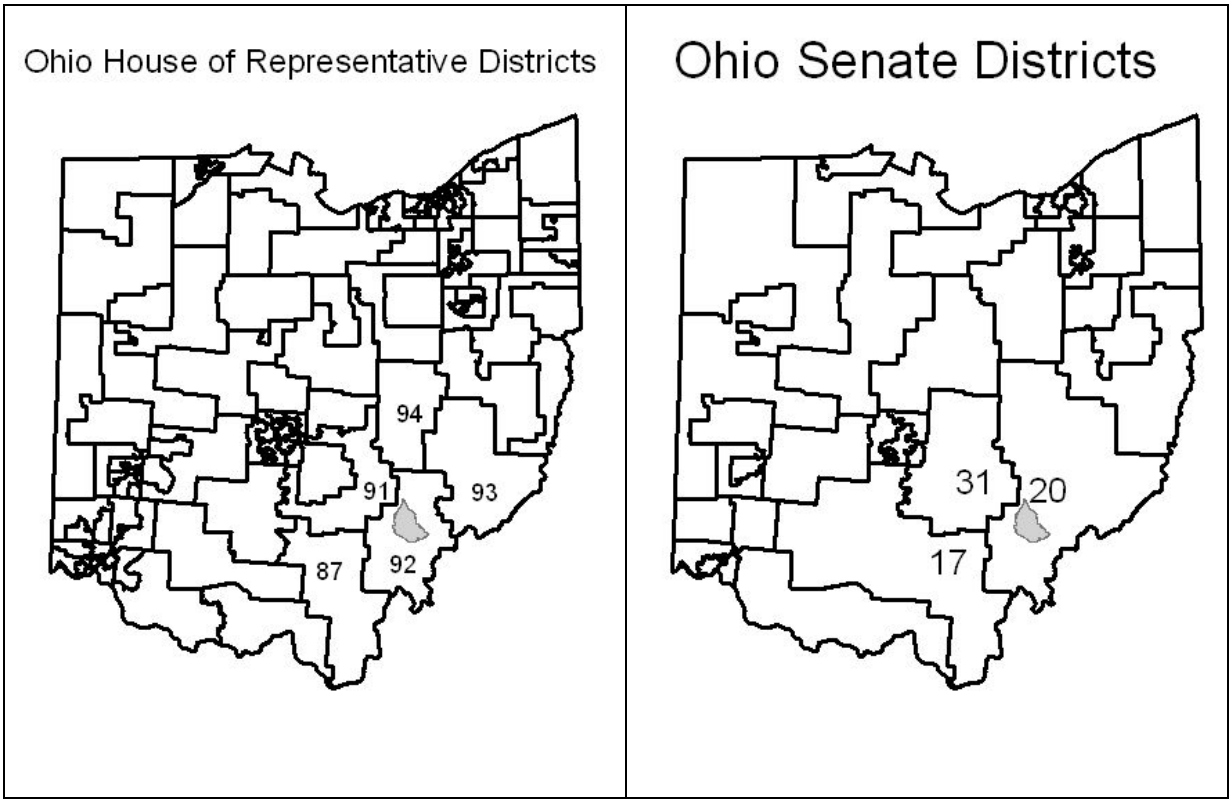
Also see appendix 5 for a table of educators.



Ohio House and Senate Districts

Map 11 Ohio House and Senate Districts

Federal Valley Watershed is in District 92 for Ohio House of Representatives and District 20 for Ohio Senate.



Resource Management Districts

The Federal Valley Watershed crosses many different resource management agency districts. Some of our resource managers work on a county level, in which case we have three, one from Washington, Morgan, and Athens County. Some resource managers work by district. In appendix 2 there is a table of many of our resource agents and their contact information.

Currently we have only three special designations in our watershed. The NRCS has designated a priority watershed with regards to EQIP and CSP; The Village of Amesville is a Tree City USA. The Nature Conservancy has designated FVW, the lower mainstem, an ecologically valuable area and stream. FVWG is interested in working on being a scenic river, and there is potential for some of our roads, like SR 550, and SR 329, and SR 555 to become a scenic highway. We do not have any phase II stormwater communities.

Source Water Assessment and Protection and Water Districts

Ohio's Source Water Assessment and Protection (SWAP) Program helps protect streams, rivers, lakes, and ground water used for public drinking water from contamination, ensuring the long term availability of safe drinking water for the citizens of Ohio. Within the Federal Valley watershed there is

only one public water system, it is in the Village of Amesville. This area has been assessed and is protected. The area begins at the Village of Amesville's groundwater wells. This area is 95 acres on an alluvial flood plain. It extends approximately one mile upstream of the wells.

With regard to public drinking water there are three systems that cross into the watershed. Tuppers Plains public water comes from Tuppers Plains, and there are some areas in the south eastern portion of the watershed that are served by this water system. Sunday Creek public water serves some of the northern and eastern areas of the watershed. Amesville serves only the area within the village limits. Most of the homes in the watershed are not served by public water companies but instead have wells and cisterns.

Background of Current and Historic Watershed Protection

Currently there are two projects that work on watershed protection. The first is USDA's farm bill programs. In the Federal Valley boundary there are 12 CRP. The average contract rental rate for the county is $73.00/acre. There are 3 EQIP contracts in the Federal Valley Watershed. One is on State Route 329 and the other 2 are on St. Rt. 550 West of Amesville. The other current program is in Amesville. This program is working on addressing the septic problem in the village. Appendix 3 will give the results of that projects current information. Historic water quality efforts can be seen in Appendix 4 a study done in 1963 to address flooding. Additionally in 2000 the village of Amesville received a FEMA grant to buy out homes that were destroyed in the 1998 floods. This area is now a green space and a park.

BIOTA

Invasive Species

FVWG have many issues with invasive species. In a survey of 137 watershed residents done by Rural Action's Sustainable Forestry Program, invasive plants were identified as a problem by 71%. The most commonly noted species was multiflora rose. Others included autumn olive, tree of heaven, various honeysuckles, Canada thistle, and other herbaceous species. This program is now beginning an assessment of invasives in the watershed; the inventory should be complete next year. The watershed group is a participant in this study. The primary species they are looking at are: Asian bittersweet; Asian stilt-grass; Garlic mustard; Amur honeysuckle; Japanese honeysuckle; Multiflora rose; Privet; Autumn olive; Winged burning-bush; Tree of heaven

Rare, Threatened, and Endangered Species in the Federal Valley Watershed

The Federal Valley Watershed is home to a wide range of plants and animals. Of the 127 endangered species found within the state of Ohio, two endangered species have been documented in the watershed. A total of 16 species, with state status, have been recorded in the watershed. The Ohio Department of Natural Resources (ODNR), Division of Natural Areas and Preserves (DNAP) compiled the list of these 16 documented species found within Federal Valley Watershed on October 27th, 2003.

The Division of Natural Areas and Preserves (DNAP) is responsible for protecting natural areas with ecological and/or geological significance under provisions of the Natural Areas Act of 1970. These protected natural areas or state nature preserves are sanctuaries for rare plants and animals. State law requires the chief of the DNAP to prepare and maintain surveys and inventories of both natural areas and rare species. The state endangered plant law additionally requires the Chief to create criteria for species listing and to compile an official list of plants that are endangered and threatened in Ohio (ODNR, DNAP, http://www.ohiodnr.com/dnap/about.htm).

This inventory data is readily obtainable in map and computer files that are cross-referenced to provide an information system known as the Heritage Data Base. The Heritage Data Base consists of the most comprehensive information on rare and endangered plants and animals, exceptional natural communities and unique geological features in the state. The information provided by this database can be used for watershed management plans, in which the species records are sorted to include the documentations found within a specific watershed boundary (ODNR, DNAP, http://www.ohiodnr.com/dnap/about.htm).

Listed below are the 16 documented species, classified either as endangered (E), potentially threatened (P), special concern (SC), and threatened (T) that have been found within the Federal Valley Watershed as identified on the Heritage Data Base. Endangered is a designation for, "a native or subspecies threatened with extirpation from the state (ODNR, Division of Wildlife, 2002)." Potentially

threatened is a designation used only for plant species. Special concern is a designation for "a species or subspecies that might become threatened in Ohio under continued or increased stress (ODNR, Division of Wildlife, 2002)". Threatened is a designation for, "a species or subspecies whose survival in Ohio is not in immediate jeopardy, but to which a threat exists (ODNR, Division of Wildlife, 2002)." The rare species in this management plan are divided up first by their HUC# and then by the subwatershed in which they were found.

A. HUC # 05030204090080

Big Run Subwatershed

The speckled wood-lily (*Clintonia umbellulata*) is a threatened plant species that was found in the Big Run Subwatershed on 2/1/1995. The speckled wood-lily (Figure 1) was specifically found in Washington County, Wesley Township Section 31. It was recorded growing in a shady area among rocks on the hillside of Wildcat Run.

Speckled Wood-Lily

Golden-knee

The golden-knee (*Chrysogonum virginianum*) is also a threatened plant species that was found within the Big Run Subwatershed on 2/1/1995. Multiple Golden-knee plants were located in Washington County, Wesley Township Section 25, along the Wildcat Run ravine. Here the golden-knees were found throughout terraces above the floodplain and on lower slopes adjacent to terraces. Their abundance was widely scattered.

B. HUC Shed # 05030204090090

Federal Creek Subwatershed

. Potamilus ohiensis

Two mollusk beds were found within Athens County, Rome Township; however, their state status is unknown. The first one was recorded on 2/1/1995. Here ten species, represented by 32 live mollusks including the state significant, *Potamilus ohiensis,* were found in the Federal Creek (Figure 3). The second mollusk bed, recorded on 8/29/1997, consisted of seven species represented by 60 live and 4 weathered shells. One of these species was also, *Potamilus ohiensis,* representing three live and one weathered shell. This bed was dominated by the species, *Lampsilis radiata luteola* (47 live shells)

The eastern sand darter, *Ammocrypta pellucida,* is a **fish** species of special concern (SC) that was documented on 2/1/1995 at two different locations within the Federal Creek Subwatershed. From seven sites within Federal Creek, Athens County, Rome Township, 92 eastern sand darters were recorded. The other sighting occurred on the same date but in Federal Creek at the mouth of Sharps Fork, Bern Township. Here one sand darter was captured and released.

Eastern Sand Darter

The river redhorse (Figure 6), *Moxostoma carinatum*, is a fish species of special concern. This species was recorded on 4/25/1996 in Federal Creek, Athens County, and Rome Township. Two of these fish were found. The river redhorse, an intolerant species to turbidity and siltation, prefers moderate to swift waters of large rivers and reservoirs or pools rather than clean gravel and rubble (Wisconsin DNR, 2003).

C. HUC Shed #05030204090050

Wyatt Run Subwatershed

The Downy White Beard-Tongue (Figure 7), *Penstemon pallidus*, is a threatened flowering **plant** specie that was located in Wyatt Run, Athens County, and Bern Township on 2/1/1995. Twenty-two flowering stems, some clumped in areas up to five meters long, were found along the roadside.

Downy WhiteBeard-Tongue

D. HUC Shed #05030204090040

Dutch Creek Subwatershed

An endangered **bird** species, the Bewick's Wren, *Thryomanes bewickii*, was documented on 2/1/1995 within the Dutch Creek subwatershed. The wren was found nested on scatter ridge, just north of Stroud's Run State Park, Athens County, Ames Township. The wren nesting is also adjacent to an oak maple forest of special interest.

Bewick's Wren

E. HUC Shed #05030204090020

Kasler Creek Subwatershed

An endangered **mammal** the Bobcat, *Lynx rufus*, was recorded on 2/1/65 in Athens County, Athens Township. It was found shot on Linscott Farm. Typical bobcat habitat in the northern U.S. include bogs, swamps, conifer stands, and rocky ledges (USDA, 2003).

Figure 9

F. HUC Shed #05030204090010

Hyde Fork Subwatershed

On two occasions the narrow-leaved toothwort, *Cardamine dissecta*, a potentially threatened **plant** species has been found. One was recorded on 2/1/1995 in Morgan County, Homer Township. Here a mixed mesophytic canopy of the plant was found in a shaded old stream terrace. One hundred stems and ten producing seeds were counted. On 11/16/1995 the narrow-leaved toothwort was again documented in relatively the same location. Here the plant was the dominant wildflower (1000+ plants were counted) located on a rich, mesic, wooded stream terrace.

NarrowLeaved Toothwort

G. HUC Shed #05030204090060

Sharps Fork Subwatershed

The green milkweed, *Asclepias viridiflora*, is a potentially threatened **plant** species that was found within the Sharps Fork subwatershed on 2/1/1995. One flowering green milkweed plant was located near the edge of an old- field pasture in Athens County, Bern Township.

Green Milkweed

The butternut, *Juglans cinerea*, is a potentially threatened **tree** species that was found within the Sharps Fork subwatershed at two separate locations. One butternut tree, six inches in diameter and 29 ft tall, was found near a vernal pool at the base of a cliff, Marion Township. The tree, located within a mature canopy, had no seedlings or fruit and 60% of the tree's crown was noted to be alive. Another butternut tree was found adjacent to the previously mentioned tree. This tree was six inches in diameter and 30 ft tall. The tree, also located within a mesic canopy, did not have any seedlings or fruit and 100% of the tree's crown was alive.

Butternut Tree Fruit

References for RTE information

Ohio Department of Natural Resources, Division of Wildlife. " Wildlife that are Considered to be Endangered, Threatened, Species of Concern, Special Interest, Extirpated, or Extinct." 2002. --- Division of Naturals Areas and Preserves (DNAP). "About the Division." http://www.ohiodnr.com/dnap/about.htm: Nov. 2003.

United States Department of Agriculture, Forest Service. "Biological and Habitat Requirements for *Lynx rufus*." http://www.fs.fed.us/database/feis/index.html: Nov. 2003.

Wisconsin Department of Natural Resources (DNR). "River Redhorse." http://www.dnr.state.wi.us/org/land/er/factsheets/fish/Rivred.htm: Nov. 2003.

Ohio Endangered Animals that could be found in Federal Valley

Picture	Scientific/ Common Name	Habitat
	Myotis sodalis/ Indiana bat	wooded areas along waterways, small caves, abandoned coal mines, free of disturbances
	Neotoma magister/ Allegheny woodrat	rock outcrops and cliffs within forested areas, boulder piles
	Felis rufus/ Bobcat	lowland swamps, partially forested mountainous areas, home ranges from 2 to 60 sq. miles
	Ursus americanus/ Black bear	heavily wooded areas hardwood and coniferous, swamps and wetlands, home ranges up to 100 sq. miles
	Botaurus lentiginosus/ American bittern	wetlands, large wet meadows

Picture	Scientific/ Common Name	Habitat
	Thryomanes bewickii/ Bewick's wren	upland shrubby edge habitats, unkempt rural residences, woodland borders
	Vermivora chryoptera/ Golden-winged warbler	shrub/sapling stage successional habitats, dense thickets
	Thamnophis radix/ Eastern plains garter snake	pond and stream edges, wetlands, forests, fields, rocky hillsides, residential areas
	Crotalus horridus/ Timber rattlesnake	dry wooded hill country
	Cryptobranchus alleganiensis/ Eastern hellbender	large swift flowing streams

Endangered Animals that could be found in Federal Valley

Picture	Scientific/ Common Name	Habitat
	Scaphiopus holbrookii/ Eastern spadefot	wetlands
	Ichthyomyzon bdellium/ Ohio lamprey	sandy small streams as juveniles, larger streams and rivers as adults
	Cyprogenia stegaria/ Fanshell	areas of packed sand and gravel in a godd current
	Lampsilis orbiculata/ Pink mucket	rivers and streams
	Plethobasus cyphyus/ Sheepnose	rivers and streams

Picture	Scientific/ Common Name	Habitat
	Ladona deplanata/ Blue corporal	along woodland edges, near small streams and ponds
	Speyeria idalia/ Regal fritillary	tall grass, damp meadows, wet fields, marches, and mountain pastures
	Nicrophorus americanus/ American burying beetle	specific habitat requirements unkown

SECTION IV INVENTORY AND ANALYSIS

WATER QUALITY INVENTORY

Ohio Water Quality Standards

"Ohio EPA employs biological, chemical, and physical monitoring and assessment techniques in bio-surveys in order to meet three major objectives:

To determine the extent to which use designations assigned in the Ohio Water Quality Standards (WQS) are either attained or not attained

To determine if use designations assigned to a given water body are appropriate and attainable

To determine if any changes in key ambient biological, chemical, or physical indicators have taken place over time, particularly before and after the implementation of point source pollution controls or best management practices. While the principal focus of a bio-survey is on the status of aquatic life uses, the status of other uses such as recreation and water supply, as well as human health concerns are also addressed.

The findings and conclusions of a biological and water quality study may factor into regulatory actions taken by Ohio EPA (*e.g.,* National Permit Discharge Elimination System (NPDES) permits, Water Quality Permit Support Documents (WQPSDs), Director's Orders, the Ohio Water Quality Standards [OAC 3745-1], and are eventually incorporated into Water Quality Permit Support Documents (WQPSDs), State Water Quality Management Plans, the Ohio Nonpoint Source Assessment, and the Ohio Water Resource Inventory (305[b] report)).

Hierarchy of Indicators A carefully conceived ambient monitoring approach, using cost-effective indicators comprised of ecological, chemical, and toxicological measures, can ensure that all relevant pollution sources are judged objectively on the basis of environmental results. Ohio EPA relies on a tiered approach in attempting to link the results of administrative activities with true environmental measures. This integrated approach is outlined in Figure 3 and includes a hierarchical continuum from administrative to true environmental indicators. The six "levels" of indicators include:

Actions taken by regulatory agencies (permitting, enforcement, grants)

Responses by the regulated community (treatment works, pollution prevention)

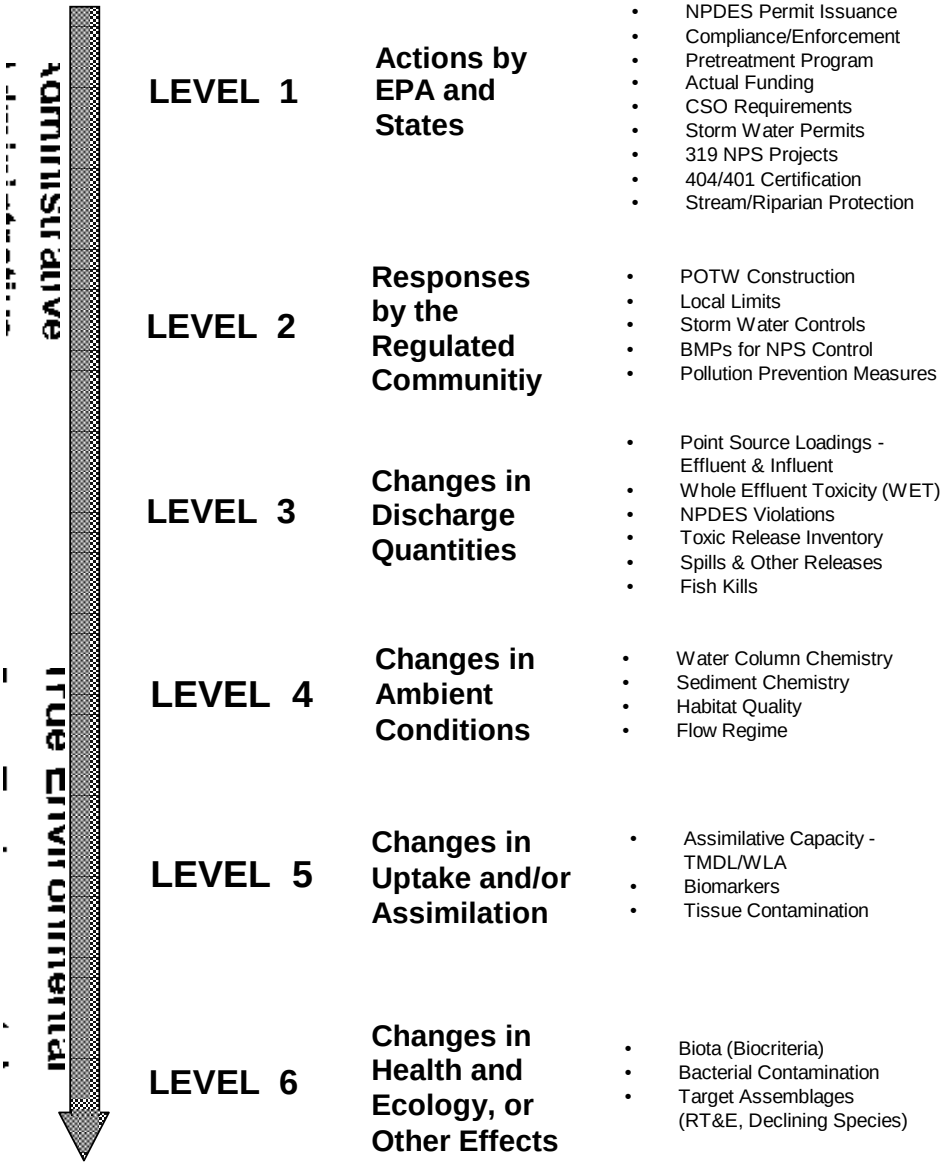
Changes in discharged quantities (pollutant loadings)

Changes in ambient conditions (water quality, habitat)

Changes in uptake and/or assimilation (tissue contamination, biomarkers, wasteload allocation)

Changes in health, ecology, or other effects (ecological condition, pathogens)

Figure 3. Hierarchical continuum from administrative to environmental indicators



In this process the results of administrative activities (levels 1 and 2) can be linked to efforts to improve water quality (levels 3, 4, and 5), which should translate into the environmental "results" (level 6). Thus, the aggregate effect of billions of dollars spent on water pollution control since the early 1970s can now be determined with quantifiable measures of environmental condition.

Superimposed on this hierarchy is the concept of stressor, exposure, and response indicators. *Stressor* indicators generally include activities which have the potential to degrade the aquatic environment such as pollutant discharges (permitted and unpermitted), land use effects, and habitat

modifications. *Exposure* indicators are those which measure the effects of stressors and can include whole effluent toxicity tests, tissue residues, and biomarkers, each of which provides evidence of biological exposure to a stressor or bio-accumulative agent. *Response* indicators are generally composite measures of the cumulative effects of stress and exposure and include the more direct measures of community and population response that are represented here by the biological indices which comprise Ohio's biological criteria. Other response indicators could include target assemblages *(i.e.*, rare, threatened, endangered, special status, and declining species or bacterial levels which serve as surrogates for the recreational uses). These indicators represent the essential technical elements for watershed-based management approaches. The key, however, is to use the different indicators *within* the roles which are most appropriate for each.

Describing the causes and sources associated with observed impairments revealed by the biological criteria and linking this with pollution sources involves an interpretation of multiple lines of evidence including water chemistry data, sediment data, habitat data, effluent data, bio-monitoring results, land use data, and biological response signatures within the biological data itself. Thus the assignment of principal causes and sources of impairment represents the association of impairments (defined by response indicators) with stressor and exposure indicators. The principal reporting venue for this process on a watershed or sub-basin scale is a biological and water quality report. These reports then provide the foundation for aggregated assessments such as the Ohio Water Resource Inventory (305[b] report), the Ohio NPS Assessment, and technical bulletins.

Ohio Water Quality Standards: Designated Aquatic Life Uses

The Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1) consist of designated uses and chemical, physical, and biological criteria designed to represent measurable properties of the environment that are consistent with the narrative goals specified by each use designation. Use designations consist of two broad groups, aquatic life and non-aquatic life uses. In applications of the Ohio WQS to the management of water resource issues in rivers and streams, the aquatic life use criteria frequently control the resulting protection and restoration requirements, hence their emphasis in biological and water quality reports. Also, an emphasis on protecting aquatic life generally results in water quality suitable for all uses. The five different aquatic life uses currently defined in the Ohio WQS with the general intent of each with respect to the role of biological criteria are described as follows:

Table 13 Use Designation Scores for Metrics

USE DESIGNATION	SIZE	IBI	MIwb	ICI	QHEI
EWH	Headwater (< 20 sp mi)	50	N/A	46	>80
EWH	Wadeable (20-30 sp mi)	50	9.4	46	>80
WWH	Headwater (< 20 sp mi)	44	N/A	34	60
WWH	Wadeable (20-30 sp mi)	44	8.4	34	60
MWH	Headwater (< 20 sp mi)	24	N/A	22	45
MWH	Wadeable (20-30 sp mi)	24	6.2	22	45

1. *Warmwater Habitat (WWH)* – this designation defines the "typical" warmwater assemblage of aquatic organisms for Ohio rivers and streams; this use represents the principal restoration target for the majority of water resource management efforts in Ohio. Biological criteria are stratified across five ecoregions for the WWH use designation. In the Western Allegheny Plateau a wadeable stream (20-300 mi^2) and a headwater streams (<20 mi^2) both must have at least a 44 for the IBI, a 8.4 for the MIwb (wadebale only), and a 34 for the ICI.
2. *Exceptional Warmwater Habitat (EWH)* - this use designation is reserved for waters which support "unusual and exceptional" assemblages of aquatic organisms which are characterized by a high diversity of species, particularly those which are highly intolerant and/or rare, threatened, endangered, or special status (*i.e.*, declining species); *this designation represents a protection goal for water resource management efforts dealing with Ohio's best water resources.* Biological criteria for EWH apply uniformly across the state. For a wadeable stream (20-300 mi^2) and a headwater streams (<20 mi^2) must have a 50 IBI score, a 46 ICI score, and a 9.4 MIwb score (wadeable only).
3. *Coldwater Habitat (CWH)* - this use is intended for waters which support assemblages of cold water organisms and/or those which are stocked with salmonids with the intent of providing a put-and-take fishery on a year round basis which is further sanctioned by the Ohio DNR, Division of Wildlife; this use should not be confused with the Seasonal Salmonid Habitat (SSH) use which applies to the Lake Erie tributaries which support periodic "runs" of salmonids during the spring, summer, and/or fall. No specific biological criteria have been developed for the CWH use although the WWH biocriteria are viewed as attainable for CWH designated streams.
4. *Modified Warmwater Habitat (MWH)* - this use applies to streams and rivers which have been subjected to extensive, maintained, and essentially permanent hydromodifications such that the biocriteria for the WWH use are not attainable *and where the activities have been sanctioned and permitted by state or federal law;* the representative aquatic assemblages are generally composed of species which are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor quality habitat. Biological criteria for MWH were derived from a separate set of habitat modified reference sites and are stratified across five ecoregions and three major modification types: channelization, run-of-river impoundments, and extensive sedimentation due to non-acidic mine drainage. In the Western Allegheny Plateau both a wadeable stream (20-300 mi^2) and a headwater streams (<20 mi^2) must have at least a 24 for the IBI, a 22 for the ICI and a 6.2 for the MIwb (wadeable only).
5. *Limited Resource Water (LRW)* - this use applies to small streams (usually <3 $mi.^2$ drainage area) and other water courses which have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported; such waterways generally include small streams in extensively urbanized areas, those which lie in watersheds with extensive drainage modifications, those which completely lack water on a recurring annual basis (*i.e.*, true ephemeral streams), or other irretrievably altered waterways. No formal biological criteria have been established for the LRW use designation.

Chemical, physical, and/or biological criteria are generally assigned to each use designation in accordance with the broad goals defined by each. As such, the system of use designations employed in the Ohio WQS constitutes a "tiered" approach in that, varying and graduated levels of protection are provided by each. This hierarchy is especially apparent for parameters such as dissolved oxygen, ammonia-nitrogen, temperature, and the biological criteria. For other parameters such as heavy metals, the technology to construct an equally graduated set of criteria has been lacking, thus the same water quality criteria may apply to two or three different use designations.

Ohio Water Quality Standards: Non-Aquatic Life Uses

In addition to assessing the appropriateness and status of aquatic life uses, each biological and water quality survey also addresses non-aquatic life uses such as recreation, water supply, and human health concerns as appropriate. The recreation uses most applicable to rivers and streams are the Primary Contact Recreation (PCR) and Secondary Contact Recreation (SCR) uses. The criterion for designating the PCR use is simply having a water depth of at least one meter over an area of at least 100 square feet or where canoeing is a feasible activity. If a water body is too small and shallow to meet either criterion the SCR use applies. The attainment status of PCR and SCR is determined using bacterial indicators (*e.g.*, fecal coliform bacteria, *E. coli)* and the criteria for each are specified in the Ohio WQS.

Water supply uses include Public Water Supply (PWS), Agricultural Water Supply (AWS), and Industrial Water Supply (IWS). Public Water Supplies are simply defined as segments within 500 yards of a potable water supply or food processing industry intake. The Agricultural Water Supply (AWS) and Industrial Water Supply (IWS) use designations generally apply to all waters unless it can be clearly shown that they are not applicable. An example of this would be an urban area where livestock watering or pasturing does not take place, thus the AWS use would not apply. Chemical criteria are specified in the Ohio WQS for each use and attainment status is based primarily on chemical-specific indicators. Human health concerns are additionally addressed with fish tissue data, but any consumption advisories are issued by the Ohio Department of Health and are detailed in other documents (Ohio EPA, Boucher 2002)."

Ohio EPA 3745-1-07 Water use designations and statewide criteria.

From Table 7-13 Statewide numerical and narrative criteria for recreational use designations. For each designation at least one of the two bacteriological standards (fecal coliform or E. coli) must be met. These criteria apply outside the mixing zone.

Bathing waters - these are waters that, during the recreation season, are suitable for swimming where a lifeguard and/or bathhouse facilities are present, and include any additional such areas where the water quality is approved by the director.

Fecal coliform - geometric mean fecal coliform content (either MPN or MF), based on not less than five samples within a thirty-day period, shall not exceed 200 per 100 ml and fecal coliform content (either MPN or MF) shall not exceed 400 per 100 ml in more than ten per cent of the samples taken during any thirty-day period.

E. coli - geometric mean E. coli content (either MPN or MF), based on not less than five samples within a thirty-day period, shall not exceed 126 per 100 ml and E. coli content (either MPN or MF) shall not exceed 235 per 100 ml in more than ten per cent of the samples taken during any thirty-day period.

Primary contact - these are waters that, during the recreation season, are suitable for full-body contact recreation such as, but not limited to, swimming, canoeing, and scuba diving with minimal threat to public health as a result of water quality.

Fecal coliform - geometric mean fecal coliform content (either MPN or MF), based on not less than five samples within a thirty-day period, shall not exceed 1,000 per 100 ml and fecal coliform content (either MPN or MF) shall not exceed 2,000 per 100 ml in more than ten per cent of the samples taken during any thirty-day period.

E. coli - geometric mean E. coli content (either MPN or MF), based on not less than five samples within a thirty-day period, shall not exceed 126 per 100 ml and E. coli content (either MPN or MF) shall not exceed 298 per 100 ml in more than ten per cent of the samples taken during any thirty-day period.

Secondary contact these are waters that, during the recreation season, are suitable for partial body contact recreation such as, but not limited to, wading with minimal threat to public health as a result of water quality.

Fecal coliform - shall not exceed 5,000 per 100 ml (either MPN or MF) in more than ten per cent of the samples taken during any thirty-day period.

E. coli - shall not exceed 576 per 100 ml in more than ten per cent of the samples taken during any thirty-day period.

Ohio Aquatic Life Use

The Ohio EPA must make a determination of the aquatic uses of Ohio's waterways. Several structural indices are used to assess the health of the biological community and measure habitat quality. Biological indicators are features of the aquatic ecosystem that demonstrate the health and vitality of that ecosystem. The indices used by the Ohio EPA are the Index of Biological Integrity (IBI), the Invertebrate Community Index (ICI) and the Qualitative Habitat Evaluation Index (QHEI).

The Index of Biological Integrity (IBI) is a measure of fish species diversity and species populations. This index gives a score which indicates how much a stream habitat is affected by pollutants, and which types of fish are present. Depending on the pollution tolerance of the species, the IBI indicates which species are likely to be found in the stream. The highest score attainable is 60, and higher scores

indicate healthier streams (Ohio EPA, 2001). Scores ranging from 44-49 are considered Warmwater Habitat in the Western Allegheny Plateau (WAP) region of Ohio.

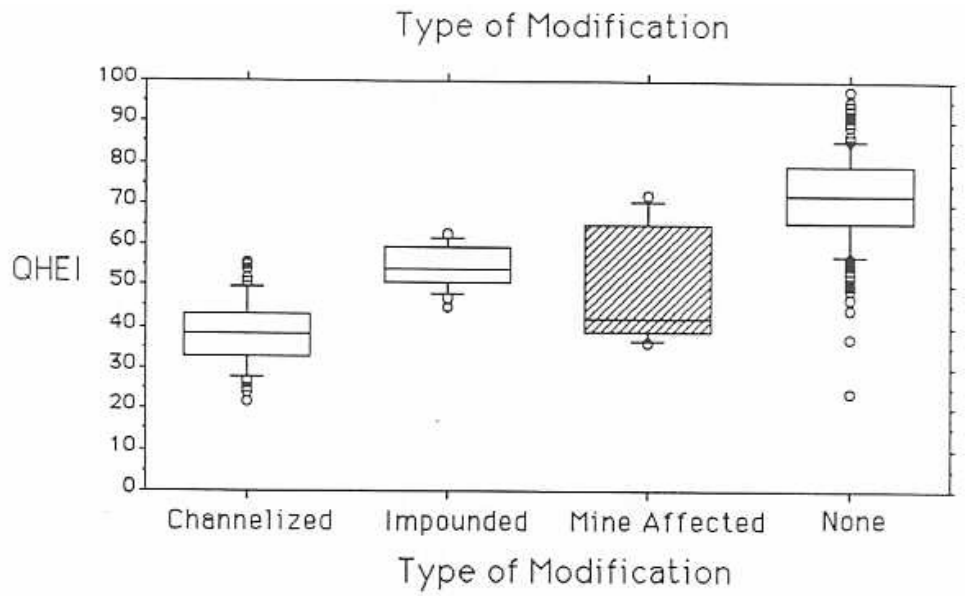
The Invertebrate Community Index (ICI) is based on measurements of macro-invertebrate communities living in a stream. Macro-invertebrate studies are important to assess because many insect taxa are known to be either pollution tolerant or intolerant. The presence of certain species indicates the general water quality of an area. This index gives helpful clues about the amount of pollution stressing the stream environment. Score ranging from 36-45 are considered Warmwater Habitat in the WAP region of Ohio (Ohio EPA, 2001).

The Qualitative Habitat Evaluation Index (QHEI) is a qualitative evaluation of stream habitat. Physical features that affect fish and invertebrate communities are evaluated. Some of the features evaluated include; type of substrate, amount and type of in-stream cover, channel width, sinuosity, and erosion. QHEI scores of 60 or above are considered conducive to the establishment of warm water fauna. Scores of 80 and above is considered conducive to EWH. Scores from 50 to 60 are considered questionable as to what type of life they can support. Scores from 45 to 59 are generally considered good for modified habitat, and lower then 45 are considered for LWH.

Table 14 *QHEI SCORING*
(Maximum = 100)

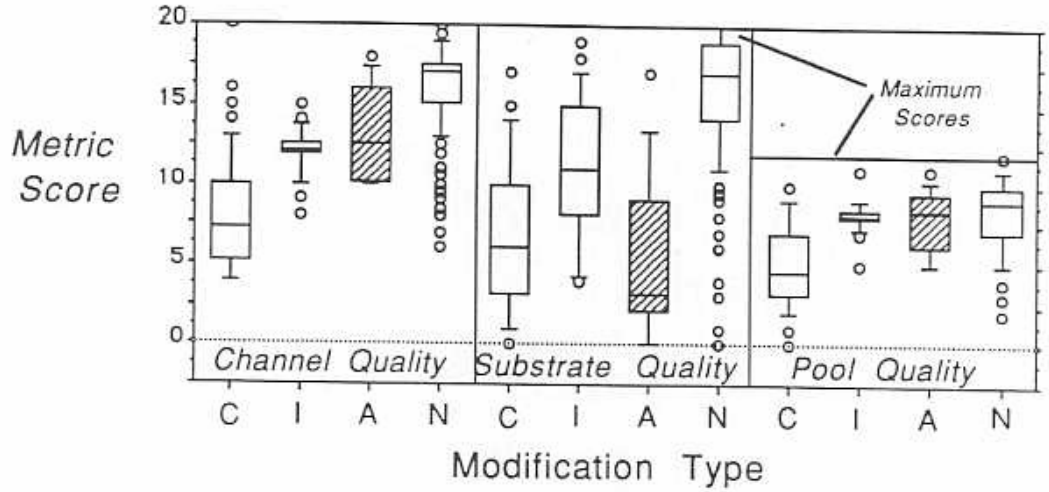
QHEI Metric	Metric Component	Component Scoring Range	Metric Maximum Score
1) Substrate	Type Quality	0 to 21 -5 to 3	20
2) Instream Cover	Type Amount	0 to 10 1 to 11	20
3) Channel Morphology	Sinuosity Development Channelization Stability	1 to 4 1 to 7 1 to 6 1 to 3	20
4) Riparian Zone	Width Quality Bank Erosion	0 to 4 0 to 3 1 to 3	10
5) Pool Quality	Max. Depth Current Morphology	0 to 6 -2 to 4 0 to 2	12
5b) Riffle Quality	Depth Substrate Stab	0 to 4 0 to 2 -1 to 2	8
Gradient		2 to 10	10

Ohio QHEI scores from http://www.epa.state.oh.us/dsw/documents/BioCrit88_QHEIResDisC.pdf



Box and Whisker Plots (medians, 25th and 75th percentiles, maximum value, minimum value, and outliers >two interquartile ranges from the median) from modified reference sites with channel modifications, impoundments, and mine affects (crosshatched) and warm water reference sites for the IBI (top panel) and QHEI (bottom panel).

QHEI metric score analysis in Ohio taken from http://www.epa.state.oh.us/dsw/documents/BioCrit88_QHEIResDisC.pdf



Box and Whisker Plots (medians, 25th and 75th percentiles, maximum value, minimum value, and outliers >two interquartile ranges from the median) for metric scores from modified reference sites with channel modifications (C) impoundments (I) and mine affects (A, crosshatched) and warmwater reference sites (N) The maximum score possible is 20 for channel and substrate quality and 12 for pool quality.

Historic aquatic use designations for Federal Valley

In order to be in compliance with the Clean Water Act, the state of Ohio is required to establish water quality standards for all surface waters in the state. Water quality standards represent a level of water quality that will support the goal of "fishable/swimmable" waters. The goals of the Clean Water Act are to protect, maintain and improve the quality of the nation's surface waters. As a result of the Clean Water Act, a stream has a designation associated with its aquatic life use. The categories of aquatic life use include Exceptional Warmwater Habitat, Warmwater Habitat, Modified Warm-water habitat, Limited Resource Water, and Limited Warmwater Habitat. Some streams that do not meet their aquatic life use but have the potential to meet this higher standard are considered non-attaining. Others are considered permanently impacted, so may have limited present use, but no hope for higher use. Those waterways are listed as attaining a limited use. These designations describe the existing or potential uses of water bodies (Ohio EPA, 2001).

Combining the three previously described indices traditionally derives these designations. Enclosed is a table of all of the use designations collected in Federal Valley by the Ohio EPA. Ohio EPA has assigned use designations on sites in the Federal Valley Watershed in 1984, 1990, 1995, and 2004. The study in 2004 was the most comprehensive, as it will be used for a watershed- wide TMDL. In 2004 MBI analyzed biological assemblage and habitat data at 43 stations in Federal Creek Watershed, with some sites funded by ODNR and others by Ohio EPA. Federal Creek has mostly "excellent" sites (EWH), some impaired to "good" conditions, and some "good" sites (WWH) impaired to fair. Most other watersheds in Ohio have sites with WWH potential ("good") impaired to fair and poor depending on the site and the type of NPS impact (e.g., habitat impairments are generally more severe than sedimentation alone). (MBI 2005). The following table lists all use designations ever derived in the Federal Valley Watershed.

Table 12 EPA use designations

Attainment table for streams sampled in the Federal Valley watershed , MBI 2005									
Station (Map #)	**Fish RM**	**Macro RM**	**IBI**	**MIwb**	**ICI or Narrative Rating**	**QHEI**	**Aquatic Life Uses Ex/Rec**	**Attain-ment Status**	**Comment**
Federal Creek - 2004									
S01100 16.152004	16.15	15.5	52	NA	48	64.5	EWH	**Full**	Ust Sharps Run
S01100 11.702004	11.70	11.70	48^{ns}	8.90^{ns}	VG^{ns}	51.5	EWH	**Full**	adj. St. Rt. 329 dst. Linscott Run
S01100 11.302004	11.30	11.40	46^{ns}	9.53	†F*‡	61.0	EWH	**Full**	St. Rt. 550, upst. McDougall Branch
S01100 9.302004	9.30	—	48^{ns}	7.88*	—	66.0	EWH	**Partial**	ust Sharps Fork
S01100 9.102004	9.10	—	47^{ns}	8.90 ^{ns}	VG^{ns}	56.0	EWH	**Full**	immediately dst Sharps Fk
S01100 7.502004	—	7.50	—	—	42*‡	—	EWH	—	dst. Sharps Fork
S01100 4.902004	4.90	4.90	48^{ns}	7.14*	34*‡	62.0	EWH	**Partial**	adj. St. Rt. 329 dst. Broadwell
S01100 0.902004	0.90	0.90	44*	9.50	†MG*	47.5	EWH	**Partial**	Twp. Rd. 231 (reference site)
Federal Creek - 1990									
S01100 11.401990	11.4	11.7	48^{ns}	9.0 ^{ns}	46	81.5	EWH	**Full**	upst. McDougall Branch
S01100 1.301990	1.3	—	46^{ns}	8.7*	54	74.5	EWH	**Partial**	Reference Site
Federal Creek - 1984									
S01100 1.301984	1.3	—	50	10.3	38	74.0	EWH	**Partial**	Reference Site
Kasler Creek - 2004									
S01101 0.402004	1.75	0.40	46	NA	F*	78.0	None/ WWH	**Partial**	Mouth
Sharps Run - 2004									
S01110 1.002004	0.01	1.00	44*	NA	VG^{ns}	64.0	EWH	**Partial**	near mouth, dst. north trib.
Sharps Run - 1995									
S01110 2.402004	2.40	—	44*	NA	—	73.5	EWH	**Non**	
Big Run - 2004									
S01130 3.902004	3.90	3.90	50	NA	G*	73.5	EWH	**Partial**	Co. Rd. 59, dst. Wildcat Run
S01130 1.602004	1.70	1.60	44*	NA	F*	59.0	EWH	**Non**	upst. Hatch Fork

Station (Map #)	Fish RM	Macro RM	IBI	MIwb	ICI or Narrative Rating	QHEI	Aquatic Life Uses Ex/Rec	Attain-ment Status	Comment
Big Run - 1995									
S01130 3.901995	3.90	—	50	NA	—	80.5	EWH	**Full**	dst. Wildcat Run
S01130 0.201995	0.20	—	46^{ns}	NA	—	63.0	EWH	**Full**	Mouth
Ellis Run - 1995									
S01131 0.501995	0.5	—	54	NA	—	64.0	EWH	**Full**	
Joes Run - 1995									
S01132 0.101995	0.1	—	54	NA	—	68.5	EWH	**Full**	
Wildcat Run - 1995									
S01133 0.101995	0.1	—	48^{ns}	NA	—	69.0	EWH	**Full**	
Sulphur Run - 2004									
S01134 0.802004	0.80	0.80	46	NA	F*	56.0	None WWH	**Partial**	Upstream
S01134 0.102004	0.01	0.10	50	NA	P*	45.5	None WWH	**Non**	Mouth
Spruce Run - 1995									
S01140 0.201995	0.20	—	54	NA	—	65.0		**Full**	
Marietta Run - 2004									
S01150 3.202004	3.20	3.50	50	NA	E	77.0	WWH	**Full**	dst. Brill Run
S01150 1.002004	1.60	1.00	44	NA	MG^{ns}	75.5	WWH	**Full**	B Below the 2 Seeps
S01150 0.102004	0.10	0.10	40^{ns}	NA	VG	62.5	WWH	**Full**	St. Rt. 329, at mouth
Brill Run - 1995									
S01151 0.101995	0.10	—	56	NA	—	79.5	EWH	**Full**	
Sharps Fork - 2004									
S01160 10.702004	10.70	10.70	50	NA	E	80.5	WWH/ EWH	**Full**	upst. Co. Rd. 85, upst. east trib
S01160 9.102004	9.10	9.10	50	NA	VG^{ns}	69.5	WWH/ EWH	**Full**	Co. Rd. 14
S01160 8.502004	8.05	8.50	54		VG^{ns}	67.0	WWH/ EWH	**Full**	Ust TR64
S01160 5.202004	5.30	5.20	50	NA	VG^{ns}	66.5	WWH/ EWH	**Full**	lane dst. Tharp Hollow
S01160 2.602004	—	2.60	—	—	VG^{ns}	—	WWH/ EWH	**Full**	Dst Opossum Adj 550
S01160 1.652004	1.65	—	48^{ns}	8.83*	-	65.5	WWH/ EWH	**Partial**	Ust Sulphur Run
S01160 1.602004	1.60	1.60	46^{ns}	8.31*	G*	55.5	WWH/ EWH	**Partial**	Dst Sulphur Run
S01160 0.012004	0.01	0.10	56	8.31*	38^{ns}	—	WWH/ EWH	**Partial**	St. Rt. 329, at mouth

Station (Map #)	Fish RM	Macro RM	IBI	MIwb	ICI or Narrative Rating	QHEI	Aquatic Life Uses Ex/Rec	Attain-ment Status	Comment
Sharps Fork - 1990									
S01160 0.011990	0.30	—	44*	8.10*	G*		WWH/ EWH	**Non**	Mouth
Opossum Run - 2004									
S01161 4.102004	4.10	4.10	24*	NA	E	59.0	EWH	**Partial**	Ust Starling Run
S01161 2.602004	2.60	2.60	44*	NA	VG^{ns}	69.5	EWH	**Partial**	Twp. Rd. 6, at compressor station
S01161 0.752004	0.75	0.80	48^{ns}	NA	G*	56.0	EWH	**Partial**	State Forest
S01161 0.202004	0.20	0.20	52	NA	VG^{ns}	59.0	EWH	**Full**	Joy Rd., near mouth
McDougall Branch - 2004									
S01170 4.902004	4.95	4.90	48	NA	G	57.5	WWH	**Full**	2nd lane upst. Bryson Branch
S01170 4.502004	4.50	4.60	50	NA	VG	59.5	WWH	**Full**	just dst. Bryson Branch
S01170 2.402004	2.90	2.90	46	8.25	†G	69.5	WWH	**Full**	dst. Mush Run (reference site)
S01170 0.502004	0.50	0.50	49	8.80	48	66.0	WWH	**Full**	lane off St. Rt. 550
McDougall Branch - 1990									
S01170 2.401990	2.40	—	42^{ns}	9.10	G		WWH	**Full**	Reference Site
McDougall Branch - 1984									
S01170 2.401984	2.40	—	48	8.40	26*		WWH	**Partial**	Reference Site
Wyatt Run - 2004									
S01171 0.402004	0.40	0.40	42*	NA	E	62.5	EWH	**Partial**	lane near mouth
Mush Run - 2004									
S01172 1.802004	1.80	1.80	52	NA	G*	63.0	EWH	**Partial**	lane dst. Riley Run
S01172 1.002004	1.00	1.00	50	NA	G*	66.5	EWH	**Partial**	Dutch Creek Rd.
Bryson Branch - 2004									
S01174 1.202004	1.20	1.40	44*	NA	G*	68.5	EWH	**NON**	Howard Rd.
Dutch Creek- 2004									
S01176 1.702004	1.70	1.70	34*	NA	G	76.5	None/ WWH	**Partial**	Dutch Creek Rd. at Twp. Rd. 216

Station (Map #)	Fish RM	Macro RM	IBI	MIwb	ICI or Narrative Rating	QHEI	Aquatic Life Uses Ex/Rec	Attain-ment Status	Comment
Linscott Run - 2004									
S01180 3.702004	3.80	3.70	38*	NA	VG ^{ns}	68.0	EWH	**Partial**	Upstream Site
S01180 0.802004	0.80	0.80	50	NA	MG*	73.5	EWH	**Partial**	St. Rt. 329
Hyde Fork - 2004									
S01190 1.802004	1.80	1.80	48^{ns}	NA	MG*	69.0	EWH	**Partial**	lane off St. Rt. 329
Miners Fork - 2004									
S01192 2.202004	2.25	2.20	44*	NA	G*	56.5	EWH	**Non**	Wrightstown Rd.
S01192 0.102004	0.05	0.10	46^{ns}	NA	G*	58.5	EWH	**Partial**	St. Rt. 329, at mouth

Ecoregion Biocriteria: Western Allegheny Plateau (WAP)

Index and Site Type	WWH	EWH	MWH	LRW-AMD
IBI – Wading & Headwater	**44**	**50**	**<u>24/24</u>**	**18**
Mod. Iwb - Wading	**8.4**	**9.4**	**<u>6.2/5,5</u>**	**4.0**
ICI/Narrative	**36/G**	**46/E**	**<u>22/30</u>**	**8/MF**

Footnotes

A qualitative narrative evaluation based on best professional judgment and sampling attributes such as community composition, EPT taxa richness, and QCTV scores were used when quantitative data were not available (E-exceptional, G-good, MG-marginally good, F-fair, P-poor, VP-very poor); for Moxahala Creek a draft Qualitative ICI index was also used.

Attainment status is given for existing use designations, except where a use designation change is recommended, in which case, the attainment status for the recommended use is given.

Limited Resource Water - acid mine drainage (LRW-AMD) benchmarks based on best professional judgment driven by the need to protect against acutely toxic stream conditions. Macroinvertebrate qualitative only data were evaluated based on densities of EPT taxa on the natural substrates, a narrative VP* or P* indicates departure from the benchmark.

MIwb not applicable at headwater sites (< 20 mi^2).

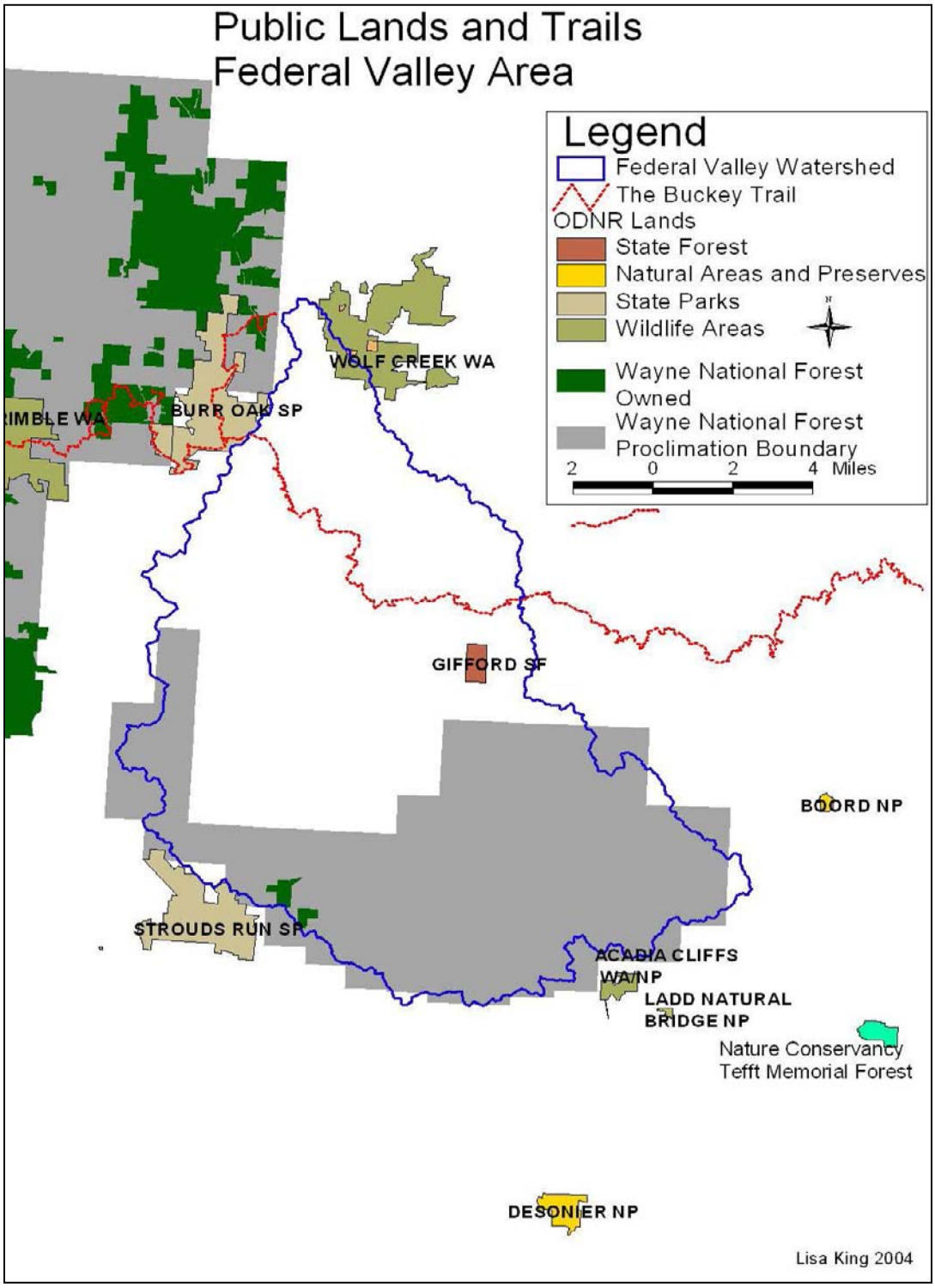
HD sampler set, but not retrieved due to flood flows destroying samplers.

Dry conditions in August followed by flooding conditions in September likely influenced assemblage conditions (data excluded from attainment decision)

Nonsignificant departure from biocriteria (<4 IBI or ICI units, or <0.5 MIwb units).

Indicates significant departure from applicable biocriteria (>4 IBI or ICI units, or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

Map 13 Public Lands Map



LANDUSE LAND COVER

Public Lands and Lands Protected

See map above for public lands in the vicinity of Federal Valley.

The majority of Federal Valley Watershed is privately owned. Within the watershed there are both Ohio and Federally owned lands. ODNR has 0.7 square mile of its Waterloo Wildlife Area (total 6 square miles) in the Sharps Fork Subwatershed. ODNR has 0.5 square mile of its Gifford State Forest in the Opossum Creek Subwatershed. Wayne National Forest manages 0.5 sq miles near Strouds Run in the Dutch Creek/ Mush Run Subwatersheds. Additionally, the Buckeye Trail cuts across the northern portion of Federal Valley, moving from Burr Oak toward Marietta. There are 14.8 miles of the Buckeye Trail within the watershed. Currently we know of no lands in the watershed that are protected by private foundations.

Road Density

This is a table of road density by subwatershed. Road density is the miles of roads divided by the area in that watershed. This will give an indication of the subwatersheds with the most roads. Within the Federal Valley Roads are the largest impermeable surfaces. Looking at road density and the table of buildings within 500 foot buffer will give a good indication of impermeable surfaces in a watershed. It should be added here that at this time there are no plans to build new roads.

Table 15 Subwatersheds and the road densities.

Subwatershed	miles of road	Area drained sq mile	density
Federal Creek	321.27	144.73	2.22
Sharps Run	11.62	5.6	2.08
Big Run	27.53	11.9	2.31
Ellis Run	3.1	1.6	1.94
Marrietta Run	15.31	10.1	1.52
Brill Run	4.79	3.24	1.48
Sharps Fork	77.05	35.7	2.16
Opossum Run	23.78	8.95	2.66
Sulphur Run	3.81	1.98	1.92

Subwatershed	miles of road	Area drained sq mile	density
McDougall Branch	81.28	37.6	2.16
Wyatt Run	12.32	6.78	1.82
Bryson Branch	21.03	7.77	2.71
Mush Run	31.26	13.2	2.37
Dutch Creek	16.22	5.88	2.76
Linscott Run	6.11	5.04	1.21
Kitten Run	3.52	1.55	2.27
Kasler Creek	11.48	3.75	3.06
Hyde Branch	16.28	6.53	2.49
Miners Fork	30.87	9.92	3.11
Smith Run	10.35	2.93	3.53

Development Projections

There are no plans for major developments, but in the Bern Township area there are plans underway to a subdivision of land and new housing in the Sharpsburg area. Residential development is averaged at approximately 4 new homes built every year. There is always potential for a lot of new development as farmers in the area retire and their children don't take their place so they subdivide their land. There are many potential farms for this in Federal Valley. Additionally in the southern portion of this watershed there is an area of approximately 3000 acres that was owned by the coal company and has since been subdivided into 40 to 300 acre lots. Absentee hunters bought most of this land. This area should be watched for development although this land has many deed restrictions that should inhibit development.

HOMES, AGRICULTURE, BACTERIA, AND SEDIMENT

Buildings in a 500 foot buffer of all main stems

An analysis was done of buildings that exist in a 500 foot buffer of each main stem within the watershed. The data was collected within an area of 500 feet on either side of the main stem for each subwatershed in the Federal Valley. The buildings were inventoried by type of building, the types that were recorded are as follows: house, abandoned house, barn, garage, shed, community building, and commercial building. This information was also qualified by the size of the building, where house size was denoted by number of bedrooms. Number of bedrooms was used because this is often the way that the health department sizes septic systems. Therefore the total number of bedrooms within 500 feet of a main stem is an indicator of the number of people utilizing the septic systems.

It has been projected by the health department that more then 80% of all home septic systems are failing. There are no permitted discharges in the watershed, however Amesville could have one in the future. All homes within the watershed have home septic systems, there are no public sewage systems in the watershed. Many of the home septic systems do not have proper leech fields and do illicitly discharge into the creek. These are to many to inventory. The later bacteria study should give a better idea of where systems are illicitly discharging.

See table 15 for the building information.
See map 14 for houses within the buffer and sites that were above the standards for E coli and Fecal Coliform 2004.
Go to page 58 for a definition of Ohio EPA bacteria standards

Summary

For the purpose of this summary FVWG is assuming that all locations with bacteria counts above the EPA standards for primary contact are priority areas for further work. (page ???107 for details)

Map 14 Houses in 500 foot buffer and bacteria sites

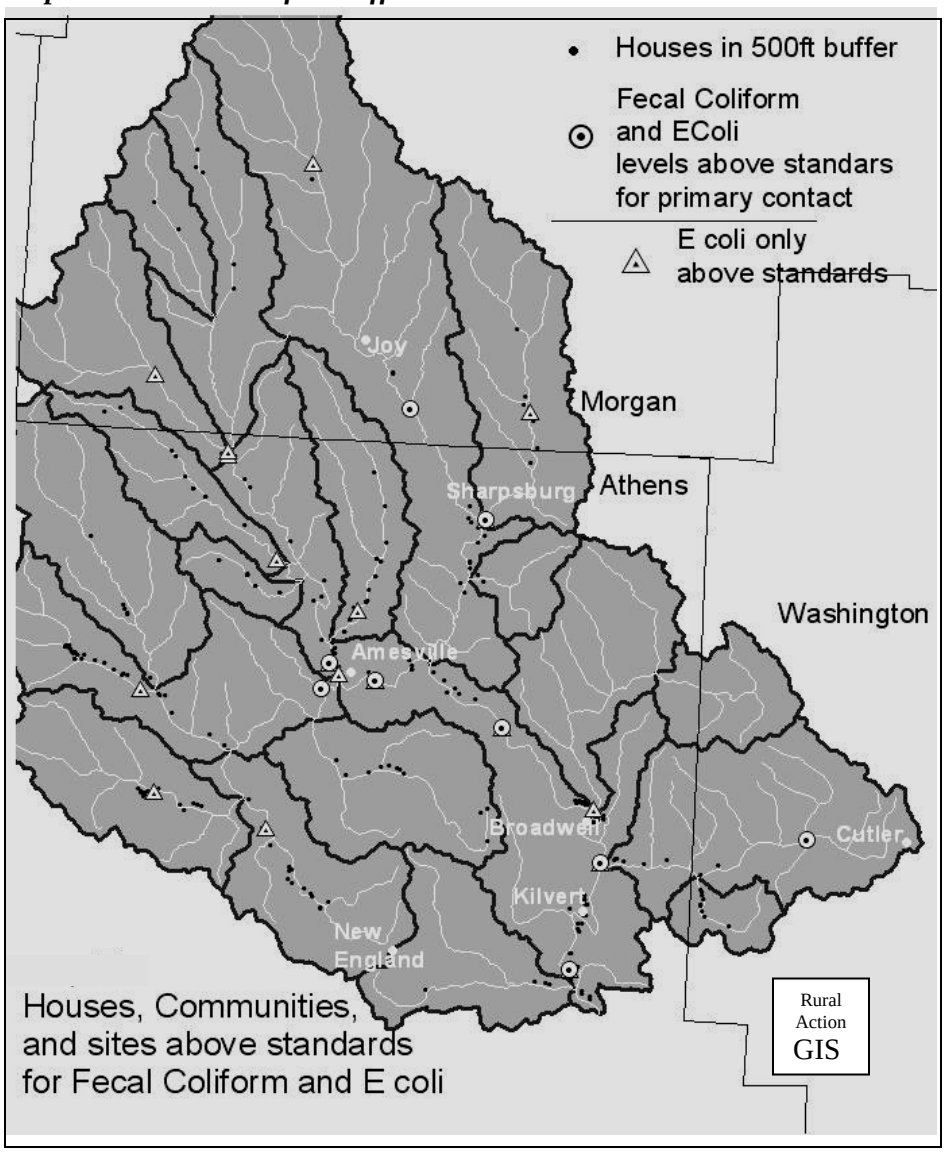


Table 15 buildings in 500 ft buffer

	14 Digit HUC Subshed 05030204090 +	Total inhabited houses	Total bedrooms	House Abandoned	House 1 bedroom	House 2 bedroom	House 3 bedroom	House 4 bedroom	House 5 bedroom	Barn Abandoned	Barn Livestock	Barn storage	Garage 1 car	Garage 2 car	Garage 3 car	Garage 4 car	Shed	Community	Commercial	Notes
Federal	**090**	83	203	12		54	23	4	2	4		9	1	2	6		27	1	3	1 Post Office 2 Food 1 Church
Sharps Run	**090**	4	10			2	2										3			
Big Run	**080**	8	17	1		7	1					1	1	2	1	1	8			
Ellis	**080**	18	29	2		6	4		1		1	4								
Marietta Run	**070**	1	3				1							1						
Brill Run	**070**																			
Sharps Fork	**060**	19	50	2		10	6	3		3	3	10		1	1		10	3		1 Lodge, 2 Churches
Opossum Run	**060**	9	22	3		6	2	1		1		3		1			7	1	5	1 Gas Station 4 Unknown Utility Bldgs 1 Twp Bldg
Sulphur Run	**060**	2	6			1		1						1			1			
Wyatt	**050**	11	30		3	4		1	3		1	4		2	2	1	2			
Mush	**040**	14	36	2	1	7	4	1	1	1	1	3		1	3		3			
Dutch	**040**	15	25	1	6	6	2	1		1		2		1	1		3			
McDougall	**030**	30	82	1	1	9	18	1	1		1	9	1	4	3		10	2	4	4 Vet Bldg, 2 Churches
Bryson Branch	**030**	6	16			2	4			1	1						4			
Kasler Creek	**020**	11	36	2		1	5	5				9					5			
Kitten Run	**020**	10	22			8	2			3		5		5			9		1	Greenhouse
Linscott Run	**020**	24	71			9	9	4	2	4	1	10		3	4		10			
Hyde Fork	**010**	1	3				1										1			
Miners Fork	**010**	6	18			2	2	2				4	1				2			
Smith Run	**010**	2	4			2														

Bacteria 2004

The Federal Valley target regarding bacteria is Primary contact - these are waters that, during the recreation season, are suitable for full-body contact recreation such as, but not limited to, swimming, canoeing, and scuba diving with minimal threat to public health as a result of water quality.

Fecal coliform target 2,000 per 100 ml

E. coli target 298 per 100 ml

Table 16 EPA 2004 Bacteria Study

Fecal Coliform	E.coli	location	stationid	dateend	timeend
60000	80000	#1000 OPOSSUM RUN @ JOY RD.	J03G50	10-Aug-04	830
32000	3300	#44 OPOSSUM RUN @ JOY RD. RM .20	J03G50	10-Aug-04	830
15300	13000	#16 Zarley Run @ SR 329	J03G74	6-Jul-04	1015
15000	1500	Big Run Rd @ RM 3.9	J03G70	16-Jun-04	1100
6700	2700	#21 McDougall Branch @ lane off SR 550 @ RM 0.5	J03G42	16-Jun-04	1035
6700	3100	#19 Federal Creek @ Sand Rock Rd - RM 10.4	J03P01	16-Jun-04	1005
5800	1100	#17A Federal Creek @ Tick Ridge Rd RM 7.5 Dup A	J03G35	16-Jun-04	1020
5300	2400	#99 Zarley Run (Amesville trib) @ SR 329	J03G74	23-Jun-04	943
4900	3700	#4 Federal Cr @ Sand Rock RD #2 RM 10.40	J03P01	6-Jul-04	1020
3800	5000	#2 Federal CR @ Tick Ridge Rd RM 7.50	J03G35	6-Jul-04	1030
3100	2800	#59 BIG RUN @ TR 129 RM .17	J03W01	10-Aug-04	946
2800	2800	#5 Federal CR @ Old Park/ Baseball Field RM 11.70	J03G38	6-Jul-04	1010
2500	2200	#12 Federal Creek @ Twp. Rd. 231	J03G72	16-Jun-04	1041
2300	2300	#16 Dup A Zarley Run @ SR 329 Amesville Trib	J03G74	30-Jun-04	1020
2200	230	44 Sharps Frk @ lane dst Tharp Hollow RM 5.3	J03G52	24-Jun-04	849
2100	4500	#29 Federal CR @ Big Run Rd CR 85 RM 3.90	J03G70	6-Jul-04	1032
1800	200	#26 Kasler Creek @ Adj Kasler Rd. RM 1.8	J03G40	16-Jun-04	930
1100	600	#11 McDougall Br ust Bryson Br RM 4.90	J03G67	6-Jul-04	1105
960	370	#16 Federal Creek @ SR 550, upst. McDougall Branch @ RM 11.4	J03S08	16-Jun-04	1030
890	170	#21 McDougall Branch @ lane off SR 550 - RM 0.5	J03G42	10-Jun-04	1105
870	140	#42 Bryson Branch @ Howard Rd. RM 1.40	J03G55	29-Jun-04	947
870	350	#16 Federal Creek @ SR 550, upst. McDougall Branch - RM 11.4	J03S08	10-Jun-04	1100
840	290	#15 Federal Creek @ St Rt. 550, upst. McDougall Br. RM 11.4	J03S08	23-Jun-04	946
840	460	#27 Linscott Run @ SR 329 RM 0.8	J03G41	16-Jun-04	945
800	20	39 Bryson Branch @ Howard Rd RM 1.4	J03G55	24-Jun-04	1025
770	140	#19 Federal Creek @ Sand Rock Rd - RM 10.4	J03P01	10-Jun-04	1040
760	590	#19 Federal Creek adj St. Rr. 329 dst Linscott Run RM 11.7	J03G38	23-Jun-04	922
740	170	#23 McDougall Branch dst. Mush Run @ RM 2.9	J03G45	16-Jun-04	1050
720	130	#20 McDougall @ lane off SR 550 - RM 0.5	J03G42	23-Jun-04	951
660	240	#27 Linscott Run @ SR 329 RM 0.8	J03G41	10-Jun-04	1025
650	420	#4 Federal Creek @ Sand Rock Rd. RM 10.40	J03P01	30-Jun-04	955
640	460	#1 Federal Creek @ SR 550 upst McDougall Branch RM 11.40	J03S08	30-Jun-04	1015
630	470	#20 Federal Creek adj SR 329 dst Linscott Run RM 11.7	J03G38	16-Jun-04	950
600	170	#20 Federal Creek adj. 329 dst. Linscott Run - RM 11.7	J03G38	10-Jun-04	1030

Fecal Coliform	E.coli	location	stationid	dateend	timeend
580	280	#46 Opossum Run @ Joy Rd. near mouth RM 0.20	J03G50	29-Jun-04	830
570	10	#3 Federal CR @ Kuhn Rd Bridge RM 16.15	J03G36	6-Jul-04	950
570	220	#25 Miners Fork @ SR329, at mouth RM 0.1	J03P07	16-Jun-04	950
570	280	#5 Federal Creek @ old park baseball field RM 11.70	J03G38	30-Jun-04	950
570	340	1000 SHARPS FORK UPST C.R. 85, UPST EAST TRIB.	J03S03	5-Aug-04	907
560	490	#45 OPPOSSUM RUN @ JOY RD.	J03G50	5-Aug-04	845
540	30	47 Mush Run @ lane dst Riley Run RM 1.8	J03G47	24-Jun-04	1014
520	130	#50 Sharps Fork @ Lane dst. Tharp Hollow RM 5.30	J03G52	29-Jun-04	837
520	350	#18 Federal Creek @ Sand Rock Rd. RM 10.4	J03P01	23-Jun-04	937
510	230	#47 SHARPS FORK @ CO. RD. 14 RM 9.10	J03G51	10-Aug-04	855
500	90	#46A DUP A SHARPS FORK UPST CO. RD. 85	J03S03	10-Aug-04	900
500	130	#23 McDougall Branch @ RM 1.5 Farm Lane	J03G78	10-Jun-04	1128
490	1000	#30 Federal CR @ Twp Rd 231 RM 0.90	J03G72	6-Jul-04	1019
480	200	#26 Kasler Ck @ Adj Kasler Rd @ RM 1.8	J03G40	10-Jun-04	1010
470	4200	#16 Federal Creek @ Tick Ridge Road. dst Sharps Fork RM 7.5	J03G35	23-Jun-04	930
460	120	#3 Federal Creek @ Kuhn Rd. bridge RM 16.15	J03G36	30-Jun-04	1050
450	380	#43 Mush Run @ Lane dst Riley RM 1.80	J03G47	29-Jun-04	938
440	100	#18 Federal Creek @ Kuhn Rd bridge @ RM 16.15	J03G36	10-Jun-04	1000
440	270	#40 BRYSON BRANCH @ HOWARD RD. RM 1.40	J03G55	10-Aug-04	952
430	310	#26 Linscott Run @ SR 329 RM 0.8	J03G41	23-Jun-04	917
420	20	48 Mush Run @ Dutch Ck Rd RM 1.0	J03G48	24-Jun-04	1010
410	10	#28 McDougall Branch upst. Bryson Branch @ Mill IronClinic RM 5.3	J03G43	6-Jul-04	1100
410	200	#17 Federal Creek @ Kahn Road. RM 16.1	J03G36	23-Jun-04	854
410	350	#43 OPOSSUM RUN @ TWP. 6 RM 2.60	J03G49	10-Aug-04	825
400	40	42 Opossum Run @ Joy Rd near mouth RM 0.2	J03G50	24-Jun-04	823
400	170	#28 McDougall Branch upst. Bryson Branch @ Mill Iron Clinic RM 5.3	J03G43	10-Jun-04	1200
380	80	#46 SHARPS FORK @ ST. RT. 329	J03S09	5-Aug-04	925
370	60	#28 McDougall Branch upst. Bryson Branch @ Mill Iron Clinic RM 5.3	J03G43	23-Jun-04	1014
370	120	#22 McDougall Branch dst. Mush Run RM 2.9	J03G45	23-Jun-04	1003
360	390	#42 MUSH RUN @ LANE DST. RILEY RUN	J03G47	5-Aug-04	936
350	10	#59 BIG RUN @ TR 192	J03W01	17-Aug-04	1000
350	160	#49 CB B Dup B Sharps Fork @ CO RD. 14 RM 9.10	J03G51	29-Jun-04	846
340	10	#43 OPOSSUM RUN @ TR 6 @ COMPRESSOR STATION RM 2.60	J03G49	17-Aug-04	815
340	130	#48 SHARPS FORK @ LANE DST THARP HOLLOW	J03G52	5-Aug-04	850
340	350	#18 Federal Creek @ Kuhn Rd bridge RM 16.15	J03G36	16-Jun-04	920
330	50	#47 SHARPS FORK @ CR 14 RM 9.10	J03G51	17-Aug-04	836
320	50	#28 McDougall Branch upst. Bryson Branch @ Mill Iron Clinic RM 5.3	J03G43	16-Jun-04	1100
320	280	#48 Sharps Fork upst. CO Rd. 85 upst. east trib C13	J03S03	29-Jun-04	854
320	320	#40A DUP A DUTCH CREEK @ DUTCH CREEK RD	J03G79	5-Aug-04	942
320	840	#14 Miners Fork @ SR 329 @ Mouth RM 0.10	J03P07	6-Jul-04	945
300	70	#44 OPOSSUM RUN @ JOY RD, NEAR MOUTH RM 0.20	J03G50	17-Aug-04	820
300	120	#43 MUSH RUN @ DUTCH CREEK RD	J03G48	5-Aug-04	939
290	220	43 Sharps Frk @ SR 329 @ mouth RM 0.1	J03S09	24-Jun-04	952

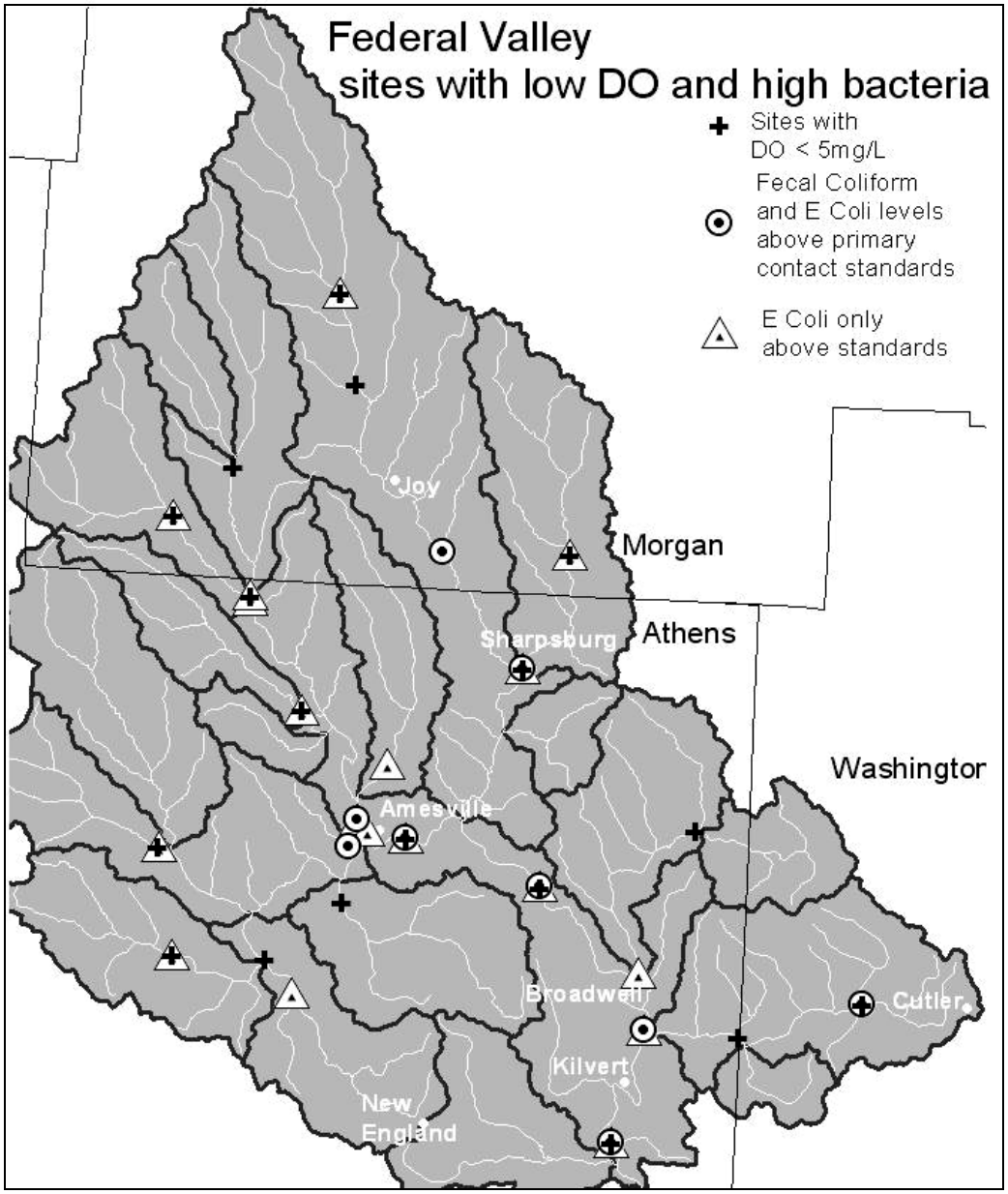
Fecal Coliform	E.coli	location	stationid	dateend	timeend
280	70	#12 Federal Cr. @ twp. rd. 231 (Reference site) RM 0.9	J03G72	23-Jun-04	952
280	110	#11 Federal Creek @ Big Run Rd. RM 3.9	J03G70	23-Jun-04	957
280	300	27 Hyde Fork @ lane off SR 329 @ RM 1.8	J03G39	23-Jun-04	830
270	70	#17A Federal Creek @ ford dst. Sharp's Fork @ RM 7.5 Dup A	J03G35	10-Jun-04	1050
270	80	#28 McDougall Branch upst. Bryson Branch @ Mill Iron Clinic RM 5.3	J03G43	10-Jun-04	1150
270	150	#47 SHARPS FORK @ CO. RD. 14	J03G51	5-Aug-04	900
260	150	#28 McDougall Branch upst. Bryson Branch @ Mill Iron Clinic RM 5.3	J03G43	30-Jun-04	1055
260	160	#44 Mush Run @ Dutch Creek Rd. RM 1.00	J03G48	29-Jun-04	935
250	10	#28 McDougall Branch upst. Bryson Branch @ Mill Iron Clinic RM 5.3	J03G43	16-Jun-04	1116
250	30	#28 McDougall Branch upst. Bryson Branch @ Mill Iron Clinic RM 5.3	J03G43	30-Jun-04	1110
240	30	38 Dutch ck Adj. Dutch Ck Rd @ RM 0.8	J03G79	24-Jun-04	1004
240	40	#41 MUSH RUN @ LANE DST. RILEY RUN RM 1.80	J03G47	10-Aug-04	935
240	140	46 Sharps Frk @ CR 14 RM 9.1	J03G51	24-Jun-04	920
240	190	#25 Kasler Creek adj. Kasler Rd RM 1.8	J03G40	23-Jun-04	905
230	230	#25 Miners Fork @ SR 329 RM 0.1	J03P07	10-Jun-04	950
230	250	#49A Dup A Sharps Fork @ Co. RD 14 RM 9.10	J03G51	29-Jun-04	846
220	40	#42 MUSH RUN @ DUTCH CR. RD. RM 1.00	J03G48	17-Aug-04	927
220	90	#9 McDougall Branch @ lane off SR 550 RM 0.50	J03G42	30-Jun-04	1030
220	90	#10 Marietta Run @ St. Rt. 329, at mouth RM .1	J03P09	16-Jun-04	1107
210	90	#42 MUSH RUN @ DUTCH CR. RD. RM 1.70	J03G48	10-Aug-04	938
210	220	#28 Hyde Fork @ lane off SR 329 - RM 1.8	J03G39	10-Jun-04	930
210	220	#41 Dutch Creek @ Dutch Creek Rd. Adj Dutch Creek Rd. @ RM 0.8	J03G79	29-Jun-04	926
200	30	#28 Hyde Fork @ lane off SR 329 RM 1.8	J03G39	16-Jun-04	850
200	100	#45 SHARPS FORK @ SR 329 RM .10	J03S09	10-Aug-04	925
200	110	#24A Miner's Fork @ SR 329 @ mouth RM 0.1 Dup A	J03P07	23-Jun-04	849
200	2000	#1 Federal CR @ SR 550 upst McDougall BR RM 11.40	J03S08	6-Jul-04	1045
190	210	#8 Linscott Run @ SR 329 RM 0.80	J03G41	30-Jun-04	945
180	30	#41 BRYSON BRANCH @ HOWARD RD.	J03G55	5-Aug-04	950
180	130	#39 DUTCH CR. @ DUTCH CR. RD. @ TR. 216 RM 1.70	J03G79	17-Aug-04	932
180	210	#6 Hyde Fork @ lane off SR 329 RM 1.80	J03G39	30-Jun-04	915
170	70	#2 Federal Creek @ Tick Ridge Rd. RM 7.50	J03G35	30-Jun-04	1005
170	4000	#28 McDougall Branch upst. Bryson Branch @ Mill Iron Clinic RM 5.3	J03G43	6-Jul-04	1115
160	20	Dup B #13B Marietta dst. Brill Run	J03G71	16-Jun-04	1120
160	40	#12 Federal Creek @ TR 231 RM 0.9	J03G72	10-Jun-04	1155
160	50	41 Opossum Run @ Twp Rd 6 @ compressor RM 2.6	J03G49	24-Jun-04	817
140	30	Dup A #13A Marietta dst Brill Run	J03G71	16-Jun-04	1119
140	40	#11A Dup A McDougall Branch upst. Bryson Branch	J03G67	30-Jun-04	1100
140	80	#46 SHARPS FORK UPST CR. 85, UPST EAST TRIB.	J03S03	17-Aug-04	843
140	100	Big Run Rd @ RM 3.9	J03G70	10-Jun-04	1200
140	160	63 Big Run @ mouth Twp 192	J03W01	24-Jun-04	1016
130	70	#7 Kasler Creek adj. Kasler Rd. RM 1.80	J03G40	30-Jun-04	930
130	130	#45 SHARPS FORK @ ST RT. 329 @ MOUTH RM 0.10	J03S09	17-Aug-04	912
120	70	#30 Federal Cr. @ T.R. 231 RM 0.90	J03G72	30-Jun-04	1027

Fecal Coliform	E.coli	location	stationid	dateend	timeend
120	80	#14 Miners Fork @ SR 329 at mouth RM 0.10	J03P07	30-Jun-04	910
110	10	45 Sharps Frk upst CR 85 upst east trib RM 10.7	J03S03	24-Jun-04	1035
100	10	#14 Marietta Run dst Brill Run RM 3.5	J03G71	23-Jun-04	1009
100	70	#44 OPPOSSUM RUN @ TWP. RD. 6. at COMPRESSOR STATION	J03G49	5-Aug-04	835
100	120	#45 Opossum Run @ TWP Rd. 6 @ Compressor	J03G49	29-Jun-04	825
90	10	#10A Marietta Run @ St. Rt. 329 RM 0.1 Dup A	J03P09	10-Jun-04	1205
80	10	#28 McDougall Branch upst. Bryson Branch @ Mill Iron Clinic RM 5.3	J03G43	23-Jun-04	1011
80	40	#48 SHARPS FORK @ LANE DST. THARP HOLLOW RM 5.30	J03G52	10-Aug-04	845
80	50	#39 DUTCH CR. @ DUTCH CR. RD. RM 1.70	J03G79	10-Aug-04	941
80	50	#13 Marietta Run dst. Brill Run - RM 3.5	J03G71	10-Jun-04	1220
70	10	#22A Dup A Marietta Run dst Brill Run RM 3.50	J03G71	30-Jun-04	1104
70	20	#61A Dup A Big Run @ TR. 192 RM 0.17	J03W01	29-Jun-04	1018
70	40	#60 BIG RUN @ TWP RD. 192	J03W01	5-Aug-04	1005
60	1300	#8 Linscott Run @ SR 329 RM 0.80	J03G41	6-Jul-04	1000
50	10	#40 BRYSON BR. @ HOWARD RD. RM 1.40	J03G55	17-Aug-04	944
30	20	#10 Marietta Run @ St. Rt. 329, at mouth RM 0.1	J03P09	23-Jun-04	1002
20	10	#23 Marietta Run @ St. Rt. 329 @ mouth @ RM .10	J03P09	30-Jun-04	1051
20	30	#41 MUSH RUN @ LANE DST RILEY RUN RM 1.80	J03G47	17-Aug-04	923
10	10	#9 McDougall Br @ Lane Off SR 550 RM 0.50	J03G42	6-Jul-04	1056
10	10	#48 SHARPS FORK @ LANE DST THARP HOLLOW RM 5.30	J03G52	17-Aug-04	827
10	200	#22A DUP A Marietta Run dst Brill Run RM 3.50	J03G71	6-Jul-04	1054
10	230	#6 Hyde Fork @ Lane off SR 329 RM 1.80	J03G39	6-Jul-04	915
10	560	#23 Marietta Run @ SR 329 @ Mouth RM 0.10	J03P09	6-Jul-04	1042
10	1600	#7 Kasler Cr Adj Kasler Rd RM 1.80	J03G40	6-Jul-04	955

High bacteria and low dissolved oxygen

The sites with high bacteria were then compared to sites that had low dissolved oxygen because one problematic symptom of high bacteria is low dissolved oxygen. For the purpose of this analysis, sites with less than 5 mg/L dissolved oxygen are labeled as sites with low dissolved oxygen. This is the standard for warm water habitat set by the Ohio EPA. This analysis is being used as another indicator of bacteria being a problem.

Map 15 sites with low DO and high bacteria



Agriculture

Table 17 Agriculture adjacent to the creek

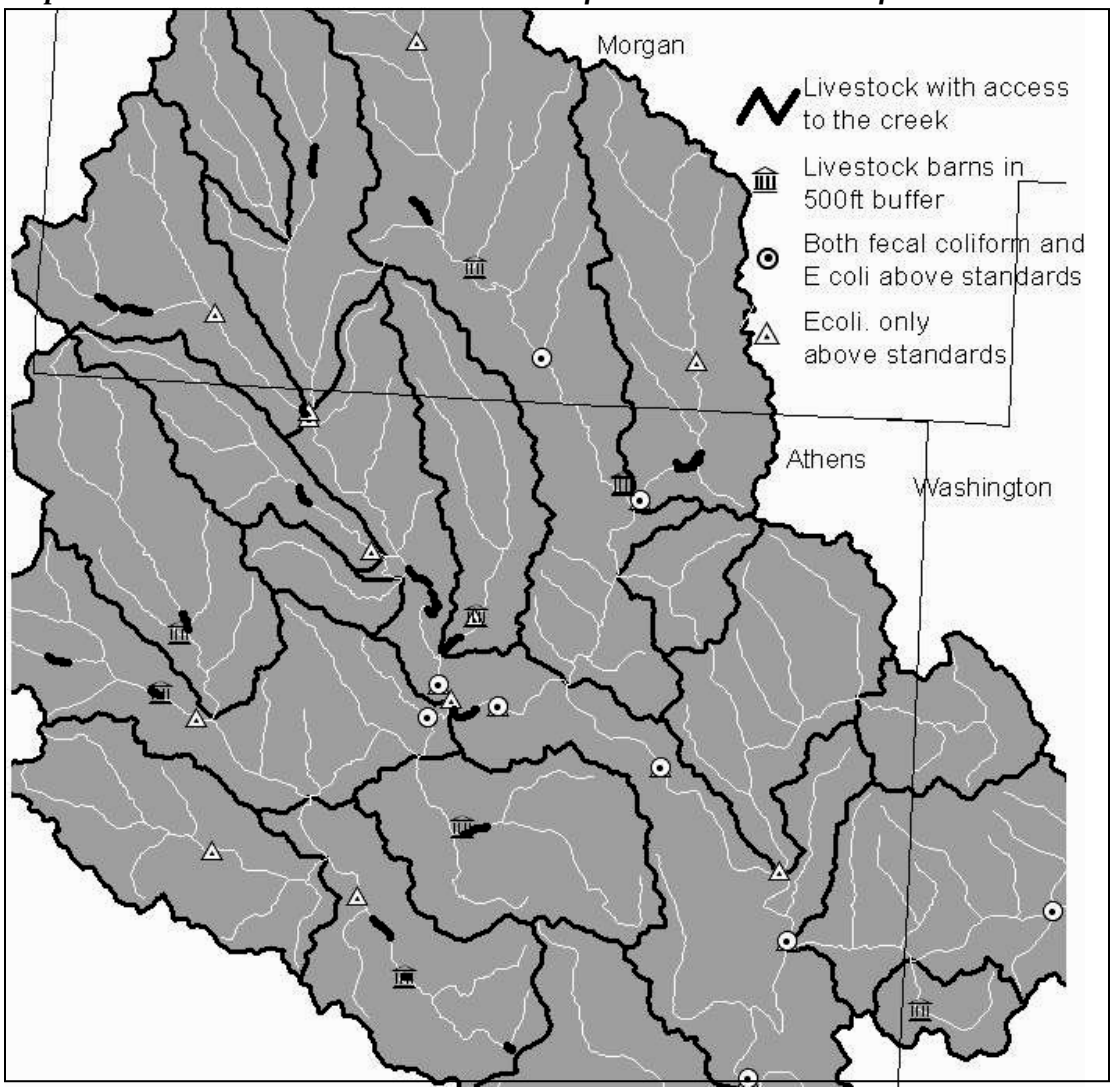
	14 Digit HUC Subwatershed	Barn Livestock within 500 feet of main stem	Livestock access (miles of stream)	Row Crop along main stem (miles of stream)
Federal	05030204090090		0.4	0.21
Sharps Run	05030204090090			
Big Run	05030204090080		0.15	0
Ellis	05030204090080	1		
Marietta Run	05030204090070		0.00	0
Brill Run	05030204090070			
Sharps Fork	05030204090060	3	0.98	0.37
Opossum Run	05030204090060			
Sulphur Run	05030204090060			
McDougall	05030204090030	1	0.54	0
Bryson Branch	05030204090030	1		
Wyatt	05030204090050	1	0.34	0.59
Mush	05030204090040	1	0.45	0
Dutch	05030204090040			
Kasler Creek	05030204090020		1.37	0.92
Kitten Run	05030204090020			
Linscott Run	05030204090020	1		
Hyde Fork	05030204090010		1.01	0.6
Miners Fork	05030204090010			
Smith Run	05030204090010			

FVWG has found no animal feeding operations with more then 150 animals, and most farmers on average have less then 50 animals. Most livestock farms contain cattle, sheep, goats, donkey, and horses.

In inventorying row crop production there are no large-scale producers. There are many small market gardens, and only a few soybean or corn producers. There are no farmers with irrigation systems

in the watershed. Chemical use patterns, and crop rotations for these farms was not accessible. There is only 1 no till farmer in the watershed at the intersection of 329 and 550.

Map 16 Livestock and sites above the standards for E coli and Fecal coliform



Recommendation

It is recommended that at all locations where there is known livestock with access to the creek or where there are livestock barns within 500 feet of the streams, or where row crops are planted adjacent to the stream, to focus efforts to work with these farmers to enter CRP and exclude the livestock from the creeks and to plant buffer strips to reduce contaminant runoff. This should especially be concentrated in areas where E coli and fecal coliform levels are above standards for primary contact. Also, many of the tributaries should be inventoried for similar activity and those farmers should be added to the list of farmers to contact.

2004 TMDL Sediment study

Metal concentrations (mg/kg) in sediments that were collected from Federal Creek tributaries in 2004. Values preceded by a < were below the reporting limit. Those preceded by (*) exceeded the threshold effect concentration (TEC) described by MacDonald, et.al. (2000). Values preceded by (#) exceeded Ohio-specific Sediment Reference Values (SRV's).

Table 52 of EPA sediments study 2004 TMDL

Marietta Run @ RM 1.5 @ Marietta Run Rd.

Al	Ba	Ca	Cr	Cu	Fe	Pb	Mg	Mn
29,600	228	3740	31	13.6	27,200	<23	4190	1040
Ni	K	Na	Sr	Zn	Hg	As	Cd	Se
<23	6210	<2830	62	66.8	0.047	***14.1**	0.137	1.16

Sulphur Run @ RM 0.5, below tipple @ culvert

Al	Ba	Ca	Cr	Cu	Fe	Pb	Mg	Mn
34,600	231	5260	41	21.9	**#68,300**	<32	4480	1050
Ni	K	Na	Sr	Zn	Hg	As	Cd	Se
***<32**[1*]	7600	<3950	150	91	0.076	**#*30.4**	0.194	2.42

Sharps Fork @ SR 329 @ mouth

Al	Ba	Ca	Cr	Cu	Fe	Pb	Mg	Mn
44,000	274	6490	***44**	18.7	31,700	<26	5190	1030
Ni	K	Na	Sr	Zn	Hg	As	Cd	Se
***30**	9380	<3230	91	86.1	0.052	***14**	0.202	<1.29

Sharps Fork @ lane down stream Tharp Hollow

Al	Ba	Ca	Cr	Cu	Fe	Pb	Mg	Mn
42,100	231	4630	41	15	37,400	<24	4080	939
Ni	K	Na	Sr	Zn	Hg	As	Cd	Se
***24**	7420	<2960	73	63.1	<0.036	***10.7**	0.145	<2.37

McDougall Branch down stream Mush Run

Al	Ba	Ca	Cr	Cu	Fe	Pb	Mg	Mn
34,200	225	4450	37	15.9	33,200	<25	3920	766
Ni	K	Na	Sr	Zn	Hg	As	Cd	Se
***27**	5840	<3060	89	64.8	<0.031	***14.4**	0.16	<1.22

Federal Creek @ SR 550, up stream. McDougall Branch

Al	Ba	Ca	Cr	Cu	Fe	Pb	Mg	Mn
37,200	243	4260	42	16.7	36,000	27	4300	1060
Ni	K	Na	Sr	Zn	Hg	As	Cd	Se
***29**	6580	<2470	86	78.3	<0.028	***14.6**	0.188	1.33

Federal Creek @ Big Run Rd. CR 85

Al	Ba	Ca	Cr	Cu	Fe	Pb	Mg	Mn
45,100	291	7530	***47**	17.4	39,300	31	5270	1570
Ni	K	Na	Sr	Zn	Hg	As	Cd	Se
***35**	8870	<3580	96	102	<0.039	***17.2**	0.254	1.44

Federal Creek @ TR 231

Al	Ba	Ca	Cr	Cu	Fe	Pb	Mg	Mn
32,300	223	4990	36	13.8	28,900	23	4040	1030
Ni	K	Na	Sr	Zn	Hg	As	Cd	Se
***26**	6690	<2700	77	71.2	<0.034	***13**	0.18	<1.08

Note: The detection limit is higher than the limit of 22.7, and therefore could be a violation, but cannot be determined.

This table of standards can be used for guidance, and provides numbers that serve as a breakpoint of what is typically below levels of concern (TEC). The SRV's are specific to the ecoregion and are used as a starting point for determining if an aquatic ecological risk may be present. Ohio-specific Sediment Reference Values (SRV's) is used in the table.

Table 18 sediment standards

Parameter	Threshold Effect Conc. (TEC)	Ohio SRV's (WAP)	Parameter	Threshold Effect Conc. (TEC)	Ohio SRV's (WAP)
Aluminum	---	53,000	Nickel	22.7	61
Barium	---	360	Potassium	---	14,000
Calcium	---	27,000	Sodium	---	------
Chromium	43.4	53	Strontium	---	250
Copper	31.6	33	Zinc	121	170
Iron	---	51,000	Mercury	0.18	0.12
Lead	35.8	47	Arsenic	9.79	19
Magnesium	---	9900	Cadmium	0.99	0.8
Manganese	---	3000	Selenium	---	2.6

2004 TMDL Total Suspended Solids study

FVWG is looking at the results of the 2004 TMDL chemistry and using the total suspended solids as an indicator of a silt problem. To set a standard to look at TSS as an indicator of a silt problem FVWG is using the A**ppendices to: Association Between Nutrients and the Aquatic Biota of Ohio River and Streams** Ohio EPA Technical Bulletin MAS//1999-1-1. The table being used is, Ohio EPA Water Column Chemistry Statistics for ALL Sites in the Ohio EPA Database by Ecoregion, Stream Size, and IBI scores in Appendix 2. Also see the table of 2004 TMDL TSS scores for the results in Federal Valley and the chart

The watershed goal is to have levels at the 40-49 IBI range (WWH) and the 75th%tile for Headwaters 18 and Wadeable streams 10. primary concerns are TSS levels above the 90th%tile in the WWH range; for Headwaters 53.9 and for wadeable streams 28.1.

Table 19 Ohio EPA Water Column Chemistry Statistics for ALL Sites in the WAP Ecoregion

IBI Range	Sample Size	Median	75th %tile	90th %tile	95th %tile	Median + 1.5*IQR	Median + 2*IQR
Headwaters							
12-19	53	14.000	26.250	50.000	75.100	32.3750	38.500
20-29	46	10.500	19.000	35.900	56.200	23.2500	27.500
30-39	38	12.000	21.000	87.400	256.600	25.5000	30.000
40-49	62	9.500	18.000	53.900	223.000	22.2500	26.500
50-60	40	5.000	6.500	24.000	30.000	7.2500	8.000
Wadeable							
12-19	62	17.000	30.000	40.300	54.800	36.5000	43.000
20-29	95	26.000	49.000	69.000	119.250	60.5000	72.000
30-39	116	17.000	28.000	49.800	131.900	33.5000	39.000
40-49	94	6.000	10.000	28.100	45.600	12.0000	14.000
50-60	71	9.000	16.000	41.000	63.800	19.5000	23.000

Wadeable streams have many sites with levels above the 90th %tile. These sites are as follows in order of score: Federal Creek at the Big Run Bridge, RM 3.90; Federal Creek at the Tick Ridge Bridge, RM 7.52; Federal Creek at Sharps Run Rd, RM .9; McDougall Branch near Amesville, RM .5; Federal Creek at Sand Rock Rd, RM 10.40.

All but one of these sites is on the lower main stem of Federal Creek. Generally the lower the gradient of a stream the less TSS it can handle. These sites would be considered the lowest gradient found in the watershed. Additionally, there are no row crops, livestock with access to the creek, or large developments in this area, and all of these sites have well forested riparian buffers. The sites at Big Run Bridge, Sand Rock Rd, and Tick Ridge Bridge are in the area of the main stem that has historically been

mined. All of these sites have low substrate scores from our 2003 QHEI study, only two of these sites also have low QHEI and substrate scores from the 2004 TMDL study; Federal Creek at RM .9 and McDougall Branch near Amesville. The McDougall Branch area does have agricultural land use and some new home development above that site, and the riparian buffer above that site is very thin.

Of the wadeable streams there is only one site that is below the 75th%tile goal, Sharps Fork at the mouth. Sharps Fork does have good QHEI scores, however this site had a very low QHEI score in the 2004 TMDL study and a low substrate in 2003.

Evaluating the headwater streams is a different matter. There are only two sites that are above the 90th%tile. These are: Opossum Run at the mouth, in Joy; and Sharps Fork headwaters at RM 10.4. There is only one location with an average score above the 75th%tile. This is at the mouth of Big Run. Opossum Run at the mouth has poor QHEI and substrate scores for both years (upstream of this site are some abandoned mines and some agriculture, and the riparian vegetation is not very good). Upper Sharps Fork did not have low QHEI scores in either year. The Big Run site had both a low QHEI and a low substrate in 2004 and 2003. There is no mining or farming in the subwatershed, however, there is a lot of logging in the area.

Recommendations

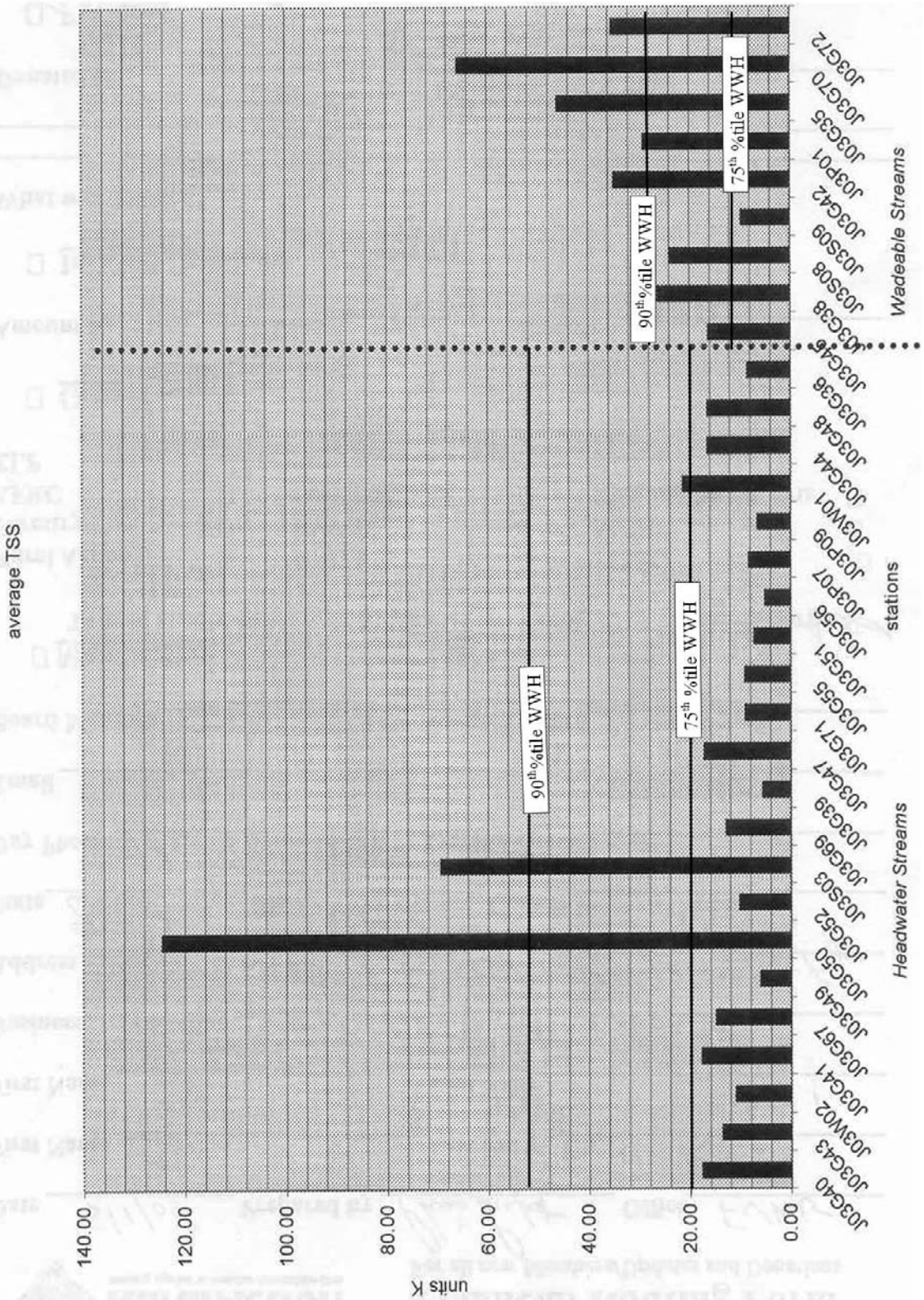
FVWG recommend that all of the streams listed above should be targeted to address any land use issues that would lead to a high TSS at the sites, particularly the sites with high TSS and low QHEI scores.

Table 20 2004 TSS Data

Average TSS for each site, in order of drainage area

station	STREAM	LOCATION	average TSS	drainage area	RM
J03G40	Kasler Creek	Adj Kasler Rd.	17.56	3.7	1.80
J03G43	McDougall Branc	upstream Bryson Branch @ Mill	13.50	4.0	5.3
J03W02	Big Run	Co. Rd. 59, dst. Wildcat Run	10.88	4.2	3.90
J03G41	Linscott Run	St. Rt. 329	17.67	4.5	0.80
J03G67	McDougall Branc	2nd lane upst. Bryson Branch	14.75	4.5	4.90
J03G49	Opossum Run	Twp. Rd. 6, at compressor station	6.00	4.5	2.60
J03G50	Opossum Run	Opossum @ Joy Rd. Near Mouth	124.36	4.5	0.20
J03G52	Sharps Fork	lane dst. Tharp Hollow	10.09	4.6	5.30
J03S03	Sharps Fork	upst. Co. Rd. 85, upst. east trib	69.27	4.6	10.70
J03G69	Dutch Creek	Dutch Creek Rd. at Twp. Rd. 216	12.73	4.8	1.70
J03G39	Hyde Fork	lane off St. Rt. 329	5.44	4.8	1.80
J03G47	Mush Run	lane dst. Riley Run	17.00	4.8	1.80
J03G71	Marietta Run	dst. Brill Run	8.89	5.4	3.50
J03G55	Bryson Branch	Howard Rd.	9.00	5.7	1.40
J03G51	Sharps Fork	Co. Rd. 14	7.18	6.0	9.10
J03G56	Big Run	upst. Hatch Fork	5.00	9.0	1.60
J03P07	Miners Fork	St. Rt. 329, at mouth	8.25	9.9	0.10
J03P09	Marietta Run	St. Rt. 329, at mouth	6.50	10.1	0.10
J03W01	BIG RUN	@ TR 192	21.20	11.8	0.17
J03G44	McDougall Branc	just dst. Bryson Branch	16.33	12.4	4.60
J03G48	Mush Run	Dutch Creek Rd.	16.33	12.7	1.00
J03G36	Federal Creek	Kuhn Rd. bridge	8.44	17.9	16.15
J03G45	McDougall Branc	dst. Mush Run (reference site)	16.14	21.0	2.90
J03G38	Federal Creek	old park / baseball field	26.11	27.0	11.70
J03S08	Federal Creek	St. Rt. 550, upst. McDougall Bran	23.67	32.0	11.40
J03S09	Sharps Fork	St. Rt. 329, at mouth	9.60	35.7	0.10
J03G42	McDougall Branc	lane off St. Rt. 550	34.78	37.5	0.50
J03P01	Federal Creek	Sand Rock Rd./CR 38	29.00	60.0	10.40
J03G35	Federal Creek	Tick Ridge Rd. TR 201	46.00	72.0	7.52
J03G70	Federal Creek	Big Run Rd CR 85	65.75	90.0	3.90
J03G72	Federal Creek	Twp. Rd. 231 (reference site)	35.25	138.0	0.90

Figure 4 average TSS concentrations



NUTRIENT POLLUTION

Nutrients are chemical elements that are essential to plant and animal nutrition. Nitrogen and phosphorus are among the most important nutrients, but in high concentrations they can be contaminants in water. Both are affected by chemical and biological processes that can change their form and can transfer them to or from water, soil, biological organisms, and the atmosphere. (USGS webpage, http://water.usgs.gov/nawqa/circ-1136/h6.html).

Direct toxic effects of nutrients do not occur until very high concentrations; however, increased concentrations well below toxic levels can adversely affect water quality through the process of eutrophication. Eutrophication is the process of a system becoming over productive. Increased amounts of nutrients in water cause prolific algal and aquatic plant growth, which can choke waterways. Subsequently, the decomposition of the abundant plant and algal growth depletes the water of oxygen, which can kill fish and other organisms. Additionally, certain types of algae commonly associated with eutrophication produce natural toxins that can harm humans and animals (Dodds 2002). Overall, eutrophication caused by the overabundance of nutrients in water can result in a variety of water-quality problems, including fishkills, noxious tastes and odors, clogged pipelines, and restricted recreation. Four major influences on nutrient concentrations in ground water and streams are land use, soil drainage, geology, and depth to ground water. (USGS webpage, http://water.usgs.gov/nawqa/circ-1136/h6.html).

Forms and Toxic Effects of Nitrogen and Phosphate

Nitrogen: Nitrogen occurs in many different forms in natural waters. Anthropogenic sources of nitrogen are sewage treatment plant effluents, septic runoff, agriculture, urban developments, recreation, industrial effluents and mining (blasting residuals).

Important forms of nitrogen to monitor for are listed below:

Nitrate (NO_3-): This is the measurement of the most oxidized and stable form of nitrogen in a water body. Nitrate is the principle form of combined nitrogen found in natural waters.

Nitrite (NO_2^-): This is of a form of nitrogen that occurs as an intermediate in the nitrogen cycle. It is an unstable form that is either rapidly oxidized to nitrate (nitrification) or reduced to nitrogen gas (de-nitrification). It is normally present in only minute quantities in surface waters.

Excessive concentrations of nitrate and/or nitrite can be harmful to humans and wildlife. Nitrate is broken down in the human intestines to become nitrite. Nitrite reacts with hemoglobin in to produce methemoglobin, which limits the ability of red blood cells to carry oxygen. This condition is called methemoglobinemia. In humans, this condition is also known as "blue baby" syndrome (because the nose and tips of ears can appear blue from lack of oxygen). It is especially serious for infants, because they lack the enzyme necessary to correct this condition. Wells contaminated by sewage or agricultural

runoff are a major concern in some areas, because of the possibility of water high in nitrite/nitrates and the subsequent increased risk of blue baby disease. High nitrate and nitrite levels can also cause methemoglobinemia in livestock and other animals. In fish this condition is called "brown blood disease". Nitrite enters the bloodstream through the gills and turns the blood a chocolate-brown color. Brown blood cannot carry sufficient amounts of oxygen, and affected fish can suffocate despite adequate oxygen concentration in the water. This accounts for the gasping behavior often observed in fish with brown blood disease, even when oxygen levels are relatively high (BASIN webpage, http://bcn.boulder.co.us/basin/data/COBWQ/info/index.html).

Total Ammonia (NH_3 & NH_4^+): This is a measure of the most reduced inorganic form of nitrogen in water and includes dissolved ammonia (NH_3) and the ammonium ion (NH_4^+). The natural conversion of ammonia to nitrate in streams removes oxygen from water and, therefore, can also adversely affect fish.

Toxic concentrations of ammonia in humans may cause loss of equilibrium, convulsions, coma, and death. Ammonia concentrations can affect hatching and growth rates of fish; changes in tissues of gills, liver, and kidneys may occur during structural development (BASIN webpage, http://bcn.boulder.co.us/basin/data/COBWQ/info/index.html).

Total kjeldahl nitrogen (TKN): This is a measure of both the ammonia and the organic forms of nitrogen, both of which are present in sewage and in sewage-treatment-plant effluents.Organic nitrogen includes all organic compounds such as proteins, polypeptides, amino acids, and urea. High TKN can indicate when untreated sewage or septic runoff is entering the waterways.

Total phosphorus: This is a measure of both inorganic and organic forms of phosphorus. It is an essential plant nutrient and is often the most limiting nutrient to plant growth in fresh water. It is rarely found in significant concentrations in surface waters. Since phosphorus is generally the most limiting nutrient, its input to fresh water systems can cause extreme proliferations of algal growth. Inputs of phosphorus are the prime contributing factors to eutrophication in most fresh water systems. Anthropogenic sources of phosphorus include sewage treatment plant effluent, agriculture, urban developments (particularly from detergents), and industrial effluents.

Water Quality Criteria

At present, no statewide criteria for nitrate-nitrogen and phosphorus exist for the protection of aquatic life. Criteria for ammonia concentrations vary according to water temperature and pH. In most natural surface waters, total ammonia concentrations greater than about 2 mg/L exceed the chronic exposure criteria for fish. In alkaline water at high temperature, the criteria can be exceeded by total ammonia concentrations of 1.1 mg/L. The EPA has established a maximum contaminant level of 10

mg/L (as nitrogen) for nitrate in drinking water. Proposed statewide criteria for nitrate-nitrite and phosphorus concentrations for WWH and EWH are presented in the table below.

Table 21 Proposed Statewide Criteria for Nitrate-Nitrite (Ohio EPA 1999)

	Drainage Area	WWH	EWH
Headwaters	<20 mi^2	1.0	0.5
Wadeable	20 mi^2-200mi^2	1.0	0.5
Small Rivers	200 mi^2-1000mi^2	1.5	1.0
Large Rivers	>1000mi^2	2.0	1.5

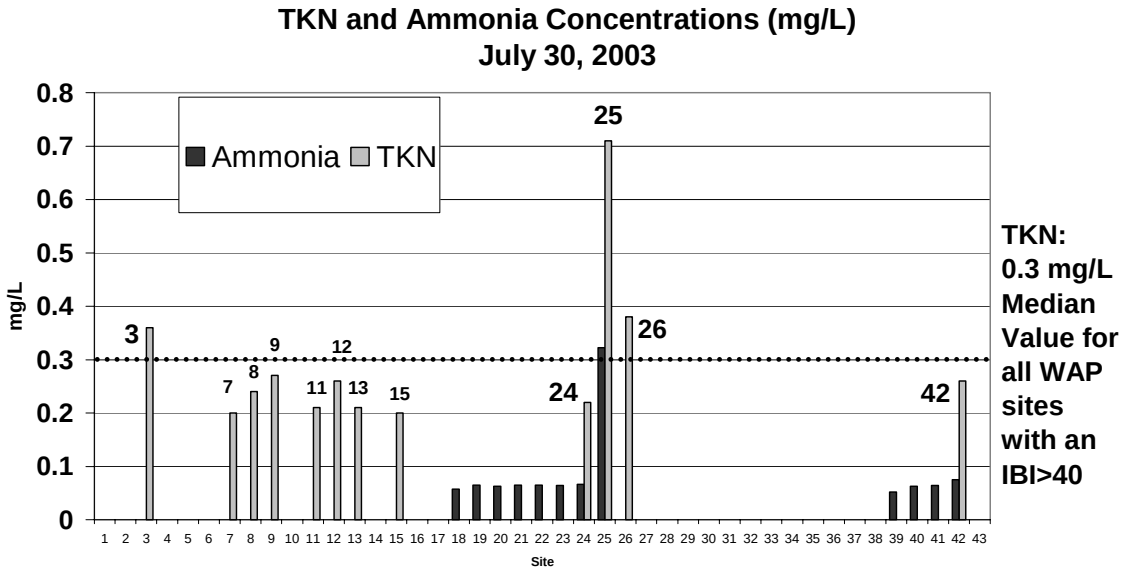
Table 22 Proposed Statewide Criteria for Phosphorus (Ohio EPA 1999)

	Drainage Area	WWH	EWH
Headwaters	<20 mi^2	0.08	0.05
Wadeable	20 mi^2-200mi^2	0.10	0.05
Small Rivers	200 mi^2-1000mi^2	0.17	0.10
Large Rivers	>1000mi^2	0.30	0.15

Nutrient Concentrations in the Federal Valley Watershed

In order to investigate if nutrient enrichment problems are occurring within the Federal Valley Watershed, FVWG collected water samples for nutrient concentrations in August 2002, November 2002, March 2003, and July 2003. On all sample dates, ammonia and nitrate-nitrite concentrations fell within acceptable ranges for proposed or existing statewide criteria for the protection of aquatic life for WWH. The highest concentration of nitrate-nitrite was 0.619 mg/L, which occurred at SF0800 in August, 2002. This value only slightly exceeds the proposed statewide criteria for EWH. The highest concentrations of ammonia were 0.322 mg/L, measured in the small creek running through Amesville on 7/30/03, and 0.310 mg/L, measured at the mouth of McDougall Branch on 3/11/03. These values fall below the statewide criteria for the protection of aquatic life for EWH for the corresponding temperatures and pH of the sample dates. Samples taken on July 30, 2003 were also analyzed for total kjeldahl nitrogen (TKN), which is a measure of organic nitrogen + ammonia. TKN can be used as an indicator of pollution from sewage and septic runoff. Figure displays the concentrations of TKN and ammonia for 43 sites sampled on July 30, 2003. Again, no statewide criteria for the protection of aquatic life exists for TKN. In figure 6, the line at 0.3 mg/L is the median value for all WAP sites with an IBI of 40 or greater for headwater, wadeable, and small river size waterways. Only 3 sites exceeded this value on July 30, 2003. These sites are: site 3, the mainstem of Federal Creek near Stuart; site 25, the small creek that runs through Amesville; and site 26, lower Federal Creek below Amesville. The concentrations of TKN are high at these sites relative to other sites in the watershed. These sites may indicate local areas of high sewage or septic runoff. Site 25, the small creek that runs through Amesville, is certainly affected by septic tank effluent.

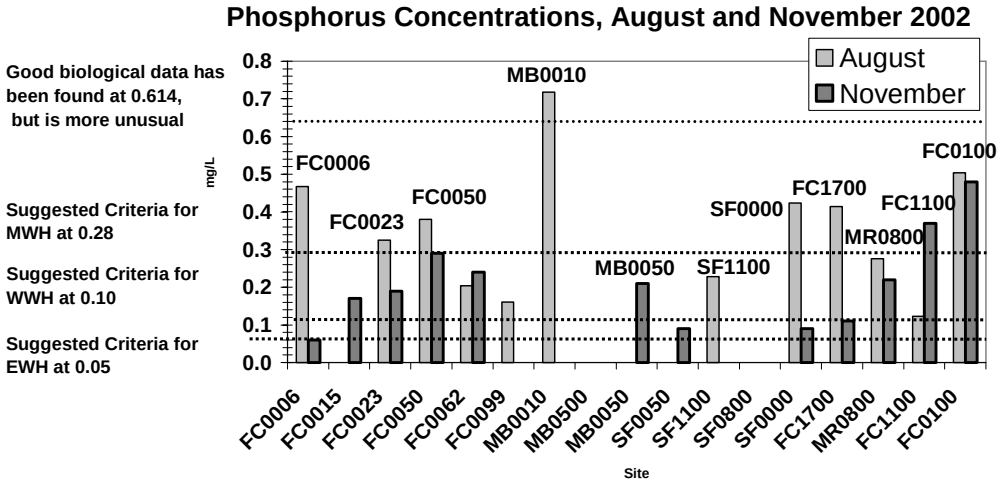
Figure 5 TKN and Ammonia



Phosphorus

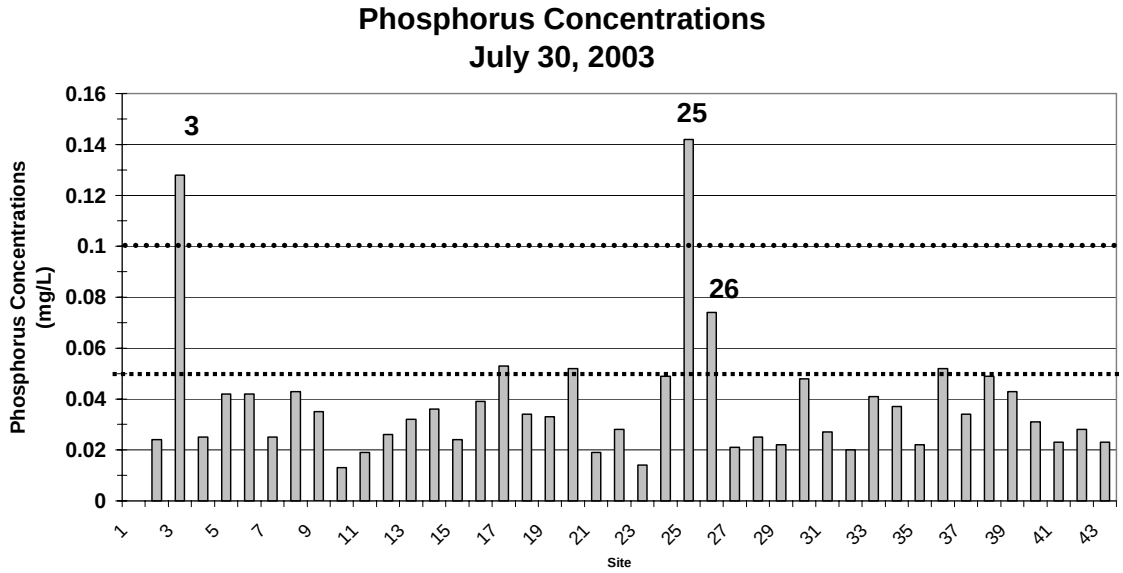
Phosphorus concentrations appeared high during the August and November sampling events. Many sites exceeded the suggested criteria for WWH, in both August and November. It is important to note that exceedances of the suggested values do not indicate water quality violations. For instance, healthy streams with good biological data exist with high phosphorus concentrations, such as 0.6 mg/L. However, in general, more water quality problems tend to be associated with levels above the suggested criteria. Sites that exceeded the suggested criteria of 0.08 mg/L or 0.1 mg/L , corresponding to the appropriate drainage size, in the August samples were: FC0006, FC0023, FC0050, FC0062, FC0099, SF1100, SF0000, FC1700, MR0800, FC1100, and FC0100. Sites that exceeded these criteria in the November samples were: FC0015, FC0023, FC0050, FC0062, MB0050, FC1700, MR0800, FC1100, FC0100. Although the concentrations at these sites appeared high, no nuisance algal or aquatic plant growth was reported.

Figure 6Phosphorus Concentrations



On the subsequent sampling dates, phosphorus levels were in the ranges of the proposed statewide criteria for WWH, with the exception of two sites sampled on July 30, 2003. Site 3 is located on the mainstem of Federal Creek, near Stuart, and Site 25 is the small stream that runs through Amesville. It is important to note that site 3, site 25, and site 26 also had the highest levels of TKN. This may indicate septic or sewage runoff at these sites.

Figure 7 Phosphorus Concentrations 2003



Conclusions

Water quality samples collected by the FVWG on four sampling dates have not indicated a significant nutrient enrichment problem. Additionally, no nuisance algal or aquatic plant growth has been documented. However, phosphorus samples collected in 2002 appear high, and further monitoring would help determine if these values are anomalous, or if seasonal variations are significant. Nitrogen values for nitrate-nitrogen, ammonia, and TKN have been within acceptable values. However, 3 sites within the watershed, 2 within or near Amesville, and one near the mouth of Federal Creek, have shown substantially higher values of TKN than other sites within the watershed. This indicates elevated septic or sewage effluence in these areas.

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BASIN webpage. http://bcn.boulder.co.us/basin/data/COBWQ/info/index.html

Dodds, W.K. 2002. Freshwater Ecology: Concepts and Environmental Applications. Academic Press: New York, NY. 569 pp.

Ohio EPA, Division of Surface Water. 1999. Association Between Nutrients, Habitat, and the Aquatic Biota in Ohio Rivers and Streams. Ohio EPA Technical Bulletin MAS/1999-1-1.

USGS webpage. http://water.usgs.gov/nawqa/circ-1136/h6.html

LAND USE LAND COVER BY SUBWATERSHED

Data Description and Technique Used

Much of the data in this section was derived from the interpretation of GIS (geographic information system) data. The information contained herein has not been technically reviewed for accuracy and conformity. FVWG does not guarantee this information to be free from errors, omissions, or inaccuracies and disclaim any responsibility or liability for interpretations or decisions.

This data may serve to give estimates of land and its various attributes, but it only represents best professional estimates. Additionally, all of these separate pieces of data compiled together were initially created at different scales. They were not created to be used specifically together. FVWG has used a computer as a tool to allow us to view these data together. In some cases there may be slight inaccuracies. Use this visual information as a way to better understand this watershed and as a general guide to land use planning.

The data layers that were used are described as follows:

Land use land cover

The land use land cover for each subwatershed was obtained by clipping the entire watershed grid. Roads and streams were also clipped based on subwatershed. The main stems of the creeks were buffered at 500 feet on each by using the buffer feature in ArcView GIS.

Due to the resolution of this coverage there are instances where pixels are misinterpreted. FVWG is not able to field check this data. Keep in mind that the data contains errors and is at a 30-meter resolution. This land cover data set was produced as part of a cooperative project between the U.S. Geological Survey (USGS) and the U.S. Environmental Protection Agency (USEPA) to produce a consistent land cover data layer for the conterminous U.S. based on 30-meter Landsat thematic mapper (TM) data. National Land Cover Data (NLCD) was developed from TM data acquired by the Multi-resolution Land Characterization (MRLC) Consortium. The MRLC Consortium is a partnership of federal agencies that produce or use land cover data. Partners include the USGS (National Mapping, Biological Resources, and Water Resources Divisions), USEPA, the U.S. Forest Service, and the National Oceanic and Atmospheric Administration. TM data is satellite imagery taken at a 30 meter x 30 meter resolution. The MRLC used many satellite scenes at both leaves-off and leaves-on time periods during the years of 1990 – 1994. These images were used to create the final landscape characterization you see here. Quantitative accuracy has not been checked.

Roads, streams and hypsography

The roads coverage was provided by the Ohio Department of Transportation, last updated in September 6, 2001. This data is best observed at 1:100,000. It is important to note that there are many roads, particularly township roads that are mapped but only exist as a right of way and are not maintained

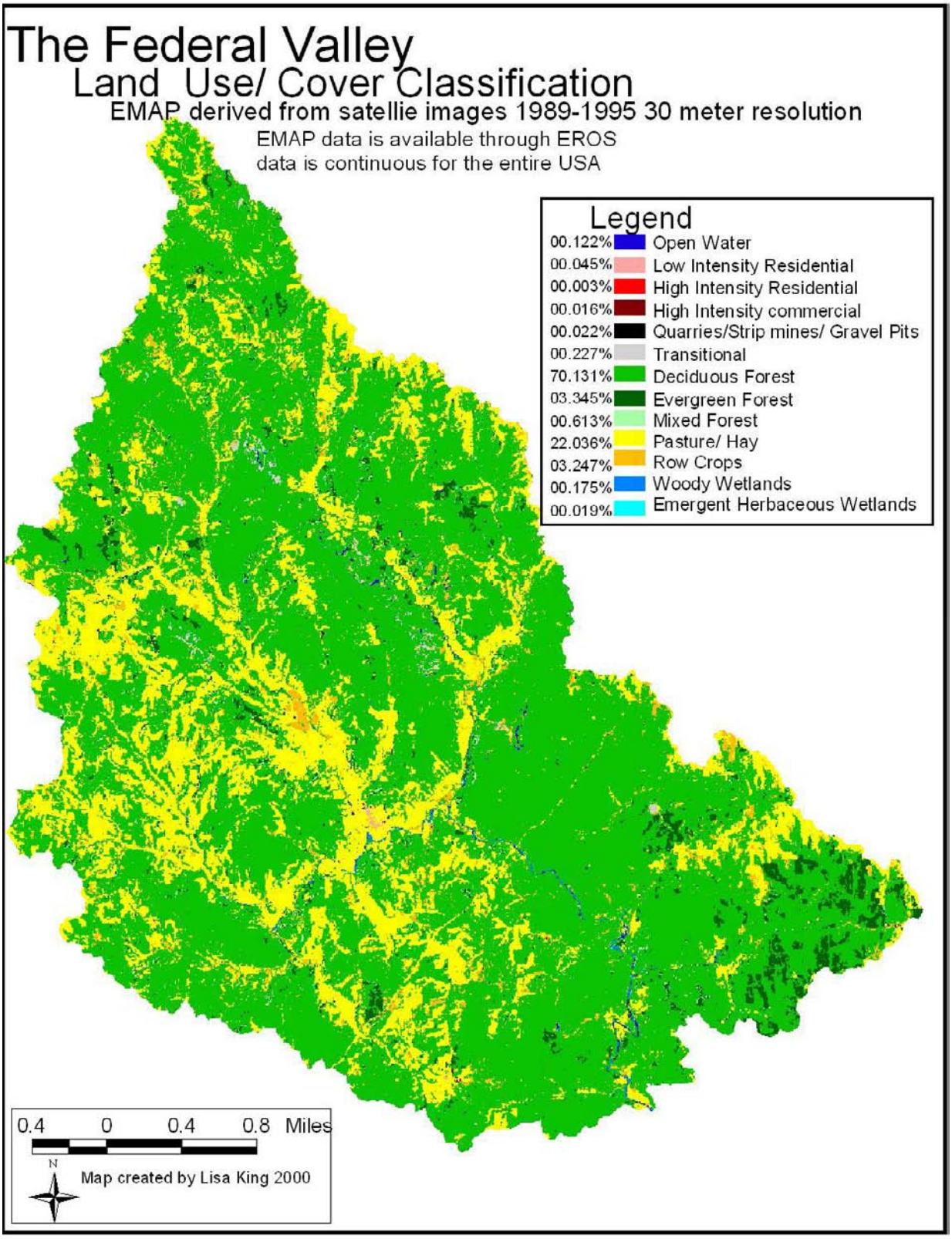
or driven on. Some roads experience frequent ATV traffic and some are totally abandoned. The information related to streams and topography was acquired through the Ohio Geographically Referenced Information Program (www.geodata.state.oh.us/data.htm). This is a computer format of data collected and compiled by the U.S. Geological Survey. The original scale of this data is 1:24,000. This data does not currently carry quantified accuracy statements. Range-of-Dates/Times: Beginning-Date: 1974 Ending-Date: 1979

The writer of this document is Jessica Janc, an Americorps VISTA who has been with the Federal Valley Watershed Group since July 2003. For more of the technical information for any of these layers please contact Lisa King at Lisa King@ruralaction.org or 740-448-1012

Table 23 Federal Valley Watershed Land Use Land Cover

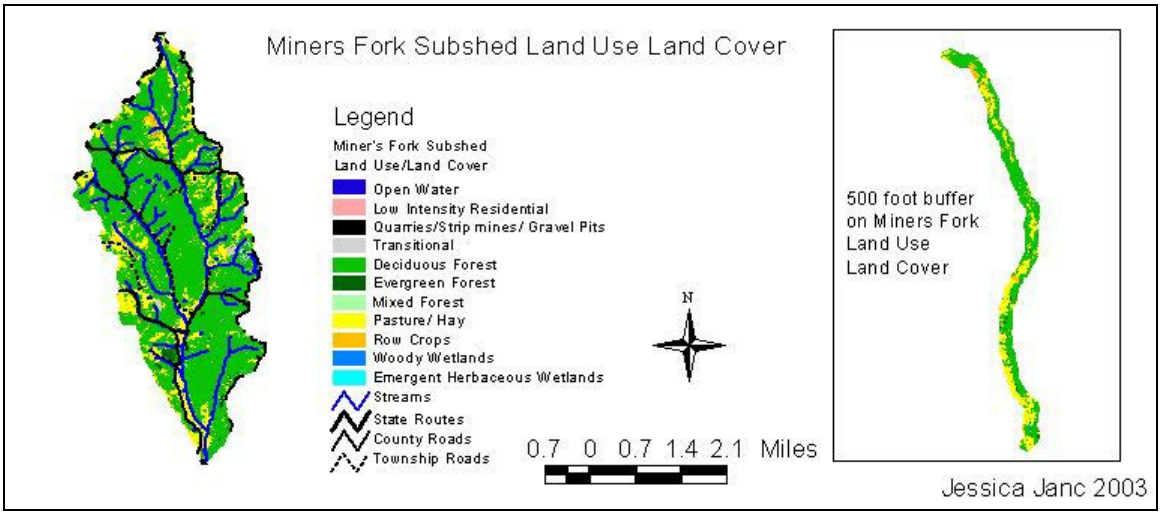
Water	0.12%
Low Intensity Residential	0.04%
High Intensity Residential	0.00%
High Intensity Commercial/Industrial/Transportation	0.02%
Quarries/Strip Mines/Gravel Pits	0.02%
Transitional	0.23%
Deciduous Forest	70.13%
Evergreen Forest	3.34%
Mixed Forest	0.62%
Pasture/Hay	22.04%
Row Crops	3.24%
Woody Wetlands	0.17%
Emergent Herbaceous Wetlands	0.02%

Map 17 Federal Valley LULC

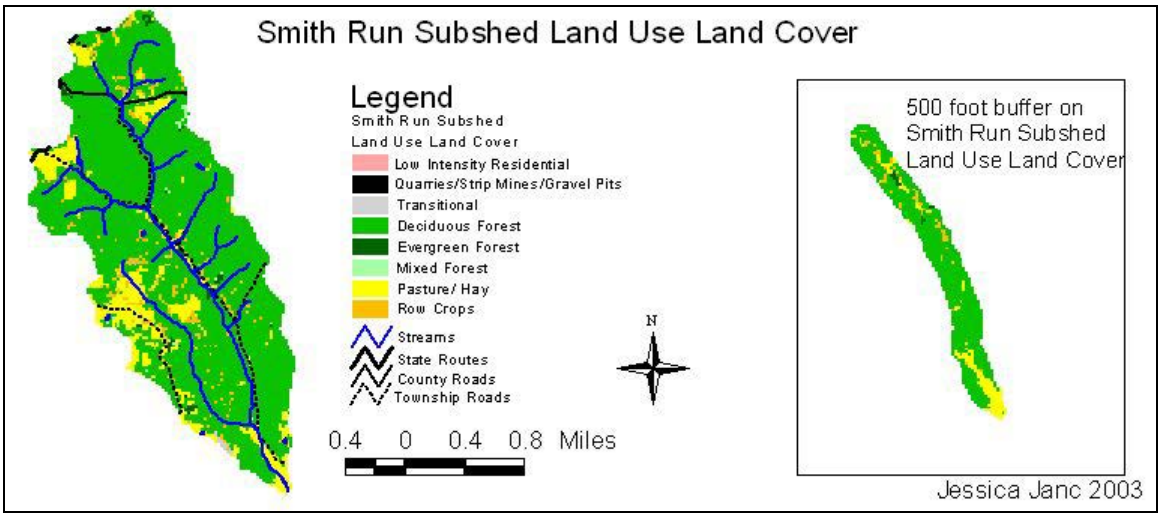


Map 16 LULC Miners Fork, Smith Run, and Hyde Fork

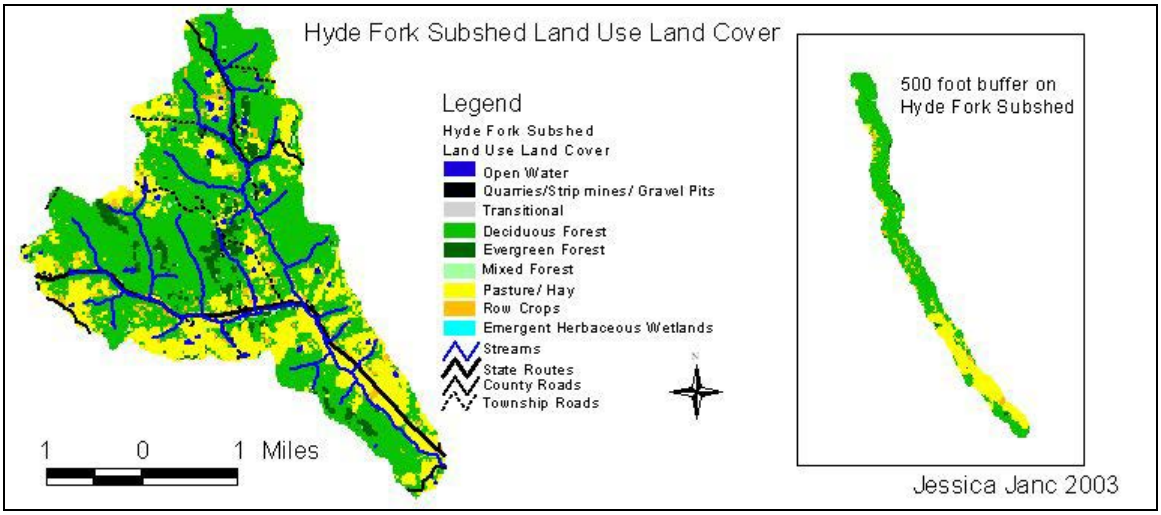
LU1



LU2



LU3



LAND USE LAND COVER BY SUBWATERSHED

05030204090010 (Miners, Hyde, Smith)

Miners Fork Subwatershed (see map LU1) covers 7.0 square miles and includes Smith Run. This subwatershed is located in the northwestern portion of the Federal Valley Watershed. State Routes 78 is the northern border of this subwatershed. Wrightstown Road and Bishopville Road are the busiest county roads in this subwatershed.

Table 21 LULC % Miners Fork

Miners Fork Subwatershed Land Use Land Cover			Miners Fork 500 ft buffer Land Use Land Cover	
Water	0.10%		Deciduous Forest	61.71%
Low Intensity Residential	0.02%		Evergreen Forest	1.90%
Quarries/Strip Mines/Gravel Pits	0.02%		Mixed Forest	0.57%
Transitional	0.62%		Pasture/Hay	29.48%
Deciduous Forest	77.87%		Row Crops	6.21%
Evergreen Forest	1.38%		Woody Wetlands	0.14%
Mixed Forest	0.60%			
Pasture/Hay	15.61%			
Row Crops	3.72%			
Woody Wetlands	0.03%			
Emergent Herbaceous Wetlands	0.02%			

Relative to other Federal Valley subwatersheds:

Combined land use land cover categories for subwatershed	Covered in subwatershed	Mean	Standard deviation from mean	Normal, High, Low
Forest		74.49%	1	Normal
Agriculture	19.34%	25.02%	1	Normal
Residential	0.02%	0.03%	1	Normal
Wetland	0.05%	0.11%	2	Low

Combined land use land cover categories for buffer	Covered in buffer	Mean	Standard deviation from mean	Normal, High, Low
Forest	64.17%	64.18%		Normal
Agriculture	35.69%	34.51%	1	Normal
Residential	0.00%	0.03%	1	Normal
Wetland	0.14%	0.74%	1	Normal

Miners Fork has a low percentage of agricultural coverage. The majority of pasture/hay area and row crops are found within the buffer of Miners Fork and its tributaries. Most of the land cover for the entire subwatershed is deciduous forest.

Wetlands inventory-

4.47 sq. miles 0.03% land coverage Woody Wetland

3.36 sq. miles 0.02% land coverage Emergent Herbaceous Wetland

There are 3 small areas of Woody Wetlands in the lower third section of the subwatershed. All the Woody Wetlands are located within a 500 foot buffer of the creeks. The Woody Wetlands comprise a total of 4.47 square miles of area. The Woody Wetlands are contiguous with the general distribution of pasture land, evergreen and deciduous forests, mixed forests and coal fields found throughout the subwatershed.

There are 3 small areas of Emergent Herbaceous Wetlands in the Miners Fork Subwatershed, one in the mid half of the subwatershed, the other two in the mid eastern half of the subwatershed. All the wetlands are within a 500 foot buffer of the creeks. The Emergent Herbaceous Wetlands comprise a total of 3.36 square miles of area. The Emergent Herbaceous Wetlands are contiguous with the general distribution of row crops, pasture/hay fields, abandoned coal fields, and deciduous forests found throughout the subwatershed.

In comparison to the mean number of wetlands in the total Federal Valley Watershed, the number of wetlands in Miners Fork is low (Std deviation, 2).

In comparison to the mean number of wetlands in the total Federal Valley Watersheds 500 foot buffer zone, the number of wetlands in Miners Forks 500 foot buffer zone is normal (Std deviation, 1).

The Smith Run Subwatershed (see map LU2) covers approximately 2.9 square miles. It is located in the northwestern portion of the Federal Valley Watershed. The percentages of land use land cover types are similar in the buffer as the entire subwatershed. State Route 78 borders this subwatershed.

Table 24 Smith Run LULC

Smith Run Subwatershed Land Use Land Cover			Smith Run 500 Foot Buffer Land Use Land Cover	
Low Intensity Residential	0.04%		Deciduous Forest	80.92%
Quarries/Strip Mines/Gravel Pits	0.01%		Evergreen Forest	1.17%
Transitional	0.20%		Mixed Forest	0.17%
Deciduous Forest	83.00%		Pasture/Hay	12.97%
Evergreen Forest	0.74%		Row Crops	4.77%
Mixed Forest	0.34%			
Pasture/Hay	11.62%			
Row Crops	4.05%			

Relative to other Federal Valley subwatersheds:

Combined land use land cover categories for subwatershed	Covered in subwatershed	Mean	Standard deviation from mean	Normal, High, Low
Forest	84.08%	74.49%	1	Normal
Agriculture	15.67%	25.02%	1	Normal
Residential	0.04%	0.03%	1	Normal
Wetland	0.00%	0.11%	2	Low

Combined land use land cover categories for buffer	Covered in buffer	Mean	Standard deviation from mean	Normal, High, Low
Forest	82.26%	64.18%		Normal
Agriculture	17.74%	34.51%	1	Normal
Residential	0.00%	0.03%	1	Normal
Wetland	0.00%	0.74%	2	Low

Smith Run subwatershed and its buffer have a high percentage of forest coverage and a low percentage of agriculture coverage. About 83% of the entire subwatershed is comprised of deciduous forest. Almost 12% of the subwatershed is pasture/hay area and 4% is row crops.

Wetlands inventory- No Wetlands noted

Hyde Fork Subwatershed (see map LU3) of the Federal Valley Watershed is approximately 6.6 square miles. It is located in the northwestern portion of the watershed.

Hyde Fork Subwatershed Land Use Land Cover			Hyde Fork 500 ft buffer Land Use Land Cover	
Water	0.14%		Deciduous Forest	65.43%
Quarries/Strip Mines/Gravel Pits	0.02%		Evergreen Forest	1.77%
Transitional	0.01%		Mixed Forest	0.45%
Deciduous Forest	63.05%		Pasture/Hay	27.48%
Evergreen Forest	5.14%		Row Crops	4.87%
Mixed Forest	0.49%			
Pasture/Hay	27.26%			
Row Crops	3.87%			
Emergent Herbaceous Wetlands	0.02%			

Relative to other Federal Valley subwatersheds:

Combined land use land cover categories for subwatershed	Covered in subwatershed	Mean	Standard deviation from mean	Normal, High, Low
Forest	68.68%	74.49%	1	Normal
Agriculture	31.14%	25.02%	1	Normal
Residential	0.00%	0.03%	1	Normal
Wetland	0.02%	0.11%	2	Low

Combined land use land cover categories for buffer	Covered in buffer	Mean	Standard deviation from mean	Normal, High, Low
Forest	67.66%	64.18%		Normal
Agriculture	32.34%	34.51%	1	Normal
Residential	0.00%	0.03%	1	Normal
Wetland	0.00%	0.74%	1	Normal

Hyde Fork has a low percentage of agriculture cover. Over half of the subwatershed and its buffer are deciduous forest. Pasture/hay areas take up almost all of the remainder of the subwatershed. Most of the pasture/hay areas are found in the southern section of the subwatershed along Hyde Fork and its largest tributary.

Wetlands inventory-

2.23 sq. miles 0.02% land coverage Emergent herbaceous wetland

There are 4 small areas of Emergent Herbaceous Wetlands in the subwatershed, 2 in the middle upper half and 2 in lower middle section of the Hyde Fork subwatershed. All the Emergent Herbaceous Wetlands are located within a 500 foot buffer of the creeks. The Emergent Herbaceous Wetlands comprise a total of 2.23 square miles of area.

No Emergent Herbaceous Wetlands noted

In comparison to the mean number of wetlands in the total Federal Valley Watershed, the number of wetlands in Hyde Fork is low (Std deviation, – 2).

05030204090020 (Upper Federal, Kasler, Kitten, Linscott)

Kasler Creek Subwatershed (see map LU4) covers approximately 3.7 square miles. It is located in the western half of the Federal Valley Watershed.

Table 25 Kasler Creek LULC

Kasler Creek Subwatershed Land Use Land Cover			Kasler Creek 500 ft buffer Land Use Land Cover	
Water	0.08%			0.07%
Quarries/Strip Mines/Gravel Pits	0.01%		Quarries/Strip Mines/Gravel Pits	0.03%
Transitional	1.18%		Transitional	2.02%
Deciduous Forest	47.37%		Deciduous Forest	43.52%
Evergreen Forest	5.13%		Evergreen Forest	1.43%
Mixed Forest	0.80%		Mixed Forest	0.07%
Pasture/Hay	42.24%		Pasture/Hay	46.27%
Row Crops	3.12%		Row Crops	6.30%
Woody Wetlands	0.05%		Woody Wetlands	0.27%
Emergent Herbaceous Wetlands	0.04%		Emergent Herbaceous Wetlands	0.03%

Relative to other Federal Valley subwatersheds:

Combined land use land cover categories for subwatershed	Covered in subwatershed	Mean	Standard deviation from mean	Normal, High, Low
Forest	53.29%	74.49%	2	Low
Agriculture	45.36%	25.02%	2	Low
Residential	0.00%	0.03%	1	Normal
Wetland	0.08%	0.11%	1	Normal

Combined land use land cover categories for buffer	Covered in buffer	Mean	Standard deviation from mean	Normal, High, Low
Forest	45.01%	64.18%		Normal
Agriculture	52.57%	34.51%	1	Normal
Residential	0.00%	0.03%	1	Normal
Wetland	0.30%	0.74%	1	Normal

Kasler Creek has a large percentage of land designated transitional. This is interesting considering there is no known mining that has occurred in this area. More than half of the subwatershed is classified as forest with agriculture as a close second. Areas of pasture/hay and row crops are found near the headwaters of this subwatershed. The buffer has similar land use land cover as the entire subwatershed, but the buffer has a high percentage of agriculture coverage.

Wetlands inventory-

2.80 sq. miles 0.05% land coverage Woody Wetlands

2.23 sq. miles 0.04% land coverage Emergent Herbaceous Wetland

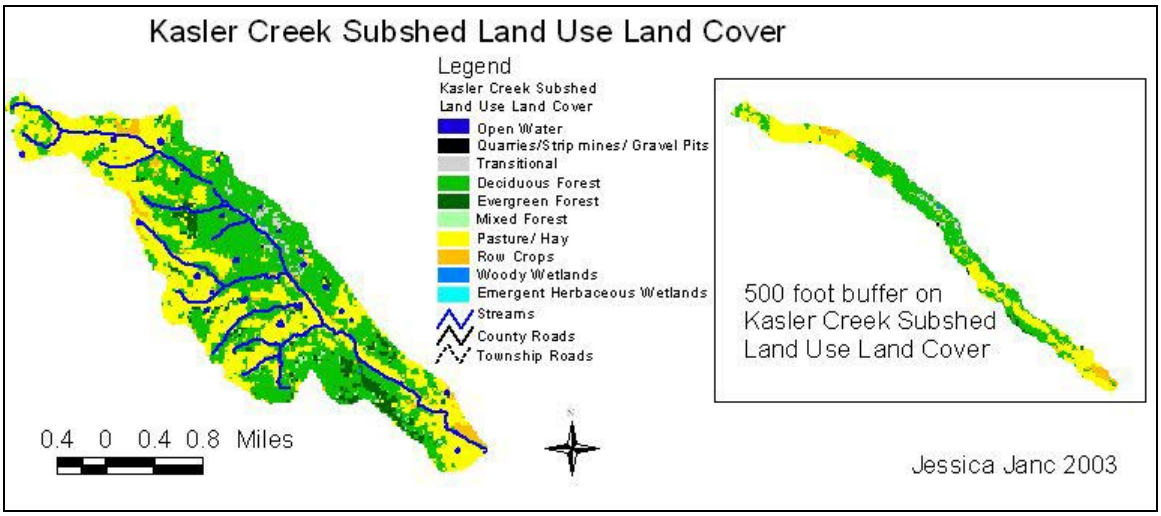
There are 2 small areas of Woody Wetlands in the Kasler Creek subwatershed. All the Woody Wetlands are located within a 500 foot buffer of the creeks. The Woody Wetlands comprise a total of 2.80 square miles of area. The Woody Wetlands are contiguous with a general distribution of Transitional forest, Evergreen and Deciduous Forests, Row Crop and Open Water found throughout the subwatershed.

There are 3 small areas of Emergent Herbaceous Wetlands in the lower half of the Kasler Creek Subwatershed. All the Emergent Herbaceous Wetlands are located within a 500 foot buffer of the creeks. The Emergent Herbaceous Wetlands comprise a total of 2.23 square miles of area. The Emergent Herbaceous Wetlands are contiguous with a general distribution of Row Crops, Pasture/Hay fields, Open Water and Deciduous Forests found throughout the subwatershed

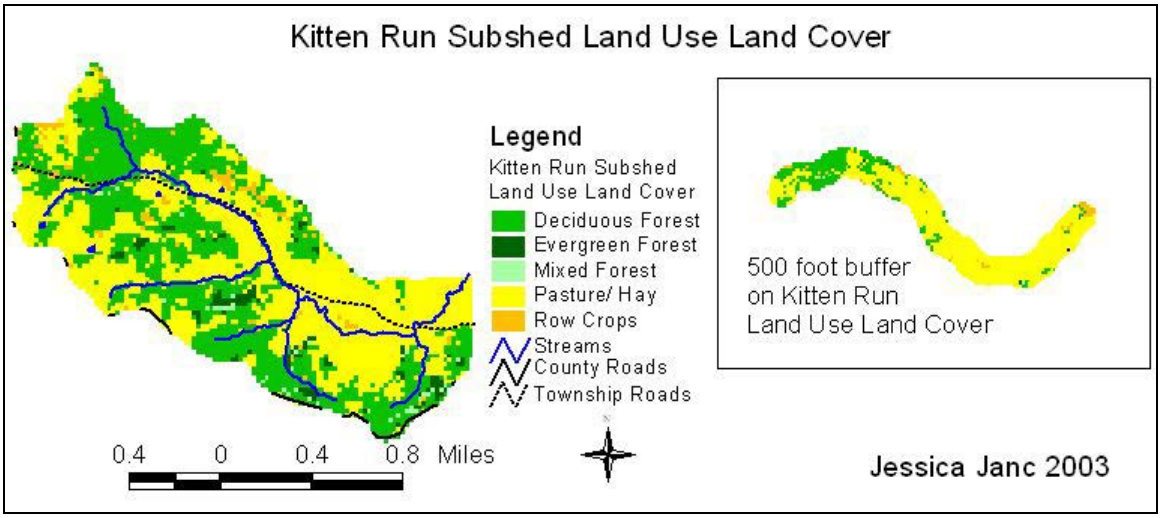
In comparison to the mean number of wetlands in the total Federal Valley Watershed, the number of wetlands in Kasler Creek is normal (Std deviation, 1). In comparison to the mean number of wetlands in the total Federal Valley Watersheds 500 foot buffer zone, the number of wetlands in Kasler Creek's 500 foot buffer zone is normal (Std deviation, 1).

Map 18 LULC Kasler Creek, Kitten Run, Linscott Run

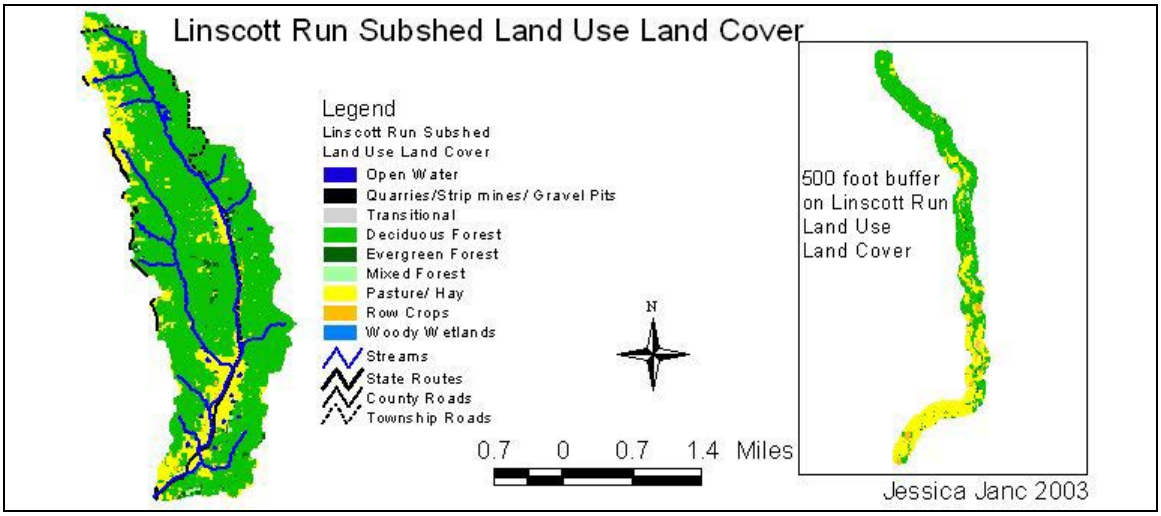
LU4



LU5



LU6



The Kitten Run Subwatershed (see map LU5) of the Federal Valley Watershed covers about 1.6 square miles. It is located in the in the middle of the watershed.

Table 26 Kitten Run LULC

Kitten Run Subwatershed Land Use Land Cover			Kitten Run 500 ft buffer Land Use Land Cover	
Deciduous Forest	41.49%		Water	0.07%
Evergreen Forest	2.85%		Deciduous Forest	20.38%
Mixed Forest	0.94%		Evergreen Forest	0.34%
Pasture/Hay	52.10%		Mixed Forest	0.27%
Row Crops	2.63%		Pasture/Hay	75.41%
			Row Crops	3.46%
			Woody Wetlands	0.07%

Relative to other Federal Valley subwatersheds:

Combined land use land cover categories for subwatershed	Covered in subwatershed	Mean	Standard deviation from mean	Normal, High, Low
Forest	45.28%	74.49%	2	Low
Agriculture	54.72%	25.02%	2	High
Residential	0.00%	0.03%	1	Normal
Wetland	0.00%	0.11%	2	Low

Combined land use land cover categories for buffer	Covered in buffer	Mean	Standard deviation from mean	Normal, High, Low
Forest	20.99%	64.18%		Low
Agriculture	78.87%	34.51%	>2	High
Residential	0.00%	0.03%	1	Normal
Wetland	0.00%	0.74%	2	Low

Kitten Run has a high percentage of agriculture cover. Over half of this subwatershed is pasture/hay area. Its buffer has an extremely high percentage of agriculture cover and a low percentage of forest cover. Almost 42% of the entire subwatershed is deciduous forest. Row crops and evergreen forest both cover about 3% of the subwatershed. The 500-foot buffer is about 75% pasture/hay area. Approximately 20% of the buffer is deciduous forest.

Wetlands inventory- No wetlands noted.

Linscott Run Subwatershed (see map LU6) is about 5.1 square miles. It is located in the center of the Federal Valley Watershed. Linscott Run Road runs along the main stem of this subwatershed.

Table 27 LULC Linscott Run

Linscott Run Subwatershed Land Use Land Cover			Linscott Run 500 ft buffer Land Use Land Cover	
Water	0.03%		Water	0.06%
Quarries/Strip Mines/Gravel Pits	0.08%		Deciduous Forest	65.17%
Transitional	0.02%		Evergreen Forest	1.21%
Deciduous Forest	80.13%		Mixed Forest	0.44%
Evergreen Forest	1.23%		Pasture/Hay	30.70%
Mixed Forest	0.54%		Row Crops	2.06%
Pasture/Hay	16.68%		Woody Wetlands	0.35%
Row Crops	1.19%			
Woody Wetlands	0.09%			

Relative to other Federal Valley subwatersheds:

Combined land use land cover categories for subwatershed	Covered in subwatershed	Mean	Standard deviation from mean	Normal, High, Low
Forest	81.89%	74.49%	1	Normal
Agriculture	17.88%	25.02%	1	Normal
Residential	0.00%	0.03%	1	Normal
Wetland	0.09%	0.11%	2	Low

Combined land use land cover categories for buffer	Covered in buffer	Mean	Standard deviation from mean	Normal, High, Low
Forest	66.83%	64.18%		Normal
Agriculture	32.76%	34.51%	1	Normal
Residential	0.00%	0.03%	1	Normal
Wetland	0.35%	0.74%	1	Normal

Linscott Run has a high percentage of forest cover and low percentage of agriculture cover. Most of Linscott Run is deciduous forest with the rest of the majority of the remainder of the subwatershed pasture/hay. Most of Linscott Run's pasture/hay areas are near the headwaters in the north or along the main stem of Linscott in the south.

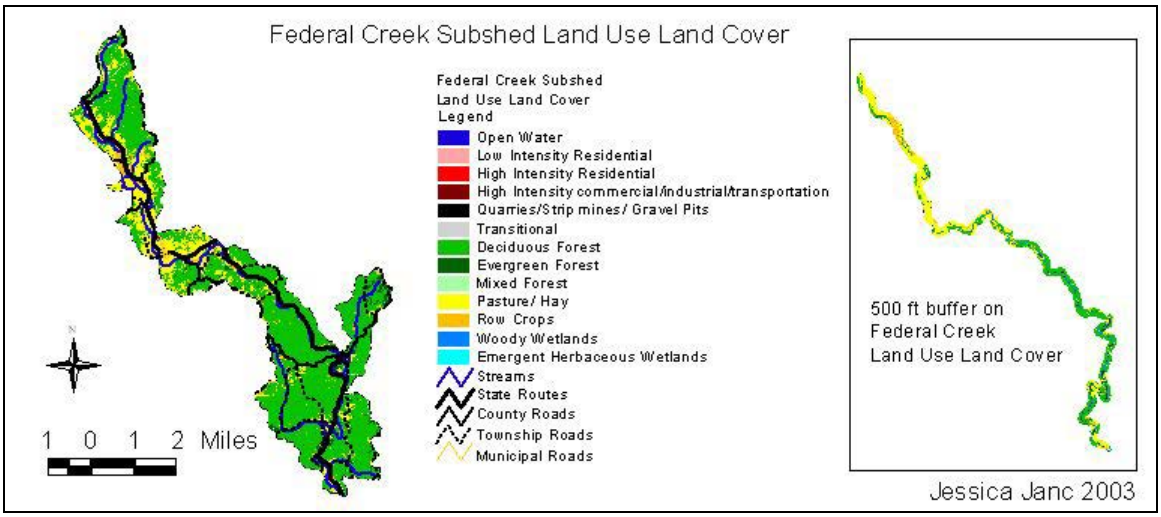
Wetlands inventory-

7.27 sq. miles 0.09% land coverage Woody Wetland. There are several small areas of Woody Wetlands in the Linscott Run subwatershed, of this, there are two clusters -- one in the lower section and the other in the middle section of the subwatershed. All the Woody Wetlands are located within a 500 foot buffer of the creeks. The Woody Wetlands comprise a total of 7.27 sq. square miles of area.

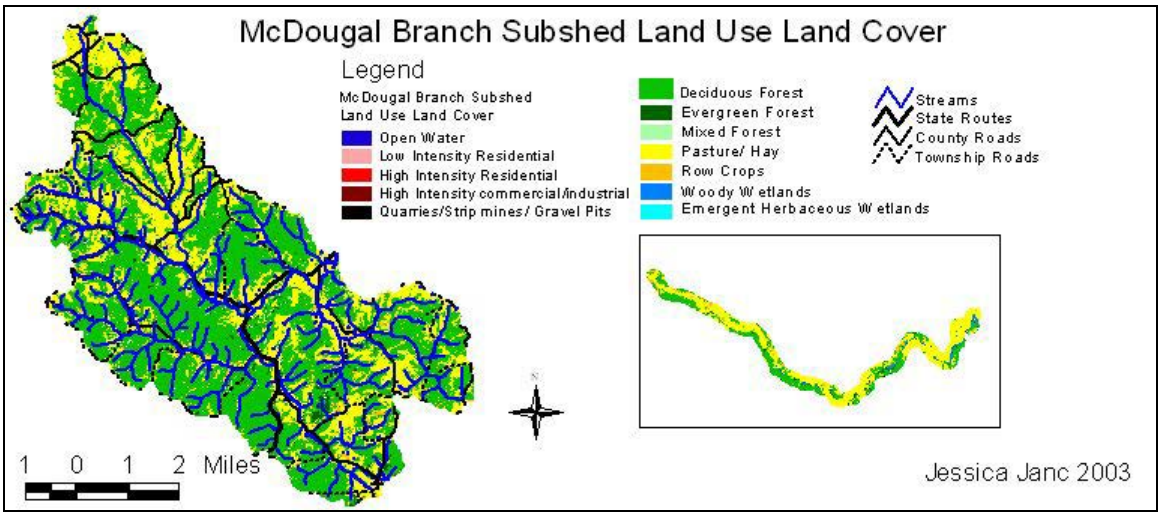
In comparison to the mean number of wetlands in the total Federal Valley Watershed, the number of wetlands in Linscott Run is low (Std deviation, 2).

Map 19 LULC Federal Mainstem, McDougall Branch, Bryson Br

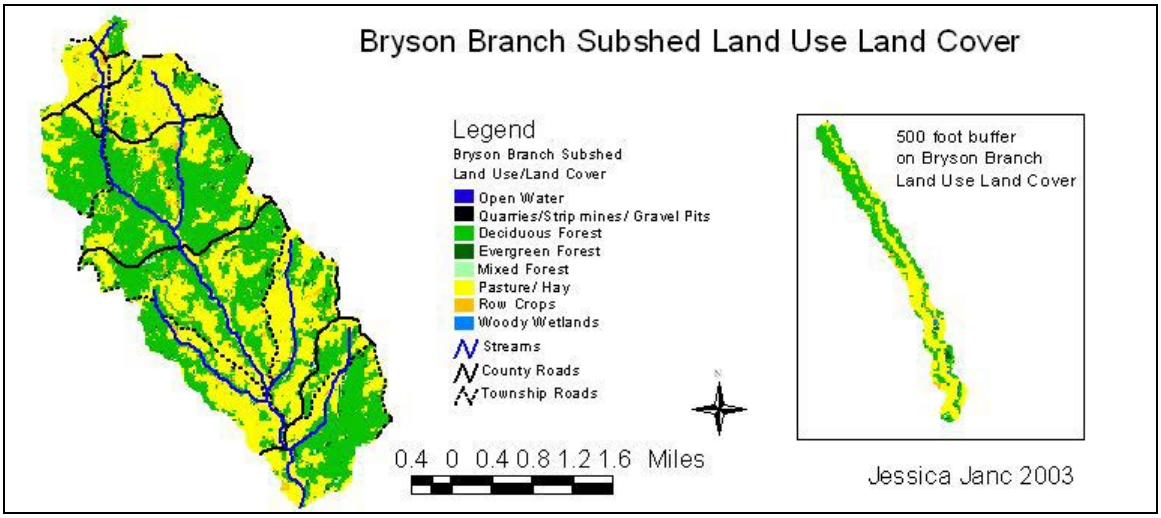
LU7



LU8



LU9



05030204090090 (Lower Federal, Sharps Run)

The Federal Creek Main Stem Subwatershed (see map LU7) is approximately 16.9 square miles. It is located in the center Federal Valley Watershed and contains the main stem of Federal Creek. In the center of this subwatershed is Amesville, the only incorporated village in the Federal Valley Watershed. The area of residential and commercial buildings is most intense in this subwatershed.

Federal Creek Subwatershed Land Use Land Cover			Federal Creek 500 ft buffer Land use Land Cover	
Water	0.39%		Water	1.93%
Low Intensity Residential	0.20%		Low Intensity Residential	0.22%
High Intensity Residential	0.02%		High Intensity Residential	0.06%
High Intensity	0.07%		High Intensity	0.23%
Quarries/Strip Mines/Gravel Pits	0.01%		Deciduous Forest	42.57%
Transitional	0.08%		Evergreen Forest	3.86%
Deciduous Forest	70.51%		Mixed Forest	1.13%
Evergreen Forest	2.80%		Pasture/Hay	37.19%
Mixed Forest	0.72%		Row Crops	7.60%
Pasture/Hay	20.51%		Woody Wetlands	5.07%
Row Crops	3.74%		Emergent Herbaceous Wetlands	0.15%
Woody Wetlands	0.90%			0
Emergent Herbaceous Wetlands	0.04%			0

Relative to other Federal Valley subwatersheds:

Combined land use land cover categories for subwatershed	Covered in subwatershed	Mean	Standard deviation from mean	Normal, High, Low
Forest	74.04%	74.49%	1	Normal
Agriculture	24.25%	25.02%	1	Normal
Residential	0.22%	0.03%	>2	High
Wetland	0.94%	0.11%	>2	High

Combined land use land cover categories for buffer	Covered in buffer	Mean	Standard deviation from mean	Normal, High, Low
Forest	47.55%	64.18%		
Agriculture	44.78%	34.51%	1	
Residential	0.28%	0.03%	>2	
Wetland	5.22%	0.74%	>2	

Federal Creek subwatershed and its buffer have high percentages of woody wetland coverage. This could be due to an error in classification since the stream is so wide in this subwatershed and areas that are actually the river may be classified as woody wetlands. Approximately 70% of the entire subwatershed is deciduous forest and 20% is designated as pasture/hay area. Less than half of the

subwatershed's buffer is designated deciduous forest, with almost the same percentage designated as pasture/hay areas. 7% of the buffer is row crop coverage and 5% is woody wetland coverage.

Wetlands inventory-

244.94 sq. miles 5.07% land coverage Woody Wetland

11.18 sq. miles 0.15% land coverage Emergent Herbaceous Wetland

There are several small areas of Woody Wetlands, most are clustered close together following the main-stem of the Federal Creek. All the Woody Wetlands are located within a 500 foot buffer of the creeks. The Woody Wetlands comprise a total of 244.94 square miles of area. The Woody Wetlands are contiguous with a general distribution of Pasture/Hay, Mixed Forest, Bare Rock, Transitional Forest, Evergreen and Deciduous Forests, Row Crop, Emergent Herbaceous Wetland and Open Water found throughout the subwatershed.

There are several areas of Emergent Herbaceous Wetlands in the subwatershed most are found along the main-stem of the Federal Creek. All the Emergent Herbaceous Wetlands are located within a 500 foot buffer of the creeks. The Emergent Herbaceous Wetlands comprise a total of 11.18 square miles of area.

In comparison to the mean number of wetlands in the total Federal Valley Watershed, the number of wetlands in Federal Creek Subwatershed is high (Std deviation, > 2). In comparison to the mean number of wetlands in the total Federal Valley Watersheds 500 foot buffer zone, the number of wetlands in Federal Creek's 500 foot buffer zone is high (Std deviation > 2).

Table 28 Sharps Run Subwatershed

(see map LU8) covers approximately 5.5 square miles. It is located in the southern portion of the Federal Valley Watershed.

Sharps Run Subwatershed Land Use Land Cover			Sharps Run 500 Foot Buffer Land Use Land Cover	
Water	0.02%		Water	0.05%
Low Intensity Residential	0.03%		Quarries/Strip Mines/Gravel	0.05%
High Intensity	0.06%		Deciduous Forest	81.28%
Quarries/Strip Mines/Gravel Pits	0.01%		Evergreen Forest	1.54%
Deciduous Forest	88.73%		Mixed Forest	0.82%
Evergreen Forest	1.20%		Pasture/Hay	14.36%
Mixed Forest	0.23%		Row Crops	1.64%
Pasture/Hay	7.90%		Woody Wetlands	0.27%
Row Crops	1.78%			
Woody Wetlands	0.04%			
Emergent Herbaceous Wetlands	0.01%			

Relative to other Federal Valley subwatersheds:

Combined land use land cover categories for subwatershed	Covered in subwatershed	Mean	Standard deviation from mean	Normal, High, Low
Forest	90.16%	74.49%	2	High
Agriculture	9.68%	25.02%	2	Low
Residential	0.03%	0.03%	1	Normal
Wetland	0.04%	0.11%	2	Low
Combined land use land cover categories for buffer	Covered in buffer	Mean	Standard deviation from mean	Normal, High, Low
Forest	83.64%	64.18%		Normal
Agriculture	15.99%	34.51%	1	Normal
Residential	0.00%	0.03%	1	Normal
Wetland	0.27%	0.74%	1	Normal

Sharps Run has a high percentage of forest coverage and low percentage agriculture coverage. Almost 90% of the entire subwatershed is deciduous forest, with the majority of the remainder of land being pasture/hay area. Much of the pasture/hay area in this subwatershed is found within the 500-foot buffer of Sharps Run and around the headwaters of the subwatershed. Its buffer has a high percentage of wetland coverage.

Wetlands inventory-

.0021 sq mi, 0.04% land coverage Woody Wetlands

.0003 sq mi, 0.01% land coverage Emergent Herbaceous Wetlands

There are a few small areas of Woody Wetlands in the lower section of the Sharps Run subwatershed near Sharps Run creek. All the Woody Wetlands are located within a 500 foot buffer of the creeks. The Woody Wetlands comprise a total of .0021 square miles of area. The Woody Wetlands are contiguous with the general distribution of pasture land and deciduous forests, found throughout the subwatershed.

There is 1 small area of Emergent Herbaceous Wetland in the Sharps Run Subwatershed, it is located in the lower half of the subwatershed and is within a 500 foot buffer of the creeks. The Emergent Herbaceous Wetlands comprise a total of .0003 square miles of area. The Emergent Herbaceous Wetlands are contiguous with the general distribution of pasture/hay fields, evergreen forests, and open water found throughout the subwatershed.

In comparison to the mean number of wetlands in the total Federal Valley Watershed, the number of wetlands in Sharps Run is low (Std deviation, 2)

In comparison to the mean number of wetlands in the total Federal Valley Watersheds 500 foot buffer zone, the number of wetlands in Sharps Run's 500 foot buffer zone is normal (Std deviation, 1).

05030204090030 (Upper McDougall, Bryson)

McDougall Branch Subwatershed (see map LU9) covers about 9.6 square miles. McDougall Branch includes Bryson Branch, Dutch Creek, Wyatt Run and Mush Run. It is located in the western portion of the Federal Valley Watershed. State Route 550 runs directly next to McDougall Branch.

Table 29 McDougall Branch LULC

McDougall Branch Subwatershed Land Use Land Cover			McDougall Branch 500 ft buffer Land use Land Cover	
Water	0..04%		Water	.11%
Low Intensity Residential	0..01%		Low Intensity Residential	.11%
Quarries/Strip Mines/Gravel Pits	0.02%		Deciduous Forest	33.31%
Transitional	0.08%		Evergreen Forest	3.40%
Deciduous Forest	57.94%		Mixed Forest	.66%
Evergreen Forest	1.64%		Pasture/Hay	55.06%
Mixed Forest	.74%		Row Crops	4.03%
Pasture/Hay	36.06%		Woody Wetlands	3.23%
Row Crops	3.17%		Emergent Herbaceous Wetlands	.09%
Woody Wetlands	.37%			
Emergent Herbaceous Wetlands	.01%			

Relative to other Federal Valley subwatersheds:

Combined land use land cover categories for subwatershed	Covered in subwatershed	Mean	Standard deviation from mean	Normal, High, Low
Forest	60.32%	74.49%	1	Normal
Agriculture	39.23%	25.02%	1	Normal
Residential	0.01%	0.03%	1	Normal
Wetland	0.38%	0.11%	2	High

Combined land use land cover categories for buffer	Covered in buffer	Mean	Standard deviation from mean	Normal, High, Low
Forest	37.37%	64.18%		Low
Agriculture	59.09%	34.51%	2	High
Residential	0.11%	0.03%	1	Normal
Wetland	3.31%	0.74%	2	High

McDougall Branch has a high percentage of agriculture coverage. Over half of the subwatershed is deciduous forest. More than a third of the subwatershed is pasture/hay area. The buffer of this subwatershed is mostly pasture/hay area with deciduous forest as the second most prominent land cover.

Wetlands inventory-

57.04 sq. miles 0.37% land coverage Woody Wetland

1.68 sq. miles 0.01% land coverage Emergent herbaceous wetland

There are several small areas of Woody Wetlands, most are clustered close together following the main-stem of the lower McDougall Branch. All the Woody Wetlands are located within a 500 foot buffer of the creeks. The Woody Wetlands comprise a total of 57.04 square miles of area. The Woody Wetlands are contiguous with the general distribution of pasture/hay, mixed forest, evergreen and deciduous forests, row crop, emergent herbaceous wetland and open water found throughout the subwatershed.

There are two small areas of Emergent Herbaceous Wetlands in the subwatershed, one located near the mouth of McDougall Branch and the other in the upper section of the subwatershed. Both are within a 500 foot buffer of the creeks. The Emergent Herbaceous Wetlands comprises a total of 1.68 square miles of area. The Emergent Herbaceous Wetlands are contiguous with the general distribution of open water, pasture/hay, deciduous and evergreen forest found throughout the subwatershed.

In comparison to the mean number of wetlands in the total Federal Valley Watershed, the number of wetlands in McDougall Branch is high (Std deviation, 2). In comparison to the mean number of wetlands in the total Federal Valley Watersheds 500 foot buffer zone, the number of wetlands in McDougall Branch's 500 foot buffer zone is high (Std deviation, 2).

The Bryson Branch Subwatershed (see map LU10) of the Federal Valley Watershed encompasses 7.9 square miles. It is located along the western edge of the watershed. There are four township roads that go through this subwatershed.

Table 30 Bryson Branch LULC

Bryson Branch Subwatershed Land Use Land Cover			Bryson Branch 500 ft buffer Land Use Land Cover	
Water	0.05%		Quarries/Strip Mines/Gravel Pits	0.05%
Quarries/Strip Mines/Gravel	0.03%		Deciduous Forest	44.53%
Deciduous Forest	48.68%		Evergreen Forest	2.11%
Evergreen Forest	1.60%		Mixed Forest	0.74%
Mixed Forest	0.66%		Pasture/Hay	49.00%
Pasture/Hay	45.96%		Row Crops	2.84%
Row Crops	2.96%		Woody Wetlands	0.74%
Woody Wetlands	0.07%			

Relative to other Federal Valley subwatersheds:

Combined land use land cover categories for subwatershed	Covered in subwatershed	Mean	Standard deviation from mean	Normal, High, Low
Forest	50.94%	74.49%	2	Low
Agriculture	48.91%	25.02%	2	High
Residential	0.00%	0.03%	1	Normal
Wetland	0.07%	0.11%	2	Low

Combined land use land cover categories for buffer	Covered in buffer	Mean	Standard deviation from mean	Normal, High, Low
Forest	47.37%	64.18%		Normal
Agriculture	51.84%	34.51%	1	Normal
Residential	0.00%	0.03%	1	Normal
Wetland	0.74%	0.74%	1	Normal

The subwatershed and its 500-foot buffer are mostly deciduous forest and pasture/hay area. Its buffer has a high percentage of wetland coverage. Most of the pasture/hay areas run along tributaries of Bryson Branch. Approximately 3% of the subwatershed and buffer is row crops.

Wetlands inventory-

8.39 sq. miles 0.07% coverage Woody Wetland

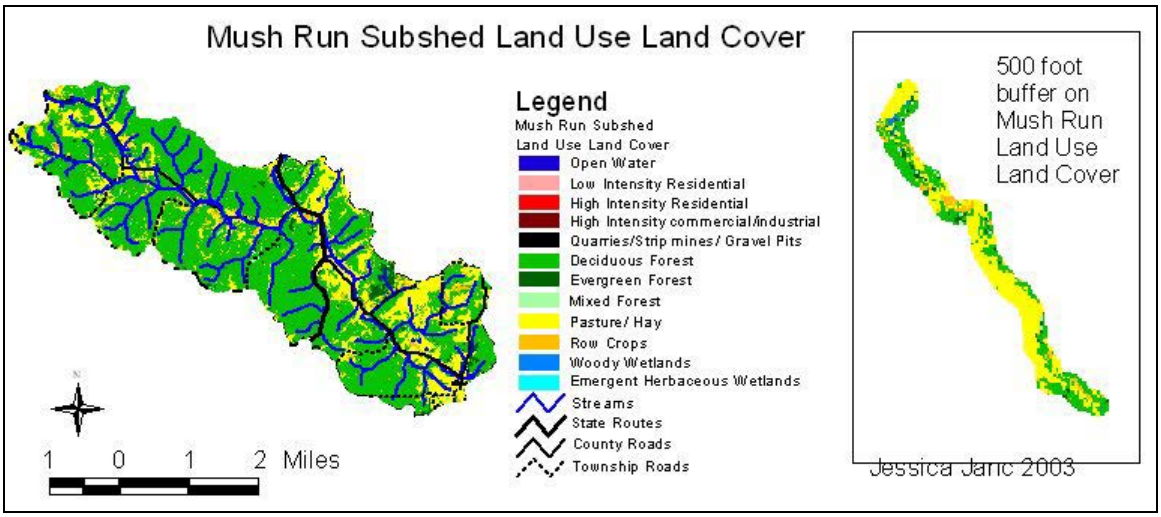
There are several small areas of Woody Wetlands, most are clustered along the main-stem of Bryson Run near the mouth of the subwatershed. All the Woody Wetlands are located within a 500 foot buffer of the creeks. The Woody Wetlands comprise a total of 8.39 square miles of area. The Woody Wetlands are contiguous with a general distribution of Pasture/Hay, Mixed Forest, Deciduous Forest, Row Crops found throughout the subwatershed.

No Emergent Herbaceous Wetlands noted

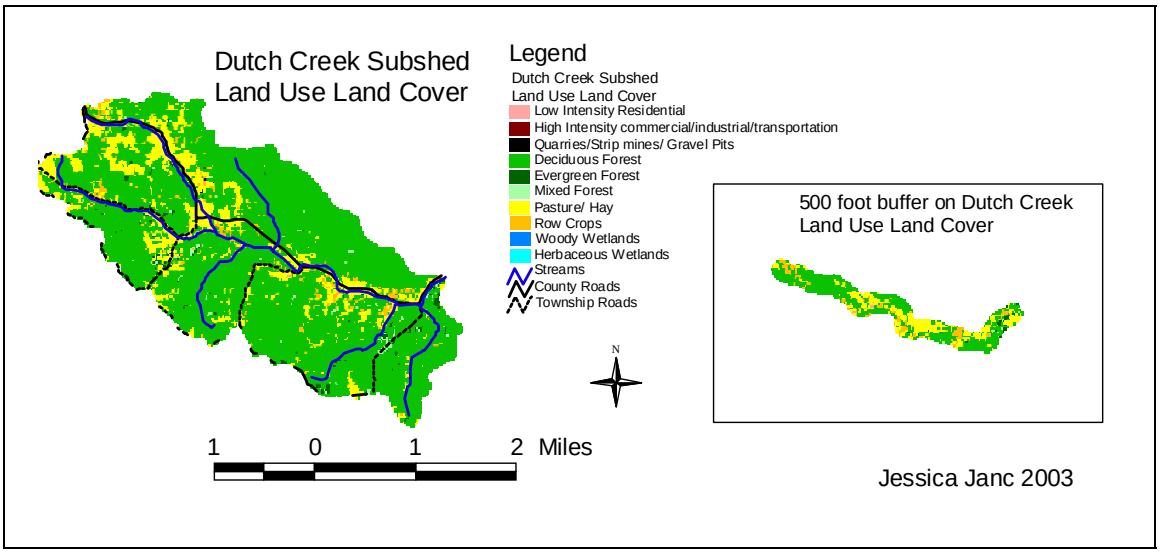
In comparison to the mean number of wetlands in the total Federal Valley Watershed, the number of wetlands in Bryson Run Subwatershed is normal (Std deviation, 1). In comparison to the mean number of wetlands in the total Federal Valley Watershed 500 foot buffer zone, the number of wetlands in Bryson Run's 500 foot buffer zone is normal (Std deviation, 1).

Map 20 LULC Mush Run, Dutch Creek, Wyatt Run

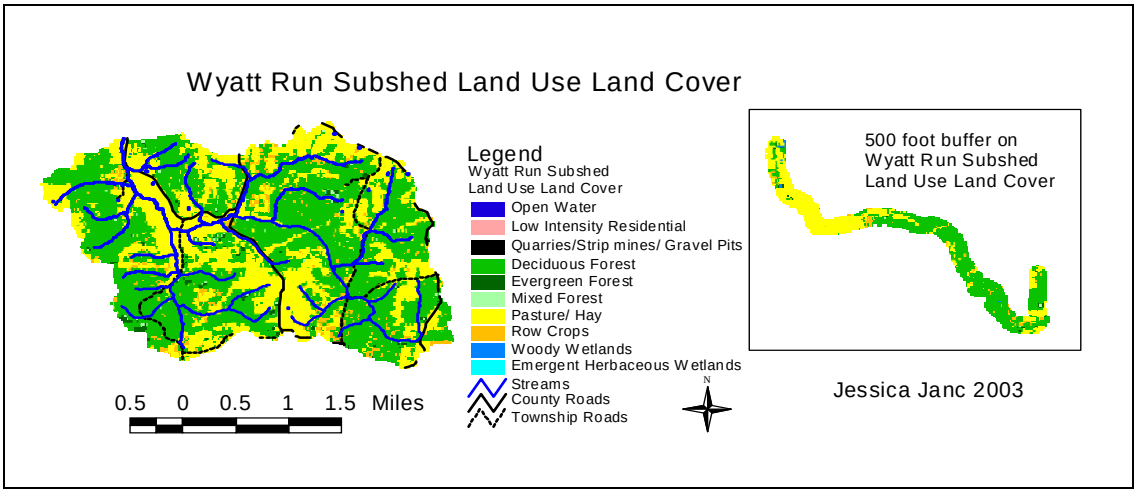
LU10



LU11



LU12



05030204090040 (Mush, Dutch)

Mush Run Subwatershed (see map LU11) covers about 6.5 square miles and includes Dutch Creek. It is located in the southwestern section of the watershed. State Route 690 runs through Mush Run subwatershed.

Table 31 *Mush Run*

Mush Run Subwatershed Land Use Land Cover			Mush Run 500 ft buffer Land Use Land Cover	
Water	0.03%		Deciduous Forest	35.67%
Low Intensity Residential	0.10%		Evergreen Forest	4.81%
High Intensity Residential	0.01%		Mixed Forest	1.70%
High Intensity	0.02%		Pasture/Hay	50.65%
Quarries/Strip Mines/Gravel Pits	0.02%		Row Crops	6.01%
Deciduous Forest	61.84%		Woody Wetlands	1.15%
Evergreen Forest	3.61%			
Mixed Forest	0.57%			
Pasture/Hay	29.91%			
Row Crops	3.72%			
Woody Wetlands	0.15%			
Emergent Herbaceous Wetlands	0.02%			

Relative to other Federal Valley subwatersheds:

Combined land use land cover categories for subwatershed	Covered in subwatershed	Mean	Standard deviation from mean	Normal, High, Low
Forest	66.03%	74.49%	1	Normal
Agriculture	33.63%	25.02%	1	Normal
Residential	0.10%	0.03%	2	High
Wetland	0.17%	0.11%	1	Normal

Combined land use land cover categories for buffer	Covered in buffer	Mean	Standard deviation from mean	Normal, High, Low
Forest	42.18%	64.18%		Low
Agriculture	56.66%	34.51%	2	High
Residential	0.00%	0.03%	1	Normal
Wetland	1.15%	0.74%	1	Normal

Mush Run has a low percentage of agriculture coverage. The majority of the subwatershed is deciduous forest, but half of its buffer is pasture/hay area. Its buffer has a high percentage of agriculture coverage, as well as wetland coverage.

Wetlands inventory-

15.66sq. miles 0.15% land coverage Woody Wetland

2.23 sq. miles 0.02% land coverage Emergent Herbaceous

There are several small areas of Woody Wetlands in the upper section and a few Woody Wetlands scattered out in the lower section of the Mush Run subwatershed. All the Woody Wetlands are located within a 500 foot buffer of the creeks. The Woody Wetlands comprise a total of 15.66 square miles of area. The Woody Wetlands are contiguous with the general distribution of pasture land, evergreen and deciduous forests, mixed forests and coal fields found throughout the subwatershed.

There are 2 small areas of Emergent Herbaceous Wetlands scattered out in the Mush Run Subwatershed. All the wetlands are within a 500 foot buffer of the creeks. The Emergent Herbaceous Wetlands comprise a total of 2.23 square miles of area. The Emergent Herbaceous Wetlands are contiguous with the general distribution of row crops, pasture/hay fields, deciduous and evergreen forests found throughout the subwatershed.

In comparison to the mean number of wetlands in the total Federal Valley Watershed, the number of wetlands in Mush Run is normal (Std deviation, 1)

In comparison to the mean number of wetlands in the total Federal Valley Watersheds 500 foot buffer zone, the number of wetlands in Mush Run's 500 foot buffer zone is normal (Std deviation, 1).

The Dutch Creek Subwatershed (see map LU12) of the Federal Valley Watershed covers about 6.7 square miles. It is located in the southwestern area of the watershed.

Table 32Dutch Creek LULC

Dutch Creek Subwatershed Land Use Land Cover			Dutch Creek 500 Foot buffer Land Use Land Cover	
Water	0.02%		Low Intensity Residential	0.19%
Low Intensity Residential	0.02%		Deciduous Forest	58.96%
High Intensity Commercial/	0.01%		Evergreen Forest	1.57%
Quarries/Strip Mines/	0.01%		Mixed Forest	0.75%
Deciduous Forest	80.61%		Pasture/Hay	28.20%
Evergreen Forest	1.05%		Row Crops	10.03%
Mixed Forest	0.69%		Woody Wetlands	0.25%
Pasture/Hay	14.47%		Emergent Herbaceous Wetlands	0.06%
Row Crops	3.11%			
Woody Wetlands	0.02%			
Emergent Herbaceous Wetlands	0.01%			

Relative to other Federal Valley subwatersheds:

Combined land use land cover categories for subwatershed	Covered in subwatershed	Mean	Standard deviation from mean	Normal, High, Low
Forest	82.34%	74.49%	1	Normal
Agriculture	17.58%	25.02%	1	Normal
Residential	0.02%	0.03%	1	Normal
Wetland	0.03%	0.11%	1	Normal

Combined land use land cover categories for buffer	Covered in buffer	Mean	Standard deviation from mean	Normal, High, Low
Forest	61.28%	64.18%		Normal
Agriculture	38.22%	34.51%	1	Normal
Residential	0.19%	0.03%	>2	High
Wetland	0.31%	0.74%	1	Normal

Dutch Creek has a high percentage of forest coverage and low percentage of agriculture coverage. The majority of this subwatershed is deciduous forest. Only about 14% of the entire subwatershed is pasture/hay, but 28% of the buffer is pasture hay. Most of this land use type is found along Dutch Creek and its tributaries.

Wetlands inventory-

2.23 sq. miles 0.02% Woody Wetland land coverage

0.56 sq. mile 0.01% Emergent Herbaceous wetland land coverage

There are 3 small areas of Woody Wetlands in the lower third of the Dutch Creek subwatershed, they are located near mouth, and following the main creek of the Subwatershed All the Woody Wetlands are located within a 500 foot buffer of the creeks. The Woody Wetlands comprise a total of 2.23 square miles of area. The Woody Wetlands are contiguous with the general distribution deciduous forests and row crops, Pasture/Hay and Mixed Forests found throughout the subwatershed.

There is 1 small area of Emergent Herbaceous Wetland in the subwatershed, it is located near the mouth of the subwatershed and is located within a 500 foot buffer of the creek. The Emergent Herbaceous Wetlands comprises a total of 0.56 square miles of area. The Emergent Herbaceous Wetland is contiguous a general distribution of Row, Pasture/Hay and Deciduous Forests found throughout the subwatershed.

In comparison to the mean number of wetlands in the total Federal Valley Watershed, the number of wetlands in Dutch Creek is normal (Std deviation, 1). In comparison to the mean number of wetlands in the total Federal Valley Watersheds 500 foot buffer zone, the number of wetlands in Dutch Creek's 500-foot buffer zone is normal (1 Std dev).

05030204090050 (Lower McDougall, Wyatt)

The Wyatt Run Subwatershed (see map LU13) covers about 6.9 square miles. It is located in the southern portion of the Federal Valley Watershed.

Table 33Wyatt Run LULC

Wyatt Run Subwatershed Land Use Land Cover			Wyatt Run 500 Foot Buffer Land Use Land Cover	
Water	0.01%		Deciduous Forest	53.43%
Low Intensity Residential	0.01%		Evergreen Forest	0.90%
Quarries/Strip Mines/Gravel Pits	0.03%		Mixed Forest	0.18%
Deciduous Forest	58.59%		Pasture/Hay	41.14%
Evergreen Forest	1.04%		Row Crops	3.85%
Mixed Forest	0.39%		Woody Wetlands	0.50%
Pasture/Hay	35.15%			
Row Crops	4.76%			
Woody Wetlands	0.02%			
Emergent Herbaceous Wetlands	0.01%			

Relative to other Federal Valley subwatersheds:

Combined land use land cover categories for subwatershed	Covered in subwatershed	Mean	Standard deviation from mean	Normal, High, Low
Forest	60.02%	74.49%	1	Normal
Agriculture	39.91%	25.02%	1	Normal
Residential	0.01%	0.03%	1	Normal
Wetland	0.03%	0.11%	2	Low

Combined land use land cover categories for buffer	Covered in buffer	Mean	Standard deviation from mean	Normal, High, Low
Forest	54.51%	64.18%		Normal
Agriculture	44.98%	34.51%	1	Normal
Residential	0.00%	0.03%	1	Normal
Wetland	0.50%	0.74%	1	Normal

Over half of the entire subwatershed is comprised of deciduous forest. With almost all of the remainder of land being pasture/hay areas. The 500-foot buffer of Wyatt Run has similar land use land cover to the entire subwatershed. About half of the buffer is deciduous forest with almost the entire buffer being pasture/hay areas.

Wetlands inventory-

5 pixels 0.02% land coverage Woody Wetland

2 pixels 0.01% land coverage Emergent Herbaceous Wetland

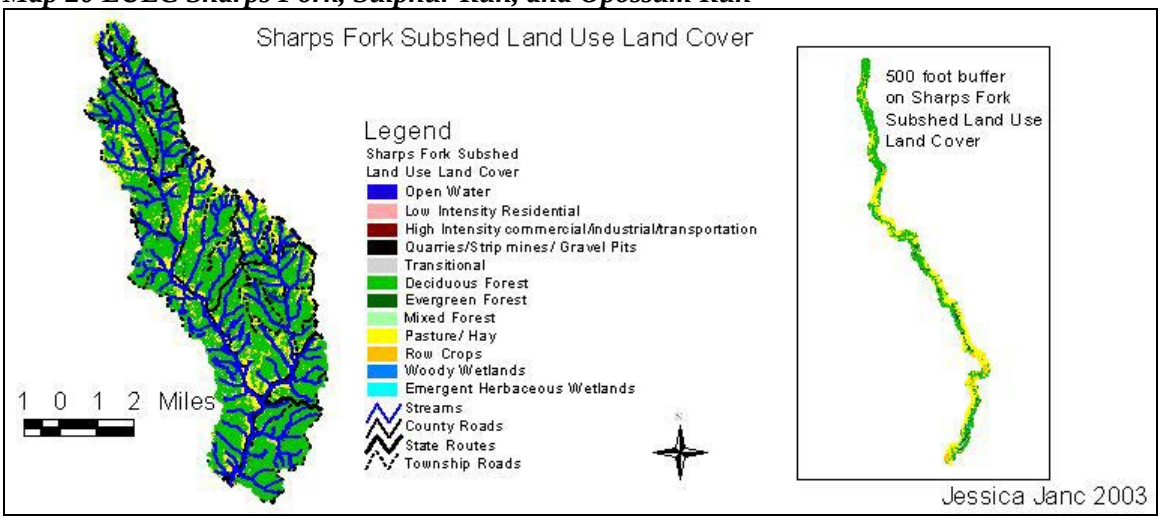
There are 3 small areas of Woody Wetlands, 1 in the lower half the rest in the upper half of the subwatershed. All the Woody Wetlands are located within a 500 foot buffer of the creek. The Woody Wetlands comprise a total of …….. square miles of area. The Woody Wetlands are contiguous with the general distribution of pasture land, evergreen and deciduous forests, mixed forests and coal fields found throughout the subwatershed.

There is 1 small area of Emergent Herbaceous Wetland in the upper middle half of the subwatershed, it is within a 500 foot buffer of the creek. The Emergent Herbaceous Wetlands comprise a total of …… square miles of area. The Emergent Herbaceous Wetlands are contiguous with the general distribution of Mixed Forest, Pasture/Hay fields, Deciduous and Evergreen Forests found throughout the subwatershed

In comparison to the mean number of wetlands in the total Federal Valley Watershed, the number of wetlands in the Wyatt subwatershed is low (Std deviation, 2)

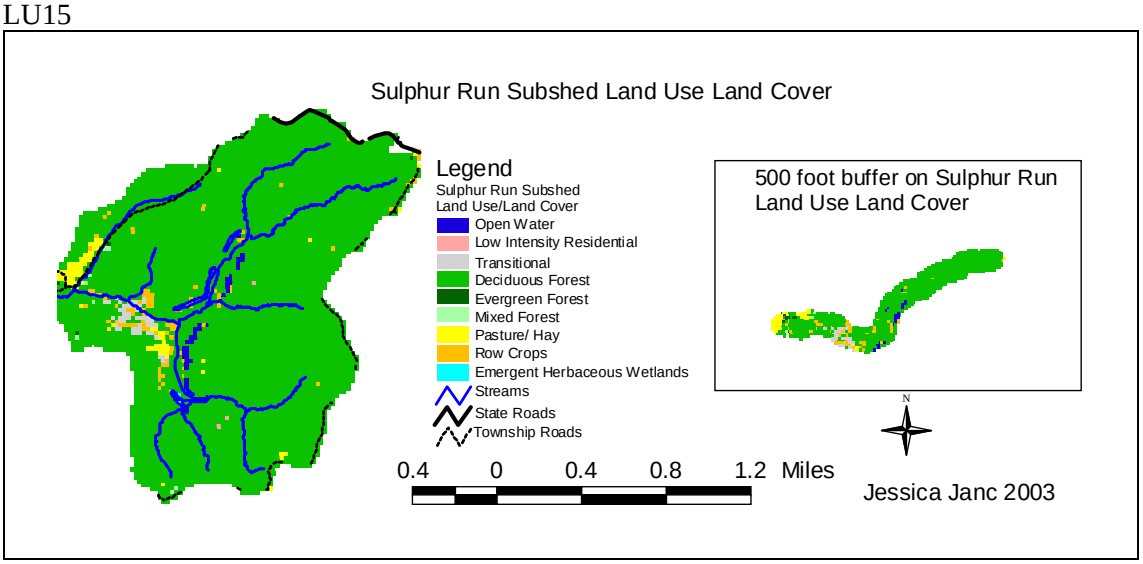
In comparison to the mean number of wetlands in the total Federal Valley Watersheds 500 foot buffer zone, the number of wetlands in Wyatt's 500 foot buffer zone is normal (Std deviation, 1).

Map 20 LULC Sharps Fork, Sulphur Run, and Opossum Run



LU14

LU15



05030204090060 (Sharps, Opossum, Sulphur)

The Sharps Fork Subwatershed (see map LU14) covers about 21.7 square miles and includes Opossum Run and Sulphur Run. It is located in the northeastern portion of the Federal Valley Watershed.

Table 34Sharps Fork LULC

Sharps Fork Land Use Land Cover			Sharps Fork 500 Foot Buffer Land Use Land Cover	
Water	0.22%		Water	0.03%
Low Intensity Residential	0.04%		Low Intensity Residential	0.02%
High Intensity	0.01%		Deciduous Forest	48.47%
Quarries/Strip Mines/Gravel Pits	0.03%		Evergreen Forest	6.88%
Transitional	0.97%		Mixed Forest	1.13%
Deciduous Forest	75.75%		Pasture/Hay	37.76%
Evergreen Forest	2.82%		Row Crops	4.76%
Mixed Forest	0.98%		Woody Wetlands	0.93%
Pasture/Hay	15.94%		Emergent Herbaceous Wetlands	0.03%
Row Crops	3.11%			
Woody Wetlands	0.10%			
Emergent Herbaceous Wetlands	0.03%			

Relative to other Federal Valley subwatersheds:

Combined land use land cover categories for subwatershed	Covered in subwatershed	Mean	Standard deviation from mean	Normal, High, Low
Forest	79.56%	74.49%	1	Normal
Agriculture	19.05%	25.02%	1	Normal
Residential	0.04%	0.03%	1	Normal
Wetland	0.13%	0.11%	1	Normal

Combined land use land cover categories for buffer	Covered in buffer	Mean	Standard deviation from mean	Normal, High, Low
Forest	56.48%	64.18%		Normal
Agriculture	42.52%	34.51%	1	Normal
Residential	0.03%	0.03%	1	Normal
Wetland	0.96%	0.74%	1	Normal

Sharps Fork has a low percentage of agriculture coverage. About 76% of the entire subwatershed is deciduous forest, about 16% is pasture/hay area and 3% is row crops. Its buffer has a high percentage of wetland coverage. About half of the 500-foot buffer is deciduous forest and 38% is pasture/hay area. Almost 5% of the buffer is row crop. The majority of pasture/hay area in this subwatershed is found along Sharps Fork and its tributaries.

Wetlands inventory-

.0198 sq mi 0.10% land coverage Woody Wetlands

.0076 sq mi 0.03% land coverage Emergent Herbaceous Wetland

There are several small areas of Woody Wetlands in the lower and middle section of Sharps Fork subwatershed – all clustered around the main creek. All the Woody Wetlands are located within a 500 foot buffer of the creeks. The Woody Wetlands comprise a total of .0198 square miles of area. The Woody Wetlands are contiguous with the general distribution of pasture land, evergreen and deciduous forests, mixed forests and coal fields found throughout the subwatershed.

There is 1 small area of Emergent Herbaceous Wetlands in the middle western section of the Sharps Fork Subwatershed. It is within a 500-foot buffer of the creek. The Emergent Herbaceous Wetlands comprise a total of .0076 square miles of area. The Emergent Herbaceous Wetlands are contiguous with the general distribution of transitional forest, mixed forest, row crops, pasture/hay fields, deciduous and evergreen forests, and open water found throughout the subwatershed.

In comparison to the mean number of wetlands in the total Federal Valley Watershed, the number of wetlands in Sharps Fork is low (Std deviation, 2)

In comparison to the mean number of wetlands in the total Federal Valley Watersheds 500 foot buffer zone, the number of wetlands in Sharp Fork's 500 foot buffer zone is normal (Std deviation, 1).

Opossum Run subwatershed (see map LU15) covers approximately 9.0 square miles. It is located in the northeastern portion of the Federal Valley Watershed. State Routes 377 Runs through this subwatershed. State Route 555 is the run along the northern border of the subwatershed.

Table 35 Opossum Run LULC

Opossum Run Subwatershed Land Use Land Cover			Opossum Run 500 ft buffer Land Use Land Cover	
Water	0.05%		Water	0.03%
Low Intensity Residential	0.04%		Low Intensity	0.32%
High Intensity	0.00%		Deciduous Forest	56.88%
Quarries/Strip Mines/Gravel Pits	0.02%		Evergreen Forest	1.10%
Transitional	0.00%		Mixed Forest	0.68%
Deciduous Forest	70.94%		Pasture/Hay	36.89%
Evergreen Forest	2.78%		Row Crops	3.94%
Mixed Forest	0.53%		Woody Wetlands	0.13%
Pasture/Hay	22.40%		Emergent Herbaceous	0.03%
Row Crops	3.22%			
Woody Wetlands	0.02%			
Emergent Herbaceous Wetlands	0.02%			

Relative to other Federal Valley subwatersheds:

Combined land use land cover categories for subwatershed	Covered in subwatershed	Mean	Standard deviation from mean	Normal, High, Low
Forest	74.25%	74.49%	1	Normal
Agriculture	25.61%	25.02%	1	Normal
Residential	0.04%	0.03%	1	Normal
Wetland	0.03%	0.11%	2	Low

Combined land use land cover categories for buffer	Covered in buffer	Mean	Standard deviation from mean	Normal, High, Low
Forest	58.66%	64.18%		Normal
Agriculture	40.83%	34.51%	1	Normal
Residential	0.03%	0.03%	1	Normal
Wetland	0.16%	0.74%	1	Normal

The majority of this subwatershed is deciduous forest. 22% is pasture/hay area and row crops cover 3%. 57% of the 500-foot buffer is deciduous forest and 37% is pasture/hay area. The majority of pasture/hay area in this subwatershed is located within the buffer area.

Wetlands inventory-

2.23 sq. miles 0.13% land coverage Woody Wetland

2.23 sq. miles0.03% land coverage Emergent Herbaceous Wetland

There are 2 small areas of Woody Wetlands in the lower section of Opossum Run subwatershed. All the Woody Wetlands are located within a 500 foot buffer of the creeks. The Woody Wetlands comprise a total of 2.23 square miles of area. The Woody Wetlands are contiguous with the general distribution of pasture land, evergreen and deciduous forests, mixed forests and coal fields found throughout the subwatershed.

There is one small area of Emergent Herbaceous Wetland located in the upper middle half of the Opossum Run Subwatershed, and is within a 500 foot buffer of the creek. The Emergent Herbaceous Wetlands comprise a total of 2.23 square miles of area. The Emergent Herbaceous Wetlands are contiguous with the general distribution of row crops, pasture/hay fields, deciduous and evergreen forests found throughout the subwatershed

In comparison to the mean number of wetlands in the total Federal Valley Watershed, the number of wetlands in Opossum Run is low (Std deviation, 2)

In comparison to the mean number of wetlands in the total Federal Valley Watersheds 500 foot buffer zone, the number of wetlands in Opossum Run's 500 foot buffer zone is normal (Std deviation, 1).

The Sulphur Run Subwatershed (see map LU1) is about 2.0 square miles. It is located on the eastern edge of the Federal Valley Watershed. The only road that runs through the subwatershed is Mission Road, which is township jurisdiction.

Table 36 Sulphur Run LULC

Sulphur Run Subwatershed Land Use Land Cover			Sulphur Run 500 Foot Buffer Land Use Land Cover	
Water	0.86%		Water	1.83%
Low Intensity Residential	0.07%		Transitional	3.33%
Transitional	0.88%		Deciduous Forest	82.45%
Deciduous Forest	94.47%		Evergreen Forest	0.92%
Evergreen Forest	0.11%		Mixed Forest	0.58%
Mixed Forest	0.18%		Pasture/Hay	5.41%
Pasture/Hay	1.56%		Row Crops	5.41%
Row Crops	1.84%		Woody Wetlands	0.08%
Emergent Herbaceous Wetlands	0.04%			

Relative to other Federal Valley subwatersheds:

Combined land use land cover categories for subwatershed	Covered in subwatershed	Mean	Standard deviation from mean	Normal, High, Low
Forest	94.75%	74.49	2	High
Agriculture	3.41%	25.02	2	Low
Residential	0.07%	0.03	1	Normal
Wetland	0.04%	0.11	2	Low
Combined land use land cover categories for buffer	Covered in buffer	Mean	Standard deviation from mean	Normal, High, Low
Forest	83.94%	64.18		Normal
Agriculture	10.82%	34.51	2	Low
Residential	0.00%	0.03	1	Normal
Wetland	0.08%	0.74	1	Normal

Sulphur Run and its buffer have a high percentage of forest coverage and a low percentage of agriculture coverage. Almost this entire subwatershed is covered by deciduous forest. The buffer also has deciduous forest as its primary land cover, but it 5% of its land its pasture/hay area and 5% is made up for row crops. State Route 550 runs along the northern border of this subwatershed.

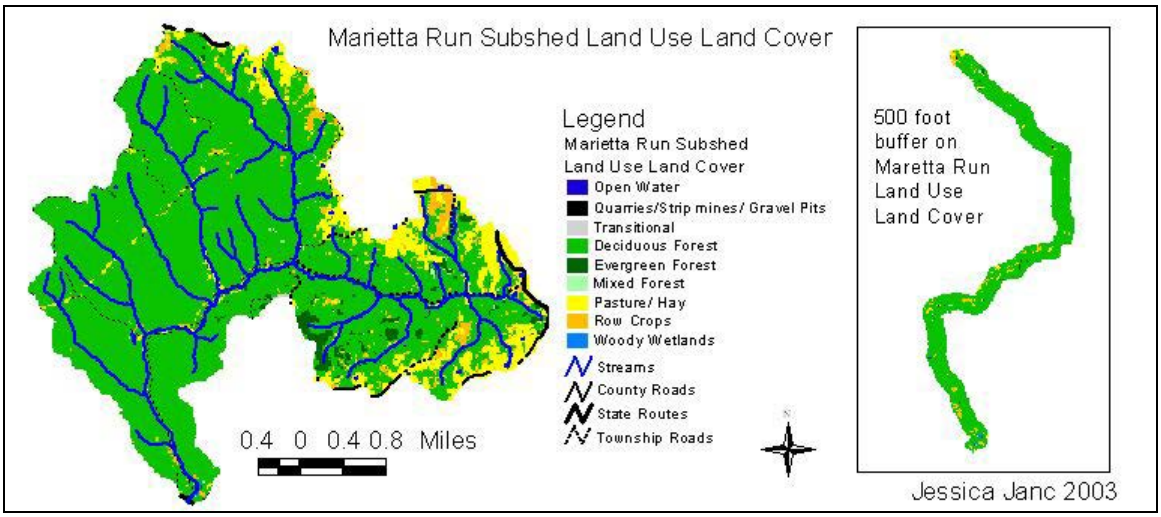
Wetlands inventory-

.0007 sq mi 0.04% land coverage Emergent Herbaceous Wetland No Woody Wetlands noted

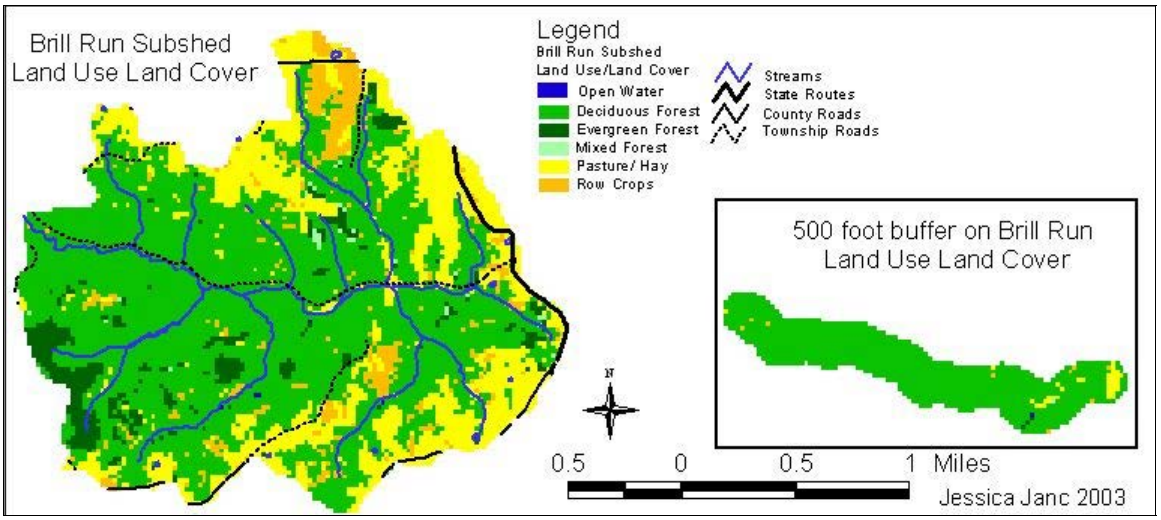
There are 2 small areas of Emergent Herbaceous Wetland in the Sulphur Run Subwatershed, they are located in the lower half of the subwatershed and are within a 500 foot buffer of the creek. The Emergent Herbaceous Wetlands comprise a total of .0007 square miles of area.

Map 21 LULC Marietta Run, Brill Run, Big Run

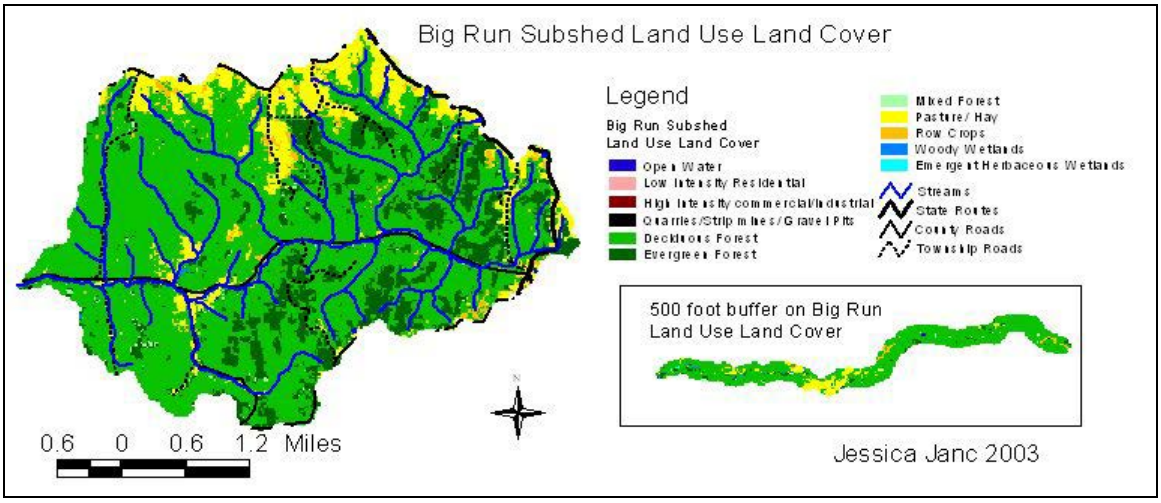
LU16



LU17



LU18



05030204090070 (Marietta, Brill)

Marietta Run Subwatershed (see map LU1) covers approximately 6.9 square miles and includes Brill Run. It is located along the eastern edge of the subwatershed. State Route 550 runs along the northern border of this subwatershed. All other roads in this subwatershed are township roads, including Marietta Run Road.

Table 37 Marietta Run LULC

Marietta Run Subwatershed Land Use Land Cover			Marietta Run 500 Foot buffer Land use Land Cover	
Water	0.03%		Water	0.12%
Quarries/Strip Mines/Gravel	0.06%		High Intensity	0.03%
Transitional	0.06%		Quarries/Strip Mines/Gravel Pits	0.06%
Deciduous Forest	92.99%		Deciduous Forest	92.22%
Evergreen Forest	0.39%		Evergreen Forest	0.75%
Mixed Forest	0.17%		Mixed Forest	0.43%
Pasture/Hay	4.11%		Pasture/Hay	2.92%
Row Crops	2.16%		Row Crops	3.21%
Woody Wetlands	0.05%		Woody Wetlands	0.26%

Relative to other Federal Valley subwatersheds:

Combined land use land cover categories for subwatershed	Covered in subwatershed	Mean %	Standard deviation from mean	Normal, High, Low
Forest	93.55%	74.49	2	High
Agriculture	6.27%	25.02	2	Low
Residential	0.00%	0.03	1	Normal
Wetland	0.05%	0.11	2	Low
Combined land use land cover categories for buffer	Covered in buffer	Mean	Standard deviation from mean	Normal, High, Low
Forest	93.40%	64.18		High
Agriculture	6.13%	34.51	2	Low
Residential	0.00%	0.03	1	Normal
Wetland	0.26%	0.74	1	Normal

Marietta Run subwatershed and its buffer both have a high percentage of forest coverage and a low percentage of wetland coverage. Almost 93% of the subwatershed and its buffer are deciduous forest. There are some areas of pasture/hay and row crops surrounding the headwaters of the subwatershed.

Wetlands inventory-

5.03sq. miles 0.05% land coverage Woody Wetlands

There is a cluster of Woody Wetlands close to the main stem of the Federal Creek. Most are clustered close together following the main-stem of the subwatershed main creek. All the Woody Wetlands are located within a 500 foot buffer of the creeks. The Woody Wetlands comprise a total of 5.03 square miles of area. The Woody Wetlands are contiguous with the general distribution of Deciduous and Mixed Forests, Row Crops and Open Water found throughout the subwatershed.

No Emergent Herbaceous Wetlands Noted

In comparison to the mean number of wetlands in the total Federal Valley Watershed, the number of wetlands in Marietta Run Subwatershed is low (Std deviation, 2). In comparison to the mean number of wetlands in the total Federal Valley Watersheds 500 foot buffer zone, the number of wetlands in Marietta Run's 500 foot buffer zone is normal (Std deviation 1).

The Brill Run Subwatershed (see map LU1) of the Federal Valley Watershed covers approximately 3.2 square miles. Brill Run is located on the eastern edge of the watershed. State route 555 is the eastern border of this subwatershed and the watershed as a whole. The only other marked roads in this watershed are township roads, with the township road following Brill Run only accessible by ATVs.

Table 38 Brill Run LULC

Brill Run Subwatershed Land Use Land Cover			Brill Run 500 ft buffer Land Use Land Cover	
Water	0.05%		Water	0.09%
Deciduous forest	63.70%		Deciduous forest	95.39%
Evergreen forest	5.50%		Evergreen forest	0.28%
Mixed forest	0.36%		Mixed forest	0.09%
Pasture/hay	23.76%		Pasture/hay	3.32%
Row crops	6.62%		Row crops	0.83%

Relative to other Federal Valley subwatersheds:

Combined land use land cover categories for subwatershed	Covered in subwatershe	Mean	Standard deviation from mean	Normal, High, Low
Forest	69.56%	74.49%	1	Normal
Agriculture	30.39%	25.02%	1	Normal
Residential	0.00%	0.03%	1	Normal
Wetland	0.00%	0.11%	2	Low
Combined land use land cover categories for buffer	Covered in buffer	Mean	Standard deviation from mean	Normal, High, Low
Forest	95.76%	64.18%		High
Agriculture	4.15%	34.51%	2	Low
Residential	0.00%	0.03%	1	Normal
Wetland	0.00%	0.74%	2	Low

Brill Run subwatershed buffer has a high percentage of forest coverage and a low percentage of agriculture coverage. More than half of the subwatershed is deciduous forest, as well as the majority of the 500-foot buffer. About a quarter of this subwatershed area is being used for pasture/hay. The majority of agriculture occurs around the headwaters.

Wetlands inventory-No Wetland noted

05030204090080 (Big, Ellis)

The **Big Run Subwatershed** (see map LU1 pg 96) of the Federal Valley Watershed encompasses about 10.3 square miles. It is located in the southeastern region of the watershed. Big Run subwatershed also includes Ellis Run. The majority of the land cover in this subwatershed and its 500-foot buffer is deciduous forest. Very few roads are found in the Big Run subwatershed. County Road 59 or Big Run Road follows the main stem of Big Run very closely. State Route 555 runs along the eastern edge of the subwatershed.

Table 39 Big Run LULC

Big Run Subwatershed Land Use Land Cover			Big Run 500 Foot Buffer Land Use Land Cover	
Water	0.03%		Water	0.19%
Low Intensity Residential	0.04%		Deciduous Forest	79.99%
High Intensity	0.02%		Evergreen Forest	4.11%
Quarries/Strip Mines/Gravel Pits	0.01%		Mixed Forest	1.40%
Deciduous Forest	70.81%		Pasture/Hay	11.17%
Evergreen Forest	13.87%		Row Crops	2.09%
Mixed Forest	0.45%		Woody Wetlands	0.85%
Pasture/Hay	12.08%		Emergent Herbaceous	0.19%
Row Crops	2.54%			
Woody Wetlands	0.12%			
Emergent Herbaceous Wetlands	0.01%			

Relative to other Federal Valley subwatersheds:

Combined land use land cover categories for subwatershed	Covered in subwatershed	Mean %	Standard deviation from mean	Normal, High, Low
Forest	85.14%	74.49	1	Normal
Agriculture	14.63%	25.02	1	Normal
Residential	0.07%	0.03	1	Normal
Wetland	0.13%	0.11	1	Normal
Combined land use land cover categories for buffer	Covered in buffer	Mean	Standard deviation from mean	Normal, High, Low
Forest	85.50%	64.18		High
Agriculture	13.26%	34.51	2	Low
Residential	0.00%	0.03	1	Normal
Wetland	1.05%	0.74	1	Normal

Big Run has a high percentage of forest cover, and the evergreen coverage is the highest of any other subwatershed, most of which occurs in Ellis Run. These are associated with a large logging operation on Mead land. Big Run has a small community in the headwaters which is where the residential classification is located. There are areas of pasture/hay around the headwaters and in a small area of the 500-foot buffer. The amount of land that is classified as woody wetlands is very high in the 500 ft buffer.

The amount of land classified as an agricultural type of cover is very low. The amount of land that is classified as woody wetlands is very high in the 500 ft buffer.

Wetlands inventory-

19.01 sq. miles, 0.12% of land coverage of woody wetlands

1.68 sq. miles, 0.01% land coverage of emergent herbaceous wetlands

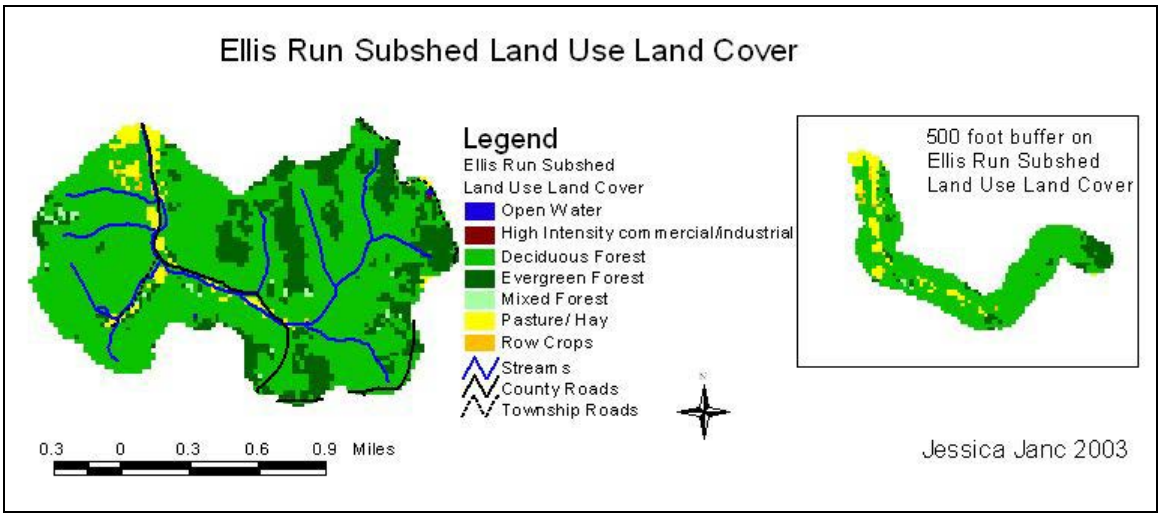
There are several small areas of Woody Wetlands, most are clustered along the main-stem of Big Run near the mouth of the Big Run Subwatershed. All the Woody Wetlands are located within a 500 foot buffer of the creeks. The Woody Wetlands comprise a total of 19.01 square miles of area. The Woody Wetlands are contiguous with a distribution of Pasture/Hay, Mixed Forest, Deciduous Forest, Evergreen Forest and Row Crops found throughout the subwatershed. .

There is a small area of Emergent Herbaceous Wetland in the subwatershed, it is located near the mouth of the subwatershed and is located within a 500 foot buffer of the creek. The Emergent Herbaceous Wetland comprises a total of 1.68 square miles of area. The Emergent Herbaceous Wetland is contiguous with a general distribution of Deciduous and Evergreen Forrest found throughout the subwatershed.

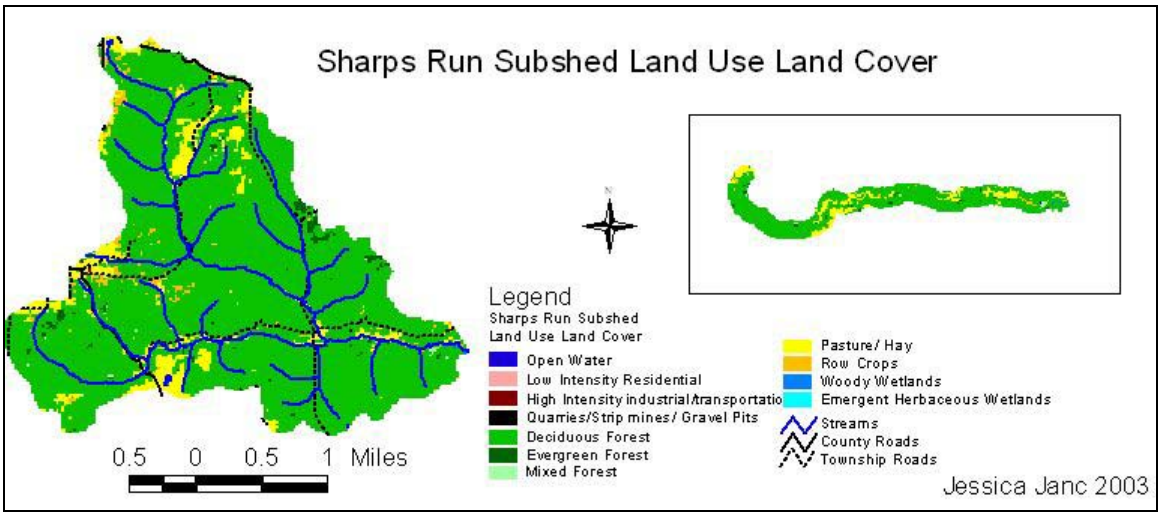
In comparison to the mean number of wetlands in the total Federal Valley Watershed, the number of wetlands in Big Run Subwatershed is normal (Std deviation, 1). In comparison to the mean number of wetlands in the total Federal Valley Watersheds 500 foot buffer zone, the number of wetlands in Big Run's 500 foot buffer zone is normal (Std deviation, 1).

Map 22 LULC Ellis Run, Sharps Run

LU19



LU20



Ellis Run Subwatershed (see map LU1) is about 1.6 square miles. It is located in the southeastern part of the Federal Valley Watershed. County Rd 98 passes over Ellis Run through the center of the subwatershed.

Table 40 Ellis Run LULC

Ellis Run Subwatershed Land Use Land Cover			Ellis Run 500 ft buffer Land Use Land Cover	
Water	0.02%		Deciduous Forest	79.40%
High Intensity Commercial/	0.02%		Evergreen Forest	9.30%
Deciduous Forest	75.27%		Mixed Forest	0.42%
Evergreen Forest	20.13%		Pasture/Hay	9.97%
Mixed Forest	0.75%		Row Crops	0.91%
Pasture/Hay	3.47%			
Row Crops	0.33%			

Relative to other Federal Valley subwatersheds:

Combined land use land cover categories for subwatershed	Covered in subwatershed	Mean	Standard deviation from mean	Normal, High, Low
Forest	96.15%	74.49%	2	High
Agriculture	3.80%	25.02%	2	Low
Residential	0.00%	0.03%	1	Normal
Wetland	0.00%	0.11%	2	Low
Combined land use land cover categories for buffer	Covered in buffer	Mean	Standard deviation from mean	Normal, High, Low
Forest	89.12%	64.18%		High
Agriculture	10.88%	34.51%	2	Low
Residential	0.00%	0.03%	1	Normal
Wetland	0.00%	0.74%	2	Low

Ellis Run and its buffer have a high percentage of forest coverage. Its buffer has a low percentage of agriculture coverage. Almost all of that area is covered in deciduous and evergreen forest. A small percentage of the subwatershed is pasture/hay area, with most of that located in the 500-foot buffer.

Wetlands inventory-

No Wetland noted

ALL BIOLOGIC AND HABITAT DATA

2004 TMDL study of the Federal Valley Watershed

The Midwest Biodiversity Institute collected biological assemblage and habitat data at 43 stations in Federal Creek watershed. Some sites were funded via the Federal Valley Watershed Group by ODNR MRM and others by Ohio EPA.

Map 23 Location of MBI 2004 sites

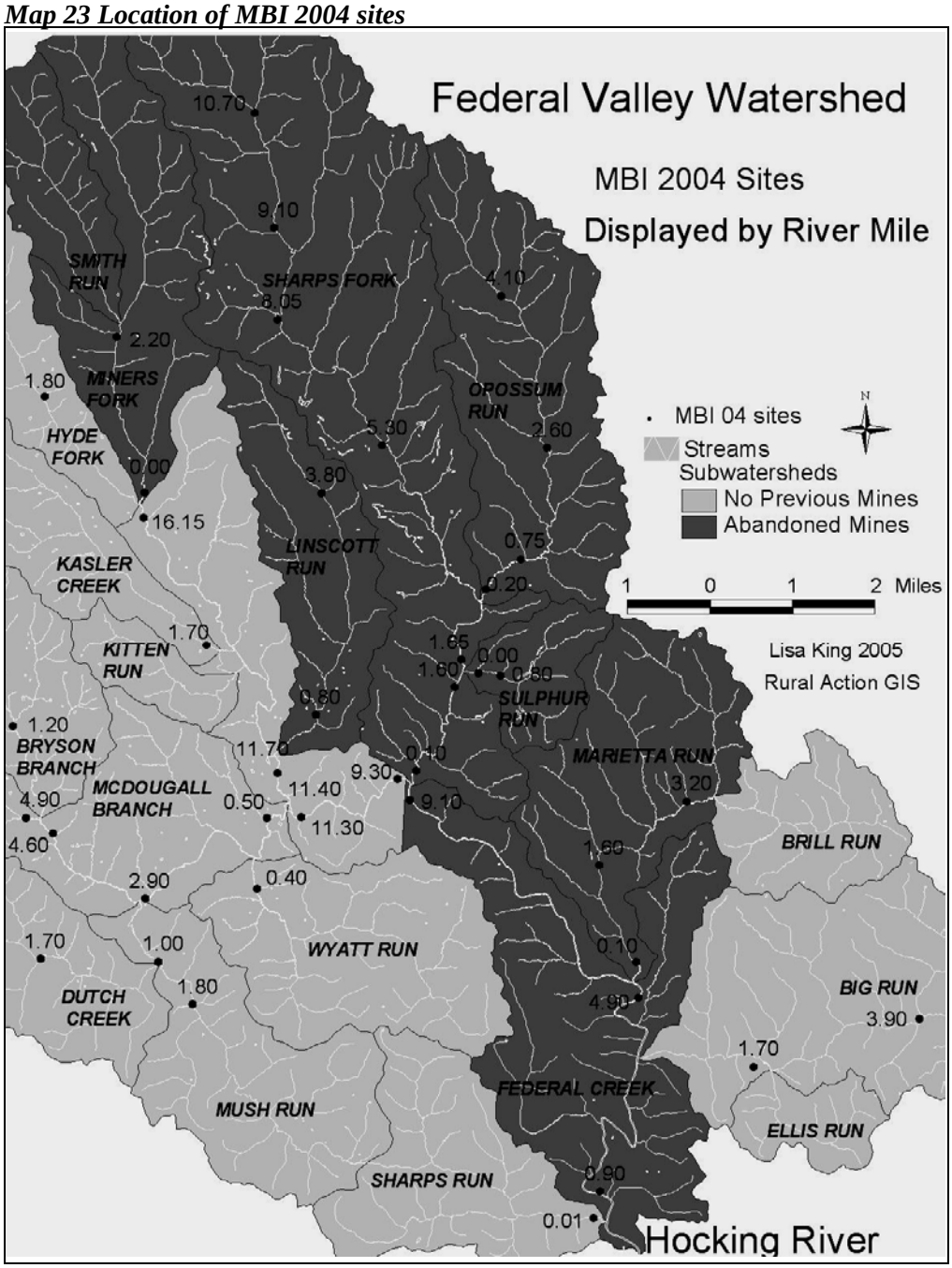


Table 41 Locations of 2004 TMDL sites

RM	Stream	Location	Latitude	Longitude	Topo Map	Storet #	Drainage Square Mile
3.90	Big Run	Co. Rd. 59, dst. Wildcat Run	39.3604142	-81.8155449	Cutler	J03W02	4.2
1.60	Big Run	upst. Hatch Fork	39.3534459	-81.8510756	Cutler	J03G56	9.0
1.40	Bryson Branch	Howard Rd.	39.4130038	-82.0193048	Jacksonville	J03G55	5.7
1.70	Dutch Creek	Dutch Creek Rd. at Twp. Rd. 216	39.3726085	-82.0137493	Athens	J03G69	4.8
16.15	Federal Creek	Kuhn Rd. bridge	39.4517	-81.9905	Amesville	J03G36	17.9
11.40	Federal Creek	St. Rt. 550, upst. McDougall Branch	39.3999882	-81.9573386	Amesville	J03S08	32.0
10.40	Federal Creek	Sand Rock Rd./CR 38	39.3984937	-81.9462265	Amesville	J03P01	70.0
7.52	Federal Creek	Tick Ridge Rd. TR 201	39.3873	-81.9078	Amesville	J03G35	107.4
3.90	Federal Creek	Big Run Rd CR 85	39.3552	-81.8783	Stewart	J03G70	122.1
0.90	Federal Creek	Twp. Rd. 231 (reference site)	39.330082	-81.887753	Stewart	J03G72	138.0
11.70	Federal Creek	old park / baseball field	39.4027	-81.9602	Amesville	J03G38	31.76
1.80	Hyde Fork	lane off St. Rt. 329	39.4708418	-82.0125104	Jacksonville	J03G39	4.8
1.80	Kasler Creek	Adj Kasler Rd.	39.4273178	-81.975904	Amesville	J03G40	3.7
0.80	Linscott Run	St. Rt. 329	39.4149222	-81.9513745	Amesville	J03G41	4.5
3.50	Marietta Run	dst. Brill Run	39.399552	-81.8628674	Chesterhill	J03G71	5.4
0.10	Marietta Run	St. Rt. 329, at mouth	39.368019	-81.8800396	Stewart	J03P09	10.1
0.50	McDougall Branch	lane off St. Rt. 550	39.396629	-81.9625751	Amesville	J03G42	37.5
4.90	McDougall Branch	2nd lane upst. Bryson Branch	39.3968444	-82.0173786	Jacksonville	J03G67	4.5
4.60	McDougall Branch	just dst. Bryson Branch	39.3959302	-82.0132625	Jacksonville	J03G44	12.4
2.90	McDougall Branch	dst. Mush Run (reference site)	39.3825448	-81.9897863	Amesville	J03G45	21.0
2.20	Miners Fork	Wrightstown Rd.	39.4815914	-81.995267	Amesville	J03G33	4.4
0.10	Miners Fork	St. Rt. 329, at mouth	39.4528746	-81.9904667	Amesville	J03P07	9.9
1.80	Mush Run	lane dst. Riley Run	39.3639847	-81.9795148	Stewart	J03G47	4.8
1.00	Mush Run	Dutch Creek Rd.	39.3714707	-81.9871663	Stewart	J03G48	12.7
2.60	Opossum Run	Twp. Rd. 6, at compressor station	39.4613867	-81.8987128	Amesville	J03G49	4.5
0.20	Opossum Run	Joy Rd., near mouth	39.4361753	-81.9123637	Amesville	J03G50	8.9
0.10	Sharps Fork	St. Rt. 329, at mouth	39.4025964	-81.9296528	Amesville	J03S09	35.7
10.70	Sharps Fork	upst. Co. Rd. 85, upst. east trib.	39.5203738	-81.9642658	Ringgold	J03S03	4.6
9.10	Sharps Fork	Co. Rd. 14	39.5001214	-81.9597472	Ringgold	J03G51	9.0
5.30	Sharps Fork	lane dst. Tharp Hollow	39.462182	-81.9352002	Amesville	J03G52	18.3
0.40	Wyatt Run	lane near mouth	39.3842379	-81.9648203	Amesville	J03G11	6.6

Fish and Macroinvertebrates

2004 Fish and Macroinvertbrates

In general, the biological assemblages in Federal Creek Watershed are in relatively good condition although some reference areas have appeared to decline in biological and habitat quality since first sampled by Ohio EPA in the mid-1980s. Most sites have intact channel habitats although silt and sand above what is thought to be background levels often degrade habitats and potentially limit better assemblages. Some of this is related to encroachment into stream riparian buffers, which are primary barriers from adjacent land uses (MBI, 2005).

For a list of all fish found in the watershed and IBI metrics MBI's report on Federal Valley for this list. Only three of the IBI scores in the entire Federal Creek Watershed scored at less than a "good" rating (< 40) and only one of these was rated poor (Opossum Run at RM 4.1). The Opossum Run site is relatively small in size (2.3 square mile), is dominated by bedrock and has a macroinvertebrate assemblage rated as excellent. Another site that was rated as fair (upper Linscott Run site) is also small and also has very good macroinvertebrate communities (MBI, 2005).

Interpretation

The Federal Valley Watershed has many excellent scores with the fish metrics,. even when there are low habitat scores and poor chemistry. All scores are above 24.There are no scores below 24. The lowest IBI scores fall in the MWH range. These sites are McDougall Creek above Wyatt Run, the mouth of Wyatt Run, the mouth of Dutch Creek, the mouth of Marietta Run, the headwaters of Linscott Run, and the headwaters of Opossum Run. There are 12 sites that fall in the range of EWH.

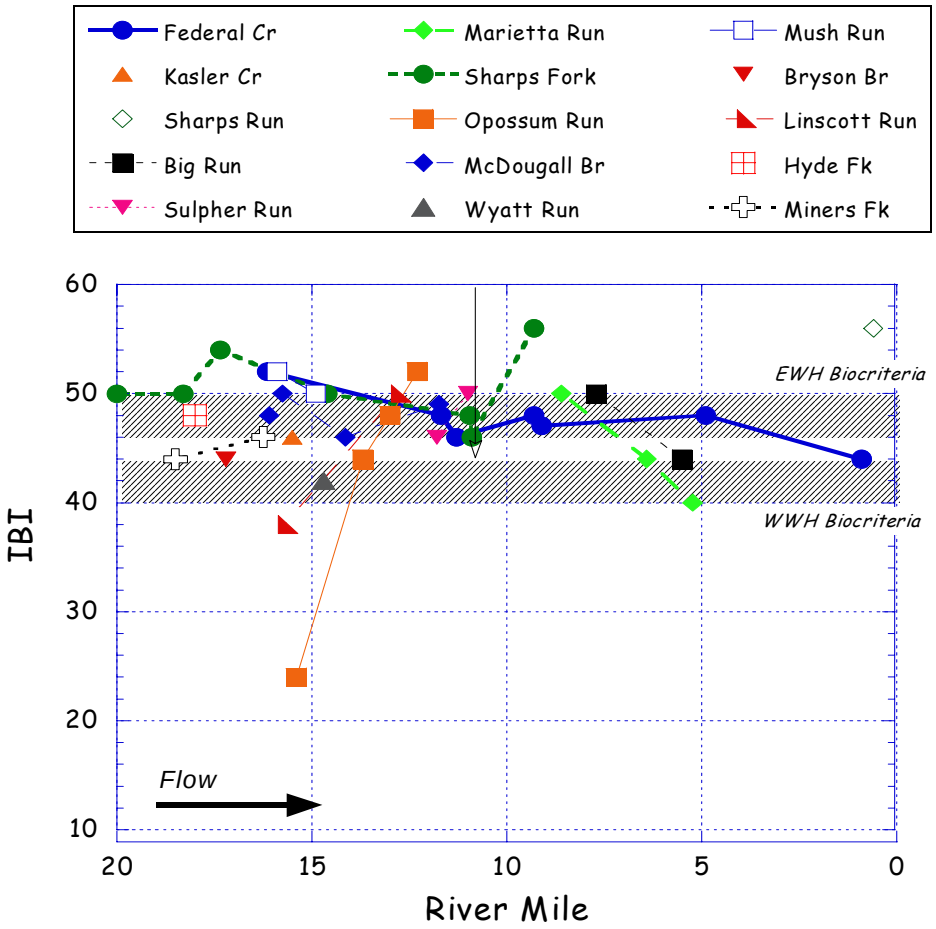
Two of the MWH fish sites are probably due to abandoned mining impacts. The mouth of Marietta Run and the headwaters of Linscott Run are primarily affected by AMD. Upstream of both of these sites there is virtually no development, residences, logging, or agriculture. The Linscott Run site is surprising because the chemistry in that area shows that the main stem is not very impacted. However, Marietta Run does have some mine seeps that affect the main stem, and there is loose sand near the mouth caused by past mining.

Other MWH sites are likely a combination of agriculture and homes impacting the fish. This is because there are no other known causes. The impact for the headwaters of Opossum Run is undetermined. Perhaps it is related to the steep and narrow topography of the watershed in that area.

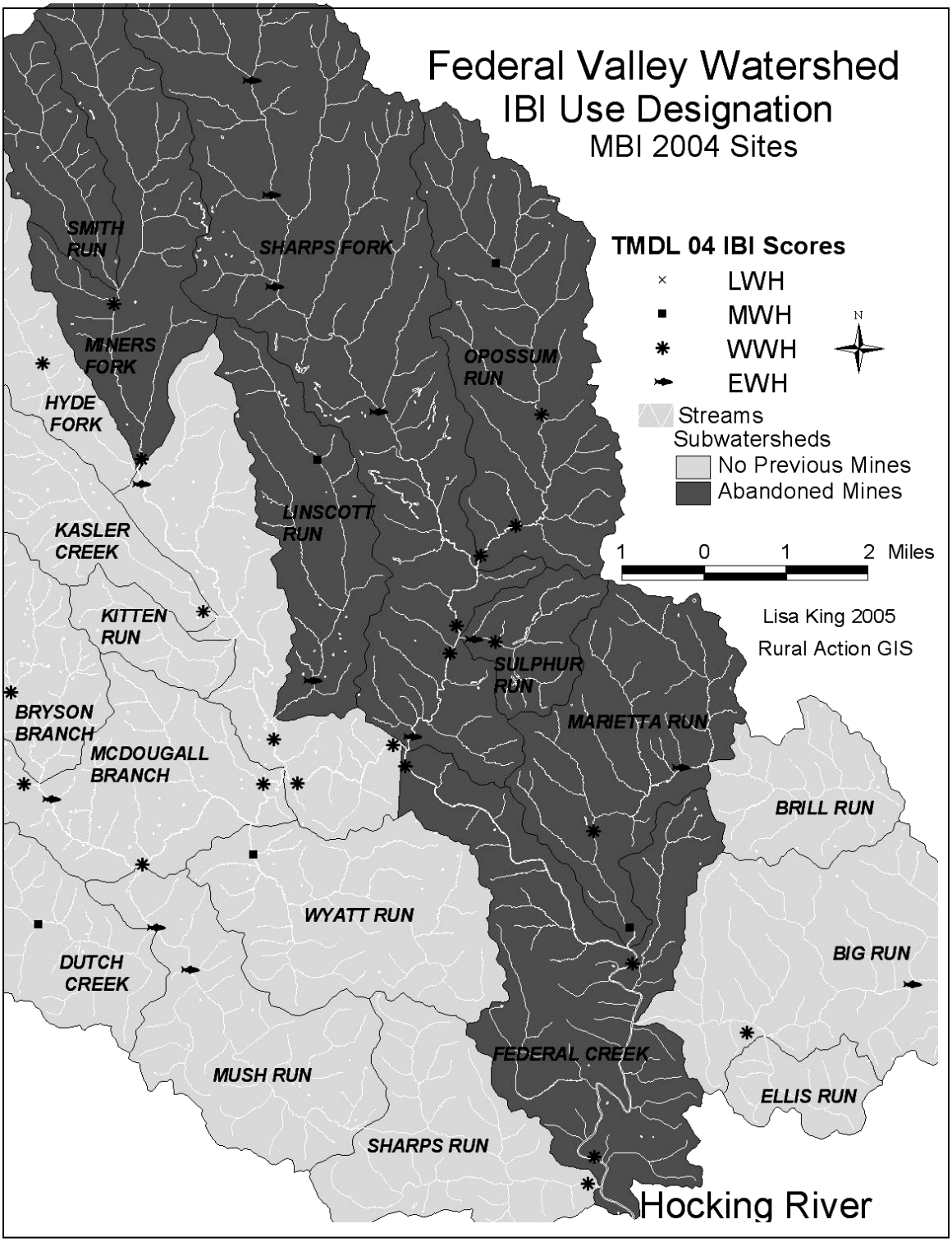
There are two surprises regarding the EWH sites. These are the mouth of Sulphur Run and the mouth of Opossum Run. Sulphur Run has bright orange water and the reach up stream of this site is extremely impacted by abandoned mine drainage. Opossum Run has notoriously poor QHEI, chemistry, and bacteria. Sharps Fork is very high quality throughout the subwatershed, and perhaps the mouths of these tributaries are benefiting from this high quality biology. It is also surprising that so many main stem

sites along Federal Creek scored in the range of WWH. Particularly those sites around Amesville. Federal Creek did not score very high in habitat and had some very high bacteria scores.

Figure 8. IBI scores of streams sampled in the Federal Creek Watershed during 2004.



Map 24 IBI Derived Use Designations 2004



FVWG Macro invertebrate Research 2002

Macroinvertebrate community health was measured by the FVWG from data collected in August and September of 2002. Dip and kick nets were used to sample macroinvertebrates from natural substrate at 17 sites within the Federal Valley Watershed. The MAIS (Macroinvertebrate Aggregated Index for Streams) was used to evaluate the macro invertebrate data and to assess the biological health of each site. The MAIS, developed by researchers at the Virginia Polytechnic Institute and State University, is the primary benthic index used by the Virginia Department of Environmental Quality in their TMDL reports, and also by the Forest Service as the rapid bioassessment tool of choice for pre and post monitoring of projects in national forest areas in Virginia and Kentucky. This index is based on family level identification, which facilitates its use by various organizations that may lack the expertise and equipment needed to successfully complete an ICI, which requires identification to a genus or species level.

The MAIS incorporates 9 individual metrics, with each metric given a value of 0, 1, or 2. These metrics are combined and calibrated to produce a single numeric score ranging from 0-18, with 0-7 indicating 'very poor' biological conditions, 8-11 'poor', 12-15 'good', 16-18 'very good' (Smith and Voshell 1997).

Results of FVWG 2002 Macroinvertebrate Sampling

MAIS scores were fairly good throughout Federal Valley Watershed. Scores ranged from 6 to 16, with the majority of sites receiving a good rating (score of 12-15). 1 out of the 17 sites was rated very poor: SF0800, the mouth of Sulphur Run. This site received a 6, and is heavily impacted by AMD. SF0800 exceeded the 75th percentile for many parameters for WWH sites within the WAP ecoregion on all 7 sample dates from 8/20/02 to 10/07/03 (Table 13). 4 sites were rated poor: FC0062; FC0099; SF1100; FC1700. Possible impacts at these sites are AMD, sedimentation, and sewage/nutrient pollution. AMD impacts are most prevalent at FC1700, the mouth of Marietta Run, which exceeded the 75th percentile values for WWH sites for specific conductivity, total manganese, pH, and sulfate on 8/20/02. SF1100, the mouth of Opossum Run, and FC0099, Federal Creek below Miner's Fork, are also known to drain areas impacted by mining, although the extent may not be as severe. These sites, and FC0062, may also be impacted by sedimentation from erosion, and nutrient enrichment from sewage and fertilizer pollution. Each of the four sites rated poor received low scores for percent haptobenthos, which is a measure of the abundance of macroinvertebrates requiring clean, coarse, and firm substrates. A low percent haptobenthos may indicate a sedimentation problem. FC0062, SF1100, and FC1700 also received low scores for the modified HBI, which ranks organisms according to their sensitivity to pollution or environmental stress, targeting organic pollutants.

11 sites were rated good: FC0006; FC0015; FC0023; FC0050; MB0010; MB0500; MB0050; SF0050; MR0800; FC1100; and FC0100. MR0800, the mouth of Brill Run, scored a 15, the second highest score, and is considered a reference site in the watershed. 1 site was rated very good: SF0000, the mouth of Sharp's Fork. The rating for Sharp's Fork appeared somewhat of an anomaly. Sharp's Fork exceeded the 75th percentile of WWH values for many parameters on the 8/20/02 sampling date (Table 13). Figure 3 displays the MAIS score for the 17 sites. The summer of 2002 was a period of drought for southeastern Ohio, which may have affected 'typical' assemblages of macroinvertebrates.

Figure 9 FV Mais Scores

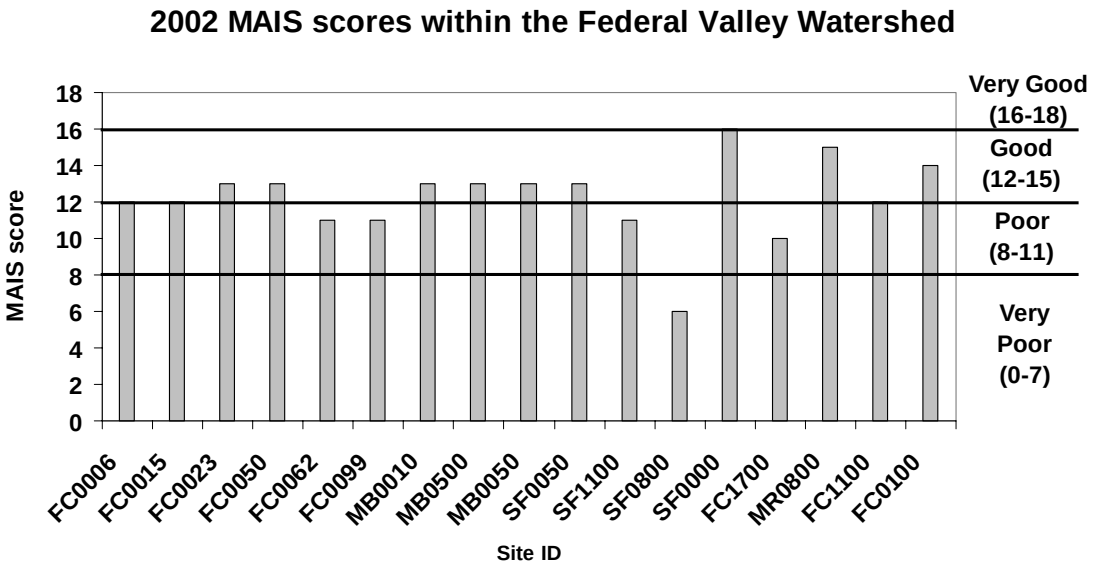


Figure 4 displays the # of total taxa, # EPT taxa, and the # of intolerant taxa found at the 17 sites within the Federal Valley Watershed. These three categories are common indicators of community health, and the latter two are used directly in the calculation of the MAIS. In the FVWG 2002 macroinvertebrate study, the term taxa refers to the number of families of macroinvertebrates. The # of total taxa indicates species richness of an area. In general, a higher number of taxa indicates greater biodiversity. The # EPT taxa refers to the number of Ephemeropteran (mayfly), Plecopteran (stonefly), and Trichopteran (caddisfly) families found at each site. These three taxa are among the most sensitive to pollution, and are often used as indicators of the health of a stream. The # of intolerant taxa reflects the number of macroinvertebrate families present that are known to be sensitive to pollution. For all categories, a higher number generally indicates better water quality.

The # of total taxa ranged from 9 to 31. Sulphur Run had the lowest number of families, whereas the mouth of Sharp's Fork had the highest number of families. The # of EPT taxa ranged from 1 to 9. Again, Sulphur Run had the lowest number of EPT families, and Sharp's Fork had the highest. The

number of intolerant taxa ranged from 5 to 16 families. Sulphur Run and FC0099, Federal Creek below Miner's Fork, had 5 intolerant families. Sharp's Fork had the 16 intolerant families. Site FC0062 has comparable total # taxa, # EPT taxa, and # intolerant taxa to sites rated good; however, FC0062 rated poor due to other factors such as a high modified HBI, indicating possible organic pollution, and a low percent haptobenthos, indicating poor sediment quality. FC0100 appears to rate low in the range of total # of taxa, # EPT taxa, and # intolerant taxa; however, FC0100 was one of the few sites to receive a low modified HBI, which indicates a lack of organic pollution at this site.

Figure 10 Macroinvertebrate Taxa Federal Creek 2002

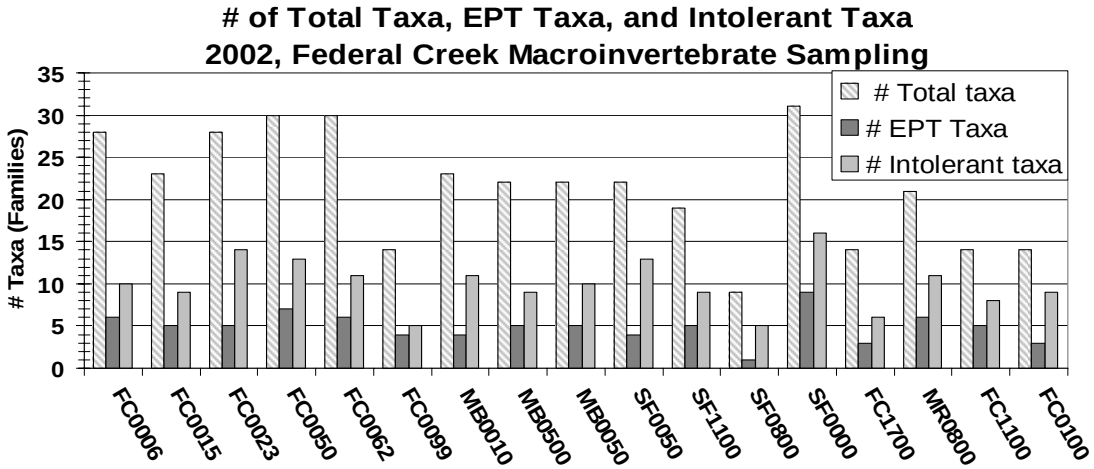
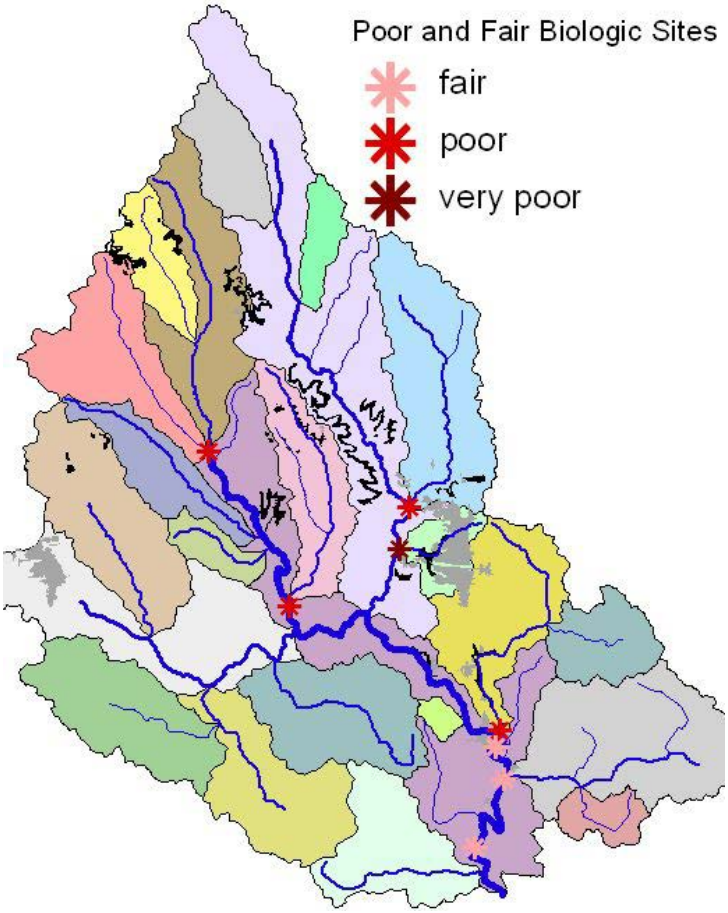


Table 42: 17 Macroinvertebrate Sampling Locations in Federal Creek, 2002

Site ID	Description	MAIS score	Rating
FC0006	Federal Creek at Adams Rd., near mouth	12	Good
FC0016	Federal Creek below Broadwell, Phillipsburg	12	Good
FC0023	Federal Creek Below Tick Ridge Rd.	13	Good
FC0050	Federal Creek Below Amesville (New England Rd.)	13	Good
FC0062	Federal Creek, Upper Amesville	11	Poor
FC0099	Federal Creek, Below Miner's Fork & Hyde Fork	11	Poor
MB0050	McDougall Branch below confluence with Bryson Branch	13	Good
MB0500	Mouth of Mush Run Mouth of Opossum Run	13	Good
MB0010	McDougall Branch near Potter Road bridge	13	Good
SF0050	Mainstem Sharp's Fork, Below Joy	13	Good
SF1100	Mouth of Opossum Run	11	Poor
SF0800	Mouth of Sulphur Run	6	Very Poor
SF0000	Mouth of Sharp's Fork	16	Very Good
FC1700	Mouth of Marietta Run	10	Poor
MR0800	Mouth of Brill Run	15	Good
FC1100	Mouth of Big Run	12	Good
FC0100	Mouth of Sharp's Run	14	Good

Map 25 Locations of poor biology sites from the 2002 macro invertebrate study by FVWG



2004 Macroinvertebrates

The table of all macroinvertebrates found in the watershed and ICI metrics is located in the appendix. In the use designation table found at the beginning of this chapter there is also a listing of all ICI scores in the watershed.

Habitat

2004 QHEI

The 2004 TMDL study yielded additional QHEI scores. MBI's report on Federal Valley for all 2004 QHEI scores and metrcis. It is notable that none of the QHEI scores are over 80. Generally a site with a score over 80 will be able to achieve EWH. It is also questionable what use designation the sites with scores between 50 and 60 can achieve. Twelve of the sites are between 50 and 60. There are two sites with scores below 45, which is generally considered LWH. Four sites are in the range of 45 to 49, which is generally considered MWH.

FVWG is also interested in the substrate scores. As was shown above, the substrate scores above 15 often attain WWH. Very few of the substrate scores are above 15. On map 26 FVWG has starred the lowest substrate scores (any below 11). These scores are indicators of sedimentation problems, particularly the sites that have both a very low substrate and a QHEI below 60. FVWG would like to see all of our areas in the watershed attain at least a 60 in the QHEI score and FVWG would like them to also achieve at least an 11 in the substrate metric. Our recommendation is to focus on all areas with a substrate score below 11 as well as working on all QHEI scores below 60.

Sites that have both a low QHEI and substrate are:

The mouth of Federal Creek above Sharps Branch; The mouth of Big Run; The mouth of McDougall Branch; All sites in Sulphur Run; Sharps Fork below Sulphur Run

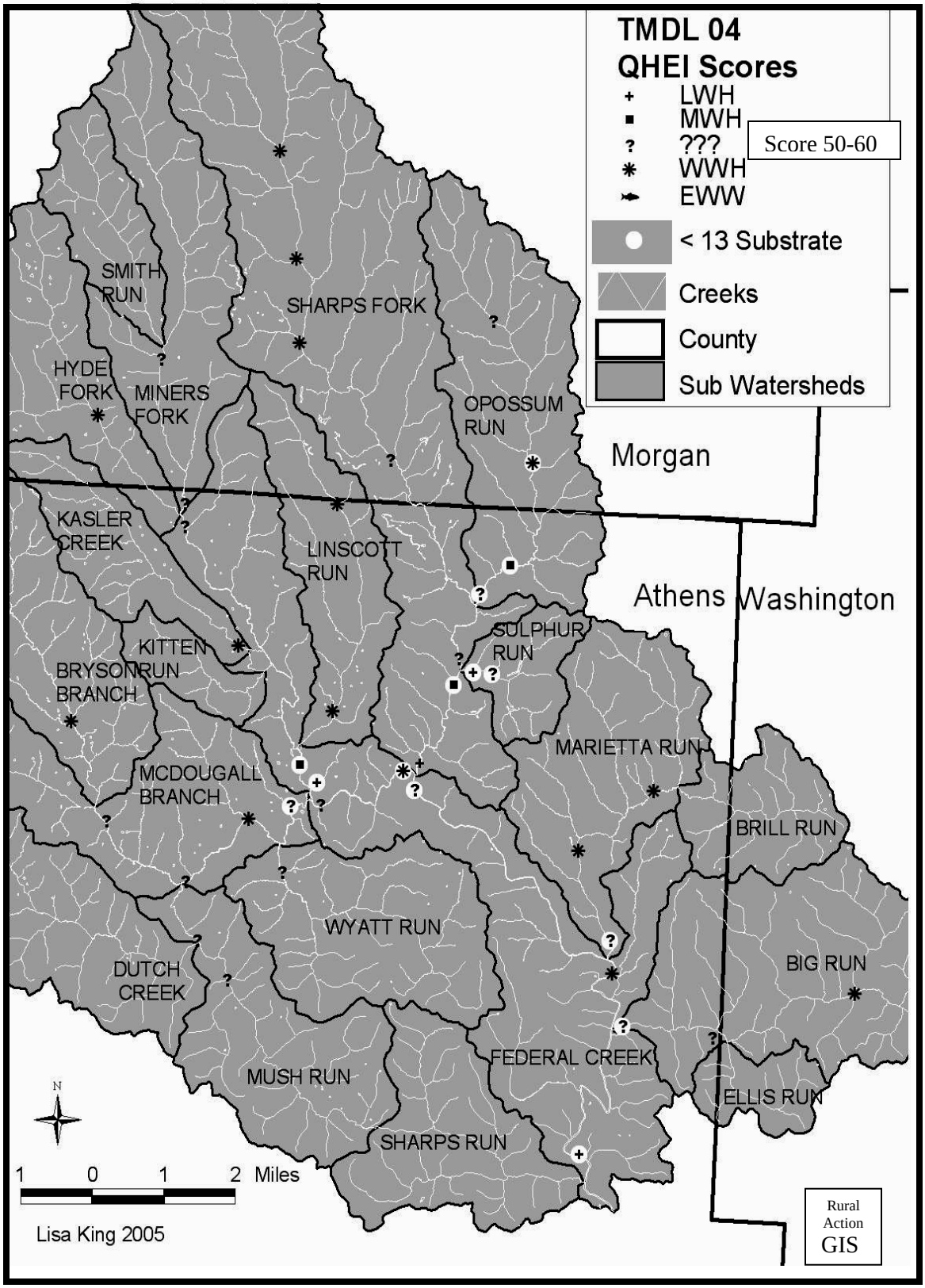
Sites that have a QHEI score below 49 :

The mouth of Sharps Fork; Opossum Run below Gifford State Forest; Federal Creek at the ball Fields in Amesville; Federal Creek below Zarley Run in Amesville

Sites with scores between 50 and 60:

Both sites in Mush Run; Wyatt Run near the Mouth; All 3 sites up stream in McDougall Branch; The Big Run below Ellis Run; The Mouth of Marietta Run; Federal Creek below Sharps Fork and below McDougall Branch; The Mouth of Miners Run and below Smith Run and Mouth of Hyde Fork

Map 26 2004 TMDL QHEI scores



2003 QHEI Evaluation of the Federal Valley Watershed

The Qualitative Habitat Evaluation Index (QHEI) is a physical habitat index designed to provide a quantified evaluation of the general lotic stream habitat characteristics that are important to fish communities. The QHEI is composed of six principal metrics including substrate quality, in stream cover, channel morphology, riparian zone and bank erosion, pool/glide riffle/run quality, and gradient/drainage area. The maximum possible QHEI score is 100. Each metric is scored individually and then summed to provide the total QHEI score (OEPA Biocriteria/QHEI CD, 2003).

In August through September of 2003, Federal Valley Watershed Group evaluated sites in the Federal Valley Watershed using the QHEI method. Sample points were chosen every 3 to 4 square miles, resulting in 38 sample sites. The numbers of QHEI sample sites are in the following drainage area ranges:

Table 43

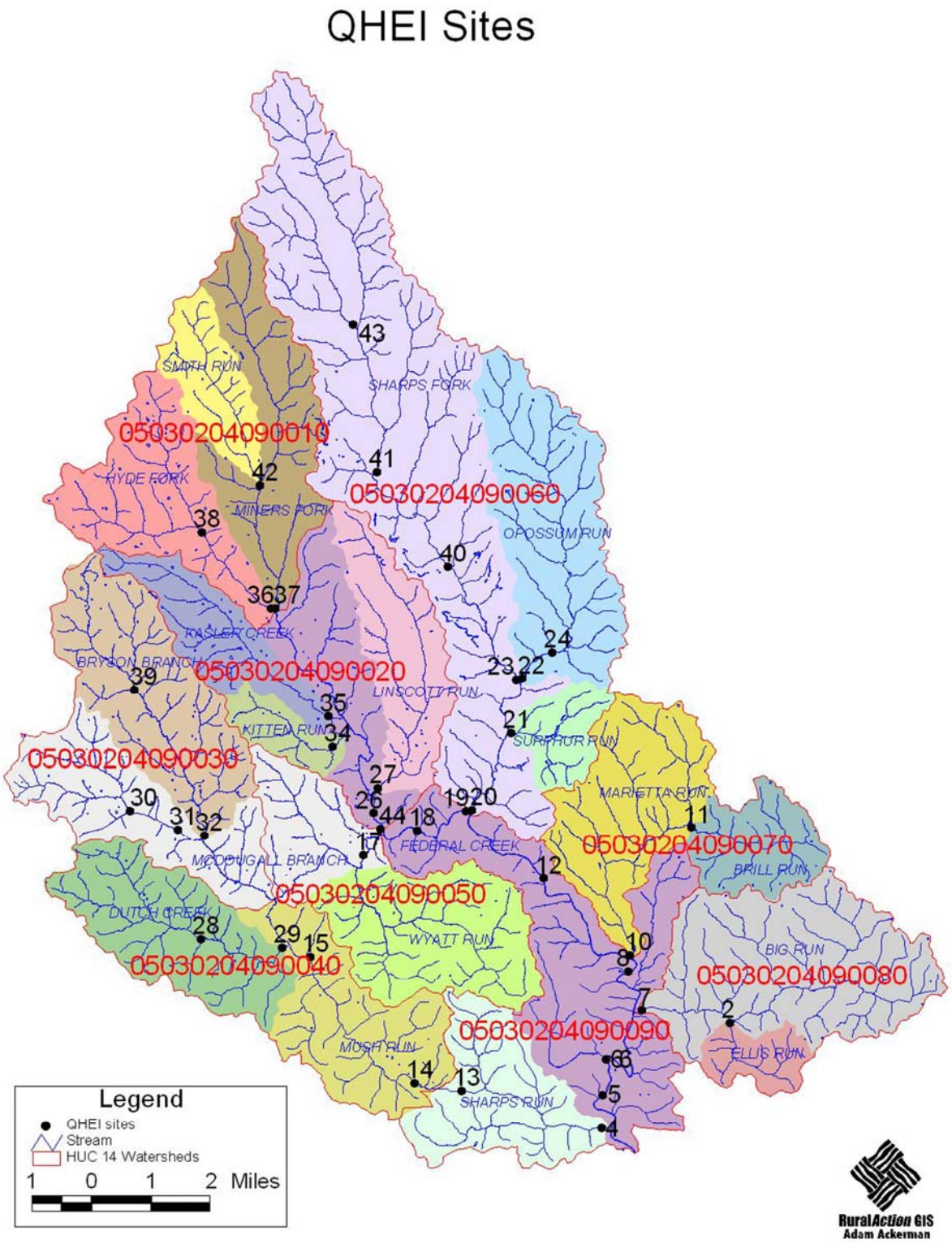
100-150 square miles	3 sites
21-100 square miles	5 sites
9-20 square miles	7 sites
6-8.9 square miles	6 sites
4-5.9 square miles	6 sites
2-3.9 square miles	5 sites
0-1.9835 square miles	6 sites

A 150m section of stream was evaluated for each site. Each crew was equipped with waders, QHEI forms, a measuring stick for depth measurements, and measuring tape for measuring the sample area. Jeff Calhoun (VISTA, FVWG) performed the QHEIs for The Federal Valley Watershed and was assisted by Mike Riggins (OSM intern) and Jessica Janc (VISTA, FVWG). Jeff attended the EPA Biocriteria/QHEI training in Groveport Ohio in July Of 2002, and July Of 2003. Jessica and Mike also attended the Groveport training in July of 2003. The following are a summary of the results.

References:

Appendix 1: Using the Qualitative Habitat Evaluation Index to Derive TMDL Targets for Sediment Impairment in Southeast Ohio (Ed Rankin). OEPA Biocriteria/QHEI CD, 2003.

Map 27 2003 QHEI Sites



Detailed Description of 2003 QHEI

05030204090010 Federal Creek Headwaters (To Below the Confluence of Hyde Fork and Miners Fork)

All QHEI sites in this 14-digit subwatershed had below average riparian zone scores. Abandoned strip mines, livestock with creek access, and open pastures/hayfields and row crops are present in all subwatersheds (Hyde Fork/Miners Fork/Smith Run). With little to no riparian zone to protect the stream from these impacts, they are probable causes of habitat degradation in the Federal Creek headwaters.

Site: 37 Stream: Miners Fork Subwatershed: Miners Fork 14 Digit: 05030204090010
Location: Mouth Of Miners Fork River Mile 0.0 Stream Enters: Federal Creek @Rm: 16.21
Drainage Area: 9.953 Sq miles Record Date: 8/12/03 *Substrate Target: Below

Low substrate score due to moderately embedded substrate/silt and a low number of substrate types.
Low in stream cover score due to a sparse amount of cover present.
Low riparian zone score due to a narrow riparian width and moderate bank erosion.
Note: Adjacent to this sample area are row crops in much of the flood plain area

Site: 36 Stream: Hyde Fork Subwatershed: Hyde Fork 14 Digit: 05030204090010
Location: Mouth of Hyde Fork River Mile 0.0 Stream Enters: Federal Creek @RM: 16.21
Drainage Area: 6.609 SQ miles Record Date: 8/12/03 *Substrate Target: Below

Low substrate score due to moderately embedded substrate/silt and a low number of substrate types.
Low in stream cover score due to lack of cover types and a sparse amount present.
Low riparian zone score due to a narrow riparian width/no riparian width, hay fields beyond the riparian zone, and moderate bank erosion.
Low riffle/run quality score due to moderately stable to unstable substrate, and moderate embedded substrate.
Note: Adjacent to this sample area contains hay fields in much of the flood plain area. Livestock with creek access above site 36 should also be recognized as a potential negative impact.

Site: 38 Stream: Hyde Fork Subwatershed: Hyde Fork 14 Digit: 05030204090010
Location: Near Intersection of Cox-Kolbe Rd/St Rt 329 River Mile 2.04
Stream Enters: Federal Creek@RM:16.21
Drainage Area: 5.207 SQ miles Record Date: 8/20/03 *Substrate Target: Above

Low riparian zone score due to a narrow riparian width, and new field beyond the riparian zone.
Low riffle/run quality score due to a low riffle/run depth, moderately stable substrate, and moderate embedded substrate.

Site: 42 Stream: Smith Run Subwatershed: Smith Run 14 Digit: 05030204090010
Location: Mouth of Smith Run River Mile 0.0 Stream Enters: Miners Fork @RM: 2.4
Drainage Area: 2.932 SQ miles Record Date: 8/12/03 *Substrate Target: Above

Low substrate score due to low number of substrate types.
Low riparian zone score due to a narrow riparian width, row crops beyond the riparian zone, and moderate bank erosion.

05030204090060 Sharps Fork (Opossum Run/Sulphur Run)

Sharps Fork (05030204090060) possible negative impacts: The Sharps fork subwatershed has been impacted by heavy strip-mining, most of it is near the mid slope or ridge tops. Hay fields in the floodplain, areas of little to no riparian zone, and residential areas also potentially impact Sharps Fork. Strip and underground mining causing noticeable AMD, high walls, and gob piles adjacent to the creek heavily impact the Sulphur Run subwatershed. The Opossum Run subwatershed has been strip mined mostly in the first 5 river miles of the subwatershed. The mining is also near the mid slopes and ridge tops (with the exception of a few small tributaries where mining is in the floodplain). Opossum Run is also possibly impacted by agricultural practices (livestock with creek access, rowcrops/hayfields, areas with little to no riparian zone, and residential areas). These are all considered possible causes of habitat degradation (particularly substrate degradation) in this 14-digit subwatershed, and is easily illustrated by the exceptionally low substrate score (6) recorded at site 20 (mouth of Sharps fork).

Site: 20 Stream: Sharps Fork Subwatershed: Sharps Fork 14 Digit: 05030204090060
Location: Mouth of Sharps Fork River Mile 0.0 Stream Enters: Federal Creek @RM: 9.3
Drainage Area: 35.649 SQ miles Record Date: 8/14/03 *Substrate Target: Below

Low substrate score due to low number of substrate types, heavy silt, and extensively embedded substrate.
Low in stream cover score due to lack of cover types and a sparse amount present.
Low riffle/run quality score due to unstable riffle/run substrate, and moderately to extensively embedded substrate.

Site: 23 Stream: Sharps Fork Subwatershed: Sharps Fork 14 Digit: 05030204090060
Location: Near Int. W/ Joy Rd./St Rt 377 River Mile 2.84 Stream Enters: Federal Creek @RM: 9.3
Drainage Area: 16.0397 SQ miles Record Date: 9/18/03 *Substrate Target: Above

Low substrate score due to moderately siltation and embedded substrate.
Low in stream cover score due to lack of cover types and a sparse amount present.
Low riffle/run quality score due to moderately stable substrate and moderate embedded substrate.
Note:, The community of Sharpsburg is located immediately above site 23.

Site: 40 Stream: Sharps Fork Subwatershed: Sharps Fork 14 Digit: 05030204090060
Location: Off Old Grade Rd, Dwnstrm from Wood Rd. River Mile 5.80 Stream Enters: Federal Creek @RM: 9.3
Drainage Area: 13.272 SQ miles Record Date: 9/18/03 *Substrate Target: Below

Low substrate score due to low number of substrate types, and moderately embedded substrate.
Low pool/glide quality score due to pool width less than riffle width, and lack of current velocity diversity.
Low riffle/run quality score due to unstable substrate and moderately embedded substrate.

Site: 41 Stream: Sharps Fork Subwatershed: Sharps Fork 14 Digit: 05030204090060
Location: Off Pounds Rd. River Mile 7.95 Stream Enters: Federal Creek @RM: 9.3
Drainage Area: 11.6987 SQ miles Record Date: 9/18/03 *Substrate Target: Below

Low substrate score due to low number of substrate types, heavy silt, and extensively embedded substrate.
Low in stream cover score due to lack of cover types and a nearly absent amount.
Low riffle/run substrate score due to no riffles present, unstable substrate, and extensively embedded substrate.
Note: Abandoned strip mines and Livestock with creek access are located immediately above site 41.

Site: 22 Stream: Opossum Run Subwatershed: Opossum Run 14 Digit: 05030204090060
Location: Mouth of Opossum Run River Mile 0.0 Stream Enters: Sharps Fork @RM: 2.83
Drainage Area: 9 SQ miles Record Date: 9/18/03 *Substrate Target: Below

Low substrate score due to moderate silt and embedded substrate
Low in stream cover score due to lack of cover types.
Low riparian zone score due to a very narrow riparian width and residential/park/new field beyond the riparian zone and moderate bank erosion.

<u>Site: 24</u> Stream: Opossum Run Subwatershed: Opossum Run 14 Digit: 05030204090060
Location: Off 377 River Mile 0.8 Stream Enters: Sharps Fork @RM: 2.83
Drainage Area: 8.507 SQ miles Record Date: 9/18/03 *Substrate Target: Above

Low substrate score due to moderate siltation and embedded substrate
Low riffle/run quality score due to moderately stable substrate and moderately embedded substrate.
<u>Note:</u> Abandoned strip/underground mines, livestock with creek access, and a small community are located immediately above site 24. Most of the mining in Opossum Run is in the first 5 river miles of the stream. There are some small tributaries that are heavily impacted in this area, but most of Opossum Run has not been mined and is more subject to agricultural practices.

<u>Site: 43</u> Stream: Sharps Fork Subwatershed: Sharps Fork 14 Digit: 05030204090060
Location: Off Pounds Rd. River Mile 10.65 Stream Enters: Federal Creek @RM: 9.3
Drainage Area: 3.273 SQ miles Record Date: 8/14/03 *Substrate Target: Above

Low substrate score due to moderate silt and moderately embedded substrate.

<u>Site: 21</u> Stream: Sulphur Run Subwatershed: Sulphur Run 14 Digit: 05030204090060
Location: Mouth of Sulphur Run River Mile 0.0 Stream Enters: Sharps Fork @RM: 2.9
Drainage Area: 1.9835 SQ miles Record Date: 9/18/03 *Substrate Target: Above

Low in stream cover score due to lack of cover types and a sparse amount.
Low riparian zone score due to very narrow to no riparian at this site, and moderate bank erosion.
<u>Note</u>: Extensive strip and underground mining next to the stream, gob piles, high walls, and AMD observed throughout Sulphur Run is possibly the cause of habitat degradation. A series of beaver ponds on the main stem are possibly minimizing the silt/erosion problems normally associated with mining.

05030204090070Marietta/Brill Run

Marietta Run (05030204090070) possible negative impacts: Abandoned strip/underground mines located next to the stream for the first 10 river miles are the possible cause of habitat degradation in the Marietta Run subwatershed, illustrated by the low substrate/riffle/run scores recorded at site 10 (mouth of Marietta Run). There are virtually no agricultural or residential areas in Marietta/Brill Run.

Site: 10 Stream: Marietta Run Subwatershed: Marietta Run 14 Digit: 05030204090070
Location: Mouth of Marietta Run River Mile 0.0 Stream Enters: Federal Creek @RM: 5.14
Drainage Area: 10.1678 SQ miles Record Date: 9/25/03 *Substrate Target: Below

Low substrate score due to low number of substrate types, heavy silt, and extensive embedded substrate.
Low riffle/run score due to unstable substrate and moderate to extensive embedded substrate.

Site: 11 Stream: Brill Run Subwatershed: Brill Run 14 Digit: 05030204090070
Location: Mouth of Brill Run River Mile 0.0 Stream Enters: Marietta Run @RM: 3.55
Drainage Area: 3.242 SQ miles Record Date: 8/14/03 *Substrate Target: Above

Brill Run shows a high QHEI score particularly in the substrate, cover, channel, and riparian metrics. Brill Run is an excellent example of good habitat. This is due to an excellent riparian zone throughout the subwatershed, little to no residential areas, and no mining.

05030204090080Big/Ellis Run

Big/Ellis Run (05030204090080) possible negative impacts: Clear cutting in Ellis Run is a possible cause of habitat degradation in Big/Ellis Run, illustrated by low substrate/riffle/run scores at site 2 and 7. Mead WestVaco owns much of the land in this subwatershed. There are virtually no agricultural practices, mining, or residential areas in Big Run or Ellis Run (with the exception of a small residential area in the extreme headwaters of ELLIS Run).

Site: 7 Stream: Big Run Subwatershed: Big Run 14 Digit: 05030204090070
Location: Mouth of Big Run River Mile 0.0 Stream Enters: Federal Creek @RM: 3.79
Drainage Area: 11.905 SQ miles Record Date: 8/13/03 *Substrate Target: Below

Low substrate score due to low number of substrate types, heavy silt, and extensively embedded substrate.
Low in stream cover score due to lack of cover types and a sparse amount.
Low riffle/run score unstable substrate and moderately to extensively embedded substrate.

Site: 2 Stream: Ellis Run Subwatershed: Ellis Run 14 Digit: 05030204090070
Location: Mouth of Ellis Run River Mile 0.0 Stream Enters: Big Run @RM: 1.6
Drainage Area: 1.586 SQ miles Record Date: 8/14/03 *Substrate Target: Above

Low substrate score due to low number of substrate types.
Low in stream cover score due to lack of cover types and a sparse amount.
Low riffle/run score due to moderately substrate stability and moderately embedded substrate.

05030204090040 Mush Run/Dutch Creek

Mush Run/Dutch Creek (05030204090040) possible negative impacts: The Dutch Creek subwatershed contains hay fields, and livestock with creek access in the flood plain area. Some stretches of Dutch Creek have little to no riparian zone to protect the stream from these non-forested areas, and are possibly the causes of habitat degradation, illustrated by the low substrate score at site 29 (mouth of Dutch Creek). The Mush Run subwatershed contains heavy residential areas in the floodplain area and in the headwaters, livestock with creek access, hay fields, and areas with little to no riparian zone. All are possible causes of habitat degradation in Mush Run.

Site: 29 Stream: Dutch Creek Subwatershed: Dutch Creek 14 Digit: 05030204090040
Location: Mouth of Dutch Creek River Mile 0.0 Stream Enters: Mush Run @RM: 1.0
Drainage Area: 6.716 SQ miles Record Date: 8/13/03 *Substrate Target: Below

Low substrate score due to moderate silt and extensive /moderately embedded substrate.
Low in stream cover score due to lack of over types and a sparse amount.
Low riffle/run quality score due to moderately stable/unstable substrate, and moderately embedded substrate.

Site: 14 Stream: Mush Run Subwatershed: Mush Run 14 Digit: 05030204090040
Location: Mush Run Rd. River Mile 4.6 Stream Enters: McDougall Branch @RM: 3.0
Drainage Area: 6.499 SQ miles Record Date: 8/13/03 *Substrate Target: Above

Low in stream cover score due to lack of cover types and a moderate/sparse amount.

Site: 15 Stream: Mush Run Subwatershed: Mush Run 14 Digit: 05030204090040
Location: Off 690, between Mush Run Rd and Dutch Creek Rd. River Mile 2.9
Stream Enters: McDougall Branch @RM: 3.0
Drainage Area: 5.4681 SQ miles Record Date: 10/2/03 *Substrate Target: Above

Low substrate score due to moderate siltation and embedded substrate.

Note: Mush Run adjacent to this sample area contains hay fields and livestock with creek access in much of the flood plain area.

Site: 28 Stream**:** Dutch Creek **Subwatershed:** Dutch Creek **14 Digit:** 05030204090040
Location: Int. of Stanley Rd and Dutch Creek Rd. River Mile 0.9 Stream Enters: Mush Run @RM: 1.0
Drainage Area: 4.3367 SQ miles Record Date: 9/26/03 *Substrate Target: Above

This area of Dutch Creek shows good overall habitat metric scores.

05030204090050 McDougall Branch/Wyatt Run (Below Mush Run to Federal Creek)

McDougall Branch/Wyatt Run (05030204090050) possible negative impacts: Hay fields and livestock with creek access with little to no riparian zone are possible causes of habitat degradation in this part of McDougall Branch and the Wyatt Run sub watershed. Wyatt Run predominantly has agricultural land use and no mining.

Site: 44 **Stream:** McDougall Branch **Subwatershed:** McDougall Branch **14 Digit:** 05030204090050
Location: Mouth of McDougall River Mile 0.0 Stream Enters: Federal Creek @RM: 11.25
Drainage Area: 37.593 SQ miles Record Date: 8/14/03 *Substrate Target: Below

Low substrate score due to heavy silt and extensively embedded substrate.
Low in stream cover score due to lack of cover types and a sparse amount.
Low riffle/run quality score due to unstable substrate and extensively embedded substrate.

Note: McDougall Branch adjacent to site 44 contains new fields and livestock with creek access in much of the floodplain area.

Site: 17 Stream: Wyatt Run Subwatershed: Wyatt Run 14 Digit: 05030204090050
Location: Mouth of Wyatt Run River Mile 0.0 Stream Enters: McDougall Branch @RM: .50
Drainage Area: 6.887 SQ miles Record Date: 8/15/03 *Substrate Target: Below

Low substrate score due to moderate silt and moderately embedded substrate.
Low in stream cover score due to lack of cover types and a sparse amount.

Note: Wyatt Run adjacent to site 17 contains new fields and livestock with creek access in much of the floodplain area.

05030204090030 McDougall/Bryson Branch (Above Mush Run)

McDougall/Bryson Branch (05030204090030) possible negative impacts: New fields livestock with creek access, and heavy residential areas in the floodplain area with little to no riparian zone are possible causes of habitat degradation in McDougall and Bryson Branch. Both subwatersheds have primarily agricultural land use.

Site: 32 **Stream:** Bryson Branch **Subwatershed:** Bryson Branch **14 Digit:** 05030204090030
Location: Mouth of Bryson Branch River Mile 0.0 Stream Enters: McDougall Branch @RM: 4.71
Drainage Area: 7.868 SQ miles Record Date: 8/14/03 *Substrate Target: Above

Low substrate score due to moderate silt and embedded substrate.

Note: Bryson Branch adjacent to site 32 contains hay fields and livestock with creek access.

Site: 31 **Stream:** McDougall Branch **Subwatershed:** McDougall Branch **14 Digit:** 05030204090030
Location: Dwnstrm. From Hooper Ridge Rd. River Mile 5.0 Stream Enters: Federal Creek @RM: 11.25
Drainage Area: 4.0018 SQ miles Record Date: 9/26/03 *Substrate Target: Above

Site: 30 **Stream:** McDougall Branch **Subwatershed:** McDougall Branch **14 Digit:** 05030204090030
Location: Int. of McDougall Rd. and 550. River Mile 4.84 Stream Enters: Federal Creek @RM: 11.25
Drainage Area: 3.3690 SQ miles Record Date: 9/26/03 *Substrate Target: Above

Sites 30 and 31 of McDougall Branch show good habitat.

Site: 39 **Stream:** Bryson Branch **Subwatershed:** Bryson Branch **14 Digit:** 05030204090030
Location: Off Sweat Hollow Rd. River Mile 3.2 Stream Enters: McDougall Branch @RM: 4.71
Drainage Area: .288 SQ miles Record Date: 8/20/03 *Substrate Target: Above

05030204090020 Federal Creek (Below Miners Fork to above McDougall Branch)

Federal Creek (05030204090020) possible negative impacts: This section of the Federal Creek subwatershed contains Livestock with creek access, hay fields/row crops, little to no riparian zone, and the village of Amesville. The Linscott Run Subwatershed contains livestock with creek access, hay fields, strip mining (located in the headwaters of the subwatershed). All are possible negative impacts in this 14-digit subwatershed.

Site: 26 Stream: Federal Creek Subwatershed: Federal Creek 14 Digit: 05030204090020
Location: Near junction of St Rt. 329 and St Rt. 550. River Mile 11.5
Stream Enters: Hocking River @RM: 15.29
Drainage Area: 69.4038 SQ miles Record Date: 10/31/03 *Substrate Target: Below

Low substrate score due to moderate siltation and embedded substrate.
Low in stream cover score due to lack of cover types and a sparse amount.
Low riffle/run quality score due to moderately stable/unstable substrate, and moderately embedded substrate.

Site: 27 Stream: Linocut Run Subwatershed: Linocut Run 14 Digit: 05030204090020
Location: Mouth of Linocut Run. River Mile 0.0 Stream Enters: Federal Creek @RM: 11.93
Drainage Area: 5.061 SQ miles Record Date: 8/12/03 *Substrate Target: Below

Low substrate score due to low number of substrate types, and moderate silt and embedded substrate.
Low in stream cover score due to lack of cover types and a sparse amount.
Note: Livestock with creek access are adjacent to site 27.

Site: 35 Stream: Kasler Creek Subwatershed: Kasler Creek 14 Digit: 05030204090020
Location: Mouth of Kasler Creek. River Mile 0.0 Stream Enters: Federal Creek @RM: 14.13
Drainage Area: 3.747 SQ miles Record Date: 8/12/03 *Substrate Target: Above

Low substrate score due to moderate silt and embedded substrate.
Low riffle/run quality score due to moderately stable/unstable substrate, and moderately embedded substrate.
Note: Livestock with creek access and new fields in much of the flood plain area with little to no riparian zone above site 35 possible causes of moderate silt and embedded substrate.

Site: 34 Stream: Kitten Run Subwatershed: Kitten Run 14 Digit: 05030204090020
Location: Mouth of Kitten Run. River Mile 0.0 Stream Enters: Federal Creek @RM: 13.54
Drainage Area: 1.459 SQ miles Record Date: 8/14/03 *Substrate Target: Above

Low substrate score due to moderate siltation and embedded substrate.
Low in stream cover score due to lack of cover types and a sparse amount. Low riffle/run quality score due to moderately stable/unstable substrate, and moderately embedded substrate.

05030204090090Federal Creek (Below McDougall Branch to H. River, Except for Sharps Fork, Marietta Run and Big Run)

Federal Creek (05030204090090) possible negative impacts: Row crops and hay fields with little to no riparian zone, the heavy residential areas, and the heavy mining along this stretch of Federal Creek are possible causes of habitat degradation. Other possible causes are McDougall Branch (site 44 w/ heavy silt and extensively embedded substrate), Sharps Fork (site 20 w/ heavy silt and extensively embedded substrate) and Marietta Run (site 10 w/ heavy silt/embedded substrate), all located along this stretch of the main stem of Federal Creek. The subwatershed of Sharps Run has sparse residential areas, a good riparian zone in the majority of the floodplain, and no mining. Located in Herold Run is the community of Kilvert. There is also little agriculture and no mining in this subwatershed.

Site: 5 **Stream:** Federal Creek **Subwatershed:** Federal Creek **14 Digit:** 05030204090090
Location: 329, downstream from Kilvert. River Mile 1.5 Stream Enters: Hocking @RM: 15.29
Drainage Area: 137.9160 SQ miles Record Date: 10/31/03 *Substrate Target: Above

Low substrate score due to moderate silt and embedded substrate.
Low in stream cover score due to lack of cover types and a sparse amount.

Note: Marietta Run and Big Run, all located above this site, had excessive silt/embedded substrate. This site is also located downstream from Kilvert and just below a lot of Federal Creek main stem mining activities.

Site: 8 **Stream:** Federal Creek **Subwatershed:** Federal Creek **14 Digit:** 05030204090090
Location: 329, downstream from intersection w/ Sand Rock Rd. River Mile 4.78
Stream Enters: Hocking @RM: 15.29
Drainage Area: 120.1777 SQ miles Record Date: 10/31/03 *Substrate Target: Below

Low substrate score due to heavy/moderate silt and extensively/moderately embedded substrate.
Low in stream cover score due to lack of cover types and a sparse amount.
Low riffle/run quality score due to unstable substrate and moderately/extensively embedded substrate.

Note: The Broadwell seep (causing noticeable erosion), and Marietta Run (site 10 w/ heavy silt/embedded substrate) are both located very close to and above site 8 and are possible causes of the heavy silt and extensively embedded substrate observed here. The communities of Broadwell and Phillipsburg are both located on creek. There are also underground mines along this stretch of the main stem, made evident by the noticeable gob piles and seeps.

Site: 12 **Stream:** Federal Creek **Subwatershed:** Federal Creek **14 Digit:** 05030204090090
Location: 329, below intersection w/ tick ridge. River Mile 5.15 Stream Enters: Hocking @RM: 15.29
Drainage Area: 108.1483 SQ miles Record Date: 10/31/03 *Substrate Target: Below

Low substrate score due to low number of substrate types, and moderately silt and embedded substrate.
Low in stream cover score due to lack of cover types and a sparse amount.

Note: Sharps Fork (site 20 w/ heavy silt and extensively embedded substrate) located above site 12 is a possible cause of the moderate silt and embedded substrate observed here. In the midst of heavy strip mining, this area historically was a large mining town now abandoned.

Site: 19 **Stream:** Federal Creek **Subwatershed:** Federal Creek **14 Digit:** 05030204090090
Location: 329, downstream junction w/ 550. River Mile 9.25 Stream Enters: Hocking @RM: 15.29
Drainage Area: 71.2529 SQ miles Record Date: 10/31/03 *Substrate Target: Above

Low substrate score due to moderate silt and embedded substrate.

Note: Row crops adjacent to site 19, is a possible cause of moderate silt and embedded substrate.

Site: 18 **Stream:** Federal Creek **Subwatershed:** Federal Creek **14 Digit:** 05030204090090
Location: Near New England Rd. bridge. River Mile 10.15 Stream Enters: Hocking River @RM: 15.29
Drainage Area: 70.2448 SQ miles Record Date: 10/3/03 *Substrate Target: Above

Low substrate score due to moderate silt and embedded substrate.

Note: McDougall Branch (site 44 w/ heavy silt and extensive embedded substrate) located above site 18 is a possible cause of the moderate silt and embedded substrate observed here. This site is above the mining areas along Federal Creek. Most of what is upstream and at site is agricultural; the village of Amesville is also above site 18.

Site: 4 **Stream:** Sharps Run **Subwatershed:** Sharps Run **14 Digit:** 05030204090090
Location: Mouth of Sharps Run. River Mile 0.0 Stream Enters: Federal Creek @RM: .59
Drainage Area: 5.513 SQ miles Record Date: 8/13/03 *Substrate Target: Below

Low substrate score due to heavy/moderate silt and extensively/moderately embedded substrate.
Low in stream cover score due to lack of cover types and a sparse amount.
Low riffle/run quality score due to moderately stable/unstable substrate, and moderately embedded substrate.

Site: 6 **Stream:** Herold Run **Subwatershed:** Herold Run **14 Digit:** 05030204090090
Location: Mouth of Herold Run. River Mile 0.0 Stream Enters: Federal Creek @RM: 3.2
Drainage Area: 1.8556 SQ miles Record Date: 9/25/03 *Substrate Target: Below

Low substrate score due to heavy/moderate silt and extensively/moderately embedded substrate.
Low in stream cover score due to lack of cover types and a sparse amount.
Low riffle/run quality score due to unstable substrate and moderate embedded substrate.
Note: Kilvert is located adjacent to site 6.

Site: 13 **Stream:** Sharps Run **Subwatershed:** Sharps Run **14 Digit:** 05030204090090
Location: Off Copeland Rd. River Mile 1.8 Stream Enters: Federal Creek @RM: 0.0
Drainage Area: .1048 SQ miles Record Date: 9/25/03 *Substrate Target: Above

Site 13 shows good habitat.

Table 44 QHEI 2003

Site Number	Stream	Riparian Width Score	Flood Plain Quality Score	Erosion Score	Total Riparian Score	Substrate quality Score (max 2)	Total Substrate Score (max 20)	Riffle/Run Embeddedness Score (max 2)	Total Riffle/Run Score(max 8)	Total Instream Cover Score (max 20)	QHEI Total (Max 100)	Total Channel Morph Score (max 20)	Total Pool/Glide/Current Quality Score	Drainage Area(sq.mi)	Gradient Score (max10)	Gradient(ft/mi)
7	Big Run	3	3	1.5	7.5	-4	5	-0.5	2.5	7	71.5	12	11	11.905	6	35.71
11	Brill Run	4	3	3	10	0	17	0	3.5	5	56	13	8	1.8556	8	60.61
39	Bryson Branch	2.5	2.5	2.5	7.5	0	15	1.5	4.5	7	63.5	13	4.5	0.288	4	181.82
32	Bryson Branch	2.5	2.5	2	7	-1	14	0.5	4.5	11	62.5	16	11	7.868	4	52.63
29	Dutch Creek	2.5	2.5	2	7	-2.5	12.5	0	3.5	7	68.5	15	10	6.716	4	66.67
28	Dutch Creek	1.5	1.5	2	5	0	15	1	4	10	69.5	16	8	4.3367	4	28.99
2	Ellis Run	2	2	3	7	0	13	0	3	6	65.5	13	6	1.586	8	40
26	Federal Creek	2	1.5	2	5.5	-2	13	0	3.5	7	73	16	10	69.4038	8	15.04
19	Federal Creek	1	1	2	4	-2	13	0	4.5	13	75	16	10	71.2529	8	5.41
18	Federal Creek	2	1.5	2	5.5	-2	13	0	4.5	11	53.5	16	9	70.2448	10	9.13
12	Federal Creek	3	2.5	2	7.5	-2	11	0	4.5	7	78.5	16	9	108.1483	8	3.13
8	Federal Creek	4	3	2	9	-3	12	-0.5	3.5	9	62.25	16	6	6.499	10	24.99
5	Federal Creek	4	3	2	9	-1	14	0	4	8	58.5	16	9	137.916	8	10.152
6	Herold Run	4	3	3	10	-3	10	0	2	8	52.5	14	9	120.1777	8	11.83
38	Hyde Fork	2	1	2	5	0	15	0	3	16	47	16	10	5.207	10	28.57
36	Hyde Fork	1	1	2	4	-2	11	0	4	7	63	14	6	6.609	4	62.5
35	Kasler Creek	2	2	2	6	-2	13	0	3.5	10	59	16	6	3.747	8	10.58
34	Kitten Run	2	1	2	5	-2	13	0	3.5	6	63.5	16	6	1.459	4	54.05
27	Lindscott Run	1.5	1.5	2.25	5.25	-2	11	0	4	9	62.5	14	9	5.061	10	15.15
10	Marietta Run	4	3	2	9	-3	10	-0.5	2.5	13	54	13	8	10.1678	10	15.5
31	McDougal Branch	1	2	2	5	0	15	0.5	5.5	14	65.5	16	10	4.0018	10	16.53
30	McDougal Branch	2.5	2	2	6.5	0	15	1	4	12	50	16	6	3.369	10	16.53
44	McDougal Run	3	2.5	1	6.5	-4	6	-1	2	6	51	11.5	7	37.593	8	22.73
37	Miners Fork	1.5	1	2	4.5	-2	11	0	5	9	67	14	6.5	9.953	4	68.97
15	Mush Run	2	2	2	6	-1	14	1	5	14	45.5	16	10	5.4681	8	12.9
14	Mush Run	3.5	3	2.5	9	-0.5	14.5	0.5	4	13	55.5	20	7	0.1048	8	181.82
24	Opossum Run	2	2	2	6	-2	13	0	3	11	67.5	16	8	8.507	10	19.05
22	Opossum Run	1	1	2	4	-2	11	0	3.5	8	51	14	10	9	8	10.93
43	Sharps Fork	3.5	2	2	7.5	0	13	0	4	16	74.5	16	8	3.273	10	23.81
41	Sharps Fork	3	2.5	2	7.5	-3	4.5	-0.5	0.5	6	68	13	8	11.6987	6	64.52
40	Sharps Fork	3	2.5	2	7.5	-0.5	12.5	0	1.5	11	75.5	15	5	13.272	10	8
23	Sharps Fork	2	2	2	6	-2	13	0	4	9	63	14.5	6	16.0397	10	11.3
20	Sharps Fork	1.5	1	2.5	5	-3	6	-0.5	3.5	6	56	12.5	8	35.649	10	15.38
4	Sharps Run	3	2.5	1.5	7	-3	10	0	3.5	8	69.5	15	8	5.513	10	28.99
42	Smith Run	2	0	2	4	0	13	1.5	5.5	10	62	16	7	2.932	10	22.47
21	Sulphur Run	0	1	2	3	-0.5	14.5	1	4	5	61.5	13	5	1.9835	8	30.3
13	Unnamed?(Sharps Run Trib)	4	3	3	10	0	15	1.5	5.5	13	62.5	18	6	3.292	4	2
17	Wyatt Run	1	2	2	5	-2	11	0.5	4.5	8	69.5	15	10	6.887	10	17.39

Stream Substrate

The following two paragraphs are taken from MBI, 2005 Federal Valley Draft Report. Fine sediments have been identified as a moderate to severe problem many watersheds in Ohio (Ohio EPA 2000, 2002). As mentioned earlier, there is some evidence that habitat conditions may have declined somewhat in Federal Creek. All three sites from 1984 and 1990 had QHEI scores in the 70s-80 (very good-excellent) while 2004 samples averaged a score of 58 (47.5 [fair] – 66 [good]) and had no sites score above 70 (Figure 6). Recent assessments were characterized as having more sand and fine sediments than earlier sites.

Sandy rather than silty sediments are more a problem in the Federal Creek watershed at most sites. The Federal Creek sites and RM 9.1 and 9.3 both have greater than 50% of surface bed materials as sand. No strong trends exist between fine substrates as measured by the pebble counts at individual sites and biological performance, however, adjacent higher quality patches of habitat can compensate for localized sediment impacts as discussed later. If the extent of fine substrate export to Federal Creek increases the biological could decline. As it is now, the IBI scores were only marginally attaining the EWH and further stress could cause impairment. Only Sulphur Run at its mouth had extremely silty conditions and this coincided with mining impacts and the only poor macroinvertebrate assemblage rating in the watershed.

Federal Valley 2003 Substrate Analysis

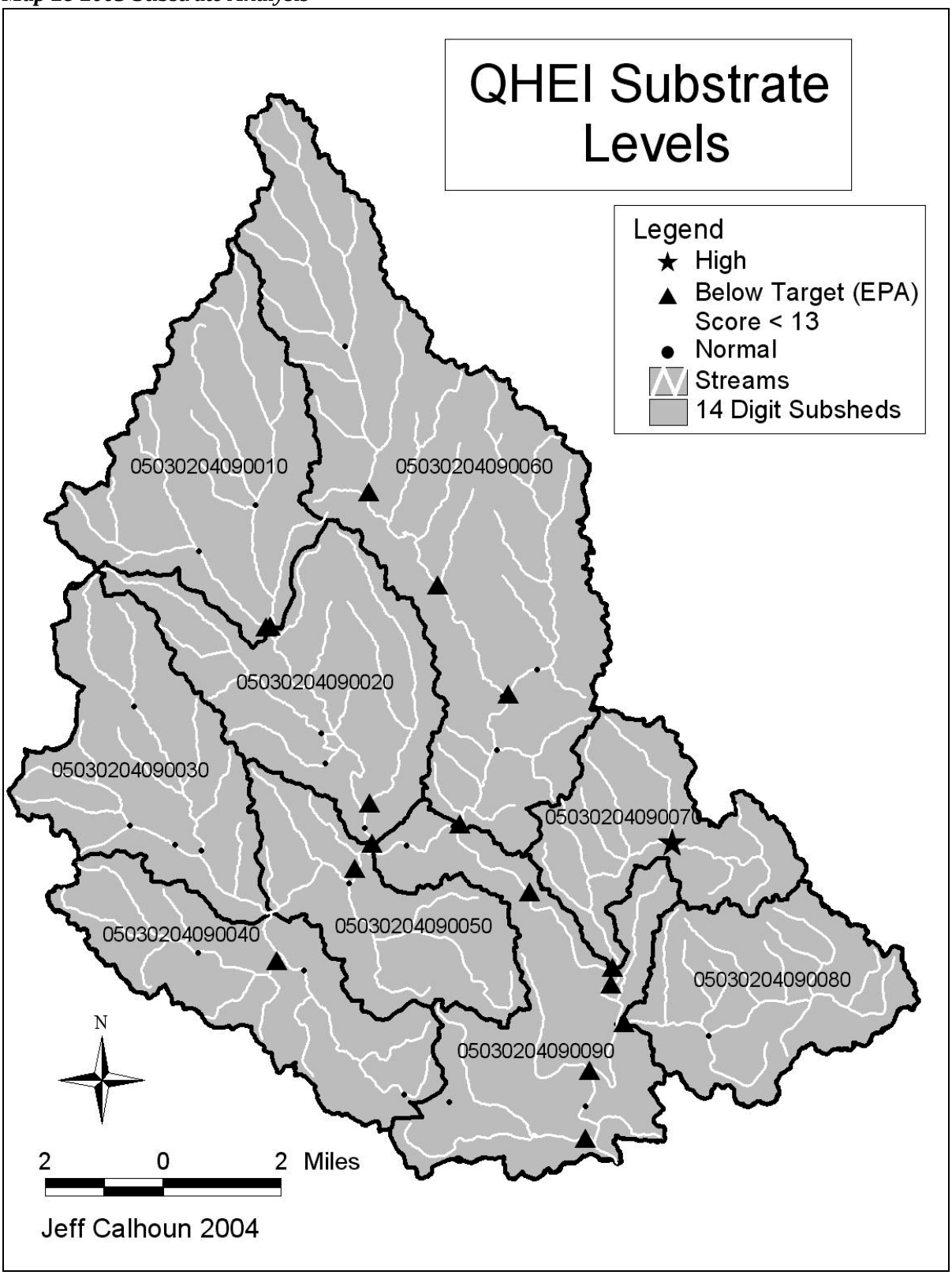
QHEI sampling conducted from August through September of 2003 shows sedimentation as a significant impact in the Federal Valley Watershed. This is illustrated in the substrate and riffle/run metric scores listed above. The substrate metric of the QHEI is basically composed of measures of substrate size and condition, including the amount of embedded substrate and silt cover throughout a sample area. According to Appendix 1: Using the Qualitative Habitat Evaluation Index to Derive TMDL Targets for Sediment Impairment in Southeast Ohio (Ed Rankin), sediment impact is a major cause of aquatic life impairment. According to Rankin, “There is a clear association of the IBI with embedded substrate with a WAP ecoregion IBI biocriteria value of 44 for headwater and wadeable streams. Fewer than 25% of streams with moderately embedded substrate achieving this IBI score and very few streams with severely embedded substrate achieve this value. Thus FVWG can use the low-no embedded substrate range as an endpoint for sediment impaired streams. For the Federal Valley Watershed (WAP ecoregion) the QHEI metric goal is 13-14 with a low to no embedded substrate range. Of the 38 sites evaluated in the Federal Valley Watershed, 16 received a substrate score of less than 13 (7 sites receiving a score of 10 or less). All of these 16 sites were found to have above normal levels of silt and embedded substrate, shown in both the substrate quality and riffle/run quality metrics. The following map shows the

location of these 16 sites in the watershed, as well as site 11 (mouth of Brill Run), which has an exceptional substrate score for the watershed (2 st. deviations above the mean). All other sites shown in Map 24 fall within the "normal" range for the Federal Valley Watershed. The following table lists the 16 below target sites with the substrate and riffle/run metric scores respectively:

Table 45 QHEI poor substrate analyses

Site	Stream	Substrate quality Score (max 2)	Total Substrate Score (max 20)	Riffle/Run Embeddedness Score (max 2)	Total Riffle/Run Score(max 8)
41	Sharps Fork	-3	4.5	-0.5	0.5
7	Big Run	-4	5	-0.5	2.5
20	Sharps Fork	-3	6	-0.5	3.5
44	McDougall Branch	-4	6	-1	2
4	Sharps Run	-3	10	0	3.5
6	Herold Run	-3	10	0	2
10	Marietta Run	-3	10	-0.5	2.5
12	Federal Creek	-2	11	0	4.5
17	Wyatt Run	-2	11	0.5	4.5
22	Opossum Run	-2	11	0	3.5
27	Linscott Run	-2	11	0	4
36	Hyde Fork	-2	11	0	4
37	Miners Fork	-2	11	0	5
8	Federal Creek	-3	12	-0.5	3.5
29	Dutch Creek	-2.5	12.5	0	3.5
40	Sharps Fork	-0.5	12.5	0	1.5

Map 28 2003 Substrate Analysis



Riparian Zone

While biological quality was generally good in the Federal Creek watershed a larger number of sites sampled in 2004 were impaired (25) than were fully meeting (17) their aquatic life goals set for them through the Ohio WQS. The most prevalent stressor associated with observed aquatic life impairment was fine sediments in the stream channel. Fine sediments can fill interstitial spaces between larger rocks and gravels and can result in declines in food resources, spawning failures, reduce habitat space, and reduction in other important ecological functions of streams. Many of the stations in this study had various land uses encroaching on the stream especially agriculture and in some places residential development. The median width of riparian strips was only 10 m and 30% were only about 2.5 meters in average width. There were a few sites with no riparian zone at all and there are probably many more disturbed small streams throughout the watershed. Establishment of sufficiently wide riparian zones generally keeps most sediment from reaching the stream and intact vegetation protects banks from eroding. Bank erosion can contribute major loadings of fine sediments, especially the sands that are a problem in Federal Creek and the Hocking River. (MBI, 2005)

Federal Valley Riparian Zone Analysis 2003

Riparian zones are important in protecting the Federal Valley Watershed from erosion and sedimentation. Of the 38 QHEI sites evaluated, 21 sites scored below the riparian metric score average (6.51) for Federal Valley and had either a narrow riparian width (less than10 meters) or no riparian width, and moderate to severe bank erosion. 18 of the 21 below average sites were not forested beyond the 100-meter riparian zone (listed as either old field, residential, or open pasture/rowcrop). 5 sites have exceptionally low riparian metric scores (2 standard deviations from the mean). These 5 sites have a narrow to no riparian zone, are non-forested beyond the 100-meter riparian zone, and have moderate bank erosion. The map shows the location of these 5 sites in the Federal Valley Watershed. The following table lists the 5 sites of concern with their riparian metric scores:

Table 46 2003 QHEI Low Riparian Metric

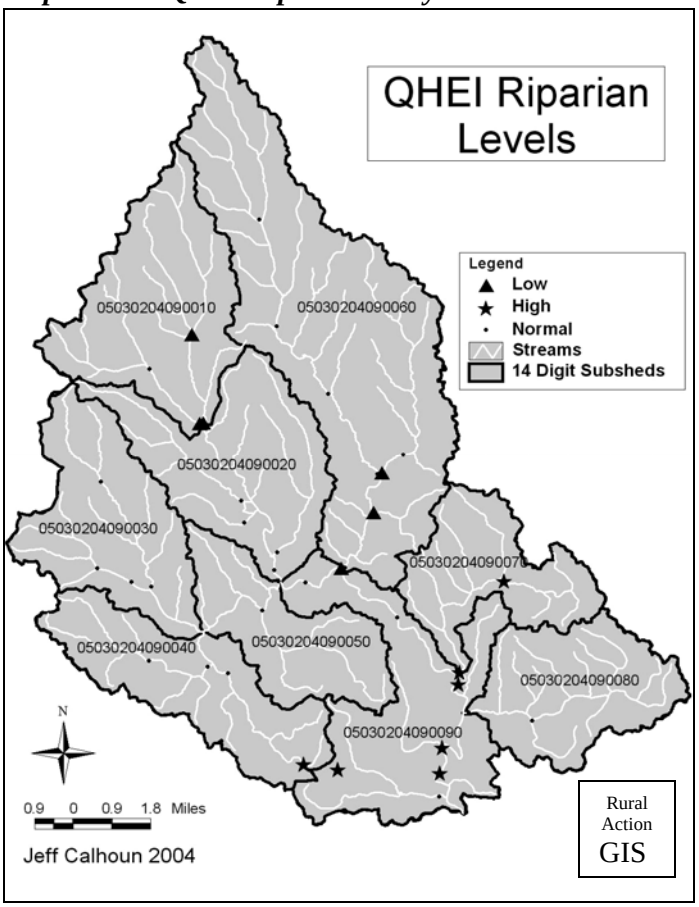
Site	Stream	Riparian Width Score	Flood Plain Quality Score	Erosion Score	Total Riparian Score
21	Sulphur Run	0	1	2	3
19	Federal Creek	1	1	2	4
22	Opossum Run	1	1	2	4
36	Hyde Fork	1	1	2	4
42	Smith Run	2	0	2	4
37	Miners Fork	1.5	1	2	4.5

7 QHEI sites had exceptionally high riparian zone metric scores in the Federal Valley Watershed (2 st. deviations above the mean). These sites have wide riparian zones (greater than50 meters), are forested beyond the 100 meter riparian zone, and have no to moderate bank erosion. Map 24 shows the location of these sites in the watershed. The following table lists these 5 sites with their riparian metric scores:

Table 47 2003 High Riparian Metric

Site	Stream	Riparian Width Score (max 4)	Flood Plain Quality Score (max 3)	Erosion Score (max 3)	Total Riparian Score (max 10)
6	Herold Run	4	3	3	10
11	Brill Run	4	3	3	10
13	Unnamed?(Sharps Run Trib)	4	3	3	10
5	Federal Creek	4	3	2	9
8	Federal Creek	4	3	2	9
10	Marietta Run	4	3	2	9
14	Mush Run	3.5	3	2.5	9

Map 29 2003 QHEI Riparian Analysis



Additional Riparian Comments

FVWG has also looked at the riparian zone by looking at aerial photographs and determining locations that do not have good riparian zones. This is analysis is general looking at the landscape at approximately a 1:100,000 scale. The following is the result of this analysis. Additionally it is noted here that only about 1 mile of riparian zone in Gifford forest has protection, and that none of the streams in FV have been channelized, riparian levees, had damns built, or have other unnatural channel characteristics. Further all of the streams in FV have good floodplain connectivity. Along the mainstem of Federal Creek there are many places with eroding stream banks, approximately 5 places along the lower mainstem and 1 above Amesville with large erosion areas but this may be completely natural. The FVWG took entrenchment measurements and found no areas that were entrenched. The river generally has good access to its floodplain.

The entire mainstem of Federal Creed has 7.1 miles where both sides of the creek have good riparian zone, 6.7 miles where there is only 1 good side, and 4 miles with zero good sides. The lower Federal Creek area, below Sharps Fork, south of SR 550 has excellent riparian corridors. This includes the entire Federal Creek lower main stem, Big Run with 4.5 miles, Marietta Run with 6 miles, and Brill Run. Sharps Run is average; there is a good forested riparian zone on one bank and grass land on the other. Ellis Run also has a similar condition.

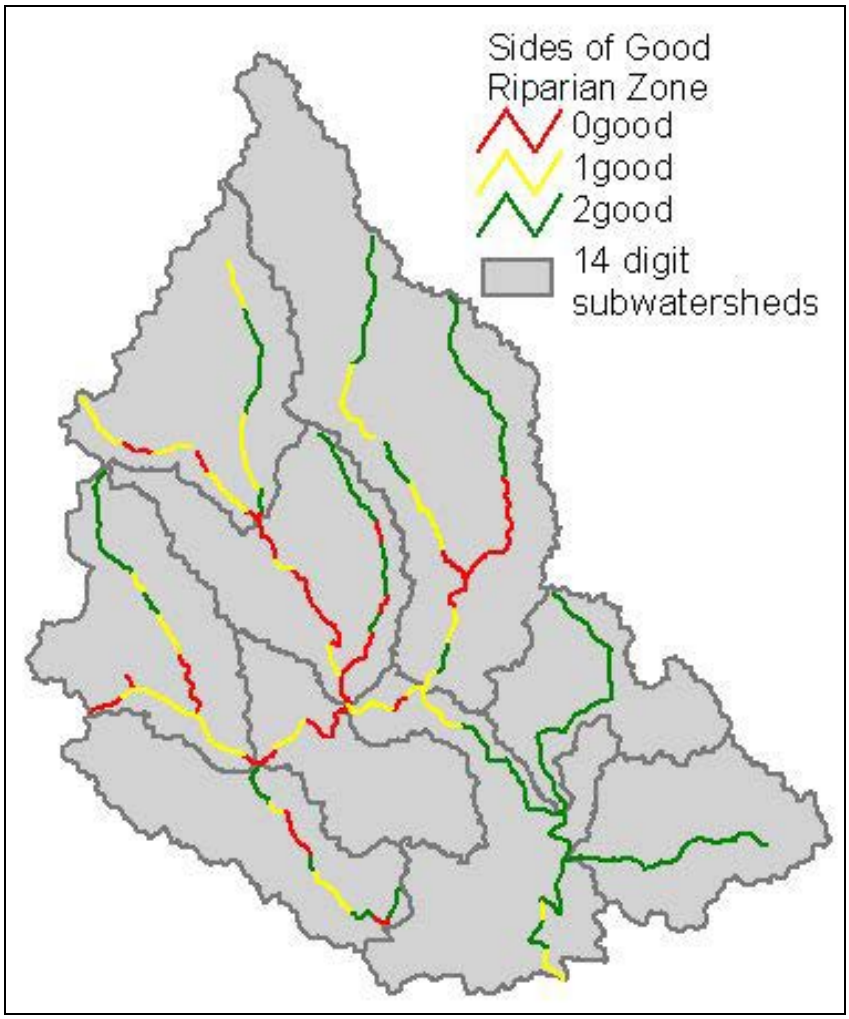
The upper Federal Creek area, along 550 and north of Amesville has a very sparse riparian zone. Occasionally there are areas with good riparian zones on one bank, but for the most part there is very little riparian coverage. Much of this land is maintained as grass land and pasture land. Most of this land is agricultural and there are some areas with row crops. These areas include Federal Creek the main stem, the lower Linscott Run, Kasler Creek, Kitten Run, and Hyde Fork. Miners Fork has .2 miles of stream with no good riparian, 2.5 miles with 1 good side, and 2.8 miles with 2 good sides of riparian zone. Linscott Run has 2 miles of stream with no good riparian zone, and 3 miles with 2 good sides of riparian zone. Hyde Fork has 1.3 miles of stream with out good riparian zones, and 3.4 miles with 1 good side riparian zone.

Most of Sharps Fork has good riparian zone on one bank but needs some work on the other bank; 4.1 miles of stream with both sides having good riparian zones, 6 miles with 1 good side, and 1.5 miles with 0 good sides. Opossum Run has 2.7 stream miles with 0 good sides and 4 miles of stream with 2 good sides

McDougall Branch and most of its tributaries have sparse riparian coverage. Generally where there is coverage it is only on one bank. The entire main stem is this way, most of Wyatt Run, Dutch Creek and Mush Run. Bryson branch has some areas with good coverage on both banks but much of it

still has sparse coverage. McDougall Branch has 3 miles with no good riparian zones and 3.8 miles with 1 good side. Bryson Branch has 2.5 miles with 2 good sides, 1.5 miles with no good sides, and 1.5 mile with 1 good side. Mush Run has 2.5 miles with 2 good sides, 1.7 mile with 1 good side, and 1.6 mile with no good sides.

There is further analysis on locations where livestock have access to the stream and where there are row crops adjacent to the streams on page 58. Most of our watershed is very rural, and there are no large-scale agricultural producers and no intense urban/ suburban areas. Much of the land discussed here with sparse riparian coverage has hay fields or other mowed lawns right up to the creek. It is difficult to use CRP money for hay fields. It would be recommended to work with these landowners to not mow next to the stream



IV. PROBLEM STATEMENTS AND ACTIONS STEPS

Problem Statements

This section will cover the top five problems identified by local citizens.

Erosion	27%
Trash	17%
Human sewage and wastewater	12%
Lack of streamside forests along the creeks	10%
Acid mine drainage	7%

SEDIMENTATION

Background

27% of local citizens say that erosion is a major cause of water quality problems in the watershed. Although erosion is a natural process, there can be too much erosion, causing heavy sedimentation in stream channels.

Potential Impact

Sediment may destroy fish habitat by: (1) blanketing spawning activities and feeding areas; (2) eliminating certain food organisms; (3) causing gill abrasion and fin rot; and (4) reducing sunlight penetration, thereby impairing photosynthesis. Suspended sediment decreases recreational values, reduces fishery habitat, adds to mechanical wear of water supply pumps and distribution systems, and adds treatment costs for water supplies. Nutrients and toxic substances attached to sediment particles may enter aquatic food chains, cause fish toxicity problems, impair recreational uses or degrade the water as a drinking water source.

The Problem Statement

Too much erosion is causing sedimentation in many of our subwatersheds. This report is using two different indicators for sediment being a problem. The QHEI scores and the substrate metric taken in both 2003 and the 2004 TMDL study. FVWG has also included the total suspended solids data taken by the EPA in the 2004 TMDL study. The data and the analysis for the 2003 QHEI and substrate scores are on page 125. The information regarding the TSS analysis for the 2004 TMDL is on page 142.

The watershed goal is to have a minimum QHEI above 50 and a preferred QHEI above 60, with a substrate score above 13. Additionally, FVWG would like for all wadeable streams to have a TSS below 28 at a minimum, preferably below 10. Headwater sites should have a minimum score of 52 and preferably below18. These numbers correlate with streams that achieve a WWH use designation with their IBI.

Sedimentation Problem

The main stem of Federal Creek below the Sharps Fork confluence is 9.3 river miles long. None of the sites in this section of Federal Creek are achieving the TSS goal from the 2004 TMDL samples. In

Sedimentation

In the Federal Valley most sites are not meeting the substrate metric goal in the 2003 QHEI study and only one site, at Mayle Ridge Bridge, met the substrate goal in the 2004 TMDL study. Some of these sites are achieving the QHEI goal. Near the mouth of Federal Creek is the lowest score, Mayle Ridge Bridge is attaining the QHEI score, and below Sharps Fork is not attaining the QHEI score. This part of the watershed has a high flow and a low gradient, and there is very little agriculture, new development, or logging in this part of the watershed. This entire area has excellent forested riparian buffers. There are abandoned coalmines in this part of the watershed. There has also been some very high flooding particularly in this part of the watershed. The creek is out of its banks in this area several times per year. One unique feature about this subwatershed is the narrow floodplain relative to the area being drained. Heavy siltation is partly a function of being the lowest part of the subwatershed..

The mouth of Big Run sub watershed is not meeting the TSS goal. All of the sites have QHEI's above 50, where only one is above 60, the furthest upstream in the headwaters. This headwaters site is the only site attaining the substrate goal. The other two sites are not attaining the substrate goal. There is some agriculture in this watershed, particularly in Ellis Run. There is very little development. Mead Westvaco owns a lot of land in this sub watershed and leases a lot as well. Local landowners have voiced concern about the logging in this area. They feel that there is a significant increase in silt in the creeks after Meade cuts an area, and they feel that BMPs are not in place.

The mouth of Marietta Run is not meeting the QHEI goal or the substrate goal. It is meeting the TSS goal. The mouth of the sub watershed has a slug of shifting sand and silt that is at least three feet deep, There is also an island in the middle of the creek at the mouth that has trees growing on it. There is no farming, development, or logging in the watershed. Past mining probably causes the sediment problem in this watershed.

In the 2004 TMDL Study, Sharps Fork is attaining QHEI scores and substrate scores, except the site below Sulphur Run. In the 2003 study, the sites at Joy and Wrightstown Ridge are also not attaining substrate or QHEI scores that would meet the watershed goal. With regard to the TSS goal, only the site at Wrightstown Ridge is not attaining. The site below Sulphur Run is probably being affected by Sulphur Run, which also has very low scores. The Wrightstown Ridge site does have cattle with access to the creek, and has abandoned mining.

Sub watersheds of Sharps Fork include Sulphur Run and Opossum Run. Although Sulphur Run has very low substrate and QHEI scores, the TSS score is met. Sulphur Run is mainly impacted by abandoned mining. Opossum Run has very high TSS in the town of Sharpsburg. All of the sites have low substrate scores and all of the lower sites have low QHEI scores. There are areas where

livestock has access to the creek, and there is potentially some development in Sharpsburg. There are also abandoned mines in this area.

McDougall Branch, at the mouth, near Amesville, is not meeting the TSS goal, the QHEI goal or the substrate goal. This site is the mouth of a relatively large watershed. This watershed does have a significant amount of agricultural land use and some livestock with access to the creek.

In the areas north of Amesville there are no elevated TSS levels. The 2004 study has good QHEI and substrate except in the Miners Fork sites and the sites just above Amesville. The sites in the region of Amesville may have some development issues, and there is some livestock with access to the creek in this area. Miners Fork has poor QHEI and substrate. There is agriculture in this subwatershed and there is some abandoned mining.

Sedimentation	Sedimentation from Livestock
Sources	**Tasks, Resources, Performance Indicator**
Some areas have livestock with access to the creek See map and table pg. 82 Federal Creek Ellis Run Opossum Run Sharps Fork McDougall Branch Bryson Branch Mush Run Wyatt Run Kasler Creek Linscott Run Hyde Fork Miners Fork (livestock with access to the creek)	**Tasks** • Educate farmers about CRP and other current USDA Farm Bill programs. • Workshops, news articles, peer-to-peer sessions with other farmers who use these programs, one on one consulting, publicly recognize farmers in this program. • Educate farmers about intensive grazing programs. • Workshops, news articles, peer-to-peer sessions with other farmers that use these programs, one on one consulting, publicly recognize farmers in this program. • Offer volunteer assistance to farmers who are keeping their livestock out of the creek. • Offer farmers additional cost share for fencing livestock out of the creek **Time Line** (Education ongoing until by 2008, volunteer and cost share 2007 - 2008) • Planning education activities; 5, 2 hour meetings in 2-3 months • Media for activities; to create it-2, 2 hour planning meetings, 40 hours design work per graphic piece (i.e. Brochure), 16 hours per text only piece (i.e. Press release, postcards, etc.), to disseminate mass mailings 16 hours per mailing, flyers 8 hours per flyer, press release, 4 hours per press release; personal outreach, phone calls and emails 40 hours per event or program. • Have workshops and peer to peer sessions 8 hours preparing; 2-3 hours actual event time; 8 hours clean up and evaluation / per event or program. • Volunteer programs 16 hours for media; 16 hours for volunteer outreach; 16 hours planning and preparation; 8 hours clean-up and evaluation/ per event **Resources** NRCS, FSA, Soil and Water Conservation Board, OEPA, OSU Extension, OU Center for Community Service, Hocking College, NCCC, **Possible Grants** CRP, 319, CSP, EQIP, **Performance Indicators** • Reduction in the number of miles where livestock has access to the creek. Current known total 5.24, Goal 60% (3.4 miles) • Rise in QHEI and substrate scores. Goal 15 metric (where applicable) • Increase in the number of farmers who know about CRP and intensive grazing. Goal outreach to 80% of farmers in above listed watersheds. • Reduction in TSS scores (where applicable) Goal 10 mg/L. • Increase in miles of stream enrolled in CRP, goal 3 miles • Increase in permanent vegetation buffers on streams. Goal 3 mile • Arrange for 3 farmers who currently use BMP's to meet with 8 farmers • Creation of 1 workshop • Creation and distribution of 100 brochures, 15 flyers, 2 press releases
Sedimentation	**Sedimentation from tilling**

Sources	Tasks, Resources, Performance Indicator
Tilling the ground in the Riparian area for agricultural purposes without adequate buffer. Subwatershed: (see table pg.81) Federal Creek Wyatt Run Opossum Run Kitten Run Linscott Run Hyde Fork Miners Fork	**Tasks** •Educate farmers about CRP and other current USDA Farm Bill programs. •Workshops, news articles, and peer-to-peer sessions with other farmers who use these programs, one on one consulting, publicly recognize farmers in this program. •Offer cost-share and in-kind volunteer assistance to farmers who use BMP and keep permanent vegetation in the riparian areas **Time Line** (Education ongoing until by 2008, volunteer and cost share 2007 – 2008 • Planning education activities; 5, 2 hour meetings in 2-3 months • Media for activities; to create it-2, 2 hour planning meetings, 40 hours design work per graphic piece (i.e. Brochure), 16 hours per text only piece (i.e. Press release, postcards, etc.), to disseminate mass mailings 16 hours per mailing, flyers 8 hours per flyer, press release, 4 hours per press release; personal outreach, phone calls and emails 40 hours per event or program. • Have workshops and peer to peer sessions 8 hours preparing; 2-3 hours actual event time; 8 hours clean up and evaluation / per event or program. • Volunteer programs 16 hours for media; 16 hours for volunteer outreach; 16 hours planning and preparation; 8 hours clean-up and evaluation/ per event **Resources** NRCS, FSA, CRP, Soil and Water Conservation Board, 319, OSU Extension, OU Center for Community Service, Hocking College, NCCC, **Performance Indicator** • Reduction in the number of miles where tillage is adjacent to creeks without buffers. Goal 50%, 1.3 miles of reduction. • Increase in miles of stream adjacent to land enrolled in CRP Goal 1 mile • Increase in acres of permanent vegetation buffers on streams. Goal 9 acres • Increase in the number of farmers who know about buffers. Goal 15 farmers • Increase in farmers meeting other farmers who use BMPs. Goal 1 farmer meeting 4 farmers • Creation and distribution of educational materials. Goal 100 brochures, 2 press releases, 20 flyers • Have 1 workshop • Reduction in TSS scores (where applicable) Goal 10 mg/L. • Rise in QHEI and substrate scores (where applicable) Target 15 **Resources** NRCS, FSA, Soil and Water Conservation Board, OEPA, OSU Extension, OU Center for Community Service, Hocking College, NCCC, **Possible Grants** CRP, CSP, EQIP, 319,
Sedimentation	**Sedimentation from logging**
Sources	**Tasks, Resources, Performance Indicator**
	Tasks

Logging without BMP's Subwatersheds where this is currently an issue: Big Run Ellis Run Mush Run Because of the high percentage of forest in Federal Valley the entire watershed has potential for logging.	• Contact Meade WestVaCo about BMP use in the Big Run Area, try to work with them, find out what their policy is. Find out if they could create an example site for BMP use • Educate loggers about BMP's, sediment control, and buffers. • Assist landowners with development of management plans- put landowners in contact with the Rural Action Forestry program, and with ODNR. • Educate landowners about BMP's and forestry • Workshops, news articles, peer-to-peer sessions with other landowners who use these programs, one on one consulting, publicly recognize landowners with management plans • Offer cost share and in kind volunteer service for landowners employing a management plan with BMPs, particularly plans that maintain setbacks from creeks, keep slopes seeded, use water bars on access roads, and take seasonal conditions into account. **Time Line** (Education ongoing until by 2009, volunteer and cost share 2007 – 2009) • Planning education activities; 5, 2 hour meetings in 2-3 months • Media for activities; to create it-2, 2 hour planning meetings, 40 hours design work per graphic piece (i.e. Brochure), 16 hours per text only piece (i.e. Press release, postcards, etc.), to disseminate mass mailings 16 hours per mailing, flyers 8 hours per flyer, press release, 4 hours per press release; personal outreach, phone calls and emails 40 hours per event or program. • Have workshops and peer to peer sessions 8 hours preparing; 2-3 hours actual event time; 8 hours clean up and evaluation / per event or program. • Volunteer programs 16 hours for media; 16 hours for volunteer outreach; 16 hours planning and preparation; 8 hours clean-up and evaluation/ per event **Resources** ODNR forestry, NRCS, Soil and Water Conservation Board, Ohio EPA, OSU Extension, Rural Actions sustainable forestry, AFRC, OU Center for Community Service, Hocking College, NCCC Possible Grant Programs 319 **Performance Indicators** • Increase number of forestland owners with a management plan. Goal 10 • Educate 10 landowners and 3 professional loggers about the benefits of creek buffers when logging. • Educate 10 landowners and 3 professional loggers about the importance of erosion management techniques related to logging roads and ditches. • Educate 10 landowners and 3 professional loggers about other logging BMP and how to find preferable BMPs. • Creation and distribution of educational materials. Goal 100 brochures, 2 press releases, 20 flyers • Have 1 workshop • Reduction in TSS scores (where applicable) Goal 10 mg/L. • Rise in QHEI and substrate scores (where applicable) Target 15
Sedimentation	**Sedimentation from development**
Sources	**Tasks, Resources, Performance Indicator**
Land Development	**Tasks**

without BMP's There are no specific subwatersheds where this is a priority. The entire watershed should be targeted.	• Educate landowners about BMP's and development • Workshops, news articles, peer-to-peer sessions with other landowners who use these programs, one on one consulting, publicly recognize landowners with management plans • Educate developers about BMP's and development • Workshops, news articles, peer-to-peer sessions with other landowners who use these programs, one on one consulting, publicly recognize developers who use BMPs **Time Line** (Education ongoing until by 2009, volunteer and cost share 2007 – 2009) • Planning education activities; 5, 2 hour meetings in 2-3 months • Media for activities; to create it-2, 2 hour planning meetings, 40 hours design work per graphic piece (i.e. Brochure), 16 hours per text only piece (i.e. Press release, postcards, etc.), to disseminate mass mailings 16 hours per mailing, flyers 8 hours per flyer, press release, 4 hours per press release; personal outreach, phone calls and emails 40 hours per event or program. • Have workshops and peer to peer sessions 8 hours preparing; 2-3 hours actual event time; 8 hours clean up and evaluation / per event or program. • Volunteer programs 16 hours for media; 16 hours for volunteer outreach; 16 hours planning and preparation; 8 hours clean-up and evaluation/ per event • Resources • ODNR soil and water, NRCS, OSU Extension, Hocking College, County Commissioners **Possible Grant Programs** 319, **Performance Indicators** • Increase in number of landowners aware of development BMPs. Goal 100 • Increase in number of developers aware of and using BMPs. Goal 5 • Creation and distribution of educational materials. Goal 100 brochures, 2 press releases, 20 flyers • Have 1 workshop • Reduction in TSS scores (where applicable) Goal 10 mg/L. • Rise in QHEI and substrate scores (where applicable) Target 15

Sedimentation	Sedimentation From Road maintenance
Sources	**Tasks, Resources, Performance Indicator**
Road maintenance The entire watershed has steep dirt roads.	**Tasks** • Identify all steep dirt roads and promote the use of silt traps at the bottom • Have workshops, create cost share for installing silt traps, and publish news articles about the benefits of silt traps. • Partner with County, Townships, and DOT to be conscious of silt when maintaining roads and cleaning ditches. Try to move policy toward proper disposal of silt piles after ditch cleaning. • Partner with County, Townships, and DOT regarding the promotion of permanent vegetation in the riparian areas. **Time Line** (GIS 2007, Education ongoing until by 2009, volunteer 2007–2009) • Steep road identification, GIS 32 hours; field check 40 hours • Planning education activities; 5, 2 hour meetings in 2-3 months • Media for activities; to create it-2, 2 hour planning meetings, 40 hours design work per graphic piece (i.e. Brochure), 16 hours per text only piece (i.e. Press release, postcards, etc.), to disseminate mass mailings 16 hours per mailing, flyers 8 hours per flyer, press release, 4 hours per press release; personal outreach, phone calls and emails 40 hours per event or program. • Have workshops or present at road maintainer meetings 8 hours preparing; 2-3 hours actual event time; 8 hours clean up and evaluation / per event **Resources** ODOT, Township Trustees, County Engineer, Floodplain Manager, SWCD **Indicators** • Increase awareness and utilization of sediment control among road maintenance workers and administrators. Work with 5 road maintainers. • Creation and distribution of educational materials. Goal 100 brochures, 2 press releases, 20 flyers • Have 1 workshop • Reduction in TSS scores (where applicable) Goal 10 mg/L. • Rise in QHEI and substrate scores (where applicable) Target 15
Abandoned Mines Sulphur Run Marietta Run Opossum Run Sharps Fork	**Sedimentation from Abandoned Mines** **Tasks** Ensure that all abandoned mine sites have permanent vegetation on them. **Time Line** (complete in 2007) GIS work 40 hours; field check; 40 hours; Landowner contact calls 40 hours/ per mine site **Resources** ODNR Division of Mineral Resource Management, Office of Surface Mining, ODNR, Division of Soil and Water Conservation Possible Grant Programs 319, Appalachian Clean Streams **Performance Indicators** • All abandoned mines have permanent vegetation • Reduction in TSS scores (where applicable) Goal 10 mg/L. • Rise in QHEI and substrate scores (where applicable) Target 15

TRASH AND SOLID WASTE

Background

17% of local citizens say that trash is a major cause of water quality problems in the watershed. There are many locations where people dump their refuse on a creek bank. These illegal dumps then erode or leach into the creek. Much of the waste in these dumpsites is recyclable. The nearest regulated landfill is more than forty miles away, and a fee is charged for refuse disposal. In the process of sampling and interviewing local residents, a list of large trash sites has been developed.

Potential Impact

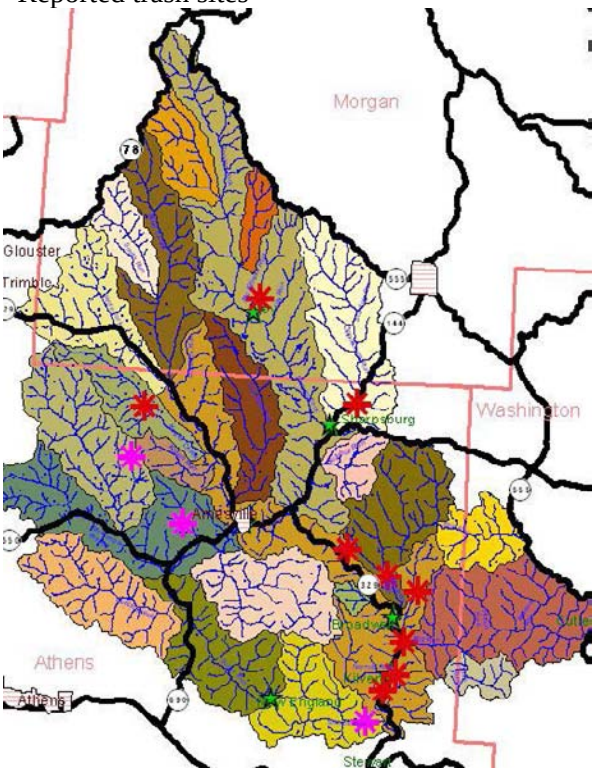
Refuse and litter in a stream can clog fish spawning areas, stress aquatic organisms, reduce water clarity, impede water treatment plant operations and impair recreational uses of the water body such as swimming, fishing, and boating. Dumpsites can contain potential polluting agents such as oil, gas, chemicals, lead, etc.

Problem Statement

There are areas in Federal Valley Watershed where people dump their refuse illegally. This refuse accumulates and washes down stream and collects at various places in the stream. Our goal is to clean up dumpsites and to find ways to reduce the illegal dumping of solid waste.

Map 30 Trash Sites

*Reported trash sites



Trash and Solid	Solid Waste problem from Future Dumping
Sources	**Tasks, Resources, Performance Indicator**
Future dumping is a potential problem. Combating future dumping will reduce solid waste.	**Tasks** • Create comprehensive anti litter program for youth that involves puppet shows, trash clean ups, visits to recycling centers and trash dumps, discussions on trash. • Work with a task force on the prevention of illegal trash dumping. Develop a list of landowners who have problems with illegal trash dumps. Investigate the possibility of cameras, fences, and signs to discourage illegal dumping. Find funding to assist landowners. • Educate youth and adults about recycling , have puppet shows and contests for the best recyclers. • Investigate ways to make recycling more accessible to small communities. • Create a solid waste component for watershed camps, including trash pick ups and recycling programs. • Investigate the possibilities of having dump coupons for people on fixed incomes. **Time Line** (Education and media ongoing until by 2009, Research, ongoing until 2008, work with landowners, 2008 to 2009,) • Landowner identification and field visits 8 hours per area • Recycling in small communities; 8 hours planning; 4, 2 hour partner meetings; 8 hours interviews; 8 hours research; 8 hours out reach; / per area • Dump coupon program; 16 hours planning; 4, 2 hour partner meetings; 8 hours interviews; 8 hours research; 8 hours out reach; / per area • Planning education activities; 5, 2 hour meetings in 2-3 months • Media for activities; to create it-2, 2 hour planning meetings, 40 hours design work per graphic piece (i.e. Brochure), 16 hours per text only piece (i.e. Press release, postcards, etc.), to disseminate mass mailings 16 hours per mailing, flyers 8 hours per flyer, press release, 4 hours per press release; personal outreach, phone calls and emails 40 hours per event or program. • Have workshops and peer to peer sessions 8 hours preparing; 2-3 hours actual event time; 8 hours clean up and evaluation / per event or program. **Resources** School districts, County Solid Waste Districts, county health departments, Rural Action Environmental Learning Program, County Recycling Centers, Reuse Industries, landowners, Ohio EPA, US EPA. **Possible Grant Programs** Environmental Education Fund, **Performance Indicators** • More recycling in small communities. Goal 2 more communities. • 40 people educated about illegal dumping and picking up trash.

Trash and Solid	**Solid Waste Problem from Existing Dumps**
Sources	**Tasks, Resources, Performance Indicator**
Existing illegal trash dumps encourage more dumping and can cause problems in the streams.	**Tasks** • Contact landowners with known dumpsites. • Assess each situation and work with the landowners who are interested in cleaning up and/or stopping dumping. • Direct calling **Time Line** (planning & volunteer coordination by 2007, actual clean ups 2007-2008 • Planning 2, 2 hour meetings; calling and setting up meetings 8 hours; landowner meetings 2, 2 hour meetings; • Actual clean ups; Volunteer programs 16 hours for media; 16 hours for volunteer outreach; 16 hours planning and preparation; 8 hours clean-up and evaluation/ per event **Resources** Township trustees, county commissioners, county health departments, Ohio EPA, **Performance Indicator** • Reduction of existing trash sites. Goal clean up 4 dump sites. • Increase of volunteers willing to pick up trash. Goal 20 volunteers. • Increase of in-kind donations such as equipment use for trash removal. Goal 1000$ in kind donations for trash pick up.

HUMAN SEWAGE, ANIMAL WASTE, AND WASTEWATER

Background

12% of local citizens say that human sewage is a major cause of water quality problems in the watershed. In the Federal Valley Watershed, very few residents have access to publicly-operated treatment. Most residents must use septic systems to process their home sewage. The local health department states that as many as 80% of home septic systems are not functioning properly. In 2004, as a part of the TMDL study, bacteria counts were taken at many sites in the watershed. See page 76 for maps, tables and analysis of this data. This study showed many sites with high levels of fecal coliform and E. coli bacteria. . In the 2004 TMDL study there were field dissolved Oxygen (DO) readings taken. At many sites where bacteria levels are high, DO levels are low.

Potential Impact

Waterborne diseases may be transmitted to humans through drinking or contact with pathogen-laden water. The principal concern in both surface and ground waters is the potential degradation of public water supply sources. Pathogens reaching a lake or other surface water body may limit primary contact recreation, such as swimming. Due to organic enrichment dissolved oxygen may be reduced below the threshold necessary to maintain aquatic life.

Problem Statement

Most residents in the watershed process their household waste with home septic systems. The health department estimates that more then 80% of these are not functioning properly. Many homes are near creeks throughout the watershed. Many sites that have been studied show high levels of fecal coliform and E coli bacteria. Many of these sites also have low dissolved oxygen.

FVWG wants to see that all areas meet the Ohio EPA standards for primary contact for both *E Coli* and fecal coliform. Also, at any site that has had high bacteria FVWG wants to be certain that DO levels are above 5 mg/L. See page 80 for information regarding this data. Lastly, FVWG wants to be certain that all homes within 500 feet of a creek have educational information regarding septic system upkeep and that all homes in target areas have the opportunity to upgrade their septic systems.

Human and Animal Waste,	**Bacteria problems from homes located near streams.**
Sources	**Tasks, Resources, Performance Indicator**
Areas where homes are within 500 feet of streams. All Subwatersheds Except Brill Run	**Tasks** • Educate youth about knowing where sewage goes and where drinking water comes from and how to be a responsible septic system owner. • Classroom presentations, watershed camp. • Educate new landowners/ homebuilders about not building near creeks, and improve awareness of septic issues. • Create outreach brochure to go to all new landowners about septic awareness and siting a new home. • Work with local real estate agents to distribute brochures. • Educate homeowners about buffers and the use of permanent vegetation to buffer pollution. • Brochures, press articles, workshops, peer-to-peer demonstrations. • Create information to include with landowner packets, send out through the sustainable forestry program, and potentially distributed through local OSU Extension. **Time Line** (planning by 2007; media and education events by 2009; information in landowner packets by 2007) • Planning education activities; 5, 2 hour meetings in 2-3 months • Media for activities; to create it-2, 2 hour planning meetings, 40 hours design work per graphic piece (i.e. Brochure), 16 hours per text only piece (i.e. Press release, postcards, etc.), to disseminate mass mailings 16 hours per mailing, flyers 8 hours per flyer, press release, 4 hours per press release; personal outreach, phone calls and emails 40 hours per event or program. • Have workshops and peer to peer sessions 8 hours preparing; 2-3 hours actual event time; 8 hours clean up and evaluation / per event or program. • Work with extension and Forestry to be included in landowner packets 2 2 hour meetings, 15 hour phone/ email consulting **Resources** Health departments, OSU Extension, schools, Ohio EPA, US EPA, ODNR, Division of Soil and Water Conservation, landowner packet program with Rural Action Sustainable Forestry Program. **Performance Indicator** • 10 septic owners install permanent vegetation buffers at leech fields and streams. • Goal 100 landowners learn about septic up keep and awareness. • Creation and distribution of educational materials and workshops. • 100 youth made aware of where their septic system is ,where their drinking water comes from and other septic issues. • Reduction of new homes being sited too close to streams. Goal, outreach to 25 new homebuilders. Creation and distribution of educational materials. Goal 100 brochures, 2 press releases, 20 flyers

Human and Animal Waste,	**Areas with high bacteria and Low DO**
Sources	**Tasks, Resources, Performance Indicator**
Areas where bacteria is above primary contact levels As well as places with low DO. Subwatershed: (see table pg.76 and map pg 80) Athens County Federal Creek, below Kilvert, Broadwell, Tick Ridge, Amesville, and at the Elementary School Ball field Opossum Run in Sharpsburg mouth of McDougall Branch Zarley Run (the creek in Amesville) Marietta Run below Philipsburg Linscott Run Kasler Creek Mush Run near Mush Run Rd Dutch Creek McDougall Branch above Hooper Ridge Rd. Washington County Big Run, above Cutler Ellis Run Morgan County upper Sharps Fork below Joy. • Opossum Run, above Starling Run; • Headwaters of Sharps Fork • Hyde Fork • Miners Fork	**Tasks** • Educate people about the dangers of high bacteria and about the areas that are high in bacteria. • Workshops, news articles, flyers, public meetings, classroom activities, watershed camp. • Seek cost-share and in-kind volunteer assistance for homeowners who want to upgrade their septic systems. Target key areas and homes within 500 feet of a creek. • Create outreach materials, PSA's about match offer, mailings to targeted areas. **Time Line** (planning by 2007; media/ education events by 2009; writing by 2008) • Planning education activities; 5, 2 hour meetings in 2-3 months • Media for activities; to create it-2, 2 hour planning meetings, 40 hours design work per graphic piece (i.e. Brochure), 16 hours per text only piece (i.e. Press release, postcards, etc.), to disseminate mass mailings 16 hours per mailing, flyers 8 hours per flyer, press release, 4 hours per press release; personal outreach, phone calls and emails 40 hours per event or program. • Have workshops and peer to peer sessions 8 hours preparing; 2-3 hours actual event time; 8 hours clean up and evaluation / per event or program. **Resources** Health departments, OSU Extension, schools, Ohio EPA, US EPA, ODNR< Division of Soil and Water Conservation, landowner packet program with Rural Action Sustainable Forestry Program **Performance Indicator** • Increase in number of people upgrading septic systems. Goal 25% of existing septic systems that are identified as having a problem by the health department and are within 500 ft of a stream, near an area with high bacteria and low DO up grade their septic systems. • Creation and distribution of educational materials. Goal 100 brochures, 2 press releases, 20 flyers • Reduction of bacteria counts, in 5 samples taken in 30 days fecal coliform 2000 per 100 ml and/or ecoli 300 per 100 ml. And rise in DO above 5 mg/L. • In areas where bacteria is high and DO is low work with 4 farmers where livestock live adjacent to streams without riparian buffers, and/ or livestock has access to the stream, to develop vegetation buffers, at least 20 feet wide that is only mowed a maximum of 1 time per year. • Creation and distribution of educational materials. Goal 100 brochures, 2 press releases, 20 flyers

	In Athens County Recommendations. The communities of Kilvert, Phillipsburg, Broadwell, Sharpsburg, Amesville and above Tick Ridge should be first priorities. The entire main stem of Federal creek, Opossum Run, Zarley Run in Amesville, and homes directly above the mouth of McDougall Branch should be assessed. Further Dutch Creek, Mush Run, Linscott Run, Kasler Creek, and upper McDougall Branch above Hooper Ridge Rd are also a priority for septic upgrades. **In Washington County** Big Run below the community of Cutler and at the mouth were sites with levels above the standards for both Fecal coliform and E coli. Recommendations: The community of Cutler should be a priority because of the high bacteria levels in an area with such a low population and because many citizens have complained about the sewage in Cutler. Additionally the entire sub watershed of Big Run, which includes Ellis Run, should be a priority for funding because of the levels at the mouth of Big Run and because of the dense population near the stream in Ellis Run. **In Morgan County** Sites that tested above the EPA standards for both E coli and Fecal coliform were Recommendations It is important to prioritize all Sharps Fork in Morgan County, including Opossum Run, Hyde Fork, and Miners Run. This includes the community of Mountville.

LACK OF STREAMSIDE FORESTS

Background

10% of local citizens say that the lack of streamside forests is a major cause of water quality problems in the watershed. At the same time there is a common perception that streamside forests cause flooding. Local residents also complain that streamside forests catch refuse and are unsightly. Scientific evidence shows that streamside forests are primary source of nutrients in stream systems, help to absorb water rather than putting it all into the channel, help to maintain stream banks, help to slow flood waters, help to moderate temperatures, and most importantly help to reduce pollution entering the stream. This disconnects between local perception and scientific evidence must be addressed.

Potential Impact

Direct sunlight may elevate stream temperatures. Elevated temperatures can exceed fish tolerance limits, reduce dissolved oxygen, and promote the growth of nuisance algae. The lack of trees along a stream bank contributes to thermal stress and excessive sunlight. Habitat modifications include activities in the landscape that alter the physical structure of the aquatic and riparian ecosystem; an example is the removal of streamside vegetation that stabilizes the stream bank and provides shade. Streamside forests can also provide a buffer for various pollutants such as sediment, pathogens, nutrients, and pesticides.

Problem Statement

There are many locations throughout the Federal Valley Watershed where there is a lack of permanent vegetation, especially woody vegetation, on the stream banks. This problem often causes stream bank erosion and allows pollutants to enter the stream directly. The goal is to have permanent vegetation on both banks of every creek for a minimum of 3 times the width of the stream channel. Most of this permanent vegetation should have a woody component and include native species.

Lack of Streamside Forests	**The belief by stakeholders that woody vegetation on streams should be removed.**
Sources	**Tasks, Resources, Performance Indicators**
There is a Strong belief by local citizens that woody vegetation on stream banks causes flooding, the increase of pests, and is unattractive. Current science shows that woody vegetation on stream banks reduces pollution, stream bank erosion, and flooding dangers. All Subwatersheds	**Tasks** • Educate all landowners and youth about the importance of permanent vegetation and the benefits of woody vegetation on stream riparian areas. Particularly the ecological, agricultural, water table, and flood benefits. • Workshops, news articles, one on one consulting and peer-to-peer meetings, and brochures. • Create a public service announcement about the benefits of permanent and woody vegetation on stream banks. Put on radio or TV or create flyers. Included in this is a 'no mow' slogan. • Find funding for public service announcement and flyers • Work with local reality agents to give out brochures. • Have local experts at presentations, do peer-to-peer demonstrations, have a fair about buffers with a contest and awards, present at local schools • Press releases on buffers and their benefits • Educate homeowners about buffers and the use of permanent vegetation to buffer pollution. • Brochures, press articles, workshops, peer-to-peer demonstrations. • Create information to include with landowner packets sent out through the Rural Action sustainable forestry program. • Conduct a long term study on log jams, log their locations by GPS, record what their contents are, study effects on stream banks , compile data on effects relating to flooding, reduction of nutrients, and the water table. Most importantly make the results of the study available to the public by interactive theater, PSAs, presentations, and flyers. **Time Line** (education ongoing until 2008; fair 2007 & 2008; landowner packet by 2008; study complete by 2009) • Planning education activities; 5, 2 hour meetings in 2-3 months • Media for activities; to create it-2, 2 hour planning meetings, 40 hours design work per graphic piece (i.e. Brochure, video psa), 16 hours per text only piece (i.e. Press release, postcards, etc.), to disseminate mass mailings 16 hours per mailing, flyers 8 hours per flyer, press release, 4 hours per press release; personal outreach, phone calls and emails 40 hours per event or program. • Buffer Fair; 40 hours planning; 24 hours outreach; 10 hour actual event; 16 hour cleanup, thank yous, and evaluations • Have workshops and peer to peer sessions 8 hours preparing; 2-3 hours actual event time; 8 hours clean up and evaluation / per event or program. • Extension/ forestry meetings to be in landowner packets 2 2hour meetings • Log jam study; outreach as an idea to graduate students 24 hours; GPS 8 hour session once per month for 1 year; Flow gathering 16 hour session once per month; bank erosion, stream profile 16 hour once per month; flooding interviews and GPS 20 hours 2-3 times per year; macros and fish twice in a season plus 1 year analysis; sinuosity, soil, topography GIS work 80 hours;

	research and writing 200 hours; outreach of study results 60 hours **Resources** Buffer CD in Federal Valley office, OSU Extension, NRCS, FSA, schools, Ohio EPA, US EPA, ODNR< Division of Soil and Water Conservation, landowner packet program with Rural Action sustainable forestry program. **Performance Indicators** • Increase in miles of permanent vegetation buffers on streams that are mowed not more then once per year in areas that currently are mowed more then that, or that that stream banks are bare from other activities. Goal 4 stream miles. • Increase in landowner awareness about benefits of permanent vegetation. Goal 100 landowners. • Creation and distribution of 100 brochures, 2 press releases, 20 flyers and host 1 workshop. • Increase in youth awareness of the importance of buffers. Work with 50 young people.
Lack of Streamside Forests	**Lack of streamside forests due to agricultural activities.**
Agriculture is a common place where streamside forests are reduced. See pages 81 for locations where livestock has access to the creeks and where row crops are directly adjacent to the creeks. Subwatershed: Federal Creek, Sharps Branch, Sharpsburg to headwaters Opossum Run McDougall Branch above Hooper Ridge Rd. Bryson Branch Linscott Run Kasler Creek Mush Run near Mush Run Rd Wyatt Run Ellis Run • Hyde Fork Miners Fork	**Tasks** • Educate farmers about farm bill programs and the benefits to taking land next to the creeks out of production, such as: reduction of pollutant loadings, easier to work field with straight edge lines, stabilize stream banks, make money from the farm bill • Workshops, news articles, one on one consulting and peer-to-peer meetings, and brochures. • Create a peer-to-peer series of tours, and presentations and farm visits where farmers can see buffers and talk to farmers who use buffers. • Workshops, news articles, flyers, public meetings, • Offer cost-share and in-kind volunteer assistance to farmers who want to use buffers. • Create outreach materials, PSA's about match offer, mailings to targeted areas. • Work with partners to include information about the benefits of forested buffers as opposed to grass buffers. • PSAs, news articles, brochures, presentations, farm tours • Conduct a literature review and a study showing the economic benefits of buffers, especially with livestock. **Time Line** • (education and media planning by 2007; education events ongoing until 2009; volunteer and in kind activities 2008 to 2009; research by 2008) • Planning education activities; 5, 2 hour meetings in 2-3 months • Media for activities; to create it-2, 2 hour planning meetings, 40 hours design work per graphic piece (i.e. Brochure, video psa), 16 hours per text only piece (i.e. Press release, postcards, etc.), to disseminate mass mailings 16 hours per mailing, flyers 8 hours per flyer, press release, 4 hours per press release; personal outreach, phone calls and emails 40 hours per event or program. • Have workshops and peer to peer sessions 8 hours preparing; 2-3 hours actual event time; 8 hours clean up and evaluation / per event or program.

	• Extension/ forestry meetings to be in landowner packets 2 2hour meetings • Research 24 hours outreach to graduate students; **Resources** NRCS, FSA, OSU Extension, Schools, Ohio EPA, US EPA, ODNR, Division of Soil and Water Conservation, landowner packet program with Rural Action sustainable forestry program, Rural Action environmental learning program **Performance Indicators** • Do outreach to 15 farmers about CRP and the goal would be to get 3 farmers enrolled in CRP. • Do outreach to 15 farmers about the benefits of forested buffers and get 2 farmers to agree to tree plantings or to not mow next to the stream. • Have 5 farmers visit 1-2 farms enrolled in CRP
Lack riparian buffers	**Use intact buffers as a way to show case the benefits.**
Some locations have been recorded as low riparian vegetation in our QHEI See discussion on pg 141-157. Other locations have been identified as areas with excellent riparian corridors. It would be nice to use these examples for educational purposes Creeks with low riparian vegetation Federal Creek above Amesville Opossum Run Sulphur Run Hyde Fork Smith Run Miners Fork Creeks with high riparian vegetation. Federal Creek below 550. Herold Run Brill Run Marietta Run Mush Run	**Tasks** • Investigate areas identified as having a lack of riparian vegetation. Target the landowners in that area for educational purposes and outreach. Try to put them in touch with programs that can help them. • Investigate areas identified as having good riparian vegetation. Use these areas as educational tools and find out the landowners feelings on preservation. • Work on getting conservation easements, finding funds and organizations interested in this. Try to connect key areas with conservation easement information. • Work on increasing public access to the streams so that people will use the creek and value it. • Research connectivity of good riparian areas and try to target key locations that would allow for more connectivity. **Time Line** (Research complete by 2008, education and media complete by 2009, connectivity and public access research complete by 2008, ODOT by 2009) • Planning education activities; 5, 2 hour meetings in 2-3 months • Media for activities; to create it-2, 2 hour planning meetings, 40 hours design work per graphic piece (i.e. Brochure, video psa), 16 hours per text only piece (i.e. Press release, postcards, etc.), to disseminate mass mailings 16 hours per mailing, flyers 8 hours per flyer, press release, 4 hours per press release; personal outreach, phone calls and emails 40 hours per event or program. • Have workshops and peer to peer sessions 8 hours preparing; 2-3 hours actual event time; 8 hours clean up and evaluation / per event or program. **Resources** Buckeye Hills RC&D, NRCS, Hocking Conservancy District, The Nature Conservancy, US Fish and Wildlife, ODNR, Division of Soil and Water Conservation, Soil and Water Conservation Districts, ODOT, township trustees, county engineers, The Nature Conservancy. **Performance Indicators** Increase in awareness of low versus high riparian vegetation and the relationship with water quality. 100 brochures 2 press releases 1 presentation.

ACID MINE DRAINAGE

Background

7% of local citizens say that acid mine drainage (AMD) is a major cause of water quality problems in the watershed. There was not extensive coal mining in the watershed and the geology offers limestone, which acts as a natural buffer on the acidity. There are some high acid sources, but they are quickly buffered in their receiving water bodies. The Federal Valley Watershed does have water with high conductivity, high sulphates, and high iron. The locations with AMD are also very unsightly. It seems that it would be possible to totally eliminate the effects of acid mine drainage in this watershed.

Description of AMD:

AMD is polluted water flowing from, or caused by, deep mining, surface mining, or left over coal refuse piles (commonly referred to as gob piles). This drainage is usually orange in color and is acidic with high levels of dissolved metals. Contaminated AMD can lower water quality and impair aquatic life (as noted in Section II water quality inventory). One or more of the following five components most often characterizes it: Low pH; High acidity; High metal concentrations; Excessive suspended solids; Excessive siltation

Chemical production of AMD:

Pyrite, an iron sulfide mineral, is frequently found in coal mine refuse piles and underground coal mines. When water and air come in contact with acidic material such as pyrite, there is a chemical reaction. It produces iron hydroxide and sulfuric acid, which contaminates surface and sub-surface waters. The sulfuric acid produced can then dissolve other metals that naturally occur in the bedrock and soils. This contamination is known as acid mine drainage (AMD).

Pyrite (in coal) + Oxygen + Water =Iron hydroxide + Sulfuric acid + Aluminum +Manganese + Sulfate

Where does AMD come from?

- Surface mining – past unregulated strip mining
- Deep mining –series of underground tunnels
- Bore holes – a hole drilled to relieve water pressure in deep mines
- Refuse piles – unused waste coal left in piles

AMD often occurs down-dip of underground coal mines. AMD forms in the void space where coal was exploited long ago. In the abandoned coal mines, there are coal pillars supporting the roofs and waste coal that was left behind. This coal contains the pyritic materials that make sulfuric acid when exposed to air and water. Air enters the mine due to the void space left during mining and through fractures in the overburden. Water also enters the mine through fractures and subsidence features. Subsidence features form when the ”rooms” of a coal mine collapse leaving moderate to large depressions in the earth. Rainwater

Acid Mine Drainage

and stream water pass through the surface fractures and subsidence features and enter the abandoned mines. Due to the air and water in the abandoned mine, a chemical reaction occurs, causing the water in the mine to become acidic. Then, the AMD drains down-dip through the mine until it reaches an old portal, or an opening to the mine, and drains into the surrounding streams. In some cases, the portals to the mines were closed off and the mine water collects until the water pressure busts a hole up to the surface where the overlying rock is weak or very thin. This mine water then drains to a nearby stream.

Effects of AMD:

Sulfuric acid in streams can corrode metal pipes and structures, break down concrete, and kill or stunt the growth of plants and other aquatic life forms. Acid waters can also break down compounds containing iron, sulfur, manganese, and aluminum found in nearby rock or earthen waste piles. Often, rock found near coal seams contains trace amounts of these elements. These metals can be dissolved from the rocks through the action of acid runoff and be washed into streams as sediment. Called flocculates, these sediments eventually precipitate out and constitute a large proportion of downstream sedimentation. Many metals can be toxic to fish and other aquatic life when found in high concentrations. Iron toxicity is in the range of 50 mg/l. The major iron problems occur from the precipitation of iron; the deposition of iron hydroxide on the gills of aquatic animals can inhibit respiration and heavy precipitation can smother fish eggs (Ohio EPA, 1979).

Indicators:

Little or no evidence of aquatic life -fish, macro-invertebrates, amphibians; High levels of metals found in the sediments in the creek; High concentrations of sulfate, iron, aluminum, manganese, acidity
Low pH and dissolved oxygen; Stream bottom coating and/or stream discoloration; Orange: evidence of iron; White/Gray: evidence of aluminum; Black: evidence of manganese

Solutions:

Reducing or eliminating acid mine drainage is costly and difficult. Controlling mine drainage can happen by either treating water after it leaves a mine (treatment- active or passive) or preventing the acid from being produced (source control).

Active treatment – acidic discharges are neutralized by the addition of strong alkaline chemicals like lime and ammonia to neutralize acidity and facilitate the precipitation of metals.
Passive treatment systems – naturally occurring chemical and biological reactions are established in a controlled environment. Construction of passive systems requires less maintenance than active systems. These systems increase the oxidation of metals and facilitate the production of clean water. The AMD passes through one or several of the following passive treatment systems: Wetlands – including marshes, swamps, or bogs; Open limestone channels – ditches lined with limestone sand/rock; Diversion wells – a holding tank filled with crushed lime; Anoxic limestone drains – beds of buried limestone that react with mine h2o before oxidation; Vertical flow reactor – AMD is diverted vertically through compost and limestone

Acid Mine Drainage

Source control – prevents the formation of acid and contaminated water, thus preventing the need for costly treatment systems. Types of source control treatment are as follows:

Closing subsidence holes – Coal mine subsidence holes and fractures are filled in to eliminate surface water from entering into the underground mine complex where AMD is generated.

Gob pile capping- coal refuse piles are covered with a layer of clay or some other impermeable substance. This reduces the amount of precipitation able to infiltrate through the coal waste piles, thus preventing AMD formation.

Re-mining – In situations where previous mining was completed using inefficient technologies, a modern surface mining operation may be viable. Under these conditions, careful planning, engineering, and post mining reclamation may reduce or eliminate mine drainage, thus providing both an environmental and economic benefit to the area.

In addition, sedimentation from run-off from poorly reclaimed or un-reclaimed mine lands chokes waterways and reduces water quality. Listed below are best management practices used to reduce sedimentation problems caused by current mining activities:

- Construction of water diversions and sediment ponds
- Construction of roadways across the slope of the land.
- Removing and storing topsoil in a protected area.
- Back filling and grading with stored soil.
- Grading to gentle slopes.
- Re-vegetation of bare soils.

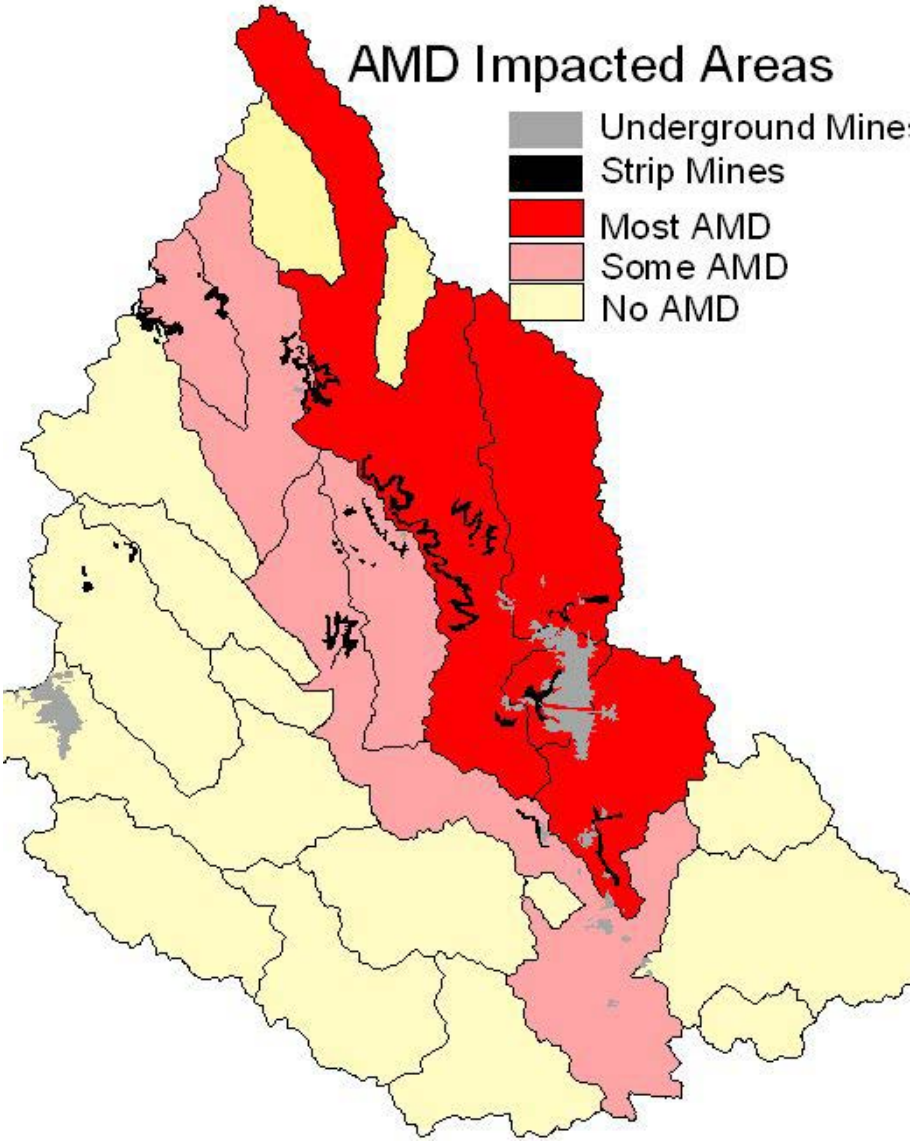
Contaminated sediments from surface mines and precipitates from mine drainage cause impairment, and solutions to remediate contaminated sediments coating the bottom of the stream from past mining practices need to be researched further. Remediation of sediment contamination is not easy, and once sediments are contaminated in a stream there are not many options for removing them without causing ecological harm. Instead, remediation is focused on eliminating the sediments at the source by capturing sediments in wetland cells for AMD seeps or by capping and sealing gob piles. Through time, sediments will be buried or carried downstream and diluted so the integrity of the stream can recover. The potential of accumulation in fish and macro-invertebrates is an area needing research.

Potential Impact

Acidic waters will adversely affect many biological processes. Low pH or acidic conditions adversely affect the reproduction and development of fish and amphibians, and can decrease microbial activity important to nutrient cycling. An extremely low pH will kill all aquatic life. Acidic conditions can also cause the release of toxic metals that were absorbed to sediments into the water column.

Current AMD impacts in the watershed:

Map 31 AMD impacts in Federal Valley

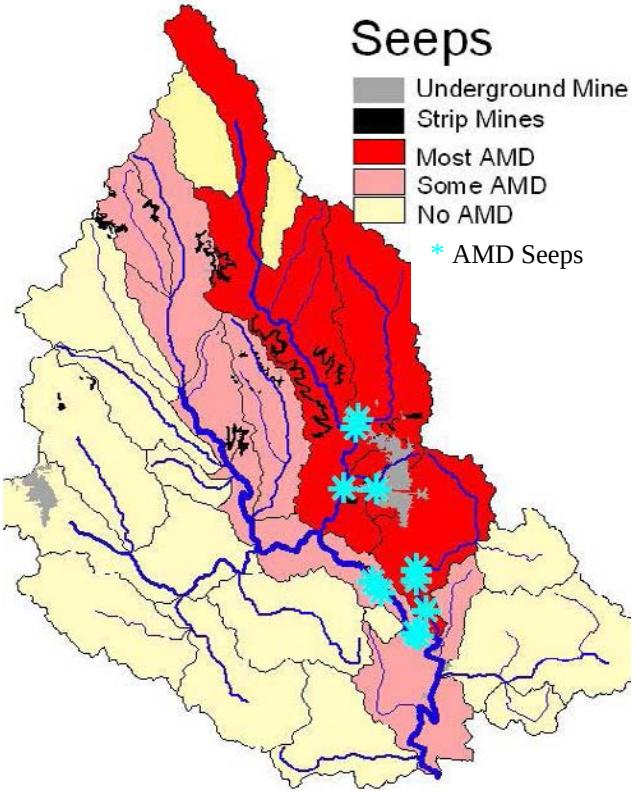


Mining impacts are dispersed and occur in some form in many areas of Federal Creek. The most extensive mining occurred in the area surrounding Sharpsburg and Joy, as well as the area along SR329 near Utley (Tick Ridge Rd.,) Phillipsburg (Marietta Run Rd.), and Broadwell (Mayle Ridge Rd.). Approximately 1.55% (2.25 sq mi) of the total watershed has been deep mined and approximately 1.44% (2.09 sq mi) has been surfaced mined for coal.

Acid Mine Drainage

In The Federal Valley Watershed there are 77 mapped underground mine entries. Subsequent strip mining has obscured many of these. Very few of these entries form acid mine drainage seeps. FVWG has studied 10 AMD seeps throughout the watershed. The data from these will be discussed below.

Map 32FVW Seeps



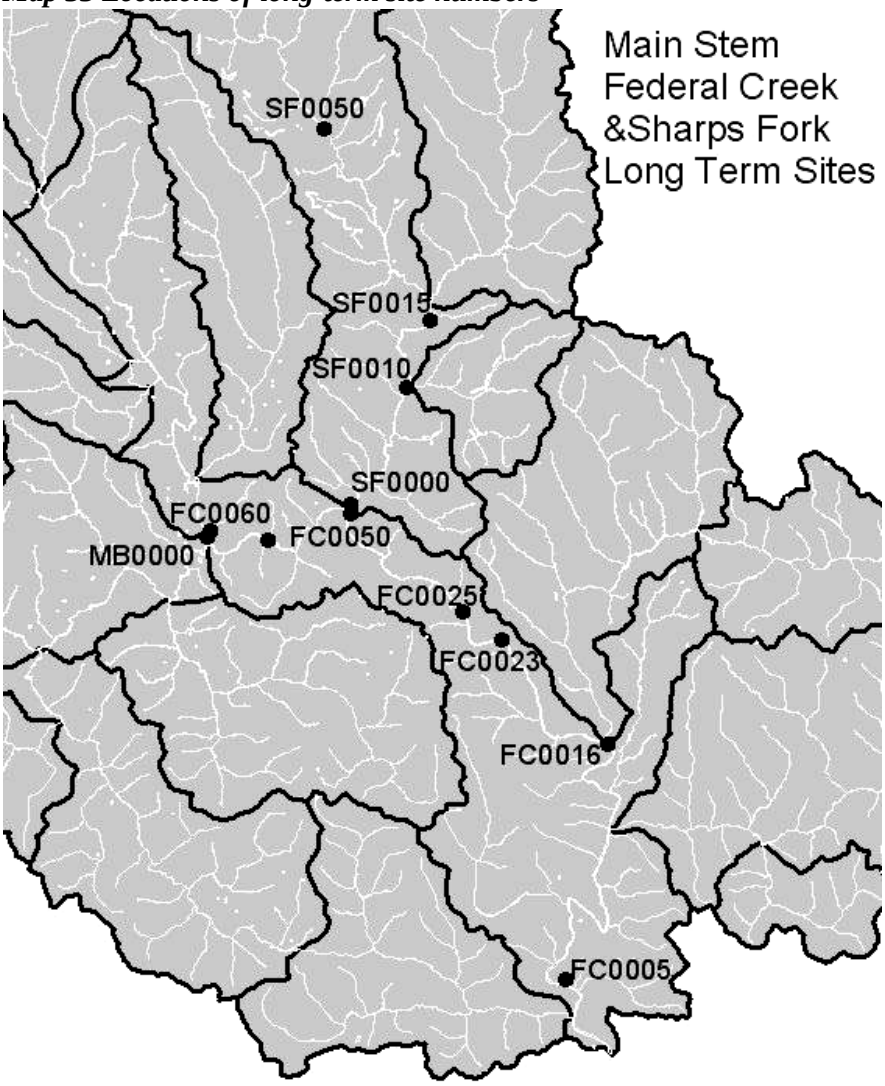
Due to high levels of naturally occurring alkalinity in the watershed, the effects of AMD are drastically reduced in Federal Valley. Federal Valley has high levels of alkalinity due to the geology of the area, which contains high concentrations of limestone. This limestone neutralizes much of the acidity that enters Federal Creek due to past mining practices. However, some areas of Federal Creek are negatively affected by mining impacts, mainly in the form of elevated metal or sulfate concentrations. Water chemistry data shows the most heavily impacted areas are within Sharp's Fork and Marietta Run. Sulphur Run in Sharp's Fork is the most impacted subwatershed in Federal Creek. Other impacted tributaries include Opossum Run, numerous unnamed tributaries to Sharp's Fork, Upper Linscott Run, Smith Run, and Miner's Fork. Additionally, AMD seeps enter the Federal Creek mainstem between Tick Ridge Road and Mayle Ridge Road. In most cases, when the contaminated water in the small tributaries

enters the larger stream channels, the water is neutralized and diluted so that a problem is not evident in the larger stream channel.

Acid Mine Drainage

Data was collected at long term monitoring sites along the mainstem of Federal Creek, Sharp's Fork, and McDougall Branch from August 2002 to February 2004. Some sites have been sampled more than others due to changes in sampling plans. Overall, most AMD effects appear to be ameliorated along the main stem of the larger sections of streams due to dilution and neutralization from alkalinity. The following box plots display some of water chemistry parameters that are often evaluated when looking at the mining related impacts.

Map 33 Locations of long-term site numbers

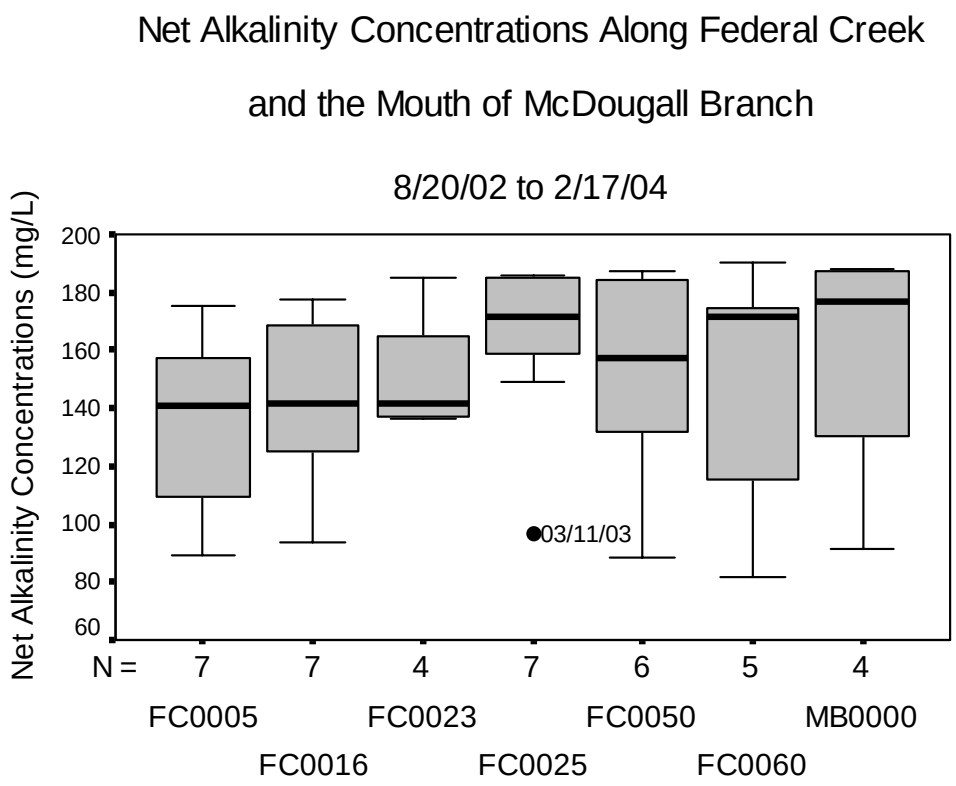


Acid Mine Drainage

Net Alkalinity

The following box plot displays the net alkalinity concentrations along the Federal Creek main stem and at the mouth of McDougall Branch. Net alkalinity concentrations are fairly high. The lowest median values (indicated by the solid black bar through the boxes) are found towards the mouth of Federal Creek. FC0005 is below all mining in the watershed. The lowest net alkalinity concentrations were found at high flow, which can be expected due to dilution. Only one outlier was found which occurred on 3/11/03. The net alkalinity concentration at FC0025, which is at Tick Ridge Bridge, was far below the range normally found at this site, however, discharge was very high on 3/11/03 (159 cfs), hence this outlier is probably due to dilution on this date. No sample was taken on FC0023 on 3/11/03, but all other sample sites had alkalinity values in a similar range as the outlier.

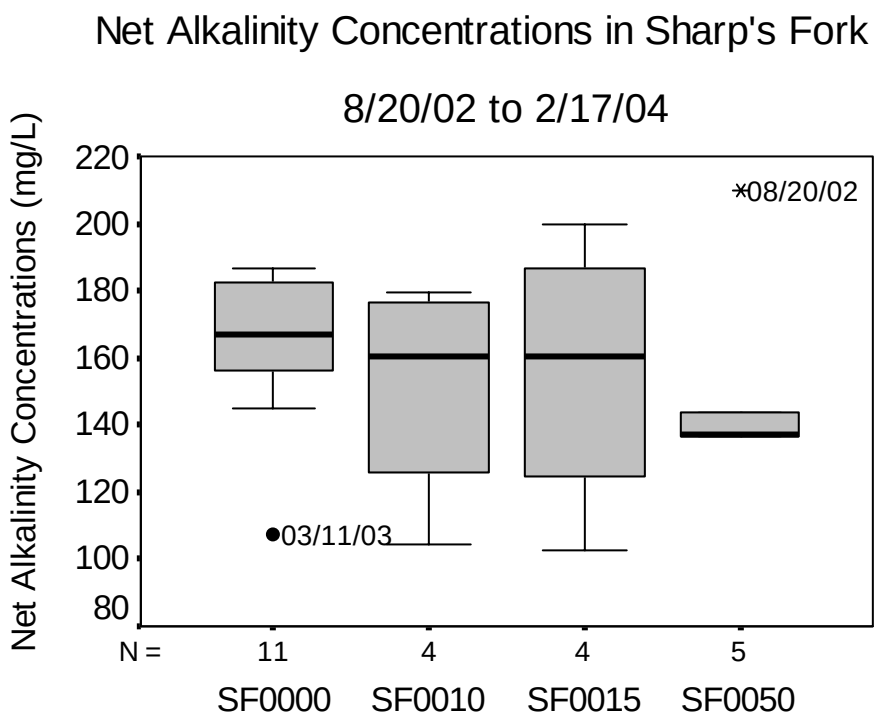
Figure 11 Net Alkalinity Concentration along Federal Creek



Acid Mine Drainage

The following graph displays net alkalinity values along Sharp's Fork. SF0015 is a sampling site below Opossum Run, a nine square mile tributary affected by abandoned mining, and SF0010 is a sampling site below Sulphur Run, a two square mile tributary affected by abandoned mining. Numerous other small mining impacts enter Sharp's Fork both below and above SF0050. The median net alkalinity concentration increases with proximity to the mouth of Sharp's Fork, indicating additions of alkalinity despite the numerous mining impacts in the area.

Figure 12 Net Alkalinity Concentrations in Sharps Fork



Overall, net alkalinity concentrations are not a concern in Federal Creek. They typically remain very high, even in the presence of numerous AMD inputs.

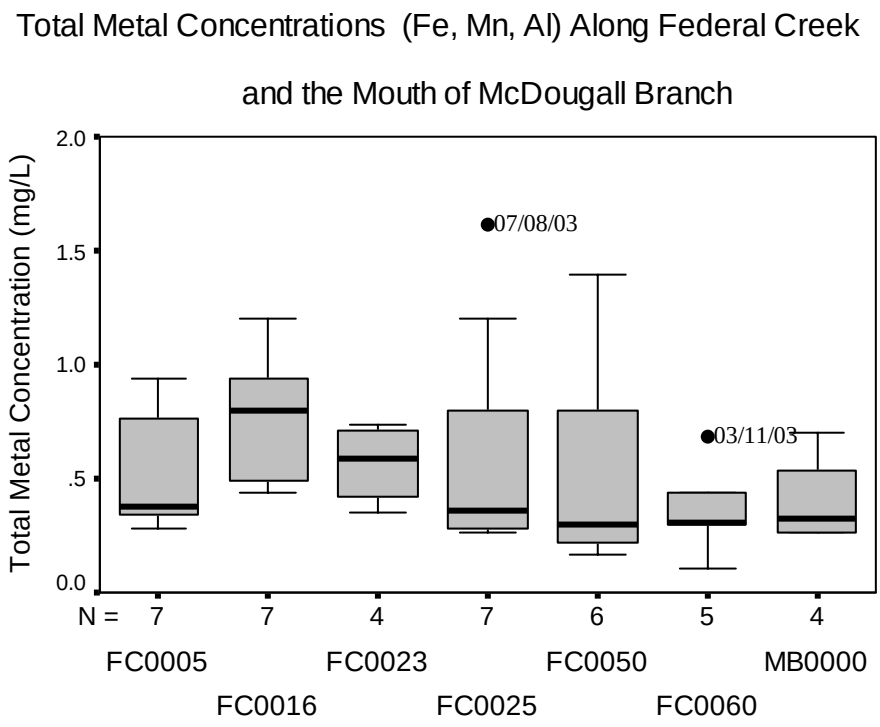
Acid Mine Drainage

Total Metal Concentrations

The following box plots display the total metal concentrations along the main stem of Federal Creek and the mouth of McDougall Branch, and along the main stem of Sharp's Fork. In this study, total metal concentrations include iron, manganese, and aluminum concentrations. These metals are the most commonly associated with acid mine drainage.

In the first box plot, a small increase in the median total metal concentration is observable from FC0050, which is above the most significant mining in the area, and FC0016, which is below the most significant mining in the area. Sharp's Fork enters Federal Creek between FC0050 and FC0025. Two tributaries affected by AMD enter Federal Creek between FC0025 and FC0023. Marietta Run and at least two other smaller AMD affected tributaries enter Federal Creek between FC000023 and FC0016. Median metal concentrations drop near the mouth of Federal Creek (FC0005). Overall, the interquartile ranges of the box plots do not vary substantially. FC0050 exhibits the largest variability.

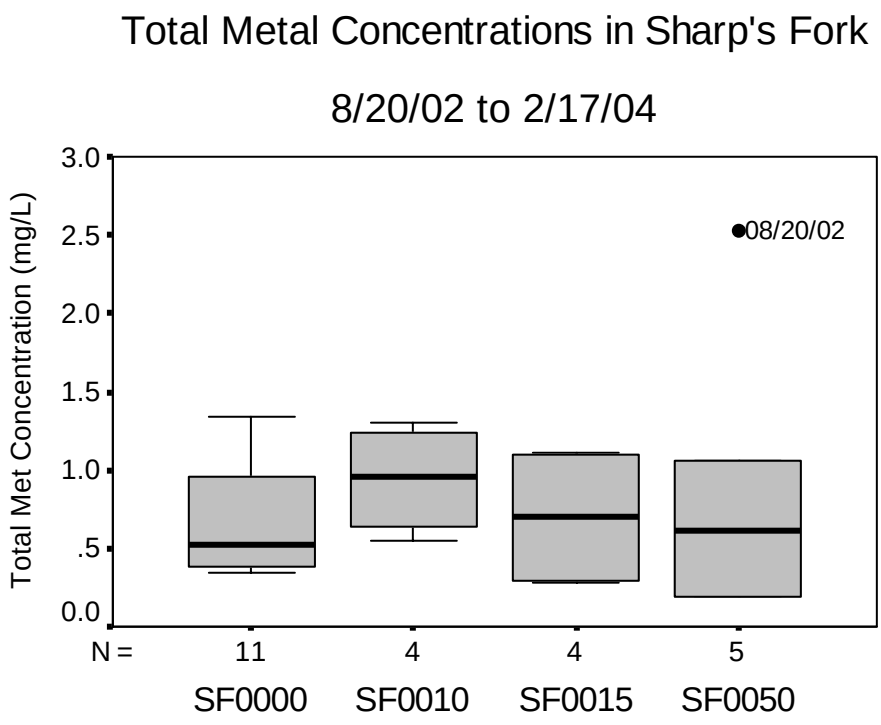
Figure 13 Metal Concentrations Federal Creek



Acid Mine Drainage

The following box plot displays the total metal concentrations along the main stem of Sharp's Fork. Although small, an observable increase is noted at SF0010, which is below the input of Sulphur Run.

Figure 14 Total Metal in Sharps Fork



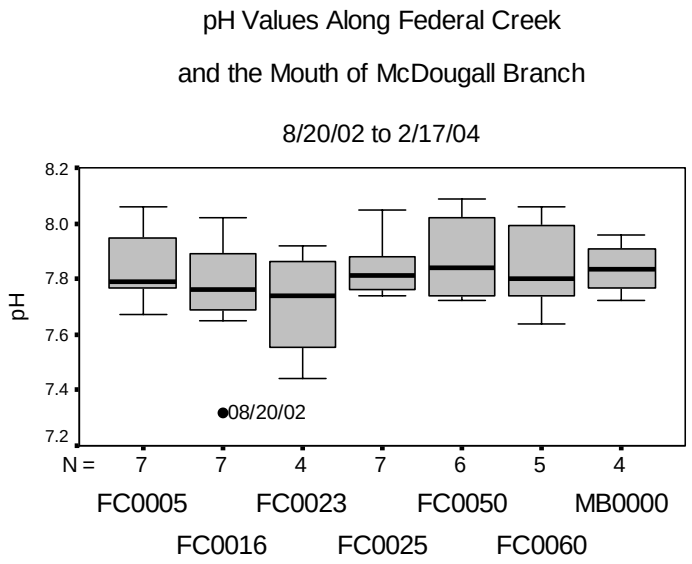
Overall, the impacts of mining are most observable in the trends of metal concentrations in the main stems of Federal Creek and Sharp's Fork. Fortunately, these metal concentrations do not reach very high levels in the main stems of Federal Creek and Sharp's Fork.

Acid Mine Drainage

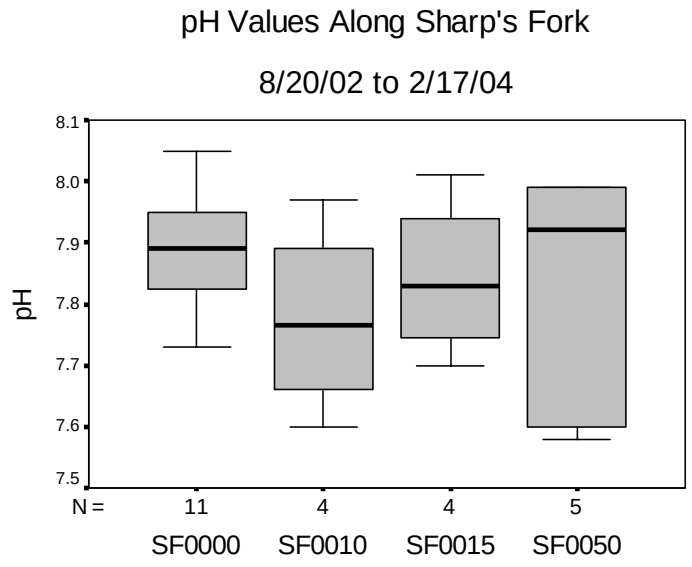
pH

pH values remain between 7 and 8 for all sampling dates at all sampling sites. The lowest pH values were seen during low flow periods. The lowest pH value on Federal Creek was seen on 8/20/02, at site FC0016, which is below most of the mining impacts in Federal Creek. This value was 7.3.

Figure 15 pH along Federal Creek and Sharps Fork



pH values along Sharp's Fork ranged between 7.5 and 8.1. The lowest median value was observed at SF0010, which is below the input of Sulphur Run.



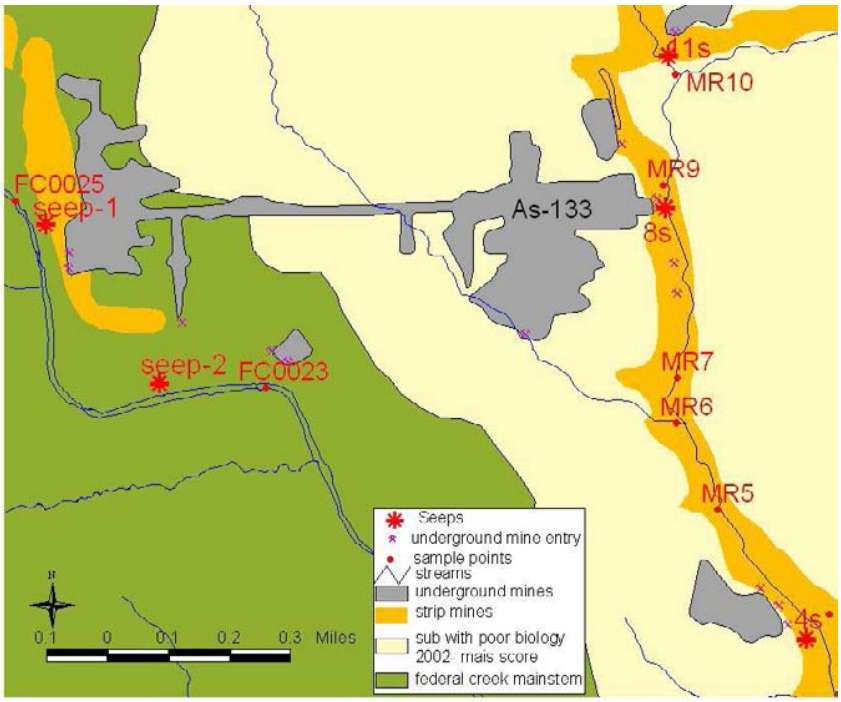
Acid Mine Drainage

Subwatershed Analysis for AMD inputs

The graphs below display some water chemistry parameters of two of the more severely impacted subwatersheds in Federal Creek. Both of these subwatersheds appear to have small impacts on the receiving stream in terms of metal loadings.

Main stem seeps

As was previously discussed there are seeps that enter the main stem of Federal Creek in the lower section of the watershed. These inputs appear to be buffered in the main stem of Federal Creek. It is noteworthy that immediately down stream of these inputs the MIwb score was 6.3 in September 2004, which would be designated MWH. Seep FC- s will be discussed here because it is part of the same mining complex as the Marietta Run seep 8s (discussed below). This seep is very easy to access and it flows year round at 4.5 to 5 gallons per minute. The pH is very low, the acidity, conductivity, metals and sulphates are all very high Included here is a map of the location of FC 2s and MR 8s in relation to the mine and the entrances. On the map seep 1 also is shown as being associated with the same mine complex but the water from that site does not seem to be a problem. The water quality data from FC 2s is also included in a table. The site called FC 2s is actually located at the site, which is right at the entrance of the mine. The site called FC 2sa is located near where the water enters Federal Creek.



Map 34 Mainstem Seeps

Table 48 Chemistry and loadings from sites FC-2S and Fc-2Sa

			(CFS)	(GPM)	%	mg/L	(US)		(MGL)	(MGL)	(MGL)
Map ID	MRM	DATE	FLOW	FLOW	DIS O2	DIS O2	CON-L	PH-L	ACID-L	SULF	TOT-FE
FC-2-S	266	4/27/2004	0.0098	4.400	6.1	0.64	3590	2.45	1625	2543	281
FC-2-S	315	6/15/2004	0.010	4.400			4140	2.52	1181	2889	395
FC-2-S	356	8/10/2004	0.010	4.400	0.25	2.5	3860	2.3	1941	3005	414
FC-2-Sa	221	10/20/2003	0.011	5.060			1970	2.92	423	1136	44.5
FC-2-Sa	128	7/8/2003	0.010	4.580			1820	3	290	881	27.4
FC-2-Sa	129	7/8/2003	0.010	4.580			1780	2.98	288	873	

			(CFS)	(GPM)	(MGL)	(MGL)	(MG(CaCO3)/L)	(MGL)	MGL		
Map ID	MRM	DATE	FLOW	FLOW	TOT-MN	TOT-AL	HARD	TDS	TSS		
FC-2-S	266	4/27/2004	0.0098	4.400	6.950	114	883	3430	17.0		
FC-2-S	315	6/15/2004	0.010	4.400	8.140	157	1077	4008	13.0		
FC-2-S	356	8/10/2004	0.010	4.400	8.030	174	1116	4210	23.0		
FC-2-Sa	221	10/20/2003	0.011	5.060	3.590	37.5	618	1560	11.0		
FC-2-Sa	128	7/8/2003	0.010	4.580	3.090	24.8	528	1290	13.0		
FC-2-Sa	129	7/8/2003	0.010	4.580			531	1290	7.0		

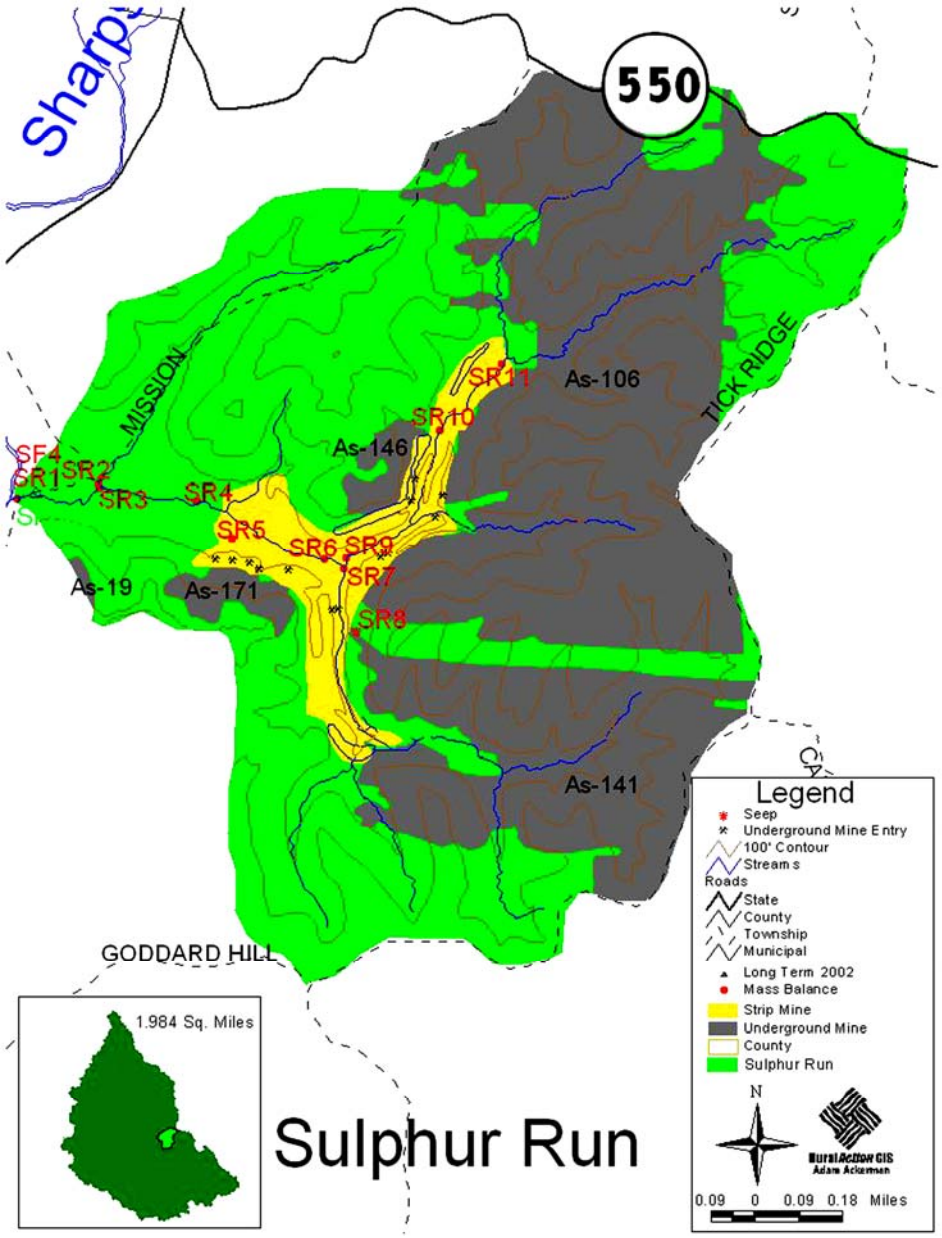
			(CFS)	(GPM)	(lbs/day)	(lbs/day)	(lbs/day)	(lbs/day)	lbs/day	(KG/DAY)	(lbs./day)
Map ID	MRM	DATE	FLOW	FLOW	Sulf Ld	TotFe ld	TotMn ld	TotAl ld	TotMet Ld	ACID-LD	Acid Ld
FC-2-S	266	4/27/2004	0.010	4.400	134.27	14.84	0.00	0.00	14.84	38.95	85.80
FC-2-S	315	6/15/2004	0.010	4.4	152.54	20.86	0.00	0.00	20.86	28.89	62.36
FC-2-S	356	8/10/2004	0.010	4.4	158.66	#REF!	#REF!	#REF!	#REF!	47.48	102.48
FC-2-Sa	221	10/20/2003	0.011	5.060	68.98	2.70	0.00	0.00	2.70	11.69	25.68
FC-2-Sa	128	7/8/2003	0.010	4.580	48.42	#REF!	#REF!	#REF!	#REF!	7.24	15.94
FC-2-Sa	129	7/8/2003	0.010	4.580	47.98	0.00	0.00	0.00	0.00	7.19	15.83

Acid Mine Drainage
Sulphur Run

See map Sulphur Run Mine for locations of sites and mines

Sulphur Run is the most AMD impacted subwatershed in the Federal Valley Watershed. Metal precipitates coat the stream bottom in virtually the entire 2.2 square mile watershed. The picture below was taken slightly above SR-10. The white color in the picture is aluminum precipitate, and the orange coloration is iron precipitate.

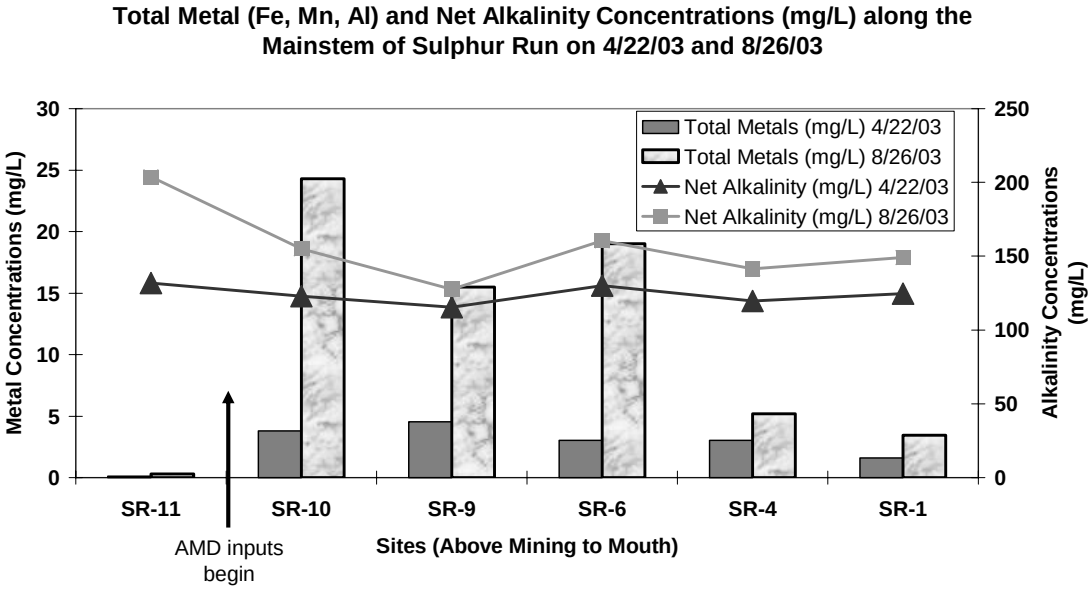
Map 35 Sulphur Run



Acid Mine Drainage

Although metal precipitates coat the stream bottom, the net alkalinity remains high, with the lowest value being 116 mg/L at SR-9 on 4/22/03. Metals increase dramatically in concentration once the mining impacts begin. These metal concentrations decrease as the water flows to the mouth, which is point SR-1 on the bar chart.

Figure 16 Metal Sulphur Run

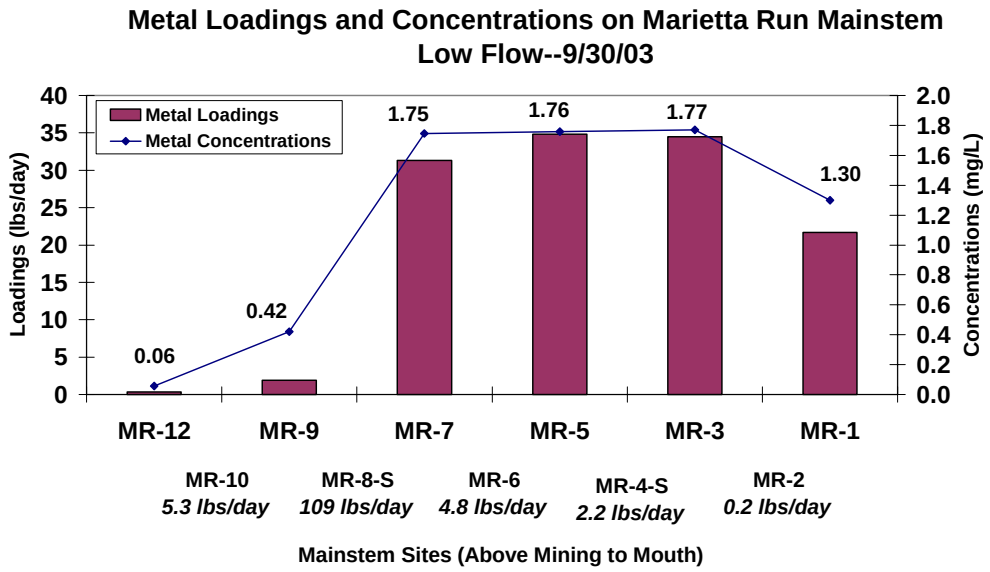


Acid Mine Drainage
Marietta Run Mine

Sulphur Run is affected by numerous diffuse AMD drainages from strip mining, as well as one large input of alkaline mine drainage from an underground mine. Marietta Run, another impacted subwatershed in The Federal Valley Watershed also is affected by unreclaimed strip mining and abandoned underground mines. However, in Marietta Run, one abandoned underground mine discharge is responsible for a majority of the metal loading into the stream. Additionally, this mine discharge is one of the few discharges into Marietta Run that is net acidic instead of net alkaline. The bar chart below depicts the impact that this abandoned underground mine, called MR-8-S, has on the metal concentrations of the main stem of Marietta Run at both high and low flow. MR-8-S is the main contributor of AMD into Marietta Run.

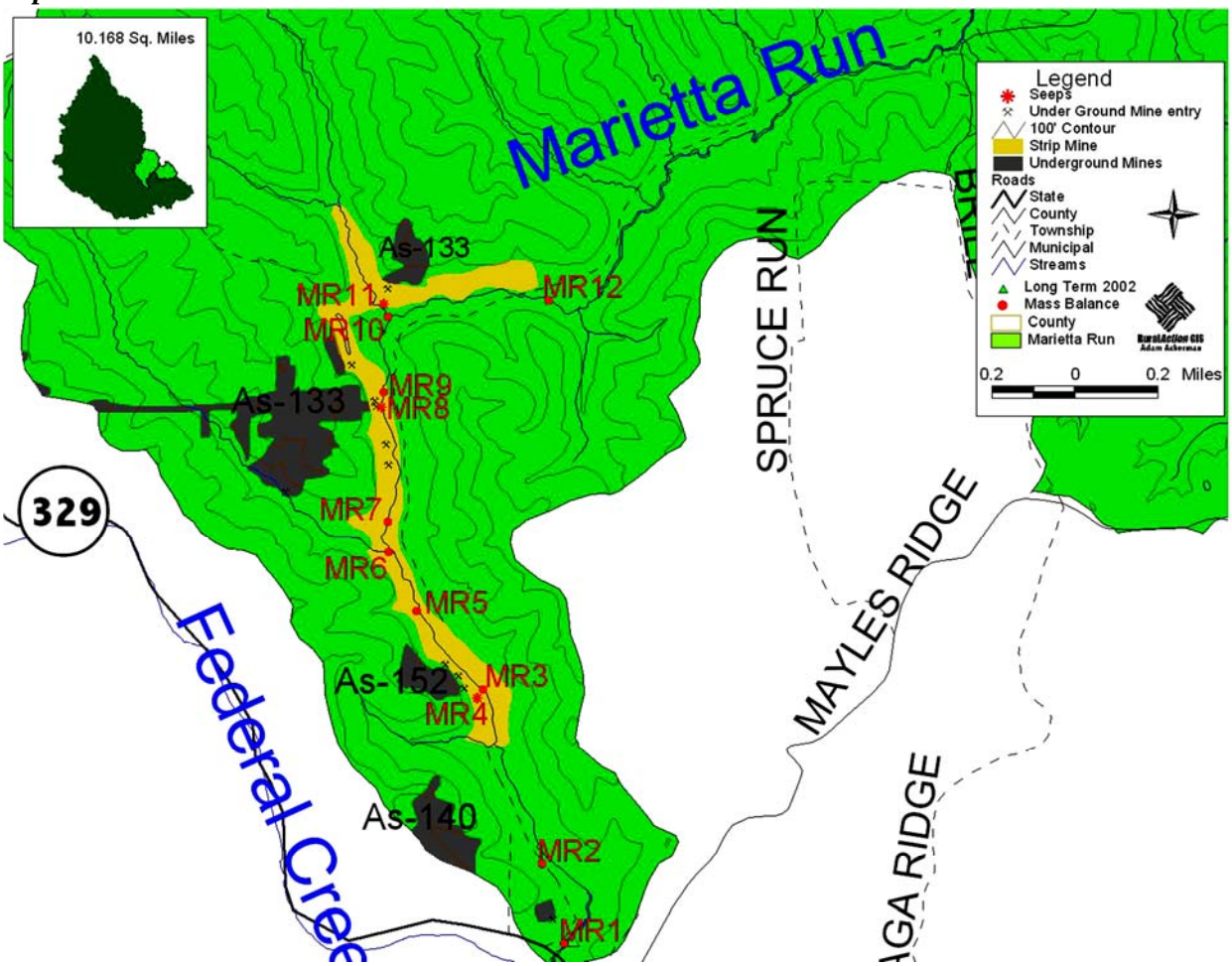
Under lower flow conditions, the metal concentration in Marietta Run changes from 0.42 mg/L above MR-8-S to 1.75 mg/L below MR-8-S.

Figure 17Metal Loadings Marietta Run



Acid Mine Drainage

Map 35 Marietta Run Mines



Acid Mine Drainage

Problem Statement:

Federal Creek Watershed has areas contaminated with sulfate and metals such as iron, aluminum, and manganese due to historic mining practices.

Cause Solution table

	Sulphur Run
Sources	**Tasks, Resources, Performance Indicators**
Sulphur Run The north (left) branch of Sulphur Run appears to be the largest contributor of metals to Sulphur Run (77% at high flow, 93% at low flow) of the 5 tributaries sampled. This tributary is affected by strip mining, and it represents an area of many diffuse mining inputs and not a few discrete sources.	**Tasks** Seek funding for the creation of a SAPS system located below the tipple to clean up 77 to 93% of the metals entering the stream. This will allow for the settling out of the metals and sulphate. The owner is interested in making the tipple inaccessible so perhaps the wetland can surround the tipple to cut off access. This tipple is Ohio's largest cement tipple. Treatment will have to involve retention ponds. . Estimated cost by ODNR for the treatment Mobilization/ Clearing $7,727 Rock Dam(s) 33,792 Revegetation 9,000 Road Elevation 8,720 Engineering 14,810 Total $74,049 **Time Line** Work with landowner and design crew complete by 2008 Construction by 2009 Monitoring ongoing to 2010 **Resources** ODNR, Division of Mineral Resources Management, Office of Surface Mining, Ducks Unlimited, US Fish and Wildlife **Performance Indicators** • Reduction in metals in stream by 100% • Reduction of sulfur in the stream by 100% • Reduction in Fe, Ni, and As in the sediment samples

	Marietta Run
Marietta Run has one very significant, discrete AMD contributor—MR-8-S, which contributes 62% of metal loading to Marietta Run at high flow, and 90% at low flow. It is also net acidic, and is the most significant acid loader to Marietta Run. It contributes 263 lbs/day of acid at high flow, and 151 lbs/day at low flow, or an average of 207 lbs/day. The second largest contributor in Marietta Run is the tributary MR-10. This sampling site represents the inputs of MR-11-S and the tributary that MR-11-S enters into, MR 11a. MR-11-S is a seep coming from the ground that has very low dissolved oxygen. It may be coming from an underground mine opening covered by strip-mining waste, or it may originate in strip mine waste.	**Tasks** Seek funding for treatment of the seep referred to as MR-8-s. Treatment would be a passive treatment that will allow for the settling of metals being loaded into Marietta Run. **ODNR Cost estimate MR 8S** Mobilization/Clearing $9,790 Steel Slag Leach Bed 5,970 Earthwork 45,017 Revegetation 1,500 Spillway(s) 12,778 Engineering 18,264 Total $93,819 **Acid Mine Drainage** Seek funding to treat the water at 11s, which includes the small tributary called 11a.This is the second biggest AMD contributor and even though it is not huge it is geographically very near to MR8s and may make sense to treat all of these at once. **Time Line** Work with landowner and design crew complete by 2008 Construction by 2009 Monitoring ongoing to 2010 ODNR cost estimate for site MR 11 **MR 11S** Mobilization/Clearing $1281 Revegetation 1500 Spillway 660 Earthwork 6,379 Engineering 2,455 Total $12, 275 **MR 11.5** Mobilization/Clearing $2,893 Revegetation 1,500 Earthwork 11,410 Spillway 6,379 Engineering 5,545 Total $27,727 **Time Line** Work with landowner and design crew complete by 2008 Construction by 2009 Monitoring ongoing to 2010 **Performance Indicators** Reduction in metals being loaded into the stream. 8-s 62% & 10 24% Reduction in Sulfate Loads 8s 25% and 10 34% Reduction in acid loads by 8s 67% and 10 18% Reduction of As in the sediment sample

	Acid Mine Drainage
	Federal Creek
Seep 2s on the main stem of Federal Creek. This seep flows year round. See map for location of this site. It is a seep coming from the same mine complex as the Marietta Run seep 8S	**Tasks** Seek funding for passive treatment of mine water. This would include working with the landowner to understand and accept the project. Mobilization/ Clearing $10,798 Limestone Leach Bed 12,031 Open Limestone Channel 2,813 Wetland 52,278 Grass Ditch 4,869 Engineering 20,697 Total $103,486 **Time Line** Work with landowner and design crew complete by 2008 Construction by 2009 Monitoring ongoing to 2010 Performance Indicators Reduction in metals, sulfates and acid loads by 100%.

Appendix 1 Methodology Description of the Federal Valley Macro invertebrate study 2002

Methods

Biological Sampling

Aquatic macroinvertebrates were collected in August and September of 2002 at 17 sites in the Federal Valley Watershed. Collections were sampled from natural substrates over 150-meter stream reaches. A composite collection of techniques utilizing kick nets and dip nets was used. A kick net (1 meter x 0.9 meter fiberglass screen, 110 micron opening mesh) was used to sample three riffles or runs in the 150-meter reach. The macroinvertebrates were removed from the net after each individual kick and combined to obtain a single sample for each site. The dip net (BioQuip standard D-frame, 0.3 meter width, 500 micron opening mesh) was used to sample multiple habitats. 10 jabs/passes were taken from various habitats, such as cobble, snags, vegetated banks, submerged macrophytes, and sand. The various habitats were sampled in approximate proportion to their occurrence within the sampling zone. For example, if cobble made up 50% of the habitat, snags made up 30%, and vegetated banks made up 20% of the habitat, 5 samples were taken from cobble, 3 from snags, and 2 from vegetated banks. Dip net samples were kept separate from kick net samples. All organisms were placed into jars with 70% ethanol, and were transported to the laboratory for identification to the family level. Merritt and Cummins (1996) was used as the final taxonomic reference.

Conditions

A drought was occurring during the biological sampling period, and flows conditions were reduced.

Appendix B Description of MAIS (Macroinvertebrate Aggregated Index for Streams)

The MAIS index (Macroinvertebrate Aggregated Index for Streams) developed for the Central Appalachians Ecoregion 69 was used to evaluate the macroinvertebrate data and to assess the biological health of each site. The MAIS index, developed by researchers at the Virginia Polytechnic Institute and State University, was developed using an ecoregion, reference site approach from data from six ecoregions in West Virginia, Virginia, Maryland, Pennsylvania, including the Western Allegheny Plateau (WAP), although proportionally fewer WAP sites were represented in the dataset. The MAIS is the primary benthic index used by the Virginia Department of Environmental Quality in their TMDL reports, and also by the Forest Service as the rapid bioassessment tool of choice for pre and post monitoring of projects in national forest areas in Virginia and Kentucky.

The Central Appalachian index was used instead of the Western Allegheny Plateau (WAP) index because the WAP index is based on data from only 13 sites (7 reference, 6 impaired) and has not been validated with new data. The Central Appalachian index was based on data from 48 sites (25 reference, 23 impaired) and has been validated with new data (Smith and Voshell, 1997, Voshell personal communication). Voshell believes that the Central Appalachian index should perform well in the WAP because their research has shown that multimetric indices based on family-level identifications do not change dramatically between ecoregions (Voshell personal communication).

Incorporated within the MAIS are nine individual metrics:
1.) % 5 dominant taxa
2.) modified Hilsenhoff Biotic Index (HBI). The HBI was developed in Wisconsin and uses a numerical scoring system to rank organisms according to their sensitivity to pollution or environmental stress, targeting organic pollutants (Hilsenhoff 1987 &1988). The HBI used in the MAIS has been modified for use in the mid-Atlantic highlands by the best professional judgement of the Aquatic Entomology program at Virginia Tech and the Virginia Department of Environmental Quality.
3.) % Haptobenthos-- a measure of the abundance of macroinvertebrates requiring clean, coarse, and firm substrates
4.) EPT index—number of mayfly (Ephemeroptera), stonefly (Plecoptera), and caddisfly (Trichoptera) families
5.) # Ephemeroptera
6.) % Ephemeroptera
7.) Simpson Diversity Index (SDI), which integrates richness and evenness into a measure of general diversity.
8.) # Intolerant taxa-number of macroinvertebrate families with tolerance values if 5 or less.
9.)% Scapers- percent abundance of macroinvertebrates scraping and feeding upon the periphyton.

These metrics are combined and calibrated to produce a single numeric score ranging from 0-18, with 0-7 indicating ‘very poor’ biological conditions, 8-11 ‘poor’, 12-15 ‘good’, 16-18 ‘very good’ (Smith and Voshell 1997).

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Appendix 2 Table of Special District Staff and Contact

APPENDIX 3 SUMMARY OF AMESVILLE VILLAGE WASTEWATER TREATMENT PROJECT
July 2005

I. SCEIG Decentralized Wastewater Work Group (DWWG)
II. Initial Project Development
III. Community Description
IV. Community Demographics
V. Existing Wastewater Treatment Systems Assessment
VI. Storm Sewer Outlet Sampling Results
VII. Federal Creek Watershed Group Sampling Results
VIII. Ohio EPA Permitting Plan
VIIII. Possible Household Sewage Treatment System Options
X. Management of Decentralized Wastewater Systems
XI. Financing Options
XII. Next Steps

I. SCEIG Decentralized Wastewater Work Group (DWWG)

In 2001 representatives from the Ohio EPA, United States Department of Agriculture, Rural Community Assistance Program, and Ohio Department of Health met to discuss the status of decentralized wastewater issues in Ohio. The main problem to be addressed was the need to develop alternative, onsite options for small communities with wastewater problems. All the agencies involved pointed to the increase in small communities where centralized wastewater collection and treatment approaches were not affordable as the focus of the group.

Shortly thereafter the group was organized under the Small Communities Environmental Infrastructure Group (SCEIG) as the SCEIG Decentralized Wastewater Work Group (DWWG). The goal of the DWWG was to examine decentralized issues, work with the Ohio EPA regarding permitting issues, and develop pilot projects in Ohio. Meetings of the DWWG throughout 2001 and 2002 dealt with permitting issues at the EPA state and district level, potential onsite wastewater treatment systems, onsite wastewater project development in other states, and financing options for onsite projects.

II. Initial Project Development

During early 2002 the DWWG began the process of identifying potential onsite projects. The DWWG was made aware of the wastewater problems the Village of Amesville had and their need for technical assistance. On May 15, 2002 the DWWG met with Amesville officials to discuss the project. Since that time a core group of state and local officials have been meeting regularly to develop the project. This core group includes Frank Hare, Mayor of Amesville, Kurtis Strickland and Roberta Acosta from RCAP, Chuck Hammer and Jeff Ditty from the Athens County Health Department, Jean Caudill from the Ohio Department of Health, Pejmaan Fallah from the Ohio EPA Division of Environmental Assistance, and Lisa King from the Federal Creek Watershed Group.

On August 29, 2002 the group conducted a public information meeting to inform residents of the efforts of the group and provide information on centralized versus onsite wastewater treatment alternatives. Participants at the meeting generally acknowledged the wastewater problems in Amesville and were interested in what options they had. The most common and least surprising comments focused on the cost per user for any alternative.

III. Community Description

The Village of Amesville is located in northeastern Athens County, Ohio east of State Route 33 on State Route 550. Amesville is bordered on the west by Federal Creek and State Route 550 runs through the

southern portion of the village. Nearly all residential structures in Amesville are now located along a hillside north of State Route 550. This is due to two recent major flood events which struck Amesville and a FEMA project that relocated 17 properties from the portion of Amesville south of State Route 550.

Amesville owns and operates its own water utility. Village water wells are located on the opposite side of Federal Creek from Amesville in a low-lying field. Amesville also has a rudimentary storm sewer system that discharges storm water into Federal Creek and a tributary of Federal Creek at four outfall locations.

IV. Community Demographics

Eight-four (84) sewage systems exist in Amesville. This includes 71 residential structures, 8 community facilities (Masonic Lodge, Grange Hall, Village Building/Fire Department, Head Start School Building, Athens County Engineer's Outpost, Amesville Elementary School, Presbyterian Church, and Methodist Church), and 5 businesses (Manna House Conveniant Store, Kasler's Kountry Kitchen, U.S. Post Office, Mary Morgan's Odds and Ends Store, and The Community Bank. Therefore, of the 84 sewage systems, 84.5% serve residential structures, 9.5% serve community facilities, and 6.0% serve businesses. There are also three apartments located on the second floor of the Kasler's Kountry Kitchen, Mary Morgan's Odds and Ends Store, and The Community Bank which share a sewage system with the business.

According to the 2000 Census 15 of the 71 households are renter-occupied, the population of Amesville is 184, the Village's Median Household Income is $35,000, and 41.6% of Amesville's households are considered low-to-moderate income.

V. Existing Wastewater Treatment Systems Assessment

The project team recommended that Amesville conduct an assessment in order to obtain detailed information about existing wastewater treatment systems throughout the village. The assessment contained 37 questions which dealt with parcel/property identification, water use and source information, and existing wastewater treatment systems. Village officials began the assessment in January 2003 and completed the assessment in May 2003.

Village officials completed assessments on 74 of the 84 structures which have sewage systems. Assessments were completed on 64 of the 71 total residential structures, 7 of the 8 community facilities, and 3 of the 5 businesses. The following assumptions can be drawn from the results that follow.

- 87.5% of the 64 residential structures assessed contain two, three, or four bedrooms (1 bedroom- 3, 4.7%, 2 bedrooms- 13, 20.3%, 3 bedrooms-29, 45.3%, 4 bedrooms- 14, 21.9%, 5 bedrooms- 2, 3.1%, No response- 3, 4.7%).
- 54.6% of the 64 residential structures assessed are one or two person households (1 person- 16, 25.0%, 2 person- 19, 29.7%, 3 person- 11, 17.2%, 4 person- 10, 15.6%, 5 person- 4, 6.2%, No response- 4, 6.3%).
- 12 of the 64 (18.7%) residential structures are rental units
- 43 of the 64 (67.1%) residential structures have either a septic tank or aerator (Septic tank- 24, 37.5%, Aerator- 20, 31.3%, Septic tank with leach bed- 7, 11.0%, Unknown- 6, 9.4%, No response- 4, 6.3%, Peat filter- 1, 1.5%, Peat filter with leach bed- 1, 1.5%, Cess pool- 1, 1.5%).
- 29 of 64 homes have basic septic tanks and are on a parcel of 1 acre or less
- 92.1% of residential structures contain water appliances (washing machines, dishwashers, garbage disposals, etc.).
- 7.8% of homes share septic systems
- 23.4% of all homes have basement drains that drain to their septic system
- Therefore, 87.5% of all residential homes contain wastewater treatment systems with high failure potential rates.

- Due to the fact that septic tank systems lack adequate lot size and are installed on poor soils, aeration units and some septic tanks discharge to storm sewers, and unknown systems most likely do not work properly; approximately 17,785 gallons of potentially untreated sewage discharges from residential structures in Amesville each day.
- The majority of residents would voluntarily allow the health department to inspect their system (Yes- 22, 41.5%, No- 14, 26.4%, Uncertain- 5, 9.0%, No response- 12, 22.6%).

VI. Storm Sewer Outlet Sampling Results

The Athens County Health Department sampled all four of the Amesville's storm sewer outlets in October 2003 in order to assess the impact of improperly treated or raw wastewater to Federal Creek. The first sampling was at the northern most outfall into Federal Creek, a 2 ½ foot culvert, and showed fist size septic flow. The second sampling was from an 18" culvert running from the south side of the former elementary school and showed extremely septic flow. The third sampling was from an outlet into a tributary of Federal Creek, 1 block north of State Route 550, and showed septic flow. The fourth sampling was from an outfall south of State Route 550 and showed low flow and no visual septic flow.

The Athens County Health Department felt that early October was an excellent time to conduct the samplings because of the lack rain during this period. Results clearly showed that storm sewer outfalls from existing onsite systems were generating septic flow and polluting Federal Creek in multiple locations.

VII. Federal Creek Watershed Group Sampling Results

The Federal Creek Watershed Group conducted water sampling at four points on Federal Creek surrounding Amesville in 2003 in order to determine the stream quality of Federal Creek. The first sampling was taken from a point in Federal Creek west of Amesville, the second from a point in Amesville Creek which runs through the middle of Amesville and empties into Federal Creek near the junction of State Route 550 and State Route 329, the third at the point where Federal Creek intersects State Route 550, and the fourth at a point in Federal Creek southeast of Amesville.

Bacteria data and presumptive tests of samples 1-3 indicated the presence of Fecal Coliform and a serious bacteria problem. Test results showed that Amesville Creek (Sampling 2) was a serious problem and negatively impacts Federal Creek.

VIII. Ohio EPA Permitting Plan

On October 14, 2003 the Amesville project team met with the Ohio EPA Southeast District Office to discuss permitting possibilities for the project. The Ohio EPA indicated that there were three options for issuing National Pollutant Discharge Elimination System (NPDES) permits: an individual NPDES permit for the village with multiple discharge locations, a general NPDES permit for the village, and individual NPDES permits for each system. The project team and Ohio EPA agreed that the best option for Amesville was an individual NPDES permit for the village with multiple discharge locations.

The NPDES permit would be issued to the village and would cover any sanitary wastewater point source discharge. Different permit tables would cover each group or type of customer in the Amesville (i.e. residential structures, churches, schools, businesses, etc.). Each table would have identified testing frequencies, parameters, etc. and the village would be the primary responsible entity for compliance with the discharge requirements in all tables.

The Ohio EPA recognized that a permitting system would need to cover new potential discharging entities such as laundry mats, hair salons, etc. because these types of structures will have discharges that will be difficult to treat by onsite methods. The village would be required to notify new businesses of the need for them to

work with the Ohio EPA if they wish to be located in Amesville. Under the proposed permitting system, the Athens County Health Department would continue to issue permits-to-install for residential structures.

In regard to the various tables (types of customers), a sample scenario might involve sampling each church and school one time per month, sampling an alternating five residential structures once per month, and also a set time period for sampling storm sewer outfalls. However, the NPDES permit would be based on meeting limits for each table and no tables or limits would be set for the storm sewer outfalls. Sampling of storm sewer outfalls would be completed mainly to monitor the quality of the discharge in order to assess the increase in water quality over time.

The Ohio EPA indicated that they do have flexibility in regard to sampling frequency associated with NPDES permits. Permit-to-install construction permits would continue to be issued by the Ohio EPA for new businesses, churches, schools, etc. (non-residential customers). New residential structures with discharges would be included in the NPDES permit that would be issued to the village. A set sampling point would be established for each residential structure, business, church, etc. The village and any entity representing the village that would be monitoring discharges under the NPDES permit would be required to work very closely with the Ohio EPA.

The main concern brought forth by the project team was how changes in NPDES permit limits in the future would impact the village's permitting structure. The Ohio EPA stated that they do not anticipate tighter effluent standards being required at the five year NPDES permit renewals. OEPA recognizes the significant benefits from the anticipated improvements in water quality following the elimination of sewage nuisance conditions.

VIIII. Possible Household Sewage Treatment System Options

The goal of the project is to provide the best possible treatment of sewage available, for individual households, businesses and facilities, and for the community at large. Achieving the goal will require installing sewage systems that provide a high degree of treatment, are very reliable, easily maintained, and have a good potential for success, both on a daily and long-term basis. System approval will take into consideration the need for individual design on a lot-by-lot basis to best accomplish the goal. Site-specific variations need, however, to be kept to a minimum if at all possible. Any system variations lot-by-lot must focus on exploiting the onsite resources (suitable soils) that may serve to eliminate or minimize treated sewage discharge to the village storm drains. Treatment needs, reliability, maintenance and cost concerns may be successfully balanced with the need for lot-by-lot design by adopting a standard prototype for basic sewage treatment. This may be accomplished by adopting, formally or in practice of installation, a brand, make and model number of basic sewage treatment system that meets strict standards as per effluent quality, is reliable, easy to maintain, holds up over time and is not prohibitively expensive.

Whenever possible, as suitable soil and available space allow, an on-lot household sewage treatment system would be permitted by the Athens County Health Department for new or replacement systems within the village. "On-lot" refers to a non-discharging system, with no open pipes discharging any sewage system water to the ground surface, storm drain or other off-lot destination other than percolation through the soil. The simplest system would be a primary treatment tank (regular septic tank) and a leach field. In most if not all cases a secondary treatment unit would be used for on-lot systems to enhance treatment and reduce the area needed for leach lines. To reduce the leaching area, a secondary treatment unit must reliably reduce both the oxygen demand (BOD/CBOD) and total suspended solids (TSS) below at least 30 mg/L before effluent is introduced into the soil. Many current secondary treatment units can meet these minimum requirements, though is noteworthy that higher treatment levels may increase the long-term success of any attempt to leach effluent into the soil, and, should soil absorption attempts fail, higher levels of secondary treatment would provide a discharge that would meet NPDES permit requirements without significant alteration of the

treatment system. Selection could also reasonably be based on life cycle costs (purchase, operation, and maintenance) and product reliability. Frequency of service to maintain effluent quality is a very important consideration.

Due to lot sizes in Amesville, most replacement systems will require a discharging system that can meet the effluent limits of a village NPDES permit issued by the Ohio EPA. The Athens County Health Department will still issue the installation permit for any household system, but a discharging treatment system will be required to meet more stringent limits than an on-lot system. Possible limits are 10 mg/L BOD or CBOD, 12 mg/L TSS, 1 mg/L ammonia, and 1000 col/100ml fecal coliform. More advanced treatment systems or a series of treatment units can meet these limits, but again it is very important to consider life cycle costs, and even more so system reliability, since the effluent will discharge to areas that are accessible to the public.

In many cases, simpler is better if equivalent treatment can be assured. Manufactured and tested advanced treatment systems such as peat biofilters, intermittent sand filters, and other types of single pass filters can meet stricter discharge limits with minimal maintenance and service requirements. If secondary treatment units are considered, additional treatment and disinfection devices would be needed to meet the stricter discharge limits, and these added components can increase costs and maintenance frequency. With the limited area available, the size of the treatment system must be a serious consideration for the village.

All systems will require some level of monitoring and maintenance. The goal is to achieve the required treatment in a cost effective and reliable manner. There are household sewage systems available to meet this goal, but a study of the alternatives is necessary before selecting the best options for the unique needs of the village.

X. Management of Decentralized Wastewater Systems

The Village of Amesville understands that the Ohio EPA will require a management entity be established in order to assure that systems are properly operated, monitored, and maintained. To obtain an NPDES permit, the village will need to have operational oversight for all existing systems and any new systems that are installed as a result of the project. Easements would need to be obtained from all property owners to provide legal access for required monitoring and maintenance. The advantages and disadvantages to village ownership of systems will be explored. Village residents and property owners need to be well informed and become actively involved in decisions related to the village wastewater management structure.

XI. Financing Options

Planning- Amesville is located in Athens County, an Appalachian Regional Commission county, and therefore is eligible for a planning grant from the Governor's Office of Appalachia. Amesville also could apply for a Village Capital Improvement Fund loan to the Ohio EPA or the Ohio Water Development Authority for a planning loan. The Ohio Water Development Authority also has a Research and Development Grant Program that may be able to finance planning for the project.

Construction- Amesville is eligible for the following state or federal programs: Ohio Public Works Commission, Ohio Department of Development CDBG Water & Sanitary Sewer Program, Appalachian Regional Commission Area Development Program, USDA Rural Development Water & Waste Program, the Ohio EPA Water Pollution Control Loan Fund, the Ohio Water Development Authority Community Assistance Program, and the Ohio Department of Development CDBG Formula Program. The most important criteria Amesville must meet in order to qualify for any loan or grant financing is that the infrastructure financed must be owned and operated by the Village of Amesville.

Amesville is located in District 18 of the Ohio Public Works Commission. Grant financing is very competitive and the village would need to be listed as one of Athens County's priority projects in order to be financed.

Loans are available at 2.0% for 20 years. Applications are accepted in October of each year by the Buckeye Hills Hocking Valley Regional Development District.

The Ohio Department of Development CDBG Water & Sanitary Sewer Program provides grants up to $500,000 for public infrastructure and an additional $100,000 for low-income customer hookups. Amesville meets all program requirements except that applicants must have a low-to-moderate income percentage of 51% or more. Ameville's LMI % is currently 41.6% therefore the village would be required to complete an income survey in order to qualify. Applications are accepted in June of each year and financing is very competitive.

Amesville is eligible for Appalachian Regional Commission financing but Athens County is not an ARC Distressed County and therefore the likelihood of obtaining funds from the other ARC Program, the Area Development Program, is slim. To rank high under the Area Development Program the project would have to demonstrate creation or retention of jobs. Pre-applications are accepted by the Buckeye Hills Hocking Valley Regional Development District around July of each year and $300,000 is the maximum award.

Amesville qualifies for both loan and grant financing from the USDA Rural Development Water and Waste Program. USDA Rural Development is in the process of restructuring their program therefore specific financing terms are subject to change. Amesville probably would qualify for a 4.5% 40 year loan and USDA typically funds projects with 75% loan and 25% grant. The USDA District Office in Marietta, Ohio accepts applications year around.

Amesville qualifies for a loan from the Ohio EPA Water Pollution Control Loan Fund at 0% for 20 years. Communities must submit a nomination form to the OEPA in order to begin the application process and applications are accepted year around.

Amesville could qualify for a 1.5% 30 year loan from the Ohio Water Development Authority Community Assistance Program if water and sewer rates are at least 2.6% of the Village's Median Household Income. The OWDA accepts applications year around.

The Ohio Department of Development also provides financing under their CDBG Formula Program to Athens County each year for projects that benefit low-to-moderate income households. Amesville would need to complete an income survey in order to qualify for this program as well. Projects typically receive between $10,000 and $50,000 and applications are accepted in May of each year.

XII. Next Steps

- Public information meeting in February/March 2004
- Commitment from village to solicit resident and property owner participation
- Procurement of consultant services
- Obtain financing for planning
- Lot-by-lot soil analysis
- Identification of and cost estimates for alternative decentralized systems
- Develop management plan
- Develop financing package
- Conduct income survey
- Obtain financing for design
- Complete detailed design
- Apply for construction financing
- Obtain NPDES and installation permits
- Complete construction
- Implement management plan

Appendix 5 Table of educators and contacts

LAST NAME	FIRST NAME	District	School	grades	ADDRESS	CITY	STATE	ZIP	PHONE
Vogt	Jeff	Federal Hocking School District	Federal Hocking Middle School	9th-12th	8461 St Rt 144	Stewart	Oh	45778	(740) 662-6691
Jones	Vickie	Federal Hocking School District	Federal Hocking Middle School	9th-12th	8461 St Rt 144	Stewart	Oh	45778	(740) 662-6691
Robinson	Valarie	Federal Hocking School District	Federal Hocking Middle School	9th-12th	8461 St Rt 144	Stewart	Oh	45778	(740) 662-6691
Schimko	Jim	Federal Hocking School District	Federal Hocking High School	9th-12th	8461 St Rt 144	Stewart	Oh	45778	(740) 662-6691
Warner	Ben	Federal Hocking School District	Federal Hocking High School	9th-12th	8461 St Rt 144	Stewart	Oh	45778	(740) 662-6691
Wryst	John	Federal Hocking School District	Federal Hocking High School	9th-12th	8461 St Rt 144	Stewart	Oh	45778	(740) 662-6691
Sekula	Tim	Federal Hocking School District	Federal Hocking High School	9th-12th	8461 St Rt 144	Stewart	Oh	45778	(740) 662-6691
Riley	Tony	Federal Hocking School District	Federal Hocking High School	9th-12th	8461 St Rt 144	Stewart	Oh	45779	(740) 662-6691
Falk	Jerramy	Federal Hocking School District	Federal Hocking High School	voc - agricuture	8461 St Rt 144	Stewart	Oh	45779	(740) 662-6691
Kasler	Pam	Federal Hocking School District	Amesville Elementary School	4th	St Rt.329	Amesville	Oh	45711	740(448-2501)
Schwarzel	Lee	Federal Hocking School District	Amesville Elementary School	4th	St Rt.329	Amesville	Oh	45711	740(448-2501)
Mcmanus	Chuck	Federal Hocking School District	Amesville Elementary School	4th	St Rt.329	Amesville	Oh	45711	740(448-2501)
Carpenter	Patty	Federal Hocking School District	Amesville Elementary School	5th	St Rt.329	Amesville	Oh	45711	740(448-2501)
Darling	Patsy	Federal Hocking School District	Amesville Elementary School	5th	St Rt.329	Amesville	Oh	45711	740(448-2501)
Leinbaugh	James	Federal Hocking School District	Coolville Elementary School	4th	26461Main St	Coolville	Oh	45723	740(667-3121)
Cogar	Janelle	Federal Hocking School District	Coolville Elementary School	4th	26461Main St	Coolville	Oh	45723	740(667-3121)
Paulson	Angela	Federal Hocking School District	Coolville Elementary School	4th	26461Main St	Coolville	Oh	45723	740(667-3121)
Korb	Kathie	Federal Hocking School District	Coolville Elementary School	5th	26461Main St	Coolville	Oh	45723	740(667-3121)
Tholin	Enid	Federal Hocking School District	Coolville Elementary School	5th	26461Main St	Coolville	Oh	45723	740(667-3121)
Ruth	Nancie	Warren Local School District	Warren High School	Science	130 Warrior Dr.	Vincent	Oh	45784	(740) 678-2393
Woods	Craig	Warren Local School District	Warren High School	Science	130 Warrior Dr.	Vincent	Oh	45784	(740) 678-2393
King	Larry	Warren Local School District	Warren High School	Science	130 Warrior Dr.	Vincent	Oh	45784	(740) 678-2393
Kohli	Heather	Warren Local School District	Warren High School	Science	130 Warrior Dr.	Vincent	Oh	45784	(740) 678-2393
Pettibone	Polly	Warren Local School District	Warren High School	Science	130 Warrior Dr.	Vincent	Oh	45784	(740) 678-2393
Elza	Jim	Warren Local School District	Warren High School	Science	130 Warrior Dr.	Vincent	Oh	45784	(740) 678-2393
Chadwell	Larry	Warren Local School District	Warren High School	Science	130 Warrior Dr.	Vincent	Oh	45784	(740) 678-2393
Clark	Allan	Warren Local School District	Warren High School	Agriculture	130 Warrior Dr.	Vincent	Oh	45784	(740) 678-2393
Alkire	Carol	Warren Local School District	Barlow-Vincent Elementary	4th	70 Warrior Drive	Vincent	Oh	45784	(740)678-2395
Jones	Tracy	Warren Local School District	Barlow-Vincent Elementary	4th	70 Warrior Drive	Vincent	Oh	45784	(740)678-2395
Logan	Cheri	Warren Local School District	Barlow-Vincent Elementary	4th	70 Warrior Drive	Vincent	Oh	45784	(740)678-2395

Crum	Joyce	Warren Local School District	Barlow-Vincent Elementary	5th	70 Warrior Drive	Vincent	Oh	45784	(740)678-2395
King	Ann	Warren Local School District	Barlow-Vincent Elementary	5th	70 Warrior Drive	Vincent	Oh	45784	(740)678-2395
Mueller	Lisa	Warren Local School District	Barlow-Vincent Elementary	5th	70 Warrior Drive	Vincent	Oh	45784	(740)678-2395
Horner	Darcy	Warren Local School District	Barlow-Vincent Elementary	6th	70 Warrior Drive	Vincent	Oh	45784	(740)678-2395
Kidder	Barb	Warren Local School District	Barlow-Vincent Elementary	6th	70 Warrior Drive	Vincent	Oh	45784	(740)678-2395
Schafer	Barb	Warren Local School District	Barlow-Vincent Elementary	6th	70 Warrior Drive	Vincent	Oh	45784	(740)678-2395
Boggers	Jossette	Warren Local School District	Barlow-Vincent Elementary	7th	70 Warrior Drive	Vincent	Oh	45784	(740)678-2395
Henry	Jay	Warren Local School District	Barlow-Vincent Elementary	7th	70 Warrior Drive	Vincent	Oh	45784	(740)678-2395
Henry	Kim	Warren Local School District	Barlow-Vincent Elementary	7th	70 Warrior Drive	Vincent	Oh	45784	(740)678-2395
Baker	Jaunita	Warren Local School District	Barlow-Vincent Elementary	8th	70 Warrior Drive	Vincent	Oh	45784	(740)678-2395
Rogers	Rita	Warren Local School District	Barlow-Vincent Elementary	8th	70 Warrior Drive	Vincent	Oh	45784	(740)678-2395
Daughety	Mark	Warren Local School District	Barlow-Vincent Elementary	8th	70 Warrior Drive	Vincent	Oh	45784	(740)678-2395
Rudinsky	Ann	Warren Local School District	Bartlett Elementary School	4th	St. Rt. 550	Bartlett	Oh	45713	(740)551-2833
Boley	Anne	Warren Local School District	Bartlett Elementary School	5th	St. Rt. 550	Bartlett	Oh	45713	(740)551-2833
Robinson	Terry	Warren Local School District	Bartlett Elementary School	6th-8th	St. Rt. 550	Bartlett	Oh	45713	(740)551-2833
Rice	Diane	Warren Local School District	Bartlett Elementary School	6th-8th	St. Rt. 550	Bartlett	Oh	45713	(740)551-2833
Vincent	Sandy	Warren Local School District	Bartlett Elementary School	6th-8th	St. Rt. 550	Bartlett	Oh	45713	(740)551-2833
Mayle	Ann	Warren Local School District	Bartlett Elementary School	special education	St. Rt. 550	Bartlett	Oh	45713	(740)551-2833
Hamilton	Terri	Warren Local School District	Bartlett Elementary School	special education	St. Rt. 550	Bartlett	Oh	45713	(740)551-2833
Hamrick	Kathy	Warren Local School District	Little Hocking Elem	5th	95 Federal Rd.	Little Hocking	Oh	45742	(740) 989-2000
Westbrook	Sharon	Warren Local School District	Little Hocking Elem	6th	95 Federal Rd.	Little Hocking	Oh	45742	(740) 989-2000
Rowland	Mikki	Warren Local School District	Little Hocking Elem	7th&8th	95 Federal Rd.	Little Hocking	Oh	45742	(740) 989-2000
Hunter	Lydia	Warren Local School District	Warren Elementary	7th &8th	RT 2	Marietta	Oh	45750	(740)373-4937
Weber	Bonnie	Warren Local School District	Warren Elementary	5th&6th	RT 2	Marietta	Oh	45750	(740)373-4937
Quaintance	Julia	Morgan Local Shool District	Morgan High School	Science	800 Raider Dr.	McConnelsville	Oh	43756	(740) 962-2944
Porter	Scott	Morgan Local School District	Morgan High School	Science	800 Raider Dr.	McConnelsville	Oh	43756	(740) 962-2944
Garner	Karen	Morgan Local School District	Morgan High School	Science	800 Raider Dr.	McConnelsville	Oh	43756	(740) 962-2944
Medbery	Paul	Morgan Local School District	Morgan High School	Science	800 Raider Dr.	McConnelsville	Oh	43756	(740) 962-2944
Fink	Adam	Morgan Local School District	Morgan High School	Agriculture	800 Raider Dr.	McConnelsville	Oh	43756	(740) 962-2944
Massey	Bill	Morgan Local School District	Morgan High School	Agriculture	800 Raider Dr.	McConnelsville	Oh	43756	(740) 962-2944
Langerman	Edi	Morgan Local Shool District	Morgan Junior High School	special education	820 Raider Dr.	McConnelsville	Oh	43756	(740)962-2833
Montgomery	Patti	Morgan Local Shool District	Morgan Junior High School	special education	820 Raider Dr.	McConnelsville	Oh	43756	(740)962-2833
Langerman	Beth	Morgan Local Shool District	Morgan Junior High School	special education	820 Raider Dr.	McConnelsville	Oh	43756	(740)962-2833
Christie	Marcia (marsha?)	Morgan Local Shool District	Morgan Junior High School	7th	820 Radar Dr.	McConnelsville	Oh	43756	(740)962-2833
Lanning	Tiffany	Morgan Local Shool District	Morgan Junior High School	7th	820 Radar Dr.	McConnelsville	Oh	43756	(740)962-2833
Bowen	Theresa	Morgan Local Shool District	Morgan Junior High School	8th	820 Radar Dr.	McConnelsville	Oh	43756	(740)962-2833

Davis	Lortta	Morgan Local Shool District	Morgan Junior High School	8th	820 Radar Dr.	McConnelsville	Oh	43756	(740)962-2833
Thompson	Susan	Morgan Local Shool District	South Elementary School	4th	3555 St. Rt. 792	Stockport	Oh	43787	(740) 559-2377
Young	Jennifer	Morgan Local Shool District	South Elementary School	4th	3555 St. Rt. 792	Stockport	Oh	43758	(740) 559-2377
Clemes	Misti	Morgan Local Shool District	South Elementary School	5th	3555 St. Rt. 792	Stockport	Oh	43758	(740) 559-2377
Milner	Lois	Morgan Local Shool District	South Elementary School	5th	3555 St. Rt. 792	Stockport	Oh	43758	(740) 559-2377
Adams	Jason	Morgan Local Shool District	South Elementary School	6th	3555 St. Rt. 792	Stockport	Oh	43758	(740) 559-2377
Spencer	Kathy	Morgan Local Shool District	South Elementary School	6th	3555 St. Rt. 792	Stockport	Oh	43758	(740) 559-2377
Hickerson	Mary Beth	Morgan Local Shool District	West Elementary School	4th	9675 W St. Rt. 37	Malta	Oh	43758	(740)342-4873
McVay	Iesa	Morgan Local Shool District	West Elementary School	4th	9675 W St. Rt. 37	Malta	Oh	43758	(740)342-4873
Gesel	Clinton	Morgan Local Shool District	West Elementary School	5th	9675 W St. Rt. 37	Malta	Oh	43758	(740)342-4873
Mansfield	Lesley	Morgan Local Shool District	West Elementary School	5th	9675 W St. Rt. 37	Malta	Oh	43758	(740)342-4873
Shaw	Debbie	Morgan Local Shool District	West Elementary School	5th	9675 W St. Rt. 37	Malta	Oh	43758	(740)342-4873
Schramm	Jill	Morgan Local Shool District	West Elementary School	6th	9675 W St. Rt. 37	Malta	Oh	43758	(740)342-4873
Suprano	Erica	Morgan Local Shool District	West Elementary School	6th	9675 W St. Rt. 37	Malta	Oh	43758	(740)342-4873

Appendix 6 table of community groups and businesses

Youth Clubs	**Contact Person**	**Phone #**
Fed. Hoc. HS	John Wryst	662-6691
FFA club	JoAnn Peiffer	662-6691
Morgan CO HS	Paul Medberry	962-2944
boy scouts	Chuck Hammer	448-2341
boy scouts	Dave Russell	662-2166
girl scouts	Cathy Damon	448-2703
girl scouts	Deb Dowler	594-5455
girl scouts	Becky Meyers	448-7321
Community Centers/ Organizations		
Kilvert Community Center	Irene Flowers	448-7332
Federal Valley Resource Center		Stewart Oh
Bern Township Building		
Amesville Village Office& park reservation		448-2411
Sustainable Forestry		767-2090
Rural Action		767-4938
Tri CountycCommunity Action		592-6601
MultiCultural Geneaological Center	David Butcher	662-0217
Buisnesses		
Manna House Conveniece Store		448-7220
Kasslers Restaurant		448-4225
Gilchrist BP		448-8251
Church name		**Phone #**
Hooper Ridge Church of Christ		(740) 448-4425
Concord Church		(740) 448-1316
South Cannan Baptist		(740) 662-4514
Ring gold Free Methodist Church		
Chesterhill Church of Nazarene		(740) 797-4224
Cannanville United Methodist		740) 592-2242
McDougal United Methodist		(740) 984-2114
Stewart United Methodist		(740) 984-2114
Amesville Presbyterian		(740) 592-5858
New England Presbyterian		(740) 593-8632
Stewart Wesleyan		
Haga Mission		
Stewart United Methodist		
Kilvert Church		(740) 662-6016
Guysville Community church		
Sharpsburg Bible Church		
Lathrop Mission		
Mt. Hermon Church		
Cutler Chapel		(740) 423-7542
Chesterhill United Methodist		(740) 554-2545
Bishopville Churchof Christ		(740)767-3092

Appendix 7 table of flow regimes in Federal Valley

Flow data sorted by date				
NAME		TYPE	(CFS)	(GPM)
STREAM	DATE	FLOW	FLOW	FLOW
Federal Creek- mouth	8/20/2002	low	1.355	608.057
Federal Creek- Tick Ridge	8/20/2002	low	1.777	797.690
Federal Creek- above Amesville	8/20/2002	low	0.083	37.300
Sharps Fork- mouth	8/20/2002	low	0.187	83.898
Federal Creek- mouth	11/18/2002	low	43.645	19589.010
Federal Creek- Tick Ridge	11/18/2002	low	27.165	12192.380
Federal Creek- above Amesville	11/18/2002	low	7.410	3325.646
Sharps Fork- mouth	11/20/2002	low	12.017	5393.680
Federal Creek- mouth	3/11/2003	high	173.880	78042.560
McDougall Branch- mouth	3/11/2003	high	42.200	18940.626
Sharps Fork- mouth	3/11/2003	high	57.120	25637.170
Federal Creek- mouth	6/23/2003	high	75.450	33863.000
Federal Creek- Tick Ridge	6/23/2003	high	47.230	21199.000
McDougall Branch- mouth	6/23/2003	high	18.103	8125.248
Sharps Fork- mouth	6/23/2003	high	22.100	9933.086
Federal Creek- Tick Ridge	10/7/2003	low	24.302	10907.240
Federal Creek- above Amesville	10/7/2003	low	4.034	1810.569
McDougall Branch- mouth	10/7/2003	low	6.740	3025.081
Sharps Fork- mouth	10/7/2003	low	13.010	5839.435

Flow data sorted by site				
NAME		TYPE	(CFS)	(GPM)
STREAM	DATE	FLOW	FLOW	FLOW
Federal Creek- above Amesville	8/20/2002	low	0.083	37.300
Federal Creek- above Amesville	11/18/2002	low	7.410	3325.646
Federal Creek- above Amesville	10/7/2003	low	4.034	1810.569
Federal Creek- mouth	8/20/2002	low	1.355	608.057
Federal Creek- mouth	11/18/2002	low	43.645	19589.010
Federal Creek- mouth	3/11/2003	high	173.880	78042.560
Federal Creek- mouth	6/23/2003	high	75.450	33863.000
Federal Creek- Tick Ridge	8/20/2002	low	1.777	797.690
Federal Creek- Tick Ridge	11/18/2002	low	27.165	12192.380
Federal Creek- Tick Ridge	6/23/2003	high	47.230	21199.000
Federal Creek- Tick Ridge	7/8/2003	medium	32.649	14653.730
Federal Creek- Tick Ridge	10/7/2003	low	24.302	10907.240
Federal Creek- Tick Ridge	10/20/2003	low	21.518	9657.924
Federal Creek- Tick Ridge	4/20/2004	high	96.892	43487.81
Federal Creek- Tick Ridge	6/15/2004	high	55.076	24719.540
McDougall Branch- mouth	3/11/2003	high	42.200	18940.626
McDougall Branch- mouth	6/23/2003	high	18.103	8125.248
McDougall Branch- mouth	10/7/2003	low	6.740	3025.081
Sharps Fork- mouth	8/20/2002	low	0.187	83.898
Sharps Fork- mouth	11/20/2002	low	12.017	5393.680
Sharps Fork- mouth	3/11/2003	high	57.120	25637.170
Sharps Fork- mouth	6/23/2003	high	22.100	9933.086
Sharps Fork- mouth	10/7/2003	low	13.010	5839.435

Fish and Macroinvertebrate Study of the Federal Creek Watershed

MBI Technical Report MB/2005-1

Fish and Macroinvertebrate Study of Federal Creek

2004 Field Year

Athens, Morgan, and Washington Counties, Ohio

June 30, 2005

MBI Technical Report MB/2005-4

Prepared for

Division of Mineral Resources Management
Ohio Department of Natural Resources

Prepared by

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For
Midwest Biodiversity Institute
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Fish and Habitat Data Collection – Jim Grow, Tony Minamyer
Macroinvertebrate Data Collection and Identification – Tracy Morman

This evaluation and report would not have been possible without the assistance of the following individuals in the field: Tony Minamyer, Jim Grow and Tracy Morman, crew leaders and their interns and the support of the Brian Armitage of the MBI and Scott Miller, Jen Bowman, Ben McCament, and others at ILGARD, Ohio University and Lisa King, coordinator of the Federal Valley Watershedgroup.

Cover photos: Top – mayfly larvae, Middle – longear sunfish, Bottom – southern redbelly dace

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Forward

This report generally follows the format used in Ohio EPA Technical Support Documents ("TSDs") and the purpose of an Ohio EPA TSD and this report are generally similar. Those familiar with a TSD should be able to use this report without much difficulty. There are some differences, however, in that a focus of this report is identifying waters affected by acid mine drainage (AMD) and other mine related stressors. This cannot be completely accomplished without an assessment of other stressors to aid in the process of discriminating among the various causes of impairment. We are also interested in generating useful endpoints for other watershed restoration efforts. In the Western Allegheny Plateau (WAP) ecoregion this typically includes understanding the effects of fine sediments on aquatic life and attainment of aquatic life uses. To accomplish this we will use data from this report and reference data from the WAP ecoregion to generate sediment endpoints for TMDL efforts.

The major objectives of a biosurvey are typically to: 1) determine the extent to which use aquatic life use designations are either attained or impaired; 2) determine the appropriate and attainable aquatic life use designation; and 3) determine the stressors responsible for any impairments or threats. The following discussion on the hierarchy of indicators is taken from Ohio EPA:

> Hierarchy of Indicators
>
> A carefully conceived ambient monitoring approach, using cost-effective indicators comprised of ecological, chemical, and toxicological measures, can ensure that all relevant pollution sources are judged objectively on the basis of environmental results. Ohio EPA relies on a tiered approach in attempting to link the results of administrative activities with true environmental measures. This integrated approach is outlined in Figure 1 and includes a hierarchical continuum from administrative to true environmental indicators. The six "levels" of indicators include: 1) actions taken by regulatory agencies (permitting, enforcement, grants); 2) responses by the regulated community (treatment works, pollution prevention); 3) changes in discharged quantities (pollutant loadings); 4) changes in ambient conditions (water quality, habitat); 5) changes in uptake and/or assimilation (tissue contamination, biomarkers, wasteload allocation); and, 6) changes in health, ecology, or other effects (ecological condition, pathogens). In this process the results of administrative activities (levels 1 and 2) can be linked to efforts to improve water quality (levels 3, 4, and 5) which should translate into the environmental "results" (level 6). Thus, the aggregate effect of billions of dollars spent on water pollution control since the early 1970s can now be determined with quantifiable measures of environmental condition. Superimposed on this hierarchy is the concept of stressor, exposure, and response indicators. Stressor indicators generally include activities which have the potential to degrade the aquatic environment such as pollutant

discharges (permitted and unpermitted), land use effects, and habitat modifications. Exposure indicators are those which measure the effects of stressors and can include whole effluent toxicity tests, tissue residues, and biomarkers, each of which provides evidence of biological exposure to a stressor or bioaccumulative agent. Response indicators are generally composite measures of the cumulative effects of stress and exposure and include the more direct measures of community and population response that are represented here by the biological indices which comprise Ohio's biological criteria. Other response indicators could include target assemblages, i.e., rare, threatened, endangered, special status, and declining species or bacterial levels which serve as surrogates for the recreational uses. These indicators represent the essential technical elements for watershed-based management approaches. The key, however, is to use the different indicators within the roles which are most appropriate for each. Describing the causes and sources associated with observed impairments revealed by the biological criteria and linking this with pollution sources involves an interpretation of multiple lines of evidence including water chemistry data, sediment data, habitat data, effluent data, biomonitoring results, land use data, and biological response signatures within the biological data itself. Thus the assignment of principal causes and sources of impairment represents the association of impairments (defined by response indicators) with stressor and exposure indicators. The principal reporting venue for this process on a watershed or subbasin scale is a biological and water quality report. These reports then provide the foundation for aggregated assessments such as the Ohio Water Resource Inventory (305[b] report, Ohio EPA 2000a), the Ohio Nonpoint Source Assessment and other technical bulletins.

Ohio Water Quality Standards: Designated Aquatic Life Use

The Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1) consist of designated uses and chemical, physical, and biological criteria designed to represent measurable properties of the environment that are consistent with the goals specified by each use designation. Use designations consist of two broad groups, aquatic life and non-aquatic life uses. In applications of the Ohio WQS to the management of water resource issues in Ohio's rivers and streams, the aquatic life use criteria frequently result in the most stringent protection and restoration requirements, hence their emphasis in biological and water quality reports. Also, an emphasis on protecting for aquatic life generally results in water quality suitable for all uses. The five different aquatic life uses currently defined in the Ohio WQS are described as follows:

1) Warmwater Habitat (WWH) - this use designation defines the "typical" warmwater assemblage of aquatic organisms for Ohio rivers and streams;

this use represents the principal restoration target for the majority of water resource management efforts in Ohio.
2) Exceptional Warmwater Habitat (EWH) - this use designation is reserved for waters which support "unusual and exceptional" assemblages of aquatic organisms which are characterized by a high diversity of species, particularly those which are highly intolerant and/or rare, threatened, endangered, or special status (i.e., declining species); this designation represents a protection goal for water resource management efforts dealing with Ohio's best water resources.

3) Cold-water Habitat (CWH) - this use is intended for waters which support assemblages of cold water organisms and/or those which are stocked with salmonids with the intent of providing a put-and-take fishery on a year round basis which is further sanctioned by the Ohio DNR, Division of Wildlife; this use should not be confused with the Seasonal Salmonid Habitat (SSH) use which applies to the Lake Erie tributaries which support periodic "runs" of salmonids during the spring, summer, and/or fall.

4) Modified Warmwater Habitat (MWH) - this use applies to streams and rivers which have been subjected to extensive, maintained, and essentially permanent hydromodifications such that the biocriteria for the WWH use are not attainable and where the activities have been sanctioned by state or federal law; the representative aquatic assemblages are generally composed of species which are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor quality habitat.

5) Limited Resource Water (LRW) - this use applies to small streams (usually <3 mi. drainage area) and other water courses which have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported; such waterways generally include small streams in extensively urbanized areas, those which lie in watersheds with extensive drainage modifications, those which completely lack water on a recurring annual basis (i.e., true ephemeral streams), or other irretrievably altered waterways.

6) Limited Resource Water - Acid Mine Drainage (LRW-AMD) -this use applies to streams and rivers which have been subjected to severe acid mine drainage pollution from abandoned mine lands or gob piles, and where there is no near term prospect for reclamation; the representative aquatic assemblages are generally composed of species which are tolerant to low pH, silt, metals, and poor quality habitat.

Chemical, physical, and/or biological criteria are generally assigned to each use designation in accordance with the broad goals defined by each. As such the system of use designations employed in the Ohio WQS constitutes a "tiered" approach in that varying and graduated levels of protection are provided by each. This hierarchy is especially apparent for parameters such as dissolved oxygen, ammonia-nitrogen, temperature, and the biological criteria. For other parameters such as heavy metals, the technology to construct an equally graduated set of criteria has been lacking, thus the same water quality criteria may apply to two or three different use designations.

Introduction

The Federal Creek watershed has a scattered history of underground and surface mining. A byproduct of this historic activity has been acid mine drainage, sedimentation, and metal loadings in streams and tributaries in the vicinity of these mines. Acid mine drainage (AMD) remediation efforts across Ohio thus far have already shown substantial improvements in aquatic life (e.g., Ohio EPA 1997). Although mining has occurred in Federal Creek, it has also has been identified as a high quality water with itself and a number of tributaries receiving the Exceptional Warmwater Habitat (EWH) aquatic life use designation. The watershed contains several Ohio EPA biological reference sites (Ohio EPA 1990) and has been used as a reference watershed for assessing recovery potential for other impaired waters such as Leading Creek after a 1993 mine spill (Ohio EPA 1994). This report focuses on identifying mining impaired waterways in the Federal Creek watershed during 2004 sampling although we reference Ohio EPA data from 1983, 1984, 1990, and 1995. The broad sampling effort in 2004, supplemented by the historical data serves as a baseline to measure the success of future abatement and protection actions in the area.

Specific objectives of this study were to:

1) evaluate the physical habitat and the biological integrity of streams in the Federal Creek watershed,
2) assess impacts from mining activities, nonpoint sources of pollution, and habitat alterations,
3) determine attainment status of aquatic life and recommend changes where appropriate, and
4) establish a baseline of biological data for assessing AMD impacts.

Benefits of Stream and River Restoration

Stream restoration is assumed to be cost-effective in many cases and many statutes drive stream restoration without clear links back to services that streams and rivers provide to society. More explicit examination of the benefits of clean water and the restoration of aquatic life would help bolster support of watershed restoration efforts. Many of the services that healthy streams provide to society are not always obvious, but can be immense (Daily et al. 1997). As summarized by Daily et al. (1997):

> "Human societies derive many essential goods from natural ecosystems, including seafood, game animals, fodder, fuelwood, timber, and pharmaceutical products. These goods represent important and familiar parts of the economy. What has been less appreciated until recently is that natural ecosystems also perform fundamental life-support services without which human civilizations would cease to thrive. These include the purification of air and water, detoxification and decomposition of wastes, regulation of climate, regeneration of soil fertility, and production and maintenance of biodiversity, from which key ingredients of our agricultural, pharmaceutical, and industrial enterprises

are derived. This array of services is generated by a complex interplay of natural cycles powered by solar energy and operating across a wide range of space and time scales. The process of waste disposal, for example, involves the life cycles of bacteria as well as the planet-wide cycles of major chemical elements such as carbon and nitrogen. Such processes are worth many trillions of dollars annually. Yet because most of these benefits are not traded in economic markets, they carry no price tags that could alert society to changes in their supply or deterioration of underlying ecological systems that generate them. Because threats to these systems are increasing, there is a critical need for identification and monitoring of ecosystem services both locally and globally, and for the incorporation of their value into decision-making processes."

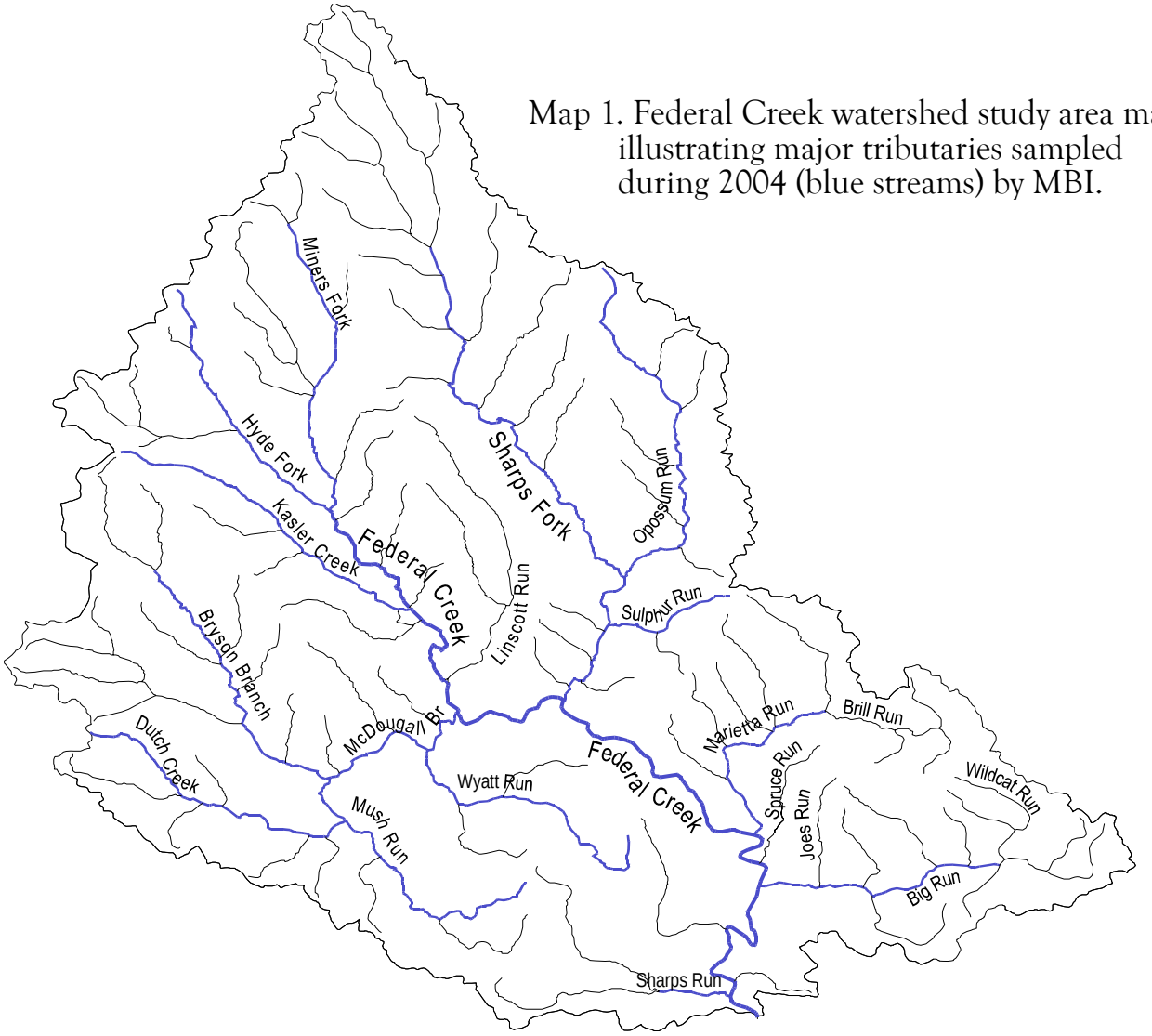
In southeast Ohio, the more obvious economics benefits of clean waters and functioning watersheds are sufficient by themselves to drive watershed restoration efforts. Southeast Ohio has recently become a recreation destination for other areas of Ohio. For streams, a predominant use of these resources is for fishing. In a study in Oklahoma about 27% of those with fishing licenses fished in streams and rivers (Fisher et al. 2002). For the subregion of eastern Oklahoma, stream fishing generated about $24 million of activity for 1993. Nationally, Americans spend about $24 billion dollars a year on fishing. Improvements in fishability, which as we will show later is correlated with biological integrity, should result in repeat visits to southeast Ohio for fishing and related recreation (e.g., canoeing).

Background

Federal Creek is a 3rd order stream with a drainage area of 145 square miles that begins in Morgan, drains part of Washington County and flows through Athens County where it enters the Hocking River. Several stations in the Federal Creek watershed serve as biocriteria reference sites for Ohio including Federal Creek at RM 1.3 and McDougall Branch at RM 2.4. Several tributaries sampled by Ohio EPA Southeast District Office in 1995 identified high quality fish assemblages (Big Run, Ellis Run, Joes Run, Brill Run, Wildcat Run, and Spruce Run) which resulted upgrades to the EWH use. Mile points of confluences of major tributaries to Federal Creek at listed in Table 1. Major tributaries sampled for fish and macroinvertebrate assemblages are illustrated on Map 1.

Photos 1 Photo of Federal Cr downstream of Marietta Run after a rainfall

Table 1. Major tributaries to Federal Creek and their confluence river miles.		
Stream	Tributary To:	Mile Point
Sharps Run	Federal Creek	0.59
Herrold Run	Federal Creek	2.09
Big Run	Federal Creek	3.79
Joes Run	Big Run	0.88
Ellis Run	Big Run	1.74
Wildcat Run	Big Run	3.97
Spruce Run	Federal Creek	4.26
Marietta Run	Federal Creek	5.14
Brill Run	Marietta Run	3.55
Sharps Fork	Federal Creek	9.28
Sulphur Run	Sharps Fork	1.70
Opossum Run	Sharps Fork	2.83
Unnamed Trib	Opossum Run	1.00
Unnamed Trib	Sharps Fork	7.92
MdDougall Branch	Federal Creek	11.25
Linscott Run	Federal Creek	11.93
Kitten Run	Federal Creek	13.54
Kasler Creek	Federal Creek	13.76
Miners Fork	Federal Creek	16.20
Hyde Fork	Federal Creek	16.21



Map 1. Federal Creek watershed study area map illustrating major tributaries sampled during 2004 (blue streams) by MBI.

Methods

All chemical, physical, and biological field, laboratory, data processing, and data analysis methodologies and procedures adhere to those specified in the *Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices* (Ohio Environmental Protection Agency 1989a) and *Biological Criteria for the Protection of Aquatic Life, Volumes I-III* (Ohio Environmental Protection Agency 1987a, 1987b, 1989b, 1989c), and *The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application* (Rankin 1989) and Rankin (1995) for aquatic habitat assessment. Biological sampling locations are listed in Table 3. Determining aquatic life use attainment status means describing the degree to which environmental indicators are either above or below criteria specified by the Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745- 1) with the most appropriate indicator typically being the Ohio EPA biological criteria (OAC 3745-1-07; Table 7-14). These are confined to ambient assessments and apply to rivers and streams outside of mixing zones. Numerical biological criteria are based on multimetric biological indices including the Index of Biotic Integrity (IBI) and modified Index of Well-Being (MIwb), indices measuring the response of the fish community, and the Invertebrate Community Index (ICI), which indicates the response of the macroinvertebrate community. Numerical endpoints are stratified by ecoregion, use designation, and stream or river size. Three attainment status results are possible at each sampling location - Full, partial, or non-attainment. Full attainment means that all of the applicable indices meet the Ohio WQS biocriteria or the LRW-AMD benchmarks. Partial attainment means that one or more of the applicable indices fails to meet the biocriteria or the LRW-AMD benchmarks. Nonattainment means that none of the applicable indices meet the biocriteria or the LRW-AMD benchmarks; or, for WWH and EWH streams, one of the organism groups reflects poor or very poor performance. An aquatic life use attainment table (see Table 3) is constructed based on the sampling results and is arranged by sampling locations indicated by river mile, the applicable biological indices, the use attainment status (i.e., full, partial, or non), the Qualitative Habitat Evaluation Index (QHEI), and comments and observations for each sampling location.

The IBI and ICI are multimetric indices patterned after an original IBI described by Karr (1981) and Fausch et al. (1984). The ICI was developed by Ohio EPA (1987b) and further described by DeShon (1995). The MIwb is a measure of fish community abundance and diversity using numbers and weight information and is a modification of the original Index of Well- Being originally applied to fish community information from the Wabash River (Gammon 1976; Gammon et al. 1981). Performance expectations for the principal aquatic life uses in the Ohio WQS (Warmwater Habitat [WWH], Exceptional Warmwater Habitat [EWH], and Modified Warmwater Habitat [MWH]) were developed using the regional reference site approach (Hughes et al. 1986; Omernik 1987) and ecoregion information (Omernik 1988; Omernik and Gallant 1988). This fits the practical definition of biological integrity as the biological performance of the natural habitats within a region (Karr and Dudley 1981).

Habitat Assessment

Physical habitat was evaluated using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Rankin 1989, 1995). Various attributes of the habitat are scored based on the overall importance of each to the maintenance of viable, diverse, and functional aquatic faunas. The type(s) and quality of substrates, amount and quality of instream cover, channel morphology, extent and quality of riparian vegetation, pool, run, and riffle development and quality, and gradient are some of the habitat characteristics used to determine the QHEI score which generally ranges from less than 20 to 100. The QHEI is used to evaluate the characteristics of a stream segment, as opposed to the characteristics of a single sampling site. As such, individual sites may have poorer physical habitat due to a localized disturbance yet still support aquatic communities closely resembling those sampled at adjacent sites with better habitat, provided water quality conditions are similar. QHEI scores from hundreds of segments around the state have indicated that values greater than 60 are generally conducive to the existence of warmwater faunas whereas scores less than 45 generally cannot support a warmwater assemblage consistent with the WWH biological criteria. Scores greater than 75 frequently typify habitat conditions that have the ability to support exceptional warmwater faunas. General narrative ranges of the QHEI are as follows: < 30 – Very Poor; 30-44 – Poor; 45-59 – Fair; 60-74 – Good; ≥ 75 Excellent.

Macroinvertebrate Community Assessment

The ICI for macroinvertebrates requires a station to be sampled quantitatively using multiple-plate, artificial substrate samplers (modified Hester/Dendy) in conjunction with a qualitative assessment of the available natural substrates. During the 2004 survey, we collected HD samples at larger sites and qualitative samples at all sites. Assessments of qualitative macroinvertebrate data result in narrative ratings ranging from very poor to excellent and coincide with narrative ranges applied to the ICI. Qualitative Community Tolerance Values (QCTVs) were used in association with EPT and other indicator taxa to arrive at a narrative rating for sites. The QCTV approximates an ICI rating by calculating a median of the weighted mean ICI for each taxa (generated from statewide data) from those collecting during a narrative assessment. A weighted ICI is based upon ICI scores from each site where the taxon has been found, weighted by the abundance data for that taxon from artificial substrate (quantitative) samples collected throughout Ohio. More recently (Rankin, draft 2004) we used statewide narrative assessments to derive a Qualitative ICI (QICI) based on the qualitative samples (no relative abundance data). We used the existing ratings on these narrative sites to "train" or score new data based on ranges of metrics at sites with "known" narrative sites. Each site was scored from 0 to 6 as is the existing ICI.

Table 2. Association between narrative macroinvertebrate ratings and Ohio aquatic life use attainment in the IP ecoregion.

Excellent (E)	Achieves EWH (ICI ≥ 46)
Very Good (VG)	Insignificant departure from EWH (ICI 42-44)
Good (G)	Achieves WWH (ICI ≥ 30)
Marginally Good (MG)	Insignificant departure from EWH (ICI 26-28)
Fair (F)	Achieves MWH (ICI > 22)
Poor (P)	Fails biocriteria (ICI 10-20)
Very Poor (VP)	Fails biocriteria (ICI 0-8)

We recently derived a draft "Qual" ICI index by selecting six important metrics from the qualitative macroinvertebrate data and "trained" the index on existing narrative ratings from the Ohio EPA database (Rankin 2004, draft). This index does not replace the expert narrative assessment because the biologist can extract qualitative information from abundance and condition of the macroinvertebrates or patterns in key taxa that are not available from the qualitative data alone which is only presence/absence data. Nevertheless, this index can help form the narrative assessment and provide a relative rating of sites in a watershed.

The use of the QCTV is limited to relative comparisons between sites and for determining narrative assessments (i.e., it is not used in place of ICI scores). For Limited Resource Waters (non assessed in this survey) we follow the Ohio EPA lead and use the numerical LRW-AMD benchmark of an ICI score of 8 for assessing attainment status. For qualitative only data in a LRW-AMD stream, a very poor narrative evaluation or a poor evaluation at a site where EPT taxa are not considered to be common or predominant on the natural substrates, is assessed as non-attainment status. A poor narrative evaluation at a qualitative only site is classified as achieving the LRW-AMD benchmark only if there are EPT taxa common or predominant on the natural substrates.

Fish Community Assessment

During 2004 fish were sampled using wading method pulsed DC electrofishing gear at all sites as specified in Ohio EPA (1987b). These methods were used at a frequency of two samples in several larger streams and one sample at each small stream site. Data here combines sites sampled as part of the Ohio DNR MRM study plan, but includes additional sites or passes funded through the Ohio EPA 319 project for the Hocking River during 2004.

Zig/Zag Pebble Count Data

The accumulation of fine substrates in aquatic habitat at rates greater than expected naturally has been identified as a primary cause of aquatic life impairment in Ohio (Ohio EPA 2000) and across the United States (U.S. EPA 2002). The effects of fine substrates that smother naturally coarse substrates can be readily observed with qualitative habitat indices such as the QHEI; however there is a need to more precisely identify the sources of these materials and to predict the fate and transport of these materials over time. As a result more precise methods have been proposed to provide data that might identify more precise trends over time with which to measure success or progress of various abatement strategies. For this study we collected zig/zag pebble counts (Bevenger and King 1995; Ohio EPA 1999) from most sites to explore how this data may be used to identify sediment impacts and to act as a baseline to measure reductions in silt and fine sediments in this watershed even before aquatic life responds to substrate changes.

Causal Associations

The identification of impairment in rivers and streams is straightforward - the numerical biological criteria are used to judge aquatic life use attainment and impairment (partial and non-attainment). The rationale for using the biological criteria, within a weight of evidence framework, has been extensively discussed elsewhere (Karr et al. 1986; Karr 1991; Ohio EPA 1987a,b; Yoder 1989; Miner and Borton 1991; Yoder 1991; Yoder 1995). Identifying the causes and sources of the observed impairments relies on an interpretation of multiple lines of evidence including water chemistry data, sediment data, habitat data, effluent data, land use data, knowledge of mining sources, and biological results (Yoder and Rankin 1995a,b, Simon 2003). Thus the assignment of principal causes and sources of impairment in this report represent the association of impairments (based on response indicators) with stressor and exposure indicators. The reliability of the identification of probable causes and sources is increased where many such prior associations have been identified, or have been experimentally or statistically linked together. The ultimate measure of success in water resource management is the restoration of lost or damaged ecosystem attributes including aquatic community structure and function. While there have been criticisms of misapplying the metaphor of ecosystem "health" compared to human patient "health" (Suter 1993), in this document we are referring to the process for evaluating biological integrity and causes or sources associated with observed impairments, not whether human health and ecosystem health are analogous concepts.

Prevalent Causes and Sources of Impairment in the WAP Ecoregion

Ecoregions are useful for developing biocriteria because they identify regions of similarity in terms of biological assemblages. They are also useful, however, in identifying important stressors because they tend to be more similar within than across ecoregions. Knowledge of prevalent stressors throughout an ecoregion or subecoregion can be informative for stressor identification in a watershed that is a part of a particular ecoregion. The prevalent stressors in the WAP ecoregion are illustrated in Figure 1. These stressors are dominated by nonpoint sources from mining (metals, pH, siltation) and agriculture (siltation, habitat alterations, nutrients, and flow alterations). As we discuss later, potential sources of impairment in the Federal Creek subwatershed are nonpoint source (NPS) and mining related, both chemical and related to habitat disturbance.

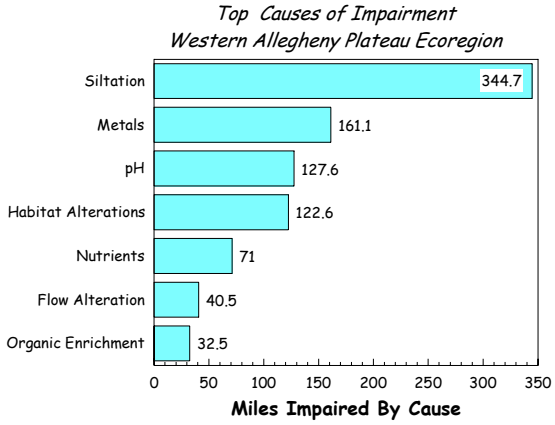


Figure 1. Prevalent causes of aquatic life impairment in the WAP ecoregion from the Ohio Water Resource Inventory (Ohio EPA 2000).

Results

Watershed Wide

Figure 2 summarizes the habitat and fish assemblage results from Federal Creek [green dots; includes other Hocking River tribs] in relation to other watersheds sampled during 2004 in Southeast Ohio including Moxahala [red squares], Leading Creek [triangles], and Saltlick Creek (blue diamonds]. These points are graphed in relation a QHEI-IBI regression line (thick line) from reference sites and modified references sites from across Ohio. EWH and WWH biocriteria are also depicted. A primary goal of watershed restoration efforts is to restore the highest potential aquatic communities for all waters in watershed. Prevalent stressors of concern in SE Ohio include AMD impacts, nonpoint pollution including sediment and nutrients, and habitat destruction. The two thick arrows on Figure 2 represent the direction restoration efforts hope to move the relationship between habitat and IBI: lower slopes and higher mean scores. Watershed approaches are necessary because of the role of cumulative impacts on aquatic life in watersheds. Small oases of good habitat are not sufficient to restore aquatic communities so watershed perspectives are required to move mean habitat condition higher and to reduce the slope of the QHEI-IBI association for a watershed.

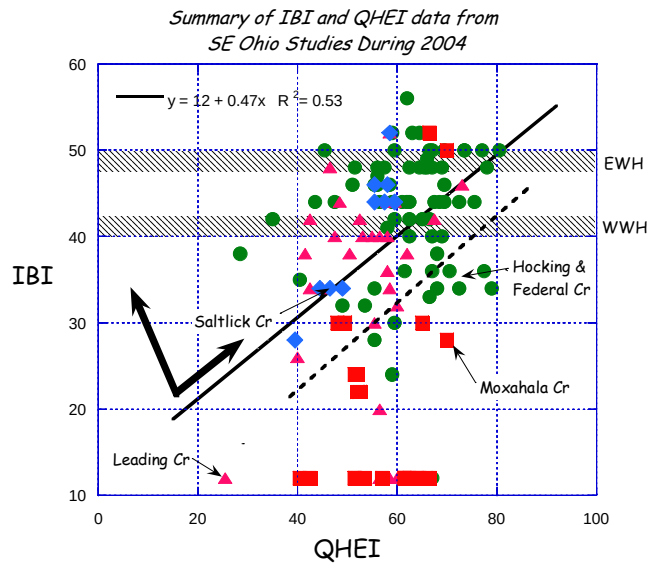


Figure 2. QHEI vs IBI for stream sampled in 2004 in Southeast Ohio by MBI. Solid line is statewide regression line from natural and modified reference sites. Dashed line represents range where factors other than local habirat strong influence biological performance.

Are These Relationships Real or Hypothetical?

Twenty-five years of biological field data provides strong evidence that these patterns are real. Figure 3 is from a study MBI did for the Nature Conservancy across the Midwest related to scale of agricultural impacts across watersheds. It is clear that upper limits to restoration of populations of sensitive taxa such as fish species are limited by average habitat conditions in watersheds. In figure 3 reductions of every 10 points of QHEI reduces or over time "extirpates" populations of sensitive fish species from these watersheds. The same pattern holds for macroinvertebrates and unionid mussel species

(Rankin and Armitage 2005 Draft). For watersheds like Federal Creek it is important to repair areas with degraded habitat, but as important is maintaining the small streams with high quality habitats found across the watershed (e.g.., Brill Run, Marietta Run, Sharps Fork, etc).

Biological assemblage and habitat data was collected at 43 stations in Federal Creek watershed with some sites funded via this project by ODNR MRM and others by Ohio EPA. Fish species collections and IBI score and metrics are listed in Appendix Tables 1 and 2 and summary fish (IBI) and macroinvertebrate (narrative assessments) data are listed in the attainment table (Table 3). Macroinvertebrate taxa collections are listed in Appendix Table 3. Figure 4 summarizes longitudinal patterns in the IBI in this watershed.

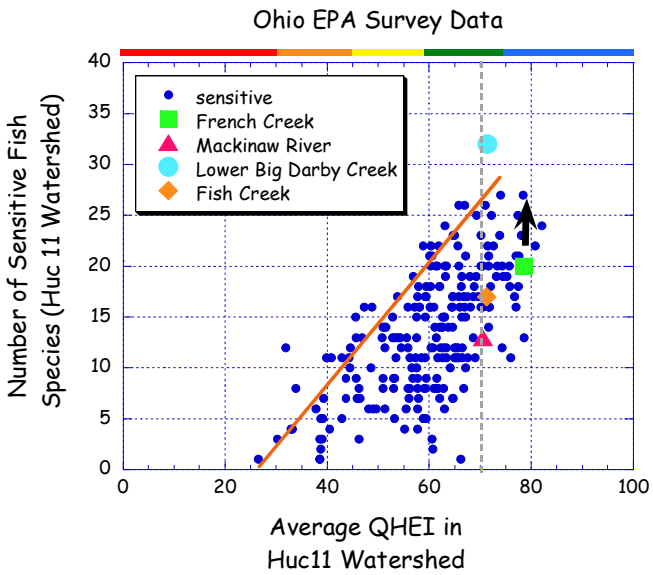


Figure 3. Plot of cumulative numbers of sensitive fish species in a Huc 11 watershed vs. average habitat quality in that watershed for sites with more than 10 samples in a watershed. Outer line is drawn by eye and represents maximum number of sensitive species expected given average habitat quality in that watershed.

In general the biological assemblages in Federal Creek watershed are in relatively good shape although some reference areas have appeared to have declined in biological and habitat quality since first sampled by Ohio EPA in the mi-1980s (see Table 3). Most sites have intact channel habitats although silt and sand above what is thought to be background levels often degrade habitats and potentially limit better assemblages (see Photo2). Some of this is related to encroachment into stream riparian buffers (see Figure 8 later) which are primary barriers from adjacent land uses.

Photo 1. Federal Creek at RM 11.7

Only three of the IBI scores in the entire Federal Creek watershed scored at less than a "good" rating (< 40) and only one of these was rated poor (Opossum Run at RM 4.1) and that site was relatively small in size (2.3 sq mi), dominated by bedrock and had a macroinvertebrate assemblage rated as excellent. Another site that was rated as fair (upper Linscott Run site) was also small in size and also had very good macroinvertebrate communities. Thus, mining influences do not appear to be having any acute impacts in the streams we surveyed in this watershed. Land use

encroachment has influenced habitat conditions, which were generally fair-good throughout the watershed with a few sites rated as excellent. The fact that the watershed and its tributaries are in generally in good shape helps insulate the biota from localized stressor impacts. In such cases short-term acute impacts can be compensated for with immigration of biota from nearby "sources" of fish species and macroinvertebrate taxa. As figure 3 illustrates however, accumulation of degradation to small headwater streams over time can have severe consequences for the health and potential of the biota in larger streams and rivers (Rankin and Armitage 2005 Draft, see earlier discussion). As average habitat conditions in a watershed decline, sensitive species are eliminated because reproductive conditions for all life-stages of these organisms are reduced until the species in essentially from the watershed. At that point small oases of good habitat cannot compensate for the more widespread loss of habitat and occasional severe natural stressors (e.g., drought) can speed these losses.

Stream Specific Assessments.

Most stream specific comments are summarized in Table 5. A few important highlights in the patterns observed in the biological assemblages are discussed below. Patterns in IBI with distance from the confluence of Federal Creek with the Hocking River are illustrated in Figure 4; similar patterns in the QHEI are illustrated in Figure 6.

Federal Creek. Although sites were not identical to those sampled historically by Ohio EPA IBI scores were very similar to those from 1984 and 1990 (Table 3) and were mostly in the high 40s and considered "not-significantly departing" from the EWH aquatic life goal. The macroinvertebrate data was influence by weather extremes in this watershed with very dry conditions in August, followed by flooding in September. Some HD samplers were lost and others were likely affected by high flows prior to being collected.

There is some concern that habitat conditions have degraded since the 1980s. The site sampled during 1990 at RM 11.4 had a QHEI of 80.5, but only scored a 61 at RM 11.3 in 2004. Sites from 2004 survey commonly have moderate embeddedness and fine, sandy substrates (EWH reference sites generally have low-no embeddedness). Overall QHEI and metric scores were on the low end of what we expect in EWH streams such as Federal Creek. The amount of sand in this

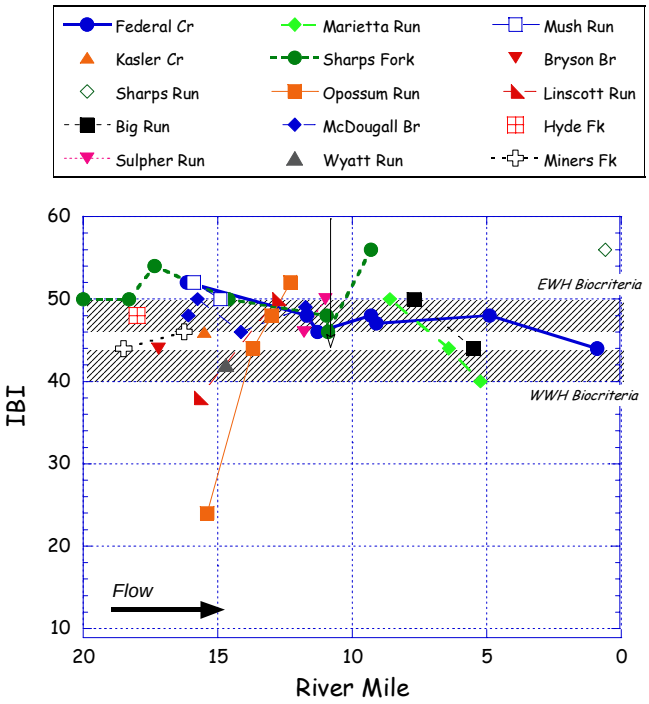


Figure 4. IBI scores of streams sampled in the Federal Creek Watershed during 2004.

stream contributes to the relatively low stability ratings given in the channel metrics. Because of the importance of clean substrates to aquatic life, management of land activities in this watershed should focus on reducing upland and bank erosion. Bank erosion in watersheds like Federal Creek (non-urban) typically arises from land uses (e.g., agriculture) that occur too close to the stream channel. Even when the mainstem waters have intact riparian vegetation, encroachment on small tributaries can result high sediment delivery to downstream reaches of larger streams. Protection of these small streams is essential to long-term viability of the fauna of downstream waters. Federal Creek still has good populations of sensitive species including banded darters (*Etheostoma zonale*), redside dace (*Clinostomus elongates*) and sand darter (*Ammocrypta pellucida*). These species would be among the first to respond to further declines in habitat and substrate conditions.

Opposum Run

Although Opposum Run had some sites in partial attainment of its aquatic life use, most of these deviations were relatively minor and the biological patterns were not clearly related to AMD-type impacts. The habitat at the site in the State Forest did not have the riffle development thata the other sites did, but still had a high number of Qual EPT taxa. The upstream site had the highest number of EPT taxa in the study. The sensitivity of the fish and macroinvertebrates in this stream should show strong effects if AMD impacts increase.

Linscott Run and Miners Run

Linscott Run and Miner Run do have some partial impairment of their EWH aquatic life uses, but the biological patterns and habitat data (e.g., QHEI substrates scores) indicate that the impairments are more likely related to fine sediment than AMD impacts. For example in upper Linscott Run the fish community is close to what one would expect for that size of stream in the upper reaches (~2 sq mi) even if the IBI was a bit low (38) and this is confirmed by the very good macro assemblage with 18 EPT taxa.

Sulpher Run

Sulpher Run was the only tributary where acute influences of AMD were observed, and in this case only strongly in the macroinvertebrates (Table 3). This was the only site that had a poor macroinvertebrate assemblage in the entire watershed. The dichotomy between the fish and macroinvertebrates was related to the episodic nature of the impacts and the fact that impacts were not especially extensive. Fish assemblages in such small streams have a strong recolonization potential if there is a good nearby refuge for re-invasion. Sharps Fork, into which Sulpher Run flows, is a high quality stream and is being recommended to be upgraded to an EWH aquatic life use.

Marietta Run

Marietta Run has some mining related seeps that discharge into it, however, impacts seemed relatively minimal. All sites met the WWH aquatic life use. The macroinvertebrate assemblages did decline below the seeps, but still attained the WWH biocriteria. In the fish assemblage, redside dace were not found downstream of the seep although they were abundant at the upstream site. Redside dace (*Clinostomus elongates*) are consider an "intolerant" fish and indicators of high quality small streams. Their absence could be related to episodic water quality impacts. This same upstream to downstream pattern was mirrored in changes in total, declining, and sensitive fish species richness (Figure 5). Habitat quality was excellent at the two most upstream sites, but only rated good near the mouth. Macroinvertebrate assemblages showed a similar pattern to the fish. Sensitive macroinvertebrates and EPT taxa declined below the seeps (Figure 5), but these sources were not severe enough to result in a change to non-attainment in the overall index scores.

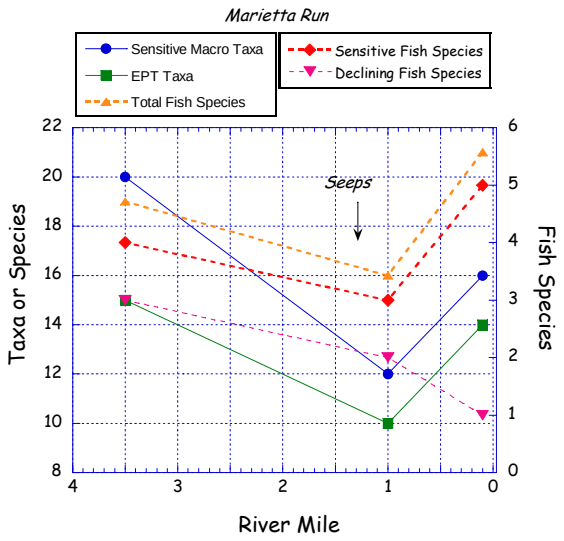


Figure 5. Various biological sensitivity indicators vs. river mile for Marietta Run in relation to mine seeps.

Sharps Fork

Sharps Fork had been designated as a WWH stream based on limited data near the mouth in 1990. Streams in the Ohio WQS where the use was verified with monitoring data are denoted with a '+' while sites not monitored, if listed, are denoted with an asterisk (*). More extensive data was collected for this study and the prevalence of IBIs above or close to the EWH range of 50, coupled with VG-E macroinvertebrate communities despite a dry August and flooding in September, 12-18 EPT taxa and very good habitat conditions support a change to an EWH aquatic life use.

Even though Sulphur Run, which has AMD impacts, is a tributary, Sharps Fork did not show any obvious impacts from Sulphur Run. Although the total abundance of fish was less below Sulphur Run, the IBI and metric scores and species richness patterns were similar up and downstream. It would be difficult to attribute any current impact from mine drainage in Sharps Fork. The general high quality of Sharps Fork may be resilient to occasional AMD events. The presence of certain intolerant and sensitive species (e.g., banded darter) would be good sentinels if AMD stressors were to increase.

The Federal Creek Watershed and other Mine Drainage Watersheds

It can be difficult to identify streams that have serious acid mine effects on the basis of chemical data alone, especially when chemical impacts are episodic or seasonal. Impacts in some streams are obvious (frequent extremely low pH or high metal loads), however, biological data can provide accurate measures of the extent and magnitude of impacts and provide a baseline for restoration actions. As restoration strategies reduce the overall loading of acid and other mining associated parameters, episodic loadings may be more frequent and biological data more important in identifying remaining problems. Although the aggregate indices are important for measuring impairment and attainment, the subcomponents of the biological indices can be very useful in diagnosing impairments. Water chemistry data is essential, however, for understanding the loading of parameters to streams and predicting downstream effects, and how they may be affecting biological assemblages, and are critical in engineering solutions to abate AMD.

Table 4 summarizes some of the fish components of the IBI at sites affected by AMD and those unimpaired or affected by other stressors in the Federal Creek as compared with other recent surveys MBI has completed in southeast Ohio. The streams we sampled in the Federal Creek watershed had no acute impacts to the fish assemblage from AMD. As demonstrated in Table 3, the NPS impaired sites in the Federal Creek watershed are not as severely impaired as sites affected by NPS impacts in Leading, Moxhala, and Raccoon Creek. In absolute sense, Federal Creek has mostly "excellent" sites (EWH) impaired to "good" conditions and some "good" sites (WWH) impaired to fair (see Table 5) while the other watersheds have mostly sites with WWH potential ("good") impaired to fair and poor depending on the site and the type of NPS impact (e.g., habitat impairments are generally more severe than sedimentation alone). The NPS impacts in the other watersheds are relatively more severe and are worsened because of relatively large expanses of AMD impacted waters (especially Moxahala Creek). The large spatial extent of AMD in the watersheds reduces the "refuges" from which fish and macroinvertebrates can recolonize recovering streams. The challenges in Federal Creek are more ones of protection of this high quality resource from the slow (relatively) cumulative impacts than can occur in watersheds by increasing riparian and in-stream habitat quality.

Table 3. Attainment table for streams sampled by MBI in the Hocking River watershed during 2004.									
Station (Map #)	Fish RM	Macro RM	IBI	MIwb	ICI or Narrative Rating	QHEI	Aquatic Life Uses Ex/Rec	Attain-ment Status	Comment
Federal Creek - 2004									
S01100 16.152004	16.15	15.5	52	NA	48	64.5	EWH	**Full**	Ust Sharps Run
S01100 11.702004	11.70	11.70	48^{ns}	8.90^{ns}	VG^{ns}	51.5	EWH	**Full**	adj. St. Rt. 329 dst. Linscott Run
S01100 11.302004	11.30	11.40	46^{ns}	9.53	†F*‡	61.0	EWH	**Full**	St. Rt. 550, upst. McDougall Branch
S01100 9.302004	9.30	–	48^{ns}	7.88*	–	66.0	EWH	**Partial**	ust Sharps Fork
S01100 9.102004	9.10	–	47^{ns}	8.90^{ns}	VG^{ns}	56.0	EWH	**Full**	immediately dst Sharps Fk
S01100 7.502004	–	7.50	–	–	42*‡	–	EWH	–	dst. Sharps Fork
S01100 4.902004	4.90	4.90	48^{ns}	7.14*	34*‡	62.0	EWH	**Partial**	adj. St. Rt. 329 dst. Broadwell
S01100 0.902004	0.90	0.90	44*	9.50	†MG*	47.5	EWH	**Partial**	Twp. Rd. 231 (reference site)
Federal Creek - 1990									
S01100 11.401990	11.4	11.7	48^{ns}	9.0^{ns}	46	81.5	EWH	**Full**	upst. McDougall Branch
S01100 1.301990	1.3	–	46^{ns}	8.7*	54	74.5	EWH	**Partial**	Reference Site
Federal Creek - 1984									
S01100 1.301984	1.3	–	50	10.3	38	74.0	EWH	**Partial**	Reference Site
Kasler Creek									
S01101 0.402004	1.75	0.40	46	NA	F*	78.0	None/ WWH	**Partial**	Mouth
Sharps Run - 2004									
S01110 1.002004	0.01	1.00	44*	NA	VG^{ns}	64.0	EWH	**Partial**	near mouth, dst. north trib.
Sharps Run - 1995									
S01110 2.402004	2.40	–	44*	NA	–	73.5	EWH	**Non**	
Big Run - 2004									
S01130 3.902004	3.90	3.90	50	NA	G*	73.5	EWH	**Partial**	Co. Rd. 59, dst. Wildcat Run
S01130 1.602004	1.70	1.60	44*	NA	F*	59.0	EWH	**Non**	upst. Hatch Fork
Big Run - 1995									
S01130 3.901995	3.90	–	50	NA	–	80.5	EWH	**Full**	dst. Wildcat Run

S01130 0.201995	0.20	–	46^{ns}	NA	–	63.0	EWH	**Full**	Mouth
Ellis Run - 1995									
S01131 0.501995	0.5	–	54	NA	–	64.0	EWH	**Full**	
Joes Run - 1995									
S01132 0.101995	0.1	–	54	NA	–	68.5	EWH	**Full**	
Wildcat Run - 1995									
S01133 0.101995	0.1	–	48^{ns}	NA	–	69.0	EWH	**Full**	
Sulphur Run									
S01134 0.802004	0.80	0.80	46	NA	F*	56.0	None WWH	**Partial**	Upstream
S01134 0.102004	0.01	0.10	50	NA	P*	45.5	None WWH	**Non**	Mouth
Spruce Run - 1995									
S01140 0.201995	0.20	–	54	NA	–	65.0		**Full**	
Marietta Run									
S01150 3.202004	3.20	3.50	50	NA	E	77.0	WWH	**Full**	dst. Brill Run
S01150 1.002004	1.60	1.00	44	NA	MG^{ns}	75.5	WWH	**Full**	B Below the 2 Seeps
S01150 0.102004	0.10	0.10	40^{ns}	NA	VG	62.5	WWH	**Full**	St. Rt. 329, at mouth
Brill Run - 1995									
S01151 0.101995	0.10	–	56	NA	–	79.5	EWH	**Full**	
Sharps Fork - 2004									
S01160 10.702004	10.70	10.70	50	NA	E	80.5	WWH/ EWH	**Full**	upst. Co. Rd. 85, upst. east trib
S01160 9.102004	9.10	9.10	50	NA	VG^{ns}	69.5	WWH/ EWH	**Full**	Co. Rd. 14
S01160 8.502004	8.05	8.50	54		VG^{ns}	67.0	WWH/ EWH	**Full**	Ust TR64
S01160 5.202004	5.30	5.20	50	NA	VG^{ns}	66.5	WWH/ EWH	**Full**	lane dst. Tharp Hollow
S01160 2.602004	–	2.60	–	–	VG^{ns}	–	WWH/ EWH	**Full**	Dst Opossum Adj 550
S01160 1.652004	1.65	–	48^{ns}	8.83*	-	65.5	WWH/ EWH	**Partial**	Ust Sulphur Run
S01160 1.602004	1.60	1.60	46^{ns}	8.31*	G*	55.5	WWH/ EWH	**Partial**	Dst Sulphur Run
S01160 0.012004	0.01	0.10	56	8.31*	38^{ns}	–	WWH/ EWH	**Partial**	St. Rt. 329, at mouth
Sharps Fork - 1990									
S01160 0.012004	0.30	–	44*	8.10*	G*		WWH/ EWH	**Non**	Mouth
Opossum Run									
S01161	4.10	4.10	24*	NA	E	59.0	EWH	**Partial**	Ust Starling Run

4.102004									
S01161 2.602004	2.60	2.60	44*	NA	VG^{ns}	69.5	EWH	**Partial**	Twp. Rd. 6, at compressor station
S01161 0.752004	0.75	0.80	48^{ns}	NA	G*	56.0	EWH	**Partial**	State Forest
S01161 0.202004	0.20	0.20	52	NA	VG^{ns}	59.0	EWH	**Full**	Joy Rd., near mouth
McDougall Branch - 2004									
S01170 4.902004	4.95	4.90	48	NA	G	57.5	WWH	**Full**	2nd lane upst. Bryson Branch
S01170 4.502004	4.50	4.60	50	NA	VG	59.5	WWH	**Full**	just dst. Bryson Branch
S01170 2.402004	2.90	2.90	46	8.25	†G	69.5	WWH	**Full**	dst. Mush Run (reference site)
S01170 0.502004	0.50	0.50	49	8.80	48	66.0	WWH	**Full**	lane off St. Rt. 550
McDougall Branch - 1990									
S01170 2.402004	2.40	–	42^{ns}	9.10	G		WWH	**Full**	Reference Site
McDougall Branch - 1984									
S01170 2.402004	2.40	–	48	8.40	26*		WWH	**Partial**	Reference Site
Wyatt Run									
S01171 0.402004	0.40	0.40	42*	NA	E	62.5	EWH	**Partial**	lane near mouth
Mush Run									
S01172 1.802004	1.80	1.80	52	NA	G*	63.0	EWH	**Partial**	lane dst. Riley Run
S01172 1.002004	1.00	1.00	50	NA	G*	66.5	EWH	**Partial**	Dutch Creek Rd.
Bryson Branch									
S01174 1.202004	1.20	1.40	44*	NA	G*	68.5	EWH	**NON**	Howard Rd.
Dutch Creek									
S01176 1.702004	1.70	1.70	34*	NA	G	76.5	None/ WWH	**Partial**	Dutch Creek Rd. at Twp. Rd. 216
Linscott Run									
S01180 3.702004	3.80	3.70	38*	NA	VG^{ns}	68.0	EWH	**Partial**	Upstream Site
S01180 0.802004	0.80	0.80	50	NA	MG*	73.5	EWH	**Partial**	St. Rt. 329
Hyde Fork									
S01190 1.802004	1.80	1.80	48^{ns}	NA	MG*	69.0	EWH	**Partial**	lane off St. Rt. 329
Miners Fork									
S01192 2.202004	2.25	2.20	44*	NA	G*	56.5	EWH	**Non**	Wrightstown Rd.
S01192 0.102004	0.05	0.10	46^{ns}	NA	G*	58.5	EWH	**Partial**	St. Rt. 329, at mouth

Ecoregion Biocriteria: Western Allegheny Plateau (WAP)					
Index and Site Type	WWH	EWH	MWH	LRW-AMD	
IBI – Wading & Headwater	44	50	24/24	18	
Mod. Iwb - Wading	8.4	9.4	6.2/5,5	4.0	
ICI/Narrative	36/G	46/E	22/30	8/MF	

Footnotes

a - A qualitative narrative evaluation based on best professional judgment and sampling attributes such as community composition, EPT taxa richness, and QCTV scores were used when quantitative data were not available (E-exceptional, G-good, MG-marginally good, F-fair, P-poor, VP-very poor); for Moxahala Creek a draft Qualitative ICI index was also used.

b - Attainment status is given for existing use designations, except where a use designation change is recommended, in which case, the attainment status for the recommended use is given.

c - Limited Resource Water - acid mine drainage (LRW-AMD) benchmarks based on best professional judgment driven by the need to protect against acutely toxic stream conditions. Macroinvertebrate qualitative only data were evaluated based on densities of EPT taxa on the natural substrates (see Methods Section), a narrative VP* or P* indicates departure from the benchmark.

na - MIwb not applicable at headwater sites (< 20 mi^2).

† - HD sampler set, but not retrieved due to flood flows destroying samplers.

‡ - Dry conditions in August followed by flooding conditions in September likely influenced assemblage conditions (data excluded from attainment decision)

ns - Nonsignificant departure from biocriteria (<4 IBI or ICI units, or <0.5 MIwb units).

* - Indicates significant departure from applicable biocriteria (>4 IBI or ICI units, or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

Table 4. Summary fish community statistics for streams in the Federal Creek watershed compared to data from other recent surveys MBI has conducted in the Middle Basin Raccoon Creek, Moxahala Creek, and Leading Creek watersheds. Sites were classified as AMD impacted, NPS impacted (e.g., siltation, habitat), or un-impacted (for fish assemblages)

Effect	IBI	Sensitive Species	Total Species	Sculpins & Darters	Headwater Species	Percent Pioneering
Federal Creek						
AMD	—	—	—	—	—	—
NPS	40.1	4.8	17.9	4.7	2.6	45.3
Attaining†	48.4	6.1	20.5	5.3	2.6	40.1
Raccoon Creek						
AMD	18.6	0.14	4.0	0.0	0.3	53.8
NPS	32.5	0.43	7.6	0.7	1.7	62.0
Attaining‡	42.0	1.43	11.4	1.6	2.1	53.5
Moxahala Creek						
AMD	16.6	0.13	2.0	0.1	0.1	31.0
NPS	31.0	0.0	9.0	1.0	1.8	69.0
Attaining*	47.3	5.7	19.3	4.7	2.0	30.5
Leading Creek						
AMD	15.1	0.0	1.7	0.1	0.1	25.2
NPS	34.9	1.0	12.2	1.7	1.7	55.5
Attaining‡	43.0	1.9	14.8	2.7	2.3	55.9
Effect	**Percent Insectivores**	**Cyprinid Species**	**DELT Anomalies**	**Percent(No.) Simple Lithophils**	**Total Relative Number**	**Relative Number w/o Tolerants**
Federal Creek						
AMD	—	—	—	—	—	—
NPS	25.5	6.2	0.00	30.9(6.7)	1246	658
Attaining†	41.9	6.8	0.01	35.6(7.9)	994	523
Raccoon Creek						
AMD	15.7	1.9	0.00	5.1(0.6)	63	10
NPS	27.1	3.3	0.58	21.3(2.5)	266	70
Attaining‡	36.1	4.6	0.13	19.4(3.4)	683	215
Moxahala Creek						
AMD	26.3	0.6	0.06	2.7(0.3)	68	22
NPS	32.5	3.8	0.05	8.4(1.8)	625	192
Attaining*	42.2	6.3	0.00	28.9(6.3)	1280	818
Leading Creek						
AMD	9.9	0.4	0.00	0.6((0.1)	31	5
NPS	29.3	6.1	0.05	28.4(3.9)	2391	667
Attaining‡	38.6	6.1	0.06	28.4(4.8)	1011	445

†Un-impaired streams consist of a mix of WWH and EWH aquatic life uses.
‡Un-impaired streams primarily WWH aquatic life uses
*Un-impaired streams were Kent Run and Jonathan Creek in an adjacent watershed.

NPS and Habitat Impacted Waters

Although a major focus of this report is to identify AMD impacts in the Federal Creek watershed, to discriminate the relative contribution of AMD compared to other stressors, it is essential to understand the other stressors that are limiting aquatic life. Various data

types help in the assessment of NPS stressors. As with AMD impacts, biological signatures[1] help in categorizing and attributing various NPS stressors as limiting factors to biological integrity. Water chemistry data is also important (e.g., nutrients, dissolved oxygen, TSS and TDS, BOD, etc.). For habitat and sediment related impacts a key tool is the QHEI and its subcomponents.

Fine sediments have been identified as a moderate to severe problem many watersheds in Ohio (Ohio EPA 2000, 2002). A study by U.S.G.S. identified the nearby Leading Creek watershed as having among the highest export of fine sediment in Ohio (Antilla and Tobin 1978). Appendix Table 4 summarizes mean QHEI and metric scores for the sites in the Federal Creek subwatershed; longitudinal patterns in the overall QHEI scores are illustrated in Figure 6. Habitat quality ranged from fair (scores 46-59) to excellent (scores > 75). As mentioned earlier, there is some evidence that habitat conditions may have declined somewhat in Federal Creek. All three sites from 1984 and 1990 had QHEI scores in the 70s-80 (very good-excellent) while 2004 samples averaged a score of 58 (47.5 [fair] – 66 [good]) and had no sites score above 70 (Figure 6). Recent assessments were characterized as having more sand and fine sediments than earlier sites.

Appendix Table 5 provides summary statistics for pebble count data and Figure 7 illustrates cumulative frequency plots for selected sites in Federal Creek and Linscott Run (top), Sharps Fork and Opossum Run (center), and for Marietta Run and Sulpher Run (bottom). Curves to the left have more fines and curves to the left are more dominated by coarser materials. Sandy rather than silty sediments are more a problem in the Federal Creek watershed at most sites. The Federal Creek sites and RM 9.1 and 9.3 both have greater than 50% of surface bed materials as sand. No strong trends exist between fine substrates as measured by the pebble counts at individual sites and biological performance, however, adjacent higher quality patches of habitat can compensate for localized sediment impacts as discussed earlier. If the extent of fine

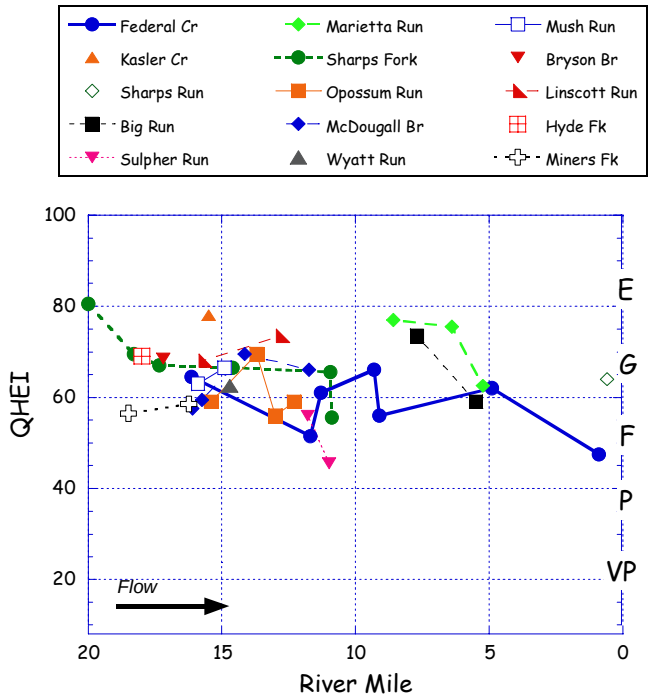
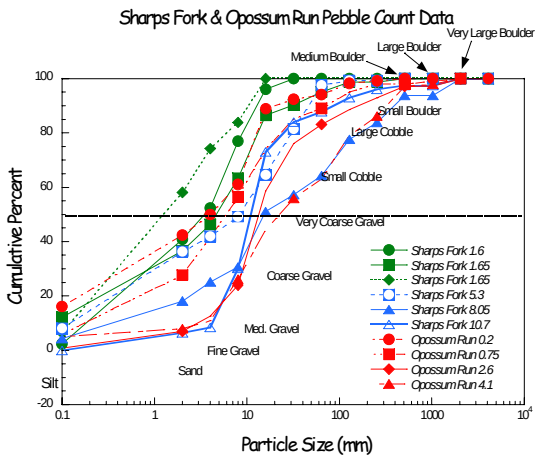
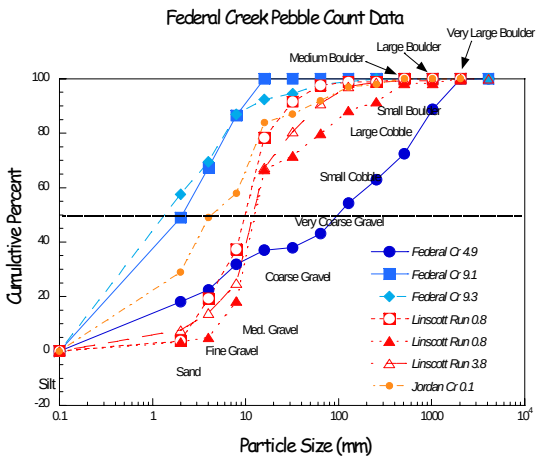


Figure 6. QHEI vs miles from the confluence of Federal Creek with the Hocking River for sites sampled by MBI during 2004.

[1] Biological signatures are patterns in the biological data associated with as specific category of impairment. Examples include DELT anomalies and toxic metals, loss of mayfly taxa with high dissolved solids, and increases in omnivorous fish with increase organic pollution.

substrate export to Federal Creek increases the biological could decline. As it is now, the IBI scores were only marginally attaining the EWH and further stress could cause impairment. Only Sulphur Run at its mouth had extremely silty conditions (Figure 6, bottom) and this coincided with mining impacts and the only poor macroinvertebrate assemblage rating in the watershed.





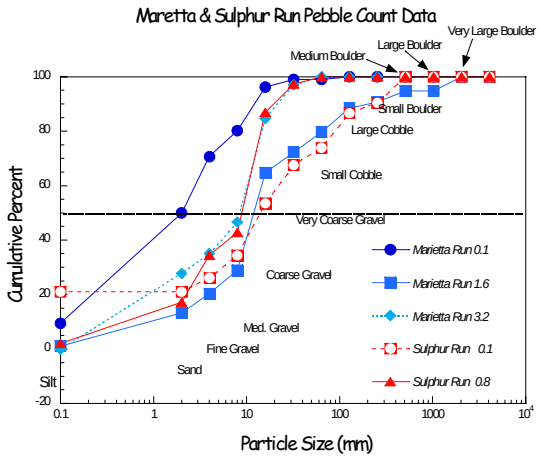


Figure 7. Zig-zag pebble counts collected in Federal Creek and Linscott Run (to rightp), Sharps Fork and Opossum Run (top left) and the Mareitta Run and Sulpher Run (Bottom) during 2004.

Table 5. Waterbody and/or site assessment summaries for impaired or partially impaired stream stations sampling during 2004 by MBI.				
Stations(s)	Segment RMs	Cause/Source of Impairment Comments	Recommended Aq Life Use	Attainment Status
Federal Creek - 01100				
Multiple	0-16.15	Causes: Habitat degradation. increase sedimentation Sources: Agriculture, mining related sedimentation	EWH	Full-Partial
Kasler Creek - 01101				
S01101 0.402004	0-2.0	Causes: Unknown Sources .It is possible that flow conditions may have hindered the macroinvertebrate collection; fish data scored well and habitat was excellent	WWH	Partial
Sharps Run – 01110				
S01110 1.002004	0-1.0	Causes: Fine Substrates Sources: This stream nearly attained the EWH aquatic life use; QHEI substrate score (10) indicates fine sediments are a problem	EWH	Partial
Big Run - 01130				
Multiple Stations	0-4.0	Causes - Fine Substrates Sources: QHEI substrate scores (12-14) suggests that fine sediments may be a problem	EWH	Partial-Non
Sulphur Run – 01134				
Multiple Station	0-1.0	Causes – AMD Sources – Mining This stream was affected by AMD which was much more evident in the macroinvertebrates than n the fish assemblages suggesting episodic events. **AMD Impairment**	WWH	Partial-Non
Sharps Fork - 01160				
Multiple Stations	0-2.0	Causes – Fine Sediments Sources: QHEI substrate scores (8-11) suggests that fine sediments may be a problem especially for an EWH streams.	EWH	Partial
Opossum Run - 01140				
Multiple Stations	0-5.0	Causes – Natural and Fine Sediments Sources: Upstream size mostly bedrock which limited pool depth and fish species – macros and water quality were excellent. Downstream sites had fine sediments from agriculture and other land sues	EWH	Partial
Wyatt Run - 01171				
S01171 0.402004	0-1.0	Causes - Habitat Sources: Habitat may be a bit marginal to support EWH at this sites (cover score = 9) although macros are excellent	EWH	Partial
Mush Run – 01-172				
Multiple Stations	0-2.0	Causes – Fine Sediments Sources: QHEI substrate scores (13-13.5) suggests that fine sediments may be a problem, especially for an EWH	EWH	Partial

		streams.		
Bryson Branch – 01174				
S01174 1.202004	0-2.0	Causes – Fine Sediments Sources: QHEI substrate scores (13-13.5) suggests that fine sediments may be a problem, specially for an EWH streams	EWH	Non
Dutch Creek 01-176				
S01176 1.702004	0-2.0	Causes – Fine Sediments Sources: QHEI substrate scores (13-13.5) suggests that fine sediments may be a problem, specially for an EWH streams	WWH	Partial
Linscott Run 01-180				
Multiple Stations	3-3.8	Causes – Fine Sediments Sources: QHEI substrate scores (13-13.5) suggests that fine sediments may be a problem, specially for an EWH streams	EWH	Partial
Hyde Fork – 01-190				
S01190 1.802004	0-2.0	Causes – Fine Sediments Sources: QHEI substrate scores (13-13.5) suggests that fine sediments may be a problem, specially for an EWH streams	EWH	Partial
Miners Fork – 01192				
Multiple Sites	0-3.0	Causes – Fine Sediments Sources: QHEI substrate scores (13-13.5) suggests that fine sediments may be a problem, specially for an EWH streams	EWH	Partial-Non

Riparian Systems

While biological quality was generally good in the Federal Creek watershed a larger number of sites sampled in 2004 were impaired (25) than were fully meeting (17) their aquatic life goals set for them through the Ohio WQS. The most prevalent stressor associated with observed aquatic life impairment was fine sediments in the stream channel. Fine sediments can fill interstitial spaces between larger rocks and gravels and can result in declines in food resources, spawning failures, reduce habitat space, and reduction in other important ecological functions of streams. Many of the stations in this study had various land uses encroaching on the stream especially agriculture and in some places residential development. The median width of riparian strips was only 10 m and 30% were only about 2.5 meters in average width (Figure 8). There were a few sites with no riparian zone at all and there are probably many more disturbed small streams throughout the watershed.

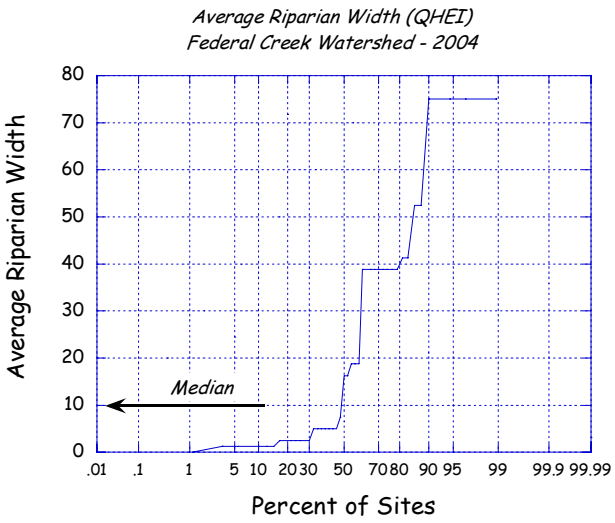


Figure 8. Cumulativer frequency distributions of width of riparian vegetation taken with QHEI data for streams sampled in the Federal Creek watershed during 2004.

Establishment of sufficiently wide riparian zones generally keeps most sediment from reaching the stream and intact vegetation protects banks from eroding. Bank erosion can contribute major loadings of fine sediments, especially the sands that are a problem in Federal Creek and the Hocking River.

Use Change Recommendations

Aquatic life use designations are based on the potential of streams to attain Ohio's listed aquatic life uses (EWH, WWH, MWH, and LRW). Recommendations on changes in aquatic life uses designations are based on a combination of biological, chemical, and physical data with biological data being the ultimate arbiter for the aquatic life use. The CWA protects uses of waterbodies that existed as of 1975. A key part of the Ohio EPA effort is to establish the proper aquatic life use for each waterbody in Ohio. Any stream that has been designated based on ambient monitoring data, subsequent to 1975 cannot have that use lowered (unless the action was in error). Waterbodies can, however, have their designations changed to a higher tier if ambient data indicates that the high use can now be attained. The existing aquatic life uses for named streams in the Federal Creek watershed are listed in Table 6. Sites where the existing use was verified with monitoring data are denoted with a "+" while unverified sites are denoted with an asterisk.

Table 5. Use designations for water bodies in the Federal Creek drainage basin.

Water Body Segment	Use Designations													Comments
		Aquatic Life Habitat						Water Supply			Recreation			
	SRW	WWH	EWH	MWH	SSH	CWH	LRW	PWS	AWS	IWS	BW	PCR	SCR	
Federal creek			+						*	*		*		
Sharps run			o						*	*		*		
Herrold run		*L							*	*		*		Acid mine drainage. Varied criteria year around: exempt from the WWH total dissolved solids criterion.
Big run			+						*	*		*		
Joes run			+						*	*		*		
Ellis run			+						*	*		*		
Wildcat run			+						*	*		*		
Spring run			+						*	*		*		
Marietta run		+							*	*		*		
Brill run			+						*	*		*		
Sharps fork		+							*	*		*		
Opossum run			*						*	*		*		
Joy run			*						*	*		*		
McElfresh run			*						*	*		*		
McDougall branch		+							*	*		*		
Wyatt run			*						*	*		*		
Mush run			*						*	*		*		
Sugar run			*						*	*		*		
Bryson branch			*						*	*		*		
Linscott run			*						*	*		*		
Ewing run			*						*	*		*		
Hyde fork			*						*	*		*		
Hyde branch			*						*	*		*		
Miners fork			*						*	*		*		

On the basis of the data we have collected during 2004 we suggest upgrading the aquatic life use for Sharps Fork from WWH to EWH and suggest WWH aquatic life uses for several stream that were not listed in the WQS (Kasler Creek, Dutch Creek, Sulpher Run). Final decisions will be made by Ohio EPA and subject to a WQS rulemaking procedure. Justifications for the changes are summarized in Table 7.

Table 7. Recommended aquatic life designated use changes for streams sampled by MBI in the Hocking River watershed during 2004.

Aquatic Life Use Designation Recommendation:	QHEI	Aquatic Life Uses Ex/Rec	Attain-ment Status	Comment
Federal Creek				
Although this years sites did not match historical sites exactly, it appears that habitat conditions are being degraded in Federal Creek although biological still shows evidence of EWH assemblages (banded darter and rainbow darter population were lower in 2004 vs. 1990 and 1984). QHEI scores in 1984 and 1990 ranged from 74-81.5 while 2004 sites (albeit it included some additional sites) ranged from 47 to 66 with most scores in the 50s to low 60s which are lower than expected for EWH streams:	64.5	EWH	**Full**	Ust Sharps Run
	51.5	EWH	**Full**	adj. St. Rt. 329 dst. Linscott Run
	61.0	EWH	**Partial**	St. Rt. 550, upst. McDougall Branch
	66.0	EWH	**Partial**	
	56.0	EWH	**Full**	
		EWH	**Non**	dst. Sharps

Federal Creek should be maintained as an EWH stream.				Fork
	62.0	EWH	**Partial**	adj. St. Rt. 329 dst. Broadwell
	47.5	EWH	**Partial**	Twp. Rd. 231 (reference site)
Kasler Creek				
Small stream with very good habitat should be assigned WWH use on basis of available data.	78.0	None/ WWH	**Partial**	Mouth
Sharps Run				
Single site insufficient to warrant any change in aquatic life use.	64.0	EWH	**Partial**	Near mouth, dst. north trib.
Big Run				
Maintain as EWH	73.5	EWH	**Partial**	Co. Rd. 59, dst. Wildcat Run
	59.0	EWH	**Partial**	upst. Hatch Fork
Sulphur Run				
Small stream with fair-good habitat should be assigned WWH use on basis of available data.	56.0	None WWH	**Partial**	Upstream
	45.5	None WWH	**Non**	Mouth
Marietta Run				
Keep as WWH	77.0	WWH	**Full**	dst. Brill Run
	75.5	WWH	**Full**	B Below the 2 Seeps
	62.5	WWH	**Full**	St. Rt. 329, at mouth
Sharps Fork				
Consistent EWH IBI scores, high numbers of total and sensitive species along with good-excellent habitat indicate that Sharps Fork should be upgraded to the EWH aquatic life use designation.	80.5	WWH	**Full**	upst. Co. Rd. 85, upst. east trib
	69.5	WWH	**Full**	Co. Rd. 14
	67.0	WWH	**Full**	Ust TR64
	66.5	WWH	**Full**	lane dst. Tharp Hollow
		WWH	**Full**	Dst Opossum Adj 550
	65.5	WWH	**Partial**	Ust Sulphur Run
	55.5	WWH	**Partial**	Dst Sulphur Run
		WWH	**Partial**	St. Rt. 329, at mouth
Opossum Run				
Keep as EWH stream	59.0	EWH	**Partial**	Ust Starling Run
	69.5	EWH	**Partial**	Twp. Rd. 6, at compressor station
	56.0	EWH	**Partial**	State Forest
	59.0	EWH	**Full**	Joy Rd., near mouth
McDougall Branch				
Keep as WWH stream at this time.	57.5	WWH	**Full**	2nd lane upst. Bryson Branch

	59.5	WWH	**Full**	just dst. Bryson Branch
	69.5	WWH	**Full**	dst. Mush Run (reference site)
	66.0	WWH	**Full**	lane off St. Rt. 550
Wyatt Run				
Keep at EWH stream, insufficient data to warrant any change at this time.	62.5	EWH	**Partial**	lane near mouth
Mush Run				
Keep at EWH stream, insufficient data to warrant any change at this time.	63.0	EWH	**Partial**	lane dst. Riley Run
	66.5	EWH	**Partial**	Dutch Creek Rd.
Bryson Branch				
Keep at EWH stream, insufficient data to warrant any change at this time.	68.5	EWH	**NON**	Howard Rd.
Dutch Creek				
Small stream with good habitat should be assigned WWH use on basis of available data.	76.5	None/ WWH	**Partial**	Dutch Creek Rd. at Twp. Rd. 216
Linscott Run				
Keeps as EWH; upstream site far into headwaters	68.0	EWH	**Partial**	
	73.5	EWH	**Partial**	St. Rt. 329
Hyde Fork				
Keep at EWH stream, insufficient data to warrant any change at this time.	69.0	EWH	**Partial**	lane off St. Rt. 329
Miners Fork				
Keep at EWH stream, insufficient data to warrant any change at this time.	56.5	EWH	**Non**	Wrightstown Rd.
	58.5	EWH	**Partial**	St. Rt. 329, at mouth

Conclusions

AMD impacts are not a major influence on the majority of the stream we monitored in the Federal Creek watershed. The most severely impaired stream was Sulphur Run which had the only site with an assemblage scoring in the poor range. Although the seeps in Marietta Run appeared to influence the biological assemblages, they impact was not severe enough during the time we monitored the stream to impair the biocriteria for this water. The remaining impairments were largely related to fine sediment (i.e., sand and fine gravels) and related habitat degradation.

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Table 8. National Land Use Cover data summarizing land use categories in Huc-14 watersheds in the Federal Creek watershed

	Percent			
Sub-Watershed Name	Forest	Wetland	Agriculture	Developed
Miners Fk	75.2	0.03	24.1	0.40
Hyde Fk	62.1	0.11	37.1	0.51
Federal Cr at Upper Hyde Fk Reservoir Site	53.8	0.09	46.0	0.03
Linscott Run at Mouth	74.4	0.09	25.3	0.07
Federal Cr above McDougall Branch at Amesville	61.6	0.29	37.9	0.03
McDougall Branch above Mush Run	77.4	0.08	21.6	0.64
Mush Run	85.5	0.03	14.3	0.09
McDougall Branch at Reservoir Site	86.4	0.11	13.2	0.09
McDougall Branch at mouth	85.0	0.87	13.5	0.23

Even though the Federal Creek is heavily forested, the dissected nature of the topography pushes human land uses to flat areas that are adjacent to streams. The result is that riparian buffers are smaller than might be expected for such a high proportion of forest, however, for the most part they are still present unlike some heavily agricultural settings where lack of woody buffers is more widespread. Even with intact buffers high loads of sediment can reach a stream where the buffers are “short circuited” by ditches and tributaries that drain agricultural, developed, and mined areas. The data we have collected here should provide a suitable baseline for measuring the effectiveness of AMD abatement efforts as well as protection and enhancements of riparian buffers and in-stream habitat conditions. The exceptional .nature of the aquatic life designated uses in the Federal Creek watershed should provide a strong impetus for protection and restoration actions in this watershed.

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Appendix Table 1. Fish species collected during electrofishing surveys by MBI in 2004 and historical fish data collections by Ohio EPA and Ohio DNR available in electronic form from Ohio EPA (electrofishing and seining [sampler type H or missing]).

River Code: **01-100**	Stream: **Federal Creek**	Sample Date: **2004**
River Mile: **16.15**	Location:	Date Range: 08/24/2004
Time Fished: 3300 sec	Drainage: 17.0 sq mi	
Dist Fished: 0.15 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Striped Shiner	N	I	S		68	136.00	19.77			
Bluntnose Minnow	N	O	C	T	56	112.00	16.28			
Creek Chub	N	G	N	T	42	84.00	12.21			
Central Stoneroller	N	H	N		37	74.00	10.76			
Longear Sunfish	S	I	C	M	23	46.00	6.69			
Greenside Darter	D	I	S	M	21	42.00	6.10			
Fantail Darter	D	I	C		20	40.00	5.81			
Golden Redhorse	R	I	S	M	16	32.00	4.65			
Johnny Darter	D	I	C		16	32.00	4.65			
Northern Hog Sucker	R	I	S	M	6	12.00	1.74			
White Sucker	W	O	S	T	6	12.00	1.74			
Rainbow Darter	D	I	S	M	5	10.00	1.45			
Redfin Shiner	N	I	N		4	8.00	1.16			
Sand Shiner	N	I	M	M	4	8.00	1.16			
Rock Bass	S	C	C		4	8.00	1.16			
Blackside Darter	D	I	S		4	8.00	1.16			
Logperch	D	I	S	M	4	8.00	1.16			
Smallmouth Bass	F	C	C	M	3	6.00	0.87			
Green Sunfish	S	I	C	T	2	4.00	0.58			
Least Brook Lamprey		F	N		1	2.00	0.29			
Silverjaw Minnow	N	I	M		1	2.00	0.29			
Largemouth Bass	F	C	C		1	2.00	0.29			
	Mile Total				344	688.00				
	Number of Species				22					
	Number of Hybrids				0					

River Code: **01-100**	Stream: **Federal Creek**	Sample Date: **2004**
River Mile: **11.70**	Location:	Date Range: 08/17/2004
Time Fished: 3600 sec	Drainage: 27.7 sq mi	
Dist Fished: 0.19 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Striped Shiner	N	I	S		89	140.53	21.60	0.93	8.57	6.63
Bluntnose Minnow	N	O	C	T	45	71.05	10.92	0.21	1.90	2.91
Creek Chub	N	G	N	T	41	64.74	9.95	0.98	9.00	15.12
Longear Sunfish	S	I	C	M	40	63.16	9.71	0.77	7.12	12.25
Greenside Darter	D	I	S	M	35	55.26	8.50	0.08	0.73	1.43
White Sucker	W	O	S	T	20	31.58	4.85	2.33	21.46	73.90
Blackside Darter	D	I	S		19	30.00	4.61	0.07	0.61	2.21
Golden Redhorse	R	I	S	M	17	26.84	4.13	1.24	11.38	46.12
Northern Hog Sucker	R	I	S	M	17	26.84	4.13	1.01	9.30	37.65
Johnny Darter	D	I	C		15	23.68	3.64	0.01	0.07	0.33
Sand Shiner	N	I	M	M	14	22.11	3.40	0.03	0.23	1.14
Green Sunfish	S	I	C	T	11	17.37	2.67	0.27	2.50	15.64
Fantail Darter	D	I	C		11	17.37	2.67	0.01	0.13	0.82
Central Stoneroller	N	H	N		8	12.63	1.94	0.01	0.13	1.13
Logperch	D	I	S	M	7	11.05	1.70	0.06	0.55	5.43
Yellow Bullhead		I	C	T	6	9.47	1.46	0.66	6.07	69.67
Rock Bass	S	C	C		6	9.47	1.46	0.21	1.88	21.67
Silverjaw Minnow	N	I	M		2	3.16	0.49	0.01	0.06	2.00
Spotted Bass	F	C	C		2	3.16	0.49	0.06	0.55	19.00
Rainbow Darter	D	I	S	M	2	3.16	0.49	0.01	0.05	1.50
Least Brook Lamprey		F	N		1	1.58	0.24	0.01	0.07	5.00
Redfin Shiner	N	I	N		1	1.58	0.24	0.00	0.02	1.00
Channel Catfish	F		C		1	1.58	0.24	1.90	17.42	1,200.00
Brindled Madtom		I	C	I	1	1.58	0.24	0.01	0.08	6.00
Longear Sf X Bluegill Sf					1	1.58	0.24	0.01	0.13	9.00
	Mile Total				412	650.53		10.88		
	Number of Species				24					
	Number of Hybrids				1					

River Code: **01-100**	Stream: **Federal Creek**	Sample Date: **1990**
River Mile: **11.40**	Location:	Date Range: 07/18/1990
Time Fished: 5520 sec	Drainage: 32.1 sq mi	Thru: 08/16/1990
Dist Fished: 0.42 km	Basin: Hocking River No of Passes: 2	Sampler Type: D
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Fantail Darter	D	I	C		146	104.29	23.32	0.11	1.63	1.05
Striped Shiner	N	I	S		130	92.86	20.77	0.43	6.45	4.68
Bluntnose Minnow	N	O	C	T	66	47.14	10.54	0.09	1.40	2.00
Creek Chub	N	G	N	T	52	37.14	8.31	0.04	0.64	1.16
Green Sunfish	S	I	C	T	41	29.29	6.55	0.66	9.84	22.63
Longear Sunfish	S	I	C	M	31	22.14	4.95	0.61	9.10	27.68
Bluegill Sunfish	S	I	C	P	26	18.57	4.15	0.26	3.91	14.17
Rock Bass	S	C	C		24	17.14	3.83	0.50	7.48	29.40
Yellow Bullhead		I	C	T	13	9.29	2.08	0.74	11.02	79.92
Golden Redhorse	R	I	S	M	10	7.14	1.60	1.14	16.91	159.40
Sand Shiner	N	I	M	M	10	7.14	1.60	0.01	0.18	1.70
Silverjaw Minnow	N	I	M		9	6.43	1.44	0.01	0.16	1.67
Johnny Darter	D	I	C		8	5.71	1.28	0.01	0.08	1.00
Greenside Darter	D	I	S	M	8	5.71	1.28	0.02	0.25	2.86
Central Stoneroller	N	H	N		7	5.00	1.12	0.01	0.13	1.82
Rainbow Darter	D	I	S	M	7	5.00	1.12	0.01	0.10	1.29
Gizzard Shad		O	M		5	3.57	0.80	0.56	8.29	156.40
White Sucker	W	O	S	T	5	3.57	0.80	0.53	7.87	148.40
Redfin Shiner	N	I	N		5	3.57	0.80	0.00	0.07	1.20
Hybrid X Sunfish					5	3.57	0.80	0.11	1.63	30.60
Blackside Darter	D	I	S		5	3.57	0.80	0.01	0.22	4.00
Northern Hog Sucker	R	I	S	M	4	2.86	0.64	0.34	4.99	117.50
Logperch	D	I	S	M	4	2.86	0.64	0.03	0.42	9.75
Spotted Bass	F	C	C		2	1.43	0.32	0.16	2.36	111.50
Largemouth Bass	F	C	C		2	1.43	0.32	0.15	2.25	106.00
Smallmouth Bass	F	C	C	M	1	0.71	0.16	0.18	2.64	249.00
	Mile Total				626	447.14		6.73		
	Number of Species				25					
	Number of Hybrids				1					

River Code: **01-100**	Stream: **Federal Creek**	Sample Date: **1985**
River Mile: **11.30**	Location:	Date Range: 08/29/1985
Time Fished:	Drainage: 32.1 sq mi	
Dist Fished: 0.00 km	Basin: Hocking River No of Passes: 1	Sampler Type:
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Golden Redhorse	R	I	S	M	8					
Northern Hog Sucker	R	I	S	M	10					
White Sucker	W	O	S	T	15					
Creek Chub	N	G	N	T	32					
Redfin Shiner	N	I	N		13					
Striped Shiner	N	I	S		123					
Sand Shiner	N	I	M	M	1					
Silverjaw Minnow	N	I	M		333					
Bluntnose Minnow	N	O	C	T	113					
Central Stoneroller	N	H	N		48					
Rock Bass	S	C	C		11					
Green Sunfish	S	I	C	T	7					
Johnny Darter	D	I	C		15					
Greenside Darter	D	I	S	M	11					
Fantail Darter	D	I	C		12					
	Mile Total				752					
	Number of Species				15					
	Number of Hybrids				0					

River Code: **01-100**	Stream: **Federal Creek**	Sample Date: **2004**
River Mile: **11.30**	Location:	Date Range: 08/17/2004
Time Fished: 6420 sec	Drainage: 32.1 sq mi	Thru: 09/15/2004
Dist Fished: 0.30 km	Basin: Hocking River No of Passes: 2	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Central Stoneroller	N	H	N		427	427.00	22.27	0.86	7.16	2.01
Creek Chub	N	G	N	T	296	296.00	15.44	1.19	9.86	4.00
Bluntnose Minnow	N	O	C	T	226	226.00	11.79	0.62	5.16	2.74
Greenside Darter	D	I	S	M	160	160.00	8.35	0.33	2.71	2.03
Striped Shiner	N	I	S		156	156.00	8.14	1.20	9.99	7.69
Johnny Darter	D	I	C		144	144.00	7.51	0.08	0.64	0.53
White Sucker	W	O	S	T	79	79.00	4.12	1.56	12.99	19.76
Longear Sunfish	S	I	C	M	66	66.00	3.44	1.10	9.14	16.64
Sand Shiner	N	I	M	M	61	61.00	3.18	0.10	0.83	1.64
Northern Hog Sucker	R	I	S	M	58	58.00	3.03	1.77	14.71	30.47
Fantail Darter	D	I	C		53	53.00	2.76	0.04	0.35	0.79
Silverjaw Minnow	N	I	M		48	48.00	2.50	0.06	0.53	1.33
Rock Bass	S	C	C		23	23.00	1.20	1.20	9.98	52.13
Green Sunfish	S	I	C	T	22	22.00	1.15	0.25	2.10	11.45
Blackside Darter	D	I	S		21	21.00	1.10	0.05	0.39	2.24
Rainbow Darter	D	I	S	M	17	17.00	0.89	0.01	0.04	0.29
Golden Redhorse	R	I	S	M	12	12.00	0.63	0.31	2.56	25.58
Banded Darter	D	I	S	I	12	12.00	0.63	0.01	0.09	0.92
Yellow Bullhead		I	C	T	10	10.00	0.52	1.10	9.17	110.20
Logperch	D	I	S	M	7	7.00	0.37	0.05	0.40	6.86
Suckermouth Minnow	N	I	S		6	6.00	0.31	0.03	0.22	4.33
Largemouth Bass	F	C	C		6	6.00	0.31	0.04	0.35	7.00
Western Blacknose Dace	N	G	S	T	2	2.00	0.10	0.00	0.01	0.50
Smallmouth Bass	F	C	C	M	2	2.00	0.10	0.07	0.56	33.50
Least Brook Lamprey		F	N		1	1.00	0.05	0.00	0.02	3.00
Spotfin Shiner	N	I	M		1	1.00	0.05	0.00	0.02	2.00
Bluegill Sunfish	S	I	C	P	1	1.00	0.05	0.00	0.02	3.00
	Mile Total				1,917	1,917.00		12.01		
	Number of Species				27					
	Number of Hybrids				0					

River Code: **01-100**	Stream: **Federal Creek**	Sample Date: **2004**
River Mile: **9.30**	Location:	Date Range: 09/07/2004
Time Fished: 7260 sec	Drainage: 60.0 sq mi	Thru: 09/28/2004
Dist Fished: 0.31 km	Basin: Hocking River No of Passes: 2	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	124	123.38	25.01	0.44	5.97	3.58
Striped Shiner	N	I	S		92	90.00	18.24	0.59	7.97	6.54
Bluntnose Minnow	N	O	C	T	39	37.44	7.59	0.07	0.91	1.77
Green Sunfish	S	I	C	T	30	29.94	6.07	0.12	1.60	3.93
Sand Shiner	N	I	M	M	31	29.69	6.02	0.05	0.72	1.77
Johnny Darter	D	I	C		29	28.06	5.69	0.01	0.20	0.52
Greenside Darter	D	I	S	M	20	19.00	3.85	0.02	0.27	1.05
Northern Hog Sucker	R	I	S	M	19	18.19	3.69	0.73	9.89	39.74
Spotfin Shiner	N	I	M		18	17.63	3.57	0.05	0.72	3.00
Trout-perch		I	M		17	16.50	3.34	0.04	0.58	2.59
Golden Redhorse	R	I	S	M	14	13.75	2.79	2.03	27.57	146.64
Fantail Darter	D	I	C		13	12.63	2.56	0.02	0.22	1.31
Banded Darter	D	I	S	I	12	11.56	2.34	0.01	0.11	0.67
Rock Bass	S	C	C		7	6.88	1.39	0.15	2.08	22.43
Central Stoneroller	N	H	N		6	6.00	1.22	0.00	0.05	0.67
Brindled Madtom		I	C	I	5	5.00	1.01	0.02	0.23	3.40
Blackside Darter	D	I	S		5	4.81	0.98	0.01	0.10	1.60
Smallmouth Bass	F	C	C	M	4	3.94	0.80	0.10	1.41	26.00
Bluegill Sunfish	S	I	C	P	4	3.81	0.77	0.02	0.32	6.25
Longear Sunfish	S	I	C	M	4	3.75	0.76	0.06	0.75	14.75
Largemouth Bass	F	C	C		3	2.94	0.60	0.01	0.19	4.67
Channel Catfish	F		C		2	1.88	0.38	2.48	33.71	1,325.00
Yellow Bullhead		I	C	T	2	1.88	0.38	0.18	2.42	95.00
Rainbow Darter	D	I	S	M	2	1.88	0.38	0.00	0.03	1.00
Black Redhorse	R	I	S	I	1	0.94	0.19	0.14	1.91	150.00
White Sucker	W	O	S	T	1	0.94	0.19	0.00	0.05	4.00
Emerald Shiner	N	I	S		1	0.94	0.19	0.00	0.04	3.00
	Mile Total				505	493.31		7.37		
	Number of Species				27					
	Number of Hybrids				0					

River Code: **01-100**	Stream: **Federal Creek**	Sample Date: **2004**
River Mile: **9.10**	Location:	Date Range: 08/11/2004
Time Fished: 8220 sec	Drainage: 60.0 sq mi	Thru: 09/15/2004
Dist Fished: 0.38 km	Basin: Hocking River No of Passes: 2	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	140	111.25	18.98	0.18	1.73	1.65
Longear Sunfish	S	I	C	M	100	79.33	13.54	0.32	3.03	4.03
Striped Shiner	N	I	S		88	70.17	11.97	0.50	4.74	7.09
Bluntnose Minnow	N	O	C	T	59	47.33	8.08	0.09	0.81	1.85
Northern Hog Sucker	R	I	S	M	46	36.75	6.27	2.71	25.45	73.28
Blackside Darter	D	I	S		37	29.58	5.05	0.05	0.47	1.68
Rock Bass	S	C	C		33	26.33	4.49	1.09	10.21	40.97
Sand Shiner	N	I	M	M	33	26.17	4.47	0.03	0.30	1.21
Golden Redhorse	R	I	S	M	24	18.92	3.23	2.61	24.56	136.75
Greenside Darter	D	I	S	M	23	18.17	3.10	0.02	0.17	1.00
Central Stoneroller	N	H	N		20	15.83	2.70	0.02	0.16	1.10
Johnny Darter	D	I	C		17	13.33	2.28	0.01	0.08	0.65
White Sucker	W	O	S	T	16	12.08	2.06	0.00	0.03	4.00
Silverjaw Minnow	N	I	M		15	11.58	1.98	0.01	0.14	1.27
Fantail Darter	D	I	C		15	11.42	1.95	0.02	0.19	1.80
Least Brook Lamprey		F	N		14	11.17	1.91	0.08	0.77	7.36
Banded Darter	D	I	S	I	12	9.42	1.61	0.01	0.10	1.08
Spotted Bass	F	C	C		10	8.08	1.38	0.13	1.19	15.30
Green Sunfish	S	I	C	T	7	5.67	0.97	0.04	0.39	7.43
Spotfin Shiner	N	I	M		6	4.92	0.84	0.02	0.15	3.17
Brindled Madtom		I	C	I	5	4.00	0.68	0.02	0.21	5.60
Logperch	D	I	S	M	5	4.00	0.68	0.04	0.33	9.00
Emerald Shiner	N	I	S		3	2.50	0.43	0.00	0.04	1.67
Smallmouth Bass	F	C	C	M	3	2.42	0.41	0.48	4.53	193.33
Rainbow Darter	D	I	S	M	2	1.67	0.28	0.00	0.01	0.50
Freshwater Drum			M	P	2	1.58	0.27	0.33	3.11	209.00
Eastern Sand Darter [S]	D	I	S	R	2	1.50	0.26	0.00	0.02	1.50
Channel Catfish	F		C		1	0.83	0.14	1.82	17.08	2,180.00
	Mile Total				738	586.00		10.64		
	Number of Species				28					
	Number of Hybrids				0					

River Code: **01-100**	Stream: **Federal Creek**	Sample Date: **2004**
River Mile: **4.90**	Location:	Date Range: 08/11/2004
Time Fished: 11640 sec	Drainage: 90.0 sq mi	Thru: 09/15/2004
Dist Fished: 0.32 km	Basin: Hocking River No of Passes: 2	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Golden Redhorse	R	I	S	M	35	32.18	18.59	4.72	33.73	148.89
Emerald Shiner	N	I	S		23	20.53	11.86	0.06	0.45	3.04
Striped Shiner	N	I	S		12	12.00	6.93	0.10	0.74	8.67
Longear Sunfish	S	I	C	M	12	11.88	6.87	0.19	1.34	15.67
Blackside Darter	D	I	S		12	11.53	6.66	0.01	0.10	1.25
Rock Bass	S	C	C		11	10.76	6.22	0.35	2.51	32.73
Spotfin Shiner	N	I	M		8	8.00	4.62	0.02	0.14	2.50
Spotted Bass	F	C	C		8	7.41	4.28	0.68	4.84	90.00
Johnny Darter	D	I	C		7	7.00	4.04	0.00	0.03	0.57
Greenside Darter	D	I	S	M	6	5.65	3.26	0.00	0.01	0.33
Bluegill Sunfish	S	I	C	P	5	4.88	2.82	0.09	0.61	17.20
Creek Chub	N	G	N	T	4	4.00	2.31	0.01	0.06	2.25
Sand Shiner	N	I	M	M	4	3.76	2.18	0.01	0.04	1.50
Bluntnose Minnow	N	O	C	T	4	3.76	2.18	0.01	0.04	1.50
Gizzard Shad		O	M		4	3.65	2.11	0.09	0.63	23.00
Northern Hog Sucker	R	I	S	M	3	2.76	1.60	0.08	0.57	28.00
Least Brook Lamprey		F	N		2	2.00	1.16	0.01	0.09	6.00
Brindled Madtom		I	C	I	2	2.00	1.16	0.02	0.14	9.50
Warmouth Sunfish	S	C	C		2	2.00	1.16	0.03	0.24	16.50
Banded Darter	D	I	S	I	2	2.00	1.16	0.00	0.01	0.50
Sauger X Walleye	E	P			2	2.00	1.16	0.78	5.57	390.00
Freshwater Drum			M	P	2	2.00	1.16	1.69	12.07	845.00
Trout-perch		I	M		2	1.88	1.09	0.00	0.03	2.50
Green Sunfish	S	I	C	T	2	1.88	1.09	0.02	0.11	8.50
Fantail Darter	D	I	C		2	1.88	1.09	0.00	0.02	1.50
Logperch	D	I	S	M	2	1.76	1.02	0.02	0.13	10.00
Common Carp	G	O	M	T	1	1.00	0.58	4.90	35.01	4,900.00
Flathead Catfish	F	P	C		1	1.00	0.58	0.08	0.54	75.00
Rainbow Darter	D	I	S	M	1	1.00	0.58	0.00	0.01	1.00
Smallmouth Bass	F	C	C	M	1	0.88	0.51	0.03	0.20	31.00
	Mile Total				182	173.06		14.00		
	Number of Species				29					
	Number of Hybrids				1					

River Code: **01-100**	Stream: **Federal Creek**	Sample Date: **1984**
River Mile: **1.30**	Location:	Date Range: 08/06/1984
Time Fished: 7020 sec	Drainage: 138.0 sq mi	Thru: 10/10/1984
Dist Fished: 0.60 km	Basin: Hocking River No of Passes: 3	Sampler Type: D
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Bluntnose Minnow	N	O	C	T	369	184.50	19.09	0.28	2.44	1.51
Sand Shiner	N	I	M	M	281	140.50	14.54	0.15	1.32	1.07
Central Stoneroller	N	H	N		185	92.50	9.57	0.44	3.82	4.73
Silverjaw Minnow	N	I	M		175	87.50	9.05	0.14	1.24	1.62
Spotfin Shiner	N	I	M		146	73.00	7.55	0.15	1.30	2.04
Banded Darter	D	I	S	I	120	60.00	6.21	0.05	0.45	0.86
Striped Shiner	N	I	S		79	39.50	4.09	0.13	1.09	3.18
Golden Redhorse	R	I	S	M	72	36.00	3.72	3.62	31.57	100.45
Emerald Shiner	N	I	S		51	25.50	2.64	0.04	0.32	1.43
Greenside Darter	D	I	S	M	51	25.50	2.64	0.03	0.29	1.29
Suckermouth Minnow	N	I	S		49	24.50	2.53	0.08	0.67	3.12
Northern Hog Sucker	R	I	S	M	48	24.00	2.48	1.28	11.18	53.38
Johnny Darter	D	I	C		43	21.50	2.22	0.02	0.15	0.77
Fantail Darter	D	I	C		41	20.50	2.12	0.01	0.12	0.66
Creek Chub	N	G	N	T	36	18.00	1.86	0.07	0.60	3.83
Rock Bass	S	C	C		35	17.50	1.81	0.87	7.62	49.89
Rainbow Darter	D	I	S	M	25	12.50	1.29	0.01	0.07	0.67
Brindled Madtom		I	C	I	23	11.50	1.19	0.05	0.39	3.91
White Sucker	W	O	S	T	17	8.50	0.88	0.44	3.82	51.47
Spotted Bass	F	C	C		13	6.50	0.67	0.16	1.38	24.31
Channel Catfish	F		C		10	5.00	0.52	0.38	3.34	76.40
Eastern Sand Darter [S]	D	I	S	R	9	4.50	0.47	0.01	0.07	1.67
Gizzard Shad		O	M		8	4.00	0.41	0.77	6.70	192.00
Smallmouth Bass	F	C	C	M	6	3.00	0.31	0.38	3.30	126.00
Least Brook Lamprey		F	N		5	2.50	0.26	0.02	0.19	8.80
Logperch	D	I	S	M	5	2.50	0.26	0.02	0.20	9.20
Freshwater Drum			M	P	5	2.50	0.26	0.87	7.62	349.00
Trout-perch		I	M		3	1.50	0.16	0.01	0.07	5.00
White Crappie	S	I	C		3	1.50	0.16	0.14	1.26	96.33
River Redhorse [S]	R	I	S	I	2	1.00	0.10	0.00	0.02	2.50
Goldfish	G	O	M	T	2	1.00	0.10	0.14	1.20	138.00
Western Blacknose Dace	N	G	S	T	2	1.00	0.10	0.00	0.01	1.00
Green Sunfish	S	I	C	T	2	1.00	0.10	0.04	0.31	36.00
Green Sf X Longear Sf					2	1.00	0.10	0.06	0.52	59.50
Quillback Carpsucker	C	O	M		1	0.50	0.05	0.01	0.04	10.00
Silver Redhorse	R	I	S	M	1	0.50	0.05	0.00	0.03	8.00
Shorthead Redhorse	R	I	S	M	1	0.50	0.05	0.02	0.16	36.00
Common Carp	G	O	M	T	1	0.50	0.05	0.50	4.35	996.00
Mimic Shiner	N	I	M	I	1	0.50	0.05	0.00	0.01	2.00
Brook Silverside		I	M	M	1	0.50	0.05	0.00	0.01	1.00
White Bass	F	P	M		1	0.50	0.05	0.00	0.03	6.00
Longear Sunfish	S	I	C	M	1	0.50	0.05	0.02	0.15	34.00
Green Sf X Bluegill Sf					1	0.50	0.05	0.03	0.25	58.00
Longear Sf X Bluegill Sf					1	0.50	0.05	0.04	0.33	76.00
	Mile Total				1,933	966.50		11.45		
	Number of Species				41					
	Number of Hybrids				3					

River Code: **01-100**	Stream: **Federal Creek**	Sample Date: **1990**
River Mile: **1.30**	Location:	Date Range: 07/19/1990
Time Fished: 6720 sec	Drainage: 138.0 sq mi	Thru: 08/16/1990
Dist Fished: 0.50 km	Basin: Hocking River No of Passes: 2	Sampler Type: D
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Central Stoneroller	N	H	N		88	52.80	23.40	0.13	4.63	2.48
Fantail Darter	D	I	C		43	25.80	11.44	0.02	0.81	0.88
Banded Darter	D	I	S	I	32	19.20	8.51	0.03	1.06	1.56
Bluntnose Minnow	N	O	C	T	25	15.00	6.65	0.02	0.85	1.60
Creek Chub	N	G	N	T	23	13.80	6.12	0.01	0.25	0.50
Spotfin Shiner	N	I	M		20	12.00	5.32	0.01	0.46	1.10
Greenside Darter	D	I	S	M	19	11.40	5.05	0.04	1.26	3.11
Golden Redhorse	R	I	S	M	13	7.80	3.46	0.74	26.06	94.52
Johnny Darter	D	I	C		13	7.80	3.46	0.01	0.21	0.75
Rainbow Darter	D	I	S	M	13	7.80	3.46	0.01	0.34	1.23
Steelcolor Shiner	N	I	M	P	11	6.60	2.93	0.01	0.27	1.09
Rock Bass	S	C	C		11	6.60	2.93	0.29	10.32	44.27
Northern Hog Sucker	R	I	S	M	9	5.40	2.39	0.18	6.24	32.67
Striped Shiner	N	I	S		8	4.80	2.13	0.09	3.09	18.25
Sand Shiner	N	I	M	M	7	4.20	1.86	0.01	0.25	1.71
Largemouth Bass	F	C	C		7	4.20	1.86	0.44	15.61	105.14
Bluegill Sunfish	S	I	C	P	7	4.20	1.86	0.03	0.90	6.06
Gizzard Shad		O	M		6	3.60	1.60	0.34	12.13	95.33
Spotted Bass	F	C	C		4	2.40	1.06	0.14	4.90	57.75
Brindled Madtom		I	C	I	3	1.80	0.80	0.01	0.21	3.33
Freshwater Drum			M	P	3	1.80	0.80	0.24	8.41	132.33
Green Sunfish	S	I	C	T	2	1.20	0.53	0.01	0.27	6.00
Blackside Darter	D	I	S		2	1.20	0.53	0.00	0.09	2.00
Eastern Sand Darter [S]	D	I	S	R	2	1.20	0.53	0.00	0.04	1.00
Silver Redhorse	R	I	S	M	1	0.60	0.27	0.03	1.06	50.00
Silverjaw Minnow	N	I	M		1	0.60	0.27	0.00	0.02	1.00
Fathead Minnow	N	O	C	T	1	0.60	0.27	0.00	0.02	1.00
Yellow Bullhead		I	C	T	1	0.60	0.27	0.00	0.07	3.00
Sauger	F	P	S		1	0.60	0.27	0.01	0.19	9.00
	Mile Total				376	225.60		2.83		
	Number of Species				29					
	Number of Hybrids				0					

River Code: **01-100**	Stream: **Federal Creek**	Sample Date: **2004**
River Mile: **0.90**	Location:	Date Range: 09/07/2004
Time Fished: 3600 sec	Drainage: 139.0 sq mi	
Dist Fished: 0.20 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Gizzard Shad		O	M		440	660.00	44.13	0.99	15.66	1.50
Emerald Shiner	N	I	S		56	84.00	5.62	0.21	3.31	2.50
Striped Shiner	N	I	S		48	72.00	4.81	0.22	3.50	3.08
Johnny Darter	D	I	C		45	67.50	4.51	0.04	0.65	0.60
Creek Chub	N	G	N	T	43	64.50	4.31	0.13	2.08	2.05
Sand Shiner	N	I	M	M	40	60.00	4.01	0.08	1.28	1.35
Bluntnose Minnow	N	O	C	T	36	54.00	3.61	0.10	1.61	1.89
Silverjaw Minnow	N	I	M		35	52.50	3.51	0.08	1.31	1.57
Golden Redhorse	R	I	S	M	34	51.00	3.41	1.43	22.61	28.09
Trout-perch		I	M		31	46.50	3.11	0.12	1.88	2.55
Northern Hog Sucker	R	I	S	M	28	42.00	2.81	0.80	12.64	19.07
Central Stoneroller	N	H	N		25	37.50	2.51	0.07	1.07	1.80
Spotfin Shiner	N	I	M		23	34.50	2.31	0.09	1.47	2.70
Blackside Darter	D	I	S		19	28.50	1.91	0.05	0.84	1.84
Greenside Darter	D	I	S	M	11	16.50	1.10	0.01	0.19	0.73
Freshwater Drum			M	P	11	16.50	1.10	0.05	0.79	3.00
Largemouth Bass	F	C	C		9	13.50	0.90	0.23	3.69	17.33
White Sucker	W	O	S	T	8	12.00	0.80	0.12	1.89	10.00
Smallmouth Bass	F	C	C	M	7	10.50	0.70	0.10	1.61	9.71
Spotted Bass	F	C	C		7	10.50	0.70	0.63	9.97	60.14
Green Sunfish	S	I	C	T	6	9.00	0.60	0.09	1.42	10.00
Eastern Sand Darter [S]	D	I	S	R	6	9.00	0.60	0.01	0.13	0.83
Channel Catfish	F		C		5	7.50	0.50	0.36	5.73	48.40
Longear Sunfish	S	I	C	M	5	7.50	0.50	0.14	2.26	19.00
Steelcolor Shiner	N	I	M	P	4	6.00	0.40	0.03	0.47	5.00
Logperch	D	I	S	M	4	6.00	0.40	0.04	0.60	6.25
Rainbow Darter	D	I	S	M	4	6.00	0.40	0.00	0.05	0.50
Banded Darter	D	I	S	I	2	3.00	0.20	0.00	0.03	0.50
Least Brook Lamprey		F	N		1	1.50	0.10	0.02	0.24	10.00
Common Carp	G	O	M	T	1	1.50	0.10	0.05	0.71	30.00
Brindled Madtom		I	C	I	1	1.50	0.10	0.02	0.24	10.00
Bluegill Sunfish	S	I	C	P	1	1.50	0.10	0.01	0.14	6.00
Fantail Darter	D	I	C		1	1.50	0.10	0.00	0.05	2.00
	Mile Total				997	1,495.50		6.34		
	Number of Species				33					
	Number of Hybrids				0					

River Code: **01-101**	Stream: **Kasler Creek (-19)**	Sample Date: **2004**
River Mile: **1.75**	Location:	Date Range: 08/19/2004
Time Fished: 3000 sec	Drainage: 3.7 sq mi	
Dist Fished: 0.14 km	Basin: No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	225	482.14	49.89			
South. Redbelly Dace	N	H	S		59	126.43	13.08			
Fantail Darter	D	I	C		35	75.00	7.76			
Central Stoneroller	N	H	N		34	72.86	7.54			
Western Blacknose Dace	N	G	S	T	24	51.43	5.32			
Striped Shiner	N	I	S		24	51.43	5.32			
White Sucker	W	O	S	T	17	36.43	3.77			
Bluntnose Minnow	N	O	C	T	17	36.43	3.77			
Johnny Darter	D	I	C		5	10.71	1.11			
Yellow Bullhead		I	C	T	4	8.57	0.89			
Rainbow Darter	D	I	S	M	3	6.43	0.67			
Longear Sunfish	S	I	C	M	2	4.29	0.44			
Green Sunfish	S	I	C	T	1	2.14	0.22			
Bluegill Sunfish	S	I	C	P	1	2.14	0.22			
	Mile Total				451	966.43				
	Number of Species				14					
	Number of Hybrids				0					

River Code: **01-110**	Stream: **Sharps Run**	Sample Date: **1995**
River Mile: **2.40**	Location:	Date Range: 08/03/1995
Time Fished:	Drainage: 1.5 sq mi	Thru: 12/02/1995
Dist Fished: 0.12 km	Basin: Hocking River No of Passes: 3	Sampler Type: H
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
South. Redbelly Dace	N	H	S		169	422.50	80.48	0.24	58.87	0.57
Creek Chub	N	G	N	T	18	45.00	8.57	0.08	20.28	1.83
Western Blacknose Dace	N	G	S	T	7	17.50	3.33	0.02	3.76	0.86
Fantail Darter	D	I	C		6	15.00	2.86	0.02	4.33	1.17
Central Stoneroller	N	H	N		4	10.00	1.90	0.03	8.01	3.25
Orangethroat Darter	D	I	S		3	7.50	1.43	0.01	3.11	1.67
Johnny Darter	D	I	C		2	5.00	0.95	0.01	1.23	1.00
Bluntnose Minnow	N	O	C	T	1	2.50	0.48	0.00	0.65	1.00
	Mile Total				210	525.00		0.41		
	Number of Species				8					
	Number of Hybrids				0					

River Code: **01-110**	Stream: **Sharps Run**	Sample Date: **1987**
River Mile: **2.00**	Location:	Date Range: 09/22/1987
Time Fished:	Drainage:	
Dist Fished: 0.00 km	Basin: Hocking River No of Passes: 1	Sampler Type:
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Golden Redhorse	R	I	S	M	25					
Northern Hog Sucker	R	I	S	M	12					
White Sucker	W	O	S	T	9					
Western Blacknose Dace	N	G	S	T	2					
Creek Chub	N	G	N	T	41					
Redfin Shiner	N	I	N		22					
Striped Shiner	N	I	S		106					
Spotfin Shiner	N	I	M		1					
Silverjaw Minnow	N	I	M		81					
Bluntnose Minnow	N	O	C	T	111					
Central Stoneroller	N	H	N		13					
Yellow Bullhead		I	C	T	1					
Rock Bass	S	C	C		7					
Green Sunfish	S	I	C	T	11					
Pumpkinseed Sunfish	S	I	C	P	4					
					2					
Blackside Darter	D	I	S		2					
Johnny Darter	D	I	C		39					
Orangethroat Darter	D	I	S		7					
Fantail Darter	D	I	C		3					
	Mile Total				499					
	Number of Species				20					
	Number of Hybrids				0					

River Code: **01-110**	Stream: **Sharps Run**	Sample Date: **2004**
River Mile: **0.01**	Location:	Date Range: 09/03/2004
Time Fished: 3600 sec	Drainage: 4.9 sq mi	
Dist Fished: 0.16 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	212	397.50	23.87	1.01	22.69	2.54
Central Stoneroller	N	H	N		173	324.38	19.48	0.50	11.27	1.54
Greenside Darter	D	I	S	M	116	217.50	13.06	0.18	4.14	0.84
Banded Darter	D	I	S	I	110	206.25	12.39	0.16	3.58	0.77
Fantail Darter	D	I	C		55	103.13	6.19	0.09	1.93	0.84
Rainbow Darter	D	I	S	M	44	82.50	4.95	0.04	0.81	0.43
Northern Hog Sucker	R	I	S	M	38	71.25	4.28	1.78	40.06	25.00
Johnny Darter	D	I	C		32	60.00	3.60	0.02	0.52	0.38
Silverjaw Minnow	N	I	M		26	48.75	2.93	0.04	0.81	0.73
Striped Shiner	N	I	S		21	39.38	2.36	0.32	7.22	8.14
Western Blacknose Dace	N	G	S	T	19	35.63	2.14	0.01	0.29	0.37
Sand Shiner	N	I	M	M	17	31.88	1.91	0.04	0.92	1.29
Bluntnose Minnow	N	O	C	T	11	20.63	1.24	0.03	0.58	1.27
Blackside Darter	D	I	S		3	5.63	0.34	0.02	0.43	3.33
Golden Redhorse	R	I	S	M	2	3.75	0.23	0.16	3.51	41.50
White Sucker	W	O	S	T	2	3.75	0.23	0.01	0.13	1.50
Green Sunfish	S	I	C	T	2	3.75	0.23	0.01	0.20	2.50
Least Brook Lamprey		F	N		1	1.88	0.11	0.01	0.25	6.00
Spotfin Shiner	N	I	M		1	1.88	0.11	0.00	0.09	2.00
Yellow Bullhead		I	C	T	1	1.88	0.11	0.00	0.04	1.00
Smallmouth Bass	F	C	C	M	1	1.88	0.11	0.00	0.04	1.00
Longear Sunfish	S	I	C	M	1	1.88	0.11	0.02	0.52	12.00
	Mile Total				888	1,665.00		4.45		
	Number of Species				22					
	Number of Hybrids				0					

River Code: **01-130**	Stream: **Big Run**	Sample Date: **1995**
River Mile: **3.90**	Location:	Date Range: 08/09/1995
Time Fished: 3600 sec	Drainage: 4.2 sq mi	
Dist Fished: 0.16 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	360	675.00	29.61			
Central Stoneroller	N	H	N		227	425.63	18.67			
White Sucker	W	O	S	T	171	320.63	14.06			
South. Redbelly Dace	N	H	S		123	230.63	10.12			
Bluntnose Minnow	N	O	C	T	95	178.13	7.81			
Striped Shiner	N	I	S		74	138.75	6.09			
Western Blacknose Dace	N	G	S	T	46	86.25	3.78			
Rainbow Darter	D	I	S	M	30	56.25	2.47			
Fantail Darter	D	I	C		23	43.13	1.89			
Johnny Darter	D	I	C		16	30.00	1.32			
Redside Dace	N	I	S	I	14	26.25	1.15			
Silverjaw Minnow	N	I	M		9	16.88	0.74			
Northern Hog Sucker	R	I	S	M	6	11.25	0.49			
Rock Bass	S	C	C		6	11.25	0.49			
Trout-perch		I	M		4	7.50	0.33			
Least Brook Lamprey		F	N		3	5.63	0.25			
Common Shiner	N	I	S		3	5.63	0.25			
Spotted Bass	F	C	C		2	3.75	0.16			
Orangethroat Darter	D	I	S		2	3.75	0.16			
Golden Redhorse	R	I	S	M	1	1.88	0.08			
Green Sunfish	S	I	C	T	1	1.88	0.08			
	Mile Total				1,216	2,280.00				
	Number of Species				21					
	Number of Hybrids				0					

River Code: **01-130**	Stream: **Big Run**	Sample Date: **2004**
River Mile: **3.90**	Location:	Date Range: 09/02/2004
Time Fished: 2580 sec	Drainage: 4.2 sq mi	
Dist Fished: 0.15 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	112	224.00	22.63			
South. Redbelly Dace	N	H	S		73	146.00	14.75			
Central Stoneroller	N	H	N		51	102.00	10.30			
White Sucker	W	O	S	T	49	98.00	9.90			
Western Blacknose Dace	N	G	S	T	34	68.00	6.87			
Striped Shiner	N	I	S		34	68.00	6.87			
Bluntnose Minnow	N	O	C	T	32	64.00	6.46			
Johnny Darter	D	I	C		32	64.00	6.46			
Fantail Darter	D	I	C		30	60.00	6.06			
Least Brook Lamprey		F	N		9	18.00	1.82			
Green Sunfish	S	I	C	T	8	16.00	1.62			
Orangethroat Darter	D	I	S		7	14.00	1.41			
Silverjaw Minnow	N	I	M		5	10.00	1.01			
Rock Bass	S	C	C		5	10.00	1.01			
Redside Dace	N	I	S	I	4	8.00	0.81			
Rainbow Darter	D	I	S	M	3	6.00	0.61			
Trout-perch		I	M		2	4.00	0.40			
Bluegill Sunfish	S	I	C	P	2	4.00	0.40			
Redside D X Striped Sh		I	S		1	2.00	0.20			
Largemouth Bass	F	C	C		1	2.00	0.20			
Green Sf X Bluegill Sf					1	2.00	0.20			
	Mile Total				495	990.00				
	Number of Species				19					
	Number of Hybrids				2					

River Code: **01-130**	Stream: **Big Run**	Sample Date: **2004**
River Mile: **1.70**	Location:	Date Range: 09/02/2004
Time Fished: 2880 sec	Drainage: 9.0 sq mi	
Dist Fished: 0.15 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Bluntnose Minnow	N	O	C	T	133	266.00	20.65			
White Sucker	W	O	S	T	103	206.00	15.99			
Central Stoneroller	N	H	N		103	206.00	15.99			
Striped Shiner	N	I	S		90	180.00	13.98			
Creek Chub	N	G	N	T	81	162.00	12.58			
Green Sunfish	S	I	C	T	25	50.00	3.88			
Silverjaw Minnow	N	I	M		21	42.00	3.26			
Rock Bass	S	C	C		15	30.00	2.33			
Trout-perch		I	M		11	22.00	1.71			
Blackside Darter	D	I	S		9	18.00	1.40			
Northern Hog Sucker	R	I	S	M	8	16.00	1.24			
Bluegill Sunfish	S	I	C	P	8	16.00	1.24			
Johnny Darter	D	I	C		8	16.00	1.24			
Largemouth Bass	F	C	C		7	14.00	1.09			
Western Blacknose Dace	N	G	S	T	6	12.00	0.93			
Longear Sunfish	S	I	C	M	4	8.00	0.62			
Redfin Shiner	N	I	N		3	6.00	0.47			
Rainbow Darter	D	I	S	M	3	6.00	0.47			
Least Brook Lamprey		F	N		2	4.00	0.31			
Fantail Darter	D	I	C		2	4.00	0.31			
Spotfin Shiner	N	I	M		1	2.00	0.16			
White Crappie	S	I	C		1	2.00	0.16			
	Mile Total				644	1,288.00				
	Number of Species				22					
	Number of Hybrids				0					

River Code: **01-130**	Stream: **Big Run**	Sample Date: **1995**
River Mile: **0.20**	Location:	Date Range: 07/26/1995
Time Fished: 4500 sec	Drainage: 11.8 sq mi	
Dist Fished: 0.15 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	263	526.00	28.90			
Bluntnose Minnow	N	O	C	T	226	452.00	24.84			
Central Stoneroller	N	H	N		173	346.00	19.01			
Rainbow Darter	D	I	S	M	61	122.00	6.70			
Johnny Darter	D	I	C		52	104.00	5.71			
Striped Shiner	N	I	S		32	64.00	3.52			
Silverjaw Minnow	N	I	M		26	52.00	2.86			
Fantail Darter	D	I	C		20	40.00	2.20			
White Sucker	W	O	S	T	18	36.00	1.98			
Western Blacknose Dace	N	G	S	T	8	16.00	0.88			
Golden Redhorse	R	I	S	M	7	14.00	0.77			
South. Redbelly Dace	N	H	S		6	12.00	0.66			
Greenside Darter	D	I	S	M	6	12.00	0.66			
Northern Hog Sucker	R	I	S	M	4	8.00	0.44			
Rock Bass	S	C	C		4	8.00	0.44			
Least Brook Lamprey		F	N		3	6.00	0.33			
Banded Darter	D	I	S	I	1	2.00	0.11			
	Mile Total				910	1,820.00				
	Number of Species				17					
	Number of Hybrids				0					

River Code: **01-131**	Stream: **Ellis Run**	Sample Date: **1995**
River Mile: **0.50**	Location:	Date Range: 07/26/1995
Time Fished: 2100 sec	Drainage: 1.3 sq mi	
Dist Fished: 0.07 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	235	1,007.14	33.33			
South. Redbelly Dace	N	H	S		194	831.43	27.52			
Western Blacknose Dace	N	G	S	T	105	450.00	14.89			
Central Stoneroller	N	H	N		58	248.57	8.23			
Fantail Darter	D	I	C		44	188.57	6.24			
White Sucker	W	O	S	T	18	77.14	2.55			
Johnny Darter	D	I	C		13	55.71	1.84			
Rainbow Darter	D	I	S	M	13	55.71	1.84			
Striped Shiner	N	I	S		10	42.86	1.42			
Bluegill Sunfish	S	I	C	P	7	30.00	0.99			
Bluntnose Minnow	N	O	C	T	3	12.86	0.43			
Redside Dace	N	I	S	I	1	4.29	0.14			
Silverjaw Minnow	N	I	M		1	4.29	0.14			
Largemouth Bass	F	C	C		1	4.29	0.14			
Green Sf X Bluegill Sf					1	4.29	0.14			
Greenside Darter	D	I	S	M	1	4.29	0.14			
	Mile Total				705	3,021.43				
	Number of Species				15					
	Number of Hybrids				1					

River Code: **01-132**	Stream: **Joes Run**	Sample Date: **1995**
River Mile: **0.10**	Location: at mouth	Date Range: 07/26/1995
Time Fished: 2400 sec	Drainage: 0.9 sq mi	
Dist Fished: 0.15 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	147	294.00	40.05			
South. Redbelly Dace	N	H	S		92	184.00	25.07			
Western Blacknose Dace	N	G	S	T	38	76.00	10.35			
Fantail Darter	D	I	C		22	44.00	5.99			
Johnny Darter	D	I	C		19	38.00	5.18			
White Sucker	W	O	S	T	15	30.00	4.09			
Central Stoneroller	N	H	N		12	24.00	3.27			
Rainbow Darter	D	I	S	M	8	16.00	2.18			
Bluntnose Minnow	N	O	C	T	5	10.00	1.36			
Striped Shiner	N	I	S		3	6.00	0.82			
Redside Dace	N	I	S	I	2	4.00	0.54			
Green Sunfish	S	I	C	T	2	4.00	0.54			
Largemouth Bass	F	C	C		1	2.00	0.27			
Orangethroat Darter	D	I	S		1	2.00	0.27			
	Mile Total				367	734.00				
	Number of Species				14					
	Number of Hybrids				0					

River Code: **01-133**	Stream: **Wildcat Run**	Sample Date: **1995**
River Mile: **0.10**	Location: at mouth	Date Range: 08/09/1995
Time Fished: 3540 sec	Drainage: 1.7 sq mi	
Dist Fished: 0.10 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
South. Redbelly Dace	N	H	S		96	288.00	31.17			
Creek Chub	N	G	N	T	75	225.00	24.35			
Bluntnose Minnow	N	O	C	T	28	84.00	9.09			
Western Blacknose Dace	N	G	S	T	24	72.00	7.79			
Central Stoneroller	N	H	N		24	72.00	7.79			
White Sucker	W	O	S	T	18	54.00	5.84			
Silverjaw Minnow	N	I	M		11	33.00	3.57			
Johnny Darter	D	I	C		10	30.00	3.25			
Fantail Darter	D	I	C		10	30.00	3.25			
Rainbow Darter	D	I	S	M	7	21.00	2.27			
Striped Shiner	N	I	S		2	6.00	0.65			
Least Brook Lamprey		F	N		1	3.00	0.32			
Cr Chub X S. Redbelly D					1	3.00	0.32			
Orangethroat Darter	D	I	S		1	3.00	0.32			
	Mile Total				308	924.00				
	Number of Species				13					
	Number of Hybrids				1					

River Code: **01-134**	Stream: **Sulphur Run**	Sample Date: **2004**
River Mile: **0.80**	Location:	Date Range: 08/06/2004
Time Fished: 2820 sec	Drainage: 1.0 sq mi	
Dist Fished: 0.11 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
South. Redbelly Dace	N	H	S		448	1,221.82	57.22			
Creek Chub	N	G	N	T	229	624.55	29.25			
White Sucker	W	O	S	T	40	109.09	5.11			
Longear Sunfish	S	I	C	M	30	81.82	3.83			
Western Blacknose Dace	N	G	S	T	12	32.73	1.53			
Johnny Darter	D	I	C		12	32.73	1.53			
Green Sunfish	S	I	C	T	5	13.64	0.64			
Striped Shiner	N	I	S		4	10.91	0.51			
Central Stoneroller	N	H	N		2	5.46	0.26			
Bluntnose Minnow	N	O	C	T	1	2.73	0.13			
	Mile Total				783	2,135.46				
	Number of Species				10					
	Number of Hybrids				0					

River Code: **01-134**	Stream: **Sulphur Run**	Sample Date: **2004**
River Mile: **0.01**	Location:	Date Range: 08/10/2004
Time Fished: 1800 sec	Drainage: 1.7 sq mi	
Dist Fished: 0.10 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	74	222.00	27.41			
South. Redbelly Dace	N	H	S		64	192.00	23.70			
Central Stoneroller	N	H	N		39	117.00	14.44			
Western Blacknose Dace	N	G	S	T	29	87.00	10.74			
White Sucker	W	O	S	T	16	48.00	5.93			
Johnny Darter	D	I	C		16	48.00	5.93			
Rainbow Darter	D	I	S	M	13	39.00	4.81			
Bluntnose Minnow	N	O	C	T	9	27.00	3.33			
Longear Sunfish	S	I	C	M	4	12.00	1.48			
Fantail Darter	D	I	C		4	12.00	1.48			
Hybrid X Minnow					2	6.00	0.74			
	Mile Total				270	810.00				
	Number of Species				10					
	Number of Hybrids				1					

River Code: **01-140**	Stream: **Spruce Run**	Sample Date: **1995**
River Mile: **0.20**	Location:	Date Range: 07/27/1995
Time Fished: 2460 sec	Drainage: 1.4 sq mi	
Dist Fished: 0.15 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	287	574.00	36.61			
South. Redbelly Dace	N	H	S		209	418.00	26.66			
Western Blacknose Dace	N	G	S	T	58	116.00	7.40			
Central Stoneroller	N	H	N		51	102.00	6.51			
White Sucker	W	O	S	T	40	80.00	5.10			
Fantail Darter	D	I	C		30	60.00	3.83			
Rainbow Darter	D	I	S	M	24	48.00	3.06			
Johnny Darter	D	I	C		21	42.00	2.68			
Green Sunfish	S	I	C	T	20	40.00	2.55			
Redside Dace	N	I	S	I	15	30.00	1.91			
Bluntnose Minnow	N	O	C	T	11	22.00	1.40			
Silverjaw Minnow	N	I	M		8	16.00	1.02			
Striped Shiner	N	I	S		6	12.00	0.77			
Golden Redhorse	R	I	S	M	1	2.00	0.13			
Trout-perch		I	M		1	2.00	0.13			
Bluegill Sunfish	S	I	C	P	1	2.00	0.13			
Orangethroat Darter	D	I	S		1	2.00	0.13			
	Mile Total				784	1,568.00				
	Number of Species				17					
	Number of Hybrids				0					

River Code: **01-150**	Stream: **Marietta Run**	Sample Date: **2004**
River Mile: **3.20**	Location:	Date Range: 07/28/2004
Time Fished: 6000 sec	Drainage: 5.5 sq mi	
Dist Fished: 0.17 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	374	660.00	45.72			
Fantail Darter	D	I	C		106	187.06	12.96			
South. Redbelly Dace	N	H	S		75	132.35	9.17			
Western Blacknose Dace	N	G	S	T	70	123.53	8.56			
White Sucker	W	O	S	T	46	81.18	5.62			
Central Stoneroller	N	H	N		34	60.00	4.16			
Johnny Darter	D	I	C		25	44.12	3.06			
Rainbow Darter	D	I	S	M	24	42.35	2.93			
Redside Dace	N	I	S	I	22	38.82	2.69			
Trout-perch		I	M		10	17.65	1.22			
Greenside Darter	D	I	S	M	10	17.65	1.22			
Blackside Darter	D	I	S		7	12.35	0.86			
Least Brook Lamprey		F	N		3	5.29	0.37			
Striped Shiner	N	I	S		3	5.29	0.37			
Silverjaw Minnow	N	I	M		3	5.29	0.37			
Bluntnose Minnow	N	O	C	T	2	3.53	0.24			
Rock Bass	S	C	C		2	3.53	0.24			
Northern Hog Sucker	R	I	S	M	1	1.77	0.12			
Green Sunfish	S	I	C	T	1	1.77	0.12			
	Mile Total				818	1,443.53				
	Number of Species				19					
	Number of Hybrids				0					

River Code: **01-150**	Stream: **Marietta Run**	Sample Date: **2004**
River Mile: **1.60**	Location:	Date Range: 08/09/2004
Time Fished: 3600 sec	Drainage: 8.0 sq mi	
Dist Fished: 0.16 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	425	796.88	63.62			
Central Stoneroller	N	H	N		45	84.38	6.74			
Western Blacknose Dace	N	G	S	T	42	78.75	6.29			
Fantail Darter	D	I	C		33	61.88	4.94			
South. Redbelly Dace	N	H	S		31	58.13	4.64			
Rainbow Darter	D	I	S	M	27	50.63	4.04			
Johnny Darter	D	I	C		25	46.88	3.74			
Striped Shiner	N	I	S		19	35.63	2.84			
Least Brook Lamprey		F	N		5	9.38	0.75			
Green Sunfish	S	I	C	T	4	7.50	0.60			
Greenside Darter	D	I	S	M	4	7.50	0.60			
White Sucker	W	O	S	T	2	3.75	0.30			
Green Sf X Bluegill Sf					2	3.75	0.30			
Bluntnose Minnow	N	O	C	T	1	1.88	0.15			
Rock Bass	S	C	C		1	1.88	0.15			
Longear Sunfish	S	I	C	M	1	1.88	0.15			
Blackside Darter	D	I	S		1	1.88	0.15			
	Mile Total				668	1,252.50				
	Number of Species				16					
	Number of Hybrids				1					

River Code: **01-150**	Stream: **Marietta Run**	Sample Date: **1995**
River Mile: **0.10**	Location: at mouth	Date Range: 07/18/1995
Time Fished: 4080 sec	Drainage: 10.1 sq mi	
Dist Fished: 0.20 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	203	304.50	30.39			
Central Stoneroller	N	H	N		129	193.50	19.31			
Striped Shiner	N	I	S		79	118.50	11.83			
Bluntnose Minnow	N	O	C	T	74	111.00	11.08			
White Sucker	W	O	S	T	49	73.50	7.34			
Silverjaw Minnow	N	I	M		37	55.50	5.54			
Johnny Darter	D	I	C		24	36.00	3.59			
Rainbow Darter	D	I	S	M	20	30.00	2.99			
Fantail Darter	D	I	C		18	27.00	2.69			
Western Blacknose Dace	N	G	S	T	7	10.50	1.05			
Least Brook Lamprey		F	N		5	7.50	0.75			
Green Sunfish	S	I	C	T	5	7.50	0.75			
Greenside Darter	D	I	S	M	5	7.50	0.75			
Northern Hog Sucker	R	I	S	M	3	4.50	0.45			
Suckermouth Minnow	N	I	S		2	3.00	0.30			
South. Redbelly Dace	N	H	S		2	3.00	0.30			
Trout-perch		I	M		2	3.00	0.30			
Yellow Bullhead		I	C	T	1	1.50	0.15			
Rock Bass	S	C	C		1	1.50	0.15			
Bluegill Sunfish	S	I	C	P	1	1.50	0.15			
Green Sf X Bluegill Sf					1	1.50	0.15			
	Mile Total				668	1,002.00				
	Number of Species				20					
	Number of Hybrids				1					

River Code: **01-150**	Stream: **Marietta Run**	Sample Date: **2004**
River Mile: **0.10**	Location: at mouth	Date Range: 07/28/2004
Time Fished: 6000 sec	Drainage: 10.1 sq mi	
Dist Fished: 0.16 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	366	686.25	54.63			
Bluntnose Minnow	N	O	C	T	78	146.25	11.64			
Central Stoneroller	N	H	N		48	90.00	7.16			
White Sucker	W	O	S	T	47	88.13	7.01			
Striped Shiner	N	I	S		30	56.25	4.48			
Silverjaw Minnow	N	I	M		26	48.75	3.88			
Johnny Darter	D	I	C		20	37.50	2.99			
Fantail Darter	D	I	C		13	24.38	1.94			
Western Blacknose Dace	N	G	S	T	7	13.13	1.04			
Greenside Darter	D	I	S	M	7	13.13	1.04			
Northern Hog Sucker	R	I	S	M	6	11.25	0.90			
Green Sunfish	S	I	C	T	5	9.38	0.75			
Least Brook Lamprey		F	N		4	7.50	0.60			
Blackside Darter	D	I	S		4	7.50	0.60			
Largemouth Bass	F	C	C		3	5.63	0.45			
Sand Shiner	N	I	M	M	1	1.88	0.15			
Trout-perch		I	M		1	1.88	0.15			
Rock Bass	S	C	C		1	1.88	0.15			
Bluegill Sunfish	S	I	C	P	1	1.88	0.15			
Green Sf X Bluegill Sf					1	1.88	0.15			
Rainbow Darter	D	I	S	M	1	1.88	0.15			
Banded Darter	D	I	S	I	0	0.00	0.00			
	Mile Total				670	1,256.25				
	Number of Species				21					
	Number of Hybrids				1					

River Code: **01-151**	Stream: **Brill Run**	Sample Date: **1995**
River Mile: **0.10**	Location: at mouth	Date Range: 07/18/1995
Time Fished: 4800 sec	Drainage: 3.2 sq mi	
Dist Fished: 0.16 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	279	523.13	23.93			
Central Stoneroller	N	H	N		251	470.63	21.53			
South. Redbelly Dace	N	H	S		201	376.88	17.24			
Redside Dace	N	I	S	I	128	240.00	10.98			
Western Blacknose Dace	N	G	S	T	111	208.13	9.52			
Fantail Darter	D	I	C		81	151.88	6.95			
White Sucker	W	O	S	T	49	91.88	4.20			
Rainbow Darter	D	I	S	M	27	50.63	2.32			
Johnny Darter	D	I	C		20	37.50	1.72			
Striped Shiner	N	I	S		12	22.50	1.03			
Blackside Darter	D	I	S		3	5.63	0.26			
Northern Hog Sucker	R	I	S	M	1	1.88	0.09			
Bluntnose Minnow	N	O	C	T	1	1.88	0.09			
Trout-perch		I	M		1	1.88	0.09			
Banded Darter	D	I	S	I	1	1.88	0.09			
	Mile Total				1,166	2,186.25				
	Number of Species				15					
	Number of Hybrids				0					

River Code: **01-160**	Stream: **Sharps Fork**	Sample Date: **2004**
River Mile: **10.70**	Location:	Date Range: 08/09/2004
Time Fished: 2700 sec	Drainage: 4.6 sq mi	
Dist Fished: 0.15 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	191	382.00	42.73			
Central Stoneroller	N	H	N		44	88.00	9.84			
Striped Shiner	N	I	S		41	82.00	9.17			
Fantail Darter	D	I	C		35	70.00	7.83			
Western Blacknose Dace	N	G	S	T	29	58.00	6.49			
Bluntnose Minnow	N	O	C	T	27	54.00	6.04			
White Sucker	W	O	S	T	23	46.00	5.15			
Longear Sunfish	S	I	C	M	11	22.00	2.46			
Johnny Darter	D	I	C		9	18.00	2.01			
Rainbow Darter	D	I	S	M	8	16.00	1.79			
Rock Bass	S	C	C		7	14.00	1.57			
Silverjaw Minnow	N	I	M		5	10.00	1.12			
South. Redbelly Dace	N	H	S		4	8.00	0.89			
Northern Hog Sucker	R	I	S	M	3	6.00	0.67			
Green Sunfish	S	I	C	T	3	6.00	0.67			
Blackside Darter	D	I	S		3	6.00	0.67			
Least Brook Lamprey		F	N		2	4.00	0.45			
Yellow Bullhead		I	C	T	1	2.00	0.22			
Smallmouth Bass	F	C	C	M	1	2.00	0.22			
	Mile Total				447	894.00				
	Number of Species				19					
	Number of Hybrids				0					

River Code: **01-160**	Stream: **Sharps Fork**	Sample Date: **2004**
River Mile: **9.10**	Location:	Date Range: 08/31/2004
Time Fished: 2640 sec	Drainage: 6.0 sq mi	
Dist Fished: 0.19 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	76	120.00	34.86			
Bluntnose Minnow	N	O	C	T	24	37.90	11.01			
Longear Sunfish	S	I	C	M	24	37.90	11.01			
Striped Shiner	N	I	S		22	34.74	10.09			
White Sucker	W	O	S	T	10	15.79	4.59			
Smallmouth Bass	F	C	C	M	7	11.05	3.21			
Green Sunfish	S	I	C	T	7	11.05	3.21			
Rock Bass	S	C	C		6	9.47	2.75			
Johnny Darter	D	I	C		6	9.47	2.75			
Northern Hog Sucker	R	I	S	M	5	7.90	2.29			
Golden Redhorse	R	I	S	M	4	6.32	1.83			
Western Blacknose Dace	N	G	S	T	4	6.32	1.83			
Bluegill Sunfish	S	I	C	P	4	6.32	1.83			
Fantail Darter	D	I	C		4	6.32	1.83			
Central Stoneroller	N	H	N		3	4.74	1.38			
Greenside Darter	D	I	S	M	3	4.74	1.38			
Silverjaw Minnow	N	I	M		2	3.16	0.92			
Largemouth Bass	F	C	C		2	3.16	0.92			
Rainbow Darter	D	I	S	M	2	3.16	0.92			
Least Brook Lamprey		F	N		1	1.58	0.46			
Spotted Bass	F	C	C		1	1.58	0.46			
Green Sf X Longear Sf					1	1.58	0.46			
	Mile Total				218	344.21				
	Number of Species				21					
	Number of Hybrids				1					

River Code: **01-160**	Stream: **Sharps Fork**	Sample Date: **2004**
River Mile: **8.05**	Location:	Date Range: 08/09/2004
Time Fished: 6000 sec	Drainage: 8.5 sq mi	
Dist Fished: 0.19 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Striped Shiner	N	I	S		76	120.00	27.44			
Creek Chub	N	G	N	T	60	94.74	21.66			
Longear Sunfish	S	I	C	M	29	45.79	10.47			
White Sucker	W	O	S	T	14	22.11	5.05			
Golden Redhorse	R	I	S	M	12	18.95	4.33			
Greenside Darter	D	I	S	M	12	18.95	4.33			
Bluntnose Minnow	N	O	C	T	10	15.79	3.61			
Smallmouth Bass	F	C	C	M	8	12.63	2.89			
Central Stoneroller	N	H	N		7	11.05	2.53			
Largemouth Bass	F	C	C		7	11.05	2.53			
Northern Hog Sucker	R	I	S	M	6	9.47	2.17			
Sand Shiner	N	I	M	M	5	7.90	1.81			
Green Sunfish	S	I	C	T	5	7.90	1.81			
Blackside Darter	D	I	S		5	7.90	1.81			
Rainbow Darter	D	I	S	M	5	7.90	1.81			
Rock Bass	S	C	C		3	4.74	1.08			
Spotted Bass	F	C	C		3	4.74	1.08			
Johnny Darter	D	I	C		3	4.74	1.08			
Least Brook Lamprey		F	N		2	3.16	0.72			
Hybrid X Minnow					1	1.58	0.36			
Bluegill Sunfish	S	I	C	P	1	1.58	0.36			
Logperch	D	I	S	M	1	1.58	0.36			
Banded Darter	D	I	S	I	1	1.58	0.36			
Fantail Darter	D	I	C		1	1.58	0.36			
	Mile Total				277	437.37				
	Number of Species				23					
	Number of Hybrids				1					

River Code: **01-160**	Stream: **Sharps Fork**	Sample Date: **2004**
River Mile: **5.30**	Location:	Date Range: 08/10/2004
Time Fished: 3600 sec	Drainage: 15.8 sq mi	
Dist Fished: 0.16 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	210	393.75	34.31			
Striped Shiner	N	I	S		71	133.13	11.60			
Central Stoneroller	N	H	N		59	110.63	9.64			
Rainbow Darter	D	I	S	M	54	101.25	8.82			
Greenside Darter	D	I	S	M	44	82.50	7.19			
Bluntnose Minnow	N	O	C	T	38	71.25	6.21			
Johnny Darter	D	I	C		29	54.38	4.74			
Fantail Darter	D	I	C		26	48.75	4.25			
White Sucker	W	O	S	T	17	31.88	2.78			
Western Blacknose Dace	N	G	S	T	13	24.38	2.12			
Silverjaw Minnow	N	I	M		12	22.50	1.96			
Rock Bass	S	C	C		9	16.88	1.47			
Northern Hog Sucker	R	I	S	M	4	7.50	0.65			
Sand Shiner	N	I	M	M	4	7.50	0.65			
Longear Sunfish	S	I	C	M	4	7.50	0.65			
Least Brook Lamprey		F	N		3	5.63	0.49			
Spotted Bass	F	C	C		3	5.63	0.49			
Green Sunfish	S	I	C	T	3	5.63	0.49			
Blackside Darter	D	I	S		3	5.63	0.49			
Banded Darter	D	I	S	I	3	5.63	0.49			
Golden Redhorse	R	I	S	M	1	1.88	0.16			
Yellow Bullhead		I	C	T	1	1.88	0.16			
Logperch	D	I	S	M	1	1.88	0.16			
	Mile Total				612	1,147.50				
	Number of Species				23					
	Number of Hybrids				0					

River Code: **01-160**	Stream: **Sharps Fork**	Sample Date: **2004**
River Mile: **1.65**	Location:	Date Range: 08/06/2004
Time Fished: 4200 sec	Drainage: 30.0 sq mi	
Dist Fished: 0.17 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Striped Shiner	N	I	S		83	146.47	18.99	1.44	10.87	9.81
Creek Chub	N	G	N	T	71	125.29	16.25	2.73	20.67	21.79
Greenside Darter	D	I	S	M	59	104.12	13.50	0.21	1.57	2.00
Central Stoneroller	N	H	N		48	84.71	10.98	0.79	6.01	9.38
Bluntnose Minnow	N	O	C	T	26	45.88	5.95	0.13	0.96	2.77
Rainbow Darter	D	I	S	M	24	42.35	5.49	0.04	0.30	0.92
White Sucker	W	O	S	T	21	37.06	4.81	2.90	21.98	78.33
Northern Hog Sucker	R	I	S	M	19	33.53	4.35	1.53	11.58	45.63
Fantail Darter	D	I	C		16	28.24	3.66	0.03	0.19	0.88
Rock Bass	S	C	C		11	19.41	2.52	0.81	6.16	41.91
Golden Redhorse	R	I	S	M	10	17.65	2.29	1.00	7.59	56.80
Sand Shiner	N	I	M	M	10	17.65	2.29	0.02	0.14	1.00
Johnny Darter	D	I	C		9	15.88	2.06	0.01	0.05	0.44
Banded Darter	D	I	S	I	9	15.88	2.06	0.01	0.07	0.56
Blackside Darter	D	I	S		8	14.12	1.83	0.02	0.17	1.63
Longear Sunfish	S	I	C	M	5	8.82	1.14	0.10	0.77	11.60
Smallmouth Bass	F	C	C	M	3	5.29	0.69	0.16	1.22	30.33
Silverjaw Minnow	N	I	M		2	3.53	0.46	0.01	0.04	1.50
Yellow Bullhead		I	C	T	2	3.53	0.46	0.98	7.41	277.00
Spotted Bass	F	C	C		1	1.77	0.23	0.30	2.24	168.00
	Mile Total				437	771.18		13.21		
	Number of Species				20					
	Number of Hybrids				0					

River Code: **01-160**	Stream: **Sharps Fork**	Sample Date: **2004**
River Mile: **1.60**	Location:	Date Range: 08/05/2004
Time Fished: 4800 sec	Drainage: 30.0 sq mi	
Dist Fished: 0.17 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Longear Sunfish	S	I	C	M	30	52.94	18.18	1.05	10.67	19.77
Green Sunfish	S	I	C	T	28	49.41	16.97	0.19	1.98	3.93
Striped Shiner	N	I	S		21	37.06	12.73	0.52	5.34	14.14
Creek Chub	N	G	N	T	14	24.71	8.48	0.37	3.76	14.93
Bluntnose Minnow	N	O	C	T	12	21.18	7.27	0.05	0.54	2.50
Golden Redhorse	R	I	S	M	11	19.41	6.67	2.90	29.53	149.18
White Sucker	W	O	S	T	8	14.12	4.85	1.37	13.98	97.13
Rock Bass	S	C	C		8	14.12	4.85	1.15	11.74	81.50
Blackside Darter	D	I	S		8	14.12	4.85	0.04	0.42	2.88
Johnny Darter	D	I	C		5	8.82	3.03	0.01	0.07	0.80
Fantail Darter	D	I	C		4	7.06	2.42	0.01	0.11	1.50
Northern Hog Sucker	R	I	S	M	3	5.29	1.82	0.48	4.92	91.00
Spotted Bass	F	C	C		3	5.29	1.82	0.55	5.58	103.33
Yellow Bullhead		I	C	T	2	3.53	1.21	0.22	2.19	61.00
Logperch	D	I	S	M	2	3.53	1.21	0.03	0.35	9.50
Greenside Darter	D	I	S	M	2	3.53	1.21	0.01	0.07	2.00
Sand Shiner	N	I	M	M	1	1.77	0.61	0.00	0.04	2.00
Smallmouth Bass	F	C	C	M	1	1.77	0.61	0.85	8.64	480.00
Bluegill Sunfish	S	I	C	P	1	1.77	0.61	0.01	0.05	3.00
Rainbow Darter	D	I	S	M	1	1.77	0.61	0.00	0.04	2.00
	Mile Total				165	291.18		9.81		
	Number of Species				20					
	Number of Hybrids				0					

River Code: **01-160**	Stream: **Sharps Fork**	Sample Date: **1990**
River Mile: **0.30**	Location:	Date Range: 07/19/1990
Time Fished: 3570 sec	Drainage: 35.7 sq mi	Thru: 08/16/1990
Dist Fished: 0.20 km	Basin: Hocking River No of Passes: 2	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	27	40.50	15.88	0.11	2.75	2.73
Fantail Darter	D	I	C		25	37.50	14.71	0.04	1.04	1.12
Striped Shiner	N	I	S		24	36.00	14.12	0.35	8.66	9.67
Bluntnose Minnow	N	O	C	T	16	24.00	9.41	0.05	1.12	1.88
Rock Bass	S	C	C		13	19.50	7.65	1.06	26.24	54.12
Northern Hog Sucker	R	I	S	M	12	18.00	7.06	0.47	11.56	25.83
Smallmouth Bass	F	C	C	M	7	10.50	4.12	0.87	21.74	83.29
White Sucker	W	O	S	T	6	9.00	3.53	0.01	0.26	1.17
Central Stoneroller	N	H	N		6	9.00	3.53	0.05	1.12	5.00
Johnny Darter	D	I	C		5	7.50	2.94	0.01	0.19	1.00
Least Brook Lamprey		F	N		4	6.00	2.35	0.08	1.94	13.00
Silverjaw Minnow	N	I	M		4	6.00	2.35	0.01	0.19	1.25
Longear Sunfish	S	I	C	M	4	6.00	2.35	0.27	6.64	44.50
Sand Shiner	N	I	M	M	3	4.50	1.76	0.01	0.15	1.33
Yellow Bullhead		I	C	T	3	4.50	1.76	0.64	15.81	141.33
Green Sunfish	S	I	C	T	3	4.50	1.76	0.01	0.22	2.00
Banded Darter	D	I	S	I	3	4.50	1.76	0.00	0.11	1.00
Rainbow Darter	D	I	S	M	3	4.50	1.76	0.00	0.11	1.00
Western Blacknose Dace	N	G	S	T	1	1.50	0.59	0.00	0.04	1.00
Blackside Darter	D	I	S		1	1.50	0.59	0.00	0.11	3.00
	Mile Total				170	255.00		4.02		
	Number of Species				20					
	Number of Hybrids				0					

River Code: **01-160**	Stream: **Sharps Fork**	Sample Date: **2004**
River Mile: **0.01**	Location:	Date Range: 08/05/2004
Time Fished: 4800 sec	Drainage: 35.7 sq mi	
Dist Fished: 0.17 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Central Stoneroller	N	H	N		104	183.53	26.67	1.14	20.14	6.23
Creek Chub	N	G	N	T	71	125.29	18.21	0.58	10.28	4.66
Banded Darter	D	I	S	I	46	81.18	11.79	0.07	1.30	0.91
Greenside Darter	D	I	S	M	34	60.00	8.72	0.11	1.99	1.88
Striped Shiner	N	I	S		32	56.47	8.21	0.48	8.45	8.50
Bluntnose Minnow	N	O	C	T	20	35.29	5.13	0.11	1.87	3.00
Sand Shiner	N	I	M	M	18	31.77	4.62	0.05	0.86	1.56
Northern Hog Sucker	R	I	S	M	16	28.24	4.10	1.66	29.20	58.75
Fantail Darter	D	I	C		14	24.71	3.59	0.04	0.77	1.79
Johnny Darter	D	I	C		7	12.35	1.79	0.01	0.09	0.43
White Sucker	W	O	S	T	5	8.82	1.28	0.38	6.67	43.00
Golden Redhorse	R	I	S	M	4	7.06	1.03	0.22	3.78	30.50
Silverjaw Minnow	N	I	M		4	7.06	1.03	0.01	0.12	1.00
Rainbow Darter	D	I	S	M	4	7.06	1.03	0.01	0.09	0.75
Rock Bass	S	C	C		3	5.29	0.77	0.63	11.00	118.00
Smallmouth Bass	F	C	C	M	2	3.53	0.51	0.09	1.55	25.00
Green Sunfish	S	I	C	T	2	3.53	0.51	0.02	0.28	4.50
Western Blacknose Dace	N	G	S	T	1	1.77	0.26	0.00	0.07	2.00
Spotfin Shiner	N	I	M		1	1.77	0.26	0.00	0.07	2.00
Longear Sunfish	S	I	C	M	1	1.77	0.26	0.07	1.30	42.00
Blackside Darter	D	I	S		1	1.77	0.26	0.01	0.09	3.00
	Mile Total				390	688.24		5.68		
	Number of Species				21					
	Number of Hybrids				0					

River Code: **01-161**	Stream: **Opossum Run**	Sample Date: **2004**
River Mile: **4.10**	Location:	Date Range: 08/10/2004
Time Fished: 2400 sec	Drainage: 2.3 sq mi	
Dist Fished: 0.13 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	116	267.69	55.77			
Western Blacknose Dace	N	G	S	T	76	175.39	36.54			
Fantail Darter	D	I	C		15	34.62	7.21			
Johnny Darter	D	I	C		1	2.31	0.48			
	Mile Total				208	480.00				
	Number of Species				4					
	Number of Hybrids				0					

River Code: **01-161**	Stream: **Opossum Run**	Sample Date: **2004**
River Mile: **2.60**	Location:	Date Range: 08/06/2004
Time Fished: 4500 sec	Drainage: 4.5 sq mi	
Dist Fished: 0.16 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	337	631.88	40.70			
South. Redbelly Dace	N	H	S		231	433.13	27.90			
Western Blacknose Dace	N	G	S	T	95	178.13	11.47			
White Sucker	W	O	S	T	50	93.75	6.04			
Central Stoneroller	N	H	N		43	80.63	5.19			
Fantail Darter	D	I	C		43	80.63	5.19			
Johnny Darter	D	I	C		17	31.88	2.05			
Striped Shiner	N	I	S		6	11.25	0.72			
Silverjaw Minnow	N	I	M		4	7.50	0.48			
Northern Hog Sucker	R	I	S	M	1	1.88	0.12			
Rainbow Darter	D	I	S	M	1	1.88	0.12			
	Mile Total				828	1,552.50				
	Number of Species				11					
	Number of Hybrids				0					

River Code: **01-161**	Stream: **Opossum Run**	Sample Date: **2004**
River Mile: **0.75**	Location:	Date Range: 09/02/2004
Time Fished: 3600 sec	Drainage: 6.0 sq mi	
Dist Fished: 0.15 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Striped Shiner	N	I	S		96	192.00	22.97			
Creek Chub	N	G	N	T	81	162.00	19.38			
White Sucker	W	O	S	T	60	120.00	14.35			
Bluntnose Minnow	N	O	C	T	51	102.00	12.20			
Central Stoneroller	N	H	N		42	84.00	10.05			
Longear Sunfish	S	I	C	M	17	34.00	4.07			
Largemouth Bass	F	C	C		12	24.00	2.87			
Bluegill Sunfish	S	I	C	P	9	18.00	2.15			
Rock Bass	S	C	C		8	16.00	1.91			
Golden Redhorse	R	I	S	M	6	12.00	1.44			
Northern Hog Sucker	R	I	S	M	6	12.00	1.44			
Redfin Shiner	N	I	N		5	10.00	1.20			
Rainbow Darter	D	I	S	M	5	10.00	1.20			
Silverjaw Minnow	N	I	M		3	6.00	0.72			
Green Sunfish	S	I	C	T	3	6.00	0.72			
Johnny Darter	D	I	C		3	6.00	0.72			
Greenside Darter	D	I	S	M	3	6.00	0.72			
Fantail Darter	D	I	C		3	6.00	0.72			
Least Brook Lamprey		F	N		2	4.00	0.48			
Blackside Darter	D	I	S		2	4.00	0.48			
Fathead Minnow	N	O	C	T	1	2.00	0.24			
	Mile Total				418	836.00				
	Number of Species				21					
	Number of Hybrids				0					

River Code: **01-161**	Stream: **Opossum Run**	Sample Date: **2004**
River Mile: **0.20**	Location:	Date Range: 08/06/2004
Time Fished: 4200 sec	Drainage: 8.9 sq mi	
Dist Fished: 0.18 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Central Stoneroller	N	H	N		85	141.67	22.31			
Striped Shiner	N	I	S		59	98.33	15.49			
Creek Chub	N	G	N	T	56	93.33	14.70			
Western Blacknose Dace	N	G	S	T	44	73.33	11.55			
Bluntnose Minnow	N	O	C	T	29	48.33	7.61			
Rainbow Darter	D	I	S	M	25	41.67	6.56			
Fantail Darter	D	I	C		24	40.00	6.30			
Johnny Darter	D	I	C		17	28.33	4.46			
White Sucker	W	O	S	T	15	25.00	3.94			
South. Redbelly Dace	N	H	S		7	11.67	1.84			
Greenside Darter	D	I	S	M	7	11.67	1.84			
Blackside Darter	D	I	S		4	6.67	1.05			
Sand Shiner	N	I	M	M	3	5.00	0.79			
Least Brook Lamprey		F	N		2	3.33	0.52			
Silverjaw Minnow	N	I	M		2	3.33	0.52			
Rock Bass	S	C	C		2	3.33	0.52			
	Mile Total				381	635.00				
	Number of Species				16					
	Number of Hybrids				0					

River Code: **01-170**	Stream: **McDougall Branch**	Sample Date: **2004**
River Mile: **4.95**	Location:	Date Range: 08/18/2004
Time Fished: 3600 sec	Drainage: 4.5 sq mi	
Dist Fished: 0.16 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	515	965.63	41.57			
Central Stoneroller	N	H	N		212	397.50	17.11			
Western Blacknose Dace	N	G	S	T	158	296.25	12.75			
South. Redbelly Dace	N	H	S		79	148.13	6.38			
Striped Shiner	N	I	S		73	136.88	5.89			
Bluntnose Minnow	N	O	C	T	57	106.88	4.60			
Fantail Darter	D	I	C		48	90.00	3.87			
White Sucker	W	O	S	T	32	60.00	2.58			
Johnny Darter	D	I	C		31	58.13	2.50			
Silverjaw Minnow	N	I	M		9	16.88	0.73			
Green Sunfish	S	I	C	T	7	13.13	0.56			
Rainbow Darter	D	I	S	M	5	9.38	0.40			
Yellow Bullhead		I	C	T	4	7.50	0.32			
Trout-perch		I	M		4	7.50	0.32			
Greenside Darter	D	I	S	M	2	3.75	0.16			
Northern Hog Sucker	R	I	S	M	1	1.88	0.08			
Cr Chub X S. Redbelly D					1	1.88	0.08			
Smallmouth Bass	F	C	C	M	1	1.88	0.08			
	Mile Total				1,239	2,323.13				
	Number of Species				17					
	Number of Hybrids				1					

River Code: **01-170**	Stream: **McDougall Branch**	Sample Date: **2004**
River Mile: **4.50**	Location:	Date Range: 08/18/2004
Time Fished: 3600 sec	Drainage: 12.4 sq mi	
Dist Fished: 0.16 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	129	241.88	20.48			
Central Stoneroller	N	H	N		129	241.88	20.48			
Striped Shiner	N	I	S		70	131.25	11.11			
White Sucker	W	O	S	T	61	114.38	9.68			
Bluntnose Minnow	N	O	C	T	52	97.50	8.25			
Johnny Darter	D	I	C		40	75.00	6.35			
Western Blacknose Dace	N	G	S	T	26	48.75	4.13			
Fantail Darter	D	I	C		25	46.88	3.97			
Silverjaw Minnow	N	I	M		21	39.38	3.33			
Green Sunfish	S	I	C	T	10	18.75	1.59			
Rainbow Darter	D	I	S	M	10	18.75	1.59			
South. Redbelly Dace	N	H	S		9	16.88	1.43			
Longear Sunfish	S	I	C	M	9	16.88	1.43			
Northern Hog Sucker	R	I	S	M	6	11.25	0.95			
Golden Redhorse	R	I	S	M	5	9.38	0.79			
Rock Bass	S	C	C		5	9.38	0.79			
Largemouth Bass	F	C	C		5	9.38	0.79			
Logperch	D	I	S	M	5	9.38	0.79			
Yellow Bullhead		I	C	T	3	5.63	0.48			
Greenside Darter	D	I	S	M	3	5.63	0.48			
Least Brook Lamprey		F	N		2	3.75	0.32			
Blackside Darter	D	I	S		2	3.75	0.32			
Redfin Shiner	N	I	N		1	1.88	0.16			
Sand Shiner	N	I	M	M	1	1.88	0.16			
Bluegill Sunfish	S	I	C	P	1	1.88	0.16			
	Mile Total				630	1,181.25				
	Number of Species				25					
	Number of Hybrids				0					

River Code: **01-170**	Stream: **McDougall Branch**	Sample Date: **2004**
River Mile: **2.90**	Location:	Date Range: 08/24/2004
Time Fished: 5700 sec	Drainage: 27.0 sq mi	Thru: 09/28/2004
Dist Fished: 0.30 km	Basin: Hocking River No of Passes: 2	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	235	282.56	27.56	1.62	30.04	6.60
Striped Shiner	N	I	S		172	185.74	18.12	1.12	20.81	6.40
Central Stoneroller	N	H	N		124	139.81	13.64	0.22	4.15	1.86
Bluntnose Minnow	N	O	C	T	71	68.11	6.64	0.17	3.21	2.45
Johnny Darter	D	I	C		51	61.51	6.00	0.02	0.40	0.37
Rainbow Darter	D	I	S	M	43	50.02	4.88	0.03	0.47	0.53
Fantail Darter	D	I	C		41	49.02	4.78	0.02	0.37	0.44
Silverjaw Minnow	N	I	M		32	29.86	2.91	0.04	0.70	1.13
White Sucker	W	O	S	T	25	29.50	2.88	0.46	8.57	15.96
Greenside Darter	D	I	S	M	28	27.85	2.72	0.05	0.99	2.04
Sand Shiner	N	I	M	M	25	21.46	2.09	0.03	0.63	1.60
Western Blacknose Dace	N	G	S	T	11	15.00	1.46	0.01	0.15	0.55
Golden Redhorse	R	I	S	M	12	11.20	1.09	0.26	4.75	21.67
Longear Sunfish	S	I	C	M	11	10.41	1.02	0.11	2.10	10.91
Northern Hog Sucker	R	I	S	M	9	9.40	0.92	0.21	3.98	26.78
Blackside Darter	D	I	S		7	6.68	0.65	0.02	0.28	2.43
Spotted Bass	F	C	C		5	5.67	0.55	0.34	6.28	67.40
Yellow Bullhead		I	C	T	4	4.31	0.42	0.45	8.35	118.25
Rock Bass	S	C	C		4	4.31	0.42	0.13	2.48	31.25
Spotfin Shiner	N	I	M		3	2.37	0.23	0.01	0.16	3.67
Logperch	D	I	S	M	2	2.15	0.21	0.02	0.28	7.50
Smallmouth Bass	F	C	C	M	2	1.58	0.15	0.02	0.43	14.50
Least Brook Lamprey		F	N		1	1.36	0.13	0.01	0.20	8.00
South. Redbelly Dace	N	H	S		1	1.36	0.13	0.00	0.03	1.00
Redfin Shiner	N	I	N		1	0.79	0.08	0.00	0.03	2.00
Green Sunfish	S	I	C	T	1	0.79	0.08	0.00	0.05	3.00
Bluegill Sunfish	S	I	C	P	1	0.79	0.08	0.00	0.02	1.00
Green Sf X Longear Sf					1	0.79	0.08	0.01	0.15	10.00
Banded Darter	D	I	S	I	1	0.79	0.08	0.00	0.02	1.00
	Mile Total				924	1,025.17		5.39		
	Number of Species				28					
	Number of Hybrids				1					

River Code: **01-170**	Stream: **McDougall Branch**	Sample Date: **1990**
River Mile: **2.60**	Location:	Date Range: 08/16/1990
Time Fished: 2880 sec	Drainage: 27.9 sq mi	
Dist Fished: 0.40 km	Basin: Hocking River No of Passes: 1	Sampler Type: D
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Striped Shiner	N	I	S		13	9.75	15.48	0.00	0.03	0.15
Green Sunfish	S	I	C	T	13	9.75	15.48	0.11	1.45	11.67
Bluntnose Minnow	N	O	C	T	10	7.50	11.90	0.01	0.10	1.10
Gizzard Shad		O	M		7	5.25	8.33	0.48	6.11	91.43
Rock Bass	S	C	C		7	5.25	8.33	0.17	2.15	32.14
Golden Redhorse	R	I	S	M	4	3.00	4.76	0.00	0.03	0.75
Creek Chub	N	G	N	T	4	3.00	4.76	0.00	0.04	1.00
Yellow Bullhead		I	C	T	4	3.00	4.76	0.49	6.29	164.75
Bluegill Sunfish	S	I	C	P	4	3.00	4.76	0.10	1.26	33.00
Rainbow Darter	D	I	S	M	4	3.00	4.76	0.00	0.05	1.25
Hybrid X Sunfish					3	2.25	3.57	0.21	2.61	91.00
White Sucker	W	O	S	T	2	1.50	2.38	0.24	3.06	160.00
Common Carp	G	O	M	T	2	1.50	2.38	5.85	74.50	3,900.00
Fantail Darter	D	I	C		2	1.50	2.38	0.00	0.03	1.00
Spotted Sucker	R	I	S		1	0.75	1.19	0.11	1.43	149.00
Trout-perch		I	M		1	0.75	1.19	0.02	0.19	20.00
Largemouth Bass	F	C	C		1	0.75	1.19	0.04	0.48	51.00
Longear Sunfish	S	I	C	M	1	0.75	1.19	0.02	0.19	20.00
Johnny Darter	D	I	C		1	0.75	1.19	0.00	0.01	1.00
	Mile Total				84	63.00		7.85		
	Number of Species				18					
	Number of Hybrids				1					

River Code: **01-170**	Stream: **McDougall Branch**	Sample Date: **1983**
River Mile: **2.40**	Location:	Date Range: 08/24/1983
Time Fished: 4800 sec	Drainage: 28.0 sq mi	Thru: 11/01/1983
Dist Fished: 0.75 km	Basin: Hocking River No of Passes: 3	Sampler Type: D
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Bluntnose Minnow	N	O	C	T	275	110.00	20.75	0.16	0.97	1.49
Striped Shiner	N	I	S		260	104.00	19.62	0.32	1.89	3.05
Green Sunfish	S	I	C	T	113	45.20	8.53	0.93	5.53	20.56
Central Stoneroller	N	H	N		106	42.40	8.00	0.15	0.92	3.63
Golden Redhorse	R	I	S	M	89	35.60	6.72	5.54	32.95	155.48
Bluegill Sunfish	S	I	C	P	79	31.60	5.96	0.70	4.18	22.22
Longear Sunfish	S	I	C	M	65	26.00	4.91	0.38	2.26	14.61
Fantail Darter	D	I	C		46	18.40	3.47	0.02	0.13	1.15
White Sucker	W	O	S	T	40	16.00	3.02	0.75	4.49	47.17
Northern Hog Sucker	R	I	S	M	27	10.80	2.04	0.28	1.65	25.60
Spotfin Shiner	N	I	M		26	10.40	1.96	0.02	0.10	1.66
Rock Bass	S	C	C		19	7.60	1.43	0.11	0.66	14.53
Rainbow Darter	D	I	S	M	17	6.80	1.28	0.00	0.02	0.47
Smallmouth Bass	F	C	C	M	16	6.40	1.21	0.50	3.00	78.88
Johnny Darter	D	I	C		15	6.00	1.13	0.01	0.03	1.00
Greenside Darter	D	I	S	M	15	6.00	1.13	0.01	0.09	2.47
Blackside Darter	D	I	S		14	5.60	1.06	0.02	0.12	3.64
Banded Darter	D	I	S	I	13	5.20	0.98	0.01	0.03	0.92
Silverjaw Minnow	N	I	M		10	4.00	0.75	0.01	0.03	1.30
Spotted Bass	F	C	C		9	3.60	0.68	0.02	0.12	5.33
Common Carp	G	O	M	T	8	3.20	0.60	5.25	31.25	1,640.63
Creek Chub	N	G	N	T	8	3.20	0.60	0.08	0.50	26.50
Trout-perch		I	M		8	3.20	0.60	0.03	0.18	9.50
White Crappie	S	I	C		7	2.80	0.53	0.40	2.37	142.29
Yellow Bullhead		I	C	T	6	2.40	0.45	0.26	1.52	106.67
Gizzard Shad		O	M		5	2.00	0.38	0.25	1.46	123.00
Green Sf X Bluegill Sf					5	2.00	0.38	0.09	0.54	45.00
Logperch	D	I	S	M	5	2.00	0.38	0.01	0.06	5.40
Largemouth Bass	F	C	C		4	1.60	0.30	0.18	1.08	113.50
Spotted Sucker	R	I	S		3	1.20	0.23	0.02	0.13	19.00
Black Bullhead		I	C	P	3	1.20	0.23	0.18	1.09	152.67
Emerald Shiner	N	I	S		2	0.80	0.15	0.00	0.01	2.00
Sand Shiner	N	I	M	M	2	0.80	0.15	0.00	0.00	1.00
Brown Bullhead		I	C	T	2	0.80	0.15	0.01	0.07	14.00
Black Redhorse	R	I	S	I	1	0.40	0.08	0.07	0.42	176.00
Redfin Shiner	N	I	N		1	0.40	0.08	0.00	0.00	1.00
Longear Sf X Bluegill Sf					1	0.40	0.08	0.02	0.12	52.00
	Mile Total				1,325	530.00		16.80		
	Number of Species				35					
	Number of Hybrids				2					

River Code: **01-170**	Stream: **McDougall Branch**	Sample Date: **1990**
River Mile: **2.40**	Location:	Date Range: 07/19/1990
Time Fished: 2940 sec	Drainage: 28.0 sq mi	
Dist Fished: 0.20 km	Basin: Hocking River No of Passes: 1	Sampler Type: D
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Central Stoneroller	N	H	N		50	75.00	13.62	0.11	0.61	1.49
Creek Chub	N	G	N	T	45	67.50	12.26	0.07	0.38	1.02
Bluntnose Minnow	N	O	C	T	42	63.00	11.44	0.11	0.58	1.67
Rainbow Darter	D	I	S	M	35	52.50	9.54	0.06	0.35	1.23
White Sucker	W	O	S	T	28	42.00	7.63	6.26	34.33	149.14
Striped Shiner	N	I	S		23	34.50	6.27	0.51	2.78	14.73
Longear Sunfish	S	I	C	M	21	31.50	5.72	1.21	6.65	38.55
Green Sunfish	S	I	C	T	15	22.50	4.09	0.68	3.73	30.29
Bluegill Sunfish	S	I	C	P	14	21.00	3.81	0.23	1.23	10.71
Golden Redhorse	R	I	S	M	12	18.00	3.27	3.16	17.29	175.33
Greenside Darter	D	I	S	M	12	18.00	3.27	0.05	0.27	2.73
Banded Darter	D	I	S	I	12	18.00	3.27	0.02	0.08	0.83
Fantail Darter	D	I	C		11	16.50	3.00	0.02	0.09	1.00
Sand Shiner	N	I	M	M	9	13.50	2.45	0.01	0.07	0.89
Gizzard Shad		O	M		5	7.50	1.36	0.73	3.98	96.80
Redfin Shiner	N	I	N		5	7.50	1.36	0.01	0.04	1.00
Northern Hog Sucker	R	I	S	M	4	6.00	1.09	0.65	3.55	108.00
Rock Bass	S	C	C		4	6.00	1.09	0.14	0.77	23.25
Spotted Bass	F	C	C		4	6.00	1.09	0.47	2.55	77.50
Hybrid X Sunfish					3	4.50	0.82	0.25	1.34	54.33
Logperch	D	I	S	M	3	4.50	0.82	0.03	0.14	5.67
Johnny Darter	D	I	C		3	4.50	0.82	0.01	0.03	1.00
Freshwater Drum			M	P	3	4.50	0.82	2.01	11.00	446.00
Spotted Sucker	R	I	S		1	1.50	0.27	0.83	4.52	550.00
Western Blacknose Dace	N	G	S	T	1	1.50	0.27	0.00	0.01	1.00
Smallmouth Bass	F	C	C	M	1	1.50	0.27	0.03	0.18	22.00
Sauger	F	P	S		1	1.50	0.27	0.63	3.45	420.00
	Mile Total				367	550.50		18.25		
	Number of Species				26					
	Number of Hybrids				1					

River Code: **01-170**	Stream: **McDougall Branch**	Sample Date: **2004**
River Mile: **0.50**	Location:	Date Range: 08/17/2004
Time Fished: 6060 sec	Drainage: 37.4 sq mi	Thru: 09/16/2004
Dist Fished: 0.34 km	Basin: Hocking River No of Passes: 2	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Striped Shiner	N	I	S		132	111.37	16.28	0.83	7.36	7.29
Creek Chub	N	G	N	T	132	110.32	16.12	0.45	4.02	3.97
Greenside Darter	D	I	S	M	96	84.42	12.34	0.12	1.08	1.42
Fantail Darter	D	I	C		57	48.79	7.13	0.03	0.28	0.61
Central Stoneroller	N	H	N		51	43.42	6.35	0.12	1.11	2.63
Banded Darter	D	I	S	I	31	27.63	4.04	0.02	0.17	0.71
White Sucker	W	O	S	T	32	27.37	4.00	4.68	41.59	168.66
Longear Sunfish	S	I	C	M	30	25.79	3.77	0.52	4.60	19.87
Johnny Darter	D	I	C		30	24.74	3.62	0.01	0.08	0.37
Green Sunfish	S	I	C	T	21	19.11	2.79	0.38	3.41	21.24
Bluntnose Minnow	N	O	C	T	19	17.95	2.62	0.04	0.38	2.32
Silverjaw Minnow	N	I	M		22	17.79	2.60	0.04	0.32	2.00
Rainbow Darter	D	I	S	M	20	17.05	2.49	0.01	0.07	0.45
Blackside Darter	D	I	S		21	17.00	2.48	0.04	0.36	2.33
Golden Redhorse	R	I	S	M	16	13.89	2.03	1.35	12.00	99.88
Northern Hog Sucker	R	I	S	M	14	11.47	1.68	0.51	4.58	43.86
Rock Bass	S	C	C		11	9.95	1.45	0.86	7.66	88.82
Western Blacknose Dace	N	G	S	T	11	8.68	1.27	0.00	0.01	0.18
Trout-perch		I	M		9	7.95	1.16	0.02	0.22	3.00
Spotfin Shiner	N	I	M		7	7.00	1.02	0.03	0.23	3.71
Sand Shiner	N	I	M	M	7	6.58	0.96	0.01	0.08	1.43
Spotted Bass	F	C	C		8	6.53	0.95	0.16	1.45	24.63
Bluegill Sunfish	S	I	C	P	7	5.95	0.87	0.02	0.21	4.00
Smallmouth Bass	F	C	C	M	5	4.37	0.64	0.23	2.01	47.80
Yellow Bullhead		I	C	T	3	2.58	0.38	0.28	2.53	106.00
White Crappie	S	I	C		2	1.79	0.26	0.05	0.47	29.50
Logperch	D	I	S	M	2	1.79	0.26	0.01	0.13	8.00
Largemouth Bass	F	C	C		1	1.00	0.15	0.01	0.04	5.00
Longear Sf X Bluegill Sf					1	1.00	0.15	0.01	0.11	12.00
Freshwater Drum			M	P	1	1.00	0.15	0.38	3.42	384.00
	Mile Total				799	684.26		11.24		
	Number of Species				29					
	Number of Hybrids				1					

River Code: **01-171**	Stream: **Wyatt Run**	Sample Date: **2004**
River Mile: **0.40**	Location:	Date Range: 08/24/2004
Time Fished: 2700 sec	Drainage: 6.6 sq mi	
Dist Fished: 0.13 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	303	699.23	43.91			
Central Stoneroller	N	H	N		114	263.08	16.52			
South. Redbelly Dace	N	H	S		48	110.77	6.96			
White Sucker	W	O	S	T	45	103.85	6.52			
Bluntnose Minnow	N	O	C	T	44	101.54	6.38			
Striped Shiner	N	I	S		29	66.92	4.20			
Johnny Darter	D	I	C		29	66.92	4.20			
Fantail Darter	D	I	C		29	66.92	4.20			
Western Blacknose Dace	N	G	S	T	27	62.31	3.91			
Silverjaw Minnow	N	I	M		7	16.15	1.01			
Green Sunfish	S	I	C	T	7	16.15	1.01			
Yellow Bullhead		I	C	T	2	4.62	0.29			
Logperch	D	I	S	M	2	4.62	0.29			
Greenside Darter	D	I	S	M	2	4.62	0.29			
Blackside Darter	D	I	S		1	2.31	0.14			
Rainbow Darter	D	I	S	M	1	2.31	0.14			
Mile Total					690	1,592.31				
Number of Species					16					
Number of Hybrids					0					

River Code: **01-172**	Stream: **Mush Run**	Sample Date: **2004**
River Mile: **1.80**	Location:	Date Range: 08/18/2004
Time Fished: 1800 sec	Drainage: 4.8 sq mi	
Dist Fished: 0.13 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	151	348.46	24.32			
Central Stoneroller	N	H	N		122	281.54	19.65			
Bluntnose Minnow	N	O	C	T	113	260.77	18.20			
Striped Shiner	N	I	S		56	129.23	9.02			
Western Blacknose Dace	N	G	S	T	40	92.31	6.44			
White Sucker	W	O	S	T	28	64.62	4.51			
Silverjaw Minnow	N	I	M		27	62.31	4.35			
Johnny Darter	D	I	C		23	53.08	3.70			
Greenside Darter	D	I	S	M	13	30.00	2.09			
Fantail Darter	D	I	C		11	25.39	1.77			
Longear Sunfish	S	I	C	M	9	20.77	1.45			
Yellow Bullhead		I	C	T	6	13.85	0.97			
Rainbow Darter	D	I	S	M	5	11.54	0.81			
Rock Bass	S	C	C		4	9.23	0.64			
Bluegill Sunfish	S	I	C	P	4	9.23	0.64			
Green Sunfish	S	I	C	T	3	6.92	0.48			
Largemouth Bass	F	C	C		2	4.62	0.32			
Least Brook Lamprey		F	N		1	2.31	0.16			
South. Redbelly Dace	N	H	S		1	2.31	0.16			
Striped Sh X S Redbelly D					1	2.31	0.16			
Smallmouth Bass	F	C	C	M	1	2.31	0.16			
	Mile Total				621	1,433.08				
	Number of Species				20					
	Number of Hybrids				1					

River Code: **01-172**	Stream: **Mush Run**	Sample Date: **2004**
River Mile: **1.00**	Location:	Date Range: 08/18/2004
Time Fished: 3300 sec	Drainage: 12.7 sq mi	
Dist Fished: 0.15 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	281	562.00	22.98			
Bluntnose Minnow	N	O	C	T	238	476.00	19.46			
Striped Shiner	N	I	S		225	450.00	18.40			
Central Stoneroller	N	H	N		163	326.00	13.33			
White Sucker	W	O	S	T	114	228.00	9.32			
Johnny Darter	D	I	C		44	88.00	3.60			
Redfin Shiner	N	I	N		22	44.00	1.80			
Longear Sunfish	S	I	C	M	22	44.00	1.80			
Silverjaw Minnow	N	I	M		20	40.00	1.64			
Western Blacknose Dace	N	G	S	T	19	38.00	1.55			
Fantail Darter	D	I	C		12	24.00	0.98			
Logperch	D	I	S	M	10	20.00	0.82			
Largemouth Bass	F	C	C		9	18.00	0.74			
Greenside Darter	D	I	S	M	7	14.00	0.57			
Rock Bass	S	C	C		6	12.00	0.49			
Green Sunfish	S	I	C	T	5	10.00	0.41			
Rainbow Darter	D	I	S	M	5	10.00	0.41			
Least Brook Lamprey		F	N		4	8.00	0.33			
Smallmouth Bass	F	C	C	M	4	8.00	0.33			
Blackside Darter	D	I	S		4	8.00	0.33			
Golden Redhorse	R	I	S	M	3	6.00	0.25			
Northern Hog Sucker	R	I	S	M	2	4.00	0.16			
Yellow Bullhead		I	C	T	2	4.00	0.16			
Bluegill Sunfish	S	I	C	P	2	4.00	0.16			
Mile Total					1,223	2,446.00				
Number of Species					24					
Number of Hybrids					0					

River Code: **01-174**	Stream: **Bryson Branch**	Sample Date: **2004**
River Mile: **1.20**	Location:	Date Range: 08/18/2004
Time Fished: 3900 sec	Drainage: 5.7 sq mi	
Dist Fished: 0.15 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	271	542.00	43.71			
Central Stoneroller	N	H	N		87	174.00	14.03			
Bluntnose Minnow	N	O	C	T	67	134.00	10.81			
Striped Shiner	N	I	S		61	122.00	9.84			
White Sucker	W	O	S	T	21	42.00	3.39			
Fantail Darter	D	I	C		19	38.00	3.06			
Green Sunfish	S	I	C	T	18	36.00	2.90			
Longear Sunfish	S	I	C	M	18	36.00	2.90			
Yellow Bullhead		I	C	T	8	16.00	1.29			
Rock Bass	S	C	C		8	16.00	1.29			
Golden Redhorse	R	I	S	M	7	14.00	1.13			
Smallmouth Bass	F	C	C	M	7	14.00	1.13			
Northern Hog Sucker	R	I	S	M	6	12.00	0.97			
Greenside Darter	D	I	S	M	6	12.00	0.97			
Largemouth Bass	F	C	C		4	8.00	0.65			
Banded Darter	D	I	S	I	3	6.00	0.48			
Redfin Shiner	N	I	N		2	4.00	0.32			
Johnny Darter	D	I	C		2	4.00	0.32			
Western Blacknose Dace	N	G	S	T	1	2.00	0.16			
South. Redbelly Dace	N	H	S		1	2.00	0.16			
Bluegill Sunfish	S	I	C	P	1	2.00	0.16			
Green Sf X Longear Sf					1	2.00	0.16			
Logperch	D	I	S	M	1	2.00	0.16			
	Mile Total				620	1,240.00				
	Number of Species				22					
	Number of Hybrids				1					

River Code: **01-176**	Stream: **Dutch Creek**	Sample Date: **2004**
River Mile: **1.70**	Location:	Date Range: 08/25/2004
Time Fished: 3300 sec	Drainage: 4.8 sq mi	
Dist Fished: 0.15 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	31	62.00	19.38			
Central Stoneroller	N	H	N		29	58.00	18.13			
White Sucker	W	O	S	T	18	36.00	11.25			
Bluntnose Minnow	N	O	C	T	13	26.00	8.13			
Striped Shiner	N	I	S		12	24.00	7.50			
Fantail Darter	D	I	C		11	22.00	6.88			
Western Blacknose Dace	N	G	S	T	9	18.00	5.63			
Rock Bass	S	C	C		9	18.00	5.63			
Blackside Darter	D	I	S		7	14.00	4.38			
Johnny Darter	D	I	C		7	14.00	4.38			
Rainbow Darter	D	I	S	M	7	14.00	4.38			
Smallmouth Bass	F	C	C	M	5	10.00	3.13			
Silverjaw Minnow	N	I	M		1	2.00	0.63			
Banded Darter	D	I	S	I	1	2.00	0.63			
	Mile Total				160	320.00				
	Number of Species				14					
	Number of Hybrids				0					

River Code: **01-180**	Stream: **Linscott Run**	Sample Date: **2004**
River Mile: **3.80**	Location:	Date Range: 08/05/2004
Time Fished: 3000 sec	Drainage: 2.0 sq mi	
Dist Fished: 0.15 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	96	192.00	44.24			
South. Redbelly Dace	N	H	S		84	168.00	38.71			
Western Blacknose Dace	N	G	S	T	19	38.00	8.76			
Fantail Darter	D	I	C		15	30.00	6.91			
White Sucker	W	O	S	T	1	2.00	0.46			
Bluegill Sunfish	S	I	C	P	1	2.00	0.46			
Johnny Darter	D	I	C		1	2.00	0.46			
	Mile Total				217	434.00				
	Number of Species				7					
	Number of Hybrids				0					

River Code: **01-180**	Stream: **Linscott Run**	Sample Date: **2004**
River Mile: **0.80**	Location:	Date Range: 08/05/2004
Time Fished: 4800 sec	Drainage: 4.5 sq mi	
Dist Fished: 0.15 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	452	904.00	37.42			
Central Stoneroller	N	H	N		279	558.00	23.10			
Western Blacknose Dace	N	G	S	T	126	252.00	10.43			
South. Redbelly Dace	N	H	S		96	192.00	7.95			
Fantail Darter	D	I	C		87	174.00	7.20			
Johnny Darter	D	I	C		45	90.00	3.73			
Bluntnose Minnow	N	O	C	T	35	70.00	2.90			
Striped Shiner	N	I	S		31	62.00	2.57			
Silverjaw Minnow	N	I	M		31	62.00	2.57			
Greenside Darter	D	I	S	M	10	20.00	0.83			
White Sucker	W	O	S	T	5	10.00	0.41			
Rainbow Darter	D	I	S	M	5	10.00	0.41			
Rock Bass	S	C	C		4	8.00	0.33			
Longear Sunfish	S	I	C	M	1	2.00	0.08			
Blackside Darter	D	I	S		1	2.00	0.08			
	Mile Total				1,208	2,416.00				
	Number of Species				15					
	Number of Hybrids				0					

River Code: **01-190**	Stream: **Hyde Fork**	Sample Date: **2004**
River Mile: **1.80**	Location:	Date Range: 08/19/2004
Time Fished: 3720 sec	Drainage: 4.8 sq mi	
Dist Fished: 0.17 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	196	345.88	40.66			
Fantail Darter	D	I	C		95	167.65	19.71			
South. Redbelly Dace	N	H	S		45	79.41	9.34			
Bluntnose Minnow	N	O	C	T	26	45.88	5.39			
Central Stoneroller	N	H	N		21	37.06	4.36			
Western Blacknose Dace	N	G	S	T	20	35.29	4.15			
Johnny Darter	D	I	C		19	33.53	3.94			
White Sucker	W	O	S	T	13	22.94	2.70			
Striped Shiner	N	I	S		10	17.65	2.07			
Rainbow Darter	D	I	S	M	10	17.65	2.07			
Yellow Bullhead		I	C	T	6	10.59	1.24			
Longear Sunfish	S	I	C	M	6	10.59	1.24			
Bluegill Sunfish	S	I	C	P	5	8.82	1.04			
Silverjaw Minnow	N	I	M		2	3.53	0.41			
Green Sunfish	S	I	C	T	2	3.53	0.41			
Greenside Darter	D	I	S	M	2	3.53	0.41			
Striped Sh X Creek Chub		I			1	1.77	0.21			
Trout-perch		I	M		1	1.77	0.21			
Rock Bass	S	C	C		1	1.77	0.21			
Blackside Darter	D	I	S		1	1.77	0.21			
	Mile Total				482	850.59				
	Number of Species				19					
	Number of Hybrids				1					

River Code: **01-192**	Stream: **Miners Fork**	Sample Date: **2004**
River Mile: **2.25**	Location:	Date Range: 08/19/2004
Time Fished: 3000 sec	Drainage: 4.4 sq mi	
Dist Fished: 0.14 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	300	642.86	54.64			
Bluntnose Minnow	N	O	C	T	39	83.57	7.10			
Western Blacknose Dace	N	G	S	T	36	77.14	6.56			
South. Redbelly Dace	N	H	S		36	77.14	6.56			
Striped Shiner	N	I	S		30	64.29	5.46			
Fantail Darter	D	I	C		23	49.29	4.19			
Johnny Darter	D	I	C		22	47.14	4.01			
Silverjaw Minnow	N	I	M		18	38.57	3.28			
Central Stoneroller	N	H	N		16	34.29	2.91			
White Sucker	W	O	S	T	10	21.43	1.82			
Rock Bass	S	C	C		8	17.14	1.46			
Yellow Bullhead		I	C	T	4	8.57	0.73			
Northern Hog Sucker	R	I	S	M	2	4.29	0.36			
Green Sunfish	S	I	C	T	2	4.29	0.36			
Rainbow Darter	D	I	S	M	2	4.29	0.36			
Longear Sunfish	S	I	C	M	1	2.14	0.18			
	Mile Total				549	1,176.43				
	Number of Species				16					
	Number of Hybrids				0					

River Code: **01-192**	Stream: **Miners Fork**	Sample Date: **2004**
River Mile: **0.05**	Location:	Date Range: 08/19/2004
Time Fished: 1260 sec	Drainage: 9.9 sq mi	
Dist Fished: 0.15 km	Basin: Hocking River No of Passes: 1	Sampler Type: E
Site ID::	Lat:: 0.00000 Lat:: 0.00000 County::	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	291	582.00	52.81			
Fantail Darter	D	I	C		56	112.00	10.16			
Johnny Darter	D	I	C		53	106.00	9.62			
Central Stoneroller	N	H	N		29	58.00	5.26			
White Sucker	W	O	S	T	27	54.00	4.90			
Bluntnose Minnow	N	O	C	T	18	36.00	3.27			
Silverjaw Minnow	N	I	M		17	34.00	3.09			
Largemouth Bass	F	C	C		8	16.00	1.45			
Rainbow Darter	D	I	S	M	8	16.00	1.45			
Western Blacknose Dace	N	G	S	T	7	14.00	1.27			
Striped Shiner	N	I	S		7	14.00	1.27			
Least Brook Lamprey		F	N		6	12.00	1.09			
Sand Shiner	N	I	M	M	6	12.00	1.09			
Rock Bass	S	C	C		4	8.00	0.73			
Green Sunfish	S	I	C	T	4	8.00	0.73			
Greenside Darter	D	I	S	M	3	6.00	0.54			
Northern Hog Sucker	R	I	S	M	2	4.00	0.36			
Longear Sunfish	S	I	C	M	2	4.00	0.36			
Golden Redhorse	R	I	S	M	1	2.00	0.18			
Smallmouth Bass	F	C	C	M	1	2.00	0.18			
Blackside Darter	D	I	S		1	2.00	0.18			
	Mile Total				551	1,102.00				
	Number of Species				21					
	Number of Hybrids				0					

Total fish species captured in the Federal Creek watershed (MBI and Ohio EPA).

Grand Total of All Streams
Date Range: 08/24/1983
Thru: 09/28/2004

Dist Fished: 11.73 km No of Streams: 21 No of Passes: 74
Site ID:: Lat:: 0.00000 Lat:: 0.00000 County::

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Creek Chub	N	G	N	T	9,589	269.62	27.32	0.42	4.72	4.92
Central Stoneroller	N	H	N		4,295	113.81	11.53	0.21	2.36	2.99
South. Redbelly Dace	N	H	S		2,484	93.62	9.49	0.02	0.23	0.57
Bluntnose Minnow	N	O	C	T	3,249	76.14	7.71	0.13	1.41	1.93
Striped Shiner	N	I	S		3,177	74.00	7.50	0.46	5.20	6.24
Fantail Darter	D	I	C		1,690	44.91	4.55	0.03	0.31	0.94
Western Blacknose Dace	N	G	S	T	1,427	43.61	4.42	0.00	0.03	0.51
White Sucker	W	O	S	T	1,607	43.15	4.37	0.91	10.19	65.23
Johnny Darter	D	I	C		1,270	33.17	3.36	0.01	0.16	0.56
Greenside Darter	D	I	S	M	877	21.68	2.20	0.06	0.64	1.62
Rainbow Darter	D	I	S	M	695	18.41	1.87	0.01	0.10	0.72
Silverjaw Minnow	N	I	M		1,128	17.82	1.81	0.03	0.30	1.47
Longear Sunfish	S	I	C	M	645	15.78	1.60	0.31	3.51	15.43
Sand Shiner	N	I	M	M	598	13.55	1.37	0.03	0.39	1.27
Green Sunfish	S	I	C	T	497	11.02	1.12	0.21	2.33	16.17
Northern Hog Sucker	R	I	S	M	475	11.00	1.11	0.76	8.54	42.23
Golden Redhorse	R	I	S	M	488	9.94	1.01	1.82	20.54	109.63
Banded Darter	D	I	S	I	427	9.91	1.00	0.02	0.19	0.88
Gizzard Shad		O	M		480	9.89	1.00	0.21	2.32	11.21
Rock Bass	S	C	C		371	8.66	0.88	0.50	5.57	43.49
Blackside Darter	D	I	S		247	5.86	0.59	0.02	0.21	2.20
Spotfin Shiner	N	I	M		262	5.50	0.56	0.03	0.28	2.16
Redside Dace	N	I	S	I	186	4.88	0.49			
Bluegill Sunfish	S	I	C	P	199	4.33	0.44	0.09	1.06	17.33
Emerald Shiner	N	I	S		136	2.93	0.30	0.01	0.15	2.17
Trout-perch		I	M		108	2.54	0.26	0.01	0.13	3.75
Yellow Bullhead		I	C	T	100	2.49	0.25	0.28	3.19	104.26
Smallmouth Bass	F	C	C	M	100	2.44	0.25	0.22	2.52	74.39
Largemouth Bass	F	C	C		96	2.42	0.25	0.06	0.68	50.61
Least Brook Lamprey		F	N		91	2.38	0.24	0.01	0.15	8.10
Spotted Bass	F	C	C		85	1.89	0.19	0.16	1.85	45.68
Logperch	D	I	S	M	72	1.74	0.18	0.02	0.19	7.40
Redfin Shiner	N	I	N		85	1.29	0.13	0.00	0.01	1.15
Suckermouth Minnow	N	I	S		57	1.23	0.12	0.01	0.09	3.25
Brindled Madtom		I	C	I	40	0.88	0.09	0.01	0.09	4.50
Orangethroat Darter	D	I	S		22	0.66	0.07	0.00	0.01	1.67
Freshwater Drum			M	P	27	0.57	0.06	0.28	3.20	222.41
Channel Catfish	F		C		19	0.41	0.04	0.34	3.86	370.32
Eastern Sand Darter [S]	D	I	S	R	19	0.39	0.04	0.00	0.01	1.32
Green Sf X Bluegill Sf					12	0.29	0.03	0.01	0.11	47.17
Steelcolor Shiner	N	I	M	P	15	0.27	0.03	0.00	0.01	2.13
White Crappie	S	I	C		13	0.26	0.03	0.05	0.56	112.00
Common Carp	G	O	M	T	13	0.22	0.02	0.94	10.59	2,065.46
Hybrid X Sunfish					11	0.19	0.02	0.02	0.22	53.55
Green Sf X Longear Sf					5	0.11	0.01	0.01	0.06	43.00
Hybrid X Minnow					3	0.11	0.01			
Longear Sf X Bluegill Sf					4	0.09	0.01	0.01	0.07	37.25

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Spotted Sucker	R	I	S		5	0.08	0.01	0.03	0.32	151.20
Common Shiner	N	I	S		3	0.08	0.01			
Cr Chub X S. Redbelly D					2	0.07	0.01			
Warmouth Sunfish	S	C	C		2	0.06	0.01	0.00	0.02	16.50
Sauger X Walleye	E	P			2	0.06	0.01	0.04	0.50	390.00
Black Bullhead		I	C	P	3	0.05	0.01	0.02	0.18	152.67
Fathead Minnow	N	O	C	T	2	0.04	0.00	0.00	0.00	1.00
Black Redhorse	R	I	S	I	2	0.04	0.00	0.01	0.16	163.00
River Redhorse [S]	R	I	S	I	2	0.04	0.00	0.00	0.00	2.50
Goldfish	G	O	M	T	2	0.04	0.00	0.01	0.13	138.00
Silver Redhorse	R	I	S	M	2	0.04	0.00	0.00	0.02	29.00
Sauger	F	P	S		2	0.04	0.00	0.02	0.21	214.50
Brown Bullhead		I	C	T	2	0.03	0.00	0.00	0.01	14.00
Striped Sh X S Redbelly D					1	0.03	0.00			
Redside D X Striped Sh		I	S		1	0.03	0.00			
Flathead Catfish	F	P	C		1	0.03	0.00	0.00	0.05	75.00
Striped Sh X Creek Chub		I			1	0.02	0.00			
Quillback Carpsucker	C	O	M		1	0.02	0.00	0.00	0.00	10.00
Shorthead Redhorse	R	I	S	M	1	0.02	0.00	0.00	0.02	36.00
Mimic Shiner	N	I	M	I	1	0.02	0.00	0.00	0.00	2.00
Brook Silverside		I	M	M	1	0.02	0.00	0.00	0.00	1.00
White Bass	F	P	M		1	0.02	0.00	0.00	0.00	6.00
Pumpkinseed Sunfish	S	I	C	P	4	0.00	0.00			
					2	0.00	0.00			
	Grand Total				37,542	986.94		8.88		
	Number of Species				61					
	Number of Hybrids				10					

Appendix Table 2a. IBI metrics and scores for headwaters sites in Federal Creek (MBI and Ohio EPA Data).

				Number of						Percent of Individuals						
River Mile	Type	Date	Drainage area (sq mi)	Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI
Federal Creek - (01-100)																
Year: 2004																
16.15	E	08/24/2004	17.0	22(5)	7(5)	2(3)	8(5)	6(5)	8(5)	31(5)	18(3)	34(3)	56(5)	0.0(5)	476(3)	52
Kasler Creek - (01-101)																
Year: 2004																
1.75	E	08/19/2004	3.7	14(5)	6(5)	3(3)	2(3)	3(5)	5(5)	64(1)	8(5)	55(3)	17(3)	0.0(5)	349(3)	46
Sharps Run - (01-110)																
Year: 2004																
0.01	E	09/03/2004	4.9	23(5)	8(5)	3(3)	8(5)	6(5)	9(5)	28(5)	2(5)	32(3)	53(5)	0.0(5)	1202(5)	56
Sharps Run - (01-110)																
Year: 1995																
2.40	H	08/03/1995	1.5	6(3)	4(3)	3(3)	0(1)	2(5)	3(5)	4(5)	0(5)	3(5)	4(1)	0.0(5)	683(5)	46
2.40	H	09/21/1995	1.5	6(3)	4(3)	3(3)	0(1)	2(5)	3(5)	28(5)	0(5)	24(5)	5(1)	0.0(5)	405(5)	46
2.40	H	12/02/1995	1.5	4(3)	2(1)	2(3)	0(1)	2(5)	1(1)	3(5)	3(5)	8(5)	8(1)	0.0(5)	293(5)	40
Big Run - (01-130)																
Year: 2004																
3.90	E	09/02/2004	4.2	20(5)	8(5)	5(5)	2(3)	4(5)	8(5)	47(3)	16(3)	40(3)	26(3)	0.0(5)	520(5)	50
1.70	E	09/02/2004	9.0	22(5)	8(5)	3(3)	3(3)	4(5)	6(5)	54(3)	37(1)	42(3)	30(3)	0.0(5)	592(3)	44
Year: 1995																
3.90	E	08/09/1995	4.2	21(5)	9(5)	5(5)	4(5)	4(5)	10(5)	55(3)	22(3)	40(3)	15(1)	0.1(5)	1018(5)	50
0.20	E	07/26/1995	11.8	17(5)	7(5)	4(5)	5(3)	5(5)	9(5)	57(1)	27(3)	62(1)	23(3)	0.0(5)	790(5)	46
Ellis Run - (01-131)																
Year: 1995																
0.50	E	07/26/1995	1.3	15(5)	8(5)	4(5)	3(5)	4(5)	7(5)	51(3)	3(5)	36(3)	13(3)	0.0(5)	1474(5)	54
Joes Run - (01-132)																
Year: 1995																
0.10	E	07/26/1995	0.9	14(5)	7(5)	4(5)	2(5)	4(5)	7(5)	56(3)	6(5)	47(3)	16(3)	0.0(5)	320(5)	54
Wildcat Run - (01-133)																
Year: 1995																

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Appendix Table 2a. Continued.

				Number of						Percent of Individuals						
River Mile	Type	Date	Drainage area (sq mi)	Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI
0.10	E	08/09/1995	1.7	13(5)	7(5)	4(5)	1(1)	4(5)	6(5)	47(3)	15(3)	41(3)	13(3)	0.0(5)	489(5)	48
Sulphur Run - (01-134)																
Year: 2004																
0.80	E	08/06/2004	1.0	10(5)	6(5)	2(3)	1(3)	1(3)	4(5)	37(3)	5(5)	32(3)	7(1)	0.1(5)	1353(5)	46
0.01	E	08/10/2004	1.7	10(5)	5(5)	3(3)	2(3)	3(5)	4(5)	47(3)	9(5)	37(3)	14(3)	0.0(5)	426(5)	50
Spruce Run - (01-140)																
Year: 1995																
0.20	E	07/27/1995	1.4	17(5)	8(5)	4(5)	3(5)	4(5)	8(5)	53(3)	7(5)	44(3)	16(3)	0.0(5)	736(5)	54
Marietta Run - (01-150)																
Year: 2004																
3.20	E	07/28/2004	5.5	19(5)	8(5)	5(5)	4(3)	5(5)	9(5)	60(1)	6(5)	50(3)	26(3)	0.1(5)	574(5)	50
1.60	E	08/09/2004	8.0	16(5)	6(5)	4(5)	3(3)	5(5)	7(5)	71(1)	1(5)	68(1)	17(1)	0.0(5)	364(3)	44
0.10	E	07/28/2004	10.1	21(5)	7(5)	3(3)	5(3)	6(5)	8(5)	75(1)	19(3)	74(1)	17(1)	0.0(5)	313(3)	40
Year: 1995																
0.10	E	07/18/1995	10.1	20(5)	8(5)	4(5)	3(3)	4(5)	8(5)	51(3)	18(3)	51(3)	30(3)	0.0(5)	494(3)	48
Brill Run - (01-151)																
Year: 1995																
0.10	E	07/18/1995	3.2	15(5)	7(5)	4(5)	4(5)	5(5)	9(5)	38(3)	4(5)	26(5)	24(3)	0.0(5)	1361(5)	56
Sharps Fork - (01-160)																
Year: 2004																
10.70	E	08/09/2004	4.6	19(5)	7(5)	4(5)	4(5)	4(5)	7(5)	62(1)	11(5)	53(3)	27(3)	0.0(5)	346(3)	50
9.10	E	08/31/2004	6.0	21(5)	6(5)	3(3)	6(5)	4(5)	7(5)	56(3)	16(3)	53(3)	38(5)	0.0(5)	153(3)	50
8.05	E	08/09/2004	8.5	23(5)	5(3)	2(3)	9(5)	7(5)	9(5)	32(5)	9(5)	28(5)	59(5)	0.0(5)	297(3)	54
5.30	E	08/10/2004	15.8	23(5)	7(5)	3(3)	8(5)	7(5)	10(5)	46(3)	9(5)	48(3)	43(3)	0.0(5)	619(3)	50
Opossum Run - (01-161)																
Year: 2004																
4.10	E	08/10/2004	2.3	4(1)	2(1)	2(3)	0(1)	2(3)	1(1)	92(1)	0(5)	56(1)	8(1)	0.0(5)	37(1)	24
2.60	E	08/06/2004	4.5	11(3)	6(5)	3(3)	2(3)	3(5)	6(5)	58(1)	6(5)	43(3)	9(1)	0.0(5)	649(5)	44

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Appendix Table 2a. Continued.

				Number of						Percent of Individuals						
River Mile	Type	Date	Drainage area (sq mi)	Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI
0.75	E	09/02/2004	6.0	21(5)	7(5)	2(3)	5(5)	5(5)	7(5)	47(3)	27(1)	34(3)	39(5)	0.0(5)	444(3)	48
0.20	E	08/06/2004	8.9	16(5)	8(5)	4(5)	3(3)	5(5)	7(5)	38(3)	12(5)	27(5)	37(3)	0.0(5)	395(3)	52
McDougall Branch - (01-170)																
Year: 2004																
4.95	E	08/18/2004	4.5	17(5)	7(5)	3(3)	4(5)	4(5)	7(5)	62(1)	7(5)	50(3)	15(1)	0.0(5)	874(5)	48
4.50	E	08/18/2004	12.4	25(5)	9(5)	4(5)	7(5)	6(5)	10(5)	45(3)	18(3)	40(3)	34(3)	0.0(5)	654(3)	50
Wyatt Run - (01-171)																
Year: 2004																
0.40	E	08/24/2004	6.6	16(5)	7(5)	3(3)	3(3)	6(5)	8(5)	62(1)	13(5)	57(1)	16(1)	0.0(5)	605(3)	42
Mush Run - (01-172)																
Year: 2004																
1.80	E	08/18/2004	4.8	20(5)	7(5)	4(5)	4(5)	4(5)	6(5)	55(3)	23(3)	51(3)	25(3)	0.0(5)	646(5)	52
1.00	E	08/18/2004	12.7	24(5)	7(5)	3(3)	7(5)	6(5)	9(5)	54(3)	29(3)	48(3)	32(3)	0.1(5)	1128(5)	50
Bryson Branch - (01-174)																
Year: 2004																
1.20	E	08/18/2004	5.7	22(5)	7(5)	3(3)	7(5)	5(5)	9(5)	62(1)	14(3)	58(1)	25(3)	0.0(5)	468(3)	44
Dutch Creek - (01-176)																
Year: 2004																
1.70	E	08/25/2004	4.8	14(5)	6(5)	2(3)	3(3)	5(5)	6(5)	44(3)	19(3)	33(3)	29(3)	0.0(5)	178(3)	46
Linscott Run - (01-180)																
Year: 2004																
3.80	E	08/05/2004	2.0	7(3)	3(3)	3(3)	0(1)	2(3)	3(3)	53(3)	1(5)	45(3)	8(1)	0.0(5)	202(5)	38
0.80	E	08/05/2004	4.5	15(5)	7(5)	3(3)	3(3)	5(5)	7(5)	51(3)	3(5)	47(3)	18(3)	0.0(5)	1180(5)	50
Hyde Fork - (01-190)																
Year: 2004																
1.80	E	08/19/2004	4.8	19(5)	7(5)	3(3)	3(3)	5(5)	7(5)	55(3)	8(5)	51(3)	33(3)	0.0(5)	387(3)	48
Miners Fork - (01-192)																
Year: 2004																

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Appendix Table 2a. Continued.

				Number of						Percent of Individuals						
River Mile	Type	Date	Drainage area (sq mi)	Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI
2.25	E	08/19/2004	4.4	16(5)	7(5)	3(3)	3(3)	3(5)	6(5)	71(1)	9(5)	69(1)	19(3)	0.0(5)	339(3)	44
0.05	E	08/19/2004	9.9	21(5)	7(5)	3(3)	7(5)	5(5)	8(5)	63(1)	8(5)	70(1)	29(3)	0.0(5)	408(3)	46

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Appendix Table 2b. IBI metrics and scores for wadeable streams in the Federal Creek watershed (MBI and Ohio EPA surveys).

				Number of					Percent of Individuals								
River Mile	Type	Date	Drainage area (sq mi)	Total species	Sunfish species	Sucker species	Intolerant species	Darter species	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI	Modified Iwb
Federal Creek - (01100)																	
Year: 2004																	
11.70	E	08/17/2004	27	24(5)	3(3)	3(5)	1(1)	6(5)	50(5)	30(3)	16(5)	1.9(3)	70(5)	0.0(5)	456(3)	48	8.9
11.30	E	08/17/2004	32	25(5)	3(3)	3(3)	1(1)	7(5)	24(3)	32(3)	16(5)	1.5(3)	39(3)	0.0(5)	1690(5)	44	9.6
11.30	E	09/15/2004	32	25(5)	4(5)	3(3)	1(1)	7(5)	34(3)	35(3)	15(5)	1.8(3)	55(5)	0.0(5)	874(5)	48	9.4
9.30	E	09/07/2004	60	21(5)	4(5)	2(3)	2(1)	5(5)	27(3)	49(1)	4(5)	3.1(3)	55(5)	0.0(5)	322(3)	44	7.7
9.30	E	09/28/2004	60	25(5)	4(5)	4(5)	2(1)	6(5)	43(5)	21(5)	14(5)	2.1(3)	78(5)	0.0(5)	278(3)	52	8.1
9.10	E	08/11/2004	60	25(5)	3(3)	3(3)	3(3)	7(5)	35(3)	30(3)	11(5)	5.2(5)	61(5)	0.0(5)	366(3)	48	8.5
9.10	E	09/15/2004	60	27(5)	3(3)	3(3)	2(1)	7(5)	35(3)	30(3)	10(5)	7.2(5)	59(5)	0.0(5)	453(3)	46	9.1
4.90	E	08/11/2004	90	26(5)	5(5)	2(3)	2(1)	6(5)	38(5)	8(5)	4(5)	16.0(5)	73(5)	0.0(5)	196(1)	50	8.0
4.90	E	09/15/2004	90	17(3)	4(5)	2(3)	0(1)	4(3)	74(5)	4(5)	7(5)	10.5(5)	83(5)	0.0(5)	129(1) *	46	6.3
0.90	E	09/07/2004	139	32(5)	3(3)	3(3)	3(3)	8(5)	22(3)	9(5)	49(1)	2.3(3)	41(3)	0.0(5)	1355(5)	44	9.5
Year: 1990																	
11.40	D	07/18/1990	32	24(5)	4(5)	3(3)	0(1)	6(5)	26(3)	28(5)	14(5)	4.9(3)	73(5)	0.0(5)	484(3)	48	9.0
1.30	D	07/19/1990	138	26(5)	3(3)	2(1)	3(3)	6(5)	26(3)	14(5)	9(5)	5.8(5)	51(3)	0.0(5)	336(3)	46	8.7
Year: 1984																	
1.30	D	09/25/1984	138	36(5)	4(5)	5(5)	4(3)	7(5)	26(3)	22(3)	20(3)	2.0(3)	64(5)	0.0(5)	1790(5)	50	10.3
Sharps Fork - (01160)																	
Year: 2004																	
1.65	E	08/06/2004	30	20(5)	2(3)	3(3)	1(1)	6(5)	53(5)	27(5)	11(5)	3.4(3)	59(5)	0.0(5)	560(3)	48	8.8
1.60	E	08/05/2004	30	20(5)	4(5)	3(3)	0(1)	6(5)	34(3)	39(3)	12(5)	7.3(5)	72(5)	0.0(5)	178(1)	46	8.3
Sharps Fork - (01160)																	
Year: 2004																	
0.01	E	08/05/2004	35	21(5)	3(3)	3(3)	1(1)	6(5)	37(5)	25(5)	6(5)	1.3(3)	47(3)	0.0(5)	514(3)	46	8.3
Sharps Fork - (01160)																	

na - Qualitative data, Modified Iwb not applicable.

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Appendix Table 2b. Continued.

				Number of					Percent of Individuals								
River Mile	Type	Date	Drainage area (sq mi)	Total species	Sunfish species	Sucker species	Intolerant species	Darter species	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI	Modified Iwb
Year: 1990																	
0.30	E	07/19/1990	35	20(5)	3(3)	2(3)	1(1)	5(5)	35(3)	32(3)	12(5)	11.7(5)	54(3)	0.0(5)	210(3)	44	8.1
McDougall Branch - (01170)																	
Year: 2004																	
2.90	E	08/24/2004	27	22(5)	2(3)	3(5)	0(1)	6(5)	32(3)	43(3)	7(5)	1.0(1)	42(3)	0.0(5)	804(5)	44	8.1
2.90	E	09/28/2004	27	25(5)	4(5)	3(5)	1(1)	7(5)	36(3)	31(3)	14(5)	1.5(3)	56(5)	0.0(5)	445(3)	48	8.4
0.50	E	08/17/2004	37	26(5)	5(5)	3(3)	1(1)	7(5)	47(5)	28(3)	5(5)	2.8(3)	65(5)	0.0(5)	621(3)	48	8.8
0.50	E	09/16/2004	37	28(5)	5(5)	3(3)	1(1)	7(5)	46(5)	26(5)	9(5)	3.9(3)	69(5)	0.0(5)	376(3)	50	8.8
Year: 1990																	
2.40	D	07/19/1990	28	26(5)	4(5)	4(5)	1(1)	6(5)	36(3)	36(3)	20(3)	2.7(3)	49(3)	0.9(3)	354(3)	42	9.1
Year: 1983																	
2.40	D	08/24/1983	28	30(5)	5(5)	4(5)	1(1)	7(5)	31(3)	33(3)	22(3)	4.0(3)	58(5)	0.0(5)	487(3)	46	9.3
2.40	D	09/08/1983	28	28(5)	5(5)	3(3)	1(1)	7(5)	43(5)	45(3)	38(1)	0.9(1)	57(5)	0.1(5)	454(3)	42	8.0
2.40	D	11/01/1983	28	27(5)	5(5)	5(5)	2(3)	5(5)	43(5)	25(5)	18(5)	5.2(5)	69(5)	0.0(5)	330(3)	56	8.8

na - Qualitative data, Modified Iwb not applicable.

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Appendix Table 3. Macroinvertebrate taxa collected during quantitative (numeric) or qualitative (+) surveys in the Federal Creek watershed by MBI in 2004 and by Ohio EPA in 1984 and 1990.

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 08/21/1984 River Code: 01-100 River: Federal Creek RM: 0.90

Taxa Code	Taxa	Tol.	Qt./Ql.
01320	Hydra sp	F	2
03360	Plumatella sp	F	1
03600	Oligochaeta	T	81 +
08601	Hydracarina	F	+
11100	Baetis sp	F	+
12200	Isonychia sp	MI	+
13000	Leucrocuta sp	I	+
13400	Stenacron sp	F	9
13510	Stenonema exiguum	I	2
13570	Stenonema terminatum	MI	3
13580	Stenonema tripunctatum (old)	F	6
15000	Paraleptophlebia sp	MI	1
16700	Tricorythodes sp	MI	139 +
17200	Caenis sp	F	112
18600	Ephemera sp	MI	1
22300	Argia sp	F	19
23909	Boyeria vinosa	F	1
34130	Acroneuria frisoni	MI	1
47600	Sialis sp	F	1
48410	Corydalus cornutus	MI	+
48620	Nigronia serricornis	F	1
51206	Cyrnellus fraternus	F	3
52200	Cheumatopsyche sp	F	1 +
53501	Hydroptilidae	F	+
53800	Hydroptila sp	F	6 +
54100	Neotrichia sp	F	39
59001	Leptoceridae	MI	32
59500	Oecetis sp	MI	+
60300	Dineutus sp	F	+
66500	Enochrus sp	F	+
68601	Ancyronyx variegata	MI	2
68700	Dubiraphia sp	F	15
68901	Macronychus glabratus	MI	16
69225	Optioservus fastiditus	MI	+
69400	Stenelmis sp	F	+
74100	Simulium sp	F	+
74501	Ceratopogonidae	F	8
77120	Ablabesmyia mallochi	F	41
77130	Ablabesmyia rhamphe group	M	142
78100	Labrundinia sp	F	20
78650	Procladius sp	M	41
79100	Thienemannimyia group	F	223 +
80350	Corynoneura sp	MI	8
80410	Cricotopus (C.) sp	F	20
81650	Parametriocnemus sp	MI	+
82141	Thienemanniella xena	F	+
82600	Axarus sp	MI	20
82710	Chironomus (C.) sp	T	20
83840	Microtendipes pedellus group	MI	+
84155	Paralauterborniella nigrohalteralis	F	20
84210	Paratendipes albimanus or P. duplicatus	MI	20
84300	Phaenopsectra obediens group	F	60
84315	Phaenopsectra flavipes	F	20
84450	Polypedilum (Uresipedilum) flavum	F	+
84460	Polypedilum (P.) fallax group	F	60
84540	Polypedilum (Tripodura) scalaenum group	F	244 +
84612	Saetheria tylus	MI	+
85200	Cladotanytarsus sp	F	41 +
85400	Micropsectra sp	F	81 +
85814	Tanytarsus glabrescens group	F	344 +
85840	Tanytarsus sepp	MI	163 +
87501	Empididae	F	1 +
92201	Valvatidae		+
95100	Physella sp	T	1
96900	Ferrissia sp	F	13
98200	Pisidium sp	F	9
98600	Sphaerium sp	F	+

No. Quantitative Taxa:	48	Total Taxa:	67
No. Qualitative Taxa:	30	ICI:	38
Number of Organisms:	2114	Qual EPT:	8

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 09/06/1990 River Code: 01-100 River: Federal Creek RM: 0.90

Taxa Code	Taxa	Tol.	Qt./Ql.
01320	Hydra sp	F	80
08260	Orconectes (Crokerinus) sanbornii sanbornii	F	+
08601	Hydracarina	F	8
11100	Baetis sp	F	660 +
11300	Procloeon sp (formerly in Centroptilum)	MI	8 +
12200	Isonychia sp	MI	60 +
13000	Leucrocuta sp	I	+
13400	Stenacron sp	F	151 +
13510	Stenonema exiguum	I	88 +
13570	Stenonema terminatum	MI	175 +
13590	Stenonema vicarium	MI	42 +
16700	Tricorythodes sp	MI	85 +
17200	Caenis sp	F	8
22001	Coenagrionidae	M	+
23909	Boyeria vinosa	F	1 +
34130	Acroneuria frisoni	MI	1 +
48410	Corydalus cornutus	MI	12 +
50315	Chimarra obscura	MI	+
51300	Neureclipsis sp	MI	16 +
51600	Polycentropus sp	MI	+
52200	Cheumatopsyche sp	F	599 +
52570	Hydropsyche simulans	MI	43 +
53501	Hydroptilidae	F	2
59520	Oecetis cinerascens	F	8
60300	Dineutus sp	F	+
63300	Hydroporus sp	F	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	15
68708	Dubiraphia vittata group	F	+
68901	Macronychus glabratus	MI	17 +
69400	Stenelmis sp	F	1 +
74100	Simulium sp	F	2 +
77500	Conchapelopia sp	F	35
77750	Hayesomyia senata or Thienemannimyia norena	F	35 +
78401	Natarsia species A (sensu Roback, 1978)	T	+
78450	Nilotanypus fimbriatus	MI	18
78650	Procladius sp	M	+
80370	Corynoneura lobata	MI	53
80430	Cricotopus (C.) tremulus group	F	+
81650	Parametriocnemus sp	MI	+
81825	Rheocricotopus (Psilocricotopus) robacki	MI	53 +
82820	Cryptochironomus sp	F	+
83840	Microtendipes pedellus group	MI	18
84155	Paralauterborniella nigrohalteralis	F	+
84300	Phaenopsectra obediens group	F	8
84450	Polypedilum (Uresipedilum) flavum	F	+
84460	Polypedilum (P.) fallax group	F	53 +
84470	Polypedilum (P.) illinoense	T	+
84540	Polypedilum (Tripodura) scalaenum group	F	+
85615	Rheotanytarsus pellucidus	MI	35 +
85625	Rheotanytarsus sp	MI	1194 +
85800	Tanytarsus sp	MI	8
85814	Tanytarsus glabrescens group	F	88
87501	Empididae	F	251
95100	Physella sp	T	+
96900	Ferrissia sp	F	10
97601	Corbicula fluminea	MI	+

No. Quantitative Taxa:	37	Total Taxa:	57
No. Qualitative Taxa:	42	ICI:	54
Number of Organisms:	3941	Qual EPT:	15

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 10/06/2004 River Code: 01-100 River: Federal Creek RM: 0.90

Taxa Code	Taxa	Tol.	Qt./Ql.
08200	Orconectes sp	F	+
12200	Isonychia sp	MI	+
13400	Stenacron sp	F	+
13521	Stenonema femoratum	F	+
13590	Stenonema vicarium	MI	+
17200	Caenis sp	F	+
17600	Baetisca sp	I	+
21200	Calopteryx sp	F	+
22001	Coenagrionidae	M	+
22300	Argia sp	F	+
23909	Boyeria vinosa	F	+
51400	Nyctiophylax sp	MI	+
52200	Cheumatopsyche sp	F	+
55300	Ptilostomis sp	F	+
68130	Helichus sp	MI	+
68901	Macronychus glabratus	MI	+
69400	Stenelmis sp	F	+
71700	Pilaria sp	F	+
74100	Simulium sp	F	+
77750	Hayesomyia senata or Thienemannimyia norena	F	+
84315	Phaenopsectra flavipes	F	+
95100	Physella sp	T	+
97601	Corbicula fluminea	MI	+
99860	Lampsilis radiata luteola	MI	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 24
No. Qualitative Taxa: 24 ICI: MG
Number of Organisms: 0 Qual EPT: 9

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 09/13/2004 River Code: 01-100 River: Federal Creek RM: 4.90

Taxa Code	Taxa	Tol.	Qt./Ql.
03600	Oligochaeta	T	4
07800	Cambarus sp	F	+
11130	Baetis intercalaris	F	3
11150	Pseudocloeon propinquum	I	+
12200	Isonychia sp	MI	1 +
13400	Stenacron sp	F	1 +
13521	Stenonema femoratum	F	4 +
13590	Stenonema vicarium	MI	12 +
15600	Ephemerella sp	MI	1
17200	Caenis sp	F	5
17600	Baetisca sp	I	+
18600	Ephemera sp	MI	1
21200	Calopteryx sp	F	+
23804	Basiaeschna janata	F	+
23909	Boyeria vinosa	F	+
48620	Nigronia serricornis	F	1
52200	Cheumatopsyche sp	F	7
52570	Hydropsyche simulans	MI	+
60300	Dineutus sp	F	+
68130	Helichus sp	MI	2 +
68901	Macronychus glabratus	MI	3 +
69400	Stenelmis sp	F	+
71900	Tipula sp	F	1 +
77800	Helopelopia sp	F	2
80370	Corynoneura lobata	MI	10
80420	Cricotopus (C.) bicinctus	M	1
81400	Orthocladius sp		1
81650	Parametriocnemus sp	MI	1
81825	Rheocricotopus (Psilocricotopus) robacki	MI	2
82141	Thienemanniella xena	F	2
84315	Phaenopsectra flavipes	F	1
84450	Polypedilum (Uresipedilum) flavum	F	2
84470	Polypedilum (P.) illinoense	T	4
85500	Paratanytarsus sp	F	2
85800	Tanytarsus sp	MI	5
85802	Tanytarsus curticornis group	MI	3
85821	Tanytarsus glabrescens group sp 7	MI	7
85840	Tanytarsus sepp	MI	5

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 29 Total Taxa: 38
No. Qualitative Taxa: 16 ICI: 34
Number of Organisms: 94 Qual EPT: 7

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 09/14/2004 River Code: 01-100 River: Federal Creek RM: 7.50

Taxa Code	Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F	2
05800	Caecidotea sp	M	2
08200	Orconectes sp	F	1
13400	Stenacron sp	F	52 +
13521	Stenonema femoratum	F	10
13590	Stenonema vicarium	MI	13 +
17200	Caenis sp	F	67 +
17600	Baetisca sp	I	+
21200	Calopteryx sp	F	1 +
22001	Coenagrionidae	M	1 +
22300	Argia sp	F	+
23804	Basiaeschna janata	F	+
23909	Boyeria vinosa	F	+
34130	Acroneuria frisoni	MI	1
47600	Sialis sp	F	3
51400	Nyctiophylax sp	MI	2 +
51600	Polycentropus sp	MI	4 +
52430	Ceratopsyche morosa group	MI	+
53800	Hydroptila sp	F	2
59580	Oecetis persimilis	MI	4
59720	Triaenodes ignitus	I	+
60300	Dineutus sp	F	+
65800	Berosus sp	M	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	+
68708	Dubiraphia vittata group	F	20
68901	Macronychus glabratus	MI	4 +
71900	Tipula sp	F	+
72700	Anopheles sp	F	+
74501	Ceratopogonidae	F	2
77120	Ablabesmyia mallochi	F	19
81825	Rheocricotopus (Psilocricotopus) robacki	MI	5
82820	Cryptochironomus sp	F	5
83040	Dicrotendipes neomodestus	F	9
83840	Microtendipes pedellus group	MI	14
84210	Paratendipes albimanus or P. duplicatus	MI	24
84460	Polypedilum (P.) fallax group	F	14
84960	Pseudochironomus sp	F	5
85500	Paratanytarsus sp	F	5
85800	Tanytarsus sp	MI	62
85821	Tanytarsus glabrescens group sp 7	MI	38
85840	Tanytarsus sepp	MI	84
87540	Hemerodromia sp	F	2

No. Quantitative Taxa:	31	Total Taxa:	43
No. Qualitative Taxa:	20	ICI:	42
Number of Organisms:	477	Qual EPT:	8

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 09/21/2004 River Code: 01-100 River: Federal Creek RM: 11.40

Taxa Code	Taxa	Tol.	Qt./Ql.
05800	Caecidotea sp	M	+
06700	Crangonyx sp	M	+
13400	Stenacron sp	F	+
13521	Stenonema femoratum	F	+
13590	Stenonema vicarium	MI	+
17200	Caenis sp	F	+
22001	Coenagrionidae	M	+
22300	Argia sp	F	+
23804	Basiaeschna janata	F	+
23909	Boyeria vinosa	F	+
24900	Gomphus sp	F	+
55300	Ptilostomis sp	F	+
59730	Triaenodes melaca	MI	+
60900	Peltodytes sp	M	+
68130	Helichus sp	MI	+
68708	Dubiraphia vittata group	F	+
68901	Macronychus glabratus	MI	+
69400	Stenelmis sp	F	+
82710	Chironomus (C.) sp	T	+
84300	Phaenopsectra obediens group	F	+
86100	Chrysops sp	F	+
95100	Physella sp	T	+
96900	Ferrissia sp	F	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 23
No. Qualitative Taxa: 23 ICI: F
Number of Organisms: 0 Qual EPT: 6

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 09/04/1990 River Code: 01-100 River: Federal Creek RM: 11.70

Taxa Code	Taxa	Tol.	Qt./Ql.
01320	Hydra sp	F	4
03600	Oligochaeta	T	2 +
05800	Caecidotea sp	M	1 +
08260	Orconectes (Crokerinus) sanbornii sanbornii	F	+
11100	Baetis sp	F	+
11400	Centroptilum sp or Procloeon sp (formerly in Cloeon)	MI	1
12200	Isonychia sp	MI	+
13400	Stenacron sp	F	28 +
13510	Stenonema exiguum	I	+
13570	Stenonema terminatum	MI	2
13580	Stenonema tripunctatum (old)	F	46 +
13590	Stenonema vicarium	MI	16 +
17200	Caenis sp	F	201 +
21200	Calopteryx sp	F	+
22001	Coenagrionidae	M	+
22300	Argia sp	F	+
23909	Boyeria vinosa	F	+
24900	Gomphus sp	F	+
26700	Macromia sp	F	+
34130	Acroneuria frisoni	MI	+
48220	Chauliodes rastricornis	F	1
48620	Nigronia serricornis	F	+
50315	Chimarra obscura	MI	+
51600	Polycentropus sp	MI	3 +
52200	Cheumatopsyche sp	F	2 +
60300	Dineutus sp	F	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	1 +
68708	Dubiraphia vittata group	F	7 +
68901	Macronychus glabratus	MI	1 +
69400	Stenelmis sp	F	3 +
70501	Tipulidae		1
71100	Hexatoma sp	MI	1 +
74100	Simulium sp	F	+
74501	Ceratopogonidae	F	1
77130	Ablabesmyia rhamphe group	M	3
77500	Conchapelopia sp	F	22 +
77800	Helopelopia sp	F	32
78140	Labrundinia pilosella	MI	7
78401	Natarsia species A (sensu Roback, 1978)	T	3 +
78450	Nilotanypus fimbriatus	MI	3
80370	Corynoneura lobata	MI	5 +
82121	Thienemanniella lobapodema	MI	3
82820	Cryptochironomus sp	F	3 +
83040	Dicrotendipes neomodestus	F	17 +
83840	Microtendipes pedellus group	MI	3
83900	Nilothauma sp	MI	3
84155	Paralauterborniella nigrohalteralis	F	3
84210	Paratendipes albimanus or P. duplicatus	MI	17 +
84300	Phaenopsectra obediens group	F	10 +
84450	Polypedilum (Uresipedilum) flavum	F	3
84460	Polypedilum (P.) fallax group	F	30
84540	Polypedilum (Tripodura) scalaenum group	F	27
85260	Cladotanytarsus vanderwulpi group	MI	3 +
85500	Paratanytarsus sp	F	7
85615	Rheotanytarsus pellucidus	MI	+
85625	Rheotanytarsus sp	MI	13 +
85800	Tanytarsus sp	MI	10
85814	Tanytarsus glabrescens group	F	81
85840	Tanytarsus sepp	MI	40 +
86100	Chrysops sp	F	+
87501	Empididae	F	7
95100	Physella sp	T	1 +
96900	Ferrissia sp	F	12 +
98600	Sphaerium sp	F	+

No. Quantitative Taxa:	46	Total Taxa:	65
No. Qualitative Taxa:	44	ICI:	46
Number of Organisms:	690	Qual EPT:	11

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 08/25/2004 River Code: 01-100 River: Federal Creek RM: 11.70

Taxa Code	Taxa	Tol.	Qt./Ql.
08200	Orconectes sp	F	+
11120	Baetis flavistriga	F	+
11130	Baetis intercalaris	F	+
12200	Isonychia sp	MI	+
13000	Leucrocuta sp	I	+
13400	Stenacron sp	F	+
13590	Stenonema vicarium	MI	+
17200	Caenis sp	F	+
21200	Calopteryx sp	F	+
22001	Coenagrionidae	M	+
23804	Basiaeschna janata	F	+
24900	Gomphus sp	F	+
26700	Macromia sp	F	+
34100	Acroneuria sp	MI	+
36001	Chloroperlidae	MI	+
52200	Cheumatopsyche sp	F	+
59730	Triaenodes melaca	MI	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	+
68708	Dubiraphia vittata group	F	+
68901	Macronychus glabratus	MI	+
69400	Stenelmis sp	F	+
71100	Hexatoma sp	MI	+
72700	Anopheles sp	F	+
81650	Parametriocnemus sp	MI	+
82710	Chironomus (C.) sp	T	+
84315	Phaenopsectra flavipes	F	+
84612	Saetheria tylus	MI	+
86100	Chrysops sp	F	+
96002	Helisoma anceps anceps	M	+
96900	Ferrissia sp	F	+
98600	Sphaerium sp	F	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 32
No. Qualitative Taxa: 32 ICI: VG
Number of Organisms: 0 Qual EPT: 11

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 09/15/2004 River Code: 01-100 River: Federal Creek RM: 15.50

Taxa Code	Taxa	Tol.	Qt./Ql.
03600	Oligochaeta	T	10
05800	Caecidotea sp	M	2
08260	Orconectes (Crokerinus) sanbornii sanbornii	F	+
11130	Baetis intercalaris	F	20
12200	Isonychia sp	MI	2 +
13400	Stenacron sp	F	34 +
13521	Stenonema femoratum	F	47 +
13590	Stenonema vicarium	MI	23 +
15000	Paraleptophlebia sp	MI	31
15600	Ephemerella sp	MI	4
17200	Caenis sp	F	82
18600	Ephemera sp	MI	2 +
21200	Calopteryx sp	F	1 +
22001	Coenagrionidae	M	+
22300	Argia sp	F	+
23909	Boyeria vinosa	F	+
26100	Cordulegaster sp	F	+
28001	Libellulidae	T	+
34100	Acroneuria sp	MI	1
47600	Sialis sp	F	+
51400	Nyctiophylax sp	MI	4 +
52200	Cheumatopsyche sp	F	3 +
55300	Ptilostomis sp	F	+
59580	Oecetis persimilis	MI	+
63300	Hydroporus sp	F	+
66500	Enochrus sp	F	+
67811	Staphylinidae		+
68025	Ectopria sp	MI	+
68130	Helichus sp	MI	4 +
69400	Stenelmis sp	F	12 +
71100	Hexatoma sp	MI	4 +
71900	Tipula sp	F	+
72340	Dixella sp	F	+
74100	Simulium sp	F	+
77120	Ablabesmyia mallochi	F	8
77800	Helopelopia sp	F	26
78401	Natarsia species A (sensu Roback, 1978)	T	+
80370	Corynoneura lobata	MI	23
81231	Nanocladius (N.) crassicornus or N. (N.) "rectinervis"	F	4
81650	Parametriocnemus sp	MI	15
82710	Chironomus (C.) sp	T	4
83900	Nilothauma sp	MI	4
84210	Paratendipes albimanus or P. duplicatus	MI	53
84300	Phaenopsectra obediens group	F	8
84450	Polypedilum (Uresipedilum) flavum	F	4
84470	Polypedilum (P.) illinoense	T	4
84540	Polypedilum (Tripodura) scalaenum group	F	41
85261	Cladotanytarsus vanderwulpi group Type 1	I	4
85615	Rheotanytarsus pellucidus	MI	4
85700	Stempellina sp	MI	1
85800	Tanytarsus sp	MI	35
85802	Tanytarsus curticornis group	MI	26
85821	Tanytarsus glabrescens group sp 7	MI	8
86100	Chrysops sp	F	2 +
87540	Hemerodromia sp	F	2

No. Quantitative Taxa:	38	Total Taxa:	55
No. Qualitative Taxa:	29	ICI:	48
Number of Organisms:	562	Qual EPT:	9

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 08/25/2004 River Code: 01-101 River: Kasler Creek (-19) RM: 0.40

Taxa Code	Taxa	Tol.	Qt./Ql.
05800	Caecidotea sp	M	+
08260	Orconectes (Crokerinus) sanbornii sanbornii	F	+
13400	Stenacron sp	F	+
13521	Stenonema femoratum	F	+
17200	Caenis sp	F	+
22001	Coenagrionidae	M	+
22300	Argia sp	F	+
24900	Gomphus sp	F	+
27404	Neurocordulia molesta	MI	+
28500	Libellula sp	T	+
47600	Sialis sp	F	+
48620	Nigronia serricornis	F	+
55300	Ptilostomis sp	F	+
59730	Triaenodes melaca	MI	+
68130	Helichus sp	MI	+
68708	Dubiraphia vittata group	F	+
68901	Macronychus glabratus	MI	+
72340	Dixella sp	F	+
72700	Anopheles sp	F	+
84210	Paratendipes albimanus or P. duplicatus	MI	+
86100	Chrysops sp	F	+
95100	Physella sp	T	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 22
No. Qualitative Taxa: 22 ICI: F
Number of Organisms: 0 Qual EPT: 5

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 08/23/2004 River Code: 01-110 River: Sharps Run RM: 1.00

Taxa Code	Taxa	Tol.	Qt./Ql.
08260	Orconectes (Crokerinus) sanbornii sanbornii	F	+
11120	Baetis flavistriga	F	+
11130	Baetis intercalaris	F	+
11250	Centroptilum sp (w/o hindwing pads)	MI	+
11430	Diphetor hageni	I	+
12200	Isonychia sp	MI	+
13000	Leucrocuta sp	I	+
13400	Stenacron sp	F	+
13521	Stenonema femoratum	F	+
17200	Caenis sp	F	+
18600	Ephemera sp	MI	+
21200	Calopteryx sp	F	+
24900	Gomphus sp	F	+
26100	Cordulegaster sp	F	+
34130	Acroneuria frisoni	MI	+
47600	Sialis sp	F	+
52200	Cheumatopsyche sp	F	+
63300	Hydroporus sp	F	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	+
71100	Hexatoma sp	MI	+
77800	Helopelopia sp	F	+
78401	Natarsia species A (sensu Roback, 1978)	T	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 23
No. Qualitative Taxa: 23 ICI: VG
Number of Organisms: 0 Qual EPT: 12

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 08/25/2004 River Code: 01-130 River: Big Run RM: 1.60

Taxa Code	Taxa	Tol.	Qt./Ql.
05800	Caecidotea sp	M	+
08260	Orconectes (Crokerinus) sanbornii sanbornii	F	+
11250	Centroptilum sp (w/o hindwing pads)	MI	+
13400	Stenacron sp	F	+
13521	Stenonema femoratum	F	+
17200	Caenis sp	F	+
22001	Coenagrionidae	M	+
22300	Argia sp	F	+
23804	Basiaeschna janata	F	+
23909	Boyeria vinosa	F	+
24900	Gomphus sp	F	+
51600	Polycentropus sp	MI	+
57900	Pycnopsyche sp	MI	+
63300	Hydroporus sp	F	+
67500	Laccobius sp	F	+
67811	Staphylinidae		+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	+
68708	Dubiraphia vittata group	F	+
69400	Stenelmis sp	F	+
71900	Tipula sp	F	+
72340	Dixella sp	F	+
72700	Anopheles sp	F	+
78140	Labrundinia pilosella	MI	+
83040	Dicrotendipes neomodestus	F	+
84040	Parachironomus frequens	F	+
84300	Phaenopsectra obediens group	F	+
84470	Polypedilum (P.) illinoense	T	+
85821	Tanytarsus glabrescens group sp 7	MI	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 29
No. Qualitative Taxa: 29 ICI: F
Number of Organisms: 0 Qual EPT: 6

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 08/25/2004 River Code: 01-130 River: Big Run RM: 3.90

Taxa Code	Taxa	Tol.	Qt./Ql.
05800	Caecidotea sp	M	+
08260	Orconectes (Crokerinus) sanbornii sanbornii	F	+
12200	Isonychia sp	MI	+
13400	Stenacron sp	F	+
13590	Stenonema vicarium	MI	+
17200	Caenis sp	F	+
18600	Ephemera sp	MI	+
21200	Calopteryx sp	F	+
23909	Boyeria vinosa	F	+
24900	Gomphus sp	F	+
25410	Progomphus obscurus	F	+
25510	Stylogomphus albistylus	MI	+
26100	Cordulegaster sp	F	+
48620	Nigronia serricornis	F	+
51400	Nyctiophylax sp	MI	+
52200	Cheumatopsyche sp	F	+
57900	Pycnopsyche sp	MI	+
59730	Triaenodes melaca	MI	+
63300	Hydroporus sp	F	+
67811	Staphylinidae		+
68025	Ectopria sp	MI	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	+
71100	Hexatoma sp	MI	+
72340	Dixella sp	F	+
74501	Ceratopogonidae	F	+
82710	Chironomus (C.) sp	T	+
83040	Dicrotendipes neomodestus	F	+
83840	Microtendipes pedellus group	MI	+
84750	Stictochironomus sp	F	+
86100	Chrysops sp	F	+
87540	Hemerodromia sp	F	+
95100	Physella sp	T	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 33
No. Qualitative Taxa: 33 ICI: G
Number of Organisms: 0 Qual EPT: 9

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 07/28/2004 River Code: 01-134 River: Sulphur Run RM: 0.10

Taxa Code	Taxa	Tol.	Qt./Ql.
13521	Stenonema femoratum	F	+
66500	Enochrus sp	F	+
69400	Stenelmis sp	F	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 3

No. Qualitative Taxa: 3 ICI: P

Number of Organisms: 0 Qual EPT: 1

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 08/03/2004 River Code: 01-134 River: Sulphur Run RM: 0.80

Taxa Code	Taxa	Tol.	Qt./Ql.
05800	Caecidotea sp	M	+
06700	Crangonyx sp	M	+
07800	Cambarus sp	F	+
24900	Gomphus sp	F	+
26100	Cordulegaster sp	F	+
33100	Leuctra sp	I	+
47600	Sialis sp	F	+
52315	Diplectrona modesta	F	+
57900	Pycnopsyche sp	MI	+
63300	Hydroporus sp	F	+
69400	Stenelmis sp	F	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 11
No. Qualitative Taxa: 11 ICI: F
Number of Organisms: 0 Qual EPT: 3

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 08/02/2004 River Code: 01-150 River: Marietta Run RM: 0.10

Taxa Code	Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	Tol.	Qt./Ql.
03600	Oligochaeta	T	+				
05800	Caecidotea sp	M	+				
08200	Orconectes sp	F	+				
11150	Pseudocloeon propinquum	I	+				
11250	Centroptilum sp (w/o hindwing pads)	MI	+				
12200	Isonychia sp	MI	+				
13400	Stenacron sp	F	+				
13590	Stenonema vicarium	MI	+				
17200	Caenis sp	F	+				
21200	Calopteryx sp	F	+				
23909	Boyeria vinosa	F	+				
34120	Acroneuria carolinensis	I	+				
47600	Sialis sp	F	+				
48620	Nigronia serricornis	F	+				
50804	Lype diversa	MI	+				
51600	Polycentropus sp	MI	+				
52200	Cheumatopsyche sp	F	+				
57900	Pycnopsyche sp	MI	+				
59580	Oecetis persimilis	MI	+				
59720	Triaenodes ignitus	I	+				
59730	Triaenodes melaca	MI	+				
68130	Helichus sp	MI	+				
68601	Ancyronyx variegata	MI	+				
68708	Dubiraphia vittata group	F	+				
68901	Macronychus glabratus	MI	+				
69400	Stenelmis sp	F	+				
71100	Hexatoma sp	MI	+				
71900	Tipula sp	F	+				
85800	Tanytarsus sp	MI	+				
86100	Chrysops sp	F	+				

No. Quantitative Taxa:	0	Total Taxa:	30
No. Qualitative Taxa:	30	ICI:	VG
Number of Organisms:	0	Qual EPT:	14

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 08/03/2004 River Code: 01-150 River: Marietta Run RM: 1.00

Taxa Code	Taxa	Tol.	Qt./Ql.
05800	Caecidotea sp	M	+
06700	Crangonyx sp	M	+
07800	Cambarus sp	F	+
13521	Stenonema femoratum	F	+
13590	Stenonema vicarium	MI	+
17200	Caenis sp	F	+
21200	Calopteryx sp	F	+
23909	Boyeria vinosa	F	+
33100	Leuctra sp	I	+
34100	Acroneuria sp	MI	+
47600	Sialis sp	F	+
48620	Nigronia serricornis	F	+
51400	Nyctiophylax sp	MI	+
51600	Polycentropus sp	MI	+
52200	Cheumatopsyche sp	F	+
57900	Pycnopsyche sp	MI	+
59720	Triaenodes ignitus	I	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	+
68708	Dubiraphia vittata group	F	+
68901	Macronychus glabratus	MI	+
69250	Optioservus ovalis	MI	+
69400	Stenelmis sp	F	+
71100	Hexatoma sp	MI	+
71900	Tipula sp	F	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 25
No. Qualitative Taxa: 25 ICI: MG
Number of Organisms: 0 Qual EPT: 10

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 07/28/2004 River Code: 01-150 River: Marietta Run RM: 3.50

Taxa Code	Taxa	Tol.	Qt./Ql.
07800	Cambarus sp	F	+
11120	Baetis flavistriga	F	+
12200	Isonychia sp	MI	+
13400	Stenacron sp	F	+
13521	Stenonema femoratum	F	+
13590	Stenonema vicarium	MI	+
17200	Caenis sp	F	+
21300	Hetaerina sp	F	+
23909	Boyeria vinosa	F	+
33100	Leuctra sp	I	+
34120	Acroneuria carolinensis	I	+
34130	Acroneuria frisoni	MI	+
48620	Nigronia serricornis	F	+
51600	Polycentropus sp	MI	+
52200	Cheumatopsyche sp	F	+
52530	Hydropsyche depravata group	F	+
57900	Pycnopsyche sp	MI	+
59580	Oecetis persimilis	MI	+
59730	Triaenodes melaca	MI	+
67750	Sperchopsis tesselatus	F	+
68025	Ectopria sp	MI	+
68075	Psephenus herricki	MI	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	+
68708	Dubiraphia vittata group	F	+
68901	Macronychus glabratus	MI	+
69250	Optioservus ovalis	MI	+
70700	Dicranota sp	MI	+
71100	Hexatoma sp	MI	+
71700	Pilaria sp	F	+
71900	Tipula sp	F	+
81650	Parametriocnemus sp	MI	+
83840	Microtendipes pedellus group	MI	+
84210	Paratendipes albimanus or P. duplicatus	MI	+
84460	Polypedilum (P.) fallax group	F	+
86200	Tabanus sp	F	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 36
No. Qualitative Taxa: 36 ICI: E
Number of Organisms: 0 Qual EPT: 15

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 09/14/2004 River Code: 01-160 River: Sharps Fork RM: 0.10

Taxa Code	Taxa	Tol.	Qt./Ql.
03600	Oligochaeta	T	36
05800	Caecidotea sp	M	2
06700	Crangonyx sp	M	+
11150	Pseudocloeon propinquum	I	+
11200	Callibaetis sp	M	+
11250	Centroptilum sp (w/o hindwing pads)	MI	+
12200	Isonychia sp	MI	12 +
13400	Stenacron sp	F	+
13521	Stenonema femoratum	F	1
13561	Stenonema pulchellum	MI	+
13590	Stenonema vicarium	MI	73 +
15000	Paraleptophlebia sp	MI	2
17200	Caenis sp	F	22 +
17600	Baetisca sp	I	2 +
21200	Calopteryx sp	F	+
22001	Coenagrionidae	M	+
23909	Boyeria vinosa	F	1 +
24900	Gomphus sp	F	+
47600	Sialis sp	F	+
50315	Chimarra obscura	MI	+
51400	Nyctiophylax sp	MI	+
52200	Cheumatopsyche sp	F	16 +
52430	Ceratopsyche morosa group	MI	+
55300	Ptilostomis sp	F	+
59580	Oecetis persimilis	MI	+
59720	Triaenodes ignitus	I	+
63300	Hydroporus sp	F	+
68130	Helichus sp	MI	+
68700	Dubiraphia sp	F	8
68901	Macronychus glabratus	MI	9 +
69400	Stenelmis sp	F	2 +
71100	Hexatoma sp	MI	6 +
71900	Tipula sp	F	+
74100	Simulium sp	F	+
77120	Ablabesmyia mallochi	F	4
77800	Helopelopia sp	F	20
78450	Nilotanypus fimbriatus	MI	1
80370	Corynoneura lobata	MI	16
80410	Cricotopus (C.) sp	F	4
81650	Parametriocnemus sp	MI	4
82121	Thienemanniella lobapodema	MI	2
82820	Cryptochironomus sp	F	4
83040	Dicrotendipes neomodestus	F	4
84210	Paratendipes albimanus or P. duplicatus	MI	17
84300	Phaenopsectra obediens group	F	7
84460	Polypedilum (P.) fallax group	F	42
85261	Cladotanytarsus vanderwulpi group Type 1	I	14
85263	Cladotanytarsus vanderwulpi group Type 3	MI	4
85800	Tanytarsus sp	MI	35
85802	Tanytarsus curticornis group	MI	4
85821	Tanytarsus glabrescens group sp 7	MI	25
86100	Chrysops sp	F	+
87540	Hemerodromia sp	F	8
97601	Corbicula fluminea	MI	+

No. Quantitative Taxa:	32	Total Taxa:	54
No. Qualitative Taxa:	31	ICI:	38
Number of Organisms:	407	Qual EPT:	16

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 09/04/1990 River Code: 01-160 River: Sharps Fork RM: 0.20

Taxa Code	Taxa	Tol.	Qt./Ql.
06700	Crangonyx sp	M	+
08260	Orconectes (Crokerinus) sanbornii sanbornii	F	+
11100	Baetis sp	F	+
11300	Procloeon sp (formerly in Centroptilum)	MI	+
11400	Centroptilum sp or Procloeon sp (formerly in Cloeon)	MI	+
12200	Isonychia sp	MI	+
13400	Stenacron sp	F	+
13580	Stenonema tripunctatum (old)	F	+
13590	Stenonema vicarium	MI	+
17200	Caenis sp	F	+
18600	Ephemera sp	MI	+
21200	Calopteryx sp	F	+
22300	Argia sp	F	+
51600	Polycentropus sp	MI	+
52200	Cheumatopsyche sp	F	+
52430	Ceratopsyche morosa group	MI	+
53800	Hydroptila sp	F	+
67700	Paracymus sp	F	+
67800	Tropisternus sp	M	+
68130	Helichus sp	MI	+
68708	Dubiraphia vittata group	F	+
68901	Macronychus glabratus	MI	+
69400	Stenelmis sp	F	+
71100	Hexatoma sp	MI	+
71910	Tipula abdominalis	MI	+
74100	Simulium sp	F	+
74501	Ceratopogonidae	F	+
78401	Natarsia species A (sensu Roback, 1978)	T	+
80420	Cricotopus (C.) bicinctus	M	+
81825	Rheocricotopus (Psilocricotopus) robacki	MI	+
82121	Thienemanniella lobapodema	MI	+
83820	Microtendipes "caelum" (sensu Simpson & Bode, 1980)	MI	+
84470	Polypedilum (P.) illinoense	T	+
84612	Saetheria tylus	MI	+
85260	Cladotanytarsus vanderwulpi group	MI	+
85500	Paratanytarsus sp	F	+
85615	Rheotanytarsus pellucidus	MI	+
85625	Rheotanytarsus sp	MI	+
85814	Tanytarsus glabrescens group	F	+
85840	Tanytarsus sepp	MI	+
86100	Chrysops sp	F	+
95100	Physella sp	T	+
96900	Ferrissia sp	F	+
98600	Sphaerium sp	F	+

No. Quantitative Taxa: 0 Total Taxa: 44
No. Qualitative Taxa: 44 ICI: G
Number of Organisms: 0 Qual EPT: 13

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 07/28/2004 River Code: 01-160 River: Sharps Fork RM: 1.60

Taxa Code	Taxa	Tol.	Qt./Ql.
05800	Caecidotea sp	M	+
08200	Orconectes sp	F	+
11150	Pseudocloeon propinquum	I	+
11251	Centroptilum sp (w/ hindwing pads)	MI	+
11651	Procloeon sp (w/o hindwing pads)	MI	+
11670	Procloeon irrubrum	MI	+
12200	Isonychia sp	MI	+
13000	Leucrocuta sp	I	+
13400	Stenacron sp	F	+
13590	Stenonema vicarium	MI	+
17200	Caenis sp	F	+
21200	Calopteryx sp	F	+
23804	Basiaeschna janata	F	+
23909	Boyeria vinosa	F	+
24900	Gomphus sp	F	+
33100	Leuctra sp	I	+
48620	Nigronia serricornis	F	+
52200	Cheumatopsyche sp	F	+
59580	Oecetis persimilis	MI	+
60300	Dineutus sp	F	+
63300	Hydroporus sp	F	+
68130	Helichus sp	MI	+
68901	Macronychus glabratus	MI	+
69400	Stenelmis sp	F	+
71100	Hexatoma sp	MI	+
77800	Helopelopia sp	F	+
84470	Polypedilum (P.) illinoense	T	+
85500	Paratanytarsus sp	F	+
85625	Rheotanytarsus sp	MI	+
85800	Tanytarsus sp	MI	+
85821	Tanytarsus glabrescens group sp 7	MI	+
86100	Chrysops sp	F	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 32
No. Qualitative Taxa: 32 ICI: G
Number of Organisms: 0 Qual EPT: 12

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 07/28/2004 River Code: 01-160 River: Sharps Fork RM: 2.60

Taxa Code	Taxa	Tol.	Qt./Ql.
05800	Caecidotea sp	M	+
06700	Crangonyx sp	M	+
08260	Orconectes (Crokerinus) sanbornii sanbornii	F	+
11120	Baetis flavistriga	F	+
11130	Baetis intercalaris	F	+
11150	Pseudocloeon propinquum	I	+
13000	Leucrocuta sp	I	+
13400	Stenacron sp	F	+
13521	Stenonema femoratum	F	+
13590	Stenonema vicarium	MI	+
15000	Paraleptophlebia sp	MI	+
17200	Caenis sp	F	+
21200	Calopteryx sp	F	+
23909	Boyeria vinosa	F	+
24900	Gomphus sp	F	+
33100	Leuctra sp	I	+
34130	Acroneuria frisoni	MI	+
47600	Sialis sp	F	+
51600	Polycentropus sp	MI	+
52200	Cheumatopsyche sp	F	+
52431	Ceratopsyche morosa	MI	+
52530	Hydropsyche depravata group	F	+
57900	Pycnopsyche sp	MI	+
59580	Oecetis persimilis	MI	+
60300	Dineutus sp	F	+
63300	Hydroporus sp	F	+
68130	Helichus sp	MI	+
68901	Macronychus glabratus	MI	+
69400	Stenelmis sp	F	+
74100	Simulium sp	F	+
77120	Ablabesmyia mallochi	F	+
77800	Helopelopia sp	F	+
81825	Rheocricotopus (Psilocricotopus) robacki	MI	+
85821	Tanytarsus glabrescens group sp 7	MI	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 34
No. Qualitative Taxa: 34 ICI: VG
Number of Organisms: 0 Qual EPT: 17

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 07/29/2004 River Code: 01-160 River: Sharps Fork RM: 5.20

Taxa Code	Taxa	Tol.	Qt./Ql.
06700	Crangonyx sp	M	+
07800	Cambarus sp	F	+
08200	Orconectes sp	F	+
11130	Baetis intercalaris	F	+
11150	Pseudocloeon propinquum	I	+
12200	Isonychia sp	MI	+
13000	Leucrocuta sp	I	+
13100	Nixe sp	I	+
13590	Stenonema vicarium	MI	+
17200	Caenis sp	F	+
21300	Hetaerina sp	F	+
23909	Boyeria vinosa	F	+
24900	Gomphus sp	F	+
33100	Leuctra sp	I	+
34100	Acroneuria sp	MI	+
48620	Nigronia serricornis	F	+
51600	Polycentropus sp	MI	+
52200	Cheumatopsyche sp	F	+
52430	Ceratopsyche morosa group	MI	+
52530	Hydropsyche depravata group	F	+
59580	Oecetis persimilis	MI	+
59730	Triaenodes melaca	MI	+
63300	Hydroporus sp	F	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	+
68708	Dubiraphia vittata group	F	+
68901	Macronychus glabratus	MI	+
69250	Optioservus ovalis	MI	+
69400	Stenelmis sp	F	+
70700	Dicranota sp	MI	+
71100	Hexatoma sp	MI	+
71900	Tipula sp	F	+
74100	Simulium sp	F	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 33
No. Qualitative Taxa: 33 ICI: VG
Number of Organisms: 0 Qual EPT: 15

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 07/29/2004 River Code: 01-160 River: Sharps Fork RM: 8.50

Taxa Code	Taxa	Tol.	Qt./Ql.
11120	Baetis flavistriga	F	+
11150	Pseudocloeon propinquum	I	+
11650	Procloeon sp (w/ hindwing pads)	MI	+
12200	Isonychia sp	MI	+
13000	Leucrocuta sp	I	+
13400	Stenacron sp	F	+
13521	Stenonema femoratum	F	+
13590	Stenonema vicarium	MI	+
17200	Caenis sp	F	+
21200	Calopteryx sp	F	+
23909	Boyeria vinosa	F	+
33100	Leuctra sp	I	+
34130	Acroneuria frisoni	MI	+
48620	Nigronia serricornis	F	+
51600	Polycentropus sp	MI	+
52200	Cheumatopsyche sp	F	+
52530	Hydropsyche depravata group	F	+
53800	Hydroptila sp	F	+
57900	Pycnopsyche sp	MI	+
59580	Oecetis persimilis	MI	+
67811	Staphylinidae		+
68075	Psephenus herricki	MI	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	+
68901	Macronychus glabratus	MI	+
69400	Stenelmis sp	F	+
71100	Hexatoma sp	MI	+
77800	Helopelopia sp	F	+
80420	Cricotopus (C.) bicinctus	M	+
84960	Pseudochironomus sp	F	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 30
No. Qualitative Taxa: 30 ICI: VG
Number of Organisms: 0 Qual EPT: 17

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 07/29/2004 River Code: 01-160 River: Sharps Fork RM: 9.10

Taxa Code	Taxa	Tol.	Qt./Ql.
08200	Orconectes sp	F	+
11150	Pseudocloeon propinquum	I	+
11250	Centroptilum sp (w/o hindwing pads)	MI	+
12200	Isonychia sp	MI	+
13000	Leucrocuta sp	I	+
13400	Stenacron sp	F	+
13521	Stenonema femoratum	F	+
17200	Caenis sp	F	+
21200	Calopteryx sp	F	+
23909	Boyeria vinosa	F	+
24900	Gomphus sp	F	+
33100	Leuctra sp	I	+
34130	Acroneuria frisoni	MI	+
48620	Nigronia serricornis	F	+
51400	Nyctiophylax sp	MI	+
51600	Polycentropus sp	MI	+
52200	Cheumatopsyche sp	F	+
57900	Pycnopsyche sp	MI	+
63300	Hydroporus sp	F	+
67000	Helophorus sp	F	+
68025	Ectopria sp	MI	+
68130	Helichus sp	MI	+
68201	Scirtidae	F	+
71100	Hexatoma sp	MI	+
72340	Dixella sp	F	+
72700	Anopheles sp	F	+
86100	Chrysops sp	F	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 27
No. Qualitative Taxa: 27 ICI: VG
Number of Organisms: 0 Qual EPT: 13

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 08/25/2004 River Code: 01-160 River: Sharps Fork RM: 10.70

Taxa Code	Taxa	Tol.	Qt./Ql.
08260	Orconectes (Crokerinus) sanbornii sanbornii	F	+
11120	Baetis flavistriga	F	+
11130	Baetis intercalaris	F	+
11250	Centroptilum sp (w/o hindwing pads)	MI	+
11651	Procloeon sp (w/o hindwing pads)	MI	+
12200	Isonychia sp	MI	+
13000	Leucrocuta sp	I	+
13400	Stenacron sp	F	+
13521	Stenonema femoratum	F	+
13590	Stenonema vicarium	MI	+
17200	Caenis sp	F	+
18600	Ephemera sp	MI	+
21200	Calopteryx sp	F	+
23909	Boyeria vinosa	F	+
33100	Leuctra sp	I	+
34130	Acroneuria frisoni	MI	+
48620	Nigronia serricornis	F	+
51400	Nyctiophylax sp	MI	+
52200	Cheumatopsyche sp	F	+
52430	Ceratopsyche morosa group	MI	+
52530	Hydropsyche depravata group	F	+
59730	Triaenodes melaca	MI	+
60300	Dineutus sp	F	+
63300	Hydroporus sp	F	+
68075	Psephenus herricki	MI	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	+
68708	Dubiraphia vittata group	F	+
68901	Macronychus glabratus	MI	+
69400	Stenelmis sp	F	+
71100	Hexatoma sp	MI	+
74100	Simulium sp	F	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 32
No. Qualitative Taxa: 32 ICI: E
Number of Organisms: 0 Qual EPT: 18

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 07/28/2004 River Code: 01-161 River: Opossum Run RM: 0.10

Taxa Code	Taxa	Tol.	Qt./Ql.
05800	Caecidotea sp	M	+
08260	Orconectes (Crokerinus) sanbornii sanbornii	F	+
11120	Baetis flavistriga	F	+
11130	Baetis intercalaris	F	+
12200	Isonychia sp	MI	+
13000	Leucrocuta sp	I	+
13400	Stenacron sp	F	+
13521	Stenonema femoratum	F	+
13590	Stenonema vicarium	MI	+
17200	Caenis sp	F	+
21200	Calopteryx sp	F	+
23804	Basiaeschna janata	F	+
23909	Boyeria vinosa	F	+
24900	Gomphus sp	F	+
34100	Acroneuria sp	MI	+
48620	Nigronia serricornis	F	+
51600	Polycentropus sp	MI	+
52200	Cheumatopsyche sp	F	+
52430	Ceratopsyche morosa group	MI	+
52530	Hydropsyche depravata group	F	+
53800	Hydroptila sp	F	+
59580	Oecetis persimilis	MI	+
59720	Triaenodes ignitus	I	+
59730	Triaenodes melaca	MI	+
60400	Gyrinus sp	F	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	+
68901	Macronychus glabratus	MI	+
70700	Dicranota sp	MI	+
71100	Hexatoma sp	MI	+
74100	Simulium sp	F	+
77750	Hayesomyia senata or Thienemannimyia norena	F	+
77800	Helopelopia sp	F	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 33
No. Qualitative Taxa: 33 ICI:
Number of Organisms: 0 Qual EPT: 17

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 07/29/2004 River Code: 01-161 River: Opossum Run RM: 0.80

Taxa Code	Taxa	Tol.	Qt./Ql.
06700	Crangonyx sp	M	+
07800	Cambarus sp	F	+
08260	Orconectes (Crokerinus) sanbornii sanbornii	F	+
11120	Baetis flavistriga	F	+
11651	Procloeon sp (w/o hindwing pads)	MI	+
13590	Stenonema vicarium	MI	+
17200	Caenis sp	F	+
21200	Calopteryx sp	F	+
22001	Coenagrionidae	M	+
22300	Argia sp	F	+
23909	Boyeria vinosa	F	+
24900	Gomphus sp	F	+
26100	Cordulegaster sp	F	+
33100	Leuctra sp	I	+
43300	Ranatra sp	F	+
43570	Neoplea sp	F	+
45300	Sigara sp	F	+
47600	Sialis sp	F	+
48620	Nigronia serricornis	F	+
51600	Polycentropus sp	MI	+
57900	Pycnopsyche sp	MI	+
59580	Oecetis persimilis	MI	+
59730	Triaenodes melaca	MI	+
63300	Hydroporus sp	F	+
63900	Laccophilus sp	T	+
67800	Tropisternus sp	M	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	+
68708	Dubiraphia vittata group	F	+
68901	Macronychus glabratus	MI	+
71100	Hexatoma sp	MI	+
71900	Tipula sp	F	+
72700	Anopheles sp	F	+
74100	Simulium sp	F	+
74501	Ceratopogonidae	F	+
77800	Helopelopia sp	F	+
78655	Procladius (Holotanypus) sp	M	+
83840	Microtendipes pedellus group	MI	+
84210	Paratendipes albimanus or P. duplicatus	MI	+
84300	Phaenopsectra obediens group	F	+
85500	Paratanytarsus sp	F	+
85821	Tanytarsus glabrescens group sp 7	MI	+
86100	Chrysops sp	F	+

No. Quantitative Taxa: 0 Total Taxa: 43
No. Qualitative Taxa: 43 ICI: G
Number of Organisms: 0 Qual EPT: 9

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 07/29/2004 River Code: 01-161 River: Opossum Run RM: 2.60

Taxa Code	Taxa	Tol.	Qt./Ql.
05800	Caecidotea sp	M	+
06700	Crangonyx sp	M	+
07800	Cambarus sp	F	+
11130	Baetis intercalaris	F	+
11150	Pseudocloeon propinquum	I	+
11250	Centroptilum sp (w/o hindwing pads)	MI	+
12200	Isonychia sp	MI	+
13590	Stenonema vicarium	MI	+
17200	Caenis sp	F	+
18600	Ephemera sp	MI	+
21300	Hetaerina sp	F	+
23909	Boyeria vinosa	F	+
33100	Leuctra sp	I	+
34100	Acroneuria sp	MI	+
51600	Polycentropus sp	MI	+
52200	Cheumatopsyche sp	F	+
52430	Ceratopsyche morosa group	MI	+
52530	Hydropsyche depravata group	F	+
59730	Triaenodes melaca	MI	+
63300	Hydroporus sp	F	+
68130	Helichus sp	MI	+
68708	Dubiraphia vittata group	F	+
68901	Macronychus glabratus	MI	+
69250	Optioservus ovalis	MI	+
69400	Stenelmis sp	F	+
70700	Dicranota sp	MI	+
71100	Hexatoma sp	MI	+
72700	Anopheles sp	F	+
74100	Simulium sp	F	+
82710	Chironomus (C.) sp	T	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 30
No. Qualitative Taxa: 30 ICI: VG
Number of Organisms: 0 Qual EPT: 14

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 07/29/2004 River Code: 01-161 River: Opossum Run RM: 4.10

Taxa Code	Taxa	Tol.	Qt./Ql.
05800	Caecidotea sp	M	+
06700	Crangonyx sp	M	+
08260	Orconectes (Crokerinus) sanbornii sanbornii	F	+
11120	Baetis flavistriga	F	+
11150	Pseudocloeon propinquum	I	+
11250	Centroptilum sp (w/o hindwing pads)	MI	+
11650	Procloeon sp (w/ hindwing pads)	MI	+
12200	Isonychia sp	MI	+
13000	Leucrocuta sp	I	+
13400	Stenacron sp	F	+
13521	Stenonema femoratum	F	+
13590	Stenonema vicarium	MI	+
15000	Paraleptophlebia sp	MI	+
17200	Caenis sp	F	+
18600	Ephemera sp	MI	+
21200	Calopteryx sp	F	+
26100	Cordulegaster sp	F	+
33100	Leuctra sp	I	+
34130	Acroneuria frisoni	MI	+
44501	Corixidae	F	+
47600	Sialis sp	F	+
48620	Nigronia serricornis	F	+
51400	Nyctiophylax sp	MI	+
51600	Polycentropus sp	MI	+
52200	Cheumatopsyche sp	F	+
52530	Hydropsyche depravata group	F	+
53800	Hydroptila sp	F	+
57400	Neophylax sp	I	+
59730	Triaenodes melaca	MI	+
63300	Hydroporus sp	F	+
68075	Psephenus herricki	MI	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	+
68901	Macronychus glabratus	MI	+
71400	Molophilus sp		+
71700	Pilaria sp	F	+
72700	Anopheles sp	F	+
82710	Chironomus (C.) sp	T	+
82820	Cryptochironomus sp	F	+
83840	Microtendipes pedellus group	MI	+
84210	Paratendipes albimanus or P. duplicatus	MI	+
84300	Phaenopsectra obediens group	F	+
84540	Polypedilum (Tripodura) scalaenum group	F	+
84750	Stictochironomus sp	F	+
85200	Cladotanytarsus sp	F	+
85500	Paratanytarsus sp	F	+
85800	Tanytarsus sp	MI	+
86100	Chrysops sp	F	+

No. Quantitative Taxa: 0 Total Taxa: 48
No. Qualitative Taxa: 48 ICI: E
Number of Organisms: 0 Qual EPT: 21

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 09/21/2004 River Code: 01-170 River: McDougall Branch RM: 0.50

Taxa Code	Taxa	Tol.	Qt./Ql.
03600	Oligochaeta	T	7
05800	Caecidotea sp	M	6 +
06700	Crangonyx sp	M	+
08200	Orconectes sp	F	+
08601	Hydracarina	F	4
11120	Baetis flavistriga	F	1 +
11130	Baetis intercalaris	F	22 +
12200	Isonychia sp	MI	3 +
13400	Stenacron sp	F	2
13521	Stenonema femoratum	F	16 +
13590	Stenonema vicarium	MI	41 +
15000	Paraleptophlebia sp	MI	1
17200	Caenis sp	F	19 +
17600	Baetisca sp	I	+
21200	Calopteryx sp	F	+
22001	Coenagrionidae	M	+
22300	Argia sp	F	+
34130	Acroneuria frisoni	MI	2
48620	Nigronia serricornis	F	1 +
50315	Chimarra obscura	MI	3 +
52200	Cheumatopsyche sp	F	21 +
52530	Hydropsyche depravata group	F	3
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	2
68700	Dubiraphia sp	F	1
68901	Macronychus glabratus	MI	3
69400	Stenelmis sp	F	11 +
71100	Hexatoma sp	MI	2
74501	Ceratopogonidae	F	5
77750	Hayesomyia senata or Thienemannimyia norena	F	3
77800	Helopelopia sp	F	14
78450	Nilotanypus fimbriatus	MI	3
80370	Corynoneura lobata	MI	3
80410	Cricotopus (C.) sp	F	14
80420	Cricotopus (C.) bicinctus	M	6
81460	Orthocladius (O.) sp	F	3
81650	Parametriocnemus sp	MI	10
81825	Rheocricotopus (Psilocricotopus) robacki	MI	3
82141	Thienemanniella xena	F	1
84210	Paratendipes albimanus or P. duplicatus	MI	14
84300	Phaenopsectra obediens group	F	3
84450	Polypedilum (Uresipedilum) flavum	F	3
84460	Polypedilum (P.) fallax group	F	14
84540	Polypedilum (Tripodura) scalaenum group	F	33
85261	Cladotanytarsus vanderwulpi group Type 1	I	6
85500	Paratanytarsus sp	F	3
85625	Rheotanytarsus sp	MI	8
85800	Tanytarsus sp	MI	6
85802	Tanytarsus curticornis group	MI	3
85821	Tanytarsus glabrescens group sp 7	MI	36
85840	Tanytarsus sepp	MI	6
86100	Chrysops sp	F	+
87540	Hemerodromia sp	F	1
99860	Lampsilis radiata luteola	MI	+

No. Quantitative Taxa:	45	Total Taxa:	54
No. Qualitative Taxa:	20	ICI:	48
Number of Organisms:	372	Qual EPT:	9

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 08/21/1984 River Code: 01-170 River: McDougall Branch RM: 2.90

Taxa Code	Taxa	Tol.	Qt./Ql.
03600	Oligochaeta	T	49 +
08260	Orconectes (Crokerinus) sanbornii sanbornii	F	2
11100	Baetis sp	F	+
11400	Centroptilum sp or Procloeon sp (formerly in Cloeon)	MI	13
11700	Acentrella sp or Plauditus sp (formerly in Pseudocloeon)	I	+
12200	Isonychia sp	MI	+
13400	Stenacron sp	F	2
13580	Stenonema tripunctatum (old)	F	5
15000	Paraleptophlebia sp	MI	1
16700	Tricorythodes sp	MI	+
17200	Caenis sp	F	11 +
18600	Ephemera sp	MI	3
23909	Boyeria vinosa	F	+
34130	Acroneuria frisoni	MI	9
47600	Sialis sp	F	3
48620	Nigronia serricornis	F	1
52200	Cheumatopsyche sp	F	11 +
53800	Hydroptila sp	F	+
68130	Helichus sp	MI	3
68700	Dubiraphia sp	F	15
68901	Macronychus glabratus	MI	1
69400	Stenelmis sp	F	+
71100	Hexatoma sp	MI	+
74100	Simulium sp	F	+
74501	Ceratopogonidae	F	9
77120	Ablabesmyia mallochi	F	4
78100	Labrundinia sp	F	21
79100	Thienemannimyia group	F	9 +
80370	Corynoneura lobata	MI	53
80410	Cricotopus (C.) sp	F	+
80420	Cricotopus (C.) bicinctus	M	+
81650	Parametriocnemus sp	MI	+
81825	Rheocricotopus (Psilocricotopus) robacki	MI	+
82820	Cryptochironomus sp	F	13
83840	Microtendipes pedellus group	MI	+
83900	Nilothauma sp	MI	13
84210	Paratendipes albimanus or P. duplicatus	MI	145
84450	Polypedilum (Uresipedilum) flavum	F	9 +
84460	Polypedilum (P.) fallax group	F	64
84540	Polypedilum (Tripodura) scalaenum group	F	34 +
84750	Stictochironomus sp	F	4
84960	Pseudochironomus sp	F	4
85200	Cladotanytarsus sp	F	+
85400	Micropsectra sp	F	26
85615	Rheotanytarsus pellucidus	MI	+
85800	Tanytarsus sp	MI	9
85814	Tanytarsus glabrescens group	F	119 +
85840	Tanytarsus sepp	MI	17 +
86100	Chrysops sp	F	1
87501	Empididae	F	+
96900	Ferrissia sp	F	6
98600	Sphaerium sp	F	+

No. Quantitative Taxa:	34	Total Taxa:	52
No. Qualitative Taxa:	26	ICI:	26
Number of Organisms:	689	Qual EPT:	7

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 09/04/1990 River Code: 01-170 River: McDougall Branch RM: 2.90

Taxa Code	Taxa	Tol.	Qt./Ql.
06700	Crangonyx sp	M	+
08260	Orconectes (Crokerinus) sanbornii sanbornii	F	+
11100	Baetis sp	F	+
11300	Procloeon sp (formerly in Centroptilum)	MI	+
13400	Stenacron sp	F	+
13580	Stenonema tripunctatum (old)	F	+
15000	Paraleptophlebia sp	MI	+
17200	Caenis sp	F	+
21200	Calopteryx sp	F	+
22001	Coenagrionidae	M	+
23909	Boyeria vinosa	F	+
24900	Gomphus sp	F	+
27500	Somatochlora sp	T	+
47600	Sialis sp	F	+
51600	Polycentropus sp	MI	+
52200	Cheumatopsyche sp	F	+
52530	Hydropsyche depravata group	F	+
60300	Dineutus sp	F	+
62200	Copelatus sp	M	+
63300	Hydroporus sp	F	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	+
68708	Dubiraphia vittata group	F	+
71100	Hexatoma sp	MI	+
74100	Simulium sp	F	+
77120	Ablabesmyia mallochi	F	+
77500	Conchapelopia sp	F	+
78450	Nilotanypus fimbriatus	MI	+
80360	Corynoneura "celeripes" (sensu Simpson & Bode, 1980)	I	+
81650	Parametriocnemus sp	MI	+
83840	Microtendipes pedellus group	MI	+
84210	Paratendipes albimanus or P. duplicatus	MI	+
84300	Phaenopsectra obediens group	F	+
84315	Phaenopsectra flavipes	F	+
84460	Polypedilum (P.) fallax group	F	+
84750	Stictochironomus sp	F	+
85260	Cladotanytarsus vanderwulpi group	MI	+
85500	Paratanytarsus sp	F	+
85615	Rheotanytarsus pellucidus	MI	+
85625	Rheotanytarsus sp	MI	+
85814	Tanytarsus glabrescens group	F	+
85840	Tanytarsus sepp	MI	+
86100	Chrysops sp	F	+
87501	Empididae	F	+
98600	Sphaerium sp	F	+

No. Quantitative Taxa: 0 Total Taxa: 45
No. Qualitative Taxa: 45 ICI: G
Number of Organisms: 0 Qual EPT: 9

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 09/21/2004 River Code: 01-170 River: McDougall Branch RM: 2.90

Taxa Code	Taxa	Tol.	Qt./Ql.
06700	Crangonyx sp	M	+
08200	Orconectes sp	F	+
11130	Baetis intercalaris	F	+
12200	Isonychia sp	MI	+
13521	Stenonema femoratum	F	+
13590	Stenonema vicarium	MI	+
17200	Caenis sp	F	+
17600	Baetisca sp	I	+
21200	Calopteryx sp	F	+
23804	Basiaeschna janata	F	+
23909	Boyeria vinosa	F	+
24900	Gomphus sp	F	+
52200	Cheumatopsyche sp	F	+
55300	Ptilostomis sp	F	+
59730	Triaenodes melaca	MI	+
63300	Hydroporus sp	F	+
67800	Tropisternus sp	M	+
67811	Staphylinidae		+
68130	Helichus sp	MI	+
68901	Macronychus glabratus	MI	+
69400	Stenelmis sp	F	+
71900	Tipula sp	F	+
86100	Chrysops sp	F	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 23
No. Qualitative Taxa: 23 ICI: G
Number of Organisms: 0 Qual EPT: 9

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 08/30/2004 River Code: 01-170 River: McDougall Branch RM: 4.60

Taxa Code	Taxa	Tol.	Qt./Ql.
08200	Orconectes sp	F	+
08601	Hydracarina	F	+
11120	Baetis flavistriga	F	+
11130	Baetis intercalaris	F	+
11200	Callibaetis sp	M	+
11430	Diphetor hageni	I	+
12200	Isonychia sp	MI	+
13000	Leucrocuta sp	I	+
13400	Stenacron sp	F	+
13521	Stenonema femoratum	F	+
17200	Caenis sp	F	+
21200	Calopteryx sp	F	+
23909	Boyeria vinosa	F	+
24900	Gomphus sp	F	+
27404	Neurocordulia molesta	MI	+
34130	Acroneuria frisoni	MI	+
48620	Nigronia serricornis	F	+
50315	Chimarra obscura	MI	+
51400	Nyctiophylax sp	MI	+
51600	Polycentropus sp	MI	+
52200	Cheumatopsyche sp	F	+
59730	Triaenodes melaca	MI	+
60400	Gyrinus sp	F	+
60900	Peltodytes sp	M	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	+
68901	Macronychus glabratus	MI	+
69400	Stenelmis sp	F	+
71100	Hexatoma sp	MI	+
72700	Anopheles sp	F	+
74100	Simulium sp	F	+
77800	Helopelopia sp	F	+
81650	Parametriocnemus sp	MI	+
84210	Paratendipes albimanus or P. duplicatus	MI	+
84450	Polypedilum (Uresipedilum) flavum	F	+
84470	Polypedilum (P.) illinoense	T	+
84750	Stictochironomus sp	F	+
95100	Physella sp	T	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 38
No. Qualitative Taxa: 38 ICI: VG
Number of Organisms: 0 Qual EPT: 15

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 08/30/2004 River Code: 01-170 River: McDougall Branch RM: 4.90

Taxa Code	Taxa	Tol.	Qt./Ql.
11120	Baetis flavistriga	F	+
11250	Centroptilum sp (w/o hindwing pads)	MI	+
13521	Stenonema femoratum	F	+
17200	Caenis sp	F	+
21200	Calopteryx sp	F	+
22300	Argia sp	F	+
23909	Boyeria vinosa	F	+
47600	Sialis sp	F	+
50315	Chimarra obscura	MI	+
51600	Polycentropus sp	MI	+
52200	Cheumatopsyche sp	F	+
59730	Triaenodes melaca	MI	+
63300	Hydroporus sp	F	+
67700	Paracymus sp	F	+
67800	Tropisternus sp	M	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	+
68901	Macronychus glabratus	MI	+
69400	Stenelmis sp	F	+
71100	Hexatoma sp	MI	+
71900	Tipula sp	F	+
72340	Dixella sp	F	+
74501	Ceratopogonidae	F	+
78401	Natarsia species A (sensu Roback, 1978)	T	+
83040	Dicrotendipes neomodestus	F	+
84460	Polypedilum (P.) fallax group	F	+
84750	Stictochironomus sp	F	+
95100	Physella sp	T	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 28
No. Qualitative Taxa: 28 ICI: G
Number of Organisms: 0 Qual EPT: 8

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 09/01/2004 River Code: 01-171 River: Wyatt Run RM: 0.40

Taxa Code	Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F	+
05800	Caecidotea sp	M	+
06700	Crangonyx sp	M	+
11130	Baetis intercalaris	F	+
12200	Isonychia sp	MI	+
13000	Leucrocuta sp	I	+
13400	Stenacron sp	F	+
13521	Stenonema femoratum	F	+
13590	Stenonema vicarium	MI	+
17200	Caenis sp	F	+
21200	Calopteryx sp	F	+
22300	Argia sp	F	+
23804	Basiaeschna janata	F	+
23909	Boyeria vinosa	F	+
34130	Acroneuria frisoni	MI	+
47600	Sialis sp	F	+
48620	Nigronia serricornis	F	+
50315	Chimarra obscura	MI	+
51400	Nyctiophylax sp	MI	+
52200	Cheumatopsyche sp	F	+
55300	Ptilostomis sp	F	+
59580	Oecetis persimilis	MI	+
59720	Triaenodes ignitus	I	+
59730	Triaenodes melaca	MI	+
63300	Hydroporus sp	F	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	+
68708	Dubiraphia vittata group	F	+
68901	Macronychus glabratus	MI	+
69400	Stenelmis sp	F	+
71100	Hexatoma sp	MI	+
74501	Ceratopogonidae	F	+
77750	Hayesomyia senata or Thienemannimyia norena	F	+
77800	Helopelopia sp	F	+
81650	Parametriocnemus sp	MI	+
82710	Chironomus (C.) sp	T	+
84210	Paratendipes albimanus or P. duplicatus	MI	+
84470	Polypedilum (P.) illinoense	T	+
85500	Paratanytarsus sp	F	+
95100	Physella sp	T	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa:	0	Total Taxa:	40
No. Qualitative Taxa:	40	ICI:	E
Number of Organisms:	0	Qual EPT:	15

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 09/01/2004 River Code: 01-172 River: Mush Run RM: 1.00

Taxa Code	Taxa	Tol.	Qt./Ql.
05800	Caecidotea sp	M	+
08260	Orconectes (Crokerinus) sanbornii sanbornii	F	+
11130	Baetis intercalaris	F	+
11651	Procloeon sp (w/o hindwing pads)	MI	+
13521	Stenonema femoratum	F	+
13590	Stenonema vicarium	MI	+
17200	Caenis sp	F	+
17600	Baetisca sp	I	+
21200	Calopteryx sp	F	+
22001	Coenagrionidae	M	+
22300	Argia sp	F	+
23804	Basiaeschna janata	F	+
23909	Boyeria vinosa	F	+
24900	Gomphus sp	F	+
27404	Neurocordulia molesta	MI	+
48620	Nigronia serricornis	F	+
50315	Chimarra obscura	MI	+
52200	Cheumatopsyche sp	F	+
55300	Ptilostomis sp	F	+
60400	Gyrinus sp	F	+
63300	Hydroporus sp	F	+
67800	Tropisternus sp	M	+
68130	Helichus sp	MI	+
68708	Dubiraphia vittata group	F	+
68901	Macronychus glabratus	MI	+
69400	Stenelmis sp	F	+
71100	Hexatoma sp	MI	+
82710	Chironomus (C.) sp	T	+
83040	Dicrotendipes neomodestus	F	+
84210	Paratendipes albimanus or P. duplicatus	MI	+
85615	Rheotanytarsus pellucidus	MI	+
85800	Tanytarsus sp	MI	+
86100	Chrysops sp	F	+
87400	Stratiomys sp	F	+
95100	Physella sp	T	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 35
No. Qualitative Taxa: 35 ICI: G
Number of Organisms: 0 Qual EPT: 9

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 09/01/2004 River Code: 01-172 River: Mush Run RM: 1.80

Taxa Code	Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F	+
05800	Caecidotea sp	M	+
11130	Baetis intercalaris	F	+
11250	Centroptilum sp (w/o hindwing pads)	MI	+
13400	Stenacron sp	F	+
13521	Stenonema femoratum	F	+
13590	Stenonema vicarium	MI	+
17200	Caenis sp	F	+
18600	Ephemera sp	MI	+
22001	Coenagrionidae	M	+
22300	Argia sp	F	+
23804	Basiaeschna janata	F	+
23909	Boyeria vinosa	F	+
27404	Neurocordulia molesta	MI	+
51400	Nyctiophylax sp	MI	+
52200	Cheumatopsyche sp	F	+
59730	Triaenodes melaca	MI	+
60300	Dineutus sp	F	+
63300	Hydroporus sp	F	+
67800	Tropisternus sp	M	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	+
68708	Dubiraphia vittata group	F	+
68901	Macronychus glabratus	MI	+
69400	Stenelmis sp	F	+
69930	Lampyridae		+
71100	Hexatoma sp	MI	+
71900	Tipula sp	F	+
74501	Ceratopogonidae	F	+
77120	Ablabesmyia mallochi	F	+
77750	Hayesomyia senata or Thienemannimyia norena	F	+
78401	Natarsia species A (sensu Roback, 1978)	T	+
82710	Chironomus (C.) sp	T	+
83040	Dicrotendipes neomodestus	F	+
83300	Glyptotendipes (G.) sp	M	+
84450	Polypedilum (Uresipedilum) flavum	F	+
84470	Polypedilum (P.) illinoense	T	+
85500	Paratanytarsus sp	F	+
85821	Tanytarsus glabrescens group sp 7	MI	+
87540	Hemerodromia sp	F	+
95100	Physella sp	T	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa:	0	Total Taxa:	41
No. Qualitative Taxa:	41	ICI:	G
Number of Organisms:	0	Qual EPT:	10

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 08/30/2004 River Code: 01-174 River: Bryson Branch RM: 1.40

Taxa Code	Taxa	Tol.	Qt./Ql.
04686	Placobdella papillifera	F	+
08260	Orconectes (Crokerinus) sanbornii sanbornii	F	+
11130	Baetis intercalaris	F	+
12200	Isonychia sp	MI	+
13000	Leucrocuta sp	I	+
13400	Stenacron sp	F	+
13521	Stenonema femoratum	F	+
13590	Stenonema vicarium	MI	+
21200	Calopteryx sp	F	+
22001	Coenagrionidae	M	+
23804	Basiaeschna janata	F	+
23909	Boyeria vinosa	F	+
24900	Gomphus sp	F	+
50315	Chimarra obscura	MI	+
51400	Nyctiophylax sp	MI	+
52200	Cheumatopsyche sp	F	+
59730	Triaenodes melaca	MI	+
63300	Hydroporus sp	F	+
68025	Ectopria sp	MI	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	+
68708	Dubiraphia vittata group	F	+
68901	Macronychus glabratus	MI	+
69400	Stenelmis sp	F	+
71100	Hexatoma sp	MI	+
72340	Dixella sp	F	+
77120	Ablabesmyia mallochi	F	+
77800	Helopelopia sp	F	+
78401	Natarsia species A (sensu Roback, 1978)	T	+
81650	Parametriocnemus sp	MI	+
84210	Paratendipes albimanus or P. duplicatus	MI	+
84315	Phaenopsectra flavipes	F	+
84450	Polypedilum (Uresipedilum) flavum	F	+
85821	Tanytarsus glabrescens group sp 7	MI	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 34
No. Qualitative Taxa: 34 ICI: G
Number of Organisms: 0 Qual EPT: 10

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 05/02/2001 River Code: 01-175 River: Trib. to McDougall Branch (RM RM: 0.04 A

Taxa Code	Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F	+
05800	Caecidotea sp	M	+
07820	Cambarus (Cambarus) sp A	F	+
10550	Ameletus sp	MI	+
11014	Acentrella turbida	I	+
12800	Epeorus sp	MI	+
13400	Stenacron sp	F	+
15000	Paraleptophlebia sp	MI	+
16200	Eurylophella sp	MI	+
26100	Cordulegaster sp	F	+
30000	Plecoptera		+
32200	Amphinemura sp	MI	+
35250	Diploperla robusta	MI	+
35570	Isoperla transmarina	F	+
36500	Sweltsa sp	MI	+
45300	Sigara sp	F	+
53104	Rhyacophila fenestra or R. ledra	F	+
53122	Rhyacophila invaria complex	MI	+
57400	Neophylax sp	I	+
69400	Stenelmis sp	F	+
74501	Ceratopogonidae	F	+
77500	Conchapelopia sp	F	+
80470	Cricotopus (C.) or Orthocladius (O.) sp	F	+
81650	Parametriocnemus sp	MI	+
85802	Tanytarsus curticornis group	MI	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 25
No. Qualitative Taxa: 25 ICI:
Number of Organisms: 0 Qual EPT: 14

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 07/31/2001 River Code: 01-175 River: Trib. to McDougall Branch (RM RM: 0.04 B

Taxa Code	Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F	+
05800	Caecidotea sp	M	+
06700	Crangonyx sp	M	+
07820	Cambarus (Cambarus) sp A	F	+
11250	Centroptilum sp (w/o hindwing pads)	MI	+
13400	Stenacron sp	F	+
15000	Paraleptophlebia sp	MI	+
26100	Cordulegaster sp	F	+
44501	Corixidae	F	+
45900	Notonecta sp	M	+
47600	Sialis sp	F	+
52315	Diplectrona modesta	F	+
63300	Hydroporus sp	F	+
67700	Paracymus sp	F	+
68025	Ectopria sp	MI	+
71900	Tipula sp	F	+
72700	Anopheles sp	F	+
79400	Zavrelimyia sp	F	+
81650	Parametriocnemus sp	MI	+
81690	Paratrichocladius sp	MI	+
84210	Paratendipes albimanus or P. duplicatus	MI	+
85625	Rheotanytarsus sp	MI	+
85800	Tanytarsus sp	MI	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 23
No. Qualitative Taxa: 23 ICI:
Number of Organisms: 0 Qual EPT: 4

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 08/30/2004 River Code: 01-176 River: Dutch Creek RM: 1.70

Taxa Code	Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F	+
08260	Orconectes (Crokerinus) sanbornii sanbornii	F	+
11130	Baetis intercalaris	F	+
12200	Isonychia sp	MI	+
13000	Leucrocuta sp	I	+
13521	Stenonema femoratum	F	+
13590	Stenonema vicarium	MI	+
17200	Caenis sp	F	+
18600	Ephemera sp	MI	+
21200	Calopteryx sp	F	+
23804	Basiaeschna janata	F	+
23909	Boyeria vinosa	F	+
24900	Gomphus sp	F	+
47600	Sialis sp	F	+
48620	Nigronia serricornis	F	+
50315	Chimarra obscura	MI	+
51400	Nyctiophylax sp	MI	+
52200	Cheumatopsyche sp	F	+
52530	Hydropsyche depravata group	F	+
59730	Triaenodes melaca	MI	+
63300	Hydroporus sp	F	+
68075	Psephenus herricki	MI	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	+
68708	Dubiraphia vittata group	F	+
69400	Stenelmis sp	F	+
71100	Hexatoma sp	MI	+
71900	Tipula sp	F	+
72340	Dixella sp	F	+
72700	Anopheles sp	F	+
74100	Simulium sp	F	+
81640	Parakiefferiella poss. coronata		+
83040	Dicrotendipes neomodestus	F	+
84210	Paratendipes albimanus or P. duplicatus	MI	+
87540	Hemerodromia sp	F	+
96900	Ferrissia sp	F	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 36
No. Qualitative Taxa: 36 ICI: G
Number of Organisms: 0 Qual EPT: 12

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 07/28/2004 River Code: 01-180 River: Linscott Run RM: 0.80

Taxa Code	Taxa	Tol.	Qt./Ql.
06700	Crangonyx sp	M	+
12200	Isonychia sp	MI	+
17200	Caenis sp	F	+
18600	Ephemera sp	MI	+
21200	Calopteryx sp	F	+
21300	Hetaerina sp	F	+
24900	Gomphus sp	F	+
48620	Nigronia serricornis	F	+
51600	Polycentropus sp	MI	+
52200	Cheumatopsyche sp	F	+
52315	Diplectrona modesta	F	+
59580	Oecetis persimilis	MI	+
59730	Triaenodes melaca	MI	+
67700	Paracymus sp	F	+
68130	Helichus sp	MI	+
68708	Dubiraphia vittata group	F	+
68901	Macronychus glabratus	MI	+
69400	Stenelmis sp	F	+
70700	Dicranota sp	MI	+
71100	Hexatoma sp	MI	+
71900	Tipula sp	F	+
74100	Simulium sp	F	+
81825	Rheocricotopus (Psilocricotopus) robacki	MI	+
83840	Microtendipes pedellus group	MI	+
84450	Polypedilum (Uresipedilum) flavum	F	+
85800	Tanytarsus sp	MI	+
87400	Stratiomys sp	F	+
87540	Hemerodromia sp	F	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 28
No. Qualitative Taxa: 28 ICI: MG
Number of Organisms: 0 Qual EPT: 8

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 09/14/2004 River Code: 01-180 River: Linscott Run RM: 3.70

Taxa Code	Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	Tol.	Qt./Ql.
05800	Caecidotea sp	M	+				
06700	Crangonyx sp	M	+				
07800	Cambarus sp	F	+				
11120	Baetis flavistriga	F	+				
11130	Baetis intercalaris	F	+				
11150	Pseudocloeon propinquum	I	+				
11250	Centroptilum sp (w/o hindwing pads)	MI	+				
11651	Procloeon sp (w/o hindwing pads)	MI	+				
13000	Leucrocuta sp	I	+				
13400	Stenacron sp	F	+				
13521	Stenonema femoratum	F	+				
13590	Stenonema vicarium	MI	+				
15000	Paraleptophlebia sp	MI	+				
17200	Caenis sp	F	+				
21200	Calopteryx sp	F	+				
34100	Acroneuria sp	MI	+				
51400	Nyctiophylax sp	MI	+				
51600	Polycentropus sp	MI	+				
52200	Cheumatopsyche sp	F	+				
52315	Diplectrona modesta	F	+				
52530	Hydropsyche depravata group	F	+				
57400	Neophylax sp	I	+				
60400	Gyrinus sp	F	+				
63300	Hydroporus sp	F	+				
68025	Ectopria sp	MI	+				
68130	Helichus sp	MI	+				
68601	Ancyronyx variegata	MI	+				
68700	Dubiraphia sp	F	+				
69250	Optioservus ovalis	MI	+				
69400	Stenelmis sp	F	+				
71100	Hexatoma sp	MI	+				
71700	Pilaria sp	F	+				
74100	Simulium sp	F	+				
77800	Helopelopia sp	F	+				
82220	Tvetenia discoloripes group	I	+				
85501	Paratanytarsus n.sp 1	MI	+				
85821	Tanytarsus glabrescens group sp 7	MI	+				

No. Quantitative Taxa: 0 Total Taxa: 37
No. Qualitative Taxa: 37 ICI: VG
Number of Organisms: 0 Qual EPT: 18

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 08/19/2004 River Code: 01-190 River: Hyde Fork RM: 1.80

Taxa Code	Taxa	Tol.	Qt./Ql.
08260	Orconectes (Crokerinus) sanbornii sanbornii	F	+
13400	Stenacron sp	F	+
13521	Stenonema femoratum	F	+
17200	Caenis sp	F	+
18600	Ephemera sp	MI	+
21200	Calopteryx sp	F	+
22001	Coenagrionidae	M	+
23909	Boyeria vinosa	F	+
48620	Nigronia serricornis	F	+
51400	Nyctiophylax sp	MI	+
51600	Polycentropus sp	MI	+
52200	Cheumatopsyche sp	F	+
59730	Triaenodes melaca	MI	+
63300	Hydroporus sp	F	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	+
68708	Dubiraphia vittata group	F	+
69400	Stenelmis sp	F	+
71100	Hexatoma sp	MI	+
72340	Dixella sp	F	+
72700	Anopheles sp	F	+
95100	Physella sp	T	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 22
No. Qualitative Taxa: 22 ICI: MG
Number of Organisms: 0 Qual EPT: 8

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 08/19/2004 River Code: 01-192 River: Miners Fork RM: 0.10

Taxa Code	Taxa	Tol.	Qt./Ql.
08260	Orconectes (Crokerinus) sanbornii sanbornii	F	+
12200	Isonychia sp	MI	+
13000	Leucrocuta sp	I	+
13400	Stenacron sp	F	+
13521	Stenonema femoratum	F	+
13590	Stenonema vicarium	MI	+
17200	Caenis sp	F	+
21200	Calopteryx sp	F	+
22001	Coenagrionidae	M	+
22300	Argia sp	F	+
23804	Basiaeschna janata	F	+
23909	Boyeria vinosa	F	+
24900	Gomphus sp	F	+
34130	Acroneuria frisoni	MI	+
48620	Nigronia serricornis	F	+
51400	Nyctiophylax sp	MI	+
51600	Polycentropus sp	MI	+
52200	Cheumatopsyche sp	F	+
57900	Pycnopsyche sp	MI	+
59730	Triaenodes melaca	MI	+
63300	Hydroporus sp	F	+
68130	Helichus sp	MI	+
68601	Ancyronyx variegata	MI	+
68708	Dubiraphia vittata group	F	+
68901	Macronychus glabratus	MI	+
69400	Stenelmis sp	F	+
72700	Anopheles sp	F	+
78401	Natarsia species A (sensu Roback, 1978)	T	+
83840	Microtendipes pedellus group	MI	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 29
No. Qualitative Taxa: 29 ICI: G
Number of Organisms: 0 Qual EPT: 12

MBI - Midwest Biodiversity Institute
Macroinvertebrate Collection

Collection Date: 08/19/2004 River Code: 01-192 River: Miners Fork RM: 2.20

Taxa Code	Taxa	Tol.	Qt./Ql.
03600	Oligochaeta	T	+
08200	Orconectes sp	F	+
13400	Stenacron sp	F	+
13521	Stenonema femoratum	F	+
13590	Stenonema vicarium	MI	+
17200	Caenis sp	F	+
21200	Calopteryx sp	F	+
22001	Coenagrionidae	M	+
22300	Argia sp	F	+
23909	Boyeria vinosa	F	+
24900	Gomphus sp	F	+
25510	Stylogomphus albistylus	MI	+
28500	Libellula sp	T	+
47600	Sialis sp	F	+
51400	Nyctiophylax sp	MI	+
51600	Polycentropus sp	MI	+
55300	Ptilostomis sp	F	+
59580	Oecetis persimilis	MI	+
59730	Triaenodes melaca	MI	+
63300	Hydroporus sp	F	+
68708	Dubiraphia vittata group	F	+
68901	Macronychus glabratus	MI	+
72700	Anopheles sp	F	+
84300	Phaenopsectra obediens group	F	+
95100	Physella sp	T	+

Taxa Code	Taxa	Tol.	Qt./Ql.

No. Quantitative Taxa: 0 Total Taxa: 25
No. Qualitative Taxa: 25 ICI: G
Number of Organisms: 0 Qual EPT: 9

Appendix Table 4. QHEI scores and metric values for the Federal Creek watershed (MBI and Ohio EPA data).

Key QHEI Components

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes: No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	Total WWH Attributes	MWH Attributes – High Influence: Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD, HW)	Total HI MWH Attributes	MWH Attributes – Moderate Influence: Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	Total MI MWH Attributes	(MWH HI+1)/(WWH+1) Ratio	(MWH MI+1)/(WWH+1) Ratio
(01100) Federal Creek																																		
Year: 1984																																		
1.3	74.0	2.57	■	■		■	■	■	■	■	■	■	9						0		■											1	0.10	0.20
Year: 1990																																		
1.3	75.5	2.57	■	■		■		■	■	■	■	■	8						0						■							1	0.11	0.22
11.4	81.5	8.30	■	■		■	■	■	■	■	■	■	9						0													0	0.10	0.10
Year: 2004																																		
0.9	47.5	2.67	■								■		2				◆		1		■			■	■			■	■	■		6	0.67	2.67
4.9	62.0	3.81	■				■	■		■	■		5						0					■				■			■	3	0.17	0.67
4.9	64.5	3.81	■	■			■	■			■		5						0		■			■				■	■		■	5	0.17	1.00
9.1	55.5	2.16	■								■	■	3				◆		1		■			■	■			■	■			5	0.50	1.75
9.1	56.0	2.16	■							■	■	■	4				◆		1		■			■	■			■				4	0.40	1.20
9.3	50.5	1.71	■					■			■	■	4				◆		2		■			■	■			■	■			5	0.60	1.60
9.3	66.0	1.71	■	■		■	■	■	■	■	■	■	9				◆		1													0	0.20	0.20
11.3	59.0	1.71	■				■	■		■	■	■	6				◆		1					■	■			■				3	0.29	0.71
11.3	61.0	3.22	■				■	■		■	■	■	6				◆		1					■	■			■				3	0.29	0.71
11.7	51.5	3.22	■	■				■			■		4				◆		1		■			■	■			■	■		■	6	0.40	1.60
16.1	64.5	8.47	■	■			■	■		■	■		6			◆	◆		2		■			■	■			■			■	5	0.43	1.14
(01101) Kasler Creek (-19)																																		
Year: 2004																																		
1.7	78.0	11.16	■	■		■	■	■		■	■	■	8						0									■				1	0.11	0.22
(01110) Sharps Run																																		
Year: 1995																																		
2.4	73.5	12.00	■	■		■	■		■	■	■	■	8				◆		1													0	0.22	0.22
Year: 2004																																		
0.0	64.0	8.00	■	■			■	■	■		■		6				◆		1		■			■						■	■	4	0.29	0.86
(01130) Big Run																																		
Year: 1995																																		
0.2	63.0	9.43	■	■			■			■		■	5				◆	◆	2					■				■				2	0.50	0.83
3.9	80.5	25.00	■	■		■	■	■	■	■	■	■	9						0													0	0.10	0.10
Year: 2004																																		
1.7	59.0	11.31	■	■				■		■	■	■	6			◆	◆		2		■			■	■			■	■			5	0.43	1.14

Appendix Table 4. Continued.

Key QHEI Components

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes: No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	Total WWH Attributes	MWH Attributes – High Influence: Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD, HW)	Total HI MWH Attributes	MWH Attributes – Moderate Influence: Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	Total MI MWH Attributes	(MWH HI+1)/(WWH+1) Ratio	(MWH MI+1)/(WWH+1) Ratio
(01130) Big Run																																		
Year: 2004																																		
3.9	73.5	16.00	■	■		■	■	■		■	■		8				◆		1									■				1	0.22	0.33
(01131) Ellis Run																																		
Year: 1995																																		
0.5	64.0	60.61	■	■		■	■	■		■	■	■	8				◆		1									■	■			2	0.22	0.44
(01132) Joes Run																																		
Year: 1995																																		
0.1	68.5	32.26	■	■		■	■	■		■	■		8				◆		1									■		■		2	0.22	0.44
(01133) Wildcat Run																																		
Year: 1995																																		
0.1	69.0	40.00	■	■		■	■	■	■	■	■		9				◆		1									■				1	0.20	0.30
(01134) Sulphur Run																																		
Year: 2004																																		
0.0	45.5	49.03	■	■		■	■		■		■		6		◆	◆	◆		3		■			■	■				■	■		5	0.57	1.29
0.8	56.0	50.00	■	■		■	■	■	■		■		7				◆		1		■			■					■	■		4	0.25	0.75
(01140) Spruce Run																																		
Year: 1995																																		
0.2	65.0	74.07	■	■		■	■			■	■	■	7			◆	◆		2						■			■				2	0.38	0.63
(01150) Marietta Run																																		
Year: 1995																																		
0.1	68.5	10.58	■			■	■		■	■	■		6				◆		1					■						■		2	0.29	0.57
Year: 2004																																		
0.1	62.5	5.71	■	■		■	■	■			■		6						0		■			■				■	■	■		5	0.14	0.86
1.6	75.5	12.40	■	■		■	■	■		■	■		8						0		■							■	■	■		4	0.11	0.56
3.2	77.0	25.15		■		■	■	■	■	■	■		8						0													0	0.11	0.11
(01151) Brill Run																																		
Year: 1995																																		
0.1	79.5	35.09	■	■	■	■	■			■	■		8				◆		1									■				1	0.22	0.33

Appendix Table 4. Continued.

Key QHEI Components

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes: No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	Total WWH Attributes	MWH Attributes – High Influence: Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD, HW)	Total HI MWH Attributes	MWH Attributes – Moderate Influence: Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	Total MI MWH Attributes	(MWH HI+1)/(WWH+1) Ratio	(MWH MI+1)/(WWH+1) Ratio
(01160) Sharps Fork																																		
Year: 1990																																		
0.3	59.0	4.39	■	■				■		■	■	■	6				◆		1					■	■			■				3	0.29	0.71
Year: 2004																																		
1.6	55.5	8.55	■					■			■		3				◆		1		■			■	■			■	■		■	6	0.50	2.00
1.6	65.5	8.55	■	■			■	■	■		■	■	7				◆		1		■		■	■	■				■			5	0.25	0.88
5.3	66.5	10.19	■	■		■	■	■		■	■	■	8				◆		1									■				1	0.22	0.33
8.0	67.0	8.28	■	■		■	■	■			■		6						0		■			■				■	■		■	5	0.14	0.86
9.1	69.5	6.67	■	■				■		■	■	■	6			◆	◆		2		■			■	■			■	■			5	0.43	1.14
10.7	80.5	22.37	■	■		■	■	■		■	■	■	8						0									■				1	0.11	0.22
(01161) Opossum Run																																		
Year: 2004																																		
0.2	59.0	12.50	■	■		■	■		■	■	■	■	8				◆		1		■		■	■					■			4	0.22	0.67
0.7	56.0	20.11	■	■			■				■		4				◆		1		■			■				■	■		■	5	0.40	1.40
2.6	69.5	22.43	■	■				■	■		■	■	6			◆			1		■			■	■				■			4	0.29	0.86
4.1	59.0	60.00	■	■			■	■		■			6			◆	◆	◆	3						■	■		■				3	0.57	1.00
(01170) McDougall Branch																																		
Year: 1983																																		
2.4	63.0	7.60		■	■			■		■	■		5	◆					1					■	■			■			■	4	0.33	1.00
Year: 1990																																		
2.4	52.0	7.60	■			■				■	■	■	5		◆		◆		2		■			■	■			■				4	0.50	1.17
Year: 2004																																		
0.5	66.0	8.64	■			■	■	■			■	■	6						0		■							■	■	■		4	0.14	0.71
2.9	65.5	16.00	■	■		■		■		■	■	■	7				◆		2					■	■			■				3	0.38	0.75
2.9	69.5	16.00	■	■		■	■	■	■	■	■	■	9						0													0	0.10	0.10
4.5	59.5	16.00	■	■						■	■		4			◆	◆		2					■	■			■			■	4	0.60	1.40
4.9	57.5	16.00	■	■			■			■	■		5				◆		1					■				■			■	3	0.33	0.83
(01171) Wyatt Run																																		
Year: 2004																																		
0.4	62.5	28.24	■	■			■			■	■		5			◆	◆		2					■	■			■			■	4	0.50	1.17

Appendix Table 4. Continued.

Key QHEI Components

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes: No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	Total WWH Attributes	MWH Attributes – High Influence: Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD, HW)	Total H.I. MWH Attributes	MWH Attributes – Moderate Influence: Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	Total M.I. MWH Attributes	(MWH HI+1)/(WWH+1) Ratio	(MWH MI+1)/(WWH+1) Ratio
(01172) Mush Run																																		
Year: 2004																																		
1.0	66.5	11.19	■	■			■	■		■	■		6						0		■			■				■		■	4	0.14	0.71
1.8	63.0	11.19	■	■			■	■		■	■	■	7						0					■				■			2	0.13	0.38
(01174) Bryson Branch																																		
Year: 2004																																		
1.2	68.5	9.33	■	■		■	■	■		■	■	■	8						0									■			1	0.11	0.22
(01176) Dutch Creek																																		
Year: 2004																																		
1.7	76.5	16.25	■	■		■	■	■		■	■	■	8						0									■			1	0.11	0.22
(01180) Linscott Run																																		
Year: 2004																																		
0.8	73.5	17.13	■	■		■	■	■	■	■	■	■	9				◆		1		■										1	0.20	0.30
3.8	68.0	31.56	■	■		■	■	■	■	■	■	■	9				◆		1												0	0.20	0.20
(01190) Hyde Fork																																		
Year: 2004																																		
1.8	69.0	19.36	■	■		■	■	■		■	■		7						0									■		■	2	0.13	0.38
(01192) Miners Fork																																		
Year: 2004																																		
0.0	58.5	11.86	■	■				■		■	■	■	6			◆	◆		2						■			■			2	0.43	0.71
2.2	56.5	9.33	■	■		■	■	■		■	■		7				◆		1					■				■		■	3	0.25	0.63

Appendix Table 5. Pebble count statistics & selected QHEI substrate-related metrics for stations in the Federal Creek watershed.

							Zig-Zag Pebble Count Data								
River Mile	QHEI	Substrate Score	Channel Score	Silt Score	Embed. Score	Riffle Substrate	Percent Silt	Percent Sand	Percent Fines	Percent Coarse	D5	D25	D50	D75	D95
(01100) Federal Creek															
Year: 2004															
4.90	62.0	13.0	12.0	2.0	2.0	No Riffle	0.0	14.7	25.0	67.3	2	12	128	1024	2048
9.10	56.0	10.5	10.5	2.5	2.0	Fine	0.0	47.9	85.0	0.0	2	2	4	8	16
9.30	66.0	13.0	16.0	2.0	2.0	Fine-Medium	0.0	55.7	88.5	5.7	2	2	2	8	32
(01134) Sulphur Run															
Year: 2004															
0.01	45.5	5.0	14.5	4.0	4.0	Large	21.5	0.0	35.5	46.9	0	4	16	128	512
0.80	56.0	9.0	15.5	4.0	4.0	Fine-Medium	1.4	10.5	35.5	13.4	2	4	16	16	32
(01150) Marietta Run															
Year: 2004															
0.10	62.5	10.0	14.0	3.0	3.0	Fine	6.4	43.7	78.3	3.4	0	2	2	8	16
1.60	75.5	13.5	15.0	3.0	2.5	Fine-Medium	0.5	11.8	21.6	40.5	2	16	16	64	512
3.20	77.0	14.5	13.5	2.0	2.0	Fine	0.0	29.7	43.9	16.6	2	2	16	16	32
(01160) Sharps Fork															
Year: 2004															
1.60	55.5	8.0	10.0	4.0	4.0	No Riffle	2.1	39.2	77.1	3.5	2	2	4	8	16
1.65	65.5	11.5	12.5	2.5	3.0	Fine	12.2	24.3	63.4	13.4	0	2	8	16	89
1.65	65.5	11.5	12.5	2.5	3.0	Fine	4.8	51.2	80.4	0.0	1	2	2	8	16
5.30	66.5	13.0	14.0	2.0	2.0	Fine	8.7	23.1	46.0	39.1	0	2	16	32	64
8.05	67.0	15.0	15.0	3.0	3.0	No Riffle	3.7	12.3	27.7	51.8	2	8	32	128	2048
10.70	80.5	16.0	16.0	2.0	2.0	Medium	0.0	8.5	30.3	22.1	2	8	16	16	128
(01161) Opossum Run															
Year: 2004															
0.20	59.0	11.5	13.5	3.0	2.5	Fine	10.6	24.5	54.1	11.1	0	2	8	16	128
0.75	56.0	11.0	11.0	3.0	3.0	No Riffle	5.9	21.7	56.4	25.7	0	2	8	32	185
2.60	69.5	12.0	12.5	3.0	3.0	Fine-Medium	0.4	4.3	19.3	43.4	3	16	16	32	512
4.10	59.0	23.0	11.5	2.0	1.0	Large	4.8	2.6	21.1	62.4	2	16	64	256	4096
(01180) Linscott Run															
Year: 2004															
0.80	73.5	17.5	17.0	2.5	2.0	Medium	0.0	3.5	36.4	23.5	4	8	16	16	80
0.80	73.5	17.5	17.0	2.5	2.0	Medium	0.0	4.1	15.4	50.5	5	16	32	4096	4096
3.80	68.0	14.0	16.5	2.0	2.0	Medium-Large	0.0	8.5	26.2	31.7	2	8	16	32	128

The Federal Valley Watershed
Acid Mine Drainage Abatement Plan

April 12, 2006

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SECTION I BACKGROUND

PURPOSE

In 2002, the Federal Valley Watershed Group, in cooperation with the Ohio Department of Natural Resources, Division of Mineral Resources Management, and Midwest Biodiversity Institute conducted an investigation to determine to what extent mine drainage is affecting stream health. Sources of acid mine drainage (AMD) were determined by characterizing chemical constituents in the water, measuring stream flow, and determining the condition of aquatic life. From this information, an Acid Mine Drainage Abatement and Treatment (AMDAT) Plan was written to systematically identify and restore mine impacted segments of Federal Creek and its tributaries to meet their "aquatic life designated use" as established by the Ohio EPA. The goal of the plan is to improve surface water quality that has been adversely affected by coal mining practices that occurred prior to passage of the Surface Mining Control and Reclamation Act (SMCRA) in 1977. The AMDAT Plan identifies all of the major existing sources of acid mine drainage in the Federal Creek Watershed, and prioritizes areas for treatment based on their chemical load and relative effects on the aquatic health of the watershed. Because acid mine drainage is diffuse in the basin, an intensive field investigation was conducted to identify (1) the impacted tributaries, and (2) sources of pollution within six subwatersheds and one section of the mainstem.

Chemical data from this investigation, along with biological data collected during the summer of 2002 by the Federal Valley Watershed Group and during the summer of 2005 by Midwest Biodiversity Institute (MBI) were used to prioritize potential sites for acid mine drainage abatement and treatment in the Federal Valley Watershed. Treatment strategy is discussed in Section II of this plan.

SCOPE OF REPORT

This AMDAT will include the following:

- An identification of the qualified hydrologic unit, including geology and physiography.
- An identification of the sources of acid mine drainage, including methodology.
- The extent to which AMD is affecting the water quality and biological resources within the hydrologic unit
- Water quality designations, and water quality targets for achieving stream health
- An identification of individual projects and the measures proposed to be undertaken to abate and treat the causes or effects of acid mine drainage. An identification of subsidence features within the watershed, if appropriate.
- The cost of undertaking the proposed abatement and treatment measures and an analysis of the cost-effectiveness and environmental benefits.
- An identification of existing and proposed sources of funding for individual projects
- A monitoring plan for assessment of actual environmental benefit realized.

Map 1 Federal Valley and its Subwatersheds

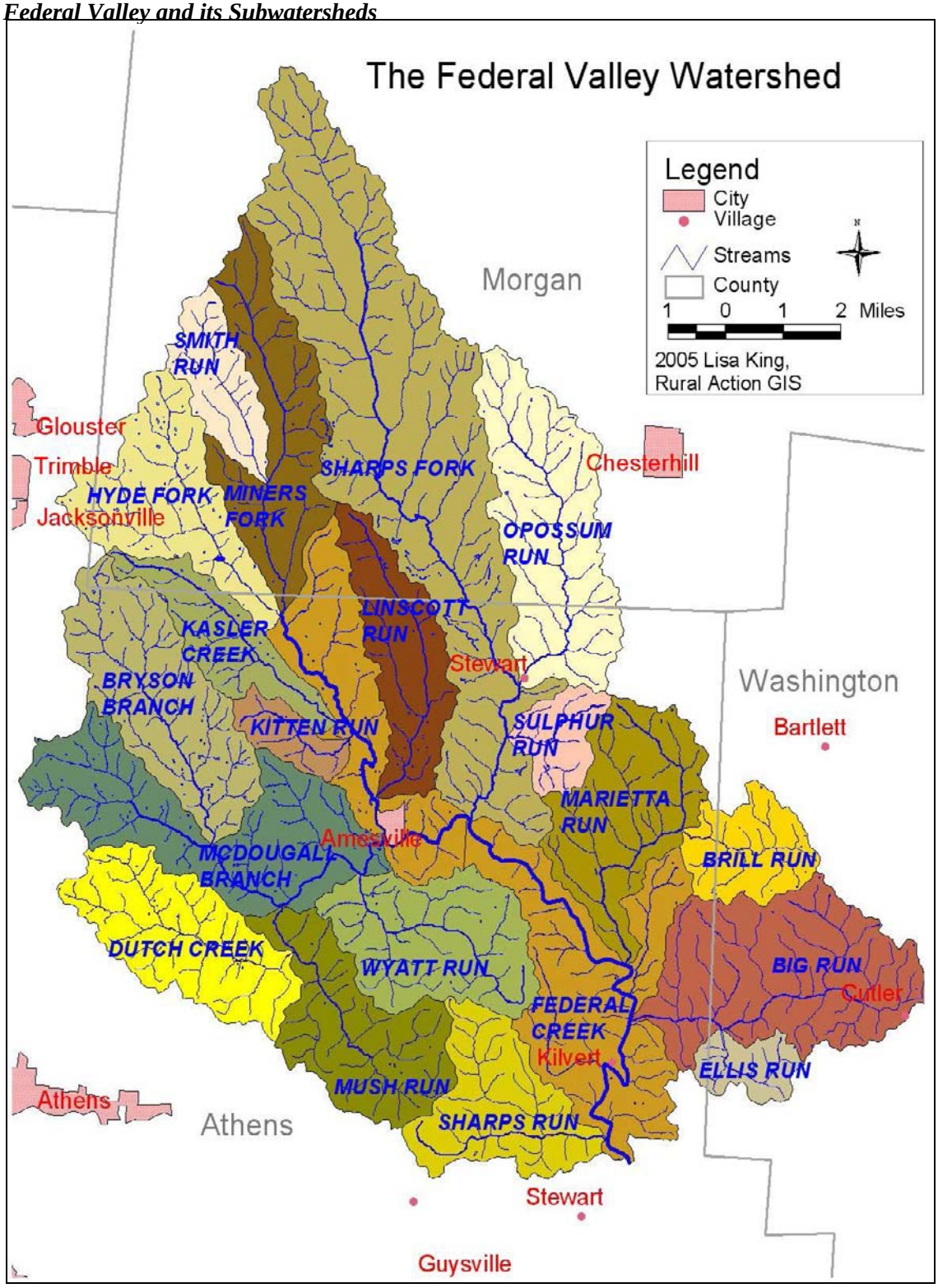
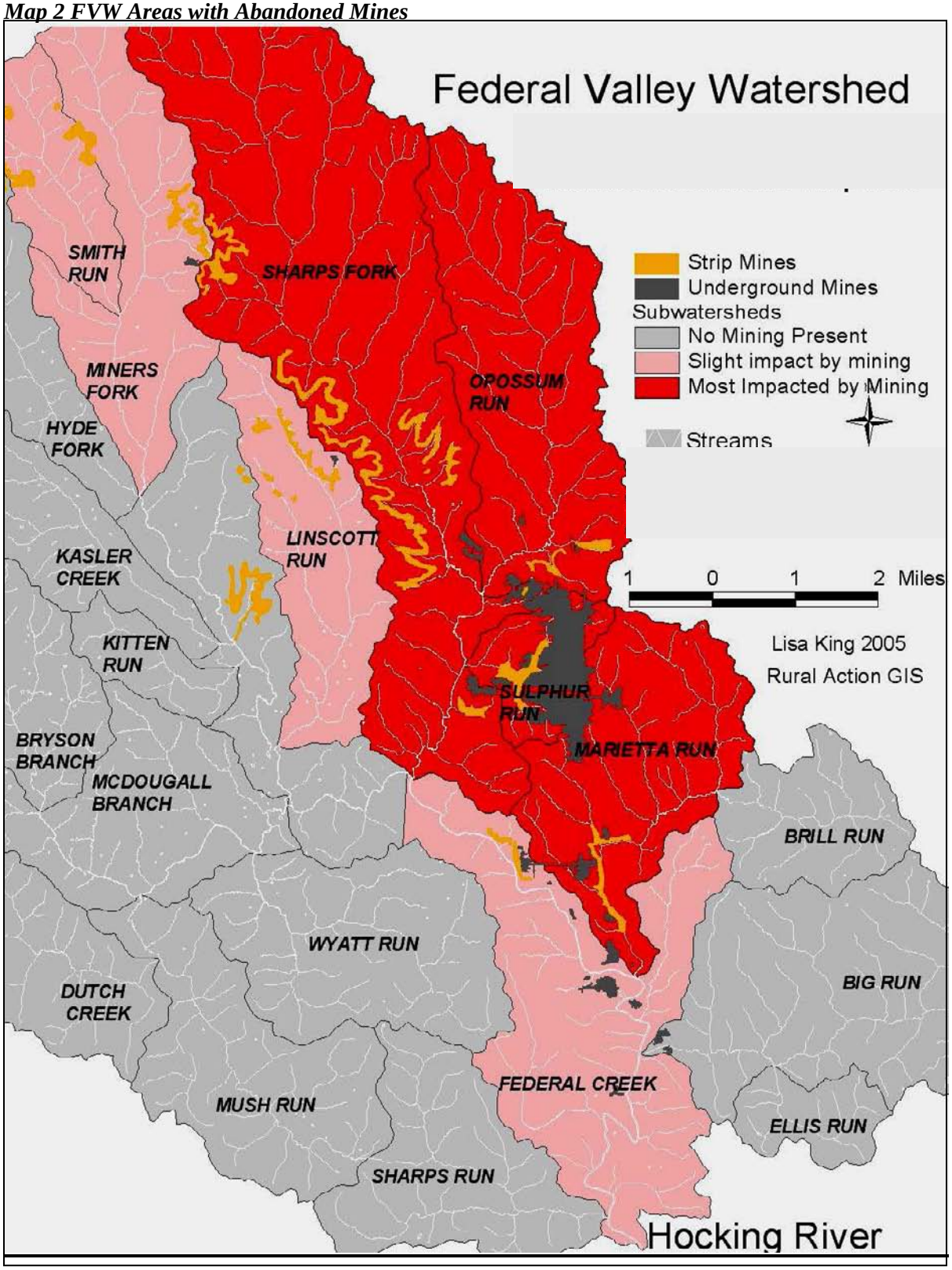


Table 1 Subwatershed Geography

Subshed Name	Flow Direction	Stream Flows Into:	River Mile Stream Flows Into:	Morgan/ Athens/ Washington County	Homer/Rome/ Ames/Bern/ Marion/ Wesley/ Decatur/ Cannan/Dover Union/Trimble Township	Proximity to Towns	Latitude	Longitude	Corning, Ringold, Chesterhill, Jacksonville, Amesville, Cutler, Stewart, Athens Quadranagle	Area Sq. Mile	Stream Length (miles)	Elevation (source)	Elevation (mouth)	Average Fall (ft/mi)	Sq Mi of Under ground Mines	% coverage of under ground mines in shed	Sq. Mile of strip mines	% coverage of strip mines in shed
Federal Creek	South/ SE	Hocking	15.29	M,A,W	H,R,A,B,M,W, DE,C,DO,U,T	Amesville: 0.0 miles, Joy: 1 mile S-SE	39.330082	-81.887753	Co,R,Cu,J,A,Ch,S,A	144.73	23.80	1040	585	19.12	2.25	1.55%	2.09	1.44%
Sharps Run	East	Federal	0.59	A	R/Ca	Stewart: 0.8 miles S			S	5.60	3.60	760	585	48.61		0.00%		0.00%
Big Run	West	Federal	3.79	W,A	R,De,W,B	Kilvert: 1 mile E	39.3552	-81.8783	Cu,Ch,S	11.90	5.50	860	595	48.18	0.03	0.24%	0.00	0.00%
Joe's Run	South	Big Run	0.83	A	R,B	Kilvert			Ch,Cu	0.90	1.90	920	612	162.11		0.00%		0.00%
Ellis Run	North	Big Run	1.60	W,A	De,R	Kilvert: 1.3 miles E,	39.3534459	-81.8510756	Cu	1.60	2.62	755	610	55.39	0.00	0.00%	0.00	0.00%
Wildcat Run	South	Big Run	4.00	W	W	Cutler	39.3604142	-81.8155449	Cu	1.75	2.20	880	650	104.55		0.00%		0.00%
Spruce Run	South	Federal	3.79	A	R,B	Broadwell			S,Ch,Cu		2.17	900	600	138.25	0.00			
Marrietta Run	South	Federal	4.26	*A*	B	Amesville: 2.5 miles E	39.368019	-81.8800396	A,Ch,S	10.10	5.80	890	604	49.31	0.32	3.12%	0.12	1.19%
Brill Run	West	Marietta Run	3.50	*A,W*	W,B	1 mile Bartlett			Ch,Cu	3.24	2.6	880	670	80.77		0.00%		0.00%
Sharps Fork	South	Federal	5.14	M,A	U,H,M,B	Joy in Sharps	39.4025964	-81.9296528	R,A	35.70	14.50	1040	621	28.90	1.15	3.22%	1.09	3.05%
Opossum Run	South	Sharp's Fork	2.83	M,A	M,B	Chesterhill, 0.8 miles E	39.4361753	-81.9123637	A,R	8.95	5.70	908	638	47.37	0.09	1.03%	0.85	9.50%
Starling Run	South	Opposum Run	3.94	M	M	Wrightstown			A		1.16	*890*	*740*	129.31				
Sulphur Run	West	Sharp's Fork	2.90	A	B	Sharpsburg: 0.3 miles NW			A	1.98	2.29	*900*	*640*	113.54	0.89	44.85%	0.13	6.52%
Joy Run	South	Sharp's Fork	6.37	M	M,H	Joy			A	1.12	1.50	820	675	96.67		0.00%		0.00%
McElfresh Run	South	Sharp's Fork	7.23	M	H,M	Joy			R,A	1.75	2.50	860	679	72.40		0.00%		0.00%
McDougall Branch	East	Federal	9.30	A	Do,A	Amesville: 0.3 miles W,	39.396629	-81.9625751	J,A,A/S	37.60	7.90	900	630	34.18	0.58	1.55%	0.08	0.20%
Wyatt Run	North	McDougal	0.50	A	A,R,C,B	New England in subshed	39.3842379	-81.9648203	S,A	6.78	4.90	895	634	53.27		0.00%		0.00%
Bryson Branch	South	McDougal	4.71	*A*	A,H,Do	Amesville: 2.0 miles E-SE	39.3959302	-82.0132625	J,A	7.77	6.48	900	660	37.04	0.00	0.01%		0.00%
Mush Run	North	McDougal	3.00	A	C,R,A	New England in subshed	39.3825448	-81.9897863	S,J,A	13.20	5.30	880	638	45.66	0.00	0.00%	0.00	0.00%
Dutch Creek	East	Mush Run	1.00	Athens	A,C	Athens: 2 miles S	39.3714707	-81.9871663	A,J,S	5.88	4.3	*900*	660	55.81		0.00%		0.00%
Linscott Run	South	Federal	11.93	M/A	H,A,B	Amesville: 0.4 miles S,	39.4027	-81.9602	A	5.04	5.50	910	634	50.18	0.01	0.14%	0.12	2.46%
Ewing Run	South	Linscott Run	1.76	M/A	A,H	Writestown			A	1.32	2.40	920	665	106.25		0.00%		0.00%
Kitten Run	East	Federal Creek	13.94	A	A	Amesville: 1.7 miles NW			J,A	1.55	2.85	*900*	*640*	91.23		0.00%		0.00%
Kasler Creek	South	Federal	14.13	M/A	H,A	Amesville .5 miles S			J,A	3.75	5.01	*940*	*660*	55.89		0.00%		0.00%
Draper's Run	South	Federal	15.99	M/A	H,A				A		2.34	*900*	*660*	102.56				
Hyde Branch	South	Federal	16.21	M	H,T,A	Trimble: 0.5 miles	39.4528746	-81.9904667	Co,J,A,R	6.53	4.60	893	634	56.30	0.00	0.00%	0.63	9.65%
Miners Fork	South	Federal	16.21	M/A	H,A	Joy: 1.3 miles W	39.4528746	-81.9904667	M, A	9.92	6.59	893	660	35.37	0.02	0.15%	0.36	3.61%
Smith Run	South	Miner's Fork	2.40	M	H	Bishopville	39.4815914	-81.995267	C,J,A	2.93	2.21	940	*760*	81.45		0.00%	0.19	6.44%

ABANDONED MINE IMPACTS IN FEDERAL VALLEY

Map 2 FVW Areas with Abandoned Mines



Mining impacts are dispersed and occur in some form in many areas of Federal Creek. The most extensive mining occurred in the area surrounding Sharpsburg and Joy, as well as the area along State Route 329 near Utley (Tick Ridge Rd.,) Phillipsburg (Marietta Run Rd.), and Broadwell (Mayle Ridge Road). Approximately 1.55 percent (2.25 square mile) of the total watershed has been deep mined and approximately 1.44 percent (2.09 square mile) has been surfaced mined for coal. In the Federal Valley Watershed, there are 77 mapped underground mine entries. Subsequent strip mining has obscured many of these. Very few of these entries form acid mine drainage seeps.

Due to high levels of naturally occurring alkalinity in the watershed, the effects of mining are reduced in Federal Valley. Federal Valley has high levels of alkalinity due to the geology of the area, which contains a high occurrence of limestone. This neutralizes much of the acidity that enters Federal Creek due to past mining practices. However, some areas of Federal Creek are negatively affected by mining impacts, mainly in the form of elevated metal or sulfate concentrations. Water chemistry data shows the most heavily impacted areas are within Sharp's Fork and Marietta Run. Sulphur Run in Sharp's Fork is the most impacted subwatershed in Federal Creek. Other impacted tributaries include Opossum Run, numerous unnamed tributaries to Sharp's Fork, Upper Linscott Run, Smith Run, and Miner's Fork. Additionally, AMD enters the Federal Creek mainstem between Tick Ridge Road and Mayle Ridge Road. In most cases, when the contaminated water in the small tributaries enters the larger stream channels, the water is neutralized and diluted so that a problem is not evident in the larger stream channel.

IDENTIFICATION OF THE HYDROLOGIC UNIT

Name: Federal Creek Watershed
11-digit Hydrologic Unit Code (HUC): 05030204090
Tributary To: Hocking River: Ohio River Basin
Drainage Area: 145 square miles
Length: 23.8 miles
Location: Athens, Morgan, and Washington Counties
Quadrangles: Ringgold, Corning, Chesterhill, Amesville, Jacksonville, Cutler, Stewart, and Athens.

WATERSHED DESCRIPTION

Federal Creek is a third order stream. Federal Valley Watershed is identified as UWA 11 digit HUC 05030204090 and is located within three counties: Athens (88 square mile), Morgan (45 square mile), and Washington (12 square mile), a total of 145 square miles. This watershed has been subdivided into nine 14-digit subwatersheds, which has been subdivided into thirteen main sub basins and a total of 20 different basins (both first and second order). There are twelve townships whose boundaries cross into

the watershed: Rome, Ames, Bern, Dover, Trimble, and Canaan in Athens County; Homer, Marion, Fairfield, and Union in Morgan County; and Wesley, and Decatur in Washington County (see map). The largest village in the watershed is Amesville with a population of approximately 250. Smaller towns in the watershed include Sharpsburg, Joy, Kilvert,, New England, Broadwell, Utley, Lathrop, Phillipsburg and Mountville. On the edge of the watershed are the towns of Cutler, Chesterhill, Bishopville, Trimble and Stewart. Federal Creek can be found on the Corning, Ringold, Chesterhill, Jacksonville, Amesville, Cutler, Stewart, and Athens USGS quad sheets.

Federal Creek is a tributary of the Hocking River in southeastern Ohio. The Hocking River Watershed contains approximately 1,199 square miles. Federal Valley Watershed is one of the four largest watersheds in the basin, representing approximately twelve percent of the Hocking River Watershed. Federal Valley Watershed originates in west-central Morgan County and flows in a southeasterly direction into Athens County. The river's confluence with the Hocking River is approximately twelve miles east of Athens, Ohio. The watershed covers an area of approximately 145 square miles, it is 16 miles wide and 18 miles long and the main stem is 23.8 miles long. The latitude ranges from 39°18'00" to 39°35'00" and the longitude ranges from 81°47'30" to 82°2'30".

GEOLOGY

The watershed lies within the Marietta Plateau, characterized as dissected and with high relief. The Marietta Plateau mostly contains fine-grained rocks and commonly contains red shale and soils. Landslides and ancient remnants of the lacustrine, clay-filled Teays drainage system are also common (ODNR, Division of Division of Geological Survey, 1998). An early land system inventory for the nearby Wayne National Forest indicated that the majority of the landscape could be mapped as maturely dissected uplands; the remainder consists of broad river valleys and floodplains (Wester 1977). Typical side slopes have a steepness gradient of 12 to over 40 percent (USDA 1967). The common lithologic types are sandstone, shale, siltstone, limestone, and coal (Cusick and Silberhorn 1977).

The Federal Valley Watershed lies within the Permian and Pennsylvanian geologic systems. Within these two systems, three distinct rock units make up the strata underlying the watershed. These include the Dunkard Group of the Permian system and the Monongahela Group and Conemaugh Group of the Pennsylvanian system (ODNR, Division of Geological Survey 2001).

The Dunkard Group's lithology or rock composition consists of sandstone, siltstone, shale, and slight amounts of limestone and coal (ODNR, Division of Geological Survey, 2001). Permian rocks, which follow immediately above the Pennsylvanian sequence, are the youngest of the coal-bearing rocks in Ohio (Sturgeon,1958). Color for this group tends to be shades of brown, gray, green, and red. The Dunkard Group also typically has a thickness of 600 or more feet and thin to massive bedding. This group features a dominance of siltstone, shale, and sandstone, and has an occurrence of non-marine

limestone. It also features quick vertical and horizontal change in rock type (ODNR, Division of Geological Survey, 2001).

The Monongahela Group, the youngest of the Pennsylvania rocks, has a lithology consisting of shale, siltstone, sandstone, limestone, and coal (Sturgeon, 1958; ODNR, Division of Geological Survey, 2001). The highest alkalinities are associated with the thick freshwater limestone sequences of this group in the Vanport limestone of the lower Allegheny Group (Brady, Hornberger, and Fleeger, 2003). Color for this group tends to be shades of gray, green, and uncommonly red. The Monongahela Group also has a thickness of 350 or more feet and nonbedded to massive bedding. This group features laterally extensive non-marine limestone layers and economic coal beds, such as the Pittsburgh (No. 8) coal bed, a mineable reserve located at the base of the formation (Sturgeon, 1958; ODNR, Division of Geological Survey 2001). Although the overlying strata of the Pittsburgh (No. 8) coal bed contain nine other coal beds, it is the only one that is of a moderate extent (Sturgeon, 1958).

The Conemaugh Group consists of layers of shale, sandstone, siltstone, and mudstone (ODNR, Division of Geological Survey, 2001). Where marine limestones are present, significant alkalinity concentrations occur in this group (Brady, Hornberger, and Fleeger, 2003). The Conemaugh Group also contains many layers of coal beds; however, none of these are sufficiently thick or extensive to be considered a mineable resource. The Conemaugh Group also has a thickness anywhere from 350 to 490 feet and nonbedded to massive bedding. This group is characterized by multicolored mudstones, thin to thick marine limestone, and shale in the lower two-thirds of the unit. It also features quick vertical and horizontal change in rock type, and it is not common to find coal beds in this group (ODNR, Division of Geological Survey 2001).

COAL RESOURCES

The Pittsburgh (No. 8) coal is one of the most extensive and valuable beds in the eastern United States and is the primary coal bed of economic importance in Athens County. Athens County has the richest Pittsburgh coal deposits in Ohio, except for the Belmont field. Two main regions in Athens County have a great extent of the resource: the Federal Creek field in northeastern Athens County and the Shade Creek field in the south-central region of the county. Although production from the Federal Creek field has declined in recent years, it contains the greatest coal reserves of the two economically important areas (Delong 1955). It is for this reason that the Federal Creek field has made the Pittsburgh coal bed famous in Athens County (Sturgeon, 1958).

The Federal Creek field is most extensive in Bern Township of Athens County and contains large reserves in Rome and Ames Townships of Athens County (Sturgeon, 1958). This field, which terminates in Decatur Township of Washington County, also includes parts of Homer and Marion Townships of Morgan County. Although the Pittsburgh coal exists in almost every township in Morgan County, the

extension of the Federal Creek field accounts for all of Morgan County's reserves. Approximately 60 percent of Morgan County's estimated original reserves are within the Federal Creek field in Marion and Homer Townships. Washington County does not contain any parts of the Federal Creek field; however, it does contain two areas of mineable Pittsburgh coal: the eastern Washington field in Aurelius and an area in Decatur Township where the Federal Creek field ends (Delong, 1955). "The Pittsburgh (No. 8) coal bed is of wide areal extent in Morgan County, but, in much of its area of occurrence, it is thin and irregular in thickness. Most of Morgan County's Pittsburgh Coal reserve is found in the southeastern part of the county, where the coal is locally more than 5 feet thick, and where it constitutes a part of the Federal Creek field. There are also small isolated areas of coal 14-24 inches thick in the northeastern and central western parts of Morgan County."

In the Federal Creek field the coal is thin, and is mixed with a carbonaceous shale or limestone, and is overlain by heavy sandstone (Delong, 1955). 42 tests showed an average sulfur of 5.71 percent. It was variable, from 0.9-12.61 percent, in a market that now desires 1-2 percent sulfur. It is also characterized by a double-benched, (lower and upper bench) structure that is divided by clay, several inches to one foot in thickness. The lower bench, more uniform in its thickness, contains slender partings of a pyritic nature. The upper bench is generally superior in quality and also contains slender irregular partings of clay, bone, and pyrite. At Sharpsburg within Bern Township, the Pittsburgh coal thickness has changed laterally from eight feet to a zone of nonbedded, mottled yellow, maroon, and tan clay shale deposited during the Pittsburgh coal forming period (Sturgeon 1958).

MINING HISTORY

Coal was used as a primary energy source by various industries in the 1920's. Other uses of coal at the turn of the century included private homes and railroads. By the 1940's about half of the coal used in the United States was used by electric utilities, with most of the remaining coal being used by industry. In the 1990's electric utilities used over three-quarters of the coal produced, with industry using almost all of the remaining coal (National Energy Foundation, 1995). Coal production has increased over the past 100 years from about 210,000 tons in 1897 to about 22,293,204 tons in 2003 (Office of Surface Mining Reclamation and Enforcement, 2004). Recent estimates suggest that at this rate the United States coal reserves will last at least 500 years.

Three different types of mining techniques have been used in the Federal Valley Watershed. S*trip mining* is used when the coal seam is near to the ground's surface. The soil and rock overburden is removed and the coal is removed before the overburden is replaced. In Federal Valley Watershed there are 2.09 square miles of abandoned strip mines. In *drift mining*, a tunnel is driven into the side of a hill at a coal outcrop. The coal is mined out by following the contour of the bed. Most of the underground mining in the watershed was taken from drift mines. In the Federal Valley Watershed, there are 1.67

square miles of drift mines. A vertical opening is driven into the coal in *shaft mining*. This technique proceeds along the coal seam with excessive depth increasing entry, exit and ventilation hazards. There are .58 square miles of shaft mines in the Federal Valley.

Shaft and deep mines were originally used until the 1940s, before strip mines became more common. From the 1940's to the present, strip mining has replaced underground mining as the dominant method. According to calculations based on digitized layers of surface and underground mines on U.S. Geological Survey 1:24,000, 7.5 minute quadrangles, approximately 2.25 square miles of underground mines and 2.09 square miles of surface mines were established in the Federal Valley Watershed. Coal mining in the Federal Valley Watershed has taken place since the 1870s. The last registered underground mine was abandoned in 1960, and the bulk of the underground mines were abandoned by 1944. There has been a steady decline of coal extraction since that time. In 1966, coal strip mines within the watershed yielded 30,000 tons of coal (USDA, 1967). Most of this strip mining took place in Sharps Fork. During the 1970's, as high sulphur coal became less valuable and transport became more expensive (i.e., lack of railroad transportation), this land use declined. Since 1998, no coal has been extracted from the watershed and most of the land owned by coal companies has been sold.

METHODOLOGY

Watershed Assessment

The assessment of the watershed was based upon data collected during water quality monitoring of selected locations along the main stem of Federal Creek as well as an individual assessment of all subwatersheds with known mine drainage impact, using a three-phased approach. A three-phased approach has become the standard method of watershed characterization for acid mine drainage abatement plans over the past five years. Phase I involves collecting field parameters (including pH, specific conductance, acidity and alkalinity) to provide investigators with a quick snapshot of water quality conditions and to be used as an initial screening. Phase II requires the collection of water quality grab samples analyzed for ODNR Group 1 parameters and discharge measurements at the confluence of all AMD-impacted tributaries identified in Phase I, some net alkaline tributaries, and selected sites along the mainstem, always including the furthest downstream location of the study area. Phase III involves the evaluation of potential project sites within the subwatershed or project area. Additionally, data collected may serve as part of a Total Maximum Daily Load (TMDL) study for the OEPA to assess water quality and aquatic health of Federal Creek and its subwatersheds.

Study Area and Site Identification

The study area for the Federal Creek AMDAT is broken into four subwatersheds and one mainstem section: Sharp's Fork, Sulphur Run, Opossum Run, Marietta Run, and the mainstem of Federal Creek between the old mining towns of Utley and Broadwell. Two additional subwatersheds were studied, Linscott Run and Miner's Fork, but preliminary results did not indicate substantial impairment,

and the investigation of these subwatersheds was abbreviated. Sampling sites were named according to their location within a defined subwatershed or mainstem section.

Table 2 AMD Streams and Input Rivermiles.

Stream	Sample Site Designation	AMD inputs in River Miles
Sharp's Fork	SF	RM 1 to RM 8
Sulphur Run	SR	RM .3 to 1.3
Opossum Run	OR	RM .5 to 1.5
Marietta Run	MR	RM .3 to 2
Federal Creek	FC	RM 4.2 to RM 8
Linscott Run	LR	RM 3 to RM 4
Miner's Fork	MF	RM 2.4 to 4

Site locations were identified on USGS topographic quadrangle sheets, GPS coordinates, and OEPA river mile maps. Drainage areas for water quality sampling sites were calculated using GIS ArcView BASINS tool and Xtools extension.

Phase I- Reconnaissance

The purpose of Phase I is a cost effective way to identify those sources of AMD that should be sampled for further characterization during Phase II. During Phase I, field reconnaissance was conducted to identify sources of water that exhibit AMD characteristics. The areas in which Phase I monitoring were conducted were determined primarily by USGS topographic quadrangles with underground and surface mines depicted on them. Field parameters were tested at the mouth of the subwatershed and at each input to the main stem and marked on a field map.

Field parameters collected included pH, specific conductivity, acidity, dissolved oxygen, and temperature. Specific conductivity and pH values were determined using a Hanna combination pH-specific conductivity probe. When using it for pH and specific conductivity, the probe was inserted into the stream in an area of moving water to a minimum depth marked on the probe. The value was then displayed on the screen of the probe. The value was not recorded until the value displayed on the probe remained constant. Water temperature was also recorded at each site also with the Hanna meter. The meter was calibrated for pH, using a two-point calibration method (pH 4 and pH 7), and one-point calibrated for conductivity (1413 uS/cm) each day it was in use. Dissolved oxygen and temperature were taken using a YSI Dissolved Oxygen meter. A GPS Garmin Etrex was used to record coordinates of each site.

Field acidity values were determined using an in-field high range HACH titration kit. Seven and one-half milliliter samples were collected in a clean test tube and placed in a 25 ml beaker for titration.

One drop of phenolphthalein indicator was added to the sample, which was then titrated using 0.035M Na(OH) that was added to the sample-indicator solution one drop at a time. The solution was mixed after each drop. When the solution turned pink following the addition of a drop of Na(OH) and remained pink after mixing for 30 seconds, the number of drops added to the sample was recorded. The total number of drops of Na(OH) added to the solution was then multiplied by 20 to determine the concentration of acid in milligrams per liter.

In addition to screening the area for AMD sources, phase I screening also involved the screening of the area for points of water loss (e.g. subsidence, sinkholes, etc). However, no subsidence features were found.

All Phase I data for each subwatershed was recorded in the field, entered into an Excel spreadsheet, and data points were entered into ArcView GIS. Phase I data was then evaluated in order to determine areas of AMD impact where further assessment was necessary.

A description of instrumentation and calibration of field equipment is located in Appendix. Due to the alkaline nature of the Federal Valley Watershed, conductivity is often the best indicator of mining impacts in the water. Field reconnaissance of mine openings indicated on ODNR mine maps was also conducted. Field parameters of pond/strip pit water were also measured when ponds were found. All results were marked on field data sheets. Site locations were documented with a GPS unit.

Phase II- Subwatershed Evaluations

Areas designated as requiring further assessment during the phase I screening then underwent a phase II study, where AMD impacted areas were sampled for water quality and flow data in a manner to create a mass balance in small subwatersheds. Impacted sites were sampled to quantify the amount of acid and metal loading into a subwatershed. A qualitative description was recorded for each site and water quality samples and discharge measurements were collected. Phase II data were collected during both high, medium and low flow stages in 2002 and 2003. All Phase II data were entered into an Excel spreadsheet and sample sites recorded on maps. Phase II data were used to determine potential reclamation sites that will require further analysis.

Phase II involved characterizing significant sources of mining impacted waters that flowed into the main stream channel. Water samples collected in Phase II were sent to the ODNR Cambridge Laboratory for Group I analysis, and discharge was measured at high and low flow. Discussions regarding high and low flow acid loading, acidity concentration, and metal loading at each sample point are displayed in Section II under each of the priority subwatershed sections.

Samples for Phase II were collected in a triple-rinsed plastic container and split into one 250 mililiter (mL) sample and one 1 liter (L) sample. The 250 mL sample was acidified with 5 mL 20 percent HNO_3. Water samples collected in the field for laboratory evaluation were preserved at 4 degrees Celsius

until they reached the Department of Mineral Resources Management laboratory in Cambridge, Ohio where they were analyzed. Samples from oxygenated, surface water were not filtered; they were visually checked for turbidity and deemed clear enough for unfiltered analysis. Samples were collected at a minimum of 48 hours after a rain event. At abandoned underground mine seeps, samples were filtered. In many cases, a filtered and unfiltered sample each were collected Additionally, at underground mine seeps, a third filtered sample for ferrous iron analysis was collected in a 125 mL brown bottle and preserved with 20 percent HCl. Parameters measured were ODNR's Group I analysis (pH, total acidity as CaCO3, total alkalinity as CaCO3, specific conductance, total suspended solids, total dissolved solids, sulfate, total iron, total manganese, total aluminum, and hardness). Group I is usually sufficient to prioritize sources based on acidity and metal loads. All data from collected samples were recorded on ODNR laboratory data sheets that were recorded into an Excel spreadsheet.

Discharge was measured for each sample in order to calculate loadings (concentration multiplied by discharge) using methods appropriate to flow volume. Loading is calculated as the product of discharge with acidity, alkalinity or metal concentration and is expressed in lb/day for treatment considerations. In this report, metal loading is the sum of the individual loads of the three Group I metals, iron, manganese and aluminum.

A Swoffer Model 2100 current velocity meter was used for larger discharges. With this method, the stream was divided into intervals of known areas (width and depth) along its cross section, and at those intervals, a depth and velocity measurement is recorded. Velocity measurements multiplied by the area of that interval was used to calculate a discharge measurement. The discharge rate for each site was defined as the sum of the discharge rates at each interval.

A collapsible cutthroat Baski flume was used in very shallow, fast moving streams. The bucket and stop watch method was used for very small discharges.

Phase III

Phase III investigation was to further characterize specific sites that have been identified as the primary acid mine drainage areas, and to collect samples for project design considerations. The subwatersheds that had Phase III sites were Sulphur Run, Marietta Run, the mine seeps on the mainstem of Federal Creek, and Opossum Run. There were also samples taken on the mainstem of Federal Creek and Sharps Fork to determine impact to the receiving bodies of water. The field procedures and flow gathering was the same as in Phase II. However, Group III parameters were gathered also. Most of these samples were filtered. The parameters included in this were (pH, specific conductance, total or dissolved acidity as CaCO3, total or dissolved alkalinity as CaCO3, chloride, sulfate, total or dissolved suspended solids, total dissolved solids, hardness, total or dissolved iron, total or dissolved manganese, total or dissolved aluminum, total or dissolved sodium, and total or dissolved potassium).

Equipment

Table 3. Equipment List

Equipment	Manufacturer	Catalog No.	Calibration
Hanna combo pH-EC probe	Hanna Instruments	4JE-89307	Two-point calibration: Acid Calibration using standard 4.01 and 7.01 solution. A 1413µS/cm calibration solution was used for specific conductivity
HACH Acidity Test Kit	HACH	4JE-100820	
Garmin etrex Vista GPS unit	Garmin	Part# 010-00243-00	
Electric current velocity flow meter	Swoffer Instruments Inc.		See Calibration and Care of the Model 2100 Current Velocity Meter pp.1-3
Collapsible Cutthroat Flume	Baski Inc.		
YSI model 55 Dissolved Oxygen Meter	YSI Inc.	4JE-221302	push-button air calibration with built-in calibration chamber

Long-term Monitoring

Long-term monitoring has been used in The Federal Valley to monitor the health of the mainstem relative to potential mine drainage inputs. Because the acid mine drainage inputs are in both the lower mainstem of Federal Creek and in Sharps Fork, the group monitors both mainstems.

Data has been collected at long-term monitoring sites along the mainstem of Federal Creek, Sharp's Fork, and McDougalll Branch (this is our reference reach, it is above all mine inputs) from August 2002 to February 2005. Some sites have been sampled more than others due to changes in sampling plans. Overall, most AMD effects appear to be ameliorated along the mainstem of the larger sections of streams due to dilution and neutralization from alkalinity. The following boxplots display water chemistry parameters that are often evaluated when looking at mining- related impacts.

Long-term Monitoring Site Descriptions

Listed below are sites where sampling has occurred. Not all of these points should be long-term sites in the future. The point numbers that are bold indicate sites that should remain long-term sites, there are eight total.

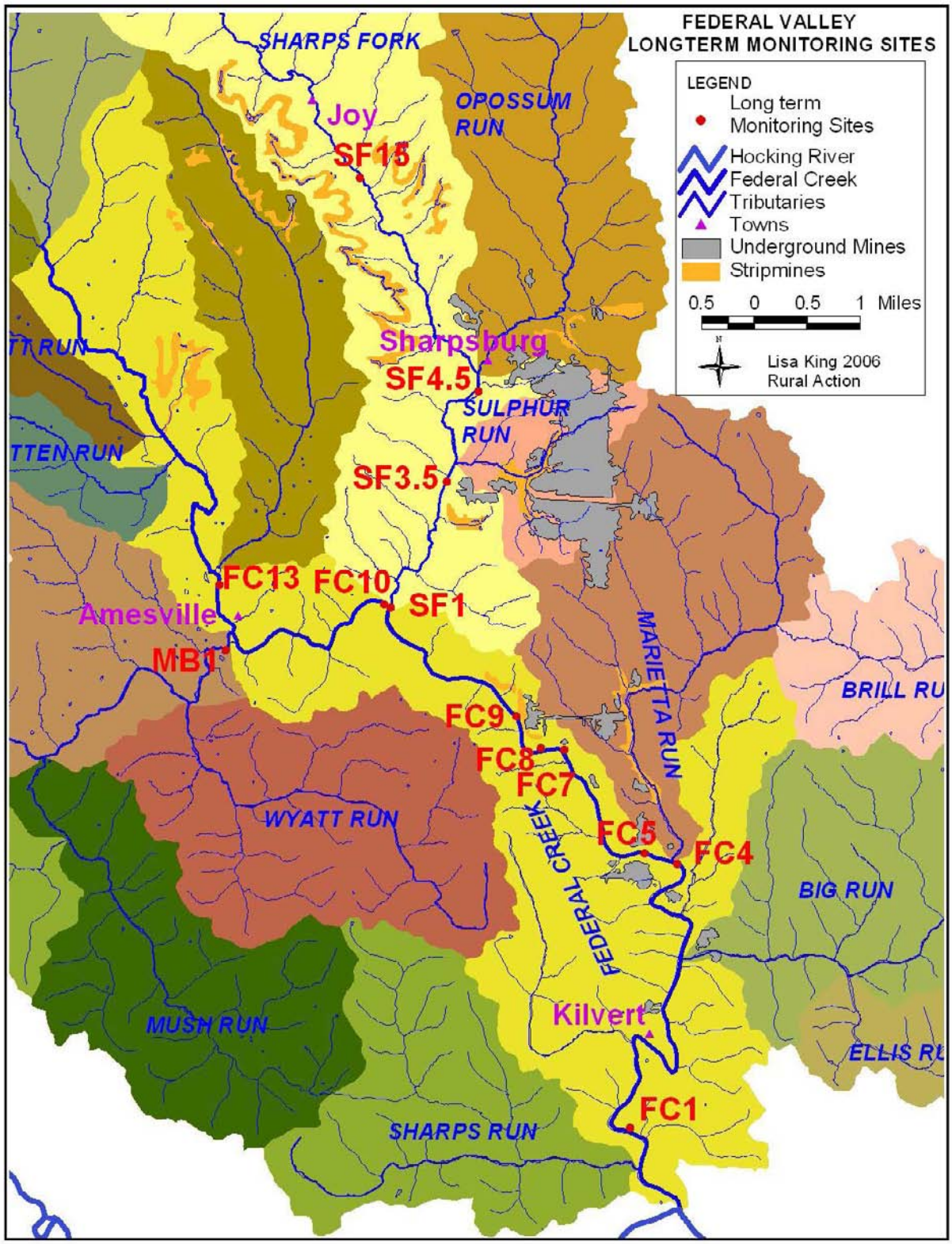
- **FC1** is near the confluence of Federal Creek with the Hocking River, it is at the first bridge on Sharps Run and is slightly up stream of Sharps Run. It is a point on the mainstem of Federal Creek at 1.4 river miles, at 39.33397109 latitude –81.88933924 longitude, and is at an elevation of 615 feet. Federal Creek is a tributary that enters the Hocking River at River Mile 15.29. The area of land above this point is 137.90 square miles and the length of the stream above this point is 14.90 miles.

- **FC4** is at the bridge on State Route 329 near Mayle Ridge Road. This location is below Marietta Run and all other mainstem inputs. This is a point on the mainstem of Federal Creek at 4.50 river miles, at 39.363665627 latitude –81.88104711 longitude, and is at an elevation of 721 feet. Federal Creek is a tributary that enters Hocking River at 15.29 river miles. The area of land above this point is 120.10 square miles and the length of the stream above this point is 11.57 miles.
- FC5 is located above Marietta Run and below all of the 'mainstem seeps'. This site is difficult to get to and often impossible to collect discharge data due to the deep channel. This is a point on the mainstem of Federal Creek at 5.1 river miles, at 39.36699444 latitude –81.87937106 longitude, and is at an elevation of 644 feet. Federal Creek is a tributary that enters Hocking River at 15.29 river miles. The area of land above this point is 120.02 square miles.
- FC 7 is located immediately below the FC-2-Sa seep input. This is a point on the mainstem of Federal Creek at 6.8 river miles, at 39.38278436 latitude –81.89917121 longitude, and is at an elevation of 653 feet. Federal Creek is a tributary that enters Hocking River at 15.29 river miles. The area of land above this point is 108.40 square miles. Due to the location and the deep stream channel, this site is impossible to collect discharge data in times of high flow.
- FC 8 is located above all of the mainstem seeps and is immediately above the FC-2-Sa seep input. This is a point on the mainstem of Federal Creek at 7 river miles, at 39.38300807 latitude –81.90324322 longitude, and is at an elevation of 692 feet. Federal Creek is a tributary that enters Hocking River at 15.29 river miles. The area of land above this point is 108.40 square miles. Due to the location and the deep stream channel, this site is impossible to collect discharge data in times of high flow.
- **FC9** is located above all mainstem mine inputs at the bridge of Tick Ridge Road. This is a point on the mainstem of Federal Creek at 7.5 river miles, at 39.38738728 latitude –81.90759092 longitude, and is at an elevation of 679 feet. The area of land above this point is 108.11 square miles
- **FC10** is located above the confluence with Sharps Fork, near the last bridge on SR-329S before SR 550. This is a point on the mainstem of Federal Creek at 10.00 river miles, at 39.39852188 latitude –81.94612345 longitude, and is at an elevation of 563 feet. Federal Creek is a tributary that enters Hocking River at 15.29 river miles. The area of land above this point is 70.24 square miles.
- FC13 is located at the bridge in Amesville, on State Route 550 near the parking lot of the convenient store. This is a point on the mainstem of Federal Creek at 11.26 river miles, at 39.57280700 latitude –81.95732745 longitude, and is at an elevation of 667 feet. Federal Creek is a tributary that enters Hocking River at 15.29 river miles. The area of land above this point is 32.13 square miles and the length of the stream above this point is 4.94 miles.
- **SF1** is located on Sharps Fork, at the confluence with Federal Creek. This site is at the last bridge on State Route 329S before State Route 550. This is a point on the mainstem of Sharps Fork at 0 river miles, at 39.40243707 latitude –81.92958981 longitude, and is at an elevation of 735 feet. Sharps Fork is a tributary that enters Federal Creek at 9.3 river miles. The area of land above this point is 35.66 square miles

- **SF3.5** is below the confluence of Sulphur Run. This is a point on the mainstem of Sharps Fork at 1.4 river miles, at 39.41873141 latitude -81.91920924 longitude, and is at an elevation of 712 feet. Sharps Fork is a tributary that enters Federal Creek at 9.3 river miles. The area of land above this point is 30.25 square miles and the length of the stream above this point is 10.45 miles.
- SF-4.5 is below the confluence of Opossum Run and above the confluence of Sulphur Run. This is a point on the mainstem of Sharps Fork at 2.82 river miles, at 39.43201480 latitude –81.91384826 longitude, and is at an elevation of 693 feet. Sharps Fork is a tributary that enters Federal Creek at 9.3 river miles. The area of land above this point is 30.25 square miles and the length of the stream above this point is 13.47 miles.
- **SF15** is below the community of Joy, this point marks the area referred to as upper Sharps Fork. SF15 is a point on the mainstem of Sharps Fork at 5.25 river miles, at 39.46135137 latitude -81.93455818 longitude, and is at an elevation of 671 feet. Sharps Fork is a tributary that enters Federal Creek at 9.30 river miles. The area of land above this point is 18.37 square miles.
- **MB1** is a point at the mouth of McDougall Branch. McDougall Branch is considered the reference reach for determining Federal Valley targets. This is a point on the mainstem of McDougall Branch at 0 river miles, at 39.23560500 latitude –81.95704565 longitude, and is at an elevation of 639 feet. McDougall Branch is a tributary that enters Federal Creek at 11.25 river miles. The area of land above this point is 37.60 square miles

The following map will display the location of all sites that have ever been considered long- term monitoring sites.

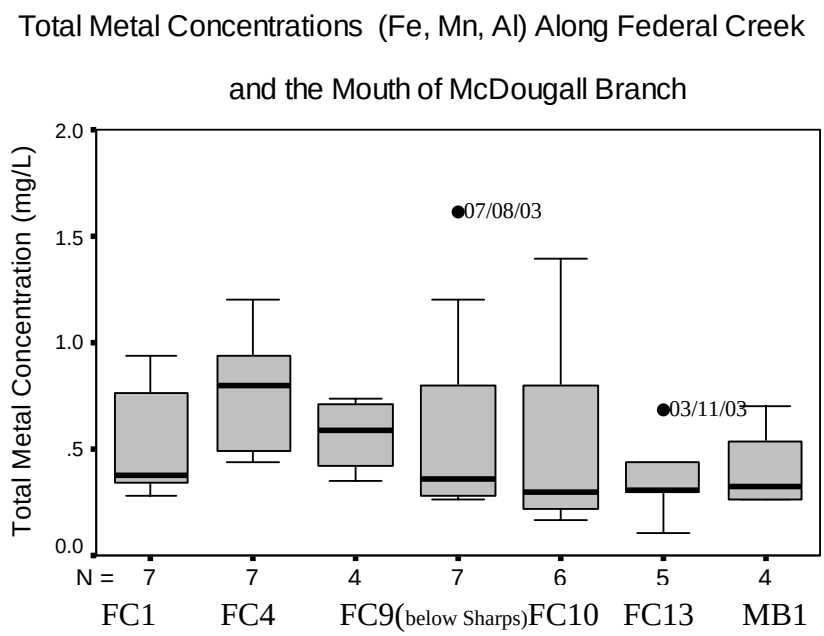
Map 3 Long-term Monitoring Sites

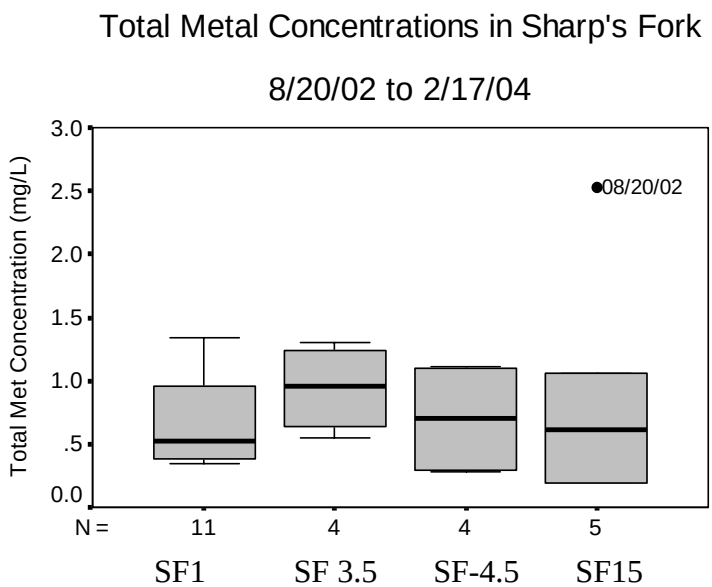


Long-term Total Metal Concentrations

The following box plots display the total metal concentrations along the mainstem of Federal Creek and the mouth of McDougall Branch, and along the mainstem of Sharp's Fork. In this study, total metal concentrations include iron, manganese, and aluminum concentrations. These metals are the most commonly associated with acid mine drainage.

Table 4. Long- Term Monitoring Box Plots





All of these sites are net alkaline in all flow regimes. All of the parameters are below the Federal Valley targets. The box plots above do show an increase in metals at FC4, which is immediately below the mainstem mine drainage inputs and below Marietta Run. This increase drops at FC9, which is above the mainstem mine drainage inputs. In Sharps Fork a detectable increase in metals is observed at SF3.5 which is immediately down stream of Sulphur Run.

Biological Assessments

As part of the OEPA's Total Maximum Daily Load (TMDL) study, in addition to water chemistry data, an assessment of the biological condition of the watershed was conducted. From June 15th to September 30, 2004, aquatic macroinvertebrates, fish, and habitat data were collected by Midwest Biodiversity Institute (MBI) for the calculation of four multi-metric indexes, the Index of Biotic Integrity (IBI), the Invertebrate Community Index (ICI), the Modified Index of Well Being (Miwb), and the Qualitative Habitat Evaluation Index, that rate the overall biologic health of the watershed. For field methods regarding this data refer to MBI's technical report titled "Fish and Macroinvertebrate Study of Federal Creek, 2004".

WATER QUALITY

Acid Mine Drainage Formation

Coal mining disturbs large amounts of geologic material and exposes it to the environment. When this material is exposed to air and water, iron sulfide (pyrite) from the coal deposits is oxidized, resulting in AMD. These conditions lower pH, increase acidity, increase dissolved metals, and lead to an overall degradation of water quality. AMD is a low pH, high sulfate water with high acidity usually due to oxidation of iron, aluminum, and manganese and due to hydrogen ions.

The formation of AMD is primarily a function of the geology, hydrology and mining technology employed at the mine site. AMD is formed by a series of complex geo-chemical and microbial reactions that occur when water comes in contact with pyrite (iron disulfide minerals) in coal, refuse or the overburden of a mine operation. The resulting water is usually high in acidity and dissolved metals. The metals stay dissolved in solution until the pH rises to a level where precipitation occurs.

Four commonly accepted chemical reactions represent the chemistry of pyrite weathering to form AMD. An overall summary reaction is as follows:

$$4\ FeS_2 + 15\ O_2 + 14\ H_2O \rightarrow 4\ Fe(OH)_3 \downarrow + 8\ H_2SO_4$$

Pyrite + Oxygen + Water → "Yellowboy" + Sulfuric Acid

The first reaction in the weathering of pyrite includes the oxidation of pyrite by oxygen. Sulfur is oxidized to sulfate and ferrous iron is released. This reaction generates two moles of acidity for each mole of pyrite oxidized.

$$2\ FeS_2 + 7\ O_2 + 2\ H_2O \rightarrow 2\ Fe^{2+} + 4\ SO_4^{2-} + 4\ H^+ \qquad \textbf{(1)}$$

Pyrite + Oxygen + Water → Ferrous Iron + Sulfate + Acidity

The second reaction involves the conversion of ferrous iron to ferric iron. The conversion of ferrous iron to ferric iron consumes one mole of acidity. Certain bacteria increase the rate of oxidation from ferrous to ferric iron. This reaction rate is pH dependant with the reaction proceeding slowly under acidic conditions (pH 2-3) with no bacteria present and several orders of magnitude faster at pH values near 5. This reaction is referred to as the “rate determining step" in the overall acid-generating sequence.

$$4\ Fe^{2+} + O_2 + 4\ H^+ \rightarrow 4\ Fe^{3+} + 2\ H_2O \qquad \textbf{(2)}$$

Ferrous Iron + Oxygen + Acidity → Ferric Iron + Water

The third reaction that may occur is the hydrolysis of iron. Hydrolysis is a reaction that splits the water molecule. Three moles of acidity are generated as a byproduct. Many metals are capable of undergoing hydrolysis. The formation of ferric hydroxide precipitate (solid) is pH dependant. Solids form if the pH is above about 3.5 but below pH 3.5 little or no solids will precipitate.

$$4\ Fe^{3+} + 12\ H_2O \rightarrow 4\ Fe(OH)_3 + 12\ H^+ \qquad \textbf{(3)}$$

Ferric Iron + Water → Ferric Hydroxide (yellowboy) + acidity

The fourth reaction is the oxidation of additional pyrite by ferric iron. The ferric iron is generated in reaction steps 1 and 2. This is the cyclic and self-propagating part of the overall reaction and takes place very rapidly, and continues until either ferric iron or pyrite is depleted. In this reaction, iron is the oxidizing agent, not oxygen.

$$FeS_2 + 14\ Fe^{3+} + 8\ H_20 \rightarrow 15\ Fe_2+ + 2\ SO_4^{2-} + 16\ H^+ \ \textbf{(4)}$$

Pyrite + Ferric Iron + Water → Ferrous Iron + Sulfate + Acidity

(PA-DEP website, 2004)

Ohio Water Quality Standards for Water Chemistry

Water chemistry values determined by the USEPA suggest AMD impacts to waters. The parameters include: pH, total dissolved solids (TDS), sulfate, iron, manganese, aluminum, and zinc. The only two standards created by the USEPA are for pH (6.5 to 9) and TDS (1,500 mg/l). Although there are no standards for the other AMD parameters, criteria limits suggest impacts from AMD and are summarized below (Table 5).

Table 5. Water quality values that suggest AMD impacts

(FWPCA, 1968)	Parameter	Criteria Limit
	Iron	> 0.5 mg/l
	Manganese	> 0.5 mg/l
	Aluminum	> 0.3 mg/l
	Conductivity	> 800 uS/cm
	Sulfate	> 74 mg/l
	Alkalinity	< 20 mg/l
	pH	< 6

Besides values that show the presence of AMD, certain other known threshold values exist for the effects of heavy metals associated with AMD on aquatic life. These thresholds (Table 6) are based on literature research and suggest that once parameters reach the limit, aquatic life may be affected. Aquatic species are affected by contaminates in various ways, so these thresholds do not suggest that all aquatic life will be affected, but that some species will be negatively affected.

Table 6. Ohio EPA values as guidelines for analysis of mine drainage systems.
(Ohio EPA 1979)

Parameter	Limit
Iron- total (mg/l)	1.0
Aluminum (mg/l)	0.5
Manganese (mg/l)	0.1

Federal Valley Water Chemistry Restoration Targets

The goal for this plan is to restore AMD- impacted waters in Federal Valley to meet Ohio EPA use designation of warm water habitat (WWH) criteria and wherever possible to meet exceptional water habitat (EWH). To accomplish this goal, water quality targets were established. Table 7 shows a summary of all targets for the Federal Valley Watershed. Included in this table are targets for iron, manganese, aluminum, alkalinity, and sulfate.

The establishment of in-stream numeric targets is a significant component of the AMDAT/TMDL process. The numeric targets serve as a measure of comparison between observed in-stream conditions and conditions that are expected to restore the stream to its designated uses. The AMDAT/TMDL identifies the load reductions and other actions that are necessary to meet the target, thus resulting in the attainment of applicable water quality standards.

Manganese, iron, alkalinity and sulfate target values were derived from “Appendices to Association Between Nutrients and the Aquatic Biota of Ohio and Streams”, Ohio EPA Technical Bulletin MAS//1999-1-1. This document will be referred to as the “Association Document”. In this document, water chemistry statistics are given for all sites in the Ohio EPA database. This data is displayed by ecoregion, stream size, and IBI range. For the targets in Federal Valley the values from the Western Allegheny Plateau ecoregion (WAP) were used. The stream size that was used is wadeable (20 to 300 square miles). The IBI range used was 40 – 49 (the score range for warm water habitat use designations). The target value used was that of the 75th percentile. The Ohio EPA has found, through correlative analyses, that when water chemistry values were less than the 75th percentile of sites that meet the WWH use designation; these sites are in attainment of the WWH use designation. Therefore, the 75th percentile was used for the watershed target.

Aluminum was not present in the Association Document. For the aluminum target, statistics were calculated by using all of the data from streams in the WAP ecoregion that are located in the WAP coalfields. The mean statistic was used for a target for aluminum.

Because there is no plan to remediate sulfate, it is simply used as an indicator of mine drainage, not a target.

The parameters of iron, manganese, aluminum, alkalinity, and sulfate (indicator), found in the Association Document, or calculated from Ohio EPA data, were used for the Federal Valley targets. In Table 7 these values were compared to the values of the same parameters in a reference stream within Federal Valley. This verified that the targets were realistic and based on water chemistry in Federal Valley. The reference reach used was McDougall Branch. All samples taken near the mouth of McDougall Branch were averaged. These samples are; 16 samples collected during three summer months in 2004 and analyzed by the Ohio EPA, and 6 high/ low flow samples collected between 2002-2003 and analyzed by the ODNR Cambridge Laboratory.

Table 7. Federal Valley Targets

Parameter	**Units**	**Reference Reach**	**Federal Valley Target**	**Source Used**	**Comments**
Iron	mg/L	0.9 McDougall	0.8	The Ohio EPA Association Document	75th percentile of sites in the WAP ecoregion
Aluminum	mg/l	0.6 McDougall	0.5	Ohio EPA data	Mean of all WAP streams with known coal influences.
Manganese	mg/L	0.2 McDougall	0.2	The Ohio EPA Association Document	75th percentile of sites in the WAP ecoregion
Alkalinity	mg/L	166 McDougall	141	The Ohio EPA Association Document	75th percentile of sites in the WAP ecoregion
Sulfate	mg/L	40 McDougall	191	The Ohio EPA Association Document	75th percentile of sites in the WAP ecoregion
The target value from McDougall Creek was from 16 samples taken in 3 months summer of 2004, and 6 high/ low flow samples from 2002-2003					

These targets were then compared to the mouths of Marietta Run, Opossum Run, and Sulphur Run, as well as receiving waters downstream of these streams in Federal Creek and Sharps Fork. These streams have acid mine drainage seeps that are thought to have the biggest impact on any surface water in the watershed. Table 8, a comparison of Federal Valley streams with the targets provides a picture of how these streams are being chemically impacted by mine drainage.

The site on Federal Creek at Mayle Ridge Bridge is located directly below several mine seeps along the mainstem. It is also immediately downstream of the confluence of Marietta Run. Nineteen samples collected at various flow regimes from 2002 to 2005 were averaged for the values displayed table 8. All of the metals are near the target. The highest concentrations occur during low flows where iron and aluminum go over the designated targets.

The site on Marietta Run is below all the recorded seeps near the mouth. Fifteen samples collected at various flow regimes between 2002 and 2005 were averaged for the value displayed in table 8. A sample taken during the fall of 2005, (a low flow condition during a drought conditions), was the first mainstem tributary in the entire Federal Valley Watershed to be net acid. All of the parameters were exceeding target levels, showing a critical condition being met. This sample was collected near the mouth of Marietta Run.

DATE	Location	FLOW cfs	FLOW gpm	COND-LAB	PH-LAB	ALK mg/L	ACIDITY-LAB mg/L	SULFATE mg/L	TOT-FE mg/L	TOT-MN mg/L	TOT-AL mg/L
9/13/02005	Marietta Run, Mouth	n/a	n/a	**1070**	**3.34**	**0**	**85.4**	**547**	**5.47**	**4.01**	**9.17**

The site on Sharps Fork is below the confluence of Sulphur Run and Sharps Fork. Eight samples collected at various flow regimes from 2002 to 2005 were averaged for the values displayed in Table 8. Both manganese and sulfate were above the targets for this watershed. During the low flow of September 2005, iron, manganese and sulfate were all ten times that of the target.

The site on Sulfur Run is at the mouth of Sulfur Run. Eleven samples collected at various flow regimes from 2002 to 2005 were averaged for the values displayed in table 8. Iron concentrations are more than twice that of the target concentration and manganese concentrations are more than three times the target. These values tend to go up during periods of low flow.

The site on Opossum Run is located at the mouth of the stream but above Sharpsburg. Eighteen samples, collected at various flow regimes from 2002 to 2005, were averaged for the values displayed in table 8. Manganese and aluminum both exceed the targets.

Table 8 Mine Impacted watersheds compared to targets

	Iron mg/L total	Manganese mg/L total	Aluminum mg/L total	Net Alkalinity mg/L	Sulfate mg/L total
Target Federal Valley Watershed	**0.80**	**0.20**	**0.50**	**141.00**	**191.00**
Federal Creek, Mayle Ridge Bridge (from 19 samples)	0.76	0.18	0.49	158.18	80.23
Marietta Run, near the mouth (from 15 samples)	0.88	0.53	0.89	119.76	116.35
Sharps Fork, below Sulfur Run (from 8 samples)	0.62	0.33	0.27	150.78	244.38
Sulphur Run, below the tipple (from 11 samples)	1.82	0.75	0.17	139.66	328.00
Opossum Run, at Gifford State Forest (from 18 samples)	0.58	0.25	0.88	189.33	107.34

BIOLOGICAL SURVEYS AND USE DESIGNATIONS

Categories of stream attainability also exist in the form of potential by way of Ohio EPA's "Designated Aquatic Life Uses". These categories are not chemical parameter specific, but instead use the biological integrity of the stream to classify the health of a stream segment. The contaminants that are affecting the biological health of the stream are identified and targeted for restoration so the stream can achieve the highest "designated use" attainment possible. The categories of aquatic life use include Exceptional Warmwater Habitat, Warmwater Habitat, Modified Warmwater Habitat, Limited Resource Water, and Limited Warmwater Habitat. Some streams that do not meet their aquatic life use but have the potential to meet this higher standard are considered non-attaining. Others are considered permanently impacted, so may have limited present use and no hope for higher use. Those waterways are listed as attaining a limited use. These designations describe the existing or potential uses of water bodies (Ohio EPA, 2001).

- Exceptional Warmwater Habitat (EWH) is the most biologically productive environment. These waters support "unusual and exceptional" assemblages of aquatic organisms, which are characterized by a high diversity of species, particularly those that are highly intolerant and/or rare, threatened, endangered, or special status. This use designation represents a protection goal for water resource management efforts dealing with Ohio's best water resources.
- Warmwater Habitat (WWH) defines the "typical" warm water assemblage of aquatic organisms of Ohio streams. It is the principal restoration target for the majority of water resource management efforts in Ohio.
- Modified Warmwater Habitat (MWH) applies to streams with extensive and irretrievable physical habitat modifications, for which the biological criteria for warm water habitat are not attainable. The activities contributing to the modified warm water habitat designation have been sanctioned and permitted by state or federal law. The

representative assemblages are generally composed of species that are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor habitat quality. The category applies to dammed or channelized rivers, and can be applied to streams affected by AMD.

- Limited Resource Water (LRW) applies to small streams (usually <3 square mile drainage area) and other water courses which have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported; such waterways generally include small streams in extensively urbanized areas, those which lie in watersheds with extensive drainage modifications, those which completely lack water on a recurring annual basis, or other irretrievably altered waterways.
- Coldwater Habitat (CWH) - this use designation is intended for waters which support assemblages of cold water organisms and/or those which are stocked with salmonids with the intent of providing a put-and-take fishery on a year round basis which is further sanctioned by the Ohio DNR, Division of Wildlife; this use should not be confused with the Seasonal Salmonid Habitat (SSH) use which applies to the Lake Erie tributaries which support periodic "runs" of salmonids during the spring, summer, and/or fall. No specific biological criteria have been developed for the CWH use although the WWH biocriteria are viewed as attainable for CWH designated streams.

In determining aquatic life uses, the Ohio EPA surveys fish and macro-invertebrate populations along with chemical and physical water quality parameters throughout a given watershed. The results from the bio-survey at each sampling station are used to calculate a metric score for both fish (IBI and MIwb) and macro-invertebrate (ICI) populations. These scores indicate the biological integrity of that given stretch of a stream.

The Index of Biologic Integrity (IBI) metric is a measure of fish species diversity and species populations. This index gives a score which indicates how much a stream habitat is affected by pollutants, and which types of fish are present. Depending on the pollution tolerance of specific species, the IBI indicates which species are likely to be found and the level of fish diversity in the stream. The modified index of well being (Miwb) is a metric that incorporates four measures of fish communities: numbers of individuals, biomass, and the Shannon Diversity Index based on numbers and weight.

The Invertebrate Community Index (ICI) metric is based on measurements of macro-invertebrate communities living in a stream. Macro-invertebrate studies are important to assess because many insect taxa are known to be either pollution tolerant or intolerant. The presence of certain species indicates the general water quality of an area. This index gives indications about the amount of pollution stressing the stream environment.

Table 9. IBI and ICI scores that suggest Designated Aquatic Life Uses

USE DESIGNATION	IBI	MIwb	ICI	QHEI
Exceptional Warmwater Habitat	50	9.4	46	>80
Warmwater Habitat	44	8.4	34	60
Modified Warmwater Habitat	24	6.2	22	45

A Qualitative Habitat Evaluation Index (QHEI), developed by the Ohio EPA, is also used to characterize physical habitat of the stream at each sampling station. Physical features that affect or are critical for fish and invertebrate communities are evaluated. Some of the features evaluated include: type of substrate, amount and type of riparian cover, channel width, sinuosity, and erosion. QHEI scores over 60 are considered conducive to meeting WWH criteria although they are not used to determine the aquatic life designated use (Ohio EPA, 2001).

AMD Impacts on Stream Health

Acid mine drainage has the potential to effect many different aspects of a stream's biological integrity. The chemical and physical changes to the stream from the AMD result in the impacts on the biological and ecological functions listed in Table 10. AMD is a complex contaminant effecting streams in many different ways. The full scope of these impacts should be considered in any watershed AMD remediation strategy.

Table 10. Major effects of acid mine drainage on stream systems
(Modified from Gray, 1997)

Chemical	Physical	Biological	Ecological
Increased acidity	Substrate modification	Behavioral	Habitat modification
Reduction of pH and buffering capacity	Turbidity	Respiratory	Niche loss
Increase in metal concentrations	Sedimentation	Reproduction	Bio-accumulation in food chain
	Absorption of metal into sediment	Acute and chronic toxicity	Loss of food source
	Decrease in light penetration	Acid-base balance in organisms	Elimination of sensitive species
		Migration or avoidance	Reduction in primary productivity
			Food chain modifications

Federal Valley Use Designations

Ohio EPA has assigned use designations on sites in the Federal Valley Watershed in 1984, 1990, 1995, and 2004. The study in 2004 was the most comprehensive, as it will be used for a watershed- wide TMDL.

The following section is an executive summary of the fish, macroinvertebrate, and habitat survey of the Federal Valley Watershed. It was conducted and written by Mid-west Biodiversity Institute (MBI) and the Center for Applied Bioassessment and Biocriteria (CABB), in 2004. Water quality data collected at biological stations are listed in Appendix 1. Sampling locations are shown on Map 4.

In 2004 MBI analyzed biological assemblage and habitat data at 43 stations in Federal Creek Watershed, with some sites funded by ODNR and others by Ohio EPA. Federal Creek has mostly "excellent" sites (EWH), some impaired to "good" conditions, and some "good" sites (WWH) impaired to fair. Most other watersheds in Ohio have sites with WWH potential ("good") impaired to fair and poor depending on the site and the type of NPS impact (e.g., habitat impairments are generally more severe than sedimentation alone). (MBI 2005). The table below gives all of the use designations for the forty-three sites studied in 2004. The sites that are in bold text represent areas considered impacted by mine drainage.

Map 4 Location of MBI 2004 sites

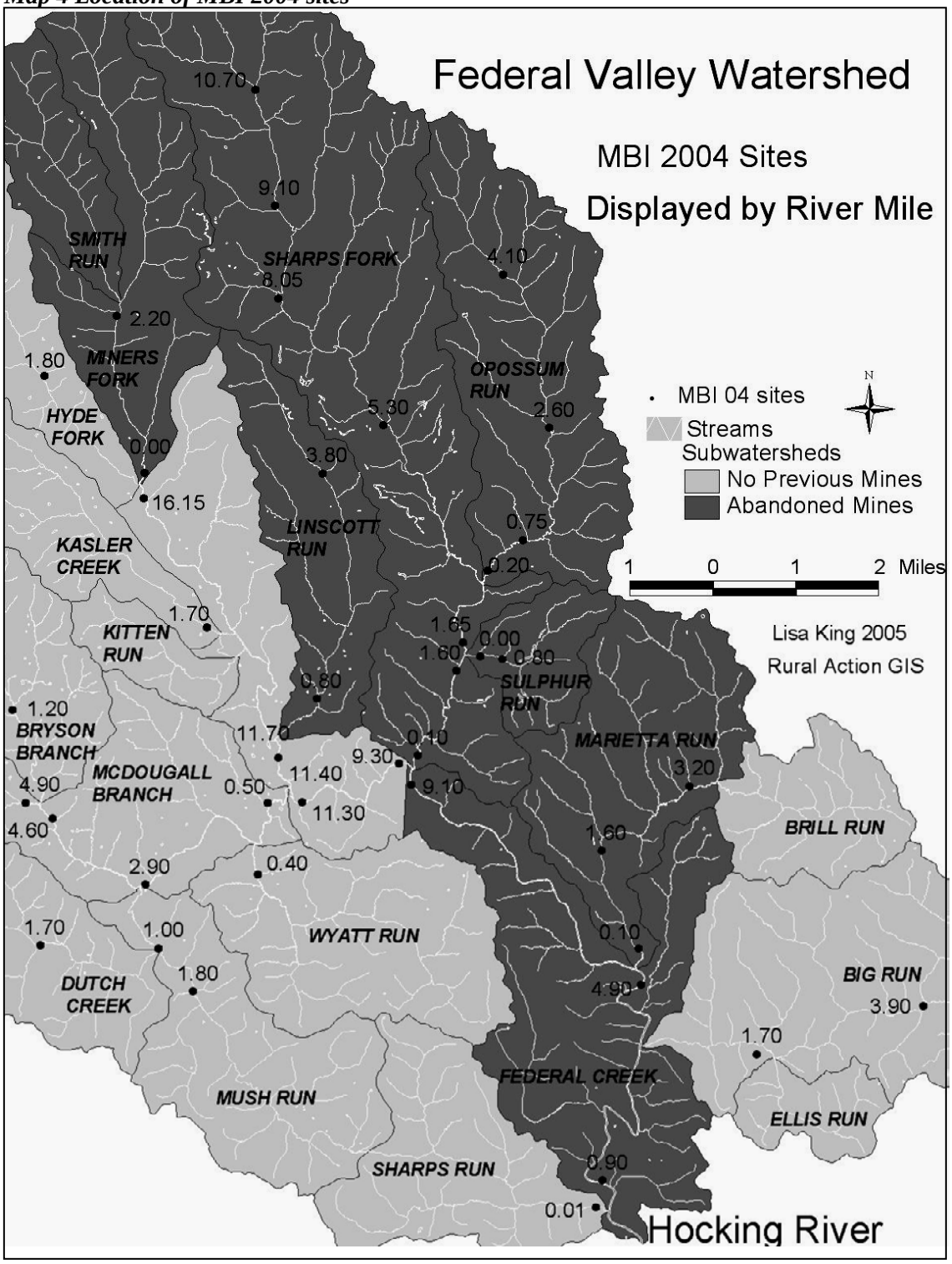


Table 11. Attainment table for streams sampled in the Federal Valley Watershed
Lines in bold are watersheds with abandoned mines present in them.

Station (Map #)	Fish RM	Macro RM	IBI	MIwb	ICI or Narrative Rating	QHEI	Aquatic Life Uses Ex/Rec	Attain-ment Status	Comment
Federal Creek - 2004									
S01100 16.152004	16.15	15.5	52	NA	48	64.5	EWH	Full	Ust Sharps Run
S01100 11.702004	11.70	11.70	48^{ns}	8.90^{ns}	VG^{ns}	51.5	EWH	Full	adj. St. Rt. 329 dst. Linscott Run
S01100 11.302004	11.30	11.40	46^{ns}	9.53	†F*‡	61.0	EWH	Full	St. Rt. 550, upst. McDougalll Branch
S01100 9.302004	**9.30**	**—**	**48^{ns}**	**7.88***	**—**	**66.0**	**EWH**	**Partial**	**ust Sharps Fork**
S01100 9.102004	**9.10**	**—**	**47^{ns}**	**8.90 ^{ns}**	**VG^{ns}**	**56.0**	**EWH**	**Full**	**immediately dst Sharps Fk**
S01100 7.502004	**—**	**7.50**	**—**	**—**	**42*‡**	**—**	**EWH**	**—**	**dst. Sharps Fork**
S01100 4.902004	**4.90**	**4.90**	**48^{ns}**	**7.14***	**34*‡**	**62.0**	**EWH**	**Partial**	**adj. St. Rt. 329 dst. Broadwell**
S01100 0.902004	0.90	0.90	44*	9.50	†MG*	47.5	EWH	Partial	Twp. Rd. 231 (reference site)
Kasler Creek - 2004									
S01101 0.402004	1.75	0.40	46	NA	F*	78.0	None/ WWH	Partial	Mouth
Sharps Run - 2004									
S01110 1.002004	0.01	1.00	44*	NA	VG^{ns}	64.0	EWH	Partial	near mouth, dst. north trib.
Big Run - 2004									
S01130 3.902004	3.90	3.90	50	NA	G*	73.5	EWH	Partial	Co. Rd. 59, dst. Wildcat Run
S01130 1.602004	1.70	1.60	44*	NA	F*	59.0	EWH	Non	upst. Hatch Fork
Sulphur Run - 2004									
S01134 0.802004	**0.80**	**0.80**	**46**	**NA**	**F***	**56.0**	**None WWH**	**Partial**	**Upstream**
S01134 0.102004	**0.01**	**0.10**	**50**	**NA**	**P***	**45.5**	**None WWH**	**Non**	**Mouth**
Marietta Run - 2004									
S01150 3.202004	3.20	3.50	50	NA	E	77.0	WWH	Full	dst. Brill Run
S01150 1.002004	**1.60**	**1.00**	**44**	**NA**	**MG^{ns}**	**75.5**	**WWH**	**Full**	**B Below the 2 Seeps**
S01150 0.102004	**0.10**	**0.10**	**40^{ns}**	**NA**	**VG**	**62.5**	**WWH**	**Full**	**St. Rt. 329, at mouth**

Station (Map #)	Fish RM	Macro RM	IBI	MIwb	ICI or Narrative Rating	QHEI	Aquatic Life Uses Ex/Rec	Attain-ment Status	Comment
Sharps Fork - 2004									
S01160 10.702004	10.70	10.70	50	NA	E	80.5	WWH/ EWH	**Full**	upst. Co. Rd. 85, upst. east trib
S01160 9.102004	9.10	9.10	50	NA	VG^{ns}	69.5	WWH/ EWH	Full	Co. Rd. 14
S01160 8.502004	8.05	8.50	54		VG^{ns}	67.0	WWH/ EWH	Full	Ust TR64
S01160 5.202004	**5.30**	**5.20**	**50**	**NA**	**VG^{ns}**	**66.5**	**WWH/ EWH**	**Full**	**lane dst. Tharp Hollow**
S01160 2.602004	**—**	**2.60**	**—**	**—**	**VG^{ns}**	**—**	**WWH/ EWH**	**Full**	**Dst Opossum Adj 550**
S01160 1.652004	**1.65**	**—**	**48^{ns}**	**8.83***	**-**	**65.5**	**WWH/ EWH**	**Partial**	**Ust Sulphur Run**
S01160 1.602004	**1.60**	**1.60**	**46^{ns}**	**8.31***	**G***	**55.5**	**WWH/ EWH**	**Partial**	**Dst Sulphur Run**
S01160 0.012004	**0.01**	**0.10**	**56**	**8.31***	**38^{ns}**	**—**	**WWH/ EWH**	**Partial**	**St. Rt. 329, at mouth**
Opossum Run - 2004									
S01161 4.102004	4.10	4.10	24*	NA	E	59.0	EWH	Partial	Ust Starling Run
S01161 2.602004	**2.60**	**2.60**	**44***	**NA**	**VG^{ns}**	**69.5**	**EWH**	**Partial**	**Twp. Rd. 6, at compressor station**
S01161 0.752004	**0.75**	**0.80**	**48^{ns}**	**NA**	**G***	**56.0**	**EWH**	**Partial**	**State Forest**
S01161 0.202004	**0.20**	**0.20**	**52**	**NA**	**VG^{ns}**	**59.0**	**EWH**	**Full**	**Joy Rd., near mouth**
McDougalll Branch - 2004									
S01170 4.902004	4.95	4.90	48	NA	G	57.5	WWH	Full	2nd lane upst. Bryson Branch
S01170 4.502004	4.50	4.60	50	NA	VG	59.5	WWH	Full	just dst. Bryson Branch
S01170 2.402004	2.90	2.90	46	8.25	†G	69.5	WWH	Full	dst. Mush Run (reference site)
S01170 0.502004	0.50	0.50	49	8.80	48	66.0	WWH	Full	lane off St. Rt. 550
Wyatt Run - 2004									
S01171 0.402004	0.40	0.40	42*	NA	E	62.5	EWH	Partial	lane near mouth
Mush Run - 2004									
S01172 1.802004	1.80	1.80	52	NA	G*	63.0	EWH	Partial	lane dst. Riley Run
S01172 1.002004	1.00	1.00	50	NA	G*	66.5	EWH	Partial	Dutch Creek Rd.

Station (Map #)	Fish RM	Macro RM	IBI	MIwb	ICI or Narrative Rating	QHEI	Aquatic Life Uses Ex/Rec	Attain-ment Status	Comment
Bryson Branch - 2004									
S01174 1.202004	1.20	1.40	44*	NA	G*	68.5	EWH	NON	Howard Rd.
Dutch Creek- 2004									
S01176 1.702004	1.70	1.70	34*	NA	G	76.5	None/ WWH	Partial	Dutch Creek Rd. at Twp. Rd. 216
Linscott Run - 2004									
S01180 3.702004	**3.80**	**3.70**	**38***	**NA**	**VG [ns]**	**68.0**	**EWH**	**Partial**	**Upstream Site**
S01180 0.802004	0.80	0.80	50	NA	MG*	73.5	EWH	Partial	St. Rt. 329
Hyde Fork - 2004									
S01190 1.802004	1.80	1.80	48[ns]	NA	MG*	69.0	EWH	Partial	lane off St. Rt. 329
Miners Fork - 2004									
S01192 2.202004	**2.25**	**2.20**	**44***	**NA**	**G***	**56.5**	**EWH**	**Non**	**Wrightstown Rd.**
S01192 0.102004	0.05	0.10	46[ns]	NA	G*	58.5	EWH	Partial	St. Rt. 329, at mouth

Ecoregion Biocriteria: Western Allegheny Plateau (WAP)

Index and Site Type	WWH	EWH	MWH	LRW-AMD
IBI – Wading & Headwater	**44**	**50**	**24/24**	**18**
Mod. Iwb - Wading	**8.4**	**9.4**	**6.2/5,5**	**4.0**
ICI/Narrative	**36/G**	**46/E**	**22/30**	**8/MF**

Footnotes

a - A qualitative narrative evaluation based on best professional judgment and sampling attributes such as community composition, EPT taxa richness, and QCTV scores were used when quantitative data were not available (E-exceptional, G-good, MG-marginally good, F-fair, P-poor, VP-very poor); for Moxahala Creek a draft Qualitative ICI index was also used.

b - Attainment status is given for existing use designations, except where a use designation change is recommended, in which case, the attainment status for the recommended use is given.

c - Limited Resource Water - acid mine drainage (LRW-AMD) benchmarks based on best professional judgment driven by the need to protect against acutely toxic stream conditions. Macroinvertebrate qualitative only data were evaluated based on densities of EPT taxa on the natural substrates (see Methods Section), a narrative VP* or P* indicates departure from the benchmark.

na - MIwb not applicable at headwater sites (< 20 mi^2).

† - HD sampler set, but not retrieved due to flood flows destroying samplers.

‡ - Dry conditions in August followed by flooding conditions in September likely influenced assemblage conditions (data excluded from attainment decision)

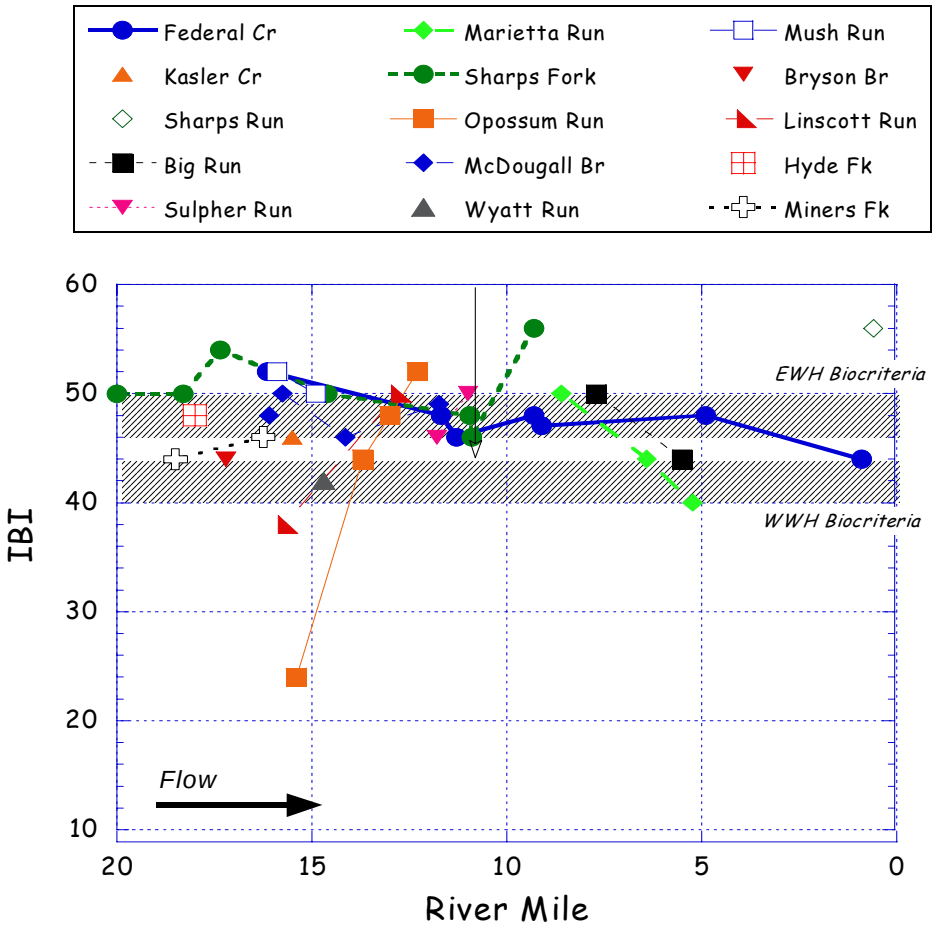
ns - Nonsignificant departure from biocriteria (<4 IBI or ICI units, or <0.5 MIwb units).

* - Indicates significant departure from applicable biocriteria (>4 IBI or ICI units, or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

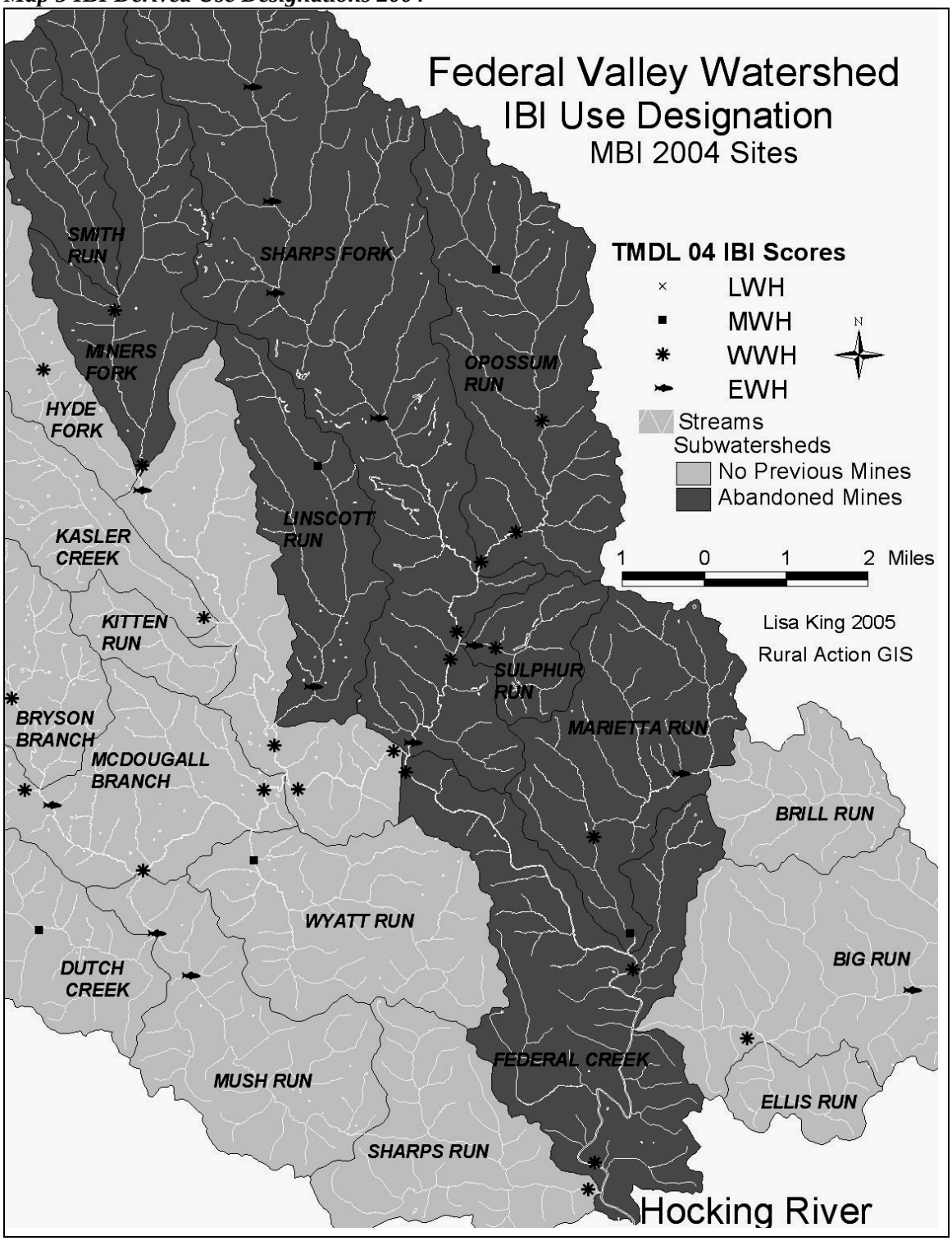
In general, the biological assemblages in Federal Creek Watershed are in relatively good condition although some reference areas have appeared to decline in biological and habitat quality since first sampled by Ohio EPA in the mid-1980s. Most sites have intact channel habitats although silt and sand above what is thought to be background levels often degrade habitats and potentially limit better assemblages. Some of this is related to encroachment into stream riparian buffers which are primary barriers from adjacent land uses (MBI, 2005).

Only three of the IBI scores in the entire Federal Creek Watershed scored at less than a "good" rating (< 40) and only one of these was rated poor (Opossum Run at RM 4.1). The Opossum Run site is relatively small in size (2.3 square mile), is dominated by bedrock and has a macroinvertebrate assemblage rated as excellent. Another site that was rated as fair (upper Linscott Run site) is also small and also has very good macroinvertebrate communities (MBI, 2005).

Figure 1. IBI scores of streams sampled in the Federal Creek Watershed during 2004.



Map 5 IBI Derived Use Designations 2004



Habitat Analysis for Federal Creek.

Although a major focus of this report is to identify mining impacts in the Federal Creek Watershed and to differentiate the relative contribution of mine drainage compared to other stressors, it is essential to understand the other stressors that are limiting aquatic life. Various data types help in the assessment of Nonpoint Source (NPS) stressors. As with AMD impacts, biological signatures help in categorizing and attributing various NPS stressors as limiting factors to biological integrity. Water chemistry is also important (e.g., nutrients, dissolved oxygen, total suspended solids and TDS, BOD, etc.). For habitat and sediment related impacts a key tool is the QHEI and its subcomponents.

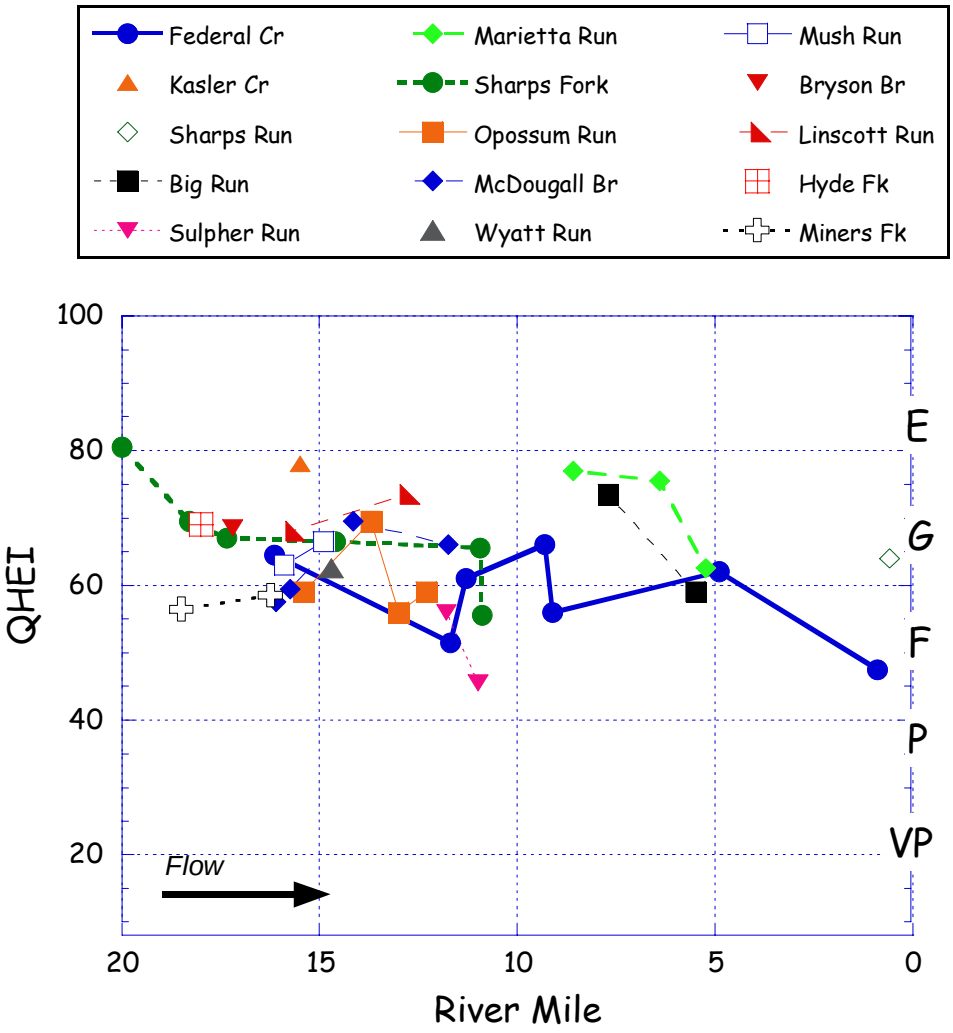
The Qualitative Habitat Evaluation Index (QHEI) is a physical habitat index designed to provide a quantified evaluation of the general lotic stream habitat characteristics that are important to fish communities. The QHEI is composed of six principal metrics including substrate quality, in stream cover, channel morphology, riparian zone and bank erosion, pool/glide riffle/run quality, and gradient/drainage area. The maximum possible QHEI score is 100. Each metric is scored individually and then summed to provide the total QHEI score (OEPA Biocriteria/QHEI CD, 2003).

Fine sediments have been identified as a moderate to severe problem in many watersheds in Ohio (Ohio EPA, 2000, 2002). A study by the USGS identified the nearby Leading Creek Watershed as having among the highest export of fine sediment in Ohio (Antilla and Tobin, 1978). Table 11 summarizes mean QHEI and metric scores for the sites in the Federal Creek Watershed; longitudinal patterns in the overall QHEI scores are illustrated in Figure 2. Habitat quality ranged from fair (scores 46-59) to excellent (scores > 75). As mentioned earlier, there is some evidence that habitat conditions may have declined somewhat in Federal Creek. All three sites from 1984 and 1990 had QHEI scores in the 70s-80 (very good-excellent) while 2004 samples averaged a score of 58 (47.5 [fair] – 66 [good]) and had no sites score above 70.

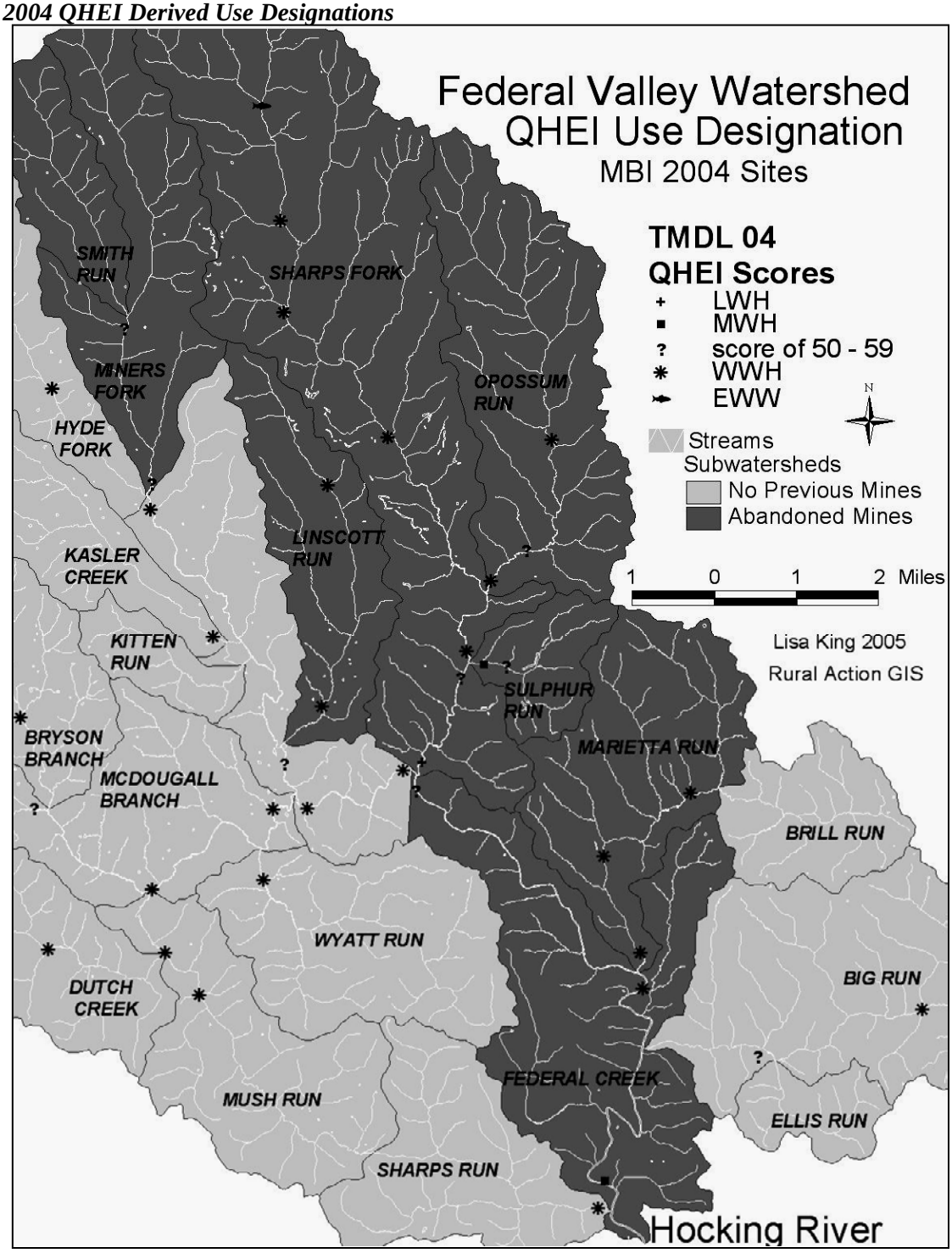
Recent assessments were characterized as having more sand and fine sediments than earlier assesments. The mouth of Sulphur Run is the only mine-impacted subwatershed to be ranked a Modified Warmwater Habitat with the QHEI score. Both Sulphur Run sites scored less then the EPA QHEI target of 13 for substrate. It is noteworthy that there is no farming and few home developments or logging operations in this watershed. The mouth of Marietta Run also scored less then 13 for the substrate component. The mouth of Marietta Run has a large shifting mound of silt that covers the entire channel. Below the mouth of Marietta Run, in the mainstem of Federal Creek, is a silt island that has trees growing on it. Marietta Run has no farming and almost no home development in the subwatershed. Above the area that has been mined, the substrate and the QHEI scores are very good. The watershed group concludes that this fine sediment choked stream is caused by previous mine activity. Oppossum Run, at Gifford State Forest, is an area of past mine activity and a site where the substrate and QHEI are low. However,

due to the farming above this point, at this point in time there is no way to differentiate between mine sediment and farming sediment.

FIGURE 2. QHEI VS MILES FROM THE CONFLUENCE OF FEDERAL CREEK WITH THE HOCKING RIVER FOR SITES SAMPLED BY MBI DURING 2004.



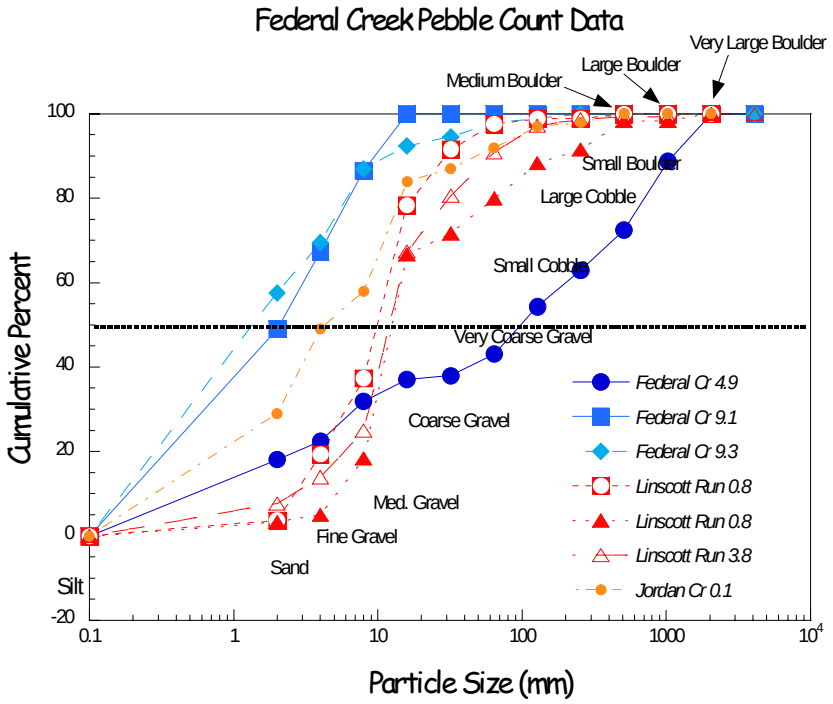
Map 6 2004 QHEI Derived Use Designations

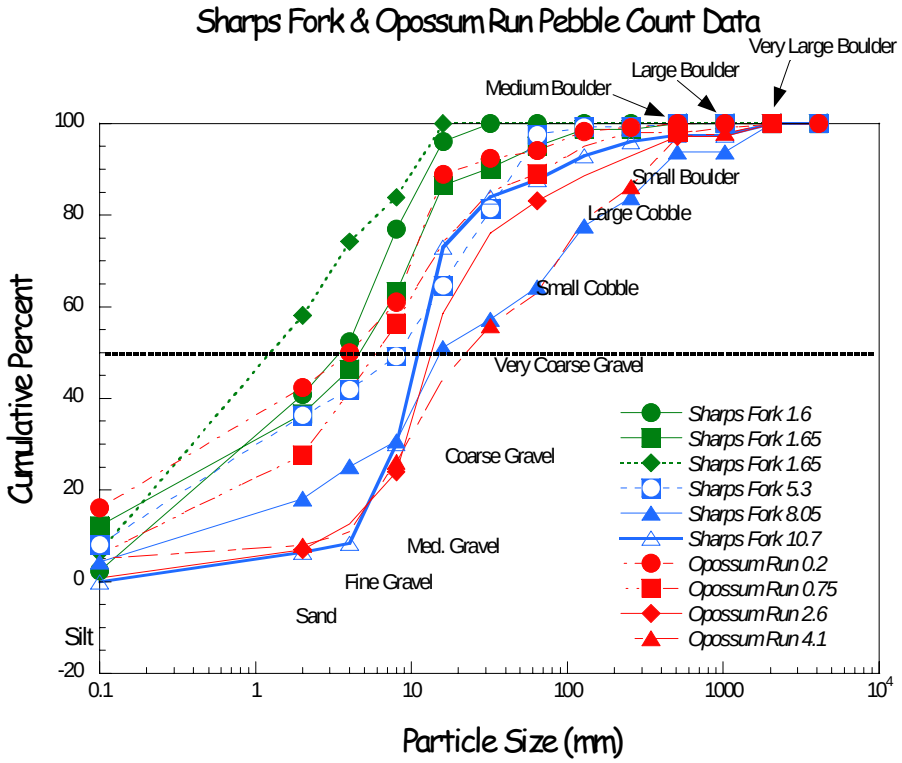


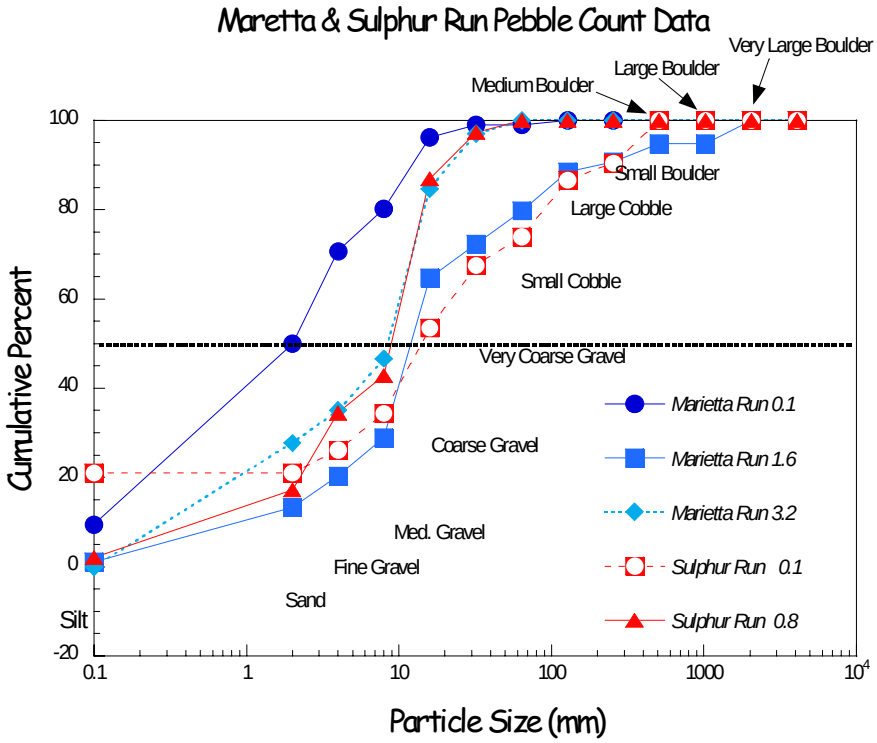
A Pebble Count is another way to investigate habitat quality. A pebble count is used to sample the surface particle size distribution of gravel-bed rivers. This allows an estimate of the distribution of substrates on the surface of the stream bottom by size and category. Unimpacted streams in Ohio typically have a coarse (gravel, cobble, some times boulders) particle size as the median. As erosion increases in a watershed the percent of fine materials in the steam bottom can increase. Figure 3 illustrates Pebble Count cumulative frequency plots for streams in the watershed with known mining. These streams are Federal Creek and Linscott Run (top), Sharps Fork and Opossum Run (center), and Marietta Run and Sulphur Run (bottom). The chart curves to the left have more fines and curves to the right are more dominated by coarser materials. Sandy rather than silty sediments are more a problem in the Federal Creek Watershed at most sites. The Federal Creek sites and river mile 9.1 and 9.3 both have greater than 50 percent of surface bed materials as sand. No strong trends exist between fine substrates as measured by the pebble counts at individual sites and biological performance, however, adjacent higher quality patches of habitat can compensate for localized sediment impacts. If the extent of fine substrate export to Federal Creek increases the biological could decline. As it is now, the IBI scores were only marginally attaining the EWH and further stress could cause impairment. Only Sulphur Run at its mouth had extremely silty conditions (Figure 3, bottom) and this coincided with mining impacts and the only poor macroinvertebrate assemblage rating in the watershed.

Figure 3. Zig-zag pebble counts

COLLECTED IN FEDERAL CREEK AND LINSCOTT RUN (TO RIGHTP), SHARPS FORK AND OPOSSUM RUN (TOP LEFT) AND THE MARIETTA RUN AND SULPHUR RUN (BOTTOM) DURING 2004. MBI 2005




Sharps Fork & Opossum Run Pebble Count Data
Very Large Boulder
Large Boulder
Medium Boulder
Small Boulder
Large Cobble
Small Cobble
Very Coarse Gravel
Coarse Gravel
Med. Gravel
Fine Gravel
Sand
Silt
Sharps Fork 1.6
Sharps Fork 1.65
Sharps Fork 1.65
Sharps Fork 5.3
Sharps Fork 8.05
Sharps Fork 10.7
Opossum Run 0.2
Opossum Run 0.75
Opossum Run 2.6
Opossum Run 4.1
Cumulative Percent
Particle Size (mm)
100
80
60
40
20
0
-20
0.1
1
10
100
1000
10^4


Maretta & Sulphur Run Pebble Count Data
Very Large Boulder
Large Boulder
Medium Boulder
Small Boulder
Large Cobble
Small Cobble
Very Coarse Gravel
Coarse Gravel
Med. Gravel
Fine Gravel
Sand
Silt
Marietta Run 0.1
Marietta Run 1.6
Marietta Run 3.2
Sulphur Run 0.1
Sulphur Run 0.8
Cumulative Percent
Particle Size (mm)
100
80
60
40
20
0
-20
0.1
1
10
100
1000
10^4

SECTION II BASIN ASSESSMENTS AND RESTORATION STRATEGY

Section II is organized into sections by each subwatershed that has abandoned mine lands in the Federal Valley Watershed. The section will begin with priority subwatersheds (subwatersheds with the most mine impacts). Each section will begin with a map of the area. The text will begin with a geography background, a brief description of mining impacts in the watershed, and a table of underground mine information for each subwatershed. For subwatersheds that have proposed mine drainage remediation, a description of the water chemistry, geography, and treatment strategies will follow. After the remediation section, mine drainage impact to the subwatershed will be described, beginning with a description of the biological investigation, sediment information (if available), water chemistry at the mouth of the subwatershed, and chemistry along the mainstem of the subwatershed. The final section is a description of the sample points in the subwatershed.

SULPHUR RUN BASIN ASSESSMENT

Map 7 Sulphur Run

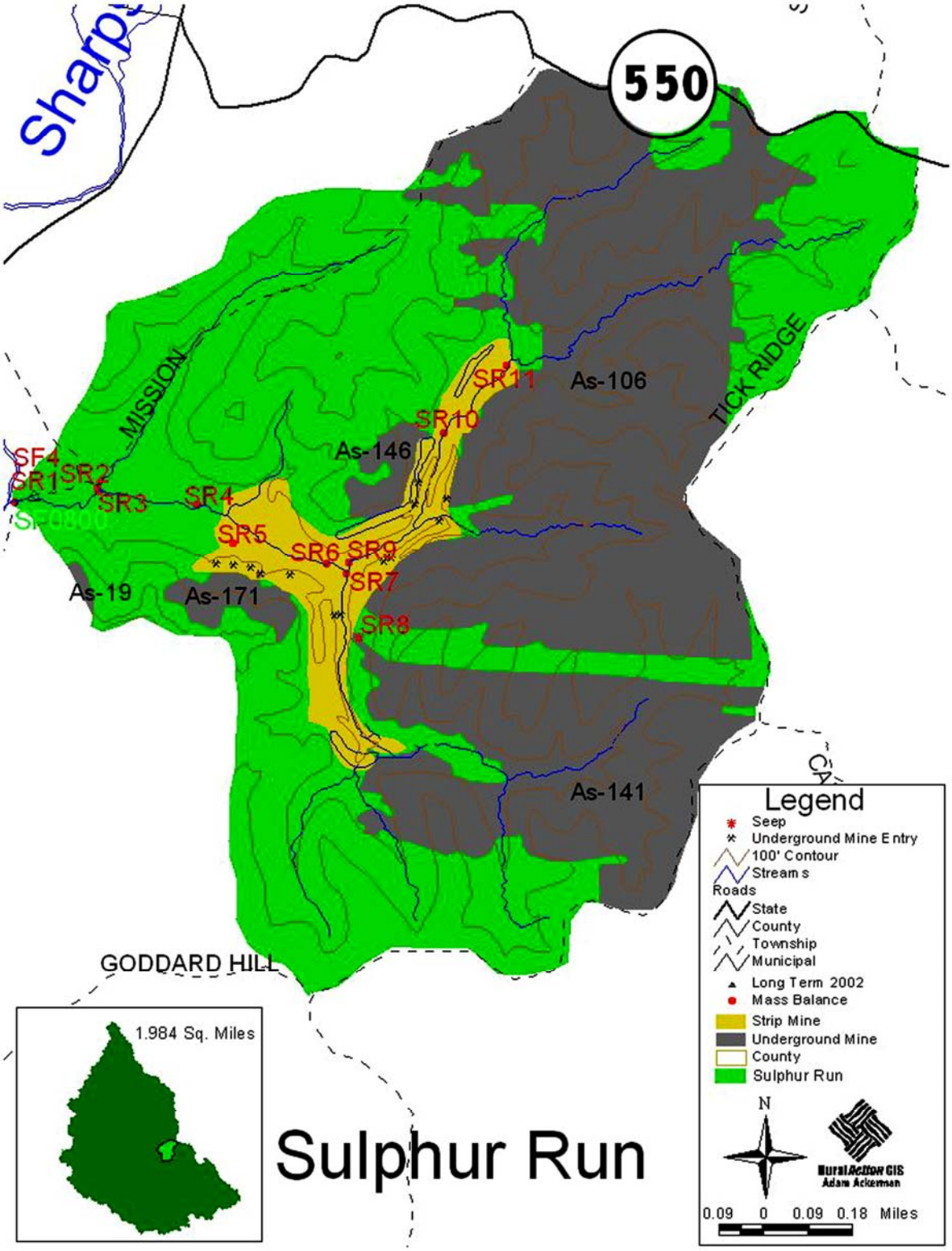


Photo of Sulphur Run

Geography Background

Sulphur Run occupies the east- central portion of the watershed, flows in a west/southwest direction, and enters Sharps Fork at river mile 2.9 . Sulphur Run is located in the southeastern portion of Sharp's Fork. It is located in Athens County, crossing Bern Township and is near the village of Sharpsburg (0.3 miles to the southeast). This subwatershed can be found on the Amesville USGS quad sheets. Sulphur Run has a drainage area of 1.98 square miles, and a stream length of 3.46 miles. Abandoned mining impacts are widespread in Sulphur Run, and include AMD generated from abandoned surface mining, underground mine discharges, and gob piles. In this subwatershed there are 0.89 square miles that have underground mines, which is 44.85 percent of the land in the entire subwatershed that has been mined underground. In this subwatershed there is 0.1 square. mile that has been strip-mined, which is 6.52 percent of the land in the entire subwatershed that has been strip-mined.

The natural stream channel has been severely disturbed by strip mining and refuse piles, and currently by beaver ponds. There is a significant amount of orange iron flocculant covering the bottom of the stream throughout the basin. Diffuse AMD sources permeate much of the area, and distinct measurable sources are few. As such, identification of distinct sources of AMD within Sulphur Run is difficult, and rating of AMD sources is defined more by areas of diffuse AMD sources rather than discrete sources. The mainstem splits into a north and a south branch midway upstream. The mainstem of Sulphur Run is the channel that begins at Sharps Fork, continues upstream to the previously mentioned split, and includes the north branch.

Mining Impacts In Brief

A summary of conclusions will be presented first and then the details of these conclusions will be provided subsequently. Sulphur Run subwatershed is the most heavily impacted area of Federal Valley Watershed by previous mining activity. Impact refers to topography, surface water chemistry, stream habitat, biotic integrity, and sediment. Mining impacts from underground mine seeps, strip mining, and strip mine spoil are seen throughout the subwatershed.

The chemistry in this stream exhibits the most mine drainage impact of any stream in Federal Valley, including all streams with a flow consistently over 100 gpm (the measured flow in Sulphur Run ranged from 550 to 1600 gallons per minute). Although there are significant impacts in this subwatershed, the alkalinity concentrations remain high and the pH along the mainstem remains between 6.7 and 8.06. At high flow the conductivity in the mainstem ranges from 356 uS/cm above the mine area to 688 uS/cm in the mine impacted area, and in low flow conditions the conductivity ranges from 473 uS/cm above mine impacts to 1340uS/cm in the mine- impacted area. Because of the naturally high pH the only treatment necessary would be retention.

This stream is a tributary of Sharps Fork, an Exceptional Warmwater Habitat stream. Sulphur Run contributes a percentage of the total known load of AMD components into Sharps Fork. This percentage of the entire AMD load into Sharps Fork is a combined metal load of 33 percent in high flow and 74 percent in low flow, and a sulfate load of 21 percent in high flow and 47 percent in low flow to Sharps Fork. Although Sharps Fork is an Exceptional Warmwater Habitat stream, it is only partially attaining this use designation downstream of Sulphur Run. The site immediately downstream of Sulphur Run scores lower on IBI and ICI than any of the other eight sites in this subwatershed.

Because Sulphur Run is a small subwatershed and the treatment needed for the impacted water is retention wetlands, it is recommended to utilize wetlands below all of the mine impacts. This should improve the water for the lower half of the subwatershed and would greatly affect loading in Sharps Fork.

Table 12 Sulphur Run underground mine information

Mine number	Mine Name	Date Abandoned	Type	Coal elevation
AS-19	Carbon (Schuler #2) Schuler Coal Co.	1923	Coal, Drift	697’ to 712’
AS-106	Black Diamond, Black Diamond Coal Company	1924	Coal, Drift	
AS-141	Black Diamond #2, Black Diamond Coal Company	1944	Coal, Drift	
AS-146	Amesville, Amesville Coal Co.	1948	Coal, Drift	699’
AS-171	Price (AS-520) Lee T. Jenkins	1951	Coal, Drift	675’

Remediation and Description of Proposed Treatment Area

This is a net alkaline stream, characterized by a Pittsburgh Seam #8 underground and surface mine complex. The only apparent requirement is oxidation and settlement. The landowner of this site, Wallace Fischer, is interested in having a treatment wetland on his property. The treatment site would be located at river mile 0.5. This site is very accessible by vehicle. It is located in the area of a large cement tipple. This tipple has potential historic interest because it is Ohio’s largest cement tipple. The landowner is interested in the historic significance of this structure but is worried about safety and liability issues

associated with this structure. One proposed idea is to surround the tipple with the treatment wetland, which would limit public access to the structure but keep the structure for the public to view from a distance. This could make a good site for the public to see mine treatment and a historic mine structure.

SR-6 is a point on the mainstem of Sulphur Run at 0.5 river miles, at 39.42081397 latitude, 81.90972302 longitude, and is at an elevation of 694 feet. Sulphur Run is a tributary that enters Sharps Fork at 1.7 river miles. The area of land above this point is 1.33 square miles and the length of the stream above this point is 1.37 miles.

Access

The proposed treatment area is above a gated private driveway. In order to access this area it is necessary to get permission from the landowner Wallace Fisher. Generally, it is best to e-mail him in advance at wfischer@frognet.net. He is supportive of Federal Valley's work on his land and of a remediation project. To find the location turn on Lathrop Rd. off of S.R. 329, just west of Sharpsburg. Follow the road less than 500 ft to a driveway/ small road that goes to the left. Wallace often works in the house on the corner of this driveway. If you continue past the house, you will come to a trailer with a gate. Continue past the gate to a place with a driveway on the right and a culvert crossing the stream on the left. This is the location. The driveway on the right is Wallace Fischer's parents' home and the road continues to Wallace's family home. The culvert crosses the stream to a field that will lead to the tipple.

Water Chemistry in treatment area

Table 13 water chemistry in treatment area

Values that are bold exceed the targets set for Federal Valley

Not Filtered													
Site number	DATE	LOCATION	FLOW type	FLOW cfs	FLOW gpm	COND-LAB uS/cm	PH-LAB	ALK mg/L	ACIDITY-LAB mg/L	SULFate mg/L	TOT-FE mg/L	TOT-MN mg/L	TOT-AL mg/L
SR-4	9/13/2005	Below the tipple, above the trailer	low	N/a	N/a	**1820**	6.63	68.2	8.98	**980**	**2.65**	**1.51**	<.05
SR-5.5	6/29/2004	Below the tipple, at the culvert	high	1.67	748.65	**1130**	7.1	150	6.62	**447**	**9.09**	**0.89**	<0.25
SR-5.5	5/3/2004	Below the tipple, at the culvert	med	2.47	1107.26	**836**	7	141	9.1	**291**	**4.47**	**0.62**	<0.25
SR-4	4/22/2003	Below the tipple, above the trailer	high	2.98	1336.35	**688**	7.5	126	6.3	**210**	**2.28**	**0.38**	0.37
SR-4	8/26/2003	Below the tipple, above the trailer	low	1.38	621.29	**1090**	7.3	152	10.5	**404**	**4.2**	**0.98**	<0.25
SR-6	4/22/2003	Above the tipple	high	1.70	763.24	**659**	7.5	136	5.82	186	**2.61**	**0.41**	<0.25
SR-6	8/26/2003	Above the tipple	low	0.85	381.62	**1060**	7.3	171	10.4	**356**	**17.7**	**0.95**	0.36

Table 14 displays loadings at the suggested treatment site, located between SR-4 and SR-6, see the map at the beginning of the chapter. (This site is below all mine inputs, it should represent 100 percent of all loadings into Sulphur Run). This table does not include the lowest flow and most recent chemistry taken on September 13, 2005 because flow was not taken on that day, the results of analysis on this day can be seen above. This most recent water sample shows the highest levels ever recorded at this site.

Table 14 Average Metal loadings in treatment area.

	Average high flow	**Average low flow**	Average Lbs/day
METAL LOAD lbs/day combined Fe and Mn- (Al is not detectable)	58.07	64.15	61.11
SULFATE LOAD lbs/day	3617.08	3513.89	3565.49

Remediation Recommendations for Sulphur Run

The recomended remediation requirement is oxidation and settlement.

Estimated cost by ODNR for the treatment

Mobilization/ Clearing	$7,727
Rock Dam(s)	33,792
Revegetation	9,000
Road Elevation	8,720
Engineering	14,810
Total	$74,049

Pre and Post Treatment Sampling

It is recommended that six samples, once per month, be analyzed of Group I parameters to fully characterize the high and low flow chemistry. These six samples should be taken both immediately downstream of the treatment site and at the mouth of Sulfur Run. This six-month sampling will provide the needed pre-reclamation water quality data to determine effectiveness of the restoration.

ODNR Cambridge Lab sample analysis $110 x 12 samples	$1320
Staff time collecting samples, 48 hours @ 30$/hr	$1440
Travel $0.42/mile, total miles 50 miles	$ 21

Post-construction water quality monitoring should be conducted at least two to four times a year and biological monitoring once a year downstream of the restoration project. Multiple sites downstream should be established to provide data on water quality and biological improvements made over a given

distance from the treatment site. Post-construction monitoring should begin within 6 months of completion.

AMD Impact to Sulphur Run

Biology Investigation for Sulphur Run

Table 15 Biology Data for Sulphur Run

MBI 2005 For information on the entire watershed see section I.

Sulphur Run - 2004

Station	Fish RM	Macro RM	IBI	MIwb	ICI or Narrative Rating	QHEI	Aquatic Life Uses Ex/Rec	Attain-ment Status	Comment
S01134 0.802004	0.80	0.80	46	NA	F*	56.0	None WWH	**Partial**	Upstream
S01134 0.102004	0.01	0.10	50	NA	P*	45.5	None WWH	**Non**	Mouth

Ecoregion Biocriteria: Western Allegheny Plateau (WAP)

Index and Site Type	WWH	EWH	MWH	LRW-AMD
IBI – Wading & Headwater	**44**	**50**	**24/24**	**18**
Mod. Iwb - Wading	**8.4**	**9.4**	**6.2/5.5**	**4.0**
ICI/Narrative	**36/G**	**46/E**	**22/30**	**8/MF**

Footnotes

a - A qualitative narrative evaluation based on best professional judgment and sampling attributes such as community composition, EPT taxa richness, and QCTV scores were used when quantitative data were not available (E-exceptional, G-good, MG-marginally good, F-fair, P-poor, VP-very poor); for Moxahala Creek a draft Qualitative ICI index was also used.

b - Attainment status is given for existing use designations, except where a use designation change is recommended, in which case, the attainment status for the recommended use is given.

c - Limited Resource Water - acid mine drainage (LRW-AMD) benchmarks based on best professional judgment driven by the need to protect against acutely toxic stream conditions. Macro-invertebrate qualitative only data were evaluated based on densities of EPT taxa on the natural substrates (see Methods Section), a narrative VP* or P* indicates departure from the benchmark.

na - MIwb not applicable at headwater sites (< 20 mi^2).

† - HD sampler set, but not retrieved due to flood flows destroying samplers.

‡ - Dry conditions in August followed by flooding conditions in September likely influenced assemblage conditions (data excluded from attainment decision)

ns - Nonsignificant departure from biocriteria (<4 IBI or ICI units, or <0.5 MIwb units).

* - Indicates significant departure from applicable biocriteria (>4 IBI or ICI units, or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

Sulphur Run was the only tributary where acute influences of AMD were observed, and in this case only strongly in the macro-invertebrates (Table 3). This was the only site that had a poor macro-invertebrate assemblage in the entire watershed. The dichotomy between the fish and macro-invertebrates was related to the episodic nature of the impacts and the fact that impacts were not especially extensive. Fish assemblages in such small streams have a strong recolonization potential if there is a good nearby refuge for re-invasion. Sharps Fork, into which Sulphur Run flows, is a high quality stream and is being recommended to be upgraded to an EWH aquatic life use.

Sediment Study Sulphur Run 2004

Metal concentrations (mg/kg) in sediments were collected from Federal Creek tributaries in 2004. Values preceded by a (<) were below the reporting limit. Those preceded by (*) exceeded the threshold effect concentration (TEC) described by MacDonald, et.al. (2000). Values preceded by (#) exceeded Ohio-specific Sediment Reference Values (SRV's).

Table 16 Sulphur Run values from OEPA sediments study **2004 TMDL**

Sulphur Run @ RM 0.5, below tipple @ culvert

Al	Ba	Ca	Cr	Cu	Fe	Pb	Mg	Mn
34,600	231	5260	41	21.9	**#68,300**	<32	4480	1050
Ni	K	Na	Sr	Zn	Hg	As	Cd	Se
***<32[1*]**	7600	<3950	150	91	0.076	**#*30.4**	0.194	2.42

Note: The detection limit is higher than the limit of 22.7, and therefore could be a violation, but cannot be determined.

Water Chemistry at the Mouth of Sulphur Run

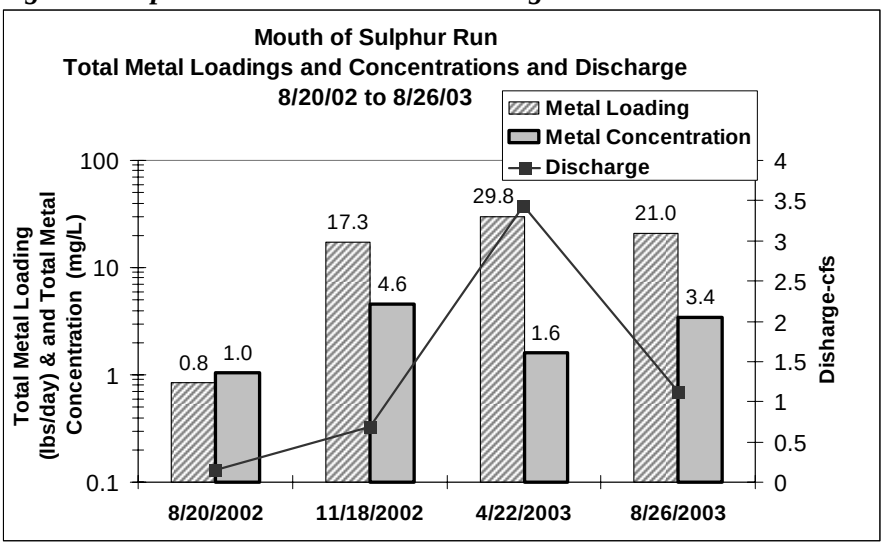
The graph below displays discharge, total metal concentrations and loadings measured at the mouth of Sulphur Run over the course of a year. Total metal concentrations were highest on the 11/18/02 sampling date. The total metal loading of Sulphur Run ranged from 0.85 lbs/day at the lowest flow on 8/20/02, to 29.8 lbs/day at the highest flow on 4/22/03. The load was 17.3 lbs/day on 11/20/03 and 21.0 lbs./day on 8/19/03. The average metal load from Sulphur Run over the period of 8/20/03 to 8/19/03 is 17.2 lbs/day, making it the most significant contributor of metal loadings into Sharp's Fork.

The site on Sulfur Run is at the mouth of Sulfur Run. Table 17 shows the data from that site. This table includes the laboratory conductivity values. This site has values higher than the target values. All of these sites are higher than the target conductivity of 600 uS/cm. All but one reading is above the target for iron, 1.1 mg/L, and the average is 2.02 mg/L. All but one site is above the target for manganese of 0.3 mg/L, where the average is 0.7 mg/L. All but 5 sites are above the target for sulfate of 204 mg/L where the average is 282mg/L. Aluminum is never above the target of 0.5 mg/L.

Table 17 Sulphur Run Mouth Chemistry Data
(bold values are above FVWG targets)

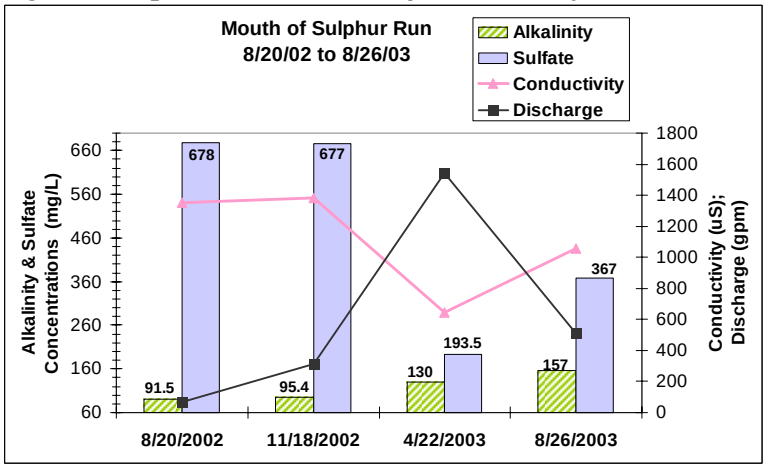
Lab	Date	Alkalinity mg/L	Sulfate mg/L	Iron mg/L	Manganese mg/L	Aluminum mg/L	Conductivity uS/cm/cm
ODNR	8/20/2002	**92**	**678**	0.35	**0.70**	<0.250	**1350**
ODNR	11/18/2002	**95**	**677**	**3.12**	**1.50**	<0.250	**1380**
ODNR	4/22/2003	**130**	189	**1.31**	**0.36**	<0.25	**646**
ODNR	5/19/2003	142	**231**	**2.45**	**0.63**	0.31	**740**
ODNR	8/26/2003	157	**367**	**2.56**	**0.90**	<0.25	**1050**
ODNR	10/7/2003	151	**402**	**2.63**	**0.89**	<0.25	**1010**
	Average	149	**282**	**2.02**	**0.70**	0.31	**898**

Figure 4 Sulphur Run Mouth Metal Loadings and Concentrations



The following graph shows alkalinity and sulfate concentrations, specific conductivity, and discharge on these same sampling events.

Figure 5 Sulphur Run Mouth Sulfate, Alkalinity, and Conductivity

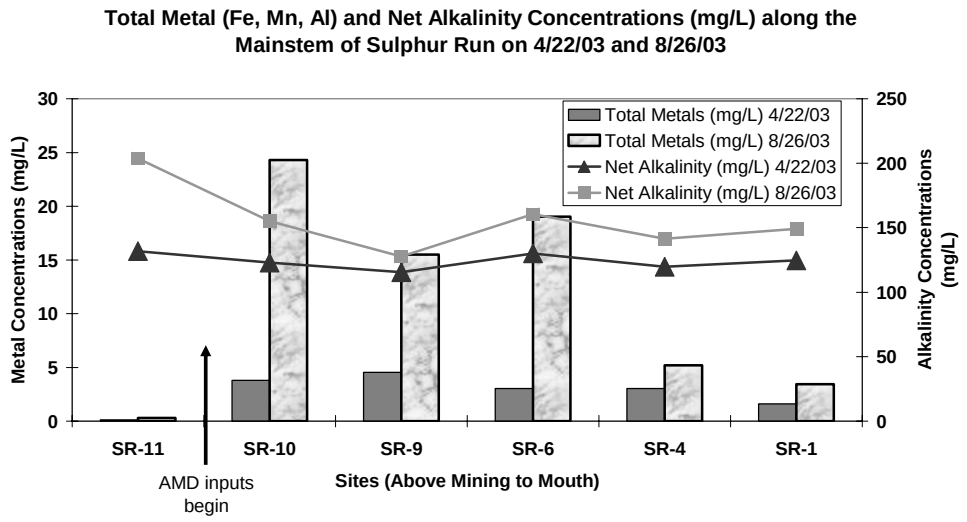


Overall, the mouth of Sulphur Run shows a trend of increasing conductivity and sulfate, as well as decreasing alkalinity, with decreasing flow. Conductivity values peak at 1380uS/cm on 11/18/02, while the lowest value is 648uS/cm on 4/22/03, the highest flow date. Sulfate values are highest on 8/20/02 and 11/18/02, at 678 and 677 mg/L, and lowest on 4/22/02 at 193.5 mg/L. The lower flow dates of 8/20/02 and 11/18/02 exhibit the lowest alkalinity values of 91.5 and 95.4 mg/L respectively. Alkalinity values were highest on the 8/26/03 sampling date at 157 mg/L. On all sampling dates, the pH values fell between 7.3 and 7.7. The neutral pH and high alkalinities facilitate rapid precipitation of metals contained in the AMD occurring throughout Sulphur Run. Sulphur Run is characteristically orange, with iron precipitate covering the stream channel in a thick flocculent layer.

Mainstem Sulphur Run

The chart below displays the metal concentrations and alkalinity concentrations along the mainstem of Sulphur Run on the Phase II sampling dates of 4/22/03 and 8/26/03. Site locations can be seen on the map at the beginning of this section.

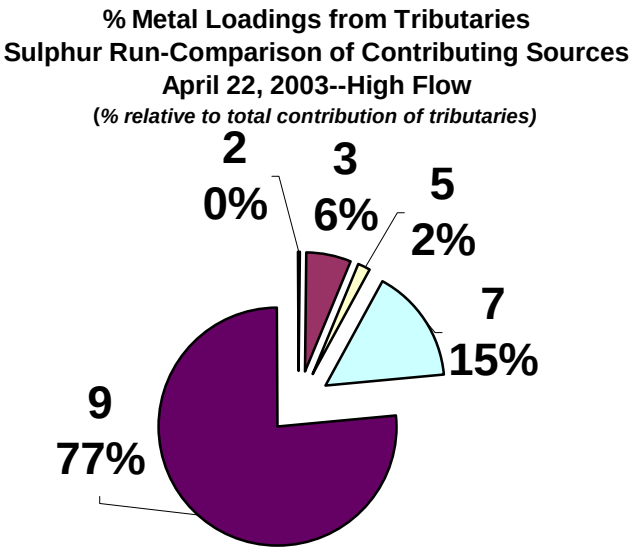
Figure 6 Sulphur Run Chemistry along the Mainstem

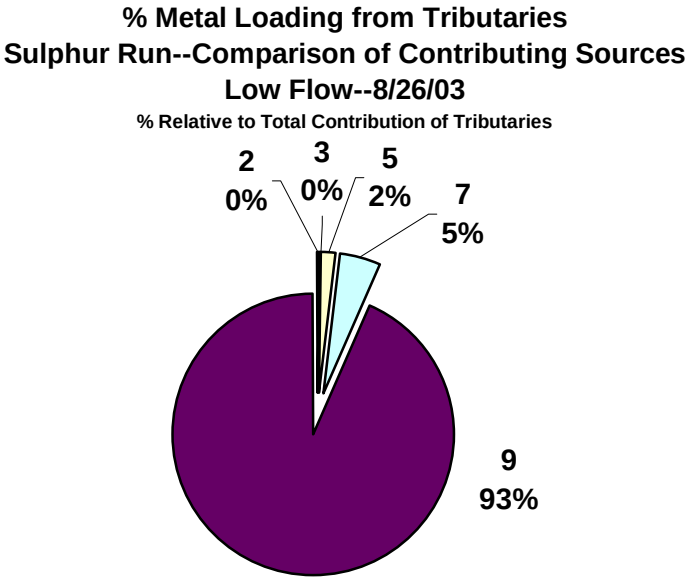


Samples were unfiltered for both sampling dates. Although metal concentrations shown may not be solely dissolved metal concentrations, the huge increase in metal concentrations below site SR-11 is apparent. Additionally, the precipitation of metals along the mainstem is also apparent in the steady drop of concentrations below site SR-6M. Many beaver ponds and dams exist along the mainstem, which may facilitate retention of precipitated metals in the stream channel. Alkalinity concentrations remain high along the mainstem. The pH along the mainstem remains between 6.7 (SR-10M, 8/26/03) and 8.06 (SR-11M, 4/22/03 and 8/26/03). At high flow the conductivity ranges from 356 uS/cm (SR-11M) to 688

uS/cm (SR-4M), and at the low flow situation the conductivity ranges from 473 uS/cm (SR-11M) to 1340uS/cm (SR-9M).

Figure 7 Sulphur Run percent of Metal Loadings from Tributaries, High and Low Flow
Stream numbers correspond with site numbers on the map at the beginning of this section.





The most significant source of metal loading in Sulphur Run is the section represented by SR-9, which is the mouth of the north fork of the two tributaries that form Sulphur Run. This north fork is considered the mainstem in this study. Identification of a discrete point source within this segment is not

possible, as nearly the entire stream segment contains numerous and diffuse seeps from strip mining. Additionally, approximately 1000 feet from the beginning of the seeping area begins a series of beaver ponds, surrounded by high walls on either side.

Tributary 7, the second most significant loader, contains the high volume seep, SR-8-S. Each of these contributors will be discussed in detail in the following section.

On both sampling dates, the metal inputs to Sulphur Run exceeded the metal output at the mouth of Sulphur Run. Precipitation and retention of metals along the Sulphur Run stream channel is visible.

Investigation of Sulphur Run

Phase I

A phase I water quality investigation was conducted of Sulphur Run subwatershed on 4/3/03 and 4/4/03. Mining disturbances are widespread throughout the 2 square mile drainage area of Sulphur Run. Preliminary field observations identified multiple acid mine seeps coming from unreclaimed surface mining and one major discharge from an abandoned underground mine contributing to the mainstem of Sulphur Run. Strip pits from surface mining and multiple gob piles were also identified throughout Sulphur Run.

Phase II

A phase II water quality investigation was conducted in Sulphur Run on 4/22/03 and 8/26/03. This information was used for the characterizations above. Six mainstem points were sampled, extending from the area above all mining to the mouth of Sulphur Run (SR-11, SR-10, SR-9, SR-6, SR-4, SR-1). One major abandoned underground mine seep was sampled (SR-8-S), and four tributaries (SR-7, SR-5, SR-3, SR-2). The major seep flows into one of the tributaries (SR-7), hence the contribution of SR-7 includes the input of SR-8-S. Site SR-8-S (seep) is associated with mine number As141.

Phase III

A phase III water quality investigation was conducted in Sulphur Run on 6/29/2004 and 5/3/2004. SR-5.5 is a new site taken below the tipple on the mainstem, at the culvert. It is slightly upstream of SR-4 from phase II. This site is closer to where the treatment site is proposed. SR-9.5 was also added. This site is on the mainstem below the location of what was a large beaver pond during phase II. Now this beaver dam is gone and this location is in a channel with large amounts of loose sediment that previously was the bottom of a pond. Additionally the sites from phase II of SR-9, SR-8, SR-10 and SR-11 were analyzed on these days.

Individual Site Descriptions

SR-9—North Fork of Sulphur Run

SR9 is a point on the mainstem of Sulphur Run at 0.72 river miles, at 39.42021945 latitude -81.90541715 longitude, and is at an elevation of 738 feet. Sulphur Run is a tributary that enters Sharps

Fork at 1.9 river miles. The area of land above this point is 0.39 square miles and the length of the stream above this point is 1.25 miles.

Access: SR-9 is a mainstem sampling site above the confluence of SR-7. Wallace Fisher owns the land. The site is accessible by foot, or by ATV.

Site Description: SR-9 represents the contribution of the widespread, diffuse seeps occurring along the mainstem of Sulphur Run. Above SR-9, Sulphur Run is characterized by numerous, diffuse seeps permeating the banks. Sampling discrete sources is further confounded by the presence of numerous beaver dams and high walls. The entire area has been greatly disturbed by strip mining, and the topography and drainage are very unnatural. The area above SR-9 appears to be the main contributor of the metal loadings to Sulphur Run.

SR-9 Metal and Sulfate Loadings 4

SR-9-S	Spring Flow	Base Flow	Average
Metal Load (lbs/day)	32.0	39.1	35.6
% Metals Contribution	77%	93%	85%
Sulfate Load (lbs/day)	1295.7	1385.7	1340.7
% Sulfate Contribution	49%	70%	59.5%

% indicated in table represents % contribution relative to total loading of five sampled tributaries

SR-7—South Fork Sulphur Run (mainstem)

SR7 is at 0 river miles, at 39.42001065 latitude -81.90547625 longitude, and is at an elevation of 731 feet. This is a tributary that enters Sulphur Run at 0.72 river miles. The area of land above this point is 0.77 square miles and the length of the stream above this point is 0.4 miles.

Access: SR-7 is the mouth of the south fork of Sulphur Run, considered a tributary in this study. The property is owned by Wallace Fisher, and is accessible by foot or ATV. Advanced permission to enter the land must be received every time sampling is done.

Site Description: SR-7 represents the AMD impacts along this major tributary. AMD impacts include the contributions of SR-8-S, as well as the diffuse seeps that occur along the tributary between SR-8-S and SR-7. These diffuse seepages cannot be quantified due to their abundance, widespread nature, and low volume. They can be characterized as acidic, highly conductive trickles from the disturbed banks of Sulphur Run.

SR-7 Metal and Sulfate Loadings

SR-7-S	Spring Flow	Base Flow	Average
Metal Load (lbs/day)	6.43	1.95	4.19
% Metals Contribution	15%	5%	10%
Sulfate Load (lbs/day)	838.9	545.0	692.0
% Sulfate Contribution	31%	28%	29.5%

% indicated in table represents % contribution relative to total loading of five sampled tributaries

The area represented by SR-7 appears to be the second largest contributor of AMD within the Sulphur Run Watershed. Most of the AMD generated within this section appears to come from SR-8-S, a large abandoned underground mine discharge.

SR-8-S—Abandoned Underground Mine Discharge

SR-8-S is a seep that enters Sulphur Run at 0.73 river miles, at 39.41806069 latitude -81.90497015 longitude, and is at an elevation of 664 feet. This seep is associated with

mine # As141.

Access: SR-8-S is located on Wallace Fisher's property, approximately 500 feet from the landowner's residence. It is accessible by foot.

Site Description: SR-8-S is an abandoned underground mine discharge. The discharge exits in four places within a twenty-five foot section at the base of a high wall. The discharge drains directly into the south branch of Sulphur Run (considered a tributary in this study), at which point the stream is a beaver/strip pit pond. The dam of this pond is approximately 100 feet downstream of the mine discharge. Below the dam, the tributary reforms a stream channel.

Location/Access: SR-6- mainstem

SR-6 is a point on the mainstem of Sulphur Run at 0.7 river miles, at 39.42009103 latitude -81.90618787 longitude, and is at an elevation of 750 feet. Sulphur Run is a tributary that enters Sharps Fork at 1.7 river miles. The area of land above this point is 1.5 square miles and the length of the stream above this point is 1.37 miles.

Access: To access this point, drive to Wallace Fisher's house and park in his parking area. Then walk down the hill north of the parking area toward the creek. A split in the stream will be obvious if using a GPS unit.

Site Description: SR-6 is located below the confluence of SR-9 and SR-7, and above another beaver pond, which has broken since the sampling period. A large coal tipple is also located downstream of this point.

SR-5—Tributary

SR-5 is at 0 river miles, at 39.42081397 latitude -81.90972302 longitude, and is at an elevation of 694 feet. This is a tributary that enters Sulphur Run at 0.5 river miles. The area of land above this point is less than 0.14 square miles. This small tributary is not mapped, therefore the stream length above this point in not available.

Access: SR-5 is a tiny tributary that passes under the Fisher's driveway before entering Sulphur Run between the mainstem sampling points of SR-6 and SR-4. The sampling site is located where Ray Fisher's driveway enters into the Fisher road/driveway. The sampling site is accessible by vehicle.

Site Description: The source of SR-5 has not yet been determined. It is believed to originate behind or near Ray Fisher's residence. Water appears to be coming from under Ray Fisher's new home. It may be associated with abandoned mine openings associated with As-171, or it may originate from strip mine refuse. Ray Fisher's residence sits on top of mining refuse.

SR-5 Metal and Sulfate Loadings

SR-5	Spring Flow	Base Flow	Average
Metal Load (lbs/day)	0.77	0.66	0.72
% Metals Contribution	2%	2%	2%
Sulfate Load (lbs/day)	56.9	32.3	44.6
% Sulfate Contribution	2%	2%	2%

% indicated in table represents % contribution relative to total loading of five sampled tributaries

SR-5.5- Mainstem

SR-5.5 is at 0.5 RM at 39.42081397 latitude -81.90972302 longitude, and is at an elevation of 694 feet. The area of land above this point is 1.6 square miles and the length of the stream above this point is 1.5 miles.

Access: SR-5.5 can be accessed by going through the gate at the trailer to a location on the road with a driveway to the right and a culvert driveway to the left. The road continues straight ahead. The sample point is in the stream, below the culvert and below the tributary of SR-5.

Description: This site is very similar to SR-4 in that it is downstream of the tipple and the SR-5 tributary. It is slightly upstream of SR-4; closer to the tipple and the proposed treatment site.

SR-4- Mainstem

SR-4 is a point on the mainstem of Sulphur Run at 0.4 river miles, at 39.42192969 latitude -81.91104652 longitude, and is at an elevation of 648 feet. Sulphur Run is a tributary that enters Sharps Fork at 1.7 river miles. The area of land above this point is 1.68 square miles and the length of the stream above this point is 1.67 miles.

Access: This point is located at the trailer and below the gate. This point is easily accessed even if the gate is locked. The creek is behind the dumpster.

Description: SR-4 is along the mainstem, below a section of beaver dams and massive stream braiding.

SR-3: Tributary

SR-3 is at 0 river miles, at 39.42248449 latitude -81.91462384 longitude, and is at an elevation of 707 feet. This is a tributary that enters Sulphur Run at 1.21 river miles. The area of land above this point is 0.031 square miles. This small tributary is not mapped, and therefore the stream length above this point in not available.

Access: SR-3 is a small tributary that flows into Sulphur Run downstream of the mainstem site SR-4. It is approximately 100 feet from the road.

Site Description: The sources contributing to tributary SR-3 have not yet been determined. SR-3 runs along the base of a hillside where mine complexes As-171 are located. This area has also been strip-mined. This tributary flows behind Wallace Fisher's trailer and it appears to be created by the earth moving and strip mining in the area, as it is not visible on any map.

SR-3 Metal and Sulfate Loadings

SR-3	Spring Flow	Base Flow	Average
Metal Load (lbs/day)	2.47	0.02	1.2
% Metals Contribution	6%	0%	3%
Sulfate Load (lbs/day)	440.1	4.6	222.4
% Sulfate Contribution	16%	0%	8%

% indicated in table represents % contribution relative to total loading of five sampled ributaries

SR-3 appears to play a more significant role during high flow conditions than low flow conditions.

SR-2-Tributary

SR-2 is at 0 river miles, at 39.4224549 latitude -81.91481679 longitude, and is at an elevation of 631 feet. This is a tributary that enters Sulphur Run at 0.2 river miles. The area of land above this point is 0.20 square miles and the length of the stream above this point is 0.9 miles.

Access: SR-2 enters the mainstem of Sulphur Run approximately 50 feet below where SR-3 enters the mainstem. It passes through a culvert under the Fisher's Road before entering Sulphur Run. It enters Sulphur Run from the northern side of the stream. This site is accessible by car.

Site Description: We do not believe SR-2 is affected by AMD, and as such, will not be described in detail. It is a small tributary with a high alkalinity, low metal concentrations, low conductivity, and low sulfate concentrations. It was sampled as it is one of the larger tributaries to enter Sulphur Run.

SR-1- Mainstem, at the mouth

SR1 is a point on the mainstem of Sulphur Run at 0 river miles, at 39.42204989 latitude -81.91785313 longitude, and is at an elevation of 690 feet. Sulphur Run is a tributary that enters Sharps Fork at 1.7 river miles. The area of land above this point is 1.98 square miles and the length of the stream above this point is 2.0 miles.

Access: SR-1 can be accessed by staying on Lathrop Rd. There is a location where there are several trailers and other various cars, etc. Park near the stream on the culvert. This site is below the culvert, although sometimes it is easier to take samples above the culvert.

Site Description: This is the mouth of Sulphur Run. It includes all water in Sulphur Run including all of the mine inputs.

MARIETTA RUN BASIN ASSESSMENT

Map 8 Marietta Run

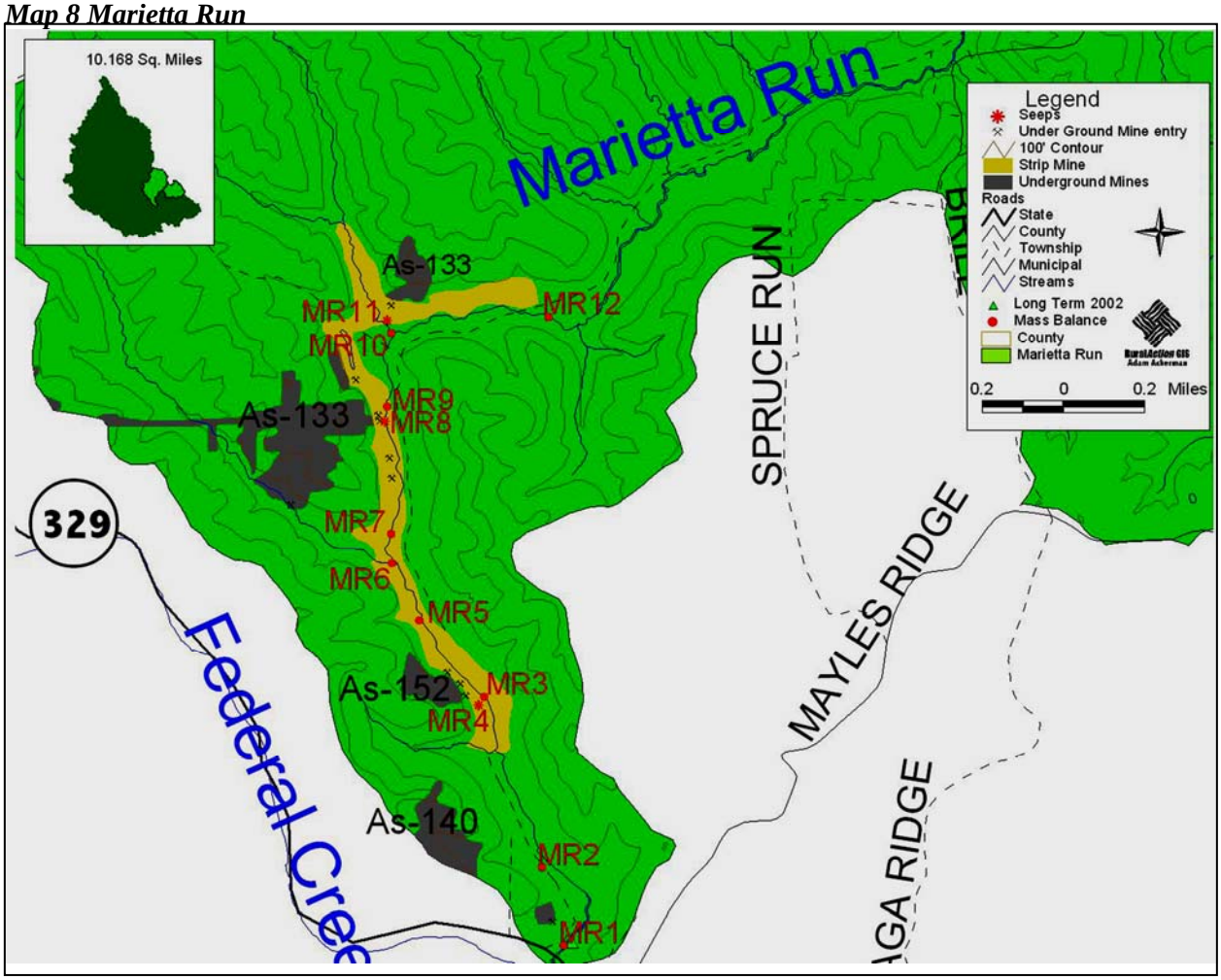


Photo of MR 8

Geography Background

Marietta Run occupies the east- central portion of the watershed and flows in a south/southwest direction, entering Federal Creek at 4.26 river miles. It is located in Athens and Washington counties, spanning Bern and Wesley Townships and is north of Kilvert and Broadwell. This subwatershed can be found on Amesville, Chesterhill and Stewart USGS quad sheets. Marietta Run has a drainage area of 6.92 square miles, and a stream length of 9.2 miles. Abandoned mining impacts are present in Marietta Run and include AMD generated from abandoned surface mining, underground mine discharges and gob piles. In this subwatershed, there are 0.32 square miles (3.10 percent) that has been mined underground. Additionally, in this subwatershed, there is 0.1 square mile (1.18 percent) that has been strip-mined. Abandoned mining impacts are widespread in the lower portion of the watershed, and include AMD generated from abandoned surface mining, underground mine discharges, and waste piles.

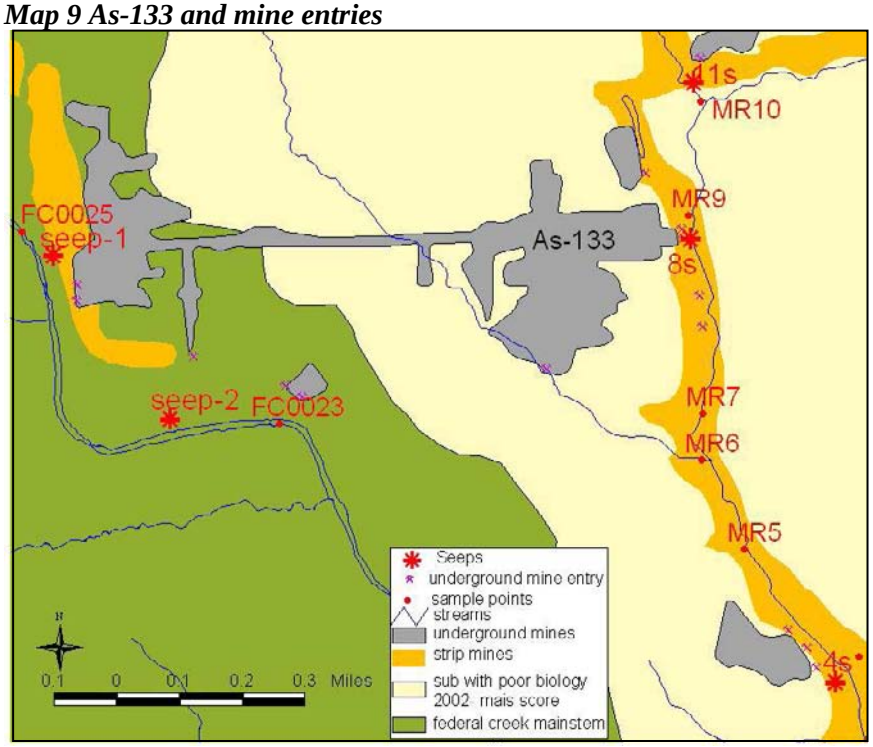
Mining Impacts In Brief

All recorded abandoned mines are in the first 2 river miles of this subwatershed. There is only one residence in the entire basin. The subwatershed is almost entirely wooded (mature forest cover), including the areas of abandoned mines. There is no agriculture in this subwatershed. In the areas where mining has taken place, the habitat is good. During low flow Marietta Run is orange with a thick flocculent material in the bottom that begins at the largest underground mine seep referred to as MR-8-S. This subwatershed has three distinct underground mine seeps, where MR-8-S is the major source of AMD in the entire watershed. The subwatershed is classified as Warm Water Habitat, however the scores drop at and below the area of abandoned mines. The mine impacts in this subwatershed are not severely impacting the water quality or biotic integrity, except in the reaches previously noted. There are tributaries of Marietta Run that have Exceptional Warm Water Habitat use designations. Currently the subwatershed is largely undisturbed by present human activity. This leads the watershed group to believe that with treatment of one major underground mine seep, and possibly one other less contaminated area, this stream could achieve an exceptional warm water rating.

MR-8-S is by far the most significant source of AMD pollution in Marietta Run, contributing an average of 76% of the metal loading to Marietta Run. MR-10 is the second most significant contributor, contributing an average of 14 percent of the metal loadings to Marietta Run. MR-6, a tributary, is ranked third, with an average of 6.5 percent of the metal loadings to Marietta Run.

In a subsequent section on the mainstem of Federal Creek, an underground mine seep referred to as FC-2-S will be discussed. It is interesting that MR-8s, MR-6 and FC-2-S are all from the same mine complex.

Map 9 As-133 and mine entries



The mainstem of Marietta Run is being episodically impacted by mine drainage. In September 2005, a filtered sample was taken on the mainstem below all of the mine drainage inputs. This was a low flow period proceeded by unusually low flows for several months. The sample was filtered because of the high amount of orange flocculent in the stream. There was no flow possible because of the lack of current in the area. The results of this sample along with other samples taken at this site can be seen in the table below. It is important to note that the water is net acidic on 9/13/05. This is unusual in Federal Valley, where there has never been a net acidic sample in any mainstem of any of the mine-impacted subwatersheds. All of the results for the sample on 9/13/2005 are dissolved, whereas on the other two days they are total. All chemical parameters were unusually high. This demonstrates the impact that mine drainage periodically has on this otherwise high quality creek.

Table 18 Marietta Run Mouth Chemistry

DATE	FLOW cfs	FLOW gpm	COND-LAB	PH-LAB	ALK mg/L	ACIDITY-LAB mg/L	SULFATE mg/L	FE mg/L	MN mg/L	AL mg/L
9/13/02005	n/a	n/a	**1070**	**3.34**	**0**	**85.4**	**547**	**5.47**	**4.01**	**9.17**
5/13/2003	17.592	7895.627	315	7.78	101	3	56.8	.8	**0.181**	0.488
9/30/2003	3.616	1622.779	408	7.77	142	5.36	50.2	**1.0**	**0.382**	0.409

A combination of the water coming from Marietta Run and the Federal Creek mainstem seeps could be having an impact on the biotic integrity of Federal Creek. The entire mainstem of Federal Creek

has been assigned an exceptional warm water habitat. The site immediately downstream of Marietta Run and the 'mainstem seeps' is only partially attaining this score, with an ICI of 34 and a MIwb of 7.14. The next site above this site on Federal Creek, located above all of the mining impacts, is fully attaining the EWH, with an ICI score of 42 and a Miwb score of 8.9. A chemistry sample was analyzed at this site on the same low flow day of 9/13/2005. The results of that sample are provided below. At times of low flow, chemical parameters rise, occasionally approaching or going above the targets set for this watershed. These periodic events of elevated chemical parameters could be the cause of this site only partially attaining its EWH use designation. Addressing the major seeps in Marietta Run could make a significant difference in Federal Creek under low flow regimes.

DATE	FLOW cfs	FLOW gpm	COND-LAB	PH-LAB	ALK mg/L	ACIDITY-LAB mg/L	SULFATE mg/L	TOT-FE mg/L	TOT-MN mg/L	TOT-AL mg/L
9/13/05	n/a	n/a	**771**	7.13	132	7.68	**236**	0.488	**1.370**	0.125

Table 19. Marietta Run underground mine information

Mine number	Mine Name	Date Abandoned	Type	Coal elevation
AS-133	Utley, Jennings Coal	1922	Coal, Drift	
AS-140	Mae Rudy of Federal ValleyJ.F. Schuller and Sons	1915	Coal, Drift	
AS-152	Young (As508) Joe Ralph Young	1950	Coal, Drift	

Remediation and Description of Proposed Treatment Area

Two potential projects in Marietta Run were examined for treatment. The first is MR-8-S, an underground mine seep that contributes 76 percent of the metal loading to Marietta Run. MR-10 is the second most significant contributor, contributing an average of 14 percent of the metal loadings to Marietta Run. These two areas are very close together.

MR-8-S

This site is an AMD discharge located approximately 25 feet from the mainstem of Marietta Run and is associated with mine complex As-133. The discharge is located at an abandoned underground mine opening, flows across an old roadbed, and then into Marietta Run. The discharge was measured at 0.09 cfs (high flow) on 5/13/03, and 4/19/04 and 0.02 cfs (low flow) on 6/14/04 and 8/9/04It consists of a series of collapsed underground mine entries that discharge to a narrow haul road. The discharge points occur where Marietta Run comes up against the embankment leaving little working room. The AMD is strongly acidic with a net acidity of 200 to 300 mg/L. Iron is largely ferrous and is around 75 mg/L.

Location: MR-8-S is a seep that enters Marietta Run at 1.57 river miles, at 39.38714605 latitude -81.8877569 longitude, and is at an elevation of 733 feet. This seep is associated with mine # As 133.

Access: MR-8-S is a seep that enters Marietta Run at RM 1.5. The site is accessible on foot by parking on Marietta Run Road and crossing the floodplain (approximately 500 feet) and then crossing Marietta Run, where orange, seeping water can be seen on the bank. Another access is via an old mine road located directly in front of the mine seep and traveling adjacent to Marietta Run. This road is passable using a four-wheel drive vehicle or ATV.

Water Chemistry of the Mine Seep

From high and low flow samples, the average pH was found to be 3.86, the average net acidity concentration was 319 mg/L, the average specific conductivity was 1320 uS, and the average sulfate concentrations was 741.5 mg/L. The total metal concentration at high flow is 120.7 mg/L, having a composition of 96.4 mg/L iron (ferrous iron equals 90.6 mg/L), 4.01 mg/L Mn, and 20.3 mg/L Al. At low flow, the total metal concentration is 135.6 mg/L, with a composition of 109.0 mg/L Fe (88 mg/L ferrous iron), 3.21 mg/L Mn, and 23.4 mg/L Al. As displayed in the table below, MR-8-S discharged an average of 83.8 lbs/day of metals into the Marietta Run mainstem, accounting for an average of 76 percent of the metal loading of the tributaries.

Table 20 MR-8-S Net Acid, Metal, and Sulfate Loadings

MR-8-S	High Flow	Low Flow	Average
Metal Load (lbs/day)	58.6	109.0	83.8
% Metals Contribution	62	90	76
Acid Load (lbs/day)	263.6	150.6	207.1
Sulfate Load (lbs/day)	383.4	557.7	470.6
% Sulfate Contribution	25	64	45.5

Table 21 Data from MR-8-S

(bold indicates above FVWG TARGET)

Site number	Filtered	DATE	FLOW cfs	FLOW gpm	DISSOLVED O2 %	DISSOLVED O2 mg/L	COND-LAB	PH-LAB	ALK mg/L	ACIDITY-LAB mg/L	SULFATE mg/L	DIS-FE mg/L	DIS-MN mg/L	DIS-AL mg/L
MR-8-S	f	5/13/2003	0.09	40.50	4.6	0.5	**1390**	3.88	**0**	310	**789**	**96.4**	**4.01**	**20.3**
MR-8-S	f	9/30/2003	0.15	66.97	3.2	0.3	**1250**	3.84	**0**	328	**694**	**109**	**3.21**	**23.4**
MR-8-S	f	4/19/2004	0.09	41.52	7.2	0.8	**954**	3.88	**0**	182	**522**	**75.9**	**2.30**	**12.5**
MR-8-S	f	4/27/2004	0.02	10.86	2.8	0.3	**988**	3.59	**0**	211	**535**	**72.5**	**2.11**	**12.2**
MR-8-S	f	6/14/2004	0.03	14.05	nr	nr	**943**	4.04	**0**	184	**515**	**69**	**2.32**	**11.1**
MR-8-S	f	8/9/2004	0.02	10.86	1.3	0.2	**856**	3.55	**0**	3.55	**512**	**74.6**	**2.08**	**10.7**

Remediation Recommendations for Marietta Run:

The site needs alkalinity, oxidation, and settlement time. To get adequate treatment space, it should be possible to redirect the AMD upstream along the haul road by adjusting the grade. This will

bring the AMD to a flood plain/bar along Marietta Run whose surface is only about 2 feet above the water table. Much like MR-10 the flats along the creek will be regularly swept by flooding so surface structures should be kept to a minimum.

The site will need an oxidizing wetland. For a nominal flow of 60 gpm and an incoming iron concentration of 75mg/L, a wetland of 2.8 acres would be required. There are two options for acquiring alkalinity on this site: Option 1 would construct a slag leach bed in the flood plain into which about 5 gpm of non- polluted water would be fed. This could either be a channel cut from Marietta Run or a collection of shallow groundwater in the flood plain.

Slag Leach Bed	-1/8 EAF slag
Variable size	
INPUT:	
Inflow	5gp
Depth	2ft
Design factor	20

DISCHARGE TO BE TREATED:

Acidity	250mg/L
Flow	50gpm
Acid load	150 lb/day
Acid load	27.5 tpy
OUTPUT:	
Infiltration rate	0.08gpm/sq.ft.
Required surface area	1319.51 sq.ft.
Side length	36.33 ft.
Resulting alkalinity	1000.00mg/L
Alkaline load generation	60.00lbs/day
Alkaline load generation	11.00tpy
Required slag	198.41 tons
Life	6.03 years

The other option for acquiring alkalinity would be to construct a J-trench arrangement, on the two sides facing the upstream and lateral sides of the flood plain surrounding the wetland on two sides. This latter option would intercept and utilize the groundwater seeping through the floodplain water table and add alkalinity prior to entering the aerobic wetland.

ODNR Cost estimate MR-8-S

Mobilization/Clearing	$9,790
Steel Slag Leach Bed	5,970
Earthwork	45,017
Revegetation	1,500
Spillway(s)	12,778
Engineering	18,264
Total	**$93,819**

Pre and Post Treatment Sampling MR-8-S

It is recommended that three samples, once per month, for six months, be analyzed of Group I parameters to fully characterize the high and low flow chemistry. These three samples should be taken both at the seep and immediately upstream and downstream of the treatment site. This six-month sampling will provide the needed pre-reclamation water quality data to determine effectiveness of the restoration.

ODNR Cambridge Lab sample analysis, $110 x 18 samples		$1980
Staff time collecting samples, (10hrs*6days) 60 hours @ 30$/hr		$1800
Travel, $0.42/mile, total miles 60 miles	(10 miles per day)	$ 25.20
Total		**$3805.20**

Post-construction water quality monitoring should be conducted at least two to four times a year with biological monitoring once a year downstream of the restoration project. Post-construction monitoring should begin within 6 months of completion.

MR-10, (11.5, and 11S)

This site consists of a high wall that is likely connected with extensive underground works. There is a large pit lake between the high wall and the original haul road. Downstream of the haul road are two primary seeps (MR-11.5 and MR11-S) that exit the floodplain and travel by channels for 200 yards where they join into one channel that travels toward Marietta Run. This channel is referred to as MR-10. The MR-11.5 is net alkaline (100mg/L alkalinity) and has the highest flow: 0-200 gpm. MR-11-S has a flow around 10 gpm, is net neutral with about 38 mg/L ferrous iron. Marietta Run's water quality is good in this area but the stream bottom is stained by metal flocculent downstream of this site. The objective is to prevent metal precipitation in Marietta Run.

Location: MR-10 is at 0 river miles, at 39.39029303 latitude -81.88742314 longitude, and is at an elevation of 644 feet. This tributary enters Marietta Run at 1.81 river miles. The area of land above this point is 0.85 square miles and the length of the stream above this point is 5.46 miles.

MR11-S is a seep that enters Marietta Run at 1.81 river miles, at 39.39075328 latitude -81.88763369 longitude, and is at an elevation of 619 feet. This seep is associated with mine # As133.

Access: MR-10 is a tributary on the northwest side of Marietta Run. It is located at RM 1.81. AMD water enters Marietta Run from a diffuse group of inputs that are on Jim Milligan's property. This site could be reached by a vehicle, with permission of the landowner (Mike Milligan). Mr. Milligan's email contact is mike@jmmarch.com. The site is accessible by foot, either by walking down a gated haul road, or by parking on Marietta Run, coming down the hill, and crossing the creek.

Water Chemistry in treatment area

MR-10 was sampled at the mouth to determine the input of MR11-S into Marietta Run. The metal, sulfate, and acid concentrations are greatly reduced at the mouth of MR-10 compared to MR11-S.

MR-10 has an average net alkalinity of 129.0 mg/L, an average pH of 7.5, an average conductivity of 470.5 uS, and an average sulfate concentration of 87.5 mg/L. Total metal concentrations are 2.7 mg/L (1.25 mg/L Fe, 0.578 mg/L Mn, and 0.906 mg/L Al) at high flow and 4.9 mg/L (2.24 mg/L Fe, 2.68 mg/L Mn) at low flow. The chart below displays the sulfate and metal loading of MR-10.

Table 22. MR-10 Metal and Sulfate Loadings

MR-10	High Flow	Low Flow	Average
Metal Load (lbs/day)	22.8	5.3	14.1
% Metals Contribution	24	4	14
Sulfate Load (lbs/day)	508.9	122.5	315.7
% Sulfate Contribution	34	14	24

Table 23. Water chemistry for Marietta Run Sites

Site number	Filtered	DATE	FLOW cfs	FLOW gpm	COND-LAB	PH-LAB	ALK mg/L	ACIDITY-LAB mg/L	SULFATE mg/L	FE mg/L	MN mg/L	AL mg/L
MR-10	nf	5/13/2003	1.55	696.37	351	7.59	112	4.79	60.9	**1.3**	**0.58**	0.91
MR11-S	f	5/13/2003	0.02	9.34	**1260**	5.94	41.6	110	**625**	**32.5**	**7.10**	0.66
MR-10	nf	9/30/2003	0.20	89.52	590	7.34	160	9.15	114	**2.2**	**2.68**	<0.25
MR11-S	f	9/30/2003	0.01	2.25	**1060**	6.13	58.6	72.3	**464**	**39.7**	**5.88**	<0.25
MR-10	nf	4/19/2004	1.17	526.90	352	7.34	122	3.48	49.8	0.5	**0.49**	<0.25
MR-11.5	nf	4/19/2004	624.58	624.58	347	7.54	121	2.86	42	0.4	**0.49**	<0.25
MR11-S	f	4/19/2004	0.01	2.24	**943**	5.78	47	64.9	**218**	**24.4**	**3.91**	<0.25
MR-10	nf	6/14/2004	2.22	997.41	446	7.55	146	5.49	77.4	**1.1**	**1.25**	<0.25
MR-11.5	nf	6/14/2004	0.23	102.33	457	7.49	147	5.04	77.8	**0.9**	**1.13**	<0.25
MR11-S	f	6/14/2004	0.00	0.02	**930**	6.11	50.9	79.9	**433**	**31.6**	**3.03**	<0.25
MR-10	nf	8/9/2004	0.00	0.02	569	7.02	177	7.02	140	0.9	**1.98**	<0.25
MR-11.5	nf	8/9/2004	0.01	5.07	568	7.26	175	7.26	140	**1.1**	**1.88**	<0.25
MR11-S	f	8/9/2004	0.00	0.56	**783**	5.71	57.7	5.71	**361**	**31.3**	**2.69**	<0.25

From available water quality data, MR-10 appears to be the second largest AMD contributor to Marietta Run. (MR-8-S is the largest). The contributions of MR-10 appear to be more significant at high flow periods. The source of AMD in MR-10 appears to be MR11-S. However, the stream channel and surrounding area is quite disturbed from unreclaimed strip mining.

Remediation Recommendations for MR-11-S and MR-11.5:

Water treatment needs include oxidation of ferrous iron and settlement of the resulting ferric hydroxide flocculants. There is no need for additional alkalinity. Therefore, an oxidizing wetland is recommended. Given a nominal flow of 100 gpm and 38mg/L of ferrous iron, a 2.4 acre wetland is recommended. Since the ground is near saturation, it might be best to consider constructing a road/berm around the perimeter and tie it into the road embankment on the upstream side rather than trying to

excavate the entire area. Maximum depth of the pond should not exceed three feet. The embankments should be designed to withstand periodic flooding and occasional cleanout of flood debris will probably be needed.

ODNR cost estimate for site MR 11

MR 11S

Mobilization/Clearing	$1281
Revegetation	1500
Spillway	660
Earthwork	6,379
Engineering	2,455
Total	**12, 275**

MR-11.5

Mobilization/Clearing	$2,893
Revegetation	1,500
Earthwork	11,410
Spillway	6,379
Engineering	5,545
Total	**$27,727**

Pre and Post Treatment Sampling MR-11S

It is recommended that six samples, once per month, be analyzed of Group I parameters to fully characterize the high and low flow chemistry. Samples should be taken at MR 11s and MR-11.5, downstream of the treatment site, and both upstream and downstream of MR-10 on Marietta Run. This six-month sampling will provide the needed pre-reclamation water quality data to determine effectiveness of the restoration. If this project were done at the same time as MR-8-S then one of the samples would be eliminated.

ODNR Cambridge Lab sample analysis, $110 x 24 samples	$2640
Staff time collecting samples, 48 hours @ 30$/hr	$1440
Travel, $0.42/mile, total miles 50 miles	$ 21

Post-construction water quality monitoring should be conducted at least two to four times a year with biological monitoring once per year downstream of the restoration project. Multiple sites downstream should be established to monitor water quality and biological improvements over a given distance from the treatment site. Post-construction monitoring should begin within 6 months of wetland completion.

AMD Impact to Marietta Run

Biology

Table 24. Biology Data for Marietta Run - 2004

Marietta Run									
Station (Map #)	Fish RM	Macro RM	IBI	MIwb	ICI or Narrative Rating	QHEI	Aquatic Life Uses Ex/Rec	Attain-ment Status	Comment
S01150 3.202004	3.20	3.50	50	NA	E	77.0	WWH	**Full**	dst. Brill Run
S01150 1.002004	1.60	1.00	44	NA	MG^{ns}	75.5	WWH	**Full**	B Below the 2 Seeps
S01150 0.102004	0.10	0.10	40^{ns}	NA	VG	62.5	WWH	**Full**	St. Rt. 329, at mouth

Ecoregion Biocriteria: Western Allegheny Plateau (WAP)

Index and Site Type	WWH	EWH	MWH	LRW-AMD
IBI – Wading & Headwater	44	50	24/24	18
Mod. Iwb - Wading	8.4	9.4	6.2/5.5	4.0
ICI/Narrative	36/G	46/E	22/30	8/MF

Footnotes

a - A qualitative narrative evaluation based on best professional judgment and sampling attributes such as community composition, EPT taxa richness, and QCTV scores were used when quantitative data were not available (E-exceptional, G-good, MG-marginally good, F-fair, P-poor, VP-very poor); for Moxahala Creek a draft Qualitative ICI index was also used.

b - Attainment status is given for existing use designations, except where a use designation change is recommended, in which case, the attainment status for the recommended use is given.

c - Limited Resource Water - acid mine drainage (LRW-AMD) benchmarks based on best professional judgment driven by the need to protect against acutely toxic stream conditions. Macroinvertebrate qualitative only data were evaluated based on densities of EPT taxa on the natural substrates (see Methods Section), a narrative VP* or P* indicates departure from the benchmark.

na - MIwb not applicable at headwater sites (< 20 mi^2).

† - HD sampler set, but not retrieved due to flood flows destroying samplers.

‡ - Dry conditions in August followed by flooding conditions in September likely influenced assemblage conditions (data excluded from attainment decision)

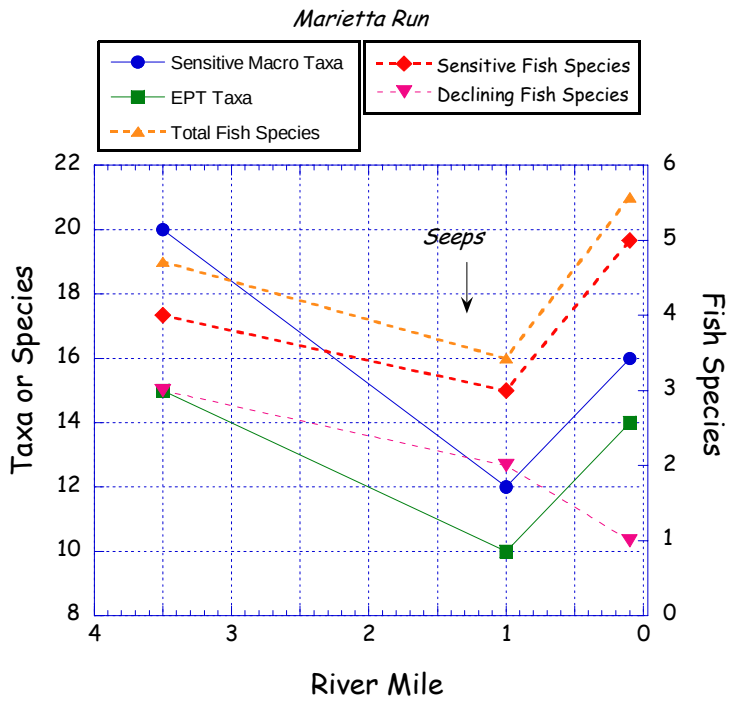
ns - Nonsignificant departure from biocriteria (<4 IBI or ICI units, or <0.5 MIwb units).

* - Indicates significant departure from applicable biocriteria (>4 IBI or ICI units, or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

Marietta Run has some mining related seeps that discharge into it, however impacts seemed relatively minimal. All sites met the WWH aquatic life use. The macroinvertebrate assemblages did decline below the seeps, but still attained the WWH biocriteria. In the fish assemblage, Redside Dace (*Clinostomus elongates*) were not found downstream of the seep although they were abundant at the upstream site. Redside Dace are considered an “intolerant” fish and indicators of high quality, small streams. Their absence could be related to episodic water quality impacts. This same upstream to

downstream pattern was mirrored in changes in total, declining, and sensitive fish species richness (Figure 5). Habitat quality was excellent at the two most upstream sites, but only rated good near the mouth. Macroinvertebrate assemblages showed a similar pattern to the fish. Sensitive macroinvertebrates and EPT taxa declined below the seeps (Figure 8), but these sources were not severe enough to result in a change to non-attainment in the overall index scores.

Figure 8. Biological sensitivity indicators vs. river mile for Marietta Run



2004 Sediment Study

Metal concentrations (mg/kg) in sediments were collected from Federal Creek tributaries in 2004. Values proceeded by a (<) were below the reporting limit. Those preceded by (*) exceeded the threshold effect concentration (TEC) described by MacDonald, et.al. (2000). Values preceded by (#) exceeded Ohio-specific Sediment Reference Values (SRV's).

Table 25 Marietta Run values from OEPA sediments study 2004 TMDL

EPA sediments study 2004 TMDL

Marietta Run @ RM 1.5 @ Marietta Run Rd.

Al	Ba	Ca	Cr	Cu	Fe	Pb	Mg	Mn
29,600	228	3740	31	13.6	27,200	<23	4190	1040
Ni	**K**	**Na**	**Sr**	**Zn**	**Hg**	**As**	**Cd**	**Se**
<23	6210	<2830	62	66.8	0.047	***14.1**	0.137	1.16

for standards see section on sediment study at the beginning of the document.

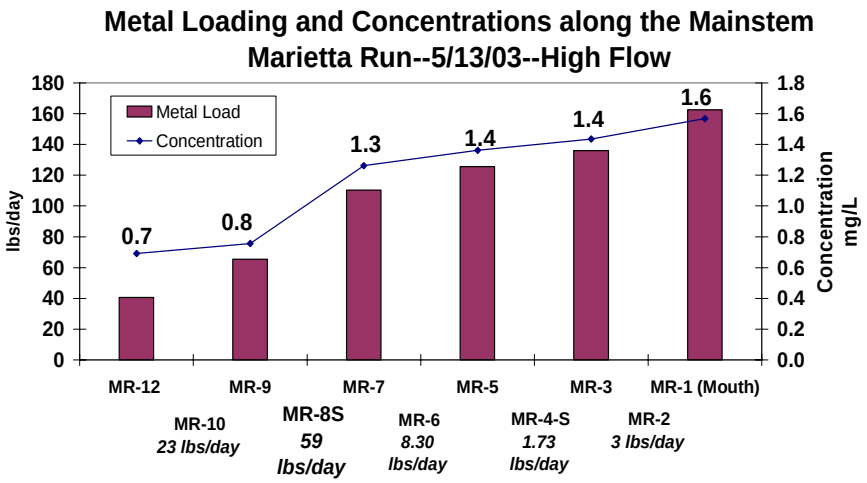
Mainstem of Marietta Run

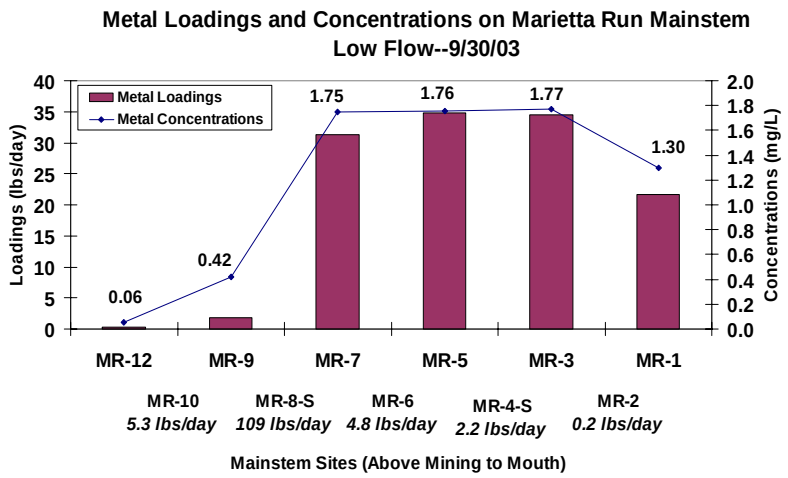
As demonstrated in the figure below, the additive effect of each AMD input is reflected in the metal concentrations of the mainstem sampling points, which begin at MR-12, an area above the mining,

and end at MR-1, the mouth of Marietta Run. The impact of MR-8-S appears the most severe, and is evident on both the 5/13/03 and 9/30/03 sampling dates. According to water chemistry data collected on 5/13/03, MR-8-S contributed 59 lbs/day of metals to Marietta Run. MR-8-S enters between sites MR-9 and MR-7, with MR-7 being the downstream location. The metal load increases from 65 lbs/day at the MR-9 location to 110 lbs/day at the MR-7 location. Metal concentrations increase from 0.8 mg/L to 1.3 mg/L. During low flow, the impact of MR-8-S is even more severe, with the metal load increasing from 1.9 lbs/day at MR-9 to 31.3 lbs/day at MR-7, and the concentration increasing from 0.4 mg/L to 1.7 mg/L.

During high flow, the increase between MR-3 and MR-1 is unexplained by the small loading of tributary MR-2. The metal load increases from 135.9 lbs/day to 162.5 lbs/day at the mouth. The concentration increases from 1.43 to 1.56 mg/L. There may be significant missing inputs in this section, as much of this area has been strip-mined. However, during low flow, this section shows the opposite trend of decreasing metal loads and concentrations between MR-3 and MR-1. (The discharge was measured to be lower at the mouth, but concentration was also reduced.)

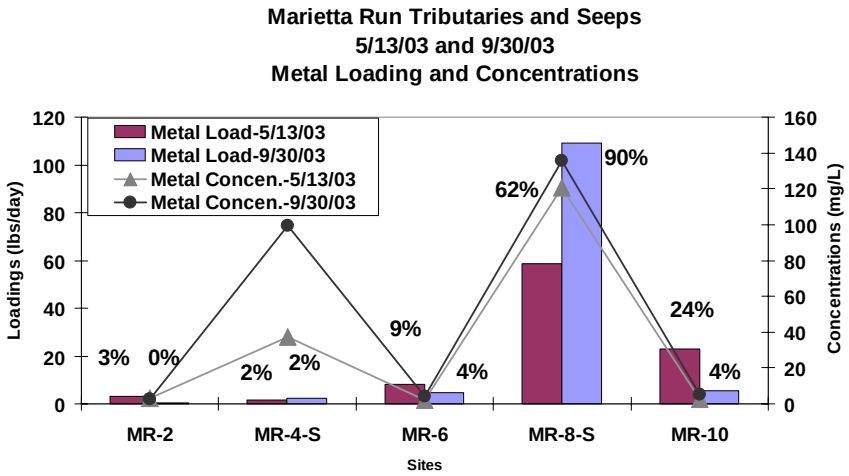
Figure 9. Marietta Run Loading and Concentrations along Mainstem





The relative percentages of metal loadings are presented in the figure below. MR-8-S is by far the most significant source of AMD pollution in Marietta Run, contributing an average of 76 percent of the metal loading to Marietta Run. MR-10 is the second most significant contributor, contributing an average of 14 percent of the metal loadings to Marietta Run. MR-6, a tributary, is ranked third, with an average of 6.5 percent of the metal loadings to Marietta Run. The source(s) of AMD contributing to MR-6 have not yet been identified. MR-4-S, an underground seep, plays a small part in the metal loadings to Marietta Run, contributing an average of 2 percent of the metal loadings. MR-2, a tributary fed by a series of strip pits, as well as unknown sources likely due to strip mining, appears to be the smallest contributor to the metal loadings of Marietta Run. The strip pits feeding MR-2 are net alkaline, with a neutral pH.

Figure 10 Metal Loadings and Concentrations for Marietta Run Tributaries.



Percentages indicated in figure relative to loading of tributaries.

Investigation of Marietta Run

A phase I water quality investigation was conducted in the Marietta Run subwatershed on 3/10/03, 3/14/03, and 4/30/03. Preliminary field observations identified strip pits and multiple gob piles from surface mining in Marietta Run. These strip pits did not show poor water quality. Three acid mine discharges from underground mines into the mainstem of Marietta Run were identified.

A phase II water quality investigation was conducted in Marietta Run on 5/13/03 and 9/30/03; three tributaries, three seeps, and five mainstem sites were sampled. Site MR-4-S (seep) is associated with mine number As152. Sites MR-8-S (seep) and MR11-S (seep) are associated with mine number As133. Numerous sources of acid mine drainage were found. Three AMD affected tributaries and three seeps were documented, as well as numerous gob piles and strip-mined areas, and diffuse, trickling seeps along the mainstem. The information relating to the loadings are presented above.

A phase III water quality investigation was conducted on 4/19/2004, 6/14/2004, and 8/9/2005. The sites were on the mainstem of Marietta Run below and above both MR-8-S and MR-10. Additionally samples were taken at both seeps.

Individual Site Descriptions

Listed below is a detailed description for the six AMD contributors in Marietta Run.

MR-6—Tributary MR-6 is at 0 river miles, at 39.38204801 latitude -81.88747091 longitude, and is at an elevation of 686 feet. This is a tributary that enters Marietta Run at 1.13 river miles. The area of land above this point is 0.56 square miles and the length of the stream above this point is 1.3 miles.

Location/Access: MR-6 is a small tributary that enters on the northwest side of Marietta Run. It is located on private property. This site is accessible by foot.

Site Description: MR-6 is a small tributary which may be impacted by AMD. The tributary has an average net alkalinity of 115.4 mg/L, an average pH of 7.65, an average conductivity of 500.5 uS, and an average sulfate concentration of 117.5 mg/L. It contributes an average of 21 percent of the sulfate load, and an average of 6.5 percent of the metal load into Marietta Run. The total metal concentration appeared high at both high and low flow, having values of 2.18 mg/L and 4.35 mg/L respectively. However, these samples were unfiltered. The TSS was 12.0 mg/L at high flow, and 16.0 mg/L at low flow

MR-4-S Seep: is a seep that enters Marietta Run at 0.8 river miles, at 39.37749613 latitude -81.88282952 longitude, and is at an elevation of 503 feet. This seep is associated with mine # As 152.

Access: MR-4-S located on the west side of Marietta Run, approximately 1 mile from the mouth. It is located approximately 20 feet from Marietta Run Rd., just below the first bridge crossing of Marietta Run Rd. over Marietta Run. It is located approximately where an abandoned underground mine is located on the mining map, but the opening of the mine is not visible.

Site Description: MR-4-S is a very low volume seep, having a discharge of 0.009 cfs at high flow and 0.004 cfs at low flow. This seep exhibits an average net acidity of 243.5 mg/L, and average pH of 4.00, and average sulfate load of 586 mg/L, and an average conductivity of 911.5. The total metal concentration at high flow is 37.08 mg/L, having a composition of 21.8 mg/L iron (ferrous iron equals 20.2 mg/L), 1.48 mg/L Mn, and 13.8 mg/L Al. At low flow, the metal concentration nearly triples, having a total concentration of 99.26 mg/L, with a composition of 57.3 mg/L Fe (45.0 mg/L ferrous iron), 2.66 mg/L Mn, and 39.3 mg/L Al. Overall, most of the AMD parameters are greatly increased at low flow, indicating possible dilution at high flow. The acidity concentration rises from 129 mg/L at high flow to 358 mg/L at low flow, the sulfate concentration rises from 413 mg/L at high flow to 759 mg/L at low flow, and the conductivity rises from 673 mg/L at high flow to 1150 mg/L at low flow. The acid, metal, and sulfate load to Marietta Run is displayed in the chart below.

MR-4-S Metal, Net Acid, and Sulfate Loadings

MR-4-S	High Flow	Low Flow	Average
Metal Load (lbs/day)	1.73	2.17	1.95
% Metals Contribution	2%	2%	2%
Acid Load (lbs/day)	6.02	7.82	6.92
Sulfate Load (lbs/day)	19.28	16.58	17.93
% Sulfate Contribution	1%	2%	1.5%

MR-2: AMD- impacted tributary

MR2 is at 0.0 river miles, at 39.37109328 latitude -81.88067269 longitude, and is at an elevation of 505 feet. This is a tributary that enters Marietta Run at 0.3 river miles. The area of land above this point is 0.044 square miles. This small tributary is not mapped therefore the stream length above this point in not available.

Access: MR-2 is a tributary on the west side of Marietta Run. It forms a ditch, which runs along the road for approximately one-quarter mile, and then flows through a culvert under Marietta Run Rd. before entering the mainstem. MR-2 collects input from strip mine ponds and strip-mined land.

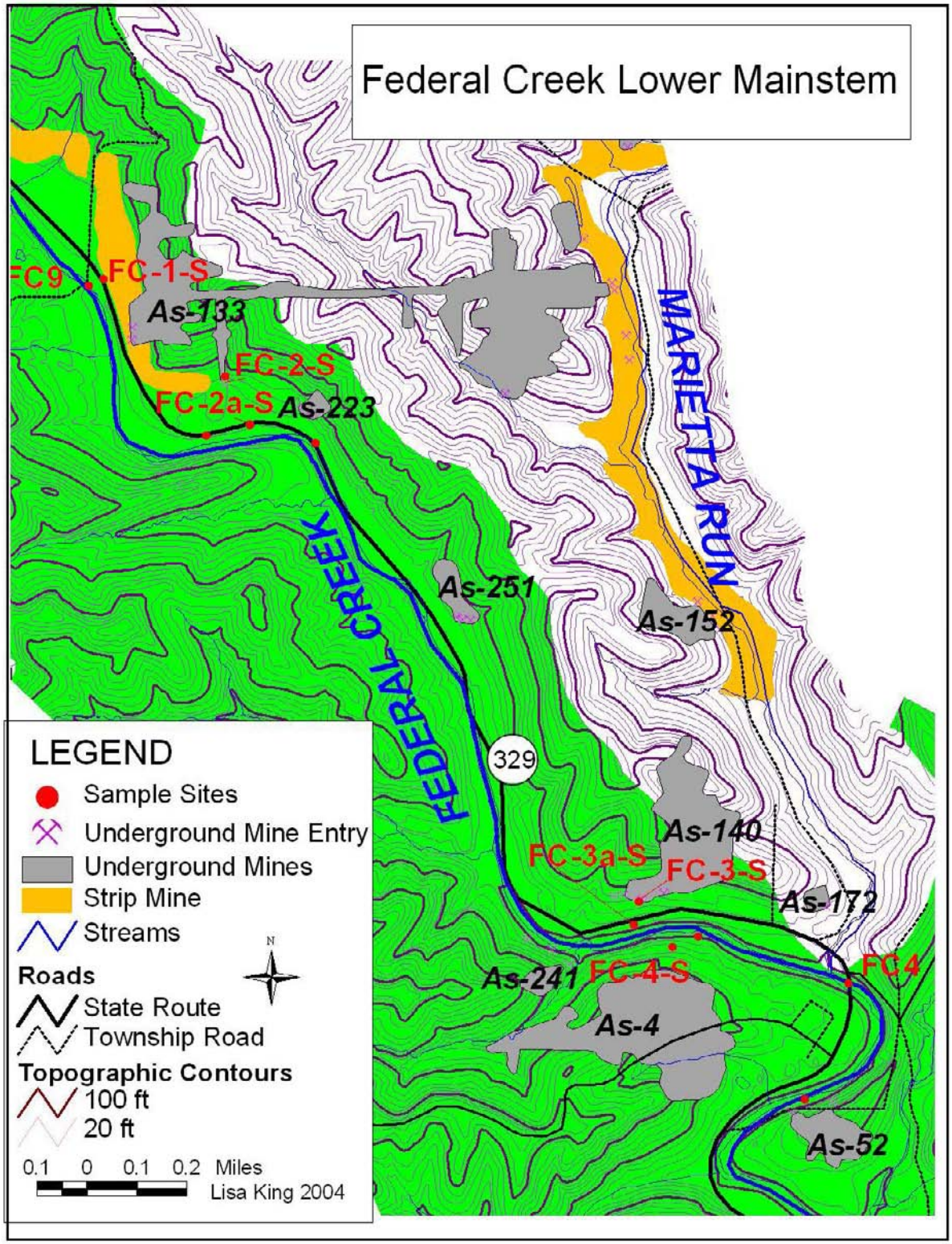
Site Description:MR-2 is a small volume input into Marietta Run, having a discharge of 0.197 cfs on 5/13/03 and a discharge of 0.015 cfs at on 9/30/03. The discharge had an average net alkaline value of 123.5 mg/L, and an average pH of 7.7. AMD is indicated in the discharge by the somewhat elevated average conductivity of 770 uS, and an average metal concentration of 2.7 mg/L (unfiltered). MR-2 does not appear to be a very significant metal or sulfate loader to Marietta Run, as shown in the table below.

MR-2 Metal and Sulfate Loadings

MR-2	High Flow	Low Flow	Average
Metal Load (lbs/day)	3.15	0.20	1.68
% Metals Contribution	3%	0%	1.5%
Sulfate Load (lbs/day)	233.0	25.9	129.5
% Sulfate Contribution	15%	3%	9%

FEDERAL CREEK LOWER MAINSTEM BASIN ASSESSMENT

Map 10 Federal Creek Lower Mainstem, in proximity to seeps



Geography Background

Lower Federal Creek occupies the southern portion of the watershed, flows in a south/southeast direction, entering the Hocking River at 15.29 river miles. It is located in Athens (61 percent), Morgan (31 percent), and Washington (8 percent) counties, crossing Homer, Rome, Ames, Bern, Marion, Wesley, Decatur, Canaan, and Dover Townships. The towns in the Federal Creek Watershed are Amesville, Kilvert, Joy, New England, Cutler, and Sharpsburg. Federal Creek can be found on the Corning, Ringold, Chesterhill, Jacksonville, Amesville, Cutler, Stewart, and Athens USGS quad sheets. Federal Creek has a drainage area of 144.73 square miles, and a stream length of 23.8 miles. In this watershed there are 2.25 square miles that have underground mines, which is 1.55 percent of the land in the entire watershed that has been mined underground. Additionally, in this watershed there are 2.09 square miles that have been strip-mined, which is 1.44 percent of the land in the entire watershed that has been strip-mined.

The stretch of Federal Creek between RM 4.8 and 8 (Tick Ridge Bridge to above Mayle Ridge Bridge) is an area affected by surface and underground mining. State Route 329 parallels the mainstem of Federal Creek during this stretch, and numerous gob piles are visible from the road. Four distinct areas within this stretch were found to contribute AMD directly into the mainstem of Federal Creek. Most of the watershed drains to this point, and this investigation was conducted to assess the impact of these small volume AMD discharges on the mainstem of Federal Creek.

Mining Impacts In Brief

The stretch of Federal Creek between river mile 4.8 and 8.0 (Tick Ridge Bridge to above Mayle Ridge Bridge) is an area affected by surface and underground mining. In this area there are four distinct mine seeps entering the Federal Creek mainstem.

The water coming into the Federal Creek mainstem from these seeps could be having an impact on the biotic integrity of Federal Creek. The entire mainstem of Federal Creek has been designated as an Exceptional Warm Water Habitat. The site immediately downstream of the ‘mainstem seeps’ is only partially attaining this score, with an ICI of 34 and a MIwb of 7.14. The next site above this site on Federal Creek, located above all of the mining impacts is fully attaining the EWH, with an ICI score of 42 and a Miwb score of 8.9. Chemistry was analyzed at this site on the same low flow day of 9/13/2005. The results of that day are included below. At times of low flow, these parameters rise, occasionally approaching or going above the targets set for this watershed. These periodic events of elevated mine drainage parameters could be the cause for this site only partially attaining its EWH use designation. Addressing the major seeps on Federal Valley could make a significant difference in Federal Creek under low flow regimes.

DATE	FLOW cfs	FLOW gpm	COND-LAB	PH-LAB	ALK mg/L	ACIDITY-LAB mg/L	SULFATE mg/L	TOT-FE mg/L	TOT-MN mg/L	TOT-AL mg/L
9/13/05	n/a	n/a	**771**	7.13	132	7.68	**236**	0.488	**1.370**	0.125

This report will discuss the water chemistry of all four seeps in this stretch. These sites are all easy to access and are very visible from State Route 329 and the mainstem of Federal Creek. Only one of the seeps (FC-2-S) will have information regarding remediation. This seep produces the highest discharge of water, and has the worst chemistry. FC-3-S has the second highest discharge and metal loadings. It is also associated with a cavernous opening that is dangerous to the public. FC-4-S does not have as much discharge and the metal loadings rank third of these three seeps. FC-4-S has a high visual impact and it is probably the best-known acid mine drainage discharge in the watershed.

Table 26. Federal Creek Mainstem Underground Mine Information

Mine number	Mine Name	Date Abandoned	Type	Coal elevation
AS-4	Broadwell Federal Coal Co.	1910		Coal Seam is 5'-8' in thickness
AS-52	Big Four Big Four Coal Co.	1916	Coal, Drift	
AS-133	Utley Jennings Coal	1922	Coal, Drift	
AS-140	Mae Rudy of Federal Valley J.F. Schuler & Son	1915	Coal, Drift	
AS-172	Broadwell (AS 522) Young & Hixon	1952	Coal, Drift	
AS-223	Harkins & White	1931	Coal, Drift	619.1'
AS-241	Smith Pioneer Coal Co.	1933	Coal, Drift	671.64
AS-251	#8 Van Dyke (As-509) Harry Van Dyke	1946	Coal, Drift	

Remediation and Description of Proposed Treatment Area

FC-2-S is a seep that enters Federal Creek at 6.9 river miles, at 39.38345826 latitude -81.90131103 longitude, and is at an elevation of 763 feet. This seep is associated with mine # As133. This mine drainage originates in a small pool approximately 500 feet from State Route 329. This pool drains into a channel that cuts directly across the floodplain to a culvert under State Route 329 and into Federal Creek. The channel is a small tributary to Federal Creek. The tributary lies in a deep channel that is lined with orange (iron) precipitate. There is a sample location in this channel referred to as FC-2-Sa. A nearby water impoundment does not drain to the channel that also contains acidic water.

Table 27 Water Chemistry of FC-2-S and FC-2-Sa

site number	filtered	DATE	LOCATION	FLOW cfs	FLOW gpm	COND-LAB	PH-LAB	ALK mg/L	ACIDITY-LAB mg/L	SULFATE mg/L	FE mg/L	MN mg/L	AL mg/L
FC-2-S	f	4/20/2004	actual seep	0.01	3.79	3610	2.4	0	1523	2453	291	7.35	123.0
FC-2-S	f	6/15/2004	actual seep	0.01	4.40	4140	2.5	0	1181	2889	395	8.14	157.0
FC-2-S	f	8/10/2004	actual seep	0.01	4.40	3860	2.3	0	1941	3005	414	8.03	174.0
FC-2Sa	nf	7/8/2003	Tributary	0.01	4.58	1820	3.0	0	290	881	27.4	3.09	24.8
FC-2Sa	nf	10/20/2003	Tributary	0.01	5.06	1970	2.9	0	423	1136	44.5	3.59	37.5

The table below shows metal and sulfate loadings into Federal Creek from data collected at the channel near the confluence with Federal Creek.

Table 28 Metal and Sulfate Loads FC-2-Sa

	medium flow	low flow	Average Lbs/day
METAL LOAD lbs/day combined Fe, Mn, Al	5.20	3.04	4.12
SULFATE LOAD lbs/day	68.98	48.42	58.70

Remediation Recommendations for FC-2-S

Cost Estimate

Mobilization/ Clearing	10,798
Limestone Leach Bed	12,031
Open Limestone Channel	2,813
Wetland	52,278
Grass Ditch	4,869
Engineering	20,697
Total	**$103,486**

Pre and Post Treatment Sampling FC-2-S

It is recommended that three samples, once per month, for six months, be analyzed of Group I parameters to fully characterize the high and low flow chemistry. These 18 samples should be taken immediately downstream of the treatment site and at both up stream and downstream sites on Federal Creek. This six-month sampling will provide the needed pre-reclamation water quality data to determine effectiveness of the restoration.

ODNR Cambridge Lab sample analysis, $110 x 18 samples	$1980
Staff time collecting samples, 48 hours @ 30$/hr	$1440
Travel, $0.42/mile, total miles 50 miles	$ 21

Post-construction water quality monitoring should be conducted twice a year, and biological monitoring once, downstream of the restoration project. Post-construction monitoring should begin within 6 months of completion.

AMD Impacts to Federal Creek

Biology Investigation for Lower Federal Creek

This table represents the 2004 data for the lower section of Federal Creek. Information on the entire watershed is provided in Section I. The first two lines in the table are sites that are above all the mine seeps located on Federal Creek. The third line represents the site located immediately downstream of the mainstem seeps. Although both locations are achieving Exceptional Warmwater Habitat, the site below the mine seeps is only partially attaining this use designation. This is because of the very low score in macroinvertbrates. This lowering of attainment could be related to periodic mine- related impacts to Federal Creek.

Table 29 Biology Data for Federal Creek Mainstem in Area of Seeps

sampled by MBI in the Hocking River watershed during 2004.

Station (Map #)	Fish RM	Macro RM	IBI	MIwb	ICI or Narrative Rating	QHEI	Aquatic Life Uses Ex/Rec	Attain -ment Status	Comment
S01100 9.102004	9.10	—	47^{ns}	8.90 ^{ns}	VG^{ns}	56.0	EWH	**Full**	immediately dst Sharps Fk
S01100 7.502004	—	7.50	—	—	42*‡	—	EWH	—	dst. Sharps Fork
S01100 4.902004	4.90	4.90	48^{ns}	7.14*	34*‡	62.0	EWH	**Partial**	adj. St. Rt. 329 dst. Broadwell

Ecoregion Biocriteria: Western Allegheny Plateau (WAP)

Index and Site Type	**WWH**	**EWH**	**MWH**	**LRW-AMD**
IBI – Wading & Headwater	**44**	**50**	**24/24**	**18**
Mod. Iwb - Wading	**8.4**	**9.4**	**6.2/5,5**	**4.0**
ICI/Narrative	**36/G**	**46/E**	**22/30**	**8/MF**

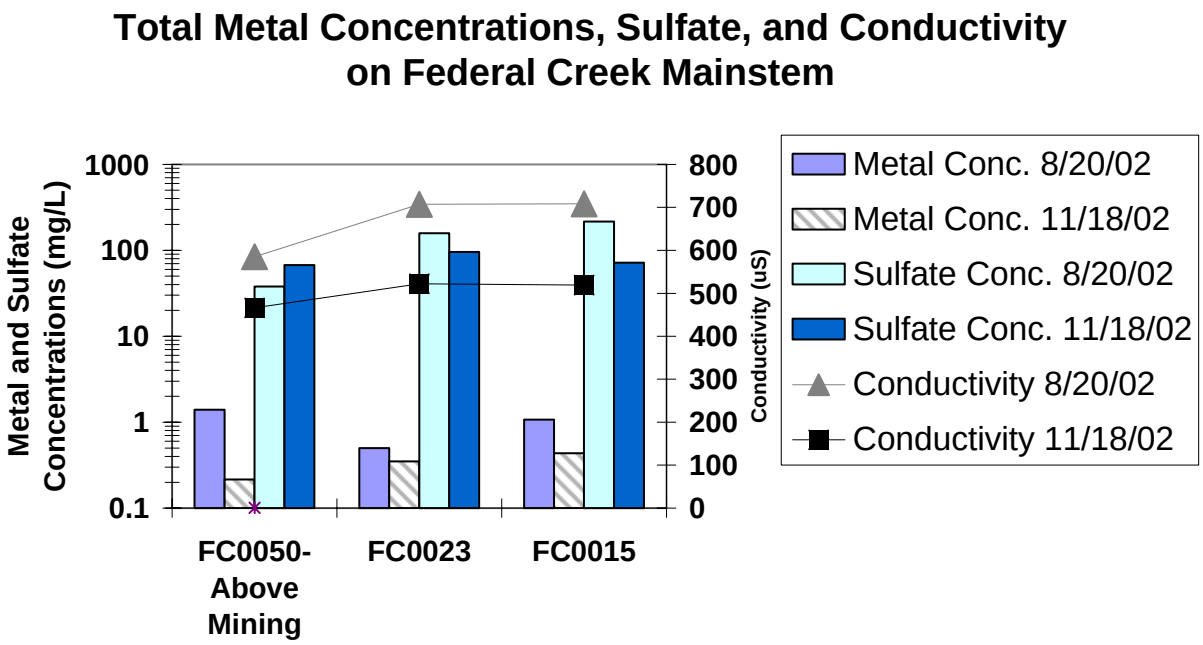
Footnotes

a - A qualitative narrative evaluation based on best professional judgment and sampling attributes such as community composition, EPT taxa richness, and QCTV scores were used when quantitative data were not available (E-exceptional, G-good, MG-marginally good, F-fair, P-poor, VP-very poor); for Moxahala Creek a draft Qualitative ICI index was also used.
b - Attainment status is given for existing use designations, except where a use designation change is recommended, in which case, the attainment status for the recommended use is given.
c - Limited Resource Water - acid mine drainage (LRW-AMD) benchmarks based on best professional judgment driven by the need to protect against acutely toxic stream conditions. Macroinvertebrate qualitative only data were evaluated based on densities of EPT taxa on the natural substrates (see Methods Section), a narrative VP* or P* indicates departure from the benchmark.
na - MIwb not applicable at headwater sites (< 20 mi^2).
† - HD sampler set, but not retrieved due to flood flows destroying samplers.
‡ - Dry conditions in August followed by flooding conditions in September likely influenced assemblage conditions (data excluded from attainment decision)
ns - Nonsignificant departure from biocriteria (<4 IBI or ICI units, or <0.5 MIwb units).
* - Indicates significant departure from applicable biocriteria (>4 IBI or ICI units, or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

Water Chemistry on the Mainstem of Federal Creek

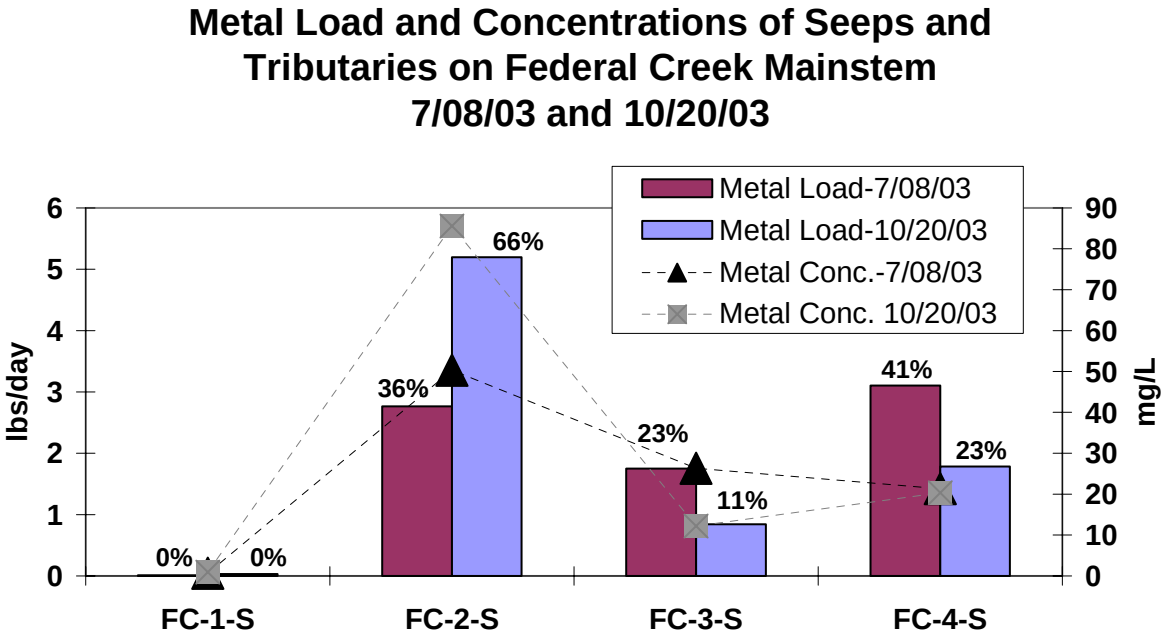
The section of Federal Creek receiving direct AMD input from mining sources is characterized by a deep channel with steep banks. In this section, Federal Creek contains a large volume of water, as its drainage area is large and it is approaching the mouth. The AMD inputs into Federal Creek have comparatively very low volume. The graph below displays the conductivity levels and sulfate and total metal concentrations taken at three points along Federal Creek in 2002. FC0050, the first set of bars on the graph, is above the majority of mining in Federal Creek. FC0023 is a point below FC-2-S. FC0015 is a point below all four AMD seeps along the mainstem, as well as the large tributary, Marietta Run. Water chemistry exhibits only a small increase in metal concentrations, conductivity, and sulfate concentrations. Sulfate concentrations are highest on 8/20/02, when discharge was lowest. Concentrations rise from the pre-mining levels of 37.9 mg/L to 158 mg/L at FC0023, and then rise further to 216 mg/L at FC0015. On this same date, metal concentrations are highest above the mining area. Conductivity values rise from 585 uS at FC0050 to 707 uS at FC0023 to 708 uS at FC0015.

Figure 11. Metal Concentrations for Mainstem Seeps



The following graph shows the total metal loading and total metal concentrations at a low (7/08/03) and high (10/20/03) flow sampling date. FC-2-S and FC-4-S are the largest contributors of the four tributaries/seeps sampled.

Figure 12. Metal Concentrations for Mainstem Seeps



Investigation of Federal Creek

Phase I

A phase I water quality investigation was conducted on the stretch of Federal Creek between river mile four and eight (Tick Ridge Bridge to above Mayle Ridge Bridge) in April 2003 and again in April 2004. Eight underground mines were investigated. Only four of these were found to contribute mine drainage directly into the mainstem of Federal Creek. Preliminary field observations also identified impoundments of water resulting from strip mining and multiple gob piles.

Phase II

A phase II water quality investigation was conducted in this section of the lower mainstem of Federal Creek on 7/8/2003 and 10/20/2003. This information was used for the characterizations above. Four of the mainstem mine drainage seeps were sampled above their confluence with Federal Creek. These sites are referred to as FC-1-S, associated with strip mining and possibly associated with underground mine AS 133; FC-2-Sa, associated with underground mine AS133; FC-3-Sa, associated with underground mine AS140; and FC-4-S associated with underground mine AS4. Further, samples were taken from the Federal Creek mainstem (FC-4 immediately downstream of all mine drainage; FC-9 immediately above all mine drainage).

Phase III

A phase III water quality investigation was conducted in this area on 4/20/2005, 6/15/2005, and 8/10/2005. For this phase, filtered samples were taken at FC-2-S and FC-3-S. The locations of these

samples were moved to locations where the mine drainage is coming out of the ground. Additionally, filtered samples were taken from FC4S and an unfiltered sample was taken from FC-3-S. Further, samples were taken from the Federal Creek mainstem (FC-4 immediately downstream of all mine drainage; FC-9 immediately above all mine drainage).

Individual Site Descriptions

FC-1-S:

Location/Access: FC-1-S is located approximately 50-100 feet downstream of Tick Ridge Rd. FC-1-S is a seep that enters Federal Creek at 7.5 river miles, at 39.38757587 latitude -81.90705414 longitude, and is at an elevation of 623 feet. This seep is associated with mine # As133. It is accessible by vehicle and can be easily seen from the bridge at Tick Ridge.

S**ite Description:** FC-1-S is a small tributary draining land that has been surface mined. Additionally, abandoned mine openings are indicated by the mining quadrangle. The mined land lies to the northeast of State Route 329. FC-1-S passes through a culvert under State Route 329 approximately 50 feet before it enters Federal Creek. The source of AMD to this tributary is from an area that has been strip-mined. It is not possible to determine if the mine drainage is from dispersed strip-mine sources or if it is from a mine entry to mine AS133 that has been destroyed in the strip-mining.

FC-1-S is a small volume, net alkaline tributary. Under higher flow conditions, on the 7/08/03 sampling date, the discharge of FC-1-S was 0.003 cfs. On the lower flow condition sampling date, 10/20/03, discharge of FC-1-S was measured at 0.006 cfs, which is twice the discharge on 7/08/03. For the 7/08/03 sampling date, FC-1-S had a conductivity of 1260 uS, a pH of 6.93, a net alkalinity of 130 mg/L, and a sulfate concentration of 502 mg/L. Total metal concentrations were 0.658 mg/L. On the 10/20/03 sampling date, FC-1-S had a conductivity of 1290 uS, a pH of 6.75, a net alkalinity of 148 mg/L, and a sulfate concentration of 557 mg/L. Total metal concentrations were 0.924 mg/L.

Of the four tributaries sampled, FC-1-S contributed an average of 0 percent of the metal loadings and 9 percent of the sulfate loadings.

FC-2-S

FC-2-S is a seep that enters Federal Creek at 6.9 river miles, at 39.38345826 latitude -81.90131103 longitude, and is at an elevation of 763 feet. This seep is associated with mine # As133. This mine drainage originates in a small pool approximately 500 feet from State Route 329. This pool drains into a channel that cuts directly across the floodplain to a culvert under State Route 329 and into Federal Creek. The channel is a small tributary to Federal Creek. The tributary lies in a deep channel that is lined with orange iron precipitate. There is a sample location in this channel referred to as FC-2-Sa. There is a nearby water impoundment that does not drain to the channel that also contains acidic water.

Access: FC-2-S enters Federal Creek at approximately 5.55 RM (about 0.5 mile below Tick Ridge Bridge). The channel passes through a culvert under State Route 329 approximately 50 feet before its confluence with Federal Creek. The sampling location is accessible by vehicle. The actual seep is approximately 500 feet from the road. The seep can be found by following the two-foot wide channel filled with orange water.

FC-3-S:

Location/Access: FC-3-Sa is a tributary that enters Federal Creek at 5.5 river miles, at 39.36873000 latitude -81.88738000 longitude, and is at an elevation of 700 feet. FC-3-S is located at the mine entry, 39.368381 latitude and _81.88749338 longitude. This water is associated with mine # As140. FC-3-Sa is the drainage of an underground mine As 140 that crosses a coal refuse pile located on S.R. 329 north of Phillipsburg. The drainage passes through a culvert under State Route 329 approximately 100 feet from its confluence with Federal Creek. The gob pile is just above the community of Phillipsburg. The site is accessible by vehicle.

FC-3-S is a low volume, net acidic input into Federal Creek. Discharge was measured at 0.012 cfs on both 7/08/03 and 10/20/03. On 7/08/03, the pH was 3.7, the net acid concentration was 120 mg/L, conductivity was 885 uS, and the sulfate concentration was 885 mg/L. Metal concentrations were 11.3 mg/L Fe, 1.22 mg/L Mn, and 13.8 mg/L Al. On 10/20/03, the pH was 4.7, the net acid concentration was 42 mg/L, the conductivity was 653 uS, and the sulfate concentration was 275 mg/L. Metal concentrations were 7.4 mg/L Fe, 0.41 mg/L Mn, and 4.37 mg/L Al. The metal load was 1.75 lbs/day on 7/08/03, and 0.84 lbs/day on 10/20/03, giving an average of 1.30 lbs/day, OR-17 percent of the average metal load of the four tributaries sampled along the mainstem. The sulfate load was 58.8 lbs/day on 7/08/03 and 19.0 lbs/day on 10/20/03, giving on average of 38.9 lbs/day, or 23.5 percent of the average total sulfate load of the four tributaries. The acid load was 8.0 lbs/day on 7/08/03 and 2.9 lbs/day on 10/20/03.

FC-4-S: Underground Mine Seep

Location/Access: FC-4-S is a seep that enters Federal Creek at 5.4 river miles, at 39.36809273 latitude -81.88596301 longitude, and is at an elevation of 678 feet. This seep is associated with mine # As 4. FC-4-S is located on private property owned by Don Schierholt. This site is approximately 200 feet downstream from the confluence of FC-3-Sa. The site is accessible by foot. A four wheel drive road exists on the property that runs behind the seep site. The seep is approximately 500 feet downhill from the road.

Site Description: FC-4-S is an underground mine seep believed to be associated with mine complex As4. The mine opening is not visible, but the location of the seep is distinct. The seep is marked by a distinct area of saturated ground that continues to widen to form a triangle shaped area of saturated

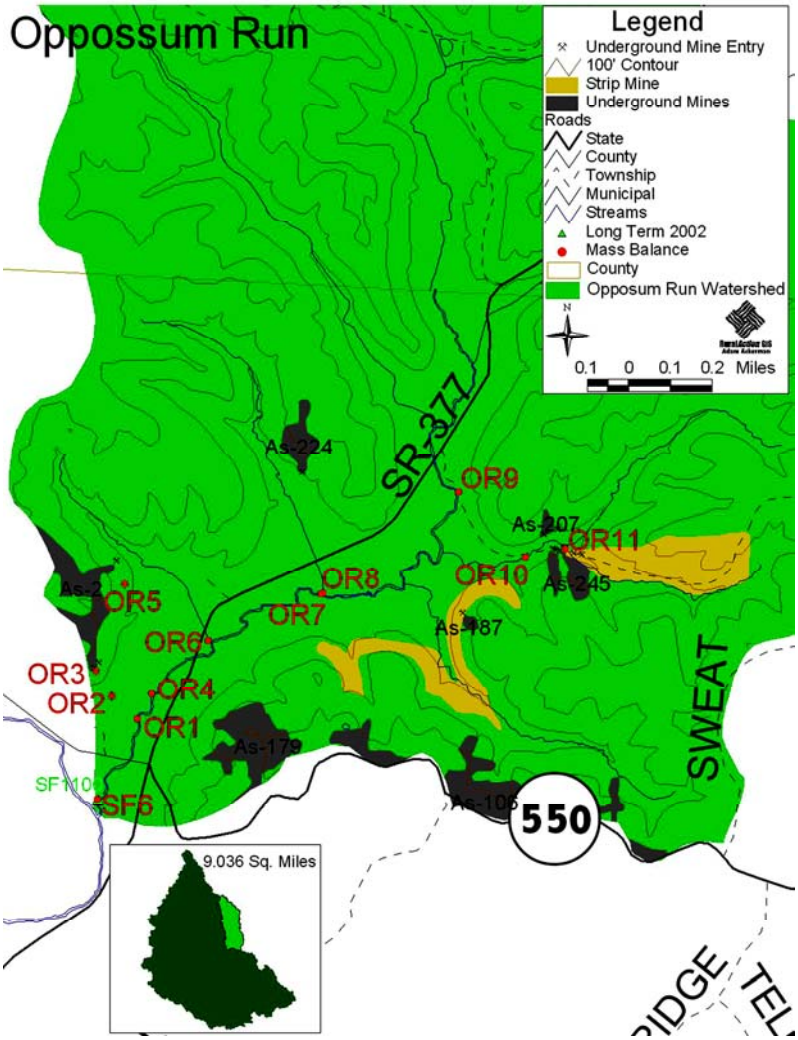
ground. This area then forms a pool of water, which then discharges across a large area, approximately a half of an acre in size.

FC-4-S is a low volume, net acidic input into Federal Creek. Discharge was measured at 0.027 cfs on 7/08/03 and 0.016 cfs on 10/20/03. Discharge at this site is difficult to measure, and the figures obtained more accurately represent the volume of water discharged by the seep as opposed to the volume of water entering Federal Creek. Discharge was not taken where the seep originates, as the ground is saturated to a depth of at least three feet, making measurement by pipe and bucket or flume not feasible. Additionally, more water appears to be discharged with distance from the point of origination. This area continues to widen, and the point below which water is no longer released is approximately 25 feet wide. The water flowing over this area is very shallow with a depth of less than one inch. This area then continues to widen into a large triangle shaped area, which is encrusted with a black and orange coating. Discharge was taken at the base of this triangle, where the water forms three distinct channels (two during low flow). However, one of these channels appears to dry up before reaching Federal Creek. Additionally, when looking at this area from the Federal Creek mainstem, subsurface seepages are apparent across the length of the bank. During the 10/20/03 sampling period, discharge of the Federal Creek mainstem was measured above and below this seep. However, the contribution of the seep could not be ascertained from this data (higher cfs on mainstem upstream of seep than downstream). On the 7/08/03 sampling date, the mainstem was too deep to be measured with available methods.

On 7/08/03, the pH was 3.64, the net acid concentration was 73 mg/L, conductivity was 963 uS, and the sulfate concentration was 435 mg/L. Metal concentrations were 11.9 mg/L ferrous iron, 4.3 mg/L ferric iron, 1.85 mg/L Mn, and 3.29 mg/L Al. On 10/20/03, the pH was 5.65, the net acid concentration was 48.6 mg/L, the conductivity was 730 uS, and the sulfate concentration was 340 mg/L. Metal concentrations were 16.3 mg/L ferrous iron, 1.9 mg/L ferric iron, 1.12 mg/L Mn, and 1.02 mg/L Al. The metal load was 3.1 lbs/day on 7/08/03, and 1.8 lbs/day on 10/20/03, giving an average of 2.45 lbs/day, or 32 percent of the average metal load of the four tributaries sampled along the mainstem. The sulfate load was 63.3 lbs/day on 7/08/03 and 29.8 lbs/day on 10/20/03, giving on average of 46.6 lbs/day, or 28.5 percent of the average total sulfate load of the four tributaries. The acid load was 10.6 lbs/day on 7/08/03 and 6.3 lbs/day on 10/20/03.

OPOSSUM RUN BASIN ASSESSMENT

Map 11 Opossum Run



Picture of AMD in Opossum

Site OR11

Gob Pile on R. Spaulding's land

Geography Background

Opossum Run occupies the northeastern portion of the watershed, flows in a southern direction and enters Sharps Fork at river mile 2.83. Opossum Run is located in Morgan and Athens counties, crossing Marion and Bern townships, and the village of Sharpsburg is located at the confluence. This subwatershed can be found on Amesville and Ringgold USGS quadrangle sheets. Opossum Run has a drainage area of 9.04 square miles, and a stream length of 7.6 miles. In this subwatershed there is 0.10 square mile or1.02 percent that has underground mines. In this subwatershed there is 0.99 square mile or 9.4 percent that has been strip-mined.

The mouth of Opossum Run enters Sharps Fork in the community of Sharpsburg. The areas impacted by past mining are small and are within the first one and a half river miles. Part of the impacted area is on Gifford State Forest. Two small tributaries have the most mine drainage. The first one is on Bob Spaulding's land. Mr. Spaulding allowed the watershed group to do a phase I assessment of the area. After that time he refused the group access to his land. The second largest contributor of acid mine drainage is the next tributary to the west that enters Opossum Run at 1.5 river miles. This tributary is generally orange in color. In places, the stream has been strip-mined and there is a significant amount of braided flow.

Mining Impacts In Brief

In Opossum Run there are two discrete underground mine seeps that presently do not appear to impact the mainstem. On Gifford State Forest, two small areas have previously been mined and cause a very small tributary to appear white and orange. These areas do not appear to have much impact on the mainstem. Two tributaries to the east of the mainstem do have impact. Of the tributaries, the watershed group only has access to a site that enters Opossum Run at 1.5 river miles. This tributary is referred to as OR-10.

OR-10 is a tributary discharging into the mainstem, and water quality samples taken here represent the mining impacts of OR-11, as well as the contributions of strip mines and a possible underground mine discharge in the region. This tributary contributes a metal load (combined iron, manganese, and aluminum) of 79 to 84 metal loads to Opossum Run. The discharge from this tributary ranges from 0.1 to 1.8 cfs. During high flow, 52 percent of the metal load in this stream comes from one tributary, referred to as OR-11. OR-11 contributes 100 percent of the metal load in this tributary during periods of low flow. Opossum Run achieved an Exceptional Warmwater Habitat use designation in 2004. However, the site immediately downstream of OR-10 is only partially achieving this use designation.

Opossum Run is a tributary of Sharps Fork, an Exceptional Warmwater Habitat stream. Opossum Run contributes a combined metal load of 10 percent to 13 percent and a sulfate load of 26 percent to Sharps Fork. Although Sharps Fork is an Exceptional Warmwater Habitat stream, it is only partially attaining this use designation downstream of Opossum Run and Sulphur Run.

Table 30 Opossum Run underground mine information

Mine number	Mine Name	Date Abandoned	Type	Coal elevation
AS-2	(Schuler #3) J.F. Schuler & Sons	1915	Coal, Drift	750' to 764'
AS-179	Gilchrist (AS 522) Gilchrist Coal Co.	1957	Coal, Drift	709'
AS-187	Elliott (As 575) Robert Withem, formerly Robert Jenkins and Frank Elliott)	1960	Coal, Drift	
AS-207	Armstrong #1, #2 J.W. & B.C. Armstrong	1933	Coal, Drift	
AS-224	Harris Lyle E. Harris Coal	1931	Coal, Drift	
AS-245	Armstrong (AS-514) Vernon Seaton	1948	Coal, Drift	

Remediation and Description of Proposed Treatment Area

OR-10 is a tributary that is a net alkaline stream. The only requirement is oxidation and settlement of metals.

Location

OR-10 is at 0.12 river miles, at 39.44322249 latitude -81.89470131 longitude, and is at an elevation of 747 feet. This is a tributary that enters Opossum Run at 1.15 river miles. The area of land above this point is 0.5 square mile and the length of the stream above this point is 0.85 miles

Access

The sample site for OR-10 lies along a tributary to Opossum Run. This tributary runs along a non-maintained township road that is accessible for State Route 377 approximately 1.5 miles north from Sharpsburg, and it is accessible by vehicle. The first 0.1 river mile of this stream is located on Bob Spaulding's land, who is not willing to allow Federal Valley staff onto his land. The part of the tributary that has abandoned mine impacts is east of Mr. Spaulding's pasture, next to the 'non-maintained' road.

Water Chemistry

During high flow, on the 5/12/03 sampling date, discharge at OR-10 was measured at 1.84 cfs. The pH was 7.8, the sulfate concentration was 64.2 mg/L, the specific conductivity was 355 uS, and metal concentrations were 1.46 mg/L Fe, 0.116 mg/L Mn, and 0.572 mg/L Al. TDS and TSS were 214 mg/L and 35 mg/L respectively. During low flow, on the 8/25/03 sampling date, discharge at OR-10 was measured at 0.143 cfs. The pH was 7.2, the sulfate concentration was 165 mg/L, the specific conductivity was 595 uS, and metal concentrations were 4.67 mg/L Fe, 0.394 mg/L Mn, and 0.1.83 mg/L Al TDS and TSS were 404 mg/L and 18 mg/L respectively. The metal and sulfate loadings on these two dates are displayed in the chart below.

OR-10 Metal and Sulfate Loadings

OR-10	Spring Flow	Base Flow	Average
Metal Load (lbs/day) of Opossum Run	21.2	5.3	13.3
% Metals Contribution of Opossum Run	79	84	81.5
Sulfate Load (lbs/day)	636.1	127.5	381.8
% Sulfate Contribution	41	59	50

% indicated in table represents % contribution relative to total loading of four sampled tributaries.

Treatment Recommendations

This is a net alkaline, underground and surface mined stream. The only requirement is oxidation and settlement of metals.

Estimated cost by ODNR for the treatment for site OR-10

Mobilization/ Clearing	$9.092
Revegetation	3,000
Spillway	6,379
Earthwork	51,235
Engineering	15,154
Total	**$84,860**

Pre- and Post- Treatment Sampling

It is recommended that six samples, once per month, be analyzed of Group I parameters to fully characterize the high and low flow chemistry. These six samples should be taken immediately downstream of the treatment area. This six-month sampling will provide the needed pre-reclamation water quality data to determine effectiveness of the restoration.

ODNR Cambridge Lab sample analysis, $110 x 6 samples	$ 660
Staff time collecting samples, 48 hours @ 30$/hr	$1440
Travel, $.42/mile, total miles 50 miles	$ 21

Post-construction water quality monitoring should be conducted at least two to four times a year and biological monitoring once per year downstream of the restoration project. Post-construction monitoring should begin within six months of completion.

AMD Impact to Opossum Run

Biology Investigation for Opossum Run

This table represents data for Opossum Run 2004 only. Information on the entire watershed is found in Section I.

Table 31 Biology Data for Opossum Run

Attainment table by MBI in the Hocking River watershed during 2004.

Station (Map #)	Fish RM	Macro RM	IBI	MIwb	ICI or Narrative Rating	QHEI	Aquatic Life Uses Ex/Rec	Attain-ment Status	Comment
S01161 2.602004	2.60	2.60	44*	NA	VG^{ns}	69.5	EWH	**Partial**	Twp. Rd. 6, at compressor station
S01161 0.752004	0.75	0.80	48^{ns}	NA	G*	56.0	EWH	**Partial**	State Forest
S01161 0.202004	0.20	0.20	52	NA	VG^{ns}	59.0	EWH	**Full**	Joy Rd., near mouth

Ecoregion Biocriteria: Western Allegheny Plateau (WAP)

Index and Site Type	**WWH**	**EWH**	**MWH**	**LRW-AMD**
IBI – Wading & Headwater	**44**	**50**	**24/24**	**18**
Mod. Iwb - Wading	**8.4**	**9.4**	**6.2/5.5**	**4.0**
ICI/Narrative	**36/G**	**46/E**	**22/30**	**8/MF**

Footnotes

a - A qualitative narrative evaluation based on best professional judgment and sampling attributes such as community composition, EPT taxa richness, and QCTV scores were used when quantitative data were not available (E-exceptional, G-good, MG-marginally good, F-fair, P-poor, VP-very poor); for Moxahala Creek a draft Qualitative ICI index was also used.
b - Attainment status is given for existing use designations, except where a use designation change is recommended, in which case, the attainment status for the recommended use is given.
c - Limited Resource Water - acid mine drainage (LRW-AMD) benchmarks based on best professional judgment driven by the need to protect against acutely toxic stream conditions. Macroinvertebrate qualitative only data were evaluated based on densities of EPT taxa on the natural substrates (see Methods Section), a narrative VP* or P* indicates departure from the benchmark.
na - MIwb not applicable at headwater sites (< 20 mi^2).
† - HD sampler set, but not retrieved due to flood flows destroying samplers.
‡ - Dry conditions in August followed by flooding conditions in September likely influenced assemblage conditions (data excluded from attainment decision)
ns - Nonsignificant departure from biocriteria (<4 IBI or ICI units, or <0.5 MIwb units).
* - Indicates significant departure from applicable biocriteria (>4 IBI or ICI units, or >0.5 MIwb units).
Underlined scores are in the Poor or Very Poor range.

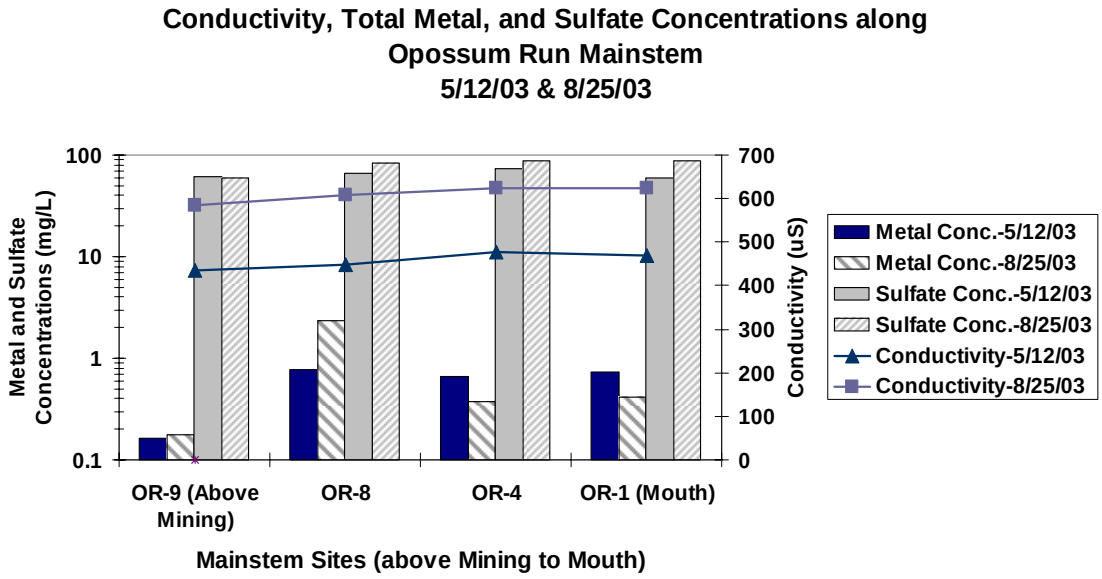
The first site listed in the table above is OR-10, located above abandoned mine sites. The middle site in the table is immediately downstream from OR-10. The bottom site in the table is at the mouth of Opossum Run near Sharpsburg. Although this stream has a use designation of Exceptional Warmwater Habitat it is only partially meeting that designation downstream of OR-10. The site immediately

downstream of OR-10 has a score that achieves a Modified Warmwater Habitat designation for QHEI, and the macroinvertebrate score only achieved a 'good'. The other two sites have a 'very good' macroinvertebrate score and the QHEI scores would achieve a Warmwater Habitat designation.

Mainstem

The mainstem of Opossum Run remains net alkaline along its entirety, with alkalinity values ranging from 173 mg/L above mining to 155 mg/L below mining impacts at high flow, and values of 211 mg/L above mining to 192 mg/L below mining at low flow. The pH remains in the range of 7.8 to 8.0. Water chemistry appears be affected by AMD sources, primarily metals. The graph below displays some AMD parameters along the mainstem.

Figure 13 Conductivity, Metal, Sulfate Concentrations for Mainstem Opossum Run

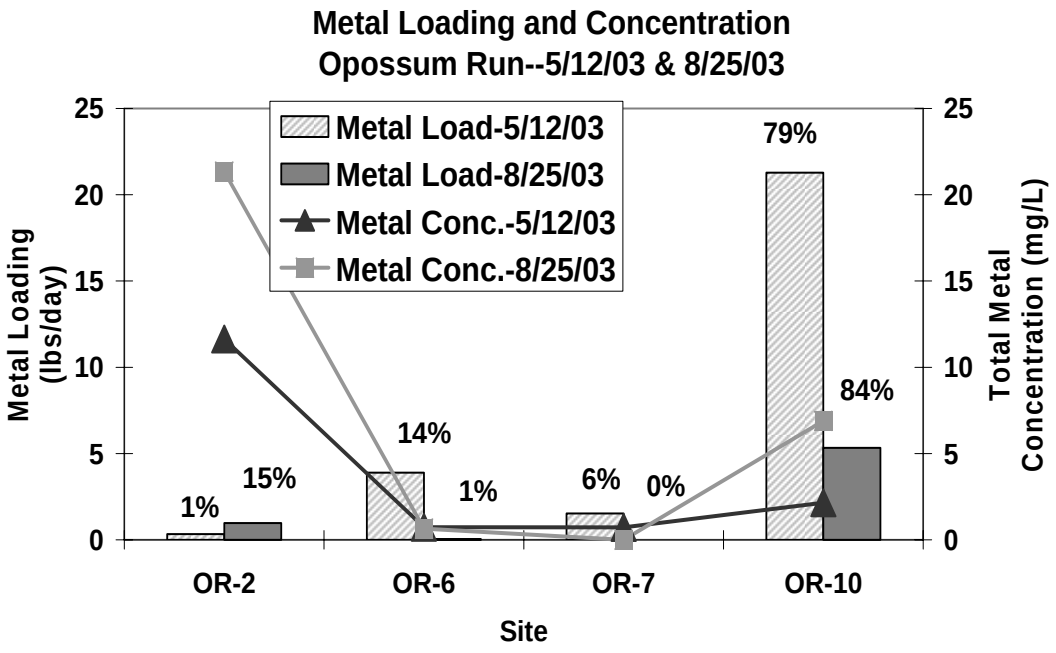


Site OR-9 is located above all abandoned mine sites on the mainstem, and site OR-1 is below all mining, towards the mouth. Metal concentrations increase at site OR-8. OR-10 discharges into Opossum Run between OR-9 and OR-8. Additionally, a small tributary draining a large section of strip-mined land discharges into the mainstem above site OR-8 and below where OR-10 discharges. However, the landowner of this section of land has denied access. Mining impacts in this section appear to have a large impact on the mainstem of Opossum Run. Below OR-8, metal concentrations decrease, but do not decrease to the low levels that occurred above the mining area. Sulfate concentrations rise slightly downstream of OR-9, but remain within the range of 59 mg/L to 89 mg/L during both high and low flow. Conductivity levels increase slightly as AMD inputs are added to the mainstem. Conductivity values range from 434 uS (OR-9) to 478 uS (OR-4) at high flow and 584 uS (OR-9) to 625 uS (OR-1) at low flow.

The water chemistry results of specific sites will be discussed in the following section. Phase II samples were unfiltered at all sites except the underground mine seeps OR-3 and OR-5. Hence, because pH is above 7 and alkalinity is high for all tributary and mainstem samples except OR-2, high metal concentrations likely overestimate the amount of dissolved metals. However, these values are used to determine priority sites, and further sampling for remediation design can use filtered samples.

The bar chart below displays the metal loadings and concentrations of the four tributaries discharging into the mainstem. OR-2 was included although its drainage may not reach the mainstem. Of these four tributaries, OR-10 is by far the largest contributor of metals to Opossum Run. OR-2 would be the second largest contributor of the 4 tributaries, however, OR-2 does not appear to discharge directly into the mainstem. The AMD carried by tributary OR-2 may completely dissipate in the field/wetland adjacent to Opossum Run. Although an abandoned underground mine discharges highly contaminated AMD into OR-6, OR-6 does not appear to have a large impact on the mainstem of Opossum Run. Each of these sites will be discussed in detail in the following section.

Figure 14 Metal Loading for Opossum Run Tributaries



% indicated in graph represents % contribution relative to total loading of sampled tributaries

Investigation of Opossum Run

Phase I

Phase I reconnaissance was conducted during March and April of 2003, in which the field parameters conductivity, pH, alkalinity, and acidity were measured. Evidence of past mining was found in many locations in the lower portion of Opossum Run. Two underground mine seeps, numerous gob piles,

and five affected tributaries were documented. Preliminary field observations identified strip pits and gob piles from surface mining, located in the first three river miles. Only one strip pit showed poor water quality. Two acid mine discharges coming from underground mines were also identified. Field parameters did not show a significant impact from surface/underground mining to the lower mainstem of Opossum Run, although some tributaries did show a significant physical impact (metal precipitation).

Phase II

A phase II water quality investigation was conducted in Opossum Run on 5/12/03 and 8/25/03 Water samples were analyzed for Group 1 parameters and discharge was measured at eleven locations within Opossum Run. The eleven locations include four mainstem sampling sites (OR-1, OR-4, OR-8, OR-9), five tributaries (OR-2, OR-6, OR-7, OR-10, and OR-11) and two abandoned underground mine seeps (OR-3, OR-5). Of the five tributaries, only three discharge directly into the mainstem. OR-2 appears to enter a slightly marshy area where it dissipates before entering Opossum Run, and OR-11 discharges into OR-10, which subsequently enters the mainstem. The four tributaries, OR-2, OR-6, OR-7, and OR-10, were assessed to determine relative percent contribution of metal and sulfate loadings. There is no visible connection between OR-2 and the mainstem of Opossum Run. The underground mine seep, OR-3, discharges into OR-2. The underground mine seep, OR-5, discharges into OR-6. Sites OR-3-S (seep) and OR-5-S (seep) are associated with mine number As2.

Phase III

A phase III water quality investigation was conducted in Opossum Run on 5/4/04 and 6/28/04. Water samples were analyzed for Group II parameters and discharge was measured at five locations. These locations include mainstem sites at the mouth of Opossum Run (OR-1); immediately downstream of the abandoned mine areas (OR-8); and above all mine impacts (OR-9). There are also sites located on (OR-10) and the main AMD impacted tributary of OR-10 (OR-11).

Individual Site Descriptions

OR-10—AMD tributary

OR-10 is at 0.12 river miles, at 39.44322249 latitude -81.89470131 longitude, and is at an elevation of 747 feet. This is a tributary that enters Opossum Run at 1.15 river miles. The area of land above this point is 0.50 square miles and the length of the stream above this point is 0.85 miles

Location/Access: The sample site for OR-10 lies along a tributary to Opossum Run. This tributary runs along a unmaintained township road that is accessible for State Route 377 approximately 1.5 miles north from Sharpsburg, and it is accessible by vehicle.

Site Description: OR-10 is a tributary discharging into the mainstem, and water quality samples taken here represent the mining impacts of OR-11, as well as the contributions of strip mines and a possible underground mine discharge in the region.

OR-10 Metal and Sulfate Loadings

OR-10	Spring Flow	Base Flow	Average
Metal Load (lbs/day)	21.2	5.3	13.3
% Metals Contribution	79	84	81.5
Sulfate Load (lbs/day)	636.1	127.5	381.8
% Sulfate Contribution	41	59	50

% indicated in table represents % contribution relative to total loading of four sampled tributaries.

OR-11—Tributary

OR-11 is at 0.15 river miles, at 39.44349892 latitude -81.89291915 longitude, and is at an elevation of 721 feet. This is a tributary that enters Opossum Run at 1.15 river miles. The area of land above this point is 0.22 square miles and the length of the stream above this point is 0.6 miles.

Access: The sample site for OR-11 lies along a tributary to Opossum Run. This tributary runs along an unmaintained township road that is accessible for State Route 377 approximately 1.5 miles north from Sharpsburg, and it is accessible by vehicle. OR-11 is located at an old bridge confluence of OR-11 and OR-10. This bridge is no longer passable by vehicles. Hence, OR-11 is located when road becomes impassable by vehicles. The land is owned by Dorrit Pruiss.

Site Description: OR-11 is located at the mouth of a small tributary to OR-10. This tributary drains an area that has been strip-mined. The stream is orange with iron precipitate.

OR-8—Mainstem Sampling Site

OR-8 is a point on the mainstem of Opossum Run at 0.8 river miles, at 39.44196805 latitude -81.90384815 longitude, and is at an elevation of 678 feet. Opossum Run is a tributary that enters Sharps Fork at 2.83 river miles. The area of land above this point is 8.53 square miles and the length of the stream above this point is 4.8 miles

Access: OR-8 is a mainstem sampling site on the border of Gifford State Forest and private land owned by Bob Spaulding. OR-8 is approximately 200 feet from State Route 377, and lies across the road from the Gifford State Forest Hunter's Parking Lot.

Site Description: OR-8 is included in this section to discuss the effects of strip-mined land owned by Bob Spaulding, which the group has not been granted permission to study. In March 2003, the group was granted permission to conduct Phase I reconnaissance. However, no further permission to access the land has been granted. A large portion of this land has been strip-mined, and numerous and extensive gob piles cover the area. Additionally, the mine map indicates an underground mine opening; however, the group was unable to locate it.

OR-8 exhibits the highest metal concentrations along the mainstem at both high and low flow. Total metal concentrations at this site were 0.78 mg/L at high flow and 2.4 mg/L at low flow. Specific conductivity values were 448 uS and 607 uS on 5/12/02 and 8/25/03, respectively. Sulfate concentrations

remained low at 65.9 mg/L on 5/12/03 and 84 mg/L on 8/25/03. FVWG is unable to sample between the inputs of OR-10 and the inaccessible piece of strip-mined land. Hence, water quality samples collected at OR-8 represent the impacts of all AMD additions between OR-9 and OR-8. These impacts are likely attributable to OR-11, OR-10, and the inaccessible piece of strip-mined land.

OR-7-Tributary

OR-7 is at 0 river miles, at 39.44200954 latitude -81.90376684 longitude, and is at an elevation of 674 feet. This tributary enters Opossum Run at 0.8 river miles. The area of land above this point is 0.28 square miles and the length of the stream above this point is 1.0 miles.

Access: OR-7 is a tributary located on the eastern border of Gifford State Forest. It runs parallel to a drive that leads to the Hunter's Parking lot, then passes through a culvert under State Route 377, and enters Opossum Run approximately 200 feet from State Route 327. Sampling was conducted at the mouth of the tributary. The tributary is accessible by vehicle approximately 200 feet from its confluence with Opossum Run.

Site Description: OR-7 drains an area on Gifford State Forest that has been strip-mined. A mine opening is indicated on the map, but the group was not able to locate this opening. A large gob pile exists adjacent to the tributary, approximately 1000 feet from the mouth. A small tributary runs on the south end of the gob pile, through a culvert under the Gifford State Forest Road, and enters tributary OR-7. AMD is believed to originate in this area, although the extent of AMD is believed to be quite small.

OR-7 Metal and Sulfate Loadings

OR-7	Spring Flow	Base Flow	Average
Metal Load (lbs/day)	1.53	0.0	0.77
% Metals Contribution	6%	0%	3%
Sulfate Load (lbs/day)	177.8	6.9	92.4
% Sulfate Contribution	11%	3%	7%

% indicated in table represents % contribution relative to total loading of four sampled tributaries

OR-6: Tributary:

OR-6 is at 0 river miles, at 39.44037918 latitude -81.9088912 longitude, and is at an elevation of 627 feet. This is a tributary that enters Opossum Run at 0.5 river miles. The area of land above this point is 0.19 square miles and the length of the stream above this point is 0.6 miles.

Access: OR-6 is the mouth of small tributary that enters Opossum Road at RM .5. The tributary passes under State Route 377 approximately 200 feet from its confluence with Opossum Run, which is located on the eastern side of State Route 377, near the Gifford State Forest Headquarters. This site is a short walk from the road. **Site Description:** OR-6 is a tributary located on the western edge of Gifford State Forest. OR-6 was sampled at the mouth to ascertain the amount of AMD entering Opossum Run. OR-5-S is the primary source of AMD contributing to OR-6, and will be discussed subsequently. OR-5-S

is an abandoned underground mine opening that discharges into OR-6. Numerous small seepages trickle out of the hillside on which OR-5-S is located. These additional seepages are the additional AMD inputs into OR-6. They are widespread and diffuse.

OR-6 Metal and Sulfate Loadings

OR-6	Spring Flow	Base Flow	Average
Metal Load (lbs/day)	3.9	0.04	1.97
% Metals Contribution	14	1	7.5
Sulfate Load (lbs/day)	704.0	19.5	361.8
% Sulfate Contribution	46	9	27.5

% indicated in table represents % contribution relative to total loading of four sampled tributaries

Of the four tributaries compared, OR-6 is the highest contributor of sulfate during high flow, however it becomes much less significant at low flow. OR-6 is the second largest contributor of metals at high flow, but again, during low flow conditions, its role becomes slight. The contributions of OR-6 can be attributed to OR-5-S, as well as the widespread, diffuse, trickling seepages that occur in the area of OR-5-S.

OR-5-S-Underground Mine Seep:

OR-5-S is a seep that enters Opossum Run at 0.42 river miles, at 39.44237533 latitude -81.9126209 longitude, and is at an elevation of 770 feet. This seep is associated with mine # As 2.

Access: OR-5-S is located approximately 1500 feet northwest from the Gifford State Forest Headquarters on State Route 377.

Site Description:

OR-5-S is a low volume discharge from an abandoned underground mine opening associated with mine complex As-2. Discharge was measured at 0.007 cfs on 5/12/03 and 0.004 cfs on 8/25/03. OR-5-S is located on a hillside adjacent to the tributary OR-6, approximately 300 feet from the stream. Additional widespread trickling seeps are located on this hillside. These seeps were not included in the discharge measurements as they do not form distinct channels, and collect in small pools at the base of the hillside or filter into the ground. Discharge for OR-5-S was measured in the most distinct channel that drains into tributary OR-6. Samples for OR-5-S were filtered.

OR-5-S exhibits the most severe levels of the AMD parameters of all sites within Opossum Run. However, much of this AMD pollution appears to be naturally remediated before entering the Opossum Run mainstem. The tributary OR-6 maintains a high pH and high alkalinity along its entirety.

OR-2—Tributary

Access: OR-2 is located on private property owned by Chuck Blythe. It lies at the eastern border of the Blythe property, adjacent to the western edge of Gifford State Forest, approximately 200 feet from

Opossum Run mainstem. The site is accessible by foot. Parking is closest near the gravel piles at Sharpsburg.

Site Description: OR-2 is located on a small channel flowing towards Opossum Run. This channel drains an area with an abandoned underground mine, and includes the discharge of OR-3-S. OR-3-S is located on the side of a hill, and is associated with mine complex As-2. The hillside also contains numerous, widespread, diffuse trickling seeps. This drainage collects at the base of the hill. Gifford State Forest has channelized this drainage so that it joins with the discharge of OR-3-S, and this forms OR-2. OR-2 appears to dry up into a field or possible wetland area approximately 150 feet before entering Opossum Run. This situation appeared to exist during both high flow and low flow sampling.

The drainage of OR-2 is a small volume, and appears not to enter Opossum Run. However, this drainage is highly acidic and highly conductive, and because the ultimate fate of the drainage remains unknown, it was included in this study.

If the contributions of OR-2 are considered to enter Opossum Run, at high flow OR-2 contributes 1 percent of the total metal load and 2 percent of the total sulfate load. At low flow, OR-2 contributes 15 percent of the metal load and 29 percent of the sulfate load. These figures give an average of 8 percent of the metal load and 15.5 percent of the sulfate load contributed by the four tributaries in this study. This would rank OR-2 third in importance in Opossum Run. However, the discharge of OR-2 appears to dissipate into a field before reaching Opossum Run. No evidence of the effect of OR-2 is seen on the mainstem below where OR-2 would enter.

OR-3-S—Underground Mine Seep

OR-3-S is a seep that enters Opossum Run at 0.3 river miles, at 39.43935315 latitude -81.91391758 longitude, and is at an elevation of 764 feet. This seep is associated with mine # As 2.

Access: OR-3-S is located on private property owned by Chuck Blythe. It is located on a hillside approximately 1000 feet from Opossum Run. The hillside is covered with thick shrubby growth and access is difficult. It is accessible by foot.

Site Description: OR-3-S is defined by a small pool of water that drains into a channel, eventually forming OR-2. This small pool of water may represent the old mine opening. This site is associated with mine complex As-2. Downhill and to the west of this site, numerous, diffuse seeps scatter across the slope of the hillside. These trickling seeps collect in a channel at the bottom of the hillside. This channel joins with the drainage of OR-3-S and forms the channel called OR-2.

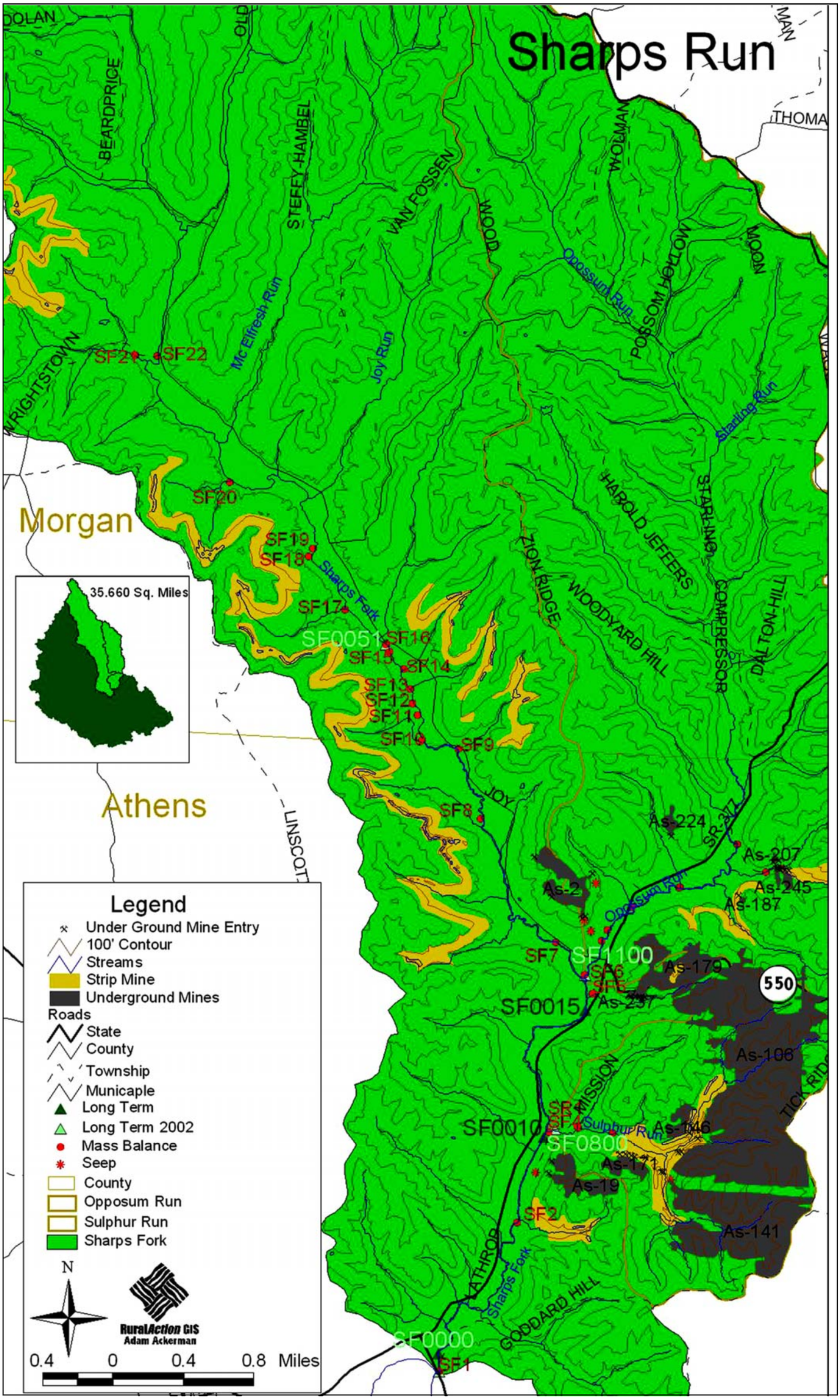
SHARP'S FORK BASIN ASSESSMENT

SF-19 tributary north of the Joy area, high acid and low flow

SF-10 tributary south of the Joy area, high acid and low flow

SF 1 mainstem at the mouth

Map 12 Sharps Fork



Geography Background

Sharp's Fork occupies the northeast portion of the watershed, flows in a south/southeast direction, entering Federal Creek at 5.14 river miles. This subwatershed represents nearly a third of the area of the Federal Valley Watershed. It is located in Morgan and Athens counties, crossing Union, Homer, Marion and Bern Townships. The towns of Sharpsburg and Joy are in the Sharp's Fork subwatershed. This subwatershed can be found on Ringgold and Amesville USGS quad sheets. Sharp's Fork has a drainage area of 35.7 square miles, and a stream length of 15.2 miles. Abandoned mining impacts are widespread in the southern two-thirds of Sharp's Fork and include AMD generated from abandoned surface mining, underground mine discharges, and gob piles. Within Sharp's Fork, two subwatersheds are impacted: Sulphur Run and Opossum Run. Many mining related impacts also occur along the mainstem and in unnamed tributaries of the mainstem. In this subwatershed, 1.15 square miles have underground mines, which is 3.22 percent of the land in the entire subwatershed. Additionally, in this subwatershed 1.09 square miles have been strip-mined, which is 3.06 percent of the land in the entire subwatershed.

Mining Impacts In Brief

AMD impacts in Sharp's Fork are diffuse, originating in several small tributaries along the mainstem, as well as the contributions of the larger subwatershed Opossum Run, and the severely affected subwatershed Sulphur Run. In Sharp's Fork, for high flow three sites stand out. The mouth of Sulphur run represents 33 percent of the metal contribution in high flow and 74 percent in low flow. Opossum Run represents 13 percent in low flow, and 9 percent in high flow for metal concentrations. A site near Wrightstown Ridge Road, known as Anderson Hollow, represents 34 percent of metal concentrations in high flow but only 3 percent in low flow. Other than the previously discussed remediation sites in Sulphur Run and Opossum Run, no other areas within Sharp's Fork are being recommended for remediation.

Table 32 Sharps Fork underground mine information

Mine number	Mine Name	Date Abandoned	Type	Coal elevation
AS-2	(Schuler #3) J.F. Schuler & Sons	1915	Coal, Drift	750’ to 764’
AS-19	Carbon (Schuler #2) Schuler Coal Co.	1923	Coal, Drift	697’ to 712’
AS-106	Black Diamond, Black Diamond Coal Company	1924	Coal, Drift	
AS-141	Black Diamond #2, Black Diamond Coal Company	1944	Coal, Drift	
AS-146	Amesville, Amesville Coal Co.	1948	Coal, Drift	699’
AS-171	Price (AS-520) Lee T. Jenkins	1951	Coal, Drift	675’
AS-179	Gilchrist (AS 522) Gilchrist Coal Co.	1957	Coal, Drift	709’
AS-187	Elliott (As 575) Robert Withem, formerly Robert Jenkins and Frank Elliott)	1960	Coal, Drift	
AS-207	Armstrong #1, #2 J.W. & B.C. Armstrong	1933	Coal, Drift	
AS-224	Harris Lyle E. Harris Coal	1931	Coal, Drift	
AS-245	Armstrong (AS-514) Vernon Seaton	1948	Coal, Drift	
As-237	Montgomery Bert Montgomery	1937	Coal, Drift	727”

AMD Impact to Sharp's Fork

Biology Investigation for Sharp's Fork

This table represents data for Sharp's Fork 2004 only. Information on the entire watershed is found in Section I.

Table 33 Biology Data for Sharps Fork

Station (Map #)	Fish RM	Macro RM	IBI	MIwb	ICI or Narrative Rating	QHEI	Aquatic Life Uses Ex/Rec	Attain-ment Status	Comment
S01160 8.502004	8.05	8.50	54		VG^{ns}	67.0	WWH/ EWH	**Full**	Ust TR64
S01160 5.202004	5.30	5.20	50	NA	VG^{ns}	66.5	WWH/ EWH	**Full**	lane dst. Tharp Hollow
S01160 2.602004	—	2.60	—	—	VG^{ns}	—	WWH/ EWH	**Full**	Dst Opossum Adj 550
S01160 1.652004	1.65	—	48^{ns}	8.83*	-	65.5	WWH/ EWH	**Partial**	Ust Sulphur Run
S01160 1.602004	1.60	1.60	46^{ns}	8.31*	G*	55.5	WWH/ EWH	**Partial**	Dst Sulphur Run
S01160 0.012004	0.01	0.10	56	8.31*	38^{ns}	—	WWH/ EWH	**Partial**	St. Rt. 329, at mouth

Ecoregion Biocriteria: Western Allegheny Plateau (WAP)

Index and Site Type	WWH	EWH	MWH	LRW-AMD
IBI – Wading & Headwater	**44**	**50**	**24/24**	**18**
Mod. Iwb - Wading	**8.4**	**9.4**	**6.2/5, 5**	**4.0**
ICI/Narrative	**36/G**	**46/E**	**22/30**	**8/MF**

Footnotes

a - A qualitative narrative evaluation based on best professional judgment and sampling attributes such as community composition, EPT taxa richness, and QCTV scores were used when quantitative data were not available (E-exceptional, G-good, MG-marginally good, F-fair, P-poor, VP-very poor); for Moxahala Creek a draft Qualitative ICI index was also used.

b - Attainment status is given for existing use designations, except where a use designation change is recommended, in which case, the attainment status for the recommended use is given.

c - Limited Resource Water - acid mine drainage (LRW-AMD) benchmarks based on best professional judgment driven by the need to protect against acutely toxic stream conditions. Macroinvertebrate qualitative only data were evaluated based on densities of EPT taxa on the natural substrates (see Methods Section), a narrative VP* or P* indicates departure from the benchmark.

na - MIwb not applicable at headwater sites (< 20 mi^2).

† - HD sampler set, but not retrieved due to flood flows destroying samplers.

‡ - Dry conditions in August followed by flooding conditions in September likely influenced assemblage conditions (data excluded from attainment decision)

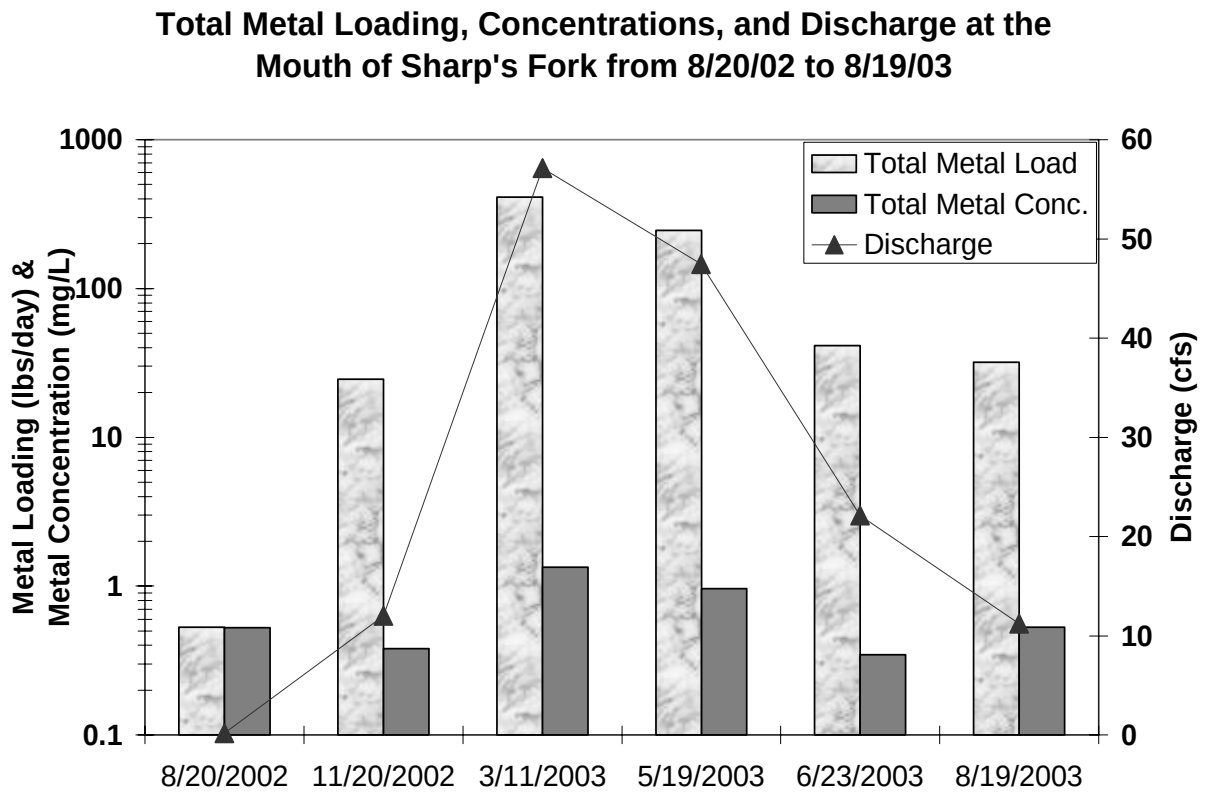
ns - Nonsignificant departure from biocriteria (<4 IBI or ICI units, or <0.5 MIwb units).

* - Indicates significant departure from applicable biocriteria (>4 IBI or ICI units, or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

Sharp's Fork had been designated as a WWH stream based on limited data near the mouth in 1990. More extensive data was collected for this study and the prevalence of IBIs above or close to the EWH range of 50, coupled with VG-E macroinvertebrate communities despite a dry August and flooding in September, 12-18 EPT taxa and very good habitat conditions support a change to an EWH aquatic life use. It is noteworthy that Sharp's Fork use designation was only partially attaining in the sites downstream of Opossum Run and Sulphur Run. These two subwatersheds are addressed separately.

The Mouth of Sharp's Fork

Figure 15 Metal Loading, Concentrations and Discharge Mouth of Sharps Fork

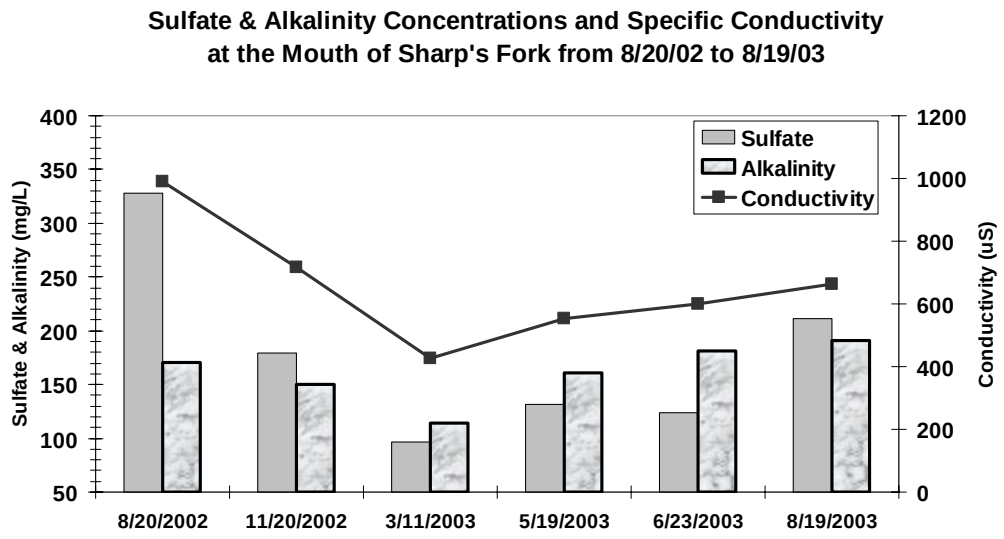


Water quality data was collected at the mouth of Sharp's Fork six times from 8/20/02 to 8/19/03. Metal concentrations and loadings were highest at high flow, with a high concentration of 1.34 mg/L on 3/11/03, a loading of 411.3 lbs/day, and a discharge of 57.1 cfs. Metal loading was lowest on 8/20/02 (0.53 lbs/day), the date which also had the lowest flow (0.19 cfs). Metal concentrations were lowest on 6/23/03 at 0.34 mg/L. This date had the third highest metal loading and discharge rate (41.2 lbs/day and 21.2 cfs) during this time.

Figure 16 displays the specific conductance and sulfate and net alkalinity concentrations for these same sampling days. Conductivity values were highest when discharge was lowest, peaking at 991uS on 8/20/03, while the lowest value of 426 uS was on 3/11/03, a high flow period. Net alkalinity values

reached a low value of 107 mg/L on 3/11/03, but otherwise remained between 145 mg/L and 186 mg/L, with the high value occurring on 8/19/03. Sulfate values reached a high value of 328 mg/L on 8/20/03, and a low value of 96 mg/L on 3/11/03. PH values remained between 7.8 and 8.0. Overall, from the available data, the mouth of Sharp's Fork exhibits a water chemistry moderately impacted by AMD, characterized by a high conductivity, yet also a high net alkalinity and neutral pH.

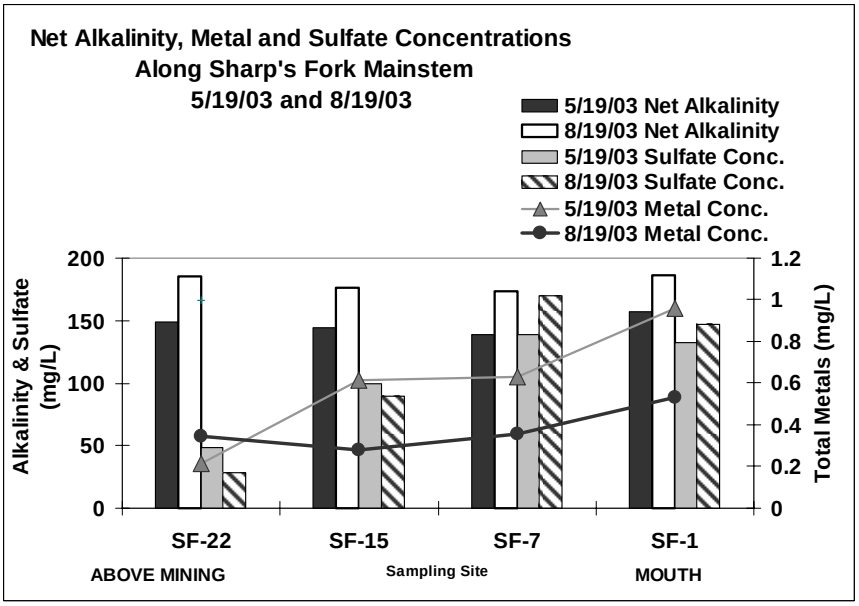
Figure 16 Sulfate, Alkalinity and Conductivity Mouth of Sharps Fork



Mainstem

The entire length of Sharp's Fork has a high net alkalinity (see Figure 17). The pH remains between 7.8 and 8.0 for both high and low flow. The concern of the abandoned mine drainage is primarily that of metal pollution.

Figure 17 Alkalinity, Metal and Sulfate Concentrations Mainstem Sharps Fork



Discharge in cubic feet per second on 5/19/03 (high flow) and 8/19/03 (low flow)

	SF-22	SF-15	SF-7	SF-1
5/19/03	11.0	14.6	18.3	47.5
8/19/03	1.5	2.9	3.5	11.2

Water quality data collected on 5/19/03 (high flow) and 8/19/03 (low flow) reflect a stable net alkaline condition along the length of Sharp's Fork. Values range from 138 mg/L (SF-7) to 157 mg/L (SF-1) at high flow, and 173 mg/L (SF-7) to 186 mg/L (SF-1) at low flow. Net alkalinity appears to show a slight decrease in concentrations as Sharp's Fork moves through the middle section, and then an increase in the lower section near the mouth; however, net alkalinity levels never fall below 138 mg/L on these two dates. Sulfate and metal concentrations increase between SF-22, the area above mining, and SF-1, the mouth of Sharp's Fork. Sulfate concentrations are highest at SF-7, reaching values of 138 mg/L at high flow and 170 mg/L at low flow. Metal concentrations are highest at SF-1, reaching 0.96 mg/L at high flow and 0.53 mg/L at low flow.

A mass balance was conducted for Sharp's Fork to prioritize remediation efforts, and the percent contributions of the 18 sampled inputs are presented in pie charts below. The percent metal and sulfate contributions are based on the sum of the load of the sampled tributaries.

As shown in the pie charts below, of the 18 tributaries/inputs studied, four contributed 86 percent of the total metal loading during high flow, and two contributed 87 percent of the total metal loading at low flow. Each of the remaining tributaries act as minor contributors during both high and low flow, never contributing more than 3 percent of the total metal loadings on these sampling dates. During high flow, Sulphur Run (SF-4) and Wrightstown Road. Tributary (SF-21), are the major contributors at 34 percent and 33 percent, respectively, followed by Opossum Run (SF-6) at 10 percent, and SF-2 at 9 percent. During low flow, Sulphur Run (SF-4) is by far the largest contributor at 74 percent, followed by Opossum Run (SF-6) at 13 percent. The contributions of Wrightstown Road tributary (SF-21) and SF-2 are reduced to 3 percent and <1 percent, respectively. All other tributaries act as minor contributors during both high and low flow, never contributing more than 3 percent.

Figure 18 Sharps Fork percent Metal Contributions High Flow

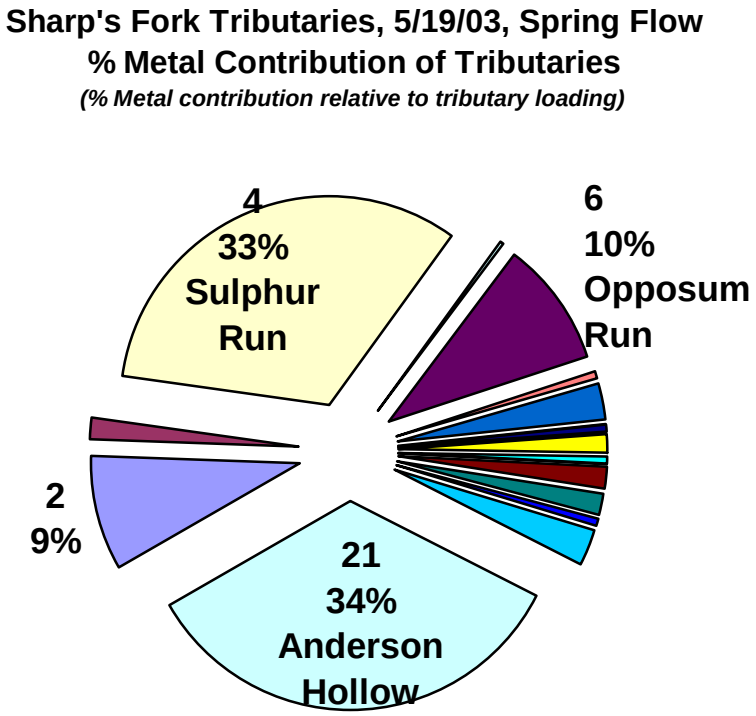
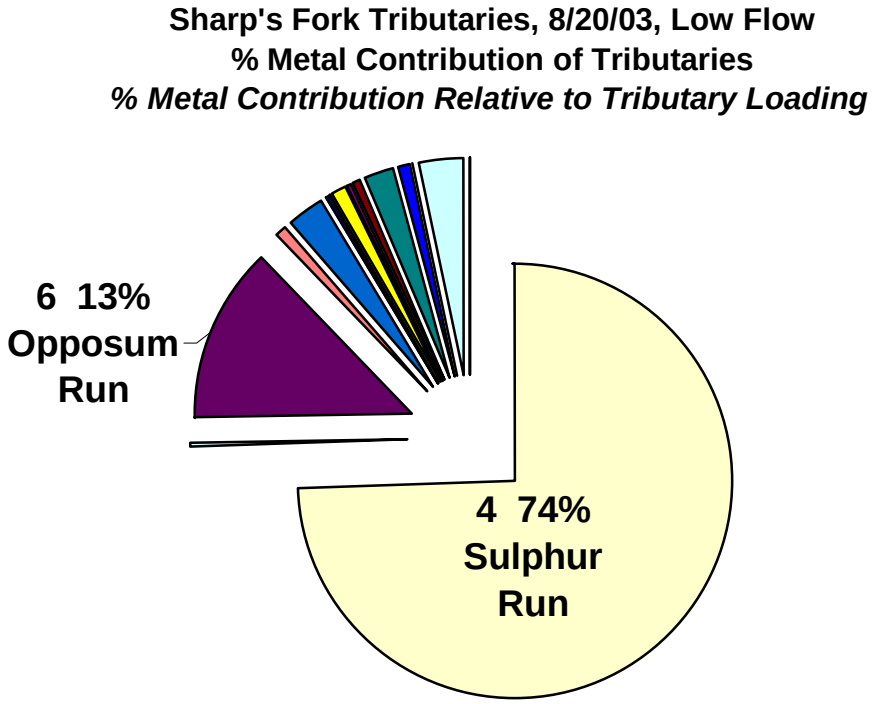


Figure 19 Sharps Fork percent Metal Contributions Low Flow



Investigation of Sharp's Fork

Phase I

A phase I water quality investigation was conducted in the Sharp's Fork subwatershed on 4/11/03, 4/15/03, 4/28/03, and 5/2/03. Preliminary field observations identified strip pits from surface mining and acid mine discharges in Sharp's Fork. Multiple tributaries flowing into the mainstem of Sharp's Fork from surface mining areas were found to have high conductivity readings. One acid mine discharge was found contributing to the main stem of Sharp's Fork (abandoned underground mine (As-19) located below Sulphur Run).

Phase II

A phase II water quality investigation was conducted in Sharp's Fork on 5/19/03 and 8/19/03; seventeen tributaries, one seep, and four mainstem sites, and 5 sites within Anderson Hollow were sampled. Site SF-3-S (seep) is associated with mine number As19.

Table 33 lists the all sampling sites within Sharp's Fork for the Phase II high and low flow sampling, which include 4 mainstem sites, 17 tributaries, and 1 seep. Map 12 shows the location within Sharp's Fork.

Table 34 Sharps Fork sample locations

Sample Site	Location/Type of Sample Site	River Mile at which Tributary/Seep enters Sharp's Fork
SF-1	Mouth of Sharp's Fork	Enters Federal Ck. At RM 9.3
SF-2	Tributary	1.16
SF-3	Underground Mine Seep	1.4
SF-4	Mouth of Sulphur Run	2.9
SF-5	Tributary	2.79
SF-6	Mouth of Opossum Run	2.83
SF-7	Mainstem Sharp's Fork	3.1
SF-8	Tributary	4.07
SF-9	Tributary	4.5
SF-10	Tributary	4.7
SF-11	Tributary	4.9
SF-12	Tributary	5
SF-13	Tributary	5.01
SF-14	Tributary	5.15
SF-15	Mainstem of Sharp's Fork	5.25
SF-16	Tributary	5.3
SF-17	Tributary	5.5
SF-18	Tributary	5.98
SF-19	Tributary	6
SF-20	Tributary	7
SF-21	Tributary	8.0
SF-22	Mainstem of Sharp's Fork	8.01
AN 0- AN-6	Anderson Hollow, Tributary of Sharp's Fork	8.0

Individual Site Descriptions

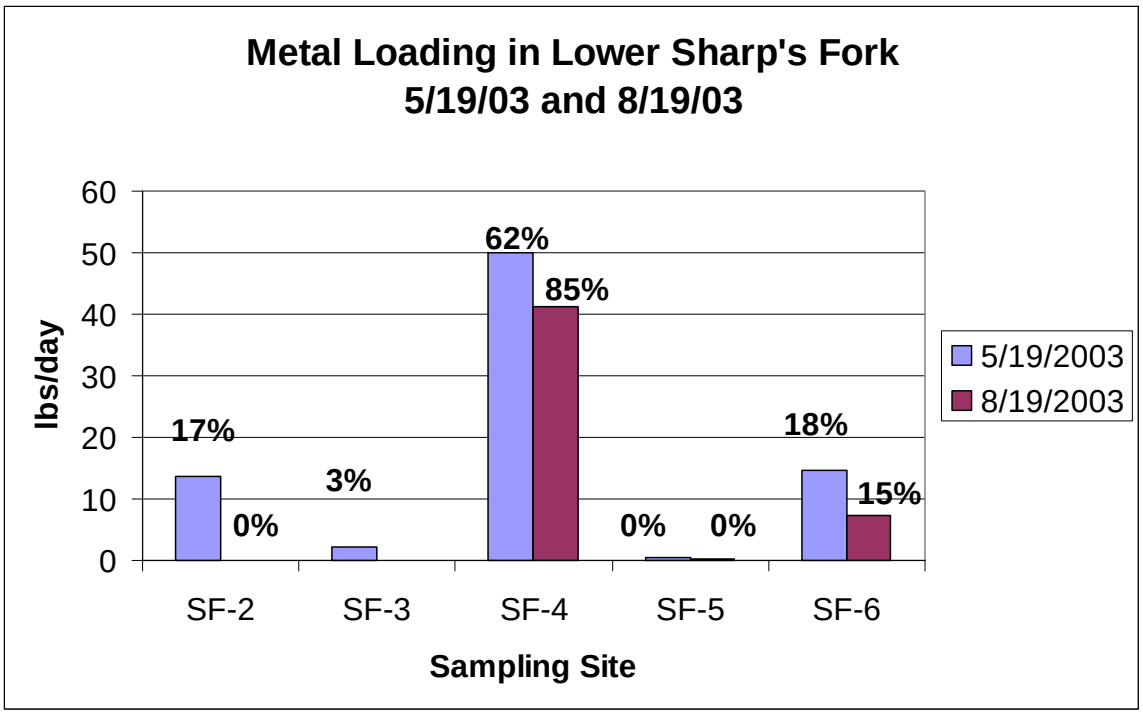
Due to the size of Sharp's Fork, the basin was broken into three sections designated lower, middle and upper. The individual site descriptions along with some analysis of the water chemistry will be presented in these sections.

Lower Section of Sharp's Fork

The lower section of Sharp's Fork is designated as starting at SF-7 (RM 9.3) and extending to the mouth of Sharp's Fork. In this section, the mouths of four tributaries, including the mouths of the subwatersheds Opossum Run and Sulphur Run, and one seep were sampled for Group 1 parameters.

The following graph presents the metal loading of the 5 sampled inputs in terms of both loadings and percent contribution relative to the total loading of the 5 inputs. According to data collected on 5/19/03 and 8/19/03, which represent high and low flow, respectively, Sulphur Run, SF-4, is by far the most significant contributor to the lower section of Sharp's Fork, contributing 62 percent of the metal load at high flow, equivalent to 50.0 lbs/day, and 85 percent at low flow, equivalent to 41.3 lbs/day. Opossum Run, SF-6, is the second largest contributor, contributing an average of 16.5 percent of the metal contribution, equivalent to 11.0 lbs/day (14.7 lbs/day at high flow, 7.3 lbs/day at low flow). SF-2 is an important contributor at high flow, contributing 13.7 lbs/day, OR-17 percent, yet becomes negligible during low flow. Discharge data for SF-3 was not included in the 8/19/03 data (due to loss of discharge data), but can be assumed to be quite small.

Figure 20 Metal Loading Contributions in Lower Sharps Fork



% indicated in graph represents % contribution relative to total loading of sampled tributaries

Site Descriptions For the Lower Section of Sharp's Fork

This section discusses each tributary/seep individually, and gives recommendations for the future.

SF-1 is a point on the mainstem of Sharp's Fork at 0 river miles, at 39.40243707 latitude - 81.92958981 longitude, and is at an elevation of 735 feet. Sharp's Fork is a tributary that enters Federal Creek at 9.3 river miles. The area of land above this point is 35.66 square miles and the length of the stream above this point is 12.4 miles.

SF-2--Tributary:

SF-2 is at 0 river miles at 39.4146625 latitude - 81.92121838 longitude, and is at an elevation of 731 feet. This is a tributary that enters Sharp's fork at 1.16 river miles. The area of land above this point is 0.24 square miles and the length of the stream above this point is 0.7 miles. The AMD appears to originate from large gob piles surrounded by beaver/strip ponds. Numerous sources of AMD continue to contribute to the stream as it travels downstream, originating in a series of refuse piles surrounded by strip/beaver ponds. Hence, SF-2 represents a region of surface mining contributing AMD, and not a discrete source.

Access: SF-2 enters Sharp's Fork at 1.16(river miles). It is located on land owned by the Brown Energy Company of Dayton, OH, and is accessible only by foot travel.

Discharge at SF-2 was measured at 0.912 cfs at high flow and 0.07 cfs at low flow, giving an average discharge of 0.491 cfs. SF-2 contributed 17 percent of the metal load within the lower section of Sharp's Fork at high flow and 0 percent at low flow. Total metal concentrations for SF-2 were 2.8 mg/L at high flow and 0.17 mg/L at low flow. The average pH and conductivity are 7.6 and 889.5 uS respectively. SF-2 contributed 14 percent of the sulfate load at high flow and 2 percent of the sulfate load at low flow within the lower section of Sharp's Fork. Sulfate concentrations were 272 mg/L at high flow and 268 mg/L at low flow, giving an average of 270 mg/L. The average net alkalinity for SF-2 was 218.4 mg/L.

SF-3-S—Underground Mine Seep:

Access: SF-3-S is located at the end of Lathrop Mission Road, behind a house on private property. The site is accessible by vehicle. Drive past the Lathrop Mission to a house and the seep is on the hill to the left of the house.

SF-3-S is a seep that enters Sharp's Fork at 1.4 river miles, at 39.41873141 latitude -81.91920924 longitude, and is at an elevation of 712 feet. This seep is associated with mine # As19.

Site Description: SF-3-S is an AMD discharge associated with abandoned mine complex As19**.** No mine entrance is visible, but a large waste/gob pile against the hillside may cover the mine opening. Samples were collected from a small pool of acidic, highly conductive water on top of the gob pile. Additional water seepages appear to come out of the gob pile. Water drains down and through the gob

pile in various trenches, and then reforms a channel at the base of the hill. The entire gob pile is covered with orange and white precipitate. The gob pile is located approximately 250 feet from Sharp's Fork.

From available water quality data, SF-3 appears to be a low volume, highly acidic seep. At high flow, discharge was 0.003 cfs. Low flow discharge is not available (due to loss of data), but was visibly assessed at the time of sample collection as less than high flow discharge. On 5/19/03, the pH was 4.4, the net acid concentration was 358 mg/L, conductivity was 2490 uS, and the sulfate concentration was 1671 mg/L. Metal concentrations were 11 mg/L Fe (III), 137 mg/L Fe (II), 3.33 mg/L Mn, and 16.5 mg/L Al. On 8/19/03, the pH was 4.48, the net acid concentration was 300 mg/L, the conductivity was 2480 uS, and the sulfate concentration was 1709 mg/L. Metal concentrations were 6 mg/L Fe (III), 115 mg/L Fe (II), 3.33 mg/L Mn, and 14.7 mg/L Al. On 5/19/03, the metal load was 2.31 lbs/day (3 percent of lower section load), the sulfate load was 22.9 lbs/day (less than 1 percent of the lower section load), and the acid load was 4.92 lbs/day. No loadings could be calculated for 8/19/03.

SF-4—Sulphur Run:

SF-4 is the mouth of Sulphur Run at 0 river miles, at 39.42204989 latitude -81.91785313 longitude, and is at an elevation of 690 feet. This tributary enters Sharp's fork at 1.9 river miles. The area of land above this point is 2.0 square miles and the length of the stream above this point is 0.8 miles.

Access: SF-4 is the mouth of Sulphur Run, which enters Sharp's Fork at 1.9. The mouth of Sulphur Run is located off Lathrop Mission Road, before the church, at a cluster of trailers, and is accessible by vehicle.

Site Description: Sulphur Run drains approximately 2.2 square miles. Much of the drainage area has been surface mined and/or overlays abandoned underground mines.

From available water quality data, Sulphur Run appears to be the largest contributor of sulfate and metal loadings to Sharp's Fork. Sulphur Run contributed 62 percent of the metal loadings within the lower section of Sharp's Fork during high flow, and 85 percent during low flow. When compared with the metal loadings of all 18 sampled inputs to Sharp's Fork, Sulphur Run contributed 33 percent during low flow and 74 percent during high flow. Sulphur Run also appears to be the most significant sulfate loader overall. During high flow, Sulphur Run contributed 36 percent of the sulfate loadings in the lower section of Sharp's Fork, and 21percent of the total sulfate loadings in Sharp's Fork. During low flow, Sulphur Run contributed 62 percent of the sulfate loadings in the lower section of Sharp's Fork, and 47 percent of the total sulfate loadings in Sharp's Fork.

SF - 4	High Flow	Low Flow	Average
Metal Load (lbs/day)	**50.04**	**41.30**	**45.67**
% Metal Contribution*	**62**	**85**	**73.5**
% Metal Contribution in SF**	**33**	**74**	**53.5**
Sulfate Load (lbs/day)	**3405.72**	**3396.21**	**3400.96**
% Sulfate Contribution*	**36**	**62**	**49**
% Sulfate Contribution in SF**	**21**	**47**	**34**

*** % Contribution in Upper Section of Sharp's Fork** % Contribution in Entire AMD region of Sharp's Fork**

SF-5—Tributary:

SF-5 is at 0 river miles, at 39.43336998 latitude -81.91307503 longitude, and is at an elevation of 609 feet. This is a tributary that enters Sharp's fork at 2.79 river miles. The area of land above this point is 0.22 square miles and the length of the stream above this point is 0.8 miles.

Access: SF-5 is the mouth of a tributary that enters Sharp's Fork at 2.79 RM. This is the tributary that was mined by the Gilchrist family. The sample site is where SF-5 passes through a culvert under State Route 550, below Wayne Gilchrist's BP station and is accessible by vehicle. Wayne Gilchrist was not interested in granting us access to do a phase I survey of his subwatershed.

Site Description: SF-5 is a tributary that appears to be slightly impacted by AMD. AMD discharge from mine complex As-179 may be entering SF-5. Access to the land drained by SF-5 was denied to the group by landowner, so field reconnaissance of AMD sources was not possible. The mouth of SF-5 was sampled to determine if these unknown sources are significant.

Conductivity and sulfate were moderately elevated during both high and low flow. Metal concentrations were low, and net alkalinity and pH were high. Discharge at SF-5 was 0.354 cfs on 5/19/03 (high flow) and 0.12 cfs on 8/19/03 (low flow). On the 5/19/03 sampling date, conductivity, sulfate, and total metal concentrations were 959 uS, 159 mg/L, and 0.19 mg/L respectively. The pH was 7.88, and the net alkalinity was 202.8 mg/L. On the 8/19/03 sampling date, conductivity, sulfate, and total metal concentrations were 958 uS, 155 mg/L, and 0.23 mg/L respectively. The pH was 7.71, and the net alkalinity was 255.3 mg/L.

SF-6—Opossum Run

SF-6 is at the mouth of Opossum Run at 0 river miles, at 39.43463313 latitude -81.91365145 longitude, and is at an elevation of 630 feet. This is a tributary that enters Sharp's fork at 2.83 river miles. The area of land above this point is 9.04 square miles and the length of the stream above this point is 5.7 miles.

Access: The mouth of Opossum Run is located near the intersection of Joy Road. and State Route 377 in Sharpsburg. To access this point follow the creek up stream from the Joy Road Bridge behind the Township Trustee building.

Site Description: Sample site SF-6 is located on the mainstem of Opossum Run, slightly upstream of the Joy Road. Bridge over Opossum Run. It is below all AMD impacts in Opossum Run, approximately 1500 feet upstream from the mouth of Opossum Run.

Opossum Run drains approximately 9 square miles. Abandoned underground mines, unreclaimed strip mines, and gob piles occur in the drainage basin. There are 0.10 square miles of abandoned underground mines representing 1.03 percent of the subwatershed. There are 0.9 square miles of strip mines representing 9.5 percent of the subwatershed.

From available water quality data, Opossum Run appears to be the second largest contributor of sulfate loadings and the third largest contributor of metal loadings to Sharp's Fork Opossum Run contributed 18 percent of the metal loadings within the lower section of Sharp's Fork during high flow, and 15 percent during low flow. When compared with the metal loadings of all 18 sampled inputs to Sharp's Fork, Opossum Run contributed 10 percent during high flow and 13 percent during low flow. Opossum Run also appears to be the second most significant sulfate loader. During high flow, Opossum Run contributed 46 percent of the sulfate loadings in the lower section of Sharp's Fork, and 26 percent of the total sulfate loadings in Sharp's Fork. During low flow, Opossum Run contributed 34 percent of the sulfate loadings in the lower section of Sharp's Fork, and 26 percent of the total sulfate loadings in Sharp's Fork.

SF - 6	High Flow	Low Flow	Average
Metal Load (lbs/day)	14.69	7.29	10.99
% Metal Contribution*	18	15	16.5
% Metal Contribution in SF**	10	13%	11.5
Sulfate Load (lbs/day)	4299.04	1870.52	3084.78
% Sulfate Contribution*	46	34	40
% Sulfate Contribution in SF**	26	26	26

*** % Contribution in Upper Section of Sharp's Fork ** % Contribution in Entire AMD Sharp's Fork**

Middle Section of AMD impacted area in Sharp's Fork

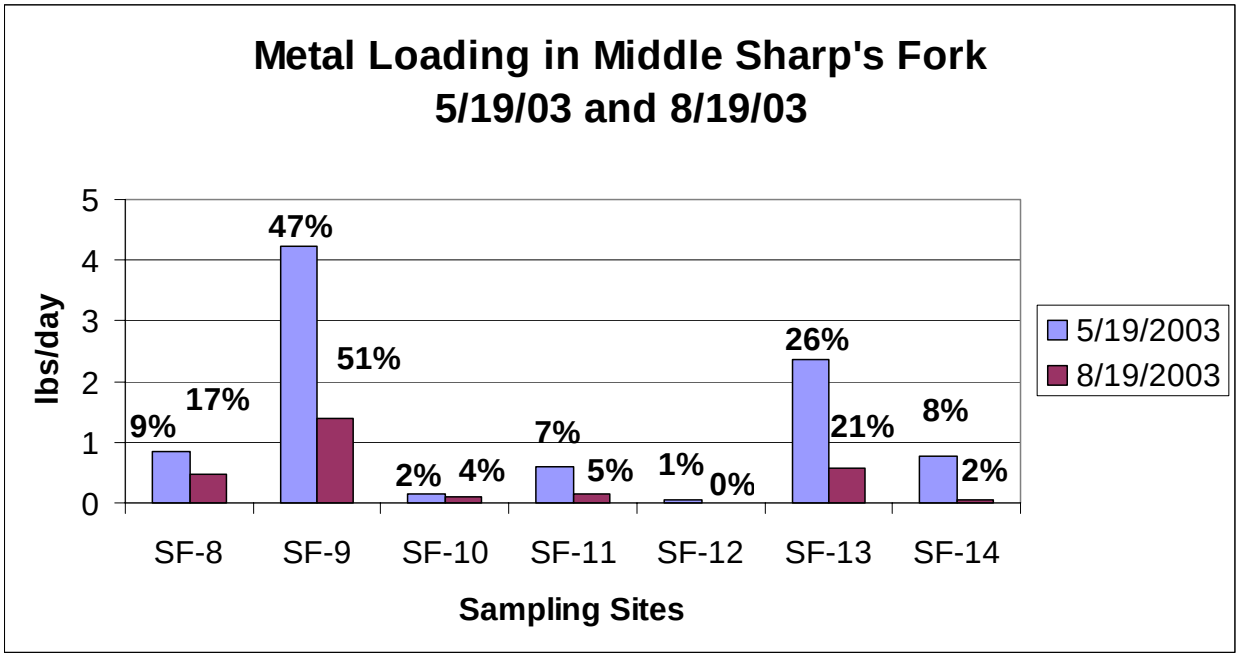
The middle section of the AMD affected area of Sharp's Fork begins at SF-15, a sample site on the mainstem, and extends down to SF-7. (The middle section extends from RM 3.1 to RM 5.25. This area drains 20.94 square miles, however 18.37 square miles are part of the upper section that will be described later. The mouths of seven tributaries into this section were sampled for Group 1 parameters on 5/19/03 and 8/19/03.

The overall high flow metal load of 14.12 lbs/day from this section is only a small proportion, 6 percent, of the total metal load within Sharp's Fork. Many low volume tributaries of low to moderate AMD loading characterize this area.

The graph below displays the metal loadings (lbs/day) and percentage contributions of the seven tributaries sampled in the middle section of Sharp's Fork. During both high and low flow, SF-9 is the

dominant contributor of metals, and SF-13 is the next largest contributor. The relative roles of the tributaries remain the same in both the high and low flow sampling.

Figure 21 Metal Loading Contributions in Middle Sharps Fork



% indicated in graph represents % contribution relative to total loading of sampled tributari

Individual Site Descriptions for Middle Section Sharp's Fork

SF-8-Tributary:

SF8 is at 0 river miles, at 39.44769398 latitude -81.92483811 longitude, and is at an elevation of 597 feet. This tributary enters Sharp's fork at 4.07 river miles. The area of land above this point is 0.27 square miles and the length of the stream above this point is 0.8 miles.

Access: SF-8 is a small tributary located on the west side of Sharp's Fork. It is located on land owned by Donnie Stevens, and is accessible by foot or ATV 0.1 to 0.2 miles from the road. Donnie Stevens provides access upon prior notification.

Site Description: SF-8 is a low volume tributary with elevated levels of conductivity, sulfate, and total metals. SF-8 had an average pH of 7.7 and an average net alkalinity of 150.4 mg/L. SF-8 ranked third in the middle section of Sharp's Fork in terms of both metal and sulfate loadings. When compared with all 18 inputs measured in Sharp's Fork, SF-8 contributed, on average, less than 1 percent of the metal loadings and 3 percent of the sulfate loadings.

SF-9-Tributary:

SF-9 is at 0 river miles, at 39.44769398 latitude -81.9271433 longitude, and is at an elevation of 634 feet. This is a tributary that enters Sharp's fork at 4.5 river miles. The area of land above this point is 0.33 square miles and the length of the stream above this point is 0.7 miles.

Access: SF-9 is a the mouth of a tributary that passes under a bridge on Old Grade Road., near the Athens County/Morgan County line. The bridge is approximately 100 feet from the mouth of the tributary. The sample site is accessible by vehicle.

Site Description: SF-9 is the mouth of a small tributary which drains a strip-mined area, and not a discrete source of AMD. The strip-mined area has not yet been assessed. The tributary appears to be moderately impacted by AMD, and has elevated conductivity levels and sulfate and metal concentrations. The discharge was 0.25 cfs on 5/19/03 (high flow), and 0.13 cfs on 8/19/03 (low flow). At high flow, conductivity, sulfate, and metal concentrations were 812 uS, 367 mg/L, and 3.16 mg/L, respectively. At low flow, these same parameters measured 839 uS, 378 mg/L, 1.99 mg/L, respectively. Aluminum was the dominant metal at this site, having a concentration of 1.77 mg/L at high flow and 0.94 mg/L at low flow. The site had an average pH of 7.3 and an average net alkalinity of 54.2 mg/L. The net alkalinity at this site is low for Sharp's Fork.

According to available water quality data, SF-9 appears to be the largest contributor of sulfate and metals in the middle section of Sharp's Fork, contributing an average of 49 percent of the metal load and 24.5 percent of the sulfate load (*relative to the 7 tributaries sampled in the middle section*). When compared with all eighteen sources within Sharp's Fork, SF-9 contributed an average of 3 percent of the total metals (Rank-fifth), and 3.5 percent of the total sulfate loading (Rank-seventh).

SF-10—Tributary:

SF-10 is at 0 river miles, at 39.45421787 latitude -81.93099042 longitude, and is at an elevation of 664 feet. This tributary enters Sharp's fork at 4.7 river miles. The area of land above this point is 0.16 square miles and the length of the stream above this point is 0.6 miles.

Access: SF-10 is the mouth of a small tributary that enters Sharp's Fork at RM 4.7. It is located to the west of Sharp's Fork. It is accessible by foot. GPS would be useful to find this site.

Site Description: SF-10 is the mouth of a small tributary draining land that has been strip-mined, and may not represent a discrete source of AMD. The strip-mined area has not yet been assessed, and it may contain numerous seeps.

SF-10 is characterized by a low discharge with high conductivity and elevated sulfate and metal concentrations. SF-10 has a neutral pH, with a high net alkalinity. Discharge was 0.026 cfs on 5/19/03 (high flow) and 0.01 cfs on 8/19/03 (low flow). At high flow, the conductivity, sulfate, and metal concentrations were 1110 uS, 467 mg/L, and 1.06 mg/L, respectively. At low flow, these parameters measured 1240 uS, 504 mg/L, and 1.7 mg/L respectively. The average pH was 7.4 and the average net alkalinity was 167.4 mg/L.

According to available water quality data, SF-10 contributed an average of 3 percent of the metal load and 3 percent of the sulfate load relative to the seven inputs sampled in the middle section of Sharp's

Fork. SF-10 was ranked sixth out of the seven inputs in the middle section for both metal and sulfate loading. When compared to all eighteen inputs into Sharp's Fork, SF-10 contributed less than 1 percent of both the average sulfate and metal load.

SF-11-Tributary:

SF-11 is at 0 river miles, at 39.45623565 latitude -81.93138722 longitude, and is at an elevation of 660 feet. This tributary enters Sharp's Fork at 4.9 river miles. The area of land above this point is .02 square miles. This small tributary is not mapped therefore the stream length above this point in not available.

Access: SF-11 is the mouth of a small tributary that enters Sharp's Fork at RM 4.9. It is located to the west of Sharp's Fork. It is accessible by foot.

Site Description: SF-11 is the mouth of a small tributary draining land that has been strip-mined, and may not represent a discrete source of AMD. The strip-mined area has not yet been assessed, and it may contain numerous diffuse seeps.

SF-11 is also characterized by a low discharge with high conductivity and elevated sulfate and metal concentrations. SF-11 has a neutral pH, with a high net alkalinity. Discharge was 0.08 cfs on 5/19/03 (high flow) and 0.03 cfs on 8/19/03 (low flow). At high flow, the conductivity, sulfate, and total metal concentrations were 1820 uS, 1062 mg/L, and 1.37 mg/L, respectively. At low flow, these parameters measured 2060 uS, 1129 mg/L, and 0.89 mg/L respectively. The average pH was 7.8 and the average net alkalinity was 177 mg/L.

According to available water quality data, SF-11 contributed an average of 6 percent of the metal load and 20 percent of the sulfate load relative to the seven inputs sampled in the middle section of Sharp's Fork. Of the seven inputs in the middle section, SF-11 was ranked fourth highest contributor of metals and the second highest contributor of sulfate. When compared with all eighteen inputs into Sharp's Fork, SF-11 contributed, on average, less than 1 percent of the metal load and 3 percent of the sulfate load (Rank-ninth).

SF-12—Tributary:

SF-12 is at 0 river miles, at 39.45719537 latitude -81.93196457 longitude, and is at an elevation of 662 feet. This is a tributary that enters Sharp's Fork at 5 river miles. The area of land above this point is 0.47 square miles. This small tributary is not mapped therefore the stream length above this point in not available.

Location/Access: SF-12 is the mouth of a small tributary that enters SF at RM 5. It is located to the west of Sharp's Fork. It is accessible by foot. GPS would be useful to find this site.

Site Description: SF-12 is the mouth of a small tributary draining land that has been strip-mined, and may not represent a discrete source of AMD. The strip-mined area has not yet been assessed, and it may contain numerous diffuse seeps.

SF-12 is also characterized by a very low discharge with high conductivity, elevated sulfate, and slightly elevated metal concentrations. SF-12 has a neutral pH, with a high net alkalinity. Discharge was 0.017 cfs on 5/19/03 (high flow) and 0.0002 cfs (0.09 gpm) on 8/19/03 (low flow). At high flow, the conductivity, sulfate, and metal concentrations were 1410 uS, 803 mg/L, and 0.65 mg/L, respectively. At low flow, these parameters measured 1380 uS, 752 mg/L, and 1.1 mg/L respectively. The average pH was 7.5 and the average net alkalinity was 96.4 mg/L.

According to available water quality data, SF-12 contributed an average of 0.5 percent of the metal load and 1.5 percent of the sulfate load relative to the 7 inputs sampled in the middle section of Sharp's Fork. Of the -seven inputs in the middle section, SF-12 was ranked the least important contributor of both metal and sulfate loadings.

SF-13-Tributary:

SF-13 is at 0 river miles, at 39.45836683 latitude -81.93212098 longitude, and is at an elevation of 693 feet. This tributary enters Sharp's fork at 5.01 river miles. The area of land above this point is 0.30 square miles and the length of the stream above this point is 0.8 miles.

Access: SF-13 is the mouth of a small tributary that enters Sharp's Fork at RM 5.01. It is located to the east of Sharp's Fork, and passes through a culvert under Old Grade Road. It is possible to park at the culvert and follow the stream to the mouth on foot.

Site Description: SF-13 is near the mouth of a small tributary draining land that has been strip-mined, and may not represent a discrete source of AMD. The strip-mined area has not yet been assessed, and it may contain numerous diffuse seeps.

SF-13 is characterized by a low discharge with high conductivity, and elevated sulfate and metal concentrations. SF-13 has a neutral pH, and is net alkaline. Discharge was 0.141 cfs on 5/19/03 (high flow) and 0.03 cfs on 8/19/03 (low flow). At high flow, the conductivity, sulfate, and metal concentrations were 1180 uS, 568 mg/L, and 3.12 mg/L, respectively. At low flow, these parameters measured 1350 uS, 815 mg/L, and 3.13 mg/L respectively. The average pH was 7.5 and the average net alkalinity was 72.9 mg/L.

According to available water quality data, SF-13 contributed an average of 23.5 percent of the metal load and 17 percent of the sulfate load relative to the 7 inputs sampled in the middle section of Sharp's Fork. Of the seven inputs in the middle section, SF-13 was ranked the second highest contributor of metal loadings and the fourth highest contributor of sulfate loadings. When compared with all 18

inputs into Sharp's Fork, SF-13 contributed 1.5 percent of the average total metal loading (Rank-seventh) and 2.5 percent of the average sulfate loading (Rank-tenth).

SF-14-Tributary:

SF-14 is at 0 river miles, at 39.46002192 latitude -81.93282078 longitude, and is at an elevation of 698 feet. This tributary enters Sharp's fork at 5.15 river miles. The area of land above this point is 0.17 square miles and the length of the stream above this point is 0.9 miles.

Access/Location: SF-14 is the mouth of a small tributary that enters Sharp's Fork at RM 5.15. It is located to the east of Sharp's Fork, and passes through a culvert under Old Grade Road. It is accessible by vehicle. It is possible to park at the culvert and follow the stream to the mouth on foot.

Site Description: SF-14 is the near the mouth of a small tributary draining land that has been strip-mined, and may not represent a discrete source of AMD. The strip-mined area has not yet been assessed, and it may contain numerous diffuse seeps.

SF-14 is characterized by a low discharge with high conductivity, and elevated sulfate and slightly elevated metal concentrations. SF-14 has a neutral pH, and is net alkaline. Discharge was 0.112 cfs on 5/19/03 (high flow) and 0.02 cfs on 8/19/03 (low flow). At high flow, the conductivity, sulfate, and metal concentrations were 1180 uS, 568 mg/L, and 3.12 mg/L, respectively. At low flow, these parameters measured 1350 uS, 815 mg/L, and 3.13 mg/L respectively. The average pH was 7.5 and the average net alkalinity was 72.9 mg/L.

According to available water quality data, SF-14 contributed an average of 5 percent of the metal load and 14.5 percent of the sulfate load relative to the 7 inputs sampled in the middle section of Sharp's Fork. Of the 7 inputs in the middle section, SF-14 was ranked the fifth highest contributor of metal loadings and the fifth highest contributor of sulfate loadings. When compared to all eighteen inputs sampled in Sharp's Fork, SF-14 contributed less than 1 percent of the average total metal loadings and 2 percent of the average sulfate loadings (Rank-eleventh).

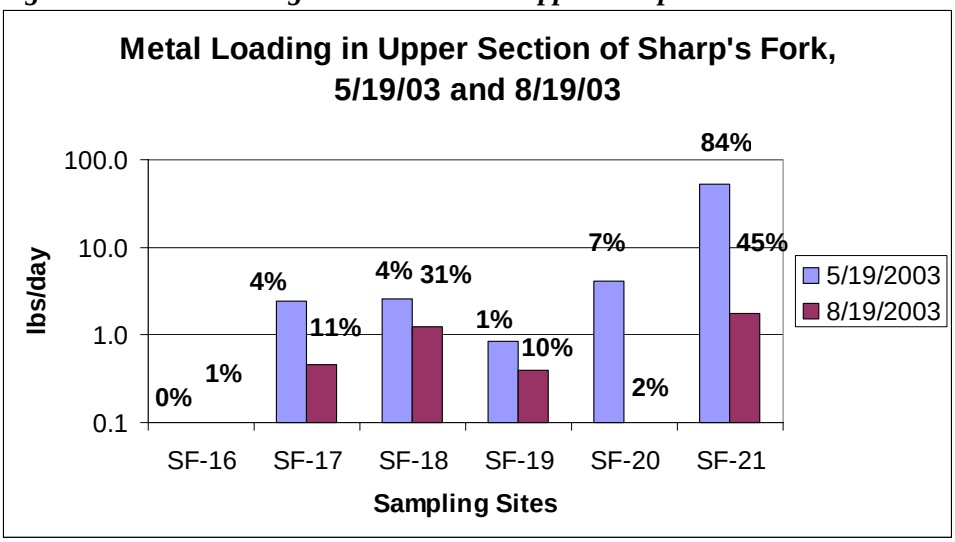
Upper Section of AMD impacted area of Sharp's Fork

The upper section begins with SF 15. SF15 is a point on the mainstem of Sharp's Fork below Joy and Tharp Hollow, at 5.25 river miles, at 39.46135137 latitude -81.93455818 longitude, and is at an elevation of 671 feet. Sharp's Fork is a tributary that enters Federal Creek at 9.3 river miles. The area of land above this point is 18.37 square miles and the length of the stream above this point is 1.0 miles.

The upper section of the AMD affected portion of Sharp's Fork begins at a sampling point on the mainstem (SF-22) above the Wrightstown Road Bridge, and extends down to a sampling point on the mainstem (SF-15) approximately 0.5 miles below Joy. The mouths of 6 tributaries into this upper section of Sharp's Fork were sampled for Group 1 parameters.

During both high and low flow, the metal inputs from these six tributaries exceeded the calculated metal load for the upper section. During high flow, the metal inputs exceeded the downstream output by 26.6 lbs/day, and during low flow, the metal inputs exceeded the downstream output by 2.38 lbs/day. This indicates that metals are being retained along the flow path in this area, most likely due to metal precipitation, adsorption, and sedimentation.

Figure 22 Metal Loading Contributions in Upper Sharps Fork



% indicated in graph represents % contribution relative to total loading of sampled tributaries.

Of the six tributaries sampled in this section of Sharp's Fork, SF-21, Anderson Hollow, is the heaviest loader under both high and low flow conditions. SF-21 metal loading is 52.1 lbs/day under high flow and 1.8 lbs/day under low flow conditions. The relative roles of the other tributaries change from high to low flow. Although SF-20 is the second largest contributor of metals during high flow, with a metal loading of 4 lbs/day, at low flow conditions SF-20 becomes a minor contributor, with a metal loading of 0.07 lbs/day. SF-18 is the third largest contributor at high flow, but becomes a much larger contributor at low flow. The importance of SF-17 and SF-19 also increases from high to low flow. SF-16 remains a negligible contributor under both flow conditions.

Individual Site Description

SF-21: Wrightstown Rd. Anderson Hollow Tributary

SF-21 is at 0 river miles, at 39.48590448 latitude -81.96105581 longitude, and is at an elevation of 464 feet. This tributary enters Sharp's fork at 7.26 river miles. The area of land above this point is 0.92 square miles and the length of the stream above this point is 0.9 miles.

Access: SF-21 enters Sharp's Fork approximately 35 meters downstream of the Wrightstown Road Bridge over Sharp's Fork. The section leading to the mouth parallels Wrightstown Road. To access, the mouth of this tributary, it is necessary to park on Wrightstown Road and walk a short way. This

tributary is very small so that will help to distinguish it from the mainstem of Sharp's Fork. The land is owned by Craig and Sherrie Downs, who are supportive of any monitoring and reclamation efforts.

Description: Along the main channel of SF-21, there is visible white and black coating on the streambed sediments downstream of the confluence of the mining tributaries. These two tributaries were sampled during Phase I reconnaissance for field parameters, and were sampled for Group I parameters during Phase II sampling in summer of 2004. The area drained by SF-21 was strip-mined. There were six sites sampled within Anderson Hollow in 2004.

SF-21 appears to be a significant source of metal loading in Sharp's Fork, contributing an average metal loading of 26.94 lbs/day, which is 64.5% of the loading in the upper section of Sharp's Fork, and 18.5% of the loading in the AMD affected area of the Sharp's Fork subwatershed. Aluminum, and manganese to a lesser degree, dominate the metal load, and the high flow metal loading appears to be more significant than the low flow metal loading, both in terms of percent contribution to the upper section of Sharp's Fork and to the entire AMD affected area of Sharp's Fork. During spring flow, the Al concentration was 10.4 mg/L, thus contributing an Al load of 40.74 lbs/day, and the Mn concentration was 2.2 mg/L, contributing a Mn load of 8.63 lbs/day. Fe concentrations were much lower at 0.69 mg/L, contributing 2.71 lbs/day. During low flow, the concentrations and loadings were less, with an Al concentration of 2.06 contributing 0.98 lbs/day, Mn concentration of 1.59 mg/L contributing 0.76 lbs/day, and Fe concentration of 0.09 mg/L contributing 0.04 lbs/day.

Although SF-21 is net alkaline during both high and low flow (66 mg/L and 17.7 mg/L CaCO3, respectively), the net alkalinity is far below typical alkalinity values for the area. The pH of the tributary is also lower than typical values for Sharp's Fork, with an average pH of 6.77. Tributary 21 also appears to be a significant source of sulfate for this section.

Tributary 21	High Flow	Low Flow	Average
Metal Load (lbs/day)	52.1	1.78	26.94
Sulfate Load (lbs/day)	1835.6	178.28	1006.9
Acidity (mg/L)	10.4	7	8.7
Net Alkalinity (mg/L)	17.70	66.00	41.85
Discharge (cfs)	0.728	0.088	0.408
pH	6.49	7.05	6.77
% Metal Contribution*	84	45	64.5
% Metal Contribution in SF**	34	3	18.5

* % Contribution in Upper Section of Sharp's Fork** % Contribution in Entire AMD region of Sharp's Fork

SF- 20 – AMD affected tributary:

SF20 is at zero river miles, at 39.47545208 latitude -81.95114957 longitude, and is at an elevation of 713 feet. This tributary enters Sharp's fork at seven river miles. The area of land above this point is 0.28 square miles and the length of the stream above this point is 0.4 miles.

Access: SF- 20 is the mouth of a tributary that enters Sharp's Fork at RM 7**.**_Sampling was conducted at the mouth, which is a short walk from a gas access road off Old Grade Road north of Joy. The land is owned by Marshall and Betty Lowe.

Description: SF-20 drains an approximate area of .284 square miles. The land is affected by strip mining and has not been investigated. The discharge at high flow was 0.352 cfs, and 0.078 cfs at low flow. The average pH was 7.36, and the average conductivity was 1175 uS. SF-20 is net alkaline, with an average net alkalinity concentration of 89.6 mg/L. Metal loadings were 4.06 lbs/day at high flow and 0.07 lbs/day at low flow. Although SF-20 was the second largest contributor of metals in the upper section of Sharp's Fork during high flow, the contribution value was low at 7 percent. At low flow, the metal contribution of SF-20 dropped to 2 percent. SF-20 is the second largest contributor of sulfate, contributing an average of 31 percent of the sulfate load in the upper section of Sharp's Fork. SF-20 contributes 8 percent of the sulfate load at high flow for the entire AMD region of Sharp's Fork, and 4 percent at low flow.

SF - 20	Low Flow	High Flow	Average
Metal Load (lbs/day)	0.07	4.06	2.07
Sulfate Load (lbs/day)	1266.2	258.3	762.3
% Metal Contribution*	7	2	4.5
% Metal Contribution in SF**	3	0	1.5

*** % Contribution in Upper Section of Sharp's Fork**

**** % Contribution in Entire AMD region of Sharp's Fork**

SF-19 – AMD affected tributary:

SF-19 is at 0 river miles, at 39.46994525 latitude -81.94241244 longitude, and is at an elevation of 729 feet. This is a tributary that enters Sharp's Fork at 6 river miles. The area of land above this point is 0.06 square miles. This small tributary is not mapped therefore the stream length above this point in not available.

Access: SF-19 is the mouth of a small tributary that enters Sharp's Fork at approximately RM 6. It is located on Marshall and Betty Lowe's land, and accessible by foot.

Description: SF-19 drains an approximate area of 0.063 square miles. The AMD impact is due to stripmining of this area. The discharge is 0.026 cfs at high flow and 0.004 cfs at low flow. At high flow, SF-19 has a pH of 4.43, a net acid concentration of 47.6mg/L, and an acid loading of 6.69 lbs/day. At low flow, SF-19 has a pH of 4.24, a net acid concentration of 54.1 mg/L, and an acid load of 1.46 lbs/day. At high flow the metal load is 0.86 lbs/day, which accounts for 1 percent of the metal load, and at low flow the metal load is 0.04 lbs/day, which accounts fOR-10 percent of the metal load in the upper section of Sharp's Fork. When ranked with all tributaries sampled for Sharp's Fork, SF-19 contributed 1 percent of the metal load at both low and high flow.

SF-19	Low Flow	High Flow	Average
Metal Load (lbs/day)	0.04	0.86	0.45
Acid Load (lbs/day)	1.46	6.69	4.08
% Metal Contribution*	1	10	5.5
% Metal Contribution in SF**	1	1	1

*** % Contribution in Upper Section of Sharp's Fork** % Contribution in Entire AMD region of Sharp's Fork**

SF-18 – AMD affected tributary:

SF-18 is at 0 river miles, at 39.46930328 latitude -81.94287387 longitude, and is at an elevation of 712 feet. This tributary enters Sharp's Fork at 5.98 river miles. The area of land above this point is 0.03 square mile. This small tributary is not mapped, therefore the stream length above this point in not available.

Access: SF-18 is at the mouth of a small tributary that enters Sharp's Fork at RM5.98. It is located on Marshall and Betty Lowe's land, and is accessible by foot.

Description: SF-18 has a drainage area of 0.03 square miles. The specific sources of AMD have not been evaluated. The discharge of SF-18 is 0.017 cfs at high flow and 0.006 cfs at low flow. The average pH was 3.2, and the average conductivity was 2080 uS. At low flow, the net acid concentration was 243 mg/L, contributing an acid load of 7.9 lbs/day, and at high flow, the net acid concentration was 192 mg/L, contributing an acid load of 17.8 lbs/day. SF-18 has a high average aluminum concentration at 26.45 mg/L (Fe-2.82, Mn-3.58), and is the second largest contributor of metals in the upper section of Sharp's Fork. The percent metal load contribution increased significantly during low flow. When compared to all eighteen inputs into Sharp's Fork, SF-18 contributed 2 percent of the average metal load (Rank-sixth) and less than 1 percent of the average sulfate load.

SF-18	Low Flow	High Flow	Average
Metal Loading (lbs/day)	1.23	2.58	1.91
Acid Loading (lbs/day)	7.9	17.8	12.85
% Metal Contribution*	4	31	17.5
% Metal Contribution in SF**	2	2	2

*** % Contribution in Upper Section of Sharp's Fork** % Contribution in Entire AMD region of Sharp's Fork**

SF-17 – AMD impacted tributary

SF-17 is at 0 river miles, at 39.46494117 latitude -81.93898114 longitude, and is at an elevation of 720 feet. This tributary enters Sharp's fork at 5.5 river miles. The area of land above this point is 0.34 square miles and the length of the stream above this point is 0.8 miles.

Access: SF-17 is a small tributary on the west side of Sharp's Fork. It is accessible by foot.

Site Description: SF-17 is the mouth of a small tributary draining land that has been strip-mined, and may not represent a discrete source of AMD. The strip-mined area has not yet been assessed, and it may contain numerous diffuse seeps.

SF-17 is characterized by a low discharge with high conductivity and elevated sulfate and metal concentrations. SF-17 has a neutral pH and is net alkaline. Discharge was 0.365 cfs on 5/19/03 (high flow) and 0.084 cfs on 8/19/03 (low flow). At high flow, the conductivity, sulfate, and total metal concentrations were 1180 uS, 625 mg/L, and 1.22 mg/L, respectively. At low flow, these parameters measured 1200 uS, 491 mg/L, and 1.00 mg/L respectively. The average pH was 7.7 and the average net alkalinity was 89.5 mg/L.

According to available water quality data, SF-17 contributed an average of 7.5 percent of the metal load and 28.5 percent of the sulfate load relative to the 7 inputs sampled in the middle section of Sharp's Fork. Of the 7 inputs in the middle section, SF-17 was ranked third highest contributor of both metals and sulfate. When compared with all eighteen inputs into Sharp's Fork, SF-17 contributed ranked eighth in terms of both metal and sulfate loadings. On average, SF-17 contributed 1percent of the metal load and 1.5 percent of the sulfate load.

SF-16-AMD impacted input

SF-16 is at 0 river miles, at 39.46204648 latitude -81.9346762 longitude, and is at an elevation of 578 feet. This is a tributary that enters Sharp's Fork at 5.3 river miles. The area of land above this point is 0.11 square mile. This small tributary is not mapped therefore the stream length above this point in not available.

Access/Location: SF-16 is located on the west side of Sharp's Fork, approximately 0.5 mile downstream of Joy. The sample site is located approximately 200 feet from Old Grade Road.

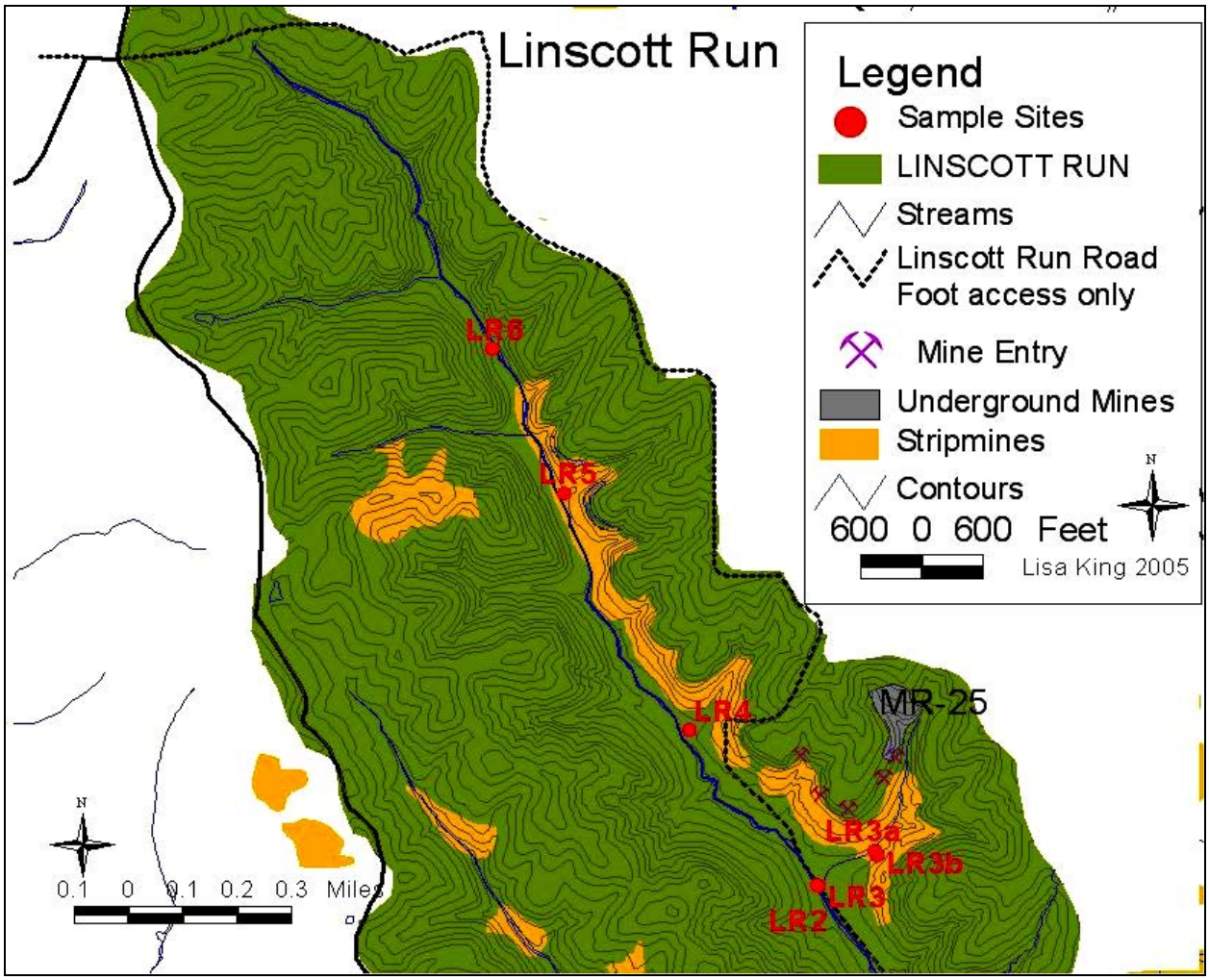
Site Description: SF-16 is a very low volume input into Sharp's Fork, contributing 0.004 cfs (2 gpm) on 5/19/03 and 0.007 cfs (3.2 gpm) on 8/19/03. The 8/19/03 had a higher discharge than the 5/19/03 sampling date, which is the opposite trend of the other sites within Sharp's Fork.

SF-16 is characterized by a neutral pH and a high net alkalinity. SF-16 also has a high conductivity, and moderately elevated levels of sulfate and metals. On the 5/19/03 sampling date, SF-16 had a conductivity of 748 uS, sulfate concentrations of 305 mg/l, and a total metal concentration of 0.72 mg/L. On the 8/19/03 sampling date, SF-16 had a conductivity of 1530 uS, sulfate concentrations of 791 mg/l, and a total metal concentration of 1.16 mg/L. AMD parameters appear to become more severe on the 8/19/03 sampling date, although the discharge was higher.

SF-16 ranks as the lowest contributor in the upper section of Sharp's Fork, contributing only 0.5 percent of the total metal loading and 2 percent of the total sulfate loading.

LINSCOTT RUN BASIN ASSESSMENT

Map 13 Linscott Run



Pictures of Linscott Run

Stobert Mine, low flow high acid

Geographic Background

Linscott Run occupies the central portion of the watershed and flows in a southern direction, entering Federal Creek at 11.93 river miles. It is located in Athens and Morgan Counties, crossing Homer, Bern, and Ames Townships and is near Amesville (0.4 miles north). This subwatershed can be found on the Amesville USGS quad sheets. Linscott Run has a drainage area of 5.06 square miles, and a stream length of 8.4 miles. In this subwatershed, 0.01 square mile has been underground mined, representing 0.14 percent of the total land. Additionally, in this subwatershed, there is 0.12 square mile that has been strip-mined, which is 2.5 percent of the total land.

Mining Impacts In Brief

Linscott Run only has abandoned mines in the northern quarter of the subwatershed. Mining has taken place between river mile 3.8 and 5.0. Impact of mine drainage has been determined to be negligible to the mainstem of Linscott Run. No further study of this area is recommended at this time.

Table 35 Linscott Run underground mine information

Mine number	Mine Name	Date Abandoned	Type	Coal elevation
MN-25	Stobert	1951	underground	

AMD Impacts to Linscott Run

Biology Investigation for Linscott Run

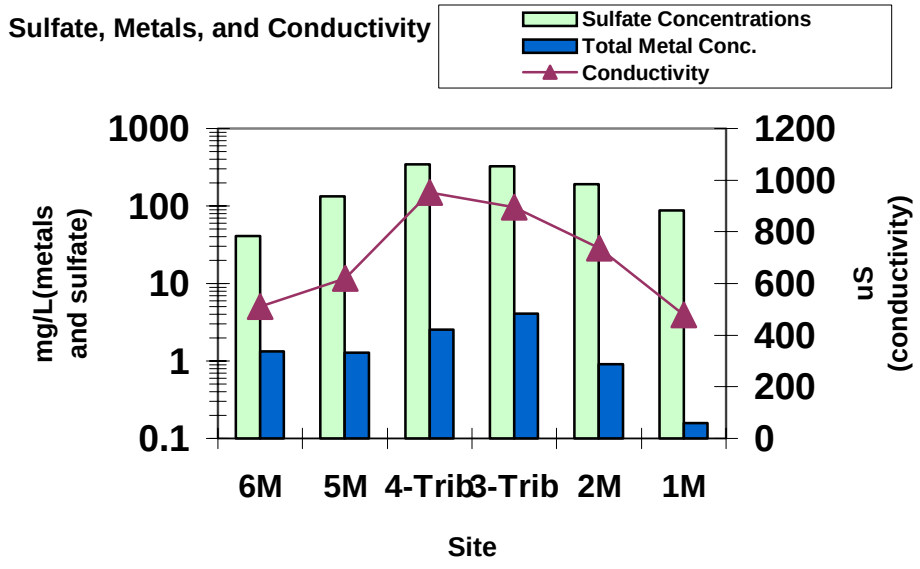
Table 36 Biology Data for Linscott Run

by MBI in the Hocking River watershed during 2004.									
Station (Map #)	Fish RM	Macro RM	IBI	MIwb	ICI or Narrative Rating	QHEI	Aquatic Life Uses Ex/Rec	Attain-ment Status	Comment
Linscott Run									
S011803.702004	3.80	3.70	38*	NA	VG ns	68.0	EWH	**Partial**	Upstream Site
S011800.802004	0.80	0.80	50	NA	MG*	73.5	EWH	**Partial**	St. Rt. 329
Ecoregion Biocriteria: Western Allegheny Plateau (WAP)									
		Index and Site Type	**WWH**	**EWH**	**MWH**	**LRW-AMD**			
		IBI – Wading & Headwater	**44**	**50**	**24/24**	**18**			
		Mod. Iwb - Wading	**8.4**	**9.4**	**6.2/5,5**	**4.0**			
		ICI/Narrative	**36/G**	**46/E**	**22/30**	**8/MF**			

Mainstem Linscott Run

In the chart below the average combined metals (iron, magnesium, and aluminum), sulfate, and conductivity are displayed. Site 1M is at the mouth of Linscott Run, 3.8 river miles from the abandoned mines. Site 2M is on the mainstem just below the abandoned mines. The underground mine and some strip mining are located on the tributary labeled 3 in the chart. The tributary labeled 4 originates in a strip-mined area. 6M is on the mainstem located above all of the abandoned mines. Mine drainage is diffuse throughout this upper area. Some of the mainstem sites and the tributaries 3 and 4 do have metal and sulfate parameters above the Federal Valley Targets. However the mainstem site that is below all of the mining located at river mile 3.8 has all of the parameters below the target during both low and high flow. The biological study of this site shows that the macroinvertebrates scored a 'very good'. The IBI score was low, scoring a modified water habitat, but the drainage basin is only 1.2 square miles above this point, which possibly could affect the ability of fish to live in this area. In the biological study conducted by MBI, fine sediments are listed as the cause of impairment in this stream, perhaps some of that is from abandoned mines but there is also farming and development in this watershed.

Figure 23 Metal, Sulfate and Conductivity Linscott Run



Investigation of Linscott Run

A phase I water quality investigation was conducted in the Linscott Run subwatershed on 4/14/03. Preliminary field observations identified strip pits and gob piles from surface mining in the headwaters of Linscott Run. An underground mine was also identified at the headwaters but was not impacting the tributary. Field parameters did not show a significant impact from surface/underground mining in Linscott Run. A phase II water quality investigation was conducted in Linscott Run on 5/14/03 and 9/30/03; two tributaries and four mainstem sites were sampled.

Individual Site Descriptions

Location LR-1 is a point on the mainstem of Linscott Run at 0.0 river miles, at 39.40865736 latitude -81.95916971 longitude, and is at an elevation of 629 feet. Linscott Run is a tributary that enters Federal Creek at 11.93 river miles. The area of land above this point is 5.06 square miles and the length of the stream above this point is 5.8 miles.

Access to LR-1, located at the intersection of Linscott Run Road and State Route 329 is accessible by parking and walking twenty feet.

Location: LR-2 is a point on the mainstem of Linscott Run at 3.74 river miles, at 39.45364891 latitude -81.94955206 longitude, and is at an elevation of 794 feet. Linscott Run is a tributary that enters Federal Creek at 11.93 river miles. The area of land above this point is 1.30 square miles and the length of the stream above this point is 2.0 miles.

Access to LR-2 requires driving north on Linscott Run, past the last house on the left.

Location LR-3 is at 0 river miles, at 39.45363642 latitude -81.94952155 longitude, and is at an elevation of 744 feet. This is a tributary that enters Linscott Run at 3.78 river miles. The area of land above this point is 0.137 square miles and the length of the stream above this point is 0.403 miles.

Access to LR-3 requires walking from the car as a culvert has rusted that makes the road impassable. The tributary should be visible flowing toward Linscott Run on the right. Marshall and Betty Lowe own this land.

Location: LR-3a is at 0.15 river miles, at 39.45457092 latitude -81.94759078 longitude, and is at an elevation of 735 feet. This tributary enters Linscott Run at 3.78 river miles. The area of land above this point is 0.04 square mile. This small tributary is not mapped, therefore the stream length above this point in not available.

Access to LR-3a requires following LR 3 to a location where a tributary diverges from the left, cutting through coal refuse. This tributary is LR-3a.

Location: LR-3b is at 0.15 river miles, at 39.45445835 latitude -81.94751057 longitude, and is at an elevation of 738 feet. This tributary enters Linscott Run at 3.78 river miles. The area of land above this point is 0.12 square mile and the length of the stream above this point is 0.3 miles.

Access to LR-3b requires following LR 3 to a location where a tributary diverges from the left. LR-3b is located immediately upstream of this tributary.

Location of LR-4 is at 0.0 river miles, at 39.45788889 latitude 81.95390655 longitude, and is at an elevation of 772 feet. This tributary enters Linscott Run at 4.2 river miles. The area of land above this point is 0.06 square miles. This small tributary is not mapped therefore the stream length above this point in not available.

Access to LR-4 requires walking 0.5 river miles up stream from LR-3. In this vicinity, a tributary will be visible originating in the strip-mined area to the left.

Location: LR-5 is a point on the mainstem of Linscott Run at 4.7 river miles, at 39.46430155 latitude -81.95811871 longitude, and is at an elevation of 817 feet. Linscott Run is a tributary that enters Federal Creek at 11.93 river miles. The area of land above this point is 0.68 square miles and the length of the stream above this point is 1.1 miles.

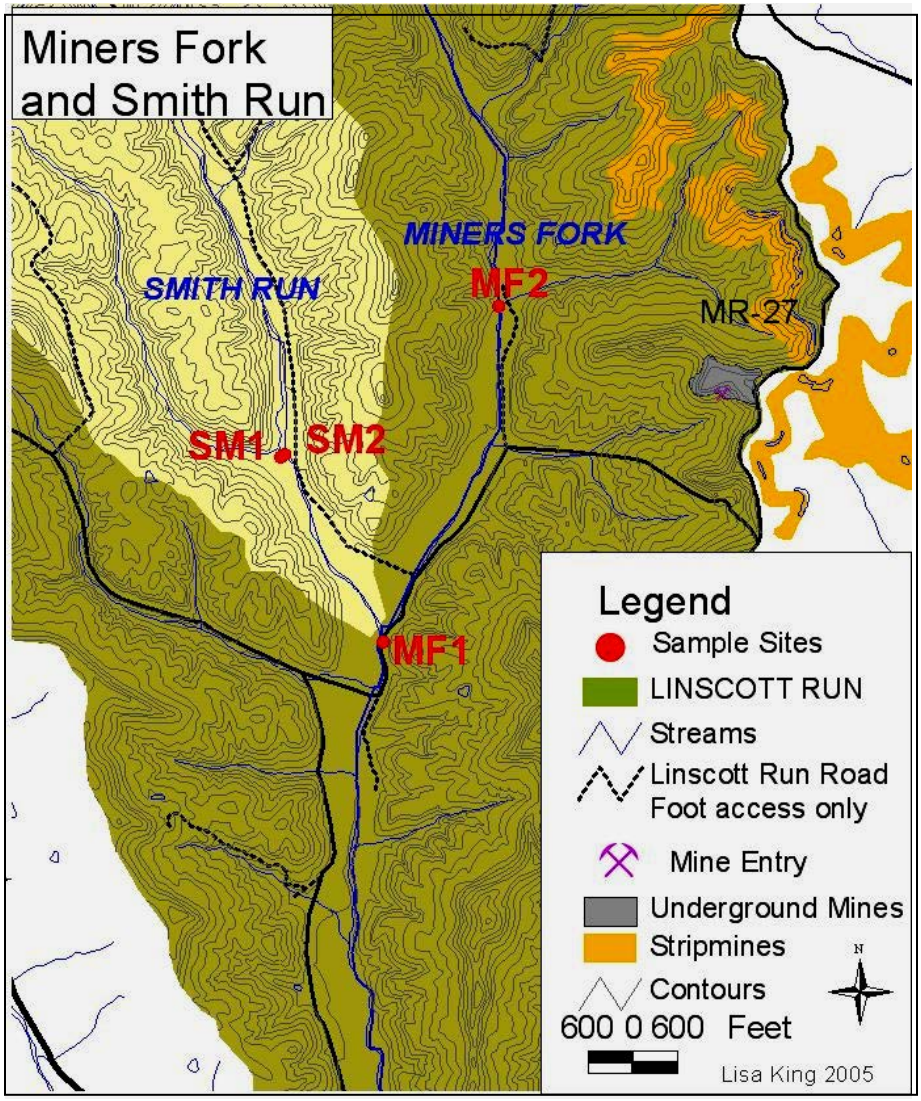
Access to LR-5 requires walking up Linscott Run. This site is located on the mainstem below an area with diffuse mine seeps originating in the bank of the stream.

Location: LR-6 is a point on the mainstem of Linscott Run at 5 river miles, at 39.46822914 latitude -81.96058877 longitude, and is at an elevation of 843 feet. Linscott Run is a tributary that enters Federal Creek at 11.93 river miles. The area of land above this point is 0.44 square miles and the length of the stream above this point is 0.8 miles.

Access to LR-6 requires walking up Linscott Run. This site is located on the mainstem above all mining impacts.

MINERS FORK/ SMITH RUN BASIN ASSESSMENT

Map 14 Miners Fork/ Smith Run



Pictures of Miners Fork

Geography Background

Smith Run occupies the northwest portion of the watershed and flows in a southeast direction, entering Miners Fork at 2.4 river miles. It is located in Morgan County, crosses Homer Township, and is near Glouster (2 miles W). This subwatershed can be found on Corning, Ringgold, Amesville, and Jacksonville USGS quad sheets. Smith Run has a drainage area of 2.93 square miles, and a stream length of 3.5 miles. There are no underground mines in this subwatershed, but there are 0.19 square miles that have been strip-mined, which is 6.4 percent of the land in the entire subwatershed.

Miners Fork occupies the northwest portion of the watershed and flows in a south/southeast direction, entering Federal Creek at 16.21 river miles. It is located in Athens and Morgan Counties, crossing Homer and Ames Townships and is near Joy (1.3 miles E). This subwatershed can be found on Corning, Ringold, Amesville, and Jacksonville USGS quad sheets. Miners Fork has a drainage area of 7.02 square miles, and has a stream length of 6.6 miles. In this subwatershed, there 0.02 square mile that has underground mines, which is 0.2 percent of the land in the entire subwatershed. Additionally, in this subwatershed there are 0.4 square miles that have been strip-mined, which is 3.6 percent of the land in the entire subwatershed.

Mining Impacts in Brief

Miners Fork only has abandoned mines in the northern quarter of the subwatershed. Mining has taken place between river mile 2.4 and 4.0. Impact of mine drainage has been determined to be negligible to the mainstem of Miners Fork. No further study of this area is recommended at this time.

Table 37 Miners Fork underground mine information

Mine number	Mine Name	Date Abandoned	Type	Coal elevation
MN-227	Hogsett	1969	underground	

AMD Impacts to Miners Fork

Biology Investigation

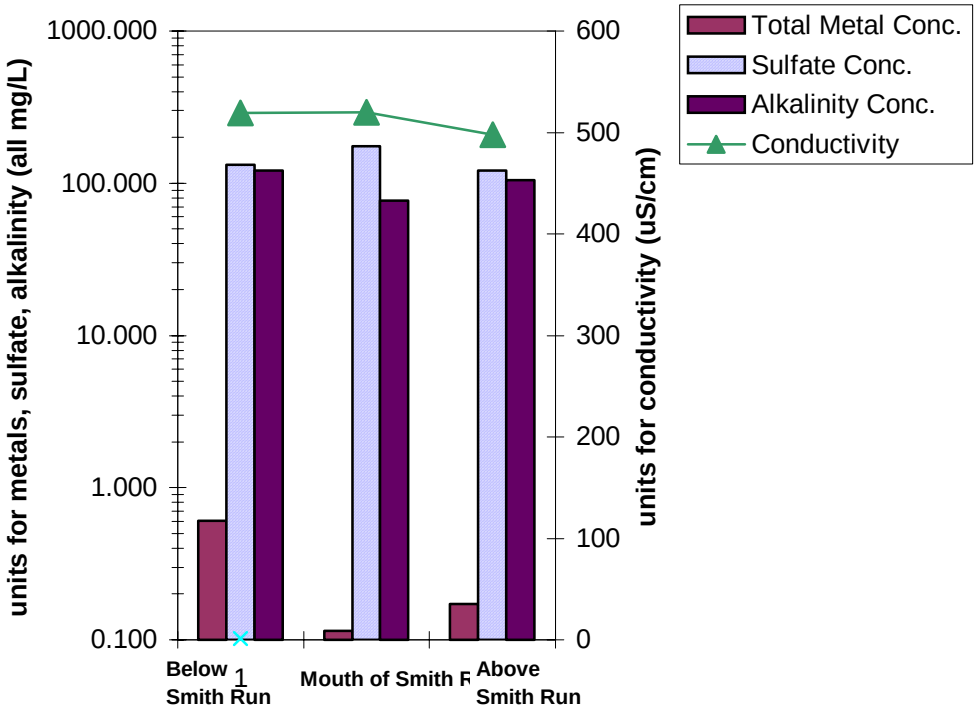
Table 38 Biology Data for Miners Fork

by MBI in the Hocking River watershed during 2004.									
Station (Map #)	Fish RM	Macro RM	IBI	MIwb	ICI or Narrative Rating	QHEI	Aquatic Life Uses Ex/Rec	Attain-ment Status	Comment
S01192 2.202004	2.25	2.20	44*	NA	G*	56.5	EWH	**Non**	Wrightstown Rd.
S01192 0.102004	0.05	0.10	46^{ns}	NA	G*	58.5	EWH	**Partial**	St. Rt. 329, at mouth

Mainstem Miners Fork

In the chart below the average combined metals (iron, magnesium, and aluminum), sulfate, alkalinity, and the conductivity are displayed. There is data from three sites, Miners Fork below Smith Run, Miners Fork above Smith Run and the mouth of Smith Run. There is strip mining and one small underground mine in this area (see map at the beginning of section). All parameters are below the Federal Valley Watershed target. Miners Fork is not attaining its Exceptional Warmwater Habitat use designation at the site below Smith Run. Miners Fork is partially attaining its Exceptional Warmwater Habitat use designation at the site at the mouth of Miners Fork.

Figure 24 Metal, Sulfate and Conductivity Miners Fork



Investigation of Smith Run and Miners Fork

Smith Run

A phase I water quality investigation was conducted in the Smith Run subwatershed on 5/9/03 and 5/22/03. Preliminary field observations identified surface mining in the headwaters of Smith Run. Field parameter data collected did not show a significant impact from surface mining on the mainstem of Smith Run. A phase II water quality investigation was conducted in Smith Run on 9/30/03; one tributary site and one mainstem site were sampled.

Miners Fork

A phase I water quality investigation was conducted in the Miners Fork subwatershed on 5/22/03. Preliminary field observations identified surface mining and 2 tributaries flowing into the mainstem of

Miners Fork with high conductivity readings. A phase II water quality investigation was conducted in Miners Fork on 9/30/03; two mainstem sites were sampled.

Individual Site Description

Location/Access: SM1 is a point on the mainstem of Smith Run at 0.5 river miles, at 39.49038737 latitude -81.99947468 longitude, and is at an elevation of 717 feet. Smith Run is a tributary that enters Miners Fork at 2.4 river miles. The area of land above this point is 2.84 square miles and the length of the stream above this point is 3.1 miles.

Location/Access: SM2 is at 0.45 river miles, at 39.49029987 latitude -81.99965162 longitude, and is at an elevation of 714 feet. This tributary enters Smith Run at 0.52 river miles. The area of land above this point is 0.611 square miles and the length of the stream above this point is 1.577 miles.

Location/Access: MF1 is a point on the mainstem of Miners Fork at 2.4 river miles, at 39.48357062 latitude -81.99492171 longitude, and is at an elevation of 648 feet. Miners Fork is a tributary that enters Federal Creek at 16.21 river miles. The area of land above this point is 7.23 square miles and the length of the stream above this point is 4.7 miles.

Location/Access: MF2 is a point on the mainstem of Miners Fork at 3.1 river miles, at 39.49575741 latitude -81.98944456 longitude, and is at an elevation of 753 feet. Miners Fork is a tributary that enters Federal Creek at 16.21 river miles. The area of land above this point is 3.69 square miles and the length of the stream above this point is 4.0 miles.

FUNDING OPPORTUNITIES

Ohio Department of Natural Resources, Division of Mineral Resources Management

1) Federally Funded Abandoned Mine Land Program: Federal excise taxes on coal are returned to the State of Ohio for reclamation of abandoned mine land sites that adversely affect the public's health and safety.
2) Acid Mine Drainage Set-Aside Program: Up to ten percent of Ohio's federal excise tax monies are set aside for acid mine drainage abatement. Priority is given to leveraging these funds with watershed restoration groups and other governmental agencies.
3) State Abandoned Mine Land Program: State excise taxes on coal and industrial minerals are dedicated to reclamation projects that improve water quality in impacted streams. Priority is given to leveraging these funds with partners.

Office of Surface Mining (OSM), Reclamation and Enforcement

1) Appalachian Clean Streams Initiative: The mission of ACSI is to facilitate and coordinate citizens groups, university researchers, the coal industry, corporations, the environmental community, and local, state, and federal government agencies that are involved in cleaning up streams polluted by acid mine drainage. OSM provides funds for ACSI projects on an annual basis.
2) Direct grants to Watershed Groups: A grant process for directly funding citizen watershed group efforts to restore acid mine drainage impacted streams on a project basis.

Environmental Protection Agency

1) EPA Section 319 Non-point Source Grant Program: Funding is available for planning, education and remediation of watershed pollution problems including acid mine drainage.
2) Office of Water – Watershed Protection and Flood Prevention/PL566 Program: This program provides technical and financial assistance to address resources and related economic problems on a watershed basis that address watershed protection, flood prevention, water supply, water quality, erosion and sediment control, wetland creation and restoration, fish and wildlife habitat enhancement, and public recreation. Technical assistance and cost sharing with varied amount are available for implementation of NRCS-authorized watershed plans.

United States Army Corps of Engineers

1) Section 905b – Water Resource Development Act (86): Recent additions to the Army Corps conventional mission include a habitat restoration grant program for the completion of feasibility studies and project construction where a Federal interest can be verified. A principle non-federal sponsor must be identified for this cost-share program.
2) Flood Hazard Mitigation and Ecosystem Restoration Program/Challenge 21: This watershed based program assists in groups involved in mitigating flood hazards and restoration of riparian ecosystems. Assistance is provided nonstructural solutions in flood-prone areas, while retaining traditional measures where appropriate. Cost-share between federal and local governments Federal share is 50 percent for studies and 65 percent for project implementation, up to a maximum federal allocation of $30 million.
3) Section 206 Aquatic Ecosystems Restoration Project under the Water Resources Development Act of 1996. Annual appropriation of $25 million. The maximum Federal cost-share is $5 million. 100% federal for study costs, 35% of the study costs are recovered from the non-federal sponsor during the first year. Both programs have a 65/35 cost-share ratio during construction.

United States Fish and Wildlife Service

1) Partners for Fish and Wildlife Program: This program assists private landowners by providing technical and financial assistance to establish self-sustaining native habitats.

2) Clean Water Action Plan Fund: The purpose of this fund is to restore streams, riparian areas and wetlands resulting in direct and measurable water quality improvements.
3) Five Star Challenge Restoration Grants: The purpose of this program is to provide modest financial assistance to support community-based wetland and riparian restoration projects that build diverse partnerships and foster local natural resource stewardship.

Ohio Division of Wildlife

1) Wildlife Diversity Fund: This fund financially assists with research, surveys (biological or sociological), management, preservation, law enforcement, education, and land acquisition.

Lindbergh Foundation

1) Lindbergh Grants: This program financially assists organizations that are making significant contributions toward the balance between technology and nature through the conservation of natural resources. The Lindbergh Grants provides a maximum grant of $10,580. The program is considered a provider of seed money and credibility for pilot projects that subsequently receive larger sums from other sources.

The Acorn Foundation

1) The Acorn Foundation supports projects dedicated to building a sustainable future for the planet and to restoring a healthy global environment. The Acorn Foundation funds community-based projects which; preserve and restore habitats supporting biological diversity and wildlife; advocate for environmental justice, particularly in low-income and indigenous communities; and prevent or remedy toxic pollution.

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APPENDIX 1 LOCATIONS OF 2004 TMDL SITES

RM	Stream	Description	AMD Site	Longitude	Latitude
0.4	Big Run	Mouth		-81.87615071	39.35453558
1.7	Big Run	downstream Ellis Run		-81.85298534	39.35228221
3.9	Big Run	Downstream Wildcat Hollow		-81.81555166	39.36049324
1.2	Bryson Branch	Haward Rd and Bryson Rd		-82.01967258	39.41301881
0.9	Federal Creek	Sharps Run Bridge near mouth		-81.88776437	39.33049033
4.9	Federal Creek	Near Mayle Ridge Bridge, Broadwell	x	-81.87891421	39.36457212
9.1	Federal Creek	below Sharps Fork	x	-81.93014312	39.3996047
9.3	Federal Creek	above Sharps Fork		-81.93303532	39.40327681
11.3	Federal Creek	Below McDougall- Amesville		-81.9547213	39.39671365
11.4	Federal Creek	550 bridge Amesville, above McDougall		-81.95543977	39.40100986
11.7	Federal Creek	Below Linscott Run, above Amesville		-81.96005221	39.40447895
16.15	Federal Creek	below Hyde/Miners		-81.98986145	39.44968809
1.8	Hyde Fork	past Cable farm		-82.01217378	39.47096845
1.7	Kassler Creek	on Hines Farm		-81.97584139	39.42703701
0.8	Linscott Run	above cows,		-81.95134785	39.41463674
3.8	Linscott Run	below mining	x	-81.94972013	39.45379513
0.1	Marietta Run	Near Mouth	x	-81.87942319	39.37083327
1.6	Marietta Run	Below large seep	x	-81.88751349	39.38792547
3.2	Marietta Run	down stream Brill Run, above all mining		-81.86767976	39.39898941
0.5	McDougall Branch	SR 550, east of Amesville		-81.96254154	39.39664177
1.7	McDougall Branch	Below Brawley		-81.97344724	39.39425973
2.9	McDougall Branch	below Mush- SR-690 bridge- refrence site		-81.99002849	39.38255809
4.6	McDougall Branch	below Bryson Branch		-82.01077139	39.39402234
4.9	McDougall Branch	above Bryson Branch, below Lucas farm		-82.01681383	39.39687976
0	Miners Fork	near mouth	x	-81.98979365	39.45404123
2.2	Miners Fork	below Smith Run	x	-81.99574966	39.48139389
1	Mush Run	below Dutch Creek		-81.98714129	39.37140986
1.8	Mush Run	above dutch creek, near Mush Run Rd.		-81.979447	39.36382399
0.2	Opossum Run	bridge in Sharpsburg	x	-81.91274194	39.43662386
0.75	Opossum Run	Gifford St Forest	x	-81.90475611	39.44194719
2.6	Opossum Run	Compressor Rd		-81.89865416	39.46144488
4.1	Opossum Run	Possum Hollow Rd		-81.90886118	39.48817714
0.1	Sharps Fork	Near mouth		-81.92863457	39.40468926
1.6	Sharps Fork	below Sulphur	x	-81.91982814	39.41938486
1.65	Sharps Fork	Above Sulphur below Opossum	x	-81.91844598	39.42426327
5.3	Sharps Fork	Below Joy, in Lowes land	x	-81.93593346	39.46205327
8.05	Sharps Fork	below anderson hollow, near writes town	x	-81.95943852	39.484315
9.1	Sharps Fork	mountville area, mountville Rd, C-4		-81.9601315	39.50035074
10.7	Sharps Fork	Pounds Rd.		-81.96433305	39.52062165
0	Sulphur Run	Mouth	x	-81.91449105	39.42174663
0.8	Sulphur Run	below tipple, Culvert	x	-81.90960248	39.42136614
0.4	Wyatt Run	Emma Wyatt Rd bridge		-81.96478186	39.38410863