The Paint Creek Watershed Management Plan

Hilary Solomon, Paint Creek Management Plan Coordinator

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July, 2002

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Completed with funding from the CWA section 319 grant program
for the Paint Creek Watershed Joint Board.

Major contributors include: Julie Brown, Paint Creek Watershed Coordinator; Todd Bishop, (former) MeadWestvaco GIS Analyst; Ed Moore, Ohio EPA Ecological Assessment Unit and the Paint Creek Watershed Advisory Group.

Significant contributions were also made by Paul Vandermeer, Ohio EPA Water Quality Unit; Sheree Gossett-Johnson, Ohio EPA Permitting and Compliance Assurance Unit; Christopher Smid, MeadWestvaco Regeneration Forester, Julio Perez, Ohio EPA Nonpoint Source Unit and Lauren Lambert, Ohio EPA Environmental Funding Unit.

Special thanks to Julie, Diana, Chris, Todd, Ed, Mike, Vince, Jeff and Randy.

EXECUTIVE SUMMARY

Purpose of the plan

The main purpose of the management plan is to help facilitate the maintenance and where appropriate the restoration of water quality and biological habitat within the Paint Creek Watershed. It provides documentation of existing conditions within the watershed and current conservation activities. The plan provides a tool to facilitate understanding of the cause and effect relationships between conditions in the watershed and current water quality trends. Initial stages of completing the plan helped define stakeholder goals and concerns. Later stages allowed the Paint Creek Project members to explore avenues to achieve stakeholder goals and address stakeholder concerns. The plan identifies management goals and solutions to water quality problems and attempts to outline a timeline for implementation and appropriate measures of success for each solution.

Over the next several years the plan will provide a guide to track implementation of solutions and the achievement of stakeholder goals. It allows for measuring the success of the project in terms of water quality and stakeholder satisfaction. Finally, it will provide a basis for redefining baseline conditions within the watershed for future management activities.

Water Quality Overview

The basis for water quality-related, regulatory authority in Ohio is the Water Quality Standards (WQS) found in the Clean Water Act. All of the creeks described in the management plan exceeded maximum criterion established in the WQS for fecal coliforms and Paint Creek exceeded dissolved oxygen standards. In addition, sections of each creek, except Lees Creek, did not meet, or only partially met, their respective habitat use designations.

All of the data collected for this management plan points to several, main causes of water quality degradation throughout the watershed. To varying degrees the entire watershed lacks intact, forested, riparian corridor. Forested, riparian land serves to slow runoff, dropping sediments and associated organics and nutrients, which are then assimilated by the trees, before they reach the creek. Forested, riparian corridor within 50 feet of the stream channel varies from 16% in the Sugar Creek basin to 50% in the Lower Paint Creek basin. The entire watershed needs to be targeted with tree projects, however, Upper Paint Creek, Sugar Creek, Rattlesnake Creek and North Fork show lack of trees as the main contributing factor to water quality degradation.

Other contributing factors in these areas (Upper Paint Creek, Sugar Creek, Rattlesnake Creek and North Fork) are erosion, nutrient inputs and channel modification associated with intensive row cropping. Erosion has caused embedded substrate, infilling of pools and turbid water, all conditions not conducive to fish and macroinvertebrate reproduction and success. Soil also carries nutrients and organic matter into the stream. These have caused increased algal and pollution tolerant species (snails, worms, leaches) growth and

decreased dissolved oxygen content. Implementing conservation practices, such as conservation tillage and precision nutrient applications, is especially important where the riparian corridor no longer functions as a buffer between agricultural lands and the stream.

Areas of the watershed that are attaining their use designations (Lower Paint Creek, Rocky Fork, Lees Creek, most of North Fork) tend to have a mixed landuse (ag/open urban and forested). These areas are threatened by decreasing riparian corridor and erosion and nutrient inputs associated with intensive farming practices. Here riparian corridors that exist must be maintained and areas without corridors need to be targeted with tree projects. Agricultural conservation practices are especially important where the forested riparian corridor is sparse or absent.

In addition to row cropping, livestock operations cause sedimentation, nutrient enrichment, high fecal coliform levels and riparian habitat destruction where they are adjacent to unfenced streams. Livestock is listed as a water quality threat in stream reaches throughout the watershed (see the Water Quality Section). Conservation practices such as exclusion fencing, alternate watering systems, manure management buildings and heavy-use feeding pads must be promoted in these areas.

Another potential problem throughout the watershed is related to on-lot wastewater or septic systems. This problem is reflected in high fecal coliform levels throughout the watershed. The Paint Creek Project is currently working with local health departments to set up a routine inspection and maintenance program for septic systems and the project has limited funds available for septic system upgrades.

In some areas of the watershed, point sources and urban areas contribute to water quality degradation. The Jeffersonville and Hillsboro WWTPs need careful review and possible upgrades. Washington Court House and Chillicothe are both initiating storm water collection programs under US EPA guidelines. It is in the best interest of the Paint Creek Project to participate and contribute in this process. Currently, where the stream passes through urban areas, it tends to be channelized and shows only limited water quality attainment.

Finally, water quality slumps are seen below both the Rocky Fork Lake dam and the Paint Lake dam. These slumps are attributed to water releases from the anoxic bottom waters combined with inconsistent releases of water. Suggestions to address these problems include changing the methods and timing of water releases to more closely mimic natural lake releases.

The map entitled, *Paint Creek Watershed; Water Quality by USGS 11- and 14-digit Subwatersheds* gives a visual representation of the segments of streams and their associated drainage units where beneficial use designations are met and where they are not met.

Concentration Reduction Analysis

A preliminary concentration reduction study based on the analytical data available from the 1997 monitoring survey, shows that the project must focus on controlling nutrient and sediment inputs to the creeks, which occur during rainfall events. The results of the analytical data indicate that contaminants such as fecal coliforms and suspended solids generally meet target reference stream conditions during low-flow periods. During storm events, however, the reference concentrations are greatly exceeded. The creeks used in the study showed a 50-70 percent exceedence of target concentrations during high flow periods. These episodic exceedences appear to impact biota in the stream and decrease the overall water quality in much of the watershed. Until such time as further studies can be initiated, a goal of 50 percent reduction in fecal coliforms and suspended solids during storm events has been set for the watershed. This goal may prove conservative as the streams will have the capacity to assimilate some of the fecal and sediment inputs associated with storm events.

Implementation Goals

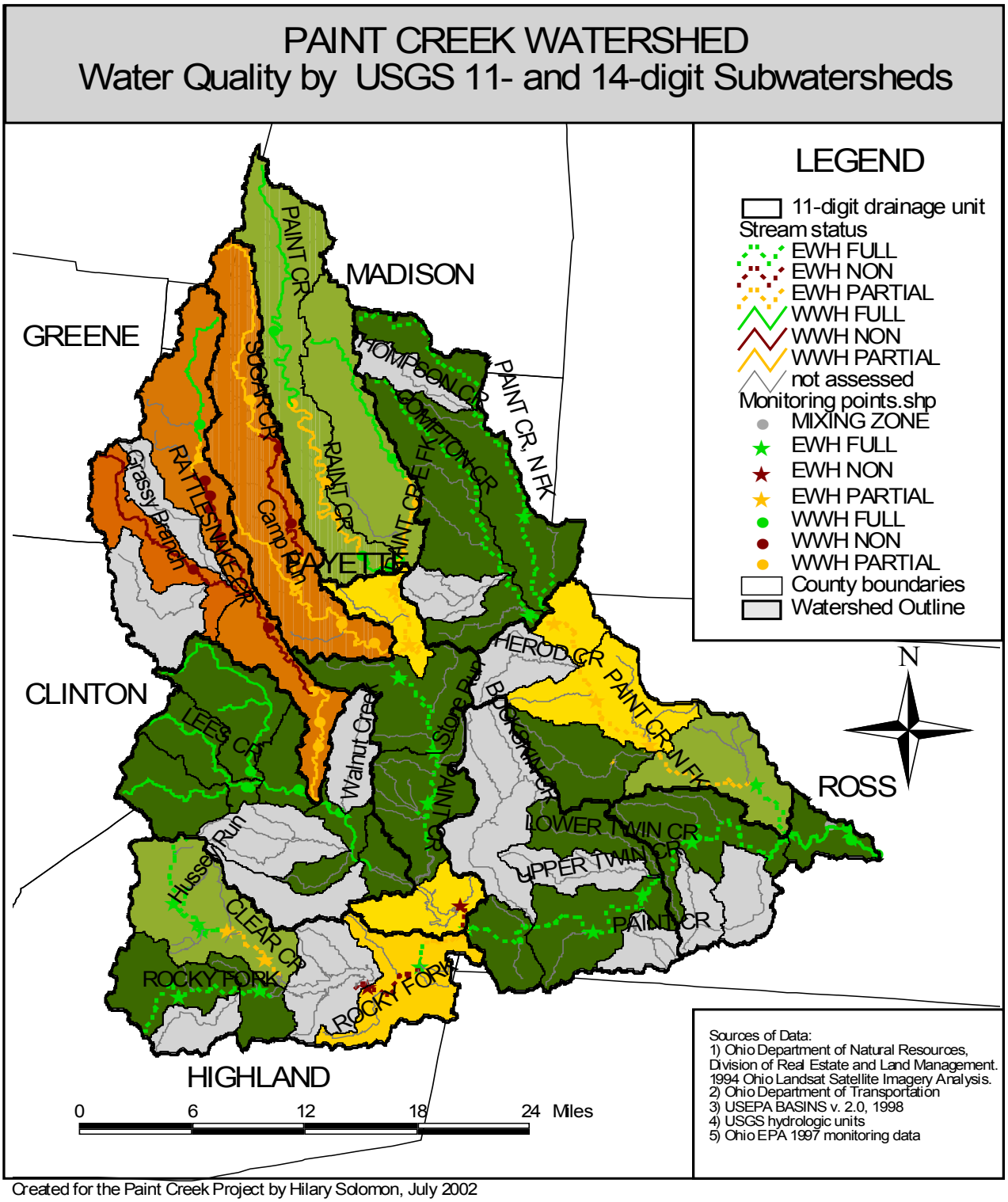
The implementation section is broken down into immediate action items and the long-term strategy. Immediate action items are critical to implementing an effective long-term strategy in the watershed. These items will provide information that will serve as the basis for determining the type and amount of each implementation strategy employed in the watershed. They will also provide for communication and participation between stakeholders in the watershed. The long-term implementation strategy is divided into six categories. These categories are based on the focus of the working groups that were tasked with developing strategies to improve water quality in the Paint Creek Watershed. They include agriculture, riparian corridors, forestry, education, urban issues, and streamside management.

The Paint Creek Watershed Project Joint Board

The Paint Creek Joint Board is made up of 1 supervisor from the 6 main Soil and Water Conservation District offices (Highland, Fayette, Ross, Clinton, Greene, Madison) and a 7th member that is chosen from one of the 3 major counties (Highland, Fayette, Ross). The 7th member rotates between the 3 counties every year. The members of the board meet monthly and make all of the decisions concerning the Project including approving applications, approving bills for payment, and evaluating employees. This Board makes the basic administrative decisions for the Management Plan but all input from Stakeholders is included in the actual document. The stakeholder group presently meets on an as needed basis but used to meet quarterly following a series of informational meetings that were held in the ten 11-digit watershed units at the beginning of the planning stage. The local working groups have endorsed the plans and stakeholder involvement is still encouraged, as the plans will need to be updated through time.

The future of the Paint Creek Watershed Project is based solely on support from the Ohio section 319 program at this current date. In 2000, the Joint Board applied for funding

through the Watershed Coordinator Grant program with the Ohio DNR, Division of Soil and Water Conservation and the Ohio EPA. This grant program was to assist districts in paying for the needed staff to organize and implement management plans. The Joint Board had letters of commitment from 6 of the 7 counties commissioners supporting the position. Unfortunately, our application was not funded and the Project continued to rely on 319 funding as the primary source of income for the programs. The Project hopes to utilize funds from Farm Bill Programs to implement many of the recommended BMP's that are found in the implementation section of these plans. Other avenues will need to be explored for continued funding for a watershed coordinator.

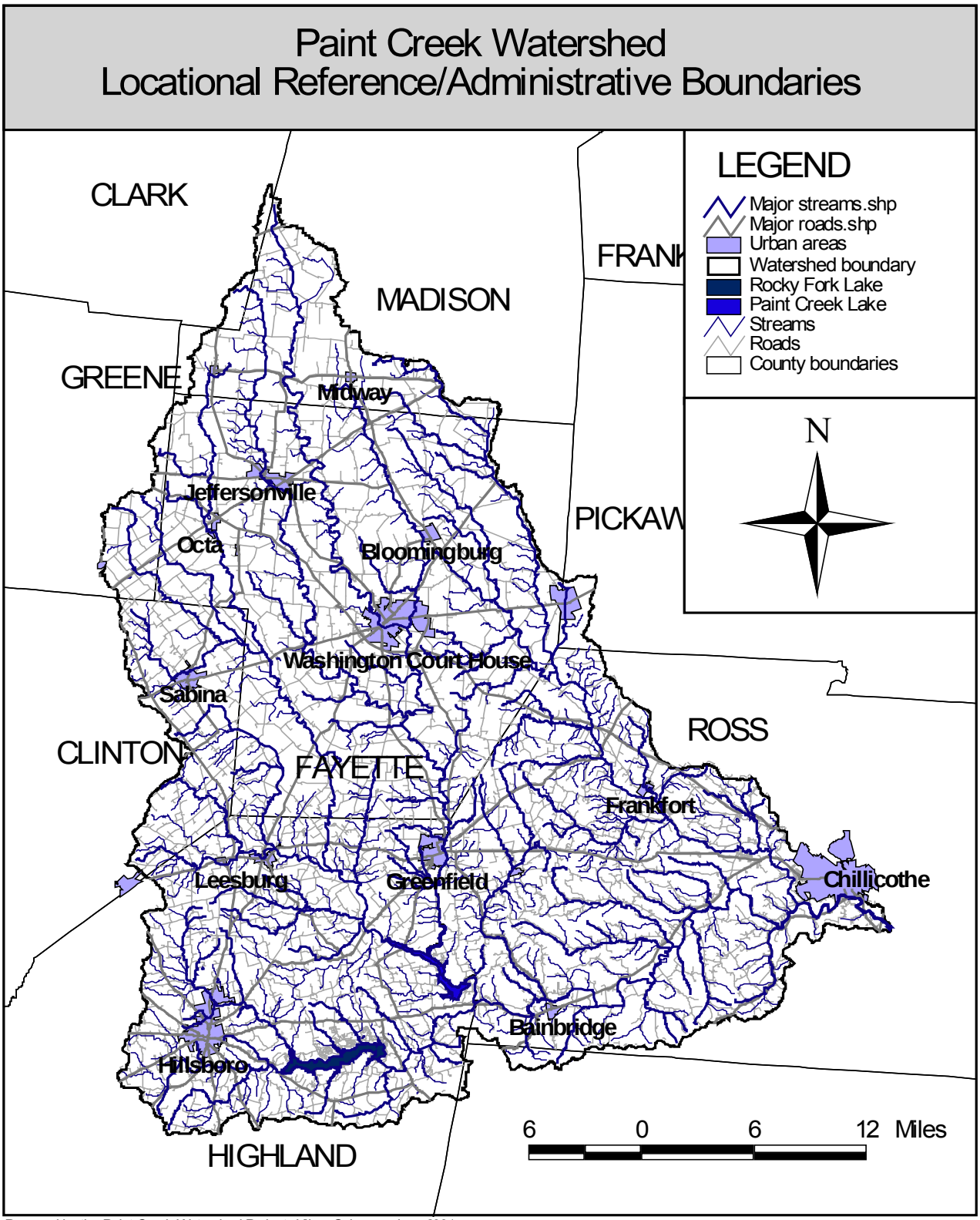


Created for the Paint Creek Project by Hilary Solomon, July 2002

PAINT CREEK WATERSHED MANAGEMENT PLAN

SECTION I: SCOPE AND BACKGROUND

JULY 2002



Prepared by the Paint Creek Watershed Project- Hilary Solomon, June 2001

INTRODUCTION

The Paint Creek Watershed Management Plan stems from an ongoing conservation ethic within the Paint Creek Watershed. Conservation practices were explored in the watershed as early as the 1960's. Public awareness and interest in maintaining and/or improving water quality in the watershed has increasingly mounted since those early studies. Land managers within the watershed are currently pursuing several conservation grants and the watershed project is distributing Clean Water Act, section 319 grant monies to fund projects in targeted areas. The management plan will provide information to ensure that future conservation efforts within the watershed are applied in the most efficient and beneficial manner.

As far as practicable, the Paint Creek Watershed Management plan follows the outline contained in Ohio EPA's *Guide to Developing Local Watershed Action Plans in Ohio* (June 1997). The plan contains four main sections: the background and scope of the project, a comprehensive watershed inventory, a watershed-wide water quality assessment with documentation of the related problems, and an outline of planned implementation activities or solutions. This last section includes a timeline and methods to evaluate the effectiveness of the activities implemented within the watershed.

General Description and Political Boundaries

The Paint Creek Watershed is comprised of 731,168.9 acres located in 9 counties: Madison, Greene, Clinton, Clark, Pickaway, Fayette, Pike, Ross, and Highland. The map entitled *Locational Reference and Administrative Boundaries* shows the location of and administrative boundaries within the watershed. The watershed is divided into 4 management units that are based on subwatersheds for the Paint Creek drainage area. These subwatersheds include the drainage areas for North Fork, Main Paint, Rattlesnake Creek, and Rocky Fork.

The Ohio Environmental Protection Agency (EPA) has divided the watershed into two stream groups, Upper and Lower Paint Creek. Upper Paint Creek (group 42-1 through 42-37) includes the Rattlesnake subwatershed and the western half of the Main Paint subwatershed. Lower Paint Creek (group 43-1 through 43-52) includes the north Fork subwatershed, the eastern half of the Main Paint subwatershed, and the Rocky Fork subwatershed. The USGS 8 digit hydrologic unit number is 0506003.

The North Fork Subwatershed covers an area of 151,168 acres. The headwaters of North Fork are in Madison County and the creek flows through Fayette and Ross Counties. North Fork is 46.6 miles long and meets the main stem of Paint Creek west of Chillicothe in Ross County. Its tributaries run an additional 70.7 miles and drain 96,793.6 acres. The largest tributary is Compton Creek, which is 19.9 miles long and drains an estimated 12,736 acres.

The Main Paint Creek Subwatershed is located in south central Ohio and covers 310,585 acres. It originates in Madison County and encompasses much of Fayette County and the eastern edge

of Highland and western edge of Ross County. Main Paint Creek meets the Scioto River south of Chillicothe in Ross County. The flood plain of Paint Creek varies in width from a few feet at its source to more than 1.5 miles at its mouth. The stream fall from source to mouth is 555 feet, an average of 5.7 feet per mile. The fall in the lowermost 50 miles is about 265 feet or 5.3 feet per mile (Corps, 1973). At the confluence of Paint Creek and Rattlesnake Creek is the Paint Creek Lake. The lake was built by the Army Corps of Engineers for flood control, but also serves recreational purposes.

The Rattlesnake Creek Subwatershed covers 177,408 acres. Rattlesnake Creek begins in Madison County near South Solon and flows through Fayette, Clinton and Highland Counties (the tributaries include Greene as well). The stream is approximately 42 miles long with an average fall of 8.2 feet per mile (Corps, 1972). The tributaries are 94 miles long and drain 127,590 acres. The subwatershed is characterized by gently rolling to steep pasture, cropland and hayfields.

The Rocky Fork Subwatershed is located entirely in Highland County and drains 92,167 acres. Rocky Fork is 27.5 miles long, while the tributaries are 41.7 miles and drain 61,261 acres. Before the confluence with the main stem of Paint Creek, Rocky Fork is impounded at the Rocky Fork Lake. The Ohio Department of Natural Resources (ODNR) constructed this lake in 1953, for recreation and flood control.

Background/reasons for implementing a management plan

The following were presented to the advisory group and community as reasons for writing and implementing a comprehensive management plan for Paint Creek Watershed.

Size/diversity of the watershed

Paint Creek Watershed covers over 731,000 acres and crosses multiple political boundaries. Additionally, the watershed may be divided into multiple subwatershed units each of which forms an independent drainage unit within the larger watershed. Depending on the topography of the area these units may be subdivided many times and each subwatershed will have slightly different chemical, physical and biological properties. In addition, many people reside in the watershed and activities such as agriculture, forestry, urban development, recreation, commerce and industry continue to grow and change.

Total Maximum Daily Loads (TMDLs). The advent of increasingly stringent enforcement of the Clean Water Act, is reflected in the introduction of TMDLs across the country. Ohio EPA recently began implementing their TMDL program and the Paint Creek Watershed is scheduled for evaluation in 2012-2013. The TMDL program establishes daily limits for a variety of pollutants, including sediment and nutrients, discharged to streams that do not meet water quality standards outlined in the Clean Water Act. This program currently only affects point source discharges though forestry, agriculture and development may be affected in the future.

Soil erosion. Soil erosion is one of the biggest problems in the watershed and the focus of most of the conservation practices implemented by both landowners and the Army Corps of Engineers. Most of the soil in South Central Ohio is depositional till resulting from the glacial activities. This soil is prone to erosion and there is erosion and erosion-related water quality problems throughout the watershed.

Water quality. There is a distinct lack of data that can be used to characterize the chemical water quality and biological health in the watershed. In 1997, Ohio EPA surveyed much of the watershed to measure the chemical and biological properties of the waters. The 2000 305(b) report lists the Upper Paint Creek Watershed (North Fork and Rocky Fork) as meeting water quality standards in 35.5 percent of the watershed. Lower Paint Creek Watershed (Main Paint and Rattlesnake) met water quality standards in 75.6 percent of the watershed. In order to establish baseline water quality information and to measure the success of our water quality solutions, we may need to implement an additional sampling program.

Species diversity. The Paint Creek Watershed contains a rich array of plant and animal species. For example, a study completed in 1999 through Ohio State University found 104 species of fish inhabiting the Paint Creek Watershed. Some of the plant and animal species in the watershed include endangered, threatened, rare, intolerant, or species of special interest. The Ohio Department of Natural Resources' Heritage database lists 52 species of interest or concern in the watershed. These include 10 endangered species and 11 threatened species.

Invasive species. Invasive species are plants and animals that are not native to the area. Usually introduced by human activities, these species may have no natural biological controls. They may invade parts of the watershed and crowd out naturally occurring species. Examples of invasive species found in the watershed include, garlic mustard, phragmites reed grass, and Japanese honeysuckle.

319 grants. Conservation practices funded through the Clean Water Act, section 319 grant program have been implemented throughout the watershed. One of the main purposes of the management plan is to look at information on soil erosion, water quality, and species diversity and concentrate conservation practices in the most sensitive areas of the watershed.

Local Conservation History

Agriculture is the main practice in the watershed and erosion has been the historic conservation concern. Land management and conservation studies began in the Paint Creek area in the early 1960's. Congress authorized a study of the Scioto River Basin, which led to the construction of the Paint Creek Lake in 1967 (Garringer). The lake is primarily for flood control, but the lands surrounding the lake provide wildlife habitat and recreational opportunities.

After heavy flooding in 1959 and 1960, the soil and water conservation districts in the Rattlesnake Creek watershed initiated the planning process to implement a project for flood control and land treatment. The initiative was eventually de-authorized but land managers recognized a need for local conservation practices. In 1988, $660,000, distributed by Ohio EPA, was used to apply conservation practices within the Rattlesnake Creek watershed (Garringer).

In 1994, after continuous siltation problems in Paint Lake, planning began for a new "Paint Creek Initiative" that would use Clean Water Act, section 319 grant monies to help introduce conservation projects throughout the watershed. This movement was inspired by activities taking place in the Darby Creek watershed, which is also funded by 319 monies and partially located in Madison County. In 1995, a proposal was submitted to Ohio EPA requesting $300,000 to partially fund a land treatment program for the entire Paint Creek watershed (Garringer).

The proposal was originally rejected, but the soil and water conservation districts (SWCDs) in Fayette, Highland and Ross Counties worked closely with Ohio EPA to come up with a proposal that would be accepted. The new proposal included dividing the watershed into four management units based on the Main Paint, North Fork, Rattlesnake, and Rocky Fork Subwatersheds. In 1996, the SWCDs applied for and received 319 grant monies for the North Fork of Paint Creek Subwatershed. These monies were received in 1997, the same year that the SWCDs applied for and received 319 grants for Main Paint and Rattlesnake subwatersheds.

In December 1997, representatives from Fayette, Highland, Ross, Madison, Clinton and Greene counties met and formed a joint board of supervisors to oversee the spending of funds from the grant. In 1998, Julie Brown was hired by the joint board to act as watershed coordinator for the entire Paint Creek watershed. Julie meets with the joint board once every month. She has administered all three 319 grants.

The cost-share practices funded through the 319 grants largely focus on reducing erosion in the watershed. The first round of grants included grass waterways, equipment buy-downs, soil testing, lime applications, livestock exclusion fencing, streambank stabilization, heavy use feeding pads, tree and grass filter strips, deep tillage tool rental (North Fork only), manure management systems (North Fork only), and alternate watering sources (North Fork only). The 319 grant applications were given a score based on the proximity of the site to a stream, the size of stream, and the erodability index of the soil. Through this process land managers tried to implement conservation practices in areas of the watershed that were contributing the greatest amount of erosion.

Table 1 lists each of the conservation practices implemented before June, 2001 and the counties in which they have been implemented. In addition, a pictorial representation of the locations of each practice can be found on the map entitled *319 Conservation Practices*. Grassed waterways were the most common cost-share practice, followed by equipment buy-downs. The least commonly implemented practices were manure management and alternate watering systems,

which are more specialized practices related to confined animal feeding operations or livestock pasturing.

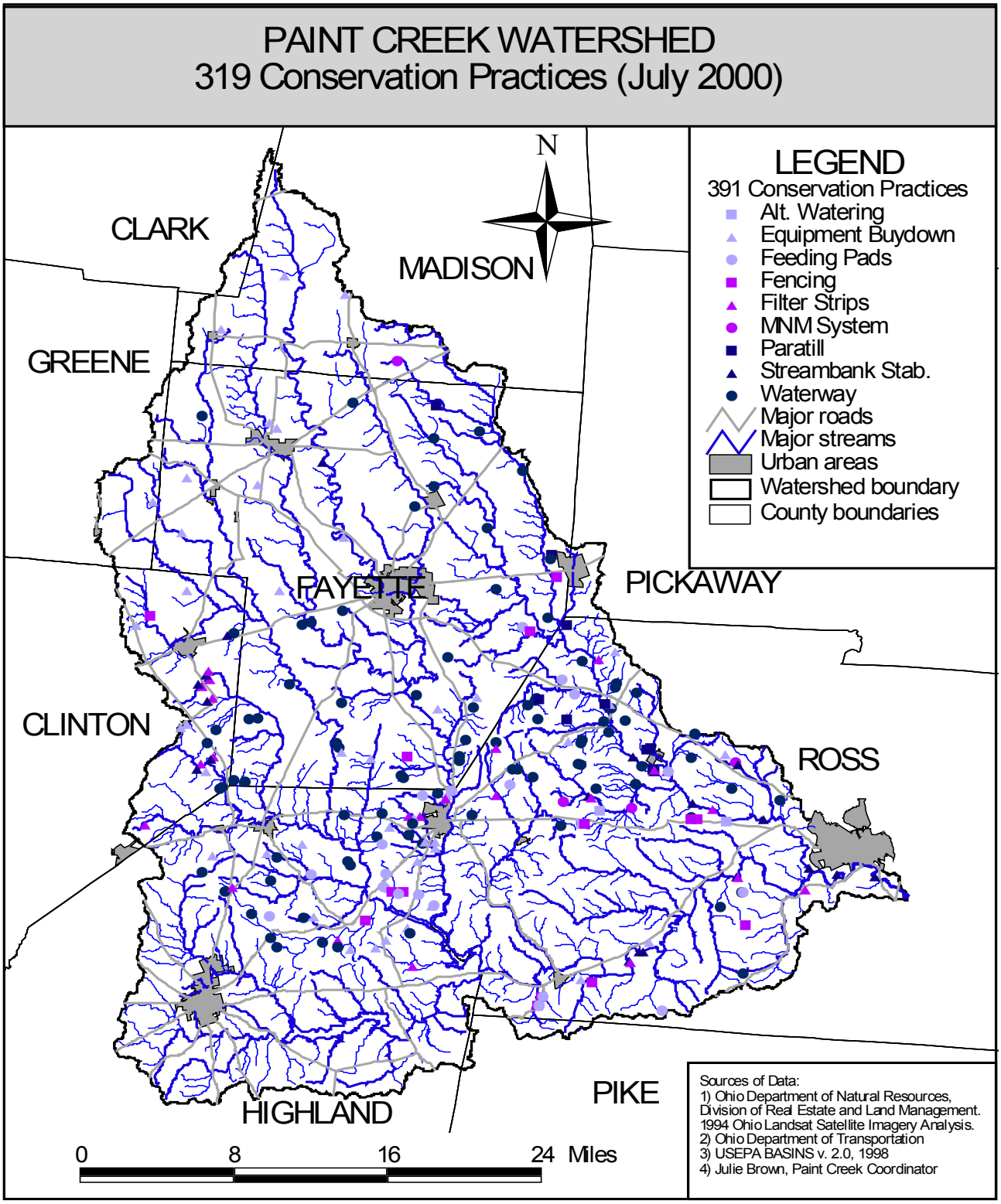
Table 1-1: Cost-share conservation practices implemented in the Paint Creek Watershed during the 1998-2001 grant cycle.

Conservation Practice	Counties Implemented	Total Number
Grass waterways	Clinton, Fayette, Highland, and Ross	82
Equipment buy-downs	Clinton, Green, Fayette, Highland, Madison, and Ross	40
Livestock exclusion fencing	Clinton, Fayette, Highland, and Ross	13
Streambank stabilization	Clinton, Fayette, Highland, and Ross	18
Heavy use feeding pads	Fayette, Highland, Ross	18
Tree and Grass Filter Strips	Clinton, Highland, and Ross	20
Manure Management Systems	Madison and Ross	4
Alternate Watering Systems	Ross	2
Paratill or Deep Tillage	Fayette and Ross	8

The 319 grants discussed above were three year grants and ended in June of 2001. Julie reapplied and was awarded money for all three subwatersheds. Currently all of Paint Creek Watershed has 319 conservation grant money.

In January of 2000, Julie formed an advisory committee to help provide guidance with the watershed project. This group meets quarterly and discusses management issues pertaining to the management plan. These meetings often feature guest speakers who have conducted studies within the watershed. In 2000, Julie wrote and was awarded a grant to help fund a part-time position for a management plan coordinator. Hilary Solomon was hired in January of 2001 to help write the management plan for the Paint Creek Watershed.

In 2000, Julie was also awarded a grant, the aim of which was "getting GIS into the hands of the conservationist." She worked closely with the consulting firm Malcolm Pirnie to acquire spatial data that could be used to make maps describing the area. Through this project, an extensive catalogue of data was acquired, which will be useful in the future water shed planning.



Created by for the Paint Creek Project by Hilary Solomon, June 2002

Current 319 Conservation Practices

Money to help cost-share conservation practices on agricultural lands is currently available for all four of the subwatersheds, Rocky Fork, Rattlesnake, Main Paint and North Fork. Distribution for the Rocky Fork conservation money is based out of Highland's SWCD, while the other subwatersheds are based out of the Ross County SWCD, though each county SWCD can provide forms and information.

The conservation practices that are currently available include: buy down on conservation tillage and GPS equipment, grassed waterways, streambank stabilization, soil sample analysis, heavy-use feeding pads, grass filter strips, riparian tree buffers, and septic system upgrades or replacements. Applicants are scored based on their proximity to a waterway, potential for the project to reduce soil erosion, current land use, and whether or not the conservation practice will be used adjacent to a high priority stream.

High priority streams are streams with poor quality or little physical habitat, which are not meeting their beneficial use designations. High priority streams may also include streams that are partially meeting their use designations if these areas support threatened or endangered species. Medium priority streams are those streams partially supporting their use designation with moderate or impaired physical habitat. Medium priority streams also include areas meeting their use designation if these areas support endangered or threatened species. Low priority areas include areas that are both meeting their use designation and have adequate physical habitat. Low priority areas do not support threatened and endangered species.

Purpose of the plan

The main purpose of the management plan is to help facilitate the maintenance and where appropriate the restoration of water quality and biological habitat within the Paint Creek Watershed. First, the plan will help achieve two goals of the Paint Creek Watershed. It will provide documentation of existing conditions within the watershed and current conservation activities. At the same time it will help define the concerns and goals of stakeholders within the watershed. The plan will then provide a tool to explore the cause and effect relationships between conditions in the watershed and water quality or habitat degradation. It will explore avenues to achieve stakeholder goals and address stakeholder concerns. It will help identify solution and management goals within the watershed and will attempt to quantify both the impediments and incentives related to the implementation of these solutions.

Over the next several years the plan will allow land managers to track implementation of solutions and the achievement of stakeholder goals. It will provide a guide for measuring the success of the project in terms of water quality and stakeholder satisfaction. Finally, it will provide a basis for redefining baseline conditions within the watershed for future management activities.

Scope and Limitations

The Paint Creek Watershed Management Plan is a watershed-wide description of goals, conditions, solutions, and measures. It focuses on the use of best management practices to address nonpoint sources of water quality degradation. It also addresses some instances of point source pollution, namely wastewater treatment plants. The scope of the plan is as broad and diverse as the goals and concerns of the stakeholders in the watershed. It is an attempt at providing a repository of information and ideas from which to base future management decisions.

Each section of the plan has some limitations resulting from a lack of time and/or existing information about the watershed. The scope and limitations are outlined as follows:

Watershed Inventory

The Inventory does not include a floodplain map. This map should be included for planning and conservation purposes.

The soil series information is from a national database called the State Soil Geologic Database (STATSGO) with descriptions from the USGS Official Soil Description Database. The local SWCDs are currently digitizing county soil maps. This information should be incorporated as soon as possible.

There are high historical wetlands losses in the watershed. Instead of showing the sites of existing wetlands, a map was created that shows the location of hydric, or wetland, soils. The existing wetlands are small and difficult to quantify. There is little available information about the wetlands in the watershed.

Landuse and cover information was derived from the Ohio Department of Natural Resources (DNR), Division of Real Estate, 1994 Land Management Statewide Landcover Inventory. The 1998 data should be available soon and may be used to compare to the 1994 baseline data.

Species diversity data includes information on fish and mussel species diversity as well as threatened, endangered and special interest species in the watershed. There is little information about invasive, non-native species in the watershed.

Groundwater and potential contamination sources information was provided by Ohio EPA, Division of Drinking and Groundwater employee, Michael Bondoc, Central District Office.

The management plan includes demographic information from six counties: Clinton, Fayette, Highland, Green, Madison, and Ross. All of the county-based economic and demographic data is based on averages for the entire county. This data is not specific to the area of the county within the watershed and may not accurately represent conditions

within the watershed. For example, county-wide economic data for Green County would include information for the Dayton suburbs and may not accurately represent the conditions in the area of Green County that falls within the watershed.

The agricultural statistics are from 1998 and 1999. This information has not been used, yet, for planning purposes. At such time as it is used, it should be updated, and analyzed for trends. The agricultural statistics are readily available in the SWCD offices.

Water Quality

The main limitations include a lack of chemical, physical and biological data within the watershed. There is an overall lack of information describing both historic and present conditions.

The management plan addresses attainment of water quality standards, problems associated with point and nonpoint sources, storm water planning, septic system management, fish kill information and stream flow data at the watershed scale. Information addressed at the subwatershed scale includes, Ohio EPA monitoring point locations, water quality data and charts, biological indices, habitat indices, nonpoint pollution sources, point sources and potential contamination sources.

Information for this section of the plan was derived mainly from Ohio EPA and DNR monitoring operations. Most of the data is several years old and the scale may not be fine enough to reflect localized water quality problems. This data will be refined through ongoing monitoring and activities in the watershed.

Implementation Goals

The implementation goals and timeline are based on available information. The limitations listed above become inherent limitations in the implementation plan. This section will be continually updated as the project gathers information and data about conditions in the watershed and the success of past conservation measures.

Stakeholders and Contributors

Paint Creek Watershed advisory group meetings are comprised of agency workers and local landowners. Representatives from Ohio EPA; Ohio DNR, Division of Wildlife; OSU agricultural extension; and Ross, Highland and Madison county SWCDs are all contributors. In addition, MeadWestvaco Corporation has three representatives and Knauff Lumber Company has one representative who provide assistance with forestry and offer valuable input. At this time we are still trying to diversify the group. The project is slowly including new members, such as city officials, department of health personnel, land developers, county commissioners, town trustees, and people that live in the watershed's urban areas.

A list of joint board members and advisory committee members is found in Table 1-2 at the end of this section.

Stakeholder Goals

The stakeholder goals and concerns were the basis for discussion among the advisory committee subgroups. Though varied and wide-ranging, they provide a means to address not only water quality concerns in the watershed, but also community concerns. Though some of the goals and concerns may not directly relate to documented water quality problems, it is the belief of the advisory group that they should be addressed if possible.

Advisory Group

During the January 1999 watershed coordination kick-off meeting, conservation priorities and goals were established. The group listed over 30 goals and/or concerns that they wanted to see the management plan address. Through subsequent quarterly meetings these were refined to reflect the following top priorities:

1. Reduce soil erosion
2. Protect riparian corridor
3. Create a community-driven watershed organization
4. Improve overall water quality
5. Protect against urbanization of farmland
6. Promote filter strips
7. Runoff/storm water management from housing developments and urban areas
8. Promote cost effective BMPs

Community Concerns

Between February 28 and March 27, 2001, Julie Brown, the Paint Creek Watershed Coordinator and Hilary Solomon, the Management Plan Coordinator held 11 community interest meetings. These meetings were held in nine of the ten USGS hydrologic subunits in the watershed. The meetings were conducted in Bainbridge, Washington Court House, Chillicothe, Frankfort, Sabina, Jeffersonville, Leesburg and Greenfield. In addition, meetings were held in Chillicothe with the Smallmouth Bass Alliance and the Symposiarts, a group that explores local culture and natural heritage.

The purpose of the subwatershed meetings was to promote public awareness of the project and ensure that the management plan addressed local concerns. The participants at the meetings will receive copies of the news letter, special publications related to watershed management and drafts of the watershed inventory and other watershed management plan sections as they become available.

The concerns and interest of the local community members were many and varied. The most common topics included stream bank erosion, public access to the creeks (countered

with fears about trespassing), modifying dam releases from Paint Creek Lake and Rocky Fork to mimic natural stream flow patterns, litter control/illegal dumping, and map availability for local interest groups. Some of the most passionate discourse related to fish tissue consumption warnings, confined animal feeding units, wastewater treatment plant installations and management, riparian corridor restoration, and promoting environmental education in schools. A full list of community concerns and suggestions can be found below.

The input from local stakeholders will be used to tailor the management plan to meet the needs of the diverse Paint Creek community. It is our hope that local input and guidance throughout the planning process will create a management plan that is implemented within the watershed. Local buy-in and support at this stage may also help realize our goal of creating a community-based watershed action group. As a final note, nearly every person who completed a survey indicated that they would be willing to provide volunteer time to help with different aspects of the project.

The Local Community Concerns were as follows (number of people citing concern):

Historic/special site preservation (2)
Maps for local interest groups (3)
Farmland/environmental compatibility (1)
Water quality monitoring/maintenance (2)
Confined animal feeding operations (2)
Wastewater treatment plants (2)
Litter/illegal dumping (3)
Roadkill (1)
Adopt-a-highway (1)
Loss of farmland (1)
BMP education and enforcement (1)
Lack of zoning (1)
Land use planning (1)
Natural dam releases (3)
Student environmental education (2)
Animal control (beavers and geese) (2)
Land stewardship education for landowners (1)
Community participation (1)
Public access to the creeks (3)
Sediment control/contamination (2)
Logging Practices (1)
Riparian corridor (2)
Heritage stream program (1)
Stream bank erosion (3)
Log jams (2)
Recreation (2)
Exotic species (1)

Table 1-2: Paint Creek Watershed Advisory Group

Name	Association	City
Agriculture Subgroup		
Hugh Trimble	Ohio EPA	Dayton
Gordon Conn	Farmer	Jeffersonville
Dave Parry	NRCS	Hillsboro
Vince Chrisman	Fayette SWCD	Washington CH
Dave Sever	Sever Consulting	Washington CH
Eric Rutherford	Landowner	Wilmington
David Caplinger	Landowner, SOFA	Hillsboro
Rosida Porter	Ohio DNR	Columbus
Forestry Subgroup		
Heidi Devine	Ohio DNR, Div of Wildlife	Xenia
Lee Crocker	Ohio DNR, Div of Forestry	Waverly
Mike Besonen	MeadWestvaco	Chillicothe
Chris Smid	MeadWestvaco	Chillicothe
Randy Sanders	Ohio DNR	Columbus
Joey Knauff	Knauff Lumber/ Master Loggers	Bainbridge
Education Subgroup		
Sam Webb	Pickaway SWCD	Circleville
Jenny Behymer	Landowner	Hillsboro
Layne Garringer	Fayette SWCD	Washington CH
Steve Hawkins	Ohio DNR/DSWC	Circleville
Jerry Iles	OSU Extension	Jackson
Urban Subgroup		
Julia Cummings	Madison SWCD	London
Steve Sobers	City Manager	Washington CH
Streamside Management Subgroup		
Dot Riley	NRCS	Grove City
Gordon Conn	Farmer	Jeffersonville
Gary Merkamp	Ross County Park District	Chillicothe
Randy Hoover	Ohio DNR, Div of Wildlife	Xenia
Bob Jones	Landowner, former Army COE	Bainbridge
Dan Imhoff	Ohio EPA	Logan
Marty Lundquist	Ohio DNR, Div of Wildlife	Columbus
Paula Wentzel	MeadWestvaco	Chillicothe

PAINT CREEK WATERSHED MANAGEMENT PLAN

SECTION II: WATERSHED INVENTORY

JULY 2002

II. WATERSHED INVENTORY

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SECTION II: WATERSHED INVENTORY

GEOLOGIC HISTORY

Ohio's geologic history includes many significant changes to it's landscape. During the Paleozoic era, 280 to 570 million years ago (Peacefull, 1996), Ohio was covered by a warm, tropical ocean, which was an arm of what is now the Gulf of Mexico (Van Fossan, 1937). Ohio's bedrock consists of limestone, shale, sandstone, and conglomerate materials that formed as sedimentary deposits in or near this epicontinental sea. After the sea receded and Ohio became dry land, a series of glaciers descended over the northwestern portion of the state (Peaceful, 1996).

In Ohio, the majority of landforms resulting from glaciation can be attributed to the last ice advance, the Wisconsin, which began about 40,000 years ago. However, some evidence does remain of the more extensive Illinoian ice sheet that preceded it, including most of the drainage changes in the Paint Creek area (Cavender, 1999; Peacefull, 1996).

The Paint Creek Watershed is composed of glacial till plains and Appalachian plateau physiographic provinces (Cavender, 1999; Peacefull, 1996). The till plains draw their name from the glacial material, or till, deposited over the region during the recent ice age (Peacefull, 1996). The Appalachian plateau province can be further separated into the unglaciated plateau and the glaciated plateau (Bond, 1941; Peacefull, 1996). The plateau is glaciated along its northern and western edges in the paint creek drainage area (Cavender, 1999). Here the plateau surface has been modified by glacial debris that filled in valleys and buried watercourses. The surrounding valleys were worn down by the ice that passed over them (Peacefull, 1996) smoothing the sharp outlines of many ridges (Bond, 1941) and leaving a rolling country with wide stretches of drift (Van Fossan, 1937). As the glaciers dammed up river channels and valleys, many streams in the watershed, including Main Paint, were reversed or diverted to new drainages (Van Fossan, 1937).

(For more information on the geology of lower Paint Creek, please see “The “New Valley” of Paint Creek, A Southern Ohio Treasure” by Tom Bain, which is located after the reference section)

TOPOGRAPHY

The watershed project has access to several genres of USGS topographic datasets. Topo-mapper, a program that prints maps by selected quadrant is available through ODNR. These maps can be printed in sizes ranging from letter paper to standard map size. Additionally, a volunteer from Mead’s Woodlands Division created a topographic coverage for use with GIS that includes all of the quadrants in the watershed. Though this map is not very useful at the watershed scale, it provides great detail at the local level. The GIS tool allows the flexibility to create maps throughout the watershed at a scale determined by the user.

HYDROLOGY

Hydrologic features addressed by this section include three scales of subwatershed, streams and tributaries, floodplains, and wetlands.

SUB-WATERSHEDS

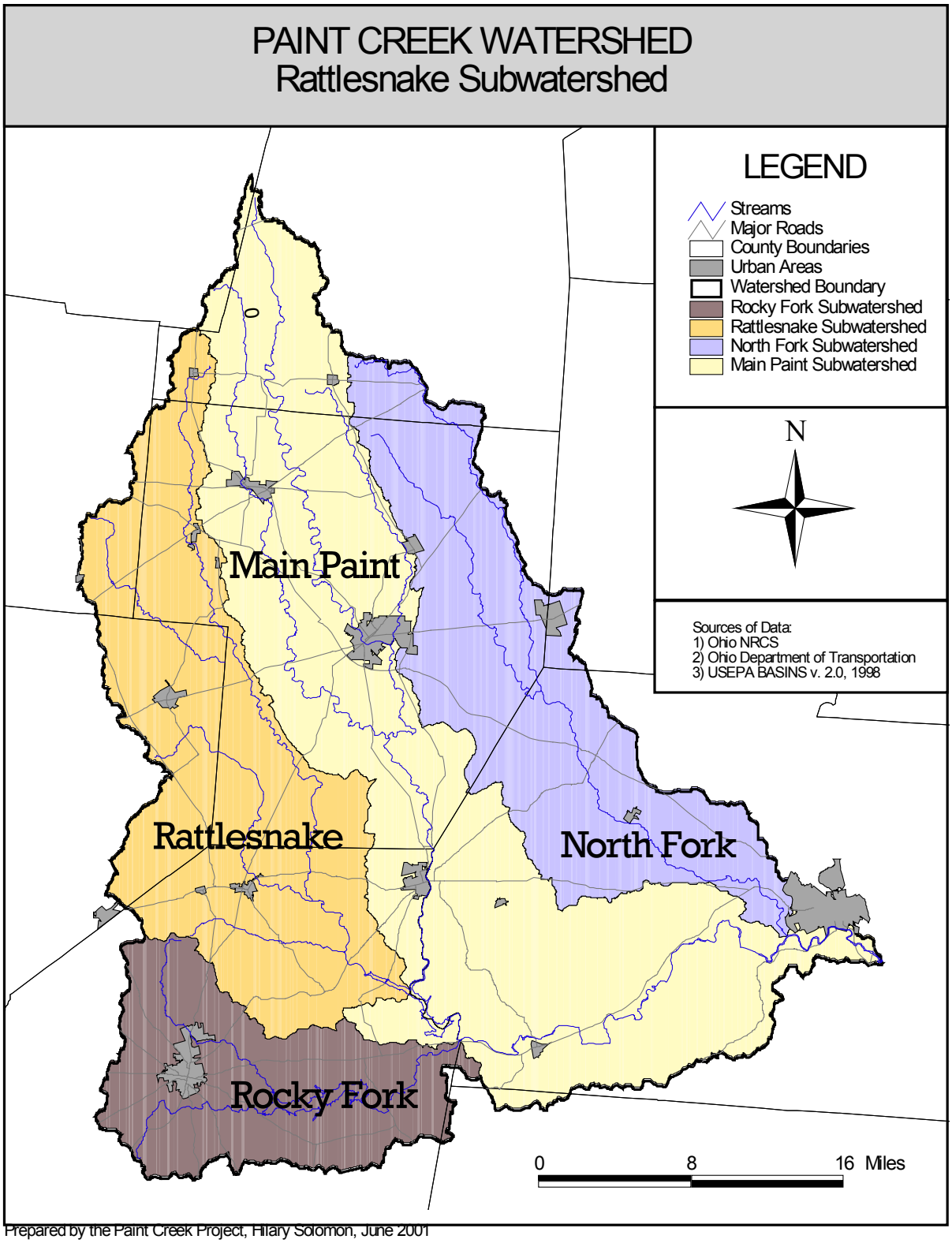
The Paint Creek Watershed is divided into many subwatersheds. Each tributary to Paint Creek has it's own watershed, or area of land that drains exclusively into that creek. These subwatersheds differ in chemical, biological, and physical characteristics, making their individual study an important component of any watershed management plan. The Paint Creek Watershed has three scales, or sizes, of commonly used subwatershed boundaries. These include the 319 grant subwatershed boundaries, the USGS 11-digit subwatershed boundaries and the USGS 14-digit subwatershed boundaries.

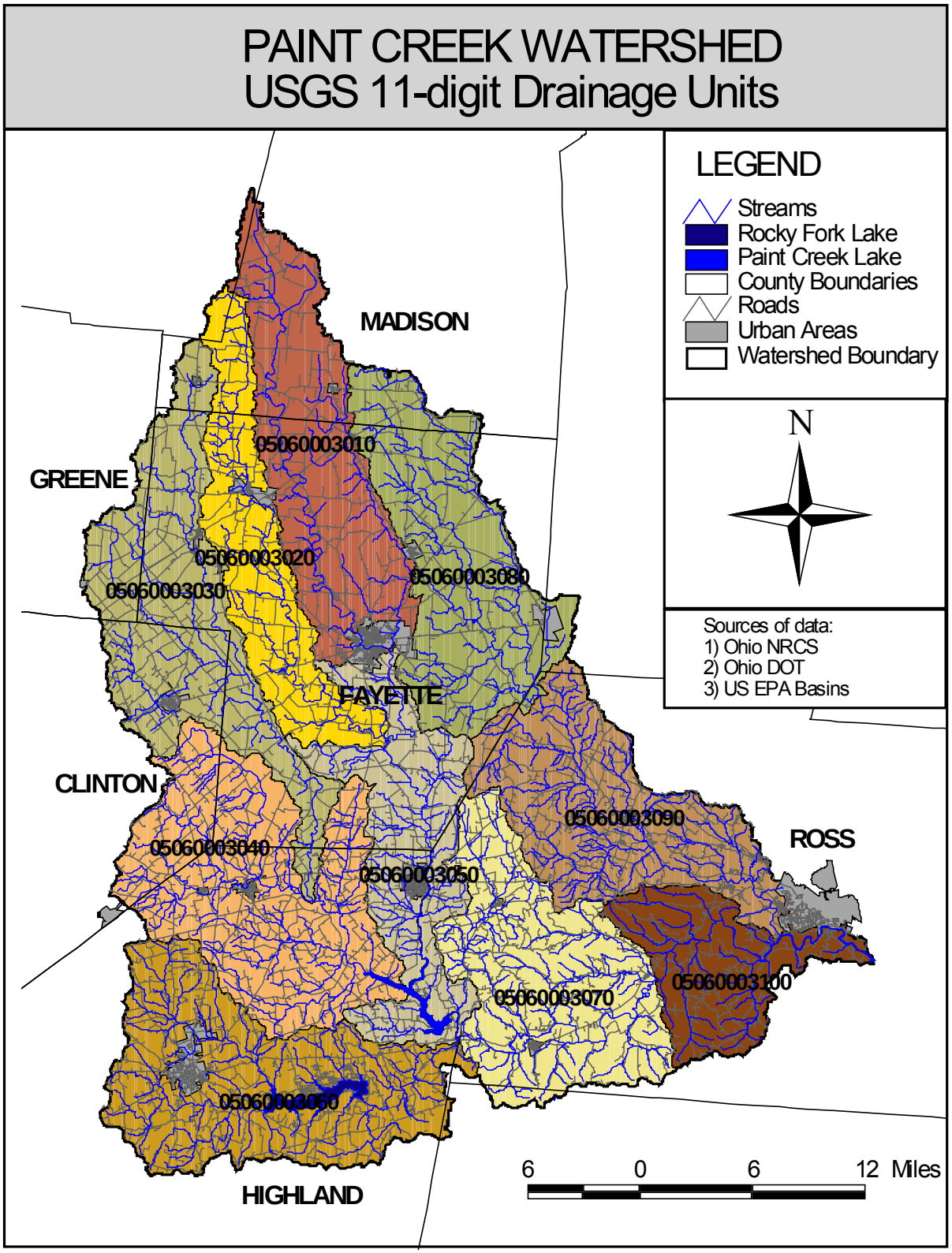
The largest scale of subwatershed is the 319 grant boundaries. Ohio EPA in conjunction with the Paint Creek Watershed Project divided the watershed into 4 major subwatersheds to create manageable units for 319 grant distribution purposes. These include the main stem of Paint Creek and its three largest tributaries: North Fork, Rattlesnake, and Rocky Fork. Please refer to the map entitled, *Paint Creek Watershed: 319 Grant Administrative Boundaries*.

The next scale is the USGS 11-digit watershed units. One of the first attempts to characterize the citizen concerns within the watershed began with a broad community outreach effort. As part of this effort ten meetings were held throughout the watershed. These meetings were based on subwatershed units derived from USGS 11-digit drainage units, with one meeting held within each of these drainage units. Please refer to the map entitled, *Paint Creek Watershed: USGS 11-digit Drainage Units*. At each meeting a wide variety of water quality and other citizen concerns were discussed (see the Stakeholder Goals section for more details about the community meetings and concerns).

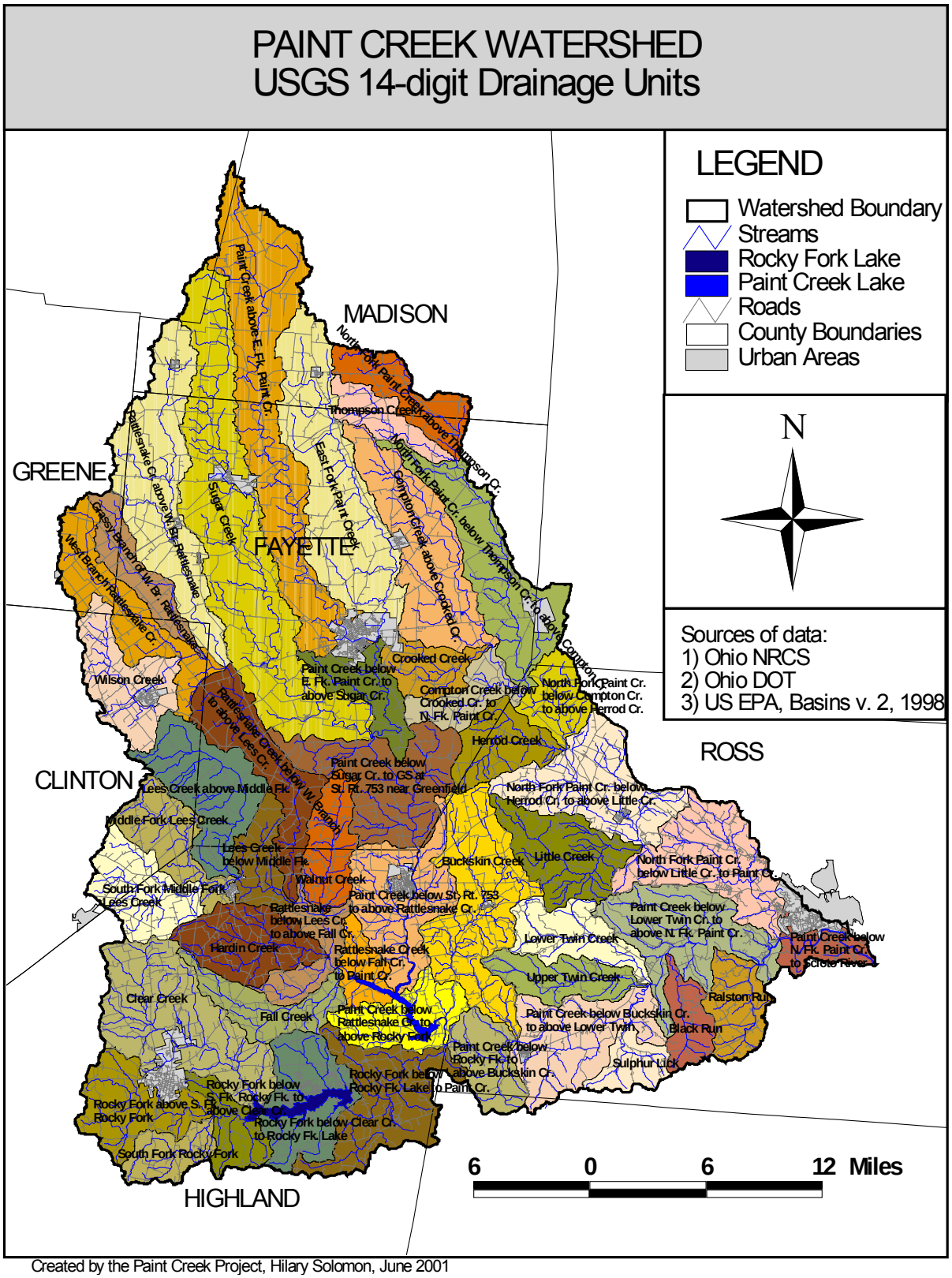
The 11-digit drainage units represent a broad scale, with each area comprised of many other unique units. The next level for which map information is available is the USGS 14-digit drainage unit scale. Please refer to the map entitled, *Paint Creek Watershed: USGS 14-digit Drainage Units*. This level is the finest scale used in maps found in this report.

The next section, Water Quality, outlines the water and habitat quality for streams in each of the subwatersheds.


PAINT CREEK WATERSHED
Rattlesnake Subwatershed
LEGEND
Streams
Major Roads
County Boundaries
Urban Areas
Watershed Boundary
Rocky Fork Subwatershed
Rattlesnake Subwatershed
North Fork Subwatershed
Main Paint Subwatershed
N
Sources of Data:
1) Ohio NRCS
2) Ohio Department of Transportation
3) USEPA BASINS v. 2.0, 1998
Main Paint
Rattlesnake
North Fork
Rocky Fork
0
8
16 Miles
Prepared by the Paint Creek Project, Hilary Solomon, June 2001



Prepared by the Paint Creek Watershed Project, Hilary Solomon, June 2001



Created by the Paint Creek Project, Hilary Solomon, June 2001

STREAMS AND TRIBUTARIES

The Paint Creek Watershed has over 75 streams and tributaries. The largest are those mentioned above: Main Paint, North Fork of Paint Creek, Rattlesnake Creek, and Rocky Fork of Paint Creek. Table 2-1 lists many of the stream names and includes details about the fall characteristics and drainage area of each. The fall characteristics include the elevation at the mouth versus the headwater of the stream and indicate the steepness, or fall, of the creek. The drainage area refers to the subwatershed associated with each stream. The map entitled, *Paint Creek Watershed: Streams and Tributaries* shows each of the main streams in the watershed.

Table 2-1: Paint Creek Watershed Stream Information.

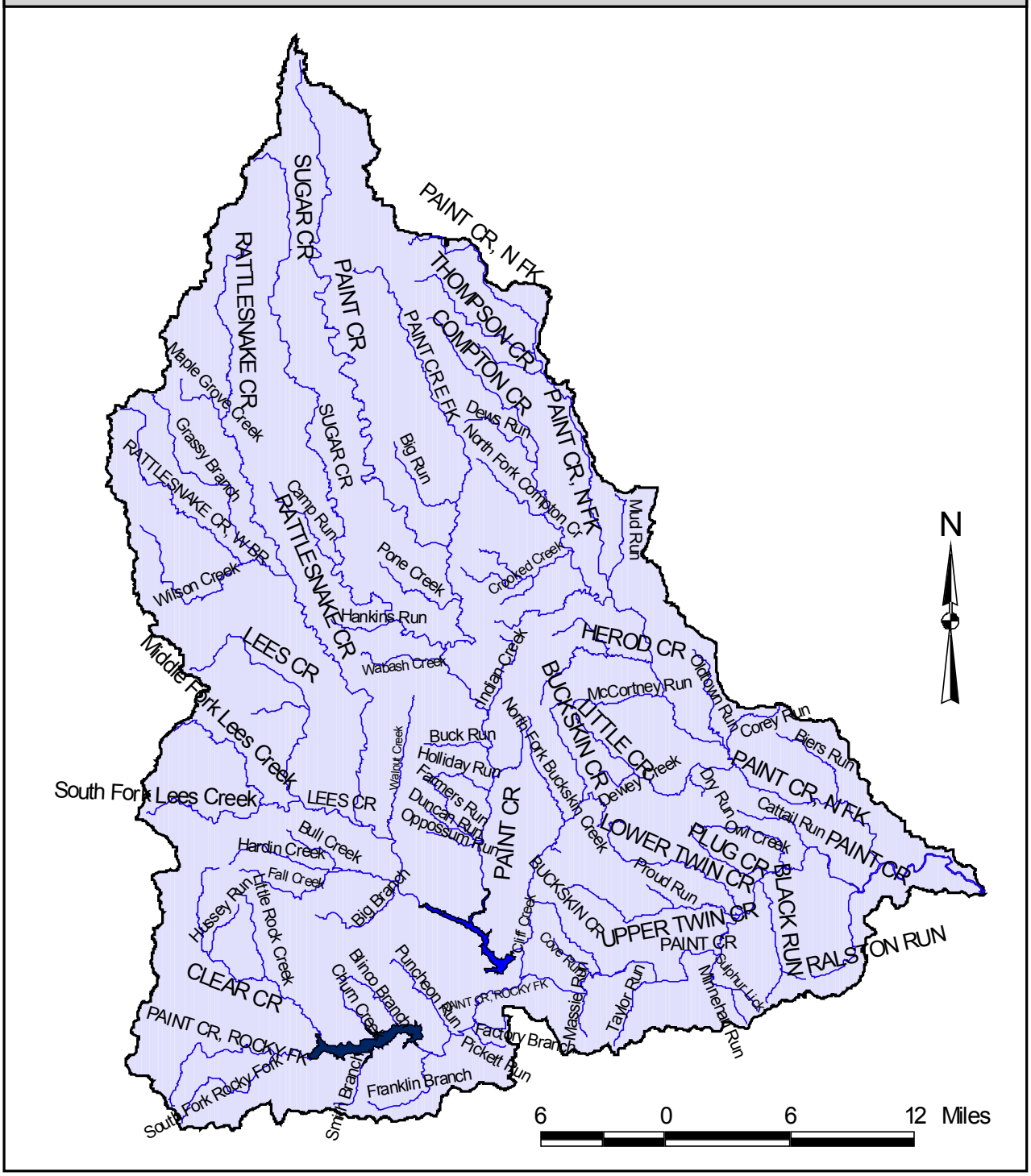
Stream Name	Length (mi)	Elevation At Source	Elevation At Mouth	Average Fall (ft/mi)	Flows Into	Mouth in County.	Drains (mi^2)
PAINT CREEK	94.7	1120	586	5.6	Scioto River	Ross	1142.7
NORTH FORK	46.6	1016	615	8.6	Paint Creek	Ross	236.2
Biers Run	4.2	810	660	35.8	North Fork	Ross	8.04
Mad Run	2.6	843	725	4.5	Biers Run	Ross	2.78
Anderson Run	3.1	779	669	35.5	North Fork	Ross	5.76
Sulphur Lick	1.5	840	682	105.2	Anderson Run	Ross	1.04
Dry Run	2	810	701	54.5	North Fork	Ross	2.44
Little Creek	8.8	915	704	23.8	North Fork	Ross	23.12
Dewey Creek	0.5	863	843	40	Little Creek	Ross	1.76
Oldtown Run	4	757	713	11	North Fork	Ross	9.32
McCortney Run	3	875	746	43	North Fork	Ross	6.96
Herrod Creek	5.5	895	761	24.4	North Fork	Ross	15.42
Whetstone Run	1.7	885	801	49.4	Herrod Creek	Ross	4.52
Compton Creek	19.9	1010	796	10.7	North Fork	Ross	61
Crooked Creek	3	885	840	15	Compton Creek	Fayette	11.2
Mud Run	4.1	838	805	8	North Fork	Fayette	7.72
Thompson Creek	6.8	1002	904	14.4	North Fork	Fayette	11.46
Ralston Run	5	893	622	54.2	Paint Creek	Ross	13.92
Cattail Run	3.8	865	643	58.3	Paint Creek	Ross	3.6
Owl Creek	5.1	880	647	45.7	Paint Creek	Ross	6.68
Plug Run	4.1	868	650	53.2	Paint Creek	Ross	4.7
Black Run	6.6	920	652	40.6	Paint Creek	Ross	10.66
Mine Run	0.4	820	770	125	Black Run	Ross	0.86
Lower Twin Creek	8.7	955	662	33.7	Paint Creek	Ross	16.8
Upper Twin Creek	9	992	663	36.5	Paint Creek	Ross	14.48
Proud Run	1.3	920	715	157.8	Upper Twin Creek	Ross	1
Sulphur Lick	4.7	840	670	36.2	Paint Creek	Ross	10.78
Minnehan Run	1.2	880	721	132.5	Sulphur Lick	Ross	1.44
Buckskin Creek	16.4	953	708	14.9	Paint Creek	Ross	39.7
Slate Run*	1.5	1060	941	79.4	Buckskin Creek	Ross	0.5
North Fork	4.1	925	874	12.4	Buckskin Creek	Ross	8.92
Cove Run	1.2	801	712	74.2	Paint Creek	Ross	1.62
Massies Run	1.2	754	721	27.5	Paint Creek	Ross	4.92
ROCKY FORK	27.5	1080	741	12.3	Paint Creek	Highland	144.7
Factory Branch	0.9	892	786	117.8	Rocky Fork	Highland	1.38
Pickett Run	1	850	788	62	Rocky Fork	Highland	1.52
Heads Branch	2.7	890	794	35.5	Rocky Fork	Highland	5.02

Stream Name	Length (mi)	Elevation At Source	Elevation At Mouth	Average Fall (ft/mi)	Flows Into	Mouth in County.	Drains (mi^2)
Puncheon Run	3.1	922	798	7.7	Rocky Fork	Highland	4.28
Franklin Branch	4.6	961	827	29.1	Rocky Fork	Highland	7.4
Plum Run	2.9	930	836	32.4	Rocky Fork	Highland	4.02
Blinco Branch	2.7	947	843	38.5	Rocky Fork	Highland	6.16
Churn Creek	1	880	850	30	Rocky Fork	Highland	2.78
Smith Branch	2.5	953	852	40.4	Rocky Fork	Highland	3.66
Clear Creek	11.9	1100	866	19.7	Rocky Fork	Highland	46
Hussey Run	2.1	1030	955	35.7	Clear Creek	Highland	3.32
South Fork	6.3	1073	895	28.2	Rocky Fork	Highland	10.18
Cliff Creek	1.7	880	748	77.7	Paint Creek	Ross	3.1
Plum Run	4.6	908	754	33.5	Paint Creek	Highland	7.78
RATTLESNAKE CR	42.3	1076	770	7.2	Paint Creek	Highland	227.2
Cedar Run*	3.4	961	780	53.2	Rattlesnake	Highland	3.1
Fell Creek	10.2	1109	790	31.2	Rattlesnake	Highland	15.52
Big Branch	3.3	940	794	44.2	Rattlesnake	Highland	5.36
Hardin Creek	7.5	1047	795	46.9	Rattlesnake	Highland	21.72
Bull Creek	1.8	940	860	44.4	Hardin Creek	Highland	4.06
Bridgewater Creek	3.4	1048	874	51.2	Hardin Creek	Highland	4.94
Walnut Creek	6.1	957	815	23.3	Rattlesnake	Highland	15.08
Lees Creek	15.9	1050	846	12.8	Rattlesnake	Highland	75.3
Middle Fork	8.5	1073	949	14.6	Lees Creek	Highland	35.92
South Fork	5.7	1077	1003	12.9	Middle Fork Lees	Highland	18.68
West Branch	11.8	1057	1001	4.7	Rattlesnake	Fayette	63.28
Grassy Branch	6.2	1066	1008	9.4	W Br Rattlesnake	Clinton	16.04
Wilson Creek	10.2	1040	1013	2.6	W Br Rattlesnake	Clinton	22.68
Opossum Run*	2.6	980	811	65	Paint Creek	Highland	2.98
Farmers Run	0.7	844	817	38.6	Paint Creek	Highland	5.64
Duncan Run*	2.4	1000	844	65	Farmers Run	Highland	1.28
Sugar Run	1.6	897	844	33.1	Farmers Run	Highland	3.42
Holliday Run	1.6	915	832	45.6	Paint Creek	Highland	2.48
Stone Run	2.3	938	838	43.5	Paint Creek	Ross	2.68
Buck Run	2.4	910	852	24.1	Paint Creek	Fayette	6.7
Indian Creek	3	910	866	14.7	Paint Creek	Fayette	9.66
Wabash Creek	3	976	909	22.3	Paint Creek	Fayette	7.74
Sugar Creek	35.7	1105	913	5.4	Paint Creek	Fayette	80.6
East Fork	17.5	1040	947	5.3	Paint Creek	Fayette	50.7
Big Run	5	990	954	7.2	East Fork	Fayette	9.38
Brock Ditch	4.4	1046	1008	8.6	East Fork	Fayette	5.82
County Ditch	2.2	1079	1074	2.3	Paint Creek	Madison	8.46

* Intermittent streams

Adapted from Ohio DNR, Division of Water, Gazetteer of Ohio Streams, 1960.

PAINT CREEK WATERSHED
Streams and Tributaries



Prepared by the Paint Creek Project, Hilary Solomon, July 2001

FLOODPLAINS

No data has been collected so far in conjunction with this report, though the advisory group hopes to create a floodplain map of the watershed. Ohio DNR, OCAP floodplain data exists for Clinton and Madison Counties only, however insurance maps may provide a good source of data.

WETLANDS

According to Bill Mitsch of Ohio State University, wetlands are not easily defined, because they have a considerable range of hydrologic conditions, because they are found along a gradient at the margins of well-defined uplands and deepwater systems, and because of their great variation in size, location and human influence (1993). Mitsch points to the definition adopted by wetland scientists in the U.S. Fish and Wildlife Serive (FWS) in 1979. The definition was presented in a report entitled Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al., 1979):

> Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water….Wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes, (2) the substrate is predominantly undrained hydric soil, (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year.

Neither Ohio DNR landuse and cover maps (Ohio DNR, 1994) nor National Wetland Inventory maps (U.S. FWS, NWI, 2002) show appreciable amounts of wetlands areas within the Paint Creek Watershed. According to the Ohio DNR data, approximately 0.2 percent of the total land area in the watershed is comprised of wetlands. Small areas appear adjacent to Paint Lake and Rocky Fork Lakes, however, these lakes are manmade, indicating that the wetlands may be a result of the lake construction, rather than naturally occurring. Ohio has lost over 90 percent of its wetlands areas, second only to California, which has lost over 97 percent (Mitsch, 1993 and NPR, 2001). (Please refer to the hydric soils section of this report for a discussion on the potential extent of wetland soils within the watershed.) This means that the remaining wetland areas in the state are of high importance to the ecological function of the region (NPR, 2001 and Ohio EPA, 2002).

Wetlands are important to the function of ecological systems for many reasons. They serve to buffer natural waters against runoff of agricultural chemicals and sediment, provide hydrologic flood damping, and maintain wildlife habitat. They may also help recharge aquifers, improve water quality, and provide an aesthetic value to property. In addition, they are home to a disproportionately high percentage of endangered and threatened species. Of the 209 endangered species listed in 1986, approximately half depended on wetlands for survival and viability. At a global scale, wetlands may be a

significant factor in the global cycles of nitrogen, sulfur, methane, and carbon dioxide (Mitsch, 1993 and Richardson, 2000).

Wetlands are often degraded or destroyed when lands are converted to agriculture. Wetlands drained for agriculture can result in high yield croplands for several reasons, but are generally associated with a steady decline in innate production as the soils revert to a nutrient poor state (Stoeckel, 1997). Farther examples of modifications to wetland ecosystems include drainage, degradation by roadbed construction, disposal of agricultural/factory effluent or sewage, applications of herbicides or pesticides, and development (Stout, 1976).

Several wetlands may be found within the Paint Creek Watershed, with approximately 0.2 percent of the land area being comprised of wetland areas. Examples of wetlands in the Paint Creek Watershed include

SOIL SERIES

Soils in the Paint Creek Watershed are greatly arisen from glacial till deposits. The State Soil Geologic Database (STATSGO) soil series map, *Paint Creek Watershed: STATSGO Soil Series*, illustrates the location of each of the major soil types within the watershed. SSURGO data, which is more detailed, is only available for Greene County. Ross and Highland counties are currently digitizing their county soil surveys and these should be incorporated into the watershed management plan as soon as they are finished. The data provided at the local scale will be much more accurate than STATSGO national data. The following are brief descriptions of each of the 17 series described as occurring in the Paint Creek Watershed. All descriptions are adapted from the USGS Official Soil Description Database.

ALGIERS SERIES

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, nonacid, mesic Aquic Udifluvents

GEOGRAPHIC SETTING: Algiers soils are on flood plains or low terraces in the Wisconsinan glacial area or in flood plains in the Illinoian glacial area where the headwaters are in the Wisconsinan till area. The soils formed in 20 to 36 inches of recent light colored alluvium and are underlain by a buried Aquoll. Slopes range from 0 to 2 percent. Mean annual precipitation ranges from about 32 to 40 inches, and mean annual temperature ranges from about 48 to 54 degrees F.

DRAINAGE AND PERMEABILITY: Somewhat poorly drained. Runoff is slow and permeability is moderate. The soil is subject to occasional or frequent flooding.

USE AND VEGETATION: A major part of the Algiers soils is cultivated. Commonly grown crops include corn, soybeans, small grain, and forage crops. Other areas are in permanent vegetation - pasture or woodland. The original vegetation consisted of elm, soft maple, sycamore, and other water-tolerant deciduous trees.

AVONBURG SERIES

TAXONOMIC CLASS: Fine-silty, mixed, active, mesic Aeric Fragic Glossaqualfs

GEOGRAPHIC SETTING: Avonburg soils are on summits of loess-covered till plains. Slopes range from 0 to 6 percent. They formed in 60 to 90 inches of loess and the underlying paleosol in Illinoian till. The upper 20 to 40 inches of loess averages about 15 percent sand, and the lower loess averages about 24 percent. This lower loess has been called "gritty loess". The mean annual air temperature ranges from 51 to 57 degrees F., the mean annual precipitation ranges from 35 to 45 inches, frost free period is 160 to 200 days, and elevation ranges from 600 to 1000 feet above mean sea level.

DRAINAGE AND PERMEABILITY: Somewhat poorly drained. The potential for surface water runoff is low or medium. Permeability is moderate or moderately slow above the root restrictive horizon, and very slow in the root restrictive horizon. In undisturbed areas, in most years, depth to an intermittent perched high water table is at a depth of 0.5 to 1.5 feet. In drained areas, depth to the water table is 0.5 to 2 feet.

USE AND VEGETATION: Most areas are being used to grow corn and soybeans. A few areas are used for growing small grain, mainly wheat, and for hay and pasture. Also a few areas are in woodland. Native vegetation is mixed hardwood forest.

BROOKSTON SERIES

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Typic Argiaquolls

GEOGRAPHIC SETTING: Brookston soils are in depressions on till plains and moraines. Slopes range from 0 to 3 percent. The Brookston soils formed in loamy Wisconsinan glacial till. In some areas the upper part of the sola formed in as much as 20 inches of silty materials. The mean annual temperature is about 48 to 53 degrees F., mean annual precipitation ranges from 30 to 42 inches, frost free days range from 130 to 180 days, and elevation ranges from 580 feet to 1530 feet above sea level.

DRAINAGE AND PERMEABILITY: Brookston soils are poorly drained. Surface runoff is negligible to low. Permeability is moderate in the subsoil and moderately slow in the underlying material. An intermittent apparent high water table is 0.5 foot above the surface to 1 foot below the surface in most years.

USE AND VEGETATION: Most areas are used to grow corn, soybeans, oats, wheat, and hay. Small areas are in permanent pasture or woodlots. Native vegetation is deciduous forest, marsh grasses, and sedges.

CANA SERIES

TAXONOMIC CLASS: Fine, mixed, active, mesic Aquultic Hapludalfs

GEOGRAPHIC SETTING: Cana soils are formed in a mantle of loess and the underlying till material and clayey residuum weathered from shale on summits, shoulders, backslopes and footslopes on glaciated hills. Slope gradients range from 2 to 35 percent. Climate is humid and temperate. Mean annual air temperature ranges 50 to 56 degrees F., and the mean annual precipitation ranges 36 to 44 inches. Frost free days range from 145 to 181 days, elevation ranges from 690 to 1220 feet above sea level.

DRAINAGE AND PERMEABILITY: Moderately well drained. The potential for surface runoff is low to very high. Permeability is moderate or moderately slow in the upper part of the solum and slow in the lower part. Depth to the top of a perched seasonal high water table ranges from 1 to 3.0 feet from January to April in most years.

USE AND VEGETATION: Cana soils are cultivated, pastured and wooded. Principle crops are hay and corn. Native vegetation is mixed, deciduous hardwood forest.

CLERMONT SERIES

TAXONOMIC CLASS: Fine-silty, mixed, superactive, mesic Typic Glossaqualfs

GEOGRAPHIC SETTING: Clermont soils typically are on broad level areas or shallow depressions on the Illinoian till plain, but slope gradient ranges from 0 to 2 percent. The soils formed in a mantle of Peorian loess 20 to 42 inches thick and the underlying pedisediment (or "gritty" loess) and/or weathered Illinoian till. The underlying sediment commonly occurs as a transition zone between the Peorian loess and till and consists of a gritty admixture of an early loess and erosional sediments from the underlying paleosol. Mean annual temperature is about 50 to 55 degrees F., and mean annual precipitation is about 39 to 43 inches.

DRAINAGE AND PERMEABILITY: Poorly drained. Runoff is slow to ponded. Very slow permeability.

USE AND VEGETATION: Most areas of Clermont soils are cultivated but some areas are used for woodland or pasture. Principal crops are corn, soybeans, wheat, and grass and legume meadow. Native vegetation is mixed hardwoods, mainly pin oak, soft maple, ash, and elm.

CLIFTY SERIES

TAXONOMIC CLASS: Fine-loamy, mixed, active, mesic Fluventic Dystrudepts

GEOGRAPHIC SETTING: These soils are on level or nearly level flood plains. Slopes are 0 to 4 percent. Clifty soils formed in mixed alluvium derived from acid siltstones, sandstones, shales, and loess. The climate is temperate and humid. Average annual precipitation is about 42 to 50 inches, and the average annual temperature is about 50 degrees to 59 degrees F.

DRAINAGE AND PERMEABILITY: Well drained. Runoff is negligible or low. Permeability is moderately rapid in the solum and moderately rapid or rapid in the substratum. Clifty soils are subject to occasional flooding of short duration in winter and spring months. Depth to a seasonal high water table is greater than 6 feet.

USE AND VEGETATION: Most areas are used for soybeans, corn, hay, and pasture. A small acreage is in forest. The native vegetation is mixed hardwoods, such as elm, river birch, poplar, willow, box elder, and red maple, oaks, shagbark hickory and sycamore; canebreaks in places.

EDWARDS SERIES

TAXONOMIC CLASS: Marly, euic, mesic Limnic Haplosaprists

GEOGRAPHIC SETTING: Edwards soils formed in herbaceous organic materials overlying marly material deposits in closed depressions on outwash plains, lake plains, and ground moraines. Slopes are normally less than 2 percent, but range to about 6 percent on some toe slopes. The mean annual temperature is about 45 to 53 degrees F., mean annual precipitation ranges from 30 to 42 inches, frost free days range from 130 to 180 days, and elevation ranges from 580 feet to 1530 feet above sea level.

DRAINAGE AND PERMEABILITY: Very poorly drained. The potential for surface runoff is negligible. Permeability is moderately slow to moderately rapid in the organic material and slow in the marly material. The depth to the seasonal high water table ranges from 1 foot above the surface to 1 foot below the surface in most years.

USE AND VEGETATION: Some areas are cropped; however, the majority of the areas are in native vegetation consisting of brush and trees. Common tree species include quaking aspen, American elm, silver maple, and northern white-cedar.

ELDEAN SERIES

TAXONOMIC CLASS: Fine, mixed, superactive, mesic Typic Hapludalfs

GEOGRAPHIC SETTING: The Eldean soils are nearly level to very steep soils of outwash terraces, kames, and moraines. Slope ranges from 0 to 35 percent. In some places the upper part of the solum has developed in silty or loamy alluvium or loess up to 18 inches thick. Mean annual precipitation ranges from about 29 to 40 inches, and mean annual temperature ranges from about 50 to 54 degrees F.

DRAINAGE AND PERMEABILITY: Well drained. Surface runoff potential is negligible to high. Permeability is moderate or moderately slow in the solum and rapid or very rapid in the substratum.

USE AND VEGETATION: The less sloping areas are cultivated. Corn, soybeans, small grains, and hay are the principal crops. The more sloping areas are generally in

permanent pasture or woods. The original vegetation was deciduous hardwood forest.

KOKOMO SERIES

TAXONOMIC CLASS: Fine, mixed, superactive, mesic Typic Argiaquolls

GEOGRAPHIC SETTING: Kokomo soils are in depressions on till plains. Slopes are 2 percent or less. Kokomo soils formed in loamy material over loam till. Mean annual precipitation ranges from 35 to 42 inches, and mean annual temperature ranges from 48 to 55 degrees F.

DRAINAGE AND PERMEABILITY: Kokomo soils are very poorly drained. The potential for surface runoff is negligible. Permeability is moderately slow or slow in the loamy material and slow in the underlying till. An intermittent apparent high water table is at 1.0 foot above the surface to 0.5 foot below the surface during the winter and spring in most years.

USE AND VEGETATION: Most areas are used to grow corn, soybeans, oats, wheat, and hay. Some areas are in permanent pasture or woodland. Native vegetation is deciduous hardwood forest of elm, maple, and ash.

MIAMIAN SERIES

TAXONOMIC CLASS: Fine, mixed, active, mesic Oxyaquic Hapludalfs

GEOGRAPHIC SETTING: The Miamian soils formed in a thin layer of loess up to 18 inches thick and loamy calcareous till on Wisconsinan age till plains and moraines. Slope gradients range from 0 to 50 percent. Climate is humid and temperate. Mean annual air temperature ranges from about 51 to 55 degrees F., mean annual precipitation ranges from about 38 to 42 inches, frost free period ranges from 145 to 190 days, and elevation ranges from 900 to 1,250 feet above mean sea level.

DRAINAGE AND PERMEABILITY: Well drained. The potential for surface runoff is medium or high. Permeability is moderately slow in the solum and slow or very slow in the substratum. The depth to the top of an intermittent perched water table is at 2.5 to 3.5 feet from January through May in normal years.

USE AND VEGETATION: Miamian soils are cultivated. The principal crops are corn, soybeans, wheat, oats, meadow and legume-grass mixtures. Some areas are in trees. The native vegetation is deciduous forest.

OTWELL SERIES

TAXONOMIC CLASS: Fine-silty, mixed, active, mesic Oxyaquic Fragiudalfs

GEOGRAPHIC SETTING: Otwell soils are typically on nearly level to very steep

topography. Slopes range from 0 to 50 percent. The soils formed in 20 to 40 inches of loess and the underlying lacustrine or outwash sediments or in mixed alluvium. Mean annual temperature ranges from 50 to 58 degrees F, and mean annual precipitation ranges from 38 to 45 inches.

DRAINAGE AND PERMEABILITY: Well drained. Runoff is medium to rapid. Permeability is very slow. A few areas are subject to flooding. Depth to an intermittend perched high water table is at 2.0 to 3.0 feet from January through April in most years.

USE AND VEGETATION: Otwell soils are used to grow corn, soybeans, small grain, and legume grass. Some areas are used for pasture and forest.

RAINSBORO SERIES

TAXONOMIC CLASS: Fine-silty, mixed, superactive, mesic Oxyaquic Fragiudalfs

GEOGRAPHIC SETTING: Rainsboro soils formed in loess and the underlying weathered Illinoian outwash deposits on risers and treads on high stream terraces in areas of Illinoian glaciation or in areas which have valleys that have carried Illinoian outwash. Slope gradients range from 0 to 15 percent. Climate is humid and temperate. Mean annual precipitation ranges from 37 to 43 inches, and mean annual temperature ranges from 49 to 55 degrees F. Frost free days range from 145 to 181 days, and elevation ranges from 600 feet to 940 feet above sea level.

DRAINAGE AND PERMEABILITY: Moderately well drained. The potential for surface runoff is negligible to high. Permeability is moderate or moderately slow in the loess, moderately slow or slow in the fragipan, and moderate or moderately rapid in the underlying material. Depth to the top of a perched seasonal high water table is at 2.0 to 3.5 feet from January through April in most years.

USE AND VEGETATION: More than half of the Rainsboro soils are used forcultivated crops. Corn, soybeans, wheat, and mixed hay are the principalcrops. A few areas are in pasture or woodland. Native vegetation was mixed,deciduous hardwood forest.

RUSSELL SERIES

TAXONOMIC CLASS: Fine-silty, mixed, superactive, mesic Typic Hapludalfs

GEOGRAPHIC SETTING: The Russell soils are on till plains of Wisconsinan age. Slope is commonly 0 to 6 percent but ranges to 25 percent. They formed in 20 to 40 inches of loess and the underlying calcareous loamy till. Mean annual temperature ranges from 46 to 55 degrees F, the mean annual precipitation ranges from 29 to 40 inches, frost free period ranges from 155 to 180 days, and elevation ranges from 680 to 1,020 feet above sea level.

DRAINAGE AND PERMEABILITY: Well drained. The potential for surface runoff is

low to high. Permeability is moderate in the solum and slow in the underlying material.

USE AND VEGETATION: Most of this soil is cultivated. Corn and soybeans are the principal crops. Native vegetation was mixed hardwoods of oak, hickory, and sugar maple.

DISTRIBUTION AND EXTENT: MLRA 111 in central and south central Indiana and southwestern Ohio; MLRA 111 and 108 in Illinois. The series is of large extent.

SHELOCTA SERIES

TAXONOMIC CLASS: Fine-loamy, mixed, active, mesic Typic Hapludults

GEOGRAPHIC SETTING: Gently sloping to very steep upland areas, foot slopes, and benches. Slopes range from 2 to 90 percent and most are concave. These soils are in areas within 42 to 54 inches average annual precipitation and average annual temperatures range from 48 to 59 degrees F. Shelocta soils have formed in the weathered product of colluvial material or colluvium and residuum from shale, siltstone, and sandstone.

DRAINAGE AND PERMEABILITY: Well drained, medium to rapid surface runoff and moderate permeability.

USE AND VEGETATION: About 25 percent of Shelocta soils are cleared and used for general crops and pasture. Wooded areas have mixed hardwoods-- oaks, gum, maple, yellow-poplar, cucumber, and some pine and hemlock.

STARKS SERIES

TAXONOMIC CLASS: Fine-silty, mixed, superactive, mesic Aeric Endoaqualfs

GEOGRAPHIC SETTING: Starks soils are on outwash plains, stream terraces, and alluvial fans. Slopes range from 0 to 5 percent. These soils formed in 24 to 40 inches of loess or other silty material and in the underlying loamy stratified outwash. Mean annual air temperature ranges from 46 to 54 degrees F, mean annual precipitation ranges from 29 to 40 inches, frost free days range from 140 to 180 days, and elevation ranges from 340 to 1,360 feet above sea level.

DRAINAGE AND PERMEABILITY: Somewhat poorly drained. An intermittent apparent seasonal high water table is present at a depth of 0.5 to 2.0 feet below the surface at some time between January and May in most years. The potential for surface runoff is low. Permeability is moderate.

USE AND VEGETATION: Most areas are cultivated. Corn, soybeans, and small grain are the principal crops. Some areas are wooded. Native vegetation is deciduous hardwood forest.

WESTLAND SERIES

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Typic Argiaquolls

GEOGRAPHIC SETTING: Westland soils are in depressions of outwash plains and stream terraces. The slope gradient ranges from 0 to 1 percent. Westland soils formed in loamy material over calcareous, stratified gravelly coarse sand and sand that can be capped with up to 20 inches of silty material. Mean annual temperature ranges from 49 to 55 degrees F., and mean annual precipitation ranges from 36 to 43 inches.

DRAINAGE AND PERMEABILITY: Poorly drained and very poorly drained; runoff is ponded or very slow; permeability is moderate in the solum and very rapid in the underlying material. In undrained areas, depth to an intermittent apparent high water table is at from 1 foot above the soil surface to 0.5 foot below the soil surface from November through June in most years. In drained areas, depth to an intermittent apparent high water table is at from 1 foot above the soil surface to 1 foot below the soil surface from December through May in most years.

USE AND VEGETATION: Most areas of these soils are used to grow corn, soybeans, small grain, and grass-legume hay. Native vegetation is a combination of forested and herbaceous wetland.

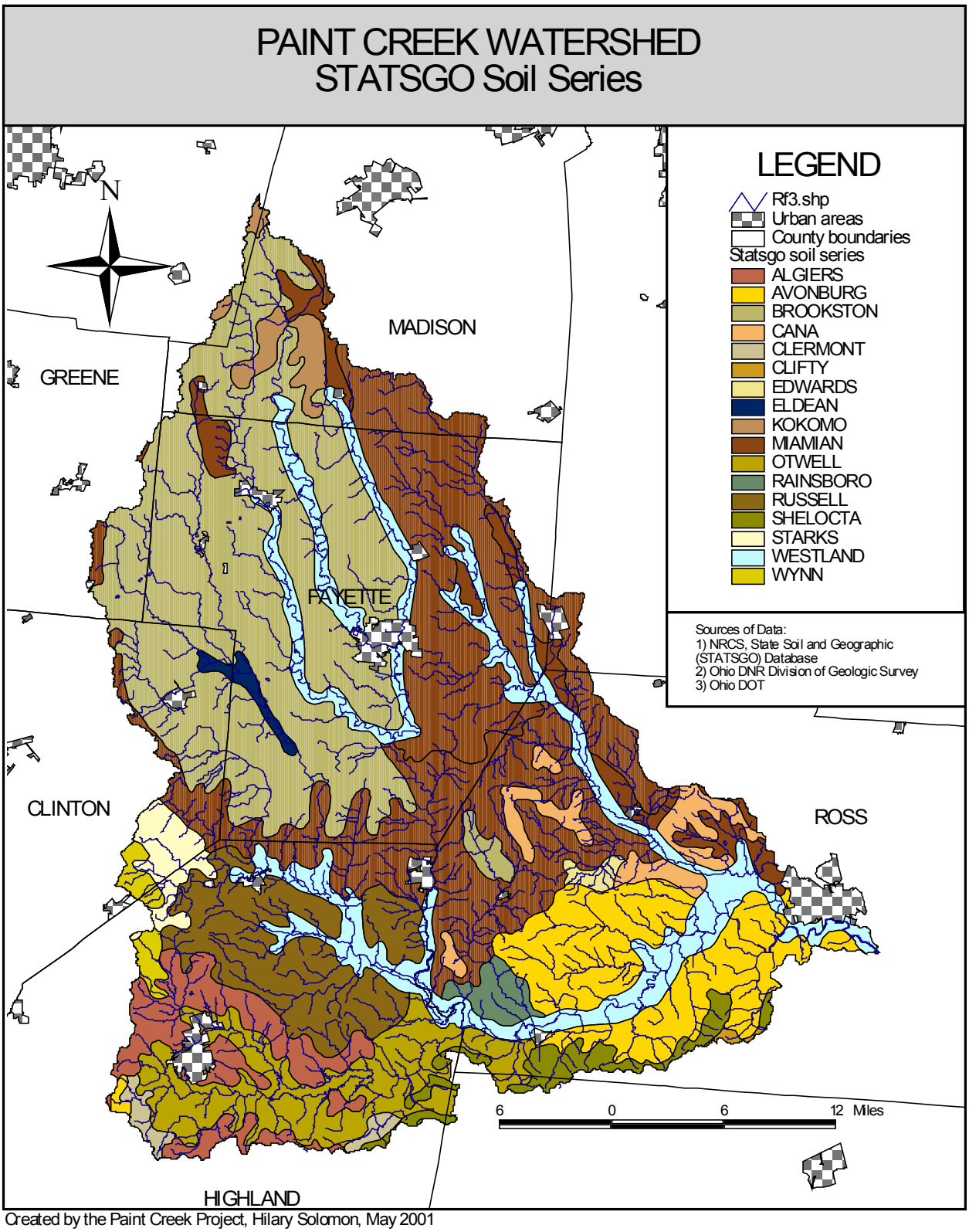
WYNN SERIES

TAXONOMIC CLASS: Fine, mixed, mesic Typic Hapludalfs

GEOGRAPHIC SETTING: Wynn soils are on areas of Late Wisconsin glaciation, typically on terrain of relatively higher elevation with bedrock-controlled topography. Slope range is from 1 to 50 percent. The soils formed in a thin loess mantle over a thin layer of weathered till underlain within a depth of 40 inches by interbedded calcareous shale and thin strata of limestone. Mean annual temperature ranges from about 52 to 55 degrees F, and mean annual precipitation ranges from about 37 to 42 inches.

DRAINAGE AND PERMEABILITY: Well drained. Medium to very rapid runoff. Moderately slow or slow permeability.

USE AND VEGETATION: Most of the Wynn soils are cultivated. Principal crops are corn, soybeans, small grains, alfalfa, and grasses. Many of the more sloping, moderately to severely eroded areas are reverting to brushy pasture or forest. Hawthorn and osage-orange brush, and bluegrass are in the more open pastured areas. Native vegetation was hardwood forest.



Created by the Paint Creek Project, Hilary Solomon, May 2001

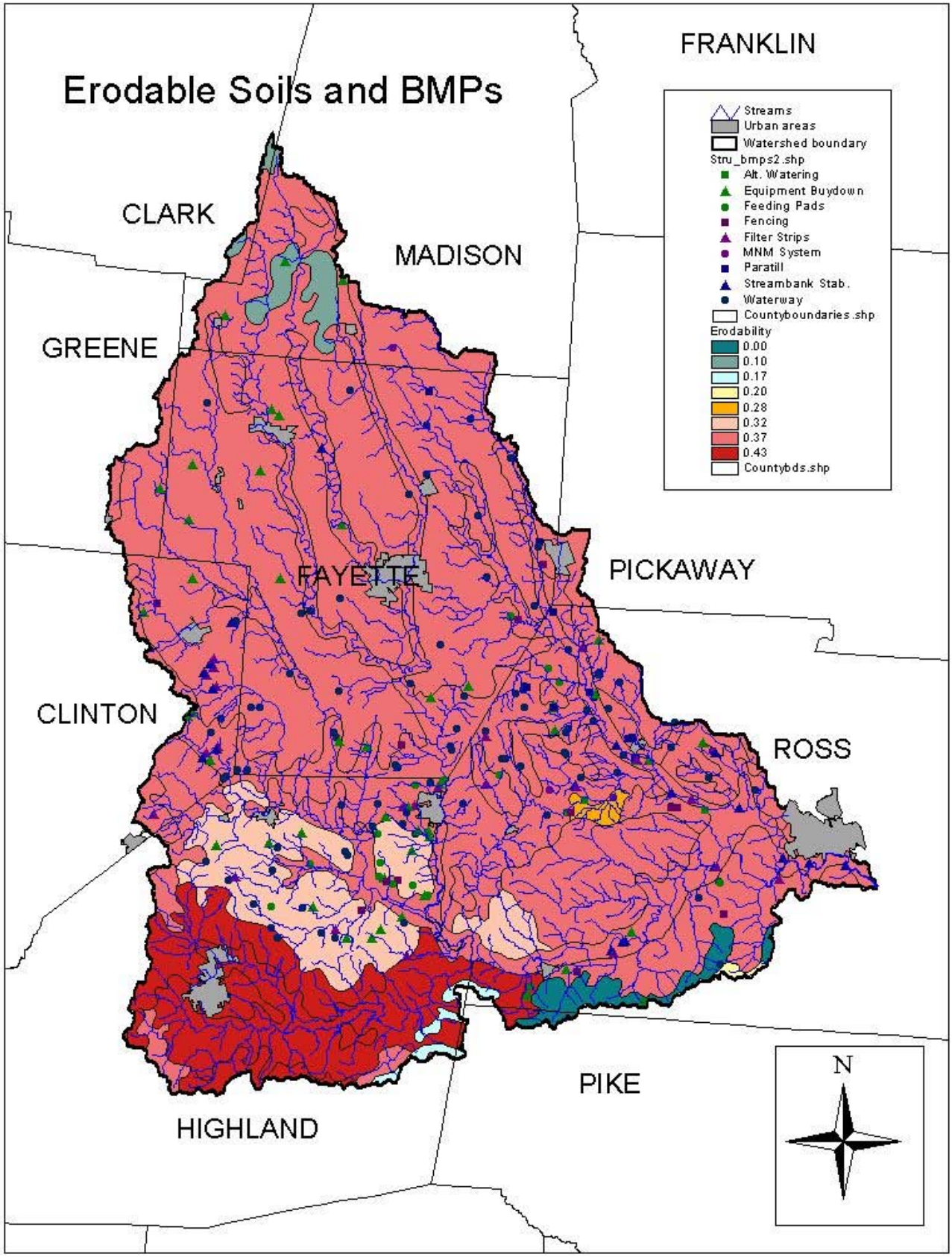
ERODABILITY

According to Fayette SWCD employee (and Advisory Board member), Layne Garringer, the K factor was incorrect in this version of STATSGO data. Due to an incorrect slope value much of the soil in the watershed was listed as highly erodable, when it should have been listed as slightly or moderately erodable. I tried to download the new version of STATSGO data, but could not project it into the same plane as the rest of the data in the GIS files. I was unable to verify, whether or not the data had changed or to create a new version of the Erodability Map. This section has not been updated from the first version of the Watershed Inventory, July 2001.

The map, Paint Creek Watershed: Potential Soil Erodability, was created using the same STATSGO data referenced above. The soil erodability index (also the K parameter in the Universal Soil Loss Equation) is an indicator of the soil's inherent susceptibility to erosion (Brady and Weil, 1999). This parameter is based on the infiltration capacity and structural stability of the soil. High infiltration means that less water will be available for runoff, and the surface is less likely to be ponded (which would make it more susceptible to splashing). Stable soil aggregates resist the beating action of the rain, and thereby save the soil even though runoff may occur (Brady and Weil, 1999).

Basic soil properties that tend to result in high K values include high contents of silt and very fine sand; expansive types of clay minerals; a tendency to form surface crusts; the presence of impervious soil layers; and blocky, platy, or massive soil structure. Soil properties that tend to make the soil more resistant to erosion (low K values) include high soil organic matter content, nonexpansive types of clays, and strong granular structure. According to Brady and Weir, soils with high infiltration rates tend to have K values of 0.025 or below, while more easily eroded soils with low infiltration rates have K factors of 0.04 or higher.

Nearly all of the soils in the Paint Creek Watershed have K values greater than 0.025, indicating that there is high potential for erosion. Please refer to the *Paint Creek Watershed: Potential Soil Erodabilty Map*. The erodability map includes several factors that lend uncertainty to the data. For example, it uses a K factor that does not take into account rock fragments, making it a conservative estimate. Additionally, the data provided by STATSGO is very general and should be replaced with local soils data when it becomes available.


Erodable Soils and BMPs
FRANKLIN
CLARK
MADISON
GREENE
FAYETTE
PICKAWAY
CLINTON
ROSS
PIKE
HIGHLAND
N
Streams
Urban areas
Watershed boundary
Stru_bmps2.shp
Alt. Watering
Equipment Buydown
Feeding Pads
Fencing
Filter Strips
MNM System
Paratill
Streambank Stab.
Waterway
Countyboundaries.shp
Erodability
0.00
0.10
0.17
0.20
0.28
0.32
0.37
0.43
Countybds.shp

HYDRIC SOILS*

As Ohio has seen such a great loss, over 90 percent, of wetland areas it is difficult to conclude where these areas may have originally occurred (NPR, 2001). One measure of wetland potential is the presence of hydric soils in an area (see *Paint Creek Watershed: Extent of Hydric Soils Map*).

Criteria for Hydric Soils

Hydric soil is a soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part. The concept of hydric soils includes soils developed under sufficiently wet conditions to support the growth and regeneration of hydrophytic vegetation. Soils that are sufficiently wet because of artificial measures are included in the concept of *hydric soils*. Also, soils in which the hydrology has been artificially modified are hydric if the soil, in an unaltered state, was hydric. Some series, designated as hydric, have phases that are not hydric depending on water table, flooding, and ponding characteristics. The following criteria reflect those soils that are likely to meet this definition.

HYDRIC SOILS

1. All Histels except Folistels and Histosols except Folists, or
2. Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, Pachic subgroups, or Cumulic subgroups that are:
   a. Somewhat poorly drained with a water table equal to 0.0 foot (ft) from the surface during the growing season, or
   b. Poorly drained or very poorly drained and have either:

      (1) water table equal to 0.0 ft during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 inches (in), or for other soils

      (2) water table at less than or equal to 0.5 ft from the surface during the growing season if permeability is equal to or greater than 6.0 in/hour (h) in all layers within 20 in, or

      (3) water table at less than or equal to 1.0 ft from the surface during the growing season if permeability is less than 6.0 in/h in any layer within 20 in, or
3. Soils that are frequently ponded for long duration or very long duration during the growing season, or
4. Soils that are frequently flooded for long duration or very long duration during the

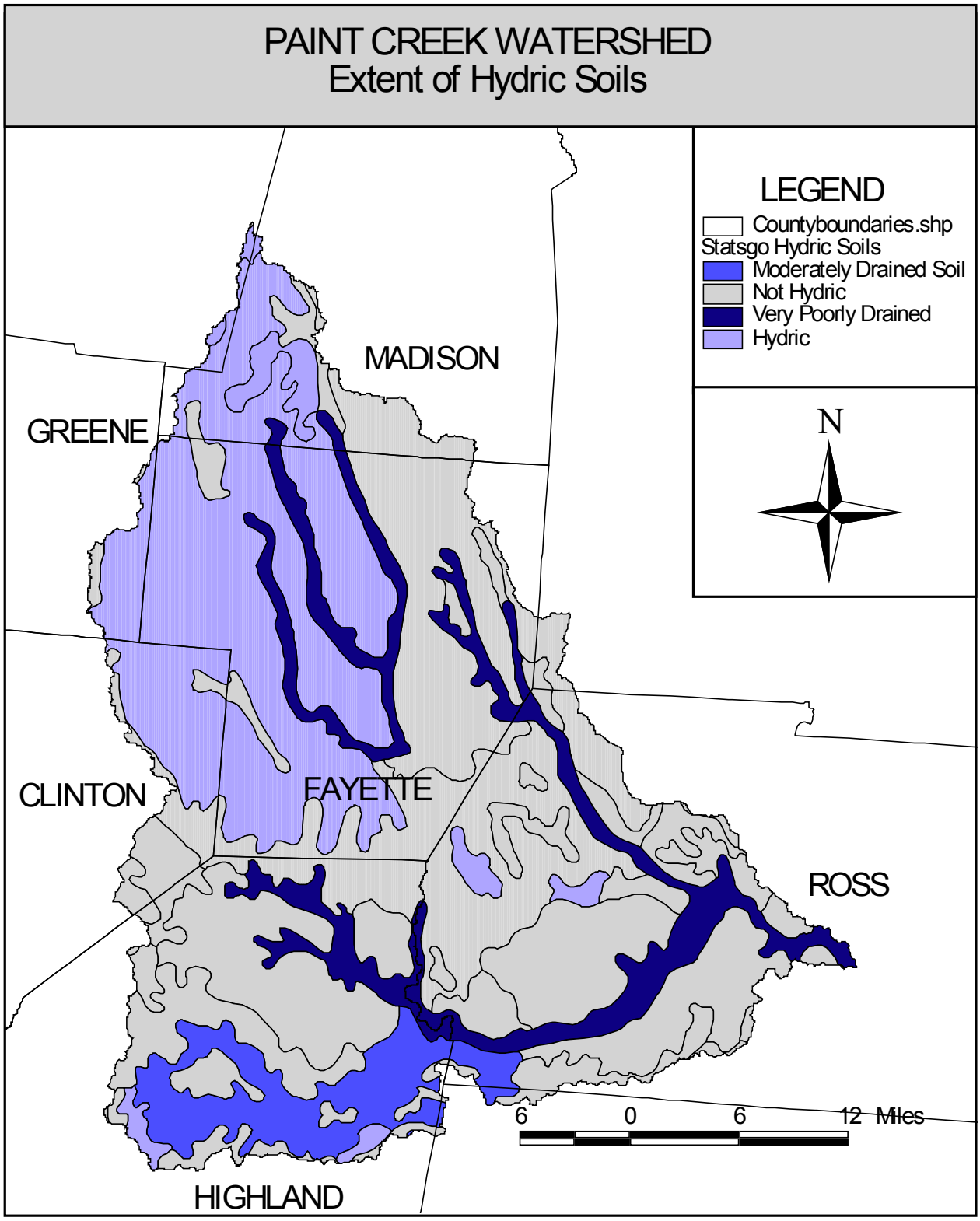
growing season.

APPLICATION OF HYDRIC SOILS MAPS

Hydric Soil maps could provide the Paint Creek Project with a number of agricultural and nonagricultural applications. These include assistance in land-use planning, conservation planning, and assessment of potential wildlife habitat. In the Paint Creek Watershed, where so few of the original wetlands remain, hydric soils may indicate areas that potentially contained wetlands in the past or could support wetlands in the future. This information may be important when landowners and resource managers make future conservation decisions. P lease note, a combination of hydr ic soil, hydrophytic vegetation, and hydrologic criteria defines wetlands as described in the literature. Therefore an area that meets the hydric soil criteria must also meet the hydrophytic vegetation and wetland hydrology criteria in order for it to be classified as a jurisdictional wetland.

> (Hydrophytic vegetation: plant life growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content.)

* Information provided by U SDA-NRCS Hydric Soils Introduction. A dditional information is available by contacting NRCS, or visiting them at www.nacdnet.org.



Prepared by the Paint Creek Watershed Project, Hilary Solomon, June 2001

LANDUSE AND COVER

The land-cover statistics are adapted from the 1994 Ohio DNR, Division of Real Estate and Land Management Statewide Land Cover Inventory. They show that the majority of the Paint Creek Watershed, 76.8%, is comprised of agricultural lands and open urban areas. Forested lands comprise the next 19.1 percent and shrub/scrub, urban, open water and wetlands make up the remaining 3.9 percent. Please refer to Figure 2-1 for graphic representation of the relative size of each landuse and cover area. Please also refer to the map entitled, *Paint Creek Watershed; Landuse and Cover*.

In acreage, this translates to 561,538 acres of agricultural or open housing areas, with a continuous shift toward increased open housing areas and decreased agricultural lands. The major crops grown in the watershed include corn, soybeans, wheat and hay. Relatively small numbers of cattle, sheep, hogs and poultry can be found in the watershed as well. Please see the Agricultural Statistics information in the Demographics section of this report for greater detail.

Forested areas make up approximately 139,653 acres and are concentrated in the southeastern area of the watershed. Forestry, limited housing, grazing and recreation are some of the main activities that occur in these areas. Private and commercial logging are important economic activities in these areas.

In 1994, urban areas covered nearly 6581 acres, with the major urban areas being Chillicothe, Washington Court House, Hillsboro, Bainbridge, Leesburg, Frankfort, Greenfield, Sabina, and Jeffersonville. Several of these urban centers have seen a significant increase in urban area annexation since 1994. Chillicothe, for instance, has continually added housing subdivisions and retail/service buildings (smart growth plan, 2001).

Shrub/scrub lands cover 16,085 acres, while open water covers 3,656 acres. The shrub/scrub lands occur near roads and urban areas and near the forest edge. They are increasingly prevalent in the southern portion of the watershed where the lands are steep and the soil potentially erodable. The areas of open water are associated with Rocky Fork and Paint Lake.

Approximately 2194 acres of wetlands remain in the watershed. Ohio has lost 90 percent of their wetlands (second only to California, which has lost over 97 percent) (NPR, 6/28/01).

The next section, Water Quality, illustrates important links between landuse and water quality/use attainment in the Paint Creek Watershed. For each subwatershed, specific water quality problems can be largely linked to the landuse in that region.

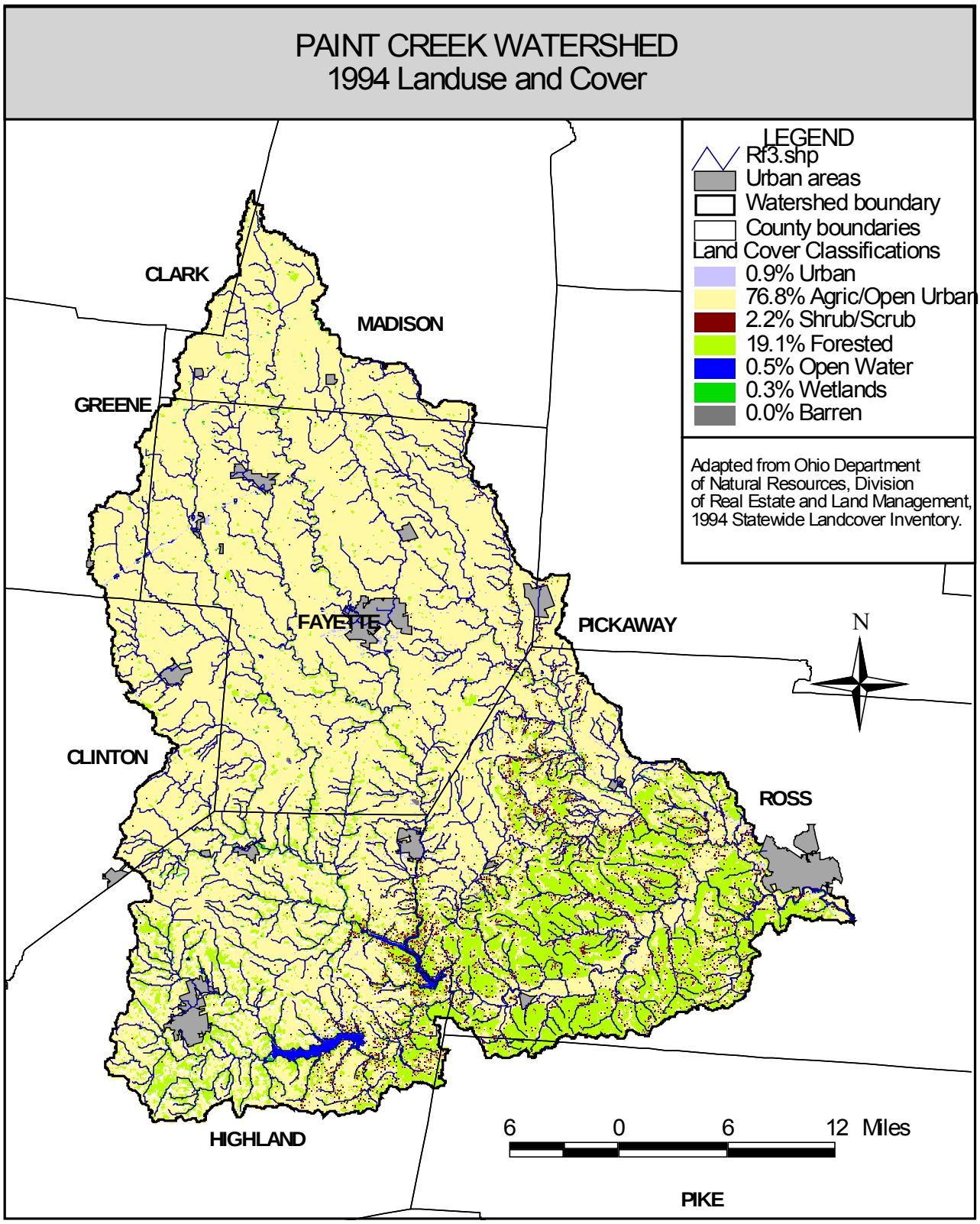
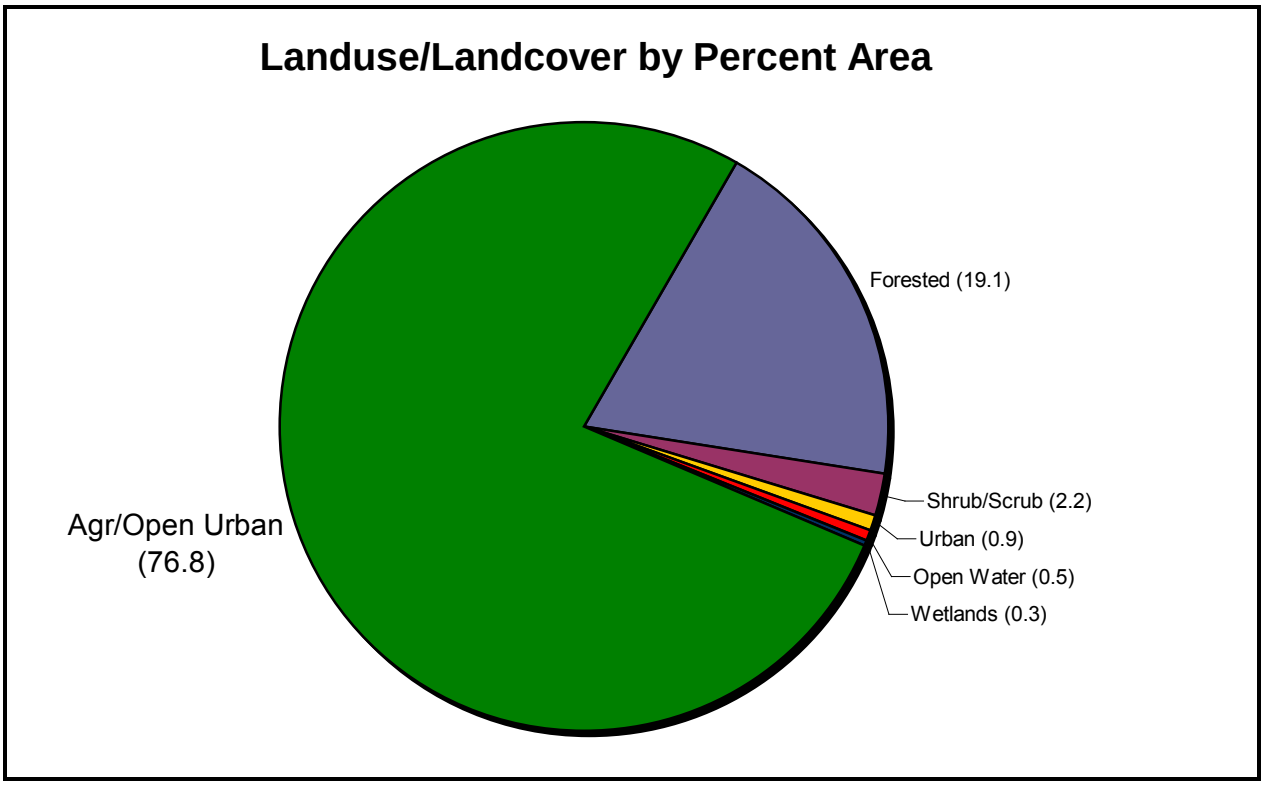

PAINT CREEK WATERSHED
1994 Landuse and Cover
LEGEND
Rf3.shp
Urban areas
Watershed boundary
County boundaries
Land Cover Classifications
0.9% Urban
76.8% Agric/Open Urban
2.2% Shrub/Scrub
19.1% Forested
0.5% Open Water
0.3% Wetlands
0.0% Barren
Adapted from Ohio Department of Natural Resources, Division of Real Estate and Land Management, 1994 Statewide Landcover Inventory.
CLARK
MADISON
GREENE
FAYETTE
PICKAWAY
CLINTON
ROSS
HIGHLAND
PIKE
N
6 0 6 12 Miles

Figure 2-1: Landuse and land cover by percent area of the Paint Creek Watershed.



Note: Approximately 1462 acres, or 0.2% of the land area in the watershed, is not accounted for on the landuse and cover percent and acreage information. This is probably due to error associated with rounding polygon areas in Arc View.

SPECIES DIVERSITY

The species diversity information collected for Paint Creek Watershed includes mussel species, fish species and threatened and endangered species. Also discussed are invasive, nonnative species found in the area.

MUSSEL SPECIES

On October 12, 1994 and again on February 3, 2001, Mr. Michael Hoggarth, a PhD with Otterbein College, surveyed the mussel fauna in Rocky Fork Creek in the vicinity of the Seven Caves. He found 13 mussels, two of which are currently listed as special interest species. Data for this site only includes living specimens that were collected and returned.

On September 28, 1997, Michael Bolton and Charles Boucher of the Ohio EPA Ecological Assessment Unit sampled the mussel fauna in Paint Creek downstream from Bainbridge. They collected 16 species, two of which are threatened species in Ohio and one was a special interest species. Data from this site includes numbers of live, dead, and weathered specimens.

The species collected during these events and their population status are listed in Table 2-2.

Table 2-2: Freshwater mussels (Unionidae) collected from Rocky Fork and Paint Creek

Species	Common Name	Number and Location	Population Status-Indicator Status
Alasmidonta marginata	Elktoe	2, Rocky Fork 3, Paint Creek	In decline-high quality indicator
Amblema plicata	Threeridge	45, Paint Creek	Stable
Anadonta grandis	Giant floater	14, Paint Creek	Stable
Anadonta suborbiculata	Flat floater	1, Paint Creek	Special interest, in decline
Elliptio dilatata	Spike	1, Rocky Fork	Stable
Epioblasma triquetra	Snuffbox	½, Paint Creek	Threatened, high quality indicator
Fusconaia flava	Wabash Pig Toe	2, Rocky Fork 3, Paint Creek	Stable
Lampsilis cardium (= ventricosa)	Plain Pocketbook	47, Rocky Fork 25, Paint Creek	Stable
Lampsilis fasciola	Wavy-rayed Lampmussel	1, Rocky Fork	Special interest- in decline- high quality indicator
Lampsilis radiata luteola	Fatmucket	43, Rocky Fork 16, Paint Creek	Increasing
Lasmigona complanata	White Heel-splitter	5, Rocky Fork 32, Paint Creek	Increasing
Lasmigona costata	Fluted-shell	29, Rocky Fork 30, Paint Creek	Stable- high quality indicator
Leptodea fragilis	Fragile Papershell	2, Rocky Fork 11, Paint Creek	Stable
Potamilus alatus	Pink Heel-splitter	2, Rocky Fork 3, Paint Creek	Stable
Ptychobranchus fasciolaris	Kidney Shell	4, Rocky Fork	In decline- high quality indicator
Pyganodon. grandis		1, Paint Creek	
Quadrula quadrula	Maple Leaf	11, Rocky Fork 20, Paint Creek	Stable- high quality indicator
Tritogonia verrucosa	Pistolgrip	21, Paint Creek	In decline, high quality indicator
Truncilla donaciformis	Fawnsfoot	1, Paint Creek	Threatened,
Truncilla truncata	Deertoe	1, Rocky Fork	Special interest-In decline- high quality indicator

Freshly dead and weathered specimens from the Paint Creek site have been cataloged at the Museum of Zoology at the Ohio State University.

FISH DIVERSITY

In 1997-1999, a survey of existing fish species in the Paint Creek Watershed was completed under the guidance of Ohio State University professors, Ted Cavendar and Marc Kibbey. The study had three main objectives, which included providing a visual distribution map of all fish species in the watershed; pinpointing stream sections with the richest species distributions; and investigating the status of all threatened, endangered, and special interest species in the watershed. This report was intended to serve as baseline information for regulators and scientists making monitoring and preservation decisions about stream sections in the watershed.

In 1957 and 1981 Trautman made limited surveys of fish species in the watershed. Ohio EPA division of surface water surveyed the fish species in the main stem of Paint Creek in 1992 and through most of the watershed in 1997. Ohio DNR has also made limited studies of the fish species in the watershed. Cavendar and Kibbey's report consolidated all of the historical information (the Ohio EPA 1997 data was not included in this study) and collected data at an additional 71 sites throughout the watershed. The survey sites were picked based on criteria including potential for species richness; usefulness as future monitoring sites; presence of threatened, endangered, and special interest species; at least two sites on each major tributary, one on smaller tributaries and several on the Paint Creek main stem.

The results of the survey found records describing 104 fish species in the Paint Creek Watershed. Of that number six are considered non-indigenous species and four other species may not be native to the drainage but reside only in the man-made lakes. Seven of the species were recorded over 50 years ago, but not within the recent surveys. The number of species recently collected in the Paint Creek drainage was 97 including the six non-indigenous species and the other four lake species, which were probably introductions. Compared to the other drainages in the Scioto river basin, only the Big Darby Creek has a similar total number of native species that are still extant (Cavendar and Kibbey, 1999). Table 2-3 lists the species described in this study.

THREATENED AND ENDANGERED SPECIES

The Ohio DNR Heritage program administers a database that tracks endangered, threatened, special interest and other rare species. According to this database, the Paint Creek Watershed is home to 10 endangered species, 12 threatened species, 15 protected species, 4 special interest species, one newly listed species, and 10 listed species whose status is not yet determined. Please refer to Table 2-4 for the complete list of listed species in the watershed.

INVASIVE, NON-NATIVE SPECIES

Not much is known about the existing non-native, invasive species in the watershed, however commonly occurring exotic species in Ohio include canary reed grass, phragmites reed grass, and purple loosestrife. The Paint Creek Watershed is known to

contain at least four invasive, non-natives including, Japanese honeysuckle, bush honeysuckle, garlic mustard, and narrow-leafed cattail (Jones, 2002).

Table 2-3: Fish Species in the Paint Creek Watershed
(Includes Ohio EPA, Cavendar's Paint Creek Project and ODNR Division of Wildlife sightings. Historical sightings include Troutman's and others and the date of the sighting).

	Latin name	Common name	Listing	Ohio EPA	PCP	ODNR, DOW	Historical	Date
1	Ichthyomyzon unicuspis	silver lamprey		5		1		
2	Lampetra aepyptera	least brook lamprey		8	1		3	
3	Polyodon spathula	Paddlefish					2	
4	Lepisosteus osseus	longnose gar		12	4		8	
5	Lepisosteus platostomus	shortnose gar		1			1	
6	Amia calva	Bowfin					1	
7	Hiodon alosoides	Goldeye					2	
8	Hiodon tergisus	Mooneye		2				
9	Alosa chrysochloris	Skipjack		1			2	
10	Dorosoma cepedianum	gizzard shad		44	18	2	20	
11	Campostoma anomalum	Stoneroller		68	44			
12	Carassius auratus	Goldfish		2	2			
13	Cteopharyngodon idella	Grass carp		1				
14	Cyprinella spiliptera	spotfin shiner		83	60			
15	Cyprinella whipplei	steelcolor shiner		21	24			
16	Cyprinus carpio	common carp		72	20	2		
17	Ericymba buccata							
18	Erimystax dissimilis	streamline chub	spec	5	3			
19	Erimystax x-punctatus	gravel chub		16	10			
20	Hybopsis amblops	bigeye chub		3	4			
21	Luxilis chrysocephalus	striped shiner		68	41	1		
22	Lythrurus ardens	rosefin shiner		19	30			
23	Macrhybopsis storeniana	silver chub					1	
24	Nocomis buguttatus	hornyhead chub					1	1942
25	Nocomis micropogon	river chub					1	1955
26	Notemigonus crysoleucas	golden shiner		17	12			
27	Notropis atherinoides	emerald shiner		8	12			
28	Notropis buccatus	silverjaw minnow		19	24			
29	Notropis heterolepis	blacknose shiner					2	1940
30	Notropis photogenis	silver shiner		25	9			
31	Notropis rubellus	rosyface shiner		14	17			
32	Notropis stramineus	sand shiner		67	58			
33	Notropis volucellus	Mimic shiner		11	18			
34	Opsopoeodus emiliae	pugnose minnow	endg/oh				1	1930's
35	Phenacobius mirabilis	suckermouth minnow		20	13			
36	Phoxinus erythrogaster	southern redbelly dace		4	4			
37	Pimephales notatus	bluntnose minnow		86	62			
38	Pimephales promelas	fathead minnow		8	9			
39	Pimephales vigilax	bullhead minnow		15	7			

	Latin name	Common name	Listing	Ohio EPA	PCP	ODNR, DOW	Historical	Date
40	Rhinichthys atratulus	blacknose dace		15	14			
41	Semotilis atromaculatus	Creek chub		53	41			
42	Carpiodes carpio	river carpsucker				1		
43	Carpiodes cyprinus	quillback carpsucker		40	3	1		
44	Carpiodes velifer	highfin carpsucker		6	1			
45	Catostomus commersoni	White sucker		52	17			
46	Erimyzon oblongus	Creek chubsucker		13	6			
47	Hypetelium nigricans	hogsucker		52	24			
48	Ictiobus bubalus	smallmouth buffalo		14	1			
49	Ictiobus cyprinellus	bigmouth buffalo		5				
50	Ictiobus niger	black buffalo		10	1	1		
51	Minytrema melanops	spotted sucker		12	5			
52	Moxostoma anisurum	silver redhorse		26	2			
53	Moxostoma breviceps	Ohio shorthead redhorse		29	3			
54	Moxostoma carinatum	river redhorse		13	1			
55	Moxostoma duquesnei	black redhorse		28	3			
56	Moxostoma erythrurum	golden redhorse		61	23			
57	Ameiurus melas	black bullhead		19				
58	Ameiurus natalis	yellow bullhead		56	19			
59	Ameiurus nebulosis	brown bullhead		10	1			
60	Ictalurus punctatus	channel catfish		38	12			
61	Noturus flavus	stonecat		21	23			
62	Noturus gyrinus	tadpole madtom		7	3			
63	Noturus miurus	brindled madtom	ind spp	4	11			
64	Noturus stigmosus	northern madtom	endg/oh		1			
65	Pylodictus olivaris	flathead catfish		18	6			
66	Esox americanus	grass pickerel		14	4		16	
67	Esox lucius	northern pike					2	1950's
68	Esox masquinongy	muskellunge		6		1	4	
69	Percopsis omiscomaycus	troutperch					1	1938
70	Labidesthes sicculus	brook silversides		11	15			
71	Fundulus notatus	blackstripe topminnow		42	35			
72	Cottus bairdi	mottled sculpin		21	6			
73	Morone americana	white perch				1		1997
74	Morone chrysops	white bass		9	1			
75	Ambloplites rupesttis	rockbass		68	44			
76	Lepomis cyanellus	green sunfish		65	34			
77	Lepomis gibbosus	pumpkinseed		9	1			
78	Lepomis gulosus	warmouth sunfish		16	5			
79	Lepomis humilis	orangespotted sunfish		7	3	1		
80	Lepomis macrochirus	bluegill sunfish		62	41	2		
81	Lepomis megalotis	longear sunfish		76	49			
82	Lepomis microlophus	redear sunfish			2			

	Latin name	Common name	Listing	Ohio EPA	PCP	ODNR, DOW	Historical	Date
83	Micropterus dolomieu	smallmouth bass		65	28			
84	Micropterus punctulatus	spotted bass		35	18			
85	Micropterus salmoides	largemouth bass		39	29			
86	Pomoxis annularis	white crappie		44	22	2		
87	Pomoxis nigromaculatus	black crappie		28	15	2		
88	Ammocrypta pellucida	sand darter		6	6			
89	Etheostoma blennioides	greenside darter		71	42			
90	Etheostoma caeruleum	rainbow darter		64	47			
91	Etheostoma camurum	bluebreast darter		3	6			
92	Etheostoma flabellare	fantail darter		30	19			
93	Etheostoma microperca	least darter		1	6			
94	Etheostoma nigrum	johnny darter		42	36			
95	Etheostoma spectabile	orangethroat darter		33	40			
96	Etheostoma tippecanoe	tippecanoe darter	threatened	1	3			
97	Etheostoma variatum	variegate darter		7	12			
98	Etheostoma zonate	banded darter		37	39			
99	Perca flavescens	yellow perch		4	2			
100	Percina caprodes	logperch		55	18			
101	Percina maculata	blackside darter		2	2			
102	Percina phoxocephala	slenderhead darter		7	1			
103	Percina sciera	dusky darter		10	9			
104	Stizostedion canadense	sauger		15		1		
105	Stizostedion vitreum	walleye		3	1	2		
106	Aplodinotus grunniens	freshwater drum		20	2	1		

Table 2-4: Threatened and Endangered Species in the Paint Creek Watershed.

Ohio status	Scientific name	Common name
Special	Ammocrypta pellucida	Eastern Sand Darter
Protected	Arabis hirsuta var. adpressipilis	Southern Hairy Rock-Cress
Threatened	Asplenium ruta-muraria	Wall Rue
Threatened	Botrychium biternatum	Sparse-lobe Grape Fern
Special	Caecidotea rotunda	Frost Cave Isopod
Threatened	Cicindela marginipennis	Cobblestone Tiger Beetle
A	Collema bachmanianum	Bachman's Pulp Lichen
Threatened	Corallorhiza wisteriana	Spring Coral-root
Endangered	Cryptobranchus alleganiensis	Eastern Hellbender
Protected	Cystoperis tenesseensis	Tennessee Bladder Fern
Protected	Desmodium pauciflorum	Few-flowered Tick-trefoil
Endangered	Epioblasma triquetra	Snuffbox
	Erimystax dissimilis	Streamline Chub
Threatened	Etheostoma camurum	Bluebreast Darter
Endangered	Hiodon alosoides	Goldeye
Threatened	Ichthyomyzon Unicuspis	Silver Lamprey
Protected	Juglans cinerea	Butternut
Endangered	Lanius ludovicians	Loggerhead Shrike
Endangered	Megalonaias nervosa	Wasboard (Mollusk)
Threatened	Melanthium virginicum	Bunchflower
	Notropis amblops	Bigeye Chub
Endangered	Noturus stigmosus	Northern Madtom
Special	Opheodrys aestivus	Rough Green Snake
	Opheodrys vernalis	Smooth Green Snake
Protected	Opuntia humifusa	Prickly Pear
Special	Percina phoxocephala	Slenderhead Darter
Protected	Poa languida	Weak Spear-grass
Endangered	Polypodium polypodioides	Little Gray Polypody
	Potamilus ohiensis	Pink papershell
	Prunus serotina	Black Cherry
	Quercus alba	White Oak
Protected	Quercus marilandica	Blackjack Oak
	Quercus muehlenbergii	Chinkapin or Yellow Oak
	Quercus shumardii	Shumard Oak
Protected	Rhamnus caroliniana	Carolina Buckthorn
Protected	Sagittaria australis	Long-beaked Arrowhead
Threatened	Satureja arkansana	Limestone Savory
Threatened	Selaginella eclipes	Midwest Spikemoss
Protected	Silene regia	Royal Catchfly
	Silver maple	Acer saccharinum
Threatened	Smilax herbacea var. lasioneura	Pale Carrion-flower
Protected	Sporobolus cryptandrus	Sand Dropseed
Threatened	Sporobolus heterolepis	Prairie Dropseed
Protected	Sullivantania sullivantania	Sullivantania
Protected	Thuja occidentalis	Arbor vitae
Protected	Trillium nivale	Snow Trillium
Threatened	Triphora trianthophora	Three-birds Orchid
Endangered	Tyto alba	Barn Owl
Endangered	Viburnum molle	Soft-leaved Arrow-wood
Endangered	Viola walteri	Walter's Violet
Protected	Zigadenus elegans var. glaucus	Wand-lily

Adapted from the Ohio DNR, Natural Heritage Database, Endangered and Threatened Species List.

GROUND WATER

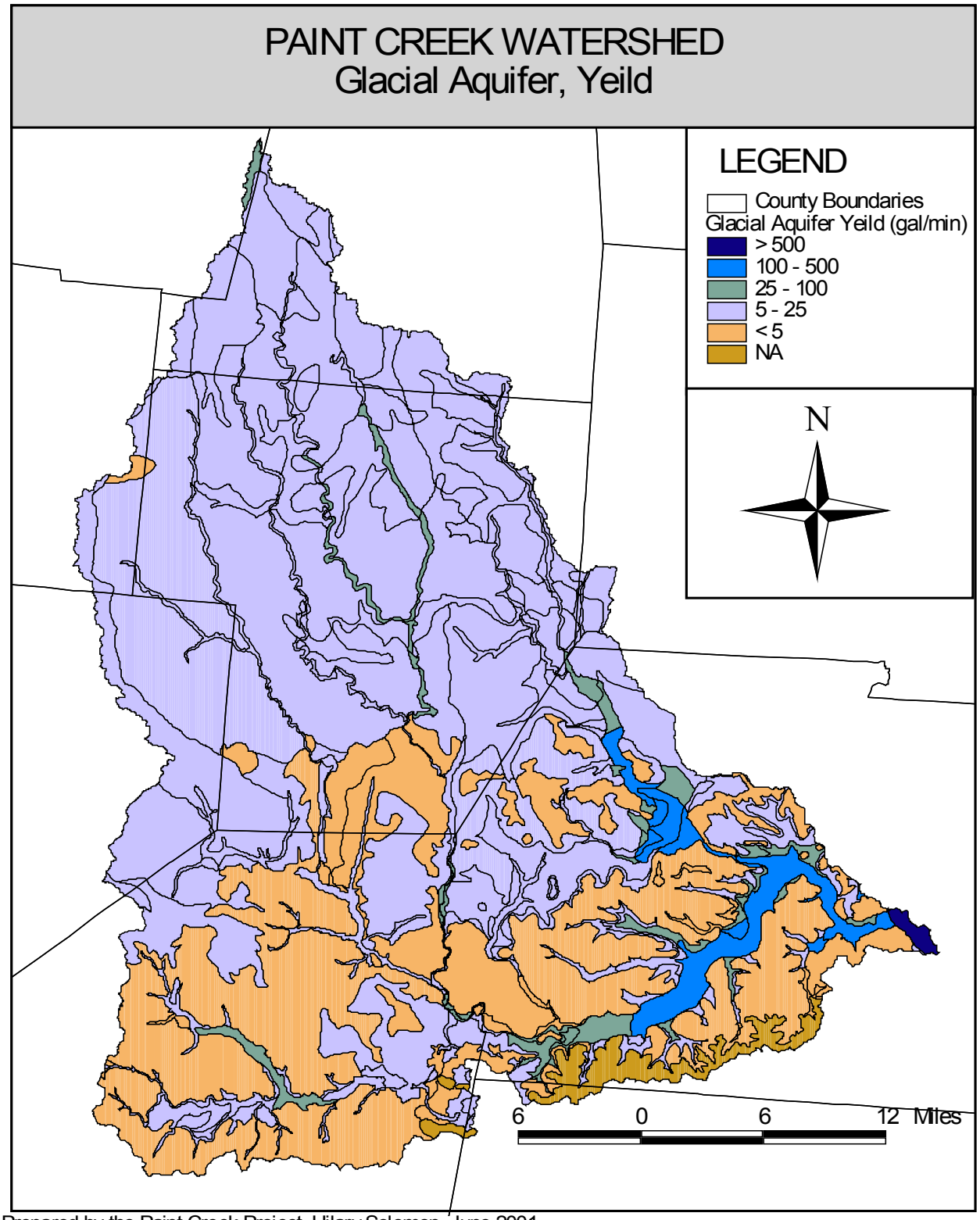
Ground water resources in the watershed are numerous with both shallow and deep aquifers underlying the entire area. Many of these aquifers exist in the glacially deposited sand and gravel layers that spread throughout much of the watershed. The map entitled *Paint Creek Watershed: Glacial Aquifer Yield* gives an approximation of the water supply potential in given areas of the watershed. This map shows a potential yield gradient across aquifer boundaries, not individual aquifers. This information, used by Ohio EPA, Division of Drinking and Ground Water (DDAGW), is from the STATSGO database.

Ohio EPA classifies public drinking supply wells into three categories: community, transient non-community, and non-transient non-community. Community drinking wells serve at least 15 service connections used by year-round residents of the area or regularly serves 25 year-round residents. Transient non-community drinking wells serve at least 25 non-residents per day for six months or less each year. Examples are restaurants, hotels and gas stations. Non-transient non-community wells serve at least 25 of the same non-resident persons per day for more than 6 months per year. Examples include offices, schools, churches and factories (Ohio EPA, DDAGW website, 2001).

Ohio EPA also collects data on oil and gas companies' oil wells and resource characterization wells. Resource characterization wells are used to capture existing hydro-geologic data for all of Ohio EPA Division of Drinking and Ground water files. These wells, which are part of the source water assessment and protection program, include public water supply and other wells (Bondoc, 2001).

PUBLIC WATER SUPPLY WELLS

Ohio EPA (DDAGW) has information on 186 public water supply wells in the Paint Creek Watershed, which serve over 70,000 people. Please refer to table 2-5, Paint Creek Watershed Public Water Supply Wells for a list of wells, well locations, and numbers served by each (DDAGW GIS, 2001).



Prepared by the Paint Creek Project, Hilary Solomon, June 2001

Table 2-5: Paint Creek Watershed Public ACTIVE Water Supply Wells

SYSTEM NAME	COUNTY	OEPA	TYPE	POP	STATUS	SOURCE NAME
ST. MARTIN, VILLAGE OF	Brown	SWDO	C	97	Active	HIGHLAND COUNTY
SABINA, VILLAGE OF	Clinton	SWDO	C	2700	Active	KENNY WF 3
SABINA, VILLAGE OF	Clinton	SWDO	C	2700	Active	KENNY WF 6
SABINA, VILLAGE OF	Clinton	SWDO	C	2700	Active	WADDELL WF 7
SABINA, VILLAGE OF	Clinton	SWDO	C	2700	Active	CITY WF 10
SABINA, VILLAGE OF	Clinton	SWDO	C	2700	Active	CITY WF 11
SABINA, VILLAGE OF	Clinton	SWDO	C	2700	Active	CITY WF 12
SABINA, VILLAGE OF	Clinton	SWDO	C	2700	Active	CITY WF 15
EAST CLINTON HIGH SCHOOL	Clinton	SWDO	P	500	Active	WELL #2
COMMUNITY CHRISTIAN CHUR	Clinton	SWDO	N	125	Active	WELL #1
BLOOMINGBURG, VILLAGE OF	Fayette	CDO	C	900	Active	WELL 1
BLOOMINGBURG, VILLAGE OF	Fayette	CDO	C	900	Active	WELL 2
FAYETTE CO.-CULPEPPER SU	Fayette	CDO	C	268	Active	WELL 1
FAYETTE CO.-CULPEPPER SU	Fayette	CDO	C	268	Active	WELL 2
HILLCREST MANOR NURSING	Fayette	CDO	C	25	Active	WELL 1
HILLCREST MANOR NURSING	Fayette	CDO	C	25	Active	WELL 2
PINE TREE COURT APARTMEN	Fayette	CDO	C	105	Active	WELL 1
JEFFERSONVILLE, VILLAGE	Fayette	CDO	C	1450	Active	WELL 1
JEFFERSONVILLE, VILLAGE	Fayette	CDO	C	1450	Active	WELL 6 SHORTWDS
JEFFERSONVILLE, VILLAGE	Fayette	CDO	C	1450	Active	WELL 7 SPAHR
JEFFERSONVILLE, VILLAGE	Fayette	CDO	C	1450	Active	WELL 8 LITHICUM
JEFFERSONVILLE, VILLAGE	Fayette	CDO	C	1450	Active	WELL 5 SAM'S
JEFFERSONVILLE, VILLAGE	Fayette	CDO	C	1450	Active	WELL 11 JEFF
JEFFERSONVILLE, VILLAGE	Fayette	CDO	C	1450	Active	WELL 12 ROLLE
WASHINGTON COURT HOUSE	Fayette	CDO	C	14000	Active	PAINT CREEK
WASHINGTON COURT HOUSE	Fayette	CDO	C	14000	Active	RESERVOIR
WASHINGTON COURT HOUSE	Fayette	CDO	C	14000	Active	WELL 8
WASHINGTON COURT HOUSE	Fayette	CDO	C	14000	Active	WELL 9
WASHINGTON COURT HOUSE	Fayette	CDO	C	14000	Active	WELL 10
WASHINGTON COURT HOUSE	Fayette	CDO	C	14000	Active	WELL 11
WASHINGTON COURT HOUSE	Fayette	CDO	C	14000	Active	PLANT TAP
ST. CATHERINE'S CARE CEN	Fayette	CDO	C	39	Active	WELL 1
PINE TREE COURT APARTMEN	Fayette	CDO	C	36	Active	WELL 3
ODOT REST AREA 6-9	Fayette	CDO	N	700	Active	WELL
ODOT REST AREA 6-10	Fayette	CDO	N	700	Active	WELL
BUCKEYE HILLS COUNTRY CL	Fayette	CDO	N	170	Active	WELL
CHAFFIN ELEMENTARY SCHOO	Fayette	CDO	P	160	Active	WELL 1
DOLLAR INN	Fayette	CDO	N	61	Active	WELL
MADISON MILLS ELEMENTARY	Fayette	CDO	P	200	Active	WELL 1
STAUNTON ELEMENTARY SCH	Fayette	CDO	P	152	active	WELL 1
WALNUT LAKE CAMPGROUND	Fayette	CDO	N	457	active	WELL
WAYNE ELEMENTARY SCHOOL	Fayette	CDO	P	271	active	WELL 2
WILSON ELEMENTARY	Fayette	CDO	P	140	active	WELL 1

SYSTEM NAME	COUNTY	OEPA	TYPE	POP	STATUS	SOURCE NAME
SCHOOL						
MIAMI TRACE HIGH SCHOOL	Fayette	CDO	P	882	active	WELL 1
EBER ELEMENTARY SCHOOL	Fayette	CDO	P	150	active	WELL 2
ASSEMBLY OF GOD CHURCH	Fayette	CDO	N	101	Active	WELL
I-71 & SR-35 WATER SYSTE	Fayette	CDO	C	35	Active	WELL 1
I-71 & SR-35 WATER SYSTE	Fayette	CDO	C	35	Active	WELL 2
I-71 & SR-35 WATER SYSTE	Fayette	CDO	C	35	Active	WELL 3
MIDWAY BAR & GRILL	Fayette	CDO	N	75	Active	WELL 1
BOWERSVILLE, VILLAGE OF	Greene	SWDO	C	360	Active	WELL 1
BOWERSVILLE, VILLAGE OF	Greene	SWDO	C	360	Active	WELL 2
GREENFIELD,CITY OF	Highland	SWDO	C	5172	Active	WELL 1
GREENFIELD,CITY OF	Highland	SWDO	C	5172	Active	WELL 2
GREENFIELD,CITY OF	Highland	SWDO	C	5172	Active	WELL 3
GREENFIELD,CITY OF	Highland	SWDO	C	5172	Active	WELL 4
GREENFIELD,CITY OF	Highland	SWDO	C	5172	Active	WELL 5
GREENFIELD,CITY OF	Highland	SWDO	C	5172	Active	WELL 6
GREENFIELD,CITY OF	Highland	SWDO	C	5172	Active	WELL 8
GREENFIELD,CITY OF	Highland	SWDO	C	5172	Active	WELL 9
GREENFIELD,CITY OF	Highland	SWDO	C	5172	Active	WELL 10
GREENFIELD,CITY OF	Highland	SWDO	C	5172	Active	PLANT TAP
HIGHLAND COUNTY WATER CO	Highland	SWDO	C	29565	Active	WELL 2
HIGHLAND COUNTY WATER CO	Highland	SWDO	C	29565	Active	WELL 3
HIGHLAND COUNTY WATER CO	Highland	SWDO	C	29565	Active	PLANT TAP
HIGHLAND COUNTY WATER CO	Highland	SWDO	C	29565	Active	WELL #4
HIGHLAND COUNTY WATER CO	Highland	SWDO	C	29565	Active	WELL #5
HIGHLAND COUNTY WATER CO	Highland	SWDO	C	29565	Active	WELL #6
HIGHLAND COUNTY WATER CO	Highland	SWDO	C	29565	Active	WELL R1
HILLSBORO, CITY OF	Highland	SWDO	C	6400	Active	CLEAR CR.INTAKE
HILLSBORO, CITY OF	Highland	SWDO	C	6400	Active	RESERVOIR
HILLSBORO, CITY OF	Highland	SWDO	C	6400	Active	PLANT TAP
LEESBURG,VILLAGE OF	Highland	SWDO	C	1200	Active	WELL 1
LEESBURG,VILLAGE OF	Highland	SWDO	C	1200	Active	WELL 2
LEESBURG,VILLAGE OF	Highland	SWDO	C	1200	Active	WELL 3
LAKE WAHOO RESORT	Highland	SWDO	N	40	Active	WELL 1
LAKE WAHOO RESORT	Highland	SWDO	N	40	Active	WELL 2
GREENFIELD BIBLE BAPTIST	Highland	SWDO	N	70	Active	WELL 1
NORTH BAY COTTAGES & BAI	Highland	SWDO	N	50	Active	WELL 1
SHADY TRAILS CAMPGROUND	Highland	SWDO	N	150	Active	WELL 1
ODOT-REST AREA 9-36	Highland	SWDO	N	100	Active	WELL 1
NORTH FORK MARINE SALES	Highland	SWDO	N	5	Inactive	WELL 1
ODNR-PAINT CREEK ST. PK.	Highland	SWDO	N	100	Active	WELL,RATTLESNKE
GOOD SHEPHERD U B CHURCH	Highland	SWDO	N	100	Active	WELL 1
GOOD SHEPHERD U B CHURCH	Highland	SWDO	N	100	Active	WELL 2
LEESBURG AMISH SCHOOL	Highland	SWDO	P	25	Active	WELL #1

SYSTEM NAME	COUNTY	OEPA	TYPE	POP	STATUS	SOURCE NAME
CEDAR HILL CAMPGROUND	Highland	SWDO	N	40	Active	WELL #1
SOUTH SOLON, VILLAGE OF	Madison	CDO	C	375	Active	WELL 1
SOUTH SOLON, VILLAGE OF	Madison	CDO	C	375	Active	WELL 2A
NEW HOLLAND, VILLAGE OF	Pickaway	CDO	C	870	Active	WEST WELL-#1
NEW HOLLAND, VILLAGE OF	Pickaway	CDO	C	870	Active	EAST WELL-#2
PIKE WATER, INC.-ROSS #1	Pike	SEDO	C	1383	Inactive	ROSS CO WATER 1
BAINBRIDGE, VILLAGE OF	Ross	SEDO	C	1050	Active	WELL #3
BAINBRIDGE, VILLAGE OF	Ross	SEDO	C	1050	Active	WELL #4
FRANKFORT, VILLAGE OF	Ross	SEDO	C	1030	Active	WELL 1
FRANKFORT, VILLAGE OF	Ross	SEDO	C	1030	Active	WELL 3
TWIN ELEMENTARY SCHOOL	Ross	SEDO	P	410	Active	WELL 1
ODOT-REST AREA 9-42	Ross	SEDO	N	25	Active	WELL
TWIN DAIRY HUT	Ross	SEDO	N	25	Active	DRIVEN WELL
PAINT VALLEY H.S.STADIUM	Ross	SEDO	N	50	Active	WELL 1

AMBIENT MEASUREMENT WELLS

Ambient measurement wells consist of a statewide network of public water supply wells that Ohio EPA samples on a semiannual basis for a specific set of parameters. These wells serve to record ambient water quality in the state and create a baseline from which Ohio EPA can measure changes to ground water quality that occur over time (Bondoc, 2001). Table 2-6 lists the ambient measurement wells that are located in the Watershed.

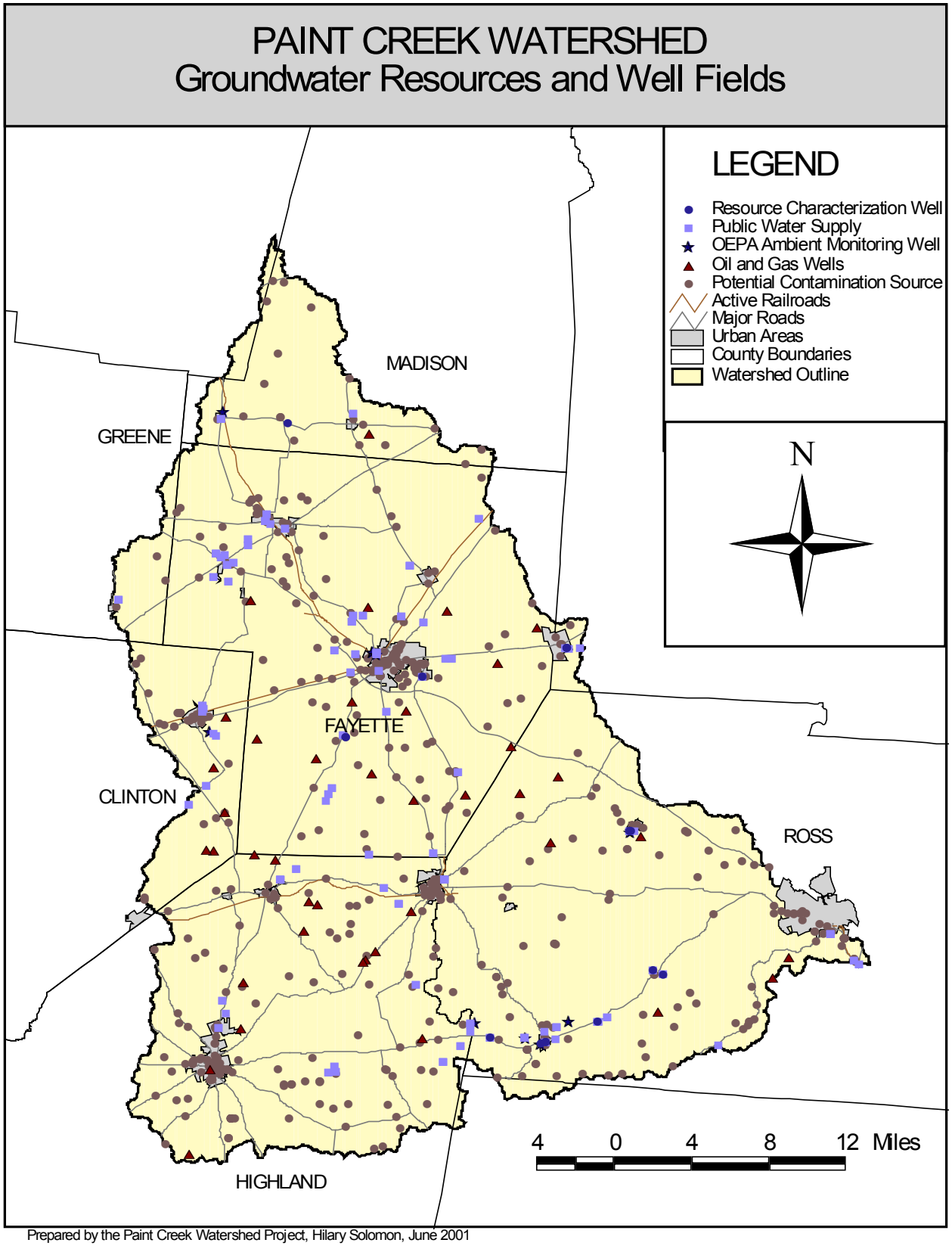
Table 2-6: Ohio EPA ambient measurement wells.

NAME	WELL #	STATUS	DNRLOG	WELL USE	GAL/MIN	WELLDRILL	DEPTH
SOUTH SOLON WELLFIELD	1	(AS) ACTIVE STANDARD	N/A	COMMUNITY PWS	0	1/1/1951	168.00
WASHINGTON C.H. WELLFIELD	11	(AS) ACTIVE STANDARD	0579855	COMMUNITY PWS	200	6/27/1988	35.00
WASHINGTON C.H. WELLFIELD	8	(AS) ACTIVE STANDARD	N/A	COMMUNITY PWS	200	6/29/1949	180.00
SABINA WELLFIELD	10	(AS) ACTIVE STANDARD	563358	COMMUNITY PWS	28	8/1/1980	110.00
HIGHLAND CO. WATER CO.	4	(AS) ACTIVE STANDARD		REGIONAL SUPPLY	0	4/6/1990	61.00
BAINBRIDGE WELLFIELD	4	(AS) ACTIVE STANDARD		COMMUNITY PWS	0	00000000	0.00
FRANKFORT WELLFIELD	3	(AS) ACTIVE STANDARD	501152	COMMUNITY PWS	408	10/29/1976	53.00
PAINT VALLEY SCHOOL WELLFIELD	1	(AS) ACTIVE STANDARD	197867	TNC PWS	45	7/24/1957	104.00
WASHINGTON C.H. WELLFIELD	9	(SB) STANDBY		COMMUNITY PWS	200	5/13/1953	190.00
HIGHLAND CO. WATER CO.	5	(SB) STANDBY	557938	COMMUNITY PWS	1364	8/24/1990	94.00

Information provided by Ohio EPA, DDAGW

POTENTIAL CONTAMINATION SOURCES

As documented by Ohio EPA and US EPA, there are over 585 sources of potential contamination to ground water supplies in the watershed. These include193 underground storage tanks, three hospitals, 12 a irports, 25 O hio EPA Division of Surface Water surface impoundments (these include settling and aeration ponds), six Ohio EPA Division of Emergency Response and Remediation sites, 154 cemeteries (high amounts of arsenic in historic embalming practices), 18 inactive landfills, 139 sites which handle hazardous materials and/or have air permits, 18 NPDES permits, and 15 agricultural-related sites, such as pesticide distributors. The potential contamination sources are included on the following map. M any are concentrated around urban areas and not easily differentiated on the map. Table 2-18 at the end of this section lists each of these potential sources of contamination and their location in the watershed. In addition, the potential contamination sources are discussed in greater detail in the Water Quality section. It should be noted that the Division of Emergency Response and Remediation sites are from the Master Sites List, which is outdated and recently discontinued. Once a site is placed on the Master Sites List, there is no procedure to remove it. The sites listed on the Master Sites List in this table are old remediated sites.



Prepared by the Paint Creek Watershed Project, Hilary Solomon, June 2001

SPECIAL VALUES

The Paint Creek Watershed provides many special services to the community and tourist destinations to nearby urban areas. These include recreation areas, wildlife preserves and hunting areas, boating access, and historical monuments.

RECREATION

There are many recreation areas within or near the Paint Creek Watershed. Below is a list of parks and hunting areas with a brief description or map and contact information for each. It should be noted that all information about the recreation areas is from the site-specific literature about each site.

Deer Creek Recreational Area

20635 Waterloo Road
Mt. Sterling, OH 43143
(740) 869-3124 Park Office
Toll Free: 1-877-678-3337 Lodge/Cottage Reservations

The Deer Creek Park area was originally inhabited by a nomadic Indian tribe. The nomads who camped here around 2,000 B.C. were hunters and gatherers and used this camp periodically throughout the year. In more recent years, a cottage owned by Harry M. Daugherty, the attorney general under President Warren G. Harding, overlooked the valley. The rustic one and one-half story cottage was built in 1918. The President was said to have visited this cottage, which now bears his name. The completion of the dam in 1968 created the lake with the park officially opening in 1974. The park offers a lodge with 110 rooms and many amenities, 25 guest cottages, camping sites, boating, fishing and hunting. In addition, the park boasts recreational activities such as swimming, picnicking, hiking, mountain biking, horseback riding, and golf.

Deer Creek Wildlife Area
http://www.dnr.state.oh.us/odnr/wildlife/hunting/wildlifeareas/

Paint Creek State Park
http://www.dnr.state.oh.us/parks/parks/PAINTCRK.htm

Before Paint Creek was impounded to form a reservoir, the creek valley was unrivaled in the state for scenic beauty and its display of wildflowers. Some of this unspoiled land yet remains above the still waters of the lake. Wild geranium, jewelweed, yarrow and Queen Anne's lace can be found blooming in the woodlands and meadows of the park.

The reservoir provides habitat for numerous waterfowl and shorebirds as well as the great blue heron. Osprey and bald eagles have been sighted over the lake. The limestone

outcroppings on the lake's edge provide nesting habitat for the cliff swallow. Other songbirds, raccoons, white-tailed deer and the elusive wild turkey inhabit the park.

Paint Creek State Park features a lake with fishing, boating, picnicking and swimming opportunities. A modern campground and meandering trails invite outdoor enthusiasts to explore and enjoy the rolling hills and streams of this scenic area. Hikers can explore four trails from .75 miles to 2.5 miles long. The trails, lined with delicate wildflowers, pass through open meadows and mature woodlands. Trail riders will enjoy the 25 miles of bridle trails through scenic parklands. There are also 14 miles of mountain bike trails. Bicycle rental is available and miniature golf can be enjoyed for a small fee. The camp office loans games and sports equipment to registered campers. The camp area also features basketball, volleyball and horseshoe courts. Additionally, on the west side of the lake is Paint Creek Pioneer Farm. The pioneer farm includes a log house, collection of log buildings, livestock, gardens and fields, which represent a typical farm of the early 1800s.

Pike Lake
http://www.dnr.state.oh.us/parks/parks/PIKELAKE.htm

1847 Pike Lake Road
Bainbridge, Ohio 45612-9640
(740) 493-2212

Pike Lake State Park is located in the midst of the scenic wooded hills of southern Ohio. The small lake and surrounding state forest contribute to the park's rustic charm. The landscape of Pike Lake is characterized by dense forests of oak, hickory, tulip, ash and other hardwoods. Several outcroppings of the sandstone bedrock have been exposed in the park. White-tailed deer, ruffed grouse, gray squirrel, rabbit and the elusive wild turkey are abundant. Other mammals in the park include skunk, opossum, raccoon and red fox. Reptiles include the box turtle, black snake, five-lined skink and the endangered timber rattlesnake. The forest is also known for its variety of ferns, mosses, lichens and fungi. The wildflowers are diverse, creating spectacular displays--spring through autumn.

The present park first began to take shape during the Civilian Conservation Corps (CCC) days of the 1930s. One of the Ohio camps was established near the future site of Pike Lake at Morgantown. Corpsmembers dug the lake by hand, built two or three fire towers in the area, constructed the roads to make them accessible and planted hundreds of pine trees. Pike Lake was originally a state forest park, but with the formation of the Division of Parks and Recreation in 1949, it became an official state park that year. The park currently offers 101 camp sites, 25 guest cottages, fishing and hunting, swimming, boating, picnicking, and hiking trails.

Fort Hill State Memorial (Highland)
http://www.ohiohistory.org/places/fthill/

Fort Hill State Memorial is a nature preserve containing one of the best preserved Indian hilltop enclosures in North America. The Hopewell Indians (100 B.C.-A.D. 500)

constructed the 1 1/2 mile long earthwork hilltop enclosure as well as at least two ceremonial buildings and probably a village in the Brush creek Valley.

Lying at the western edge of the Allegheny Plateau, immediately south of the glacial boundary, this hilly area contains an impressive diversity of bedrock, soils, flora, and fauna. There are 11 miles of hiking trails at the 1,200-acre preserve as well as a picnic area. The museum reopened in the fall of 2000 after an extensive renovation. New exhibits include a variety of hands-on and interactive, multimedia displays depicting the geology, flora and fauna of Fort Hill.

Miller Nature Sanctuary

Miller Nature Sanctuary, a state nature preserve, contains rare native Ohio plants, outstanding geologic formations and several dolomite caves. Access is by written permission only by contacting the chief of the ODNR Division of Natural Areas and Preserves.

Oldaker Wildlife Area
http://www.dnr.state.oh.us/wildlife/hunting/default.htm

Fallsville Wildlife Area
http://www.dnr.state.oh.us/wildlife/hunting/default.htm

Ross Lake State Wildlife Area
http://www.dnr.state.oh.us/wildlife/hunting/default.htm

Buzzard's Roost

Buzzard's Roost is a property recently left to the Ross County Parks and Recreation Association to be managed as a scenic and natural area. The property, currently closed to the public, is accessible with permission from the Ross County Parks and Recreation Office. Buzzard's Roost is located several miles off of Hwy 50 in the southern area of the watershed. It is mountainous and offers scenic views of a river gorge and the Paint Creek Valley. The currant managers are buying adjacent land to help protect the river gorge.

Pleasant Valley State Wildlife Area
http://www.dnr.state.oh.us/wildlife/hunting/default.htm

Rocky Fork State Park
http://www.dnr.state.oh.us/parks/parks/ROCKYFRK.htm

9800 North Shore Drive
Hillsboro, Ohio 45133
(937) 393-4284

(Much of the website's description of the park is found in this section of the report, because it is so interesting.)

Rocky Fork State Park derives its name from the stream flowing through the park. This stream, winding over dolomite limestone, has eroded numerous gorges and caves, which house rare and unique species assemblages. Unlimited horsepower boating allows for skiing on the lake, which also provides catches of bass, muskellunge and walleye. A scenic gorge, dolomite caves and natural wetlands add to the natural features boasted by this recreation area.

The park offers camping, swimming and picnicking facilities, hiking and mountain biking trails, fishing and hunting areas and three marinas.

The Nature of the Area

Present-day Rocky Fork Creek flows through an ancient valley. Blocked by glacial ice more than 12,000 years ago, the stream reversed direction and rapidly cut the 75-foot gorge seen today. Caves in the region formed as rainwater, trickling through the limestone, dissolved the bedrock. Dolomite limestone is particularly vulnerable to this type of weathering. Sullivantia, extremely rare in Ohio, blooms in the gorge. The small white flowers can be seen from the moist cliff face in mid-summer. Other wildflowers include wild geranium, jewelweed, yarrow and Queen Anne's lace.

Rocky Fork provides habitat for numerous waterfowl, songbirds, raccoons, skunk, red fox and white-tailed deer. The wetlands in the park are home to the green frog, bullfrog, opossum and muskrat.

History of the Area

Rocky Fork State Park is an area steeped in the rich Indian history of Ohio. The land provided abundant game and a ready transportation system in the nearby creeks and rivers. These same streams provided access to the Rocky Fork area for the first settlers.

Plentiful water attracted a number of millwrights to the Highland County region. During the 1800s and the early 1900s, at least six different mill sites were established along Rocky Fork's banks. These mills not only ground flour, but also cut lumber, carded wool and even wove blankets. Water-powered industry was instrumental in the early development of the locale.

The only mill remaining on the Rocky Fork is the J. A. McCoppin Mill found just below the Rocky Fork spillway and operated until the 1970s. First built by David Reece in 1810, the earliest mill was washed out during high water. Soon after the destructive flood, the present cut-stone dam was built. These mills were the focal point of early rural life.

In 1897, surveyors for a proposed railroad came to the countryside that would one day be the park. Local people had high hopes that the new "Black Diamond" rail line would bring prosperity to the area. The addition of rail transportation would enable the local

mills to ship flour and other mill industry goods all over the country. There was to be a depot built in Rainsboro with a stockyard and telegraph office. Meetings were held by railroad officials to secure a right-of-way from nearby landowners. A town was planned near McCoppin's (at that time Costello's) Mill. Unfortunately, the "Black Diamond" never got past the planning stages, and the new town of Lodore never came to be.

The eastern part of Highland County has been a resort location for many years. The "Seven Caves" and nearby Rocky Fork gorge attracted visitors even in the mid 1800s. At the turn of the century, Colonel Walter H. Hutchins, a regular visitor to the area from Cincinnati, first dreamed of building a dam near McCoppin's Mill. He was the lake's biggest promoter and saw construction begin in 1949. The first water spilled over the dam in April 1953. Since that summer, thousands of people have visited Rocky Fork State Park. The lake has become a favorite of fishermen and water sports enthusiasts.

Pike State Forest
http://hortwww-2.ag.ohio-state.edu/ODNR/Forests/stateforests/pike.htm

334 Lapperrel Road
Latham, Ohio 45646-9722
740-493-2441

Land acquisition for Pike State Forest began in 1924, with the objective of returning abused hill farms and fire-damaged timber lands to productive forests. The Civilian Conservation Corps and the Division of Forestry completed most of the reforestation work in the 1930s. Pike State Forest now covers 11,960 acres in 13 separate tracts located in western Pike County and eastern Highland County.

The forest offers a wide range of outdoor recreational opportunities. The Pike State Forest APV area has 15 miles of trails open to motorcycles and off road all-terrain vehicles. Additionally, thirty-three miles of bridle trails located in the forest are available for hiking, horseback riding and mountain biking. Hiking is also available on the Buckeye trail, which runs through the forest. For those who want to stay on the beaten path, there are numerous county and township roads that pass through the forest. Pike State Forest is also open to public hunting and fishing in season.

E-mail questions, or for more information about Pike State Forest please contact:
Dana.Gamble@dnr.state.oh.us

BOATING ACCESS - PLEASE SEE APPENDIX FOR LAKE ACCESS.

Paint Creek Boating Access
PAINT CREEK
DAM - upstream of Eyman Park Drive ½ mile at the Waterworks facility in Washington Courthouse, portage river left

Eyman Park at Eyman Park Drive/North Street in Washington Courthouse, access river right or left
DAM - At Eyman Park downstream of Eyman Park Drive bridge and North Street in Washington Courthouse, portage river left or right
Creek Road and Old S.R. 35 bridge east of Washington Courthouse, roadside access river right
FORD - Creek Rock Bridge Road is a concrete ford with a good hydraulic at high water, portage river left or right
Creek Rock Bridge Road bridge north of Rock Mills, roadside pulloff river left
Miami Trace Road bridge/Sturgeon Mills-Rock Mills Road in Rock Mills, roadside access river left
Ghormley Road bridge north of Greenfield, roadside access river right and left
S.R. 753 bridge north of Greenfield, roadside access river right
DAM - about 1 mile upstream of the S.R. 23 bridge off Island Grove Road in Greenfield, portage river right or left, whichever is best at the water level
Greenfield City ballpark field off McArthur Way in Greenfield, access river right
Paint Creek Lake State Park off Rapid Forge Road south of Greenfield, access river right below dam
DAM - Paint Creek rapids just below Rapid Forge Road west of Bainbridge, Class 2-3, portage river right if necessary; dangerous at high water for novices
Roadside rest stop off S.R. 50 one mile below Rapid Forge Road west of Bainbridge, access river right
FALLS - Paint Creek Falls about 1 mile downstream from the S.R. 50 rest stop west of Bainbridge. One chute on river right is runnable if not clogged; approach with caution, portage river right with permission
Quarry Street bridge (S.R. 41) in Bainbridge, roadside access river right
S.R. 50 bridge east of Bainbridge with parking about 1/8 mile east at Seip Mount State Memorial, roadside access river right and left
S.R. 772 bridge in Chillicothe, roadside access river right
PAINT CREEK--NORTH FORK
S.R. 62/3 bridge in Madison Mills, roadside access river right
Woodrow Road east of Plano, roadside access river right
Plano Road/Street R. 35 bridge north of Austin, roadside access river right
Dexter Road bridge south of Austin, roadside access river right and left
S.R. 50 bridge behind store in Slate Mills, access river right with permission
Plyley's Lane Road bridge in Chillicothe at mouth of North Fork flowing into the main branch of Paint Creek, access river left

HISTORICAL IMPORTANCE

Dentist History Museum

Located in Bainbridge, this museum commemorates the first dental school in the nation.

Adena, Thomas Worthington's Estate

http://www.ohiohistory.org/places/adena/

Adena was the 5,000-acre estate of Thomas Worthington (1773-1827), sixth governor of Ohio and the state's first United States Senator. The mansion house, completed in 1807, is furnished today with antiques of the federal period, some of which belonged to Thomas Worthington himself. Situated on the 300 remaining acres are five outbuildings and the formal gardens. Looking east from the north lawn, one can see across the Scioto River Valley to the Mount Logan range of hills. This view is depicted on the Great Seal of the State of Ohio.

Adena is an important site for many reasons. It is the only plantation-type complex of its kind in our state. It is one of only three houses designed by Benjamin Latrobe still standing in the U.S. (Latrobe is considered the first professional American architect and served as Jefferson's surveyor of public buildings.) It is an original building, not a reconstruction. It is extremely well documented and that documentation was followed to the letter in the restoration. And, of course, it was the home of the Father of Ohio Statehood, Thomas Worthington, and was thus visited by many of the important political figures of the day.

As part of Ohio's bicentennial celebration in 2003, Adena State Memorial will be added a visitor center to the site. The home of Thomas Worthington also underwent an extensive renovation.

Hopewell Cultural Mounds
http://www.nps.gov/hocu/

From about 200 BC to AD 500, the Ohio River Valley was a focal point of the prehistoric Hopewell culture. The term Hopewell describes a broad network of beliefs and practices among different Native American groups over a large portion of eastern North America. The culture is characterized by the construction of enclosures made of earthen walls, often built in geometric patterns, and mounds of various shapes. Visible remnants of Hopewell culture are concentrated in the Scioto River valley near present-day Chillicothe, Ohio. The most striking Hopewell sites contain earthworks in the form of squares, circles, and other geometric shapes. Many of these sites were built to a monumental scale, with earthen walls up to 12 feet high outlining geometric figures more than 1000 feet across. Conical and loaf-shaped earthen mounds up to 30 feet high are often found in association with the geometric earthworks.
The park contains nationally significant archeological resources including large earthwork and mound complexes that provide an insight into the social, ceremonial, political, and economic life of the Hopewell people. The park visitor center features museum exhibits, an orientation film, book sales area, and self-guided and guided (summer only) tours.

Story Mound
http://www.ohiohistory.org/places/story/

Story Mound, of interest primarily to archaeologists, consists of a large, rounded earthen mound located on slightly less than an acre of ground in Chillicothe. This prehistoric

burial mound stands 19.5 feet high, with a basal diameter of 95 feet. Erected by prehistoric Adena Indians (800 BC-AD 100) it was excavated in 1897 by Clarence Loveberry. It yielded the first documented example of a circular Adena timber building, a structural type now known as the norm in Adena ceremonial and domestic architecture.

Please note that the mound is surrounded by a chain-link fence and is not accessible.

Seip Mound
http://www.ohiohistory.org/places/seip/#location

Seip Mound is the central mound in a group of geometric earthworks. Farming and erosion have degraded the surrounding earthworks leaving the central mound an outstanding feature. It is 240 feet long, 130 feet wide, and 30 feet high. Excavations have revealed that prehistoric Indian buildings existed near the earthworks. Today, visitors can see the location of some of these buildings as they are outlined by short posts in the ground. The Hopewell Indians (100 BC-AD 500) built Seip Mound for burials. This culture had a highly developed craft industry, as is evidenced by artifacts found with bodies in the burial site.

EDUCATION AND MONITORING

Each of the Soil and Water Conservation Districts in the watershed employ people who specialize in environmental education and each district partakes in educational activities at many different levels. The districts aid in multiple education programs within the county, partnering with Ohio EPA, OSU extension, county organizations, and local interest groups. Area 5 SWCDs sponsor an annual Envirothon competition, which tests high school students on forestry, wildlife, aquatics, soils, and environmental issues. The SWCDs also target landowners in the watershed. For example, at the annual Farm Bureau meeting, SWCD representatives used the enviroscape model to illustrate point and nonpoint source pollution. In addition, the counties are distributing "A Guide to Ohio Streams" books, watershed and macro-invertebrate posters, and National Association of Conservation Districts (NACD) stewardship materials.

Highland County

Highland SWCD helps administer OSU Extension's education programs, Rocky Fork's earth week field days, and Fayette County Lucas Outdoor Inc. field days. Each of these programs focuses on the wise use of natural resources. Highland SWCD gives presentations and holds a poster contest for all 6th graders in the county. They also founded a program in conjunction with the Highland's Nature Sanctuary to educate citizens on macro-invertebrate species and associated water quality. In addition, Highland SWCD works closely with local Boy Scouts of America troops on activities such as "Hooked on Fishing, Not on Drugs" and awarding water conservation merit badges.

Fayette County

Fayette County participates in many of the same programs including "Hooked on Fishing, Not on Drugs." The education specialist holds classroom presentations, which include a number of educational aids such as Fred the Fish and other puppets. Fayette SWCD focuses on teaching water quality concepts through the understanding of wetland functions, the water cycle, ground water, and fish habitat. They put on an annual all day event for 4th graders called waterfest. In addition, the Natural Resource Conservation Service (NRCS) is sponsoring a "Thank the Farmer" program, where students will discuss farming techniques and write a postcard to a farmer to thank them for conserving natural resources.

Fayette SWCD also works with two high school biology teachers to take 3-4 classes each semester to four stream locations to sample water quality conditions. The students characterize the physical, chemical, and biological aspects of the streams and discuss their similarities and differences. The monitoring results in a report with new data added each semester that illustrates water quality trends. The students monitor areas on the West Branch of Rattlesnake, Sugar Creek, and Main Paint in two locations, Washington Court House and south of Washington Court House.

Madison County

Madison SWCD recently conducted a tour of all of the watersheds in the county including the Paint Creek Watershed. The tour received newspaper coverage and appeared to be well attended.

Ross County

Ross SWCD participates in many of the aforementioned educational activities. In addition, Ross and Madison SWCDs recently collaborated with Malcolm Pirnie, a consulting firm in Columbus, on a grant to gather GIS information for the watershed. They also recently received a grant in conjunction with Ohio Department of Natural Resources (ODNR) to fund an urban storm water project on the North Fork of Paint Creek. Finally, Ross SWCD is responsible for writing the grant that will pay for the completion of the first Paint Creek Management Plan.

DEMOGRAPHIC INFORMATION

Local demographic information provides an overview of social trends, such as population distribution and growth rate, whose study may help point to important issues affecting the watershed. According the Ohio EPA, "Social trends can provide insights into a watershed's current situation as well as methods to design strategies to achieve strong local participation."

The following sections address social trends such as population density, age structure, education and income. Statewide averages from the 2000 census (US Census Bureau, 2000) are provided for comparison purposes.

Ohio

The estimated population for Ohio is 11,256,654. Ohio's average change in population is an approximately 3.8 percent increase between 1990 and 1999 (as compared with 9.6 percent for the country). The number of people 18 years old or less is 25.4 percent and the number 65 or older is 13.4 percent. Minorities comprise approximately 14.3 percent of the population with 11.5 percent African American, 1.1 percent Asian, 0.2 percent Native American, and 1.6 percent Hispanic. In 1990 approximately 75.7 percent of Ohio's population were high school graduates and 17.0 percent graduated from college. Over 67 percent of families owned homes, with an average of 2.59 persons per household. The median household income for Ohio is $33,958 with 11.3 percent below the poverty rate (as compared with 13.8 percent for the country) and 18.0 percent of children below the poverty level (US Census Bureau, 2000).

Paint Creek Watershed

Paint Creek Watershed is principally comprised of areas of six counties; Clinton, Fayette, Highland, Greene, Madison and Ross. Population data for each of these counties is described in tables seven through ten. Table 2-7 lists the population size, population density, and the percent of the population below the poverty level for each county. Greene county, which borders Dayton's corporate limits has the highest population size and population density and the lowest percent of the population below the poverty level in the watershed. The total population in Greene county is 139,704 with a population density of 337 people per square mile. The percent of the population below the poverty level in Greene county is 7.6. Fayette county has the lowest population size and population density in the watershed with a total population of 28,599 and an average population density of 70 people per square mile. Ross county has the highest percent of the population below the poverty level in the watershed with 15.1 percent of its population having a household income below the poverty level.

Table 2-7. Population size per county in the Paint Creek Watershed.

Category	Clinton	Fayette	Greene	Highland	Madison	Ross
Pop size	39,318	28,599	139,704	39,814	41,486	75,195
Pop density (per mi^2)	96	70	337	72	89	109
Below poverty level (%)	9.1	12.5	7.6	12.9	8.5	15.1

US Department of Health and Human Services, Health Resources and Services Administration, Community Health Status Indicators Project, http://www.communityhealth.hrsa.gov/countyInfo.asp.

The age distribution is similar throughout the counties in the watershed (please refer to

table 2-8). The population under 18 years of age ranges from 23.7 percent in Madison County to 26.7 percent in Clinton County. This is consistent with the statewide average which is 25.4 percent. The percent over 65 years old ranges from 8.8 percent in Greene County to 13.8 percent in Highland County. Again this is consistent with the state average, which is 13.4 percent. These numbers indicate that the population within the Paint Creek Watershed is growing at a comparable pace to the population within the state and a lower rate than that seen for the country as a whole.

Another way in which age distributions may be useful is as a predictive tool. Populations with high percentages under 18 years of age or high numbers of women at childbearing age may be poised for a future growth spurt, while populations with high percentages near retirement age may need to prepare for changes in the economic structure within the area.

Table 2-8. Age distribution percent per county

Age Distribution	Clinton	Fayette	Greene	Highland	Madison	Ross
Under 18	26.7	25.6	25	26.6	23.7	24.2
65-84	12	13.5	8.8	13.8	9.3	11.3
85+	1.7	1.8	1.1	1.9	0.9	1.3

US Department of Health and Human Services, Health Resources and Services Administration, Community Health status Indicators Project, http://www.communityhealth.hrsa.gov/countyInfo.asp.

The non-white population in the watershed is slightly lower than that seen for the state (see table 2-9). Clinton, Fayette, and Highland counties have only approximately 3 percent non-white population, while Greene, Madison, and Ross have closer to the state average of 14.3 percent.

Table 2-9. Non-white population percent per county

Non-white population	Clinton	Fayette	Greene	Highland	Madison	Ross
Black/African American	2.3	2.6	7.8	2.2	8.8	7.3
Native American	0.2	0.2	0.3	0.2	0.3	0.2
Asian/Pacific Islander	0.5	0.5	2.1	0.3	0.6	0.5
Hispanic	0.4	0.4	1.2	0.4	0.7	0.6

US Department of Health and Human Services, Health Resources and Services Administration, Community Health status Indicators Project, http://www.communityhealth.hrsa.gov/countyInfo.asp.

EMPLOYMENT TRENDS

Madison County has the lowest unemployment with approximately 2.5 percent of the workforce unemployed and Highland County has the highest with approximately 5 percent unemployment. Unemployment rates appear to increase with increasing distance from urban centers. Table 2-10 lists the percent unemployed for each county in the watershed.

Table 2-10. Percent employment in workforce

County	Percent Unemployed
Clinton	2.9
Greene	3.3
Fayette	3.8
Highland	5.0
Madison	2.5
Ross	4.3

Ohio County Profiles, Ohio Department of Development, Office of Strategic Research

Table 2-11 shows employment by industry sector. Manufacturing, wholesale and retail trade, and services employ the largest amounts of workers throughout the watershed. Though agricultural employment numbers are not available for Clinton, Fayette, Madison and Ross counties, significant numbers are employed in the agricultural sector. The next section, agricultural statistics, lists crop and livestock information for each county in the watershed.

Table 2-11. Employment by Industry (1998)

Industry	Clinton	Fayette	Greene	Highland	Madison	Ross
All Industries	24,277	10,270	47,920	11,600	12,030	25,386
Agriculture, Forestry and Fishing	na	na	383	57	na	na
Mining	na	na	95	156	na	na
Construction	314	223	1,685	427	592	999
Manufacturing	5,139	2,631	5,291	3,815	3,164	5,361
Transportation & Utilities	7,816	197	1,173	287	260	1,127
Wholesale & Retail Trade	4,146	3,899	15,776	2,782	2,548	7,004
Finance, Insurance, & R. Estate	809	275	1,676	396	197	516
Services	3,061	1,522	13,753	1,705	2,184	5,513

Industry	Clinton	Fayette	Greene	Highland	Madison	Ross
Government	2,868	1,465	8,089	1,974	2,956	4,713

Ohio County Profiles, Ohio Department of Development, Office of Strategic Research

AGRICULTURAL STATISTICS BY COUNTY

The following tables list agricultural statistics provided by the Ohio Department of Agriculture Annual Report and Statistics. This information is presented by county.

Table 2-12. **Clinton County**

1998 Crops	Acres Harvested	Yield	Production	Rank
Corn for grain, Bu.	74,900	136.9	10,254,300	17
Soybeans, Bu.	104,900	42.9	4,498,700	13
Wheat, Bu.	11,000	52.5	577,800	41
Oats, Bu.	---	---	---	---
All Hay, Ton	5,500	3.29	18,100	73

Livestock	Number	Rank
All Cattle and Calves (1/1/99)	6,500	69
Milk Cows (1/1/99)	---	---
All Hogs and Pigs (12/1/98)	28,400	20
All Sheep and Lambs (1/1/99)	---	---

Based on 1997 Cash Receipts from marketing farm commodities.

Table 2-13. **Fayette County**

1998 Crops	Acres Harvested	Yield	Production	Rank
Corn for grain, Bu.	85,100	141.8	12,071,400	6
Soybeans, Bu.	110,100	43.5	4,788,500	11
Wheat, Bu.	15,900	71.4	1,135,900	25
Oats, Bu.	---	---	---	---
All hay, Ton	7,600	3.76	28,600	54

Livestock	Number	Rank
All Cattle and Calves (1/1/99)	6,500	69
Milk Cows (1/1/99)	---	---
All Hogs and Pigs (12/1/98)	28,400	20
All Sheep and Lambs (1/1/99)	---	---

Based on 1997 Cash Receipts from marketing farm commodities.

Table 2-14. **Greene County**

1998 Crops	Acres Harvested	Yield	Production	Rank
Corn for grain, Bu.	61,500	137.6	8,461,200	28
Soybeans, Bu.	68,500	42.8	2,933,200	34
Wheat, Bu.	9,600	56.6	543,100	45
Oats, Bu.	---	---	---	---
All hay, Ton	8,100	2.94	23,800	61

Livestock	Number	Rank
All Cattle and Calves (1/1/99)	8,800	60
Milk Cows (1/1/99)	---	---
All Hogs and Pigs (12/1/98)	26,700	21
All Sheep and Lambs (1/1/99)	2,200	17

Based on 1997 Cash Receipts from marketing farm commodities.

Table 2-15. **Highland County**

1998 Crops	Acres Harvested	Yield	Production	Rank
Corn for grain, Bu.	46,300	134.6	6,233,900	37
Soybeans, Bu.	80,600	41.2	3,322,500	30
Wheat, Bu.	14,400	54.0	777,200	33
Oats, Bu.	---	---	---	---
All hay, Ton	23,800	2.88	68,600	19
Tabacco, Lbs	930	1,830	1,701,000	3

Livestock	Number	Rank
All Cattle and Calves (1/1/99)	22,900	13
Milk Cows (1/1/99)	1,500	45
All Hogs and Pigs (12/1/98)	9,300	50
All Sheep and Lambs (1/1/99)	2,200	18

Based on 1997 Cash Receipts from marketing farm commodities.

Table 2-16. **Madison County**

1998 Crops	Acres Harvested	Yield	Production	Rank
Corn for grain, Bu.	91,200	135.0	12,314,100	5
Soybeans, Bu.	115,800	43.7	5,060,600	8
Wheat, Bu.	15,600	69.3	1,081,200	27

Oats, Bu.	1,000	77.7	77,700	27
All hay, Ton	7,300	3.42	25,000	60

Livestock	Number	Rank
All Cattle and Calves (1/1/99)	12,400	37
Milk Cows (1/1/99)	2,000	34
All Hogs and Pigs (12/1/98)	10,500	48
All Sheep and Lambs (1/1/99)	1,800	25

Based on 1997 Cash Receipts from marketing farm commodities.

Table 2-17. **Ross County**

1998 Crops	Acres Harvested	Yield	Production	Rank
Corn for grain, Bu.	53,500	136.5	7,301,300	32
Soybeans, Bu.	59,100	43.7	2,583,300	36
Wheat, Bu.	21,000	68.4	1,435,400	22
Oats, Bu.	---	---	---	---
All hay, Ton	21,300	3.42	72,900	17

Livestock	Number	Rank
All Cattle and Calves (1/1/99)	7,000	66
Milk Cows (1/1/99)	1,600	44
All Hogs and Pigs (12/1/98)	16,700	34
All Sheep and Lambs (1/1/99)	---	---

Based on 1997 Cash Receipts from marketing farm commodities.

Table 2-18: Potential Contamination Sources in the Paint Creek Watershed

NAME	CITY	COUNTY	TYPE	SOURCE
Ashland Station	Moscow	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Cincinnati Bell Vault	Batavia	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Unknown	Sabina	Clinton	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Bp #08695	Sabina	Clinton	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Superior Tire	Sabina	Clinton	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Sabina Blue Flame	Sabina	Clinton	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Mac Tools Inc	Sabina	Clinton	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Broad Meadow Farm Co	Sabina	Clinton	Leaking Underground Tank	BUSTR: LUST database (geocoded)
West Side Pizza	Sabina	Clinton	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Bean Vault Co	Sabina	Clinton	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Sabina Farmers Exchange Inc	Sabina	Clinton	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Sabina Farmers Exchange	Sabina	Clinton	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Gates Amoco	Sabina	Clinton	Leaking Underground Tank	BUSTR: LUST database (geocoded)

NAME	CITY	COUNTY	TYPE	SOURCE
Pauley's Service	Sabina	Clinton	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Rich Oil Co	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Dayton Power & Light	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Unknown	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Abandoned Sinclair	Jeffersonville	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Unknown (Greeno Residence)	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
(Unknown) Former Gas Sta	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Jeffersonville Elem School	Jeffersonville	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Truckstops Of America	Jeffersonville	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Jeffersonville Outpost (Odot)	Jeffersonville	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Dettys Serv Sta	Jeffersonville	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Courthouse Tool Rental	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Cudahy Property	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Clark Oil & Refining Corpo	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Mac Tools	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Rons EZ Serv Sta	Bloomingburg	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Eastside Elementary School	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Village Union 76	Jeffersonville	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Miami Trace Bus Garage	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Miami Trace Local Schools	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
American Aggregates	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Truck O Mat	Jeffersonville	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Bonded 1130	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Chaney Tire	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Indianola Plaza Co	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Kmart 9006	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Gmac Auto Sales	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Calmar Inc	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Ok Tire Service	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Patton Estate	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Buckeye Countrymark Drive	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Interiors By Lynn (Former	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Unknown (Sewer Line Repair)	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Union 76	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Muffler Bros	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Flagway # 7	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Crestar Foods	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Stinson Residence	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
At&T	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Rankin Oil Co	Sabina	Clinton	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Circle K 2312	Jeffersonville	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Marting Mfg	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Kiseley Collision	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Carroll Halliday Inc	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Basic Construction Materials	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
C.B. Shop	Jeffersonville	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Karen Hoppes Residence	Washington C.H.	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Jacksons Marathon	Washington C.H.	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Bp #08146	Washington C.H.	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Swifty Station #209	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Swifty Station #209	Washington C.H.	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)

NAME	CITY	COUNTY	TYPE	SOURCE
Fayette County Engineers	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Penningtons	Greenfield	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Ameritech	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Former Countymark	Jeffersonville	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Fayette County Airport	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Richard E. Beechler	Washington C.H.	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Milsted Tire	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
H & H Trucking Inc.	Washington C.H.	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Car Shine Auto Wash	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
John A.Beier Co.	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Fayette Co Garage - Odot	Washington C H	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Sugar's Dairy Depot	Washington C.H.	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Omega	Jeffersonville	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Active Omega Truck Stop	Jeffersonville	Fayette	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Dean Pickle & Specialty	Delta	Madison	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Rosemoor Farm	Jamestown	Greene	Leaking Underground Tank	BUSTR: LUST database (geocoded)
J & B Bunfill Service	Fairview	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Us Shoe Corp	Greenfield	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Shell	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Rocky Fork Work Unit	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Ohio Div Of Wildlife - Odnr	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Bp 69544	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Rocky Fork State Park	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Rocky Fork State Park	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Rocky Fork State Park	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Greenfield Implement Co	Greenfield	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Unknown	Greenfield	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Certified Oil	Greenfield	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Pmi Food Equip Group	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Unknown (Smith Property)	Rainsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Rainsboro Elem School	Greenfield	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Us Army Corps Of Engineers	Banbridge	Ross	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Ohio Dept Of Transportation	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Beechwood Food Shop	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Beechwood Food Market	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Highland Stone Div	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Pepsi Cola	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Lynns Pizza	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Waits Serv Sta	New Market	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
American Seal Tite	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
North Fork Marine	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Chaney Gas	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Jonco Gas Station	Greenfield	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Hixson Oil Co	Greenfield	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Newbys Citgo	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Newbys Citgo	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Newbys (95 Closure)	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Jerry Haag Motors	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Jerry Haus Motors Inc.	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Bp 08582	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Bp #08582	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)

NAME	CITY	COUNTY	TYPE	SOURCE
Hillsboro Transportation Co	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Quick Stoppe	Greenfield	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Sunoco	Greenfield	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
United Dairy Store 095	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Charlies Market	Greenfield	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Rotary Forms Press Inc	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Rotary Forms Press Inc.	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Flagway 6	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Vandykes Marathon	Greenfield	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Vacant Service Station	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Unknown (Mays Residence)	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Fairfield Local School	Leesburg	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Jones Market	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Wa Hudson Inc	Leesburg	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Orphan	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Vacant Property	New Petersburg	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
South High Shell	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
South High Street Shell	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
South High Street Shell	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
West Main Auto Repair	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Greenfield City Schools	Greenfield	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Highland Co Engineer	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Mason Company	Leesburg	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Speedway 1189	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Speedway #1189	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Hillsboro City Schools	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Rocky Fork Truck Stop	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Baxla/Fishermans Corner	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Highland Cnty Airport	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Speedway #5413	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Meredith Chaney	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Doug Smith	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Odnr Paint Creek South Const.	Bainbridge	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Petron Inc Greenfield Plant	Greenfield	Highland	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Bainbridge Sunoco	Bainbridge	Ross	Leaking Underground Tank	BUSTR: LUST database (geocoded)
Flagway Inc	South Solon	Madison	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Sward Residence/Farm	Mt Sterling	Madison	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Sawyer Farm	London	Madison	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Ag Lands	London	Madison	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Pitstop 76 Inc.	New Holland	Pickaway	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Bettys Grocery	Bainbridge	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Gladys Taylor	Frankfort	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Huntington Bus Garage	C Hillicothe	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Huntington Local Schools	C Hillicothe	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Chillicothe Motor Express	C Hillicothe	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Certified 216	Bainbridge	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Adena High School	Frankfort	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Certified 285	C Hillicothe	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Budd Co	Frankfort	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Vacant	Frankfort	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Paint Creek Marina	Hillsboro	Highland	Leaking Underground Tank	BUSTR: LUST Database (geocoded)

NAME	CITY	COUNTY	TYPE	SOURCE
Odnr Paint Creek State Park	Bainbridge	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Huntington Grocery	C Hillicothe	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Dons Market	C Hillicothe	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Ohio University	C Hillicothe	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Lawrence Countryman	Bainbridge	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Continental Baking Co	C Hillicothe	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Robert Bowles	C Hillicothe	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Country Trader	Bourneville	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Bobs Sunoco	Frankfort	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Western Sunoco	C Hillicothe	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Bainbridge Elementary	Bainbridge	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Genes Sunoco	Bournville	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Newmans Sohio	Bainbridge	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Paint Twp	Bainbridge	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Bainbridge Auto Parts	Bainbridge	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Buckskin Elmentary	South Salem	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
South Bridge St Carryout	C Hillicothe	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Huntington Twp Trustees	Huntington	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Clark #1736	C Hillicothe	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Imc Agribusiness	Frankfort	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Union Twp Trustees	C Hillicothe	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Petron Oil Co	C Hillicothe	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Petron Oil Co	C Hillicothe	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
George's Market	C Hillicothe	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Ellis Shoemaker	C Hillicothe	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Buckskin Twp Trustees	Lyndon	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
A & J Grocery	Bainbridge	Ross	Leaking Underground Tank	BUSTR: LUST Database (geocoded)
Crop Production	Hillsboro		SSTS	US EPA Envirofacts
Palm Harbor Homes	Sabina	Clinton	TRIS	US EPA Envirofacts
American Agg	Midway	Clark	PCS	US EPA Envirofacts
Cgohio Dept Natl Resources	Hillsboro	Highland	PCS	US EPA Envirofacts
Cgohio Dept Natl Resource	Hillsboro	Highland	PCS	US EPA Envirofacts
Highland Cnty Bd Comm	New Market Twp	Highland	PCS	US EPA Envirofacts
Fayette Commissioners	Fayette County	Fayette	PCS	US EPA Envirofacts
Cgohio Dept Natl Resources	Bainbridge	Ross	PCS	US EPA Envirofacts
City Greenfield	Greenfield	Highland	PCS	US EPA Envirofacts
City Hillsboro	Hillsboro	Highland	PCS	US EPA Envirofacts
Kroger Truck Repair	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Wa Ch City	Washington C H	Fayette	PCS	US EPA Envirofacts
Greenfield City Director	Greenfield	Highland	PCS	US EPA Envirofacts
Federal Aviation Administration	London	Madison	RCRIS	US EPA Envirofacts
Southern Oh Asphalt No 40	Greenfield	Fayette	RCRIS	US EPA Envirofacts
Buckeye Countrymark	Washington C.H.		SSTS	US EPA Envirofacts
Village Leesburg	Leesburg	Highland	PCS	US EPA Envirofacts
Crop Production	Bainbridge	Ross	SSTS	US EPA Envirofacts
Garman Feed Supply	Lyndon	Ross	SSTS	US EPA Envirofacts
Imc Farmarket 623	Frankfort	Ross	SSTS	US EPA Envirofacts
Buckeye Countrymark	Jeffersonville		SSTS	US EPA Envirofacts
Imc Agribusiness	Jeffersonville	Fayette	SSTS	US EPA Envirofacts
Imc Agribusiness	New Holland	Pickaway	SSTS	US EPA Envirofacts
Imc Agribusiness	Hillsboro	Highland	SSTS	US EPA Envirofacts

NAME	CITY	COUNTY	TYPE	SOURCE
Crop Production	Bainbridge	Ross	SSTS	US EPA Envirofacts
Sabina Farmers	Sabina	Clinton	SSTS	US EPA Envirofacts
Imc Agribusiness	Highland	Highland	SSTS	US EPA Envirofacts
Imc Agribusiness	Fayette	Fayette	SSTS	US EPA Envirofacts
Vigoro	Washington C H	Franklin	SSTS	US EPA Envirofacts
Dbj Auto Body Repair	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Super Kmart No 4964	Hillsboro	Highland	RCRIS	US EPA Envirofacts
Sears No 2850	C Hillicothe	Ross	RCRIS	US EPA Envirofacts
Knisleys Collision Repair	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Parts Plus	Hillsboro	Highland	RCRIS	US EPA Envirofacts
Clark Store No 1736	C Hillicothe	Ross	RCRIS	US EPA Envirofacts
Mears Welding	Cynthiana	Pike	RCRIS	US EPA Envirofacts
Cgohio Dept Natl Resources	Hillsboro	Highland	PCS	US EPA Envirofacts
Village New Holland	New Holland	Pickaway	PCS	US EPA Envirofacts
City Hillsboro	Hillsboro	Highland	PCS	US EPA Envirofacts
Village Sabina	Sabina	Clinton	PCS	US EPA Envirofacts
Mays Mobile Home		Ross	PCS	US EPA Envirofacts
Highland Water	Bainbridge	Highland	PCS	US EPA Envirofacts
Village Frankfort	Frankfort	Ross	PCS	US EPA Envirofacts
Yellow Freight	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Pennant Moldings	Sabina	Clinton	RCRIS	US EPA Envirofacts
Tfo	Jeffersonville	Fayette	RCRIS	US EPA Envirofacts
West Main Auto Repair	Hillsboro	Highland	RCRIS	US EPA Envirofacts
G G Body	Hillsboro	Highland	RCRIS	US EPA Envirofacts
Odot Hwy Bridge	Scioto Twp	Ross	RCRIS	US EPA Envirofacts
Odot Hwy Bridge	Scioto Twp	Ross	RCRIS	US EPA Envirofacts
Odot Hwy Bridge	Scioto Twp	Ross	RCRIS	US EPA Envirofacts
Odot Hwy Bridge	Scioto Twp	Ross	RCRIS	US EPA Envirofacts
Odot Hwy Bridge	Scioto Twp	Ross	RCRIS	US EPA Envirofacts
Odot Hwy Bridge	Scioto Twp	Ross	RCRIS	US EPA Envirofacts
Us Arc Skaggs	C Hillicothe	Ross	RCRIS	US EPA Envirofacts
Us Arc Jamestown	Jamestown	Greene	RCRIS	US EPA Envirofacts
Us Army Coe	Bainbridge	Ross	RCRIS FFIS	US EPA Envirofacts
Sunoco Sta	Sabina	Clinton	RCRIS	US EPA Envirofacts
Sunoco Sta	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Oh Bell Tel Ofc 335	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Dayton Power Lt Wa	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Bp Oil Bulk	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Bp Oil Bulk	Hillsboro	Highland	RCRIS DOCKET	US EPA Envirofacts
Sohio Greenfield Bulk 518	Greenfield	Highland	RCRIS	US EPA Envirofacts
Cor Tec	Washington C H	Fayette	RCRIS	US EPA Envirofacts
City Norwalk	Norwalk	Huron	AIRS/AFS	US EPA Envirofacts
Mac Tools	Washington C H	Fayette	TRIS RCRIS	US EPA Envirofacts
Rotary Forms Press	Hillsboro	Highland	RCRIS	US EPA Envirofacts
Us Shoe	Greenfield	Highland	TRIS RCRIS	US EPA Envirofacts
Steelox	Washington C.H.	Fayette	TRIS RCRIS AIRS/AFS	US EPA Envirofacts
Highland Stone	Hillsboro	Highland	AIRS/AFS	US EPA Envirofacts
Vigoro	Washington C H	Fayette	TRIS AIRS/AFS	US EPA Envirofacts
Johnson Controls	Greenfield	Highland	TRIS RCRIS AIRS/AFS	US EPA Envirofacts
Cor Tec	Washington C H	Fayette	TRIS RCRIS AIRS/AFS	US EPA Envirofacts
Kirks Auto Parts	Washington C H	Fayette	RCRIS	US EPA Envirofacts

NAME	CITY	COUNTY	TYPE	SOURCE
Greenline	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Ronay Auto Parts	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Raven	Washington C H	Fayette	TRIS RCRIS	US EPA Envirofacts
Packaging Resources	New Vienna	Highland	RCRIS	US EPA Envirofacts
Ross Landmark	C Hillicothe	Ross	SSTS AIRS/AFS	US EPA Envirofacts
Mead Container	Washington	Fayette	AIRS/AFS	US EPA Envirofacts
Borden Smith Douglass	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Countrymark Feed	Washington C H	Fayette	TRIS SSTS	US EPA Envirofacts
Haag Jerry Motors	Hillsboro	Highland	RCRIS	US EPA Envirofacts
Clinton Chrome	Sabina	Clinton	RCRIS	US EPA Envirofacts
Bell Fndy Emerson	Hillsboro	Highland	RCRIS AIRS/AFS	US EPA Envirofacts
Thatcher Plastic Pkg Dart	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Highland Precision Plating	Hillsboro	Highland	RCRIS	US EPA Envirofacts
Sherwin Williams	Hillsboro	Highland	RCRIS	US EPA Envirofacts
Mac Tools	Sabina	Clinton	TRIS RCRIS	US EPA Envirofacts
Calmar	Washington C H	Fayette	RCRIS	US EPA Envirofacts
John A Biewer Oh	Washington C H	Fayette	TRIS RCRIS	US EPA Envirofacts
Truckstops America	Jeffersonville	Fayette	RCRIS PCS	US EPA Envirofacts
Sparkle Clnr	C Hillicothe	Ross	RCRIS	US EPA Envirofacts
Houser Fuzz Sons Automotive	C Hillicothe	Ross	RCRIS	US EPA Envirofacts
Tri Cnty Paving	Washington C H	Fayette	AIRS/AFS	US EPA Envirofacts
Dayton Power Light	Washington C H	Fayette	RCRIS PADS	US EPA Envirofacts
Weastec	Hillsboro	Highland	RCRIS	US EPA Envirofacts
Petro Env Petro Cell	Washington C H	Fayette	RCRIS	US EPA Envirofacts
City Wa C H	Washington C H	Fayette	PCS	US EPA Envirofacts
Williamson	Hillsboro	Highland	RCRIS	US EPA Envirofacts
Att Long Lines Frankfort	Frankfort	Ross	RCRIS	US EPA Envirofacts
Att	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Bundy Sabina	Sabina	Clinton	TRIS RCRIS	US EPA Envirofacts
Old Towne Antiques	Frankfort	Ross	RCRIS	US EPA Envirofacts
Rocal	Frankfort	Ross	RCRIS	US EPA Envirofacts
Oh Dept	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Oh Dept	Jeffersonville	Fayette	RCRIS	US EPA Envirofacts
Rocal	Frankfort	Ross	RCRIS	US EPA Envirofacts
Wa Clnr	Washington C H	Fayette	RCRIS	US EPA Envirofacts
B H Drycleaners	Hillsboro	Highland	RCRIS	US EPA Envirofacts
Carroll Halliday	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Capital Lincoln Mercury	C Hillicothe	Ross	RCRIS	US EPA Envirofacts
New Sabina	Sabina	Clinton	RCRIS	US EPA Envirofacts
Oh State Hwy Garage	C Hillicothe	Ross	RCRIS	US EPA Envirofacts
Oh State Hwy Garage	Hillsboro	Highland	RCRIS	US EPA Envirofacts
Csx Chillicothe	C Hillicothe	Ross	RCRIS	US EPA Envirofacts
Bundy	Washington C H	Fayette	TRIS RCRIS	US EPA Envirofacts
Columbia Gas Transmission	Bloomingburg	Fayette	RCRIS	US EPA Envirofacts
Columbia Gas Transmission	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Columbia Gas Transmission	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Columbia Gas Transmission	Greenfield	Highland	RCRIS	US EPA Envirofacts
Columbia Gas Transmission	Reesville	Clinton	RCRIS	US EPA Envirofacts
Yusa	Washington C H	Fayette	TRIS RCRIS AIRS/AFS	US EPA Envirofacts
Opi Chillicothe Correctional Inst	C Hillicothe	Ross	RCRIS	US EPA Envirofacts
Waddell Ghent	Greenfield	Highland	RCRIS	US EPA Envirofacts

NAME	CITY	COUNTY	TYPE	SOURCE
Pfizer	C Hillicothe	Ross	TRIS RCRIS	US EPA Envirofacts
Hillsboro Aero Testing	Hillsboro	Highland	RCRIS	US EPA Envirofacts
Colonial Stair Woodwork	Jeffersonville	Fayette	AIRS/AFS	US EPA Envirofacts
Intl Multifoods East Monr	Leesburg	Highland	AIRS/AFS	US EPA Envirofacts
Candle Lite	Leesburg	Highland	TRIS RCRIS AIRS/AFS	US EPA Envirofacts
Doa	Bainbridge	Ross	AIRS/AFS	US EPA Envirofacts
Tiffin Elem Sch	C Hillicothe	Ross	AIRS/AFS	US EPA Envirofacts
Western Elem Sch	C Hillicothe	Ross	AIRS/AFS	US EPA Envirofacts
Massie Elem Sch	C Hillicothe	Ross	AIRS/AFS	US EPA Envirofacts
Bells Fndy	Hillsboro	Highland	TRIS	US EPA Envirofacts
Odot Project 308 90	Jeffersonville	Fayette	RCRIS	US EPA Envirofacts
Odot Project 308 90 Part 7	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Greenfield Research	Greenfield	Highland	RCRIS	US EPA Envirofacts
Visador	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Bp Oil	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Pmi Food Equipment Group	Hillsboro	Highland	TRIS RCRIS	US EPA Envirofacts
New Sabina	Sabina	Clinton	TRIS	US EPA Envirofacts
Banta Pub Greenfield	Greenfield	Highland	RCRIS	US EPA Envirofacts
Cobbs	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Knisleys Collision	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Mccullahs Detail Body	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Columbus So. Power	C Hillicothe	Ross	RCRIS	US EPA Envirofacts
Knisley Bodyshop	Greenfield	Highland	RCRIS	US EPA Envirofacts
Doane	Washington C H	Fayette	TRIS	US EPA Envirofacts
Willis Lumber	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Starfire Express	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Johnsons Body	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Gay Chaffin	C Hillicothe	Ross	RCRIS	US EPA Envirofacts
Calmar Spring	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Bosch Braking Americas	Frankfort	Ross	TRIS RCRIS AIRS/AFS	US EPA Envirofacts
Agrico Agronomic	Washington C H	Fayette	RCRIS	US EPA Envirofacts
Mound	South Salem	Ross	RCRIS	US EPA Envirofacts
Att Long Lines New Vienna Oh	New Vienna	Clinton	RCRIS	US EPA Envirofacts
Fayette County Landfill	Jefferson Twp	Fayette	Closed Landfill	OEPA Landfill GIS Layer
New Holland Dump	Perry Twp	Pickaway	Closed Landfill	OEPA Landfill GIS Layer
Creamer Road Dump	Jefferson Twp	Fayette	Closed Landfill	OEPA Landfill GIS Layer
Bloomingburg Landfill	Paint Twp	Fayette	Closed Landfill	OEPA Landfill GIS Layer
Washington C.H. City Landfill	Union Twp	Fayette	Closed Landfill	OEPA Landfill GIS Layer
Fayette County Landfill	Jefferson Twp	Fayette	Closed Landfill	OEPA Landfill GIS Layer
Mead Industrial Landfill (Paint	C Hillicothe	Ross	Closed Landfill	OEPA Landfill GIS Layer
Highland County Sanitary	Paint Twp	Highland	Closed Landfill	OEPA Landfill GIS Layer
Hillsboro Landfill	New Market Twp	Highland	Closed Landfill	OEPA Landfill GIS Layer
Osborn Sanitary Landfill	Union Twp	Ross	Closed Landfill	OEPA Landfill GIS Layer
Unauthorized Roadside Dump	Sunbury Twp	Monroe	Closed Landfill	OEPA Landfill GIS Layer
Buckskin Twp Dump	Buckskin Twp	Ross	Closed Landfill	OEPA Landfill GIS Layer
Penn Twp Dump	Penn Twp	Highland	Closed Landfill	OEPA Landfill GIS Layer
Leesburg Dump	Fairfield Twp	Highland	Closed Landfill	OEPA Landfill GIS Layer
Glenn Penn Farm Disposal Site	Madison Twp	Highland	Closed Landfill	OEPA Landfill GIS Layer
Rocky Fork State Park North	Marshall Twp	Highland	Closed Landfill	OEPA Landfill GIS Layer
Rocky Fork State Park South	Marshall Twp	Highland	Closed Landfill	OEPA Landfill GIS Layer
Unauthorized Roadside Dump	Ames Twp	Athens	Closed Landfill	OEPA Landfill GIS Layer

NAME	CITY	COUNTY	TYPE	SOURCE
Fayette County C&Dd Facility		Fayette	Demolition Landfill	OEPA Landfill GIS Layer
Ambrose Cemetery		Highland	cemetery	USGS Geonames
Anders Cemetery		Fayette	cemetery	USGS Geonames
Anderson Cemetery		Fayette	cemetery	USGS Geonames
Antioch Cemetery		Highland	cemetery	USGS Geonames
Archer Cemetery		Fayette	cemetery	USGS Geonames
Asbury Chapel Cemetery		Fayette	cemetery	USGS Geonames
Auburn Cemetery		Highland	cemetery	USGS Geonames
Baldwin Cemetery		Madison	cemetery	USGS Geonames
Baum Hill Cemetery		Ross	cemetery	USGS Geonames
Beavers Cemetery		Highland	cemetery	USGS Geonames
Benner Cemetery		Ross	cemetery	USGS Geonames
Bethel Cemetery		Madison	cemetery	USGS Geonames
Biers Cemetery		Ross	cemetery	USGS Geonames
Bloomingburg Cemetery		Fayette	cemetery	USGS Geonames
Booco-Ryan Cemetery		Fayette	cemetery	USGS Geonames
Boyd Cemetery		Highland	cemetery	USGS Geonames
Britton Chaffin Cemetery		Fayette	cemetery	USGS Geonames
Burnett Cemetery		Highland	cemetery	USGS Geonames
Bush Cemetery		Fayette	cemetery	USGS Geonames
Butters Cemetery		Highland	cemetery	USGS Geonames
Caldwell Cemetery		Highland	cemetery	USGS Geonames
Carlisle Cemetery		Highland	cemetery	USGS Geonames
Carmean Cemetery		Fayette	cemetery	USGS Geonames
Chapman Cemetery		Highland	cemetery	USGS Geonames
Cochran Cemetery		Fayette	cemetery	USGS Geonames
Coffman Orr Cemetery		Fayette	cemetery	USGS Geonames
Compton Cemetery		Fayette	cemetery	USGS Geonames
Cook Cemetery		Fayette	cemetery	USGS Geonames
Correl Cemetery		Madison	cemetery	USGS Geonames
Coulter Cemetery		Clinton	cemetery	USGS Geonames
Counts Cemetery		Madison	cemetery	USGS Geonames
Cowman Cemetery		Highland	cemetery	USGS Geonames
Creamer Cemetery		Fayette	cemetery	USGS Geonames
Creek Cemetery		Highland	cemetery	USGS Geonames
Crispin Cemetery		Highland	cemetery	USGS Geonames
Curp Cemetery		Highland	cemetery	USGS Geonames
Davis Cemetery		Fayette	cemetery	USGS Geonames
Dick Cemetery		Highland	cemetery	USGS Geonames
Dollarhide Cemetery		Highland	cemetery	USGS Geonames
Dunkard Cemetery		Highland	cemetery	USGS Geonames
Dwyer Cemetery		Ross	cemetery	USGS Geonames
Evans Cemetery		Clinton	cemetery	USGS Geonames
Eyeman-Bryant Cemetery		Fayette	cemetery	USGS Geonames
Fairfield Cemetery		Highland	cemetery	USGS Geonames
Fairview Cemetery		Fayette	cemetery	USGS Geonames
Fenner Number 1 Cemetery		Highland	cemetery	USGS Geonames
Fenner Number 2 Cemetery		Highland	cemetery	USGS Geonames
Fenner Number 3 Cemetery		Highland	cemetery	USGS Geonames
Friends Cemetery		Highland	cemetery	USGS Geonames
Garface Cemetery		Clinton	cemetery	USGS Geonames

NAME	CITY	COUNTY	TYPE	SOURCE
Garner Cemetery		Ross	cemetery	USGS Geonames
Gilboa Cemetery		Highland	cemetery	USGS Geonames
Glascock Cemetery		Highland	cemetery	USGS Geonames
Good Hope Cemetery		Fayette	cemetery	USGS Geonames
Grandview Cemetery		Ross	cemetery	USGS Geonames
Grassy Run Cemetery		Clinton	cemetery	USGS Geonames
Greenfield Cemetery		Highland	cemetery	USGS Geonames
Greenlawn Cemetery		Ross	cemetery	USGS Geonames
Grey Cemetery		Ross	cemetery	USGS Geonames
Hagler Cemetery		Fayette	cemetery	USGS Geonames
Hansbrough Cemetery		Highland	cemetery	USGS Geonames
Hartman Cemetery		Highland	cemetery	USGS Geonames
Head Cemetery		Highland	cemetery	USGS Geonames
Hidy Cemetery		Fayette	cemetery	USGS Geonames
High Top Cemetery		Highland	cemetery	USGS Geonames
Highbee Cemetery		Fayette	cemetery	USGS Geonames
Highlawn Memory Gardens		Fayette	cemetery	USGS Geonames
Hines Cemetery		Fayette	cemetery	USGS Geonames
Hixon Cemetery		Ross	cemetery	USGS Geonames
Hogue Allen Cemetery		Fayette	cemetery	USGS Geonames
Huff Cemetery		Highland	cemetery	USGS Geonames
Hulitt Cemetery		Highland	cemetery	USGS Geonames
Hyer Cemetery		Fayette	cemetery	USGS Geonames
Hymiller Cemetery		Ross	cemetery	USGS Geonames
Jeff Cemetery		Clinton	cemetery	USGS Geonames
Jefferson-Jasper Twp		Fayette	cemetery	USGS Geonames
Johnson Cemetery		Fayette	cemetery	USGS Geonames
Johnson Cemetery		Highland	cemetery	USGS Geonames
Johnson Cemetery		Ross	cemetery	USGS Geonames
Jones Cemetery		Pike	cemetery	USGS Geonames
Kelly Cemetery		Highland	cemetery	USGS Geonames
Kirk Cemetery		Fayette	cemetery	USGS Geonames
Leaverton Cemetery		Highland	cemetery	USGS Geonames
Lloyd Cemetery		Fayette	cemetery	USGS Geonames
Lunbeck Cemetery		Highland	cemetery	USGS Geonames
Luttrell Cemetery		Clinton	cemetery	USGS Geonames
Madison Mills Cemetery		Fayette	cemetery	USGS Geonames
Mallow Cemetery		Ross	cemetery	USGS Geonames
Mallow Perrill Cemetery		Fayette	cemetery	USGS Geonames
Mark Cemetery		Fayette	cemetery	USGS Geonames
Mcdill Cemetery		Ross	cemetery	USGS Geonames
Mckillip Kirk Cemetery		Fayette	cemetery	USGS Geonames
Milledgeville Plymouth		Fayette	cemetery	USGS Geonames
Mills Mckillip Cemetery		Fayette	cemetery	USGS Geonames
Moore Cemetery		Ross	cemetery	USGS Geonames
Moore Cemetery		Highland	cemetery	USGS Geonames
Mount Carmel Cemetery		Ross	cemetery	USGS Geonames
New Holland Cemetery		Pickaway	cemetery	USGS Geonames
New Light Cemetery		Highland	cemetery	USGS Geonames
Nuckols Cemetery		Ross	cemetery	USGS Geonames
Old Creamer Cemetery		Fayette	cemetery	USGS Geonames

NAME	CITY	COUNTY	TYPE	SOURCE
Old Jeffersonville Cemetery		Fayette	cemetery	USGS Geonames
Old Stone Cemetery		Ross	cemetery	USGS Geonames
Old Washington Cemetery		Fayette	cemetery	USGS Geonames
Pake Cemetery		Ross	cemetery	USGS Geonames
Pancake Cemetery		Madison	cemetery	USGS Geonames
Parrott Marshall Cemetery		Fayette	cemetery	USGS Geonames
Platter Cemetery		Ross	cemetery	USGS Geonames
Pleasant Hill Cemetery		Highland	cemetery	USGS Geonames
Pleasant Hill Cemetery		Ross	cemetery	USGS Geonames
Poole Cemetery		Ross	cemetery	USGS Geonames
Pope Cemetery		Highland	cemetery	USGS Geonames
Potts Hill Cemetery		Ross	cemetery	USGS Geonames
Ralston Cemetery		Ross	cemetery	USGS Geonames
Range Cemetery		Madison	cemetery	USGS Geonames
Richland Cemetery		Clinton	cemetery	USGS Geonames
Roads Cemetery		Highland	cemetery	USGS Geonames
Roberts Cemetery		Ross	cemetery	USGS Geonames
Rock Mills Cemetery		Fayette	cemetery	USGS Geonames
Rocky Spring Cemetery		Highland	cemetery	USGS Geonames
Rogers Cemetery		Fayette	cemetery	USGS Geonames
Rogers Mcelwain Cemetery		Fayette	cemetery	USGS Geonames
Rowe Cemetery		Ross	cemetery	USGS Geonames
Rowe Cemetery		Fayette	cemetery	USGS Geonames
Saint Colmans Cemetery		Fayette	cemetery	USGS Geonames
Saint Marys Cemetery		Highland	cemetery	USGS Geonames
Satchel Cemetery		Ross	cemetery	USGS Geonames
Sates Gamble Cemetery		Fayette	cemetery	USGS Geonames
Seelig Cemetery		Ross	cemetery	USGS Geonames
Sheep Pen Cemetery		Highland	cemetery	USGS Geonames
Sheron Cemetery		Ross	cemetery	USGS Geonames
Shoults Cemetery		Ross	cemetery	USGS Geonames
Snyder Cemetery		Ross	cemetery	USGS Geonames
Sollars Cemetery		Fayette	cemetery	USGS Geonames
South Solon Cemetery		Madison	cemetery	USGS Geonames
Spurgeon Cemetery		Clinton	cemetery	USGS Geonames
Stader Cemetery		Ross	cemetery	USGS Geonames
Staunton Cemetery		Fayette	cemetery	USGS Geonames
Stewart Cemetery		Greene	cemetery	USGS Geonames
Storms Cemetery		Ross	cemetery	USGS Geonames
Strain Cemetery		Highland	cemetery	USGS Geonames
Stuckey Cemetery		Fayette	cemetery	USGS Geonames
Sugar Creek Cemetery		Fayette	cemetery	USGS Geonames
Sugar Creek Cemetery		Fayette	cemetery	USGS Geonames
Sugar Grove Cemetery		Fayette	cemetery	USGS Geonames
Swadley Cemetery		Highland	cemetery	USGS Geonames
Thomas Cemetery		Madison	cemetery	USGS Geonames
Thorpe Cemetery		Clinton	cemetery	USGS Geonames
Tuvell Cemetery		Ross	cemetery	USGS Geonames
Tyler Cemetery		Highland	cemetery	USGS Geonames
Tyler Cemetery		Highland	cemetery	USGS Geonames
Underwood Cemetery		Highland	cemetery	USGS Geonames

NAME	CITY	COUNTY	TYPE	SOURCE
Union Chapel Cemetery		Fayette	cemetery	USGS Geonames
Vesey Cemetery		Fayette	cemetery	USGS Geonames
Walnut Creek Cemetery		Fayette	cemetery	USGS Geonames
Washington Cemetery		Fayette	cemetery	USGS Geonames
Waugh Cemetery		Ross	cemetery	USGS Geonames
Weller Cemetery		Ross	cemetery	USGS Geonames
Whiteman Cemetery		Madison	cemetery	USGS Geonames
Williams Chapel Cemetery		Madison	cemetery	USGS Geonames
Wilson Cemetery		Ross	cemetery	USGS Geonames
Wilson Cemetery		Fayette	cemetery	USGS Geonames
Yankee Hill Cemetery		Ross	cemetery	USGS Geonames
Zink Cemetery		Highland	cemetery	USGS Geonames
Zink Cemetery		Highland	cemetery	USGS Geonames
Emery Transportation Tanker	Octa	Fayette	Master Sites List	Ohio EPA-DERR MSL GIS layer
Calmar Corp	Washington C H	Fayette	Master Sites List	Ohio EPA-DERR MSL GIS layer
Biewer John A Co Of Ohio	Washington C H	Fayette	Master Sites List	Ohio EPA-DERR MSL GIS layer
Armco Steelox Building	Washington C H	Fayette	Master Sites List	Ohio EPA-DERR MSL GIS layer
Allied Technology	Sabina	Clinton	Master Sites List	Ohio EPA-DERR MSL GIS layer
Mead Paint Street Landfill	C Hillicothe	Ross	Master Sites List	Ohio EPA-DERR MSL GIS layer
Frank Sollars	Washington C H	Fayette		OEPA-DSW Surface Impoundment
Ohio Water Service Company	Poland	Fayette		OEPA-DSW Surface Impoundment
Armco Steel Corporation	Middletown	Fayette	SETTLING	OEPA-DSW Surface Impoundment
Board Of Public Affairs	Jeffersonville	Fayette	SLUDGE	OEPA-DSW Surface Impoundment
City Of Washington	Washington C H	Fayette		OEPA-DSW Surface Impoundment
Village Of Jeffersonville	Jeffersonville	Fayette	AERATION	OEPA-DSW Surface Impoundment
Standard Oil Company	Columbus	Fayette	RETENTION	OEPA-DSW Surface Impoundment
Roger Conrlin Hog Farm	Xenia	Greene		OEPA-DSW Surface Impoundment
Greenfield Bulk Station -Sohio	Greenfield	Highland		OEPA-DSW Surface Impoundment
B&B Plating Co.	Hillsboro	Highland		OEPA-DSW Surface Impoundment
Hugh Garrison	Hillsboro	Highland	SETTLING	OEPA-DSW Surface Impoundment
Ervin Parshall	Hillsboro	Highland		OEPA-DSW Surface Impoundment
Collins Packing Company	Greenfield	Highland	AERATION	OEPA-DSW Surface Impoundment
Stephen Boike Farm	Hillsboro	Highland		OEPA-DSW Surface Impoundment
Highland County Water Co.	Hillsboro	Highland	SETTLING	OEPA-DSW Surface Impoundment
Hillsboro Manufacturing Co.	Hillsboro	Highland	SETTLING	OEPA-DSW Surface Impoundment
Bells Foundry	Hillsboro	Highland		OEPA-DSW Surface Impoundment
Paint Creek St.Park -Boat	New Petersburg	Highland	SETTLING	OEPA-DSW Surface Impoundment
Mead Paper-Forms Paper	C Hillicothe	Ross	AERATION	OEPA-DSW Surface Impoundment
Pioneer School	C Hillocothe	Ross	SETTLING	OEPA-DSW Surface Impoundment
Ohio Dept.Of Natural	Columbus	Ross	SETTLING	OEPA-DSW Surface Impoundment
Ralph Brust Farm	Buckskin Twp.	Ross		OEPA-DSW Surface Impoundment
Russell Bawdle Farm	Union Twp.	Ross		OEPA-DSW Surface Impoundment
Bob Brittenger Farm	Twin Twp.	Ross		OEPA-DSW Surface Impoundment
North Fork Village Sewage	C Hillicothe	Ross	SETTLING	OEPA-DSW Surface Impoundment
Quality Feeder Pigs	South Solon	Madison	hogs	OEPA Livestock GIS Coverage
Washington Ch Gas Light	Washington C H	Fayette	COALGAS	OEPA Town Gas Sites GIS Layer
Hillsboro Gas & Electric	Hillsboro	Highland	COAL GAS	OEPA Town Gas Sites GIS Layer
Fayette County Memorial		Fayette	hospital	USGS Geonames
Greenfield Area Medical Center		Highland	hospital	USGS Geonames
Highland Hospital		Highland	hospital	USGS Geonames
Camstra Airport		Fayette	airport	USGS Geonames

NAME	CITY	COUNTY	TYPE	SOURCE
Creamer Airpark		Fayette	airport	USGS Geonames
Fayette County Airport		Fayette	airport	USGS Geonames
Gordin Airport		Madison	airport	USGS Geonames
Haas Airport		Ross	airport	USGS Geonames
Highland County Airport		Highland	airport	USGS Geonames
Highland District Medical		Highland	airport	USGS Geonames
Merritt Airport		Fayette	airport	USGS Geonames
Ross Field		Ross	airport	USGS Geonames
Terrell Airport		Clinton	airport	USGS Geonames
Unger Field		Highland	airport	USGS Geonames
Valley Vista Airport		Ross	airport	USGS Geonames

PAINT CREEK WATERSHED MANAGEMENT PLAN

SECTION III: WATER QUALITY

JULY 2002

SECTION III: WATER QUALITY

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III. WATER QUALITY SECTION

Water Quality Standards

Our water quality is constantly threatened by many different sources and types of pollution. Under the Clean Water Act, every state must adopt water quality standards to protect, maintain and improve the quality of the nation's surface waters. These standards represent a level of water quality that will support the goal of "swimmable/fishable" waters. Water quality standards are ambient standards as opposed to discharge-type standards. These ambient standards, through a process of back calculation procedures known as total maximum daily loads or wasteload allocations form the basis of water quality based permit limitations that regulate the discharge of pollutants into surface waters under the National Pollutant Discharge Elimination System (NPDES) permit program.

Ohio's water quality standards, set forth in Chapter 3745-1 of the Ohio Administrative Code, include four major components:

- beneficial use designations,
- narrative "free froms",
- numeric criteria, and
- antidegradation policy.

Beneficial Use Designations

Beneficial use designations describe existing or potential uses of waterbodies. They take into consideration the use and value of water for public water supplies, protection and propagation of aquatic life, recreation in and on the water, agricultural, industrial and other purposes. Ohio EPA assigns beneficial use designations to waterbodies in the state. There may be more than one use designation assigned to a waterbody. Examples of beneficial use designations include: aquatic life use, recreational use, public water supply and state resource water.

Aquatic Life Use Designation

Aquatic life uses are based on three biological indices. These are: (1) the index of biological integrity (IBI); (2) the macroinvertebrate community index (ICI); and (3) the modified index of well being (MIwb). These indices measure the populations and diversity of fish and macroinvertebrates (including aquatic insects, crayfish, mussels, snails, etc…) living in the stream. For each of the use designations, the criterion for each index is different. See tables 7-1 and 7-17, Chapter 3745-1, of the Ohio Administrative Code for a complete listing of numeric criteria for these use designations. Please also refer to the Biological Indicators section of this report for more information about these indices and map 1, which shows aquatic life use attainment in the watershed.

A large percentage of the Paint Creek Watershed, including North Fork, Rocky Fork and the lower portion of Main Paint Creek are categorized as Exceptional Warmwater Habitat (EWH). 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 represents a protection goal for water resource management efforts dealing with Ohio's best water resources. The standards for ammonia and dissolved oxygen are more stringent than in the other use designations.

Much of the rest of the watershed is classified as Warmwater Habitat (WWH). WWH defines the "typical" warmwater assemblage of aquatic organisms for Ohio rivers and streams. It is the principal restoration target for the majority of water resource management efforts in Ohio. Criteria vary by ecoregion and site type.

Only one stream in the Paint Creek Watershed, Sugar Creek, is considered Modified Warmwater Habitat (MWH). MWH applies to streams with extensive and irretrievable physical habitat modifications. The biological criteria for warmwater habitat are not presently or in the near future (<20 years) attainable. The activities contributing to the modified warmwater habitat designation must be sanctioned and permitted by state or federal law. The representative aquatic assemblages are generally composed of species that are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor habitat quality. The ammonia and dissolved oxygen standards are less stringent than warmwater habitat. There are three subcategories:

Modified Warmwater Habitat - A (MWH-A) for those streams affected by acidic mine runoff; Modified Warmwater Habitat - C (MWH-C) for those streams like Sugar Creek, which are heavily channelized; and Modified Warmwater Habitat - I (MWH-I) for those streams that are extensively impounded. The biocriteria are set separately for each subcategory.

None of the following designations apply to streams in the Paint Creek Watershed:

Limited Resource Water (LRW) applies to streams that have drainage areas of less than three square miles and either may lack water on a recurring annual basis, or have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported; no formal biological criteria are established for this designation.

Limited Warmwater Habitat (LWH) was adopted in 1978 as a temporary variance mechanism for individual segments that had point source discharge problems and as a result could not meet Clean Water Act goals. This designation is being phased out.

Seasonal Salmonid Habitats (SSH) are Lake Erie tributaries that support periodic "runs" of salmonids during the spring, summer, and/or fall.

Coldwater Habitat (CH) describes waters that support assemblages of coldwater organisms and/or those that are stocked with salmonids with the intent of providing a fishery on a year round basis; it should not be confused with the Seasonal Salmonid

Recreational Use

Based on language found in the Clean Water Act, Ohio EPA recognizes three categories of recreational uses. Fecal coliform standards for each of the recreational use categories are listed in table 3-1.

Bathing Waters - Swimming areas with lifeguard, bathhouse, and regular water testing.

Primary Contact - Suitable for full body contact recreation (e.g. swimming or canoeing). To qualify as a primary contact recreation use, a stream must have at least one pool of 100 square feet greater than a depth of three feet, high probability of full contact due to nearby residences, or be located in or near parks or areas of high public access.

Secondary Contact - Suitable for partial body contact recreation (e.g. wading). One of two criteria may be used to evaluate recreational use attainment: fecal coliform bacteria or E. coli. A stream segment must meet whichever of these criteria it is tested for to be in attainment of its use designation.

Each use designation is defined in the Ohio Administrative Code. Attainment of uses is based on specific numeric and narrative criteria. To ensure protection of these uses, Ohio EPA determines and assigns maximum concentrations for over 100 chemicals.

Table 3-1: Fecal Coliform Standards by Recreational Use Category

Recreational Use Category	Fecal Coliform Standard	E. coli Standard
Bathing waters	Min. of five samples within 30 day period not to exceed 200 per 100 ml and not to exceed 400 per 100 ml in more than 10% of the samples during any 30 day period.	td>Min. of five samples within 30 day period not to exceed 126 per 100 ml and not to exceed 235 per 100 ml in more than 10% of samples taken during any 30 day period.
Primary contact	td>Min. of five samples within 30 day period not to exceed 1,000 per 100 ml and not to exceed 2,000 per 100 ml in more than 10% of the samples during any 30 day period.	Min. of five samples within 30 day period not to exceed 126 per 100 ml and not to exceed 298 per 100 ml in more than 10% of samples taken during any 30 day period.
secondary contact	Not to exceed 5,000 per 100 ml in more than 10% of the samples taken during any 30-day period.	Not to exceed 576 per 100 ml in more than 10% of samples taken during any 30-day period. Source: Table 7-2, Chapter 3745-1, of the Ohio Administrative Code.

Public Water Supply

Based on language found in the Clean Water Act, Ohio EPA recognizes three categories of water supply uses:

- Public - Meets drinking water standards with conventional treatment.
- Agricultural - Suitable for irrigation and livestock watering without treatment.
- Industrial - Suitable for industrial and commercial use with or without treatment.

See table 7-1,Chapter 3745-1, of the Administrative Code for a complete listing of numeric criteria for these use designations.

State Resource Waters

State resource waters are waters within park systems, scenic rivers, wetlands and other ecologically significant areas. The amount of pollutant loadings allowed in these waters is very limited.

Narrative "Free Froms"

Narrative "free froms" are general water quality criteria that apply to all surface waters. These criteria state that all waters shall be free from sludge, floating debris, oil and scum, color and odor producing materials, substances that are harmful to human, animal or aquatic life, and nutrients in concentrations that may cause algal blooms.

Much of Ohio EPA's present strategy regarding water quality based permitting is based upon the narrative free from, "no toxics in toxic amounts." Ohio EPA developed its strategy based on an evaluation of the potential for significant toxic impacts within the receiving waters. Very important components of this evaluation are the biological survey program and the biological criteria used to judge aquatic life use attainment.

Numeric Criteria

Numeric criteria are estimations of concentrations of chemicals and degree of aquatic life toxicity allowable in a waterbody without adversely impacting its beneficial uses. Although numeric criteria are applied to waterbodies, they primarily are used to regulate dischargers through NPDES permits. Numeric criteria consist of chemical criteria, whole effluent toxicity criteria and biological criteria.

Chemical Criteria

Aquatic life water quality criteria for individual chemicals are derived from laboratory studies of biological organisms' sensitivity to specific chemicals or combinations of chemicals.

In these studies, a variety of fish, benthic macro- invertebrates and zooplankton are exposed to known concentrations of a chemical under varying conditions. Based on these tests, guidelines or national criteria recommendations are established by U.S. EPA. Ohio EPA uses these national criteria recommendations in combination with the latest scientific information in setting the appropriate chemical water quality criteria for Ohio's surface waters.

Another class of chemical criteria is that associated with the Agricultural Water Supply use designation. These criteria protect against long-term adverse effects on crops and livestock as a result of crop irrigation and livestock watering.

Whole Effluent Toxicity Criteria

Whole Effluent Toxicity (WET) measures the harmful effects of an effluent on living organisms. A bioassay or toxicity test measures the degree of response of an exposed test organism to a specific chemical or effluent. WET can only be measured using living organisms, not by an instrument. WET consists of acute and chronic toxicity tests. Acute toxicity tests measure the responses of organisms that occur soon after exposure to a test substance. Chronic tests measure the long-term response to test substances. WET measures the accumulative effects of chemicals present in an effluent that cannot be assessed using chemical- specific criteria. These tests are usually utilized during permit renewals for entities with point source discharges.

Biological Criteria

Biological criteria are based on aquatic community characteristics that are measured both structurally and functionally. These criteria are used to evaluate the attainment of aquatic life uses. The data collected in these assessments are used to characterize aquatic life impairment and to help diagnose the cause of this impairment.

The principal biological evaluation tools used by Ohio EPA are the Index of Biotic Integrity (IBI), the Modified Index of Well-being (MIwb) and the Invertebrate Community Index (ICI). These three indices are based on species richness, trophic composition, diversity, presence of pollution-tolerant individuals or species, abundance of biomass, and the presence of diseased or abnormal organisms. The IBI and the MIwb apply to fish; the ICI applies to macroinvertebrates. Ohio EPA uses the results of sampling reference sites in each of the five ecoregions in Ohio to set minimum criteria index scores for use designations in water quality standards.

Antidegradation Policy

The antidegradation policy describes the conditions under which water quality may be lowered in surface waters. Existing beneficial uses must be maintained and protected. Further, water quality better than that needed to protect existing beneficial uses must be maintained unless lower quality is deemed necessary to allow important economic or social development (existing beneficial uses must still be protected).

Public Participation

Any interested individuals can have a role in the process of developing water quality standards. Ohio EPA reviews and, as appropriate, revises water quality standards at least once every three years. When water quality standards revisions are proposed, the public is notified of these revisions. A public hearing is held to gather input and comments.

Biological Indicators

Biological indicators are features of the aquatic ecosystem that demonstrate the health and vitality of the ecosystem. There are three indices that Ohio EPA uses to assess the health of the biological community and determine aquatic life use designations. These are the Index of Biological Integrity (IBI), the Modified Index of Well-being, (MIwb) and the Invertebrate Community Index (ICI). These may be referenced in other sections of the 305(b) or in various monitoring or technical support documents.

Index of Biological Integrity (IBI)

The Index of Biological Integrity is a measure of fish species diversity and species populations. The criteria used to establish the index for each of the five ecoregions reflect the biological performance exhibited by natural or least impacted habitats of each region based on specific reference sites. The index is a number that reflects total native species composition, indicator species composition, pollutant intolerant and tolerant species composition, and fish condition. Combined, the higher the calculation, the healthier the aquatic ecosystem; conversely, the lower the index, the poorer the health of the aquatic ecosystem. The highest score is 60.

Invertebrate Community Index (ICI)

The Invertebrate Community Index is based on measurements of the macroinvertebrate communities living in a stream or river. It is particularly useful in evaluating stream health because: (1) there are a wide variety of macroinvertebrate taxa, which are known to be pollutant intolerant; and (2) there are a number of macroinvertebrate taxa, which are known to be pollutant tolerant. Like the IBI, the ICI scale is 0 to 60 with higher scores representing healthier macroinvertebrate communities and therefore more biologically diverse communities.

Modified Index of Well-being (MIwb)

The Modified Index of Well-being is based upon fish biomass, which is a calculation of fish mass and density. The Modified Index of Well-being factors out 13 pollutant tolerant species of fish from certain calculations. This prevents false high readings on polluted streams that have large populations of pollutant tolerant fish.

Causes and Sources of Impairment

Causes of aquatic life impairment are defined as the actual agents that affect the aquatic life use (e.g., low dissolved oxygen, silt, habitat modification, etc.). Sources of impairment are the entities or activities from which the pollutant or effect originated (e.g., municipal wastewater treatment plant, row crop agriculture, bank de-stabilization, etc.). For example, a source of heavy metals (a cause of impairment) may be a municipal wastewater treatment plant (WWTP) or an industrial operation (a source of impairment). Table 3-2 lists the causes, sources and impacts of nonpoint source pollution. The information listed in the table is pertinent to the water quality of the Paint Creek Watershed and provides a good reference for the stream-specific water quality described in the latter half of this section.

Table 3-2: Causes, Sources and Impacts of Point and Nonpoint Source Pollution

Causes (Pollutant or Stressor)	Possible Sources	Potential Adverse Impacts
Sediment/Siltation (sand, silt, clay)	Cropland Forestry activities Pasture Stream banks Construction Roads Gullies Livestock operations Other land-disturbing activities	Sediment may destroy fish habitat by: (1) blanketing spawning 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.
Nutrients (phosphorus, nitrogen)	Erosion and runoff from fertilized fields Urban runoff Wastewater treatment plants Industrial discharges Septic systems Animal production operations Cropland or pasture where manure is spread	Nutrient enrichment may cause excessive algae and aquatic plant growth, which may choke open waters and consume oxygen (primarily from decomposition of dead plants and algae). These conditions will adversely affect fish and aquatic organisms, fishing and boating, and the taste and odor of finished drinking water. Nitrogen contaminants in drinking water significantly above the drinking water standard may cause methoglobinemia (blood disease) in infants, and have forced the closure of many water supplies.
Pathogens (bacteria and viruses)	Human and animal excreta	Waterborne diseases may be transmitted to humans through drinking or contact with

Causes (Pollutant or Stressor)	Possible Sources	Potential Adverse Impacts
	Animal operations Cropland or pasture where manure is spread Wastewater treatment plants Septic systems Urban runoff Wildlife	pathogen-laden water. Eating shellfish taken from or uncooked crops irrigated with pathogen-laden waters may also transmit waterborne diseases. 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 or fishing.
Pesticides	All land where pesticides are used (forest, pastures, urban/suburban areas, golf courses, waste disposal sites) Sites of historical usage (chlorinated pesticides) Urban runoff Irrigation return flows	Pesticides may enter surface waters either dissolved in runoff or attached to sediment or organic materials, and may enter ground water through soil infiltration. The principal concerns in surface water are their entry into the food chain, bioaccumulation, toxic effects on fish, wildlife and microorganisms, habitat degradation and potential degradation of public water supply sources. Ground water impacts are primarily related to water supply sources.
Toxic Substances (heavy metals, oil and petroleum products)	Urban runoff Wastewater treatment plants Industrial discharges	Toxic substances may enter surface waters either dissolved in runoff or attached to sediment or organic materials and may enter ground waters through soil infiltration. Principal concerns in surface water include entry into the food chain, bioaccumulation, toxic effects on aquatic organisms, other wildlife and microorganisms, habitat degradation and degradation of water supplies. Ground water impacts are primarily related to degradation of water supply sources.
Organic Enrichment (depletion of dissolved oxygen)	Human and animal excreta Decaying plant/animal matter Discarded litter and food waste	Organic materials (natural or synthetic) may enter surface waters dissolved or suspended in runoff. Natural decomposition of these materials may deplete oxygen supplies in surface waters. Dissolved oxygen may be reduced to below the threshold necessary to maintain aquatic life.
Thermal Stress/ Sunlight	Riparian corridor destruction Bank destruction Urban runoff Hydromodifications	Direct exposure of sunlight to streams may elevate stream temperatures, which can exceed fish tolerance limits, promote the growth of nuisance algae and reduce dissolved oxygen. The lack of trees along a stream bank

Causes (Pollutant or Stressor)	Possible Sources	Potential Adverse Impacts
	Industrial dischargers	contributes to thermal stress and excessive sunlight. Thermal stress may also be the result of storm water runoff, which is heated as it flows over urban streets. Hydromodifications that create wider, shallower channels create more surface area and allow for quicker temperature changes. Modifications that create pools and increase the storage time of water may also contribute to thermal stress by increasing surface area and not allowing the warmed water to wash out of the watershed. Coldwater fish may be eliminated or only marginally supported in streams affected by thermal stress.
pH (acidic and alkaline waters)	Atmospheric deposition Industrial point source discharges	Acidic or alkaline 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 adsorbed to sediments into the water column. High pH, or alkaline conditions, can cause ammonia to be more toxic to aquatic organisms.
Salinity (dissolved solids)	Brine from oil extraction Road deicing	High levels of dissolved solids will affect the taste of drinking water. High concentrations of sodium sulfate or magnesium sulfate in drinking water can cause laxative effects, and excess sodium may affect persons restricted to low sodium diets. High concentrations of salts can inhibit aquatic plant growth and have an adverse effect on aquatic life. Lakes receiving runoff with high salt concentrations may form a saline layer near the bottom that will resist mixing, thereby reducing dissolved oxygen in the saline layer.
Flow Alterations (hydrologic modifications)	Channelization Dams Dredging Streambank	Hydrologic modifications alter the flow of water through the stream. Structures or activities in the water body that alter stream flow may in turn be the source of stressors,

Causes (Pollutant or Stressor)	Possible Sources	Potential Adverse Impacts
	modifications	such as habitat modifications, or exacerbate others, such as thermal stress and erosion. Dams may also act as a barrier to the upstream migration of aquatic organisms and decrease in-stream treatment of wastes, chemicals or other compounds. Stream flow alterations may result from a stressor such as sedimentation, which may change a streambed from narrow with deep pools to broad and shallow as the stream drops sediment and tries to repair itself.
Habitat Modifications	Channelization Construction Changing land uses in the watershed Stream burial Dredging Removal of riparian vegetation Streambank modifications	Habitat modifications include activities in the landscape or in the water body that alter the physical structure of the aquatic and riparian ecosystem. Some examples include: removal of stream side vegetation that stabilizes the stream bank and provides shade; excavation in the stream and removal of cobbles from the stream bed that provide nesting habitat for fish; stream burial; and development that alters the natural drainage pattern by increasing the intensity, magnitude and energy of runoff waters.
Refuse, Litter and Other Debris	Litter Illegal dumping of solid wastes Liquid spills Hazardous waste spills	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. Spills of farm materials or hazardous wastes can kill aquatic organisms and disrupt the ecosystem.

Point Sources of Pollution

There are a variety of human activities that influence water quality, which manifest themselves in point source and nonpoint source pollutants.

Point sources of pollution are those that have a known discharge point, such as a pipe. Point sources of pollution are regulated by Ohio EPA's Division of Surface Water (DSW), which maintains records on permits and related water quality monitoring, which are available upon request. Point sources include wastewater treatment plants, combined sewer overflows and storm water systems.

National Pollutant Discharge Elimination Systems

In most cases, point sources are required to operate under a National Pollutant Discharge Elimination System (NPDES) permit. Examples of point source discharges include industrial and sanitary wastewater treatment plants (WWTP) that discharge directly to a stream, and certain livestock facilities. The map entitled, *Paint Creek Watershed: NPDES and Surface Impoundments*, shows NPDES permits and Surface Impoundments regulated by DSW. Table 3-3 lists NPDES permits found within the Paint Creek Watershed and Table 3-4 lists the Surface Impoundments.

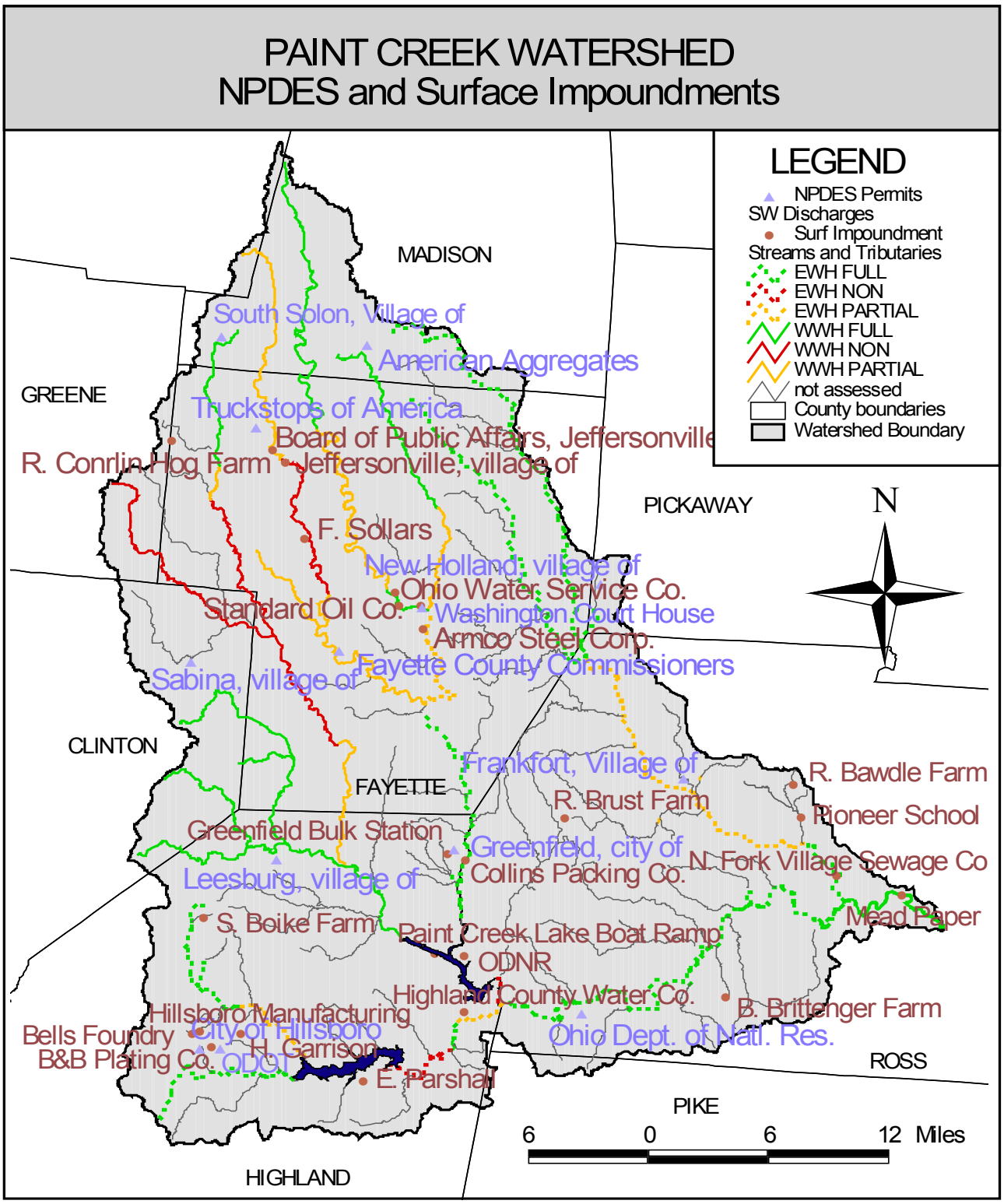
Table 3-3: NPDES permits in Paint Creek Watershed.

TYPE	ID_NUMBER	NAME	SIC_CODE	DESCRIPTION	LOCATION
NPDES	OH0047350	American Aggregates	3281	cut stone and stone products	10263 Lower Valley, Midway
NPDES	OHL020389	City of Hillsboro	4952	sewerage systems	1488 N. High St., Hillsboro
NPDES	OH0036196	Fayette Co. Commissioners	4952	sewerage systems	US Rte 35, E. Jefferson Twp
NPDES	OH0021482	Frankfort, Village of	4952	sewerage systems	91 S. Main St.
NPDES	000008049782	Greenfield, city of	4952	sewerage systems	187 Lost Bridge St.
NPDES	OH0000513903	Leesburg, village of	4952	sewerage systems	7 East St.
NPDES	OH0001638667	New Holland, village of	4952	sewerage systems	800 Good Hope-New Holland
NPDES	OH0001636315	Ohio Dept. of Trans.	4952	sewerage systems	I-71 NB at 179, Mifflin Twp
NPDES	0000073672220	Ohio Dept. of Natl. Res.	4952	sewerage systems	1847 Pike Lake Rd., Bainbridge
NPDES	OH0001664903	Sabina, village of	4952	sewerage systems	
NPDES	000010179498	South Solon, village of	4952	sewerage systems	
NPDES	OHD089420889	Truckstops of America	4952	sewerage systems	13023 US Rte 35, Jeffersonville
NPDES	000008047104	City of Washington Courth	4952	sewerage systems	1210 S. Elm St.

The following site-specific information is from Paul Vandermeer, 1997, Pollutant Loadings: 1976-1997, Ohio EPA, Division of Surface Water, Central District Office.

The Washington CH WWTP at 1210 S. Elm St. had 28 untreated bypasses in the first 9 months of 1997. The average bypass event discharged 70.81 kg/day of suspended solids and 48.34 kg/day of carbon-based or organic biological oxygen demand ($CBOD_5$). According to Ohio EPA, bypass events increased markedly in 1996 and 1997 versus the 1994 and 1995 values. Ohio EPA additionally reports that although flow values have remained relatively constant since 1976, the 95th percentile flow values have been steadily increasing. Other measurements such as suspended solids, BOD-CBOD and nutrients have been steady or decreasing. Efforts are currently underway to bring the WWTP into compliance.

The Village of New Holland WWTP was designed to treat 0.16 million gallons per day (MGD) and discharges to North Fork of Paint Creek at river mile (RM) 26.7. Flow from the plant has remained around 50-60% of design capacity, but has begun to increase very slowly. Pollutant loadings vary widely, but are insignificant. Ammonia and oil and grease loadings have decreased, while CBOD loadings have increased and suspended solids are variable. The 95th percentile values are wide-ranging and highly variable. Due to the increasing flow and variable loading trends, New Holland WWTP should closely monitor its operations to ensure continued good treatment.



Prepared for the Paint Creek Project by Hilary Solomon, October 2001

The Village of Bloomingburg WWTP was designed to treat 0.16 MGD and discharges to East Fork Paint Creek at RM 6.32. According to Ohio EPA, the plant experiences inflow/infiltration problems with the 95th percentile flow value over 1.5 times the design capacity in 1997. However, pollutant loadings to East Fork have been steadily declining over the last 5-9 years and flows have remained stable. Proper maintenance and control of inflow/infiltration problems should assist in maintaining good treatment.

The Village of Jeffersonville WWTP is designed to treat 0.233 MGD of municipal wastewater and discharges to Sugar Creek. The system includes a controlled discharge lagoon that only releases when stream flow exceeds 1.0 cubic feet per second (cfs) and then the maximum discharge rate equals 90 gallons per minute. Because of the long holding times suspended solids in the form of algae can be a problem.

The Ohio Department of Transportation operates two rest areas along interstate 71 approximately 2 miles north of the US Rte 35 exit. Each rest area contains a package WWTP designed to treat 0.010 MGD of sanitary sewage. The effluent flows to a roadside ditch which confluences with Sugar Creek at RM 26.0. Loadings to the creek are generally negligible due to the small size of each plant, however treatment consistency varies widely and permit violations occur regularly.

The Fayette County Commissioners operate the Rattlesnake Sewer District WWTP #1. The plant receives waste from a variety of sources including restaurants, truck stops and a truck washing operation. The plant is designed to treat 0.18 MGD and discharges to Rattlesnake Creek. Flows from the plant have been steadily increasing since 1992 and the 95th percentile flow exceeded the design capacity for the first time in 1997. High loads of CBOD, suspended solids and ammonia from commercial operations are exceeding treatment capacity. Permit revisions in 1998-1999 to expand the plant to 0.25 MGD treatment capacity have hopefully helped some of these issues.

Finally not listed in the tables above, Flakes Ford Estates WWTP consists of a pond constructed to collect wastewater from a trailer park. This pond overflows during storm events and should eventually be upgraded (Gossett-Johnson, 2002).

Table 3-4: Surface impoundments in the Paint Creek Watershed.

TYPE	UNIQUE_ID	NAME	DESCRIPTION	MAILING ADDRESS
Surf Impoundment	SIM0585	Frank Sollars		2463 Bunkerhill Glendon, Washington CH
Surf Impoundment	SIM0586	Ohio Water Service Company		6650 South Ave., Poland
Surf Impoundment	SIM0587	Armco Steel Corporation	Settling	Post Office Box 1970, Middletown
Surf Impoundment	SIM0588	Board of Public Affairs	Sludge	Box 7, Jeffersonville
Surf Impoundment	SIM0589	City of Wshington		208 North Fayette St., Washington CH
Surf Impoundment	SIM0590	Village of Jeffersonville	Aeration	N. Main St., Jeffersonville
Surf Impoundment	SIM0591	Standard Oil Company	Retention	6050 Busch Blvd, Columbus
Surf Impoundment	SIM0664	Roger Conrlin Hog Farm	Hogs	1350 Hook Rd., Xenia
Surf Impoundment	SIM0790	Greenfield Bulk Station- Sohio		PO Box 5, Greenfield
Surf Impoundment	SIM0791	B&B Plating Co.		428 S.West St., Hillsboro
Surf Impoundment	SIM0793	Hugh Garrison	Settling	Rte 4 Box 410-A, Hillsboro
Surf Impoundment	SIM0794	Ervin Parshall		RR 8, Hillsboro
Surf Impoundment	SIM0795	Collins Packing Company	Aeration	618 S. Washington St., Greenfield
Surf Impoundment	SIM0796	Stephen Boike Farm		7276 Hightop Hills, Hillsboro
Surf Impoundment	SIM0799	Highland County Water Treatment Co. In	Settling	Merchants Nat'l Bank Bldg, Hillsboro
Surf Impoundment	SIM0800	Hillsboro Manufacturing Co.	Settling	120 Moore Rd., Hillsboro
Surf Impoundment	SIM0801	Bells Foundry		PO Box 100, Hillsboro
Surf Impoundment	SIM0802	Paint Creek St. Park- Boat Ramp	Settling	New Petersburg
Surf Impoundment	SIM2329	Mead Paper	Aeration	PO Box 2500, Chillicothe
Surf Impoundment	SIM2330	Pioneer School	Settling	US Rte 35, Chillicothe
Surf Impoundment	SIM2331	Ohio Department of Natural Resources	Settling	Fountain Square, Columbus
Surf Impoundment	SIM2332	Ralph Brust Farm		Parrett Rd., Buckskin Twp.
Surf Impoundment	SIM2333	Russell Bawdle Farm		Cattail Rd., Union Twp
Surf Impoundment	SIM2334	Bob Brittenger Farm		Camelin Hill Rd., Twin Twp
Surf Impoundment	SIM2335	North Fork Village Sewage Disposal	Settling	PO Box 1805, Chillicothe
	LIV0098	Quality Feeder Pigs	Hogs	750 Counts Rd., South Solon

The map entitled, *Paint Creek Watershed; Potential Sources of Contamination*, (see Section II: Watershed Inventory) shows potential sources of contamination in the Paint Creek Watershed. Not all of these sources are regulated point sources. Sources of contamination within the watershed may include leaking underground storage tanks (regulated by the Bureau of Underground Storage Tanks), hazardous spill clean ups from the Master Sites List (regulated by Ohio EPA's Division of Emergency Response and Remediation), DSW Surface Impoundments and cemeteries. Cemeteries contain high levels of arsenic from historic embalming practices.

Combined Sewer Overflows and Sanitary Sewer Overflows

Combined sewers are built to collect sanitary and industrial wastewater as well as storm water runoff and transport this combined wastewater to treatment facilities. When it rains, the volume of storm water and wastewater may exceed the capacity of the combined sewers or of the treatment plant, and a portion of the combined wastewater may be allowed to overflow untreated into the nearest ditch, stream, river or lake. This is a combined sewer overflow, or CSO. Ohio has about 1,600 known CSOs in 102 communities, ranging from small, rural villages to large metropolitan areas.

According to Sheree Gossett-Johnson, a member of the permitting and compliance unit with Ohio EPA's DSW, the Paint Creek Watershed does not contain any CSOs.

Another similar overflow is called a Sanitary Sewer Overflow (SSO). This type of system is designed to bypass the treatment plant when the wastewater load exceeds capacity. Most of these are being phased out in the watershed. One example is the Washington Court House WWTP, which has recently been upgraded (Gosset-Johnson, 2002).

Storm Water Discharges

Storm water discharges are currently regulated under a phased approach. The first phase of regulation included certain categories of storm water discharges associated with industrial activity, and discharges from municipal separate storm sewer systems serving a population of 100,000 or more. No municipalities in the Paint Creek Watershed are large enough to require phase I permits.

Phase II of storm water regulation includes urban areas with a population of at least 10,000 and outlying densities of at least 1,000/sqmi. About 280 municipalities located in urbanized areas and that operate municipal separate storm sewer systems (MS4s) will be included in the program in the State of Ohio. Pollutants from MS4s include floatables, oil and grease, as well as other pollutants from illicit discharges. Chillicothe and Washington Court House are currently involved in this program.

The regulations will also affect discharges from MS4s owned by the state or political subdivisions of the state or the United States. This includes runoff from highways, hospitals, prisons, military bases or universities, which are located within the urban areas affected by this regulation.

Operators of small MS4s will be required to develop a storm water management program that implements six minimum measures, which focus on a Best Management Practice (BMP) approach. The BMPs chosen by the MS4 must significantly reduce pollutants in urban storm water compared to existing levels in a cost-effective manner. The Six Minimum Control Measures include:

Public Education and Outreach Program on the impacts of storm water on surface water and possible steps to reduce storm water pollution. The program must be targeted at both the general community and commercial, industrial and institutional dischargers.

Public Involvement and Participation in developing and implementing the Storm Water Management Plan.

Elimination of Illicit Discharges to the MS4.

Construction Site Storm Water Runoff Ordinance that requires the use of appropriate BMPs, pre-construction review of Storm Water Pollution Prevention Plans (SWP3s), site inspections during

construction for compliance with the SWP3, and penalties for non-compliance.

Post-Construction Storm Water Management Ordinance that requires the implementation of structural and non-structural BMPs within new development and redevelopment areas, including assurances of the long-term operation of these BMPs.

Pollution Prevention and Good Housekeeping for municipal operations such as efforts to reduce storm water pollution from the maintenance of open space, parks and vehicle fleets.

Nonpoint Sources of Pollution

The term nonpoint source pollution (NPS) refers to water pollution that results from a variety of human land uses such as farming, development, logging, resource extraction, land disposal, livestock production and hydromodification. Nonpoint source pollution occurs when rain or snow melt drains over the land. The type of land use determines the type of pollutants that run off with the precipitant and eventually finds its way back to a stream, river or ground water table. As a product of weather patterns, nonpoint source discharges are naturally intermittent and occur more sporadically than point source discharges. Most are diffuse and difficult to quantify. Refer to the landuse/land cover map in the Watershed Inventory section of this plan for an overview of land use patterns in the Paint Creek Watershed.

Except for on-lot wastewater systems, nonpoint sources of pollution related to land use are discussed in great detail in the subwatershed water quality analysis later in this chapter. They are also outlined in Table 3-2, earlier in this section.

On-lot Wastewater Systems

By implementing House Bill 110 (HB110) in 1984, the Ohio General Assembly created Ohio EPA's HB110 program. The program is a contractual partnership between Local Health Districts (LHDs) and Ohio EPA, whereby LHDs conduct, on behalf of the Agency, inspection and enforcement services for commercial sanitary waste treatment/disposal systems discharging between 0-25,000 gallons per day (semi-publics). In addition, local health departments regulate residential on-lot systems such as septic systems.

The Paint Creek Project is currently working with the health departments in each of the nine counties containing portions of the watershed; Clinton, Greene, Fayette, Pickaway, Pike, Highland, Ross, Madison and Clarke. The Paint Creek Project hopes to collect information on the sewered versus unsewered areas in the watershed and areas where potential problems exist. This information will help promote the use of available finds to upgrade and maintain existing systems. One of the implementation goals for the watershed involves inspecting septic systems at regular intervals to ensure acceptable operation. Septic systems are a source of nutrients, organics and fecal coliforms.

Fish Kill Information (ODNR, DOW)

The following information was prepared by Doug Maloney at Ohio DNR, Division of Wildlife. According to Mr. Maloney this information is a conservative record of fish kills in the Paint Creek Watershed. Many fish kills are never reported and smaller kills may not be investigated, even if they are reported. F ish kills caused by unknown sources may have resulted from naturally occurring anoxic conditions or other naturally occurring phenomenon.

Table 3-5: Fish kill information

District	Date	Creek	County	No. killed	Cause
One	8/11/81	Thompson	Fayette	120	No cause
One	9/11/86	Saxton Ditch/Sugar Creek	Madison	50	Not listed
One	8/24/90	Thompson Creek	Fayette/ Madison	6,559 (wild animals)	Liquid hog manure from Quality Feeder Pigs (disputed)
One	10/20/95	Thompson Creek	Fayette/ Madison	1,028	Liquid hog manure from Quality Feeder Pigs
One	8/24/96	Rattlesnake Creek	Fayette	616	Untreated sewage from Rattlesnake WWTP breakdown
One	1/7/07	Sugar Creek	Fayette	None	Fuel oil in stream
One	10/27/97	Rattlesnake Creek	Fayette	18	Cause unknown
One	8/14/98	East Fork Paint Creek	Fayette	108	Cause unknown
One	6/15/99	Sugar Creek	Fayette	43	Cause unknown
Four	5/11/97	Upper Twin Creek	Ross	30	Cause unknown
Five	6/14/90	Lees Creek	Clinton	166	Improper lagoon management and land application

DERR Master Sites List

Table 3-6: Spills or uncontrolled hazardous waste sites

Site Name/Spill	Location	County
EMERY TRANSPORTATION TANKER SPILL	OCTA	Fayette
CALMAR CORP	WASHINGTON CH	Fayette
BIEWER JOHN A CO OF OHIO	WASHINGTON CH	Fayette
ARMCO STEELOX BUILDING TECHNOLOGIES CORP	WASHINGTON CH	Fayette
ALLIED TECHNOLOGY	SABINA	Clinton
MEAD PAINT STREET LANDFILL	CHILLICOTHE	Ross

The sites listed in Table 5 are from the Ohio EPA Division of Emergency and Remedial Response, Master Sites List. Due to lack of relevant information and quality control, this information will be ignored in this report.

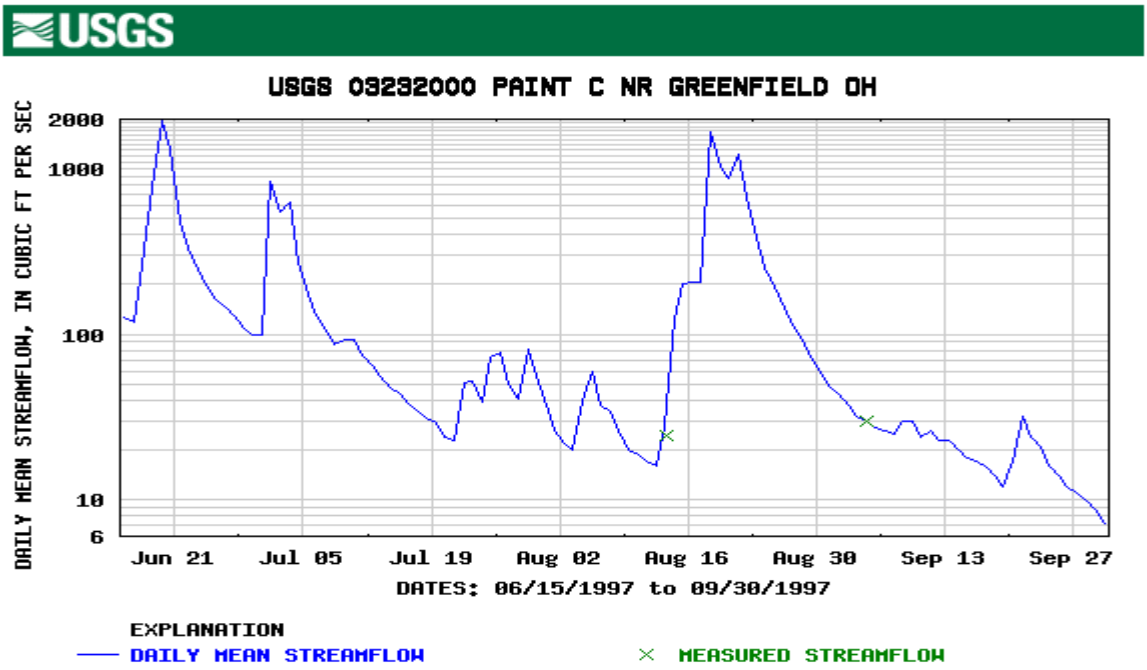
USGS Streamflow Data

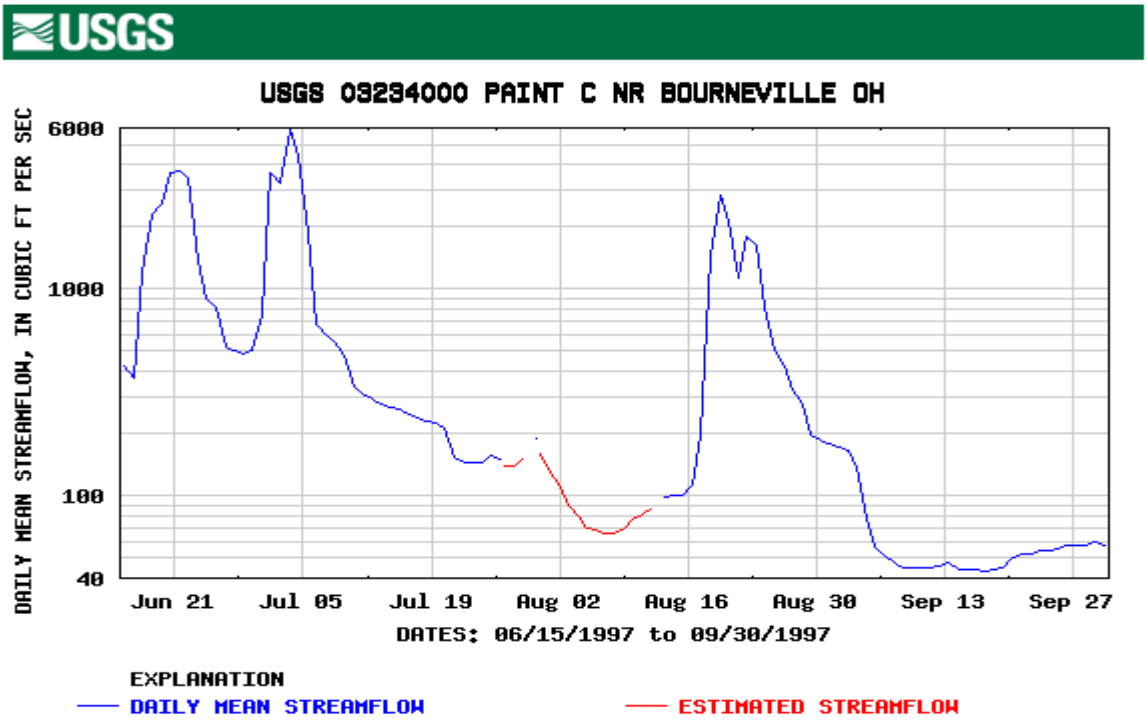
Streamflow data is an important component when characterizing the chemical water quality of a stream. Runoff from a rainfall event may carry sediment and nutrients causing high results in analytical tests. These high results may in turn signify that the buffering capacity of the stream during normal rainfall events is limited and that the channel has been modified or the riparian corridor is of poor quality. The following are streamflow results from the three USGS stream gages that collected data during the 1997 OEPA sampling period.

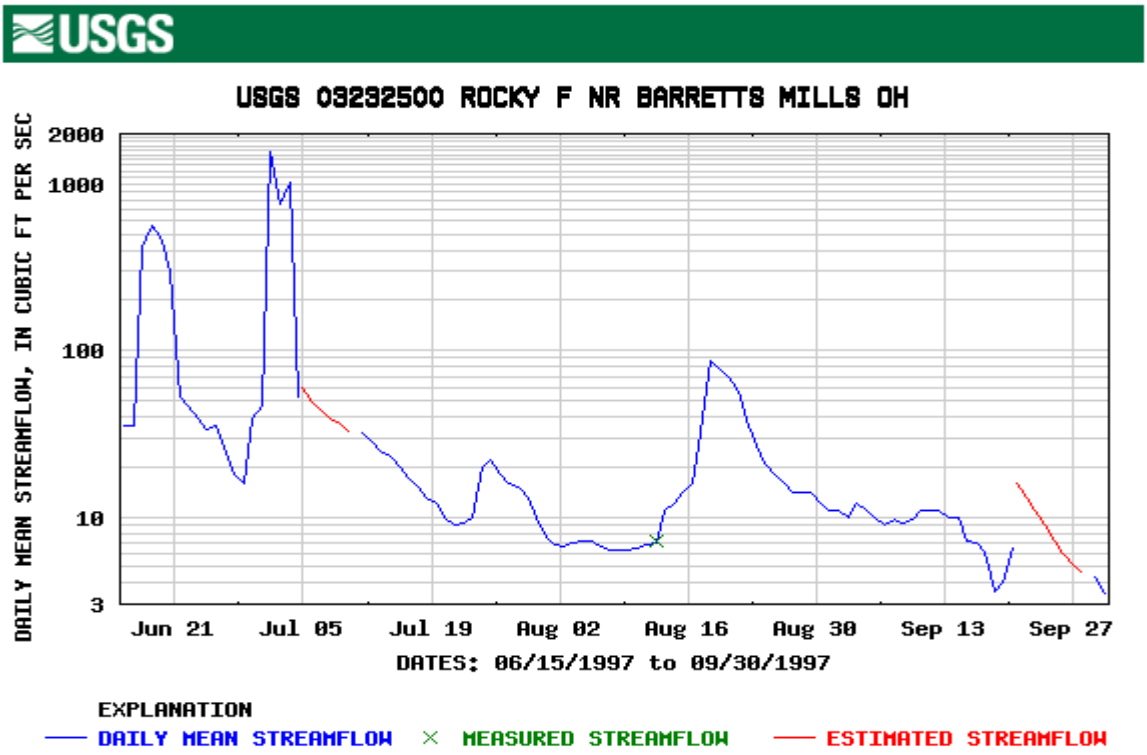
USGS data from Paint Creek near Greenfield indicates that streamflow peaked in June then drops through July. A smaller peak is seen in late July and then a large peak around the 20th of August. The same type of pattern is seen in at the USGS streamflow monitoring station in Paint Creek near Bourneville, except that the stream is much larger at this downstream gauging station and the peaks are much larger. There is some missing data from late July through early August. The USGS data from the monitoring gage on Rocky Fork at Barrett's Mill shows similar peaks in June and July, but a much-reduced peak in late August.

This data indicates that several rainfall events in June, July and August affected the streamflow in the entire watershed. Water quality monitoring information, collected in mid-July and mid-August potentially reflects conditions of the streams after rainfall events, while measurements from early August and early September represent normal low-flow conditions. This information should be taken into account when assessing the water quality of these streams.

Figure 3-1. USGS Streamflow tables (see next page)


USGS
USGS 03232000 PAINT C NR GREENFIELD OH
DAILY MEAN STREAMFLOW, IN CUBIC FT PER SEC
2000
1000
100
10
6
Jun 21
Jul 05
Jul 19
Aug 02
Aug 16
Aug 30
Sep 13
Sep 27
DATES: 06/15/1997 to 09/30/1997
EXPLANATION
DAILY MEAN STREAMFLOW
MEASURED STREAMFLOW


USGS
USGS 03234000 PAINT C NR BOURNEVILLE OH
DAILY MEAN STREAMFLOW, IN CUBIC FT PER SEC
6000
1000
100
40
Jun 21
Jul 05
Jul 19
Aug 02
Aug 16
Aug 30
Sep 13
Sep 27
DATES: 06/15/1997 to 09/30/1997
EXPLANATION
DAILY MEAN STREAMFLOW
ESTIMATED STREAMFLOW



Stream-specific Water Quality Introduction

Habitat, water supply and recreational use designations determine the water quality standards to which a stream must legally comply. Water quality standards are numeric measures of chemical, physical and biological criteria that the state of Ohio uses to show that a stream meets (or does not meet) Federal requirements outlined in the Clean Water Act. Paint Creek Watershed is comprised of both exceptional warm water habitat (EWH) and warm water habitat (WWH), with one stretch of Sugar Creek qualifying as modified warm water habitat (MWH). The streams in the watershed, which are monitored for water quality, are all designated as appropriate for primary contact recreation (PCR), which means that the streams are deep enough to encourage swimming. They are also designated as agricultural and industrial water supplies (AWS and IWS). Paint Creek at river mile 78 is designated as a public water supply as well.

In terms of the criteria assessed in this management plan, only dissolved oxygen and fecal coliforms have water quality standards based on the Clean Water Act. Dissolved oxygen must remain above 5.0 mg/L (24-hour average) for WWH and 6.0 mg/L (24-hour average) for EWH. For WWH individual samples must not dip below 4.0 mg/L and for EWH individual samples must not dip below 5.0 mg/L. Maximum fecal coliform concentrations are determined by recreation designation. For primary contact waters fecal coliform concentrations (by geometric mean of at least five samples) must be less than 1000 bacteria per 100 mL of water, with no more

than 10% of the samples over 2000 bacteria per 100 mL of water. Nitrate concentrations may be compared to maximum contaminant levels (MCLs) for drinking water, which are 10 mg/L, but do not have regulatory limits based on aquatic use designation.

303(d) Listed Streams

Based on water quality standards alone, several streams in the Paint Creek Watershed are listed as not historically meeting Clean Water Act criteria. These streams have been placed on a Federal list called a 303(d) list. They include Paint Creek, Sugar Creek, Rocky Fork, Clear Creek West Branch Rattlesnake Creek and lower Rattlesnake Creek. Please refer to the map entitled, *Paint Creek Watershed: US EPA 303(d) Listed Streams and Lakes*. In addition, Table 3-7 lists the information that is currently available from U.S. EPA on the listed stream segments in the Paint Creek Watershed. This information was some of the earliest information that the Paint Creek Project used to determine streams with water quality impairments. This information is scheduled to be updated every two years.

The last field survey in the Paint Creek Basin was conducted in 1997, and several streams including Rocky Fork, Clear Creek and Paint Creek may subsequently be removed from the 303(d) list. These streams, for the most part, met their designated standards. The next series of maps entitled, *Paint Creek Watershed: Monitoring Point Locations by Subwatershed*, *Paint Creek Watershed: Monitoring Points by River Mile*, and *Paint Creek Watershed: Water Quality by USGS 11- and 14-digit Subwatersheds*, illustrate where the watershed was sampled during the 1997 survey, the overall attainment of the streams at each monitoring point, and the inferred water quality throughout the watershed.

Table 3-7: Summary table of 303 (d) listed streams (please refer to water quality information by subwatershed for more information).

Waterbody River mile	Attainment	Documented WQ problems	Sources of problems
Clear Creek HW-5.2	Full-EWH		
Clear Creek 5.2-RFL	Partial-EWH	Habitat alteration	Hydromodification-agriculture, streambank destabilization-ag, natural
Clear Creek Moberly Branch	Partial-WWH	Cause unknown, flow alteration	Source unknown, urban runoff/stormwater, other urban runoff
Rocky Fork HW-RFL	Full-EWH		
Rattlesnake Creek HW-38.10	Full-WWH		
Rattlesnake	Partial-WWH	Habitat alterations,	Hydromodification, agriculture,

Waterbody River mile	Attainment	Documented WQ problems	Sources of problems
Creek 38.10-35.50		nutrients, organic enrichment, low DO, pH, ammonia	channelization-agriculture, pasture, agriculture, point source, minor municipal point source, land disposal, septic systems, non-irrigated crop production
Rattlesnake Creek 35.50-18.0	Non-WWH	Habitat alterations, nutrients, organic enrichment, low DO, pH, ammonia	Hydromodification, agriculture, channelization-agriculture, pasture, agriculture, point source, minor municipal point source, land disposal, septic systems, non-irrigated crop production
Rattlesnake Creek 18.0-7.8	Partial-WWH	Habitat alterations, nutrients, organic enrichment, low DO, pH, ammonia	Hydromodification, agriculture, channelization-agriculture, pasture, agriculture, point source, minor municipal point source, land disposal, septic systems, non-irrigated crop production
Rattlesnake Creek 7.8-PCL	Full-WWH		
Sugar Creek HW-24.3	Partial WWH	Habitat alterations, nutrients, siltation, organic enrichment, low DO	Lack of physical habitat- riparian and in-channel, organic enrichment from intensive row crop and livestock agriculture, channelization
Sugar Creek 24.3-12.0	Non-WWH	Habitat alterations, nutrients, siltation, organic enrichment, low DO	Lack of physical habitat- riparian and in-channel, organic enrichment from intensive row crop and livestock agriculture, channelization, point source-Jeffersonville WWTP creates suspended solids loading (algae) and DO problems dstr, also minor municipal point source
Sugar Creek 12.0-Confl w/ Paint Cr	Partial-WWH	Habitat alterations, nutrients, siltation, organic enrichment, low DO	Lack of physical habitat- riparian and in-channel, organic enrichment from intensive row crop and livestock agriculture, recovery from Jeffersonville WWTP inputs is not complete
Paint Creek HW-88.6	Full- WWH	Nutrients, siltation, organic enrichment, low DO	Agriculture, Crop production, pasture, hydromodification, removal or riparian vegetation
Paint Creek 88.6-	Partial-	Nutrients, siltation,	Agriculture, Crop production,

Waterbody River mile	Attainment	Documented WQ problems	Sources of problems
70.9	WWH	organic enrichment, low DO	pasture, hydromodification, removal or riparian vegetation
Paint Creek 70.9-67.3	Mixed full and partial-WWH	Nutrienst, siltation, organic enrichment, low DO	Includes Washington CH WWTP mixing zone, stormwater runoff
Paint Creek 67.3-58.7	Partial- EWH	Organic enrichment, low DO,	Washington CH WWTP, stormwater runoff
Paint Creek 58.7-PCL	Full-EWH		
Paint Creek PCL(37.5)-35.5	Non-EWH	Flow alteration	Outfall PCL causes low DO, and high ammonia concentrations
Paint Creek 35.5-4.6	Full-EWH		
Paint Creek 4.6-Confl w/ Scioto River	Full-WWH	Slight organic enrichment	MeadWestvaco

Reference Stream Values by Ecoregion

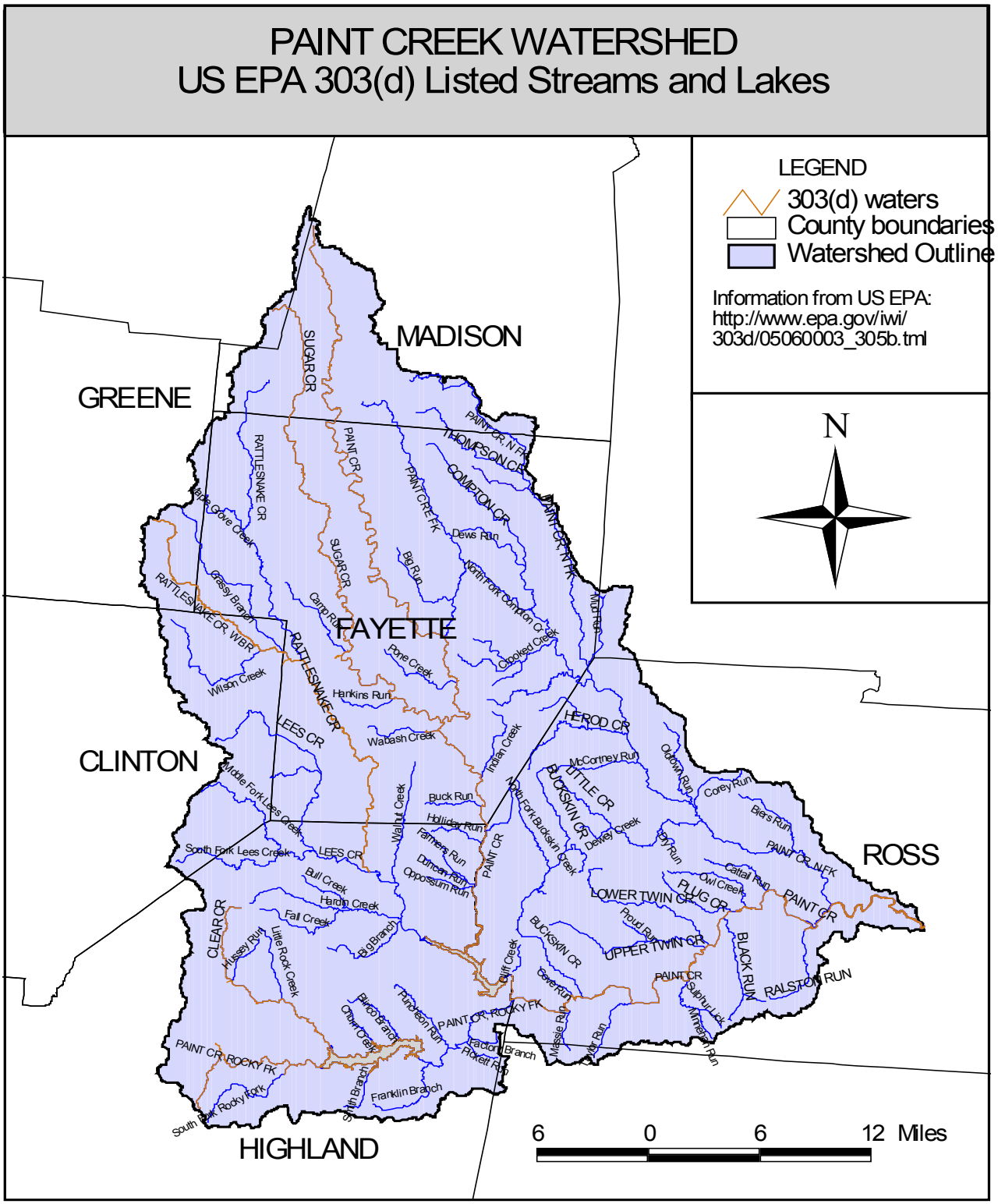
Another way in which to judge the water quality of streams in the watershed is look at how their chemical measurements compare to those of other streams of similar sizes in other watersheds. In 1999, Ohio EPA compiled the measurements of hundreds of streams that represented the best water quality in the state and published a paper entitled, Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams. The streams were all grouped by ecoregion and their values averaged to generate a numeric representation of a reference or background condition. Numbers that represent the 75th, 95th and 99th percentiles were also generated. This study uses the 75th percentile values as benchmarks against which to measure the water quality monitoring results from the 1997 Paint Creek Watershed data.

Paint Creek Watershed falls into three ecoregions. It is mainly located in the Eastern Cornbelt Plains (ECBP), but some areas fall within the Western Allegheny Plateau (WAP) and the Interior Plateau (IP). Several of the monitoring points in the Paint Creek Watershed are categorized as reference points and used in this study. It should be noted that while the reference sites represent high quality streams that meet all water quality standards, they still exhibit some degree of anthropogenic influence. Table 3-8 lists the 75th percentile reference values for different sized streams in each of the ecoregions.

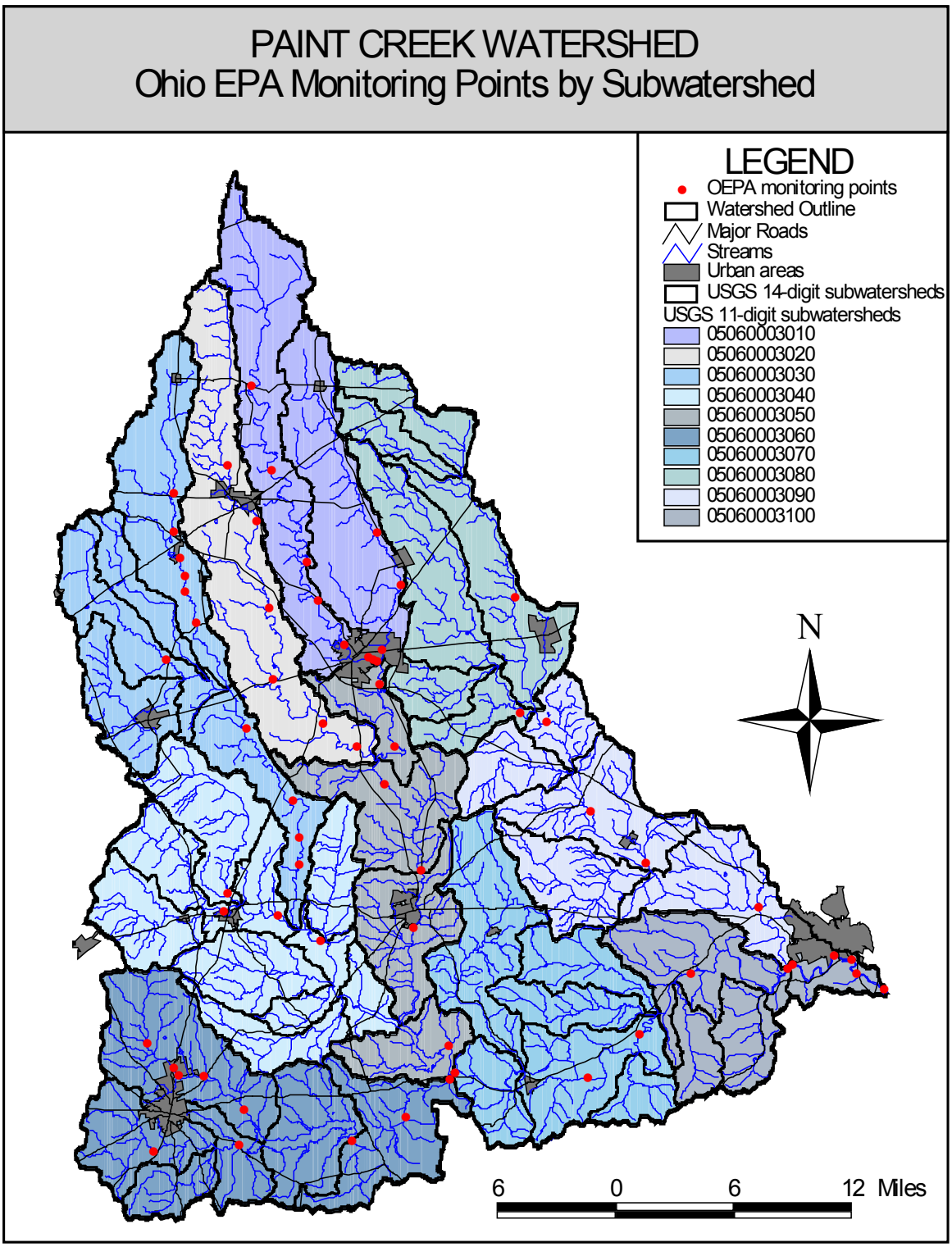
Table 3-8: Reference water quality values by Paint Creek Watershed ecoregion

Parameter	Headwaters 75th Percentile	Wadeable 75th Percentile	Small River 75th Percentile	Large River 75th Percentile
Eastern Cornbelt Plains				
Dissolved oxygen	6.6 mg/L	6.95 mg/L	7.6 mg/L	5.975 mg/L
Fecal coliform	960 per 100 mL	860 per 100 mL	375 per 100 mL	1387 per 100 mL
Total suspended solids	14.000 NTU	29.000 NTU	41.000 mg/L	46.000 NTU
Nitrate/nitrite	2.268 mg/L	2.815 mg/L	3.09 mg/L	4.250 mg/L
Total phosphorous	0.080 mg/L	0.130 mg/L	0.240 mg/L	0.868 mg/L
Western Allegheny Plateau				
Dissolved oxygen	7.175 mg/L	7.000 mg/L	7.025 mg/L	6.875 mg/L
Fecal coliform	1220 per 100 mL	900 per 100 mL	2430 per 100 mL	490 per 100 mL
Total suspended solids	11.000 NTU	16.500 NTU	19.000 NTU	34.000 NTU
Nitrate/nitrite	0.350 mg/L	0.480 mg/L	1.043 mg/L	2.220 mg/L
Total phosphorous	0.050 mg/L	0.060 mg/L	0.100 mg/L	0.248 mg/L
Interior Plateau				
Dissolved oxygen	7.700 mg/L	6.600 mg/L	6.400 mg/L	8.100 mg/L
Fecal coliform		515 per 100 mL	423 per 100 mL	
Total suspended solids	25.000 NTU	41.250 NTU	31.000 NTU	
Nitrate/nitrite	1.205 mg/L	0.520 mg/L	1.000 mg/L	2.960 mg/L
Total phosphorous	0.205 mg/L	0.130 mg/L	0.138 mg/L	0.665 mg/L

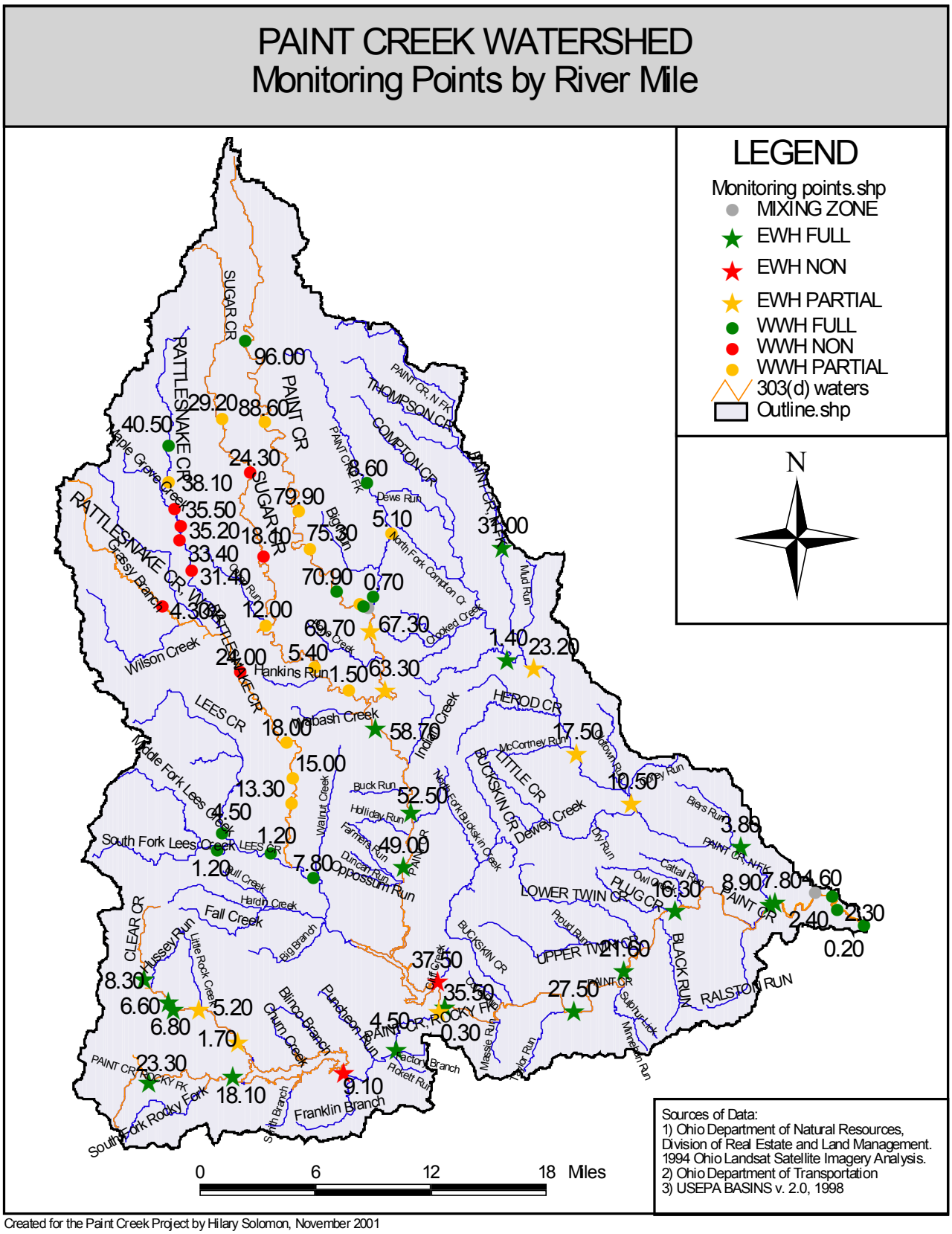
Headwater, <20 miles^2 watershed area; Wadeable, ≥20 and <200 miles^2 watershed area; Small River, ≥200 miles^2 watershed area and <2000 miles^2 watershed area; and Large River, >1000 miles^2 watershed area.



Created by Hilary Solomon for the Paint Creek Project, September 2001



Prepared for the Paint Creek Project by Hilary Solomon, September 2001



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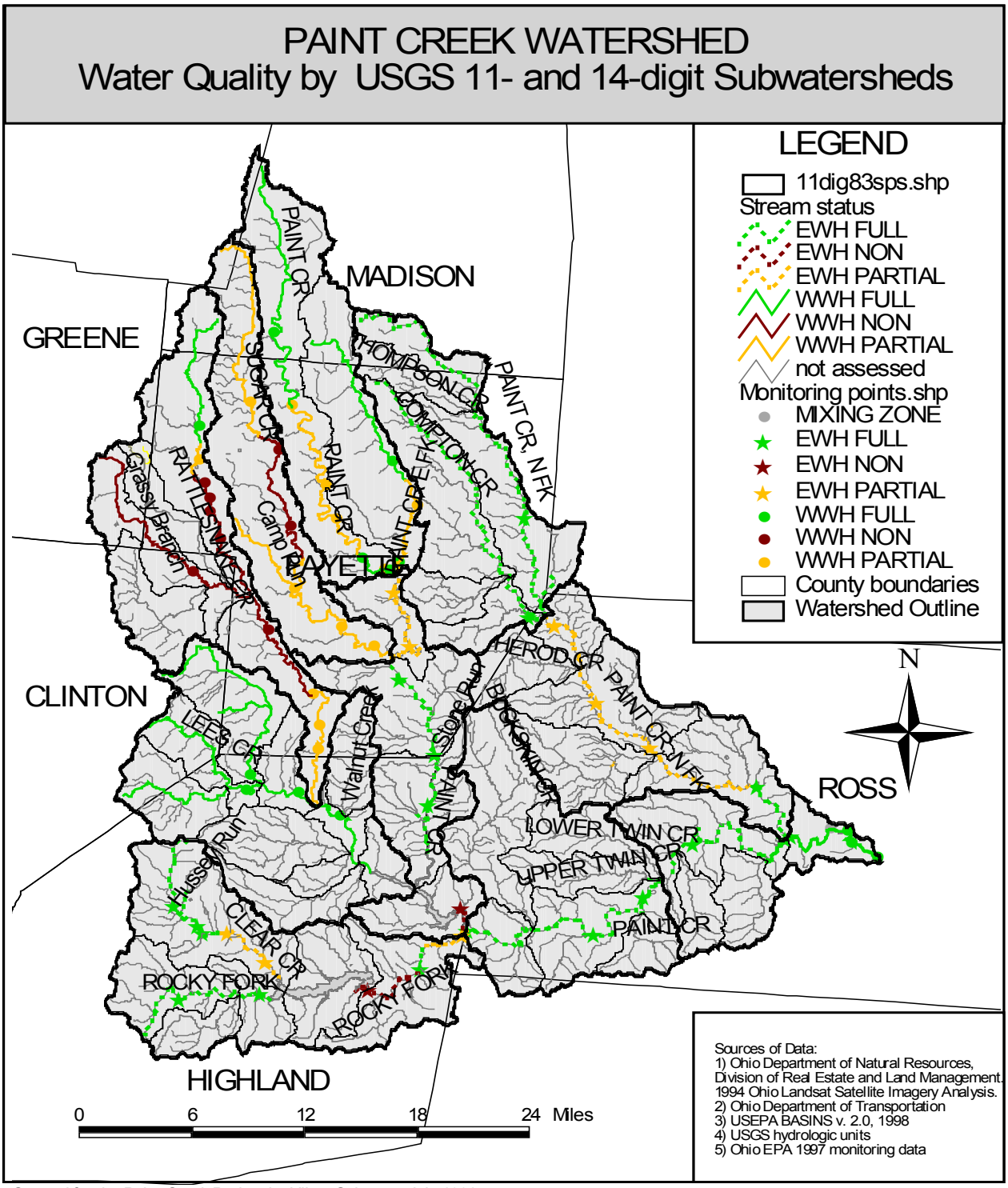
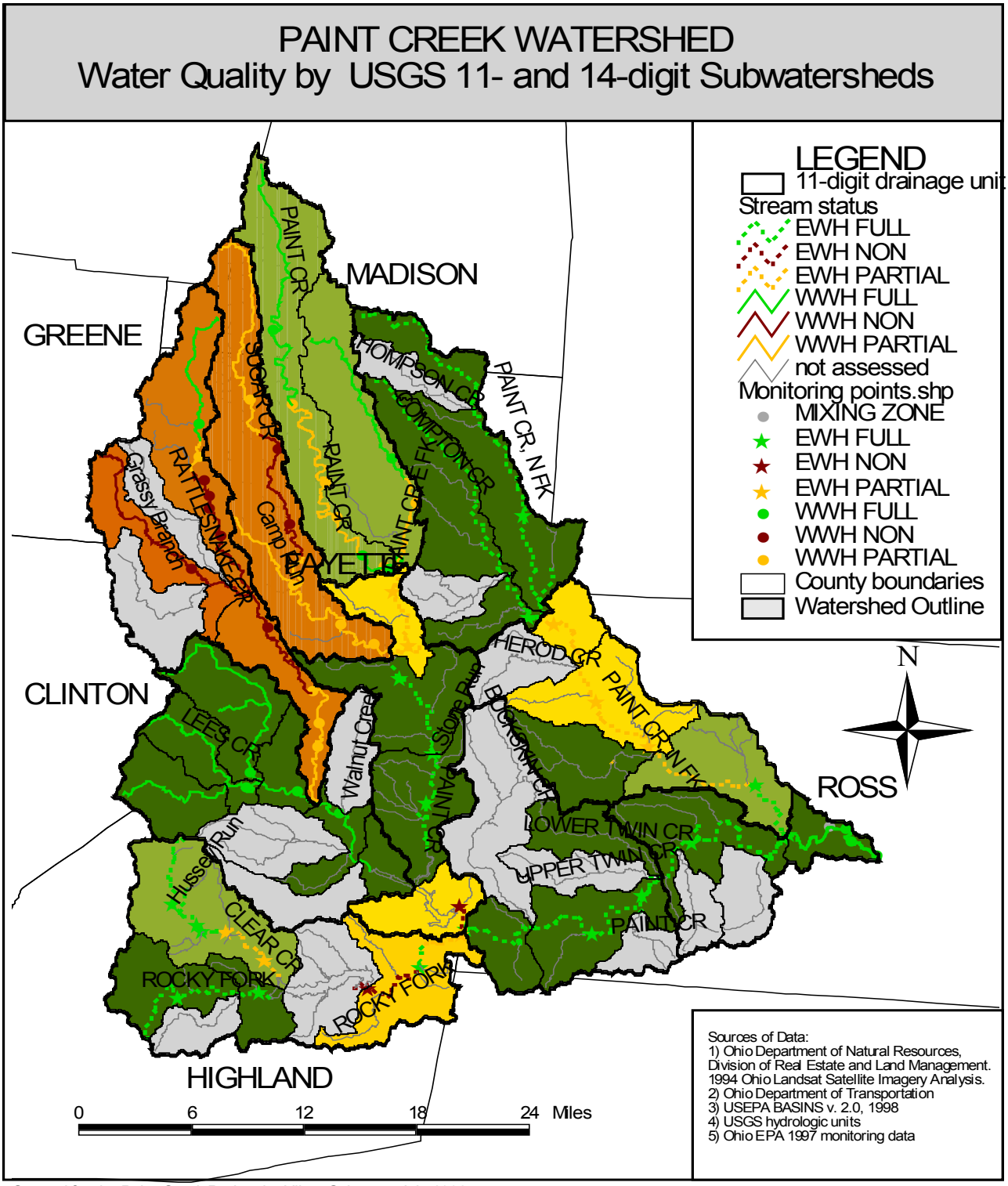
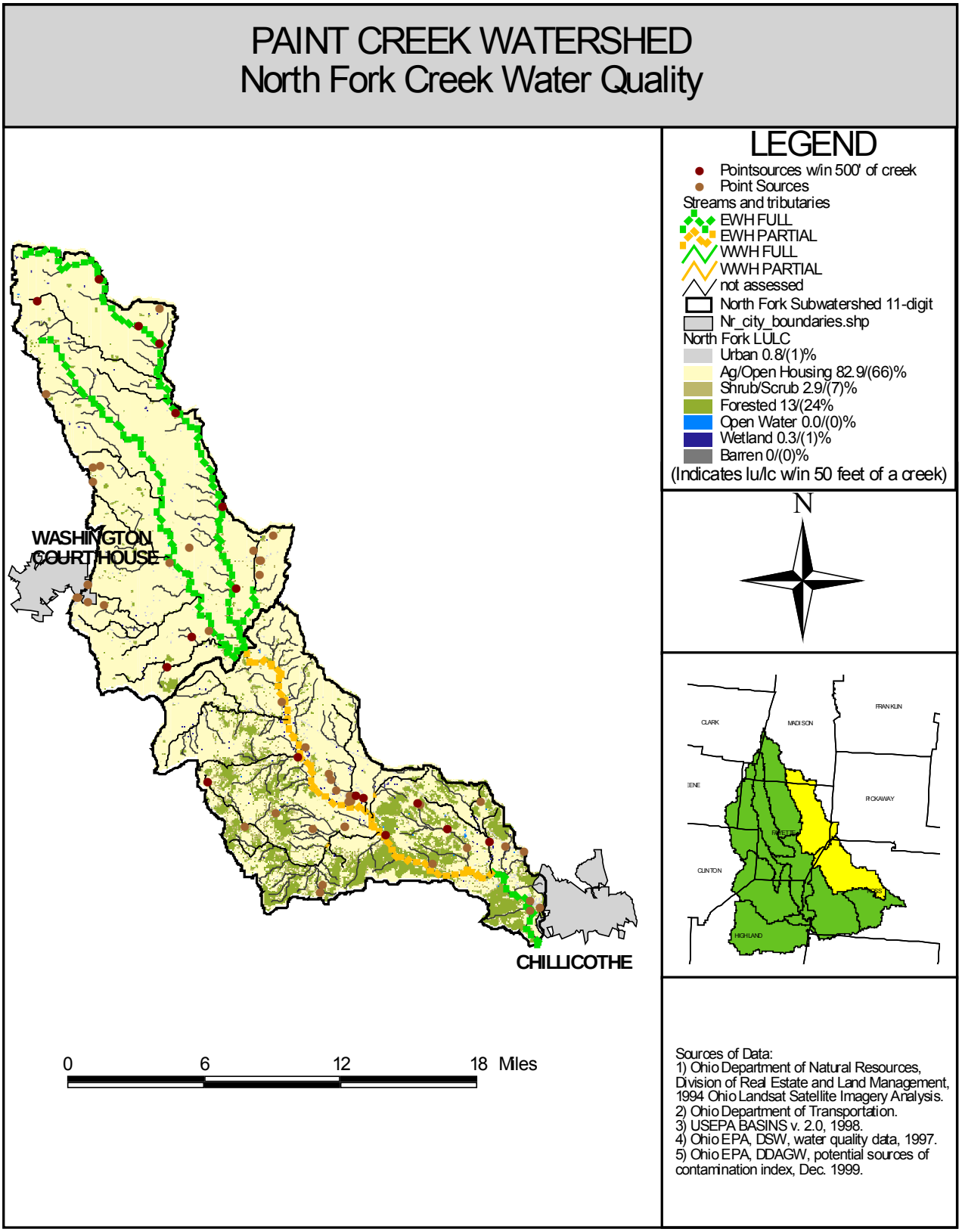


Created for the Paint Creek Project by Hilary Solomon, July 2002



Created for the Paint Creek Project by Hilary Solomon, July 2002

NORTH FORK of PAINT CREEK



Created by Chris Smid for the Paint Creek Project, May 2002

North Fork Paint Creek Water Quality

During the summer of 1997, the North Fork subwatershed was sampled in six locations. Chemical, biological and habitat monitoring was conducted by Ohio EPA. The monitoring locations are described in Table 3-9.

Table 3-9: North Fork monitoring point locations

RIVER MILE	STREAM	LOCATION	ECO-REGION	SIZE*	HABITAT	ATTAINMENT
3.80	North Fork Paint Creek	US 50 Dst. Pleasant Valley WWT	ECBP	SR	EWH	Full
10.50	North Fork Paint Creek	Musselman Dst. Frankfort WWTP	ECBP	SR	EWH	Partial
17.50	North Fork Paint Creek	Dexter Rd. Ust. Frankfort WWTP	ECBP	W	EWH	Partial
23.20	North Fork Paint Creek	Woodrow Rd. Dst. N. Holland WW	ECBP	W	EWH	Partial
31.00	North Fork Paint Creek	Glaze Road	ECBP	W	EWH	Full
1.40	Compton Creek	Dogtown Rd.	ECBP	W	EWH	Full

*HW=Headwater, <20 miles^2 watershed area; W=Wadeable, ≥20 and <200 miles^2 watershed area; SR=Small River, ≥200 miles^2 watershed area and <2000 miles^2 watershed area; and LR=Large River, >1000 miles^2 watershed area.

North Fork is located in the Eastern Corn Belt Plains Ecoregion. It is characterized in the Ohio Administrative Code (OAC) 3745-1-09; Table 9-1, as exceptional warmwater habitat (EWH) used for agricultural water supply (AWS), industrial water supply (IWS) and primary contact recreation (PCR). Of the parameters described in this report; total suspended solids (TSS), fecal coliform, nitrate/nitrite, total phosphorous and dissolved oxygen; only fecal coliform and dissolved oxygen have water quality standards. Nitrate concentrations may be compared to maximum contaminant levels (MCLs) for drinking water.

For primary contact waters fecal coliform concentrations (by geometric mean of at least five samples) must be less than 1000 bacteria per 100 mL of water, with no more than 10% of the samples over 2000 bacteria per 100 mL of water. With measurements of 4400 and 1200 bacteria per 100 mL of water, fecal coliform bacteria concentrations in North Fork exceeded the primary contact recreation (PCR) maximum criterion on one of the five sample dates, August 14, 1997. Dissolved oxygen concentrations and nitrate concentrations did not exceed the legal maximums.

In comparison to similar size high quality reference streams located in the same ecoregion, North Fork exceeded average total suspended solids concentrations (29 mg/L) on July 29 and August 14, both rainfall events. Fecal coliforms were exceeded on August 14 and nitrate/nitrite was exceeded in all but one measurement. Phosphorous concentrations (0.13 mg/L) were exceeded on July 14, 1997. Additionally the monitoring point at river mile 31 did not meet dissolved oxygen minimum numbers in July. The data thus illustrated that sediment, fecal coliforms and nutrients were substantial pollutants in the North Fork basin, with substantial inputs associated with rainfall events.

North Fork of Paint Creek Water Quality Data*

Total Suspended Solids

River Mile	7/14/1997	7/29/1997	8/14/1997	9/5/1997	9/16/1997	Reference
31	19	**34**	**41**	10	8	29
23.2	16	**42**	**72**	5	5	29

Fecal Coliforms

River Mile	7/14/1997	7/29/1997	8/14/1997	9/5/1997	9/16/1997	Reference
31	480	340	**4400**	120	150	860
23.2	230	440	**1200**	130	160	860

Nitrate/nitrite

River Mile	7/14/1997	7/29/1997	8/14/1997	9/5/1997	9/16/1997	Reference
31	**2.59**	**1.85**	**0.75**	**0.94**	**0.92**	0.49
23.2	**3.02**	**1.57**	0.3	**1.59**	**1.38**	0.49

Phosphorous

River Mile	7/14/1997	7/29/1997	8/14/1997	9/5/1997	9/16/1997	Reference
31	**0.52**	0.12	0.09	0.11	0.05	0.13
23.2	**0.47**	0.08	0.09	0.6	0.09	0.13

Dissolved Oxygen

River Mile	7/14/1997	7/29/1997	8/14/1997	9/5/1997	9/16/1997	Reference
31	**6.34**	**6.52**	7.26	9.78	7.22	6.95
23.2	11.01	8.52	8.94	10.93	NA	6.95

*Adapted from Ohio EPA 1997 Paint Creek Basin field survey

Bolded values are above (or below in the case of dissolved oxygen) associated reference stream 75th percentile concentrations.

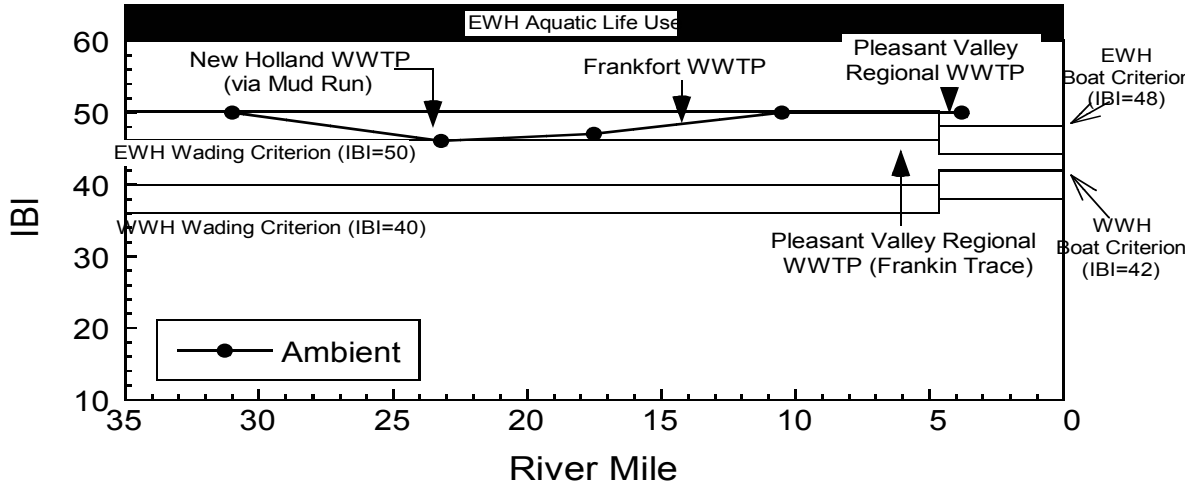
Biological Indices

The North Fork of Paint Creek Subwatershed is located in the Eastern Corn Belt Plains (ECBP) Ecoregion. The species composition expected in each ecoregion is slightly different, which translates into different numeric biocriteria for each aquatic use designation. Again, the IBI measures fish species diversity and population composition. It accounts for total native populations, indicator species, overall fish condition and pollution intolerant versus pollution tolerant fish species. The MIwb measures similar characteristics of the fish population, however, it subtracts 13 pollution tolerant fish species out of the final score. The ICI measures the composition of the invertebrate community and compares the numbers of pollution tolerant species with pollution intolerant species. The biocriteria for ECBP ecoregion are listed below:

Ecoregion Biocriteria: E. Corn Belt Plains (ECBP)
(OAC 3745-1-07, Table 7-14)

Index- Site Type	WWH	EWH
IBI- Boat	42	48
MIwb- Boat	8.5	9.6
ICI	36	46

Though the IBI scores decreased slightly near the New Holland WWTP, they remained within EWH criterion throughout the length of the stream. The ICI scores were also excellent, with no decrease near the New Holland WWTP. The MIwb scores showed a significant departure from EWH criteria near the New Holland WWTP (approximately RM 24) and did not recover until river mile 10, near the Pleasant Valley WWTP. The upper reaches of the subwatershed are threatened by agricultural activities such as livestock access, channelization, and riparian removal. These threats are manifested in high fecal coliform measurements and excessive siltation. The result is decreased dissolved oxygen in the water column and filling of deep pools. Fish scores at Dexter Road (RM 17.5) in 1983 were higher than the 1997 survey results, indicating a decrease in fish population quality (Moore, 2002).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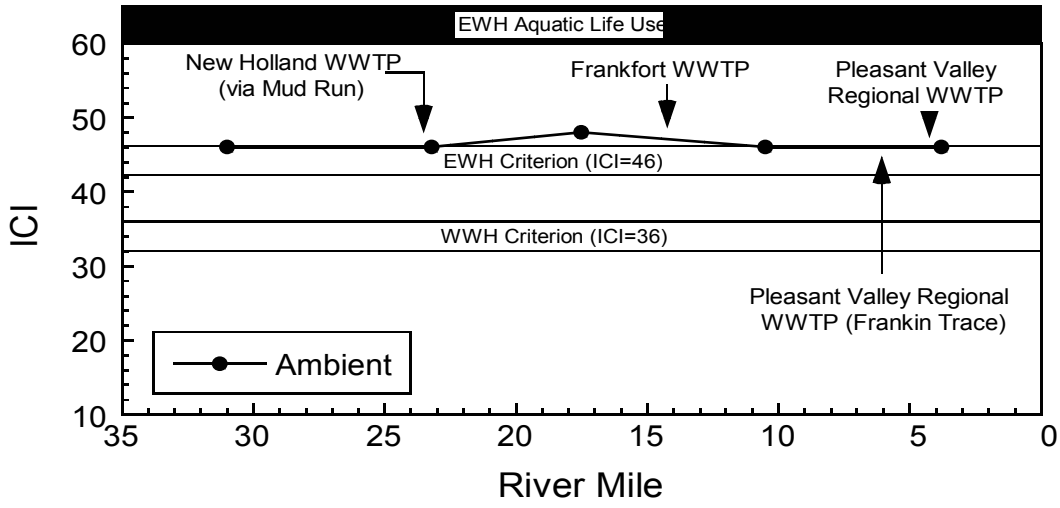
New Holland WWTP
(via Mud Run)
Frankfort WWTP
Pleasant Valley
Regional WWTP
EWH
Boat Criterion
(IBI=48)
EWH Wading Criterion (IBI=50)
WWH Wading Criterion (IBI=40)
Pleasant Valley Regional
WWTP (Frankin Trace)
WWH
Boat Criterion
(IBI=42)
Ambient
IBI
River Mile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(via Mud Run)
Frankfort WWTP
Pleasant Valley
Regional WWTP
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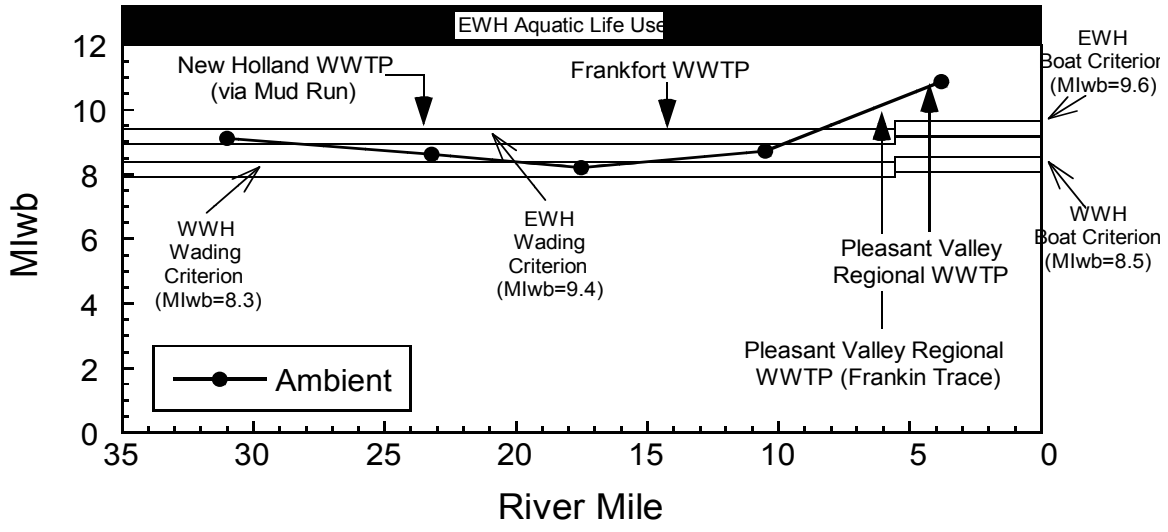
WWH Criterion (ICI=36)
Pleasant Valley Regional
WWTP (Frankin Trace)
Ambient
ICI
River Mile


EWH Aquatic Life Use
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Frankfort WWTP
EWH
Boat Criterion
(MIwb=9.6)
WWH
Wading
Criterion
(MIwb=8.3)
EWH
Wading
Criterion
(MIwb=9.4)
Pleasant Valley
Regional WWTP
WWH
Boat Criterion
(MIwb=8.5)
Pleasant Valley Regional
WWTP (Frankin Trace)
Ambient
MIwb
River Mile

Qualitative Habitat Evaluation Index (QHEI)

The QHEI is a qualitative measurement of the presence and quality of physical habitat components that support aquatic life. 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 habitat characteristics that are used to determine the QHEI score include substrate, instream cover, channel morphology, riparian vegetation and bank erosion, gradient, and flow patterns (pool, run and riffle development). The QHEI score ranges from 20 to less than 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 sites around the state (OEPA, 2002, Bokes TMDL) 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 having the ability to support exceptional warmwater faunas. The QHEI can be used to direct restoration efforts for habitat and to provide a monitoring tool to measure progress toward habitat goals.

The QHEI scores for North Fork indicate that the upper reaches of the creek show evidence of substantial siltation and channel embeddedness. The channel was recovering from modification and canopy removal and the riparian corridor consisted of grass banks with heavy erosion. Past unrestrained cattle access and loss of riparian corridor caused large-scale sedimentation. At RM 31.0 there is an unsupported outside bend adjacent to agricultural fields with no riparian zone. These badly eroding banks illustrate the adverse effects of activities too close to the stream and removal of the riparian buffer. In addition, braided channels have formed in the upper reaches of the watershed. This area will need to be targeted with education, conservation tillage and riparian buffer enhancement programs.

North Fork QHEI scores were high in the lower reaches of the creek. However, insufficient riparian buffer continues to threaten water quality. In places channel modification, lack of instream habitat and sedimentation also threaten the creek in the lower reaches. Throughout the stream, deep pools are filling with sediments and fish biomass is decreasing (Moore, 2002).

Table 3-10 describes the QHEI scores from the 1997 survey of North Fork of Paint Creek. These scores and the information in the comments field are derived from the field notes taken by employees of Ohio EPA's Ecological Assessment Unit.

Table 3-10. Qualitative Habitat Evaluation Index (QHEI) for North Fork Paint Creek

River Mile	Location	Score	Comments
31.0	Glaze Road	66.5	• **Substrate**: moderate to heavy silt and moderate embeddedness • **Instream habitat**: moderate • **Morphology**: good pool, riffle, run development, recovering from channelization and canopy removal • **Riparian**: none to very narrow (<5m), grass banks with moderate to severe erosion • **Flood plain**: open pasture with livestock in stream and row crop
23.2	Woodrow Road downstream New Holland WWTP	72.0	• **Substrate**: moderate silt with normal to moderate embeddedness • **Instream habitat**: sparse to moderate • **Morphology**: Recovering from channelization, levied beyond narrow riparian • **Riparian**: very narrow to moderate • **Flood plain**: row crops on both sides
17.5	Dexter Road Upstream Frankfort WWTP	74.5	• **Substrate**: moderate to normal silt and normal embeddedness • **Instream habitat**: moderate • **Riparian**: narrow to wide (5-10m), no to little bank erosion • **Flood plain**: open pasture and row crop
10.5	Musselman Road downstream Frankfort WWTP	86.5	• **Substrate**: normal to moderate silt and normal embeddedness • **Instream habitat**: moderate • **Morphology**: classic pool, riffle and run development • **Riparian**: narrow to wide (5->50m), little to moderate bank erosion • **Flood plain**: fenced pasture and row crop
3.8	Upstream Paint Creek	76.5	• **Substrate**: normal silt and moderate embeddedness • **Instream habitat**: moderate • **Morphology**: good development • **Riparian**: narrow to moderate • **Floodplain**: residential, Super K-Mart
1.4	Compton Creek	80.0	•

Nonpoint Sources of Pollution

Nonpoint sources of pollution include the following associated problems: siltation, nutrient/organic enrichment, low dissolved oxygen, and habitat alteration. Habitat alteration may include channelization, which creates a lack of riparian and in-stream physical habitat. Landuse and land cover within the subwatershed is a good indicator of potential sources of pollution. The main land uses in the Rocky Fork subwatershed are agricultural/open housing (83%) and forested (13%). Within 50 feet of the creeks, land use is also predominantly agricultural/open housing (66%) with increased forest cover of 24% (ODNR, 1994).

It is apparent from the land use statistics listed below that the majority of the nonpoint source pollution in this subwatershed will be related to agricultural and open residential with miner contributions from logging and forestry operations. Agriculture is commonly associated with sedimentation, nutrient enrichment, organic loading, and channel modification. If livestock pasturing along the creek is involved, fecal coliform bacteria and bank destabilization may also be present. Open residential may be associated with nutrients and fecal coliforms from lawn care and failing on-lot waste treatment systems. During land development activities such as grading and building, sedimentation is also usually a problem. Forestry, like agriculture, can be associated with sedimentation and canopy removal near the stream banks.

Nonpoint sources in the subwatershed are not limited to rural activities. Urban areas, such as Frankfort, also contribute nonpoint pollutants from storm water runoff and development. Urban areas, with high percentages impervious surfaces are also associated with increased and/or sporadic creek flow rates due to runoff quickly reaching the creek after a rainfall event. This causes extremely high flows shortly after the rainfall event as the water rushes across paved surfaces to the creek instead of infiltrating the soil and recharging the groundwater aquifer. This unnaturally high flow is followed by low flows deprived of groundwater recharge.

Table 3-11: Landuse and land cover in the North Fork Subwatershed

Landuse/land cover category	Percent in North Fork Paint Creek subwatershed	Percent w/in 50 feet of creek and tributaries
Urban	0.8	1.0
Ag/Open Housing	82.9	66.0
Shrub/Scrub	2.9	7.0
Forested	13.0	24.0
Open Water	0.0	0.0
Wetlands	0.3	1.0
Barren	0.0	0.0

Derived from the Ohio DNR, Division of Real Estate, 1994 land cover data.

Point Sources of Pollution

Point sources of pollution include direct discharges to the stream. The Village of New Holland WWTP was designed to treat 0.16 MGD and discharges to North Fork of Paint Creek at RM 26.7. Flow from the plant has remained around 50-60% of design capacity, but has begun to increase very slowly. According to Ohio EPA records, pollutant loadings vary widely, but are insignificant. The Village of Frankfort also operates a WWTP that discharges to North Fork. Both of these dischargers are regulated by Ohio EPA's National Pollution Discharge Elimination System (NPDES) permit program. The other NPDES permit in the subwatershed is operated by American Aggregates, a cut stone and stone processing facility.

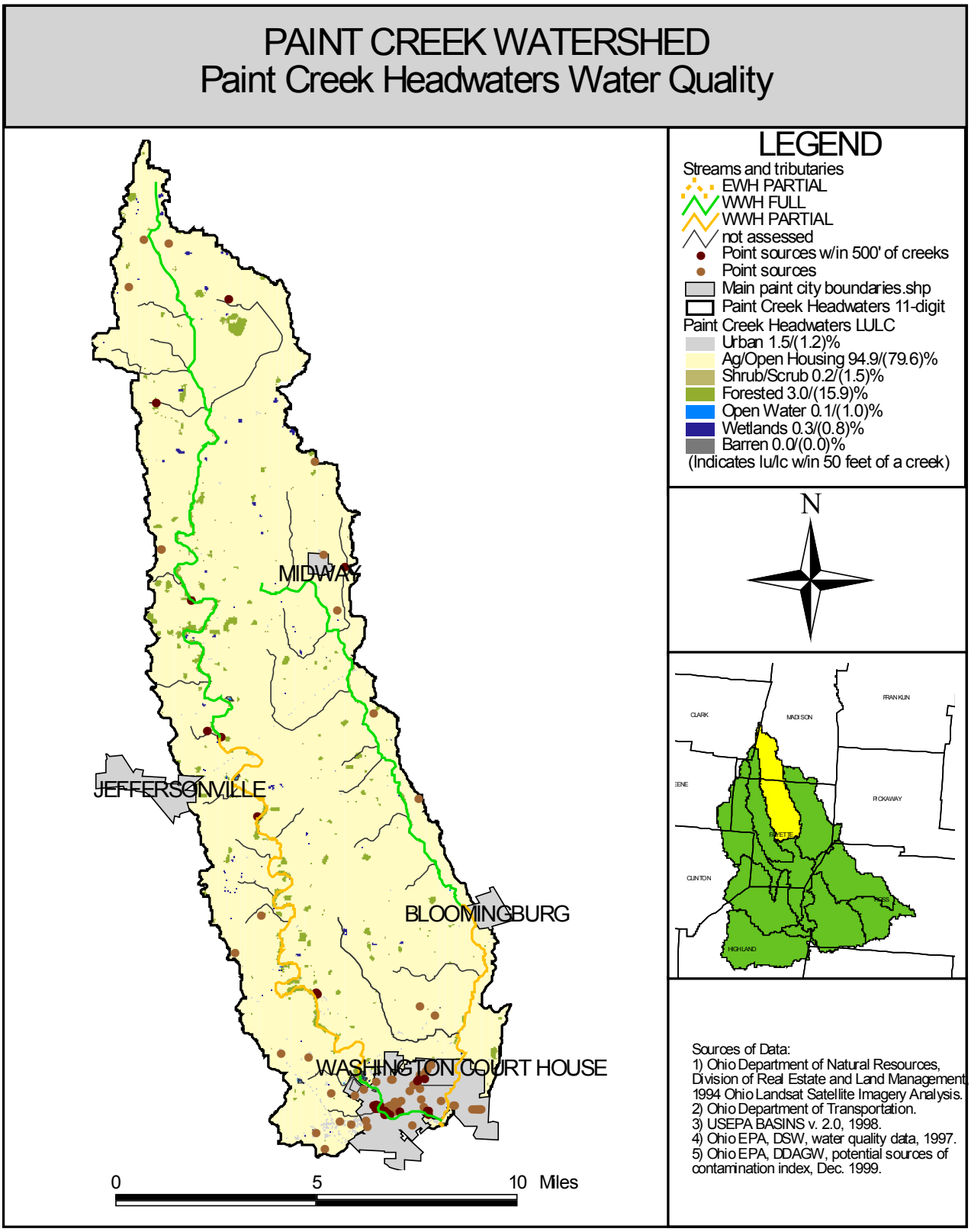
Other types of point sources are surface impoundments, or ponds that only discharge during rainfall/overflow events. Surface impoundments in the North Fork subwatershed include the Russell Bawdle Farm, Pioneer School, and North Fork Village.

Problem Statement

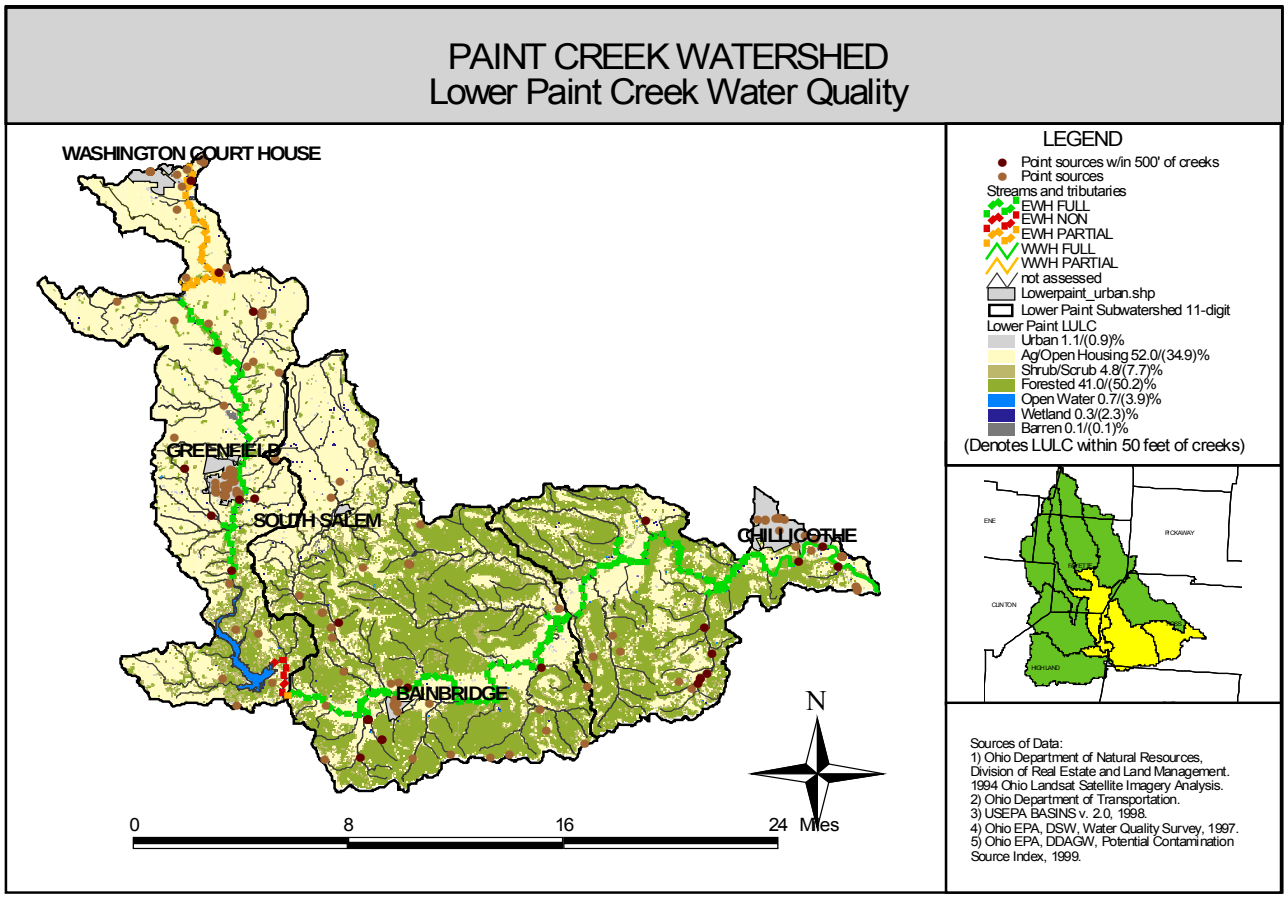
North Fork only partially attains its use designation between RM 23.2 and 3.8. The high quality conditions that characterize the upper reaches of North Fork are threatened by agricultural activities: livestock access, channelization, riparian removal, and the coinciding siltation from erosion. Other threats present in the basin include several minor WWTPs, the possibility of on-lot wastewater system failures and storm water drainage for urban areas. In the headwaters (Glaze Rd. RM 31.0) there are narrow to non-existent riparian corridors, sediment embedding the channel substrate and nutrient enrichment. Unrestrained cattle access (4400/100mL fecal coliform bacteria) and loss of riparian corridor has allowed large-scale sedimentation. In places a braided channel has formed in response to excess sedimentation, while in others deep pools are filling with silt and sand. In addition, enriched conditions have contributed to low diel dissolved oxygen in the water column. These problems have resulted in lower fish scores in 1999 when compared to 1983 scores, indicating a decrease in species composition and quality. Though the scores still meet EWH targets, they are threatening to dip below if this degradation trend continues.

MAIN STEM of PAINT CREEK

Including East Fork



Created by Hilary Solomon for the Paint Creek Project, May 2002



Created by Hilary Solomon for the Paint Creek Project, May 2002

Main Stem Paint Creek Water Quality

During Ohio EPA's 1997 monitoring survey of the Paint Creek Watershed, Paint Creek was sampled in 24 locations. The creek was sampled for chemical, biological and habitat parameters. The monitoring locations are listed in Table 3-12.

Table 3-12: Paint Creek monitoring point locations.

RIVER MILE	STREAM	LOCATION	ECO-REGION	W/S SIZE*	HABITAT	ATTAINMENT
96.00	Paint Creek	Charles Chillicothe Rd.	ECBP	HW	WWH	Full
88.60	Paint Creek	Hidy Rd. adj Hidy Cemetary	ECBP	HW	WWH	Partial
79.90	Paint Creek	adj. Wildwood Rd	ECBP	W	WWH	Partial
75.30	Paint Creek	Eber Bloomongburg Rd.	ECBP	W	WWH	Partial
70.90	Paint Creek	downstream from Perry Park	ECBP	W	WWH	Full
69.70	Paint Creek	Ust Bypass, highly modified re	ECBP	W	WWH	Partial
67.50	Paint Creek	Dst. WCH WWTP Ust. Old SR 35	ECBP	W	WWH	
69.40	Paint Creek	WCH WWTP mixing zone	ECBP	W	WWH	Full
67.30	Paint Creek	Dst. WCH WWTP, Dst. Old 35	ECBP	W	EWH	Partial
63.30	Paint Creek	Flakes Ford Rd	ECBP	W	EWH	Partial
58.70	Paint Creek	Miami Trace Rd. at Rock Mills	ECBP	SR	EWH	Full
52.50	Paint Creek	SR 753 Ust Greenfield WWTP	ECBP	SR	EWH	Full
49.00	Paint Creek	Dst. Greenfield WWTP Ust Reser	ECBP	SR	EWH	Full
37.50	Paint Creek	Dst. Paint Creek Reservoir	WAP	SR	EWH	Non
35.50	Paint Creek	Dst. Rocky Fork Creek Converge	WAP	SR	EWH	Full
27.50	Paint Creek	Dills Rd.	WAP	SR	EWH	Full
21.60	Paint Creek	USGS Gauge at Bournville	WAP	SR	EWH	Full
16.30	Paint Creek	Shotts Bridge	WAP	SR	EWH	Full
8.90	Paint Creek	Ust. North Fork Paint Creek	WAP	SR	EWH	Full
7.80	Paint Creek	Dst. North Fork Paint Creek	WAP	LR	EWH	Full
4.60	Paint Creek	Ust. Mead Paper at SR 104	WAP	LR	WWH	
2.40	Paint Creek	Mead Paper Mixing Zone	WAP	LR	WWH	Full
2.30	Paint Creek	Ust. US 23	WAP	LR	WWH	Full
0.20	Paint Creek	at mouth, convergence Scioto	WAP	LR	WWH	Full

*HW=Headwater, <20 miles^2 watershed area; W=Wadeable, ≥20 and <200 miles^2 watershed area; SR=Small River, ≥200 miles^2 watershed area and <2000 miles^2 watershed area; and LR=Large River, >1000 miles^2 watershed area.

Paint Creek is located in the Eastern Corn Belt Plains (ECBP) Ecoregion between the headwaters and river mile 49, and the Western Allegheny Plains (WAP) Ecoregion from river mile 49 to the mouth. It is characterized in the Ohio Administrative Code (OAC) 3745-1-09; Table 9-1, as warmwater habitat (WWH) between the headwaters and river mile 69 and again from river mile 5 to the mouth. Paint Creek is characterized as exceptional warmwater habitat between river mile 69 and river mile 5. The creek is used for agricultural water supply (AWS), industrial water supply (IWS) and primary contact recreation (PCR). It is also a source of public drinking water.

Of the parameters described in this report; total suspended solids (TSS), fecal coliforms, nitrate/nitrite, total phosphorus and dissolved oxygen; only fecal coliforms and dissolved oxygen have water quality standards. Nitrate concentrations may be compared to maximum contaminant levels (MCLs) for drinking water.

For primary contact waters fecal coliform concentrations (by geometric mean of at least five samples) must be less than 1000 bacteria per 100 mL of water, with no more than 10% of the samples over 2000 bacteria per 100 mL of water. Fecal coliform data was only collected between river miles 96 and 48.7. The coliform concentrations were elevated on August 13, with 11 of the 13 samples above 2000 bacteria per 100 mL of water, and river mile 88.57 was elevated on July 28 as well. Coliforms were elevated throughout much of the summer in the mixing zone for the Washington Court House WWTP, with measurements of 40,000 and 47,000 bacteria per 100 mL of water on September 4, 1997. Below the mixing zone the fecal coliform concentrations returned to normal levels except for slight elevation on August 13.

Dissolved oxygen concentrations were below WQS (3.06 mg/L on 9/15/97) in the headwaters. They were maintained in the mixing zone for the Washington Court House WWTP, but then sagged 1.5-5 miles downstream of the WWTP. Additional testing completed by Ohio EPA's ecological assessment unit showed a water quality exceedence for diel oxygen measurements (night vs day values) at river mile 67.7. The monitoring equipment recorded a dissolved oxygen low of 3.78 mg/L (minimum values for WWH are 4.0 mg/L) on July 31, 1997. This same study showed diel dissolved oxygen exceedences downstream of the Greenfield WWTP at river mile 48.1. Sixteen of the 24 samples were lower than the minimum (5.0 mg/L for EWH). Downstream of the Paint Creek Lake outfall at river mile 37.5 the dissolved oxygen concentrations were low throughout July and August, but showed signs of recovering in September. The low values were likely due to anoxic water from the bottom of the lake being released into the stream. The higher concentrations on September 15 brought the average stream values above minimum levels such that they may not actually reflect summer conditions in the stream. Dissolved oxygen dropped at the MeadWestvaco effluent area and did not recover before the confluence with the Scioto. This may have been an effect of Paint Creek converging with the larger Scioto River.

In comparison with reference streams, Paint Creek showed elevated TSS concentrations on July 28 and extremely elevated concentrations on August 13. This was probably associated with a storm event. Most high TSS concentrations were correlated with agricultural areas (row crop agriculture or cattle pastures) with limited riparian corridor to capture sediments during storm water runoff.

Nitrogen concentrations were elevated in July in the upper reaches of the creek, which flows through a predominantly agricultural area. Nitrogen concentrations were also elevated in the Washington Court House WWTP mixing zone throughout the monitoring period. Between river mile 48.7 and 37.5, Paint Creek enters the Western Allegheny Plateau Ecoregion. Here nitrogen levels for the reference streams drop, which was mirrored in the drop of nitrogen concentrations in Paint Creek. However, despite the

decrease in nitrogen concentrations in the water column, the nitrogen levels in Paint Creek remained above the 75th percentile for similar size streams in the WAP Ecoregion.

Measured phosphorus concentrations in Paint Creek appeared high when compared to the reference stream values. Elevated phosphorus levels were apparent in the headwaters, south of Washington Court House with extremely high concentrations downstream of the WWTP and downstream of the MeadWestvaco NPDES discharge area. In the Washington CH WWTP mixing area phosphorus values were approximately 5-50 times higher than the upstream reaches and 50 times higher than the reference stream 75th percentile values.

Please refer to the Paint Creek water quality data and charts on the following pages for more specific information. Bolded values are above (or below in the case of dissolved oxygen) associated reference stream 75th percentile concentrations.

Paint Creek Water Quality Data

Total Suspended Solids

							EWCH		
River Mile	**96**	**88.57**	**79.8**	**75.3**	**71.16**	**69.52**	**69.45**	**69.4**	**67.3**
14-Jul-97	**50**	**31**	24	**47**	**32**	20	5	6	24
28-Jul-97	**67**	**58**	**38**	**42**	**35**	26	5	5	15
13-Aug-97	**110**	**174**	**59**	**149**	**39**	27	8	16	**103**
4-Sep-97	**15**	10	12	14	20	22	**42**	**38**	11
15-Sep-97	**49**	5	8	17	8	10	5	5	6
AVG	58.2	55.6	28.2	53.8	26.8	21	13	14	31.8
MAX	110	174	59	149	39	27	42	38	103
Reference	14	14	29	29	29	29	29	29	29

Fecal Coliform

							EWCH		
River Mile	**96**	**88.57**	**79.8**	**75.3**	**71.16**	**69.52**	**69.45**	**69.4**	**67.3**
14-Jul-97	760	930	520	460	170	160	150	640	230
28-Jul-97	**1900**	**6400**	**1700**	800	310	360	110	320	310
13-Aug-97	**6000**	**5800**	**6000**	**5600**	**2300**	**5600**	**3900**	**4200**	**6000**
4-Sep-97	410	270	450	370	10	130	**40000**	**47000**	171
15-Sep-97	460	120	540	370	60	240	**3600**	**1400**	160
AVG	1906	2704	1842	1520	570	1298	9552	10712	1374.2
MAX	6000	6400	6000	5600	2300	5600	40000	47000	6000
Reference	960	960	860	860	860	860	860	860	860

Nitrate/nitrite

							EWCH		
River Mile	**96**	**88.57**	**79.8**	**75.3**	**71.16**	**69.52**	**69.45**	**69.4**	**67.3**
14-Jul-97	**6.76**	**5.96**	**5.6**	**4.78**	**4.98**	**4.27**	**11**	**10.8**	**5.87**
28-Jul-97	**3.92**	**3.93**	**3.8**	**3.42**	2.39	1.97	**4.46**	**4.43**	2.49
13-Aug-97	0.67	0.93	0.29	0.61	0.22	0.34	2.74	**7.97**	**3.28**
4-Sep-97	0.88	1.42	1.76	1.79	1.64	1.49	**9.82**	2.64	2.64
15-Sep-97	0.26	0.76	1	1.2	1.02	0.56	**9.2**	**8.29**	
AVG	2.498	2.6	2.49	2.36	2.05	1.726	7.444	6.826	2.856
MAX	6.76	5.96	5.6	4.78	4.98	4.27	11	10.8	5.87
Reference	2.268	2.268	2.815	2.815	2.815	2.815	2.815	2.815	2.815

Phosphorus

							EWCH		
River Mile	**96**	**88.57**	**79.8**	**75.3**	**71.16**	**69.52**	**69.45**	**69.4**	**67.3**
14-Jul-97	**0.86**	**1.28**	**0.35**	**0.32**	**0.14**	0.06	**4.94**	**4.88**	**0.66**
28-Jul-97	**0.19**	**0.18**	**0.12**	**0.14**	0.09	0.12	**5.74**	**6.18**	**1.08**
13-Aug-97	**0.14**	**0.15**	**0.17**	**0.23**	**0.16**	0.05	**6.19**	**5.08**	**2.34**
4-Sep-97	0.05	0.05	0.05	0.07	0.09	**0.14**	**4.88**	**3.36**	**0.57**
15-Sep-97	0.07	0.07	0.05	**0.15**	0.05	0.05	**4.06**	**3.85**	
MAX	0.86	1.28	0.35	0.32	0.16	0.14	6.19	6.18	2.34
Reference	0.08	0.08	0.13	0.13	0.13	0.13	0.13	0.13	0.13

Dissolved oxygen

							EWCH		
River Mile	**96**	**88.57**	**79.8**	**75.3**	**71.16**	**69.52**	**69.45**	**69.4**	**67.3**
14-Jul-97	7	7.19	8.5	8.58	7.56	7.68	9.68	9.81	**6.33**
28-Jul-97	**4.6**	**5.25**	**5.5**	**5.7**	**4.8**	**6.7**	9.78	9.53	**5.38**
13-Aug-97	**6.56**	7.75	8.16	7.64	8.39	6.9	9.34	**6.07**	**6.11**
4-Sep-97	7.1	8.92	9.15	9.3	7.99	**6.63**	8.09	8.26	**6.23**
15-Sep-97	**3.06**	7.61	9.41	7.7	NA	**5.12**	9.01	8.98	
MAX	7.1	8.92	9.41	9.3	8.39	7.68	9.78	9.81	6.33
Reference	6.6	6.6	6.95	6.95	6.95	6.95	6.95	6.95	6.95

Total Suspended Solids

River Mile	63.3	58.75	52.54	48.7	37.5	31.67	27.5	21.6	16.3	8.2
14-Jul-97	8	7	5	5	5	11	**20**	16		12
28-Jul-97	17	8	8	10	8	14	12	10	12	**29**
13-Aug-97	18	8	**130**	16	5	**34**	**38**	**43**	**81**	**104**
4-Sep-97	6	5	5	5	19	12	8	9	8	**20**
15-Sep-97	7	5	5	5	10	5	5	12	5	5
AVG	11.2	6.6	30.6	8.2	9.4	15.2	16.6	18	21.2	34
MAX	18	8	130	16	19	34	38	43	81	104
Reference	29	41	41	41	19	19	19	19	19	19

Fecal Coliform

River Mile	63.3	58.75	52.54	48.7	37.5	31.67	27.5	21.6	16.3	8.2
14-Jul-97	220	280	160	280						
28-Jul-97	220	240	430	110						
13-Aug-97	780	400	**3200**	**4900**						
4-Sep-97	250	80	200	180						
15-Sep-97	200	100	200	100						
AVG	334	220	838	1114						
MAX	780	400	3200	4900						
Reference	860	580	580	580						

Nitrate/nitrite

River Mile	63.3	58.75	52.54	48.7	37.5	31.67	27.5	21.6	16.3	8.2
14-Jul-97	**4.83**	**4.67**	**4.36**	**3.7**	**2.62**	**2.48**	**2.71**	**2.79**		**2.26**
28-Jul-97	1.98	1.84	1.59	1.45	0.8	**1.62**	**2.39**	**2.48**	**2.03**	**2.03**
13-Aug-97	1.92	0.68	0.9	1.04	**2.55**	**1.4**	**1.41**	**1.48**	**1.69**	**1.48**
4-Sep-97	2.65	1.94		1.57	**2**	**2.18**	**2.17**	**2.11**	**2.01**	**1.77**
15-Sep-97	1.48			1.04	0.41	0.16	1.01	0.99	0.92	0.88
AVG	2.572	1.826	1.37	1.76	1.676	1.568	1.938	1.97	1.33	1.684
MAX	4.83	4.67	4.36	3.7	2.62	2.48	2.71	2.79	2.03	2.26
Reference	2.815	3.09	3.09	3.09	1.043	1.043	1.043	1.043	1.043	1.043

Phosphorus

River Mile	63.3	58.75	52.54	48.7	37.5	31.67	27.5	21.6	16.3	8.2
14-Jul-97	**0.52**	**0.34**	**0.41**	0.24	0.06	0.06	0.1	0.05		0.05
28-Jul-97	**0.75**	**0.48**	**0.81**	**0.34**	0.05	0.05	0.05	0.05	**0.27**	0.05
13-Aug-97	**1.61**	**0.82**	**0.52**	**0.26**	0.09	**0.29**	**0.16**	**0.13**	0.12	**0.23**
4-Sep-97	**2.8**	**0.39**		**0.25**	**0.18**	0.07	**0.26**	**0.43**	0.05	**0.32**
15-Sep-97	**1.11**	**0.67**	**0.49**	0.5	0.06	0.05	0.05	0.07	0.014	0.07
MAX	2.8	0.82	0.81	0.5	0.18	0.29	0.26	0.43	0.27	0.32
Reference	0.13	0.24	0.24	0.24	0.1	0.1	0.1	0.1	0.1	0.1

Dissolved oxygen

River Mile	63.3	58.75	52.54	48.7	37.5	31.67	27.5	21.6	16.3	8.2
14-Jul-97	7.09	9.51	10.35	8.11	**6.7**	7.8	**6.4**	**6.6**		7.7
28-Jul-97	**5.8**	9.09	9.38	9.14	7.9	8.7	**6.3**	**6.7**	7.2	**6.9**
13-Aug-97	**5.89**	7.84	8.65	7.97	7.4	7.3	7.2	7.3	7.1	7.1
4-Sep-97	**6.86**	11.04	10.74	9.62	6.5	7.7	7.3	7.6	8	7.9
15-Sep-97	**5.7**	10.52	10.97	9.32	13.8	13.8	12.2	12.3	13.3	11.5
MAX	7.09	11.04	10.97	9.62	13.8	13.8	12.2	12.3	13.3	11.5
Reference	6.95	7.6	7.6	7.6	7.025	7.025	7.025	7.025	7.025	7.025

Total Suspended Solids

Emead

River Mile	7.8	3.8	2.55	2.54	1.89	1.2	0.1
14-Jul-97	11	9	14	11	15	16	12
28-Jul-97	9	22	29	32	33	**37**	**40**
13-Aug-97	**156**	**151**	18	**134**	**138**	**174**	**125**
4-Sep-97	5	7	17	10	12	14	17
15-Sep-97	5	5	30	20	14	14	18
AVG	37.2	38.8	21.6	41.4	42.4	51	42.4
MAX	156	151	30	134	138	174	125
Reference	34	34	34	34	34	34	34

Fecal Coliform

Emead

River Mile	7.8	3.8	2.55	2.54	1.89	1.2	0.1
14-Jul-97							
28-Jul-97							
13-Aug-97							
4-Sep-97							
15-Sep-97							
Reference							

Nitrate/nitrite

Emead

River Mile	7.8	3.8	2.55	2.54	1.89	1.2	0.1
14-Jul-97	1.44	1.97	0.1	1.77	1.82	1.88	1.66
28-Jul-97	1.36	1.77	0.1	1.5	1.37	1.39	1.4
13-Aug-97	1.17	1.45	0.1	1.36	1.64	1.36	1.35
4-Sep-97	1.07	1.54	0.1	1.44	1.36	1.35	1.44
15-Sep-97	0.88	0.84	0.1	0.46	0.44	0.41	0.63
AVG	1.184	1.514	0.1	1.306	1.326	1.278	1.296
MAX	1.44	1.97	0.1	1.77	1.82	1.88	1.66
Reference	2.22	2.22	2.22	2.22	2.22	2.22	2.22

Phosphorus

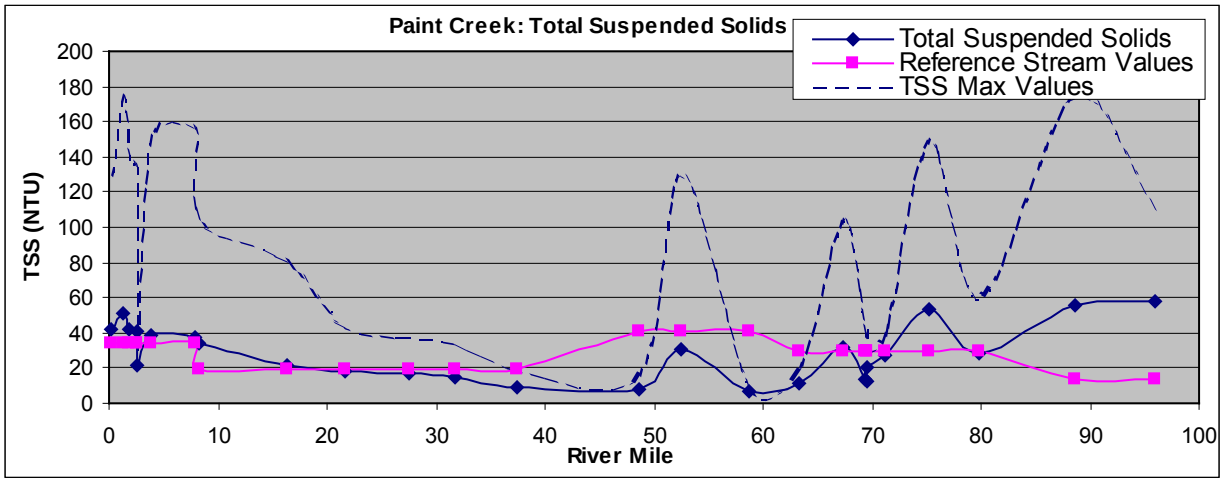
Emead

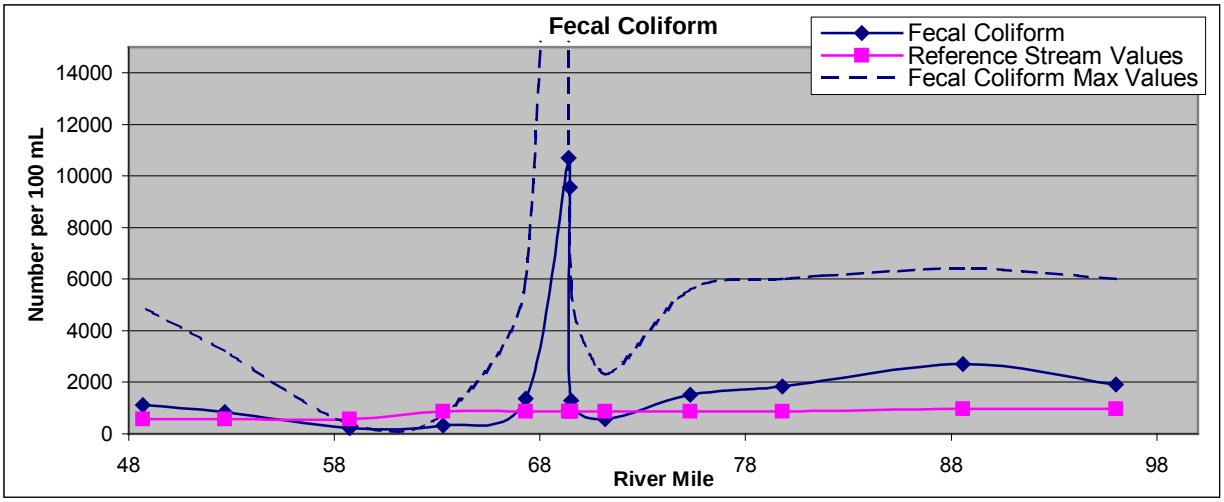
River Mile	7.8	3.8	2.55	2.54	1.89	1.2	0.1
14-Jul-97	0.05	0.05	**0.46**	0.09	0.21	0.11	0.31
28-Jul-97	0.043	0.07	**0.34**	0.06	0.13	0.07	0.13
13-Aug-97	**0.46**	0.11	**0.29**	0.2	**0.29**	0.06	**0.37**
4-Sep-97	**0.4**	0.12	**0.53**	0.14	**1.33**	0.18	0.24
15-Sep-97	0.05	0.05	**0.35**	**0.26**	0.18	0.25	0.21
AVG	0.2006	0.08	0.394	0.15	0.428	0.134	0.252
MAX	0.46	0.12	0.53	0.26	1.33	0.25	0.37
Reference	0.1	0.248	0.248	0.248	0.248	0.248	0.248

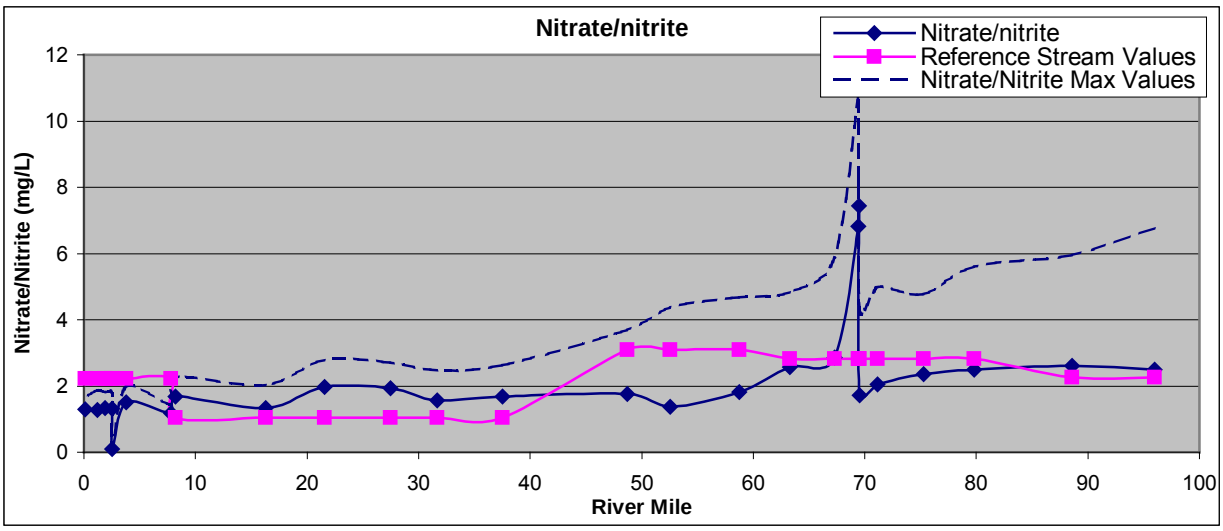
Dissolved oxygen

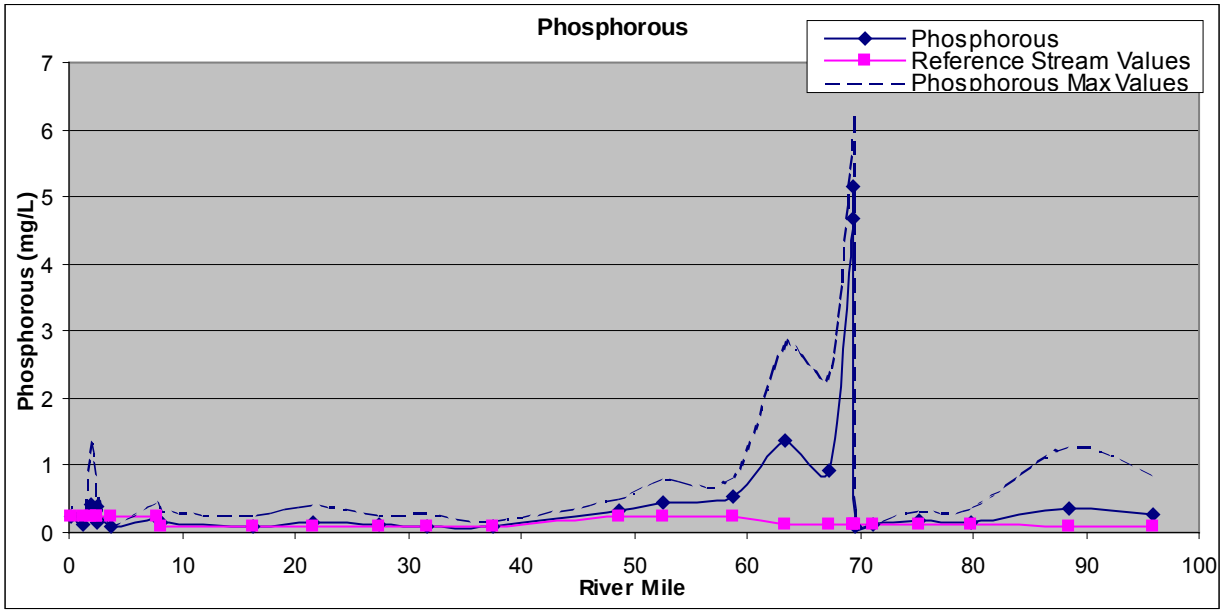
Emead

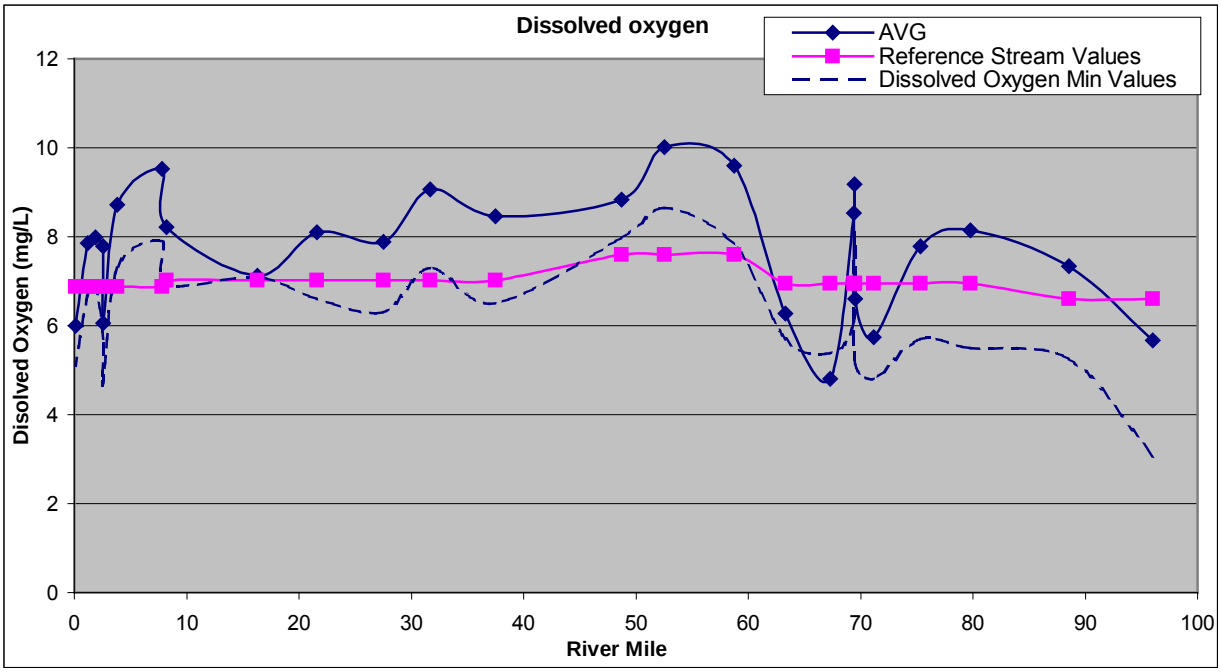
River Mile	7.8	3.8	2.55	2.54	1.89	1.2	0.1
14-Jul-97	8.8	7.7	**6.1**	7.3	8.2	6.8	**6.1**
28-Jul-97	8.5	7.4	**5.3**	**6.7**	6.9	**6.7**	**5.7**
13-Aug-97	7.9	7.3	**5**	**5.7**	7	7.3	7
4-Sep-97	9.6	8.4	**4.7**	8	7.4	7.8	**6.1**
15-Sep-97	12.8	12.8	9.2	11.2	10.4	10.7	**5.1**
AVG	9.52	8.72	6.06	7.78	7.98	7.86	6
MAX	12.8	12.8	9.2	11.2	10.4	10.7	7
Reference	7.025	6.875	6.875	6.875	6.875	6.875	6.875


Paint Creek: Total Suspended Solids
Total Suspended Solids
Reference Stream Values
TSS Max Values
TSS (NTU)
River Mile


Fecal Coliform
Fecal Coliform
Reference Stream Values
Fecal Coliform Max Values
Number per 100 mL
River Mile


Nitrate/nitrite
Nitrate/nitrite
Reference Stream Values
Nitrate/Nitrite Max Values
Nitrate/Nitrite (mg/L)
River Mile


Phosphorous
Phosphorous
Reference Stream Values
Phosphorous Max Values
Phosphorous (mg/L)
River Mile
0
1
2
3
4
5
6
7
0
10
20
30
40
50
60
70
80
90
100


Dissolved oxygen
AVG
Reference Stream Values
Dissolved Oxygen Min Values
Disolved Oxygen (mg/L)
River Mile
0
2
4
6
8
10
12
0
10
20
30
40
50
60
70
80
90
100

Biological Indices

The majority of the Paint Creek Subwatershed is located in the Eastern Corn Belt Plains (ECBP) Ecoregion except for Paint Creek downstream of Paint Creek Lake, which is located in the Western Allegheny Plateau (WAP) Ecoregion.

The species composition expected in each of these ecoregions is slightly different, which translates into different numeric biocriteria for each aquatic use designation. Again, the IBI measures fish species diversity and population composition. It accounts for total native populations, indicator species, overall fish condition and pollution intolerant versus pollution tolerant fish species. The MIwb measures similar characteristics of the fish population, however, it subtracts 13 pollution tolerant fish species out of the final score. The ICI measures the composition of the invertebrate community and compares the numbers of pollution tolerant species with pollution intolerant species. The biocriteria for the ECBP and WAP ecoregions are listed below:

Ecoregion Biocriteria: Eastern Corn Belt Plains (ECBP)
(OAC 3745-1-07, Table 7-14)

Index- Site Type	WWH	EWH
IBI- Boat	42	48
MIwb- Boat	8.5	9.6
ICI	36	46

Ecoregion Biocriteria: Western Allegheny Plateau (WAP)
(OAC 3745-1-07, Table 7-14)

Index- Site Type	WWH	EWH
IBI- Boat	40	48
MIwb- Boat	8.6	9.6
ICI	36	46

The Main Stem of Paint Creek is WWH above Washington CH and EWH from Washington CH until one mile upstream of the confluence with the Scioto River. The last mile of Paint Creek is WWH. A slight decrease in water quality typifies stream behavior at the confluence with a larger river. Paint Creek showed significant departures from WWH IBI biocriteria scores in two locations. The first was adjacent to Wildwood Road and the second was upstream of the Washington CH WWTP near the highway 35 by-pass in a highly modified reach of stream through a park. The stream briefly met the EWH criteria for IBI below Washington CH and then was not measured until the outfall from Paint Creek Lake, where it did not meet EWH criteria. The stream quickly recovered and met EWH criteria until the MeadWestvaco outfall, where the aquatic life use designation changed to WWH. The IBI score did not fall below acceptable criteria within the vicinity of the MeadWestvaco paper plant.

The MIwb did not meet WWH criteria in the upper reaches of the stream except for downstream of Perry Park in Washington CH. South of Washington CH Paint Creek met the EWH biocriteria except for isolated deviations downstream of the Washington CH WWTP and below the Paint Creek Reservoir.

The partial attainment in the headwaters near Hidy Rd. (RM ~88) was due primarily to multiple physical and chemical stressors from row crop and livestock production. Deficient physical habitat (stream channelization, siltation, destabilized streambanks), organic and nutrient enrichment, depressed dissolved oxygen concentrations, and bacteriological contamination were causes. Primary Contact Recreation (PCR) use is threatened by livestock activities in this reach, as fecal coliform concentrations were greatest in the upper headwaters. Culpepper Estates WWTP inputs and wastewater from home septic systems also contribute as sources of discharges in these reaches. Miami Trace High School treated wastewater enters Paint Creek just downstream from sampled area.

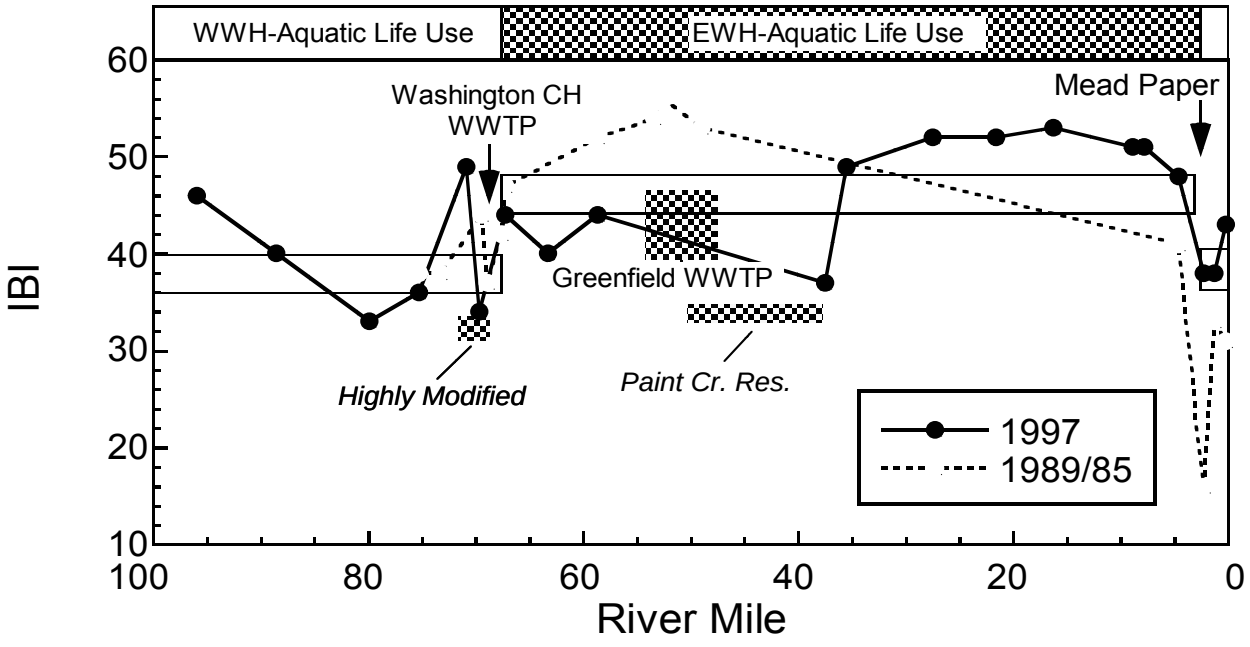
The partial attainment in Washington Court House (WCH) was attributed to the continued influence from upstream agricultural concerns as well as the channelization, impoundment, urban runoff, sediment contamination and bypasses (untreated wastewater). PCR use is also threatened by the urban inputs.

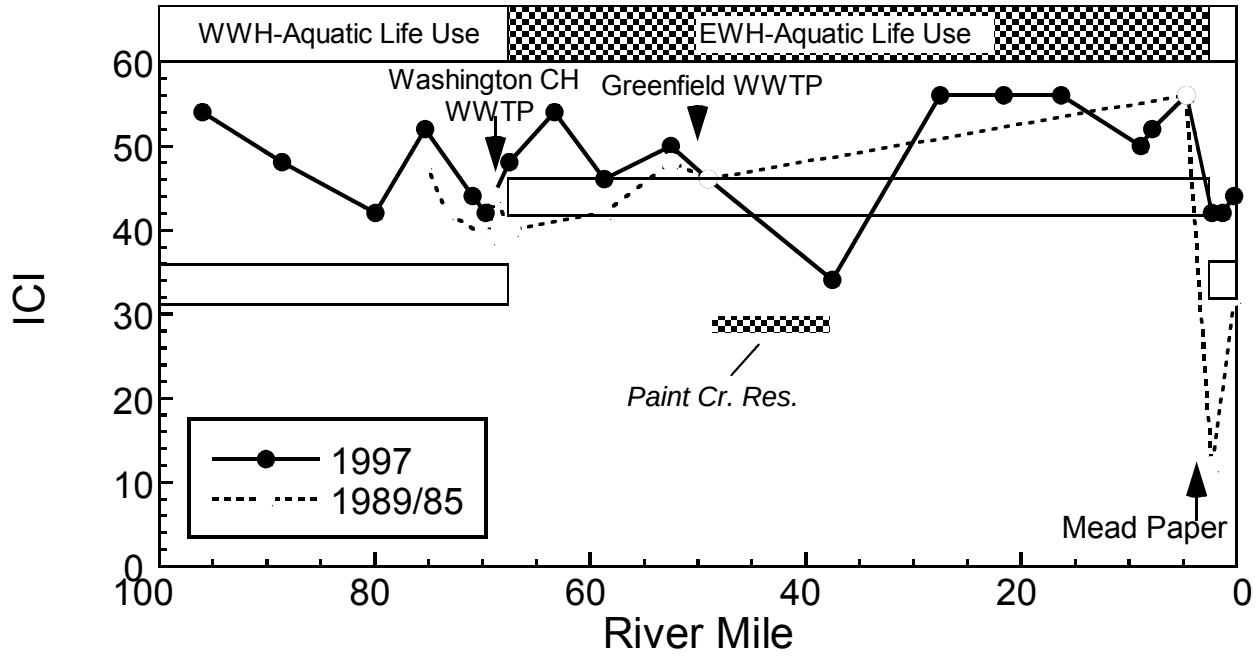
According to Ed Moore, in comparison with previous evaluations, ambient conditions of Paint Creek downstream from WCH have remained stable. The results from the 1997 survey again indicated moderate aquatic life use impairment. Despite reduced loadings of selected heavy metals achieved by the WCH WWTP since 1994, the facility's loads of oxygen demanding wastes, NH_3-N, and TSS had remained stable through time. Also, loads of NO^3-N, rose slightly between 1996 and 1997, suggesting diminished nitrification. Pollutant loads from bypasses increased sharply in 1996-97. The combined effect of treated effluent and bypasses resulted in diminished instream dissolved oxygen, including several WQS exceedences and a violation, and biological performance below EWH standards. Much of the impact appeared to be from organic enrichment.

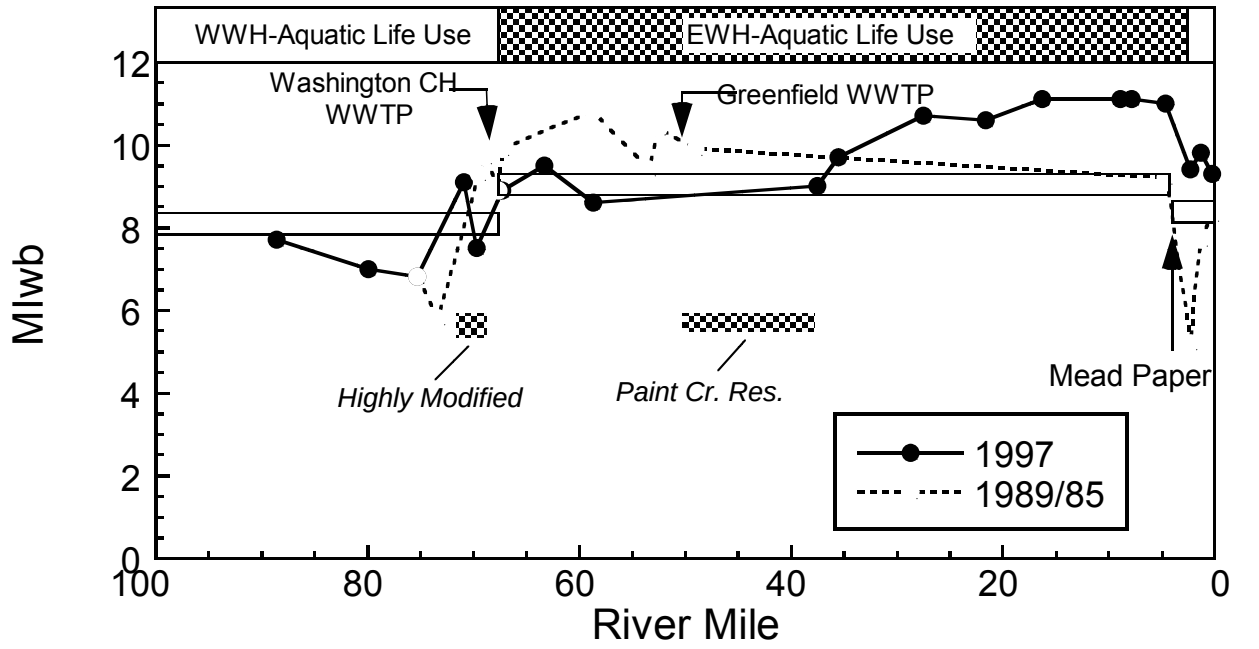
Overall, the ICI met biocriteria scores throughout the entire stream. The only significant departure appeared below the outfall from Paint Creek Reservoir. Likely causes of impairment were hypolimnetic water releases (from the anoxic waters at the bottom of the lake) with periodic higher ammonia concentrations and lower dissolved oxygen concentrations. According to Ed Moore, organic enrichment (algal production in the lake from elevated total N and P inputs) with diel dissolved oxygen fluctuations was evident from dissolved oxygen grab samples (range= 13.8 - 6.5 mg/l). Higher ammonia concentrations in grab samples were confirmed (0.27 and 0.45 mg/l at > 95th percentile for WAP Ecoregion samples). Diel nighttime D.O. concentrations likely were lower than day grab samples collected. Pool substrates were covered on almost all sides with algae. Macroinveretebrate density increased from 420/ $ft.^2$ to 3600/ $ft.^2$ downstream from Paint Creek Reservoir (lots of filter feeders). Total EPT taxa (pollution intolerant mayflies, stoneflies and caddis flies) dropped from 18 upstream to nine below the Paint Creek Reservoir. Physical flow changes (inconsistent flow in river downstream of reservoir)

from changing reservoir water release patterns can also affect biological performance. In addition, downstream of the outfall, there was a loss of under-story riparian vegetation as a result of livestock in the stream.

The IBI and ICI scores recovered quickly downstream from the Paint Creek Reservoir tailwaters toward the Scioto River. T he lower reach was designated WWH and biological scores met or exceeded biocriteria standards. The scores decreased somewhat downstream of MeadWestvaco, but recovered quickly and were all very good over the last mile of stream above the confluence with the Scioto River.




WWH-Aquatic Life Use
EWH-Aquatic Life Use
Washington CH WWTP
Greenfield WWTP
Paint Cr. Res.
Mead Paper
1997
1989/85
ICI
River Mile
0
10
20
30
40
50
60
100
80
60
40
20
0


WWH-Aquatic Life Use
EWH-Aquatic Life Use
Washington CH WWTP
Greenfield WWTP
Highly Modified
Paint Cr. Res.
Mead Paper
1997
1989/85
MIwb
River Mile
0
2
4
6
8
10
12
100
80
60
40
20
0

Qualitative Habitat Evaluation Index (QHEI)

The QHEI is a qualitative measurement of the presence and quality of physical habitat components that support aquatic life. 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 habitat characteristics that are used to determine the QHEI score include substrate, instream cover, channel morphology, riparian vegetation and bank erosion, gradient, and flow patterns (pool, run and riffle development). The QHEI score ranges from 20 to less than 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 sites around the state (OEPA, 2002, Bokes TMDL) 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 having the ability to support exceptional warmwater faunas. The QHEI can be used to direct restoration efforts for habitat and to provide a monitoring tool to measure progress toward habitat goals.

In the Paint Creek headwaters only two out of six QHEI scores met the target score for WWH (60). The most significant problems included lack of riparian habitat and channelization of the creek. Other problems included sedimentation and embedded creek bottom. The main landuse in this area is row crop, with some residential and urban areas. One section near the Hwy 35 bypass scored extremely low at 38.0. This area is highly modified and channelized with little instream or riparian habitat.

Below Washington CH the stream is considered EWH and due to improved physical habitat largely met the target score of 75. Directly downstream of Washington CH, the score was slightly lower due to inputs from above plus only moderate instream habitat and narrow (but intact) riparian corridor. Downstream of the reservoir (Paint Creek Lake) to below the confluence with Rocky Fork, the scores averaged around 66. Here the riparian buffer was narrow, flow rates were highly variable due to unnatural discharge rates from the lake and cattle were pastured with access to the stream. All of these factors worked together to cause destabilization of the banks. QHEI scores dipped slightly below Chillicothe with variable amounts of riparian corridor and moderate scores on most measures.

The QHEI scores and comments about each of the main components of the score are described in Table 3-13. This information is from the QHEI field notes recorded during the 1997 monitoring survey of the watershed. The QHEI was completed by Ohio EPA Ecological Assessment Unit personnel.

Table 3-13. QHEI scores and habitat component quality

River Mile	Location	QHEI	Comments
96.0	Charles Chillicothe Road	62.5	•
88.6	Hidy Road	54.5	•
79.9	Adjacent Wildwood Road	55.0	• **Substrate**: moderate to heavy silt, moderate to extensive embeddedness • **Instream cover**: moderate • **Morphology**: recovering from channelization, low gradient dumps silt from upstream • **Riparian**: moderate, old field species • **Flood plain**: residential and row crop
75.3	Eber Bloomingburg Road	71.5	• **Substrate**: moderate silt and normal to moderate embeddedness, habitually turbid water column but substrate not overly burdened • **Instream cover**: extensive • **Riparian**: wide and intact with low impact landuse outside of riparian, little bank erosion • **Flood plain**: shrub/old field, residential and conservation tillage, some livestock • *Fish catches small and not diverse, check this site
71.7	Downstream Perry Park	52.5	• **Substrate**: moderate silt and embeddedness • **Instream cover**: sparse with some artificial • **Morphology**: channel highly modified, channelized • **Riparian**: no riparian vegetation, 2:1 grass banks, sewer crossings provide habitat, little bank erosion
69.5	Upstream bypass, highly modified reach	38.0	• **Substrate**: normal to moderate silt and normal to moderate embeddedness • **Instream cover**: aquatic macrophytes • **Morphology**: channelized • **Riparian**: none, grassed 2:1 banks, little bank erosion • **Flood plain**: park
67.3	Downstream WA CH WWTP, Downstream Old SR 35	72.0	• **Substrate**: normal to moderate silt with moderate to extensive embeddedness • **Instream cover**: moderate (75%) • **Riparian**: moderate with mature trees, little bank erosion
63.3	Flakes Ford Road	74.0	• **Substrate**: normal silt with normal to moderate embeddedness • **Instream cover**: moderate to extensive • **Riparian**: narrow, but wooded and intact except for 100m, little bank erosion

River Mile	Location	QHEI	Comments
			• **Flood plain**: residential and row crop
58.7	Miami Trace Road at Rockmill	85.5	• **Substrate**: normal silt and embeddedness • **Instream cover**: extensive • **Morphology**: completely natural channel • **Riparian**: wide (>50m), mature, complete corridor, no bank erosion • **Flood plain**: row crop
52.5	SR 753, Upstream Greenfield WWTP	74.0	• **Substrate**: normal silt and embeddedness • **Instream cover**: sparse to moderate • **Morphology**: stable, natural channel • **Riparian**: narrow to moderate, mature corridor, but patchy and narrow on one bank, no bank erosion • **Flood plain**: row crop
48.9	Downstream Greenfield WWTP, Upstream reservoir	78.5	• **Substrate**: normal silt and embeddedness • **Instream cover**: sparse • **Morphology**: channel monotonous, mostly glide • **Riparian**: variable- narrow to wide, mature and complete corridor, no bank erosion • **Flood plain**: forest and old field
37.5	Downstream Paint Creek Reservoir	66.5	• **Substrate**: sand, gravel, cobble and boulder, moderate silt and embeddedness • **Instream cover**: moderate • **Channel morphology**: highly variable discharge from reservoir and cattle access to creek have destabilized • **Riparian zone**: narrow but intact riparian, livestock have removed under-story vegetation, little bank erosion • **Flood Plain**: residential and row crop
32.5	Downstream Rocky Fork	65.5	• **Substrate**: normal to moderate silt and embeddedness • **Instream cover**: moderate • **Morphology**: fine substrate predominate, but channel dominated by bedrock • **Riparian**: very narrow, no bank erosion **Flood plain**: row crop and low density residential
27.2	Dills Road	80.5	• **Substrate**: cobble, boulder, sand and gravel with normal silt and embeddedness • **Instream cover**: moderate • **Riparian zone**: very narrow to wide, mature riparian, little to moderate bank erosion • **Flood Plain**: forest and low density residential
21.6	USGS gauge at Bourneville	73.0	• **Substrate**: boulder, cobble, sand and gravel with normal silt and embeddedness • **Instream cover**: moderate to extensive

River Mile	Location	QHEI	Comments
			• **Riparian zone**: narrow 5-10m, with moderate erosion • **Flood Plain**: row crop
16.3	Near Shotts Bridge	80.0	• **Substrate**: sand, gravel, cobble and boulder, normal silt and embeddedness • **Instream cover**: moderate to extensive • **Riparian zone**: narrow riparian, with little bank erosion • **Flood Plain**: row crop
8.9	Upstream North Fork of Paint Creek	82.5	• **Substrate**: normal silt and embeddedness • **Instream cover**: moderate • **Riparian**: moderate and intact • **Flood plain**: row crop
7.8	Downstream North Fork of Paint Creek	83.5	• **Substrate**: normal silt and embeddedness • **Instream cover**: moderate to extensive • **Riparian**: variable, none to wide, erosion controlled by riprap • **Flood plain**: row crop
4.6	Upstream of MeadWestvaco	73.0	• **Substrate**: normal silt and embeddedness • **Instream cover**: moderate • **Riparian**: moderate to wide • **Flood plain**: forest and residential
2.3	Downstream MeadWestvaco	68.5	• **Substrate**: boulder, cobble, gravel, sand, and artificial with moderate silt and embeddedness • **Instream cover**: moderate • **Channel morphology**: low sinuosity, fair-good development, no channelization, moderate-high stability • **Riparian**: moderate, banks stabilized through ½ of zone • **Flood plain**: row crop
1.3	Upstream US 23	68.0	• **Substrate**: boulder, cobble, gravel, sand with normal to moderate silt and embeddedness • **Instream cover**: moderate • **Channel morphology**: moderate • **Riparian zone**: none to moderate • **Flood plain**: row crop
0.2	Convergence with Scioto	75.0	• **Substrate**: boulder, cobble, gravel, sand, and artificial with moderate silt and moderate-average embeddedness • **Instream cover**: moderate • **Channel morphology**: moderate, appeared unstable at the mouth • **Riparian zone**: moderate with moderate to severe bank erosion • Flood plain: row crop

Land use and Land Cover/Nonpoint Sources

Land use and land cover within the subwatershed is a good indicator of potential sources of nonpoint source pollution. In the upper Paint Creek region, nearly 95% of land use is agricultural/open urban, while in the lower Paint Creek region (please refer to the maps provided), agricultural/open urban only constitutes 52% of the land use. In the lower region of Paint Creek forested areas constitute 41% of the land use. One of the best ways to filter nonpoint sources of pollution before they reach the creek is through an expansive, forested riparian corridor. One way that the Paint Creek Project measured the quality of the forested corridor in the watershed was to measure the percent forested landuse in 50-foot buffers along the creeks. Upper Paint Creek and its tributaries showed that only 16% of the lands along the creek were forested. In contrast, the lower Paint Creek region was over 50% forested within a 50 foot buffer area. The value of the forested corridor was reflected in the exceptional assemblage of species in these waters and the overall attainment of WQS. One of the goals of the Paint Creek Project is to increase the quantity and quality of riparian corridors throughout the watershed.

Nonpoint pollution from agricultural activities includes siltation, nutrient and organic enrichment, fecal coliform bacteria and low dissolved oxygen downstream of the inputs. These inputs are a result of intensive row crop activities or livestock agriculture combined with decreased assimilative capacity of the stream ecosystem caused by habitat alteration to the stream or banks. An example of habitat alteration is channelization, which creates a lack of riparian and in-stream physical habitat. These problems are documented in Ohio EPA's 305(b) report and supported by chemical, biological and habitat surveys. In addition, members of the advisory committee have documented that these problems exist. A more extensive survey of this subwatershed is planned for the summers of 2002-2005.

Nonpoint sources in the subwatershed include not only agriculture, but also storm water and other urban runoff from Washington CH, Greenfield, Bainbridge and Chillicothe. Other nonpoint sources include failing on-lot wastewater systems and pasture and livestock operations along the banks.

Table 3-13. Landuse and Land Cover in Paint Creek Subwatershed and along Tribs

Landuse/land cover category	Percent in Upper Paint Creek subwatershed	Percent w/in 50 feet of creek and tributaries	Percent in Lower Paint Creek subwatershed	Percent w/in 50 feet of creek and tributaries
Urban	1.5	1.2	1.1	0.9
Ag/Open Housing	94.9	79.6	52.0	34.9
Shrub/Scrub	0.2	1.5	4.8	7.7
Forested	3.0	15.9	41.0	50.2
Open Water	0.1	1.0	0.7	3.9
Wetlands	0.3	0.8	0.3	2.3
Barren	0.0	0.0	0.1	0.1

Potential contamination sources within 500 feet of Paint Creek

Another component of this study, related to landuse, includes the potential contamination sources found within the vicinity of the creeks. Table 3-14 includes a list of all potential sources that are found within 500 feet of Paint Creek. Many of these potential contamination sources are former leaking underground storage tanks (LUSTs), which most likely have been cleaned up and closed years ago, and cemeteries, which may contribute arsenic from historic embalming practices. The most important of the potential contamination sources are point sources such as WWTP, which discharge directly to the creeks. The point sources along paint creek include, Culpepper Estates WWTP, Washington Court House and Greenfield WWTPs, and the Miami Trace wastewater plant.

Other types of point sources include surface impoundments, which may only flow into the creek during storm or overflow events. The Ohio Water Service Company, Standard Oil Company, Armco Steel Corporation and Collins Packing Company operate surface impoundments along Paint Creek.

At this time the health departments in the watershed are gathering information about other potential point sources of pollution, such as sewer bypasses.

` Table 3-14: Point sources within 500 feet of Paint Creek

NAME	ADDRESS	CITY	COUNTY	TYPE
Rich Oil Co.	CENTER & ELM STS	Washington CH	Fayette	Leaking Underground Tank
Unknown, Greeno Residence	10192 SR 62 N	Washington CH	Fayette	Leaking Underground Tank
Unknown, Former Gas Station	10232 SR 62 N	Washington CH	Fayette	Leaking Underground Tank
Courthouse Tool Rental	276 W OAKLAND AVE	Washington CH	Fayette	Leaking Underground Tank
Cudahy Property	532 DAYTON AVE	Washington CH	Fayette	Leaking Underground Tank
Clark Oil & Refining Corp.	330 W COURT ST	Washington CH	Fayette	Leaking Underground Tank
MAC Tools	S FAYETTE ST	Washington CH	Fayette	Leaking Underground Tank
Eastside Elementary School	S ELM ST	Washington CH	Fayette	Leaking Underground Tank
Miami Trace Bus Garage	3722 SR 41 NW	Washington CH	Fayette	Leaking Underground Tank
Miami Trace Local Schools	3722 ST RT 41 NW	Washington CH	Fayette	Leaking Underground Tank
Indianola Plaza Co.	300 WASHINGTON SQ	Washington CH	Fayette	Leaking Underground Tank
GMAC Auto Sales	333 W COURT ST	Washington CH	Fayette	Leaking Underground Tank
OK Tire Service	1358 RT 22 NW	Washington CH	Fayette	Leaking Underground Tank
Buckeye Countrymark Drive Thru	302 S FAYETTE ST	Washington CH	Fayette	Leaking Underground Tank
Interiors by Lynn (former Sunoco)	701 DAYTON	Washington CH	Fayette	Leaking Underground Tank
Unknown, Sewer Line Repair	14 FRONT 702 DAYTON	Washington CH	Fayette	Leaking Underground Tank
Union 76	635 DAYTON AVE	Washington CH	Fayette	Leaking Underground Tank
Flagway #7	635 DAYTON AVE	Washington CH	Fayette	Leaking Underground Tank
Stinson Residence	5362 US RT 35 SE	Washington CH	Fayette	Leaking Underground Tank
AT&T	4087 US RT 62 N3	Washington CH	Fayette	Leaking Underground Tank
Ameritech	210 NORTH ST	Washington CH	Fayette	Leaking Underground Tank
Richard E. Beechler	1659 RT 22 E	Washington CH	Fayette	Leaking Underground Tank
Car Shine Auto Wash	1220 COLUMBUS AVE	Washington CH	Fayette	Leaking Underground Tank
Fayette Co. Garage-ODOT	2331 US RT 22 SW	Washington CH	Fayette	Leaking Underground Tank
Washington CH City Maintenance		Washington CH	Fayette	PCS
Federal Aviation Administration	2199 OLD XENIA RD	London	Madison	RCRIS- Hazardous Waste
Sunoco Station	WEST 347 COURT ST	Washington CH	Fayette	RCRIS- Hazardous Waste
BP Bulk Oil	WEST 304 MARKET ST	Washington CH	Fayette	RCRIS- Hazardous Waste
City Washington CH		Washington CH	Fayette	PCS
Knisleys Collision	1159 COLUMBUS AVE	Washington CH	Fayette	RCRIS- Hazardous Waste
McCullahs Detail Bodyshop	702 DAYTON AVE	Washington CH	Fayette	RCRIS- Hazardous Waste
Starfire Express	WEST 330 COURT ST	Washington CH	Fayette	RCRIS- Hazardous Waste
Fayette Co. Landfill	SR-41	Jefferson TWP	Fayette	Inactive/Closed Landfill
Correl Cemetery			Madison	cemetery
Hidy Cemetery			Fayette	cemetery
Kirk Cemetery			Fayette	cemetery
Old Washington Cemetery			Fayette	cemetery
Range Cemetery			Madison	cemetery
Whiteman Cemetery			Madison	cemetery
City Washington CH	208 NORTH FAYETTE ST	Washington CH	Fayette	WWTP
Standard Oil Company	6050 BUSCH BLVD	Columbus	Fayette	RETENTION

Problem Statement

The main stem of Paint Creek did not fully meet water quality standards in several areas. The partial attainment in the headwaters near Hidy Rd. (RM ~88) was due primarily to multiple physical and chemical stressors from row crop and livestock production. Deficient physical habitat (stream channelization, siltation, destabilized streambanks), organic and nutrient enrichment, depressed dissolved oxygen concentrations, and bacteriological contamination were causes. The lack of physical habitat is well documented in the QHEI field sheets, landuse data analysis and by members of the advisory group. Primary Contact Recreation (PCR) use is threatened by livestock activities in this reach, as fecal coliform concentrations were greatest in the upper headwaters. Culpepper Estates WWTP inputs and wastewater from home septic systems also contribute as sources of discharges in these reaches. Miami Trace High School treated wastewater enters Paint Creek just downstream from sampled area.

The partial attainment in Washington Court House (WCH) was attributed to the continued influence from upstream agricultural concerns as well as the channelization, impoundment, urban runoff, sediment contamination and bypasses (untreated wastewater). PCR use is also threatened by urban inputs. Pollutant loads from bypasses increased sharply in 1996-97. The combined effect of treated effluent and bypasses resulted in diminished instream dissolved oxygen, including several WQS exceedences and a violation, and biological performance below EWH standards. Overall, the impact appeared to be from organic enrichment.

EWH attainment was lost for a short segment downstream of the Paint Creek Lake dam. Likely causes of impairment were hypolimnetic water releases (from the anoxic waters at the bottom of the lake) with periodic high ammonia concentrations and low dissolved oxygen concentrations. According to Ed Moore, organic enrichment (algal production in the lake from elevated total N and P inputs) with diel dissolved oxygen fluctuations was evident from dissolved oxygen grab samples (range= 13.8 - 6.5 mg/l). Pool substrates were covered on almost all sides with algae. Physical flow changes (inconsistent flow in river downstream of reservoir) from changing reservoir water release patterns can also affect biological performance. In addition, downstream of the outfall, there was a loss of understory riparian vegetation as a result of livestock in the stream.

East Fork of Paint Creek Water Quality

During the summer of 1997, East Fork of Paint Creek was sampled by Ohio EPA in three locations. The creek was sampled for chemical, biological and habitat parameters. The locations are listed in Table 3-15.

Table 3-15. East Fork of Paint Creek monitoring point locations.

RIVER MILE	STREAM	LOCATION	ECO-REGION	SIZE	HABITAT	ATTAINMENT
0.70	East Fork Paint Creek	Washington Ave.	ECBP	W	WWH	Full
5.10	East Fork Paint Creek	Mathews Rd. Dst Bloomingburg W	ECBP	W	WWH	Partial
8.60	East Fork Paint Creek	Lewis Rd. Ust. Bloomingburg WW	ECBP	W	WWH	Full

(W = wadeable, >20 and <200 acres drainage to stream)

East Fork is located in the Eastern Corn Belt Plains Ecoregion. It is characterized in the Ohio Administrative Code (OAC) 3745-1-09; Table 9-1, as warmwater habitat (WWH) used for agricultural water supply (AWS), industrial water supply (IWS) and primary contact recreation (PCR). Of the parameters described in this report; total suspended solids (TSS), fecal coliforms, nitrate/nitrite, total phosphorous and dissolved oxygen; only fecal coliforms and dissolved oxygen have water quality standards. Nitrate concentrations may be compared to maximum contaminant levels (MCLs) for drinking water.

For primary contact waters fecal coliform concentrations (by geometric mean of at least five samples) must be less than 1000 bacteria per 100 mL of water, with no more than 10% of the samples over 2000 bacteria per 100 mL of water. With measurements of 4100, 24000 and 4100 bacteria per 100 mL of water on July 28, 1997, and 6000, 4800 and 5000 bacteria per 100 mL of water on August 13, 1997, fecal coliform concentrations in East Fork exceeded maximum PCR maximum criterion at all three monitoring sites on two of the five sample dates.

Dissolved oxygen concentrations were notably low, below 5.0 mg/L, on July 28, 1997 at river mile 8.6. This indicates that dissolved oxygen concentrations were extremely low in the headwaters of East Fork at this time. This may have been related to the relatively high levels of fecal coliforms, suspended solids and nutrients (when compared to reference streams) measured at this site during the July sampling dates. Nitrate concentrations did not exceed the legal maximums.

In comparison to similar size high quality reference streams located in the same ecoregion, East Fork exceeded average total suspended solids concentrations (29 mg/L) at river mile 8.6 on July 15 and at all monitoring points on July 28 and August 13. Fecal coliforms exceeded the large river average values (860 per 100 mL water) on the same days that the legal limits were exceeded. Nitrate/nitrite concentrations (2.815 mg/L) were exceeded on July 15, 1997. Phosphorus concentrations were exceeded throughout the

creek on July 28 and August 13. Additionally dissolved oxygen minimum numbers were not met throughout the stream on any date except September 4, 2001. Eight of the twelve dissolved oxygen measurements were below the reference stream 75th percentile values.

High concentrations of fecal coliforms and sediments and low concentrations of dissolved oxygen affected East Fork of Paint Creek water quality. Not only did the stream not meet reference stream values for these parameters, but it only partially met warmwater chemical and biological criteria at the river mile 6.5 monitoring site. The Bloomingburg WWTP, agricultural landuse and habitat modification are potential causes of water quality degradation in the East Fork basin.

Please see the East Fork of Paint Creek water quality data tables on the following page for site- specific water quality information.

East Fork Paint Creek Water Quality Data*

Total Suspended solids

River Mile	7/15/1997	7/28/1997	8/13/1997	9/4/1997	9/15/1997	AVG	MAX	Reference
8.6	**43**	**60**	**75**	22	**32**	46.4	75	29
6.5	**30**	**56**	**74**	10	16	37.2	74	29
0.6		**78**	**56**	20	22	44	78	29

Fecal Coliforms

River Mile	7/15/1997	7/28/1997	8/13/1997	9/4/1997	9/15/1997	AVG	MAX	Reference
8.6	680	**4100**	***6000***	480	370	2326	6000	860
6.5	**4400**	**24000**	**4800**	320	240	6752	24000	860
0.6		**4100**	**5000**	330	NA	2357.5	5000	860

Nitrate/nitrite

River Mile	7/15/1997	7/28/1997	8/13/1997	9/4/1997	9/15/1997	AVG	MAX	Reference
8.6	**3.64**	2.46	1.79	2.55	1.91	2.47	3.64	2.815
6.5	**3.88**	2.73	1.22	2.79	2.08	2.54	3.88	2.815
0.6		2.05	0.57	2.22	1.43	1.5675	2.22	2.815

Phosphorus

River Mile	7/15/1997	7/28/1997	8/13/1997	9/4/1997	9/15/1997	AVG	MAX	Reference
8.6	0.1	**0.28**	**0.39**	0.05	0.12	0.188	0.39	0.13
6.5	0.09	**0.29**	**0.34**	0.05	0.05	0.164	0.34	0.13
0.6		**0.18**	**0.19**	0.09	0.11	0.1425	0.19	0.13

Dissolved Oxygen

River Mile	7/15/1997	7/28/1997	8/13/1997	9/4/1997	9/15/1997	AVG	MIN	Reference
8.6	**6.16**	**4.8**	**6.58**	9.29	**5.34**	6.434	4.8	6.95
6.5	**6.35**	**5.5**	7.48	8.67	**6.8**	6.96	5.5	6.95
0.6		**5.5**	7.21	9.12	7.28	7.2775	5.5	6.95

Bolded values are above (or below in the case of dissolved oxygen) associated reference stream 75th percentile concentrations.

Biological Indices

The East Fork of Paint Creek Subwatershed is located in the Eastern Corn Belt Plains (ECBP) Ecoregion.

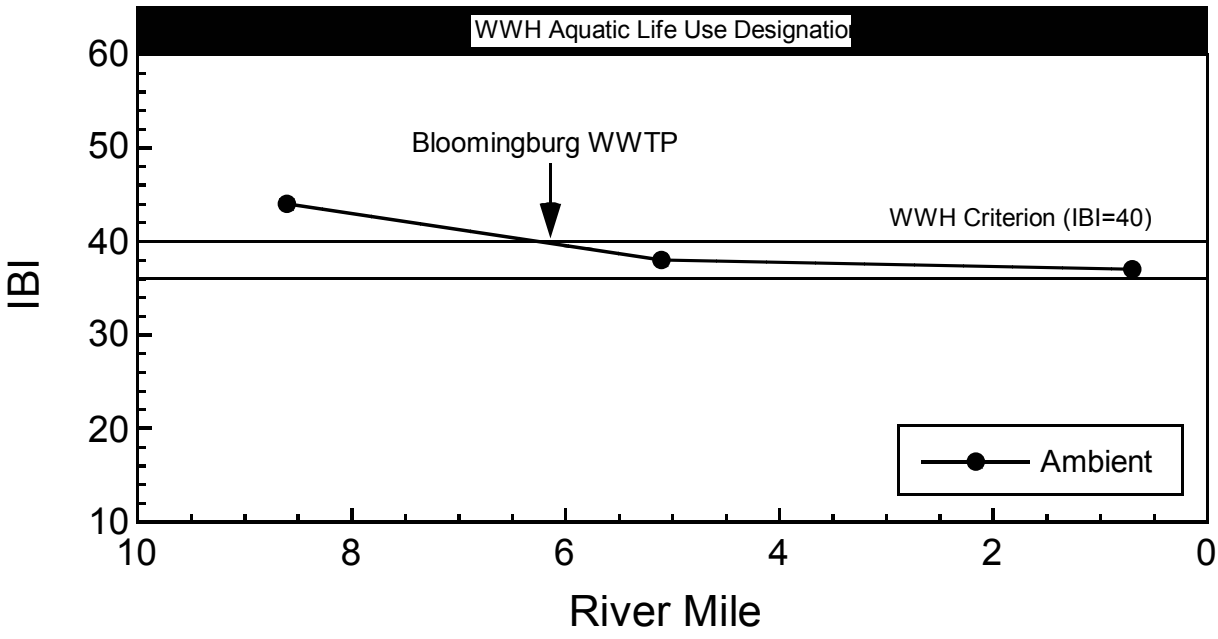
The species composition expected in each of these ecoregions is slightly different, which translates into different numeric biocriteria for each aquatic use designation. Again, the IBI measures fish species diversity and population composition. It accounts for total

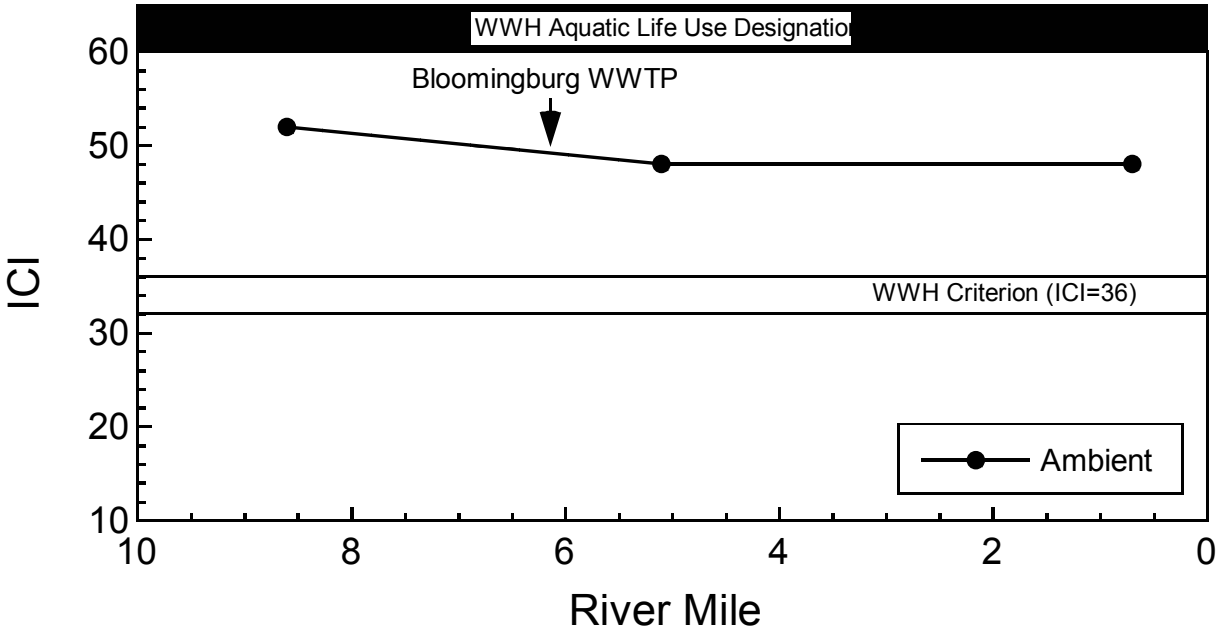
native populations, indicator species, overall fish condition and pollution intolerant versus pollution tolerant fish species. The MIwb measures similar characteristics of the fish population, however, it subtracts 13 pollution tolerant fish species out of the final score. The ICI measures the composition of the invertebrate community and compares the numbers of pollution tolerant species with pollution intolerant species. The biocriteria for the ECBP Ecoregion is listed below:

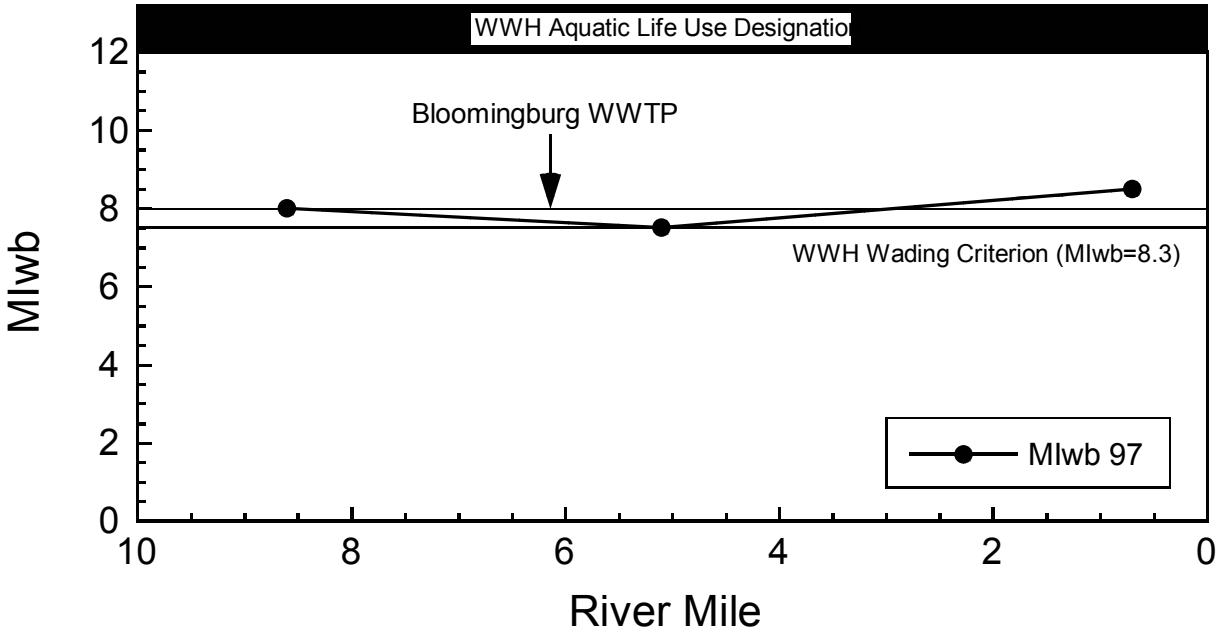
Ecoregion Biocriteria: Eastern Corn Belt Plains (ECBP)
(OAC 3745-1-07, Table 7-14)

Index- Site Type	WWH	EWH
IBI- Boat	42	48
MIwb- Boat	8.5	9.6
ICI	36	46

The biological indices along the East Fork of Paint Creek indicated that the fish scores were marginal while the invertebrate community scores were fairly high. However, all of the scores along the East Fork of Paint Creek met the minimum criteria for WWH.







Qualitative Habitat Evaluation Index (QHEI)

The QHEI is a measure of the presence and quality of physical habitat components that support aquatic life. 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 habitat characteristics that are used to determine the QHEI score include substrate,

instream cover, channel morphology, riparian vegetation and bank erosion, gradient, and flow patterns (pool, run and riffle development). The QHEI score ranges from 20 to less than 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 sites around the state (OEPA, 2002, Bokes TMDL) 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 having the ability to support exceptional warmwater faunas. The QHEI can be used to direct restoration efforts for habitat and to provide a monitoring tool to measure progress toward habitat goals.

The Qualitative Habitat Evaluation Index (QHEI) scores for East Fork indicated that heavy sediment loads, narrow riparian corridors and incidences of channelization contribute to less than optimal habitat along the creek.

Table 3-16. Qualitative Habitat Evaluation Index for East Fork Paint Creek

River Mile	Location	Score	Comments
8.6			• **Substrate**: heavy silt with moderate embeddedness and silt deposits in channel margins (course substrate retained in riffles and center of channel) • **Instream habitat**: extensive • **Riparian**: very narrow to narrow (<5-10m), intact through reach but nonexistent upstream and downstream, little bank erosion • **Flood plain**: open pasture and row crop
5.1			• **Substrate**: heavy silt and embeddedness, substrate almost entirely fine w/ large silt deposits • **Morphology**: Recent channelization, no riffle development • **Riparian**: very narrow to narrow (<5-10m), moderate bank erosion

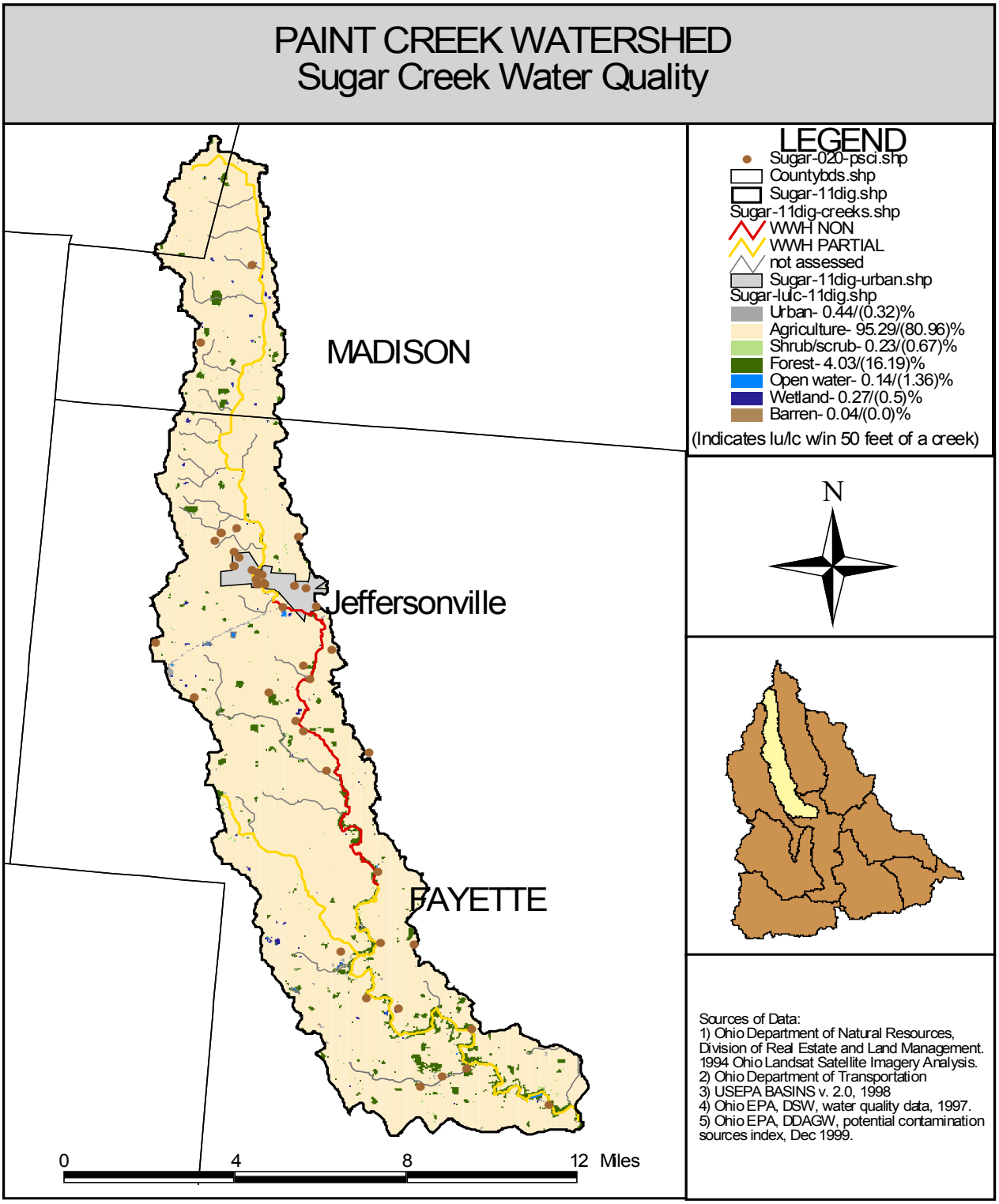
Nonpoint Source Pollutants

Please refer to the nonpoint source section for Upper Paint Creek.

Problem Statement

East Fork does not attain its WWH use designation between river mile 5.1 and 0.7. Compared to reference streams in Ohio, East Fork of Paint Creek has high sediments and nutrients, and low dissolved oxygen. Nine of fourteen total suspended solids (TSS) measurements in 1997 were above the 75th percentile value for similar size streams. In addition, fecal coliforms exceeded water quality standards on two of five monitoring days in 1997. Habitat was limited by heavy sediment loads, lack of riparian corridor and channelization. Nonpoint source pollution is attributed largely to activities related to agricultural landuse (95% of landuse in the subwatershed). The biologic indices met but were near the cutoff for warmwater habitat.

SUGAR CREEK



Created by Hilary Solomon for the Paint Creek Project, April 2002

Sugar Creek Water Quality

During Ohio EPA's 1997 monitoring survey, Sugar creek was sampled in six locations. These locations are described in Table 3-17. Sugar Creek chemical data is compared to legal limits for parameters of concern, where they exist, and to reference stream chemical data for streams from the same Ecoregion and same size watershed.

Table 3-17. Sugar Creek monitoring point locations.

RIVER MILE	STREAM	LOCATION	ECO-REGION	SIZE*	HABITAT	ATTAINMENT
1.50	Sugar Crk	Washington-New Martinsburg	ECBP	W	WWH	Partial
5.40	Sugar Crk	Mark Rd.	ECBP	W	WWH	Partial
12.00	Sugar Crk	US 22/SR3, near Jasperville	ECBP	W	WWH	Partial
18.10	Sugar Crk	Ford Rd.	ECBP	W	WWH	Non
24.30	Sugar Crk	Creamer Rd. Dst. Jeffersonvill	ECBP	W	WWH	Non
29.20	Sugar Crk	McKillip Rd. Ust Jeffersonvill	ECBP	W	WWH	Partial

*W = wadeable, >20 and <200 square miles drainage area

Sugar Creek is located in the Eastern Corn Belt Plains Ecoregion. It is characterized in the Ohio Administrative Code (OAC) 3745-1-09; Table 9-1, as warmwater habitat (WWH) used for agricultural water supply (AWS), industrial water supply (IWS) and primary contact recreation (PCR). Of the parameters described in this report; total suspended solids (TSS), fecal coliforms, nitrate/nitrite, total phosphorus and dissolved oxygen; only fecal coliforms and dissolved oxygen have water quality standards. Nitrate concentrations may be compared to maximum contaminant levels (MCLs) for drinking water.

For primary contact waters fecal coliform concentrations (by geometric mean of at least five samples) must be less than 1000 bacteria per 100 mL of water, with no more than 10% of the samples over 2000 bacteria per 100 mL of water. With measurements between 2000 and 3200 for the upper twenty miles of the stream on August 14, 1997, fecal coliform concentrations in Sugar Creek exceeded PCR maximum criterion at four monitoring sites.

Dissolved oxygen concentrations were notably low on September 16, 1997 at river mile 4.91, downstream of Jeffersonville. This indicates that dissolved oxygen levels were extremely low in this area at this time. This may have been related to the relatively high concentrations of fecal coliform and nutrients (when compared to reference streams) in July at this site. Nitrate concentrations did not exceed the legal maximums.

In comparison to the 75th percentile levels of high quality reference streams located in the same ecoregion, Sugar Creek exceeded average total suspended solids concentrations (29 mg/L) on August 14, at every monitoring point except the headwaters, RM 29.2. Fecal coliforms exceeded the wadeable stream average values (860 per 100 mL water) at one monitoring point in July (RM 24.3) and every monitoring point on August 14, except

near the confluence (RM 1.5). Nitrate/nitrite concentrations (2.815 mg/L) were exceeded consistently in July and August. Approximately half of the nitrogen measurements from this survey were above the 75th percentile for reference streams, showing Sugar Creek to have relatively high nutrient levels when compared to similarly sized streams in the same Ecoregion. Dissolved oxygen concentrations were low in several areas throughout the summer (RM 18.5 and 5.4) and every monitoring point on September 16. This indicates nutrient and organic enrichment throughout the summer and increased degradation late in the summer, which is depleting oxygen in the water column. Phosphorus concentrations were above reference stream 75th percentile measurements on September 16th and also on several other occasions throughout the summer.

High concentrations of fecal coliforms and nutrients and low concentrations of dissolved oxygen affect Sugar Creek water quality. Not only did the stream not meet reference stream values for these parameters, it did meet warmwater biological criteria throughout much of the stream. Sugar Creek is channelized through much of Jeffersonville, with little or no riparian corridor throughout its reaches. Channelization and poor riparian habitat combined with WWTP effluent and predominantly agricultural landuse are potential causes of water quality degradation in the Sugar Creek basin.

Please see the Sugar Creek water quality data tables for site-specific water quality information. Bolded values are above (or below in the case of dissolved oxygen) associated reference stream 75th percentile concentrations.

Sugar Creek Water Quality Data*

TSS-Sugar Creek

River Mile	14-Jul-97	29-Jul-97	14-Aug-97	5-Sep-97	16-Sep-97	AVG	MAX	Reference
29.2	5	5	24	5	5	8.8	24	29
24.3	8	5	**36**	5	5	11.8	36	29
18.5	9	7	**38**	10	9	14.6	38	29
12	8	17	**44**	5	6	16	44	29
5.4	8	8	**44**	5	5	14	44	29
1.5	10	10	**38**	5		15.75	38	29

Fecal Coliform

River Mile	14-Jul-97	29-Jul-97	14-Aug-97	5-Sep-97	16-Sep-97	AVG	MAX	Reference
29.2	120	300	**2000**	310	110	568	2000	860
24.3	150	**900**	**2000**	120	170	668	2000	860
18.5	390	240	**3200**	160	70	812	3200	860
12	380	660	**2900**	250	200	878	2900	860
5.4	250	480	**870**	210	520	466	870	860
1.5	300	270	850	210		407.5	850	860

Nitrite/Nitrate

River Mile	14-Jul-97	29-Jul-97	14-Aug-97	5-Sep-97	16-Sep-97	AVG	MAX	Reference
29.2	**4**	**5.98**	**4.51**	2.12	0.41	3.404	5.98	2.815
24.3	2.74	**4.13**	**3.44**	1.2	0.1	2.322	3.44	2.815
18.5	**4.1**	**2.52**	**2.87**	1.56	0.14	2.238	2.87	2.815
12	**4.6**	**3.04**	1.7	1.48	0.41	2.246	3.04	2.815
5.4	**4.74**	**3.7**	0.47	1.57	0.92	2.28	4.74	2.815
1.5	**4.91**	**2.83**	0.9	1.47		2.5275		2.815

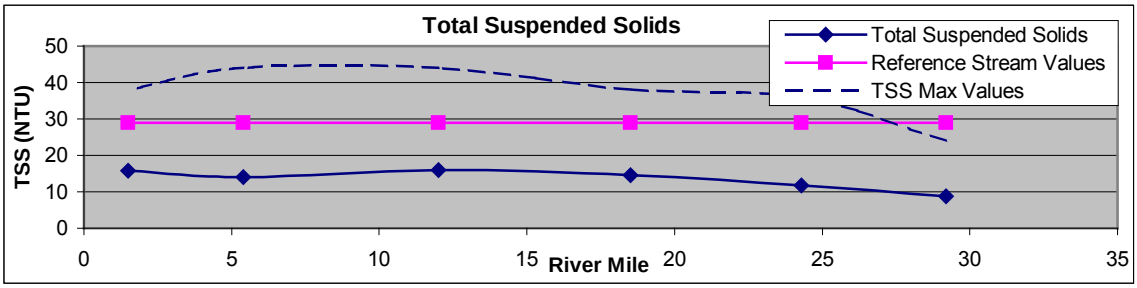
Phosphorus

River Mile	14-Jul-97	29-Jul-97	14-Aug-97	5-Sep-97	16-Sep-97	AVG	MAX	Reference
29.2	0.12	0.05	0.09	0.05	0.05	0.072	0.12	0.13
24.3	**0.26**	0.05	**0.17**	0.05	0.05	0.116	0.26	0.13
18.5	0.08	0.08	**0.24**	**0.14**	0.05	0.118	0.24	0.13
12	0.05	0.07	**0.16**	0.06	0.05	0.078	0.16	0.13
5.4	0.05	0.1	0.11	0.05	0.05	0.072	0.11	0.13
1.5	0.05	**0.22**	**0.23**	0.09		0.1475	0.23	0.13

Dissolved Oxygen

River Mile	14-Jul-97	29-Jul-97	14-Aug-97	5-Sep-97	16-Sep-97	AVG	MAX	Reference
29.2	13.79	11.13	8.01	9.43	**6.75**	9.822	13.79	6.95
24.3	14.7	7.25	7.29	8.15	**4.91**	8.46	14.7	6.95
18.5	8.15	**5.86**	**6.7**	7.86	**5.25**	6.764	8.15	6.95
12	8.96	7.85	7.23	10.08	**6.32**	8.088	10.08	6.95
5.4	7.15	**6.38**	7.8	8.95	**6.7**	7.396	8.95	6.95
1.5	8.51	8.22	8.35	11.78				6.95

*Compiled from Ohio EPA 1997 field survey raw data


Total Suspended Solids
TSS (NTU)
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40
30
20
10
0
0
5
10
15
River Mile
20
25
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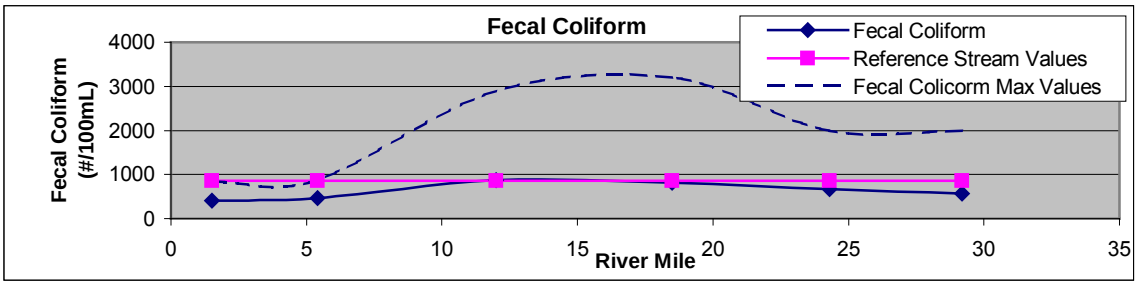
Total Suspended Solids
Reference Stream Values
TSS Max Values


Fecal Coliform
Fecal Coliform (#/100mL)
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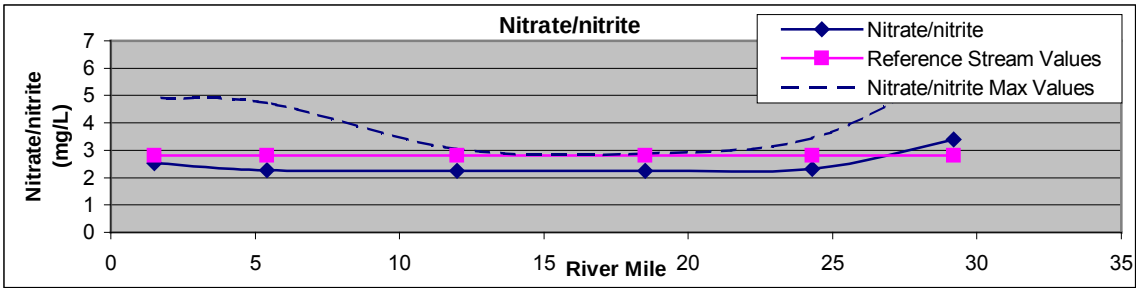
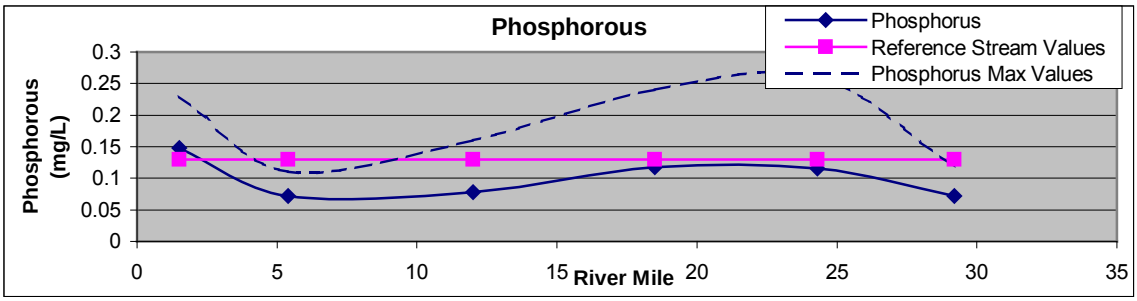
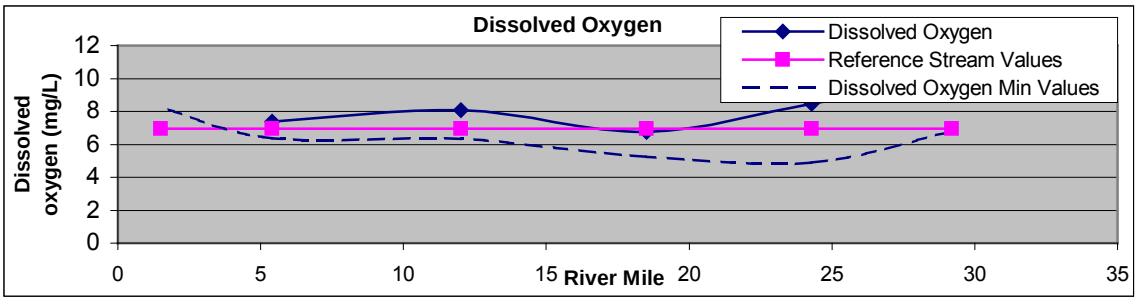
3000
2000
1000
0
0
5
10
15
River Mile
20
25
30
35
Fecal Coliform
Reference Stream Values
Fecal Colicorm Max Values


Nitrate/nitrite
Nitrate/nitrite (mg/L)
7
6
5
4
3
2
1
0
0
5
10
15
River Mile
20
25
30
35
Nitrate/nitrite
Reference Stream Values
Nitrate/nitrite Max Values


Phosphorous
Phosphorous (mg/L)
0.3
0.25
0.2
0.15
0.1
0.05
0
0
5
10
15
River Mile
20
25
30
35
Phosphorus
Reference Stream Values
Phosphorus Max Values


Dissolved Oxygen
Dissolved oxygen (mg/L)
12
10
8
6
4
2
0
0
5
10
15
River Mile
20
25
30
35
Dissolved Oxygen
Reference Stream Values
Dissolved Oxygen Min Values

Biological Indices

The Sugar Creek Subwatershed is located in the Eastern Corn Belt Plains (ECBP) Ecoregion.

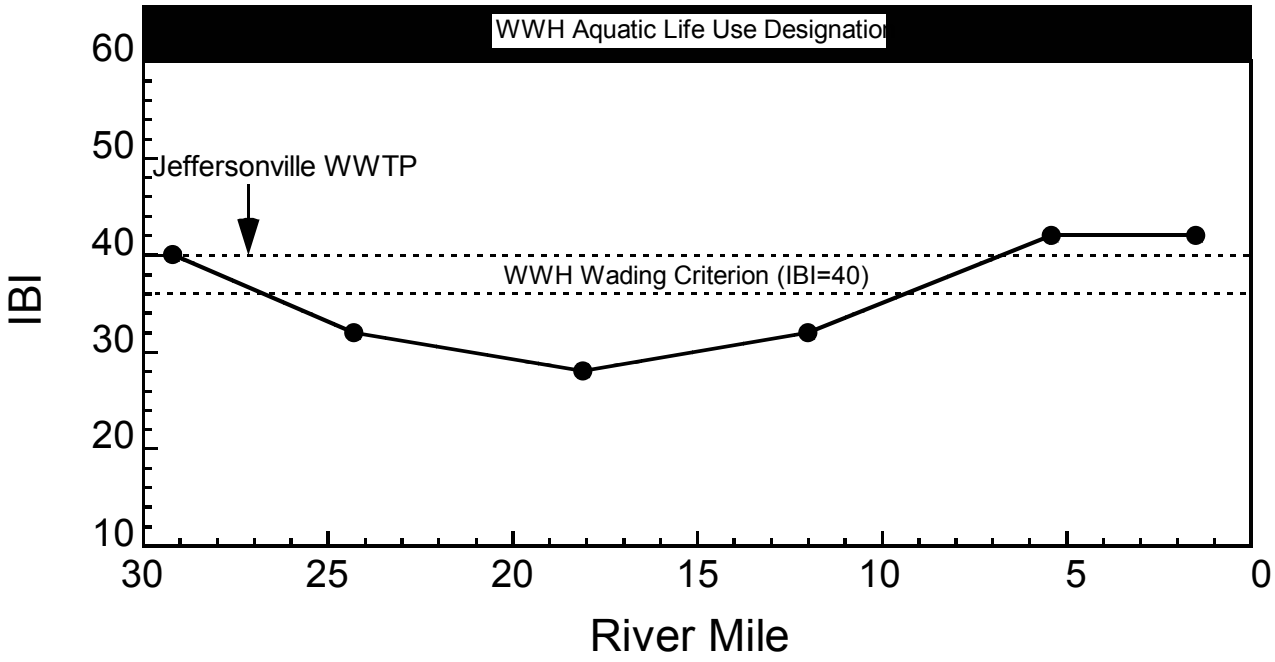
The species composition expected in each of these ecoregions is slightly different, which translates into different numeric biocriteria for each aquatic use designation. Again, the IBI measures fish species diversity and population composition. It accounts for total native populations, indicator species, overall fish condition and pollution intolerant versus pollution tolerant fish species. The MIwb measures similar characteristics of the fish population, however, it subtracts 13 pollution tolerant fish species out of the final score. The ICI measures the composition of the invertebrate community and compares the numbers of pollution tolerant species with pollution intolerant species. The biocriteria for the ECBP Ecoregion is listed below:

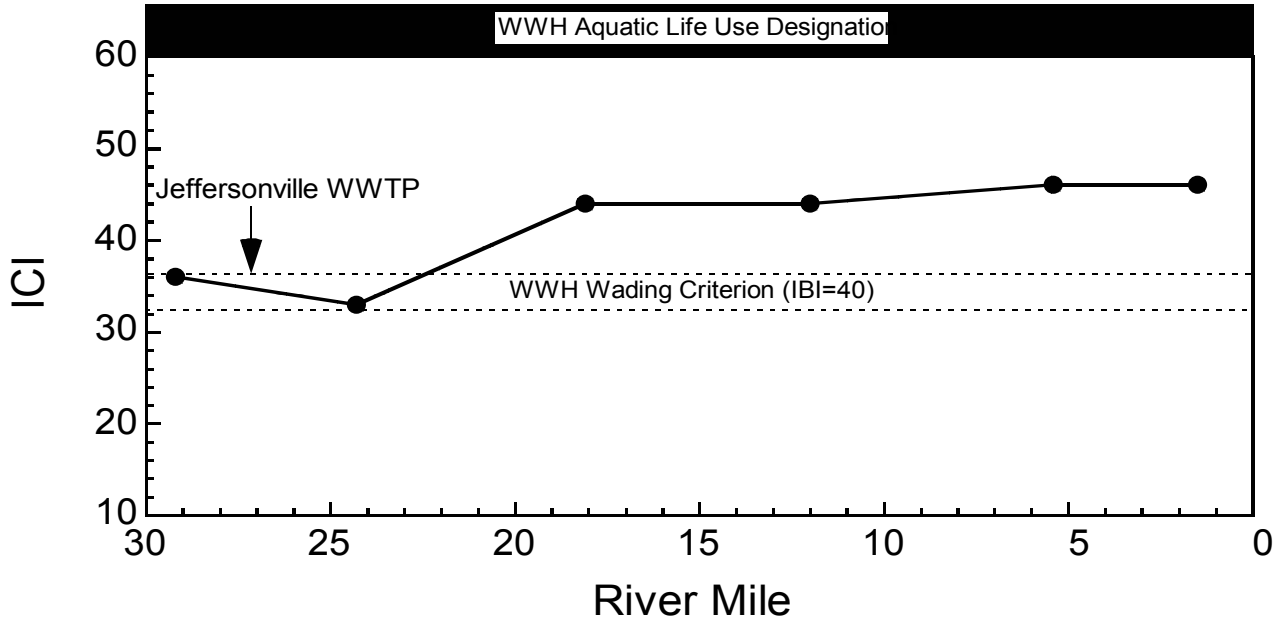
Ecoregion Biocriteria: Eastern Corn Belt Plains (ECBP)
(OAC 3745-1-07, Table 7-14)

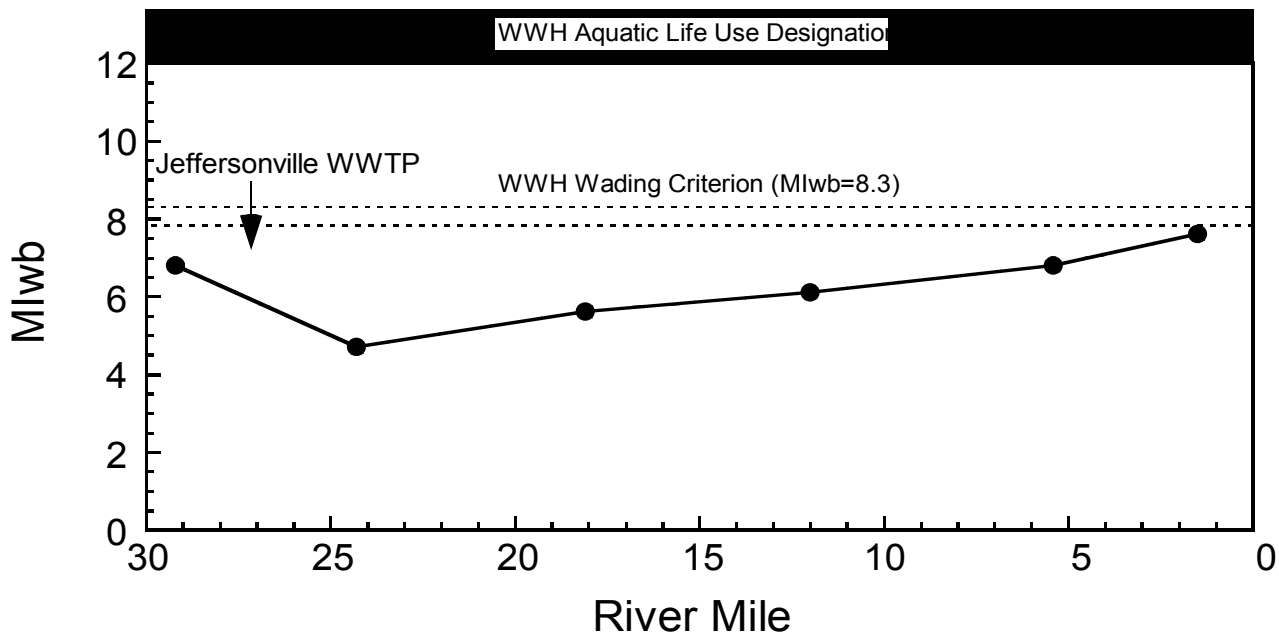
Index- Site Type	WWH	EWH
IBI- Boat	42	48
MIwb- Boat	8.5	9.6
ICI	36	46

The Index of Biological Integrity (IBI), which is a measure of fish species diversity, dropped below WWH criteria at the Jeffersonville WWTP. It began to recover in approximately 17 miles. The Invertebrate Community Index (ICI) was within WWH criteria for the entire length. The lowest score was downstream of the Jeffersonville WWTP. The Modified Index of Well-being (MIwb), a measure of pollution intolerant fish species, was entirely below WWH criteria. This indicates that even though the IBI meets WWH criteria at three monitoring stations, many of the fish species may be pollution tolerant species. For more information on the biological indices, please refer to the Water Quality Background section of this plan.

Biological Index Graphics







Qualitative Habitat Evaluation Index (QHEI)

The QHEI is a measure of the presence and quality of physical habitat components that support aquatic life. 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 habitat characteristics that are used to determine the QHEI score include substrate, instream cover, channel morphology, riparian vegetation and bank erosion, gradient, and flow patterns (pool, run and riffle development). The QHEI score ranges from 20 to less than 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 sites around the state (OEPA, 2002, Bokes TMDL) 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 having the ability to support exceptional warmwater faunas. The QHEI can be used to direct restoration efforts for habitat and to provide a monitoring tool to measure progress toward habitat goals.

The QHEI scores in the headwaters of Sugar Creek were very low, well below the level that indicates appropriate habitat for warmwater species. The QHEI field sheets

indicated that the habitat deviations included nearly absent instream cover, poor stream morphology with channelization and canopy removal, no r iparian buffer, substrate embedded with excess silt and no riffle development. By river mile 24.3 the silt load was heavy and the bottom extensively embedded. The instream habitat was sparse and the riparian zone was narrow, however there was some recovery from channelization and the stream channel was moderately stable. There was no riffle development in this section. Downstream of Jeffersonville, the QHEI scores improved vastly, however due to organic inputs from the WWTP, the dissolved oxygen levels remained problematic and the biologic community did not recover (please refer to the biological indices). Additionally, though stream development and morphology improve, the riparian buffer remains narrow for most of the creek. R iparian width and quality will need to be addressed in the implementation section of this plan. Table 3-18 lists the score and describes the habitat characteristics for each QHEI sample location recorded during Ohio EPA's 1997 monitoring survey.

Table 3-18. QHEI scores and habitat component quality

River Mile	Location	QHEI	Comments
29.2	McKillip Rd.	37.0	• **Substrate**: silt, sand, gravel, cobble, moderately embedded • **Instream cover**: nearly absent • **Channel morphology**: very poor, channelized with canopy removal • **Riparian zone**: no riparian, but little bank erosion • **Flood Plain**: open pasture/row crop • **Development**: 85% glide, 10% pool, 5% riffle, moderately slow, unstable
24.3	Creamer Rd.	45.0	• **Substrate**: silt, gravel, sand, with pockets of muck and sludge, heavy silt, extensively embedded • **Instream cover**: sparse • **Channel morphology**: some recovery from channelization and moderate stability • **Riparian zone**: narrow, some bank erosion • **Flood Plain**: row crop • **Development**: 80% glide, 20% pool and no riffles
18.1	Ford Rd.	79.5	• **Substrate**: cobble, hardpan, muck, silt, sand and gravel with moderate silt and embeddedness • **Instream cover**: extensive and diverse • **Channel morphology**: no channelization, moderate stability, excellent sinuosity and development • **Riparian zone**: mostly wide to moderate riparian zone, moderate to heavy bank erosion • **Flood Plain**: row crop

River Mile	Location	QHEI	Comments
			• **Development**: 60% pool, 30% riffle, 30% run; fast, deep chutes, little embeddedness of riffle and run
12.0	US 22/SR 3	71.5	• **Substrate**: boulder, cobble, muck, silt, sand and gravel with moderate silt and moderate-average embeddedness • **Instream cover**: moderate, but diverse • **Channel morphology**: recovering from channelization, moderate-low sinuosity and moderate development • **Riparian zone**: mostly narrow 5-10m • **Flood Plain**: shrub, residential, row crop • **Development**: 40% pool, 40% riffle, 20% run; mostly gravel, some cobble
5.4	Mark Road	74.5	• **Substrate**: boulder, cobble, silt, sand and gravel with moderate silt and embeddedness • **Instream cover**: moderate and diverse • **Channel morphology**: no channelization, moderate stability, low sinuosity and good development • **Riparian zone**: mostly moderate riparian zone, wooded with large trees, little to moderate bank erosion • **Flood Plain**: row crop and residential • **Development**: 50% pool, 40% riffle, 10% run; fast, deep
1.5	Washington-New Martinsburg	79.0	• **Substrate**: cobble, silt, sand and gravel with moderate silt and embeddedness • **Instream cover**: moderate and diverse • **Channel morphology**: no channelization, high stability, moderate-high sinuosity and good development • **Riparian zone**: very narrow riparian zone, little to moderate bank erosion • **Flood Plain**: row crop • **Development**: 40% pool, 50% riffle, 10% run

Landuse and Land Cover/Nonpoint Sources

Landuse and land cover within the subwatershed is a good indicator of potential sources of pollution. For example, while the streams in the Paint Creek Watershed that attain WQS have an average of 50 percent forested within 50 feet of the creek, Sugar Creek has only 16.19 percent forested within that area, and the area within 50 meters of the creek and tributaries has even less percent forested area. This supports the QHEI results listed above, which consistently showed less than 50 m of forested land on either side of the

creek. Within the watershed itself, there is only 4 percent forested area. The vast majority, 95.29 percent, is comprised of agricultural lands or open housing. Agricultural landuse is generally associated with sediment and nutrient contributions and a subsequent lowering of dissolved oxygen in nearby streams. The effect of a predominantly agricultural landuse with little or no riparian buffer to act as a filter strip is seen in the water quality and biological survey results in this basin. There are many BMPs for agriculture and housing developments that help to mitigate these problems. These solutions will be addressed in the implementation section of this plan.

Nonpoint sources in the subwatershed include not only agriculture, but also storm water and other urban runoff from Jeffersonville, failing on-lot wastewater systems along the creek, and pasture and livestock operations near the headwaters.

Table 3-19. Landuse and Land Cover in Sugar Creek Subwatershed and along creeks

Landuse/land cover category	Percent in Sugar Creek subwatershed	Percent w/in 50 meters of creek and tributaries	Percent w/in 50 feet of creek and tributaries
Urban	0.44	0.38	0.32
Ag/open housing	95.29	82.35	80.96
Shrub/scrub	0.23	0.55	0.67
Forested	4.03	15.23	16.19
Open water	0.14	1.15	1.36
Wetlands	0.27	0.32	0.50
Barren	0.04	0.00	0.0

Point sources within 500 feet of Sugar Creek

Another component of this study, related to landuse, includes the point sources, or direct discharge locations, found within the vicinity of the creeks. The two point sources focused on in this study include both wastewater treatment plant surface impoundments (WWTP) in Jeffersonville. These have caused documented degradation to water quality in the past and continue to cause biological damage in the stream as noted by the results of the biological indices. The Jeffersonville WWTP creates suspended solids loading (algae) when the settling ponds discharge to the creek during rainfall events. These organics lend to dissolved oxygen deficiencies downstream. In addition, Truckstops of America has a package plant, and Frank Sollars has a surface impoundment in this subwatershed.

Table 3-20 includes a list of potential contamination sources that are found within 500 feet of Sugar Creek.

Table 3-20: Potential contamination sources within 500 feet of Sugar Creek

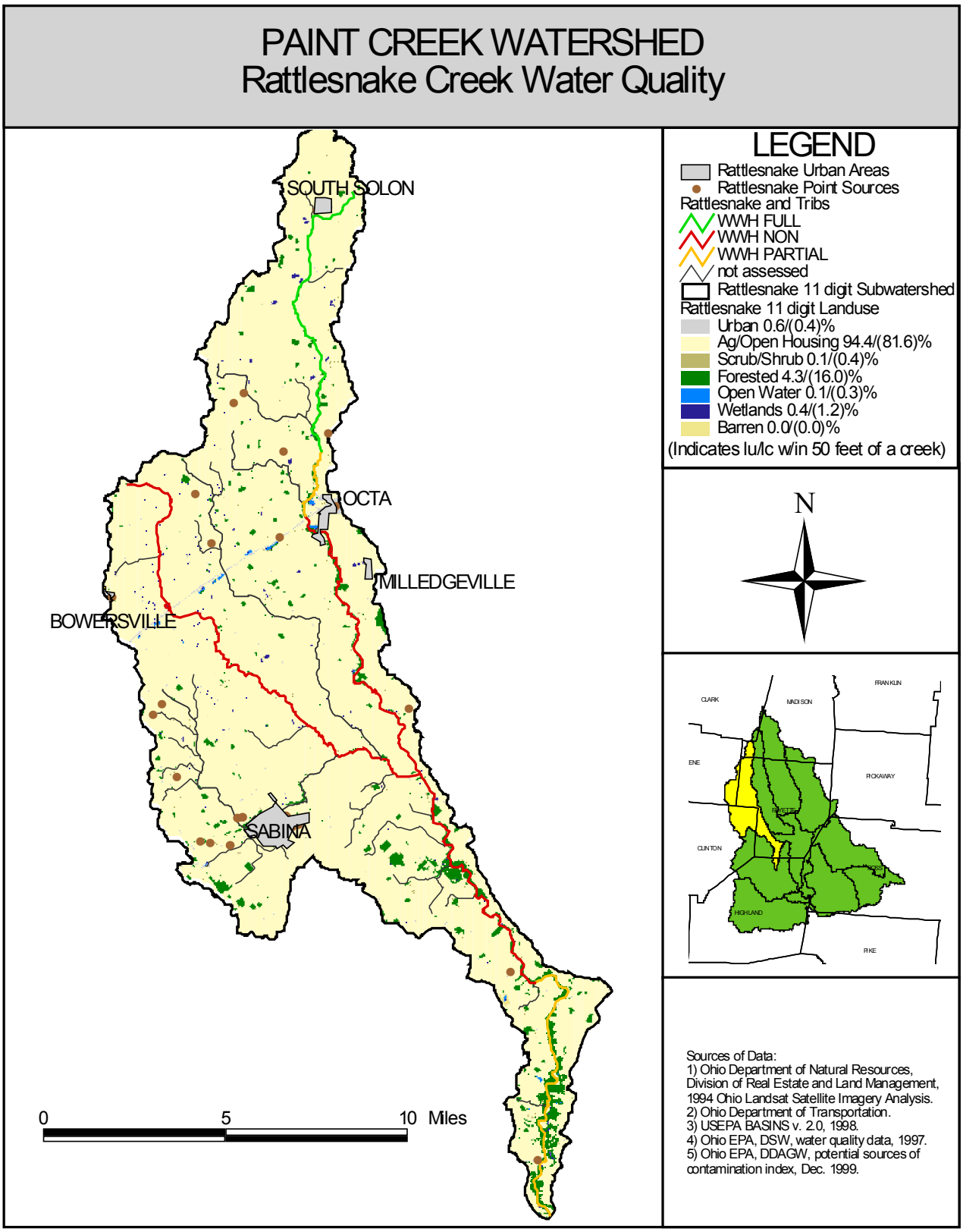
NAME	ADDRESS	CITY	COUNTY	TYPE
Abandoned Sinclair	26 MAIN ST	Jeffersonville	Fayette	Leaking Underground Tank
Jeffersonville Elem School	23 W HIGH ST	Jeffersonville	Fayette	Leaking Underground Tank
Village Union 76	31 S MAIN ST	Jeffersonville	Fayette	Leaking Underground Tank
OH Dept	N 77 MAIN ST	Jeffersonville	Fayette	RCRIS
Creamer Road Dump	Creamer Rd	Jeffersonville Twp	Fayette	Inactive/Closed Landfill
Bush Cemetery			Fayette	cemetery
Hagler Cemetery			Fayette	cemetery
Hyer Cemetery			Fayette	cemetery
Old Creamer Cemetery			Fayette	cemetery
Old Jeffersonville Cemetery			Fayette	cemetery
Sugar Creek Cemetery			Fayette	cemetery
Sugar Grove Cemetery			Fayette	cemetery
Board of Public Affairs	BOX 7	Jeffersonville	Fayette	SLUDGE
Village of Jeffersonville	N MAIN STREET	Jeffersonville	Fayette	AERATION

Problem Statement

Sugar Creek is only partially attaining its use designation between the headwaters and Jeffersonville. From Jeffersonville and continuing 17 miles downstream, Sugar Creek does not meet its use designation. The lower section of Sugar Creek begins to show recovery, but only partially meets its use attainment designation. Riparian and instream habitat is highly degraded or absent in the upper 2/3 of the watershed, with parts of the stream in this area channelized. The lack of buffering capacity from sparse riparian habitat exacerbates sedimentation and nutrient inputs from agriculture. Additionally, point sources and urban discharge from Jeffersonville appear to be contributing to the water quality problems in this creek. Fecal coliform and organic loading result in low dissolved oxygen concentrations downstream of the wastewater treatment plant. Organic inputs from failing septic may also be a potential threat to water quality.

RATTLESNAKE WATER QUALITY

Includes Lees Creek



Created by Hilary Solomon for the Paint Creek Project, May 2002

Rattlesnake Creek Water Quality

During the summer of 1997, Ohio EPA conducted a field survey of the Paint Creek Watershed. The field unit surveyed Rattlesnake creek in eleven locations and the West Branch of Rattlesnake Creek in one location. The monitoring locations are described below.

Table 3-21. Rattlesnake Creek monitoring point locations

RIVER MILE	STREAM	LOCATION	ECO-REGION	SIZE*	HABITAT	ATTAINMENT
40.50	Rattlesnake Creek	SR 734	ECBP	HW	WWH	Full
38.10	Rattlesnake Creek	SR 35, SR 753, Ust. Octa	ECBP	W	WWH	Partial
35.50	Rattlesnake Creek	Dst. Octa, Ust. Milledgeville	ECBP	W	WWH	Non
35.20	Rattlesnake Creek	Dst. Octa, Dst. Milledgeville	ECBP	W	WWH	Partial
33.40	Rattlesnake Creek	Marchant-Luttel Rd.	ECBP	W	WWH	Non
31.40	Rattlesnake Creek	SR 729	ECBP	W	WWH	Non
24.00	Rattlesnake Creek	Snow Hill Rd.	ECBP	W	WWH	Non
18.00	Rattlesnake Creek	Staford Rd.	ECBP	W	WWH	Partial
15.00	Rattlesnake Creek	Zimmerman Rd.	ECBP	W	WWH	Partial
13.30	Rattlesnake Creek	Fisherback Rd.	ECBP	W	WWH	Partial
7.80	Rattlesnake Creek	Jefferson St., Centerfield	ECBP	SR	WWH	Full
4.30	Branch Rattlesnake	SR 729	ECBP	SR	WWH	Non

*Where HW = headwaters, W = wadeable, and SR = Small River values

Rattlesnake Creek is located in the Eastern Corn Belt Plains Ecoregion. It is characterized in the Ohio Administrative Code (OAC) 3745-1-09; Table 9-1, as warmwater habitat (WWH) used for agricultural water supply (AWS), industrial water supply (IWS) and primary contact recreation (PCR). Of the parameters described in this report; total suspended solids (TSS), fecal coliforms, nitrate/nitrite, total phosphorous and dissolved oxygen; only fecal coliforms and dissolved oxygen have water quality standards. Nitrate concentrations may be compared to maximum contaminant levels (MCLs) for drinking water.

For primary contact waters fecal coliform concentrations (by geometric mean of at least five samples) must be less than 1000 bacteria per 100 mL of water, with no more than 10% of the samples over 2000 bacteria per 100 mL of water. Fecal coliform concentrations at river mile 40.5 and 13.2 exceeded the maximum levels for primary contact waters on July 16. On August 14, every monitoring location except two exceeded these limits.

Dissolved oxygen concentrations were below 6.0 mg/L on September 16, 1997 at river mile 38.1 (4.64 mg/L) and West Branch river mile 4.3 (5.85 mg/L). Supersaturated dissolved oxygen levels (11.8-12.8 mg/L) upstream in Rattlesnake Creek, through cropped fields, (river mile 40.4) with lower values directly downstream at river mile 38.1 is indicative of diel dissolved oxygen swings caused from nutrient enrichment. This may have been related to the relatively high levels of fecal coliforms, suspended solids and

nutrients (when compared to reference streams) measured in July and August. Nitrate concentrations did not exceed the legal maximums.

In comparison to similar-sized high quality reference streams located in the same Ecoregion (75th percentile values), Rattlesnake only exceeded average total suspended solids concentrations (29 mg/L) on August 14. Fecal Coliform values (860 per 100 mL water) were exceeded in July and August with eight of ten measurements above reference values on August 14. Nitrate/nitrite concentrations (2.8 mg/L) were also exceeded in July and August, with all measurements above reference on July 16 and most measurements exceeding reference values on July 29 and August 14. Phosphorous concentrations (0.13 mg/L) were exceeded in July, August and September, with exceedences occurring on all sample days. Dissolved oxygen concentrations at several monitoring points were below reference values in July, August and September.

Diel dissolved oxygen was indicative of a nutrient enrichment scenario, and included exceedences. Bacteriological measures indicated significant contamination, with counts as high as 44,000/100 ml, which is well in excess of the applicable water quality standards. Downstream from Octa, the contribution of treated effluent (Octa WWTP) and septic drainage from unsewered areas exacerbated existing impacts, as degradation processes released ammonia and used oxygen. Additional evidence of the severe nature of these sources is documented in a fish kill in 1996. Severe algal production was also noted in this reach, during the 1997 monitoring survey (Moore, 2002).

The WWTP has recently expanded to treat 0.25 MGD and includes some previously unsewered areas near Octa. Before the upgrade, the plant had numerous permit violations and contributed high levels of organics to the stream.

High levels of fecal coliforms and nutrients and low concentrations of dissolved oxygen affect Rattlesnake water quality. Not only did the stream not meet reference stream values for these parameters, but it only partially met warmwater biologic criteria. As illustrated by high fecal coliform values, the Octa WWTP, livestock with access to the creeks and failing septic systems all pose potential threats to water quality in the Rattlesnake Basin. High nutrients and low dissolved oxygen may also be associated with fecal or organic loading. Agricultural landuse potentially causes water quality degradation in the Rattlesnake basin through soil, nutrient and organic loads to the stream.

Please see the Rattlesnake water quality data and charts for more detail. Please also refer to the qualitative habitat evaluation index for a discussion on hydromodification and habitat loss along Rattlesnake Creek.

Rattlesnake Water Quality Data*

Total Suspended Solids

River Mile	16-Jul-97	29-Jul-97	14-Aug-97	5-Sep-97	16-Sep-97	AVG	MAX	Reference
40.4	5	5	**22**	5	5	8.4	22	14
38.1	8	6	28	6		12	28	29
35.4	5	10	**48**	5	5	14.6	48	29
35.3	5	10	26	8	5	10.8	26	29
33.4	6	20	**38**	5	7	15.2	38	29
31.4	12	28	**63**	8	6	23.4	63	29
24	27	22	**77**	6	5	27.4	77	29
18	10		**30**	5	5	12.5	30	29
13.23	5	8	9	5	5	6.4	9	29
7.8	5	8	11	5	6	7	11	41
W. Br. 4.3	5	5	12	5		6.75	12	41

Fecal Coliforms

River Mile	16-Jul-97	29-Jul-97	14-Aug-97	5-Sep-97	16-Sep-97	AVG	MAX	Reference
40.4	**44000**	590	**2600**	200	370	9552	44000	960
38.1	**1200**	820	**3800**	280	160	1252	3800	860
35.4	420	580	**4500**	340	380	1244	4500	860
35.3	500	860	**3600**	520	380	1172	3600	860
33.4	580	400	**4900**	210	300	1278	4900	860
31.4	600	280	**6000**	310	140	1466	6000	860
24		**1000**	**3700**	110	110	1230	3700	860
18			**2000**	100	50	717	2000	860
13.23	**11200**	80	200	110	180	2354	11200	860
7.8		110	220	40	250	155	250	1386
W. Br. 4.3	510	405		340	210	293	510	1386

Nitrate/nitrite

River Mile	16-Jul-97	29-Jul-97	14-Aug-97	5-Sep-97	16-Sep-97	AVG	MAX	Reference
40.4	**3.37**	**6.04**	**4.62**	1.56		3.8975	6.04	2.268
38.1	**3.37**	**5.83**	**4.27**	1.39	0.36	3.044	5.83	2.815
35.4	**3.43**	**4.9**	**3.38**	1.39	0.9	2.8	4.9	2.815
35.3	**3.5**	**4.89**	**3.91**	1.33	0.91	2.908	4.89	2.815
33.4	**3.82**	**4.61**	**3.77**	0.74	0.68	2.724	4.61	2.815
31.4	**3.58**	**3.4**	**3.25**	0.9	0.22	2.27	3.58	2.815
24	**3.66**	**2.18**	1.21	0.74	0.28	1.614	3.66	2.815
18	**3.79**		1.3	0.81	0.6	1.625	3.79	2.815
13.23	**4.01**	0.28	0.41	0.88	0.8	1.276	4.01	2.815
7.8	**3.6**	0.76	0.7	0.24	0.56	1.172	3.6	3.09
W. Br. 4.3	**3.8**	0.45	0.14		0.22	1.1525	3.8	3.09

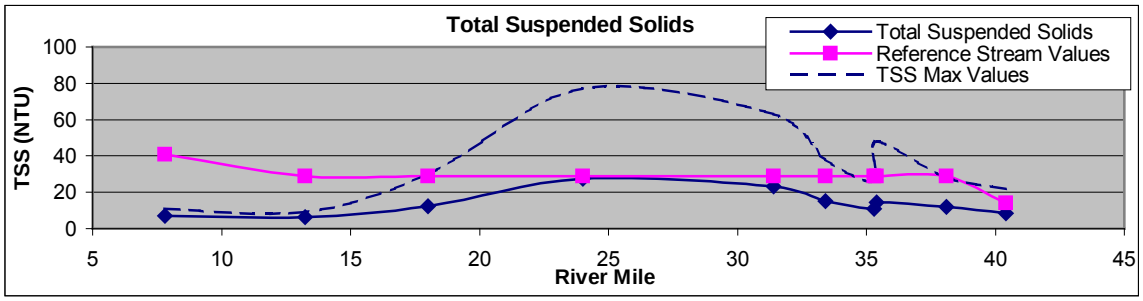
Phosphorous

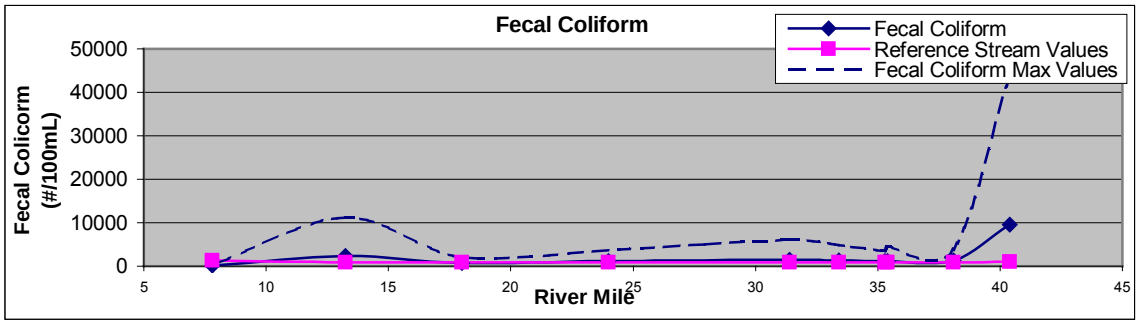
River Mile	16-Jul-97	29-Jul-97	14-Aug-97	5-Sep-97	16-Sep-97	AVG	MAX	Reference
40.4	**0.13**	**0.09**	**0.12**	0.05		0.0975	0.13	0.08
38.1	**0.19**	**0.28**	0.12	**0.15**	0.1	0.168	0.28	0.13
35.4	**0.84**	**0.18**	**0.26**	**0.16**	**0.63**	0.414	0.84	0.13
35.3	**0.89**	**0.26**	0.13	**0.15**	**0.78**	0.442	0.89	0.13
33.4	**0.38**	**0.24**	**0.23**	0.11	**0.41**	0.274	0.41	0.13
31.4	**0.23**	**0.2**	**0.19**	0.1	0.11	0.166	0.23	0.13
24	**0.28**	0.12	0.3	0.05	0.05	0.16	0.3	0.13
18	**0.27**		**0.16**	0.05	0.05	0.1325	0.27	0.13
13.23	**0.39**	**0.15**	0.06	**0.49**	0.05	0.228	0.49	0.13
7.8	0.11	0.09	0.05	0.06	0.05	0.072	0.11	0.24
W. Br. 4.3	0.21	**0.27**	0.05		0.05	0.145	0.27	0.24

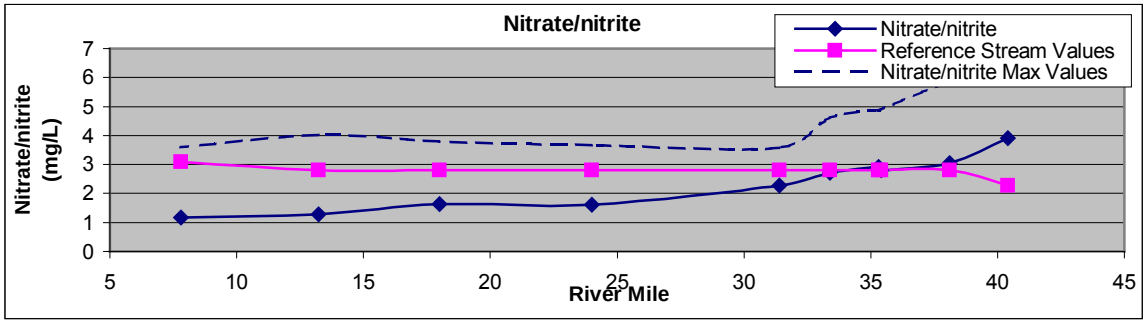
Dissolved Oxygen

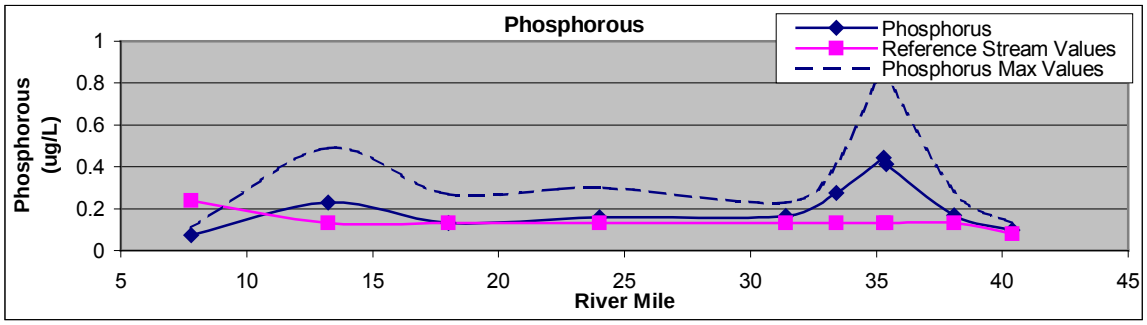
River Mile	16-Jul-97	29-Jul-97	14-Aug-97	5-Sep-97	16-Sep-97	AVG	MAX	Reference
40.4	11.83		9.62	9.5	12.76	10.9275	12.76	6.60
38.1	7.24		8.74	7.88	**4.64**	7.125	8.74	6.95
35.4	**6.55**		7.97	8.65	7.22	7.5975	8.65	6.95
35.3	**6.71**		7.91	8.97	**6.22**	7.4525	8.97	6.95
33.4	8.7		7.87	10.07	12.78	9.855	12.78	6.95
31.4	**6.56**		7.44	9.16	7.32	7.62	9.16	6.95
24	8.7		**6.01**	8.76	7.19	7.665	8.76	6.95
18	8.97		**6.67**	10.62	9.18	8.86	10.62	6.95
13.23	8.66	**6.2**	7.16	10.97	8.19	8.236	10.97	6.95
7.8	8.59	**6.5**	8.2	11.36	8.63	8.656	11.36	7.60
W. Br. 4.3	7.44		7.16	7.83	**5.85**	7.07	7.83	7.60

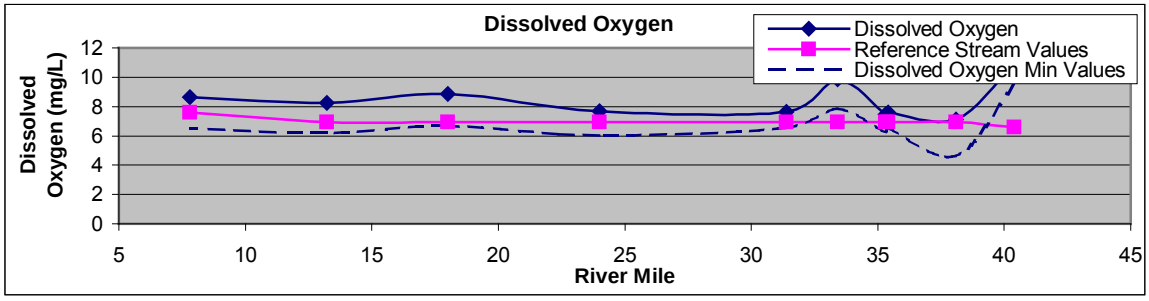
Bolded values are above (or below in the case of dissolved oxygen) associated reference stream 75th percentile concentrations.


Total Suspended Solids
Total Suspended Solids
Reference Stream Values
TSS Max Values
TSS (NTU)
100
80
60
40
20
0
5
10
15
20
25
30
35
40
45
River Mile


Fecal Coliform
Fecal Coliform
Reference Stream Values
Fecal Coliform Max Values
Fecal Colicorm (#/100mL)
50000
40000
30000
20000
10000
0
5
10
15
20
25
30
35
40
45
River Mile


Nitrate/nitrite
Nitrate/nitrite
Reference Stream Values
Nitrate/nitrite Max Values
Nitrate/nitrite (mg/L)
7
6
5
4
3
2
1
0
5
10
15
20
25
30
35
40
45
River Mile


Phosphorous
Phosphorus
Reference Stream Values
Phosphorus Max Values
Phosphorous (ug/L)
1
0.8
0.6
0.4
0.2
0
5
10
15
20
25
30
35
40
45
River Mile


Dissolved Oxygen
Dissolved Oxygen
Reference Stream Values
Dissolved Oxygen Min Values
Dissolved Oxygen (mg/L)
12
10
8
6
4
2
0
5
10
15
20
25
30
35
40
45
River Mile

Biological Indices

The East Fork of Paint Creek Subwatershed is located in the Eastern Corn Belt Plains (ECBP) Ecoregion.

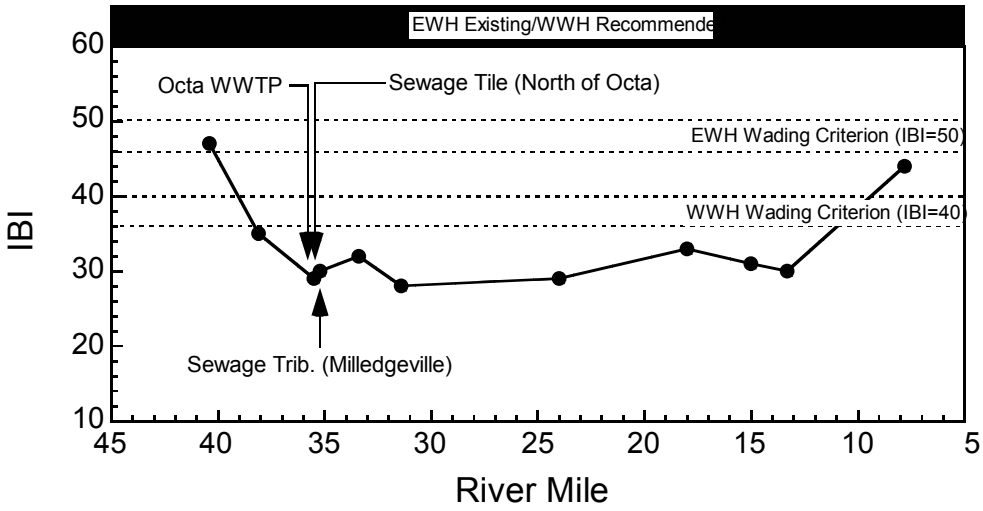
The species composition expected in each of these ecoregions is slightly different, which translates into different numeric biocriteria for each aquatic use designation. Again, the IBI measures fish species diversity and population composition. It accounts for total native populations, indicator species, overall fish condition and pollution intolerant versus pollution tolerant fish species. The MIwb measures similar characteristics of the fish population, however, it subtracts 13 pollution tolerant fish species out of the final score. The ICI measures the composition of the invertebrate community and compares the numbers of pollution tolerant species with pollution intolerant species. The biocriteria for the ECBP Ecoregion is listed below:

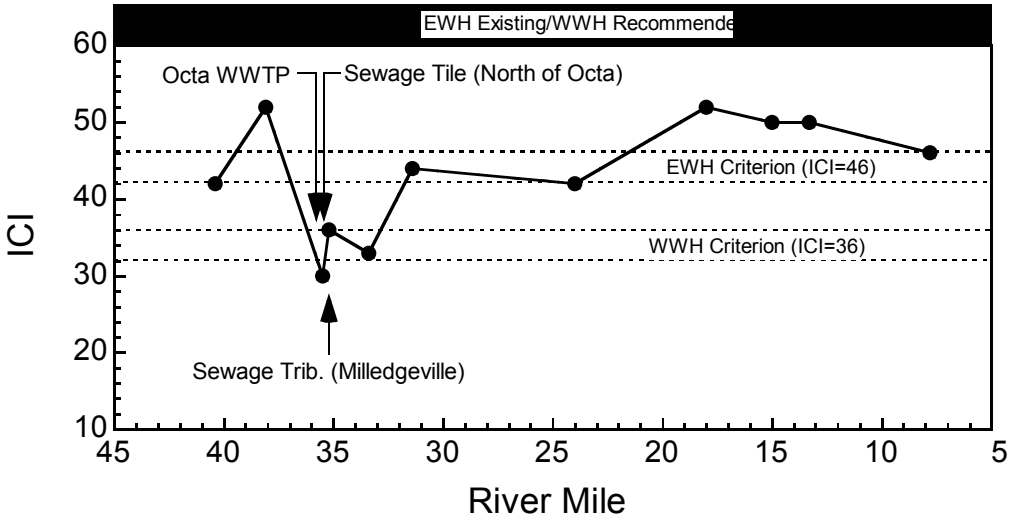
Ecoregion Biocriteria: Eastern Corn Belt Plains (ECBP)
(OAC 3745-1-07, Table 7-14)

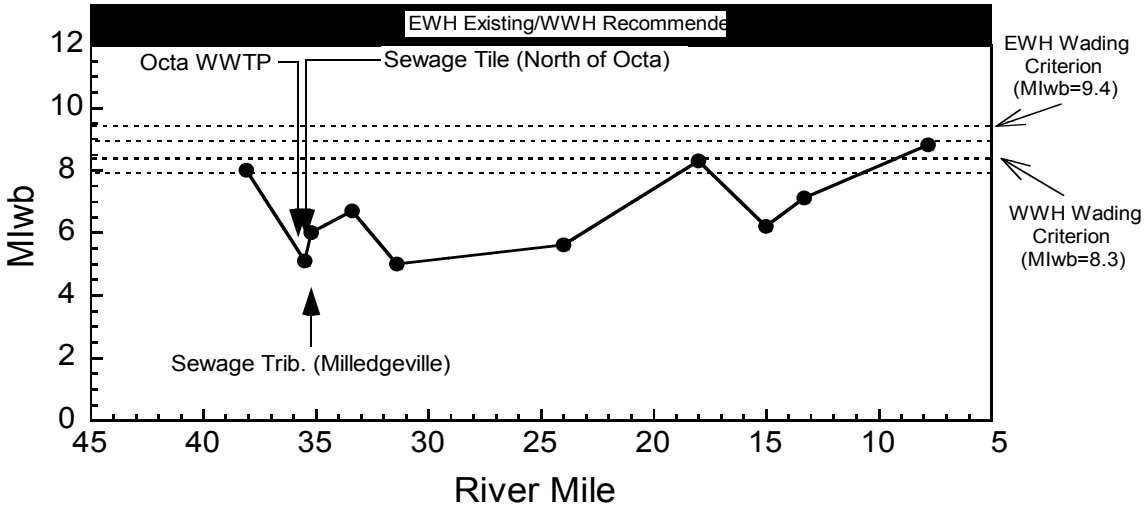
Index- Site Type	WWH	EWH
IBI- Boat	42	48
MIwb- Boat	8.5	9.6
ICI	36	46

Though Rattlesnake Creek was recently downgraded from EWH to WWH (according to some at Ohio EPA the first designation may not have been appropriate), the stream does not meet even WWH criteria for IBI scores at any monitoring point. The ICI scores are high, between WWH and EWH target scores while the MIwb scores are mostly below the target WWH score.

Please refer to the subsection entitled, Detailed Analysis by Ed Moore for site-specific information about the biological indices scores and causes of nonattainment for Rattlesnake Creek. Ed Moore collected much of the information that makes up the Ohio EPA 1997 monitoring survey and recently completed a report as part of the WWTP upgrade process for the Rattlesnake/Fayette County WWTP upgrade.


EWH Existing/WWH Recommende
Octa WWTP
Sewage Tile (North of Octa)
EWH Wading Criterion (IBI=50)
WWH Wading Criterion (IBI=40)
Sewage Trib. (Milledgeville)
IBI
River Mile


EWH Existing/WWH Recommende
Octa WWTP
Sewage Tile (North of Octa)
EWH Criterion (ICI=46)
WWH Criterion (ICI=36)
Sewage Trib. (Milledgeville)
ICI
River Mile


EWH Existing/WWH Recommende
Octa WWTP
Sewage Tile (North of Octa)
EWH Wading Criterion (MIwb=9.4)
WWH Wading Criterion (MIwb=8.3)
Sewage Trib. (Milledgeville)
MIwb
River Mile

Qualitative Habitat Evaluation Index (QHEI)

The QHEI is a measure of the presence and quality of physical habitat components that support aquatic life. 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 habitat characteristics that are used to determine the QHEI score include substrate, instream cover, channel morphology, riparian vegetation and bank erosion, gradient, and flow patterns (pool, run and riffle development). The QHEI score ranges from 20 to less than 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 sites around the state (OEPA, 2002, Bokes TMDL) 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 having the ability to support exceptional warmwater faunas. The QHEI can be used to direct restoration efforts for habitat and to provide a monitoring tool to measure progress toward habitat goals.

Please refer to the subsection entitled, Detailed Analysis by Ed Moore for site-specific information about the QHEI scores and causes of nonattainment for Rattlesnake Creek. Ed Moore collected much of the information that makes up the Ohio EPA 1997 monitoring survey and recently completed a report as part of the WWTP upgrade process for the Fayette County/Rattlesnake Creek WWTP upgrade.

Table 3-22. Rattlesnake Creek Qualitative Habitat Evaluation Index.

River Mile	Location	Score	Comments
40.4	SR 734	41.0	• **Substrate**: heavy silt with moderate to extensive embeddedness • **Instream cover**: sparse • **Morphology**: poor morphology, recent and recovering channelization • **Riparian**: none to very narrow with little bank erosion and canopy removal • **Flood plain**: row crop
38.1	SR 35/SR 734 Upstream Octa	59.5	• **Substrate**: moderate to heavy silt with extensive embeddedness, some rip-rap from bridge • **Instream cover**: sparse to moderate • **Morphology**: poor morphology, recovering

River Mile	Location	Score	Comments
			channelization • **Riparian**: none to moderate with little to moderate bank erosion • **Flood plain**: row crop
35.5	Downstream Octa WWTP/Upstream Milledgeville sewage Ditch	40.5	• **Substrate**: heavy silt with extensive embeddedness • **Instream cover**: sparse • **Morphology**: poor morphology, recovering channelization • **Riparian**: very narrow to moderate with moderate to heavy bank erosion • **Flood plain**: row crop, milledgeville drain tile
35.2	Dst. Octa, Dst. Milledgeville	39.0	• **Substrate**: heavy silt with extensive embeddedness • **Instream cover**: sparse to moderate • **Morphology**: poor morphology, recovering channelization • **Riparian**: very narrow to moderate with little to moderate bank erosion • **Flood plain**: row crop
33.4	Marchant-Luttel Rd.	41.0	• **Substrate**: moderate to heavy silt with moderate to extensive embeddeness • **Instream cover**: nearly absent • **Morphology**: false banks caused by unrestricted livestock access • **Riparian**: none to narrow, with heavy erosion on one bank and little on the other • **Flood plain**: open pasture
31.4	SR 729	50.0	• **Substrate**: heavy silt with extensive embeddedness • **Instream cover**: sparse to moderate • **Morphology**: past and present channelization • **Riparian**: very narrow to narrow with moderate bank erosion • **Flood plain**: row crop
24.0	Snow Hill Rd.	44.5	• **Substrate**: moderate silt with normal to moderate embeddedness • **Instream cover**: sparse • **Riparian**: none to narrow, moderate bank erosion and canopy removal • **Flood plain**: mowed field and row crops
18.0	Staford Rd.	83.0	• **Substrate**: moderate silt and embeddedness

River Mile	Location	Score	Comments
			• **Instream cover**: extensive • **Riparian**: moderate with little to moderate bank erosion • **Flood plain**: row crops
15.0	Zimmerman Rd.	79.0	• **Substrate**: normal to moderate silt with normal embeddedness • **Instream cover**: moderate • **Morphology**: Recovered from channelization, channel is straight, but flow is sinuous • **Riparian**: narrow to wide, little to moderate bank erosion • **Flood plain**: row crop
13.3	Fisherback Rd.	89.0	• **Substrate**: normal to moderate silt and embeddedness • **Instream cover**: moderate to extensive • **Riparian**: narrow to moderate, removed for 10m with algae-covered rocks • **Flood plain**: old field and row crop
7.8	Jefferson St., Centerfield	85.0	• **Substrate**: normal to moderate silt with moderate embeddedness, deep pools have some silt and muck • **Instream cover**: moderate • **Riparian**: narrow to moderate, heavily eroding banks near row crops, elsewhere none to moderate • **Flood plain**: row crops and ODNR public lands
4.4	West Branch Rattlesnake, SR 729	--	• **Substrate**: moderate to heavy silt with moderate embeddedness • **Instream cover**: sparse • **Riparian**: very narrow to narrow, with moderate to severly eroding banks • **Flood plain**: row crop

Detailed Analysis by Ed Moore

The Qualitative Habitat Evaluation Index (QHEI) scores indicated the upper portion of Rattlesnake Creek had been influenced by some past and present land uses and agricultural practices. At RM 40.4, the reach was previously channelized with heavily embedded and silted substrates, a sparse amount of instream cover, and limited riparian vegetation with agricultural land encroachment common to both banks. Downstream from the Fayette County / Rattlesnake Creek WWTP at RM 35.5 and RM 35.2, silted and

embedded conditions with sparse cover and no riffles were observed. The mean QHEI score for these sites was 40.2. At RM 38.1 (upstream from the WWTP) more favorable habitat conditions prevailed (moderate instream cover, faster currents, and riffles in the reach) with a QHEI score of 59.5. A score of approximately 60 or higher is indicative of the ability to support a WWH community. Permitting riparian growth will decrease sedimentation/siltation. If these changes are permitted, the habitat quality in these reaches will improve and expand the warmwater communities present. The habitat scores indicated warmwater habitat potential in the upper reaches of Rattlesnake Creek, while the lower reaches (< RM ~21) indicated much greater habitat potential for community diversity (mean QHEI = 84.0 for RM 18.0 to RM 7.8).

Despite some poor habitat attributes that were heavily influenced by agriculture at the upstream site, the biological communities fully and partially attained the WWH use designation criteria at RM 40.4 and RM 38.1, respectively, upstream from the Fayette Co./Rattlesnake Cr. WWTP (RM 36.27). Despite past channelization, lack of canopy cover, moderate to heavy embeddedness from siltation and large nutrient inputs as evidenced by long algal strands on substrates, the ICI of 42 and fish IBI score of 47 still indicated very good conditions. Cased caddisflies *Hydroptila sp.* and *Helicopsyche borealis* (purse-shaped and snail-cased caddisflies) were the predominant taxa in the riffles and runs with riffle beetles very common. As stream temperatures increased and nutrient enriched conditions likely caused lower diel dissolved oxygen concentrations in late night and early AM hours, almost all of the *Helicopsyche* caddisflies had emerged prior to macroinvertebrate colonizer retrieval. The relative density of 2346/ft.^{2} confirmed nutrient enriched conditions. The presence of some moderately intolerant Tanytarsini midges and eleven total EPT (pollution intolerant macroinvertebrates) still point to very good water quality conditions. With better riparian conditions downstream at St. Rt. 35 (RM 38.1) and cooler water temperatures the total EPT taxa increased to 14 as well as total taxa collected (60). The relative density decreased some to 1732/ft.^{2} (still enriched) as nutrient inputs decreased. Some sensitive mayflies and tanytarsini midges along with several additional caddisfly taxa collected confirmed the water quality improvements present (ICI = 52). Still enriched conditions and other agriculture-related affects (sedimentation, periodic lower night diel D.O. (= 4.64), community population shift) contributed to lower IBI scores. However, riparian enhancement upstream in the upper headwater area would allow for improved biological community quality and full attainment of the warmwater habitat criteria in the reach above the WWTP (RM 38.1) and decrease sedimentation downstream below the WWTP. It would decrease stream temperatures, increase margin habitat and decrease siltation and embeddedness. It would also increase the time for more nutrient assimilation into the biological community and would lessen nutrient-related impacts.

The Fayette County / Rattlesnake Creek WWTP discharge along with the septic drain tile discharge (which caused a confirmed fish kill in 1996) contributed to significantly lower IBI scores downstream at RM 35.5, though present habitat limitations (some sedimentation with slower flows and detritus riffles) also influenced the fish community. The total number of species decreased from 18 to 13, and the percent simple lithophils also decreased. The percent tolerant fishes increased, and the relative numbers (minus

tolerants) decreased substantially from 519 to 89. The IBI and MIwb scores increased slightly with increased distance from the WWTP. The MIwb scores decreased from a marginally good score of 8.0 upstream of Octa to a poor score of 5.1 downstream from the Fayette County / Rattlesnake Creek WWTP and tile drainage from the unsewered area near I-71 and U.S. Rt. 35 / SR 729. The MIwb scores increased from poor to a narrative evaluation of fair (6.0 and 6.7) downstream from the Milledgeville sewage ditch (RM 35.2) and at the cattle-influenced reach at Marchant-Luttrell Rd. (RM 33.4). The Fayette County / Rattlesnake Creek WWTP effluent, the septic drainage tile discharge from unsewered service area and unrestricted livestock at RM 33.4 influenced the fair to poor MIwb scores.

Downstream from the Fayette Co./Rattlesnake Creek WWTP fair conditions persisted in the macroinvertebrate community (ICI = 30). The number of total EPT taxa decreased from 14 upstream to six downstream. The total EPT population collected (mayflies and caddisflies) decreased from 17.5 percent upstream at RM 38.1 to less than three percent at RM 35.4 (ust. Milledgeville-Octa Rd.) downstream from the WWTP. Sedimentation and influences from the Fayette Co./Rattlesnake Cr. WWTP and unsewered areas likely limit caddisfly recolonization. Any increase in effluent quality and some NPS input abatement would increase water quality through this reach to allow for the attainment of WWH water quality criteria.

A marginally good macroinvertebrate community was present downstream from Milledgeville-Octa Rd. at RM 35.3. The intermittent drainage from unsewered Milledgeville might be adding nutrients that caused a green algal bloom in the pooled area just downstream from the bridge. In stream nutrients from the upstream sources (Rattlesnake Creek WWTP, unsewered area inputs) were likely contributing to the increased algal growth. The number of mayflies (particularly stenonemids) though increased compared to upstream due to sedimentation and more rocky substrates available. Though still six EPT taxa were collected during qualitative sampling, the total EPT population numbers were increasing.

Cattle in open pastures near Marchant-Luttrell Rd have caused slumped banks, acute erosion, widening and shallower depths in silted-in pools, and large amounts of sedimentation bedload. Decreased water quality conditions were evident (fair), as flatworms were common or predominant in most habitats sampled. Muddy conditions covered rocks and limited diversity (1-2 EPT taxa). To improve quality in the stream segment downstream near Marchant-Luttrell Rd. encouraging the fencing off near streambanks to cattle, establish riparian corridors, and limiting crossing areas would promote bank stabilization and protect the riparian area that is still present.

Gross sedimentation from crop agriculture-related erosion reduced IBIs, fish biomass and MIwb scores into the poor range near SR 729 and Snow Hill Road (RMs 34-32). Increased distance from WWTP effluents and direct cattle inputs allowed some recovery for macroinvertebrate quality at SR 729 to very good - despite channel being somewhat choked with sediment that limited large segments to shallow glides. Bank stabilization near SR 729 through expanded woody riparian development is needed, or gross erosion

(from bank cave-ins and false banks) will continue to degrade stream quality. Grass mowed strips were not protecting the streambanks through this reach. Macroinvertebrate performance was similar but slightly lower near Snow Hill Road (RM 24.2) due to increased agriculture inputs (sediment, organic material instream, entrenchment, and past channelization).

Improved habitat downstream from Stafford Rd. (QHEI improved by ~40 points) and some reduced sedimentation allowed for improved fish community quality and partial attainment (MIwb= 8.3). Agricultural effects still are present as IBI scores are still in fair condition from Stafford Rd. (RM 18) through Fishback Rd. (RM 13) despite excellent habitat. D.O.s through this reach widely fluctuated (~ 6 -11 mg/l) illustrating elevated nutrient concentrations still present and affecting algal production instream. Elevated and very elevated fecal coliform bacteria concentrations at RM 18 (possible agricultural effects or unsewered Buena Vista runoff) and RM 13 (possible horse / cattle upstream inputs or upstream agriculture) would also indicate periodic pollutant source(s) that affect water quality and biological quality. Also slightly elevated sediment metals arsenic, chromium and lead at RM 13.27 were present in pooled reach.

From Stafford Rd. to Fishback Rd. (RM13.2) the macroinvertebrate community attained exceptional scores (ICI=52-50). Below Stafford Rd., lower Rattlesnake Creek flows through some of the most scenic and higher quality habitat in Ohio, and near Centerfield (RM 7.9) the creek descends into a somewhat protected steep canyon-like open valley that continues quite a distance toward Paint Creek Reservoir. Fish scores near Centerfield improved with less continuing NPS inputs and less riparian disturbance, though some fluctuating D.O.s (6.5-11.4 mg/l) still indicate some nutrient enrichment (from upstream sources). Field notes indicate some sediment and algal mats covered surfaces of rocky substrates exposed to light. This limited some surface habitat to protected surfaces under first layer or undersides with interstitial area. Fish scores were the highest for this watershed here (IBI= 44; MIwb=8.8) but did not reach EWH biocriteria.

Macroinvertebrate scores were exceptional (ICI=46) but decreased slightly due likely from conditions mentioned above. Decreases in sedimentation and nutrient inputs from various upstream sources will increase biological performance throughout the Rattlesnake Creek basin. High quality unsampled tributaries in the lower Rattlesnake Creek area should be preserved if possible for two reasons: 1) they likely have EWH potential; and 2) preserving riparian corridor in these tributaries would maintain and improve the surface water quality flowing into Paint Creek Reservoir (lower N and P inputs, lower water temperatures, and higher minimum D.O.s).

Landuse and Nonpoint Sources

Landuse and land cover within the subwatershed is a good indicator of potential sources of pollution. For example, while the streams in the Paint Creek Watershed that attain WQS have an average of 51 percent forested within 50 feet of the creek, Rattlesnake has only 16 percent forested within that area. This supports the QHEI results listed above,

which consistently showed less than 50 m of forested land on either side of the creek. Within the watershed itself, there is only 4 percent forested area. The vast majority, 94 percent, is comprised of agricultural lands or open housing. Agricultural landuse is generally associated with sediment and nutrient contributions and a subsequent lowering of dissolved oxygen in nearby streams. The effect of a predominantly agricultural landuse with little or no riparian buffer to act as a filter strip is seen in the water quality and biological survey results in this basin. There are many BMPs for agriculture and housing developments that help to mitigate these problems. These solutions will be addressed in the implementation section of this plan.

Nonpoint sources in the subwatershed include not only agriculture, but also failing septic systems along the creek, and pasture and livestock operations near the headwaters.

Table 3-23. Landuse and Land Cover in Rattlesnake Creek Subwatershed

Landuse/land cover category	Percent in Rattlesnake Creek subwatershed	Percent w/in 50 feet of creek and tributaries
Urban	0.6	0.4
Agricultural or open housing	94.4	81.6
Shrub/scrub	0.1	0.4
Forested	4.3	16.0
Open water	0.1	0.3
Wetlands	0.4	1.2
Barren	0.0	0.0

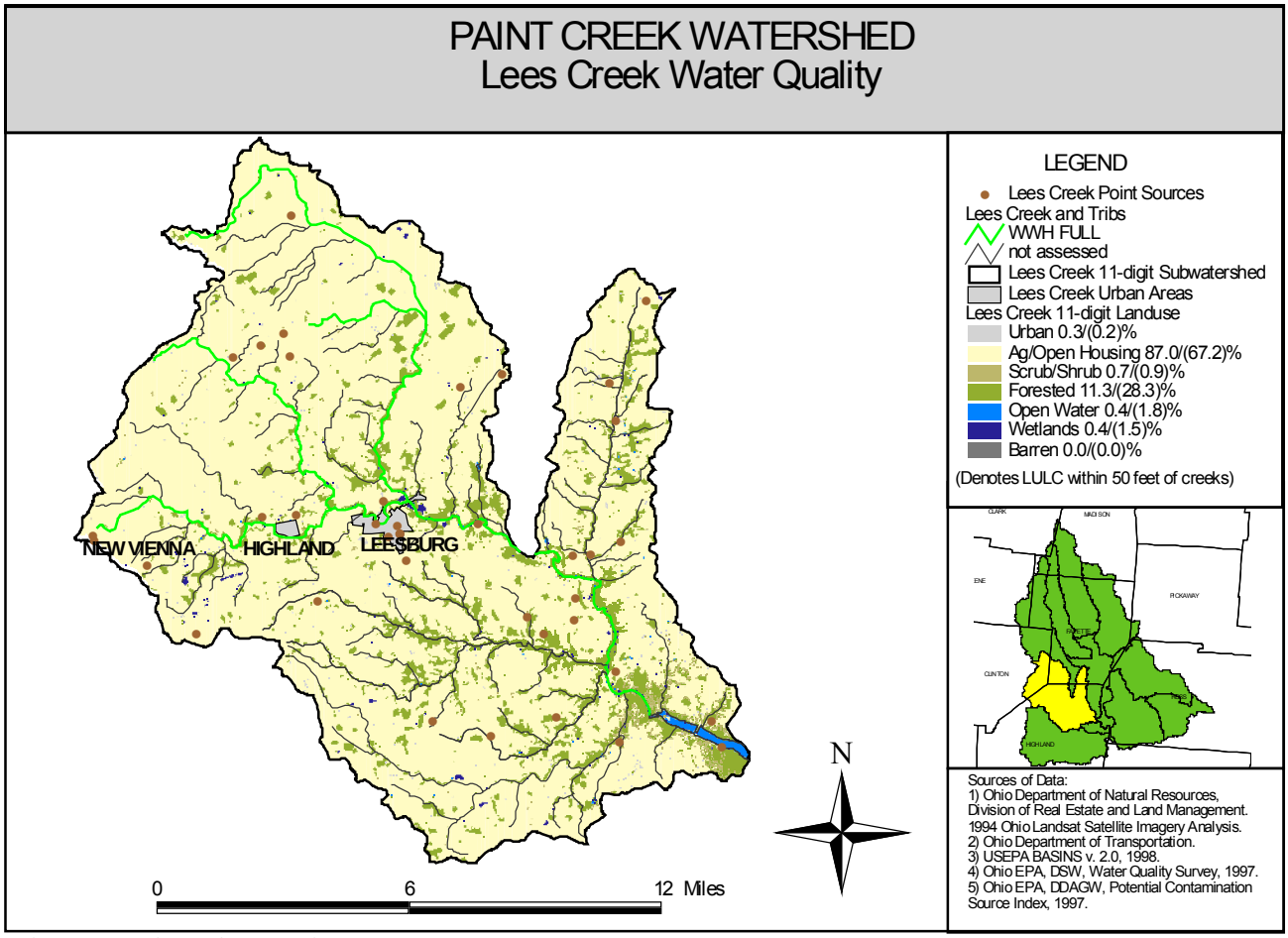
Point Sources

Point sources are direct discharges to creeks, such as WWTP outfalls. These discharges are often regulated by Ohio EPA's National Pollution Discharge Elimination System (NPDES) permit program. NPDES outfalls in the Rattlesnake subwatershed include the Village of South Solon and the Village of Sabina sewerage systems. In addition, the Octa WWTP, also called Fayette County/Rattlesnake Creek WWTP (4PH00007) is located at river mile 36.27. This WWTP has recently been upgraded. The affects to water quality are discussed in the beginning of this section with the chemical data results.

Another type of point source, surface impoundments, consist of holding ponds that may only overflow to the creek during rainfall events. The Roger Conrlin Hog Farm operates a surface impoundment in the Rattlesnake subwatershed.

Problem Statement

Rattlesnake Creek was recently downgraded from EWH to WWH, however it does not even attain these lower standards. The chemical data showed exceedences of Ohio's water quality standards (WQS) in July and August for fecal coliform bacteria, with 80 percent of the measurements from August exceeding WQS. Nutrients were high throughout the summer months and the dissolved oxygen levels reflected this nutrient enrichment scenario. The biological indices showed healthy populations of invertebrate species, but fish populations that did not meet WWH target scores. The physical habitat, determined by the QHEI scores, was substandard above river mile 24, but exceptional between river mile 18 and 7.8. The landuse in this basin is almost entirely agricultural (94%), with only four percent forested lands. The riparian corridor within 50 feet of the creeks, in turn, only contains 16 percent forested lands. To exacerbate the existing lack of habitat, much of the headwaters of Rattlesnake Creek are currently in ditch maintenance programs. The water quality in this subwatershed is habitat-limited with inputs from agricultural practices flowing directly to the stream. Additionally, there are three WWTP in the watershed, one of which was recently upgraded due its inability to properly handle the sewage load.



Created by Hilary Solomon for the Paint Creek Project, May 2002

Lees Creek Water Quality

In the summer of 1997, Ohio EPA sampled the Paint Creek Watershed for chemical, biological and habitat parameters. Lees creek was sampled in three locations. The monitoring locations are described in Table 3-24.

Table 3-24: Lees Creek monitoring point locations.

RIVER MILE	STREAM	LOCATION	ECOREGION	HABITAT	ATTAINMENT
1.20	Lees Creek	Monroe Rd. Dst. Leesburg WWTP	ECBP	WWH	Full
4.50	Lees Creek	SR 62, Ust. Leesburg	ECBP	WWH	Full
1.20	Middle Fork Lees Creek	SR 62	ECBP	WWH	Full

Lees Creek is located in the Eastern Corn Belt Plains Ecoregion. It is characterized in the Ohio Administrative Code (OAC) 3745-1-09; Table 9-1, as warmwater habitat (WWH) used for agricultural water supply (AWS), industrial water supply (IWS) and primary contact recreation (PCR). Of the parameters described in this report; total suspended solids (TSS), fecal coliforms, nitrate/nitrite, total phosphorous and dissolved oxygen; only fecal coliforms and dissolved oxygen have water quality standards. Nitrate concentrations may be compared to maximum contaminant levels (MCLs) for drinking water.

Ohio EPA measured for suspended solids, nitrate/nitrite, and phosphorus concentrations during each of the six monitoring dates in 1997. Fecal coliforms, however, were only measured on the last four dates and dissolved oxygen was only measured on the first two dates.

For primary contact waters fecal coliform concentrations (by geometric mean of at least five samples) must be less than 1000 bacteria per 100 mL of water, with no more than 10% of the samples over 2000 bacteria per 100 mL of water. With measurements of 4200, 2800 and 2200 bacteria per 100 mL of water on August 19, 1997, fecal coliform concentrations in Lees Creek exceeded the PCR maximum criterion at all three monitoring sites on one of the four sample dates.

Dissolved oxygen concentrations remain above the legal minimum throughout the summer in the Lees Creek basin. Nitrate levels are extremely high on July 8, 1997, exceeding drinking water MCLs by over 400 percent.

In comparison to similar-sized, high quality reference streams located in the same Ecoregion (75th percentile values), Lees Creek exceeded average total suspended solids concentrations (29 mg/L) throughout the stream August 19, and at river mile 1.15 (Lees Creek) on September 23. Fecal coliforms exceeded the wadeable stream 75th percentile values (860 per 100 mL water) on the August 5 at river mile 1.15 and August 19 at all monitoring points. Nitrate/nitrite concentrations (2.815 mg/L) were exceeded greatly on July 8, 1997. Nitrate/nitrite levels ranged from a high of 45.7 mg/L to 6.7 mg/L.

Additionally, dissolved oxygen numbers were a little low on July 22 and then not measured for the rest of the summer. Phosphorous concentrations are very low throughout the summer except for slight exceedences at river mile 1.15 Lees Creek and Middle Fork on August 18, 2001 (0.23 and 0.24 mg/L respectively).

Total suspended solids, fecal coliform, and total phosphorus were high on August 19th, which followed a rain event. Nitrate/nitrite values were high on July 8. The decrease in nitrogen through the summer may indicate that it originated from a seasonal source such as fertilizers.

High concentrations of fecal coliforms and highly fluctuating sediment and nutrient loading rates are combined with potentially low levels of dissolved oxygen in the Lees Creek basin. These potentially adverse influences on water quality are mitigated by the lack of urbanization and relatively healthy riparian corridor along the creek. The Leesburg WWTP, failing septic systems and agricultural landuse are potential causes of water quality degradation in the Lees Creek basin.

Please see the Lees Creek water quality data tables on the following page for site-specific water quality information.

Lees Creek Water Quality Data

Total Suspended Solids

River Mile	8-Jul	22-Jul	5-Aug	19-Aug	9-Sep	23-Sep	AVG	MAX	Reference
4.5	5	5	8	**84**	7	5	19	84	29
1.15	5	5	6	**44**	5	**53**	19.66	53	29
Middle Fork 1.15	5	5	5	**250**	6	5	46	250	29

Fecal Coliforms

River Mile	8-Jul	22-Jul	5-Aug	19-Aug	9-Sep	23-Sep	AVG	MAX	Reference
4.5			**800**	**4200**	380	580	1490	4200	860
1.15			**1000**	**2800**	820	80	1175	2800	860
Middle Fork 1.15			420	**2200**	130	80	707.5	2200	860

Nitrate/nitrite

River Mile	8-Jul	22-Jul	5-Aug	19-Aug	9-Sep	23-Sep	AVG	MAX	Reference
4.5	**45.7**	2.3	0.43	2.47	0.15	0.1	8.525	45.7	2.815
1.15	**6.7**	2.5	1.52	1.98	1.05	1.41	2.52	6.7	2.815
Middle Fork 1.15	**7.09**	2.54	0.66	1.9	0.26	0.5	2.14	7.09	2.815

Phosphorous

River Mile	8-Jul	22-Jul	5-Aug	19-Aug	9-Sep	23-Sep	AVG	MAX	Reference
4.5	0.05	0.05	0.07	0.09	0.05	0.05	0.06	0.09	0.13
1.15	0.05	0.05	0.05	**0.23**	0.05	0.05	0.08	0.23	0.13
Middle Fork 1.15	0.05	0.05	0.06	**0.24**	0.05	0.05	0.083	0.24	0.13

Dissolved Oxygen

River Mile	8-Jul	22-Jul	5-Aug	19-Aug	9-Sep	23-Sep	AVG	MIN	Reference
4.5	8.9	7.2					8.05	7.2	6.95
1.15	8.8	7					7.9	7	6.95
Middle Fork 1.15	9.3	8.3					8.8	8.3	6.95

*Adapted from Ohio EPA 1997 Paint Creek Basin field survey.
Bolded values are above (or below in the case of dissolved oxygen) associated reference stream 75th percentile concentrations.

Qualitative Habitat Evaluation Index (QHEI)

The QHEI is a measure of the presence and quality of physical habitat components that support aquatic life. 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 habitat characteristics that are used to determine the QHEI score include substrate, instream cover, channel morphology, riparian vegetation and bank erosion, gradient, and flow patterns (pool, run and riffle development). The QHEI score ranges from 20 to less than 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 sites around the state (OEPA, 2002, Bokes TMDL) 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 having the ability to support exceptional warmwater faunas. The QHEI can be used to direct restoration efforts for habitat and to provide a monitoring tool to measure progress toward habitat goals.

Table 3-26. Lees Creek and Middle Fork Lees Creek QHEI

River Mile	Location	Score	Comments
4.5	SR 62, Upstream Leesburg	72.5	• **Substrate**: normal silt with normal to moderate embeddedness • **Instream cover**: moderate • **Morphology**: riprap or old bridge material at the start of the zone, canopy removal • **Riparian**: none to moderate, severe bank erosion where riparian is removed • **Flood plain**: open pasture, row crop
1.2	McNroe Road, Downstream Leesburg WWTP	77.5	• **Substrate**: normal silt with normal to moderate embeddedness • **Instream cover**: moderate • **Morphology**: good, but canopy removal • **Riparian**: some completely removed, other narrow to moderate, moderate bank erosion • **Flood plain**: row crop
1.1	Middle Fork Lees Creek, SR 62	68.5	• **Substrate**: normal to moderate silt with normal to moderate embeddedness • **Instream cover**: sparse to moderate • **Riparian**: mostly narrow with road and

			residential on both sides • **Flood plain**: residential and row crop

Landuse and Nonpoint Sources

Landuse and land cover within the subwatershed is a good indicator of potential sources of pollution. For example, while the streams in the Paint Creek Watershed that attain WQS have an average of 51 percent forested within 50 feet of the creek, Lees Creek has only 28 percent forested within that area. Within the watershed itself, there is only 11 percent forested area. The vast majority, 87 percent, is comprised of agricultural lands or open housing. Lees Creek currently attains its WWH use designation, in part because of the presence of an adequate riparian corridor throughout parts of the creek. Agricultural landuse is generally associated with sediment and nutrient contributions and a subsequent lowering of dissolved oxygen in nearby streams and may pose a threat to the water quality in this basin. There are many BMPs for agriculture and housing developments that help to mitigate these problems. These solutions will be addressed in the implementation section of this plan.

Nonpoint sources in the subwatershed include not only agriculture, but also failing septic systems along the creek and pasture and livestock operations near the headwaters.

Table 3-27. Landuse and Land Cover in Lees Creek Subwatershed and along Tribs

Landuse/land cover category	Percent in Lees Creek subwatershed	Percent w/in 50 feet of creek and tributaries
Urban	0.3	0.2
Agricultural or open housing	87.0	67.2
Shrub/scrub	0.7	0.94
Forested	11.3	28.3
Open water	0.4	1.75
Wetlands	0.4	1.54
Barren	0.0	0.0

Point Sources

Point sources, such as Leesburg WWTP often contribute to water quality degradation, however the Lees Creek subwatershed has very few of these potential contamination sources. Those within 500-1000 feet of creeks are listed below.

Table 3-28. Lees Creek Point Sources

Point Source	Type	Address
Washington Hudson Inc.	Leaking Underground Tank	342 W. Main St., Leesburg
Leesburg Dump	Closed Landfill	Fairfield Township
Penningtons	Leaking Underground Tank	117 Greenfield-Sabina Rd
Paint Creek Lake boat ramp	Surface Impoundment	Paint Creek Lake State Park
Leesburg WWTP	NPDES permit	Leesburg

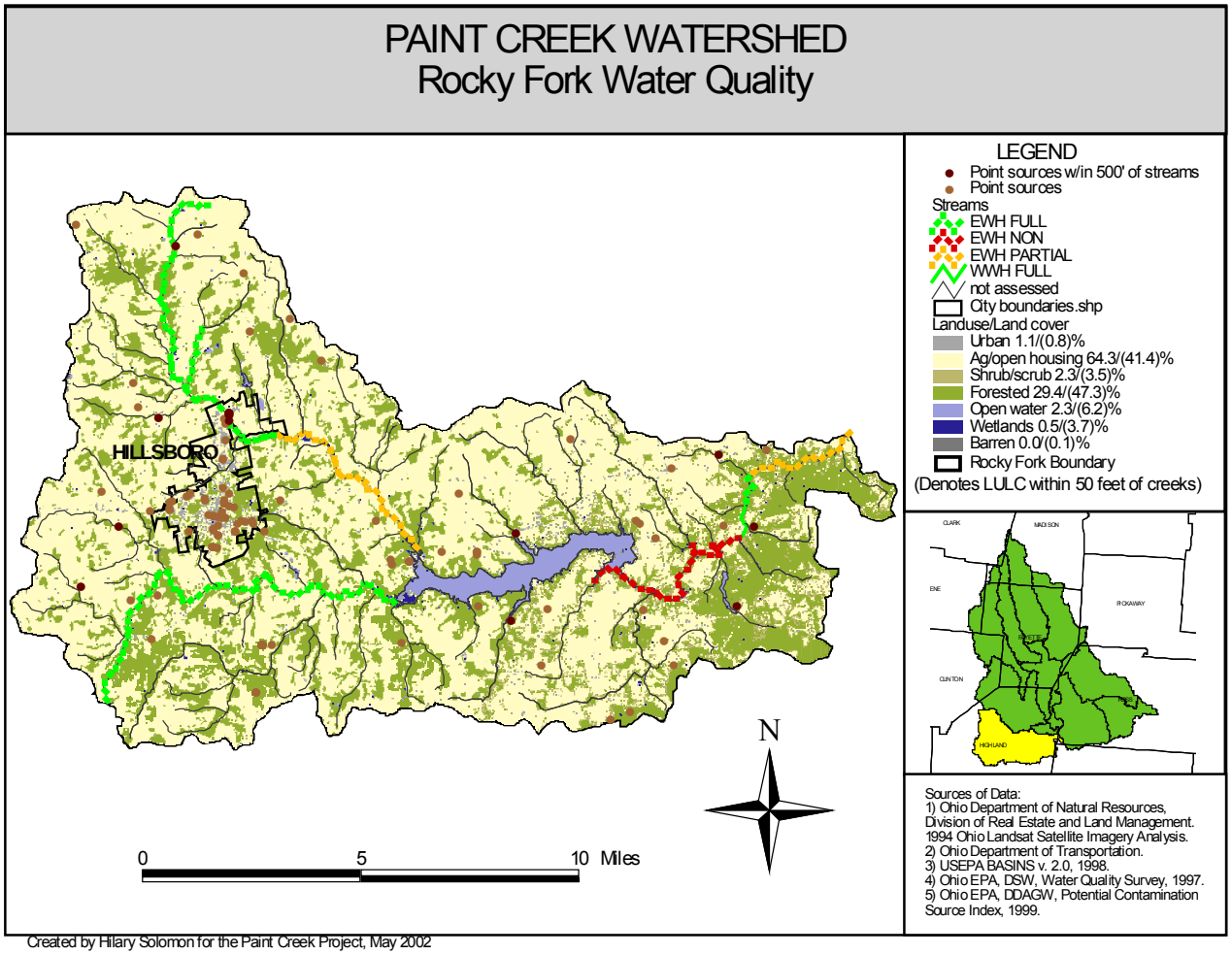
In addition, 10 cemeteries located near Lees Creek may contribute arsenic.

Problem Statement

Lees Creek is designated, and meets, WWH use designation. High concentrations of fecal coliforms and highly fluctuating sediment and nutrient loading rates are combined with potentially low levels of dissolved oxygen in the Lees Creek basin to pose potential threats to water quality. These potentially adverse influences on water quality are mitigated by the lack of urbanization and relatively healthy riparian corridor along the creek. The landuse in the Lees Creek basin is primarily agricultural (87%), with 11% forested land cover. Forested riparian corridor, within 50 feet of the creeks comprises 28.3 percent of the land cover. The Leesburg WWTP, failing septic systems and agricultural landuse are potential causes of water quality degradation in the Lees Creek basin.

ROCKY FORK WATER QUALITY

Including Clear Creek



Created by Hilary Solomon for the Paint Creek Project, May 2002

Rocky Fork of Paint Creek Water Quality

During Ohio EPA's 1997 monitoring survey, Rocky Fork Creek was sampled in five locations. These locations are described in Table 3. In this section, Rocky Fork chemical data is compared to legal limits for parameters of concern, where they exist, and to reference stream chemical data for streams from the same Ecoregion and same size watershed.

Table 3-29. Rocky Fork of Paint Creek monitoring point locations

RIVER MILE	STREAM	LOCATION	ECO-REGION	W/S SIZE	HABITAT	ATTAINMENT
0.30	Rocky Fork Creek	The Point	IP	HW	EWH	Partial
4.50	Rocky Fork Creek	Barrets Mill	IP	W	EWH	Full
9.10	Rocky Fork Creek	Rocky Fork Lake Tailwaters	IP	W	EWH	Non
18.10	Rocky Fork Creek	Fettro Road	IP	W	EWH	Full
23.30	Rocky Fork Creek	US 62	IP	W	EWH	Full

*HW=Headwater, <20 miles^2 watershed area; W=Wadeable, ≥20 and <200 miles^2 watershed area; SR=Small River, ≥200 miles^2 watershed area and <2000 miles^2 watershed area; and LR=Large River, >1000 miles^2 watershed area.

Rocky Fork is located in the Interior Plateau Ecoregion (Vandermeer, 1997). It is characterized in the Ohio Administrative Code (OAC) 3745-1-09; Table 9-1, as excellent warmwater habitat (EWH) used as a state resource water (SRW), agricultural water supply (AWS), industrial water supply (IWS) and for primary contact recreation (PCR). Of the parameters described in this report; total suspended solids (TSS), fecal coliforms, nitrate/nitrite, total phosphorous and dissolved oxygen; only fecal coliforms and dissolved oxygen have water quality standards. Nitrate concentrations may be compared to maximum contaminant levels (MCLs) for drinking water. All parameters may be compared to Ohio reference stream data.

For primary contact waters fecal coliform concentrations (by geometric mean of at least five samples) must be less than 1000 bacteria per 100 mL of water, with no more than 10% of the samples over 2000 bacteria per 100 mL of water. Rocky Fork only exceeded 1000 per 100 mL of water at one monitoring point in August. Fecal coliform concentrations in Rocky Fork were generally very low in comparison with levels seen in the rest of the watershed.

Dissolved oxygen concentrations were consistently below the minimum outlined in the water quality standards at the headwaters of Rocky Fork and the confluence with Paint Creek. Dissolved oxygen also dipped in the tailwaters of Rocky Fork Lake on September 9. This may be related to a lack of oxygen in the lake at this time. Nitrate levels did not exceed the legal maximums.

In comparison to similar size high quality reference streams located in the same ecoregion, Rocky Fork did not exceed 75th percentile average total suspended solids concentrations. Fecal coliforms slightly exceeded the wadeable average values (515 per 100 mL water) in several of the samples taken. Fecal coliform samples were only collected on three dates for Rocky Fork. Nitrate/nitrite level were excellent and well below the reference stream average values (0.57 mg/L). Dissolved oxygen concentrations were either low, around 5 mg/L, or fairly high with a maximum of 30 mg/L. Again, they appeared low in the headwaters, outfall and at the confluence with Paint creek. Nutrient levels in the stream were very low.

Overall Rocky Fork has very good water quality. Fecal coliform concentrations were slightly elevated throughout the stream and dissolved oxygen concentrations fluctuated greatly, however the stream showed low levels of nutrients and suspended solids. Potential threats to water quality include increasing development pressure in the region, agricultural runoff, and the effluent from the Hillsboro WWTP, which enters from Clear Creek. Sediments from Clear Creek are also a threat. Currently, Rocky Fork meets all of its EWH criteria.

Please see the Rocky Fork of Paint Creek water quality data tables on the following page for site- specific water quality information.

Rocky Fork Water Quality Tables*

Total Suspended Solids

River Mile	8-Jul-97	22-Jul-97	5-Aug-97	19-Aug-97	9-Sep-97	23-Sep-97	AVG	MAX	Reference
23.27	5	5	5	14	5	5	6.5	14	25
18.05	11	15	9	30	11	8	14	30	41.25
9.15	12	10	9	8	5	11	9.17	12	41.25
4.45	11	8	8	12	5	11	9.17	12	41.25
0.2	6	5	5	13	14	10	8.83	14	41.25

Fecal Coliform

River Mile	8-Jul-97	22-Jul-97	5-Aug-97	19-Aug-97	9-Sep-97	23-Sep-97	AVG	MAX	Reference
23.27			100	460	140		233.33	460	515
18.05			280	**1200**	160		546.67	1200	515
9.15			30	20	170		73.33	170	515
4.45			140	**530**	140		270	530	515
0.2			110	**580**	60		250	580	515

Nitrate/nitrite

River Mile	8-Jul-97	22-Jul-97	5-Aug-97	19-Aug-97	9-Sep-97	23-Sep-97	AVG	MAX	Reference
23.27	0.65	0.61	0.48	0.56	0.41	0.28	0.498	0.65	1.2
18.05	**0.58**	0.39	0.3	0.45	0.13	0.26	0.352	0.58	0.57
9.15	0.1	0.11	0.19	0.1	0.1	0.24	0.14	0.24	0.57
4.45	0.24	0.42	0.27	0.12	0.5	0.44	0.332	0.5	0.57
0.2	0.37	0.42	0.4	0.23	0.43	0.34	0.365	0.43	0.57

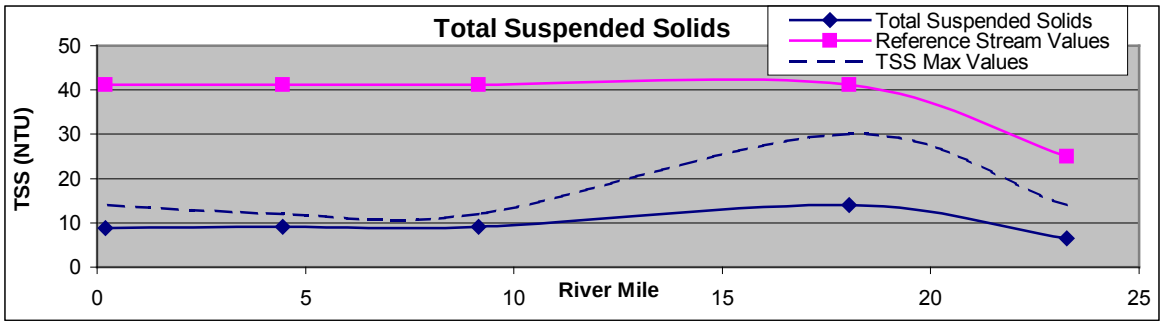
Phosphorous

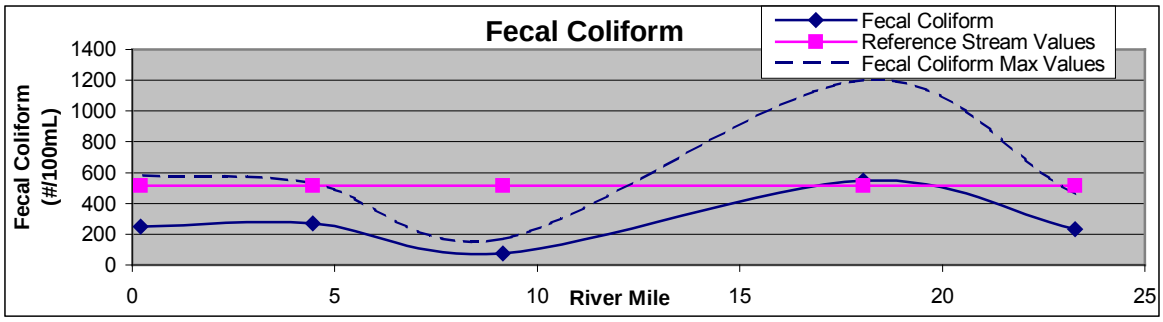
River Mile	8-Jul-97	22-Jul-97	5-Aug-97	19-Aug-97	9-Sep-97	23-Sep-97	AVG	MAX	Reference
23.27	0.05	0.05	**1.19**	0.16	0.05	0.05	0.258	1.19	0.205
18.05	0.05	0.07	**0.16**	0.05	0.05	0.05	0.072	0.16	0.13
9.15	0.05	0.05	0.08	0.06	0.05	0.13	0.07	0.13	0.13
4.45	0.13	0.14	0.07	0.05	0.05	0.05	0.082	0.14	0.13
0.2	0.7	0.05	0.08	0.12	0.06	0.05	0.177	0.7	0.13

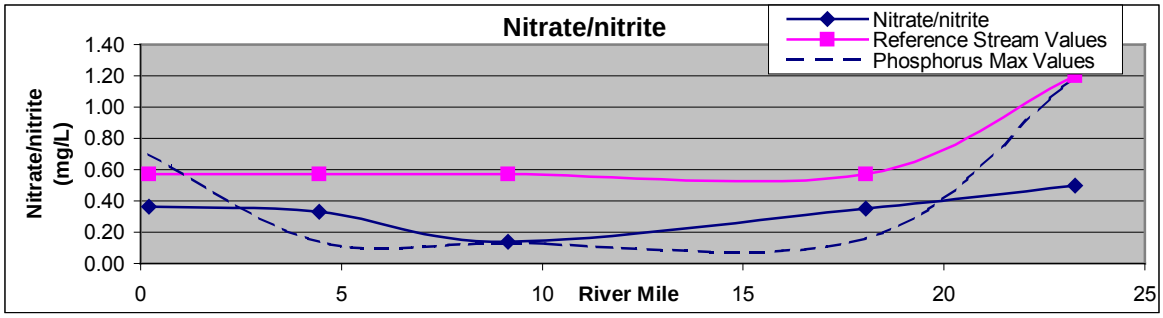
Dissolved Oxygen

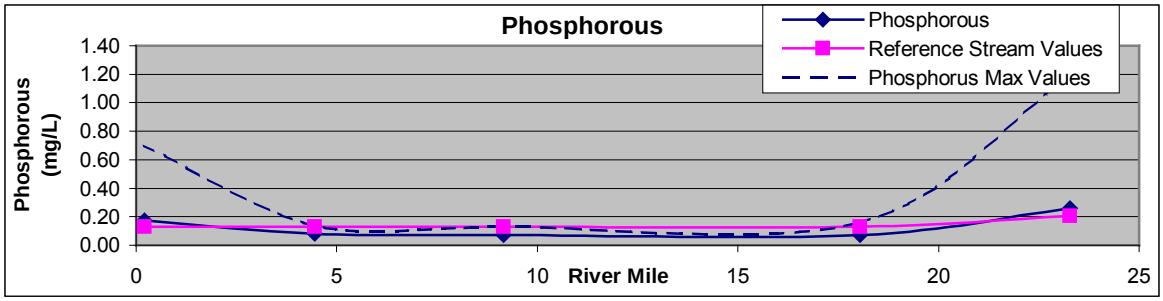
River Mile	8-Jul-97	22-Jul-97	5-Aug-97	19-Aug-97	9-Sep-97	23-Sep-97	AVG	MIN	Reference
23.27	**5**	**5**	**5**	14	**5**	**5**	6.5	5	7.7
18.05	11	15	9	30	11	8	14	8	6.6
9.15	12	10	9	8	**5**	11	9.2	5	6.6
4.45	11	8	8	12	**5**	11	9.2	5	6.6
0.2	**6**	**5**	**5**	13	14	10	8.8	5	6.6

Bolded values are above (or below in the case of dissolved oxygen) associated reference stream 75th percentile concentrations.


Total Suspended Solids
Total Suspended Solids
Reference Stream Values
TSS Max Values
TSS (NTU)
50
40
30
20
10
0
0
5
10
River Mile
15
20
25


Fecal Coliform
Fecal Coliform
Reference Stream Values
Fecal Coliform Max Values
Fecal Coliform (#/100mL)
1400
1200
1000
800
600
400
200
0
0
5
10
River Mile
15
20
25


Nitrate/nitrite
Nitrate/nitrite
Reference Stream Values
Phosphorus Max Values
Nitrate/nitrite (mg/L)
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0
5
10
River Mile
15
20
25


Phosphorous
Phosphorous
Reference Stream Values
Phosphorus Max Values
Phosphorous (mg/L)
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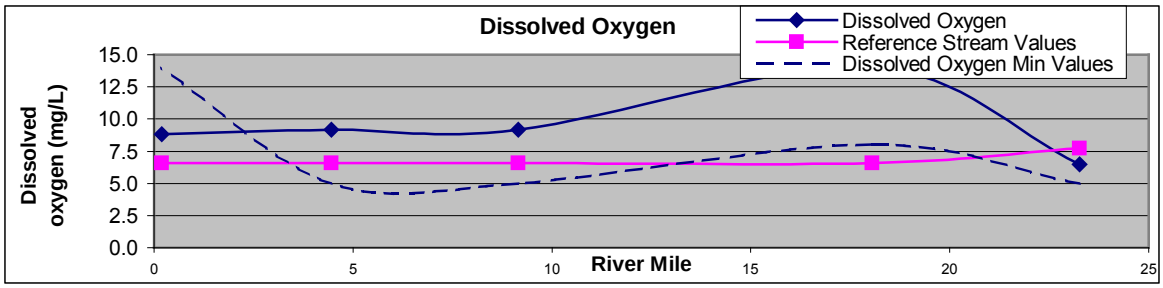
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0
5
10
River Mile
15
20
25


Dissolved Oxygen
Dissolved Oxygen
Reference Stream Values
Dissolved Oxygen Min Values
Dissolved oxygen (mg/L)
15.0
12.5
10.0
7.5
5.0
2.5
0.0
0
5
10
River Mile
15
20
25

Qualitative Habitat Evaluation Index (QHEI)

The QHEI is a measure of the presence and quality of physical habitat components that support aquatic life. 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 habitat characteristics that are used to determine the QHEI score include substrate, instream cover, channel morphology, riparian vegetation and bank erosion, gradient, and flow patterns (pool, run and riffle development). The QHEI score ranges from 20 to less than 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 sites around the state (OEPA, 2002, Bokes TMDL) 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 having the ability to support exceptional warmwater faunas. The QHEI can be used to direct restoration efforts for habitat and to provide a monitoring tool to measure progress toward habitat goals.

Rocky Fork QHEI scores from Ohio EPA's 1997 watershed survey ranged from 66.5 to 77.5. While only one score was over the EWH target of 75, the other three scores were close. At river mile 23.3, the presence of silt in the water and channel embeddedness combined with narrow, and in some places nonexistent, riparian in the headwaters and tributaries lowered the score. Downstream of the Rocky Fork Lake outfall (RM 9.1) silt and embeddedness are normal and the riparian is comprised of wide, mature forested areas. The instream cover is sparse, however, due to scouring and variable outfall from the dam. Downstream of Barrett's mill (RM 4.5), there is evidence of silt loading and channel embeddedness with sparse instream cover. The riparian corridor in this area is adequate, however. At The Point (RM 0.1) the sediments begin to drop out of the water column and build up in the channel. Instream and riparian habitat is moderate. The QHEI indices for Rocky Fork indicate that sediment, instream cover and riparian areas need to be addressed.

Table 3-30. Rocky Fork QHEI scores and habitat component quality

River Mile	Location	QHEI	Comments
23.3	U.S. 62 (RR site)	66.5	• **Substrate**: sand, gravel, cobble, boulder, bedrock and slabs, moderate silt and embeddedness • **Instream cover**: moderate • **Channel morphology**: moderate sinuosity, good development, no channelization, moderate stability • **Riparian zone**: narrow riparian, with little bank erosion • **Flood Plain**: residential
18.1	Fettro Road (RR site)		• No information
9.1	Rocky Fork Lake tailwaters	71.5	• **Substrate**: cobble, boulder, slabs, bedrock, sand and gravel (coarse native and glacial till) with normal silt and embeddedness • **Instream cover**: sparse to moderate • **Channel morphology**: no channelization, low sinuosity and high stability • **Riparian zone**: wide, mature riparian, little or no bank erosion • **Flood Plain**: row crop and forest
4.5	Downstream Barrets Mill	70.0	• **Substrate**: boulder, slabs, cobble, sand, bedrock and gravel with normal-moderate silt and moderate embeddedness • **Instream cover**: sparse to moderate • **Channel morphology**: typical bedrock system, wide and shallow except for a few pools • **Riparian zone**: narrow 5-10m on the left bank, wide on the right >50m, little to no bank erosion • **Flood Plain**: row crop
0.1	The Point	77.5	• **Substrate**: sand, gravel, cobble, boulder, bedrock, normal silt but moderately to extensively embedded • **Instream cover**: moderate • **Channel morphology**: low sinuosity, fair to good development, no channelization, high stability • **Riparian zone**: narrow to moderate riparian, with little bank erosion • **Flood Plain**: row crop

Nonpoint Sources of Pollution

Nonpoint sources of pollution include the following associated problems: siltation, nutrients, low dissolved oxygen, habitat alteration, and organic enrichment. Habitat alteration may include channelization, which creates a lack of riparian and in-stream physical habitat. Landuse and land cover within the subwatershed is a good indicator of potential sources of pollution. The main land uses in the Rocky Fork subwatershed are agricultural/open housing (64.3%) and forested (29.4%). Within 50 feet of the creeks, the landuse is predominantly forested (47.3%) with only 38.5% agriculture/open housing.

It is apparent from the landuse statistics listed below that the majority of the nonpoint source pollution in this subwatershed will be related to agricultural, open residential and logging/forestry operations. Agriculture is commonly associated with sedimentation, nutrient enrichment, organic loading, and channel modification. If livestock pasturing along the creek is involved, fecal coliforms and bank destabilization may also be present. Open residential may be associated with nutrients and fecal coliforms from lawn care and failing septic systems. During the development stage, sedimentation is also usually a problem. Forestry, like agriculture, is associated with sedimentation and canopy removal near the stream banks.

Nonpoint sources in the subwatershed are not limited to rural activities. Urban areas, such as Hillsboro, also contribute nonpoint pollutants from storm water runoff and development. Urban areas, with high percentages impervious surfaces are also associated with increased creek flow rates after storms due to runoff passing over pavement and quickly reaching the creek. Rainfall no longer infiltrates soil and recharges the groundwater so that there are diminished low flows in streams as well. This repetitive cycle of repeated high stream flow directly after storms followed by extremely low flows is called “flashiness.”

Table 3-31. Landuse and Land Cover in Rocky Fork Creek Subwatershed

Landuse/land cover category	Percent in Rocky Fork Creek subwatershed	Percent w/in 50 meters of creek and tributaries	Percent w/in 50 feet of creek and tributaries
Urban	1.1	0.7	0.7
Agricultural or open housing	64.3	41.4	38.5
Shrub/scrub	2.3	3.3	3.5
Forested	29.4	45.9	47.3
Open water	2.3	5.8	6.2
Wetlands	0.5	2.8	3.7
Barren	0.0	0.0	0.1

Point sources within 500 feet of Rocky Fork and Clear Creek

Another component of this study, related to landuse, includes the point sources found within the vicinity of the creeks. Point sources include inputs from National Pollution Discharge Elimination Sytems (NPDES) permitted sites such as WWTP. Rocky Fork and its tributaries have very few point sources. Ohio DNR has an NPDES permit that discharges to Rocky Fork and several companies have surface impoundments or wastewater treatment ponds that may discharge during storm events. These sites include B&B Plating in Hillsboro, the Highland County Water Company, Inc. and Ervin Parshall.

Other potential sources of contamination include underground storage tanks, hazardous waste generators, cemeteries and others.

Problem statement

Except for a short reach of creek below the Rocky Fork Lake dam, Rocky Fork attains its use designation throughout the subwatershed. The chemistry reflects overall good water quality, with most measurements below reference stream 75th percentile values. (Fecal coliforms, phosphorus and dissolved oxygen slightly exceeded reference values, which may indicate that the water quality is threatened.) The loss of attainment downstream of the dam may be attributed to (hypolimnetic) releases from the bottom anoxic lake waters. In addition destabilization of the channel below the dam was attributed to highly variable releases of lake water. Habitat scores were fairly high overall, but showed sedimentation and lack of forested riparian corridor as threats to water quality. The main nonpoint sources appear to be agricultural landuse, with 64% of the subwatershed categorized as agriculture/open housing. One of the main reasons that Rocky Fork attains its use designation throughout most of the creek may be due to the prevalence of forested area when compared to the upper 2/3 of the Paint Creek Watershed. Within 50 feet of the creek the landuse was 47% forested. This is second only to the lower reaches of Paint Creek, which are 51% forested. There are no major point sources, such as WWTP on Rocky Fork Creek, however inputs from the Hillsboro WWTP on Clear Creek should be monitored.

Clear Creek Water Quality

During Ohio EPA's 1997 monitoring survey, Clear Creek was sampled in five locations. These locations are described in Table 3-32. In this subsection, Creek chemical data is compared to legal limits for parameters of concern, where they exist, and to reference stream chemical data for streams from the same Ecoregion and same size watershed.

Table 3-32: Clear Creek monitoring point locations

RIVER MILE	STREAM	LOCATION	ECO-REGION	SIZE	HABITAT	ATTAINMENT
1.70	Clear Creek	Lilly Rd.	IP	W	EWH	Partial
5.20	Clear Creek	Selph Rd.	ECBP	W	EWH	Partial
6.60	Clear Creek	Dst. Hillsboro WWTP	ECBP	W	EWH	Full
6.80	Clear Creek	Ust. Hillsboro WWTP	ECBP	W	EWH	Full
8.30	Clear Creek	Reg. Reference Site	ECBP	HW	EWH	Full

HW = <20miles^2 drainage area, W = ≥20 miles^2 and less than 200 miles^2 drainage area.

Except for the last 3 miles, Clear Creek is located in the Eastern Corn Belt Plains Ecoregion (Vandermeer, 1997). It is characterized in the Ohio Administrative Code (OAC) 3745-1-09; Table 9-1, as excellent warmwater habitat (EWH) used for (SRW) agricultural water supply (AWS), industrial water supply (IWS) and primary contact recreation (PCR). Of the parameters described in this report; total suspended solids (TSS), fecal coliforms, nitrate/nitrite, total phosphorous and dissolved oxygen; only fecal coliforms and dissolved oxygen have water quality standards. Nitrate concentrations may be compared to maximum contaminant levels (MCLs) for drinking water.

For primary contact waters fecal coliform concentrations (by geometric mean of at least five samples) must be less than 1000 bacteria per 100 mL of water, with no more than 10% of the samples over 2000 bacteria per 100 mL of water. With measurements of 5900 and 3400 bacteria per 100 mL of water on August 16, 1997, and 6800, 2600, 2800, 2500 and 2400 bacteria per 100 mL of water on August 19, 1997, fecal coliform concentrations in Clear Creek exceed these legal limits at most of the monitoring sites on two of the four sample dates. Dissolved oxygen concentrations above 6.0 mg/L met the water quality standards and nitrate levels did not exceed the MCL.

In comparison to high quality reference streams located in the same ecoregions, Clear Creek exceeded average total suspended solids concentrations (29 mg/L) at all monitoring points on August 19. The suspended solids concentrations were extremely high at the confluence with the lake, 562 NTU. Fecal coliforms exceeded the wadeable creek average values (860 per 100 mL water for ECBP) (or wadeable values for IP, 515 per 100 mL) for nearly every measurement. Nitrate/nitrite concentrations (2.815 mg/L ECBP) were consistently below the wadeable creek average values. Dissolved oxygen was only measured twice, both times in July. The oxygen concentrations in the latter half of the month were slightly lower than those in early July. Several of the monitoring

locations dipped slightly below the large river average values. P hosphorous concentrations were elevated near the Hillsboro WWTP.

High levels of fecal coliform, sediment and phosphorous affected Clear Creek water quality. Not only did the stream not meet reference stream values for these parameters, but it only partially met excellent warmwater chemical and biological criteria at the river mile 1.7 and 5.2 monitoring sites. Both the Hillsboro WWTP and agricultural landuse are potential causes of water quality degradation in the Clear Creek basin.

Please see t he Clear Creek water quality data tables for site- specific water quality information.

Clear Creek Water Quality Data

Total Suspended Solids

River Mile	08-Jul-97	23-Jul-97	06-Aug-97	19-Aug-97	11-Sep-97	24-Sep-97	MAX	AVG	Reference
8.2	5	5	5	**16**	5	8	16	7.3	14
6.8	5	5	5	**24**	5	8	24	8.7	29
6.73	5	5	5	5	5	5	5	5.0	29
6.6	5	5	5	19	5	5	19	7.3	29
5.45	5	5	5	24	8	6	24	8.8	29
1.65	25	12	6	**562**	10	6	562	103.5	41.25

Fecal Coliform

River Mile	08-Jul-97	23-Jul-97	06-Aug-97	19-Aug-97	11-Sep-97	24-Sep-97	MAX	AVG	Reference
8.2			290	**6800**	210	80	6800	1845	960
6.8			400	**2600**	600	45	2600	911	860
6.73			**5900**	**2800**	270		5900	2990	860
6.6			**3400**	**2500**	680	580	3400	1790	860
5.45			180	**2400**	530		2400	1037	860
1.65			100	**700**	230		700	343	515

Nitrite/nitrate

River Mile	08-Jul-97	23-Jul-97	06-Aug-97	19-Aug-97	11-Sep-97	24-Sep-97	MAX	AVG	Reference
8.2	1.59	1.56	1.56	0.86	1.03	1.18	1.59	1.30	2.268
6.8	1.14	0.86	0.61	0.69	0.67	0.1	1.14	0.68	2.815
6.73	1.33	1.51	1.49	1.02	2.44	1.88	2.44	1.61	2.815
6.6	1.15	1.06	0.98	0.76	1.61	1.04	1.61	1.10	2.815
5.45	1.15	0.83	0.54	0.67	2	0.98	2	1.03	2.815
1.65	1.6		0.56	0.75	0.77	0.45	1.6	0.83	0.57

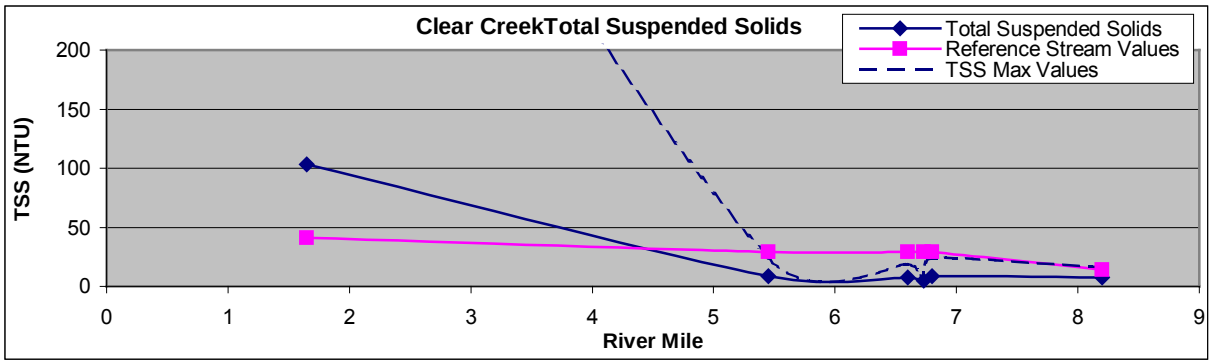
Phosphorus

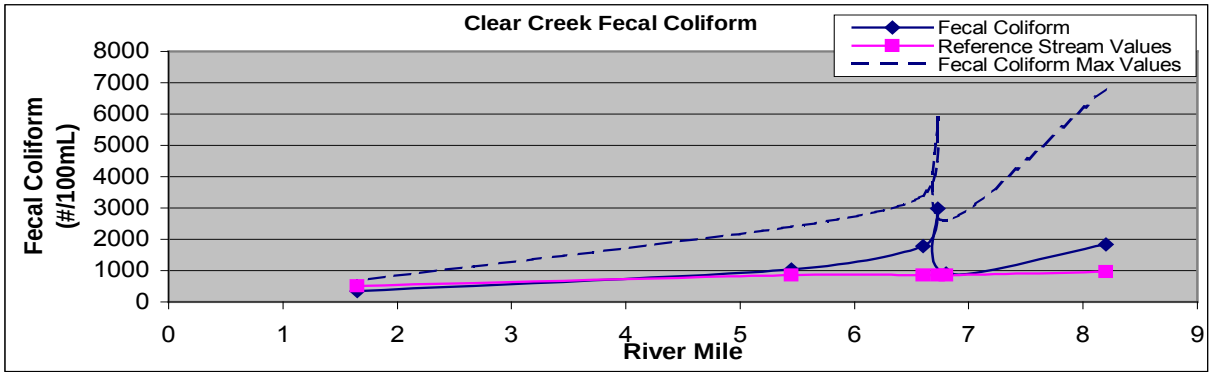
River Mile	08-Jul-97	23-Jul-97	06-Aug-97	19-Aug-97	11-Sep-97	24-Sep-97	MAX	AVG	Reference
8.2	0.05	0.05	0.08	**0.11**	**0.9**	0.05	0.9	0.21	0.08
6.8	0.13	0.05	0.06	**0.18**	**0.27**	0.07	0.27	0.13	0.13
6.73	0.4	**1.17**	**0.85**	**0.14**	**0.56**	**0.21**	1.17	0.56	0.13
6.6	**0.14**	**0.38**	**0.72**	**0.24**	**0.68**	0.13	0.72	0.38	0.13
5.45	**0.22**	**0.26**	**0.18**	**0.2**	**0.82**	0.05	0.82	0.29	0.13
1.65	0.05		**0.17**	0.09	**0.74**	0.05	0.74	0.22	0.13

Dissolved oxygen

River Mile	08-Jul-97	23-Jul-97	06-Aug-97	19-Aug-97	11-Sep-97	24-Sep-97	MIN	AVG	Reference
8.2	8.4	**5.8**					5.8	7.1	6.6
6.8	8.4	8.3					8.3	8.35	6.95
6.73	9.4	8.5					8.5	8.95	6.95
6.6	9.4	8.6					8.6	9	6.95
5.45	9.2	7					7	8.1	6.95
1.65	10.8	7.5					7.5	9.15	6.6

Bolded values are above (or below in the case of dissolved oxygen) associated reference stream 75th percentile concentrations.


Clear CreekTotal Suspended Solids
Total Suspended Solids
Reference Stream Values
TSS Max Values
TSS (NTU)
200
150
100
50
0
0 1 2 3 4 5 6 7 8 9
River Mile


Clear Creek Fecal Coliform
Fecal Coliform
Reference Stream Values
Fecal Coliform Max Values
Fecal Coliform (#/100mL)
8000
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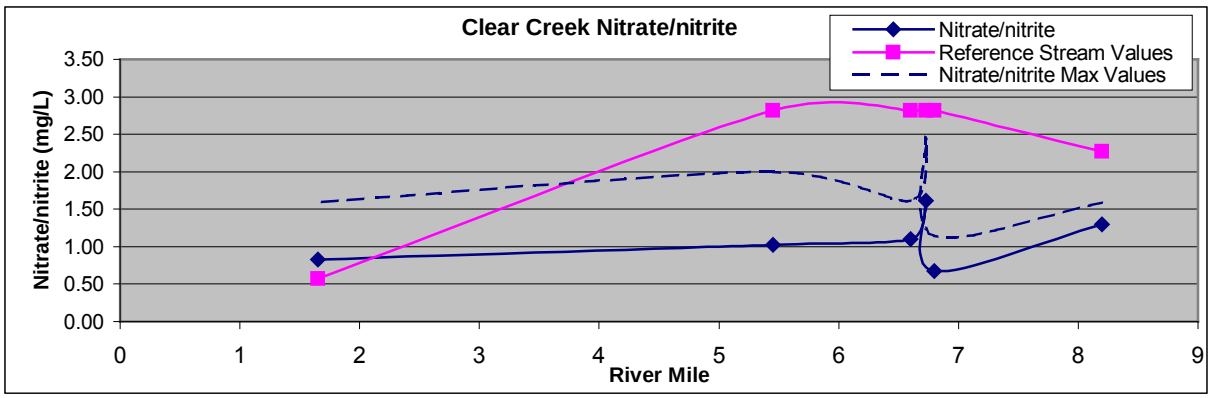
6000
5000
4000
3000
2000
1000
0
0 1 2 3 4 5 6 7 8 9
River Mile


Clear Creek Nitrate/nitrite
Nitrate/nitrite
Reference Stream Values
Nitrate/nitrite Max Values
Nitrate/nitrite (mg/L)
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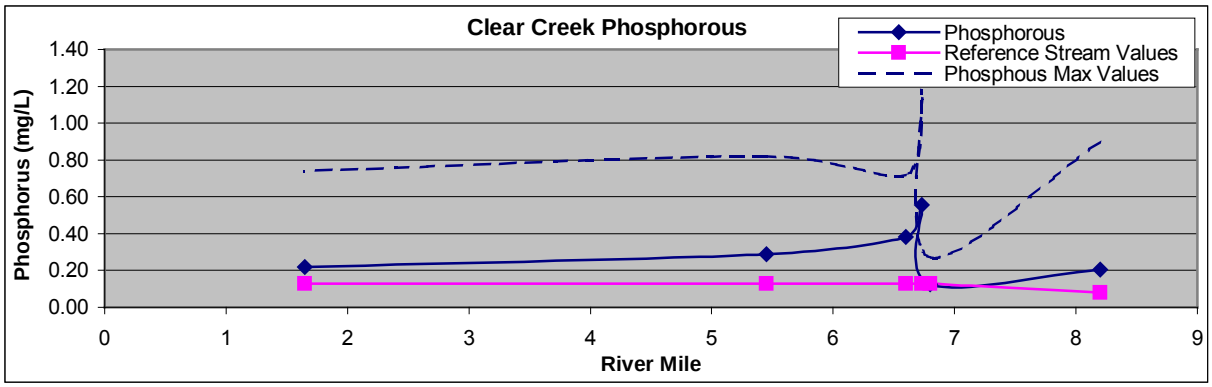
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0 1 2 3 4 5 6 7 8 9
River Mile


Clear Creek Phosphorous
Phosphorous
Reference Stream Values
Phosphous Max Values
Phosphorus (mg/L)
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0 1 2 3 4 5 6 7 8 9
River Mile

Qualitative Habitat Evaluation Index (QHEI)

The QHEI is a measure of the presence and quality of physical habitat components that support aquatic life. 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 habitat characteristics that are used to determine the QHEI score include substrate, instream cover, channel morphology, riparian vegetation and bank erosion, gradient, and flow patterns (pool, run and riffle development). The QHEI score ranges from 20 to less than 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 sites around the state (OEPA, 2002, Bokes TMDL) 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 having the ability to support exceptional warmwater faunas. The QHEI can be used to direct restoration efforts for habitat and to provide a monitoring tool to measure progress toward habitat goals.

None of the QHEI scores along Clear Creek met the EWH target of 85, because the habitat is highly influenced by anthropogenic activities. The scores only remain as high as they do because of the inherently high quality substrate and water depth in this creek. The substrates are diverse with bedrock, cobbles, boulders and slabs all being components. River mile 8.5 was channelized between the original QHEI measure in August, 1997, and a second measure in October of that year. While, the score may not have been revised from the original survey, the comments section of table 3-33, reflects the effects of this channelization. Note the heavy silt and channel embeddedness with deep pools filling in and the morphology changing to predominantly glide. Sedimentation and narrow riparian corridor continue to affect water quality throughout the stream, with erosion from upstream depositing in the lower reaches. This type of sedimentation negatively affects the reproduction and viability of many species of fish and invertebrates, with pollution tolerant species such as snail and worms becoming more abundant.

Table 3-33: QHEI scores for Clear Creek

River Mile	Location	QHEI	Comments
8.5	Reference Site	68.0	• **Substrate**: heavy silt and extensive embeddedness • **Instream cover**: sparse • **Morphology**: recent channelization, all run/glide, downstream pool filling in, unstable channel • **Riparian**: very narrow to moderate, recent tree removal upstream • **Flood Plain**: old field, open pasture and row crop
6.8	Upstream Hillsboro WWTP	67.0	• **Substrate**: normal silt and moderate to extensive embeddedness • **Instream cover**: moderate • **Morphology**: good, but unstable channel • **Riparian**: narrow to moderate, moderate to severe bank erosion • **Flood Plain**: adjacent Hillsboro WWTP
6.6	Downstream Hillboro WWTP	66.0	• **No info**
5.2	Selph Road	62.0	• **Substrate**: normal to moderate silt and normal embeddedness • **Instream cover**: moderate • **Morphology**: fair, abundant sand and gravel deposits plus unvegetated point bars, unstable channel • **Riparian**: very narrow riparian with moderate to severe bank erosion • **Flood Plain**: row crops and a mowed field
1.7	Lilly Road	65.5	• **Substrate**: heavy silt and extensive embeddedness • **Instream cover**: sparse • **Morphology**: recent channelization, all run/glide, downstream pool filling in, unstable • **Riparian**: very narrow to moderate, recent tree removal upstream • **Flood Plain**: old field, open pasture and row crop
0.9	Moberly Branch, US 62 Ref. Site	74.0	• **Substrate**: normal silt and embeddedness • **Instream cover**: moderate to extensive • **Morphology**: very low stability, large, recent sand and gravel deposit • **Riparian**: narrow but intact corridor, moderate to severe bank erosion • **Flood Plain**: row crop

Nonpoint Source Pollution (NPS)

Please refer to the NPS/landuse subsection and map for Rocky Fork as Clear Creek is in the same subwatershed.

Point Sources

Point sources in Clear Creek include permitted discharges to the creek such as the Hillsboro WWTP, which is regulated by Ohio EPA's National Pollution Discharge Elimination System (NPDES) and requires a permit. The Hillsboro WWTP may be a major source of pollution in this subwatershed. Fecal coliform and phosphorus concentrations were high near the effluent outfall. The permit, compliance history and facility operations should be reviewed immediately by Ohio EPA.

In addition to the WWTP, there are several surface impoundments or wastewater ponds in the Clear Creek subwatershed. These include the Stephen Boike Farm, Hillsboro Manufacturing Co, Bells Foundry and Hugh Garrison farm.

Other potential contamination sources include underground storage tanks, hazardous waste generators, cemeteries and others.

Problem Statement

Clear Creek is EWH, which only partially attains its use designation between river mile 5.2 and the confluence with Rocky Fork. Chemical data indicates that the Hillsboro WWTP is adding both fecal coliform bacteria and phosphorus to Clear Creek in levels above reference stream 75th percentile values. The chemical data also indicates that the headwaters show excedeences in sediments, nutrients (nitrogen and phosphorus) and fecal coliforms. This area is agricultural in nature. The habitat evaluation shows that the forested riparian corridor is not intact throughout the creek. In areas without or with narrow corridors, the banks show erosion and the channel is excessively embedded with silt and sand. Sediment appeared to be the limiting factor for use attainment, with a portion of the creek recently channelized. Nonpoint source contributions appear to come from agricultural landuse with urban inputs from Hillsboro. The main point source is the Hillsboro WWTP, which adds phosphorus and fecal coliform loads to the creek. One other concern in this subwatershed is failing septic systems.

PAINT CREEK WATERSHED MANAGEMENT PLAN

SECTION IV: IMPLEMENTATION GOALS

JULY 2002

IMPLEMENTATION GOALS IN THE PAINT CREEK WATERSHED

Following a water quality overview, this section outlines immediate action items and long-term implementation goals for the Paint Creek Watershed.

Water Quality Overview

The basis for water quality-related, regulatory authority in Ohio is the Water Quality Standards (WQS) found in the Clean Water Act. All of the creeks described in the management plan exceeded maximum criterion established in the WQS for fecal coliforms and Paint Creek exceeded dissolved oxygen standards. In addition, sections of each creek, except Lees Creek, did not meet, or only partially met, their respective habitat use designations.

All of the data collected for this management plan points to several, main causes of water quality degradation throughout the watershed. To varying degrees the entire watershed lacks intact, forested, riparian corridor. Forested, riparian land serves to slow runoff, dropping sediments and associated organics and nutrients, which are then assimilated by the trees, before they reach the creek. Forested, riparian corridor within 50 feet of the stream channel varies from 16% in the Sugar Creek basin to 50% in the Lower Paint Creek basin. The entire watershed needs to be targeted with tree projects, however, Upper Paint Creek, Sugar Creek, Rattlesnake Creek and North Fork show lack of trees as the main contributing factor to water quality degradation.

Other contributing factors in these areas (Upper Paint Creek, Sugar Creek, Rattlesnake Creek and North Fork) are erosion, nutrient inputs and channel modification associated with intensive row cropping. Erosion has caused embedded substrate, infilling of pools and turbid water, all conditions not conducive to fish and macroinvertebrate reproduction and success. Soil also carries nutrients and organic matter into the stream. These have caused increased algal and pollution tolerant species (snails, worms, leaches) growth and decreased dissolved oxygen content. Implementing conservation practices, such as conservation tillage and precision nutrient applications, is especially important where the riparian corridor no longer functions as a buffer between agricultural lands and the stream.

Areas of the watershed that are attaining their use designations (Lower Paint Creek, Rocky Fork, Lees Creek, most of North Fork) tend to have a mixed landuse (ag/open urban and forested). These areas are threatened by decreasing riparian corridor and erosion and nutrient inputs associated with intensive farming practices. Here riparian corridors that exist must be maintained and areas without corridors need to be targeted with tree projects. Agricultural conservation practices are especially important where the forested riparian corridor is sparse or absent.

In addition to row cropping, livestock operations cause sedimentation, nutrient enrichment, high fecal coliform levels and riparian habitat destruction where they are adjacent to unfenced streams. Livestock is listed as a water quality threat in stream reaches throughout the watershed (see the Water Quality Section). Conservation practices such as exclusion fencing, alternate

watering systems, manure management buildings and heavy-use feeding pads must be promoted in these areas.

Another potential problem throughout the watershed is related to on-lot wastewater or septic systems. This problem is reflected in high fecal coliform levels throughout the watershed. The Paint Creek Project is currently working with local health departments to set up a routine inspection and maintenance program for septic systems and the project has limited funds available for septic system upgrades.

In some areas of the watershed, point sources and urban areas contribute to water quality degradation. The Jeffersonville and Hillsboro WWTPs need careful review and possible upgrades. Washington Court House and Chillicothe are both initiating storm water collection programs under US EPA guidelines. It is in the best interest of the Paint Creek Project to participate and contribute in this process. Currently, where the stream passes through urban areas, it tends to be channelized and shows only limited water quality attainment.

Finally, water quality slumps are seen below both the Rocky Fork Lake dam and the Paint Lake dam. These slumps are attributed to water releases from the anoxic bottom waters combined with inconsistent releases of water. Suggestions to address these problems include changing the methods and timing of water releases to more closely mimic natural lake releases.

Concentration Reduction Analysis

A preliminary concentration reduction study based on the analytical data available from the 1997 monitoring survey, shows that the project must focus on controlling nutrient and sediment inputs to the creeks, which occur during rainfall events. The results of the analytical data indicate that contaminants such as fecal coliforms and suspended solids generally meet target reference stream conditions during low-flow periods. During storm events, however, the reference concentrations are greatly exceeded. The creeks used in the study showed a 50-70 percent exceedence of target concentrations during high flow periods. These episodic exceedences appear to impact biota in the stream and decrease the overall water quality in much of the watershed. Until such time as further studies can be initiated, a goal of 50 percent reduction in fecal coliforms and suspended solids during storm events has been set for the watershed. This goal may prove conservative as the streams will have the capacity to assimilate some of the fecal and sediment inputs associated with storm events.

Immediate Action Items for Paint Creek Watershed

The following are items are critical to implementing an effective long-term strategy in the watershed. These items will provide information that will be the basis for determining the type and amount of each implementation strategy that will be employed in the watershed. They will also provide for communication and participation between stakeholders in the watershed. The following list of action items, while outside the scope of this management plan, provide the basis for the next step in the planning process.

1) Implement a scoring system to target critical areas in the watershed with 319 monies. Julie Brown is currently developing this system. It will be in place by July 2002.

2) Have Ohio EPA review permits and compliance records of all NPDES permitted sites in the watershed. Establish dialogue with Ohio EPA personnel who oversee permitting and/or permit compliance and request that the Paint Creek Project be notified of new NPDES permits and/or permit violations. To be completed August 2002.

3) Create agreements with local community members to complete the following implementation items. At least one person should be responsible for overseeing each item. This needs to be initiated immediately.

4) Complete a list of locations and number of acres in the watershed with ditch petition status by September 2002. Minimize acres in ditch maintenance and do not allow new areas on the stream to enter ditch maintenance. Educate landowners in these areas.

5) Develop GIS layer of property ownership in the watershed. Target property owners on Sugar Creek and Rattlesnake Creek with water quality information and watershed function education. Complete by December 2002.

6) Continue outreach with County Commissioners, Township Trustees, local government and planning bodies. Create a list by December 2002, of "urban" contacts and make sure each entity has a copy of the management plan.

7) Measure or collect information on conservation practices, such as acres of conservation tillage in each county. This needs to be completed by June 2003.

8) Continue work with county health departments to outline sewered versus unsewered areas in the watershed. Develop a 5-year maintenance schedule for all septic systems in the watershed.

9) By year 2005 measure and quantify existing riparian corridor width and quality, including a survey of tree species, corridor width, height of the tallest tree, average diameter and possibly basal area. During the survey, also note the condition of the streambanks and denote areas with unstable banks.

Long-term Implementation Strategy for Paint Creek Watershed

The long-term implementation strategy is divided into five categories. These categories are based on the focus of the working groups that were tasked with developing strategies to improve water quality in the Paint Creek Watershed. Detailed information about each of these strategies can be found in Appendix B, Solutions Tables. These tables should be referred to for more information on each of the implementation strategies listed below. The solutions tables list potential goals and objectives of the strategies, possible funding, starting points, and other information. Any solution that is appropriate should be applied to this watershed, whether or not it is listed in the implementation plan or the solutions section of this report.

The implementation strategy for Paint Creek Watershed, as outlined by the Paint Creek Watershed Advisory Group, is as follows:

1) Agriculture
   a. Measure or collect information on conservation practices, such as acres of conservation tillage in each county. This needs to be completed by June 2003.
   b. Correlate this information with existing water quality information and determine the maximum percent of acreage that can remain under traditional (non-conservation) tillage/application practices (this information will be from mixed-use areas of the watershed, as those are the only areas attaining WQS, which is why a maximum traditional not a minimum conservation must be used as an initial measure).
   c. Increase conservation practices in the watershed by 5% total agricultural acreage every five years until sustainable levels are met.
   d. Adjust types of practices available and target areas when this information is complete. Work with agricultural consultants to help incorporate implementation of these measures.
   e. Promote the use of precision agriculture techniques for nutrient applications, etc.
   f. Promote exclusion fencing and other means to exclude livestock from streams. By 2005, develop a map that illustrates livestock owners (>100 animals) in the watershed and denotes whether they exclude these animals from the creek. All livestock should be excluded from streams by the year 2010.
   g. Outline existing options and promote both farmland and forested riparian corridor conservation through perpetual easements and other financial incentives.
   h. Try to reclaim floodplain function and some functional wetlands. Work with Ohio DNR, Farm Bureau, Ohio EPA and other groups on exploring options and existing projects in the state.
   i. Increase awareness about the role of agriculture in stream function. Educate landowners about the potential economic benefits of BMPs and the potential to degrade water quality where they are not used.
   j. Maintain positive public relations between the watershed project and local farmers. Give farmers credit where innovative conservation activities take place.

k. Continue to work with farmers to address Streambank erosion. Consider bioengineering as an alternative to riprap.

2) Riparian corridor and streambank erosion (derived from forestry group, but each of the five groups explored riparian corridor topics, applicable to entire watershed)
   a. Achieve an intact, forested riparian corridor throughout the watershed by year 2055. The first choice for corridor width will be 2.5 times the width of the channel at the outside bank connected by a straight line between bends. Second choice will be 2.5 times the width of the channel at the outside bank, however, instead of creating a straight corridor from outside bend to outside bend, the corridor will follow the river channel. Finally, riparian widths between one and two times the width of the channel will be accepted if the other choices are not possible.
   b. Conserve existing riparian corridor
   c. By year 2005 measure and quantify existing riparian corridor width and quality, including a survey of tree species, corridor width, height of the tallest tree, average diameter and possibly basal area. During the survey, also note the condition of the streambanks and target areas with unstable banks.
   d. Determine increment (will be between five and ten percent increase of wooded riparian acreage in the study area every five years) to increase forested riparian area. This will depend on the study listed in (a) above.
   e. Re-measure and quantify riparian corridor every five years. Use QHEI or similar index to quantify the habitat and corridor every five years and at least every ten years measure the species diversity, corridor width, etc… listed above.
   f. Incorporate tree buffers into cost-share for other conservation practices. For example, in some areas grass waterways will only be used in conjunction with trees.
   g. Keep track of the activities and money that are used toward this goal.

3) Urban
   a. Have Ohio EPA review permit and compliance record of WWTPs and other NPDES permits in the watershed. Establish dialogue with Ohio EPA personnel who oversee permitting and/or permit compliance and request that the Paint Creek Project be notified of new NPDES permits and/or permit violations. To be completed July 2002.
   b. Concentrate on urban inputs, such as ensuring that storm water and development BMPs are in place. Incorporate green spaces and minimize impervious surfaces, where possible. Initiate meeting and steps to coordinate by December 2002.
   c. Continue work with county health departments to outline sewered versus unsewered areas in the watershed. Develop a 5-year maintenance schedule for all septic systems in the watershed.
   d. Continue outreach with County Commissioners, Township Trustees, local government and planning bodies.
   e. Create a list by December 2002, of "urban" contacts and make sure each entity has a copy of the management plan.

f. Meet (at least) annually with the urban group to discuss issues such as development BMPs and future landuse and zoning actions.
g. Ensure that provisions in the community development plan, zoning and subdivision regulations are protective of water quality. Address sedimentation resulting from construction. Also the effects of increased impermeability and runoff peaks.
h. Explore landuse planning options including floodplain regulations, conservation easements, greenspace conservation, riparian corridor protection, appropriate utilities and community growth options.

4) Education
a. Continue work to educate local communities in the watershed
b. Develop new activities and continue to encourage stream monitoring at the local level
c. Continue to educate landowners and children about the importance of maintaining the riparian buffer and other watershed concepts.
d. Address public access issues, identify access points and create a guide.
e. Address trash and illegal dumping through recycling, stream clean-ups, storm sewer stenciling, and adopt-a-stream programs.
f. Hang signs for stream crossings and watershed boundaries to promote community awareness, produce a video, write news articles for local papers, and focus on local watershed issues.
g. Promote "Friends of Paint Creek."
h. Educate public and elected officials about the benefits of watershed ecology.

5) Streamside management
a. Explore restoration options and begin a pilot project by the year 2003 at the latest.
b. Restore stream banks that are highly degraded.
c. Work with the Army Corps of Engineers to naturalize and increase oxygen in releases from Paint Lake and Rocky Fork Lake.
d. Eliminate encroachment on flood plain and allow stream to meander.
e. Protect high quality corridor/buffers through education, funding, and promoting multi-use areas in corridor.
f. Work with Ohio Department of Transportation (ODOT) to incorporate access into plans for bridge repair/replacement.
g. Begin to implement a wetland monitoring and augmentation program.

6) Forestry (for Lower Paint Creek, Rocky Fork and Lees Creek subwatersheds)
a. Protect existing riparian corridor by leaving appropriate streamside management zone and connect areas where riparian corridor is absent.
b. Evaluate public lands for forested riparian quality.
c. Research financial incentives to encourage private landowners to leave trees in the riparian corridor.
d. ID exotic species and implement control measures where problematic.
e. Promote land stewardship and conservation easements.

f. Develop GIS layer of property ownership along the creeks.
g. Hire a full time contact for streamside corridor management.
h. Characterize riparian the corridors.
i. Hang signs for stream crossings and watershed boundaries to promote community awareness.
j. Consider bioengineering as an alternative to riprap.

Timeline and Measures

The Qualitative Habitat Evaluation Index (QHEI) is the main measure of success throughout this section, because it is a direct measure of (among other things) riparian habitat quality. Habitat is the most limiting factor throughout the watershed and its improvement is therefore the greatest determination of success in this project. Chemical water quality data and biological indices are also appropriate measures of success and may be used additionally or substituted where appropriate.

For Tables 1 and 2, items not listed in the tables are assumed to be difficult to quantify and ongoing. "Completion date" for items with a measurable end, is just that, however, for ongoing items it may represent more of a start, or "evaluation of progress" date.

Table 4-1: Timeline and measures of success for immediate action items.

Completion Date	Goal	Measure of Success	Complete?
July 2002	PCW Management Plan	Version I completed	Yes
July 2002	Develop 319 target areas	Point system to target 319 monies to approp. areas	Yes, will be revisited
July 2002	Request Ohio EPA review NPDES permits	Review initiated	
August 2002	Agreements to oversee implementation items	Signed agreements with tentative timeframe. "Person responsible" in solutions tables is filled out.	
September 2002	Complete list of ditch maintenance segments and educate landowners	List completed, info to landowners of ditch maintenance areas	
December 2002	Develop GIS layer of property owners in PCW	Layer complete	
December 2002	List of "urban" contacts	List complete and first meeting	
June 2003	Collect information on conservation practices in place by county	Map/list and determination of % conservation practices necessary to maintain water quality	
June 2003	Continue to work with health depts. on sewered/ unsewered areas and 5-yr maint. schedule for septic	Knowledge of location and maintenance of septic in watershed- Continual upkeep and maintenance	Started
June 2005	Quantify riparian corridor	Map/list complete	

Table 4-2: Timeline and measures of success for keystone events in the long-term implementation strategy (Items not listed in this table are assumed to be ongoing, or difficult to measure).

Completion Date	Goal	Measure of Success	Complete?
Agriculture			
June 2003	Collect information on conservation practices in place by county	Map/list completed	Started
July 2003	Determine percent acres w/ conservation practices necessary to maintain water quality	Total acreage in each subwatershed that need conservation practices (correlate with riparian quality info)	
2003, ongoing	Increase conservation practices in watershed by 5% total agric. acres every 5 yrs until WQS are met	5% increase of acreage in conservation tillage and precision applications per five year period until WQS are met	
2005	Map that shows farms with >100 animals and where livestock is in creeks	Map completed	
2010	Through conservation practices and education, all livestock owners have exclusion fencing, watering systems, manure management, and/or feeding pads to exclude animals from the creek and control nutrients	All livestock out of creek. Feeding, watering and manure handled per BMPs. Nutrient levels and fecal coliforms decreased in streams. Increased QHEI near formerly affected areas.	
Annually	Keep track of activities and money toward this goal	Report completed each March	
Riparian Corridor and Streambank Erosion			
July 2002	Incorporate tree buffers into cost share for other practices	Trees mandatory with certain cost share (potentially all) Improved QHEI	Started
2002, ongoing	Conserve existing riparian	QHEI maintained, 2005 survey	
2005	Measure corridor quality	Completed	
2005	Determine increment to increase forested riparian every five years	Completed	
2010, 2015, 2020	Re-measure corridor quality every five years	QHEI score increases, survey results denote increase	
2055	Fully intact riparian corridor with high-quality native tree species	QHEI score >75 and survey results determine complete	

Completion Date	Goal	Measure of Success	Complete?
Annually	Keep track of activities	Report completed each March	
Urban			
July 2002	Request Ohio EPA review NPDES permits	Review initiated Decrease nutrients, fecal coliforms and increase DO dstr.	
December 2002	Compile list of "urban" contacts and initiate conversations about protecting water quality through stormwater, development BMPs, and other actions. Also discuss planning future growth to protect water quality.	List compiled and talks initiated. Long term- construction BMPs enforced, future landuse planning considers water quality. Sedimentation associated with development decreases in growing areas.	
June 2003	Continue to work with health depts. on sewered/ unsewered areas and 5-yr maintenance schedule for septic systems	Knowledge of location and maintenance of septic in watershed- Continual upkeep and maintenance. Decreased fecal colif. in streams.	Started
Education (and Monitoring)			
July 2002	Educate public and elected officials about benefits of watershed ecology	(See urban goals)	Started
December 2002	Hang signs at stream crossings and watershed boundaries	Completed	
July 2003	Address public access, create guide of access points	Guide complete and distributed	
July 2003	Continue to promote stream monitoring at the local level	One group per year signs up to monitor local streams until active participation across area	
Streamside Management			
July 2002	Restore streambanks that are highly degraded	Create list of target areas and begin implementation of restoration projects, continue at several per year, until problem areas are restored. Continue to oversee projects until banks are well-established. Do not abandon sites that are not successful the first time. Local sediment levels decrease.	Started!
July 2002	Protect high quality	Begin immediately, will be	

Completion Date	Goal	Measure of Success	Complete?
	corridor through education and incentives	ongoing- expect no net loss within next several years, followed by net gain in corridor. QHEI stable or increases over next several years.	
December 2004	Incorporate access to creeks at ODOT bridges	Incorporated and beginning implementation-	
July 2010	Begin to implement wetland monitoring and augmentation program	Increased wetlands and wetland function in the watershed Increased species diversity, decreased turbidity, decreased nutrient levels in adjacent creeks	
Forestry			
July 2002	Protect existing corridor by leaving streamside management zones (SMZs) and connect areas where corridor is absent	QHEI maintained and improves, master loggers, Div. Of Forestry and MeadWestvaco continue support and BMP classes. Biologic indices meet W/EWH	Started
August 2002	Evaluate public lands for forested riparian quality	Completed	
August 2002	Research public funds available for private landowners to leave trees in corridor	Report completed and appropriate people are using information (Master loggers, Ohio Chapter of Loggers Association, MeadWestvaco, Div of Forestry)	
July 2002	Promote land stewardship and conservation easements	Improved QHEI and biologic indices, land in perpetual easements increases over time- goal 50 acres per year- create map showing information	

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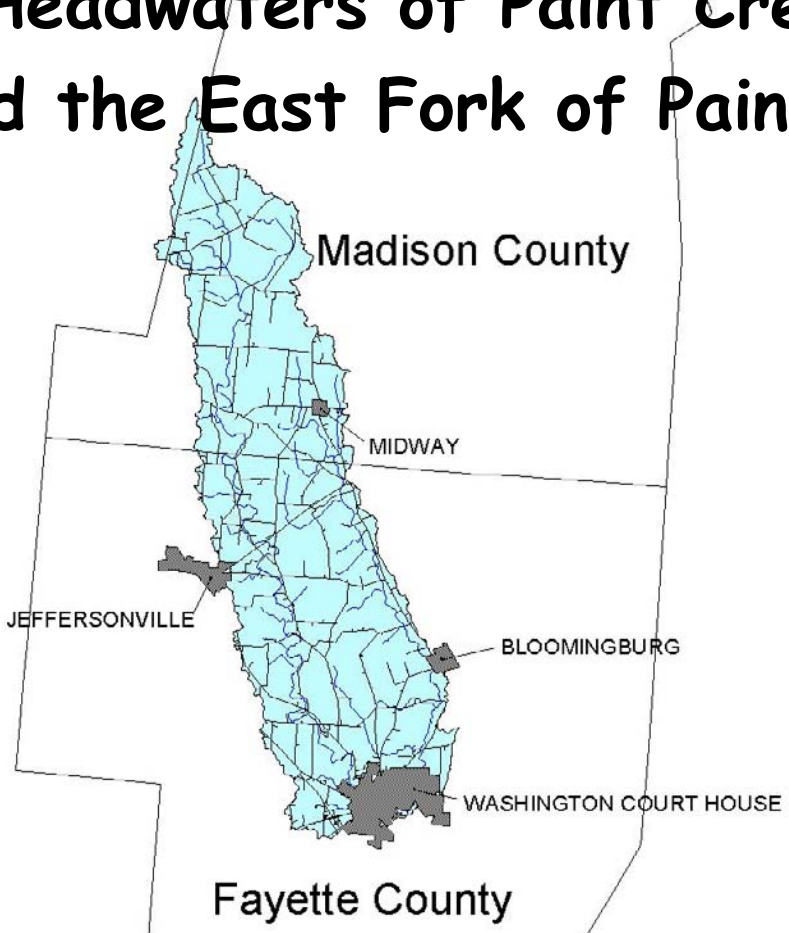
Watershed Action Plan for the Headwaters of Paint Creek and the East Fork of Paint Creek



Hydrologic Unit Numbers:
05060003 010 010 Paint Creek above E. Fk. Paint Creek
05060003 010 020 East Fork of Paint Creek

Written and Compiled by:
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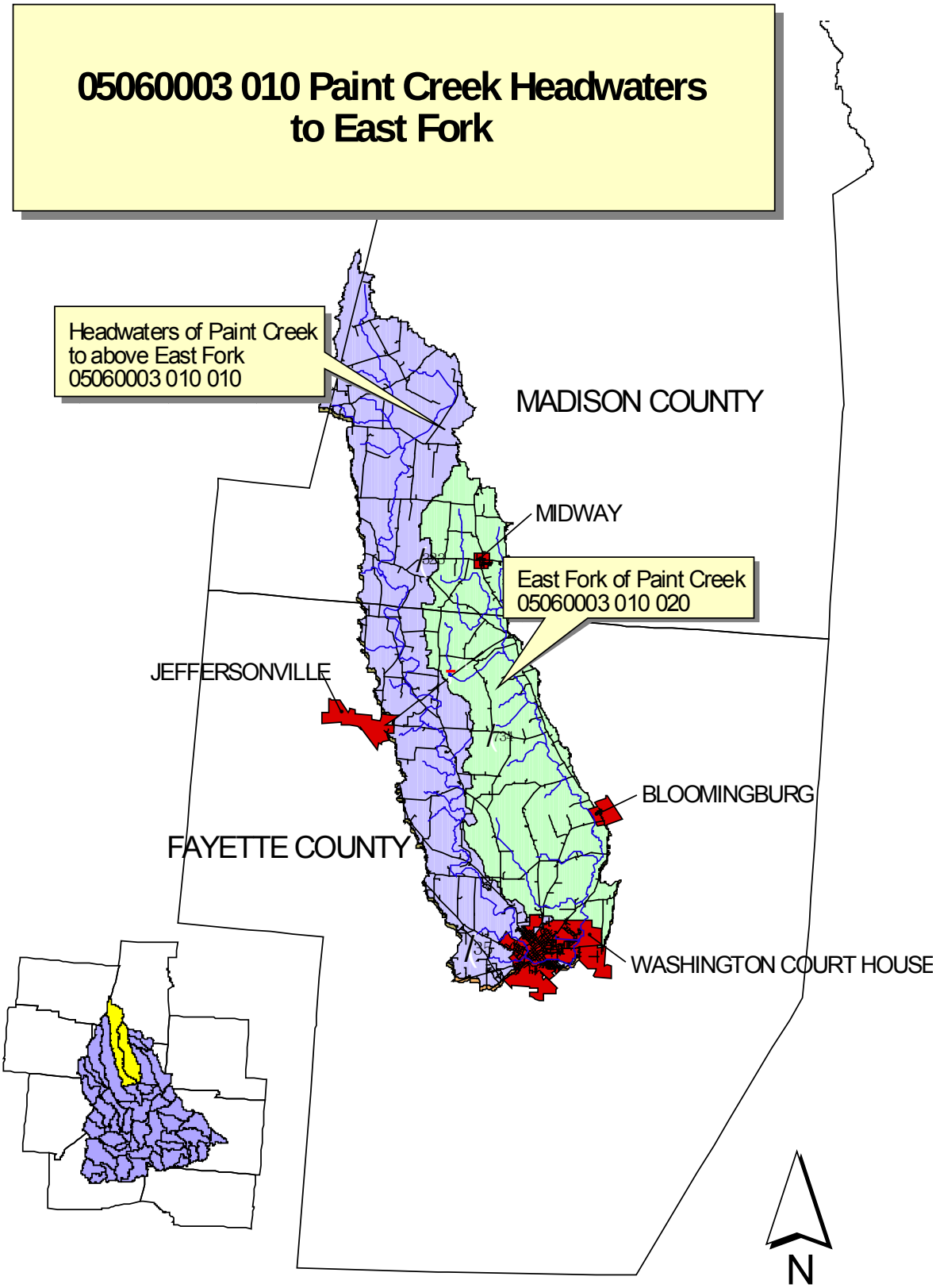
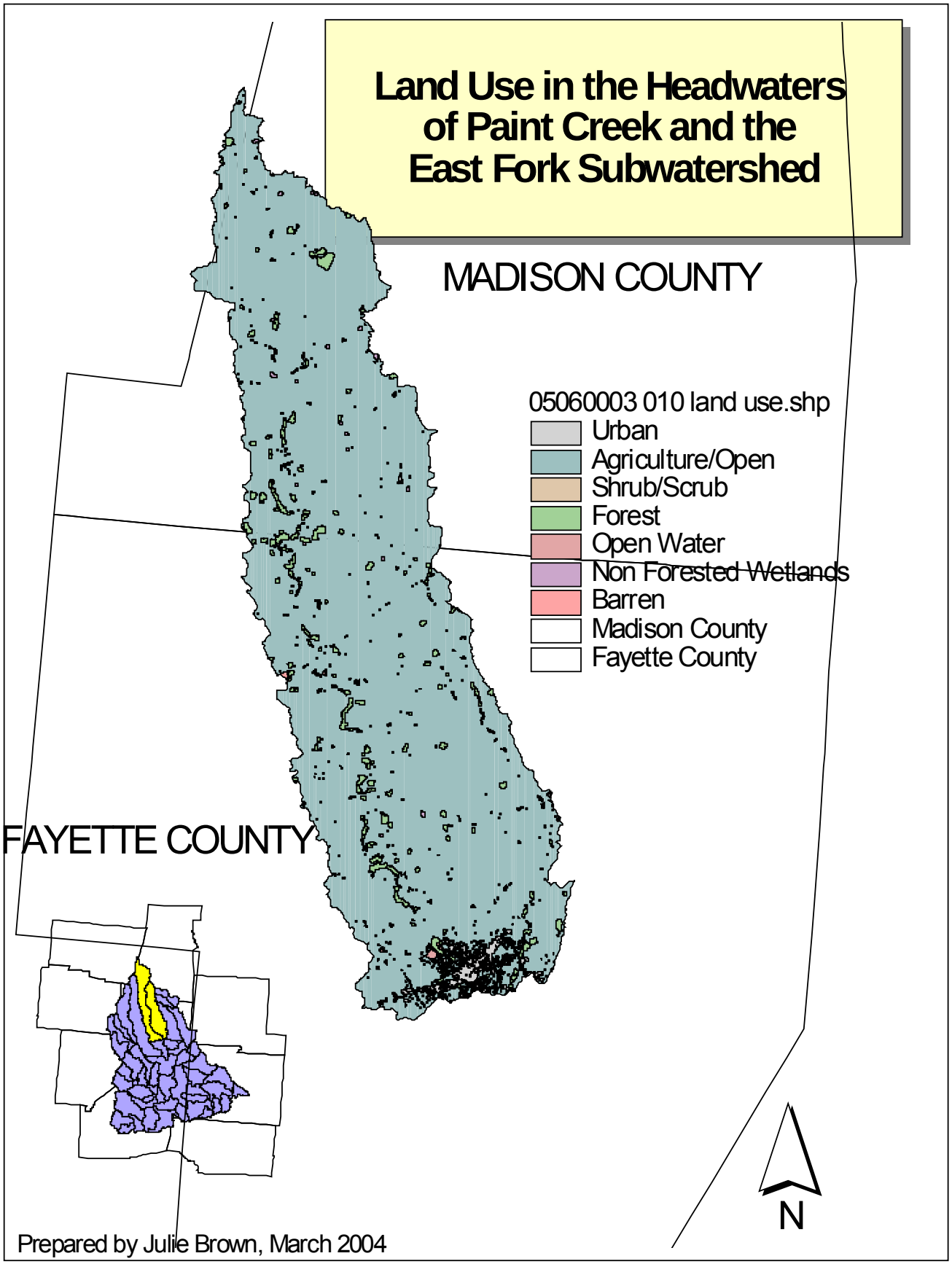
05060003 010 Paint Creek Headwaters to East Fork



Prepared by Julie Brown, March 2004


Land Use in the Headwaters of Paint Creek and the East Fork Subwatershed
MADISON COUNTY
FAYETTE COUNTY
05060003 010 land use.shp
Urban
Agriculture/Open
Shrub/Scrub
Forest
Open Water
Non Forested Wetlands
Barren
Madison County
Fayette County
N
Prepared by Julie Brown, March 2004

Introduction

The Paint Creek Watershed Management Plan stems from an ongoing conservation ethic within the Paint Creek Watershed. Conservation practices were explored in the watershed as early as the 1960's. Public awareness and interest in maintaining and/or improving water quality in the watershed has increasingly mounted since those early studies. Land managers within the watershed are currently pursuing several conservation grants and the watershed project is distributing Clean Water Act, section 319 grant monies to fund projects in targeted areas. The management plan will provide information to ensure that future conservation efforts within the watershed are applied in the most efficient and beneficial manner.

As far as practicable, the Paint Creek Watershed Management plan follows the outline contained in Ohio EPA's *Guide to Developing Local Watershed Action Plans in Ohio* (June 1997). The plan contains four main sections: the background and scope of the project, a comprehensive watershed inventory, a watershed-wide water quality assessment with documentation of the related problems, and an outline of planned implementation activities or solutions. This last section includes a timeline and methods to evaluate the effectiveness of the activities implemented within the watershed.

General Description and Political Boundaries

The Paint Creek Watershed is comprised of 731,168.9 acres located in 9 counties: Madison, Greene, Clinton, Clark, Pickaway, Fayette, Pike, Ross, and Highland.

The Main Paint Creek Subwatershed is located in south central Ohio and covers 310,585 acres. It originates in Madison County and encompasses much of Fayette County and the eastern edge of Highland and western edge of Ross County. Main Paint Creek meets the Scioto River south of Chillicothe in Ross County. The flood plain of Paint Creek varies in width from a few feet at its source to more than 1.5 miles at its mouth. The stream fall from source to mouth is 555 feet, an average of 5.7 feet per mile. The fall in the lowermost 50 miles is about 265 feet or 5.3 feet per mile (Corps, 1973). At the confluence of Paint Creek and Rattlesnake Creek is the Paint Creek Lake. The lake was built by the Army Corps of Engineers for flood control, but also serves recreational purposes.

Background/reasons for implementing a management plan

The following were presented to the advisory group and community as reasons for writing and implementing a comprehensive management plan for Paint Creek Watershed.

Size/diversity of the watershed

Paint Creek Watershed covers over 731,000 acres and crosses multiple political boundaries. Additionally, the watershed may be divided into multiple subwatershed units each of which forms an independent drainage unit within the larger watershed. Depending on the topography of the area these units may be subdivided many times and each subwatershed will have slightly different chemical, physical and

biological properties. In addition, many people reside in the watershed and activities such as agriculture, forestry, urban development, recreation, commerce and industry continue to grow and change.

Total Maximum Daily Loads (TMDLs). The advent of increasingly stringent enforcement of the Clean Water Act, is reflected in the introduction of TMDLs across the country. Ohio EPA recently began implementing their TMDL program and the Paint Creek Watershed is scheduled for evaluation in 2012-2013. The TMDL program establishes daily limits for a variety of pollutants, including sediment and nutrients, discharged to streams that do not meet water quality standards outlined in the Clean Water Act. This program currently only affects point source discharges though forestry, agriculture and development may be affected in the future.

Soil erosion. Soil erosion is one of the biggest problems in the watershed and the focus of most of the conservation practices implemented by both landowners and the Army Corps of Engineers. Most of the soil in South Central Ohio is depositional till resulting from the glacial activities. This soil is prone to erosion and there is erosion and erosion-related water quality problems throughout the watershed.

Water quality. In 1997, Ohio EPA surveyed much of the watershed to measure the chemical and biological properties of the waters. The 2000 305(b) report lists the Upper Paint Creek Watershed (North Fork and Rocky Fork) as meeting water quality standards in 35.5 percent of the watershed. Lower Paint Creek Watershed (Main Paint and Rattlesnake) met water quality standards in 75.6 percent of the watershed. In order to establish baseline water quality information and to measure the success of our water quality solutions, we may need to implement an additional sampling program.

Species diversity. The Paint Creek Watershed contains a rich array of plant and animal species. For example, a study completed in 1999 through Ohio State University found 104 species of fish inhabiting the Paint Creek Watershed. Some of the plant and animal species in the watershed include endangered, threatened, rare, intolerant, or species of special interest. The Ohio Department of Natural Resources' Heritage database lists 52 species of interest or concern in the watershed. These include 10 endangered species and 11 threatened species.

Invasive species. Invasive species are plants and animals that are not native to the area. Usually introduced by human activities, these species may have no natural biological controls. They may invade parts of the watershed and crowd out naturally occurring species. Examples of invasive species found in the watershed include, garlic mustard, phragmites reed grass, and Japanese honeysuckle.

319 grants. Conservation practices funded through the Clean Water Act, section 319 grant program have been implemented throughout the watershed. One of the main purposes of the management plan is to look at information on soil erosion, water quality, and species diversity and concentrate conservation practices in the most sensitive areas of the watershed.

Local Conservation History

Agriculture is the main practice in the watershed and erosion has been the historic conservation concern. Land management and conservation studies began in the Paint Creek area in the early 1960's. Congress authorized a study of the Scioto River Basin, which led to the construction of the Paint Creek Lake in 1967 (Garringer). The lake is primarily for flood control, but the lands surrounding the lake provide wildlife habitat and recreational opportunities.

After heavy flooding in 1959 and 1960, the soil and water conservation districts in the Rattlesnake Creek watershed initiated the planning process to implement a project for flood control and land treatment. The initiative was eventually de-authorized but land managers recognized a need for local conservation practices.

In 1994, after continuous siltation problems in Paint Creek Lake, planning began for a new "Paint Creek Initiative" that would use Clean Water Act, section 319 grant monies to help introduce conservation projects throughout the watershed. This movement was inspired by activities taking place in the Darby Creek watershed which is partially located in Madison County. In 1995, a proposal was submitted to Ohio EPA requesting $300,000 to partially fund a land treatment program for the entire Paint Creek watershed (Garringer).

The proposal was originally rejected, but the soil and water conservation districts (SWCDs) in Fayette, Highland and Ross Counties worked closely with Ohio EPA to come up with a proposal that would be accepted. The new proposal included dividing the watershed into four management units based on the Main Paint, North Fork, Rattlesnake, and Rocky Fork Subwatersheds. In 1996, the SWCDs applied for and received 319 grant monies for the North Fork of Paint Creek Subwatershed. These monies were received in 1997, the same year that the SWCDs applied for and received 319 grants for Main Paint and Rattlesnake subwatersheds.

In December 1997, representatives from Fayette, Highland, Ross, Madison, Clinton and Greene counties met and formed a joint board of supervisors to oversee the spending of funds from the grant. In 1998, Julie Brown was hired by the joint board to act as watershed coordinator for the entire Paint Creek watershed. Julie meets with the joint board once every month.

The cost-share practices funded through the 319 grants largely focus on reducing erosion in the watershed. The first round of grants included grass waterways, equipment buy-downs, soil testing, lime applications, livestock exclusion fencing, streambank stabilization, heavy use feeding pads, tree and grass filter strips, deep tillage tool rental (North Fork only), manure management systems (North Fork only), and alternate watering sources (North Fork only). The 319 grant applications were given a score based on the proximity of the site to a stream, the size of stream, and the erodability index of the soil. Through this process land managers tried to implement conservation practices in areas of the watershed that were contributing the greatest amount of erosion.

The 319 grants discussed above were three year grants and ended in June of 2001. The project reapplied and was awarded money for all three subwatersheds. Currently all of Paint Creek Watershed has 319 conservation grant money.

In January of 2000, Julie formed an advisory committee to help provide guidance with the watershed project. This group meets quarterly and discusses management issues pertaining to the management plan. These meetings often feature guest speakers who have conducted studies within the watershed. In 2000, the project wrote and was awarded an additional 319 planning grant to help fund a part-time position for a management plan coordinator. Hilary Solomon was hired in January of 2001 to help write the management plan for the Paint Creek Watershed.

In 2000, Julie was also awarded a grant, the aim of which was "getting GIS into the hands of the conservationist." She worked closely with the consulting firm Malcolm Pirnie to acquire spatial data that could be used to make maps describing the area. Through this project, an extensive catalogue of data was acquired, which will be useful in the future water shed planning.

Addendum to the Paint Creek Watershed Management Plan

This additional section of the management plan tries to include information specific to the headwaters of Paint Creek and the East Fork of Paint Creek. For watershed wide information including wildlife and soils, please see the draft copy of the Paint Creek Management Plan.

The Headwaters of Paint Creek including East Fork

The Paint Creek Watershed has already put together an extensive management plan that was submitted for review from the Ohio EPA in July of 2002. The original plan gave information on a larger scale, splitting the watershed into 4 sections: Main Paint, Rattlesnake, North Fork and Rocky Fork Creeks. The Ohio EPA's suggestion after reviewing the document was to return with more detail. The project than choose their 3 priority areas and the headwaters of Paint Creek including the East Fork of Paint was picked as one of these areas.

This section of Main Paint includes the headwaters, which begins in Madison County. The stream continues south into Fayette County and this 11-digit hydrologic section includes most of the city of Washington Courthouse, part of Bloomingburg and Jeffersonville and all of Midway. Below is the drainage information for Paint Creek and this watershed in particular:

Table 1

Watershed Name	**Hydrologic Unit #**	**Counties**	**Drainage Area**	**Stream Miles**
Paint Creek	05060003	Ross, Highland, Fayette, Greene, Clinton, Madison, Clark, Pickaway, Pike	731,161.9 acres	1572.53 (total)
Paint Creek (headwaters to below East Fork)	05060003-010	Madison, Fayette	76,296 acres	109.28 miles
Paint Creek above East Fork	05060003-010-010	Madison, Fayette	43,069 acres	64.04 miles
East Fork of Paint	05060003-010-020	Madison, Fayette	33,227 acres	45.24 miles

Please see map #1

Land Use

While the Paint Creek Watershed is a diverse watershed from the flat upper watershed to the rolling lower sections, the land uses in this smaller section are predominantly agriculturally based. The following table shows the land uses for the 8, 11 and 14 digit watersheds.

Table 2

Watershed Name	**Hydrologic Unit #**	Land use Type	Percent of Whole	Acreage
Paint Creek	05060003	Urban	.88	6466.3
		Agriculture/Urban	76.89	562190.3
		Shrub/Scrub	2.22	16210.1
		Wooded	19.14	139931.6
		Open Water	.53	3871.5

		Non Forested Wetlands	.32	2308.2
		Barren	.03	183.9
Paint Creek (headwaters to below East Fork)	05060003-010	Urban	1.49	1140
		Agriculture/Urban	94.84	72360
		Shrub/Scrub	.23	178
		Wooded	2.99	2281
		Open Water	.10	76
		Non Forested Wetlands	.30	232
		Barren	.04	29
Paint Creek above East Fork	05060003-010-010	Urban	2.27	976
		Agriculture/Urban	93.05	40074
		Shrub/Scrub	.24	104
		Wooded	3.91	1686
		Open Water	.15	63
		Non Forested Wetlands	.36	154
		Barren	.03	12
East Fork of Paint	05060003-010-020	Urban	.55	184
		Agriculture/Urban	97.22	32302
		Shrub/Scrub	.19	62
		Wooded	1.76	586
		Open Water	.07	24
		Non Forested Wetlands	.2	65
		Barren	.01	4

Please see map #2

Water Quality Issues in the Paint Creek Watershed

While it is assumed the bulk of the pollution problems in this section are from non-point source pollution, we will also cover the potential sources of point sources based on the National Pollutant Discharge Elimination Systems permits, Presence of combines sewer overflows, surface impoundments and data from fish kills.

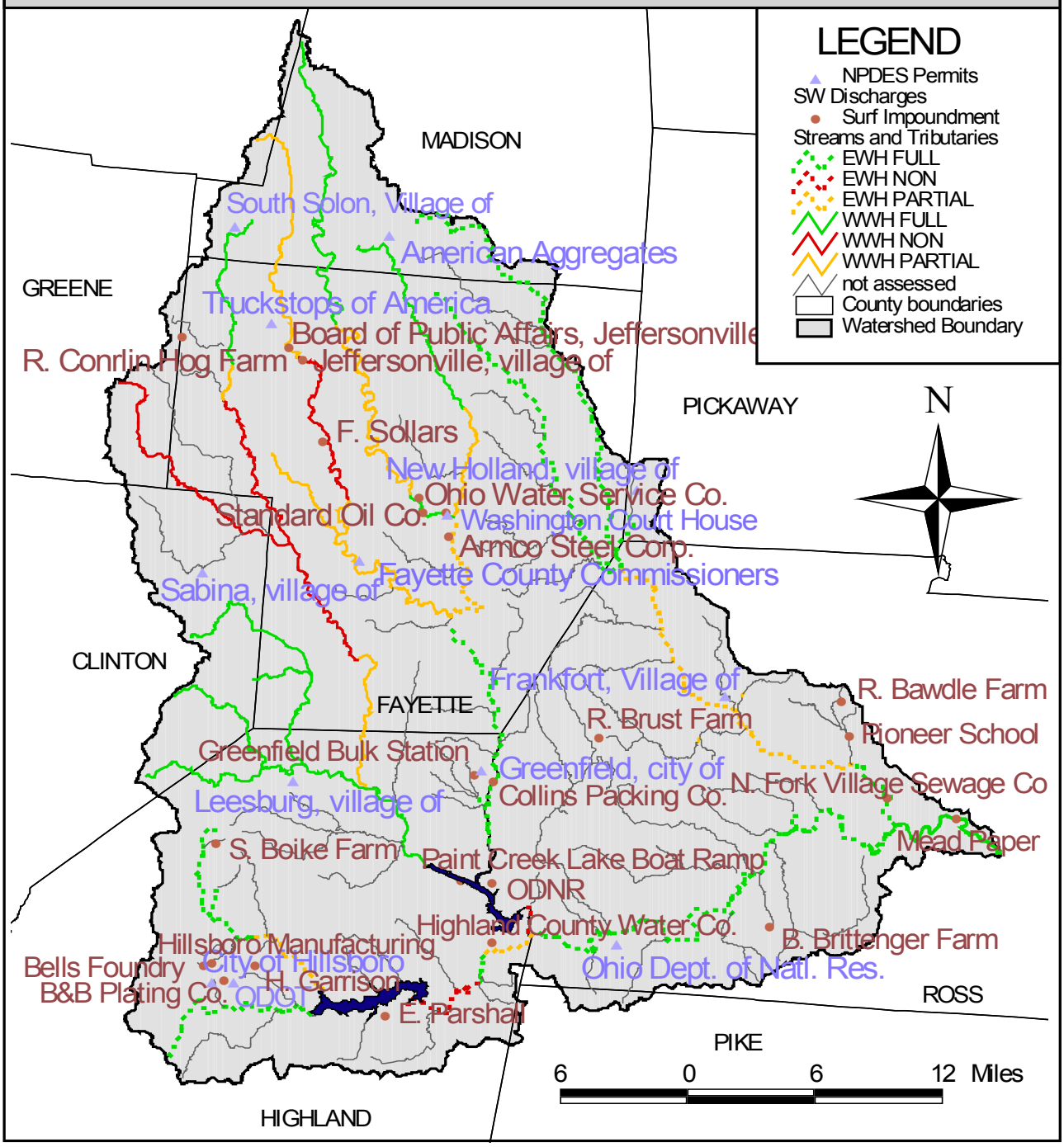
Table 3: NPDES permits in the Paint Creek Watershed.

TYPE	ID_NUMBER	NAME	SIC_CODE	DESCRIPTION	LOCATION
NPDES	OH0047350	American Aggregates	3281	cut stone and stone products	10263 Lower Valley, Midway
NPDES	OHL020389	City of Hillsboro	4952	sewerage systems	1488 N. High St., Hillsboro
NPDES	OH0036196	Fayette Co. Commissioners	4952	sewerage systems	US Rte 35, E. Jefferson Twp
NPDES	000008047104	City of Washington Courth	4952	sewerage systems	1210 S. Elm St.

The following site-specific information is from Paul Vandermeer, 1997, Pollutant Loadings: 1976-1997, Ohio EPA, Division of Surface Water, Central District Office.

The Washington CH WWTP at 1210 S. Elm St. had 28 untreated bypasses in the first 9 months of 1997. The average bypass event discharged 70.81 kg/day of suspended solids and 48.34 kg/day of carbon-based or organic biological oxygen demand ($CBOD_5$). According to Ohio EPA, bypass events increased markedly in 1996 and 1997 versus the 1994 and 1995 values. Ohio EPA additionally reports that although flow values have remained relatively constant since 1976, the 95th percentile flow values have been steadily increasing. Other measurements such as suspended solids, BOD-CBOD and nutrients have been steady or decreasing. Efforts are currently underway to bring the WWTP into compliance.

PAINT CREEK WATERSHED
NPDES and Surface Impoundments



Prepared for the Paint Creek Project by Hilary Solomon, October 2001

The Village of Bloomingburg WWTP was designed to treat 0.16 MGD and discharges to East Fork Paint Creek at RM 6.32. According to Ohio EPA, the plant experiences inflow/infiltration problems with the 95th percentile flow value over 1.5 times the design capacity in 1997. However, pollutant loadings to East Fork have been steadily declining over the last 5-9 years and flows have remained stable. Proper maintenance and control of inflow/infiltration problems should assist in maintaining good treatment.

Combined Sewer Overflows and Sanitary Sewer Overflows

Combined sewers are built to collect sanitary and industrial wastewater as well as storm water runoff and transport this combined wastewater to treatment facilities. When it rains, the volume of storm water and wastewater may exceed the capacity of the combined sewers or of the treatment plant, and a portion of the combined wastewater may be allowed to overflow untreated into the nearest ditch, stream, river or lake. This is a combined sewer overflow, or CSO. Ohio has about 1,600 known CSOs in 102 communities, ranging from small, rural villages to large metropolitan areas.

According to Sheree Gossett-Johnson, a member of the permitting and compliance unit with Ohio EPA's DSW, the Paint Creek Watershed does not contain any CSOs.

On-lot Wastewater Systems

The Paint Creek Project is currently working with the health departments in each of the nine counties containing portions of the watershed; Clinton, Greene, Fayette, Pickaway, Pike, Highland, Ross, Madison and Clarke. The Paint Creek Project hopes to collect information on the sewered versus unsewered areas in the watershed and areas where potential problems exist. This information will help promote the use of available finds to upgrade and maintain existing systems. One of the implementation goals for the watershed involves inspecting septic systems at regular intervals to ensure acceptable operation. Septic systems are a source of nutrients, organics and fecal coliforms.

East Fork: For primary contact waters fecal coliform concentrations (by geometric mean of at least five samples) must be less than 1000 bacteria per 100 mL of water, with no more than 10% of the samples over 2000 bacteria per 100 mL of water. With measurements of 4100, 24000 and 4100 bacteria per 100 mL of water on July 28, 1997, and 6000, 4800 and 5000 bacteria per 100 mL of water on August 13, 1997, fecal coliform concentrations in East Fork exceeded maximum PCR maximum criterion at all three monitoring sites on two of the five sample dates.

Fish Kill Information (ODNR, DOW)

The following information was prepared by Doug Maloney at Ohio DNR, Division of Wildlife. According to Mr. Maloney this information is a conservative record of fish kills in the Paint Creek Watershed. Many fish kills are never reported and smaller kills may not be

investigated, even if they are reported. Fish kills caused by unknown sources may have resulted from naturally occurring anoxic conditions or other naturally occurring phenomenon.

Table 4: Fish kill information

District	Date	Creek	County	No. killed	Cause
One	8/11/81	Thompson	Fayette	120	No cause
One	9/11/86	Saxton Ditch/Sugar Creek	Madison	50	Not listed
One	8/24/90	Thompson Creek	Fayette/ Madison	6,559 (wild animals)	Liquid hog manure from Quality Feeder Pigs (disputed)
One	10/20/95	Thompson Creek	Fayette/ Madison	1,028	Liquid hog manure from Quality Feeder Pigs
One	8/24/96	Rattlesnake Creek	Fayette	616	Untreated sewage from Rattlesnake WWTP breakdown
One	1/7/07	Sugar Creek	Fayette	None	Fuel oil in stream
One	10/27/97	Rattlesnake Creek	Fayette	18	Cause unknown
One	8/14/98	East Fork Paint Creek	Fayette	108	Cause unknown
One	6/15/99	Sugar Creek	Fayette	43	Cause unknown
Four	5/11/97	Upper Twin Creek	Ross	30	Cause unknown
Five	6/14/90	Lees Creek	Clinton	166	Improper lagoon management and land application

Watershed Pollution Problems

This section of the Paint Creek Watershed received it's first extensive water quality survey in 1997 from the Ohio EPA. They collected fish and macroinvertebrate data along with a survey of the physical habitat and water chemistry. At the same time, an Ohio State University Professor by the name of Dr. Ted Cavender conducted a stream survey of the diversity and species richness of the fishes of the Paint Creek Watershed. These 2 studies are the primary sources of water quality data available for this area.

OHIO EPA DATA

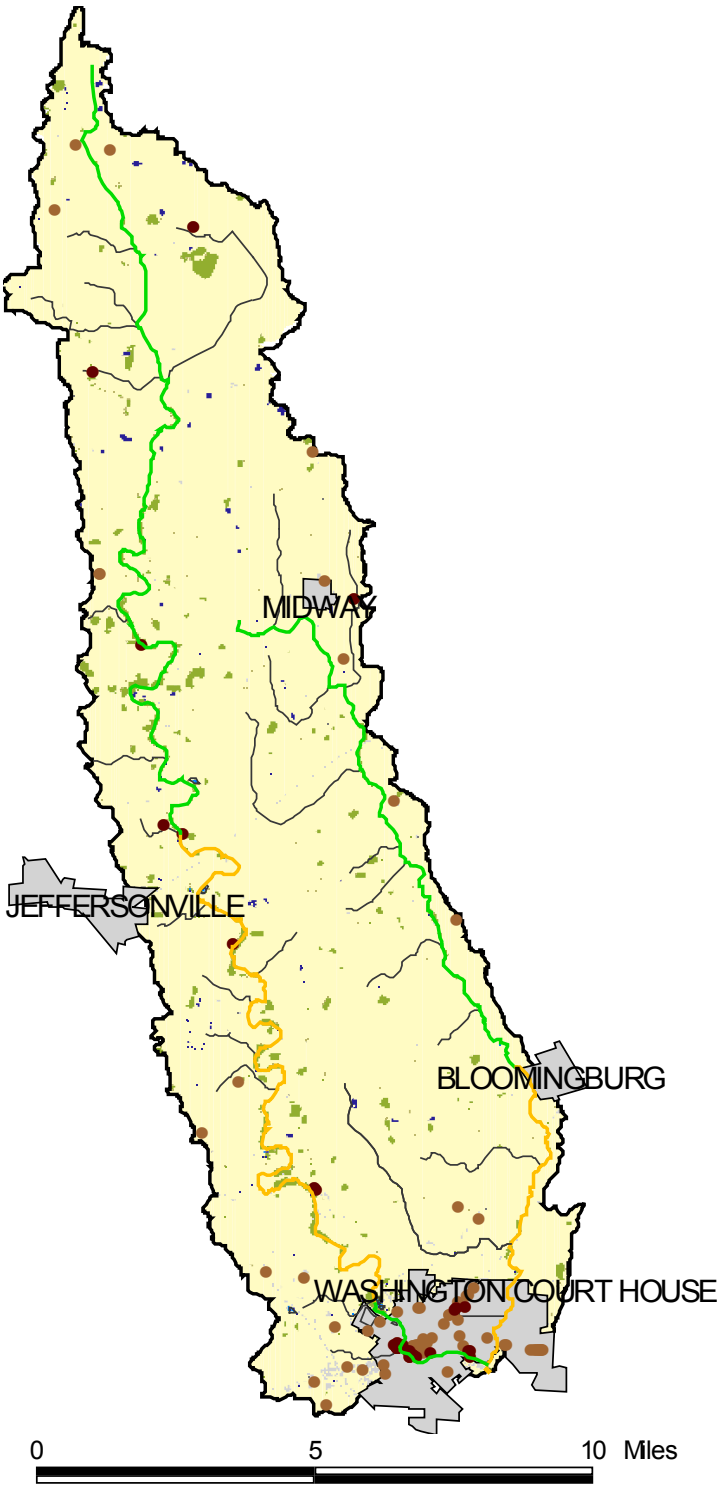
Waterbody River mile	Attainment	Documented WQ problems	Sources of problems
Paint Creek HW-88.6	Full- WWH	Nutrients, siltation, organic enrichment, low DO	Agriculture, Crop production, pasture, hydromodification, removal or riparian vegetation

Waterbody River mile	Attainment	Documented WQ problems	Sources of problems
Paint Creek 88.6-70.9	Partial-WWH	Nutrients, siltation, organic enrichment, low DO	Agriculture, Crop production, pasture, hydromodification, removal or riparian vegetation
Paint Creek 70.9-67.3	Mixed full and partial-WWH	Nutrients, siltation, organic enrichment, low DO	Includes Washington CH WWTP mixing zone, stormwater runoff
Paint Creek 67.3-58.7	Partial-EWH	Organic enrichment, low DO,	Washington CH WWTP, stormwater runoff

Reference Stream Values by Ecoregion

Paint Creek Watershed falls into three ecoregions. It is mainly located in the Eastern Cornbelt Plains (ECBP), but some areas fall within the Western Allegheny Plateau (WAP) and the Interior Plateau (IP). Several of the monitoring points in the Paint Creek Watershed are categorized as reference points and used in this study. It should be noted that while the reference sites represent high quality streams that meet all water quality standards, they still exhibit some degree of anthropogenic influence.

PAINT CREEK WATERSHED
Paint Creek Headwaters Water Quality



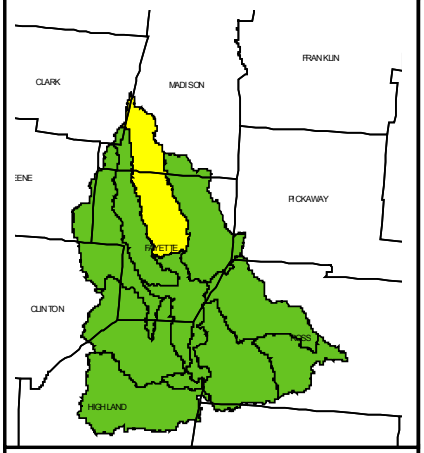
LEGEND

Streams and tributaries
- EWH PARTIAL
- WWH FULL
- WWH PARTIAL
- not assessed
- Point sources w/in 500' of creeks
- Point sources
- Main paint city boundaries.shp
- Paint Creek Headwaters 11-digit

Paint Creek Headwaters LULC
- Urban 1.5/(1.2)%
- Ag/Open Housing 94.9/(79.6)%
- Shrub/Scrub 0.2/(1.5)%
- Forested 3.0/(15.9)%
- Open Water 0.1/(1.0)%
- Wetlands 0.3/(0.8)%
- Barren 0.0/(0.0)%

(Indicates lu/lc w/in 50 feet of a creek)

N



Sources of Data:
1) Ohio Department of Natural Resources, Division of Real Estate and Land Management, 1994 Ohio Landsat Satellite Imagery Analysis.
2) Ohio Department of Transportation.
3) USEPA BASINS v. 2.0, 1998.
4) Ohio EPA, DSW, water quality data, 1997.
5) Ohio EPA, DDAGW, potential sources of contamination index, Dec. 1999.

Created by Hilary Solomon for the Paint Creek Project, May 2002

Main Stem Paint Creek Water Quality

During Ohio EPA's 1997 monitoring survey of the Paint Creek Watershed, Paint Creek was sampled in 24 locations. The creek was sampled for chemical, biological and habitat parameters. The monitoring locations are listed in Table 5.

Table 5: Paint Creek monitoring point locations.

RIVER MILE	STREAM	LOCATION	ECO-REGION	W/S SIZE*	HABITAT	ATTAINMENT
96.00	Paint Creek	Charles Chillicothe Rd.	ECBP	HW	WWH	Full
88.60	Paint Creek	Hidy Rd. adj Hidy Cemetary	ECBP	HW	WWH	Partial
79.90	Paint Creek	adj. Wildwood Rd	ECBP	W	WWH	Partial
75.30	Paint Creek	Eber Bloomongburg Rd.	ECBP	W	WWH	Partial
70.90	Paint Creek	downstream from Perry Park	ECBP	W	WWH	Full
69.70	Paint Creek	Ust Bypass, highly modified re	ECBP	W	WWH	Partial
67.50	Paint Creek	Dst. WCH WWTP Ust. Old SR 35	ECBP	W	WWH	
69.40	Paint Creek	WCH WWTP mixing zone	ECBP	W	WWH	Full
67.30	Paint Creek	Dst. WCH WWTP, Dst. Old 35	ECBP	W	EWH	Partial

*HW=Headwater, <20 miles^2 watershed area; W=Wadeable, ≥20 and <200 miles^2 watershed area; SR=Small River, ≥200 miles^2 watershed area and <2000 miles^2 watershed area; and LR=Large River, >1000 miles^2 watershed area.

Paint Creek is located in the Eastern Corn Belt Plains (ECBP) Ecoregion between the headwaters and river mile 49, and the Western Allegheny Plains (WAP) Ecoregion from river mile 49 to the mouth. It is characterized in the Ohio Administrative Code (OAC) 3745-1-09; Table 9-1, as warmwater habitat (WWH) between the headwaters and river mile 69 and again from river mile 5 to the mouth. Paint Creek is characterized as exceptional warmwater habitat between river mile 69 and river mile 5. The creek is used for agricultural water supply (AWS), industrial water supply (IWS) and primary contact recreation (PCR). It is also a source of public drinking water.

Of the parameters described in this report; total suspended solids (TSS), fecal coliforms, nitrate/nitrite, total phosphorus and dissolved oxygen; only fecal coliforms and dissolved oxygen have water quality standards. Nitrate concentrations may be compared to maximum contaminant levels (MCLs) for drinking water.

For primary contact waters fecal coliform concentrations (by geometric mean of at least five samples) must be less than 1000 bacteria per 100 mL of water, with no more than 10% of the samples over 2000 bacteria per 100 mL of water. Fecal coliform data was only collected between river miles 96 and 48.7. The coliform concentrations were elevated on August 13, with 11 of the 13 samples above 2000 bacteria per 100 mL of water, and river mile 88.57 was elevated on July 28 as well. Coliforms were elevated throughout much of the summer in the mixing zone for the Washington Court House WWTP, with measurements of 40,000 and 47,000 bacteria per 100 mL of water on September 4, 1997. Below the mixing zone the fecal coliform concentrations returned to normal levels except for slight elevation on August 13.

Dissolved oxygen concentrations were below WQS (3.06 mg/L on 9/15/97) in the headwaters. They were maintained in the mixing zone for the Washington Court House WWTP, but then sagged 1.5-5 miles downstream of the WWTP. Additional testing completed by Ohio EPA's ecological assessment unit showed a water quality exceedence for diel oxygen measurements (night vs day values) at river mile 67.7. The monitoring equipment recorded a dissolved oxygen low of 3.78 mg/L (minimum values for WWH are 4.0 mg/L) on July 31, 1997.

In comparison with reference streams, Paint Creek showed elevated TSS concentrations on July 28 and extremely elevated concentrations on August 13. This was probably associated with a storm event. Most high TSS concentrations were correlated with agricultural areas (row crop agriculture or cattle pastures) with limited riparian corridor to capture sediments during storm water runoff.

Nitrogen concentrations were elevated in July in the upper reaches of the creek, which flows through a predominantly agricultural area. Nitrogen concentrations were also elevated in the Washington Court House WWTP mixing zone throughout the monitoring period.

Measured phosphorus concentrations in Paint Creek appeared high when compared to the reference stream values. Elevated phosphorus levels were apparent in the headwaters, south of Washington Court House with extremely high concentrations downstream of the WWTP. In the Washington CH WWTP mixing area phosphorus values were approximately 5-50 times higher than the upstream reaches and 50 times higher than the reference stream 75th percentile values.

Please refer to the Paint Creek water quality data and charts on the following pages for more specific information. Bolded values are above (or below in the case of dissolved oxygen) associated reference stream 75th percentile concentrations.

Paint Creek Water Quality Data

Total Suspended Solids

EWCH

River Mile	96	88.57	79.8	75.3	71.16	69.52	69.45	69.4	67.3
14-Jul-97	**50**	**31**	24	**47**	**32**	20	5	6	24
28-Jul-97	**67**	**58**	**38**	**42**	**35**	26	5	5	15
13-Aug-97	**110**	**174**	**59**	**149**	**39**	27	8	16	**103**
4-Sep-97	**15**	10	12	14	20	22	**42**	**38**	11
15-Sep-97	**49**	5	8	17	8	10	5	5	6
AVG	58.2	55.6	28.2	53.8	26.8	21	13	14	31.8
MAX	110	174	59	149	39	27	42	38	103
Reference	14	14	29	29	29	29	29	29	29

Fecal Coliform

EWCH

River Mile	96	88.57	79.8	75.3	71.16	69.52	69.45	69.4	67.3
14-Jul-97	760	930	520	460	170	160	150	640	230
28-Jul-97	**1900**	**6400**	**1700**	800	310	360	110	320	310
13-Aug-97	**6000**	**5800**	**6000**	**5600**	**2300**	**5600**	**3900**	**4200**	**6000**
4-Sep-97	410	270	450	370	10	130	**40000**	**47000**	171
15-Sep-97	460	120	540	370	60	240	**3600**	**1400**	160
AVG	1906	2704	1842	1520	570	1298	9552	10712	1374.2
MAX	6000	6400	6000	5600	2300	5600	40000	47000	6000
Reference	960	960	860	860	860	860	860	860	860

Nitrate/nitrite

EWCH

River Mile	96	88.57	79.8	75.3	71.16	69.52	69.45	69.4	67.3
14-Jul-97	**6.76**	**5.96**	**5.6**	**4.78**	**4.98**	**4.27**	**11**	**10.8**	**5.87**
28-Jul-97	**3.92**	**3.93**	**3.8**	**3.42**	2.39	1.97	**4.46**	**4.43**	2.49
13-Aug-97	0.67	0.93	0.29	0.61	0.22	0.34	2.74	**7.97**	**3.28**
4-Sep-97	0.88	1.42	1.76	1.79	1.64	1.49	**9.82**	2.64	2.64
15-Sep-97	0.26	0.76	1	1.2	1.02	0.56	**9.2**	**8.29**	
AVG	2.498	2.6	2.49	2.36	2.05	1.726	7.444	6.826	2.856
MAX	6.76	5.96	5.6	4.78	4.98	4.27	11	10.8	5.87
Reference	2.268	2.268	2.815	2.815	2.815	2.815	2.815	2.815	2.815

Phosphorus

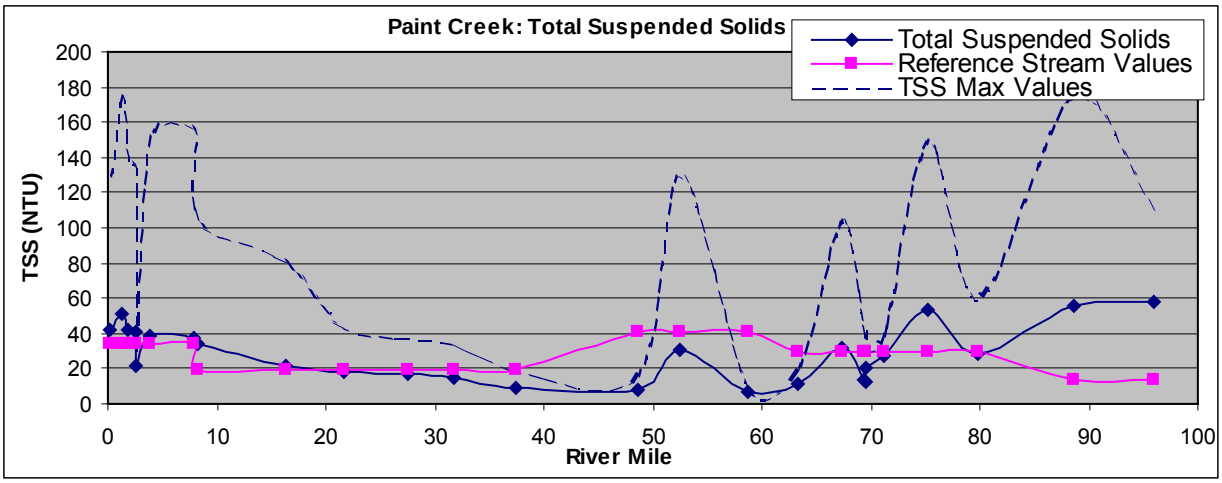
EWCH

River Mile	96	88.57	79.8	75.3	71.16	69.52	69.45	69.4	67.3
14-Jul-97	**0.86**	**1.28**	**0.35**	**0.32**	**0.14**	0.06	**4.94**	**4.88**	**0.66**
28-Jul-97	**0.19**	**0.18**	**0.12**	**0.14**	0.09	0.12	**5.74**	**6.18**	**1.08**
13-Aug-97	**0.14**	**0.15**	**0.17**	**0.23**	**0.16**	0.05	**6.19**	**5.08**	**2.34**
4-Sep-97	0.05	0.05	0.05	0.07	0.09	**0.14**	**4.88**	**3.36**	**0.57**
15-Sep-97	0.07	0.07	0.05	**0.15**	0.05	0.05	**4.06**	**3.85**	
MAX	0.86	1.28	0.35	0.32	0.16	0.14	6.19	6.18	2.34
Reference	0.08	0.08	0.13	0.13	0.13	0.13	0.13	0.13	0.13

Dissolved oxygen

EWCH

River Mile	96	88.57	79.8	75.3	71.16	69.52	69.45	69.4	67.3
14-Jul-97	7	7.19	8.5	8.58	7.56	7.68	9.68	9.81	**6.33**
28-Jul-97	**4.6**	**5.25**	**5.5**	**5.7**	**4.8**	**6.7**	9.78	9.53	**5.38**
13-Aug-97	**6.56**	7.75	8.16	7.64	8.39	6.9	9.34	**6.07**	**6.11**
4-Sep-97	7.1	8.92	9.15	9.3	7.99	**6.63**	8.09	8.26	**6.23**
15-Sep-97	**3.06**	7.61	9.41	7.7	NA	**5.12**	9.01	8.98	
MAX	7.1	8.92	9.41	9.3	8.39	7.68	9.78	9.81	6.33
Reference	6.6	6.6	6.95	6.95	6.95	6.95	6.95	6.95	6.95


Paint Creek: Total Suspended Solids
Total Suspended Solids
Reference Stream Values
TSS Max Values
TSS (NTU)
River Mile
0
20
40
60
80
100
120
140
160
180
200
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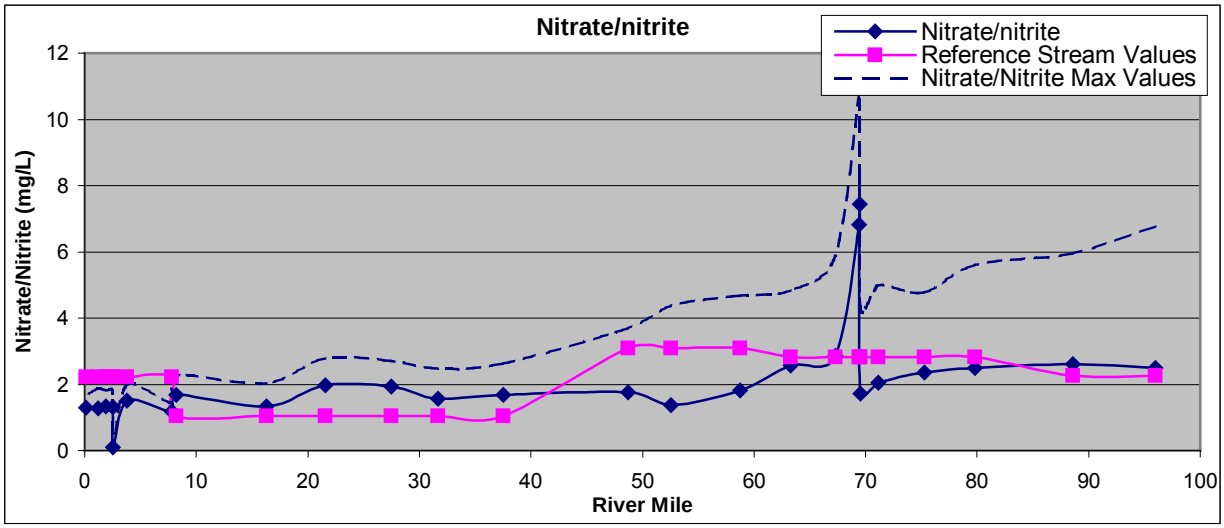
10
20
30
40
50
60
70
80
90
100


Nitrate/nitrite
Nitrate/nitrite
Reference Stream Values
Nitrate/Nitrite Max Values
Nitrate/Nitrite (mg/L)
River Mile
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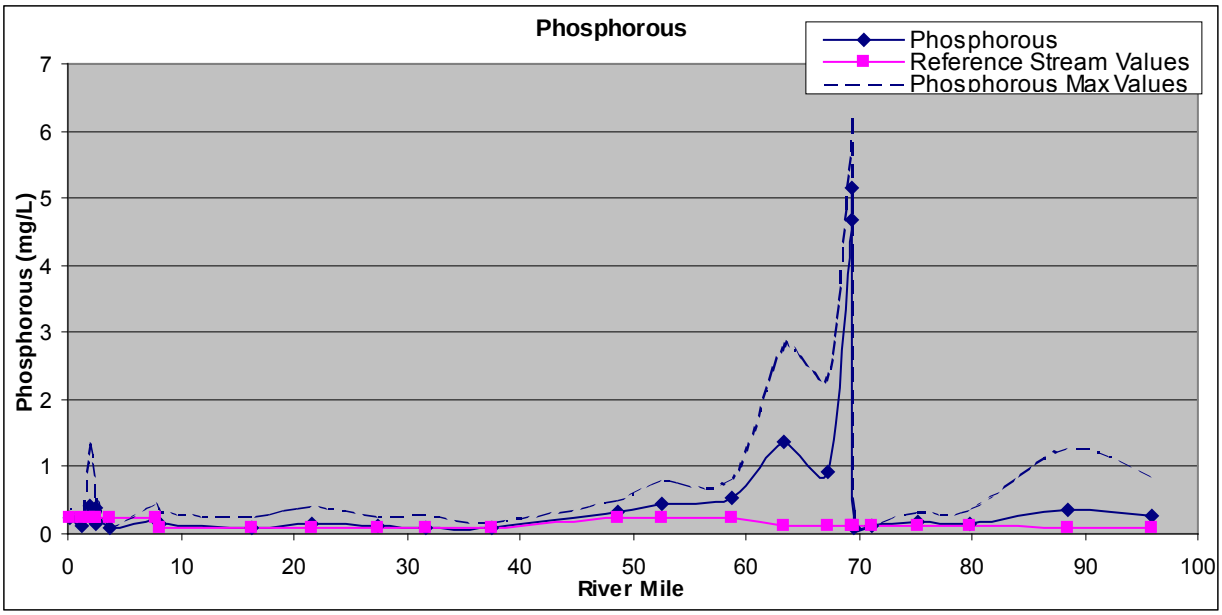
2
4
6
8
10
12
0
10
20
30
40
50
60
70
80
90
100


Phosphorous
Phosphorous
Reference Stream Values
Phosphorous Max Values
Phosphorous (mg/L)
River Mile
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3
4
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7
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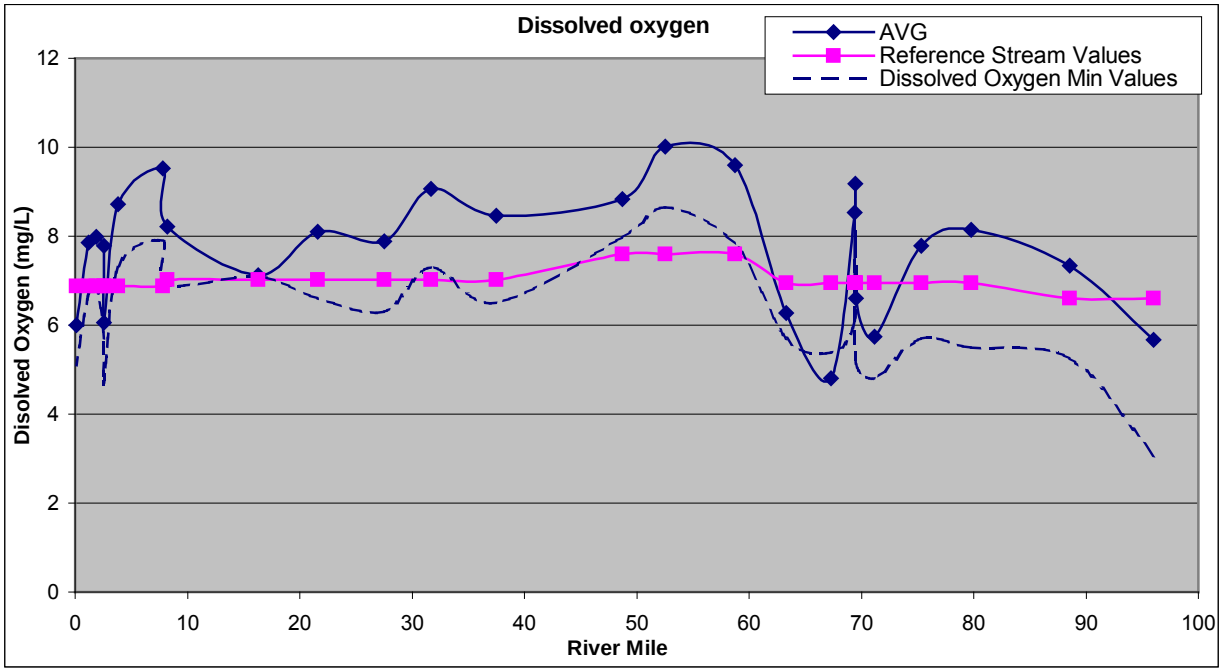
10
20
30
40
50
60
70
80
90
100


Dissolved oxygen
AVG
Reference Stream Values
Dissolved Oxygen Min Values
Disolved Oxygen (mg/L)
River Mile
0
2
4
6
8
10
12
0
10
20
30
40
50
60
70
80
90
100

Biological Indices

The majority of the Paint Creek Subwatershed is located in the Eastern Corn Belt Plains (ECBP) Ecoregion except for Paint Creek downstream of Paint Creek Lake, which is located in the Western Allegheny Plateau (WAP) Ecoregion.

The species composition expected in each of these ecoregions is slightly different, which translates into different numeric biocriteria for each aquatic use designation. Again, the IBI measures fish species diversity and population composition. It accounts for total native populations, indicator species, overall fish condition and pollution intolerant versus pollution tolerant fish species. The MIwb measures similar characteristics of the fish population, however, it subtracts 13 pollution tolerant fish species out of the final score. The ICI measures the composition of the invertebrate community and compares the numbers of pollution tolerant species with pollution intolerant species. The biocriteria for the ECBP and WAP ecoregions are listed below:

Ecoregion Biocriteria: Eastern Corn Belt Plains (ECBP)
(OAC 3745-1-07, Table 7-14)

Index- Site Type	WWH	EWH
IBI- Boat	42	48
MIwb- Boat	8.5	9.6
ICI	36	46

Ecoregion Biocriteria: Western Allegheny Plateau (WAP)
(OAC 3745-1-07, Table 7-14)

Index- Site Type	WWH	EWH
IBI- Boat	40	48
MIwb- Boat	8.6	9.6
ICI	36	46

The Main Stem of Paint Creek is WWH above Washington CH and EWH from Washington CH until one mile upstream of the confluence with the Scioto River. The last mile of Paint Creek is WWH. A slight decrease in water quality typifies stream behavior at the confluence with a larger river. Paint Creek showed significant departures from WWH IBI biocriteria scores in two locations. The first was adjacent to Wildwood Road and the second was upstream of the Washington CH WWTP near the highway 35 by-pass in a highly modified reach of stream through a park. The stream briefly met the EWH criteria for IBI below Washington CH and then was not measured until the outfall from Paint Creek Lake, where it did not meet EWH criteria.

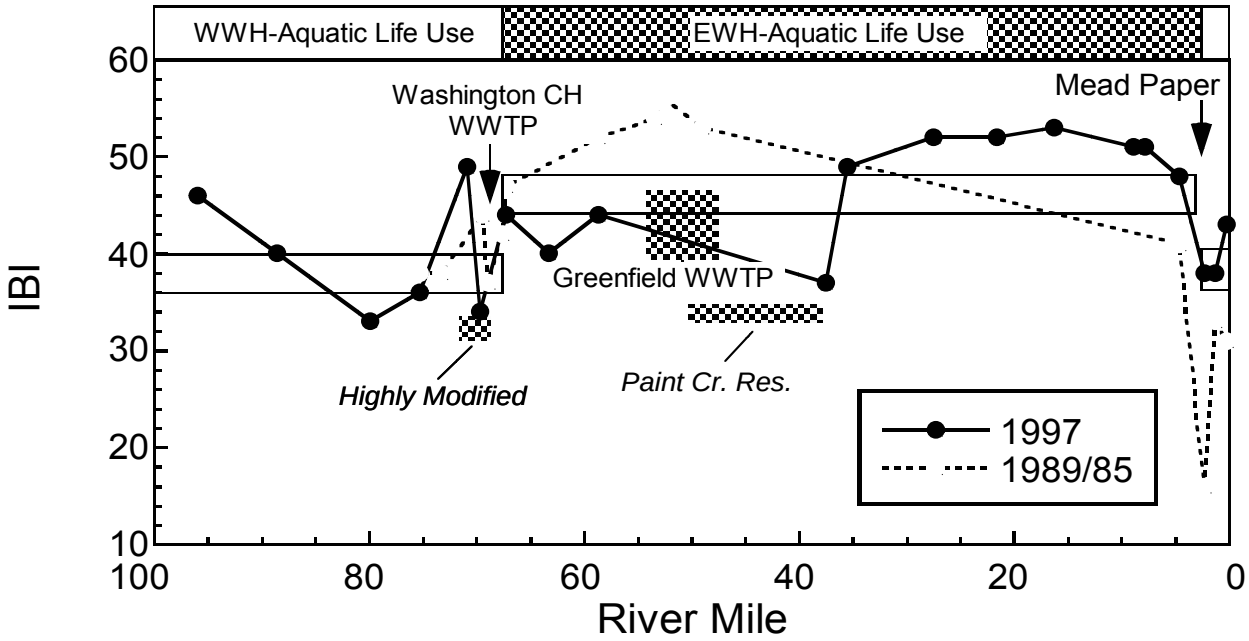
The MIwb did not meet WWH criteria in the upper reaches of the stream except for downstream of Perry Park in Washington CH. South of Washington CH Paint Creek met the EWH biocriteria except for isolated deviations downstream of the Washington CH WWTP and below the Paint Creek Reservoir.

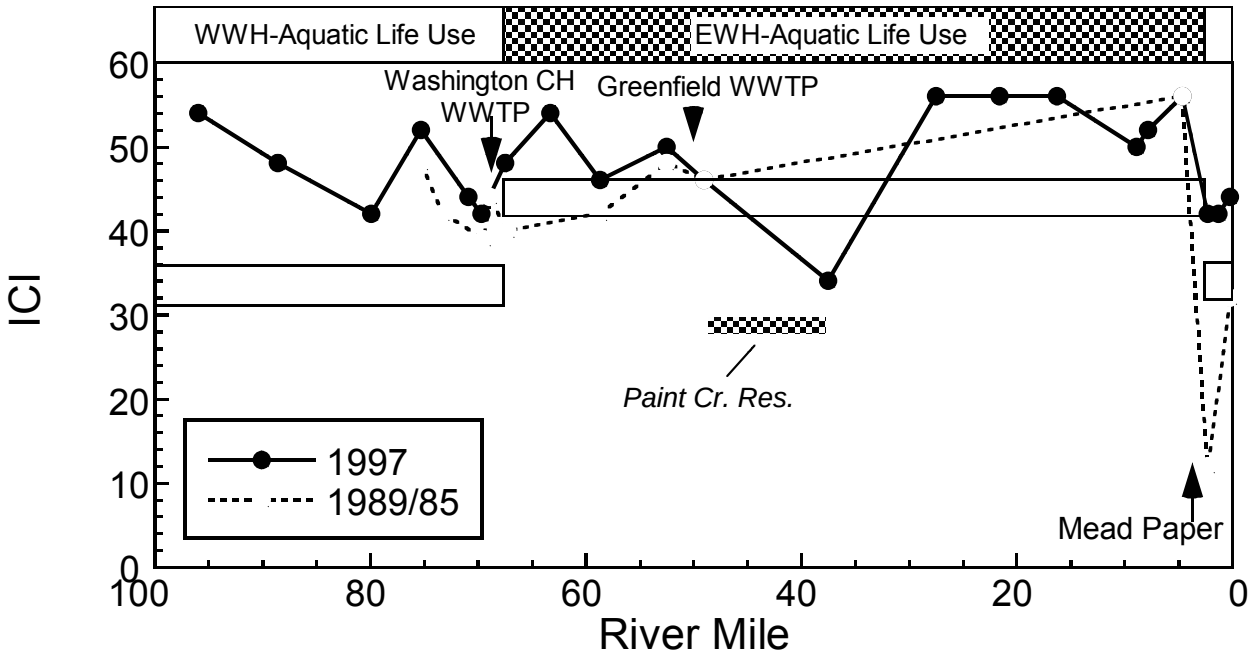
The partial attainment in the headwaters near Hidy Rd. (RM ~88) was due primarily to multiple physical and chemical stressors from row crop and livestock production. Deficient physical habitat (stream channelization, siltation, destabilized streambanks), organic and nutrient enrichment, depressed dissolved oxygen concentrations, and bacteriological contamination were causes. Primary Contact Recreation (PCR) use is threatened by livestock activities in this reach, as fecal coliform concentrations were greatest in the upper headwaters. Culpepper Estates WWTP inputs and wastewater from home septic systems also contribute as sources of discharges in these reaches. Miami Trace High School treated wastewater enters Paint Creek just downstream from sampled area.

The partial attainment in Washington Court House (WCH) was attributed to the continued influence from upstream agricultural concerns as well as the channelization, impoundment, urban runoff, sediment contamination and bypasses (untreated wastewater). PCR use is also threatened by the urban inputs.

According to Ed Moore, in comparison with previous evaluations, ambient conditions of Paint Creek downstream from WCH have remained stable. The results from the 1997 survey again indicated moderate aquatic life use impairment. Despite reduced loadings of selected heavy metals achieved by the WCH WWTP since 1994, the facility's loads of oxygen demanding wastes, NH_3-N, and TSS had remained stable through time. Also, loads of NO^3-N, rose slightly between 1996 and 1997, suggesting diminished nitrification. Pollutant loads from bypasses increased sharply in 1996-97. The combined effect of treated effluent and bypasses resulted in diminished instream dissolved oxygen, including several WQS exceedences and a violation, and biological performance below EWH standards. Much of the impact appeared to be from organic enrichment.

Overall, the ICI met biocriteria scores throughout the entire stream. The only significant departure appeared below the outfall from Paint Creek Reservoir.


WWH-Aquatic Life Use
EWH-Aquatic Life Use
Washington CH WWTP
Mead Paper
Greenfield WWTP
Highly Modified
Paint Cr. Res.
1997
1989/85
IBI
River Mile
60
50
40
30
20
10
100
80
60
40
20
0


WWH-Aquatic Life Use
EWH-Aquatic Life Use
Washington CH WWTP
Greenfield WWTP
Paint Cr. Res.
1997
1989/85
Mead Paper
ICI
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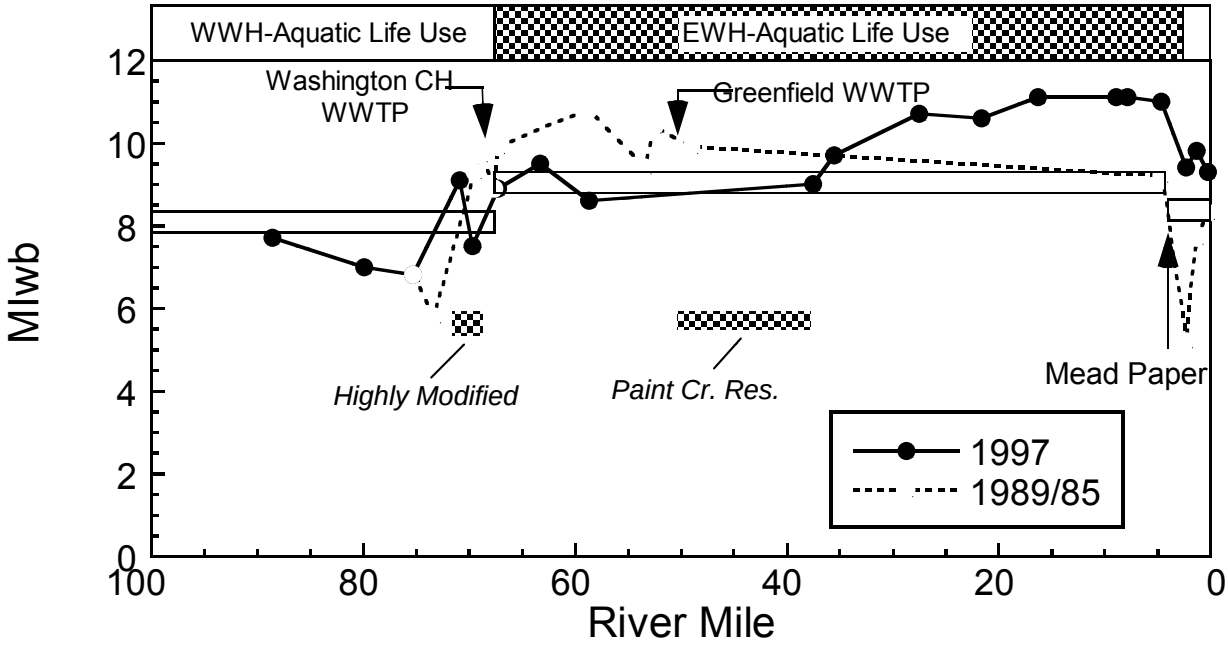
20
0



Qualitative Habitat Evaluation Index (QHEI)

The QHEI is a qualitative measurement of the presence and quality of physical habitat components that support aquatic life. 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 habitat characteristics that are used to determine the QHEI score include substrate, instream cover, channel morphology, riparian vegetation and bank erosion, gradient, and flow patterns (pool, run and riffle development). The QHEI score ranges from 20 to less than 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 sites around the state (OEPA, 2002, Bokes TMDL) 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 having the ability to support exceptional warmwater faunas. The QHEI can be used to direct restoration efforts for habitat and to provide a monitoring tool to measure progress toward habitat goals.

In the Paint Creek headwaters only two out of six QHEI scores met the target score for WWH (60). The most significant problems included lack of riparian habitat and

channelization of the creek. Other problems included sedimentation and embedded creek bottom. The main landuse in this area is row crop, with some residential and urban areas. One section near the Hwy 35 bypass scored extremely low at 38.0. This area is highly modified and channelized with little instream or riparian habitat.

Below Washington CH the stream is considered EWH and due to improved physical habitat largely met the target score of 75. Directly downstream of Washington CH, the score was slightly lower due to inputs from above plus only moderate instream habitat and narrow (but intact) riparian corridor.

The QHEI scores and comments about each of the main components of the score are described in Table 6. This information is from the QHEI field notes recorded during the 1997 monitoring survey of the watershed. The QHEI was completed by Ohio EPA Ecological Assessment Unit personnel.

Table 6. QHEI scores and habitat component quality

River Mile	Location	QHEI	Comments
96.0	Charles Chillicothe Road	62.5	•
88.6	Hidy Road	54.5	•
79.9	Adjacent Wildwood Road	55.0	• **Substrate**: moderate to heavy silt, moderate to extensive embeddedness • **Instream cover**: moderate • **Morphology**: recovering from channelization, low gradient dumps silt from upstream • **Riparian**: moderate, old field species • **Flood plain**: residential and row crop
75.3	Eber Bloomingburg Road	71.5	• **Substrate**: moderate silt and normal to moderate embeddedness, habitually turbid water column but substrate not overly burdened • **Instream cover**: extensive • **Riparian**: wide and intact with low impact landuse outside of riparian, little bank erosion • **Flood plain**: shrub/old field, residential and conservation tillage, some livestock • *Fish catches small and not diverse, check this site
71.7	Downstream Perry Park	52.5	• **Substrate**: moderate silt and embeddedness • **Instream cover**: sparse with some artificial • **Morphology**: channel highly modified, channelized • **Riparian**: no riparian vegetation, 2:1 grass banks, sewer crossings provide habitat, little bank erosion
69.5	Upstream bypass, highly modified reach	38.0	• **Substrate**: normal to moderate silt and normal to moderate embeddedness • **Instream cover**: aquatic macrophytes • **Morphology**: channelized • **Riparian**: none, grassed 2:1 banks, little bank erosion • **Flood plain**: park
67.3	Downstream WA CH WWTP, Downstream Old SR 35	72.0	• **Substrate**: normal to moderate silt with moderate to extensive embeddedness • **Instream cover**: moderate (75%) • **Riparian**: moderate with mature trees, little bank erosion

Potential contamination sources within 500 feet of Paint Creek

Another component of this study, related to landuse, includes the potential contamination sources found within the vicinity of the creeks. Table 7 includes a list of all potential sources that are found within 500 feet of Paint Creek. Many of these potential

contamination sources are former leaking underground storage tanks (LUSTs), which most likely have been cleaned up and closed years ago, and cemeteries, which may contribute arsenic from historic embalming practices. The m ost important of the potential contamination sources are point sources such as WWTP, which discharge directly to the creeks. The point sources along paint creek include, Culpepper Estates WWTP, Washington Court House and Greenfield WWTPs, and the Miami Trace wastewater plant.

Other types of point sources include surface impoundments, which may only flow into the creek during storm or overflow events. The Ohio Water Service Company, Standard Oil Company, Armco Steel Corporation and Collins Packing Company operate surface impoundments along Paint Creek.

At this time the health departments in the watershed are gathering information about other potential point sources of pollution, such as sewer bypasses.

` Table 7: Point sources within 500 feet of Paint Creek

NAME	ADDRESS	CITY	COUNTY	TYPE
Rich Oil Co.	CENTER & ELM STS	Washington CH	Fayette	Leaking Underground Tank
Unknown, Greeno Residence	10192 SR 62 N	Washington CH	Fayette	Leaking Underground Tank
Unknown, Former Gas Station	10232 SR 62 N	Washington CH	Fayette	Leaking Underground Tank
Courthouse Tool Rental	276 W OAKLAND AVE	Washington CH	Fayette	Leaking Underground Tank
Cudahy Property	532 DAYTON AVE	Washington CH	Fayette	Leaking Underground Tank
Clark Oil & Refining Corp.	330 W COURT ST	Washington CH	Fayette	Leaking Underground Tank
MAC Tools	S FAYETTE ST	Washington CH	Fayette	Leaking Underground Tank
Eastside Elementary School	S ELM ST	Washington CH	Fayette	Leaking Underground Tank
Miami Trace Bus Garage	3722 SR 41 NW	Washington CH	Fayette	Leaking Underground Tank
Miami Trace Local Schools	3722 ST RT 41 NW	Washington CH	Fayette	Leaking Underground Tank
Indianola Plaza Co.	300 WASHINGTON SQ	Washington CH	Fayette	Leaking Underground Tank
GMAC Auto Sales	333 W COURT ST	Washington CH	Fayette	Leaking Underground Tank
OK Tire Service	1358 RT 22 NW	Washington CH	Fayette	Leaking Underground Tank
Buckeye Countrymark Drive Thru	302 S FAYETTE ST	Washington CH	Fayette	Leaking Underground Tank
Interiors by Lynn (former Sunoco)	701 DAYTON	Washington CH	Fayette	Leaking Underground Tank
Unknown, Sewer Line Repair	14 FRONT 702 DAYTON	Washington CH	Fayette	Leaking Underground Tank
Union 76	635 DAYTON AVE	Washington CH	Fayette	Leaking Underground Tank
Flagway #7	635 DAYTON AVE	Washington CH	Fayette	Leaking Underground Tank
Stinson Residence	5362 US RT 35 SE	Washington CH	Fayette	Leaking Underground Tank
AT&T	4087 US RT 62 N3	Washington CH	Fayette	Leaking Underground Tank
Ameritech	210 NORTH ST	Washington CH	Fayette	Leaking Underground Tank
Richard E. Beechler	1659 RT 22 E	Washington CH	Fayette	Leaking Underground Tank
Car Shine Auto Wash	1220 COLUMBUS AVE	Washington CH	Fayette	Leaking Underground Tank
Fayette Co. Garage-ODOT	2331 US RT 22 SW	Washington CH	Fayette	Leaking Underground Tank
Washington CH City Maintenance		Washington CH	Fayette	PCS
Federal Aviation Administration	2199 OLD XENIA RD	London	Madison	RCRIS- Hazardous Waste
Sunoco Station	WEST 347 COURT ST	Washington CH	Fayette	RCRIS- Hazardous Waste
BP Bulk Oil	WEST 304 MARKET ST	Washington CH	Fayette	RCRIS- Hazardous Waste
City Washington CH		Washington CH	Fayette	PCS
Knisleys Collision	1159 COLUMBUS AVE	Washington CH	Fayette	RCRIS- Hazardous Waste
McCullahs Detail Bodyshop	702 DAYTON AVE	Washington CH	Fayette	RCRIS- Hazardous Waste
Starfire Express	WEST 330 COURT ST	Washington CH	Fayette	RCRIS- Hazardous Waste
Fayette Co. Landfill	SR-41	Jefferson TWP	Fayette	Inactive/Closed Landfill
Correl Cemetery			Madison	cemetery
Hidy Cemetery			Fayette	cemetery
Kirk Cemetery			Fayette	cemetery
Old Washington Cemetery			Fayette	cemetery
Range Cemetery			Madison	cemetery
Whiteman Cemetery			Madison	cemetery
City Washington CH	208 NORTH FAYETTE ST	Washington CH	Fayette	WWTP
Standard Oil Company	6050 BUSCH BLVD	Columbus	Fayette	RETENTION

OSU Study Results

Dr. Cavender and several interns conducted a seining survey to obtain information on the distribution of Paint Creek fishes across the drainage. This study was conducted to construct distribution maps, to pinpoint areas with the greatest diversity, and to investigate the presence of rare or endangered species. This study brought together all previous

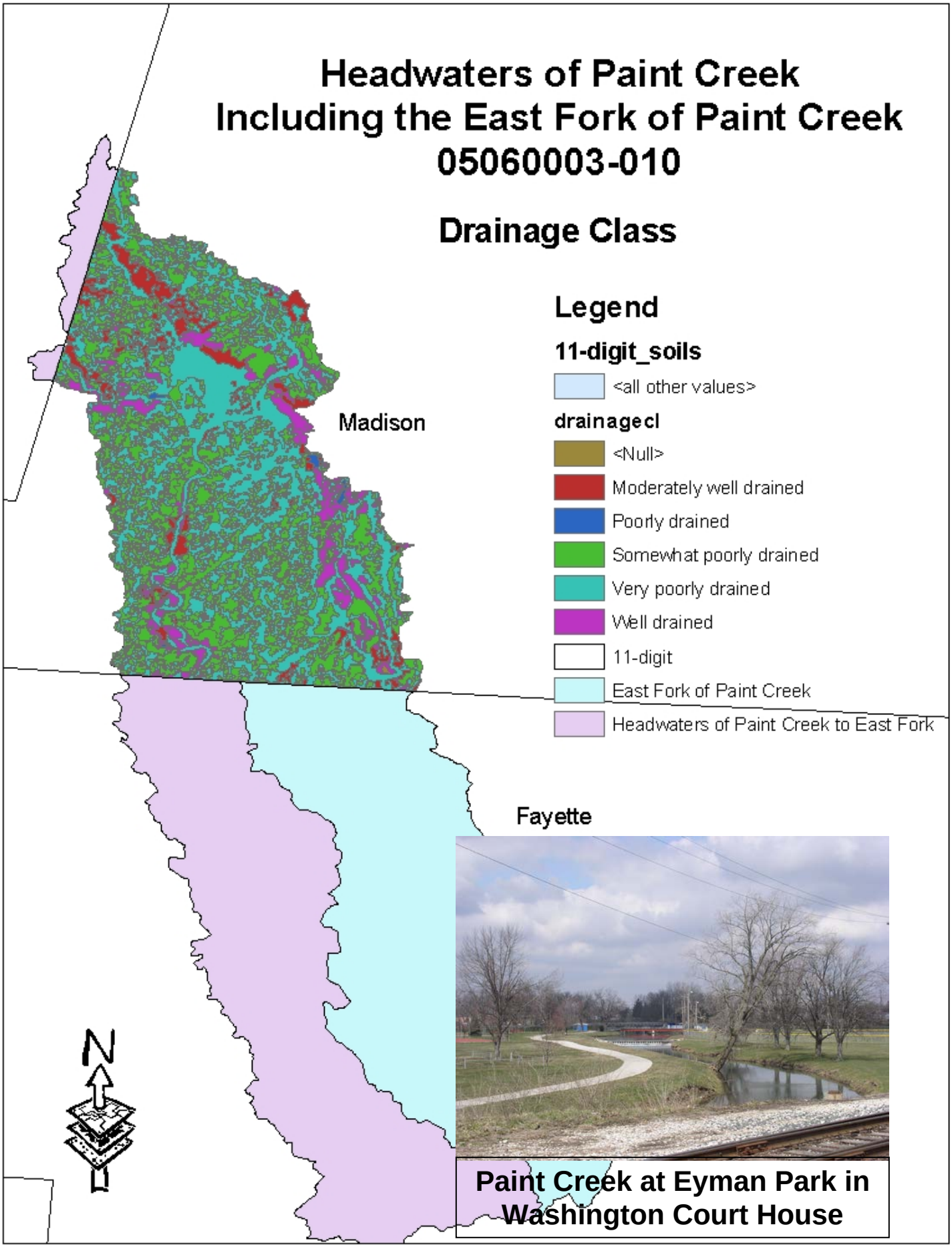
collection data to create an accurate representation of the fishes in Paint Creek. The study of the headwaters and East Fork showed a total of 55 species present in this subwatershed. It is also noted that some of this area is characteristic of a prairie fish association. This study notes that the East Fork of Paint has been damaged by channelization but not so much by livestock and rowcrops as other Paint Creek tributaries.

Soils Information

Since the digitized soil information for Fayette County is not yet available, we only have Madison County information to work with when looking at soil information at this time. The soils in the headwaters of Paint Creek are generally not hydric and are somewhat poorly drained to very poorly drained soils. This explains why the greater percentage of the streams in this watershed are on county ditch maintenance or are at least being maintained as ditches by the landowners. They are also potentially highly erodable to not highly erodable soils with a minor slope generally between 1-4%. Please see the following maps for information pertaining to the soils.

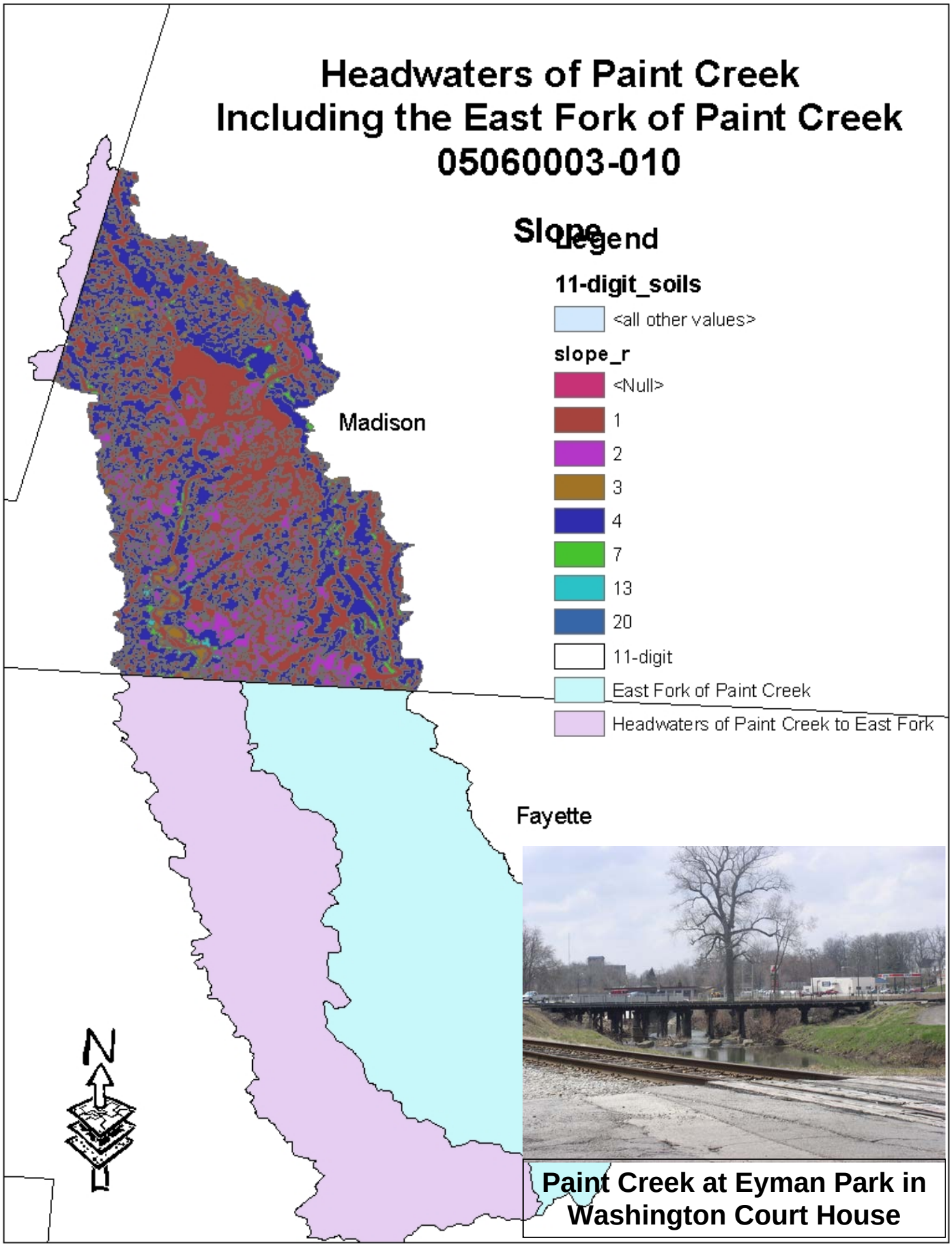
Headwaters of Paint Creek Including the East Fork of Paint Creek 05060003-010

Drainage Class

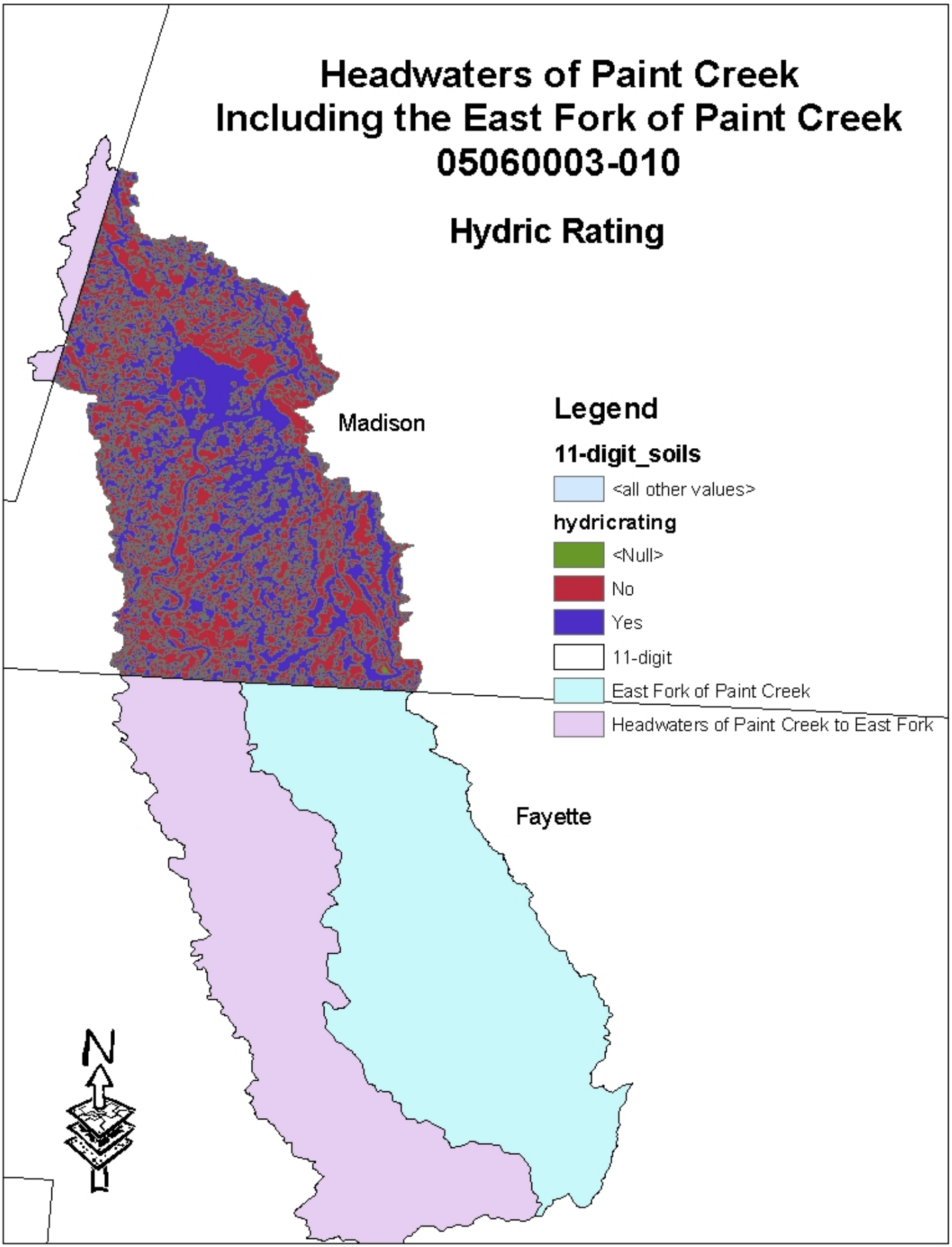


Paint Creek at Eyman Park in Washington Court House

Headwaters of Paint Creek
Including the East Fork of Paint Creek
05060003-010



Paint Creek at Eyman Park in Washington Court House


Headwaters of Paint Creek
Including the East Fork of Paint Creek
05060003-010
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Fayette
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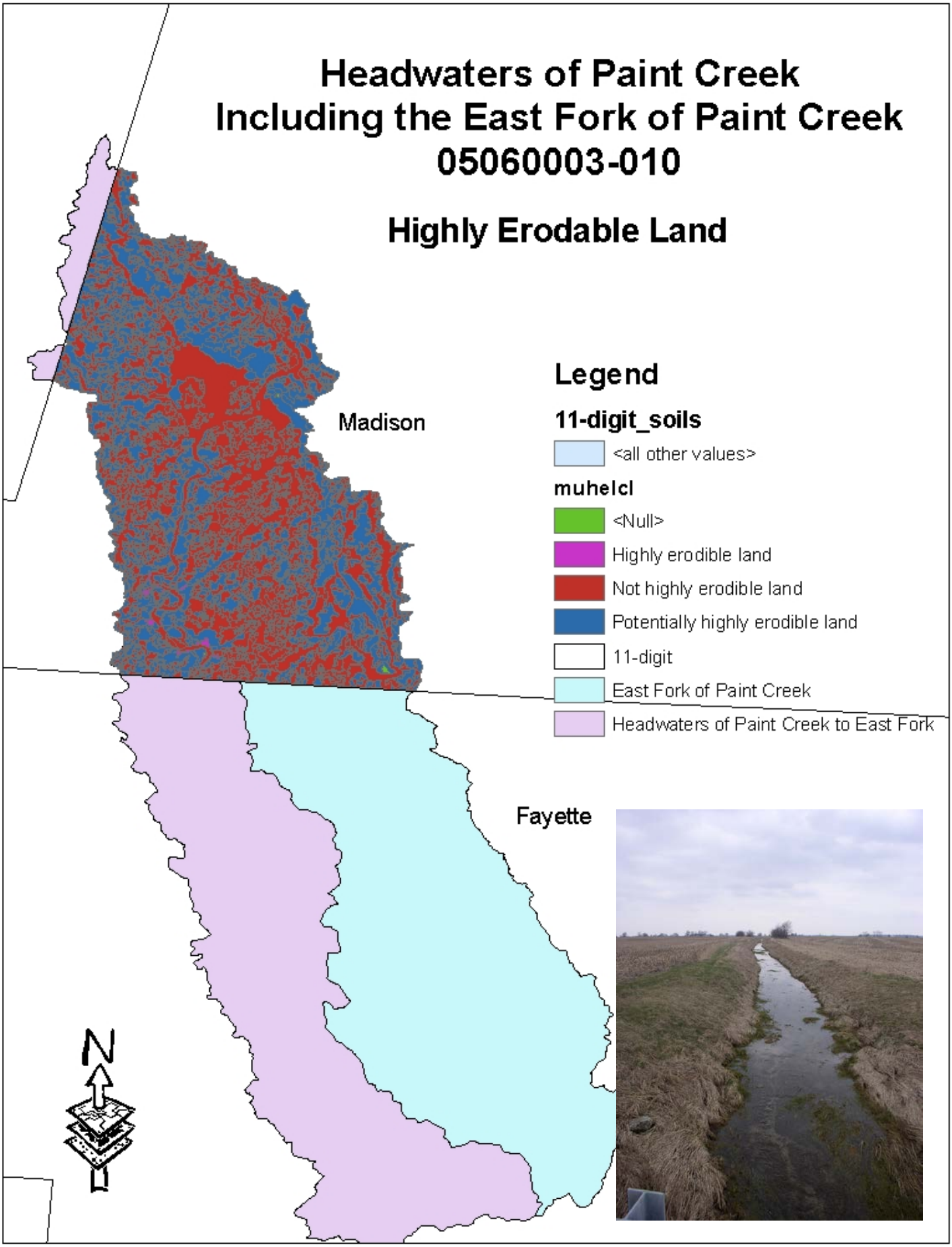
Yes
11-digit
East Fork of Paint Creek
Headwaters of Paint Creek to East Fork
N

Headwaters of Paint Creek Including the East Fork of Paint Creek 05060003-010

Highly Erodable Land



Headwaters of Paint Creek
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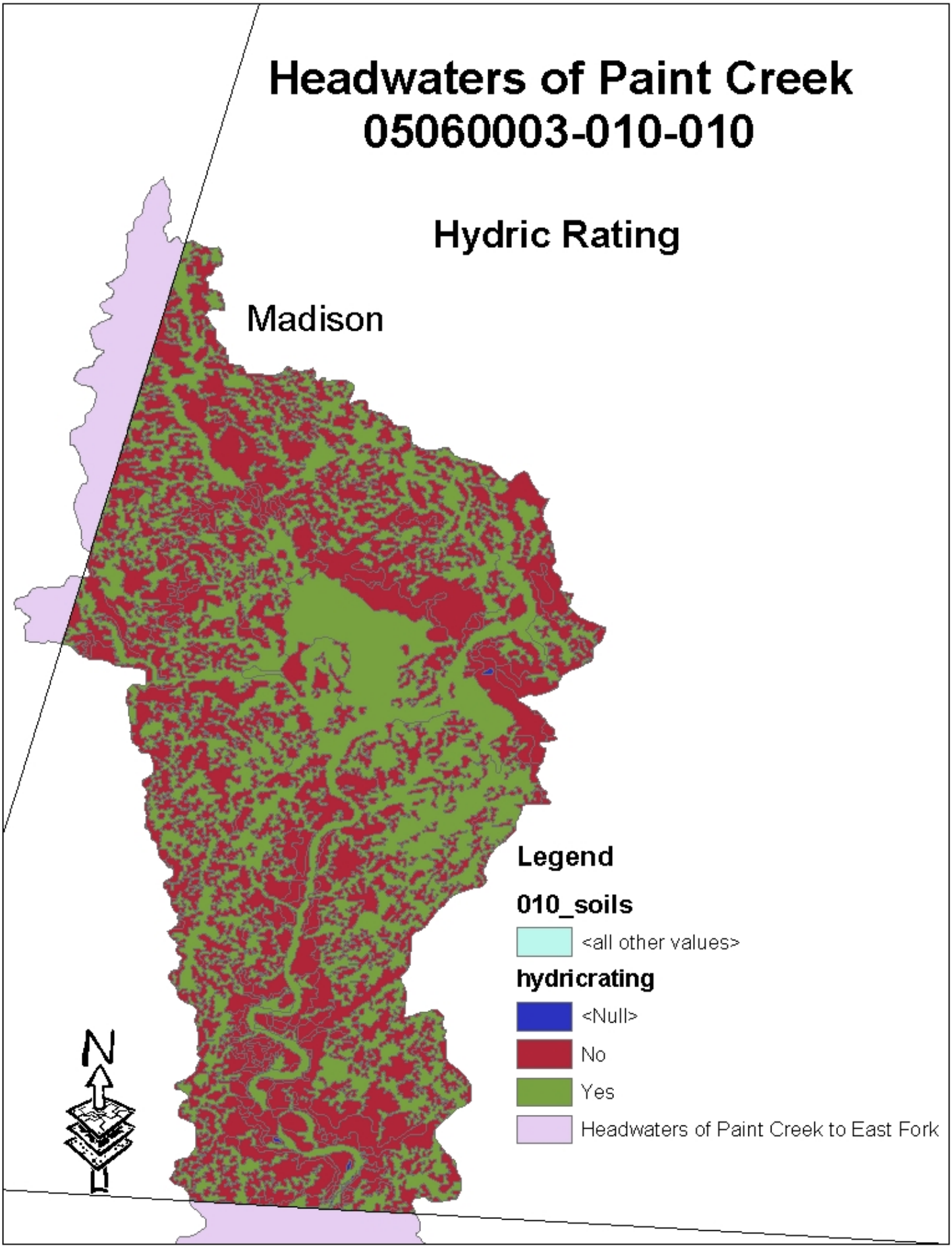
Hydric Rating



Headwaters of Paint Creek
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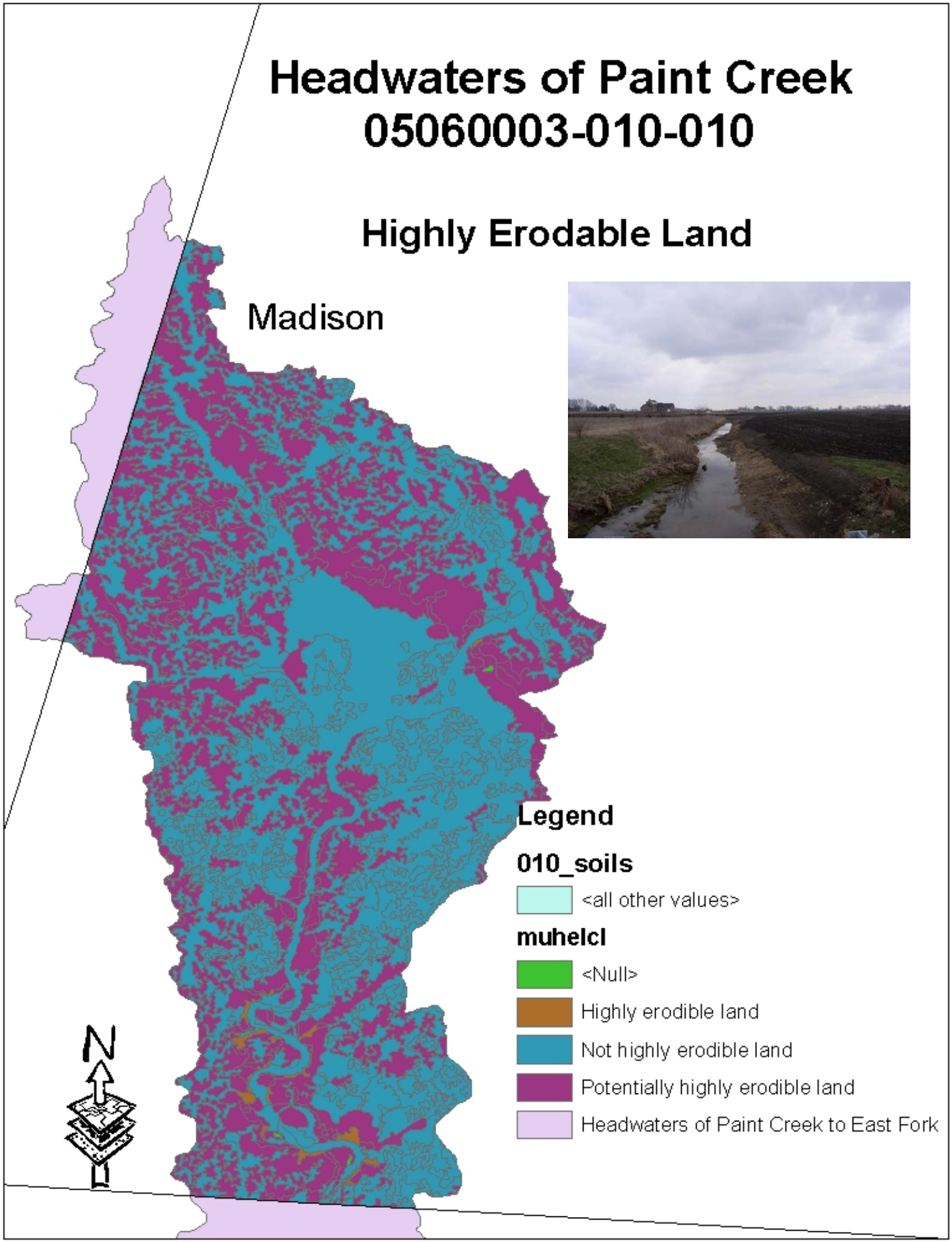
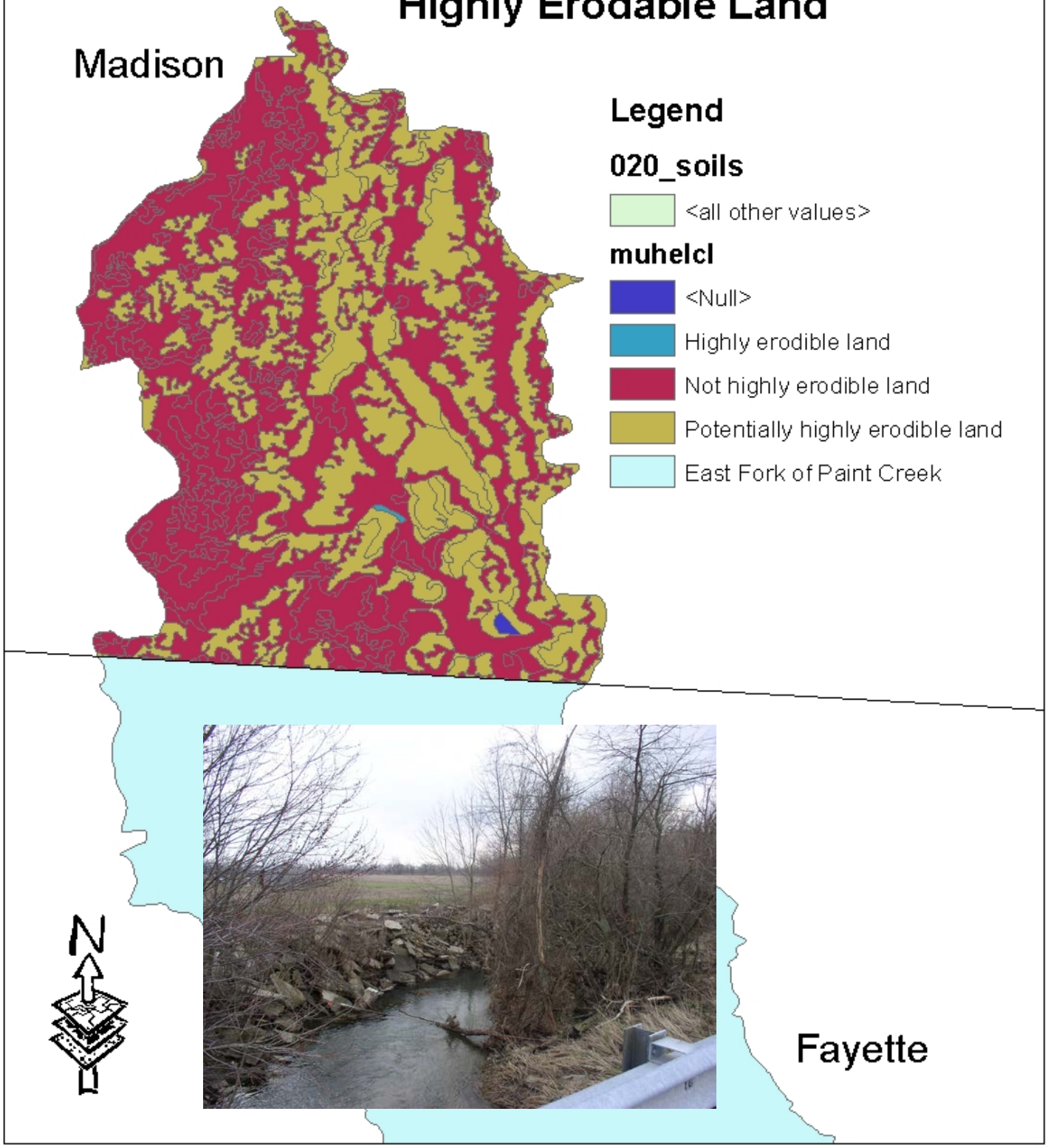
Highly Erodable Land



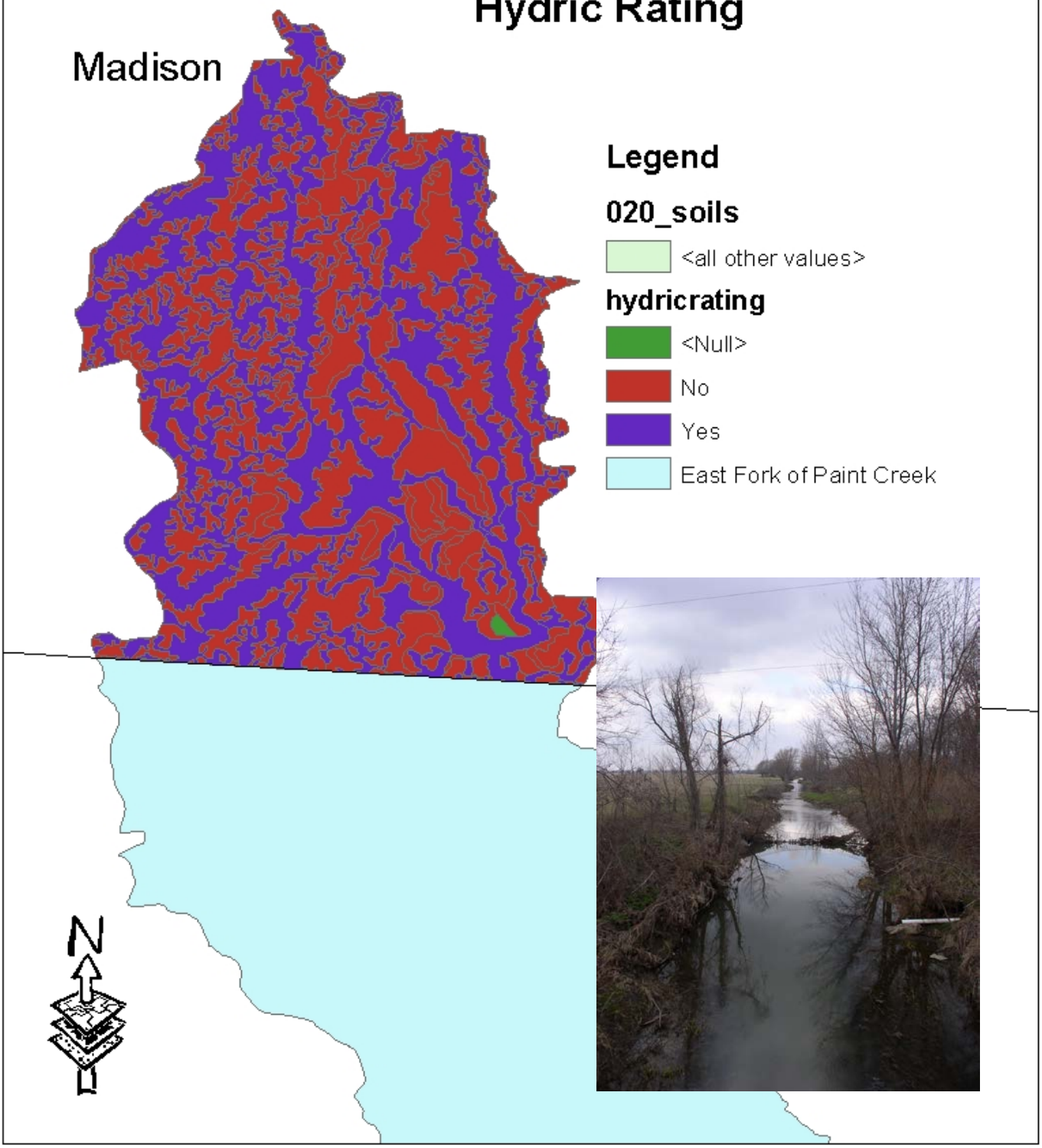
East Fork of Paint Creek
05060003-010-020

Highly Erodable Land



East Fork of Paint Creek
05060003-010-020

Hydric Rating



Problem Statement

The main stem of Paint Creek did not fully meet water quality standards in several areas. The partial attainment in the headwaters near Hidy Rd. (RM ~88) was due primarily to multiple physical and chemical stressors from row crop and livestock production. Deficient physical habitat (stream channelization, siltation, destabilized streambanks), organic and nutrient enrichment, depressed dissolved oxygen concentrations, and bacteriological contamination were causes. The lack of physical habitat is well documented in the QHEI field sheets, landuse data analysis and by members of the advisory group. Primary Contact Recreation (PCR) use is threatened by livestock activities in this reach, as fecal coliform concentrations were greatest in the upper headwaters. Culpepper Estates WWTP inputs and wastewater from home septic systems also contribute as sources of discharges in these reaches. Miami Trace High School treated wastewater enters Paint Creek just downstream from sampled area.

The partial attainment in Washington Court House (WCH) was attributed to the continued influence from upstream agricultural concerns as well as the channelization, impoundment, urban runoff, sediment contamination and bypasses (untreated wastewater). PCR use is also threatened by urban inputs. Pollutant loads from bypasses increased sharply in 1996-97. The combined effect of treated effluent and bypasses resulted in diminished instream dissolved oxygen, including several WQS exceedences and a violation, and biological performance below EWH standards. Overall, the impact appeared to be from organic enrichment.

East Fork of Paint Creek Water Quality

During the summer of 1997, East Fork of Paint Creek was sampled by Ohio EPA in three locations. The creek was sampled for chemical, biological and habitat parameters. The locations are listed in Table 8.

Table 8. East Fork of Paint Creek monitoring point locations.

RIVER MILE	STREAM	LOCATION	ECO-REGION	SIZE	HABITAT	ATTAINMENT
0.70	East Fork Paint Creek	Washington Ave.	ECBP	W	WWH	Full
5.10	East Fork Paint Creek	Mathews Rd. Dst Bloomingburg W	ECBP	W	WWH	Partial
8.60	East Fork Paint Creek	Lewis Rd. Ust. Bloomingburg WW	ECBP	W	WWH	Full

(W = wadeable, >20 and <200 acres drainage to stream)

East Fork is located in the Eastern Corn Belt Plains Ecoregion. It is characterized in the Ohio Administrative Code (OAC) 3745-1-09; Table 9-1, as warmwater habitat (WWH) used for agricultural water supply (AWS), industrial water supply (IWS) and primary contact recreation (PCR). Of the parameters described in this report; total suspended solids (TSS), fecal coliforms, nitrate/nitrite, total phosphorous and dissolved oxygen; only fecal coliforms and dissolved oxygen have water quality standards. Nitrate concentrations may be compared to maximum contaminant levels (MCLs) for drinking water.

For primary contact waters fecal coliform concentrations (by geometric mean of at least five samples) must be less than 1000 bacteria per 100 mL of water, with no more than 10% of the samples over 2000 bacteria per 100 mL of water. With measurements of 4100, 24000 and 4100 bacteria per 100 mL of water on July 28, 1997, and 6000, 4800 and 5000 bacteria per 100 mL of water on August 13, 1997, fecal coliform concentrations in East Fork exceeded maximum PCR maximum criterion at all three monitoring sites on two of the five sample dates.

Dissolved oxygen concentrations were notably low, below 5.0 mg/L, on July 28, 1997 at river mile 8.6. This indicates that dissolved oxygen concentrations were extremely low in the headwaters of East Fork at this time. This may have been related to the relatively high levels of fecal coliforms, suspended solids and nutrients (when compared to reference streams) measured at this site during the July sampling dates. Nitrate concentrations did not exceed the legal maximums.

In comparison to similar size high quality reference streams located in the same ecoregion, East Fork exceeded average total suspended solids concentrations (29 mg/L) at river mile 8.6 on July 15 and at all monitoring points on July 28 and August 13. Fecal coliforms exceeded the large river average values (860 per 100 mL water) on the same days that the legal limits were exceeded. Nitrate/nitrite concentrations (2.815 mg/L) were exceeded on July 15, 1997. Phosphorus concentrations were exceeded throughout the creek on July 28 and August 13. Additionally dissolved oxygen minimum numbers were not met throughout the stream on any date except September 4, 2001. Eight of the twelve dissolved oxygen measurements were below the reference stream 75th percentile values.

High concentrations of fecal coliforms and sediments and low concentrations of dissolved oxygen affected East Fork of Paint Creek water quality. Not only did the stream not meet reference stream values for these parameters, but it only partially met warmwater chemical and biological criteria at the river mile 6.5 monitoring site. The Bloomingburg WWTP, agricultural landuse and habitat modification are potential causes of water quality degradation in the East Fork basin.

Please see the East Fork of Paint Creek water quality data tables on the following page for site- specific water quality information.

East Fork Paint Creek Water Quality Data*

Total Suspended solids

River Mile	7/15/1997	7/28/1997	8/13/1997	9/4/1997	9/15/1997	AVG	MAX	Reference
8.6	**43**	**60**	**75**	22	**32**	46.4	75	29
6.5	**30**	**56**	**74**	10	16	37.2	74	29
0.6		**78**	**56**	20	22	44	78	29

Fecal Coliforms

River Mile	7/15/1997	7/28/1997	8/13/1997	9/4/1997	9/15/1997	AVG	MAX	Reference
8.6	680	**4100**	***6000***	480	370	2326	6000	860
6.5	**4400**	**24000**	**4800**	320	240	6752	24000	860
0.6		**4100**	**5000**	330	NA	2357.5	5000	860

Nitrate/nitrite

River Mile	7/15/1997	7/28/1997	8/13/1997	9/4/1997	9/15/1997	AVG	MAX	Reference
8.6	**3.64**	2.46	1.79	2.55	1.91	2.47	3.64	2.815
6.5	**3.88**	2.73	1.22	2.79	2.08	2.54	3.88	2.815
0.6		2.05	0.57	2.22	1.43	1.5675	2.22	2.815

Phosphorus

River Mile	7/15/1997	7/28/1997	8/13/1997	9/4/1997	9/15/1997	AVG	MAX	Reference
8.6	0.1	**0.28**	**0.39**	0.05	0.12	0.188	0.39	0.13
6.5	0.09	**0.29**	**0.34**	0.05	0.05	0.164	0.34	0.13
0.6		**0.18**	**0.19**	0.09	0.11	0.1425	0.19	0.13

Dissolved Oxygen

River Mile	7/15/1997	7/28/1997	8/13/1997	9/4/1997	9/15/1997	AVG	MIN	Reference
8.6	**6.16**	**4.8**	**6.58**	9.29	**5.34**	6.434	4.8	6.95
6.5	**6.35**	**5.5**	7.48	8.67	**6.8**	6.96	5.5	6.95
0.6		**5.5**	7.21	9.12	7.28	7.2775	5.5	6.95

Bolded values are above (or below in the case of dissolved oxygen) associated reference stream 75th percentile concentrations.

Biological Indices

The East Fork of Paint Creek Subwatershed is located in the Eastern Corn Belt Plains (ECBP) Ecoregion.

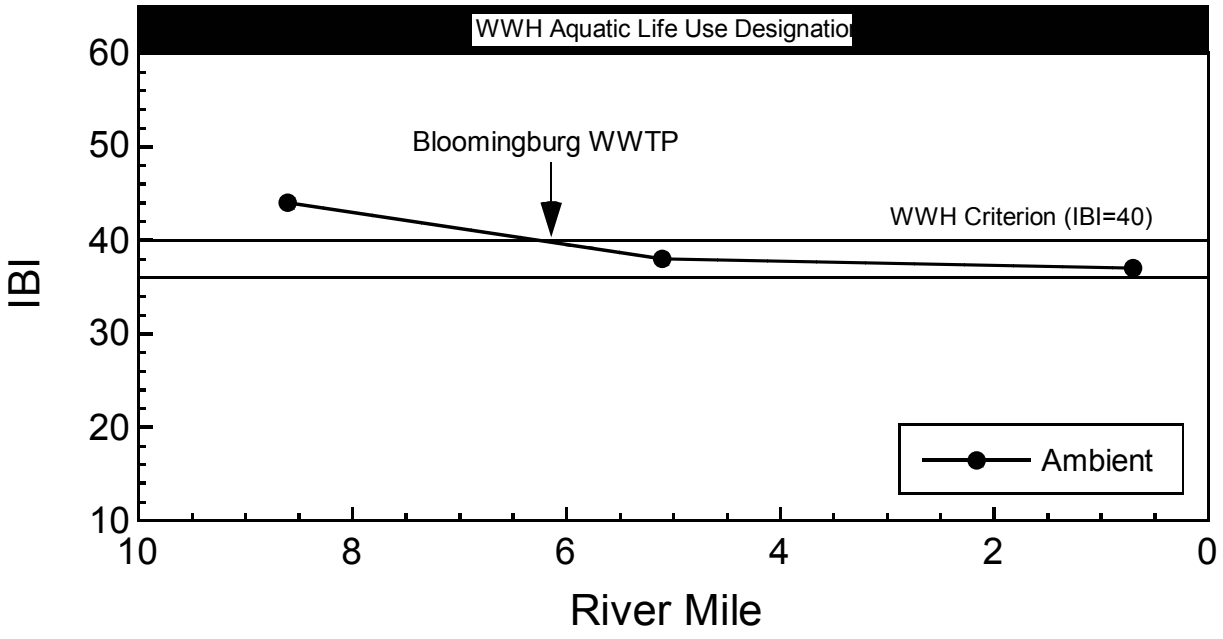
The species composition expected in each of these ecoregions is slightly different, which translates into different numeric biocriteria for each aquatic use designation. Again, the IBI measures fish species diversity and population composition. It accounts for total native populations, indicator species, overall fish condition and pollution intolerant versus pollution tolerant fish species. The MIwb measures similar characteristics of the fish population, however, it subtracts 13 pollution tolerant fish species out of the final score.

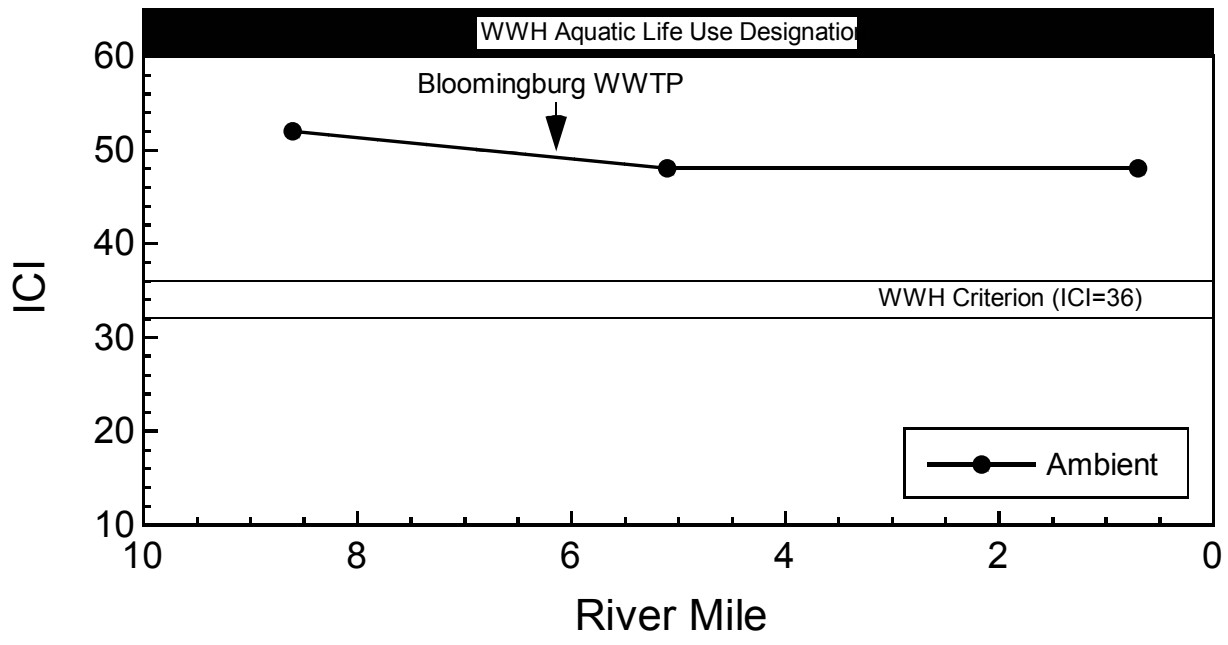
The ICI measures the composition of the invertebrate community and c ompares the numbers of pollution tolerant species with pollution intolerant species. The biocriteria for the ECBP Ecoregion is listed below:

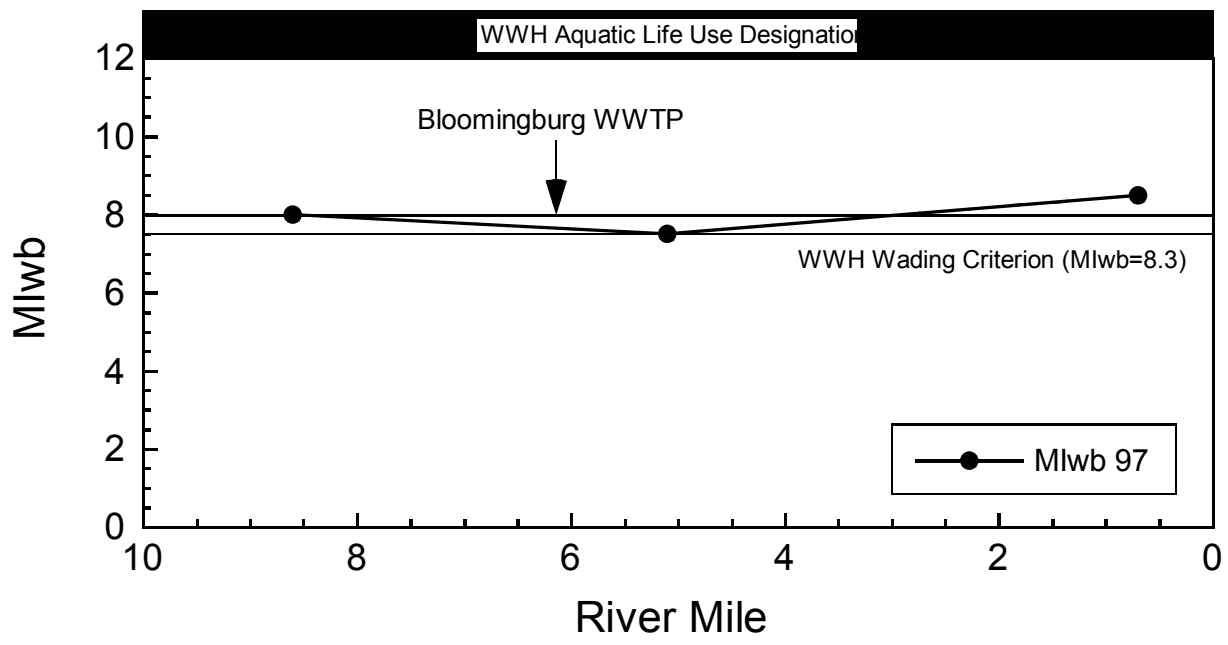
Ecoregion Biocriteria: Eastern Corn Belt Plains (ECBP)
(OAC 3745-1-07, Table 7-14)

Index- Site Type	WWH	EWH
IBI- Boat	42	48
MIwb- Boat	8.5	9.6
ICI	36	46

The biological indices along the East Fork of Paint Creek indicated that the fish scores were marginal while the invertebrate community scores were fairly high. However, all of the scores along the East Fork of Paint Creek met the minimum criteria for WWH.







Qualitative Habitat Evaluation Index (QHEI)

The QHEI is a measure of the presence and quality of physical habitat components that support aquatic life. 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 habitat characteristics that are used to determine the QHEI score include substrate, instream cover, channel morphology, riparian vegetation and bank erosion, gradient, and

flow patterns (pool, run and riffle development). The QHEI score ranges from 20 to less than 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 sites around the state (OEPA, 2002, Bokes TMDL) 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 having the ability to support exceptional warmwater faunas. The QHEI can be used to direct restoration efforts for habitat and to provide a monitoring tool to measure progress toward habitat goals.

The Qualitative Habitat Evaluation Index (QHEI) scores for East Fork indicated that heavy sediment loads, narrow riparian corridors and incidences of channelization contribute to less than optimal habitat along the creek.

Table 9. Qualitative Habitat Evaluation Index for East Fork Paint Creek

River Mile	Location	Score	Comments
8.6			• **Substrate**: heavy silt with moderate embeddedness and silt deposits in channel margins (course substrate retained in riffles and center of channel) • **Instream habitat**: extensive • **Riparian**: very narrow to narrow (<5-10m), intact through reach but nonexistent upstream and downstream, little bank erosion • **Flood plain**: open pasture and row crop
5.1			• **Substrate**: heavy silt and embeddedness, substrate almost entirely fine w/ large silt deposits • **Morphology**: Recent channelization, no riffle development • **Riparian**: very narrow to narrow (<5-10m), moderate bank erosion

Problem Statement

East Fork does not attain its WWH use designation between river mile 5.1 and 0.7. Compared to reference streams in Ohio, East Fork of Paint Creek has high sediments and nutrients, and low dissolved oxygen. Nine of fourteen total suspended solids (TSS) measurements in 1997 were above the 75th percentile value for similar size streams. In addition, fecal coliforms exceeded water quality standards on two of five monitoring days in

1997. Habitat was limited by heavy sediment loads, lack of riparian corridor and channelization. Nonpoint source pollution is attributed largely to activities related to agricultural landuse (95% of landuse in the subwatershed). The biologic indices met but were near the cutoff for warmwater habitat.

Public Support and Participation

The Paint Creek Watershed Project began holding public meetings in January of 1999 with their Watershed Coordination Kick-Off meeting. There were over 60 people in attendance and they came up with a listing of issues and concerns and then they were asked to pick the ones of priority. Those priority issues are seen below in the first listing. The project did not hold structured meetings again until 2002 due to the lack of availability of the Coordinator to hold meetings along with other day to day duties. In mid 1999, the Project wrote and was awarded a Section 319 grant to hire and write a management plan and in January of 2002, Hilary Solomon was hired. That February, both the Plan Coordinator, Hilary Solomon, and the Project Coordinator, Julie Brown, held meetings throughout the watershed having one in each 11-digit area to start gathering support for the project and to find out the issues and concerns. These meetings were held in the evenings in order to attract all possible interest parties and turn out was rather varied with as little as 2 participants in areas where the stream was smaller and on county maintenance to as many as 60 people where there were more urban communities. After these meetings, the citizens were invited to attend the Advisory Council meetings that were held quarterly for a year and a half after where subgroups sat at the table to formulate objectives and goals for the issues and concerns gathered at the local meetings. The final product was the draft Management Plan that was submitted to Ohio EPA in July of 2002. Soon after submitting the plan, Hilary Solomon's resigned her position and with her went the structured planned meetings. Hilary's work on the plan was invaluable and she is sorely missed as the revisions are completed.

Although the watershed is diverse in landscape and landuse, the issues and concerns that came up regularly at our evening meetings were the same across the watershed and very similar to the original list that was created in 1999. Here is a listing of those concerns.

Priority list from January 1999 meeting (in order of priority):

1. Reduce soil erosion
2. Protect riparian corridor
3. Create a community-driven watershed organization
4. Improve overall water quality
5. Protect against urbanization of farmland
6. Promote filter strips
7. Runoff/storm water management from housing developments and urban areas
8. Promote cost effective BMPs

Between February 28 and March 27, 2001, the Project held the 11 community interest meetings. These meetings were held in nine of the ten USGS hydrologic subunits in the

watershed. The meetings were conducted in Bainbridge, Washington Court House, Chillicothe, Frankfort, Sabina, Jeffersonville, Hillsboro, Leesburg and Greenfield. In addition, meetings were held in Chillicothe with the Smallmouth Bass Alliance and the Symposiarts, a group that explores local culture and natural heritage.

The concerns and interest of the local community members were many and varied. The most common topics included stream bank erosion, public access to the creeks (countered with fears about trespassing), modifying dam releases from Paint Creek Lake and Rocky Fork to mimic natural stream flow patterns, litter control/illegal dumping, and map availability for local interest groups. Some of the most passionate discourse related to fish tissue consumption warnings, confined animal feeding units, wastewater treatment plant installations and management, riparian corridor restoration, and promoting environmental education in schools. A full list of community concerns and suggestions can be found below. Topics in bold were frequent concerns.

The Local Community Concerns were as follows:

Historic/special site preservation
Maps for local interest groups
Farmland/environmental compatibility
Water quality monitoring/maintenance
Confined animal feeding operations
Wastewater treatment plants and failing home septic systems
Litter/illegal dumping
Roadkill
Adopt-a-highway
Loss of farmland
BMP education and enforcement
Lack of zoning
Land use planning
Natural dam releases
Student environmental education
Animal control (beavers and geese)
Land stewardship education for landowners
Community participation
Public access to the creeks
Sediment control/contamination
Logging Practices
Riparian corridor
Stream bank erosion
Log jams
Recreation
Exotic species

The Watershed project again came to the table in the first week of February, 2004 to discuss these issues again but in a much smaller watershed. They looked at the water quality problems and formulated solutions. A listing of the issues discussed follows and this loist will be what helps us formulate the load reductions and BMP's that we hope to see in this watershed in the future.

Meeting to Discuss the Water Quality Issues in Paint Creek Watershed Main Stem

Attendance:
Ron Carter, ODNR-DOW, Pheasants Forever
Vince Chrisman, Fayette SWCD
Heidi Devine, ODNR-DOW
Lee Crocker, ODNR-DOW
Rob Hamilton, ODNR-DSWC
Ron Rockhold, Fayette County Landowner
Gordon Conn, Fayette County Landowner
Ed Bailey, Pickaway County Ag. Dealer
Wayne Hidy, Fayette County Landowner
Jay McElroy, Fayette NRCS
Eric Imerman, OSU Extension, Madison Co.
David Sever, Sever Consulting
Mike Greenlee, ODNR-DOW
Jerry Iles, OSU Extension
Jim McClure, Fayette County Landowner
Julie Cumming, Madison SWCD
Others not able to be in attendance but gave input:
Geoff Mavis, Fayette County Landowner
Rick Garrison, Fayette County Health Department

Statistics provided to Working Group:
11 Digit Watershed: 05060003 010
11 Digit Watershed Name: Paint Creek (hedwaters to the East Fork of Paint Creek)
14 Digit Watershed(s) and Name(s):
05060003 010 010 Paint Creek to upstream Sugar Creek
05060003 010 020 East Fork of Paint Creek
Sources of Water Quality Impairment: Nutrients, siltation, habitat alteration
Causes of Water Quality Impairment: Crop production, urban runoff/storm sewers, channelization

Forested Buffer Along Streams 05060003 010:
Acreage Within 50 foot of Stream on either side: 3958 acres
Forested Acreage within 50 feet of stream: 569 acres
Percent forested coverage within 50 ft: 14.37%

Forested Buffer Along Streams 05060003 010 010:
Acreage Within 50 foot of Stream on either side: 2314 acres
Forested Acreage within 50 feet of stream: 446 acres
Percent forested coverage within 50 ft: 19%

Forested Buffer Along Streams 05060003 010 020:
Acreage Within 50 foot of Stream on either side: 1638 acres
Forested Acreage within 50 feet of stream: 120 acres
Percent forested coverage within 50 ft: 7%

Background: The section of Main Paint Creek from the Headwaters to below East Fork Creek is currently not meeting its use designation or partially meeting its use designation throughout the watershed due to nutrients, siltation and other habitat alterations. Exact locations of impairment are as follows:

RIVER MILE	STREAM	LOCATION	ECO-REGION	SIZE	HABITAT	PRIORITY	ATTAINMENT
0.70	East Fork Paint Creek	Washington Ave.	ECBP	W	WWH	Low	Full
5.10	East Fork Paint Creek	Mathews Rd. Dst Bloomingburg W	ECBP	W	WWH	Medium	Partial
8.60	East Fork Paint Creek	Lewis Rd. Ust. Bloomingburg WW	ECBP	W	WWH	Low	Full

RIVER MILE	STREAM	LOCATION	ECO-REGION	W/S SIZE*	HABITAT	PRIORITY	ATTAINMENT
96.00	Paint Creek	Charles Chillicothe Rd.	ECBP	HW	WWH	Low	Full
88.60	Paint Creek	Hidy Rd. adj Hidy Cemetary	ECBP	HW	WWH	Medium	Partial
79.90	Paint Creek	adj. Wildwood Rd	ECBP	W	WWH	Medium	Partial
75.30	Paint Creek	Eber Bloomongburg Rd.	ECBP	W	WWH	Medium	Partial
70.90	Paint Creek	downstream from Perry Park	ECBP	W	WWH	Low	Full
69.70	Paint Creek	Ust Bypass, highly modified re	ECBP	W	WWH	Medium	Partial
67.50	Paint Creek	Dst. WCH WWTP Ust. Old SR 35	ECBP	W	WWH		
69.40	Paint Creek	WCH WWTP mixing zone	ECBP	W	WWH	Low	Full
67.30	Paint Creek	Dst. WCH WWTP, Dst. Old 35	ECBP	W	EWH	Medium	Partial

Problem statement: Excessive nutrients, siltation and habitat alteration in the upper section of the Main Paint Creek watershed are causing impairment of the use designation. Through field inventory, the source of the erosion is believed to be from over land runoff and streambank erosion. The source of the nutrients and organic enrichment are believed to be widespread row crop agriculture, livestock, failing septic systems (livestock and septic discussed later) and habitat alterations predominantly channelization. More precise locations of eroding banks are not yet confirmed. The total sediment load is 32,821 tons/year with a total nutrient load of 206,255 lb/year per the STEPL program.

The task descriptions below were formulated using recommendations from experts at the local Soil and Water Conservation Districts, Health Departments, Ohio Department of Natural Resources, Division of Forestry, Division of Wildlife, and Division of Soil and Water Conservation, along with the Natural Resource Conservation Service and the Ohio Environmental Protection Agency.

Loading reductions calculated using Load Reduction Spreadsheet v1.2.

Goals:

1. Reduce nutrient load and organic enrichment by 30% from agricultural fields.
2. Reduce sedimentation by 50% from habitat alterations

Task Description	Resources	How	Time Frame	Performance Indicators
Establish conservation tillage on 5000 acres. The first priority being highly erodable	$125,000	Local watershed group will	January 2006-January 2011	Document soil and nutrients saved/not

land within 1000 feet of the stream. It is estimated that this will reduce the nutrient load 30662 lb/year and the sediment load by 8209 tons/year		apply for 319 grant.		delivered to stream using RUSLE or other model, Improved QHEI scores
Control erosion and nutrient runoff with the installation of 21,000 linear feet of grassed waterways and water and sediment control basins. It is estimated that this will reduce the nutrient load by 27,000 lb/year and the sediment load by 7000 tons/year	$150,000	CRP, EQIP, Local watershed group will apply for 319 grant program	January 2006-January 2011	Document soil and nutrients saved/not delivered to stream using RUSLE or other model, improved QHEI scores
Establish a total of 1410 acres within 50 feet of the stream of riparian corridor, natural regeneration and/or warm season grasses along the impaired segments. It is estimated that this will reduce the nutrient load 7947lb/year and the sediment load by 5640 tons/year	$4,000,000 for an incentive program	CREP, CRP, EQIP, WHIP, FLEP, DOW free seed and Pastures to Prairies Program, Pheasants Forever, National Wild Turkey Federation, Paint Creek Watershed Project 319 program	January 2005 to January 2020	Document soil saved/not delivered to stream using RUSLE or other model, improved QHEI scores

Headwaters of Paint Creek in Madison County

Downstream view with tree planting through USDA incentive program

Problem statement: Excessive nutrients in the upper section of Paint Creek watershed are causing impairment of the use designation. After discussions with the SWCD and local Health Dept. it is accepted that approximately 15% of the on-site septic systems in this area are failing which is approximately 147 homes. There are also other septic issues with several treated wastewater outfalls . More precise locations of failing systems are not yet confirmed. The total nutrient load for this watershed is 206,255 lb/year. The estimated nutrient load from these 147 homes is 22.05 lbs/day of nitrogen and 14.7 lbs/day of phosphorus.

The task descriptions below were formulated using recommendations from experts at the local Soil and Water Conservation Districts, Health Departments, Ohio Department of Natural Resources, Division of Forestry, Division of Wildlife, and Division of Soil and Water Conservation, along with the Natural Resource Conservation Service and the Ohio Environmental Protection Agency.

Goals:

1. Reduce nutrient load and organic enrichment from failing on-site home septic systems by repairing all failing systems.

Task Description	Resources	How	Time Frame	Performance Indicators
Work with county Health Departments to determine more accurate number of failing systems	HD Inspectors time to inspect all systems	Inspect all systems	January 2004-January 2005	Report of failing systems generated
Replace/upgrade failing systems	Health Dept. time to write plan	Apply to DEFA for low interest on-site loan program for county	October 2002-December 2004	DEFA program available in county,
Search for funding options to upgrade failing systems	Watershed Coordinator and/or Health Dept. time to write 319 grant application	Local watershed group or Health Dept. will apply for grant funding	January 2006	Grant Submitted
Replace/upgrade all failing systems	County sanitarians time to approve applications and inspect	Local watershed group or Health Dept. will apply for grant funding	January 2006-December 2011	All failing systems replaced or upgraded

Loading reductions calculated using Load Reduction Spreadsheet v1.2.

Problem statement: Excessive nutrients, organic enrichment and habitat alteration in the upper section of the Paint Creek watershed are causing impairment of the use designation. Through field inventory, the source of some of the nutrients and organic enrichment are believed to be livestock and their access to the stream. According to the county SWCD's, there are approximately 1500 hogs, 900 sheep, 210 horses, 675 cattle and 3199 dairy cattle in the watershed. The total nutrient load for the watershed is 229,654 lb/year. While this is not a large number of livestock, there are problems with their proximity to the stream which are causing slumping banks, sedimentation and nutrient enrichment.

The task descriptions below were formulated using recommendations from experts at the local Soil and Water Conservation Districts, Health Departments, Ohio Department of Natural Resources, Division of Forestry, Division of Wildlife, and Division of Soil and Water Conservation, along with the Natural Resource Conservation Service and the Ohio Environmental Protection Agency.

Goal:

1. Stabilize 3000 feet of eroding banks by excluding livestock.
2. Reduce nutrients entering the stream from livestock feeding and watering

Task Description	Resources	How	Time Frame	Performance Indicators
Establish a livestock nutrient reduction program with a combination of heavy use feeding pads, exclusion fencing, and alternate watering sources.	75,000 for an incentive program	CREP, CRP, EQIP, Paint Creek Watershed Project 319 program	January 2006 to January 2009	Document decreased nutrient and sediment load using estimated load reduction spreadsheet.

Loading reductions calculated using Load Reduction Spreadsheet v1.2.

Problem statement: Excessive nutrients, organic enrichment and habitat alteration in the upper section of the Rattlesnake Creek watershed are causing impairment of the use designation. Education programs and personnel are needed to educate the community and provide an awareness of the issues, both agricultural and urban, and to deal with concerns. Pursue recreational alternatives to encourage use of the natural resource. Pursue recreational alternatives to encourage use of the natural resource.

The task descriptions below were formulated using recommendations from experts at the local Soil and Water Conservation Districts, Health Departments, Ohio Department of Natural Resources, Division of Forestry, Division of Wildlife, and Division of Soil and Water Conservation, along with the Natural Resource Conservation Service and the Ohio Environmental Protection Agency.

Goals:

1. Reduce nutrient load, organic enrichment, and sedimentation through education and awareness programs

Task Description	Resources	How	Time Frame	Performance Indicators
Work with local stakeholders to create an awareness of the watershed issues and concerns and available programs. Use GIS to formulate watershed mailing lists to keep landowners aware of programs.	Maintain a watershed coordinator	Local watershed group will search for other funding source	On going	Watershed Coordinator is hired/continues employment.
Work with developers, builders and government agencies to ensure county urban erosion control guidelines are followed.	Add an urban streams conservationist to the watershed project	Local watershed group will search for other funding source	January 2008	Urban Streams Conservationist is hired.
Provide increased public access to the stream for recreational use.	Funding needs unknown at current time	Local recreation entities will look into water based recreation grant opportunities with the Div. of Watercraft.	January 2008	Recreational access increased for public use.

Evaluation Strategy and Plan Update/Revision:

The Paint Creek Management Plan is anticipated to be a living and working document that does not end up on a shelf collecting dust. In order to accomplish this, evaluation and updating will be key components for the future.

Since the formulation of the Management Plan relied heavily on stakeholder input, their evaluation of the plan will be crucial to its future. The Project would like to implement a yearly progress meeting to discuss the original goals of the plan and to determine the status of these goals and the need for additional response or update. The success of some measures such the BMP's will be measured on a basis of application and implementation in the watershed. This information will be provided by the local Soil and Water Conservation Districts, Natural Resource Conservation Service and the County Health Departments. A measure of success for the education aspect of the plan will be the number of programs provided and the attendance of the community. It is anticipated that as awareness of the watershed increases that the interest in monitoring local streams will increase and that this data will also be used to evaluate and monitor the success of the plan at improving the water quality.

The ultimate responses that the Project hopes will come out of this planning process is:

- Increased awareness in the community of the Paint Creek Watershed and
- Water quality in the watershed meeting use designations with QHEI scores consistently improving.

This watershed is slated to be sampled by the Ohio EPA Ecological Assessment Unit in 2006 with a TMDL completion date of 2008. Paint Creek received it's first intensive sampling effort in 1997 so the project will also be able to look for any changes from one sampling period to the next and compare that with the work the Project that has already completed.

The progress of the plan will be made available to interested local and state governments as well as all watershed citizens through newsletters, brochures, news articles, radio programs and at some point a web site. These duties will be the responsibility of the Watershed Coordinator and the Paint Creek Joint Board of Supervisors along with the Sub-watershed Work Groups.

It is anticipated that as a working document, the plan will be revised yearly after the progress meetings have determined the successes and failures.

The Paint Creek Watershed Project is pleases to have had the involvement of the following people and organizations in the completion of this community based watershed action plan.

Name	Association	City
Agriculture Subgroup		
Hugh Trimble	Ohio EPA	Dayton
Gordon Conn	Farmer	Jeffersonville
Dave Parry	NRCS	Hillsboro
Vince Chrisman	Fayette SWCD	Washington CH
Dave Sever	Sever Consulting	Washington CH
Eric Rutherford	Landowner	Wilmington
David Caplinger	Landowner, SOFA	Hillsboro
Rosida Porter	Ohio DNR	Columbus
Forestry Subgroup		
Heidi Devine	Ohio DNR, Div of Wildlife	Xenia
Lee Crocker	Ohio DNR, Div of Forestry	Waverly
Mike Besonen	MeadWestvaco	Chillicothe
Chris Smid	MeadWestvaco	Chillicothe
Randy Sanders	Ohio DNR	Columbus
Joey Knauff	Knauff Lumber/ Master Loggers	Bainbridge
Education Subgroup		
Sam Webb	Pickaway SWCD	Circleville
Jenny Behymer	Landowner	Hillsboro
Layne Garringer	Fayette SWCD	Washington CH
Steve Hawkins	Ohio DNR/DSWC	Circleville
Jerry Iles	OSU Extension	Jackson
Urban Subgroup		
Julia Cummings	Madison SWCD	London
Steve Sobers	City Manager	Washington CH
Streamside Management Subgroup		
Dot Riley	NRCS	Grove City
Gordon Conn	Farmer	Jeffersonville
Gary Merkamp	Ross County Park District	Chillicothe
Randy Hoover, Kipp Brown	Ohio DNR, Div of Wildlife	Xenia
Bob Jones	Landowner, former Army COE	Bainbridge
Dan Imhoff	Ohio EPA	Logan
Marty Lundquist	Ohio DNR, Div of Wildlife	Columbus
Paula Wentzel	MeadWestvaco	Chillicothe

Watershed Action Plan for the Upper Half of Rattlesnake Creek

Hydrologic Unit Numbers:

05060003 030 010 Rattlesnake Creek Above West Branch

05060003 030 020 West Branch

05060003 030 030 Wilson Creek

05060003 030 040 Grassy Branch Creek

05060003 030 050 Rattlesnake Creek from West branch to Lees Creek

Written and Compiled by:
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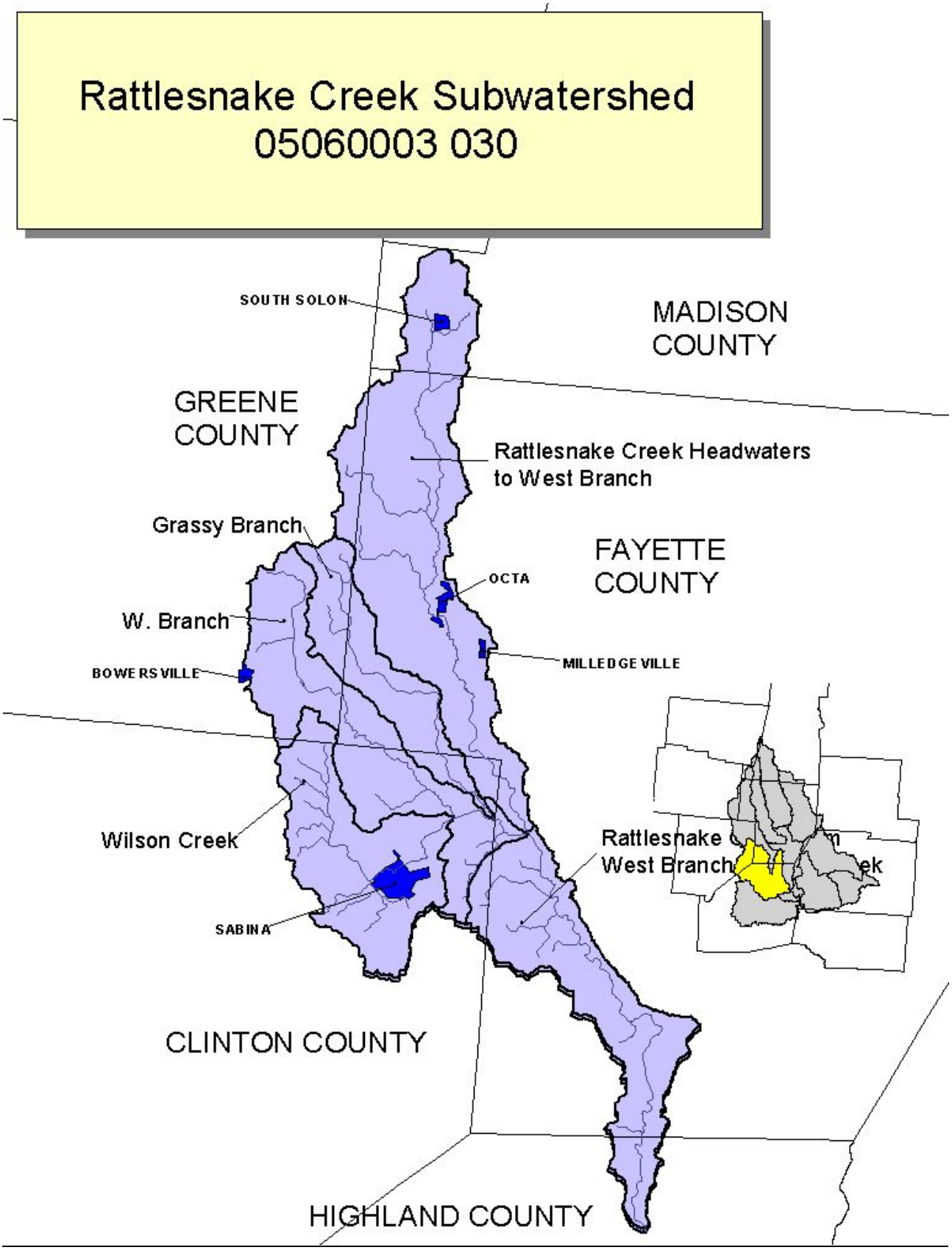
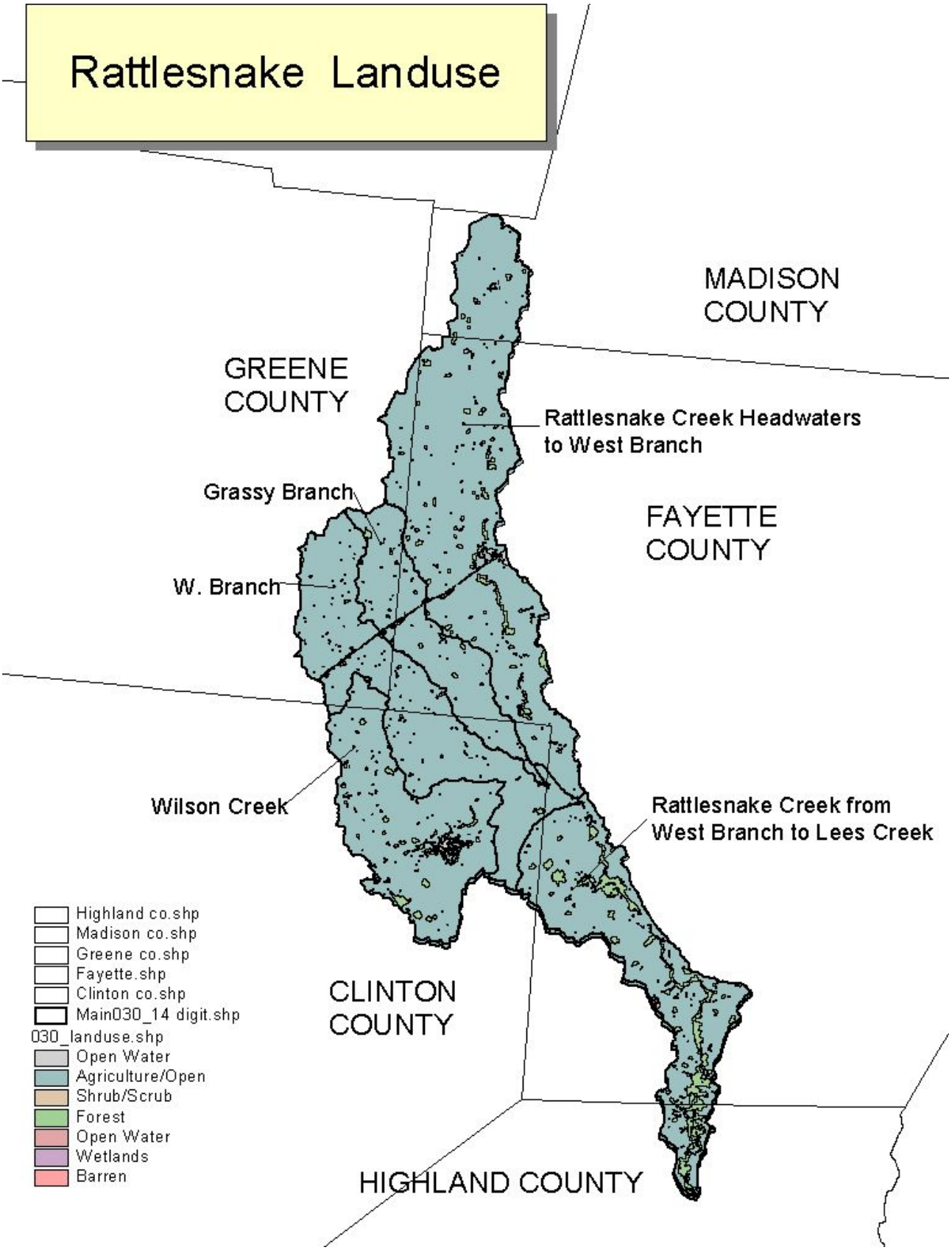

Rattlesnake Creek Subwatershed
05060003 030
SOUTH SOLON
MADISON COUNTY
GREENE COUNTY
Rattlesnake Creek Headwaters to West Branch
Grassy Branch
FAYETTE COUNTY
OCTA
W. Branch
MILLEDGEVILLE
BOWERSVILLE
Wilson Creek
SABINA
CLINTON COUNTY
HIGHLAND COUNTY


Rattlesnake Landuse
MADISON COUNTY
GREENE COUNTY
Rattlesnake Creek Headwaters to West Branch
Grassy Branch
FAYETTE COUNTY
W. Branch
Wilson Creek
Rattlesnake Creek from West Branch to Lees Creek
Highland co.shp
Madison co.shp
Greene co.shp
Fayette.shp
Clinton co.shp
Main030_14 digit.shp
030_landuse.shp
Open Water
Agriculture/Open
Shrub/Scrub
Forest
Open Water
Wetlands
Barren
CLINTON COUNTY
HIGHLAND COUNTY

INTRODUCTION

The Paint Creek Watershed Management Plan stems from an ongoing conservation ethic within the Paint Creek Watershed. Conservation practices were explored in the watershed as early as the 1960's. Public awareness and interest in maintaining and/or improving water quality in the watershed has increasingly mounted since those early studies. Land managers within the watershed are currently pursuing several conservation grants and the watershed project is distributing Clean Water Act, section 319 grant monies to fund projects in targeted areas. The management plan will provide information to ensure that future conservation efforts within the watershed are applied in the most efficient and beneficial manner.

As far as practicable, the Paint Creek Watershed Management plan follows the outline contained in Ohio EPA's *Guide to Developing Local Watershed Action Plans in Ohio* (June 1997). The plan contains four main sections: the background and scope of the project, a comprehensive watershed inventory, a watershed-wide water quality assessment with documentation of the related problems, and an outline of planned implementation activities or solutions. This last section includes a timeline and methods to evaluate the effectiveness of the activities implemented within the watershed.

The Watershed Project was originally formed in 1998 when 6 coordinating Soil and Water Conservation Districts received Section 319 funds for implementation. It was always the plan that A watershed Coordinator would administer the grants and also work on putting together a management plan for the watershed. The Project is governed by a Joint Board of Supervisors, one from each of the 6 main county SWCD's, that follow the operational procedures of a District SWCD. The Joint Board also put together bylaws that are available from the Watershed Coordinator. This Board makes all decisions based on funding and application approval for the implementation program but decisions about the contents of the plan have been left completely up to the stakeholders involved in the development process. The stakeholder groups have been open to the public and new attendees are welcome at any time.

General Description and Political Boundaries

The Paint Creek Watershed is comprised of 731,168.9 acres located in 9 counties: Madison, Greene, Clinton, Clark, Pickaway, Fayette, Pike, Ross, and Highland.

The Main Paint Creek Subwatershed is located in south central Ohio and covers 310,585 acres. It originates in Madison County and encompasses much of Fayette County and the eastern edge of Highland and western edge of Ross County. Main Paint Creek meets the Scioto River south of Chillicothe in Ross County. The flood plain of Paint Creek varies in width from a few feet at its source to more than 1.5 miles at its mouth. The stream fall from source to mouth is 555 feet, an average of 5.7 feet per mile. The fall in the lowermost 50 miles is about 265 feet or 5.3 feet per mile (Corps, 1973). At the confluence of Paint Creek and Rattlesnake Creek is the Paint Creek Lake. The lake was built by the Army Corps of Engineers for flood control, but also serves recreational purposes.

Background/reasons for implementing a management plan

The following were presented to the advisory group and community as reasons for writing and implementing a comprehensive management plan for Paint Creek Watershed.

Size/diversity of the watershed

Paint Creek Watershed covers over 731,000 acres and crosses multiple political boundaries. Additionally, the watershed may be divided into multiple subwatershed units each of which forms an independent drainage unit within the larger watershed. Depending on the topography of the area these units may be subdivided many times and each subwatershed will have slightly different chemical, physical and biological properties. In addition, many people reside in the watershed and activities such as agriculture, forestry, urban development, recreation, commerce and industry continue to grow and change.

Total Maximum Daily Loads (TMDLs). The advent of increasingly stringent enforcement of the Clean Water Act, is reflected in the introduction of TMDLs across the country. Ohio EPA recently began implementing their TMDL program and the Paint Creek Watershed is scheduled for evaluation in 2012-2013. The TMDL program establishes daily limits for a variety of pollutants, including sediment and nutrients, discharged to streams that do not meet water quality standards outlined in the Clean Water Act. This program currently only affects point source discharges though forestry, agriculture and development may be affected in the future.

Soil erosion. Soil erosion is one of the biggest problems in the watershed and the focus of most of the conservation practices implemented by both landowners and the Army Corps of Engineers. Most of the soil in South Central Ohio is depositional till resulting from the glacial activities. This soil is prone to erosion and there is erosion and erosion-related water quality problems throughout the watershed.

Water quality. In 1997, Ohio EPA surveyed much of the watershed to measure the chemical and biological properties of the waters. The 2000 305(b) report lists the Upper Paint Creek Watershed (North Fork and Rocky Fork) as meeting water quality standards in 35.5 percent of the watershed. Lower Paint Creek Watershed (Main Paint and Rattlesnake) met water quality standards in 75.6 percent of the watershed. In order to establish baseline water quality information and to measure the success of our water quality solutions, we may need to implement an additional sampling program.

Species diversity. The Paint Creek Watershed contains a rich array of plant and animal species. For example, a study completed in 1999 through Ohio State University found 104 species of fish inhabiting the Paint Creek Watershed. Some of the plant and animal species in the watershed include endangered, threatened, rare, intolerant, or species of special interest. The Ohio Department of Natural Resources' Heritage database lists 52 species of interest or concern in the watershed. These include 10 endangered species and 11 threatened species.

Invasive species. Invasive species are plants and animals that are not native to the area. Usually introduced by human activities, these species may have no natural biological controls. They may invade parts of the watershed and crowd out naturally occurring species. Examples of invasive species found in the watershed include, garlic mustard, phragmites reed grass, and Japanese honeysuckle.

319 grants. Conservation practices funded through the Clean Water Act, section 319 grant program have been implemented throughout the watershed. One of the main purposes of the management plan is to look at information on soil erosion, water quality, and species diversity and concentrate conservation practices in the most sensitive areas of the watershed.

Local Conservation History

Agriculture is the main practice in the watershed and erosion has been the historic conservation concern. Land management and conservation studies began in the Paint Creek area in the early 1960's. Congress authorized a study of the Scioto River Basin, which led to the construction of the Paint Creek Lake in 1967 (Garringer). The lake is primarily for flood control, but the lands surrounding the lake provide wildlife habitat and recreational opportunities.

After heavy flooding in 1959 and 1960, the soil and water conservation districts in the Rattlesnake Creek watershed initiated the planning process to implement a project for flood control and land treatment. The initiative was eventually de-authorized but land managers recognized a need for local conservation practices.

In 1994, after continuous siltation problems in Paint Creek Lake, planning began for a new "Paint Creek Initiative" that would use Clean Water Act, section 319 grant monies to help introduce conservation projects throughout the watershed. This movement was inspired by activities taking place in the Darby Creek watershed which is partially located in Madison County. In 1995, a proposal was submitted to Ohio EPA requesting $300,000 to partially fund a land treatment program for the entire Paint Creek watershed (Garringer).

The proposal was originally rejected, but the soil and water conservation districts (SWCDs) in Fayette, Highland and Ross Counties worked closely with Ohio EPA to come up with a proposal that would be accepted. The new proposal included dividing the watershed into four management units based on the Main Paint, North Fork, Rattlesnake, and Rocky Fork Subwatersheds. In 1996, the SWCDs applied for and received 319 grant monies for the North Fork of Paint Creek Subwatershed. These monies were received in 1997, the same year that the SWCDs applied for and received 319 grants for Main Paint and Rattlesnake subwatersheds.

In December 1997, representatives from Fayette, Highland, Ross, Madison, Clinton and Greene counties met and formed a joint board of supervisors to oversee the spending of funds from the grant. In 1998, Julie Brown was hired by the joint board to act as watershed coordinator for the entire Paint Creek watershed. Julie meets with the joint board once every month.

The cost-share practices funded through the 319 grants largely focus on reducing erosion in the watershed. The first round of grants included grass waterways, equipment buy-downs, soil

testing, lime applications, livestock exclusion fencing, streambank stabilization, heavy use feeding pads, tree and grass filter strips, deep tillage tool rental (North Fork only), manure management systems (North Fork only), and alternate watering sources (North Fork only). The 319 grant applications were given a score based on the proximity of the site to a stream, the size of stream, and the erodability index of the soil. Through this process land managers tried to implement conservation practices in areas of the watershed that were contributing the greatest amount of erosion.

The 319 grants discussed above were three year grants and ended in June of 2001. The project reapplied and was awarded money for all three subwatersheds. Currently all of Paint Creek Watershed has 319 conservation grant money.

In January of 2000, Julie formed an advisory committee to help provide guidance with the watershed project. This group meets quarterly and discusses management issues pertaining to the management plan. These meetings often feature guest speakers who have conducted studies within the watershed. In 2000, the project wrote and was awarded an additional 319 planning grant to help fund a part-time position for a management plan coordinator. Hilary Solomon was hired in January of 2001 to help write the management plan for the Paint Creek Watershed.

In 2000, Julie was also awarded a grant, the aim of which was “getting GIS into the hands of the conservationist.” She worked closely with the consulting firm Malcolm Pirnie to acquire spatial data that could be used to make maps describing the area. Through this project, an extensive catalogue of data was acquired, which will be useful in the future water shed planning.

Addendum to the Paint Creek Watershed Management Plan

This additional section of the management plan tries to include information specific to the lower half of Rattlesnake Creek. For watershed wide information including wildlife and soils, please see the draft copy of the Paint Creek Management Plan.

The Upper Half of Rattlesnake Creek

The Paint Creek Watershed has already put together an extensive management plan that was submitted for review from the Ohio EPA in July of 2002. The original plan gave information on a larger scale, splitting the watershed into 4 sections: Main Paint, Rattlesnake, North Fork and Rocky Fork Creeks. The Ohio EPA's suggestion after reviewing the document was to return with more detail. The project than choose their 3 priority areas and the upper section of Rattlesnake Creek was picked as one of these areas.

This section of Rattlesnake Creek includes the upper section, which includes sections of Fayette, Madison, Greene, Clinton and Highland Counties. This section includes the cities of Sabina, Octa, Milledgeville, South Solon, East Monroe and a small part of Bowersville.

Table 1

Watershed Name	Hydrologic Unit #	Counties	Drainage Area (acres)	Stream Miles
Paint Creek	05060003	Ross, Highland, Fayette, Greene, Clinton, Madison, Clark, Pickaway, Pike	731,161.9	1572.53 (total)
Rattlesnake Creek Headwaters to Lees Creek	05060003 030	Clinton, Fayette, Greene, Madison, Highland	82660.1	121.5
Rattlesnake Creek above West Branch	05060003 030 010	Clinton, Fayette, Greene, Madison	28106.57	32.6
West Branch	05060003 030 020	Clinton, Greene, Fayette	15683.5	23
Wilson Creek	05060003 030 030	Clinton, Greene,	13787.2	23.2
Grassy Branch	05060003 030 040	Clinton, Fayette, Greene,	8454.0	14.8
Rattlesnake below W. Branch to Lees Creek	05060003 030 050	Clinton, Fayette, Highland	15602.6	27.9

Please see map #1

Land Use

While the Paint Creek Watershed is a diverse watershed from the flat upper watershed to the rolling lower sections, the land uses in this smaller section are predominantly agriculturally based with a larger amount of forested acreage as compared with the upper part of North Fork. The following table shows the land uses for the 8, 11 and 14 digit watersheds.

Table 2

Watershed Name	Hydrologic	Land use Type	Percent of	Acreage

	Unit #		Whole	
Paint Creek	05060003	Urban	.88	6466.3
		Agriculture/Urban	76.89	562190.3
		Shrub/Scrub	2.22	16210.1
		Wooded	19.14	139931.6
		Open Water	.53	3871.5
		Non Forested Wetlands	.32	2308.2
		Barren	.03	183.9
Rattlesnake Creek (Headwaters to Lees Creek)	05060003-030	Urban	.64	527.4
		Agriculture/Urban	94.37	78286.4
		Shrub/Scrub	.15	123.4
		Wooded	4.32	3585.6
		Open Water	.13	104.2
		Non Forested Wetlands	.36	295
		Barren	.05	37.8
Rattlesnake Creek above West Branch	05060003-030-010	Urban	.58	160.9
		Agriculture/Urban	96.02	26866.7
		Shrub/Scrub	.17	47.7
		Wooded	3.11	869.3
		Open Water	.02	41.5
		Non Forested Wetlands	.11	116.8
		Barren	.00	.771
West Branch	05060003-030-020	Urban	.4	63.3
		Agriculture/Urban	98.41	15430
		Shrub/Scrub	.10	15.6
		Wooded	.58	90.5
		Open Water	.10	15.6
		Non Forested Wetlands	.41	63.6
		Barren	0	0
Wilson Creek	05060003-030-030	Urban	1.7	234.3
		Agriculture/Urban	94.79	13062.8
		Shrub/Scrub	.14	18.9

		Wooded	3.21	442.7
		Open Water	.03	4.6
		Non Forested Wetlands	.09	12.2
		Barren	.04	5
Grassy Branch	05060003-030-040	Urban	.46	38.6
		Agriculture/Urban	97.51	8243.4
		Shrub/Scrub	.07	5.88
		Wooded	1.22	103.2
		Open Water	.25	21.3
		Non Forested Wetlands	.49	41.2
		Barren	0	0
Rattlesnake Creek below W. Branch to above Lees Creek	05060003-030-050	Urban	.18	28.3
		Agriculture/Urban	85.88	13399.4
		Shrub/Scrub	.22	34.1
		Wooded	13.5	2035.8
		Open Water	.13	20.8
		Non Forested Wetlands	.36	56.3
		Barren	.18	27.663

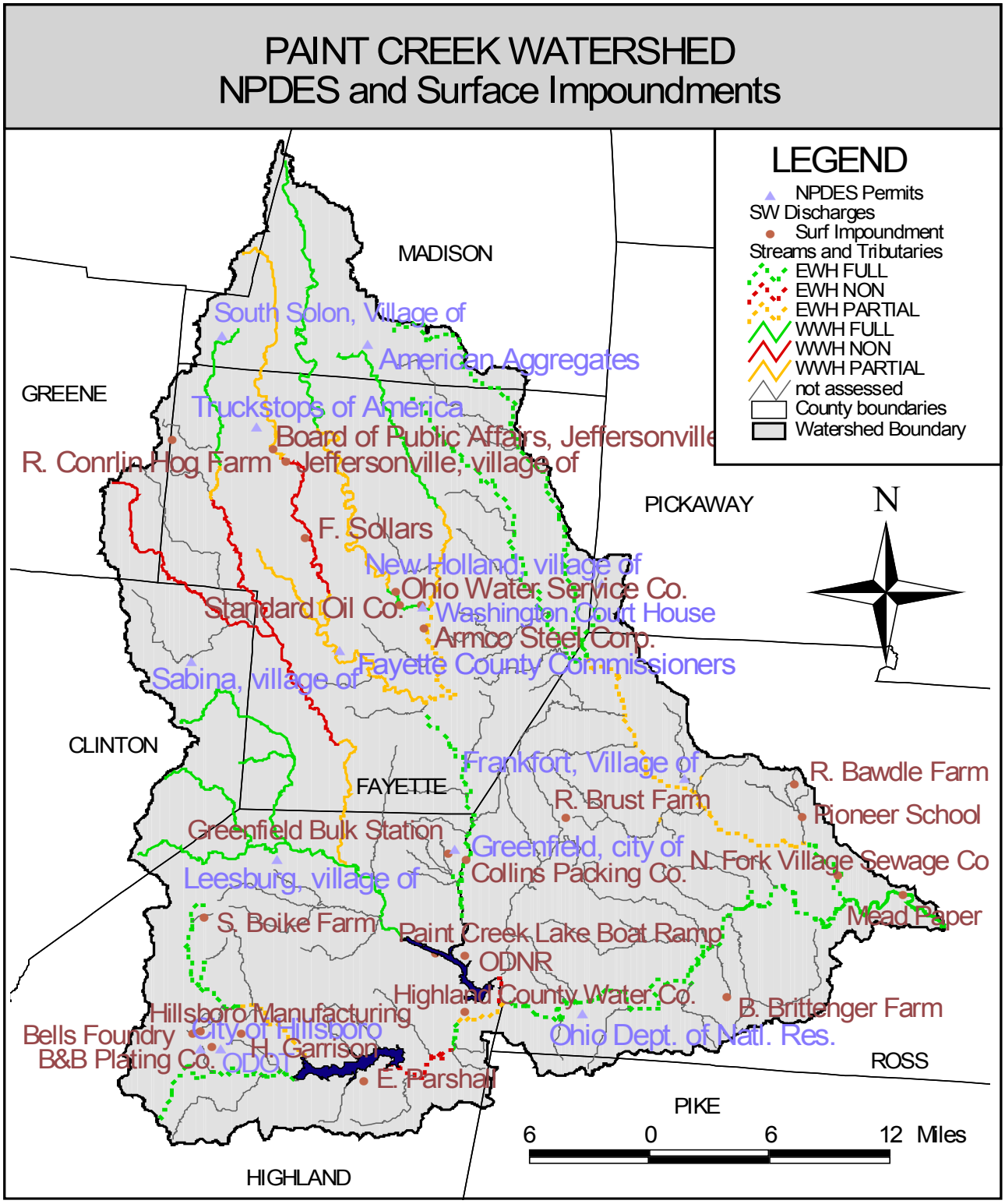
Please see map #2

Water Quality Issues in the Paint Creek Watershed

While it is assumed the bulk of the pollution problems in this section are from non-point source pollution, we will also cover the potential sources of point sources based on the National Pollutant Discharge Elimination Systems permits, Presence of combines sewer overflows, surface impoundments and data from fish kills.

Table 3-3: NPDES permits in Paint Creek Watershed.

TYPE	ID_NUMBER	NAME	SIC_CODE	DESCRIPTION	LOCATION
NPDES	OH0001664903	Sabina, village of	4952	sewerage systems	
NPDES	000010179498	South Solon, village of	4952	sewerage systems	



Prepared for the Paint Creek Project by Hilary Solomon, October 2001

The Fayette County Commissioners operate the Rattlesnake Sewer District WWTP #1. The plant receives waste from a variety of sources including restaurants, truck stops and a truck washing operation. The plant is designed to treat 0.18 MGD and discharges to Rattlesnake Creek. Flows from the plant have been steadily increasing since 1992 and the 95th percentile flow exceeded the design capacity for the first time in 1997. High loads of CBOD, suspended solids and ammonia from commercial operations are exceeding treatment capacity. Permit revisions in 1998-1999 to expand the plant to 0.25 MGD treatment capacity have hopefully helped some of these issues.

Combined Sewer Overflows and Sanitary Sewer Overflows

Combined sewers are built to collect sanitary and industrial wastewater as well as storm water runoff and transport this combined wastewater to treatment facilities. When it rains, the volume of storm water and wastewater may exceed the capacity of the combined sewers or of the treatment plant, and a portion of the combined wastewater may be allowed to overflow untreated into the nearest ditch, stream, river or lake. This is a combined sewer overflow, or CSO. Ohio has about 1,600 known CSOs in 102 communities, ranging from small, rural villages to large metropolitan areas.

According to Sheree Gossett-Johnson, a member of the permitting and compliance unit with Ohio EPA's DSW, the Paint Creek Watershed does not contain any CSOs.

Another similar overflow is called a Sanitary Sewer Overflow (SSO). This type of system is designed to bypass the treatment plant when the wastewater load exceeds capacity. Most of these are being phased out in the watershed. One example is the Washington Court House WWTP, which has recently been upgraded (Gosset-Johnson, 2002).

Nonpoint Sources of Pollution

The term nonpoint source pollution (NPS) refers to water pollution that results from a variety of human land uses such as farming, development, logging, resource extraction, land disposal, livestock production and hydromodification. Nonpoint source pollution occurs when rain or snow melt drains over the land. The type of land use determines the type of pollutants that run off with the precipitant and eventually finds its way back to a stream, river or ground water table. As a product of weather patterns, nonpoint source discharges are naturally intermittent and occur more sporadically than point source discharges. Most are diffuse and difficult to quantify. Refer to the landuse/land cover map in the Watershed Inventory section of this plan for an overview of land use patterns in the Paint Creek Watershed.

Except for on-lot wastewater systems, nonpoint sources of pollution related to land use are discussed in great detail in the subwatershed water quality analysis later in this chapter. They are also outlined in Table 3-2, earlier in this section.

On-lot Wastewater Systems

By implementing House Bill 110 (HB110) in 1984, the Ohio General Assembly created Ohio EPA's HB110 program. The program is a contractual partnership between Local Health Districts (LHDs) and Ohio EPA, whereby LHDs conduct, on behalf of the Agency, inspection and enforcement services for commercial sanitary waste treatment/disposal systems discharging between 0-25,000 gallons per day (semi-publics). In addition, local health departments regulate residential on-lot systems such as septic systems.

The Paint Creek Project is currently working with the health departments in each of the nine counties containing portions of the watershed; Clinton, Greene, Fayette, Pickaway, Pike, Highland, Ross, Madison and Clarke. The Paint Creek Project hopes to collect information on the sewered versus unsewered areas in the watershed and areas where potential problems exist. This information will help promote the use of available finds to upgrade and maintain existing systems. One of the implementation goals for the watershed involves inspecting septic systems at regular intervals to ensure acceptable operation. Septic systems are a source of nutrients, organics and fecal coliforms.

In this particular watershed, only the Greene, Madison, Highland and Fayette County Health Depts. are currently working on HSTS plans for this watershed. Clinton County has decided not to participate. According to the Greene Co. Health District, the only small municipal area in the Rattlesnake watershed is the village of Bowersville. This town is not sewered but is currently looking into it. The rest of the Rattlesnake Creek Watershed in Greene County is characterized by individual homes with individual HSTS installed when the house was built or when indoor plumbing was installed in the house. This office began issuing sewage permits in the late 1950's and we have some good records on most of the homes in the PCW. There are approximately 200 homes in the PCW that are not part of the Village of Bowersville. These homes are not likely to ever have sanitary sewer service and will have to rely on an HSTS. In Fayette County, the 2 small towns of Octa and Milledgeville are in need of a sanitary sewer system. Parts of Octa are serviced by the WWTP at the outlet mall plant on SR 35 but not the entire town. The areas of New Martinsburg and Buena Vista are also concern areas in the Rattlesnake Watershed and are unlikely to ever be on a central sewer. In Madison County, the village of S. Solon is in need of a central sewer but it is unsure when and if this will happen. Homes in the area areound this town are generally over 20-30 years old are many are expected to have failing systems. Lastly, In the small part of Highland County covered by this plan is the small town of East Monroe. Because of the size of this town and the lack of new development in it, it would probably never receive sanitary sewers. Homes around this town are older homes and a some are certian to have failing systems.

Fish Kill Information (ODNR, DOW)

The following information was prepared by Doug Maloney at Ohio DNR, Division of Wildlife. According to Mr. Maloney this information is a conservative record of fish kills in the Paint Creek Watershed. Many fish kills are never reported and smaller kills may not be investigated, even if they are reported. Fish kills caused by unknown sources may have resulted from naturally occurring anoxic conditions or other naturally occurring phenomenon.

Table 3-5: Fish kill information

District	Date	Creek	County	No. killed	Cause
One	8/24/96	Rattlesnake Creek	Fayette	616	Untreated sewage from Rattlesnake WWTP breakdown
One	10/27/97	Rattlesnake Creek	Fayette	18	Cause unknown

303(d) Listed Streams

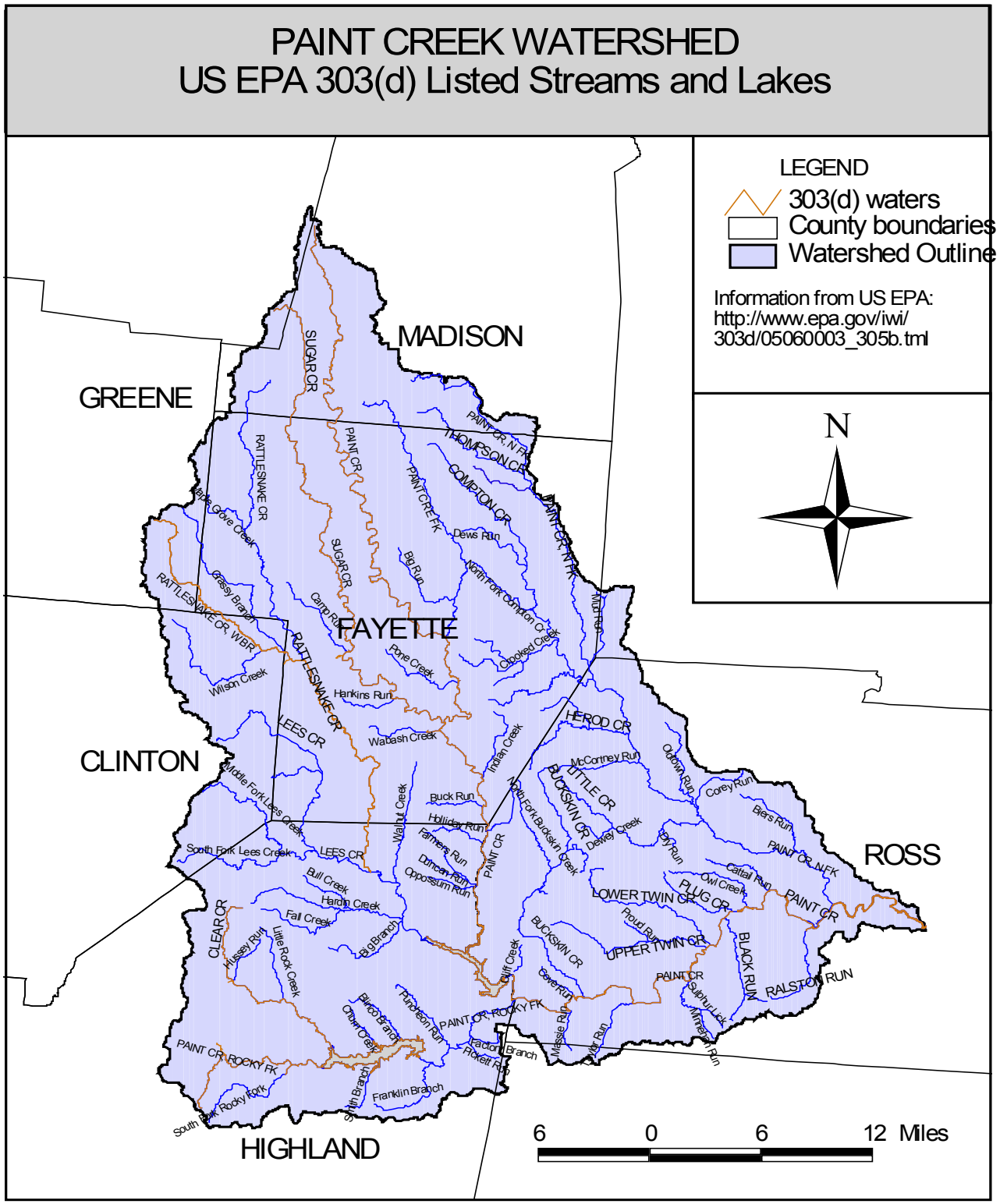
Based on water quality standards alone, several streams in the Paint Creek Watershed are listed as not historically meeting Clean Water Act criteria. These streams have been placed on a Federal list called a 303(d) list. They include Paint Creek, Sugar Creek, Rocky Fork, Clear Creek West Branch Rattlesnake Creek and lower Rattlesnake Creek. Please refer to the map entitled, *Paint Creek Watershed: US EPA 303(d) Listed Streams and Lakes*. In addition, Table 3-7 lists the information that is currently available from U.S. EPA on the listed stream segments in the Paint Creek Watershed. This information was some of the earliest information that the Paint Creek Project used to determine streams with water quality impairments. This information is scheduled to be updated every two years.

The last field survey in the Paint Creek Basin was conducted in 1997, and several streams including Rocky Fork, Clear Creek and Paint Creek may subsequently be removed from the 303(d) list. These streams, for the most part, met their designated standards. The next series of maps entitled, *Paint Creek Watershed: Monitoring Point Locations by Subwatershed*, *Paint Creek Watershed: Monitoring Points by River Mile*, and *Paint Creek Watershed: Water Quality by USGS 11- and 14-digit Subwatersheds*, illustrate where the watershed was sampled during the 1997 survey, the overall attainment of the streams at each monitoring point, and the inferred water quality throughout the watershed.

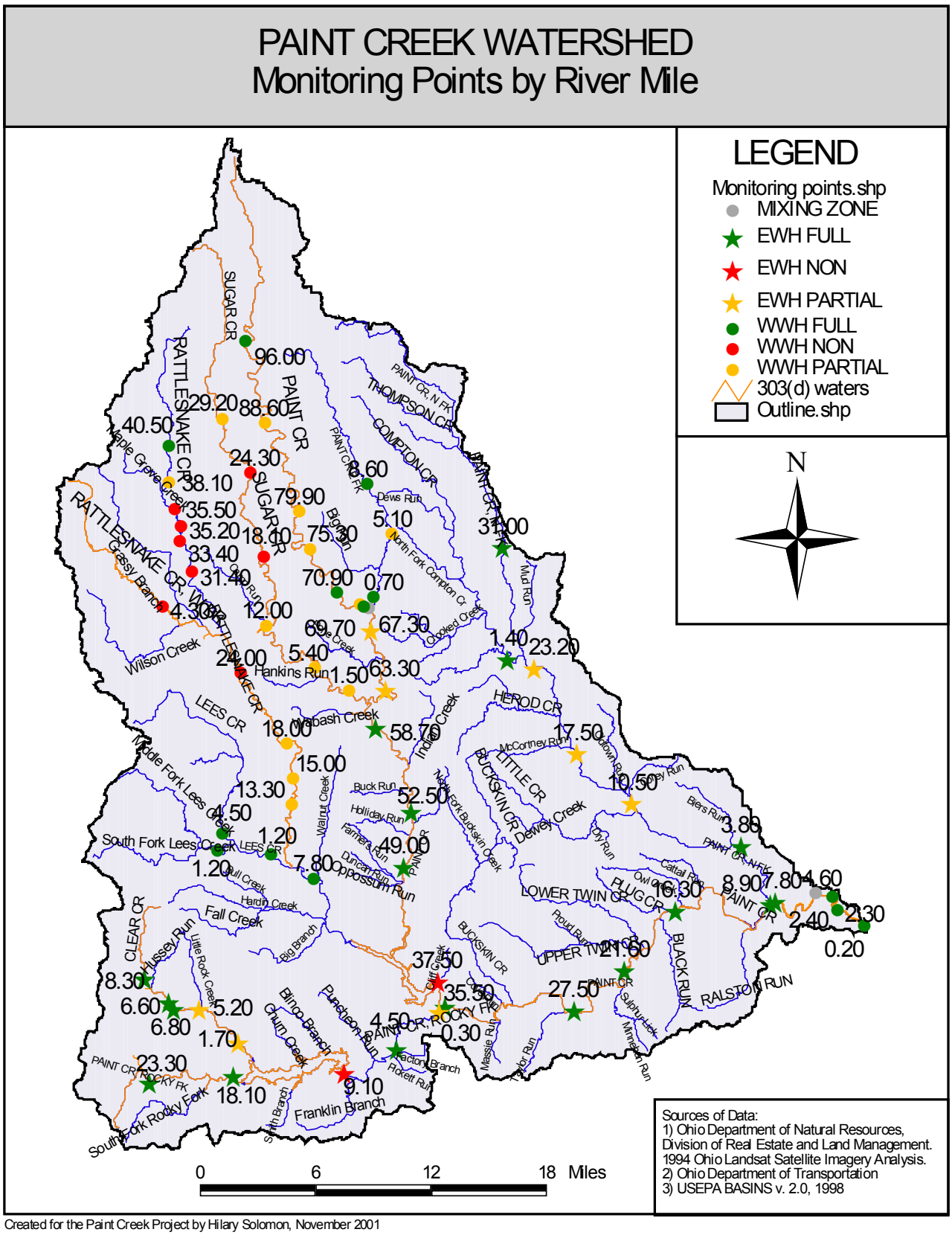
Table 3-7: Summary table of 303 (d) listed streams (please refer to water quality information by subwatershed for more information).

Waterbody River mile	Attainment	Documented WQ problems	Sources of problems
Rattlesnake Creek HW-38.10	Full-WWH		
Rattlesnake Creek 38.10-35.50	Partial-WWH	Habitat alterations, nutrients, organic enrichment, low DO, pH, ammonia	Hydromodification, agriculture, channelization-agriculture, pasture, agriculture, point source, minor municipal point source, land disposal, septic systems, non-irrigated crop production

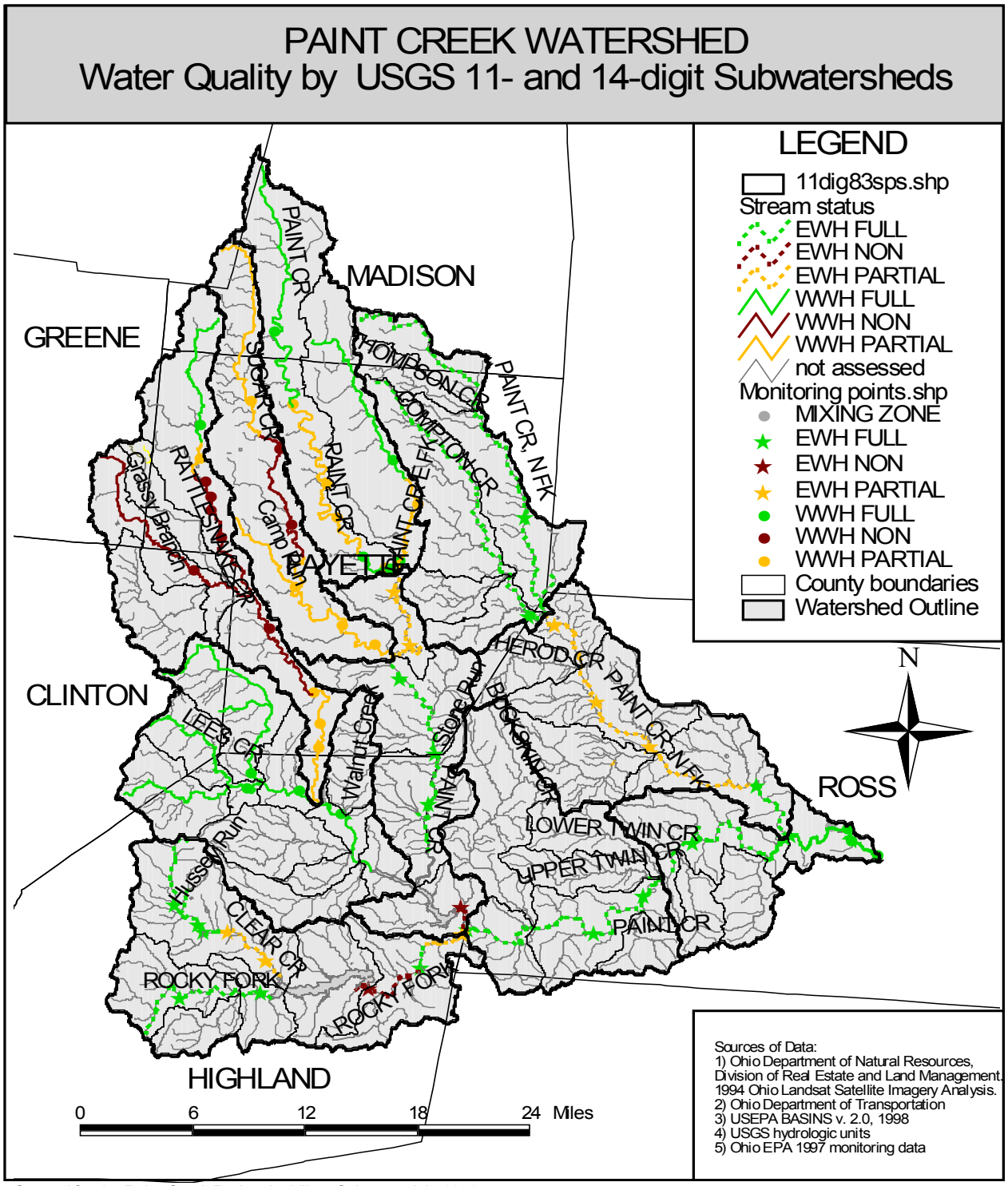
Waterbody River mile	Attainment	Documented WQ problems	Sources of problems
Rattlesnake Creek 35.50-18.0	Non-WWH	Habitat alterations, nutrients, organic enrichment, low DO, pH, ammonia	Hydromodification, agriculture, channelization-agriculture, pasture, agriculture, point source, minor municipal point source, land disposal, septic systems, non-irrigated crop production
Rattlesnake Creek 18.0-7.8	Partial-WWH	Habitat alterations, nutrients, organic enrichment, low DO, pH, ammonia	Hydromodification, agriculture, channelization-agriculture, pasture, agriculture, point source, minor municipal point source, land disposal, septic systems, non-irrigated crop production
Rattlesnake Creek 7.8-PCL	Full-WWH		



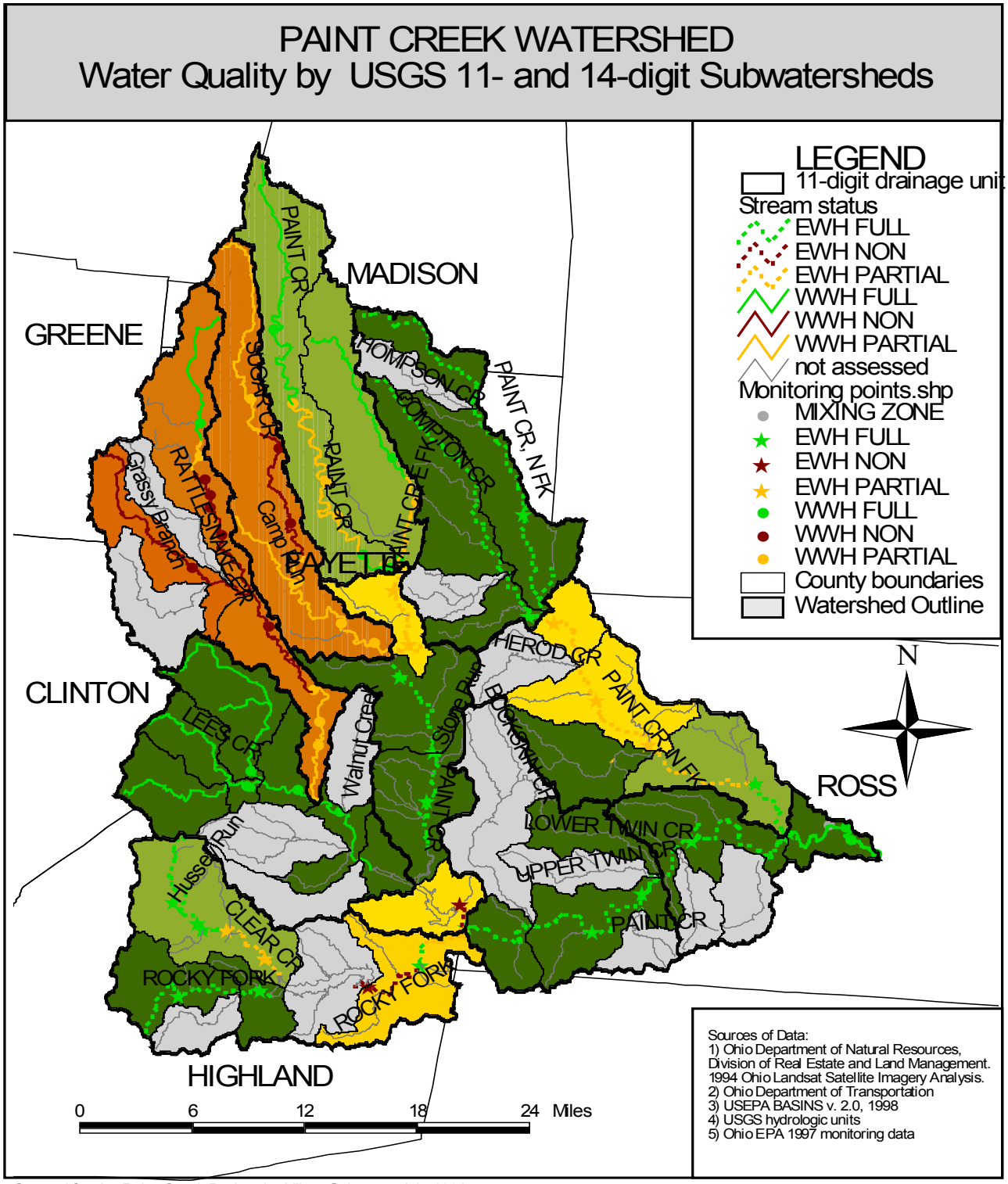
Created by Hilary Solomon for the Paint Creek Project, September 2001



Created for the Paint Creek Project by Hilary Solomon, November 2001



Created for the Paint Creek Project by Hilary Solomon, July 2002



Created for the Paint Creek Project by Hilary Solomon, July 2002

Rattlesnake Creek Water Quality

During the summer of 1997, Ohio EPA conducted a field survey of the Paint Creek Watershed. The field unit surveyed Rattlesnake creek in eleven locations and the West Branch of Rattlesnake Creek in one location. The monitoring locations are described below.

Table 3-21. Rattlesnake Creek monitoring point locations

RIVER MILE	STREAM	LOCATION	ECO-REGION	SIZE*	HABITAT	ATTAINMENT
40.50	Rattlesnake Creek	SR 734	ECBP	HW	WWH	Full
38.10	Rattlesnake Creek	SR 35, SR 753, Ust. Octa	ECBP	W	WWH	Partial
35.50	Rattlesnake Creek	Dst. Octa, Ust. Milledgeville	ECBP	W	WWH	Non
35.20	Rattlesnake Creek	Dst. Octa, Dst. Milledgeville	ECBP	W	WWH	Partial
33.40	Rattlesnake Creek	Marchant-Luttel Rd.	ECBP	W	WWH	Non
31.40	Rattlesnake Creek	SR 729	ECBP	W	WWH	Non
24.00	Rattlesnake Creek	Snow Hill Rd.	ECBP	W	WWH	Non
18.00	Rattlesnake Creek	Staford Rd.	ECBP	W	WWH	Partial
15.00	Rattlesnake Creek	Zimmerman Rd.	ECBP	W	WWH	Partial
13.30	Rattlesnake Creek	Fisherback Rd.	ECBP	W	WWH	Partial
7.80	Rattlesnake Creek	Jefferson St., Centerfield	ECBP	SR	WWH	Full
4.30	Branch Rattlesnake	SR 729	ECBP	SR	WWH	Non

This plan will only cover detail from the headwaters to approximately RM 13.3

*Where HW = headwaters, W = wadeable, and SR = Small River values

Rattlesnake Creek is located in the Eastern Corn Belt Plains Ecoregion. It is characterized in the Ohio Administrative Code (OAC) 3745-1-09; Table 9-1, as warmwater habitat (WWH) used for agricultural water supply (AWS), industrial water supply (IWS) and primary contact recreation (PCR). Of the parameters described in this report; total suspended solids (TSS), fecal coliforms, nitrate/nitrite, total phosphorous and dissolved oxygen; only fecal coliforms and dissolved oxygen have water quality standards. Nitrate concentrations may be compared to maximum contaminant levels (MCLs) for drinking water.

For primary contact waters fecal coliform concentrations (by geometric mean of at least five samples) must be less than 1000 bacteria per 100 mL of water, with no more than 10% of the samples over 2000 bacteria per 100 mL of water. Fecal coliform concentrations at river mile 40.5 and 13.2 exceeded the maximum levels for primary contact waters on July 16. On August 14, every monitoring location except two exceeded these limits.

Dissolved oxygen concentrations were below 6.0 mg/L on September 16, 1997 at river mile 38.1 (4.64 mg/L) and West Branch river mile 4.3 (5.85 mg/L). Supersaturated dissolved oxygen levels (11.8-12.8 mg/L) upstream in Rattlesnake Creek, through cropped fields, (river mile 40.4) with lower values directly downstream at river mile 38.1 is indicative of diel dissolved oxygen swings caused from nutrient enrichment. This may have been related to the relatively high levels of fecal coliforms, suspended solids and nutrients (when compared to reference streams) measured in July and August. Nitrate concentrations did not exceed the legal maximums.

In comparison to similar-sized high quality reference streams located in the same Ecoregion (75th percentile values), Rattlesnake only exceeded average total suspended solids concentrations (29 mg/L) on August 14. Fecal Coliform values (860 per 100 mL water) were exceeded in July and August with eight of ten measurements above reference values on August 14. Nitrate/nitrite concentrations (2.8 mg/L) were also exceeded in July and August, with all measurements above reference on July 16 and most measurements exceeding reference values on July 29 and August 14. Phosphorous concentrations (0.13 mg/L) were exceeded in July, August and September, with exceedences occurring on all sample days. Dissolved oxygen concentrations at several monitoring points were below reference values in July, August and September.

Diel dissolved oxygen was indicative of a nutrient enrichment scenario, and included exceedences. Bacteriological measures indicated significant contamination, with counts as high as 44,000/100 ml, which is well in excess of the applicable water quality standards. Downstream from Octa, the contribution of treated effluent (Octa WWTP) and septic drainage from unsewered areas exacerbated existing impacts, as degradation processes released ammonia and used oxygen. Additional evidence of the severe nature of these sources is documented in a fish kill in 1996. Severe algal production was also noted in this reach, during the 1997 monitoring survey (Moore, 2002).

The WWTP has recently expanded to treat 0.25 MGD and includes some previously unsewered areas near Octa. Before the upgrade, the plant had numerous permit violations and contributed high levels of organics to the stream.

High levels of fecal coliforms and nutrients and low concentrations of dissolved oxygen affect Rattlesnake water quality. Not only did the stream not meet reference stream values for these parameters, but it only partially met warmwater biologic criteria. As illustrated by high fecal coliform values, the Octa WWTP, livestock with access to the creeks and failing septic systems all pose potential threats to water quality in the Rattlesnake Basin. High nutrients and low dissolved oxygen may also be associated with fecal or organic loading. Agricultural landuse potentially causes water quality degradation in the Rattlesnake basin through soil, nutrient and organic loads to the stream.

Please see the Rattlesnake water quality data and charts for more detail. Please also refer to the qualitative habitat evaluation index for a discussion on hydromodification and habitat loss along Rattlesnake Creek.

Rattlesnake Water Quality Data*

Total Suspended Solids

River Mile	16-Jul-97	29-Jul-97	14-Aug-97	5-Sep-97	16-Sep-97	AVG	MAX	Reference
40.4	5	5	**22**	5	5	8.4	22	14
38.1	8	6	28	6		12	28	29
35.4	5	10	**48**	5	5	14.6	48	29
35.3	5	10	26	8	5	10.8	26	29
33.4	6	20	**38**	5	7	15.2	38	29
31.4	12	28	**63**	8	6	23.4	63	29
24	27	22	**77**	6	5	27.4	77	29
18	10		**30**	5	5	12.5	30	29
13.23	5	8	9	5	5	6.4	9	29
7.8	5	8	11	5	6	7	11	41
W. Br. 4.3	5	5	12	5		6.75	12	41

Fecal Coliforms

River Mile	16-Jul-97	29-Jul-97	14-Aug-97	5-Sep-97	16-Sep-97	AVG	MAX	Reference
40.4	**44000**	590	**2600**	200	370	9552	44000	960
38.1	**1200**	820	**3800**	280	160	1252	3800	860
35.4	420	580	**4500**	340	380	1244	4500	860
35.3	500	860	**3600**	520	380	1172	3600	860
33.4	580	400	**4900**	210	300	1278	4900	860
31.4	600	280	**6000**	310	140	1466	6000	860
24		**1000**	**3700**	110	110	1230	3700	860
18			**2000**	100	50	717	2000	860
13.23	**11200**	80	200	110	180	2354	11200	860
7.8		110	220	40	250	155	250	1386
W. Br. 4.3	510	405		340	210	293	510	1386

Nitrate/nitrite

River Mile	16-Jul-97	29-Jul-97	14-Aug-97	5-Sep-97	16-Sep-97	AVG	MAX	Reference
40.4	**3.37**	**6.04**	**4.62**	1.56		3.8975	6.04	2.268
38.1	**3.37**	**5.83**	**4.27**	1.39	0.36	3.044	5.83	2.815
35.4	**3.43**	**4.9**	**3.38**	1.39	0.9	2.8	4.9	2.815
35.3	**3.5**	**4.89**	**3.91**	1.33	0.91	2.908	4.89	2.815
33.4	**3.82**	**4.61**	**3.77**	0.74	0.68	2.724	4.61	2.815
31.4	**3.58**	**3.4**	**3.25**	0.9	0.22	2.27	3.58	2.815
24	**3.66**	**2.18**	1.21	0.74	0.28	1.614	3.66	2.815
18	**3.79**		1.3	0.81	0.6	1.625	3.79	2.815
13.23	**4.01**	0.28	0.41	0.88	0.8	1.276	4.01	2.815
7.8	**3.6**	0.76	0.7	0.24	0.56	1.172	3.6	3.09
W. Br. 4.3	**3.8**	0.45	0.14		0.22	1.1525	3.8	3.09

Phosphorous

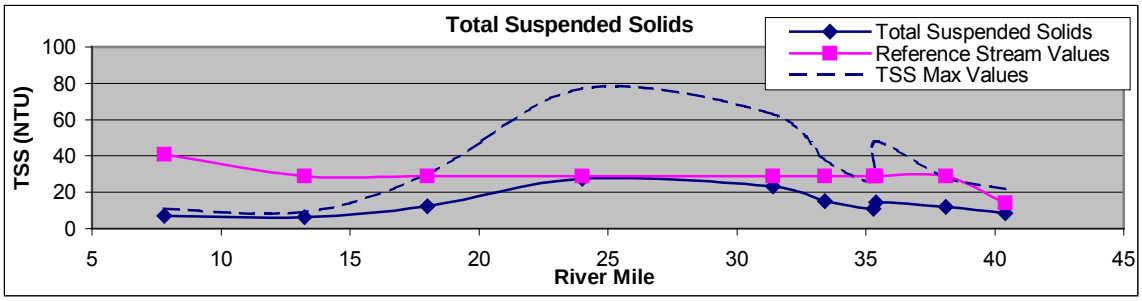
River Mile	16-Jul-97	29-Jul-97	14-Aug-97	5-Sep-97	16-Sep-97	AVG	MAX	Reference
40.4	**0.13**	**0.09**	**0.12**	0.05		0.0975	0.13	0.08

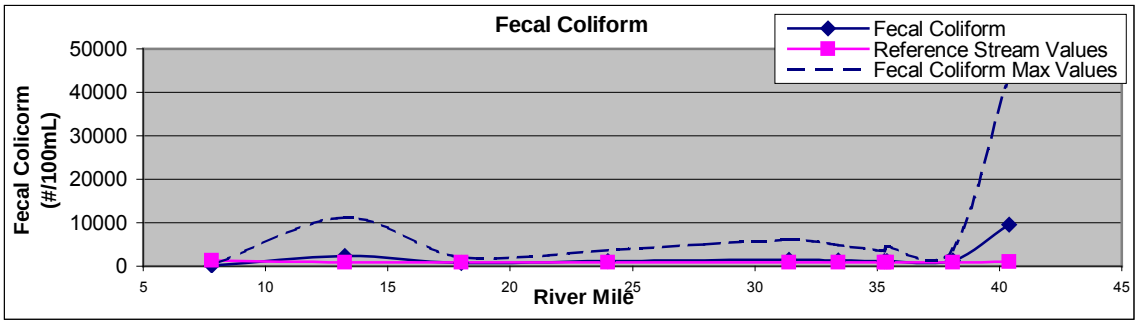
38.1	**0.19**	**0.28**	0.12	**0.15**	0.1	0.168	0.28	0.13
35.4	**0.84**	**0.18**	**0.26**	**0.16**	**0.63**	0.414	0.84	0.13
35.3	**0.89**	**0.26**	0.13	**0.15**	**0.78**	0.442	0.89	0.13
33.4	**0.38**	**0.24**	**0.23**	0.11	**0.41**	0.274	0.41	0.13
31.4	**0.23**	**0.2**	**0.19**	0.1	0.11	0.166	0.23	0.13
24	**0.28**	0.12	0.3	0.05	0.05	0.16	0.3	0.13
18	**0.27**		**0.16**	0.05	0.05	0.1325	0.27	0.13
13.23	**0.39**	**0.15**	0.06	**0.49**	0.05	0.228	0.49	0.13
7.8	0.11	0.09	0.05	0.06	0.05	0.072	0.11	0.24
W. Br. 4.3	0.21	**0.27**	0.05		0.05	0.145	0.27	0.24

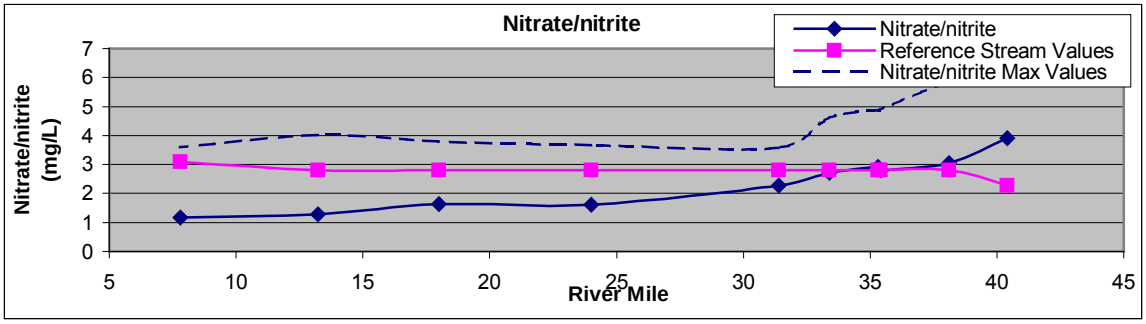
Dissolved Oxygen

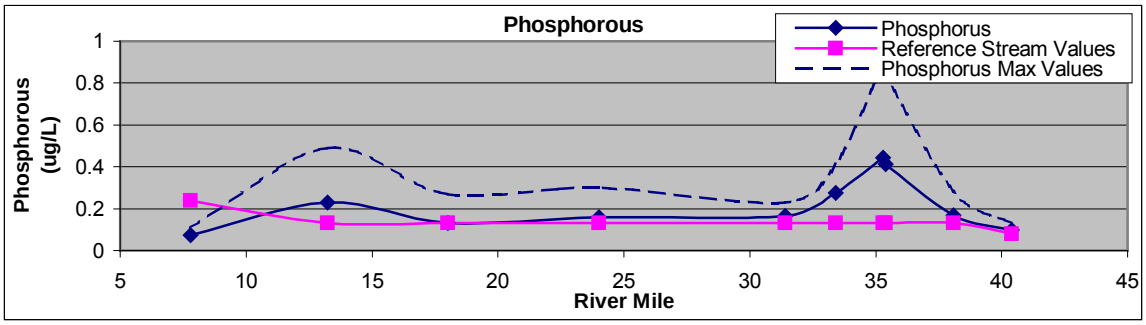
River Mile	16-Jul-97	29-Jul-97	14-Aug-97	5-Sep-97	16-Sep-97	AVG	MAX	Reference
40.4	11.83		9.62	9.5	12.76	10.9275	12.76	6.60
38.1	7.24		8.74	7.88	**4.64**	7.125	8.74	6.95
35.4	**6.55**		7.97	8.65	7.22	7.5975	8.65	6.95
35.3	**6.71**		7.91	8.97	**6.22**	7.4525	8.97	6.95
33.4	8.7		7.87	10.07	12.78	9.855	12.78	6.95
31.4	**6.56**		7.44	9.16	7.32	7.62	9.16	6.95
24	8.7		**6.01**	8.76	7.19	7.665	8.76	6.95
18	8.97		**6.67**	10.62	9.18	8.86	10.62	6.95
13.23	8.66	**6.2**	7.16	10.97	8.19	8.236	10.97	6.95
7.8	8.59	**6.5**	8.2	11.36	8.63	8.656	11.36	7.60
W. Br. 4.3	7.44		7.16	7.83	**5.85**	7.07	7.83	7.60

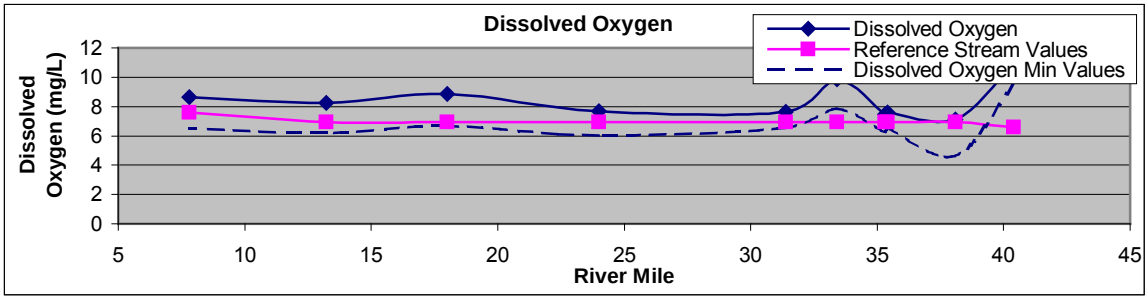
Bolded values are above (or below in the case of dissolved oxygen) associated reference stream 75th percentile concentrations.


Total Suspended Solids
Total Suspended Solids
Reference Stream Values
TSS Max Values
TSS (NTU)
100
80
60
40
20
0
5
10
15
20
25
30
35
40
45
River Mile


Fecal Coliform
Fecal Coliform
Reference Stream Values
Fecal Coliform Max Values
Fecal Colicorm (#/100mL)
50000
40000
30000
20000
10000
0
5
10
15
20
25
30
35
40
45
River Mile


Nitrate/nitrite
Nitrate/nitrite
Reference Stream Values
Nitrate/nitrite Max Values
Nitrate/nitrite (mg/L)
7
6
5
4
3
2
1
0
5
10
15
20
25
30
35
40
45
River Mile


Phosphorous
Phosphorus
Reference Stream Values
Phosphorus Max Values
Phosphorous (ug/L)
1
0.8
0.6
0.4
0.2
0
5
10
15
20
25
30
35
40
45
River Mile


Dissolved Oxygen
Dissolved Oxygen
Reference Stream Values
Dissolved Oxygen Min Values
Dissolved Oxygen (mg/L)
12
10
8
6
4
2
0
5
10
15
20
25
30
35
40
45
River Mile

Biological Indices

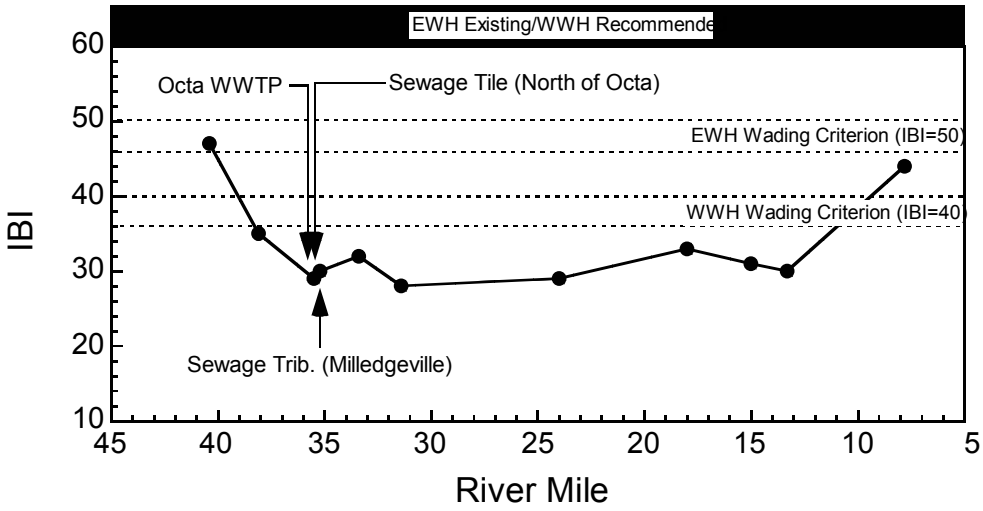
The species composition expected in each of these ecoregions is slightly different, which translates into different numeric biocriteria for each aquatic use designation. Again, the IBI measures fish species diversity and population composition. It accounts for total native populations, indicator species, overall fish condition and pollution intolerant versus pollution tolerant fish species. The MIwb measures similar characteristics of the fish population, however, it subtracts 13 pollution tolerant fish species out of the final score. The ICI measures the composition of the invertebrate community and compares the numbers of pollution tolerant species with pollution intolerant species. The biocriteria for the ECBP Ecoregion is listed below:

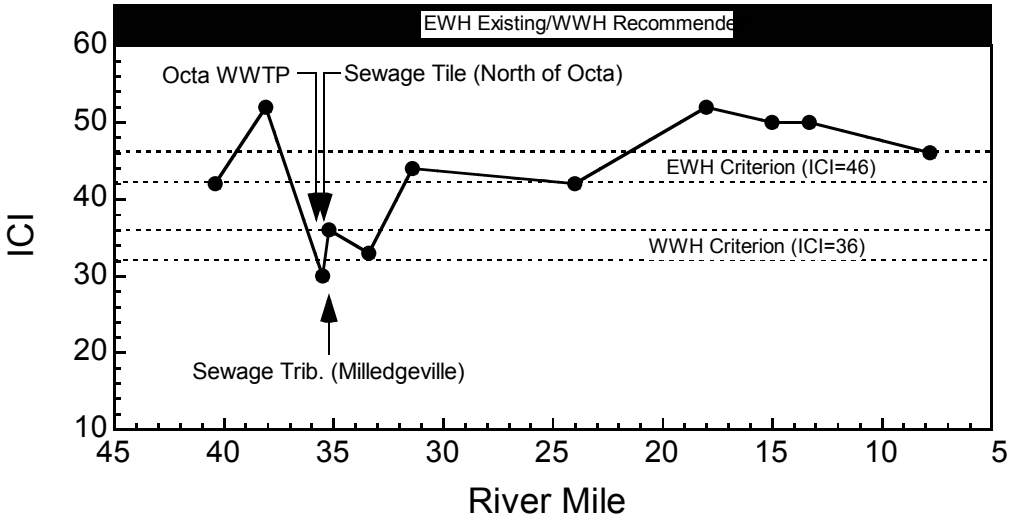
Ecoregion Biocriteria: Eastern Corn Belt Plains (ECBP)
(OAC 3745-1-07, Table 7-14)

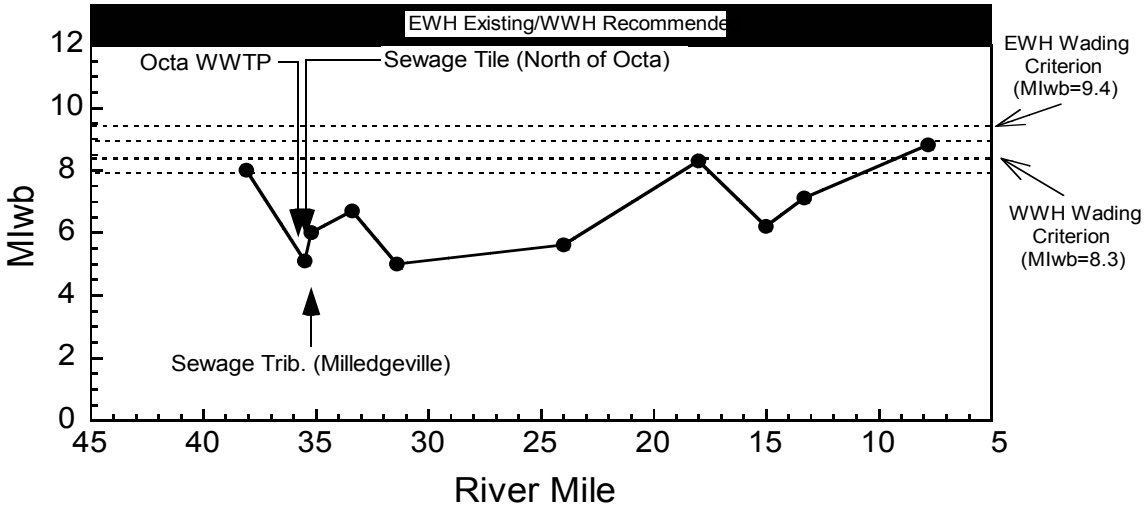
Index- Site Type	WWH	EWH
IBI- Boat	42	48
MIwb- Boat	8.5	9.6
ICI	36	46

Though Rattlesnake Creek was recently downgraded from EWH to WWH (according to some at Ohio EPA the first designation may not have been appropriate), the stream does not meet even WWH criteria for IBI scores at any monitoring point. The ICI scores are high, between WWH and EWH target scores while the MIwb scores are mostly below the target WWH score.

Please refer to the subsection entitled, Detailed Analysis by Ed Moore for site-specific information about the biological indices scores and causes of nonattainment for Rattlesnake Creek. Ed Moore collected much of the information that makes up the Ohio EPA 1997 monitoring survey and recently completed a report as part of the WWTP upgrade process for the Rattlesnake/Fayette County WWTP upgrade.


EWH Existing/WWH Recommende
Octa WWTP
Sewage Tile (North of Octa)
EWH Wading Criterion (IBI=50)
WWH Wading Criterion (IBI=40)
Sewage Trib. (Milledgeville)
IBI
River Mile


EWH Existing/WWH Recommende
Octa WWTP
Sewage Tile (North of Octa)
EWH Criterion (ICI=46)
WWH Criterion (ICI=36)
Sewage Trib. (Milledgeville)
ICI
River Mile


EWH Existing/WWH Recommende
Octa WWTP
Sewage Tile (North of Octa)
EWH Wading Criterion (MIwb=9.4)
WWH Wading Criterion (MIwb=8.3)
Sewage Trib. (Milledgeville)
MIwb
River Mile

Qualitative Habitat Evaluation Index (QHEI)

The QHEI is a measure of the presence and quality of physical habitat components that support aquatic life. 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 habitat characteristics that are used to determine the QHEI score include substrate, instream cover, channel morphology, riparian vegetation and bank erosion, gradient, and flow patterns (pool, run and riffle development). The QHEI score ranges from 20 to less than 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 sites around the state (OEPA, 2002, Bokes TMDL) 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 having the ability to support exceptional warmwater faunas. The QHEI can be used to direct restoration efforts for habitat and to provide a monitoring tool to measure progress toward habitat goals.

Please refer to the subsection entitled, Detailed Analysis by Ed Moore for site-specific information about the QHEI scores and causes of nonattainment for Rattlesnake Creek. Ed Moore collected much of the information that makes up the Ohio EPA 1997 monitoring survey and recently completed a report as part of the WWTP upgrade process for the Fayette County/Rattlesnake Creek WWTP upgrade.

Table 3-22. Rattlesnake Creek Qualitative Habitat Evaluation Index.

River Mile	Location	Score	Comments
40.4	SR 734	41.0	• **Substrate**: heavy silt with moderate to extensive embeddedness • **Instream cover**: sparse • **Morphology**: poor morphology, recent and recovering channelization • **Riparian**: none to very narrow with little bank erosion and canopy removal • **Flood plain**: row crop
38.1	SR 35/SR 734 Upstream Octa	59.5	• **Substrate**: moderate to heavy silt with extensive embeddedness, some rip-rap from bridge • **Instream cover**: sparse to moderate • **Morphology**: poor morphology, recovering channelization • **Riparian**: none to moderate with little to moderate bank erosion • **Flood plain**: row crop
35.5	Downstream Octa	40.5	• **Substrate**: heavy silt with extensive

River Mile	Location	Score	Comments
	WWTP/Upstream Milledgeville sewage Ditch		embeddedness • **Instream cover**: sparse • **Morphology**: poor morphology, recovering channelization • **Riparian**: very narrow to moderate with moderate to heavy bank erosion • **Flood plain**: row crop, milledgeville drain tile
35.2	Dst. Octa, Dst. Milledgeville	39.0	• **Substrate**: heavy silt with extensive embeddedness • **Instream cover**: sparse to moderate • **Morphology**: poor morphology, recovering channelization • **Riparian**: very narrow to moderate with little to moderate bank erosion • **Flood plain**: row crop
33.4	Marchant-Luttel Rd.	41.0	• **Substrate**: moderate to heavy silt with moderate to extensive embeddeness • **Instream cover**: nearly absent • **Morphology**: false banks caused by unrestricted livestock access • **Riparian**: none to narrow, with heavy erosion on one bank and little on the other • **Flood plain**: open pasture
31.4	SR 729	50.0	• **Substrate**: heavy silt with extensive embeddedness • **Instream cover**: sparse to moderate • **Morphology**: past and present channelization • **Riparian**: very narrow to narrow with moderate bank erosion • **Flood plain**: row crop
24.0	Snow Hill Rd.	44.5	• **Substrate**: moderate silt with normal to moderate embeddedness • **Instream cover**: sparse • **Riparian**: none to narrow, moderate bank erosion and canopy removal • **Flood plain**: mowed field and row crops
18.0	Stafford Rd.	83.0	• **Substrate**: moderate silt and embeddedness • **Instream cover**: extensive • **Riparian**: moderate with little to moderate bank erosion • **Flood plain**: row crops
15.0	Zimmerman Rd.	79.0	• **Substrate**: normal to moderate silt with

River Mile	Location	Score	Comments
			normal embeddedness • **Instream cover**: moderate • **Morphology**: Recovered from channelization, channel is straight, but flow is sinuous • **Riparian**: narrow to wide, little to moderate bank erosion • **Flood plain**: row crop
13.3	Fisherback Rd.	89.0	• **Substrate**: normal to moderate silt and embeddedness • **Instream cover**: moderate to extensive • **Riparian**: narrow to moderate, removed for 10m with algae-covered rocks • **Flood plain**: old field and row crop
4.4	West Branch Rattlesnake, SR 729	--	• **Substrate**: moderate to heavy silt with moderate embeddedness • **Instream cover**: sparse • **Riparian**: very narrow to narrow, with moderate to severely eroding banks • **Flood plain**: row crop

Detailed Analysis by Ed Moore

The Qualitative Habitat Evaluation Index (QHEI) scores indicated the upper portion of Rattlesnake Creek had been influenced by some past and present land uses and agricultural practices. At RM 40.4, the reach was previously channelized with heavily embedded and silted substrates, a sparse amount of instream cover, and limited riparian vegetation with agricultural land encroachment common to both banks. Downstream from the Fayette County / Rattlesnake Creek WWTP at RM 35.5 and RM 35.2, silted and embedded conditions with sparse cover and no riffles were observed. The mean QHEI score for these sites was 40.2. At RM 38.1 (upstream from the WWTP) more favorable habitat conditions prevailed (moderate instream cover, faster currents, and riffles in the reach) with a QHEI score of 59.5. A score of approximately 60 or higher is indicative of the ability to support a WWH community. Permitting riparian growth will decrease sedimentation/siltation. If these changes are permitted, the habitat quality in these reaches will improve and expand the warmwater communities present. The habitat scores indicated warmwater habitat potential in the upper reaches of Rattlesnake Creek, while the lower reaches (< RM ~21) indicated much greater habitat potential for community diversity (mean QHEI = 84.0 for RM 18.0 to RM 7.8).

Despite some poor habitat attributes that were heavily influenced by agriculture at the upstream site, the biological communities fully and partially attained the WWH use designation criteria at RM 40.4 and RM 38.1, respectively, upstream from the Fayette Co./Rattlesnake Cr. WWTP (RM 36.27). Despite past channelization, lack of canopy cover, moderate to heavy embeddedness from siltation and large nutrient inputs as evidenced by long algal strands on substrates, the ICI

of 42 and fish IBI score of 47 still indicated very good conditions. Cased caddisflies *Hydroptila sp.* and *Helicopsyche borealis* (purse-shaped and snail-cased caddisflies) were the predominant taxa in the riffles and runs with riffle beetles very common. As stream temperatures increased and nutrient enriched conditions likely caused lower diel dissolved oxygen concentrations in late night and early AM hours, almost all of the *Helicopsyche* caddisflies had emerged prior to macroinvertebrate colonizer retrieval. The relative density of 2346/ft.^{2} confirmed nutrient enriched conditions. The presence of some moderately intolerant Tanytarsini midges and eleven total EPT (pollution intolerant macroinvertebrates) still point to very good water quality conditions. With better riparian conditions downstream at St. Rt. 35 (RM 38.1) and cooler water temperatures the total EPT taxa increased to 14 as well as total taxa collected (60). The relative density decreased some to 1732/ft.^{2} (still enriched) as nutrient inputs decreased. Some sensitive mayflies and tanytarsini midges along with several additional caddisfly taxa collected confirmed the water quality improvements present (ICI = 52). Still enriched conditions and other agriculture-related affects (sedimentation, periodic lower night diel D.O. (= 4.64), community population shift) contributed to lower IBI scores. However, riparian enhancement upstream in the upper headwater area would allow for improved biological community quality and full attainment of the warmwater habitat criteria in the reach above the WWTP (RM 38.1) and decrease sedimentation downstream below the WWTP. It would decrease stream temperatures, increase margin habitat and decrease siltation and embeddedness. It would also increase the time for more nutrient assimilation into the biological community and would lessen nutrient-related impacts.

The Fayette County / Rattlesnake Creek WWTP discharge along with the septic drain tile discharge (which caused a confirmed fish kill in 1996) contributed to significantly lower IBI scores downstream at RM 35.5, though present habitat limitations (some sedimentation with slower flows and detritus riffles) also influenced the fish community. The total number of species decreased from 18 to 13, and the percent simple lithophils also decreased. The percent tolerant fishes increased, and the relative numbers (minus tolerants) decreased substantially from 519 to 89. The IBI and MIwb scores increased slightly with increased distance from the WWTP. The MIwb scores decreased from a marginally good score of 8.0 upstream of Octa to a poor score of 5.1 downstream from the Fayette County / Rattlesnake Creek WWTP and tile drainage from the unsewered area near I-71 and U.S. Rt. 35 / SR 729. The MIwb scores increased from poor to a narrative evaluation of fair (6.0 and 6.7) downstream from the Milledgeville sewage ditch (RM 35.2) and at the cattle-influenced reach at Marchant-Luttrell Rd. (RM 33.4). The Fayette County / Rattlesnake Creek WWTP effluent, the septic drainage tile discharge from unsewered service area and unrestricted livestock at RM 33.4 influenced the fair to poor MIwb scores.

Downstream from the Fayette Co./Rattlesnake Creek WWTP fair conditions persisted in the macroinvertebrate community (ICI = 30). The number of total EPT taxa decreased from 14 upstream to six downstream. The total EPT population collected (mayflies and caddisflies) decreased from 17.5 percent upstream at RM 38.1 to less than three percent at RM 35.4 (ust. Milledgeville-Octa Rd.) downstream from the WWTP. Sedimentation and influences from the Fayette Co./Rattlesnake Cr. WWTP and unsewered areas likely limit caddisfly recolonization. Any increase in effluent quality and some NPS input abatement would increase water quality through this reach to allow for the attainment of WWH water quality criteria.

A marginally good macroinvertebrate community was present downstream from Milledgeville-Octa Rd. at RM 35.3. The intermittent drainage from unsewered Milledgeville might be adding nutrients that caused a green algal bloom in the pooled area just downstream from the bridge. Instream nutrients from the upstream sources (Rattlesnake Creek WWTP, unsewered area inputs) were likely contributing to the increased algal growth. The number of mayflies (particularly stenonemids) though increased compared to upstream due to sedimentation and more rocky substrates available. Though still six EPT taxa were collected during qualitative sampling, the total EPT population numbers were increasing.

Cattle in open pastures near Marchant-Luttrell Rd have caused slumped banks, acute erosion, widening and shallower depths in silted-in pools, and large amounts of sedimentation bedload. Decreased water quality conditions were evident (fair), as flatworms were common or predominant in most habitats sampled. Muddy conditions covered rocks and limited diversity (1-2 EPT taxa). To improve quality in the stream segment downstream near Marchant-Luttrell Rd. encouraging the fencing off near streambanks to cattle, establish riparian corridors, and limiting crossing areas would promote bank stabilization and protect the riparian area that is still present.

Gross sedimentation from crop agriculture-related erosion reduced IBIs, fish biomass and MIwb scores into the poor range near SR 729 and Snow Hill Road (RMs 34-32). Increased distance from WWTP effluents and direct cattle inputs allowed some recovery for macroinvertebrate quality at SR 729 to very good - despite channel being somewhat choked with sediment that limited large segments to shallow glides. Bank stabilization near SR 729 through expanded woody riparian development is needed, or gross erosion (from bank cave-ins and false banks) will continue to degrade stream quality. Grass mowed strips were not protecting the streambanks through this reach. Macroinvertebrate performance was similar but slightly lower near Snow Hill Road (RM 24.2) due to increased agriculture inputs (sediment, organic material instream, entrenchment, and past channelization).

Improved habitat downstream from Stafford Rd. (QHEI improved by ~40 points) and some reduced sedimentation allowed for improved fish community quality and partial attainment (MIwb= 8.3). Agricultural effects still are present as IBI scores are still in fair condition from Stafford Rd. (RM 18) through Fishback Rd. (RM 13) despite excellent habitat. D.O.s through this reach widely fluctuated (~ 6 -11 mg/l) illustrating elevated nutrient concentrations still present and affecting algal production instream. Elevated and very elevated fecal coliform bacteria concentrations at RM 18 (possible agricultural effects or unsewered Buena Vista runoff) and RM 13 (possible horse / cattle upstream inputs or upstream agriculture) would also indicate periodic pollutant source(s) that affect water quality and biological quality. Also slightly elevated sediment metals arsenic, chromium and lead at RM 13.27 were present in pooled reach.

From Stafford Rd. to Fishback Rd. (RM13.2) the macroinvertebrate community attained exceptional scores (ICI=52-50). Below Stafford Rd., lower Rattlesnake Creek flows through some of the most scenic and higher quality habitat in Ohio, and near Centerfield (RM 7.9) the creek descends into a somewhat protected steep canyon-like open valley that continues quite a distance toward Paint Creek Reservoir. Fish scores near Centerfield improved with less continuing NPS inputs and less riparian disturbance, though some fluctuating D.O.s (6.5-11.4

mg/l) still indicate some nutrient enrichment (from upstream sources). Field notes indicate some sediment and algal mats covered surfaces of rocky substrates exposed to light. This limited some surface habitat to protected surfaces under first layer or undersides with interstitial area. Fish scores were the highest for this watershed here (IBI= 44; MIwb=8.8) but did not reach EWH biocriteria.

Macroinvertebrate scores were exceptional (ICI=46) but decreased slightly due likely from conditions mentioned above. Decreases in sedimentation and nutrient inputs from various upstream sources will increase biological performance throughout the Rattlesnake Creek basin. High quality unsampled tributaries in the lower Rattlesnake Creek area should be preserved if possible for two reasons: 1) they likely have EWH potential; and 2) preserving riparian corridor in these tributaries would maintain and improve the surface water quality flowing into Paint Creek Reservoir (lower N and P inputs, lower water temperatures, and higher minimum D.O.s).

Landuse and Nonpoint Sources

Landuse and land cover within the subwatershed is a good indicator of potential sources of pollution. For example, while the streams in the Paint Creek Watershed that attain WQS have an average of 51 percent forested within 50 feet of the creek, Rattlesnake has only 16 percent forested within that area. This supports the QHEI results listed above, which consistently showed less than 50 m of forested land on either side of the creek. Within the watershed itself, there is only 4 percent forested area. The vast majority, 94 percent, is comprised of agricultural lands or open housing. Agricultural landuse is generally associated with sediment and nutrient contributions and a subsequent lowering of dissolved oxygen in nearby streams. The effect of a predominantly agricultural landuse with little or no riparian buffer to act as a filter strip is seen in the water quality and biological survey results in this basin. There are many BMPs for agriculture and housing developments that help to mitigate these problems. These solutions will be addressed in the implementation section of this plan.

Nonpoint sources in the subwatershed include not only agriculture, but also failing septic systems along the creek, and pasture and livestock operations near the headwaters.

Table 3-23. Landuse and Land Cover in Rattlesnake Creek Subwatershed

Landuse/land cover category	Percent in Rattlesnake Creek subwatershed	Percent w/in 50 feet of creek and tributaries
Urban	0.6	0.4
Agricultural or open housing	94.4	81.6
Shrub/scrub	0.1	0.4
Forested	4.3	16.0
Open water	0.1	0.3
Wetlands	0.4	1.2
Barren	0.0	0.0

Point Sources

Point sources are direct discharges to creeks, such as WWTP outfalls. These discharges are often regulated by Ohio EPA's National Pollution Discharge Elimination System (NPDES) permit program. NPDES outfalls in the Rattlesnake subwatershed include the Village of South Solon and the Village of Sabina sewerage systems. In addition, the Octa WWTP, also called Fayette County/Rattlesnake Creek WWTP (4PH00007) is located at river mile 36.27. This WWTP has recently been upgraded. The affects to water quality are discussed in the beginning of this section with the chemical data results.

Another type of point source, surface impoundments, consist of holding ponds that may only overflow to the creek during rainfall events. The Roger Conlin Hog Farm operates a surface impoundment in the Rattlesnake subwatershed.

OSU Study Results

Dr. Cavender and several interns conducted a seining survey to obtain information on the distribution of Paint Creek fishes across the drainage. This study was conducted to construct distribution maps, to pinpoint areas with the greatest diversity, and to investigate the presence of rare or endangered species. This study brought together all previous collection data to create an accurate representation of the fishes in Paint Creek. The study showed 57 species have been collected over the years but only 45 of them have been resampled during the OEPA/OSU summer sampling time. Dr. Cavender states that "the overall finding for Rattlesnake Creek is one of poor water quality with a reduction and loss of fish species that are intolerant to pollution". He adds that the only way to save and improve the fish community is to stop further channelization and create a permanent riparian corridor.

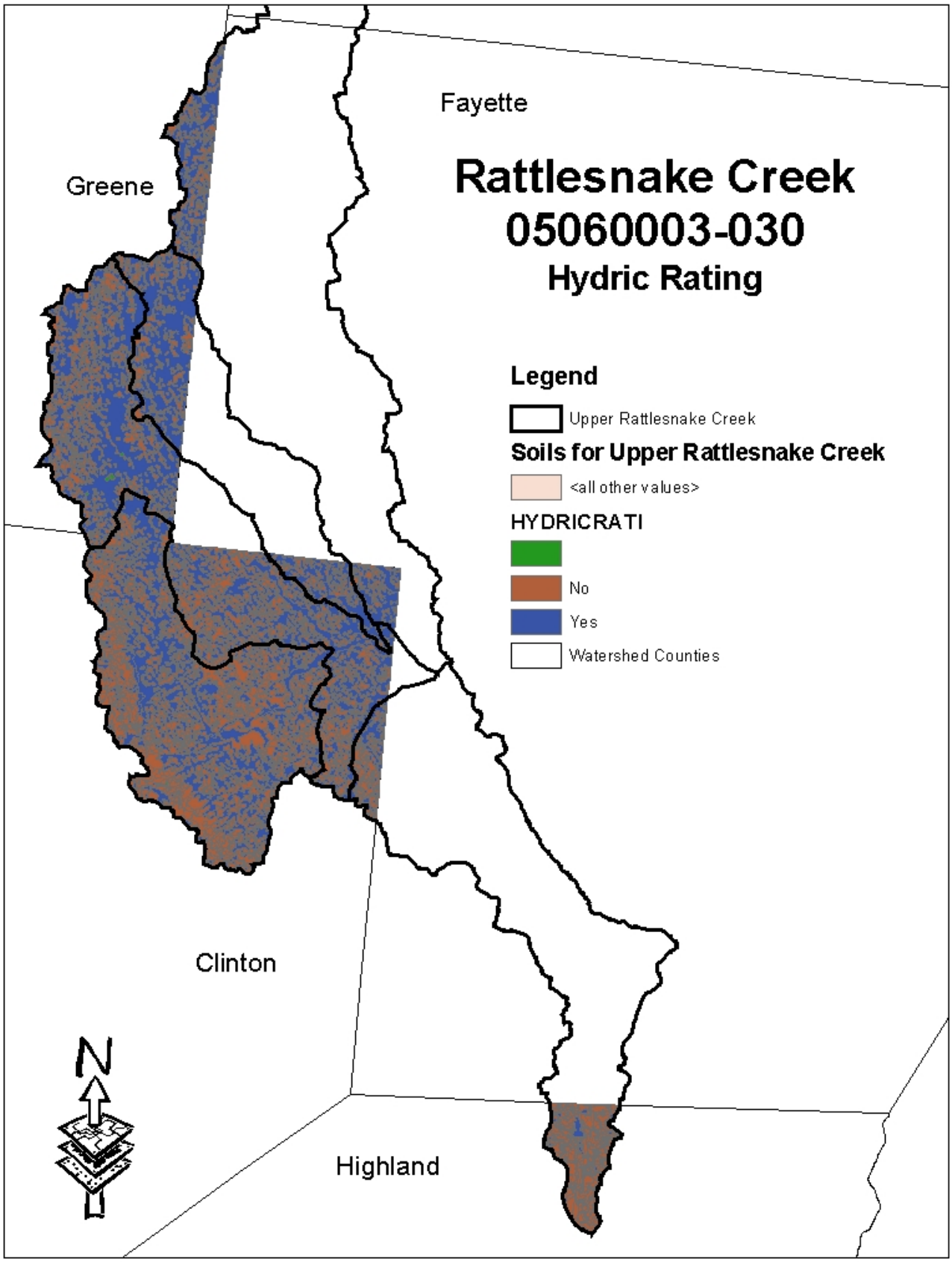
Soils Information

The soils in the Rattlesnake Creek subwatershed fall in Fayette, Clinton and Greene Counties. They are equally hydric and non hydric soils that are not highly erodable with very minimal slope. They greatest percentages of them are somewhat poorly drained, poorly drained or very poorly drained. This explains why the greater percentage of the streams in this watershed are on county ditch maintenance or are at least being maintained as ditches by the landowners. If we look at the 3 14-digit subwatersheds that are we have substantial soil data for, we see again that they are hydric soils that are not generally highly erodable. Please see the following maps for information pertaining to the soils. Please note that soil data is not yet available for the sections in Fayette County.

Summary

Rattlesnake Creek was downgraded from EWH to WWH after the 1997 survey due to it's inability to even meet warm water habitat standards. Channelized streams that are on county maintenance or are least being maintained locally as a ditch characterize this subwatershed. There is very little riparian corridor with some 14-digit areas having less than 5% of riparian cover within 50 feet of the stream. With the lack of cover and predominant land use of row crop agriculture, there are consistent signs of siltation, channelization, embeddedness and high nutrients producing excessive algal blooms. The chemical data from the 1997 sampling

showed exceedences of Ohio's water quality standards (WQS) for fecal coliform bacteria, with 80 percent of the measurements from late summer exceeding WQS. Nutrients were high throughout the summer months and the dissolved oxygen levels reflected this nutrient enrichment scenario. The biological indices showed healthy populations of invertebrate species, but fish populations did not meet WWH target scores. The physical habitat, determined by the QHEI scores, was substandard above river mile 24 and just begin to improve at the lower part of this subwatershed. The landuse in this basin is almost entirely agricultural (94%), with only four percent forested lands. The riparian corridor within 50 feet of the creeks, in turn, only contains 16 percent forested lands. The water quality in this subwatershed is habitat-limited with inputs from agricultural practices flowing directly to the stream. Additionally, there are three WWTP in the watershed, one of which was recently upgraded due its inability to properly handle the sewage load. It is assumed that all BMP's for this watershed will equally benefit all of the 5 subwatersheds since the causes and sources are similar throughout the watershed.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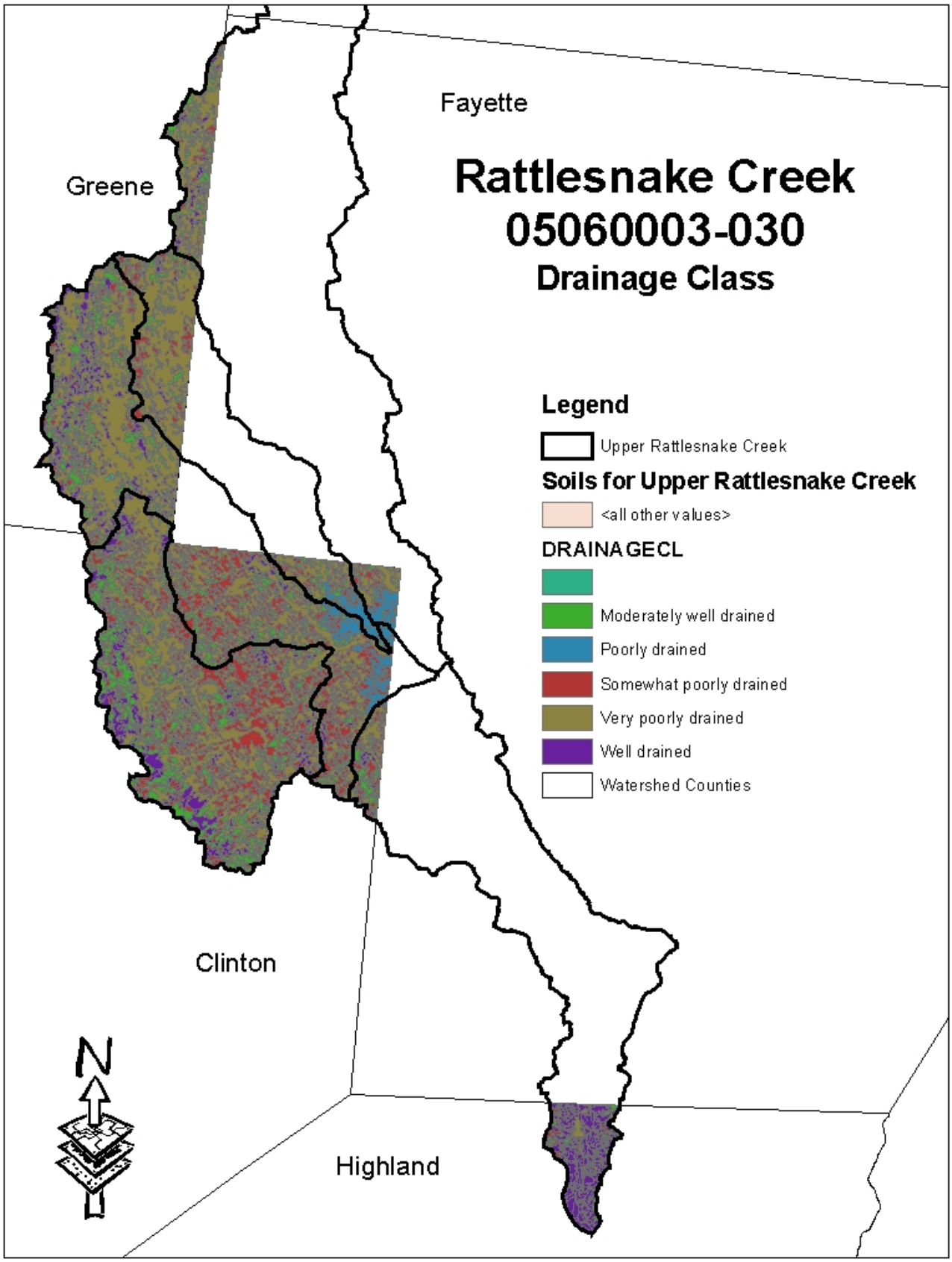
No
Yes
Watershed Counties
Clinton
Highland
N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Somewhat poorly drained
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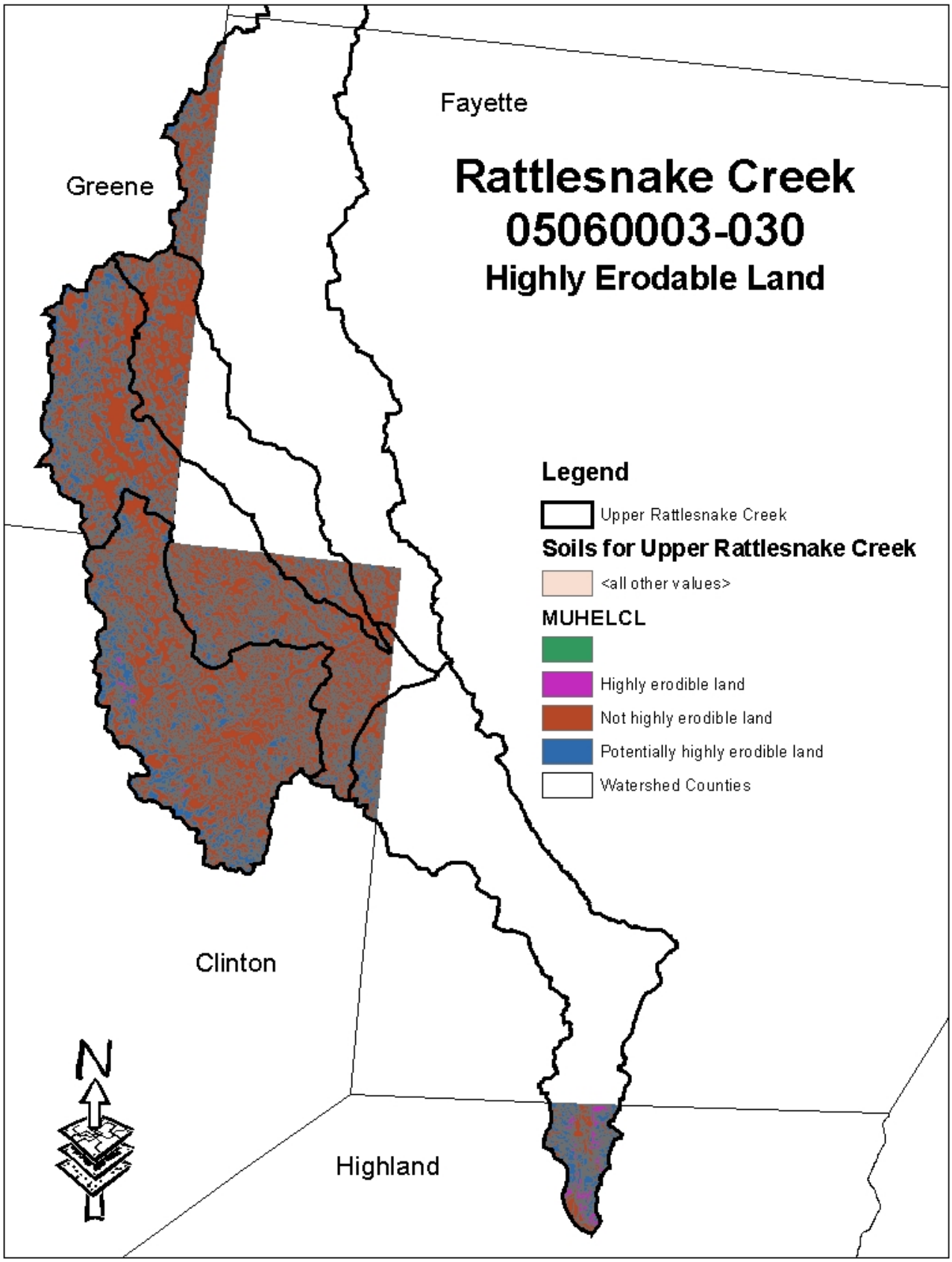
Watershed Counties
Clinton
Highland
N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Upper Rattlesnake Creek
Soils for Upper Rattlesnake Creek
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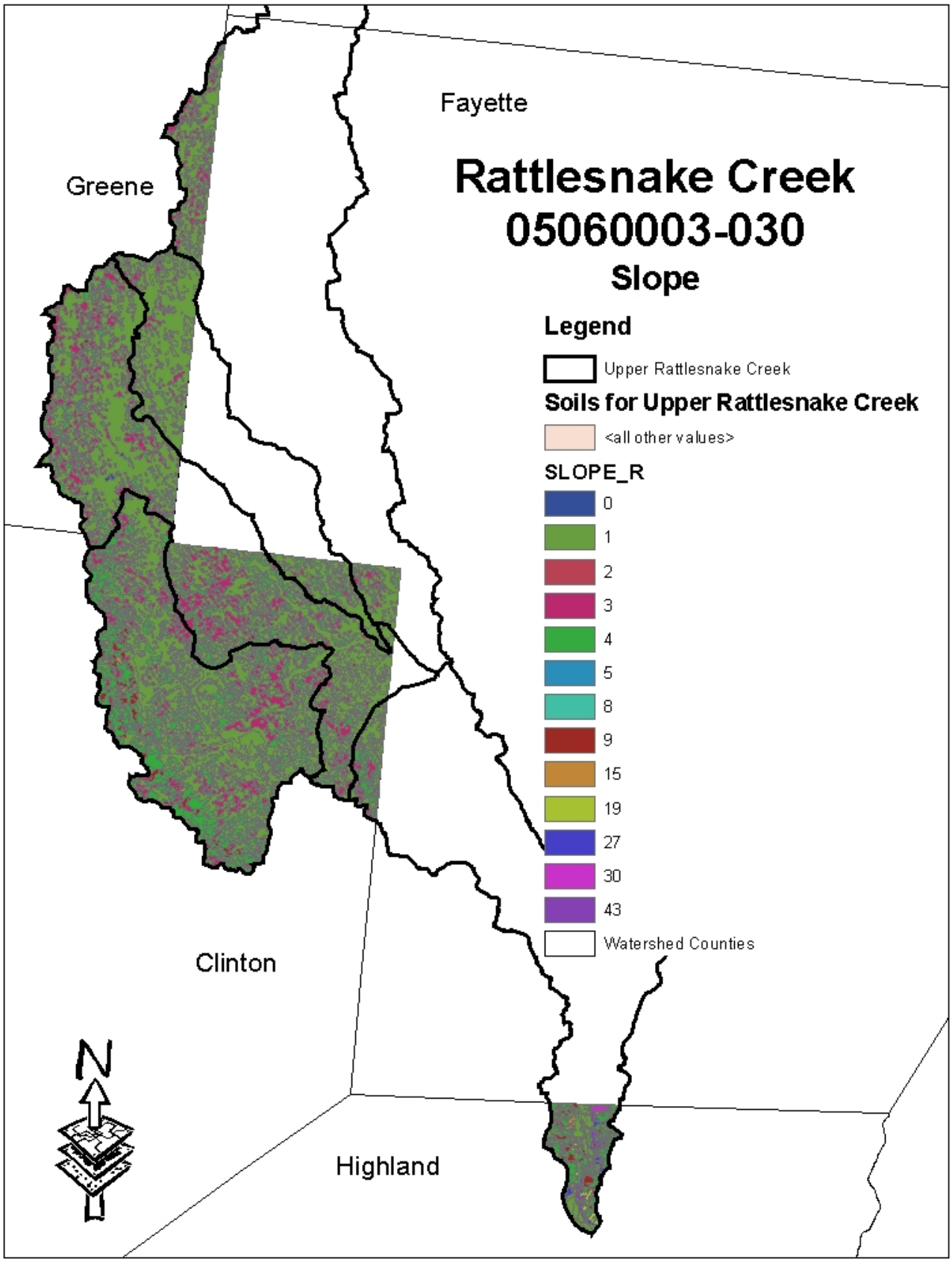
Potentially highly erodible land
Watershed Counties
Clinton
N
Highland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Rattlesnake Creek
05060003-030
Slope
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Upper Rattlesnake Creek
Soils for Upper Rattlesnake Creek
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SLOPE_R
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2
3
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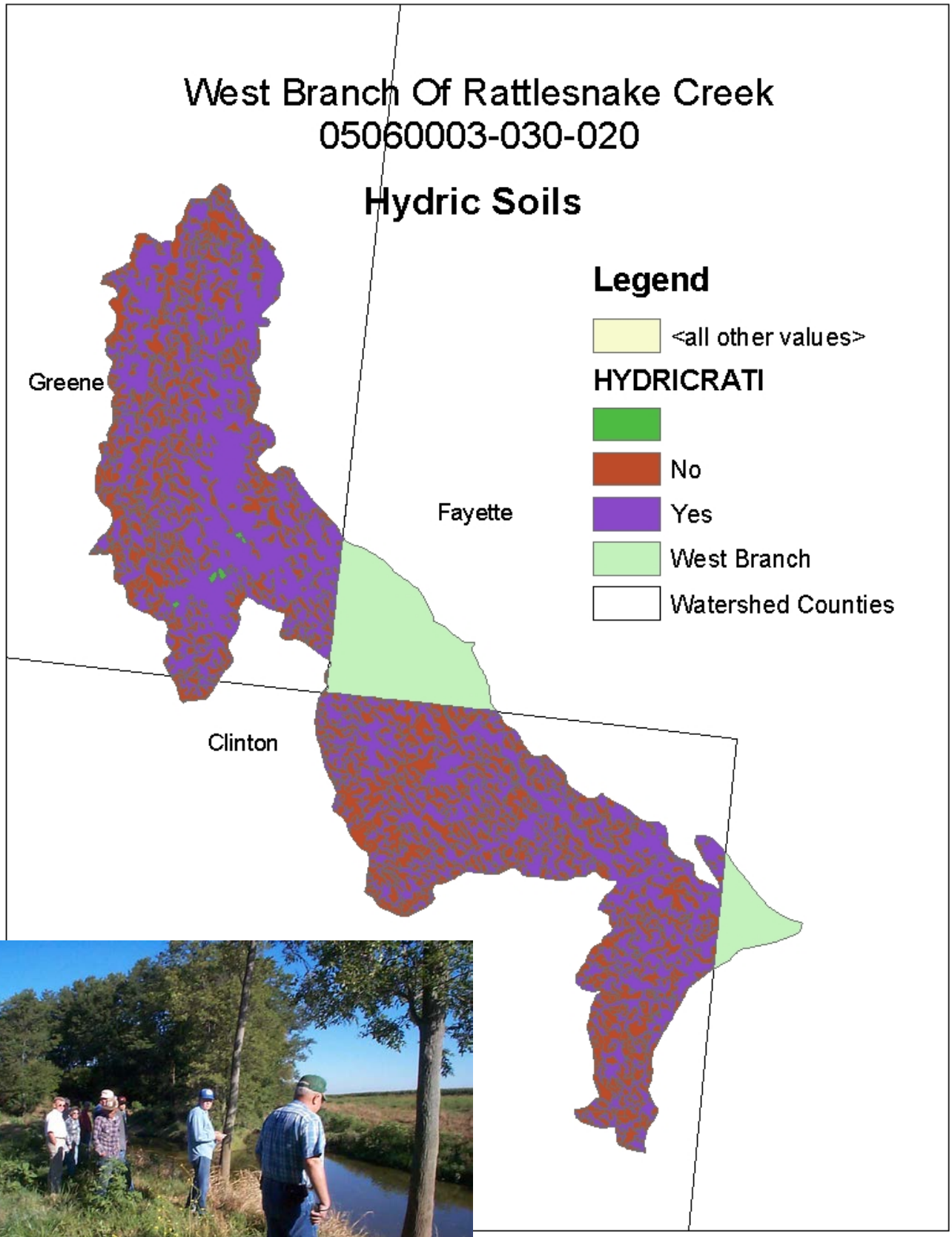
8
9
15
19
27
30
43
Watershed Counties
Clinton
Highland
N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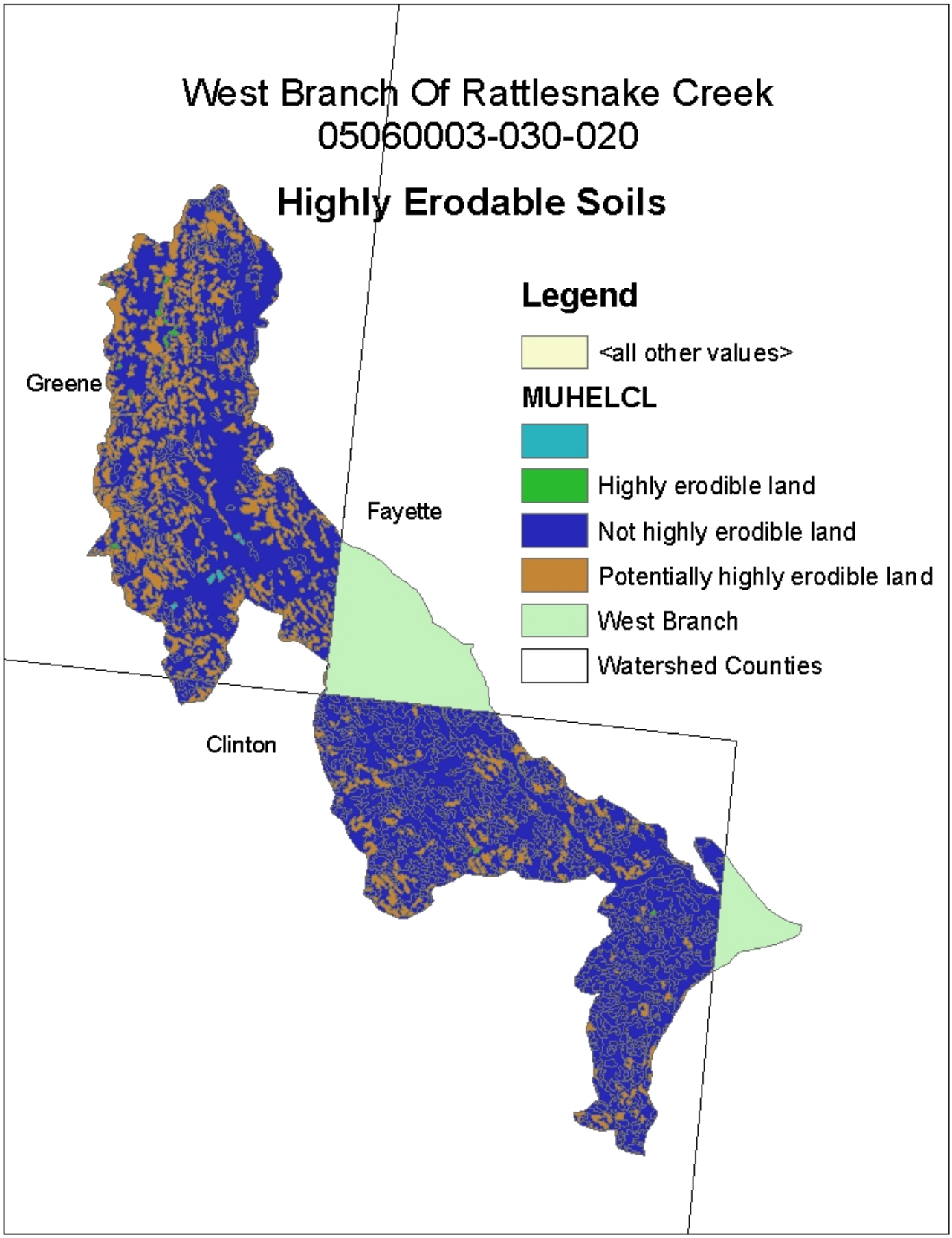
Yes
West Branch
Watershed Counties
Greene
Fayette
Clinton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Potentially highly erodible land
West Branch
Watershed Counties
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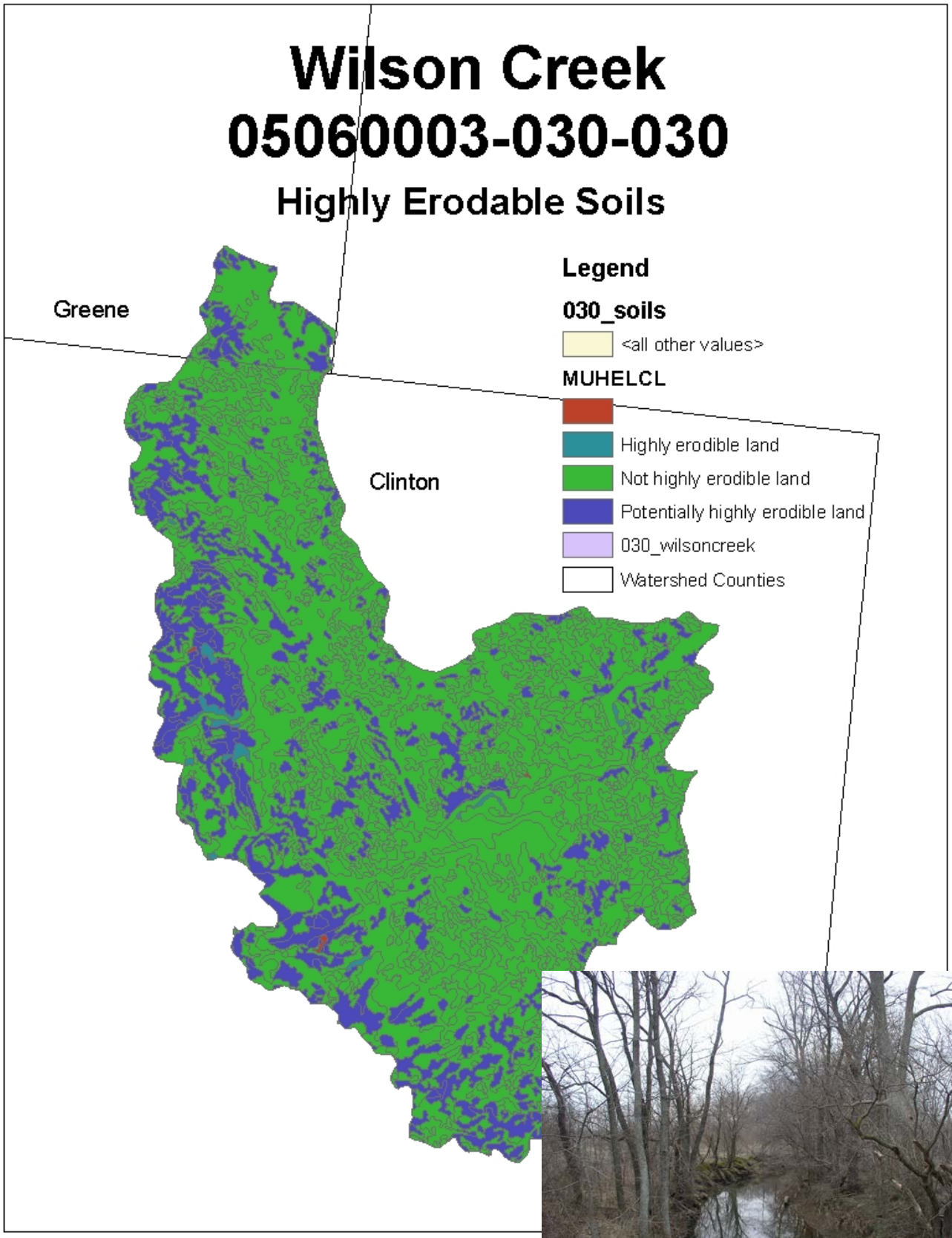
Fayette
Clinton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Clinton
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Not highly erodible land
Potentially highly erodible land
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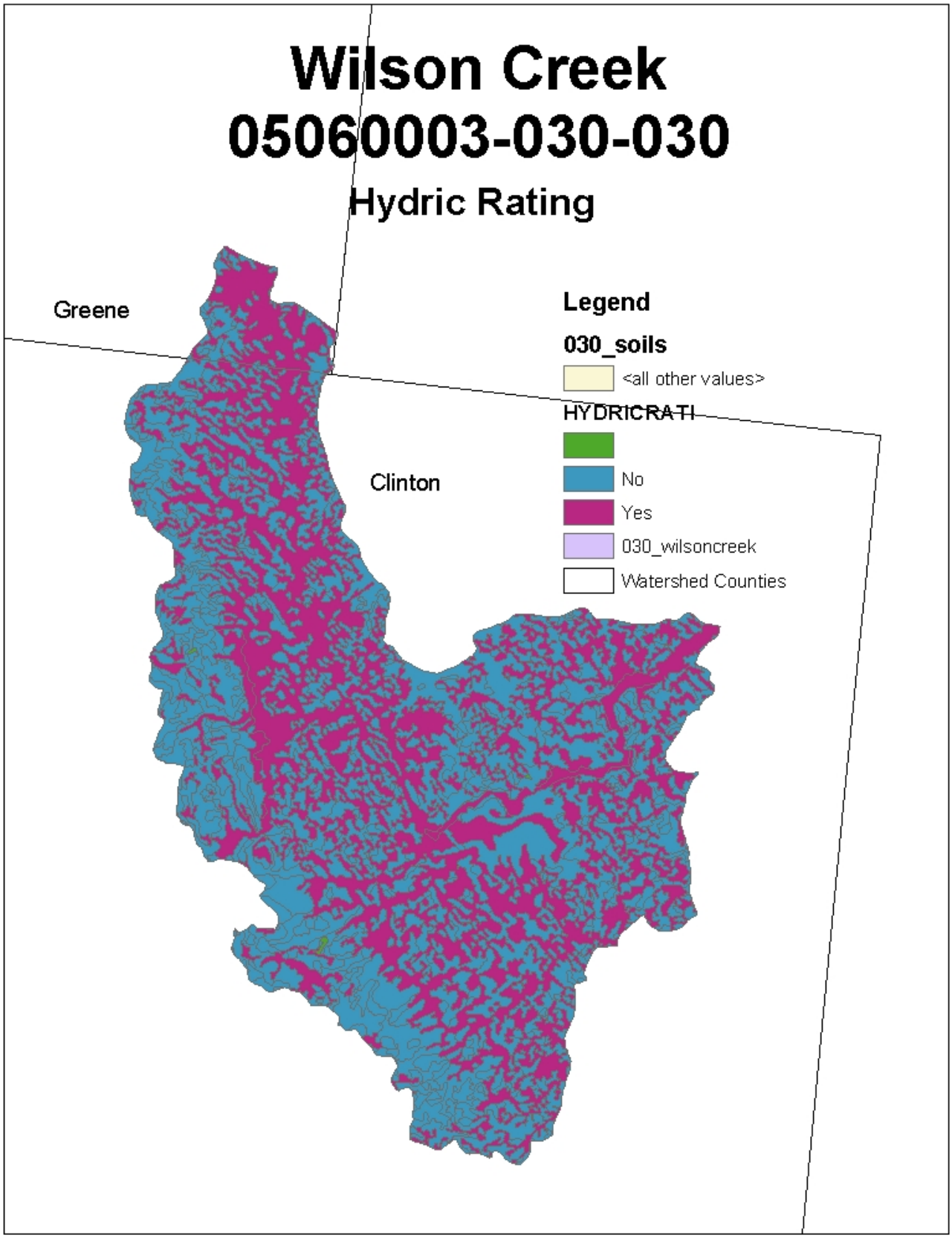
Watershed Counties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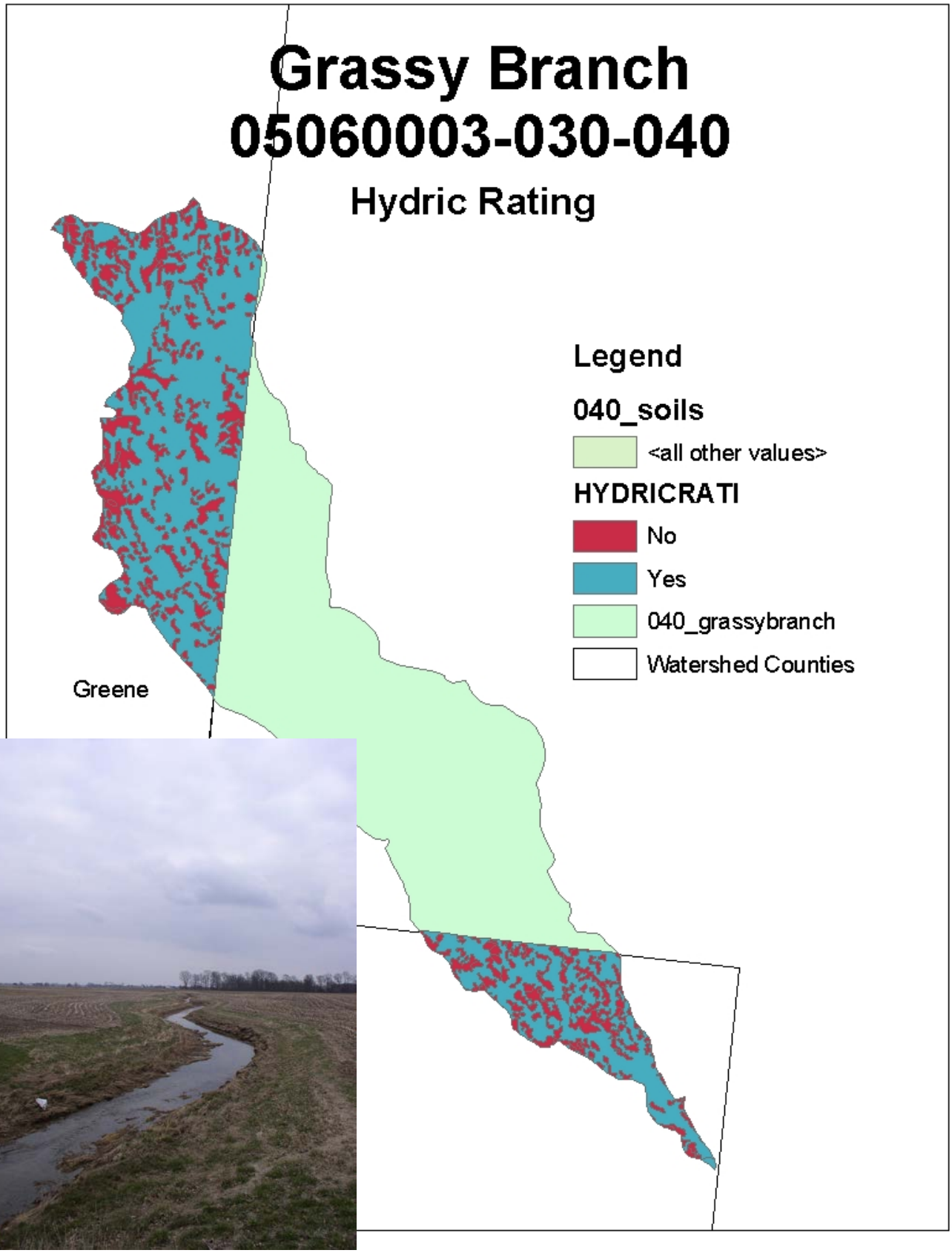
Watershed Counties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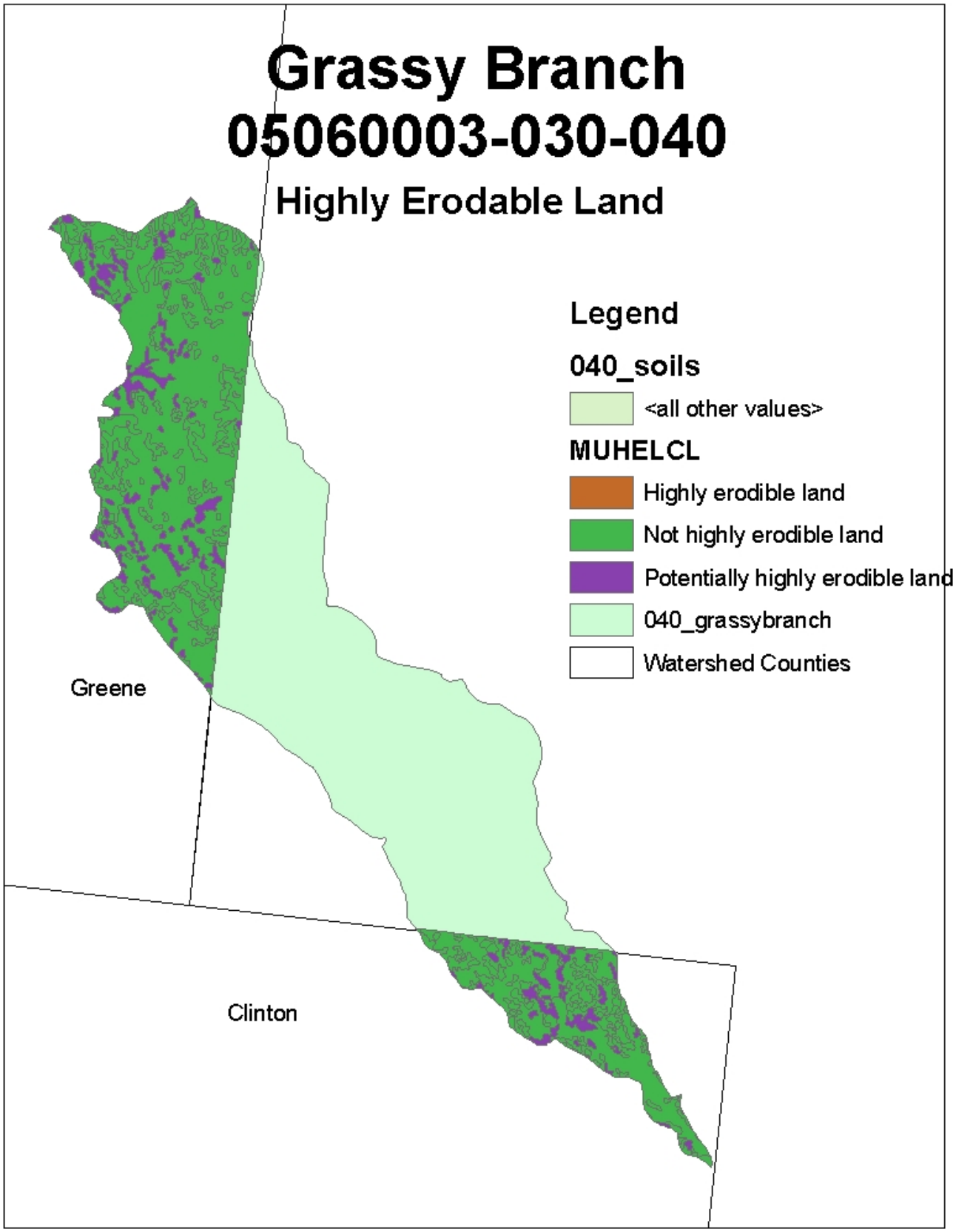
Watershed Counties
Greene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Potentially highly erodible land
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Watershed Counties
Greene
Clinton

Concerns by Subwatershed

Watershed Name	Hydrologic Unit #	Suspected or known causes	Suspected or known sources
Rattlesnake Creek above West Branch	05060003 030 010	Habitat Alteration, Siltation, nutrients, organic enrichment/DO	Crop Production, Channelization, Livestock/pasture Failing HSTS's
West Branch	05060003 030 020	Habitat Alteration, Siltation, nutrients, organic enrichment	Crop Production, Channelization, Failing HSTS's
Wilson Creek	05060003 030 030	Habitat Alteration, Siltation, nutrients, organic enrichment	Crop Production, Channelization, Failing HSTS's
Grassy Branch	05060003 030 040	Habitat Alteration, Siltation, nutrients, organic enrichment/DO	Crop Production, Channelization, Failing HSTS's
Rattlesnake below W. Branch to Lees Creek	05060003 030 050	Habitat Alteration, Siltation, nutrients, organic enrichment/DO	Crop Production, Channelization, Failing HSTS's

Public Support and Participation

The Paint Creek Watershed Project began holding public meetings in January of 1999 with their Watershed Coordination Kick-Off meeting. There were over 60 people in attendance and they came up with a listing of issues and concerns and then they were asked to pick the ones of priority. Those priority issues are seen below in the first listing. The project did not hold structured meetings again until 2002 due to the lack of availability of the Coordinator to hold meetings along with other day to day duties. In mid 1999, the Project wrote and was awarded a Section 319 grant to hire and write a management plan and in January of 2002, Hilary Solomon was hired. That February, both the Plan Coordinator, Hilary Solomon, and the Project Coordinator, Julie Brown, held meetings throughout the watershed having one in each 11-digit area to start gathering support for the project and to find out the issues and concerns. These meetings were held in the evenings in order to attract all possible interest parties and turn out was rather varied with as little as 2 participants in areas where the stream was smaller and on county maintenance to as many as 60 people where there were more urban communities. After these meetings, the citizens were invited to attend the Advisory Council meetings that were held quarterly for a year and a half after where subgroups sat at the table to formulate objectives and goals for the issues and concerns gathered at the local meetings. The final product was the draft Management Plan that was submitted to Ohio EPA in July of 2002. Soon after submitting the plan, Hilary Solomon's resigned her position and with her went the structured planned meetings. Hilary's work on the plan was invaluable and she is sorely missed as the revisions are completed.

Although the watershed is diverse in landscape and landuse, the issues and concerns that came up regularly at our evening meetings were the same across the watershed and very similar to the original list that was created in 1999. Here is a listing of those concerns.

Priority list from January 1999 meeting (in order of priority):

1. Reduce soil erosion
2. Protect riparian corridor
3. Create a community-driven watershed organization
4. Improve overall water quality
5. Protect against urbanization of farmland
6. Promote filter strips
7. Runoff/storm water management from housing developments and urban areas
8. Promote cost effective BMPs

Between February 28 and March 27, 2001, the Project held the 11 community interest meetings. These meetings were held in nine of the ten USGS hydrologic subunits in the watershed. The meetings were conducted in Bainbridge, Washington Court House, Chillicothe, Frankfort, Sabina, Jeffersonville, Hillsboro, Leesburg and Greenfield. In addition, meetings were held in Chillicothe with the Smallmouth Bass Alliance and the Symposiarts, a group that explores local culture and natural heritage.

The concerns and interest of the local community members were many and varied. The most common topics included stream bank erosion, public access to the creeks (countered with fears about trespassing), modifying dam releases from Paint Creek Lake and Rocky Fork to mimic natural stream flow patterns, litter control/illegal dumping, and map availability for local interest groups. Some of the most passionate discourse related to fish tissue consumption warnings, confined animal feeding units, wastewater treatment plant installations and management, riparian corridor restoration, and promoting environmental education in schools. A full list of community concerns and suggestions can be found below. Topics in bold were frequent concerns.

The Local Community Concerns were as follows:

Historic/special site preservation
Maps for local interest groups
Farmland/environmental compatibility
Water quality monitoring/maintenance
Confined animal feeding operations
Wastewater treatment plants and failing home septic systems
Litter/illegal dumping
Roadkill
Adopt-a-highway
Loss of farmland
BMP education and enforcement
Lack of zoning
Land use planning
Natural dam releases
Student environmental education
Animal control (beavers and geese)
Land stewardship education for landowners

Community participation
Public access to the creeks
Sediment control/contamination
Logging Practices
Riparian corridor
Stream bank erosion
Log jams
Recreation
Exotic species

The Watershed project again came to the table in the first week of February, 2004 to discuss these issues again but in a much smaller watershed. They looked at the water quality problems and formulated solutions. A listing of the issues discussed follows and this list will be what helps us formulate the load reductions and BMP's that we hope to see in this watershed in the future.

Meeting to Discuss the Water Quality Issues in the North Fork of Paint Creek
Attendance:
Vince Chrisman, Fayette SWCD
Jeff Thomas, ODNR, DSWC
Heidi Devine, ODNR, DOW
Kipp Brown, ODNR, DOW
Liz Cline, ODNR, DSWC
Neal Bond, Landowner
Kenneth Shuablin, Clinton Co. Planning Commission
Rick Garrison, Fayette County Health Dept.
Jim Wolary, Clinton SWCD

11 Digit Watershed: 05060003 030
11 Digit Watershed Name: Rattlesnake Creek (Headwaters to Lees Creek)
14 Digit Watershed(s) and Name(s):
05060003 030 010 Rattlesnake Creek above West Branch
05060003 030 020 West Branch Rattlesnake Creek
05060003 030 030 Wilson Creek
05060003 030 040 Grassy Branch of West Branch
05060003 030 050 Rattlesnake Creek below West branch to Lees Creek
Sources of Water Quality Impairment: Organic enrichment/DO, habitat alteration, siltation
Causes of Water Quality Impairment: Municipal point source, channelization, crop prod.

Forested Buffer Along Streams: 05060003 030
Acreage Within 50 foot of Stream on either side: 1478 acres
Forested Acreage within 50 feet of stream: 232 acres
Percent forested coverage within 50 ft: 16%

Forested Buffer Along Streams: 05060003 030 010
Acreage Within 50 foot of Stream on either side: 410 acres

Forested Acreage within 50 feet of stream: 63.5 acres
Percent forested coverage within 50 ft: 15%

Forested Buffer Along Streams: 05060003 030 020
Acreage Within 50 foot of Stream on either side: 279 acres
Forested Acreage within 50 feet of stream: 4.4 acres
Percent forested coverage within 50 ft: 1.6%

Forested Buffer Along Streams: 05060003 030 030
Acreage Within 50 foot of Stream on either side: 281 acres
Forested Acreage within 50 feet of stream: 13 acres
Percent forested coverage within 50 ft: 5%

Forested Buffer Along Streams: 05060003 030 040
Acreage Within 50 foot of Stream on either side: 179 acres
Forested Acreage within 50 feet of stream: .5 acres
Percent forested coverage within 50 ft: .3%

Forested Buffer Along Streams: 05060003 030 050
Acreage Within 50 foot of Stream on either side: 337 acres
Forested Acreage within 50 feet of stream: 149 acres
Percent forested coverage within 50 ft: 44%

Background: The section of Rattlesnake Creek from the headwaters to Lees Creek is currently not meeting its use designation or partially meeting its use designation throughout the watershed due to nutrients, organic enrichment and other habitat alterations. It is also believed, based on data from the QHEI, that siltation is contributing to the impairment. Exact locations of impairment are as follows:

RIVER MILE	STREAM	LOCATION	ECO-REGION	SIZE*	HABITAT	PRIORITY	ATTAINMENT
40.50	Rattlesnake Creek	SR 734	ECBP	HW	WWH	Low	Full
38.10	Rattlesnake Creek	SR 35, SR 753, Ust. Octa	ECBP	W	WWH	Medium	Partial
35.50	Rattlesnake Creek	Dst. Octa, Ust. Milledgeville	ECBP	W	WWH	High	Non
35.20	Rattlesnake Creek	Dst. Octa, Dst. Milledgeville	ECBP	W	WWH	Medium	Partial
33.40	Rattlesnake Creek	Marchant-Luttel Rd.	ECBP	W	WWH	High	Non
31.40	Rattlesnake Creek	SR 729	ECBP	W	WWH	High	Non
24.00	Rattlesnake Creek	Snow Hill Rd.	ECBP	W	WWH	High	Non
18.00	Rattlesnake Creek	Staford Rd.	ECBP	W	WWH	Medium	Partial
15.00	Rattlesnake Creek	Zimmerman Rd.	ECBP	W	WWH	Medium	Partial
13.30	Rattlesnake Creek	Fisherback Rd.	ECBP	W	WWH	Medium	Partial
7.80	Rattlesnake Creek	Jefferson St., Centerfield	ECBP	SR	WWH	Low	Full
4.30	Branch Rattlesnake	SR 729	ECBP	SR	WWH	High	Non

Problem statement: Excessive nutrients, organic enrichment and habitat alteration in the upper section of the Rattlesnake Creek watershed are causing impairment of the use designation. Through field inventory, the source of the erosion is believed to be from over land runoff and streambank erosion. The source of the nutrients and organic enrichment are believed to be widespread row crop agriculture, livestock, failing septic systems (livestock and septic discussed later) and habitat alterations predominantly channelization. More precise locations of eroding banks are not yet confirmed. The total sediment load is 30,000 tons/year with a total nutrient load of 229,654 lb/year as calculated by the STEPL program.

The task descriptions below were formulated using recommendations from experts at the local Soil and Water Conservation Districts, Health Departments, Ohio Department of Natural Resources, Division of Forestry, Division of Wildlife, and Division of Soil and Water Conservation, along with the Natural Resource Conservation Service and the Ohio Environmental Protection Agency.

Goals:

1. Reduce nutrient load and organic enrichment by 30% from agricultural fields and failing on-site home septic systems.
2. Reduce sedimentation by 50% from habitat alterations

Task Description	Resources	How	Time Frame	Performance Indicators
Establish conservation tillage on 28000 acres. The first priority being highly erodable land within 1000 feet of the stream. It is estimated that	$350,000	Local watershed group will apply for 319 grant.	January 2006-January 2011	Document soil and nutrients saved/not delivered to stream using

this will reduce the nutrient load 16,832 lb/year and the sediment load by 4535 tons/year				RUSLE or other model, Improved QHEI scores
Control erosion and nutrient runoff with the installation of 28,000 linear feet of grassed waterways and water and sediment control basins. It is estimated that this will reduce the nutrient load by 27,000 lb/year and the sediment load by 7000 tons/year	$150,000	CRP, EQIP, Local watershed group will apply for 319 grant program	January 2006-January 2011	Document soil and nutrients saved/not delivered to stream using RUSLE or other model, improved QHEI scores
Establish a total of 135 acres within 50 feet of the stream of riparian corridor, natural regeneration and/or warm season grasses along the impaired segments. It is estimated that this will reduce the nutrient load 21,893lb/year and the sediment load by 6000 tons/year	$350,000 for an incentive program	CREP, CRP, EQIP, WHIP, FLEP, DOW free seed and Pastures to Prairies Program, Pheasants Forever, National Wild Turkey Federation, Paint Creek Watershed Project 319 program	January 2005 to January 2015	Document soil saved/not delivered to stream using RUSLE or other model, improved QHEI scores

Loading reductions calculated using Load Reduction Spreadsheet v1.2.

Problem statement: Excessive nutrients and organic enrichment in the upper section of the Rattlesnake Creek watershed are causing impairment of the use designation. After discussions with the SWCD and local Health Dept. it is accepted that approximately 15% of the on-site septic systems in this area are failing which is approximately 132 homes. There are also other septic issues with the unsewered communities of Milledgeville and parts of Octa. More precise locations of failing systems are not yet confirmed. The total nutrient load for this watershed is 229,654 lb/year. Ed Moore from the Ecological Assessment Unit at Ohio EPA stated that an increase in effluent quality from the Fayette Co./Rattlesnake Creek WWTP and some NPS input abatement would increase water quality through this reach enough to allow for the attainment of WWH water quality criteria. The estimated nutrient load from these 132 homes is 19.8 lbs/day of nitrogen and 13.2 lbs/day of phosphorus. Loading reductions calculated using Load Reduction Spreadsheet v1.2.

The task descriptions below were formulated using recommendations from experts at the local Soil and Water Conservation Districts, Health Departments, Ohio Department of Natural Resources, Division of Forestry, Division of Wildlife, and Division of Soil and Water Conservation, along with the Natural Resource Conservation Service and the Ohio Environmental Protection Agency.

Goals:

1. Reduce nutrient load and organic enrichment from failing on-site home septic systems by repairing all failing systems.

Task Description	Resources	How	Time Frame	Performance Indicators
Work with county Health Departments to determine more accurate number of failing systems	HD Inspectors time to inspect all systems	Inspect all systems	January 2004-January 2005	Report of failing systems generated
Replace/upgrade failing systems	Health Dept. time to write plan	Apply to DEFA for low interest on-site loan program for county	October 2002-December 2004	DEFA program available in county,
Search for funding options to upgrade failing systems	Watershed Coordinator and/or Health Dept. time to write 319 grant application	Local watershed group or Health Dept. will apply for 319 grant program	January 2006	Grant Submitted
Replace/upgrade all failing systems	County sanitarians time to approve applications and inspect	Local watershed group or Health Dept. will apply for grant program	January 2006-December 2011	All failing systems replaced or upgraded

Problem statement: Excessive nutrients, organic enrichment and habitat alteration in the upper section of the Rattlesnake Creek watershed are causing impairment of the use designation. Through field inventory, the source of some of the nutrients and organic enrichment are believed to be livestock and their access to the stream. According to the county SWCD's, there are approximately 12,000 hogs, 220 sheep, 170 horses, 600 cattle and 100 dairy cattle in the watershed. The total nutrient load for the watershed is 229,654 lb/year. While this is not a large number of livestock, there are problems with thier proximity to the stream which according to Ed Moore's description of the watershed earlier in this document, they are causing slumping banks, sedimentation and nutrient enrichment.

The task descriptions below were formulated using recommendations from experts at the local Soil and Water Conservation Districts, Health Departments, Ohio Department of Natural Resources, Division of Forestry, Division of Wildlife, and Division of Soil and Water Conservation, along with the Natural Resource Conservation Service and the Ohio Environmental Protection Agency.

Goal:
1. Stabilize 3000 feet of eroding banks by excluding livestock.
2. Reduce nutrients entering the stream from livestock feeding and watering

Task Description	Resources	How	Time Frame	Performance Indicators
Establish a livestock nutrient reduction program with a combination of heavy use feeding pads, exclusion fencing, and alternate watering sources.	75,000 for an incentive program	CREP, CRP, EQIP, Paint Creek Watershed Project 319 program	January 2006 to January 2009	Document decreased nutrient and sediment load using estimated load reduction spreadsheet.

Loading reductions calculated using Load Reduction Spreadsheet v1.2.

Problem statement: Excessive nutrients, organic enrichment and habitat alteration in the upper section of the Rattlesnake Creek watershed are causing impairment of the use designation. Education programs and personnel are needed to educate the community and provide an awareness of the issues, both agricultural and urban, and to deal with concerns. Pursue recreational alternatives to encourage use of the natural resource.

The task descriptions below were formulated using recommendations from experts at the local Soil and Water Conservation Districts, Health Departments, Ohio Department of Natural Resources, Division of Forestry, Division of Wildlife, and Division of Soil and Water Conservation, along with the Natural Resource Conservation Service and the Ohio Environmental Protection Agency.

Goals:

1. Reduce nutrient load, organic enrichment, and sedimentation through education and awareness programs

Task Description	Resources	How	Time Frame	Performance Indicators
Work with local stakeholders to create an awareness of the watershed issues and concerns and available programs. Use GIS to formulate watershed mailing lists to keep landowners aware of programs.	Maintain a watershed coordinator	Local watershed group will search for other funding source	On going	Watershed Coordinator is hired/continues employment.
Work with developers, builders and government agencies to ensure county urban erosion control guidelines are followed.	Add an urban streams conservationist to the watershed project	Local watershed group will search for other funding source	January 2008	Urban Streams Conservationist is hired.
Provide increased public access to the stream for recreational use.	Funding needs unknown at current time	Local recreation entities will look into water based recreation grant opportunities with the Div. of Watercraft.	January 2008	Recreational access increased for public use.

Evaluation Strategy and Plan Update/Revision:

The Paint Creek Management Plan is anticipated to be a living and working document that does not end up on a shelf collecting dust. In order to accomplish this, evaluation and updating will be key components for the future.

Since the formulation of the Management Plan relied heavily on stakeholder input, their evaluation of the plan will be crucial to it's future. The Project would like to implement a yearly progress meeting to discuss the original goals of the plan and to determine the status of these goals and the need for additional response or update. The success of some measures such the BMP's will be measured on a basis of application and implementation in the watershed. This information will be provided by the local Soil and Water Conservation Districts, Natural Resource Conservation Service and the County Health Departments. A measure of success for the education aspect of the plan will be the number of programs provided and the attendance of the community. It is anticpated that as awareness of the watershed increses that the interest in monitoring local streams will increse and that this data will also be used to evaluate and monitor the success of the plan at improving the water quality.

The ultimate responses that the Project hopes will come out of this planning process is:

- Increased awareness in the community of the Paint Creek Watershed and
- Water quality in the watershed meeting use designations with QHEI scores consistently improving.

This watershed is slated to be sampled by the Ohio EPA Ecological Assessment Unit in 2006 with a TMDL completion date of 2008. Paint Creek received it's first intensive sampling effort in 1997 so the project will also be able to look for any changes from one sampling period to the next and compare that with the work the Project that has already completed.

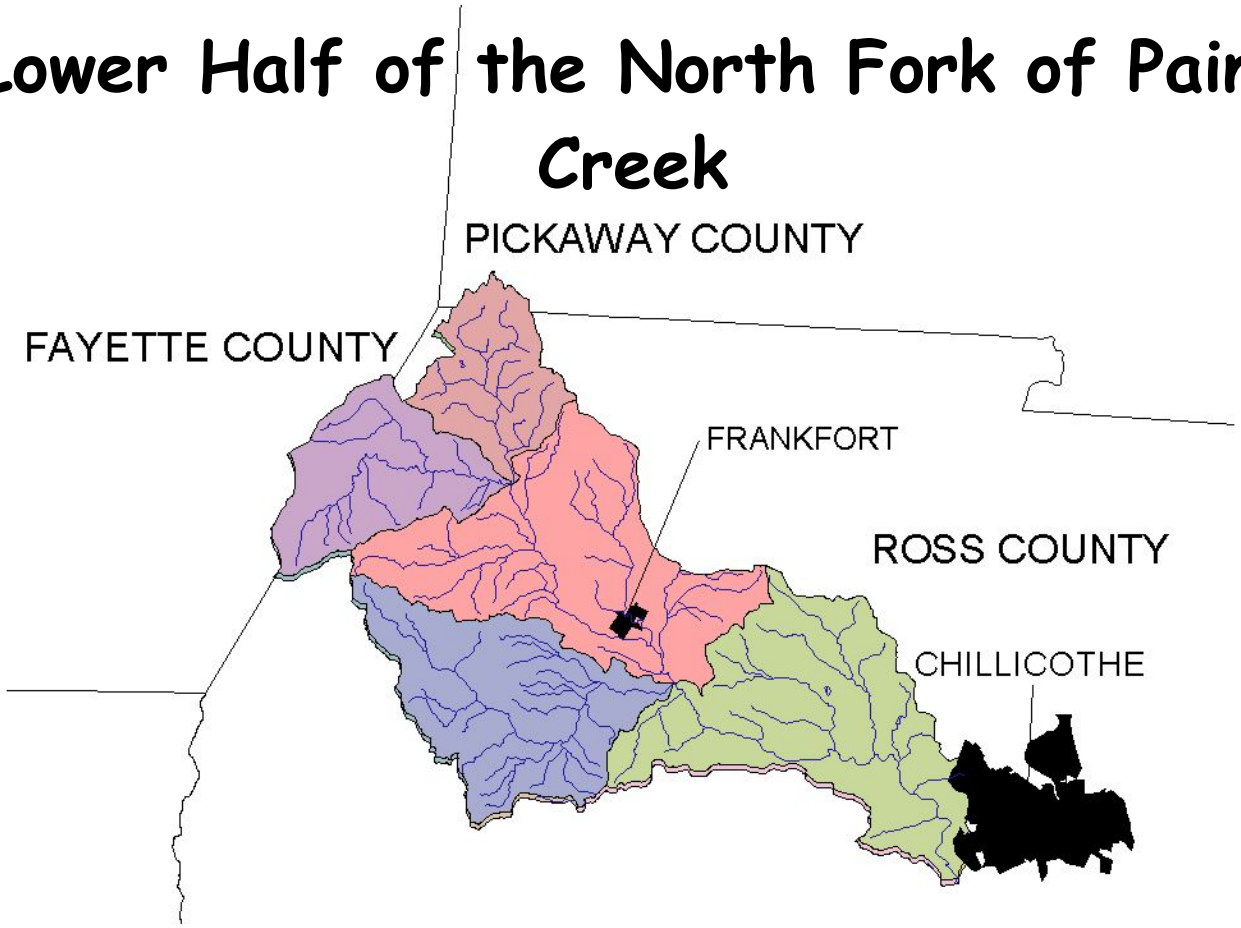
The progress of the plan will be made available to interested local and state governments as well as all watershed citizens trough newsletters, brochures, news articles, radio programs and at some point a web site. These duties will be the responsibility of the Watershed Coordinator and the Paint Creek Joint Board of Supervisors along with the Sub-watershed Work Groups.

It is anticipated that as a working document, the plan will be revised yearly after the progress meetings have determined the successes and failures.

The Paint Creek Watershed Project is pleases to have had the involvement of the following people and organizations in the completion of this community based watershed action plan.

Name	Association	City
Agriculture Subgroup		
Hugh Trimble	Ohio EPA	Dayton
Gordon Conn	Farmer	Jeffersonville
Dave Parry	NRCS	Hillsboro
Vince Chrisman	Fayette SWCD	Washington CH
Dave Sever	Sever Consulting	Washington CH
Eric Rutherford	Landowner	Wilmington
David Caplinger	Landowner, SOFA	Hillsboro
Rosida Porter	Ohio DNR	Columbus
Forestry Subgroup		
Heidi Devine	Ohio DNR, Div of Wildlife	Xenia
Lee Crocker	Ohio DNR, Div of Forestry	Waverly
Mike Besonen	MeadWestvaco	Chillicothe
Chris Smid	MeadWestvaco	Chillicothe
Randy Sanders	Ohio DNR	Columbus
Joey Knauff	Knauff Lumber/ Master Loggers	Bainbridge
Education Subgroup		
Sam Webb	Pickaway SWCD	Circleville
Jenny Behymer	Landowner	Hillsboro
Layne Garringer	Fayette SWCD	Washington CH
Steve Hawkins	Ohio DNR/DSWC	Circleville
Jerry Iles	OSU Extension	Jackson
Urban Subgroup		
Julia Cummings	Madison SWCD	London
Steve Sobers	City Manager	Washington CH
Streamside Management Subgroup		
Dot Riley	NRCS	Grove City
Gordon Conn	Farmer	Jeffersonville
Gary Merkamp	Ross County Park District	Chillicothe
Randy Hoover, Kipp Brown	Ohio DNR, Div of Wildlife	Xenia
Bob Jones	Landowner, former Army COE	Bainbridge
Dan Imhoff	Ohio EPA	Logan
Marty Lundquist	Ohio DNR, Div of Wildlife	Columbus
Paula Wentzel	MeadWestvaco	Chillicothe

Watershed Action Plan for the Lower Half of the North Fork of Paint Creek



Hydrologic Unit Numbers:

05060003 090 010 North Fork below Compton Creek to above Herrod Creek

05060003 090 020 Herrod Creek

05060003 090 030 North Fork below Herrod Creek to above Little Creek

05060003 090 040 Little Creek

05060003 090 050 North Fork below Little Creek to Paint Creek

Written and Compiled by:
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Julie Brown, Watershed Coordinator
Paint Creek Watershed Project
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Chillicothe, Ohio 45601
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INTRODUCTION

The Paint Creek Watershed Management Plan stems from an ongoing conservation ethic within the Paint Creek Watershed. Conservation practices were explored in the watershed as early as the 1960's. Public awareness and interest in maintaining and/or improving water quality in the watershed has increasingly mounted since those early studies. Land managers within the watershed are currently pursuing several conservation grants and the watershed project is distributing Clean Water Act, section 319 grant monies to fund projects in targeted areas. The management plan will provide information to ensure that future conservation efforts within the watershed are applied in the most efficient and beneficial manner.

As far as practicable, the Paint Creek Watershed Management plan follows the outline contained in Ohio EPA's *Guide to Developing Local Watershed Action Plans in Ohio* (June 1997). The plan contains four main sections: the background and scope of the project, a comprehensive watershed inventory, a watershed-wide water quality assessment with documentation of the related problems, and an outline of planned implementation activities or solutions. This last section includes a timeline and methods to evaluate the effectiveness of the activities implemented within the watershed.

The Watershed Project was originally formed in 1998 when 6 coordinating Soil and Water Conservation Districts received Section 319 funds for implementation. It was always the plan that A watershed Coordinator would administer the grants and also work on putting together a management plan for the watershed. The Project is governed by a Joint Board of Supervisors, one from each of the 6 main county SWCD's, that follow the operational procedures of a District SWCD. The Joint Board also put together bylaws that are available from the Watershed Coordinator. This Board makes all decisions based on funding and application approval for the implementation program but decisions about the contents of the plan have been left completely up to the stakeholders involved in the development process. The stakeholder groups have been open to the public and new attendees are welcome at any time.

General Description and Political Boundaries

The Paint Creek Watershed is comprised of 731,168.9 acres located in 9 counties: Madison, Greene, Clinton, Clark, Pickaway, Fayette, Pike, Ross, and Highland.

The Main Paint Creek Subwatershed is located in south central Ohio and covers 310,585 acres. It originates in Madison County and encompasses much of Fayette County and the eastern edge of Highland and western edge of Ross County. Main Paint Creek meets the Scioto River south of Chillicothe in Ross County. The flood plain of Paint Creek varies in width from a few feet at its source to more than 1.5 miles at its mouth. The stream fall from source to mouth is 555 feet, an average of 5.7 feet per mile. The fall in the lowermost 50 miles is about 265 feet or 5.3 feet per mile (Corps, 1973). At the confluence of Paint Creek and Rattlesnake Creek is the Paint Creek Lake. The lake was built by the Army Corps of Engineers for flood control, but also serves recreational purposes.

Background/reasons for implementing a management plan

The following were presented to the advisory group and community as reasons for writing and implementing a comprehensive management plan for Paint Creek Watershed.

Size/diversity of the watershed

Paint Creek Watershed covers over 731,000 acres and crosses multiple political boundaries. Additionally, the watershed may be divided into multiple subwatershed units each of which forms an independent drainage unit within the larger watershed. Depending on the topography of the area these units may be subdivided many times and each subwatershed will have slightly different chemical, physical and biological properties. In addition, many people reside in the watershed and activities such as agriculture, forestry, urban development, recreation, commerce and industry continue to grow and change.

Total Maximum Daily Loads (TMDLs). The advent of increasingly stringent enforcement of the Clean Water Act, is reflected in the introduction of TMDLs across the country. Ohio EPA recently began implementing their TMDL program and the Paint Creek Watershed is scheduled for evaluation in 2012-2013. The TMDL program establishes daily limits for a variety of pollutants, including sediment and nutrients, discharged to streams that do not meet water quality standards outlined in the Clean Water Act. This program currently only affects point source discharges though forestry, agriculture and development may be affected in the future.

Soil erosion. Soil erosion is one of the biggest problems in the watershed and the focus of most of the conservation practices implemented by both landowners and the Army Corps of Engineers. Most of the soil in South Central Ohio is depositional till resulting from the glacial activities. This soil is prone to erosion and there is erosion and erosion-related water quality problems throughout the watershed.

Water quality. In 1997, Ohio EPA surveyed much of the watershed to measure the chemical and biological properties of the waters. The 2000 305(b) report lists the Upper Paint Creek Watershed (North Fork and Rocky Fork) as meeting water quality standards in 35.5 percent of the watershed. Lower Paint Creek Watershed (Main Paint and Rattlesnake) met water quality standards in 75.6 percent of the watershed. In order to establish baseline water quality information and to measure the success of our water quality solutions, we may need to implement an additional sampling program.

Species diversity. The Paint Creek Watershed contains a rich array of plant and animal species. For example, a study completed in 1999 through Ohio State University found 104 species of fish inhabiting the Paint Creek Watershed. Some of the plant and animal species in the watershed include endangered, threatened, rare, intolerant, or species of special interest. The Ohio Department of Natural Resources' Heritage database lists 52 species of interest or concern in the watershed. These include 10 endangered species and 11 threatened species.

Invasive species. Invasive species are plants and animals that are not native to the area. Usually introduced by human activities, these species may have no natural biological controls. They may invade parts of the watershed and crowd out naturally occurring species. Examples of invasive species found in the watershed include, garlic mustard, phragmites reed grass, and Japanese honeysuckle.

319 grants. Conservation practices funded through the Clean Water Act, section 319 grant program have been implemented throughout the watershed. One of the main

purposes of the management plan is to look at information on soil erosion, water quality, and species diversity and concentrate conservation practices in the most sensitive areas of the watershed.

Local Conservation History

Agriculture is the main practice in the watershed and erosion has been the historic conservation concern. Land management and conservation studies began in the Paint Creek area in the early 1960's. Congress authorized a study of the Scioto River Basin, which led to the construction of the Paint Creek Lake in 1967 (Garringer). The lake is primarily for flood control, but the lands surrounding the lake provide wildlife habitat and recreational opportunities.

After heavy flooding in 1959 and 1960, the soil and water conservation districts in the Rattlesnake Creek watershed initiated the planning process to implement a project for flood control and land treatment. The initiative was eventually de-authorized but land managers recognized a need for local conservation practices.

In 1994, after continuous siltation problems in Paint Creek Lake, planning began for a new "Paint Creek Initiative" that would use Clean Water Act, section 319 grant monies to help introduce conservation projects throughout the watershed. This movement was inspired by activities taking place in the Darby Creek watershed which is partially located in Madison County. In 1995, a proposal was submitted to Ohio EPA requesting $300,000 to partially fund a land treatment program for the entire Paint Creek watershed (Garringer).

The proposal was originally rejected, but the soil and water conservation districts (SWCDs) in Fayette, Highland and Ross Counties worked closely with Ohio EPA to come up with a proposal that would be accepted. The new proposal included dividing the watershed into four management units based on the Main Paint, North Fork, Rattlesnake, and Rocky Fork Subwatersheds. In 1996, the SWCDs applied for and received 319 grant monies for the North Fork of Paint Creek Subwatershed. These monies were received in 1997, the same year that the SWCDs applied for and received 319 grants for Main Paint and Rattlesnake subwatersheds.

In December 1997, representatives from Fayette, Highland, Ross, Madison, Clinton and Greene counties met and formed a joint board of supervisors to oversee the spending of funds from the grant. In 1998, Julie Brown was hired by the joint board to act as watershed coordinator for the entire Paint Creek watershed. Julie meets with the joint board once every month.

The cost-share practices funded through the 319 grants largely focus on reducing erosion in the watershed. The first round of grants included grass waterways, equipment buy-downs, soil testing, lime applications, livestock exclusion fencing, streambank stabilization, heavy use feeding pads, tree and grass filter strips, deep tillage tool rental (North Fork only), manure management systems (North Fork only), and alternate watering sources (North Fork only). The 319 grant applications were given a score based on the proximity of the site to a stream, the size of stream, and the erodability index of the soil. Through this process land managers tried to implement conservation practices in areas of the watershed that were contributing the greatest amount of erosion.

The 319 grants discussed above were three year grants and ended in June of 2001. The project reapplied and was awarded money for all three subwatersheds. Currently all of Paint Creek Watershed has 319 conservation grant money.

In January of 2000, Julie formed an advisory committee to help provide guidance with the watershed project. This group meets quarterly and discusses management issues pertaining to the management plan. These meetings often feature guest speakers who have conducted studies within the watershed. In 2000, the project wrote and was awarded an additional 319 planning grant to help fund a part-time position for a management plan coordinator. Hilary Solomon was hired in January of 2001 to help write the management plan for the Paint Creek Watershed.

In 2000, Julie was also awarded a grant, the aim of which was "getting GIS into the hands of the conservationist." She worked closely with the consulting firm Malcolm Pirnie to acquire spatial data that could be used to make maps describing the area. Through this project, an extensive catalogue of data was acquired, which will be useful in the future water shed planning.

Addendum to the Paint Creek Watershed Management Plan

This additional section of the management plan tries to include information specific to the lower half of the North Fork of Paint Creek. For watershed wide information including wildlife and soils, please see the draft copy of the Paint Creek Management Plan.

The Lower Half of the North Fork of Paint Creek

The Paint Creek Watershed has already put together an extensive management plan that was submitted for review from the Ohio EPA in July of 2002. The original plan gave information on a larger scale, splitting the watershed into 4 sections: Main Paint, Rattlesnake, North Fork and Rocky Fork Creeks. The Ohio EPA's suggestion after reviewing the document was to return with more detail. The project than choose their 3 priority areas and the lower section of the North Fork of Paint Creek was picked as one of these areas.

This section of North Fork includes the lower half , which includes a small section of Fayette County and then a larger section of Ross County. This section includes the city of Frankfort and part of Chillicothe.

Table 1

Watershed Name	**Hydrologic Unit #**	**Counties**	**Drainage Area (acres)**	**Stream Miles**
Paint Creek	05060003	Ross, Highland, Fayette, Greene, Clinton, Madison, Clark, Pickaway, Pike	731,161.9	1572.53 (total)
North Fork (below Compton Creek to Paint Creek)	05060003 090	Ross, Fayette, Pickaway	72,968.5	200.4
North Fork below Compton Creek to Herrod Creek	05060003 090 010	Ross, Pickaway	7005.2	23
Herrod Creek	05060003 090 020	Ross, Fayette	9630.1	24.8
North Fork below Herrod Creek to Little Creek	05060003 090 030	Ross	20327.5	58.3
Little Creek	05060003 090 040	Ross	14855.2	46.1
North Fork from Little Creek to Paint Creek	05060003 090 050	Ross	20327.5	48.2

Please see map #1

Land Use

While the Paint Creek Watershed is a diverse watershed from the flat upper watershed to the rolling lower sections, the land uses in this smaller section are predominantly agriculturally based with a larger amount of forested acreage as compared with the upper part of North Fork. The following table shows the land uses for the 8, 11 and 14 digit watersheds.

Table 2

Watershed Name	**Hydrologic Unit #**	Land use Type	Percent of Whole	Acreage
Paint Creek	05060003	Urban	.88	6466.3

		Agriculture/Urban	76.89	562190.3
		Shrub/Scrub	2.22	16210.1
		Wooded	19.14	139931.6
		Open Water	.53	3871.5
		Non Forested Wetlands	.32	2308.2
		Barren	.03	183.9
North Fork (below Compton Creek to Paint Creek)	05060003-090	Urban	1.08	769
		Agriculture/Urban	68.55	48937.1
		Shrub/Scrub	5.32	3797.1
		Wooded	24.55	17525.2
		Open Water	.08	55.5
		Non Forested Wetlands	.42	301
		Barren	.00	3.4
North Fork below Compton Creek to above Herrod Cr.	05060003-090-010	Urban	.41	28.6
		Agriculture/Urban	90.08	6309.6
		Shrub/Scrub	3.47	242.8
		Wooded	5.53	387.4
		Open Water	.07	4.6
		Non Forested Wetlands	.45	31.5
		Barren	.00	.154
Herrod Creek	05060003-090-020	Urban	.47	45
		Agriculture/Urban	88.81	8552.5
		Shrub/Scrub	3.25	313
		Wooded	7.16	689.4
		Open Water	.02	2.3
		Non Forested Wetlands	.29	27.55
		Barren	0	0
North Fork below Herrod Cr. to above Little Creek	05060003-090-030	Urban	1.42	289.2
		Agriculture/Urban	77.99	15853
		Shrub/Scrub	3.94	801.2
		Wooded	15.9	3232.5
		Open Water	.03	6.8
		Non Forested	.70	142.7

		Wetlands		
		Barren	.01	1.7
Little Creek	05060003-090-040	Urban	.41	60.3
		Agriculture/Urban	59.33	8812.6
		Shrub/Scrub	8.42	1250.6
		Wooded	31.68	4705
		Open Water	.05	7
		Non Forested Wetlands	.12	17.7
		Barren	0	.6
North Fork from Little Creek to Paint Creek	05060003-090-050	Urban	1.77	346.5
		Agriculture/Urban	47.96	9368.8
		Shrub/Scrub	6.09	1189.3
		Wooded	43.57	8510.7
		Open Water	.18	35
		Non Forested Wetlands	.42	81.4
		Barren	0	.925

Please see map #2

Water Quality Issues in the Paint Creek Watershed

While it is assumed the bulk of the pollution problems in this section are from non-point source pollution, we will also cover the potential sources of point sources based on the National Pollutant Discharge Elimination Systems permits, Presence of combines sewer overflows, surface impoundments and data from fish kills.

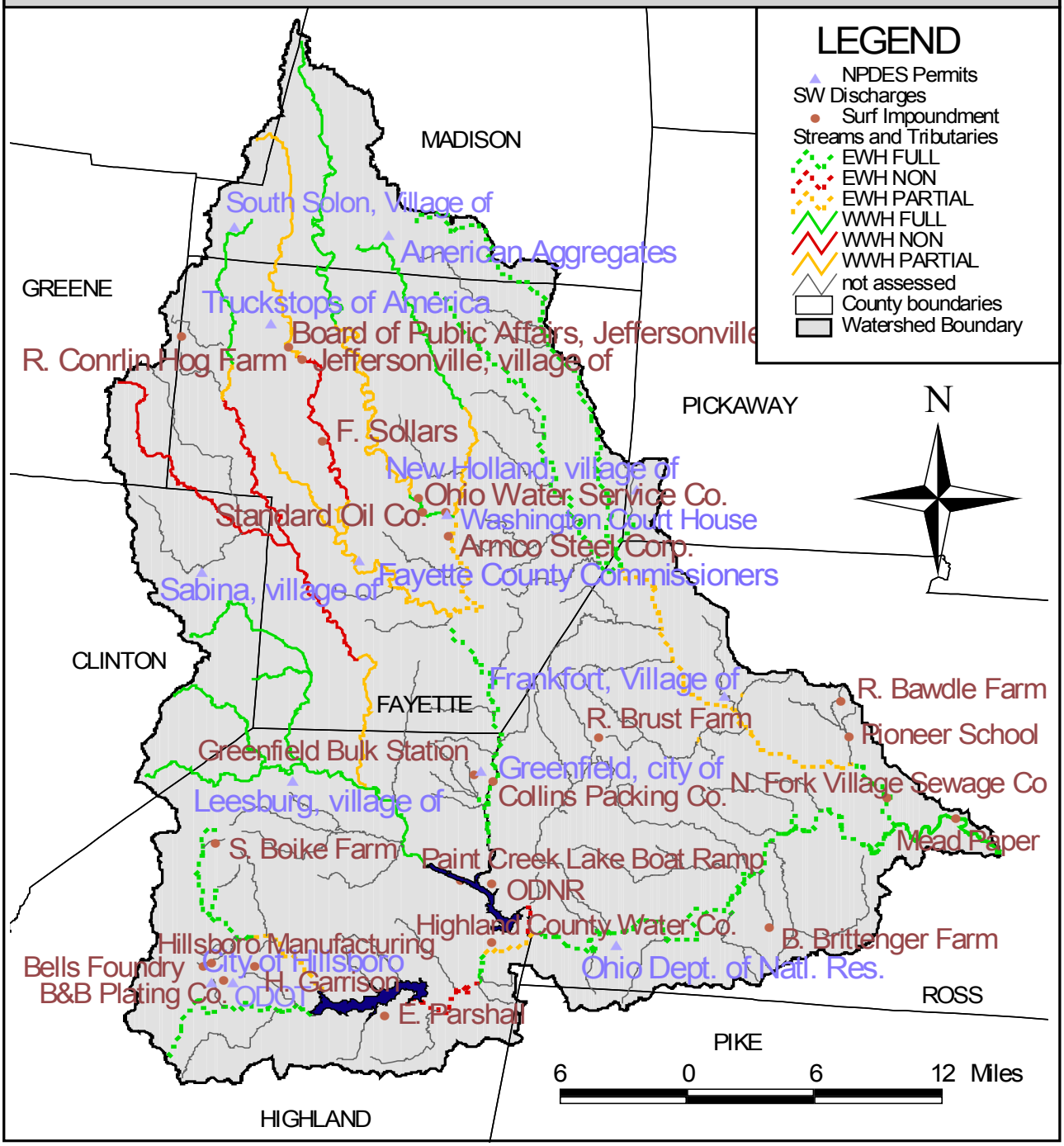
Table 3-3: NPDES permits in Paint Creek Watershed.

TYPE	ID_NUMBER	NAME	SIC_CODE	DESCRIPTION	LOCATION
NPDES	OH0021482	Frankfort, Village of	4952	sewerage systems	91 S. Main St.
NPDES	OH0001638667	New Holland, village of	4952	sewerage systems	800 Good Hope-New Holland

The following site-specific information is from Paul Vandermeer, 1997, Pollutant Loadings: 1976-1997, Ohio EPA, Division of Surface Water, Central District Office.

The Village of New Holland WWTP was designed to treat 0.16 million gallons per day (MGD) and discharges to North Fork of Paint Creek at river mile (RM) 26.7. Flow from the plant has remained around 50-60% of design capacity, but has begun to increase very slowly. Pollutant loadings vary widely, but are insignificant. Ammonia and oil and grease loadings have decreased, while CBOD loadings have increased and suspended solids are variable. The 95th percentile values are wide-ranging and highly variable. Due to the increasing flow and variable loading trends, New Holland WWTP should closely monitor its operations to ensure continued good treatment.

PAINT CREEK WATERSHED
NPDES and Surface Impoundments



Prepared for the Paint Creek Project by Hilary Solomon, October 2001

Combined Sewer Overflows and Sanitary Sewer Overflows

Combined sewers are built to collect sanitary and industrial wastewater as well as storm water runoff and transport this combined wastewater to treatment facilities. When it rains, the volume of storm water and wastewater may exceed the capacity of the combined sewers or of the treatment plant, and a portion of the combined wastewater may be allowed to overflow untreated into the nearest ditch, stream, river or lake. This is a combined sewer overflow, or CSO. Ohio has about 1,600 known CSOs in 102 communities, ranging from small, rural villages to large metropolitan areas.

According to Sheree Gossett-Johnson, a member of the permitting and compliance unit with Ohio EPA's DSW, the Paint Creek Watershed does not contain any CSOs.

Another similar overflow is called a Sanitary Sewer Overflow (SSO). This type of system is designed to bypass the treatment plant when the wastewater load exceeds capacity. Most of these are being phased out in the watershed. One example is the Washington Court House WWTP, which has recently been upgraded (Gosset-Johnson, 2002).

On-lot Wastewater Systems

By implementing House Bill 110 (HB110) in 1984, the Ohio General Assembly created Ohio EPA's HB110 program. The program is a contractual partnership between Local Health Districts (LHDs) and Ohio EPA, whereby LHDs conduct, on behalf of the Agency, inspection and enforcement services for commercial sanitary waste treatment/disposal systems discharging between 0-25,000 gallons per day (semi-publics). In addition, local health departments regulate residential on-lot systems such as septic systems.

The Paint Creek Project is currently working with the health departments in each of the nine counties containing portions of the watershed; Clinton, Greene, Fayette, Pickaway, Pike, Highland, Ross, Madison and Clarke. The Paint Creek Project hopes to collect information on the sewered versus unsewered areas in the watershed and areas where potential problems exist. This information will help promote the use of available finds to upgrade and maintain existing systems. One of the implementation goals for the watershed involves inspecting septic systems at regular intervals to ensure acceptable operation. Septic systems are a source of nutrients, organics and fecal coliforms.

The Ross County Health Dept is the predominant Health district in this watershed. They are currently working on improving thier HSTS plan for the watershed project. They have sited the following areas in the North Fork Watershed as those that have higher numbers of failing on site septic systems.

1. Hopewell Point (US 50 & Maple Grove Rd): This area has an estimated thirty lots and has had a history of failing systems. Soil is rated moderate to severe due to permeability and a water table.

2. Arrowhead Village (CR 550 to Climer Road): This area has an estimated twenty lots. The soil is rated moderated to severe due to permeability.

3. Egypt Pike and Rustic Acres Subdivision: (#5500 to 9000): History of failing systems noted. Many homes have aeration treatment units that discharge into the road ditch. Soil is rated severe due to low permeability and a high seasonal water table. There also is the possibility of non-point discharge to a lake.

4. Northridge Estates (Maple Grove Road N of SR 28): This area has an estimated thirty lots. Soil is rated severe due to high permeability.

5. Queen Meadows (SR 28 to Queen Drive): There is a history of failing systems in this area of estimated thirty lots. Soil is rated severe due to low permeability and inclusions of clay soils with high permeability.

6. Summerhill Farms (Polk Hollow to Summerhill Drive): The area has an estimated twenty-five lots. Soil is rated severe due to low permeability, shallow to bedrock, and on some lots slope is a limiting factor as well.

Watershed Pollution Problems

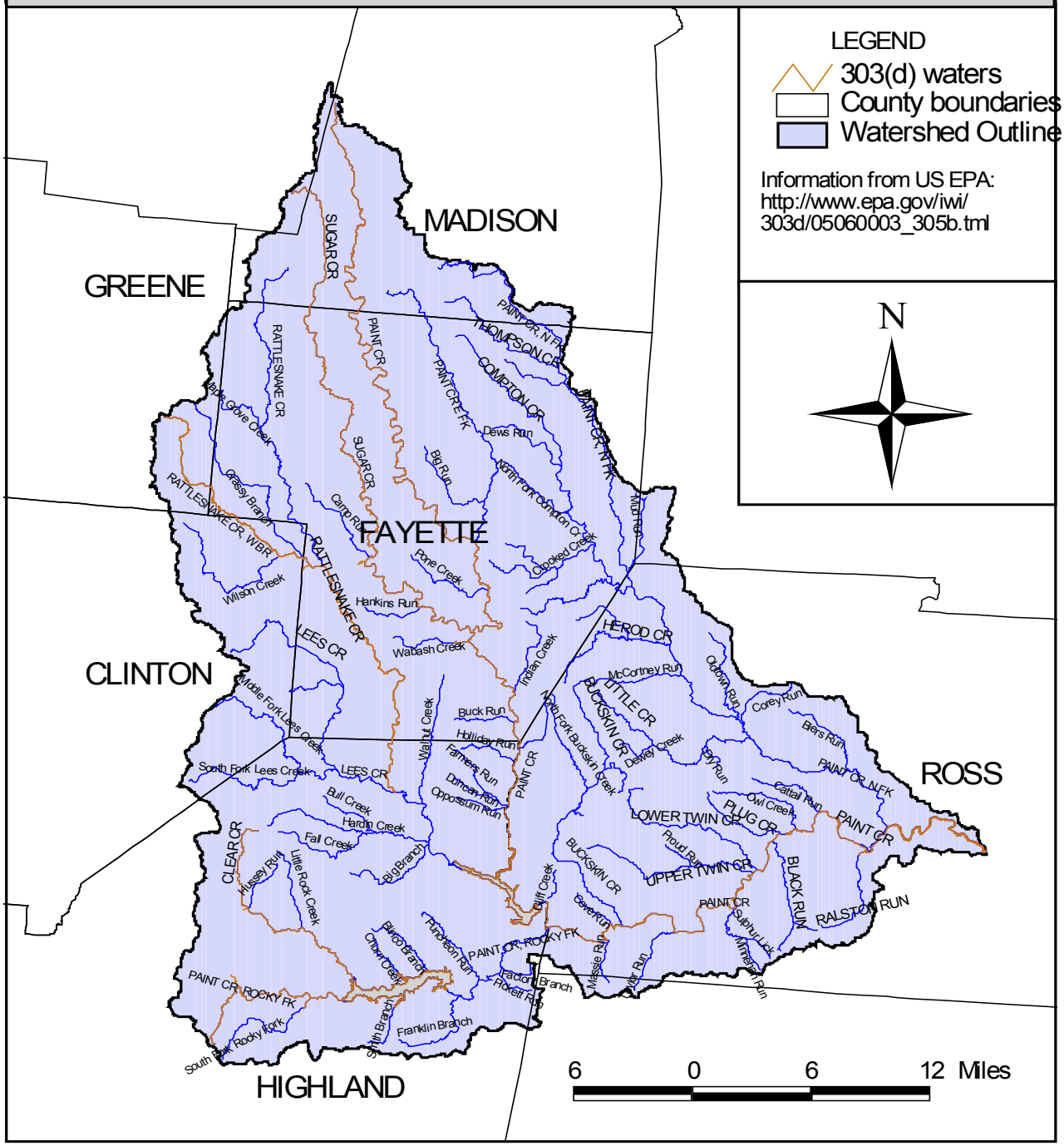
This section of the Paint Creek Watershed received it's first extensive water quality survey in 1997 from the Ohio EPA. They collected fish and macroinvertebrate data along with a survey of the physical habitat and water chemistry. At the same time, an Ohio State University Professor by the name of Dr. Ted Cavender conducted a stream survey of the diversity and species richness of the fishes of the Paint Creek Watershed. These 2 studies are the primary sources of water quality data available for this area.

Reference Stream Values by Ecoregion

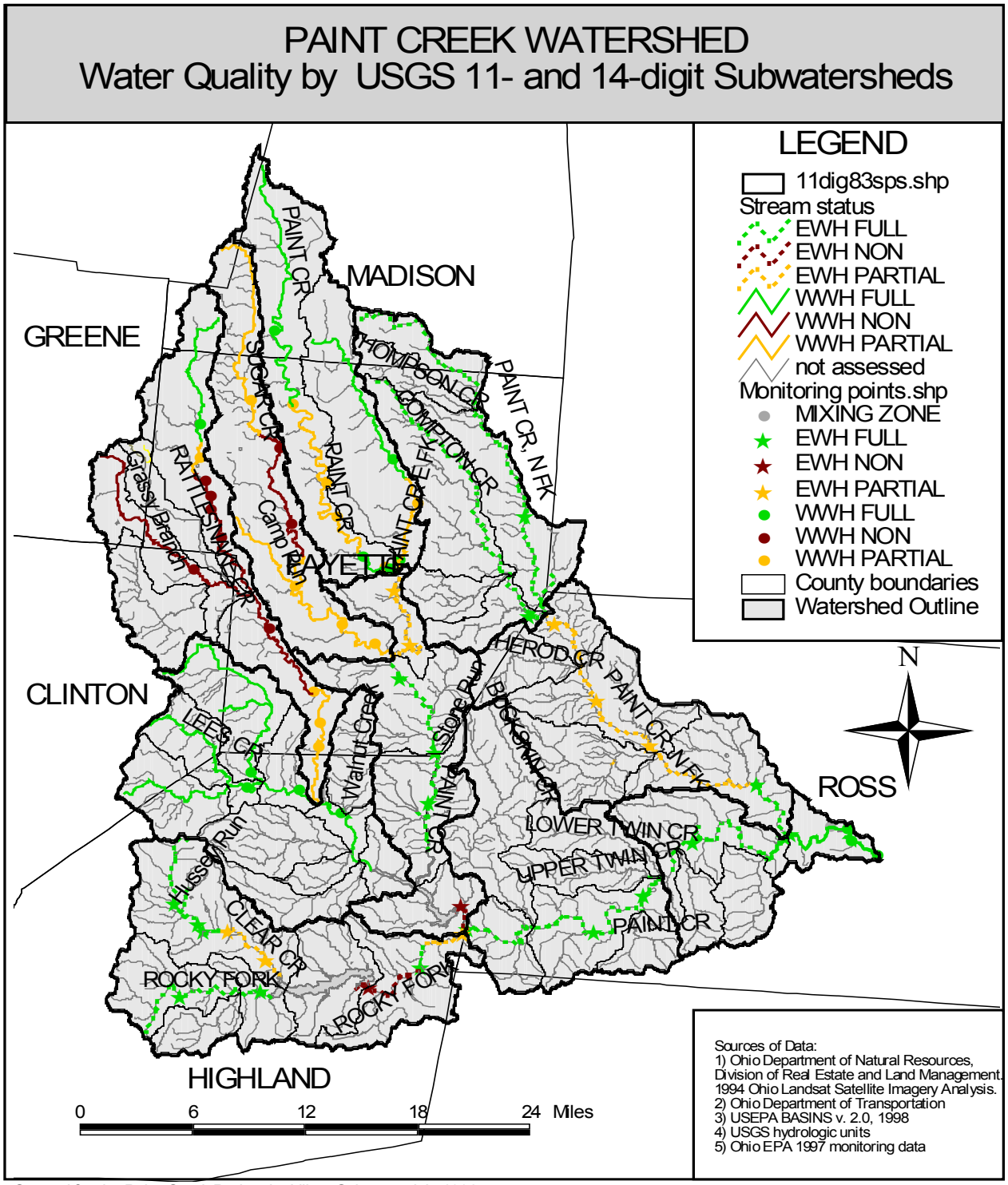
Another way in which to judge the water quality of streams in the watershed is look at how their chemical measurements compare to those of other streams of similar sizes in other watersheds. In 1999, Ohio EPA compiled the measurements of hundreds of streams that represented the best water quality in the state and published a paper entitled, Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams. The streams were all grouped by ecoregion and their values averaged to generate a numeric representation of a reference or background condition. Numbers that represent the 75th, 95th and 99th percentiles were also generated. This study uses the 75th percentile values as benchmarks against which to measure the water quality monitoring results from the 1997 Paint Creek Watershed data.

Paint Creek Watershed falls into three ecoregions. It is mainly located in the Eastern Cornbelt Plains (ECBP), but some areas fall within the Western Allegheny Plateau (WAP) and the Interior Plateau (IP). Several of the monitoring points in the Paint Creek Watershed are categorized as reference points and used in this study. It should be noted that while the reference sites represent high quality streams that meet all water quality standards, they still exhibit some degree of anthropogenic influence.

PAINT CREEK WATERSHED
US EPA 303(d) Listed Streams and Lakes



Created by Hilary Solomon for the Paint Creek Project, September 2001



Created for the Paint Creek Project by Hilary Solomon, July 2002

North Fork Paint Creek Water Quality

During the summer of 1997, the North Fork subwatershed was sampled in six locations. Chemical, biological and habitat monitoring was conducted by Ohio EPA. The m onitoring locations are described in Table 3-9.

Table 3-9: North Fork monitoring point locations

RIVER MILE	STREAM	LOCATION	ECO-REGION	SIZE*	HABITAT	ATTAINMENT
3.80	North Fork Paint Creek	US 50 Dst. Pleasant Valley WWT	ECBP	SR	EWH	Full
10.50	North Fork Paint Creek	Musselman Dst. Frankfort WWTP	ECBP	SR	EWH	Partial
17.50	North Fork Paint Creek	Dexter Rd. Ust. Frankfort WWTP	ECBP	W	EWH	Partial
23.20	North Fork Paint Creek	Woodrow Rd. Dst. N. Holland WW	ECBP	W	EWH	Partial
31.00	North Fork Paint Creek	Glaze Road	ECBP	W	EWH	Full
1.40	Compton Creek	Dogtown Rd.	ECBP	W	EWH	Full

***This report only covers the lower half of the North Fork Watershed which will include the first 4 monitoring points listed above.

*HW=Headwater, <20 miles^2 watershed area; W=Wadeable, ≥20 and < 200 miles^2 watershed area; SR=Small River, ≥200 miles^2 watershed area and < 2000 miles^2 watershed area; and LR=Large River, >1000 miles^2 watershed area.

North Fork is located in the Eastern Corn Belt Plains Ecoregion. It is characterized in the Ohio Administrative Code (OAC) 3745-1-09; Table 9-1, as exceptional warmwater habitat (EWH) used for agricultural water supply (AWS), industrial water supply (IWS) and primary contact recreation (PCR). Of the parameters described in this report; total suspended solids (TSS), fecal coliform, nitrate/nitrite, total phosphorous and dissolved oxygen; only fecal coliform and dissolved oxygen have water quality standards. Nitrate concentrations may be compared to maximum contaminant levels (MCLs) for drinking water.

For primary contact waters fecal coliform concentrations (by geometric mean of at least five samples) must be less than 1000 bacteria per 100 mL of water, with no more than 10% of the samples over 2000 bacteria per 100 mL of water. With measurements of 4400 and 1200 bacteria per 100 mL of water, fecal coliform bacteria concentrations in North Fork exceeded the primary contact recreation (PCR) maximum criterion on one of the five sample dates, August 14, 1997. Dissolved oxygen concentrations and nitrate concentrations did not exceed the legal maximums.

In comparison to similar size high quality reference streams located in the same ecoregion, North Fork exceeded average total suspended solids concentrations (29 mg/L) on July 29 and August 14, both rainfall events. Fecal coliforms were exceeded on August 14 and nitrate/nitrite was exceeded in all but one measurement. Phosphorous concentrations (0.13 mg/L) were exceeded on July 14, 1997. Additionally the monitoring point at river mile 31 did not meet dissolved oxygen minimum numbers in July. The data thus illustrated that sediment, fecal coliforms and nutrients were substantial pollutants in the North Fork basin, with substantial inputs associated with rainfall events.

North Fork of Paint Creek Water Quality Data*

Total Suspended Solids

River Mile	7/14/1997	7/29/1997	8/14/1997	9/5/1997	9/16/1997	Reference
31	19	**34**	**41**	10	8	29
23.2	16	**42**	**72**	5	5	29

Fecal Coliforms

River Mile	7/14/1997	7/29/1997	8/14/1997	9/5/1997	9/16/1997	Reference
31	480	340	**4400**	120	150	860
23.2	230	440	**1200**	130	160	860

Nitrate/nitrite

River Mile	7/14/1997	7/29/1997	8/14/1997	9/5/1997	9/16/1997	Reference
31	**2.59**	**1.85**	**0.75**	**0.94**	**0.92**	0.49
23.2	**3.02**	**1.57**	0.3	**1.59**	**1.38**	0.49

Phosphorous

River Mile	7/14/1997	7/29/1997	8/14/1997	9/5/1997	9/16/1997	Reference
31	**0.52**	0.12	0.09	0.11	0.05	0.13
23.2	**0.47**	0.08	0.09	0.6	0.09	0.13

Dissolved Oxygen

River Mile	7/14/1997	7/29/1997	8/14/1997	9/5/1997	9/16/1997	Reference
31	**6.34**	**6.52**	7.26	9.78	7.22	6.95
23.2	11.01	8.52	8.94	10.93	NA	6.95

*Adapted from Ohio EPA 1997 Paint Creek Basin field survey

Bolded values are above (or below in the case of dissolved oxygen) associated reference stream 75th percentile concentrations.

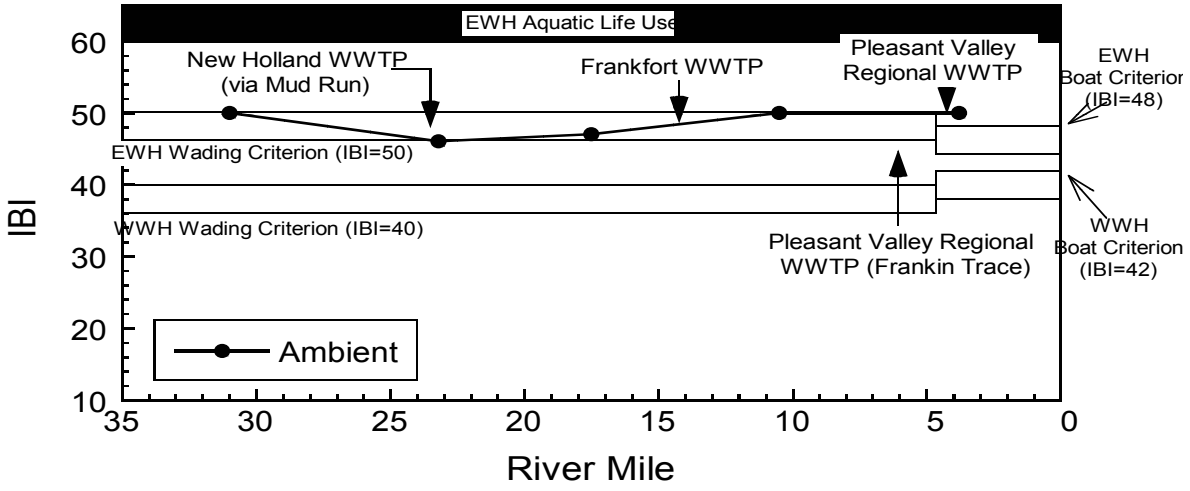
Biological Indices

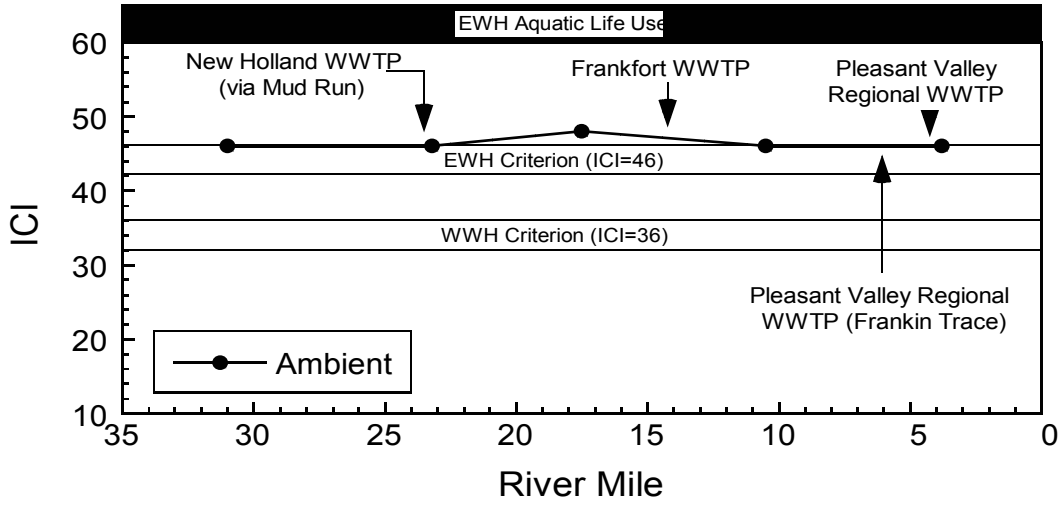
The North Fork of Paint Creek Subwatershed is located in the Eastern Corn Belt Plains (ECBP) Ecoregion. The species composition expected in each ecoregion is slightly different, which translates into different numeric biocriteria for each aquatic use designation. Again, the IBI measures fish species diversity and population composition. It accounts for total native populations, indicator species, overall fish condition and pollution intolerant versus pollution tolerant fish species. The MIwb measures similar characteristics of the fish population, however, it subtracts 13 pollution tolerant fish species out of the final score. The ICI measures the composition of the invertebrate community and compares the numbers of pollution tolerant species with pollution intolerant species. The biocriteria for ECBP ecoregion are listed below:

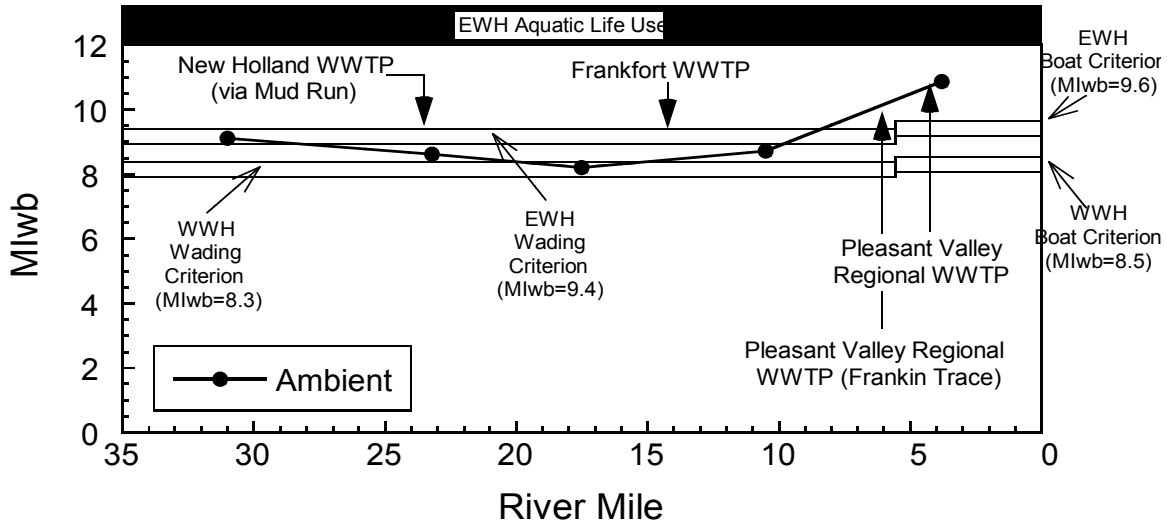
Ecoregion Biocriteria: E. Corn Belt Plains (ECBP)
(OAC 3745-1-07, Table 7-14)

Index- Site Type	WWH	EWH
IBI- Boat	42	48
MIwb- Boat	8.5	9.6
ICI	36	46

Though the IBI scores decreased slightly near the New Holland WWTP, they remained within EWH criterion throughout the length of the stream. The ICI scores were also excellent, with no decrease near the New Holland WWTP. The MIwb scores showed a significant departure from EWH criteria near the New Holland WWTP (approximately RM 24) and did not recover until river mile 10, near the Pleasant Valley WWTP. The upper reaches of the subwatershed are threatened by agricultural activities such as livestock access, channelization, and riparian removal. These threats are manifested in high fecal coliform measurements and excessive siltation. The result is decreased dissolved oxygen in the water column and filling of deep pools. Fish scores at Dexter Road (RM 17.5) in 1983 were higher than the 1997 survey results, indicating a decrease in fish population quality (Moore, 2002).







Qualitative Habitat Evaluation Index (QHEI)

The QHEI is a qualitative measurement of the presence and quality of physical habitat components that support aquatic life. 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 habitat characteristics that are used to determine the QHEI score include substrate, instream cover, channel morphology, riparian vegetation and bank erosion, gradient, and flow patterns (pool, run and riffle development). The QHEI score ranges from 20 to less than 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 sites around the state (OEPA, 2002, Bokes TMDL) 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 having the ability to support exceptional warmwater faunas. The QHEI can be used

to direct restoration efforts for habitat and to provide a monitoring tool to measure progress toward habitat goals.

The QHEI scores for North Fork indicate that the upper reaches of the creek show evidence of substantial siltation and channel embeddedness. The channel was recovering from modification and canopy removal and the riparian corridor consisted of grass banks with heavy erosion. Past unrestrained cattle access and loss of riparian corridor caused large-scale sedimentation. At RM 31.0 there is an unsupported outside bend adjacent to agricultural fields with no riparian zone. These badly eroding banks illustrate the adverse effects of activities too close to the stream and removal of the riparian buffer. In addition, braided channels have formed in the upper reaches of the watershed. This area will need to be targeted with education, conservation tillage and riparian buffer enhancement programs.

North Fork QHEI scores were high in the lower reaches of the creek. However, insufficient riparian buffer continues to threaten water quality. In places channel modification, lack of instream habitat and sedimentation also threaten the creek in the lower reaches. Throughout the stream, deep pools are filling with sediments and fish biomass is decreasing (Moore, 2002).

Table 3-10 describes the QHEI scores from the 1997 survey of North Fork of Paint Creek. These scores and the information in the comments field are derived from the field notes taken by employees of Ohio EPA's Ecological Assessment Unit.

Table 3-10. Qualitative Habitat Evaluation Index (QHEI) for North Fork Paint Creek

River Mile	Location	Score	Comments
23.2	Woodrow Road downstream New Holland WWTP	72.0	• **Substrate**: moderate silt with normal to moderate embeddedness • **Instream habitat**: sparse to moderate • **Morphology**: Recovering from channelization, levied beyond narrow riparian • **Riparian**: very narrow to moderate • **Flood plain**: row crops on both sides
17.5	Dexter Road Upstream Frankfort WWTP	74.5	• **Substrate**: moderate to normal silt and normal embeddedness • **Instream habitat**: moderate • **Riparian**: narrow to wide (5-10m), no to little bank erosion • **Flood plain**: open pasture and row crop
10.5	Musselman Road downstream Frankfort WWTP	86.5	• **Substrate**: normal to moderate silt and normal embeddedness • **Instream habitat**: moderate • **Morphology**: classic pool, riffle and run development • **Riparian**: narrow to wide (5->50m), little to moderate bank erosion • **Flood plain**: fenced pasture and row

River Mile	Location	Score	Comments
			crop
3.8	Upstream Paint Creek	76.5	• **Substrate**: normal silt and moderate embeddedness • **Instream habitat**: moderate • **Morphology**: good development • **Riparian**: narrow to moderate • **Floodplain**: residential, Super K-Mart

Nonpoint Sources of Pollution

Nonpoint sources of pollution include the following associated problems: siltation, nutrient/organic enrichment, low dissolved oxygen, and habitat alteration. Habitat alteration may include channelization, which creates a lack of riparian and in-stream physical habitat. Landuse and land cover within the subwatershed is a good indicator of potential sources of pollution. Within 50 feet of the creeks, land use is also predominantly agricultural/open housing (66%) with increased forest cover of 24% (ODNR, 1994).

It is apparent from the land use statistics listed below that the majority of the nonpoint source pollution in this subwatershed will be related to agricultural and open residential with miner contributions from logging and forestry operations. Agriculture is commonly associated with sedimentation, nutrient enrichment, organic loading, and channel modification. If livestock pasturing along the creek is involved, fecal coliform bacteria and bank destabilization may also be present. Open residential may be associated with nutrients and fecal coliforms from lawn care and failing on-lot waste treatment systems. During land development activities such as grading and building, sedimentation is also usually a problem. Forestry, like agriculture, can be associated with sedimentation and canopy removal near the stream banks.

Nonpoint sources in the subwatershed are not limited to rural activities. Urban areas, such as Frankfort, also contribute nonpoint pollutants from storm water runoff and development. Urban areas, with high percentages impervious surfaces are also associated with increased and/or sporadic creek flow rates due to runoff quickly reaching the creek after a rainfall event. This causes extremely high flows shortly after the rainfall event as the water rushes across paved surfaces to the creek instead of infiltrating the soil and recharging the groundwater aquifer. This unnaturally high flow is followed by low flows deprived of groundwater recharge.

Table 3-11: Landuse and land cover in the North Fork Subwatershed

Landuse/land cover category	Percent in North Fork Paint Creek subwatershed	Percent w/in 50 feet of creek and tributaries
Urban	0.8	1.0
Ag/Open Housing	82.9	66.0
Shrub/Scrub	2.9	7.0
Forested	13.0	24.0
Open Water	0.0	0.0

Wetlands	0.3	1.0
Barren	0.0	0.0

Derived from the Ohio DNR, Division of Real Estate, 1994 land cover data.

Point Sources of Pollution

Point sources of pollution include direct discharges to the stream. The Village of New Holland WWTP was designed to treat 0.16 MGD and discharges to North Fork of Paint Creek at RM 26.7. Flow from the plant has remained around 50-60% of design capacity, but has begun to increase very slowly. According to Ohio EPA records, pollutant loadings vary widely, but are insignificant. The Village of Frankfort also operates a WWTP that discharges to North Fork. Both of these dischargers are regulated by Ohio EPA's National Pollution Discharge Elimination System (NPDES) permit program. The other NPDES permit in the subwatershed is operated by American Aggregates, a cut stone and stone processing facility.

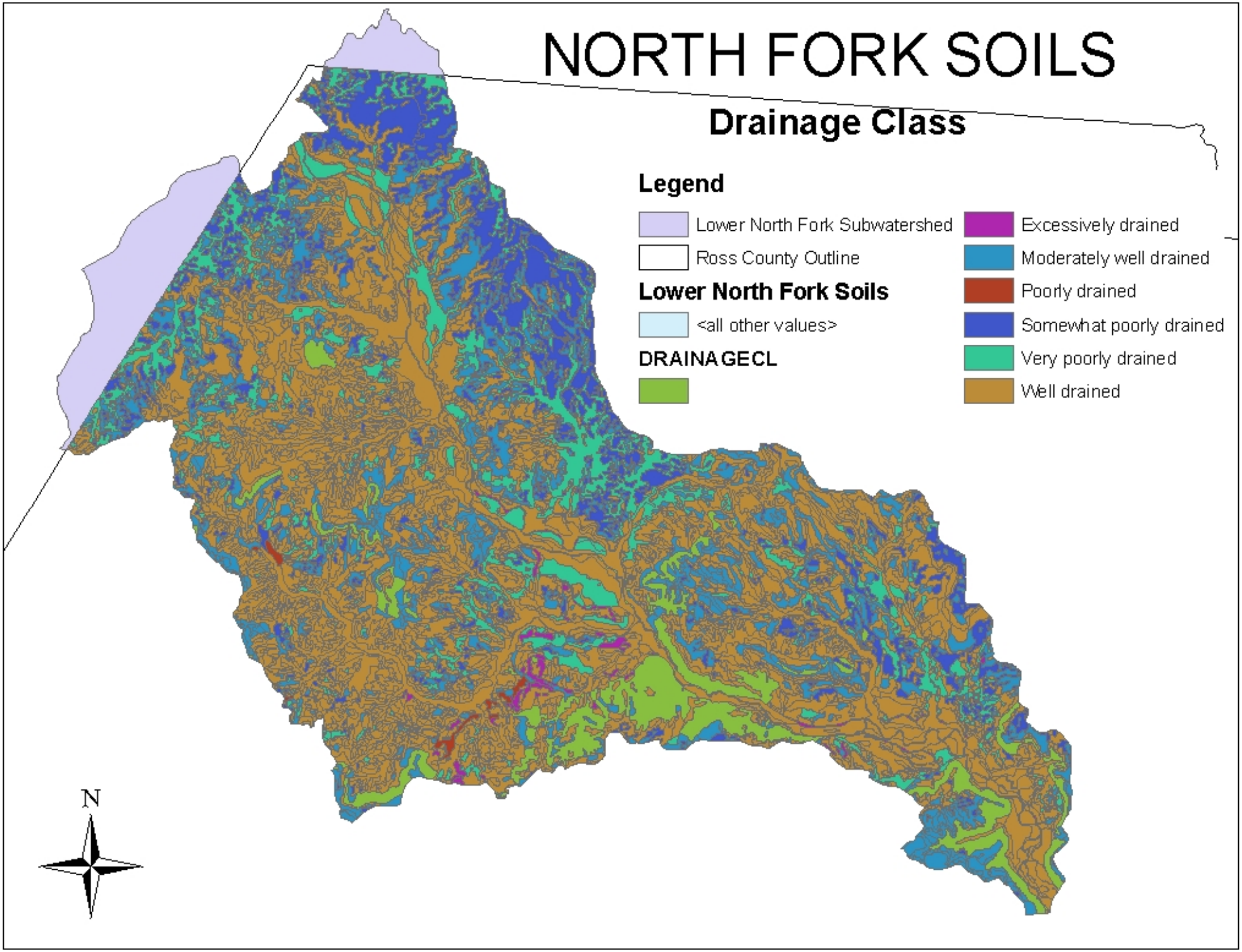
Other types of point sources are surface impoundments, or ponds that only discharge during rainfall/overflow events. Surface impoundments in the North Fork subwatershed include the Russell Bawdle Farm, Pioneer School, and North Fork Village.

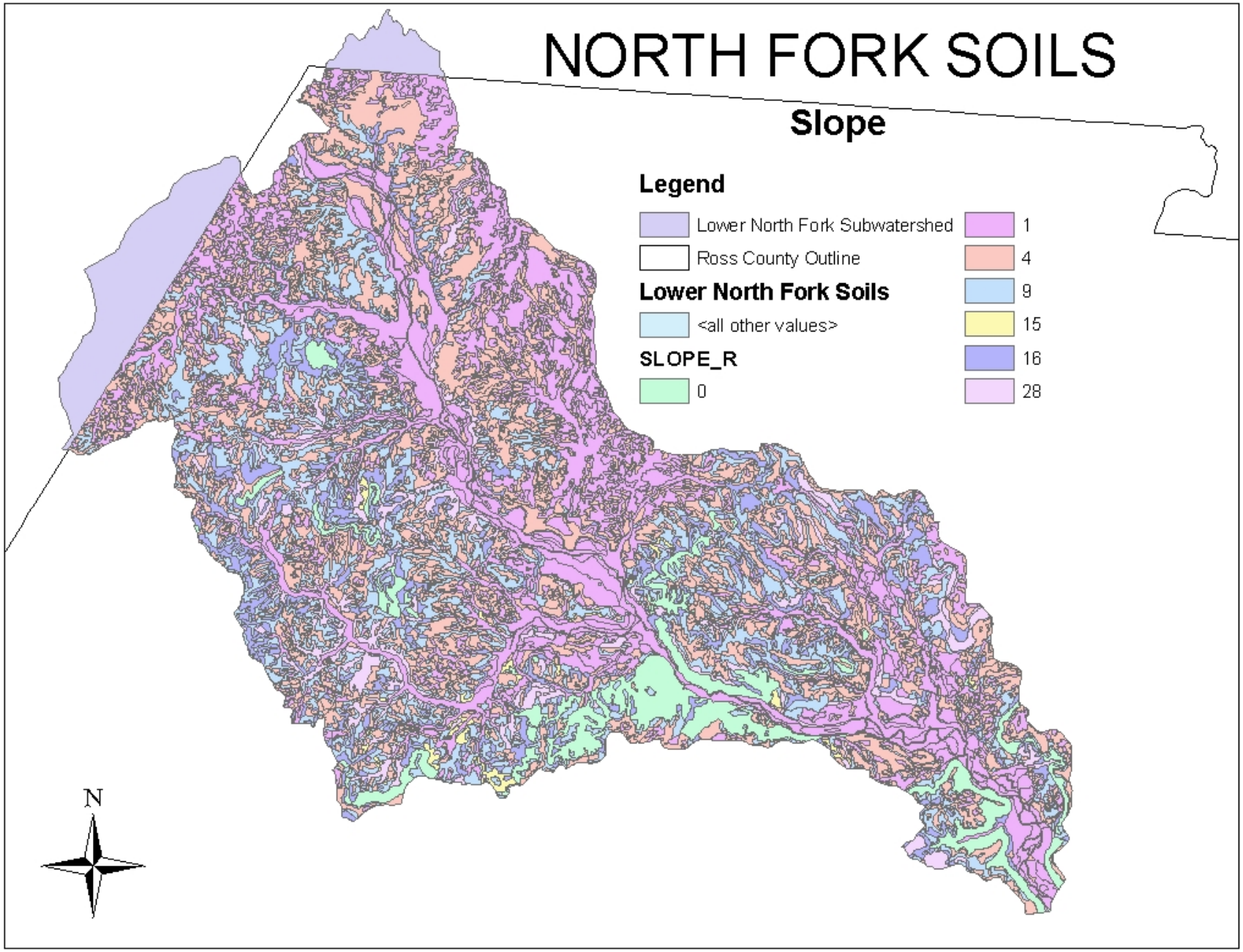
OSU Study Results

Dr. Cavender and several interns conducted a seining survey to obtain information on the distribution of Paint Creek fishes across the drainage. This study was conducted to construct distribution maps, to pinpoint areas with the greatest diversity, and to investigate the presence of rare or endangered species. This study brought together all previous collection data to create an accurate representation of the fishes in Paint Creek. The study showed 67 species being collected with at least 6 new drainage records. "Of the 5 major tributaries sampled in the Paint Creek Watershed, North Fork was by far the best one in terms of species richness" (Cavender et al.). The report goes on to say that they caught pollution intolerant species at almost all sampling sites and that the stream has good substrates and gradient characteristics and a diversity of habitats. It is also noted that the major problems in this watershed seem to be the agricultural runoff and enrichment, channelization and heavy siltation.

Soils Information

The soils in the North Fork of Paint Creek subwatershed in Ross County are generally well drained, non-hydric soils that are highly erodable to potentially highly erodable (HEL) and have a slope from 0-9. When setting up priority areas, it should be noted that while all sections of the watershed have high levels of HEL or potential HEL. It appears that the Little Creek subwatershed and the North Fork Subwatershed from Little Creek to Paint Creek seem to have have a higher percentage of HEL and should be of greater priority when installing BMP's for erosion reduction. Please see the following maps for information pertaining to the soils. Please note that soil data is not yet available for the small section in Fayette County.


NORTH FORK SOILS
Drainage Class
Legend
Lower North Fork Subwatershed
Ross County Outline
Lower North Fork Soils
<all other values>
DRAINAGECL
Excessively drained
Moderately well drained
Poorly drained
Somewhat poorly drained
Very poorly drained
Well drained
N


NORTH FORK SOILS
Slope
Legend
Lower North Fork Subwatershed
Ross County Outline
Lower North Fork Soils
<all other values>
SLOPE_R
0
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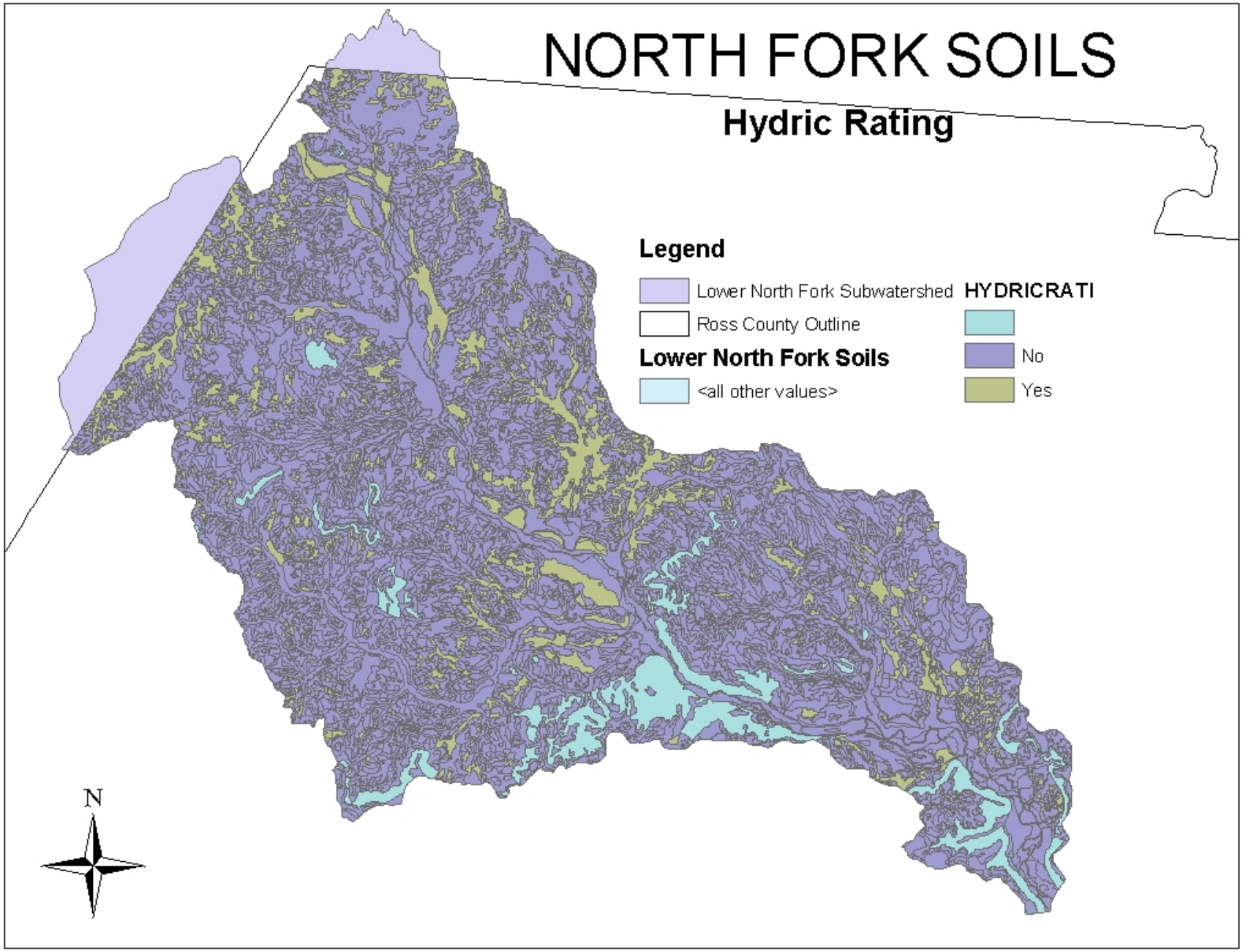
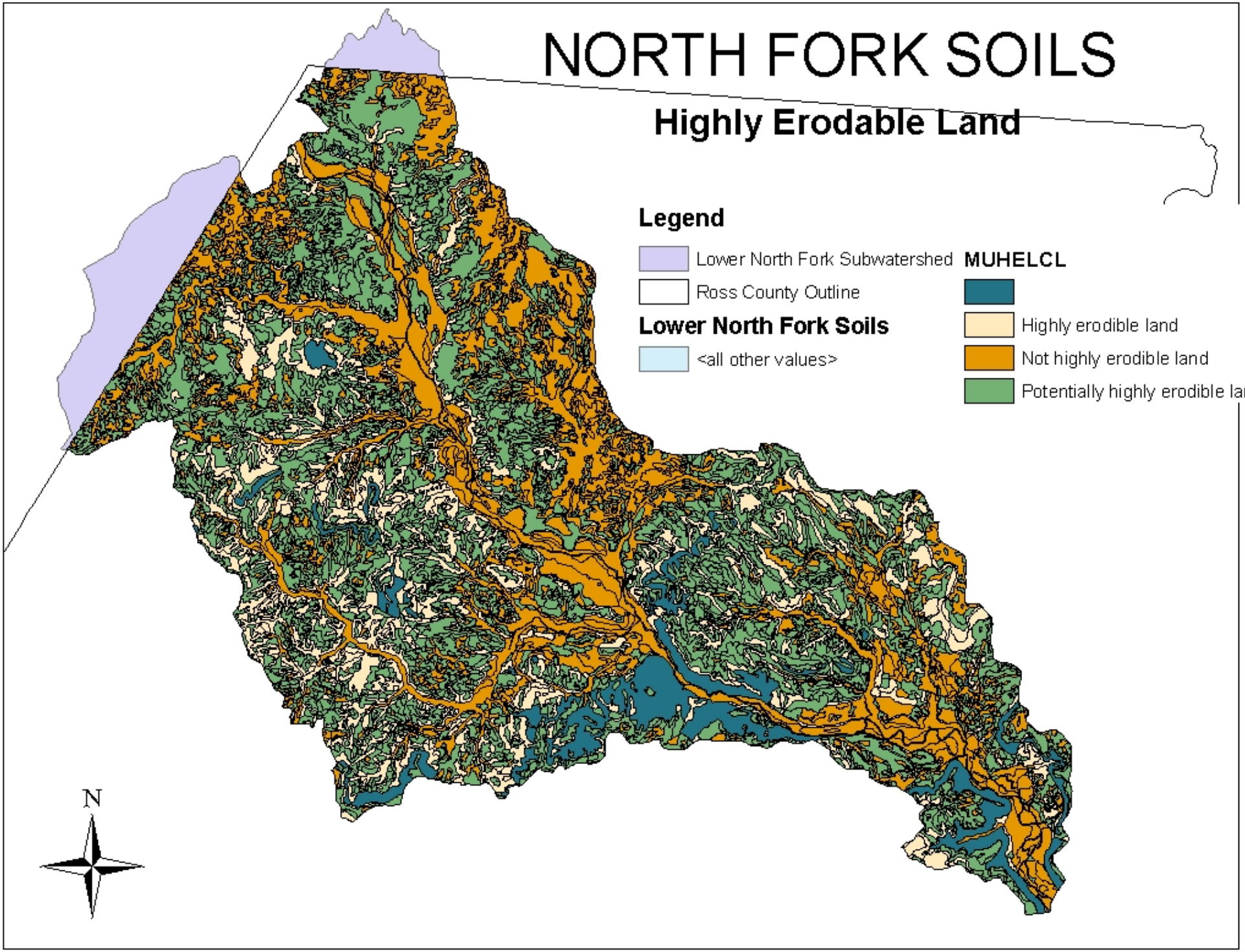
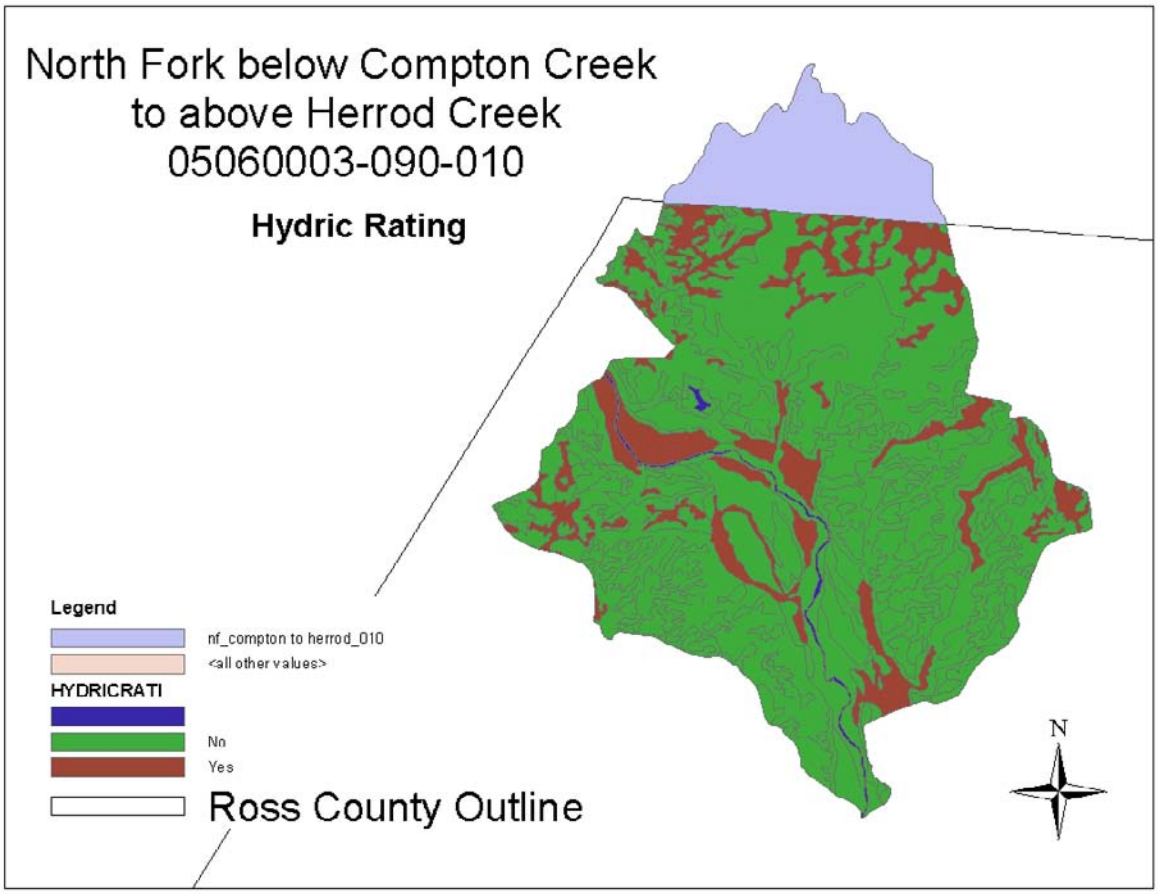
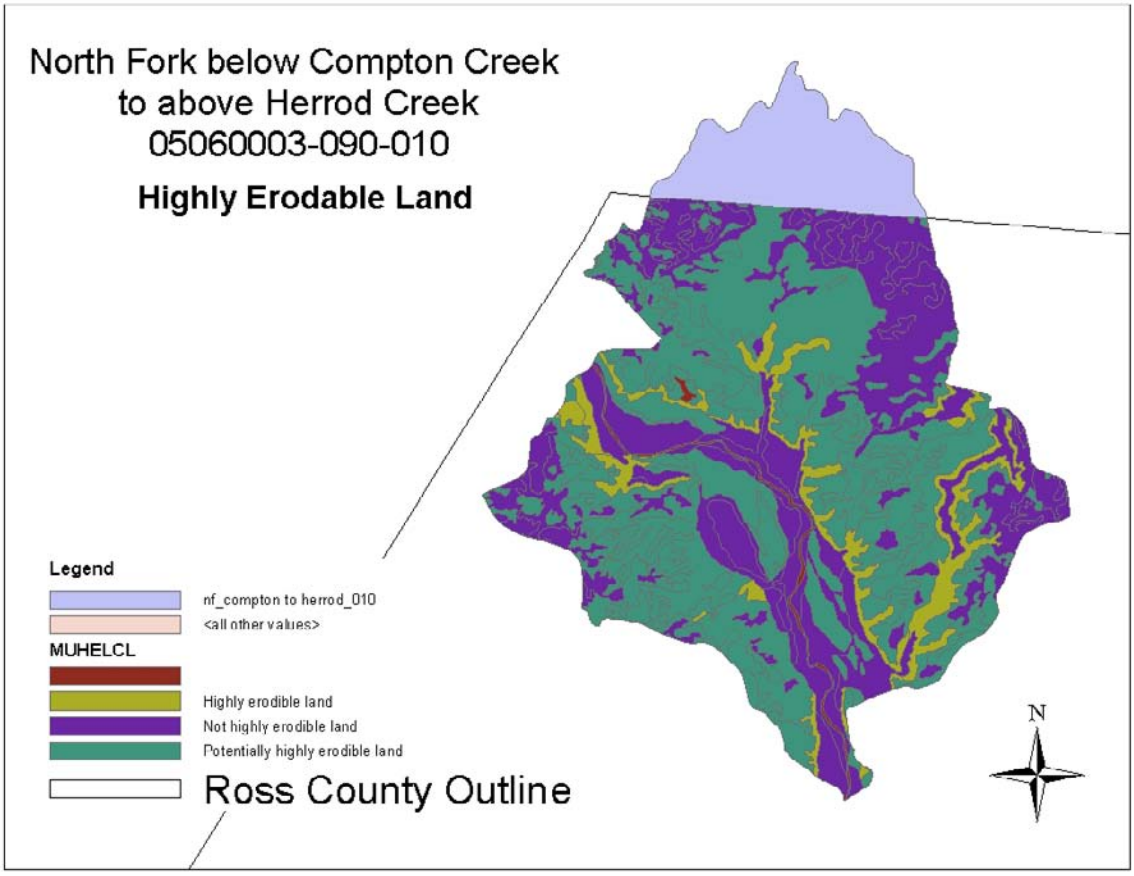
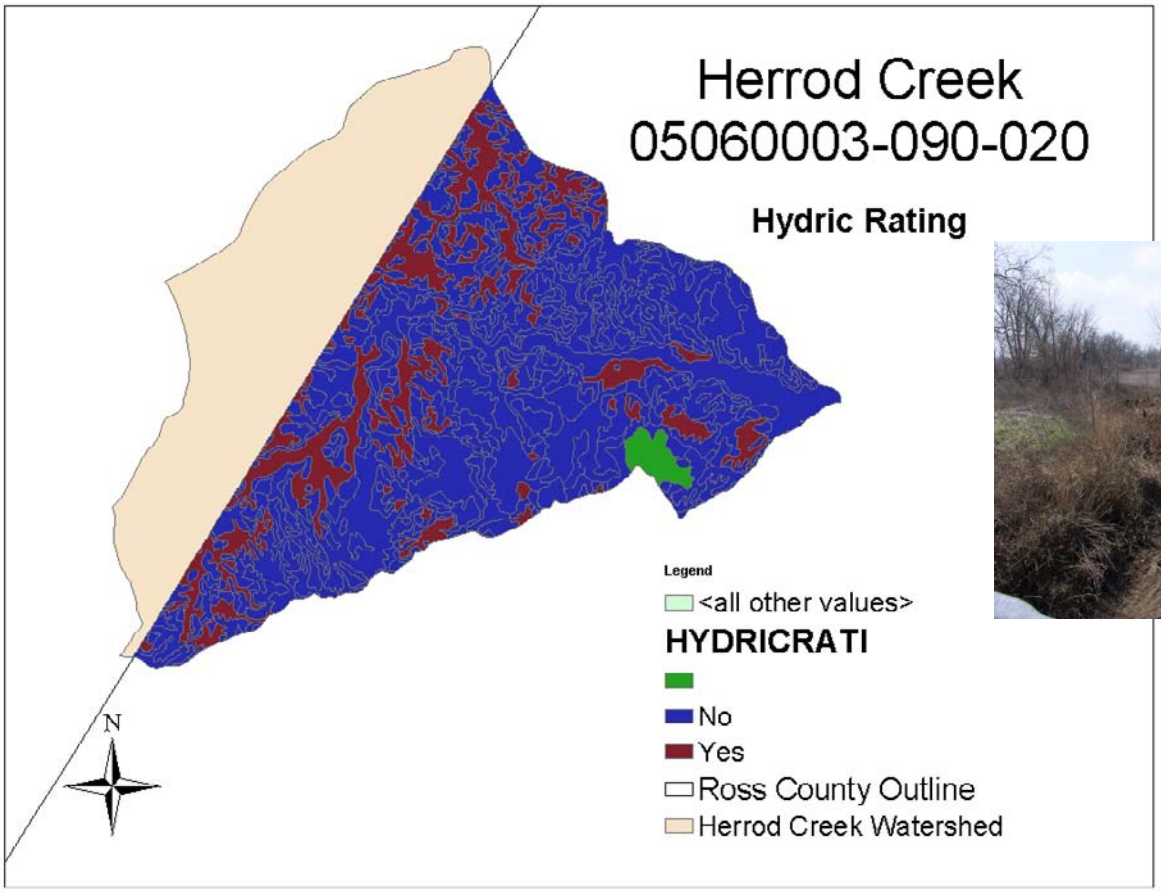
4
9
15
16
28
N

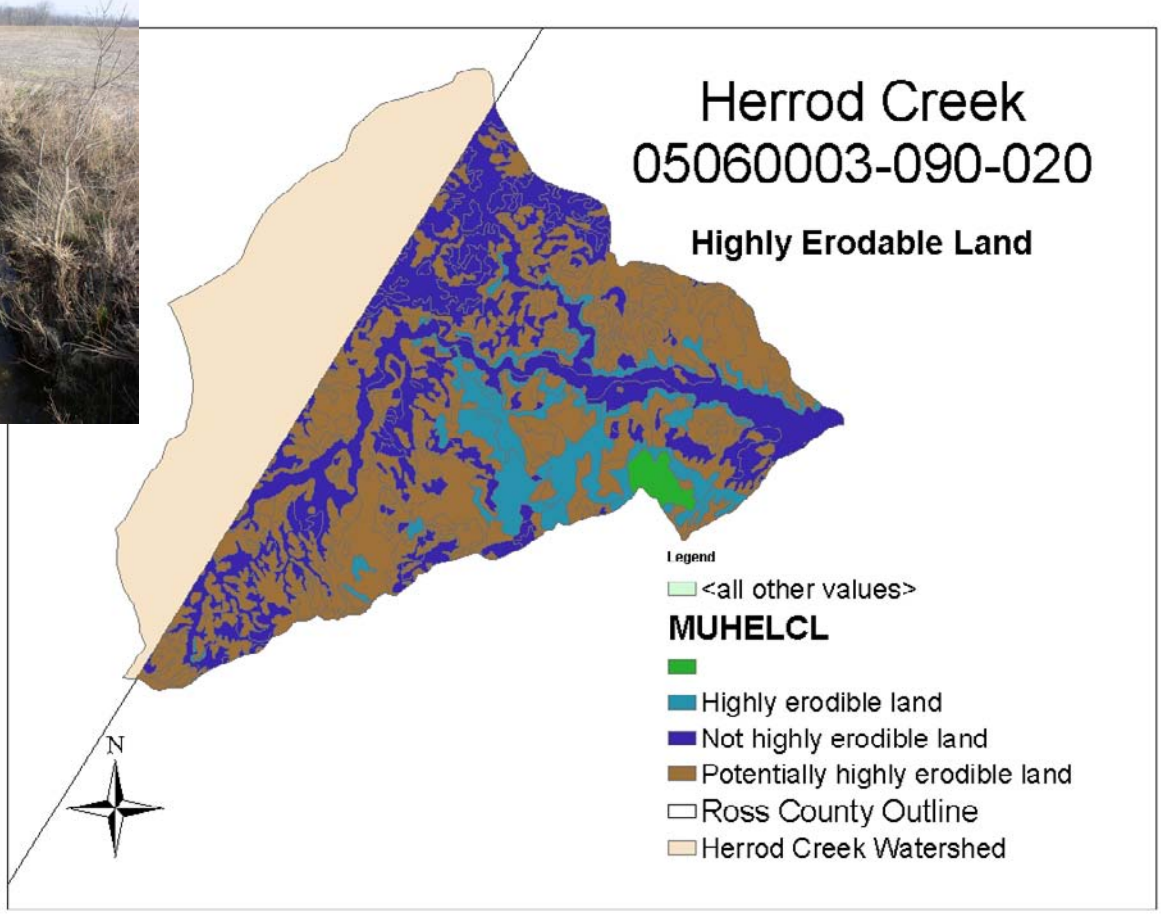

NORTH FORK SOILS
Hydric Rating
Legend
Lower North Fork Subwatershed
Ross County Outline
Lower North Fork Soils
<all other values>
HYDRICRATI
No
Yes
N

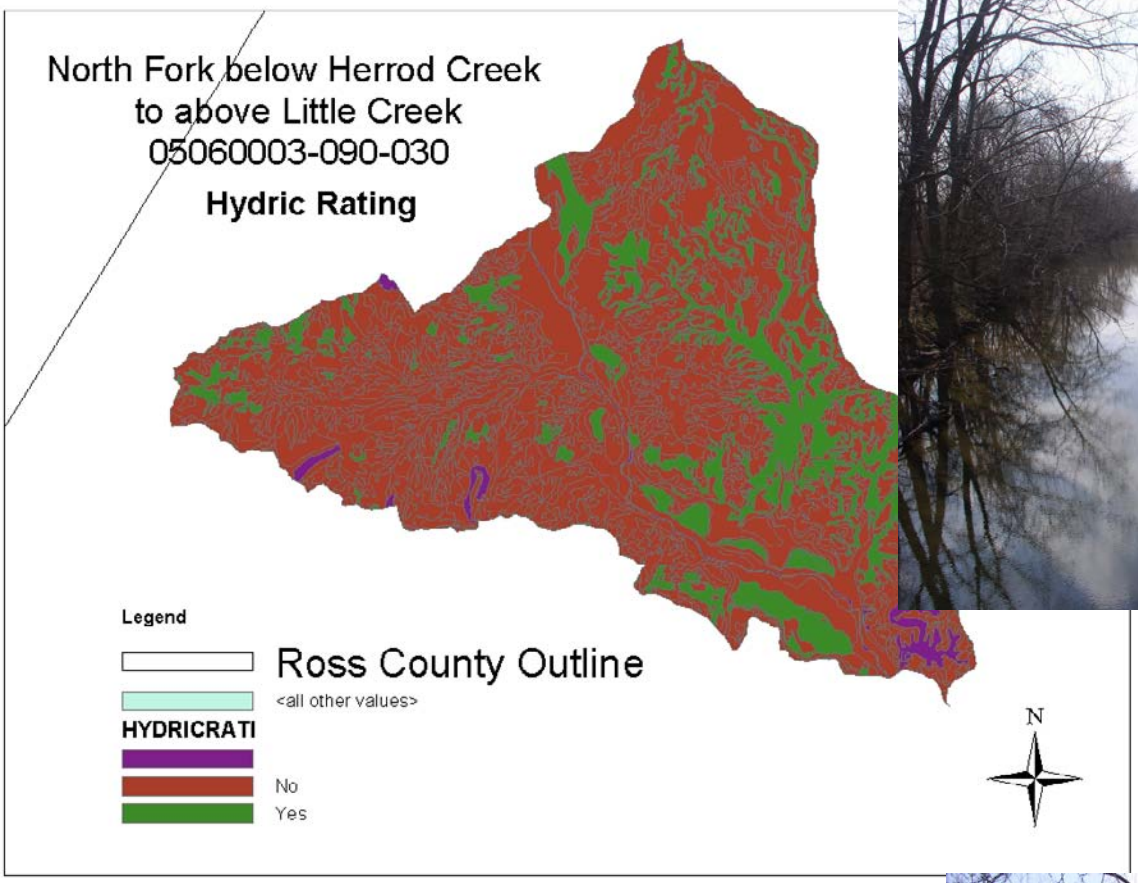

NORTH FORK SOILS
Highly Erodable Land
Legend
Lower North Fork Subwatershed
Ross County Outline
Lower North Fork Soils
<all other values>
MUHELCL
Highly erodible land
Not highly erodible land
Potentially highly erodible land
N

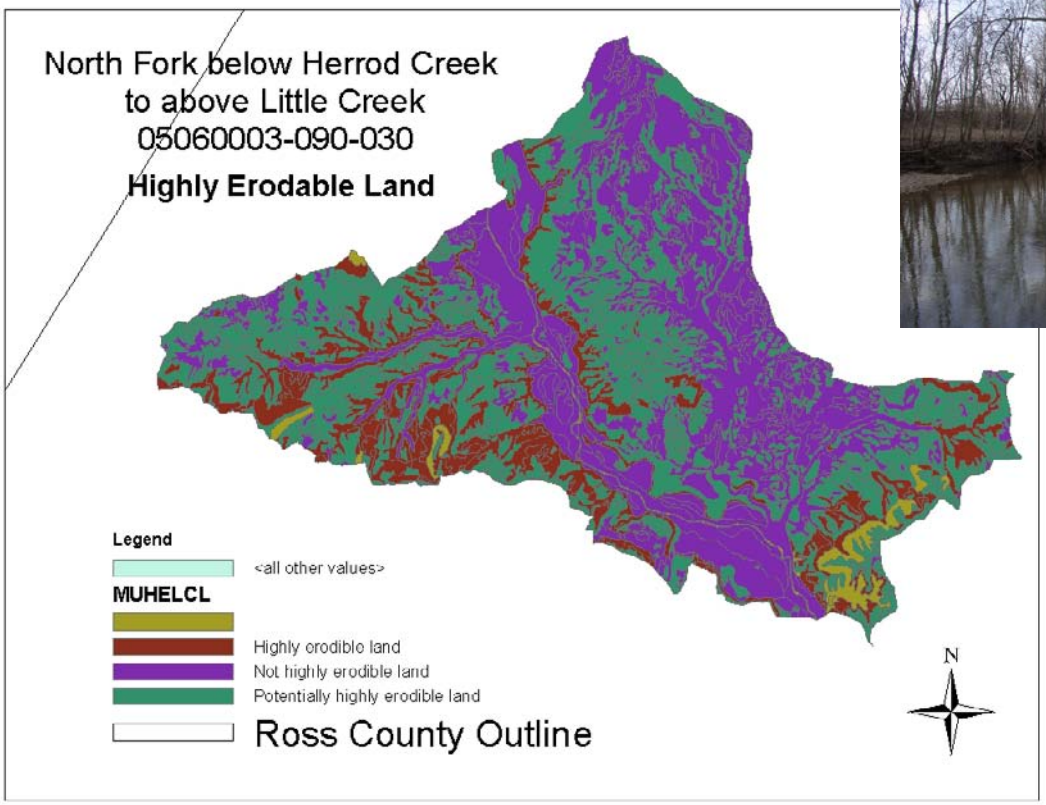

North Fork below Compton Creek
to above Herrod Creek
05060003-090-010
Hydric Rating
Legend
nf_compton to herrod_010
<all other values>
HYDRICRATI
No
Yes
Ross County Outline
N

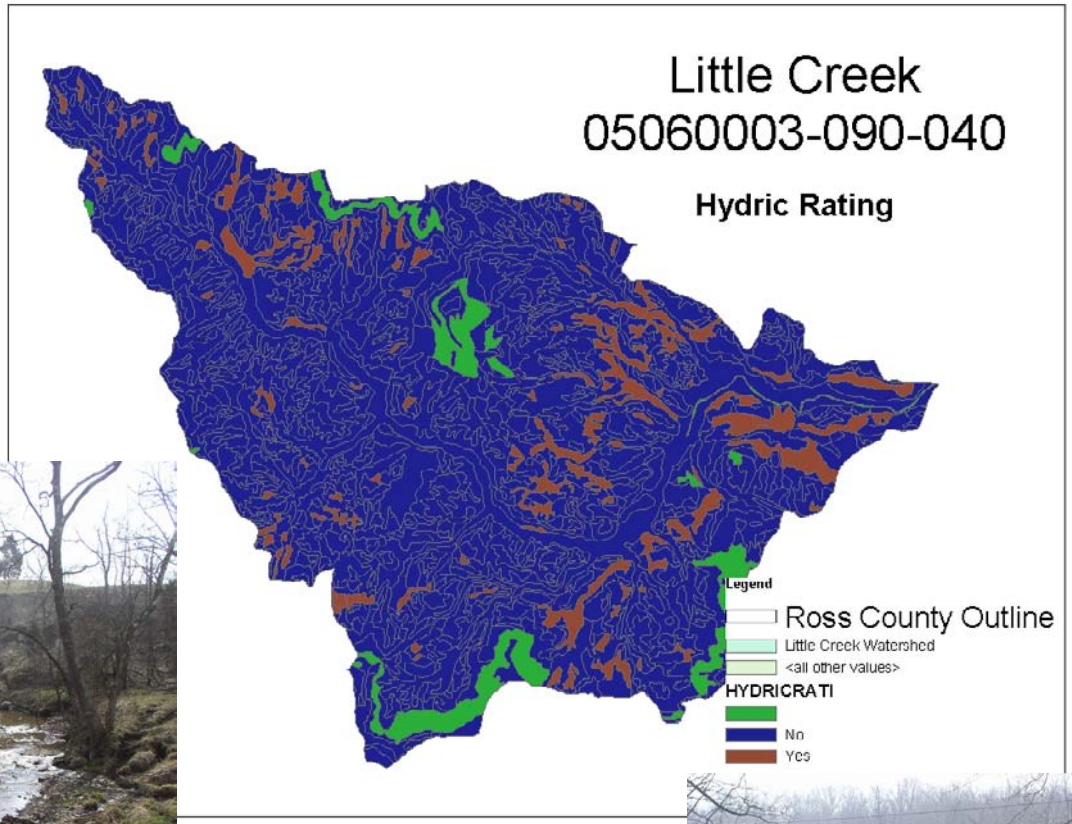

North Fork below Compton Creek
to above Herrod Creek
05060003-090-010
Highly Erodable Land
Legend
nf_compton to herrod_010
<all other values>
MUHELCL
Highly erodible land
Not highly erodible land
Potentially highly erodible land
Ross County Outline
N

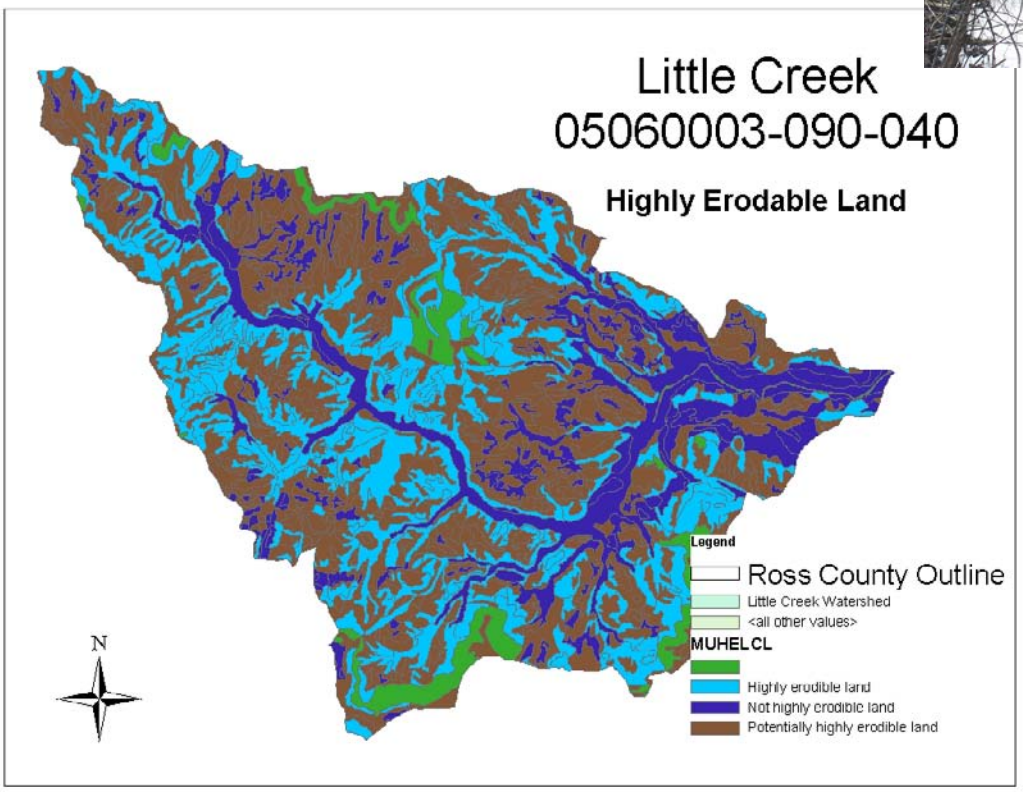

Herrod Creek
05060003-090-020
Hydric Rating
Legend
<all other values>
HYDRICRATI
No
Yes
Ross County Outline
Herrod Creek Watershed
N

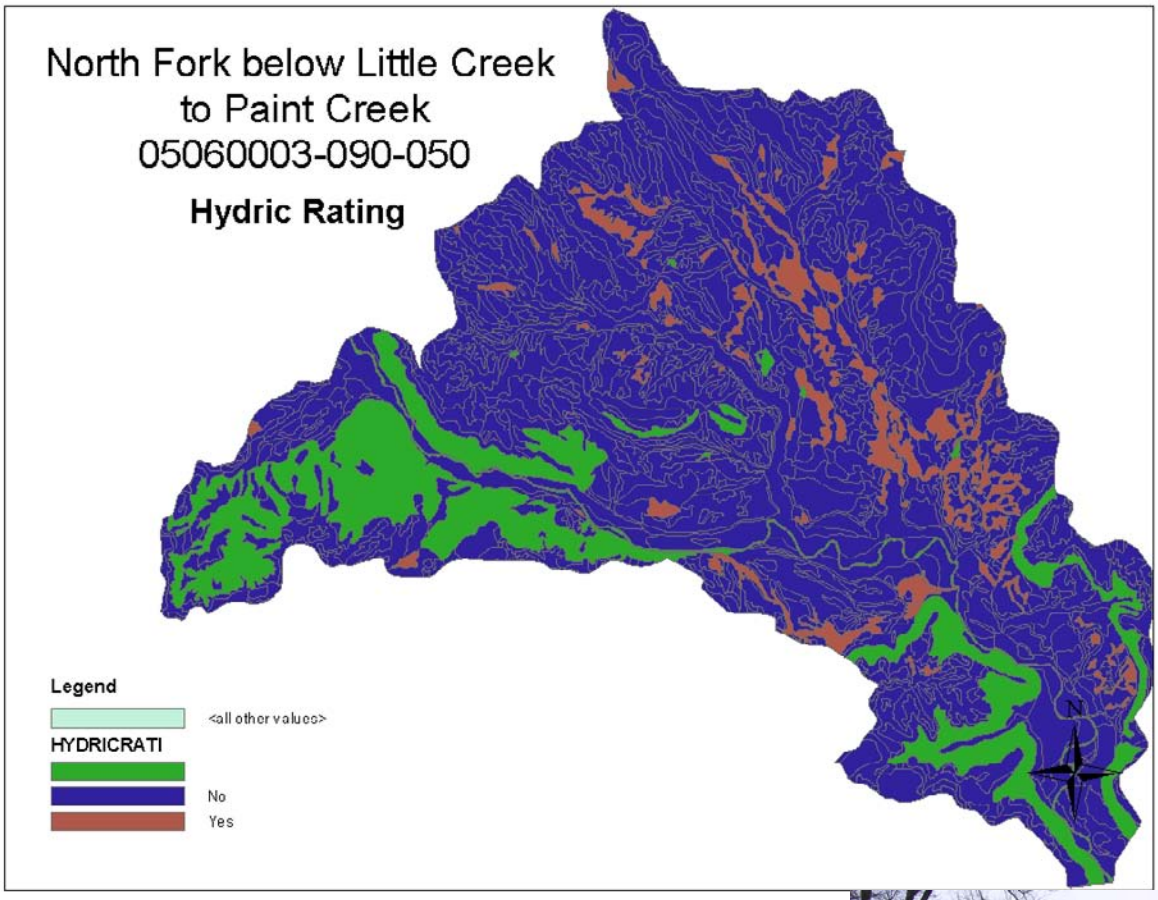

Herrod Creek
05060003-090-020
Highly Erodable Land
Legend
<all other values>
MUHELCL
Highly erodible land
Not highly erodible land
Potentially highly erodible land
Ross County Outline
Herrod Creek Watershed
N

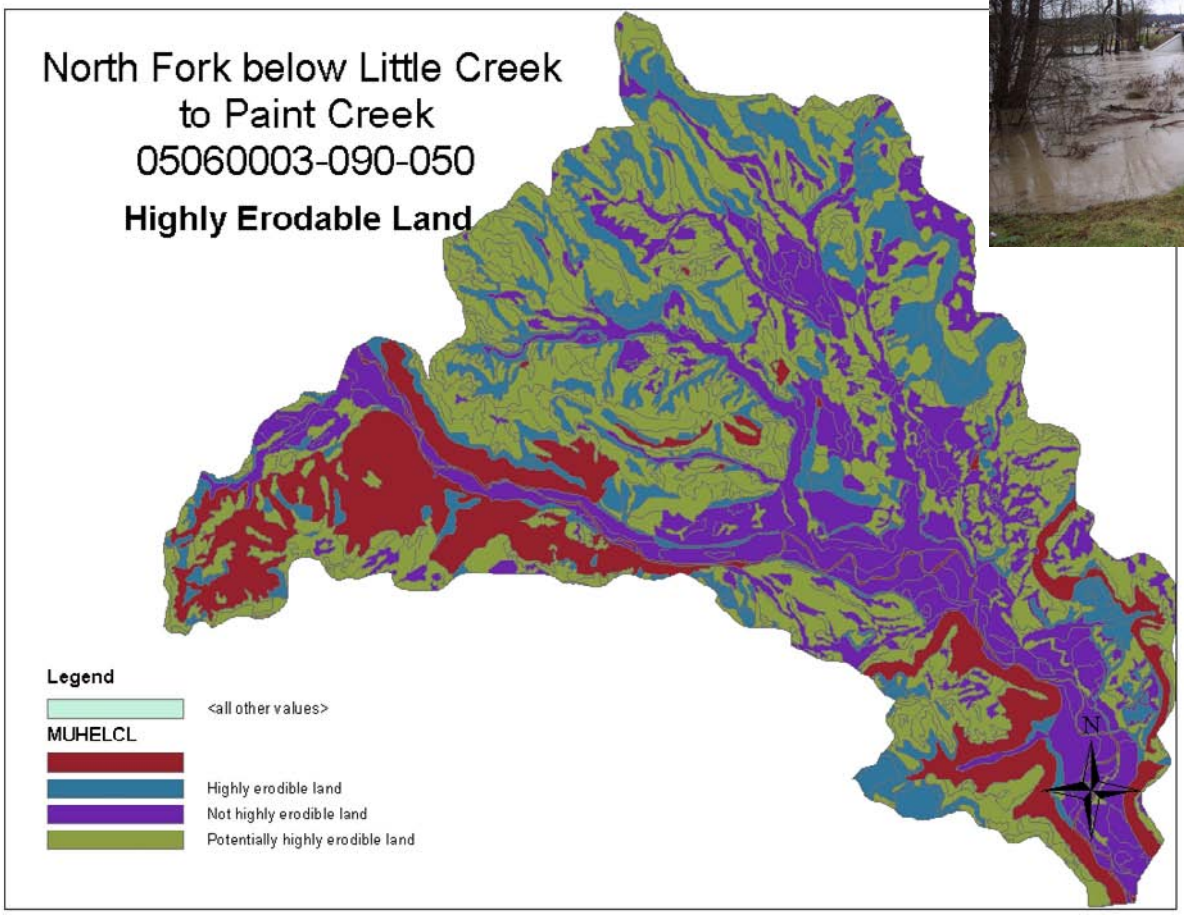

North Fork below Herrod Creek
to above Little Creek
05060003-090-030
Hydric Rating
Legend
Ross County Outline
<all other values>
HYDRICRATI
No
Yes
N


North Fork below Herrod Creek
to above Little Creek
05060003-090-030
Highly Erodable Land
Legend
<all other values>
MUHELCL
Highly erodible land
Not highly erodible land
Potentially highly erodible land
Ross County Outline
N


Little Creek
05060003-090-040
Hydric Rating
Legend
Ross County Outline
Little Creek Watershed
<all other values>
HYDRICRATI
No
Yes


Little Creek
05060003-090-040
Highly Erodable Land
Legend
Ross County Outline
Little Creek Watershed
<all other values>
MUHELCL
Highly erodible land
Not highly erodible land
Potentially highly erodible land
N


North Fork below Little Creek
to Paint Creek
05060003-090-050
Hydric Rating
Legend
<all other values>
HYDRICRATI
No
Yes
N


North Fork below Little Creek
to Paint Creek
05060003-090-050
Highly Erodable Land
Legend
<all other values>
MUHELCL
Highly erodible land
Not highly erodible land
Potentially highly erodible land
N

Problem Statement

The 2002 Ohio EPA Integrated report lists this section of North Fork from Compton Creek to Paint Creek as having unknown impairment because of the lack of sampling locations. It is our belief, based on the lack of full attainment of the aquatic life use from downstream of the New Holland WWTP to the Pleasant Valley WWTP there is a distinct problem with the water quality in this area that needs attention immediately before the use fails to meet any of the attainments. There are only minor inputs from WWTP's in the watershed and very little urban impact in this section so it is our concern, based on the dominant landuse, that there are agricultural inputs contributing to the declining water quality. The 2000 305(b) report states that there are several causes of impairment and sources of impairment and those are listed in the following table:

Stream Segment	Aquatic Life Use	Attainment	Causes	Sources
North Fork from Compton Creek to Little Creek	EWH	Partial	Nutrients, organic enrichment/DO, habitat alteration	Pasture, crop production, Channelization, minor municipal point source
North Fork Paint Creek from Little Creek to Paint Creek	EWH	full/partial	Non-priority organics, siltation	Crop production, minor municipal point source

Since neither Little Creek or Herrod Creek have a history of sampling data, these 2 tributaries would be a priority and in need of additional sampling.

As North Fork gets closer to the confluence with Paint Creek, the city of Chillicothe is quickly grower out and there is concern that storm water and land use changes in this watershed will cause there to be a decline in water quality in the last few miles of the creek.

Concerns by Subwatershed

Watershed Name	**Hydrologic Unit #**	**Suspected or known causes**	**Suspected or known sources**
North Fork below Compton Creek to Herrod Creek	05060003 090 010	Habitat Alteration, Siltation, nutrients, organic enrichment	Crop Production, Channelization, Failing HSTS's
Herrod Creek	05060003 090 020	Habitat Alteration, Siltation, nutrients, organic enrichment	Crop Production, Channelization, Failing HSTS's
North Fork below Herrod Creek to Little Creek	05060003 090 030	Habitat Alteration, Siltation, nutrients, organic enrichment	Crop Production, Channelization, Failing HSTS's
Little Creek	05060003 090 040	Nutrients, Organic Enrichment/DO, Habitat alteration, siltation	Livestock/pasture, Crop production, Failing HSTS's
North Fork from Little Creek to Paint Creek	05060003 090 050	Nutrients, Organic Enrichment/DO, Habitat Alteration, Siltation	Livestock/pasture, Crop production, Urban Runoff

Public Support and Participation

The Paint Creek Watershed Project began holding public meetings in January of 1999 with their Watershed Coordination Kick-Off meeting. There were over 60 people in attendance and they came up with a listing of issues and concerns and then they were asked to pick the ones of priority. Those priority issues are seen below in the first listing. The project did not hold structured meetings again until 2002 due to the lack of availability of the Coordinator to hold meetings along with other day to day duties. In mid 1999, the Project wrote and was awarded a Section 319 grant to hire and write a management plan and in January of 2002, Hilary Solomon was hired. That February, both the Plan Coordinator, Hilary Solomon, and the Project Coordinator, Julie Brown, held meetings throughout the watershed having one in each 11-digit area to start gathering support for the project and to find out the issues and concerns. These meetings were held in the evenings in order to attract all possible interest parties and turn out was rather varied with as little as 2 participants in areas where the stream was smaller and on county maintenance to as many as 60 people where there were more urban communities. After these meetings, the citizens were invited to attend the Advisory Council meetings that were held quarterly for a year and a half after where subgroups sat at the table to formulate objectives and goals for the issues and concerns gathered at the local meetings. The final product was the draft Management Plan that was submitted to Ohio EPA in July of 2002. Soon after submitting the plan, Hilary Solomon's resigned her position and with her went the structured planned meetings. Hilary's work on the plan was invaluable and she is sorely missed as the revisions are completed.

Although the watershed is diverse in landscape and landuse, the issues and concerns that came up regularly at our evening meetings were the same across the watershed and very similar to the original list that was created in 1999. Here is a listing of those concerns.

Priority list from January 1999 meeting (in order of priority):

1. Reduce soil erosion
2. Protect riparian corridor
3. Create a community-driven watershed organization
4. Improve overall water quality
5. Protect against urbanization of farmland
6. Promote filter strips
7. Runoff/storm water management from housing developments and urban areas
8. Promote cost effective BMPs

Between February 28 and March 27, 2001, the Project held the 11 community interest meetings. These meetings were held in nine of the ten USGS hydrologic subunits in the watershed. The meetings were conducted in Bainbridge, Washington Court House, Chillicothe, Frankfort, Sabina, Jeffersonville, Hillsboro, Leesburg and Greenfield. In addition, meetings were held in Chillicothe with the Smallmouth Bass Alliance and the Symposiarts, a group that explores local culture and natural heritage.

The concerns and interest of the local community members were many and varied. The most common topics included stream bank erosion, public access to the creeks (countered with fears about trespassing), modifying dam releases from Paint Creek Lake and Rocky Fork to mimic natural stream flow patterns, litter control/illegal dumping, and map availability for local interest

groups. Some of the most passionate discourse related to fish tissue consumption warnings, confined animal feeding units, wastewater treatment plant installations and management, riparian corridor restoration, and promoting environmental education in schools. A full list of community concerns and suggestions can be found below. Topics in bold were frequent concerns.

The Local Community Concerns were as follows:

Historic/special site preservation
Maps for local interest groups
Farmland/environmental compatibility
Water quality monitoring/maintenance
Confined animal feeding operations
Wastewater treatment plants and failing home septic systems
Litter/illegal dumping
Roadkill
Adopt-a-highway
Loss of farmland
BMP education and enforcement
Lack of zoning
Land use planning
Natural dam releases
Student environmental education
Animal control (beavers and geese)
Land stewardship education for landowners
Community participation
Public access to the creeks
Sediment control/contamination
Logging Practices
Riparian corridor
Stream bank erosion
Log jams
Recreation
Exotic species

The Watershed project again came to the table in the first week of February, 2004 to discuss these issues again but in a much smaller watershed. They looked at the water quality problems and formulated solutions. A listing of the issues discussed follows and this list will be what helps us formulate the load reductions and BMP's that we hope to see in this watershed in the future.

Meeting to Discuss the Water Quality Issues in the North Fork of Paint Creek

Attendance:
Vince Chrisman, Fayette SWCD
Mike Greenlee, ODNR-DOW
Kathryn Madden, Ross County Health Dept.
Kurt Simon, Ohio Valley RC&D
Chad McIlvaine, landowner
Doug Pauley, Rocc NRCS
Marvin Garrison, Ross SWCD
Debbie McFadden, Friends of the Buzzards Roost Nature Preserve
Kelly Seig, Friends of the Buzzards Roost Nature Preserve

Statistics provided to Working Group:
11 Digit Watershed: 05060003 090
11 Digit Watershed Name: North Fork (downstream Compton Creek to mouth)
14 Digit Watershed(s) and Name(s):
05060003 090 010 North Fork below Compton Creek to above Herrod Creek
05060003 090 020 Herrod Creek
05060003 090 030 North Fork below Herrod Creek to above Little Creek
05060003 090 040 Little Creek
05060003 090 050 North Fork below Little Creek to Paint Creek
Sources of Water Quality Impairment: Siltation, Nutrients, Organic Enrichment/DO, Habitat Alteration
Causes of Water Quality Impairment: Crop Production, Municipal Point Source, Pasture Land, Channelization

Forested Buffer Along Streams: 05060003 090
Acreage Within 50 foot of Stream on either side: 2426 acres
Forested Acreage within 50 feet of stream: 856 acres
Percent forested coverage within 50 ft: 35%

Forested Buffer Along Streams: 05060003 090 010
Acreage Within 50 foot of Stream on either side: 585 acres
Forested Acreage within 50 feet of stream: 302 acres
Percent forested coverage within 50 ft: 52%

Forested Buffer Along Streams: 05060003 090 020
Acreage Within 50 foot of Stream on either side: 558 acres
Forested Acreage within 50 feet of stream: 252 acres
Percent forested coverage within 50 ft: 45%

Forested Buffer Along Streams: 05060003 090 030
Acreage Within 50 foot of Stream on either side: 705 acres
Forested Acreage within 50 feet of stream: 180 acres
Percent forested coverage within 50 ft: 25%

Forested Buffer Along Streams: 05060003 090 040
Acreage Within 50 foot of Stream on either side: 300 acres
Forested Acreage within 50 feet of stream: 56 acres
Percent forested coverage within 50 ft: 19%

Forested Buffer Along Streams: 05060003 090 050
Acreage Within 50 foot of Stream on either side: 255 acres
Forested Acreage within 50 feet of stream: 49 acres
Percent forested coverage within 50 ft: 19%

The Paint Creek Watershed Project is pleases to have had the involvement of the following people and organizations in the completion of this community based watershed action plan.

Name	Association	City
Agriculture Subgroup		
Hugh Trimble	Ohio EPA	Dayton
Gordon Conn	Farmer	Jeffersonville
Dave Parry	NRCS	Hillsboro
Vince Chrisman	Fayette SWCD	Washington CH
Dave Sever	Sever Consulting	Washington CH
Eric Rutherford	Landowner	Wilmington
David Caplinger	Landowner, SOFA	Hillsboro
Rosida Porter	Ohio DNR	Columbus
Forestry Subgroup		
Heidi Devine	Ohio DNR, Div of Wildlife	Xenia
Lee Crocker	Ohio DNR, Div of Forestry	Waverly
Mike Besonen	MeadWestvaco	Chillicothe
Chris Smid	MeadWestvaco	Chillicothe
Randy Sanders	Ohio DNR	Columbus
Joey Knauff	Knauff Lumber/ Master Loggers	Bainbridge
Education Subgroup		
Sam Webb	Pickaway SWCD	Circleville
Jenny Behymer	Landowner	Hillsboro
Layne Garringer	Fayette SWCD	Washington CH
Steve Hawkins	Ohio DNR/DSWC	Circleville
Jerry Iles	OSU Extension	Jackson
Urban Subgroup		
Julia Cummings	Madison SWCD	London
Steve Sobers	City Manager	Washington CH
Streamside Management Subgroup		
Dot Riley	NRCS	Grove City
Gordon Conn	Farmer	Jeffersonville
Gary Merkamp	Ross County Park District	Chillicothe
Randy Hoover, Kipp Brown	Ohio DNR, Div of Wildlife	Xenia
Bob Jones	Landowner, former Army COE	Bainbridge
Dan Imhoff	Ohio EPA	Logan
Marty Lundquist	Ohio DNR, Div of Wildlife	Columbus
Paula Wentzel	MeadWestvaco	Chillicothe

Background: The section of the North Fork of Paint Creek from Compton Creek to Paint Creek is currently not meeting its use designation or partially meeting its use designation throughout the watershed. According to the 2004 Integrated Report, there was not enough data to do a complete assessment. The Project however, gathered technical advice from local Agencies and with the 2000 305(b) report believe that the watershed is being impaired nutrients, organic enrichment, siltation and other habitat alterations. Exact locations of impairment from the 1997 OEPA assessment are as follows:

RIVER MILE	STREAM	LOCATION	ECO-REGION	SIZE*	HABITAT	ATTAINMENT	PRIORITY
3.80	North Fork Paint Creek	US 50 Dst. Pleasant Valley WWT	ECBP	SR	EWH	Full	Low
10.50	North Fork Paint Creek	Musselman Dst. Frankfort WWTP	ECBP	SR	EWH	Partial	Medium
17.50	North Fork Paint Creek	Dexter Rd. Ust. Frankfort WWTP	ECBP	W	EWH	Partial	Medium
23.20	North Fork Paint Creek	Woodrow Rd. Dst. N. Holland WW	ECBP	W	EWH	Partial	Medium
31.00	North Fork Paint Creek	Glaze Road	ECBP	W	EWH	Full	Low
1.40	Compton Creek	Dogtown Rd.	ECBP	W	EWH	Full	Low

Problem statement: Excessive nutrients, siltation and habitat alteration in the lower section of the North Fork of Paint Creek watershed are causing impairment of the use designation. Through field inventory, the source of the erosion is believed to be from over land runoff and streambank erosion. The source of the nutrients and organic enrichment are believed to be widespread row crop agriculture, livestock, failing septic systems (livestock and septic discussed later) and habitat alterations, predominantly channelization. More precise locations of eroding banks are not yet confirmed. The total sediment load is 29,596.8 tons/year with a total nutrient load of 229,654 lb/year per the STEPL program.

The task descriptions below were formulated using recommendations from experts at the local Soil and Water Conservation Districts, Health Departments, Ohio Department of Natural Resources, Division of Forestry, Division of Wildlife, and Division of Soil and Water Conservation, along with the Natural Resource Conservation Service and the Ohio Environmental Protection Agency.

Goals:

1. Reduce nutrient load and organic enrichment by 30% from agricultural fields.
2. Reduce sedimentation by 67% from habitat alterations

Task Description	Resources	How	Time Frame	Performance Indicators
Establish conservation tillage on 5197 acres. The first priority being highly erodable land within 1000 feet of the stream. It is estimated that this will reduce the nutrient load 28597 lb/year and the sediment load by 8552 tons/year	$130,000	Local watershed group will apply for 319 grant.	January 2006-January 2011	Document soil and nutrients saved/not delivered to stream using RUSLE or other model, Improved QHEI scores
Control erosion and nutrient runoff with the installation of	$145,000	CRP, EQIP, Local	January 2006-January 2011	Document soil and nutrients

20,000 linear feet of grassed waterways and water and sediment control basins. It is estimated that this will reduce the nutrient load by 19,125 lb/year and the sediment load by 6375 tons/year		watershed group will apply for 319 grant program		saved/not delivered to stream using RUSLE or other model, improved QHEI scores
Establish a total of 600 acres within 50 feet of the stream of riparian corridor, natural regeneration and/or warm season grasses along the impaired segments. It is estimated that this will reduce the nutrient load 17325lb/year and the sediment load by 5778 tons/year	$1,800,000 for an incentive program	CREP, CRP, EQIP, WHIP, FLEP, DOW free seed and Pastures to Prairies Program, Pheasants Forever, National Wild Turkey Federation, Paint Creek Watershed Project 319 program	January 2005 to January 2020	Document soil saved/not delivered to stream using RUSLE or other model, improved QHEI scores

Loading reductions calculated using Load Reduction Spreadsheet v1.2.

Problem statement: Excessive nutrients in the lower section of the North Fork of Paint Creek watershed are causing impairment of the use designation. According to OEPA sampling data from 1997, fecal coliforms and phosphorus counts were exceeded on at least one sampling day and nitrate/nitrite counts were exceeded repeatedly. After discussions with the SWCD and local Health Dept. it is accepted that approximately 15% of the on-site septic systems in this area are failing which is approximately 344 homes. More precise locations of failing systems are not yet confirmed. The total nutrient load for this watershed is 229,654 lb/year. The estimated nutrient load from these 344 homes is 51.6 lbs/day of nitrogen and 34.4 lbs/day of phosphorus.

The task descriptions below were formulated using recommendations from experts at the local Soil and Water Conservation Districts, Health Departments, Ohio Department of Natural Resources, Division of Forestry, Division of Wildlife, and Division of Soil and Water Conservation, along with the Natural Resource Conservation Service and the Ohio Environmental Protection Agency.

Goals:

1. Reduce nutrient load and organic enrichment from failing on-site home septic systems by repairing all failing systems.

Task Description	Resources	How	Time Frame	Performance Indicators
Work with county Health Departments to determine more accurate number of failing systems	HD Inspectors time to inspect all systems	Inspect all systems	January 2004-January 2005	Report of failing systems generated
Replace/upgrade failing systems	Health Dept. time to write plan	Apply to DEFA for low interest on-site loan program for county	October 2002-December 2004	DEFA program available in county,
Search for funding options to upgrade failing systems	Watershed Coordinator and/or Health Dept. time to write 319 grant application	Local watershed group or Health Dept. will apply for 319 grant program	January 2006	Grant Submitted
Replace/upgrade all failing systems	County sanitarians time to approve applications and inspect	Local watershed group or Health Dept. will apply for 319 grant program	January 2006-December 2011	All failing systems replaced or upgraded

Loading reductions calculated using Load Reduction Spreadsheet v1.2.

Problem statement: Excessive nutrients, organic enrichment and habitat alteration in the upper section of the Paint Creek watershed are causing impairment of the use designation. Through field inventory, the source of some of the nutrients and organic enrichment are believed to be livestock and their access to the stream. According to the county SWCD's, there are approximately 2294 hogs, 407 sheep, 85 horses, 1825 cattle and 456 dairy cattle in the watershed. The total nutrient load for the watershed is 229,654 lb/year. While this is not a large number of livestock, there are problems with their proximity to the stream which are causing slumping banks, sedimentation and nutrient enrichment.

The task descriptions below were formulated using recommendations from experts at the local Soil and Water Conservation Districts, Health Departments, Ohio Department of Natural Resources, Division of Forestry, Division of Wildlife, and Division of Soil and Water Conservation, along with the Natural Resource Conservation Service and the Ohio Environmental Protection Agency.

Goal:

1. Stabilize 3000 feet of eroding banks by excluding livestock.
2. Reduce nutrients entering the stream from livestock feeding and watering

Task Description	Resources	How	Time Frame	Performance Indicators
Establish a livestock nutrient reduction program with a combination of heavy use feeding pads, exclusion fencing, and alternate watering sources.	75,000 for an incentive program	CREP, CRP, EQIP, Paint Creek Watershed Project 319 program	January 2006 to January 2009	Document decreased nutrient and sediment load using estimated load reduction spreadsheet.

Loading reductions calculated using Load Reduction Spreadsheet v1.2.

Streambank Stabilization and Willow Planting on Little Creek

Problem statement: Excessive nutrients, organic enrichment and habitat alteration in the lower section of the North Fork of Paint Creek watershed are causing impairment of the use designation. Education programs and personnel are needed to educate the community and provide an awareness of the issues, both agricultural and urban, and to deal with concerns.

The task descriptions below were formulated using recommendations from experts at the local Soil and Water Conservation Districts, Health Departments, Ohio Department of Natural Resources, Division of Forestry, Division of Wildlife, and Division of Soil and Water Conservation, along with the Natural Resource Conservation Service and the Ohio Environmental Protection Agency.

Goals:

1. Reduce nutrient load, organic enrichment, and sedimentation through education and awareness programs

Task Description	Resources	How	Time Frame	Performance Indicators
Work with local stakeholders to create an awareness of the watershed issues and concerns and available programs. Use GIS to formulate watershed mailing lists to keep landowners aware of programs.	Maintain a watershed coordinator	Local watershed group will apply for 319 grant program or other funding source	On going	Watershed Coordinator is hired/continues employment.
Work with developers, builders and government agencies to ensure county urban erosion control guidelines are followed.	Add an urban streams conservationist to the watershed project	Local watershed group will apply for 319 grant program or other funding source	January 2006	Urban Streams Conservationist is hired.

Loading reductions calculated using Load Reduction Spreadsheet v1.2.

The Paint Creek Watershed Project is pleases to have had the involvement of the following people and organizations in the completion of this community based watershed action plan.

Name	Association	City
Agriculture Subgroup		
Hugh Trimble	Ohio EPA	Dayton
Gordon Conn	Farmer	Jeffersonville
Dave Parry	NRCS	Hillsboro
Vince Chrisman	Fayette SWCD	Washington CH
Dave Sever	Sever Consulting	Washington CH
Eric Rutherford	Landowner	Wilmington
David Caplinger	Landowner, SOFA	Hillsboro
Rosida Porter	Ohio DNR	Columbus
Forestry Subgroup		
Heidi Devine	Ohio DNR, Div of Wildlife	Xenia
Lee Crocker	Ohio DNR, Div of Forestry	Waverly
Mike Besonen	MeadWestvaco	Chillicothe
Chris Smid	MeadWestvaco	Chillicothe
Randy Sanders	Ohio DNR	Columbus
Joey Knauff	Knauff Lumber/ Master Loggers	Bainbridge
Education Subgroup		
Sam Webb	Pickaway SWCD	Circleville
Jenny Behymer	Landowner	Hillsboro
Layne Garringer	Fayette SWCD	Washington CH
Steve Hawkins	Ohio DNR/DSWC	Circleville
Jerry Iles	OSU Extension	Jackson
Urban Subgroup		
Julia Cummings	Madison SWCD	London
Steve Sobers	City Manager	Washington CH
Streamside Management Subgroup		
Dot Riley	NRCS	Grove City
Gordon Conn	Farmer	Jeffersonville
Gary Merkamp	Ross County Park District	Chillicothe
Randy Hoover, Kipp Brown	Ohio DNR, Div of Wildlife	Xenia
Bob Jones	Landowner, former Army COE	Bainbridge
Dan Imhoff	Ohio EPA	Logan
Marty Lundquist	Ohio DNR, Div of Wildlife	Columbus
Paula Wentzel	MeadWestvaco	Chillicothe

Evaluation Strategy and Plan Update/Revision:

The Paint Creek Management Plan is anticipated to be a living and working document that does not end up on a shelf collecting dust. In order to accomplish this, evaluation and updating will be key components for the future.

Since the formulation of the Management Plan relied heavily on stakeholder input, their evaluation of the plan will be crucial to its future. The Project would like to implement a yearly progress meeting to discuss the original goals of the plan and to determine the status of these goals and the need for additional response or update. The success of some measures such the BMP's will be measured on a basis of application and implementation in the watershed. This information will be provided by the local Soil and Water Conservation Districts, Natural Resource Conservation Service and the County Health Departments. A measure of success for the education aspect of the plan will be the number of programs provided and the attendance of the community. It is anticipated that as awareness of the watershed increases that the interest in monitoring local streams will increase and that this data will also be used to evaluate and monitor the success of the plan at improving the water quality.

The ultimate responses that the Project hopes will come out of this planning process is:

- Increased awareness in the community of the Paint Creek Watershed and
- Water quality in the watershed meeting use designations with QHEI scores consistently improving.

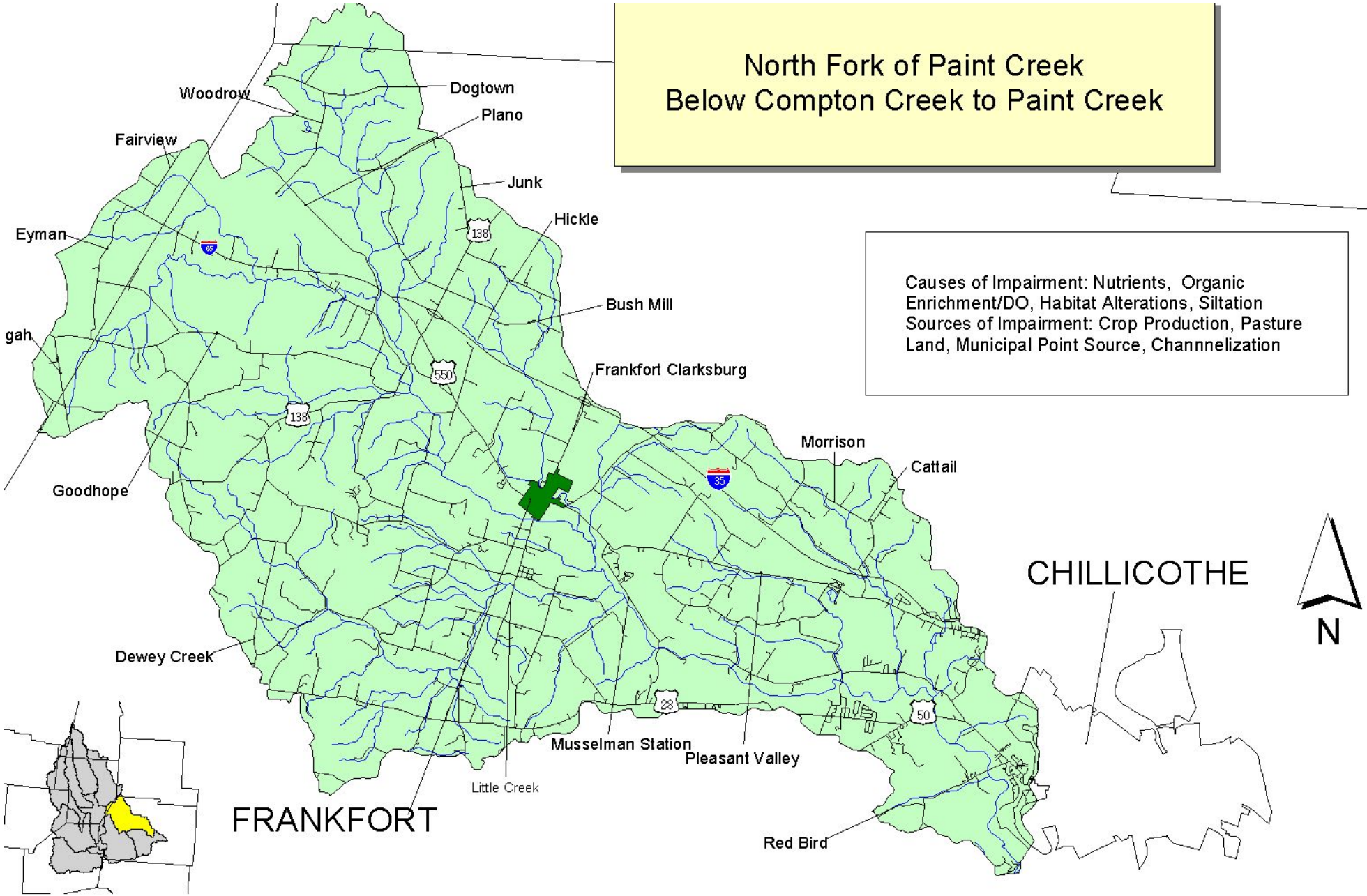
This watershed is slated to be sampled by the Ohio EPA Ecological Assessment Unit in 2006 with a TMDL completion date of 2008. Paint Creek received it's first intensive sampling effort in 1997 so the project will also be able to look for any changes from one sampling period to the next and compare that with the work the Project that has already completed.

The progress of the plan will be made available to interested local and state governments as well as all watershed citizens through newsletters, brochures, news articles, radio programs and at some point a web site. These duties will be the responsibility of the Watershed Coordinator and the Paint Creek Joint Board of Supervisors along with the Sub-watershed Work Groups.

It is anticipated that as a working document, the plan will be revised yearly after the progress meetings have determined the successes and failures.

North Fork of Paint Creek
Below Compton Creek to Paint Creek

Causes of Impairment: Nutrients, Organic Enrichment/DO, Habitat Alterations, Siltation
Sources of Impairment: Crop Production, Pasture Land, Municipal Point Source, Channnelization



Watershed Action Plan for the Paint Creek Gorge Area

Hydrologic Unit Numbers:

05060003 100 010 Paint Creek below Lower Twin to above North Fork

05060003 100 020 Black Run

05060003 100 030 Ralston Run

05060003 100 040 Paint Creek below North Fork to the Scioto River

Written and Compiled by:
Hilary Solomon, Plan Coordinator
Julie Brown, Watershed Coordinator
Paint Creek Watershed Project
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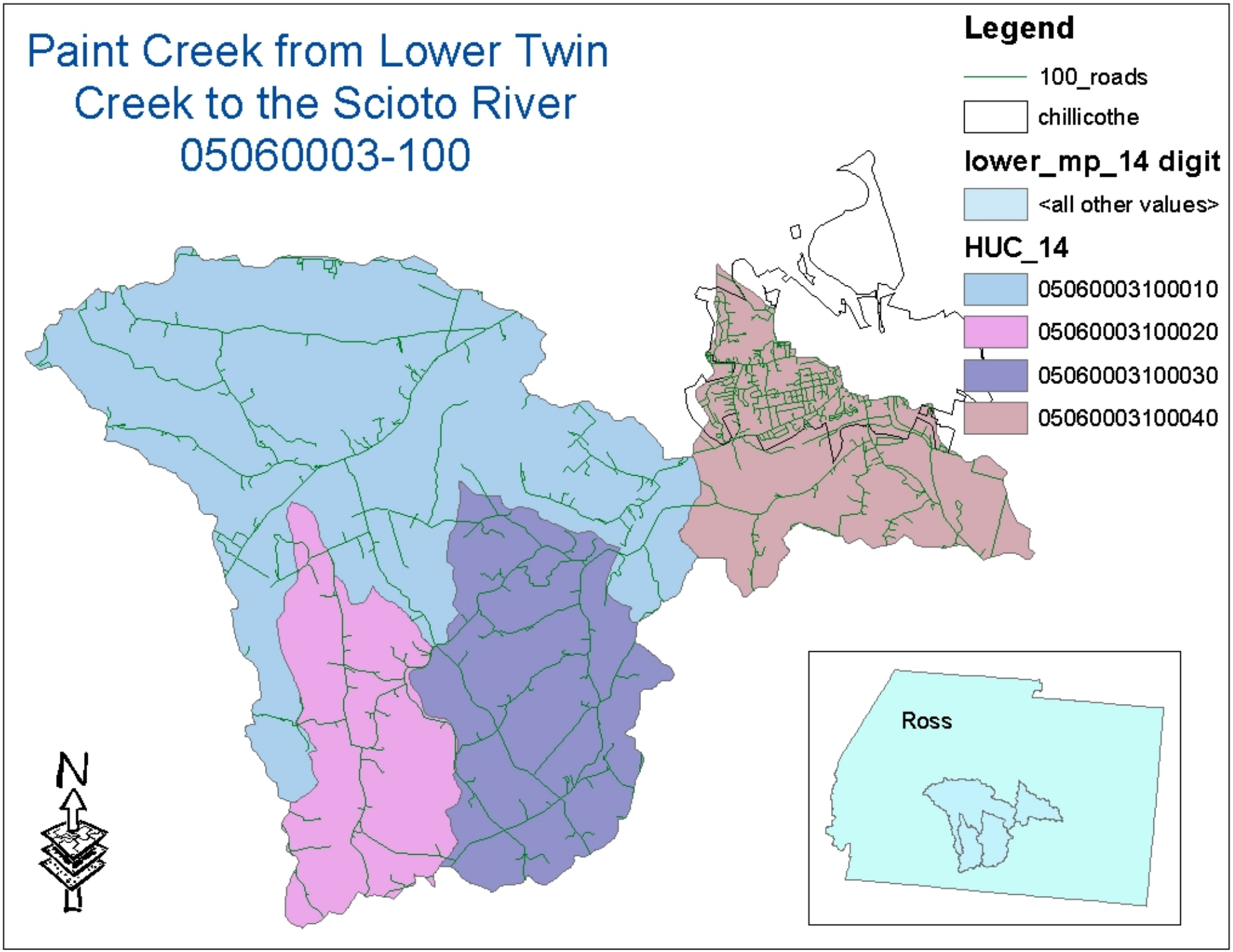
Phone: (740) 772-4110 ext. 117
Fax: (740) 775-5623
Email: julie.brown@oh.nacdnet.net

Paint Creek from Lower Twin Creek to the Scioto River 05060003-100



INTRODUCTION

The Paint Creek Watershed Management Plan stems from an ongoing conservation ethic within the Paint Creek Watershed. Conservation practices were explored in the watershed as early as the 1960's. Public awareness and interest in maintaining and/or improving water quality in the watershed has increasingly mounted since those early studies. Land managers within the watershed are currently pursuing several conservation grants and the watershed project is distributing Clean Water Act, section 319 grant monies to fund projects in targeted areas. The management plan will provide information to ensure that future conservation efforts within the watershed are applied in the most efficient and beneficial manner.

As far as practicable, the Paint Creek Watershed Management plan follows the outline contained in Ohio EPA's *Guide to Developing Local Watershed Action Plans in Ohio* . The plan contains four main sections: the background and scope of the project, a comprehensive watershed inventory, a watershed-wide water quality assessment with documentation of the related problems, and an outline of planned implementation activities or solutions. This last section includes a timeline and methods to evaluate the effectiveness of the activities implemented within the watershed.

The Watershed Project was originally formed in 1998 when 6 coordinating Soil and Water Conservation Districts received Section 319 funds for implementation. It was always the plan that A watershed Coordinator would administer the grants and also work on putting together a management plan for the watershed. The Project is governed by a Joint Board of Supervisors, one from each of the 6 main county SWCD's, which follow the operational procedures of a District SWCD. The Joint Board also put together bylaws that are available from the Watershed Coordinator. This Board makes all decisions based on funding and application approval for the implementation program but decisions about the contents of the plan have been left completely up to the stakeholders involved in the development process. The stakeholder groups have been open to the public and new attendees are welcome at any time.

General Description and Political Boundaries

The Paint Creek Watershed is comprised of 731,168.9 acres located in 9 counties: Madison, Greene, Clinton, Clark, Pickaway, Fayette, Pike, Ross, and Highland.

The Main Paint Creek Subwatershed is located in south central Ohio and covers 310,585 acres. It originates in Madison County and encompasses much of Fayette County and the eastern edge of Highland and western edge of Ross County. Main Paint Creek meets the Scioto River south of Chillicothe in Ross County. The flood plain of Paint Creek varies in width from a few feet at its source to more than 1.5 miles at its mouth. The stream fall from source to mouth is 555 feet, an average of 5.7 feet per mile. The fall in the lowermost 50 miles is about 265 feet or 5.3 feet per mile (Corps, 1973). At the confluence of Paint Creek and Rattlesnake Creek is the Paint Creek Lake. The lake was built by the Army Corps of Engineers for flood control, but also serves recreational purposes.

Background/reasons for implementing a management plan

The following were presented to the advisory group and community as reasons for writing and implementing a comprehensive management plan for Paint Creek Watershed.

Size/diversity of the watershed

Paint Creek Watershed covers over 731,000 acres and crosses multiple political boundaries. Additionally, the watershed may be divided into multiple subwatershed units each of which forms an independent drainage unit within the larger watershed. Depending on the topography of the area these units may be subdivided many times and each subwatershed will have slightly different chemical, physical and biological properties. In addition, many people reside in the watershed and activities such as agriculture, forestry, urban development, recreation, commerce and industry continue to grow and change.

Total Maximum Daily Loads (TMDLs). The advent of increasingly stringent enforcement of the Clean Water Act, is reflected in the introduction of TMDLs across the country. Ohio EPA recently began implementing their TMDL program and the Paint Creek Watershed is scheduled for evaluation in 2012-2013. The TMDL program establishes daily limits for a variety of pollutants, including sediment and nutrients, discharged to streams that do not meet water quality standards outlined in the Clean Water Act. This program currently only affects point source discharges though forestry, agriculture and development may be affected in the future.

Soil erosion. Soil erosion is one of the biggest problems in the watershed and the focus of most of the conservation practices implemented by both landowners and the Army Corps of Engineers. Most of the soil in South Central Ohio is depositional till resulting from the glacial activities. This soil is prone to erosion and there is erosion and erosion-related water quality problems throughout the watershed.

Water quality. In 1997, Ohio EPA surveyed much of the watershed to measure the chemical and biological properties of the waters. The 2000 305(b) report lists the Upper Paint Creek Watershed (North Fork and Rocky Fork) as meeting water quality standards in 35.5 percent of the watershed. Lower Paint Creek Watershed (Main Paint and Rattlesnake) met water quality standards in 75.6 percent of the watershed. In order to establish baseline water quality information and to measure the success of our water quality solutions, we may need to implement an additional sampling program.

Species diversity. The Paint Creek Watershed contains a rich array of plant and animal species. For example, a study completed in 1999 through Ohio State University found 104 species of fish inhabiting the Paint Creek Watershed. Some of the plant and animal species in the watershed include endangered, threatened, rare, intolerant, or species of special interest. The Ohio Department of Natural Resources' Heritage database lists 52 species of interest or concern in the watershed. These include 10 endangered species and 11 threatened species.

Invasive species. Invasive species are plants and animals that are not native to the area. Usually introduced by human activities, these species may have no natural biological controls. They may invade parts of the watershed and crowd out naturally

occurring species. Examples of invasive species found in the watershed include, garlic mustard, phragmites reed grass, and Japanese honeysuckle.

319 grants. Conservation practices funded through the Clean Water Act, section 319 grant program have been implemented throughout the watershed. One of the main purposes of the management plan is to look at information on soil erosion, water quality, and species diversity and concentrate conservation practices in the most sensitive areas of the watershed.

Local Conservation History

Agriculture is the main practice in the watershed and erosion has been the historic conservation concern. Land management and conservation studies began in the Paint Creek area in the early 1960's. Congress authorized a study of the Scioto River Basin, which led to the construction of the Paint Creek Lake in 1967 (Garringer). The lake is primarily for flood control, but the lands surrounding the lake provide wildlife habitat and recreational opportunities.

After heavy flooding in 1959 and 1960, the soil and water conservation districts in the Rattlesnake Creek watershed initiated the planning process to implement a project for flood control and land treatment. The initiative was eventually de-authorized but land managers recognized a need for local conservation practices.

In 1994, after continuous siltation problems in Paint Creek Lake, planning began for a new "Paint Creek Initiative" that would use Clean Water Act, section 319 grant monies to help introduce conservation projects throughout the watershed. This movement was inspired by activities taking place in the Darby Creek watershed which is partially located in Madison County. In 1995, a proposal was submitted to Ohio EPA requesting $300,000 to partially fund a land treatment program for the entire Paint Creek watershed (Garringer).

The proposal was originally rejected, but the soil and water conservation districts (SWCDs) in Fayette, Highland and Ross Counties worked closely with Ohio EPA to come up with a proposal that would be accepted. The new proposal included dividing the watershed into four management units based on the Main Paint, North Fork, Rattlesnake, and Rocky Fork Subwatersheds. In 1996, the SWCDs applied for and received 319 grant monies for the North Fork of Paint Creek Subwatershed. These monies were received in 1997, the same year that the SWCDs applied for and received 319 grants for Main Paint and Rattlesnake subwatersheds.

In December 1997, representatives from Fayette, Highland, Ross, Madison, Clinton and Greene counties met and formed a joint board of supervisors to oversee the spending of funds from the grant. In 1998, Julie Brown was hired by the joint board to act as watershed coordinator for the entire Paint Creek watershed. Julie meets with the joint board once every month.

The cost-share practices funded through the 319 grants largely focus on reducing erosion in the watershed. The first round of grants included grass waterways, equipment buy-downs, soil testing, lime applications, livestock exclusion fencing, streambank stabilization, heavy use feeding pads, tree and grass filter strips, deep tillage tool rental (North Fork only), manure management systems (North Fork only), and alternate watering sources (North Fork only). The 319 grant applications were given a score based on the proximity of the site to a stream, the size of stream, and the erodability index of the soil. Through this process land managers tried to implement conservation practices in areas of the watershed that were contributing the greatest amount of erosion.

The 319 grants discussed above were three year grants and ended in June of 2001. The project reapplied and was awarded money for all three subwatersheds. Currently all of Paint Creek Watershed has 319 conservation grant money.

In January of 2000, Julie formed an advisory committee to help provide guidance with the watershed project. This group meets quarterly and discusses management issues pertaining to the management plan. These meetings often feature guest speakers who have conducted studies within the watershed. In 2000, the project wrote and was awarded an additional 319 planning grant to help fund a part-time position for a management plan coordinator. Hilary Solomon was hired in January of 2001 to help write the management plan for the Paint Creek Watershed.

In 2000, Julie was also awarded a grant, the aim of which was "getting GIS into the hands of the conservationist." She worked closely with the consulting firm Malcolm Pirnie to acquire spatial data that could be used to make maps describing the area. Through this project, an extensive catalogue of data was acquired, which will be useful in the future water shed planning.

Addendum to the Paint Creek Watershed Management Plan

This additional section of the management plan tries to include information specific to the lower half of Rattlesnake Creek. For watershed wide information including wildlife and soils, please see the draft copy of the Paint Creek Management Plan.

Main Paint Creek from Lower Twin Creek to the Scioto River

The Paint Creek Watershed has already put together an extensive management plan that was submitted for review from the Ohio EPA in July of 2002. The original plan gave information on a larger scale, splitting the watershed into 4 sections: Main Paint, Rattlesnake, North Fork and Rocky Fork Creeks. The O hio EPA's suggestion after reviewing the document was to return with more detail. The project than choose their 3 priority areas and the upper section of Rattlesnake Creek was picked as one of these areas.

This section of Paint Creek includes the entire 11-digit area, which is entirely in Ross County. This section includes only one major city and that is Chillicothe, the county seat for Ross.

Table 1

Watershed Name	Hydrologic Unit #	Counties	Drainage Area (acres)	Stream Miles
Paint Creek	05060003	Ross, Highland, Fayette, Greene, Clinton, Madison, Clark, Pickaway, Pike	731,161.9	1572.53 (total)
Main Paint Creek from Lower Twin Creek to the Scioto River	05060003 100	Ross	43048.8	212.11
Paint Creek below Lower Twin to above North Fork	05060003 100 010	Ross	205961	110.77
Black Run	05060003 100 020	Ross	6318.3	30.02
Ralston Run	05060003 100 030	Ross	8835.2	36.70
Paint Creek below North Fork to the Scioto River	05060003 100 040	Ross	7299.2	34.62

Water Quality Issues in the Paint Creek Watershed

While it is assumed the bulk of the pollution problems in this section are from non-point source pollution, we will also cover the potential sources of point sources based on the National Pollutant Discharge Elimination Systems permits, Presence of combines sewer overflows, surface impoundments and data from fish kills.

NPDES Permits: MeadWestVaco, MW Custom Papers LLC, discharge to Paint Creek approximately 2 miles upstream from Scioto River

Combined Sewer Overflows and Sanitary Sewer Overflows

Combined sewers are built to collect sanitary and industrial wastewater as well as storm water runoff and transport this combined wastewater to treatment facilities. When it rains, the volume of storm water and wastewater may exceed the capacity of the combined sewers or of the

treatment plant, and a portion of the combined wastewater may be allowed to overflow untreated into the nearest ditch, stream, river or lake. This is a combined sewer overflow, or CSO. Ohio has about 1,600 known CSOs in 102 communities, ranging from small, rural villages to large metropolitan areas.

According to Sheree Gossett-Johnson, a member of the permitting and compliance unit with Ohio EPA's DSW, the Paint Creek Watershed does not contain any CSOs.

Another similar overflow is called a Sanitary Sewer Overflow (SSO). This type of system is designed to bypass the treatment plant when the wastewater load exceeds capacity. Most of these are being phased out in the watershed. One example is the Washington Court House WWTP, which has recently been upgraded (Gosset-Johnson, 2002).

Nonpoint Sources of Pollution

The term nonpoint source pollution (NPS) refers to water pollution that results from a variety of human land uses such as farming, development, logging, resource extraction, land disposal, livestock production and hydromodification. Nonpoint source pollution occurs when rain or snow melt drains over the land. The type of land use determines the type of pollutants that run off with the precipitant and eventually finds its way back to a stream, river or ground water table. As a product of weather patterns, nonpoint source discharges are naturally intermittent and occur more sporadically than point source discharges. Most are diffuse and difficult to quantify. Refer to the landuse/land cover map in the Watershed Inventory section of this plan for an overview of land use patterns in the Paint Creek Watershed.

Except for on-lot wastewater systems, nonpoint sources of pollution related to land use are discussed in great detail in the subwatershed water quality analysis later in this chapter. They are also outlined in Table 3-2, earlier in this section.

On-lot Wastewater Systems

By implementing House Bill 110 (HB110) in 1984, the Ohio General Assembly created Ohio EPA's HB110 program. The program is a contractual partnership between Local Health Districts (LHDs) and Ohio EPA, whereby LHDs conduct, on behalf of the Agency, inspection and enforcement services for commercial sanitary waste treatment/disposal systems discharging between 0-25,000 gallons per day (semi-publics). In addition, local health departments regulate residential on-lot systems such as septic systems.

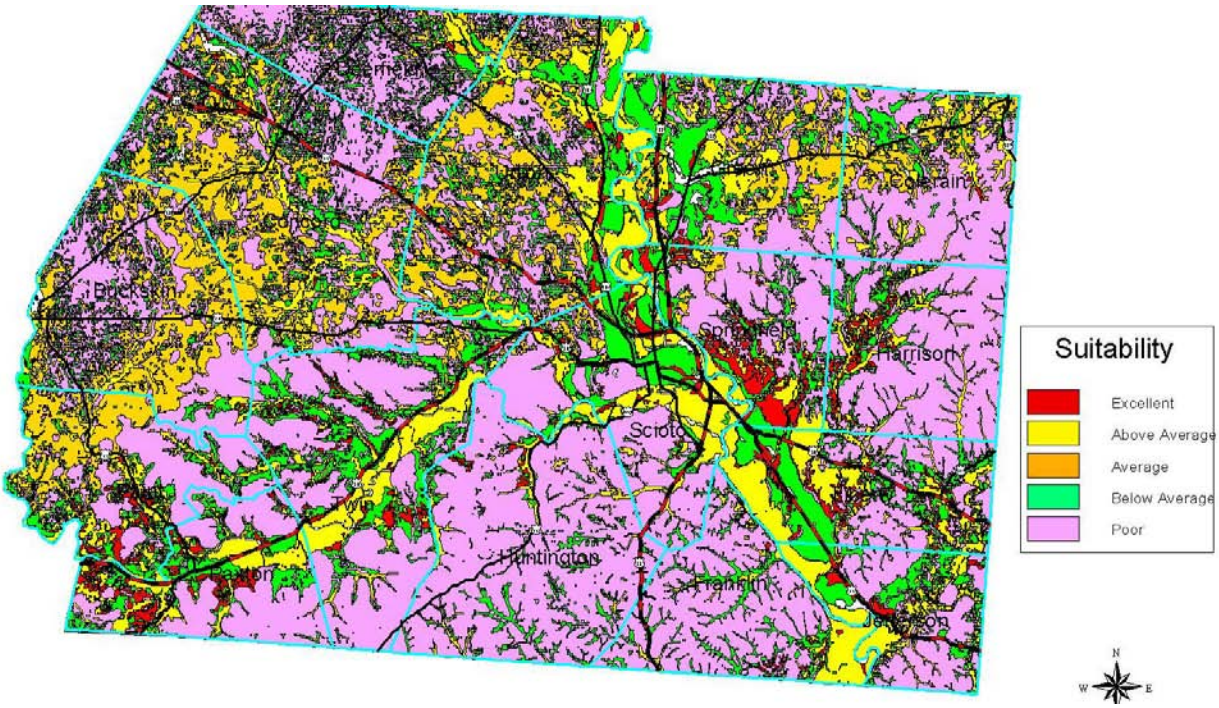
The Paint Creek Project is currently working with the health departments in each of the nine counties containing portions of the watershed; Clinton, Greene, Fayette, Pickaway, Pike, Highland, Ross, Madison and Clarke. While the Ross Co. Health Dept. plan was never finished due to staffing issues on their part, we believe that there is quite a bit of good data in their draft report. The Paint Creek Project hopes to collect information on the sewered versus unsewered areas in the watershed and areas where potential problems exist. This information will help promote the use of available finds to upgrade and maintain existing systems. One of the implementation goals for the watershed involves inspecting septic systems at regular intervals to

ensure acceptable operation. Septic systems are a source of nutrients, organics and fecal coliforms.

HSTS information for Ross County and the Paint Creek Region from the Ross County Health District HSTS plan:

Geology and soils

There are over 70 soil types and 12 soil associations located in Ross County. At least 80% of the soils are rated severe for onsite sewage disposal systems (see Figure 1). The most limiting soil types occur in the following townships: Franklin, Liberty, Harrison, **Huntington**, **Twin**, Paint, Paxton, and **Scioto** South. The severe soils, primarily clay, located in the above mentioned townships (bold are in this section of watershed) generally show the following limitations: slow permeability, high groundwater during extended wet periods, slope, and shallow to bedrock.



Priority Areas

- Hopewell Point (US 50 & Maple Grove Rd): This area has an estimated thirty lots and has had a history of failing systems. Soil is rated moderate to severe due to permeability and a water table.
- Huntington Acres (SR 772 & West on Blain Hwy): This area has an estimated twelve lots and a history of failing systems. Many systems are Aeration Treatment Units installed in the 1980's and discharge to the ditch. Soil is rated severe due to low permeability.
- Northridge Estates (Maple Grove Road N of SR 28): This area has an estimated thirty lots. Soil is rated severe due to high permeability.
- Summerhill Farms (Polk Hollow to Summerhill Drive): The area has an estimated twenty-five lots. Soil is rated severe due to low permeability, shallow to bedrock, and on some lots slope is a limiting factor as well

SYSTEM DESIGN

A. Soil permeability at leaching depth shall be determined, as well as seasonally high water table depth, and depth to restrictive layer.

LIMITING FACTORS SYSTEM REQUIREMENTS

Depth to Bedrock:

> 5'6"……..Aeration, TDS, or Alternative

> 5'6"……Septic Tank and leaching

Water Table Depth

00' to 12"……..Generally unsuited for leaching

12" to 48"……Curtain drain required

>48"……..None

Permeability (in/hr) Ranking System Recommendations

< 0.6……very severe ……Aeration, TDS, or Alternative/Experimental system

0.6 - 2.0…….severe……Aeration with leaching or Septic tank with effluent filter and leaching @ 300' per bedroom

2.0 - 6.3……moderate……Septic tank with effluent filters and leaching @200per bedroom

> 6.3……...…….slight……..Aeration system with leaching @ 150'per bedroom or alternative/experimental system

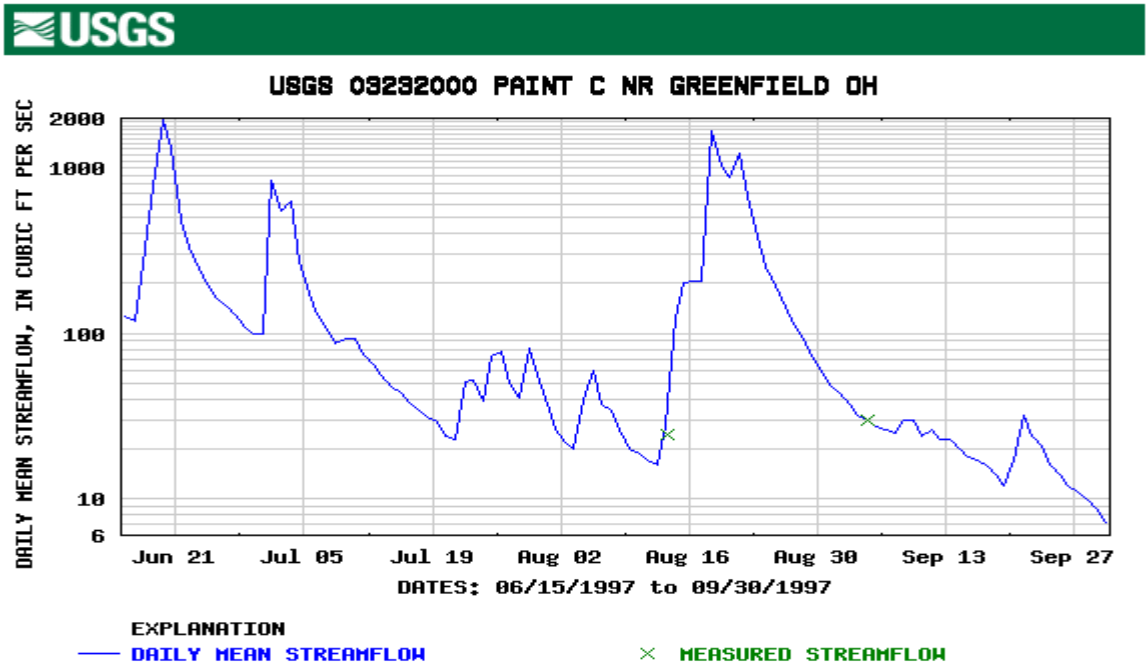
USGS Streamflow Data

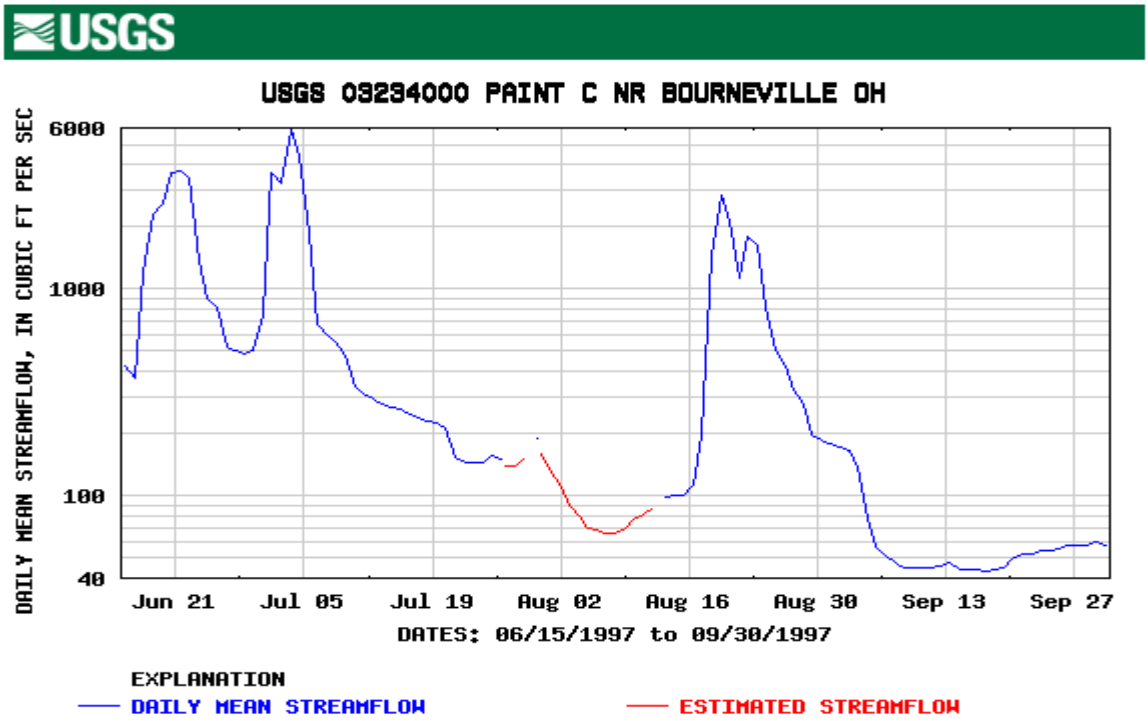
Streamflow data is an important component when characterizing the chemical water quality of a stream. Runoff from a rainfall event may carry sediment and nutrients causing high results in analytical tests. These high results may in turn signify that the buffering capacity of the stream during normal rainfall events is limited and that the channel has been modified or the riparian corridor is of poor quality. The following are streamflow results from the three USGS stream gages that collected data during the 1997 OEPA sampling period.

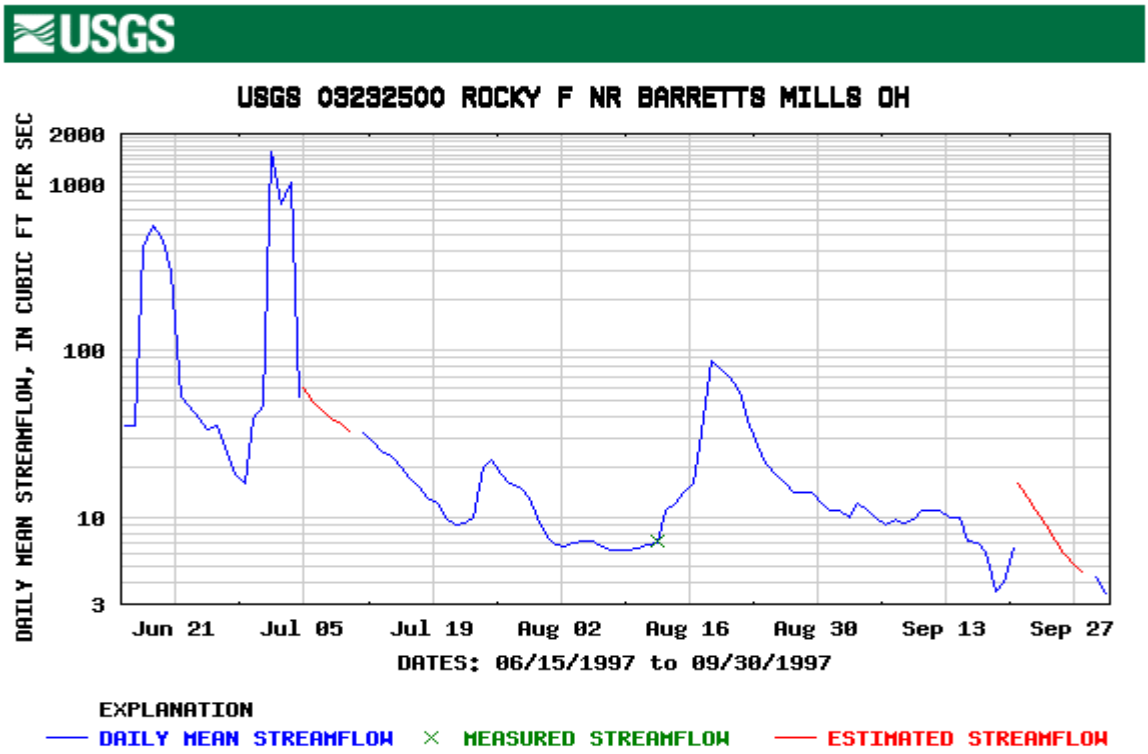
USGS data from Paint Creek near Greenfield indicates that streamflow peaked in June then drops through July. A smaller peak is seen in late July and then a large peak around the 20th of August. The same type of pattern is seen in at the USGS streamflow monitoring station in Paint Creek near Bourneville, except that the stream is much larger at this downstream gauging station and the peaks are much larger. There is some missing data from late July through early August. The USGS data from the monitoring gage on Rocky Fork at Barrett's Mill shows similar peaks in June and July, but a much-reduced peak in late August.

This data indicates that several rainfall events in June, July and August affected the streamflow in the entire watershed. Water quality monitoring information, collected in mid-July and mid-August potentially reflects conditions of the streams after rainfall events, while measurements from early August and early September represent normal low-flow conditions. This information should be taken into account when assessing the water quality of these streams.

Figure 3-1. USGS Streamflow tables (see next page)


USGS
USGS 03232000 PAINT C NR GREENFIELD OH
DAILY MEAN STREAMFLOW, IN CUBIC FT PER SEC
2000
1000
100
10
6
Jun 21
Jul 05
Jul 19
Aug 02
Aug 16
Aug 30
Sep 13
Sep 27
DATES: 06/15/1997 to 09/30/1997
EXPLANATION
DAILY MEAN STREAMFLOW
MEASURED STREAMFLOW


USGS
USGS 03234000 PAINT C NR BOURNEVILLE OH
DAILY MEAN STREAMFLOW, IN CUBIC FT PER SEC
6000
1000
100
40
Jun 21
Jul 05
Jul 19
Aug 02
Aug 16
Aug 30
Sep 13
Sep 27
DATES: 06/15/1997 to 09/30/1997
EXPLANATION
DAILY MEAN STREAMFLOW
ESTIMATED STREAMFLOW



303(d) Listed Streams

Based on water quality standards alone, several streams in the Paint Creek Watershed are listed as not historically meeting Clean Water Act criteria. These streams have been placed on a Federal list called a 303(d) list. They include Paint Creek, Sugar Creek, Rocky Fork, Clear Creek West Branch Rattlesnake Creek and lower Rattlesnake Creek. Please refer to the map entitled, *Paint Creek Watershed: US EPA 303(d) Listed Streams and Lakes*. In addition, Table 3-7 lists the information that is currently available from U.S. EPA on the listed stream segments in the Paint Creek Watershed. This information was some of the earliest information that the Paint Creek Project used to determine streams with water quality impairments. This information is scheduled to be updated every two years.

The last field survey in the Paint Creek Basin was conducted in 1997, and several streams including Rocky Fork, Clear Creek and Paint Creek may subsequently be removed from the 303(d) list. These streams, for the most part, met their designated standards. The next series of maps entitled, *Paint Creek Watershed: Monitoring Point Locations by Subwatershed*, *Paint Creek Watershed: Monitoring Points by River Mile*, and *Paint Creek Watershed: Water Quality by USGS 11- and 14-digit Subwatersheds*, illustrate where the watershed was sampled during the 1997 survey, the overall attainment of the streams at each monitoring point, and the inferred water quality throughout the watershed.

Table 3-7: Summary table of 303 (d) listed streams (please refer to water quality information by subwatershed for more information).

Waterbody River mile	Attainment	Documented WQ problems	Sources of problems
Paint Creek 35.5-4.6	Full-EWH		
Paint Creek 4.6-Confl w/ Scioto River	Full-WWH	Slight organic enrichment	MeadWestvaco

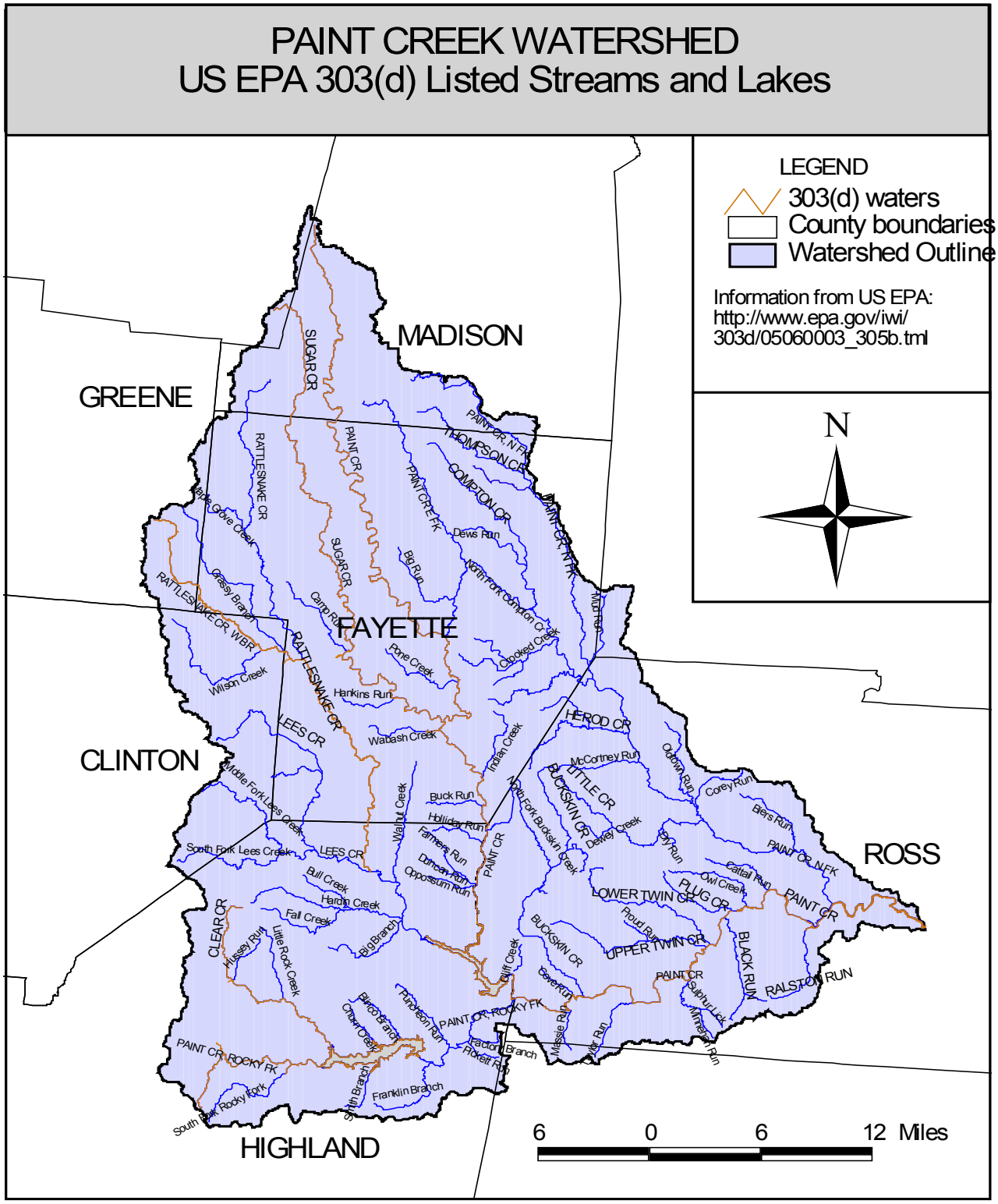
Reference Stream Values by Ecoregion

Another way in which to judge the water quality of streams in the watershed is look at how their chemical measurements compare to those of other streams of similar sizes in other watersheds. In 1999, Ohio EPA compiled the measurements of hundreds of streams that represented the best water quality in the state and published a paper entitled, Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams. These streams were all grouped by ecoregion and their values averaged to generate a numeric representation of a reference or background condition. Numbers that represent the 75th, 95th and 99th percentiles were also generated. This study uses the 75th percentile values as benchmarks against which to measure the water quality monitoring results from the 1997 Paint Creek Watershed data.

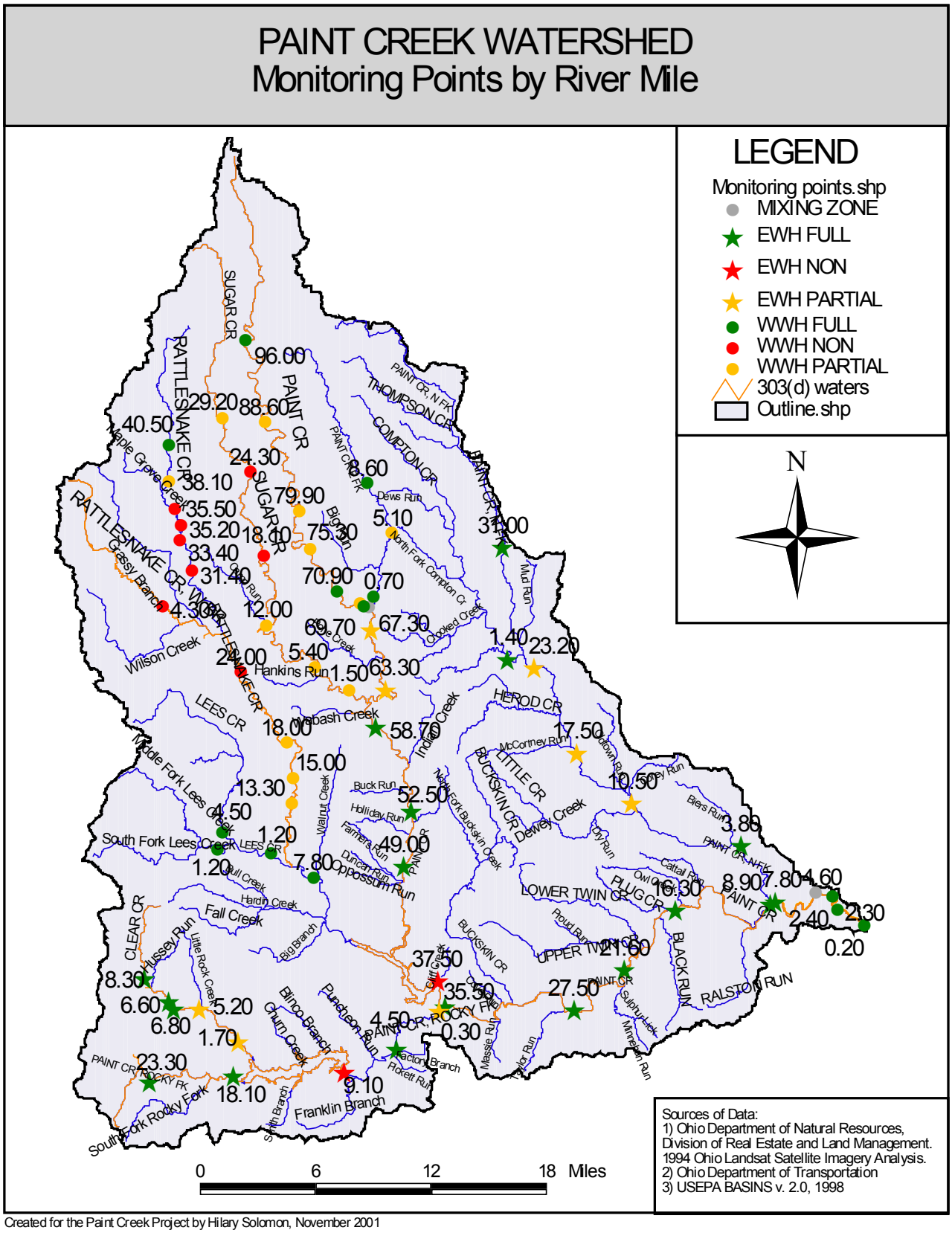
The lower section of Main Paint from Lower Twin to the Scioto River falls in the Western Allegheny Plateau ecoregion described belo.

70. WESTERN ALLEGHENY PLATEAU

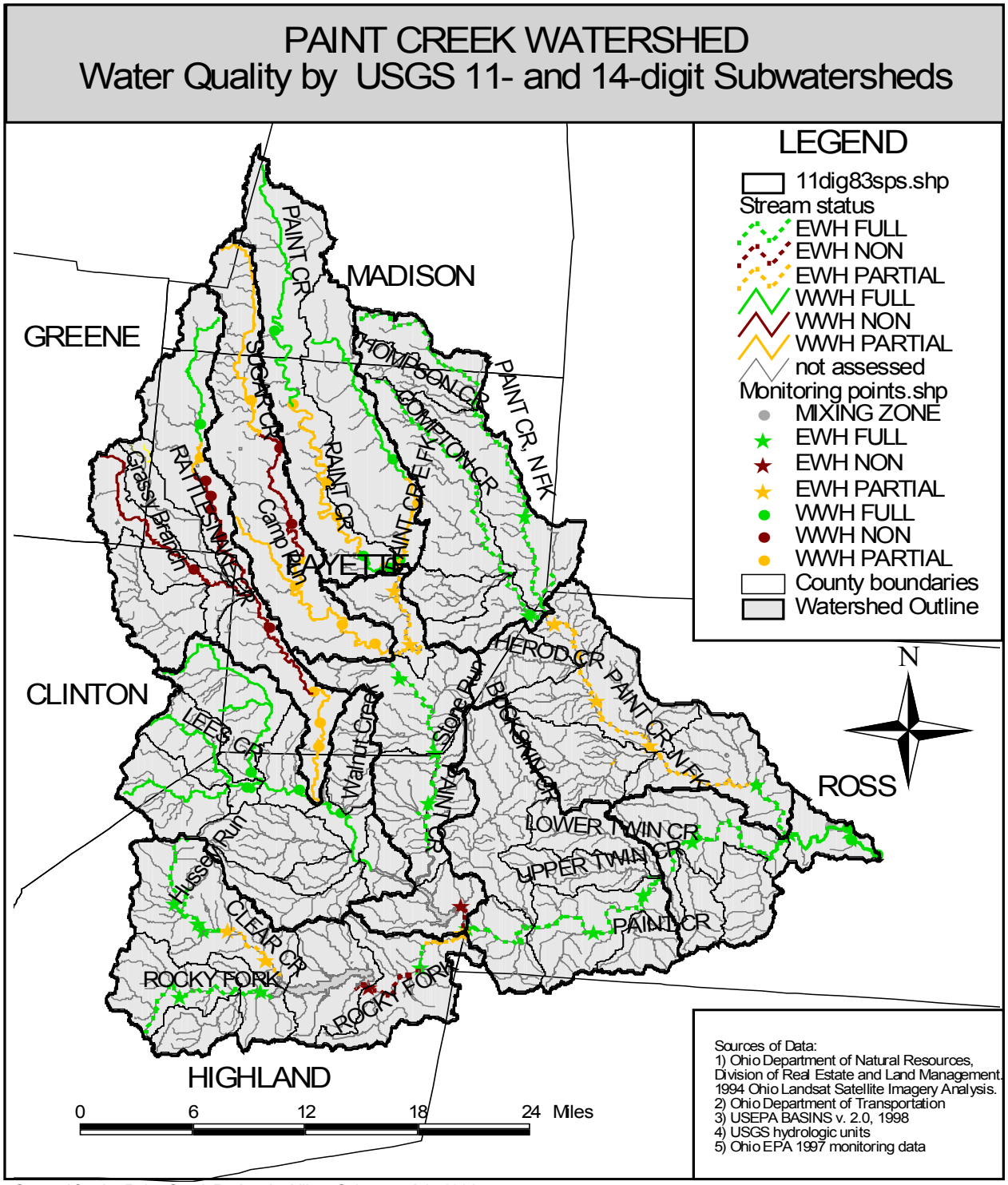
The hilly and wooded terrain of the Western Allegheny Plateau was not muted by glaciation and is more rugged than the agricultural till plains of Ecoregions 61 and 55 to the north and west, but is less rugged and not as forested as Ecoregion 69 to the east and south. Extensive mixed mesophytic forests and mixed oak forests originally grew in the Western Allegheny Plateau and, today, most of its rounded hills remain in forest; dairy, livestock, and general farms as well as residential developments are concentrated in the valleys. Horizontally-bedded sedimentary rock underlying the region has been mined for bituminous coal.



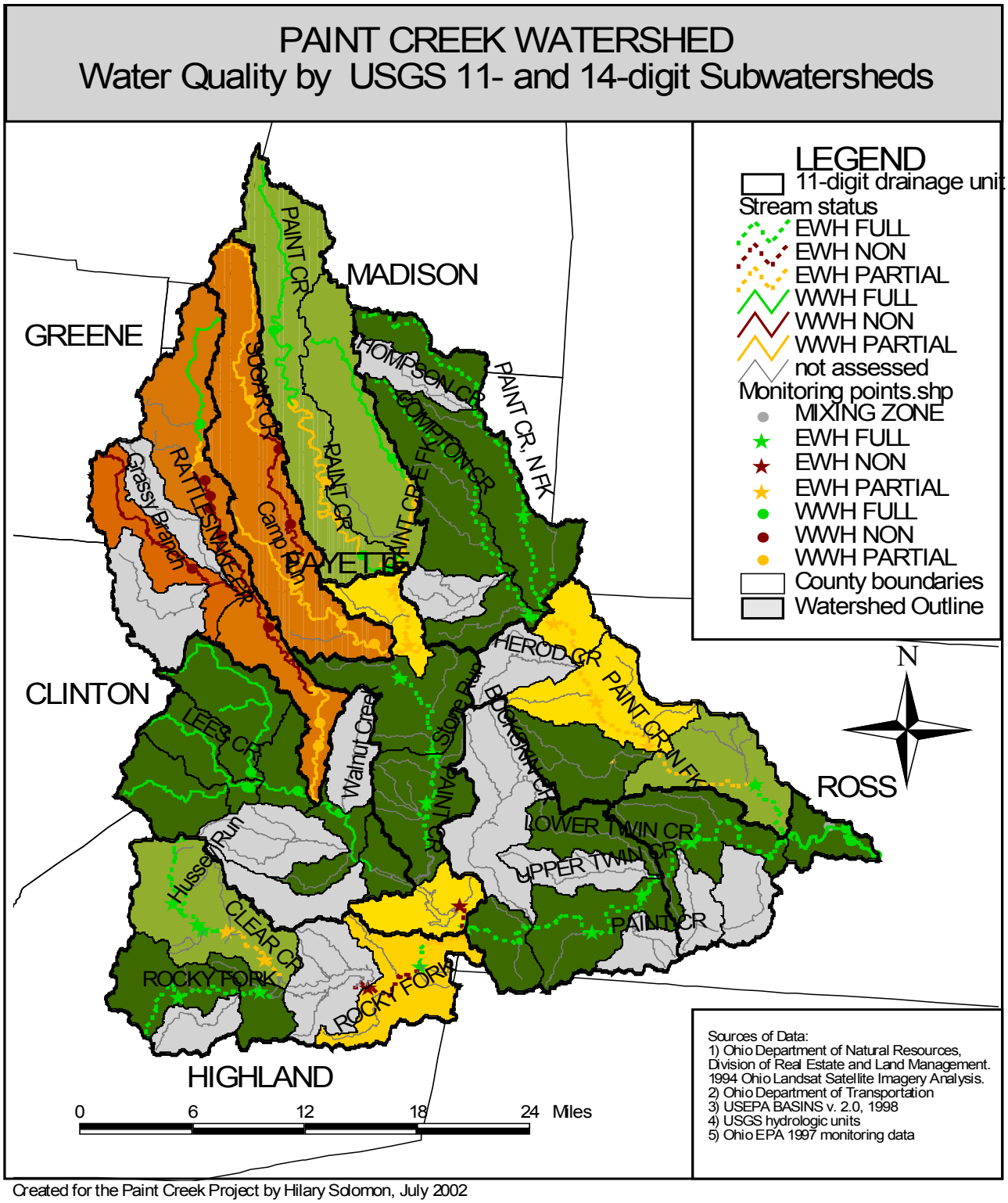
Created by Hilary Solomon for the Paint Creek Project, September 2001



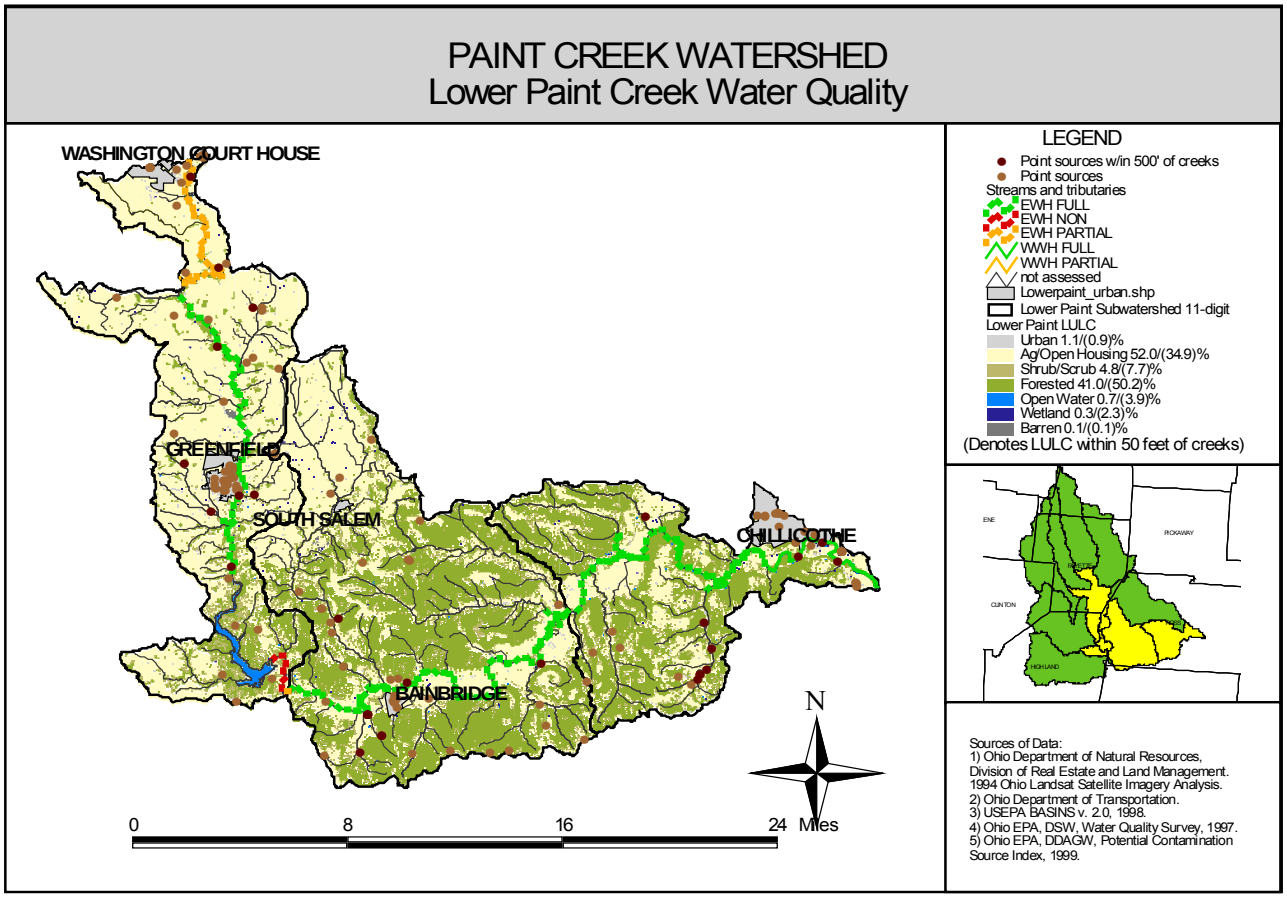
Created for the Paint Creek Project by Hilary Solomon, November 2001



Created for the Paint Creek Project by Hilary Solomon, July 2002



Created for the Paint Creek Project by Hilary Solomon, July 2002



Created by Hilary Solomon for the Paint Creek Project, May 2002

Main Stem Paint Creek Water Quality

During Ohio EPA's 1997 monitoring survey of the Paint Creek Watershed, Paint Creek was sampled in 24 locations. The creek was sampled for chemical, biological and habitat parameters. The monitoring locations are listed in Table 3-12.

Table 3-12: Paint Creek monitoring point locations.

RIVER MILE	STREAM	LOCATION	ECO-REGION	W/S SIZE*	HABITAT	PRIORITY	ATTAINMENT
21.60	Paint Creek	USGS Gauge at Bournville	WAP	SR	EWH	LOW	Full
16.30	Paint Creek	Shotts Bridge	WAP	SR	EWH	LOW	Full
8.90	Paint Creek	Ust. North Fork Paint Creek	WAP	SR	EWH	LOW	Full
7.80	Paint Creek	Dst. North Fork Paint Creek	WAP	LR	EWH	LOW	Full
4.60	Paint Creek	Ust. Mead Paper at SR 104	WAP	LR	WWH		
2.40	Paint Creek	Mead Paper Mixing Zone	WAP	LR	WWH	LOW	Full
2.30	Paint Creek	Ust. US 23	WAP	LR	WWH	LOW	Full
0.20	Paint Creek	at mouth, convergence Scioto	WAP	LR	WWH	LOW	Full

Paint Creek is located in the Eastern Corn Belt Plains (ECBP) Ecoregion between the headwaters and river mile 49, and the Western Allegheny Plains (WAP) Ecoregion from river mile 49 to the mouth. It is characterized in the Ohio Administrative Code (OAC) 3745-1-09; Table 9-1, as warmwater habitat (WWH) between the headwaters and river mile 69 and again from river mile 5 to the mouth. Paint Creek is characterized as exceptional warmwater habitat between river mile 69 and river mile 5. The creek is used for agricultural water supply (AWS), industrial water supply (IWS) and primary contact recreation (PCR). It is also a source of public drinking water.

Of the parameters described in this report; total suspended solids (TSS), fecal coliforms, nitrate/nitrite, total phosphorus and dissolved oxygen; only fecal coliforms and dissolved oxygen have water quality standards. Nitrate concentrations may be compared to maximum contaminant levels (MCLs) for drinking water.

Dissolved oxygen dropped at the MeadWestvaco effluent area and did not recover before the confluence with the Scioto. This may have been an effect of Paint Creek converging with the larger Scioto River.

In comparison with reference streams, Paint Creek showed elevated TSS concentrations on July 28 and extremely elevated concentrations on August 13. This was probably associated with a storm event. Most high TSS concentrations were correlated with agricultural areas (row crop agriculture or cattle pastures) with limited riparian corridor to capture sediments during storm water runoff.

Nitrogen concentrations were elevated in July in the upper reaches of the creek, which flows through a predominantly agricultural area. Nitrogen concentrations were also elevated in the Washington Court House WWTP mixing zone throughout the monitoring period. Between river mile 48.7 and 37.5, Paint Creek enters the Western Allegheny Plateau Ecoregion. Here nitrogen levels for the reference streams drop, which was mirrored in the drop of nitrogen concentrations in Paint Creek. However, despite the decrease in nitrogen concentrations in the water column, the nitrogen levels in Paint Creek remained above the 75th percentile for similar size streams in the WAP Ecoregion.

Measured phosphorus concentrations in Paint Creek appeared high when compared to the reference stream values. Elevated phosphorus levels were apparent in the headwaters, south of Washington Court House with extremely high concentrations downstream of the WWTP and downstream of the MeadWestvaco NPDES discharge area. In the Washington CH WWTP mixing area phosphorus values were approximately 5-50 times higher than the upstream reaches and 50 times higher than the reference stream 75th percentile values.

Please refer to the Paint Creek water quality data and charts on the following pages for more specific information. Bolded values are above (or below in the case of dissolved oxygen) associated reference stream 75th percentile concentrations.

Paint Creek Water Quality Data

Total Suspended

River Mile	63.3	58.75	52.54	48.7	37.5	31.67	27.5	21.6	16.3	8.2
14-Jul-97	8	7	5	5	5	11	**20**	16		12
28-Jul-97	17	8	8	10	8	14	12	10	12	**29**
13-Aug-97	18	8	**130**	16	5	**34**	**38**	**43**	**81**	**104**
4-Sep-97	6	5	5	5	19	12	8	9	8	**20**
15-Sep-97	7	5	5	5	10	5	5	12	5	5
AVG	11.2	6.6	30.6	8.2	9.4	15.2	16.6	18	21.2	34
MAX	18	8	130	16	19	34	38	43	81	104
Reference	29	41	41	41	19	19	19	19	19	19

Fecal Coliform

River	63.3	58.75	52.54	48.7	37.5	31.67	27.5	21.6	16.3	8.2
14-Jul-97	220	280	160	280						
28-Jul-97	220	240	430	110						
13-Aug-	780	400	**3200**	**4900**						
4-Sep-97	250	80	200	180						
15-Sep-	200	100	200	100						
AVG	334	220	838	1114						
MAX	780	400	3200	4900						
Referenc	860	580	580	580						

Nitrate/nitrite

River	63.3	58.75	52.54	48.7	37.5	31.67	27.5	21.6	16.3	8.2
14-Jul-97	**4.83**	**4.67**	**4.36**	**3.7**	**2.62**	**2.48**	**2.71**	**2.79**		**2.26**
28-Jul-97	1.98	1.84	1.59	1.45	0.8	**1.62**	**2.39**	**2.48**	**2.03**	**2.03**
13-Aug-	1.92	0.68	0.9	1.04	**2.55**	**1.4**	**1.41**	**1.48**	**1.69**	**1.48**
4-Sep-97	2.65	1.94		1.57	**2**	**2.18**	**2.17**	**2.11**	**2.01**	**1.77**
15-Sep-	1.48			1.04	0.41	0.16	1.01	0.99	0.92	0.88
AVG	2.572	1.826	1.37	1.76	1.676	1.568	1.938	1.97	1.33	1.684
MAX	4.83	4.67	4.36	3.7	2.62	2.48	2.71	2.79	2.03	2.26
Referenc	2.815	3.09	3.09	3.09	1.043	1.043	1.043	1.043	1.043	1.043

Phosphorus

River	63.3	58.75	52.54	48.7	37.5	31.67	27.5	21.6	16.3	8.2
14-Jul-97	**0.52**	**0.34**	**0.41**	0.24	0.06	0.06	0.1	0.05		0.05
28-Jul-97	**0.75**	**0.48**	**0.81**	**0.34**	0.05	0.05	0.05	0.05	**0.27**	0.05
13-Aug-	**1.61**	**0.82**	**0.52**	**0.26**	0.09	**0.29**	**0.16**	**0.13**	0.12	**0.23**
4-Sep-97	**2.8**	**0.39**		**0.25**	**0.18**	0.07	**0.26**	**0.43**	0.05	**0.32**
15-Sep-	**1.11**	**0.67**	**0.49**	0.5	0.06	0.05	0.05	0.07	0.014	0.07
MAX	2.8	0.82	0.81	0.5	0.18	0.29	0.26	0.43	0.27	0.32
Referenc	0.13	0.24	0.24	0.24	0.1	0.1	0.1	0.1	0.1	0.1

Dissolved oxygen

River Mile	63.3	58.75	52.54	48.7	37.5	31.67	27.5	21.6	16.3	8.2
14-Jul-97	7.09	9.51	10.35	8.11	**6.7**	7.8	**6.4**	**6.6**		7.7
28-Jul-97	**5.8**	9.09	9.38	9.14	7.9	8.7	**6.3**	**6.7**	7.2	**6.9**
13-Aug-	**5.89**	7.84	8.65	7.97	7.4	7.3	7.2	7.3	7.1	7.1
4-Sep-97	**6.86**	11.04	10.74	9.62	6.5	7.7	7.3	7.6	8	7.9
15-Sep-	**5.7**	10.52	10.97	9.32	13.8	13.8	12.2	12.3	13.3	11.5
MAX	7.09	11.04	10.97	9.62	13.8	13.8	12.2	12.3	13.3	11.5
Referenc	6.95	7.6	7.6	7.6	7.025	7.025	7.025	7.025	7.025	7.025

Total Suspended Emead

River	7.8	3.8	2.55	2.54	1.89	1.2	0.1
14-Jul-97	11	9	14	11	15	16	12
28-Jul-97	9	22	29	32	33	**37**	**40**
13-Aug-	**156**	**151**	18	**134**	**138**	**174**	**125**
4-Sep-97	5	7	17	10	12	14	17
15-Sep-	5	5	30	20	14	14	18
AVG	37.2	38.8	21.6	41.4	42.4	51	42.4
MAX	156	151	30	134	138	174	125
Referenc	34	34	34	34	34	34	34

Fecal Coliform Emead

River	7.8	3.8	2.55	2.54	1.89	1.2	0.1
14-Jul-97							
28-Jul-97							
13-Aug-							
4-Sep-97							
15-Sep-							
Referenc							

Nitrate/nitrite Emead

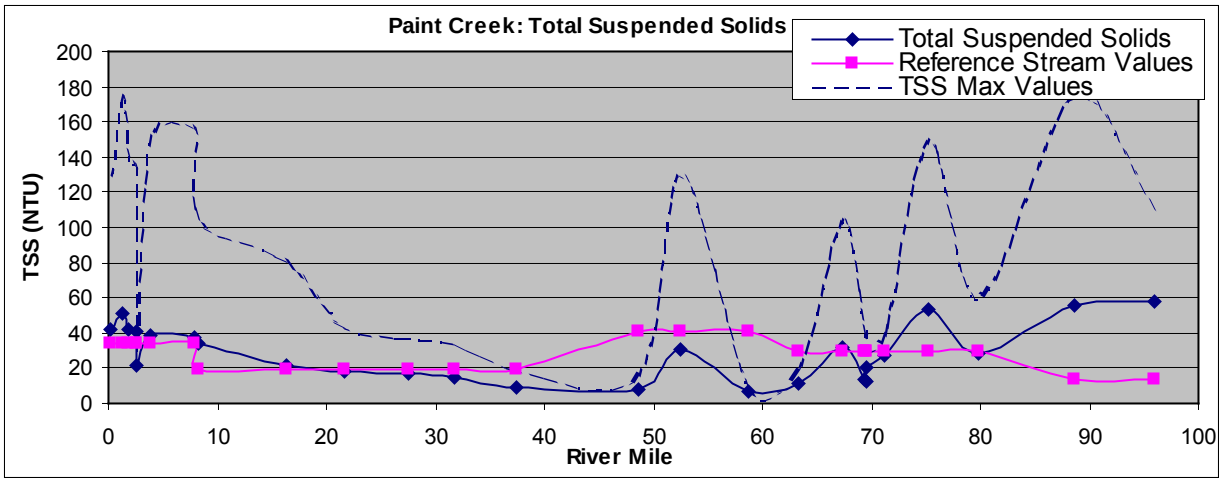
River	7.8	3.8	2.55	2.54	1.89	1.2	0.1
14-Jul-97	1.44	1.97	0.1	1.77	1.82	1.88	1.66
28-Jul-97	1.36	1.77	0.1	1.5	1.37	1.39	1.4
13-Aug-	1.17	1.45	0.1	1.36	1.64	1.36	1.35
4-Sep-97	1.07	1.54	0.1	1.44	1.36	1.35	1.44
15-Sep-	0.88	0.84	0.1	0.46	0.44	0.41	0.63
AVG	1.184	1.514	0.1	1.306	1.326	1.278	1.296
MAX	1.44	1.97	0.1	1.77	1.82	1.88	1.66
Referenc	2.22	2.22	2.22	2.22	2.22	2.22	2.22

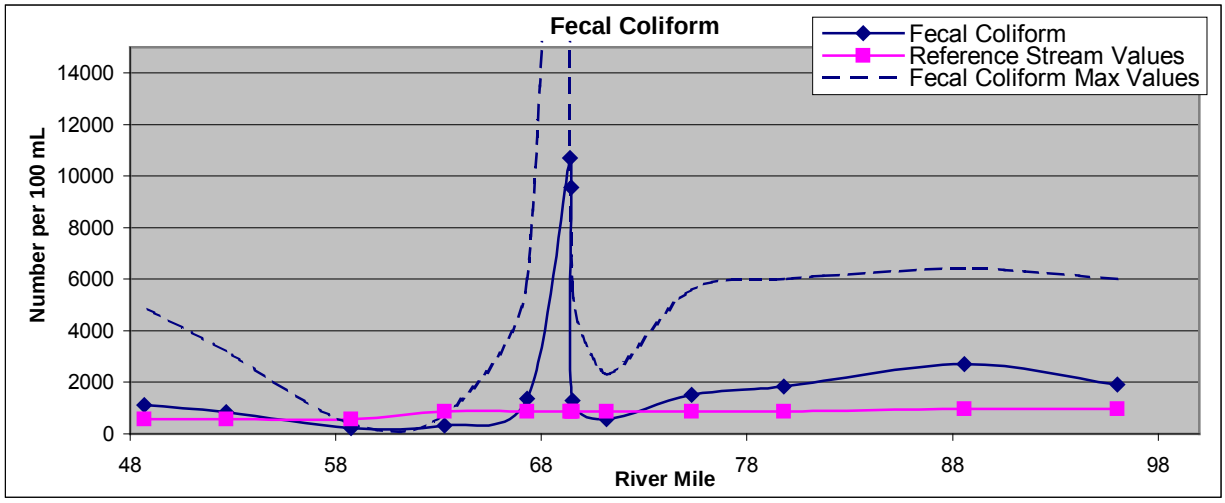
Phosphorus Emead

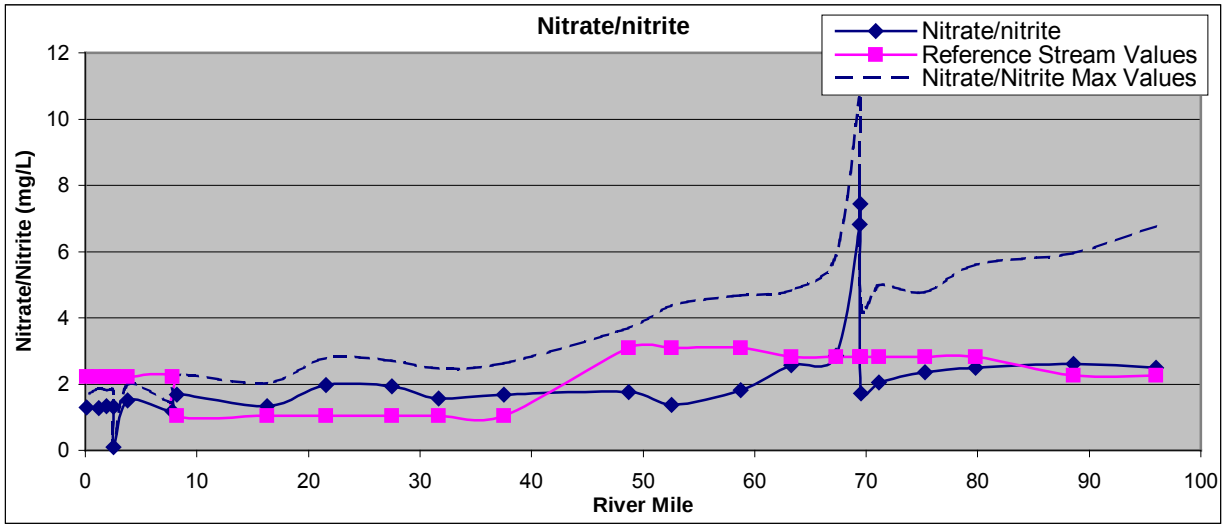
River	7.8	3.8	2.55	2.54	1.89	1.2	0.1
14-Jul-97	0.05	0.05	**0.46**	0.09	0.21	0.11	0.31
28-Jul-97	0.043	0.07	**0.34**	0.06	0.13	0.07	0.13
13-Aug-	**0.46**	0.11	**0.29**	0.2	**0.29**	0.06	**0.37**
4-Sep-97	**0.4**	0.12	**0.53**	0.14	**1.33**	0.18	0.24
15-Sep-	0.05	0.05	**0.35**	**0.26**	0.18	0.25	0.21
AVG	0.200	0.08	0.394	0.15	0.428	0.134	0.252
MAX	0.46	0.12	0.53	0.26	1.33	0.25	0.37
Referenc	0.1	0.248	0.248	0.248	0.248	0.248	0.248

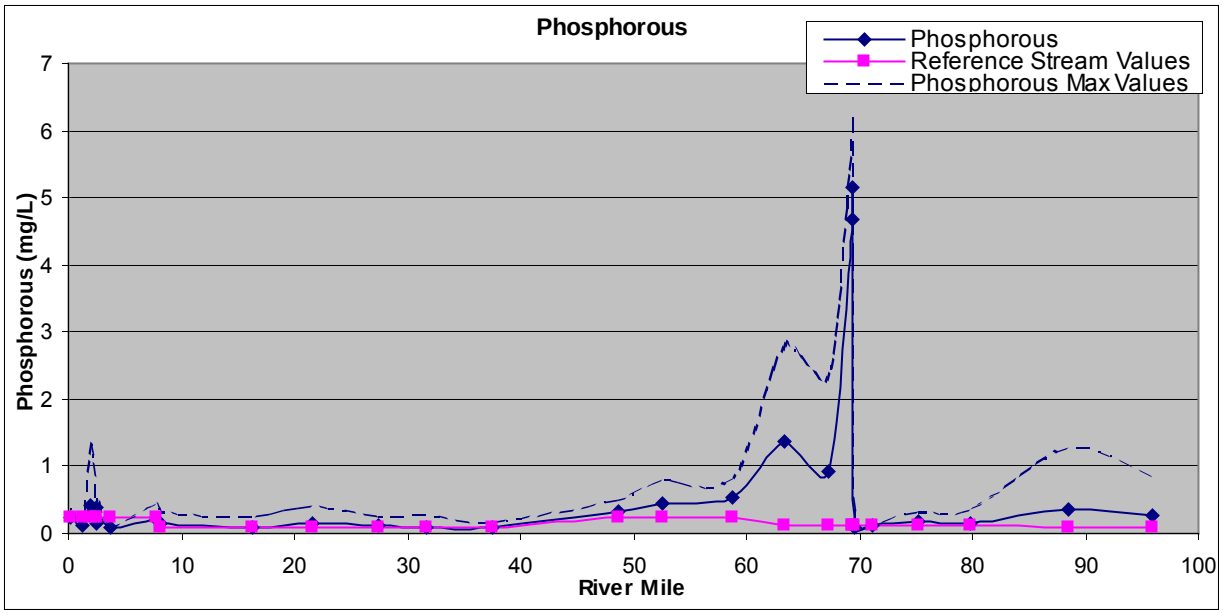
Dissolved oxygen Emead

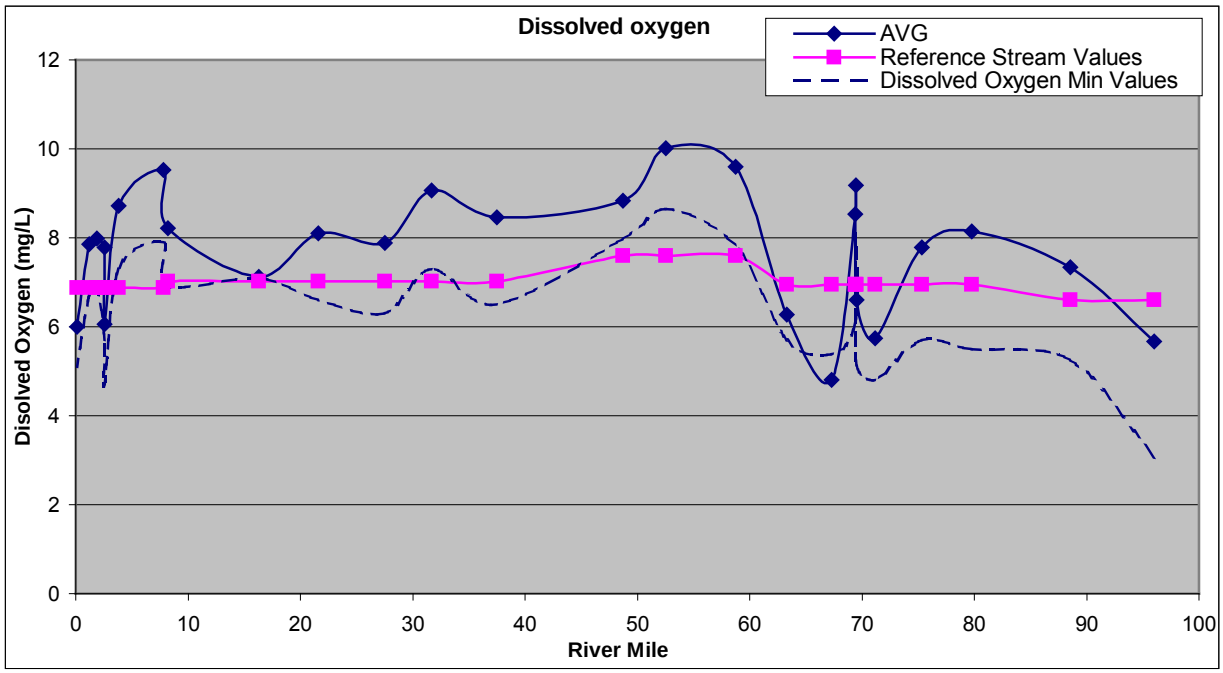
River Mile	7.8	3.8	2.55	2.54	1.89	1.2	0.1
14-Jul-97	8.8	7.7	**6.1**	7.3	8.2	6.8	**6.1**
28-Jul-97	8.5	7.4	**5.3**	**6.7**	6.9	**6.7**	**5.7**
13-Aug-	7.9	7.3	**5**	**5.7**	7	7.3	7
4-Sep-97	9.6	8.4	**4.7**	8	7.4	7.8	**6.1**
15-Sep-	12.8	12.8	9.2	11.2	10.4	10.7	**5.1**
AVG	9.52	8.72	6.06	7.78	7.98	7.86	6
MAX	12.8	12.8	9.2	11.2	10.4	10.7	7
Referenc	7.025	6.875	6.875	6.875	6.875	6.875	6.875


Paint Creek: Total Suspended Solids
Total Suspended Solids
Reference Stream Values
TSS Max Values
TSS (NTU)
River Mile


Fecal Coliform
Fecal Coliform
Reference Stream Values
Fecal Coliform Max Values
Number per 100 mL
River Mile


Nitrate/nitrite
Nitrate/nitrite
Reference Stream Values
Nitrate/Nitrite Max Values
Nitrate/Nitrite (mg/L)
River Mile


Phosphorous
Phosphorous
Reference Stream Values
Phosphorous Max Values
Phosphorous (mg/L)
River Mile
0
1
2
3
4
5
6
7
0
10
20
30
40
50
60
70
80
90
100


Dissolved oxygen
AVG
Reference Stream Values
Dissolved Oxygen Min Values
Disolved Oxygen (mg/L)
River Mile
0
2
4
6
8
10
12
0
10
20
30
40
50
60
70
80
90
100

Biological Indices

The majority of the Paint Creek Subwatershed is located in the Eastern Corn Belt Plains (ECBP) Ecoregion except for Paint Creek downstream of Paint Creek Lake, which is located in the Western Allegheny Plateau (WAP) Ecoregion.

The species composition expected in each of these ecoregions is slightly different, which translates into different numeric biocriteria for each aquatic use designation. Again, the IBI measures fish species diversity and population composition. It accounts for total native populations, indicator species, overall fish condition and pollution intolerant versus pollution tolerant fish species. The MIwb measures similar characteristics of the fish population, however, it subtracts 13 pollution tolerant fish species out of the final score. The ICI measures the composition of the invertebrate community and compares the numbers of pollution tolerant species with pollution intolerant species. The biocriteria for the WAP ecoregions are listed below:

Ecoregion Biocriteria: Western Allegheny Plateau (WAP)
(OAC 3745-1-07, Table 7-14)

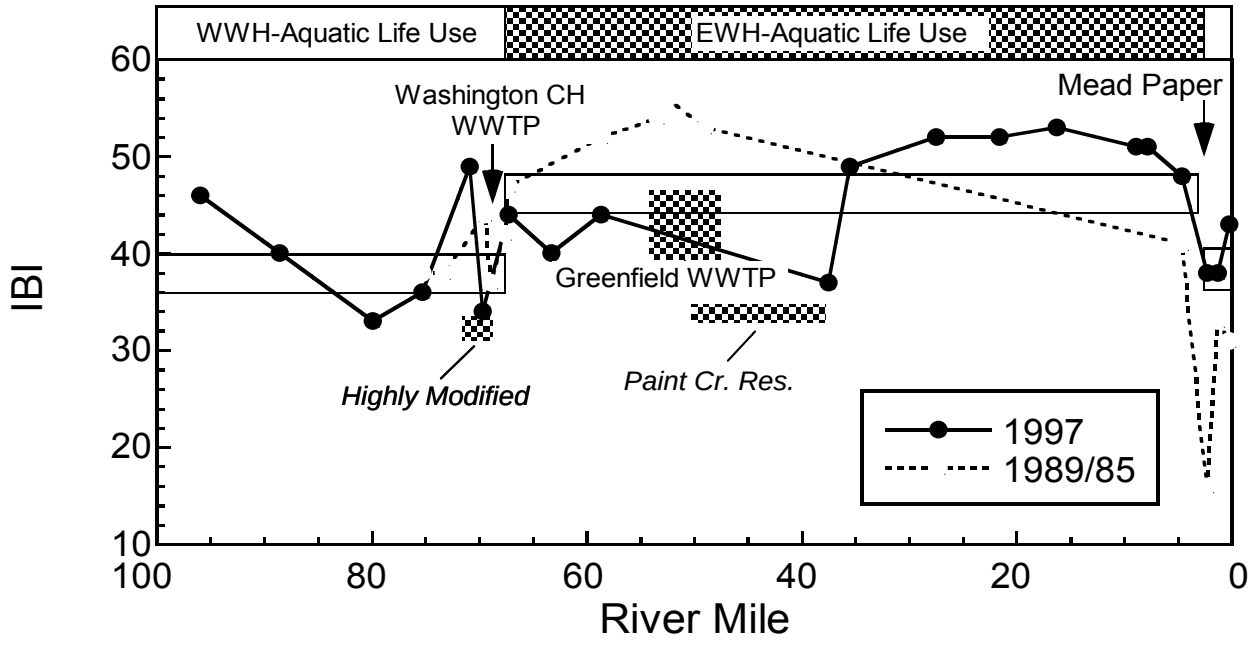
Index- Site Type	WWH	EWH
IBI- Boat	40	48
MIwb- Boat	8.6	9.6
ICI	36	46

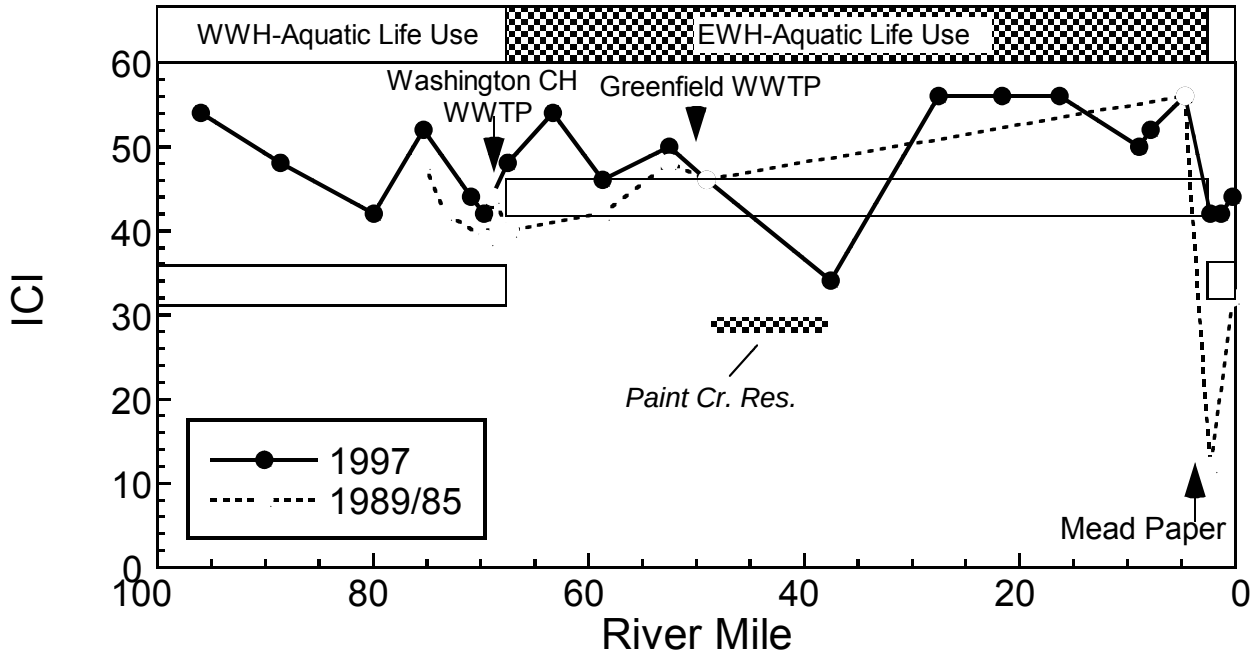
The Main Stem of Paint Creek is WWH above Washington CH and EWH from Washington CH until one mile upstream of the confluence with the Scioto River. The last mile of Paint Creek is WWH. A slight decrease in water quality typifies stream behavior at the confluence with a larger river. Paint Creek showed significant departures from WWH IBI biocriteria scores in two locations. The first was adjacent to Wildwood Road and the second was upstream of the Washington CH WWTP near the highway 35 by-pass in a highly modified reach of stream through a park. The stream briefly met the EWH criteria for IBI below Washington CH and then was not measured until the outfall from Paint Creek Lake, where it did not meet EWH criteria. The stream quickly recovered and met EWH criteria until the MeadWestvaco outfall, where the aquatic life use designation changed to WWH. The IBI score did not fall below acceptable criteria within the vicinity of the MeadWestvaco paper plant.

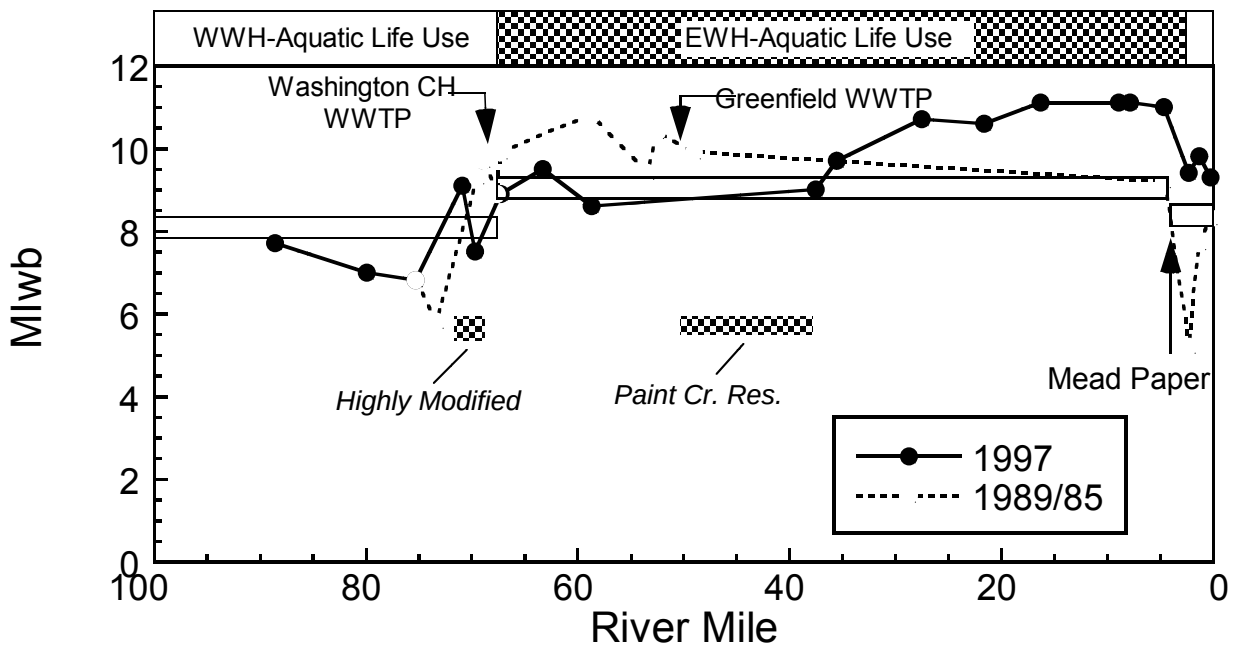
The MIwb did not meet WWH criteria in the upper reaches of the stream except for downstream of Perry Park in Washington CH. South of Washington CH Paint Creek met the EWH biocriteria except for isolated deviations downstream of the Washington CH WWTP and below the Paint Creek Reservoir.

According to Ed Moore, in comparison with previous evaluations, ambient conditions of Paint Creek downstream from WCH have remained stable. The results from the 1997 survey again indicated moderate aquatic life use impairment. Overall, the ICI met biocriteria scores throughout the entire stream. Physical flow changes (inconsistent flow in river downstream of reservoir) from changing reservoir water release patterns can also affect biological performance. In addition, downstream of the outfall, there was a loss of under-story riparian vegetation as a result of livestock in the stream.

The IBI and ICI scores recovered quickly downstream from the Paint Creek Reservoir tailwaters toward the Scioto River. The lower reach was designated WWH and biological scores met or exceeded biocriteria standards. The s cores decreased somewhat downstream of MeadWestvaco, but recovered quickly and were all very good over the last mile of stream above the confluence with the Scioto River.







Qualitative Habitat Evaluation Index (QHEI)

The QHEI is a qualitative measurement of the presence and quality of physical habitat components that support aquatic life. 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 habitat characteristics that are used to determine the QHEI score include substrate, instream cover, channel morphology, riparian vegetation and bank erosion, gradient, and flow patterns (pool, run and riffle development). The QHEI score ranges from 20 to less than 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 sites around the state (OEPA, 2002, Bokes TMDL) 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 having the ability to support exceptional warmwater faunas. The QHEI can be used to direct restoration efforts for habitat and to provide a monitoring tool to measure progress toward habitat goals.

In the Paint Creek headwaters only two out of six QHEI scores met the target score for WWH (60). The most significant problems included lack of riparian habitat and channelization of the creek. Other problems included sedimentation and embedded

creek bottom. The main landuse in this area is row crop, with some residential and urban areas. One section near the Hwy 35 bypass scored extremely low at 38.0. This area is highly modified and channelized with little instream or riparian habitat.

Below Washington CH the stream is considered EWH and due to improved physical habitat largely met the target score of 75. Directly downstream of Washington CH, the score was slightly lower due to inputs from above plus only moderate instream habitat and narrow (but intact) riparian corridor. Downstream of the reservoir (Paint Creek Lake) to below the confluence with Rocky Fork, the scores averaged around 66. Here the riparian buffer was narrow, flow rates were highly variable due to unnatural discharge rates from the lake and cattle were pastured with access to the stream. All of these factors worked together to cause destabilization of the banks. QHEI scores dipped slightly below Chillicothe with variable amounts of riparian corridor and moderate scores on most measures.

The QHEI scores and comments about each of the main components of the score are described in Table 3-13. This information is from the QHEI field notes recorded during the 1997 monitoring survey of the watershed. The QHEI was completed by Ohio EPA Ecological Assessment Unit personnel.

Table 3-13. QHEI scores and habitat component quality

River Mile	Location	QHEI	Comments
96.0	Charles Chillicothe Road	62.5	•
88.6	Hidy Road	54.5	•
79.9	Adjacent Wildwood Road	55.0	• **Substrate**: moderate to heavy silt, moderate to extensive embeddedness • **Instream cover**: moderate • **Morphology**: recovering from channelization, low gradient dumps silt from upstream • **Riparian**: moderate, old field species • **Flood plain**: residential and row crop
75.3	Eber Bloomingburg Road	71.5	• **Substrate**: moderate silt and normal to moderate embeddedness, habitually turbid water column but substrate not overly burdened • **Instream cover**: extensive • **Riparian**: wide and intact with low impact landuse outside of riparian, little bank erosion • **Flood plain**: shrub/old field, residential and conservation tillage, some livestock • *Fish catches small and not diverse, check this site
71.7	Downstream Perry Park	52.5	• **Substrate**: moderate silt and embeddedness • **Instream cover**: sparse with some artificial • **Morphology**: channel highly modified, channelized • **Riparian**: no riparian vegetation, 2:1 grass banks, sewer crossings provide habitat, little bank erosion
69.5	Upstream bypass, highly modified reach	38.0	• **Substrate**: normal to moderate silt and normal to moderate embeddedness • **Instream cover**: aquatic macrophytes • **Morphology**: channelized • **Riparian**: none, grassed 2:1 banks, little bank erosion • **Flood plain**: park
67.3	Downstream WA CH WWTP, Downstream Old SR 35	72.0	• **Substrate**: normal to moderate silt with moderate to extensive embeddedness • **Instream cover**: moderate (75%) • **Riparian**: moderate with mature trees, little bank erosion
63.3	Flakes Ford Road	74.0	• **Substrate**: normal silt with normal to moderate embeddedness • **Instream cover**: moderate to extensive • **Riparian**: narrow, but wooded and intact except for 100m, little bank erosion • **Flood plain**: residential and row crop
58.7	Miami Trace Road at	85.5	• **Substrate**: normal silt and embeddedness

River Mile	Location	QHEI	Comments
	Rockmill		• **Instream cover**: extensive • **Morphology**: completely natural channel • **Riparian**: wide (>50m), mature, complete corridor, no bank erosion • **Flood plain**: row crop
52.5	SR 753, Upstream Greenfield WWTP	74.0	• **Substrate**: normal silt and embeddedness • **Instream cover**: sparse to moderate • **Morphology**: stable, natural channel • **Riparian**: narrow to moderate, mature corridor, but patchy and narrow on one bank, no bank erosion • **Flood plain**: row crop
48.9	Downstream Greenfield WWTP, Upstream reservoir	78.5	• **Substrate**: normal silt and embeddedness • **Instream cover**: sparse • **Morphology**: channel monotonous, mostly glide • **Riparian**: variable- narrow to wide, mature and complete corridor, no bank erosion • **Flood plain**: forest and old field
37.5	Downstream Paint Creek Reservoir	66.5	• **Substrate**: sand, gravel, cobble and boulder, moderate silt and embeddedness • **Instream cover**: moderate • **Channel morphology**: highly variable discharge from reservoir and cattle access to creek have destabilized • **Riparian zone**: narrow but intact riparian, livestock have removed under-story vegetation, little bank erosion • **Flood Plain**: residential and row crop
32.5	Downstream Rocky Fork	65.5	• **Substrate**: normal to moderate silt and embeddedness • **Instream cover**: moderate • **Morphology**: fine substrate predominate, but channel dominated by bedrock • **Riparian**: very narrow, no bank erosion **Flood plain**: row crop and low density residential
27.2	Dills Road	80.5	• **Substrate**: cobble, boulder, sand and gravel with normal silt and embeddedness • **Instream cover**: moderate • **Riparian zone**: very narrow to wide, mature riparian, little to moderate bank erosion • **Flood Plain**: forest and low density residential
21.6	USGS gauge at Bourneville	73.0	• **Substrate**: boulder, cobble, sand and gravel with normal silt and embeddedness • **Instream cover**: moderate to extensive • **Riparian zone**: narrow 5-10m, with moderate erosion

River Mile	Location	QHEI	Comments
			• **Flood Plain**: row crop
16.3	Near Shotts Bridge	80.0	• **Substrate**: sand, gravel, cobble and boulder, normal silt and embeddedness • **Instream cover**: moderate to extensive • **Riparian zone**: narrow riparian, with little bank erosion • **Flood Plain**: row crop
8.9	Upstream North Fork of Paint Creek	82.5	• **Substrate**: normal silt and embeddedness • **Instream cover**: moderate • **Riparian**: moderate and intact • **Flood plain**: row crop
7.8	Downstream North Fork of Paint Creek	83.5	• **Substrate**: normal silt and embeddedness • **Instream cover**: moderate to extensive • **Riparian**: variable, none to wide, erosion controlled by riprap • **Flood plain**: row crop
4.6	Upstream of MeadWestvaco	73.0	• **Substrate**: normal silt and embeddedness • **Instream cover**: moderate • **Riparian**: moderate to wide • **Flood plain**: forest and residential
2.3	Downstream MeadWestvaco	68.5	• **Substrate**: boulder, cobble, gravel, sand, and artificial with moderate silt and embeddedness • **Instream cover**: moderate • **Channel morphology**: low sinuosity, fair-good development, no c hannelization, moderate-high stability • **Riparian**: moderate, banks stabilized through ½ of zone • **Flood plain**: row crop
1.3	Upstream US 23	68.0	• **Substrate**: boulder, cobble, gravel, sand with normal to moderate silt and embeddedness • **Instream cover**: moderate • **Channel morphology**: moderate • **Riparian zone**: none to moderate • **Flood plain**: row crop
0.2	Convergence with Scioto	75.0	• **Substrate**: boulder, cobble, gravel, sand, and artificial with moderate silt and moderate-average embeddedness • **Instream cover**: moderate • **Channel morphology**: moderate, appeared unstable at the mouth • **Riparian zone**: moderate with moderate to severe bank erosion • Flood plain: row crop

Areas highlighted in yellow are specific to the lower section of Paint Creek from Lower Twin to the Scioto River.

Land use and Land Cover/Nonpoint Sources

Land use and land cover data changes dramatically for this small watershed because the Ross SWCD GIS Coordinator has arranged for better coverages in recent months. This new coverage contains 41 different land uses. Since there are so many different uses to explore, I have split them out for the 4 14-digit watersheds and created maps for each. Pertinent info like forested areas will be discussed later.

Paint Creek from Lower Twin to North Fork:

Predominant land uses:	Deciduous Forest
(In order)	Cropland
	Residential

Black Run:

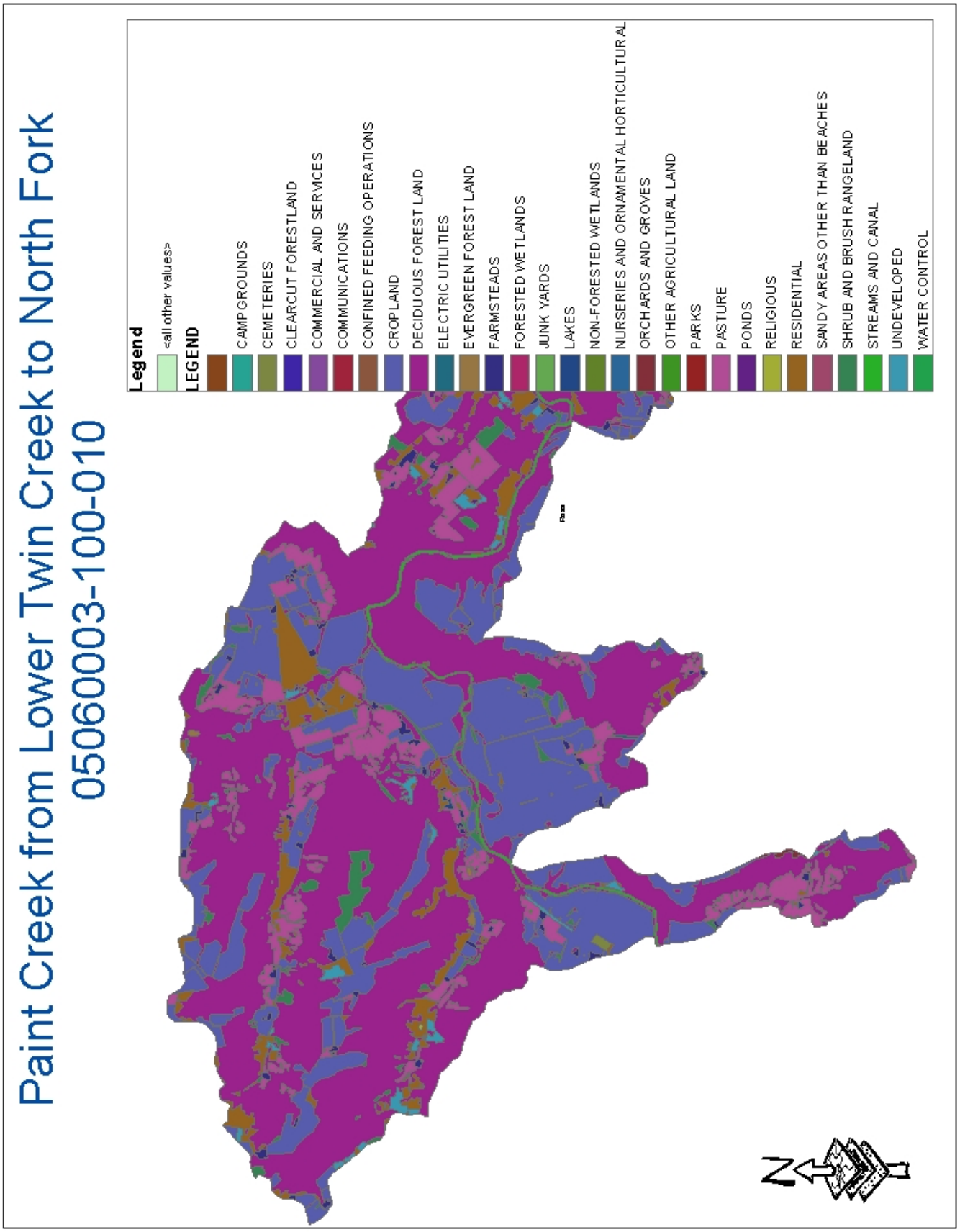
Predominant land uses:	Deciduous Forest
(In order)	Cropland
	Pasture
	Residential

Ralston Run:

Predominant land uses:	Deciduous Forest
(In order)	Cropland
	Residential
	Pasture

Paint Creek from North Fork to the Scioto River:

Predominant land uses:	Deciduous Forest
(In order)	Cropland
	Pasture
	Residential


Paint Creek from Lower Twin Creek to North Fork
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CEMETERIES
CLEARCUT FORESTLAND
COMMERCIAL AND SERVICES
COMMUNICATIONS
CONFINED FEEDING OPERATIONS
CROPLAND
DECIDUOUS FOREST LAND
ELECTRIC UTILITIES
EVERGREEN FOREST LAND
FARMSTEADS
FORESTED WETLANDS
JUNK YARDS
LAKES
NON-FORESTED WETLANDS
NURSERIES AND ORNAMENTAL HORTICULTURAL
ORCHARDS AND GROVES
OTHER AGRICULTURAL LAND
PARKS
PASTURE
PONDS
RELIGIOUS
RESIDENTIAL
SANDY AREAS OTHER THAN BEACHES
SHRUB AND BRUSH RANGELAND
STREAMS AND CANAL
UNDEVELOPED
WATER CONTROL
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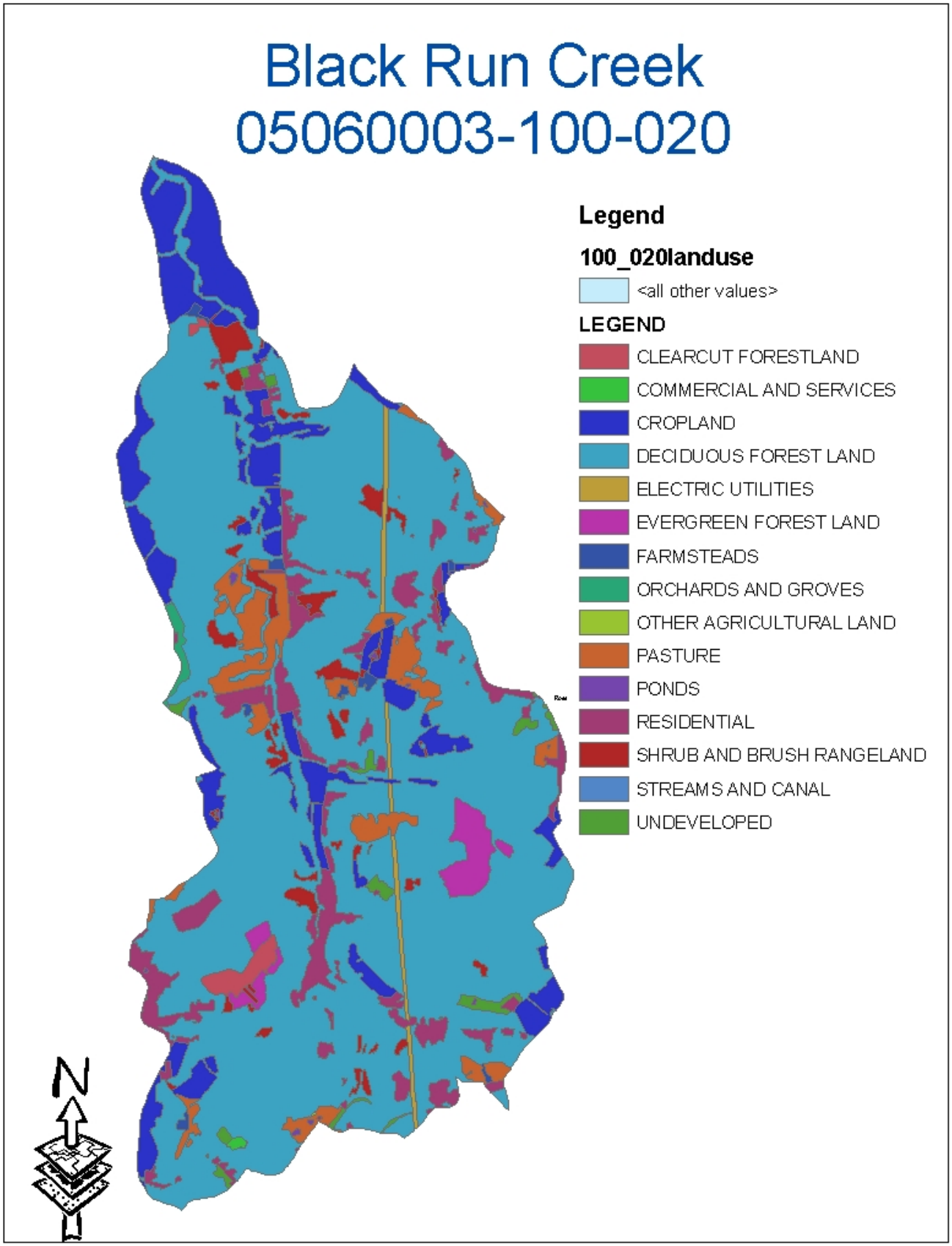
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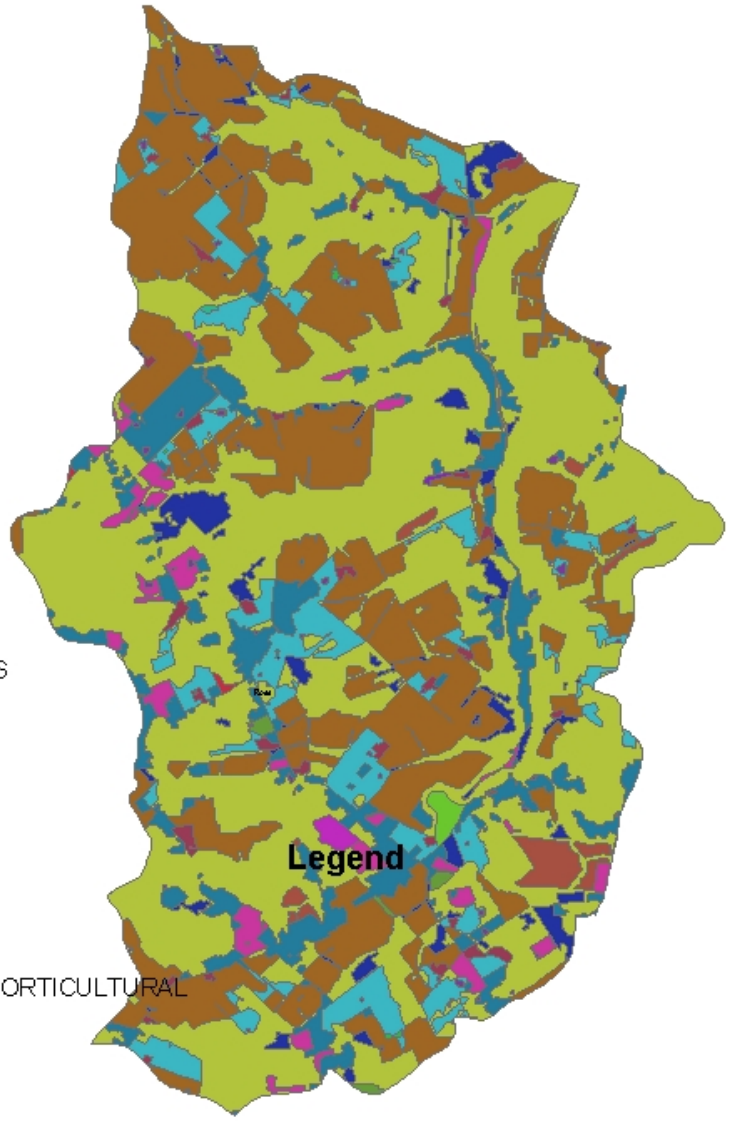
CLEARCUT FORESTLAND
COMMERCIAL AND SERVICES
CROPLAND
DECIDUOUS FOREST LAND
ELECTRIC UTILITIES
EVERGREEN FOREST LAND
FARMSTEADS
ORCHARDS AND GROVES
OTHER AGRICULTURAL LAND
PASTURE
PONDS
RESIDENTIAL
SHRUB AND BRUSH RANGELAND
STREAMS AND CANAL
UNDEVELOPED
N

Ralston Run Creek
05060003-100-030



Legend

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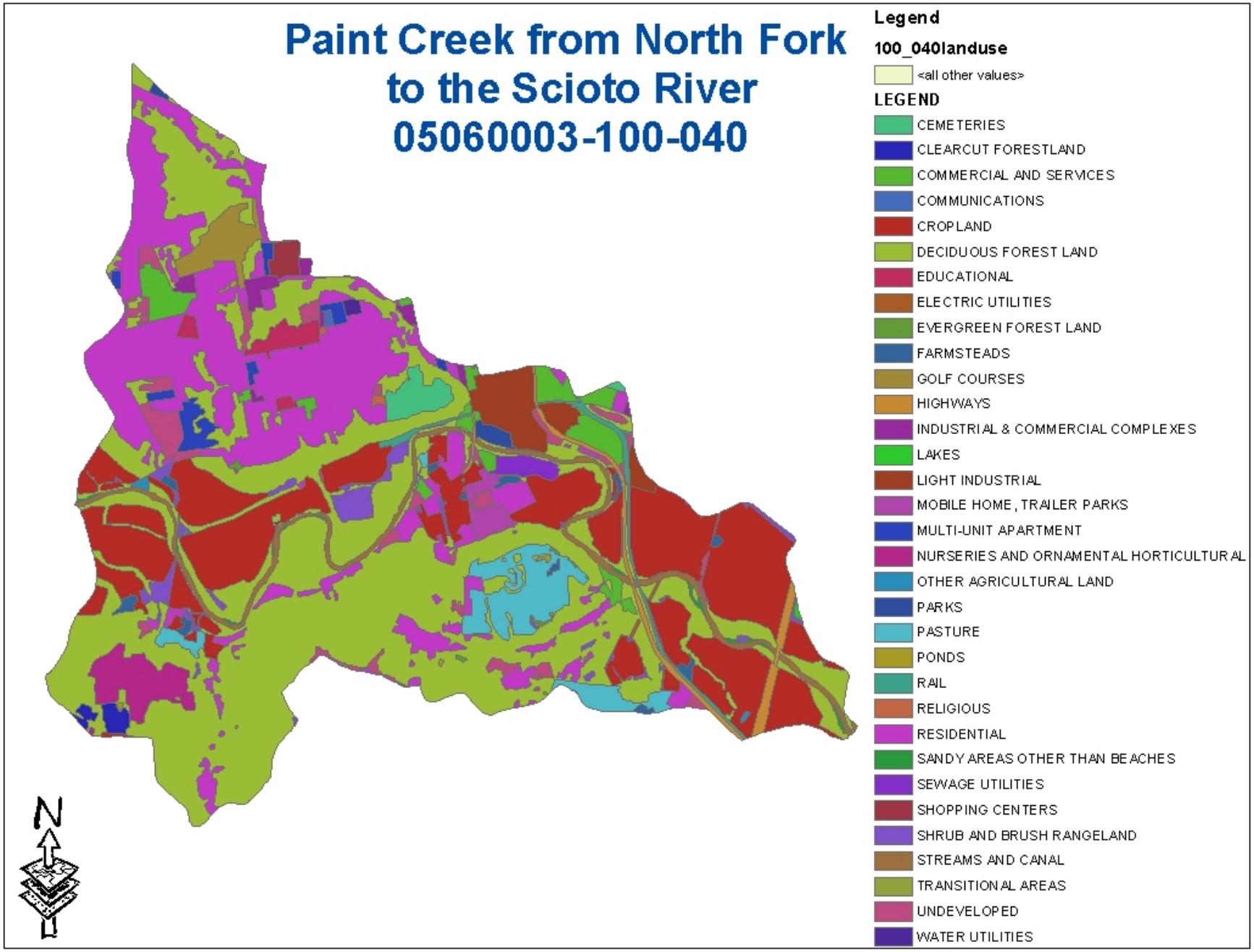
LEGEND

-
- CEMETERIES
- COMMERCIAL AND SERVICES
- COMMUNICATIONS
- CONFINED FEEDING OPERATIONS
- CROPLAND
- DECIDUOUS FOREST LAND
- EDUCATIONAL
- EVERGREEN FOREST LAND
- FARMSTEADS
- MUNICIPAL SPORTS FACILITIES
- NURSERIES AND ORNAMENTAL HORTICULTURAL
- OTHER AGRICULTURAL LAND
- PASTURE
- PONDS
- RELIGIOUS
- RESIDENTIAL
- SHRUB AND BRUSH RANGELAND
- STREAMS AND CANAL
- UNDEVELOPED
- WATER UTILITIES


Paint Creek from North Fork
to the Scioto River
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LEGEND
CEMETERIES
CLEARCUT FORESTLAND
COMMERCIAL AND SERVICES
COMMUNICATIONS
CROPLAND
DECIDUOUS FOREST LAND
EDUCATIONAL
ELECTRIC UTILITIES
EVERGREEN FOREST LAND
FARMSTEADS
GOLF COURSES
HIGHWAYS
INDUSTRIAL & COMMERCIAL COMPLEXES
LAKES
LIGHT INDUSTRIAL
MOBILE HOME, TRAILER PARKS
MULTI-UNIT APARTMENT
NURSERIES AND ORNAMENTAL HORTICULTURAL
OTHER AGRICULTURAL LAND
PARKS
PASTURE
PONDS
RAIL
RELIGIOUS
RESIDENTIAL
SANDY AREAS OTHER THAN BEACHES
SEWAGE UTILITIES
SHOPPING CENTERS
SHRUB AND BRUSH RANGELAND
STREAMS AND CANAL
TRANSITIONAL AREAS
UNDEVELOPED
WATER UTILITIES

OSU Study Results
Dr. Cavender and several interns conducted a seining survey to obtain information on the distribution of Paint Creek fishes across the drainage. This study was conducted to construct distribution maps, to pinpoint areas with the greatest diversity, and to investigate the presence of rare or endangered species. This study brought together all previous collection data to create an accurate representation of the fishes in Paint Creek. Dr. Cavender found that the lower 35 miles of main stem Paint Creek (of which this sub-basin is part of) has 91 species of fish recorded. He notes that "this is an exceptionally high number and immediately calls attention to this stream as one of Ohio's best". In the 4 mile stretch from river mile 8.9 to 4.0, there exists the largest number of species per mile. The total recorded for this section is 81 species!

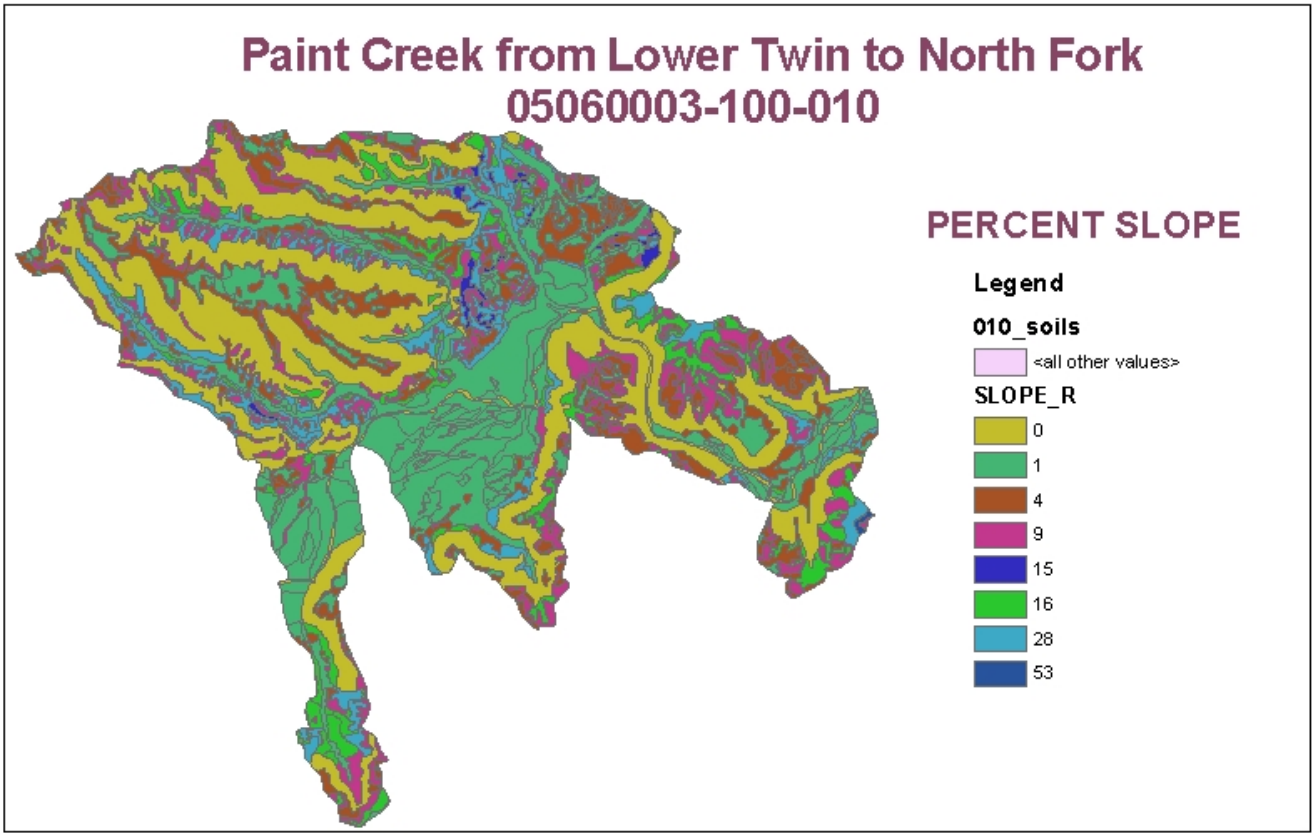
Soils Information

The soils in the this section are entirely in Ross county and are characterized as unglaciated soils that lie in a broad valley cut deeply into the Appalacian plateau (Cavender, 1997). Because of the detailed soil information available for this area, we have provided soil maps for all 4 parameters (drainage class, highly erodable land, slope and hydric rating) for each 14-digit area. You will notice that the soils are moderately well drained to well drained and are generally not hydric. The slopes are wide ranging...from 1% to 53%. While these slopes are the extremes, it is common for soils in the lower 14-digit watersheds to have average slopes between 15% and 28%. These soils are potentially highly erodable as well as highly erodable over most of the area.

Please see the following maps for information pertaining to the soils.

Summary
The lower section of the Paint Creek Watershed is an extremely high quality stream with almost all sections in full attainment of the aquatic life use. There is little channelization of the stream and there is moderate to extensive cover, good t o excellent substrate throughout with a boulder/cobble/gravel substrate. In this section of Paint Creek the Index of Biotic Integrity (IBI) consistently reached over 50: 50 be ing the minimum for exceptional warm water habitat designation. There is even 1 location (river mile 4.6) were the Ohio EPA recorded the 4th highest species diversity in the whole state for one pas s during their fish sampling program. As was nboted in the study by OSU, this is a remarkable stream with incredible diversity.

There were some problems with the chemistry measures with high total suspended solids, nitrates, and phosporus levels in the upper section of the main stem from river mile 21 to river mile 8. There were no fecal coliform measurements made downstream of the Paint Creek Lake so while we can not make a direct correlation with the high nitrates and failing septic systems we believe tht this may be one of our nutrient problems. There were continued elevated levels of total suspended solids downstream in river miles 7.8 to .1 but the other levels were within recommended ranges except at the outfall for the Mead paper plant. There were also some low dissolved oxygen levels at river mile .1 but that is believed to more related to the confluence of Paint Crek with the larger Scioto River.


Paint Creek from Lower Twin to North Fork
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SLOPE_R
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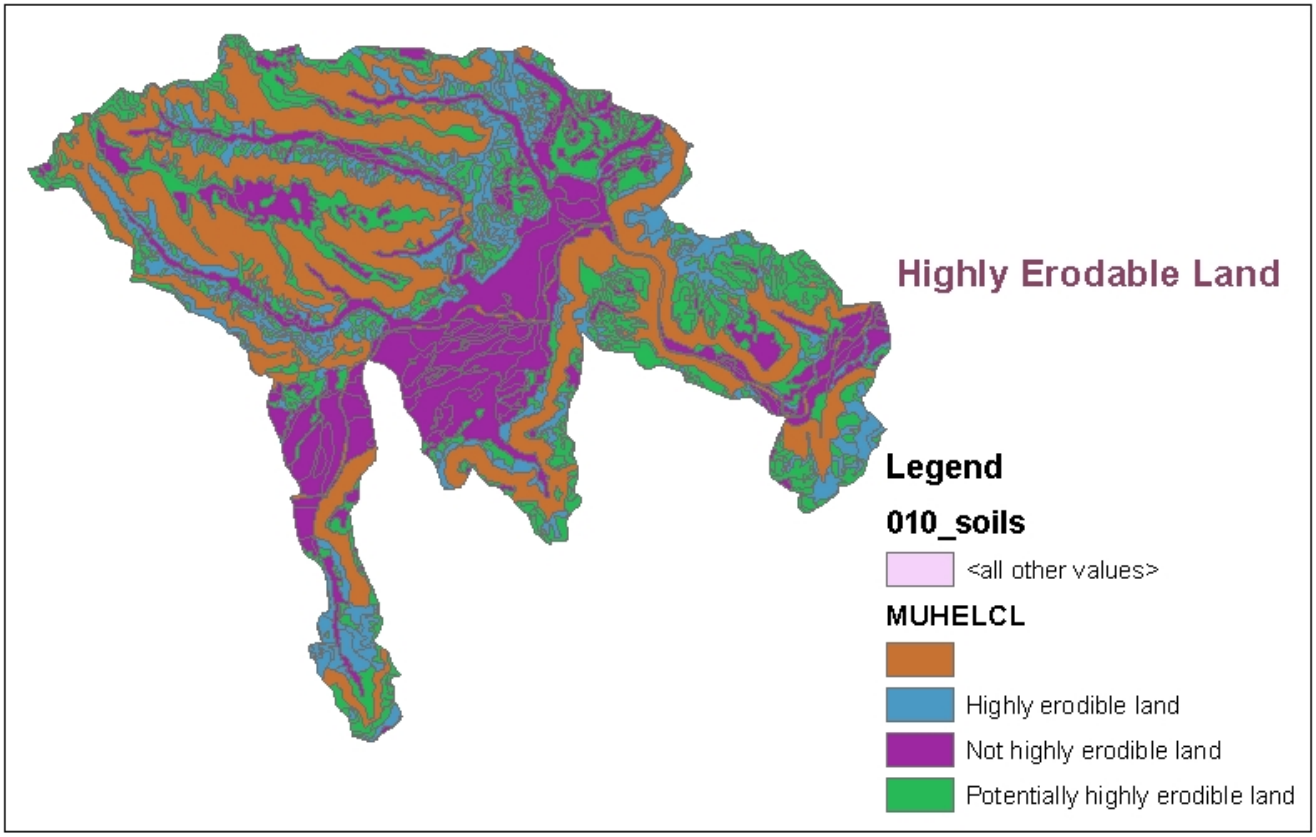
1
4
9
15
16
28
53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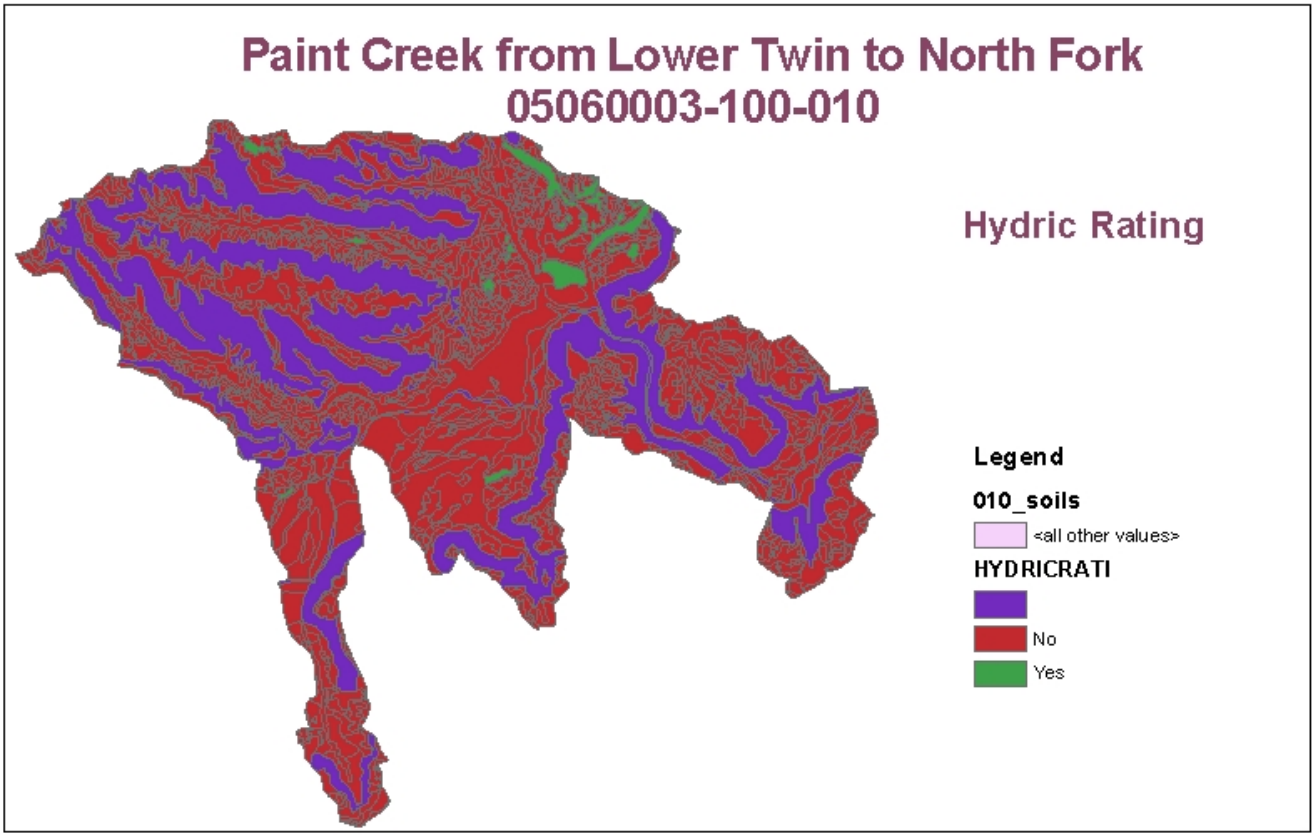
Not highly erodible land
Potentially highly erodible land


Paint Creek from Lower Twin to North Fork
05060003-100-010
Hydric Rating
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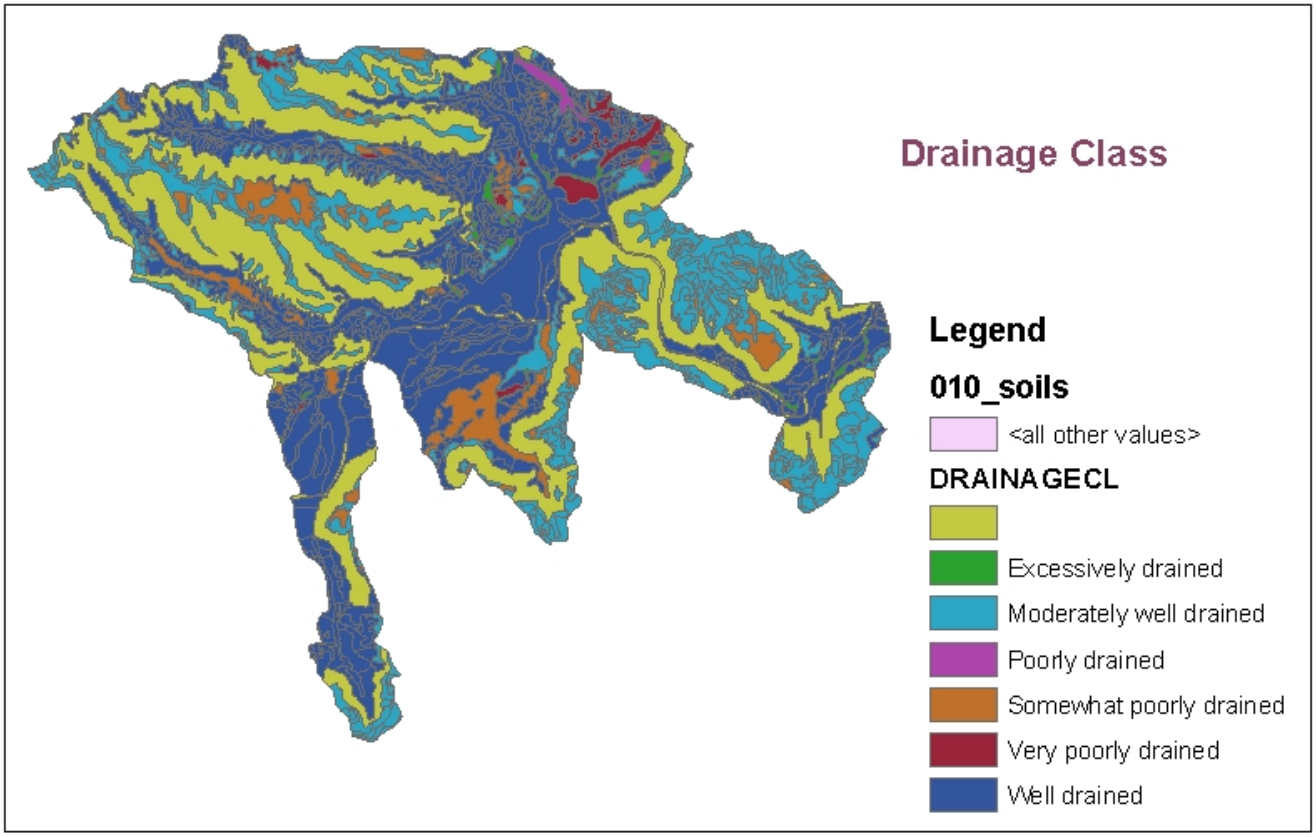
HYDRICRATI
No
Yes


Drainage Class
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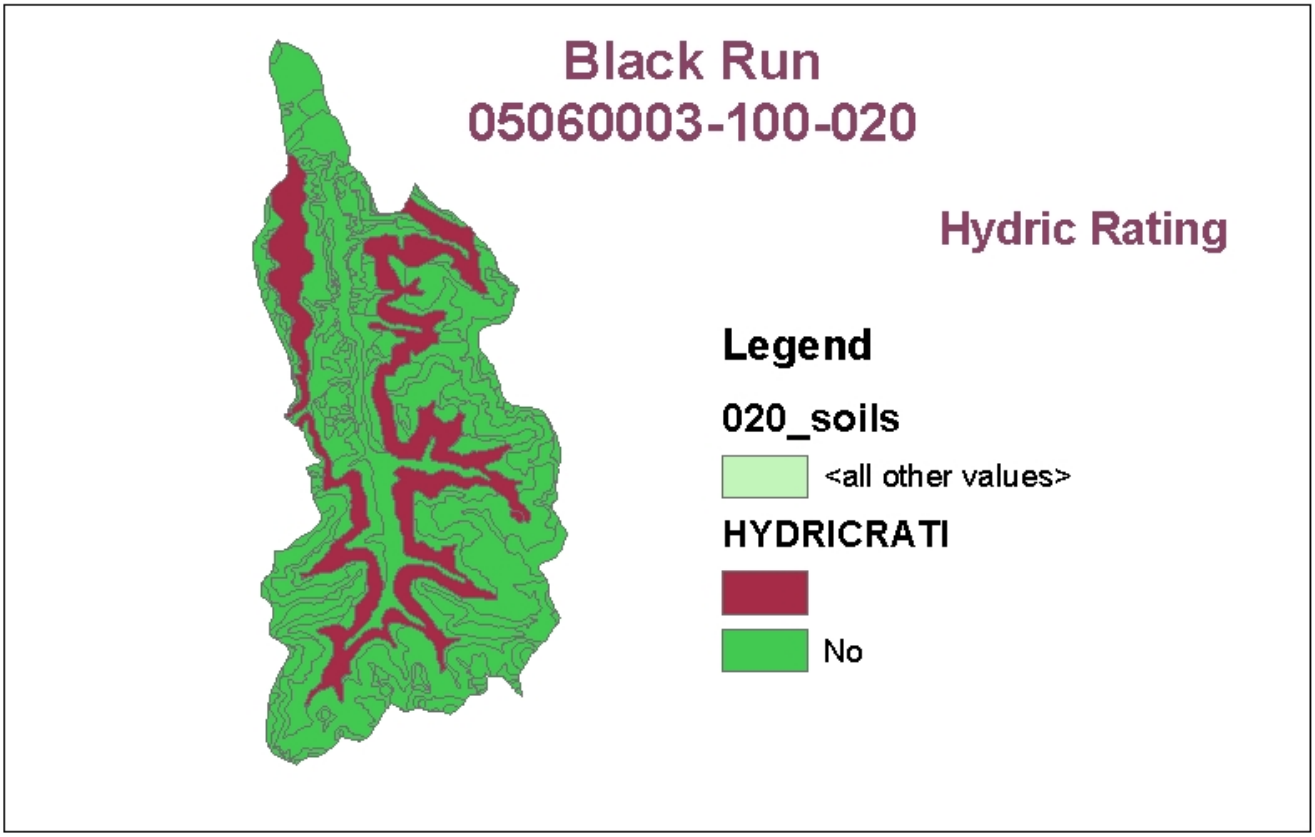
Excessively drained
Moderately well drained
Poorly drained
Somewhat poorly drained
Very poorly drained
Well drained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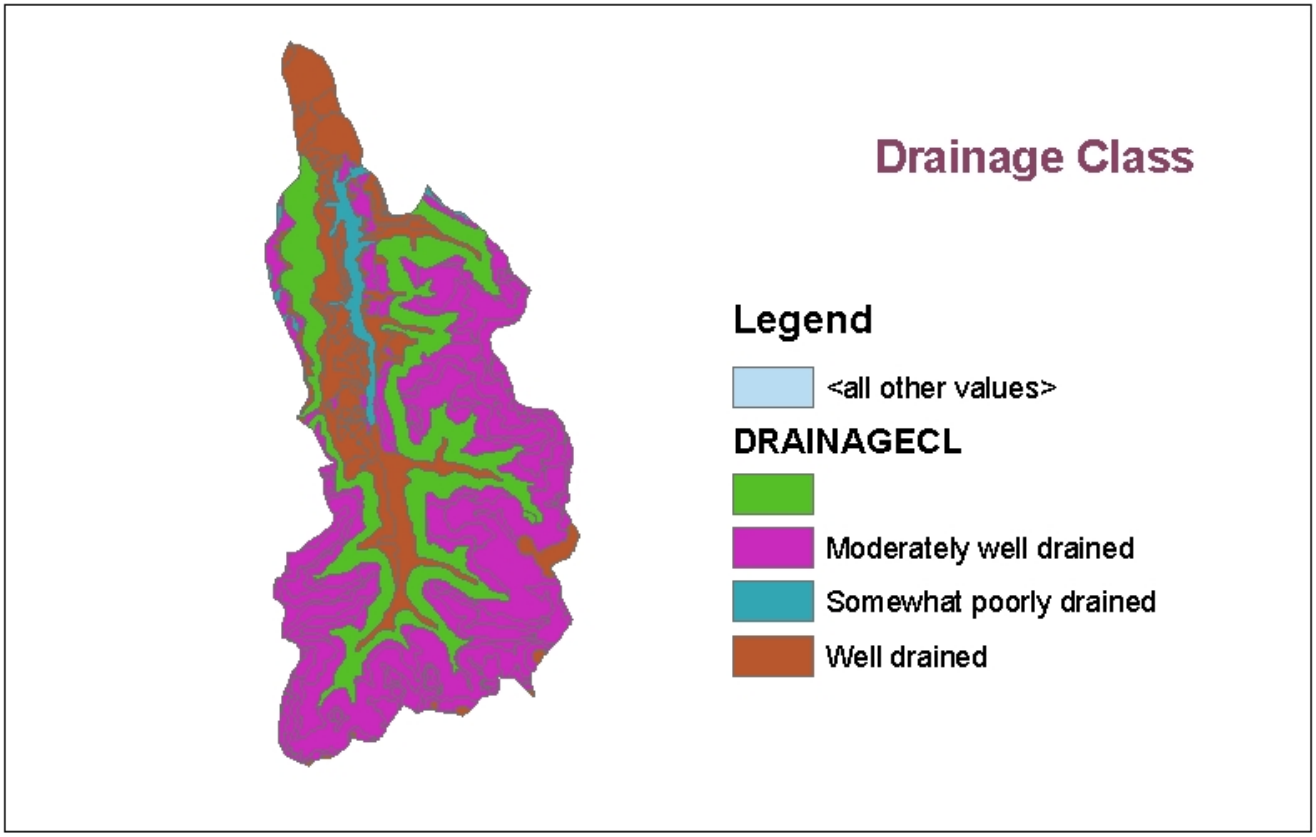
No


Drainage Class
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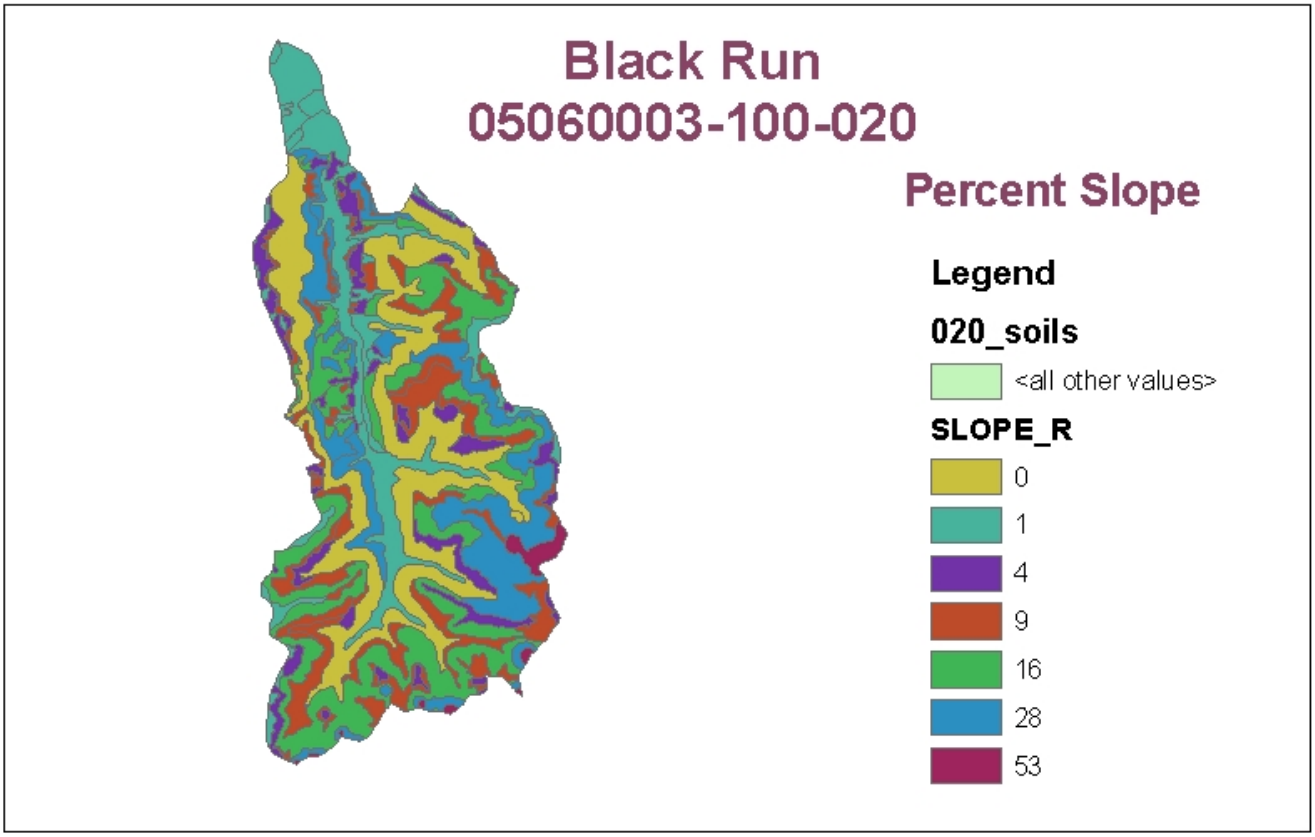
Somewhat poorly drained
Well drained


Black Run
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Percent Slope
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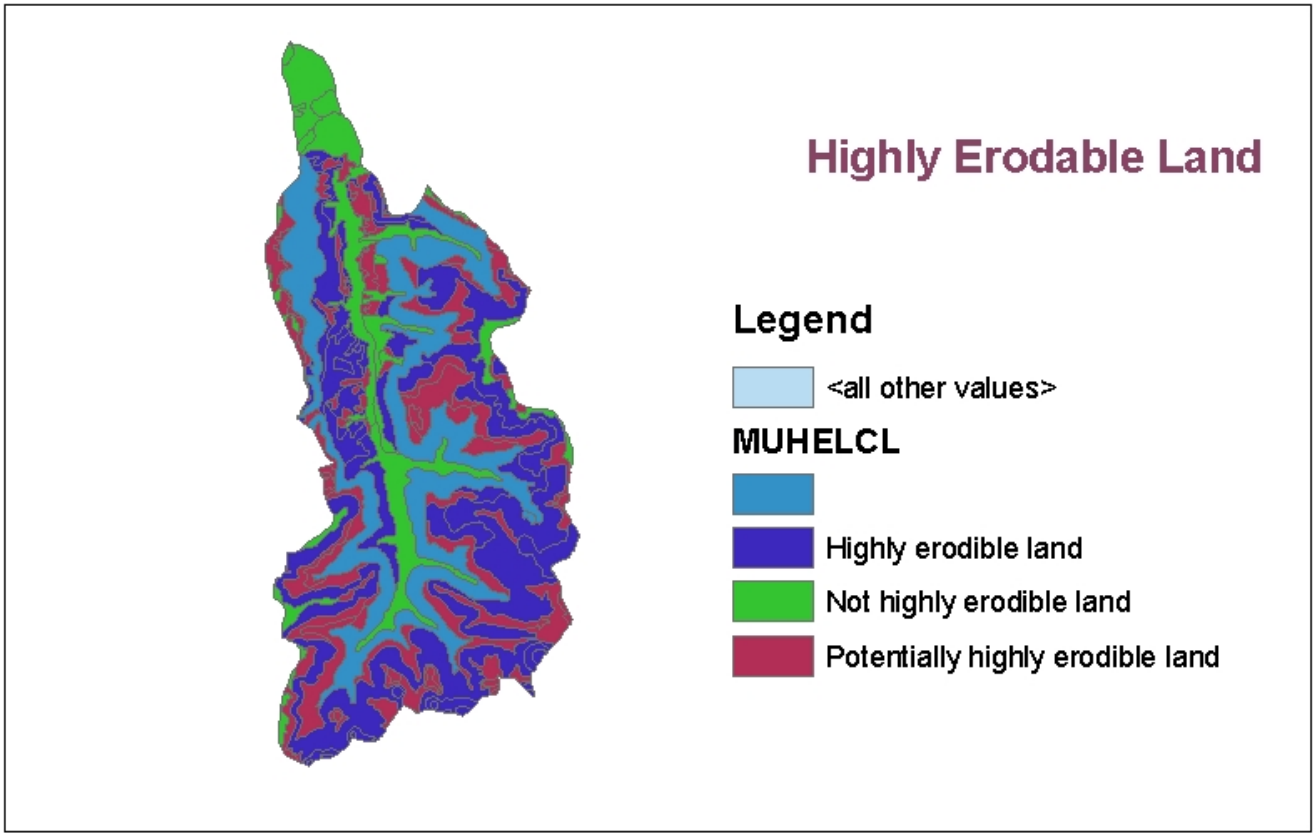
16
28
53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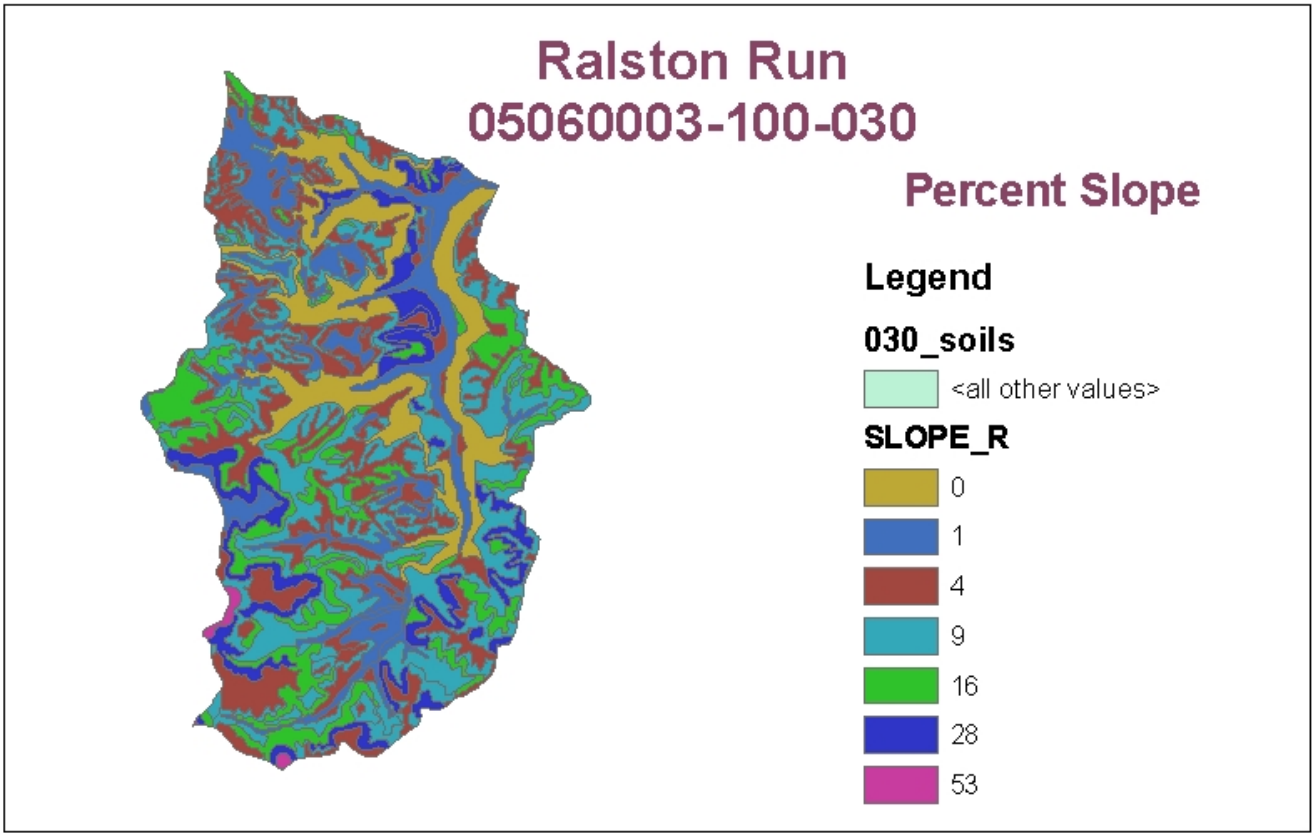
Not highly erodible land
Potentially highly erodible land


Ralston Run
05060003-100-030
Percent Slope
Legend
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4
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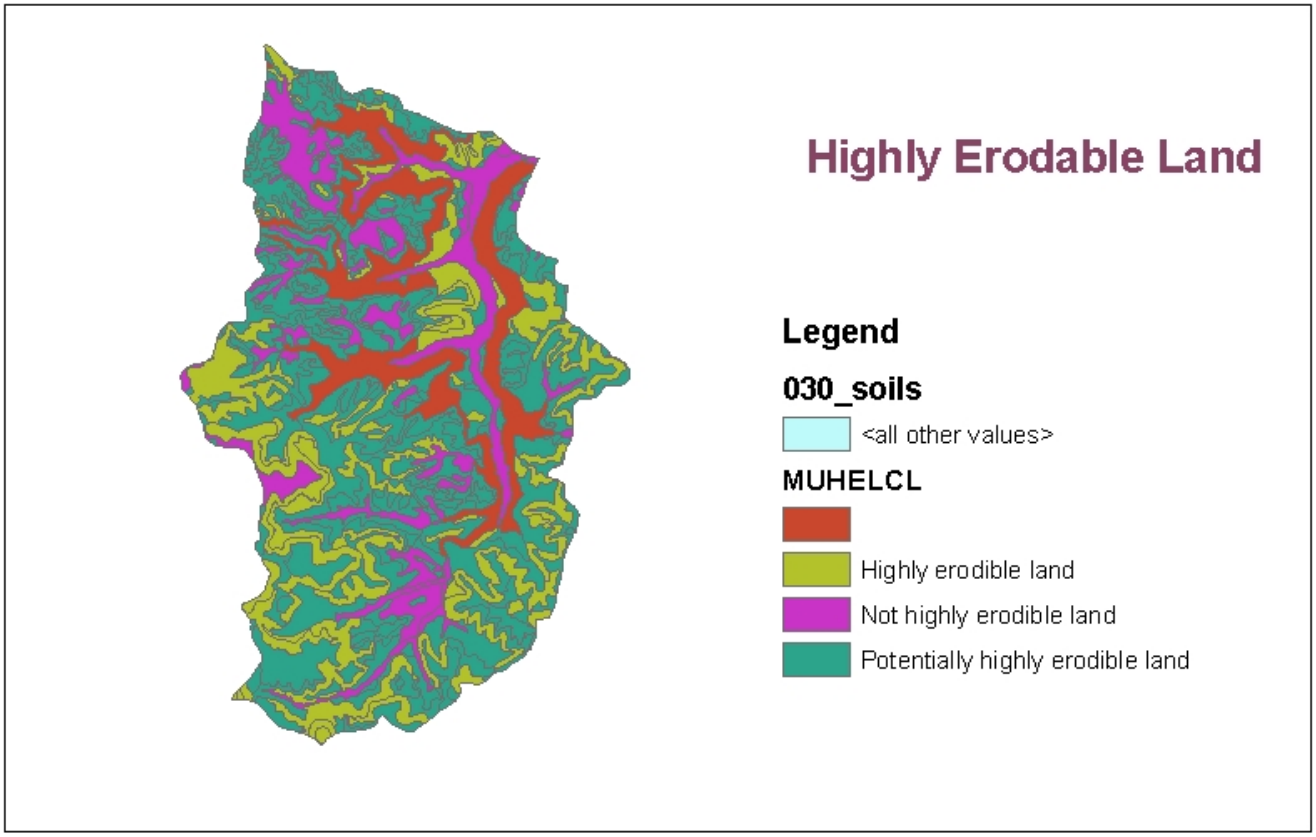
16
28
53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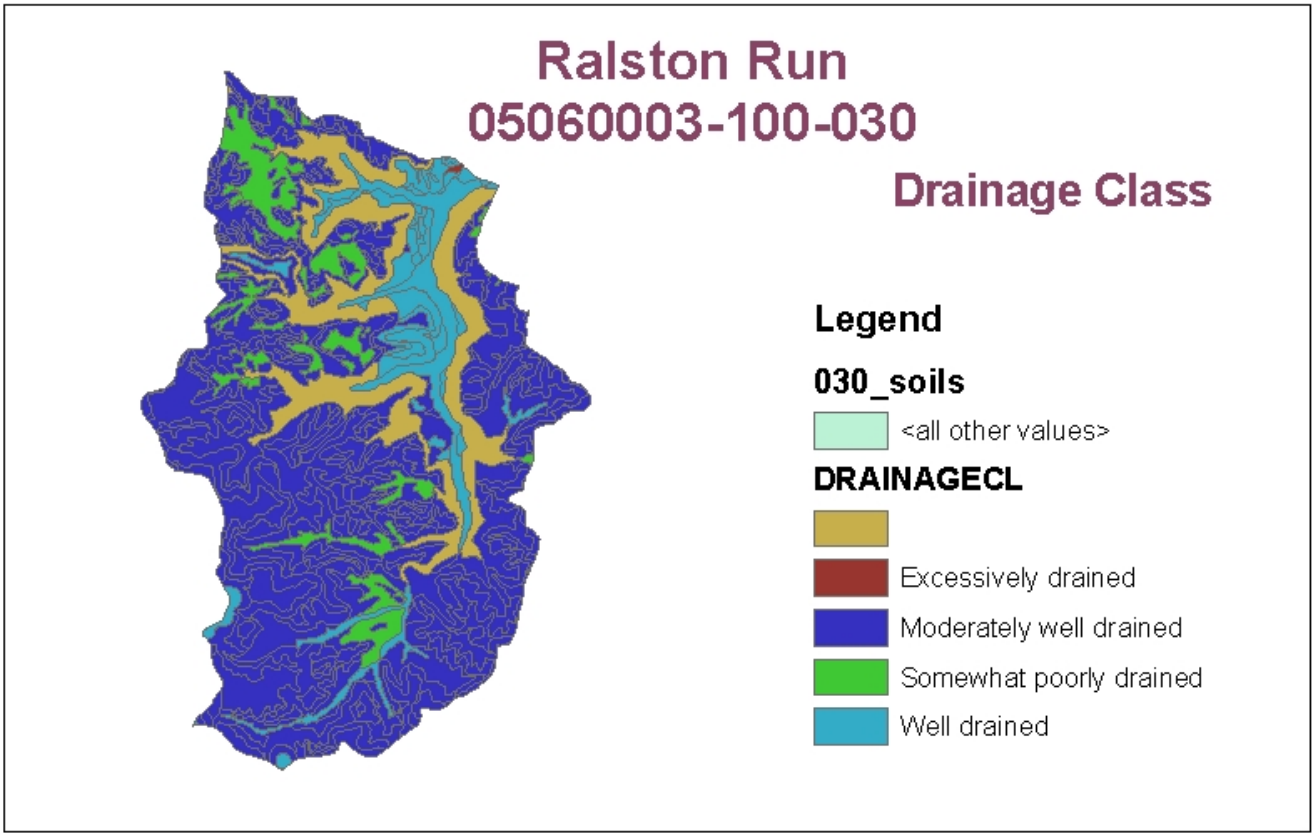
Not highly erodible land
Potentially highly erodible land


Ralston Run
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Drainage Class
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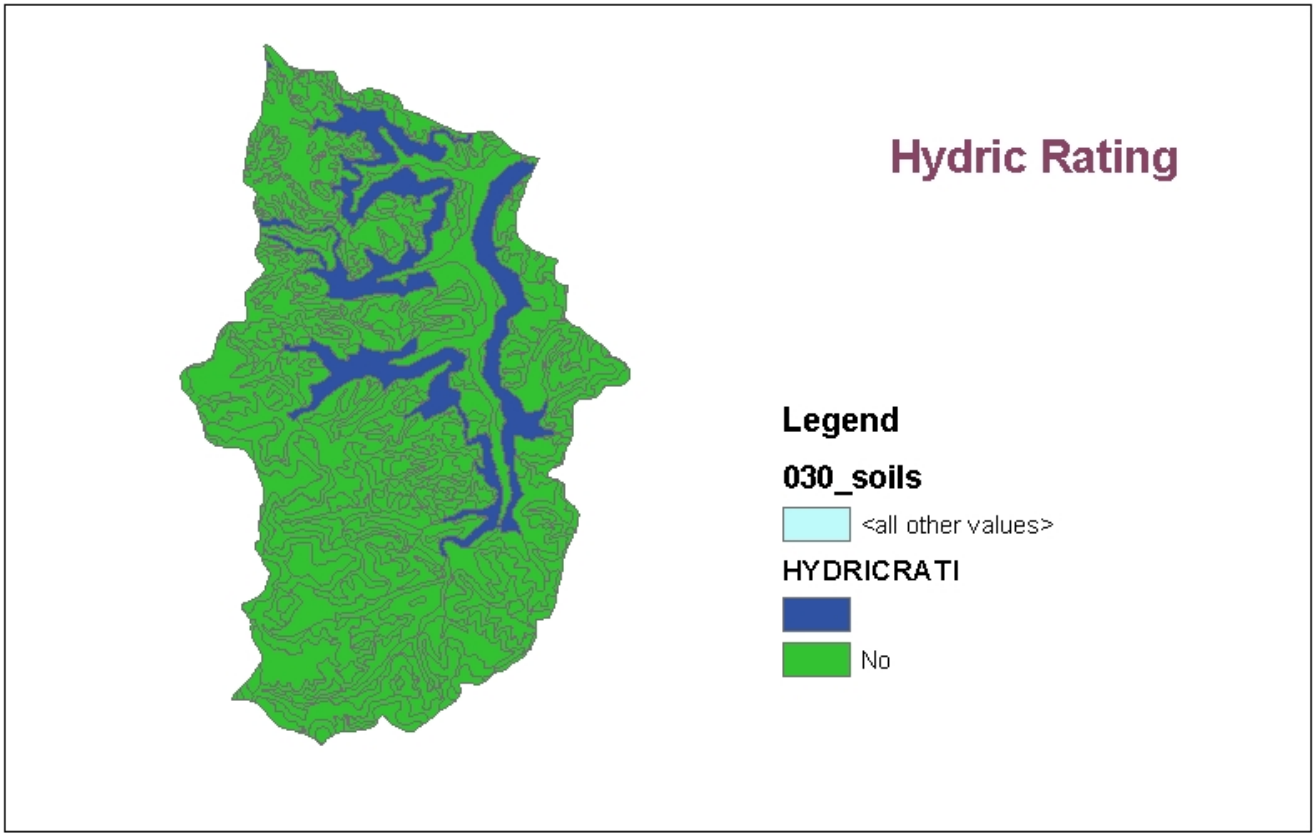
Excessively drained
Moderately well drained
Somewhat poorly drained
Well drained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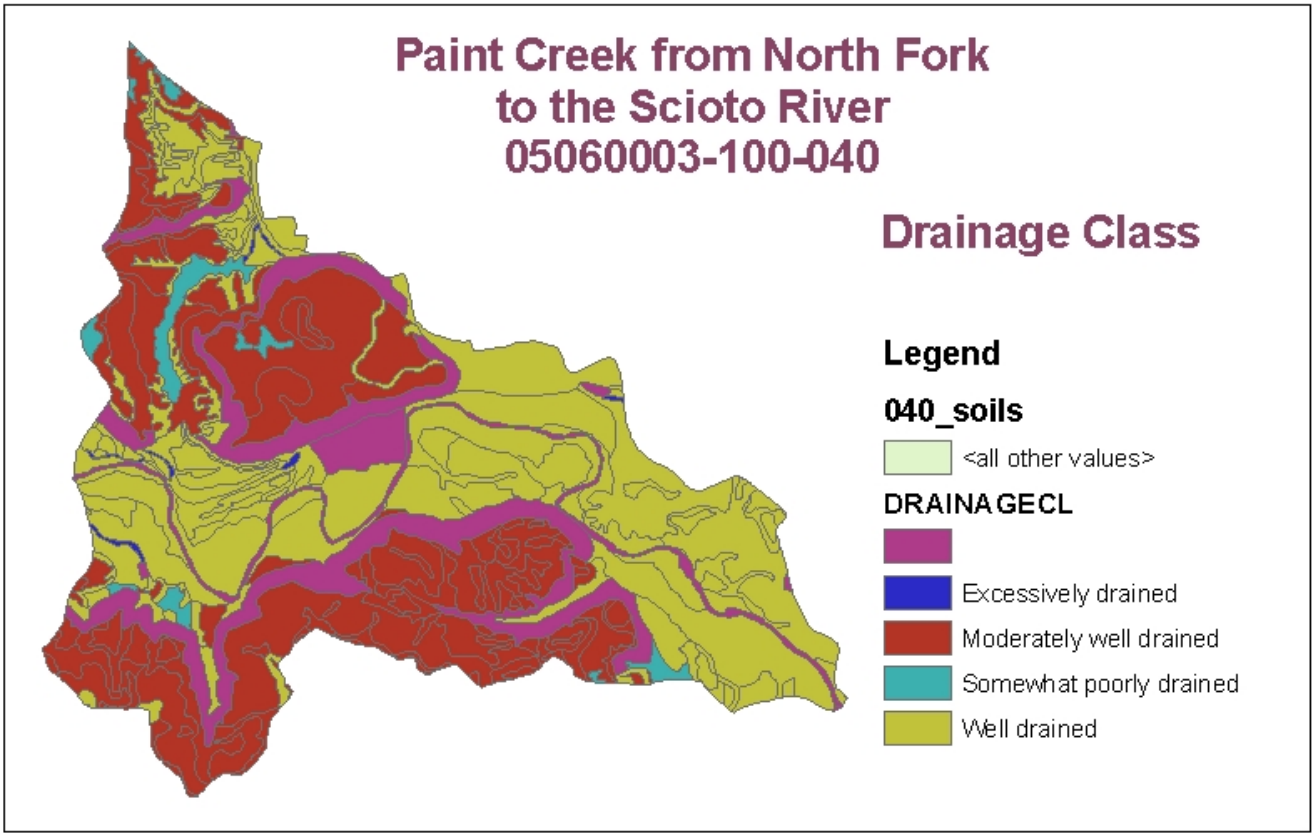
HYDRICRATI
No


Paint Creek from North Fork
to the Scioto River
05060003-100-040
Drainage Class
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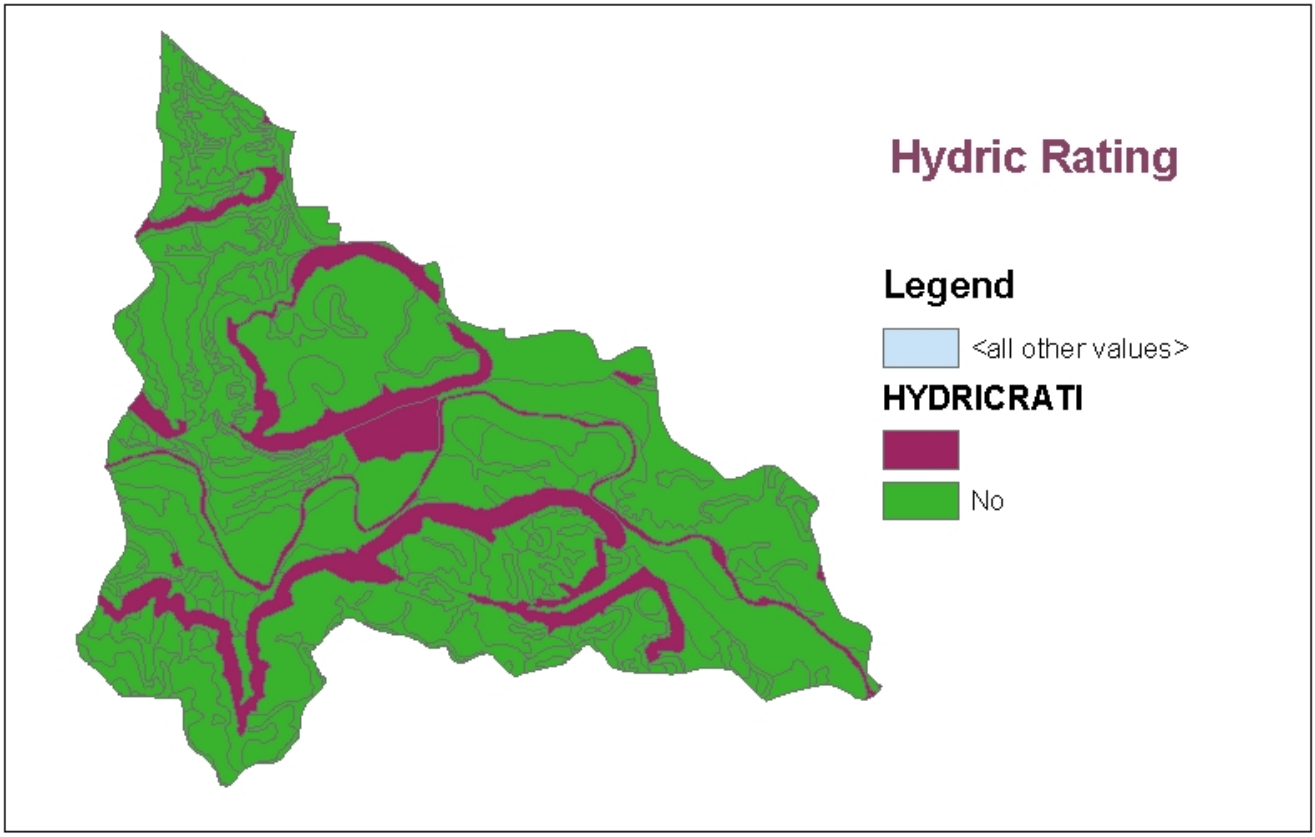
Moderately well drained
Somewhat poorly drained
Well drained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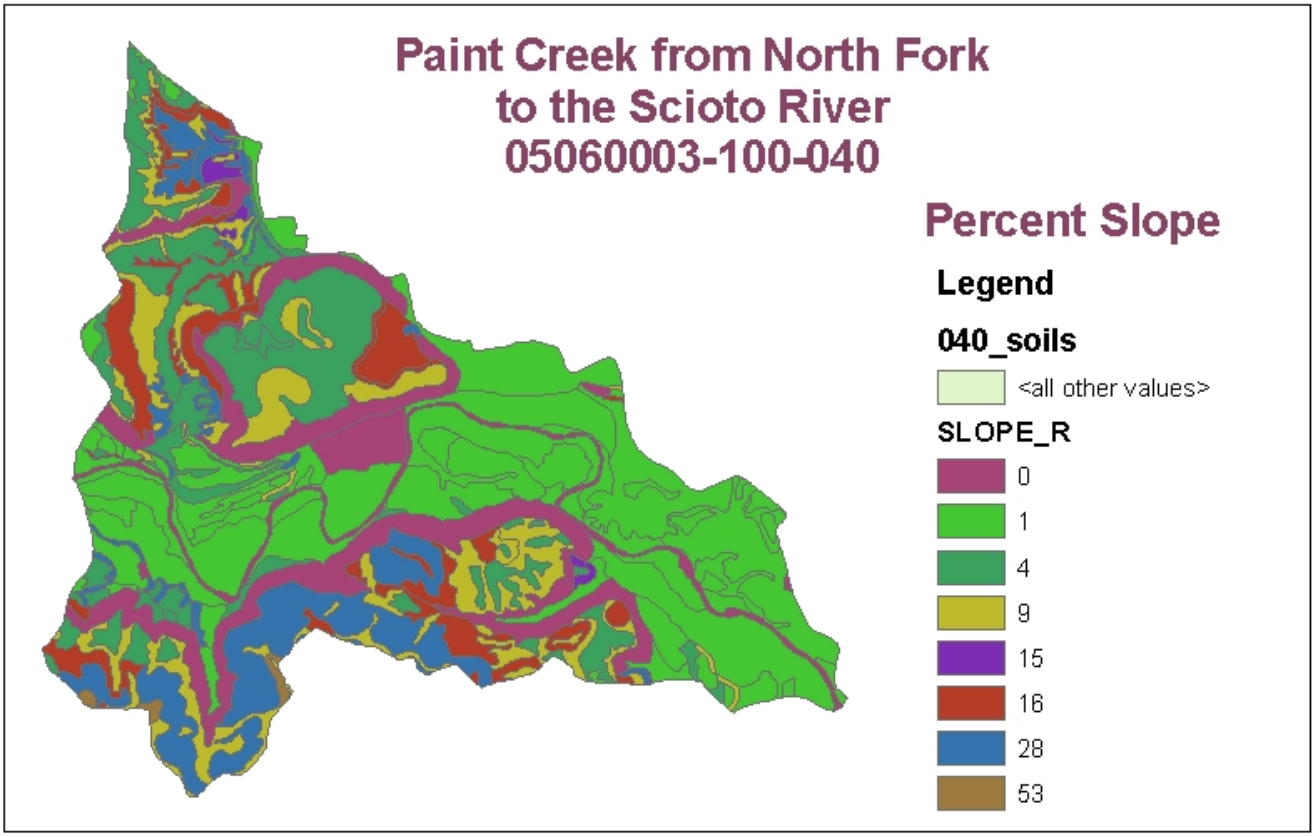
Paint Creek from North Fork
to the Scioto River
05060003-100-040
Percent Slope
Legend
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SLOPE_R
0
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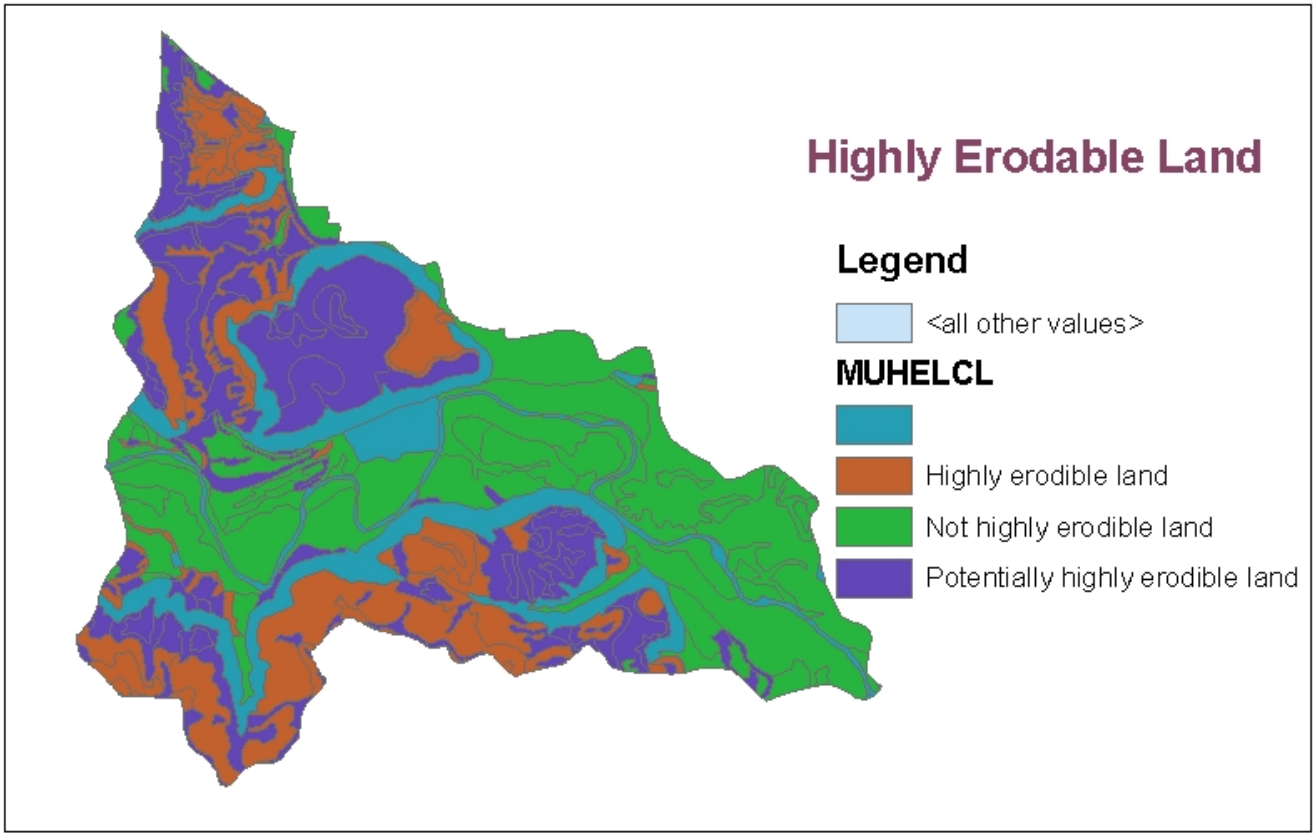
53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Highly erodible land
Not highly erodible land
Potentially highly erodible land

Concerns by Subwatershed

Watershed Name	Hydrologic Unit #	Suspected or known causes	Suspected or known sources
Paint Creek from Lower Twin to North Fork	05060003-100-010	Habitat Alteration, Siltation, nutrients, organic enrichment/DO	Residential, Crop Production, Livestock/pasture, Logging, Failing HSTS's
Black Run	05060003-100-020	Habitat Alteration, Siltation, nutrients, organic enrichment	Residential, Crop Production, Livestock/pasture, Logging, Failing HSTS's
Ralston Run	05060003-100-030	Habitat Alteration, Siltation, nutrients, organic enrichment	Residential, Crop Production, Livestock/pasture, Logging, Failing HSTS's
Paint Creek from North Fork to Scioto River	05060003-100-040	Habitat Alteration, Siltation, nutrients, organic enrichment/DO	Residential, Crop Production, Livestock/pasture, Logging, Failing HSTS's, point source

Public Support and Participation

The Paint Creek Watershed Project began holding public meetings in January of 1999 with their Watershed Coordination Kick-Off meeting. There were over 60 people in attendance and they came up with a listing of issues and concerns and then they were asked to pick the ones of priority. Those priority issues are seen below in the first listing. The project did not hold structured meetings again until 2002 due to the lack of availability of the Coordinator to hold meetings along with other day to day duties. In mid 1999, the Project wrote and was awarded a Section 319 grant to hire and write a management plan and in January of 2002, Hilary Solomon was hired. That February, both the Plan Coordinator, Hilary Solomon, and the Project Coordinator, Julie Brown, held meetings throughout the watershed having one in each 11-digit area to start gathering support for the project and to find out the issues and concerns. These meetings were held in the evenings in order to attract all possible interest parties and turn out was rather varied with as little as 2 participants in areas where the stream was smaller and on county maintenance to as many as 60 people where there were more urban communities. After these meetings, the citizens were invited to attend the Advisory Council meetings that were held quarterly for a year and a half after where subgroups sat at the table to formulate objectives and goals for the issues and concerns gathered at the local meetings. The final product was the draft Management Plan that was submitted to Ohio EPA in July of 2002. Soon after submitting the plan, Hilary Solomon's resigned her position and with her went the structured planned meetings. Hilary's work on the plan was invaluable and she is sorely missed as the revisions are completed.

Although the watershed is diverse in landscape and landuse, the issues and concerns that came up regularly at our evening meetings were the same across the watershed and very similar to the original list that was created in 1999. Here is a listing of those concerns.

Priority list from January 1999 meeting (in order of priority):

1. Reduce soil erosion
2. Protect riparian corridor
3. Create a community-driven watershed organization
4. Improve overall water quality
5. Protect against urbanization of farmland
6. Promote filter strips
7. Runoff/storm water management from housing developments and urban areas
8. Promote cost effective BMPs

Between February 28 and March 27, 2001, the Project held the 11 community interest meetings. These meetings were held in nine of the ten USGS hydrologic subunits in the watershed. The meetings were conducted in Bainbridge, Washington Court House, Chillicothe, Frankfort, Sabina, Jeffersonville, Hillsboro, Leesburg and Greenfield. In addition, meetings were held in Chillicothe with the Smallmouth Bass Alliance and the Symposiarts, a group that explores local culture and natural heritage.

The concerns and interest of the local community members were many and varied. The most common topics included stream bank erosion, public access to the creeks (countered with fears about trespassing), modifying dam releases from Paint Creek Lake and Rocky Fork to mimic natural stream flow patterns, litter control/illegal dumping, and map availability for local interest groups. Some of the most passionate discourse related to fish tissue consumption warnings, confined animal feeding units, wastewater treatment plant installations and management, riparian corridor restoration, and promoting environmental education in schools. A full list of community concerns and suggestions can be found below. Topics in bold were frequent concerns.

The Local Community Concerns were as follows:

Historic/special site preservation
Maps for local interest groups
Farmland/environmental compatibility
Water quality monitoring/maintenance
Confined animal feeding operations
Wastewater treatment plants and failing home septic systems
Litter/illegal dumping
Roadkill
Adopt-a-highway
Loss of farmland
BMP education and enforcement
Lack of zoning
Land use planning
Natural dam releases
Student environmental education
Animal control (beavers and geese)
Land stewardship education for landowners
Community participation
Public access to the creeks
Sediment control/contamination
Logging Practices
Riparian corridor

Stream bank erosion
Log jams
Recreation
Exotic species

Meeting to Discuss the Water Quality Issues in Main Stem of Paint Creek
Attendance:
Mike Greenlee, ODNR-DOW
Kathryn Madden, Ross County Health Dept.
Kurt Simon, Ohio Valley RC&D
Chad McIlvaine, landowner
Doug Pauley, Rocc NRCS
Marvin Garrison, Ross SWCD
Debbie McFadden, Friends of the Buzzards Roost Nature Preserve
Kelly Seig, Friends of the Buzzards Roost Nature Preserve

11 Digit Watershed: 05060003 100
05060003 100 010 Paint Creek below Lower Twin to above North Fork
05060003 100 020 Black Run
05060003 100 030 Ralston Run
05060003 100 040 Paint Creek below North Fork to the Scioto River
Sources of Water Quality Impairment: Organic enrichment/DO, habitat alteration, siltation
Causes of Water Quality Impairment: Impoundment, Municipal point source, streambank destabilization (agriculture), crop production, livestock/pasture.

Background: The section of Paint Creek is currently meeting its use designation throughout most of the lower section of the watershed. Even though this is a high quality watershed, there is development pressure from the city of Chillicothe. This area is not as suited to row crop agriculture but there is an increase in livestock pasture. Many of the houses in this area are on on-site septic systems that may have been put into soils that were not conducive to proper leaching. The problem in this watershed is more of a preservation aspect then it is an issue of repair. There is an active watershed group focused on the Earl Barnhart Buzzard Roost Preserve which is owned by the Ross County Park District. They are concerned with the status of the Paint Creek water quality as it flows through the middle of the park forming a beautiful gorge area.

According to the STEPL program, Version 2.0, the current estimated loadings are 27,889 lbs/year of nitrogen, 8,2614 lbs/year of phosphorus, 75,413 lbs/year of biological oxygen demand, and 1,129 tons/year of sediment. (The project believes that these numbers are grossly under the total loading. This watershed doe have good riparian cover but there is row crop agriculture, development and failing septic systems)

RIVER MILE	STREAM	LOCATION	ECO-REGION	W/S SIZE*	HABITAT	PRIORITY	ATTAINMENT
21.60	Paint Creek	USGS Gauge at Bournville	WAP	SR	EWH	LOW	Full
16.30	Paint Creek	Shotts Bridge	WAP	SR	EWH	LOW	Full
8.90	Paint Creek	Ust. North Fork Paint Creek	WAP	SR	EWH	LOW	Full
7.80	Paint Creek	Dst. North Fork Paint Creek	WAP	LR	EWH	LOW	Full
4.60	Paint Creek	Ust. Mead Paper at SR 104	WAP	LR	WWH		
2.40	Paint Creek	Mead Paper Mixing Zone	WAP	LR	WWH	LOW	Full
2.30	Paint Creek	Ust. US 23	WAP	LR	WWH	LOW	Full
0.20	Paint Creek	at mouth, convergence Scioto	WAP	LR	WWH	LOW	Full

Problem statement: Organic enrichment, siltation and habitat alteration in the Paint Creek watershed are concerns in this high quality watershed. Through field inventory, the source of the erosion is believed to be from over land runoff and streambank erosion. More precise locations of eroding banks are not yet confirmed.

The task descriptions below were formulated using recommendations from experts at the local Soil and Water Conservation Districts, Health Departments, Ohio Department of Natural Resources, Division of Forestry, Division of Wildlife, and Division of Soil and Water Conservation, along with the Natural Resource Conservation Service and the Ohio Environmental Protection Agency.

Goals:

1. Protect and restore riparian corridor by establishing an easement program and repairing streambank erosion.

Task Description	Resources	How	Time Frame	Performance Indicators
Encourage the establishment of conservation easements to protect current riparian corridor.	$350,000	Research farmland preservation funds, ODOT mitigation funds, Issue 1 funds, etc.	2008	Document soil and nutrients saved/not delivered to stream using RUSLE or other model, Improved QHEI scores
Restore eroded streambanks using bioengineering methods along with conventional methods that will be able to withstand the high flows in this large stream. 5000 feet of repair will reduce the sediment load by 5100 tons/year, phosporus by 5100 lbs/year and nitrogen by 10,200 lbs/yr	$500,000	Apply for grant funding through 319, research other possible funding sources	2008	Document soil and nutrients saved/not delivered to stream using RUSLE or other model, Improved QHEI scores

Loading reductions calculated using Load Reduction Spreadsheet v1.2.

Problem statement: Excessive nutrients and organic enrichment in the Paint Creek watershed are suspected of causing impairment.. After discussions with the SWCD and local Health Dept. it is accepted that approximately 10% of the on-site septic systems in this area are failing which is approximately 60 homes. There are also other septic issues with the unsewered communities south of Rocky Fork Lake. More precise locations of failing systems are not yet confirmed. The estimated nutrient load not discharged from these 60 homes would be 6504 lbs. of nitrogen, 2463 lbs. of phosphorus and 23060 lbs. of BOD.

The task descriptions below were formulated using recommendations from experts at the local Soil and Water Conservation Districts, Health Departments, Ohio Department of Natural Resources, Division of Forestry, Division of Wildlife, and Division of Soil and Water Conservation, along with the Natural Resource Conservation Service and the Ohio Environmental Protection Agency.

Goals:

1. Reduce nutrient load and organic enrichment from failing on-site home septic systems by repairing all failing systems.

Task Description	Resources	How	Time Frame	Performance Indicators
Work with county Health Departments to determine more accurate number of failing systems	HD Inspectors time to inspect all systems	Inspect all systems	January 2008-January 2009	Report of failing systems generated
Replace/upgrade failing systems	Health Dept. time to write plan	Apply to DEFA for low interest on-site loan program for county	October 2008-December 2009	DEFA program available in county,
Search for funding options to upgrade failing systems	Watershed Coordinator and/or Health Dept. time to research and write grant application	Local watershed group or Health Dept. will apply for grant program	January 2008	Grant Submitted
Replace/upgrade all failing systems	County sanitarians time to approve applications and inspect	Local watershed group or Health Dept. will apply for grant program	January 2009-December 2014	All failing systems replaced or upgraded

Loading reductions calculated using Load Reduction Spreadsheet v1.2.

Problem statement: Excessive nutrients, organic enrichment and habitat alteration in the Rocky Fork Watershed are causing impairment of the use designation. Education programs and personnel are needed to educate the community and provide an awareness of the issues, both agricultural and urban, and to deal with concerns. Pursue recreational alternatives to encourage use of the natural resource.

The task descriptions below were formulated using recommendations from experts at the local Soil and Water Conservation Districts, Health Departments, Ohio Department of Natural Resources, Division of Forestry, Division of Wildlife, and Division of Soil and Water Conservation, along with the Natural Resource Conservation Service and the Ohio Environmental Protection Agency.

Goals:

1. Reduce nutrient load, organic enrichment, and sedimentation through education and awareness programs

Task Description	Resources	How	Time Frame	Performance Indicators
Work with local stakeholders to create an awareness of the watershed issues and concerns and available programs. Use GIS to formulate watershed mailing lists to keep landowners aware of programs.	Maintain a watershed coordinator	Local watershed group will search for other funding source	On going	Watershed Coordinator is hired/continues employment.
Work with developers, builders and government agencies to ensure county urban erosion control guidelines are followed.	Add an urban streams conservationist to the watershed project	Local watershed group will search for other funding source	January 2008	Urban Streams Conservationist is hired.
Provide increased public access to the stream for recreational use.	Funding needs unknown at current time	Local recreation entities will look into water based recreation grant opportunities with the Div. of Watercraft.	January 2008	Recreational access increased for public use.

Problem statement: Sedimentation and habitat alteration in the Paint Creek Watershed along with the high water quality in the Paint Creek Watershed have spurred the Ohio Chapter of The Nature Conservancy to look closer at protecting this natural resource. They have developed a conservation strategy that includes a flow management project for Paint Creek. The tasks listed below are from a draft Paint Creek Watershed Conservation Action Plan from The Nature Conservancy in January of 2006.

The task descriptions below were formulated using recommendations from experts at The Nature Conservancy, Ohio Chapter.

Goals:

1. Change the flow management regime and levee system so that x% of the floodplain is flooded and all indicators of hydrologic alteration are within their natural range of variation x% of the time by October 2008.

Task Description	Resources	How	Time Frame	Performance Indicators
Establish a partnership for flow and floodplain restoration along the Paint Creek mainstem.	$0	The Nature Conservancy, Ross SWCD, Paint Creek Project, ODNR, COE, Metro Parks	By Oct. 2006	Contacted and meet with potential partner organizations and hold orientation meeting to discuss goals.
Review and collect necessary ecological, hydrologicval, and infrastructure data to develop flow recommendations for Paint Creek Mainstem	Sstaffing time	The Nature Conservancy, Paint Creek Watershed OEPA	By October 2007	Conduct analysis, review historical and current data, collect data if needed. Map levees, property ownership, etc.
Conduct experts driven flow recommendation Workshop to develop flow prescriptions. Develop model.	?	The Nature Conservancy (and experts)	October 2007	Workshop conducted
Model flooding and recreational impacts of flow recommendations	$50,000-$75,000 for model	TNC and ACOE	December 2007	Model developed, flow scenarios produced
Get stakeholder support for implementation of revised ecological flow recommendations	?	TNC, Paint Creek Watershed Project	March 2008	Landowners contacted, public meetings held
Implement ecological flow recommendations	?	TNC, COE	May 2008	Approval from congress, changes made to reservoir

				operations plan
Develop measures of success program for project	?	TNC	May 2008	Monitoring funds secured. Appopriate ecological indicators identified.

***All photos courtesy of Anthony Sasson, The Nature Conservancy

Evaluation Strategy and Plan Update/Revision:

The Paint Creek Management Plan is anticipated to be a living and working document that does not end up on a shelf collecting dust. In order to accomplish this, evaluation and updating will be key components for the future.

Since the formulation of the Management Plan relied heavily on stakeholder input, their evaluation of the plan will be crucial to it's future. The Project would like to implement a yearly progress meeting to discuss the original goals of the plan and to determine the status of these goals and the need for additional response or update. The success of some measures such the BMP's will be measured on a basis of application and implementation in the watershed. This information will be provided by the local Soil and Water Conservation Districts, Natural Resource Conservation Service and the County Health Departments. A measure of success for the education aspect of the plan will be the number of programs provided and the attendance of the community. It is anticipated that as awareness of the watershed increases that the interest in monitoring local streams will increase and that this data will also be used to evaluate and monitor the success of the plan at improving the water quality.

The ultimate responses that the Project hopes will come out of this planning process is:

- Increased awareness in the community of the Paint Creek Watershed and
- Water quality in the watershed meeting use designations with QHEI scores consistently improving.

This watershed is slated to be sampled by the Ohio EPA Ecological Assessment Unit in 2006 with a TMDL completion date of 2008. Paint Creek received it's first intensive sampling effort in 1997 so the project will also be able to look for any changes from one sampling period to the next and compare that with the work the Project that has already completed.

The progress of the plan will be made available to interested local and state governments as well as all watershed citizens' trough newsletters, brochures, news articles, radio programs and at some point a web site. These duties will be the responsibility of the Watershed Coordinator and the Paint Creek Joint Board of Supervisors along with the Sub-watershed Work Groups.

It is anticipated that as a working document, the plan will be revised yearly after the progress meetings have determined the successes and failures.

The Paint Creek Watershed Project is pleases to have had the involvement of the following people and organizations in the completion of this community based watershed action plan.

Name	Association	City
Agriculture Subgroup		
Hugh Trimble	Ohio EPA	Dayton
Gordon Conn	Farmer	Jeffersonville
Dave Parry	NRCS	Hillsboro
Vince Chrisman	Fayette SWCD	Washington CH
Dave Sever	Sever Consulting	Washington CH
Eric Rutherford	Landowner	Wilmington
David Caplinger	Landowner, SOFA	Hillsboro
Rosida Porter	Ohio DNR	Columbus
Forestry Subgroup		
Heidi Devine	Ohio DNR, Div of Wildlife	Xenia
Lee Crocker	Ohio DNR, Div of Forestry	Waverly
Mike Besonen	MeadWestvaco	Chillicothe
Chris Smid	MeadWestvaco	Chillicothe
Randy Sanders	Ohio DNR	Columbus
Joey Knauff	Knauff Lumber/ Master Loggers	Bainbridge
Education Subgroup		
Sam Webb	Pickaway SWCD	Circleville

Jenny Behymer	Landowner	Hillsboro
Layne Garringer	Fayette SWCD	Washington CH
Steve Hawkins	Ohio DNR/DSWC	Circleville
Jerry Iles	OSU Extension	Jackson
Urban Subgroup		
Julia Cummings	Madison SWCD	London
Steve Sobers	City Manager	Washington CH
Streamside Management Subgroup		
Dot Riley	NRCS	Grove City
Gordon Conn	Farmer	Jeffersonville
Gary Merkamp	Ross County Park District	Chillicothe
Randy Hoover, Kipp Brown	Ohio DNR, Div of Wildlife	Xenia
Bob Jones	Landowner, former Army COE	Bainbridge
Dan Imhoff	Ohio EPA	Logan
Marty Lundquist	Ohio DNR, Div of Wildlife	Columbus
Paula Wentzel	MeadWestvaco	Chillicothe

Watershed Action Plan for the Rocky Fork of Paint Creek

Hydrologic Unit Numbers:

05060003 060 010 Rocky Fork above South Fork of Rocky Fork

05060003 060 020 South Fork of Rocky Fork

05060003 060 030 Rocky Fork below South Fork to above Clear Creek

05060003 060 040 Clear Creek

05060003 060 050 Rocky Fork below Clear Creek to Rocky Fork Lake

05060003 060 060 Rocky Fork below Lake to Paint Creek

Written and Compiled by:
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Paint Creek Watershed Project
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Chillicothe, Ohio 45601
Phone: (740) 772-4110 ext. 117
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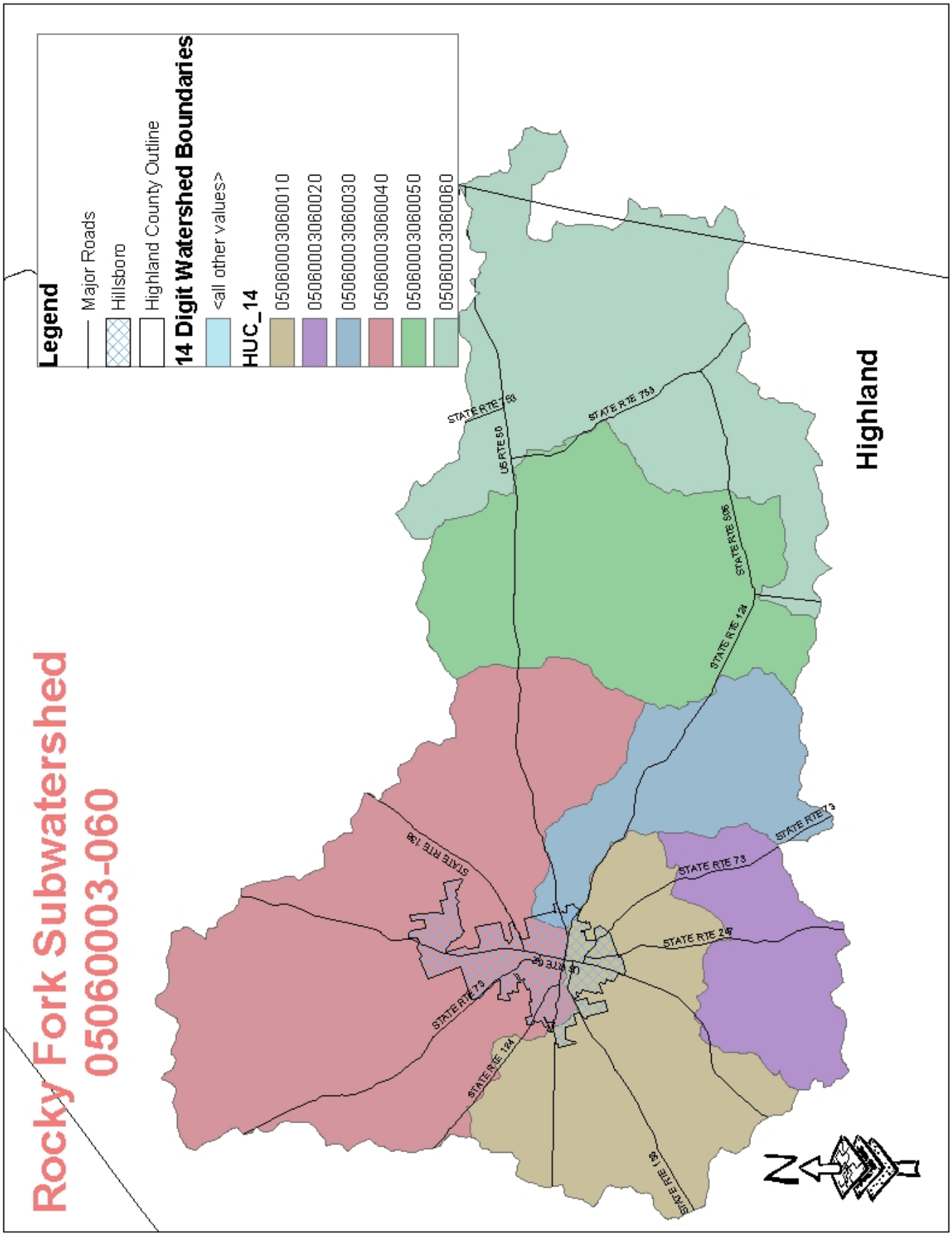
Rocky Fork Subwatershed
05060003-060
Legend
Major Roads
Hillsboro
Highland County Outline
14 Digit Watershed Boundaries
<all other values>
HUC_14
05060003060010
05060003060020
05060003060030
05060003060040
05060003060050
05060003060060
Highland
STATE RTE 753
US RTE 50
STATE RTE 506
STATE RTE 124
STATE RTE 73
STATE RTE 138
STATE RTE 247
US RTE 62
STATE RTE 124
STATE RTE 73
STATE RTE 73
STATE RTE 68
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INTRODUCTION

The Paint Creek Watershed Management Plan stems from an ongoing conservation ethic within the Paint Creek Watershed. Conservation practices were explored in the watershed as early as the 1960's. Public awareness and interest in maintaining and/or improving water quality in the watershed has increasingly mounted since those early studies. Land managers within the watershed are currently pursuing several conservation grants and the watershed project is distributing Clean Water Act, section 319 grant monies to fund projects in targeted areas. The management plan will provide information to ensure that future conservation efforts within the watershed are applied in the most efficient and beneficial manner.

As far as practicable, the Paint Creek Watershed Management plan follows the outline contained in Ohio EPA's *Guide to Developing Local Watershed Action Plans in Ohio* . The plan contains four main sections: the background and scope of the project, a comprehensive watershed inventory, a watershed-wide water quality assessment with documentation of the related problems, and an outline of planned implementation activities or solutions. This last section includes a timeline and methods to evaluate the effectiveness of the activities implemented within the watershed.

The Watershed Project was originally formed in 1998 when 6 coordinating Soil and Water Conservation Districts received Section 319 funds for implementation. It was always the plan that A watershed Coordinator would administer the grants and also work on putting together a management plan for the watershed. The Project is governed by a Joint Board of Supervisors, one from each of the 6 main county SWCD's, which follow the operational procedures of a District SWCD. The Joint Board also put together bylaws that are available from the Watershed Coordinator. This Board makes all decisions based on funding and application approval for the implementation program but decisions about the contents of the plan have been left completely up to the stakeholders involved in the development process. The stakeholder groups have been open to the public and new attendees are welcome at any time.

General Description and Political Boundaries

The Paint Creek Watershed is comprised of 731,168.9 acres located in 9 counties: Madison, Greene, Clinton, Clark, Pickaway, Fayette, Pike, Ross, and Highland.

The Main Paint Creek Subwatershed is located in south central Ohio and covers 310,585 acres. It originates in Madison County and encompasses much of Fayette County and the eastern edge of Highland and western edge of Ross County. Main Paint Creek meets the Scioto River south of Chillicothe in Ross County. The flood plain of Paint Creek varies in width from a few feet at its source to more than 1.5 miles at its mouth. The stream fall from source to mouth is 555 feet, an average of 5.7 feet per mile. The fall in the lowermost 50 miles is about 265 feet or 5.3 feet per mile (Corps, 1973). At the confluence of Paint Creek and Rattlesnake Creek is the Paint Creek Lake. The lake was built by the Army Corps of Engineers for flood control, but also serves recreational purposes.

Background/reasons for implementing a management plan

The following were presented to the advisory group and community as reasons for writing and implementing a comprehensive management plan for Paint Creek Watershed.

Size/diversity of the watershed

Paint Creek Watershed covers over 731,000 acres and crosses multiple political boundaries. Additionally, the watershed may be divided into multiple subwatershed units each of which forms an independent drainage unit within the larger watershed. Depending on the topography of the area these units may be subdivided many times and each subwatershed will have slightly different chemical, physical and biological properties. In addition, many people reside in the watershed and activities such as agriculture, forestry, urban development, recreation, commerce and industry continue to grow and change.

Total Maximum Daily Loads (TMDLs). The advent of increasingly stringent enforcement of the Clean Water Act, is reflected in the introduction of TMDLs across the country. Ohio EPA recently began implementing their TMDL program and the Paint Creek Watershed is scheduled for evaluation in 2012-2013. The TMDL program establishes daily limits for a variety of pollutants, including sediment and nutrients, discharged to streams that do not meet water quality standards outlined in the Clean Water Act. This program currently only affects point source discharges though forestry, agriculture and development may be affected in the future.

Soil erosion. Soil erosion is one of the biggest problems in the watershed and the focus of most of the conservation practices implemented by both landowners and the Army Corps of Engineers. Most of the soil in South Central Ohio is depositional till resulting from the glacial activities. This soil is prone to erosion and there is erosion and erosion-related water quality problems throughout the watershed.

Water quality. In 1997, Ohio EPA surveyed much of the watershed to measure the chemical and biological properties of the waters. The 2000 305(b) report lists the Upper Paint Creek Watershed (North Fork and Rocky Fork) as meeting water quality standards in 35.5 percent of the watershed. Lower Paint Creek Watershed (Main Paint and Rattlesnake) met water quality standards in 75.6 percent of the watershed. In order to establish baseline water quality information and to measure the success of our water quality solutions, we may need to implement an additional sampling program.

Species diversity. The Paint Creek Watershed contains a rich array of plant and animal species. For example, a study completed in 1999 through Ohio State University found 104 species of fish inhabiting the Paint Creek Watershed. Some of the plant and animal species in the watershed include endangered, threatened, rare, intolerant, or species of special interest. The Ohio Department of Natural Resources' Heritage database lists 52 species of interest or concern in the watershed. These include 10 endangered species and 11 threatened species.

Invasive species. Invasive species are plants and animals that are not native to the area. Usually introduced by human activities, these species may have no natural biological controls. They may invade parts of the watershed and crowd out naturally

occurring species. Examples of invasive species found in the watershed include, garlic mustard, phragmites reed grass, and Japanese honeysuckle.

319 grants. Conservation practices funded through the Clean Water Act, section 319 grant program have been implemented throughout the watershed. One of the main purposes of the management plan is to look at information on soil erosion, water quality, and species diversity and concentrate conservation practices in the most sensitive areas of the watershed.

Local Conservation History

Agriculture is the main practice in the watershed and erosion has been the historic conservation concern. Land management and conservation studies began in the Paint Creek area in the early 1960's. Congress authorized a study of the Scioto River Basin, which led to the construction of the Paint Creek Lake in 1967 (Garringer). The lake is primarily for flood control, but the lands surrounding the lake provide wildlife habitat and recreational opportunities.

After heavy flooding in 1959 and 1960, the soil and water conservation districts in the Rattlesnake Creek watershed initiated the planning process to implement a project for flood control and land treatment. The initiative was eventually de-authorized but land managers recognized a need for local conservation practices.

In 1994, after continuous siltation problems in Paint Creek Lake, planning began for a new "Paint Creek Initiative" that would use Clean Water Act, section 319 grant monies to help introduce conservation projects throughout the watershed. This movement was inspired by activities taking place in the Darby Creek watershed which is partially located in Madison County. In 1995, a proposal was submitted to Ohio EPA requesting $300,000 to partially fund a land treatment program for the entire Paint Creek watershed (Garringer).

The proposal was originally rejected, but the soil and water conservation districts (SWCDs) in Fayette, Highland and Ross Counties worked closely with Ohio EPA to come up with a proposal that would be accepted. The new proposal included dividing the watershed into four management units based on the Main Paint, North Fork, Rattlesnake, and Rocky Fork Subwatersheds. In 1996, the SWCDs applied for and received 319 grant monies for the North Fork of Paint Creek Subwatershed. These monies were received in 1997, the same year that the SWCDs applied for and received 319 grants for Main Paint and Rattlesnake subwatersheds.

In December 1997, representatives from Fayette, Highland, Ross, Madison, Clinton and Greene counties met and formed a joint board of supervisors to oversee the spending of funds from the grant. In 1998, Julie Brown was hired by the joint board to act as watershed coordinator for the entire Paint Creek watershed. Julie meets with the joint board once every month.

The cost-share practices funded through the 319 grants largely focus on reducing erosion in the watershed. The first round of grants included grass waterways, equipment buy-downs, soil testing, lime applications, livestock exclusion fencing, streambank stabilization, heavy use feeding pads, tree and grass filter strips, deep tillage tool rental (North Fork only), manure management systems (North Fork only), and alternate watering sources (North Fork only). The 319 grant applications were given a score based on the proximity of the site to a stream, the size of stream, and the erodability index of the soil. Through this process land managers tried to implement conservation practices in areas of the watershed that were contributing the greatest amount of erosion.

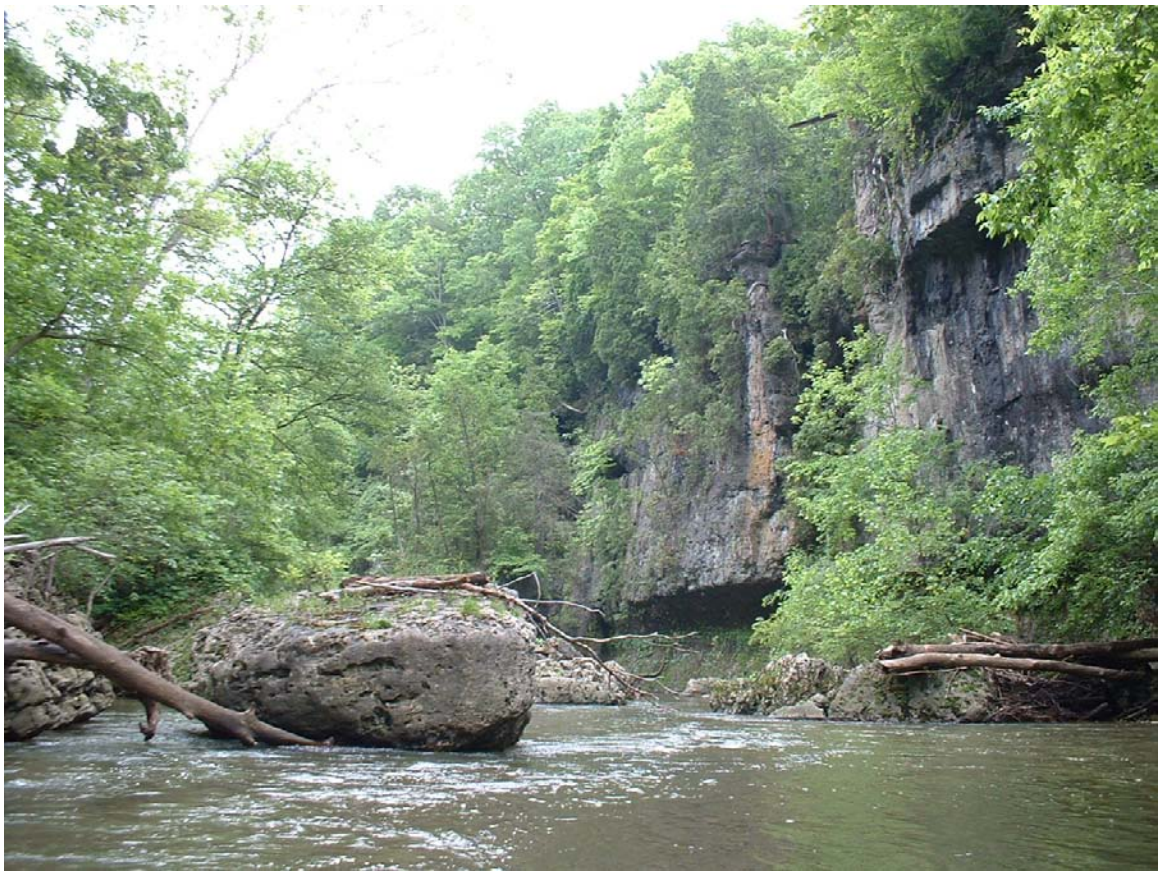
The 319 grants discussed above were three year grants and ended in June of 2001. The project reapplied and was awarded money for all three subwatersheds. Currently all of Paint Creek Watershed has 319 conservation grant money.

In January of 2000, Julie formed an advisory committee to help provide guidance with the watershed project. This group meets quarterly and discusses management issues pertaining to the management plan. These meetings often feature guest speakers who have conducted studies within the watershed. In 2000, the project wrote and was awarded an additional 319 planning grant to help fund a part-time position for a management plan coordinator. Hilary Solomon was hired in January of 2001 to help write the management plan for the Paint Creek Watershed.

In 2000, Julie was also awarded a grant, the aim of which was "getting GIS into the hands of the conservationist." She worked closely with the consulting firm Malcolm Pirnie to acquire spatial data that could be used to make maps describing the area. Through this project, an extensive catalogue of data was acquired, which will be useful in the future water shed planning.

Addendum to the Paint Creek Watershed Management Plan

This additional section of the management plan tries to include information specific to the lower half of Rattlesnake Creek. For watershed wide information including wildlife and soils, please see the draft copy of the Paint Creek Management Plan.



Picture courtesy of Anthony Sasson, The Nature Conservancy

The Rocky Fork of Paint Creek

The Paint Creek Watershed has already put together an extensive management plan that was submitted for review from the Ohio EPA in July of 2002. The original plan gave information on a larger scale, splitting the watershed into 4 sections: Main Paint, Rattlesnake, North Fork and Rocky Fork Creeks. The O hio EPA's suggestion after reviewing the document was to return with more detail. The project than choose their 3 priority areas and the upper section of Rattlesnake Creek was picked as one of these areas.

This section of Rocky Fork includes the entire 11-digit area, which is entirely in Highland County. This section includes only one major city and that is Hillsboro, the county seat for Highland.

Table 1

Watershed Name	Hydrologic Unit #	Counties	Drainage Area (acres)	Stream Miles
Paint Creek	05060003	Ross, Highland, Fayette, Greene, Clinton, Madison, Clark, Pickaway, Pike	731,161.9	1572.53 (total)
Rocky Fork	05060003 060	Highland	92163.7	234.11
Rocky Fork above South Fork of Rocky Fork	05060003 060 010	Highland	14082.2	30.72
South Fork of Rocky Fork	05060003 060 020	Highland	6622	18.52
Rocky Fork below South Fork to above Clear Creek	05060003 060 030	Highland	7239.7	21.1
Clear Creek	05060003 060 040	Highland	28967.3	74.37
Rocky Fork below Clear Creek to Rocky Fork Lake	05060003 060 050	Highland	15888.5	42.39
Rocky Fork below Lake to Paint Creek	05060003 060 060	Highland	19364	47.01

Picture courtesy of Anthony Sasson, The Nature Conservancy

Land Use

While the Paint Creek Watershed is a diverse watershed from the flat upper watershed to the rolling lower sections, the land uses in this smaller section are predominantly agriculturally based with a larger amount of forested acreage as compared with other sections of the watershed. The following table shows the land uses for the 8, 11 and 14 digit watersheds.

Table 2

Watershed Name	**Hydrologic Unit #**	Land use Type	Percent of Whole	Acreage
Paint Creek	05060003	Urban	.88	6466.3
		Agriculture/Open	76.89	562190.3
		Shrub/Scrub	2.22	16210.1
		Wooded	19.14	139931.6
		Open Water	.53	3871.5
		Non Forested Wetlands	.32	2308.2
		Barren	.03	183.9

Rocky Fork	05060003 060	Urban	.65	1049.72
		Agriculture/Open	64.68	59250.12
		Shrub/Scrub	2.33	2134.5
		Wooded	29.55	27087.54
		Open Water	2.29	2103.8
		Non Forested Wetlands	.47	431.86
		Barren	.04	33.76
Rocky Fork above South Fork of Rocky Fork	05060003 060 010	Urban	1.60	225.17
		Agriculture/Open	71.46	10062.85
		Shrub/Scrub	.20	28.42
		Wooded	26.31	3705.48
		Open Water	.22	30.73
		Non Forested Wetlands	.20	27.49
		Barren	.01	1.70
South Fork of Rocky Fork	05060003 060 020	Urban	.21	13.59
		Agriculture/Open	60.40	3999.69
		Shrub/Scrub	.29	19.46
		Wooded	38.94	2578.84
		Open Water	.07	4.94
		Non Forested Wetlands	.09	5.87
		Barren	0	0.00
Rocky Fork below South Fork to above Clear Creek	05060003 060 030	Urban	.53	38.14
		Agriculture/Open	61.76	4469.96
		Shrub/Scrub	.32	23.48
		Wooded	34.70	2511.35
		Open Water	1.78	128.80
		Non Forested Wetlands	.90	64.86
		Barren	.01	0.62
Clear Creek	05060003 060 040	Urban	1.56	
		Agriculture/Open	72.36	20961.22
		Shrub/Scrub	.26	75.52
		Wooded	24.79	7182.23
		Open Water	.56	160.93

		Non Forested Wetlands	.38	111.04
		Barren	.08	24.25
Rocky Fork below Clear Creek to Rocky Fork Lake	05060003 060 050	Urban	1.26	195.06
		Agriculture/Open	62.68	9728.80
		Shrub/Scrub	3.65	566.18
		Wooded	20.62	3200.00
		Open Water	11.08	1719.23
		Non Forested Wetlands	.69	106.72
		Barren	.03	4.63
Rocky Fork below Lake to Paint Creek	05060003 060 060	Urban	.61	119.69
		Agriculture/Open	51.17	10098.52
		Shrub/Scrub	7.20	1421.31
		Wooded	40.14	7920.45
		Open Water	.30	59.30
		Non Forested Wetlands	.56	111.35
		Barren	.02	3.55

Water Quality Issues in the Paint Creek Watershed

While it is assumed the bulk of the pollution problems in this section are from non-point source pollution, we will also cover the potential sources of point sources based on the National Pollutant Discharge Elimination Systems permits, Presence of combines sewer overflows, surface impoundments and data from fish kills.

Table 3-3: NPDES permits in Paint Creek Watershed.

TYPE	ID_NUMBER	NAME	SIC_CODE	DESCRIPTION	LOCATION
NPDES	OHL020389	City of Hillsboro	4952	sewerage systems	1488 N. High St., Hillsboro

Combined Sewer Overflows and Sanitary Sewer Overflows

Combined sewers are built to collect sanitary and industrial wastewater as well as storm water runoff and transport this combined wastewater to treatment facilities. When it rains, the volume of storm water and wastewater may exceed the capacity of the combined sewers or of the treatment plant, and a por tion of the combined wastewater may be allowed to overflow untreated into the nearest ditch, stream, river or lake. This is a combined sewer overflow, or

CSO. Ohio has about 1,600 known CSOs in 102 communities, ranging from small, rural villages to large metropolitan areas.

According to Sheree Gossett-Johnson, a member of the permitting and compliance unit with Ohio EPA's DSW, the Paint Creek Watershed does not contain any CSOs.

Another similar overflow is called a Sanitary Sewer Overflow (SSO). This type of system is designed to bypass the treatment plant when the wastewater load exceeds capacity. Most of these are being phased out in the watershed. One example is the Washington Court House WWTP, which has recently been upgraded (Gosset-Johnson, 2002).

Nonpoint Sources of Pollution

The term nonpoint source pollution (NPS) refers to water pollution that results from a variety of human land uses such as farming, development, logging, resource extraction, land disposal, livestock production and hydromodification. Nonpoint source pollution occurs when rain or snow melt drains over the land. The type of land use determines the type of pollutants that run off with the precipitant and eventually finds its way back to a stream, river or ground water table. As a product of weather patterns, nonpoint source discharges are naturally intermittent and occur more sporadically than point source discharges. Most are diffuse and difficult to quantify. Refer to the landuse/land cover map in the Watershed Inventory section of this plan for an overview of land use patterns in the Paint Creek Watershed.

Except for on-lot wastewater systems, nonpoint sources of pollution related to land use are discussed in great detail in the subwatershed water quality analysis later in this chapter. They are also outlined in Table 3-2, earlier in this section.

On-lot Wastewater Systems

By implementing House Bill 110 (HB110) in 1984, the Ohio General Assembly created Ohio EPA's HB110 program. The program is a contractual partnership between Local Health Districts (LHDs) and Ohio EPA, whereby LHDs conduct, on behalf of the Agency, inspection and enforcement services for commercial sanitary waste treatment/disposal systems discharging between 0-25,000 gallons per day (semi-publics). In addition, local health departments regulate residential on-lot systems such as septic systems.

The Paint Creek Project is currently working with the health departments in each of the nine counties containing portions of the watershed; Clinton, Greene, Fayette, Pickaway, Pike, Highland, Ross, Madison and Clarke. The Paint Creek Project hopes to collect information on the sewered versus unsewered areas in the watershed and areas where potential problems exist. This information will help promote the use of available finds to upgrade and maintain existing systems. One of the implementation goals for the watershed involves inspecting septic systems at regular intervals to ensure acceptable operation. Septic systems are a source of nutrients, organics and fecal coliforms.

HSTS information for Highland County and the Rocky Fork Region from the Highland County Health District HSTS plan

Summary of Unsewered and Sewered Areas, Highland County, Ohio

Governmental Unit	Population	Estimated # of Households served by HSTS
City of Hillsboro (part of)*	6,368	**0**
Remainder of Liberty Township	3,430	1319
Marshall Township	1,008	388
Paint Township (total)	4,112	82
Rocky Fork Lake, N. Shore (part of)*	3,900	**0**

Current and Potential Future Sewer Service Areas

Hillsboro, Greenfield, Leesburg, Lynchburg, and the Rocky Fork Lake region are served by centralized sewers in Highland County. In total, these facilities serve approximately 7,300 customers.

Identification of Critical Areas

For the purposes of the Highland County HSTS Plan, critical areas are defined as those areas where local conditions are particularly limiting to proper installation and function of HSTS, and where a high number of existing HSTS are known to be malfunctioning. These are also areas where there is no immediate plan or expectation of centralized sewer installation or extension.

Paint Creek Watershed: Community of Rainsboro, Community of Marshall, Greystone Subdivision (Woodland Drive), Rocky Fork Lake south

While the Health Dept. believes that there is a 10% failure rate in Highland County for on-site home sewage septic systems, we believe this number is higher in the Rocky Fork Watershed especillay in the Rocky Fork Lake Region. The northern half of the Lake was sewered several years ago but the southern half still relies on small systems. This area is dominated by trailer parks and small residences that were originally designed to be vacation homes but are now lived in year round.

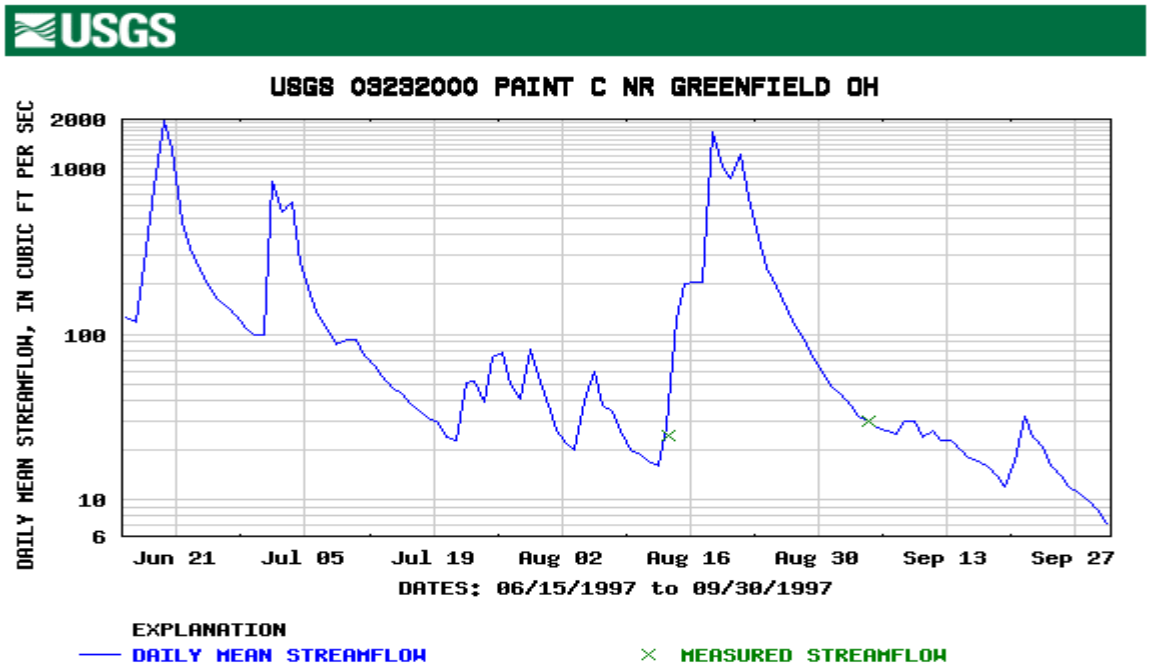
USGS Streamflow Data

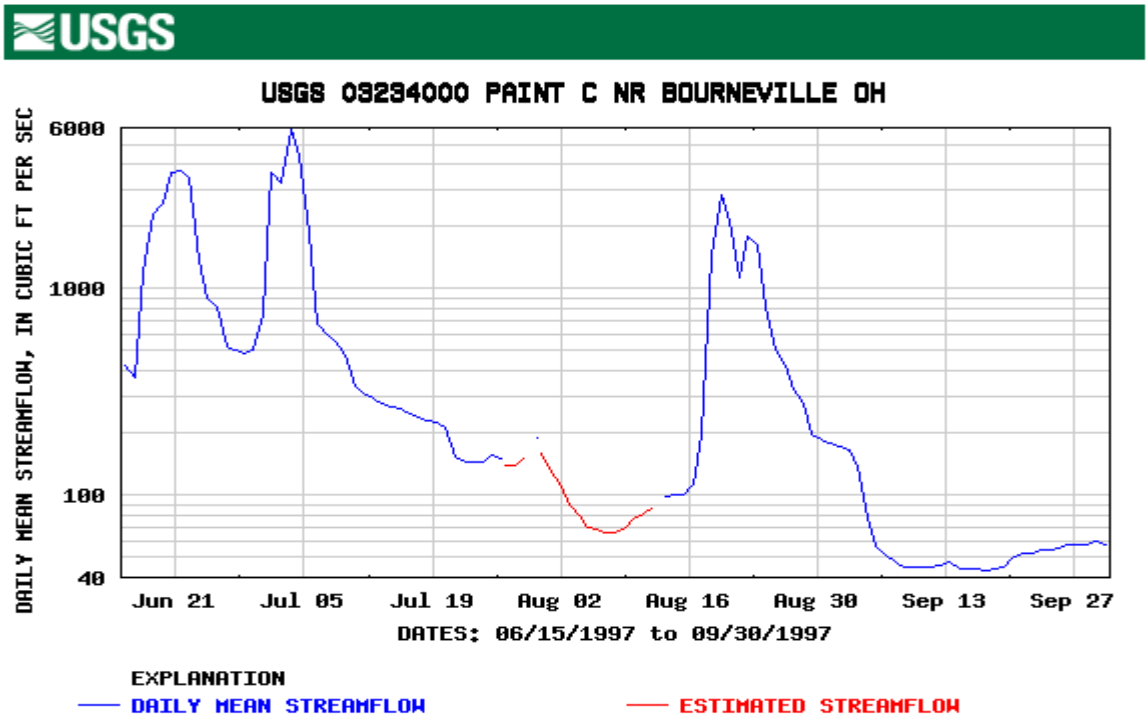
Streamflow data is an important component when characterizing the chemical water quality of a stream. Runoff from a rainfall event may carry sediment and nutrients causing high results in analytical tests. These high results may in turn signify that the buffering capacity of the stream during normal rainfall events is limited and that the channel has been modified or the riparian corridor is of poor quality. The following are streamflow results from the three USGS stream gages that collected data during the 1997 OEPA sampling period.

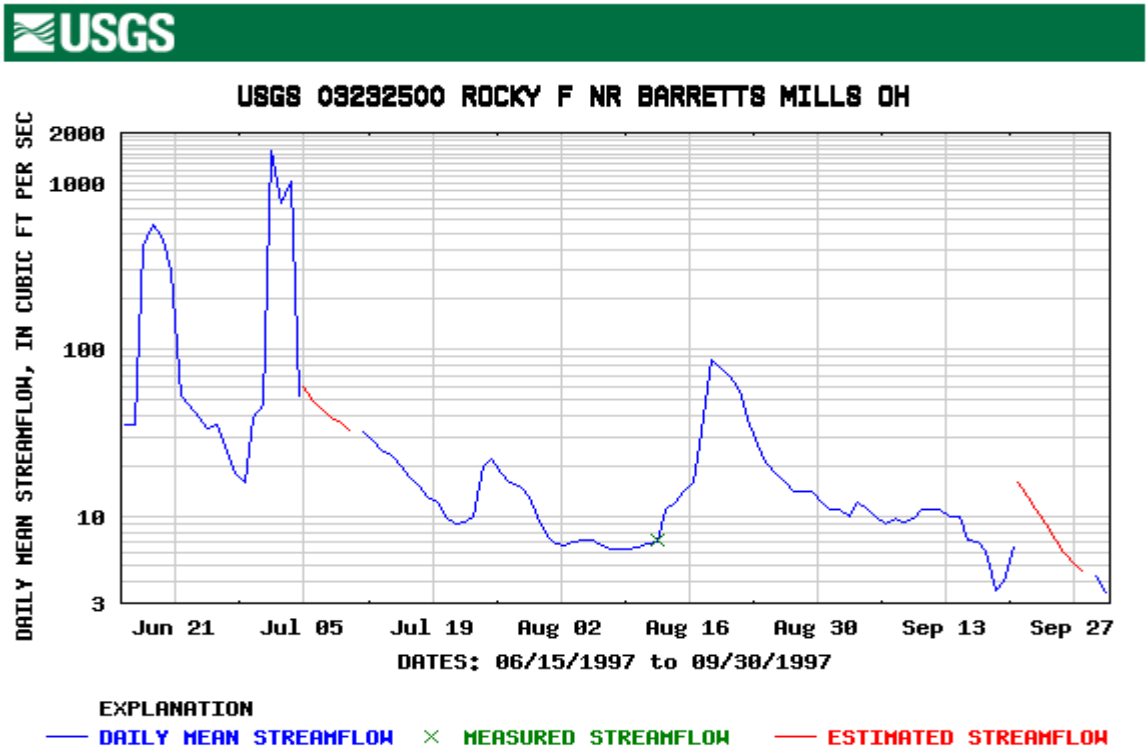
USGS data from Paint Creek near Greenfield indicates that streamflow peaked in June then drops through July. A smaller peak is seen in late July and then a large peak around the 20th of August. The same type of pattern is seen in at the USGS streamflow monitoring station in Paint Creek near Bourneville, except that the stream is much larger at this downstream gauging station and the peaks are much larger. There is some missing data from late July through early August. The USGS data from the monitoring gage on Rocky Fork at Barrett's Mill shows similar peaks in June and July, but a much-reduced peak in late August.

This data indicates that several rainfall events in June, July and August affected the streamflow in the entire watershed. Water quality monitoring information, collected in mid-July and mid-August potentially reflects conditions of the streams after rainfall events, while measurements from early August and early September represent normal low-flow conditions. This information should be taken into account when assessing the water quality of these streams.

Figure 3-1. USGS Streamflow tables (see next page)







303(d) Listed Streams

Based on water quality standards alone, several streams in the Paint Creek Watershed are listed as not historically meeting Clean Water Act criteria. These streams have been placed on a Federal list called a 303(d) list. They include Paint Creek, Sugar Creek, Rocky Fork, Clear Creek West Branch Rattlesnake Creek and lower Rattlesnake Creek. Please refer to the map entitled, *Paint Creek Watershed: US EPA 303(d) Listed Streams and Lakes*. In addition, Table 3-7 lists the information that is currently available from U.S. EPA on the listed stream segments in the Paint Creek Watershed. This information was some of the earliest information that the Paint Creek Project used to determine streams with water quality impairments. This information is scheduled to be updated every two years.

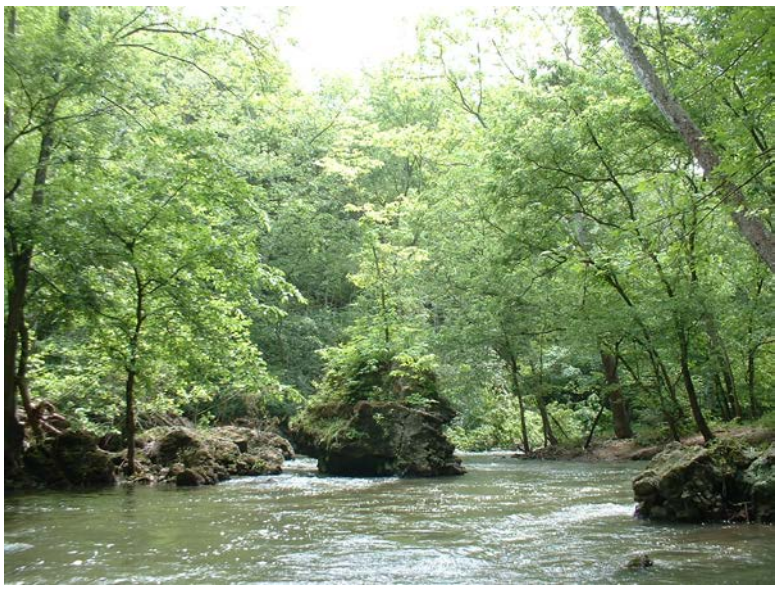
The last field survey in the Paint Creek Basin was conducted in 1997, and several streams including Rocky Fork, Clear Creek and Paint Creek may subsequently be removed from the 303(d) list. These streams, for the most part, met their designated standards. The next series of maps entitled, *Paint Creek Watershed: Monitoring Point Locations by Subwatershed*, *Paint Creek Watershed: Monitoring Points by River Mile*, and *Paint Creek Watershed: Water Quality by USGS 11- and 14-digit Subwatersheds*, illustrate where the watershed was sampled during the 1997 survey, the overall attainment of the streams at each monitoring point, and the inferred water quality throughout the watershed.

Table 3-7: Summary table of 303 (d) listed streams (please refer to water quality information by subwatershed for more information).

Waterbody River mile	Attainment	Documented WQ problems	Sources of problems
Clear Creek HW-5.2	Full-EWH		
Clear Creek 5.2-RFL	Partial-EWH	Habitat alteration	Hydromodification-agriculture, streambank destabilization-ag, natural
Clear Creek Moberly Branch	Partial-WWH	Cause unknown, flow alteration	Source unknown, urban runoff/stormwater, other urban runoff
Rocky Fork HW-RFL	Full-EWH		

Reference Stream Values by Ecoregion

Another way in which to judge the water quality of streams in the watershed is look at how their chemical measurements compare to those of other streams of similar sizes in other watersheds. In 1999, Ohio EPA compiled the measurements of hundreds of streams that represented the best water quality in the state and published a paper entitled, Association Between Nutrients, Habitat and the Aquatic Biota in Ohio Rivers and Streams. These streams were all grouped by ecoregion and their values averaged to generate a numeric representation of a reference or background condition. Numbers that represent the 75th, 95th and 99th percentiles were also generated. This study uses the



Picture courtesy of Anthony Sasson, The Nature Conservancy

75th percentile values as benchmarks against which to measure the water quality monitoring results from the 1997 Paint Creek Watershed data.

The Rocky Fork area is especially unique because all 3 of these ecoregions come together in this watershed. It is mainly located in the Eastern Cornbelt Plains (ECBP), but some areas fall within the Western Allegheny Plateau (WAP) and t he Interior Plateau (IP). Listed below is a brief description on these 3 ecoregions from the USEPA website.

55. EASTERN CORN BELT PLAINS

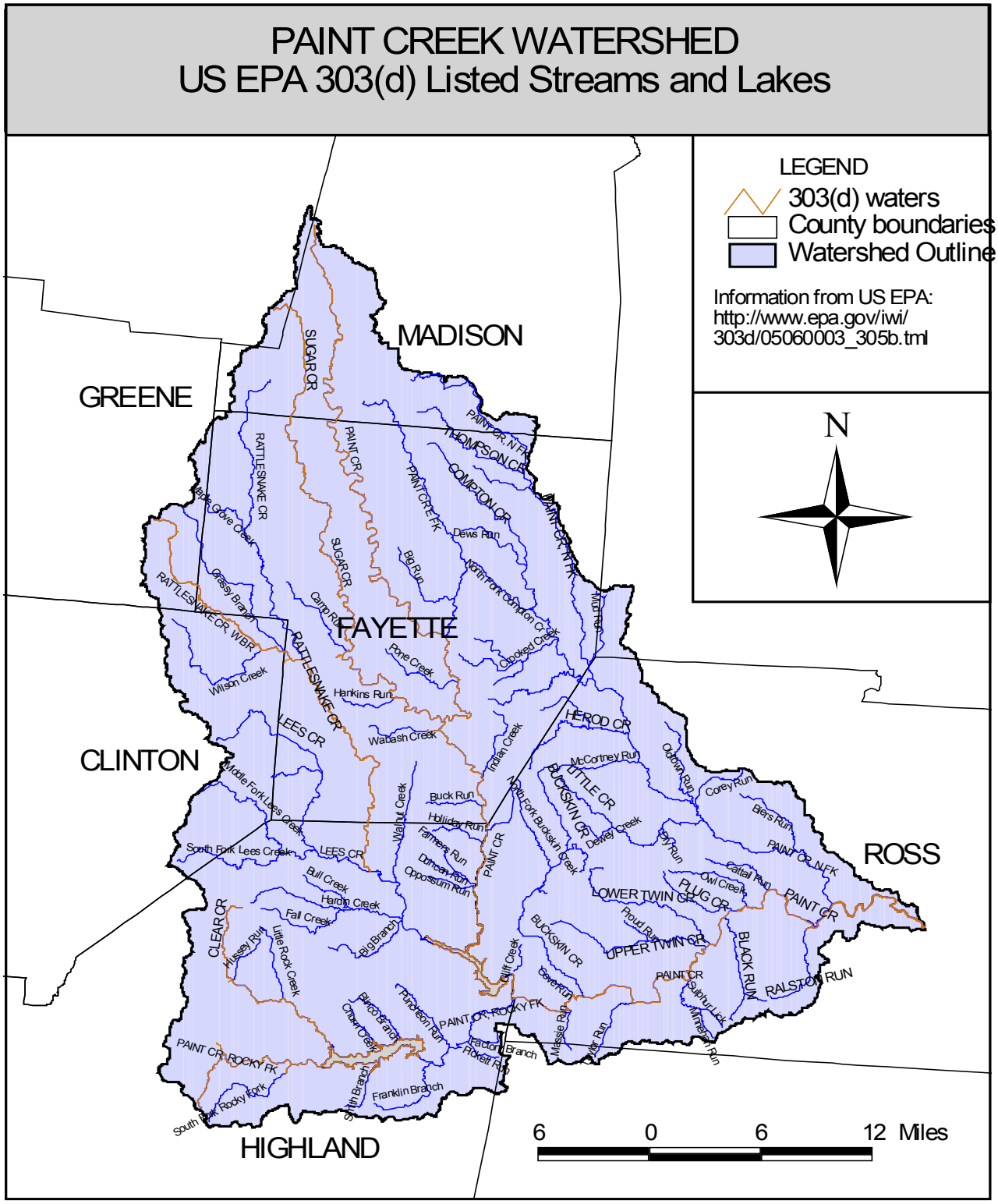
The Eastern Corn Belt Plains is primarily a rolling till plain with local end moraines; it had more natural tree cover and has lighter colored soils than the Central Corn Belt Plains (54). The region has loamier and better drained soils than the Huron/Erie Lake Plain (57), and richer soils than the Erie Drift Plain (61). Glacial deposits of Wisconsinan age are extensive. They are not as dissected nor as leached as the pre-Wisconsinan till which is restricted to the southern part of the region. Originally, beech forests were common on Wisconsinan soils while beech forests and elm-ash swamp forests dominated the wetter pre-Wisconsinan soils. Today, extensive corn, soybean, and livestock production occurs and has affected stream chemistry and turbidity.

70. WESTERN ALLEGHENY PLATEAU

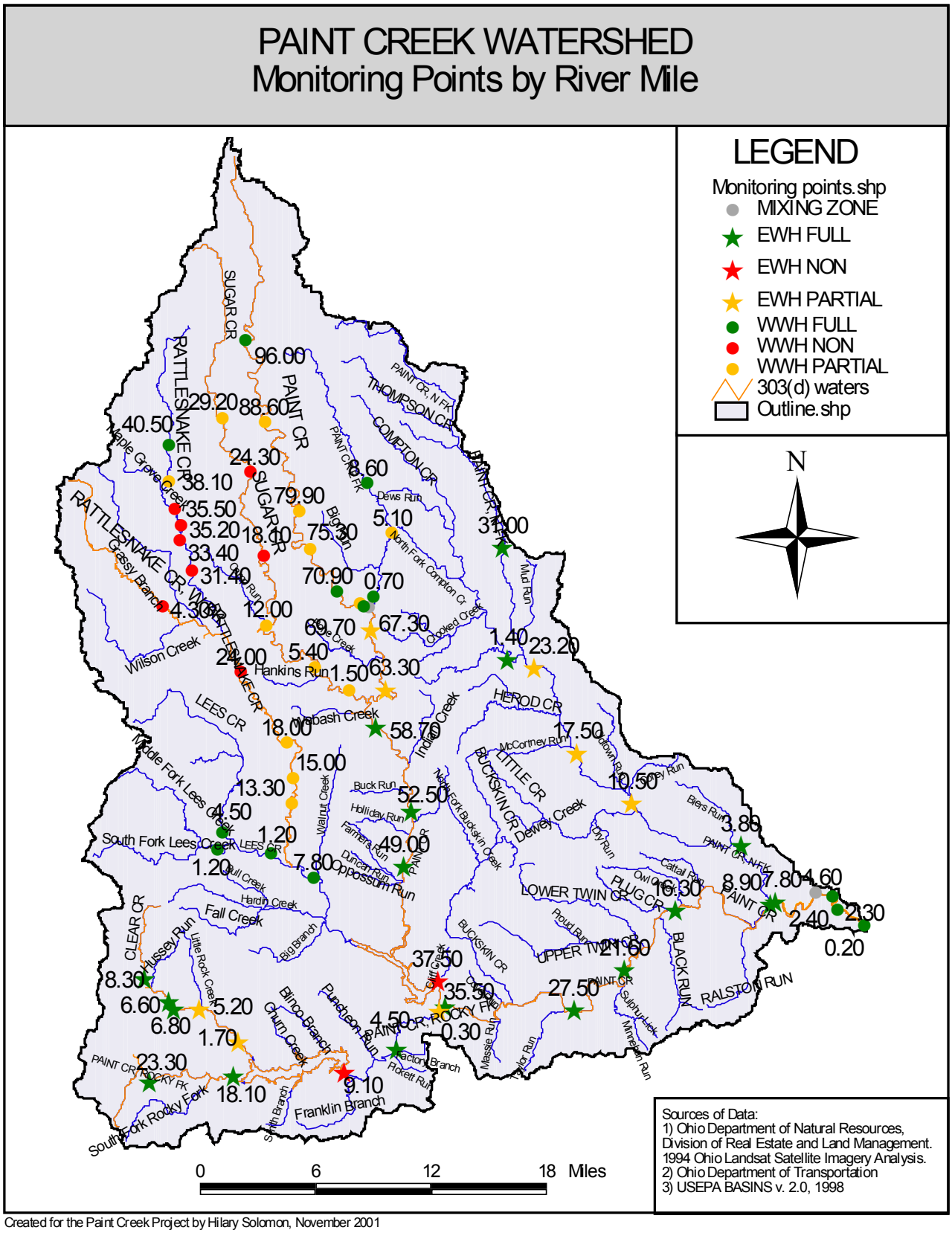
The hilly and wooded terrain of the Western Allegheny Plateau was not muted by glaciation and is more rugged than the agricultural till plains of Ecoregions 61 and 55 to the north and west, but is less rugged and not as forested as Ecoregion 69 to the east and south. Extensive mixed mesophytic forests and mixed oak forests originally grew in the Western Allegheny Plateau and, today, most of its rounded hills remain in forest; dairy, livestock, and general farms as well as residential developments are concentrated in the valleys. Horizontally-bedded sedimentary rock underlying the region has been mined for bituminous coal.

71. INTERIOR PLATEAU

The Interior Plateau is a diverse ecoregion extending from southern Indiana and Ohio to northern Alabama. Rock types are distinctly different from the coastal plain sediments and alluvial deposits to the west, and elevations are lower than the Appalachian ecoregions (66, 67, 68) to the east. Mississippian to Ordovician-age limestone, chert, sandstone, siltstone and shale compose the landforms of open hills, irregular plains, and tablelands. The natural vegetation is primarily oak-hickory forest, with some areas of bluestem prairie and cedar glades. The region has a diverse fish fauna.



Created by Hilary Solomon for the Paint Creek Project, September 2001



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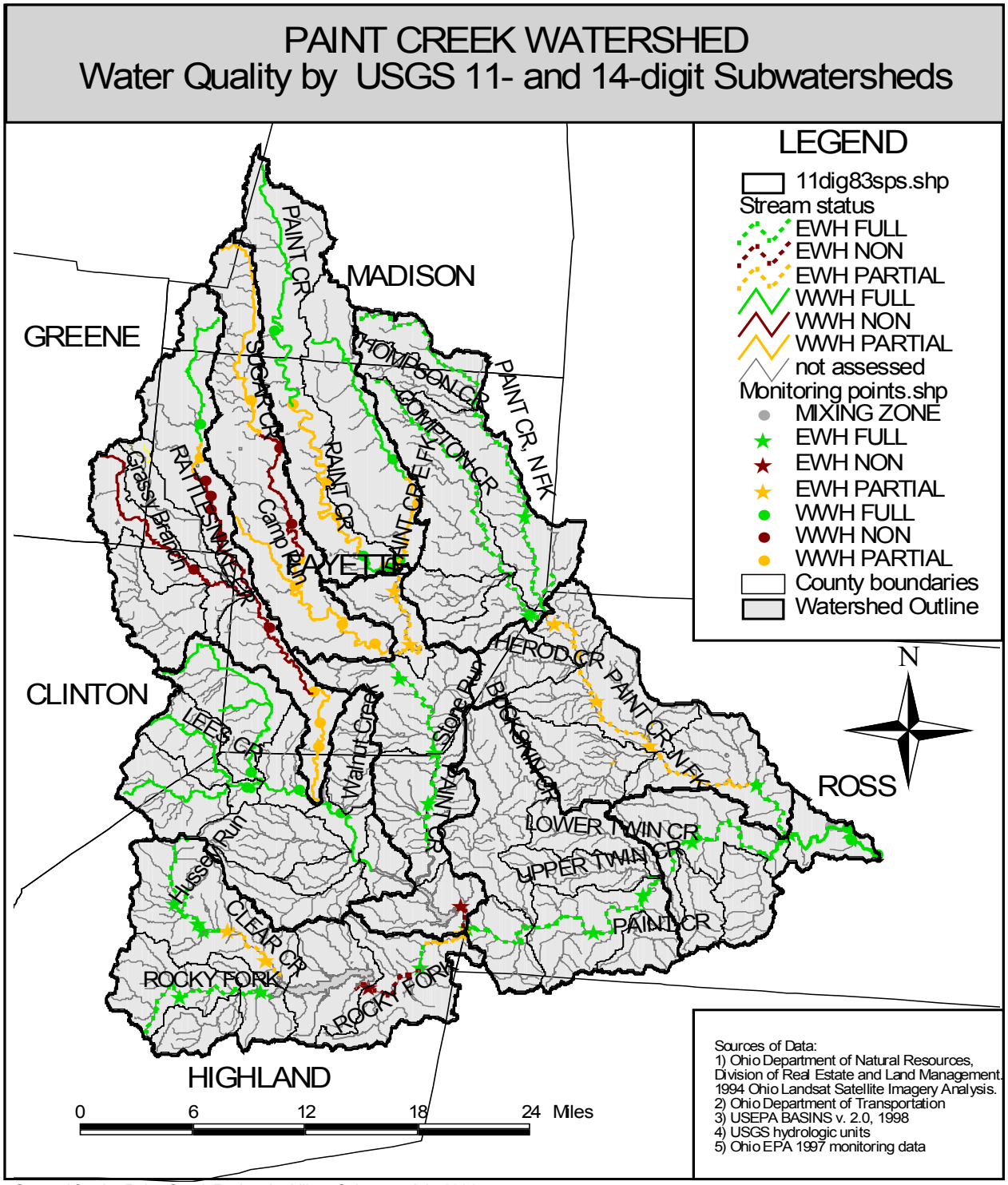

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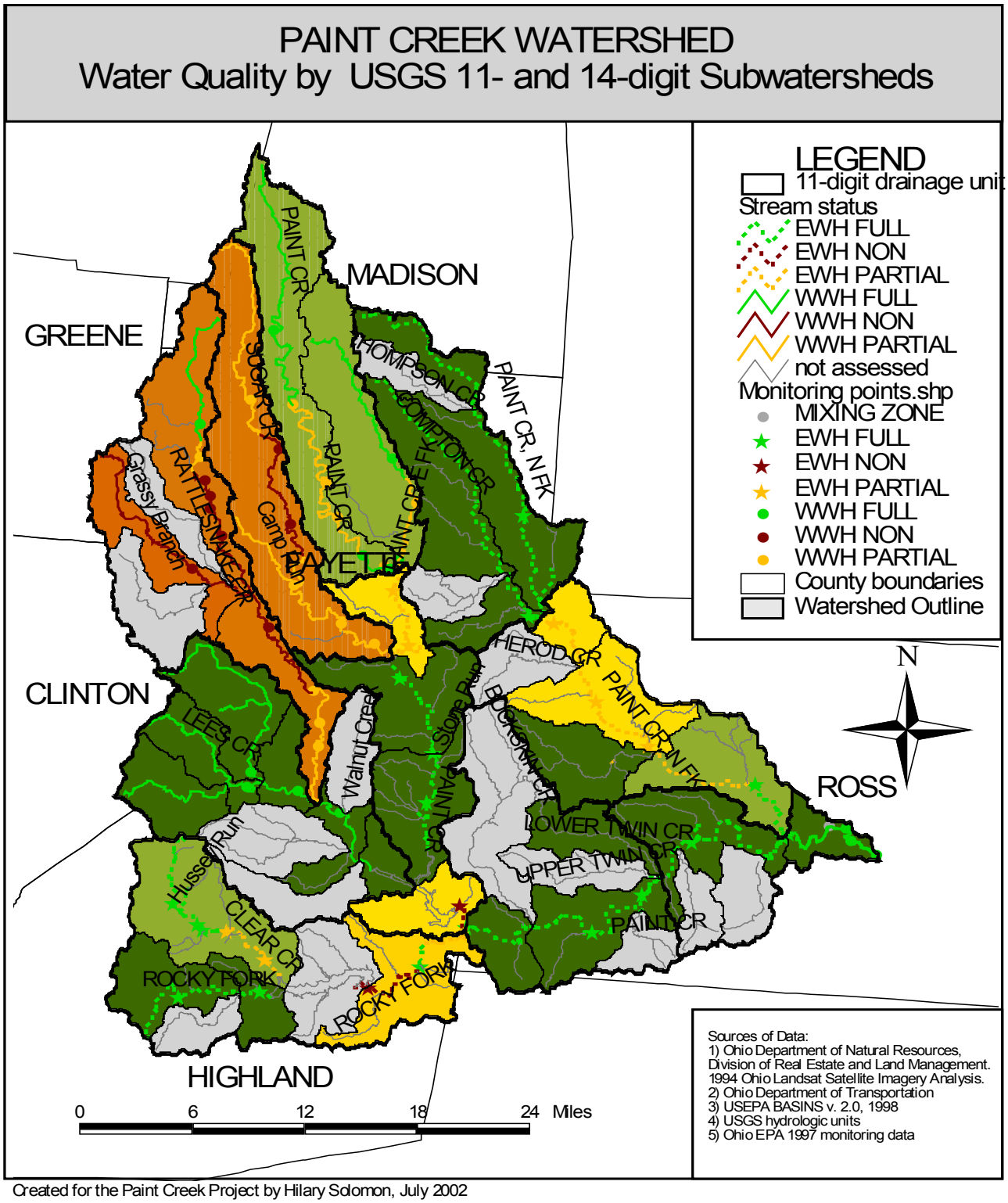

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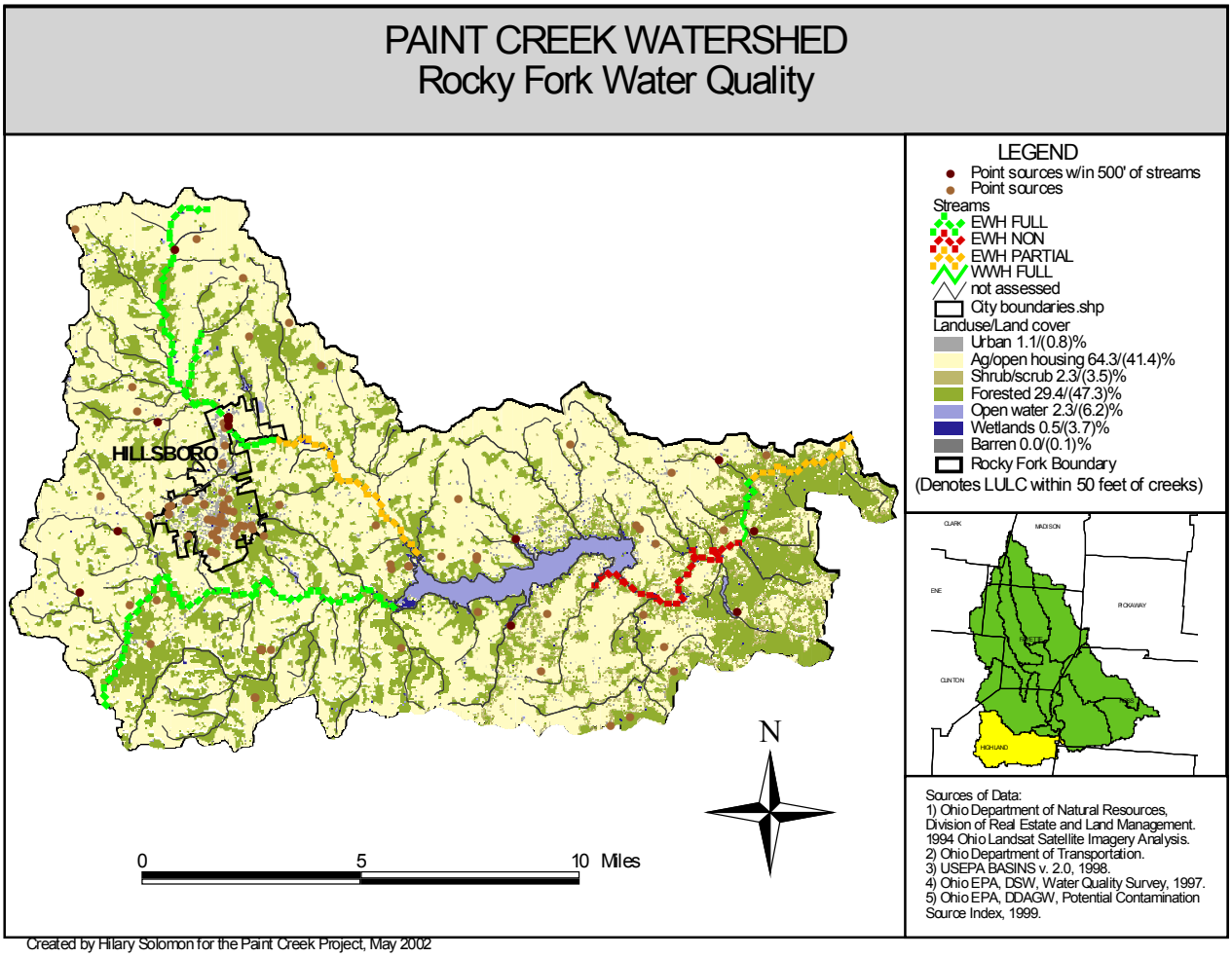


Picture courtesy of Anthony Sasson, The Nature Conservancy

Rocky Fork of Paint Creek Water Quality

During Ohio EPA's 1997 monitoring survey, Rocky Fork Creek was sampled in five locations. These locations are described in Table 3. In this section, Rocky Fork chemical data is compared to legal limits for parameters of concern, where they exist, and to reference stream chemical data for streams from the same Ecoregion and same size watershed.

Table 3-29. Rocky Fork of Paint Creek monitoring point locations

RIVER MILE	STREAM	LOCATION	ECO-REGION	W/S SIZE	HABITAT	ATTAINMENT
0.30	Rocky Fork Creek	The Point	IP	HW	EWH	Partial
4.50	Rocky Fork Creek	Barrets Mill	IP	W	EWH	Full
9.10	Rocky Fork Creek	Rocky Fork Lake Tailwaters	IP	W	EWH	Non
18.10	Rocky Fork Creek	Fettro Road	IP	W	EWH	Full
23.30	Rocky Fork Creek	US 62	IP	W	EWH	Full

*HW=Headwater, <20 miles^2 watershed area; W=Wadeable, ≥20 and <200 miles^2 watershed area; SR=Small River, ≥200 miles^2 watershed area and <2000 miles^2 watershed area; and LR=Large River, >1000 miles^2 watershed area.

Rocky Fork is located in the Interior Plateau Ecoregion (Vandermeer, 1997). It is characterized in the Ohio Administrative Code (OAC) 3745-1-09; Table 9-1, as excellent warmwater habitat (EWH) used as a state resource water (SRW), agricultural water supply (AWS), industrial water supply (IWS) and for primary contact recreation (PCR). Of the parameters described in this report; total suspended solids (TSS), fecal coliforms, nitrate/nitrite, total phosphorous and dissolved oxygen; only fecal coliforms and dissolved oxygen have water quality standards. Nitrate concentrations may be compared to maximum contaminant levels (MCLs) for drinking water. All parameters may be compared to Ohio reference stream data.

For primary contact waters fecal coliform concentrations (by geometric mean of at least five samples) must be less than 1000 bacteria per 100 mL of water, with no more than 10% of the samples over 2000 bacteria per 100 mL of water. Rocky Fork only exceeded 1000 per 100 mL of water at one monitoring point in August. Fecal coliform concentrations in Rocky Fork were generally very low in comparison with levels seen in the rest of the watershed.

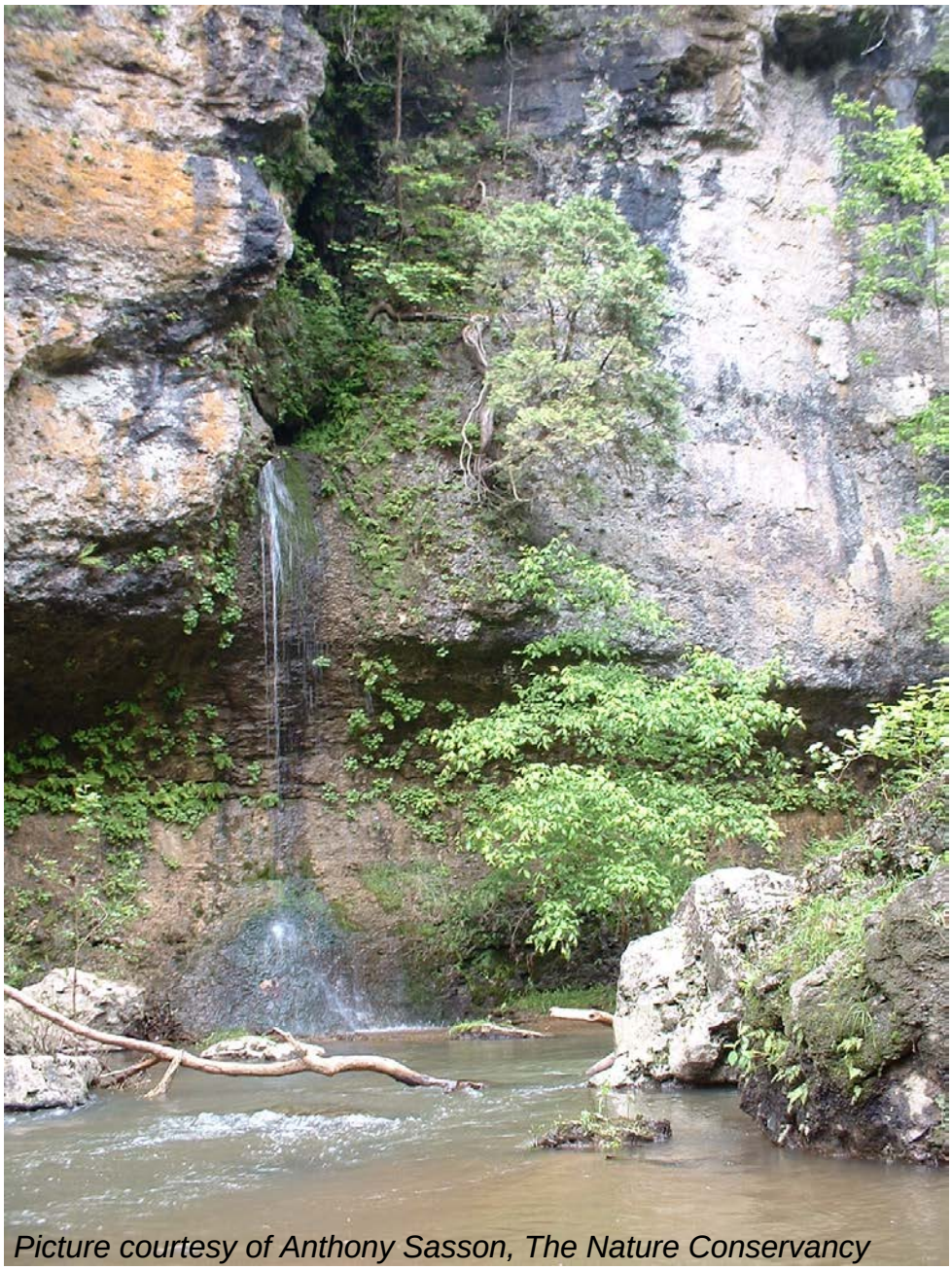
Dissolved oxygen concentrations were consistently below the minimum outlined in the water quality standards at the headwaters of Rocky Fork and the confluence with Paint Creek. Dissolved oxygen also dipped in the tailwaters of Rocky Fork Lake on September 9. This may be related to a lack of oxygen in the lake at this time. Nitrate levels did not exceed the legal maximums.

In comparison to similar size high quality reference streams located in the same ecoregion, Rocky Fork did not exceed 75th percentile average total suspended solids concentrations. Fecal coliforms slightly exceeded the wadeable average values (515 per 100 mL water) in several of the samples taken. Fecal coliform samples were only collected on three dates for Rocky Fork. Nitrate/nitrite level were excellent and well below the reference stream average values (0.57 mg/L). Dissolved oxygen

concentrations were either low, around 5 mg/L, or fairly high with a maximum of 30 mg/L. Again, they appeared low in the headwaters, outfall and at the confluence with Paint creek. Nutrient levels in the stream were very low.

Overall Rocky Fork has very good water quality. Fecal coliform concentrations were slightly elevated throughout the stream and d issolved oxygen concentrations fluctuated greatly, however the stream showed low levels of nutrients and suspended solids. Potential threats to water quality include increasing development pressure in the region, agricultural runoff, and the effluent from the Hillsboro WWTP, which enters from Clear Creek. Sediments from Clear Creek are also a threat. Currently, Rocky Fork meets all of its EWH criteria.

Please see the Rocky Fork of Paint Creek water quality data tables on the following page for site- specific water quality information.



Picture courtesy of Anthony Sasson, The Nature Conservancy

Rocky Fork Water Quality Tables*

Total Suspended Solids

River Mile	8-Jul-97	22-Jul-97	5-Aug-97	19-Aug-97	9-Sep-97	23-Sep-97	AVG	MAX	Reference
23.27	5	5	5	14	5	5	6.5	14	25
18.05	11	15	9	30	11	8	14	30	41.25
9.15	12	10	9	8	5	11	9.17	12	41.25
4.45	11	8	8	12	5	11	9.17	12	41.25
0.2	6	5	5	13	14	10	8.83	14	41.25

Fecal Coliform

River Mile	8-Jul-97	22-Jul-97	5-Aug-97	19-Aug-97	9-Sep-97	23-Sep-97	AVG	MAX	Reference
23.27			100	460	140		233.33	460	515
18.05			280	**1200**	160		546.67	1200	515
9.15			30	20	170		73.33	170	515
4.45			140	**530**	140		270	530	515
0.2			110	**580**	60		250	580	515

Nitrate/nitrite

River Mile	8-Jul-97	22-Jul-97	5-Aug-97	19-Aug-97	9-Sep-97	23-Sep-97	AVG	MAX	Reference
23.27	0.65	0.61	0.48	0.56	0.41	0.28	0.498	0.65	1.2
18.05	**0.58**	0.39	0.3	0.45	0.13	0.26	0.352	0.58	0.57
9.15	0.1	0.11	0.19	0.1	0.1	0.24	0.14	0.24	0.57
4.45	0.24	0.42	0.27	0.12	0.5	0.44	0.332	0.5	0.57
0.2	0.37	0.42	0.4	0.23	0.43	0.34	0.365	0.43	0.57

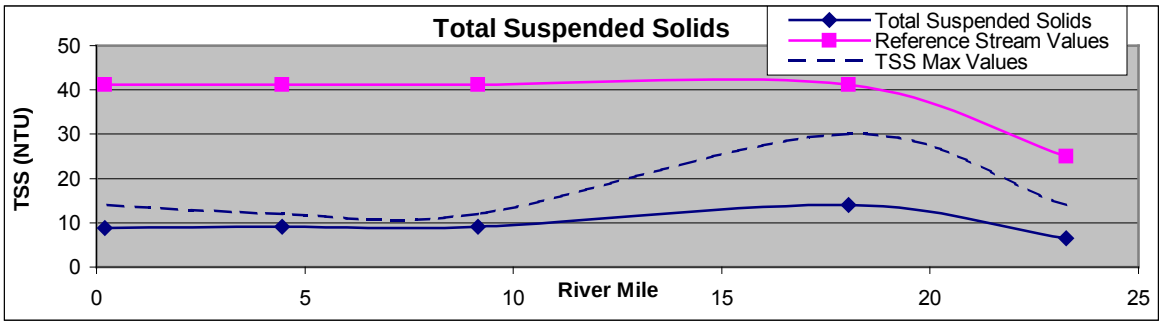
Phosphorous

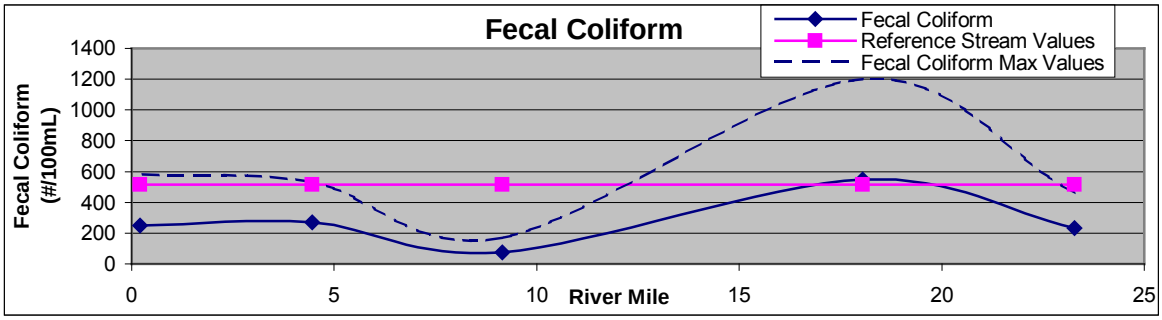
River Mile	8-Jul-97	22-Jul-97	5-Aug-97	19-Aug-97	9-Sep-97	23-Sep-97	AVG	MAX	Reference
23.27	0.05	0.05	**1.19**	0.16	0.05	0.05	0.258	1.19	0.205
18.05	0.05	0.07	**0.16**	0.05	0.05	0.05	0.072	0.16	0.13
9.15	0.05	0.05	0.08	0.06	0.05	0.13	0.07	0.13	0.13
4.45	0.13	0.14	0.07	0.05	0.05	0.05	0.082	0.14	0.13
0.2	0.7	0.05	0.08	0.12	0.06	0.05	0.177	0.7	0.13

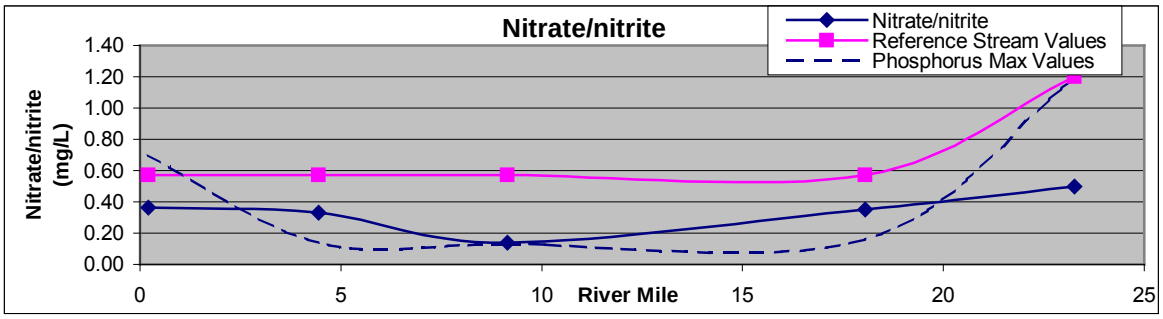
Dissolved Oxygen

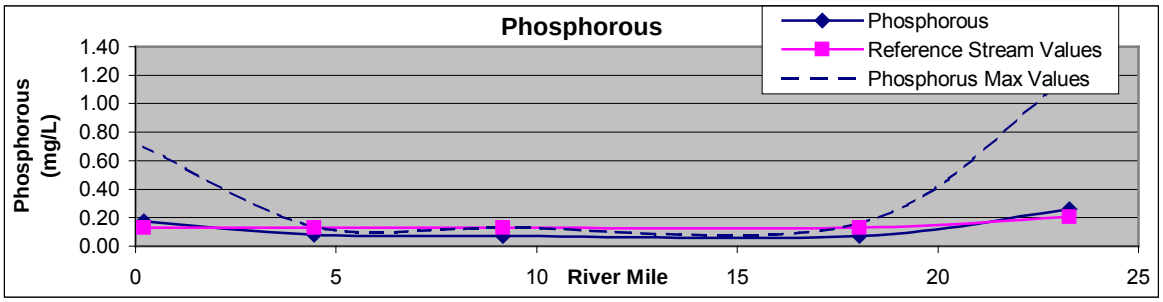
River Mile	8-Jul-97	22-Jul-97	5-Aug-97	19-Aug-97	9-Sep-97	23-Sep-97	AVG	MIN	Reference
23.27	**5**	**5**	**5**	14	**5**	**5**	6.5	5	7.7
18.05	11	15	9	30	11	8	14	8	6.6
9.15	12	10	9	8	**5**	11	9.2	5	6.6
4.45	11	8	8	12	**5**	11	9.2	5	6.6
0.2	**6**	**5**	**5**	13	14	10	8.8	5	6.6

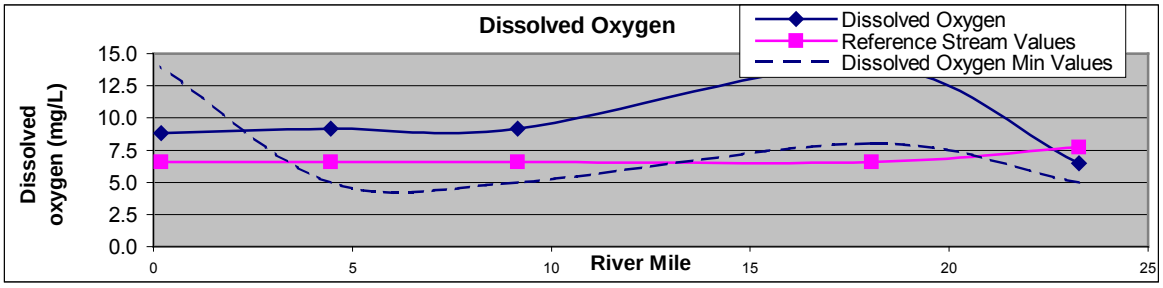
Bolded values are above (or below in the case of dissolved oxygen) associated reference stream 75th percentile concentrations.


Total Suspended Solids
Total Suspended Solids
Reference Stream Values
TSS Max Values
TSS (NTU)
50
40
30
20
10
0
0
5
10
River Mile
15
20
25


Fecal Coliform
Fecal Coliform
Reference Stream Values
Fecal Coliform Max Values
Fecal Coliform (#/100mL)
1400
1200
1000
800
600
400
200
0
0
5
10
River Mile
15
20
25


Nitrate/nitrite
Nitrate/nitrite
Reference Stream Values
Phosphorus Max Values
Nitrate/nitrite (mg/L)
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0
5
10
River Mile
15
20
25


Phosphorous
Phosphorous
Reference Stream Values
Phosphorus Max Values
Phosphorous (mg/L)
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0
5
10
River Mile
15
20
25


Dissolved Oxygen
Dissolved Oxygen
Reference Stream Values
Dissolved Oxygen Min Values
Dissolved oxygen (mg/L)
15.0
12.5
10.0
7.5
5.0
2.5
0.0
0
5
10
River Mile
15
20
25

Qualitative Habitat Evaluation Index (QHEI)

Photo courtesy of Anthony Sasson of The Nature Conservancy

The QHEI is a measure of the presence and quality of physical habitat components that support aquatic life. 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 habitat characteristics that are used to determine the QHEI score include substrate, instream cover, channel morphology, riparian vegetation and bank erosion, gradient, and flow patterns (pool, run and riffle development). The QHEI score ranges from 20 to less than 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 sites around the state (OEPA, 2002, Bokes TMDL) 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 having the ability to support exceptional warmwater faunas. The QHEI can be used to direct restoration efforts for habitat and to provide a monitoring tool to measure progress toward habitat goals.

Rocky Fork QHEI scores from Ohio EPA's 1997 watershed survey ranged from 66.5 to 77.5. While only one score was over the EWH target of 75, the other three scores were close. At river mile 23.3, the presence of silt in the water and channel embeddedness combined with narrow, and in some places nonexistent, riparian in the headwaters and tributaries lowered the score. Downstream of the Rocky Fork Lake outfall (RM 9.1) silt and embeddedness are normal and the riparian is comprised of wide, mature forested areas. The instream cover is sparse, however, due to scouring and variable outfall from the dam. Downstream of Barrett's mill (RM 4.5), there is evidence of silt loading and channel embeddedness with sparse instream cover. The riparian corridor in this area is adequate, however. At The Point (RM 0.1) the sediments begin to drop out of the water column and build up in the channel. Instream and riparian habitat is moderate. The QHEI indices for Rocky Fork indicate that sediment, instream cover and riparian areas need to be addressed.

Table 3-30. Rocky Fork QHEI scores and habitat component quality

River Mile	Location	QHEI	Comments
23.3	U.S. 62 (RR site)	66.5	• **Substrate**: sand, gravel, cobble, boulder, bedrock and slabs, moderate silt and embeddedness • **Instream cover**: moderate • **Channel morphology**: moderate sinuosity, good development, no channelization, moderate stability • **Riparian zone**: narrow riparian, with little bank erosion • **Flood Plain**: residential
18.1	Fettro Road (RR site)		• No information
9.1	Rocky Fork Lake tailwaters	71.5	• **Substrate**: cobble, boulder, slabs, bedrock, sand and gravel (coarse native and glacial till) with normal silt and embeddedness • **Instream cover**: sparse to moderate • **Channel morphology**: no channelization, low sinuosity and high stability • **Riparian zone**: wide, mature riparian, little or no bank erosion • **Flood Plain**: row crop and forest
4.5	Downstream Barrets Mill	70.0	• **Substrate**: boulder, slabs, cobble, sand, bedrock and gravel with normal-moderate silt and moderate embeddedness • **Instream cover**: sparse to moderate • **Channel morphology**: typical bedrock system, wide and shallow except for a few pools • **Riparian zone**: narrow 5-10m on the left bank, wide on the right >50m, little to no bank erosion • **Flood Plain**: row crop
0.1	The Point	77.5	• **Substrate**: sand, gravel, cobble, boulder, bedrock, normal silt but moderately to extensively embedded • **Instream cover**: moderate • **Channel morphology**: low sinuosity, fair to good development, no channelization, high stability • **Riparian zone**: narrow to moderate riparian, with little bank erosion • **Flood Plain**: row crop

Nonpoint Sources of Pollution

Nonpoint sources of pollution include the following associated problems: siltation, nutrients, low dissolved oxygen, habitat alteration, and organic enrichment. Habitat alteration may include channelization, which creates a lack of riparian and in-stream physical habitat. Landuse and land cover within the subwatershed is a good indicator of potential sources of pollution. The main land uses in the Rocky Fork subwatershed are agricultural/open housing (64.3%) and forested (29.4%). Within 50 feet of the creeks, the landuse is predominantly forested (47.3%) with only 38.5% agriculture/open housing.

It is apparent from the landuse statistics listed below that the majority of the nonpoint source pollution in this subwatershed will be related to agricultural, open residential and logging/forestry operations. Agriculture is commonly associated with sedimentation, nutrient enrichment, organic loading, and channel modification. If livestock pasturing along the creek is involved, fecal coliforms and bank destabilization may also be present. Open residential may be associated with nutrients and fecal coliforms from lawn care and failing septic systems. During the development stage, sedimentation is also usually a problem. Forestry, like agriculture, is associated with sedimentation and canopy removal near the stream banks.

Nonpoint sources in the subwatershed are not limited to rural activities. Urban areas, such as Hillsboro, also contribute nonpoint pollutants from storm water runoff and development. Urban areas, with high percentages impervious surfaces are also associated with increased creek flow rates after storms due to runoff passing over pavement and quickly reaching the creek. Rainfall no longer infiltrates soil and recharges the groundwater so that there are diminished low flows in streams as well. This repetitive cycle of repeated high stream flow directly after storms followed by extremely low flows is called “flashiness.”

Table 3-31. Landuse and Land Cover in Rocky Fork Creek Subwatershed

Landuse/land cover category	Percent in Rocky Fork Creek subwatershed	Percent w/in 50 meters of creek and tributaries	Percent w/in 50 feet of creek and tributaries
Urban	1.1	0.7	0.7
Agricultural or open housing	64.3	41.4	38.5
Shrub/scrub	2.3	3.3	3.5
Forested	29.4	45.9	47.3
Open water	2.3	5.8	6.2
Wetlands	0.5	2.8	3.7
Barren	0.0	0.0	0.1

Point sources within 500 feet of Rocky Fork and Clear Creek

Another component of this study, related to landuse, includes the point sources found within the vicinity of the creeks. Point sources include inputs from National Pollution Discharge Elimination Sytems (NPDES) permitted sites such as WWTP. Rocky Fork and its tributaries have very few point sources. Ohio DNR has an NPDES permit that discharges to Rocky Fork and several companies have surface impoundments or wastewater treatment ponds that may discharge during storm events. These sites include B&B Plating in Hillsboro, the Highland County Water Company, Inc. and Ervin Parshall.

Other potential sources of contamination include underground storage tanks, hazardous waste generators, cemeteries and others.

Problem statement

Except for a short reach of creek below the Rocky Fork Lake dam, Rocky Fork attains its use designation throughout the subwatershed. The chemistry reflects overall good water quality, with most measurements below reference stream 75th percentile values. (Fecal coliforms, phosphorus and dissolved oxygen slightly exceeded reference values, which may indicate that the water quality is threatened.) The loss of attainment downstream of the dam may be attributed to (hypolimnetic) releases from the bottom anoxic lake waters. In addition destabilization of the channel below the dam was attributed to highly variable releases of lake water. Habitat scores were fairly high overall, but showed sedimentation and lack of forested riparian corridor as threats to water quality. The main nonpoint sources appear to be agricultural landuse, with 64% of the subwatershed categorized as agriculture/open housing. One of the main reasons that Rocky Fork attains its use designation throughout most of the creek may be due to the prevalence of forested area when compared to the upper 2/3 of the Paint Creek Watershed. Within 50 feet of the creek the landuse was 47% forested. This is second only to the lower reaches of Paint Creek, which are 51% forested. There are no major point sources, such as WWTP on Rocky Fork Creek, however inputs from the Hillsboro WWTP on Clear Creek should be monitored.

Clear Creek Water Quality

During Ohio EPA's 1997 monitoring survey, Clear Creek was sampled in five locations. These locations are described in Table 3-32. In this subsection, Creek chemical data is compared to legal limits for parameters of concern, where they exist, and to reference stream chemical data for streams from the same Ecoregion and same size watershed.

Table 3-32: Clear Creek monitoring point locations

RIVER MILE	STREAM	LOCATION	ECO-REGION	SIZE	HABITAT	ATTAINMENT
1.70	Clear Creek	Lilly Rd.	IP	W	EWH	Partial
5.20	Clear Creek	Selph Rd.	ECBP	W	EWH	Partial
6.60	Clear Creek	Dst. Hillsboro WWTP	ECBP	W	EWH	Full
6.80	Clear Creek	Ust. Hillsboro WWTP	ECBP	W	EWH	Full
8.30	Clear Creek	Reg. Reference Site	ECBP	HW	EWH	Full

HW = <20miles^2 drainage area, W = ≥20 miles^2 and less than 200 miles^2 drainage area.

Except for the last 3 miles, Clear Creek is located in the Eastern Corn Belt Plains Ecoregion (Vandermeer, 1997). It is characterized in the Ohio Administrative Code (OAC) 3745-1-09; Table 9-1, as excellent warmwater habitat (EWH) used for (SRW) agricultural water supply (AWS), industrial water supply (IWS) and primary contact recreation (PCR). Of the parameters described in this report; total suspended solids (TSS), fecal coliforms, nitrate/nitrite, total phosphorous and dissolved oxygen; only fecal coliforms and dissolved oxygen have water quality standards. Nitrate concentrations may be compared to maximum contaminant levels (MCLs) for drinking water.

For primary contact waters fecal coliform concentrations (by geometric mean of at least five samples) must be less than 1000 bacteria per 100 mL of water, with no more than 10% of the samples over 2000 bacteria per 100 mL of water. With measurements of 5900 and 3400 bacteria per 100 mL of water on August 16, 1997, and 6800, 2600, 2800, 2500 and 2400 bacteria per 100 mL of water on August 19, 1997, fecal coliform concentrations in Clear Creek exceed these legal limits at most of the monitoring sites on two of the four sample dates. Dissolved oxygen concentrations above 6.0 mg/L met the water quality standards and nitrate levels did not exceed the MCL.

In comparison to high quality reference streams located in the same ecoregions, Clear Creek exceeded average total suspended solids concentrations (29 mg/L) at all monitoring points on August 19. The suspended solids concentrations were extremely high at the confluence with the lake, 562 NTU. Fecal coliforms exceeded the wadeable creek average values (860 per 100 mL water for ECBP) (or wadeable values for IP, 515 per 100 mL) for nearly every measurement. Nitrate/nitrite concentrations (2.815 mg/L ECBP) were consistently below the wadeable creek average values. Dissolved oxygen was only measured twice, both times in July. The oxygen concentrations in the latter half of the month were slightly lower than those in early July. Several of the monitoring locations dipped slightly below the large river average values. Phosphorous concentrations were elevated near the Hillsboro WWTP.

High levels of fecal coliform, sediment and phosphorous affected Clear Creek water quality. Not only did the stream not meet reference stream values for these parameters, but it only partially met excellent warmwater chemical and biological criteria at the river mile 1.7 and 5.2 monitoring sites. Both the Hillsboro WWTP and agricultural landuse are potential causes of water quality degradation in the Clear Creek basin.

Please see the Clear Creek water quality data tables for site- specific water quality information.

Clear Creek Water Quality Data

Total Suspended Solids

River Mile	08-Jul-97	23-Jul-97	06-Aug-97	19-Aug-97	11-Sep-97	24-Sep-97	MAX	AVG	Reference
8.2	5	5	5	**16**	5	8	16	7.3	14
6.8	5	5	5	**24**	5	8	24	8.7	29
6.73	5	5	5	5	5	5	5	5.0	29
6.6	5	5	5	19	5	5	19	7.3	29
5.45	5	5	5	24	8	6	24	8.8	29
1.65	25	12	6	**562**	10	6	562	103.5	41.25

Fecal Coliform

River Mile	08-Jul-97	23-Jul-97	06-Aug-97	19-Aug-97	11-Sep-97	24-Sep-97	MAX	AVG	Reference
8.2			290	**6800**	210	80	6800	1845	960
6.8			400	**2600**	600	45	2600	911	860
6.73			**5900**	**2800**	270		5900	2990	860
6.6			**3400**	**2500**	680	580	3400	1790	860
5.45			180	**2400**	530		2400	1037	860
1.65			100	**700**	230		700	343	515

Nitrite/nitrate

River Mile	08-Jul-97	23-Jul-97	06-Aug-97	19-Aug-97	11-Sep-97	24-Sep-97	MAX	AVG	Reference
8.2	1.59	1.56	1.56	0.86	1.03	1.18	1.59	1.30	2.268
6.8	1.14	0.86	0.61	0.69	0.67	0.1	1.14	0.68	2.815
6.73	1.33	1.51	1.49	1.02	2.44	1.88	2.44	1.61	2.815
6.6	1.15	1.06	0.98	0.76	1.61	1.04	1.61	1.10	2.815
5.45	1.15	0.83	0.54	0.67	2	0.98	2	1.03	2.815
1.65	1.6		0.56	0.75	0.77	0.45	1.6	0.83	0.57

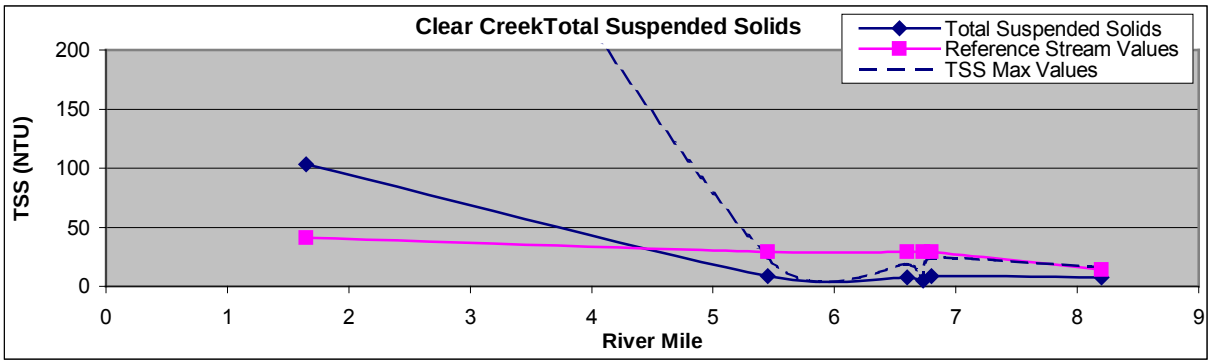
Phosphorus

River Mile	08-Jul-97	23-Jul-97	06-Aug-97	19-Aug-97	11-Sep-97	24-Sep-97	MAX	AVG	Reference
8.2	0.05	0.05	0.08	**0.11**	**0.9**	0.05	0.9	0.21	0.08
6.8	0.13	0.05	0.06	**0.18**	**0.27**	0.07	0.27	0.13	0.13
6.73	0.4	**1.17**	**0.85**	**0.14**	**0.56**	**0.21**	1.17	0.56	0.13
6.6	**0.14**	**0.38**	**0.72**	**0.24**	**0.68**	0.13	0.72	0.38	0.13
5.45	**0.22**	**0.26**	**0.18**	**0.2**	**0.82**	0.05	0.82	0.29	0.13
1.65	0.05		**0.17**	0.09	**0.74**	0.05	0.74	0.22	0.13

Dissolved oxygen

River Mile	08-Jul-97	23-Jul-97	06-Aug-97	19-Aug-97	11-Sep-97	24-Sep-97	MIN	AVG	Reference
8.2	8.4	**5.8**					5.8	7.1	6.6
6.8	8.4	8.3					8.3	8.35	6.95
6.73	9.4	8.5					8.5	8.95	6.95
6.6	9.4	8.6					8.6	9	6.95
5.45	9.2	7					7	8.1	6.95
1.65	10.8	7.5					7.5	9.15	6.6

Bolded values are above (or below in the case of dissolved oxygen) associated reference stream 75th percentile concentrations.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Total Suspended Solids
Reference Stream Values
TSS Max Values
TSS (NTU)
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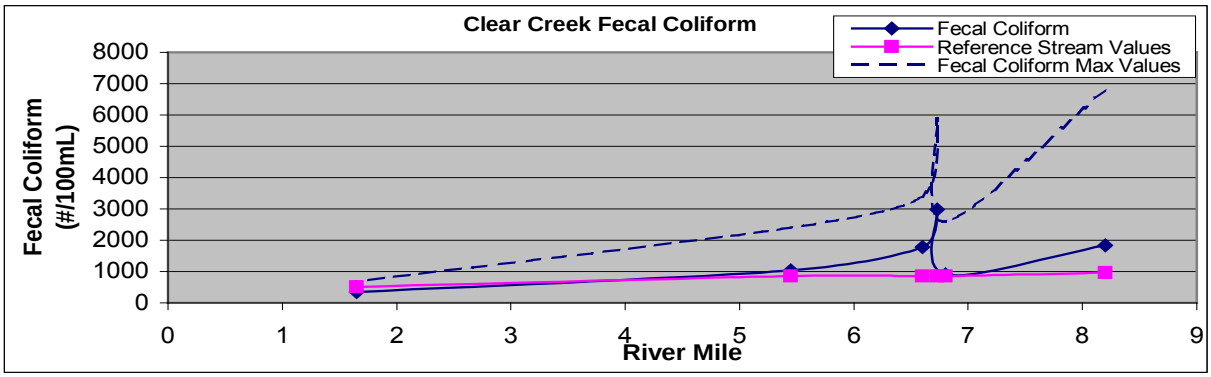
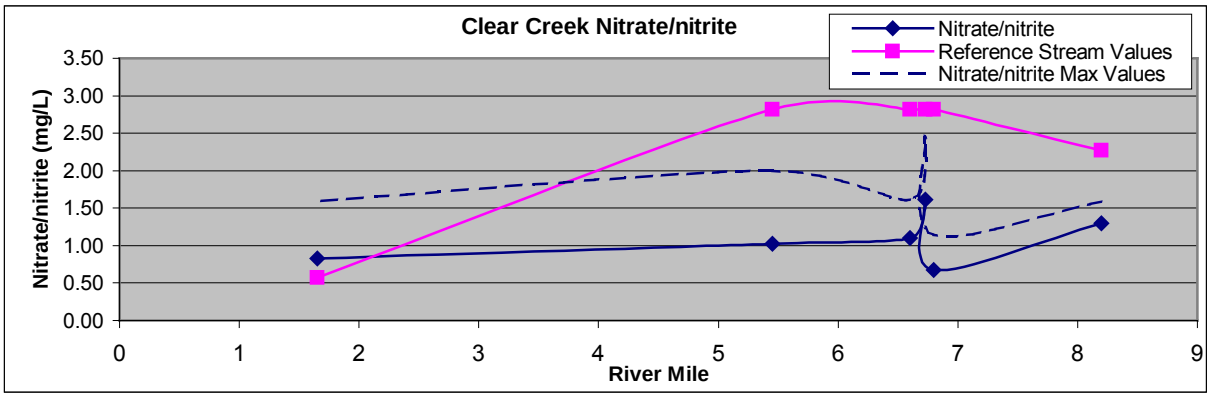
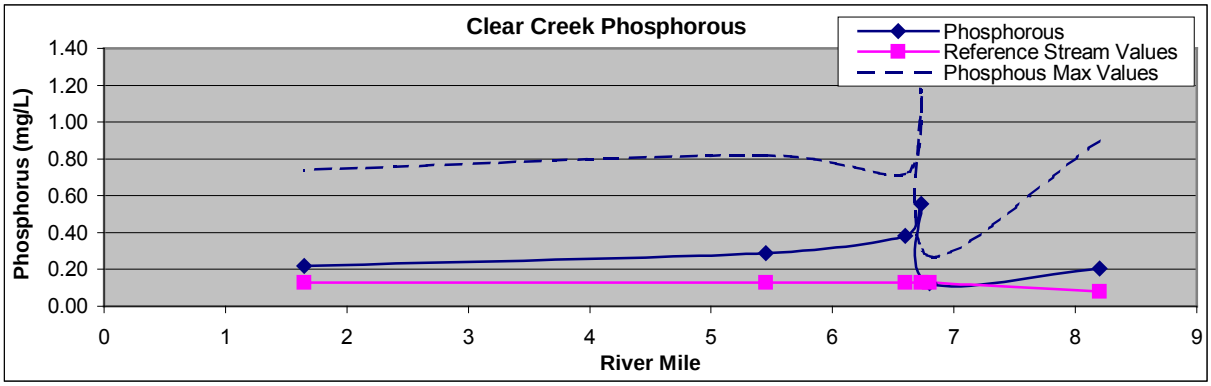
150
100
50
0
0
1
2
3
4
5
6
7
8
9
River Mile


Clear Creek Fecal Coliform
Fecal Coliform
Reference Stream Values
Fecal Coliform Max Values
Fecal Coliform (#/100mL)
8000
7000
6000
5000
4000
3000
2000
1000
0
0
1
2
3
4
5
6
7
8
9
River Mile


Clear Creek Nitrate/nitrite
Nitrate/nitrite
Reference Stream Values
Nitrate/nitrite Max Values
Nitrate/nitrite (mg/L)
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0
1
2
3
4
5
6
7
8
9
River Mile


Clear Creek Phosphorous
Phosphorous
Reference Stream Values
Phosphous Max Values
Phosphorus (mg/L)
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0
1
2
3
4
5
6
7
8
9
River Mile

Qualitative Habitat Evaluation Index (QHEI)

The QHEI is a measure of the presence and quality of physical habitat components that support aquatic life. 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 habitat characteristics that are used to determine the QHEI score include substrate, instream cover, channel morphology, riparian vegetation and bank erosion, gradient, and flow patterns (pool, run and riffle development). The QHEI score ranges from 20 to less than 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 sites around the state (OEPA, 2002, Bokes TMDL) 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 having the ability to support exceptional warmwater faunas. The QHEI can be used to direct restoration efforts for habitat and to provide a monitoring tool to measure progress toward habitat goals.

None of the QHEI scores along Clear Creek met the EWH target of 85, because the habitat is highly influenced by anthropogenic activities. The scores only remain as high as they do because of the inherently high quality substrate and water depth in this creek. The substrates are diverse with bedrock, cobbles, boulders and slabs all being components. River mile 8.5 was channelized between the original QHEI measure in August, 1997, and a second measure in October of that year. While, the score may not have been revised from the original survey, the comments section of table 3-33, reflects the effects of this channelization. Note the heavy silt and channel embeddedness with deep pools filling in and the morphology changing to predominantly glide. Sedimentation and narrow riparian corridor continue to affect water quality throughout the stream, with erosion from upstream depositing in the lower reaches. This type of sedimentation negatively affects the reproduction and viability of many species of fish and invertebrates, with pollution tolerant species such as snail and worms becoming more abundant.

Table 3-33: QHEI scores for Clear Creek

River Mile	Location	QHEI	Comments
8.5	Reference Site	68.0	• **Substrate**: heavy silt and extensive embeddedness • **Instream cover**: sparse • **Morphology**: recent channelization, all run/glide, downstream pool filling in, unstable channel • **Riparian**: very narrow to moderate, recent tree removal upstream • **Flood Plain**: old field, open pasture and row crop
6.8	Upstream Hillsboro WWTP	67.0	• **Substrate**: normal silt and moderate to extensive embeddedness • **Instream cover**: moderate • **Morphology**: good, but unstable channel • **Riparian**: narrow to moderate, moderate to severe bank erosion • **Flood Plain**: adjacent Hillsboro WWTP
6.6	Downstream Hillboro WWTP	66.0	• **No info**
5.2	Selph Road	62.0	• **Substrate**: normal to moderate silt and normal embeddedness • **Instream cover**: moderate • **Morphology**: fair, abundant sand and gravel deposits plus unvegetated point bars, unstable channel • **Riparian**: very narrow riparian with moderate to severe bank erosion • **Flood Plain**: row crops and a mowed field
1.7	Lilly Road	65.5	• **Substrate**: heavy silt and extensive embeddedness • **Instream cover**: sparse • **Morphology**: recent channelization, all run/glide, downstream pool filling in, unstable • **Riparian**: very narrow to moderate, recent tree removal upstream • **Flood Plain**: old field, open pasture and row crop
0.9	Moberly Branch, US 62 Ref. Site	74.0	• **Substrate**: normal silt and embeddedness • **Instream cover**: moderate to extensive • **Morphology**: very low stability, large, recent sand and gravel deposit • **Riparian**: narrow but intact corridor, moderate to severe bank erosion • **Flood Plain**: row crop

Point Sources

Point sources in Clear Creek include permitted discharges to the creek such as the Hillsboro WWTP, which is regulated by Ohio EPA's National Pollution Discharge Elimination System (NPDES) and requires a permit. The Hillsboro WWTP may be a major source of pollution in this subwatershed. Fecal coliform and phosphorus concentrations were high near the effluent outfall. The permit, compliance history and facility operations should be reviewed immediately by Ohio EPA.

In addition to the WWTP, there are several surface impoundments or wastewater ponds in the Clear Creek subwatershed. These include the Stephen Boike Farm, Hillsboro Manufacturing Co, Bells Foundry and Hugh Garrison farm.

Other potential contamination sources include underground storage tanks, hazardous waste generators, cemeteries and others.

Problem Statement

Clear Creek is EWH, which only partially attains its use designation between river mile 5.2 and the confluence with Rocky Fork. Chemical data indicates that the Hillsboro WWTP is adding both fecal coliform bacteria and phosphorus to Clear Creek in levels above reference stream 75th percentile values. The chemical data also indicates that the headwaters show excedeences in sediments, nutrients (nitrogen and phosphorus) and fecal coliforms. This area is agricultural in nature. The habitat evaluation shows that the forested riparian corridor is not intact throughout the creek. In areas without or with narrow corridors, the banks show erosion and the channel is excessively embedded with silt and sand. Sediment appeared to be the limiting factor for use attainment, with a portion of the creek recently channelized. Nonpoint source contributions appear to come from agricultural landuse with urban inputs from Hillsboro. The main point source is the Hillsboro WWTP, which adds phosphorus and fecal coliform loads to the creek. One other concern in this subwatershed is failing septic systems.

Landuse and Nonpoint Sources

Landuse and land cover within the subwatershed is a good indicator of potential sources of pollution. For example, the streams in the Paint Creek Watershed that attain WQS have an average of 51 percent forested within 150 feet of the creek. As you can see from the graph below, about 46 percent of the land within that same area is forested. While this isn't the exact equivalent, it is very close. Considering that this watershed is only 30 percent wooded, we are pleased that there is such a high number close to the stream. The watershed is primarily agricultural but only 41 percent of that agriculture is within the 150 foot buffer. Agricultural landuse is generally associated with sediment and nutrient contributions and a subsequent lowering of dissolved oxygen in nearby streams. The effect of a predominantly agricultural landuse with a decent amount of riparian cover to act as a filter strip is seen in the generally high water quality and biological survey results in this basin. There are many BMPs for agriculture and housing developments that help to mitigate these problems. These solutions will be addressed in the implementation section of this plan.

Nonpoint sources in the subwatershed include not only agriculture, but also failing septic systems along the creek, and pasture and livestock operations near the headwaters.

Table 3-23. Landuse and Land Cover in Rocky Fork Creek Subwatershed

Landuse/land cover category	Percent in Rocky Fork Creek subwatershed	Percent w/in 150 feet of creek and tributaries
Urban	.65	.74
Agriculture/Open	64.68	41.38
Shrub/Scrub	2.33	3.31
Wooded	29.55	45.87
Open Water	2.29	5.85
Non Forested Wetlands	.47	2.8
Barren	.04	.05

Point Sources

Point sources are direct discharges to creeks, such as WWTP outfalls. These discharges are often regulated by Ohio EPA's National Pollution Discharge Elimination System (NPDES) permit program. NPDES outfalls in the Rattlesnake subwatershed include the Village of South Solon and the Village of Sabina sewerage systems. In addition, the Octa WWTP, also called Fayette County/Rattlesnake Creek WWTP (4PH00007) is located at river mile 36.27. This WWTP has recently been upgraded. The a ffects to water quality are discussed in the beginning of this section with the chemical data results.

Another type of point source, surface impoundments, consist of holding ponds that may only overflow to the creek during rainfall events. Below is a list of impoundments.

TYPE	UNIQUE_ID	NAME	DESCRIPTION	MAILING ADDRESS
Surf Impoundment	SIM0791	B&B Plating Co.		428 S.West St., Hillsboro
Surf Impoundment	SIM0793	Hugh Garrison	Settling	Rte 4 Box 410-A, Hillsboro
Surf Impoundment	SIM0794	Ervin Parshall		RR 8, Hillsboro
Surf Impoundment	SIM0796	Stephen Boike Farm		7276 Hightop Hills, Hillsboro
Surf Impoundment	SIM0799	Highland County Water Treatment Co. Inc	Settling	Merchants Nat'l Bank Bldg, Hillsboro
Surf Impoundment	SIM0800	Hillsboro Manufacturing Co.	Settling	120 Moore Rd., Hillsboro
Surf Impoundment	SIM0801	Bells Foundry		PO Box 100, Hillsboro

OSU Study Results

Dr. Cavender and several interns conducted a seining survey to obtain information on the distribution of Paint Creek fishes across the drainage. This study was conducted to construct distribution maps, to pinpoint areas with the greatest diversity, and to investigate the presence of rare or endangered species. This study brought together all previous collection data to create an accurate representation of the fishes in Paint Creek. Dr. Cavendar noted that "the Rocky Fork Creek drainage stands out from almost all others in the size of its fish fauna (over 60 species) in relation to it's drainage area". He goes on to say that "it is remarkable because a number of it's faunal members are unique within the Paint Creek drainage or at least are most abundant in parts of the Rocky Fork drainage". He believes that that while Rocky Fork has no endangered fish species, it "deserves special study because of it's southwestern position in the Scioto Basin and it's atypical faunal composition for the Paint Creek drainage".

Soils Information

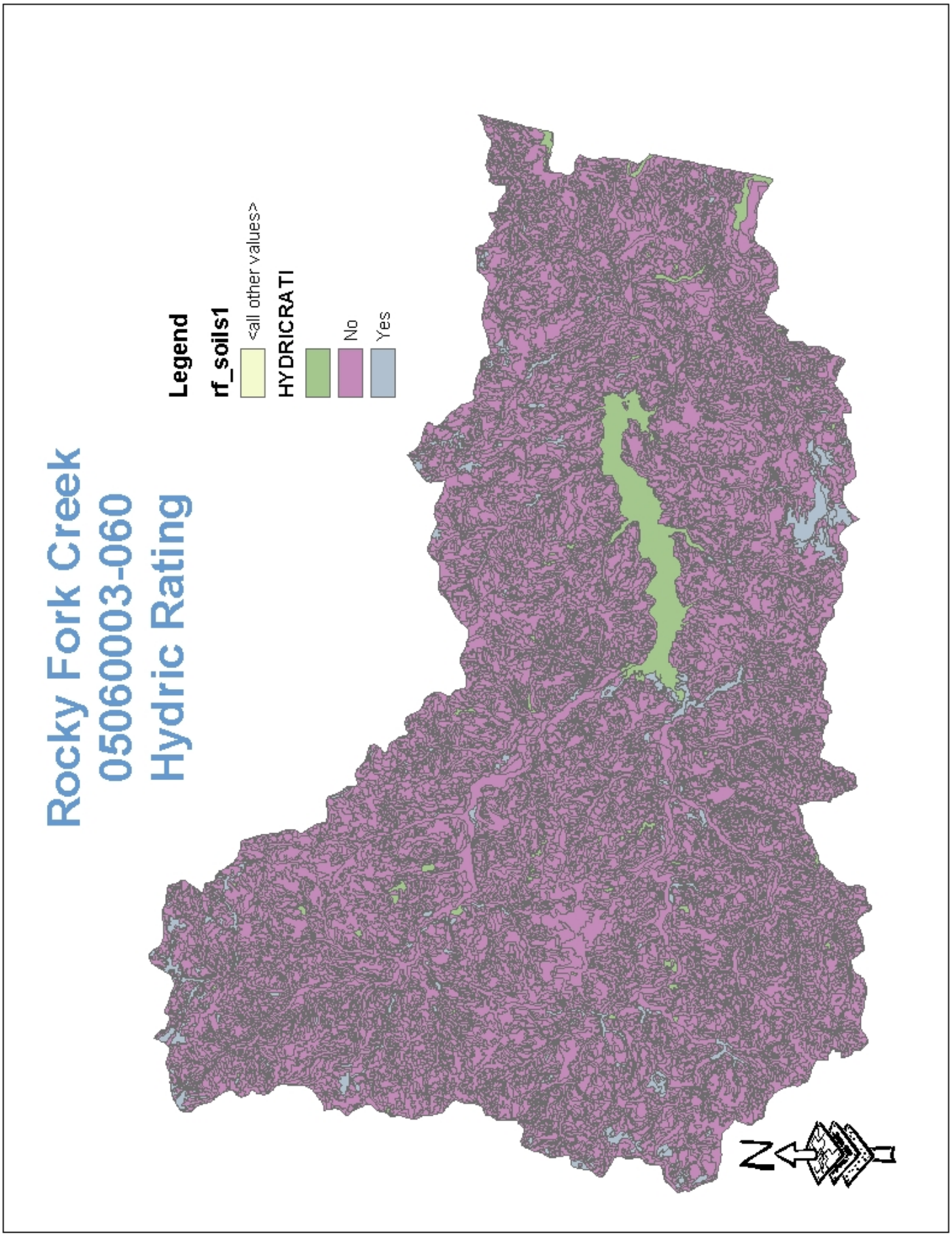
The soils in the Rocky Fork Watershed fall almost entirely in Highland County. They are generally non-hydric soils that are moderately well drained to well drained. The soils in this watershed are predominantly highly erodable and potentially highly erodable with a slopes generally above 9%. If we look at the 14-digit subwatersheds we see again that they are all highly erodable and potentially highly erodable with a slopes above 6% with slopes in Clear Creek generally above 9% with some areas from Clear Creek to the confluence with Paint Creek having slopes upwards of 43%.,

Please see the following maps for information pertaining to the soils.

Summary

The Rocky Fork Watershed is a high quality stream with many sections in full attainment of the aquatic life use. There is little channelization of the stream and there is moderate to extensive cover throughout with a boulder/cobble/gravel substrate. In the headwaters of Rocky Fork and Clear Creek, they consistently scored over 50 in the Index of Biotic Integrity (IBI): 50 being the minimum for exceptional warm water habitat designation. There is even 1 location on Rocky Fork with a score of 60, the highest possible score and one only achieved at a few sites in the state. Overall Rocky Fork has very good water quality. Fecal coliform concentrations were slightly elevated throughout the stream and dissolved oxygen concentrations fluctuated greatly, however the stream showed low levels of nutrients and suspended solids. Clear Creek is EWH, which only partially attains its use designation between river mile 5.2 and the confluence with Rocky Fork. Chemical data indicates that the Hillsboro WWTP is adding both fecal coliform bacteria and phosphorus to Clear Creek in levels above reference stream values. The chemical data also indicates that the headwaters show excedeences in sediments, nutrients (nitrogen and phosphorus) and fecal coliforms. This area is agricultural in nature. The habitat evaluation shows that the forested riparian corridor is not intact throughout the creek. In areas without or with narrow corridors, the banks show erosion and the channel is excessively embedded with silt and sand. Sediment appeared to be the limiting factor for use attainment, with a portion of the creek recently channelized. Nonpoint source contributions appear to come from agricultural landuse with urban inputs from Hillsboro. The main point source is the Hillsboro WWTP, which adds phosphorus and fecal coliform loads to the creek. One other concern in this subwatershed is failing septic systems.

It is assumed that all BMP's for this watershed will equally benefit all of the 5 subwatersheds since the causes and sources are similar throughout the watershed.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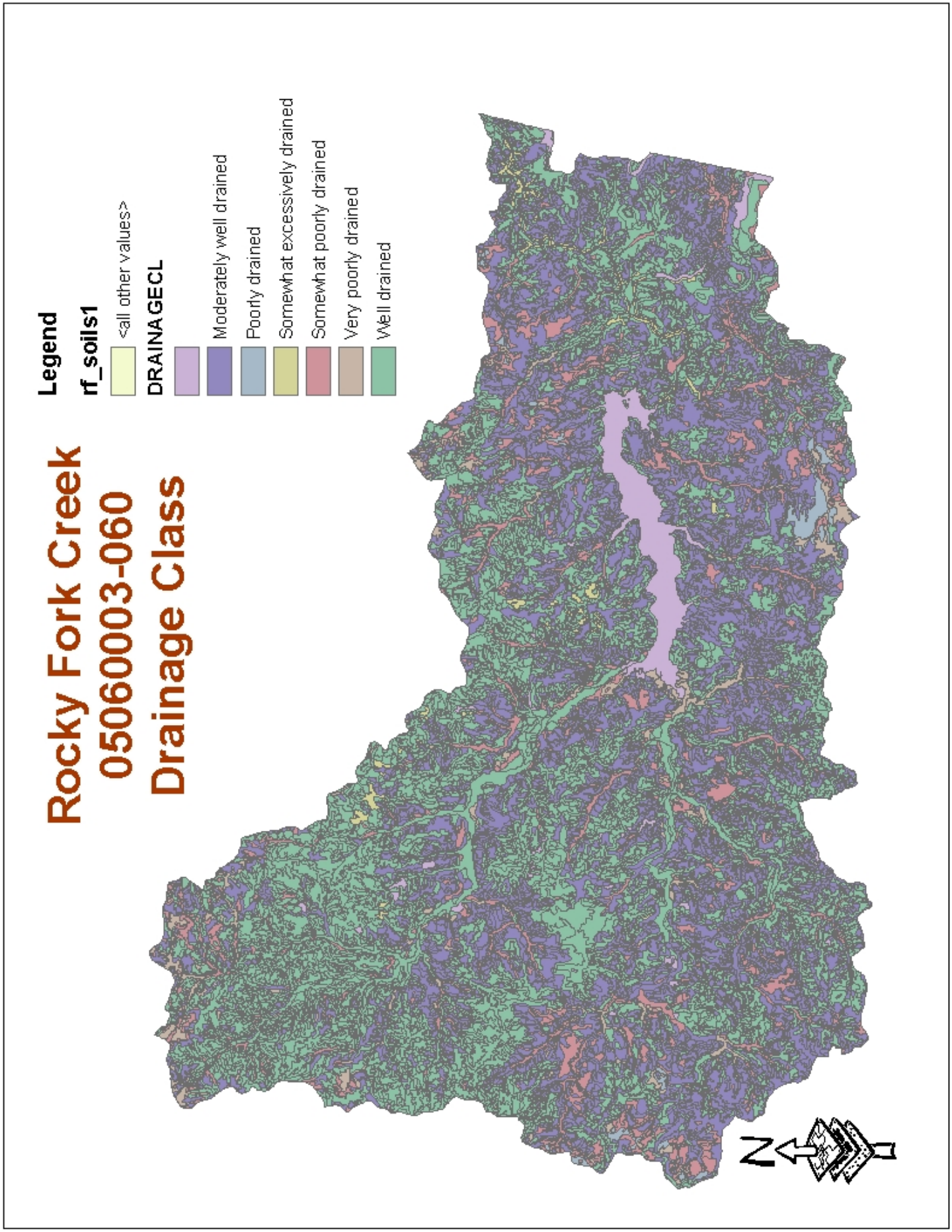
Yes
N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Drainage Class
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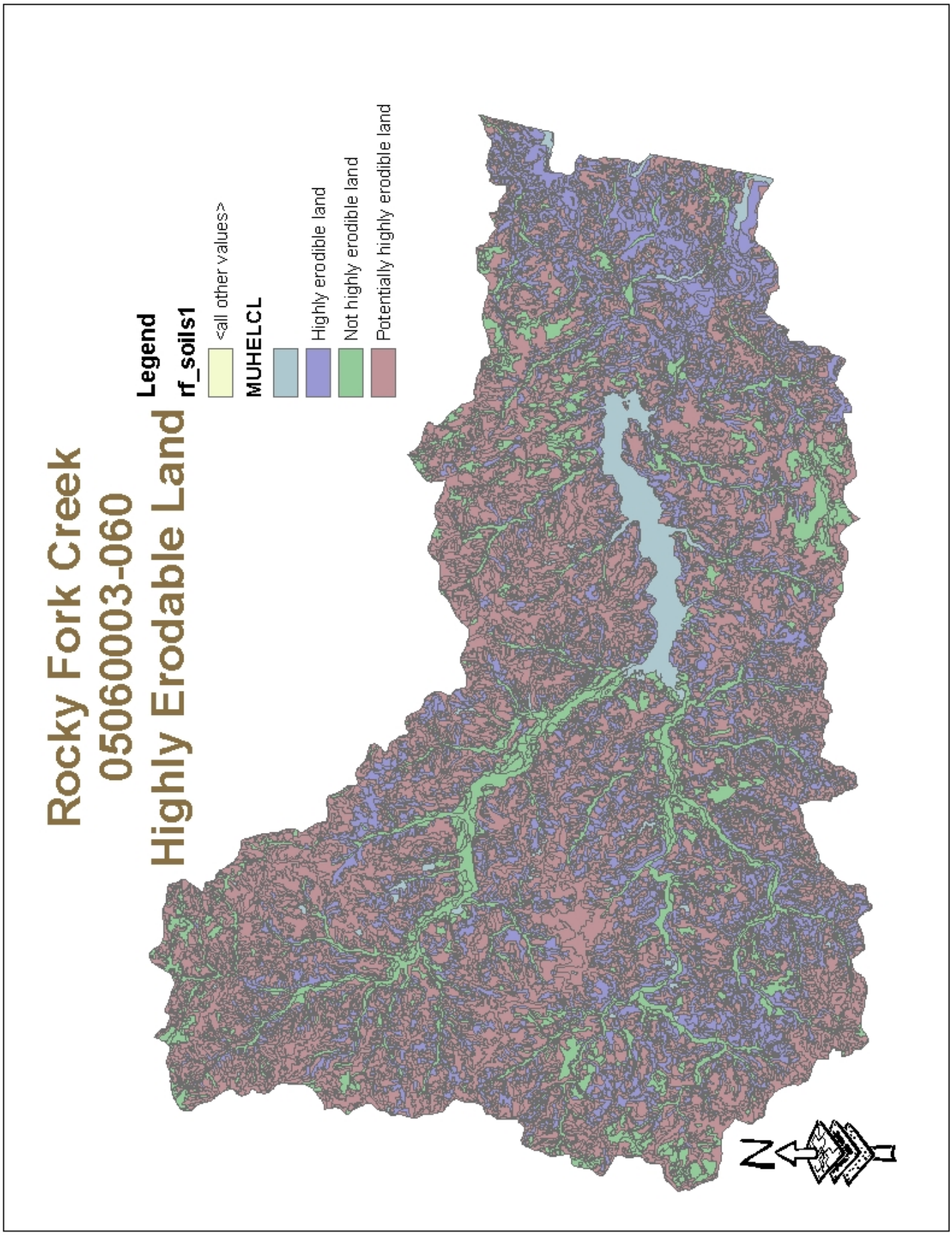
Somewhat poorly drained
Very poorly drained
Well drained
N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Highly Erodable Land
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Highly erodible land
Not highly erodible land
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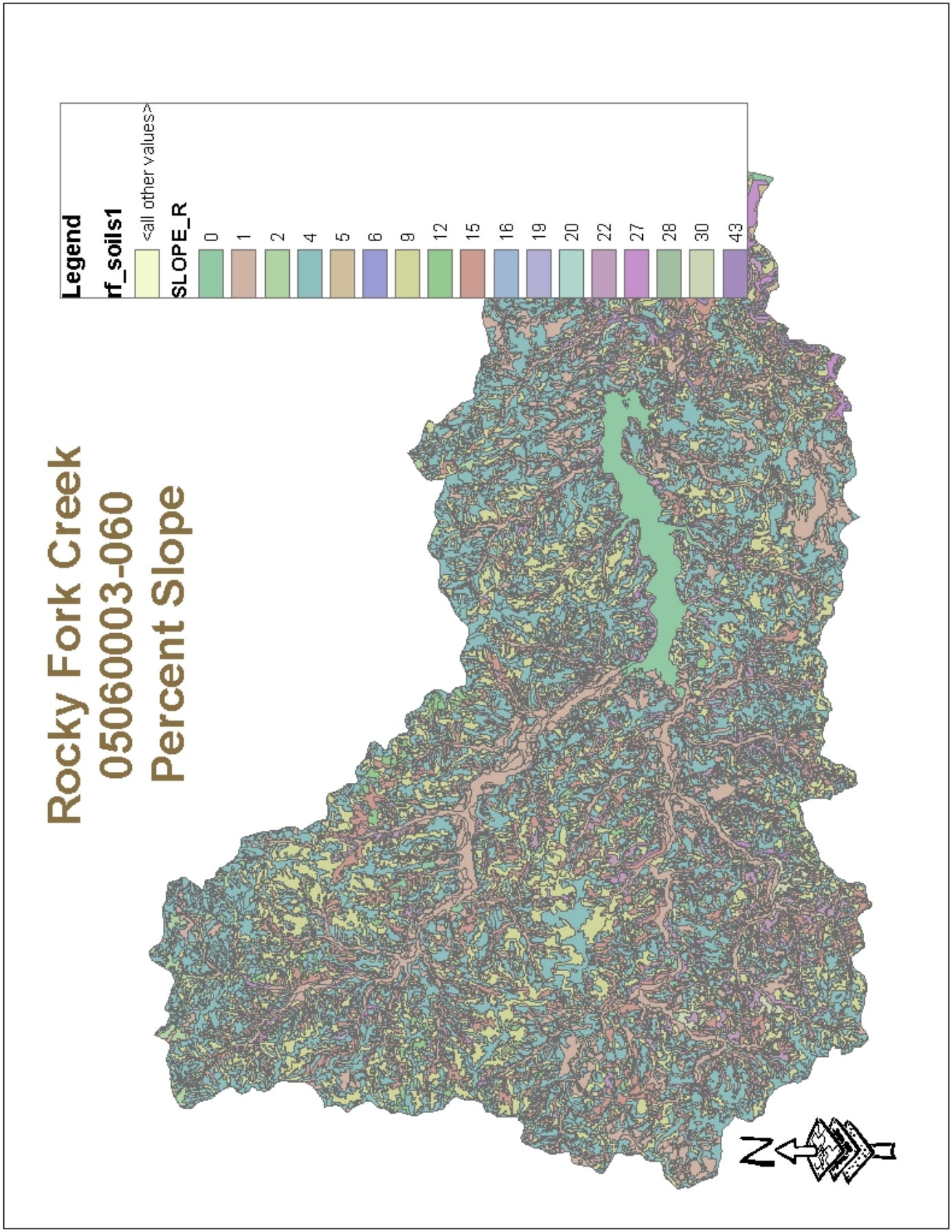
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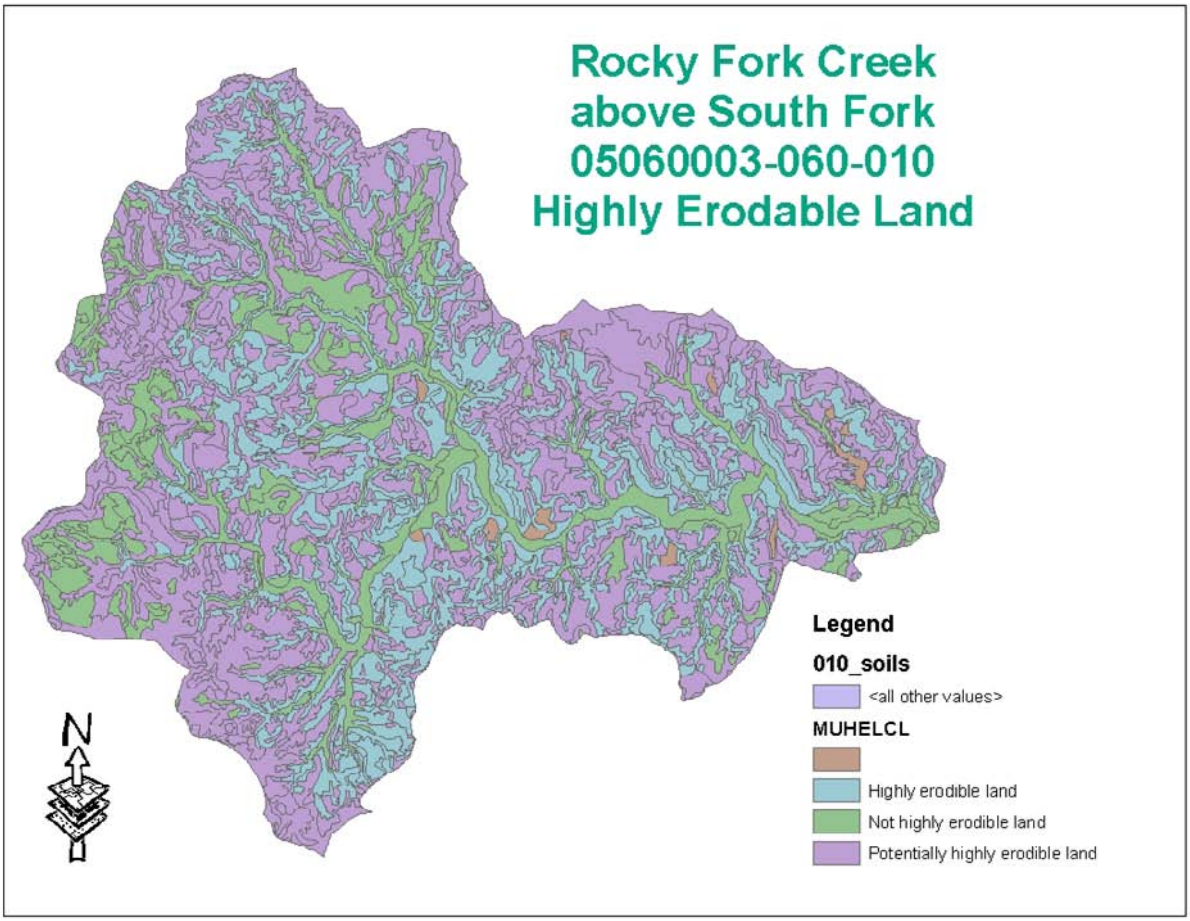
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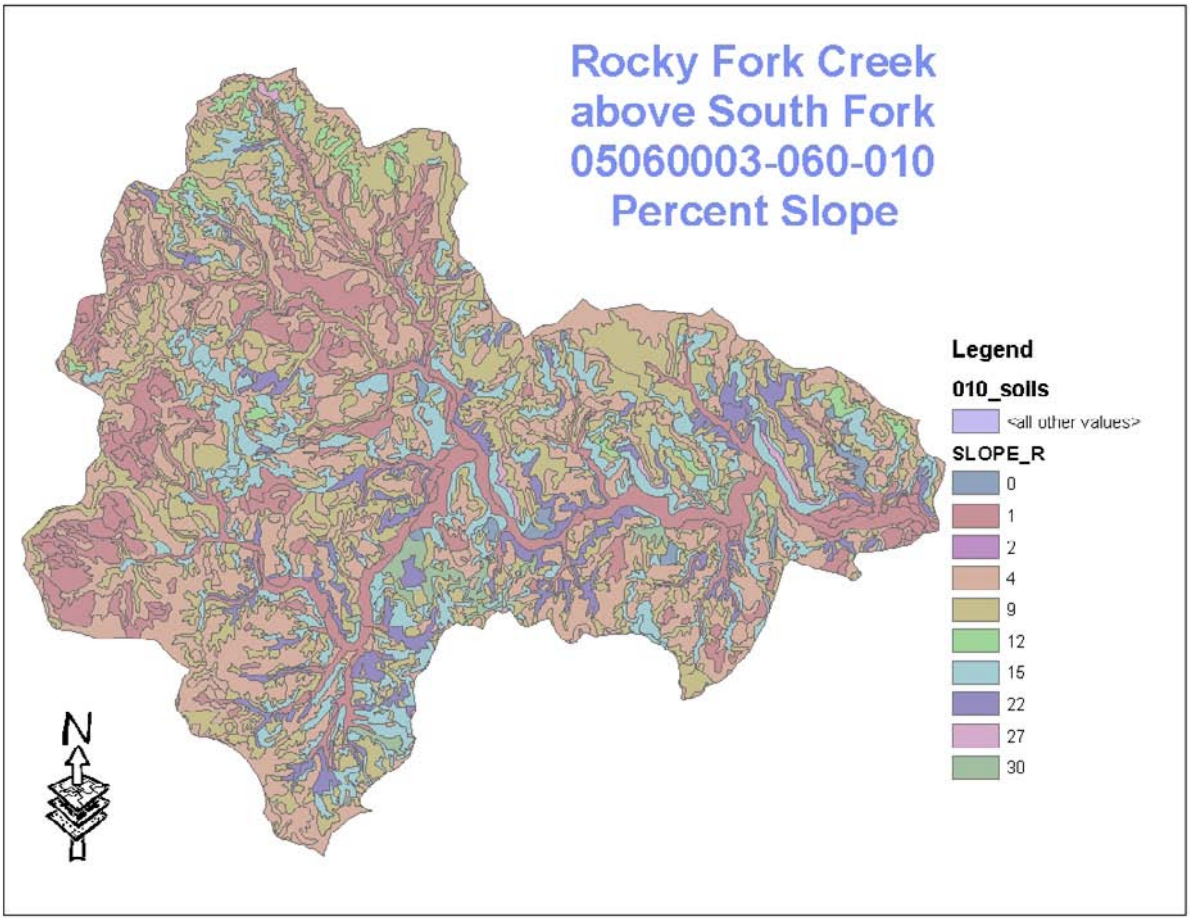
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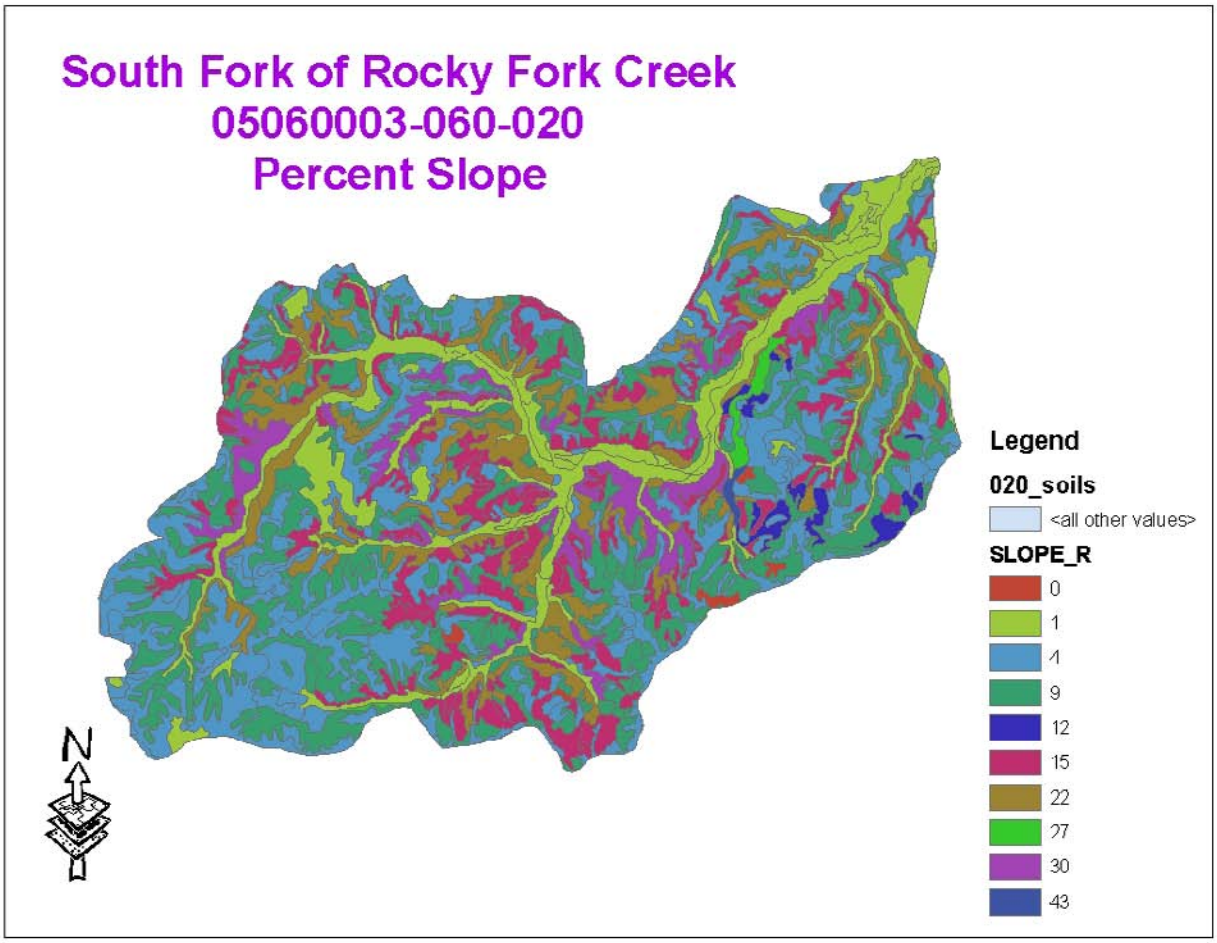
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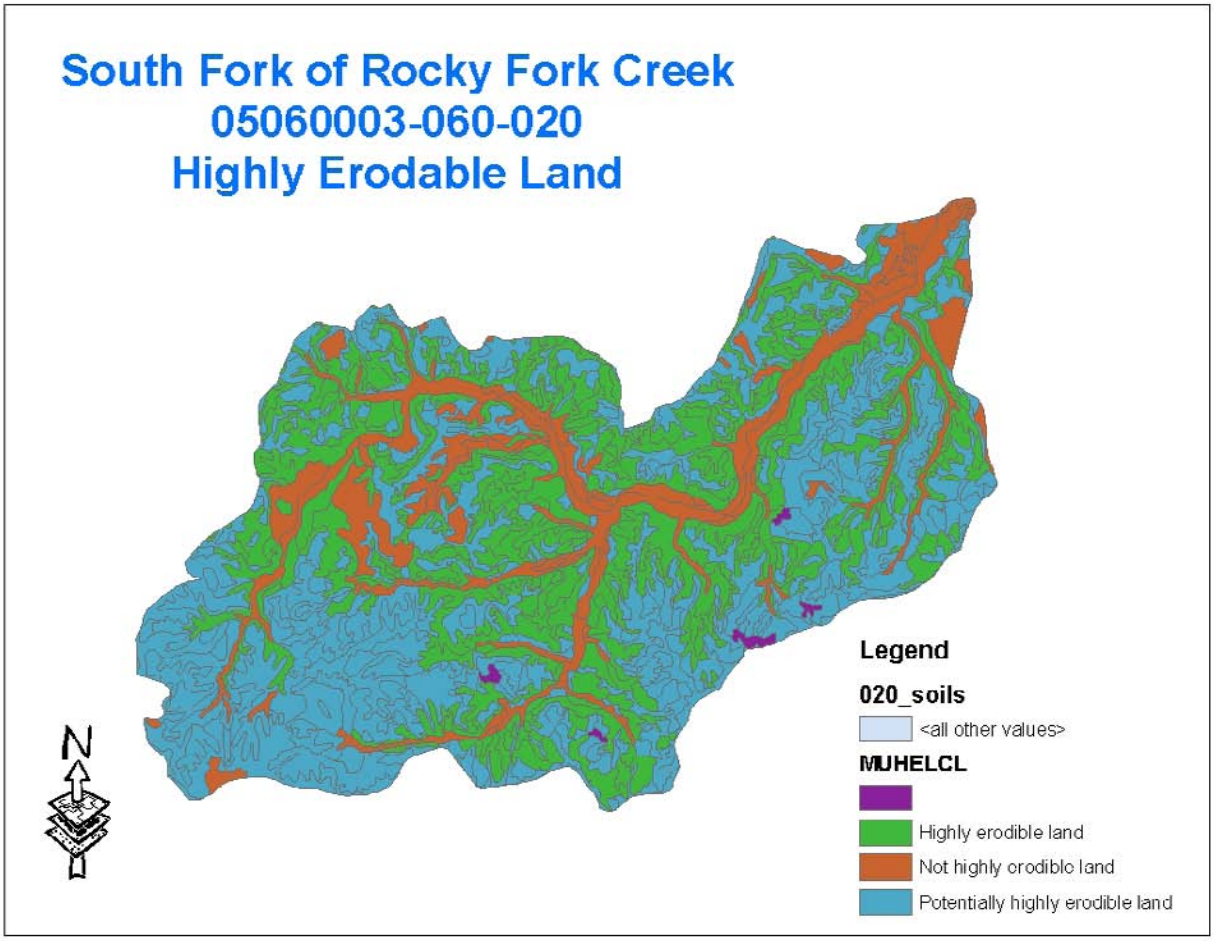
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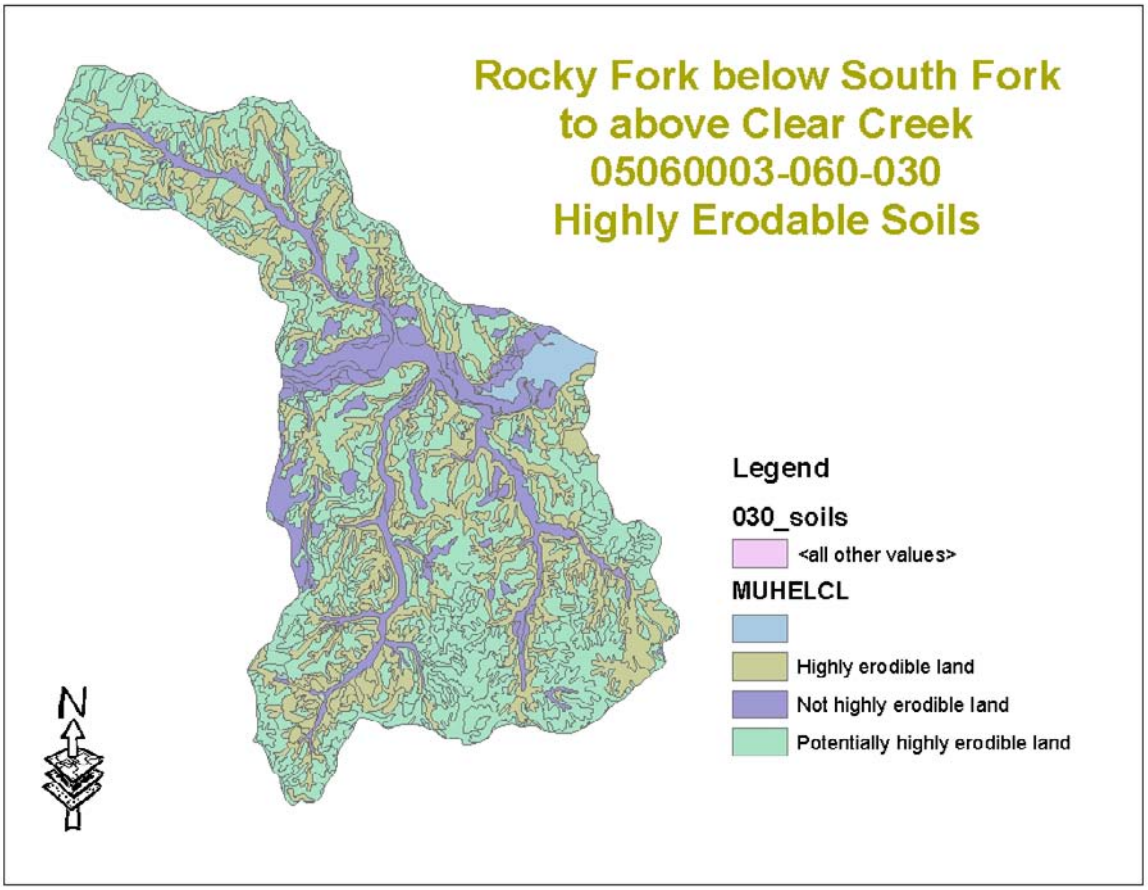
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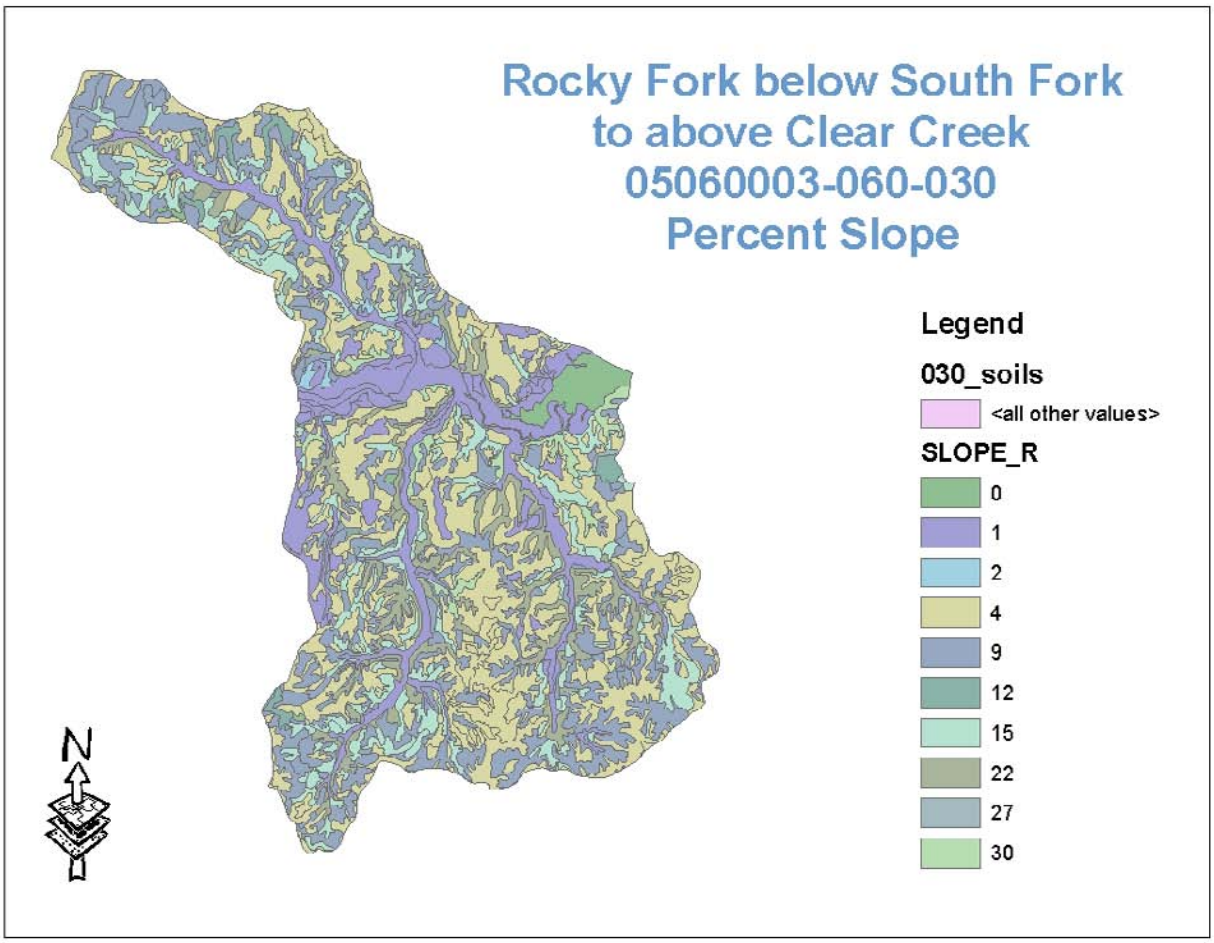
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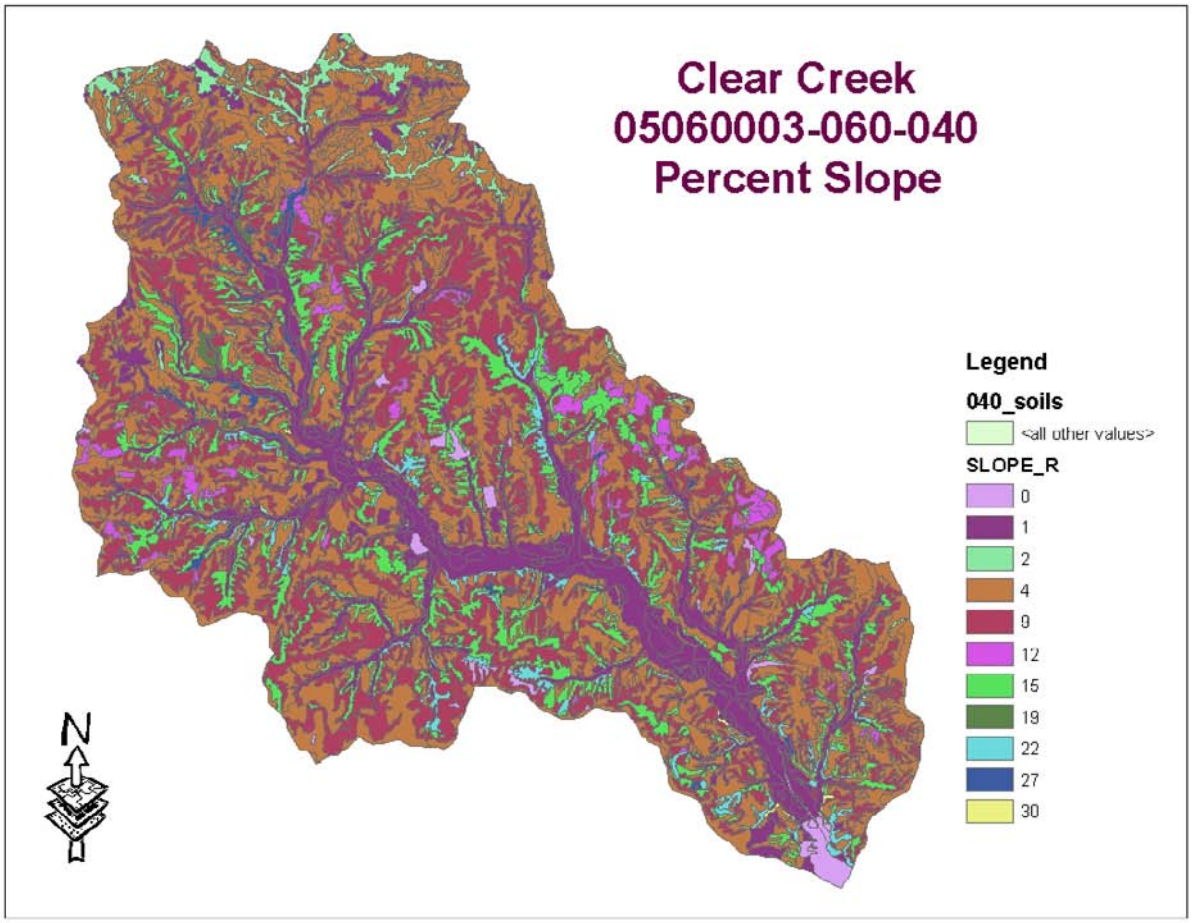
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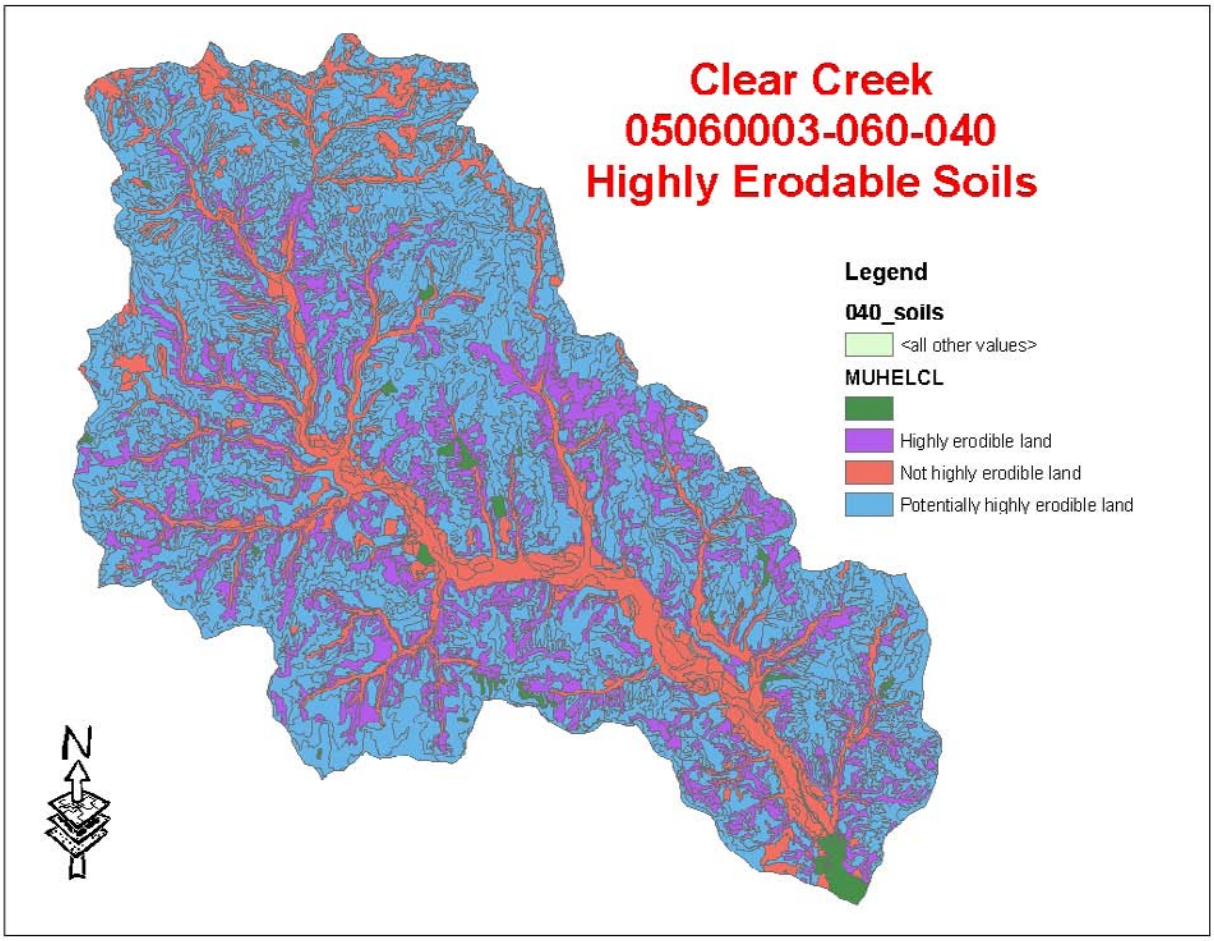
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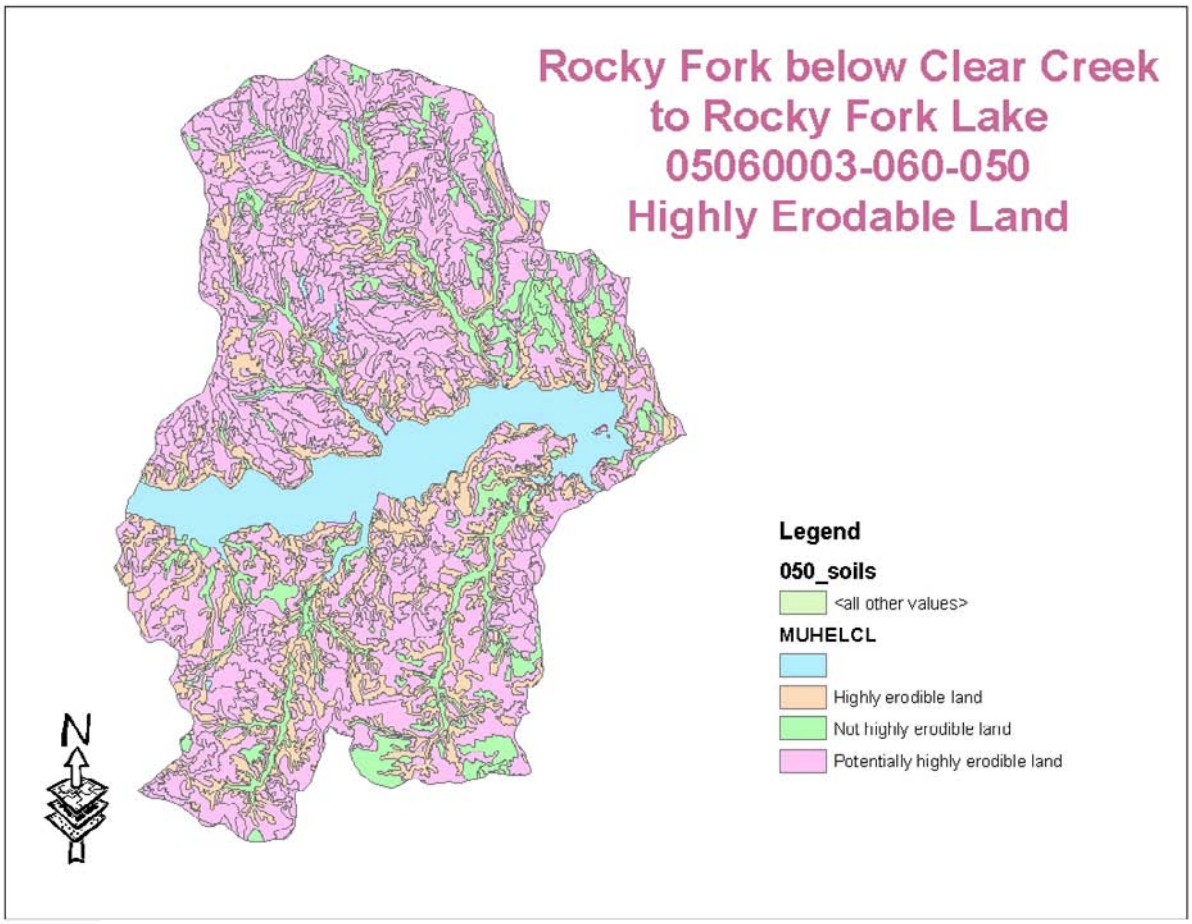
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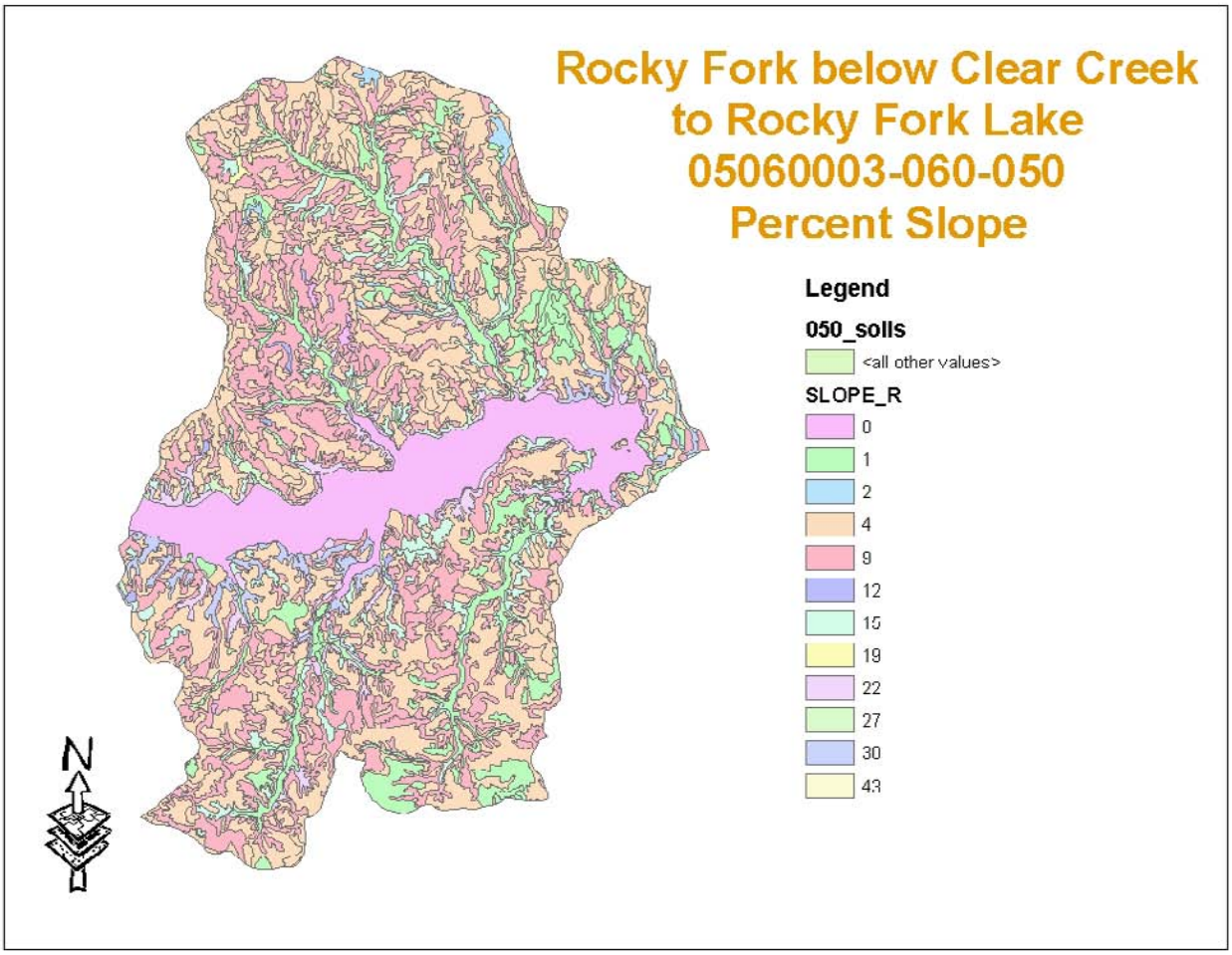
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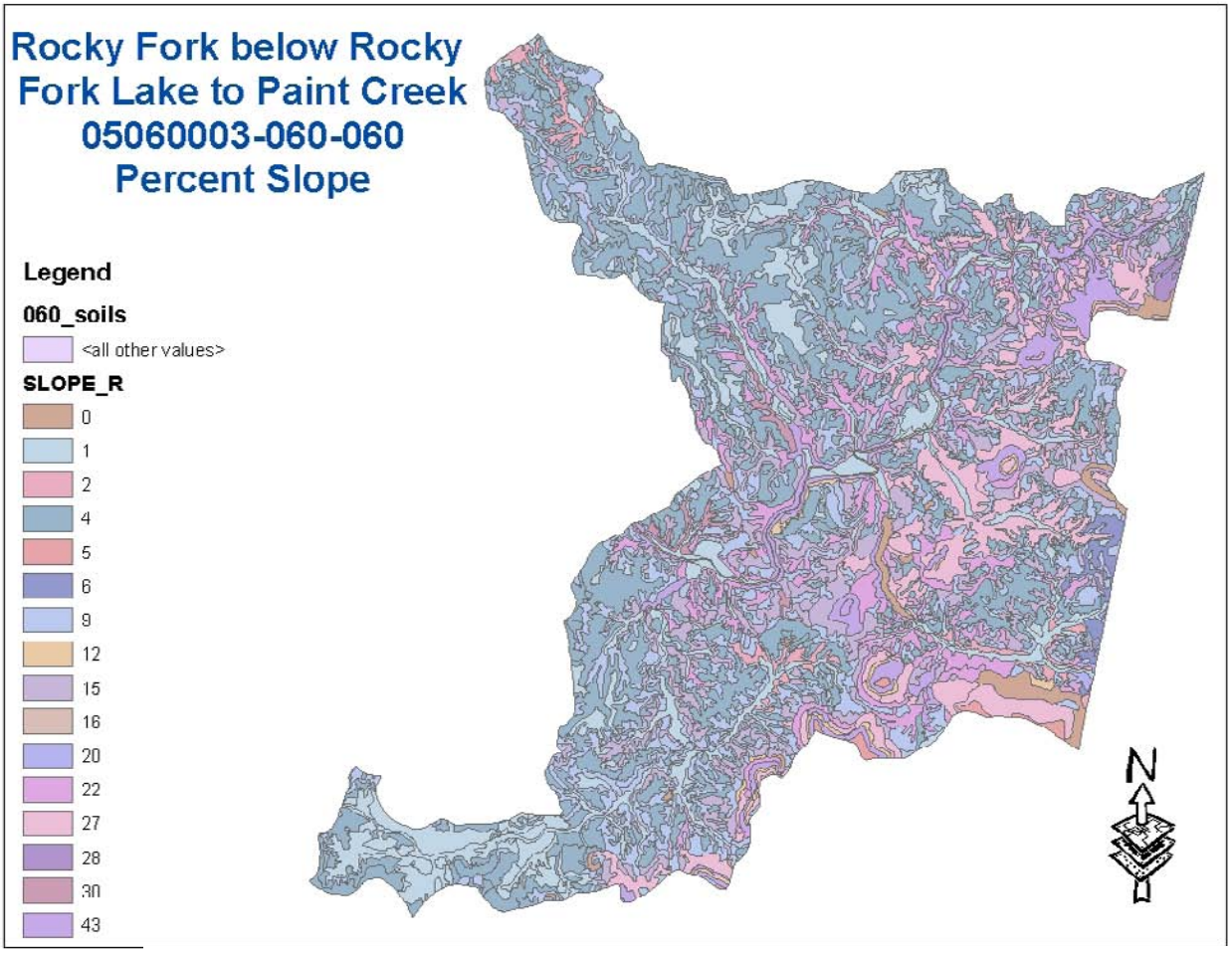
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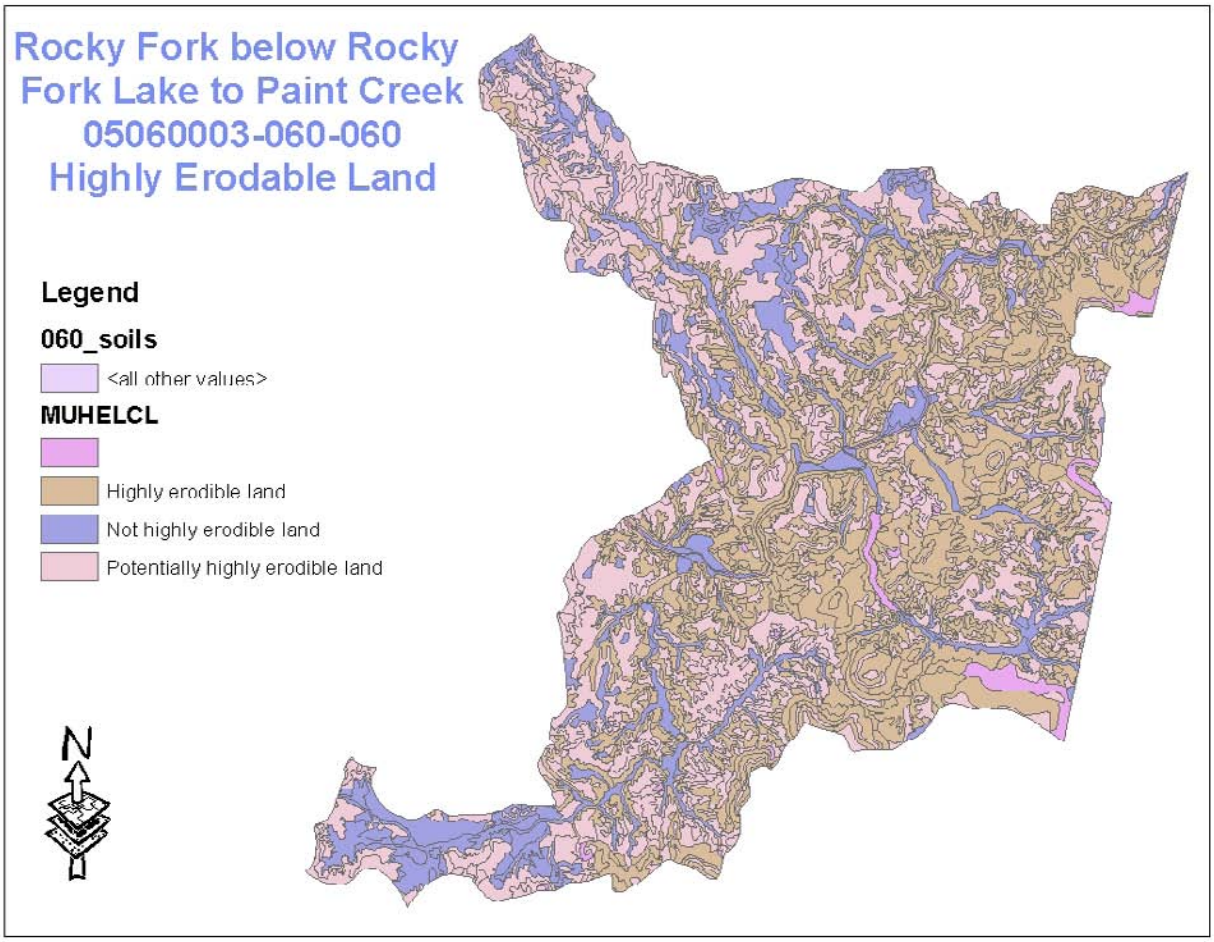
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Concerns by Subwatershed

Watershed Name	Hydrologic Unit #	Suspected or known causes	Suspected or known sources
Rocky Fork above South Fork of Rocky Fork	05060003 060 010	Habitat Alteration, Siltation, nutrients, organic enrichment/DO	Crop Production, Livestock/pasture Urban Development
South Fork of Rocky Fork	05060003 060 020	Habitat Alteration, Siltation, nutrients, organic enrichment	Crop Production, Failing HSTS's
Rocky Fork below South Fork to above Clear Creek	05060003 060 030	Habitat Alteration, Siltation, nutrients, organic enrichment	Crop Production, Failing HSTS's, Urban Development
Clear Creek	05060003 060 040	Habitat Alteration, Siltation, nutrients, organic enrichment/DO	Crop Production, Failing HSTS's, Urban Development, Livestock/Pasture
Rocky Fork below Clear Creek to Rocky Fork Lake	05060003 060 050	Habitat Alteration, Siltation, nutrients, organic enrichment/DO	Crop Production, Failing HSTS's, Livestock/Pasture
Rocky Fork below Lake to Paint Creek	05060003 060 060	Habitat Alteration, Siltation, nutrients, organic enrichment/DO	Crop Production, Failing HSTS's, Livestock/Pasture, upstream impoundment

Public Support and Participation

The Paint Creek Watershed Project began holding public meetings in January of 1999 with their Watershed Coordination Kick-Off meeting. There were over 60 people in attendance and they came up with a listing of issues and concerns and then they were asked to pick the ones of priority. Those priority issues are seen below in the first listing. The project did not hold structured meetings again until 2002 due to the lack of availability of the Coordinator to hold meetings along with other day to day duties. In mid 1999, the Project wrote and was awarded a Section 319 grant to hire and write a management plan and in January of 2002, Hilary Solomon was hired. That February, both the Plan Coordinator, Hilary Solomon, and the Project Coordinator, Julie Brown, held meetings throughout the watershed having one in each 11-digit area to start gathering support for the project and to find out the issues and concerns. These meetings were held in the evenings in order to attract all possible interest parties and turn out was rather varied with as little as 2 participants in areas where the stream was smaller and on county maintenance to as many as 60 people where there were more urban communities. After these meetings, the citizens were invited to attend the Advisory Council meetings that were held quarterly for a year and a half after where subgroups sat at the table to formulate objectives and goals for the issues and concerns gathered at the local meetings. The final product was the draft Management Plan that was submitted to Ohio EPA in July of 2002. Soon after submitting the plan, Hilary Solomon's resigned her position and with her went the structured planned meetings. Hilary's work on the plan was invaluable and she is sorely missed as the revisions are completed.

Although the watershed is diverse in landscape and landuse, the issues and concerns that came up regularly at our evening meetings were the same across the watershed and very similar to the original list that was created in 1999. Here is a listing of those concerns.

Priority list from January 1999 meeting (in order of priority):

1. Reduce soil erosion
2. Protect riparian corridor
3. Create a community-driven watershed organization
4. Improve overall water quality
5. Protect against urbanization of farmland
6. Promote filter strips
7. Runoff/storm water management from housing developments and urban areas
8. Promote cost effective BMPs

Between February 28 and March 27, 2001, the Project held the 11 community interest meetings. These meetings were held in nine of the ten USGS hydrologic subunits in the watershed. The meetings were conducted in Bainbridge, Washington Court House, Chillicothe, Frankfort, Sabina, Jeffersonville, Hillsboro, Leesburg and Greenfield. In addition, meetings were held in Chillicothe with the Smallmouth Bass Alliance and the Symposiarts, a group that explores local culture and natural heritage.

The concerns and interest of the local community members were many and varied. The most common topics included stream bank erosion, public access to the creeks (countered with fears about trespassing), modifying dam releases from Paint Creek Lake and Rocky Fork to mimic natural stream flow patterns, litter control/illegal dumping, and map availability for local interest groups. Some of the most passionate discourse related to fish tissue consumption warnings, confined animal feeding units, wastewater treatment plant installations and management, riparian corridor restoration, and promoting environmental education in schools. A full list of community concerns and suggestions can be found below. Topics in bold were frequent concerns.

The Local Community Concerns were as follows:

Historic/special site preservation
Maps for local interest groups
Farmland/environmental compatibility
Water quality monitoring/maintenance
Confined animal feeding operations
Wastewater treatment plants and failing home septic systems
Litter/illegal dumping
Roadkill
Adopt-a-highway
Loss of farmland
BMP education and enforcement
Lack of zoning
Land use planning
Natural dam releases
Student environmental education
Animal control (beavers and geese)
Land stewardship education for landowners
Community participation

Public access to the creeks
Sediment control/contamination
Logging Practices
Riparian corridor
Stream bank erosion
Log jams
Recreation
Exotic species

11 Digit Watershed: 05060003 060
05060003 060 010 Rocky Fork above South Fork of Rocky Fork
05060003 060 020 South Fork of Rocky Fork
05060003 060 030 Rocky Fork below South Fork to above Clear Creek
05060003 060 040 Clear Creek
05060003 060 050 Rocky Fork below Clear Creek to Rocky Fork Lake
05060003 060 060 Rocky Fork below Lake to Paint Creek
Sources of Water Quality Impairment: Organic enrichment/DO, habitat alteration, siltation
Causes of Water Quality Impairment: Impoundment, Municipal point source, streambank destabilization (agriculture), crop production, livestock/pasture.

Forested Buffer Along Streams: 05060003 060
Acreage Within 150 foot of Stream on either side: 8702.7
Forested Acreage within 150 feet of stream: 3991.54
Percent forested coverage within 150 FT: 45%

Forested Buffer Along Streams: 05060003 060 010
Acreage Within 150 foot of Stream on either side: 1301.46
Forested Acreage within 150 feet of stream: 538.38
Percent forested coverage within 150 ft: 41.4%

Forested Buffer Along Streams: 05060003 060 020
Acreage Within 150 foot of Stream on either side: 769.85
Forested Acreage within 150 feet of stream: 507.6
Percent forested coverage within 150 ft: 65.8%

Forested Buffer Along Streams: 05060003 060 030
Acreage Within 150 foot of Stream on either side: 867.5
Forested Acreage within 150 feet of stream: 448.2
Percent forested coverage within 150 ft: 51.7%

Forested Buffer Along Streams: 05060003 060 040
Acreage Within 150 foot of Stream on either side: 3060
Forested Acreage within 150 feet of stream: 1269.1
Percent forested coverage within 150 ft: 41.5%

Forested Buffer Along Streams: 05060003 060 050
Acreage Within 150 foot of Stream on either side: 1752.25
Forested Acreage within 150 feet of stream: 572.08
Percent forested coverage within 150 ft: 32.65%

Forested Buffer Along Streams: 05060003 060 060
Acreage Within 150 foot of Stream on either side: 1930.3
Forested Acreage within 150 feet of stream: 1340.0
Percent forested coverage within 150 ft: 69.4%

Background: The section of Rocky Fork Creek is currently not meeting its use designation or partially meeting its use designation throughout the watershed due to organic enrichment and other habitat alterations. It is also believed, based on data from the QHEI, that siltation is contributing to the impairment. According to the STEPL program, Version 2.0, the current estimated loadings are 163,289.8 lbs/year of nitrogen, 46,437.7 lbs/year of phosphorus, 407,045.2 lbs/year of biological oxygen demand, and 23,634.1 tons/year of sediment. Exact locations of impairment are as follows:

RIVER MILE	STREAM	LOCATION	ECO-REGION	W/S SIZE	HABITAT	PRIORITY	ATTAINMENT
0.30	Rocky Fork Creek	The Point	IP	HW	EWH	Medium	Partial
4.50	Rocky Fork Creek	Barrets Mill	IP	W	EWH	Low	Full
9.10	Rocky Fork Creek	Rocky Fork Lake Tailwaters	IP	W	EWH	High	Non
18.10	Rocky Fork Creek	Fettro Road	IP	W	EWH	Low	Full
23.30	Rocky Fork Creek	US 62	IP	W	EWH	Low	Full

RIVER MILE	STREAM	LOCATION	ECO-REGION	SIZE	HABITAT	PRIORITY	ATTAINMENT
1.70	Clear Creek	Lilly Rd.	IP	W	EWH	Medium	Partial
5.20	Clear Creek	Selph Rd.	ECBP	W	EWH	Medium	Partial
6.60	Clear Creek	Dst. Hillsboro WWTP	ECBP	W	EWH	Low	Full
6.80	Clear Creek	Ust. Hillsboro WWTP	ECBP	W	EWH	Low	Full
8.30	Clear Creek	Reg. Reference Site	ECBP	HW	EWH	Low	Full

Problem statement: Organic enrichment, siltation and habitat alteration in the Rocky Fork Watershed are causing impairment of the use designation. Through field inventory, the source of the erosion is believed to be from over land runoff and streambank erosion. The source of the nutrients and organic enrichment are believed to be widespread row crop agriculture, livestock, failing septic systems, WWTPs and habitat alterations. More precise locations of eroding banks are not yet confirmed. The total sediment load per the STEPL program is 23,634.1 tons/year with a total nutrient load of 163,289.8 lbs/year of nitrogen, 46,437.7 lbs/year of phosphorus, and 407,045.2 lbs/year of BOD lb/year.

The task descriptions below were formulated using recommendations from experts at the local Soil and Water Conservation Districts, Health Departments, Ohio Department of Natural Resources, Division of Forestry, Division of Wildlife, and Division of Soil and Water Conservation, along with the Natural Resource Conservation Service and the Ohio Environmental Protection Agency.

Goals:

1. Reduce nutrient load and organic enrichment from agricultural fields. There are over 48,000 acres within 1000 feet of the stream; approximately 28,928 of these acres are in agricultural production. Since only about 50% of this production can be assumed to be corn, we are looking at about 7,230 acres every year that are not in a conservation tillage program. We would like to increase the use of no-till to 75% in these corn acreages which would be an increase of 3,616 acres or 12.5% overall. Reduce an additional 10% of sedimentation from installation of grass waterways and increase riparian corridor within 50 feet of the stream by 10%.

Task Description	Resources	How	Time Frame	Performance Indicators
Establish conservation tillage on priority land within 1000 feet of the stream. It is estimated that this will reduce the nutrient load by 2520 lb/year of phosphorus, 5040 lb/yr nitrogen and 2520 tons/year of sediment.	$180,800	Utilize current farm bill programs. Use upcoming CSP program as incentive for landowners	January 2008-January 2013	Document soil and nutrients saved/not delivered to stream using RUSLE or other model, Improved QHEI scores
Control erosion and nutrient runoff with the installation of 9,000 linear feet of grassed waterways and water and sediment control basins. It is estimated that this will reduce the nutrient load by 2520 lb/year of phosphorus, 5040 lb/yr nitrogen and 2520 tons/year of sediment.	$50,000	Utilize current farm bill programs. Use upcoming CSP program as incentive for landowners	January 2008-January 2013	Document soil and nutrients saved/not delivered to stream using RUSLE or other model, improved QHEI scores
Establish a total of 144 acres within 50 feet of the stream of riparian corridor, natural	$350,000 for an incentive	CREP, CRP, EQIP, WHIP, FLEP, DOW	January 2008-January 2013	Document soil saved/not delivered to

regeneration and/or warm season grasses along the impaired segments. It is estimated that this will reduce the nutrient load 21,893lb/year and the sediment load by 6000 tons/year	program	free seed and Pastures to Prairies Program, Pheasants Forever, National Wild Turkey Federation, 319 program		stream using RUSLE or other model, improved QHEI scores
Encourage the establishment of conservation easements to protect riparian corridor.	$350,000	Research farmland preservation funds, ODOT mitigation funds, Issue 1 funds, etc.	Ongoing	Document soil and nutrients saved/not delivered to stream using RUSLE or other model, Improved QHEI scores

Loading reductions calculated using Load Reduction Spreadsheet v1.2.

Problem statement: Excessive nutrients and organic enrichment in the Rocky Fork Watershed are causing impairment of the use designation. After discussions with the SWCD and local Health Dept. it is accepted that approximately 10% of the on-site septic systems in this area are failing which is approximately 180 homes. There are also other septic issues with the unsewered communities south of Rocky Fork Lake. More precise locations of failing systems are not yet confirmed. The estimated nutrient load not discharged from these 180 homes would be 19512.9 lbs. of nitrogen, 7391.3 lbs. of phosphorus and 69182 lbs. of BOD.

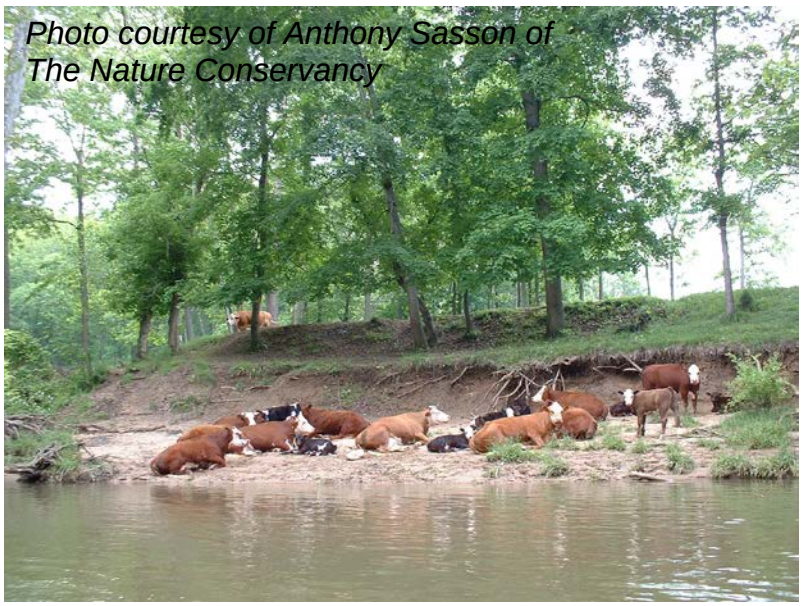
The task descriptions below were formulated using recommendations from experts at the local Soil and Water Conservation Districts, Health Departments, Ohio Department of Natural Resources, Division of Forestry, Division of Wildlife, and Division of Soil and Water Conservation, along with the Natural Resource Conservation Service and the Ohio Environmental Protection Agency.

Goals:

1. Reduce nutrient load and organic enrichment from failing on-site home septic systems by repairing all failing systems.

Task Description	Resources	How	Time Frame	Performance Indicators
Work with county Health Departments to determine more accurate number of failing systems	HD Inspectors time to inspect all systems	Inspect all systems	January 2008-January 2009	Report of failing systems generated
Replace/upgrade failing systems	Health Dept. time to write plan	Apply to DEFA for low interest on-site loan program for county	October 2008-December 2009	DEFA program available in county,
Search for funding options to upgrade failing systems	Watershed Coordinator and/or Health Dept. time to research and write grant application	Local watershed group or Health Dept. will apply for grant program	January 2008	Grant Submitted
Replace/upgrade all failing systems	County sanitarians time to approve applications and inspect	Local watershed group or Health Dept. will apply for grant program	January 2009-December 2014	All failing systems replaced or upgraded

Loading reductions calculated using Load Reduction Spreadsheet v1.2.



Problem statement: Excessive nutrients, organic enrichment and habitat alteration in the Rocky Fork Watershed are causing impairment of the use designation. Through field inventory, the source of some of the nutrients and organic enrichment are believed to be livestock and their access to the stream. According to the county SWCD's, there are approximately 100 hogs, 1200 sheep/goats, 100 horses, 5000 cattle and 600 dairy cattle in the watershed. It is believed that they are causing slumping banks, sedimentation and nutrient enrichment from manure application and run-off. Estimated load reductions are 9,922 lbs/year of nitrogen, 1,690 lbs/year of phosphorus, 13,170 lbs/year of BOD lb/year.

The task descriptions below were formulated using recommendations from experts at the local Soil and Water Conservation Districts, Health Departments, Ohio Department of Natural Resources, Division of Forestry, Division of Wildlife, and Division of Soil and Water Conservation, along with the Natural Resource Conservation Service and the Ohio Environmental Protection Agency.

Goal:
1. Stabilize 1000 feet of eroding banks by excluding livestock.
2. Reduce nutrients entering the stream from livestock feeding and watering

Task Description	Resources	How	Time Frame	Performance Indicators
Establish a livestock nutrient reduction program with a combination of heavy use feeding pads, exclusion fencing, alternate watering sources, intensively managed grazing, nutrient mgmt. plans, and manure storage facilities.	200,000 for an incentive program	Utilize current farm bill programs. Use upcoming CSP program as incentive for landowners	January 2008-January 2013	Document decreased nutrient and sediment load using estimated load reduction spreadsheet.

Loading reductions calculated using Load Reduction Spreadsheet v1.2.

Problem statement: Excessive nutrients, organic enrichment and habitat alteration in the Rocky Fork Watershed are causing impairment of the use designation. Education programs and personnel are needed to educate the community and provide an awareness of the issues, both agricultural and urban, and to deal with concerns. Pursue recreational alternatives to encourage use of the natural resource.

The task descriptions below were formulated using recommendations from experts at the local Soil and Water Conservation Districts, Health Departments, Ohio Department of Natural Resources, Division of Forestry, Division of Wildlife, and Division of Soil and Water Conservation, along with the Natural Resource Conservation Service and the Ohio Environmental Protection Agency.

Goals:

1. Reduce nutrient load, organic enrichment, and sedimentation through education and awareness programs

Task Description	Resources	How	Time Frame	Performance Indicators
Work with local stakeholders to create an awareness of the watershed issues and concerns and available programs. Use GIS to formulate watershed mailing lists to keep landowners aware of programs.	Maintain a watershed coordinator	Local watershed group will search for other funding source	On going	Watershed Coordinator is hired/continues employment.
Work with developers, builders and government agencies to ensure county urban erosion control guidelines are followed.	Add an urban streams conservationist to the watershed project	Local watershed group will search for other funding source	January 2008	Urban Streams Conservationist is hired.
Provide increased public access to the stream for recreational use.	Funding needs unknown at current time	Local recreation entities will look into water based recreation grant opportunities with the Div. of Watercraft.	January 2008	Recreational access increased for public use.

Evaluation Strategy and Plan Update/Revision:

The Paint Creek Management Plan is anticipated to be a living and working document that does not end up on a shelf collecting dust. In order to accomplish this, evaluation and updating will be key components for the future.

Since the formulation of the Management Plan relied heavily on stakeholder input, their evaluation of the plan will be crucial to it's future. The Project would like to implement a yearly progress meeting to discuss the original goals of the plan and to determine the status of these goals and the need for additional response or update. The success of some measures such the BMP's will be measured on a basis of application and implementation in the watershed. This information will be provided by the local Soil and Water Conservation Districts, Natural Resource Conservation Service and the County Health Departments. A measure of success for the education aspect of the plan will be the number of programs provided and the attendance of the community. It is anticipated that as awareness of the watershed increases that the interest in monitoring local streams will increase and that this data will also be used to evaluate and monitor the success of the plan at improving the water quality.

The ultimate responses that the Project hopes will come out of this planning process is:

- Increased awareness in the community of the Paint Creek Watershed and
- Water quality in the watershed meeting use designations with QHEI scores consistently improving.

This watershed is slated to be sampled by the Ohio EPA Ecological Assessment Unit in 2006 with a TMDL completion date of 2008. Paint Creek received it's first intensive sampling effort in 1997 so the project will also be able to look for any changes from one sampling period to the next and compare that with the work the Project that has already completed.

The progress of the plan will be made available to interested local and state governments as well as all watershed citizens' trough newsletters, brochures, news articles, radio programs and at some point a web site. These duties will be the responsibility of the Watershed Coordinator and the Paint Creek Joint Board of Supervisors along with the Sub-watershed Work Groups.

It is anticipated that as a working document, the plan will be revised yearly after the progress meetings have determined the successes and failures.

The Paint Creek Watershed Project is pleases to have had the involvement of the following people and organizations in the completion of this community based watershed action plan.

Name	Association	City
Agriculture Subgroup		
Hugh Trimble	Ohio EPA	Dayton
Gordon Conn	Farmer	Jeffersonville
Dave Parry	NRCS	Hillsboro
Vince Chrisman	Fayette SWCD	Washington CH
Dave Sever	Sever Consulting	Washington CH
Eric Rutherford	Landowner	Wilmington
David Caplinger	Landowner, SOFA	Hillsboro
Rosida Porter	Ohio DNR	Columbus
Forestry Subgroup		
Heidi Devine	Ohio DNR, Div of Wildlife	Xenia
Lee Crocker	Ohio DNR, Div of Forestry	Waverly
Mike Besonen	MeadWestvaco	Chillicothe
Chris Smid	MeadWestvaco	Chillicothe
Randy Sanders	Ohio DNR	Columbus
Joey Knauff	Knauff Lumber/ Master Loggers	Bainbridge
Education Subgroup		
Sam Webb	Pickaway SWCD	Circleville
Jenny Behymer	Landowner	Hillsboro
Layne Garringer	Fayette SWCD	Washington CH
Steve Hawkins	Ohio DNR/DSWC	Circleville
Jerry Iles	OSU Extension	Jackson
Urban Subgroup		
Julia Cummings	Madison SWCD	London
Steve Sobers	City Manager	Washington CH
Streamside Management Subgroup		
Dot Riley	NRCS	Grove City
Gordon Conn	Farmer	Jeffersonville
Gary Merkamp	Ross County Park District	Chillicothe
Randy Hoover, Kipp Brown	Ohio DNR, Div of Wildlife	Xenia
Bob Jones	Landowner, former Army COE	Bainbridge
Dan Imhoff	Ohio EPA	Logan
Marty Lundquist	Ohio DNR, Div of Wildlife	Columbus
Paula Wentzel	MeadWestvaco	Chillicothe