Yellow Creek Watershed Action Plan

Executive Summary

The Yellow Creek Watershed Action Plan is designed as a comprehensive document encompassing the threats, impairments, and proposed improvements to the Yellow Creek Watershed. These improvements will be made in order to protect areas showing exceptional water quality, and to improve the water quality in areas not meeting Clean Water Act standards. It has been compiled with research supplied by several agencies and contains input from stakeholders and the community at large.

The Yellow Creek Watershed was chosen as the first watershed in Jefferson County to receive a watershed action plan for several reasons: first, Yellow Creek had an active citizen's group whose formation was motivated by acid mine drainage concerns (This coalition has since branched out to address other water quality concerns and is a major asset to any remediation attempts); second, a Total Maximum Daily Load study was published for the Yellow Creek Watershed in 2009; finally, an Acid Mine Drainage Abatement and Treatment Plan was completed on July 31, 2008.

Yellow Creek has been designated as a priority watershed for restoration, with several known causes of impairment. These impairments and their sources, which were detailed in the 2009 Yellow Creek Watershed TMDL, include: failing home sewage treatment systems, cattle access to streams, eutrophication from lakes, acid mine drainage, sedimentation contributed by ATV use, and lack of sewer treatment systems in incorporated areas. By identifying the water quality impairments in Yellow Creek, outlining strategies to amend these issues, and identifying the involvement necessary for remediation the Watershed Action Plan will serve as a guide for the watershed group and its partners to bring all stream segments into full attainment of water quality standards. These goals will be reached by the installation of BMPs, and restoration projects specific to issues such as sedimentation, acid mine drainage, etc. Ultimately these efforts aim at leading to the removal of Yellow Creek form the 303(d) List of Impaired Waters under the Clean Water Act.

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Plan Endorsement

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Jefferson County Commissioners

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Carroll Soil and Water Conservation District

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Columbiana Soil and Water Conservation District

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Columbiana County Commissioners

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OEPA

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ODNR

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Yellow Creek Watershed Restoration Coalition

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AMD	Acid Mine Drainage
BMP	Best Management Practices
CRP	Conservation Reserve Program
DEFA	Department of Environmental Financial Assistance
EQIP	Environmental Quality Incentive Program
FSA	Farm Service Agency
GIS	Geographic Information System
GPS	Global Positioning System
HUC	Hydrologic Unit Code
HSTS	Household Sewage Treatment Systems
IBI	Index of Biological Integrity
ICI	Invertebrate Community Index
NPS	Non Point Source Pollution
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
OSUE	Ohio State University Extension
NRCS	Natural Resources Conservation Service
RC&D	Resources Conservation and Development
RM	River Mile
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load
USGS	United States Geological Society
WWTP	Wastewater Treatment Plant
319	Section 319 of the Clean Water Act
YCWRC	Yellow Creek Watershed Restoration Coalition

Table 2. Unit Descriptions

CFU	Colonies per forming unit
Kg	Kilogram
L	Liter
Mg	Milligram

Section I. Watershed Overview

Chapter I. Introduction

Updates and Revisions

This document is designed to identify roles to be filled and actions to be completed by both citizens and agencies in the Yellow Creek Watershed in order to accomplish the previously stated goals. As a living document, it may be changed as more data is collected, projects are implemented, and action items are completed. The plan is designed to identify problems and discuss projects for the next ten years, but will be updated during that time. The plan will be evaluated yearly by stakeholders and members of the technical advisory committee and any additions to the plan may be submitted to the watershed coordinator or the Jefferson Soil and Water Conservation District.

This management plan was authored under the premise of *adaptive management* which suggests that future management planning will evolve based on the findings and recommendations of this Plan. Watershed conditions experience constant change and this Plan attempts to identify priority projects for the next five to ten years.

Previous Water Quality Efforts

Watershed planning and restoration activities have been underway in the Yellow Creek Watershed since 1998, since the formation of the Yellow Creek Watershed Committee, later renamed the Yellow Creek Watershed Restoration Coalition. In 2000, an early draft of the Yellow Creek Watershed Plan was developed by Carroll Soil and Water Conservation District, Jefferson Soil and Water Conservation District and the citizen's advisory committee.

Water quality studies in the Yellow Creek Watershed include the efforts of the Ohio EPA and the Division of Mineral Resource Management. An Acid Mine Drainage Abatement and Treatment plan for the Yellow Creek Watershed was developed by the Division of Mineral Resource Management in 2008. Ohio EPA completed sampling for a Total Maximum Daily Load (TMDL) study in 2005 and the full report and technical support documents for the Yellow Creek Watershed TMDL were published in November 2009.

Watershed Approach

A watershed is an area of land that drains water to a particular stream, river, lake or wetland. Yellow Creek, a direct tributary to the Ohio River, is a part of the Upper Ohio River Watershed which in turn is a part of the Mississippi-Atchafalaya River Basin, the largest river basin in North America.

The Yellow Creek Watershed Action Plan was created with a "watershed approach," an approach which uses hydrologically defined areas (watersheds) to coordinate the management of water resources. The approach is advantageous because it considers all activities within a landscape that affect watershed health. Ideally, this approach will integrate biology, chemistry, economics and social considerations into decision-making. It considers local stakeholder input as well as national and state goals and regulations. We all live in a watershed, and our individual actions can directly affect it. (Ohio Watershed Network)

Fig. 1: Watershed Model produced by Natural Resources Conservation Service

Watershed Facts

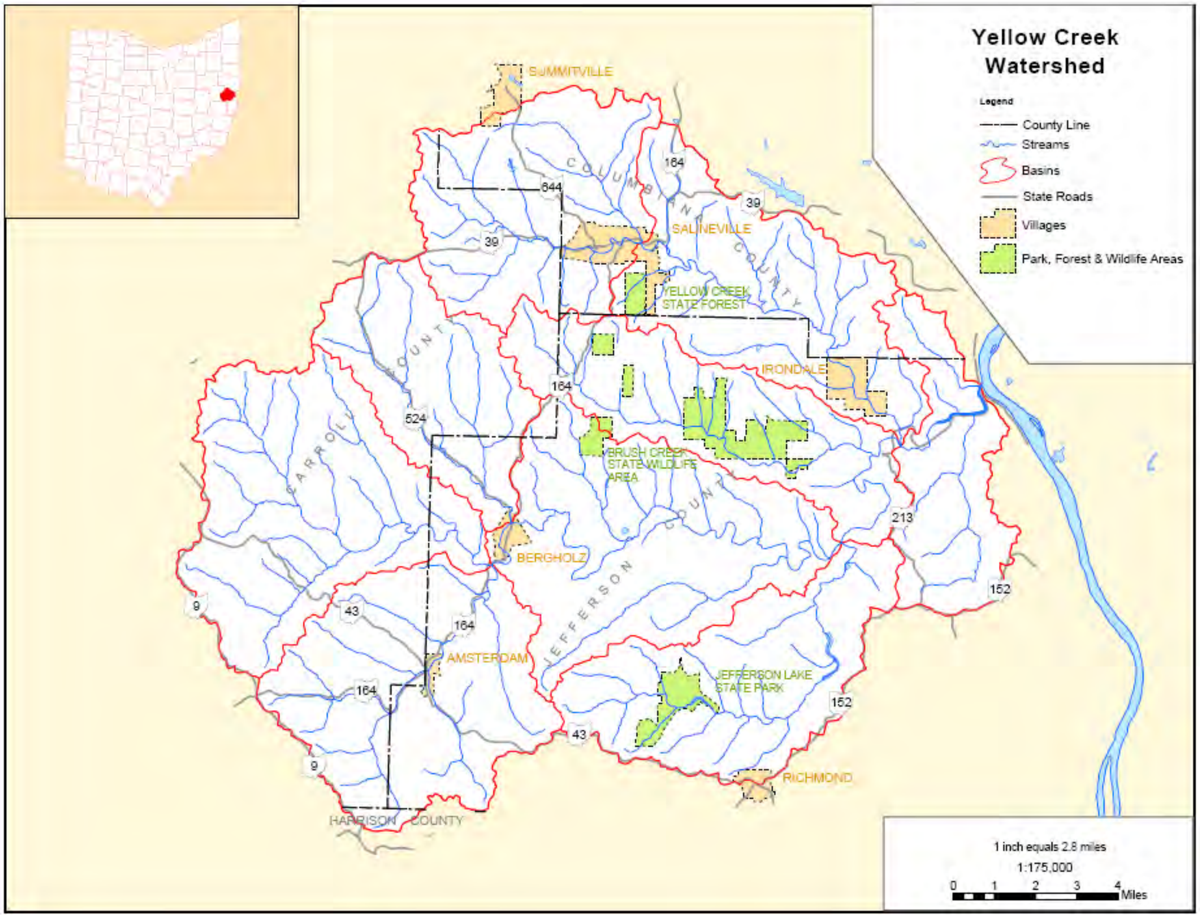

Fig. 2: Yellow Creek Watershed Map (Novacek)

Yellow Creek Watershed is a part of the Upper Ohio River Watershed which in turn is a part of the Mississippi-Atchafalaya River Basin, the largest river basin in North America. The Mississippi River has a negative effect on habitat and wildlife upon entering the Gulf of Mexico. The hypoxic zone in the northern Gulf of Mexico was forecast to be 8,456 to 9,668 square miles in 2010.

Fig. 3: Mississippi Watershed Map (USEPA)

Produced by USEPA

Hypoxia refers to a body or section of water where the dissolved oxygen level is below 2mg/l.

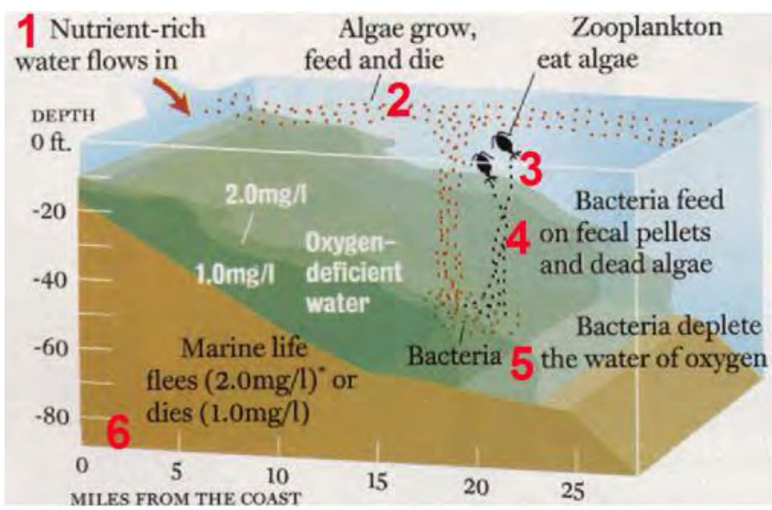

Fig. 4: Hypoxia Diagram (Louisiana Universities Marine Consortium)

These “dead zones” are avoided by mobile species and can kill species that are unable to escape these low-oxygen waters. They are caused by excess nutrients such as phosphorus and nitrogen related to land use throughout the Mississippi Watershed. Upon entering the gulf these nutrients create massive algal blooms. During the decomposition process of the algae oxygen is depleted from surrounding waters. Oxygen exchange with the atmosphere is inhibited in this instance by the stratification of the water column where the Mississippi River meets the Gulf of Mexico. (Mississippi River/Gulf of Mexico Watershed Nutrient Task Force) Non-point source pollution throughout the entire Mississippi River Watershed is a major contributor to the hypoxic conditions in the Gulf of Mexico.

Yellow Creek Watershed Restoration Coalition

Founded in 1998, the Yellow Creek Watershed Restoration Coalition is a grassroots group composed of concerned citizens, land owners, business owners, and local, state, and federal governmental agencies and was formed to preserve and restore the quality of the Yellow Creek Watershed. The Coalition began when Brush Creek Township trustees contacted the Jefferson Soil and Water Conservation District out of concern for acid mine drainage pollution in area streams. Since then other sources of pollution in the watershed have been discussed at bi-monthly meetings and through surveys of watershed residents. The YCWRC is now an incorporated 501(c) 3 organization that has grown in size and capacity since its inception thirteen years ago. The Coalition’s mission is to restore and protect the water quality in the Yellow Creek Watershed. The Coalition has adopted bylaws and a Conflict of Interest Policy that it endorses yearly.

Prioritization of Yellow Creek Watershed Restoration Coalition concerns

1. Illegal Dumping
    a. Enforce Dumping Laws
    b. Turn In a Dumper Program
    c. Promote Tire & Appliance Collection
    d. Clean-Up Major Dump Sites
    e. Promote/Educate about Pesticide Disposal

2. Reclaimed Strip-Mine Ground
    a. Prioritize Cost Benefit for Reclamation Projects

3. Install Acid Mine-land Drainage (AMD) Treatment System

4. Mining Regulation – Seek policy adoption for larger setbacks from streams

5. Promote Reforestation
    a. Promote Best Management Practices (BMP) Certification for Loggers
    b. Partner with Steel Valley Logger’s Chapter
    c. Landowner’s Forestry Seminars

6. Household Water Treatment
    a. Educate Developers and Homeowners about Septic Systems
    b. 319 Money for Septic Improvements
    c. Enforce Existing Regulations
    d. Better oversight of Land Application of Sewer / Septic Sludge
    e. Seek funding for Sewer Systems in communities without sewers
    f. Assess Scope of Impact from Septic System (# of Systems)

7. Cost Share for Farmers – Conservation Practices
    a. Cattle Exclusion from Streams and Woods
    b. Develop Nutrient Management Plans
    c. Determine Miles of Stream Cattle Have Access to
    d. Grazing Land Training / Education

8. Education on Land Usage Impacting Water Quality
    a. Educate ODOT on Reseeding Jobs

Results of Yellow Creek Watershed Resident Survey

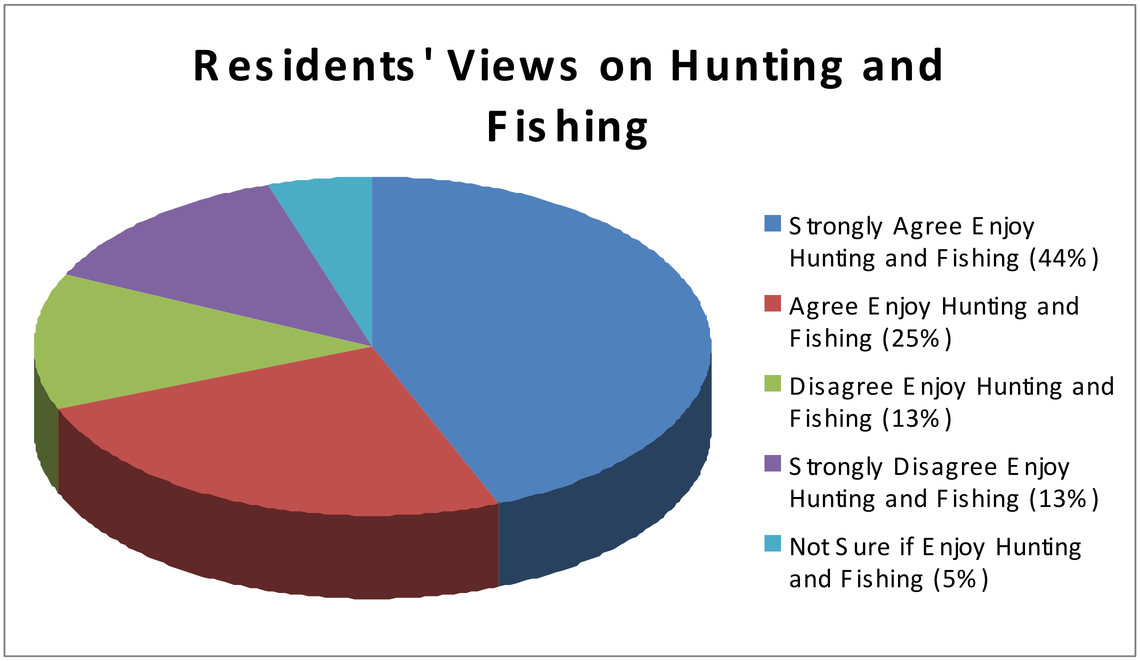

Fig. 5: Chart of Residents' views in hunting and fishing.

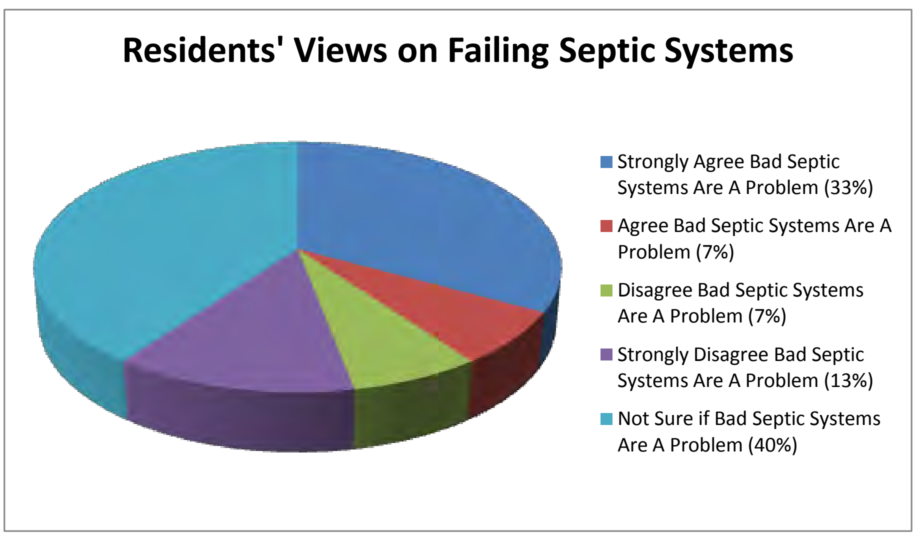

Fig. 6: Chart on Residents' view on failing septic systems.

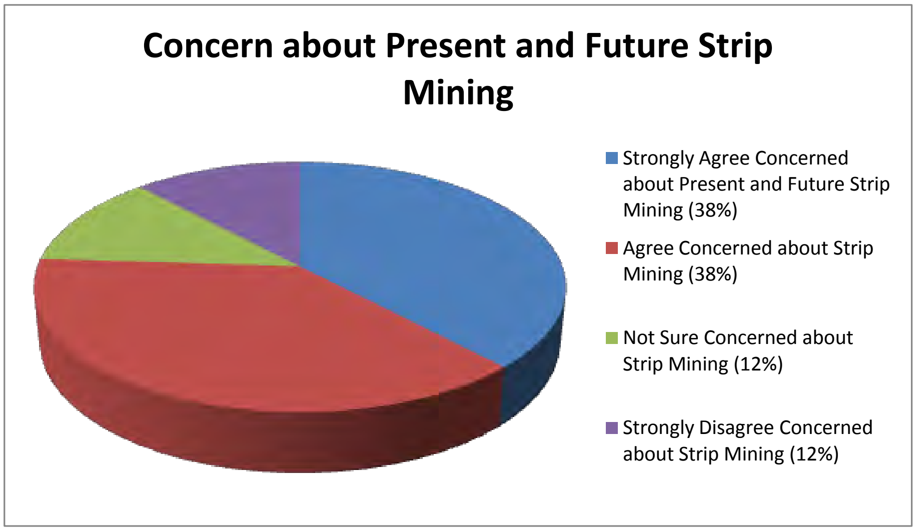

Fig. 7: Chart on concerns about present and future strip mining.

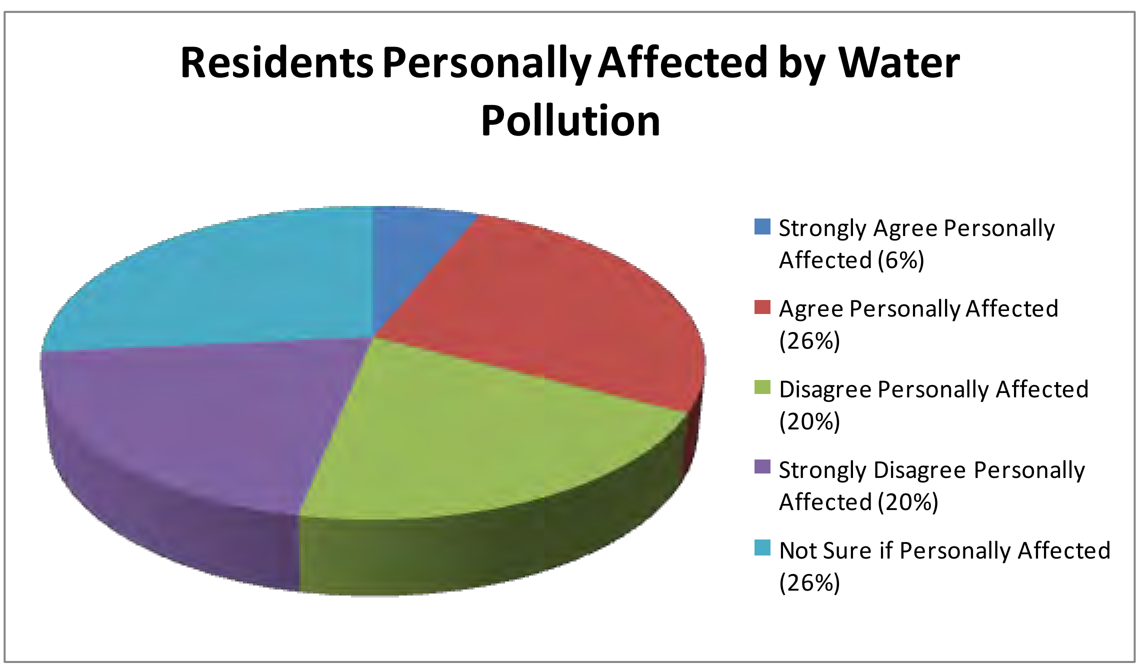

Fig. 8: Chart on residents' personally affected by water pollution.

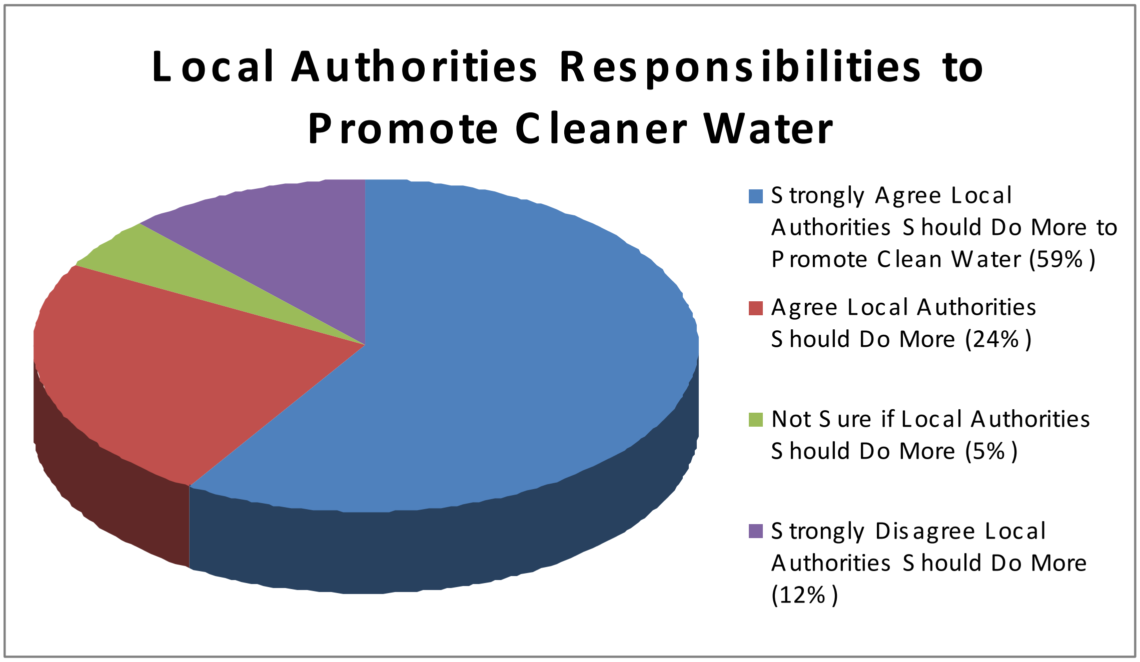

Fig. 9: Chart on local authorities responsibilities to promote cleaner water.

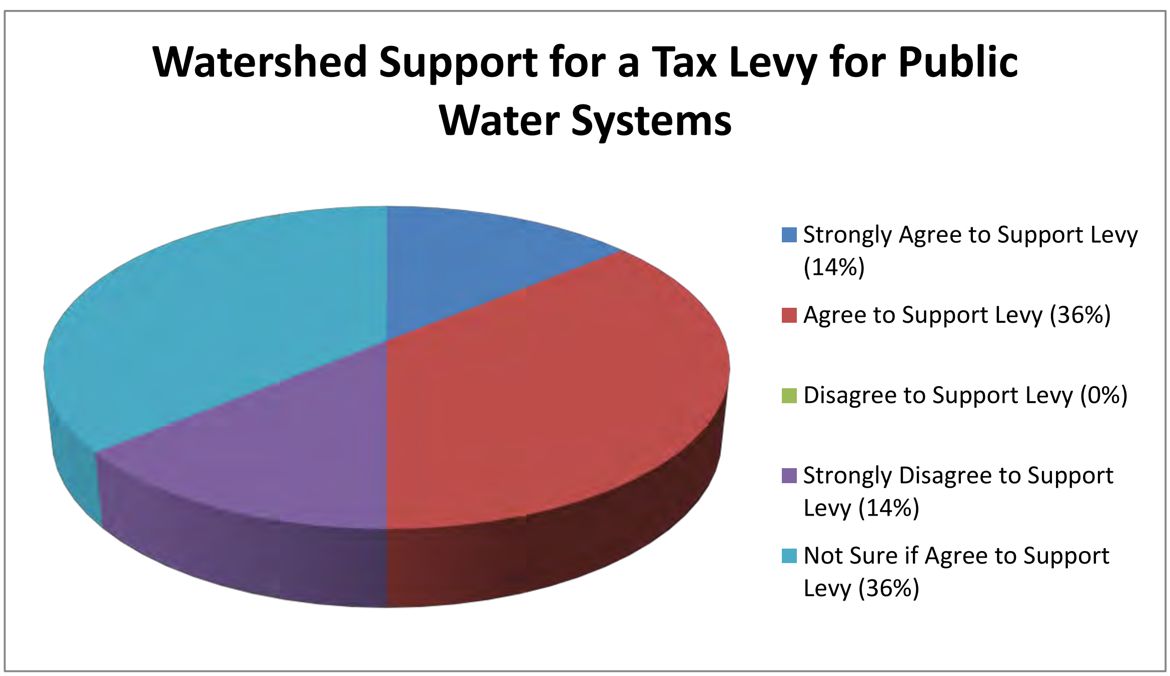

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Fig.10: Chart on Watershed Support for a tax levy for public water systems.

Yellow Creek Watershed Activities

Table 3. Monetary Activities

Grants Received	Providing Funding For
$500 - Jefferson Soil & Water Conservation District (1998)	Forming a citizen's group to promote the improvement of water quality
$10,000 - Crossroads RC&D - Ohio EPA 319 Inventory Grant (1998)	water monitoring, cost of meeting room space, data entry, printing and publishing newsletter, printing and publishing inventory, airing a commercial, drafting a Yellow Creek Watershed Plan, and aiding the Hopedale GIS Station fund
$500.00 Women in Mining (May 1999)	purchase and planting of Pisolithus Tinctorius (PT) inoculated trees on the spoil banks of old mining operations within the watershed.
Office of Surface Mining (April 2000)	hiring an intern to assist with public relations, water monitoring and the purchase of the GIS station in Hopedale, Ohio.
Watershed Awareness to Watershed Action (WAWA) (2000)	watershed festival, logo promotion for the Yellow Creek Watershed Restoration Coalition, purchase an enviroscape, display board and saplings for a tree planting.
VISTA (Volunteer in Service to America)	Staff assistance in coordinating an inventory and assessment in current water quality.
$750 donation, Bergholz Community Foundation (February 2006)	Administration for Yellow Creek Watershed Restoration Coalition
$625 – Carroll Community Foundation (2011)	Creation of rain gardens at Bell-Herron Elementary School Carroll County
$400 – Community in Action Award (March 2011)	Stream monitoring with Southern Local students and purchase of knee boots.
$960 - JB Green Team grant (2011)	Purchase and installation of a trail camera for use at illegal dumping sites.
$700.00- Carroll Community Foundation (2012)	Expansion of rain gardens at Bell-Herron Elementary School in Carroll County

Educational Activities

Provide school presentations on water quality monitoring techniques, acid mine drainage and water quality assessment.

Fig. 11: Enviroscape Model (ODNR)

The enviroscape model is used for classroom demonstrations for grades K-12. It is an education tool to exhibit how everyday activities can result in Non-Point Source Water Pollution (NPS). Students in the watershed are also being educated on the aspects of biological and chemical water quality monitoring. On-site stream monitoring with middle school students from Stanton Middle School is an annual event on the main stem of Yellow Creek.

Provide public information through the JSWCD newsletter.

Jefferson County residents are provided with information specific to Yellow Creek and told of upcoming events through the Jefferson Soil and Water Conservation District newsletter. Some of the highlights include:

Conducted public trash pick-ups and participate in Ohio River Sweep

The Yellow Creek Watershed Restoration Coalition has participated in the Ohio River Sweep annually since 2000. They also organize a separate litter clean up in the fall, which rotates based on area need.

Fig. 12: Yellow Creek Litter Pick-Up (Stocklein)

Bi- Monthly Meetings

The Yellow Creek Watershed Restoration Coalition meets bi-monthly to discuss matters that the citizens of the watershed deem important. Acid mine drainage treatment, education and outreach, events planning, rain garden implementation, and other activities are discussed at these meetings.

Fig. 13 YCWRC (Stocklein)

Practical Public Education and Outreach

Fig. 14: FirstEnergy Sammis Plant Tour (Corder)

The coalition has sponsored four tours –through a neighboring watershed with similar acid mine drainage impairments, the FirstEnergy Sammis power plant and gypsum landfill, the Buckeye Industrial Mining Operation, and the Apex landfill.

The coalition toured the nearby Huff Run watershed to familiarize coalition members and stakeholders with AMD treatment systems and how they are positively affecting water quality.

The Coalition had the opportunity to tour the recently updated Sammis power plant near Stratton, Ohio. After touring the addition to the facility, they traveled to the gypsum landfill site which is located in the Yellow Creek Watershed. Tour attendees were informed of the safety and environmental measures that were involved in protecting surface and ground water at the site of the

Fig. 15: Buckeye Mine Tour (Corder)

gypsum landfill.
A tour of one of the active mines in Yellow Creek occurred in the spring of 2006. While the operation was a deep mine, the tour remained above ground and discussion points included the environmental controls used onsite and the differences in pre- and post-law mining.

The development of the Apex landfill in the watershed was a heavily contested event. After operating without incident for several years, members of the Coalition were given a tour of the facility and informed once again on the environmental controls employed at the landfill. Wetland mitigation areas at the landfill were viewed, as well as daily operational procedures.

Fig.16: YCWRC tour of Apex Environmental Landfill (Stocklein)

Fig.17: YCWRC tour of Apex Environmental Landfill (Stocklein)

Fig. 18: Bell-Herron Rain Garden Planting (Corder)

Public awareness through displays at community events and watershed festivals

Since its inception, the Coalition has held five watershed festivals and has participated in numerous community events. The Yellow Creek display, along with publications pertaining to water quality, are available to the public, as is information on conservation and remediation updates specific to the watershed.

Fig. 19: YCWRC Field Day (Zadanski)

Rain Garden installation at two area schools

Fig. 20: Stanton Rain Garden Planting (Corder)

Through grants received from Heritage-WTI waste incinerators and the Carroll Community Foundation the Yellow Creek Watershed Restoration Coalition was able to install rain gardens at both Stanton and Bell-Herron Middle Schools. Students were informed on the effects that impervious surfaces can have on our waterways, and what can be done to offset that impact. Stanton Elementary seventh grade students worked together installing native rain garden plants. Many of the native plants and materials needed for this project were donated by local nurseries and other businesses. Stanton Elementary is located near the floodplain along the main stem of Yellow Creek.

Seventh grade students at Bell-Herron middle school in Carrollton are seen in the photo above amending soil at the site of their rain garden. Many of the students who attend Bell-Herron live in the headwater region of the Yellow Creek Watershed that includes the eastern portion of Carroll County.

Outreach and Education by Yellow Creek Watershed Restoration Coalition

On March 13th, 1998, a meeting was held to discuss the restoration of the Yellow Creek Watershed. Jefferson Soil and Water Conservation District provided a $500 grant to help form a citizens group, the Yellow Creek Watershed Restoration Coalition (YCWRC), to promote the improvement of water quality.

Crossroads RC&D received an Ohio EPA 319 Inventory Grant of $10,000 in 1998 to be used to support the developing YCWRC's efforts. This grant was used to assist in water monitoring, the cost of meeting room space, data entry, printing and publishing newsletters, printing and publishing inventory, and funding a commercial to build public support for the Yellow Creek Watershed on WTOV9. The grant was also used to provide Carroll Soil and Water Conservation District, Jefferson Soil and Water Conservation District and the YCWRC funds to draft a Yellow Creek Watershed Action Plan in 2000. A portion of the grant was also used to contribute funds towards the GIS station in Hopedale, Ohio. The YCWRC began meeting monthly as a citizen's advisory committee to government agencies shortly thereafter.

In May of 1999, a $500.00 Women in Mining grant administered by Jefferson Soil and Water was used to purchase and plant PT inoculated trees on the spoil banks of old mining operations within the watershed. Jefferson Soil and Water also administered another grant in 2000 from the Watershed Awareness to Watershed Action, which was used to fund a watershed festival, logo promotion for the Yellow Creek Watershed Restoration Coalition, purchase an enviroscape, display board and saplings for a tree planting.

The Jefferson Soil and Water Conservation District received a grant in April of 2000 from the Office of Surface Mining, which was used to hire an intern for Yellow Creek Watershed Restoration Coalition to assist with public relations and water monitoring.

In cooperation with the Environmental Quality Incentive Program, the Natural Resource Conservation Service provided a 75% cost share to qualified landowners from 2001-2003. This cost share was put towards specified conservation practices, such as tree plantings, fencing, manure storage structures, brush management, spring development, grazing management, and nutrient management. The final amount dispensed by the Natural Resource Conservation Service for this program was $70,000.

Table 4. Yellow Creek Watershed Stakeholders

Partner	**Organization Type**	**Primary Role**
Bergholz Community Foundation	Civic group	Financial
Bergholz Volunteer Fire Department	Outreach	Outreach
Carroll County Regional	Local government agency	Technical

Planning Office		
Carroll Soil and Water Conservation District	Local government agency	Financial/technical
Columbiana Soil and Water Conservation District	Local government agency	Financial/technical
Crossroads RC&D	not-for-profit organization	Outreach/technical
ODNR/Division of Mineral Resource Management	State government agency	Outreach/technical
Eastern Gateway Community College	Academic Institution	Outreach/technical/education
Franciscan University of Steubenville	Academic Institution	Technical
Jefferson-Belmont Solid Waste District	Local government agency	Financial/technical
Jefferson County General Health District	Local government agency	Outreach/technical
Jefferson County Data Processing	Local government agency	Technical
Jefferson Soil and Water Conservation District	Local government agency	Technical/Outreach/Financial
Keep Jefferson County Beautiful	Local government agency	Outreach/Financial
Natural Resource Conservation Service	Federal government Agency	Technical/Financial
Ohio Breeding Bird Atlas II		Outreach/Education

ODNR/Division of Soil and Water	State government Agency	Technical/Financial
Ohio Environmental Council	Non-profit organization	Outreach
Ohio EPA	State government agency	Technical/Financial
Ohio Mineland Partnership		Technical
OSU Extension-Watershed team, Jefferson, Carroll, Columbian offices	Academic Institution	Technical/Education
Saline Twp Trustees	Local government	Outreach
Springfield Twp Trustees	Local government	Outreach
Voinovich School of Leadership & Public Affairs	Academic Institution	Technical
Yellow Creek Watershed Restoration Coalition	Civic group	Outreach/Education/Technical
Cleveland Museum of Natural History	Museum	Technical
Western Reserve	Land Conservancy	Technical/Education
Ohio University/Voinovich School	University	Technical

Water Quality

The Ohio EPA uses several structural indices to measure habitat quality and assess the health of aquatic communities in order to determine use designations. Indices used by the Ohio EPA are the Index of Biotic Integrity (IBI), the Invertebrate Community Index (ICI) and the Qualitative Habitat Evaluation Index (QHEI).

The IBI is a measure of fish species populations and species diversity. The criteria used to establish the index reflect the biological performance exhibited in natural or least impacted habitats. The IBI index is a number that reflects total native species composition, indicator species composition, pollutant intolerant and tolerant species composition, and fish condition.

The highest possible score is 60, with higher scores indicating healthier aquatic ecosystems. Depending on the pollution tolerance of individual species, the IBI is a general indicator of which species are likely to be found in a given stream.

The ICI is derived from measurements of the macroinvertebrate communities living in a stream or river. The ICI is particularly useful in evaluating stream health because a large number of macro-invertebrate taxa are known to be either pollution tolerant or intolerant. Like the IBI, the ICI scale is 0-60, with higher scores reflecting healthier macroinvertebrate communities and therefore more biologically diverse aquatic ecosystems.

The QHEI is a quantitative assessment of the physical characteristics and in-stream geography of streams and rivers (Rankin, 1989). The QHEI is essential in evaluating land use practices and stream disturbance. Six variables comprise the QHEI metric: substrate type and quality, in-stream cover, channel morphology, riparian zone, pool quality, and riffle quality. The QHEI scale is 0-100, with higher scores reflecting less disturbed and therefore higher quality streams.

The Ohio Water Quality Standards stated in chapter 3745-1 of the Ohio Administrative Code defines designated uses and associated chemical, physical, and biological criteria for surface waters. The standards are designed to represent measurable properties of the environment consistent with the goals of each use designation. Rivers and streams in Ohio are assigned "use designations" that reflect their suitability for commercial and recreational activities and determine biological potential based on in-stream habitat and watershed characteristics. Water quality standards are then established to support those uses. In applications of Ohio water quality standards to management of water resource issues, aquatic life use criteria frequently control protection and restoration requirements. Generally, emphasis on protecting aquatic life results in attaining water quality suitable for all uses, hence the emphasis of aquatic life uses in water quality reports and planning. The five different aquatic life uses currently defined in the Ohio water quality standards which are potentially applicable to streams in the Yellow Creek watershed, and the intent of each with respect to the role of biological criteria, are described in the following section. Currently, all recommended uses for the Yellow Creek basin are subject to a future WQS rulemaking which has not yet been completed. Table 5 summarizes the minimum biological criteria scores for each habitat designation in the Western Allegheny Plateau Ecoregion, of which southeast Ohio is a member. (McCament, 2007)

Table 5. Ecoregion Biocriteria: Western Allegheny Plateau (OEPA, 2001)

	EWH	WWH	MWH(Channel Modified)	MWH (Mine Affected)	LRW-AMD	CWH*
QHEI	**75**	**60**	**45**	**45**	**NA**	**NA**
ICI	**46**	**36**	**22**	**30**	**8**	**NA**
IBI*	**50**	**44**	**24**	**24**	**18**	**NA**

wading and headwater sampling methodology

* Attainment of the coldwater habitat (CWH) use designation is based on the presence of specific numbers of cool/cold water indicative fish and macroinvertebrate populations. In addition, structural and compositional elements of the community should be, at minimum, similar to those found in WWH streams and, on occasion, EWH streams.

Warmwater Habitat

This designation defines the typical warmwater assemblage of aquatic organisms in Ohio's rivers and streams; waters so designated are capable of maintaining a balanced, integrated, and adaptive community of warmwater aquatic organisms. Biological criteria are stratified across five ecoregions for the WWH designation. This aquatic use designation represents the principal restoration target for the majority of water resource management planning in Ohio.

Exceptional Warmwater Habitat (EWH)

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

Modified Warmwater Habitat (MWH)

This designation applies to streams and rivers that have been found incapable of maintaining a balanced, integrated, and adaptive community of warmwater organisms. Streams and rivers designated MWH have been subjected to extensive and essentially permanent hydrological modifications and/or excessive mine run-off. Aquatic assemblages in these streams generally comprise species that are tolerant of low dissolved oxygen, silt, and high nutrient concentrations.

What is Nonpoint Source Pollution?

Nonpoint source pollution, unlike pollution from industrial and sewage treatment plants, comes from diffuse sources. NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, depositing them into lakes, rivers, wetlands, coastal waters and even our underground sources of drinking water.

These pollutants include:

• Excess fertilizers, herbicides, and insecticides from agricultural lands and residential areas

• Oil, grease, and toxic chemicals from urban runoff and energy production

• Sediment from improperly managed construction sites, crop and forest lands, and eroding streambanks

• Salt from winter road practices

• Acid Mine Drainage from Abandoned Mines

• Bacteria and nutrients from livestock, pet wastes, and faulty sewage treatment systems

(Source: EPA's Polluted brochure EPA-841-F-94-005, 1994)

Environmental Policies and Programs in the Yellow Creek Watershed

Clean Water Act (CWA)

Selected programs that resulted from the CWA, and are relevant for the Yellow Creek Watershed, include: the Total Maximum Daily Load (TMDL) program, Section 319 nonpoint source management programs, and a permitting system called the National Pollutant Discharge Elimination System (NPDES) that includes the Storm Water Program.

When the CWA was reauthorized through the Water Quality Act of 1987, new emphasis was placed on controlling nonpoint sources of pollution. Section 319 of the CWA compels states to identify waters that are threatened by nonpoint sources of pollution and develop programs to reduce and eliminate this type of “poison runoff.” The State of Ohio is in the process of updating its program that deals with nonpoint source pollution.

Total Maximum Daily Load Program (TMDL)

The TMDL program was established under Section 303(d) of the CWA to assess water quality of surface water bodies (e.g., streams, lakes) and develop recommendations for pollution reduction to meet specific water quality standards.

The process includes an assessment of waterbody health (biological, chemical, and habitat), the development of a restoration target, and recommendations for implementing solutions, and validation to monitor progress. This program is essentially a pollutant “budget” for restoring impaired water bodies in order that they may fully attain designated use(s). Regulations that the

US Environmental Protection Agency (USEPA) set forth in 1985 and amended in 1992 remain in effect for the TMDL program.

The State of Ohio, much like all other states, is compelled by law to assess the quality of state waters relative to their designated use(s), identify waters that are impaired for one or more of their designated uses, and develop a TMDL for remedial action where appropriate. The "Total Maximum Daily Loads for the Yellow Creek Watershed– Final Report" is a product of this program that was developed by the Ohio Environmental Protection Agency (OEPA) and released to the public in November, 2009.

National Pollutant Discharge Elimination System (NPDES) Stormwater Program

The NPDES Stormwater Program was developed by the USEPA in response to the 1987 Amendments to the CWA. The Phase I program was implemented in 1990 and requires discharge permits for medium and large municipal separate storm sewer systems (MS4s) located in cities and counties with populations of 100,000+, selected industrial activity, and construction activity with soil disturbance of 5+ acres. At the end of 1999, the USEPA expanded the NPDES Stormwater Program with the release of the Phase II Final Rule published in the Federal Register. This ruling required discharge permits for small MS4s (selection based on US Census data) and construction activities with 1-5 acres of soil disturbance. There are no Phase II communities within the Yellow Creek watershed. Construction activities where the development plans disturbance of one acre or more within the Yellow Creek watershed do require NPDES Phase II permits.

Pollution control expectations center on implementation of programs and practices to control polluted storm water runoff through the use of NPDES permits. The Phase II program approach attempts, among other things, to facilitate and promote watershed planning and to implement the storm water program on a watershed basis (USEPA, 2000). Storm water management, therefore, will play an increasingly important role in both the planning and implementation of watershed action plans that aim to remediate impaired waterbodies.

Section 319 also serves as a significant source of federal funding, channeled through the states, for programs (e.g. BMP adoptions) that are designed to reduce nonpoint source pollution. State-endorsed Watershed Action Plans are currently an eligibility criteria/requirement for Section 319 funding in Ohio. Pollution reduction strategies outlined in Chapter 6 are designed to facilitate application for and approval of future Section 319 grants.

Safe Drinking Water Act (SDWA)

The SDWA created a federal program to monitor and improve the safety of the nation's drinking water supply. The SDWA authorizes the USEPA to set and implement drinking water standards to protect against both naturally occurring and man-made contaminants in public drinking water. The roots of Ohio's Source Water Protection Plan, a program to assist public water suppliers in protecting their sources of drinking water (streams and aquifers) from contamination, can be traced back to the SDWA.

Ohio's Source Water Protection Program addresses only public water systems and features two phases. The first phase is an assessment phase which involves delineating the area in need of protection, identifying the potential contaminant sources in that area, and determining the susceptibility of the drinking water source(s) to potential pollution. The OEPA reported that this phase was better than 99% complete for Ohio's community public water systems by January 2004. The second phase, just getting underway, involves developing and implementing a local drinking water source protection plan. This second phase is led by the public water system owner/operator with assistance from others, including local watershed groups. It makes sense that these source water protection plans be integrated into watershed action plans as both strive to protect the vital water resources necessary for human health, ecosystem health, and a healthy economy. In the OWC watershed, water is provided to residents and businesses through Erie County Department of Environmental Services and Northern Ohio Rural Water. Both agencies distribute water purchased from the cities of Sandusky, Huron, and Vermilion, whose source water is taken directly from Lake Erie. Although the Safe Drinking Water Act may act as a key driver of watershed planning efforts, this act is not directly tied to the OWC watershed due to the absence of a source water intake within its boundaries.

Farm Bill Programs
This first farm bill was in effect after the Agricultural Adjustment Act of 1933 which was set to aid in regulation of crop production prices. In 1935 The Soil Conservation Act was passed which provided for funding of soil conservation practices being used in crop production. It wasn't until the 1980s that the conservation programs expanded to encompass natural resource conservation as well as soil erosion reduction. In the 1985 Farm Bill, Highly Erodible Land Conservation ("Sodbuster"), Wetland Conservation ("Swampbuster"), and Conservation Reserve Programs were introduced to protect lands more vulnerable to soil loss and provided protection of wetland areas at risk of being converted to crop land. The 2008 Farm Bill has several conservation programs for protecting our natural resources including: wetland creation and protection, pasture management, manure storage, nutrient management, tillage practices, wildlife enhancements, and erosion control. In the Yellow Creek Watershed, three programs are available to be utilized by agricultural producers: Conservation Reserve Program (CRP), Environmental Quality Incentives Program (EQIP), and Conservation Security Program (CSP).

Conservation Reserve Program (CRP).
This program was designed to transfer highly erodible land from crop production to conservation status. This program provides annual rental payments based on the length of the agreement and cost shares up to 50% to assist with conversion of land to less intensive use. The requirements of the producer are to develop and implement a plan for land conversion, agree to a term of 10-15 years for the practice, and meet land eligibility requirement of the program.

Environmental Quality Incentive Program (EQIP). This program was designed to mitigate environmental problems associated with farming operations. This program has been used to assist with livestock waste facilities, stream fencing, livestock crossing, waterways, and wildlife habitats. The cost share provided by this program is up to 75% for a period of 1-10 years. All private land in agricultural production is eligible if the producer agrees to develop and follow an EQIP plan that describes the conservation practices and environmental benefits to be achieved.

Conservation Stewardship Program (CSP- Formerly Conservation Security Program). This program was designed to provide incentives to producers that have implemented various conservation practices in their farm operation based on the number of environmental concerns resolved. The CSP provides annual payments based on the length of the agreement and the level qualified by the producers' conservation practices (total of three tiers). To qualify, the producer must have land incorporated into farming operations, agree to a 5-10 year length of agreement, and install/maintain conservation practices on working lands.

Chapter II. Yellow Creek Watershed Inventory

Administrative Boundaries

Table 6. Counties in the Yellow Creek Watershed

Carroll	31.3% of watershed
Columbiana	15.6% of watershed
Harrison	.3% of watershed
Jefferson	52.8% of watershed

Table 7. Villages in the Yellow Creek Watershed

Amsterdam	Bergholz
Irondale	Salineville
Summitville	

Table 8. Jefferson County Townships

Brush Creek Springfield	Knox
Salem	Saline
Ross	

Table 9. Carroll County Townships

Center	Fox
Lee	Loudon
Washington	

Table 10. Columbiana County Townships

East	Franklin
Washington	Wayne
Yellow Creek	

Table 11. Harrison County Townships

German

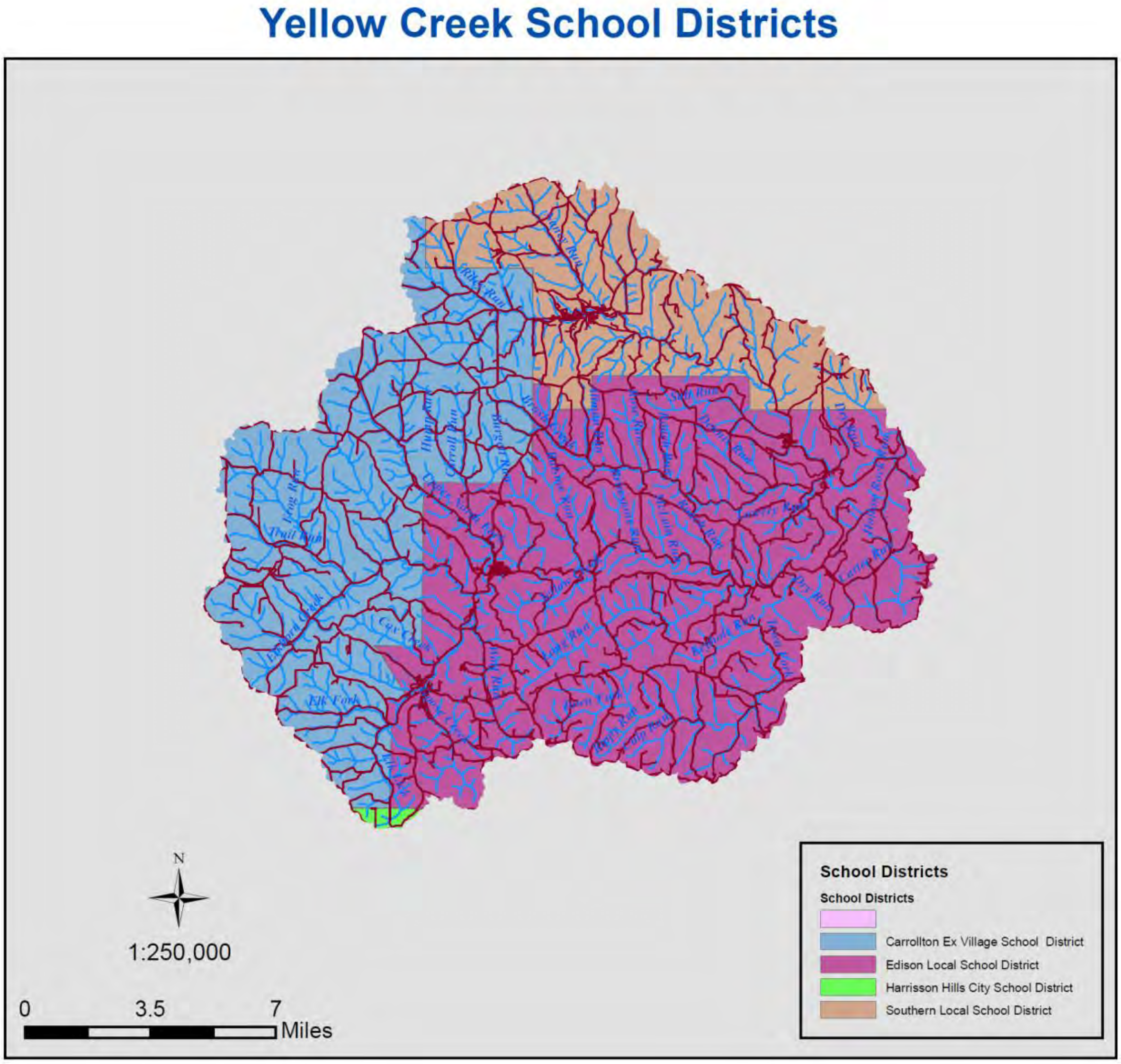

Fig. 21: School District Map (Corder)

Protected Public Lands

Brush Creek Wildlife Area: This 4,131 acre wildlife area was purchased in 1944, and serves as recreational hunting ground, as well as a scenic attraction. Several species of hardwood trees and a variety of game species such as fish, squirrels, rabbits, deer, and other furbearers common to the region, are present in the Brush Creek Wildlife Area. In 1970, wild turkeys from Southern Ohio were released onto two tracts of land in the park by the National Wild Turkey Federation in order to provide the area's sportsmen and women with additional turkey hunting opportunities. Improvements to the park have encompassed planting thousands of conifers, protecting and improving woodlands, allowing some areas to return to woodland through natural succession, clear-cuts on small blocks of old timer, and management of existing open fields. These improvements were made in order to maintain habitat diversity.

Jefferson Lake State Park

Located on land that once belonged to the famous Mingo chief, Logan, whose family was murdered in an event which would spark Lord Dunmore's War in 1774, this Park was developed in 1928 and included 962 acres of land. In 1934 a dam was constructed, and by 1946 a 17-acre lake was created in the park. This project was completed in partnership with the National Park Service by the Ohio Division of Conservation as a Civilian Conservation Corps service during the Great Depression. The Park is primarily populated by trees such as second-growth oaks, hickories, beech and maples. However, there is also an abundance of wildflowers, birds, turkeys and grouses. The park provides camping, boating, picnicking, fishing, and hunting facilities, as well as several hiking and horse trails.

Fig. 22: Jefferson Lake State Park (Stocklein)

Yellow Creek State Forest: This 756 acre forest is comprised of three parcels of land, which do not adjoin each other and which border private properties. Recreational uses of this park include: mushroom and berry picking, photography, hunting, and off-trail hiking. There are no developed trails or facilities in the park and camping, horseback riding, and ATV usage are currently prohibited.

<u>Privately Owned Recreation Areas</u>

Austin Lake Park: This 1,300 acre family-oriented nature area has been operated by the Cable family for four generations. Camping, boating, wakeboarding, outdoor sports, hiking, picnicking, and pet areas are among the

Fig. 23: Austin Lake (Park

recreational opportunities the park affords.

Happy Lake Resort

Located in the Long Run-Yellow Creek subwatershed, Happy Lake Resort offers camping and fishing at Lake George. This campground is still under development.

Fig. 24: Happy Lake Resort (Website)

Elkhorn Valley Christian Camp and Retreat Center

Elkhorn Valley Christian Camp and Retreat Center consists of 225 acres in the Elkhorn Creek subwatershed. It is a Christian Service camp that operates during all seasons, with more activities occurring in the summer months.

Historical Background

The history of most watersheds can be traced from the present day to a little squiggle on an Eighteenth Century map, designating a flowing body of water occupying a particular geographical location in a cartographer's path. Usually, little else is known about the body of water before its presence on the map, except for what local legends tell. However, this is not the case with the Yellow Creek Watershed. The history of Yellow Creek can be traced back 8,000 years, from the evidence of the first intrepid inhabitants in 6,000 BC to the wild and free outdoorsmen which occupy the watershed today.

Undoubtedly, there are artifacts in the watershed which date back to the paleo period (11,000-8,000 BC), but they have yet to be discovered. Thus, the first official evidence of human habitation of the watershed dates to 6,000 BC. The prehistoric inhabitants of the Ohio Valley occupied the land surrounding the Ohio River tributaries, and often used these streams as aquatic highways to reach their seasonal hamlets and villages along the watersheds. Yellow Creek was a particularly attractive tributary for prehistoric peoples, owing to its varied ecotonal zones. There were many large and low floodplains, which offered fertile land for the seasonal village sites; and the steep and lofty (for this part of Ohio) ridges of the watershed provided access to higher elevations when needed. It is important to note that the Meadowcroft Rock Shelter, one of the oldest prehistoric sites in North America, is located a mere twenty-two miles from the mouth of Yellow Creek, and occupies a similar geological parallel drainage. This site has produced artifacts dating as far back as 14,000 BC; and thus, it is not unreasonable to believe that Yellow Creek also may have been home to the people of this time period as well.

In more recent history, Yellow Creek was the scene of the infamous 1774 Yellow Creek Massacre, where a dozen of Chief Logan's family members were murdered in cold blood with no apparent provocation. Though he had been a peaceful man up to this point, the Native American code by which he lived gave Logan the right to seek revenge against those who had harmed his family. He did so, and the resulting conflict between the Native Americans and the settlers came to be known as Lord Dunmore's War. The Native Americans attacked many villages before retreating at the Battle of Point Pleasant, in modern-day West Virginia. The Virginian troops then moved into Ohio, forcing the Native Americans to negotiate a peace treaty. In accordance with Native American custom, Logan did not attend the negotiations, and instead delivered a speech, which has since come to be known as Logan's Lament:

> *"I appeal to any white man to say, if ever he entered Logan's cabin hungry, and he gave him not meat; if ever he came cold and naked, and he clothed him not. During the course of the last long and bloody war, Logan remained idle in his cabin, an advocate for peace. Such was my love for the whites, that my countrymen pointed as they passed, and said, Logan is the friend of white men. I had even thought to have lived with you, but for the injuries of one man. Col. Cresap, the last spring, in cold blood, and unprovoked, murdered all the relations of Logan, not sparing even my women and children. There runs not a drop of my blood in the veins of any living creature. This called on me for revenge. I have sought it: I have killed many: I have fully glutted my vengeance. For my country, I rejoice at the beams of peace. But do not harbor a thought that mine is the joy of fear. Logan never felt fear. He will not turn on his heel to save his life. Who is there to mourn for Logan? Not one."* *(http://www.ohiohistorycentral.org/entry.php?rec=2846)*

Yellow Creek also served as a starting point for those looking to move to the Western frontier. In the early 1800s, there are accounts from pioneers which describe passing through Yellow Creek the trail west. But it is during the days of the Ohio frontier and the beginning of statehood that life in Yellow Creek begins to be described in detail. For generations, stories were passed down orally but in 1942Dr. R. W. Shilling thought it would be a beneficial to collect these stories, local histories and folklore into a volume, which he entitled Tales of Yellow Creek. He published an additional volume in 1947, entitled Yellow Creek Stories. These books are extremely uncommon currently, and original copies are among the possessing families' most prized possessions. An interest in local history recently resurfaced prompting Virginia Glenn, the great niece of Shilling, and her husband, Curt, to combine the original volumes and republish them as Tales and Stories of Yellow Creek. This volume has been remarkably successful, and has inspired the Glenns to begin collecting stories for a sequel, Yellow Creek: Up the Hollows and Over the Ridges, in which stories from the next generation of Yellow Creek inhabitants will be recorded and shared.

Today, Yellow Creek continues to attract those looking for a more rural lifestyle. Outdoor recreational opportunities are plentiful, and hunting and fishing remain popular pastimes around the watershed. There are several farms in the hills and valley which have operated for many years. The area's rich land has even attracted a new migration of Amish families, producing a small but flourishing Amish community.

Thus, Yellow Creek stands out among watersheds as a site loved by its occupants for thousands of years. Its rugged scenery attracts those seeking to live in nature and be surrounded by history, providing them with the individualistic lifestyle they desire. For the inhabitants of Yellow Creek, it is an area that holds promise for generations to come.

Mining History

Southeastern Ohio is in the northern part of the Appalachian Coal Basin, one of the largest coal fields in the United States Coal mining in Ohio began during the early 1800's and with an increase in railroads and industry, coal production in Ohio increased to ten million tons by 1886, from five million tons in 1872.

There are still remnants of the towns that grew around the coal mines of this time. In areas such as Wolf Run and Amsterdam a few of the cinderblock homes and fruit cellars the miners inhabited are still standing. These towns were often controlled by the owner of the mine they were associated with. Mine employees were paid in script, money that was accepted only at company-owned stores, allowing the companies to have a great amount of control over the miners. Partially due to the lack of government regulation of the industry, miners faced threatening work conditions, low pay and long hours until the nineteenth century..

Physical Characteristics

Yellow Creek is located in northeastern Ohio and drains portions of four counties before it reaches the Ohio River near Hammondsville. Yellow Creek is 31.6 miles long, drains 239 square miles, and has an average fall of 17.8 feet/mile. Flowing east of the Flushing escarpment, the headwaters begin in Carroll County at the confluence of Elk Lick and Elk Fork, and continue to flow north, then east through Jefferson County. Running from the drift border near Kensington, Columbiana County to the Ohio River two miles north of Hannibal, the escarpment can be easily traced by the change in elevation of the ridge summits and by the difference of contour pattern. The pattern east of the Flushing escarpment lacks the deep indentations of that to the west, thus the eastern surfaces have wider ridges, less direct relief, fewer small streams, and in general more uniformity. (Stout, Lamb 1938) The North Fork of Yellow Creek has its headwaters in Columbiana County, and flows south into Yellow Creek. High streamflow generally occurs in the spring and baseflow occurs in the late summer or fall. Average annual rainfall in the watershed is 37 inches.

The Yellow Creek Watershed is located within the Western Allegheny Plateau (WAP) ecoregion, a region with a sub-humid, temperate climate and precipitation distributed throughout the water year. An ecoregion is an area having broad similarity in ecosystems with respect to climate, soil, topography and dominant natural vegetation. Aquatic biological communities, chemical water equality, and physical stream attributes are expected to vary less within an individual ecoregion when compared to the variation of those throughout the state. For this reason, some of Ohio's WQS are ecoregion-specific. (Bowman, Hughes, 2008)

Although entirely within the unglaciated portion of Ohio, the drainage patterns in the Yellow Creek Watershed were influenced by multiple glaciations (Barrett & Angle, 2005). The many river valleys in southeast Ohio carried glacial meltwater from the ice front to the Ohio River. In this process, many of the valleys at times were either made deeper by erosive force of fast flowing meltwater streams and other times they were partially filled with sediment. Other valleys contain thick deposits of clay and silt that accumulated on the bottoms of lakes formed when glacial ice blocked the river mouths. The hills in the Yellow Creek region reach up to 1400 feet in altitude. Different bedrock types consist mainly of sandstone, shale, limestone and coal.

The Yellow Creek Watershed drainage has benefited greatly from its Pennsylvanian limestone bedrock. Without the natural buffering capacity of this bedrock material, the results of acid mine drainage entering the watershed's streams would be devastating to organisms downstream. An example of this buffering capacity can be seen at the site of a deep mine impact that flows directly into the mainstem of Yellow Creek from a roadside ditch. The water leaving the pipe discharges from a shaft to this abandoned deep mine. It has an average pH of 2.5 and a conductivity reading that exceeds 10,000 us/cm. Waters samples pulled from the mainstem of Yellow Creek, roughly 100 yards downstream, have a pH reading of 5.5 and the conductivity is lowered to an average of 500 us/cm.

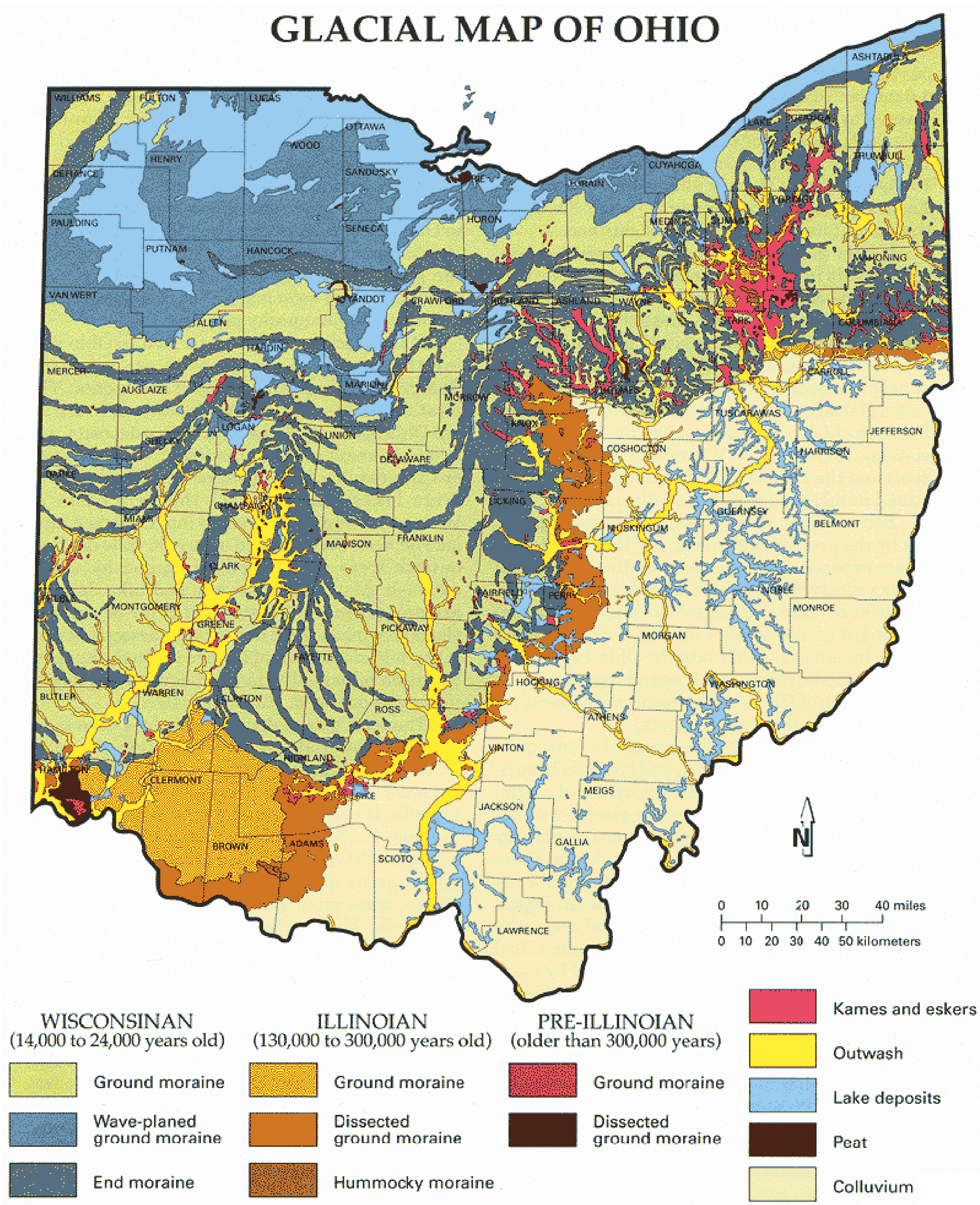

Fig. 25: Glacial Map of Ohio

Phase II Stormwater

Polluted stormwater runoff is commonly transported through Municipal Separate Storm Sewer Systems (MS4s), from which it is often discharged untreated into local waterbodies. To prevent harmful pollutants from being washed or dumped into an MS4, operators must obtain a NPDES permit and develop a stormwater management program (U.S. EPA)

● Phase I, issued in 1990, requires *medium* and *large* cities or certain counties with populations of 100,000 or more to obtain NPDES permit coverage for their stormwater discharges.
● Phase II, issued in 1999, requires regulated small MS4s in urbanized areas, as well as small MS4s outside the urbanized areas that are designated by the permitting authority, to obtain NPDES permit coverage for their stormwater discharge.

There are no Phase II stormwater communities in the Yellow Creek watershed.

Table 12. NPDES permitted facilities

Facility	Permit Number	Type
Sterling Mining Corporation	0IL00135, 0IL00136, 3IN00328	Industrial
Buckeye Industrial Mining	0IL00147	Industrial
Apex Limestone Pit	0II00022	Industrial
Salineville WWTP	3PB00026	Municipal
Southern Local HS	3PT00098	Municipal
Elkhorn Valley Christian Service Camp	3PR00454	Municipal

Groundwater

There are three basic hydrogeological settings in the Yellow Creek Watershed. One of the geological settings is the upland areas, which consist of a thin regolith of alternating sandstone, limestone and shale. The water is deep, and ground water yields are poor, averaging less than 5 GPM. Another setting is the small tributary valleys of Yellow Creek which are hydro geologically similar to the glacial lakes and slack water terraces, the difference lies in the fact that the valleys and floodplains are narrower and the alluvial deposits are much thinner. Well yields are generally below 5 GPM, with the primary aquifer underlying dirty sandstones, shales, thin limestones, claystones, clays and coals (Barrett & Angle 2005). The groundwater in this section is often connected to deeper bedrock aquifers. The third setting is along the larger stream channels of Yellow Creek and North Fork where the glacial lake and slackwater terraces lie. Unlike the small tributary valleys, these areas have broad valleys and thicker drift. Groundwater is developed from thin sand and gravel lenses interbedded with finer lacustrine and alluvial deposits. The depth to water is shallow in both the small tributary valleys and the flat-lying areas.

Source Water Protection Plan

The 1996 Amendments to the Safe Drinking Water Act establish a program for states to assess the drinking water source for all public water systems. Ohio's Source Water Assessment and Protection Program is designed to help public water systems protect their sources of drinking water from becoming contaminated. This assessment identifies the drinking water source protection area, based on the area that supplies water to the wells; inventories the potential contaminant sources in the area; recommends protective strategies.

Listed sources of potential contamination in the Yellow Creek watershed include pasture, other agricultural sources, cemeteries, septic systems, water wells not in use, oil and gas wells, highway/transportation routes and pipelines.

Protective strategies for consideration for source water protection within the watershed include

Potential Contaminant Source Protective Strategies To Consider:

General

Purchase additional property or development rights

Providing educational material to members of the community on topics regarding the drinking water protection area.

Include drinking water source protection into the local school curriculum.

Provide education (material/meetings) to local businesses & industries on topics relating to drinking water protection.

Encourage 'ground water friendly' development.

Develop/enact/enforce a local ordinance which may include any of the following: changing zoning; requiring registration of existing facilities; banning certain new types of activities; dictating chemical handling procedures; maintaining/filing a chemical inventory; facility spill/contingency planning; engineering controls for existing/new facilities; paralleling existing federal or state requirements.

Agricultural Sources

Assess the use of best management practices and recommend additional practices.

Encourage road safety with agricultural chemicals.

Provide education (material/meetings) to local farmers and agribusinesses on appropriate topics.

Plan/design/implement methods to control impacts to surface water.

Residential Sources

Inventory/remove underground home heating oil tanks in the protection area.

Identify areas used for illegal dumping.

Provide education (material/meetings) to home owners on: drinking water protection; use/maintenance of septic systems; illegal dumping; proper well abandonment (both the reason and the process).

Develop a centralized wastewater collection/treatment system.

Encourage/require (and provide incentives) for sealing unused wells.

Ensure enforcement of existing requirements for closing unused wells.

Ensure the proper construction of new wells.

Municipal Sources

Monitor compliance with existing regulations through inspections and/or contact with regulatory agencies (such as the local fire department, State Fire Marshal, or the Ohio EPA).

Encourage/arrange hazardous materials training or waste and disposal assessments for employees.

Develop an early release notification system for spills and emergency planning; educate emergency responders to be aware of drinking water protection areas; or coordinate facility spill/contingency planning.

Encourage compliance with materials handling procedures/requirements.

Install of engineering controls at municipal facilities

Implement pollution prevention strategies.

Work with the street department and Ohio DOT to minimize use of road salt.

Evaluate and close fire cisterns or other city owned wells.

Conduct routine sewer inspections, maintenance & upgrades.

Oil & gas wells

Provide education (material/meetings) to owners on maintenance.

Ensure/monitor proper operation and maintenance.

Develop an early release notification system for spills.6

Spills

Develop an early release notification system for spills and an emergency response plan.

Include drinking water protection in response planning and training.

Post signs indicating the extent of the protection area.

Transportation

Create hazardous materials routes around the protection area and require/encourage transporters to use them.

Work with local transporters on protection area awareness.

Encourage road safety with chemicals.

Post signs indicating the extent of the protection area

Contamination Potential

The ground water pollution potential is based on the DRASTIC report prepared by the Ohio Department of Natural Resources Division of Water Resources Section.

According to this report, the greatest risk of ground water pollution is in the glacial lakes and slackwater terraces that the mainstem of North Fork and of Yellow Creek now flow through. These regions have a pollution potential range of 124-139. The hydro geological zone of river alluvium with over bank deposits in the small tributary valleys of Yellow Creek has a rating of 92-130. The lowest pollution potential ratings occur in the upland areas of Jefferson County, the hydro geological setting of alternating sandstone, limestone and shale. This is the dominant rating in the Yellow Creek Watershed. The upland areas are characterized by a greater depth to water, which explains the lower pollution potential rating. The rating range in this setting is 55-93.

Both shallow and deep ground water aquifers reveal some contamination by previous surface and subsurface coal mining activities. Ground water wells in areas where mining has occurred are typically higher in concentrations of total dissolved solids, iron, sulfates and hardness. Well yields throughout the basin are meager and the water obtained is calcareous and highly mineralized.

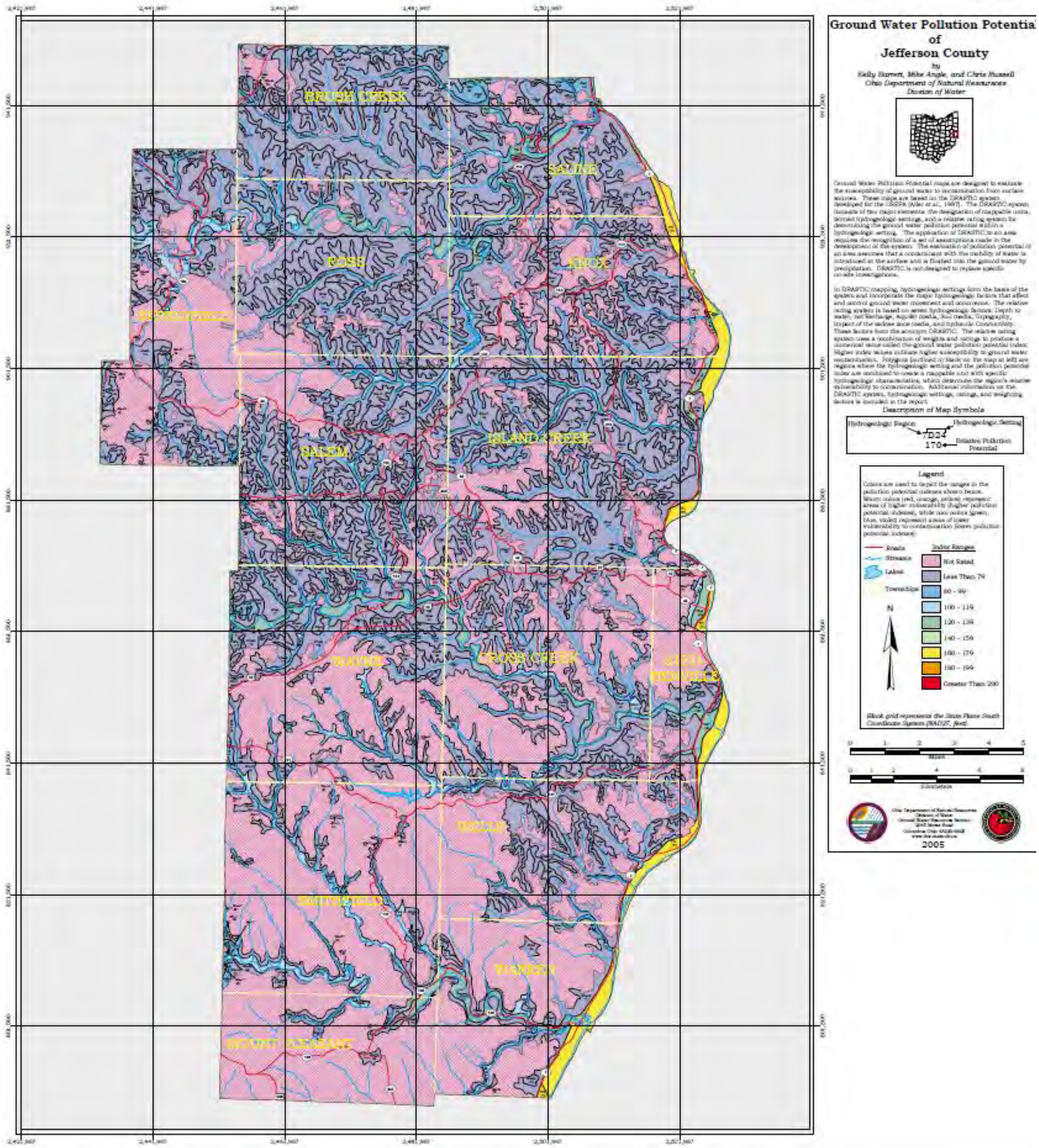

Fig. 26: Ground Water Pollution Potential Map

Wetlands

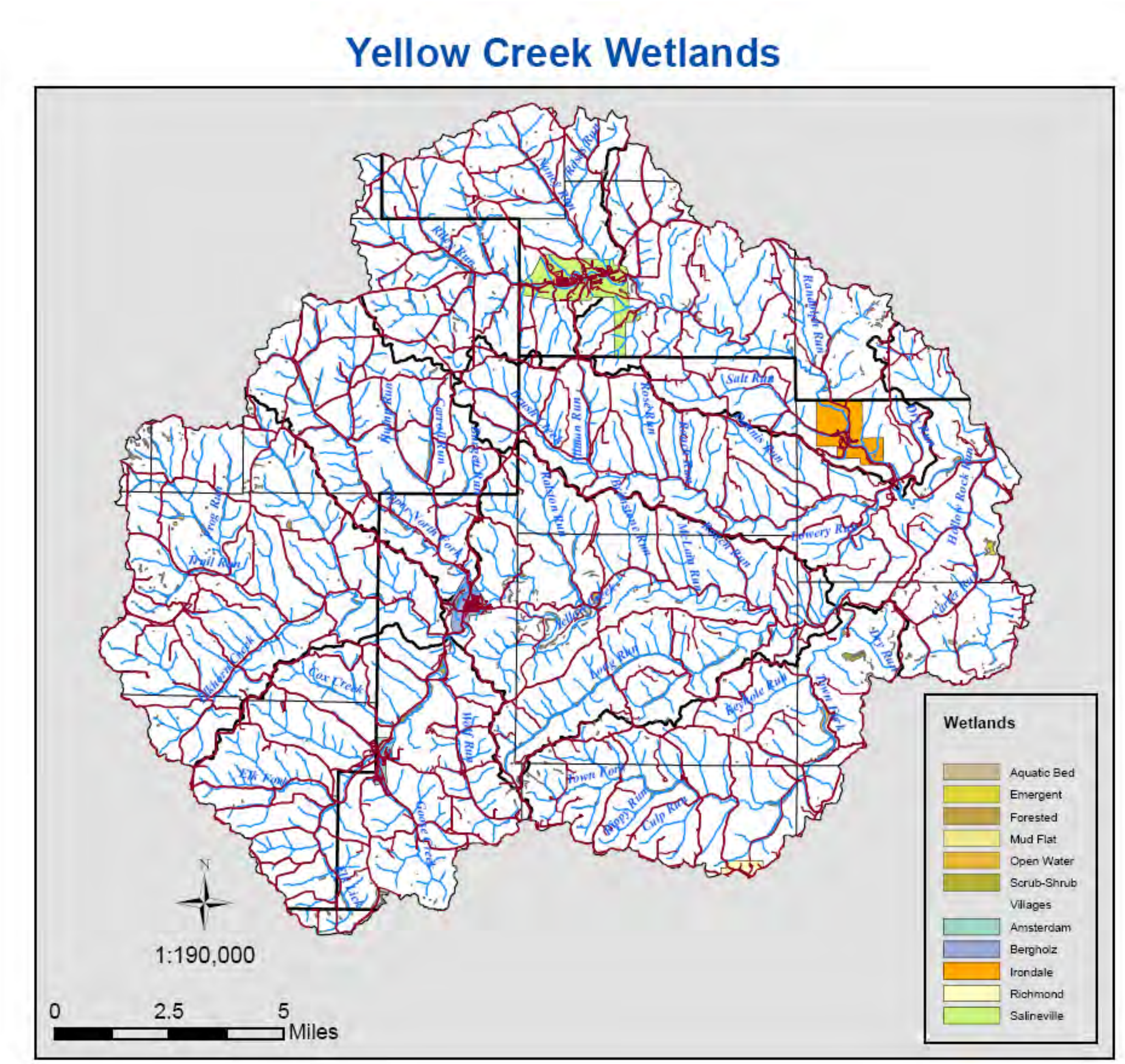

Fig. 27: NWI Wetlands Data

Marshes, swamps, and bogs have been well-known terms for centuries, but only recently have attempts been made to group these landscapes under the single term, "wetlands."

Along with the recognition of the classification of wetlands the value of wetlands is also being recognized. Some of the benefits of wetlands include the controlling of floodwaters and the filtering of pollutants. In the Yellow Creek Watershed, wetlands are especially helpful in removing iron and manganese from acid mine drainage. Wetlands provide habitat for waterfowl and other wildlife and are sanctuaries for rare and endangered species. Many birds, especially waterfowl, build nests and raise their young in wetlands. Amphibians and reptiles also take advantage of wetlands as a habitat; salamanders, frogs and toads, turtles and snakes all live in wetlands. Wetlands are also places where people can enjoy recreational activities such as fishing, boating, hunting, and bird watching.

In general terms, wetlands are lands where saturation with water is the dominant factor determining the nature of the soil development and the types of plant and animal communities living in the soil and on the surface. The water creates severe physiological problems for plants and animals unless they are adapted to life in water or saturated soil.

Wetlands are transitional lands between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered by shallow water. For purposes of this classification, wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominately hydrophytic (water-loving) plants; (2) the substrate is predominately undrained hydric soil; and (3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year.

Fig. 28: Long Run wetland in Wetlands Reserve program (Corder)

The inventory of wetlands in the Yellow Creek Watershed was accomplished as an interagency cooperative venture between the U.S. Department of Agriculture's National Resources Conservation Service, The Center for Mapping and School of Natural Resources at the Ohio State University, and the Ohio Department of Natural Resources' Divisions of Wildlife, Real Estate and Land Management. Each agency contributed expertise, financial support, equipment, or space towards the completion of this project. The inventory depicts wetland conditions in Ohio from 1985 through 1987; originally chosen to provide base year wetland information for use in administering "swampbuster" legislation.

<u>Sources of Data</u> The Ohio Wetland Inventory (OWI) was derived from a variety of data sources. In proportion to the entire Yellow Creek Watershed (143,460.29 acres), the amount of non-

forested wetland (including shallow marsh, wet meadow, and scrub/shrub wetland) is nominal at 588.1 acres, or .18 percent of the entire watershed. Regardless of the small amount of acreage present, the existing wetlands serve a productive component within the watershed.

Fig. 29: Mitigated wetlands at Apex Environmental Landfill site (Andresen)

Seeking wetland mitigation will be a priority of the watershed action plan. A map containing the hydric soils rating and existing wetlands has been prepared for each subwatershed. While there are no hydric soils listed in the Yellow Creek Watershed, areas with partially hydric soils that are not already occupied by wetlands will be targeted as potential sites for wetland creation. Once identified based on hydric soil rating, potential areas for wetland creation will be visually investigated to determine suitability.

Table 13. Streams of the Yellow Creek Watershed

Stream Name	Length (Miles)	Elev. At Source	Elev. At Mouth	Av. Fall Ft. per mile	Flows into	Mouth In County	Drains Sq. Mi.
Yellow Creek	34	1260	654	17.8	Ohio River	Jefferson	239
Rocky Run	3.6	1140	643	138	Yellow Creek	Jefferson	2.9
Hollow Rock Run	6.4	1200	653	85.5	Yellow Creek	Jefferson	9.8
Tarburner Run	2.5	1180	754	170	Hollow Rock Run	Jefferson	1.94
Carter Run	1.5	1182	858	216	Hollow Rock Run	Jefferson	1.2
North Fork Yellow Creek	17.9	1240	678	31.4	Yellow Creek	Jefferson	59.5
Dry Run	2.3	1198	679	226	North Fork Yellow Creek	Jefferson	1.26
Salt Run	4.6	1217	707	111	North Fork Yellow Creek	Jefferson	3.96
Salisbury Run	2.5	1190	750	176	North Fork Yellow Creek	Columbiana	2.38

Randolph Run	2.8	1100	755	123	North Fork Yellow Creek	Columbiana	2.24
Nancy Run	5.3	1160	868	55.1	North Fork Yellow Creek	Columbiana	9.12
Roses Run	2.3	1179	926	110	Nancy Run	Columbiana	1.96
Riley Run	7.5	1240	868	49.6	North Fork Yellow Creek	Columbiana	17.64
Brush Creek	11	1120	687	41.2	Yellow Creek	Jefferson	15.3
Dennis Run	1.5	1140	720	280	Brush Creek	Jefferson	2.3
Roach Run	3.1	1260	869	126	Brush Creek	Jefferson	0.72
Lowery Run	1.2	1161	695	463	Yellow Creek	Jefferson	0.94
Town Fork	12.4	1280	738	43.7	Yellow Creek	Jefferson	26
Dry Run	1.3	1180	748	342	Town Fork	Jefferson	1.24
Culp Run	2.1	1200	940	124	Town Fork	Jefferson	1.54
Rippy Run	1.8	1260	959	167	Town Fork	Jefferson	1.2
Long Run	8	1300	756	68	Yellow Creek	Jefferson	10.4
Hildebrand Run	2.2	1238	970	122	Long Run	Jefferson	1.74
Roach Run	2.2	1220	770	205	Yellow Creek	Jefferson	1.72
Ralston Run	4.3	1202	813	92.6	Yellow Creek	Jefferson	5.64
Matthews Run	1.8	1180	845	186	Ralston Run	Jefferson	0.86
Upper North Fork Yellow Creek	8.4	1211	857	42.1	Yellow Creek	Jefferson	19.1
Hump Run	4.2	1194	898	70.5	Upper North Fork Yellow Creek	Jefferson	7.02
Burgett Run	2.5	1280	929	141	Hump Run	Jefferson	1.74
Carroll Run	2.8	1172	950	79.3	Hump Run	Carroll	2.22
Hazel Run	3.1	1220	990	74.2	Upper North Fork Yellow Creek	Carroll	3.12
Elkhorn Creek	8.9	1230	876	37.5	Yellow Creek	Jefferson	33.5
Strawcamp Run	4.8	1230	939	60.7	Elkhorn Creek	Carroll	5.2
Center Fork Elkhorn Creek	5	1113	958	31	Elkhorn Creek	Carroll	12.5
Trail Run	1.9	1090	999	47.8	Center Fork	Carroll	3.34
Frog Run	2.5	1180	1013	66.8	Center Fork	Carroll	1.96
Wolf Creek	4.5	1280	892	86.2	Yellow Creek	Jefferson	5.12
Cox Creek	3	1230	920	103	Yellow Creek	Jefferson	2.86
Goose Creek	3.8	1290	930	94.7	Yellow Creek	Jefferson	5.88
Elk Fork	3.4	1230	982	72.9	Yellow Creek	Jefferson	4.62
Elk Lick	3.6	1260	982	72.3	Yellow Creek	Jefferson	6.04

Table 14. USGS Gauge Information

USGS Stream Gauge No.	Location	Period of Record	Drainage Area	Stream/River	Site Status	Datum of Gauge
03110000	Lat 40°32'16" long 80°43'31" Jefferson County	October 1940 to current year	147 square miles	Yellow Creek near Hammondsville	Real- Time Daily discharge, Cubic feet per second	692.1 feet above sea level

http://waterdata.usgs.gov/oh/nwis/uv?site_no=03110000

Geology

The landscape in the Yellow Creek Watershed is characterized by rolling foothills, patchy deciduous forest, and moderate to deep valleys. Bedrock in the area consists of sedimentary rocks of the lower and middle Pennsylvanian Period, which has four subdivisions (in order of oldest to youngest): the Pottsville, Allegheny, Conemaugh, and Monongehela Groups (Slucher et al., 2006). These rocks originated as fluvial and marine deposits approximately 300 million years ago. The sediments were subsequently lithified, then faulted during the Appalachian orogeny. Most of the bedrock in the watershed is comprised of the Conemaugh Group. The Pottsville and Allegheny Groups are less common and are mainly exposed at the base of valley walls. All three groups are dominated by shale, siltstone, and sandstone, but differ in their relative amounts of limestone and coal. The bedrock units strike to the north-northeast and dip slightly to east-southeast (Bowman, Hughes, 2008). The sandstone of this region is responsible for the naturally occurring but slightly elevated conductivity in area streams and the limestone plays a significant role in Yellow Creek's recovery from a history of heavy mining.

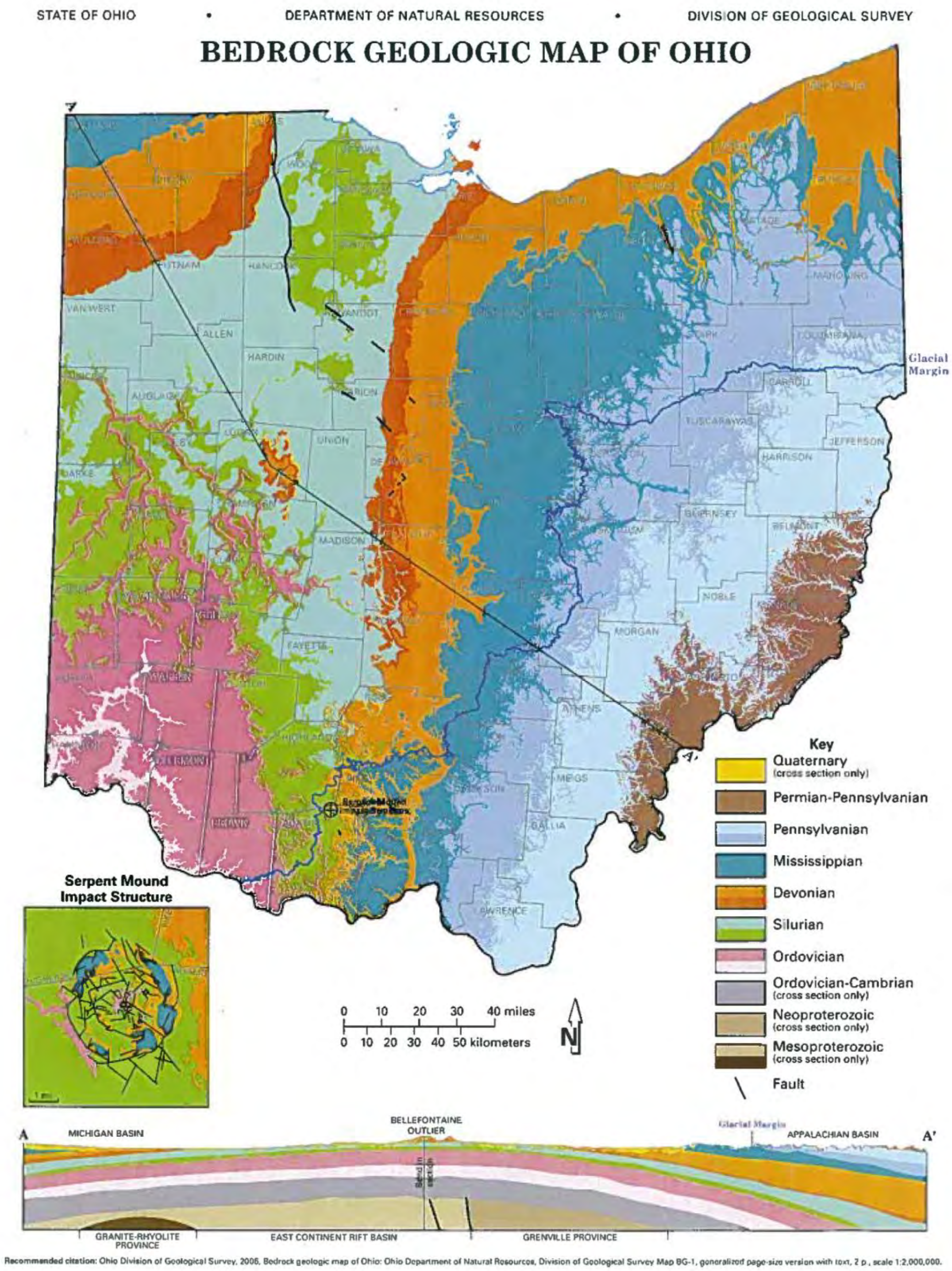

Fig. 30: Bedrock Geological Map of Ohio

Acidic water discharging from abandoned deep mines and some surface mines led to a significant decline in the biological and chemical performance in the watershed during the 1983 EPA study. Since that time the number of operating mines in the watershed has greatly declined. When the watershed was first approached for study by both the Division of Mineral Resource Management and the Ohio EPA, the expectation was that it was going to be a watershed severely impaired by acid mine drainage. Results from both the TMDL study as well as the AMDAT revealed that while there were some tributaries suffering the effect of acid mine drainage, the effects were localized and most streams were in attainment of their designations. This unexpected lack of damage can be attributed partially to the neutralizing properties of the limestone bedrock that forms the foundation in a large percentage of the watershed. This characteristic proves to be beneficial in other watersheds existing east of the Flushing Escarpment as well.

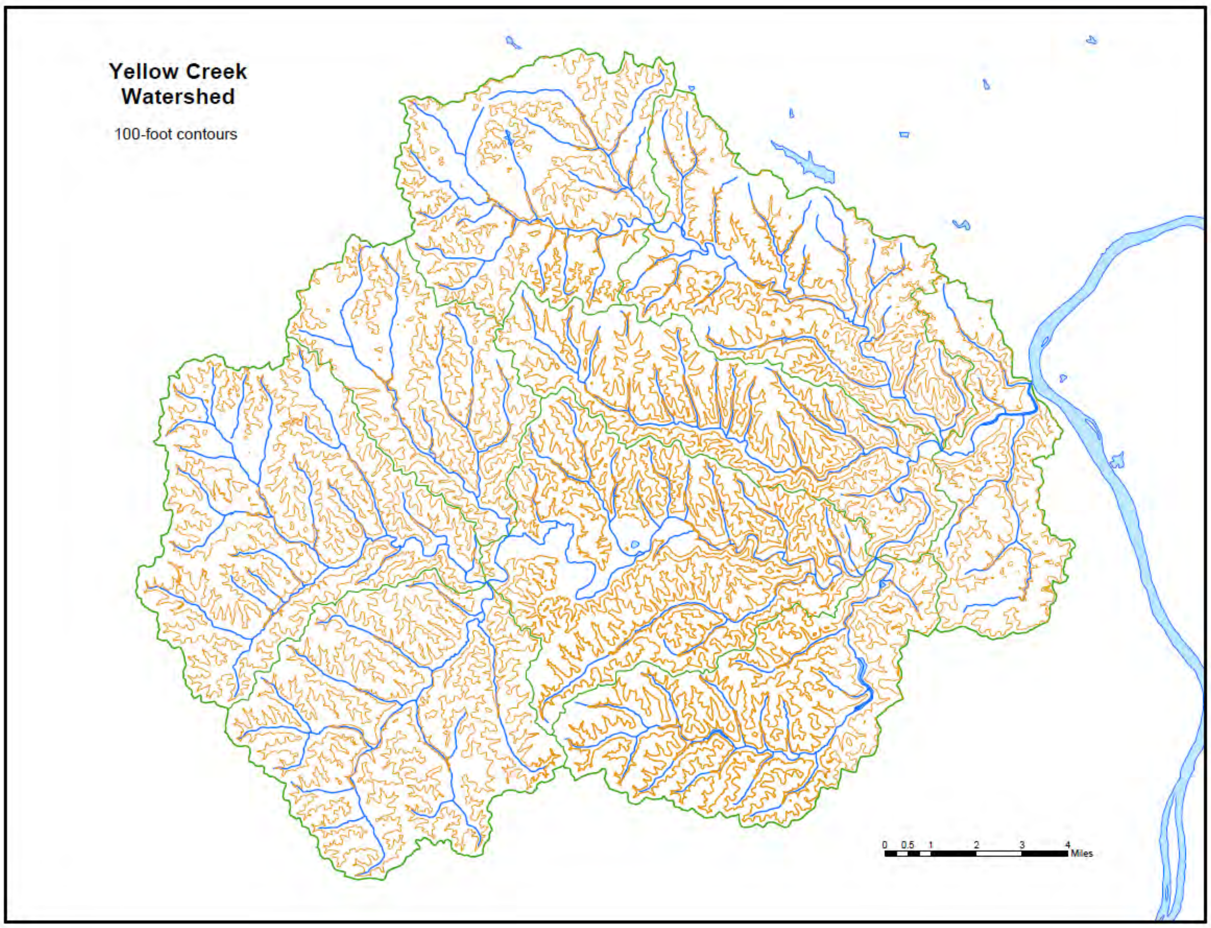

Fig. 31: Topographic map of Yellow Creek

Wildlife

Wildlife has four basic needs in order to survive and reproduce. These include quality food, water, cover and space. The wildlife habitat in the Yellow Creek Watershed has been impacted by past land use, such as mining and agriculture. Careful habitat management could result in a significant positive impact on the watershed's fauna population. Restoring water quality and re-establishing sufficient vegetation in the watershed would be an important start to achieving this goal.

ENDANGERED - a native species or subspecies threatened with elimination from the state. This danger can result from one or multiple causes, such as habitat loss, pollution, predation, interspecies competition, or disease.

THREATENED - a species or subspecies whose survival in Ohio is not in immediate jeopardy, but to which a threat exists. Continued or increased stress on the species of subspecies survival will result in it becoming endangered.

SPECIES OF CONCERN – a species or subspecies which might become threatened in Ohio under continued or increased stress. Also, a species or subspecies for which there is some concern, but for which information is insufficient to permit an adequate status evaluation. This category may contain species designated as a furbearer or game species, but whose statewide population is dependent on the quality and/or quantity of habitat and is not adversely impacted by regulated harvest.

SPECIAL INTEREST - a species that occurs periodically and is capable of breeding in Ohio. It is at the edge of a larger, contiguous range with viable population(s) within the core of its range. These species have no federal endangered or threatened status, are at low breeding densities in the state, and have not been recently released to enhance Ohio's wildlife diversity. With the exception of efforts to conserve occupied areas, minimal management efforts will be directed for these species because it is unlikely to result in significant increases in their populations within the state.

EXTIRPATED - a species or subspecies that occurred in Ohio at the time of European settlement and that has since disappeared from the state.

EXTINCT – a species or subspecies that occurred in Ohio at the time of European settlement and that has since disappeared from its entire range. (ODNR- Division of Wildlife)

The Yellow Creek Watershed is home to many species typical of riverine species, as well as several that are unique to this portion of Ohio. These include: Beavers, Muskrats, Raccoons, Coyotes, Red Foxes, Ground Hogs, White - tailed Deer, Cottontail Rabbits, Ruffed Grouse, Opossum, Gray Squirrels and Flying Squirrels. In addition to these species Tim Stevens, Jefferson County Wildlife Officer, has verified the habitation of the Yellow Creek Watershed by bobcats and a female black bear with cubs, both of which are endangered species in the state of Ohio.

Aquatic Wildlife

Table 15. Macroinvertebrates

Spongillidae	Simulium sp
Hydra sp	Ceratopogonidae
Nemertea	Atrichopogon websteri
Plumatella	Ablabesmyia mallochi
Oligochaeta	Conchapelopia Sp
Placobdella ornata	Hayesomyia senata or Thienemannimyia norena
Orconectes	Helopelopia sp
Orconectes (Crokerinus) obscurus	Nilotanypus fimbriatus
Hydracarina	Procladius (Holotanypus) sp
Baetidae	Potthastia gaedii group
Acentrella turbida	Brillia flavifrons group
Pseudocloeon frondale	Cardiocladius obscurus
Baetis intercalaris	Corynonerua lobata
Procloeon Sp (w/ Hindwing Pads)	Crictopus (C.) sp
Procloeon irrubrum	Crictopus (C.) bicinctus
Isonychia sp	Cricotopus (C.) tremulus troup
Leucrocuta Sp	Paraphaenocladius Sp
Stenacron sp	Paratrichocladius Sp
Stenonema femoratum	Rheocricotopus (Psilocricotopus) robacki
Stenonema pulchellum	Thienemanniella taurocapita
Stenonema vicarium	Thienemanniella xena
Tricorythodes sp	Chironomus (C.) sp

Caenis sp	Chironomus (C.) decorus group
Ephemera sp	Cryptochironomus sp
Hexagenia sp	Dicrotendipes fumidus
Hexagenia bilineata	Dicrotendipes neomodestus
Calopteryx sp	Microtendipes "caelum" (sensu Simpson & Bade, 1980)
Hetaerina sp	Microtendipes pedellus group
Coenagrionidae	Paratendipes albimanus or P. duplicatus
Argia sp	Phaenopsectra sp or tribelos sp
Boyeria vinosa	Phaenopsectra obdiens group
Gomphidae	Phaenopsectra flavipes
Gomphus sp	Polypedilum (Uresipedilum) aviceps
Ophiogomphus sp	Polypedilum (Uresipedilam) flavum
Macromia sp	Polypedilum (P.) fallax group
Leuctra sp	Polpedilum (P.) illinoense
Acroneuria frisoni	Polypedilum (Tripodura) scalaenum group
Corydalus cornutus	Stenochironomus sp
Nigronia serricornis	Cladotanytarsus mancus group
Chimarra obscura	Cladotanytarsus vanderwulpi group Type 1
Polycentropus sp	Cladotanytarsus vanderwulpi group Type 4
Cheumatopsyche sp	Cladotanytarsus vanderwulpi group Type 5
Ceratopsyche morosa group	Paratanytarsus sp
Hydropsyche depravata group	Rheotanytarsus sp
Hydropsyche dicantha	Stempellinella n.sp 1
Hydroptila sp	Sublettea coffmani
Pycnopsyche sp	Tanytarsus sp

Mystadices sp	Tanytarsus curticornis group
Nectopsyche diarina	Tanytarsus glabrescens group sp 7
Oecetis sp	Tanytarsus guerlus group
Triaenodes injustus	Atherix lantha
Dineutus sp	Hemerodromia sp
Ancyronyx variegata	Ferrissia sp
Dubiraphia sp	Physella sp
Dubiraphia vittata group	Helisoma anceps anceps
Optioservus ampliatus	
Stenelmis sp	Ferrissia sp
Antocha sp	Corbicula fluminea
Pisidium sp	

Table 16. Fish in the Watershed

Silver Lamprey	Common Shiner	Green Sunfish
Least Brook Lamprey	Spotfin Shiner	Bluegill Sunfish
Amer Brook Lamprey	Sand Shiner	Pumpkinseed Sunfish
Longnose Gar	Mimic Shiner	Green Sf X Bluegill Sf
Gizzard Shad	Silverjaw Minnow	Sauger
Brown Trout	Fathead Minnow	Walleye
Quillback Carpsucker	Bluntnose Minnow	Logperch
Silver Redhorse	Central Stoneroller	Johnny Darter
Black Redhorse	Striped Sh X Rosyface Sh	Greenside Darter
Golden Redhorse	Striped Sh W Stoneroller	Banded Darter
Shorthead Redhorse	Channel Catfish	Variegate Darter

River Redhorse (S)	Yellow Bullhead	Rainbow Darter
Northern Hog Sucker	Black Bullhead	Orangethroat Darter
White Sucker	Stonecat Madtom	Fantail Darter
Smallmouth Redhorse	White Bass	Sauger X Walleye
Common Carp	White Crappie	Freshwater Drum
South. Redbelly Dace	Black Crappie	Mottled Sculpin
Redside Dace	Rock Bass	Striped Shiner
Emerald Shiner	Smallmouth Bass	Warmouth Sunfish
Silver Shiner	Spotted Bass	Largemouth Bass
Rosyface Shiner		

Table 17. Odonates

Shadow Darner	Common Green Darner	Fawn Darner
Eastern Pondhawk	Widow Skimmer	Twelve-Spotted Skimmer
Blue Dasher	Eastern Amberwing	Common Whitetail
Ruby Meadowhawk	Black Saddlebags	Great Spreadwing
Swamp Spreadwing	Violet Dancer	Double-striped Bluet
Familiar Bluet	Orange Bluet	Skimming Bluet
Fragile Forktail	Eastern Forktail	Slender Spreadwing
Autumn Meadowhawk		

Table 18. Leps-Butterflies

Black Swallowtail	Tiger Swallowtail	Spicebush Swallowtail
Cabbage Butterfly	Clouded (Yellow) Sulfur	Orange Sulfur
American Copper	Banded Hairstreak	Eastern Tailed Blue

Summer Azure	Variegated Fritillary	Great Spangled Fritillary
Aphrodite Fritillary	Meadow Fritillary	Silvery Checkerspot
Pearl Crescent	Northern Crescent	Question Mark
Eastern Comma	Gray Comma	Mourning Cloak
Milbert's Tortoiseshell	Red Admiral	American Painted Lady
Buckeye	Viceroy	Northern Pearly-Eye
Monarch	Silver-Spotted Skipper	Least Skipper
Fiery Skipper	Peck's Skipper	Gray Hairstreak
Red-Spotted Purple	Wild Indigo Duskywing	Checkered Skipper

Table 19. Amphibians

American Toad	Gray Treefrog	Northern Spring Peeper
American Bullfrog	Northern Green Frog	Spotted Salamander
Northern Dusky Salamander	Northern Two-Lined Salamander	Long-Tailed Salamander
Northern Spring Salamander	Eastern Red-Backed Salamander	Northern Ravine Salamander
Northern Slimy Salamander	Red-Spotted Newt	Mudpuppy

Table 20. Reptiles

Eastern Garter Snake	Eastern Box Turtle
Midland Painted Turtle	Copperhead
Queensnake	Snapping Turtle
Black Rat Snake	Eastern Snapping Turtle
Queensnake	Milk Snake
Hognose Snake	Soft Shell Turtle

Fig. 32: Queensnake identified in Town Fork downstream of Jefferson Lake State Park (Lipps)

Results of Breeding Bird Blockbuster

The Ohio Breeding Bird Atlas II, Jefferson Soil and Water Conservation District and the Yellow Creek Watershed Restoration Coalition partnered to host a “blockbuster” for Region 53, which encompasses the Yellow Creek Watershed. On May 30 and 31 of 2008, experienced birders made a pilgrimage to the Yellow Creek Watershed to survey the region. One hundred and eighteen bird species were identified during the two day event. Results from the survey of the watershed will be recorded in OBBA II which covers observations from 2006-2010. Additional species were added after the blockbuster event from employees of The Cleveland Museum of Natural History as well as resident birders.

Table 21. Nesting Birds of the Yellow Creek Watershed, Blockbuster Results

Canada Goose	Eastern Wood-Pewee	Chestnut-Sided Warbler
Wood Duck	Acadian Flycatcher	Black-Throated Green Warbler
Mallard	Willow Flycatcher	Yellow-throated Warbler
Ring-Necked Pheasant	Eastern Phoebe	Prairie Warbler
Ruffed Grouse	Great Crested Flycatcher	Black-and-White Warbler
Wild Turkey	Eastern Kingbird	American Redstart
Great Blue Heron	White-eyed Vireo	Worm-Eating Warbler
Green Heron	Yellow-throated Vireo	Ovenbird
Turkey Vulture	Warbling Vireo	Louisiana Waterthrush
Cooper's Hawk	Blue Jay	Kentucky Warbler
Red-Shouldered Hawk	American Crow	Common Yellowthroat
Broad-Winged Hawk	Tree Swallow	Hooded Warbler
Red-Tailed Hawk	Northern Rough-Winged Swallow	Yellow-breasted Chat
American Krestrel	Barn Swallow	Summer Tanager
Virginia Rail	Bank Swallow	Scarlet Tanager
Killdeer	Carolina Chickadee	Eastern Towhee
Spotted Sandpiper	Black-Capped Chickadee	Chipping Sparrow
American Woodcock	Tufted Titmouse	Field Sparrow
Rock Pigeon	White-breasted Nuthatch	Vesper Sparrow
Mourning Dove	Carolina Wren	Savannah Sparrow
Black-billed Cuckoo	House Wren	Grasshopper Sparrow
Yellow-billed Cuckoo	Blue-Gray Gnatcatcher	Song Sparrow
Eastern Screech Owl	Eastern Bluebird	Swamp Sparrow
Great Horned Owl	Veery	Northern Cardinal
Barred Owl	Wood Thrush	Rose-Breasted Grosbeak
Chimney Swift	American Robin	Red-Winged Blackbird
Ruby-Throated Hummingbird	Gray Catbird	Eastern Meadowlark
Belted Kingfisher	Northern Mockingbird	Common Grackle
Red-headed Woodpecker	Brown Thrasher	Brown-Headed Cowbird
Red-bellied Woodpecker	European Starling	Orchard Oriole
Downy Woodpecker	Cedar Waxing	Baltimore Oriole
Hairy Woodpecker	Blue-Winged Warbler	House Finch
Northern Flicker	Northern Parula	American Goldfinch
Pileated Woodpecker	Yellow Warbler	House Sparrow
Ruby-Crowned Knightlet	Pine Warbler	Indigo Bunting

Table 22. Nesting Bird Additions after Blockbuster

Common Merganser	Northern Bobwhite	Solitary Sandpiper
Ruby-Crowned Kinglet	Hermit Thrush	Pine Warbler
Indigo Bunting	Yellow-Billed Cuckoo	Blue-Headed Vireo
Red-Eyed Vireo	Scarlet Tanager	Brown Thrasher
Tennessee Warbler	Nashville Warbler	Yellow-Rumped Warbler
Blackpoll Warbler	Gray-Cheeked Thrush	

State Threatened Species:

Cavespring Crayfish (Hump Run, Long Run, North Fork Yellow Creek, Roses Run)

Psilotreta indecisa (caddisfly; OEPA collection) (Strawcamp Run)

Ohio Species of Concern

Allegheny Crayfish (Brush Creek, North Fork Yellow Creek, Town Fork, Upper North Fork, Yellow Creek)

Longnose Dace (fish; OEPA collection) [Hollow Rock Run, Tarburner Run (Hollow Rock Run Trib)]

Table 23. Avian Species of Concern in the Yellow Creek Watershed

Species	**Level of Concern**
Sharp-Shined Hawk	Species of Concern
Peregrine Falcon	Threatened
Long-Eared Owl	Species of Special Interest
Least Flycatcher	Threatened
Brown Creeper	Species of Special Interest
Winter Wren	Species of Special Interest
Magnolia Warbler	Species of Special Interest
Cerulean Warbler	Species of Concern
Henslow’s Sparrow	Species of Concern
Blue Grosbeak	Species of Special Interest
Bobolink	Species of Concern
Purple Finch	Species of Special Interest
Northern Bobwhite	Species of Concern
Hermit Thrush	Threatened
Dark-Eyed Junco	Threatened
Golden-Crowned Kinglet	Species of Special Interest

Endangered Species

Eastern Hellbender Salamander

The Eastern Hellbender is a giant salamander that is native to streams in eastern Ohio as well as sixteen other states from southern New York to northern Georgia. Another subspecies, the Ozark Hellbender, is found only in the Ozarks of Northern Arkansas and Southern Missouri. Hellbenders may have attained their name through their unusual appearance. Having blotchy brown skin, beady eyes, folds of skin along its sides and short legs, it is hypothesized by the Missouri Department of Conservation that the name "Hellbender" was derived by early settlers who thought: "It's a creature from hell where it's bent on returning." The Hellbender is unique for several reasons. It is the largest salamander in its range, and the third largest salamander in the world, reaching lengths of up to two feet. The Hellbender's method of respiration consists of the cutaneous gas exchange through capillaries found in their dorsoventral folds. The only similar species that may be mistaken for a Hellbender would be the mudpuppy (Nectorus maculosus). The two can be differentiated by the lack of external gills on the adult Hellbender, as well as the fact that hellbenders have five toes on their hind feet where mudpuppies have only four.

Threats to Habitat

While hellbenders were once known to be abundant in the Appalachian basin, there are several threats to their habitat that have caused a severe decrease in population in the Yellow Creek Watershed as well as many other watersheds that they once called home. Due to under-regulated strip mining occurring in the Yellow Creek Watershed in the 1970's there was a dramatic increase in sedimentation to area streams. This, coupled with the acid mine drainage that was pumped into tributaries of Yellow Creek while dewatering deep mines, had dramatic and damaging effects on aquatic wildlife spanning the entire length of the mainstem of Yellow Creek. Sedimentation, increases in temperature, and reductions in available dissolved oxygen have proven to be the most limiting factors in the existence of hellbenders in area streams. While adult hellbenders can still be found in Jefferson and Columbiana Counties, with one adult found in Yellow Creek, the only stream in eastern Ohio where a reproducing population has been located is the Captina Creek Watershed that flows through the counties of Belmont and Monroe.

Hellbenders in Yellow Creek

Since the 1970's and the passage of the Surface Mine and Reclamation Act of 1979 the aquatic health of Yellow Creek has improved dramatically, and for the most part without human assistance or intervention. When surveying the mainstem of Yellow Creek as well as several larger tributaries in 2008, it was noted by Ralph Pfingsten, that the habitat in many areas surveyed was ideal to support a Hellbender population, yet only one adult hellbender was found. The aquatic habitat has improved enough for hellbenders to survive but there are not enough animals in the watershed to allow for population recovery. Hellbenders are solitary animals, usually only gathering during their autumn breeding season. They will not, however, cross sections of stream that are embedded with sediment. This can limit the availability of mating partners.

Forest Resources

The most reliable and extensive information on forest resources within the Yellow Creek Watershed can be obtained from a USDA Forest Service inventory that was completed in 1991. The inventory was conducted for the entire state of Ohio and was summarized by dividing Ohio into 6 separate units. The bulk of the Yellow Creek Watershed lies in the East-Central Unit. Inventory information in the report was broken down by individual county, as well. The Yellow Creek Watershed is spread across Jefferson, Carroll, Columbiana, and Harrison counties.

The East-Central Unit consists of 11 counties and includes the entire Yellow Creek Watershed, except for the portion of the watershed in Columbiana County. Approximately 50% of this region is timberland. Of this timberland, 60% can be classified as oak/hickory type forest and 37% as mixed central hardwoods. The forested areas consist of "second growth" mixed mesophytic deciduous forest. A small percentage of the region can be classified as mixed northern hardwoods or sugar maple/beech type. The two most predominant species in this region are red maple and yellow-poplar followed by other significant species such as black cherry, ash, sugar maple, oak, hickory, and (to a small degree) white pine.

On average, there are 113 trees per acre containing an average volume of 1,280 cubic feet per acre and 3,735 board feet per acre in the East-Central Unit. The region as a whole contains just less than 6.5 billion board feet of growing stock. The board foot growth to removal ratio for this region is 1.8:1. This means that the region grows 1.8 as much saw timber as is harvested annually. However, it should be noted that there is a negative growth to removal ratio for the select red and white oak species, suggesting that red and white oak are being harvested in excess of annual growth.

Forest Resources – Carroll, Columbiana, Harrison and Jefferson Counties

Table 24. Net land area by county and land class, Ohio, 1991 (in thousands of acres)

Counties	**Land Class**						
	Timber-Land	Other Forest	Reserved Timberland	Other Reserved Forest	Total Forest Land	Nonforest Land	All Classes
Carroll	112	0	0.1	0	112.1	140.5	252.6
Columbiana	144.7	0	2.3	0	147	193.8	340.8
Harrison	156.2	0	0.1	0	156.3	102.1	258.3
Jefferson	150.1	0	0.9	0	151	111.1	262.1

Table 25. Area of timberland by county and ownership class, Ohio, 1991 (in thousands of acres)

Counties	Land Class						
	Other Public	State	County/ Municipal	Farmer	Corporate	Individual	All Ownership
Carroll	3.7	.4	0	18.7	0	88.9	112
Columbiana	0	2.7	0	26.4	18.7	96.9	144.7
Harrison	9.7	1.3	2.7	40.1	45.3	57.1	156.2
Jefferson	0	4.3	1.4	26.9	21.9	95.6	150.1

The preceding two tables illustrate the ownership of forestland within the region. Table 24 shows the acreage of forestland and non-forestland in each county. Note that almost the entire forestland acreage in the four counties is unreserved. Reserved forestland would include land, such as parks and dedicated natural preserves that are unavailable for timber harvesting. This means that the majority of the forestland within these counties is available for timber production. Table 25 shows ownership by county. Non-industrial, privately owned land accounts for the majority of the forestland in all four counties. Non-industrial private forestland includes the farmer, corporate, and individual ownership classes.

Most of the forestland within the watershed has been disturbed through harmful land usage. Much of the forestland has also reverted naturally from past agricultural use as cropland or pasture. Other areas of forest have established on ground which was surface mined (reclaimed and un-reclaimed). The remaining forestland acreage has been disturbed through past cutting and grazing practices.

They typical forestland within the watershed is in the pole and saw timber size class. Most of the forestland is classified as the oak/hickory type. Overall the forest health within the region is good, but there are several problems that reduce productivity within individual stands.

Logging is a large industry in the watershed. The DeNoon Lumber Company processes forest products from all over the region, and operates a lumber yard and drying facility in the town of Bergholz. A Master Logging Company, DeNoon is certified in proper logging techniques and forest management and assists the local Loggers Chapter, the Steel Valley Loggers, in ensuring the continued production and future not only of Yellow Creek's forests, but of the rest of Ohio's as well.

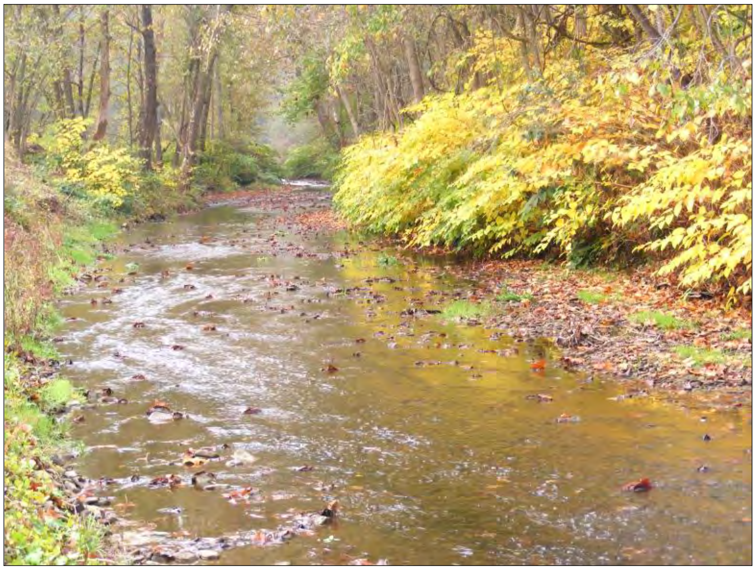

Fig. 33: Japanese Knotwood growing in riparian area of North Fork Yellow Creek (Corder)

Wild grapes are common in the region and significant vine damage is prevalent throughout the watershed. Non-native invasive plants such as Autumn Olive, Multi-flora rose and Japanese Knotweed have hindered natural regeneration of forest trees and important understory species. Japanese Knotweed is especially concerning as it is a competitor in riparian areas. Blooming in the early spring, it shades any saplings. Inhibiting the growth of trees adjacent to streams; this has a negative effect on stream habitat as shade is not provided to regulate water temperatures.

In areas where woodland grazing is practiced, significant erosion, poor forest health and reduced growth have resulted.   Past cutting practices have led to high-grading, which in turn leaves many stands in need of improvement, such as removing cull trees and enhancing the stand's genetic composition. Timber harvesting that does not utilize best management practices has led to significant soil erosion during logging operations.

General Soil Information for the Yellow Creek Watershed

Evaluating water quality necessitates identifying and discussing the soils of that watershed. Soil types vary greatly, and must be considered when planning any use of the land. Waterways adjacent to land which is being improperly used considering its soil may be impaired. The following section discussed the various soil types and their location in the Yellow Creek Watershed.

There are 94 different soil types and soil complexes found within the Yellow Creek Watershed. These soils differ depending on where they are found on the landscape, parent material, drainage, steepness and permeability.

The different landscape positions are depressional areas, flood plains, slack water terraces, terraces, upland soils, foot slopes, upland side slopes, upland ridge tops, footslopes, hillsides, upland ridge tops and side slopes.

There are many parent materials including organic soils, alluvial material, soils weathered from limestone, sandstone, siltstone, shale, mudstone, red clay shale, stratified lacustrine sediments, glacial outwash, colluvium, glacial drift, silt and loess.

The drainage ranges from very poor to well drained soils with permeability from very slow to rapid.

Carlisle, Kerston and Willette are depressional soils found in bogs and swamps. They are generally organic soils that are very poorly drained and unsuitable for cropland, pasture or woodland.

Chagrin, Holly, Lobdell, Melvin, Nolin, Orville, Papaking, Tiogaand are flood plain soils. They are generally deep, to very deep soils, formed of alluvium. The drainage ranges from very poor to well drained and permeability from moderately slow to moderately rapid. The very poorly drained soils are not well suited for cropland, pasture or woodland use. The moderately well drained and well-drained soils are well suited for cropland, pasture and woodland with a minimal potential for erosion.

The slack water terrace soils are composed of Fitchville, Glenfore, Lorain and Sebring soils. The drainage varies from very poorto moderate with permeability rates of slow to moderately slow. These soils can be used for cropland if drained. They are suitable for pasture and woodland uses.

The terrace soils are Allegheny, Allegheny and Monongahela , Bogart, Boyer, Canadice, Caneadea, Chiki, Chilo, Damascus, Elkinsville, Jimtown, Laidig, Luray and Marengo, Nagley, Olmsted, Omulga, Oshtemo, Park, Pekin, Peoga, Purdy, Rainsboro, Tyler and Wheeling. These soils range from poorly drained to well-drained with permeability from very slow to rapid. The parent materials very greatly and consist of alluvium, glacial outwash and loess. Land use potential varies with the drainage and permeability. The moderately and well-drained soils with moderated permeability are good for cropland, pasture and woodland. Some of the poorly drained soils can be used for cropland if drained. The pHs amongst these soils vary greatly due to parent materials of limestone and acid shales.

Brookside, Clarksburg, Ernst, Lowel, Richland and Titusville soils are found on the footslopes. They are somewhat poorly drained to well-drained with permeability rates of slow to moderate. These soils are excellent for cropland, pasture and woodland. There is a potential for soil erosion on the steeper slopes

The upland soils are Canfield, Frenchtown, Gresham, Hanover, Revenna, Rittman, Summitville, Wharton and Wooster. They were formed primarily from glacial till and colluvial. The drainage is poor to well-drained with permeability of slow to moderate. The soils are generally well suited for cropland, pasture and woodland with the poorer drained soils needing drainage.

Upland soils found on hillsides consist of Berks-Guernsey complex, Cavode, Chili, Conotton and Nagely complex, Wadworth, Weikert and Muskingum complex. These soils are somewhat poorly drained to well-drained with slow to rapid permeability. The poorly drained soils are not well suited for cropland but the well-drained soils, on the flatter slopes are well suited for cropland. The slopes range from 2% to 50% slopes resulting in a high potential risk for erosion. The steeper slopes are most effectively utilized for pasture and woodland.

Coshoction, Gilpin, Guernsey,Berks, Bethesda, Dekalb, Elba, Fairpoint, Germano, Gipin-Coshocton complex, Gilpin-Lowell complex, Loundonville, Loudonville-Muskingum, Morristown, Rigley, Steinberg-Rigly, Upsur, Westmoreland, Westmoreland-Berks, Westmoreland-Coshocton, Westmoreland-Dekalb, Westmoreland-Lowell are all soils found on the upland side slopes, ridge tops, foot slopes and hillsides. The soils are, in general, moderately drained with a moderate permeability rate. They are suitable for use as cropland, pasture and woodland. The steeper slopes are better utilized for pasture and woodland due to the high potential for erosion.

The upland ridgetop soils consist of Aaron, Berks-Aaron, Coshocton-Keene, Culleoka, Keebe, Library variant and Wellston. They are somewhat poorly drained to well-drained with permeability rates of slow to moderately rapid. They are generally well suited for cropland, pasture, and woodland uses, with potential for erosion on the steeper slopes.

General Soils of the Yellow Creek Watershed

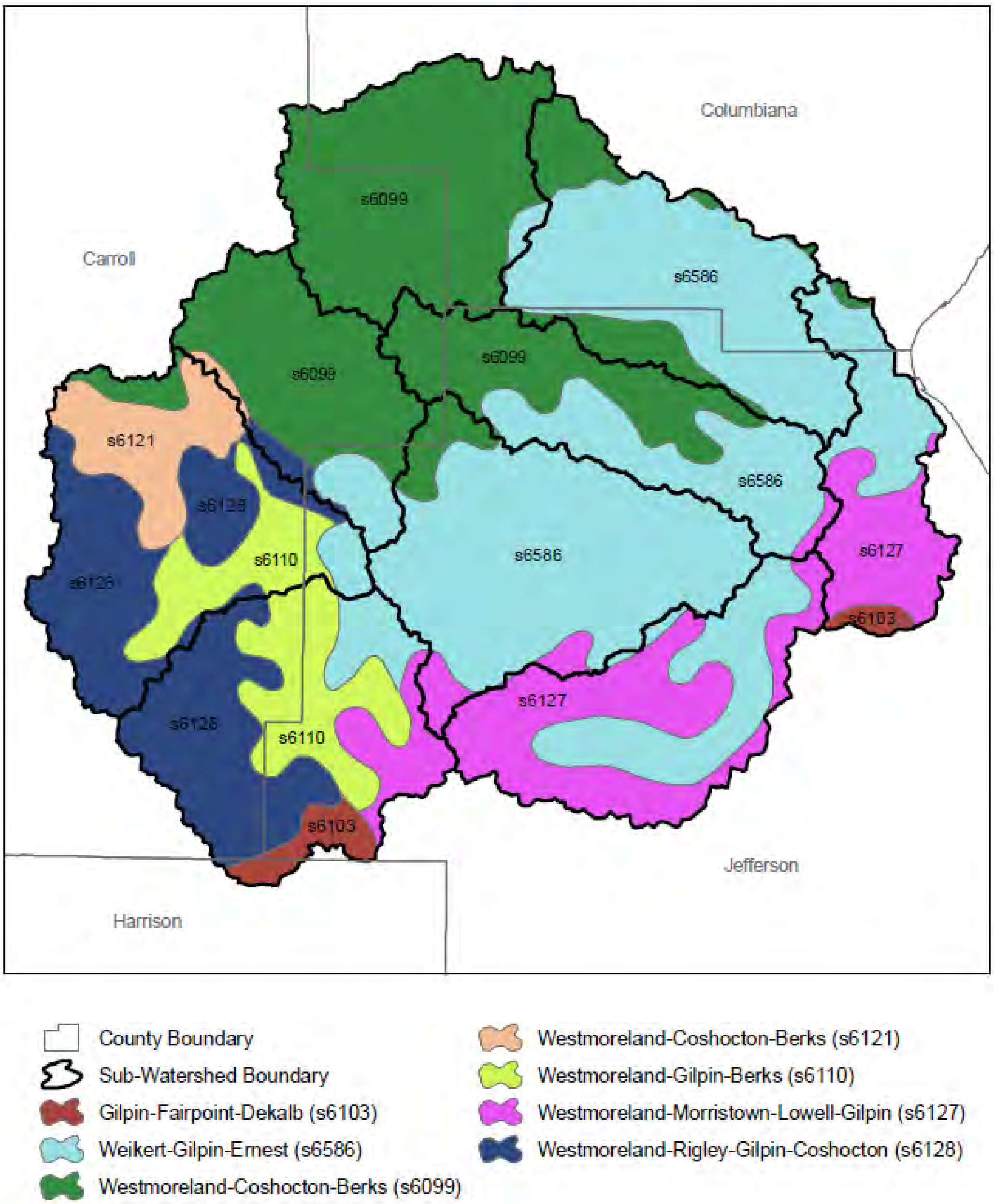

Fig. 34 General Soils of Yellow Creek Watershed

Land Use

The Yellow Creek Watershed is 72% forested and 26% agriculture or open land. The remainder of land is classified as residential, urban or disturbed (strip-mined) land.

Land uses vary in watershed and include cropland, pasture, forested land, tree farms and nurseries. Strip mine land (ranging in various conditions from reclaimed in grass, to barren un-reclaimed, to land being actively mined), urban areas and other land provides space for farmsteads, houses, pastures, ponds and shrub areas.

During the creation of the TMDL for Yellow Creek, the projection of growth within the Yellow Creek watershed was limited. Since then the discovery of the ability to extract minerals from the Marcellus, Utica and Point Pleasant Shale utilizing hydraulic fracturing technology has greatly altered that growth projection. Industrial sites including well pads, pipe yards, pipeline construction, water recycling centers, etc. have already developed in the watershed within two years after the beginning of the oil and gas "boom" in Ohio. Residential expansion is also expected to progress with the growth of the industry.

Demographics

Table 26. Population Demographics as of 2010 Census

County	Total Population	Percentage of Watershed Land
Carroll	28,836	31.3
Columbiana	107,841	15.6
Harrison	15,864	.3
Jefferson	69,709	52.8

Table 27. Population by Age

County	Under 18	18 and Over	20-24	25-34	35-49	50-64	65 and Over
Carroll	6,637	22,199	1,379	2,904	5,836	6,600	4,803
Columbiana	23,584	84,257	5,665	11,989	22,105	24,147	17,793
Harrison	3,472	12,392	794	1,557	3,030	3,770	2,880
Jefferson	14,054	55,655	4,554	6,934	13,201	16,082	12,756

Table 28. Education Levels

County	High School	Bachelor's Degree
Carroll	87.3%	12.0%
Columbiana	85.7%	13.0%
Harrison	85.0%	8.6%
Jefferson	87.3%	14.2%

Table 27. Population of Watershed Villages as of 2006

Village	2006 Total Population
Amsterdam	553
Bergholz	748
Irondale	408
Salineville	1354

Table 28. Employment Statistics as of 2000 Census

County	Total employment in all industries	Largest Employers
Carroll	12,800	Manufacturing
Columbiana	48,800	Construction
Harrison	6,600	Local Government
Jefferson	27,900	Health Care & Social Assistance

Table 29. Civilian Labor Force Estimates, as of December 2009
(http://lmi.state.oh.us/laus/OhioCivilianLaborForceEstimates.pdf)

County	Employment	Unemployment	Unemployment Rate	Unemployment Rank in Ohio
Carroll	12,100	1600	11.8	16
Columbiana	46,400	5,900	11.2	21
Harrison	6,500	800	11.2	22
Jefferson	29,200	4,100	12.4	12

Table 30. Land in Agricultural Production

County	Number of Farms	Acres per Farm	Land in Farms (Acres)
Carroll	770	151	116,000
Columbiana	1030	126	130,000
Harrison	410	210	86.000
Jefferson	480	148	71,000

Table 31. Watershed Agricultural Statistics, as of 2007
(http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Watersheds/o05.pdf)

Crop	Number of Farms	Number of Acres

Corn, all	2,391	171,739
Soybeans, all	1,026	103,483
Small Grains	1,435	42,338
Vegetables and melons for sale	608	5,104
Fruit and tree nuts	322	1,663

Watershed Livestock Statistics, as of 2007
(http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Watersheds/o05.pdf)

Agriculture

Agricultural Influences in the Subwatersheds

Fig. 35: Soybean Crop planted in the floodplain along the mainstem of Yellow Creek (Corder)

The Yellow Creek Watershed is comprised of eight (8) subwatersheds. Across the eight sub- watersheds, overall agricultural land use tends to be relatively similar. This similarity is due, in part, to topography and the characteristics of the primary soils associations across the watershed as a whole. Farm size across the watershed is generally small, with most farms averaging between 125 and 150 acres. Primary crop acreage is comprised of forage crops, including hay, pasture and silage. Livestock raised in the watershed include cattle and calves, broilers and meat chickens, sheep and lambs, hogs and pigs, and horses and ponies *(2007 USDA Census of Agriculture – Carroll, Columbiana and Jefferson counties)*. Most livestock operations are small to medium sized cattle operations on continuous or rotationally grazed pastures.

It is important to note that though agricultural land use trends in the Yellow Creek Watershed on an average of the whole are generally similar, there are other factors at play that cause inconsistency across county lines. For example, there are higher dairy cattle numbers in the subwatersheds located primarily in Columbiana County versus very low dairy numbers in the subwatersheds located primarily within Jefferson County. Despite similar landforms and geological factors across each subwatershed, differing economics, political systems, landowner social networks and cultural trends within each county also heavily influence agricultural land uses in individual counties.

Possible Agricultural Impairments

Overall, the TMDL study done in the Yellow Creek Watershed does not identify agriculture as a predominant source of impairment. That data is testament to the many producers in the watershed who have installed conservation practices for the purpose of reducing agricultural impacts.

However, because of the terrain, vegetative cover, and soil types, the potential for adverse impacts to the watershed does exist with improper management. The subwatersheds of Yellow Creek consist of many steep hillsides and flat floodplain areas. Many farm fields are separated from one another by steep ravines and forested areas, and some agricultural areas are in very remote locations. Practices of concern and possible impacts are as follows:

•*Allowing livestock unmanaged access to streams, tributaries, ponds and wetland areas* – impacts include stream bank erosion, nutrient pollution and headwater habitat destruction.

•*Allowing livestock unmanaged access to quality woodland areas* – impacts include erosion, compaction, increased runoff, poor forest health and headwater habitat destruction.

•*Farming crop fields up to the creek's edge, without installing or maintaining buffers or riparian areas* – impacts include nutrient pollution, increased sedimentation, erosion and stream habitat impairment.

•*Not developing paddocks and access lanes on the contour* – impacts include erosion and accelerated nutrient runoff.

•*Allowing livestock to loaf in and/or create consistently exposed and manure covered areas near streams and tributaries* – impacts include nutrient pollution and habitat impairments.

•*Allowing dairy milk house waste to enter streams and tributaries* – impacts include nutrient pollution and habitat impairments.

•*Storing manure in areas where it is exposed to flooding or drains into streams and tributaries* – impacts include nutrient pollution and habitat impairments.

•*Overgrazing* – impacts include erosion, poor soil health and nutrient pollution.

•*Undergrazing* – impacts include increased proliferation of invasive species.

Conservation Practices and Special Projects to Reduce Agricultural Impacts in the Watershed

There are several conservation and best management practices commonly used by livestock producers throughout the watershed. Because of the topography of the watershed and types of livestock operations, these practices are used by producers to reduce livestock impacts in the watershed, increase economic gains and manage land use sustainably. Since most livestock is grazed in upland areas and water sources are commonly in lowland areas, ravines, or along creeks and streams, many producers have installed spring developments, watering facilities, pumping facilities and pipeline as a way to locate livestock water where it can best be utilized. Additionally, most producers have installed fencing to keep livestock out of sensitive areas including streams, steep areas, woodlands and wetlands. Also, a growing number of producers in the watershed are changing their management style from the utilization of continuously grazed and overgrazed pastures to managed and rotationally grazed pastures. Livestock operators commonly control surface water runoff on their operations by managing runoff from hard surfaces with gutters, downspouts and diversions. Many have also installed access roads for livestock and equipment travel as a way to reduce soil impacts. Several producers have installed heavy use pads for the purpose of feeding livestock in the wet winter and spring months.

In 2001, the Jefferson County portion of the Yellow Creek Watershed was designated a special project area as part of the UDSA Environmental Quality Incentives Program (EQIP) and ODNR Division of Soil and Water Resources Non-Point Source Watershed Program. State and federal dollars funded cost-shared agricultural practices to reduce impairments to the watershed. Thirteen producers participated in the program.

The following conservation and management practices were installed in the project area:

Livestock Use Exclusion	8,450 feet
Livestock Fence	40,150 feet
Tree Planting	2.5 acres
Pasture/Hayland Seeding	176 acres
Brush Management	78 acres
Livestock Use Protection Area	18,100 square feet
Spring Development	5
Pipeline	1,280 feet
Water Trough or Tank	7
Roof Runoff Management	684 feet
Access Road	300 feet
Manure Storage Structure	3,072 cubic feet of storage
Critical Area Treatment	10 acres
Planned Grazing Management	336.8 acres
Conservation Crop Rotation	305.8 acres
Nutrient Management	681.1 acres
Pest Management	601.1 acres
Riparian Field Buffer	430 acres
Field Border	7.6 acres
Waste Utilization	80 acres

Marcellus and Utica Shale Development

Natural Gas and Oil Exploration in the Yellow Creek Watershed

Development of the Marcellus and Utica Shale formations for the purpose of gas and oil production has the potential to greatly impact the Yellow Creek Watershed and its inhabitants. The Marcellus shale formation's namesake is the village of Marcellus, New York, where an outcrop of this black shale is located. The Marcellus extends throughout the northern Appalachian Basin of North America, including all or portions of the states of New York, Pennsylvania, Maryland, West Virginia and Virginia, New Jersey, Kentucky, Tennessee, and a small section in Canada. The Marcellus is found at a depth of 4,000 to 5,000 feet in Yellow Creek region, and the Utica lies at 6,000 to 8,000. Age dating of the Marcellus indicates that it was formed 391.9 to 383.7 million years ago. The Marcellus formation thins as it extends to the west with a fifteen meter thickness along the Ohio River and trailing off to only a few feet in Licking County. The Utica Shale formation is estimated at a thickness of 250 to 300.

Advancements in Drilling Techniques

Fig. 36: Chesapeake Well Pad within the Headwaters to Yellow Creek subwatershed

The impervious limestone layers of the Onondaga directly below the Marcellus and the Tully Limestone at the top of the Hamilton Group have trapped valuable natural gas reserves in the Marcellus formation (Wynne). Gas is stored in the pore spaces of the shale as well as in vertical cracks. It is estimated by the United States Department of Energy that the Marcellus contains 262 trillion cubic feet of recoverable gas.

The current method of gas extraction out of the Marcellus and Utica formations is hydraulic fracturing and directional drilling. Before these different techniques were combined in the Barnett shale play in Texas, vertical wells were the only method employed for Marcellus shale gas extraction. These vertical wells had a low rate of return, although they did have a very long productive life. Horizontal wells that are hydraulically fractured are producing gas at more than double the rate of the vertical wells. Directional drilling into the Marcellus and Utica involves drilling vertically for thousands of feet (7,000-12,000) and then gradually angling out horizontally through the targeted deposit. The horizontal portion of the well generally extends for 6,000 feet. Horizontal drilling increases the amount of natural gas captured once the well is hydraulically fractured.

Hydraulic fracturing or “Hydrofacking” as it is commonly called is the pumping of a mixture of water, chemicals and sand into the well under extremely high pressure (upwards of 500 and 2000 pounds per square inch) into the well to create small fractures in the shale formation. After the water creates the fractures, the sand fills these spaces and prevents the fractures from closing after the water recedes. Though efficient, there are environmental concerns regarding this method.

Environmental Impact

This highly lucrative industry is not without its share of controversy. Environmental and infrastructure concerns have been voiced by many residents, environmental groups, government officials and state and local agencies since the natural gas boom has began in the Marcellus and Utica formation. A major concern is that the process is so new that the true environmental impacts are not yet known. In response to this issue the state of New York has placed a moratorium on directional drilling utilizing hydraulic fracturing until further studies prove its environmental soundness.

One concern of the drilling process includes the vast amounts of water required to develop the well. Estimates show that two to five million gallons of water will be needed to develop one well, with up to six wells on one well pad. While some of the water used for drilling does surface again, it is usually around 30% and not all of the companies operating in the area are recycling it. Under Ohio law, water needed for fracking can be withdrawn from surface waters of the state without permit unless the draw amount exceeds 100,000 gallons per day. While this amount of water pulled from a very large lake or river may be concerning, it is even more detrimental to smaller streams where the flow cannot support sizeable withdraws. Currently there has been no water budget created for the state of Ohio to determine if the amount of freshwater available in the state can support the hydrofracking industry in addition to all other freshwater needs.

Sedimentation to streams due to the clearing of land for the large well pads used for Marcellus and Utica well development is another environmental concern. Oil and gas exploration companies were given a reprieve under the Bush administration that allows them to develop the well pads that can be ten to fifteen acres in size, not including access roads, without first attaining a NPDES permit. It was determined that due to the amount of well pads that were to be created the permit costs would create a financial hardship for the exploration companies. This limits the role the soil and water conservation districts can play in ensuring the pads are developed according to the NPDES standards, eliminating the possibility of an increase in sediments entering our waterways.

The chemicals used in the hydraulic fracturing mixture are toxic, and the water that returns to the surface after drilling cannot be treated by traditional wastewater treatment plants. ODNR has authority over the disposal of flowback water from wells. Ohio prohibits the direct discharge of brine water into surface waters of the state. Most of the wastewater affected by the chemicals used in hyrdofracking is injected into deep wells in the state of Ohio. There is one treatment plant created to treat this flowback waster located in Warren, Ohio. Before additional laws were created to prevent it, hyrdrofracking fluid in Pennsylvania was passed through wastewater treatment plants during times of high flow. This causes problems for water treatment facilities downstream that must treat water with increased levels of Bromide. When they chlorinate incoming water, the chlorine and bromide react to form tri-halo methanes. ORSANCO now monitors bromide levels in the Ohio River and the information pertaining to this project can be found on their website.

Methane migration from the development of Marcellus and Utica formations has also become an environmental concern. A recent study performed by Harvard University determined that the methane found in freshwater wells in areas of hydrofracking activity can be identified as methane from a deep source by identifying its isotopes.

Another source of groundwater contamination is flowback water that contains minerals accumulated from the shale formation as well as high concentrations of total dissolved solids. The possibility also exists that, as stated by the Ohio Division of Natural Resources, Division of Oil and Gas, the flowback water may contain naturally occurring radioactive elements, such as radium.

Perhaps one of the least discussed consequences to the expansive natural gas industry in the area is the possible affect on wildlife. The main reason that the Yellow Creek Watershed is ranked as one of the ten healthiest watersheds in the state of Ohio is because it is not extensively developed. The majority of Yellow Creek is forested. A certain degree of deforestation must exist for the installation of pads and access roads, destroying natural habitat in the process. In order to determine the level of impact the increase of drilling activity will have on native populations, baseline data should be collected whenever possible.

It is estimated that 90% of the landowners in the Yellow Creek Watershed have leased their land to natural gas companies, with Chesapeake Energy as the main lease holder. While there are several wells currently being drilled in the Yellow Creek Watershed, the number is expected to rise exponentially in the next two years with the increase in infrastructure.

Physical Attributes

Stream channelization in the Yellow Creek watershed is most frequently correlated with pre-law surface mining, especially in the area of the Jensie Mine Site in the Headwaters to Yellow Creek subwatershed. Other areas of channelization occur at a bond forfeiture site on Dennis Run in the Hollow Rock subwatershed where the stream has been armored with prefabricated cement structures. Channelization by the creation of roadways and rail lines along floodplains throughout the watershed has prevented the natural migration of stream channels.

There are no known riparian levees or streams levied within the Yellow Creek watershed.

Entrenchment and enclosing the stream via culverting is not prevalent in the watershed due to its rural nature. Areas of the watershed where non-natural entrenchment does occur include areas downstream of bridge crossings and stream segments immediately downstream of villages such as Bergholz, Amsterdam and Irondale. This is due to an increase in runoff due to impervious surfaces associated with urbanization.

As previously stated the majority of the watershed is forested. The following table describes the amount of forested riparian corridor for each watershed.

Table 33. Forested Riparian Corridor Assessment

Subwatershed	Forested Riparian Corridor
Headwaters to Yellow Creek	17.6 miles
Elkhorn Creek	9.702 miles
Upper North Fork	3.14 miles
Long Run	34.905 miles
Town Fork	21.9 miles
Hollow Rock Run	8.1 miles
Headwaters to North Fork	30.2 miles
Salt Run	19.0 miles

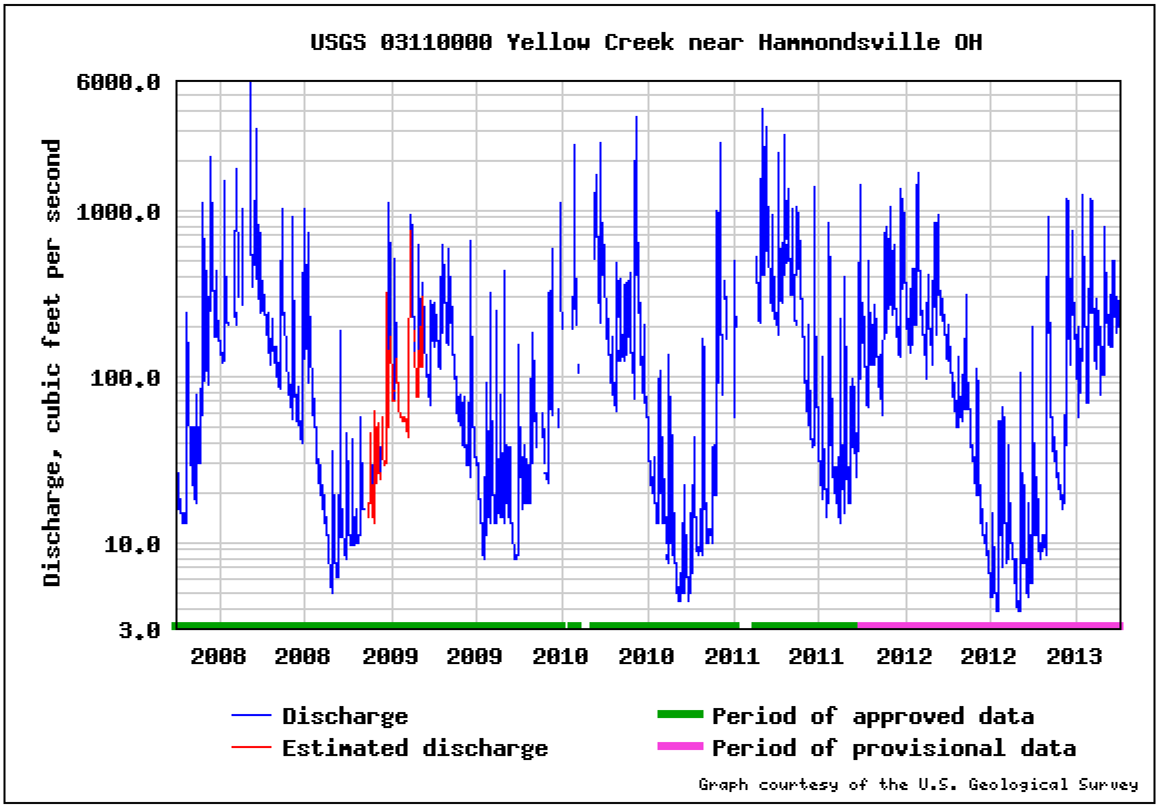

Fig. 37: Flow history at Yellow Creek USGS Gauge

The lowest flows experienced in Yellow Creek in the last six years occurred during the summer of 2012. A combination of a typical La Nina winter with mild temperatures and little precipitation was predicted to be followed by a spring and summer with drought-like conditions. This prediction came to fruition, and coupled with the possible impacts of a recently developed, semi-permanent water withdrawal site on the mainstem of Yellow Creek, extremely low flows followed.

Section II: Watershed Action Plans for 12 Digit HUC Subwatersheds

Subwatershed Inventories

Yellow Creek Watershed has been broken down into nine different 14 digit hydrologic units. During the development of this watershed plan the numeric system by which watersheds are categorized, according to the United States Geological Society (USGS), has changed slightly. This change resulted in eight different 12 digit subwatersheds in the 10 digit Yellow Creek

Watershed. The reduction to eight subwatersheds from nine occurred with the combination of the 14 digit subwatershed 05030101 190 020 (Yellow Creek below Town Fork to above North Fork Yellow Creek) and 05030101 190 050 (Yellow Creek below North Fork to Ohio River). In order to provide a more detailed plan, the Yellow Creek Watershed Action Plan will use the twelve digit hydrologic units.

Table 32. 12- And 14- digit USGS Hydrologic Unit Codes for the Yellow Creek Watershed

HUC 12	HUC 14	Subwatershed Name	Acres
05030101 0701	05030101 180 010	Headwaters Yellow Creek	20,455
05030101 0702	05030101 180 020	Elkhorn Creek	21,453
05030101 0703	05030101 180 030	Upper North Fork	12,257
05030101 0704	05030101 180 040	Long Run-Yellow Creek	21,886
05030101 0801	05030101 190 010	Town Fork	16,618
05030101 0802	05030101 190 030	Headwaters North Fork Yellow Creek	16,960
05030101 0803	05030101 190 040	Salt Run- North Fork Yellow Creek	18,364
05030101 0804	05030101 190 020 05030101 190 050	Hollow Rock Run	25,120

Subwatershed Goals

The ultimate goal of the Yellow Creek Watershed Action Plan is to restore all stream segments to full water quality attainment. As documented by Ohio EPA, there are four main sources of impairment in Yellow Creek: home sewage treatment systems, livestock with stream access, stream impoundment and pre-law mining. While all of the eight subwatersheds are experiencing impairments due to one or more of the issues mentioned above, the degree to which they are affected varies. Best management practices along with education are the methods that will be used to accomplish the goals of the watershed action plan.

Chapter I. Mechanisms for Water Quality Impairment

The following section on mechanisms for water quality impairment is provided by the Ohio EPA and found in the Yellow Creek Technical Support Document, which discusses both the biological study and water quality study of Yellow Creek.

Causes of Impairment in the Yellow Creek Watershed

Fig. 38: Straight pipe emptying into Yellow Creek near Bergholz (Corder)

Failing Home Septic Treatment Systems

Home septic treatment systems are used to treat human waste in areas that lack centralized sewage treatment systems. Most of the Yellow Creek Watershed is very rural in nature and therefore the majority of homes in the watershed use home septic treatment systems. Untreated or inadequately treated human waste can be extremely damaging upon entering a waterway. Bacteria and pathogens associated with the waste make recreational use of the stream unsafe. Organic enrichment and nutrients entering the stream prove damaging to biological communities. In its 2005 study the Ohio EPA found there were several hundred failing septic systems in four of the Yellow Creek Subwatersheds.

In addition to failing septic systems within the Yellow Creek Watershed, there are also three villages with no waste treatment facilities which exude extremely high levels of contaminants to waterways. These villages include Amsterdam, houses clustered outside Bergholz and within Bergholz, and Irondale.

All the watersheds within the Yellow creek basin were sampled for fecal coliform bacteria during the summer of 2005. Results of this sampling effort were reviewed and basins which had exceedances of bacteria standards (recreational use) were determined as summarized in the table below. The HUC 14 units determined to be modeled for pathogen impairment were found by review of the significance of the number of samples in exceedance coupled with the proportion of sites within the HUC 14 that had exceedances. If a HUC unit had numerous sampling locations with multiple samples that exceeded recreational use standards, the entire 14-digit

HUC is modeled. All recreational use impaired watersheds are modeled by BIT, USEPA's Bacteria Indicator Tool. (OEPA)

Table 33. Home sewage treatment systems estimated values for Yellow Creek Watershed (OEPA)

	Total Area	Failing Septic Systems	Total Persons Served	Septic Flow to Stream	Fecal Coliform Loading
Subwatershed	**(acres)**	**(#)**	**(#)**	**(gal/day)**	**(count/day)**
Headwaters to Yellow Creek	20,279.3	655	1,720	120,391	4.56E+14
Elkhorn Creek	21,352.9	560	1,398	97,878	3.70E+14
Long Run-Yellow Creek	21,510.3	524	1,382	96,754	3.66E+14
Salt Run-North Fork Yellow Creek	18,222.2	604	1,700	118,978	4.50E+14

Livestock Operations

Livestock with stream access (mainly cattle) is a minor source of impairment in Yellow Creek. (OEPA, 2009) The cattle have free access to streams, causing problems with bacterial contamination (from the direct deposit of waste into the stream), habitat and channel degradation, elimination of essential riparian vegetation, and bank erosion. Areas of concern are those with elevated bacteria concentrations and observed cattle activity. The Natural Resource Conservation Service provided 75% cost share to qualified landowners within the Yellow Creek Watershed who were interested in the following conservation practices: tree plantings, fencing, manure storage structures, brush management, spring development, grazing management and nutrient management. This was part of the Environmental Quality Incentive Program which between 2001 and 2003 provided residents of the watershed $70,000 to implement these practices. Due to this assistance targeted to landowners in Yellow Creek agricultural issues do not play as large of a role in Yellow Creek as do failing or non-existent home sewage treatment systems.

Stream Impoundments

As is incumbent with stream impoundments, the two reservoirs within the Yellow Creek Watershed produce adverse impacts to their biological communities by simplifying their habitats, obstructing fish migration and degrading water quality. As these reservoirs provide important community recreational opportunities and access to drinking water, removal of the impoundments is not reasonable or recommended.

Acid Mine Drainage

Acid mind drainage (AMD) is the seepage or runoff of groundwater and precipitation which has come into contact with coal or coal mine waste materials called "gob". Acid Mine Drainage (AMD) is generated when coal mining, either surface or underground, exposes iron pyrite 30 in bedrock units to water and air. The result is an oxidation reaction that creates sulfuric acid. A simplified version of this reaction is listed below. (McCament, 2007)

$4FeS_2 + 15O_2 + 14H_2O = 4Fe(OH)_3^- + 8H_2SO_4$
Pyrite + Oxygen + Water = Ferric Hydroxide + Sulfuric Acid

Fig. 39: Roach Run AMD Seep (Leuhrs)

The sulfuric acid then dissolves heavy metals in the bedrock in high concentrations.
These heavy metals, mostly iron, aluminum, and manganese in highest concentrations, convert to hydroxides and precipitate as a solid when buffered and pH is raised. This solid is referred to as flocculent (floc) or yellow boy due to its yellow-orange color caused by iron. (See figure 24) Acid mine drainage in Ohio is characterized by low pH, high metal concentrations, and low buffering capacity because of the lack of alkalinity. (OEPA, 2009) The areas of mining contamination in the Yellow Creek watershed are restricted to localized areas near the AMD sources. Due to high buffering capacity acid mine drainage is localized in he Yellow Creek watershed, occurring almost exclusively in small- or medium-sized streams that directly receive drainage from abandoned underground mines. (Bowman, Hughes 2008)
An Acid Mine Drainage Abatement and Treatment plan was competed for the Yellow Creek watershed in 2008. In the Yellow Creek watershed, streamflow is strongly net alkaline in its natural state and mine drainage impacts do not tend to carry or accumulate downstream as they do in more balances or net acidic waters. As a result, the goals for conceptual design of mine-drainage treatment systems for the Yellow Creek watershed is the reduction or elimination of impacts to immediately receiving streams and the removal of mine drainage as a factor limiting the attainment of a designated uses for surface waters under the Clean Water Act. (Bowman, Hughes 2008) Strategies for acid mine drainage treatments were

limited to four project areas: Wolf Run, Roach Run, Salisbury Run and the source at County Road 53.

Streambank Erosion

Fig.40: Streambank erosion on the mainstem of Yellow Creek near Bergholz (Corder)

Streambank erosion is a natural process, but acceleration of this natural process leads to a disproportionate sediment supply, stream channel instability, land loss, habitat loss and other adverse effects. Streambank erosion processes, although complex, are driven by two major components: stream bank characteristics (erodibility) and hydraulic/gravitational forces. Many land use activities can affect both of these components and lead to accelerated bank erosion. The vegetation rooting characteristics can protect banks from fluvial entrainment and collapse, and also provide internal bank strength. When riparian vegetation is changed from woody species to annual grasses and/or forbs, the internal strength is weakened, causing acceleration of mass wasting processes. Streambank degradation is often a response to stream channel instability. Since bank erosion is often a symptom of a larger, more complex problem, the long-term solutions often involve much more than just bank stabilization.

Chapter II. Headwaters to Yellow Creek

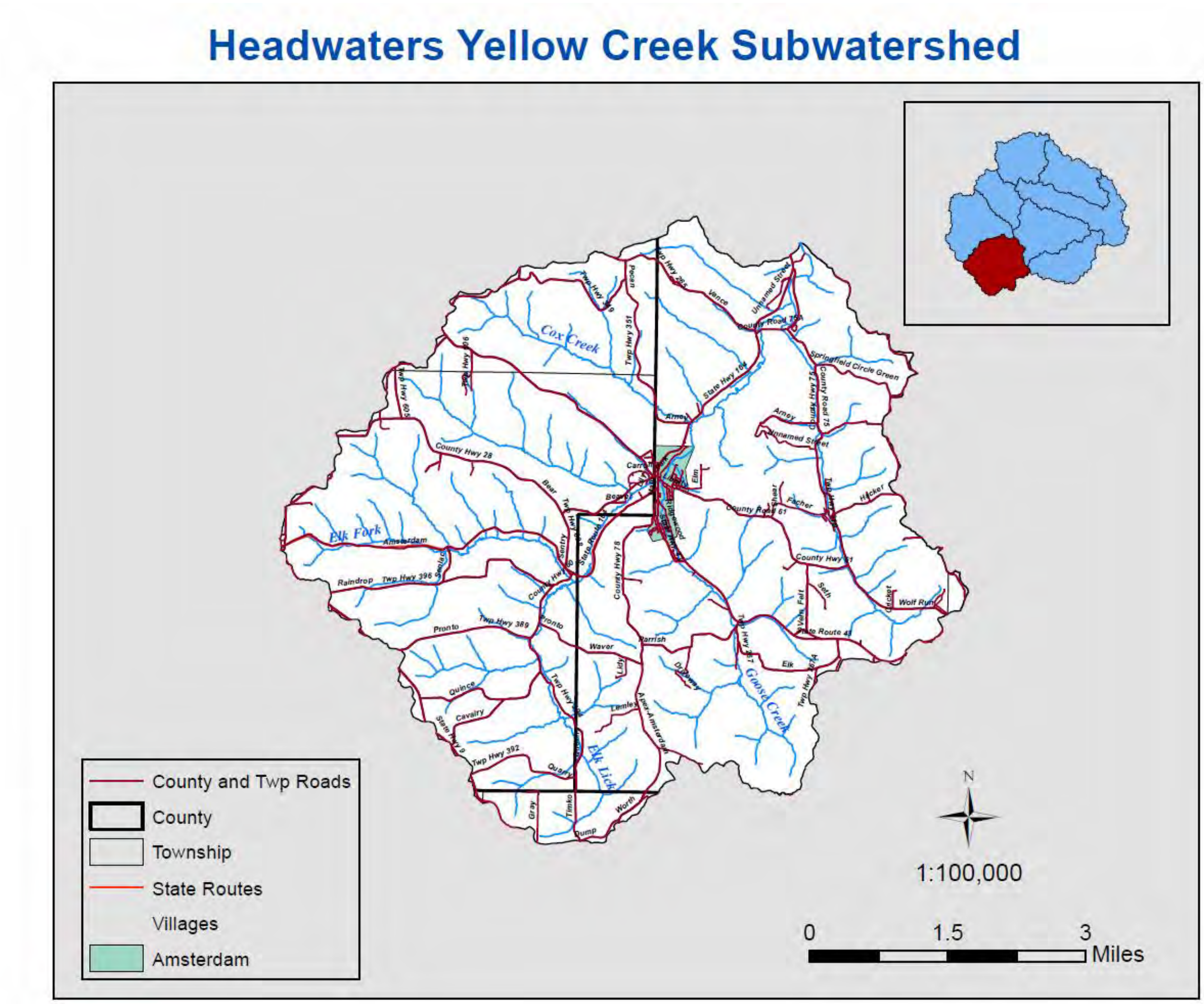

Fig. 41: Headwaters to Yellow Creek

05030101 0701

20,455 acres

The mainstem of Yellow Creek begins in the subwatershed Headwaters of Yellow Creek at the confluence of Elk Fork and Elk Lick streams. Of the sixteen streams or stream segments recommended for designation as coldwater habitat by Ohio EPA, five of those occur in the subwatershed Headwaters of Yellow Creek. Streams recommended for coldwater habitat designation tended to be smaller drainages of ten square miles or less. All sites in this subwatershed that were sampled by OEPA in 2005 were in attainment.

Municipalities:

Amsterdam is the only incorporated village in this subwatershed. Amsterdam amounts to 204.1 acres with a population of 553 residents.

Fig. 42: The mainstem of Yellow Creek channelized through the village of Amsterdam (Corder)

Geology

The bedrock of the Headwaters to Yellow Creek Subwatershed consists mainly of shale and siltstone. The area having probable Karst features amounts to 20,476.8 acres.

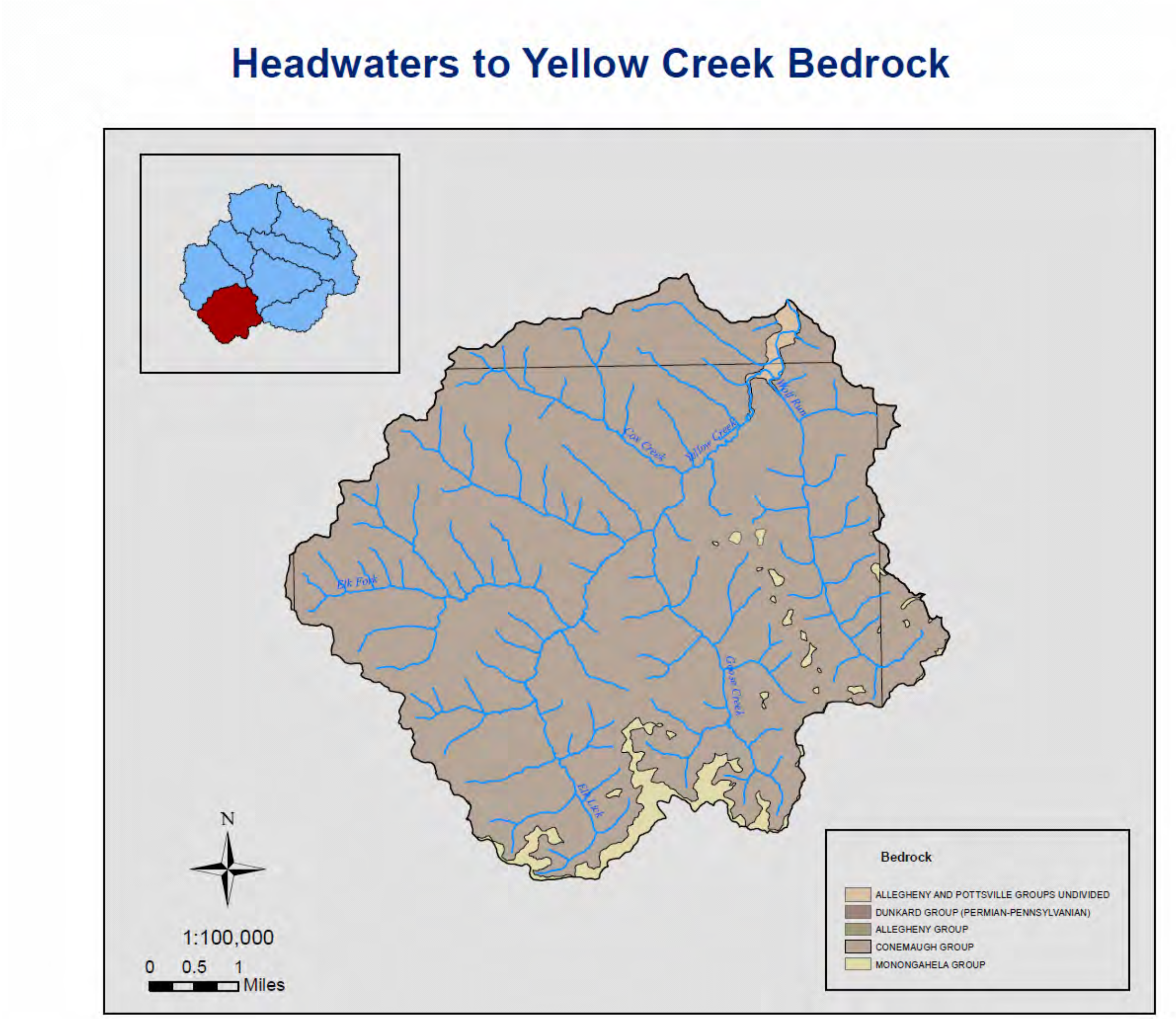

Fig.43: Headwaters to Yellow Creek Bedrock

Population

The population in this area has decreased sharply over the last thirty years, with a small amount of rebound between 1990 and 2000.

1980: 2,091

1990: 1352

2000: 1402

The average household size is 2.5, and the average household income is $37,934.00.

Soil Resources

Unlike the majority of subwatersheds in Yellow Creek, the majority of soils in the Headwaters to Yellow Creek rank well for drainage. There are 11,907.3 acres considered prime farmland and 19,713 acres are highly erodible land.

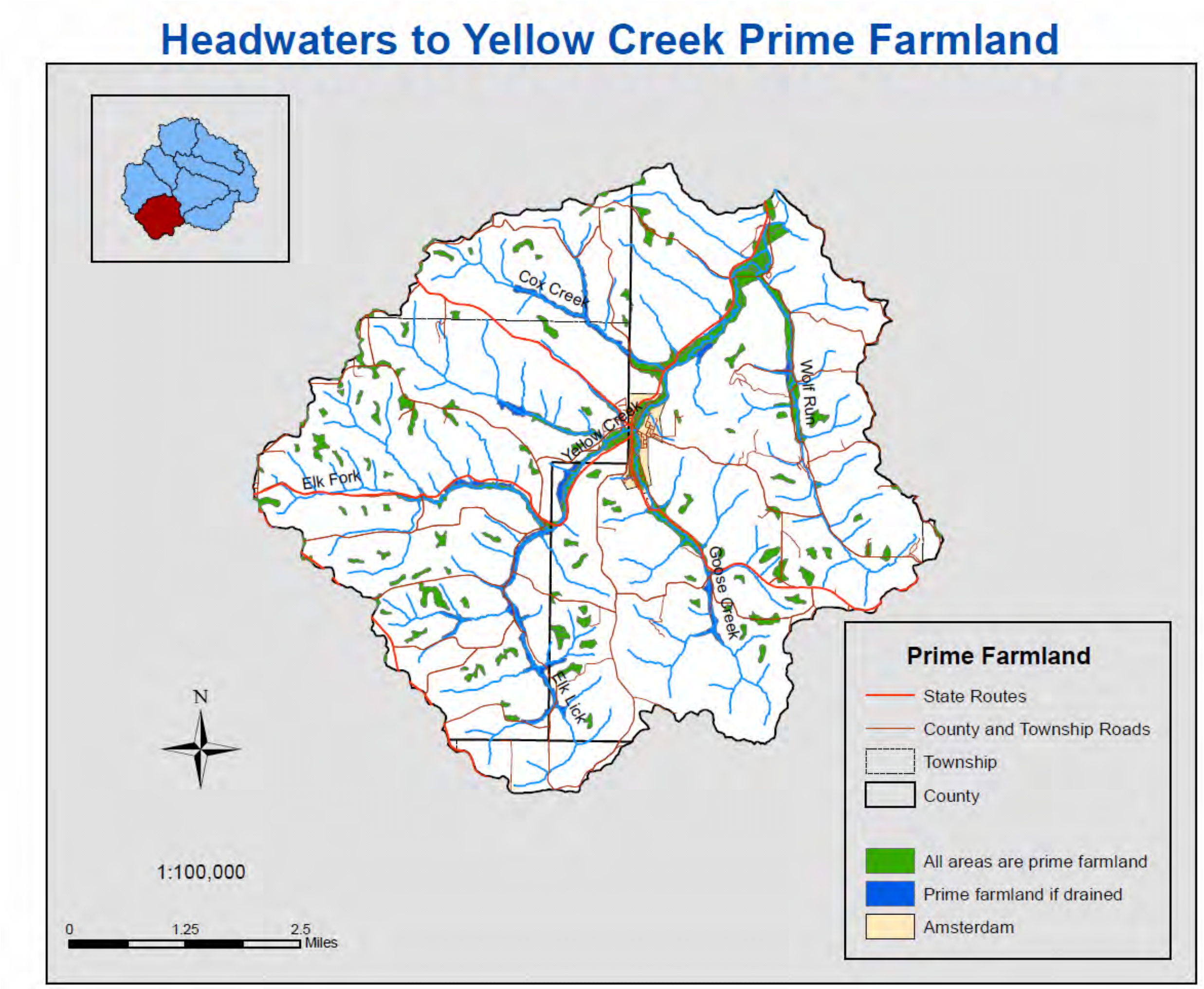

Fig. 44: Headwaters to Yellow Creek Prime Farmland

While there are no hydric soils, 1,777 acres are partially hydric.

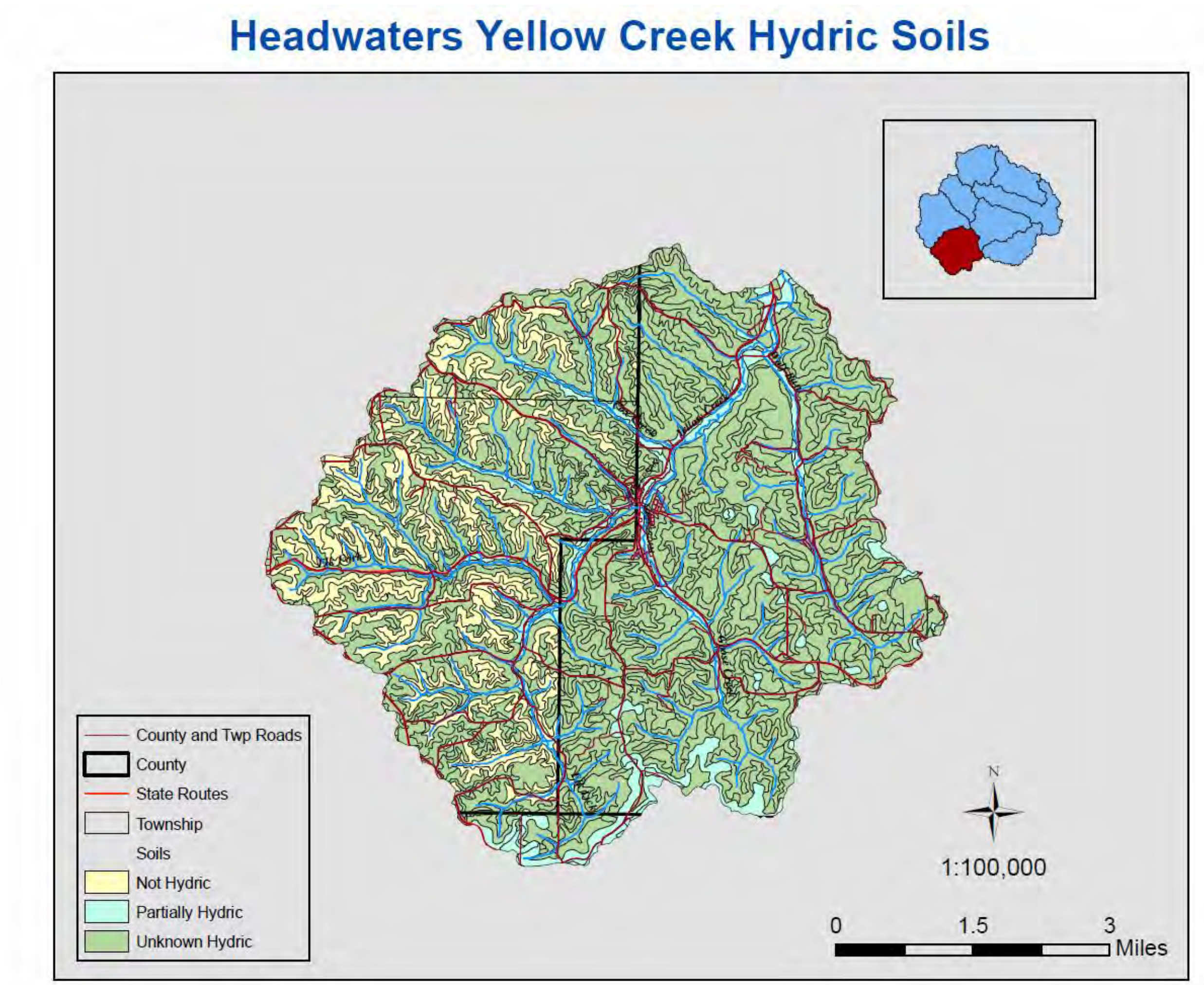

Fig.45: Headwaters to Yellow Creek Hydric Soils

There is a small area, 49.5 acres, which is frequently flooded in the Headwaters to Yellow Creek.

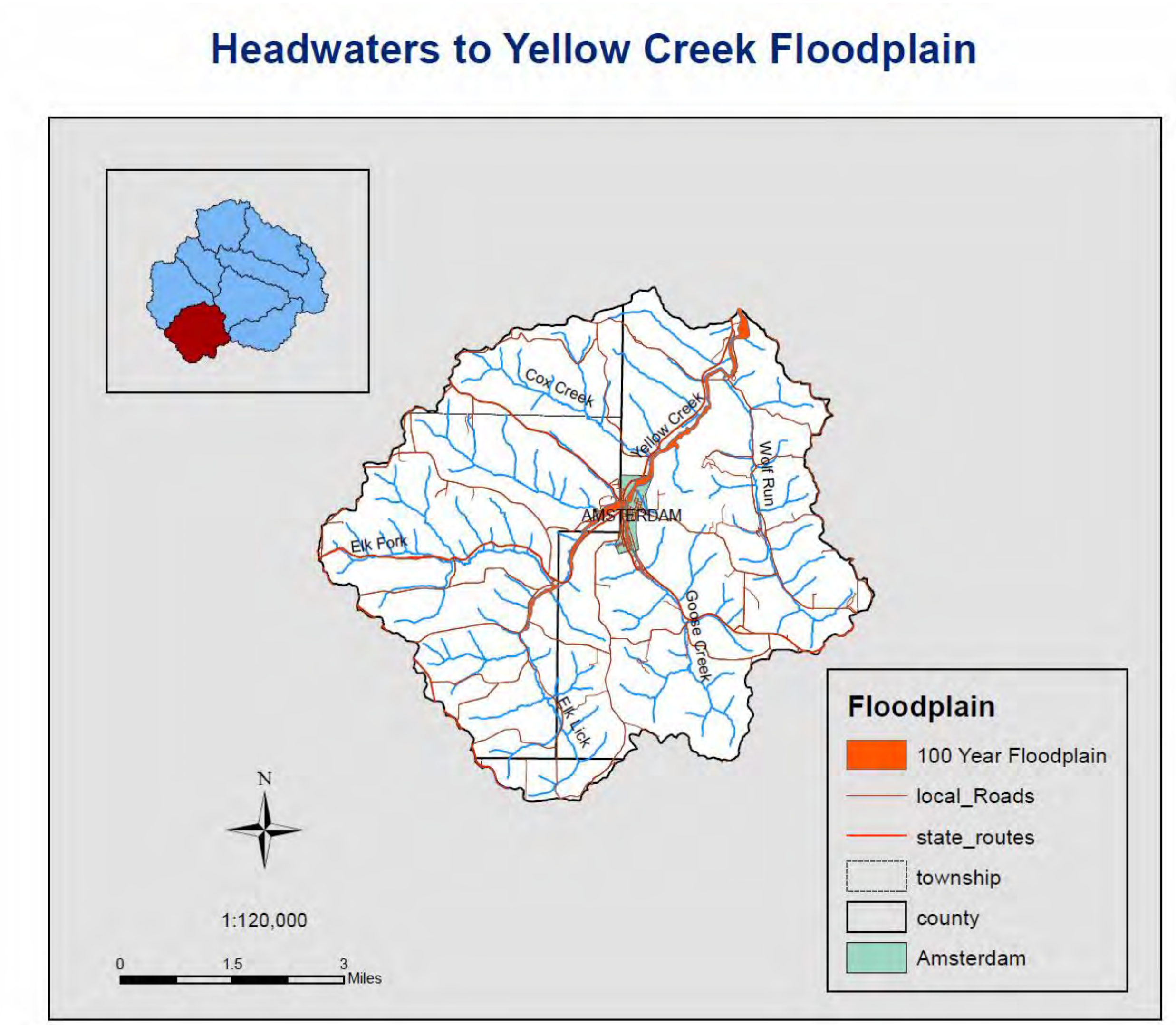

Fig. 46: Headwaters to Yellow Creek Floodplain

Table 34. Headwaters to Yellow Creek Riparian Tree Species

Sugar Maple	American Elm
Black Cherry	Shagbark Hickory
Silver Maple	White Pine
Black Walnut	Osage Orange

Staghorn Sumac	American Sycamore
Black Alder	Weeping Willow
Red Elm	Butternut
Slippery Elm	Box Elder
White Oak	Black Locust
Shingle Oak	Ash

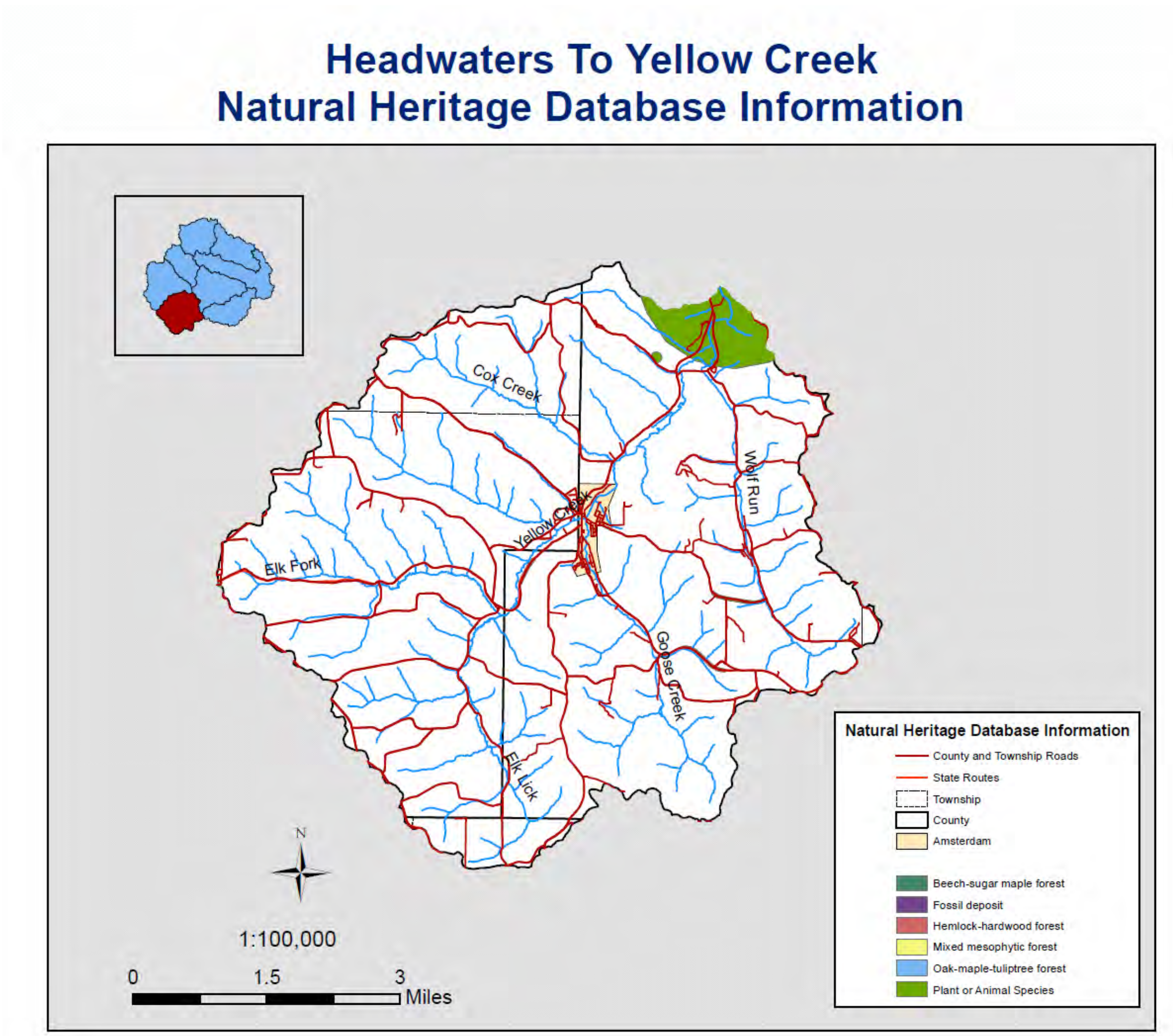

Fig. 47: Headwaters to Yellow Creek NHD Information

Headwaters to Yellow Creek Land Use

By looking at land use trends over a fifteen year period in Headwaters to Yellow Creek one can gain insight into the reasoning for water quality improvements. A greater area was once used in agriculture production than we see today. The majority of the land use in this subwatershed is forested, followed by land in agricultural production then urbanized areas.

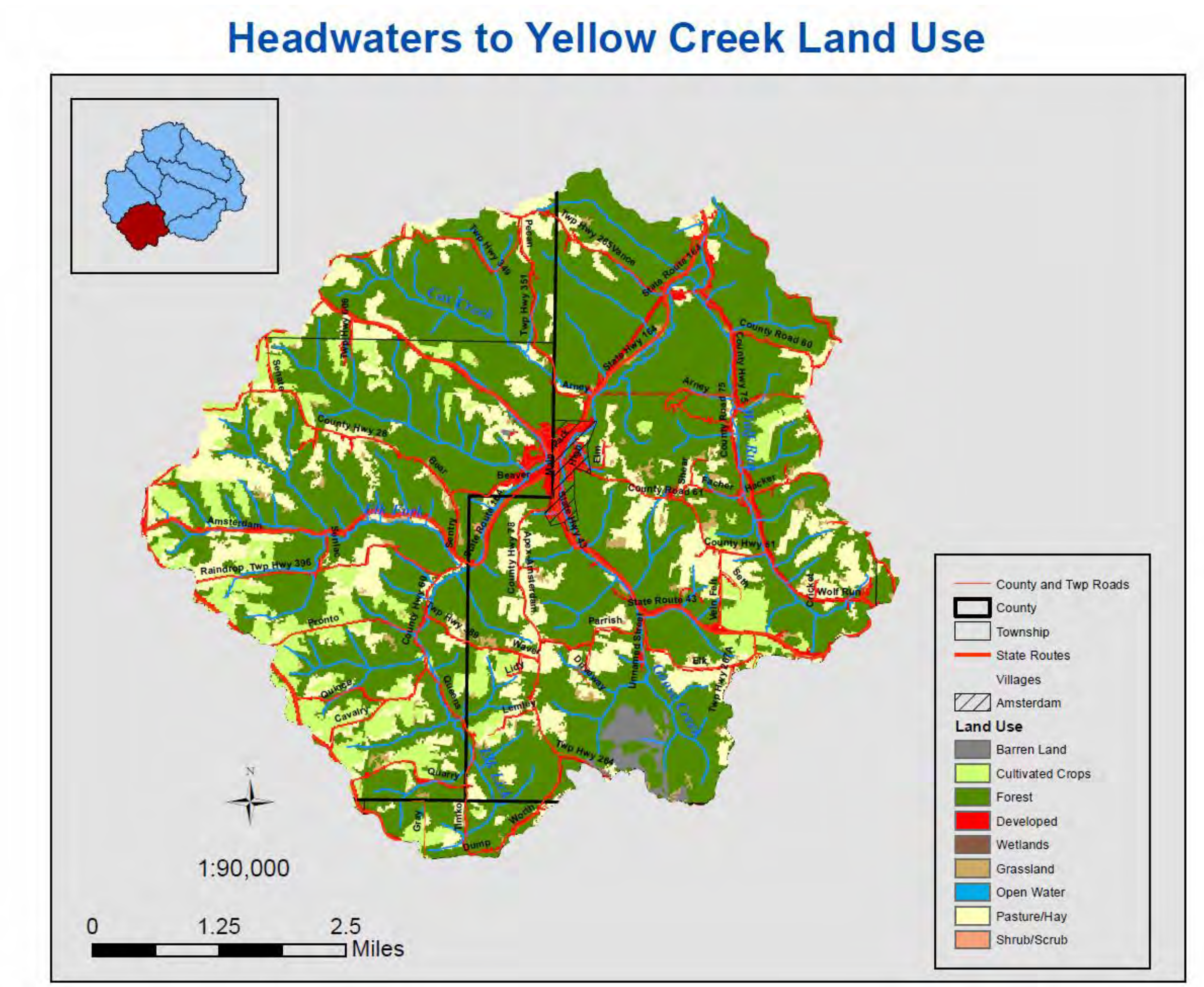

Fig. 48: Headwaters to Yellow Creek Land Use

Table 35. Headwaters Yellow Creek Land Use (acres)

	2009	2001	1994
Agriculture	4,926.2	6,991.7	6,271.1
Water	8.5	138.1	43.5
Urban	1,434.4	301.8	47.4
Forest	14,094.2	13,042.5	13,804.3
Barren	.8	0	.3
Shrub/Scrub	0	0	312.7

Agricultural Characteristics

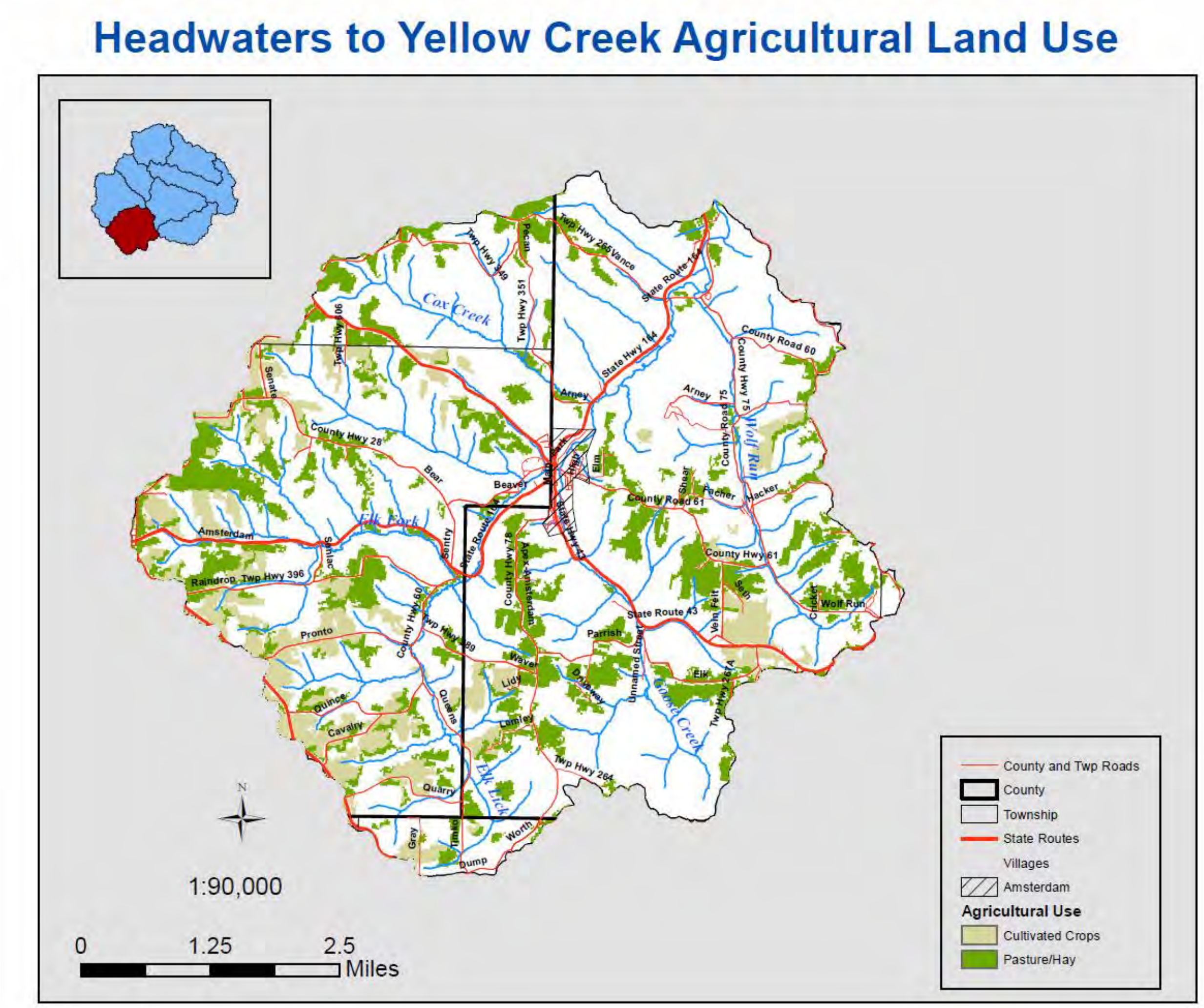

Fig. 49: Headwaters to Yellow Creek Agricultural Land Use

Headwaters to Yellow Creek

The subwatershed of Headwaters to Yellow Creek, at the southwestern corner of the watershed, is located nearly half in Jefferson County and half in Carroll, with a very small portion extending into the uppermost section of Harrison County. Soils in this subwatershed are of four different associations: Gilpin-Berks-Steinsburg, Westmoreland-Hazelton-Berks, Gilpin-Lowell-Morristown and Gilpin-Steinsburg-Hazelton.

In the Jefferson County portion of this subwatershed, agriculture is the primary land use. There are some areas that have been surface mined for coal. In these areas, the surface mined soils present a number of limitations for growth of agricultural crops, including moderate to moderately low organic content and slow permeability. As a result, agricultural producers in have opted to use most surface mined upland areas as pasture or hay fields. In the parts of this subwatershed that have not been surface mined, there are large acreages of land being managed for row crop production. Some of these producers began practicing contour farming, contour strip cropping, and crop rotation over thirty years ago, and continue to use these practices today. Livestock operations in this area are primarily beef grazing operations. Additionally, there are several small horse operations located within this sub watershed.

Headwaters Yellow Creek Water Quality

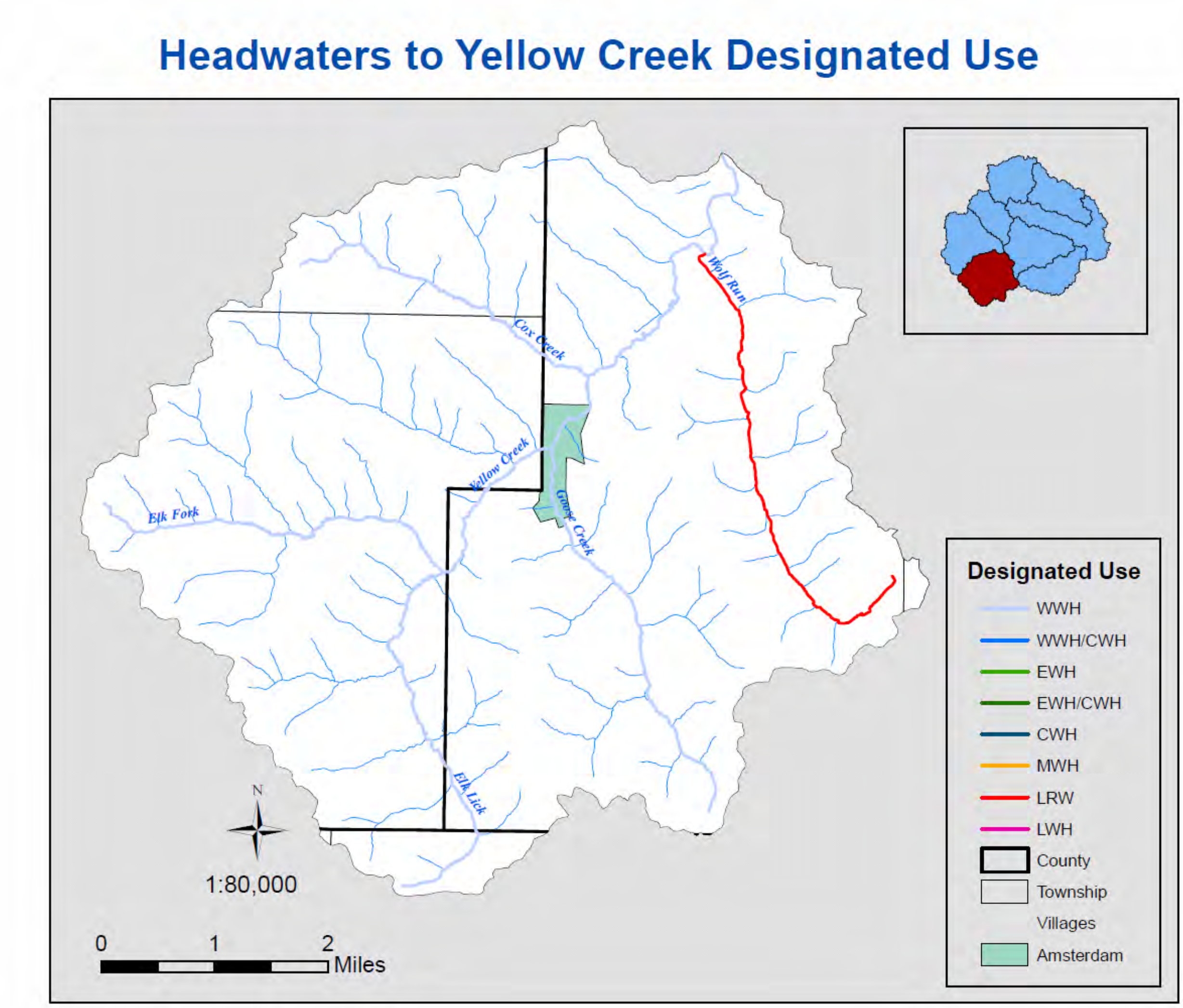

Fig. 50: Headwaters to Yellow Creek OEPA Designated Use

Ground Water

The approximate number of water wells in the subwatershed is 102, although it is very likely that there are more wells that were not recorded or submitted to the Ohio Division of Natural Resources. Over 20,000 acres are highly sensitive to groundwater contamination.

Surface Water

The 100 year floodplain encompasses 219.6 acres in the Headwaters Yellow Creek Subwatershed. There are 191.6 acres in wetlands, some of which are part of required mitigation projects completed by APEX landfill. Other surface water features include 42.6 acres of ponds and lakes and 89.6 acres of streams. There are four dams and no municipal discharge permits in this subwatershed.

Nine different locations were sampled in the Headwaters to Yellow Creek Subwatershed during the TMDL study. Of those nine sites, eight of them met their use designation. The only site that failed to meet its use designation was downstream of Amsterdam on the mainstem of Yellow Creek, which received partial attainment.

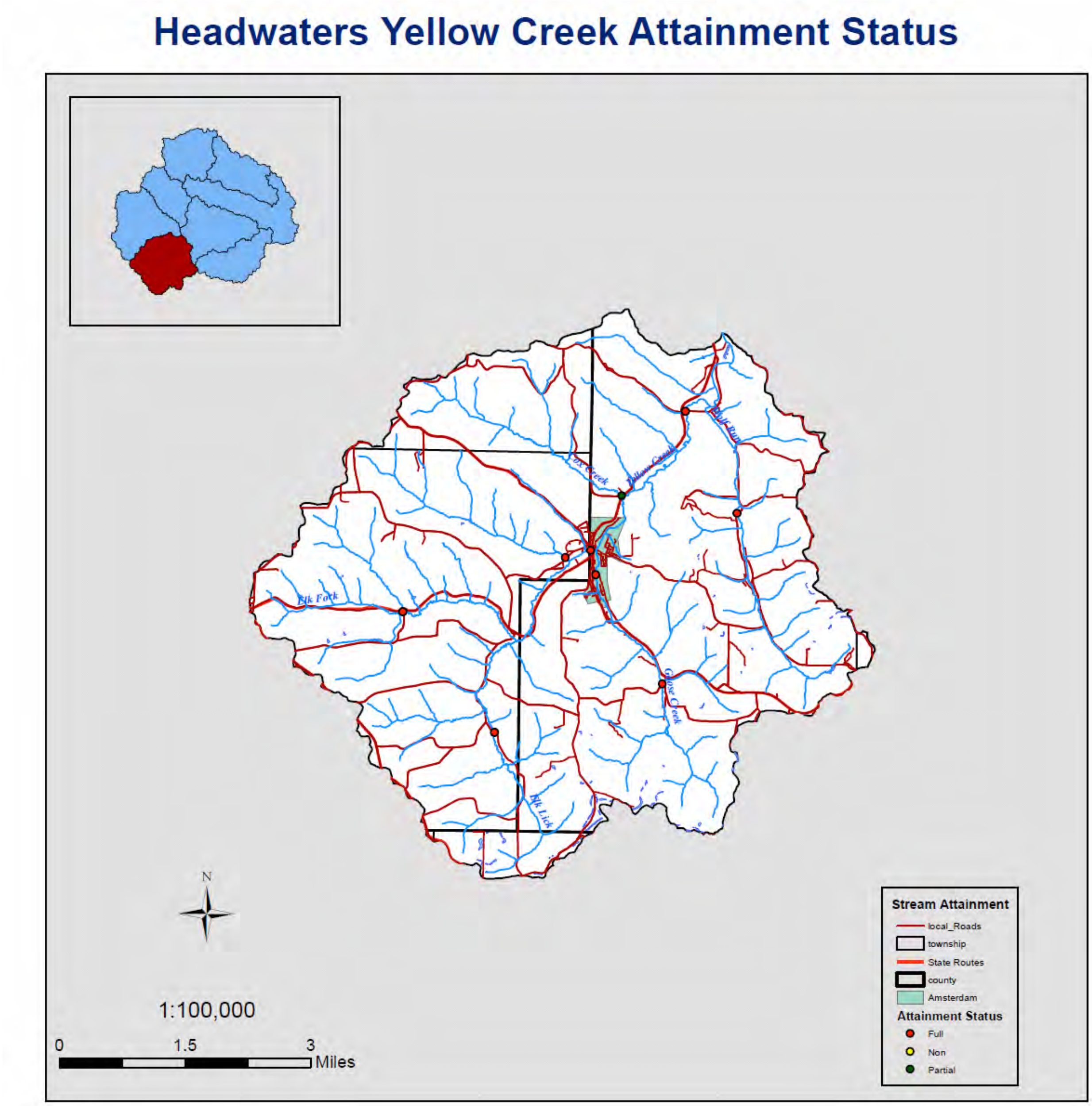

Fig. 51: Headwaters to Yellow Creek Attainment Status

Table 36. Headwaters of Yellow Creek Water Quality Results

Stream Name and River Mile	Attainment Status	IBI	ICI	MiWb	QHEI	Aquatic Life Use
Cox Creek	**Partial**	**48**	**Fair**	**NA**	**81.0**	**WWH**
Elk Fork	**Full**	**44**	**Exceptional**	**NA**	**44**	**WWH**
Elk Lick	**Full**	**46**	**Exceptional**	**NA**	**63**	**WWH**
Goose Creek River Mile 1.9	**Full**	**48**	**Marginally Good**	**NA**	**63**	**WWH**
Goose Creek 0.2/0.3	**Full**	**50**	**Marginally Good**	**NA**	**73.5**	**WWH**
Wolf Run 1.5/1.3	**Full**	**42**	**Exceptional**	**NA**	**69**	**LRW**
Yellow Creek 30.1	**Full**	**48**	**Good**	**NA**	**65.5**	**WWH**
Yellow Creek 27.6	**Full**	**46**	**46**	**10.2**	**73**	**WWH**

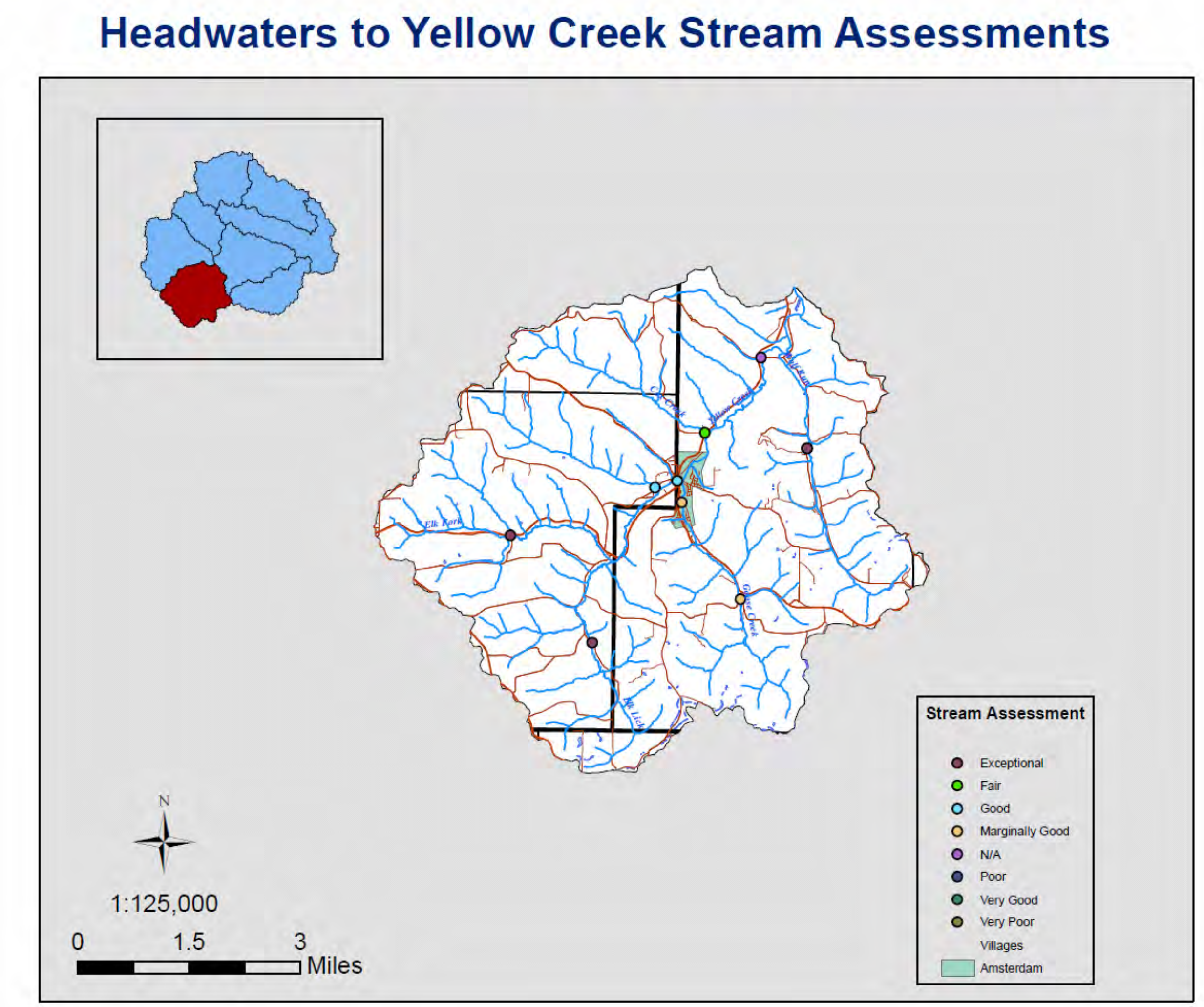

Fig. 52: Headwaters to Yellow Creek Stream Assessments

Potential Contamination Source in Headwaters to Yellow Creek

Apex Environmental Landfill

The Apex Landfill is located on County Road 78 and is situated in both Jefferson and Harrison Counties. It is a solid waste landfill that accepts the majority of its contents from New Jersey by rail. The landfill accepts approximately 200 tons of undigested waste per day from ALCOSAN (Allegheny County Sanitation), which treats all waste in the city of Pittsburgh, Pennsylvania.

The development of the landfill has been a local source of contention since its beginnings, but has recently entered a new realm due to Clean Air Act violations as well as surface water contamination violations. During the summer of 2011, while constructing a new cell for trash collection, water was drained from the cell and discharged directly into Goose Creek, instead of into a required sediment pond. The sedimentation turned Goose Creek a milky white, and residents notified the Jefferson Soil and Water Conservation District Office as well as Ohio EPA.

A Notice of Violation letter to APEX Environmental was drafted by Ohio EPA for the intentional discharge into Goose Creek, and a sediment pond has since been constructed.

Problem Statement 1: (Bacteria)

As confirmed by the 2009 OEPA TMDL report, stream segments in the Headwaters of Yellow Creek are not meeting attainment status due to failing home sewage treatment systems. During the sampling season for the Yellow Creek TMDL in 2005 the monitoring site on the mainstem of Yellow Creek downstream of Amsterdam was only in partial attainment of its warm water habitat designation due to improperly treated sewage.

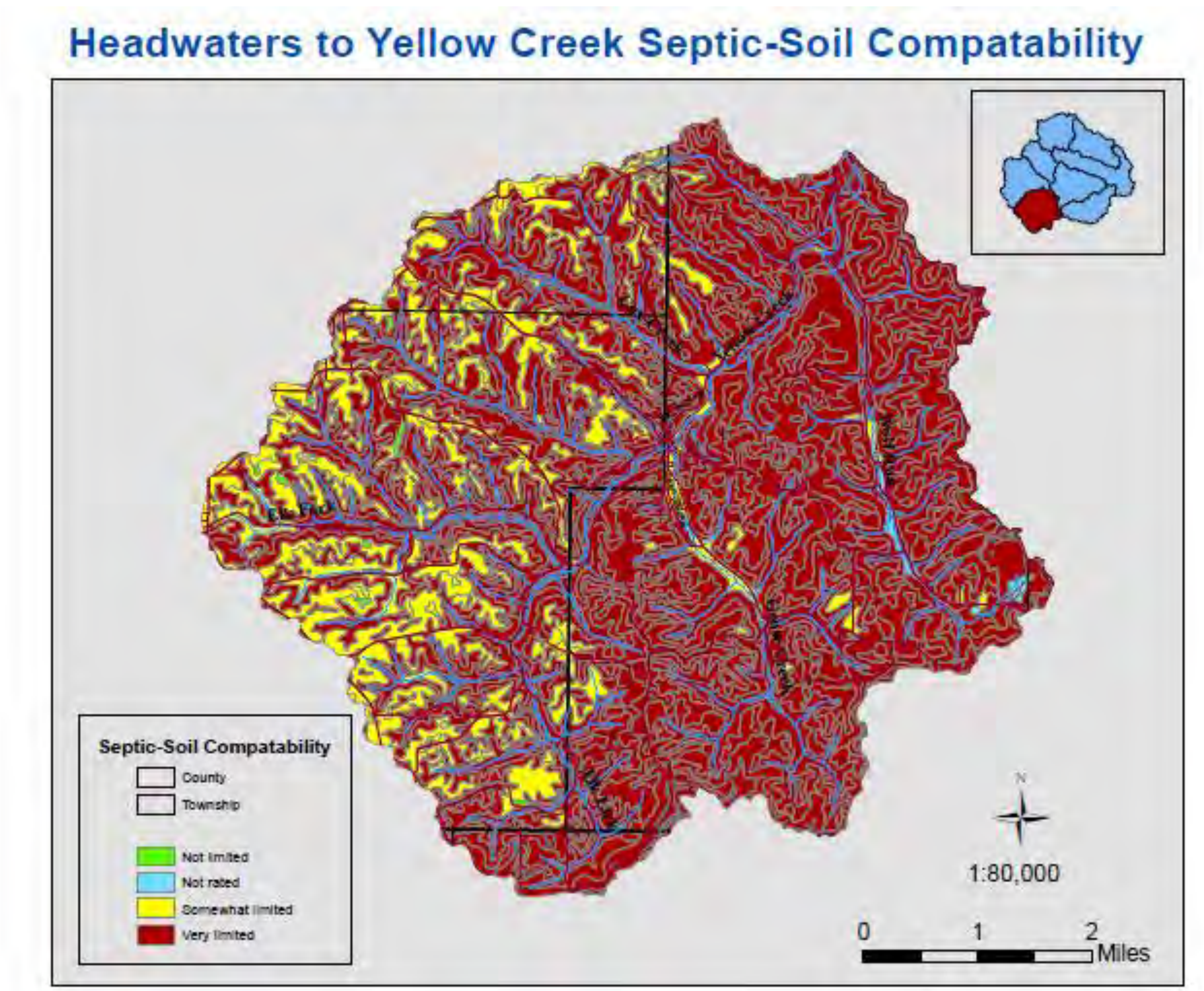

Fig. 53: Headwaters to Yellow Creek Septic-Soil Compatibility

Goal 1.1: Reduce Fecal Coliform loadings to meet recreational bacteria water standards by eliminating 120,391 gallons/day.

Objective 1. Complete survey of failing home sewage treatment systems to identify and prioritize needed sewage treatment upgrades.

Objective 2. Upgrade 429 of those identified failing HSTS in the Headwaters to Yellow Creek subwatershed to reduce Fecal Coliform loading by 65.5%

Objective 3. Partner with Village of Amsterdam to seek funding for construction of a wastewater treatment plant to assist in the reduction of Fecal Coliform loading by 120,391 gallons/day.

Pollutant	Goal	Task Description	Resources	How	Time Frame	Performance Indicator
Pathogens/ Bacteria	1.1	1. Partner with health departments, particularly in Jefferson County, to complete an HSTS inventory which identifies failing systems in the watershed, along with the cause of failure.	Funding for flyover and use of infrared to identify and inventory failing systems. The Jefferson County General Health District has committed to creating a GIS layer of failing HSTS upon investigation of complaints, as well as any studies done.	Unidentified grant	2012-2013	GIS layer of failing HSTS created.
Pathogens/ Bacteria	1.1	Replace or upgrade 534 HSTS systems reducing the amount of fecal coliform	Repair or Replace approximately 534systems through principal forgiveness loans (DEFA),costsh	$160,000 principal forgiveness loan, DEFA	2011-2021	Upgraded systems will reduce the amount of e. coli and fecal coliform discharging into stream.

		by 98,239gallons a day	are programs (water quality credit trading), grants and homeowner contribution. 534 systems * $7,000.00 = $3,738,000.00			Amounts reduced will be calculated using the BATHTUB model.
Pathogens/bacteria	1.1	Work with Village of Amsterdam sewage treatment plant planning committee and RCAP to seek funding for planning. Seek financial assistance for installation of sewage treatment plant	Amsterdam will partner with RCAP to complete application and seek an engineering firm for feasibility study and planning. Will include Bergholz in feasibility study.	$120,000 in planning grant awarded to village.	2011-2015 2015-2020	Completed plan for sewage treatment plant Installation of sewage treatment plant.

Problem Statement 2: (acid mine drainage)

As confirmed by the 2008 AMDAT and the 2009 OEPA TMDL report, Wolf Run and two of its tributaries are affected by acid-mine drainage. Acid-mine drainage flows from a culvert at the headwaters of Wolf Run at the Jensie Mine Site. Field measurements at the inlet and outlet of the culvert indicate that low flows entering the culvert are only slightly affected by acid mine drainage. Field measurements downstream of the culvert show a much greater flow that is non-attaining.

In March of 2011, Phase I of a planned multi-phased abatement project at the Jensie Mine Site was completed. This included the removal of the culvert and replacement with a limestone channel as well as two steel slag channels at the very beginning of the stream. Test pits were dug during the Phase I remediation to identify the location of buried gob in anticipation of an interceptor channel for Phase II.

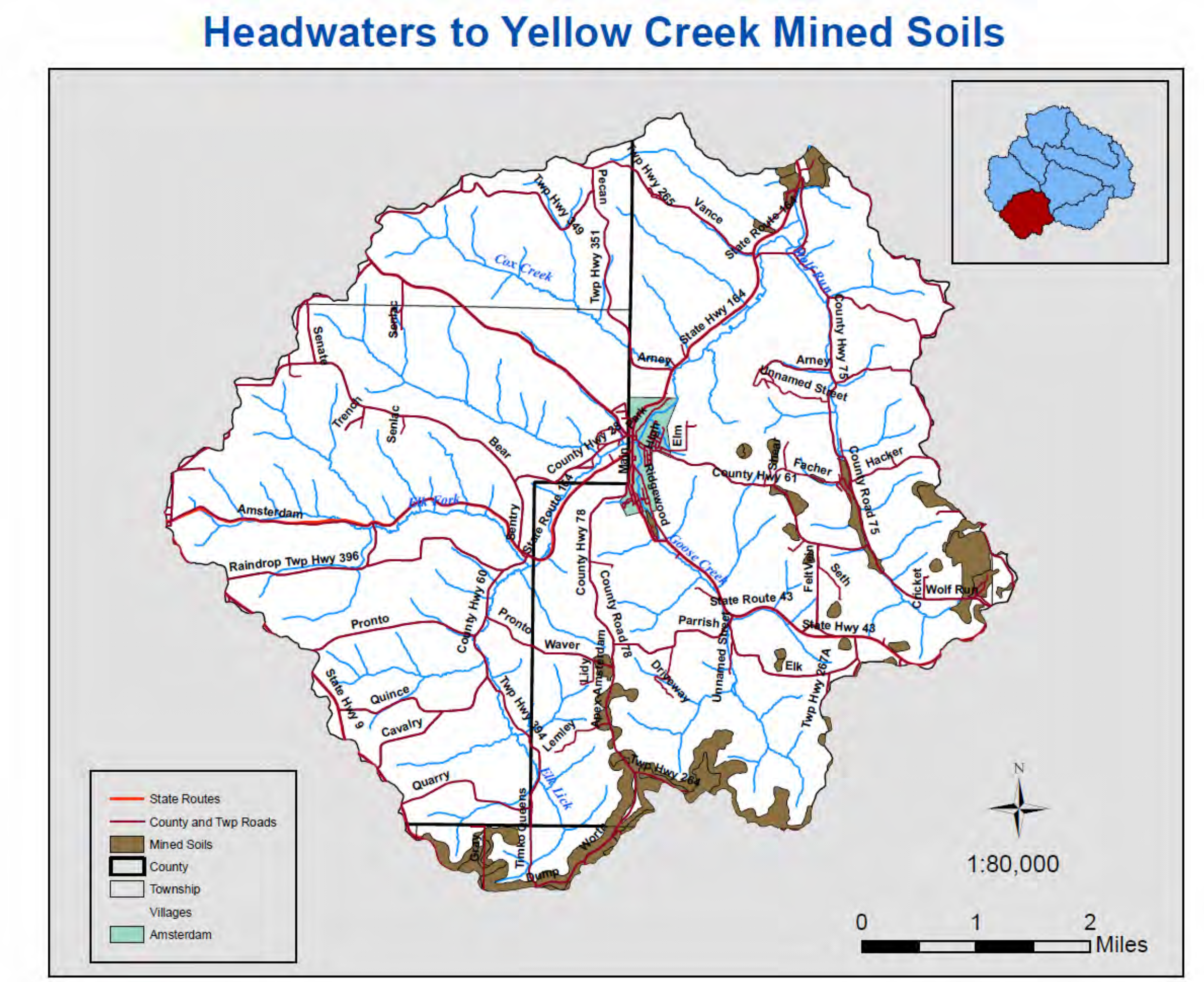

Fig. 54: Headwaters to Yellow Creek Mined Soils

Goal: 2.1: To treat and abate acid mine drainage at the Jensie Mine Site

Objective 1. Reduce acid loads at entering Wolf Run at Jensie Mine Site to reach attainment in Wolf Run at river mile 1.5

Action 1 Continue post-construction monitoring to assist with Phase II planning.

Pollutant	Goals	Task Description	Resources	How	Time Frame	Performance Indicator
Acid Mine Drainage	2.1	Monitor chemical water quality downstream of Phase I treatment at Jensie Mine Site	Jefferson Soil and Water Conservation District Staff for data collection at monthly for one year	AML set-aside funding for sample analysis	2011-2012	Water quality data entered into online database.
Acid Mine Drainage	2.1	Biological monitoring downstream of Phase I treatment at Jensie Mine Site	JSWCD staff and volunteers for annual MAIS sampling	JSWCD staff	2011-2012	Water quality data entered into online database.
Acid Mine Drainage	2.1	Provide information to Division of Mineral Resource Management engineers for design of Phase II treatment at Jensie Mine Site	DMRM engineers and staff will design a Phase II treatment. The treatment system will be funded by FirstEnergy funds provided to JSWCD and dedicated to AMD treatment in the Yellow Creek watershed partnered with AML set aside funding.	AML set-aside and $50,000.00 from FirstEnergy mitigation funding targeted at Acid Mine Drainage in the Yellow Creek Watershed	2012-2014	Installation of Phase II treatment system at Jensie Mine Site. Improved water quality in the 1.5 river miles of Wolf Run currently non-attaining due to acid mine drainage.

Problem Statement 3: (Sedimentation, Nutrients)

As confirmed by the 2009 TMDL, the Headwaters to Yellow Creek subwatershed is fairly scattered with livestock operations that are contributing to sedimentation and nutrient loading issues in tributaries to Yellow Creek.

Goal 3.1: Reduce sedimentation and nutrient loading in the Headwaters to Yellow Creek subwatershed by protecting 3.17 miles of streambank from livestock access.

> **Objective:** Install 16,709 feet of livestock exclusion fencing and necessary auxiliary practices along Elk Lick and Elk Fork streams.

Pollutant	Goal	Task Description	Resources	Time Frame	Performance Indicator
Sedimentation, Nutrients	3.1	Target 3 cattle operations along Elk Lick and Elk Fork to install 16,709 feet of exclusion fencing along 1.59 miles of stream	$36,267.00 for fencing and auxiliary practices. 16,790ft* $2.16/foot= $36,267.00	Jan. 2013- Jan. 2015	Document 1.59 miles of streambank fencing installed along with acreage of riparian area protected. Improved QHEI scores.

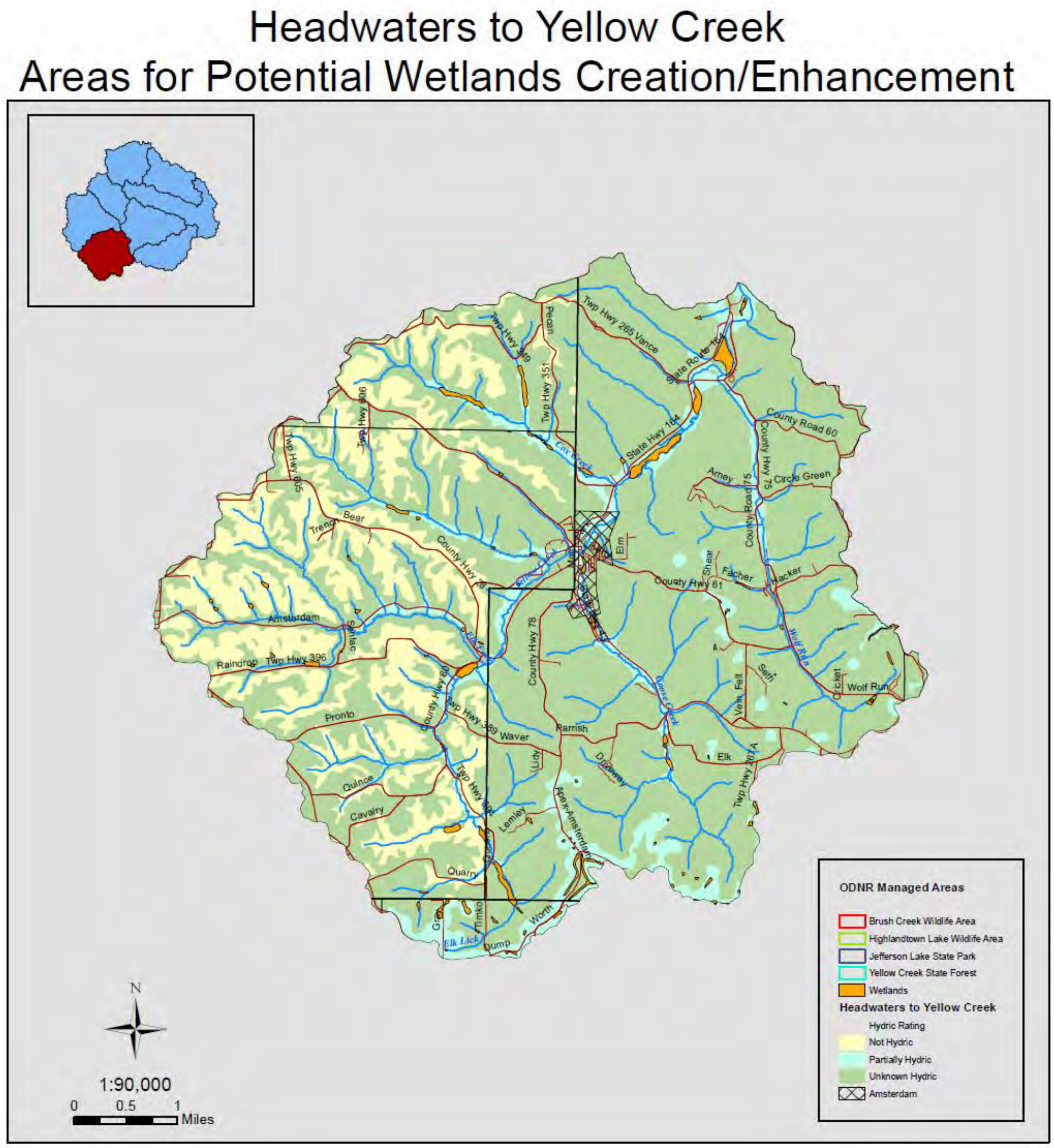

Fig. 55: Wetlands Creation/Enhancement Potential

Chapter III. Elkhorn Creek

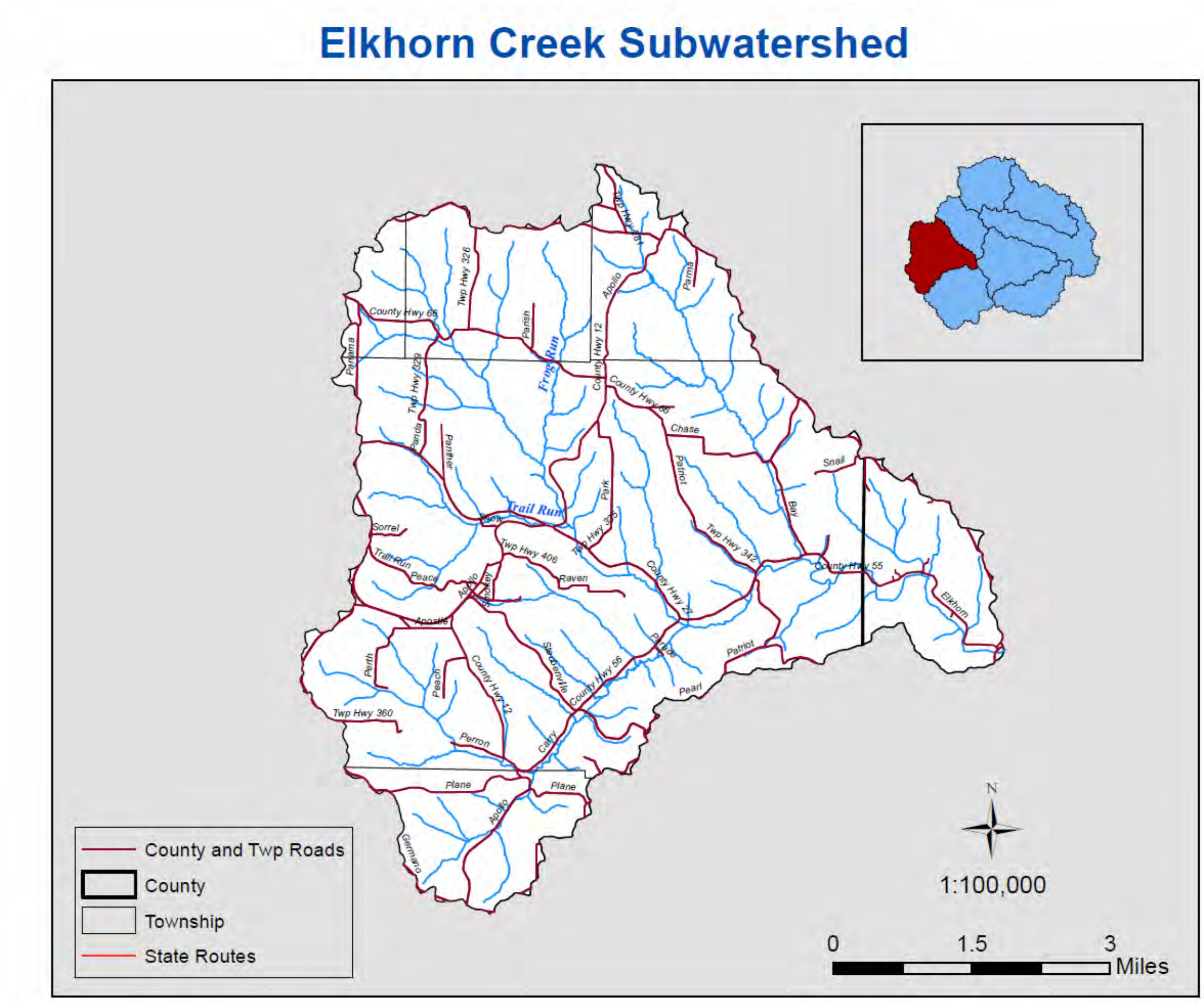

Fig. 56: Elkhorn Creek

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21,453 acres

The Subwatershed of Elkhorn Creek lies northwest of the Headwaters to Yellow Creek. Major tributaries in this subwatershed include Elkhorn Creek, Frog Run, Strawcamp Run and Trail Run. Of the nine sites sampled in Elkhorn Creek Subwatershed all were in full attainment. 24.4 miles of stream were deemed superior high quality waters by Ohio EPA.

Climate

The average annual maximum temperature in the Elkhorn Creek Subwatershed is 84.6°F, with an average annual minimum temperature of 19° F. The average annual precipitation rate is 40 inches.

Municipalities

There are no municipalities within the boundaries of the Eklhorn Creek Subwatershed.

Geology

The bedrock of the Elkhorn Creek Subwatershed consists mainly of shale and siltstone. The area having probable Karst features amounts to 21,476.3 acres.

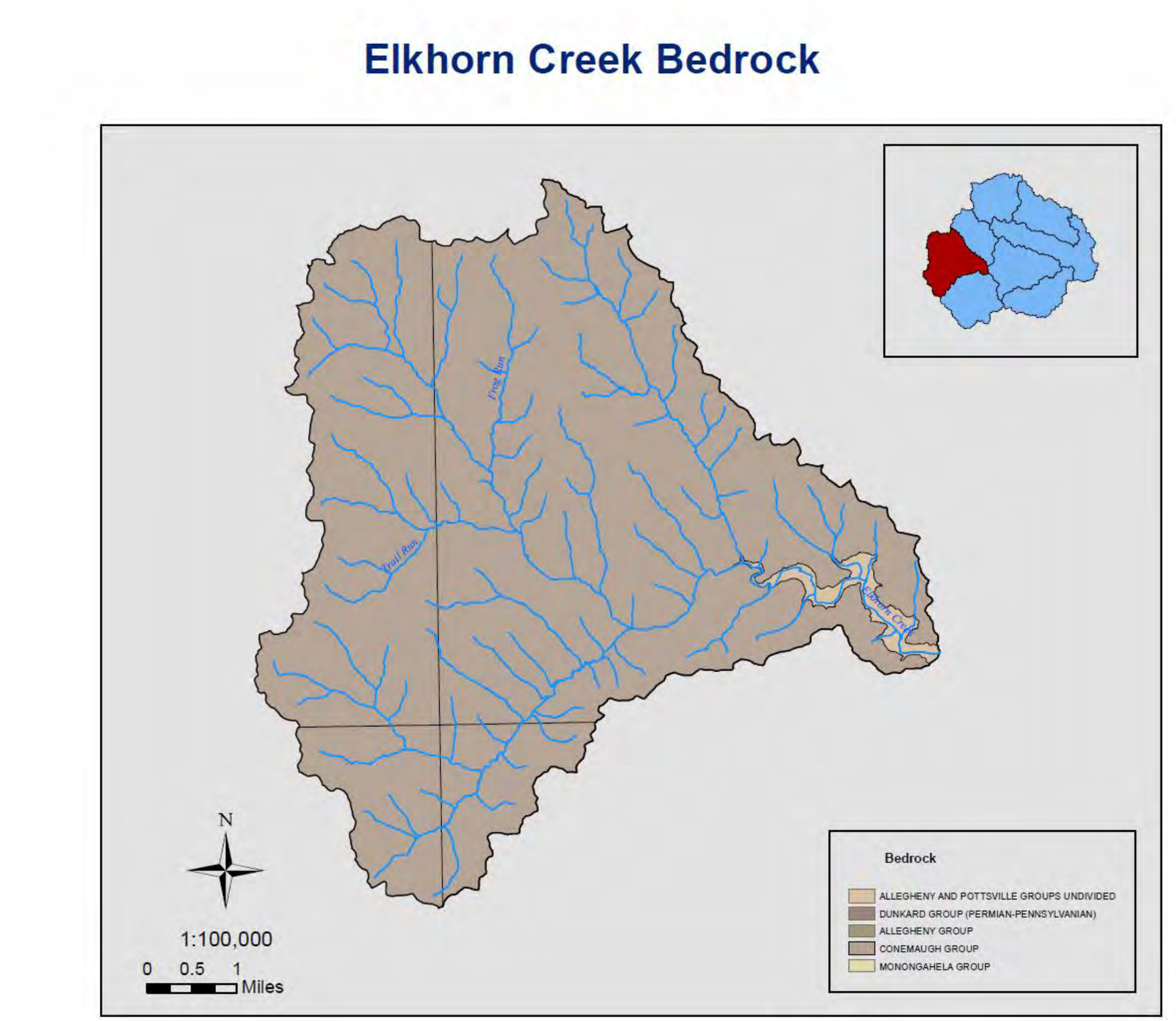

Fig. 57: Elkhorn Creek Bedrock

Population

Unlike the trend seen in other subwatersheds within Yellow Creek, census results from 1980 through 2000 show a gradual increase in population.

1980: 1,048

1990: 1,062

2000: 1,176

The average household size is 2.6, and the average household income is $39,697.00

Soil Resources

The majority of soils in the Elkhorn Creek Subwatershed rank well for drainage. In the subwatershed, 11,250.4 acres are considered prime farmland and 20,186.1 acres are highly erodible land.

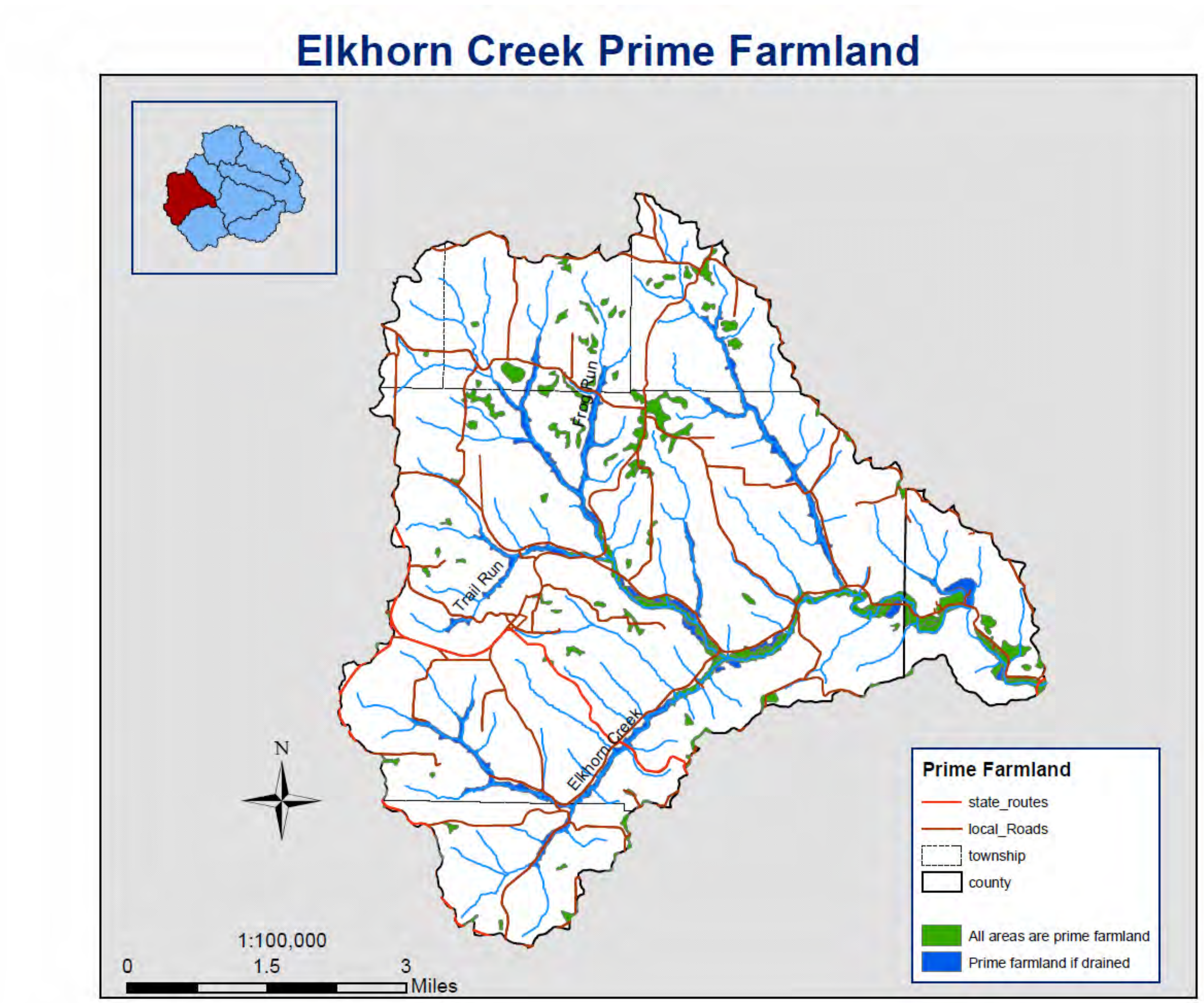

Fig. 58: Elkhorn Creek Prime Farmland

While there are no hydric soils, 2,347.5 acres are partially hydric.

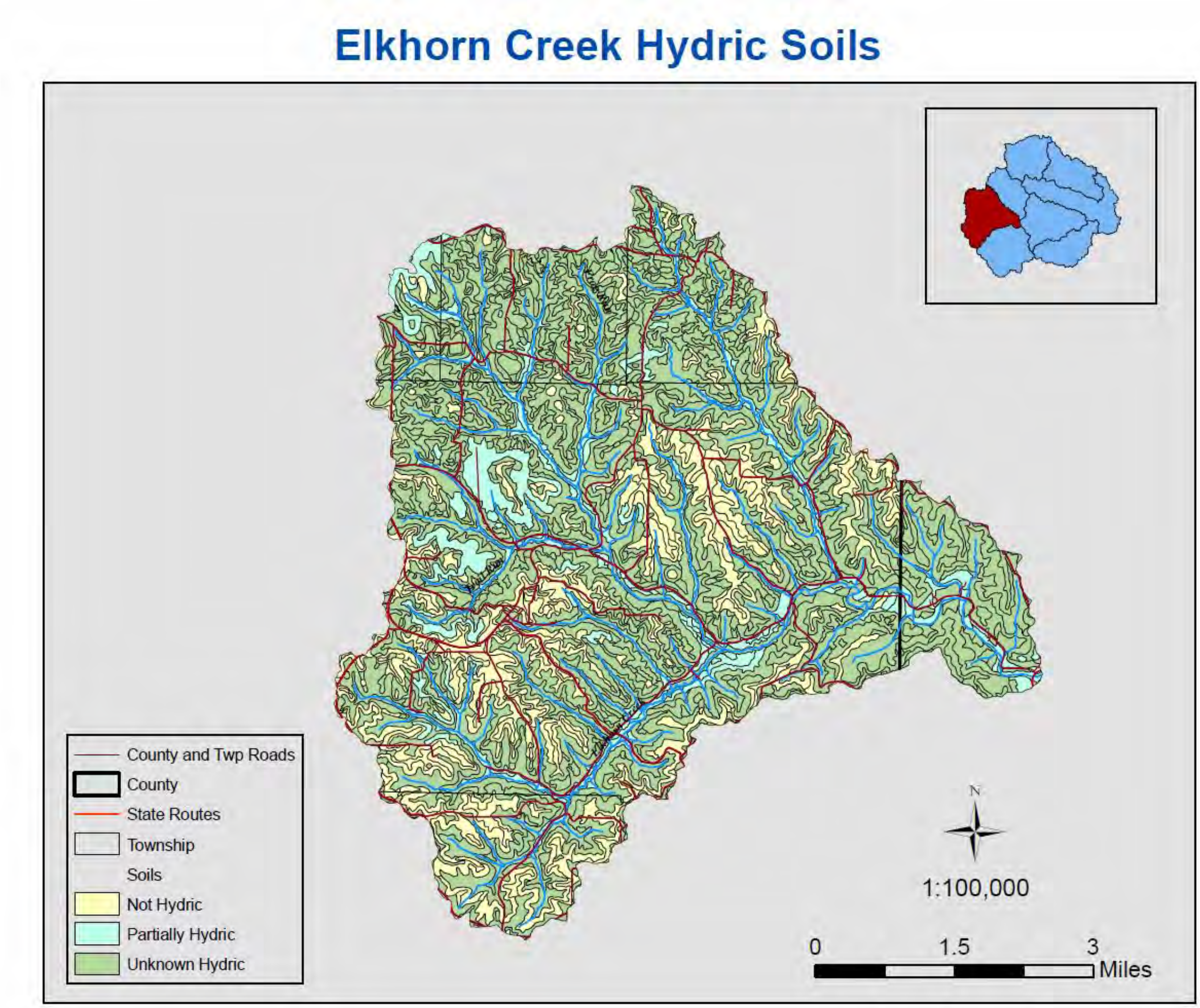

Fig. 59: Elkhorn Creek Hydric Soils

Lastly, 150.4 acres in this subwatershed are frequently flooded.

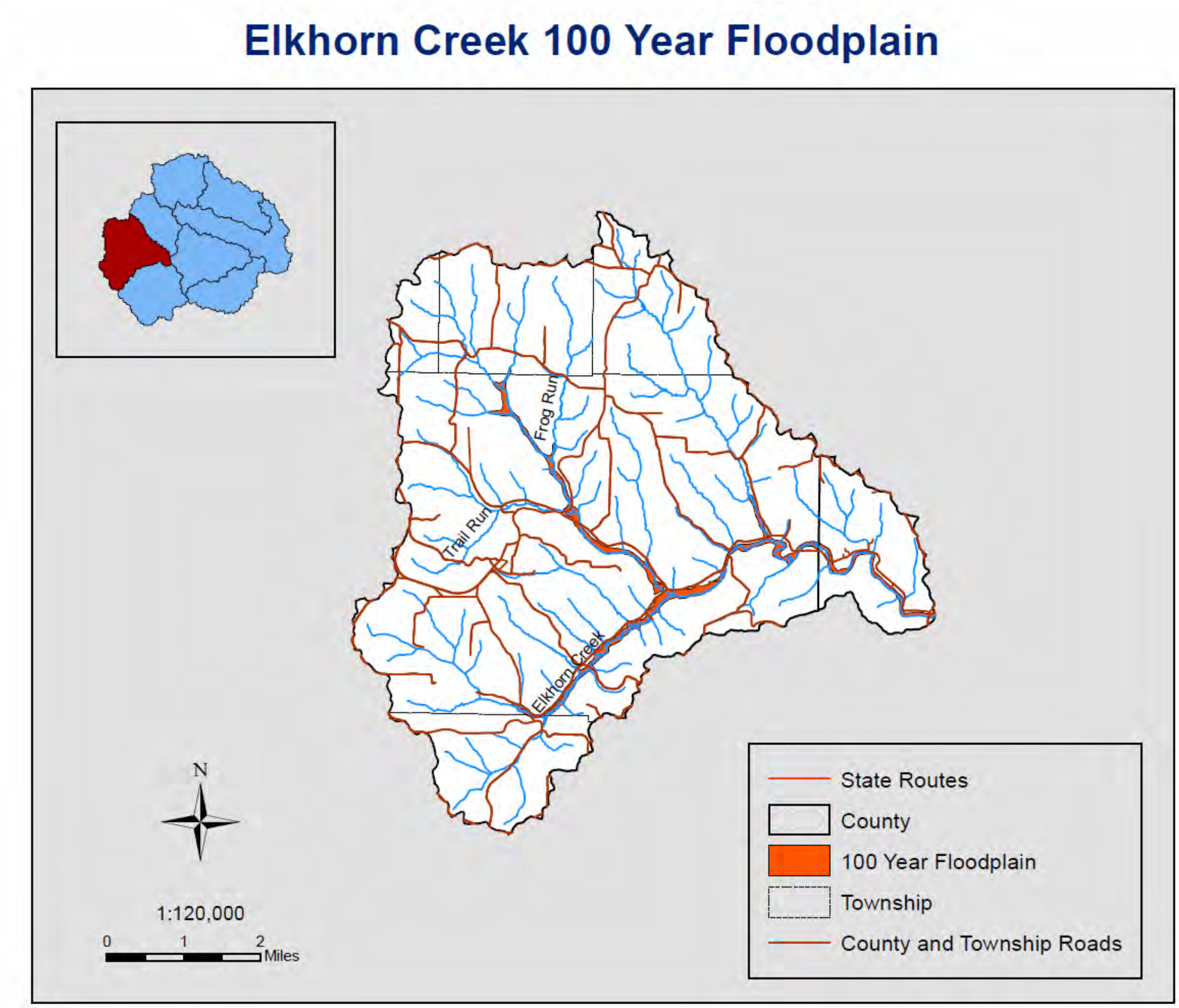

Fig. 60: Elkhorn Creek 100 Year Floodplain

Table 37. Elkhorn Creek Riparian Tree Species

Eastern Hemlock	Black Oak
Cottonwood	White Oak
White Pine	Shagbark Hickory

Red Maple	Willow (Native)
Ash	Red Oak
Sassafras	Bitternut Hickory
Black Cherry	Aspen
Cucumber Tree	Sumac
Red Elm	Dogwood
Black Locust	Box elder
Yellow Poplar	Ailanthus
Black Walnut	Basswood
American Sycamore	Yellow Poplar
Sugar Maple	

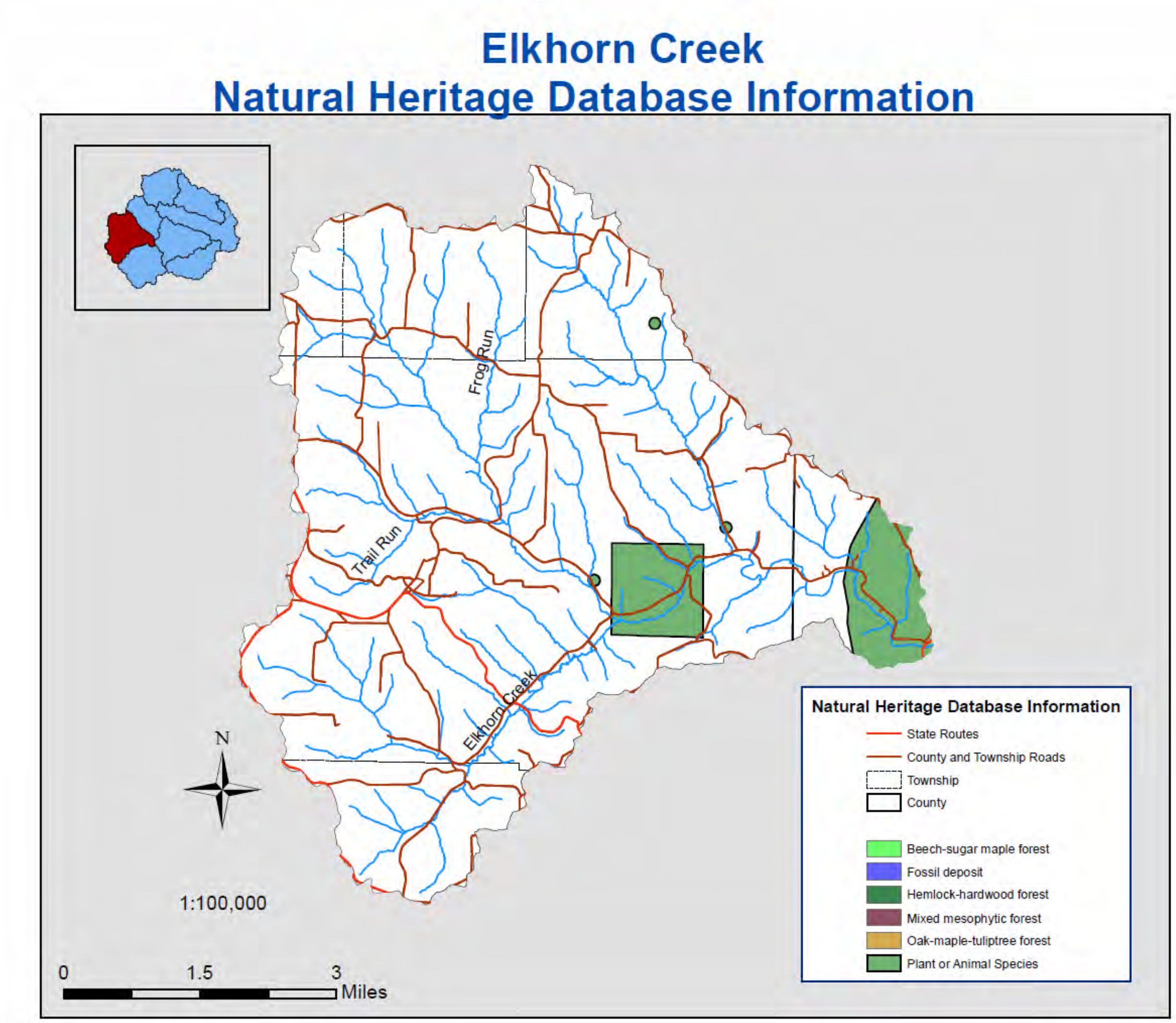

Fig. 61: Elkhorn Creek NHD Information

Elkhorn Creek Land Use

By looking at land use trends over a fifteen year period in Elkhorn Creek one can observe one main reason for water quality improvements, that is, a greater area was once used in agriculture production than we see today. While there has been a decrease in agriculture, as well as improvements made in the way we approach agriculture, Elkhorn Creek Subwatershed still contains the highest amount of acres in production. The majority of the land use in this subwatershed is forested, followed by land in agricultural production then urbanized areas.

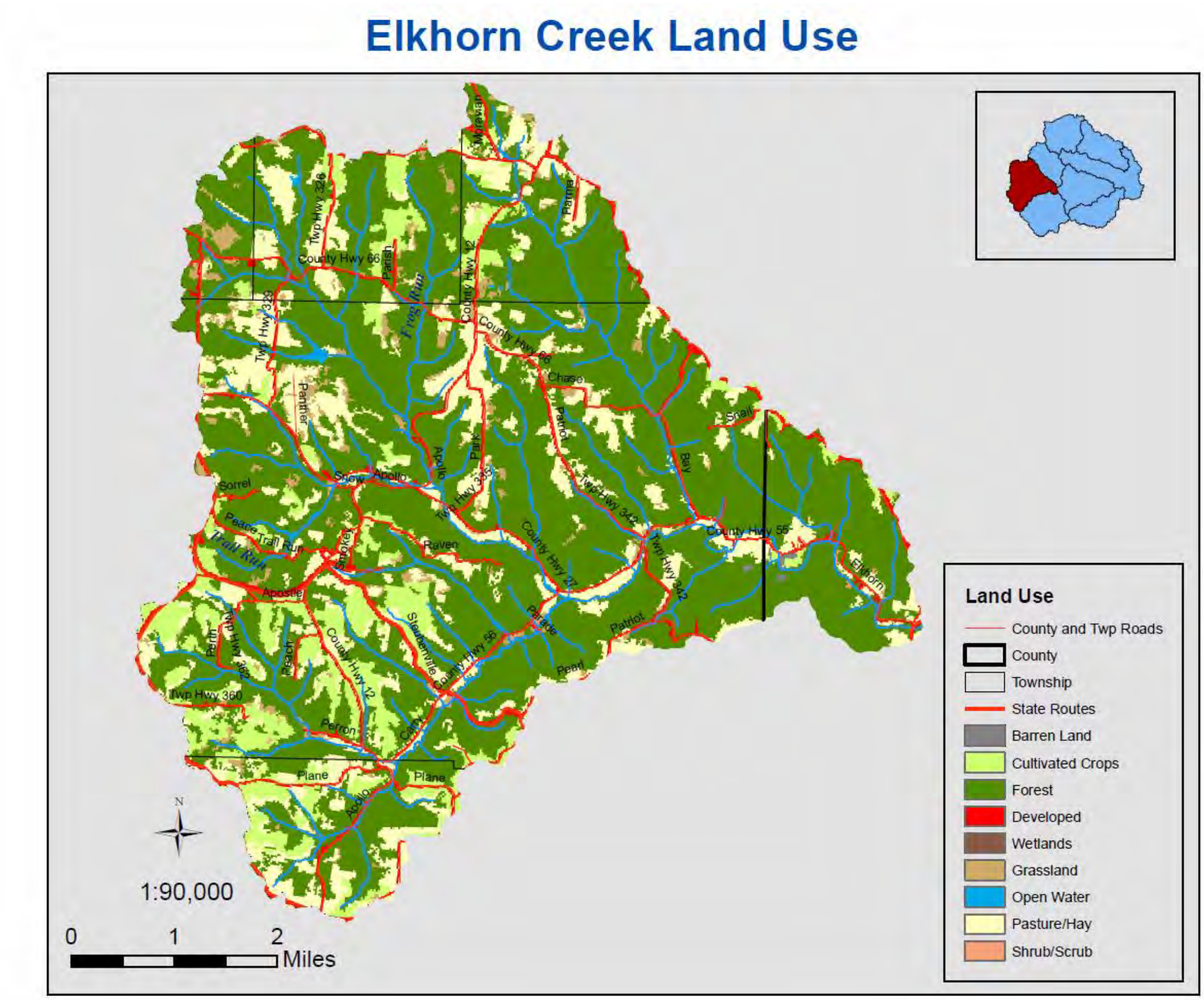

Fig. 62: Elkhorn Creek Land Use

Table 38. Elkhorn Creek Land Use (acres)

	2009	2001	1994
Agriculture	5,396.5	7,368.7	7,258.7
Water	57.3	114.1	60.2
Urban	1,088.0	50.3	20.5
Forest	14,921.8	13,766.5	13,731.9
Barren	0.0	152.4	11.9

Shrub/Scrub	0.8	27.8	391.9

Agricultural Characteristics

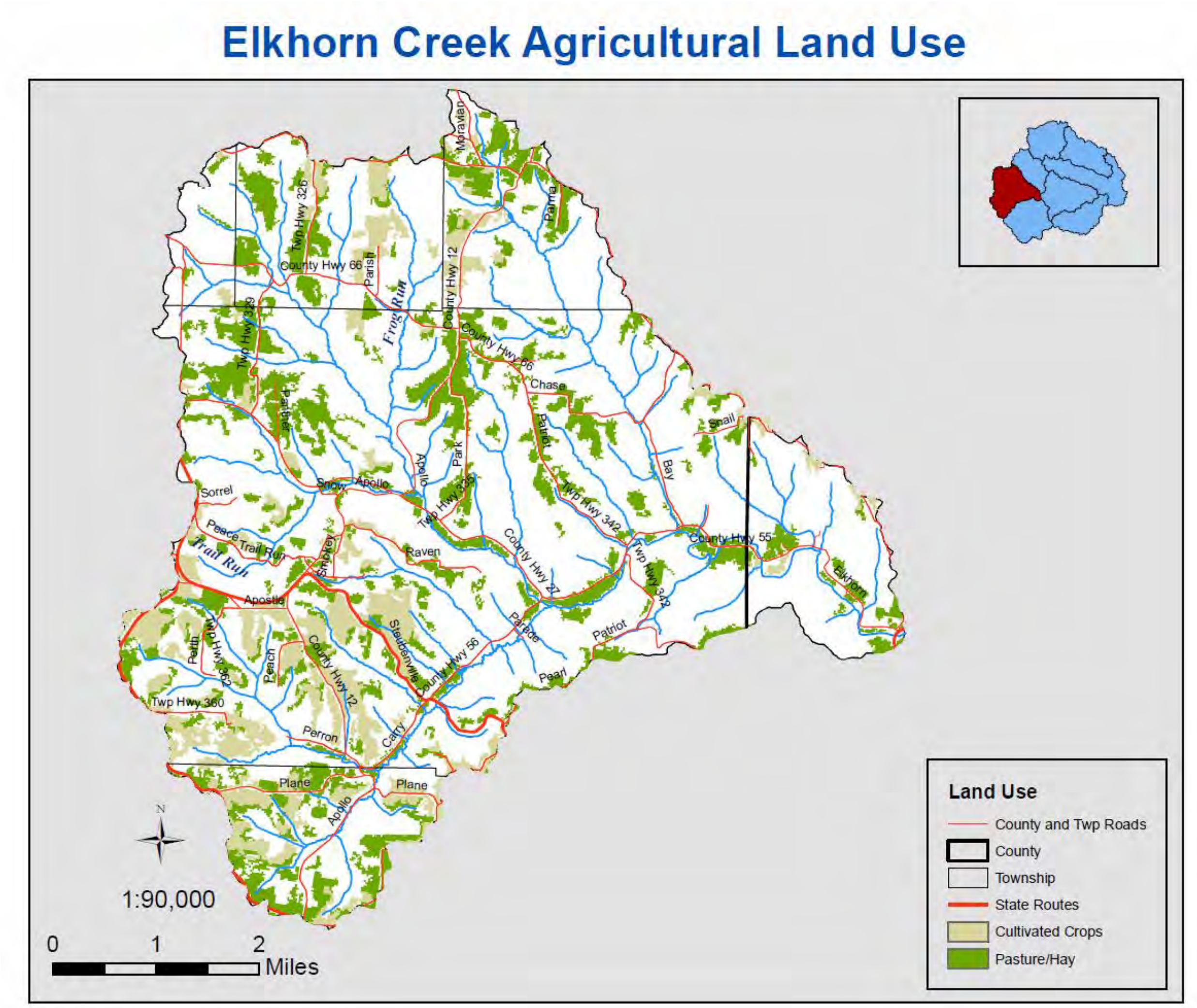

Fig. 63: Elkhorn Creek Agricultural Land Use

<u>Elkhorn Creek</u>

The subwatershed of Elkhorn Creek, at the western most portion of the watershed, is located primarily in Carroll County, with a small portion extending westward into Jefferson County's Springfield Township. There are three soil associations in this sub watershed: Westmoreland-Coshocton, Berks-Westmoreland, Rigley-Westmoreland associations.

In the Carroll County portion of this sub watershed, agriculture is the primary land use. There are some areas that have been surfaced mined for coal. In these areas, the surfaced mined soils present some limitations for growth of agricultural crops, including moderately low to low organic content and slow permeability. Agricultural producers have opted to use most surface mined upland areas for hay land and pastureland. There are large acreages of land being managed for cash row crops on areas not affected by mining. Producers are practicing contour farming, contour strip cropping, no-till planting and crop rotation. Livestock operations are mostly small beef cow grazing operations. There are some small horse operations in this sub watershed.

Elkhorn Creek Subwatershed Water Quality

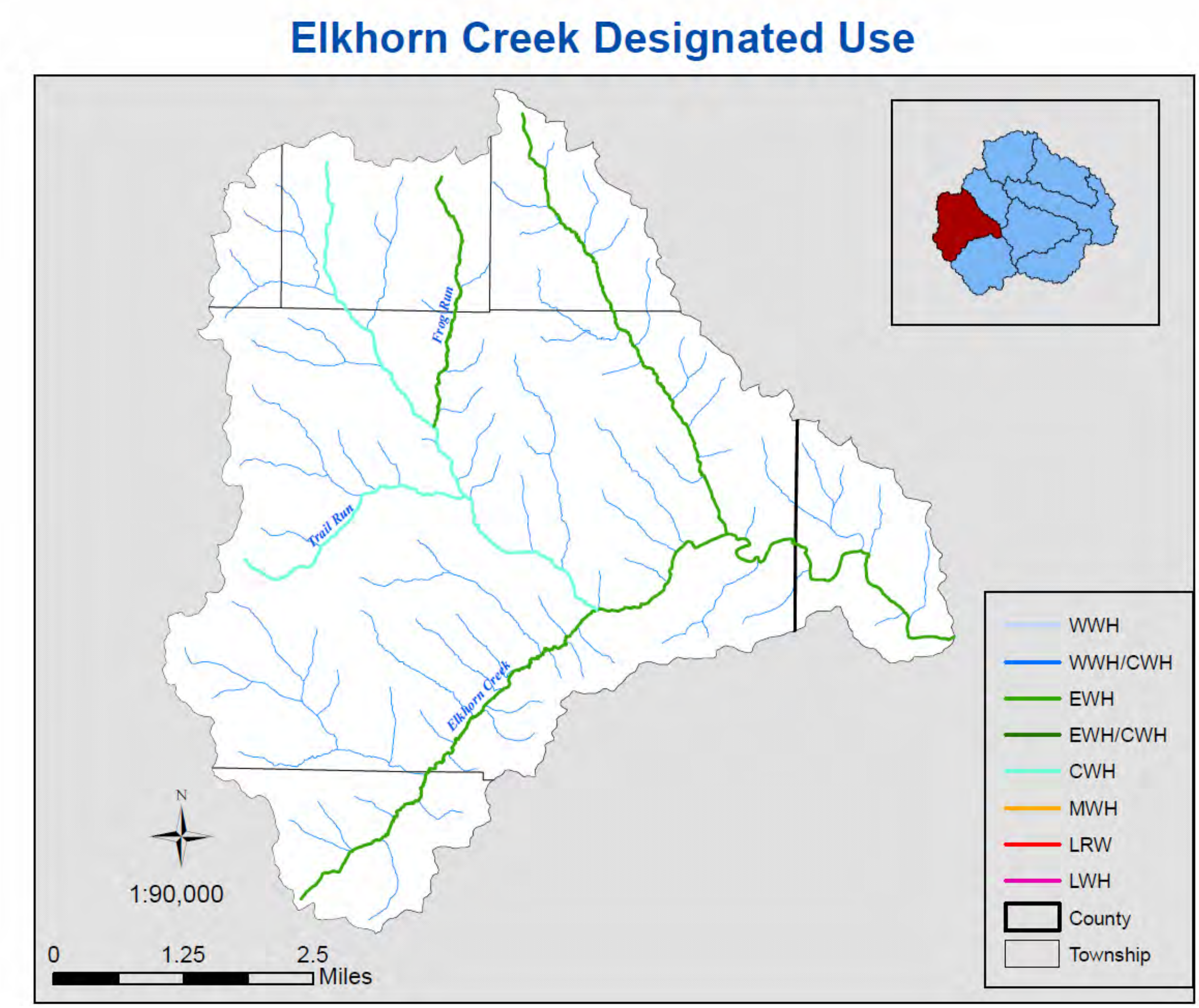

Fig. 64: Elkhorn Creek Designated Use

Ground Water

The approximate number of water wells in the subwatershed is 211, although it is very likely that there are more wells that were not recorded or submitted to the Ohio Division of Natural Resources. Over 21,476.3 acres are highly sensitive to groundwater contamination.

Surface Water

The total area determined to be within the 100 year floodplain in the Elkhorn Creek Subwatershed is 520.6 acres. This subwatershed has the most wetlands areas at 407.4 acres. Other surface water features include 52.6 acres of ponds and lakes and 87.9 acres of streams. There are two municipal discharge permits within this subwatershed and six dams.

Nine sites in the Elkhorn Creek Subwatershed were sampled; all were in attainment of their designated use. In the subwatershed, 8.7 miles were designated as coldwater habitat and 18.5 were designated exceptional warmwater habitat.

Elkhorn Creek Water Quality

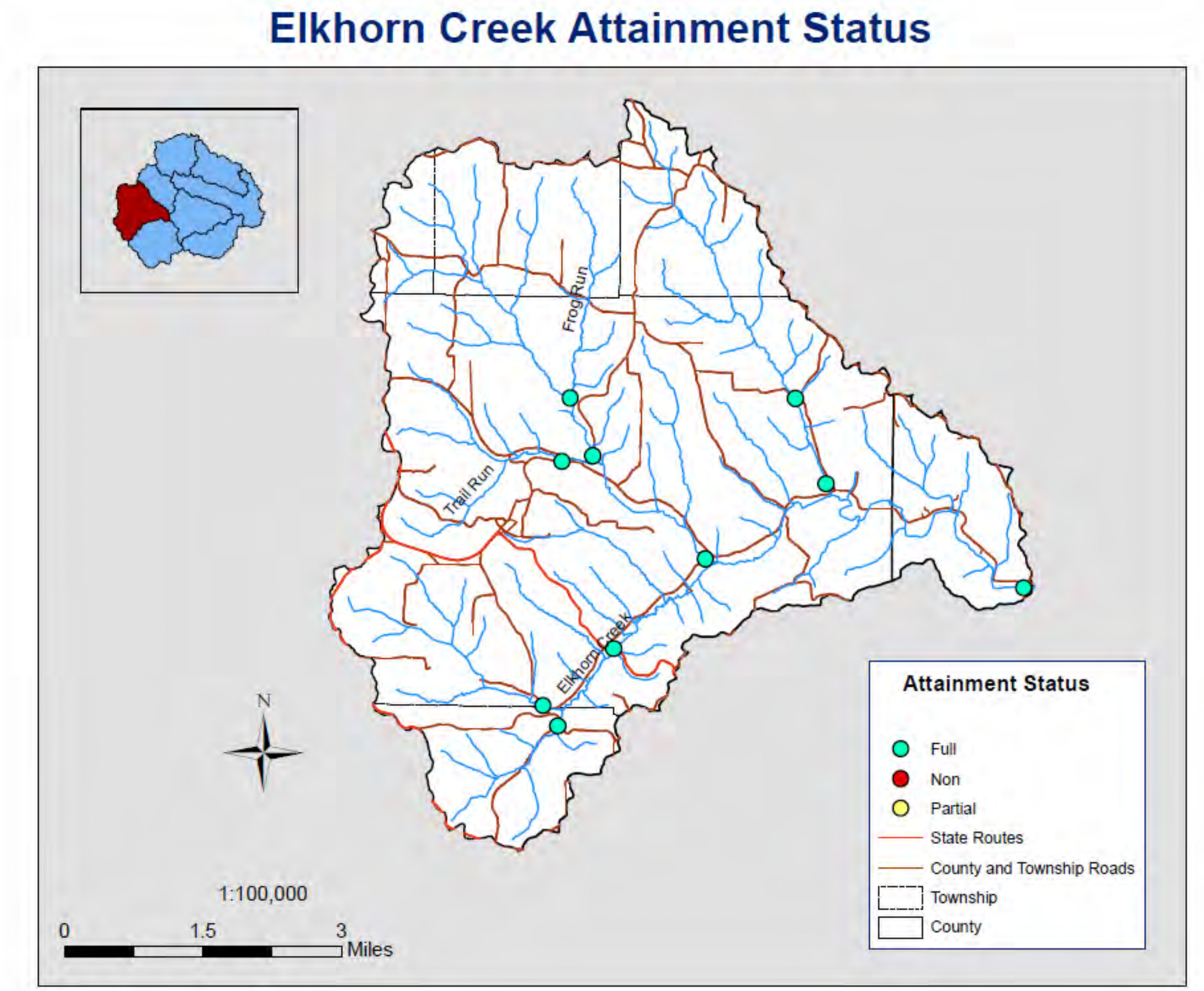

Fig. 65: Elkhorn Creek subwatershed attainment status

Table 39. Elkhorn Creek Water Quality Results

Stream Name and River Mile	Attainment Status	IBI	ICI	MiWb	QHEI	Aquatic Life Use
Center Fork 2.7	**Unknown**	**NA**	**Exceptional**	**NA**	**NA**	**CWH**
Center Fork 1.9	**Full**	**50**	**Very Good**	**NA**	**68**	**CWH**
Center Fork 0.2/0.1	**Full**	**54**	**60**	**NA**	**64.5**	**CWH**
Elkhorn Creek 7.9	**Full**	**52**	**Exceptional**	**NA**	**76.0**	**EWH**
Elkhorn Creek 6.8/6.7	**Full**	**54**	**56**	**NA**	**50**	**EWH**
Elkhorn Creek 0.2	**Full**	**50**	**54**	**11**	**95.0**	**EWH**
Frog Run	**Full**	**40**	**Exceptional**	**NA**	**56.5**	**EWH**
Strawcamp Run 2.2/2.1	**Full**	**48**	**Exceptional**	**NA**	**91.0**	**EWH**
Strawcamp Run 0.4/0.3	**Full**	**48**	**Very Good**	**NA**	**55.0**	**EWH**
Trail Run	**Full**	**50**	**54**	**NA**	**63.5**	**CWH**

Gault Run	Full	52	Exceptional	NA	67	WWH

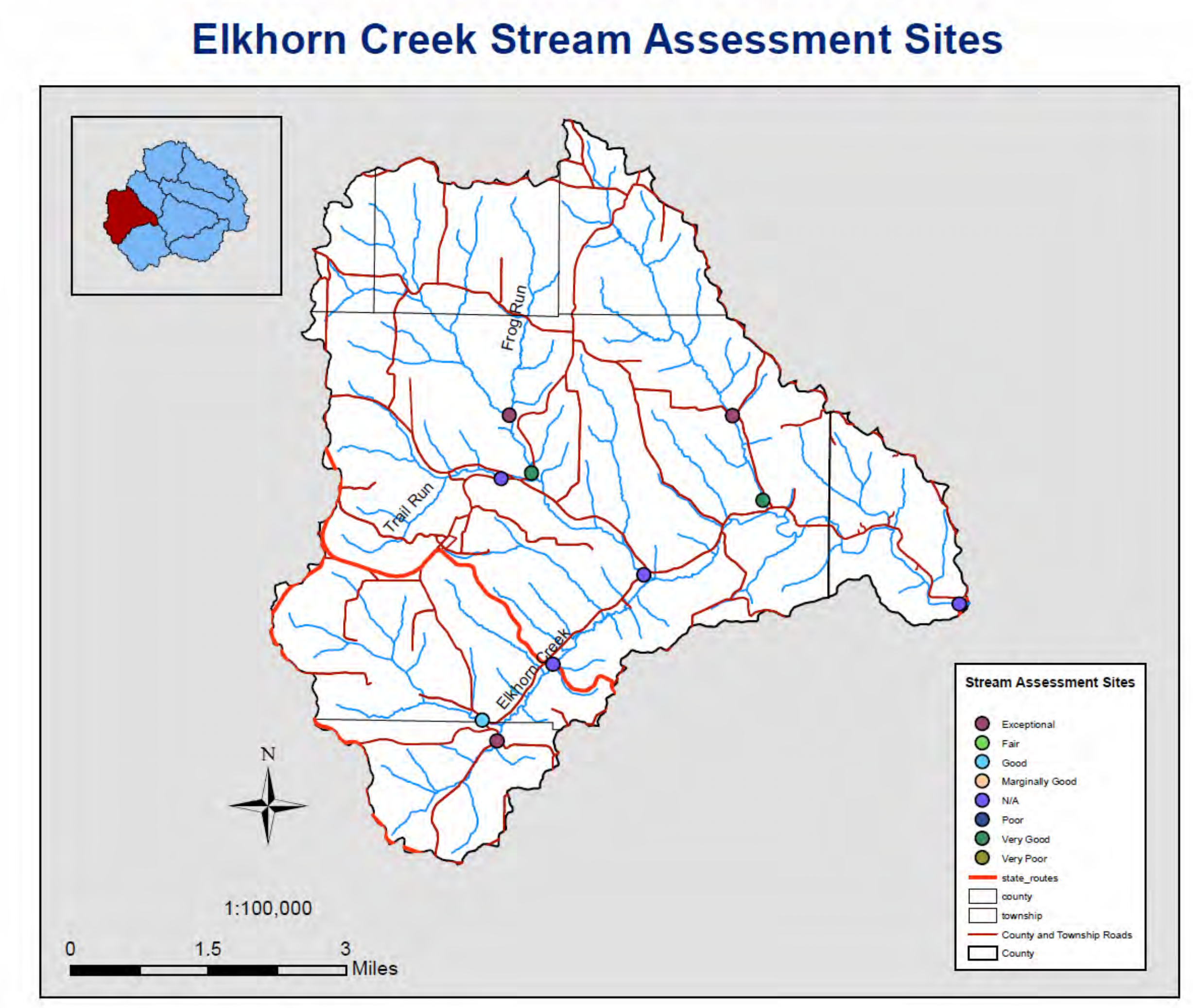

Fig. 66: Elkhorn Creek Stream

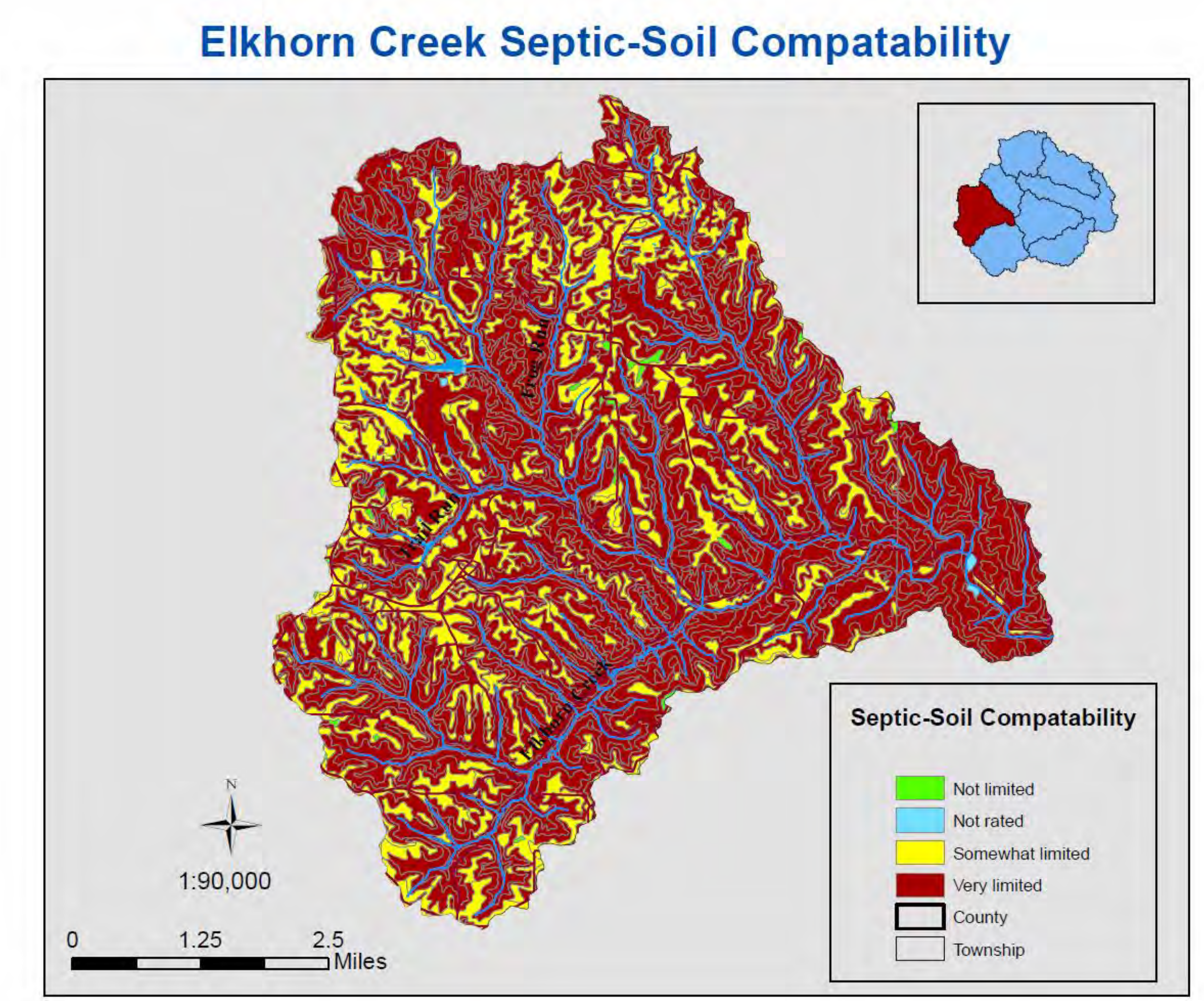

Fig. 67: Elkhorn Creek Septic-Soil Compatibility

Problem Statement 1: (Bacteria)

The Subwatershed Elkhorn Creek is impaired due to untreated human waste. Based on estimates from Jefferson County General Health District and Ohio EPA there were 367 failing septic systems releasing 64,110 gallons of improperly treated flow water per day

> **Goal 1.1** Complete survey of failing home sewage treatment systems to identify and prioritize needed sewage treatment upgrades.
>
> **Goal 1.2** Upgrade 367 failing HSTS in the Elkhorn Creek subwatershed

Pollutant	Goal	Task Description	Resources	How	Time Frame	Performance Indicator
Bacteria	1.1	1. Work with health departments, particularly in Jefferson County, to complete an HSTS inventory which identifies failing systems in the watershed, along with the cause of failure.	Funding for flyover and use of infrared to identify failing systems.	Seek funding for payment of flyover and infrared survey of failing HSTS. The Jefferson County General Health District has committed to creating a GIS layer of failing HSTS upon investigation of complaints, as well as any studies done.	2012-2013	GIS layer of failing HSTS created. Prioritized list of systems.
	1.2	Replace or upgrade identified HSTS systems reducing the amount of fecal coliform and e. coli present in Elkhorn Creek	Repair or replace approximately 367 systems at $7,000.00 per system totals $2,569,000.00	Repair or Replace approximately 367 systems through principal forgiveness loans (DEFA), costshare programs (water quality credit trading), grants and homeowner contribution. The watershed coordinator and/or the county health departments may seek funding through principal forgiveness loans through DEFA.	2011-2021	Upgraded systems will reduce the amount of e. coli and fecal coliform discharging into stream. Amounts reduced will be calculated using the BATHTUB model.

Problem Statement 2: (Sedimentation/Nutrients)

As confirmed by the 2009 TMDL, Elkhorn Creek subwatershed is impaired by elevated levels of nutrients and sedimentation related to livestock operations that have access to the stream. The livestock operations are concentrated on Elkhorn Creek and Gault Run.

Goal 2.1 Reduce sedimentation and nutrient loadings entering Elkhorn Creek and Gault Run

Objective: Target cattle and bison operations along Elkhorn Creek and Gault Run where livestock have access to the stream.

Action: Install 31,680 feet of streambank fencing and necessary auxiliary practices to protect at least three miles of streambank .

Pollutant	Goals	Task Description	Resources	How	Time Frame	Performance Indicator
Sedimentation, Nutrients	2.1	Target cattle and bison operations along Elkhorn and Gault Run where livestock have access to the stream. Work with landowners to install 31,680 feet of streambank fencing and necessary auxiliary practices to protect at least 3 miles of streambank.	$68,428.80 for fencing and auxiliary practices. 31,680 ft* $2.16/foot= $68,428.80	Ohio Division of Wildlife, US Fish and Wildlife, US Forest Service, USDA	Jan. 2013- Jan. 2015	Document 3 miles of streambank protected. Improved QHEI, IBI and ICI scores.

Problem Statement 3: (Habitat)

Habitat impairments from a lack of riparian cover, bank instability and erosion are evident in the Elkhorn Creek and several of its tributaries.

Goal 3.1: 7.55 river miles of improved riparian cover

Objectives: 45 acres of riparian area planting (25 foot buffer)

Pollutant	Goal	Task Description	Resources	How	Time Frame	Performance Indicator
Lack of riparian protection	3.1	Establish riparian protection and plantings that will enhance approximately 45 acres of riparian area with 25 foot buffer.	$33,389.00 45 Acres* $741.98 (established hardwood trees/shrubs w/ weed control)= $33,389.00	Ohio Division of Forestry, Western Reserve, Jefferson and Carroll Soil and Water Conservation Districts	2012-2016	7.55 r iver miles with improved riparian cover. Improved IBI. ICI and QHEI scores

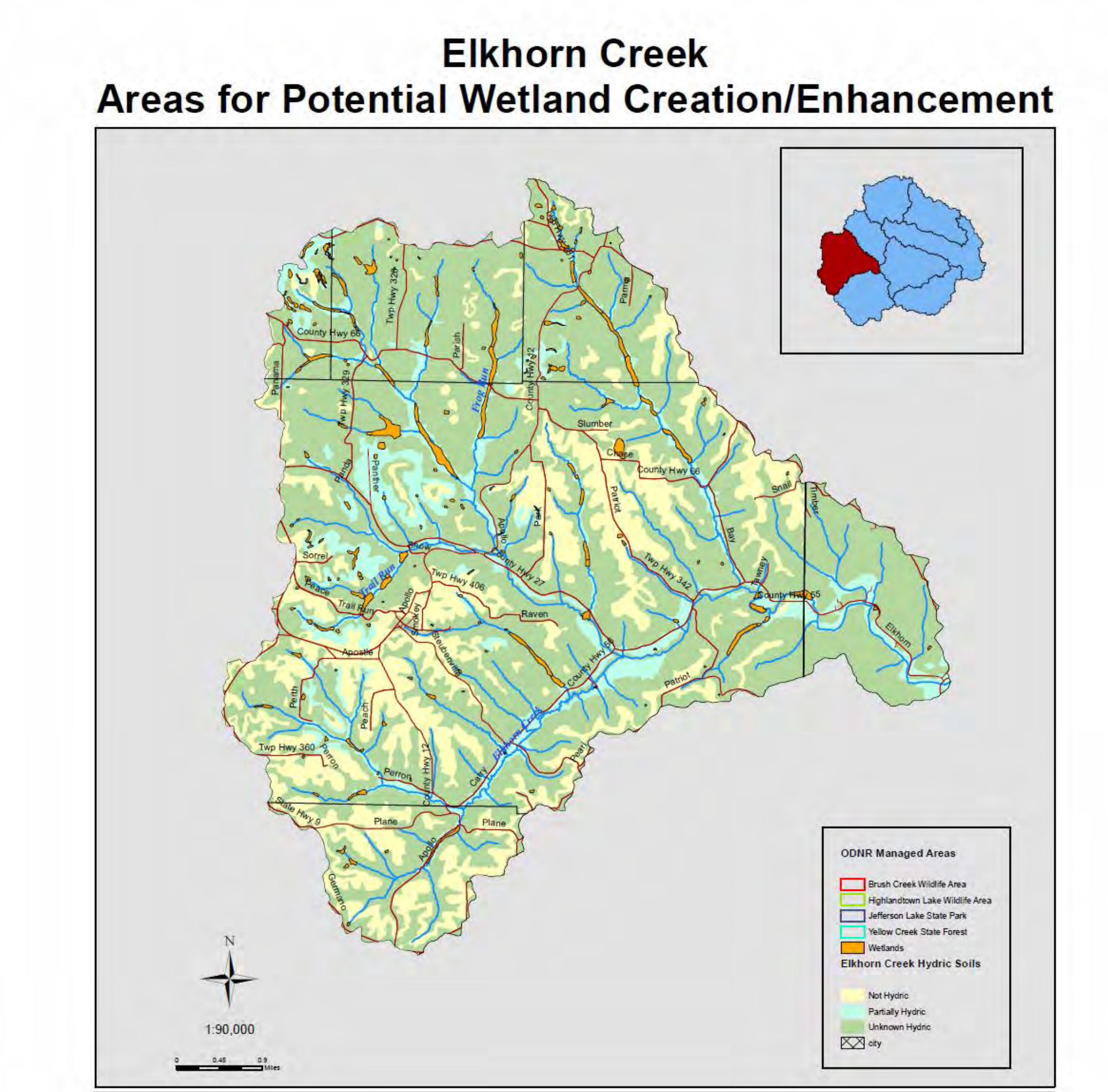

Fig. 68: Elkhorn Creek Land Use

Areas to be prioritized for protection:

Elkhorn Creek, Strawcamp Run, Trail Run and Center Run are streams classified as either exceptional warmwater habitat and/or coldwater habitat. These streams will be prioritized for protection through conservation easements and riparian setbacks.

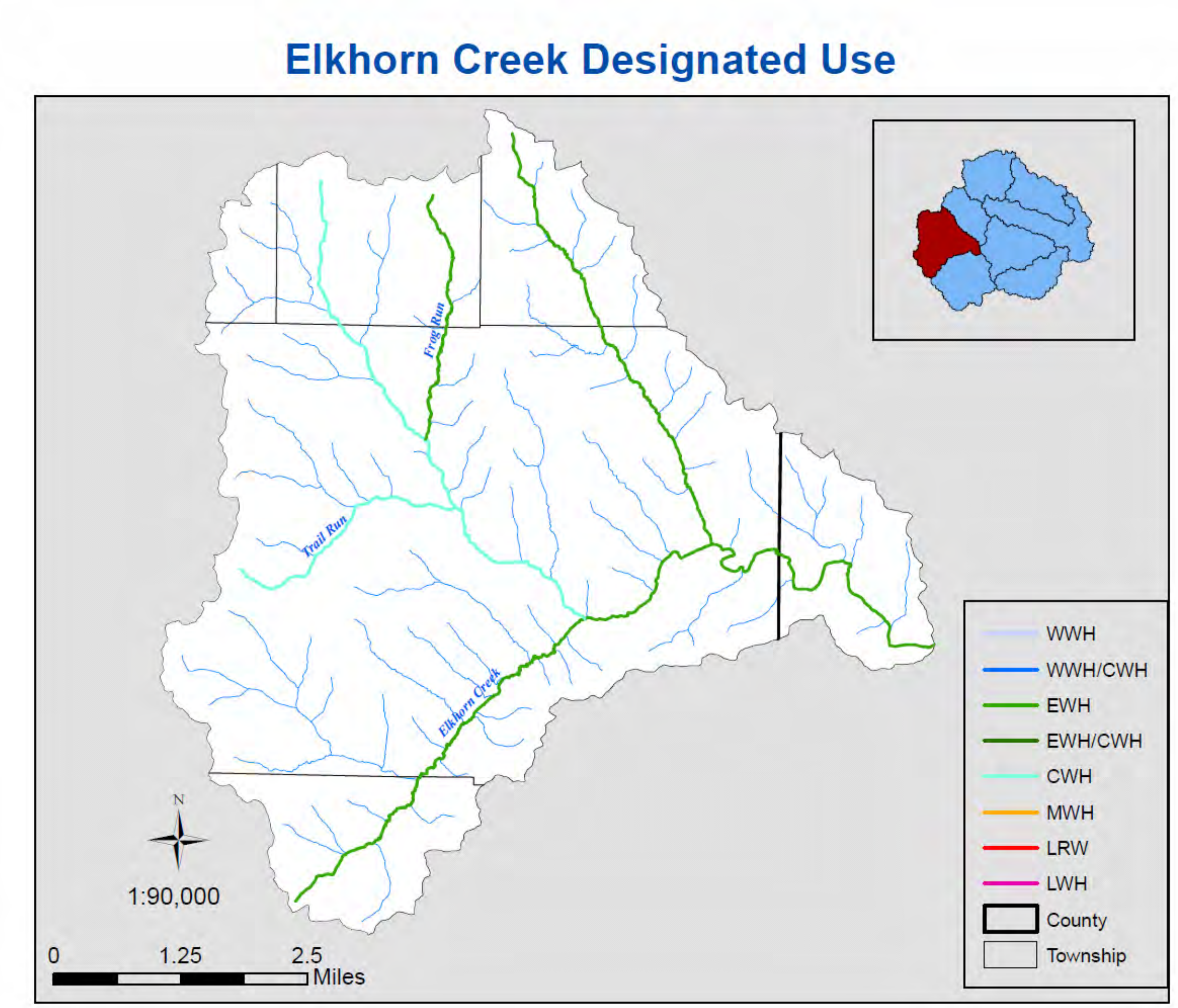

Fig. 69: Elkhorn Creek Designated Use

Chapter IV. Upper North Fork

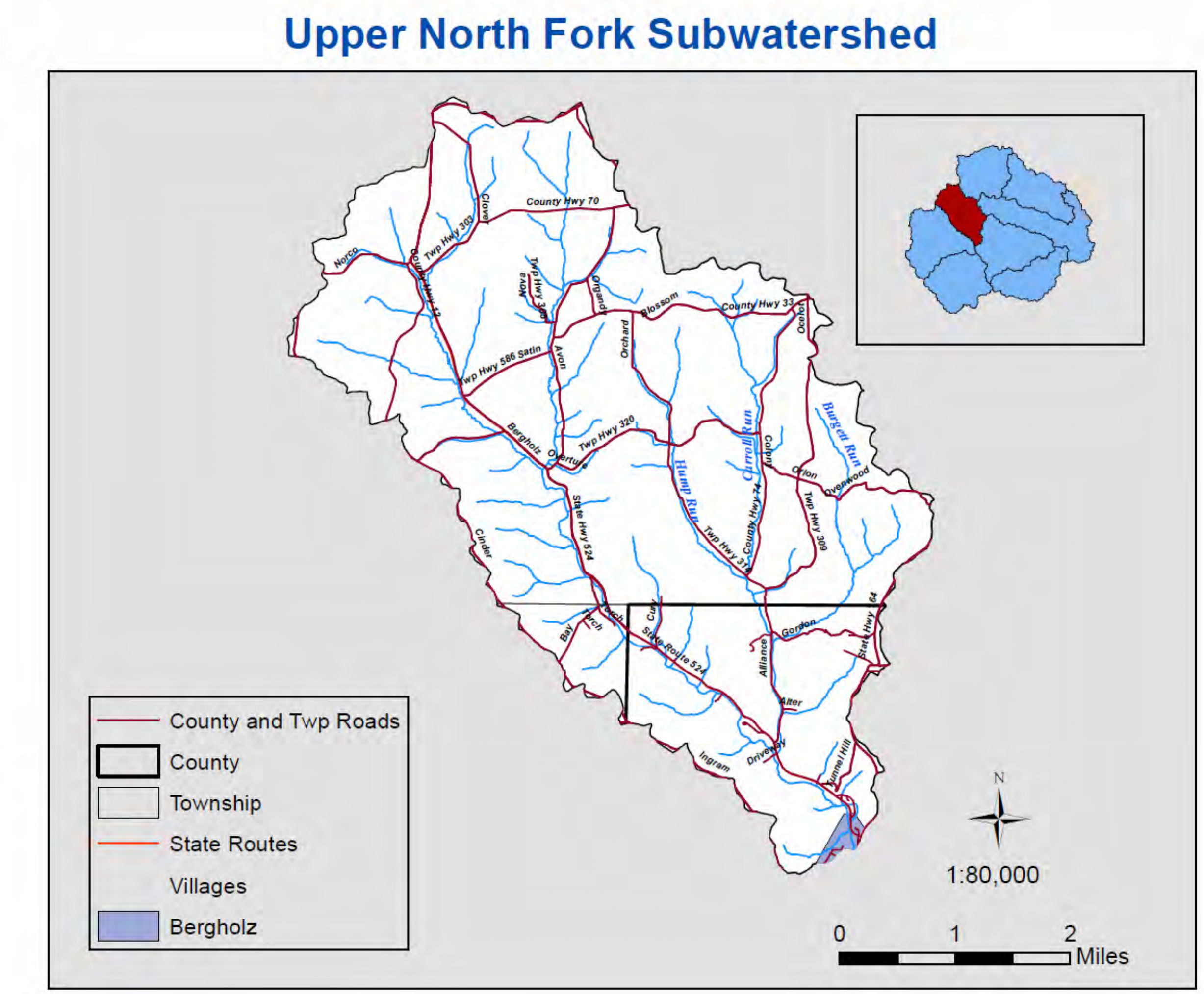

Fig. 70: Upper North Fork

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12,257 acres

The Subwatershed of Upper North Fork lies northwest of Elkhorn Creek Subwatershed. Major tributaries in this subwatershed include Upper North Fork, Burgett Run, Carroll Run, Hazel Run and Hump Run. Of the five sites sampled in Upper North Fork watershed all were in full attainment. There were no sections of stream deemed superior high quality waters by Ohio EPA.

Municipalities

A small section of the northern end of the municipality of Bergholz lies within the boundaries of the Upper North Fork Subwatershed.

Geology

The bedrock of the Upper North Fork Subwatershed consists mainly of shale and siltstone. The area having probable Karst features amounts to 12,270.5 acres.

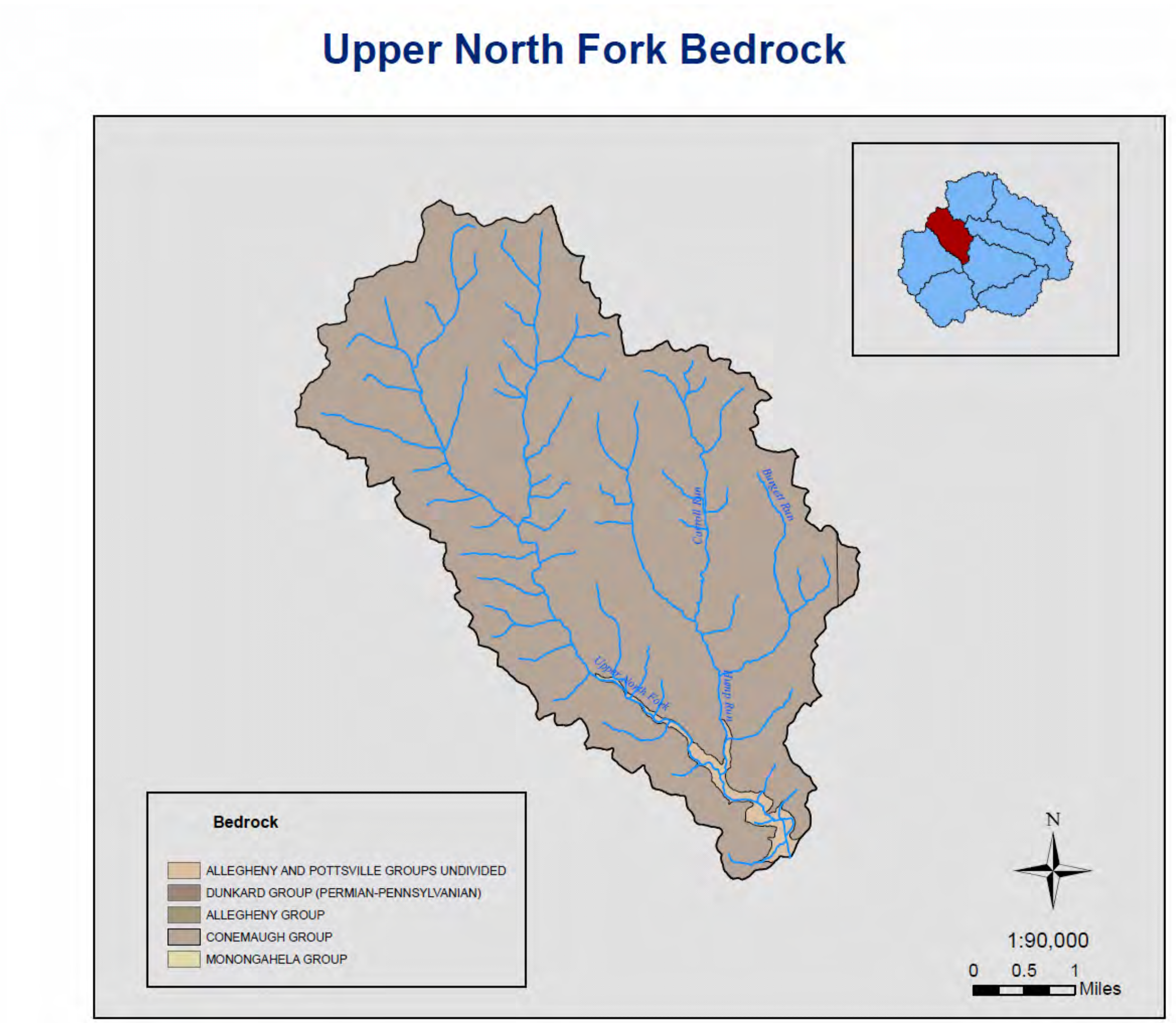

Fig. 71: Upper North Fork Bedrock

Population

Unlike the trend seen in other subwatersheds within Yellow Creek, census results from 1980 through 2000 show a gradual increase in population.

1980: 692

1990: 659

2000: 715

The average household size is 2.6, and the average household income is $39,214.00

Soil Resources

The majority of soils in the Upper North Fork Subwatershed rank well for drainage. There are 6,249.2 acres which are considered prime farmland and 11,642.3 acres are highly erodible land.

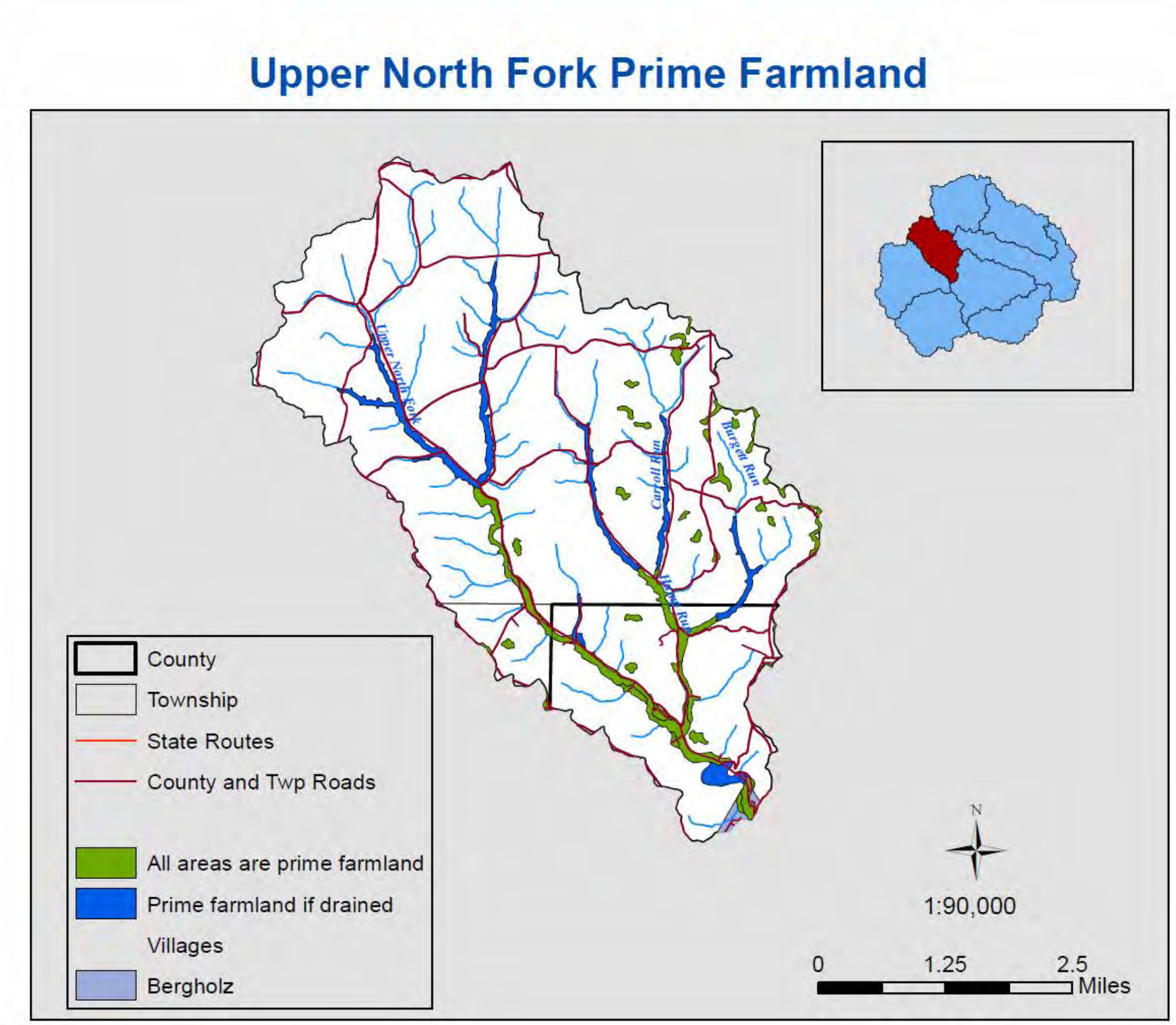

Fig. 72: Upper North Fork Prime Farmland

While there are no hydric soils, 698.9 acres are partially hydric.

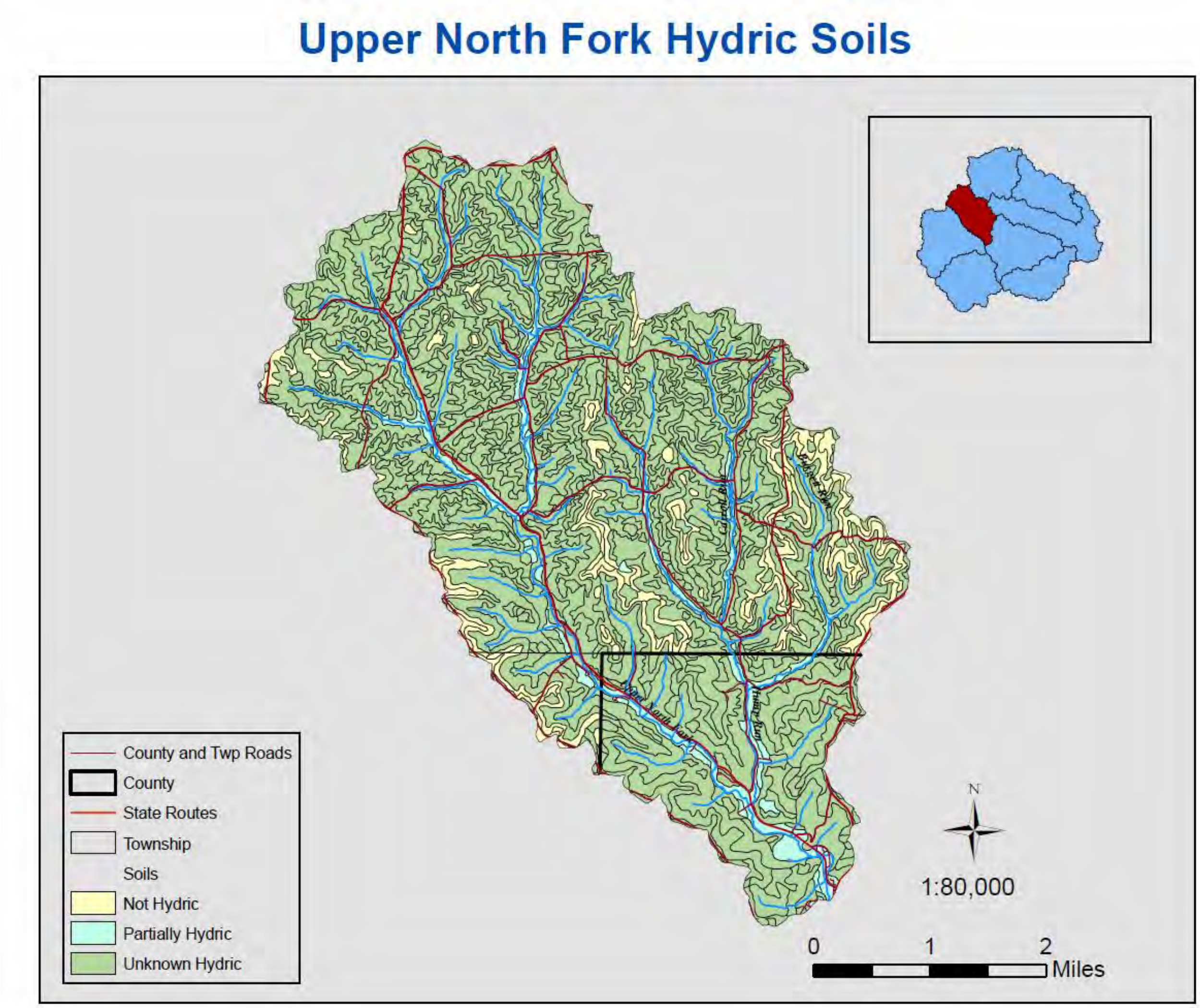

Fig. 73: Upper North Fork Hydric Soils

Lastly, 5.2 acres in this subwatershed are frequently flooded.

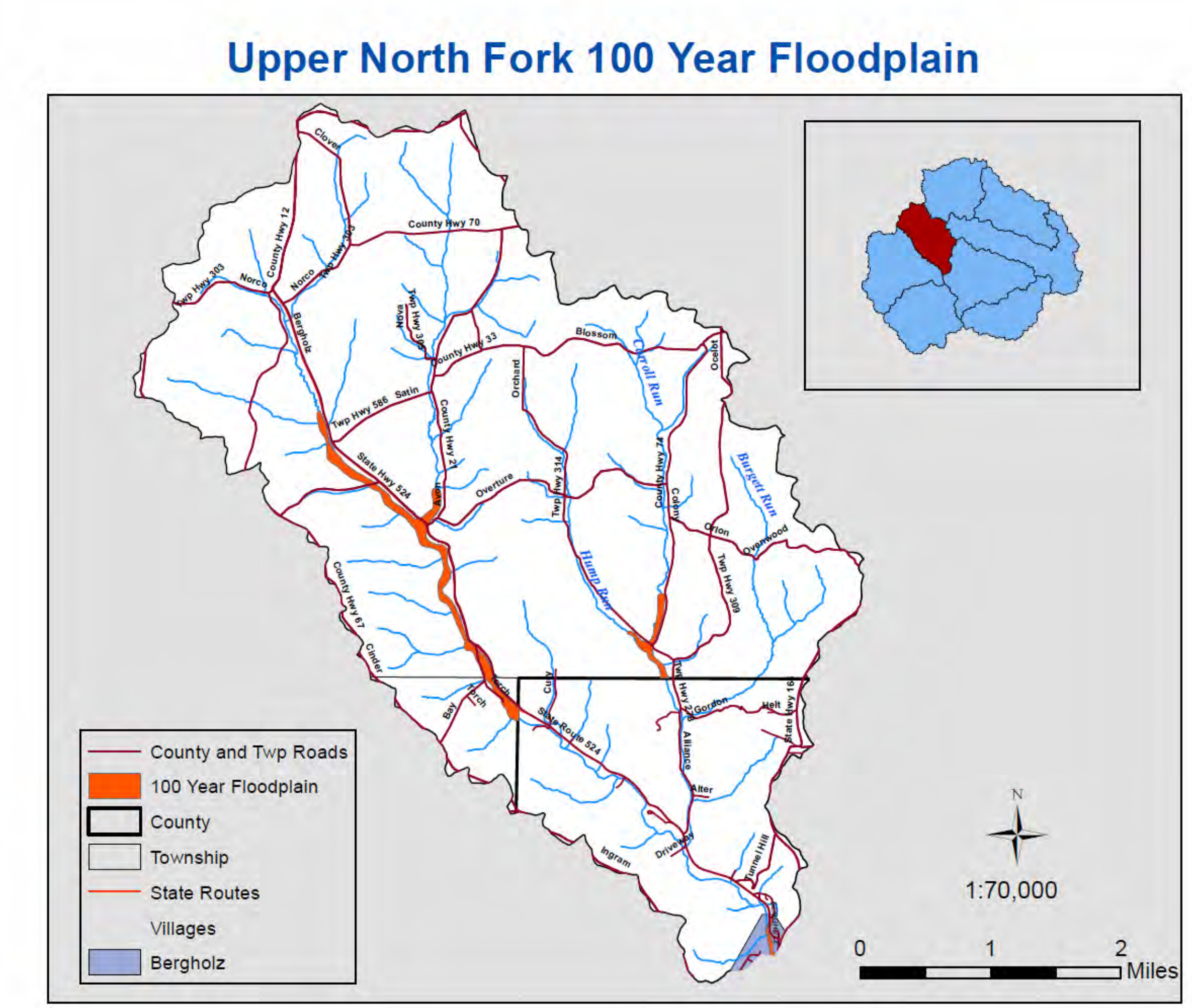

Fig. 74: Upper North Fork 100 Year Floodplain

Table 40. Upper North Fork Subwatershed Riparian Tree Species

American Elm	Black Walnut
Sycamore	Red Elm
Black Cherry	Black Locust
Ash	Red Oak
White Oak	Basswood
Sugar Maple	Willow (Native)
Pignut Hickory	Alder
Bigtooth Aspen	Box Elder
Bitternut Hickory	

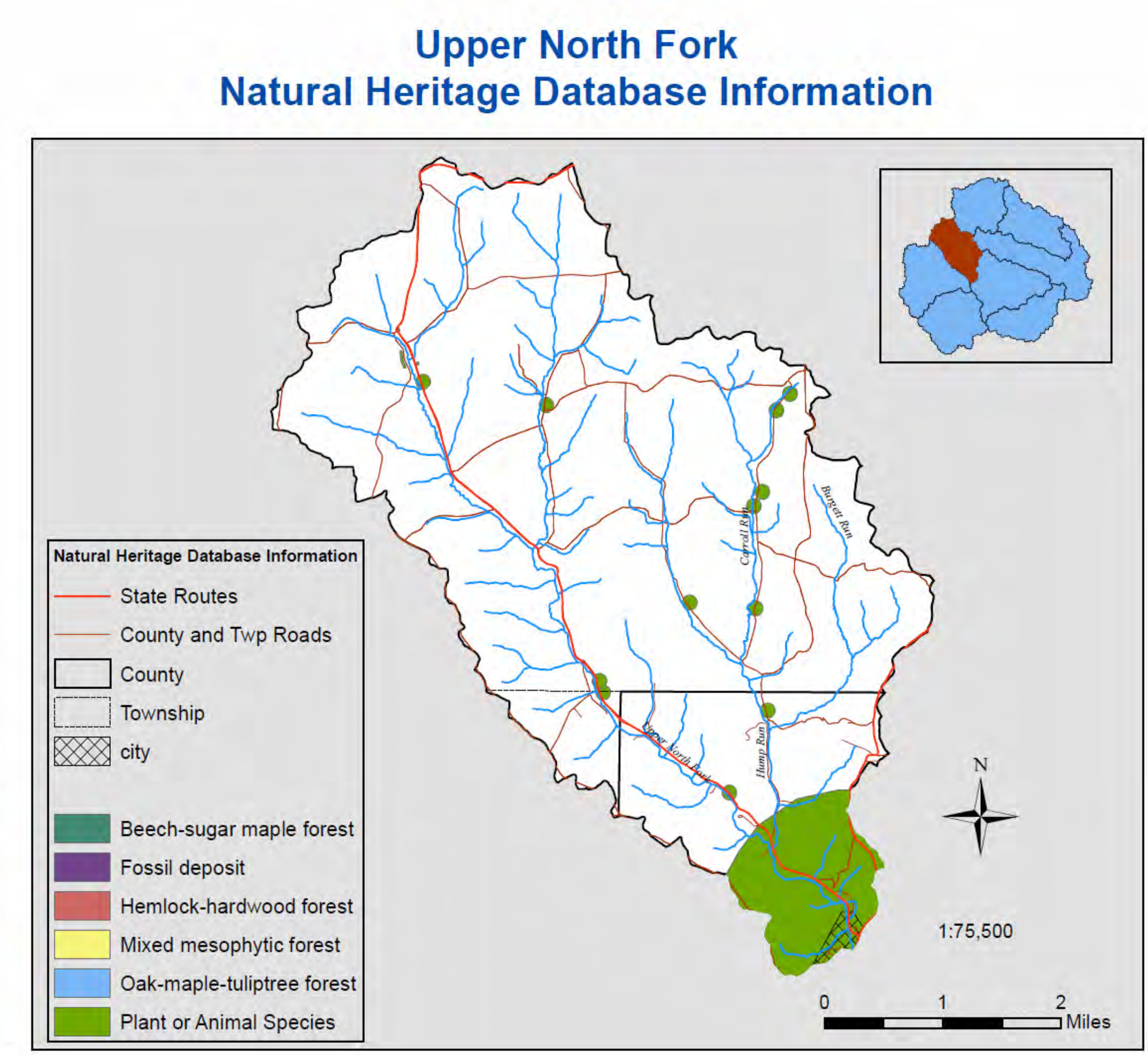

Fig. 75: Upper North Fork NHD Information

Upper North Fork Land Use

A greater area was once used in agriculture production than we see today in the Upper North Fork Subwatershed. There has been an increase in urban land use over the last fifteen years. The majority of the land use in this subwatershed is forested, followed by land in agricultural production then urbanized areas. There are 58.1 acres approved through Ohio EPA for bio-solid application to fields.

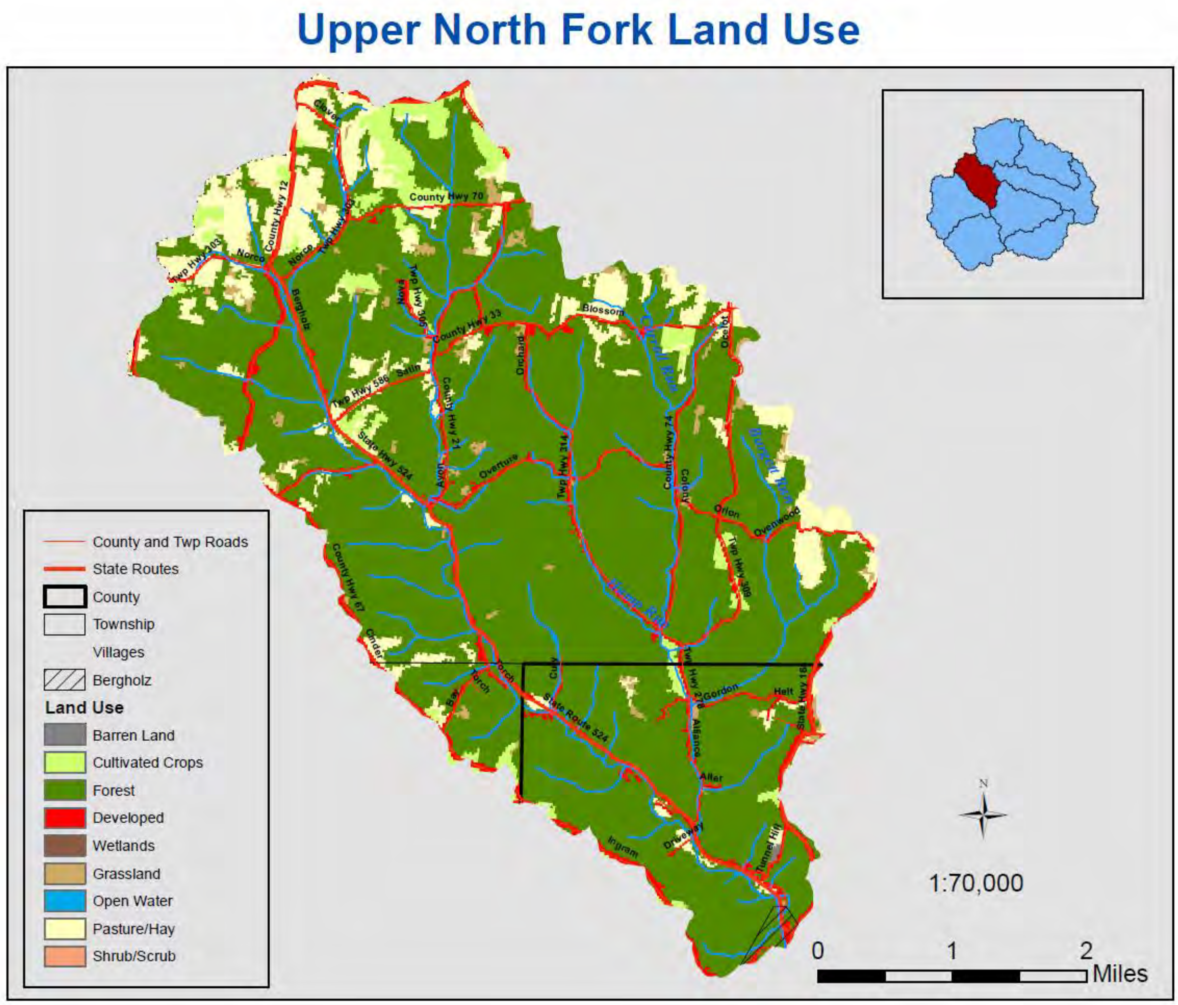

Fig. 76: Upper North Fork Land Use

Table 41. Upper North Fork Land Use (acres)

	2009	2001	1994
Agriculture	1,752.9	2,854.5	2,842.0
Water	6.2	40.3	21.5
Urban	720.7	14.5	6.5
Forest	9,798.1	9,361.1	9,206.4
Barren	0.0	0.0	2.6
Shrub/Scrub	0.8	0.0	191.6

Agricultural Characteristics

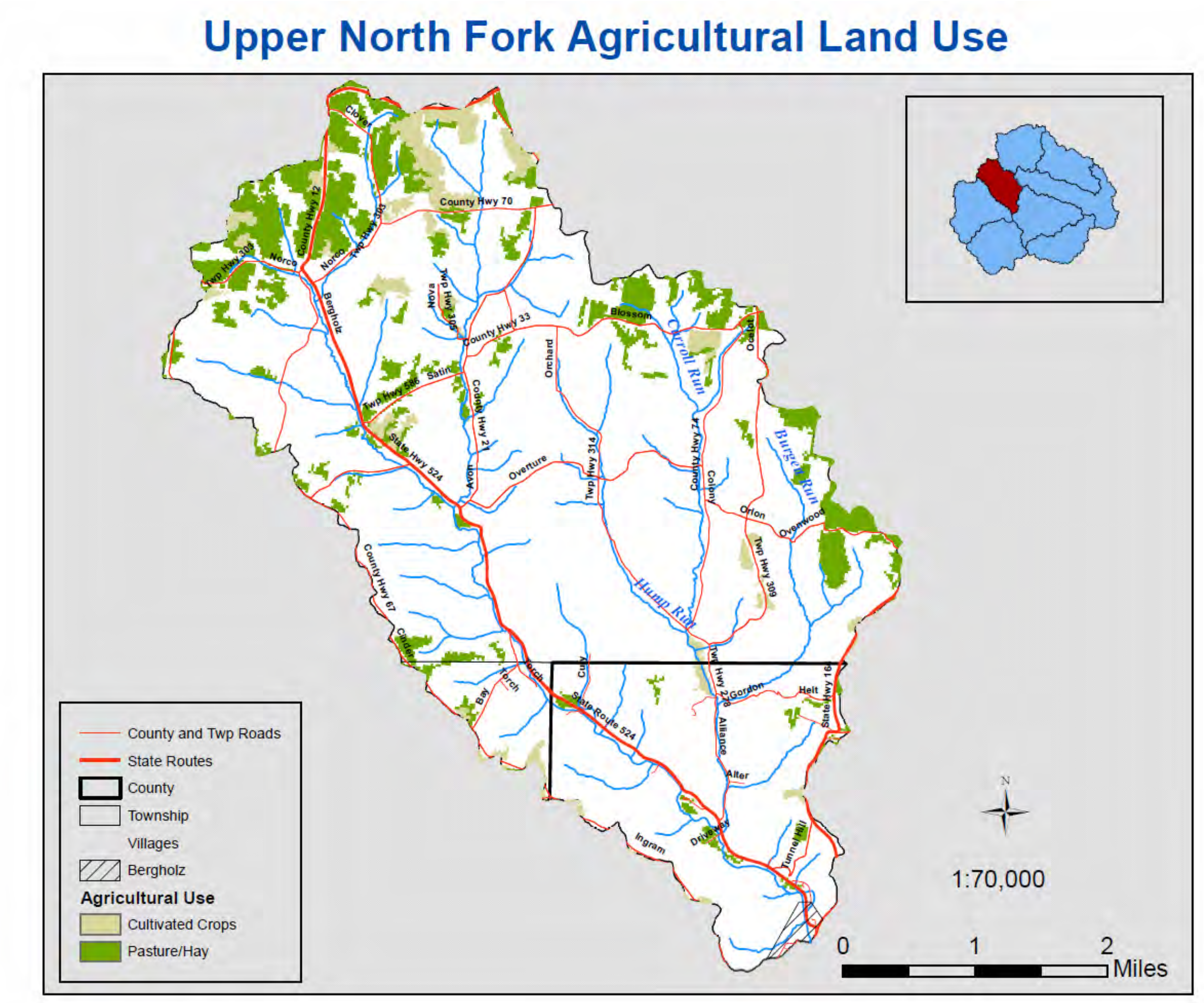

Fig. 77: Upper North Fork Agricultural Land Use

<u>Upper North Fork</u>

The sub watershed know as Upper North Fork, is on the western half of the watershed, located in Carroll County and extending down into Jefferson County's Springfield Township. There are two different soil associations in this sub watershed: Berks-Westmoreland and Rigley-Westmoreland associations.

The Carroll County portion is very rugged with large acreages of forest land, with small acreages of hay and pastureland interspersed. Few farmers are growing significant acreages of cash crops in this sub watershed. Crops are grown on the contour and use no-till as the planting method.

Upper North Fork Water Quality

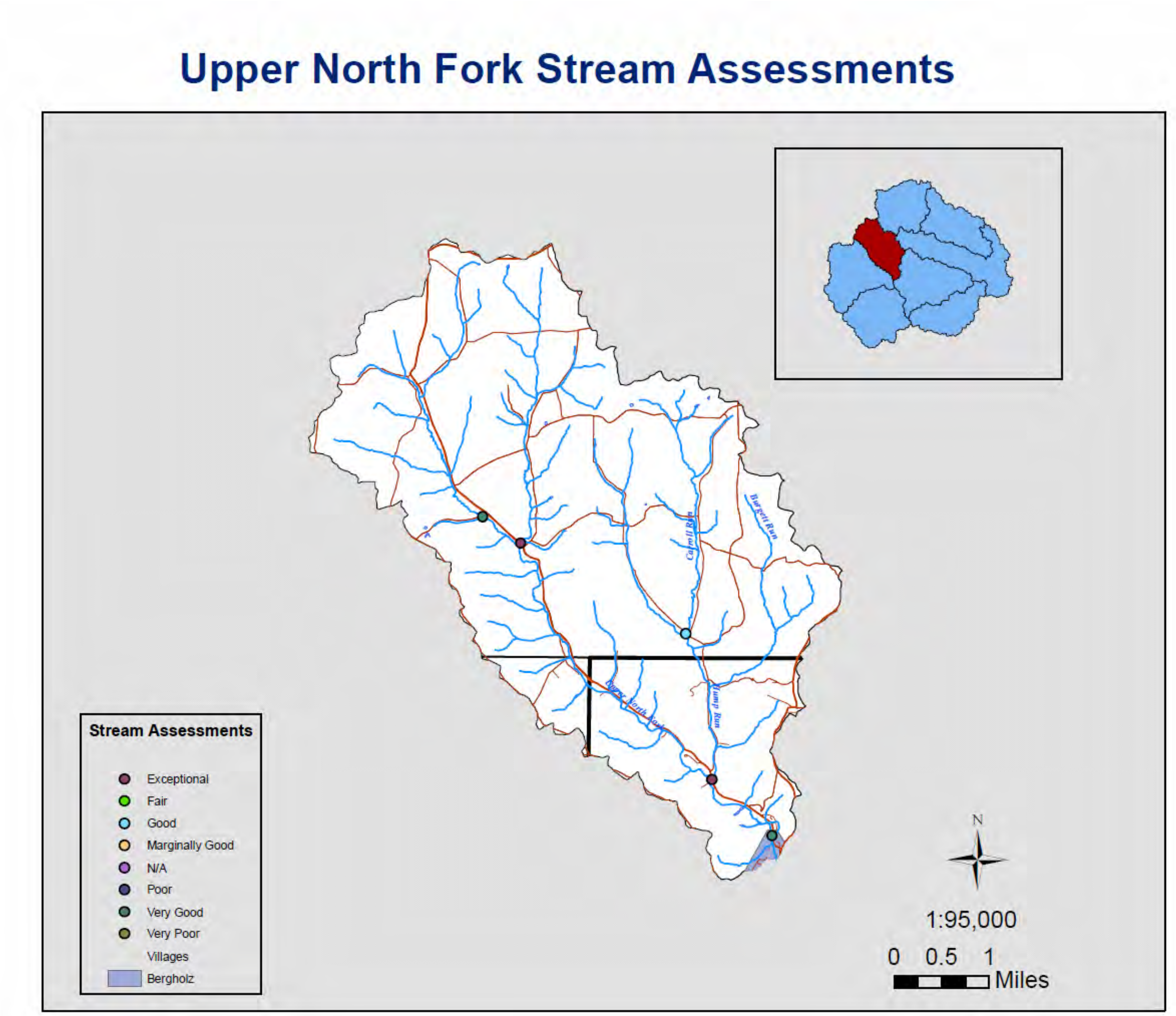

Fig.78: Upper North Fork Stream Assessments

Ground Water

The approximate number of water wells in the Upper North Fork Subwatershed is 116, although it is very likely that there are more wells that were not recorded or submitted to the Ohio Division of Natural Resources. In this subwatershed, 12,269.9 acres are highly sensitive to groundwater contamination.

Surface Water

There are 138.6 acres determined to be within the 100 year floodplain. There are 211.3 acres in wetlands in the Upper North Fork Subwatershed. Other surface water features include 7.9 acres of ponds and lakes and 51.8 acres of streams. There is one municipal discharge permit for this subwatershed and no dams listed.

Five sites were sampled by Ohio EPA during the 2005 total maximum daily load study. Of those sites all five were in attainment of their designated use status. A total of 22.4 miles of stream were designated as warmwater habitat. No stream segments were designated as coldwater habitat or exceptional warmwater habitat.

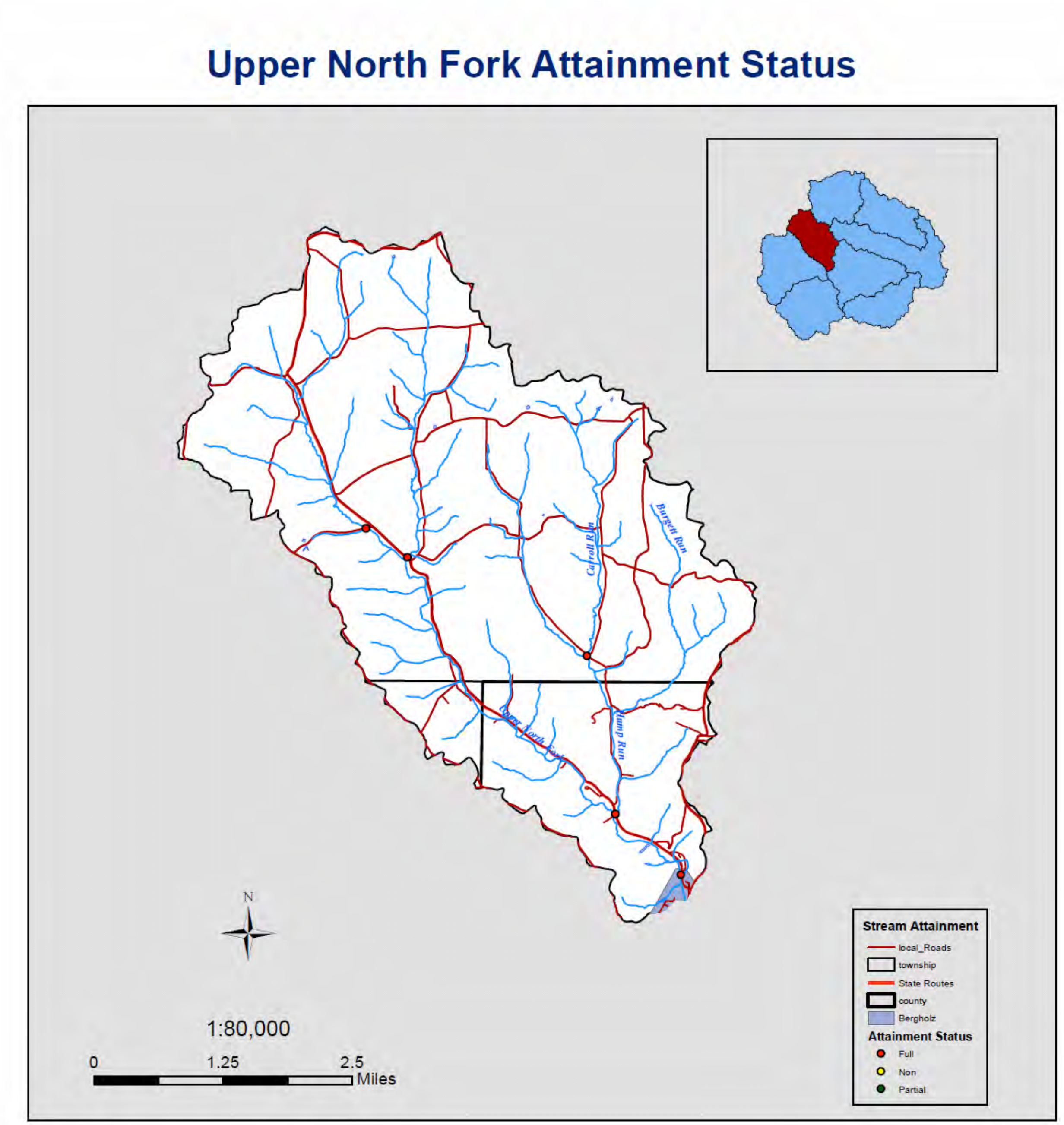

Fig. 79: Upper North Fork Attainment Status

Table 42. Upper North Fork Water Quality

Stream Name and River Mile	Attainment Status	IBI	ICI	MiWb	QHEI	Aquatic Life Use
Carroll Run	**Full**	**48**	**Good**	**NA**	**65.5**	**WWH**
Hazel Run	**Full**	**46**	**Excellent**	**NA**	**73.0**	**WWH**
Hump Run	**Full**	**54**	**Excellent**	**NA**	**65.5**	**WWH**
Upper North Fork 5.7/5.5	**Full**	**48**	**Very Good**	**NA**	**53.5**	**WWH**
Upper North Fork 0.3	**Full**	**58**	**Very Good**	**NA**	**78.5**	**WWH**

Problem Statement 1: (Habitat)

The Subwatershed of Upper North Fork lacks riparian species in headwater areas. This leads to increased sedimentation, stream temperatures and habitat alteration in the form of streambank erosion.

Goals 1.1: Reduce sedimentation and nutrient loading in the Upper North Fork subwatershed by protecting and enhancing 1.78 miles riparian area

Objective: 10.79 acres of riparian area planting (25 foot buffer)

Pollutant	Goals	Task Description	Resources	How	Time Frame	Performance Indicator
Sedimentation, increased stream temperatures, habitat alteration	1.1	In headwaters of Upper North Fork implement riparian forest buffer on approximately 10.79 acres of riparian area. This will decrease the amount of sedimentation	$8,006.00 10.79 Acres* $741.98 (established hardwood trees/shrubs w/ weed control)= $8,006.00	Western Reserve, Carroll Soil and Water Conservation District, Carroll Community Foundation, Oil and Gas mitigation	Jan. 2013-Jan. 2015	1.78 miles with intact riparian corridor improvement. Improved IBI, ICI and QHEI scores

Problem Statement 2: (Sedimentation/ nutrients)

The subwatershed of Upper North Fork is impaired due to areas with livestock access to stream.

Objective: Install 34,214 feet of streambank fencing and necessary auxiliary practices to protect at least three miles of stream.

Pollutant	Goals	Task Description	Resources	How	Time Frame	Performance Indicator
Bacteria, Sedimentation	2.1	Target horse and cattle operations along the mainstem of Upper North Fork where there is livestock access to stream to install 34,214 feet of exclusion fencing along 3.24 miles of stream	$73,903.10 34,214.4ft. of fence* $2.16/ft= $73,903.10	Ohio Division of Wildlife, US Fish and Wildlife, US Forest Service, USDA	Jan. 2013-Jan. 2015	Document miles of streambank fencing installed along with acreage of riparian area protected. Improved QHEI scores.

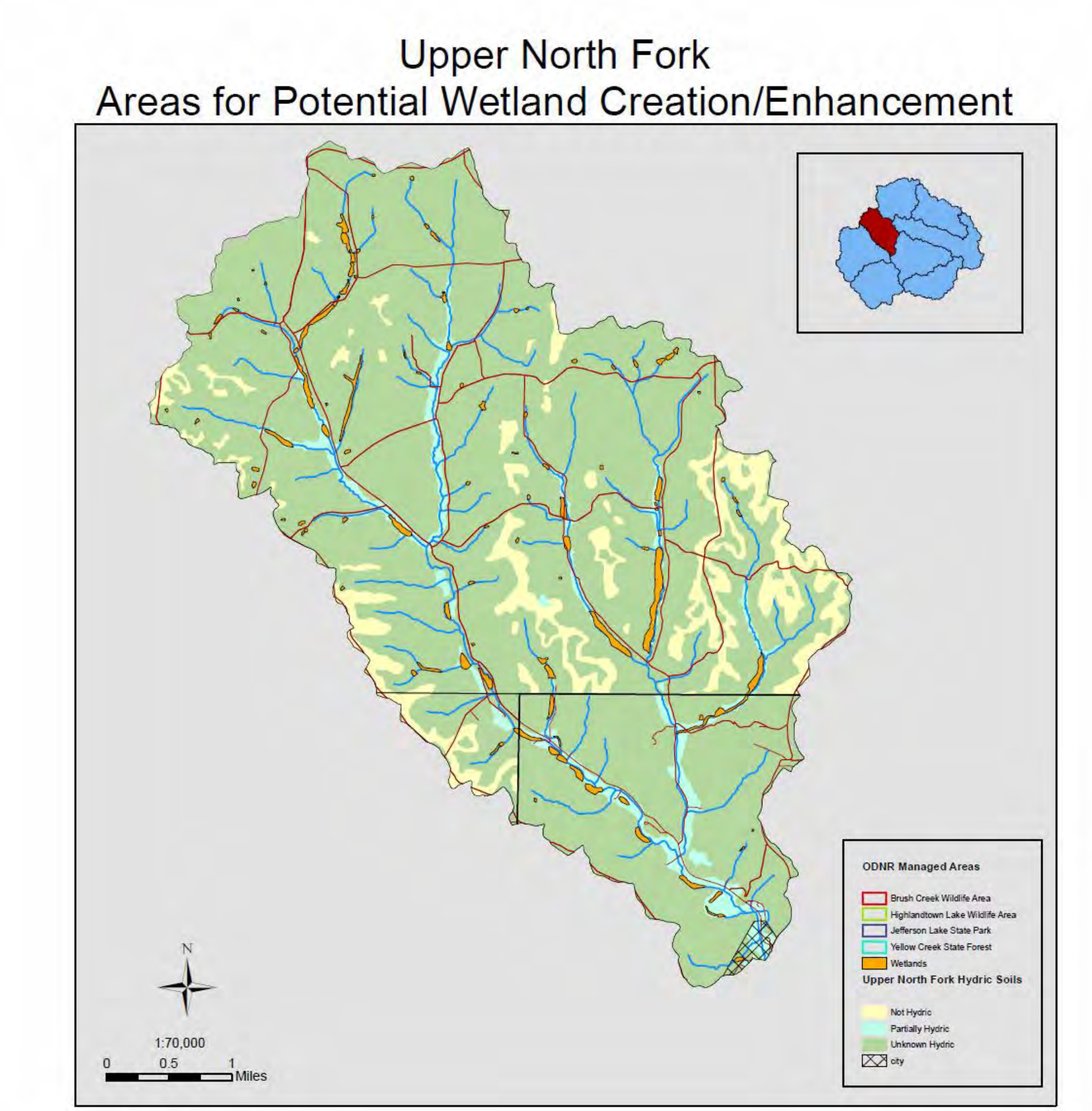

Fig. 80: Wetlands Creation/Enhancement Potential

Areas to be prioritized for protection:

The mainstem of Upper North Fork is classified as exceptional warmwater habitat, and Hump Run, a tributary to Upper North Fork, is classified coldwater habitat. These streams will be prioritized for protection through conservation easements and riparian setbacks.

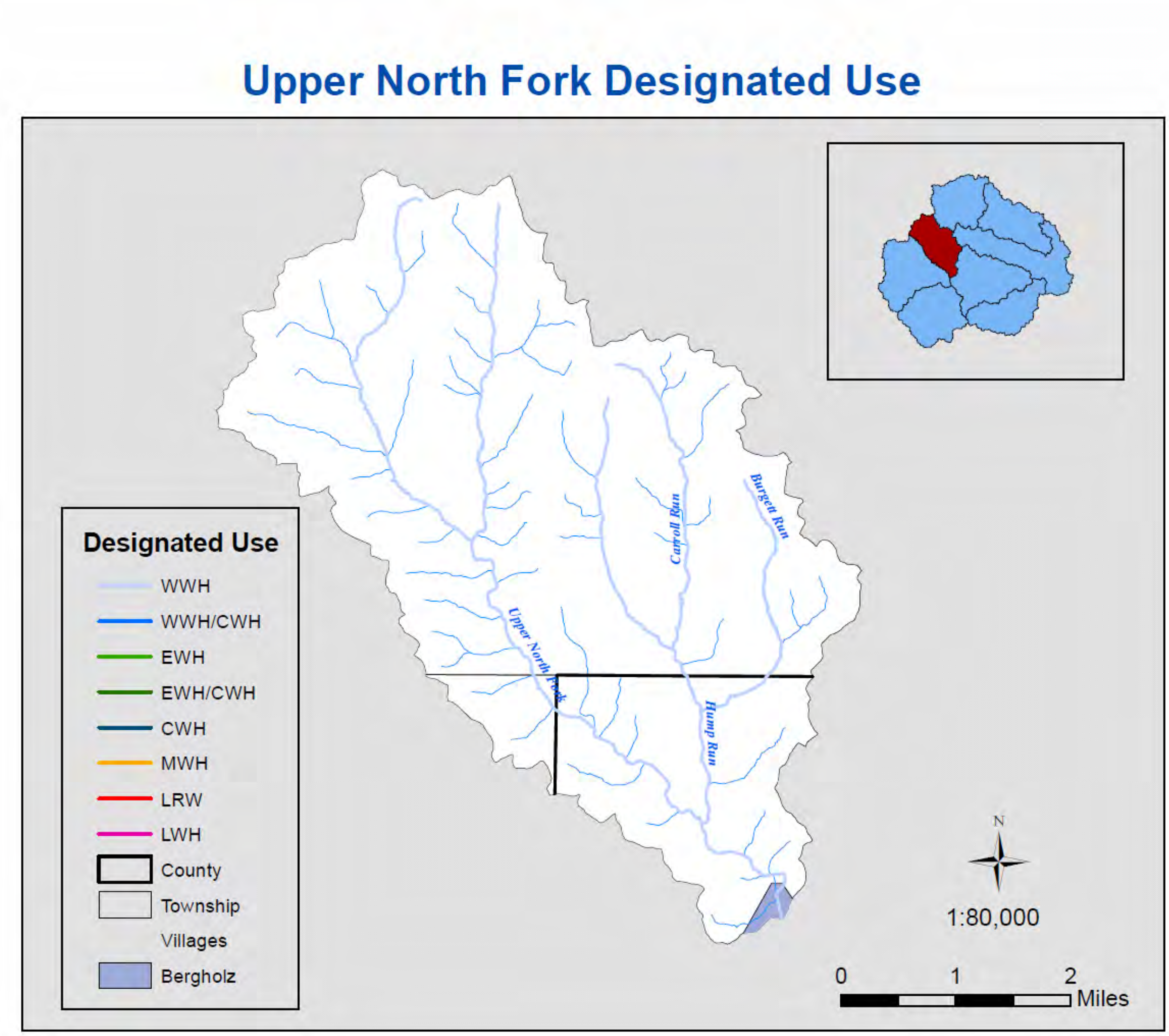

Fig. 81: Upper North Fork Designated Use

Chapter V. Long Run- Yellow Creek Subwatershed

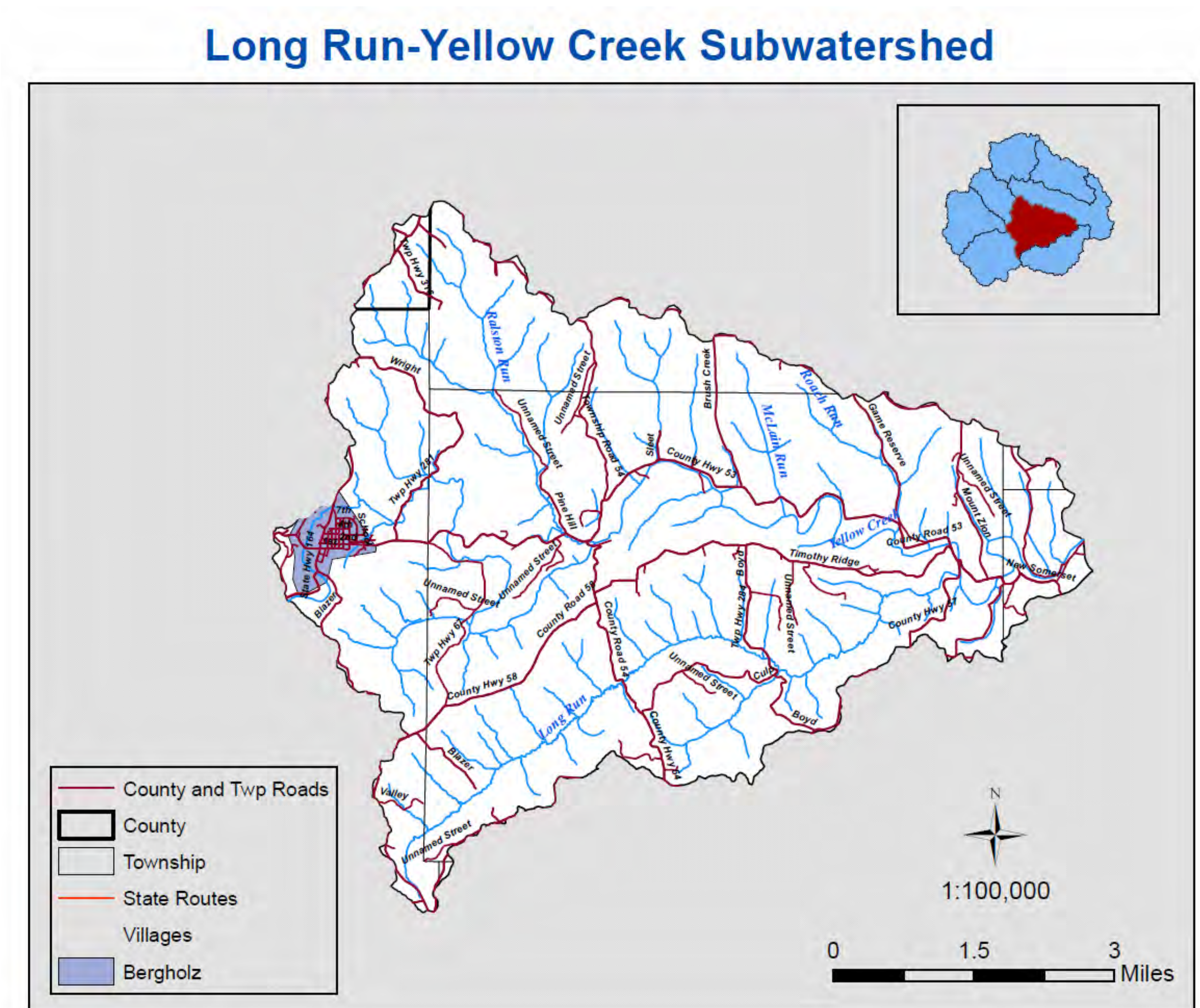

Fig. 82: Long Run-Yellow Creek subwatershed

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21,886 acres

The subwatershed of Long Run-Yellow Creek lies in the center of the Yellow Creek Watershed, and completely within Jefferson County. Major tributaries in this subwatershed include Hildebrand Run, Long Run, Mathews Run, Ralston Run, and Roach Run. Of the seven sites sampled in Long Run-Yellow Creek six were in full attainment of the designation while one sampling site on Long Run only reached partial attainment. There were no sections of stream deemed superior high quality waters by Ohio EPA.

Municipalities

The village of Bergholz occupies 327.2acres within Long Run-Yellow Creek Subwatershed.

Fig. 83: 2nd Street in Bergholz (Corder)

Geology

The bedrock of the Long Run-Yellow Creek Subwatershed consists mainly of shale and siltstone. The area having probable Karst features amounts to 21,909.3 acres.

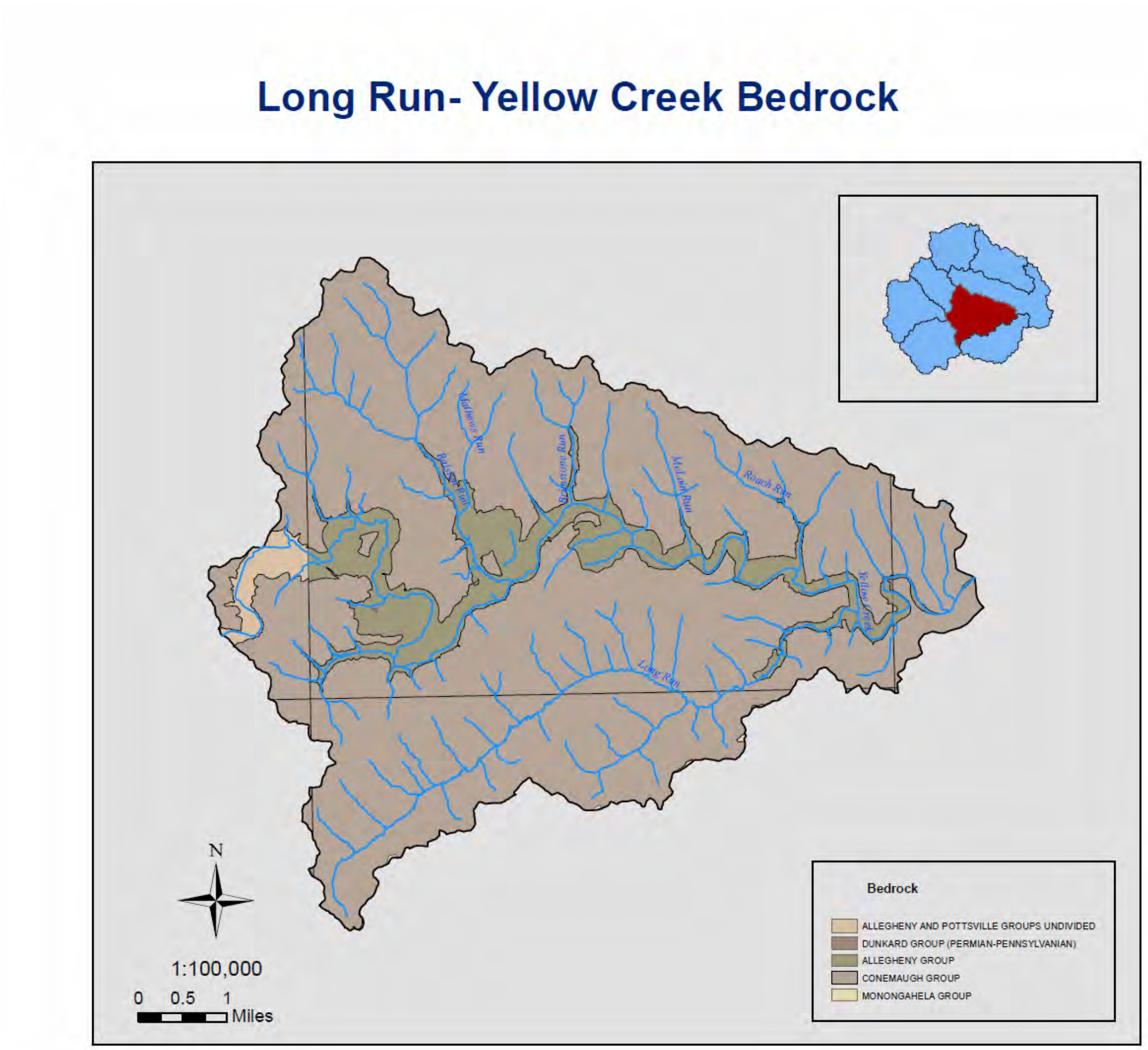

Fig. 84: Long Run-Yellow Creek Bedrock

Population

Census results from 1980 through 2000 show a gradual increase in population.

1980: 1,645

1990: 1,831

2000: 1,814

The average household size is 2.5, and the average household income is $37,402.00

Soil Resources

The majority of soils in the Long Run-Yellow Creek Subwatershed rank well for drainage. 9402.1 acres are considered prime farmland and 20,770.9 acres are highly erodible land.

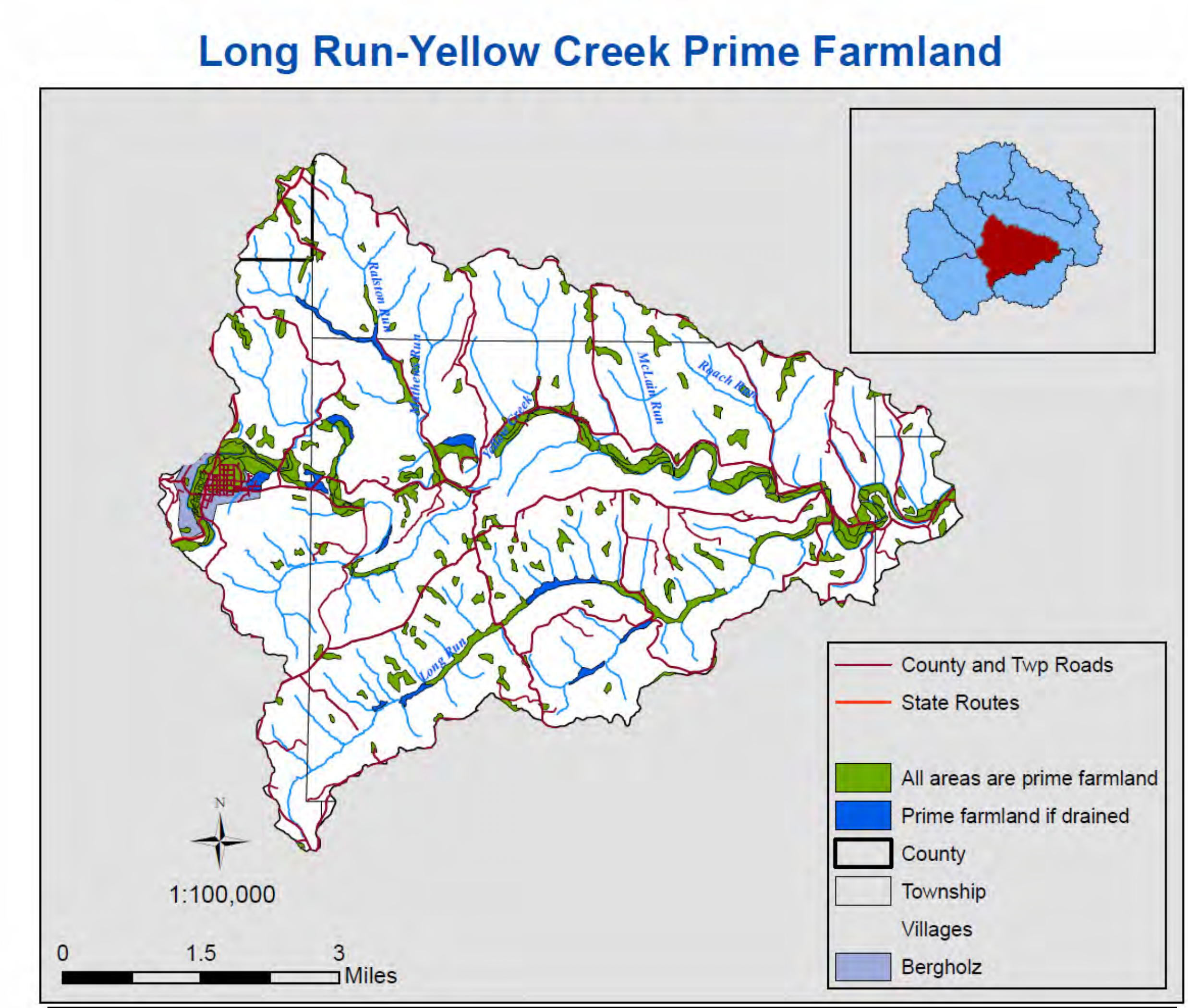

Fig. 85: Long Run-Yellow Creek Prime Farmland

While there are no hydric soils, 2,759.9 acres are partially hydric.

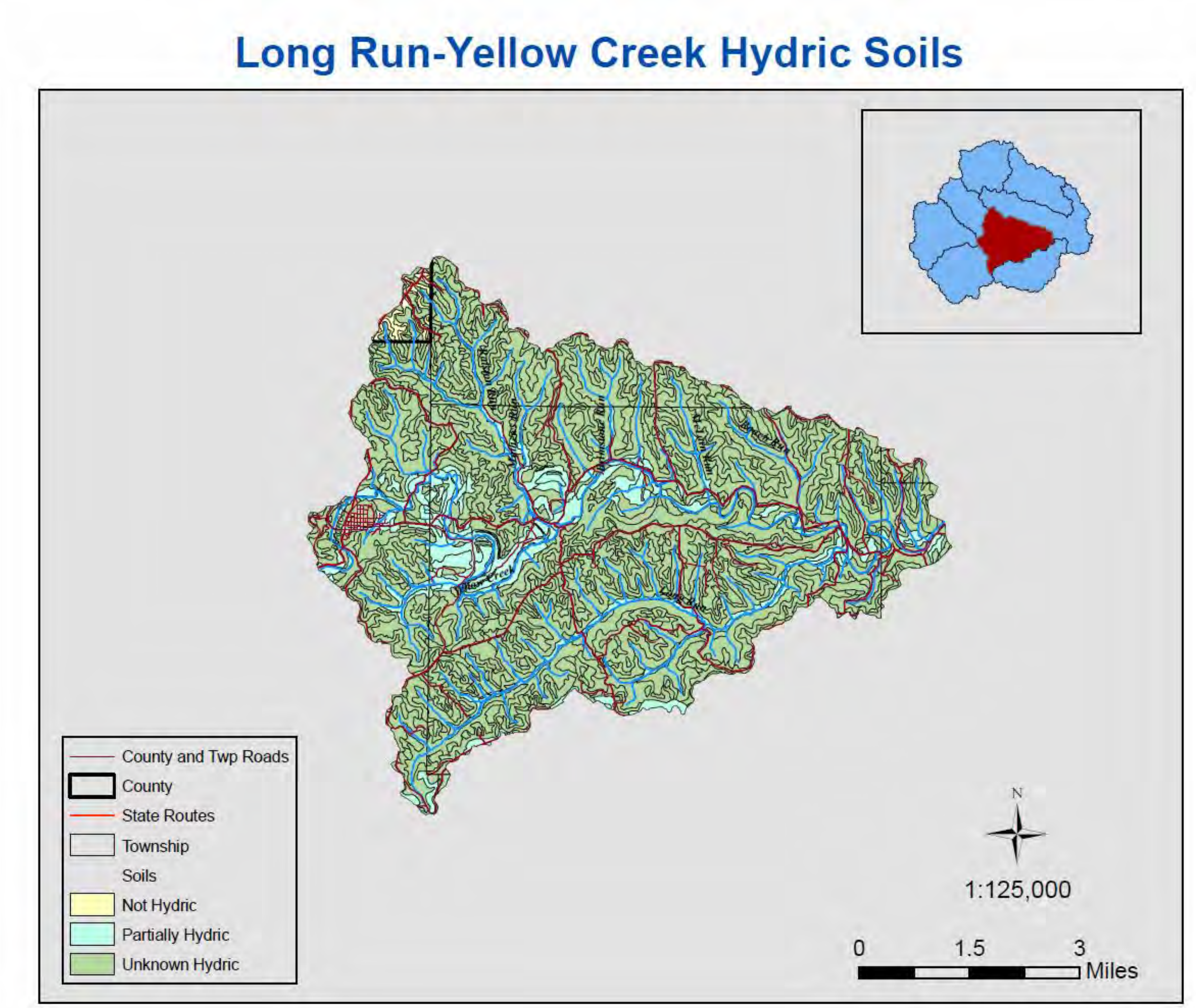

Fig. 86: Long Run-Yellow Creek Hydric Soils

Within the subwatershed, 41.2 acres are frequently flooded.

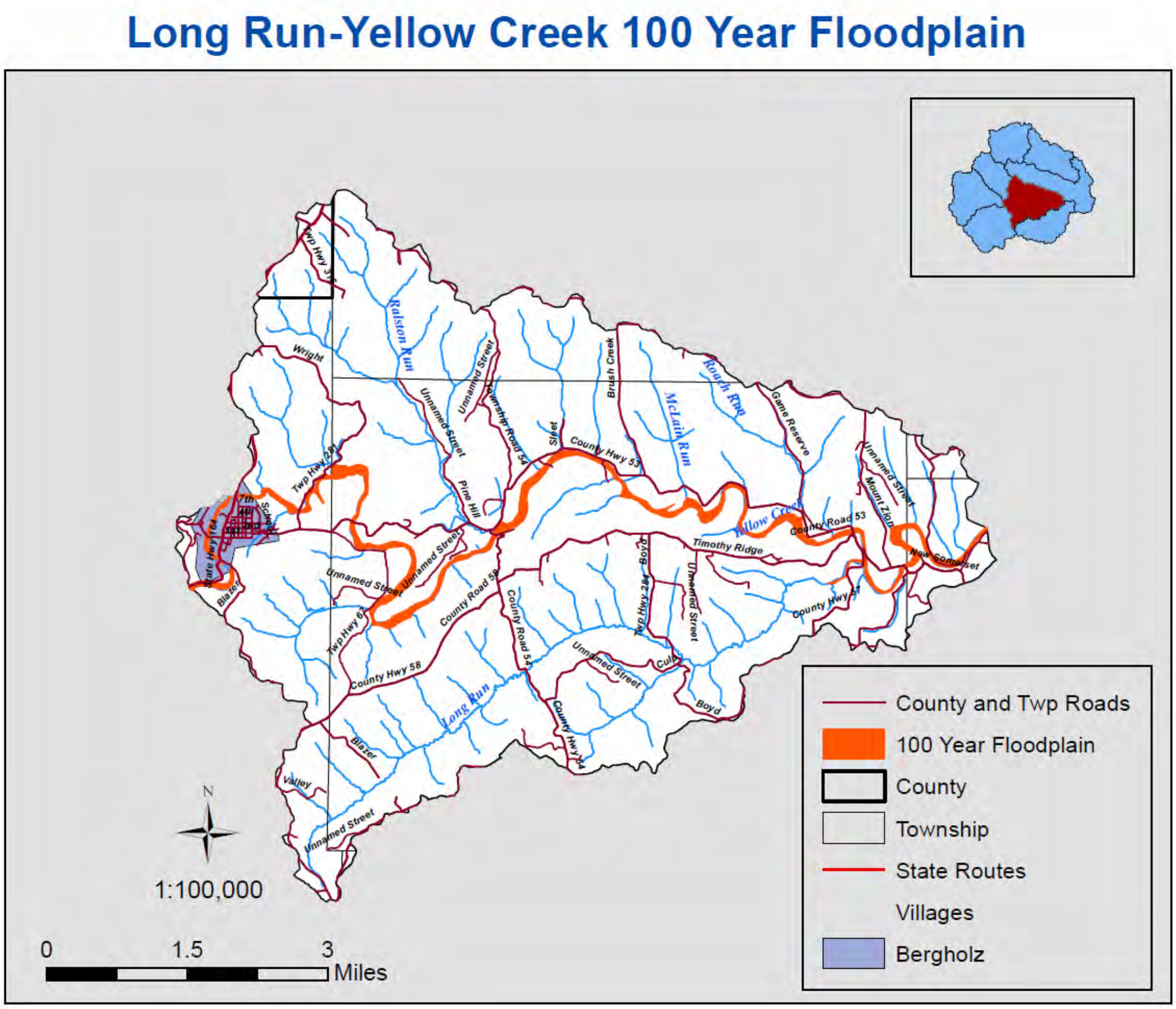

Fig. 87: Long Run-Yellow Creek Floodplain

Table 43. Long Run- Yellow Creek Riparian Tree Species

Black Cherry	Bitternut Hickory
Native Willow	Sumac
Black Walnut	Ailanthus
Shingle Oak	Willow
Red Elm	Silver Maple

Red Oak	Box Elder
Sugar Maple	Beech
Cottonwood	White Oak
Black Oak	Basswood
Black Gum	Buckeye
American Elm	Osage Orange
Eastern Hemlock	Black Locust
Yellow Poplar	Shagbark Hickory

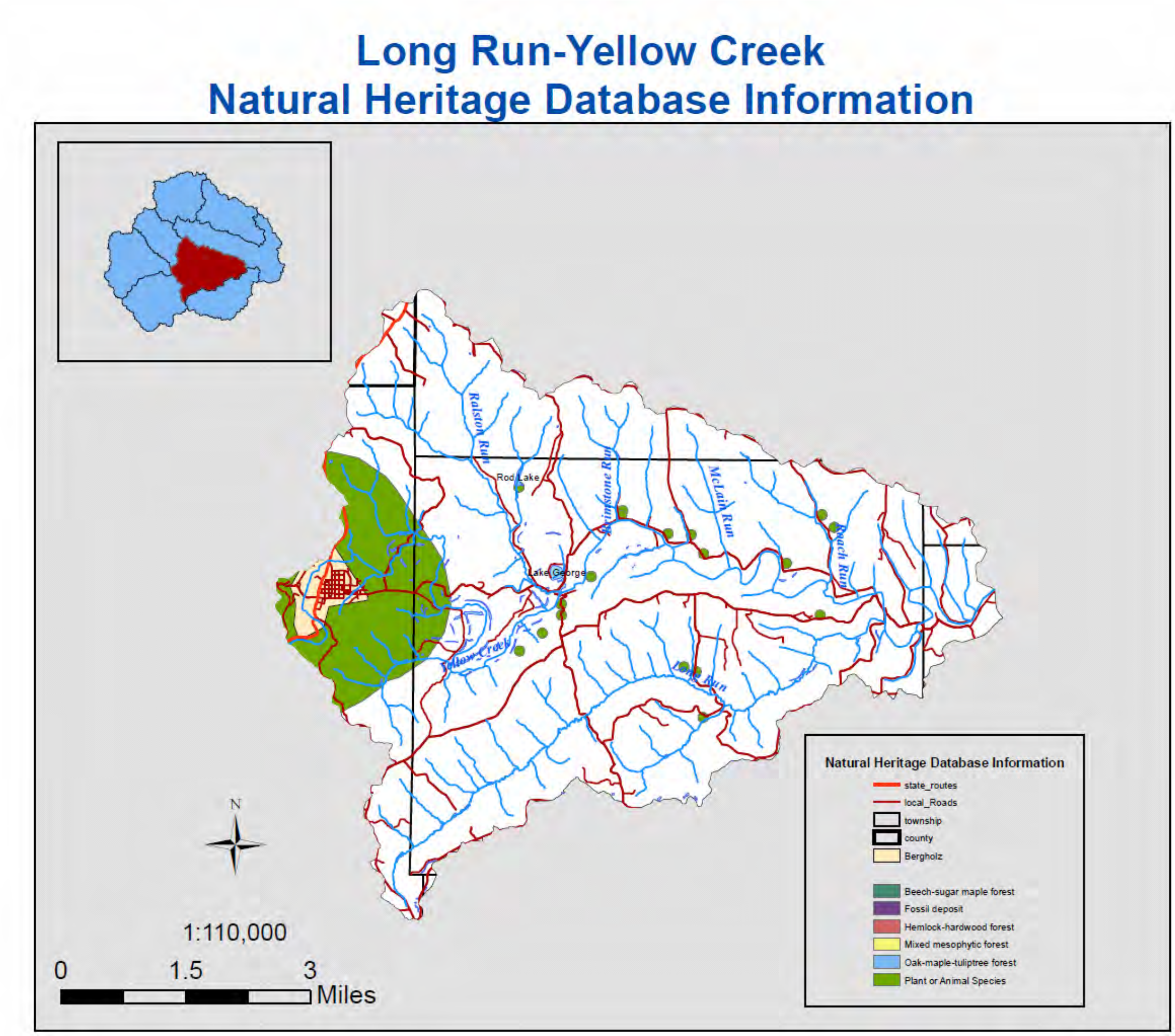

Fig. 88: Long Run-Yellow Creek NHD Information

Long Run-Yellow Creek Land Use

Trends in land use throughout the last fifteen years include a decline in land designated for agriculture and an increase in urban land use. The majority of the land use in this subwatershed is forested, followed by land in agricultural production then urbanized areas. In this subwatershed 1,066.5 acres are dedicated to conservation and recreation land in the form of the Brush Creek Wildlife Area that stretches into the subwatershed of Hollow Rock Run-Yellow Creek.

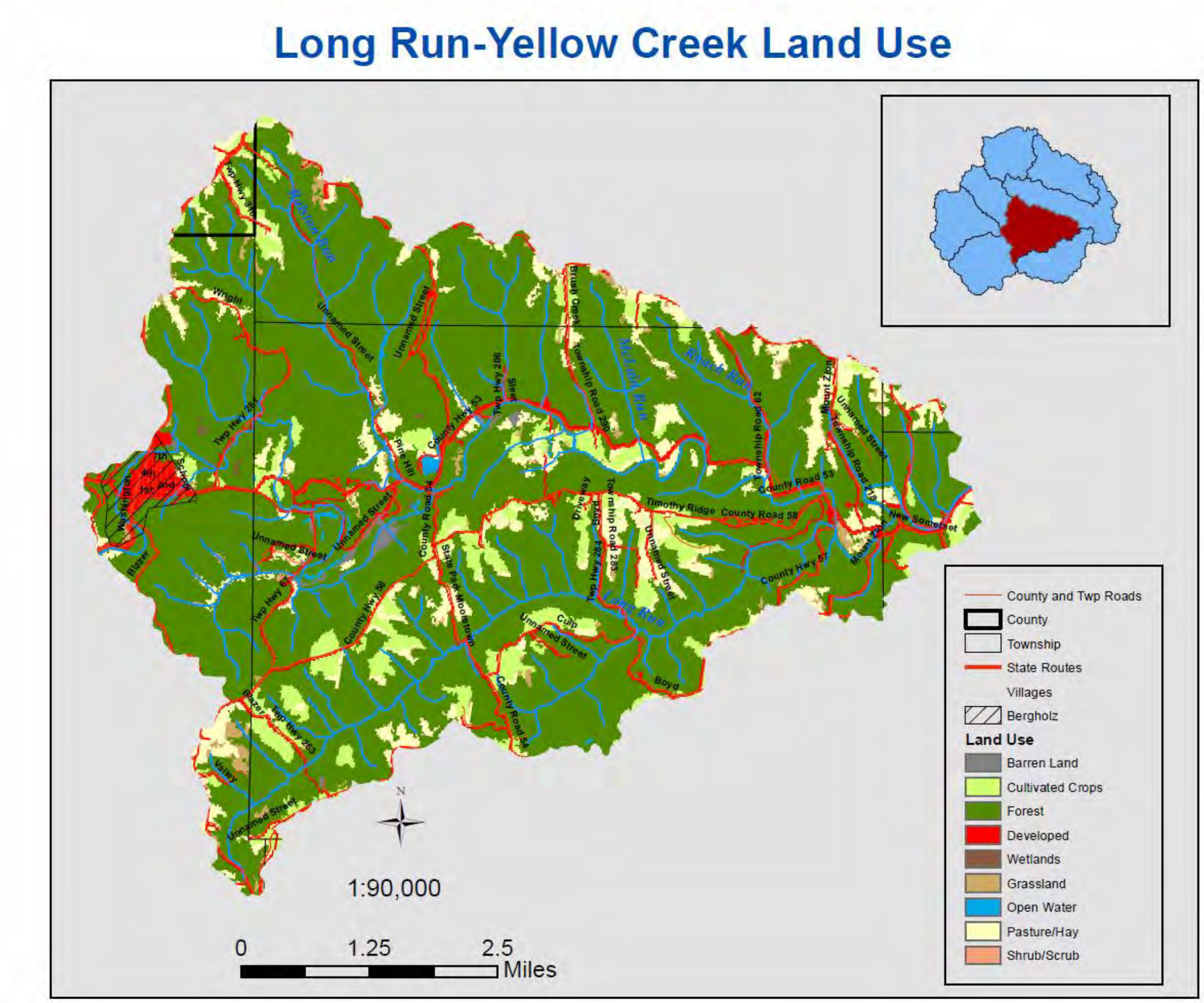

Fig. 89: Long Run-Yellow Creek Land Use

Table 44. Long Run-Yellow Creek Land Use (acres)

	2009	2001	1994
Agriculture	3,195.8	4,838.2	4,350.4
Water	69.7	446.4	192.6
Urban	1,239.1	152.6	31.6
Forest	17,414.0	16,468.6	17,090.6
Barren	0.0	0.0	2.6
Shrub/Scrub	0.0	0.0	238.8

Agricultural Characteristics

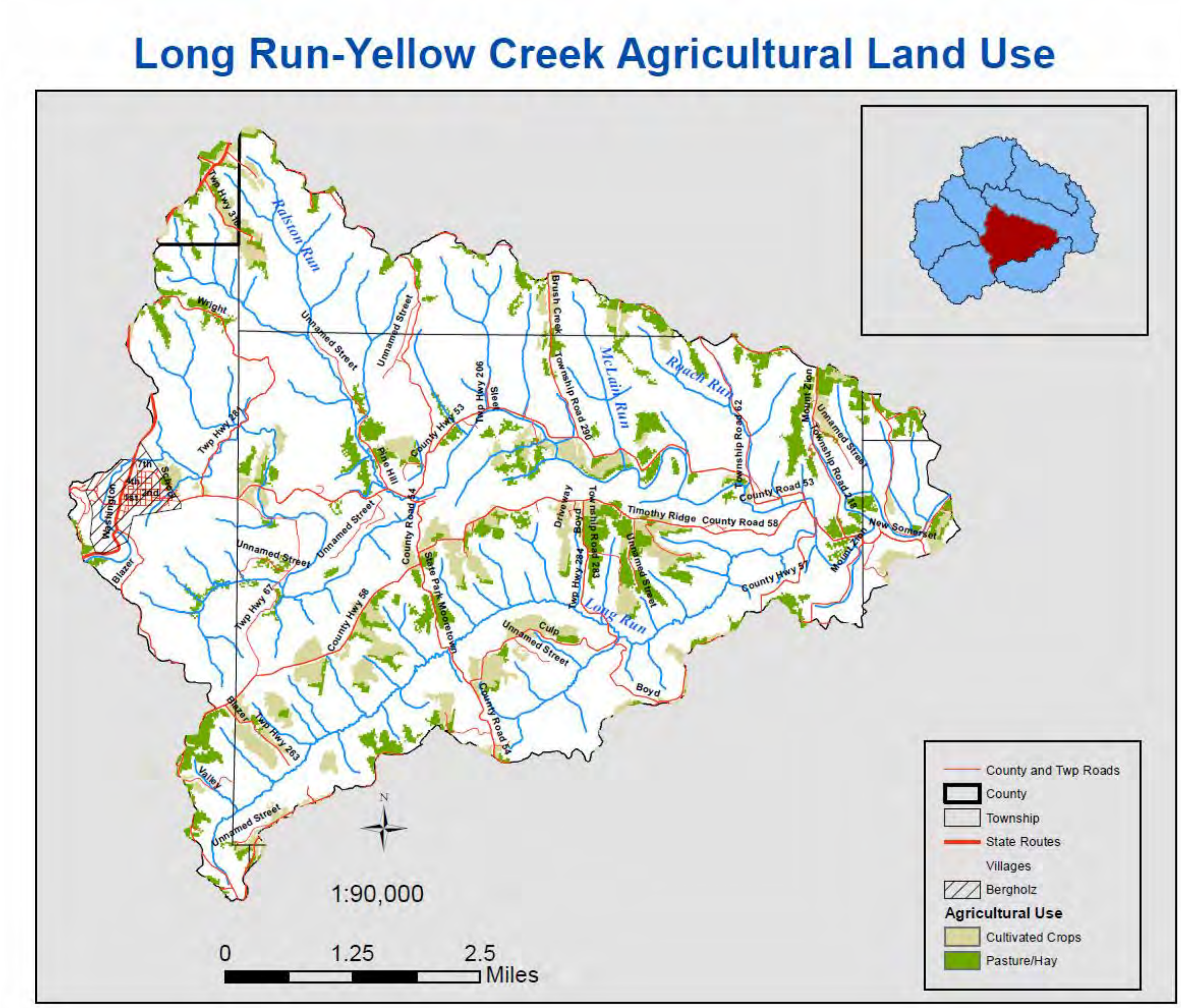

Fig. 90: Long Run-Yellow Creek Agricultural Land Use

The subwatershed of Long Run-Yellow Creek is located nearly completely within Jefferson County, toward the center of the watershed. Soils in this area are of three different associations: Gilpin-Steinsburg-Hazelton, Westmoreland-Hazelton-Berks and Gilpin-Lowell-Morristown.

As in the Town Fork subwatershed, along the length of where the Long Run and Town Fork watersheds meet, the land was heavily surface mined for coal. These surface mined soils present a number of limitations for growth of agricultural crops, including moderate to moderately low organic content and slow permeability. As a result, agricultural producers in this area of the sub-watershed have opted to use most surface mined upland areas as pasture or hay fields.

Again, despite declining row crop production in the watershed overall, there is still significant row crop production in the upland areas of this subwatershed near County Road 58. Situated in this area are a handful of small to medium sized dairy operations. These producers practice no till, contour farming, contour strip cropping, and crop rotation, as well as other conservation management practices to protect the health of the watershed.

The Long Run subwatershed is home to the main stem of Yellow Creek. There are a number of large, flat fields along the main stem used for agriculture, including crop, hay and livestock production. Livestock operations in this area are primarily beef grazing operations, with one or two intermittent sheep and goat producers. Nearly all livestock operators located on the main stem have installed fencing or other riparian buffers along the stream.

Agricultural production in the remainder of the Long Run subwatershed is primarily made up of beef grazing operations in upland areas. There are also intermittent small horse operations. Additionally, there are several small Amish communities in this subwatershed, as well, whose agricultural operations consist mainly of small numbers of livestock and horses.

Long Run-Yellow Creek Water Quality

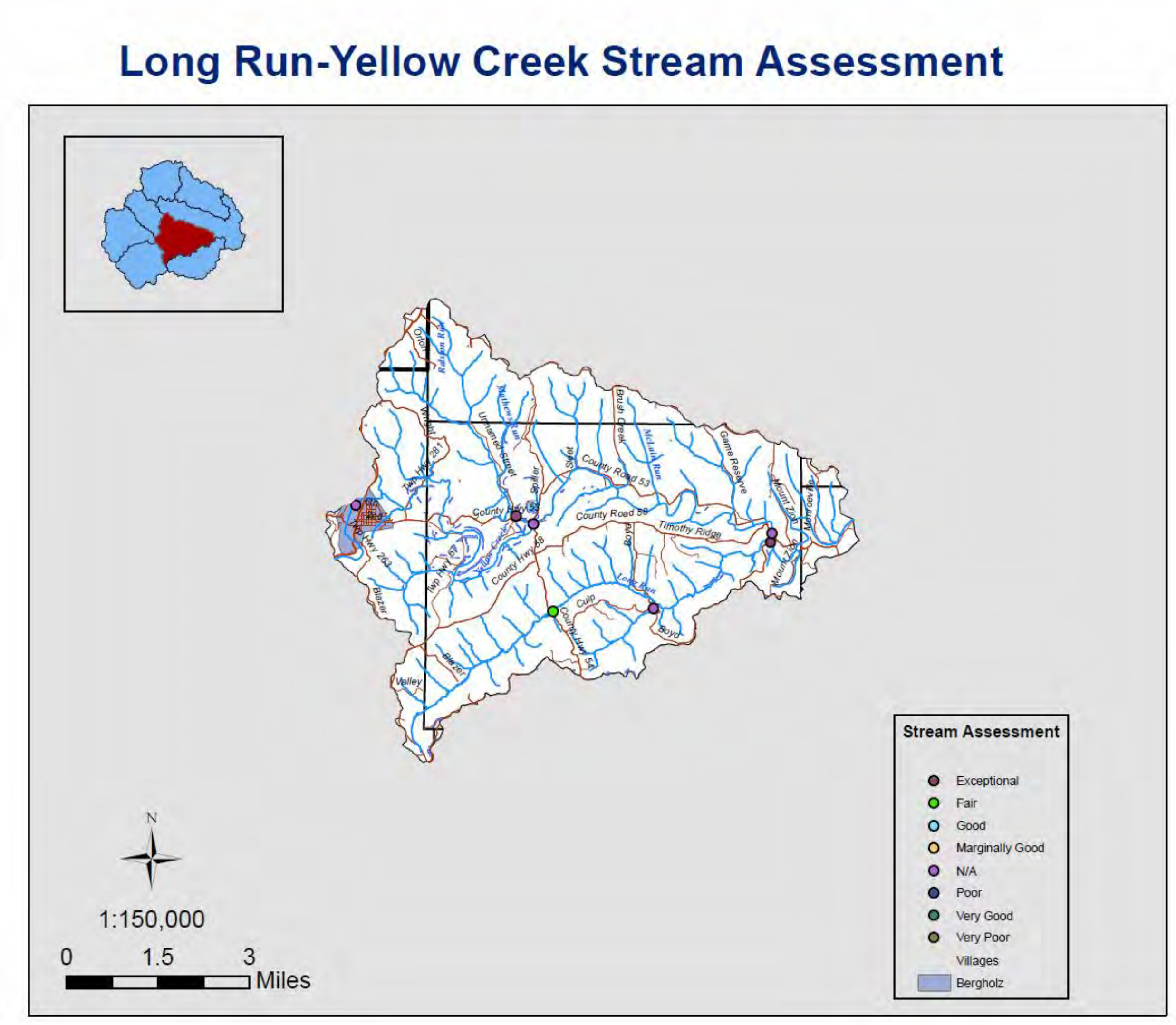

Fig. 91: Long Run-Yellow Creek Stream Assessment

Ground Water

The approximate number of water wells in the Long Run-Yellow Creek Subwatershed is 23, although it is very likely that there are more wells that were not recorded or submitted to the Ohio Division of Natural Resources. The fact that the number of groundwater wells in this subwatershed is also relatively low compared to other portions of the Yellow Creek Watershed can be attributed to the fact that county water lines supply the village of Bergholz with water. In the subwatershed 21,909.3 acres are highly sensitive to groundwater contamination.

Surface Water

There are 701.9 acres of wetland determined to be within the 100 year floodplain. The area in wetlands in the Long Run-Yellow Creek Subwatershed is 391.7 acres. Other surface water features include 111.1 acres of ponds and lakes and 95.0 acres in streams. There is one municipal discharge permit in this subwatershed and four dams listed.

Seven sites were sampled in 2005 during the total maximum daily load study performed on Yellow Creek. Of those seven sites only one failed to reach full attainment of its designated use, reaching only partial attainment. This site was located downstream of a wetland area created by beaver dams in the headwaters of Long Run. In the subwatershed 37.4 miles of stream were designated as warmwater habitat, and no stream segments were found to be coldwater habitat or exceptional warmwater habitat.

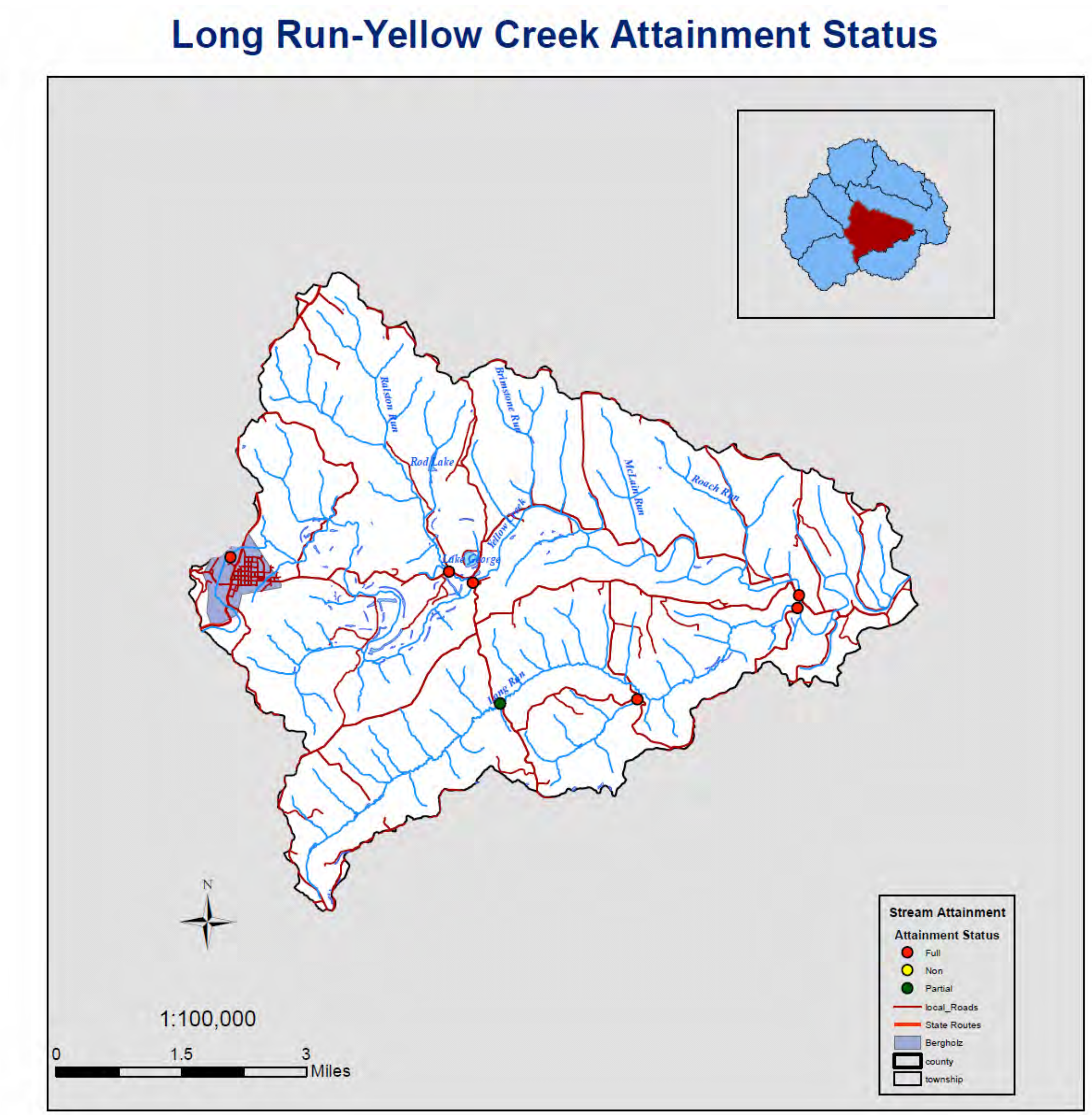

Fig. 92: Long Run-Yellow Creek Attainment Status

Table 45. Long Run- Yellow Creek Water Quality Results

Stream Name and River Mile	Attainment Status	IBI	ICI	MiWb	QHEI	Aquatic Life Use
Hildebrand Run	Full	48	NA	NA	66.5	WWH

Long Run 4.3	**Partial**	**42**	**Fair**	**NA**	**74.5**	**WWH**
Long Run 2.7	**Unknown**	**NA**	**Good**	**NA**	**NA**	**WWH**
Long Run 0.3/0.1	**Full**	**60**	**Exceptional**	**NA**	**92.5**	**WWH**
Matthews Run	**NA**	**NA**	**NA**	**NA**	**NA**	**WWH**
Ralston Run	**Full**	**50**	**Exceptional**	**NA**	**71.5**	**WWH**
Roach Run	**NA**	**NA**	**NA**	**NA**	**NA**	**WWH**
Yellow Creek	**NA**	**NA**	**NA**	**NA**	**NA**	**WWH**
Unnamed Tributary (Yellow Creek RM 12.0)	**NA**	**NA**	**NA**	**NA**	**NA**	**LRW**

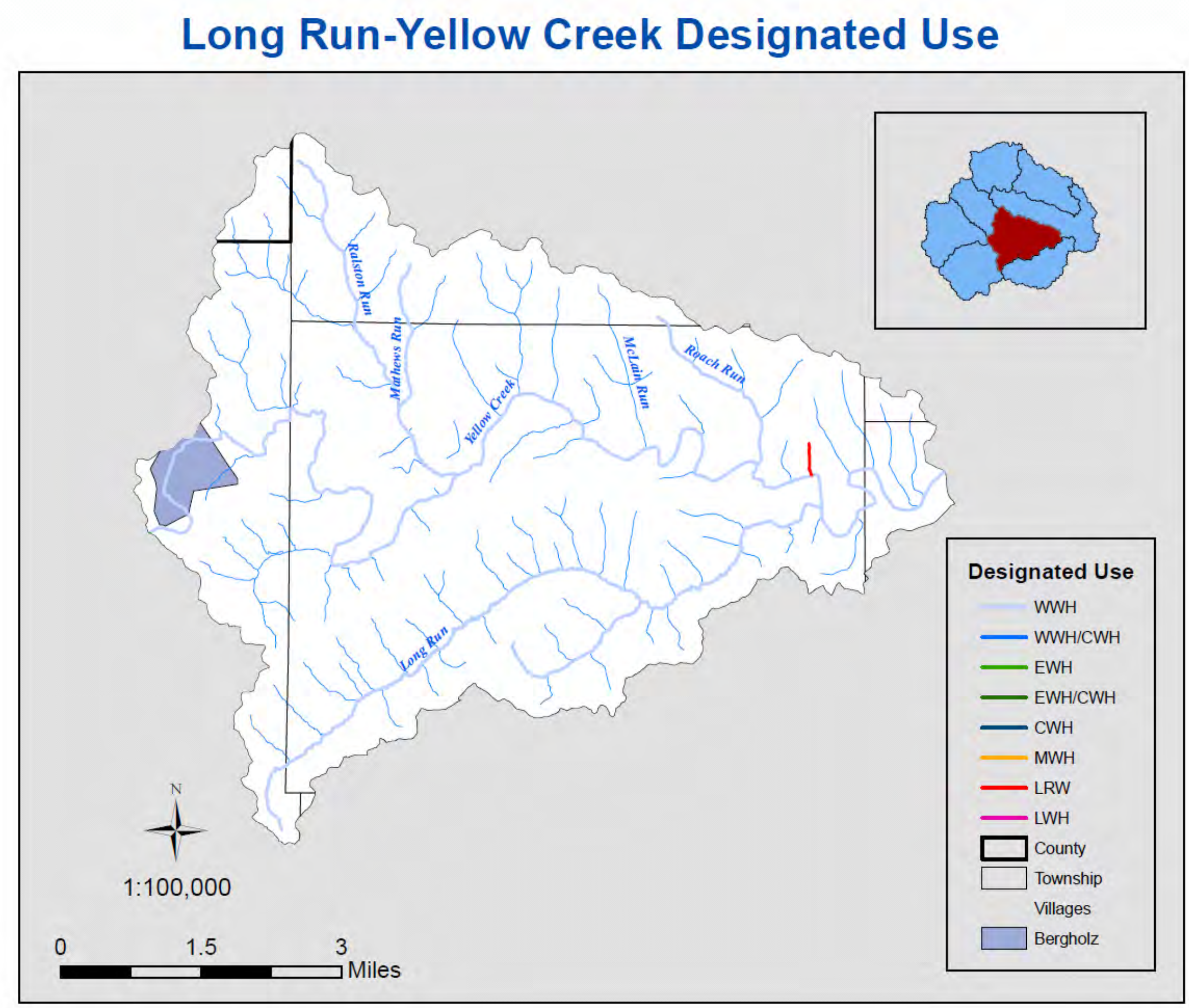

Fig. 93: Long Run-Yellow Creek Designated Use

Problem Statement 1: (Sedimentation/Nutrients)

As confirmed by the 2009 TMDL, Long Run-Yellow Creek subwatershed is impaired by elevated levels of nutrients and sedimentation related to livestock operations that have access to the stream. The livestock operations are concentrated on Long Run and Ralston Run.

Goal 1.1: Reduce sedimentation and nutrient loading in the Long Run-Yellow Creek subwatershed by protecting .93 miles of stream

Objective: Install 9,820 feet of livestock exclusion fencing and necessary auxiliary practices along Long Run and Ralston Run.

Pollutant	Goal	Task Description	Resources	How	Time Frame	Performance Indicator
Sedimentation, Nutrients	1.1	Target cattle operations along Long Run and Ralston Run, and Hildebrand Run where livestock have access to the stream. Work with landowners to install 9,820 feet of exclusion fencing along .93 miles of stream	$21,211.00 9,820ft* $2.16/foot= $21,211.00	Ohio Division of Wildlife, US Fish and Wildlife, US Forest Service, USDA	Jan. 2013-Jan. 2015	Document miles of streambank fencing installed along with acreage of riparian area protected. Improved QHEI scores.

Problem statement 2: (Acidity)

Acid Mine drainage entering Roach Run is concentrated during drier periods and persists further downstream than during wetter periods. The highest metal loading of all acid mine drainage sampled in the Yellow Creek watershed was recorded at the deep mine source at Roach Run. Roach Run increased the acidity 20% and decreased the alkalinity 0% in Yellow Creek.

Goal 2.1: Further characterize AMD at Roach Run deep mine source

Objective 1: Collection and analysis of chemical and biological data associated with Roach Run deep mine source

Goal 2.2: Reduce metal loading to Roach Run.

Objective 1: Design and install treatment system to reduce metal loading to meet water quality standards

Pollutant	Goal	Task Description	Resources	How	Time Frame	Performance Indicator
Acidity	2.1	Monitor chemical water quality associated with Roach Run deep mine source to further characterize AMD	JSWCD staff will collect data and submit to DMRM	AMD set-aside funding for sample analysis.	2015-2016	Water quality data entered into online database and submitted to DMRM
	2.2	Alternative 1: Channel relocation and installation of step-pool limestone channel Alternative2: Slag bed to boost alkalinity in tributary for in-stream treatment of AMD in Roach Run	DMRM engineering and design staff	AML Set-aside/ mitigation funding sought by Jefferson Soil and Water Conservation District	2017-2020	Reduction of acidity by 16.2 tons per year

Problem statement 3: (Acidity)

Acid Mine drainage entering Yellow Creek, County Rd 53 Source

Goal 3.1: Further characterize AMD entering the mainstem of Yellow Creek from a deep mine source along County Road 53

Objective: Collection of chemical and biological samples associated with County Road 53 deep mine source

Goal 3.2: Reduce acidity entering the mainstem of Yellow Creek from County Road 53 deep mine source

Objective: Design and install treatment system to reduce acidity entering the mainstem of Yellow Creek

Pollutant	Goal	Task Description	Resources	How	Time Frame	Performance Indicator
Acidity	3.1	Monitor chemical water quality associated with Roach Run deep mine source to further characterize AMD	JSWCD staff will collect data and submit to DMRM	AMD set-aside funding for sample analysis.	2015-2016	Water quality data entered into online database and submitted to DMRM
	3.2	Alternative 1: Limestone leach bed, limestone discharge channel Alternative 2: Open limestone diversion channel	DMRM engineering and design staff	AML Set-aside/ mitigation funding sought by Jefferson Soil and Water Conservation District	2017-2020	Reduction in acidity by 153 tons per year

Problem Statement 4: (Bacteria)

Bergholz and homes clustered outside of Bergholz total 317 homes that need improved waste treatment.

Goal 4.1: Reduce Fecal Coliform loadings to meet recreational bacteria water standards by eliminating 29,026 gallons/day of effluent.

Objective: Repair/replace 157 failing septic systems to reduce fecal coliform loading by 30.0%

Objective: Partner with Village of Bergholz to seek funding for construction of a wastewater treatment plant to assist in the reduction of Fecal Coliform loading in the Long Run-Yellow Creek subwatershed.

Pollutant	Goal	Task Description	Resources	How	Time Frame	Performance Indicator
Pathogens/bacteria	4.1	Work with Village of Bergholz and Village of Amsterdam sewage treatment plant planning committee and RCAP to seek funding for planning. Seek financial assistance for installation of sewage treatment plant	Amsterdam will partner with RCAP to complete application and seek an engineering firm for feasibility study and planning. Bergholz will be included in feasibility study.	$120,000 in planning grant awarded to village.	2011-2015	Completed plan for sewage treatment plant Installation of sewage treatment plant.

Problem Statement 5: (Habitat)

The Subwatershed of Long Run-Yellow Creek lacks riparian species in headwater areas. This leads to increased sedimentation, stream temperatures and habitat alteration in the form of streambank erosion.

Goal 5.1: 3.66 river miles of improved riparian cover

Objectives: 22.18 acres of riparian planting (25 foot buffer)

Pollutant	Goal	Task Description	Resources	How	Time Frame	Performance Indicator
Sedimentation, increased stream temperatures, habitat alteration	5.1	Establish riparian protection and plantings that will enhance approximately 22.18 acres of riparian area with 25 foot buffer.	$16,457.00 22.18 Acres* $741.98 (established hardwood trees/shrubs w/ weed control)= $16.457.00	Ohio Division of Forestry, Western Reserve, Jefferson and Carroll Soil and Water Conservation Districts	2012-2016	3.66 river miles with improved riparian cover

Problem Statements 6: (Bacteria)

As confirmed by the 2009 OEPA TMDL report, stream segments in the Long Run-Yellow Creek subwatershed are not meeting attainment status due to failing home sewage treatment systems.

Goals 6.1: Reduce Fecal Coliform loadings to meet recreational bacteria water standards by eliminating 29,026 gallons/day of effluent.

Objective: Repair/replace 157 failing septic systems

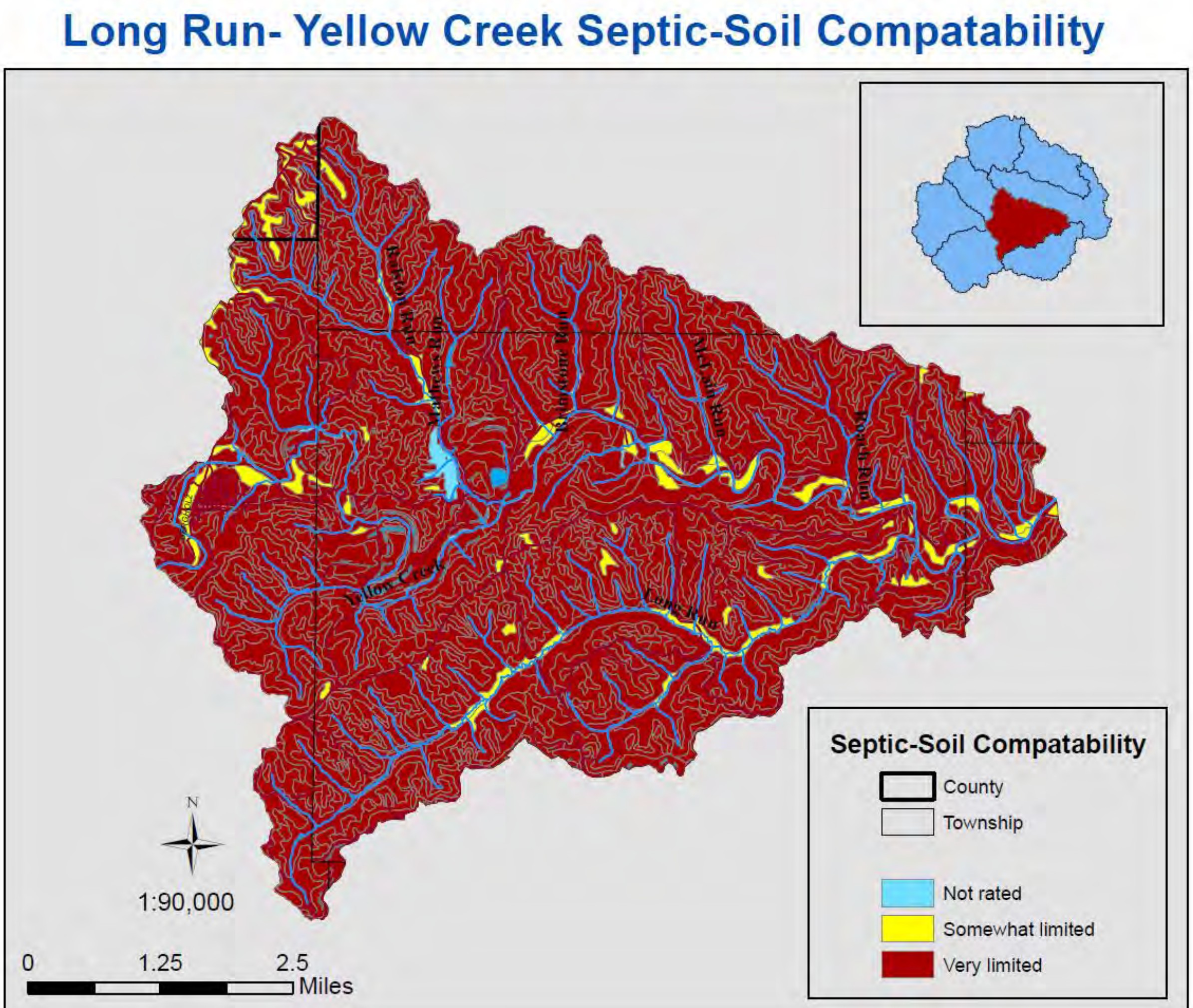

Fig. 94: Long Run-Yellow Creek Septic-Soil Compatibility

Pollutant	Goal	Task Description	Resources	How	Time Frame	Performance Indicator
Bacteria	6.1	1. Partner with health departments, particularly in Jefferson County, to complete an HSTS inventory	Funding for flyover and use of infrared to identify failing systems.	Seek funding for flyover and infrared survey of failing HSTS. The Jefferson County General Health District has committed to creating a GIS	2012-2013	GIS layer of failing HSTS created. Prioritized list of systems.

		which identifies failing systems in the watershed, along with the cause of failure.		layer of failing HSTS upon investigation of complaints, as well as any studies done.		
		Replace or upgrade identified HSTS systems reducing the amount of fecal coliform and e. coli present in Long Run-Yellow Creek subwatershed	Repair or Replace approximately 157 systems through principal forgiveness loans (DEFA), costshare programs (water quality credit trading), grants and homeowner contribution. 157 systems * \$7,000.00 = \$1,099,000.00	Repair or Replace approximately # systems through principal forgiveness loans (DEFA),costshare programs (water quality credit trading), grants and homeowner contribution. The watershed coordinator and/or the county health departments may seek funding through principal forgiveness loans through DEFA.	2011-2021	Upgraded systems will reduce the amount of e. coli and fecal coliform discharging into stream. Amounts reduced will be calculated using the BATHTUB model.

Emergency Protection: Debee Property, streambank erosion.

Fig. 95: Streambank erosion on the mainstem of Yellow Creek (Corder)

Due to streambank erosion and the absence of suitable vegetation in the riparian area, the mainstem of Yellow Creek is nearing County Road 53 near river mile 12.5 and is approximately 105 feet away from causing damage to County Road 53. Mr. Debee, the absentee landowner of the surrounding crop fields, is willing to partner in programming to address the issue, and has unsuccessfully applied for floodplain programming through NRCS in 2008. Funding will continue to be sought by the Jefferson Soil and Water Conservation District office to remedy this site.

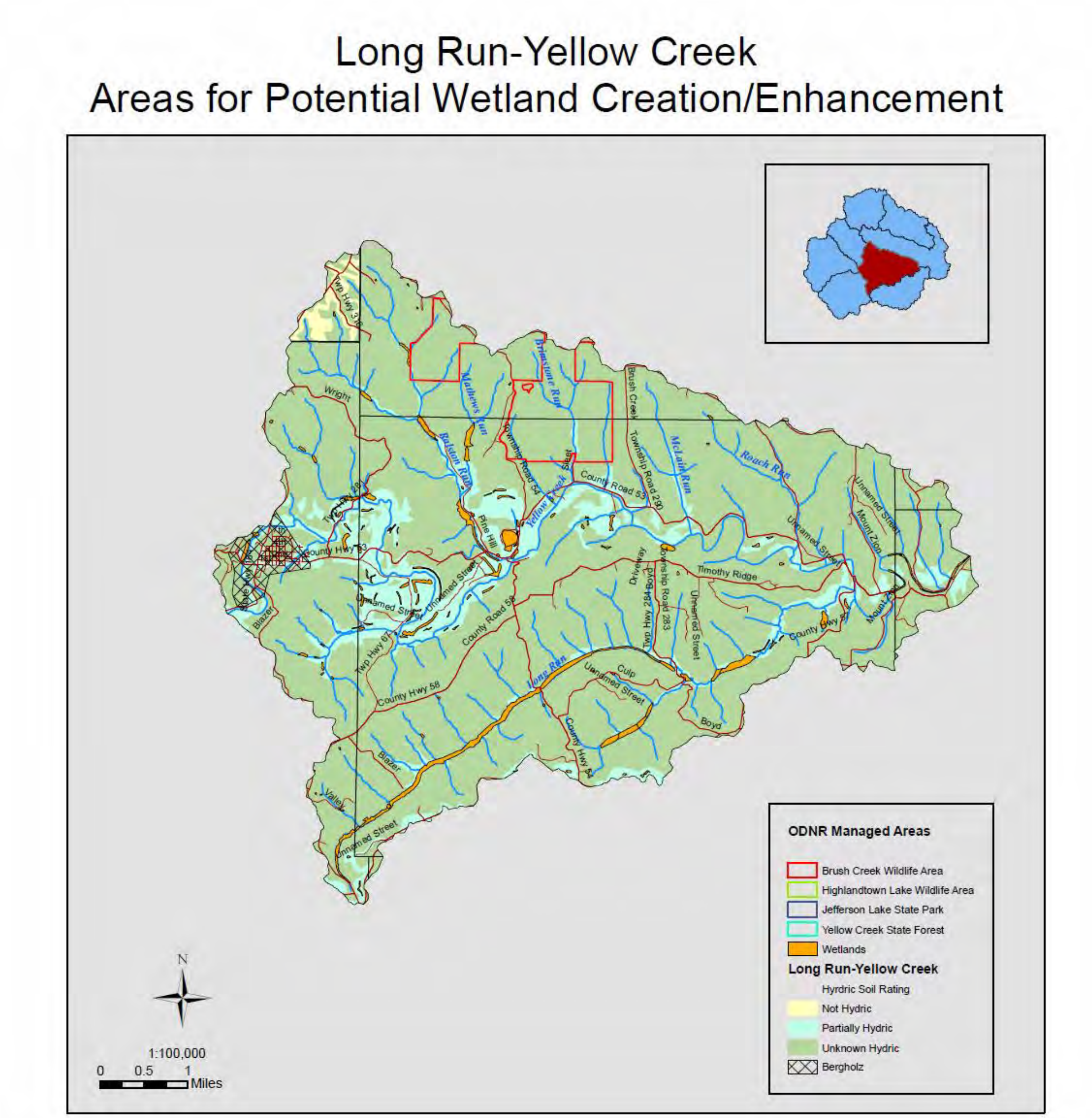

Fig. 96: Wetlands Creation/Enhancement Potential

Chapter VI. Town Fork Subwatershed

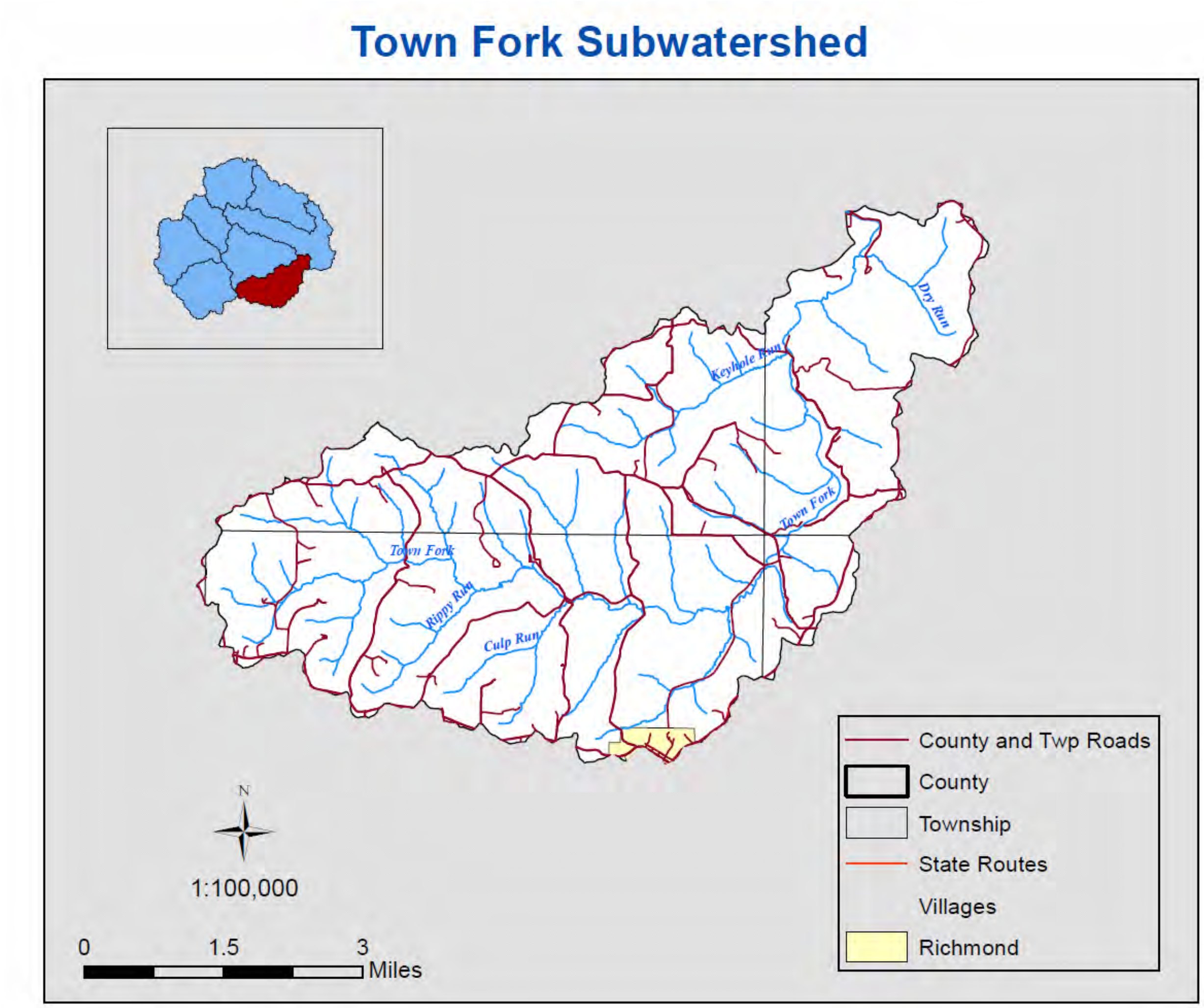

Fig. 97: Town Fork

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16,618 acres

The subwatershed of Town Fork lies on the southeastern edge of the Yellow Creek watershed. Major tributaries to Yellow Creek in this subwatershed include Culp Run, Dry Run, Rippy Run and Town Fork. Of the four sites sampled within the Town Fork subwatershed three of them were in full attainment while one only reached partial attainment of its designated use status. There were no stream segments designated as superior high quality waters. Jefferson Lake State Park and the privately owned Austin Lake are located within this subwatershed.

Fig. 98: Town Fork immediately downstream of the Jefferson Lake dam (Corder)

Municipalities

The village of Richmond occupies 141.0 acres within Town Fork Subwatershed.

Geology

The bedrock of the Town Fork Subwatershed consists mainly of shale and siltstone. The area having probable Karst features amounts to 16,635.1 acres.

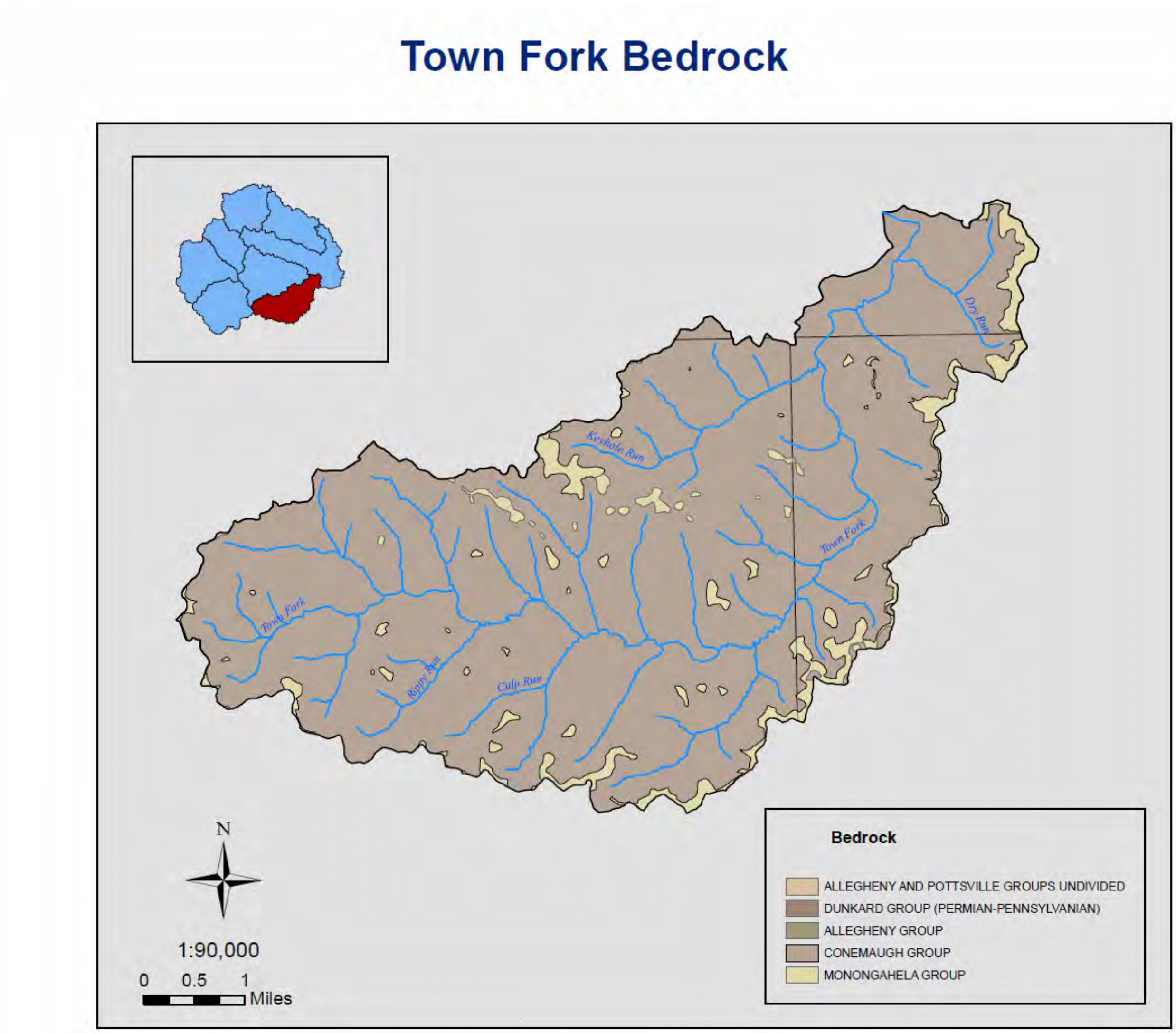

Fig. 99: Town Fork Bedrock

Population

Census results from 1980 through 2000 show an increase in population between 1980 and 1990, and a decrease between 1990 and 2000.

1980: 1,973

1990: 2,390

2000: 2,178

The average household size is 2.5, and the average household income is $38,727.00

Soil Resources

The majority of soils in the Town Fork Subwatershed rank well for drainage. Within Town Fork 9,360.2 acres are considered prime farmland and 16,254.2 acres are considered highly erodible land.

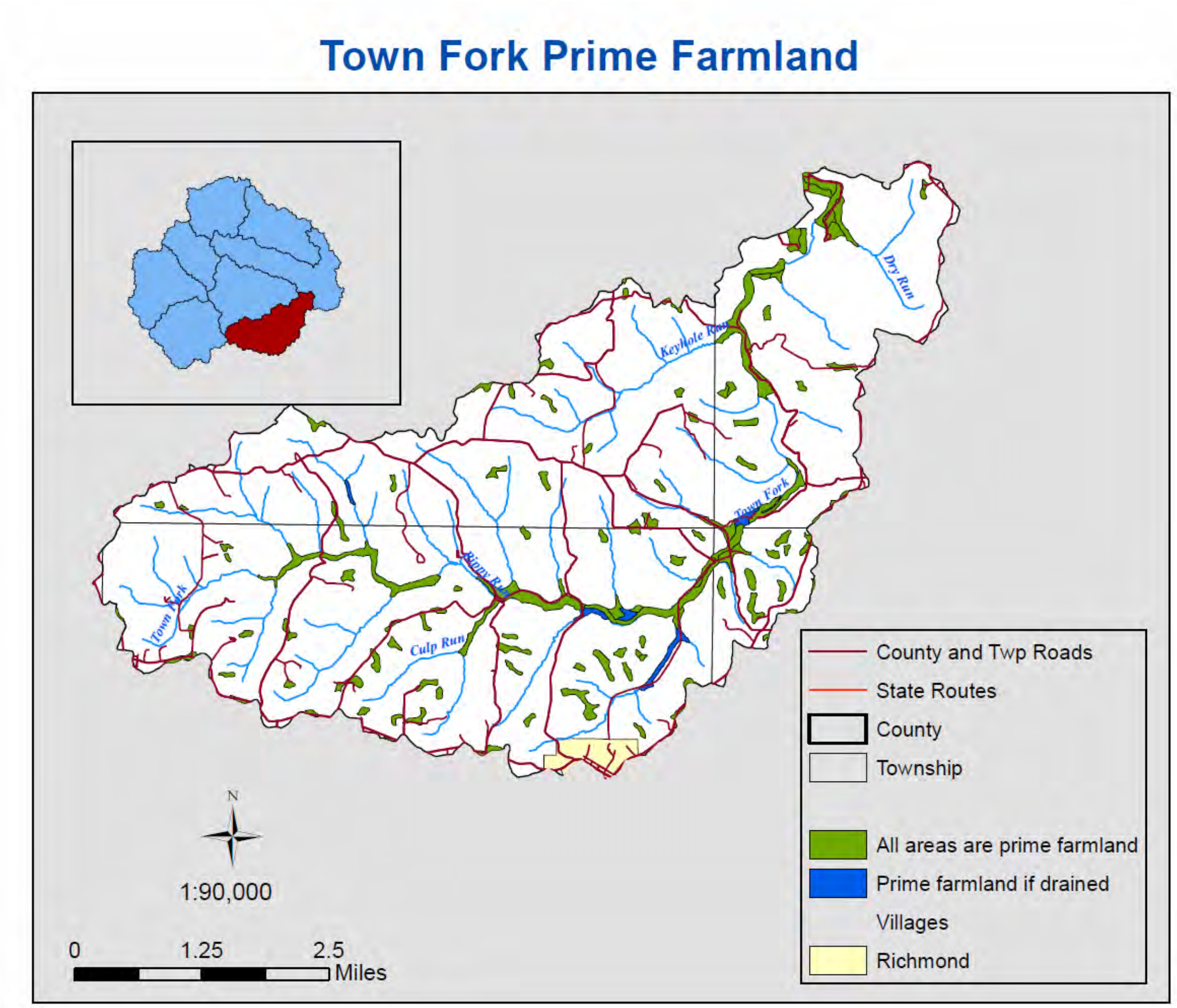

Fig. 100: Town Fork Prime Farmland

While there are no hydric soils, 2,938.2 acres are partially hydric.

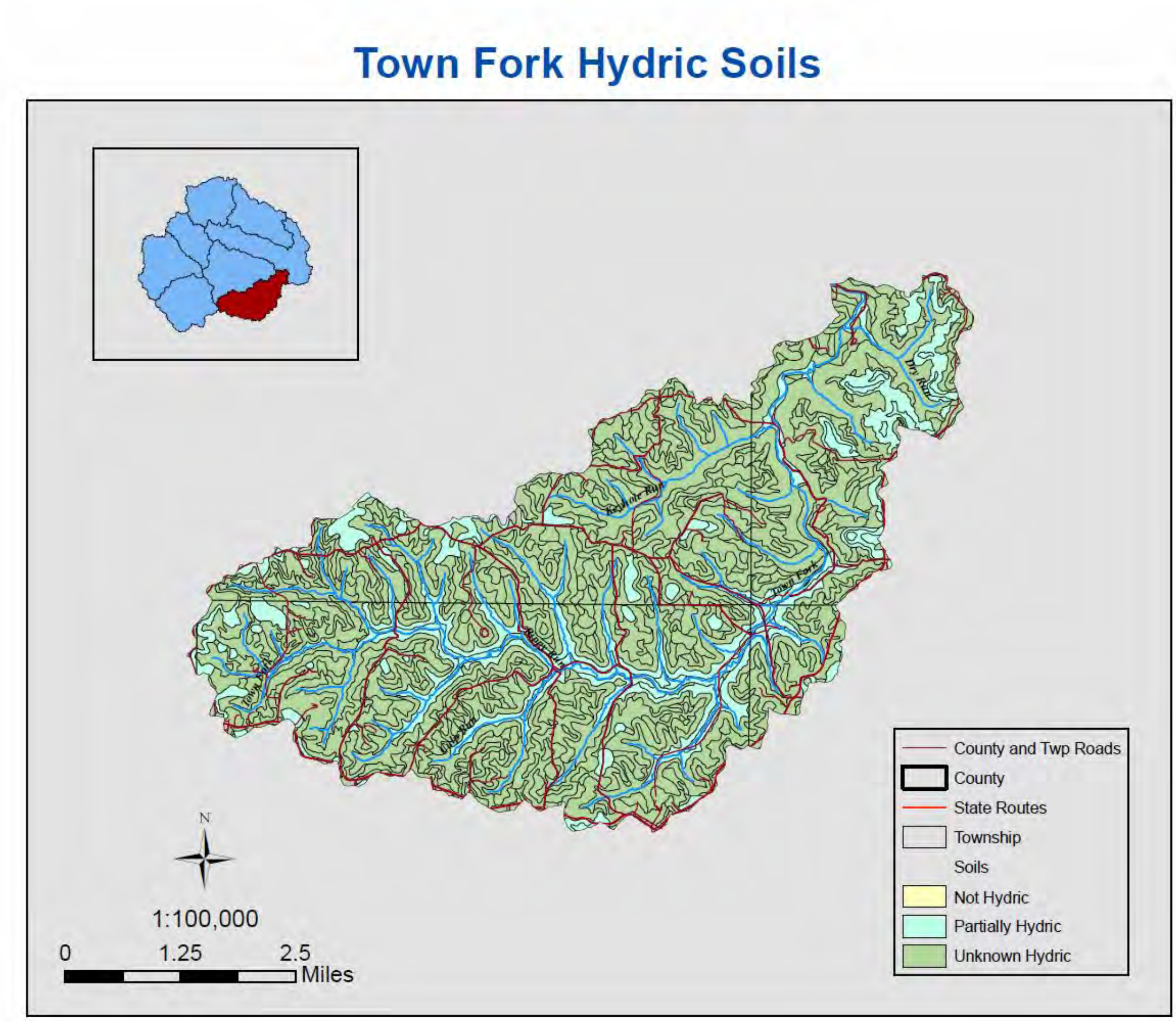

Fig. 101: Town Fork Hydric Soils

Within the subwatershed 30.6 acres are frequently flooded.

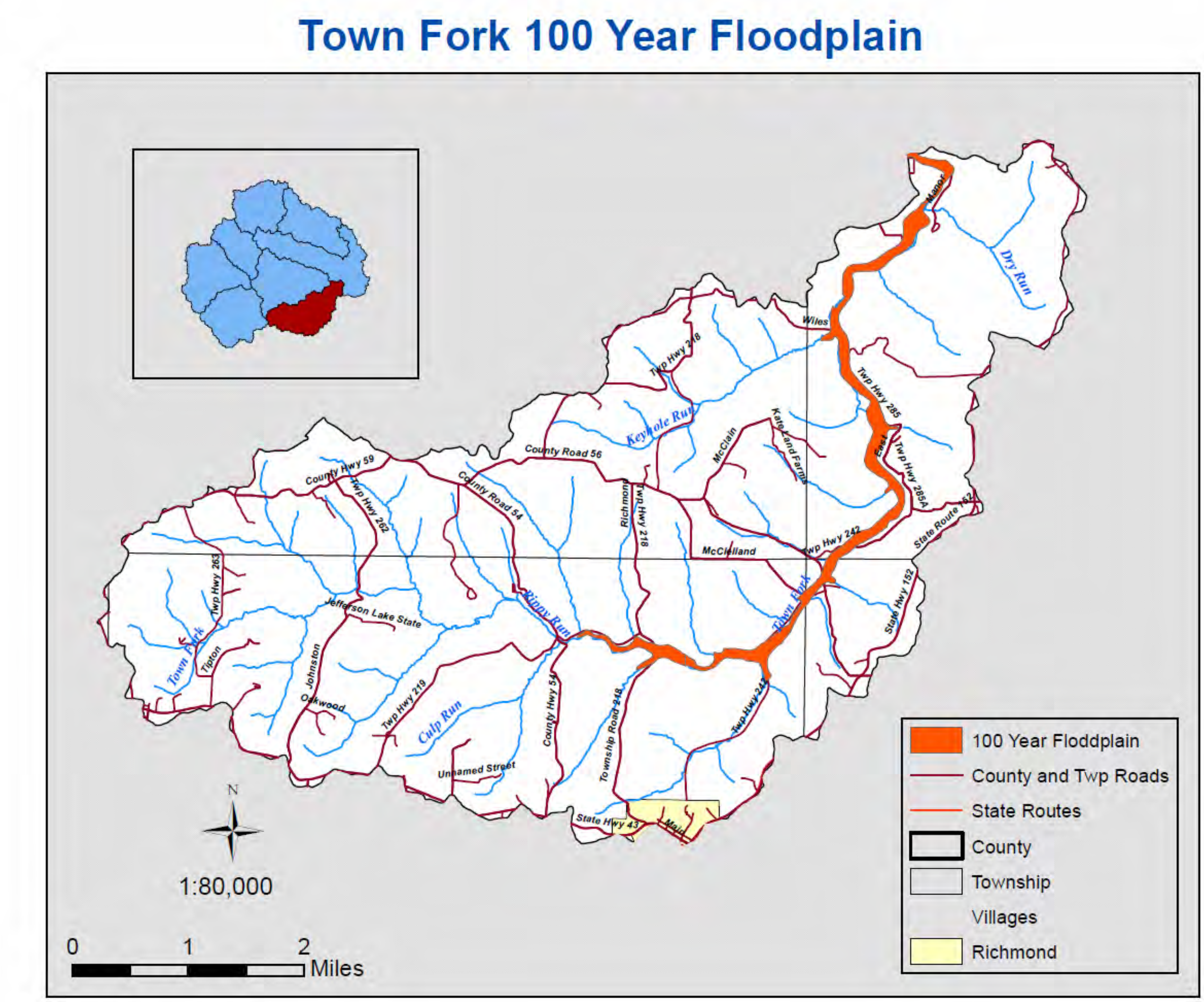

Fig. 102: Town Fork 100 Year Floodplain

Table 46. Town Fork Riparian Tree Species

Black Cherry	Sycamore
Silver Maple	Locust
Buckeye	White Oak
Ash	Ailanthus
American Elm	Native Willow

Red Maple	Yellow Poplar
Sumac	Sugar Maple

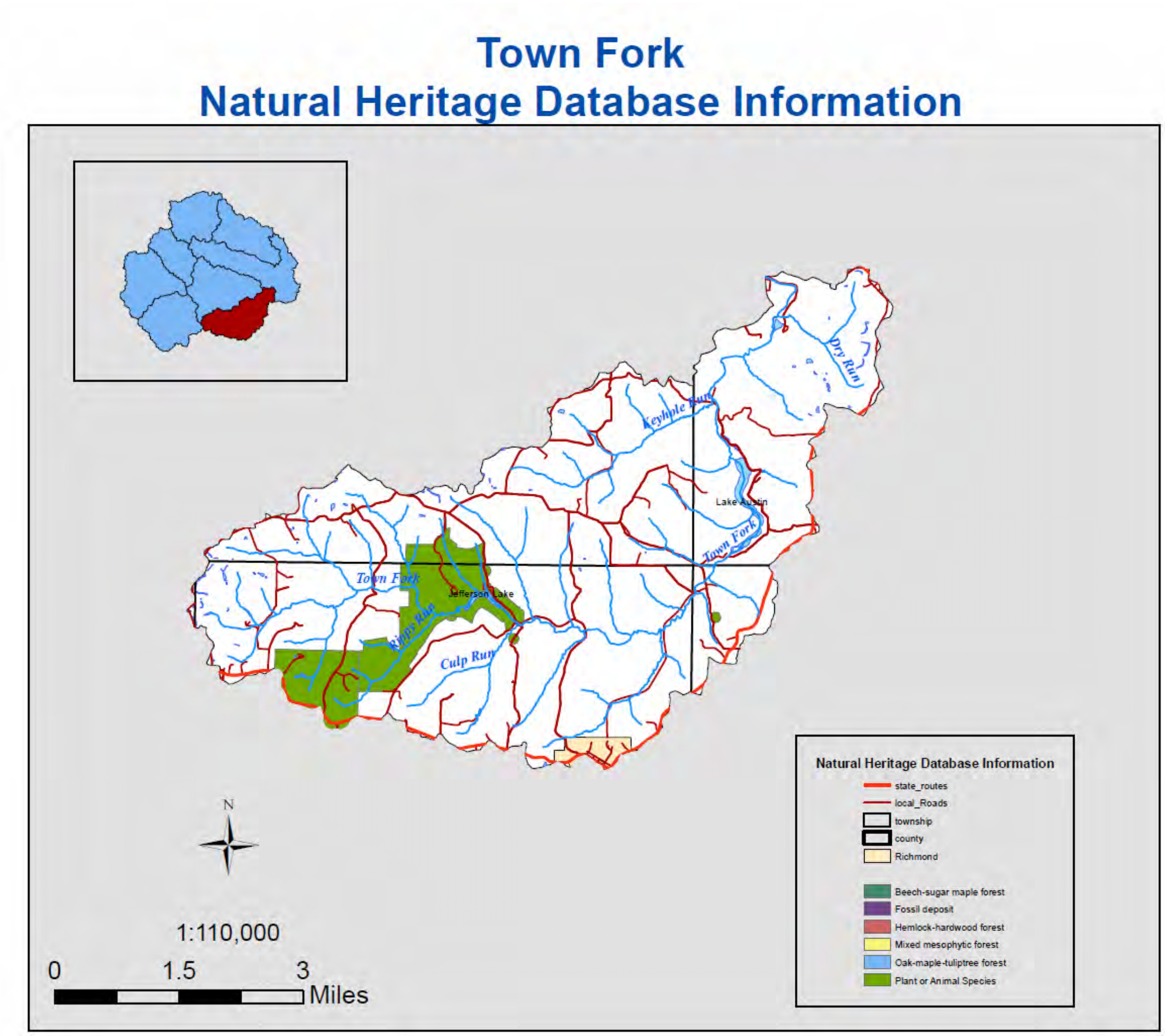

Fig. 103: Town Fork NHD Information

Town Fork Land Use

Trends in land use throughout the last fifteen years include a decline in land designated for agriculture and an increase in urban land use. The majority of the land use in this subwatershed is forested, followed by land in agricultural production then urbanized areas. From the watershed

970.2 acres are dedicated to conservation and recreation land in the form of Jefferson Lake State Park.

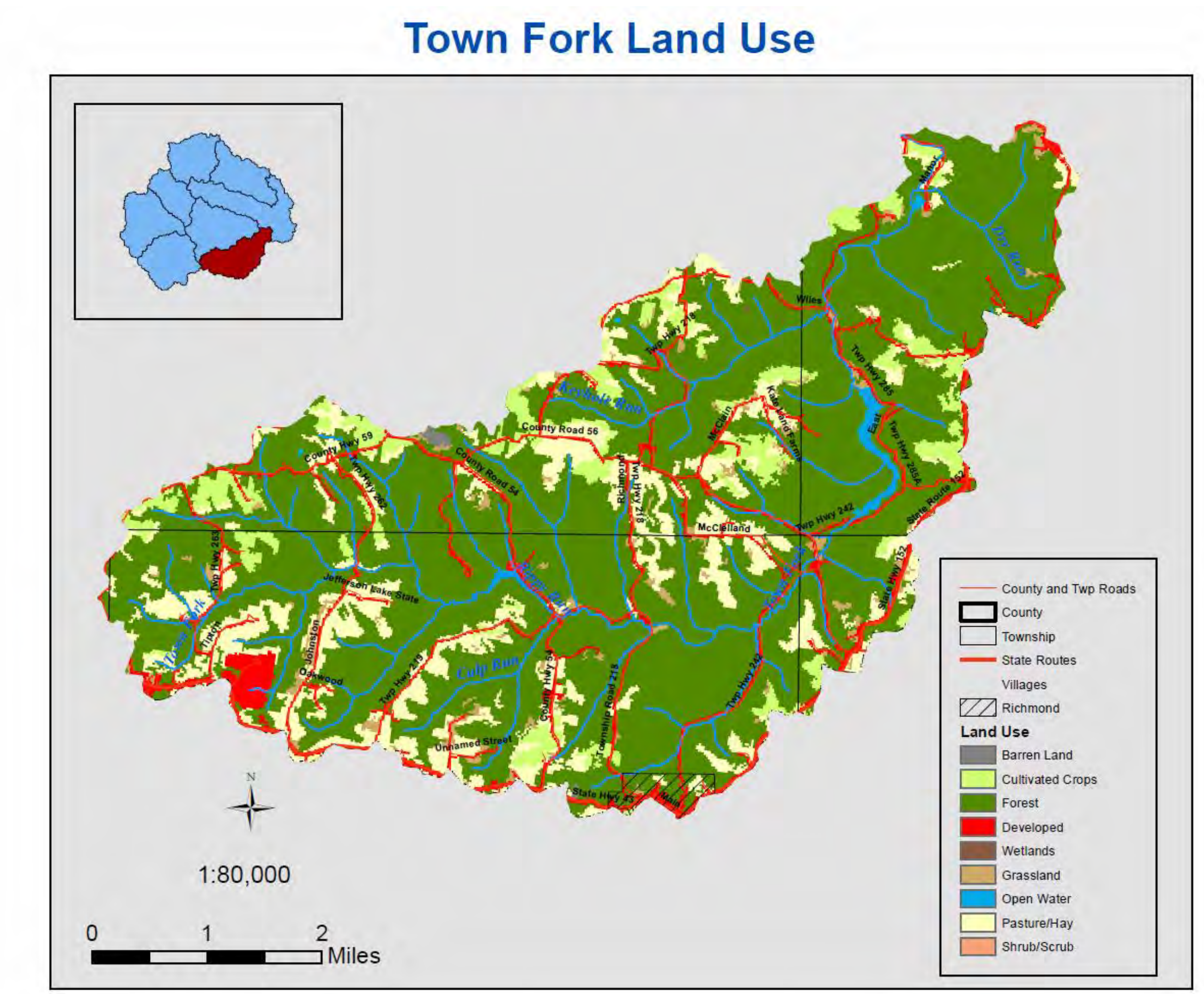

Fig. 104: Town Fork Land Use

Table 47. Town Fork Land Use (acres)

	2009	2001	1994
Agriculture	3,165.5	4,704.8	4,227.7
Water	94.5	263.6	128.7

Urban	1,096.5	136.3	12.7
Forest	12,272.4	11,533.4	12,061.5
Barren	0.0	0.0	4.5
Shrub/Scrub	0.0	0.0	201.8

Agricultural Characteristics

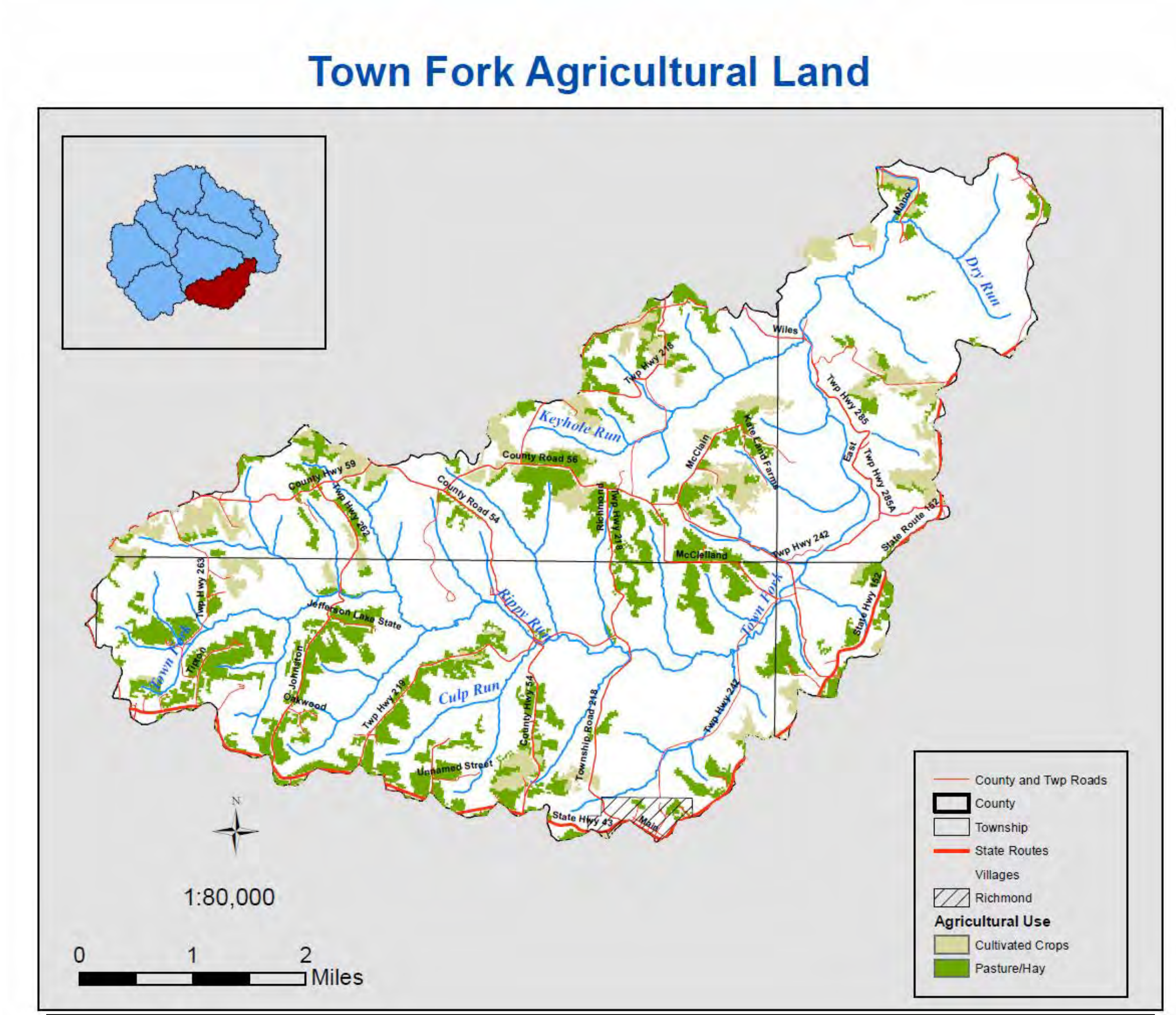

Fig. 105: Town Fork Agricultural Land

Town Fork

The subwatershed of Town Fork is located entirely within Jefferson County, at the southeastern edge of the watershed. Soils in this area are primarily of the Gilpin-Lowell-Morristown association.

In this subwatershed, along the length of where the Long Run and Town Fork subwatersheds meet, the land was heavily surface mined for coal. These surface mined soils present a number of limitations for growth of agricultural crops, including moderate to moderately low organic content and slow permeability. As a result, agricultural producers in this area of the sub-watershed have opted to use most surface mined upland areas as pasture or hay fields.

Despite declining row crop production in the watershed overall, there is still significant row crop production in the upland areas of this subwatershed surrounding Jefferson Lake State Park. Once an area of concern due to erosion and nutrient runoff, many producers now practice no till, contour farming, contour strip cropping, and crop rotation. These practices help to reduce soil and nutrient runoff entering the lake.

Agricultural production in the remainder of the Town Fork subwatershed is primarily made up of beef grazing operations in upland areas. There are also a small number of sheep raised in the subwatershed, as well as intermittent small horse operations.

Town Fork Subwatershed Water Quality

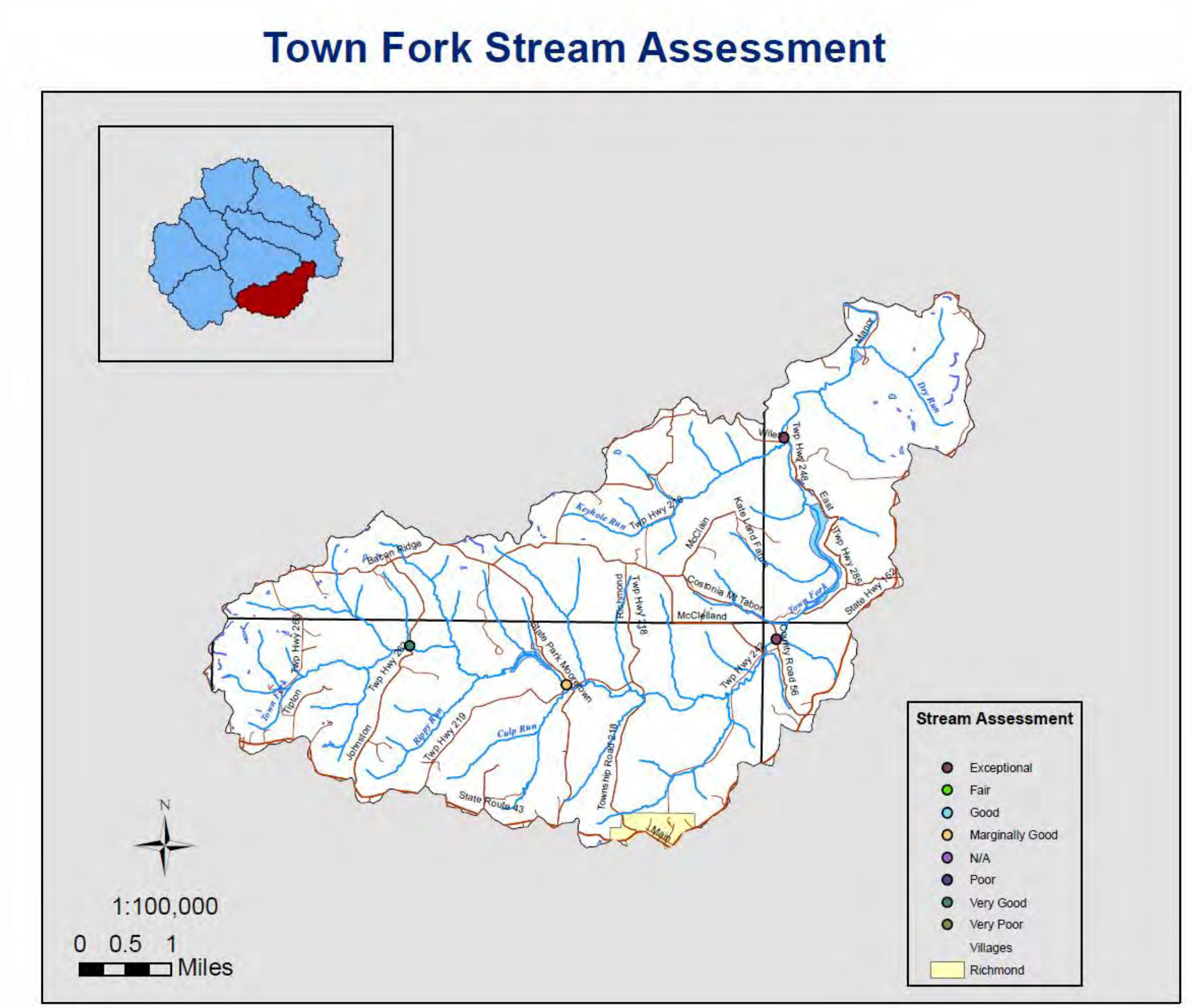

Fig. 106: Town Fork Stream Assessment

Ground Water

The approximate number of water wells in the Town Fork Subwatershed is 41, although it is very likely that there are more wells that were not recorded or submitted to the Ohio Division of Natural Resources. The fact that the number of groundwater wells in this subwatershed is also relatively low compared to other portions of the Yellow Creek Watershed can be attributed to the fact that county water lines supply the village of Richmond along with other portions of the subwatershed with water. Within the subwatershed 16,635.1 acres are highly sensitive to groundwater contamination.

Surface Water

The area determined to be within the 100 year floodplain is 405.8 acres. The area in wetlands in the Town Fork Subwatershed is 312.5. Other surface water features include 134.1 acres of ponds and lakes 58.0 acres of streams. Six dams are listed in this subwatershed.

There were four sites sampled during the summer of 2005 during the Total Maximum Daily Load study performed on Yellow Creek. Of the four sites only one did not reach full attainment of its designated use status. The sampling site located downstream of the Jefferson Lake spillway was in partial attainment. Within the subwatershed 18.6 miles of stream were designated as warmwater habitat. There were no stream segments classified as superior high quality waters.

Town Fork Stream Attainment

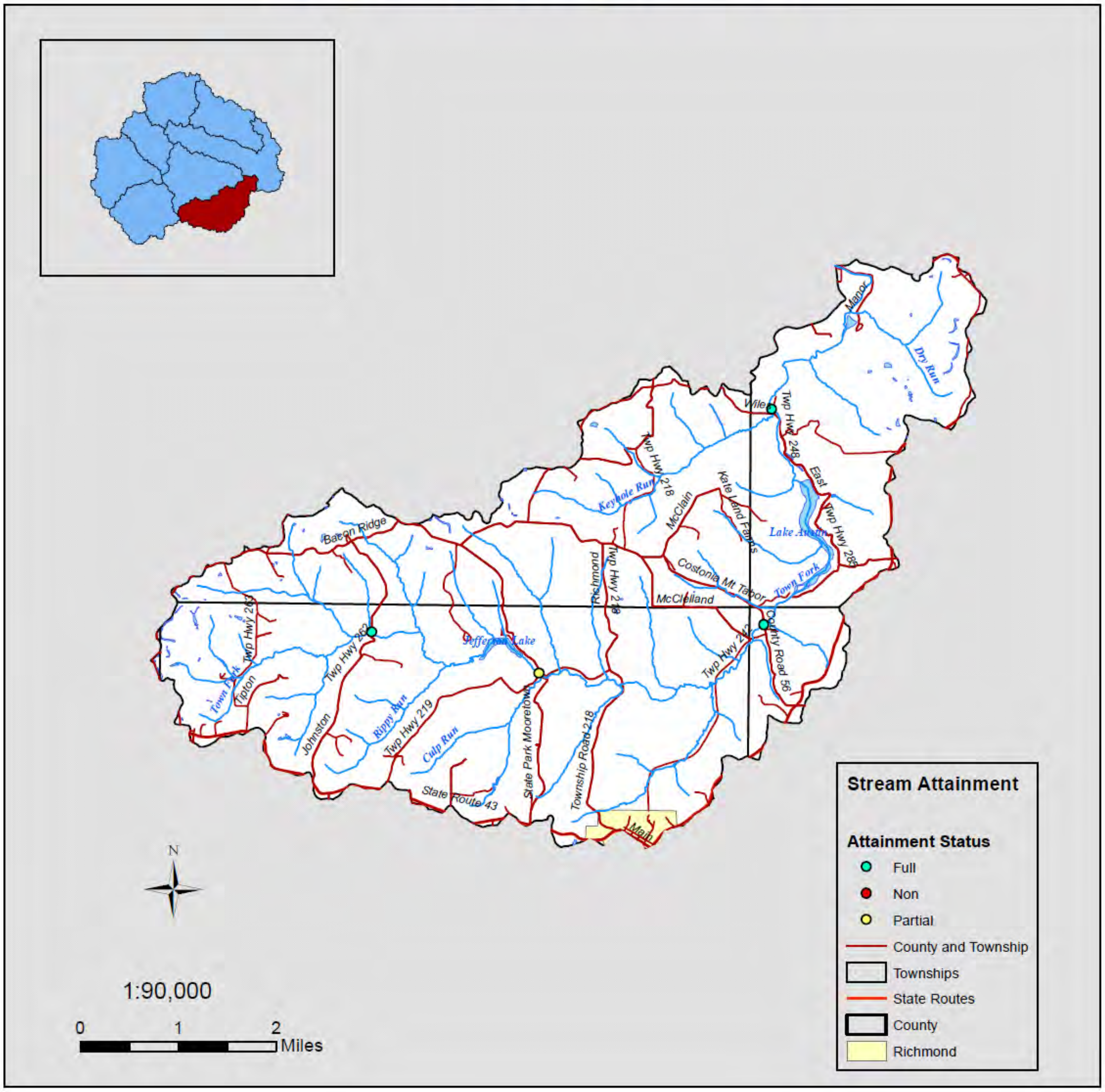

Fig. 107: Town Fork Stream Attainment

Table 48. Town Fork Water Quality

Stream Name and River Mile	Attainment Status	IBI	ICI	MiWb	QHEI	Aquatic Life Use
Culp Run	**NA**	**NA**	**NA**	**NA**	**NA**	**WWH**
Dry Run	**NA**	**NA**	**NA**	**NA**	**NA**	**WWH**
Rippy Run	**NA**	**NA**	**NA**	**NA**	**NA**	**WWH**
Town Fork 10.4	**Full**	**46**	**Very Good**	**NA**	**60.0**	**WWH**
Town Fork 8.0/8.1	**Partial**	**52**	**Marginally Good**	**NA**	**77.0**	**WWH**
Town Fork 5.1/5.3	**Full**	**50**	**Exceptional**	**NA**	**79.0**	**WWH**
Town Fork 0.2	**Full**	**46**	**52**	**10.2**	**76.0**	**WWH**
Keyhole Run	**Full**	**52**	**Exceptional**	**NA**	**72.0**	**EWH**

Problem Statement 1: (Phosphorus)

The stream of Town Fork has two impoundments that produce adverse impacts to its biological communities by simplifying their habitats, obstructing fish migration and degrading water quality. As these reservoirs provide important community recreational opportunities, removal of the impoundment s is not reasonable or recommended. However, the poor water quality stemming from Jefferson Lake is affecting Town Fork, as its water is algae-ridden and contains undesirable levels of other organic matter. A modification to the release of the Jefferson Lake waters which removes surface algae would remedy this situation.

Goal 1.1: Reduce phosphorus entering Town Fork from Jefferson Lake State Park impoundment.

Objective: Develop plans for alteration of release at impoundment. Amendment to impoundment will fluctuate between surface and deep release, depending on season.

Fig. 108: Spillway at Jefferson Lake State Park

Pollutant	Goal	Task Description	Resources	How	Time Frame	Performance Indicator
Phosphorus	1.1	Partner with Parks and Dam Safety to develop plans for alteration of release at impoundment. Amendment to impoundment to fluctuate between surface and deep release, depending on season.	Cost estimate to be developed with plan.	Jefferson Soil and Water Conservation District will seek stream mitigation funding from oil and gas development.	2013-2015	Attainment at sampling point downstream of impoundment. Reduction in amount of near-surface algae exported from the lake.

Problem Statement 2: (Nutrients)

As confirmed by the 2009 TMDL, Town Fork subwatershed is impaired by elevated levels of nutrients related to livestock operations that have access to the stream.

Goal 2.1: Reduce livestock with access to 1.25 miles of Town Fork upstream of Jefferson Lake State Park

> **Objective:** Install 6,600 feet of exclusion fencing and necessary auxiliary practices along Town Fork

Pollutant	Goal	Task Description	Resources	How	Time Frame	Performance Indicator
Sedimentation, Nutrients	2.1	Target cattle operations along Town Fork upstream of Jefferson Lake where livestock have access to the stream. Work with landowners to install 13,200 feet of fencing and needed auxiliary practices to protect at least 1.25 miles of streambank.	6,600 ft* $2.16/foot= $14,256.00	Ohio Division of Wildlife, US Fish and Wildlife, US Forest Service, USDA	Jan. 2013- Jan. 2015	Document 1.25 miles of streambank fencing installed along with acreage of riparian area protected. Improved QHEI scores.

Problem Statement 3: (Habitat)

The Subwatershed of Town Fork lacks riparian species in headwater areas. This leads to increased sedimentation, stream temperatures and habitat alteration in the form of streambank erosion.

Goal 3.1 Establish riparian protection and plantings that will enhance riparian cover for 4.6 river miles

Objective: Protect and plant 27.85 acres of riparian area with a 25 foot stream buffer

Pollutant	Goal	Task Description	Resources	How	Time Frame	Performance Indicator
Sedimentation, increased stream temperatures, habitat alteration	3.1	Establish riparian protection and plantings that will enhance approximately 27.85 acres of riparian area with 25 foot buffer.	$20,664.00 27.85 Acres* $741.98 (established hardwood trees/shrubs w/ weed control)= $20,664.00	Ohio Division of Forestry, Western Reserve, Jefferson and Carroll Soil and Water Conservation Districts	2012-2016	4.60 river miles with improved riparian cover

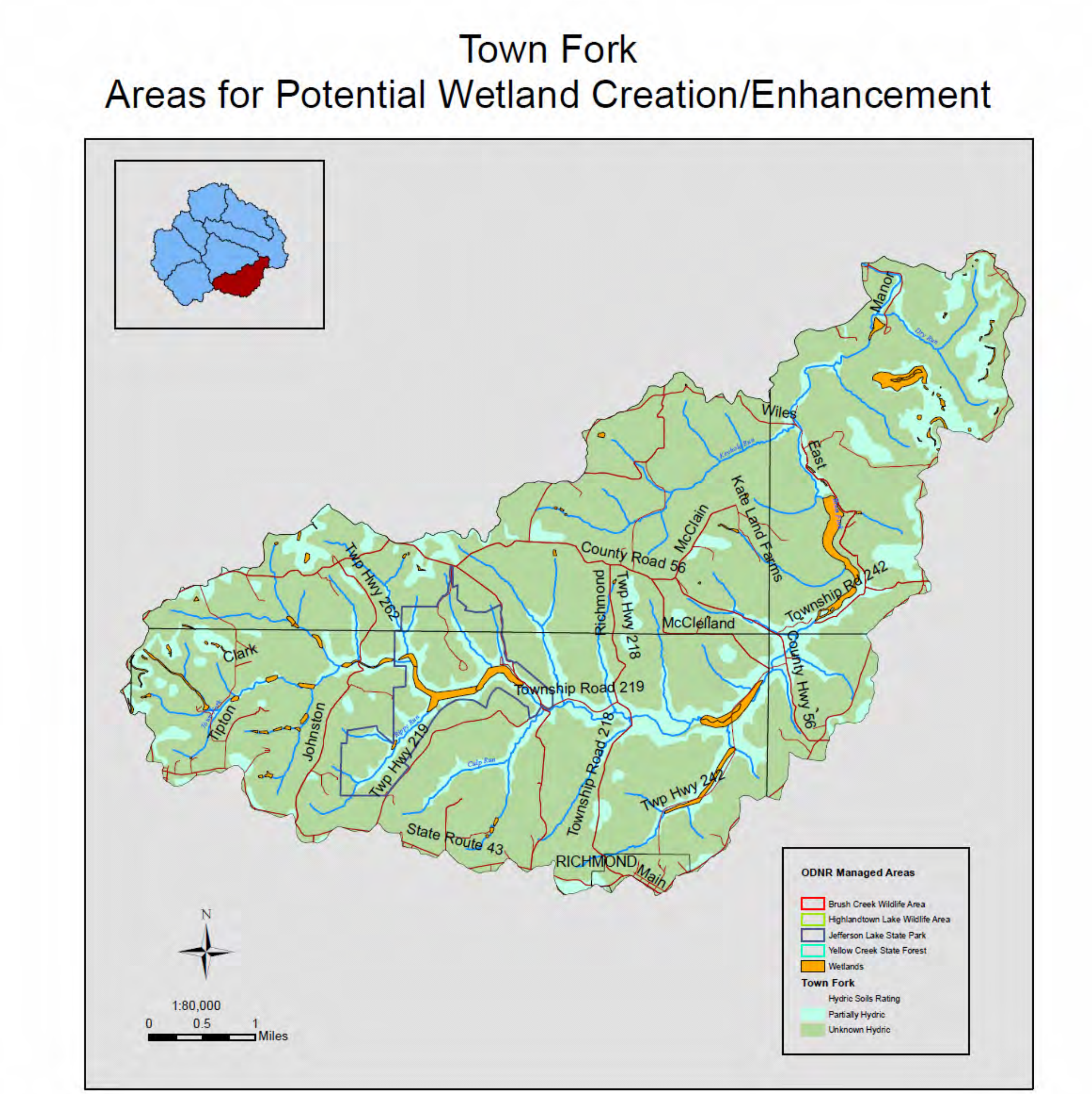

Fig. 109: Wetlands Creation/Enhancement Potential

Areas to be prioritized for protection:

The mainstem of Town Fork upstream from Jefferson Lake State Park at River Mile 5.1/5.3 and Keyhole Run were designated as Exceptional Warmwater Habitat. These streams will be prioritized for protection through conservation easements and riparian setbacks.

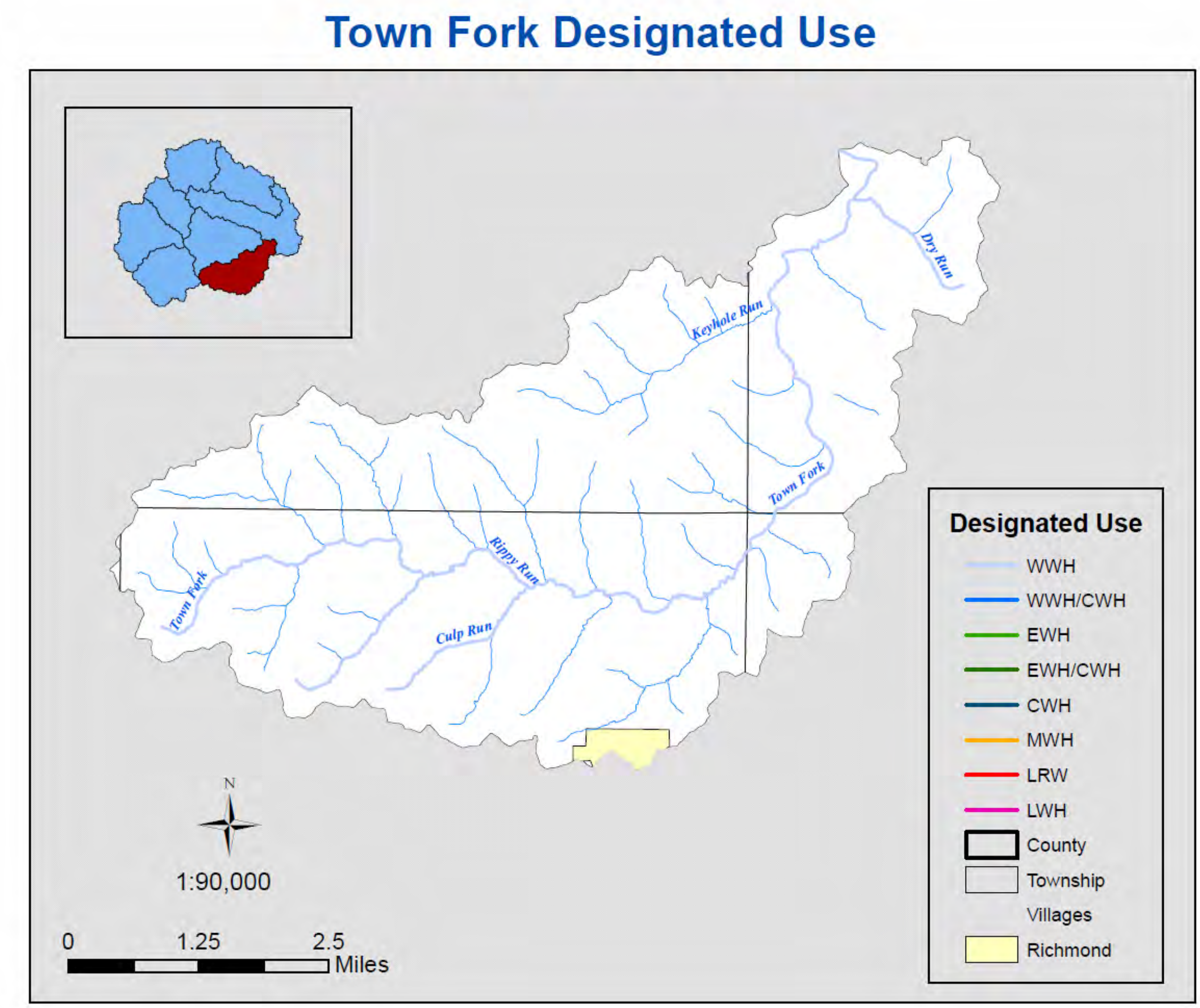

Fig. 110: Town Fork Designated Use

Chapter VII. Headwaters to North Fork Yellow Creek

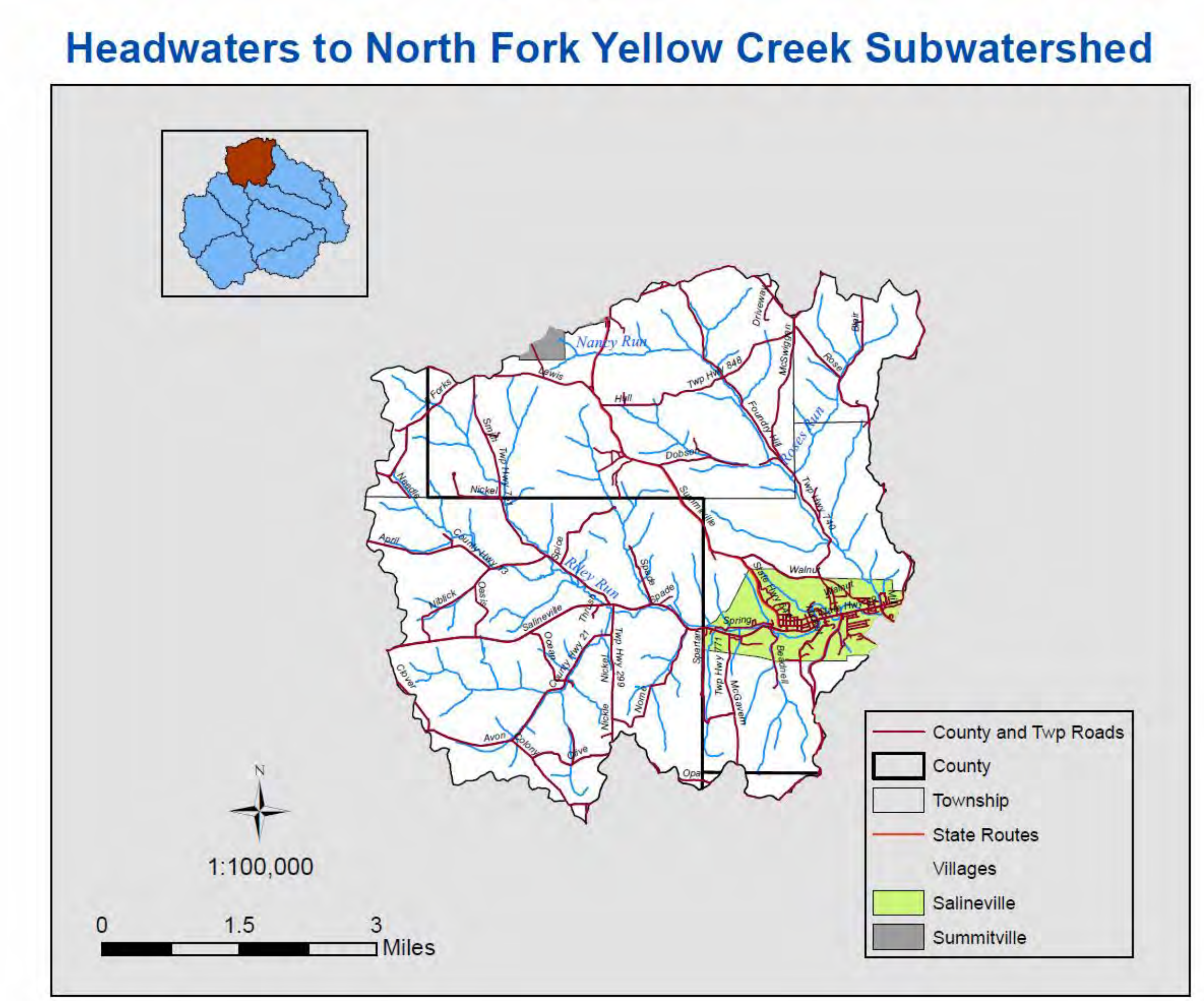

Fig. 111: Headwaters to North Fork Yellow Creek

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16,960 acres

The Subwatershed of Headwaters North Fork Yellow Creek is the northern-most area in the watershed. Major tributaries in this subwatershed include Nancy Run, North Fork Yellow Creek, Riley Run and Roses Run. The majority of this watershed lies within Columbiana County, with the southwestern portion in Carroll County and a very small portion in Jefferson County.

Municipalities

A small section (95.9 acres) of the southern end of the village of Summitville lies within the boundaries of the Headwaters North Fork Yellow Creek Subwatershed. The majority of the village of Salineville (1,020.2 acres) lies within this watershed as well.

Geology

The bedrock of the Upper North Fork Subwatershed consists mainly of shale and siltstone. The area having probable Karst features amounts to 16,979.8 acres.

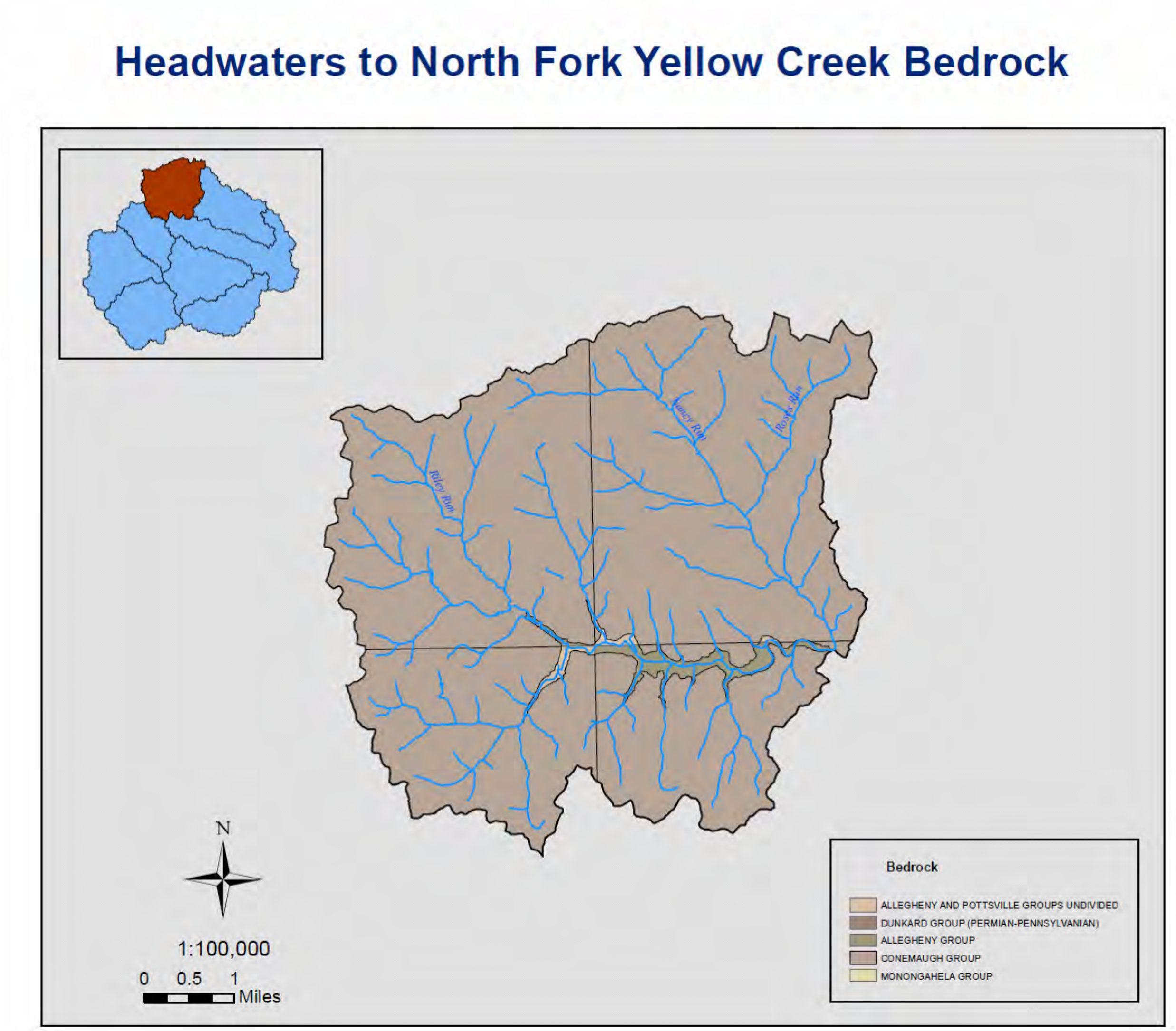

Fig. 112: Headwaters to North Fork Yellow Creek Bedrock

Population

Unlike the trend seen in other subwatersheds within Yellow Creek, census results from 1980 through 2000 show a dramatic decrease in population, with the area losing nearly 50% of its population.

1980: 2,584

1990: 1,354

2000: 1,423

The average household size is 2.7, and the average household income is $41,695.00

Soil Resources

The majority of soils in the Headwaters North Fork Yellow Creek Subwatershed rank well for drainage. Within the subwatershed 5,476.8 acres are considered prime farmland and 6,446.5 acres are highly erodible land.

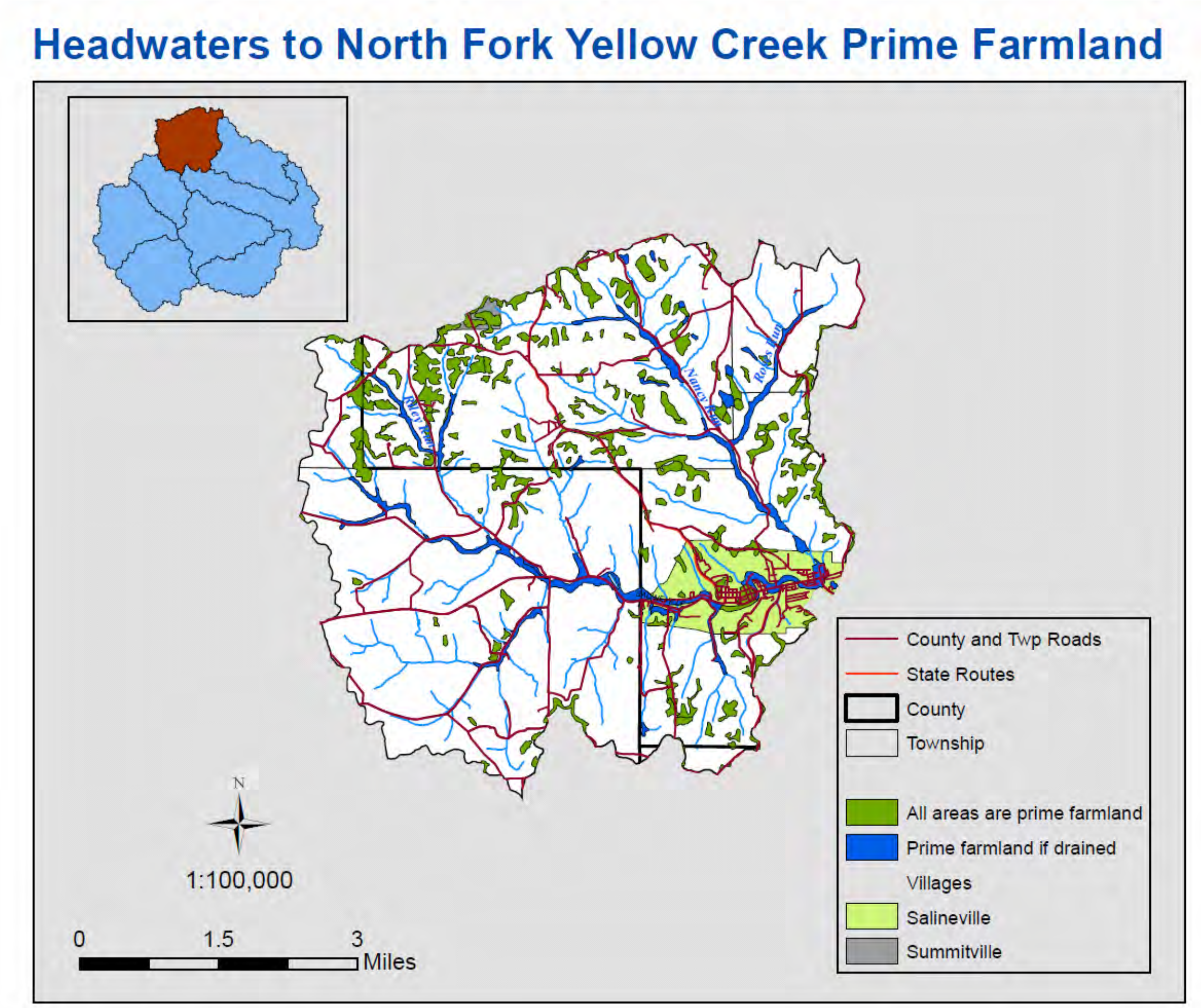

Fig. 113: Headwaters to North Fork Yellow Creek Prime Farmland

While there are no hydric soils, 1,250.8 acres are partially hydric.

Headwaters to North Fork Yellow Creek Hydric Soils

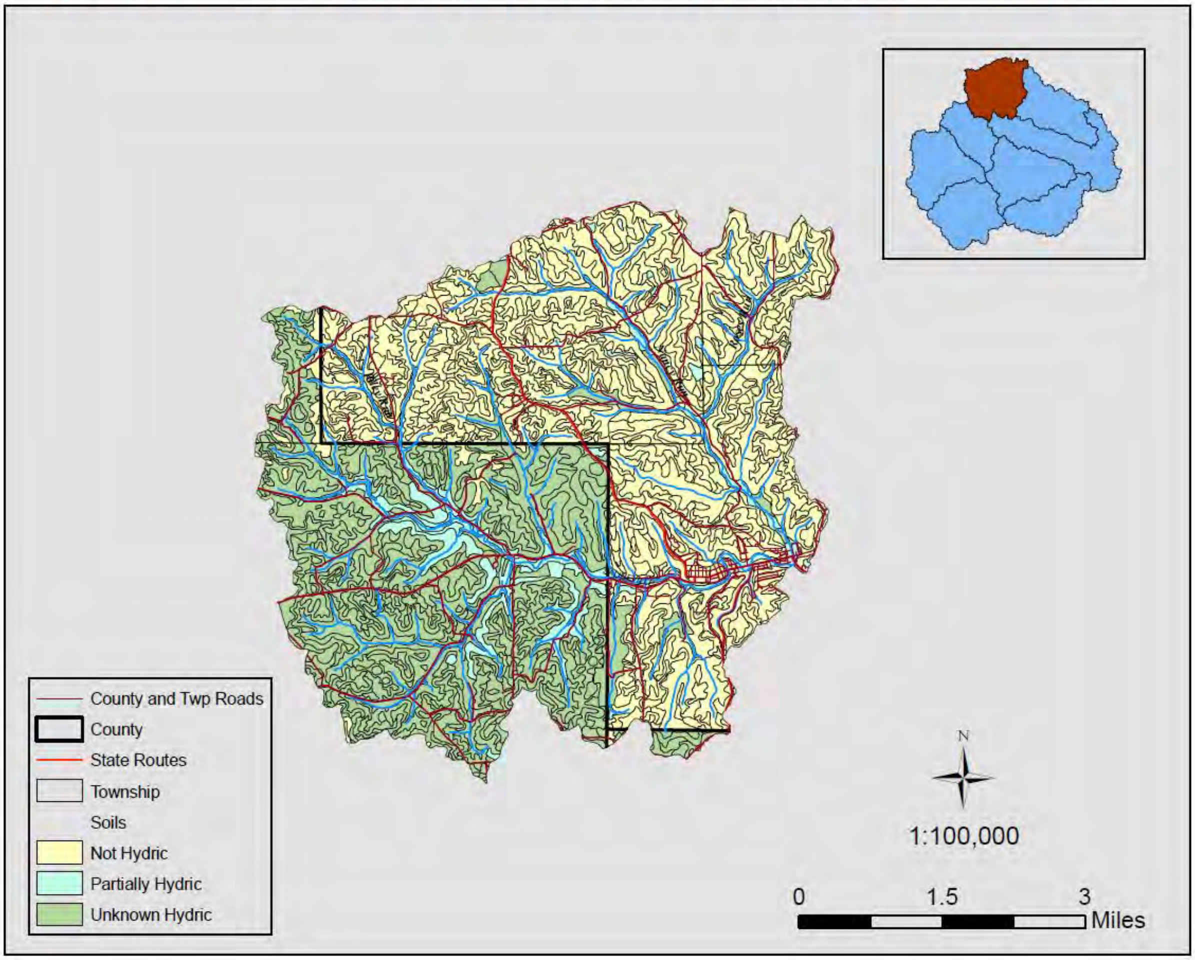

Fig. 114: Headwaters to North Fork Yellow Creek Hydric Soils

There are no areas listed as frequently flooded in this subwatershed.

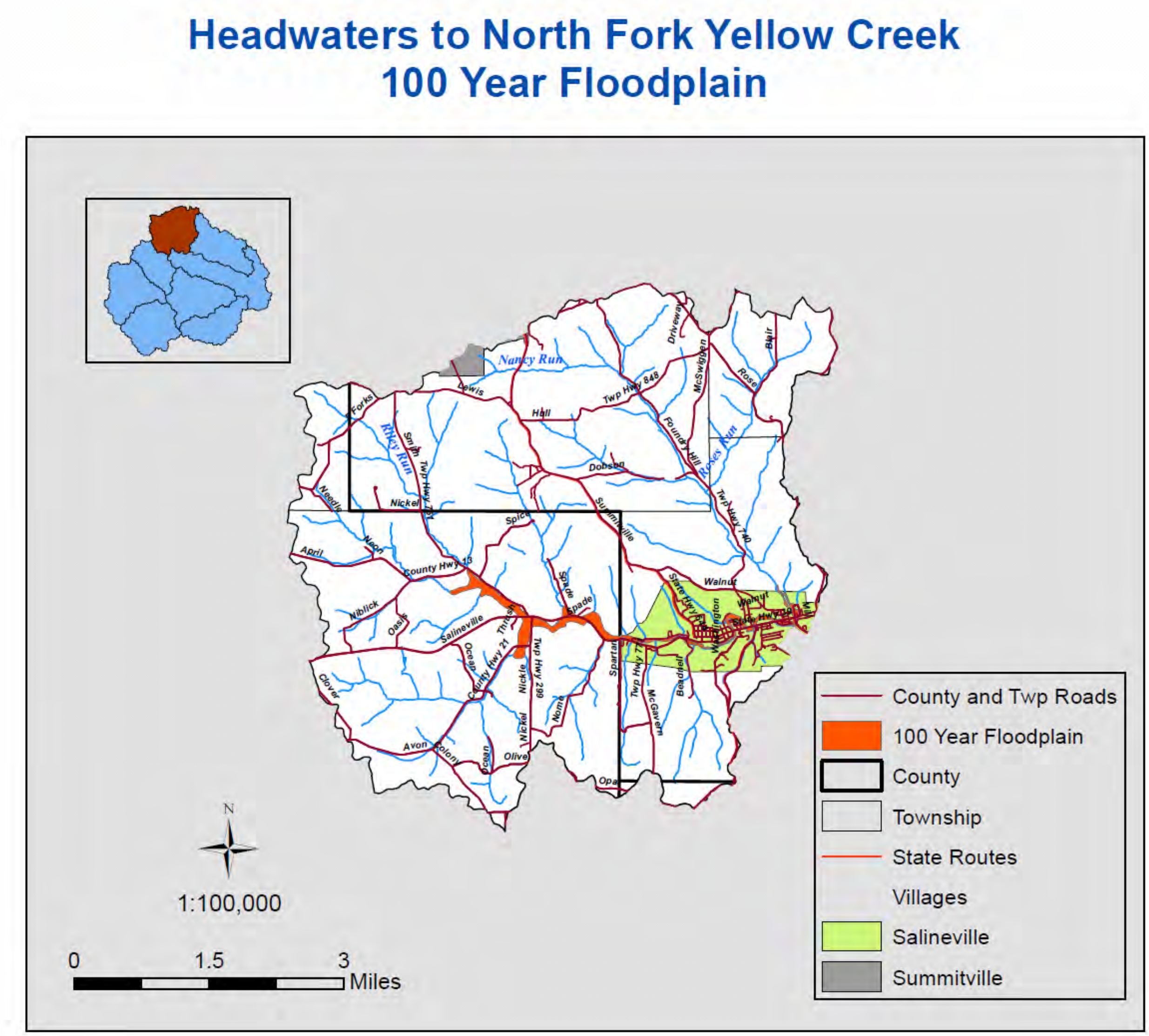

Fig. 115: Headwaters to North Fork Yellow Creek 100 Year Floodplain

Table 49. Headwaters to North Fork Yellow Creek Riparian Tree Species

Hemlock	Tulip Poplar
Maple	Ash
Beech	Elm

Table 50. Headwaters to North Fork Yellow Creek subwatershed species identified by employees and volunteers from the Cleveland Museum of Natural History

Black Walnut	Crack Willow	Pussy Willow
American Witch-Hazel	Black Willow	Sycamore
Green Alder	Red Ash	Bigtooth Aspen
Quaking Aspen	American Basswood	American Beech
Highbush Blueberry	Ohio Buckeye	Butternut
Black Cherry	American Chestnut	Chinese Chestnut
Eastern Cottonwood	Crabapple	Deerberry
Flowering Dogwood	Silky Dogwood	Gray Dogwood
Common Elderberry	American Elm	Slippery Elm
Gooseberry	Hazelnut	Hawthorn
Bitternut Hickory	Shagbark Hickory	American Hophornbeam
Black Locust	Cucumber Magnolia	Red Maple
Sugar Maple	Ninebark	Black Oak
Chestnut Oak	Chinkapin Oak	Pin Oak
Red Oak	Scarlet Oak	Shingle Oak
White Oak	Eastern White Pine	Redbud
Carolina Rosa	Swamp Rose	Sassafras
Serviceberry	Sourgum	Spicebush
Smooth Sumac	Staghorn Sumac	Tuliptree
Mapleleaf Viburnum	Nannyberry Viburnum	

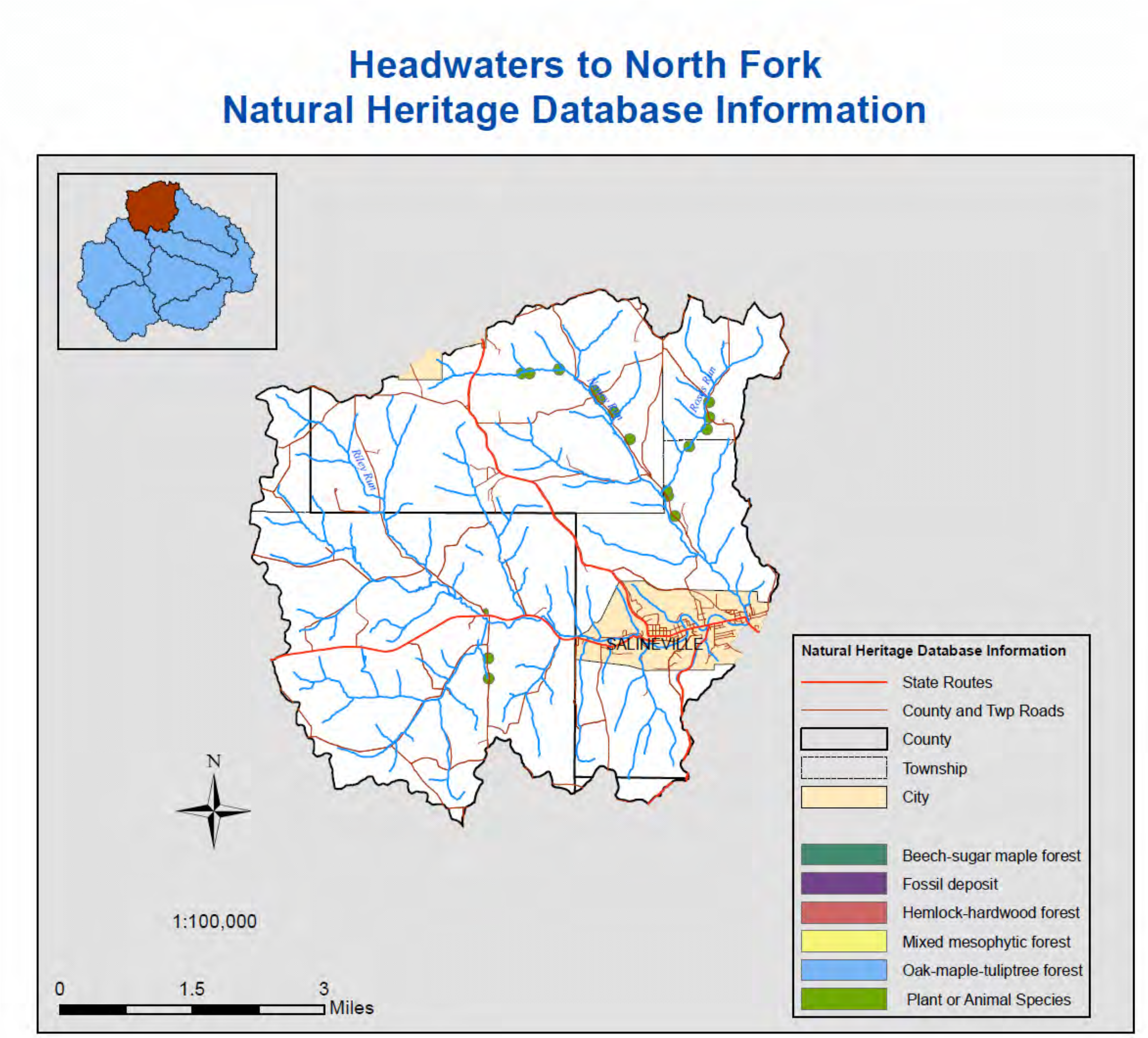

Fig. 116: Headwaters to North Fork Yellow Creek NHD Information

Headwaters North Fork Yellow Creek Land Use

A greater area was once used in agriculture production than we see today in the Headwaters North Fork Yellow Creek Subwatershed. There has been an increase in urban land use amounting to 1,210.4 acres over the last fifteen years. The majority of the land use in this subwatershed is forested, followed by land in agricultural production then urbanized areas. There are 165.7 acres approved through Ohio EPA for bio-solid application to fields.

Conservation and Forestry Legacy Program

For the last several years a group of families has applied for their adjoining properties to be accepted into the national Forestry Legacy Program. The Ohio Division of Forestry, Cleveland Museum of Natural History, Western Reserve, Jefferson Soil and Water Conservation District, Ohio Breeding Bird Atlas, and Division of Mineral Resource Management provided information as to why the section of forest they manage is nationally significant. After being denied admittance into the program, the Watkins family has donated 520 acres into a conservation easement through Western Reserve Land Conservancy. The Coldwell family has applied three separate times to enter their property into the Forestry Legacy Program, but have been denied. They have met the maximum amount of submittals permitted. These properties border and benefit the stream Nancy Run, which is designated as coldwater habitat.

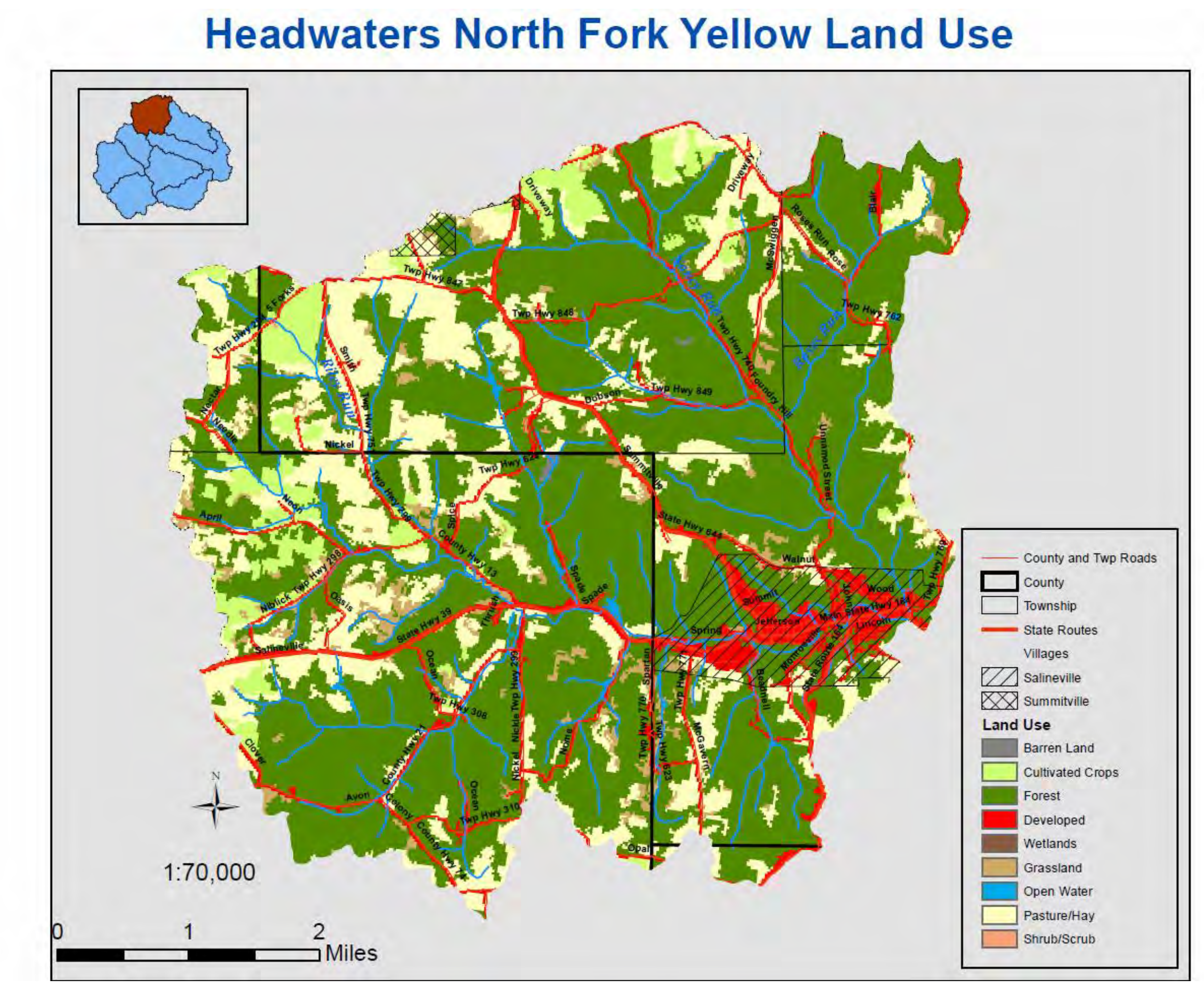

Fig. 117: Headwaters to North Fork Yellow Creek Land Use

Table 51. Headwaters North Fork Yellow Creek Land Use (acres)

	2009	2001	1994
Agriculture	4,385.3	5,916.7	5,298.9
Water	38.7	114.3	59.1
Urban	1,262.3	212.4	51.9
Forest	11,295.2	10,660.0	11,233.1
Barren	0.0	77.4	61.7
Shrub/Scrub	0.0	0.0	275.1

Agricultural Characteristics

In the Columbiana County portion of this watershed agriculture is the primary land use. There are several beef herds with a significant number of cows grazing pastures in this area. Some rotational grazing is used, but most of the cattle herds are on continuously grazed pastures. The majority of the row crops in the watershed are produced using contour strip crop farming and crop rotation. Some producers use no-till methods to plant crops, while others still feel the need to use conventional tillage methods. There are also operations within this watershed that have small horse herds; usually one to five horses per farm.

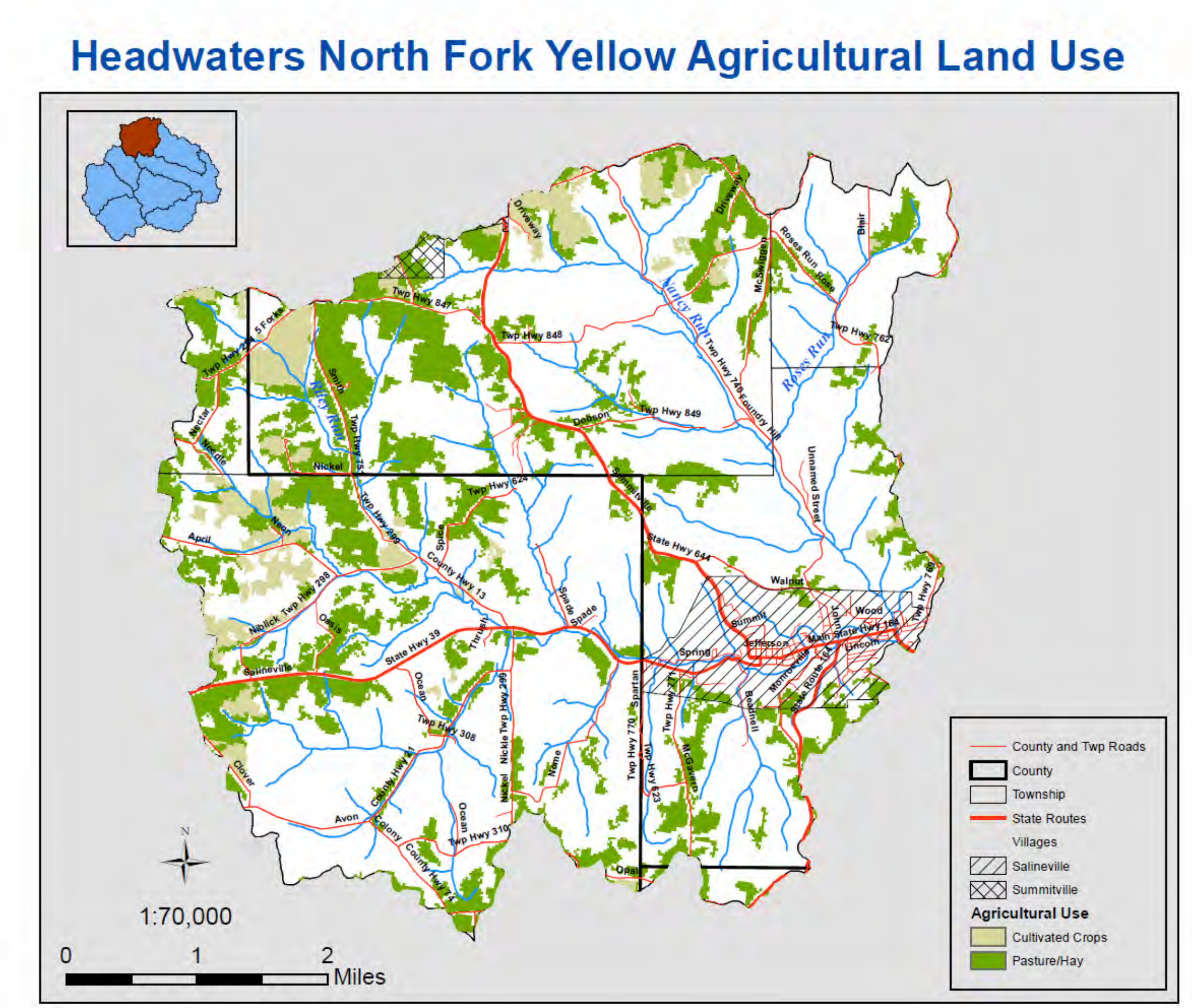

Fig. 118: Headwaters to North Fork Yellow Creek Agricultural Land Use

<u>Headwaters to North Fork of Yellow Creek</u>

The subwatershed of Headwaters to North Fork Yellow Creek, at the northern most section of the watershed, is located half in Columbiana County and half in Carroll Soils in this sub watershed are of two different associations: Berks-Westmoreland and Rigley-Westmoreland association.

The Carroll County portion of this watershed is primarily agriculture land use. The primary land use is forest land with small areas being cash cropped. Some producers are practicing contour farming, contour strip cropping, no-till planting, and crop rotation.

Headwaters to North Fork Yellow Creek Water Quality

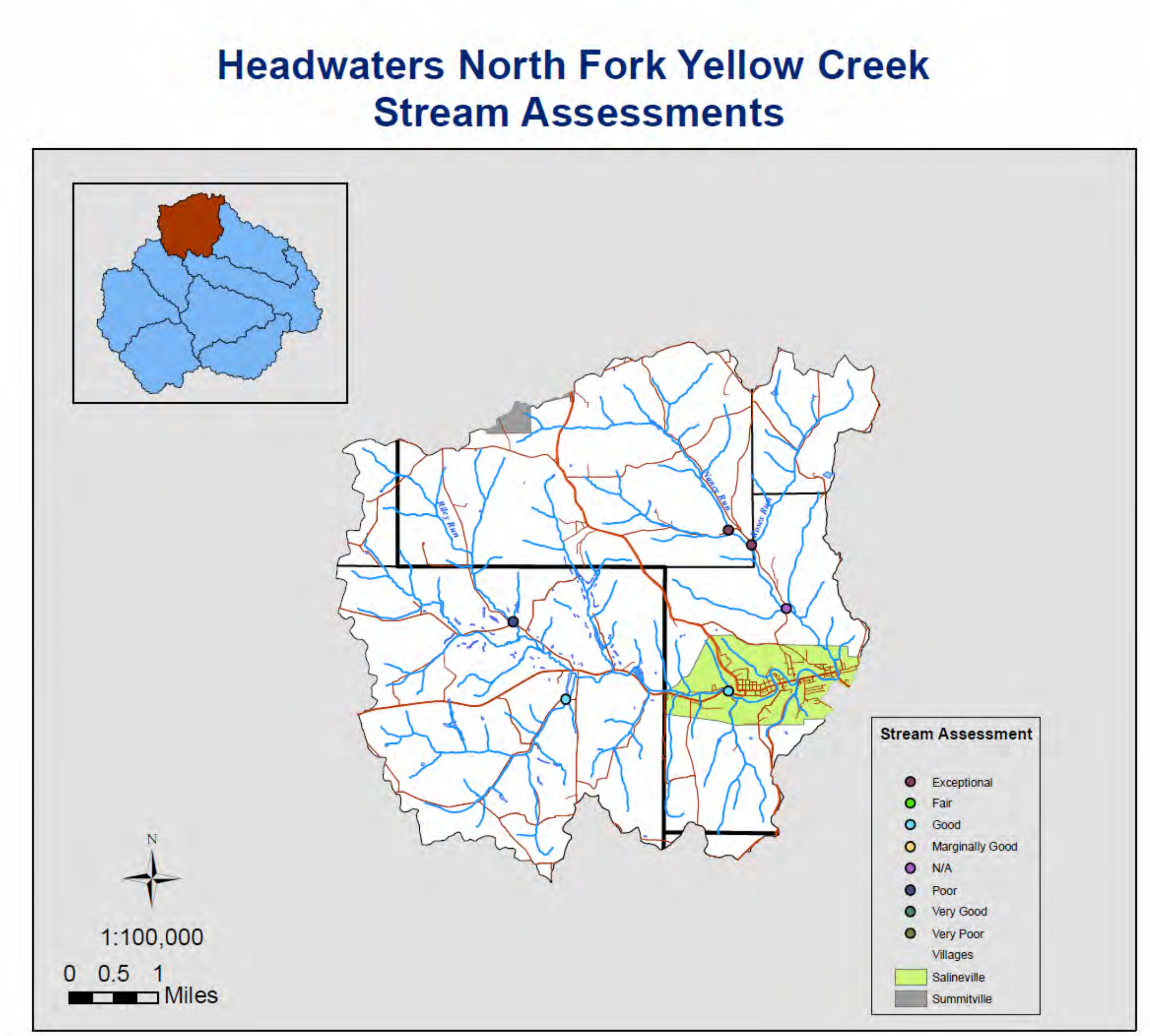

Fig. 119: Headwaters to North Fork Yellow Creek Stream Assessments

Ground Water

The approximate number of water wells in the Headwaters North Fork Yellow Creek Subwatershed is 127, although it is very likely that there are more wells that were not recorded or submitted to the Ohio Division of Natural Resources. Within the subwatershed 16,972.5 acres are highly sensitive to groundwater contamination.

Surface Water

The area determined to be within the 100 year floodplain is 209.9 acres. There are currently 220.4 acres of wetlands in the Headwaters to North Fork Yellow Creek Subwatershed. Other surface water features include 65.8 acres of ponds and lakes and 73.7 acres of stream. One municipal discharge permit is listed for this subwatershed. Headwaters to North Fork Yellow Creek has the most dams of all the subwatersheds with a total of seventeen.

During the summer of 2005 six sites were sampled in the Headwaters to North Fork Yellow Creek Subwatershed during the total maximum daily load study of Yellow Creek. Of the six sites sampled only one was found to be in non-attainment of its designated use. Within the subwatershed 5.4 miles of stream (Nancy Run) were designated as coldwater habitat, 10.3 miles were designated as warmwater habitat and 5.4 miles are classified as superior high quality waters.

Headwaters to North Fork Attainment Status

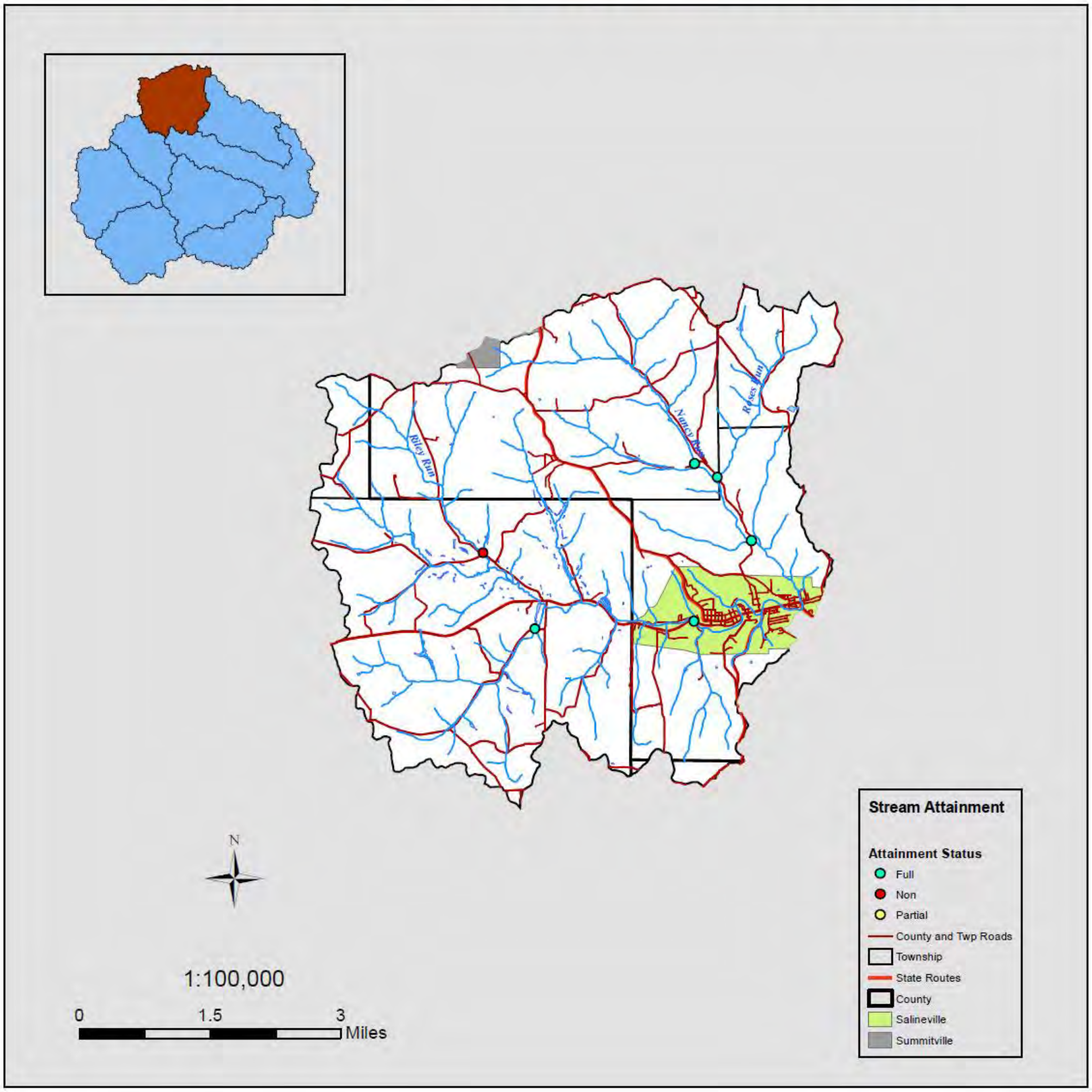

Fig. 120: Headwaters to North Fork Yellow Creek Attainment Status

Table 52. Headwaters North Fork Yellow Creek Water Quality

Stream Name and River Mile	Attainment Status	IBI	ICI	MiWb	QHEI	Aquatic Life Use
Nancy Run 2.2	**Full**	**NA**	**Exceptional**	**NA**	**71.5**	**CWH**
Nancy Run 1.0/1.2	**Full**	**46**	**Exceptional**	**NA**	**65.0**	**CWH**
North Fork Yellow Creek 10.6/10.4	**Full**	**40**	**50**	**9.1**	**78.5**	**WWH**
North Fork Yellow Creek 10.1	**Full**	**44**	**48**	**9.3**	**67.5**	**WWH**
North Fork Yellow Creek 6.1/6.2	**Full**	**52**	**50**	**10.1**	**96.5**	**WWH**
North Fork Yellow Creek 2.2	**Full**	**52**	**34**	**10.8**	**66.0**	**WWH**
North Fork Yellow Creek 0.5/0.7	**Full**	**46**	**Good**	**10.6**	**78.0**	**WWH**
Riley Run 4.9	**Non**	**42**	**Poor**	**NA**	**62.5**	**WWH**
Riley Run	**Full**	**56**	**Good**	**NA**	**NA**	**WWH**

1.8						
Riley Run **(**Headwaters to Trib @ RM 3.75**)**	**Partial**	**42ns**	**NA**	**NA**	**62.5**	**WWH**
Riley Run (Riley Run trib @RM 3.75 to mouth)	**Full**	**56**	**NA**	**NA**	**NA**	**CWH**
Roses Run	**Full**	**48**	**Exceptional**	**NA**	**70.5**	**WWH**
Unnamed Tributary **(RM 6.1)**	**Partial**	**50**	**Fair**	**NA**	**79**	**WWH**

Problem Statement 1: Riley Run downstream of the former water source for the Village of Salineville is not in attainment due to the presence of a low head dam.

Goal 1.1: Achieve attainment downstream of Riley Run low head dam

Objective: Remove low head dam on Riley Run

Fig. 121: Riley Run Dam (Corder)

ollutant	Goal	Task Description	Resources	How	Time Frame	Performance Indicator
Habitat Alteration	1.1	Removal of low head dam on Riley Run	Cost estimate to be developed	319 Funding/ Stream mitigation funding - Oil and Gas development	2014-2015	Improved QHEI, IBI and ICI scores downstream of dam

Problem Statement 2: (Bacteria)

As confirmed by the 2009 TMDL, the subwatershed Headwaters to North Fork Yellow Creek is impaired by elevated levels of bacteria related to livestock operations that have access to the stream.

Goal 2.1: Reduce sedimentation and nutrient loadings in Riley Run

Objective: Target cattle operations along Riley Run to install 33,739.2 feet of fencing and needed auxiliary practices to protect at least 6.39 miles of streambank.

Pollutant	Goal	Task Description	Resources	How	Time Frame	Performance Indicator
Sedimentation, Nutrients	2.1	Target cattle operations along Riley Run to install 33,739.2 feet of fencing and needed auxiliary practices to protect at least 6.39 miles of streambank.	33,739.2 ft* $2.16/foot= $72,876.67	Ohio Division of Wildlife, US Fish and Wildlife, US Forest Service, USDA	Jan. 2013- Jan. 2015	Document 6.39 miles of streambank fencing installed along with acreage of riparian area protected. Improved QHEI scores.

Problem Statement 3: (Habitat Impairment)

The Subwatershed of Headwaters North Fork Yellow Creek lacks riparian corridor species. This leads to increased sedimentation, stream temperatures and habitat alteration in the form of streambank erosion.

Goal 1.1: 7.13 river miles of improved riparian cover

Objective: 27.85 acres of riparian area planting (25 foot buffer)

Pollutant	Goal	Task Description	Resources		Time Frame	Performance Indicator
Sedimentation, increased stream temperatures, habitat alteration	1.1	Establish riparian protection and plantings that will enhance approximately 27.85 acres of riparian area with 25 foot buffer.	$32,060.96 27.85 Acres* $741.98 (established hardwood trees/shrubs w/ weed control)= $32,060.96	Ohio Division of Forestry, Western Reserve, Jefferson and Carroll Soil and Water Conservation Districts	2012-2016	7.13 river miles with improved riparian cover

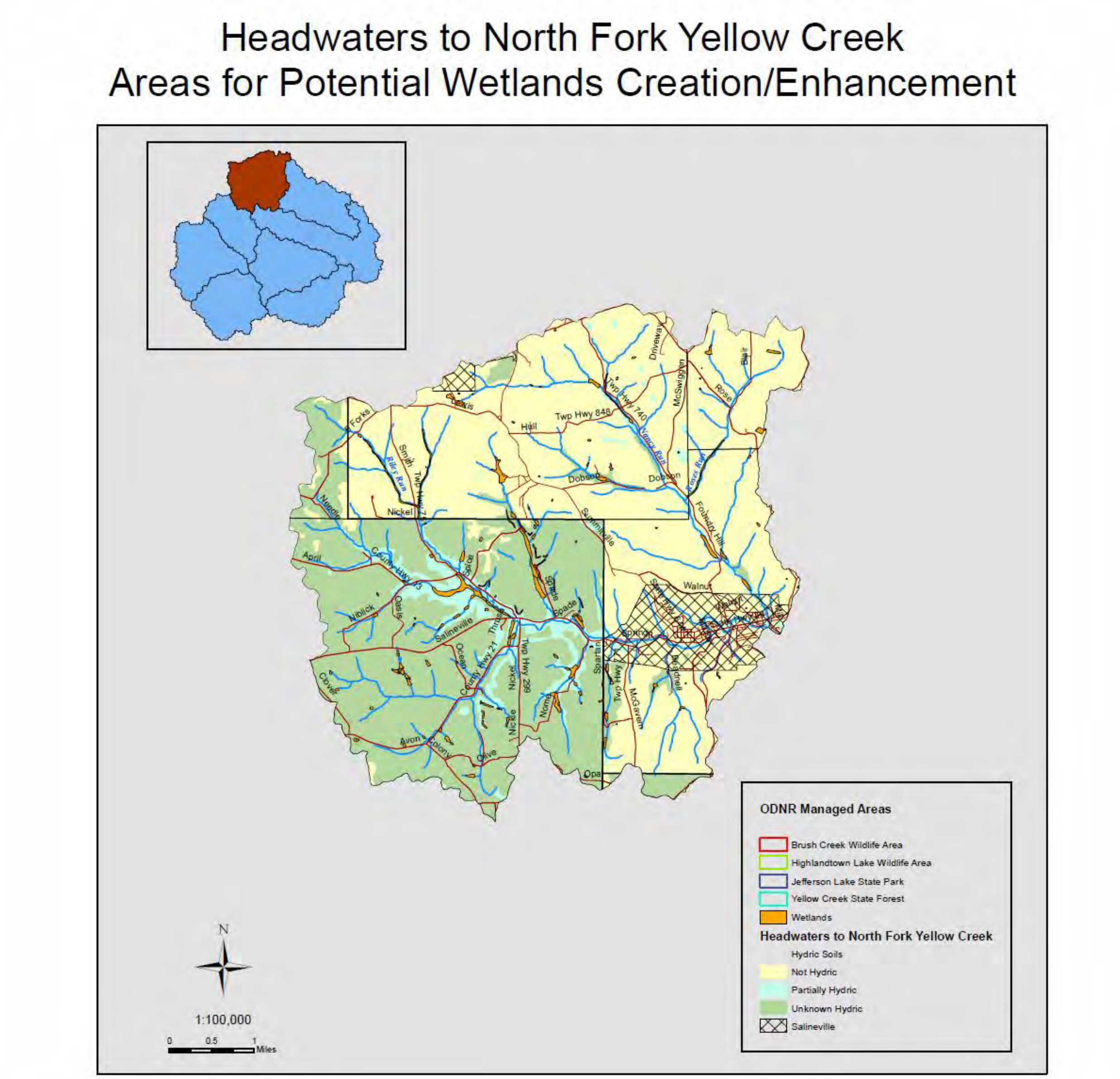

Fig. 122: Wetlands Creation/Enhancement Potential

Areas of protection:

Nancy Run and Roses Run are both designated as coldwater habitat. These stream segments have been surveyed by the Cleveland Museum of Natural History in 2009 and are considered to have significant flora and fauna. This survey was conducted by request of private landowners adjacent to Nancy and Roses Run in anticipation of using data collected during the Forestry Legacy Program application process. These areas will continue to be focused on for protection through conservation easements.

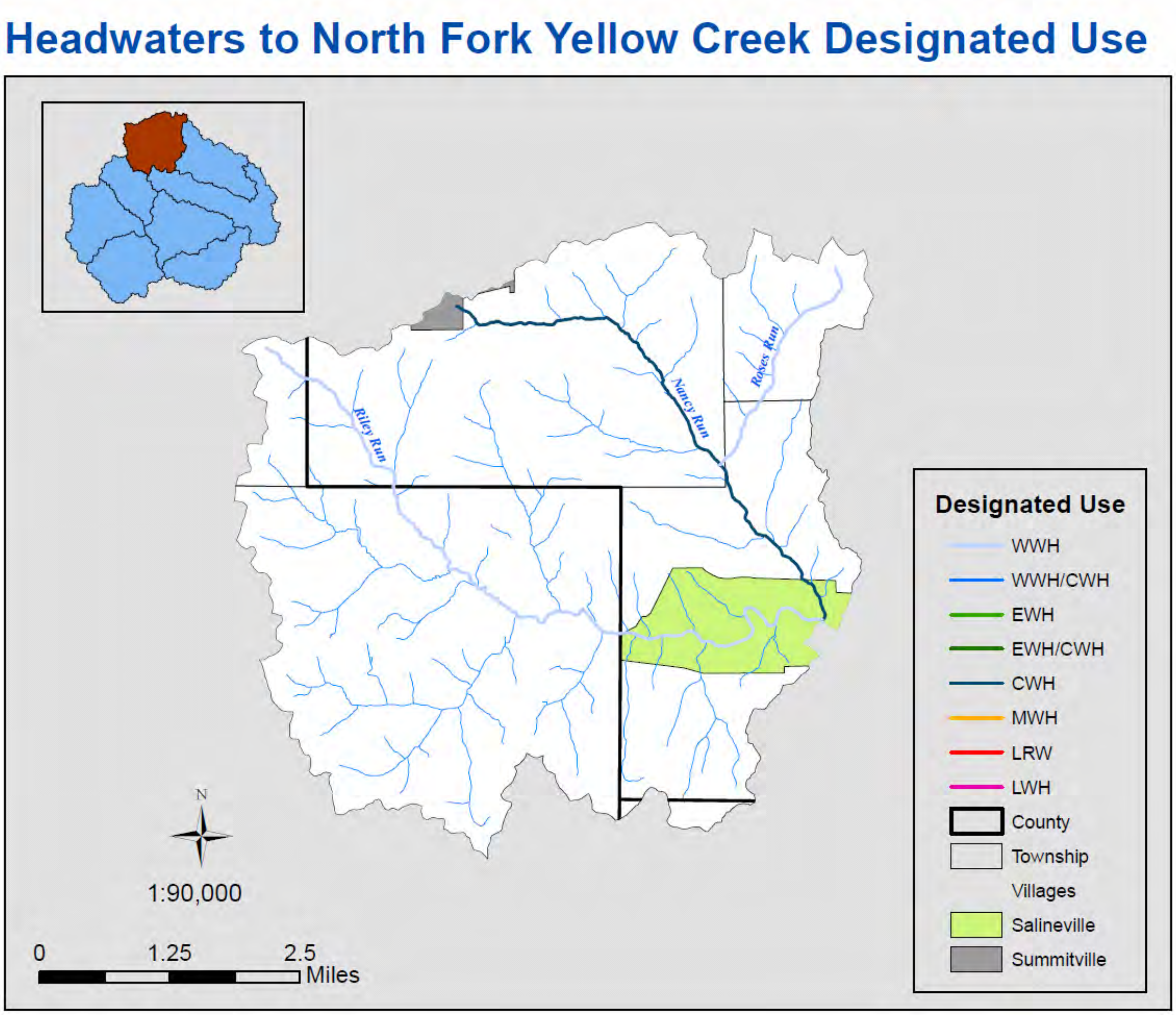

Fig. 123: Headwaters to North Fork Yellow Creek Designated Use

Chapter VIII. Salt Run-North Fork Yellow Creek

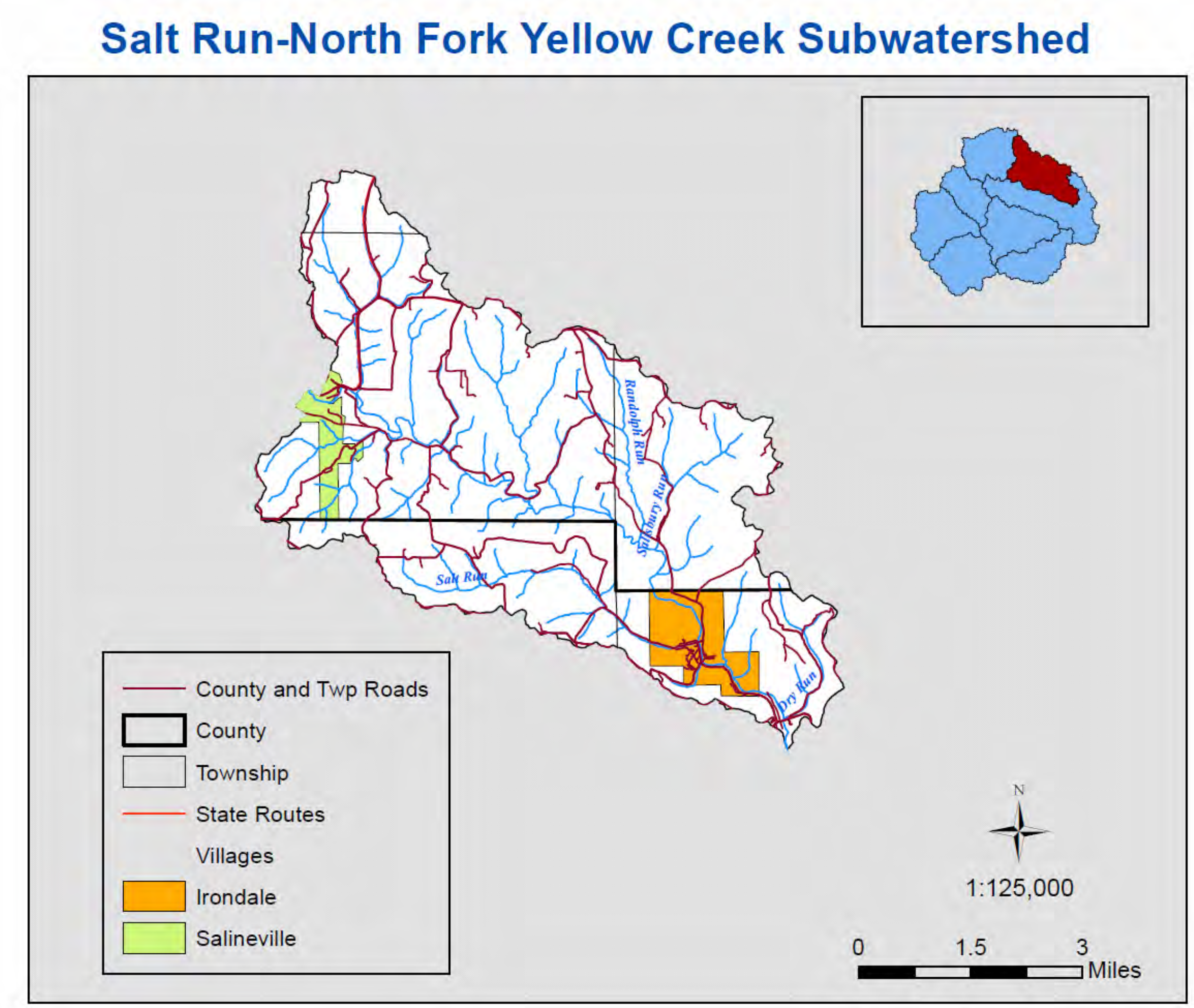

Fig. 124: Salt Run-North Fork Yellow Creek

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18,364 acres

The Subwatershed of Salt Run- North Fork Yellow Creek encompasses the northeast portion of the Yellow Creek Watershed. Major tributaries in this subwatershed include Dry Run, North Fork Yellow Creek, Randolph Run, Salisbury Run, and Salt Run. This subwatershed contains the most sampling points that failed to meet their designated use during the 2005 sampling by Ohio EPA.

Climate

The average annual maximum temperature in the Salt Run-North Fork Yellow Creek Subwatershed is 84°F, with an average annual minimum temperature of 20° F. The average annual precipitation rate is 38 inches.

Municipalities

A small section (402.7) of the eastern end of the village of Salineville lies within the boundaries of this subwatershed, as well as the entire village of Irondale (909.2 acres).

Geology

The bedrock of the Salt Run North Fork Yellow Creek Subwatershed consists mainly of shale and siltstone. The area having probable Karst features amounts to 18,384.5 acres.

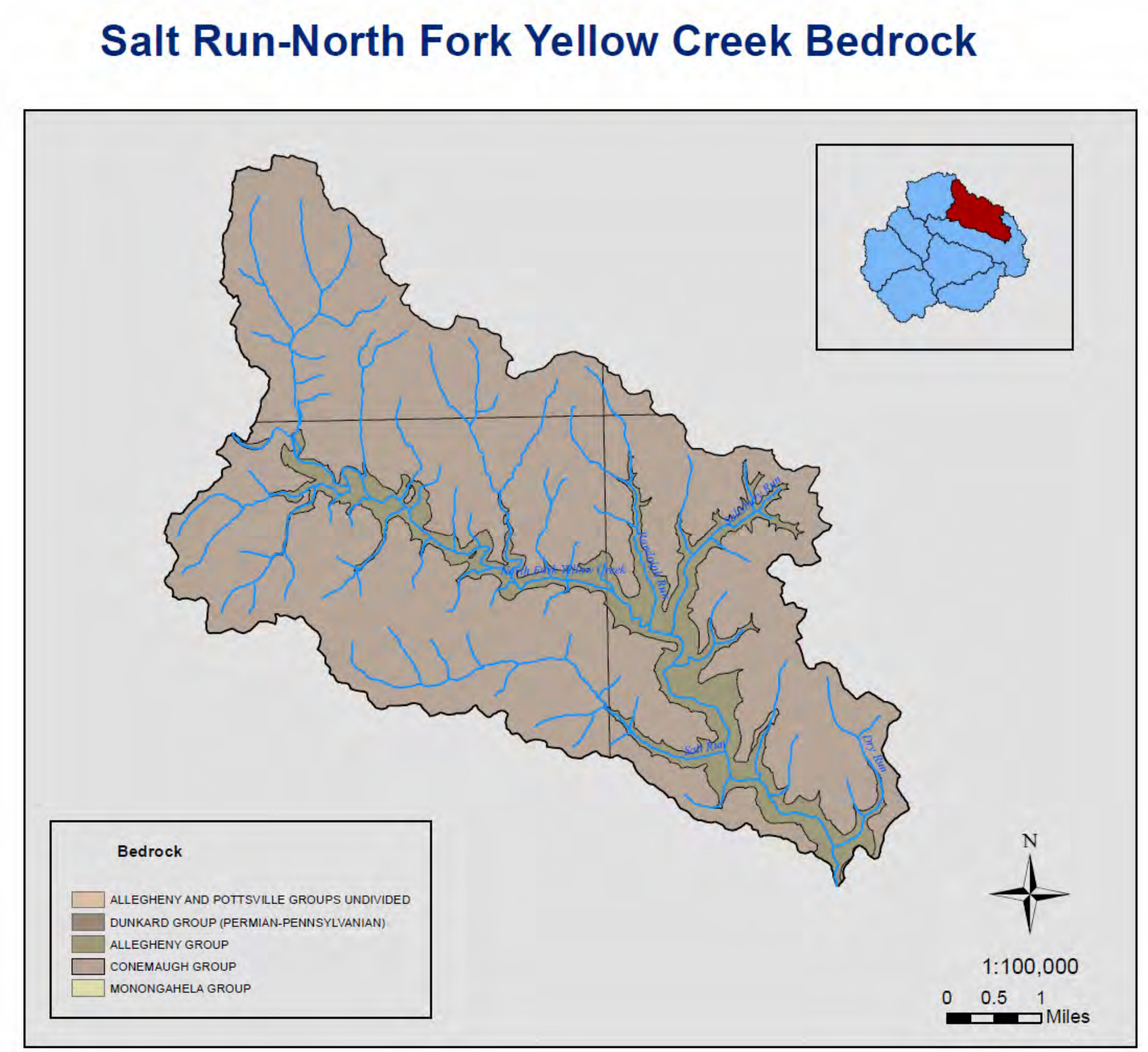

Fig. 125: Salt Run-North Fork Yellow Creek Bedrock

Population

The Subwatershed of Salt Run-North Fork Yellow Creek has shown the most dramatic decrease in population, losing nearly 62% of its inhabitants between 1980 and 2000.

1980: 4,388

1990: 1,669

2000: 1,677

The average household size is 2.6, and the average household income is $45,779.00

Soil Resources

The majority of soils in the Salt Run-North Fork Yellow Creek Subwatershed rank well for drainage. Within the subwatershed 3,964.2 acres are considered prime farmland and 5,464.2 acres are highly erodible land.

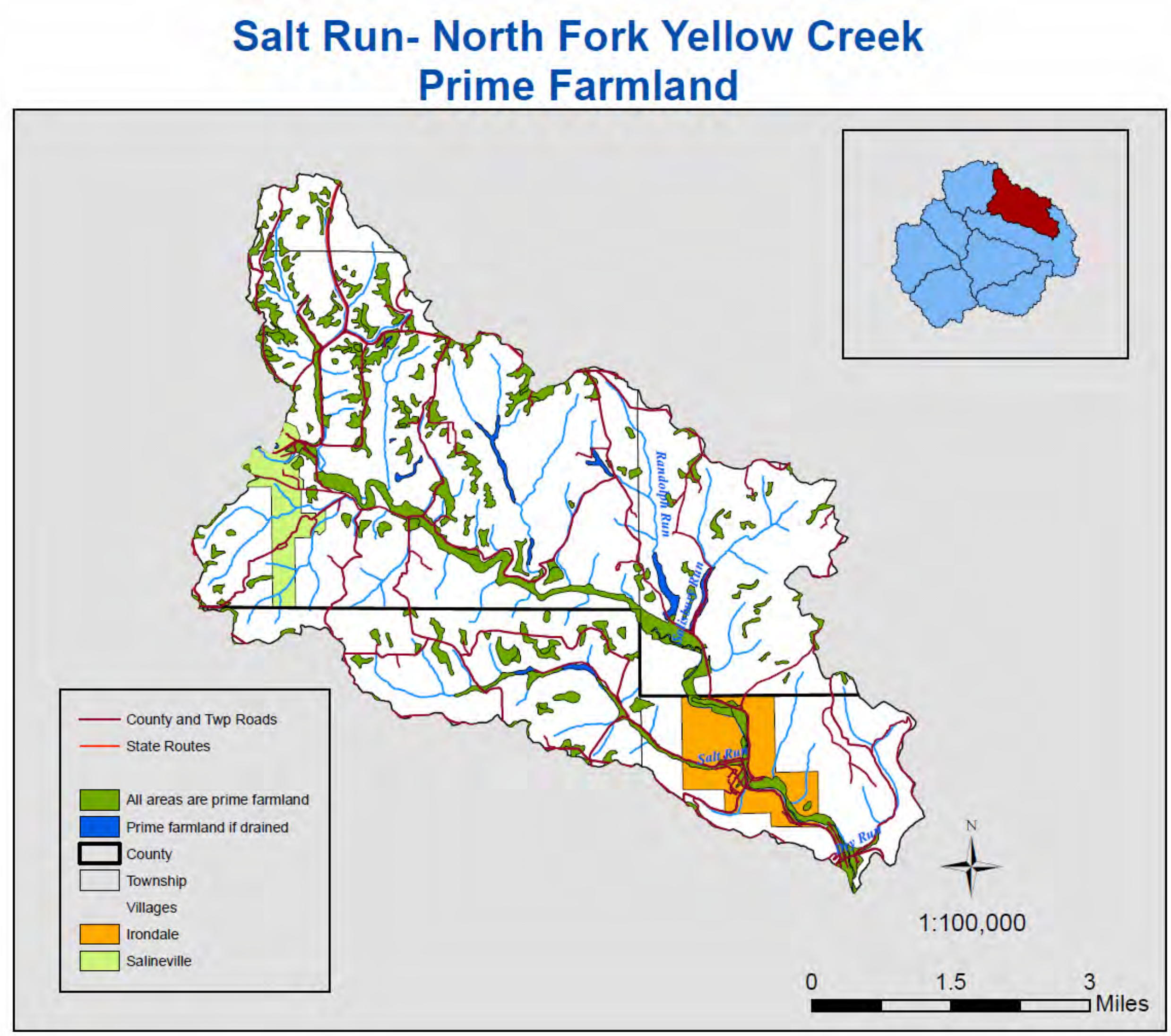

Fig. 126: Salt Run-North Fork Yellow Creek Prime Farmland

While there are no hydric soils, 997.9 acres are partially hydric.

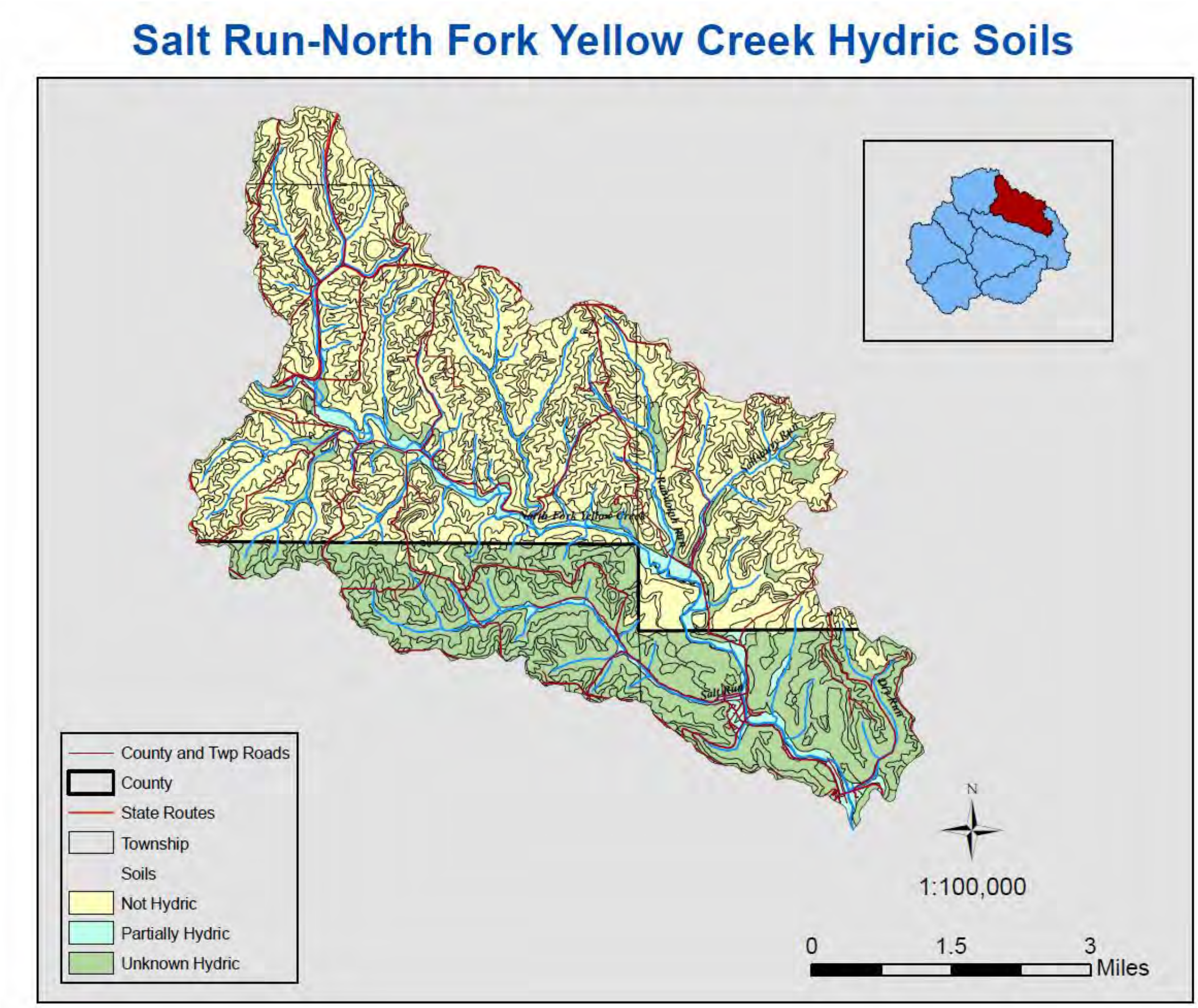

Fig. 127: Salt Run-North Fork Yellow Creek Hydric Soils

Although this subwatershed is listed as having no acres that flood frequently, almost the entire village of Irondale lies within the floodplain.

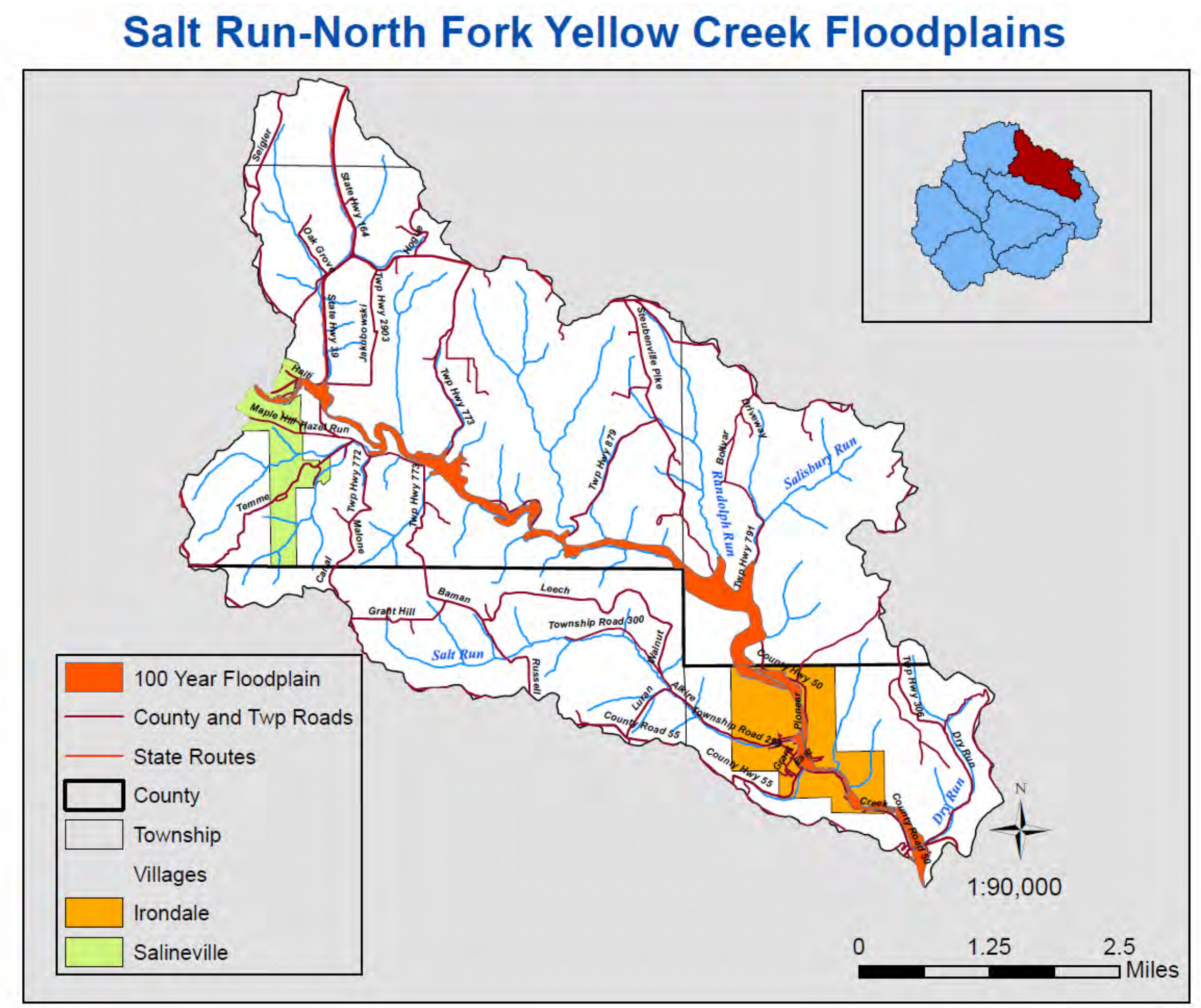

Fig. 128: Salt Run-North Fork Yellow Creek 100 Year Floodplain

Table 53. Salt- Run North Fork Yellow Creek Riparian Tree Species

Black Locust	American Elm
Ash	Cherry

Sycamore	Black Walnut
Box Elder	Sumac

Salt Run-North Fork Yellow Creek Land Use

The decline in agriculture that is pervasive throughout the entire watershed is present in the Salt Run-North Fork Yellow Creek Subwatershed as well. The decline in this subwatershed, however, has not been as drastic as in others, rising in 2001 before declining by 2009. As in several of the more populated watersheds there has been an increase in land use designated as urban, even though there has been a decrease in population. The majority of the land use in this subwatershed is forested, followed by land in agricultural production then urbanized areas. From the subwatershed 535.00 acres are dedicated to conservation and recreation land in the form of the Highlandtown Wildlife area as well as Yellow Creek State Forest.

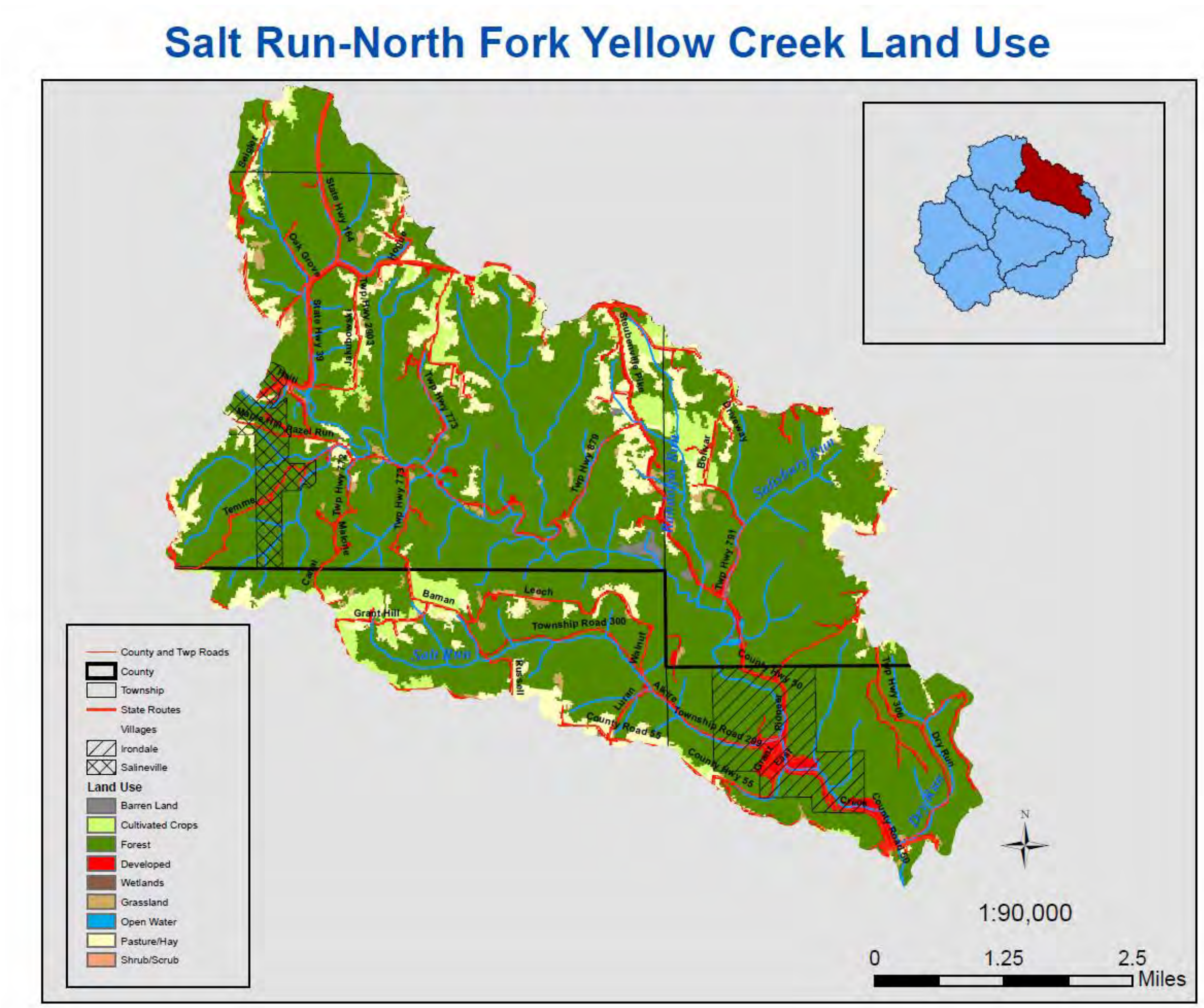

Fig. 129: Salt Run-North Fork Yellow Creek Land Use

Table 54. Salt Run- North Fork Yellow Creek Land Use (acres)

	2009	2001	1994
Agriculture	2,345.7	4,058.2	3,648.0
Water	17.0	191.5	119.9
Urban	1,146.1	177.7	47.7
Forest	14,872.3	13,915.0	14,334.7
Barren	0.0	30.7	0.6
Shrub/Scrub	1.5	7.6	232.8

Agricultural Characteristics

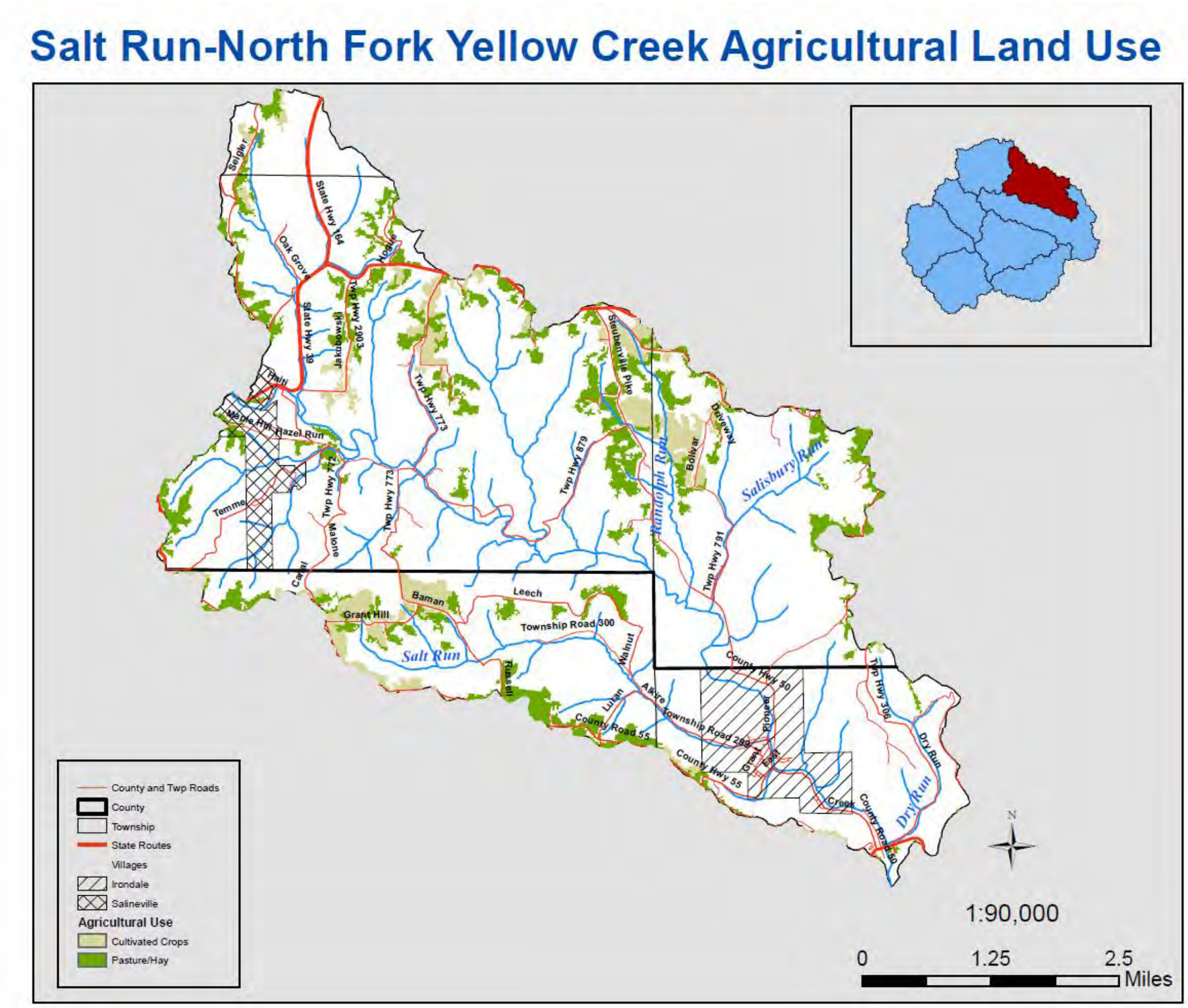

Fig. 130: Salt Run-North Fork Yellow Creek Agricultural Land Use

The subwatershed of Salt Run-North Fork Yellow Creek is located at the northeastern edge of the watershed, primarily in Columbiana County, but extending into northern Jefferson County.

Soils in this subwatershed are of three different associations: Gilpin-Berks-Steinsburg, Westmoreland-Hazelton-Berks and Gilpin-Lowell-Morristown.

In northern Jefferson County, agricultural land use in the Salt Run watershed is again primarily concentrated across the ridgetop adjacent to County Road 55. Agricultural production on this ridge consists primarily of beef and dry dairy grazing operations. There are also a small number of sheep and rabbits, and several other producers own one to five horses. Producers in this area do raise crops and hay. Nearly all producers in this area practice no till, contour farming, contour strip cropping, and crop rotation, and have installed other conservation practices such as exclusion fencing and spring developments to protect the health of the watershed.

The portion of this subwatershed in Jefferson County's Saline Township is mainly the Village of Irondale, where agriculture is not a major land use.

In Columbiana County most of the land in this watershed is used for agricultural production. Beef and dairy are the primary agricultural operations. Much of the land is used for producing hay. The majority of the row crop production is done using no-till planting, contour strip farming, and crop rotation. This watershed also contains several operations with horses on pasture. Most of these are on continuously grazed paddocks.

Salt Run-North Fork Yellow Creek Water Quality

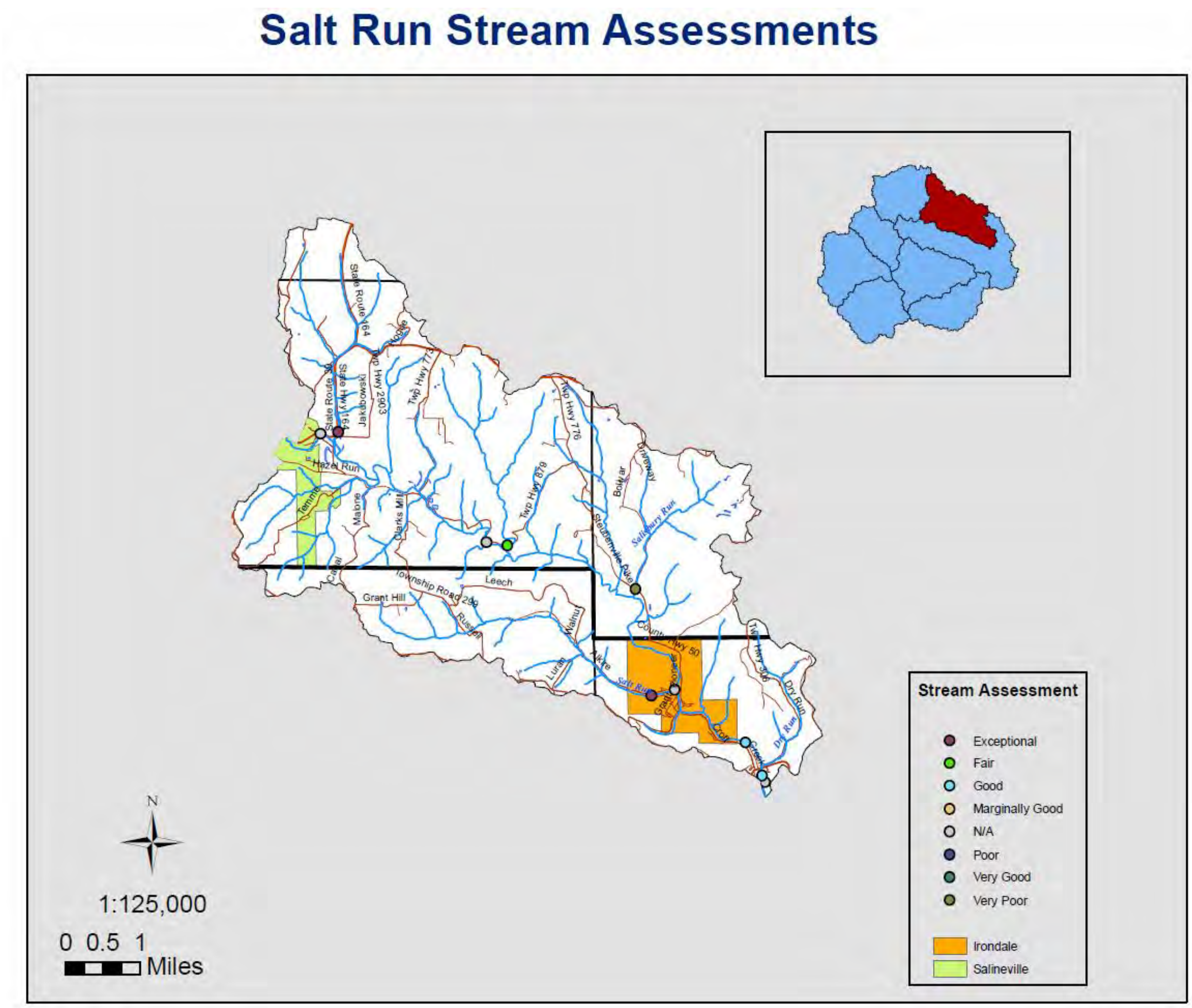

Fig. 131: Salt Run-North Fork Yellow Creek Stream Assessments

Ground Water

The approximate number of water wells in the Salt Run-North Fork Yellow Creek Subwatershed is 85, although it is very likely that there are more wells that were not recorded or submitted to the Ohio Division of Natural Resources. Within the watershed 18,348.4 acres are highly sensitive to groundwater contamination.

Surface Water

A total of 617.3 acres within this subwatershed have been determined to be within the 100 year floodplain. There is a total of 120.3 acres of wetland, the least amount of all the subwatersheds. Other surface water features include 26.8 acres of ponds and lakes and 71.9 acres of streams. There is one municipal discharge and four dams listed for the Salt Run Subwatershed.

This particular subwatershed has proven to have the most sites in non-attainment of their designation status during the 2005 summer sampling event performed by Ohio EPA. Out of the eight sampling locations only five achieved full attainment status, one reached partial attainment, and two were in a state of non-attainment. One of the sites that failed to attain its designated status was downstream of the Salineville sewage treatment facility. Since the completion of the TMDL study the facility has been brought into compliance under the guidance of the northeast district of Ohio EPA.

Salt Run- North Fork Yellow Creek Attainment Status

Fig. 132: Salt Run-North Fork Yellow Creek Attainment Status

Table 55. Salt Run- North Fork Yellow Creek Water Quality

Stream Name and River Mile	Date	IBI	ICI	MiWb	QHEI	Aquatic Life Use
Dry Run	**NA**	**NA**	**NA**	**NA**	**NA**	**WWH**
North Fork Yellow Creek	**NA**	**NA**	**NA**	**NA**	**NA**	**WWH**
Randolf Run	**Full**	**Dry**	**Fair**	**NA**	**NA**	**LRW**
Salisbury Run 0.6	**Unknown**	**NA**	**Good**	**NA**	**NA**	**LRW**
Salisbury Run 0.2/0.1	**Non**	**12**	**Very Poor**	**NA**	**56.0**	**LRW**
Salt Run	**Full**	**40**	**Exceptional**	**NA**	**55.0**	**WWH**

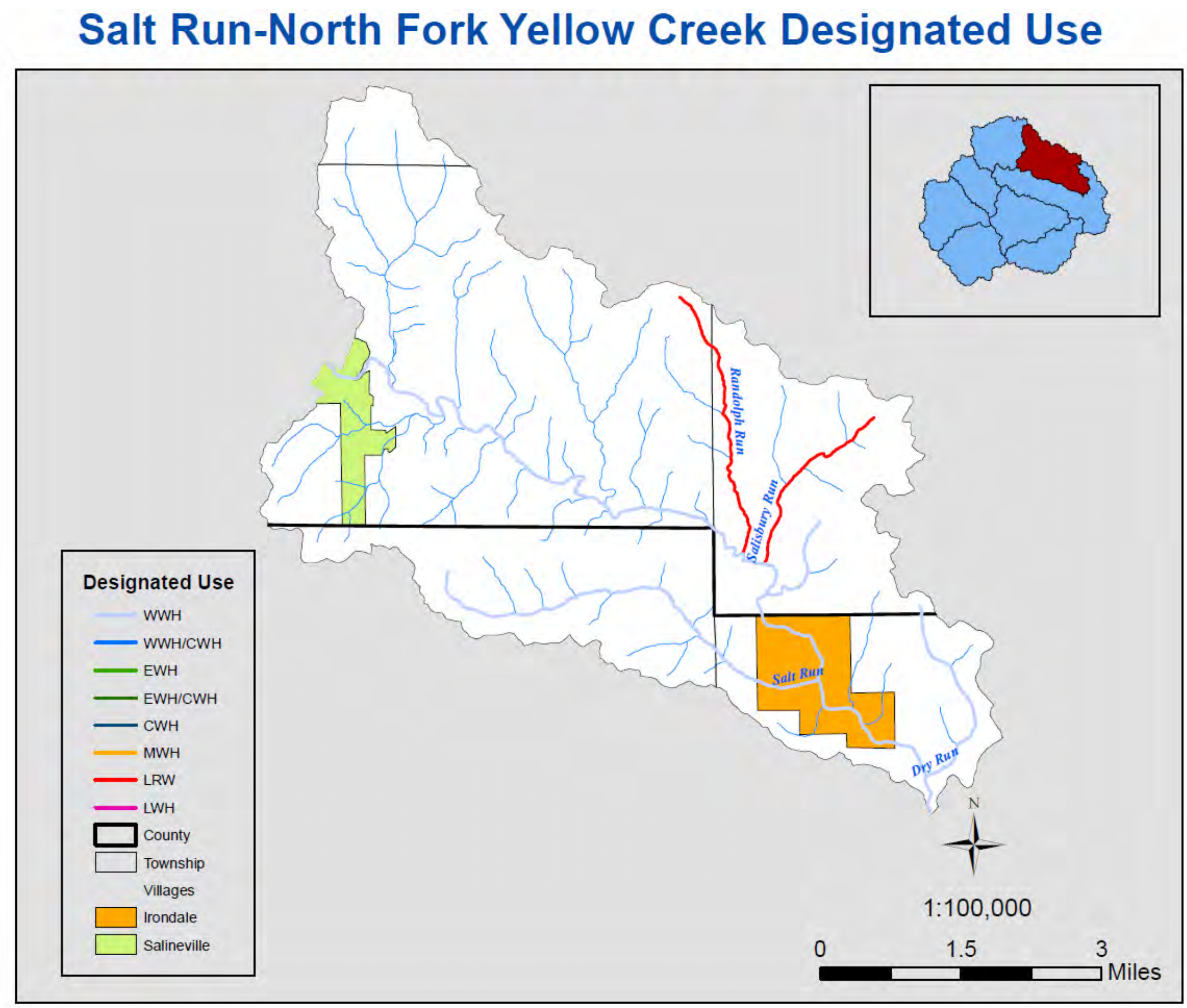

Fig. 133: Salt Run-North Fork Yellow Creek Designated Use

Problem Statement 1: (Bacteria)

The unsewered village of Irondale, located almost completely within the floodplain of the North Fork of Yellow Creek, needs an overall load reduction of 100% of its untreated human waste for surrounding stream segments to reach attainment.

Goal 1.1: Partner with Village of Irondale and RCAP to seek funding for construction of wastewater treatment plant to assist in the reduction of Fecal Coliform loading in the Salt Run-North Fork watershed by 106,009 gallons per day.

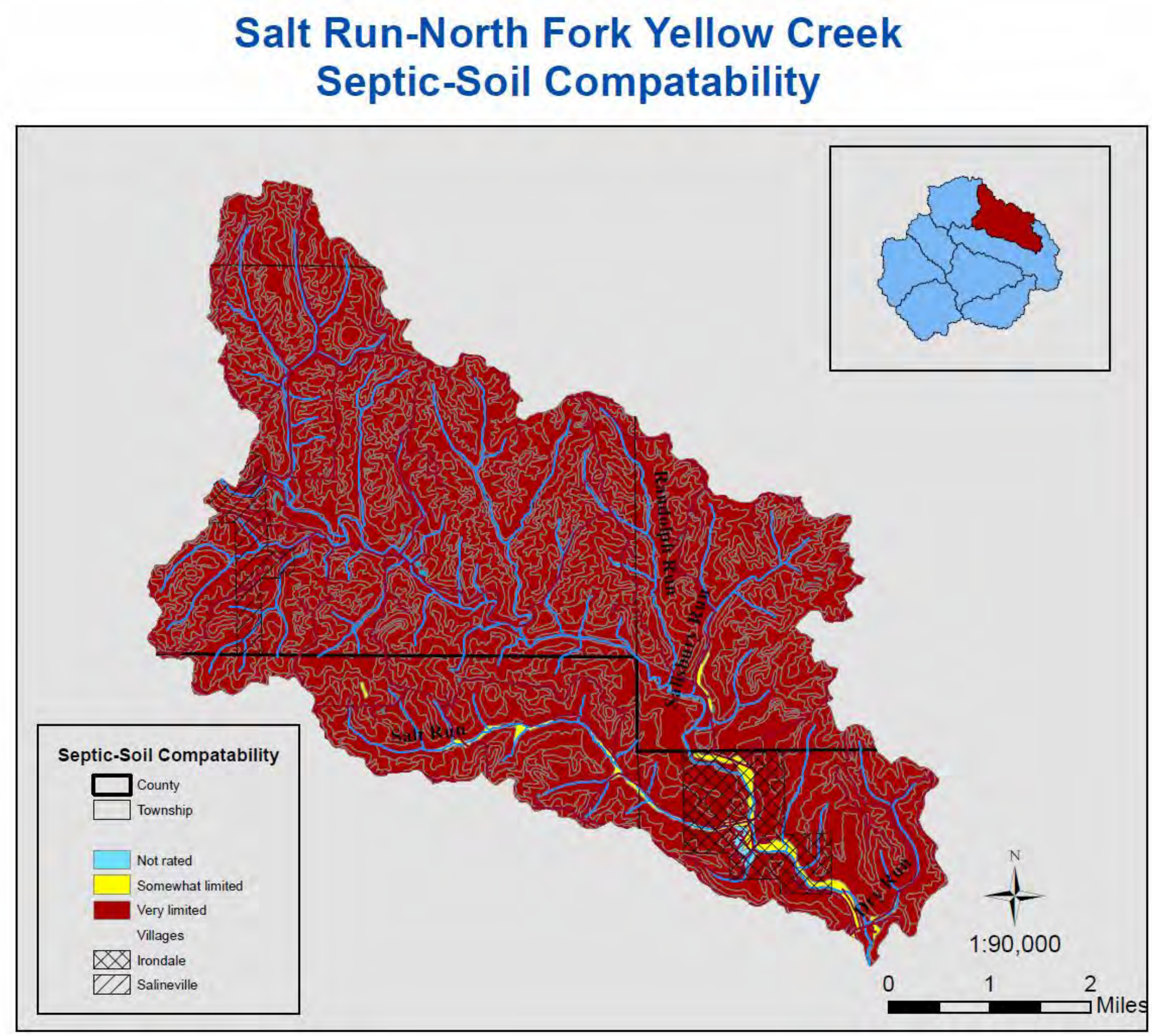

Fig. 134: Salt Run-North Fork Yellow Creek Septic-Soil Compatibility

Pollutant	Goal	Task Description	Resources	How	Time Frame	Performance Indicator
Bacteria	1.1	Seek funding for development of decentralized sewage treatment system feasibility study for the village of Irondale	$100,000 for study	RCAP, DEFA, Jefferson Soil and Water Conservation District, OEPA	2013-2014	One completed feasibility study
		Seek financial assistance for installation of sewage treatment plant			2015-2020	Installation of sewage treatment plant.

Problem statement 2: (Acidity)

Acid Mine drainage entering Salisbury Run

Goal 2.1: Further characterize acid mine drainage entering Salisbury Run from a deep mine source

> **Objective:** Collection of chemical and biological data from Salisbury Run deep mine source

Goal 2.2: Reduction of acidity entering Salisbury Run by 95 tons per year

> **Objective:** Design and installation of treatment system at deep mine source on Salisbury Run

Pollutant	Goal	Task Description	Resources	How	Time Frame	Performance Indicator
Acidity	2.1	Collection of chemical and biological samples	JSWCD staff will collect data and submit to DMRM	AMD set-aside funding for sample analysis.	2015-2016	Water quality data entered into online database and submitted to DMRM
	2.2	Alternative 1: Construction of two aerobic wetlands, limestone drain channels and crossdrains	DMRM engineering and design staff	AML Set-aside/ mitigation funding sought by Jefferson Soil and Water Conservation District	2017-2020	Reduction of acidity by 95 tons per year

Problem Statement 3: (Sedimentation/nutrients)

As confirmed by the 2009 TMDL, Salt Run-North Fork Yellow Creek subwatershed is impaired by elevated levels of bacteria related to livestock operations that have access to the stream.

Goal 3.1: Reduce sedimentation and nutrient loadings entering Randolph Run

Objective: Target cattle and dairy operations along Randolph Run where livestock have access to the stream.

Actions: Install 26,400 feet of exclusion fencing.

Pollutant	Goal	Task Description	Resources	How	Time Frame	Performance Indicator
Sedimentation, Nutrients	3.1	Target cattle and dairy operations along Randolph Run where livestock have access to the stream. Work with landowners to install 13,200 feet of fencing and needed auxiliary practices to protect at least 2.58 miles of streambank.	26,400 ft* $2.16/foot= $57024.00	Ohio Division of Wildlife, US Fish and Wildlife, US Forest Service, USDA	Jan. 2013- Jan. 2015	Document 2.58 miles of streambank fencing installed along with acreage of riparian area protected. Improved QHEI scores.

Problem Statement 4: (Habitat)

The subwatershed of Salt Run-North Fork Yellow Creek lacks adequate riparian corridor species throughout the watershed. This leads to increased sedimentation, stream temperatures and habitat alteration in the form of streambank erosion.

Goal 4.1: 4.5 river miles of improved riparian cover

Objective: 27.27 acres of riparian area planting (25 foot buffer)

Pollutant	Goal	Task Description	Resources	How	Time Frame	Performance Indicator
Sedimentation, increased stream temperatures, habitat	4.1	Establish riparian protection and plantings that will enhance	$20,664.00 27.27 Acres* $741.98	Ohio Division of Forestry, Western Reserve,	2012-2016	4.5 river miles with improved riparian

alteration		approximately 27.27 acres of riparian area with 25 foot buffer.	(established hardwood trees/shrubs w/ weed control)= $20,233.00	Jefferson and Carroll Soil and Water Conservation Districts		cover

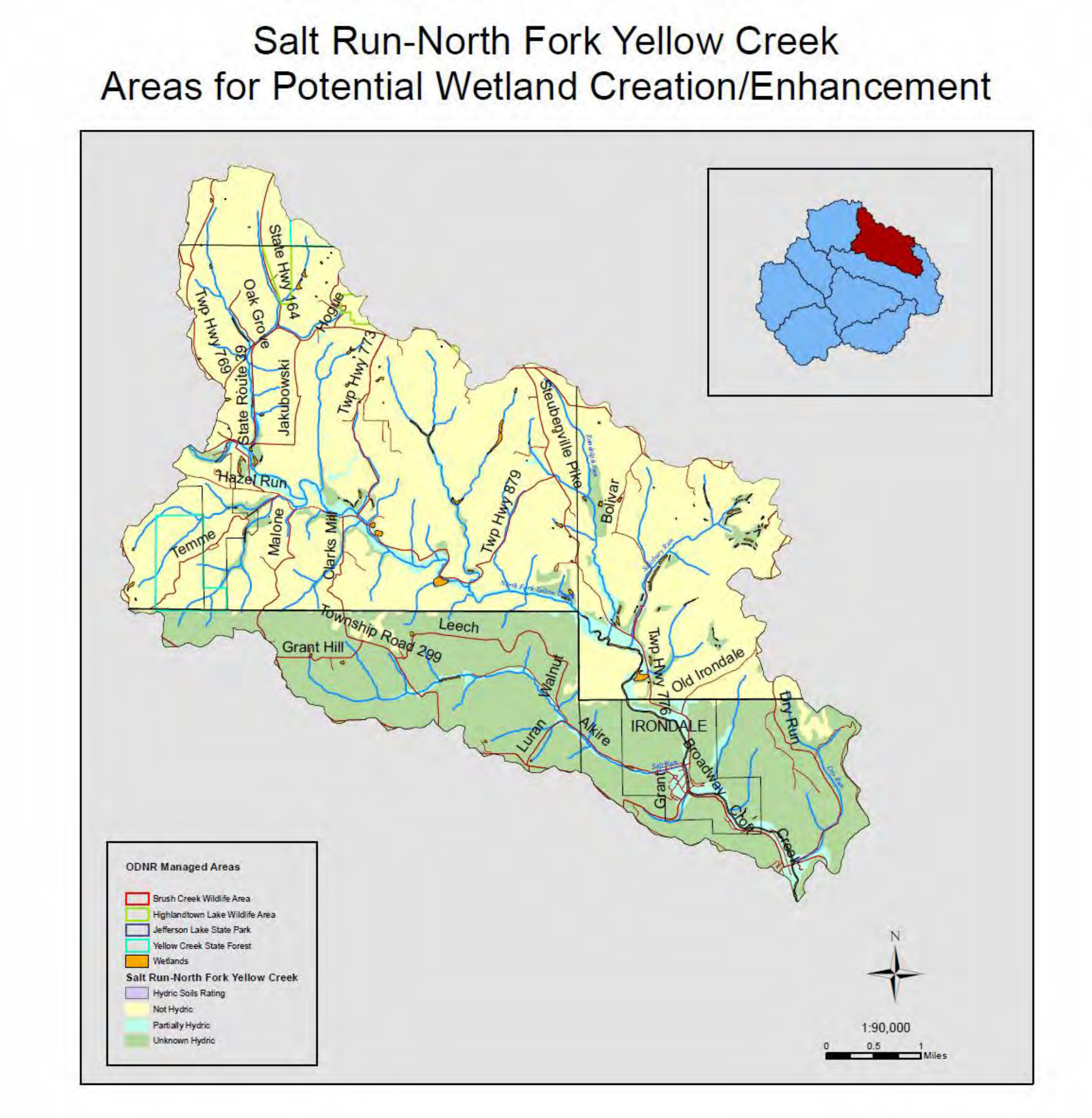

Fig. 135: Wetlands Creation/Enhancement Potential (Corder)

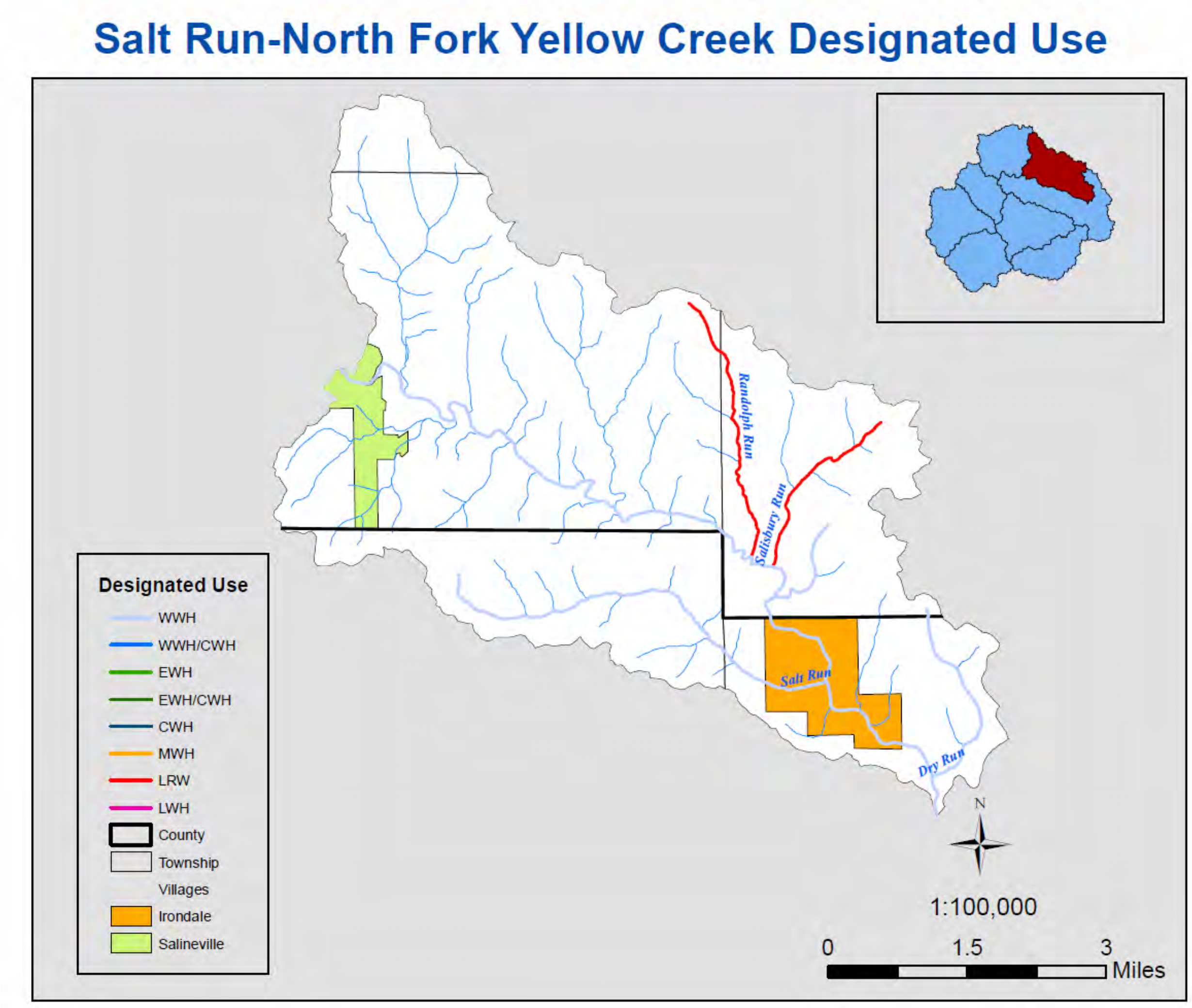

Fig. 136: Salt Run-North Fork Yellow Creek Designated Use (Corder)

Chapter IX. Hollow Rock Run-Yellow Creek Subwatershed

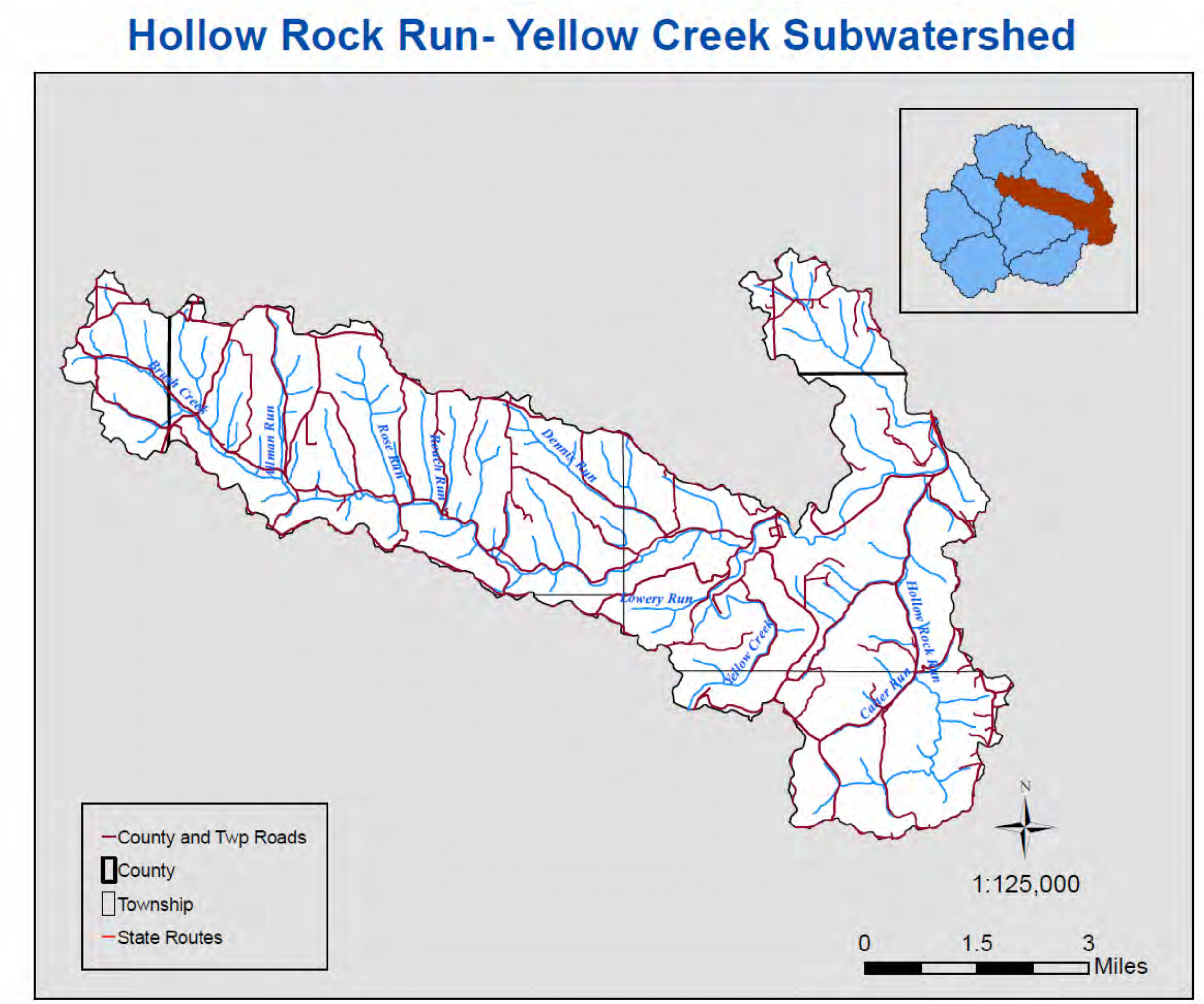

Fig. 137: Hollow Rock Run-Yellow Creek

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25,120 acres

The Subwatershed of Hollow Rock Run-Yellow Creek includes the portion of the mainstem of Yellow Creek that enters the Ohio River. The point at which Yellow Creek enters the Ohio River is on a bend, and this fact coupled with the pooling of water in the Ohio River due to the locks and dam system has lead to sluggish conditions in Yellow Creek. Yellow Creek can be seen to contain backwaters of the Ohio River from the mouth to river mile 2. Major tributaries of this subwatershed include Brush Creek, Carter Run, Dennis Run, Hollow Rock Run, Lowery Run, North Fork Yellow Creek, Roach Run, Rocky Run, and Tarburner Run. Out of the ten sites sampled in 2005 as a part of the total maximum daily load study on Yellow Creek nine were in full attainment of their designated status while one site reached only partial attainment.

Municipalities

There are no municipalities located within the subwatershed of Hollow Rock Run- Yellow Creek.

Geology

The bedrock of the Hollow Rock Run-Yellow Creek subwatershed consists mainly of shale and siltstone. The area having probable Karst features amounts to 21,147.3 acres.

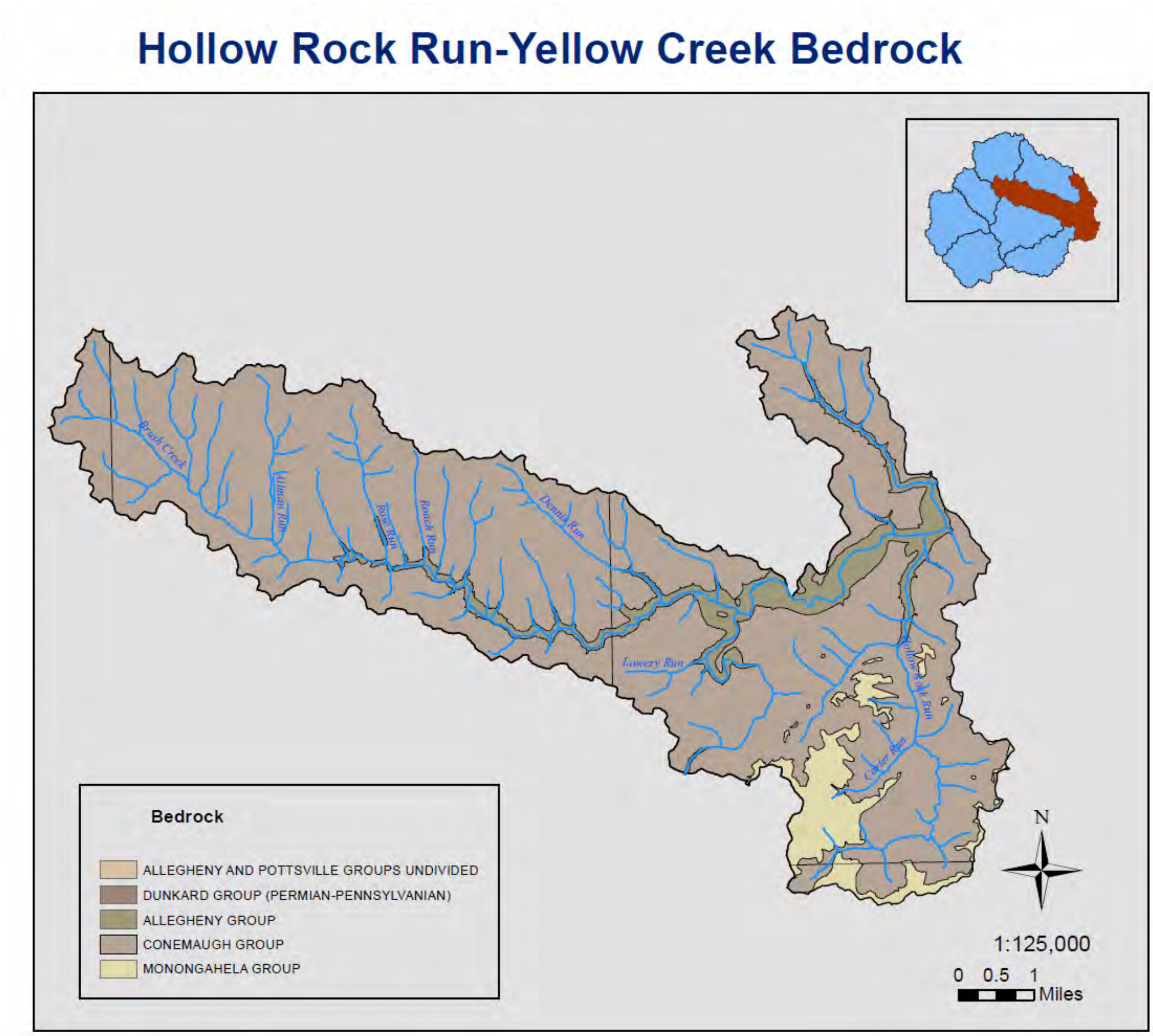


Fig. 138: Hollow Rock Run-Yellow Creek Bedrock

Population

Hollow Rock Run-Yellow Creek has shown smaller fluctuations in population compared to other subwatersheds within Yellow Creek. While population was on the rise from 1980 to 1990, it dipped slightly between 1990 and 2000.

1980: 2,080

1990: 2,315

2000: 2,254

The average household size is 2.6, and the average household income is $45,370.00

Soil Resources

The majority of soils in the Hollow Rock Run-Yellow Creek Subwatershed rank well for drainage. 10,267.2 acres are considered prime farmland and 22,547.6 acres are highly erodible land.

Hollow Rock Run-Yellow Creek
Prime Farmland

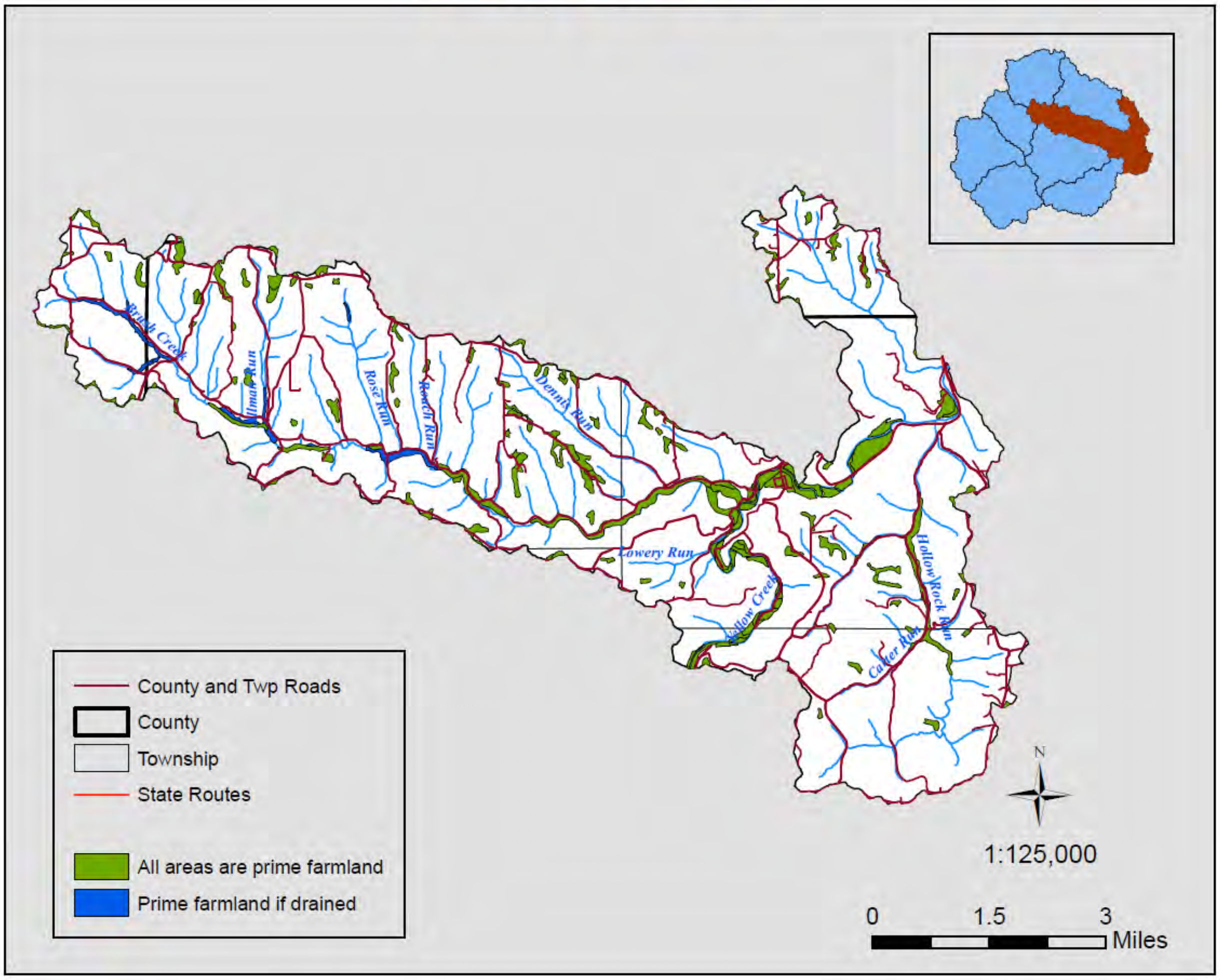


Fig. 139: Hollow Rock Run-Yellow Creek Prime Farmland

While there are no hydric soils, 2,252.4 acres are partially hydric.

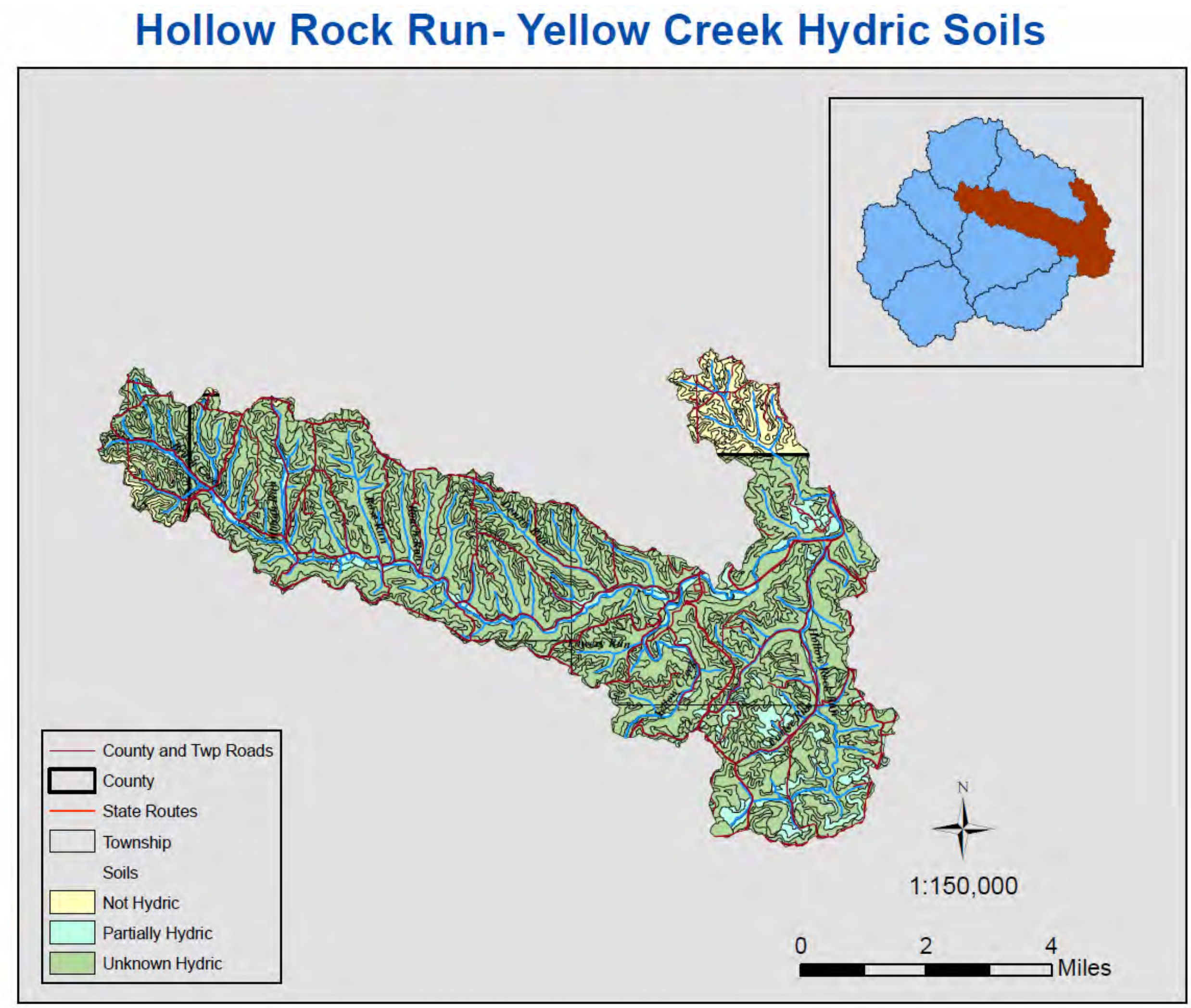


Fig. 140: Hollow Rock Run-Yellow Creek Hydric Soils

The area listed as being frequently flooded in the Hollow Rock Run-Yellow Creek Subwatershed is 16.3 acres.

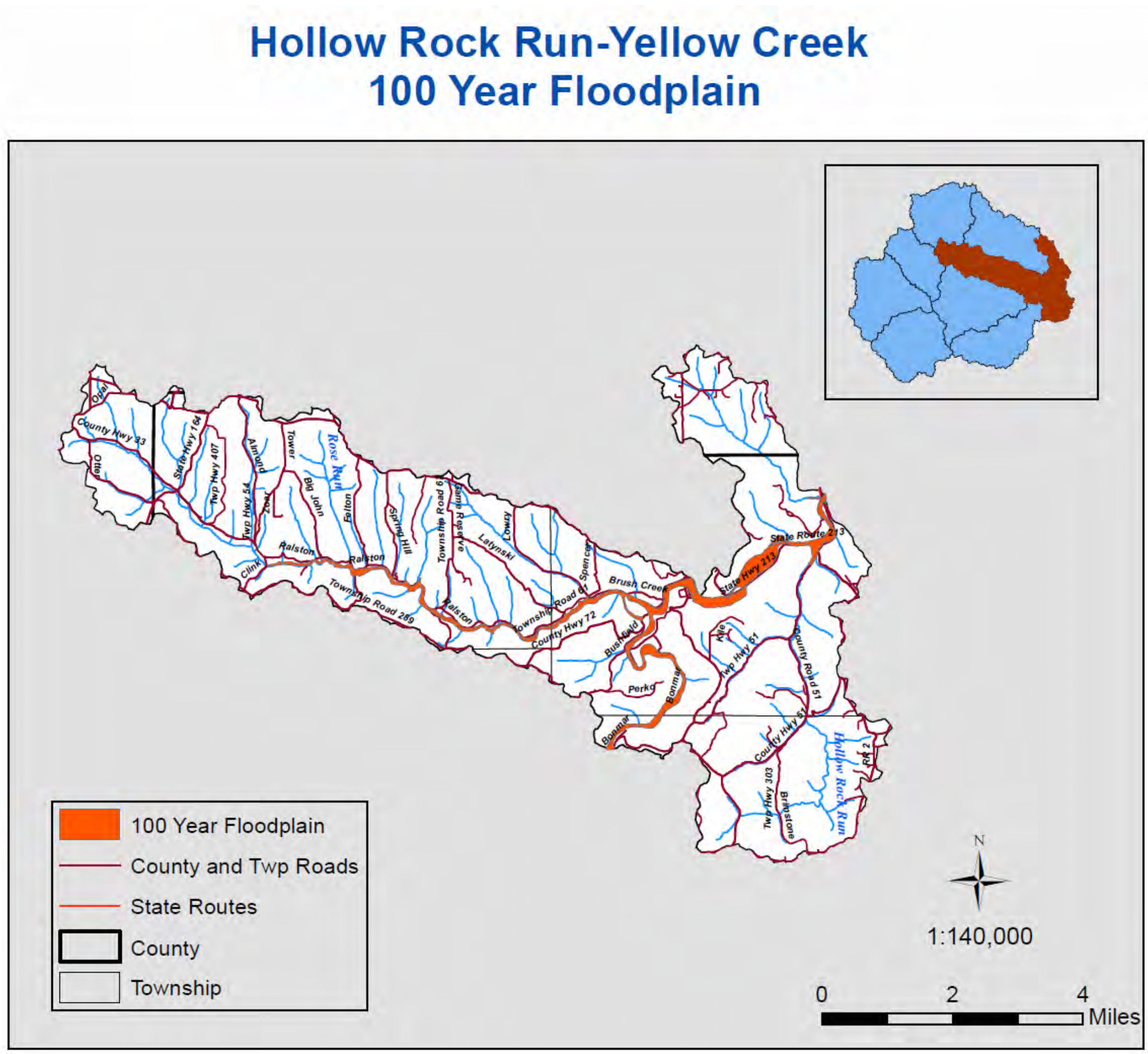


Fig. 141: Hollow Rock Run-Yellow Creek 100 Year Floodplain

Table 56. Hollow Rock Run-Yellow Creek Riparian Tree Species

Sycamore	Tulip Poplar
Maple	Ash
Beech	Elm

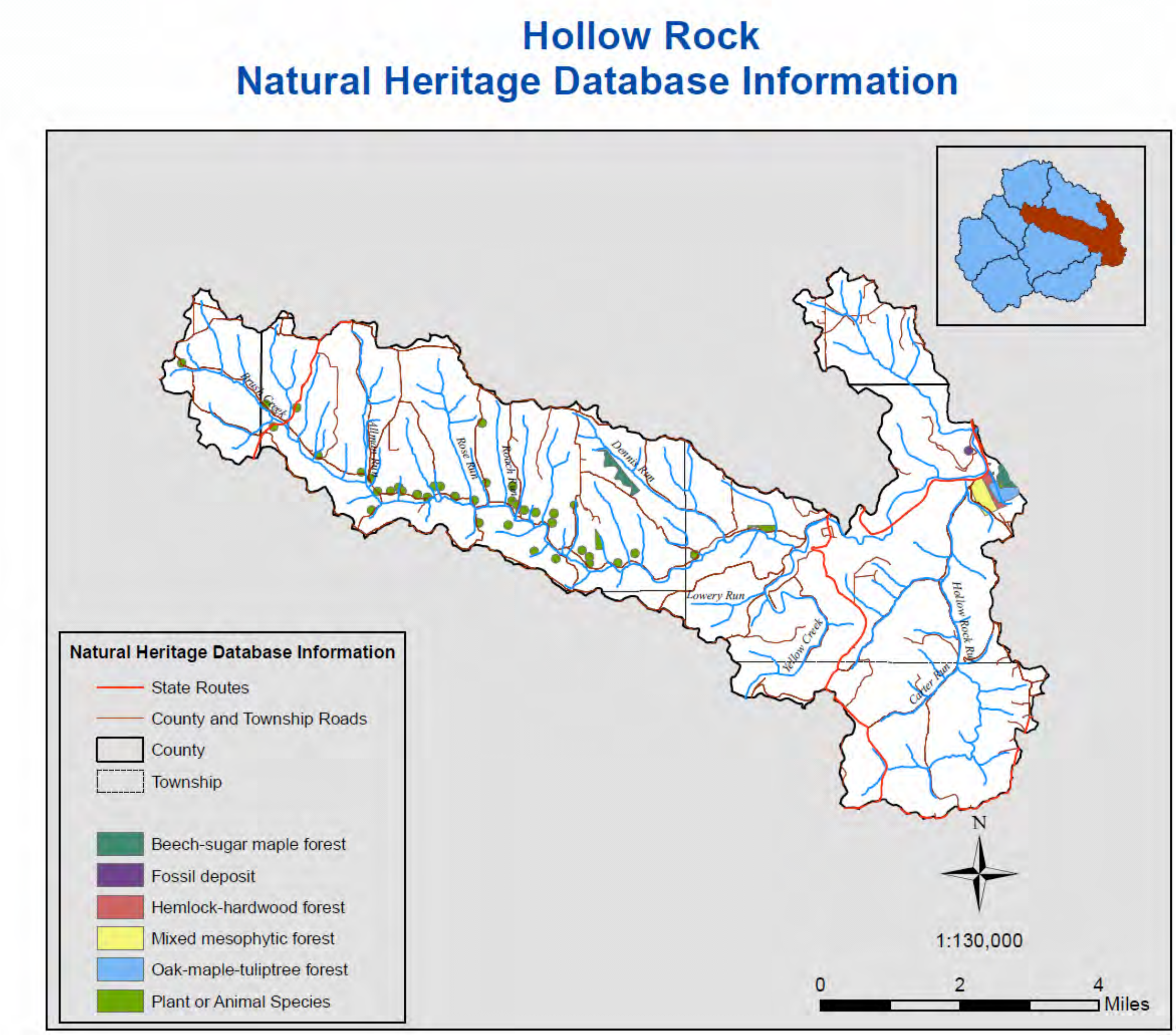


Fig. 142: Hollow Rock Run-Yellow Creek NHD Information

Hollow Rock Run-Yellow Creek Land Use

The decline in agriculture that is pervasive throughout the entire watershed is present in the Hollow Rock Run-Yellow Creek Subwatershed as well. The decline in this subwatershed, however has not been as drastic as in others, rising in 2001 before declining by 2009. As in several of the more populated watersheds there has been an increase in land use designated as urban, even though there has been a slight decrease in population. From the watershed 2,815.6 acres are dedicated to conservation and recreation land in the form of the Brush Creek Wildlife Area. The majority of the land use in this subwatershed is forested, followed by land in agricultural production then urbanized areas.

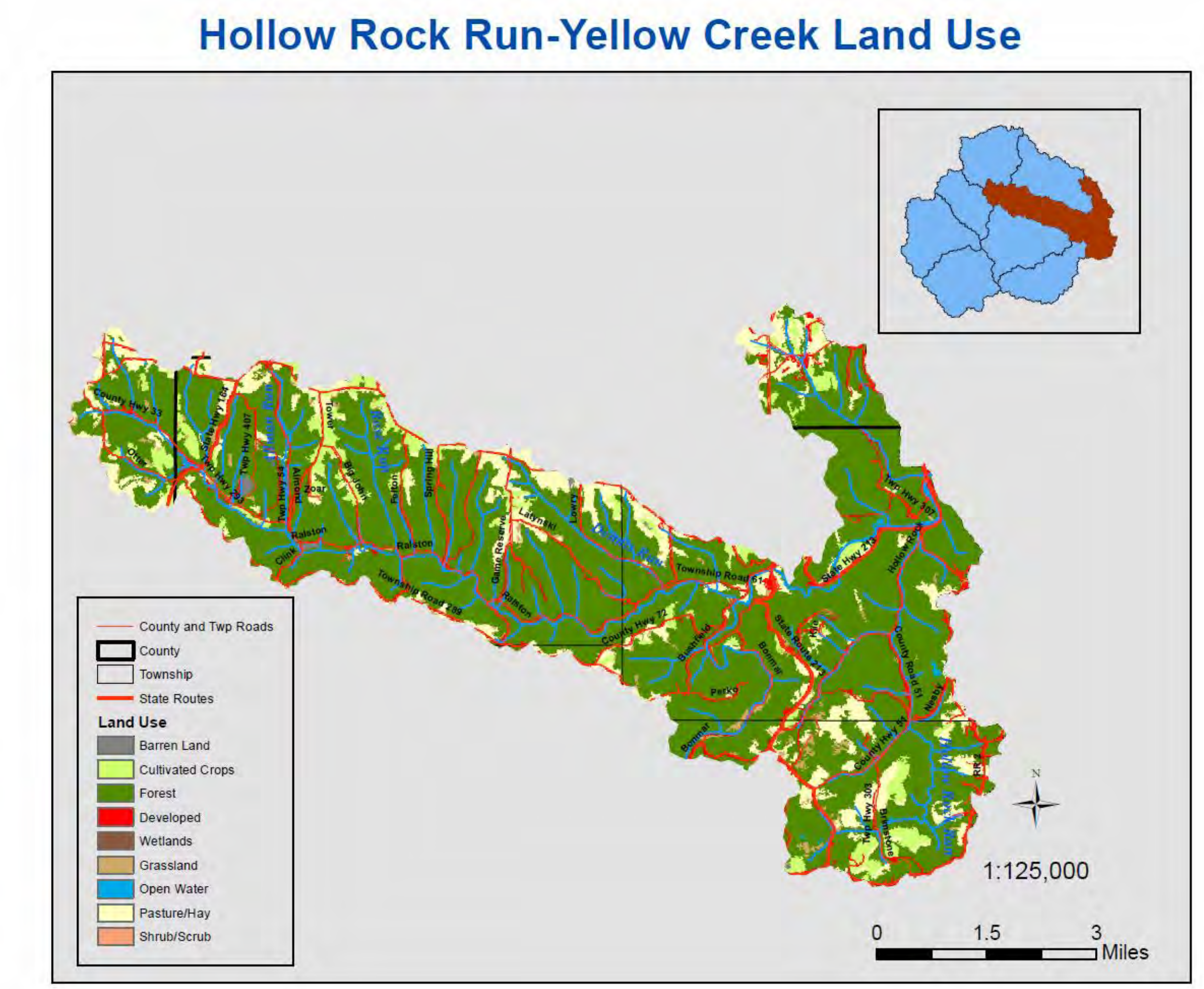


Fig. 143: Hollow Rock Run-Yellow Creek Land Use

Table 57. Hollow Rock Run- Yellow Creek Land Use (acres)

	2009	2001	1994
Agriculture	4,111.7	6,265.5	5,376.6
Water	126.3	388.3	248.8
Urban	1,644.4	149.9	67.1
Forest	19,261.4	18,280.4	19,148.0

Barren	3.9	34.5	21.3
Shrub/Scrub	0.0	31.4	289.0

Agricultural Characteristics

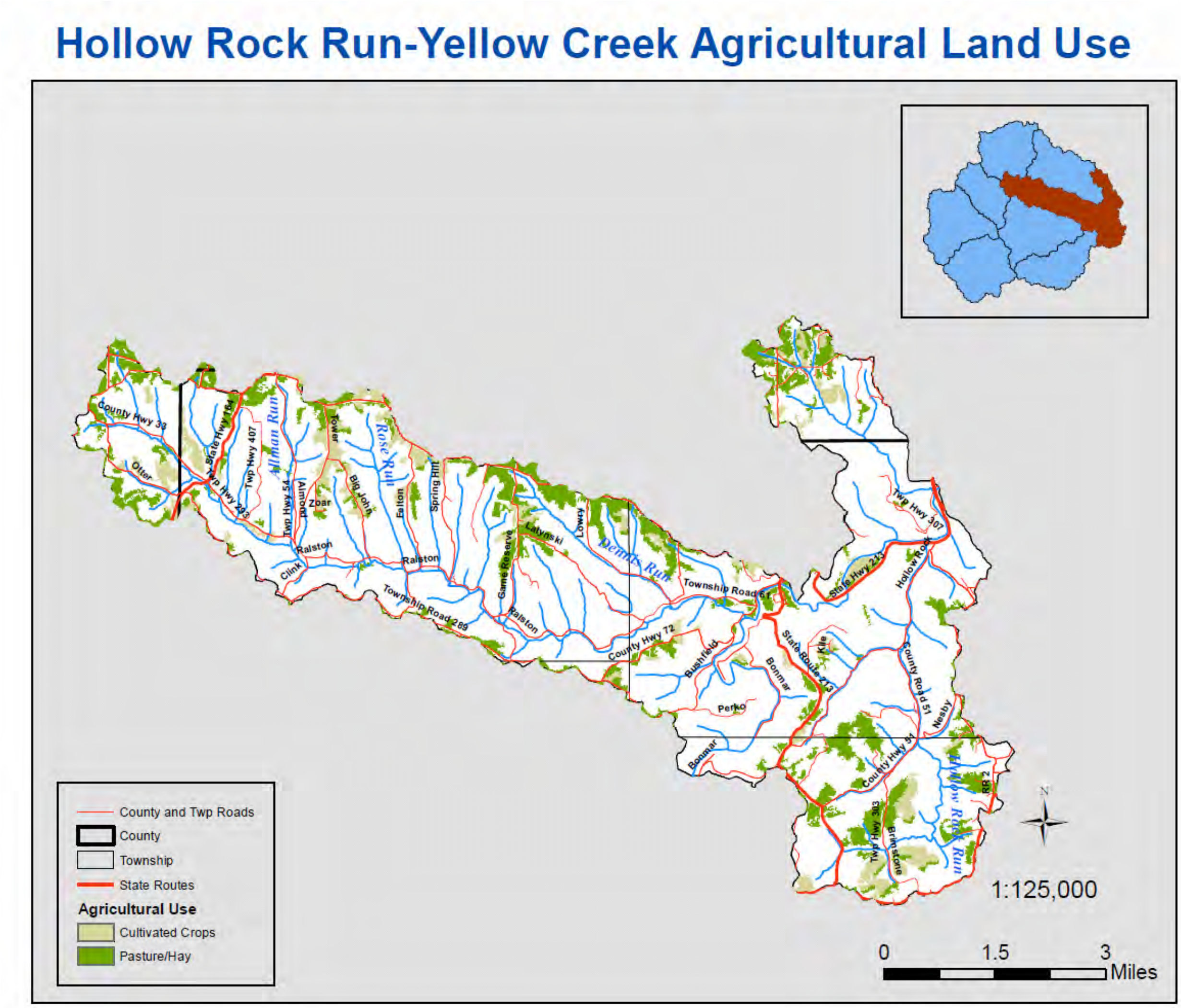


Fig. 144: Hollow Rock Run-Yellow Creek Agricultural Land Use

Hollow Rock Run

The subwatershed of Hollow Rock Run is also located nearly completely within Jefferson County, ending at the eastern edge of the watershed. Soils in this sub watershed are of three different associations: Gilpin-Berks-Steinsburg, Westmoreland-Hazelton-Berks and Gilpin-Lowell-Morristown.

In the Jefferson County portions of this subwatershed, agriculture makes up only a small fraction of the total land use. Most of the acreage is instead in forest and wildlife lands, much of which is managed as the Brush Creek Wildlife Area by the State of Ohio. The Hollow Rock Run sub-watershed also houses a gypsum landfill owned and operated by Ohio Edison power.

The small amount of agriculture in this subwatershed is most prevalent across the ridgetop adjacent to County Road 55. Agricultural production on this ridge consists primarily of beef and dry dairy grazing operations. There are also a small number of sheep and rabbits, and several other producers also own one to five horses. Producers in this area also raise row crops and hay. Nearly all producers in this area practice no till, contour farming, contour strip cropping, and crop rotation, and have installed other conservation practices such as exclusion fencing and spring developments to protect the health of the watershed.

Hollow Rock Run-Yellow Creek Water Quality

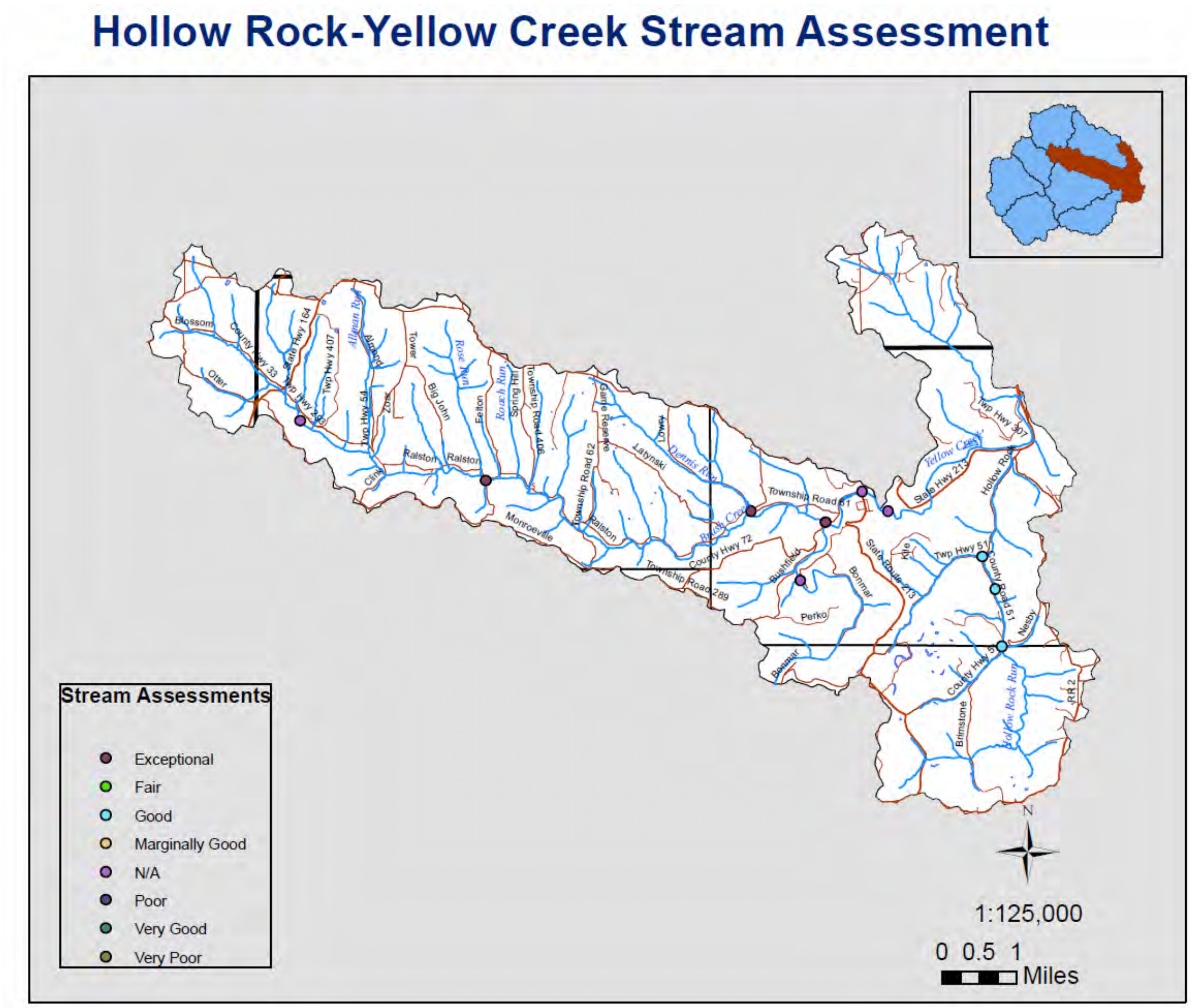


Fig. 145: Hollow Rock Run-Yellow Creek Stream Assessment

Ground Water

The approximate number of water wells in the Hollow Rock Run-Yellow Creek Subwatershed is 55, although it is very likely that there are more wells that were not recorded or submitted to the Ohio Division of Natural Resources. Within the subwatershed 25,138.7 acres are highly sensitive to groundwater contamination.

Surface Water

The area determined to be within the 100 year floodplain in this subwatershed amounts to 755.3 acres. There are 301.3 acres of wetland, some of which can be attributed to required wetland mitigation implemented by FirstEnergy Corp. Other surface water features include 55.1 acres of ponds and lakes and 95.1 acres of streams. There are six municipal discharge permits and seven dams within the Hollow Rock Run-Yellow Creek Subwatershed.

During the summer of 2005, ten sites were sampled in the Hollow Rock Run-Yellow Creek Subwatershed during the total maximum daily load study on Yellow Creek. Of the ten sites sampled only one was found to be in non-attainment of its designated use, reaching only partial attainment. Within the subwatershed 38.7 miles of stream were designated as warmwater habitat. There were no stream segments classified as superior high quality waters.

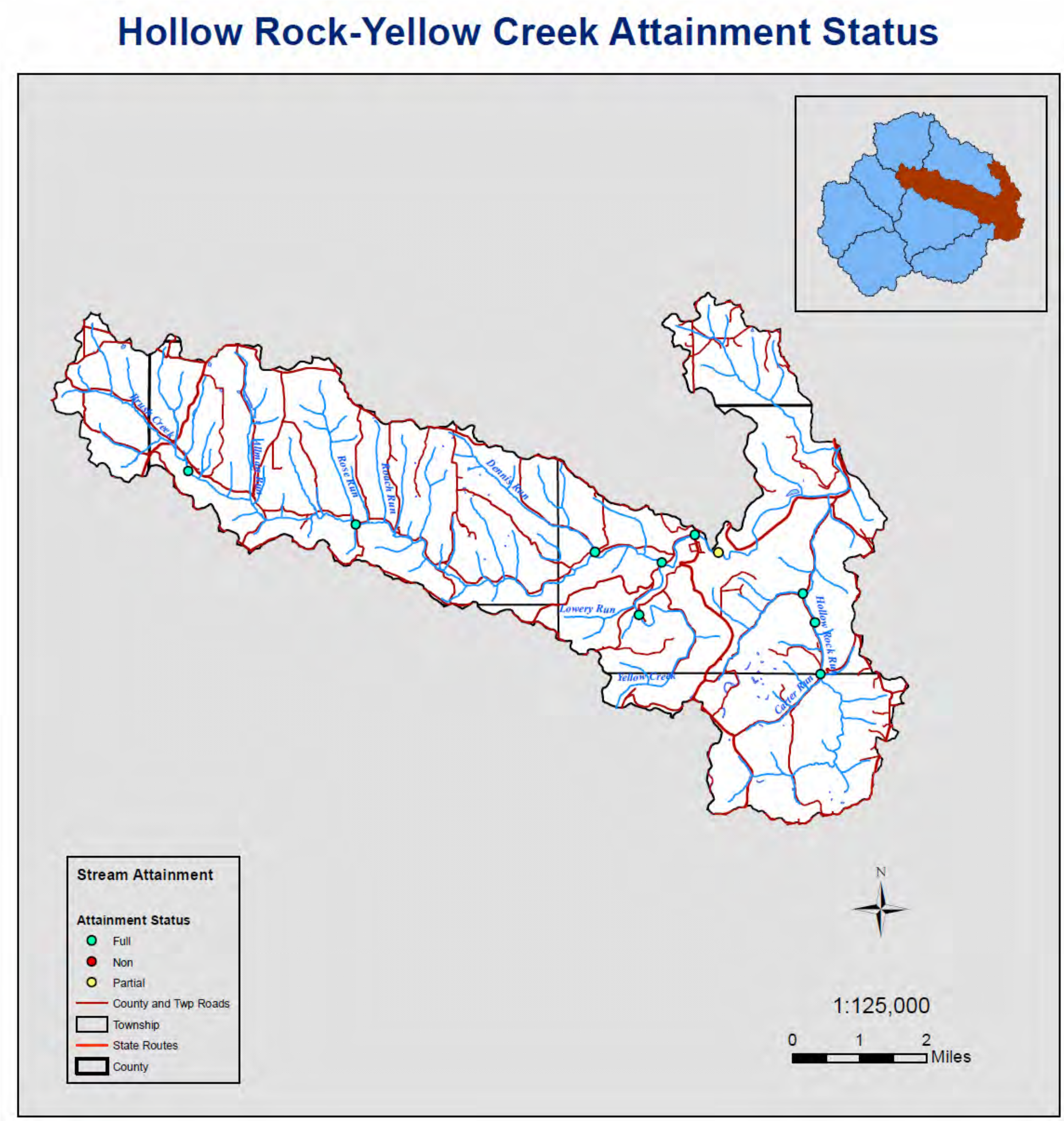


Fig. 146: Hollow Rock Run-Yellow Creek Attainment Status

Table 58. Hollow Rock Run-Yellow Creek Water Quality

Stream Name and River Mile	Attainment Status	IBI	ICI	MiWb	QHEI	Aquatic Life Use
Brush Creek 8.8	**Full**	**44**	**NA**	**NA**	**69.0**	**WWH**
Brush Creek 6.0	**Full**	**50**	**NA**	**NA**	**89.5**	**EWH**
Brush Creek 0.8	**Full**	**60**	**NA**	**NA**	**81.0**	**EWH**
Carter Run	**NA**	**NA**	**NA**	**NA**	**NA**	**WWH**
Dennis Run	**NA**	**NA**	**NA**	**NA**	**NA**	**WWH**
Hollow Rock Run 3.0	**Full**	**42**	**Good**	**NA**	**65.0**	**WWH**
Hollow Rock Run 2.2/2.0	**Full**	**44**	**Good**	**NA**	**48.5**	**WWH**
Lowery Run	**NA**	**NA**	**NA**	**NA**	**NA**	**WWH**
North Fork Yellow Creek	**NA**	**NA**	**NA**	**NA**	**NA**	**WWH**
Roach Run	**NA**	**NA**	**NA**	**NA**	**NA**	**WWH**
Rocky	**NA**	**NA**	**NA**	**NA**	**NA**	**WWH**

Run						
Tarburner Run	**Full**	**46**	**Good**	**NA**	**69.0**	**WWH**
Yellow Creek	**NA**	**NA**	**NA**	**NA**	**NA**	**WWH**

Problem Statement 1:

ATV traffic through streams and the riparian area contributes to the sediment load to streams as well as habitat degradation

Goal 1.1 Reduce ATV access to streams

Objective 1: Education to ATV enthusiasts

Objective 2: Develop Task Force to address illegal ATV activity

Pollutant	Goal	Task Description	Resources	How	Time Frame	Performance Indicator
Sedimentation/habitat alteration	1.1	Develop ATV task force with Saline Twp Police Dept, JSWCD, YCWRC, concerned citizens		Saline Twp. Police Dept., YCWRC, concerned citizens	2013-2014	Reduction of sediment by entering Rocky Run and Dry Run

Problem Statement 2: (Habitat)

The Subwatershed of Hollow Rock Run-Yellow Creek lacks riparian corridor coverage throughout the watershed. This leads to increased sedimentation, stream temperatures and habitat alteration in the form of streambank erosion.

Goal 2.1: 4.00 river miles of improved riparian cover

Objective: 31.18 acres of riparian planting (25 foot buffer)

Pollutant	Goal	Task Description	Resources	How	Time Frame	Performance Indicator
Sedimentation, increased stream temperatures, habitat alteration	2.1	Establish riparian protection and plantings that will enhance approximately 22.18 acres of riparian area with 25 foot buffer.	$18,089.47 31.18Acres* $741.98 (established hardwood trees/shrubs w/ weed control)= $23.134.94	Ohio Division of Forestry, Western Reserve, Jefferson and Columbiana Soil and Water Conservation Districts	2012-2016	4.00 river miles with improved riparian cover

Problem Statement 3:

As confirmed by the 2009 TMDL, the subwatershed Hollow Rock Run-Yellow Creek is impaired by elevated levels of sedimentation and nutrients related to livestock operations that have access to the stream.

Goal 3.1: Reduce sedimentation and nutrient loadings entering Yellow Creek and Brush Creek

Objective: Target cattle operations along the mainstem of Yellow Creek and Brush Creek

Action: Install 1,626 feet of exclusion fencing and necessary auxiliary practices to protect at least .154 miles of stream .

Pollutant	Goal	Task Description	Resources	How	Time Frame	Performance Indicator
Sedimentation, Nutrients	3.1	Target cattle operations along Riley Runs to install 1,626.24 feet of fencing and needed auxiliary practices to protect at least .154 miles of streambank.	1,626.24ft* $2.16/foot= $3,512.68	Ohio Division of Wildlife, US Fish and Wildlife, US Forest Service, USDA	Jan. 2013- Jan. 2015	Document .154 miles of streambank fencing installed along with acreage of riparian area protected. Improved QHEI scores.

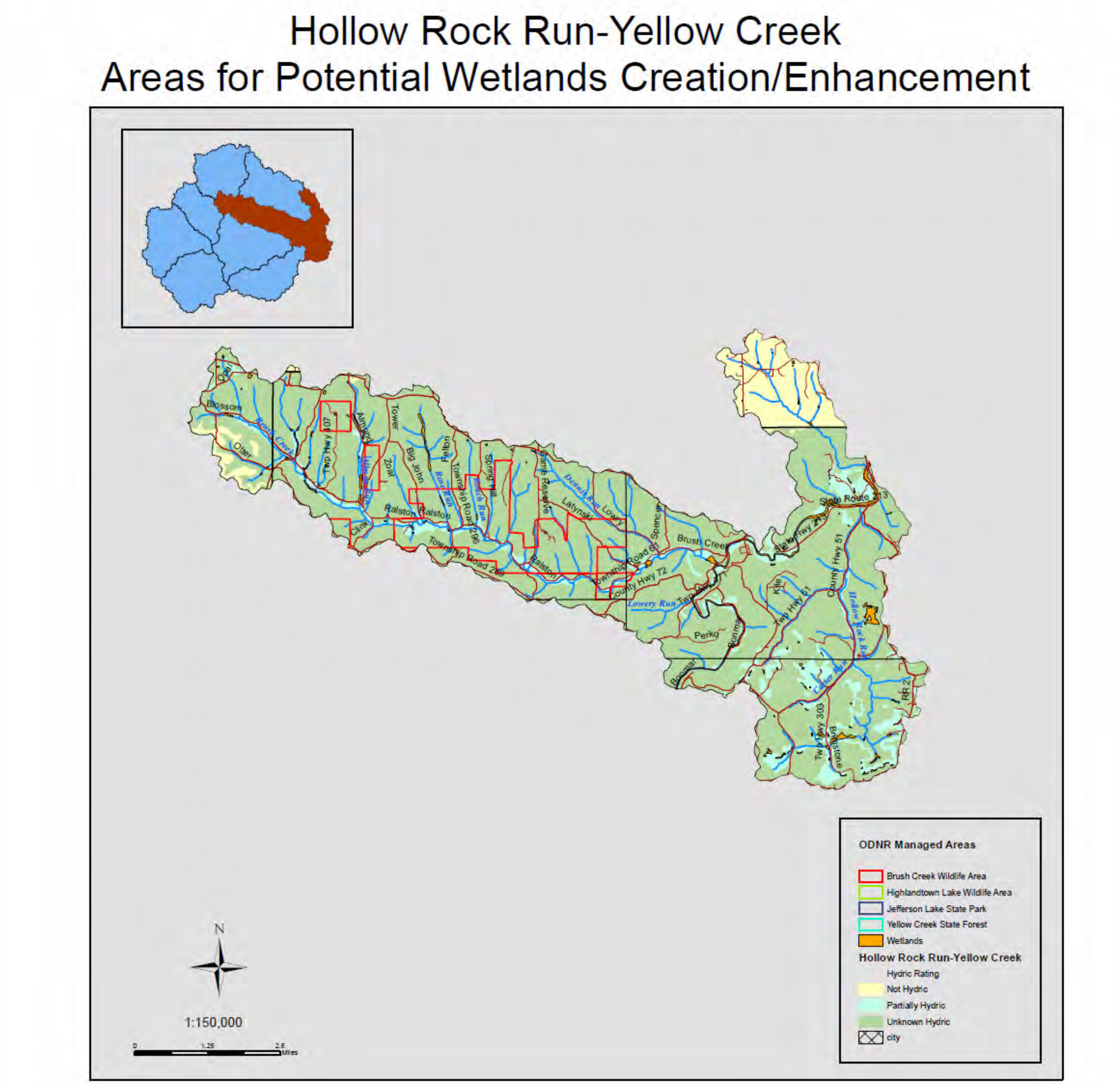


Fig. 147: Wetlands Creation/Enhancement Potential

Areas to be prioritized for protection:

The mainstem of Brush Creek from Rose Run to the mouth, Dennis Run, Hollow Rock Run and Tarburner Run are classified as exceptional warmwater habitat. These streams will be prioritized for protection through conservation easements and riparian setbacks.

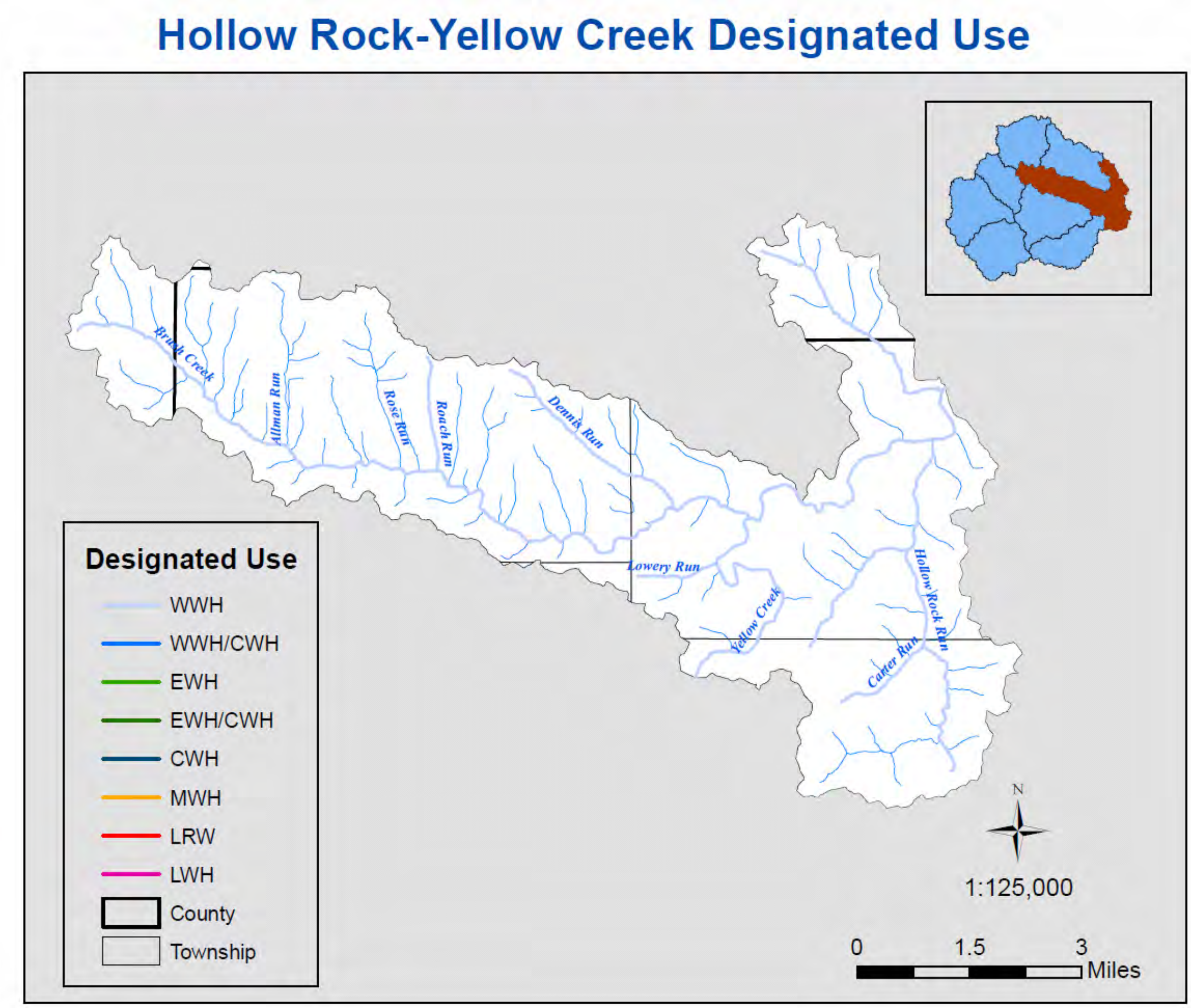


Fig. 148: Hollow Rock Run-Yellow Creek Designated Use

Review and Revision

An internal review of plan strategies completed will be completed each year. This review will be conducted by the FCT coordinator and the Advisory Board. Successes and challenges will be discussed and the watershed action plan implementation timeline adjusted accordingly. After the yearly review, a report will be presented to the FCT partners at the next partners' lunch and will be included in the subsequent newsletter. An update for the plan will be initiated by the Advisory Board after five years, unless otherwise stated by the Board. As in the initial planning process, residents, business owners, civic groups, public officials, and agency staff will participate in the revision process.

Appendices

INTERNAL REVENUE SERVICE
P. O. BOX 2508
CINCINNATI, OH 45201

DEPARTMENT OF THE TREASURY

Date: JUN 29 2007

YELLOW CREEK WATERSHED RESTORATION
COALITION
131 MAIN ST LOWER LEVEL
WINTERSVILLE, OH 43953

Employer Identification Number:
06-1656453
DLN:
17053086045037
Contact Person:
WILLIAM J BARD ID# 31333
Contact Telephone Number:
(877) 829-5500
Accounting Period Ending:
December 31
Public Charity Status:
170(b)(1)(A)(vi)
Form 990 Required:
Yes
Effective Date of Exemption:
June 23, 2005
Contribution Deductibility:
Yes

Dear Applicant:

We are pleased to inform you that upon review of your application for tax exempt status we have determined that you are exempt from Federal income tax under section 501(c)(3) of the Internal Revenue Code. Contributions to you are deductible under section 170 of the Code. You are also qualified to receive tax deductible bequests, devises, transfers or gifts under section 2055, 2106 or 2522 of the Code. Because this letter could help resolve any questions regarding your exempt status, you should keep it in your permanent records.

Organizations exempt under section 501(c)(3) of the Code are further classified as either public charities or private foundations. We determined that you are a public charity under the Code section(s) listed in the heading of this letter.

Please see enclosed Information for Exempt Organizations Under Section 501(c)(3) for some helpful information about your responsibilities as an exempt organization.

If you distribute funds to other organizations, your records must show whether they are exempt under section 501(c)(3). In cases where the recipient organization is not exempt under section 501(c)(3), you must have evidence the funds will be used for section 501(c)(3) purposes.

If you distribute funds to individuals, you should keep case histories showing the recipient's name and address; the purpose of the award; the manner of selection; and the relationship of the recipient to any of your officers, directors, trustees, members, or major contributors.

Yellow Creek Watershed Restoration Coalition 061656453

Annual Conflict of Interest Policy Statement

Adopted into policy at the Yellow Creek Watershed Restoration Coalition Meeting on October 19th, 2006.

I ______________________________ have received a copy of the conflict of interest policy for the Yellow Creek Watershed Restoration Coalition. I understand that the Yellow Creek Watershed Restoration Coalition is charitable and in order for the Yellow Creek Watershed Restoration Coalition to maintain its federal tax-exemption status, I will engage only in activities, as they relate to the Coalition, which will not cause the loss of the federal tax-exemption status and comply with the Conflict of Interest Policy. I have read and understand the conflict of interest policy and agree to comply with it.

Signature: ____________________________________

Date:

____

Yellow Creek Watershed Restoration Coalition 061656453

Articles of Incorporation

for

Yellow Creek Watershed

Restoration Coalition

Articles of Incorporation of the undersigned, a majority of whom are citizens of the United states, desiring to form a Non-Profit Corporation under the Non-Profit Corporation Law Ohio do certify:

First: The name of the Corporation shall be **Yellow Creek Watershed Restoration Coalition.**

Second: The place in this state where the principal office of the Corporation is to be located is the City of Wintersville, Ohio (Jefferson County), United States of America.

Third: Said Corporation is organized exclusively for charitable, religious, educational and scientific purposes, including, for such purposes, the making of distribution to organizations that qualify as exempt organizations under section 501(c) 3 of the Internal Revenue Code, or the corresponding section of any future federal tax code.

Fourth: The names and addresses of the persons who are the initial trustees of the corporation are as follows:

Name: Betsy Cain Address: 204 Cricket Street

Amsterdam, Ohio 43903

Fifth: No part of the net earnings of the corporation shall inure to the benefit of or be distributable to its members, trustees, officers, or other private persons, except that the corporation shall be authorized and empowered to pay reasonable compensation for services rendered and to make payments and distributions in furtherance of the purposes set forth in Article Third hereof. No substantial part of the activities of the corporation shall be the carrying on of propaganda, or otherwise attempting to influence legislation, and the corporation shall not participate in, or intervene in (including the publishing or distribution of statements) any political campaign on behalf of or in opposition to any corporation shall not carry on any other activities not permitted to be carried on (a) by a Revenue Code, or the corresponding section of any future federal tax code, or (b) by a corporation , contributions to which are deductible under section 107(c)(2) of the Internal Revenue Code, or the corresponding section of any future federal tax code.

Sixth: Upon the dissolution of the corporation, assets shall be distributed for one or more exempt purposes within the meaning of section 501(c)3 of the Internal Revenue Code, r the corresponding section of any future federal tax code, or shall be distributed to the federal tax code, or shall be distributed by the local government, for a public purpose. Any such assets not so disposed of shall be disposed of by a Court of Competent Jurisdiction of the county in which the principal office of the corporation is then located, exclusively for such purposes or to such organization or organizations, as said Court shall determine, which are organized and operated exclusively for such purposes.

In witness whereof, we have hereunto subscribed our names this Thursday, 26th day of May, 2005.

Yellow Creek Watershed Restoration Coalition 061656453

Yellow Creek Watershed Restoration Coalition

Bylaws

1.0 TITLE

1.1 The title of this organization will be Yellow Creek Watershed Restoration Coalition.

2.0 MISSIONS AND OBJECTIVES

2.1 The mission of this organization is to improve and protect the environment in the Yellow Creek Watershed.

2.2 The primary objectives of the Yellow Creek Watershed are:

- Research the water quality history of Yellow Creek.
- Study the watershed
- Inform and involve the public about water quality in the community.
- Develop water quality monitoring in the watershed.
- Work toward continued, improved water quality within the Yellow Creek Watershed.
- Assist in the achievement of balance between the needs of the community and the stewardship of the resource.
- Identify resources to enable the implementation of water quality improvement practices.

3.0 MEMBERSHIP AND VOTING

3.1 Membership is open to any individual, family, business, group or affiliated member (including federal, state and county agencies) that subscribes to the purposes of the organization.

3.2 Each individual who has attended two consecutive meetings will earn the right to vote.

3.3 Dues for yearly membership are: $5.00 for individuals, $20.00 for families and affiliated members and $35.00 for businesses and organizations. Dues shall be paid upon becoming a member of the organization and at the October meeting of every calendar year afterwards.

4.0 ORGANIZATION AND OFFICERS

4.1 The officers of the organization are the President, Vice-President, Secretary and Treasurer. The President shall be one of the voting eligible watershed residents (an individual residing in Carroll, Columbiana, Harrison or Jefferson Counties.)

4.2 The duties of the President include but are not limited to:
- Developing meeting ideas
- Presiding over all meetings
- Serving as Chair of the Steering Committee and as ad hoc member of other committees.

4.3 The Vice-President may be any member of the organization. The Vice-President shall assume the duties of the President for the remainder of that term should that office become vacant, and shall preside at meetings of the organization and Steering Committee when the President is unable to attend.

4.4 The Secretary may be any member of the organization. The duties of the Secretary include, but are not limited to:
- Maintaining the official records of the organization
- Recording and distributing the minutes
- Maintaining a current record of the names and addresses of the members
- Sending out notices of meetings and any supporting meeting materials at least one (1) week prior to scheduled meetings.

4.5 Election of the President, Vice-President, Secretary and Treasurer shall be by written secret ballot. For the initial election, nominations may be made by any member or a member may volunteer or nominate themselves. In subsequent elections, nominations may be made by any member from the floor or in writing to any member of the Steering Committee. It is incumbent upon the nominator to determine the willingness of the nominee to serve.

During an election year nominations for officers shall be received at the October meeting or by mail from October 1st to January 1st, and from the floor at the January meeting. Nominations by mail shall be sent to the Jefferson Soil and Water Conservation District office. Elections shall take place at the January meeting. Nominations for each office shall be listed in the agenda for the January meeting.

4.6 The President, Vice-President, Secretary and Treasurer shall initially be elected for a one-year term, thereafter the offices will be two-year terms. Re-election to these offices is permitted.

4.7 Resignation:

Resignation shall be given verbally at a public meeting and noted in the meeting minutes. A vote will be taken to fill the position for the remainder of the term.

4.8 Removal of Officers:
Officers missing four consecutive meetings shall be considered as having given resignation. A vote will be taken to fill the position for the remainder of the term.

5.0 COMMITTEES

5.1 Ad Hoc Committees:
The following ad hoc committees shall be established by the Steering Committee to address the concerns of the organization.

5.2 Other Committees:
The Steering Committee may create and dissolve other standing or ad hoc committees as deemed necessary to support the efforts of the organization.

5.3 Steering Committee:
The Steering Committee shall be composed of the President and Vice-President of the organization and the Chairs of the established committees. The duties of the Steering Committee shall include but not be limited to:

- Directing the business activities of the organization
- Nominating members for elected positions
- Creating or disbanding standing or ad hoc committees
- Calling emergency meetings without one week notice
- Recommending projects to committees

5.4 Each meeting shall elect a Committee Chair by the end of its second meeting. The Committee Chair shall serve as a member of the Steering Committee.

6.0 MEETINGS

6.1 The organization shall meet as determined by the Steering Committee

6.2 Notice shall be mailed or emailed to all members at least one (1) week in advance of all meetings. Notice shall include an agenda, the minutes from previous meeting and business materials that may be considered or acted upon, whether or not set forth in the agenda.

7.0 DECISION MAKING

7.1 The organization shall strive to operate by consensus. Group decisions shall be made by consensus of all members present at any meeting with a minimum five (5) voting members present for passage.

7.2 Any member may call for a vote on any issue during the course of any meeting.

7.3 Decisions made by vote shall require a two-thirds majority of the voting members with a minimum of five (5) voting members present for passage.

Voting eligibility is discussed in Section 3.2.

7.4 In case of a tie the president shall vote to break the tie. This shall be the only instance the president is permitted to vote.

7.5 Members of the coalition shall sign an agreement to the YCWRC Conflict of Interest Policy annually at the January meeting.

8.0 FINANCIAL PROVISIONS

8.1 The organization may accept and use gifts, contributions, funds, grants and other articles of value from individuals, groups, companies, corporations, foundations and government (federal, state, local) in discharging its responsibilities.

8.2 The organization will provide for any audits as required by law.

8.3 The Treasurer will provide the financial report for all scheduled meetings. The Treasurer will be responsible for handling receipts and disbursements of all monies of the Yellow Creek Watershed. He/she will make all reports as required by law and perform other such duties as required by the Yellow Creek Watershed Restoration Coalition. He/she will serve, mail or deliver all notices required by law and these bylaws, and shall make a full report of all matters and business pertaining to the members as the President directs him/her to do.

9.0 NON-PROFIT STATUS

9.1 This organization is being formed as a coalition joining together citizens, local firms, agencies, organizations, institutions, corporations and governmental units with a common purpose. This organization shall be a non profit organization and is being formed exclusively for educational and scientific purposes within the meaning of section 501(c)3 of the Internal Revenue Code. This organization will not be used for personal gain of its individual members.

10.0 ADOPTION AND AMENDMENTS

10.1 These bylaws and any amendments shall be adopted by two-thirds majority vote of the organization. Amendments to the bylaws shall be summarized in the notice of the meeting at which the proposed amendments are to be voted on.

11.0 DISSOLUTION

11.1 In the event of the dissolution of the Yellow Creek Watershed Restoration Coalition the remaining assets of the organization shall be distributed for purposes within the scope of the Internal Revenue Service Code 501(c)3 or amendments thereof after the satisfaction of all obligations.

Yellow Creek Watershed Restoration Coalition Financial Policies and Procedures

A. Board

The Board is responsible for prudent management of the Yellow Creek Watershed

Restoration Coalition's funds so that mismanagement, non-management, or self- dealing does not occur. In order to fulfill this responsibility the Board shall:

1. Review and approve written financial policies and procedures at the end of each fiscal year.
2. Initiate an annual internal audit/review and a biennial commissioned external audit/review.
3. Distribute an annual financial report to all Yellow Creek Watershed Restoration Coalition members.

B. Treasurer

The Treasurer is responsible for maintaining the financial records and managing the financial affairs of the chapter in accordance with the established financial policies. In order to fulfill these responsibilities, the treasurer shall:

1. Maintain the Yellow Creek Watershed Restoration Coalition's financial information system which includes:
    a. Keeping a record of the Coalition's expenditures and income in a ledger or on a computer program.
    b. Keeping the ledger balanced.
    c. Maintaining a balanced checkbook that is congruent with the ledger.
    d. Maintaining a filing system where the vouchers, receipts, bank statements and cancelled checks are kept as documentation of all transactions.
    e. Keeping a supply of banking items such as vouchers, checkbooks, receipts etc.
    f. Maintaining a file of financial reports and internal and external audit reports.

2. Present a financial report to the Board at each scheduled meeting. The financial report should include a statement of income, the expenses, and be balanced. Annually the internal audit report is also presented to the Board at the end of the fiscal year.
3. Work with the external auditor and/or internal audit committee during the examination of the Coalition's financial policies, procedures and records.
4. Prepare IRS and State tax forms when required.

C. Internal Auditing Procedures

I. Objective

To take all practical steps to insure that all funds intended for the Coalition have been received and recorded.

II. Basic Principle

There must be supporting evidence for both the acceptance of money and the disbursement of funds. The evidence must be available for review by auditors and persons authorized to accept monies, approve disbursement and sign checks.

D. Procedures

1. Three designated officers (Chair, Vice-President, and Treasurer) shall have signature rights on the checking and savings accounts. The signatures of two of the above-designated officers are required to withdraw monies.
2. All disbursements are made by check.
3. All income is deposited promptly into the checking account.
4. All records, ledgers, bank statements, program registration lists, files etc. are retained for seven years.
5. There will be a separation of duties for handling cash at special events. Person with primary responsibilities in keeping the journal will not collect cash at these events.
6. The designated officers have authority to spend no more than $100.00 without vote.

E. Financial Information System

The financial information system provides a means of identifying sources of income and justifying expenditures in accordance with the approved budget. It permits reporting of the current financial state of the Yellow Creek Watershed Restoration Coalition for prediction and control when economic decisions must be made.

I. Receipts

a. Transactions are made promptly.
b. Deposit slips are checked against bank statements.
c. Receipts and deposits are recorded correctly.

II. Disbursements

a. All disbursements are made by check.

III. Banking

a. The Coalition accounts are maintained at Huntington Bank, located in Bergholz, Ohio.
b. The kind of account and the account numbers shall be identified.
c. All interest, transfer of funds, deposits and withdrawals shall be documented.
d. The fiscal year shall be January 1st through December 31st.
e. At the end of each fiscal year all account balances are reconciled.

IV. Checkbook

a. All deposits are correctly and promptly recorded in the checkbook.
b. The checkbook indicates not only the payee but also the reason for payment.
c. Vouchers and cancelled checks are retained for all disbursements.
d. The checkbook is reconciled with the bank statement every month.
e. All checks will be made out to payee before board signature.

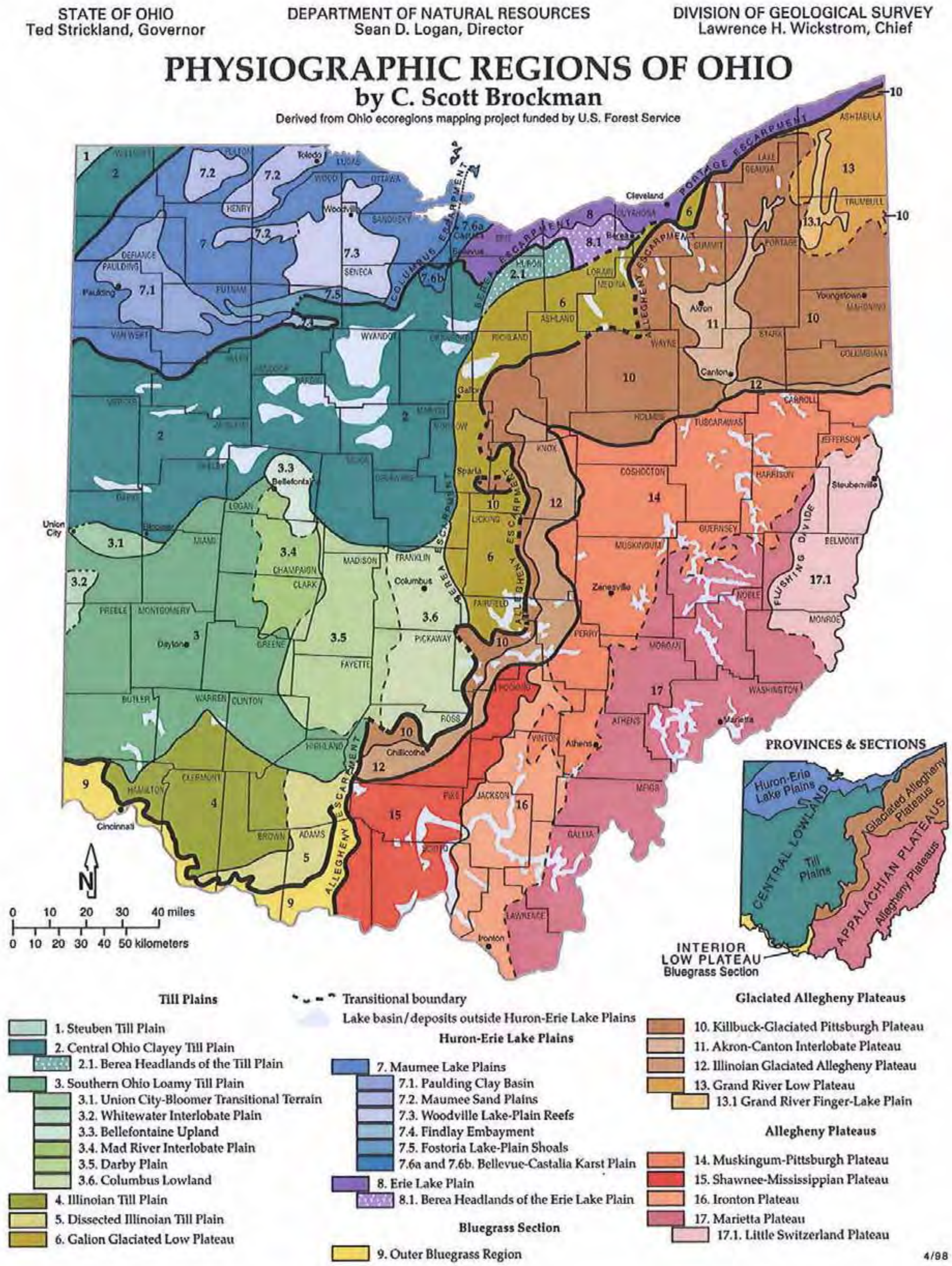
F. Audit

1. Objective
   To verify the accounting procedures provide for proper accounting of receipts and expenditures

2. Purpose
   To confirm the Coalition's accounting practices

3. Frequency of Audit
   a. An internal audit shall be completed annually.
   b. An external audit shall be completed annually by March 31st when funds exceed $25,000.

4. Special audits required of grants will be conducted in accordance to grant requirements.
5. The treasurer and two other members shall conduct the internal audit.
6. An external audit could be requested by a majority vote of the members at any time.


STATE OF OHIO
Ted Strickland, Governor
DEPARTMENT OF NATURAL RESOURCES
Sean D. Logan, Director
DIVISION OF GEOLOGICAL SURVEY
Lawrence H. Wickstrom, Chief
PHYSIOGRAPHIC REGIONS OF OHIO
by C. Scott Brockman
Derived from Ohio ecoregions mapping project funded by U.S. Forest Service
PROVINCES & SECTIONS
Huron-Erie Lake Plains
CENTRAL LOWLAND
Till Plains
Glaciated Allegheny Plateaus
APPALACHIAN PLATEAUS
Allegheny Plateaus
INTERIOR LOW PLATEAU
Bluegrass Section
0 10 20 30 40 miles
0 10 20 30 40 50 kilometers
Till Plains
1. Steuben Till Plain
2. Central Ohio Clayey Till Plain
2.1. Berea Headlands of the Till Plain
3. Southern Ohio Loamy Till Plain
3.1. Union City-Bloomer Transitional Terrain
3.2. Whitewater Interlobate Plain
3.3. Bellefontaine Upland
3.4. Mad River Interlobate Plain
3.5. Darby Plain
3.6. Columbus Lowland
4. Illinoian Till Plain
5. Dissected Illinoian Till Plain
6. Galion Glaciated Low Plateau
Transitional boundary
Lake basin/deposits outside Huron-Erie Lake Plains
Huron-Erie Lake Plains
7. Maumee Lake Plains
7.1. Paulding Clay Basin
7.2. Maumee Sand Plains
7.3. Woodville Lake-Plain Reefs
7.4. Findlay Embayment
7.5. Fostoria Lake-Plain Shoals
7.6a and 7.6b. Bellevue-Castalia Karst Plain
8. Erie Lake Plain
8.1. Berea Headlands of the Erie Lake Plain
Bluegrass Section
9. Outer Bluegrass Region
Glaciated Allegheny Plateaus
10. Killbuck-Glaciated Pittsburgh Plateau
11. Akron-Canton Interlobate Plateau
12. Illinoian Glaciated Allegheny Plateau
13. Grand River Low Plateau
13.1 Grand River Finger-Lake Plain
Allegheny Plateaus
14. Muskingum-Pittsburgh Plateau
15. Shawnee-Mississippian Plateau
16. Ironton Plateau
17. Marietta Plateau
17.1. Little Switzerland Plateau
4/98

PHYSIOGRAPHIC REGIONS OF OHIO

Major Divisions	Provinces	Sections *	DISTINGUISHING CHARACTERISTICS OF REGIONS & DISTRICTS	GEOLOGY	BOUNDARIES
INTERIOR PLAINS	CENTRAL LOWLAND	Till Plains	**1. Steuben Till Plain.** Hummocky terrain with rolling hills, interspersed flats and closed depressions; wetlands, few streams, deranged drainage; only a small part of the region is in Ohio; elevation 950'-1100', moderately low relief (60')	Wisconsinan-age (latest Ice-Age) loamy till from a northern source (Saginaw glacial lobe) over Mississippian-age Coldwater Shale	Southeast: edge of Wabash Moraine
			2. Central Ohio Clayey Till Plain. Surface of clayey till; well-defined moraines with intervening flat-lying ground moraine and intermorainal lake basins; no boulder belts; about a dozen silt-, clay- and till-filled lake basins range in area from a few to 200 square miles; few large streams; limited sand & gravel outwash; elevation 700'-1150', moderate relief (100')	Clayey, high-lime Wisconsinan-age till from a northeastern source (Erie glacial lobe) and lacustrine materials over lower Paleozoic-age carbonate rocks and, in the east, shales; loess thin to absent	North: Lake Plain; northeast: limit of Berea Sandstone; east: Berea Escarpment; south: Powell and Union City/Bloomer Moraines, northern segment boundaries: Wabash Moraine and lake plain
			2.1. Berea Headlands of the Till Plain. Gently rolling to flat terrain of thin drift descending to Lake Erie, punctuated by more than 20 streamlined "whalebacks" of Berea Sandstone, 0.5 to 2.5 miles long, 30'-60' high; somewhat poorly drained; elevation 600'-1000', low relief (20')	Thin, clayey, medium-lime Wisconsinan-age till over resistant Mississippian-age Berea Sandstone	South: limit of Berea Sandstone; elsewhere: Berea Escarpment and/or margin of highest Pleistocene lake
			3. Southern Ohio Loamy Till Plain. Surface of loamy till; end and recessional moraines, commonly associated with boulder belts, between relatively flat-lying ground moraine, cut by steep-valleyed large streams; stream valleys filled with outwash and alternate between broad floodplains and narrows; buried valleys common, elevation 530'-1150', moderate relief (200')	Loamy, high-lime Wisconsinan-age till, outwash, and loess over Lower Paleozoic-age carbonate rocks and, in the east, shales	East: Berea and Allegheny Escarpments; north: Powell and Union City/Bloomer Moraines; south: limit of Wisconsinan-age till
			3.1. Union City-Bloomer Transitional Terrain. Well-defined moraines with low relief, hummocky ground moraine like the Central Ohio Clayey Till Plain to the north; loamy till with loess cap like Southern Ohio Loamy Till Plain to the south; elevation 920'-1075', moderately low relief (50')	Loamy, high-lime Wisconsinan-age till with thin loess cap over Silurian-age dolomites	North: Bloomer Moraine and limit of loamy till; south: Union City Moraine
			3.2. Whitewater Interlobate Plain. An upland between two converging glacial lobes with hummocky moraines, moraine complexes, kames, boulder belts, and broad outwash trains/plains; contains highest elevations in Indiana (1257') and in adjacent Ohio counties (1210'); elevation in Ohio 980'-1260', moderate relief (150')	Loamy, high-lime Wisconsinan-age till and sand and gravel outwash over resistant Silurian-age carbonate rocks (north) and less-resistant Ordovician-age shales and limestones (south)	North: limit of Knightstown/Farmersville Moraines and kame fields; east: high, dissected hills draining to Whitewater River
			3.3. Bellefontaine Upland. Moderately high relief (350') dissected topography with moraine complexes, boulder belts, high-gradient major streams, caves and sinkholes; few glacial depressions/kettles compared to surrounding areas; elevation 1160'-1549', includes highest elevation in Ohio (Campbell Hill, 1549')	Loamy, high-lime Wisconsinan-age till over generally deeply buried Silurian- to Devonian-age carbonate rocks and Ohio Shale	North: areas with hilltops above 1200'; elsewhere: hilltops above about 1300'
			3.4. Mad River Interlobate Plain. Area between two major converging glacial lobes with extensive outwash, outwash terraces, and bordering moraines; springs and cool, ground-water-fed surface waters; elevation 800'-1350', moderate relief (200')	Loamy, high-lime Wisconsinan-age till and sand and gravel outwash over Silurian- to Devonian-age carbonate rocks and Ohio Shale	East and north: rear edge of Cable Moraine Complex; south: outwash to Clifton Gorge, west: western edge of Mad River Outwash
			3.5. Darby Plain. Moderately low relief (25'), broadly hummocky ground moraine with several broad, indistinct recessional moraines; between hummocks are broad, poorly drained swales which held wet prairies/meadows in pioneer days; few large streams; elevation 750'-1080'	Loamy, high-lime Wisconsinan-age till and sparse outwash over Silurian- and Devonian-age carbonate rocks and Ohio Shale in the southeast	South and west: front of Reesville and rear of Cable Moraines; north: Powell Moraine; east: increasing eastward slope (see 3.6)
			3.6. Columbus Lowland. Lowland surrounded in all directions by relative uplands, having a broad regional slope toward the Scioto Valley; many larger streams; elevation 600'-850' (950' near Powell Moraine), moderately low relief (25')	Loamy, high-lime (west) to medium-lime (east) Wisconsinan-age till and extensive outwash in Scioto Valley over deep Devonian- to Mississippian-age carbonate rocks, shales, and siltstones	North: Powell Moraine; east and south: Berea and/or Allegheny Escarpments; west: flatter and higher Darby Plain
			4. Illinoian Till Plain. Rolling ground moraine of older till generally lacking ice-constructional features such as moraines, kames, and eskers; many buried valleys; modern valleys alternating between broad floodplains and bedrock gorges; elevation 600'-1100', moderately low relief (50')	Silt-loam, high-lime, Illinoian-age till with loess cap; soils leached several feet; underlain by Ordovician- and Silurian-age carbonate rocks and calcareous shales	North: Wisconsinan glacial margin (Cuba and Hartwell Moraines); elsewhere: limit of common till-covered hilltops
			5. Dissected Illinoian Till Plain. Hilly former till plain in which glacial deposits have been eroded from many valley sides; relatively high stream density; elevation 600'-1,340', moderate relief (200')	Hilltops of high-lime Illinoian-age till with loess cap; slopes of bedrock- and till-derived colluvium and Ordovician- and Silurian-age carbonate rocks and calcareous shales	East: maximum glacial margin; elsewhere: limit of general absence of till on hilltops
			6. Galion Glaciated Low Plateau. Rolling upland transitional between the gently rolling Till Plain and the hilly Glaciated Allegheny Plateau; mantled with thin to thick drift; elevation 800'-1400', moderate relief (100')	Medium- to low-lime Wisconsinan-age till over Mississippian-age shales and sandstones	North: limit of Berea Sandstone; west: Berea Escarpment; south and east: Allegheny Escarpment
		Huron-Erie Lake Plains	**7. Maumee Lake Plains.** Flat-lying Ice-Age lake basin with beach ridges, bars, dunes, deltas, and clay flats; contained the former Black Swamp; slightly dissected by modern streams; elevation 570'-800', very low relief (5')	Pleistocene-age silt, clay, and wave-planed clayey till over Silurian- and Devonian-age carbonate rocks and shales	Northeast: Lake Erie; elsewhere: margin of highest Pleistocene lake
			7.1. Paulding Clay Basin. Nearly flat lacustrine plain; most clayey of all Lake Plain subregions; low-gradient, highly meandering streams; easily ponded soils; elevation 700'-725', extremely low relief (less than 5')	Pleistocene-age lacustrine clay over clay till and Silurian-age dolomites	Northeast: subdued ("drowned") remnant of Defiance Moraine; elsewhere: limit of lacustrine clay
			7.2. Maumee Sand Plains. Lacustrine plain mantled by sand; includes low dunes, inter-dunal pans, beach ridges, and sand sheets of glacial lakeshores; well to poorly drained, elevation 600'-800', very low relief (10')	Late Wisconsinan-age sand over clay till and lacustrine deposits; Silurian- and Devonian-age carbonate rocks and shales buried deeply	Limit of sandy deposits and/or low dunes
			7.3. Woodville Lake-Plain Reefs. Very low relief (10') lacustrine plain with low dunes and lake-margin features, punctuated by more than 75 ancient bedrock reefs rising 10' to 40' above the level of the plain and ranging in area from 0.1 to 3.0 square miles; the oblong reefs are thinly draped with drift; elevation 600'-775'	Thin to absent Wisconsinan-age wave-planed clay till, lacustrine deposits, and sand over Silurian-age reefal Lockport Dolomite	Limit of thinly mantled Lockport Dolomite (Bowling Green Fault to the west and the Defiance Moraine to the south)
			7.4. Findlay Embayment. Very low relief (10'), broadly rolling lacustrine plain; embayment of ancestral Lake Erie in which relatively coarse lacustrine sediments collected; elevation 775'-800'	Silty to gravelly Wisconsinan-age lacustrine deposits and wave-planed clayey till over Silurian-age Lockport Dolomite	West: 775' beach ridge; north: Defiance Moraine; south: margin of highest Pleistocene lake level
			7.5. Fostoria Lake-Plain Shoals. Portion of the Defiance Moraine lightly eroded by shallow Lake Maumee with low north-south trending hillocks and shallow, closed depressions; many sandy areas; elevation 750'-815', low relief, decreasing westward (10'-15')	Silty to gravelly Wisconsinan-age lacustrine deposits and wave-planed clay till over deeply covered Silurian-age dolomite	South and east: unmodified Defiance Moraine; elsewhere: very low-relief lake plain
			7.6a and 7.6b. Bellevue-Castalia Karst Plain. Hummocky plain of rock knobs and numerous sinkholes, large solution features, and caves; large springs; thinly mantled by drift; region straddles both Lake Plain (7.6a) and Till Plain (7.6b); 7.6a has greatest relief of any Lake Plain region (35'); elevation 570'-835'	Columbus and Delaware Limestones overlain by thin clay till in 7.6b, and thin silty and sandy Wisconsinan-age lacustrine deposits and wave-planed clay till in 7.6a	Limit of thinly mantled Columbus and Delaware Limestones, which is marked in the west by the Columbus Escarpment
			8. Erie Lake Plain. Edge of very low-relief (10') Ice-Age lake basin separated from modern Lake Erie by shoreline cliffs; major streams in deep gorges; elevation 570'-800'	Pleistocene-age lacustrine sand, silt, clay, and wave-planed till over Devonian- and Mississippian-age shales and sandstones	North: Lake Erie; south: margin of highest Pleistocene lake
			8.1 Berea Headlands of the Erie Lake Plain. Portion of the Erie Lake Plain underlain by resistant Berea Sandstone; several large sandstone headlands jut into the Ice-Age lake basin, contains several streamlined "whalebacks" of Berea Sandstone, 0.5 to 2.0 miles long, 20'-35' high; poorly drained; elevation 670'-800', very low relief (10')	Thin lacustrine deposits over thin, wave-planed, clayey, medium-lime Wisconsinan-age till; underlain by resistant Berea Sandstone	North: portion of Lake Plain underlain by soft shales; south: margin of highest Pleistocene lake
	INT. LOW PLATEAUS	Bluegrass Section	**9. Outer Bluegrass Region.** Moderately high relief (300') dissected plateau of carbonate rocks; in east, caves and other karst features relatively common; in west, thin, early drift caps narrow ridges; elevation 455'-1120'	Ordovician- and Silurian-age dolomites, limestones, and calcareous shales; thin pre-Wisconsinan drift on ridges in west; silt-loam colluvium	Eastern segment: maximum glacial margin and high eastern ridges capped by noncarbonate rocks; connected by Ohio River bluffs to western segment which is bounded by nondissected till plain
APPALACHIAN HIGHLANDS	APPALACHIAN PLATEAUS	Glaciated Allegheny (Southern New York) Plateaus	**10. Killbuck-Glaciated Pittsburgh Plateau.** Ridges and flat uplands generally above 1200', covered with thin drift and dissected by steep valleys; valley segments alternate between broad drift-filled and narrow rock-walled reaches; elevation 600'-1505', moderate relief (300')	Thin to thick Wisconsinan-age clay to loam till over Mississippian- and Pennsylvanian-age shales, sandstones, conglomerates and coals	West and north: resistant sandstones of the Allegheny and Portage Escarpments; south and east: Wisconsinan glacial margin
			11. Akron-Canton Interlobate Plateau. Hummocky area between two converging glacial lobes dominated by kames, kame terraces, eskers, kettles, kettle lakes, and bogs/fens; deranged drainage with many natural lakes; elevation 900'-1300', moderate relief (200')	Sandy Wisconsinan-age and older drift over Devonian- to Pennsylvanian-age sandstones, conglomerates and shales	Limit of common, sandy ice-contact features and deposits
			12. Illinoian Glaciated Allegheny Plateau. Dissected, rugged hills; loess and older drift on ridgetops, but absent on bedrock slopes; dissection similar to unglaciated regions of the Allegheny Plateau; elevation 600'-1400', moderate relief (200')	Colluvium and Illinoian-age till over Devonian- to Pennsylvanian-age shales, siltstones and sandstones	North and west: Wisconsinan glacial margin; south and east: Illinoian (maximum) glacial margin
			13. Grand River Low Plateau. Gently rolling ground and end moraine having thin to thick drift; poorly drained areas and wetlands relatively common; elevation 700'-1200', low relief (30') except near Grand River Valley (200')	Clayey, low-lime Wisconsinan-age till over deeply buried, soft Devonian-age shales and near-surface Mississippian-age sandstones and shales	North: Portage Escarpment; south and west: Defiance Moraine; southeast: increasing relief from proximity of buried Pennsylvanian-age sandstones
			13.1. Grand River Finger-Lake Plain. Very low relief (10') lake deposits in steep-sided troughs (200' relief) within the Grand River Low Plateau, cut by glacial and stream erosion; extensive wetlands; elevation 800'-900'	Surficial lacustrine clay and drift over deeply buried, soft Devonian-age shales	Margins of steeply sloping troughs containing the Grand River and parts of Rock and Mosquito Creeks
		Allegheny (Kanawha) Plateaus	**14. Muskingum-Pittsburgh Plateau.** Moderately high to high relief (300'-600') dissected plateau having broad major valleys that contain outwash terraces, and tributaries with lacustrine terraces; medium-grained bedrock sequences coarser than those in Marietta Plateau (17) but finer than those in Ironton Plateau (16); remnants of ancient Teays-age drainage system uncommon; elevation 650'-1400'	Mississippian and Pennsylvanian-age siltstones, shales, sandstones and economically important coals and claystones; Wisconsinan-age sand, gravel, and lacustrine silt; silt-loam colluvium	North and west: maximum glacial margin; southeast: transition to finer grained bedrock; southwest: transition to coarser grained bedrock
			15. Shawnee-Mississippian Plateau. High relief (400'-600'), highly dissected plateau of coarse and fine grained rock sequences; most rugged area in Ohio; remnants of ancient lacustrine clay-filled Teays drainage system are extensive in lowlands, absent in uplands; elevation 490'-1,340'	Devonian- and Mississippian-age shales, siltstones, and locally thick sandstones; Pleistocene-age sandy outwash in Scioto River; Teays-age Minford Clay; silt-loam and channery colluvium	North: Maximum glacial margin; west: carbonate bedrock; east: limit of Mississippian-age bedrock
			16. Ironton Plateau. Moderately high relief (300') dissected plateau; coarser grained coal-bearing rock sequences more common than in other regions of the Allegheny Plateau; common lacustrine clay filled Teays Valley remnants; elevation 515'-1060'	Pennsylvanian-age (Pottsville, Allegheny and Conemaugh Groups) cycles of sandstones, siltstones, shales and economically important coals; Pleistocene (Teays)-age Minford Clay; silt-loam and channery colluvium	West: limit of common Pennsylvanian-age bedrock; north and east: gradation to finer rock sequences
			17. Marietta Plateau. Dissected, high-relief (generally 350', to 600' near Ohio River) plateau; mostly fine-grained rocks; red shales and red soils relatively common; landslides common; remnants of ancient lacustrine clay-filled Teays drainage system common; elevation 515'-1400'	Pennsylvanian-age Upper Conemaugh Group through Permian-age Dunkard Group cyclic sequences of red and gray shales, and siltstones, sandstones, limestones and coals; Pleistocene (Teays)-age Minford Clay; red and brown silty-clay loam colluvium; landslide deposits	North and west: transition to medium-grained Lower Conemaugh rocks; east: Flushing Divide
			17.1. Little Switzerland Plateau. Highly dissected, high-relief (generally 450', to 750' along Ohio River) plateau; mostly fine-grained rocks; red shales and red soils relatively common; landslides common; high-gradient shale-bottomed streams subject to flash flooding; no remnants of ancient Teays drainage system; elevation 560'-1400'	Similar to Marietta Plateau but lacking Pleistocene (Teays)-age Minford Clay	North: transition to medium-grained rocks; west and south: Flushing Divide; east: Ohio River

* Section names modified from Fenneman (1938, 1946).