Arcola Creek
HUC-12: 041100030203
Nine-Element
Nonpoint Source Implementation
Strategy (NPS-IS)

Version 1.0

June 13, 2019

Table of Contents **Page**

List of Figures

Acknowledgements

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Chapter 1: Introduction

1.1 Report Background

Lake County Soil & Water Conservation District guided the development of a watershed action plan (WAP) for the Arcola Creek Watershed in 2012 with the assistance of public officials, state and local agencies and local citizens. This document is the update of the WAP that was endorsed on March 19, 2013 to the revised EPA protocol, the Nonpoint Source Implementation Strategic Plan (NPS-IS). The purpose of the NPS-IS is to restore and maintain the chemical, physical and biological integrity of water bodies within the watershed and to access funding from USEPA, Ohio EPA and other granting entities for those purposes.

The goals that were identified in WAP stakeholder meetings included the following:

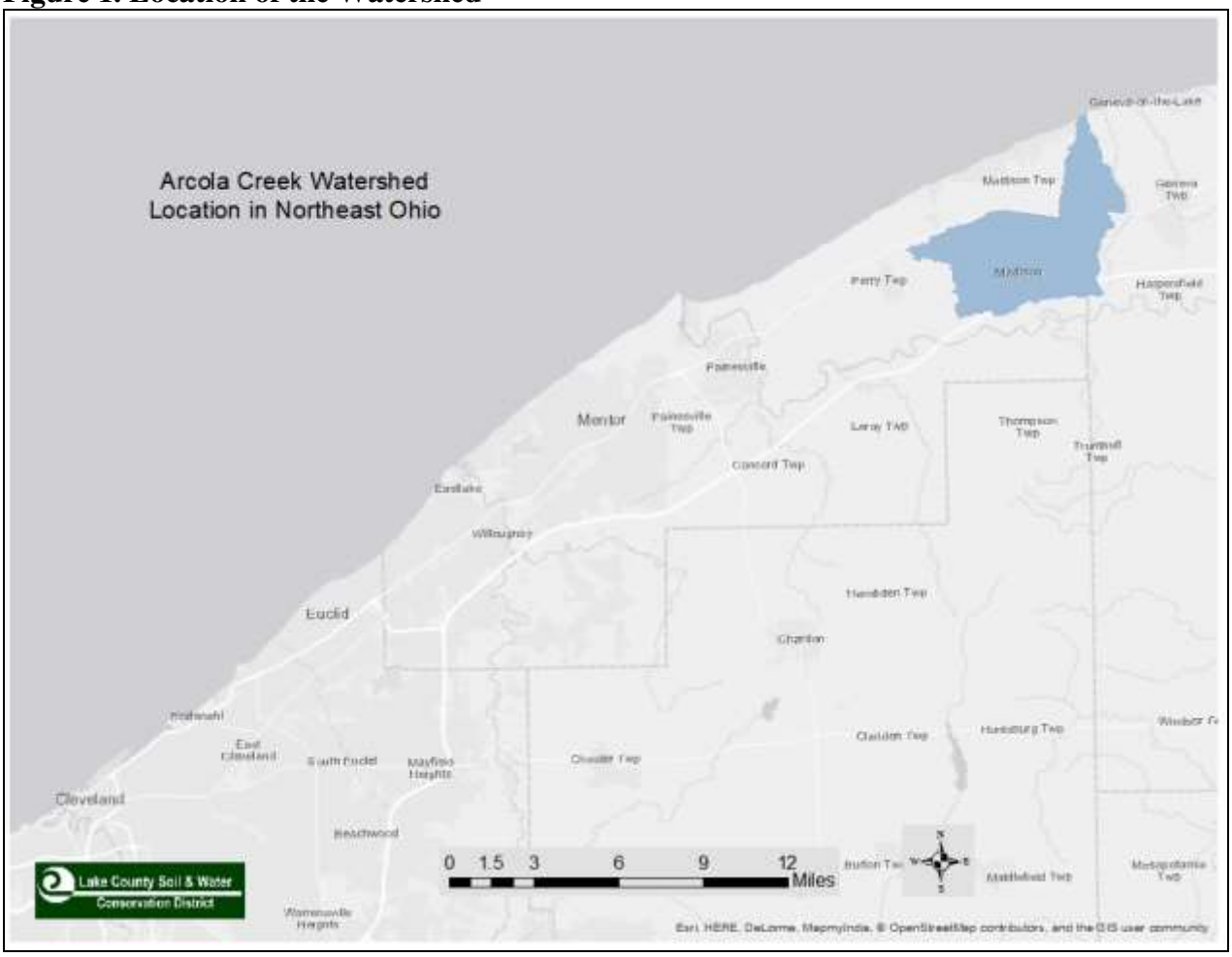
1. Restoration of headwater channels that have been modified over time, allowing fish and aquatic organisms to return and filter and clean the water
2. Giving channels access to their floodplains, where floodwaters can spread out, drop sediments, soak into the soil and lose their erosive energy
3. Protecting and utilizing wetlands to filter contaminants, store water and recharge the groundwater
4. Restoring vegetative buffers along the riparian corridor to stabilize the stream banks and keep the water temperatures cool so they can support aquatic life
5. Reducing the amount of impervious surfaces by using more porous or pervious surfaces
6. Reducing the amount of pollutants that we introduce to the water
7. Improving public awareness through education and outreach activities

A stakeholder meeting was held on January 16, 2019 to provide an update to the implementation of the WAP, and to solicit input for the development of the NPS-IS.

1.2 Watershed Profile & History

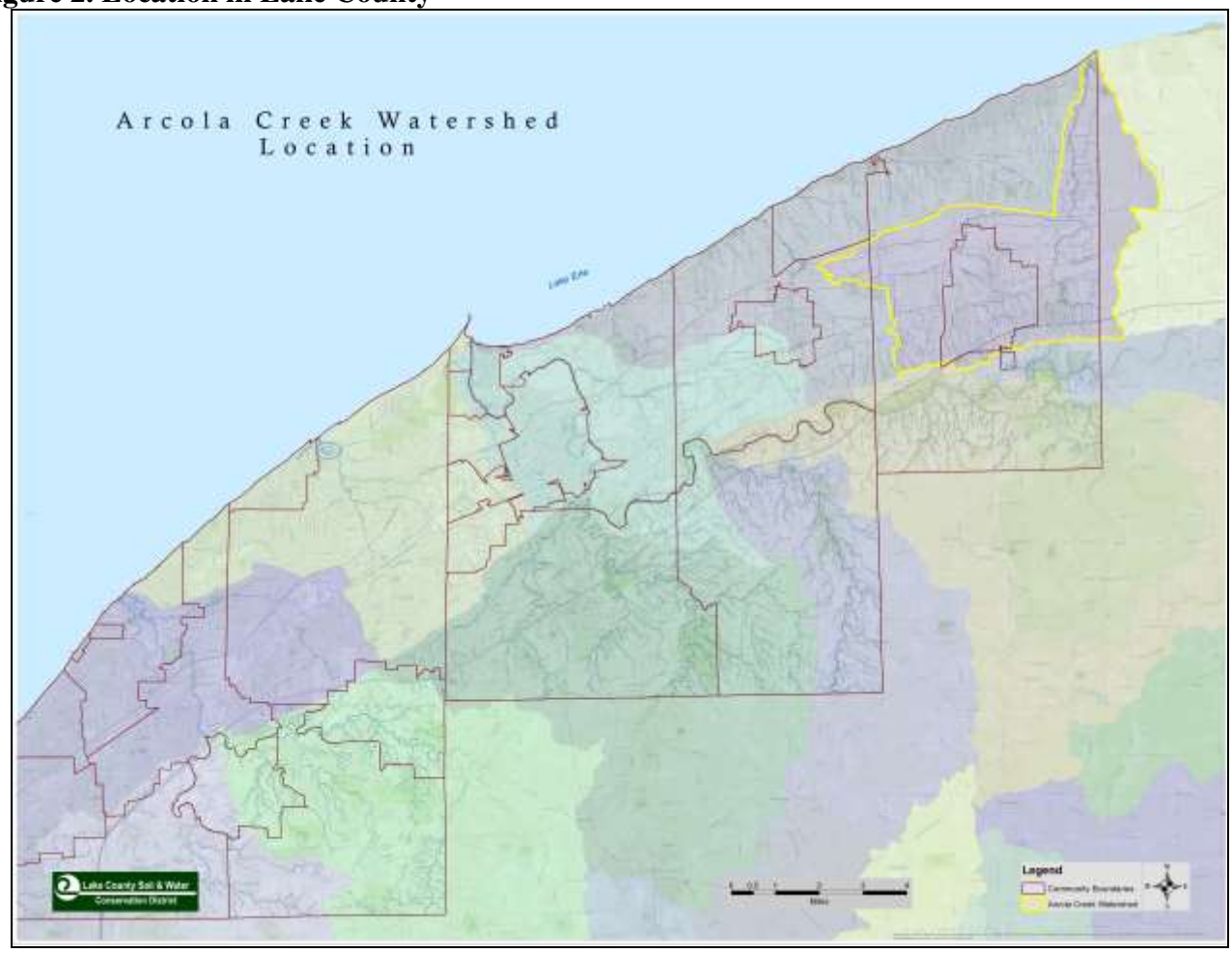
The Arcola Creek Watershed is located in northeastern Lake County and northwestern Ashtabula County (Figures 1 and 2). The watershed begins on the ridge just north of the Grand River Valley and drains to the north, emptying into Lake Erie through the Arcola Estuary. It collects all the water from Madison Village and parts of Madison, Perry and Geneva Townships, draining about a 25 square mile area. The Arcola Creek Watershed 12 digit Hydrologic Unit Code (HUC) is 041100030203.

Figure 1. Location of the Watershed



Two counties, one village and three townships are contained either partially or completely within the watershed boundaries. In Lake County, all of Madison Village, the mid-section of Madison Township and a small portion of Perry Township are in the watershed. In Ashtabula County, a small portion of western Geneva Township is drained by the Arcola Creek Watershed (Figure 4).

Figure 2. Location in Lake County



Madison Township, Perry Township and Madison Village are the only Phase 2 Stormwater Communities within the Arcola Creek Watershed. Madison Village joined the Lake County Stormwater Management District (LCSMD) in the fall of 2012, after watershed planning discussions opened up lines of communication. Having both Madison Township and Village participate in the LCSMD allows a more cohesive and unified treatment of stormwater within the Watershed. Perry Township is taking care of its National Pollution Discharge Elimination System (NPDES) requirements on its own.

Prior to WWII, the region was primarily agricultural, in nursery production. With the evolution of the street car, automobile and federal home financing programs, the population began to grow after 1930.Much of the growth can be described as "sprawl" from the Cleveland Metropolitan Area to the west. This west to east migration trend continues and eastern Lake County rural communities are growing to semi-rural and suburban landscapes (Figure 3).

According to the Lake County Office of Planning and Community Development, the staff to the Lake County Planning Commission, the conversion of land from nursery to residential has been slow in Madison and Perry Townships. Since 1986 there have only been 22 subdivisions submitted to the Lake County Planning Commission for land in Madison Township. Of those 22

subdivision only 9 have been completed and three that could be completed in the next five years. Ten of those subdivisions were either withdrawn or did not progress past preliminary plan approval. Two of the projects that did not go much further than the approval process are located in the watershed and could restart at any time. Perry Township has had eleven subdivisions submitted in the same period and all eleven have been recorded. The last plats recorded in either township were in 2006.

While development pressure has been slow in this area, things could change. Lake County Planning and Community Development reviewed factors that could come into play for development including ownership of large tracts of land, transportation, and utilities. There is land available for development: 127.58 acres have been submitted for Lake County Subdivision Review, 515 acres of land are being held by land developers, and another 208 acres adjacent to that acreage that could be added into development later. There is also 300 acre golf course in the watershed that could be converted to development. Recently, a national home builder just completed a project in Madison Village and is rumored to be looking for additional land.

The watershed also includes access to Interstate 90. This provides easy access to Cleveland (41 miles, 40 minutes) and to Erie, Pennsylvania (63 miles, 60 minutes). Laketran also has a park-n-ride located in Madison Village which provides public transportation to Cleveland, Ohio.

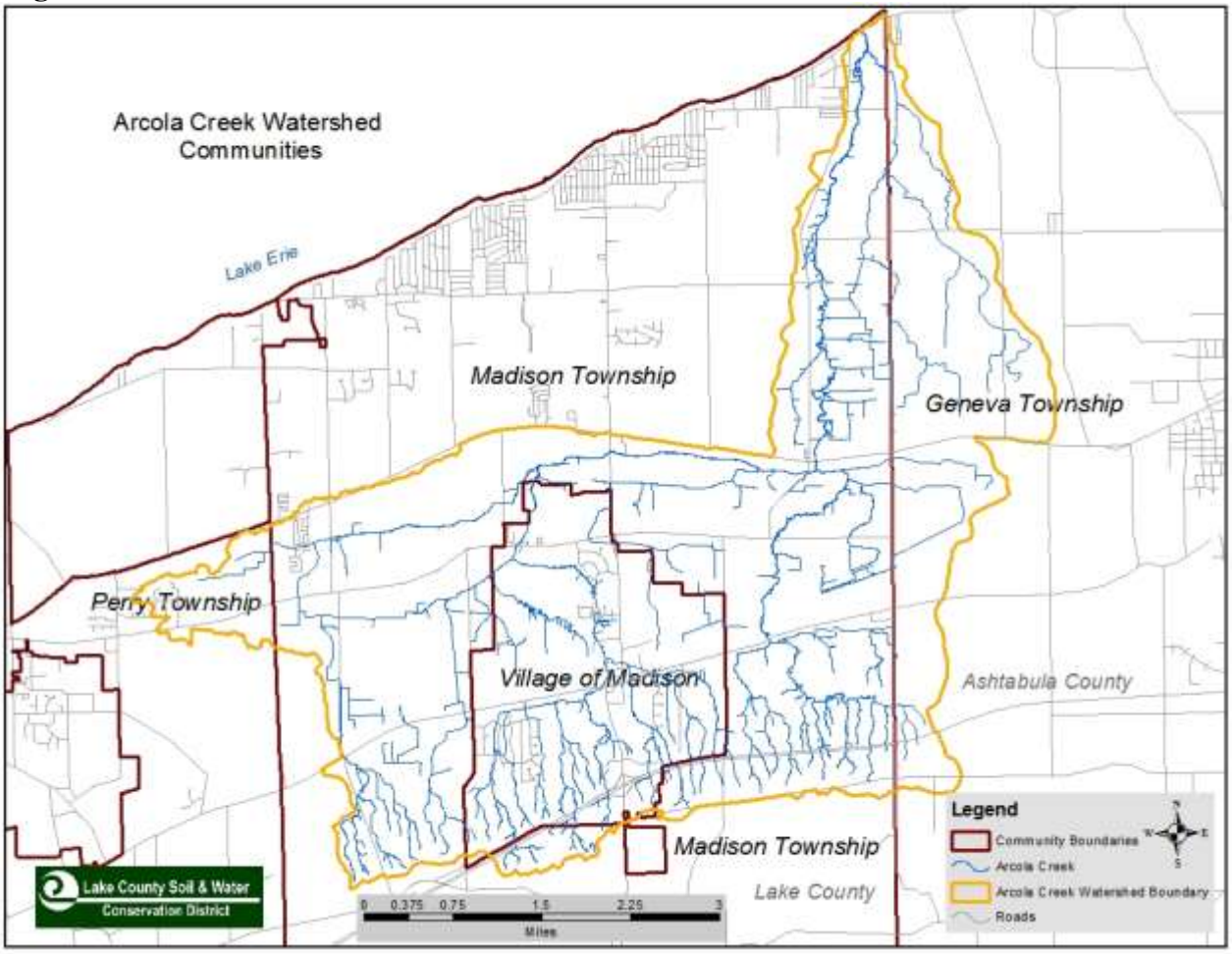
Sanitary sewer and central water owned by Madison Village are in the process of being transferred to the Lake County Board of Commissioners and improvements are being made. This may increase capacity and lower utility costs making development more appealing.

Figure 3. Land Use Change

	Pop. 1990	Pop. 2000	Pop. 2010	Pop. 2017	Change 1990-2000	Change 2000-10	Change 2010-17
Madison Village	2,477	2,921	3,184	3,168	17.9%	8.9%	-0.5%
Madison Township	15,477	15,494	15,693	15,609	0.11%	1.3%	-0.5%
Lake County	215,500	227,482	230,041	230,117	5.6%	1.1%	0.03%

Lake County's agricultural industry is located in the eastern part of Lake County, and is largely nursery industry. The predominant agricultural enterprise in the Arcola Creek Watershed is nursery businesses. The nursery industry began in Lake County in 1854 because of the favorable rainfall, good soil variety and drainage, lake effect climatic conditions, nearness to major markets, interstate highways and good rail transportation. The industry grew from one nursery to many; at one time Lake County was the rose capital of the world. In 2009, those responding to a nursery industry survey reported estimated sales at $87.5 million. (Lake SWCD. 2010.) 35 years ago, S.R. 306 in Mentor was the heart of the nursery industry. Suburbanization and growth have pushed the nurseries "out" to Perry and Madison.

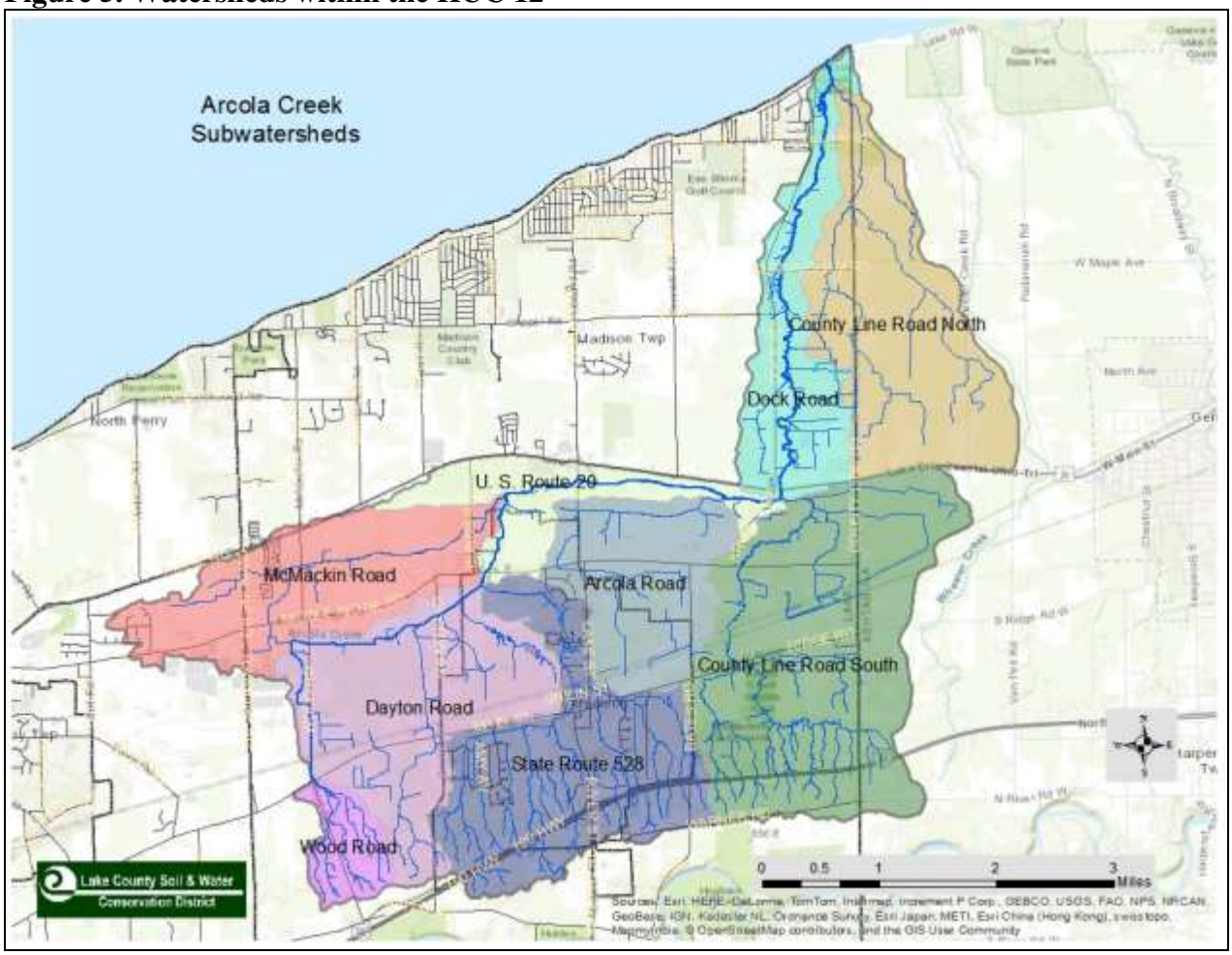
Figure 4. Watershed Communities



Nurseries have continued to feel development pressures, and have looked to various alternatives to remain in business without moving further to the east- where the resources are not as favorable. They utilize the Current Agricultural Use Value (CAUV) to help keep property taxes in check, some have sold off frontage around the edges, some have sold their land to other nurseries, some have passed the nursery on to the next generation; one recently completed the first nursery operation in the country to be protected with an agricultural easement through the Farm and Ranch Land Protection Program (FRPP). Some have sold to real estate developers. Preserving the nursery industry is critical to maintaining the quality of life in northeastern Lake County and is a focus of the nursery industry as well as Lake SWCD, Lake County Planning Commission, the Lake County Development Council & its Agribusiness Committee, and the Western Reserve Land Conservancy.

The demographic and development trends of the country are reflected in Lake County's history and growth patterns. It is likely that the same will hold true of future growth trends. In a community that has a substantial agricultural base, sprawl can negatively affect the amount of productive land needed to sustain and maintain a viable agricultural industry. Agricultural preservation programs and innovative zoning strategies will be an important part of retaining the balances of land use in the watershed.

Figure 5. Watersheds within the HUC 12



The Arcola Creek Watershed has nine subwatersheds: County Line Road South, State Route 528, Dayton Road, Wood Road, McMackin Road, U.S. Route 20, Arcola Road, Dock Road and County Line Road North, listed in a clockwise direction from the southeastern corner (Figure 5).

Arcola Estuary

The Arcola Creek Watershed includes a marsh and estuary just above the mouth of the river where it empties into Lake Erie (Figure 6). An estuary is a special area where river and lake waters mix in a transition zone to create critical habitat for many plants and animals. The Arcola Creek Estuary is one of only two natural estuaries that remain along the southern shores of Lake Erie in Ohio. The other natural estuary is Old Woman Creek, a National Estuarine Research Reserve near Huron Ohio. Estuaries are some of the most productive ecosystems in the world and are important stopover areas for migrating waterfowl and birds, nurseries for fish, and habitat for numerous species of amphibians.

The estuary at the mouth of Arcola Creek helps to keep water quality problems in the watershed from polluting Lake Erie. Water levels in the Arcola Creek estuary are controlled largely by natural barriers of beach material built at the mouth of the creek by wave action. Short-term and long-term changes in water level in the estuary also occur as the level of Lake Erie changes. In

the prior two decades, the water was several feet deep and visitors could use canoes to explore the estuary and upstream tributaries. Recent lower levels of Lake Erie caused the water to flow only in the center of the estuary. This variation is a natural occurrence, and allows for some species of flora and fauna to gain new footholds in the estuary area.

Narrow sand beaches and low lake shore bluffs extend west and east of the Arcola mouth, and represent an area with a lower shoreline recession rate than found in the rest of Lake County shoreline. "The beaches west of the mouth of Arcola Creek have been in existence from 1876 to the present." (Bissell. 1982. Referring to study by Charles Carter in 1976.)

Field work performed by Lake Metroparks, The Cleveland Museum of Natural History, and Lake County Soil and Water Conservation District has found numerous species of endangered, rare, and threatened species of plants and animals in Arcola Creek and the estuary. There are also invasive plant species found in the creek and estuary.

In the summer of 1980, The Nature Conservancy and the Lake County Commissioners began discussions about preserving 35 acres of county land purchased previously to build a wastewater treatment plant. In 1983, approximately 38 acres were preserved through a combination of conservation easement and purchase by The Nature Conservancy. Public reaction to proposed housing and marina development was the catalyst to the permanent protection of this unique resource. In a Painesville Tribune article published on April 25, 1982, James Guyette stated that "The area is far too precious to be flooded and bulldozed into a boat marina. It's one of two remaining natural creek mouths along the lake. It should stay that way." Lake Metroparks (LMP) now leases 28.67 acres from Madison Township and owns 28.67, which it manages as Arcola Creek Park. LMP also owns 181.94 acres along the Arcola Creek corridor.

Jim Bissell, botanist with the Cleveland Museum of Natural History noted that the Arcola Creek Estuary was an important breeding ground for several species of fish, the site of plants on the state endangered species list, a haven for migrating waterfowl and one of the few remaining undisturbed estuarine habitats along the southern shore of Lake Erie. (Bissell. 1982.) "All river mouths along the Lake Erie shoreline were marshlands and swamplands prior to European settlement." Most were converted to harbors through dredging and construction of breakwalls. "Arcola Creek Estuary today is the finest "estuarine" marsh along the Lake Erie shoreline between Cleveland and the Pennsylvania border. The Arcola Creek March presents a preserved panorama reminiscent of the large marshes which once flourished at Cleveland, Eastlake, Fairport, Ashtabula and Conneaut." (Bissell. 1980.)

Figure 6. Arcola Creek Estuary

Figure 6a. Arcola Creek Estuary Orthophoto

1.3 Public Participation and Involvement

This plan was created with the input of members of the community, local officials, and state and local agencies. See Acknowledgements.

Chapter 2: HUC-12 Watershed Characterization and Assessment Summary

2.1 Summary of HUC-12 Watershed Characterization

2.1.1 Physical and Natural Features

A brief set of descriptive data follows.

Water Resources

100 year floodplain	837 ac
Wetlands (2007)	947 ac
Ponds & lakes	99 ac
Streams & rivers	76 ac
Approx. number of water wells	206
Highly sensitive to groundwater contamination	15,058 ac
Ohio EPA permitted CSOs	0

Land Use and Environment

Conservation and recreation land	336.4 ac
Ohio EPA Approved bio-solid application fields	57.4 ac
Ohio EPA NPDES industrial and municipal discharge permits	11
Dams	3

Ecological region: Erie Lake Plain, Mosquito Creek/Pymatuning lowlands, Erie Gorges

Land Use (acres)	**1994**	**2001**	**2009**
Agriculture	4,422	5,836	3,284
Water	905	2000	60
Urban	696	1,098	5,175
Forest	8,292	6,122	6,571
Barren	4	0	8
Shrub/Scrub	739	2	22

Ohio EPA Aquatic Life Use Designation

Coldwater Habitat (CWH)	0
Exceptional Warmwater Habitat (EWH)	0
Warmwater Habitat (WWH)	11 miles
Seasonal Salmonid Habitat (SSH)	4.8 miles

Ohio EPA Stream Classifications (Miles)

Superior High Quality Waters	0
Primary Contact Recreation Class A Waters	0
Outstanding State Waters	0

People (reported by tract)

Rural	2891
Urban	6169
Agricultural	78
In Labor Force	4748

Source: 2011 ERIN Watershed Report

Topography
Arcola Creek is located in northeastern Lake and northwestern Ashtabula Counties. It drains approximately 23.5 square miles and flows directly into Lake Erie. The elevation ranges from 860 feet in the southern watershed boundary to 580 feet at the mouth of the Arcola where it flows into Lake Erie (Figure 7).

The watershed is bisected by two physiographic regions, the Glaciated Allegheny Plateau of the Appalachian Plateau or "Glaciated Plateau" in the southern portions and the Eastern lake section of the Central Lowland province or "Lake Plain" in the north, adjacent to Lake Erie. The Portage Escarpment divides the two regions in a northeast-southwesterly line across the watershed. The headwaters of the Arcola flow through the northern extent of the Allegheny Plateau before dropping to the Lake Plain, over which the greatest extent of the watershed flows.

Figure 7. Topography

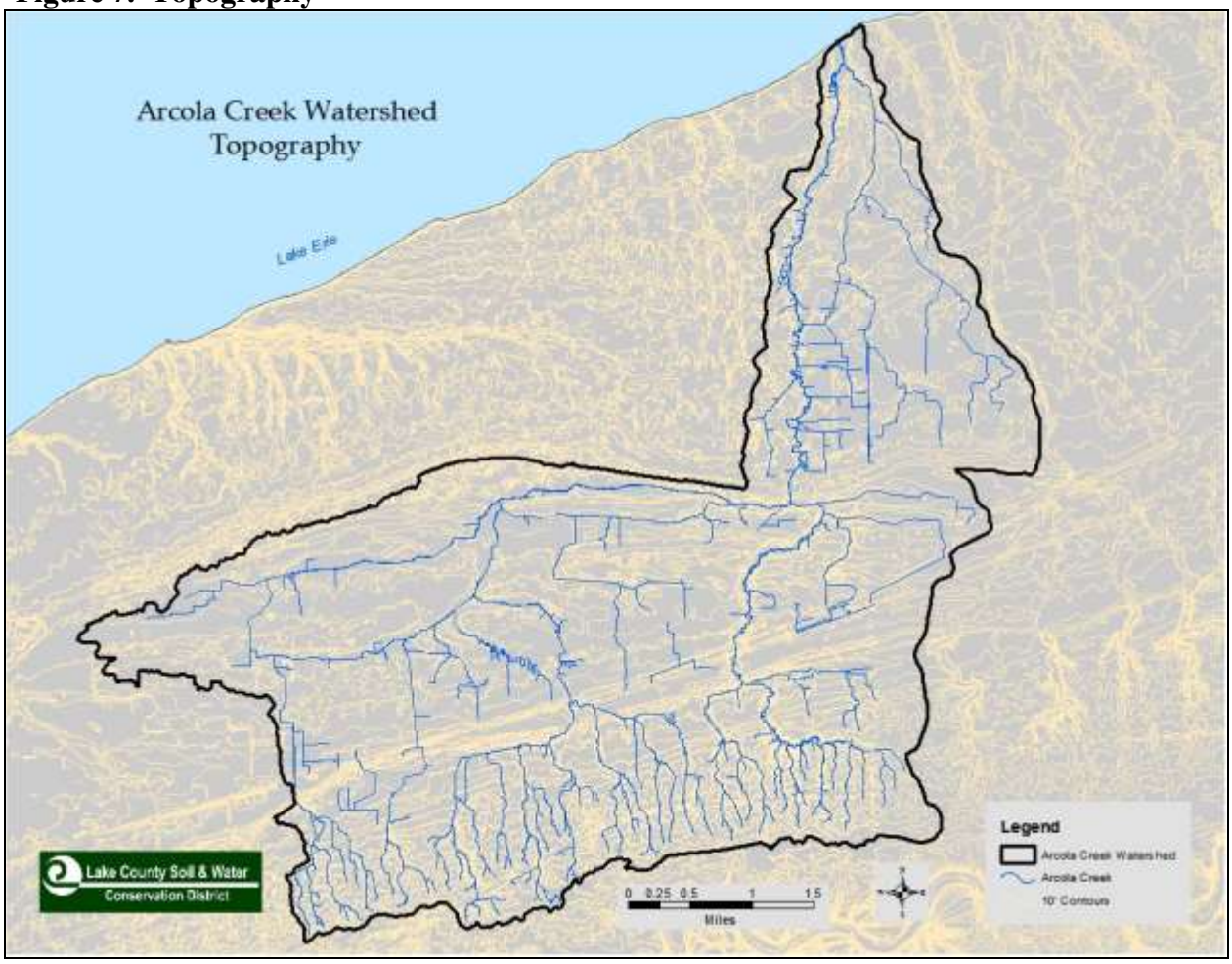
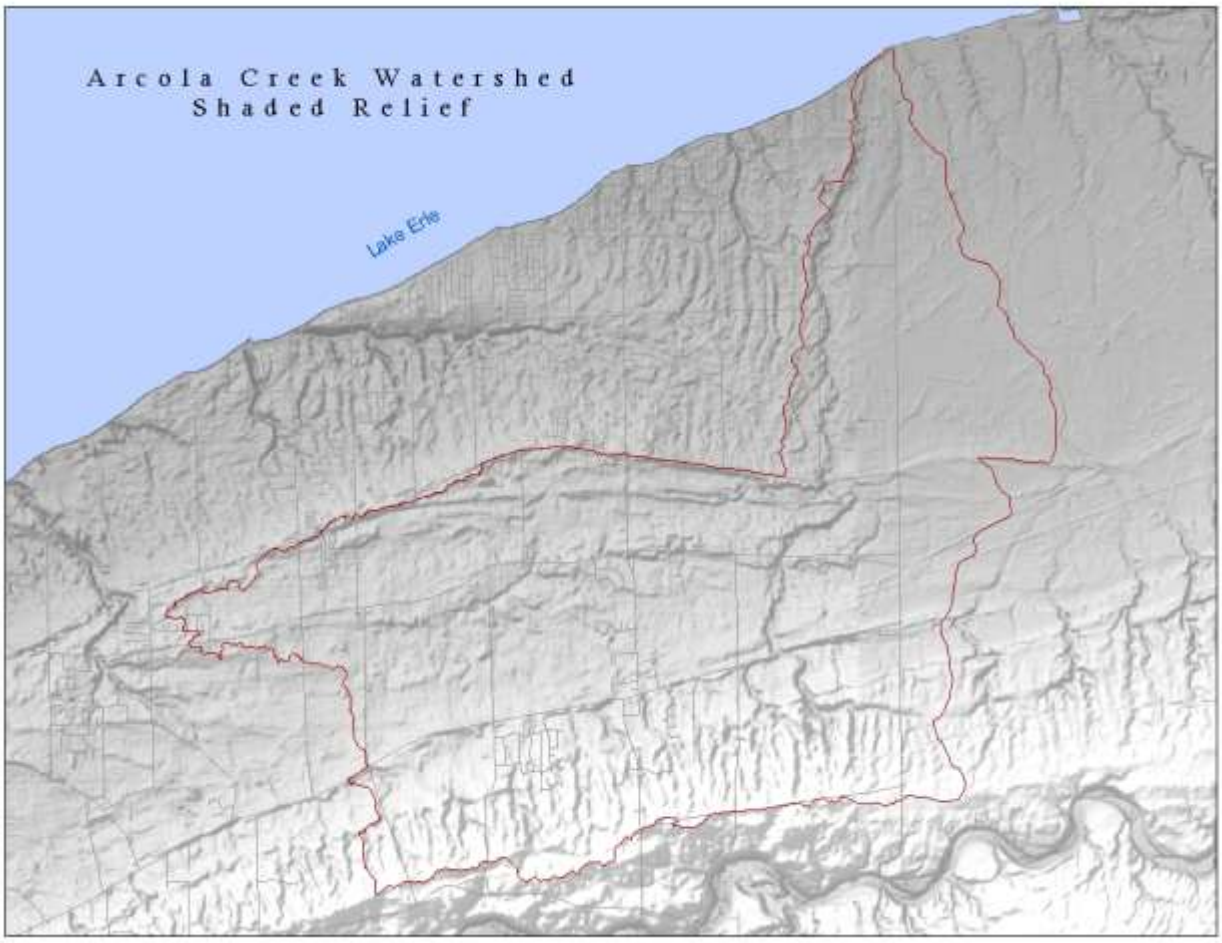


Figure 8. Topography- Shaded Relief View of Arcola Creek Watershed



Geology & Glacial History

The Arcola Creek Watershed is a part of the glaciated plateau of Ohio and underlain by the Glaciated Plateau to the south and the Lake Plain to the north. The Portage Escarpment delineates the boundary between the two landforms (Figure 8).

The Lake Plain is relatively level and is characterized by poor drainage, except where there are beach remnants from ancient lakes (Figure 9). It averages 4 miles in width. Early Lake Erie was more than 200 feet higher than it is today. As the glaciers retreated, lower outlets were uncovered by the melting ice and the lake decreased in size and elevation. The beach ridge deposits that were left behind are the location of the progressively lower shorelines.

Three sandy and gravelly ridges, from earlier higher lake levels parallel the present Lake Erie shoreline, are identifiable by the three major roads running in an east-west direction- North Ridge (ancient Lake Warren), Middle Ridge and South Ridge (ancient Lake Whittlesey) Roads. The South Ridge Road ridge is the approximate boundary between the lake plain and the Portage Escarpment. These beach-dune ridges were early Native American trails and were important in the European settlement of the region because of their sandy, slightly elevated ground, which provided well-drained, nearly level areas for roads and homesites.

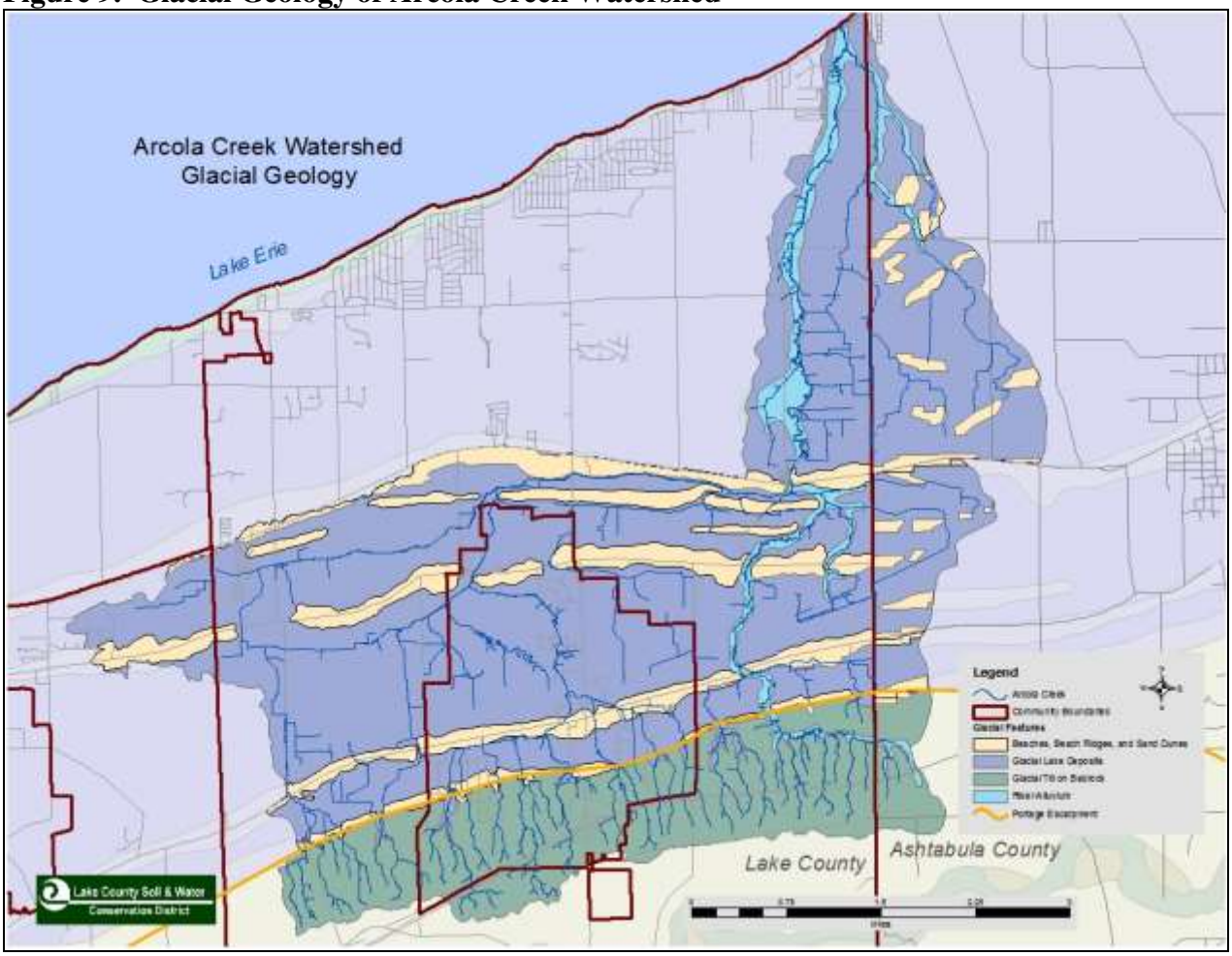
The beach ridges interrupt the northward flow of water, and create ponding along the southern edge of the ridges. Many of these original swamplands have been artificially drained. The tributaries of the Arcola flow in a northerly direction until they reach the ridges which then deflect them in an easterly direction.

The Arcola headwaters originate at the top edge of the escarpment and flow north across the steepest portion of the watershed where the plateau drops down to the lake plain, creating a series of shorter steeper "fingers" across the top of the watershed.

The upper portion of the watershed on the plateau is characterized by high quality cold water streams with a diversity of aquatic species, which are strongly correlated with the Ashtabula glacial till. "Those streams that do originate and flow in the glacial till have been found to have the best habit and water quality in the watershed. Conversely, ephemeral streams and low quality warmwater streams are also very strongly correlated with the lake plain soils of northern Lake County." (Edgar; 2004)

Unlike much of the Lake Erie coastline in Ohio, the mouth of Arcola Creek does not have a cliff at the land/lake interface, but flows into Lake Erie through an estuary at a low gradient.

Figure 9. Glacial Geology of Arcola Creek Watershed



Soils

The soils in the watershed (Figure 9) reflect the glacial history of the region and can be divided into four categories: soils on the lake plain and offshore bars; soils on beach ridges, terraces and offshore bars; soils on flood plains, terraces and marshes; and soils on till plains. Refer to the Soil Survey of Lake County and Soil Survey of Ashtabula County, Ohio for more information about the soils and their properties.

64% of the soils are hydric or somewhat poorly drained, 24% are moderately well drained and 10.5% are exceptionally well drained (Figure 11). Soil drainage characteristics information is essential for siting Best Management Practices (BMPs) so that they will work properly. BMPs such as rain gardens and pervious pavers that are based on infiltration are best suited for well drained soils (in shades of green, Figure 12), whereas wetlands and on-site storage BMPs should be utilized in hydric soils (in shades of blue, Figure 12).

Figure 10. Soils of the Arcola Creek Watershed

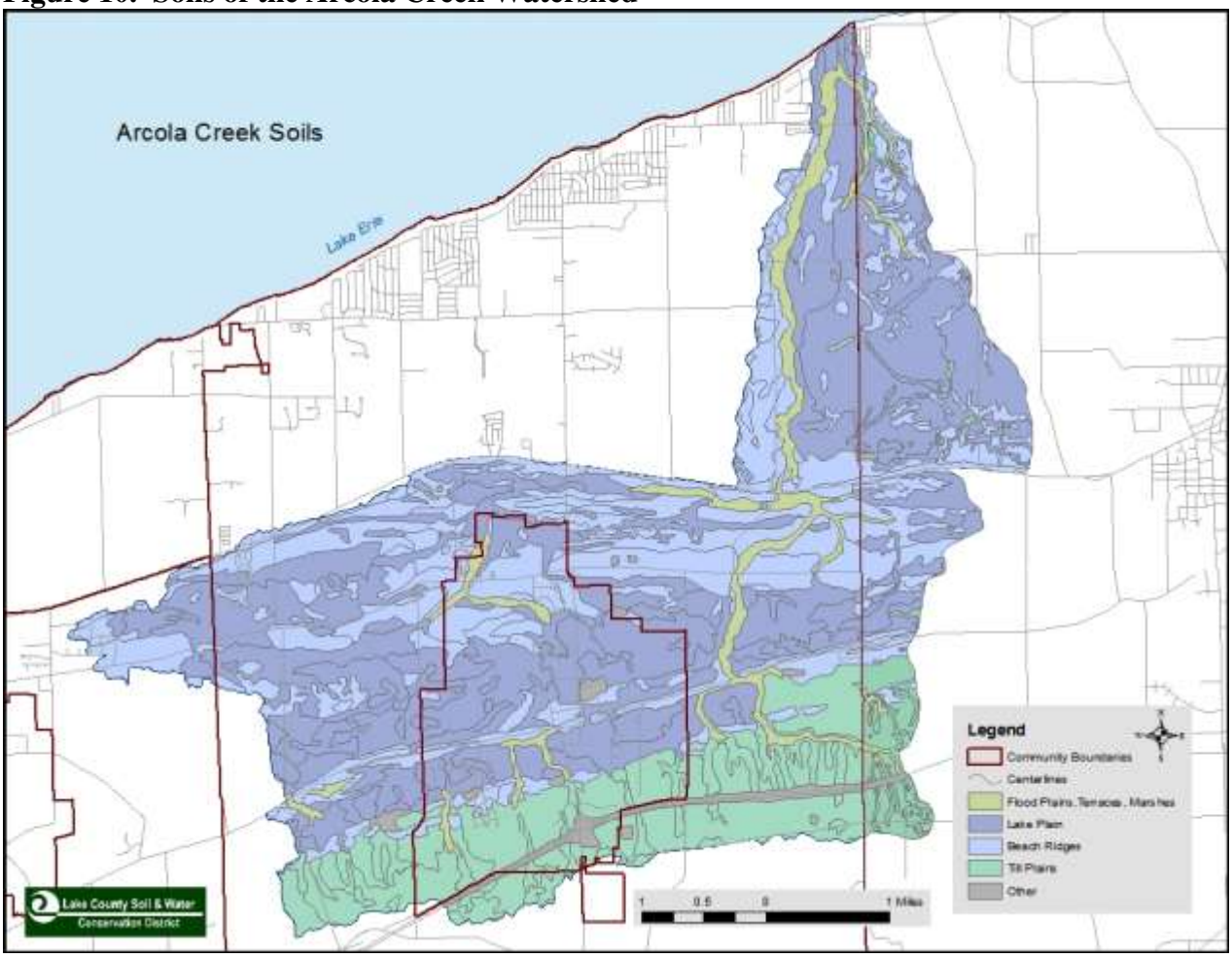
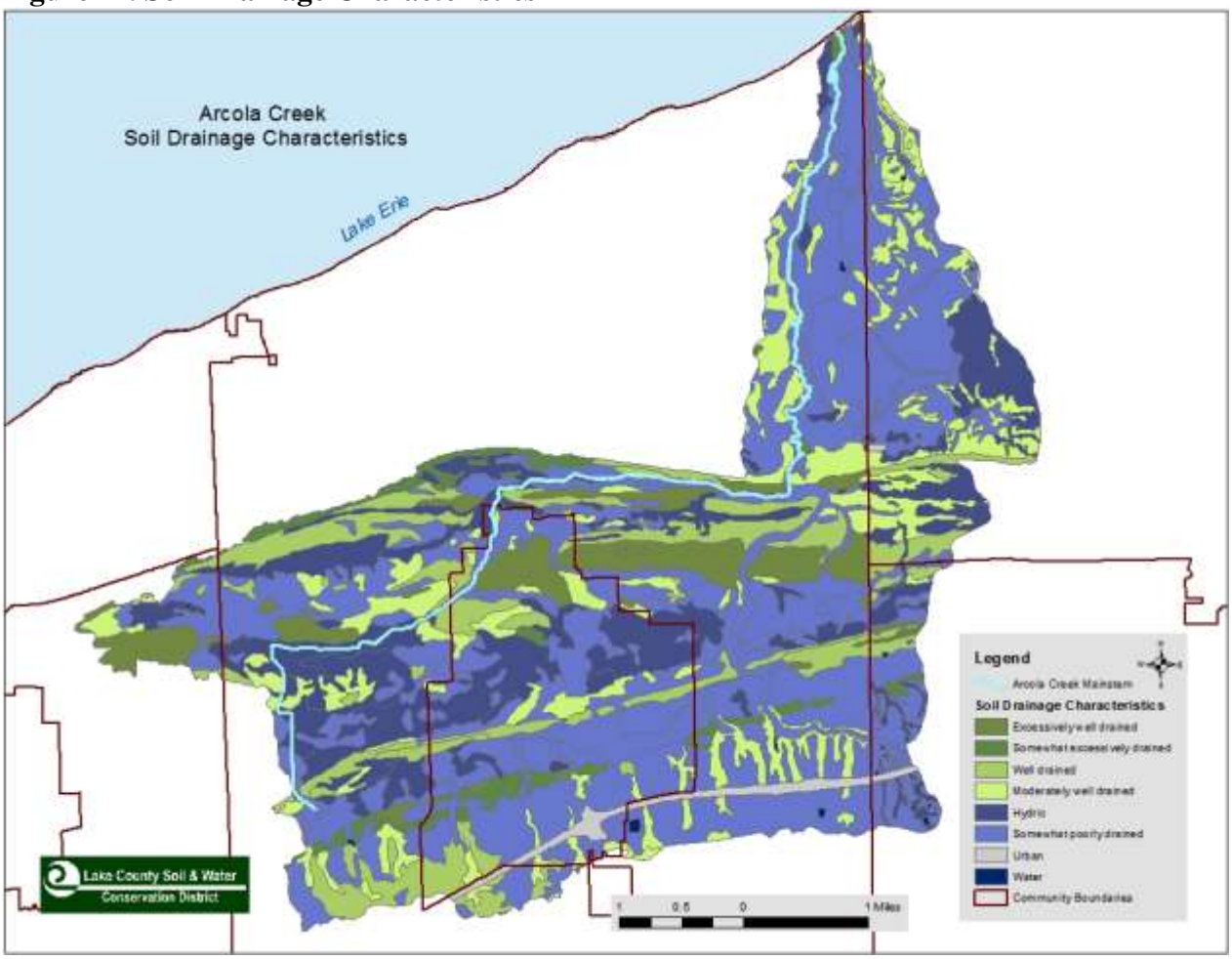


Figure 11. Soil Drainage Characteristics

Drainage Characteristic	Acreage	%
Exceptionally well drained	1111.5	9.0
Somewhat excessively well drained	178.7	1.4
Well drained	1143.0	9.2
Moderately well drained	1767.2	14.4
Somewhat poorly drained	1597.0	13.0
Primary hydric	2799.7	22.8
Non-hydric with hydric components and inclusions	3423.2	27.9
Urban	234.2	1.9
Water	16.1	0.1

Figure 12. Soil Drainage Characteristics



Wetlands

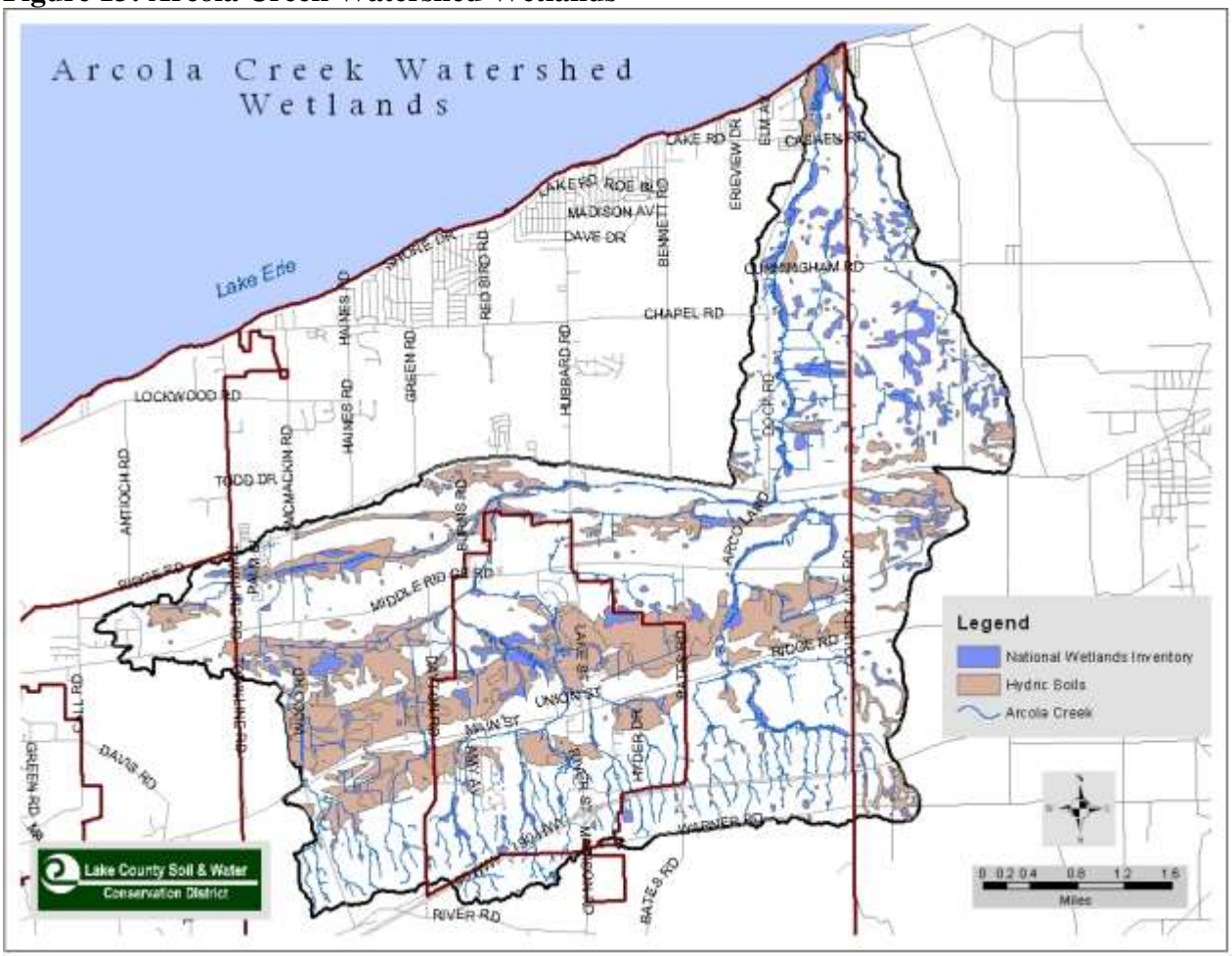
Most of the land between Lake Erie and the old beach ridges is level and poorly drained. "Much of northern Lake County was swampy and covered by large tracts of swamp forest until draining of the area by settlers began 200 years ago." (Szubski. 2002.) Very little of the swamp forest remains and most of the County's extensive wetland areas have been drained. The Arcola Estuary is one of the few river-mouth wetlands that remain in the County.

The overall percentage of land in the watershed covered by water and wetlands is 13.3%. (USGS. StreamStats.) Wetlands provide valuable ecosystem services. They are reservoirs of biodiversity; they provide flood control, replenish groundwater, purify surface waters of nutrients and sediments and act as a carbon sink. Protecting wetlands from further diminishment is an important component of the Arcola Creek Watershed Action Plan.

The Arcola Creek Watershed Wetlands map (Figure 13) is comprised of the National Wetlands Inventory (NWI), compiled and updated in November of 2009 by the U.S Fish and Wildlife Survey and Ducks Unlimited Great Lakes/Atlantic Regional Office. The NWI was created in 1974 to provide resource managers with information about the location, types and extent of

wetlands in the country. The map is supplemented with hydric soils data to provide further detail on the extent of wetlands in the watershed.

Figure 13: Arcola Creek Watershed Wetlands



Invasives

According to the Ohio Department of Natural Resources (ODNR), about one-quarter of the plants growing in Ohio have come from other parts of the continent or world (ODNR, Ohio Biodiversity Database. Their presence can be dated to the onset of European settlement in the mid-1700s. Since they are foreign to our ecosystem, there are no natural checks and balances and many of these species have become invasive, crowding out native species. Invasive plants usually have fast growth rates, very efficient seed dispersal and high rates of germination. They have spread to many natural areas, forests and parks across the state. ODNR lists the top ten invasive species as Japanese Honeysuckle, Japanese Knotweed, Autumn Olive, Buckthorns, Purple Loosestrife, Common Reed, Reed Canary Grass, Garlic Mustard, Multiflora Rose and Bush Honeysuckles.

Most of these species can be found in the Arcola Creek Watershed. The most prevalent species is likely Common Reed, also known as Phragmites.

Four alien aquatic plants were inventoried in the Arcola Creek Marsh in 1982 by James K. Bissell, Curator of Botany at the Cleveland Museum of Natural History. Two were submersed aquatic plants, water milfoil and curly pondweed, and two were emergent aquatic plants, yellow iris and barnyard grass. The woods south of the beach have a high count of alien plants, including Japanese honeysuckle, privet, Norway maple, bouncing bet, crack willow and the balm of Gilead (a sterile form of poplar). All of the woodlands surrounding the Estuary are secondary, as the first trees were cleared during the bog iron and ship-building era. Alien species have replaced many of the first growth trees and shrubs and the woodlands are now poor quality natural areas. "The chief value of these upland woods is buffer protection and scenic backdrop for the marsh area." (Bissell. 1982.)

In woodlands, invasive plants displace our native spring wildflowers. In wetlands and along stream corridors they create monocultures and reduce biological diversity. We need to protect our native plant diversity for wildlife habitat, food, cover and breeding habitat and for the aesthetics of our communities. Management of invasives can be complex, and it is important for citizens to avoid unwittingly spreading them by planting non-native plant species. Management of invasives includes hand pulling and cutting, mowing, treatment with herbicides and prescribed burning.

"The removal of one plant, phragmites from Arcola Creek Marsh should be attempted. Phragmites, also known as common reed grass can out-compete diverse assemblages of shoreline emergent aquatic plants. Phragmites, formerly a rare plant in northeastern Ohio, has recently become common to abundant within open marshes, roadside ditches and lake shores…Once established, phragmites tends to change once diverse marshes into monotonous phragmites stands containing fewer species." (Bissell. 1982.)

Invasive non-native earthworms are also affecting the wooded areas of the watershed. They consume most of the leaf cover by mid-summer, destroying the ground cover and nesting cover for other small organisms which live in the topsoil organic matter. They create an impervious surface which causes water to runoff rather than soak into the soil. Earthworms also destroy a fungus which maple seedlings need to germinate and grow. Invasive plants, such as garlic mustard thrive where the earthworms are, as well.

It will be an important part of restoration projects in the watershed to remove invasive species and to restore native plant populations. Our partners in the Nursery industry can play a large role in the reduction and control of invasive plants in the Arcola Creek Watershed. Holden Arboretum and other institutions in the country are researching the non-native earthworm problem, but have found no resolutions as yet.

2.1.2 Land Use and Protection

The ERIN Watershed Report delineated 44% of the land use as forest in 2009, 34% of the land use as urban and 21% of the land use as agriculture (Figure 14).

Figure 14. Land Use Percentage (ERIN Watershed Report 2009)

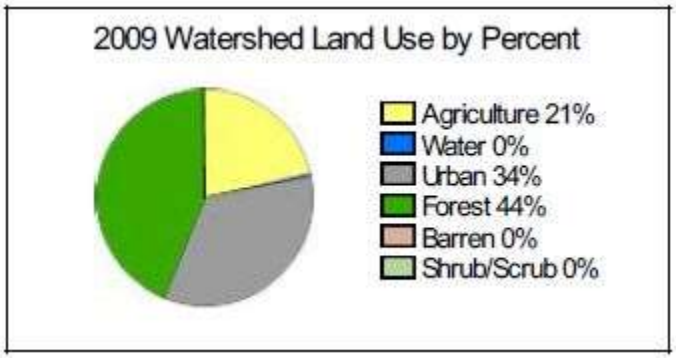
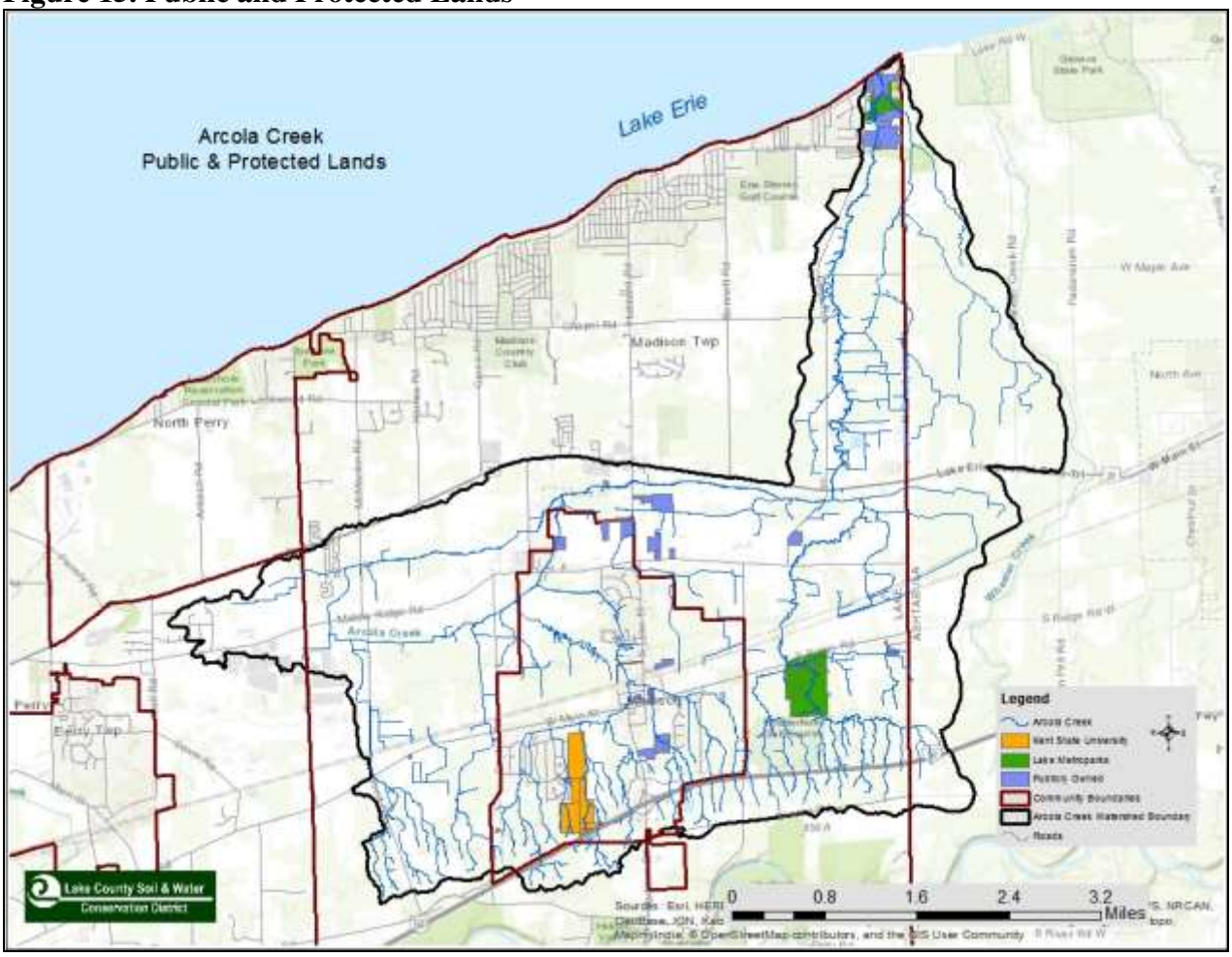


Figure 15. Public and Protected Lands



Only about 4.1% of the land is publicly owned or protected (Figure 15). 185.6 acres are publicly owned and 146 acres are protected by Lake Metroparks, which includes Arcola Creek Park (at the estuary) and South Ridge Reservation (not open to the public). Lake SWCD holds 55 acres of conservation easements, and Kent State University owns 106 acres that are protected with a deed restriction.

Imperviousness of a watershed has an effect on the physical and biological characteristics of a stream. Increases in impervious cover cause decreases in conditions. Channel instability will occur when the impervious area is greater than 10%. Sharp declines in macroinvertebrate diversity occur when imperviousness is greater than 8%. According to the Center for Watershed Protection's Watershed Vulnerability Analysis report (Center for Watershed Protection, 2002), "…certain zones of stream quality exist, most notably at about 10% impervious cover, where the most sensitive stream elements are lost from the system. A second threshold appears to exist at around 25 to 30% impervious cover, where most indicators of stream quality consistently shift to a poor condition (e.g., diminished aquatic diversity, water quality and habitat scores)."

U.S. Geological Survey StreamStats data show the imperviousness in selected subwatersheds (Figure 16):

Figure 16. Imperviousness

Subwatershed	Percent Impervious	Drainage Area- Sq Miles
Dayton Road	4.53%	3.84
Arcola Road	7.74%	2.10
U.S. Route 20	9.61%	2.03
State Route 528	9.83%	3.31
McMackin Road	6.4%	2.60

The U.S. Route 20 and State Route 528 subwatersheds are very close to the balance point for degradation. Opportunities for retrofits with green infrastructure should be utilized as much as possible.

A course of action to stem the rate of increased impervious surfaces appearing in the watershed could include infiltration trenches/basins and pervious overflow in parking areas. "A non-structural method to counter increased impervious surfaces is riparian setbacks. As the amount and velocity of stormwater runoff increases in the watershed the stream banks will begin to erode. If setbacks are put in place then the tree roots will help to protect the streambanks. In areas where tree roots are not capable of maintaining channel stability the setback will allow room for the stream to meander without causing undue problems with nearby structures." (Edgar. 2004.)

2.2 Summary of HUC-12 Biological Trends

Ohio EPA uses biological assessments to support the use attainability in the state, basing the relationship between biology, habitat and the potential for water quality improvement. OEPA has designated the Aquatic Life Use of Arcola Creek as a Warmwater Habitat (WWH) with 11 miles in the use designation. It also identifies 4.8 miles from the stream mouth as Seasonal Salmonid Habitat (SSH). The key attributes for WWH are the typical assemblages of fish and invertebrates, similar to the least impacted conditions. The SSH attributes are that they support lake run steelhead trout fisheries.

The OEPA sampled 8 sites in 2015 (Figure 17) for aquatic life use attainment, updating the data found in the January 7, 1997 Biological and Water Quality Study of The Grand and Ashtabula River Basins including Arcola Creek, Cowles Creek and Conneaut Creek. Of the 8 sites, 2 were found to be in Full Attainment of Aquatic Life Use for Warmwater Habitat, 1 in Partial Attainment, and 5 in Non-Attainment (Figures 17 and 18). The mouth of Arcola Creek at Lake Erie was one of the sampling sites in Non-Attainment of Aquatic Life Use for Exceptional Warmwater Habitat.

Figure 17. 2015 Sampling Locations & Attainment Status

Figure 18. Sampling Data

Location Number	River Mile	Drainage Area (mi2)	IBI/Rating	MIwb*	ICI/Rating	QHEI/Rating	Attain. Status
1	7.4	7.8	34/Fair	-	Fair	56/Fair	NON
2	7.05	7.9	30/Fair	-	Poor	49/Fair	NON
3	5.1	11.1	26/Poor	-	38/Good	44/Poor	NON
4	0.1	4.94	38/ marg. good	-	Cold Water/Good	61/Good	FULL
5	2.02	19.8	30/Fair	-	38/Good	59.5/Fair	PARTIAL
6	0.7	20.3	42/Good	7.5/Fair	38/Good	52/Fair	FULL
7	0.2	3.3	28/Fair	-	Low/Fair	48/Fair	NON
8	0.0	23.5	26/Poor	4.5/Poor	-	-	NON

*MIwb (Modified Index of well-being for fish): not applicable to drainage areas with headwater streams <20 mi2.

Figure 19: Aquatic Life Use Attainment Thresholds for Warmwater Habitat

	IBI	MIwb	ICI	QHEI (Excellent)
Headwaters	40	N/A	34	70
Wadeable	38	7.9	34	70

Headwater Habitat Evaluation Index

Lake SWCD worked with the EPA to develop the Headwater Habitat Evaluation Index (HHEI) protocol for use in drainage areas that are less than one square mile. Lake SWCD has used the HHEI to assess and establish a baseline database of existing conditions in many Lake County watersheds. HHEI data was collected by Lake SWCD staff in the Arcola Creek Watershed between 2000 and 2002. There is no HHEI data for Ashtabula County.

79 sites were assessed throughout the watershed. The lower reaches of the watershed have fewer sampling sites because there are fewer tributaries there and because it is inappropriate to do the HHEI sampling on the Main Stem due to the size of the drainage area at that point.

The Class is determined by the assessment of the biological community and the presence or lack of indicator species. See Figure 22 and the following text for a description of the three classes of Primary Headwater Habitat (PHWH) streams found in Ohio. 95% of the streams in the Arcola Creek Watershed are in the Class I, Class I Modified, Class II and Class II Modified categories (Figures 20 and 21).

The geological parent material has a strong correlation with the natural stream class and influences the potential for stream restoration in a watershed. Cold water streams are strongly correlated with glacial till in Lake County, and those streams that originate and flow in the glacial till have been found to have the best habitat and water quality. The slopes and variety of substrate sizes in glacial till create a higher potential for better quality habitats. Ephemeral streams and low quality warmwater streams are strongly correlated with the lake plain soils of

northern Lake County, and have a more limited application for habitat improvement through restoration projects.

Although the headwater streams in the Arcola Creek Watershed are located in the glacial till and would have the better potential for restoration, they are poor candidates for restoration projects. The size of their watersheds is so small and flow length so short that they don't have the power to create good habitat and morphology (channel shape). They do not rank very high on HHEI assessments, which is reflected in the large number of Class I and Class I Modified sites in the headwater streams (Figure 21). If the headwater streams are not entrenched, they still perform the functions of floodwater storage, sediment reduction and nutrient assimilation in spite of their low quality habitat.

Although the natural limitations of the watershed affect the quality of habitat, the human activities that disrupt the natural function and habitat of the watershed can be minimized. The philosophy of the strategic plan is to restore habitat and stream health throughout the watershed wherever possible rather than continuing the historic cycle of ditching and channel modification. Capitalizing on the natural cleaning and flood management services that healthy streams provide through the aquatic macroinvertebrates reduces the costs and impacts associated with managing the watershed in any other way.

Figure 20. Stream Class Percentages

Class	% of Total	Combined Class %
Class I	39.1	56.8
Class I Modified	17.7	
Class II	23.0	38.2
Class II Modified	15.2	
Class III	5.0	5.0

Figure 21. Stream Class for the Lake County Section

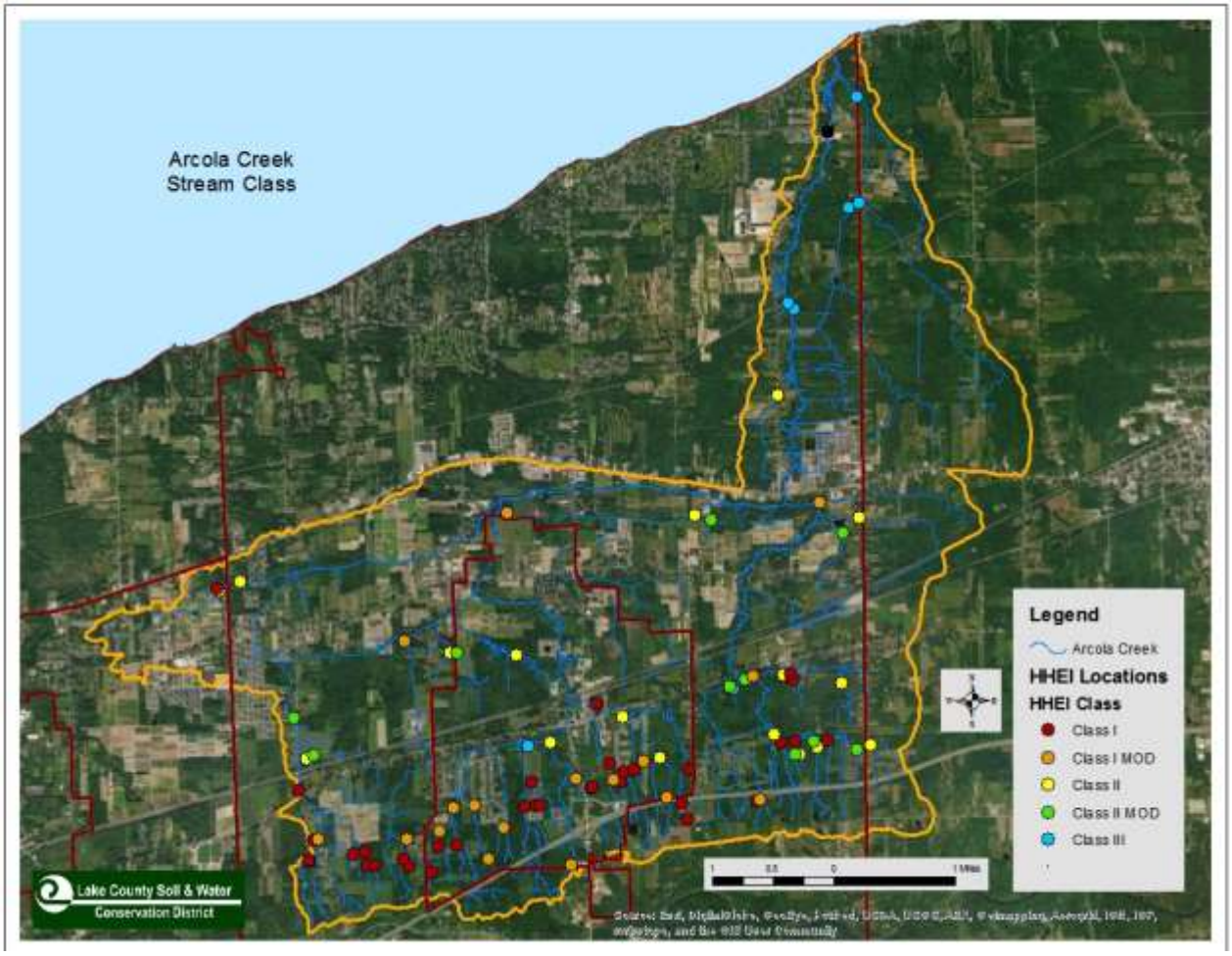
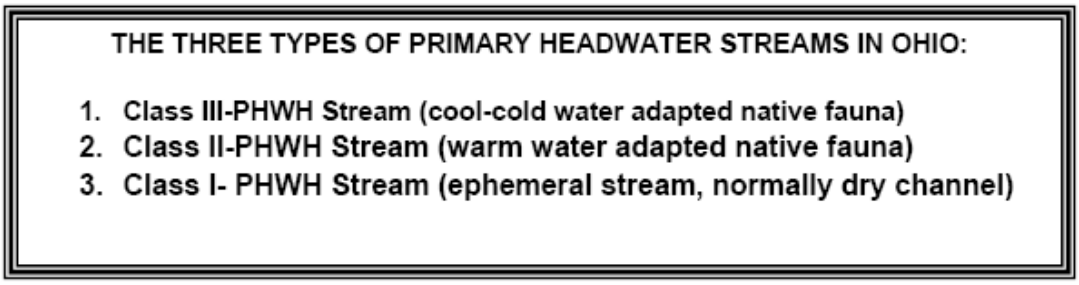


Figure 22: Three Types of Primary Headwater Streams in Ohio (OEPA. 2009.)



Class III-PHWH (Primary Headwater Habitat) streams have a diverse population of native fauna adapted to cool-cold perennial flowing water, with larval stages continuously present in the stream.

Class II-PHWH streams have a moderately diverse population of warm-water adapted native fauna on a seasonal or annual basis.

Class I-PHWH streams are ephemeral, with water present for short periods of time, from snow melt or rainwater runoff. Since they are normally dry, there is little or no aquatic life present.

The primary physical habitat distinction between Class I and Class II- PHWH streams is that Class II-PHWH streams are watered- either with the presence of flowing water or isolated pools during the summer months, and Class I-PHWH steams are dry. The primary biological habitat distinction is that Class I-PHWH streams have either no species of aquatic life present or the biological community has poor diversity. (OEPA. 2009.)

A natural "stream channel is characterized by the presence of riffles and pools, heterogeneous substrate deposition, the presence of point bars or other evidence of floodplain sediment deposition, appropriate stream channel sinuosity for the setting of the stream in the landscape, varied water depths and current velocity (when flowing), no obvious evidence of current or past bank shaping or armoring activities is present. Natural wooded or wetland riparian vegetation dominates the stream margin." (OEPA. 2009.)

When channels have been historically altered by man, they are categorized as "Modified". This can include a status of "Recovered", where the stream shows evidence of channel alteration, but has fully recovered many of the natural stream channel characteristics listed above; "Recovering", where there is evidence of alteration and the stream is in the process of adjusting, channel sinuosity is lacking and riparian vegetation is in early stages of re-growth; and "Recent or No Recovery", where alteration is evident and few if any natural characteristics are present. Highly modified streams are characterized by uniform depths, over-wide channels, homogeneous substrates, embeddedness of substrates and low sinuosity. (OEPA. 2009.)

2.3 Summary of HUC-12 Pollution Causes and Associated Sources

On the Ohio EPA Division of Surface Water's website, the Water Quality: Assessment Unit Summaries (2018) identifies the causes of impairment in the watershed as follows:

- Organic Enrichment
- Combined Biota/Habitat Bioassessments
- Flow Regime Modification
- Pesticides
- Habitat Alterations

The sources of impairment were identified as follows:

- Sediment resuspension (contaminated sediment)
- Loss of riparian habitat
- Natural sources
- Urban runoff/storm sewers
- Dam or impoundment
- Municipal point source discharges
- Channelization
- Agriculture

2.4 Additional Information Determining Critical Areas and Developing Implementation Strategies

Lake County Soil & Water Conservation District (SWCD)

Lake SWCD was formed in 1946 to provide leadership and technical expertise to guide the protection and conservation of the unique soil and water resources of Lake County. The District has worked with landowners and nursery owners in the Arcola Creek watershed to address water quality and quantity issues since its inception.

In a 1998 issue of the District newsletter, CrosSection, Dan Donaldson wrote an article entitled, "Madison's special watershed: Arcola Creek". He outlined the history of the watershed and raised awareness of the impacts of specialty crop agriculture and increased residential development, stating that a riparian ordinance and a sound stormwater management plan would help guide further development in the watershed.

The District was honored in 2009 with the Ohio Federation of Soil and Water Conservation Districts President's Award "For Distinctive Leadership and Visionary Governance Fostering the Development and Implementation of the Headwater Habitat Evaluation Index". In 2003, District staff began using the EPA's Headwater Habitat Evaluation Index (HHEI) in the Arcola Creek watershed (among others) to assign aquatic life use designations to unclassified streams in order to gather data to assist with their protection and conservation.

Over a ten-year period, staff collected data throughout Lake County and compiled a unique database of HHEI and QHEI (Qualitative Habitat Evaluation Index) information on local watersheds. The District utilized this data to assist communities in Lake County in

establishing riparian setback ordinances and monitoring erosion and sediment control programs that would meet the goals of the USEPA Phase 2 and Lake Stormwater Management Department programs. The data was also used to evaluate and prioritize resource values for conservation easements, and to develop baseline and monitoring information for restoration assessments. As a result, comprehensive historical data exists for Arcola Creek which can be used for comparisons with future restoration efforts that arise from the Arcola Creek NPS-IS.

Agriculture

The largest land use in the watershed is agricultural, at 48.61%. This classification includes forested lands. The majority of the agricultural land under cultivation is in nursery production. Nursery production includes container grown stock, which takes place in above-ground propagation, and in-ground or field propagation of larger stock. Nursery operations do not till the soil seasonally as do other agricultural operations, so soil loss from nursery fields is minimal. However, harder soil surfaces may contribute to greater runoff than that found with traditional agriculture. There is no conventional rotation of crops in nursery operations.

The nursery industry in the watershed is part of a larger industry in Lake County that employs more than 1,300 people and has total annual estimated sales of $87.5 million. (Results of the Lake County Nursery Industry Study. 2009.)

The nurseries in the Arcola Creek watershed are very dependent on Arcola Creek as a source of water for irrigation and irrigation of nursery stock is a major use of water in the watershed. High water quality is essential for the production of nursery and greenhouse crops. The watershed planning process needs to consider two aspects of water quality in regards to the important nursery industry: high quality water for irrigation, and high quality water returning to the stream.

The nursery industry began in Lake County in 1854 because of the favorable rainfall, good soil variety and drainage, lake effect climatic conditions, nearness to major markets, interstate highways and good rail transportation. The industry grew from one nursery to many; at one time Lake County was the rose capital of the world. 35 years ago, S.R. 306 in Mentor was the heart of the nursery industry. Suburbanization and growth have pushed the nurseries “out” to Perry and Madison.

Nurseries continue to feel development pressures, and look to various alternatives to remain in business without moving further to the east- where the resources are not as favorable. They utilize the Current Agricultural Use Value (CAUV) to help keep property taxes in check, some have sold off frontage around the edges, some have sold their land to other nurseries, some have passed the nursery on to the next generation; one recently completed the first nursery operation in the country to be protected with an agricultural easement through the Farm and Ranch Land Protection Program (FRPP). Some have sold to real estate developers. Preserving the nursery industry is critical to maintaining the quality of life in northeastern Lake County and the Arcola Creek Watershed and is a focus of the nursery industry as well as Lake SWCD, Lake County Planning Commission, the Lake County Development Council & its Agribusiness Committee, and the Western Reserve Land Conservancy.

OEPA Biological and Water Quality Study of Grand & Ashtabula River Basins, including Arcola Creek, Cowles Creek & Conneaut Creek, January 1997
As part of the Ashtabula River Basin, Arcola Creek was surveyed by the Ohio EPA in 1995 with four objectives in mind:

1. Evaluate the physical habitat, surface water, sediment quality and biological integrity,
2. Assess impacts from municipal wastewater treatment plants, nonpoint sources of pollution, habitat alterations and suburban development,
3. Determine attainment status of aquatic life use and non-aquatic use designations and make recommendations for change where appropriate, and
4. Compare results with previous surveys to assess changes in water quality and biological integrity.

The study found that Arcola Creek "had significant areas not meeting WWH (Warm Water Habitat) biological criteria owing to nutrient enrichment from municipal WWTP (Wastewater Treatment Plants) or extensive habitat and flow alterations". The five sampled segments were found to be non-attainment because of an upstream and downstream wastewater treatment plant, channelization and dewatering.

Recommendations included the following:

1. Warm Water Habitat (WWH) is warranted for aquatic life use; a redesignation to Modified Warmwater Habitat (MWH) upstream of U.S. 20 is not warranted because channel modifications are not sanctioned by 404 or 401 permits.
2. Expand Seasonal Salmonid use designation to include the lower 3 river miles of the free flowing portion of the creek.
3. Obtain water management plans from the nurseries withdrawing water from the creek to maintain minimum stream flows in summer.
4. Remove oxygen demanding compounds and reaerate Madison Village WWTP effluent to provide dissolved oxygen in excess of current minimum concentration of 5.0 mg/l specified in the NPDES permit (Nonpoint Discharge Elimination System).
5. Monitor channel maintenance activities and identify unpermitted activities.
6. Incorporate phosphorus removal in the treatment process in the Madison Village WWTP expansion; limit concentrations to 0.73 mg/l.
7. Assess biotic communities and nursery function for Lake Erie fishes in the Arcola Estuary/wetland area.
8. Investigate impacts to wetlands from flow appropriations.
9. Investigate bypasses of sewage from the Lake County Madison WWTP holding basins.

Lake County General Plan of Drainage, March 2003
The Lake County General Plan of Drainage was written in March, 2003, to gather background information supporting the need for creating a stormwater management department within Lake County. State, County, Township and Village officials were interviewed to gather data on stormwater management issues in each watershed in the County. Existing regional stormwater facilities, outfalls and flow direction were also mapped.

The Plan listed the water quality threats in Arcola Creek identified by the Ohio EPA in its 1995 study: hydromodification, stream bed/bank erosion, habitat modification, siltation, agricultural chemicals, and nutrient enrichment from wastewater treatment plant discharges. It stated that the water quality of Arcola Creek is significantly limited by the fine sand, silt and clay of the glacial lake deposits which dominate the watershed. The Plan concluded that the operation and maintenance of drainage systems and the control of stormwater runoff in the watershed by the communities have been limited by inadequate funding. Although the solutions recommended by the Plan address stormwater improvements, water quality benefits as well from better stormwater management.

Based upon community interviews, specific stormwater issues were identified in the plan and the following regional stormwater improvements within the Arcola Creek watershed were recommended:

1. Address flooding at bridge on U.S. Route 20 and Arcola Creek with bridge project administered by the Ohio Department of Transportation.
2. Reconstruct undersized sewer on Lake Road in Madison Village.
3. Acquire land for possible regional retention basin sites throughout the watershed.
4. Clean railroad culverts and clear ditches for increased capacity; introduce bioengineering wherever appropriate.
5. Coordinate with the Lake County General Health District to evaluate septic systems to determine where effluent is entering surface waters.
6. Increase capacity and introduce bioengineering to the drainage ditch between Townline Rd. and Antioch Rd. in North Perry Village.
7. Implement ditch lining project between single-family homes on Bates Rd. in Madison Township.
8. Construct underdrains to eliminate at ponding the edge of pavement and tree lawns on streets in northern Madison Township.
9. Drain, clean and maintain detention basins in the watershed.
10. Install/replace storm sewers to address flooding issues near Lake/Elm and behind the Hawaiian Isle Mobile Park.

Other areas of concern within the Arcola Creek drainage basin were identified. Rapidly growing residential areas present the biggest threat of future stormwater issues.

The water table is very shallow and fluctuates seasonally. Groundwater depth impacts surface water runoff during spring snowmelt and rainfall, when the soils are saturated and unable to absorb runoff. High ground water levels have impacted new developments,

causing wetness and flooding in basements. Future regulations and ordinances might include provisions to address effects of shallow groundwater on building construction.

The Plan estimated the total cost to address regional stormwater issues to be $3,350,000, and the cost to address local issues to be $1,700,000.

Arcola Creek Watershed Management Plan, October 2004
Lake County Soil & Water Conservation District received a grant in 1999 from Ohio Department of Natural Resources to study the Arcola Creek Watershed and design a watershed management plan to address land-use issues, flooding and conservation of natural resources. The project goal was to determine high quality areas for increased conservation efforts and lower quality areas for restoration.

The District did a mailed survey to 372 watershed landowners in 1999. There was a 40% response, which indicated a high interest in the Creek. Respondents identified the top four characteristics for which Arcola Creek is best known, as attracting birds and other wildlife, moving stormwater, Arcola's historical significance and fishing. They also expressed concerns of trash, debris, eroding banks, flooding and water clarity. "An overwhelming majority of respondents recognized that protecting small creeks is necessary to the health of larger rivers." Public meetings with landowners in May of 2000 uncovered interest in developing a comprehensive watershed plan to address issues with flooding, current and projected land use, pollution, stream erosion and environmental quality. Another meeting with 13 nursery stakeholders along Arcola Creek in May of 2000 allowed a forum to express concerns with culvert sizes, wetlands, flooding, conservation easements and water chemistry quality issues.

Chad Edgar, Urban Stream Specialist with Lake SWCD made recommendations in the Plan that include the following:

1. Develop new regulations to prohibit fill in 100-yr floodplains
2. Stop wetland filling; mitigate within the watershed
3. Use riparian setbacks
4. Devise financial incentives for conservation subdivisions
5. Stem the rate of increasing impervious surfaces, using infiltration techniques and pervious parking
6. Reduce surface and groundwater withdrawals
7. Remove on-line ponds
8. Preserve recharge areas with conservation easements
9. Educate landowners on riparian zones
10. Educate the community on how channel alteration has caused streams to lack ability to provide nutrient retention, habitat and floodwater storage

U.S. Army Corps of Engineers (USACE) Section 206 Aquatic Ecosystem Restoration Study

See description in the Arcola Creek Watershed Action Plan for background and a description of the 1996 Preliminary Restoration Plan.

The Section 206 Arcola Creek Ecosystem Restoration Project intends to develop and implement a plan to enhance the functional capacity and biological integrity of Arcola Creek to restore water levels, provide riparian corridors, and improve in-stream habitat within the Arcola Creek Watershed. A conceptual plan has been developed to do a floodplain, riparian and aquatic habitat restoration in the Madison Village Public Park. The anticipated project schedule included a Final Feasibility Report Approval in November 2018, Project Partnership Agreement Execution in March 2019, Project Design in the Fall of 2019, implementation beginning in the Spring of 2020 and project completion at the end of Summer 2022.

Lake County Stormwater Management Department

The Lake County Stormwater Management Department (LCSMD) was formed in 2003 to collaborate with Lake County Communities that were required to meet NPDES Phase II mandates. There are currently 15 communities within Lake County that participate in the Lake County Program, including Madison Township and Madison Village which are contained within the Arcola Creek watershed. Perry Township has elected to meet the NPDES requirements as individual community.

The LCSMD partners with the Lake County General Health District (LCGHD), Lake County Soil and Water Conservation District (LCSWCD) and Chagrin River Watershed Partners, Inc. (CRWP) to assist with the implementation of the NPDES Phase II mandates.

There are currently two levels of service provided to the member communities of the LCSMD. Level One consists of assistance with Minimum Control Measures (MCM's) 1-3, while Level Two services include assistance with MCM's 1-6 and additional funding for capital infrastructure and maintenance projects. Projects initiated and/or completed within Madison Township include:

- Storm Sewer Upgrades
- Storm Sewer Maintenance and Cleaning
- Regional Ditch Maintenance-including log jam and debris removals
- Erosion Control Projects
- Regular Street Sweeping
- Stormwater Pollution Prevention Plan (SWPPP) for the Madison Twp. Service Garage

Stormwater Best Management Practices (BMP's) are utilized and incorporated into the capital projects and maintenance operations undertaken by Madison Township as well as any new development or redevelopment projects. These include the use of Erosion and Sediment Control BMP's during construction, Post-Construction BMP's (when required),

and the proper disposal of pollutants collected during maintenance operations. The practices chosen are based on site conditions and by referencing the Ohio Department of Natural Resources (ODNR) Rainwater and Development Manual.

There are many miles of channelized/modified streams within the Arcola Creek Watershed. The LCSMD and Madison Township have partnered to initiate a program aimed at removing accumulated sediments and logjams within these streams to restore channel capacity and reduce the probability of flooding events. Stormwater BMP's such as silt fence, rock check dams, and rock channel protection are utilized during maintenance activities to reduce the amount of sediment transport downstream. Upon completion, the areas are seeded and mulched in order to re-establish vegetative cover.

Lake County Planning Commission

The Lake County Planning Commission updated the Madison Village and Madison Township Comprehensive Plans in 2009. They included provisions to address water quality and stormwater runoff, such as riparian buffers, recommendations for conservation developments, larger lots, low impact development techniques and reduction of impervious areas. In 2012, the department changed its name and function to Lake County Planning and Community Development.

Riparian and Wetland Setbacks

Madison Township has adopted a Riparian Setback Zoning Code to protect the riparian headwater streams and wetlands in the Township. The setback distances are as follows:

Riparian Setbacks

a. A minimum of 120feet on each side of all watercourses draining an area greater than or equal to 20 square miles.
b. A minimum of 75 feet on each side of all watercourses draining an area greater than or equal to one square mile and up to 20 square miles.
c. A minimum of 25 feet on each side of all watercourses draining an area less than one square mile and having a defined bed and bank.
d. A minimum of 75 feet on each side of all watercourses designated as Class III Primary Headwater Habitat streams.

Wetland Setbacks

a. 50 feet extending beyond the outmost boundary of a Category 3 wetland.
b. 30 feet extending beyond the outermost boundary of a Category 2 wetland.
c. 10 feet extending beyond the outermost boundary of a Category 1 wetland.

Nutrient and Chemical Ranges of Irrigation Water within Nursery Operations of Lake County, Lake SWCD, Spring 2010

With funding through a Coastal Management Assistance Grant from the Ohio Department of Natural Resources in 2010, Lake SWCD sampled nutrient and chemical ranges at 10 locations on nursery operations in Perry and Madison Townships. Sampling was done at both entry and exit points from the selected nursery properties. This project was to establish a baseline sampling and analysis to develop reference data in an effort to

protect irrigation water sources. It was the first step in developing irrigation water protection strategies for local nurseries.

Nutrients and chemicals tested included pH, alkalinity, total dissolved salts, electrical conductivity, sodium adsorption ratio, hardness, sodium, chlorides, Calcium, Magnesium, Sulfur, Nitrogen, Phosphorus and Potassium. Dissolved salts, electrical conductivity and sodium adsorption ratios fell both below and above recommended levels for irrigation water depending upon the location of the samples taken. Nitrogen, Phosphorus and Potassium concentrations were all below the recommended amounts for irrigation water.

An Irrigation Management Self Evaluation Workbook was also created as a guide to nurseries to measure their practices and identify where they can improve performance with best management practices.

Arcola Creek Watershed Action Plan

The Arcola Creek WAP was endorsed by the Ohio EPA and Ohio Department of Natural Resources on April 30, 2013. Two projects have been completed in Madison Village: a stream restoration on 900 feet on Arcola Creek in the Fairview Cemetery in 2017, funded by the EPA 319 grant (Figures 23 and 24), and a green infrastructure installation of pervious pavers and nine rain gardens along the north side of Main Street in the business district, funded by the EPA Surface Water Improvement Fund (SWIF) in 2016 (Figures 25 and 26).

Figure 23. Stream restoration: Before

Figure 24. Stream Restoration: After

Figure 25. Green Infrastructure: Before

Figure 26. Green Infrastructure: After

Chapter 3: Critical Area Conditions & Restoration Strategies

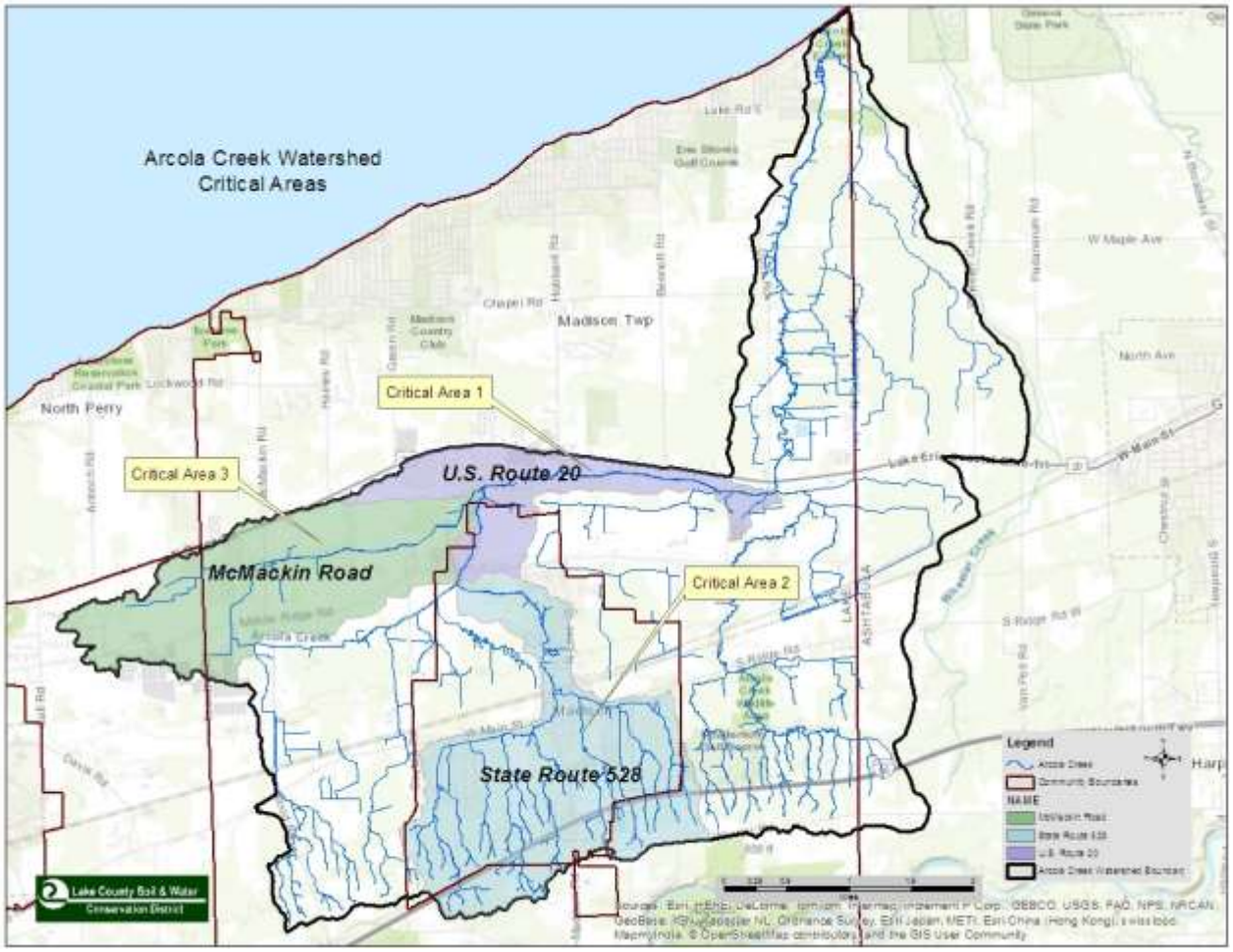
3.1 Overview of Critical Areas

The Critical Areas for the Arcola Creek Watershed are the McMackin Subwatershed, State Route 528 Subwatershed and the U.S. Route 20 Subwatershed (Figures 27 and 28). All three are very close to the balance point for degradation because of the amount of imperviousness in the watersheds. They are all impacted by development, inadequately managed stormwater runoff and stream channelization. The rationale for this determination follows in the individual descriptions of the Critical Areas.

Figure 27. Critical Areas

U.S. Route 20 Subwatershed	Critical Area 1
State Route 528 Subwatershed	Critical Area 2
McMackin Road Subwatershed	Critical Area 3

Figure 28. Critical Areas



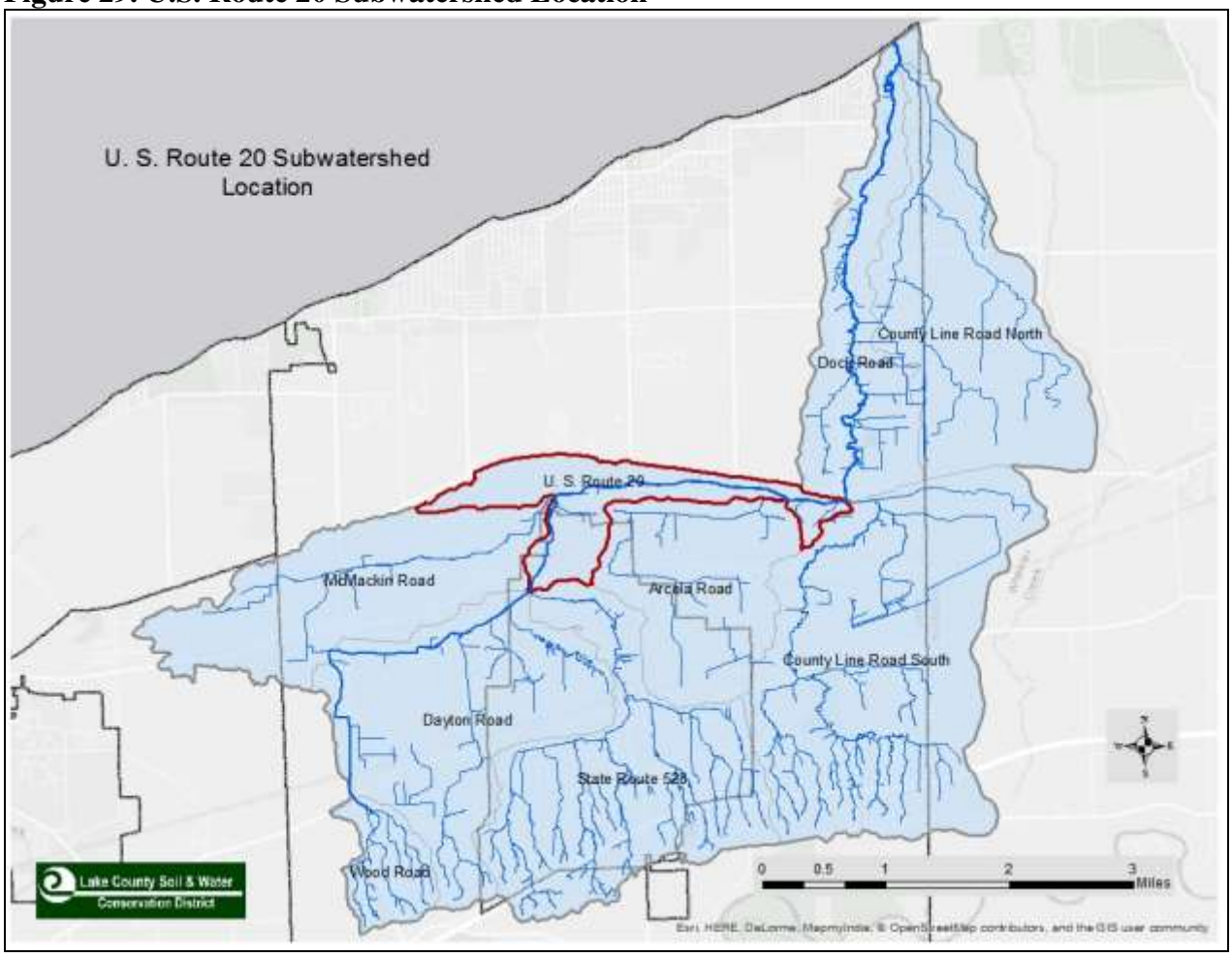
3.2 Critical Area 1: Conditions, Goals & Objectives for the U. S. Route 20 Subwatershed

3.2.1 Critical Area 1: Detailed Characterization

The U.S. Route 20 Subwatershed (Figure 29) drains 2.17 square miles. It has one of the largest amounts of impervious areas in the watershed, at around 8%, and is nearing the balance point for channel degradation and loss of macroinvertebrate diversity.

U.S. Route 20 is the center of commercial and business development in Madison and forms the northern watershed boundary for the subwatershed and the Arcola Creek Watershed land use along U.S. Route 20 is mostly commercial, with nursery production fields and residential land along road corridors in the other sections of the subwatershed (Figure 30). Land cover is largely urban in the U.S. Route 20 corridor, with the largest concentrations of commercial businesses located between Burns and Hubbard Roads. Water lines and Sanitary mains cover much of the watershed. There are several multi-family residences in the southwestern corner.

Figure 29. U.S. Route 20 Subwatershed Location



Agriculture and forestland still comprises the largest land use at 34%, with nurseries and one beef farm (Figures 30 and 31). Commercial and Residential land uses are each around 26%. One of the areas classified as residential is a 50 acre block of "vacant" land owned by a realty company, which comprises 6% of the watershed and has the potential to make a significant impact if developed. Some of the land uses have changed slightly since the Arcola Creek WAP was written, and Agricultural land uses have gone down 1.1%, Commercial up 1.1%; Residential down 0.8% and Public up 0.8%. The Madison Village Wastewater Treatment Plant is located along Arcola Creek in the south central portion of the subwatershed, but is in the process of being decommissioned and diverted for treatment to the County Wastewater Treatment Plant on Cashen Road.

This subwatershed is likely to become the most developed in the HUC-12 watershed, with U.S. Route 20 serving as the commercial center for Madison and eastern Lake County.

Figure 30. U.S. Route 20 Land Use

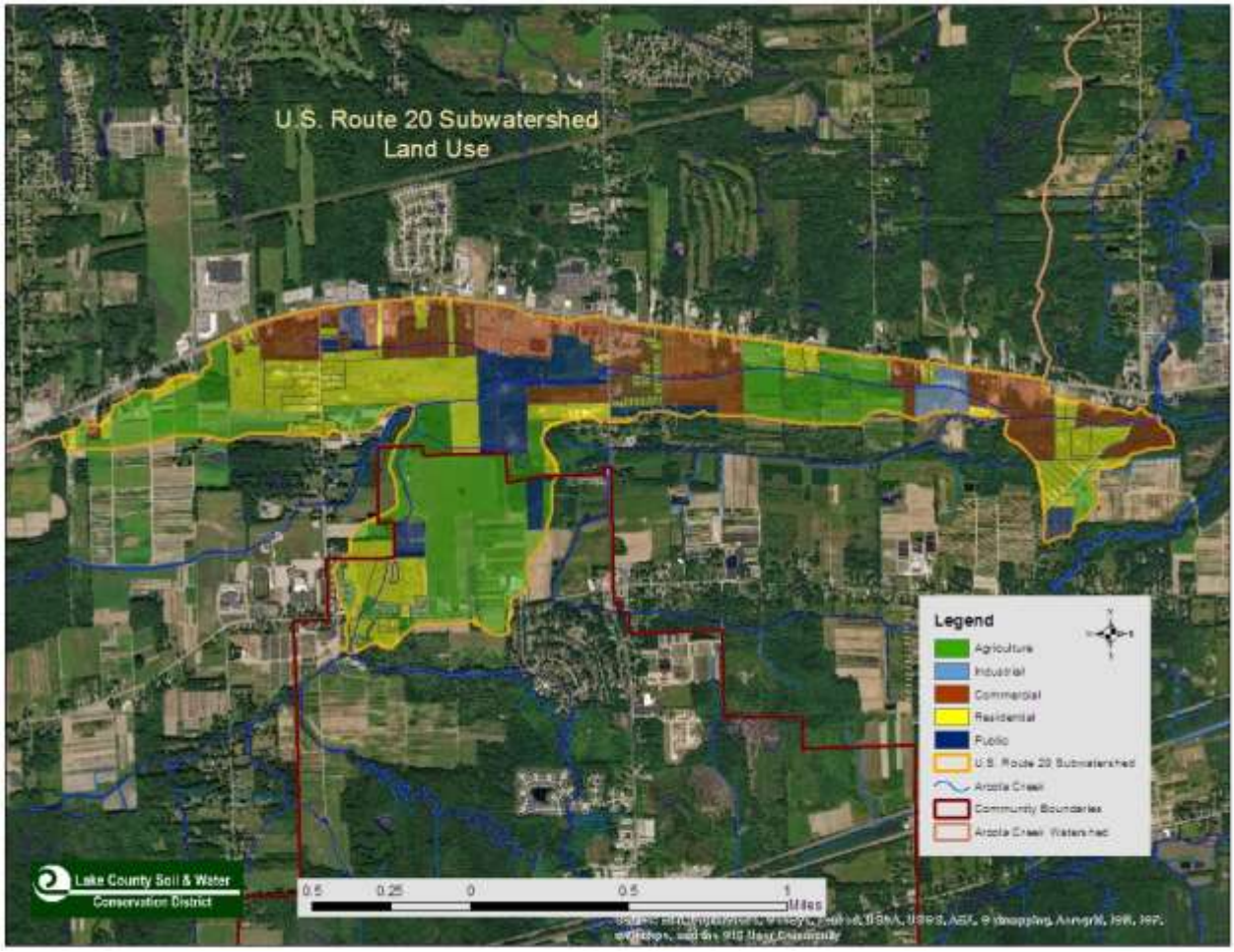


Figure 31. U.S. Route 20 Land Use Data

Land Use	Acres	% of Total	%Change from WAP
Agricultural (green)	279.3	34.1	-1.1
Industrial (light blue)	13.6	1.6	-
Commercial (red)	221.7	27.1	+1.1
Residential (yellow)	203.7	24.9	-0.8
Public (dark blue)	89.9	10.9	+0.8

There are extensive areas of 100-year floodplain along the main channel and adjacent to Burns Road (Figure 32). 26.5% of the subwatershed is in the 100-year floodplain. The channel is incised and there is limited access to the floodplain. The channel has been historically modified and dredged spoils have been levied along the channel to increase flood capacity within the channel. Other modifications include over-widening, deepening and straightening, which have resulted in a loss of stream function. On-line ponds have been constructed, further reducing the habitat by increasing average stream temperatures and disrupting the natural hydrology.

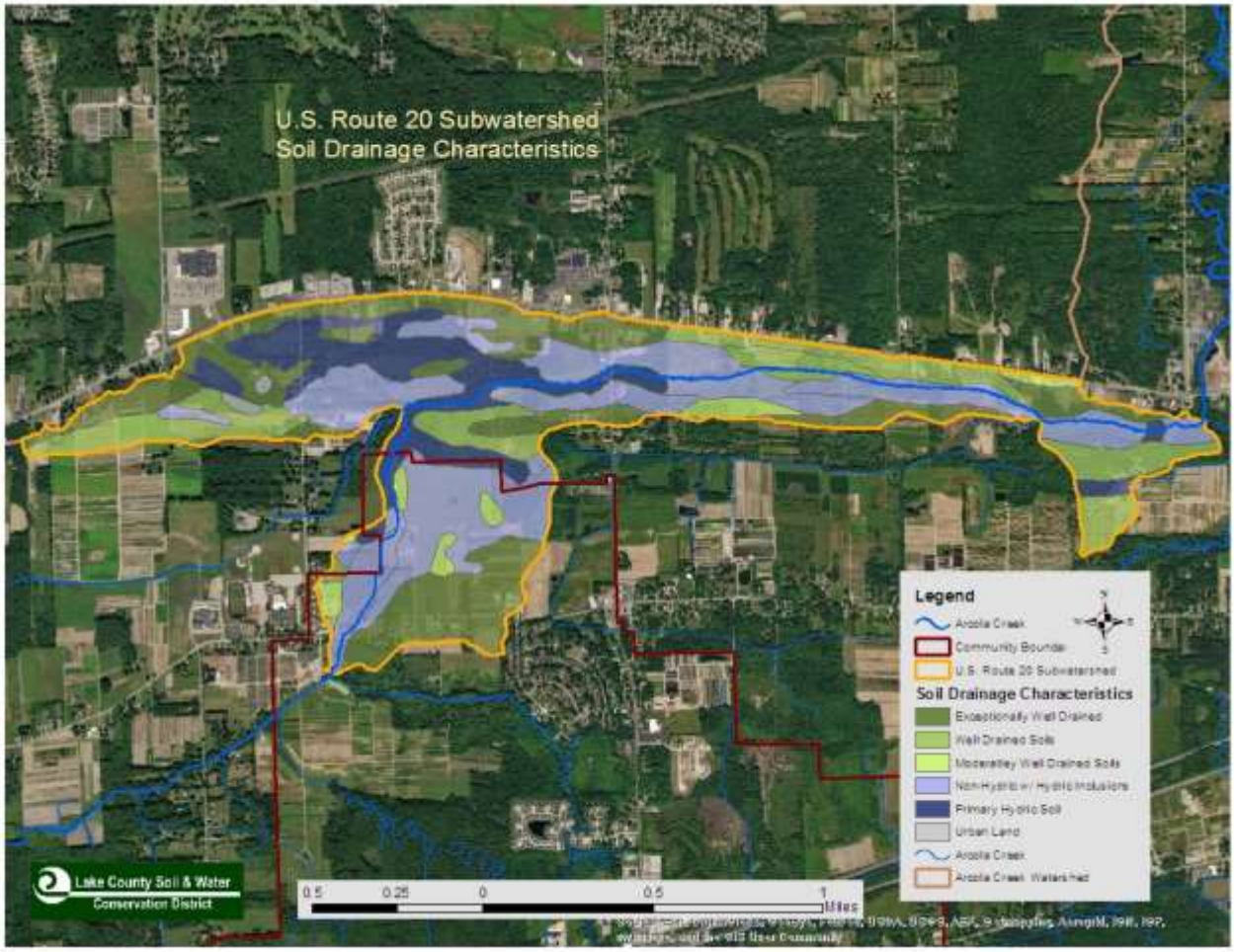
Figure 32. U.S. Route 20 100-Year Floodplain

49.7% of the soils have hydric drainage characteristics; 49.8 are very well drained (Figures 33 and 34).

Figure 33. U. S. Route 20 Soil Drainage Characteristics

Soil Drainage Characteristics	Acres	% of Total
Exceptionally Well Drained	231.8	28.3
Well Drained	148.3	18.1
Moderately Well Drained	28.1	3.43
Primary Hydric	128.7	15.7
Non-Hydric w/ Hyd. Inclusions	278.1	34.0
Urban	3.8	0.46

Figure 34. U.S. Route 20 Soil Drainage Characteristics



3.2.2 Detailed Biological Conditions

The three points sampled by the OEPA in 2015 in the U.S. Route 20 subwatershed (Figure 36) were all in Non-Attainment status of Warmwater Habitat (Figure 35). One QHEI score was Fair (56), and two were Poor (44 and 49); the Index of biotic integrity (IBI) scores were two Fair (30 and 34) and one Poor (26), and the Invertebrate Community Index (ICI) scores were one Fair, one Poor and one Good (38) (Figure 35).

Figure 35. EPA 2015 Sampling Data

Sampling Location	Drainage Area (mi2)	IBI/Narrative	ICI/Narrative	QHEI/Status	Attainment Status
1	7.8	34/Fair	Fair	56/Fair	NON
2	7.9	30/Fair	Poor	49/Fair	NON
3	11.1	26/Poor	38/Good	44/Poor	NON

Figure 36. Critical Area 1 Attainment Status

The following tables show the scoring schemes and ranges for QHEI (Figure 37), ICI (Figure 37a) and IBI (Figure 37b).

Figure 37. QHEI Scoring Scheme

Narrative score	Wading streams and rivers
Excellent	>= 75
Good	60-74
Fair	45-59
Poor	30-44
Very Poor	< 30

Figure 37a. Invertebrate Community Index (ICI) Range

Narrative	Erie/Ontario Lake Plains
Exceptional	46-60
Very Good	42-44
Good	34-40
Marginally Good	30-32
Fair	22-28
Low Fair	14-20
Poor	8-12
Very Poor	0-6

Ohio EPA Biological Criteria for the Protection of Aquatic Life: Volume III. Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities. Rev. June 26, 2015.

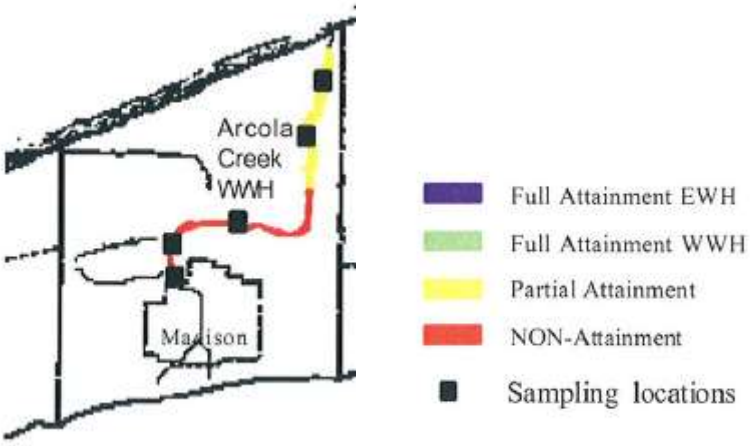
Figure 37b. Index of Biotic Integrity (IBI) Criteria

Modified Warmwater habitat	Warmwater Habitat	Exceptional Warmwater Habitat
24	40	48

Ohio Administrative Code (OAC) Chapter 3745-1, Water Quality Standards

The Ohio EPA 1995 Biological and Water Quality Study of the Grand and Ashtabula River Basins published a sketch that showed a section of NON-Attainment from the U.S. Route 20 intersection upstream to the edge of the Madison Village boundary (Figure 38). This is the same section to be found in NON-Attainment in the 2015 sampling (Figure 36).

Figure 38. Attainment Status for stream segments (Ohio EPA. 1995.)



3.2.3 Detailed Causes and Associated Sources

The causes and sources of impairment in Critical Area 1 are listed in the Ohio EPA online Water Quality Assessment Unit Summaries (2018) for the HUC-12 watershed.

Cause	Source
Organic enrichment	Municipal point source discharges, natural sources
Combined biota/habitat bioassessments	Channelization, loss of riparian habitat, dam or impoundment
Flow regime modification	Channelization, urban runoff/storm sewers, dam or impoundment
Pesticides	Sediment resuspension (contaminated sediment), agriculture
Habitat alterations	Loss of riparian habitat

3.2.4 Outline Goals and Objectives for Critical Area 1

Goals

The overarching nonpoint source restoration goal is to improve IBI, MIwb, ICI and QHEI scores so that the *partial* or *non-attainment* status can achieve full attainment of the designated aquatic life use for that waterbody. The goal is to reach Full Attainment with practices implemented in all three Critical Areas.

Goal 1. QHEI raise to 70 at RM 7.4

- NOT ACHIEVED: Site currently has a QHEI of 56

Goal 2. IBI raise to 40 at RM 7.4

- NOT ACHIEVED: Site currently has an IBI of 34

Goal 3. ICI raise to 34 or higher at RM 7.4

- NOT ACHIEVED: Site currently has an ICI of Fair (22-28)

Goal 4. QHEI raise to 70 at RM 7.05

- NOT ACHIEVED: Site currently has a QHEI of 49

Goal 5. IBI raise to 40 at RM 7.05

- NOT ACHIEVED: Site currently has an IBI of 30

Goal 6. ICI raise to 34 or higher at RM 7.05

- NOT ACHIEVED: Site currently has an ICI of Poor (8-12)

Goal 7. QHEI raise to 70 at RM 5.1

- NOT ACHIEVED: Site currently has a QHEI of 44
-

Goal 8. IBI raise to 40 at RM 5.1

- NOT ACHIEVED: Site currently has an IBI of 26

Goal 9. ICI maintain score of 38

Objectives
Objective 1. Reduce urban runoff from impervious surfaces through impervious surface reduction and infiltrative green infrastructure practices. We want to install LID practices on approximately 2 acres to treat at least 20 acres of urban drainage area, for each of the following locations:

- Install 2 acres of Low Impact Development (LID) practices in the commercial properties on U.S. Route 20
- Install 2 acres of LID practices in the upstream State Route 528 subwatershed, Critical Area 2

Objective 2. Restore natural hydrology by creating access to the floodplain and restoring wetlands

- Restore 2500 linear feet of stream on the mainstem where it parallels U.S. Route 20
- Restore 2 acres of wetlands
- Restore 1200 linear feet of stream downstream of the Madison Village WWTP

Objective 3. Restore diversity of plants along the riparian corridor

- Remove invasives from 13 acres adjacent to the mainstem

As the objectives are implemented, water quality monitoring will be conducted (both project related and regularly scheduled monitoring) to determine progress toward meeting the identified water quality goals. These objectives will be reevaluated and modified or added to if determined to be necessary. Reevaluation will utilize the Ohio EPA Nonpoint Source Management Plan Update (Ohio EPA, 2013) which lists all the eligible NPS management strategies to address:

- Urban sediment and nutrient reduction
- Altered stream and habitat restoration
- Nonpoint source reduction
- High quality waters protection

3.3.1 Critical Area 2: Conditions Goals & Objectives for State Road 528 Subwatershed

3.3.1 Detailed Characterization

Critical Area 2, State Road 528 Subwatershed drains 3.39 square miles (Figure 39). This subwatershed contains the Madison Village center, has commercial operations along State Route 528 and area of concentrated residential development. The largest zoning district is residential. Many of the large wooded parcels in the subwatershed are owned by land development companies, awaiting future development. Interstate 90 crosses the

southern portion and the I-90/State Route 528 interchange has a high potential for development of industrial businesses and for commercial businesses oriented to tourism.

The subwatershed will face intense development pressures because of the Madison Village amenities and the interstate exchange. Indeed, “Residential and commercial developments and loss of floodplain function are the biggest threats” (Edgar. 2004) to this subwatershed.

Figure 39. State Route 528 Subwatershed Location

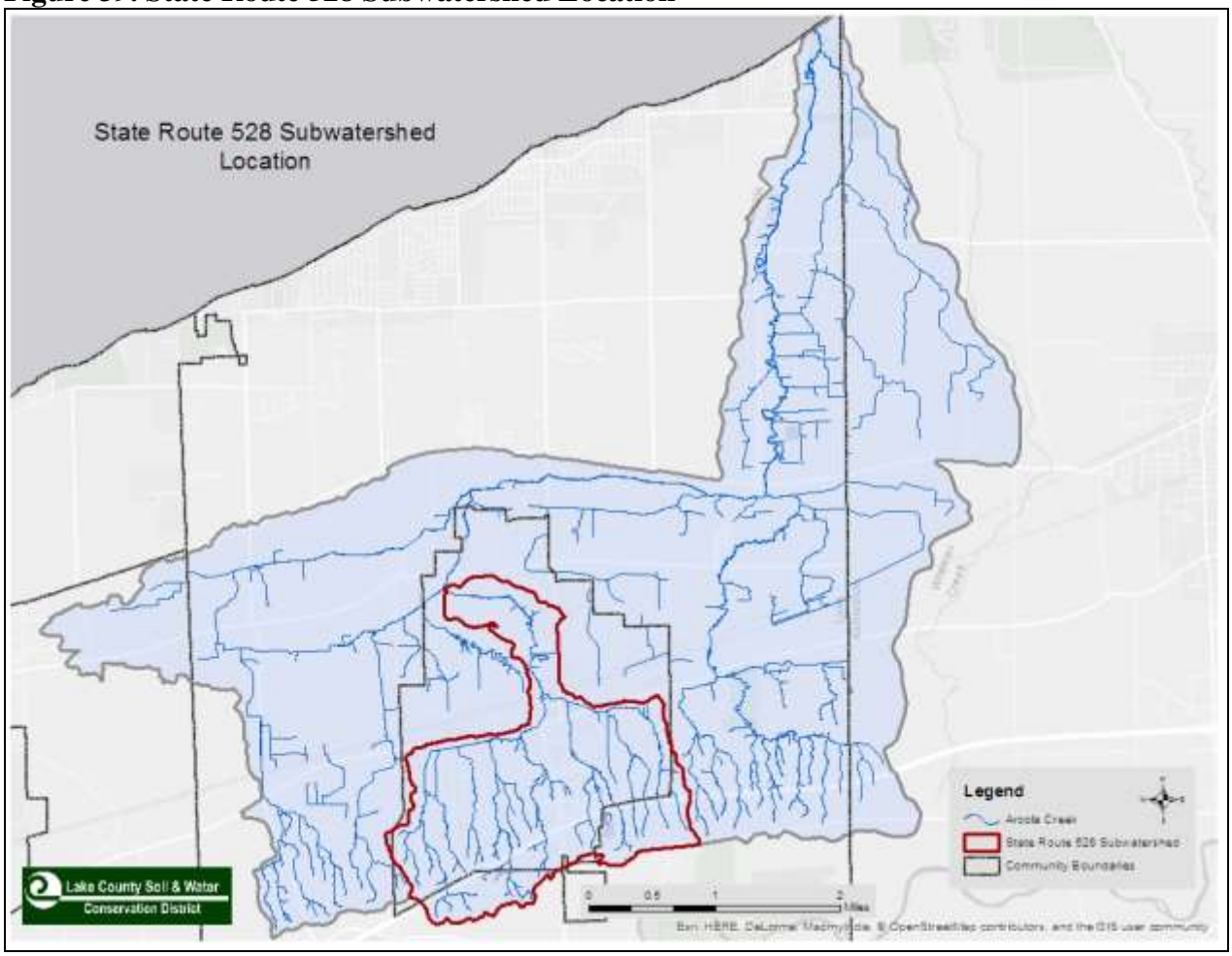


Figure 40. State Route 528 Land Use

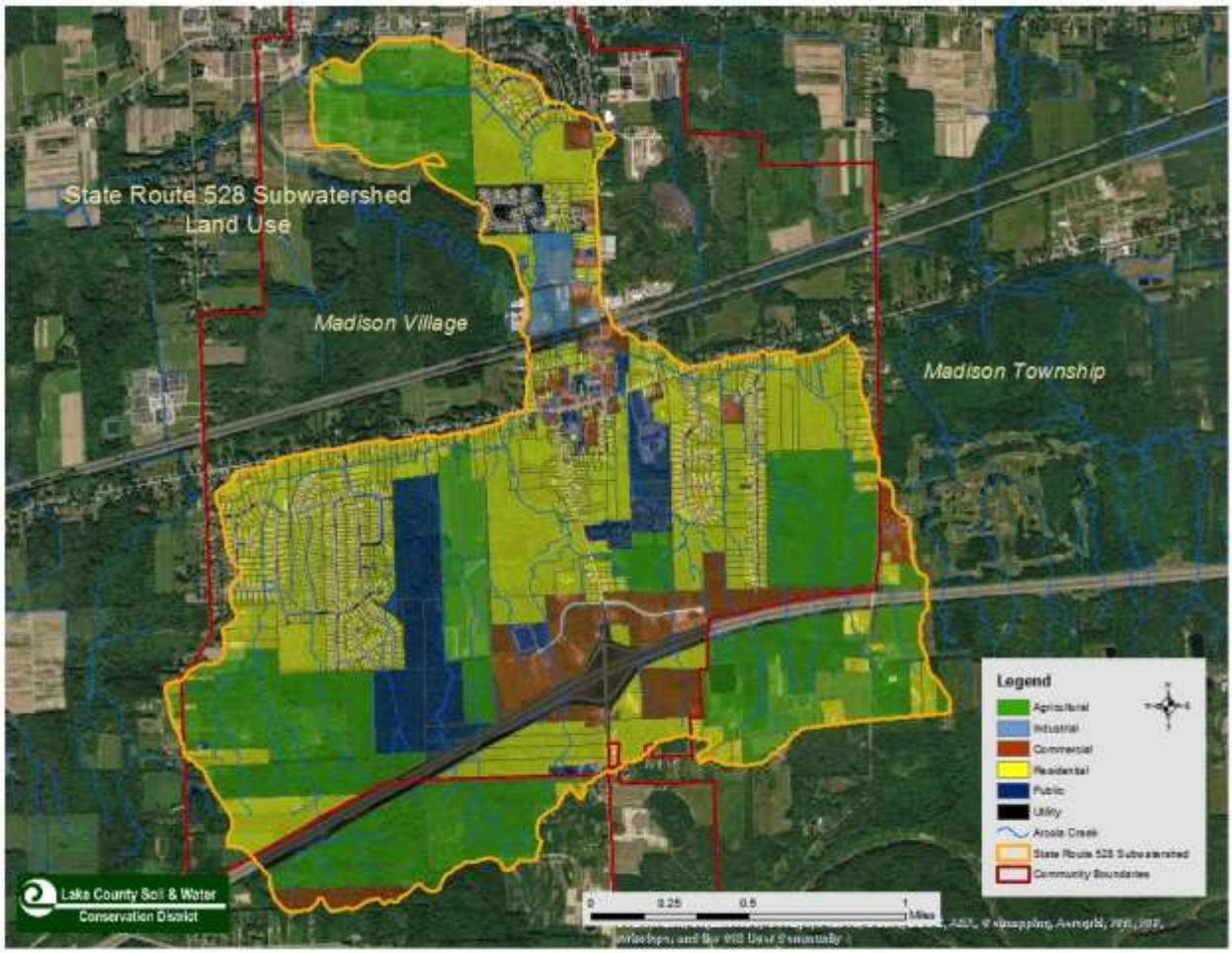
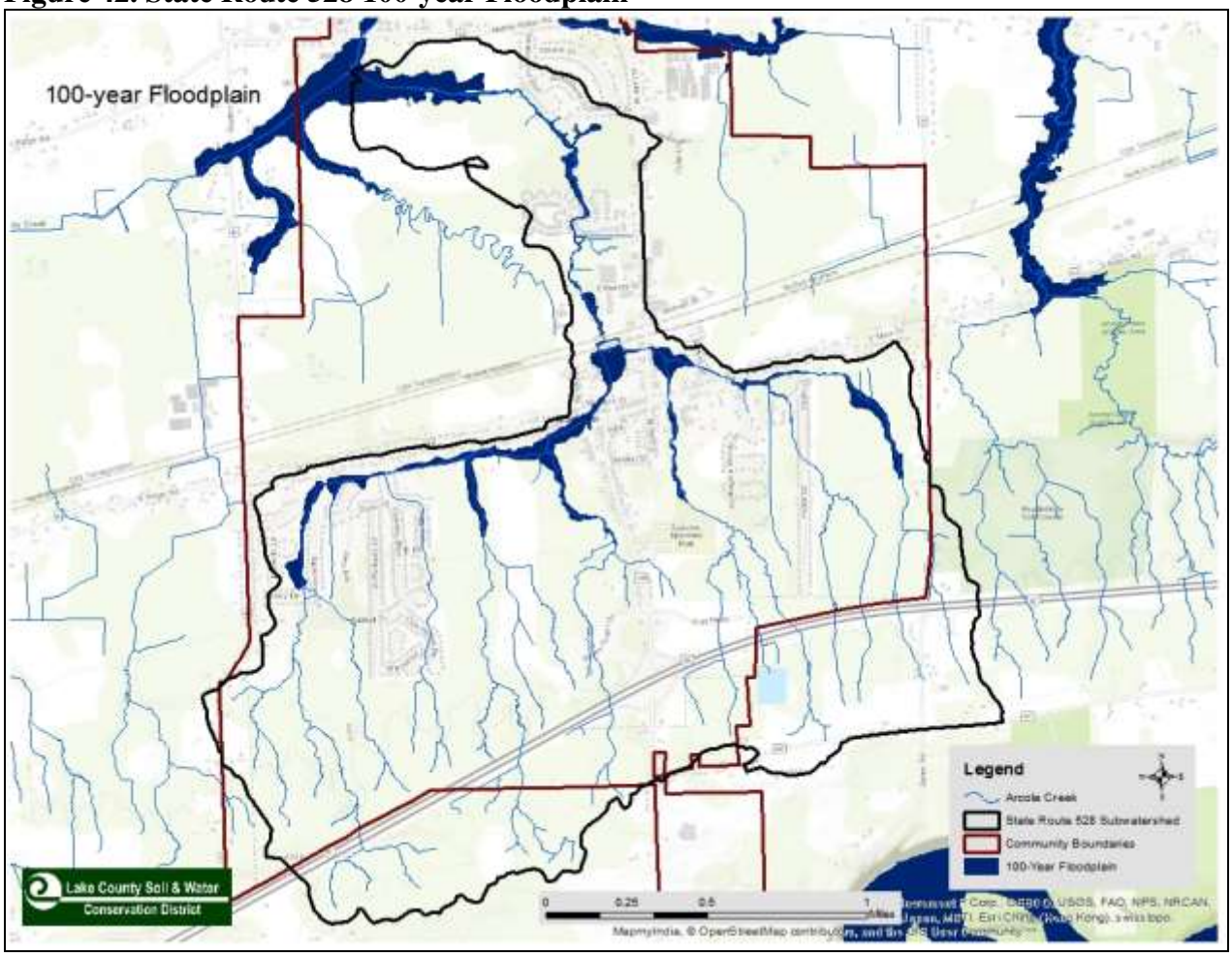


Figure 41. State Route 528 Land Use

Land Use	Acres	% of Total
Agricultural (green)	738.5	35.5
Industrial (light blue)	29.1	1.5
Commercial (red)	188.9	9.1
Residential (yellow)	859.3	41.3
Public (dark blue)	177.1	8.5
Utility (black)	84.6	4.1

The largest land use is residential with agricultural second (Figures 40 and 41). This balance could change quickly once the Village Wastewater Treatment Plant is decommissioned and a trunk line is built to send the wastewater to the County's Cashen Road treatment plant, which would greatly increase capacity. Commercial development is clustered around the SR 528 and I-90 interchange and in the Village central business district.

Figure 42. State Route 528 100-year Floodplain



The 100-year floodplain is extensive in the Madison Village center as well as at the northern section of the subwatershed (Figure 42).

The subwatershed has a broad headwater area, and the beach ridge underlying State Route 84 deflects the flow to the center and through a narrow neck in the center of the Madison Village business district, which causes flooding to be an issue in the most congested part of the community.

Stream morphology data was measured by Lake SWCD in 2004 at 21 locations (Edgar. 2004.). Three channels were found to be entrenched; of the three, one (Figures 23 and 24) was restored with an OEPA 319 grant in 2017.

There are two sections in Madison Village where the floodplain access has been limited by placement of ditching spoils along the streamside: behind Madison Village Hall to the railroad tracks, and where the creek flows west from Safford Street to Lake Street.

Figure 43. State Route 528 Soil Drainage Characteristics

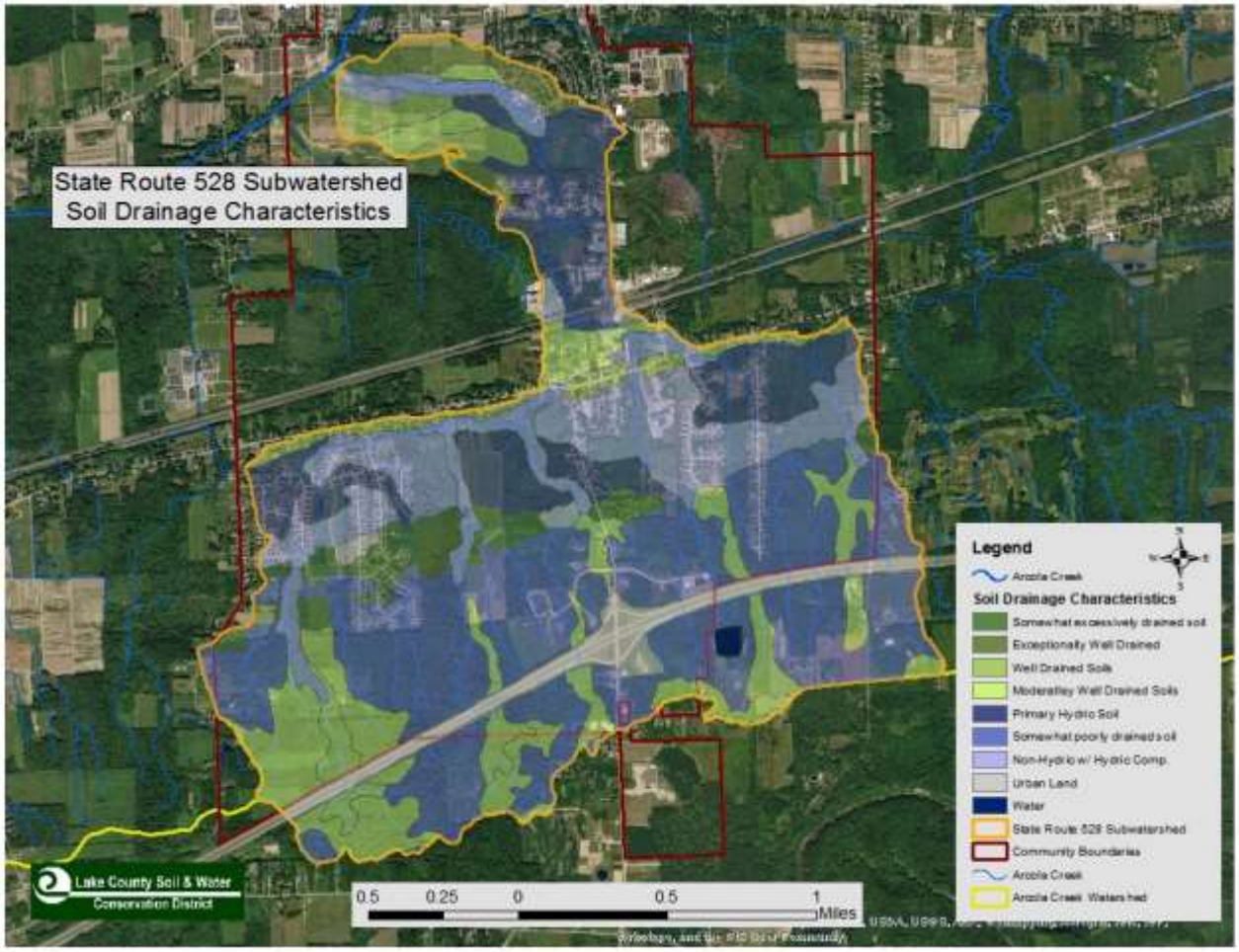


Figure 44. State Route 528 Soil Drainage Characteristics

Soil Drainage Characteristics	Acres	% of Total
Somewhat Excessively Drained	86.4	4
Exceptionally Well Drained	62.6	2.9
Well Drained	89.3	4.1
Moderately Well Drained	362.6	16.7
Primary Hydric	333.6	15.4
Somewhat Poorly	753.2	34.7
Non-Hydric w/ Hyd. Inclusions	362.5	16.7
Urban	115.3	5.3
Water	6.1	.2

Much of the subwatershed has hydric or poor drainage conditions (Figures 43 and 44). Selection and location of restoration practices will need to take this into account.

3.3.2 Detailed Biological Conditions

There were no sites sampled in this subwatershed during the most recent assessment of the OEPA in 2015. The water quality was given an impaired status for Aquatic Life Use in the 2010 Waterbody Report for Arcola Creek.

Further assessment of the biological conditions in the subwatershed is possible using data collected by Lake SWCD in 2000 and 2001. Headwater Habitat Evaluation Index (HHEI) is an assessment of the *habitat*; Headwater Macroinvertebrate Field Evaluation Index (HMFEI) is an assessment of the *biology*. Biology trumps habitat, so a stream with a good HHEI score may still be a lower class if the biology is not there.

By HHEI class, **67.7%** are Class I; **25.8%** are Class II and **6.5%** are Class III (Figures 45 and 46). By HMFEI class, **91%** are Class I; **3%** are Class II and **6%** are Class III (Figures 47 and 48).

Figure 45. HHEI Stream Class

Class	Number	% of Total
Class I	18	58
Class I Modified	3	9.7
Class II	5	16.1
Class II Modified	3	9.7
Class III	2	6.5

Figure 46. State Route 528 HHEI Stream Class

Figure 47. HMFEI Stream Class

Class	Number	% of Total
Class I	31	91
Class II	1	3
Class III	2	6

Figure 48. State Route 528 HMFEI Stream Class

3.3.3 Detailed Causes and Associated Sources

The most recent causes and sources of impairment in Critical Area 2 are listed in the Ohio EPA online Water Quality Assessment Unit Summaries (2018) for the HUC-12 watershed.

Cause	Source
Organic enrichment	Municipal point source discharges, natural sources
Combined biota/habitat bioassessments	Channelization, loss of riparian habitat, dam or impoundment
Flow regime modification	Channelization, urban runoff/storm sewers, dam or impoundment
Pesticides	Sediment resuspension (contaminated sediment), agriculture
Habitat alterations	Loss of riparian habitat

3.3.4 Outline Goals and Objectives for Critical Area 2

Goals

The overarching nonpoint source restoration goal is to improve IBI, MIwb, ICI and QHEI scores so that the *partial* or *non-attainment* status can achieve full attainment of the designated aquatic life use for that waterbody.

A watershed is a system; the whole is only as good as its parts. The headwaters need to be functioning properly for the downstream sections to function well. Three important functions of headwater streams are:

1. Sediment retention
2. Nutrient retention
3. Floodwater storage

Improving any one of these three functions upstream will improve downstream conditions. Floodwater storage can be increased through infiltration practices. More infiltration in the upper parts of a watershed will help the headwater streams go through the process of healing through channel evolution. As streams build their own floodplains floodwater storage increases as well. The biology will be helped with reducing the flow of floodwaters. By increasing the hydro-period through infiltration more water is available to aquatic life as it makes its way slowly through the soil pores.

The State Route 528 subwatershed contains a significant amount of the headwaters that drain into Critical Area 1, so achieving full attainment in Critical Area 1 starts with practices implemented upstream in this Critical Area 2.

Goal 1. QHEI raise to 70 at RM 7.4

- NOT ACHIEVED: Site currently has a QHEI of 56

Goal 2. IBI raise to 40 at RM 7.4

- NOT ACHIEVED: Site currently has an IBI of 34

Goal 3. ICI raise to 34 or higher at RM 7.4

- NOT ACHIEVED: Site currently has an ICI of Fair (22-28)

Objectives

Objective 1. Reduce urban runoff from impervious surfaces through impervious surface reduction and infiltrative green infrastructure practices. We want to install LID practices on approximately 2 acres to treat at least 20 acres of urban drainage area.

- Install 2 acres of LID practices within the critical area

Objective 2. Restore natural hydrology by restoring wetlands

- Restore 2 acres of wetlands

As the objectives are implemented, water quality monitoring will be conducted (both project related and regularly scheduled monitoring) to determine progress toward meeting the identified water quality goals. These objectives will be reevaluated and modified or added to if determined to be necessary. Reevaluation will utilize the Ohio EPA Nonpoint Source Management Plan Update (Ohio EPA, 2013) which lists all the eligible NPS management strategies to address:

- Urban sediment and nutrient reduction
- Altered stream and habitat restoration
- Nonpoint source reduction
- High quality waters protection

3.4.1 Critical Area 3: Conditions Goals & Objectives for McMackin Road Subwatershed

3.4.1 Detailed Characterization

The McMackin Road Subwatershed (Figure 49) has a 2.6 square mile drainage area. The impervious area is 6.4%. The land use is mixed commercial, agricultural and residential with large areas of nursery production fields growing container stock. It is the heart of nursery country. Historically the nursery operations have raised concerns with the public about water withdrawals and potential pesticide contamination affecting the water quantity and quality in this subwatershed.

Two notable developed areas are the Sahara Mobile Home Park, a large complex on the south side U.S. Route 20 between Townline and McMackin Roads, and the Madison High School complex in the northeast section of the subwatershed on Burns and Middle Ridge Roads.

There are pockets in the 100-year floodplain along the mainstem (Figure 52). Several of them occur in the Sahara Mobile Home Park.

This subwatershed is characterized by glacial lake deposits and beach ridges. The main creek channel is called McMackin Ditch and is highly modified; no habitat features are discernable. The primary headwater habitats are severely degraded through channel modifications and impervious cover associated with nursery operations. Stream morphology in three locations was found to have limited floodplain access and relative instability.

Figure 49. McMackin Road Subwatershed Location

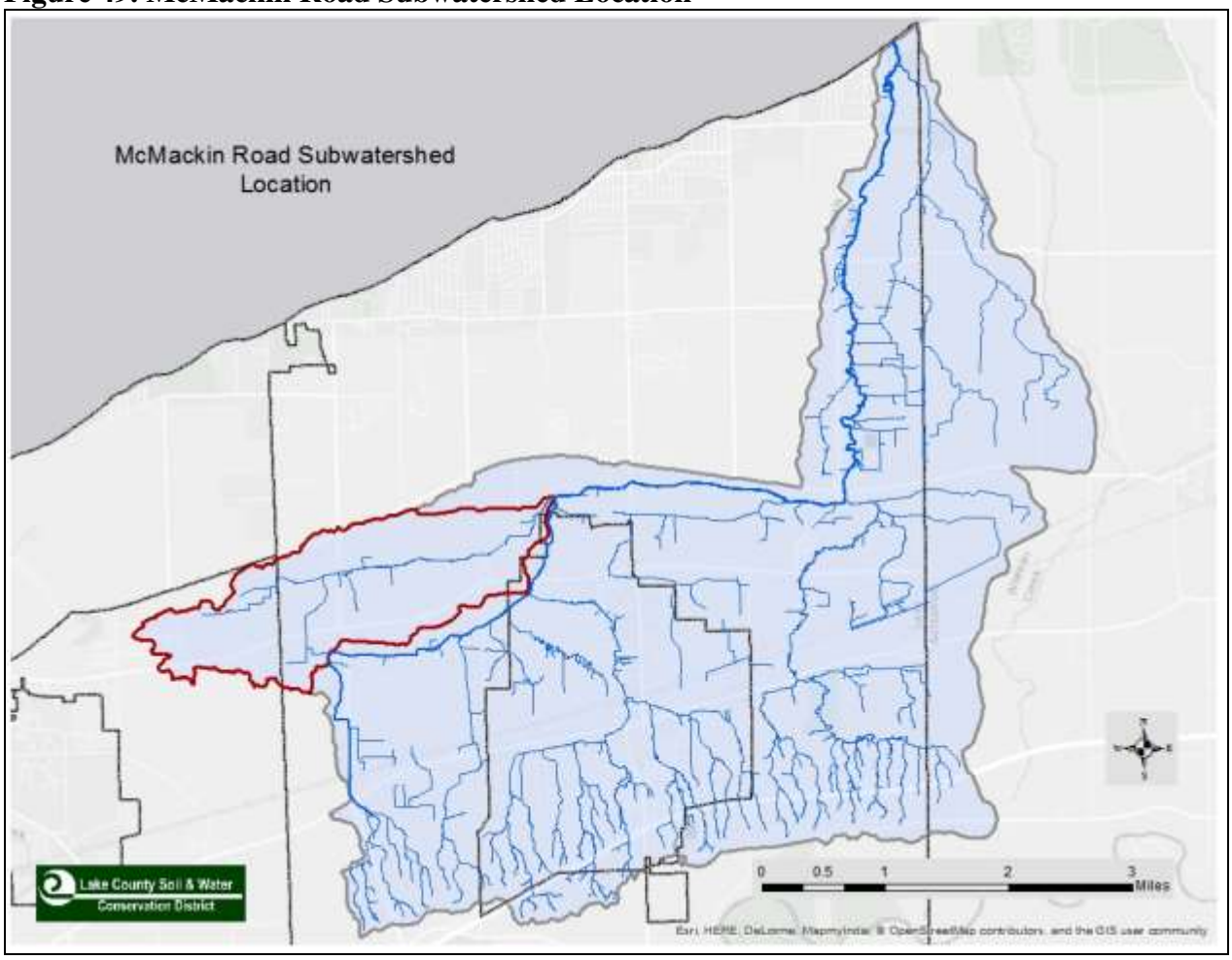


Figure 50. McMackin Road Land Use

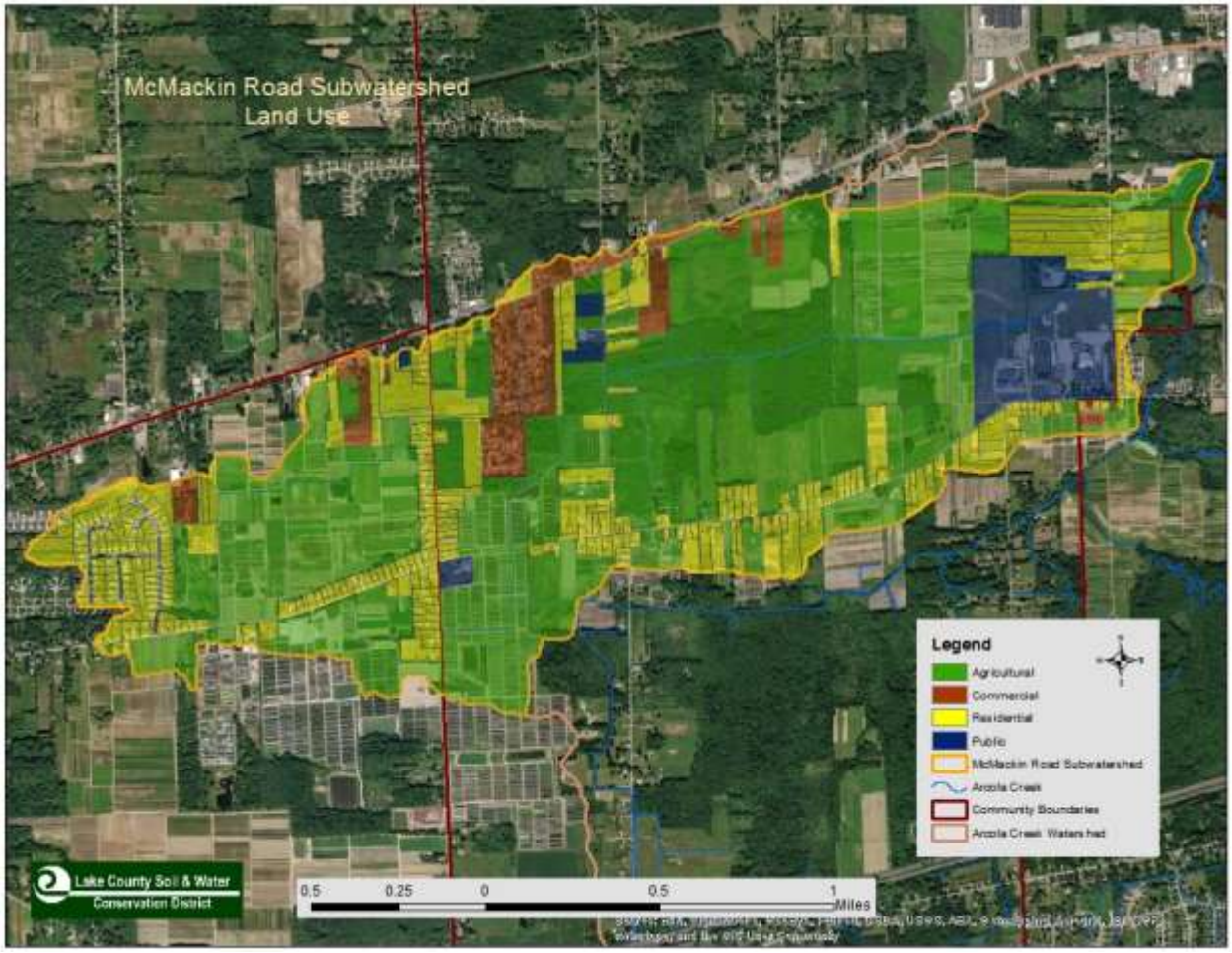
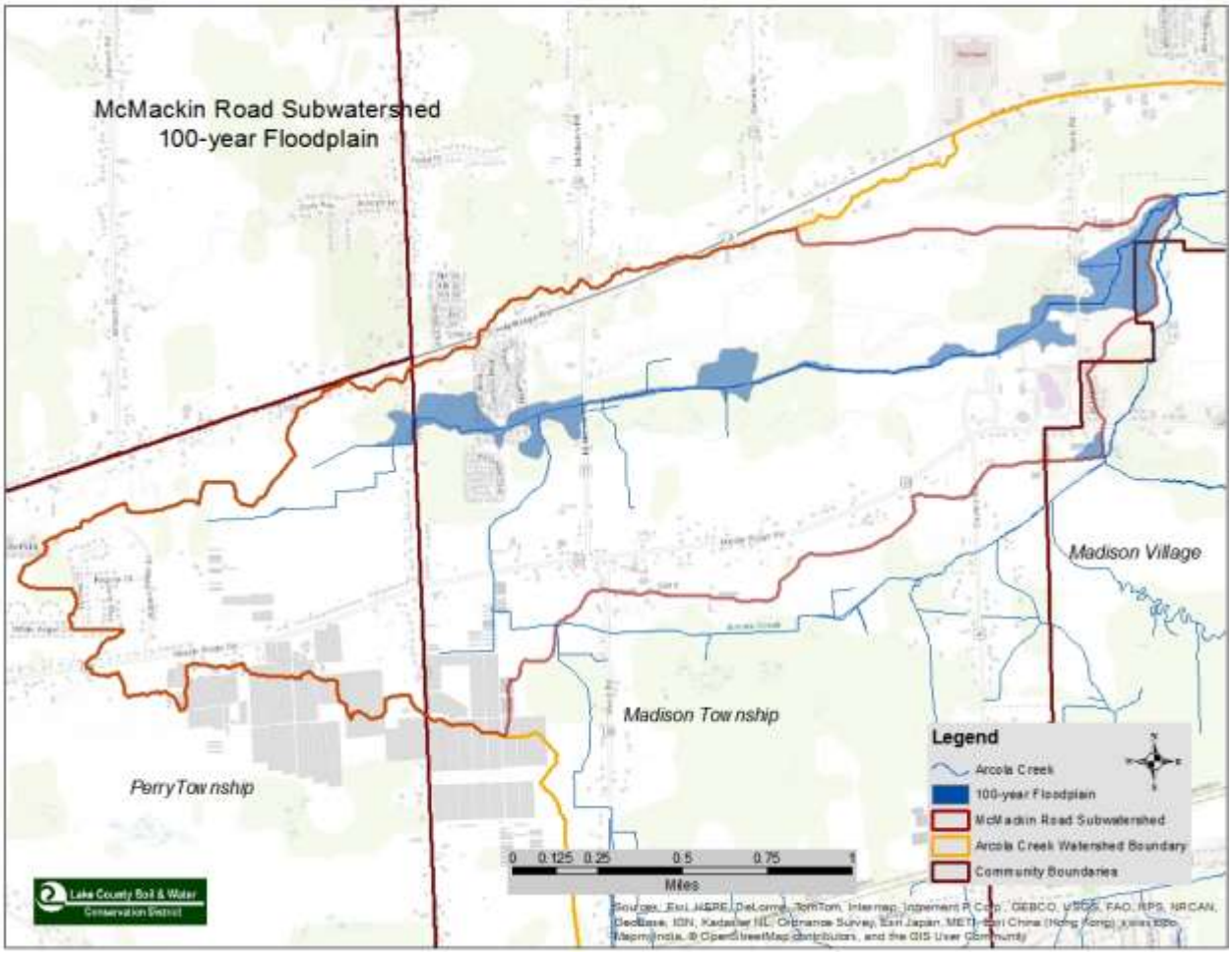


Figure 51. McMackin Road Land Use

Land Use	Acres	% of Total
Agricultural (green)	1024.7	61.8
Commercial (red)	105.7	6.4
Residential (yellow)	405.5	24.5
Public (dark blue)	122.5	7.4

Agriculture is the largest land use in the subwatershed (Figures 50 and 51). Of the agricultural land use, approximately 22% is forested land. A large portion of the land use classified Commercial in the central part of the subwatershed is a trailer park. Many of the residential areas are road frontage lots with agriculture behind them. The large blue area of Public land use is the Madison High School and Middle School campus on Burns and Middle Ridge Roads.

Figure 52. McMackin Road 100-Year Floodplain



The large area of 100-year floodplain in the west central portion of the watershed (Figure 52) bisects the trailer home park; flooding in some of the units is a perennial/seasonal issue. The large area of 100-year floodplain at the downstream end of the watershed occurs in largely wooded areas, so property damage may be slight in that area.

Areas of channelization can be easily identified from the map as the straight and right-angled lines (Figure 53). Some areas where the channels were cleaned prior to the creation of the Lake County Stormwater Management Department (SMD) have had the spoils mounded on the channel banks. These areas have been identified by the SMD as being in the McMackin subwatershed east and west of where the Arcola crosses McMackin Road (Figure 53). This area, known locally as McMackin Ditch has been notorious for slow moving flow. The spoil areas have been there so long that large trees are growing in it, restricting the flow on the north side of the channel.

Figure 53: Channelization and Riparian Levees

Figure 54. McMackin Road Soil Drainage Characteristics

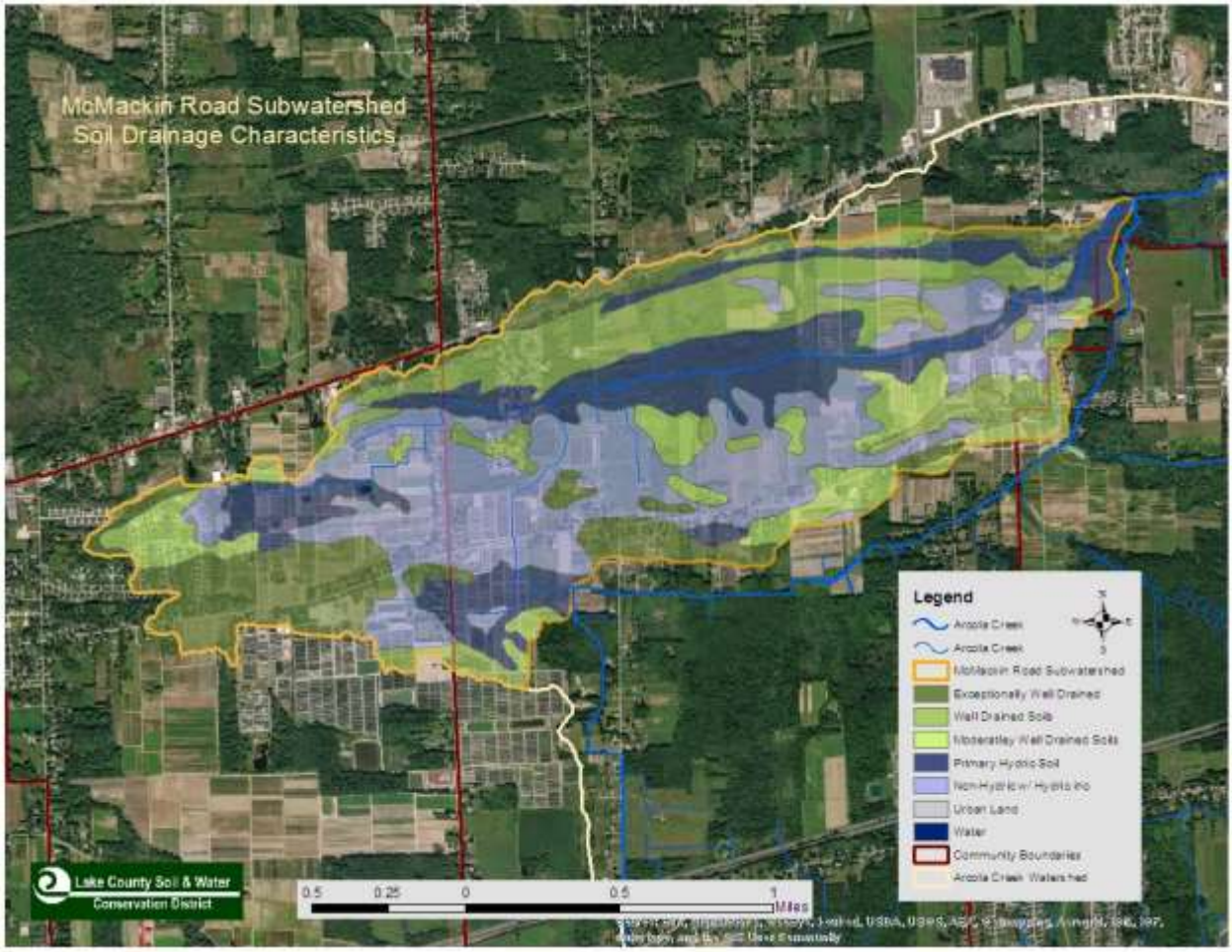


Figure 55. McMackin Road Soil Drainage Characteristics

Soil Drainage Characteristics	Acres	% of Total
Exceptionally Well Drained	279	16.7
Well Drained	328.4	19.7
Moderately Well Drained	163.2	9.8
Primary Hydric	365.4	21.9
Non-Hydric w/ Hyd. Inclusions	530.8	31.8
Water	1	.1

Approximately 46% of the soils have good drainage, and 54% are poorly drained (Figures 54 and 55). Well drained soils can be seen to parallel S.R. 84, as they are part of the beach ridge configuration (Figure 54). The most hydric soils can be seen as a part of the main east-west channel of Arcola Creek in this watershed.

3.4.2 Detailed Biological Conditions

There were no sites sampled in this subwatershed during the most recent assessment of the OEPA in 2015. The water quality was given an impaired status for Aquatic Life Use in the 2010 Waterbody Report for Arcola Creek.

Lake SWCD assessed the HHEI in 3 locations in the subwatershed in 2001 (Figure 56), upstream and downstream of Townline Road. All 3 were Class II Modified. The two sites west of Townline had HHEI scores of 62, which are in the "good" range. Both had a channel modification status of "recovering". The site east of Townline had an HHEI score of 52, which is in the "fair" range. It had a channel modification status of "Recent/No Recovery". No HMFEI assessment was done on any of the sites.

Figure 56. McMackin Road HHEIs

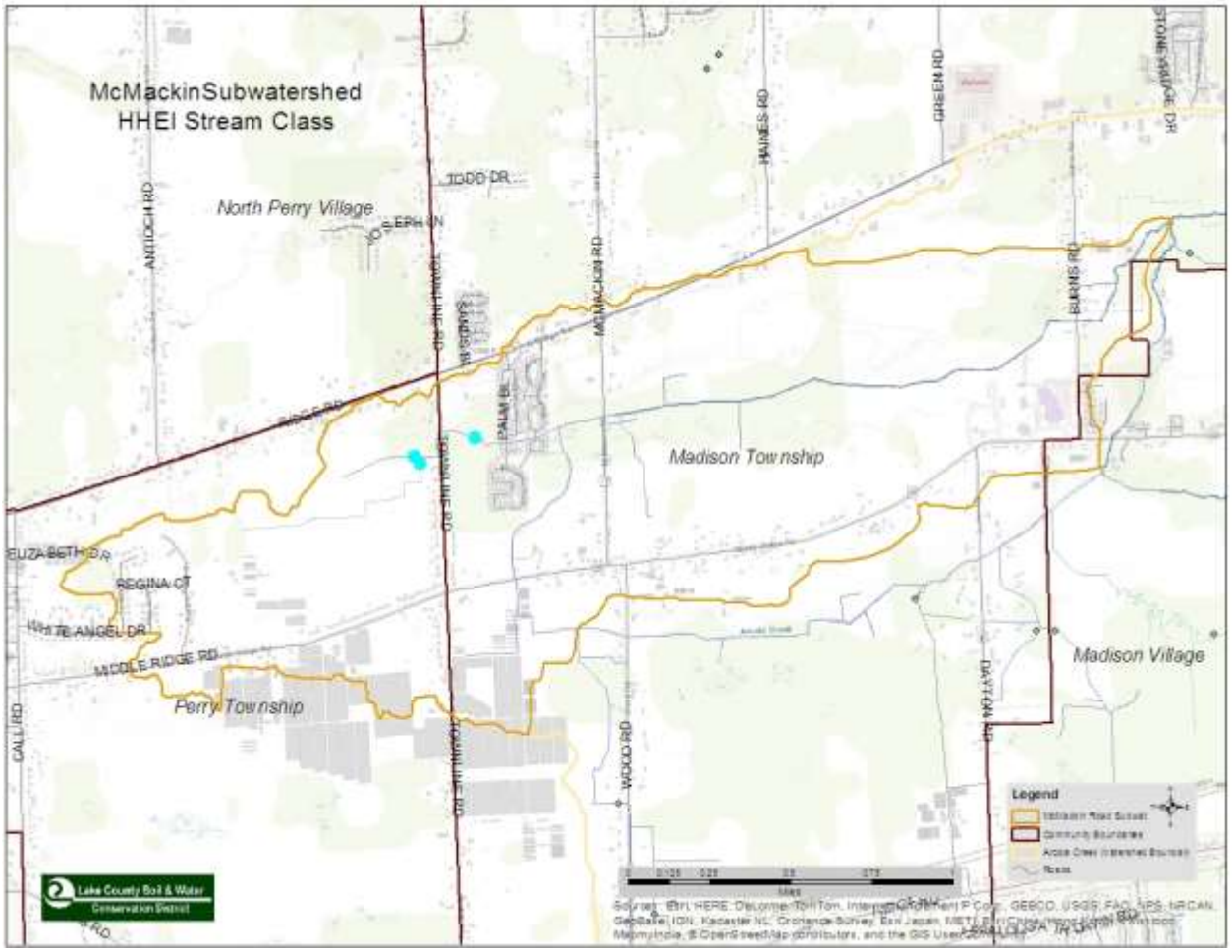


Figure 57. HHEI Scoring Scheme

Narrative score	Wading streams and rivers
Excellent	>= 70
Good	55-69
Fair	43-54
Poor	30-42
Very Poor	< 30

3.4.3 Detailed Causes and Associated Sources

The most recent causes and sources of impairment in Critical Area 3 are listed in the Ohio EPA online Water Quality Assessment Unit Summaries (2018) for the HUC-12 watershed.

Cause	Source
Organic enrichment	Municipal point source discharges, natural sources
Combined biota/habitat bioassessments	Channelization, loss of riparian habitat, dam or impoundment
Flow regime modification	Channelization, urban runoff/storm sewers, dam or impoundment
Pesticides	Sediment resuspension (contaminated sediment), agriculture
Habitat alterations	Loss of riparian habitat

3.4.4 Outline Goals and Objectives for the Critical Area

Goals

The restoration goal for all 3 Critical Areas is to improve IBI, MIwb, ICI and QHEI scores so that the *partial* or *non-attainment* status can achieve full attainment of the designated aquatic life use for that waterbody.

The upstream functions of sediment and nutrient retention and floodwater storage help the downstream sections to function well. Improving any one of these functions will improve the greater watershed. Floodwater storage can be increased through infiltration practices. Improving infiltration in the upper parts of a watershed will help the headwater streams go through the process of healing through channel evolution. As streams build their own floodplains floodwater storage increases as well. The biology will be helped with reducing the flow of floodwaters. By increasing the hydro-period through infiltration more water is available to aquatic life as it makes its way slowly through the soil pores.

The McMackin Road subwatershed is directly upstream of the EPA sampling location number 3 (Figure 17) which was found to be in non-attainment in 2015, so achieving full

attainment at that point and other points downstream will be assisted with practices implemented in Critical Area 3.

Arcola Creek has been impacted by channel modifications in this subwatershed, by straightening, relocating and ditching. It has been buried to make room for baseball fields on the Madison High School (Madison Board of Education or BOE) property (Figure 58) and widened to provide irrigation water for a former nursery. The HHEI score at that location is 42, which is "poor". The property is close to the confluence of all three Critical Areas (Figure 59). Daylighting of Arcola Creek by relocating it around the ball fields and restoring the channel morphology will greatly improve its hydrological function.

Much of the streamflow is through woodlands, but where Arcola Creek flows through nursery fields, there are no riparian buffers to filter sediment and provide shade for the aquatic organisms which are an important part of the stream hydrology (Figure 60). Buffering the creek and filtering the sediment are important practices for restoration of hydraulic functions.

Figure 58. Madison BOE Property

Figure 59. Daylighting Restoration Project

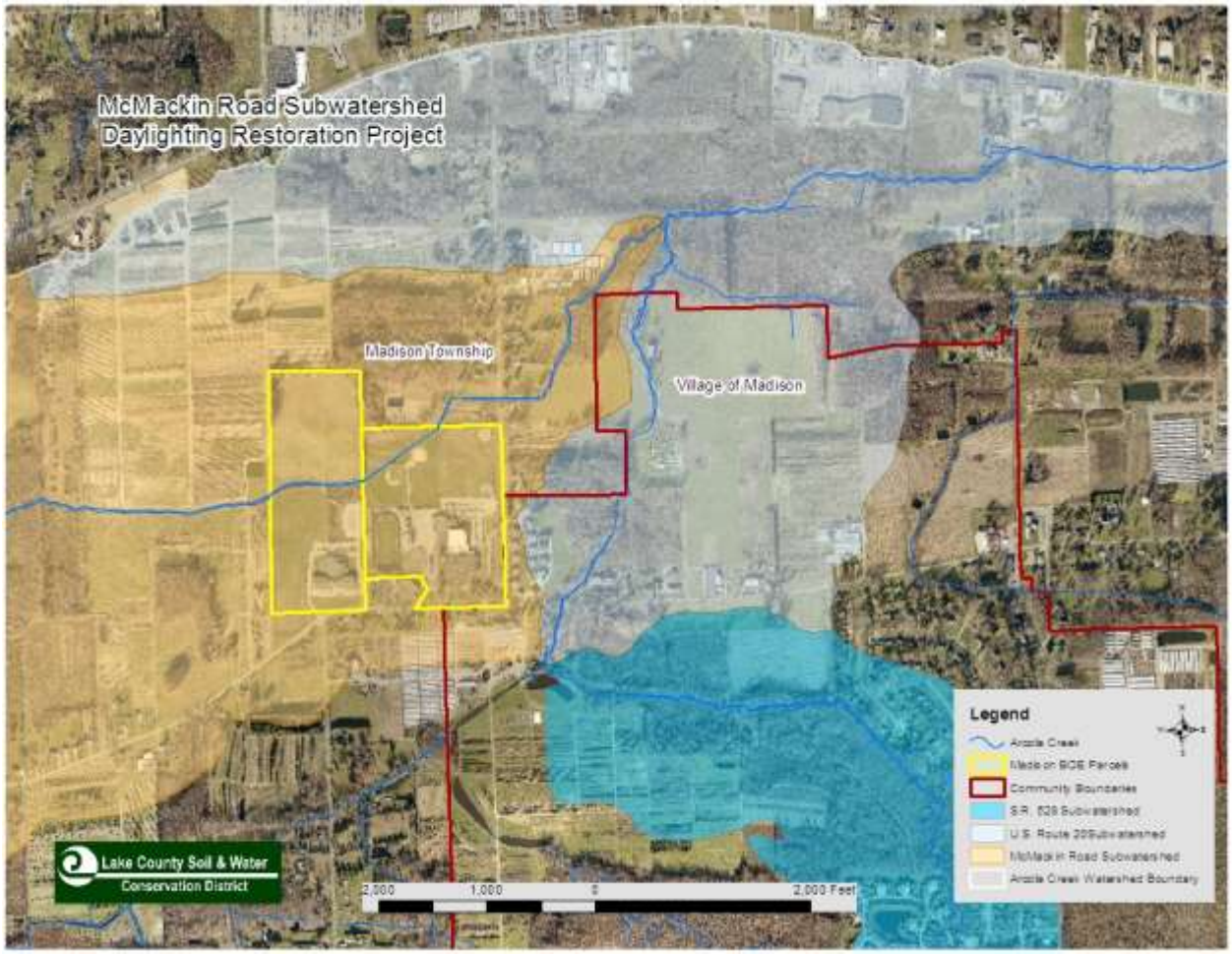
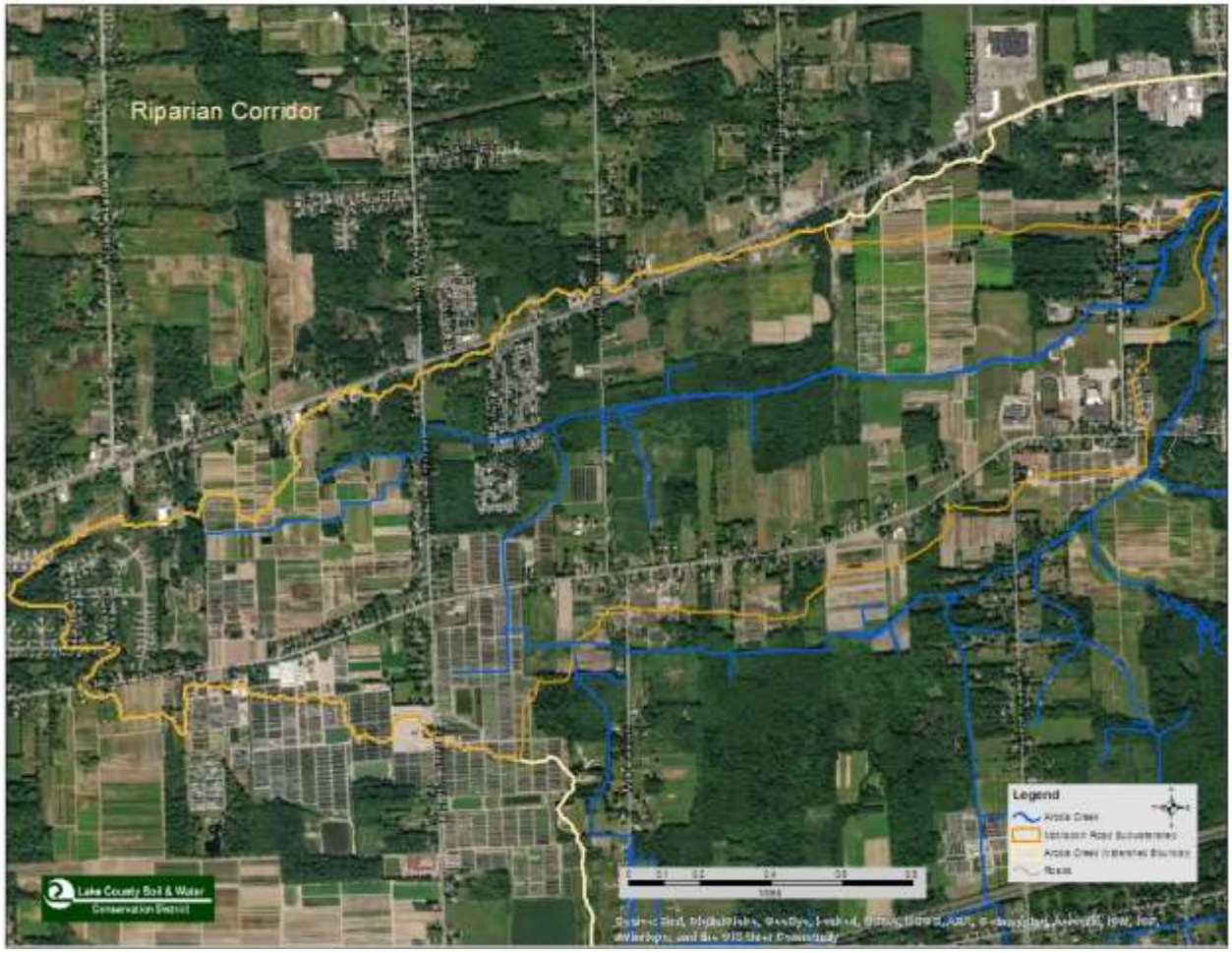


Figure 60. Riparian Corridor



Goal 1. QHEI raise to 70 at RM 5.1

- NOT ACHIEVED: Site currently has a QHEI of 42

Goal 2. IBI raise to 40 at RM 5.1

- NOT ACHIEVED: Site currently has an IBI of 26

Goal 3. ICI maintain score of 38

Objectives

Objective 1. Restore natural hydrology by restoring stream morphology

- Daylight 860 feet of Arcola Creek
- Restore access to the floodplain on 880 feet

Objective 2. Restore natural hydrology with riparian buffers

- Establish buffers on 2500 feet of stream
- Trap sediment on 2500 feet of stream

As the objectives are implemented, water quality monitoring will be conducted (both project related and regularly scheduled monitoring) to determine progress toward meeting the identified water quality goals. These objectives will be reevaluated and modified or added to if determined to be necessary. Reevaluation will utilize the Ohio EPA Nonpoint Source Management Plan Update (Ohio EPA, 2013) which lists all the eligible NPS management strategies to address:

- Urban sediment and nutrient reduction
- Altered stream and habitat restoration
- Nonpoint source reduction
- High quality waters protection

Chapter 4. Projects and Implementation Strategy

4.1 Projects and Implementation Strategy Overview Table

The projects and evaluation needs that are believed to be appropriate to remove the impairments to the Arcola Creek HUS-12 are listed below. They were determined by evaluating the identified causes and associated sources of nonpoint source pollution. Because the attainment status is based upon biological conditions, it will be necessary to periodically re-evaluate whether or not the implemented projects are sufficient to achieve attainment. The response of biological systems may take some time following project implementation. If issues other than nonpoint source pollution are causing impairments, they will need to be addressed under different initiatives, authorities or programs.

There are three Project and Implementation Strategy Overview Tables, one for each Critical Area. The Critical Areas goals aim to address the sources of impairment, including loss of riparian habitat, urban runoff, channelization and agriculture through increased infiltration of stormwater runoff and restoration of natural flow conditions and habitat.

The projects described in the Overview Tables have been prioritized using the following three step prioritization method:

Priority 1. Projects that specifically address one or more of the listed Objectives for the Critical Area.

Priority 2. Projects where there is land-owner willingness to engage in projects that are designed to address the cause(s) and source(s) of impairment or where there is an expectation that such potential projects will improve water quality in the Arcola Creek HUC-12 Watershed.

Priority 3. In an effort to generate interest in projects, an information and education campaign will be developed and delivered. Such outreach will engage citizens to spark interest as stakeholders to participate and implement projects like those mentioned in Priority 1 and 2.

Project Summary Sheets (PSS) are in subsection 4.2. These PSS provide the essential nine elements for short-term and/or next step projects that are in development and/or in need of funding. As projects are implemented and new projects developed these sheets will be updated. Any new PSS created will be submitted to the State of Ohio for funding eligibility verification (i.e., all nine elements are included).

4.1 Project and Implementation Strategy Overview Tables

For *Arcola Creek HUC-12* (*041100030203*) — Critical Area 1								
Applicable Critical Area	**Goal**	**Objective**	**Project #**	**Project Title** *(EPA Criteria g)*	**Lead Organization** *(criteria d)*	**Time Frame** *(EPA Criteria f)*	**Estimated Cost** *(EPA Criteria d)*	**Potential/Actual Funding Source** *(EPA Criteria d)*
Recommend that your critical areas be numbered or coded for reference.That number/code listed here comes from Chapter 3 section 3.1	*It is recommended that your goals and objectives be numbered or coded for easy reference. The number/code listed here comes from Chapter 3 section 3.x.4.*		*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*
Urban Sediment and Nutrient Reduction Strategies								
Altered Stream and Habitat Restoration Strategies								
1	7, 8, 9	1	1	LID on 20	Madison Village	Medium	To be determined	319
1	1, 2, 3	1	2	LID in Village	Madison Village	Medium to Long		319
1	7, 8, 9	2	3	Stream Restoration on 20	Madison Township	Long		319
1	7, 8, 9	2	4	Wetland Restoration	Madison Village	Long		319
1	4, 5, 6	2	5	WWTP Stream Restoration	Madison Village	Long		319

1	7, 8, 9	3	6	Invasives Treatment on 20	Madison Township	Medium		GLRI
Agricultural Nonpoint Source Reduction Strategies								
High Quality Waters Protection Strategies								
Other NPS Causes and Associated Sources of Impairment								

For *Arcola Creek HUC-12* (*041100030203*) — Critical Area 2								
Applicable Critical Area	**Goal**	**Objective**	**Project #**	**Project Title** *(EPA Criteria g)*	**Lead Organization** *(criteria d)*	**Time Frame** *(EPA Criteria f)*	**Estimated Cost** *(EPA Criteria d)*	**Potential/Actual Funding Source** *(EPA Criteria d)*
Recommend that your critical areas be numbered or coded for reference.That number/code listed here comes from Chapter 3 section 3.1	*It is recommended that your goals and objectives be numbered or coded for easy reference. The number/code listed here comes from Chapter 3 section 3.x.4.*		*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*
Urban Sediment and Nutrient Reduction Strategies								
Altered Stream and Habitat Restoration Strategies								
2	1, 2, 3	1	1	LID in the Village	Madison Village	Medium	To be determined	319
2	1, 2, 3	2	2	Wetland Restoration	Madison Village	Medium to Long		319
Agricultural Nonpoint Source Reduction Strategies								
High Quality Waters Protection Strategies								
Other NPS Causes and Associated Sources of Impairment								

For *Arcola Creek HUC-12* (*041100030203*) — Critical Area 3								
Applicable Critical Area	**Goal**	**Objective**	**Project #**	**Project Title** *(EPA Criteria g)*	**Lead Organization** *(criteria d)*	**Time Frame** *(EPA Criteria f)*	**Estimated Cost** *(EPA Criteria d)*	**Potential/Actual Funding Source** *(EPA Criteria d)*
Recommend that your critical areas be numbered or coded for reference.That number/code listed here comes from Chapter 3 section 3.1	*It is recommended that your goals and objectives be numbered or coded for easy reference. The number/code listed here comes from Chapter 3 section 3.x.4.*		*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*
Urban Sediment and Nutrient Reduction Strategies								
Altered Stream and Habitat Restoration Strategies								
3	1, 2, 3	1	1	Arcola Creek Stream Restoration and Daylighting	Madison Village & BOE	Short term	$1,000,000	319, US Fish & Wildlife, WRRSP, GLRI
3	1, 2, 3	2	2	Riparian Buffers	Madison Township	Medium to Long		319
Agricultural Nonpoint Source Reduction Strategies								
High Quality Waters Protection Strategies								
Other NPS Causes and Associated Sources of Impairment								

4.2 Critical Area 3: Project Summary Sheet

Nine Element Criteria	Information needed	Explanation
n/a	**Title**	Arcola Creek Stream Restoration and Daylighting
criteria d	**Project Lead Organization & Partners**	Madison Board of Education and Lake SWCD
criteria c	**HUC-12 and Critical Area**	HUC: 041100030203 Arcola Creek Critical Area 3: McMackin Road Subwatershed
criteria c	**Location of Project**	3100 Burns Road Madison Township, Ohio 44057 Coordinates: 41.791789, -81.072134
n/a	**Which strategy is being addressed by this project?**	Altered Stream and Habitat Restoration Strategies
criteria f	**Time Frame**	Short-Term (Priority) (1-3 yr)
criteria	**Short Description**	A stream restoration and daylighting project located at Madison School District's high school property to address the direct habitat alteration, organic enrichment, and flow alteration impairments within Arcola Creek.
criteria g	**Project Narrative**	The Madison Board of Education will partner with Lake SWCD to restore a segment of Arcola Creek and daylight a portion of Arcola Creek that has been culverted beneath the Madison High School. The banks of Arcola Creek are steep and eroding in this location, the creek has lost access to its floodplain, further destabilizing the area and increasing sedimentation and flashiness of downstream flows. The restoration will use natural channel design to restore 880 LF of stream and daylight 860 LF of stream for a total of 1740 LF to reduce sedimentation, improve in-stream fish habitat, and restore floodplain connectivity. Two acres of native vegetation will be replanted along the floodplain corridor. The project site encompasses the northern portion of the Board of Education property that is composed of a soccer field and baseball diamonds. This project will address the impairments in this area of Arcola Creek subwatershed as well as improve water quality, enhance habitat, and mitigate downstream flooding.
criteria d	**Estimated Total cost**	**Stream Restoration Phase** Design/Permitting: $104,210 Construction: $330,000 Grant Management/Education and Outreach: $10,000 Restoration Oversight: $15,000 *Total Stream Restoration*: $459,210

		Daylighting Phase Design/Permitting: $135,790 Construction: $430,000 Grant Management/Education and Outreach: $10,000 Construction Oversight: $15,000 *Total Daylighting*: $590,790 Total Project Cost: $1,050,000 *Costs may need to be updated at time of grant application.*
criteria d	**Possible Funding Source**	Ohio EPA 319, GLRI, WRRSP, U.S. Fish and Wildlife
criteria a	**Identified Causes and Sources**	Causes: Combined biota/habitat bioassessments, habitat alterations, pesticides, organic enrichment, flow regime modification Sources: Agriculture, loss of riparian habitat, natural sources, urban runoff/storm sewers, sediment resuspension, channelization, municipal point source discharges, dam or impoundment
criteria b & h	**Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?**	QHEI score raised from 42 to 70 IBI raised from 26 to 40 ICI maintain score of 38
	Part 2: How much of the needed improvement for the whole Critical Area is *estimated* to be accomplished by this project?	This project will improve the functional capacity of the riparian corridor to 1,800 feet of the tributary west of Burns Road. It completely addresses Object 1 in Critical Area 3. It is anticipated that the QHEI score will reach 65 in the short term and 70 in the long term through the implementation of this project.
	Part 3: Load Reduced?	Nitrogen Reduction: 29.8 lbs/year Phosphorus Reduction: 14.9 lbs/year Sediment Reduction: 17.6 tons/year
criteria i	**How will the effectiveness of this project in addressing the NPS impairment be measured?**	The success of the project will be evaluated through the reduction of pollutant loads at the project site and the increase of QHEI scores for the downstream waters of Arcola Creek. Success will also be measured by achieving full attainment of Arcola Creek's warmwater habitat aquatic life use designation. Project site and downstream habitat assessments will be conducted Spring 2019. If the project is funded through the Ohio EPA 319 program, staff from the OEPA-DSW Ecological Assessment Unit will perform both pre- and post-project monitoring.
criteria e	**Information and Education**	The following Outreach Deliverables are proposed: Project Fact Sheet 1 Create/Maintain Websites 1 Develop Displays 1

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Appendix A. Acronyms

BMPs	Best Management Practices
CAUV	Current Agricultural Use Value
CWH	Cold Water Habitat
CRWP	Chagrin River Watershed Partners
FRPP	Farm and Ranch Land Protection Program
HEL	Highly Erodible Land
HHEI	Headwater Habitat Evaluation Index
HMFEI	Headwater Macroinvertebrate Field Evaluation Index
HUC	Hydrologic Unit Code
IBI	Index of Biotic Integrity
ICI	Invertebrate Community Index
LCGHD	Lake County General Health District
LCSMD	Lake County Stormwater Management Department
LID	Low Impact Development
LMP	Lake Metroparks
MCM	Minimum Control Measure
MIwb	Modified Index of Well-Being
MWH	Modified Warmwater Habitat
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resources Conservation Service
NWI	National Wetlands Inventory
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
PHWH	Primary Headwater Habitat
QHEI	Qualitative Habitat Evaluation Index
RM	River Mile
SSH	Seasonal Salmonid Habitat
SWCD	Soil and Water Conservation District
SWD	Stormwater Management Department
SWIF	Surface Water Improvement Fund
TMDL	Total Maximum Daily Load
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WAP	Watershed Action Plan
WWH	Warmwater Habitat
WWTP	Wastewater Treatment Plant