ARCOLA CREEK WATERSHED ACTION PLAN

MARCH 19, 2013

Written by Maurine Orndorff,
Watershed Coordinator
Lake County Soil & Water Conservation District
125 E. Erie Street, Painesville OH 44077
morndorff@lakecountyohio.gov
440.350.5863

With assistance from:

Matt Adkins, ODNR Soil & Water Resources
Larry Advey, Madison Township Administrator
Ryan Babcock, Lake County Farm Bureau
Don Bartlett, Madison Village Council President
Susan Bell, Lake County General Health District
Jason Boyd, Lake County Administrator
Eric Cotton, Lake County Farm Bureau
Becky Donaldson, Madison Village Resident
Chad Edgar, Lake SWCD Resource Protection Specialist
Brian George, GIMS Specialist, ODNR Coastal Management
Mark Gilson, Gilson Gardens, Nursery Growers of Lake County Ohio
George Hadden, Lake County Engineer
Susanna Hinkelman, Historian
Rebecca Hinkley, Intern, Lake Erie College
Marie Kozan, Madison Township resident, Lake Metroparks
Jonathan Mauk, District Conservationist, NRCS
Michael Kraynik, Madison Village Service Director
Laura Kramer Kuns, Lake County General Health District
Larry Lamphier, Business Coach
Beth Landers, Lake SWCD Coastal & Non-Point Educator
Amanda Miller, Intern, Lake County General Health District
Tim Miller, Director, Lake County Stormwater Management Department
Alyson Moritz, Madison Village Administrator
John Pogacnik, Biologist, Lake Metroparks
David Radachy, Lake County Planning Commission
Brett Rodstrom, Western Reserve Land Conservancy
Matt Scharver, Associate Director, Chagrin River Watershed Partners
Alan Siewert, Urban Forester
Carol Takacs, Chair, Friends of Arcola Creek
Kurt Unger, Ridge Manor Nursery, NGLCO
Lisa Ungers, Roemer Nursery, NGLCO
Bill Zawiski, Ohio EPA
Randy Zondag, Agricultural Agent, Ohio State University Extension

Drawing by Marie Kozan

ARCOLA CREEK WATERSHED ACTION PLAN COMMUNITY ENDORSEMENT

We support and agree to pursue implementation of this plan and agree to seek the resources to improve and protect the water quality of Arcola Creek.

Madison Township, OH	**Perry Township, OH**
Max Anderson, Chair	*Rick Amos, ~~Chair Trustee~~ VICE CHAIR*
Bill Brotzman, Co-Chair	*Nancy Steele, ~~Vice Chair~~ Trustee*
Peter Wayman, Clerk Pro ~~Tempore~~	*Phillip S. Haskell, ~~Trustee~~ Chair*
Madison Village, OH	**Geneva Township, OH**
Sam Britton, Mayor	*Timothy J. Mills, Chair*
Don Bartlett, Council President	*Robert Russell, Vice Chair*
	Dennis Brown, Trustee

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LIST OF ACRONYMS

AC	Arcola Creek
BMP	Best Management Practice
BOD	Biological Oxygen Demand
CAUV	Current Agricultural Use Value
cfs	Cubic Feet Per Second
CIG	Conservation Innovation Grant
CMAG	Coastal Management Assistance Grant
CNPCP	Coastal Nonpoint Pollution Control Program
CZARA	Coastal Zone Act Reauthorization Amendments
CSO	Combined Sewer Overflow
CWH	Cold Water Habitat
CWRP	Chagrin River Watershed Partners
CZMA	Coastal Zone Management Act
DO	Dissolved Oxygen
DRASTIC	Depth to water, Recharge, Aquifer media, Soil media, Topography, Impact of vadose zone, and Conductivity
EOLP	Erie-Ontario Lake Plain
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
ERIN	Earth Resources Information Network
ERS	Economic Research Service
EWH	Exceptional Warmwater Habitat
F	Fahrenheit
FC	Fecal Coliform
FEMA	Federal Emergency Management Agency
FOAC	Friends of Arcola Creek
FRPP	Farm and Ranch Land Protection Program
GIMS	Geographic Information Management System
GIS	Geographic Information System
GLPB	Great Lakes Basin Program
GLRI	Great Lakes Restoration Initiative
gpd	Gallons per day
HEL	Highly Erodible Land
HHEI	Headwater Habitat Evaluation Index
HSTS	Home Sewage Treatment System
HUC	Hydrologic Unit Code
IBI	Index of Biotic Integrity
ICI	Invertebrate Community Index
LCE	Lake County Engineer
LCPCD	Lake County Planning and Community Development
LCGHD	Lake County General Health District
LCSWCD	Lake County Soil & Water Conservation District
LCSMD	Lake County Stormwater Management Department
LEPF	Lake Erie Protection Fund

LID	Low Impact Development
LMP	Lake Metroparks
MCM	Minimum Control Measure
MIwb	Modified Index of Well-Being
MWH	Modified Warmwater Habitat
NFWF	National Fish and Wildlife Foundation
NLCD	National Land Cover Database
NOAA	National Oceanic & Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NPS	Non-Point Source
NRCS	Natural Resources Conservation Service
NWI	National Wetlands Inventory
OCAP	Ohio Capabilities Analysis Program
OCM	Office of Coastal Management
OCMP	Ohio Coastal Management Program
ODH	Ohio Department of Health
ODNR	Ohio Department of Natural Resources
ODNRDF	Ohio Department of Natural Resources Division of Forestry
ODOT	Ohio Department of Transportation
OEEF	Ohio Environmental Education Fund
Ohio EPA	Ohio Environmental Protection Agency
OPWC	Ohio Public Works Commission
OSDS	On Site Disposal System
OSUE	Ohio State University Extension
PHWH	Primary Headwater Habitat
QHEI	Qualitative Habitat Evaluation Index
SRF	Slow Release Fertilizers
SSH	Seasonal Salmonid Habitat
STS	Sewage Treatment System
SWCD	Soil and Water Conservation District
SWD	Stormwater Management Department
SWIF	Surface Water Improvement Fund
SWPPP	Stormwater Pollution Prevention Plan
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WAP	Watershed Action Plan
WRRC&D	Western Reserve Resource Conservation & Development Council
WRRSP	Water Resource Restoration Sponsor Program
WRP	Wetlands Reserve Program
WWH	Warmwater Habitat
WWTP	Wastewater Treatment Plant

INTRODUCTION

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. The purpose of the WAP is to reduce flooding and erosion and improve water quality within the Arcola Creek Watershed through the implementation of watershed and stormwater management best management practices that address issues of concern raised by the community. The WAP provides a framework for implementation and will assist in qualifying for federal, state and local grant funding to install watershed restoration and protection projects. Funding dedicated to the development of the WAP was provided by an Ohio Department of Natural Resources (ODNR) Watershed Coordinator grants program.

For many people, the term watershed is recognizable but its meaning is elusive. A watershed is the area of land that drains to a common body of water, such as a stream or lake. Water flows downhill, so a watershed boundary is comprised of the high points of the landscape. The Arcola Creek Watershed collects all the water from Madison Village, and parts of Madison, Perry and Geneva Townships, and drains into Lake Erie through the Arcola Estuary. Everyone lives in a watershed and has an effect on the water quality, even if no stream runs through their property. Planning on a watershed basis rather than using man-made boundaries provides a more logical and complete way to manage our water resources.

Watersheds provide many services for us. They store precipitation in soils, wetlands and aquifers, sustain natural flood control, filter sediment and contaminants. They protect our water quality, secure our water supplies, provide habitat for flora and fauna and maintain our quality of life. Many folks in the Arcola Creek Watershed rely on shallow wells for their drinking water, so maintaining a secure, clean source of water is vital. When we build roads, rooftops and parking lots and cover the soil with impervious surfaces, we alter the natural watershed functions. Rainfall can't soak into the soil and recharge the aquifers. Runoff increases, and channels scour, erode and resize to adjust to the increased flows. We have further reduced the water absorbing and cleaning functions by draining wetlands, straightening stream courses and removing streamside vegetation and trees. The effects have become very visible in the Arcola Creek Watershed, with increased flooding and widening channels.

Investing in the restoration and maintenance of a healthy watershed can significantly lower the costs of water treatment and flooding. Water-related impacts of a changing climate are occurring, and utilizing available ecosystem services, building out of harm's way, maintaining vegetated stream or riparian corridors and conserving and restoring wetlands will enable the Arcola Creek Watershed to be more resilient in the long run.

Studies and resource protection efforts have taken place in the Arcola Creek Watershed in recent decades, but plans, data and proposals are collecting dust in the drawers of governmental offices. These historical resources are helping to guide the Watershed Action Plan, but this time improvement projects will take place- because this is the

community's plan, created by people who live and work in the community. The plan is also being created in a time when funding is being dedicated to addressing water quality problems of the State on a watershed basis. In the ten years that Ohio Department of Natural Resources has funded a watershed coordinator grant program, local watershed action plans have brought in more than ten times the outlay for staff in grant money to put restoration projects on the ground. Funding for Lake Erie watersheds is increasing at this time as well, to help address issues of phosphorus loading and increased and sometimes toxic algal blooms.

The overarching philosophy of the Arcola Creek Watershed Action Plan is that a healthy stream will provide services for us naturally and for free- just as stream ecosystems have for millions of years. To accomplish this, the plan goals include:

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

Watershed models calculate the nitrogen, phosphorus and sediment that enter Arcola Creek as a result of our land uses and practices. These nutrient and sediment loadings come from urban sources, cropland and pastureland, forests and malfunctioning sewage treatment systems. The watershed action plan will address these sources through stream restoration projects, bringing household sewage treatment systems into compliance with Lake County General Health District and Ohio Environmental Protection Agency regulations, planting trees, increasing infiltration, using stormwater and erosion control best management practices (BMPs) in new construction projects and retrofitting existing developments, using BMPs in agricultural operations and educating watershed residents on healthy watershed practices.

Just as the Arcola Creek Watershed Action Plan development was a cooperative community effort, the plan implementation will occur through the joint efforts of the stakeholders. The plan will also remain relevant, and will undergo an updating process every five years. A new atmosphere of cross-political boundary communication and cooperation has emerged, and together we will work to improve the Arcola Creek Watershed community.

I. ARCOLA CREEK WATERSHED CHARACTERISTICS

A. Defining the Watershed

1. Location

The Arcola Creek Watershed is located in northeastern Lake County and northwestern Ashtabula County. 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 mouth of Arcola Creek is located at 41.85 N Latitude 81.01 W Longitude.

2. Communities

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
A small portion of Perry Township

In Ashtabula County:
A small portion of western Geneva Township

3. Special Districts

Ashtabula and Lake county each has a soil and water conservation district (SWCD), a planning commission, a general health district and a park district. Lake SWCD has 12,226 acres and Ashtabula SWCD has 2,797 acres in the Watershed. Lake County has a stormwater management district, the Lake County Stormwater Management Department (LCSMD), which was formed in 2003. Of the communities in the watershed that are required to meet the National Pollution Discharge Elimination System (NPDES) standards, Madison Township and Madison Village are participants in the County program. Madison Village joined the LCSMD in the fall of 2012. Perry Township has elected to meet the NPDES requirements as an individual community. Ashtabula County has not yet been mandated by the Ohio EPA to meet NPDES requirements and does not have a stormwater management district.

Both Ashtabula County and Lake County are in Ohio Department of Transportation District 12, which is responsible for maintaining Interstate Routes and State and U.S. Routes outside of incorporated areas, including snow and ice removal, road surface maintenance, mowing, litter pick-up, lighting, traffic signals and bridge maintenance. Madison Local School District has 11,838 acres, Perry Local School District has 426 acres and Geneva Area City School District has 2,758 acres within the Watershed.

4. Special Designations

There are no special designations within the watershed.

5. Phase 2 Stormwater Communities

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 a line of communication. Having both Madison Township and Village participate in the LCSMD will allow there to be a more cohesive and unified treatment of stormwater within the Watershed. Perry Township is taking care of its NPDES requirements on its own.

Figure 1:
B. Demographics

Population Characteristics by County Data	**Lake County**	**Ashtabula County**	**Ohio**
Population 2011 estimate	229,885	101,345	11,544,951
Population 2010	230,041	101,497	11,536,504
Population, percent change April 1, 2010 to July 1, 2011	-0.1%	-0.1%	0.1%
Persons under 5 years, percent, 2011	5.3%	6.1%	6.2%
Persons under 18 years, percent 2011	21.8%	23.2%	23.3%
Persons 65 years and over, percent, 2011	16.3%	15.9%	14.3%
Female persons, percent, 2011	51.2%	50.0%	51.2%
White persons, percent, 2011	93.7%	93.6%	83.6%
Black persons, percent, 2011	3.5%	3.7%	12.4%
American Indian and Alaska Native persons, percent, 2011	0.2%	0.3%	0.3%
Asian persons, percent, 2011	1.2%	0.4%	1.7%
Persons reporting two or more races, percent, 2011	1.4%	2.0%	1.9%
Persons of Hispanic or Latino Origin, percent, 2011	3.6%	3.5%	3.2%
White persons not Hispanic, percent, 2011	90.5%	90.5%	81.0%
Living in same house 1 year & over, 2006-2010	89.3%	85.3%	85.0%
Foreign born persons, percent, 2006-2010	5.3%	1.6%	3.8%
Language other than English spoken at home, pct age 5+, 2006-2010	7.6%	4.9%	6.3%
High school graduates, percent of persons age 25+, 2006-2010	90.7%	84.2%	87.4%
Bachelor's degree or higher, pct of persons age 25+, 2006-2010	24.2%	12.9%	24.1%
Veterans, 2006-2010	20,830	10,272	936,383
Mean travel time to work (minutes), workers age 16+, 2006-2010	23.2	24.8	22.7
Housing units, 2011	101,515	46,067	5,133,446
Homeownership rate, 2006-2010	77%	72.8%	69.2%
Housing units in multi-unit structures, percent, 2006-2010	18.30%	15.1%	23.0%
Median value of owner-occupied housing units, 2006-2010	$158,100	$118,500	$136,400
Households, 2006-2010	94,211	38,911	4,552,270
Persons per household, 2006-2010	2.41	2.54	2.46
Per capita money income in past 12 mos. (2010 $$), 2006-2010	$28,221	$19,898	$25,113
Median household income 2006-2010	$54,896	$42,139	$47,358

Persons below poverty level, percent,2006-2010	8.1%	15.7%	14.2%
Business Characteristics			
Private nonfarm establishments, 2010	6,139	1,987	253,491
Private nonfarm employment, 2010	82,878	24,159	4,352,481
Private nonfarm employment, percent change, 2000-2010	-14.7	-21.0	-13.0
Nonemployer establishments, 2010	14,630	6,310	730,393
Total number of firms, 2007	20,222	8,375	897,939
Black-owned firms, percent, 2007	1.1%		5.8%
American Indian- and Alaska Native-owned firms, pct, 2007	0.2%		0.3%
Asian-owned firms, percent, 2007	1.7%	1.2%	2.0%
Women-owned firms, percent, 2007	25.8%	24.3%	27.7%
Manufacturers shipments, 2007 ($1000)	5,220,926	2,201,426	295,890,890
Merchant wholesaler sales, 2007 ($1000)	1,867,798		135,575,279
Retail sales, 2007, ($1000)	3,460,873	1,077,599	138,816,008
Retail sales per capita, 2007	$14,759	$10,627	$12,049
Accommodation and food service sales, 2007 ($1000)	390,752	110,649	17,779,905
Building permits, 2011	226	64	17,779,905
Land area in square miles, 2010	227.49	701.93	40,860.69
Persons per square mile, 2010	1,011.20	144.6	282

Source: US Census Bureau; State and County QuickFacts, Data derived from Population Estimates, American Community Survey, Census of Population and Housing, State and County Housing Unit Estimates, County Business Patterns, Nonemployer Statistics, Economic Census, Survey of Business Owners, Building Permits, Consolidated Federal Funds Report.

Figure 2: Building Permits

Lake County

Year	Single Family	Multiple Family	Total
1990	787	41	828
2000	674	29	703
2005	817	35	852
2010	269	2	271
2011	222	1	223

Ashtabula County

Year	Single Family	Multiple Family	Total
1990	132	3	135
2000	445	2	447
2005	274	2	276
2010	77	2	79
2011	64	0	64

Source: factfinder2.census.gov

Building permits have taken a downward turn since the high growth period between 1990 and 2005. The economic and financial crisis of the past few years has reduced housing starts dramatically. This trend may continue with a cultural shift in the American Dream, as the younger, first-home buying population looks to live closer to the city centers. The

reduction in housing starts has a direct effect on the nursery and landscaping industries in two ways: the pressures to convert nursery land to housing developments are relieved, but at the same time, there are fewer new homes needing landscaping plants.

Figure 3: Agricultural Data

	Lake County	Ashtabula County	Ohio
Number of farms	259	1,058	75,861
Land in farms (acres)	16,065	150,534	13,956,563
Average size of farm (acres)	62	142	184
Total cropland (acres)	10,126	109,312	10,832,772
Harvested cropland (acres)	7,316	99,326	9,991,007
Irrigated land (acres)	2,180	72	37,959
Market value of ag products sold ($1000)	$88,866	$72,264	$7,070,212

Source: 2007 Census of Agriculture, USDA NASS

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. Ashtabula County has more traditional agricultural businesses, although there are nurseries in western Geneva Township in the Arcola Creek Watershed. More land is in agricultural production in Ashtabula County than Lake County, but the market value of agricultural products sold in Lake County far exceeds that of Ashtabula because of the high per acre value of nursery crops. Lake County ranks eleventh (according to the 2007 Census of Agriculture) in Ohio in total value of agricultural products sold. It ranks 88th (or last) out of value of livestock, poultry and their products. Ashtabula ranks 54th in nursery and greenhouse products sold, and 27th in value of livestock, poultry and their products.

Figure 4: Demographic & Environmental Data of the Arcola Creek Watershed

Population	
1980	5755
1990	8590
2000	9060
People	
Rural	2891
Urban	6169
Agricultural	78
In Labor Force	4748
Education	
Enrolled K-12	1738
Enrolled College	278
Completed <9th	3460
Completed HS diploma or GED	2429
Some college	1376

Associates degree	420
Bachelors degree	618
Graduate degree	300
Households	
Average Size	2.6
Average Income	$53,020
Soil Resources	
Prime farmland	12,911 ac
Highly erodible land	6103 ac
Frequently flooded	737 ac
Hydric	2,010 ac
Partially hydric	3865 ac
Soil Drainage	
Well	1,153 ac
Moderately well	2,313 ac
Somewhat poorly	7416 ac
Poorly drained	1,340 ac
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 (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

Source: ERIN Watershed Report

C. Geographic Locators

The Arcola Creek Watershed 12 digit Hydrologic Unit Code (HUC) is 041100030203.

D. General Watershed Information

1. Previous and Current Watershed Protection and Management

a. Ashtabula County

Ashtabula County has a comprehensive plan, adopted in 2003. In the process of developing the plan, seven priority areas were developed, with corresponding visions that show the value of the natural resources to the community.

"Greenspace: to treasure the County's openness, waterways, woodlands and wildlife as important parts of our lives. County residents desire to preserve and sustain these natural resources for the health and enjoyment of present and future generations by planning for the protection and prudent use of its land and water.

Farmland Preservation: To maintain and enhance the rural character of prime and unique farmland, balanced with commercial and residential development and the important areas of natural resources.

Transportation: To promote a safe, convenient, efficient and economical transportation system to move people and goods, that will provide improved conditions, make better use of inter-modal resources, and create a greater array of transportation choices for the residents of Ashtabula County.

Economic Development: To promote areas within Ashtabula County, which are suited for infrastructure improvements, benefitting and stimulating residential, recreational, commercial, and industrial economic prosperity through expanded employment opportunities, while enhancing and protecting community assets and quality of life.

History and Heritage: To value the county's history and heritage of the past, present and future. The physical reminders of historical, architectural and archaeological sites help form our sense of community. In order to preserve the uniqueness of history and heritage, Ashtabula County will include the preservation and protection of our significant historical resources with other county policies in order to guide the development of any type and size.

Recreation: To enjoy access to many unique and diverse places and spaces that provides opportunities for active and passive recreation. These recreational opportunities make the best use of our land, water and natural resources throughout the four seasons." (Ashtabula County Comprehensive Plan. 2003.)

Ashtabula County also has a Farmland Preservation Plan prior to 2005, to build a framework of voluntary farmland preservation in Ashtabula County.

b. Lake County

The Arcola Creek Watershed Action Plan was created in collaboration with the Lake County Planning Commission, and is consistent with the following plans, in the desire to develop the community in a sustainable manner.

The Lake County Farmland Preservation Plan was completed in 2001 with the objective to provide a foundation for preserving Lake County's farmland for the benefit of current residents and future generations, while respecting individual property owners' rights. With the exception of a portion of Madison Village, the proposed agricultural preservation areas encompass the Arcola Creek Watershed.

c. Madison Township

The Madison Township Comprehensive Plan was updated in 2009. The following vision statement reflects the value of the township's resources.

"Madison Township seeks to balance the preservation of its semi-rural character with the accommodation of new growth and development to create a desirable community with a positive and unique character and enhance the quality of life for residents. Through this comprehensive plan Madison Township will implement land use policies that protect and enhance its natural resources, promote and preserve viable agriculture and viniculture, support sustainable economic development, mandate high aesthetic standards and high quality appearance of public spaces, and ensure new development is carefully integrated into the semi-rural and agrarian landscape." (Madison Township Comprehensive Plan. 2009.)

Madison Township adopted a US 20 Corridor Study in February 2006 done by the Lake County Planning Commission to shape the built environment and land uses along the US 20/North Ridge Road corridor. It contains the following goals:

1. Improve the safety, traffic flow and capacity of US 20, in the face of increasing commercial and residential development in the area.
2. Improve sewer and water service, *not* to encourage more development along the corridor, but rather as a tool to shape it, and make the area more appealing for quality middle-end retail and office uses.
3. Increase the diversity and quality of commercial and retail uses along the corridor, while reducing the proliferation of low-end, vehicle-related and semi-industrial uses.
4. Halt and reverse the pattern of unplanned strip development, and channel retail and commercial uses into well-defined, healthy nodes.
5. Improve the appearance of the corridor, including architecture, landscaping, business signage, and other elements of the built environment, so it presents a positive impression of the township, fosters a distinctive sense of place, and becomes an attractive gateway between Lake and Ashtabula counties.
6. Preserve the viability of the nursery industry along the corridor. (US 20 Corridor Study. 2006.)

d. Madison Village

Madison Village adopted the 2009 Madison Village Comprehensive Plan, prepared by the Lake County Planning Commission in May 2009. The plan has the following vision statement:

"Madison Village seeks to balance the preservation of its semi-rural character with the accommodation of new growth and development and downtown revitalization while creating a desirable community with a positive and unique character. Through this comprehensive plan, Madison Village will implement land use policies that protect its natural resources, capitalize on its proximity to I-90, ensure new development is carefully integrated into the semi-rural landscape, mandate high aesthetic standards in the Village downtown, support sustainable economic development, and promote innovative and sound planning practice." (Madison Village Comprehensive Plan, 2009.)

e. Perry Township

Perry Township updated its Comprehensive Plan in 2006. The plan identifies six goals for Perry Township "to achieve a balance of residential, commercial, industrial, agricultural, institutional and recreational land uses in order to maintain a healthy economic base and provide a quality living environment for residents of the Township." (Perry Township Comprehensive Plan. 2006.)

f. Arcola Creek Watershed Management Plan

An Arcola Creek Watershed Management Plan was written in 2004, and made recommendations to address land-use, flooding and conservation of natural resources issues. See **History of previous water quality efforts in the watershed**, pp. 96-102 for more a more in-depth discussion of the Management Plan and other previous water quality efforts.

g. Riparian Buffers

All of the communities in the Arcola Creek Watershed have riparian buffer ordinances, with the exception of Geneva Township. Madison Township has a wetland buffer ordinance as well.

II. WATERSHED PLAN DEVELOPMENT

A. Watershed Partners

This watershed action plan was created and crafted by members of the community, local officials, state and local agencies. It is a plan of the people and for the people. The stakeholder group is comprised of the following:

1. Watershed residents and landowners
2. Local businesses: local businesses, local nurseries, Nursery Growers of Lake County Ohio
3. Community organizations: Friends of Arcola Creek
4. Local and State Government Agencies: ODNR, LCGHD, Lake County Engineer, LCSMD, Lake County Planning Commission, Lake SWCD, ODNR Division of Forestry, Madison Township, Madison Village, Ohio State University Extension, NRCS, Lake County Commissioners
5. Educational institutions: Madison Local School District

6. Non Governmental Organizations: Lake County Farm Bureau, Chagrin River Watershed Partners, Western Reserve Land Conservancy

B. Vision Statement

The vision of the Arcola Creek Watershed Action Plan is to develop a balanced implementation plan that promotes the full potential of the watershed, that improves awareness through education and public outreach, that addresses drainage improvements, that develops recreational uses, that is compatible with business and development and improves the water quality.

C. Organizational Structure

The Stakeholder group convened initially to discuss and prioritize issues of concern and kick-off the planning process. Members of the Stakeholder group were invited to participate in the plan development, and two work groups were formed: one to create the plan, and one to develop an educational strategy. The two work groups met on a monthly basis throughout the winter and spring of 2012. To facilitate the development of the plan, the plan work group divided into three sub-groups to discuss and find solutions for water quantity, water quality and habitat issues. The goals and action items of each group were then discussed with the plan work group as a whole, and then integrated into the plan by the Watershed Coordinator.

The education work group met separately, and some of the members were also part of the plan work group, bringing a good cohesiveness between the two groups. The focus of the education work group was to create a community education program to increase the understanding of the issues, provide information on solutions and to foster a sense of pride and ownership of the Arcola Creek Watershed.

Just as the plan development was a cooperative community effort, the implementation of the plan will occur through the joint efforts of the stakeholders, under the guidance of the watershed coordinator. A watershed advisory committee comprised of watershed communities and technical advisors that were a part of the plan's development will meet twice each year. The committee will follow the operational procedures of Lake SWCD, and strive to operate by consensus. Subcommittees will be utilized for project development and educational activities. The watershed advisory committee will maintain strong working relationships in the watershed, evaluate the plan's implementation, propose projects, and provide guidance on any changing priorities within the watershed. The nutrient and sediment reduction priorities in Section VI will assist in guiding the plan implementation and the quest for funding to support projects. An annual plan will be developed at the beginning of each year, which will be reviewed by the Lake Soil & Water Conservation District Board of Supervisors.

Lake County Soil & Water Conservation District will provide the organizational status of the Watershed Action Plan. Grants will be submitted by Lake SWCD, utilizing the

District's Federal ID number, as well as by other County offices whose staff are stakeholders.

D. Outline of Plan

This plan is written following the "Outline of a Watershed Plan", from "A Guide to Developing Local Watershed Action Plans in Ohio" (Ohio EPA Division of Surface Water). The plan contains an introduction, which includes a description of the watershed, its demographics, geography and background information; and a discussion of the watershed plan development and endorsement process. It includes a comprehensive watershed inventory (Section III), discussion of watershed impairments (Section IV), watershed restoration and protection goals (Section V), action items and a timeline for implementation (Section VI), and implementation Ohio Coastal Nonpoint Pollution Control Management Measures (Section VII). Plan evaluation is described in Section VIII and Plan updates and revision strategies are discussed in Section IX.

E. Endorsement of the Plan by key watershed partners

"To access funding from USEPA, Ohio EPA or ODNR, the overall purpose of the watershed plan is to restore and maintain the chemical, physical and biological integrity of waterbodies within the watershed, an objective of the Clean Water Act of 1972." (Appendix 8 update, Outline of a Watershed Plan. A Guide to Developing Local Watershed Action Plans in Ohio. 1997/) Accordingly, endorsement for this plan will be sought and obtained from the Ohio EPA and ODNR.

F. Endorsement of Plan by Local Units of Government

The local units of government were involved in the plan development. The final plan will be formally presented to the local governing bodies prior to the completion of the endorsement by key watershed partners process, and each will have an opportunity to provide final input prior to signing the endorsement page located at the beginning of the plan.

G. Education Component

A community education program has been developed as an integral part of the watershed restoration objectives. It includes an initial direct mailing of a brochure, installation of watershed maps and educational signs throughout the watershed, a presence at public events in the community, workshops, technical meetings, creek clean-ups and a geocaching program. Lake SWCD has built long-term relationships with the schools in the western part of Lake County, and developing stronger ties with teachers in the watershed and engaging students in hands-on activities is a priority.

An Arcola Creek Facebook page was created in early 2012, and the Lake SWCD website is maintained with watershed information and seasonal photographs.

A survey of the nursery industry will help to establish the needs of the nursery industry and to develop technical tools and educational materials and programs for this unique form of agriculture.

The relatively small size of the watershed is ideal for restoration initiatives and focused outreach campaigns, and news media will be regularly utilized to publicize projects and successes.
A watershed monitoring program will be developed with volunteers from the community to engage the residents, and to record progress in watershed restoration efforts.

III. WATERSHED INVENTORY

A. Description of the watershed

1. Geology

a. 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 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.

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 5. Topography- Elevation Change in the Arcola Creek Watershed

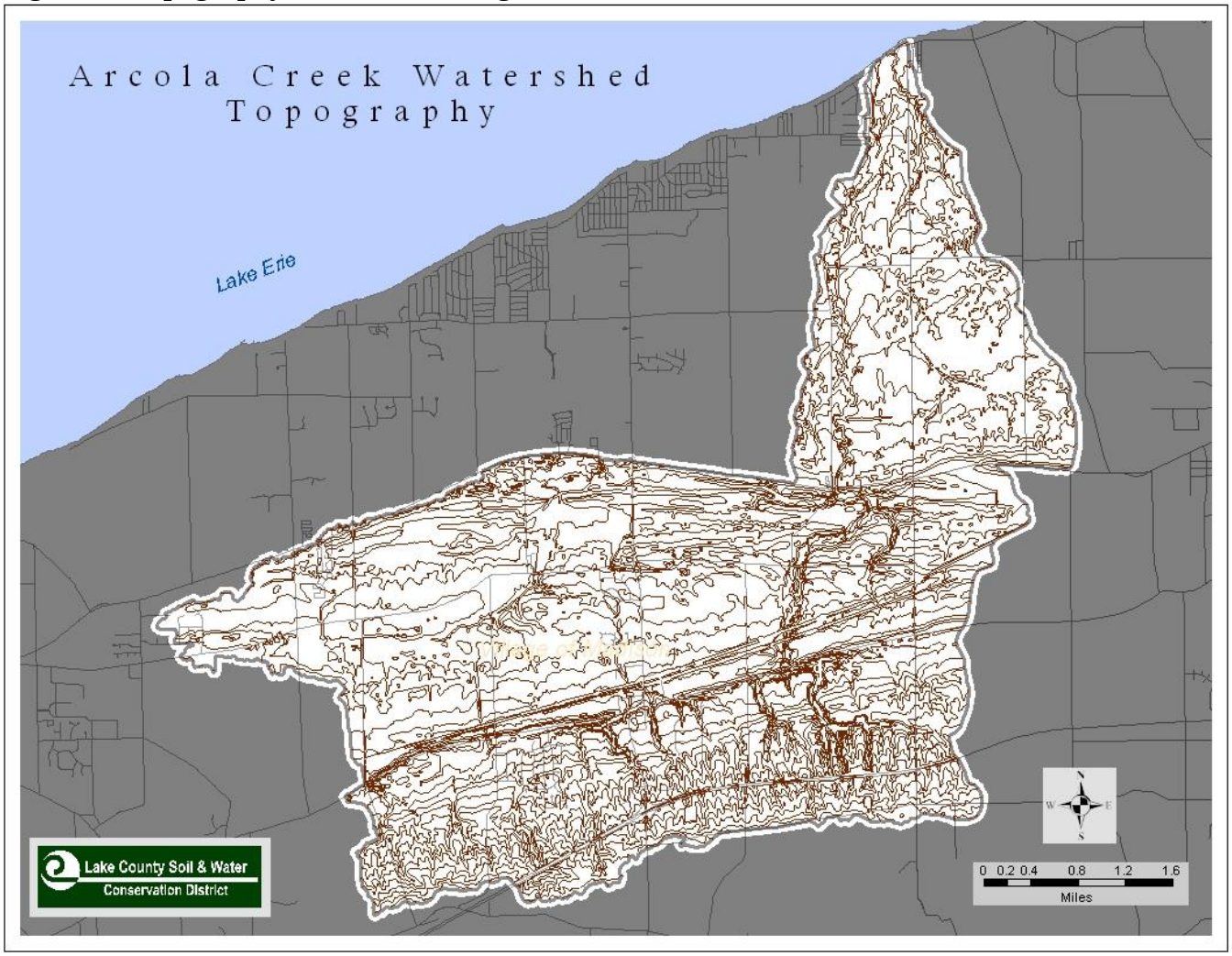
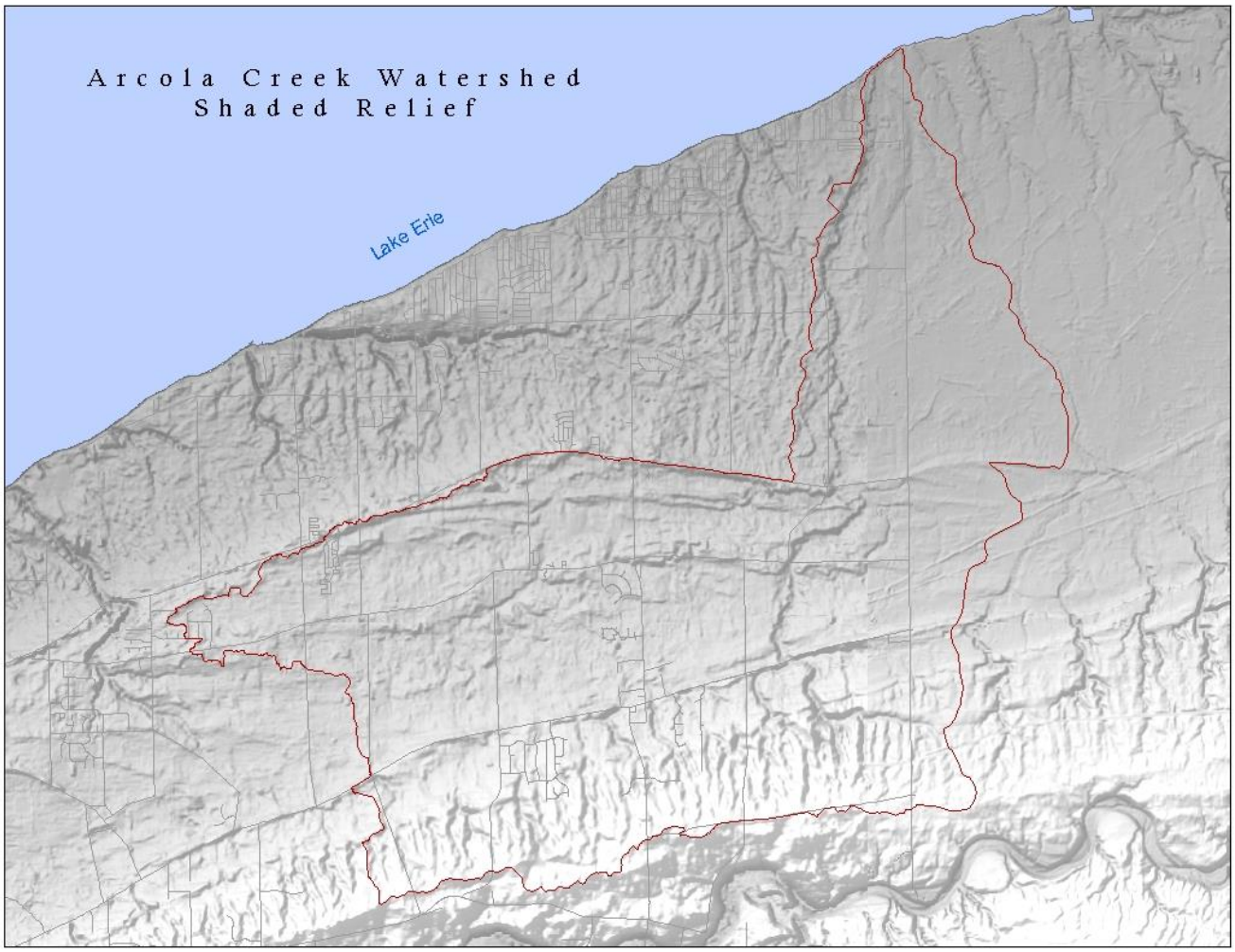


Figure 6. Topography- Shaded Relief View of Arcola Creek Watershed



b. Geology & Glacial History

The Arcola Creek Watershed is underlain by the Glaciated Plateau to the south and the Lake Plain to the north. It is in the glaciated plateau of Ohio.

The Lake Plain averages 4 miles in width. Unlike much of the Lake Erie coastline in Ohio, the Arcola does not have a cliff at the land/lake interface, but flows into Lake Erie through an estuary at a low gradient.

The Lake Plain is relatively level and is characterized by poor drainage, except where there are beach remnants from ancient lakes. 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 watershed is underlain by Chagrin Shale bedrock of Devonian age, part of the Paleozoic area which lasted about 416 to 2.8 million years ago. The gray shales and siltstones of the Chagrin Shale were deposited as sea-bottom muds in alternating layers which were compressed over time into shale and siltstone. The Chagrin Shale bedrock is close to the surface in some areas and exposed in some stream beds.

The last glacial advance into the watershed (and Ohio) was the Ashtabula advance, which occurred in a narrow belt along Lake Erie. This advance deposited the Ashtabula Till, which contains a high proportion of ground-up shale from the bottom of the lake. Ashtabula Till is calcareous, silty, clayey and somewhat pebbly. The sand content is less than 20 percent, the clay content is generally about 35 percent and the silt content is generally greater than 50 percent. This high silt content distinguishes the Ashtabula Till from all other tills in Ohio, which have less than 50 percent silt content. The Ashtabula Till ranges from thick wedges to thin veneers over earlier tills. On the Lake Plain, lacustrine silt and clay overlie the Ashtabula Till in large areas.

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)

Mineral Resources of Note

Sand and Gravel

Sand and gravel on the beach ridges and as deposits from glacial outwash-terraces are important resources for construction and industrial uses in the watershed.

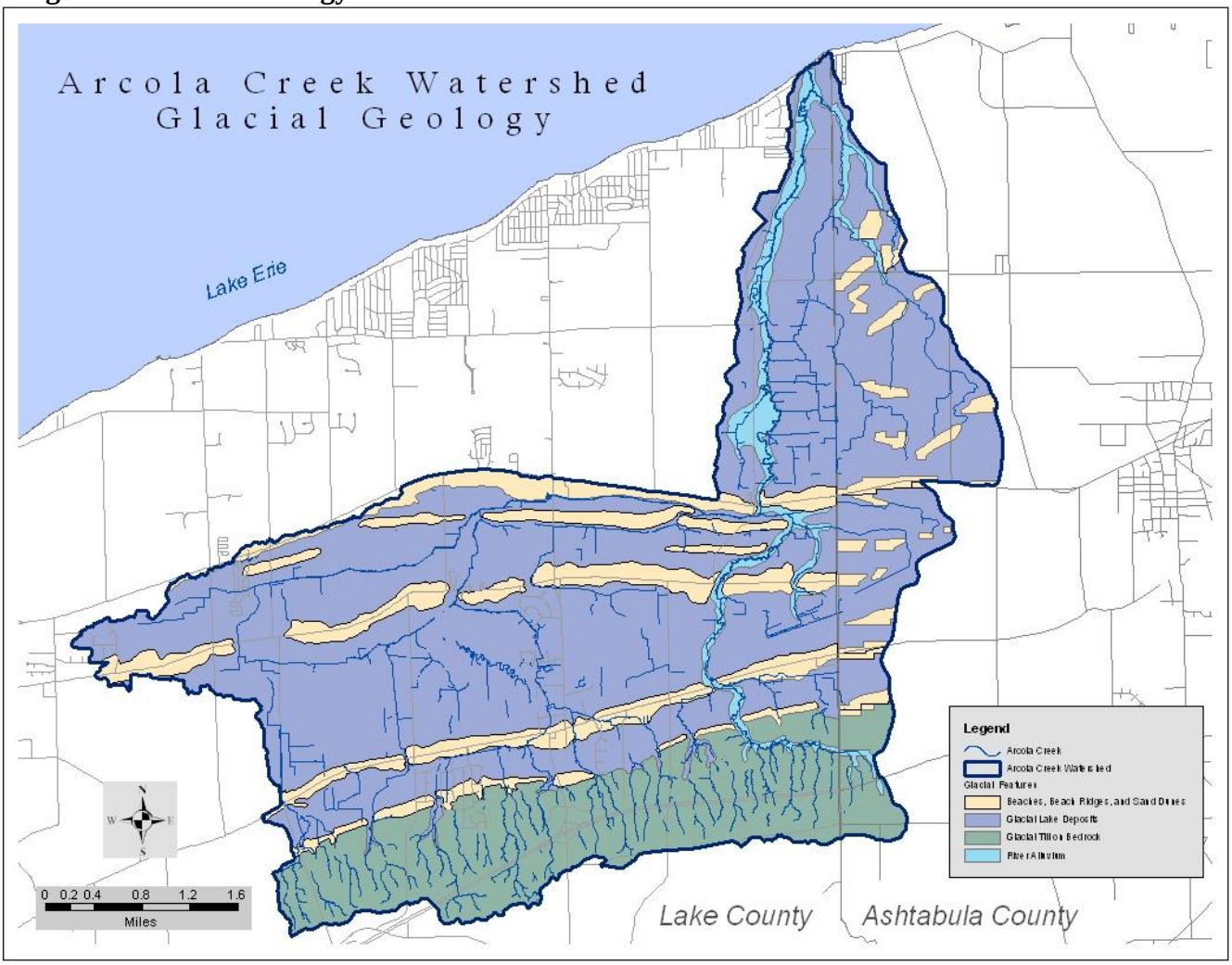
Bog Iron

Iron deposits accumulated in some of the swampy low-lying areas of the lake plain after the last retreat of the glaciers 10,000 years ago, forming pockets of bog iron. Bog iron was found in significant amounts in the Arcola Creek Watershed and supported a bog iron industry from 1826 to 1845. The ore contained 25 to 35 percent iron and was used to make stoves and cookware for the pioneer settlers. Arcola Creek was named for the Arcole Furnace Company, with the variation due to a spelling error.

Natural Gas and Oil

The Arcola Creek Watershed is underlain by rock formations that contain Marcellus and Utica oil shales, deeper resources that can be mined through hydraulic fracturing- more commonly called "fracking". Large amounts of water are needed in the drilling process, and the potential for environmental degradation can be high if proper regulations are not implemented for this emerging industry in Ohio.

Figure 7. Glacial Geology of Arcola Creek Watershed



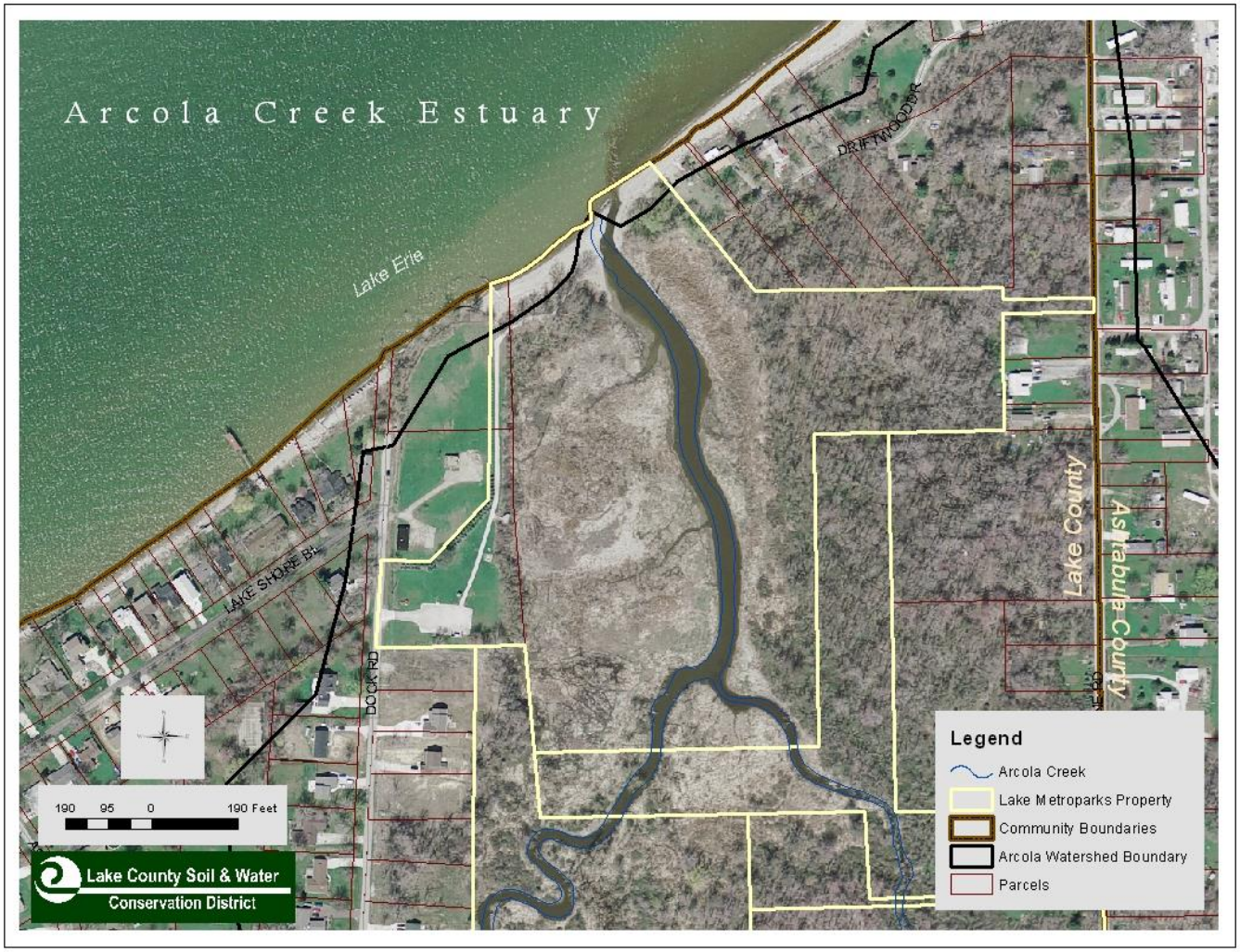
Arcola Estuary

The Arcola Creek Watershed includes a marsh and estuary just above the mouth of the river where it empties into Lake Erie. 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. Estuaries are some of the most productive ecosystems in the world. The Arcola Creek Estuary is one of only two natural estuaries that remain along the southern shores of Lake Erie in Ohio. "Arcola Creek Marsh is not considered an outstanding refugia of rare plant elements in Ohio; instead, Arcola Creek represents one of the last remaining stream mouths into Lake Erie where the natural processes of sand beach damming can still take place allowing the continual persistence of a submerged riverine marsh. Within this marsh the natural processes of plant growth, mineral cycling, energy flow, pollution filtration, and fish and waterfowl breeding can still operate, unimpeded by retaining walls, buildings or unduly high human activity." (Bissell. 1982.) The estuary and marsh also provide an important stopover for migratory birds as they cross Lake Erie.

The Arcola Creek channel has cut through the layers of glacial till of the Lake Plain and the main channel basin throughout the marsh is well below the level of Lake Erie. The shoreline and outlet of Arcola Creek Marsh is composed of recently deposited sands. "The water level of Arcola Creek Marsh is dependent upon the amount and depth of accumulated sands at the Arcola Creek outlet into Lake Erie. Wave action along the shoreline from prevailing westerly winds typically erodes the shoreline bluffs to the west of Arcola Creek. These same waves carry the eroded sand particles eastward along the beach shelf. The clay and silt portion of the eroded bluffs west of Arcola Creek stay suspended in the lake water. The bluff materials contain about fifteen to twenty percent sand and gravels. The sands and gravels carried eastward on the beach shelf are deposited and accumulate as a beach at the mouth of Arcola Creek. The damming of the creek outlet by the beach sands raises the water leveling the creek bed south of the beach thereby creating the Arcola Creek Marsh. The continual downward erosion of the outlet or replenishment of sand in the outlet by wave action produces countless short term elevation changes in the outlet." (Bissell. 1982.)

Short-term and long-term changes in water level in the estuary also occur as the level of Lake Erie changes. 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.)

Figure 8. Arcola Creek Estuary



c. Soils

The soils in the watershed 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.

The soils on the broad flats of the lake plain and offshore bars are poorly and somewhat poorly drained. They are nearly level and gently sloping soils formed in silty and loamy lakebed sediment and outwash material. Seasonal wetness is the major limitation. Soils in these mapping units include Conneaut-Painesville and Red Hook plus Hornell and Kingsville in Ashtabula County. The land use is mixed, with agricultural (mostly nursery crops), natural shrubs and trees and residential uses. Most of the undeveloped areas have not been drained. When drained, these soils have a fair potential for most cultivated crops, good or fair potential for wetland wildlife habitat, and poor potential for residential or other urban uses.

The beach ridge, terrace and offshore bar soils are sandy and gravelly with good internal drainage. They can be droughty during extended dry periods. They range from somewhat poorly drained to excessively drained. They are used for nurseries and community growth. Soils in these mapping units include Elnora-Stafford, Tyner-Otisville and Conotton plus Chenango, Colonie and Harbor in Ashtabula County. They have good potential for nursery crops if irrigated, and good potential for residential and urban development if community sewage disposal systems are available.

The soils on till plains formed in silty and loamy glacial till and are found on broad flats and along drainageways. They range from somewhat poorly drained to moderately well drained. Some have a fragipan, or dense, compact subsurface layer with slow permeability to water, which restricts internal drainage. Erosion, seasonal wetness and slow permeability are the major use limitations. Water commonly ponds in lower lying areas after heavy rains. Soils in these mapping units include Platea-Pierpont, Darien-Mahoning and Mahoning-Ellsworth, plus Mill and Towerville in Ashtabula. The wetness and slow permeability severely limit most uses, although the potential for both farming and wetland wildlife habitat is fair.

Soils on flood plains, terraces and marshes are found on broad flats and in long, narrow areas with little change in elevation. They formed in lake bed sediments, recent stream deposition and organic deposits. Land use is very diverse and depends upon the extent of flooding. Orrville is included in this mapping unit plus Holly in Ashtabula County. Wetness and flooding are the major limitations of these soils, and they have good potential for cultivated crops and residential or urban development when adequately drained and protected from flooding.

Figure 9. Soils of Arcola Creek Watershed

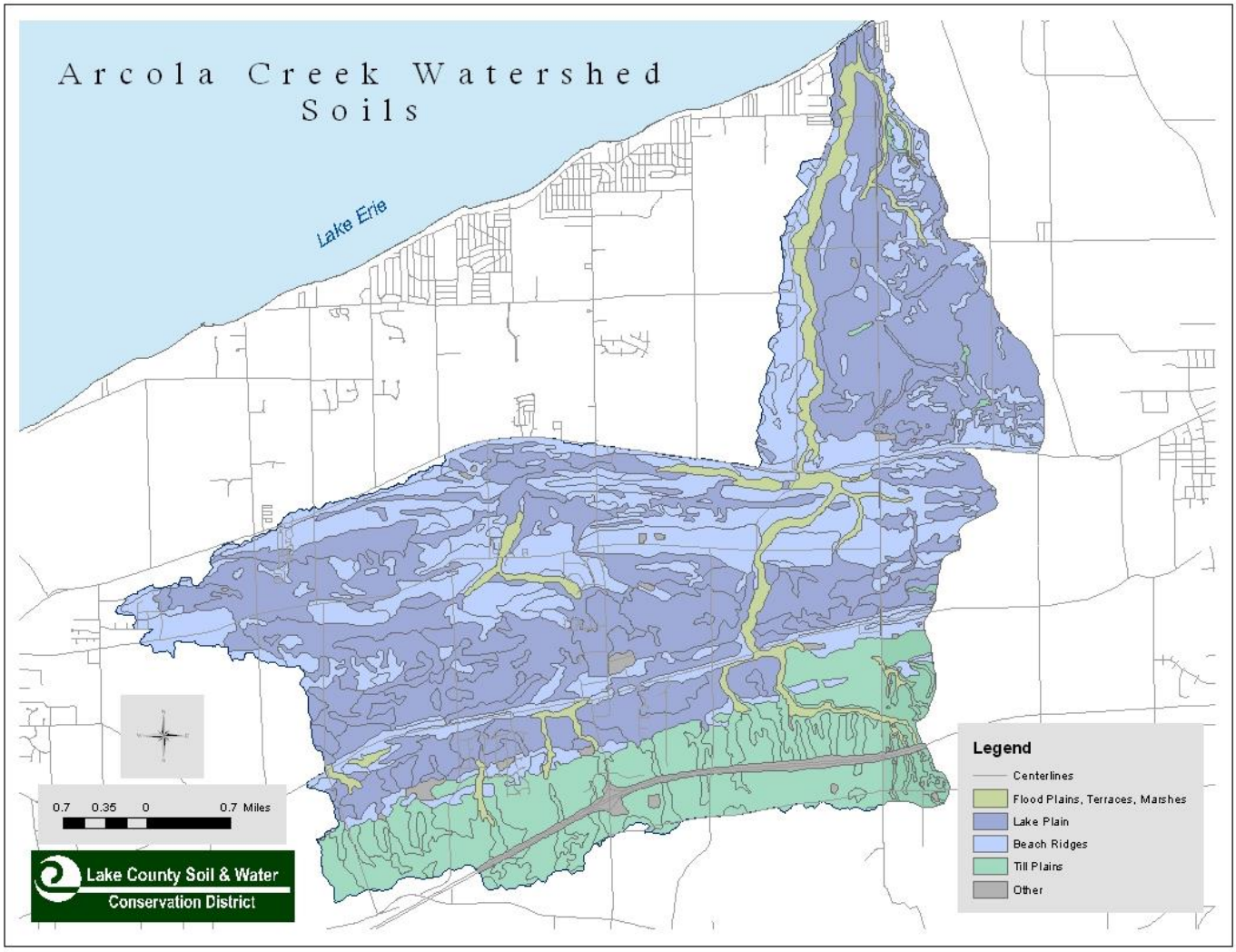
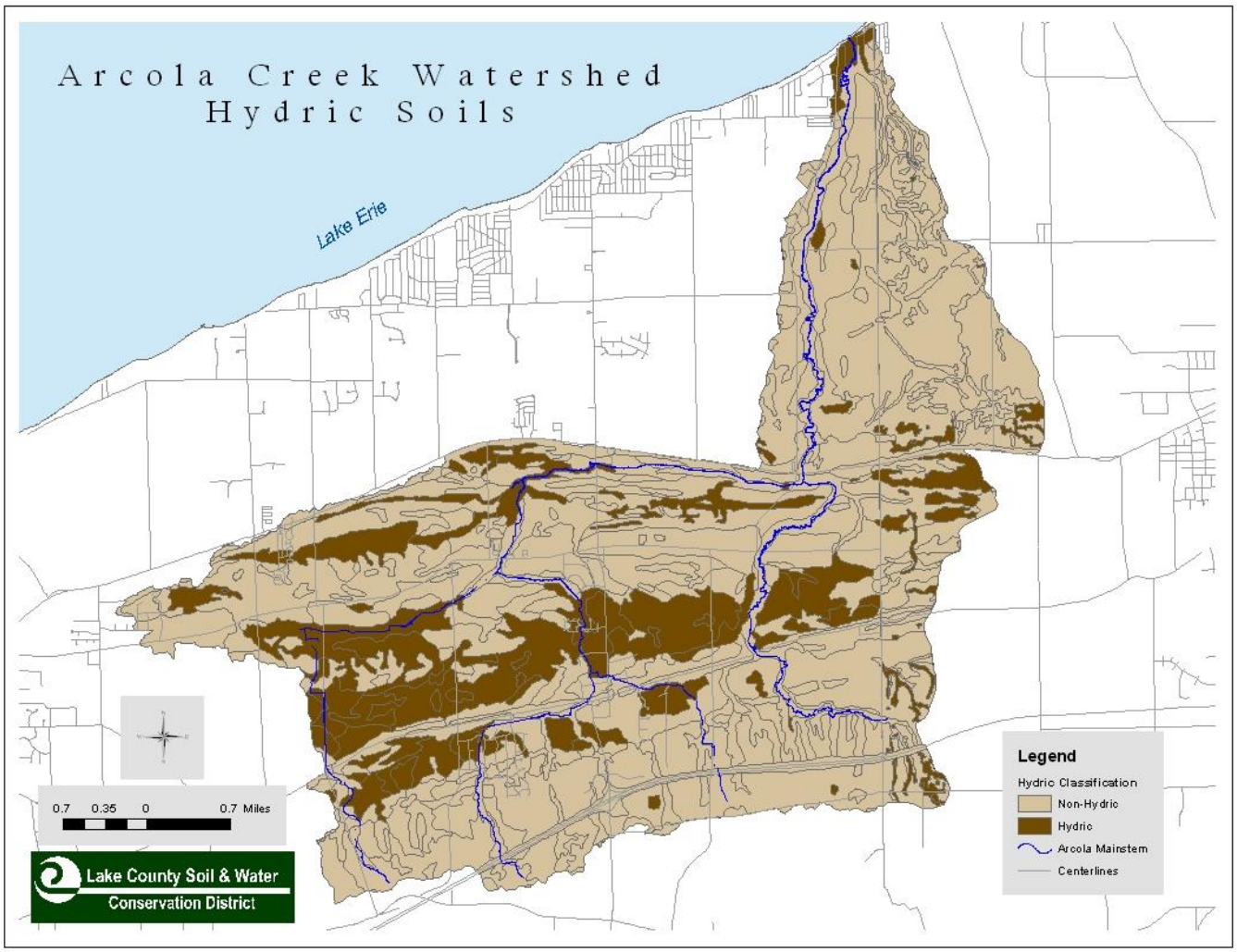
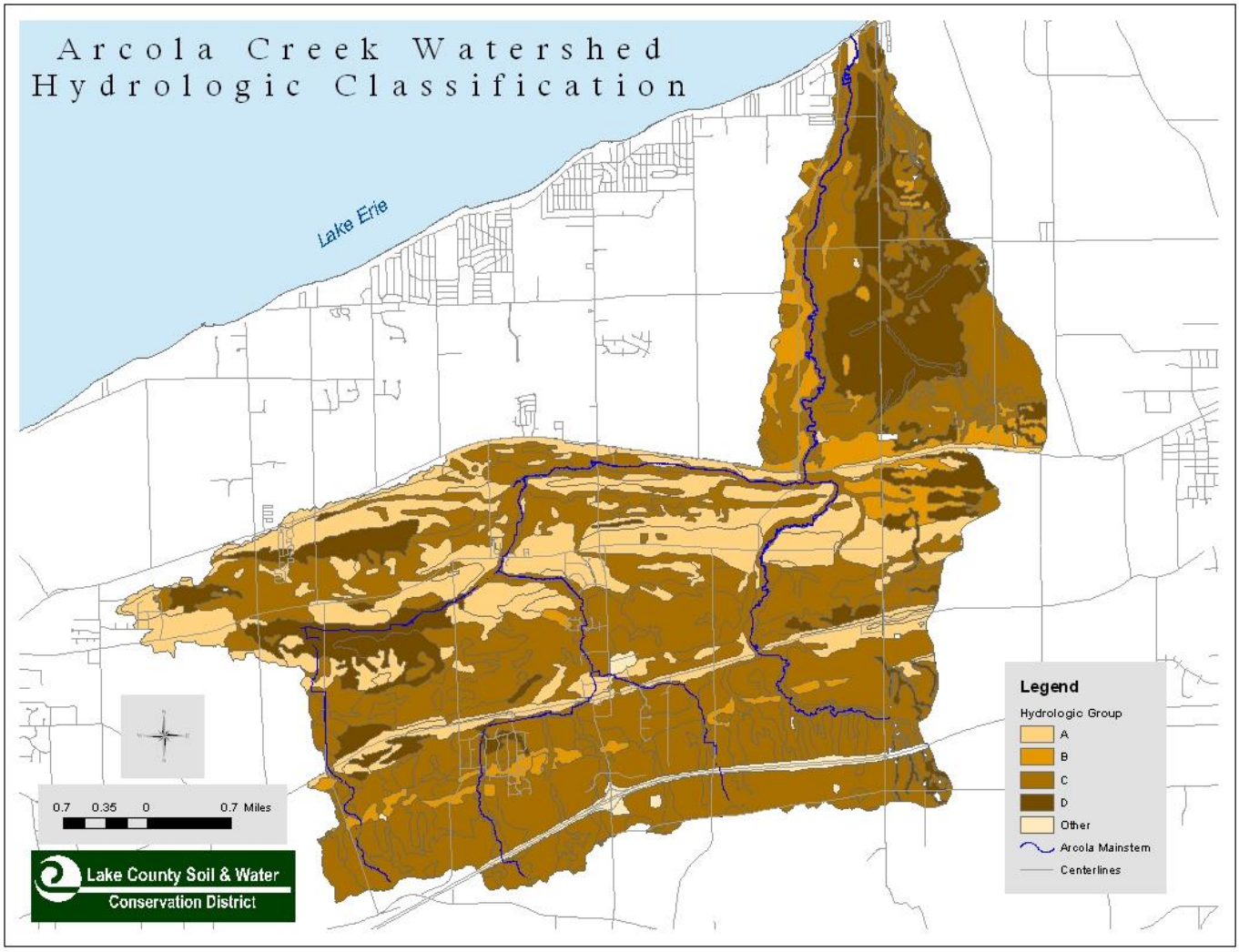


Figure 10. Hydric Soils of Arcola Creek Watershed



Hydric soils are soils that have formed under prolonged saturated, flooded or ponded conditions and have developed anaerobic (limited oxygen) qualities. They are used to delineate wetlands and are most suitable for non-developed land uses.

Figure 11. Hydrologic Soil Classification of Arcola Creek Watershed



Hydrological soil groups are used to estimate runoff potential from precipitation. These estimates are useful for land use planning that involves engineering considerations, as well as establishing best management practices for all land uses.

Figure 12: Hydrologic Soils Description

Hydrologic Soil Group	Description	Soils	Depth to High Water Table	Percentage of the Watershed
A	High infiltration rate and low runoff potential when wet	Deep, well to excessively well drained sands or gravels	> 6 feet	35.80%
B	Moderate infiltration rate when wet	Moderately deep, moderately well to well drained soils with moderately fine to moderately coarse texture	1.5 to > 6 ft	14.80%
C	Slow infiltration rate when wet	Soils with layer that impedes downward movement of water, with moderately fine to fine texture	0.5 to > 6 ft	30.60%
D	Very slow infiltration rate with high runoff when wet	Clay soils with permanent high water table, shallow over nearly impervious material with very slow rate of water transmission	0 to 1.5 ft	18.80%

Sources: Soil Survey of Lake County, Ohio and ERIN Watershed Report

2. Biological Features

a. Rare, threatened and endangered species

John Pogacnik, Biologist with Lake Metroparks has collected data from Arcola Creek Park, located at the Arcola marsh and estuary, and from South Ridge Reservation, located on Arcola Creek on South Ridge Road in Madison Township. Lake Metroparks conducted a critical resources inventory in 1996 in the Arcola Creek Natural Resource Management Plan. (Pogacnik; 1996.) All data in the following section are attributed to this reference unless otherwise noted. Mr. Pogacnik also shared more recent data collected in the two Arcola Creek Watershed Metroparks properties.

The Ohio Biodiversity Database was also utilized though it lists only seventeen rare, threatened, potentially threatened, endangered species and species of concern in the Arcola Creek Watershed. Chad Edgar, Resource Protection Specialist with Lake County Soil & Water Conservation District surmised that more rare, threatened or endangered species may exist, but field work in the Arcola Creek Watershed to identify these species has been limited because the resource is impacted and it may not have been worth the experts' time.

Figure 13: Ohio Status Designations for Animals

E	Endangered	A native species or subspecies threatened with extirpation from the state. The danger may result form one or more causes, such as habitat loss, pollution, predation, inter-specific competition, or disease.
T	Threatened	A native species or subspecies whose survival in Ohio is not in immediate jeopardy, but to which a threat exists. Continued or increased stress will result in its becoming endangered.
SC	Species of Concern	A species or subspecies which might become threatened in Ohio under continued or increased stress. Also, a species or subspecies for which there is some concern but for which information is insufficient to permit an adequate status evaluation. This category may contain species designated as a furbearer or game species but whose statewide population is dependent on the quality and/or quantity of habitat and is not adversely impacted by regulated harvest.
SI	Special Interest	A species that occurs periodically and is capable of breeding in Ohio. It is at the edge of a larger, contiguous range with viable population(s) within the core of its range. These species have no federal endangered or threatened status, are at low breeding densities in the state, and have not been recently released to enhance Ohio's wildlife diversity. With the exception of efforts to conserve occupied areas, minimal management efforts will be directed for these species because it is unlikely to result in significant increases in their populations within the state.

i. Fish

Northern Brook Lamprey- *Ichthyomyzon fossor*, has been found in Arcola Creek in 1983 and 1986 at the crossing of State Route 20. It is a non-invasive species and is listed as endangered. Long-nosed Dace- *Rhinichthys cataractae*, a species of concern, has been found in Lake Erie near the mouth of Arcola Creek. In Ohio its range is restricted to waterways in the northeast that adjoin the Lake Erie shoreline only during the cooler months of September through April. Silver Lamprey- *Ichthyomyzon unicuspis*, a parasitic species, has been found in the Chagrin River and may be possible in Arcola Creek.

Although not rare, threatened or endangered, it is significant that Arcola Creek hosts Steelhead (lake run Rainbow Trout) from fall through spring. Rainbow Trout (*Salmo gairdneri*), native to the western United States and Canada was first introduced to Ohio in 1884.

The Ohio Division of Wildlife annually stocks about 400,000 fish in Conneaut Creek, and the Grand, Chagrin and Rocky Rivers. The young steelhead migrate downstream to the lake and return as adults after two or three summers in Lake Erie. Although most return to the rivers in which they were stocked, many are found in other tributaries such as Arcola Creek. Steelhead were stocked into Arcola Creek only once, during the 1990's.
Limited natural reproduction does occur, but populations must be sustained through annual stocking.

Rainbow Smelt- *Osmerus mordax* has also had a small run in Arcola Creek, but the smelt fishing has been in decline.

ii. Mussels

According to the Ohio Department of Natural Resources Ohio Biodiversity Database, to the best of their knowledge, there are no rare, threatened and endangered species of mussels in the Arcola Creek Watershed.

iii. Invertebrates

There are no rare, threatened or endangered species of invertebrates in the Arcola Creek Watershed listed in the Ohio Biodiversity Database. Chad Edgar, Resource Protection Specialist with Lake County Soil & Water Conservation District has done extensive Headwater Habitat Evaluation Index (HHEI) studies of the Arcola headwaters over the past decade attributes this lack to the high degree in which the habitat has been impacted.

Marsh Bluet- *Enallagma erbium*, a threatened species, has been found by Mr. Pogacnik in Arcola Creek Park, though not on an annual basis.

iv. Mammals

The Ohio Biodiversity Database lists no rare, threatened or endangered species of mammals in the Arcola Creek Watershed. However, Lake Metroparks staff found one record of the Star-nosed Mole, a state special interest species, of one individual just northeast of the Arcola Creek Metropark parking lot on Dock Road.

The Indiana Bat or Indiana Myotis, Order-*Chiroptera,* listed as endangered may be found in the Arcola Estuary area because it has been an excellent area to view bats migrating and feeding over the marsh. Bat migration patterns are similar to birds and they tend to follow the Lake Erie shoreline, rather than cross Lake Erie. No bat surveys have been done, however, to classify the species of bats in the Arcola.

The Ermine, listed as special interest, may also be found in the Arcola Creek Estuary, because young animals in search of new territory often follow the Lake Erie shore, and its natural habitat is abundant along the marsh border. There is a lack of information about the species range and status in Ohio because of their secretive nature and the difficulty in identifying Ermine by sight.

v. Birds

There are no birds listed on the Ohio Biodiversity Database for the Arcola Creek Watershed.

Lake Metroparks staff conducted several bird surveys in the 1990's. The Sedge Wren, a species of concern was found during the summer of 1995. This species has declined greatly in Ohio because of the destruction of wetlands. Habitat can be improved by controlling the spread of Narrow-leaved Cattail *Typhus angustifolia* and *Phragmites* in the marsh. The Marsh Wren, a special interest species in Ohio is also found in Arcola Creek Park. Its decline is also due mainly to habitat loss of cattail marshes.

"Arcola Creek (AC) is also an important stopover for migrating birds. The habitat at AC is the best example of the marsh habitat that was once present at the mouths of the many rivers and streams emptying into Lake Erie. In northeast Ohio this habitat has been almost completely eliminated. Many species of migrating birds and insects that typically utilize this specialized type of habitat must now concentrate into fewer and fewer areas such as AC. While AC is rather small in size it is extremely important to these migrants. The marsh can be a magnet for small birds when the water is open which typically is from March through December. Due to the marsh's small size, waterfowl and shorebirds are not common, but they can be occasionally observed." (Pogacnik; 1996.)

Arcola Creek Park is located within the Atlantic flyway, a migration route used by migrants from the east coast and the southeast. Large numbers of waterfowl and gulls come through in early spring as the lake waters begin to open, and again in the fall. Hawks come through in March and April.

"Several rare birds have occurred at AC, with the rarest being a Louisiana Heron that was seen in the spring of 1993. Other birds that are rare or locally uncommon that have been reported from AC are: (number of sightings in parentheses): Eared Grebe (1), American White Pelican (1), Yellow-crowned Night Heron (1), American Bittern (1), Least Bittern (1), Brant (1), Bald Eagle (several), Peregrine Falcon (2), Red Phalarope (1), Sharp-tailed Sparrow (several), and Le Conte's Sparrow (1). All records are from 1992-1995." (Pogacnik; 1996.)

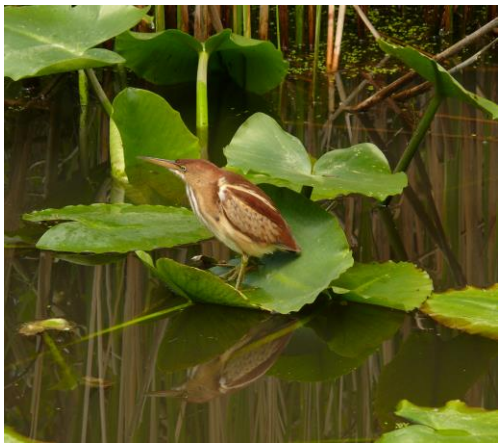
Figure 14: Birds found at Arcola Creek Park (John Pogacnik)

Common Name	Scientific Name	Status	Comments
American Bittern	*Botaurus lentiginosus*	E	None in recent years
Least Bittern	*Ixobrychus exilis*	T	Last in 2007
Least Flycatcher	*Empidonax minimus*	T	None in recent years
Virginia Rail	*Rallus limicola*	SC	2010
Sora	*Porzana carolina*	SC	None in recent years
Common Moorhen	*Gallinula chloropus*	SC	Last in 2008
Marsh Wren	*Cistothorus palustris*	SC	2010, Annual in occurrence
Sedge Wren	*Cistothorus platensis*	SC	Last in 2006
Prothonotary Warbler	*Protonotaria citrea*	SC	None in recent years
Purple Finch	*Carpodacus purpureus*	SI	Last in 2009

Figure 15: Birds found at South Ridge Reservation (John Pogacnik)

Common Name	Scientific Name	Status	Comments
Yellow-bellied Sapsucker	*Sphyrapicus varius*	E	2010
Least Flycatcher	*Empidonax minimus*	T	2010
Dark-eyed Junco	*Junco hyemalis*	T	2010

Marsh Wren (Pogacnik)



Least Bittern (Pogacnik)

vi. Reptiles & Amphibians

Several herpetological surveys were conducted at Arcola Creek Metropark in 1982 and 1995 in a cooperative effort with Lake Metroparks and Dr. Timothy O. Matson, Curator of Vertebrate Zoology at the Cleveland Museum of Natural History. The results showed a dearth of reptiles and amphibians. There were no Bullfrogs-*Rana catesbeiana*, and only one Green Frog-*Rana clamitans* was found in the marsh. The only other amphibians were a few Northern Leopard Frogs-*Rana pipiens* found in the marsh and Fowler's Toads-*Bufo woodhousei fowlerii* found near the mouth of the creek, both of which are considered uncommon locally in Lake County. One Eastern Garter Snake-*Thamnophis s. sirtalis* was found along with a pair of Two-lined Salamanders found in the east stream bed, south of the marsh.

Dr. Matson has concerns about the lack of reptiles and amphibians in the marsh and suggested it may be due to pollution, such as heavy metals originating from the bog iron mining or from some other source, and predation by Snapping Turtles. Pesticide spraying upstream may also be a factor in the decline. Ohio EPA found Dieldrin, Endrin, and Heptachlor in the creek south of North Ridge Road in samples taken in 1995. Although the samples exceeded the water quality standard levels, the values were obtained from single samples so they are not technically over the limit.

Spotted Turtle-*Clemmys guttata*, a special interest species may inhabit the Arcola Estuary. It has been found along the lake at Mentor Marsh, at the Perry Nuclear Power Plant, and in Geneva; it has a shy nature and may be present but not evident.

Great Lakes Crayfish- *Orconectes propinquus*, a species of concern have been found at both Arcola Creek Park and South Ridge Reservation by Mr. Pogacnik.

vii. Plants

Figure 16: Ohio Status Designations for Plants

E Endangered
T Threatened
P Potentially Threatened

Atlantic coastal dune plants not typical in Ohio can be found in the Arcola Creek Estuary and mouth because of the dune and beach processes that occur along the Lake. At times, sand dams at the river mouth can back up water levels to as much as eight feet above Lake Erie levels, creating aquatic bed communities- which have become rare with alteration of the natural river mouths along the Ohio coastline.

Figure 17: Rare Plant Species found at Arcola Creek Park (John Pogacnik)

Common Name	Scientific Name	Status	Comments
Northern Poison Ivy	*Toxicodendron rydbergii*	E	
Inland Beach Pea	*Lathyrus japonicus*	T	
American Reed Grass	*Phragmites australis americanus*	T	
American Sweet-flag	*Acorus americanus*	P	
Inland Sea Rocket	*Cakile endentula*	P	
Leafy Tussock Sedge	*Carex aquatilis*	P	
Seaside Spurge	*Euphorbia polygonifolia*	P	Not seen the last 2-3 years
Oake's Evening Primrose	*Oenothera oakesiana*	P	
Small-flowered Evening Primrose	*Oenothera parviflora*	P	
Purple Sand grass	*Triplasia purpurea*	P	Not seen since 1995


Northern Poison Ivy (Pogacnik)

Figure 18: Rare Plant Species found at South Ridge Reservation (John Pogacnik)

Common Name	Scientific Name	Status	Comments
American Chestnut	*Castanea dentata*	P	One fruiting tree

Figure 19: Ohio State Listed Plants in the Arcola Creek Watershed

Common Name	Scientific Name	Last Observed	State Status
Necklace Sedge	*Carex projecta*	1986-07	threatened
Small-flowered Evening-primrose	*Oenothera parviflora*	2003-09	potentially threatened
Inland Beach Pea	*Lathyrus japonicus*	2009-08-18	threatened
Seaside Spurge	*Euphorbia polygonifolia*	2003-09	potentially threatened
Purple Sand Grass	*Triplasis purpurea*	1977-09-28	potentially threatened
Inland Sea Rocket	*Cakile edentula*	2009-08-18	potentially threatened
Northern Poison-ivy	*Toxicodendron rydbergii*	1991-06-24	endangered
American Sweet-flag	*Acorus americanus*	2009-08-18	potentially threatened
Leafy Tussock Sedge	*Carex aquatilis*	1999-06-16	potentially threatened
Leafy Tussock Sedge	*Carex aquatilis*	1998-06-18	potentially threatened
Oakes' Evening-primrose	*Oenothera oakesiana*	2003-09	potentially threatened
American Beach Grass	*Ammophila breviligulata*	1995-08-22	threatened
American Reed Grass	*Phragmites australis ssp. americanus*	2009-08-18	threatened
Mixed emergent marsh	*Plant Community*	2009-8-18	
Beach-dune community	*Plant Community*	2009-08-18	

Figure 20: Additional Species Considered Uncommon by Cleveland Museum of Natural History botanist James K. Bissell in the Arcola Estuary (Pogacnik; 1996.)

Common Name	Scientific Name	State Status
False Dragonhead	*Physostegia virginiana*	uncommon
Trailing Wild Bean	*Strophostyles helvola*	uncommon
Canada Anemone	*Anemone canadensis*	uncommon
Hairy Agrimony	*Agrimonia striata*	uncommon
Wafer Ash (Hop-tree)	*Ptelea trifoliata*	uncommon
Sweet Flag	*Acorus americanus*	uncommon
Hard-stemmed Bulrush	*Scirpus acutus*	uncommon
River Bulrush	*Scirpus fluviatilis*	uncommon
Walter’s Barnyard Grass	*Echinochloa walteri*	uncommon

b. Invasive nonnative species and their potential impacts

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. 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.

3. Water Resources

a. Climate and Precipitation

Lake County has a humid-continental climate with warm summers and cold winters. The following climate data is from Painesville, OH, which adequately represents the climate of the parts of Lake County along Lake Erie. The average winter temperature is 30 degrees Fahrenheit (F), and the average daily low is 23 degrees F. The average summer temperature is 70 degrees F, and the average daily high is 79 degrees F. Precipitation is well distributed through the year. The average annual precipitation is 40 inches, with the monthly average around 3 inches. The average annual snowfall is 40 inches. Snow squalls are frequent from late fall through winter.

The prevailing wind direction is from the west and high-pressure systems with strong winds cross Lake Erie from the northwest. The Arcola Creek Watershed is in the Lake Erie Snow Belt, an where heavy snowfall or lake-effect snow occurs because of its location downwind of Lake Erie. In the winter, cold air moves over the warmer lake water and absorbs moisture which falls as snow when the air moves over land and cools. This produces heavier snowfall and cloudy skies throughout the winter as long as the air temperatures are colder than water and the lake is not frozen. The probability of sunshine drops from 70 percent in summer to 30 percent in winter.

Lake Erie mitigates the temperature early in the spring and late in the fall. Lake water heats and cools more slowly than the land, so in the early spring the danger of frost damage to grapes and nursery crops is minimized because they do not bud out as early as crops farther south. In the fall, the growing season is extended because the Lake stays warm longer than the land and moderates the temperatures in the adjacent lands. Lake County has a longer growing season than more southern parts of the state because of the Lake effect. Nine years out of ten, Painesville has 166 growing days above freezing compared with132 growing days in Chardon. Five years out of ten the first freezing temperature in the fall in Painesville is November 1, compared with October 15 for Chardon. These conditions make the region a prime horticultural and viticultural area.

b. Surface Water

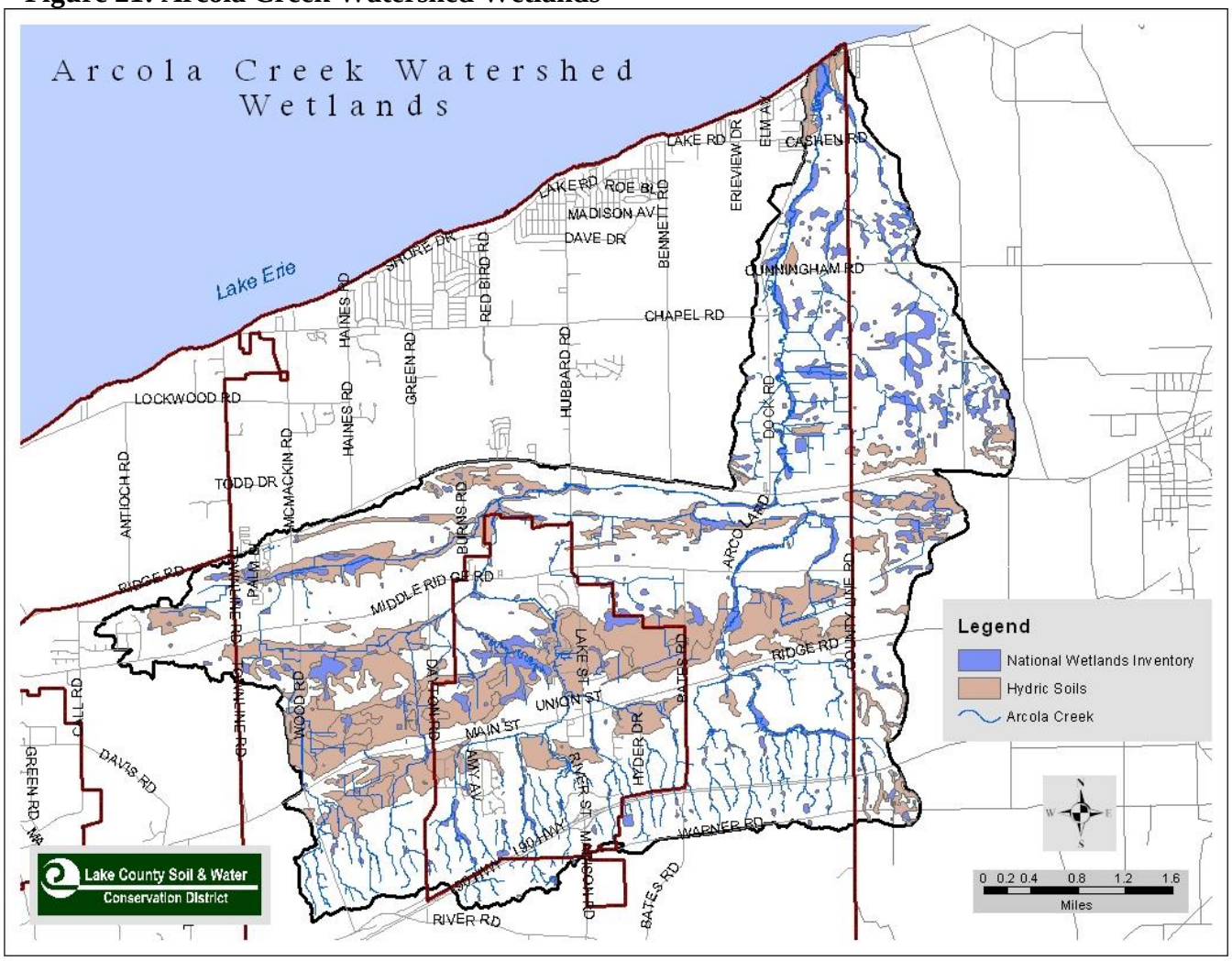
i. Wetlands

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 21) 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 21: Arcola Creek Watershed Wetlands

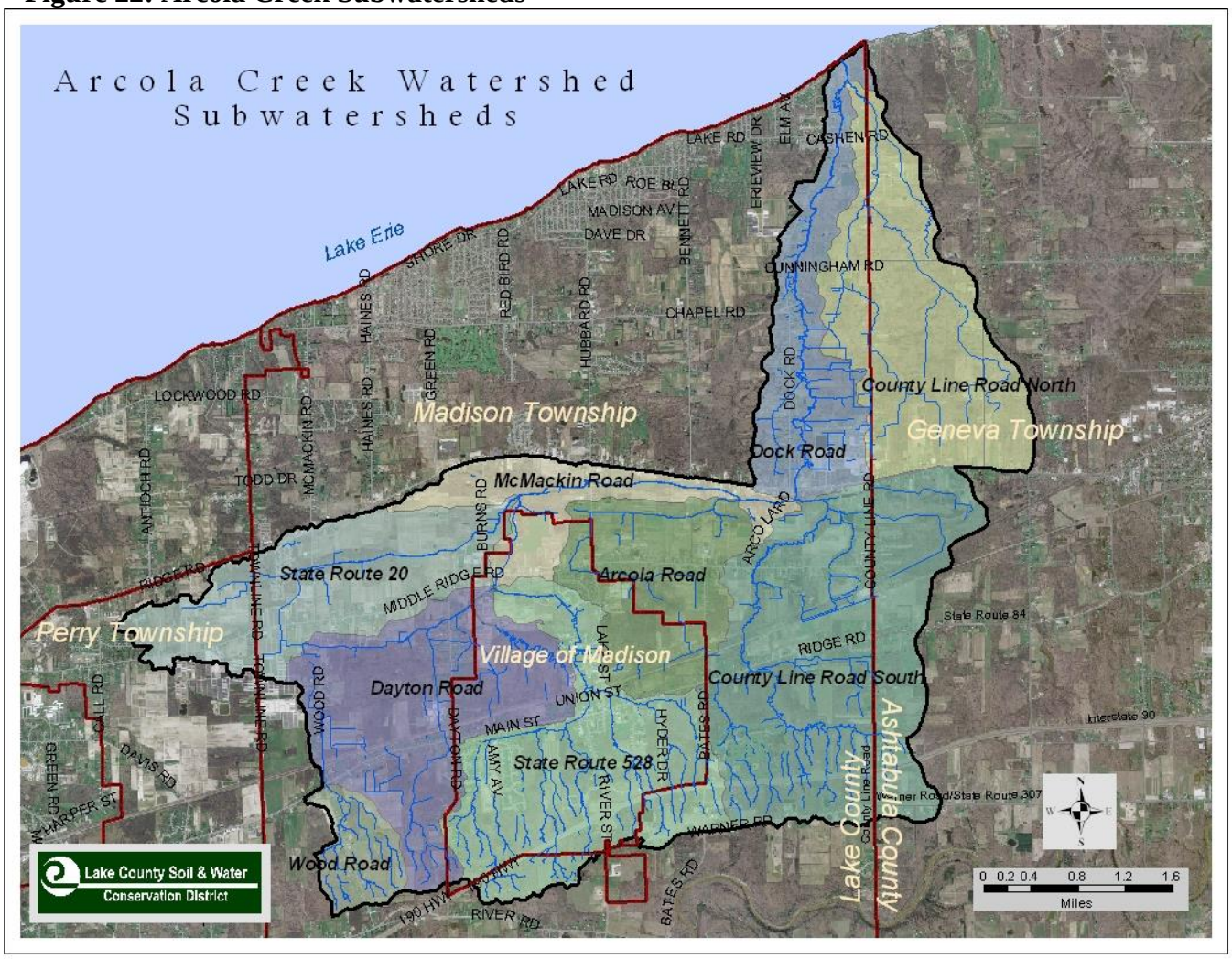


ii. Streams

1. Description of Subwatersheds

The Arcola Creek Watershed has nine subwatersheds: County Line Road South, State Route 528, Dayton Road, Wood Road, McMackin Road, Route 20 Corridor, Arcola Road, Dock Road and County Line Road North, listed in a clockwise direction from the southeastern corner. (See Figure 22.)

Figure 22: Arcola Creek Subwatersheds



The subwatershed data has been extracted from the Arcola Creek Watershed Management Plan (Edgar, 2004.) and from Headwater Habitat Evaluation Index (HHEI) data collected by Lake County Soil & Water Conservation District staff in the field over a ten year period. 90% of the streams in the watershed were assessed by measuring channel parameters of bankfull width, pool depth and stream substrate as an indicator of quality of habitat. Species presence and abundance was measured by collection of salamanders and macroinvertebrates. Water chemistry parameters including dissolved oxygen, salinity, conductivity and temperature were measured as well.

The following figures will assist in the interpretation of data presented in each subwatershed. Figure 23, Representative Entrenchment Ratios shows the degree of entrenchment of a stream section based upon the relationship between flood-prone areas and bankfull cross-sections. Figure 24, The Three Types of Primary Headwater Streams in Ohio, describes the three classes of Primary Headwater Habitat (PHWH) streams found in Ohio.

Figure 23: Representative Entrenchment Ratios (Rosgen. 1996.)

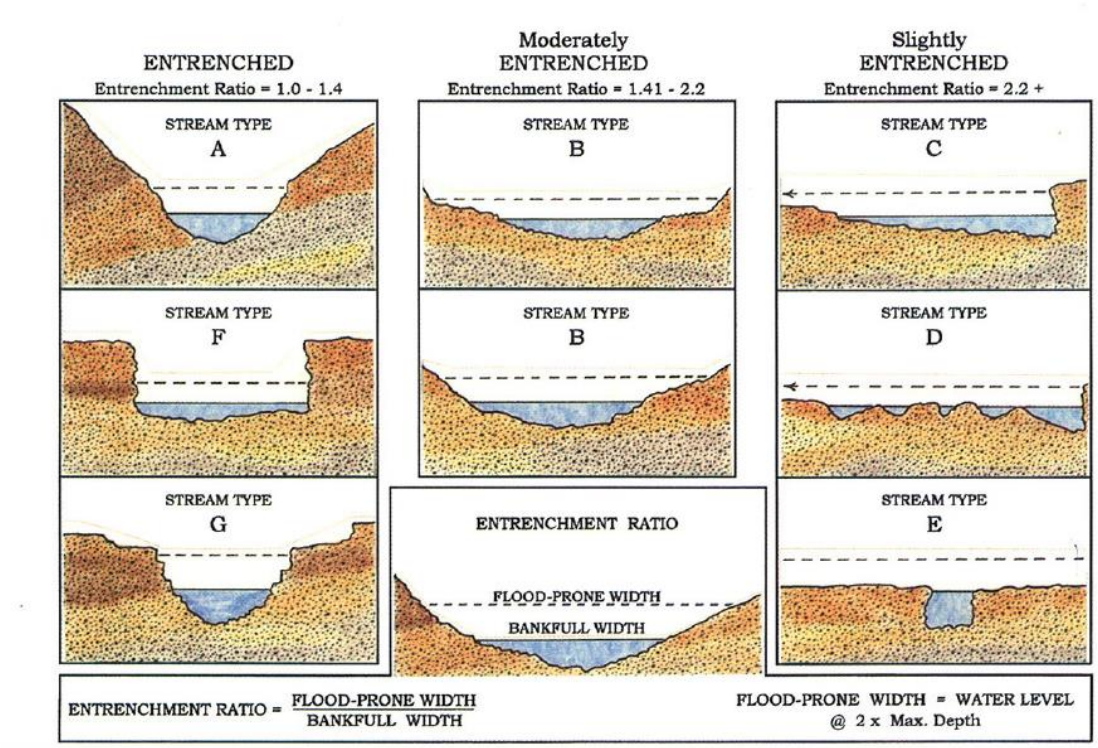


Figure 24: Three Types of Primary Headwater Streams in Ohio (OEPA. 2009.)

THE THREE TYPES OF PRIMARY HEADWATER STREAMS IN OHIO:

1. Class III-PHWH Stream (cool-cold water adapted native fauna)
2. Class II-PHWH Stream (warm water adapted native fauna)
3. Class I- PHWH Stream (ephemeral stream, normally dry channel)

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.

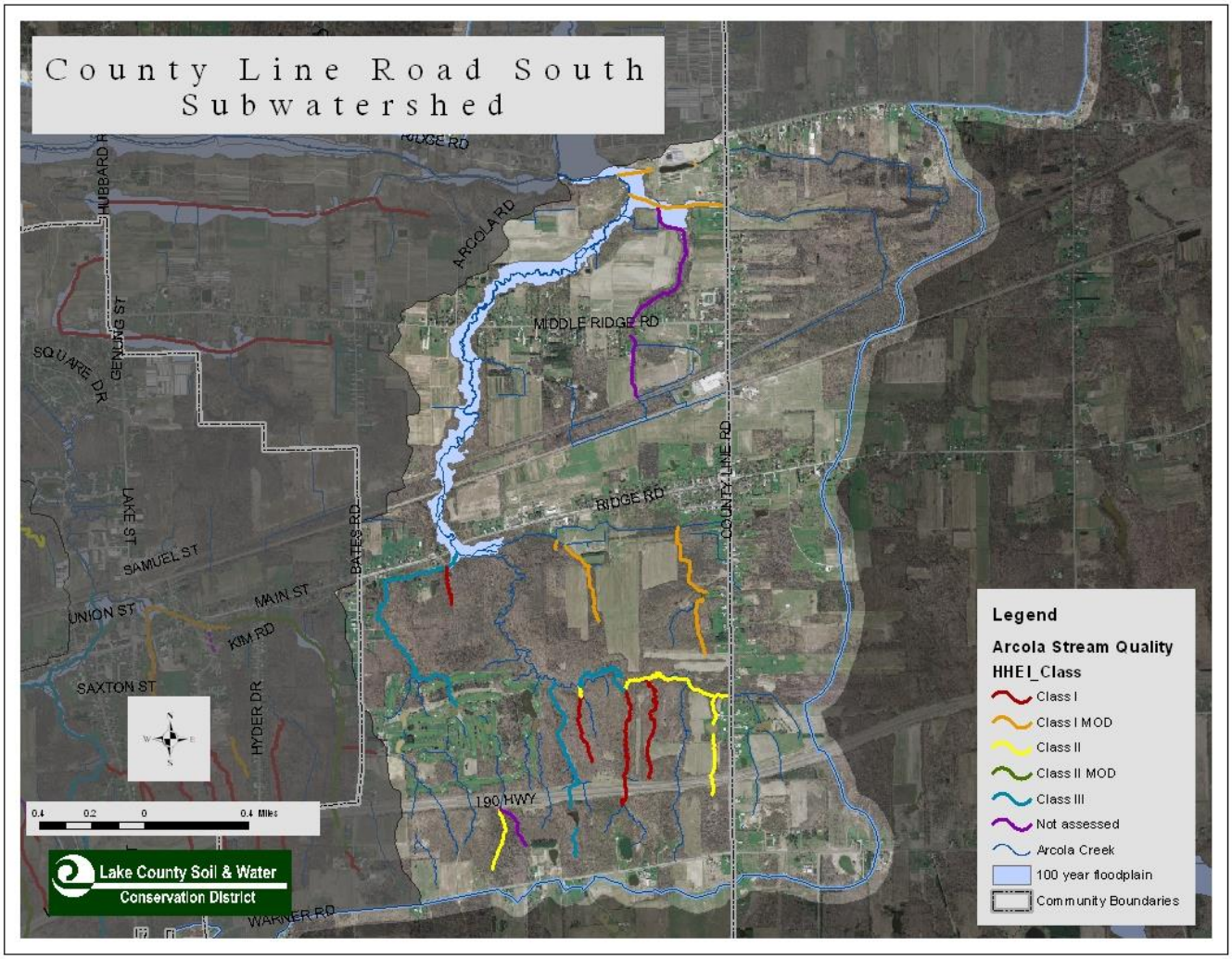
Class I-PHWH streams are ephemeral, with water present for short periods of time, from snow melt or rainwater runoff. Since they are normally dry, there is little or no aquatic life present.

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.)

Figure 25: County Line Road South Subwatershed



County Line Road South

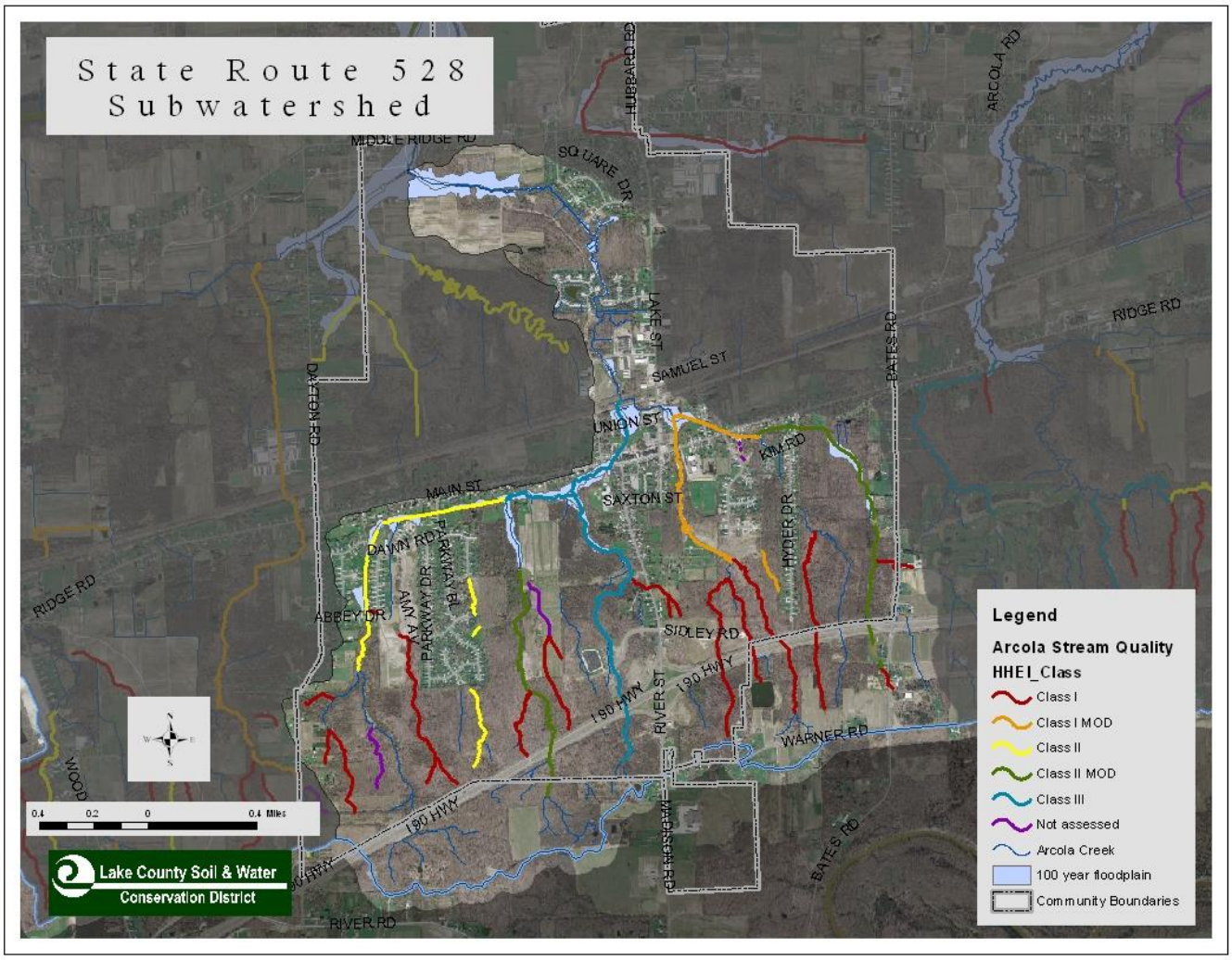
The County Line Road South subwatershed is 5.30 square miles in extent. Impervious cover is 2.12% of the drainage area. The mean annual flow is 24.4 cubic feet per second (cfs). There is an elevation change of two hundred feet. Most of the watershed is undeveloped, with large areas of wooded land and nursery production. A 100-year floodplain is present along the mainstem of this tributary, starting at South Ridge Road and going north to Route 20.

Streams in this subwatershed have some of the best headwater quality in the watershed because of increased gradient, influx of cold groundwater and larger substrate from the glacial till. Of the headwater streams evaluated, four are Class III perennial streams, eight are Class II, four Class II Modified, seven Class I and two are Class I Modified. See Figure 24 for classification key and Fig. 25 for map.

Stream morphology data was collected at 18 locations. Eight locations were classified as B channels, five as C channels, for as F channels and one was an E channel. The C and E channels were relatively stable with access to their floodplains; the F channels were entrenched and unstable. (Edgar. 2004.) See Figure 23 for classification key.

Sinuosity and entrenchment indices are missing from this section of the inventory. 10 year low flow data is not available for the Arcola Creek Watershed.

Figure 26: State Route 528 Subwatershed



State Route 528

The State Route 528 subwatershed covers 3.39 square miles. 5.45% has impervious cover. The elevation change is 170 feet. The mean annual flow is 3.61 cfs. This subwatershed is divided by Interstate 90, has commercial operations along State Route 528 and concentrated residential development. "Residential and commercial developments and loss of floodplain function are the biggest threats" to this subwatershed. (Edgar. 2004.) The

Madison Village Waste Water Treatment plant is in this subwatershed and has been identified by the Ohio EPA as contributing increased nutrient loadings to the creek.

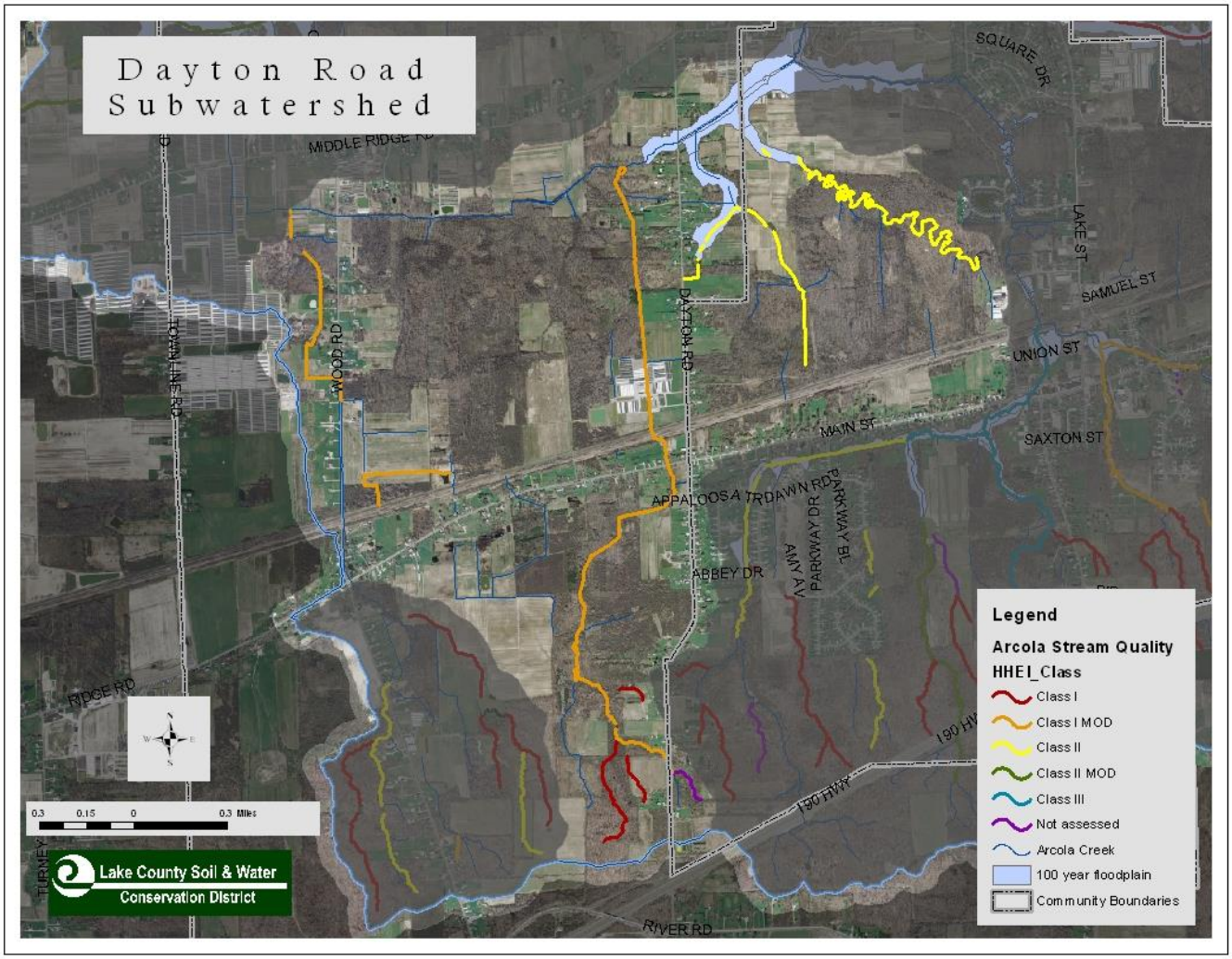
The 100-year floodplain is extensive in the Madison Village center as well as at the northern section of the subwatershed. Thirty-four structures are located in the floodplain. (Edgar. 2004.)

Glacial till overlying bedrock characterizes the southern portion of the subwatershed, which with the influx of cold groundwater and larger substrate create the best habitat in the subwatershed. The beach ridge underlying State Route 84 deflects the flow of the western tributaries to the east and glacial lake deposits dominate the northern portion of the subwatershed. Headwater habitat evaluations were performed on 34 streams in the southern portion of the subwatershed. Two headwater streams were evaluated as Class III perennial streams, eleven were Class II, three Class II Modified, fourteen Class I and four Class I Modified.

Stream morphology data was measured at 21 locations and found nine C channels, seven B channels, two G, Two E channels and one F channel. The C and E channels are relatively stable and have access to their floodplains; the G and F channels are unstable and have lost access to the floodplain. The stability of the B channels depends upon localized conditions; they have limited access to the floodplain.

Sinuosity and entrenchment indices are missing from this section of the inventory. 10 year low flow data is not available for the Arcola Creek Watershed.

Figure 27: Dayton Road Subwatershed



Dayton Road

The Dayton Road subwatershed drains 3.21 square miles. Impervious surfaces cover 1.56% of the subwatershed. The elevation changes 152 feet. The mean annual flow is 4.4 cfs. The land use is largely undeveloped. Residential land uses line the roadways, with mixed agricultural use and forest cover predominating.

100-year floodplains are found in the northern section of the subwatershed and encompass mostly nursery production lands. Five structures are located in the floodplain along Dayton Road. (Edgar. 2004.)

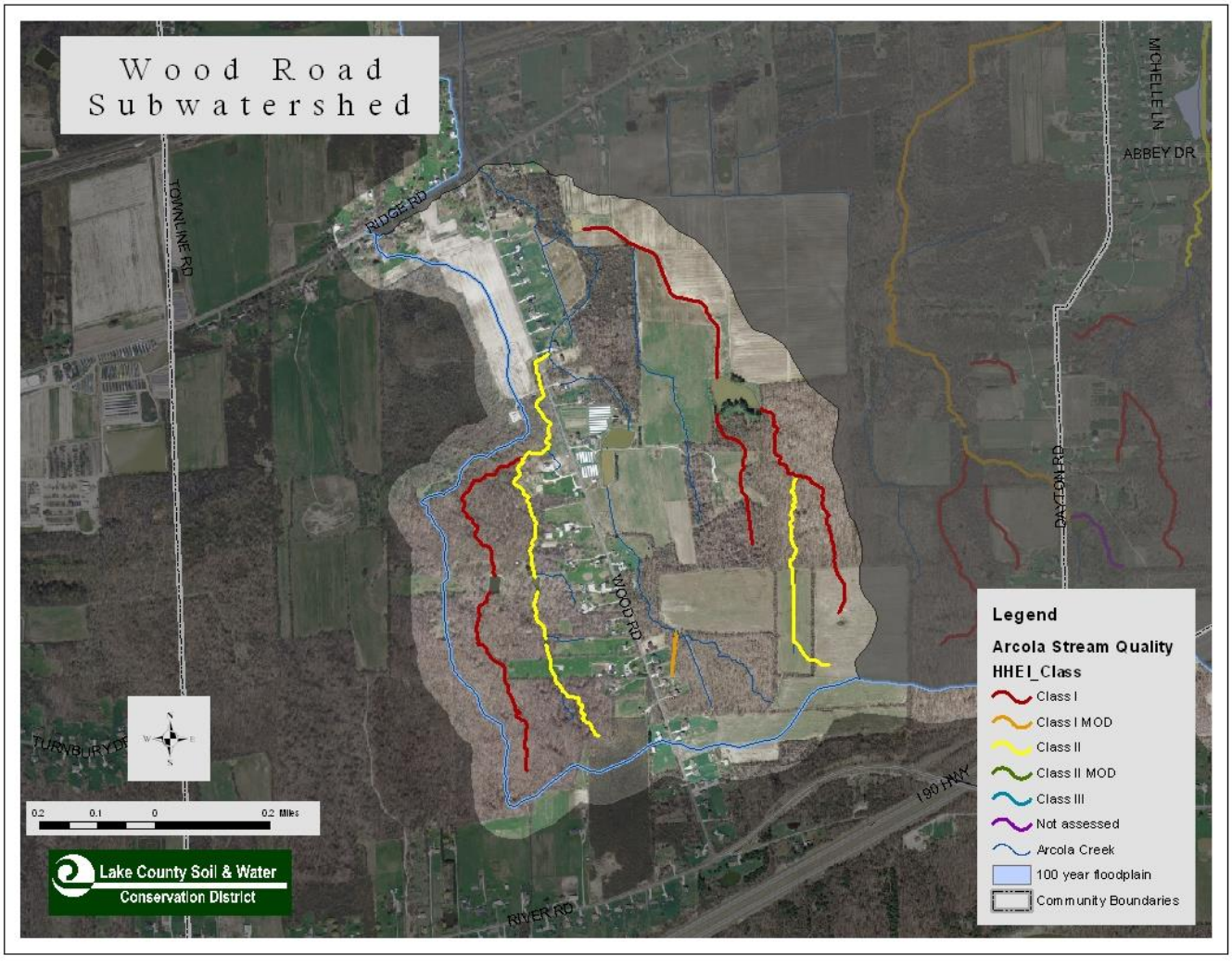
The stream morphology is similar to the previous three subwatersheds described, with headwaters of the subwatershed in glacial till over shale bedrock, a beach ridge separating the subwatershed and glacial lake deposits in the northern portion. HHEIs were performed on three streams in the subwatershed. "None of the headwater streams are perennial and

they provide very little habitat for aquatic macroinvertebrates and salamanders." (Edgar. 2004.) Two sampled habitats were Class II Modified and the other was a Class II.

Stream morphology was measured at three locations as well; two on Arcola Creek and one headwater stream. The Arcola Creek channel had one C channel and one E channel; the headwater stream was an F channel. Sections of the channels in this subwatershed have been human-altered, as evidenced by the straight and right angles of the channels.

Sinuosity and entrenchment indices are missing from this section of the inventory. 10 year low flow data is not available for the Arcola Creek Watershed.

Figure 28: Wood Road Subwatershed



Wood Road

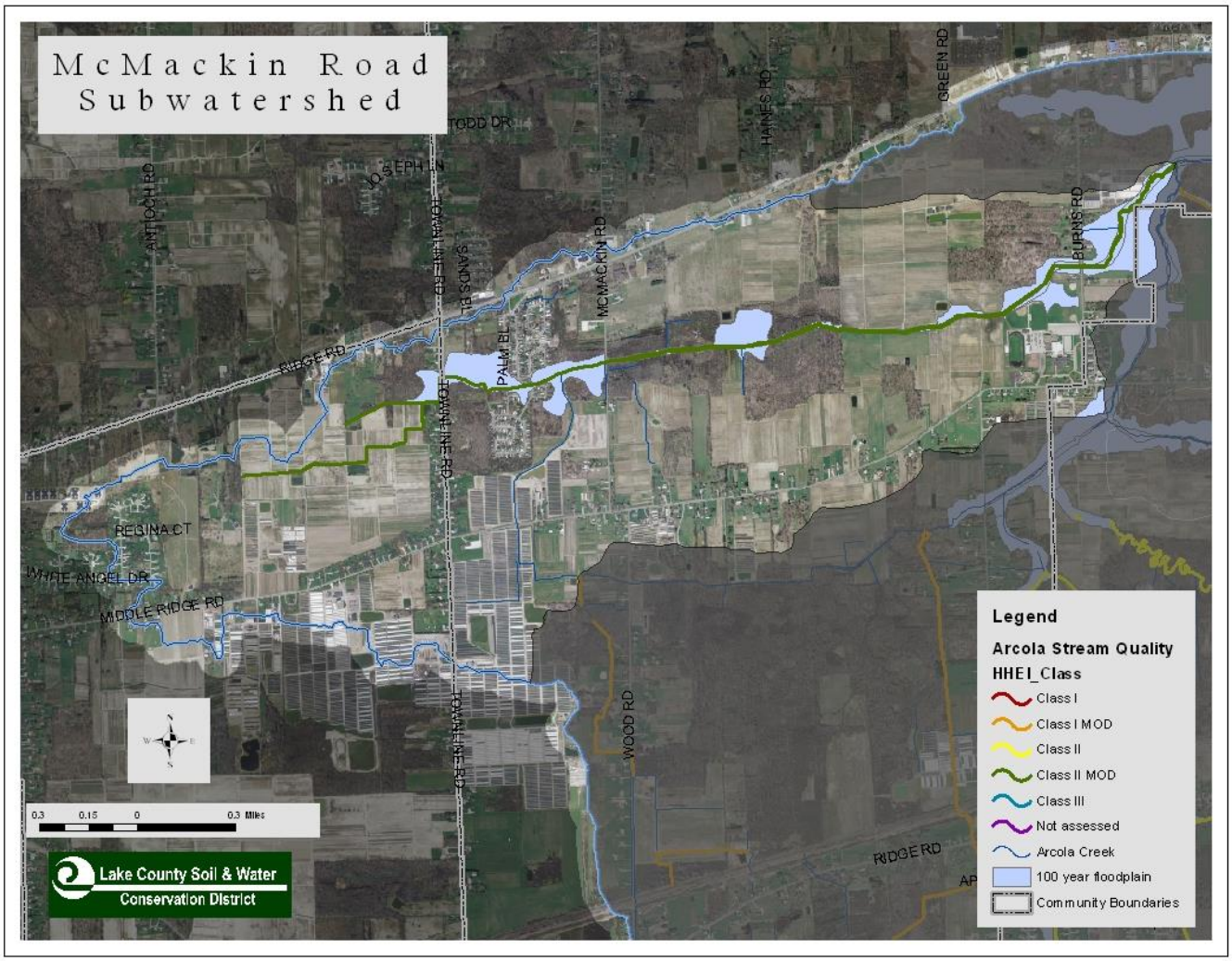
The Wood Road subwatershed is the smallest of the watershed, at 0.58 square miles of drainage. The impervious cover is 1.31%. The mean annual flow is 5.94 cfs. The elevation changes 126 feet. The land use is mostly undeveloped, with single family homes along the road frontages. There is a large amount of forested land and open spaces with warm season grass habitat, with small areas of wet meadow, shallow marsh and scrub/shrub wetlands.

There are no 100-year floodplains, but there is a history of landowner complaints of stormwater flooding. The main channel of Arcola Creek has been highly modified in this subwatershed and is a 6-foot deep by 4-foot wide ditch along the east side of Wood Road. The southern two-thirds is the upland glacial till over shale bedrock, with a beach ridge separating the glacial lake deposits in the north. Headwater habitat evaluations were done on 14 headwater streams. None of them are perennial; five are Class II, three Class II Modified, three Class I and three Class I Modified.

Stream morphology was measured at nine locations and identified four C channels, two E, Two B and one G channel.

Sinuosity and entrenchment indices are missing from this section of the inventory. 10 year low flow data is not available for the Arcola Creek

Figure 29: McMackin Road Subwatershed



McMackin Road

The McMackin Road subwatershed has a 2.60 square mile drainage area. The impervious cover is measured at 6.40%. There is a 28 foot elevation change. The land use is mixed commercial, agricultural and residential, with large areas of nursery production fields growing container stock. Two notable developed areas are the Sahara Mobile Home Park, a large complex off of Route 20 near Townline Road and the Madison High School complex on Burns and Middle Ridge Roads.

There are pockets of floodplains along the mainstem. 47 structures are located in the floodplain, all of which are house trailers in the Sahara Mobile Home Park. Many of the nursery operations have irrigation ponds, which capture much of the rainfall, and the rainwater permeates rapidly into the sandy soils.

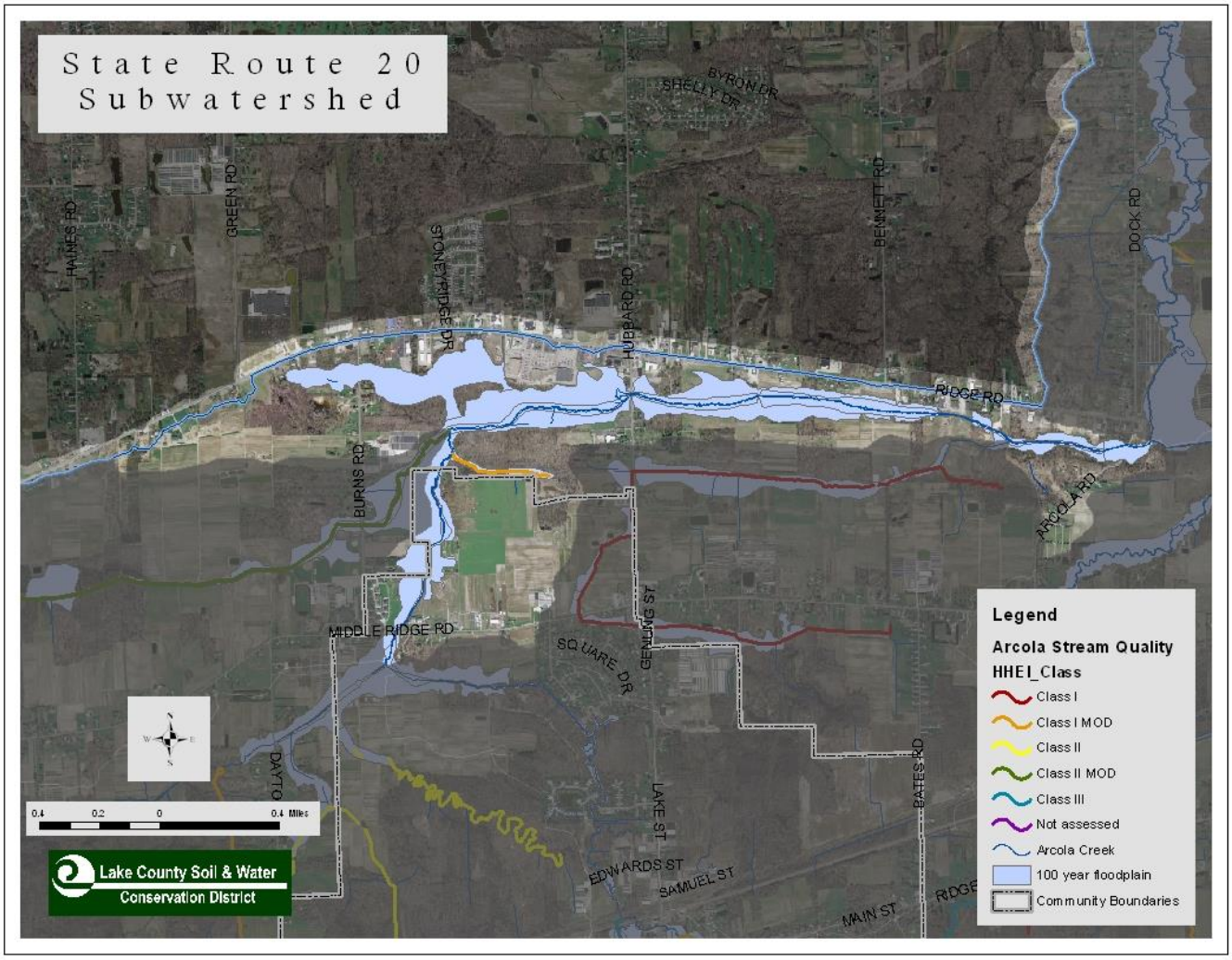
This subwatershed is characterized by glacial lake deposits and beach ridges. The primary headwater habitats are severely degraded through channel modifications and impervious

cover and may be impacted by fertilizers and pesticides in runoff from nursery irrigation. The OEPA found the pesticide dieldrin in samples taken from this subwatershed "at concentrations chronically toxic to aquatic life". The main creek channel is called McMackin Ditch, and is highly modified; no habitat features are discernable. Of the three headwater habitats evaluated, one was Class II and two were Class II Modified.

Stream morphology was measured at three locations; there was one F, one G, and one B channel. All had limited floodplain access and were relatively unstable.

Stream data missing from this subwatershed includes flow rates in cubic feet per second, sinuosity and entrenchment indices. 10 year low flow data is not available for the Arcola Creek Watershed.

Figure 30: U.S. Route 20 Subwatershed



U.S. Route 20

The U.S. Route 20 subwatershed has 13.10 square miles of drainage area. It has the largest amount of impervious area in the watershed, at 7.55%. The mean annual flow is 1.95 cfs. There is an elevation change of about 40 feet. 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.

This subwatershed is likely to become the most developed in the watershed, with U.S. Route 20 serving as the commercial center for Madison and eastern Lake County. The large amount of land use in nursery production has raised concerns with water withdrawals and potential pesticide contamination affecting the water quantity and water quality in this section of the watershed.

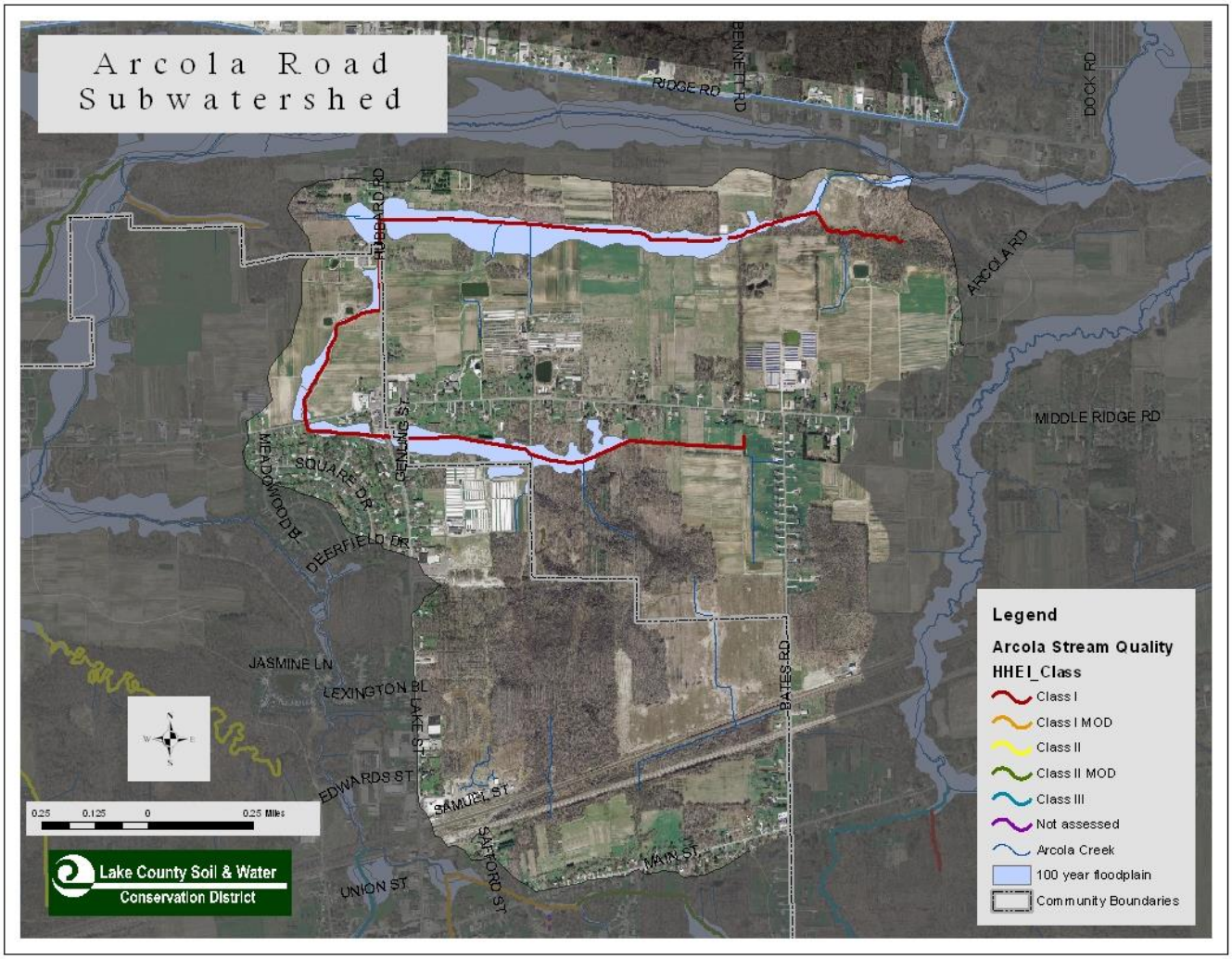
There are extensive areas of 100-year floodplain along the main channel and adjacent to Burns Road. Eleven structures are located either partially or fully in the Federal Emergency Management Agency (FEMA) designated 100-year floodplain.

Being in the northern part of the watershed, this subwatershed is mostly glacial lake deposits with two beach ridges bisecting the area. There were only two habitat evaluations performed in this subwatershed, a Headwater Habitat and a Qualitative Habitat Evaluation (QHEI). The primary headwater habitat is a Class I Modified.

Stream morphology was measured on the Arcola Creek mainstem. It is a G channel with limited access to the floodplain. The channel has been historically modified and dredged spoils have been levied along the channel to increase flood capacity. 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.

Sinuosity and entrenchment indices are missing from this section of the inventory. 10 year low flow data is not available for the Arcola Creek Watershed.

Figure 31: Arcola Road Subwatershed



Arcola Road

The Arcola Road subwatershed has a drainage area of 2.01 square miles. There is an elevation change of approximately 80 feet. The subwatershed is 2.76% impervious. The mean annual flow is 2.15 cfs. There are large areas of undeveloped woodlands and warm season grass habitat. Nursery production fields also comprise a large percent of the land use. Residential dwellings are found along road frontages and as a larger subdivision on State Route 528 and Middle Ridge Road. Commercial land uses are present along 528 in Madison Village. The potential for suburban sprawl is high.

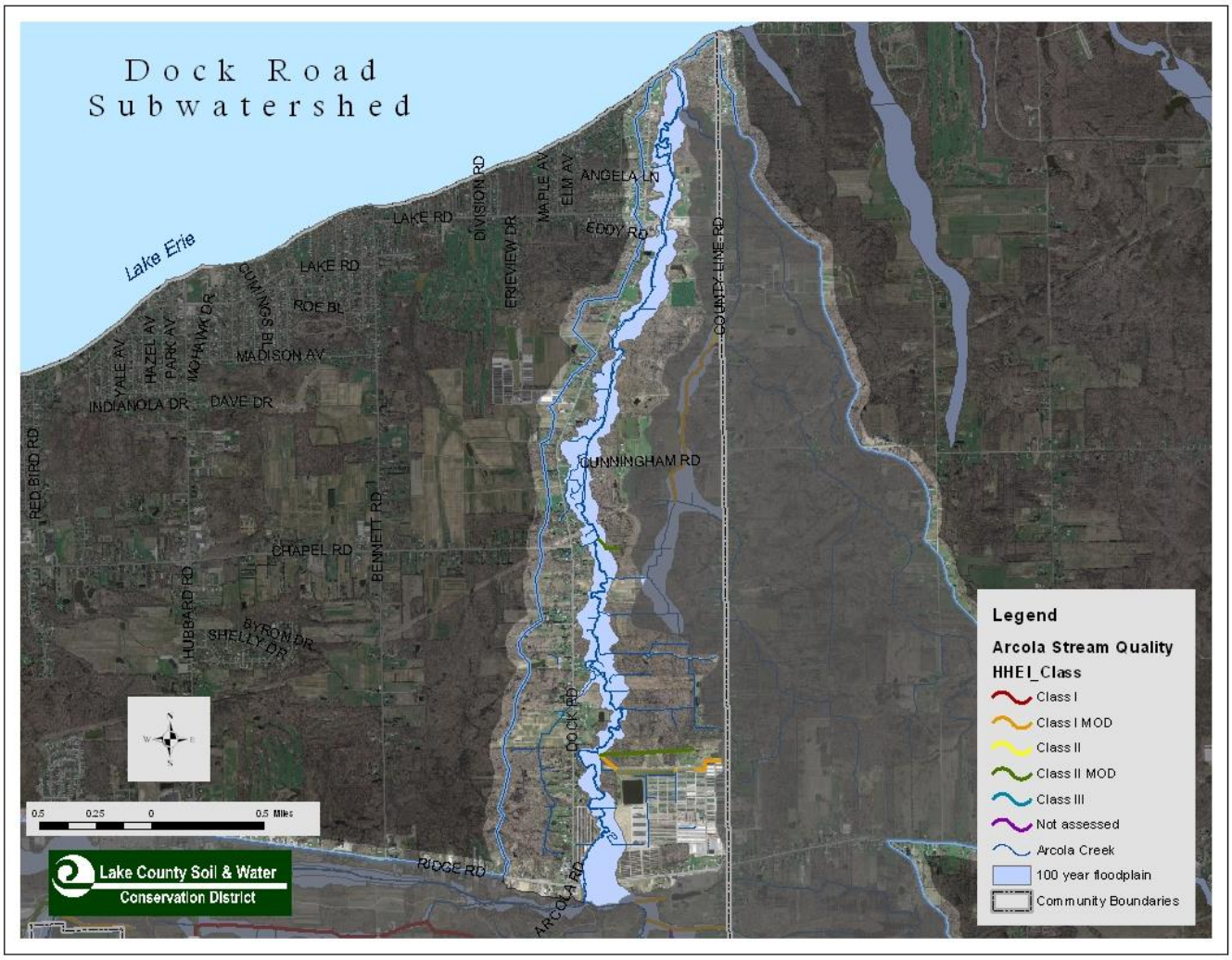
FEMA designated 100-year floodplains are extensive along both east-west stretches of the channel and as it flows north of Middle Ridge Road.

The Arcola Road subwatershed is characterized by glacial lake deposits and three beach ridges. Headwater habitat evaluations were done on two streams; neither was perennial and there was very little habitat for aquatic organisms. Both streams were Class I.

Stream morphology was measured on one location and showed an F channel.

Sinuosity and entrenchment indices are missing from this section of the inventory. 10 year low flow data is not available for the Arcola Creek Watershed.

Figure 32: Dock Road Subwatershed



Dock Road

The Dock Road subwatershed has a drainage area of 1.98 square miles. Impervious cover is 2.72%. The elevation changes 90 feet. Land use is largely residential, with some nursery operations, and commercial operations along State Route 20.

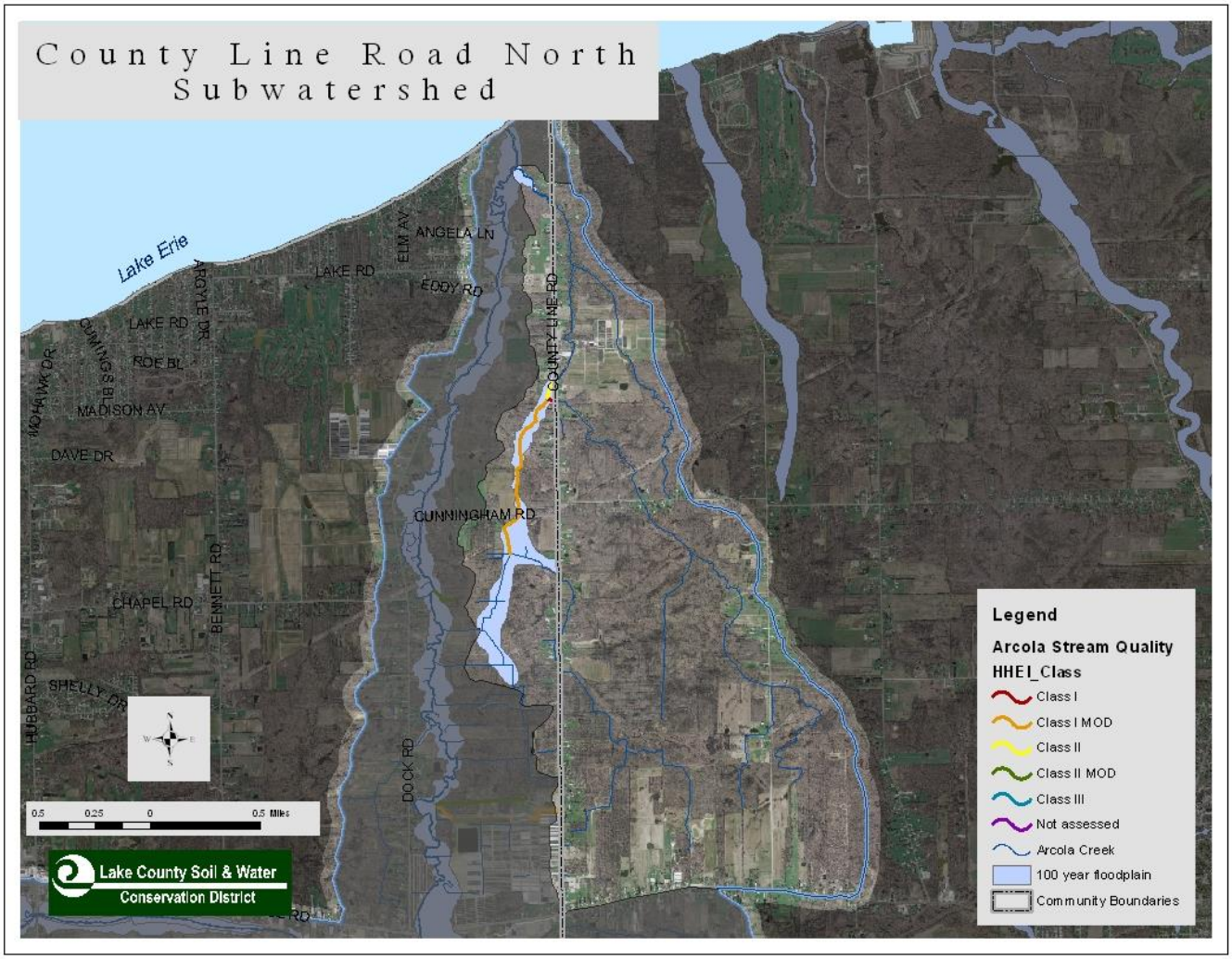
The extent of the subwatershed is in the FEMA 100-year floodplain. The floodplain is largely unaltered and the stream can access its floodplain. Eleven structures are located in the floodplain.

The Dock Road subwatershed is located in the lake plain, with a beach ridge at the southern edge. The creek has eroded through the lake plain materials to the Ashtabula Till, which provides larger cobble size substrate in the stream channel, giving this section of the stream better stream habitat quality. The headwater streams are not perennial, however and provide little aquatic habitat. The five Headwater Habitat Evaluations found one Class I Modified, three Class II Modified and one Class II.

Stream morphology data was collected at three locations, two on the mainstem of Arcola Creek. The mainstem channels were measured as C and F channels, with the C being stable and the F unstable and in the process of down-cutting and widening. The smaller tributary was measured as an E channel.

Stream data missing from this section of the inventory includes flow rates in cubic feet per second, sinuosity and entrenchment indices. 10 year low flow data is not available for the Arcola Creek Watershed.

Figure 33: County Line Road North Subwatershed



County Line Road North

The County Line Road North subwatershed has a 3.28 square mile drainage area. Impervious cover is 1.10%. The elevation change is 94 feet. The mean annual flow is 3.29 cfs. Most of the land use is wooded with residential land use along the road frontage. A wastewater treatment plant is located at Vrooman and County Line Road. Land use is not likely to change to a great degree in this subwatershed.
A floodplain runs parallel to the main channel along Dock Road; five structures are built in the floodplain.

The subwatershed is dominated by glacial lake deposits, with small unconnected areas of beach sands and a beach ridge on the southern edge. Headwater Habitat Evaluations were performed on four streams; none were perennial and habitat was poor. One stream was Class II Modified, two were Class I Modified, and one was Class I.

No stream morphology data was collected in this subwatershed.

Sinuosity and entrenchment indices are missing from this section of the inventory. 10 year low flow data is not available for the Arcola Creek Watershed.

2. Tributary Use Designation

Arcola Creek is on the Ohio EPA Section 303(d) List of Prioritized Impaired Waters. The overall status of the watershed is Impaired. The Aquatic Life Use Assessment is listed as Impaired, with a TMDL (Total Maximum Daily Load) needed. The USEPA 2010 Waterbody Report for Arcola Creek presented more detailed information, stating that 54% of the stream miles were found to be fully attaining applicable aquatic life uses and 46% had partial or non-attaining uses. Causes of impairment were listed as cause unknown, direct habitat alterations, flow alteration, nutrients and organic enrichment/dissolved oxygen. Sources of impairment were stated as channelization-development, flow regulation/modification/development, minor municipal point source and source unknown. Human Health Use and Recreation Use were not assessed; Public Drinking Water Supply Use was not applicable. The next field monitoring for Arcola Creek on the 303(d) list is scheduled for 2014; the Projected TMDL is 2017.

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.

iii. Lakes and Reservoirs

There are no lakes or reservoirs in the Arcola Creek Watershed, although the watershed is dotted with small irrigation ponds used by individual nursery operations.

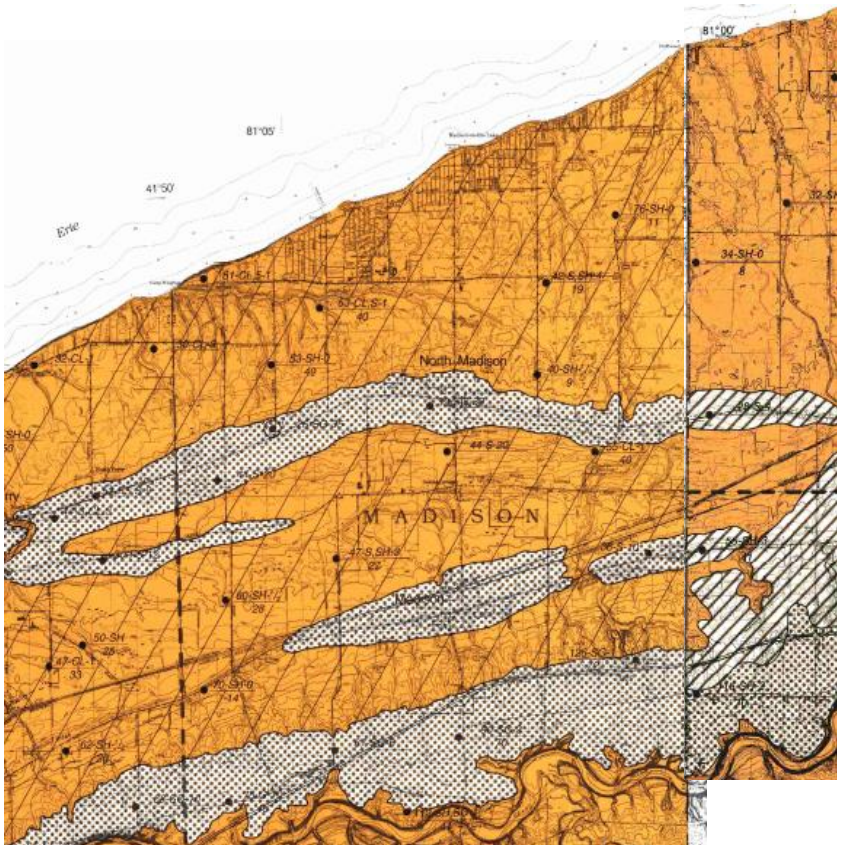
c. Ground Water

i. Aquifers

The groundwater resources of the Arcola Creek Watershed can be divided into two categories: areas in which wells yield less than 3 gallons per minute and areas which yield between 5 and 25 gallons per minute. The areas yielding less than 3 gallons per minute have very shallow layers of permeable silt, fine sand and sand with some gravel overlying thick clay or weathered shale. They are poor for domestic supplies; dug wells and cisterns are common. These areas are shown on the Groundwater Resources map (Figure 34) in orange. The legend differs between Lake and Ashtabula counties, with diagonal lines across the orange in Lake County.

The areas yielding greater than 3 gallons per minute are in found in sand and gravel deposits at depths of up to 200 feet. This area is shown in gray with a dot pattern in Lake County, and gray with a stripe pattern in Ashtabula County. It is evident that the wells in this higher yielding area are found in the three sandy beach ridges straddling the watershed.

Figure 34: Groundwater Resources (ODNR Statewide Aquifer Mapping Project)



The flow regime is non-confined. Wells in the watershed are typically shallow, and are in shale bedrock except in beach ridge locations. The wells in the shale bedrock are drilled through the Ashtabula Till, which is an unconsolidated glacial aquifer. Figure 35, Arcola Creek Aquifers, shows two types of aquifers in the watershed: Beaches and No Significant Recharge Areas.

There are no surface water-based public systems in the watershed. There are two private small ground water systems for Stewart Lodge on South Ridge Road and Madison Congregation of Jehovah's Witnesses on Middle Ridge and Arcola Roads. (Ohio EPA Division of Drinking and Ground Waters. 2012.)

Figure 35: Arcola Creek Aquifers (OCAP)

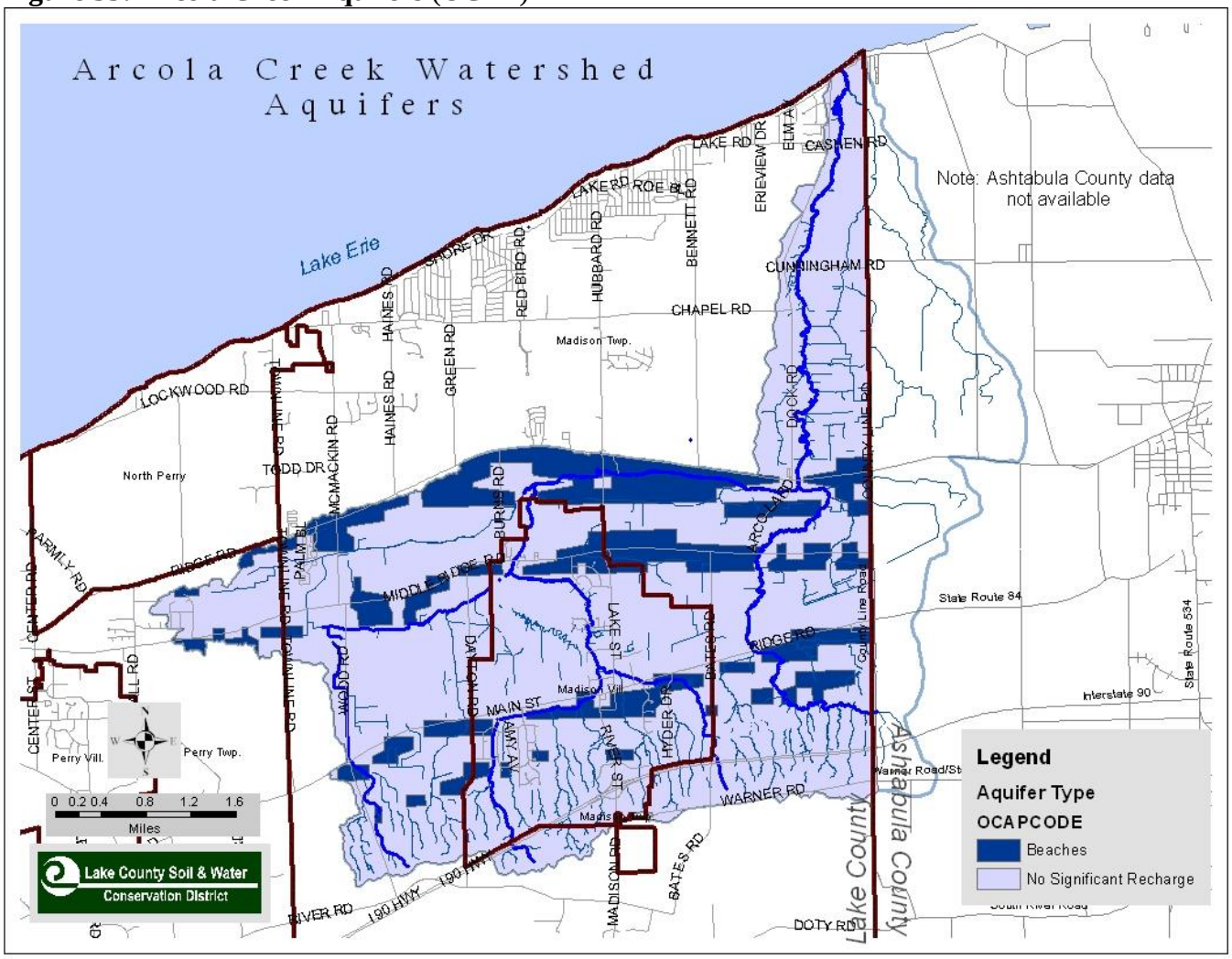
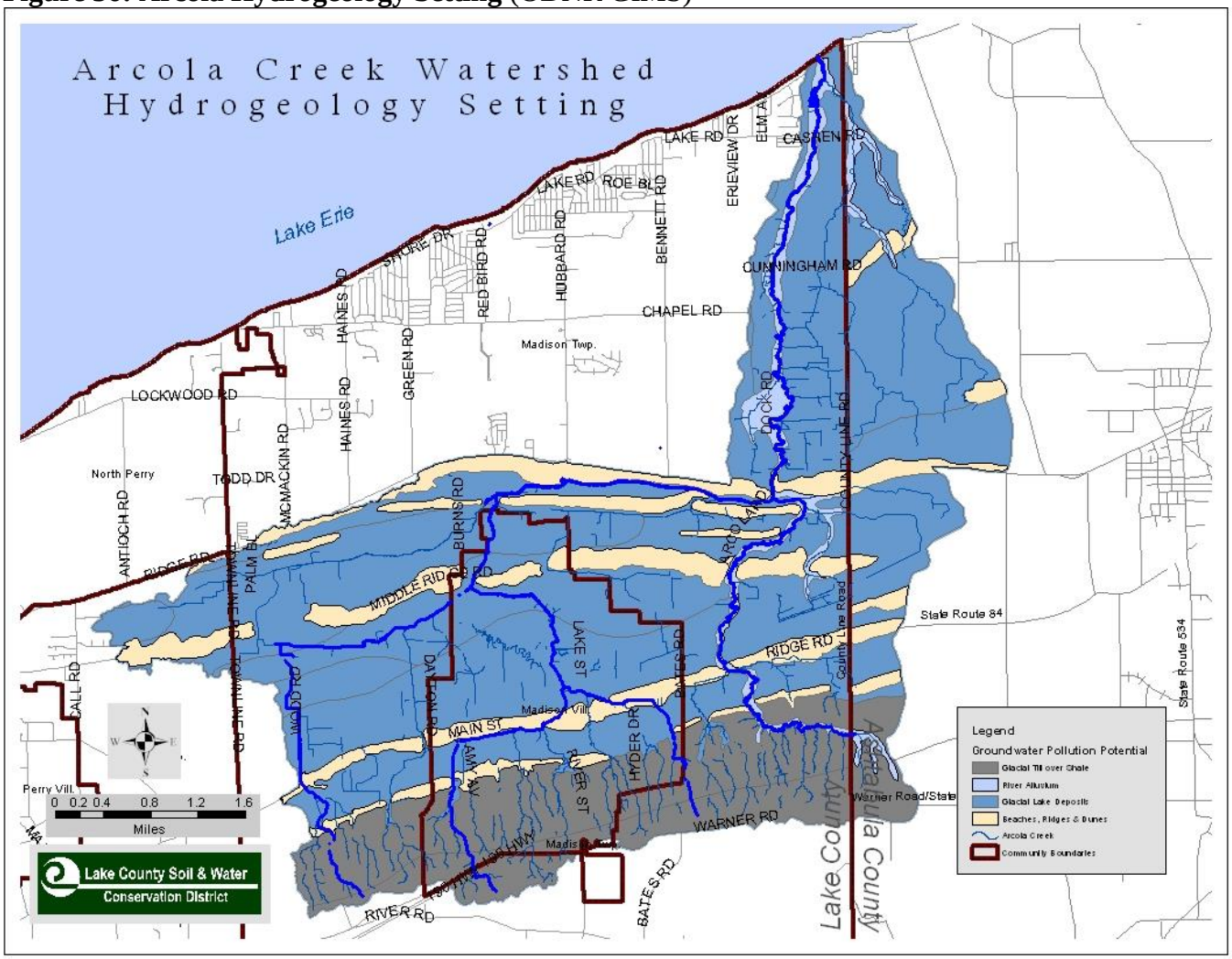


Figure 36, Arcola Hydrogeology Setting, shows four categories: Glacial Till over Shale, River Alluvium, Glacial Lake Deposits and Beaches, Beach Ridges and Sand Dunes.

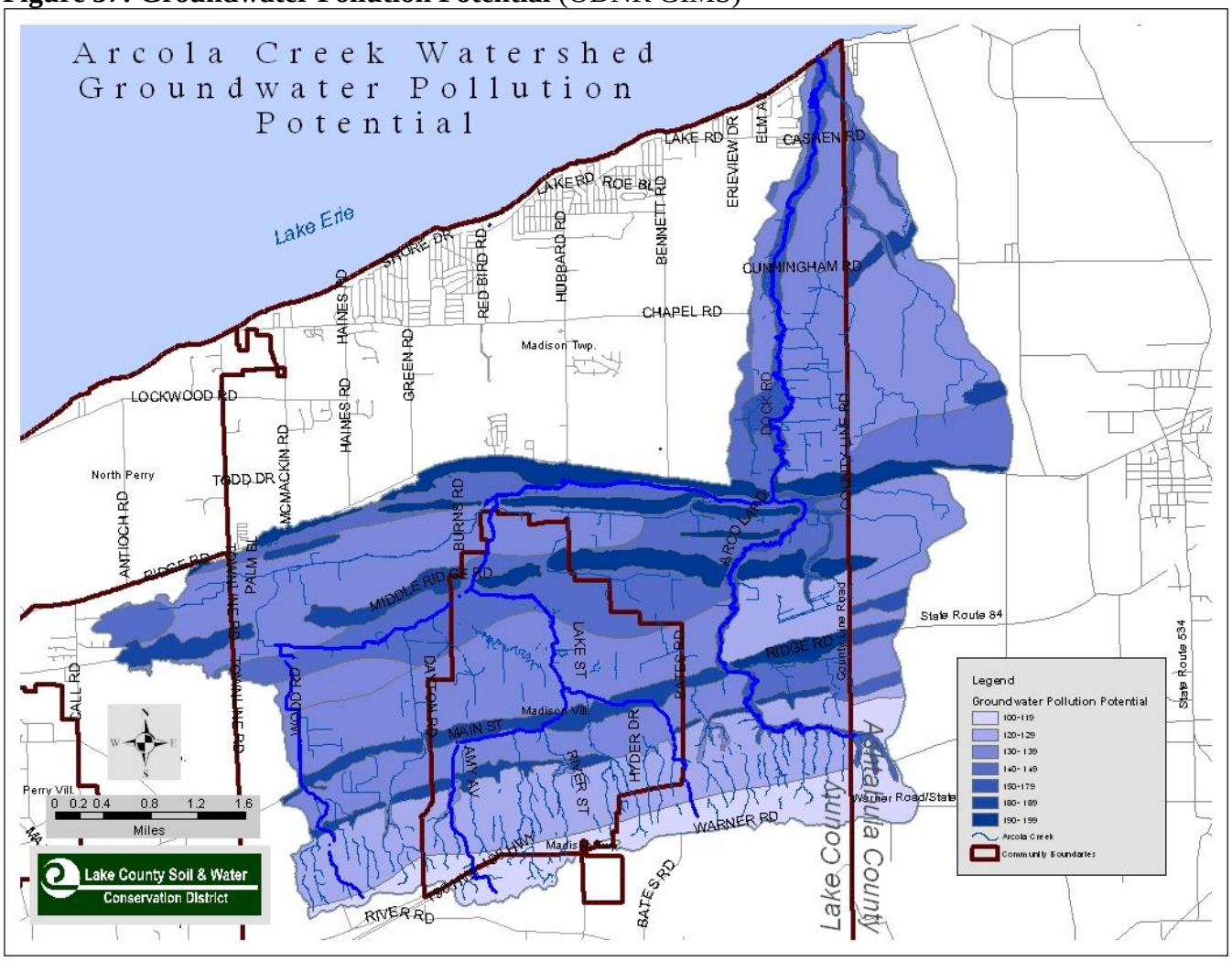
These underlying glacial materials set the stage for all of the other water and soil resource characteristics of the Arcola Creek Watershed.

Figure 36: Arcola Hydrogeology Setting (ODNR GIMS)



The Ohio Department of Natural Resources Geographic Information Management Systems (GIMS) DRASTIC database contains information about the groundwater pollution potential for each county in Ohio. DRASTIC is an acronym for Depth to water, Recharge, Aquifer media, Soil media, Topography, Impact of vadose zone (located above the water table), and Conductivity. All these factors are combined to assess the sensitivity of groundwater to local sources of contamination. In Figure 37, Groundwater Pollution Potential, the higher the DRASTIC index, or the darkest colors- are the areas with the greatest vulnerability or the highest likelihood of contamination, which are logically the sandy beach ridges.

Figure 37: Groundwater Pollution Potential (ODNR GIMS)



4. Land Use

a. Land Cover Description

Land use and cover data for the watershed has been obtained from the Lake and Ashtabula County Auditors' Geographic Information System (GIS) parcel layer which contains the Auditor's Land Use Codes, and the USEPA National Land Cover Database (NLCD). Each set has its strengths and limitations; the two classification systems are not comparable or interchangeable, but a picture of the watershed emerges. The land use codes classify an entire parcel in one category, which provides a generalized description of the land uses, while the NLCD provides generalized land cover information based on 2006 orthophotos. The land use codes classify a land use as agricultural, industrial, commercial, residential or exempt (governmental, school, church, etc.); the NLCD classifies land cover as level of development intensity (low, medium and high), type of agricultural use (cultivated, pasture), and type of vegetation (grassland, shrub, deciduous or evergreen forest, or woody wetlands).

Figure 38: Land Use by County GIS Land Use Codes

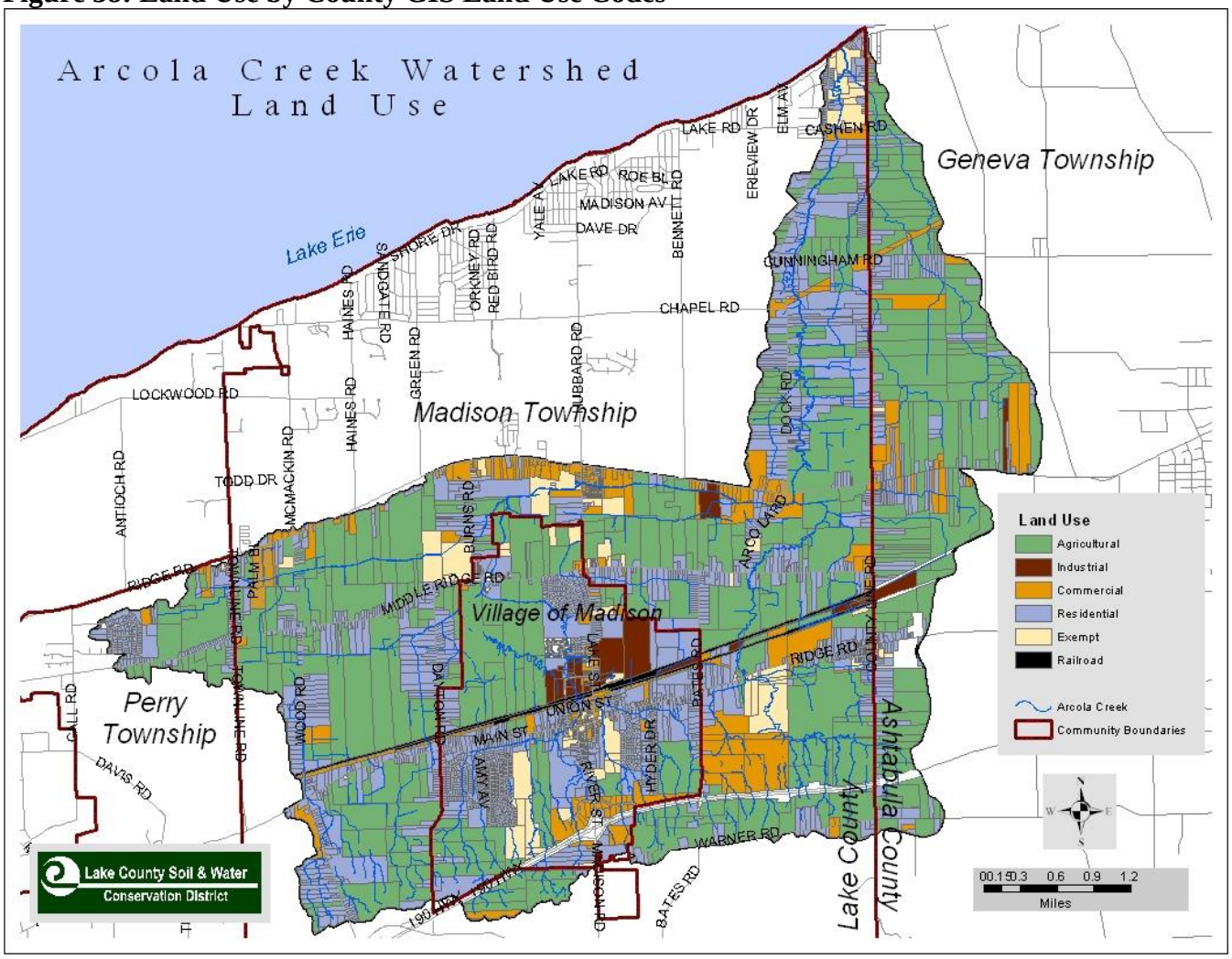


Figure 39: Percent of Land Use by Land Use Code

Land Use	Percent of Watershed
Agricultural	48.61
Residential	32.30
Commercial	12.85
Exempt	4.63
Industrial	1.61

i. Agriculture

The largest land use in the watershed by land use code 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.

There is little livestock in the watershed; the presence of livestock is noted in the applicable subwatershed in the subwatershed descriptions that follow.

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. Randy Zondag, Lake County Extension Director, Ohio State University Extension estimates that at the worst of times, the nursery industry countywide would need ten million gallons to maintain supply during a twenty day period of drought. In normal times, greenhouse production uses large volumes of water. A one-acre greenhouse may use 22,000 gallons of water a day for irrigation and 4.5 million gallons per year. (Lake SWCD. 2010.)

Nurseries use two types of irrigation practices: overhead and micro-irrigation. Overhead irrigation includes sprinklers and spinners, which broadcast water over the container or field-grown crops. Micro-irrigation uses drip and spray stakes in pots, which reduces the amount of water needed by getting it directly to the plant.

Chemical use patterns for nursery crops include chemical and fertilizer applications as well as chemigation and fertigation, which are soluble applications through irrigation water. Chemicals used include pesticides, fungicides and plant growth regulators. Directed applications of chemicals is the method most used because chemigation is very expensive. Slow release fertilizers (SRF) are used more often than traditional agricultural/garden fertilizers because they are more cost effective. The SRF release nutrients over time through osmosis; they are used in propagation houses, containers and fields. Traditional fertilizers are incorporated in the soil/media mix, top dressed to containers, or banded in the field. Broadcast of fertilizers is rarely used as a distribution method. Nursery cost-benefit considerations lead to a reduction of materials applied. With specialized nutrient mixes and rising oil prices (which affect fertilizer costs), nurseries cannot afford to be applying more fertilizers and chemicals than their plants require. Nurseries test their soil, media mixes and water on a regular basis.

High water quality is essential for the production of nursery and greenhouse crops. Impurities in irrigation water can lead to excessively high salts, pH extremes, nutritional problems, reduced plant growth, fouling of irrigation devices and algae growth. (Lake SWCD. 2010. Citing Bilderback, et al., 2006.) Lake County Soil & Water Conservation District sampled 10 locations on nursery operations in Perry and Madison Townships in 2010 to conduct baseline water sampling and analysis as a first step in protecting irrigation

water sources for the nursery industry. Sampling was done at both entry and exit points from sampled nursery properties. 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. (Lake SWCD. 2010.)

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.

A look at an orthophoto taken during winter would show an unusual sight, as many nurseries cover their hoop houses with plastic to protect their stock in cold weather. This practice separates the nursery industry from traditional agriculture by adding to the imperviousness of the watershed on a seasonal basis.

Other agricultural enterprises include fruit and vegetable production as well as several small vineyards.

Nursery nutrients are at the top of the list of issues of concern in the watershed by the non-agricultural population, but whether this is a real or perceived issue will need to be determined as a part of the watershed planning process.

Figure 40: Orthophoto of nursery operation in winter (Lake SWCD files)

Figure 41: Hoop houses in the summer (Lake SWCD files)

ii. Urban

Residential land use is the second largest land use in the watershed, based on land use codes. Residential areas are comprised of older homes that are densely spaced along roads that don't have curbs, where drainage is provided by an aging storm sewer system in sandy soils, and of newer homes that are located in subdivisions or in frontage lots along existing roadways. (Lake County General Plan of Drainage. 2003.) 32.3% of the watershed is in residential land use. Residential and agricultural land uses are interspersed with one another, which contributes to the rural character of the watershed.

Commercial land uses make up 12.85% of the land use in the watershed. The commercial land uses are found mostly along the U.S. 20 corridor and around the State Route 528/Interstate 90 interchange. It is likely that the older businesses do not have stormwater control practices. (Lake County General Plan of Drainage. 2003.) North Ridge Road has curbs and a storm sewer system that discharges into Arcola Creek and Red Mill Creek. The large commercial block to the southeast of Madison Village is a golf course.
The watershed is bisected by two railroad lines, owned by Norfolk Southern Combined Railroad and CSX Transportation Inc. The crossings are at grade throughout the watershed. Interstate 90 also crosses the southern portion of the watershed, which alters the natural flow of the headwater streams and impacts the volume and quality of water draining from the highway road surface.

1. Impervious Surfaces

Most of the subwatersheds have less than 1% imperviousness, with the exception of McMackin, U.S. 20 and S.R. 528, which have 1.01%, 3.49% and 1.43% respectively.

2. Home Sewage Treatment Systems

Figure 42: Sewage Treatment Statistics (Lake County General Health District)

Total No. Household Sewage Treatment Systems (HSTS)**	994
No. of soil absorption HSTS	979
No. of discharging HSTS	15
Total No. of commercial Sewage Treatment Systems (STS)**	75
No. of commercial soil absorption STS	63
No. of commercial discharging STS	12
No. of commercial STS <25,000 gpd	9
No. of commercial STS >25,000 gpd	3

** Please note that total numbers of systems is based on records contained in Lake County General Health District files and does not necessarily represent every sewage system that exists.

The age range for HSTS in the watershed is 5-40 years; the average age is 25 years.
The average number of sewage nuisance complaints since 1987 is 2 per year.
The average flow for HSTS is 360-480 gpd.

Most of Madison Township is on home sewage treatment systems. Most of Madison Village is on sanitary sewers. Madison Township has sanitary mains in the U.S. 20/S.R. 528 area, in the subdivision in the western corner of the watershed, and in the northern section, running along County Line Road, crossing Arcola Creek north of Cashen Road and along Dock Road to the Lake. Madison Village has HSTS in the Squares Acres subdivision in the northeast corner of the Village, across from Squares Acres on the east side of Lake Street and in older homes along a short section of Dayton Road just south of Abbey Drive.

Based upon system type, system age and soil types, the Lake County General Health District estimates a 10% failure rate in the watershed.

Figure 43: Sanitary Treatment

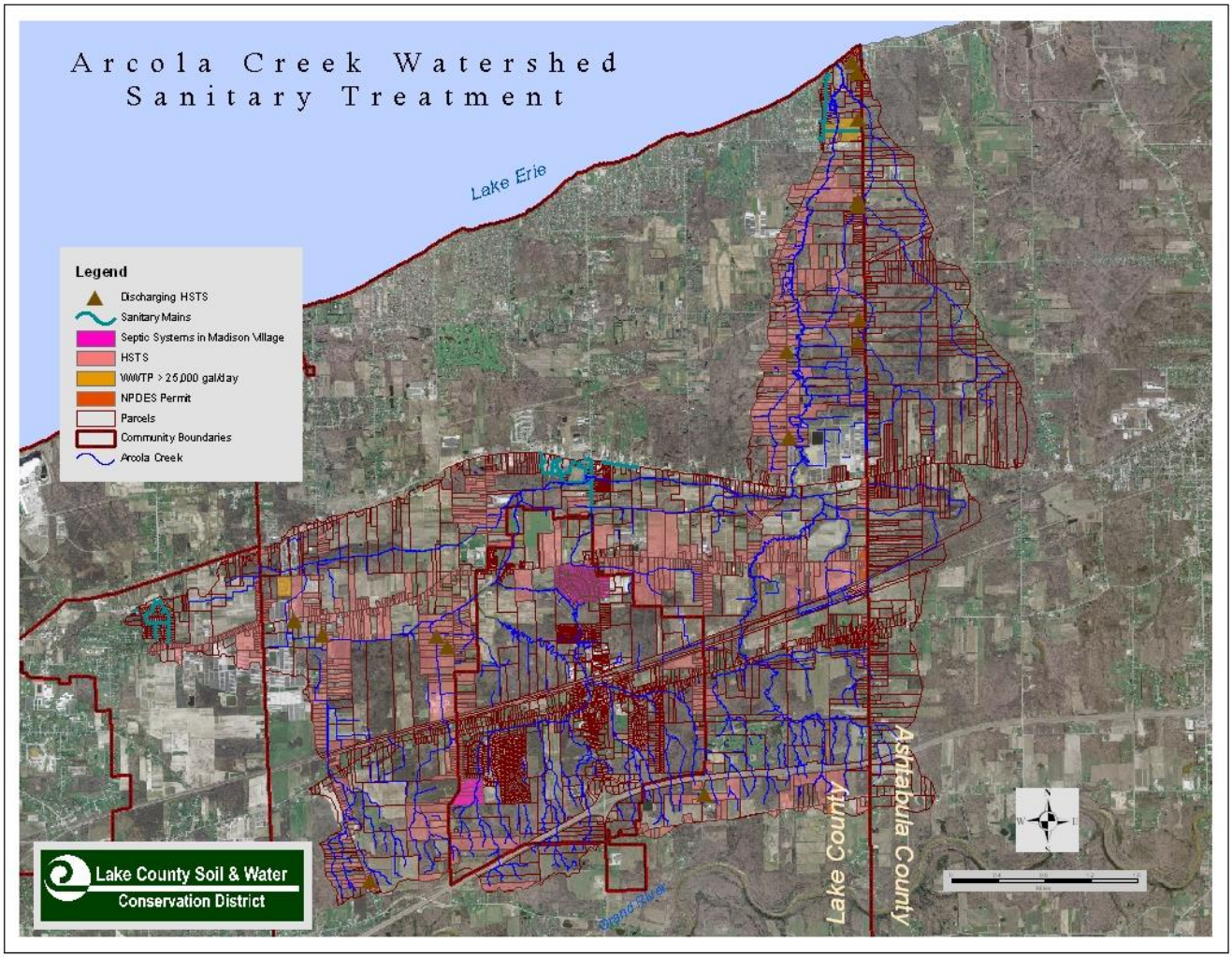


Figure 44: Land Cover by National Land Cover Database (NLCD) Classification

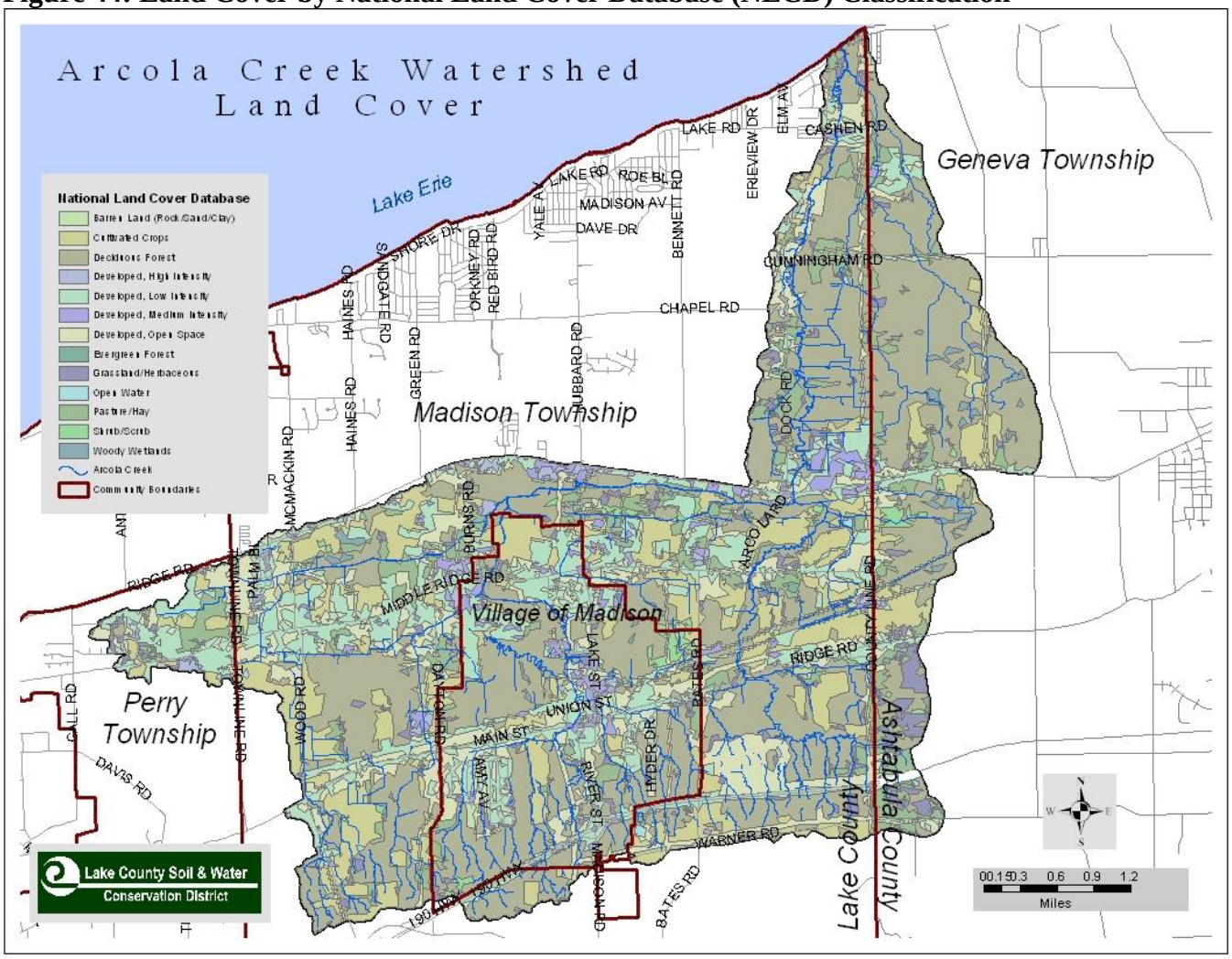


Figure 45: Percent of Land Cover by NLCD Classification

Land Use	Percent of Watershed
Forest	41.58
Urban	32.90
Agriculture	21.46
Natural open space	3.78
Non-forested wetlands	0.15
Water	0.13

iii. Forest

The largest land cover in the watershed, at 41.58% is forest, according to the National Land Cover Database. This includes deciduous forest, evergreen forest and woody wetlands. Urban use is the next largest land cover, at 32.90%, which includes low, medium and high density development as well as "developed" open space. Agriculture is the third largest

land cover at 21.46%, which includes cultivated crops and pasture/hay. Natural open space, which includes grassland/herbaceous and shrub/scrub, is low at 3.78% of the watershed.

iv. Water

A small portion of the watershed is classified as water: 0.13%. The water features are small excavated ponds scattered throughout the watershed and used for nursery irrigation and for homeowner recreation.

v. Non-forested wetlands

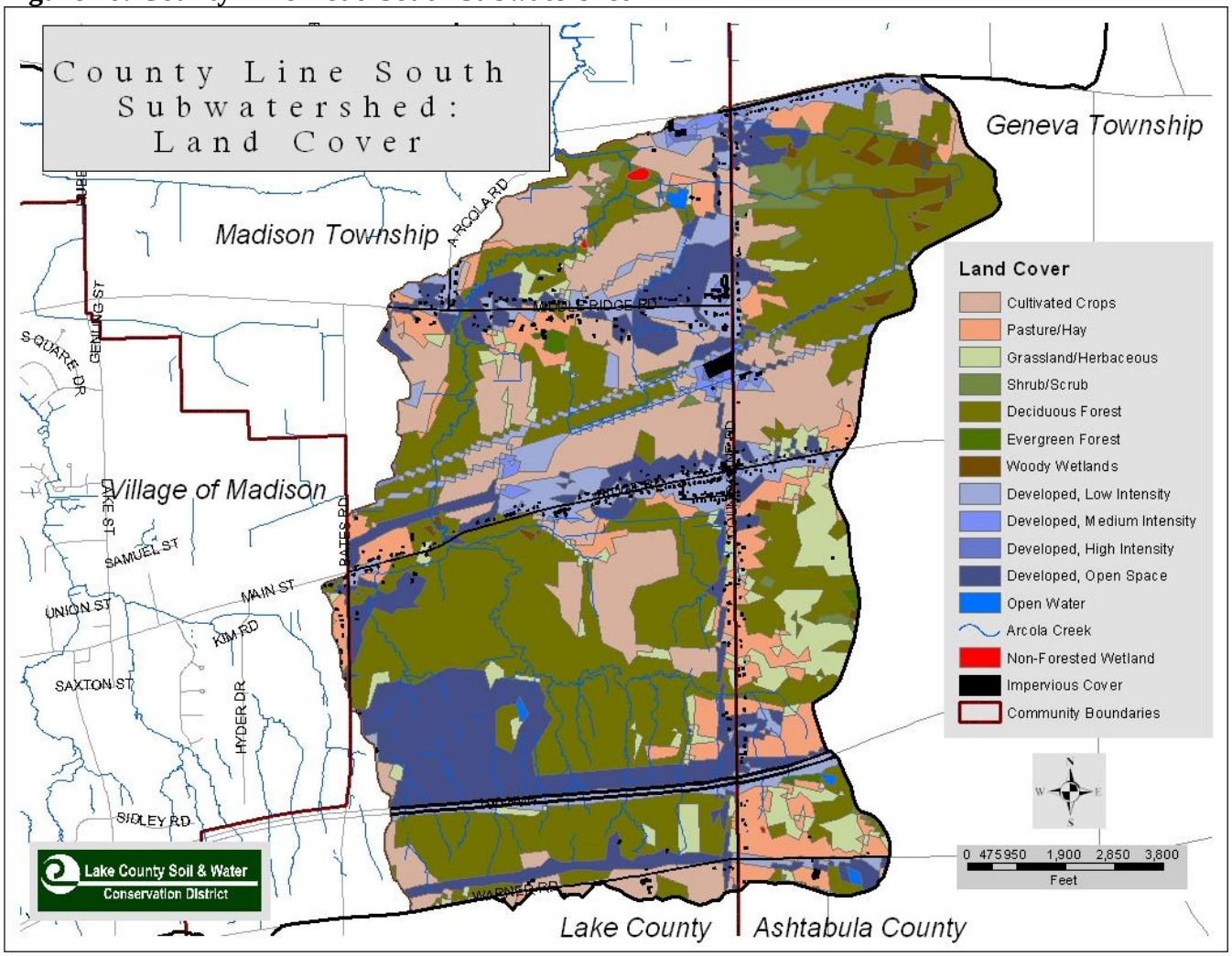
Non-forested wetlands and water comprise a very small portion of the watershed, at 0.15%. The existing non-forested wetlands are located on the following applicable subwatershed maps.

vi. Barren

There is no barren land in the watershed.

vii. Land Cover Descriptions by Subwatershed

Figure 46: County Line Road South Subwatershed

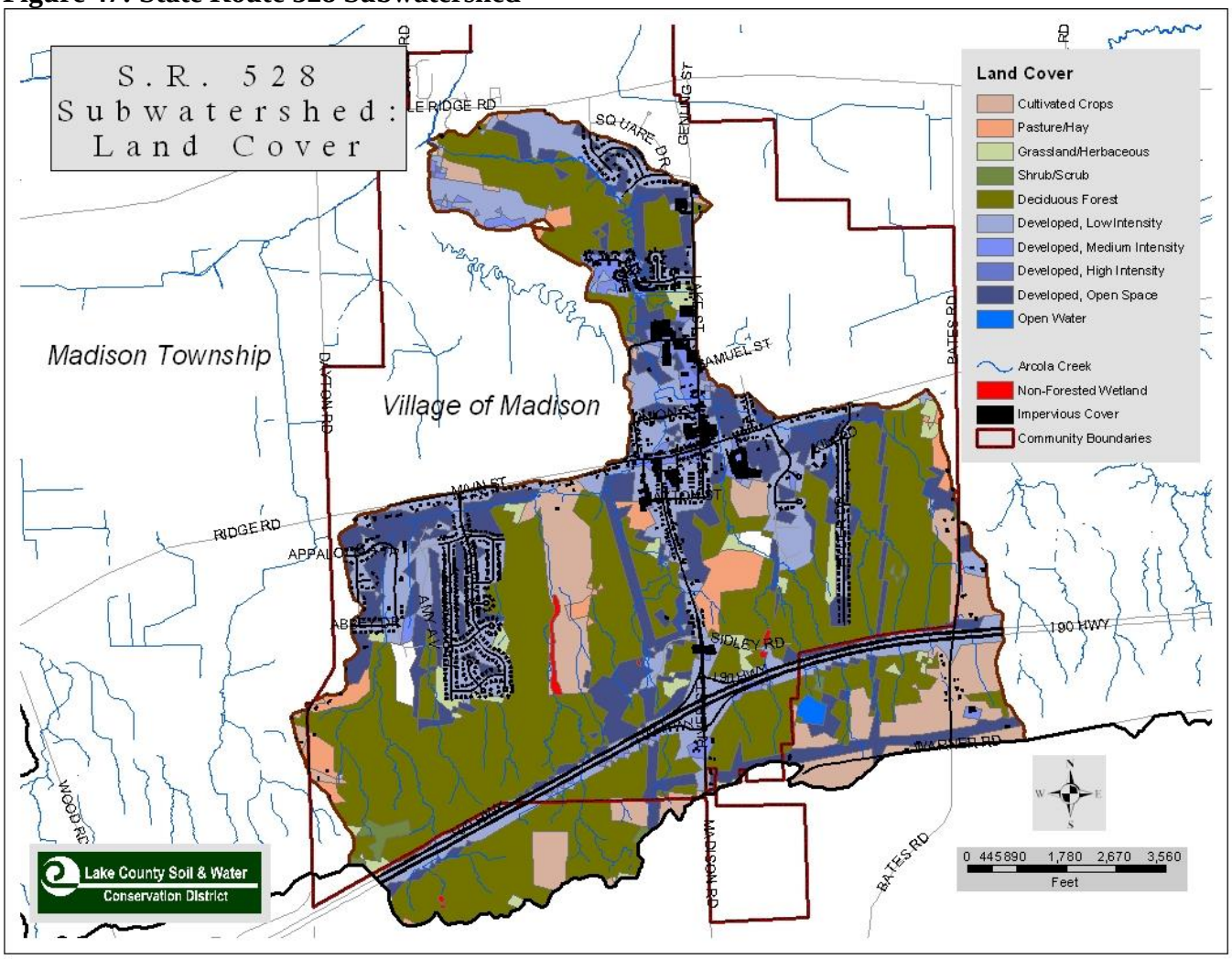


Subwatershed: County Line Road South

Drainage Area: 5.03 square miles
Percentage of Imperviousness: 0.6%
Urban Land: 30.1%
Forested Land: 36.7%
Agricultural Land: 26.4 %
Natural Open Space: 6.5%
Water: 0.2%
Non-Forested Wetlands: 0.1%

Forested land comprises the majority of the land cover. Many of the headwater tributaries flow through forested land. Two active railroads and Interstate 90 cross the subwatershed. Nursery land use is predominantly in the central and northwestern portions of the area. Several vineyards are located in this subwatershed along Warner Road. A golf course is located in the southwest. Residential areas front the roadways. Lake Metroparks owns a 114.2 acre forested plot on the south side of South Ridge Road east of Madison Village, through which Arcola Creek flows. This property is not developed or open to the public; it provides a good example of the conditions of the watershed prior to human intervention. An ODOT salt storage facility is located between the two railroad tracks along County Line Road. Water lines are installed along the length of County Line Road, along South Ridge Road from County Line west to the middle of the watershed and on West and Southern Streets, off of South Ridge and County Line.

Figure 47: State Route 528 Subwatershed



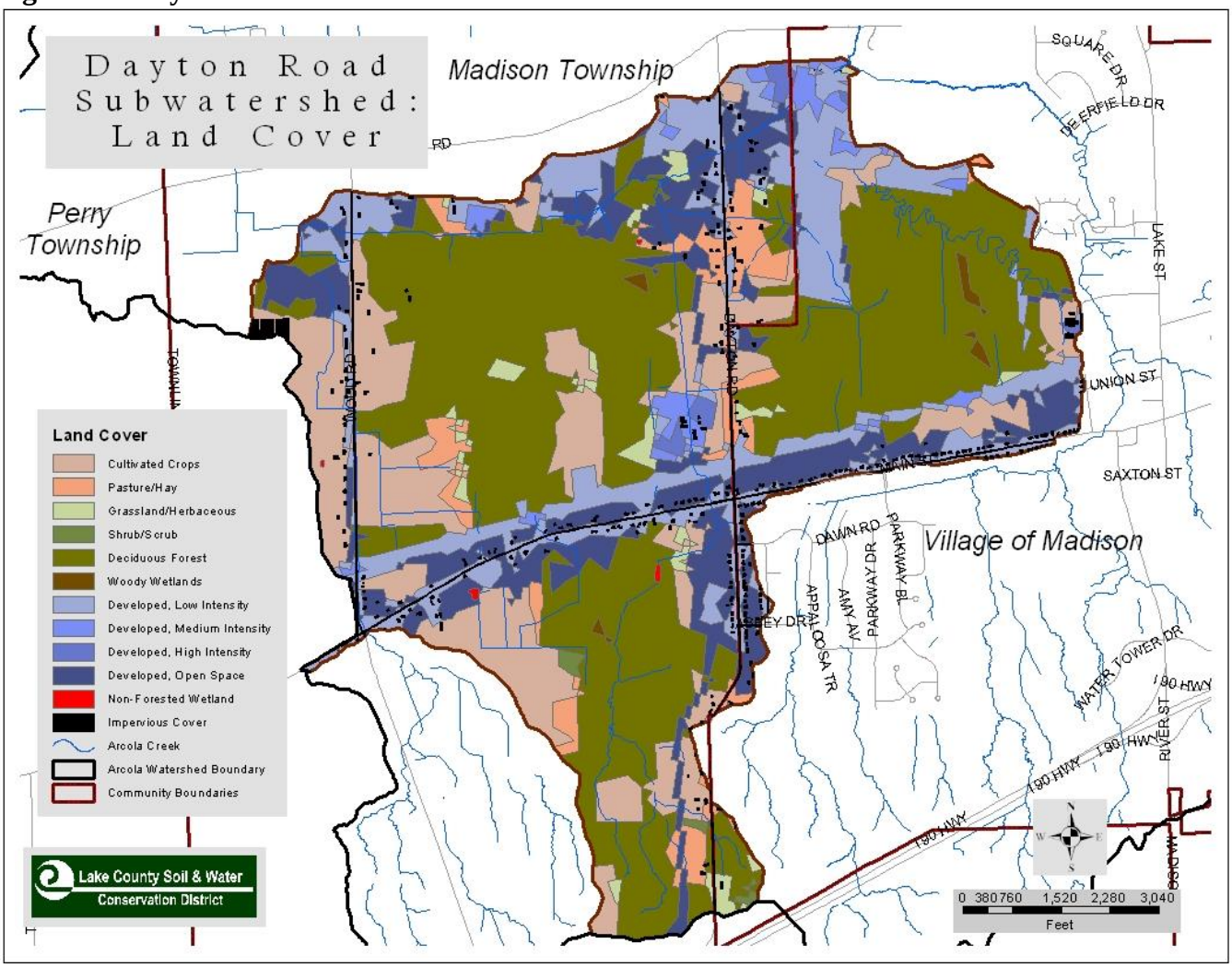
Subwatershed: State Route 528

Drainage Area: 3.39 square miles
Percentage of Imperviousness: 1.4%
Urban Land: 42.2%
Forested Land: 46.8%
Agricultural Land: 9%
Natural Open Space: 1.8%
Water: 0.1%
Non-Forested Wetlands: 0.1%

Forested land is the largest land cover in the watershed with urban land a close second. This subwatershed covers the southern half of Madison Village and has the greatest number of residential subdivisions in the Arcola watershed. The largest zoning district of the subwatershed is residential. Many of the large wooded parcels are owned by land development companies, awaiting future development. Interstate 90 crosses the southern

portion of the subwatershed and the I-90/State Route 528 interchange has a high potential for development of industrial businesses and commercial businesses oriented to tourism. The State Route 528 corridor contains both commercial and residential development. The State Route 528 subwatershed will face intense development pressures because of its proximity to Madison Village, Interstate 90 and State Route 528.

Figure 48: Dayton Road Subwatershed

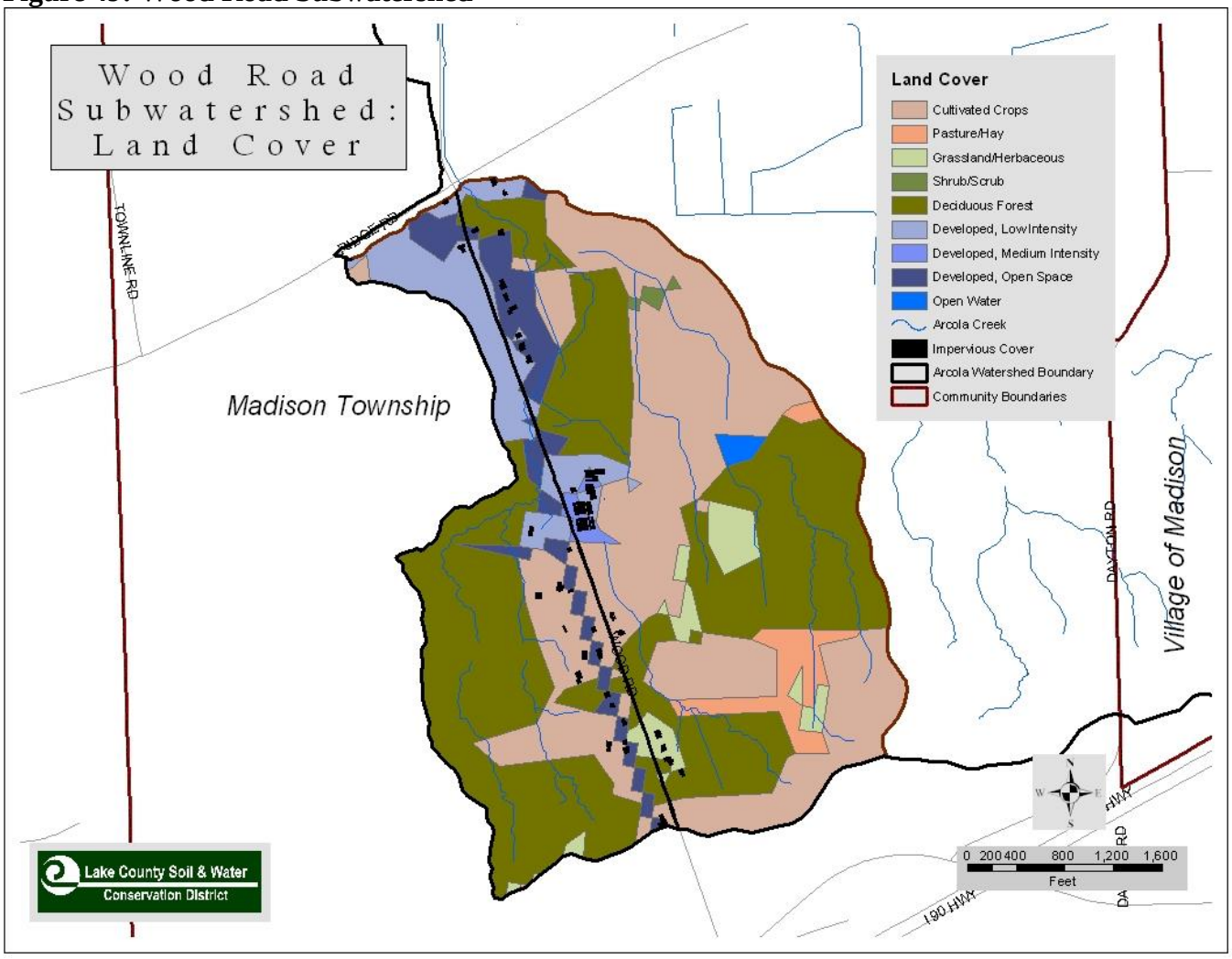


Subwatershed: Dayton Road

Drainage Area: 3.22 square miles
Percentage of Imperviousness: 0.4%
Urban Land: 36.3%
Forested Land: 40.7%
Agricultural Land: 21.6%
Natural Open Space: 0%
Water: 1.3%
Non-Forested Wetlands: 0.1%

Forested Land covers the largest portion of the subwatershed, with residential development along Dayton Road and South Ridge Road. The subwatershed covers the northwest portion of Madison Village. South Ridge Road, the main east-west road through Madison Village and two railroad tracks bisect the watershed. Nurseries comprise the agricultural land use. A number of large parcels are owned by development companies.

Figure 49: Wood Road Subwatershed

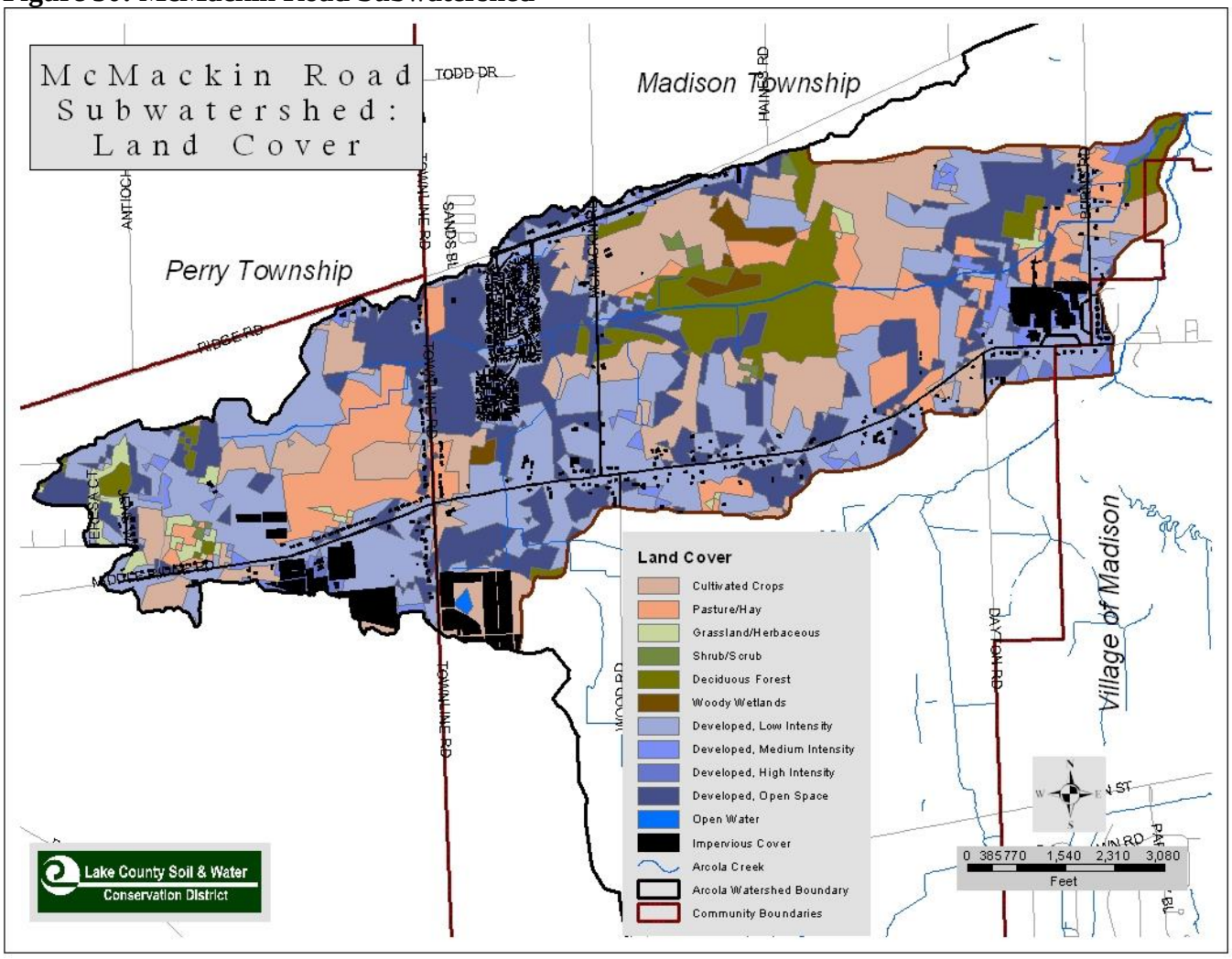


Subwatershed: Wood Road

Drainage Area: .59 square miles
Percentage of Imperviousness: 0.3%
Urban Land: 9.4%
Forested Land: 55.2%
Agricultural Land: 33.1%
Natural Open Space: 2%
Water: 0.25%
Non-Forested Wetlands: 0%

Land cover is mixed forested and agricultural in this small watershed. The subwatershed is divided by Wood Road. A township water line runs along the length of Wood Road through the watershed. Single family residential development lines the road frontage. Several large parcels are owned by land development companies. The agricultural operations are in nursery production.

Figure 50: McMackin Road Subwatershed

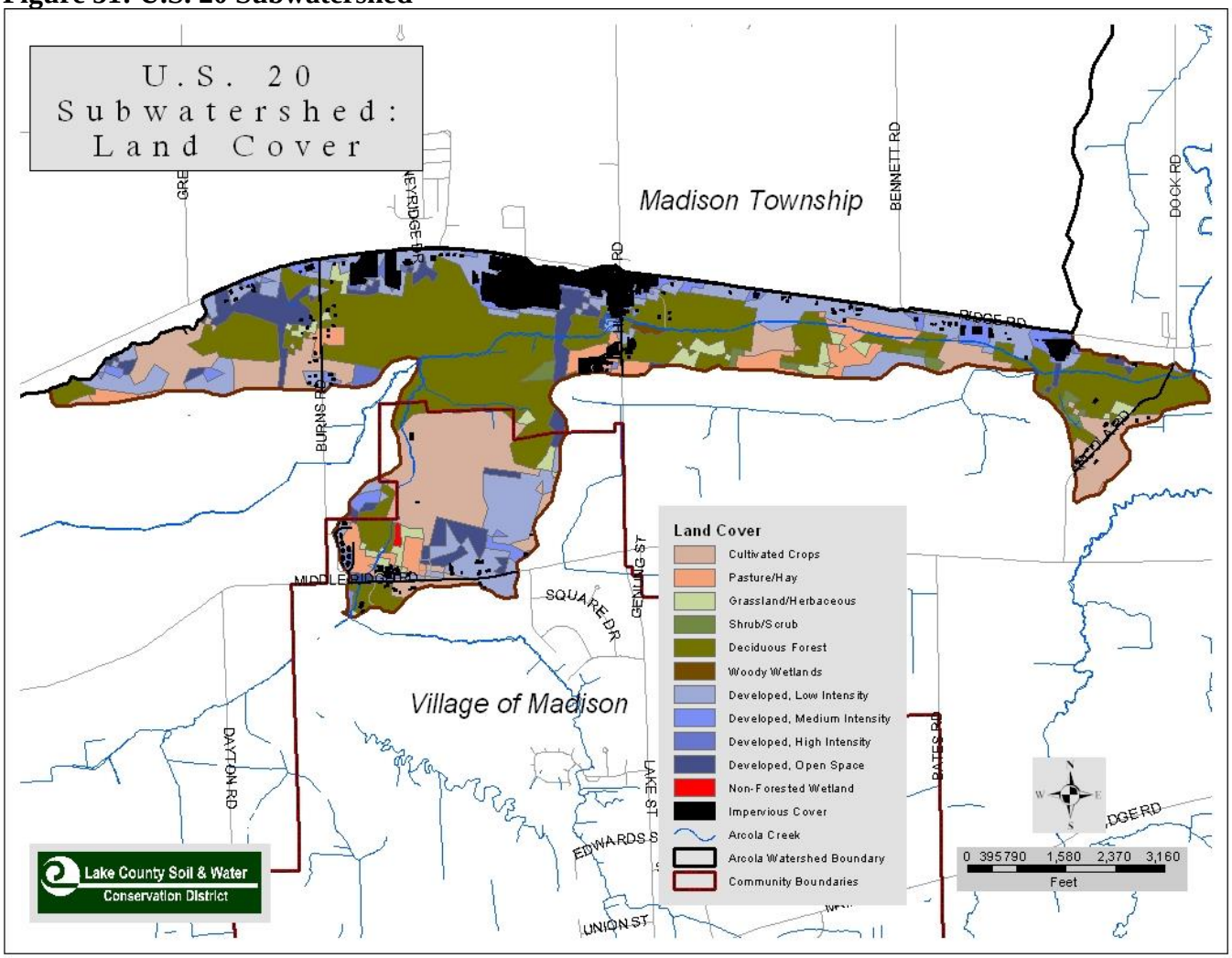


Subwatershed: McMackin Road

Drainage Area: 1.28 square miles
Percentage of Imperviousness: 1%
Urban Land: 36%
Forested Land: 41.7%
Agricultural Land: 19.9%
Natural Open Space: 2.3%
Water: 0%
Non-Forested Wetlands: 0.1%

This is the heart of nursery country. Some of the plastic hoop houses were included in the impervious cover data, which account for the black areas in the southernmost portion of the subwatershed. If imperviousness includes nursery hoop houses for container grown stock, then the number will increase greatly in winter months and be reduced drastically in the summer months, when the protective plastic covers are removed. Much of the nursery land is in field production of larger stock, which grows plants and trees directly in the soil and does not use hoop houses. Urban land cover includes a residential development in the western tip of the watershed, single family residences on the road frontages, a large mobile home park in the north central section off of North Ridge Road, (both of which have sanitary sewers) and the Madison High School campus in the southeastern corner. As Arcola Creek flows east of McMackin Road, it has been highly channelized and maintained and is known as "McMackin Ditch".

Figure 51: U.S. 20 Subwatershed

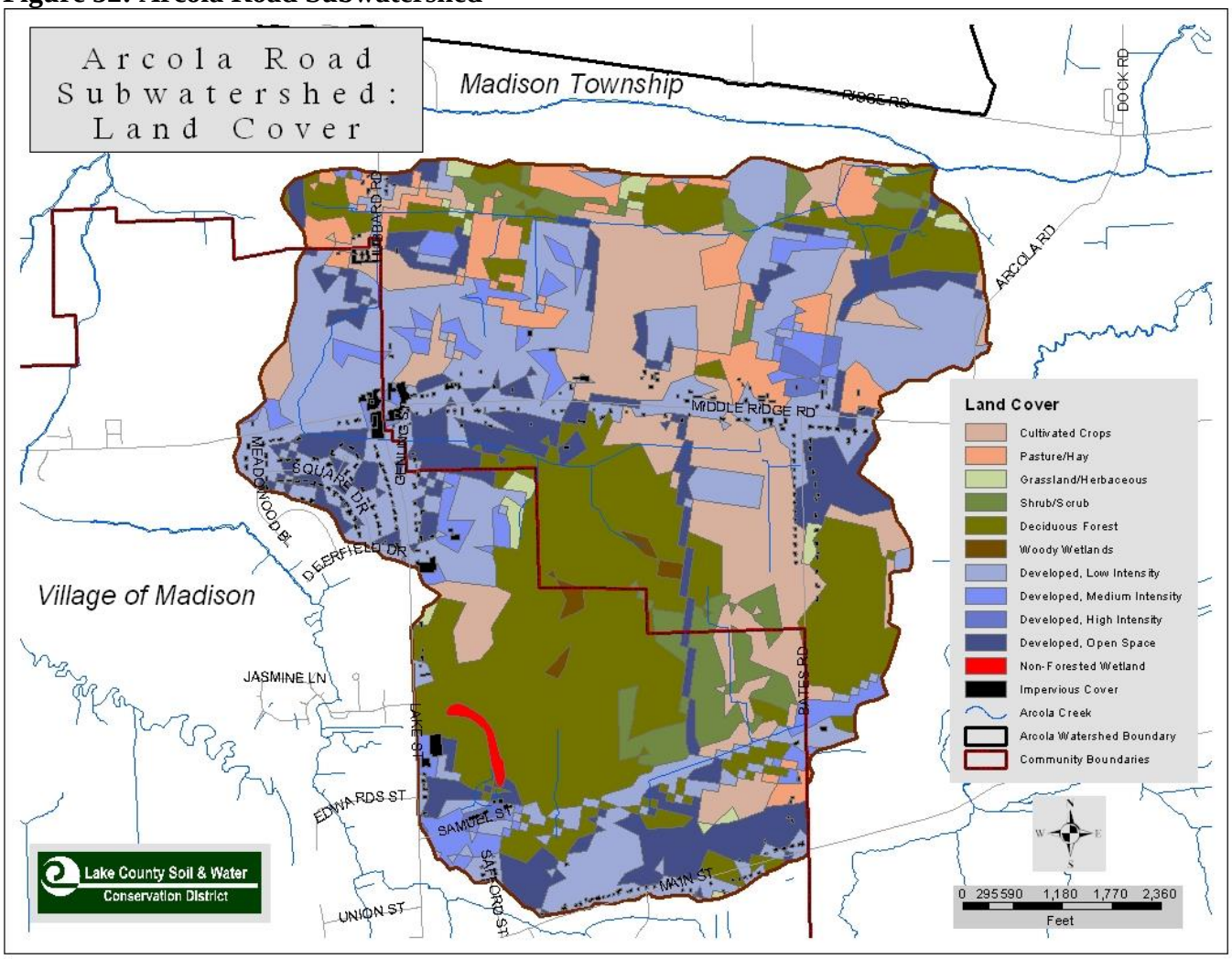


Subwatershed: U.S. 20

Drainage Area: 2.61 square miles
Percentage of Imperviousness: 3.5%
Urban Land: 51.2%
Forested Land: 14.4%
Agricultural Land: 32.4%
Natural Open Space: 1.4%
Water: 0.1%
Non-Forested Wetlands: 0%

U.S. 20, the center of commercial and business development in Madison, forms the northern watershed boundary for the subwatershed and the Arcola Creek Watershed. Land cover is largely urban in the U.S. 20 corridor, with the largest concentrations of commercial businesses located between Burns and Hubbard Roads. Madison Township water lines run the length of U.S. 20, and along Burns, Hubbard and Arcola Roads. Sanitary mains run on portions of U.S. 20, along Hubbard Road and through the southwest corner of U.S. 20 and Hubbard. There are several multi-family residences in the southwestern corner of the watershed. Nurseries comprise the northwestern and eastern tips of the watershed. Livestock are raised in the southern section of the watershed, which is in the northern part of Madison Village. A waste water treatment plant is located along Arcola Creek in the south central portion of the subwatershed. The largest amount of impervious cover is found in this subwatershed, and it is likely to become the most developed subwatershed of the Arcola Creek Watershed.

Figure 52: Arcola Road Subwatershed



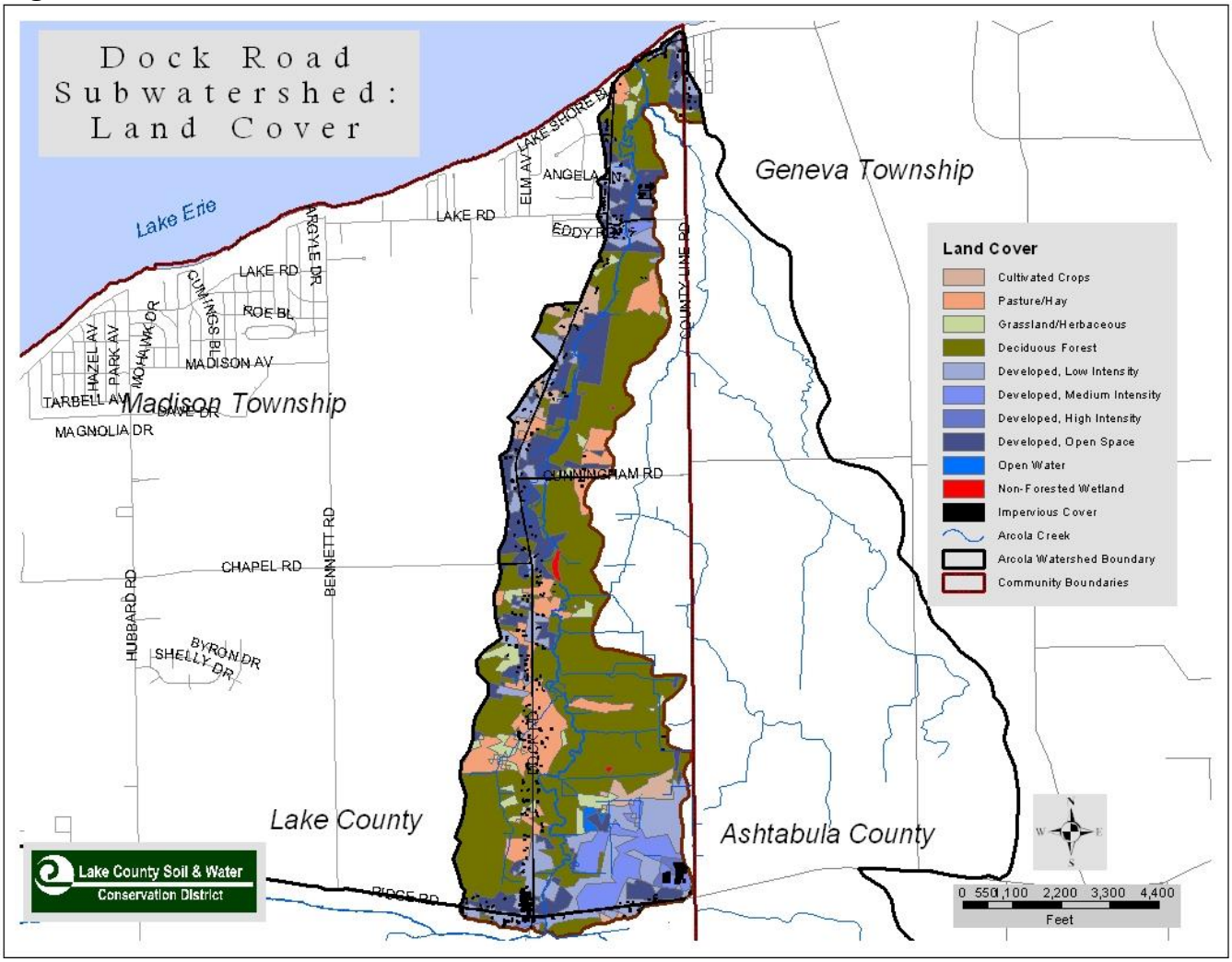
Subwatershed: Arcola Road

Drainage Area: 2.02 square miles
Percentage of Imperviousness: 1%
Urban Land: 39.4%
Forested Land: 34.6%
Agricultural Land: 21.4%
Natural Open Space: 4.4%
Water: 0%
Non-Forested Wetlands: 0.2%

The Arcola Road subwatershed has a mix of forested and nursery land with residential development along road frontages. A residential subdivision in the west central section accounts for a higher amount of urban land cover, and the remainder of the subwatershed is relatively rural. Commercial and business enterprises are located at the Hubbard/Middle Ridge Road intersection. A Madison Township water line runs along Hubbard Road and

East for 1200 feet on Middle Ridge Road. There is one small horse paddock on Middle Ridge Road in the center of the subwatershed. The southern and western portion of the subwatershed is located in Madison Village, and includes two railroad tracks with a small industrial park on the northeast side of the tracks and Lake Street. Several of the larger forested parcels are owned by a land development company and the potential for increased development is higher in this watershed because of its location in Madison Village.

Figure 53: Dock Road Subwatershed



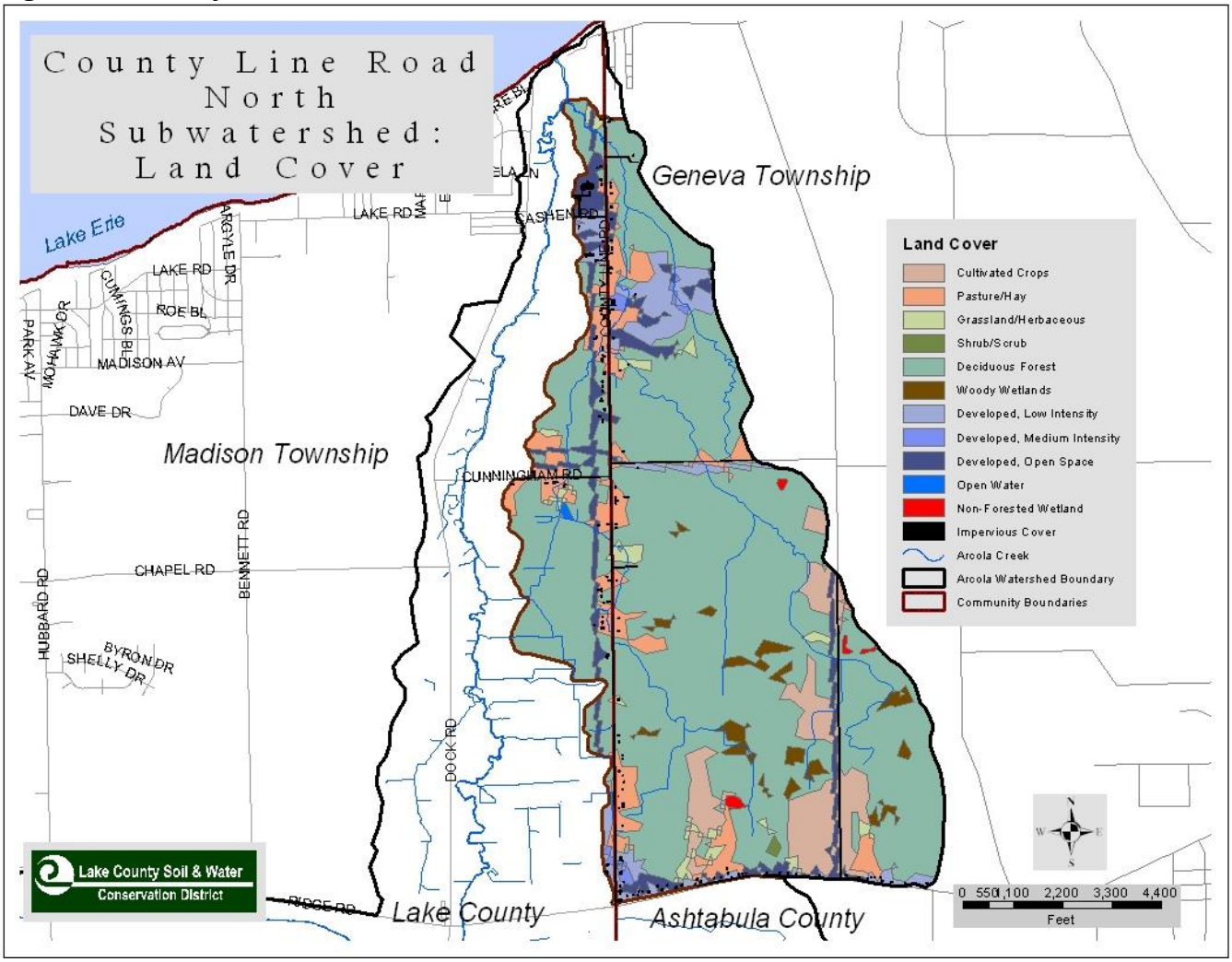
Subwatershed: Dock Road

Drainage Area: 1.98 square miles
Percentage of Imperviousness: 0.5%
Urban Land: 19.6%
Forested Land: 70.3 %
Agricultural Land: 8.2%
Natural Open Space: 1.7%

Water: 0.1%
Non-Forested Wetlands: 0.1%

Forested land dominates in the Dock Road subwatershed with residences lining the road frontage. There are several nurseries including a large nursery on the southeast corner of the subwatershed. The mouth of Arcola Creek empties into Lake Erie through the Arcola Estuary. The Estuary and several parcels upstream totaling 64.2 acres are protected through Lake Metroparks ownership. U.S. 20 runs along the southern subwatershed boundary. A Madison Township water line is located along U.S. 20, on Cashen Road and on the northern portion of Dock Road. A waste water treatment facility is located on the east side of Arcola Creek just north of Cashen Road. A sanitary main crosses the Creek just north of Cashen to join a line that runs along the northern portion of Dock Road to Lake Erie. A cement plant is located on the Arcola Creek mainstem at Cashen Road and the owners cross the creek with truck traffic on a small roadway constructed in the creek. An 8 acre parcel on the east side of Dock Road near the Chapel Road intersection is protected by a conservation easement held by Lake SWCD. This parcel also has a small alpaca herd, which is fenced off from the creek.

Figure 54: County Line Road North Subwatershed



Subwatershed: County Line Road North

Drainage Area: 3.28 square miles
Percentage of Imperviousness: 0.3%
Urban Land: 13.4%
Forested Land: 73.6 %
Agricultural Land: 11.4%
Natural Open Space: 1.7%
Water: 0.1%
Non-Forested Wetlands: 0.2%

Land cover in the County Line Road North subwatershed is mostly forested. Residential development is on the road frontages. The agricultural land includes hay and grapes along U.S. 20 and nursery land in the northern portion of the subwatershed. There are several parcels along U.S. 20 and on County Line Road just north of U.S. 20 that have junk

automobiles. The waste water treatment facility north of Cashen Road straddles this subwatershed and the Dock Road subwatershed.

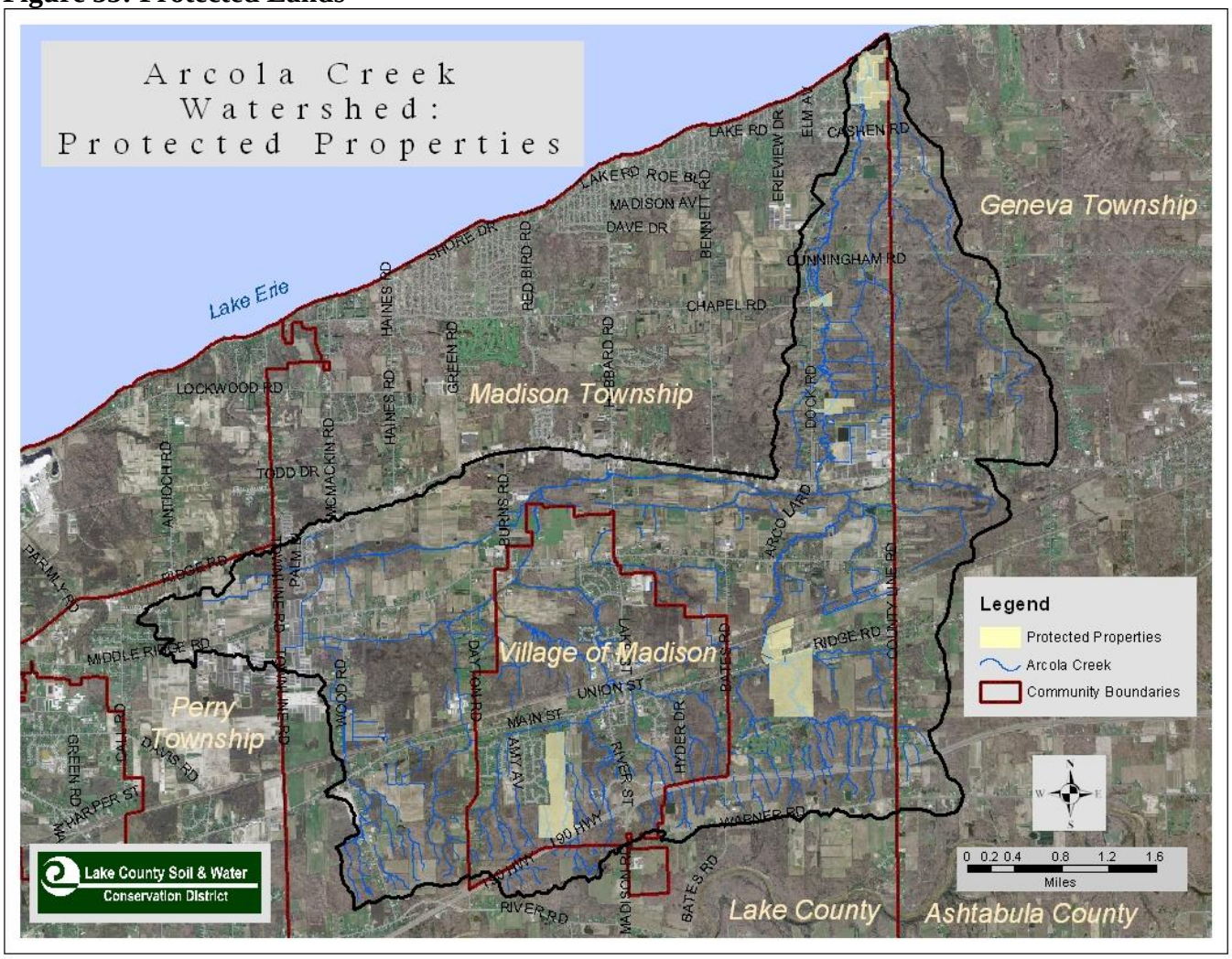
b. Protected Lands

There are few protected lands in the Arcola Creek watershed. Lake Metroparks leases the 32.86 Arcola Creek Park from Madison Township; The Nature Conservancy owns an additional 31.34 acres adjacent to Arcola Creek Park, protecting the estuary and marsh ecosystems. Lake Metroparks owns 114.22 acres on the south side of South Ridge Road east of Madison Village, known as South Ridge Reservation. This property is not open to the public.

Lake County Soil & Water Conservation District holds a 4.98 acre conservation easement along Arcola Creek on the Rosencrans property, near Dock and Chapel Roads, a 17.16 acre Wetlands Reserve Program (WRP) easement on the Usaj property on Dock Road, and a 33 acre conservation easement on South Ridge Road east of Madison Village on the Nash property.

Kent State University owns 105 acres in the southwest area of Madison Village, which is protected with a deed restriction.

Figure 55: Protected Lands



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.

c. Status and Trends

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.

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.

According to the Lake County Planning Commission, the pressure of land use conversions from nursery to residential land has been relatively stable in the past five years because of a depressed economy, but the slowdown in development and in household landscaping has affected the viability of the nursery industry. The Lake County Planning Commission expects the balance of residential and agricultural land uses to be stable in the future, unless there is an expansion of water and sewer services south of U.S. 20- which it believes unlikely at the present time.

Figure 56: Population Trends

Pop. 1990	Pop. 2000	Pop. 2010	Pop. 2011	Change 1990-2000	Change 2000-2010	Change 2010-2011
215,500	227,482	230,041	229,885	5.6%	1.1%	-0.7%

USDA ERS (Economic Research Service)

The National Oceanic and Atmospheric Agency (NOAA) Coastal Change Analysis Program (C-CAP) Land Use data is another way to analyze land use change. This database classifies land use by a visual assessment of cells on orthophotos. According to this

database, from 1996 to 2001, the total change of land use in the watershed was 430 acres. From 2001 to 2006, the total change of land use was 88 acres. In the 1996-2001 period, 45% of the change was from grassland (195 ac.) being converted to cultivated land (161 ac.) and to low intensity development (16 ac.). 31% of the change was from deciduous forest (135 ac.) to cultivated land (69 ac.) and grassland (35 ac). In the 2001-2006 period, 48% of the change was from deciduous forest (43 ac.) to bare land (33 ac.) and cultivated land (9 ac.). 24% of the change was from low intensity development (21 ac.) to medium intensity development (14 ac.) and high intensity development (5 ac.). The data confidence is lacking with this database, however, because when viewed in map form, the land use designations do not correspond very well with the actual land uses.

Mark Hinshaw of the American Planning Association recently wrote that 2012 marks the 60th anniversary of the enclosed suburban shopping mall, and the end of a major land use trend. The boom of the "mall" coincided with the development of the national interstate highway system and federal loans and subsidies that encouraged people to live farther from the city centers. Malls were an integral part of the outer rings of urban areas, and were the cause of the destruction of thousands of acres of farmland, forests and wetlands- and the construction of thousands of acres of parking lots.

Hinshaw states that recent census data show a sharp slowdown of growth in the outer suburbs, with growth now tending to occur in urban areas. Very few shopping malls are being constructed and existing malls are dead, dying, or being refashioned. Demographic changes are creating the shift: younger generations are delaying marriage and starting a family while aging people want to live in areas that are walkable and close to urban centers. Housing foreclosures, the national recession and an increase in personal bankruptcies have changed the perception and desire for the American dream of owning a house in the country. Some believe that we have enough single family housing stock built to last us at least a decade.

As the "baby boomers" age, there will be a need for housing to accommodate this sector of the population. Planning should be considered to supply housing stock for one or two occupants that does not require yard maintenance activities, and that is close to the business and commercial centers. As the older residents move into housing stock more suited to their needs, the single family homes will open up for young families. Conscious planning for such trends in housing needs will help to reduce the need for new single family homes and keep a balance of housing stock in the community.

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.

Figure 57: Roses at Lake County Nursery (photo courtesy of Lake County Nursery)

B. Resources of historical, cultural or recreational significance

1. History

The Arcola Creek watershed has an interesting history, with ship building, bog iron mining and Underground Railroad connections. The watershed area has had various names over time, first known as Harpers Landing, then Ellensburg, Madison Docks, and now Arcola Creek.

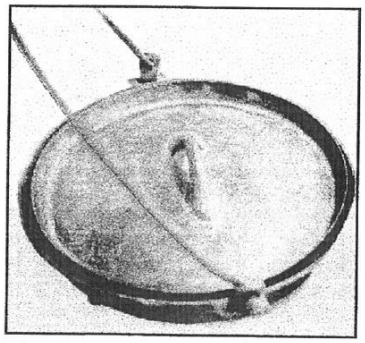
In June 1798, Col. Alexander Harper and 25 others landed at the mouth of the creek, becoming the first permanent settlers to arrive and claim their land in the new Connecticut Western Reserve Territory. They started to clear the land, built shelter and constructed a dock, opening the door for migration and settlement into the new territory. Colonel Harper died in the summer of 1798 and was buried in the southeast corner of South Ridge and County Line Roads in Unionville, which was then just a junction of two forest paths. His grave is likely the oldest marked grave in the Western Reserve. (Orris. 1980.)

In 1803, the first light house west of Buffalo was constructed at the creek mouth, allowing for industry and shipping to flourish. The largest and fastest ships on the Great Lakes during this period were constructed here.

Capt. John Cunningham and his sons acquired a large tract of land in 1811 and discovered bog iron on their property in 1812. Bog iron is produced by sediment collecting at the bottom of swamps over millions of years and the oxidation of the iron in the water. The bog iron provided the raw material for the development of a new industry, when combined with the abundance of hardwood timber stands and limestone shipped in from Kelly's Island. In 1826, Judge Samuel Wilkerson and his sons came to the area and bought a small iron refinery furnace here and named it Arcole Furnace. The Arcole Furnace produced stoves, kettles and tools that were used by early settlers around the Lake Erie basin. By 1835 this operation had become the largest industry in the State of Ohio and employed 2,000 people.

The creek that ran through the Cunningham property was known as Cunningham Creek. The present-day name of Arcola is a misspelling of the Arcole company name.

Figure 58: Cooking kettle made by Arcole Furnace Co. (Tag. 1998.)



Madison Dock became a busy port during this time, serving as a fishing, shipping and shipbuilding center. There was a bar and hotel- popular with sailors and ironworkers, two lighthouses, a company store, a three-storied frame boarding house, a post office, grist-mill, pattern shops and harness makers. There were about 200 log cabins and frame houses surrounding the furnace to support the ironworkers. (Orris. 1980.)

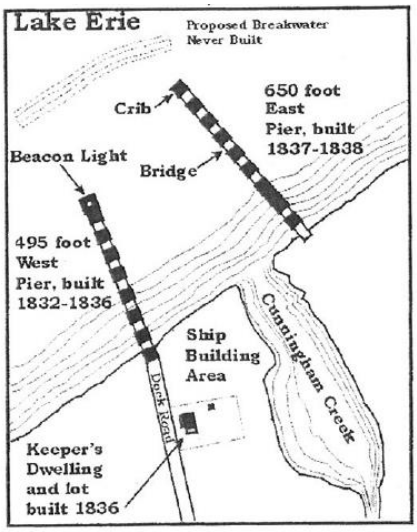
In 1850 the supply of local bog ore had declined and the land had been cleared of timber to make charcoal for operation of the furnaces. The cleared land and climatic conditions set the stage for the nursery and farming industries that are still vital businesses today.

Ship building was an important early industry and shipbuilding began at the mouth of Cunningham Creek in 1825. This settlement was known as Ellensburg and the dock at the creek mouth was known as Madison Dock (named for President James Madison). Ships were also built at Mentor Headlands and Perry, but Ellensburg was the leader of the industry. The first steamboat built west of Buffalo on the Great Lakes was built here in 1825; the last was built and launched in 1863.

Around 1834, through the combined efforts of the Arcole Furnace and Colonel Robert Harper, an attempt was made to construct a harbor. Although this project failed, probably due to sand formation at the mouth of the harbor, boats continued to load and unload at the dock. This harbor was active for many years with boats bringing in limestone for the blast furnaces and shipping out the finished product. (Pogacnik. 1996.)

The harbor also played a part in the Underground Railroad. Slaves were brought in to the Old Tavern in Unionville and from there they were transported to the Madison Harbor where they boarded ships and sailed to Canada. Amos and Cyrus Cunningham also opened their homes for the slaves' protection when needed. (Pogacnik. 1996.)

Figure 59: Cunningham Creek Harbor Plan (Tag. 1998.)



Remnants of the west pier are still visible on the beach and extending into the Lake.

There is an historical marker on Arcola Road just south of North Ridge Road (U.S. 20) at the location of the Arcole Iron Company- which is all that remains of this early industry.

Figure 60: Historical Marker

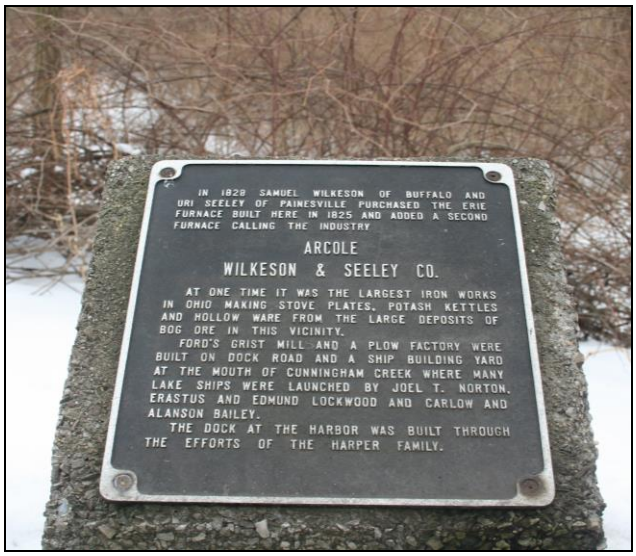
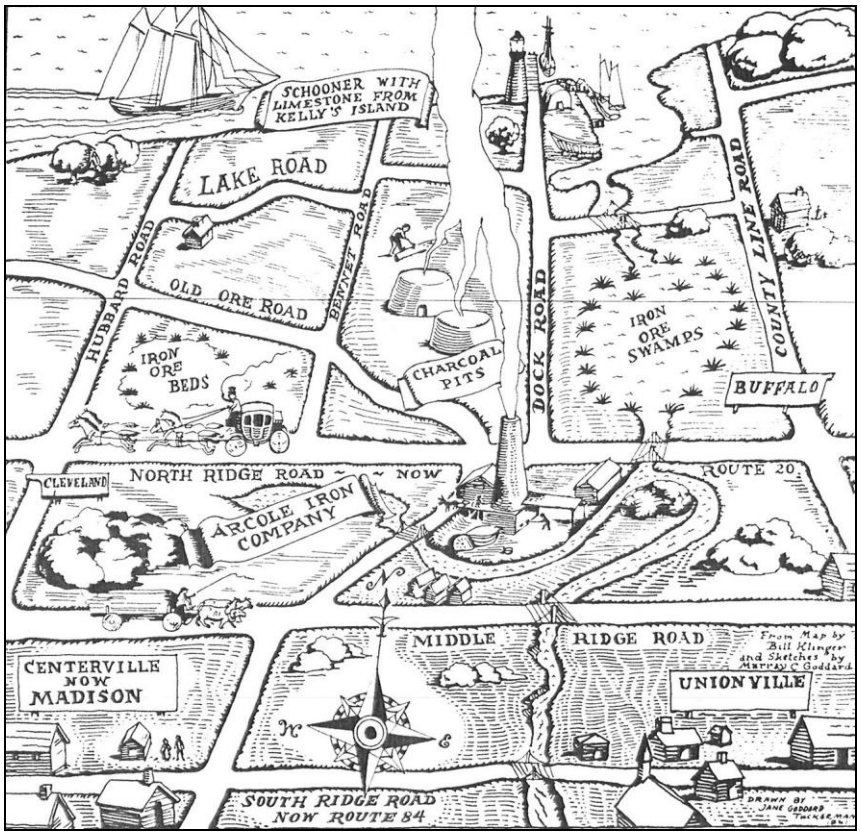


Figure 61: Historic map of lower watershed



Madison Township is the largest township in Ohio, covering close to fifty square miles. This occurred because there are two Gores at the northern and southern ends of the township. A Gore is a small, usually triangular piece of land. The northern Gore was formed by the northeastern angle of the Lake Erie shoreline, and the southern Gore is created by the space between the Grand River and the township to the south. Without compensating for the loss of land through the Gores, the Township would have been very small.

Madison Village was built with a traditional New England park square, and there are many buildings in the village center and on South Ridge Road listed in the National Register of Historic Places.

Figure 62: National Register of Historic Places Map- Madison Village

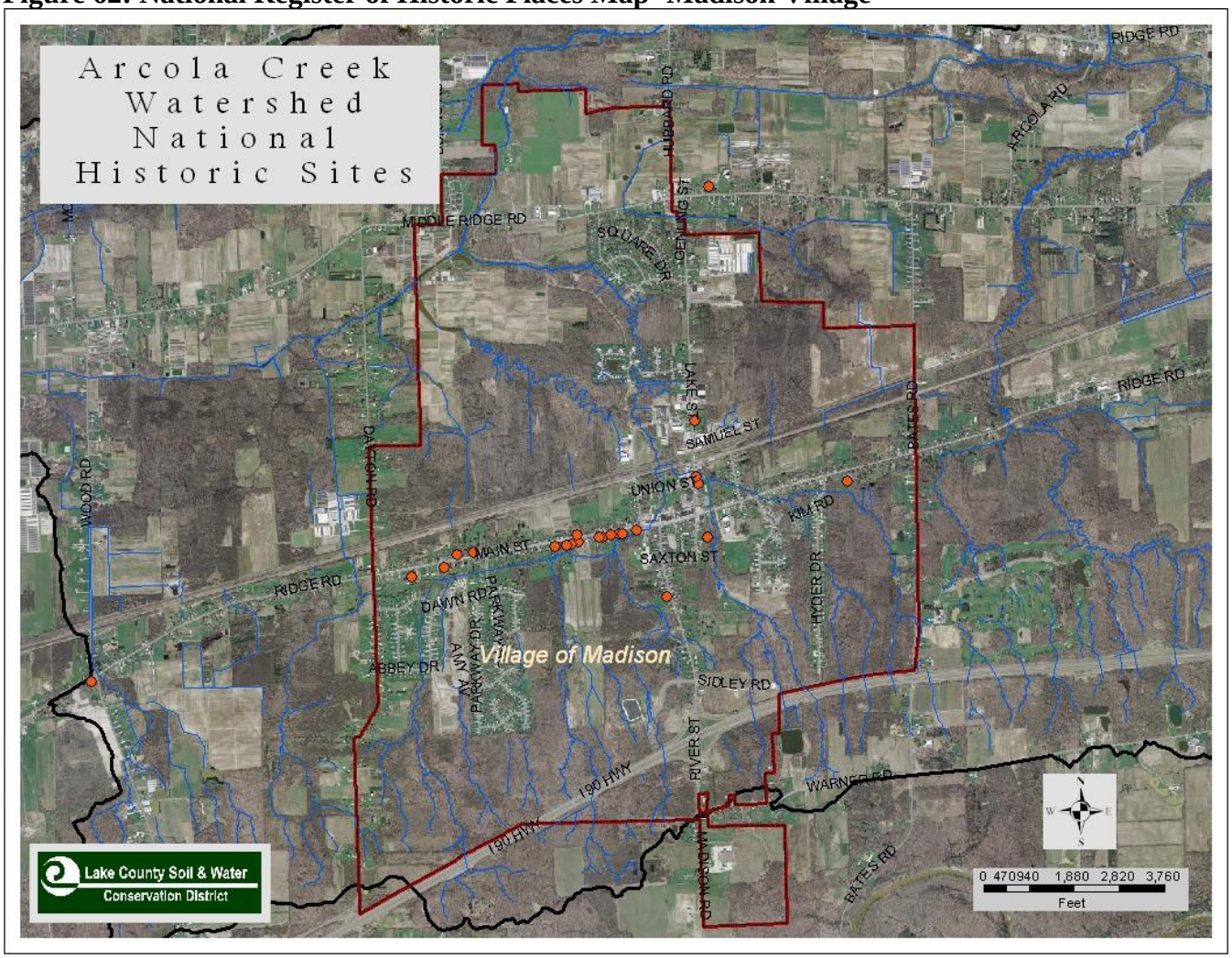


Figure 63: National Register of Historic Places sites

Ladd's Tavern	Addison Kimball House
State Soldiers & Sailors Home	James Dayton II House
Connecticut Land Co. Office, Madison	Albert DeHeck House
Charles Gilbreathe House	William Lyman House
Brick Vernacular House #2	Frances Ensign Fuller House
Robertus Childs House	George Damon House
Cyrus Ingersoll House	James Dayton House
Francis Hendry House	Lemuel Kimball House II
Soloman Kimball House	H. Gill House
Jane Gllbert House	John Jones House
Rev Harlan Metcalf House	John Kellogg House and Barn

2. Arcola Estuary

The Arcola Creek Watershed is home to one of only two remaining natural estuaries on the south shore of Lake Erie. The other natural estuary is Old Woman Creek, a National Estuarine Research Reserve near Huron Ohio. An estuary is an area where water from a river or stream mixes with water from a lake or ocean and has features of both ecosystems. Estuaries are important 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. The water depth in the estuary fluctuates over time. In the prior two decades, the water was several feet deep and visitors could use canoes to explore the estuary and upstream tributaries. Today the lower level of Lake Erie causes 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.

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.”

In September 1993, Lake Metroparks entered into a management agreement with the Lake County Commissioners, to manage approximately 40 acres of land for a period of ten years with an option to extend at the end of each ten year period if agreed to by both parties. Lake Metroparks leases 32.86 acres from Madison Township and manages Arcola Creek Park. An additional 31.34 acres are protected under ownership by The Nature Conservancy.

Friends of Arcola Creek, a local watershed community group was formed shortly thereafter to assist with the stewardship of the estuary and watershed.

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.)

3. Recreation

The Arcola Estuary has been a recreational site since the arrival of European settlers. The area has continued as a recreational area for canoeing, swimming, beach combing, fishing and skating in the winter.

Fishing has changed over time. Older members of the Friends of Arcola Creek remember seeing Lake Erie sturgeon when they were children. This endangered species was nearly lost from the Great Lakes due to overfishing in the mid-1800s but recent sightings have caused some optimism for their comeback. Ohio Department of Natural Resources (ODNR) now stocks steelhead trout in the Vermilion, Rocky, Chagrin and Grand rivers and Conneaut Creek, but stray fish make their way into Arcola Creek and other rivers that empty into Lake Erie. Arcola Creek is a popular spot for steelhead and draws fishermen from a wide area. The steelhead industry is a great economic driver for the region as fisherman look for places to stay, eat, buy gas and shop for supplies. According to the ODNR Division of Wildlife Fairport Harbor Research Unit, 245 Steelhead Trout were caught in 2006, with 1,855 Angler hours reported. Steelhead have been as far as the upper reaches of Arcola Creek. (See Figure 64.)

Lower lake levels and low flows in the creek have reduced recreational opportunities; canoeing is limited, and skating on the marsh is mostly a distant memory of older folks.

Northern Madison Township grew as a beach community, and the housing stock is now used as year-round residences.

Figure 64: Upstream Reaches of Steelhead Trout

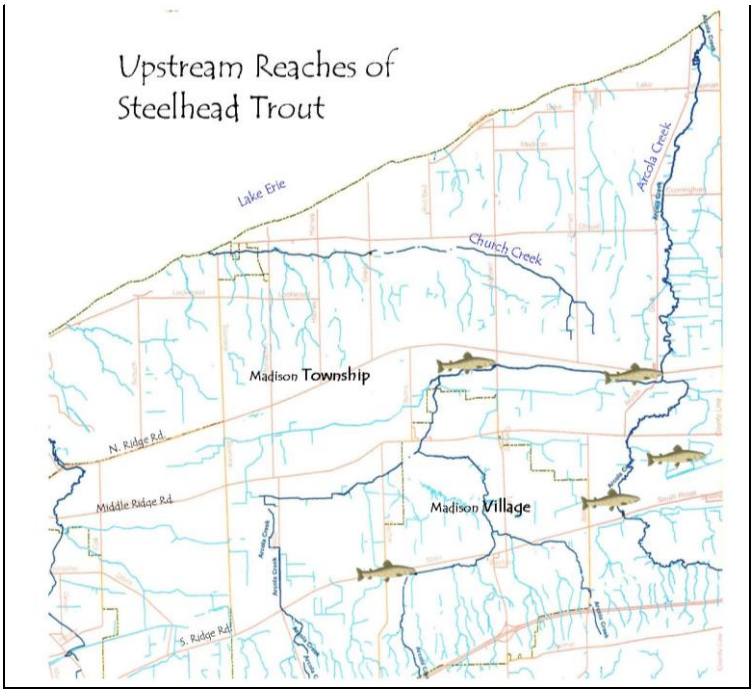


Figure 65: Steelhead Trout fishing in Lake Erie at Arcola Estuary mouth with remnant of historic dock to left (photo taken by Jeff Hyrne)

C. Previous and Complementary Efforts

1. History of previous water quality efforts in the watershed

a. 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 recruited landowner-cooperators along Arcola Creek and provided assistance with stream corridor restoration, buffer management and conservation easements.

The District has protected property in the watershed with a 4.98 acre conservation easement along Arcola Creek on the Rosencrans property, near Dock and Chapel Roads, a 17.16 acre Wetlands Reserve Program (WRP) easement on the Usaj property on Dock Road, and a 33 acre conservation easement on the Nash property on South Ridge Road east of Madison Village.

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 Watershed Action Plan.

b. Formation of Friends of Arcola Creek (FOAC), 1986

The Friends of Arcola Creek have been active as a grass-roots organization since 1986, working to educate the community on the ecological, cultural and recreational value of the Arcola Estuary and Watershed. The Friends have attended local zoning meetings, Lake County Planning Commission meetings, made comments on Ohio Environmental Agency (OEPA) and United States Army Corps of Engineer (USACE) permits, promoted public awareness projects and conducted beach clean-ups and invasives removals.

c. 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.

d. 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 Lake County General Health District has identified numerous failing septic systems in both new and older developments due to poor soil conditions, which are causing water quality issues. Existing farm tiles have been damaged and natural drainage courses have been altered with new construction.

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.

e. 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

f. U.S. Army Corps of Engineers (USACE) Preliminary Restoration Plan, 1996

As a result of increased awareness of the Arcola Creek watershed and its issues, U.S. Representative Stephen LaTourette caused congress to appropriate $100,000 to the United States Army Corps of Engineers to study the Arcola Creek watershed. Lake SWCD and FOAC asked the USACE to keep in mind that any study and practices installed should benefit the estuary and the watershed's water quality.

The USACE proposed the consideration of the following measures:

1. Creating regional stormwater retention facilities
2. Installing a weir at the estuary mouth
3. Restoring native riparian corridors
4. Replacing round culverts with box culverts to enhance fish migration during spawning season

The estimated cost for the project was $7.3 million dollars.

A Determination of Federal Interest was reviewed in January 2011, which supported further evaluation of ecosystem restoration efforts on Arcola Creek, and recommended moving forward with a Feasibility Study. A review of the 1996 study raised concerns about the proposed measures. One recommendation was to use water "quantity" rather than water "quality" to avoid tying the objectives to habitat improvements; water quality improvements should still be included in the Feasibility Study, however. The regional stormwater retention facilities concept should avoid the globally rare beach ridge and swale ecotype areas. The technical viability and sustainability of such retention ponds was also questioned, and a recommendation was made to discuss other restoration options for hydrologic resurgence.

In response to the installation of a weir at the estuary, it was observed that lake levels should be allowed to fluctuate at the river mouth and wax and wane with Lake Erie's levels. It was suggested that the ill effects of a flashy stream system can be mitigated by attenuating water upstream through wetland restoration or Best Management Practices (BMPs).

The box culvert measure raised recommendations to evaluate replacing bridges with alternative structures to allow the stream to free flow rather than be confined to a box culvert. Using box culverts with no bottom should also be considered.

At the present time, the status of funding for the project is in question, and the Watershed Planning work group is maintaining open communications with the USACE to coordinate efforts.

g. Lake County Stormwater Management Department

The Lake County Stormwater Management Department (LCSMD) was formed in 2003 as a means 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. Madison Village joined the program in 2012, during the watershed planning process and 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.

h. 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.

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

With the assistance of 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.

Lake SWCD works in cooperation with the Lake County nursery industry to assist the industry with its water quality issues, as well as to improve the water quality in the county watercourses.

2. Current efforts to help meet water quality standards

a. Madison Village Comprehensive Watershed Study for the Arcola Watershed, Village of Madison, Ohio; Phase I- Southern Portion of the Village

Madison Village contracted in 2011 with URS Corporation, a Cleveland engineering firm, to prepare a Comprehensive Watershed Study of the Arcola Watershed to assess flooding issues and stormwater conveyance in the Village. The heavy rainfalls in 2006 created extensive flooding and accumulation of woody and other debris, causing damage to homes, vehicles, yards and roads. The purpose of the study is to identify existing flooding problems and the location of inadequate conveyances, prioritize solutions and costs, develop a long range plan to assist with future development, and identify funding mechanisms for the long range plan.

The study was divided into two phases, with the first phase assessing flooding issues south of the CSX and Norfolk Southern railroad bridge in the Village, and the second and future phase to assess the flooding issues north of the same railroad bridge. The study

included “proposed improvements such as the enlargement of existing piping, channel modifications, detention/retention basins or modifications of existing basins, wetland modifications, bio-retention areas, and other proven methodologies.”

A draft of Phase I of the study was completed on January 16, 2012. Madison Village is planning a public comment period and the Village Council President is engaged in the Arcola Creek Watershed Planning process in a cooperative relationship.

b. Lake County Agricultural Water Coalition

Lake County nurseries formed the Lake County Agricultural Water Coalition in 2010 to work together in identifying and addressing water quality issues affecting nursery operations in eastern Lake County. The Coalition is currently working with Lake SWCD and the Chagrin River Watershed Partners to refine the Irrigation Management Self Evaluation Workbook to determine the type and level of best management practices economically feasible for nursery operation implementation and include document existing best management practices already implemented by nursery operators.

The group is also working to expand upon the Irrigation Management Self-Evaluation Workbook to include a greater sampling area. It is also discussing opportunities for the Coalition group to conduct outreach to additional nursery operations to expand understanding of water resource uses, needs and potential pollution issues.

c. Lake County Stormwater Management Department

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.

In addition to the infrastructure and maintenance projects, the LCSMD has assisted Madison Township in performing routine inspections of stormwater quality basins. The basins the Township have been inventoried, mapped and inspected. Inspections will occur during construction as well as post-construction. Post-construction routine inspections occur once every two to three years.

Stormwater outfalls within Madison Township have also been inventoried, mapped and inspected. Outfalls containing illicit discharges will be identified and corrected in future work plans.

Madison Village recently joined the LCSMD in 2012, and the relationship is newly developing.

D. Physical Attributes/Habitat Modification Inventory

The Arcola Creek Watershed has the benefit of 92 Headwater Habitat Evaluation Index (HHEI) measurements taken in the field by Lake County Soil & Water Conservation District staff over a two year period, from May 2000 through August 2002. This data collection provides a unique level of data for the Arcola Creek Watershed, and provides a snapshot of the watershed conditions from about a decade ago. It provides a good baseline for future analysis of the watershed, and for the development of the watershed action plan. The data was collected at points of confluence, and is representative of the portion of the watershed upstream to the next point of confluence. 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.

As a part of the Ohio EPA Primary Headwater Habitat Evaluation assessment, a significant amount of data was collected for each site. This included stream channel modifications, riparian width and quality, biotic evaluation, canopy cover, channel characteristics and entrenchment ratio. This data was used to assess the physical attributes of the streams and floodplains for this inventory.

Floodplain condition is measured by the entrenchment ratio, which is the relationship between flood-prone areas and bankfull cross-sections. (See Figure 23.) A stream with a ratio close to 1 is very entrenched and has little or no access to its floodplain. Conversely, a stream with an entrenchment ratio of 2.2 and greater is only slightly entrenched, and has access to its floodplain.

1. Early settlement conditions

The Arcola Creek watershed was forested prior to European settlement, primarily in beech-maple species in the uplands and swamp forest comprised of elm, ash and maple plant communities in the wetlands. A series of old beach ridges running parallel to the present-day Lake Erie shoreline, remnants of earlier glacial lakes, were used as thoroughfares by the earliest populations. Except for the beach ridges, most of the lake plain was swampy and covered by large tracts of swamp forest. Drainage of the wetlands began 200 years ago, and miles of subsurface tiles cover the watershed from efforts to move water off the land and to the Lake as quickly as possible.

The swamp forest has a hummock/hollow terrain, which forms when the shallow-rooted trees blow over in strong winds, leaving an exposed root ball which forms a “hummock” or small rise, and a “hollow” or depression in the ground which the root mass once occupied. The opening of the tree canopy allows other species such as tulip, cherry, beech, cucumber magnolia, sassafras, yellow birch, black walnut and hickory to grow in the swamp forest. The hollows provide springtime breeding habitat for salamanders, wood frogs and spring peepers. Most of the extensive wetlands in Lake County have been drained, and only a few examples remain- including undeveloped areas in eastern Madison Township north of U.S. Route 20. (Szubski. 2002.)

The discovery of bog iron in the wetland areas led to the removal of the trees over time, to provide charcoal to fuel the furnaces. Once the bog iron was tapped out and the trees gone, there was a natural transition to the nursery and farming industries, which exist today.

Arcola Creek was once a major water transportation route, supporting the bog iron industry, and the Estuary was home to a large ship building and shipping economy. Today, nature has reclaimed the Creek and Estuary, and plants, animals, migratory birds and spawning fish are protected by Lake Metroparks.

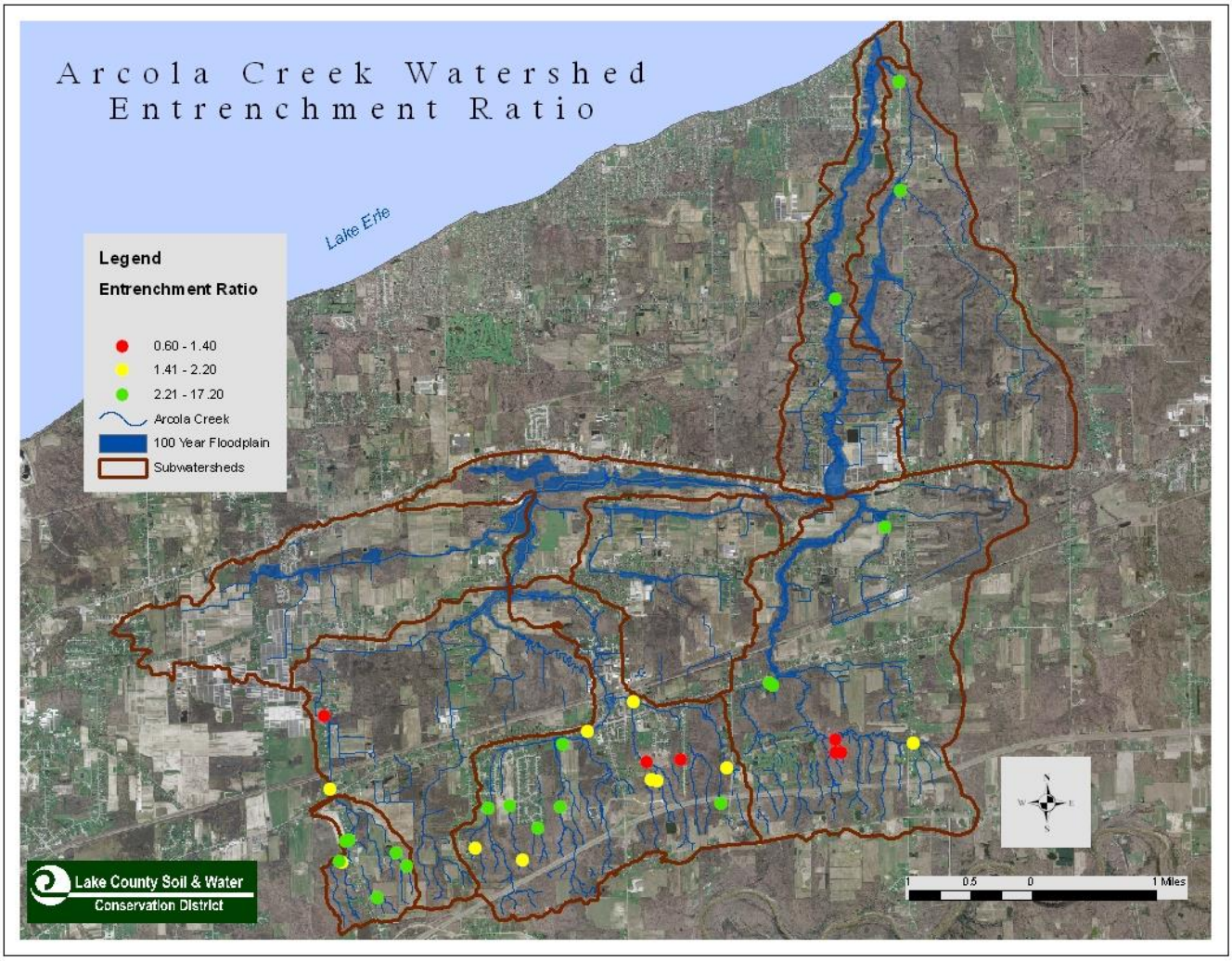
2. Channel and floodplain condition

Does the channel have access to an appropriate sized floodplain? Figure 66 shows the level of entrenchment by subwatershed. Out of 36 sites sampled, 19 had low entrenchment values, 10 had medium values and 7 had high entrenchment values. The locations of the sampled sites are shown in Figure 67.

Figure 66: Entrenchment Ratio Table

	Low	Medium	High	# of Sites
County Line South	3	1	3	7
State Route 528	6	7	3	16
Wood Road	6	1		7
Dayton Road		1	1	2
McMackin Road				
U.S. 20				
Arcola Road				
Dock Road	1			1
County Line North	3			3
Total	**19**	**10**	**7**	**34**

Figure 67: Entrenchment Ratio Map



3. Forested riparian corridor assessment

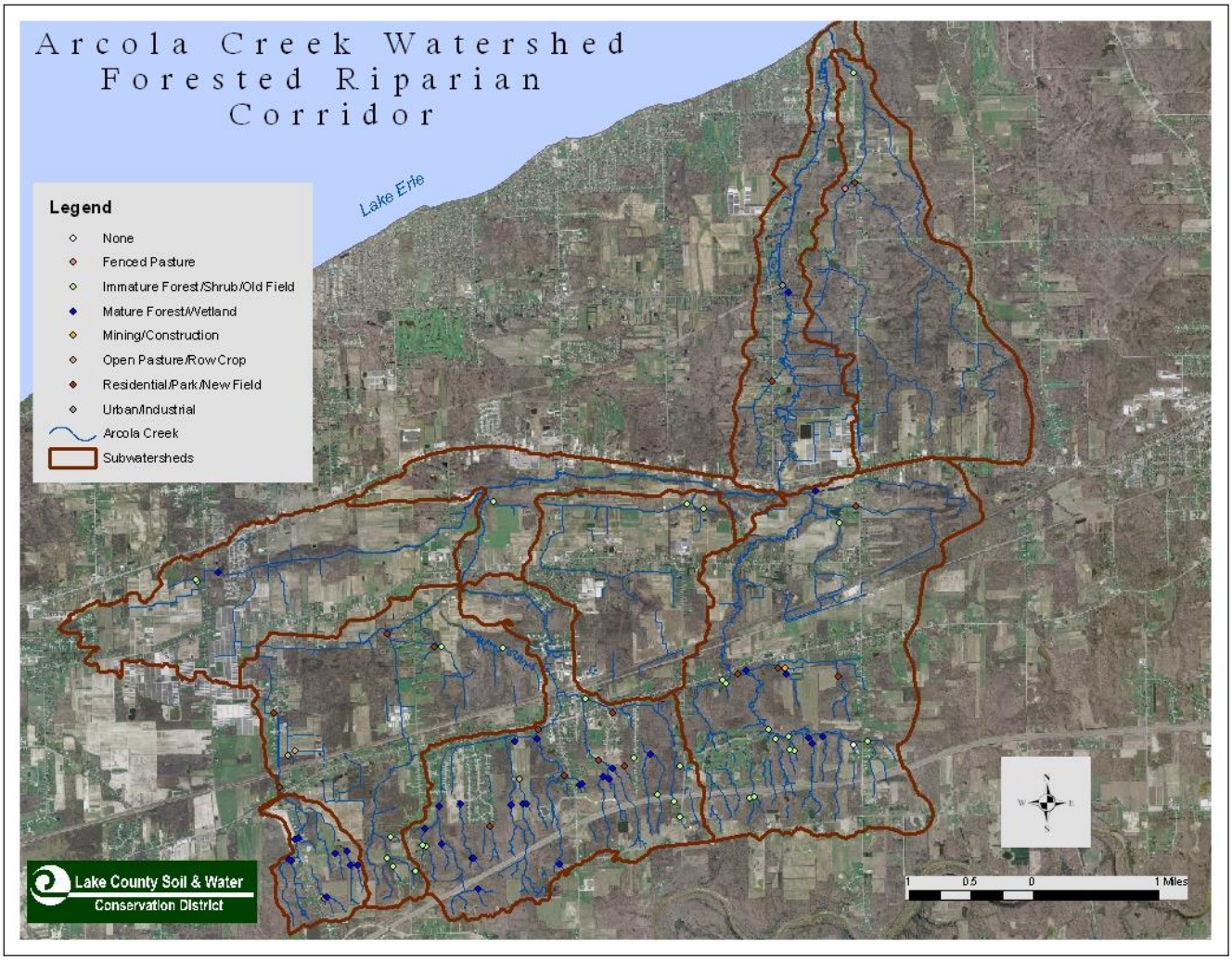
A forested riparian corridor is an important factor in the health of a stream. Trees provide shade to cool the water temperatures in the summer, stabilize the stream banks thereby reducing bank erosion and sedimentation, absorb floodwaters and absorb nutrients, reducing the amounts entering the water.

The data for the following table was gathered during the HHEI field evaluations in 2000 through 2002. Of the sample sites, the types of riparian corridor that were most present were Mature Forest/Wetland- occurring in 36 locations, Immature Forest/Shrub/Old Field, occurring in 29 locations and Residential/Park/New Field- occurring in 18 locations.

Figure 68: Forested Riparian Corridor Quality Table

Category	CLS	528	Wood	Dayton	McMackin	20	Arcola	Dock	CLN
None	2								
Immature Forest/Shrub/Old Field	11	8		6	1		2		1
Open Pasture/Row Crop				2					
Fenced Pasture			1						1
Mature Forest/Wetland	6	19	9			1		1	
Mining/Construction	1	1							
Urban/Industrial								1	
Residential/Park/New Field	4	6		4		2		1	1
Number of Sites Sampled	24	34	10	12	1	3	2	3	3

Figure 69: Forested Riparian Corridor Quality Map



4. Number of miles with forested natural riparian buffer

It can be seen on the forested riparian corridor map above (Figure 69) that the headwater stretches are mostly forested, with a few exceptions, including a golf course, some housing developments and a few agricultural fields. Interstate 90 also cuts a swath through the forested headwater segments. In the middle reaches of the watershed, there are more nursery fields, with an occasional forested section. The lower stretch along Dock Road is predominantly forested, with low density residential areas lining the mainstem.

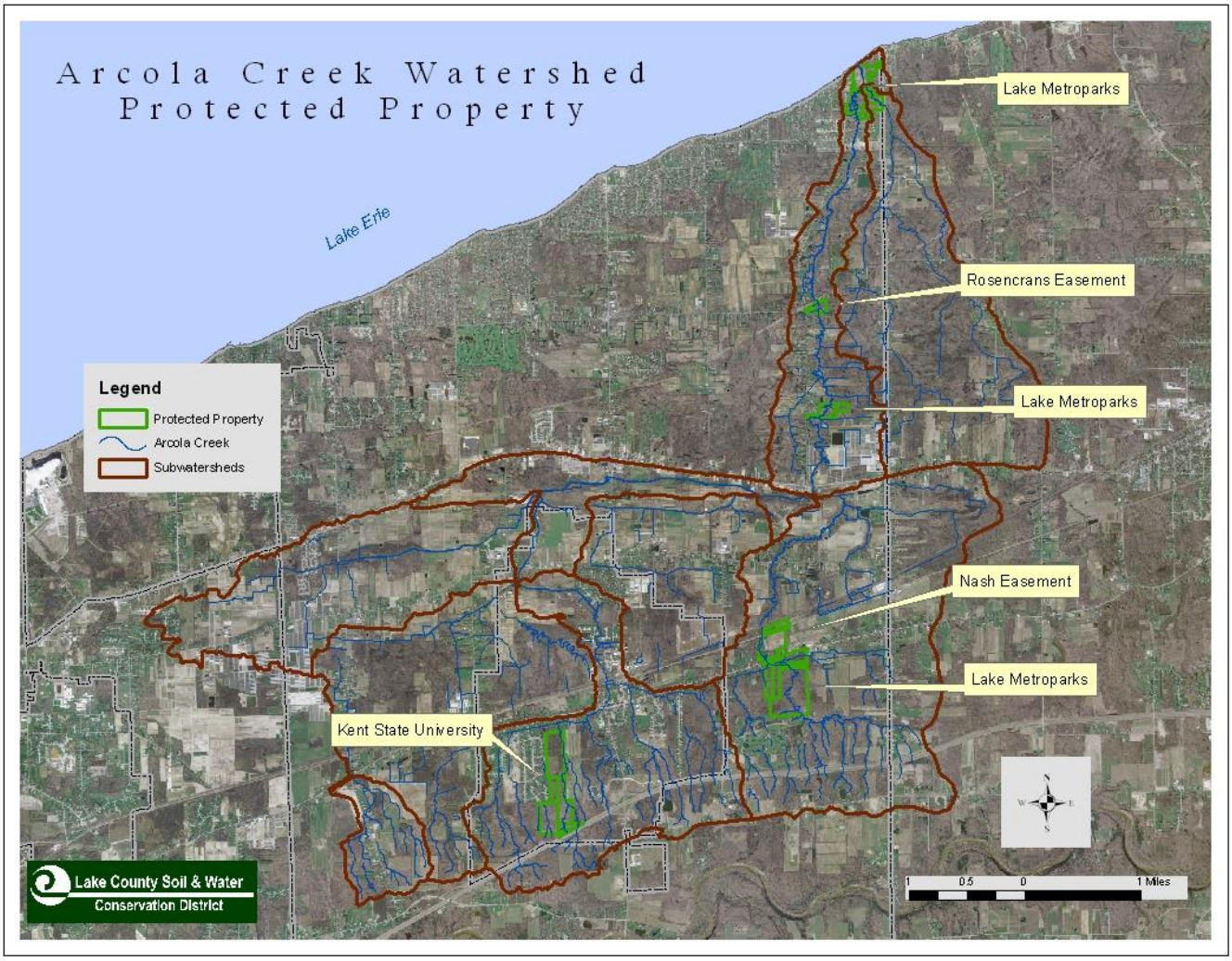
5. Number of miles with permanent protection

Three subwatersheds have stream sections that are protected. In the County Line South subwatershed, the parcels are protected by Lake Metroparks South Ridge Reservation and the Nash Easement, held by Lake County Soil & Water Conservation District. The State Route 528 subwatershed has property protected by Kent State University. The Dock Road subwatershed has Lake Metroparks Arcola Park, and an easement as well as the Rosencrans easement held by Lake SWCD.

Figure 70: Miles of Protected Property

County Line South	1.9
State Route 528	1.37
Dock Road	1.66

Figure 71: Protected Property



6. Miles of natural channel

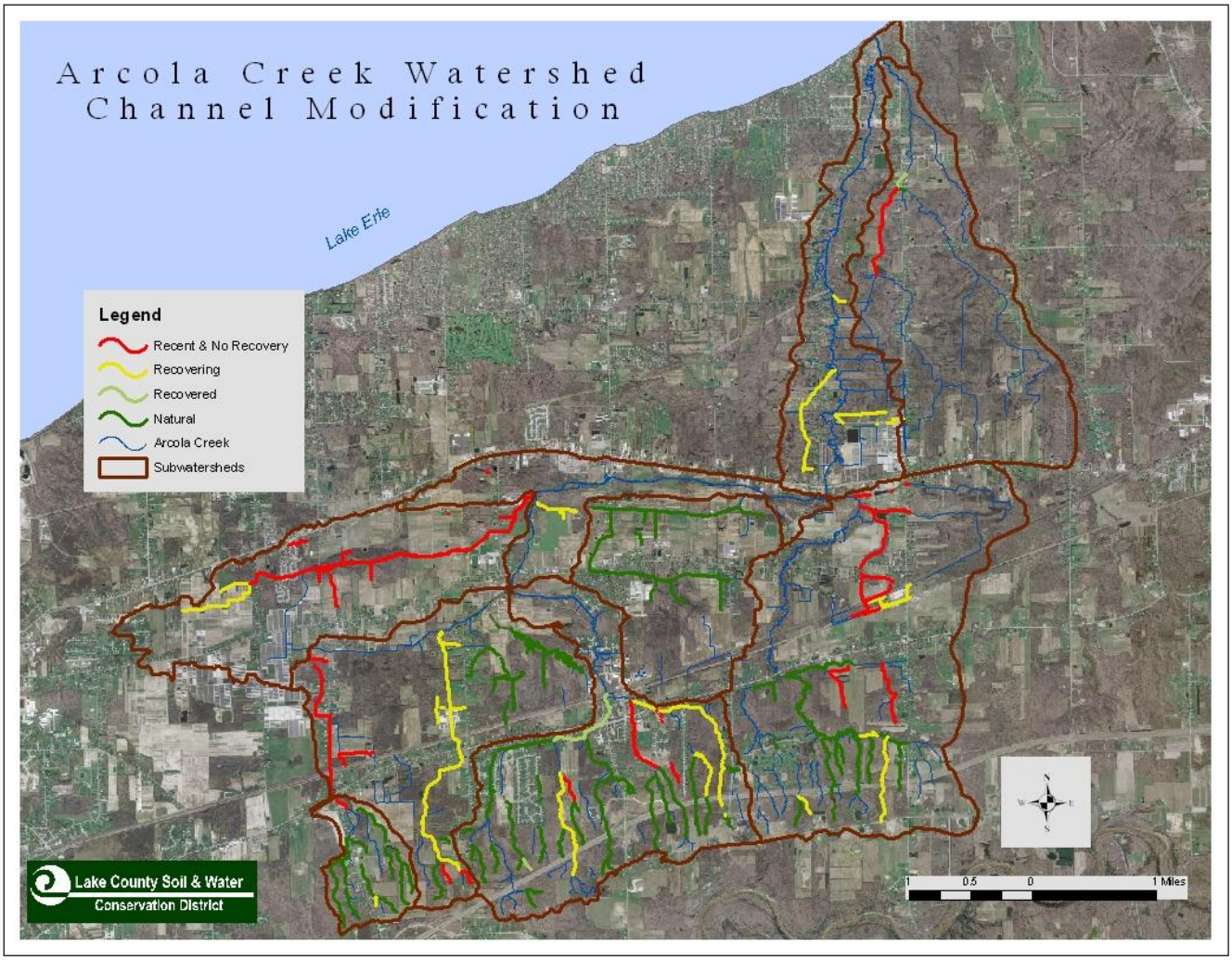
As a part of the HHEI data collection, the condition of the stream channel was assessed, using four categories to characterize channel modification: Natural Channel, Recovered Channel, Recovering Channel and Recent or No Recovery. Although the data was collected at point locations, it represents the channel characteristics from that point upstream to the next confluence. Keep in mind that the HHEI was not done on the lower reaches of the Main Stem because the HHEI is only appropriate for smaller watersheds. The Main Stem in the U.S. Route 20 subwatershed as well as the lower sections of the upper watersheds have not had data collected. Data collection in these areas using other measurement systems may become necessary in the future.

The headwaters have the most miles of natural channel. The subwatersheds that have more residential, commercial and industrial development have been modified by ditching and channelization in efforts to drain the water more quickly from the infrastructure.

Figure 72: Miles of Natural Channel

County Line South	5.26
State Route 528	9.33
Wood Road	3.77
Dayton Road	4.02
McMackin Road	0
U.S. 20	0
Arcola Road	4.35
Dock Road	0
County Line North	0.07

Figure 73: Channel Modification



7. Miles & location of modified channel

Only three subwatersheds have had little channel modifications, where data has been collected: Wood Road, Arcola and County Line North. The U.S. 20 subwatershed looks relatively unchanged, but many sections along Route 20 have been ditched and channelized- there is just no data. The major areas channel modifications are found in the County Line South, S.R. 528, Dayton Road and McMackin subwatersheds. See Figure 73.

Figure 74: Miles of Modified Channel

County Line South	5.3
State Route 528	5.12
Wood Road	0.07
Dayton Road	5.13
McMackin Road	0.48
U.S. 20	6.62
Arcola Road	0
Dock Road	1.72
County Line North	1

8. Dams

There are no dams in the watershed.

9. Channelization

Areas of channelization can be easily identified from the map since streams rarely travel in straight lines. In the midsection of the County Line South subwatershed, the channels were interrupted by the railroad tracks and straightened to run parallel to the tracks for about a half a mile. The northwest section of the Dayton Road subwatershed along Wood Road has some right angles, and in the western end of the McMackin subwatershed the channel has been moved to flow around nursery fields.

10. Streams with unrestricted livestock access

There are very few livestock operations in the watershed. There is a beef cattle operation in the U.S. 20 subwatershed, in the northwestern corner of Madison Village with approximately 1400 feet of unfenced tributary. There is also a smaller mixed backyard livestock field in the north-central section of the County Line South subwatershed with approximately 400 feet of unfenced stream.

11. Eroding banks

A cement company on Cashen Road in the Dock Road subwatershed straddles the Arcola Main Stem. It has no vegetative buffer on either side of the creek, and cement trucks

drive through the Creek for convenience and to avoid crossing on the Cashen Road bridge, which currently has weight load restrictions. The Lake County Engineer has plans to replace the bridge by 2015.

The outer edge of the channel is eroding north of Middle Ridge Road, where the Creek flows under Middle Ridge just east of the Madison High School complex. Riprap has been placed in efforts to address the issue, but the erosion issue will likely be addressed in the Watershed Action Plan in a more natural way through upstream channel restoration.

Channel erosion in the mainstem along Dock Road is severe where the channel meanders in snake-like curves. It is damaging nursery operations and providing a heavy sediment load to the Arcola Estuary and Lake Erie.

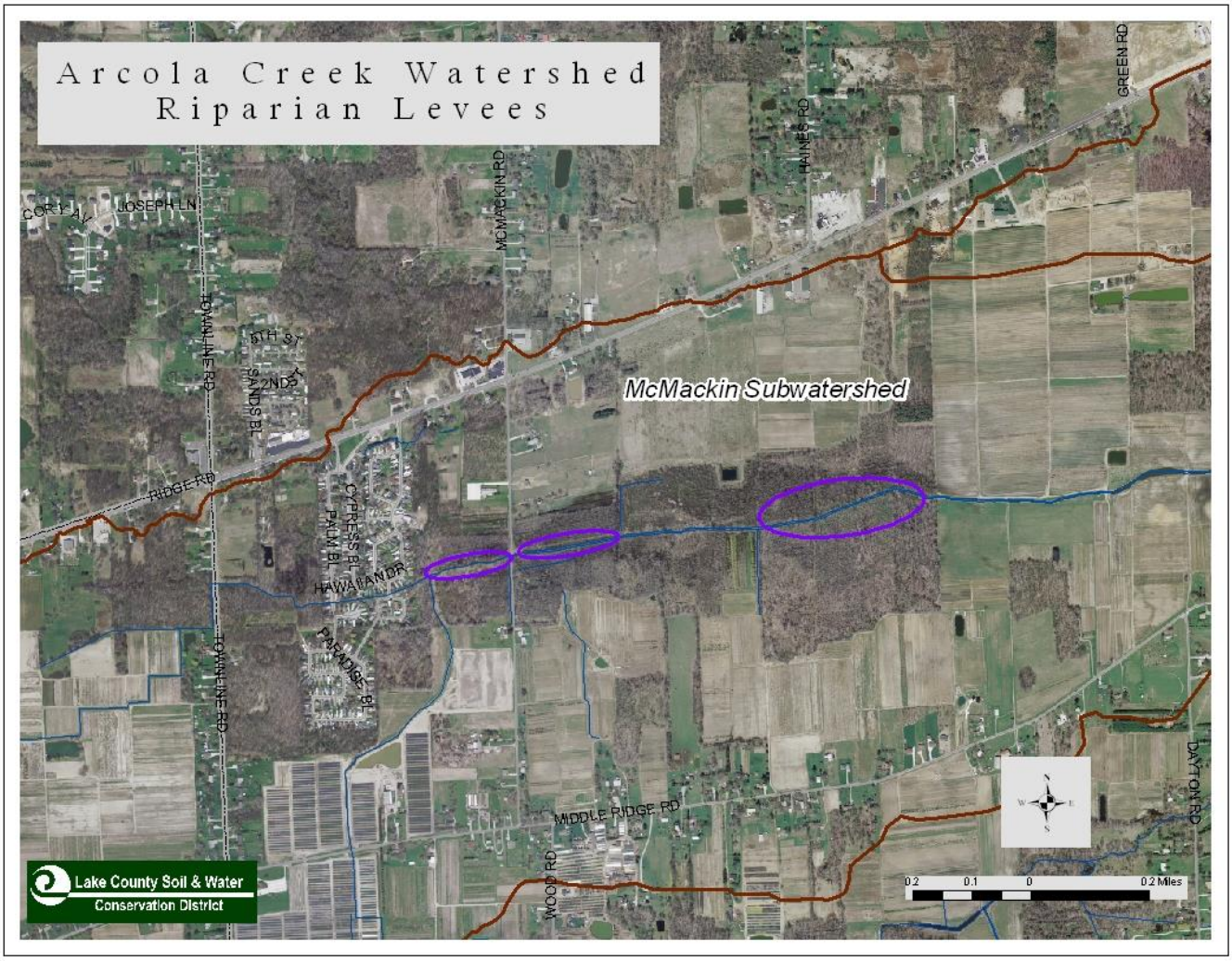
12. Floodplain connectivity

In general, the connectivity to the floodplain in the Arcola Creek watershed is moderately good. As stated in Channel and floodplain condition, ii above, 19 had low entrenchment values, 10 had medium values and 7 had high entrenchment values out of the 36 sites sampled. The watershed tends to be flashy during precipitation events, particularly in Madison Village, where there are more impervious areas and greater changes in elevation.

13. Riparian levees

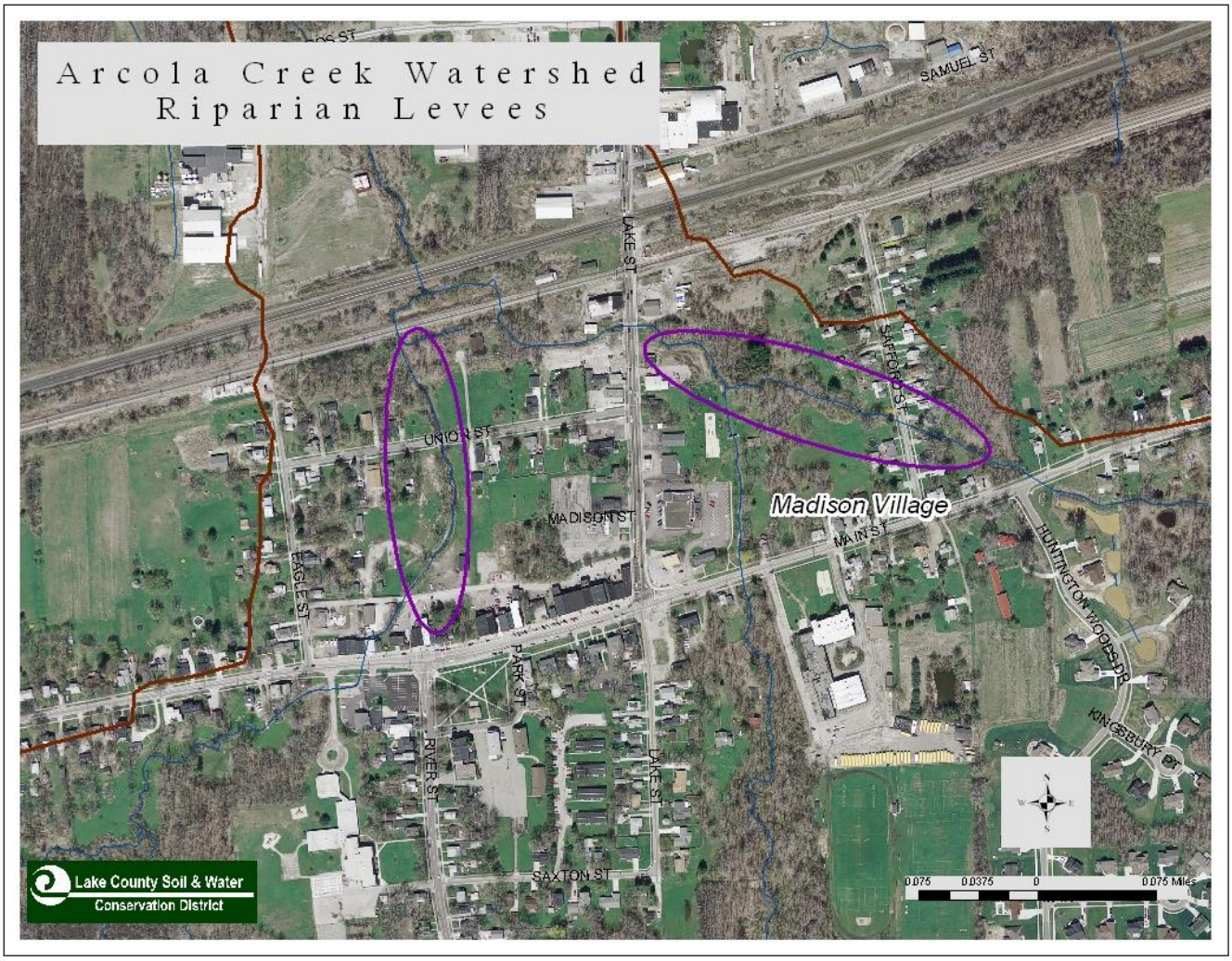
The Lake County Stormwater Management Department (SMD) works closely with Madison Township to address stormwater issues in the Township. When the SMD cleans out the creek channel, it removes the spoil and seeds disturbed areas. In the past, prior to the creation of the SMD, the creek was ditched and the spoils were mounded on the channel banks in a few areas. These areas have been identified by the SMD as being in the McMackin subwatershed east and west of where the Arcola crosses McMackin Road. (See Figure 75.) This area has been notorious for slow moving flow, and it is known locally as McMackin Ditch. The spoil areas have been there so long that large trees are growing in it. It restricts the flow on the north side of the channel and it should be a priority to restore the floodplain access in this section.

Figure 75: Riparian Levees in Madison Township



There are two sections in Madison Village in the S.R. 528 subwatershed where the floodplain access has been limited by the streamside placement of ditching spoils: behind Madison Village Hall to the railroad tracks, and where the creek flows west from Safford Street to Lake Street. (See Figure 76.)

Figure 76: Riparian Levies in Madison Village



14. Entrenched miles

There are approximately 3.1 miles of entrenched channel in the Arcola Creek Watershed. This was calculated using the HHEI sample sites that show entrenchment ratios of 1.4 and less- or the medium to high entrenchment levels. The entrenched stream channel was measured starting at the sample site going upstream to the next sample site of a lower entrenchment level.

15. Status and Trends

Development activity has slowed with the economic downturn and the Lake County Planning Commission does not see major residential growth in the future, except in the unlikely event that the water and sewer lines are extended south of U.S. 20. In Perry Township, at the western end of the watershed off of Middle Ridge Road homes continue to be built at a slow pace in Azalea Ridge subdivision. The Madison School District is

building a new Middle School to the west of the existing High School complex; work commenced in the winter of 2012.

There will likely be continuing tourism development, with the proximity to Lake Erie and to the regional vineyards, which should be concentrated by the I-90 exit at S.R. 528. The Ohio Department of Transportation is currently replacing the S.R. 84 culvert east of Lake Street in Madison Village, changing from a 60 inch steel corrugated culvert to a 4 foot by 8 foot concrete box culvert. This will be completed by May 2012. The Cashen Road bridge will be replaced by 2015. There are no other road reconstruction or bridge projects planned at this time in the watershed.

E. Water Resource Quality

1. Attainment Status

a. Number of miles in full attainment

The water quality in Arcola Creek has been assessed by the USEPA for Aquatic Life Use, and it was given an impaired status in 2010. In addition to the overall categorization of the watershed as impaired, the level of attainment was broken down to show 54% of the stream miles as fully attaining applicable aquatic life uses and 46% as partial/non-attaining.

The Human Health, Public Drinking Water Supply and Recreational Uses were not assessed.

The Ohio EPA Division of Surface Water also assessed the watershed in 2010. It assessed the Aquatic Life Use as 5hx, which translates to Impaired: TMDL needed. The h means the assessment was based on historical data and the x means that data was retained from the previous 2008 report. The Recreational Use and Fish Tissue Assessments were both reported as use attainment unknown, and the Public Drinking Water Assessment was reported as not applicable.
The Ohio EPA has designated 11 miles from the mouth as Warmwater Habitat (WWH) and 4.8 miles as Seasonal Salmonid Habitat (SSH).

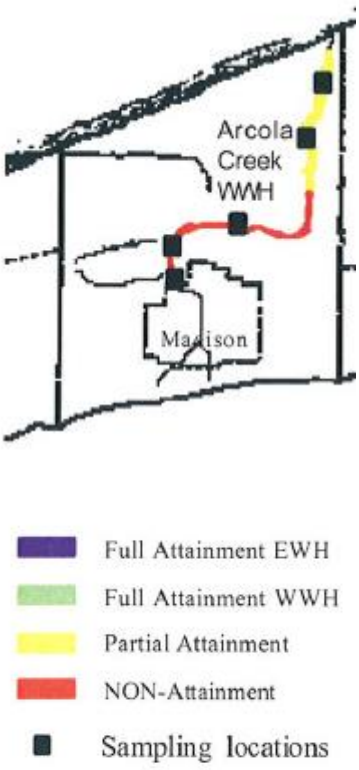
b. Number of threatened miles

This data is not available.

i. Number of miles in partial attainment

According to the USEPA, 46% of the stream miles were in partial or non-attainment. The Ohio EPA 1995 Biological and Water Quality Study of the Grand and Ashtabula River Basins shows a sketch where the creek from the mouth to just north of the U.S. 20 intersection is in partial attainment, and the section from that point to the north edge of Madison Village is in non-attainment. Refer to Figure 77 below.

Figure 77: Attainment Status for stream segments (Ohio EPA. 1995.)



ii. Number of miles in non-attainment

In its 1995 (published in 1997) Biological and Water Quality Study, the Ohio EPA Division of Surface Water found that four out of five locations sampled did not meet Warm Water Habitat (WWH) criteria, which resulted in 7 miles of non-attainment.

iii. Number of streams designated but not monitored

There are no streams that are designated but not being monitored.

iv. Lakes/quality

This information is not available.

v. Wetlands/quality

This information is not available.

vi. Groundwater/quality

The Ohio ERIN Watershed Report listed 15,057.8 acres of area highly sensitive to groundwater contamination. It also shows the aquifer vulnerability as between Moderately High and High in the sandy beach ridge areas.

2. Causes and sources of impairment or threats

The Ohio EPA 2010 Waterbody Report listed the following causes of impairment:

- Cause Unknown
- Direct Habitat Alterations
- Flow Alterations
- Nutrients
- Organic Enrichment/Low Dissolved Oxygen.

The Ohio EPA 1995 Biological and Water Quality Study listed the causes of biological impairment as habitat modifications, water withdrawals, nutrient loadings from the Madison Waste Water Treatment Plant (WWTP) and an unidentified source of enrichment upstream of the WWTP. It also listed water withdrawals by local nurseries for irrigation as responsible to reducing the stream flow in late summer to extremely low or no flows, severely limiting the habitat available to aquatic life. Oxygen depletion in the middle reach of Arcola Creek was a factor, likely a result of enrichment from the WWTP. In addition, the pesticide dieldrin was found at river mile 7.3 in concentrations that are chronically toxic to aquatic life.

The sources of impairment were determined to be:

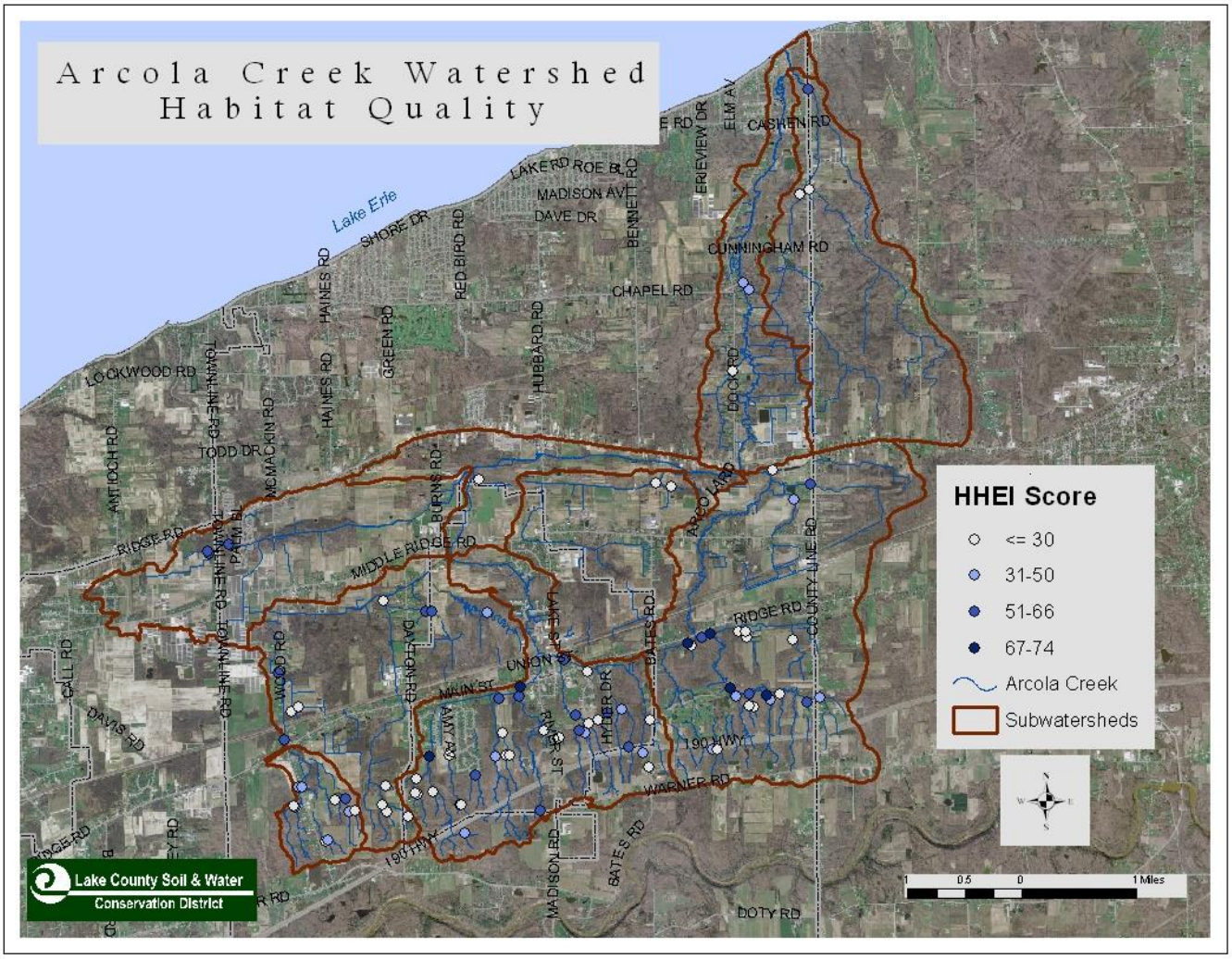
- Channelization from development
- Flow modification from development
- Minor municipal point source
- Source unknown

The creek had recently been channelized at river mile 7.3, 7.1 and 5.0, which had severely degraded the physical habitats. The work at river mile 5.0 was not sanctioned under EPA 404 or 401 permits.

Ohio EPA's Appendix A-1 to volume 1 of the 1996-305b includes an Ecological Priority List with Aquatic Life Long Term Restorability Categories. Using QHEI data, Arcola Creek was rated with a Moderate to High restorability, where the mean QHEI scores are greater than or equal to 60 and less than 75. The Mean QHEI river-wide was 49.7; the Minimum was 34 and the Maximum was 67.5. The range of scores is rather large; it reflects a watershed that is not built out, but where the low gradient makes it hard for the stream to fix itself.

Lake County Soil & Water Conservation District gathered HHEI data in the Arcola Creek watershed over a two year period from May 2000 through August 2002. The HHEI scores ranged from 8 to 74. 49% of the sites had an HHEI score below 30, 19.5% were in the 31 to 50 range, 25 % were in the 51 to 66 range and only 6.5% were above 67. The scores are mapped in Figure 78, below.

Figure 78: Arcola Habitat Quality



The stream Class provides the ultimate indication of the aquatic life use designation of a primary headwater habitat stream, regardless of the biology and the HHEI score from a site. The HHEI allows a determination of the aquatic life use potential, but according to the Ohio EPA protocol, biological surveys must be done to determine if the potential is being realized, or if the existing use is impaired by some other factor, such as a wastewater discharge.

The three types of primary headwater streams (PHWH) in Ohio, categorized by the Ohio EPA are as follows:

1. Class III-PHWH Stream, which has cool to cold water adapted native fauna
2. Class II-PHWH Stream, with warm water adapted native fauna
3. Class I-PHWH Stream, which is an ephemeral stream with a normally dry channel

Channels that have been historically altered by man are classified as “modified”.

The determination of a stream’s class is based upon an assessment of the biological community and the presence or lack of indicator species.

Class III-PHWH 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.

Figure 79 shows the stream classes for the sampled sites in the watershed, highlighting the stream sections that are the most impaired.

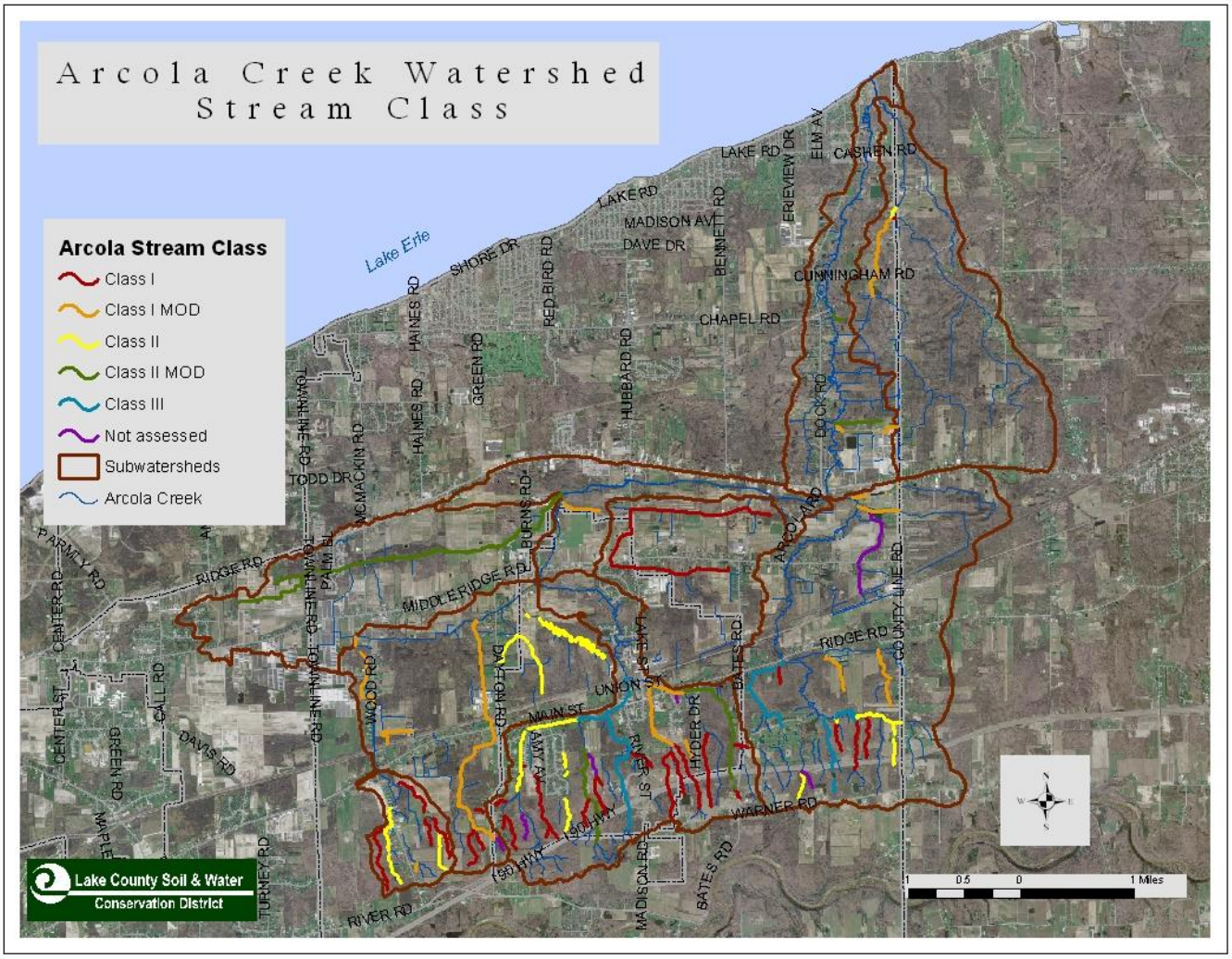
Figure 79: Stream Class Summary

Stream Class	Length in Feet	Percent of Total	Combined Class %
Class I	17,905	46%	58.6%
Class I Modified	4,937	12.6%	
Class II	8,674	22.2%	37.6%
Class II Modified	6,026	15.4%	
Class III	837	2.2%	
Undesignated	738	1.6%	

Ohio EPA Division of Surface Water estimates the miles of Class I-PHWH in Ohio as 21.8% of the total, Class II-PHWH as 31% and Class III-PHWH as 16.5% of the total unnamed streams in the State. (OEPA. 2002.)

For a view of the stream classes by subwatershed, refer to Section 3, Water Resources inventory and Figures 25 through 33.

Figure 80: Arcola Stream Class



3. Point sources

a. Permitted discharges

Ten entities in the watershed have National Pollution Discharge Elimination System (NPDES) permits from the Ohio EPA.

Figure 81: **NPDES Permits**

Lake County Madison WWTP	7815 Cashen Rd.
Madison Health Care Inc.	7600 S. Ridge Rd.
Madison Care Center Inc./Broadfield Care Center	7927 Middle Ridge Rd.
JETY, Inc./Yogi's Place	7924 North Ridge Rd.
Dean's Restaurant	6080 North Ridge Rd.
Alexson Services/Stewart Lodge	7774 Warner Rd.
Living Opportunities/Lakeland Nursing Home	3142 County Line Rd.

Holly Ridge Apartments	7327 North Ridge Rd.
Village of Madison WWTP	Middle Ridge Rd.
Braff Mobile Home Park Co.	5300 North Ridge Rd.

b. Spills and illicit discharges

The Lake County General Health Department (LCGHD) estimates a 10% failure rate of the Home Sewage Treatment Systems (HSTS) in the watershed. The LCGHD has received an average of two sewage nuisance complaints in the watershed since 1987.

4. Non-point sources

a. Inventory of home sewage treatment systems

The Lake County General Health Department provided the following sewage treatment information for the Arcola Creek watershed.

Figure 82: Sewage Treatment Statistics

Total no. Household Sewage Treatment Systems (HSTS)**	994
No. of soil absorption HSTS	979
No. of discharging HSTS	15
Total no. of commercial Sewage Treatment Systems (STS)**	75
No. of commercial soil absorption STS	63
No. of commercial discharging STS	12
No. of commercial STS <25,000gpd	9
No. of commercial STS >25,000gpd	3

**The total numbers of systems is based on records contained in the Health District files and does not necessarily represent every sewage system that exists.

The average range for HSTS in watershed is 5-40 years old; the average age is 25 years.
The average number of sewage nuisance complaints since 1987 is 2 per year.
The average flow for a HSTS is 360-480 gpd.

Existing commercial STS over 25,000 gpd by location are the Braff Mobile Home Park Co. (aka Sahara Manufactured Home Park), 5300 N. Ridge Rd., Madison; Lake County Madison WWTP, 7815 Vrooman Rd., Madison; Village of Madison WWTP, Middle Ridge Rd., Madison

All the lots in the watershed in Ashtabula County have HSTS.

There are no Ohio EPA permitted combined sewer outflow locations.

b. Number of new homes being built

The housing market has slowed with the economic state. The only construction in the Township as reported by the Planning Commission is in the Azalea Ridge subdivision in the McMackin subwatershed. 46 sublots were recorded in 2006 and homes are slowly being built there.

c. Number and size of animal feeding operations

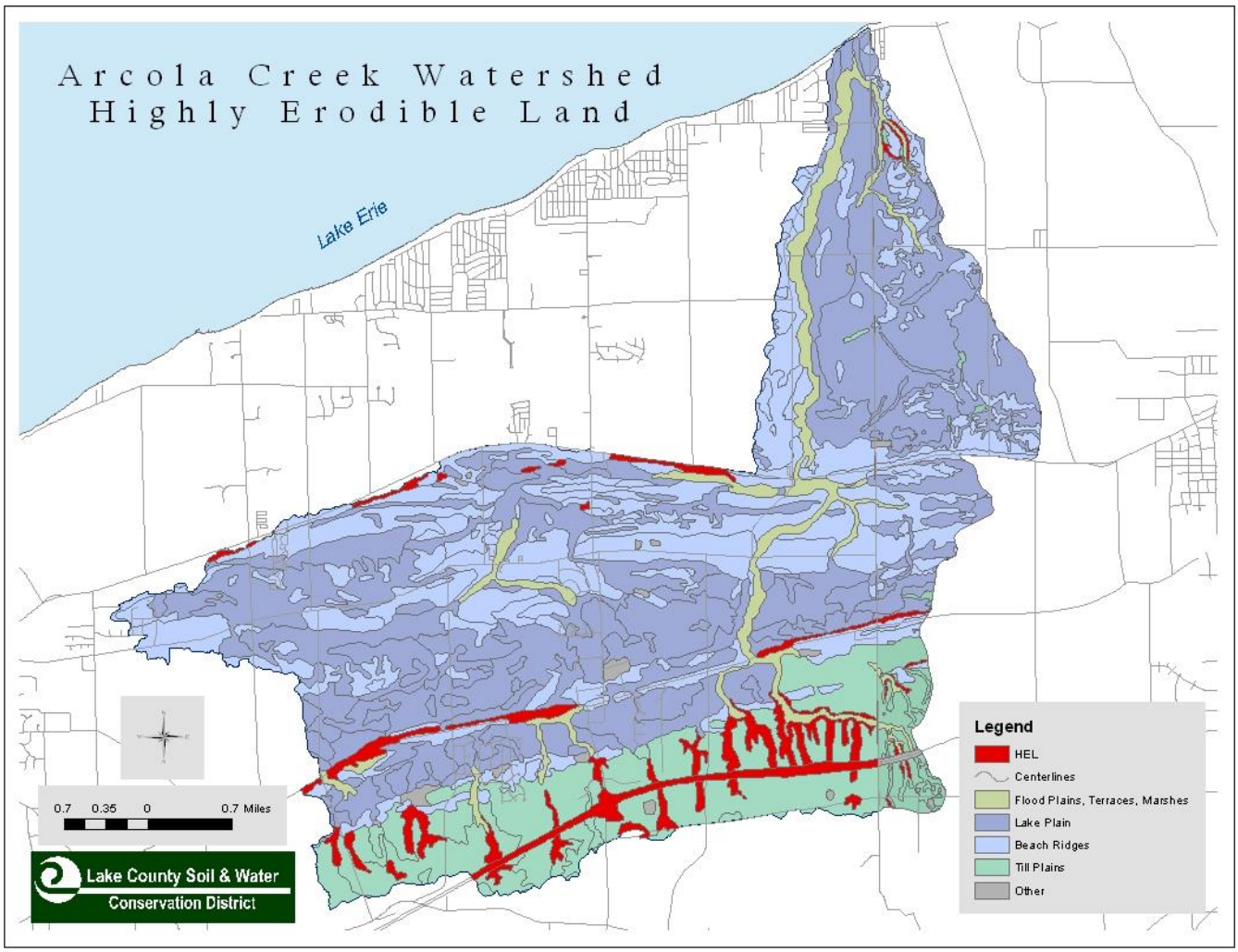
There are no feedlots in the watershed, but is one farm pasturing beef in the south-central section of the U.S. 20 subwatershed. There are two or three other small parcels where landowners are raising small numbers of mixed livestock; see section 10 in the Physical Attributes inventory on pg. 111.

d. Acres of Highly Erodible Land (HEL) and potential soil loss

The Natural Resource Conservation Service has an equation for determining Highly Erodible Land that uses slope steepness and slope length, which it uses on individual properties. For the purposes of this inventory, it is acceptable to use slopes of 6% or greater to indicate HEL on the watershed scale. There are 786 acres of HEL in the Arcola Creek Watershed, which is 5% of the watershed area. Refer to Figure 83, below. The HEL are found on the steeper slopes in the headwaters, along the beach ridges and along the man-made infrastructure of I-90. The small circular areas in the northern part of the County Line North subwatershed do not look like highly erodible areas on the map, and will require some field investigation.

The potential soil loss is difficult to determine on a watershed basis because it will vary with each soil type and management type (cropland, urban, grass, forest etc.) used on the land.

Figure 83: Highly Erodible Land (HEL)



e. Is the stream culverted?

Arcola Creek flows in an open channel throughout the watershed, except where it flows under road crossings. There are several culverts installed on private property for crossing purposes, which may be undersized and may be restricting the flow in the U.S. 20 subwatershed.

f. Is the stream channelized?

Some sections of the watershed have been channelized. In the midsection of the County Line South subwatershed, the channels were interrupted by the railroad tracks and straightened to run parallel to the tracks for about a half a mile. The northwest section of the Dayton Road subwatershed along Wood Road has some right angles, and in the western end of the McMackin subwatershed the channel has been moved to flow around nursery fields.

g. Is the stream levied?

Just a few sections of Arcola Creek were levied in the past. They are located near the McMackin Road crossing in Madison Township, and in the Madison Village Center. See Figures 75 and 76, Riparian Levies in Madison Township and Madison Village, respectively, for the locations. The Stormwater Management Department's stream channel cleaning policy is to remove the spoils from the site.

h. Is the stream exhibiting little human impact?

The watershed has a mix of developed areas, nursery fields and forested lands. It has been impacted by humans through the removal of trees to fuel the bog iron furnaces, an increase in impervious areas with the construction of roads, houses and commercial areas, the construction of sewage treatment facilities, and through subsurface drainage to move the water quickly off the land. The impacts are seen in increased flooding, channel degradation, nutrient pollution and habitat loss. However, these impacts are relative when compared to urbanized watersheds, and the watershed planning and implementation process is very timely, giving the community an opportunity to direct its future growth in a manner that minimizes its impact on the watershed.

There are periods of low flow, which are currently being attributed to excessive water withdrawals from the nursery industry for irrigation purposes; however it is not known whether this attribution is correct. Low flows may be a natural characteristic of the Arcola Creek watershed, and this will be researched as a part of the Watershed Action Plan.

i. What's the effluent volume?

There are nine commercial sewage treatment systems that discharge less than 25,000 gallons per day and three that discharge more than 25,000 gpd. The average flow for a HSTS is 360-480 gpd.

j. Is the stream dammed?

There are no dams in the watershed, but there are several excavated on-line ponds.

k. Is the stream officially classified or unofficially maintained as petition ditches?

There are no petition ditches in the watershed.

5. Status and trends

Building in the floodplain should cease; where there are riparian setbacks, it should be remembered that the floodplain is usually wider than the setback distance. New residential developments should utilize conservation development practices to preserve sensitive riparian areas, and the Township and Village would do well to implement financial incentives for such practices.

Natural channels will begin to alter and degrade from stormwater flows when impervious cover reaches and exceeds 10%. The impervious cover in the Arcola Creek watershed is currently at 3.42%. New construction should use Low Impact Development (LID)

techniques, such as infiltration trenches or basins and pervious parking areas as a routine practice. Riparian setbacks and the establishment of trees along the riparian corridor will further protect the natural channels.

The low gradient and poor substrates of the watershed, which are natural features and the long history of channel modifications, due to man-made activities will always limit the amount of habitat available. However, increasing the groundwater recharge and reducing the surface and groundwater withdrawals will help to increase the quality of the water resources. (Edgar. 2004.)

The philosophy for maintaining drainage and stream health throughout the watershed should be oriented to restoring natural channel function wherever possible rather than continuing the historic cycle of ditching and channel modification.

IV. WATERSHED IMPAIRMENTS

A. Pollutant Loading

The watershed has no TMDL; the EPA projects that it will do a TMDL in 2017. In the absence of a TMDL, Arcola Creek watershed impairments have been identified by the Ohio EPA Biological and Water Quality Study of The Grand and Ashtabula River Basins including Arcola Creek, Cowles Creek and Conneaut Creek (Ohio EPA. 1997), the Ohio EPA 2010 Waterbody Report, and Ohio EPA's Appendix A-1 to volume 1 of the 1996-305b. The following is a review of the causes and sources of impairment or threats section on pages 116 & 117.

The Ohio EPA 2010 Waterbody Report listed the following causes of impairment:

- Cause Unknown
- Direct Habitat Alterations
- Flow Alterations
- Nutrients
- Organic Enrichment/Low Dissolved Oxygen.

The sources of impairment were determined to be:

- Channelization from development
- Flow modification from development
- Minor municipal point source
- Source unknown

The Ohio EPA 1995 Biological and Water Quality Study listed the causes of biological impairment as:

- habitat modifications
- water withdrawals
- nutrient loadings from the Madison Waste Water Treatment Plant (WWTP)
- an unidentified source of enrichment upstream of the WWTP

- water withdrawals by local nurseries for irrigation reducing the stream flow in late summer, severely limiting the habitat available to aquatic life
- oxygen depletion in the middle reach of Arcola Creek likely from WWTP enrichment
- dieldrin found at river mile 7.3 in concentrations that are chronically toxic to aquatic life

1. Modeling

Modeling programs exist to estimate the nutrient and sediment loadings for a watershed, when empirical data are not available. The Spreadsheet Tool for Estimating Pollutant Load (STEPL) program developed by the USEPA was used to provide loadings of nitrogen, phosphorus and sediment from different land uses for purposes of this watershed action plan. The USEPA Region 5 model was used to estimate agricultural nonpoint source pollution loadings. Both models were utilized to estimate loadings, estimate the load reductions with both urban and agricultural best management practices and to develop reduction goals. Input from the stakeholders and technical advisors was also used to assess the health of the watershed and to develop the plan's goals, objectives and actions. In the following section, the Problem Statements outline the watershed restoration and protection goals.

2. Habitat Conditions

The watershed naturally has low gradient in the lake plain and poor substrates, which will always limit the amount of habitat available. However, human activities that disrupt the natural function and habitat of the watershed can be minimized. The philosophy of this watershed action plan is to restore habitat and stream health throughout the watershed wherever possible rather than continuing the historic cycle of ditching and channel modification. We can capitalize on the natural cleaning and flood management services that healthy streams provide through the macroinvertebrates, and reduce the costs and impacts associated with managing the watershed in any other way.

V. WATERSHED RESTORATION AND PROTECTION GOALS

A. Problem Statements

Problem Statement 1: Arcola Creek is impaired due to 8,000 pounds of excess Nitrogen from stormwater runoff, agricultural cropland, pastureland and failing HSTS.

Goal 1: Reduce the annual nitrogen load by 1,500 pounds per year from stormwater runoff

Objective 1 Establish 20 acres of bioretention

Action 1: Conduct meeting with public officials and Giant Eagle plaza business owners

Action 2: Seek grant funding to establish demonstration site

Objective 2 Install 10’ x 10’ pervious collars around all drain inlets in Giant Eagle Commercial plaza at Rt. 20 and Rt. 528

Action 1: Schedule meeting with business owners

Action 2: Seek grant funding

Objective 3 Restore 5,000 feet of Class I, Class II and modified streams

Action 1: Hold landowner meeting

Action 2: Seek grant funding for restoration

Objective 4 Eliminate barriers to floodplain on 5,000 feet of stream channel by removing previously placed spoils from old ditching methods

Action 1: Coordinate with Stormwater Management Department

Action 2: Ensure that this restoration will not affect wetlands that may have been created by the spoil placement

Objective 5 Restore 3,000 feet of floodplain connectivity on headwater streams with entrenchment ratios of >2.2

Action 1: Coordinate with Stormwater Management Department

Action 2: Seek additional grant funding if needed

Objective 6 Create new floodplains to function as stormwater infrastructure along 2,500 feet of waterway corridors

Action 1: Coordinate with Stormwater Management Department

Action 2: Seek additional grant funding if needed

Objective 7 Restore riparian vegetation on 5,000 feet of stream corridor

Action 1: Hold landowner meeting

Action 2: Seek grant funding for restoration

Action 3: Look into establishing volunteer network to help with planting

Action 4: Source plants from local nurseries

Objective 8 Reforest 5,000 feet of agricultural “ditches” with riparian buffers

Action 1: Hold landowner meeting

Action 2: Seek grant funding for restoration

Action 3: Look into establishing volunteer network to help with planting

Action 4: Source plants from local nurseries

Objective 9 Establish riparian setback policies in Geneva Township

Action 1: Schedule meeting with Geneva Township officials

Action 2: Work with Planning Commission to develop policies

Objective 10 Plant 500 trees in urban settings

Action 1: Partner each community with the ODNR Division of Forestry Urban Forester to develop and implement an urban forestry management plan

Action 2: Engage the Madison Garden Club to do some projects

Objective 11 Increase infiltration by 20%

Action 1: Create policies for planting, maintaining and protecting trees and the soil in which they grow

Action 2: Seek grant to cost-share program to help landowners replace impervious pavement with pervious driveways

Action 3: Encourage the use of low impact development BMPs

Action 4: Sponsor a contest for the three ugliest landscaped yards and re-design using rain gardens and pervious hard surfaces

Objective 12 Establish 20 linear feet of bioretention above each catch basin to pre-treat I-90 runoff in median

Action 1: Meet with ODOT and develop protocol

Action 2: Seek grant funding

Objective 13 Install infiltration trenches in ditches 20' above catch basins or above ditches outletting to streams in soils having no high water table

Action 1: Work with Stormwater Management Department and County Engineer

Action 2: Seek outside grant funding as needed

Objective 14 Reduce imperviousness by 20% as roadways are reconstructed by redoing aprons with pervious surfaces where the soils are conducive to infiltration

Action 1: Schedule meeting with County Engineer and Stormwater Management Department

Objective 15 Build stormwater detention pond in Parkway development

Action 1: Coordinate with Madison Village

Action 2: Build pond off-line

Action 3: Seek source of funding

Goal 2: Reduce the nitrogen from cropland by 1,200 pounds per year

Objective 1 Install 200 linear feet of micro-irrigation on nursery land

Action 1: Schedule meeting with nursery owners

Action 2: Utilize NRCS EQIP programs

Action 3: Seek other sources of funding

Objective 2 Re-design five on-line irrigation ponds as off-line ponds

Action 1: Inventory on-line ponds

Action 2: Contact landowners

Action 3: Seek funding source

Objective 3 Establish 2,500 square feet of bioretention cell and subsurface gravel wetlands

Action 1: Hold nursery meeting

Action 2: Seek Conservation Innovation Grant

Action 3: Do a demonstration project at Lake County Nursery

Objective 4 Reforest streambanks with riparian buffers on 5,000 linear feet of agricultural "ditches"

Action 1: Hold landowner meeting
Action 2: Seek grand funding for restoration
Action 3: Look into establishing volunteer network to help with planting
Action 4: Source plants from local nurseries

Objective 5 Restore the riparian corridor on 5,000 feet of stream channels with riparian buffers

Action 1: Conduct a public meeting on maintaining the riparian corridor to restore natural stream functions
Action 2: Identify locations in the watershed where there is no riparian corridor present or where riparian corridor is too narrow
Action 3: Outreach to landowners to create a list of restoration sites
Action 4: Identify locations to harvest live whips of dogwood and willow
Action 5: Organize a community day with volunteers to install live whips on restoration sites

Goal 3: Reduce the nitrogen from pastureland by 500 pounds per year

Objective 1 Restore riparian buffers on 50 % of pasturelands

Action 1: Work with NRCS to design buffer
Action 2: Seek funding through EQIP program

Objective 2 Restore filter strips on 50 % of pasturelands

Action 1: Work with NRCS to design filter strips
Action 2: Seek funding through EQIP program

Objective 3 Promote pasture nutrient management practices on all pasturelands

Action 1: Develop nutrient management plans through NRCS

Objective 4 Exclude all livestock from streams

Action 1: Develop livestock exclusion practices through NRCS

Goal 4: Reduce 500 pounds of nitrogen by preserving wetlands

Objective 1 Establish conservation easements on 1600 acres of existing wetlands

Action 1: Hold easement workshop
Action 2: Create map of potential wetland resources
Action 3: Prioritize parcels based on size potential
Action 4: Look for grant dollars to match easement purchase programs
Action 5: Create wetland mitigation packages
Action 6: Create list of cash and in-kind "match" wetlands

Objective 2 Create new wetlands on 60 acres

Action 1: Inventory potential wetland restoration sites using hydric soils, LIDAR data, aerial photos and parcels
Action 2: Conduct wetland restoration meeting

Action 3: Distribute USDA fact sheet to landowners on cost share programs
Action 4: Crush field tile in restoration areas
Action 5: Conduct annual field day for wetland restoration

Objective 3 Improve 10 acres of Category 1 wetlands by improving plant quality
Action 1: Determine extent of invasives in watershed
Action 2: Conduct wetland restoration meeting
Action 3: Remove invasives
Action 4: Seed to increase diversity
Action 5: Plant live plants & trees to increase diversity
Action 6: Raise or lower water levels to favor certain species to create diversity of habitat

Objective 4 Create wetland seed bank program
Action 1: Develop fact sheet on USDA cost share programs
Action 2: Create a recommended plant list and list of vendors
Action 3: Outreach to potential landowners on priority sites
Action 4: Organize annual field day
Action 5: Replant five sites with purchased plant material as grant funding is available

Objective 5 Educate landowners on benefits/effects on habitat and community quality of life and community cost of services of wetlands
Action 1: Identify landowners with wetlands
Action 2: Create brochure
Action 3: Hold workshop for landowners, realtors and public officials
Action 4: Erect educational signs on preserved & improved wetlands
Action 5: Create list of beneficial uses and consumptive uses of wetlands as an alternative to fill/impact

Goal 5: Reduce the nitrogen from incomplete sewage treatment by 3,800 pounds per year
Objective 1 Repair 10 malfunctioning HSTS
Action 1: Perform dry weather screening of all outfalls to determine where further sampling is needed
Action 2: Perform further outfall sampling (wet weather or fecal coliform)
Action 3: Interpret data and identify sources of potential pollution
Action 4: Implement corrective measures through Lake County General Health District process
Action 5: Seek funding to provide grants for low income residents, and encourage use of Linked Deposit Loan program for HSTS repairs or replacements

Objective 2 Repair any of the 75 commercial sewage treatment systems that are malfunctioning

Action 1: Perform fecal coliform sampling to locate malfunctioning commercial sewage treatment systems
Action 2: Refer owners of malfunctioning commercial sewage treatment systems to Ohio EPA for compliance
Action 3: Seek funding for small businesses to provide cost-share for necessary repairs

Objective 3 Bring all 12 discharging commercial sewage treatment systems into compliance with their NPDES permit

Action 1: Perform fecal coliform sampling to locate malfunctioning commercial sewage treatment systems
Action 2: Refer owners of malfunctioning commercial sewage treatment systems to Ohio EPA for compliance
Action 3: Seek funding for small businesses to provide cost-share for necessary repairs

Objective 4 Bring Sahara Mobile Home Park into compliance with its NPDES permit

Action 1: Seek funding source and compliance

Objective 5 Bring the Madison Village Wastewater Treatment Plant into compliance with EPA standards

Action 1: Monitor EPA progress until accomplished

Goal 6: Reduce nitrogen by 500 pounds by reaching attainment of aquatic life use status

Objective 1 Restore stream habitat on 1,000 feet of Class I, Class II and modified streams

Action 1: Increase the score of habitat metrics (QHEI > 55 and HHEI > 50)
Action 2: Prioritize sites by score
Action 3: Outreach to landowners on priority list to identify willing participants
Action 4: Create a restoration template
Action 5: Identify funding sources

Problem Statement 2: Arcola Creek is impaired due to 4,000 pounds of excess phosphorus from failing HSTS, agricultural cropland and stormwater runoff.

Goal 1: Reduce the phosphorus load by 1,500 pounds per year from failing HSTS

Objective 1 Repair 10 malfunctioning HSTS

Action 1: Perform dry weather screening of all outfalls to determine where further sampling is needed
Action 2: Perform further outfall sampling (wet weather or fecal coliform)
Action 3: Interpret data and identify sources of potential pollution
Action 4: Implement corrective measures through Lake County General Health District process

Action 5: Seek funding to provide grants for low income residents, and encourage use of Linked Deposit Loan program for HSTS repairs or replacements

Objective 2 Repair any of the 75 commercial sewage treatment systems that are malfunctioning

Action 1: Perform fecal coliform sampling to locate malfunctioning commercial sewage treatment systems

Action 2: Refer owners of malfunctioning commercial sewage treatment systems to Ohio EPA for compliance

Action 3: Seek funding for small businesses to provide cost-share for necessary repairs

Objective 3 Bring all 12 discharging commercial sewage treatment systems into compliance with their NPDES permit

Action 1: Perform fecal coliform sampling to locate malfunctioning commercial sewage treatment systems

Action 2: Refer owners of malfunctioning commercial sewage treatment systems to Ohio EPA for compliance

Action 3: Seek funding for small businesses to provide cost-share for necessary repairs

Objective 4 Bring Sahara Mobile Home Park into compliance with its NPDES permit

Action 1: Seek funding source/compliance

Objective 5 Bring the Madison Village Wastewater Treatment Plant into compliance with EPA standards

Action 1: Monitor EPA progress until accomplished

Goal 2: Reduce the phosphorus associated with runoff from urban areas by 50 pounds per year

Objective 1 Establish 20 acres of bioretention

Action 1: Conduct meeting with public officials and Giant Eagle plaza business owners

Action 2: Seek grant funding to establish demonstration site

Objective 2 Plant 500 trees in the urbanized environment to clean and reduce stormwater runoff

Action 1: Conduct an Urban Tree Canopy (UTC) Assessment in urbanized areas of the watershed to quantify the extent and quality of the urban forest resource

Action 2: Partner each community with the ODNR Division of Forestry Urban Forester to develop and implement an urban forestry management plan

Goal 3: Reduce the phosphorus from cropland by 50 pounds per year

Objective 1 Install 200 linear feet of micro-irrigation

Action 1: Hold nursery meeting

Action 2: Seek Conservation Innovation Grant

Objective 2 Re-design 5 on-line irrigation ponds as off-line ponds

Action 1: Hold nursery meeting

Action 2: Seek Conservation Innovation Grant

Objective 3 Establish 2,500 square feet of bioretention cell and subsurface gravel wetlands

Action 1: Hold nursery meeting

Action 2: Seek Conservation Innovation Grant

Action 3: Do a demonstration project at Lake County Nursery

Objective 4 Reforest streambanks with riparian buffers on 5,000 linear feet of agricultural "ditches"

Action 1: Hold nursery meeting

Action 2: Seek grant funding

Action 3: Look into establishing volunteer network to help with planting

Action 4: Source plants from local nurseries

Problem Statement 3: Arcola Creek is impaired due to 1,340 pounds of excess sediment from cropland, pastureland and eroding stream banks.

Goal 1: Reduce the sediment from agricultural areas by 1,000 tons per year

Objective 1 Install 200 linear feet of micro-irrigation

Action 1: Hold nursery meeting

Action 2: Seek Conservation Innovation Grant

Objective 2 Re-design 5 on-line irrigation ponds as off-line ponds

Action 1: Hold nursery meeting

Action 2: Seek Conservation Innovation Grant

Objective 3 Establish 2,500 square feet of bioretention cell and subsurface gravel wetlands

Action 1: Hold nursery meeting

Action 2: Seek Conservation Innovation Grant

Action 3: Do a demonstration project at Lake County Nursery

Objective 4 Reforest streambanks with riparian buffers on 5,000 linear feet of agricultural "ditches"

Action 1: Hold nursery meeting

Action 2: Seek grant funding

Goal 2: Reduce the sediment from eroding streambanks by 340 tons per year

Objective 1 Restore the stream channel and floodplain shape on 5,000 linear feet of streambank where erosion is occurring from channel evolution

Action 1: Hold landowner meeting
Action 2: Seek grant funding
Action 3: Hire design/build contractor
Action 4: Revegetate the bank face with live stakes
Action 5: Identify locations to harvest live whips of dogwoods and willows
Action 6: Organize field days with volunteers to install live whips

Objective 2 Restore and stabilize eroding streambanks on 5,000 linear feet

Action 1: Hold landowner meeting
Action 2: Seek grant funding
Action 3: Hire design/build contractor
Action 4: Revegetate the bank face with live stakes
Action 5: Identify locations to harvest live whips of dogwoods and willows
Action 6: Organize field days with volunteers to install live whips

Objective 3 Establish a 20 foot minimum no-mow zone on the top of the stream bank

Action 1: Hold landowner meeting

Problem Statement 4: Bringing the Arcola Creek Watershed into water quality attainment will require a strong education program across all ages and all land uses to accompany the technical solutions to the watershed action plan. This education program will help bring about changes in philosophy and practice of watershed users and residents.

Goal 1: Promote stewardship through education and engagement

Objective 1 Increase understanding of issues and solutions

Action 1: Direct Mail existing brochure, "Household Habits for Healthy Water" to the 3,800 households in the watershed
Action 2: Develop fact sheet on riparian stewardship for landowners and distribute at community events
Action 3: Develop fact sheet on nursery BMPs and distribute at community events
Action 4: Develop fact sheet on land use BMPs and distribute at community events
Action 5: Develop fact sheet on floodplain services and natural infrastructure and distribute at community events

Objective 2 Collaborate with FOAC on programs and outreach activities

Action 1: Increase membership through activities

Action 2: Utilize member contacts to solicit local business sponsorship of events

Objective 3 Develop K-12 program

Action 1: Train science teachers in Madison High School to teach watershed principles

Action 2: Recruit sponsor for Students & Teachers Restoring a Watershed (STRAW) project

Objective 4 Expand awareness of creek location and services

Action 1: Post signage at crossings and watershed boundaries

Action 2: Create 6 full color wall-sized laminated watershed maps to display at community locations

Action 3: Design 4 permanent weatherproof signs that teach about various aspects of the watershed and install them in local parks and community areas along or near Arcola Creek

Action 4: Purchase a portable display for staff and volunteers to use to promote Arcola Creek Watershed education at public events

Objective 5 Develop outreach program

Action 1: Create a geocache program and place caches at 6 to 10 locations in the watershed to draw regional audiences of different ages and educate them about the importance of headwater streams, the impacts of stormwater and points of historical significance

Action 2: Hold educational workshops on topics such as lawn maintenance habits, rain barrels and rain gardens

Action 3: Hold public meeting and bring in speakers

Action 4: Plan fun run/bike event

Action 5: Hang banners in Madison Village using 10 designs from high school art class contest

Action 6: Write quarterly e-newsletter

Objective 6 Establish volunteer network

Action 1: Train volunteers about watershed functions

Action 2: Schedule annual stream clean up

Action 3: Have display at local events, including Madison Village Social in the Park and Old Fashioned Days

Objective 7 Establish volunteer monitoring program

Action 1: Identify appropriate biology monitoring sites

Action 2: Create flow monitoring program

Action 3: Solicit and train participants

Research Needs

Other issues exist that do not fit into the problem statement format at this time. We cannot measure load reductions until we find more information about how to solve these issues. They are important objectives for restoration of the Arcola Creek Watershed and are included here as research needs and other non-measurable but important practices.

Objective 1 Study the watershed hydrology

Action 1: Partner with the USGS to study whether seasonal low flow conditions are caused by natural geologic and hydrologic conditions or by water withdrawals from Arcola Creek, its tributaries and groundwater

Action 2: Write newspaper articles to educate the community about the importance of water withdrawals and water infiltration on the flow regime of the watershed

Action 3: Conduct a study to determine where regional stormwater management facilities would do the most to reduce flooding, including basins and floodplain expansion

Objective 2 Develop new practices for nursery water management

Action 1: Work with OSU Extension and NRCS

Action 2: Do demonstration projects

Action 3: Obtain grant funding

Objective 3 Retrofit existing stormwater systems where feasible with infiltration BMPs

Action 1: Work with County Engineer and Stormwater Department to inventory

Action 2: Develop schedule

Objective 4 Conduct pilot project in the Rt. 528 subwatershed above the choke point to retrofit driveway aprons in the ROW with pervious surfaces, to see how much infiltration practices will reduce the flooding

Action 1: Schedule meeting with Madison Village, Stormwater Management Department and County Engineer

Action 2: Seek grant funding

Objective 5 Assess where restrictions to stormwater flow are negatively impacting the water quality in the watershed

Action1: Conduct study to assess size of culverts on private property for proper sizing (minimum of 24" suggested for fish passage)

Action 2: Develop guidelines for evaluating whether log jam removals are warranted for stream processes desired

Action 3: Develop policy for daylighting or replacing culverts and storm sewer systems with open channels

Objective 6 Increase storage capacity of stormwater flows

Action 1: Identify vacant parcels, parcels for sale or large tracts conducive to siting of regional basins
Action 2: Convene work group to determine feasibility of basins
Action 3: Seek grant funding

Objective 7 Establish alternative deicing BMPs that reduce the use of chloride-based materials

Action 1: Continue annual LCSMD pollution prevention housekeeping training workshop for roadway departments that operate within the watershed

Objective 8 Establish sensible salting protocol for roadway departments

Action 1: Inventory deicing application procedures
Action 2: Map sensitive application locations implemented by public roadway maintenance departments and look for areas of concern
Action 3: Assess salt storage structure practices at Madison Village salt storage facility, schools, libraries and other community facilities as possible sources of discharge
Action 4: Provide training in equipment calibration

Objective 9 Establish sensible salting protocol explicitly for watershed commercial and residential landowners

Action 1: Conduct a training workshop for private commercial property owners, residential property owners and private contractors conducting deicing operations within the watershed
Action 2: Develop and distribute an informational pamphlet on deicing BMPs

VI. IMPLEMENTATION

Plan implementation actions and priorities are listed in the following tables. The nitrogen, phosphorus and sediment reduction objectives and actions are convergent, and so are presented in one table.

The importance of headwater stream restoration is reflected in the actions and priorities of the plan. Headwater streams contain most of the stream miles of a watershed. When headwater streams have been changed by ditching or the filling of floodplains the impacts are a reduction in floodplain storage, higher channel velocities, increased downstream peak flows and increased flood heights. Restoring and managing headwater streams in a natural condition allows floodwaters to flood, drop sediments and lose their erosive energy; vegetation further slows and stores floodwaters, and downstream peak flows and flood heights are reduced and lowered.

NUTRIENT & SEDIMENT REDUCTION PRIORITIES					
Objective	**Action**	**Agencies Involved**	**Funding Source**	**Cost**	**Time Line**
HIGH Priority					
Establish 20 acres of bioretention	Conduct meeting with public officials and Giant Eagle plaza business owners	LCSMD, CRWP, Madison Twp., LSWCD			2013
Establish 20 acres of bioretention	Seek grant funding to establish demonstration site	LCSMD, Madison Twp., LSWCD	Ohio EPA SWIF, Ohio EPA 319, LEPF	$16.53 sq.ft.	2013-2018
Install 10' x 10' pervious collars around all drain inlets in Giant Eagle Commercial plaza	Schedule meeting with business owners	LCSMD, LSWCD, CWRP			2014
Install 10' x 10' pervious collars around all drain inlets in Giant Eagle Commercial plaza	Seek grant funding		Ohio EPA 319, Ohio EPA SWIF, GLRI, LEPF	$3,500 per practice installed	2013-2018
Restore 5,000 feet of Class I, Class II and modified streams	Hold landowner meeting	LSWCD, LCSMD			2013
Restore 5,000 feet of Class I, Class II and modified streams	Seek grant funding for restoration	LSWCD, LCSMD	Ohio EPA SWIF, Ohio EPA 319, GLBP for Erosion & Sediment Control, GLRI, Clean Ohio Fund, WRRSP, LEPF, NFWF Five-Star, NFWF Stewardship Grants	$75-200/ LF	2013-2018
Restore stream channel & floodplain shape on 5,000 feet of streambank where erosion is occurring from channel evolution	Hold landowner meeting	LSWCD, LCSMD			2013
Restore stream channel & floodplain shape on 5,000 feet of streambank where erosion is occurring from channel evolution	Seek grant funding	LSWCD, LCSMD	Ohio EPA SWIF, Ohio EPA 319, GLBP for Erosion & Sediment Control, GLRI, Clean Ohio Fund, WRRSP, LEPF, NFWF Five-Star, NFWF Stewardship Grants	$75-200/ LF	2013-2018
Restore stream channel & floodplain shape on 5,000 feet of streambank where erosion is occurring from channel evolution	Hire design/build contractor	LSWCD, LCSMD			2013-2018
Restore stream	Revegetate the bank	LSWCD, LCSMD			2013-

NUTRIENT & SEDIMENT REDUCTION PRIORITIES					
Objective	**Action**	**Agencies Involved**	**Funding Source**	**Cost**	**Time Line**
channel & floodplain shape on 5,000 feet of streambank where erosion is occurring from channel evolution	face with live stakes				2018
Restore stream channel & floodplain shape on 5,000 feet of streambank where erosion is occurring from channel evolution	Identify locations to harvest live whips of dogwoods and willows	LSWCD, LCSMD, NGLCO		$50-75/ac	2013-2018
Restore stream channel & floodplain shape on 5,000 feet of streambank where erosion is occurring from channel evolution	Organize field days with volunteers to install live whips	LSWCD, LCSMD, NGLCO			2013-2018
Restore and stabilize eroding streambanks on 5,000 feet	Hold landowner meeting	LSWCD, LCSMD			2013
Restore and stabilize eroding streambanks on 5,000 feet	Seek grant funding	LSWCD, LCSMD	Ohio EPA SWIF, Ohio EPA 319, GLBP for Erosion & Sediment Control, GLRI, Clean Ohio Fund, WRRSP, LEPF, NFWF Five-Star, NFWF Stewardship Grants	$150-200/LF	
Restore and stabilize eroding streambanks on 5,000 feet	Hire design/build contractor	LSWCD, LCSMD			2013-2018
Restore and stabilize eroding streambanks on 5,000 feet	Revegetate the bank face with live stakes	LSWCD, LCSMD		$50-75/ac	2013-2018
Restore and stabilize eroding streambanks on 5,000 feet	Identify locations to harvest live whips of dogwoods and willows	LSWCD, LCSMD, NGLCO			2013-2018
Restore and stabilize eroding streambanks on 5,000 feet	Organize field days with volunteers to install live whips	LSWCD, LCSMD, NGLCO			2013-2018
Establish 20 foot minimum no-mow zone on top of the stream bank	Hold landowner meeting	LSWCD, LCSMD			2013
Eliminate barriers to floodplain on 5,000 feet of stream channel by removing previously placed spoils	Coordinate with LCSMD	LCSMD, Madison Township, Madison Village, Ashtabula County	LCSMD, Ohio EPA 319, Ohio EPA SWIF, WRRSP	$75/ LF	2013-2015

NUTRIENT & SEDIMENT REDUCTION PRIORITIES					
Objective	**Action**	**Agencies Involved**	**Funding Source**	**Cost**	**Time Line**
Eliminate barriers to floodplain on 5,000 feet of stream channel by removing previously placed spoils	Ensure that this restoration will not affect wetlands that may have been created	LCSMD, Madison Township, Madison Village, Ashtabula County			2013-2015
Restore 3,000 feet of floodplain connectivity on headwater streams with entrenchment ratios of > 2.2	Coordinate with LCSMD	LCSMD, Madison Township, Madison Village, Ashtabula County			2013-2018
Restore 3,000 feet of floodplain connectivity on headwater streams with entrenchment ratios of > 2.2	Seek additional grant funding if needed	LSWCD, LCSMD	LCSMD, Ohio EPA 319, Ohio EPA SWIF, WRRSP	$75-150/ LF	2013-2018
Create new floodplains to function as stormwater infrastructure along 2,500 feet of stream corridors	Coordinate with LCSMD	LSWCD, LCSMD	LCSMD		2013-2018
Create new floodplains to function as stormwater infrastructure along 2,500 feet of stream corridors	Seek additional grant funding if needed	LSWCD	Ohio EPA 319, Ohio EPA SWIF, WRRSP	$75-150/ LF	2013-2018
Restore riparian vegetation on 5,000 feet of stream corridor	Hold landowner meeting	LSWCD			2013
Restore riparian vegetation on 5,000 feet of stream corridor	Seek grant funding for restoration	LSWCD	LCSMD, Ohio EPA 319, SWIF, OPWC, Local funding, USACE, GLBP for Erosion & Sediment Control	$50-75/acre	2013-2018
Restore riparian vegetation on 5,000 feet of stream corridor	Look into establishing volunteer network to help with planting	LSWCD			2013
Restore riparian vegetation on 5,000 feet of stream corridor	Source plants from local nurseries	LSWCD, NGLCO			2013-2018
Reforest 5,000 feet of agricultural “ditches” with riparian buffers	Hold landowner meeting	LSWCD			2013
Reforest 5,000 feet of agricultural “ditches” with riparian buffers	Seek grant funding for restoration	LSWCD, ODNRDF, Madison Township, Madison Village, Perry Township, Ashtabula County, Volunteer Groups, Nursery Growers	LCSMD, Ohio EPA 319, SWIF, OPWC, Local funding, USACE, GLBP for Erosion & Sediment Control		2013-2018

NUTRIENT & SEDIMENT REDUCTION PRIORITIES					
Objective	**Action**	**Agencies Involved**	**Funding Source**	**Cost**	**Time Line**
Reforest 5,000 feet of agricultural "ditches" with riparian buffers	Look into establishing volunteer network to help with planting	LSWCD			2013-2018
Reforest 5,000 feet of agricultural "ditches" with riparian buffers	Source plants from local nurseries	LSWCD, NGLCO			2013-2018
Reforest 5,000 feet of agricultural "ditches" with riparian buffers	Establish a 20 foot no-mow zone on the top of the stream bank	LSWCD			2013-2018
Plant 500 trees in urban settings	Partner each community with the ODNR Division of Forestry Urban Forester to develop and implement an urban forestry management plan	ODNRDF, Madison Township, Madison Village, Perry Township, Ashtabula County, Volunteer Groups, Nursery Growers	ODNRDF		2013-2018
Plant 500 trees in urban settings	Engage the Madison Garden Club to do some projects	ODNRDF, LSWCD, NGLCO			2013-2018
Plant 500 trees in urban settings	Source plants from local nurseries				2013-2018
Install 200 linear feet of micro-irrigation on nursery land	Schedule meeting with nursery owners	LSWCD, OSUE, NGLCO			2013
Install 200 linear feet of micro-irrigation on nursery land	Utilize NRCS EQIP programs	NRCS, LSWCD, OSUE, NGLCO	NRCS EQIP	Potted stock $.04/sq.ft.; Field stock $2,600/acre	2013-2018
Install 200 linear feet of micro-irrigation on nursery land	Seek other sources of funding	LSWCD			2013-2018
Redesign five on-line irrigation ponds as off-line ponds	Inventory on-line ponds	LSWCD			2013
Redesign five on-line irrigation ponds as off-line ponds	Contact landowners	LSWCD			2013
Redesign five on-line irrigation ponds as off-line ponds	Seek funding source	LSWCD	GLPB, LEPF		2013-2018
Restore riparian buffers on 50% of pasturelands	Work with NRCS to design buffers	LSWCD, NRCS			2013-2018
Restore riparian buffers on 50% of pasturelands	Seek funding through EQIP program	LSWCD, NRCS	NRCS EQIP, FSA CRP	$750/acre	2013-2018
Restore filter strips on 50% of pasturelands	Work with NRCS to design filter strips	LSWCD, NRCS			2013-2018
Restore filter strips on 50% of pasturelands	Seek funding through EQIP program	LSWCD, NRCS	NRCS EQIP	$300/acre	2013-2018
Promote pasture	Develop nutrient	NRCS	NRCS EQIP, EPA	$4,000	2013-

NUTRIENT & SEDIMENT REDUCTION PRIORITIES					
Objective	**Action**	**Agencies Involved**	**Funding Source**	**Cost**	**Time Line**
nutrient management practices on all pasturelands	management plans through NRCS				2018
Exclude all livestock from streams	Develop livestock exclusion practices through NRCS	LSWCD, NRCS	NRCS EQIP		2013-2018
Establish conservation easements on 1,600 acres of existing wetlands	Hold easement workshop	LSWCD, WRLC, TNC			2013
Establish conservation easements on 1,600 acres of existing wetlands	Create map of potential wetland resources	LSWCD			2013
Establish conservation easements on 1,600 acres of existing wetlands	Prioritize parcels based on size potential	LSWCD, WRLC			2013
Establish conservation easements on 1,600 acres of existing wetlands	Look for grant dollars to match easement purchase programs	LSWCD, WRLC	Clean Ohio Fund, WRRSP	$2,000-$6,000/acre	2013-2018
Establish conservation easements on 1,600 acres of existing wetlands	Create wetland mitigation packages	LSWCD, WRLC, LCPCD, LMP	Ohio Water Development Authority	$250,000	2013-2018
Establish conservation easements on 1,600 acres of existing wetlands	Create list of cash and in-kind “match” wetlands	LSWCD, WRLC, LCPCD, LMP	Ohio Water Development Authority	$250,000	2013-2018
Repair 10 malfunctioning HSTS	Perform dry weather screening of all outfalls to determine where further sampling is needed	LCGHD, LCSMD	LCGHD		2013-2014
Repair 10 malfunctioning HSTS	Perform further outfall sampling (wet weather or fecal coliform)	LCGHD, LCSMD	LCGHD		2013-2014
Repair 10 malfunctioning HSTS	Interpret data and identify sources of potential pollution	LCGHD			2013-2014
Repair 10 malfunctioning HSTS	Implement corrective measures through LCGHD process	LCGHD			2013-2015
Repair 10 malfunctioning HSTS	Seek funding to provide grants for low income residents, and encourage use of Linked Deposit Loan program for HSTS repairs or replacements	LCGHD	EPA Water Pollution Control Loan Fund, Community Development Block Grant	$5-20,000 per system	2013-2018

NUTRIENT & SEDIMENT REDUCTION PRIORITIES					
Objective	**Action**	**Agencies Involved**	**Funding Source**	**Cost**	**Time Line**
Repair any of the 75 commercial sewage treatment systems that are malfunctioning	Perform fecal coliform sampling to locate malfunctioning commercial sewage treatment systems	LCGHD, LCSMD, OEPA	LCGHD		2013-2014
Repair any of the 75 commercial sewage treatment systems that are malfunctioning	Refer owners of malfunctioning commercial sewage treatment systems to Ohio EPA for compliance	LCGHD			2013-2018
Repair any of the 75 commercial sewage treatment systems that are malfunctioning	Seek funding for small businesses to provide cost-share for necessary repairs	LCGHD		$10-25,000 per system	2013-2018
Bring all 12 discharging commercial sewage treatment systems into compliance with their NPDES permit	Perform fecal coliform sampling to locate malfunctioning commercial sewage treatment systems	LCGHD, OEPA			2013-2018
Bring all 12 discharging commercial sewage treatment systems into compliance with their NPDES permit	Refer owners of malfunctioning commercial sewage treatment systems to Ohio EPA for compliance	LCGHD, OEPA			
Bring all 12 discharging commercial sewage treatment systems into compliance with their NPDES permit	Seek funding for small businesses to provide cost-share for necessary repairs	LCGHD		Upgrades from $10-30,000 per system	2013-2018
Bring Sahara Mobile Home Park into compliance with its NPDES permit	Seek funding source and compliance	LCGHD, OEPA	User fees	$50,000	2013-2014
Bring the Madison Village Wastewater Treatment Plant into compliance with EPA standards	Monitor EPA progress until accomplished	Madison Village, OEPA	Water Pollution Control Loan Fund, Ohio Public Works Commission loans & grants		2013-2018
Restore stream habitat on 1,000 feet of Class I, Class II and modified streams	Increase the score of habitat metrics (QHEI > 55 and HHEI > 50)	LSWCD	SWIF, EPA 319, LEPF, CMAG	$150-200/LF	2013-2018
Restore stream habitat on 1,000 feet of Class I, Class II and modified streams	Prioritize sites by score	LSWCD			2013-2018
Restore stream habitat on 1,000 feet of Class I, Class II and modified streams	Outreach to landowners on priority list to identify willing participants	LSWCD			2013-2018

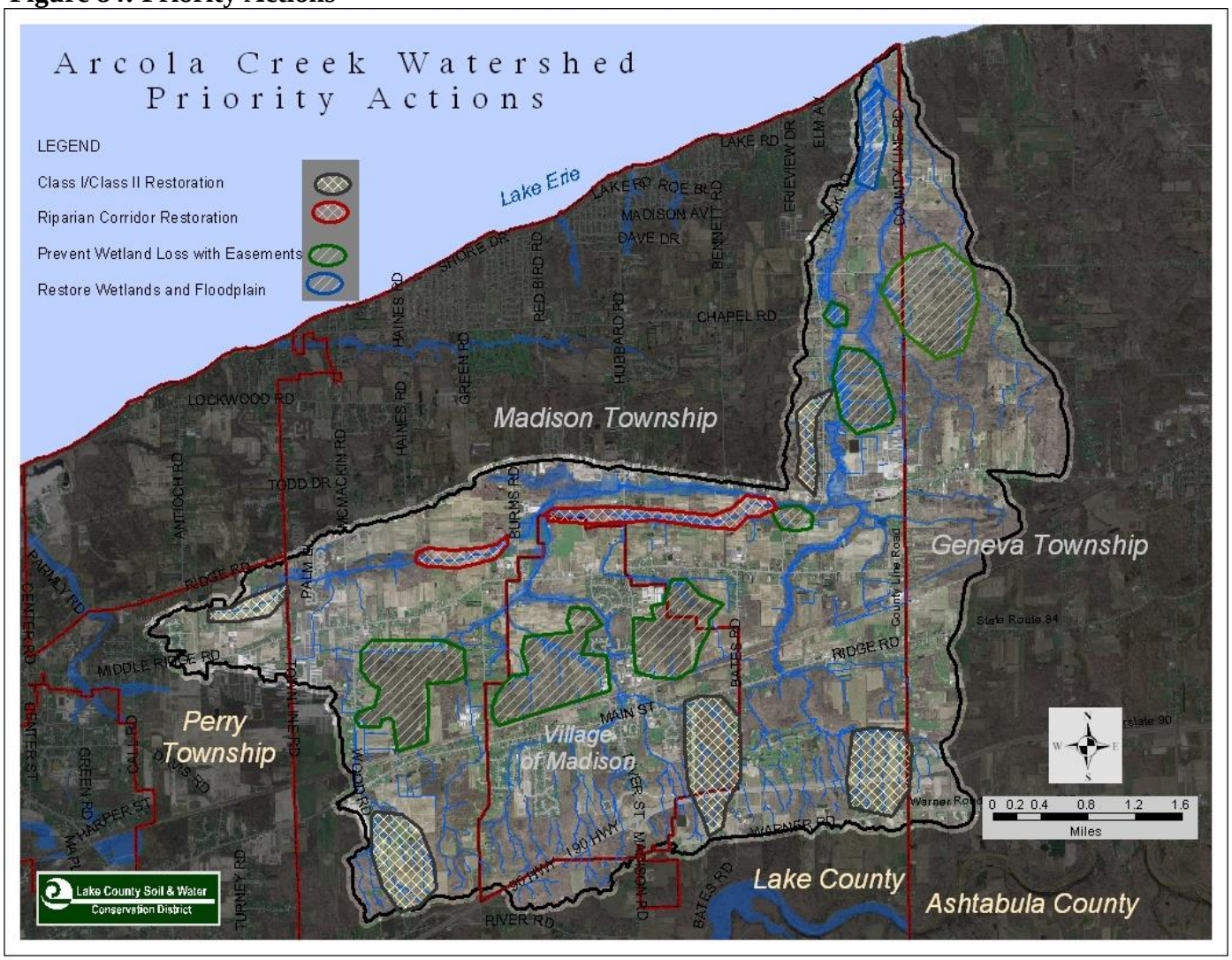
NUTRIENT & SEDIMENT REDUCTION PRIORITIES					
Objective	**Action**	**Agencies Involved**	**Funding Source**	**Cost**	**Time Line**
Restore stream habitat on 1,000 feet of Class I, Class II and modified streams	Create a restoration template	LSWCD	LEPF, CMAG	$15,000	2013
Restore stream habitat on 1,000 feet of Class I, Class II and modified streams	Identify funding sources	LSWCD			2013-2018
MEDIUM Priority					
Establish riparian setback policies in Geneva Township	Schedule meeting with Geneva Township officials	LSWCD, Geneva Township			2014
Establish riparian setback policies in Geneva Township	Work with Planning Commission to develop policies	LSWCD, Lake and Ashtabula Planning			2014
Install infiltration trenches in ditches 20' above catch basins or above ditches outletting to streams in soils with no high water table	Work with LCSMD and LCE	LCSMD, LSWCD	LCSMD		2014-2018
Install infiltration trenches in ditches 20' above catch basins or above ditches outletting to streams in soils with no high water table	Seek outside grant funding as needed		Ohio EPA SWIF	$250/LF	2014-2018
Build stormwater detention pond in Parkway development	Coordinate with Madison Village	LCSMD, Madison Village		$250,000	2014
Build stormwater detention pond in Parkway development	Build pond off-line	LCSMD, Madison Village			2014
Build stormwater detention pond in Parkway development	Seek source of funding	LCSMD, Madison Village	LCSMD, Ohio EPA 319, SWIF, OPWC, Local Funding		2014
Educate landowners on benefits/effects on habitat and community quality of life and community cost of services of wetlands	Identify landowners with wetlands	LSWCD			2014
Educate landowners on benefits/effects on habitat and community quality of life and community cost of services of wetlands	Create brochure	LSWCD, LMP	LEPF, OEEF mini-grant	$1,500	2014
Educate landowners on benefits/effects on	Hold workshop for landowners, realtors	LSWCD, LCPCD	OEEF mini-grant	$2,500	2014

NUTRIENT & SEDIMENT REDUCTION PRIORITIES					
Objective	**Action**	**Agencies Involved**	**Funding Source**	**Cost**	**Time Line**
habitat and community quality of life and community cost of services of wetlands	and public officials				
Educate landowners on benefits/effects on habitat and community quality of life and community cost of services of wetlands	Erect educational signs on preserved & improved wetlands	LSWCD	USFWS Partners for Wildlife	$75/sign	2015
Educate landowners on benefits/effects on habitat and community quality of life and community cost of services of wetlands	Create list of beneficial uses and consumptive uses of wetlands as an alternative to fill/impact	LSWCD	LEPF		2014
LOW Priority					
Increase infiltration by 20%	Create policies for planting, maintaining and protecting trees and the soil in which they grow	ODNRDF, LSWCD	LEPF	$10,000	2014
Increase infiltration by 20%	Seek grant to cost-share program to help landowners replace impervious pavement with pervious driveways	LCSMD, LSWCD	LCSMD, GLRI		2015-2018
Increase infiltration by 20%	Encourage the use of low impact development BMPs	Local Political Subdivisions-Zoning, LCSMD, CRWP, Madison Township, Madison Village, Perry Township, Ashtabula, LSWCD	Ohio EPA 319, SWIF, LEPF	Bioretention cell $16.53/sq.ft., Pervious pavers $11.10/sq.ft., Porous concrete $12.36/sq.ft.	2013-2018
Increase infiltration by 20%	Sponsor a contest to redesign 3 yards with rain gardens and pervious hard surfaces	LSWCD, LCSMD	LCSMD, GLRI	$25,000	2015
Establish 20 L.F. of bioretention above each catch basin to pre-treat I-90 runoff in median	Meet with ODOT and develop protocol	LCSMD, LSWCD	ODOT R&D Program		2015
Establish 20 L.F. of bioretention above each catch basin to pre-treat I-90 runoff in median	Seek grant funding	LCSMD, LSWCD	ODOT R&D Program	$250/LF	2015
Reduce	Schedule meeting with	LCSMD, LCE	LCSMD		2013-

NUTRIENT & SEDIMENT REDUCTION PRIORITIES					
Objective	**Action**	**Agencies Involved**	**Funding Source**	**Cost**	**Time Line**
imperviousness by 20% as roadways are reconstructed by redoing aprons with pervious surfaces where the soils are conducive to infiltration	LCE and LCSMD				2018
Create new wetlands on 60 acres	Inventory potential wetland restoration sites	LSWCD			2015
Create new wetlands on 60 acres	Conduct wetland restoration meeting	LSWCD, LCSMD, LMP			2015
Create new wetlands on 60 acres	Distribute USDA fact sheet to landowners on cost share programs	LSWCD, NRCS			2015
Create new wetlands on 60 acres	Crush field tile in restoration areas				2015-2018
Create new wetlands on 60 acres	Conduct annual field day for wetland restoration	LSWCD, NRCS, LMP			2015-2018
Improve 10 acres of Category 1 wetlands by improving plant quality	Determine extent of invasives in watershed	LSWCD, LMP			2015-2018
Improve 10 acres of Category 1 wetlands by improving plant quality	Conduct wetland restoration meeting	LSWCD, LMP			2015
Improve 10 acres of Category 1 wetlands by improving plant quality	Remove invasives	LSWCD, LMP	NFWF Stewardship Grant, USFWS Partners for Wildlife	$500-3,000/ac	2015-2018
Improve 10 acres of Category 1 wetlands by improving plant quality	Seed to increase diversity	LSWCD, LMP	NFWF Stewardship Grant, USFWS Partners for Wildlife	$800-1,500/ac	2015-2018
Improve 10 acres of Category 1 wetlands by improving plant quality	Plant live plants & trees to increase diversity	LSWCD, LMP	NFWF Stewardship Grant, USFWS Partners for Wildlife	$5-10/ea per quart container	2015-2018
Improve 10 acres of Category 1 wetlands by improving plant quality	Raise or lower water levels to favor certain species to create diversity of habitat	LSWCD, LMP	NFWF Stewardship Grant, USFWS Partners for Wildlife	Project dependent	2015-2018
Create wetland seed bank program	Develop fact sheet on USDA cost share programs	LSWCD, NRCS			2015
Create wetland seed bank program	Create a recommended plant list and list of vendors	LSWCD, NGLCO			2015
Create wetland seed bank program	Outreach to potential landowners on priority sites	LSWCD			2015-2018
Create wetland seed bank program	Organize annual field day	LSWCD, LMP			2015-2018
Create wetland seed bank program	Replant five sites with purchased plant	LSWCD, LMP			2015-2018

NUTRIENT & SEDIMENT REDUCTION PRIORITIES					
Objective	**Action**	**Agencies Involved**	**Funding Source**	**Cost**	**Time Line**
	material as grant funding is available				

Figure 84: Priority Actions



VII. IMPLEMENTATION OF OHIO COASTAL NONPOINT POLLUTION CONTROL PROGRAM

Watershed plans within the Ohio Lake Erie Basin are required to describe how the Management Measures of the Ohio Coastal Nonpoint Pollution Control Program will be implemented, where they are applicable in the watershed.

Congress enacted the Coastal Zone Management Act (CZMA) on October 27, 1972, in recognition of the pressures on our nation's coastal regions. Congress enacted Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA) in November 1990 to specifically address the impacts of nonpoint source pollution on coastal water quality. Section 6217 requires each State with an approved coastal zone management program to develop and submit for approval a Coastal Nonpoint Pollution Control Program (CNPCP) to the USEPA and the National Oceanic and Atmospheric Administration (NOAA). The purpose of the program is "to develop and implement management measures for nonpoint source pollution to restore and protect coastal waters, working in close conjunction with other State and local authorities."

Ohio's Nonpoint Source Management Program is integrated as a part of the Ohio Coastal Management Program (OCMP). It completed an Upgrade in 1999, which contains ten "Guiding Principles" for the state's program, as follows.

Guiding Principles

1. Local groups organized to protect or improve water resources are vital to the successful implementation of nonpoint source programs and projects.
2. The State of Ohio shares responsibility with local agencies and organizations in the implementation of watershed protection projects.
3. Protection and restoration of stream integrity (sinuosity, riparian habitat and flow) is one of the highest priorities of Ohio's nonpoint program.
4. Program priorities are set by involving multiple stakeholders including, but not limited to, government, academia, industry, environmental groups and local citizens.
5. Attention and funding is focused on local watershed and aquifer projects that directly improve water quality.
6. Water resources are prioritized and programs and projects targeted to priority areas.
7. Federal, state and locally funded best management practices have coordinated cost sharing amounts and requirements.
8. Existing regulations that target nonpoint sources are uniformly enforced.
9. Funding is available for nonpoint source research and evaluation of nonpoint source programs and best management practices.
10. Education and training are integral to the success of nonpoint source programs.

Agricultural Protection Measures

3.3.6 Grazing Management
This measure is intended to protect sensitive areas such as streambanks, wetlands, estuaries, ponds, lake shores and riparian zones from physical disturbance and sediment caused by livestock and to reduce direct loading of animal waste into the water body.

The plan contains an Action to encourage landowners who pasture livestock to implement riparian buffers and filter strips, exclude livestock from the stream, and to work with the Natural Resources Conservation Service to develop a nutrient management plan.

3.3.7 Irrigation Water Management
The goal of this measure is to reduce nonpoint source pollution of surface waters caused by irrigation by utilizing the following practices:

1. Operate the irrigation system so that the timing and amount of irrigation water applied match crop water needs;
2. When chemigation is used, include backflow preventers for wells, minimize the harmful amounts of chemigated waters that discharge from the edge of the field, and control deep percolation; and
3. By increasing the water use efficiency, the discharge volume from the system will usually be reduced.

Addressing the needs and issues of the nursery industry is an important component of this plan. Action items include establishing BMPs on nursery land, educating nursery owners about micro-irrigation, installing micro-irrigation systems, establishing bioretention cells and subsurface gravel wetlands to treat and recycle irrigation water, doing research to develop new practices for nursery water management and doing a demonstration project of practices at a respected local nursery.

Urban Protection Measures

5.3.3 Site Development
The goal of this measure is to:

1. Protect areas that provide important water quality benefits and/or are particularly susceptible to erosion and sediment loss;
2. Limit increases of impervious areas, except where necessary;
3. Limit land disturbance activities such as clearing and grading, and cut and fill to reduce erosion and sediment loss; and
4. Limit disturbance of natural drainage features and vegetation.

These practices are addressed in the plan as an integral part of the restoration philosophy. All the communities with the exception of Geneva Township have riparian setbacks, which protect the wetlands and floodplain corridor, allowing the natural infrastructure to

treat the water and limiting the disturbance to the corridor. The plan contains an Action for Geneva Township to develop a riparian setback.

Several Action items call for use of low impact development (LID) practices, which will limit the increases of imperviousness, the land disturbance activities and the disturbance of the natural drainage features and vegetation. Retrofitting developed areas with LID practices will also help to reach these goals.

There are also Actions in the plan to protect the existing wetlands and floodplains through conservation easements, ensuring that they remain intact to provide services and benefits in perpetuity.

5.6.1 New On-Site Disposal Systems (Part 3)
This measure is designed to ensure that new On-Site Disposal Systems (OSDS) are located, designed, installed, operated, inspected and maintained to prevent the discharge of pollutants to the surface of the ground. Part 3 recommends protective setbacks from surface waters, wetlands, and floodplains. Lateral setbacks should be based on soil type, slope, hydrologic factors and the type of OSDS. Where uniform protective setbacks cannot be achieved, site the development so as not to adversely affect waterbodies and/or contribute to a public health nuisance.

All of the sections 1-5 will be included in the new Ohio Department of Health Regulations for HSTS and Small Flow Onsite sewage treatment systems that are currently being drafted. All the parameters will be met in these sections as they are the meat of the new draft rule making. According to the Lake County General Health District, no one uses the term On-site disposal, systems are either soil based or discharging and they use the word treatment instead of disposal.

5.6.2 Operating On-Site Disposal Systems
This measure is to establish protective setbacks from surface waters, wetlands, and floodplains for conventional as well as alternative On-Site Disposal Systems (OSDS). The lateral setbacks should be based on soil type, slope, hydrologic factors, and type of OSDS. Where uniform protective setbacks cannot be achieved, attain site development with OSDS so as not to adversely affect waterbodies and/or contribute to a public health nuisance.

ORC 3701-29 are the current ODH Rules with the law additions for small flows. The ORC section governing HSTS and Small Flows systems is now ORC 3718. The new draft rules will also address all of the parts of this section as well. The General NPDES permit for HSTS contains nitrogen standards in the effluents limits. There are no phosphorus limits, but that is governed by Ohio EPA.

5.8.1 Planning, Siting and Developing Local Roads and Highways
This measure applies to site development and land disturbing activities for new, relocated and reconstructed roads and highways.

1. Protect areas that provide important water quality benefits or are particularly susceptible to erosion or sediment loss;
2. Limit land disturbance such as clearing and grading and cut and fill to reduce erosion and sediment loss; and
3. Limit disturbance of natural drainage features and vegetation.

Madison Township, and more recently, Madison Village are member communities with the Lake County Stormwater Management Department (LCSMD), which was formed in 2003 to meet National Pollution Discharge Elimination System (NPDES) Phase II mandates, requiring all State, County and municipalities to have measures in place to control illicit discharges and sedimentation. Perry Township has elected to meet the NPDES requirements as an individual community and Geneva Township is not yet a mandated community.
This measure is addressed under the NPDES Phase II program, where all construction over one acre is required to follow an erosion and sediment control plan. This includes new road and bridge development, residential home construction, capital improvements, commercial and industrial development and any other construction activity within the community boundary.

Lake Soil and Water Conservation District (LSWCD), Lake County General Health District (LCGHD), and Chagrin River Watershed Partners, Inc. (CRWP) assist with the implementation and enforcement of the NPDES Phase II requirements.

5.8.2 Bridges (Local Only)
This measure requires the siting, design and maintenance of bridge structures so sensitive and valuable aquatic ecosystems and areas providing important water quality benefits are protected from adverse effects.

Staff from the Lake County Engineer played a technical advisory role in the development of the Arcola Creek Watershed Action Plan, and is well acquainted with the goals and objectives of the plan. The department will bring any bridge projects to the attention of the Lake County Soil & Water Conservation District to assure that appropriate erosion and sediment controls are designed, implemented and maintained.

Hydromodification Management Measures

7.4.1 Channelization and Channel Modification- Physical & Chemical Characteristics of Surface Waters
The goal of this measure is to:

1. Evaluate the potential effects of proposed channelization and channel modification on the physical and chemical characteristics of surface waters in coastal areas;
2. Plan and design channelization and channel modification to reduce undesirable impacts; and

3. Develop an operation and maintenance program for existing modified channels that includes identification and implementation of opportunities to improve physical and chemical characteristics of surface waters in those channels.

The channel modifications that are Actions in the Arcola Creek Watershed Action Plan will be solely to restore the channels that have lost their natural morphology, been previously modified, or lost access to the floodplain. The watershed action plan philosophy is to restore the riparian system to a morphologically sound riparian system that allows many of the water quality treatment and stormwater management needs to be treated by the system itself. Such work will be in compliance with State and Federal permitting programs and will utilize stream hydromodification BMPs.

7.4.2 Channelization and Channel Modification- Instream and Riparian Habitat Restoration
This measure is designed to:

1. Evaluate the potential effects of proposed channelization and channel modification on instream and riparian habitat in coastal areas;
2. Plan and design channelization and channel modification to reduce undesirable impacts; and
3. Develop an operation and maintenance program with specific timetables for existing modified channels that includes identification of opportunities to restore instream and riparian habitat in those channels.

Restoration of Class I, Class II and modified channels is an Action in the plan, with the goal to restore channel morphology, aquatic and wildlife habitat and the riparian corridor. The Action is a restoration project to improve the instream and riparian habitat, and not a modification project that will adversely affect the river system.

7.5.1 Dams- Erosion and Sediment Control
Not applicable

7.5.2 Dams- Chemical and Pollutant Control
Not applicable

7.5.3 Dams- Protection of Surface Water Quality and Instream and Riparian Habitat
Not applicable

7.6.1 Eroding Streambanks and Shorelines
This measure is designed to manage eroding streambanks and shorelines.

1. Where streambank or shoreline erosion is a nonpoint source pollution problem, streambanks and shorelines should be stabilized. Vegetative methods are strongly preferred unless structural methods are more cost-effective, considering the

severity of wave and wind erosion, offshore bathymetry, and the potential adverse impact on other streambanks, shorelines, and offshore areas.
2. Protect streambank and shoreline features with the potential to reduce NPS pollution.
3. Protect streambanks and shorelines from erosion due to uses of either the shorelands or adjacent surface waters.

The mouth of Arcola Creek as it drains into Lake Erie has little change in elevation from the Arcola Estuary. The coastline does not have a bluff on this part of the lake shore. There is an existing protective vegetative buffer on the edge of the beach, which includes shrubs and trees. In the winter, the shoreline is protected by the frozen water. In the winter of 2012, however, the lake did not freeze, and the wave action cause a multitude of trees to fall. Lake Metroparks plans to leave the fallen trees in place to provide continuing protection of the shoreline.

There are sections of eroding streambanks on the Dock Road portion of the watercourse, and these will be addressed by Actions to restore the riparian corridor and the riparian buffer.

VIII. EVALUATION

Under the guidance of the watershed coordinator, the plan implementation will occur through the joint efforts of the stakeholders. The prioritization of activities will assist in guiding the plan implementation and the quest for funding to support projects. Progress will be tracked and publicized as an integral part of project development.

The Arcola Creek Watershed does not have a TMDL and does not anticipate one before 2017, but the STEPL model will be utilized as one benchmark to evaluate implementation efforts. Empirical data will be collected by volunteers and Lake SWCD staff using the HHEI methodology both pre-and post-project. This data will be compared with Lake SWCD's historical HHEI database to track improvement and measure attainment goals. Post-project sampling will be done annually or until attainment is achieved. We will work to engage the local universities in research and data collection as much as possible.

The watershed advisory committee will meet on a semi-annual basis to monitor the plan's progress and evaluate projects that have taken place in the interval. Empirical data will be reviewed as well as the effectiveness of the implementation of each project. The committee will discuss whether a change of strategy or revision to objectives and activities is advisable at the semi-annual meetings.

Progress and data will be monitored by the watershed advisory committee and the Lake SWCD Board of Supervisors. This information will be shared at public meetings, on the Lake SWCD website, on the Arcola Creek Facebook, through traditional media, and in Lake SWCD and Arcola Creek newsletters.

A watershed advisory committee will be created, comprised of watershed communities and technical advisors that were a part of the plan's development. This group will meet twice each year to maintain strong working relationships in the watershed, evaluate the plan's implementation, and provide guidance on any changing priorities within the watershed.

IX. Plan Update and Revision

The Arcola Creek Watershed Action Plan is a dynamic document that will be updated every 5 years to keep it relevant. Revisions will be made as needed in the implementation process. Updates will be guided by the watershed coordinator and engage community stakeholders. Public access to the current plan will be through the Lake SWCD website, community websites and in the local public libraries. Lake SWCD, which hosts the watershed coordinator, will house all records and documents involved in the plan for future reference.

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(Photo taken by John Pogacnik)