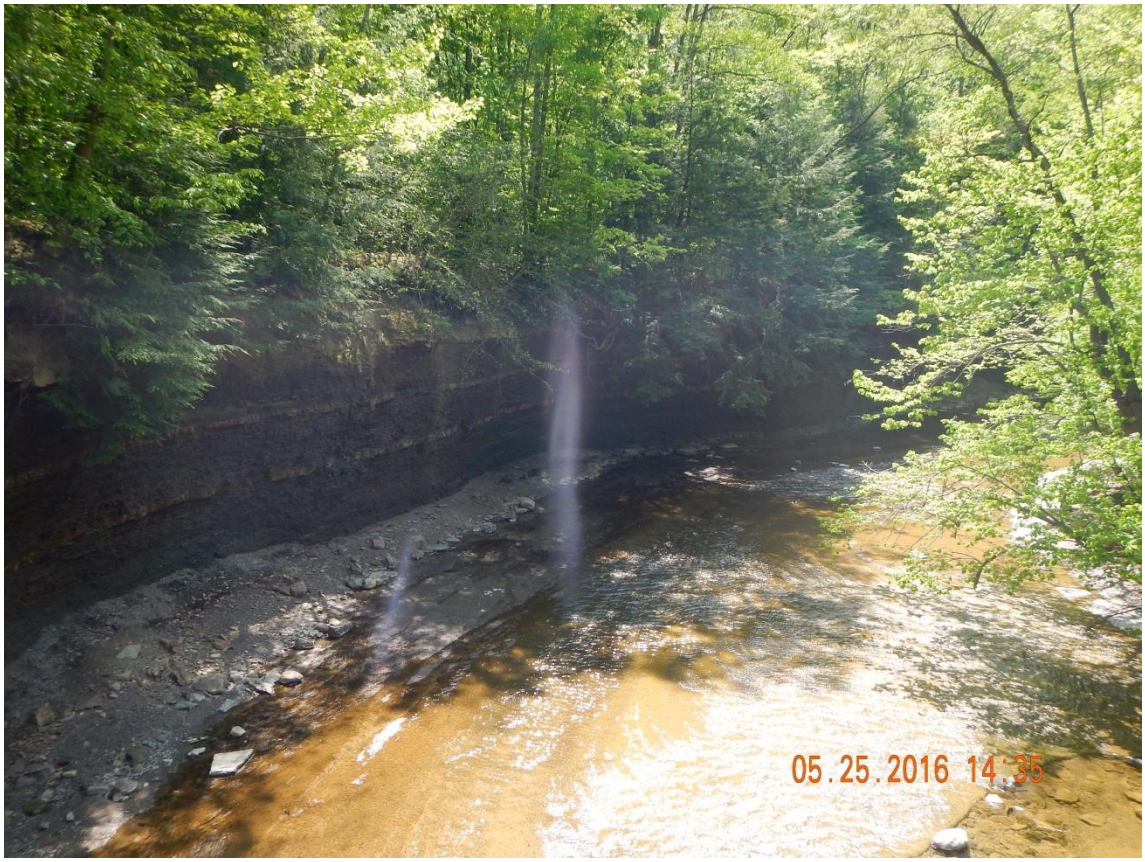
Big Creek
HUC-12: 041100040606
Nine-Element
Nonpoint Source Implementation Strategy (NPS-IS)



Version 1.2

March 9, 2020

Approved: April 1, 2020

Table of Contents **Page**

List of Figures 3

Acknowledgements 4

Chapter 1: Introduction 4
1.1 Report Background
1.2 Watershed Profile & History
1.3 Public Participation and Involvement 8

Chapter 2: HUC-12 Watershed Characterization and Assessment Summary 10
2.1 Summary of HUC-12 Watershed Characterization
2.1.1 Physical and Natural Features
2.1.2 Land Use and Protection 16
2.2 Summary of HUC-12 Biological Trends 19
2.3 Summary of HUC-12 Pollution Causes and Associated Sources 27
2.4 Additional Information for Critical Areas and Implementation Strategies 28

Chapter 3: Critical Area Conditions & Restoration Strategies 33
3.1 Overview of Critical Areas
3.2.1 Critical Area 1: Conditions, Goals & Objectives 37
3.2.1 Detailed Characterization
3.2.2 Detailed Biological Conditions 43
3.2.3 Detailed Causes and Associated Sources 48
3.2.4 Outline Goals and Objectives for the Critical Area
3.2.2 Critical Area 2: Conditions, Goals & Objectives 49
3.2.1 Detailed Characterization
3.2.2 Detailed Biological Conditions 58
3.2.3 Detailed Causes and Associated Sources 59
3.2.4 Outline Goals and Objectives for the Critical Area 60

Chapter 4: Projects and Implementation Strategy 63
4.1 Projects and Implementation Strategy Overview Table 64
4.2 Project Summary Sheets 66

Works Cited 71
Appendix A: Acronyms 72

List of Figures **Page**

Figure 1	Location of Watershed	6
Figure 2	Location in Grand River Watershed	7
Figure 3	Watersheds within the HUC-12	8
Figure 4	Named Tributaries in the Big Creek Subwatershed	9
Figure 5	Topography	11
Figure 6	Topography- Shaded Relief	12
Figure 7	Glacial Geology	13
Figure 8	Soil Drainage Characteristics Table	14
Figure 9	Soils	14
Figure 10	Soil with Steep Slopes	15
Figure 11	Soil Drainage Characteristics	16
Figure 12	Land Use Percentages	17
Figure 13	Concord Township Transportation Hub	17
Figure 14	Public and Protected Lands	19
Figure 15	Big Creek Aquatic Life Use	21
Figure 16	Stream Class Percentages for Lake County Section	22
Figure 17	Stream Class for Lake County Section	22
Figure 18	Three Types of Primary Headwater Streams in Ohio	23
Figure 19	Channel Modification Percentages	24
Figure 20	Channel Modification	24
Figure 21	Class I Stream in East Creek Subwatershed	25
Figure 22	Class I Modified Stream, in Kellogg Creek Subwatershed	25
Figure 23	Class II Stream in Big Creek Subwatershed	26
Figure 24	Class III Stream in Aylworth Creek Subwatershed	26
Figure 25	Lower Grand River WAUs to be addressed by TMDLs	27
Figure 26	Big Creek Subwatershed Critical Areas	34
Figure 27	Potential Causes of Aquatic Life Use Impairments	34
Figure 28	Erosion and Sediment Delivery	35
Figure 29	Big Creek Subwatershed Land Use Table	37
Figure 30	Big Creek Subwatershed Location	38
Figure 31	Big Creek Subwatershed Land Use	39
Figure 32	Big Creek Subwatershed Protected Property	40
Figure 33	Big Creek Subwatershed Communities	41
Figure 34	Big Creek Subwatershed Topography	42
Figure 35	Aquatic Life Use Attainment for Big Creek	44
Figure 36	Aquatic Life Use Attainment Thresholds for WWH	44
Figure 37	Streambank Erosion & Sedimentation on Big Creek	45
Figure 38	Sedimentation of Big Creek Main Channel at Woodin Road	45
Figure 39	Channel Armoring	46
Figure 40	River Mile Reference	47
Figure 41	Brightwood Lake & Dam	50
Figure 42	Kellogg Creek Location	51
Figure 43	Kellogg Creek Land Use	52
Figure 44	Kellogg Creek Channelized Section	53
Figure 45	Lower Kellogg Creek Riparian Corridor	53
Figure 46	Kellogg Creek Communities	54
Figure 47	Kellogg Creek Topography	55
Figure 48	Kellogg Creek Soil Drainage Characteristics	56
Figure 49	Kellogg Creek Soil Drainage Percentages	57
Figure 50	Aquatic Life Use Attainment for Kellogg Creek 2004	58

Figure 51 Kellogg Creek River Mile 5.7 Locations 61

Acknowledgements

Prepared and 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 gratitude for the assistance from:

- Chad Edgar, Resource Protection Specialist, Lake County Soil & Water Conservation District
- Tim Miller, Director, Lake County Stormwater Management Department
- David Radachy, Director, Lake County Planning & Community Development
- Frank Kraska, Concord Township Service Director
- Dan Davis, Concord Township Service Department
- Joel Firem, Land Steward, Geauga Park District
- Paul Pira, Biologist, Supervisor of Natural Resource Management, Geauga Park District
- Keely Davidson-Bennett, Chagrin River Watershed Partners
- Christina Znidarsic, Chagrin River Watershed Partners
- Bob Griesmer, Geauga Soil & Water Conservation District
- Tom Koritansky, Natural Resource Manager, Lake Metroparks

Chapter 1: Introduction

1.1 Report Background

The Big Creek Nine-Element Nonpoint Source Implementation Strategy (NPS-IS) brings Lake and Geauga County communities together to address water quality issues in the watershed, manage stormwater runoff and reduce flooding. This plan was created to restore and maintain the chemical, physical and biological integrity of water bodies within the watershed and to access funding from USEPA, Ohio EPA and other granting entities for these purposes.

1.2 Watershed Profile & History

The Big Creek HUC-12 Watershed is located in northeastern Lake County in Northeast Ohio (Figure 1). The Big Creek 12 digit Hydrologic Unit Code (HUC) is 041100040606; the watershed drains approximately 50.3 square miles. It is located within the 10-digit HUC 0411000406 known as the Lower Grand River Watershed. 41% of the watershed is in Geauga County and 59% is in Lake County. This subwatershed is located upstream of the Red Creek-Grand River, which empties into Lake Erie (figure 2). The Grand River, including both upper and lower, drains 705.5 square miles as it flows through portions of Ashtabula, Trumbull, Geauga, Portage and Lake Counties.

The HUC-12 watershed encompasses six subwatersheds (Figure 3): Kellogg Creek, Ellison Creek, Jordan Creek, Big Creek, Aylworth Creek and East Creek. The Big Creek watershed does not contain any part of the Grand River mainstem, and empties into the mainstem at Helen Hazan

Wyman Metropark off of SR 86 in Painesville. There are two named tributaries in the Big Creek subwatershed: Cutts Creek and Jenks Creek (Figure 4).
The watershed encompasses portions of Concord and Leroy Townships, a small portion of Painesville Township, small portions of the City of Mentor and Kirtland Hills Village in Lake County and portions of Chardon and Hambden Townships in Geauga County. The center of the watershed is approximately 30 miles from the City of Cleveland central business district.

As described by the Upper Grand River Watershed Action Plan (December 13, 2012), "*The Grand River has two distinct reaches. The Upper reach flows slowly through the broad valley of an ancient glacial lake, past some of the state's largest wetlands, floodplain forests, marshes, wet meadows, and swamps. The lower reach, west of Harpersfield, has cut a steep shale gorge notable for its cold, fast flow, spectacular sedge meadows, glacial slumps, and deep ravines. The lowest reaches of the river created sand dunes and palustrine sand plains; and aquatic beds and emergent marshes were once plentiful. Lake effect precipitation in Ohio's "snow belt" increases the biological diversity of the watershed."*

"*Flow in the Grand River is fed primarily by rainfall and snow melt, with very little base flow sustained by ground water because of the river's glacial and bedrock geology. Consequently, discharge becomes quite small in the summer (relative to drainage area) resulting in the Grand River and its tributaries having limited assimilative capacity. The Grand River is sustained by the many coldwater tributaries that continually discharge ground water into the river. Those coldwater tributaries and other sources of base flow are essential to the overall health of the Grand River*." (Total Maximum Daily Loads for the Grand River (Lower) Watershed; p. 15.)

The coldwater tributaries within the Big Creek watershed are East Creek, Jordan Creek and Aylworth Creek. All the CWH designated streams are meeting attainment status, and are important to the downstream Big Creek and Grand River in preserving base flow conditions.

The hydrology of the Big Creek Watershed is dominated by small coldwater tributary streams and storm water flows. However, development within the Kellogg Creek, Red Creek and upper portions of Big Creek likely leads to larger runoff volumes, higher peak flows, and flashy streams. Data indicate that Big Creek contributes 4 to 11.5 percent of the total flow volume in the lower Grand River over all flow conditions. (Total Maximum Daily Loads for the Grand River (Lower) Watershed; p. 48.)

The single greatest threat to the Grand River basin is suburbanization. Localized areas of aquatic life use impairment are caused by urban/suburban landuse in Kellogg Creek, Ellison Creek, Jordan Creek, and the headwaters of Big Creek. Suburban landuse within the headwaters of Kellogg Creek is so dense that attainment of the WWH aquatic life may not be possible but the lower reaches are still marginally meeting expectations for WWH.

Figure 1. Location of Watershed

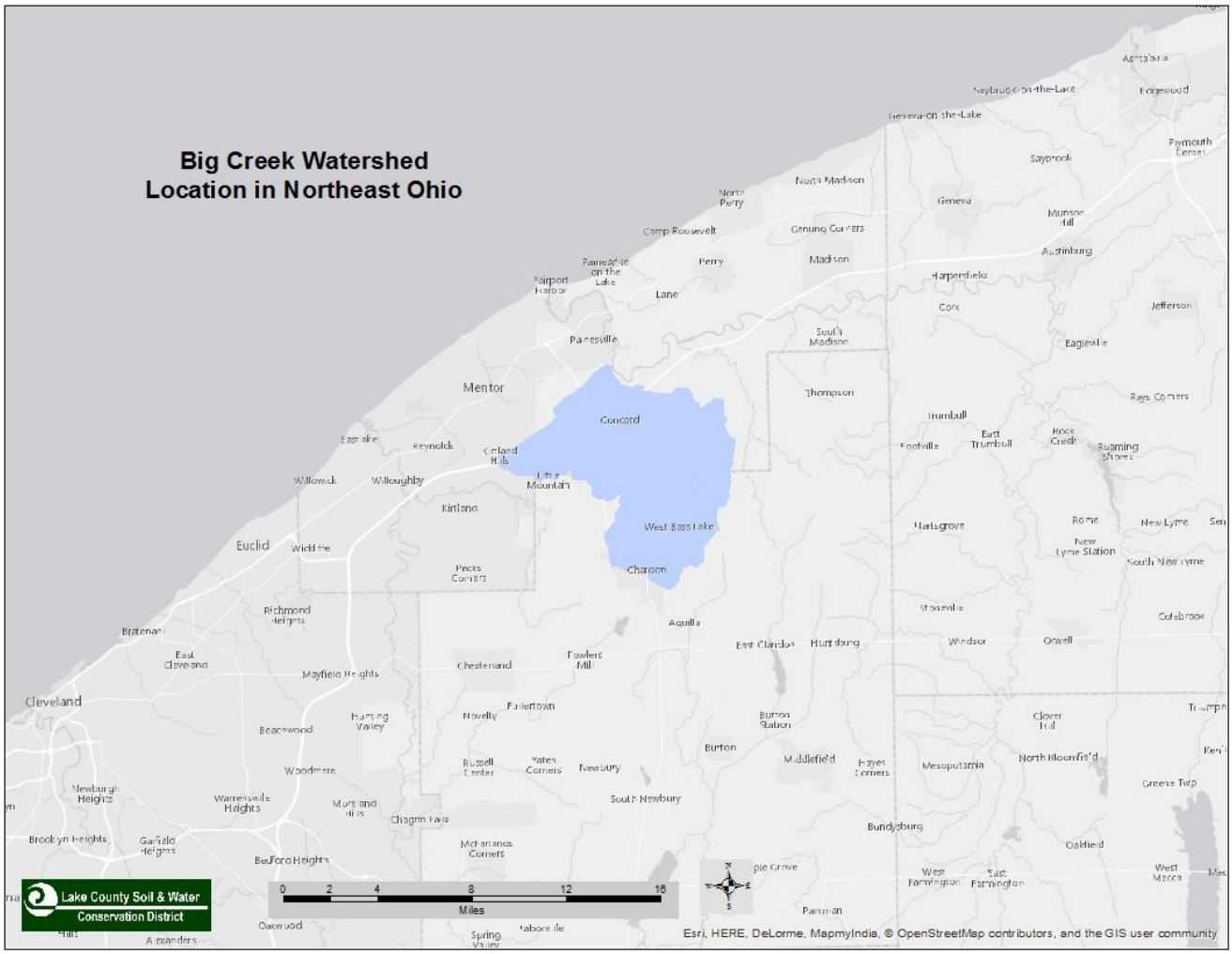
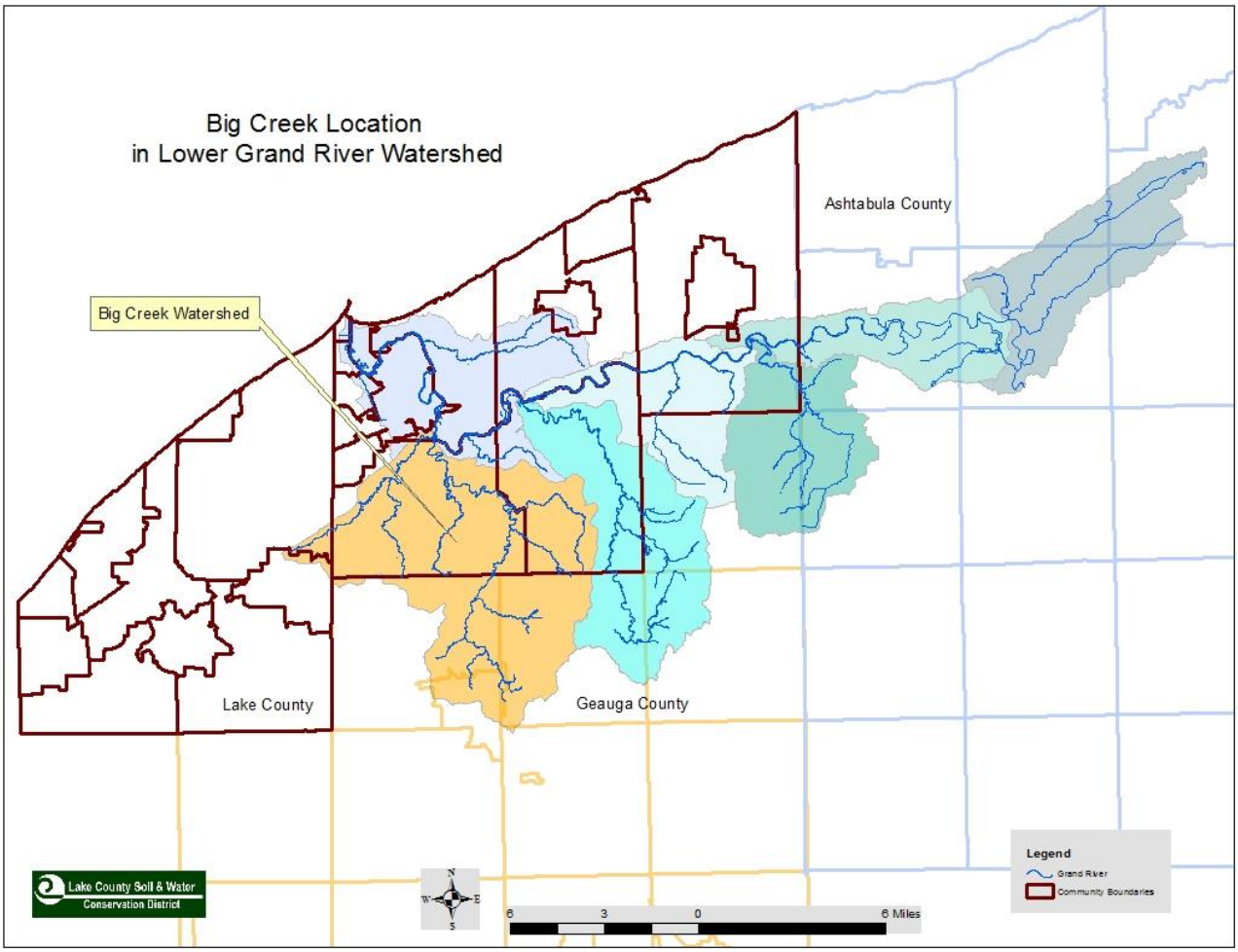


Figure 2. Location in the Lower Grand River Watershed

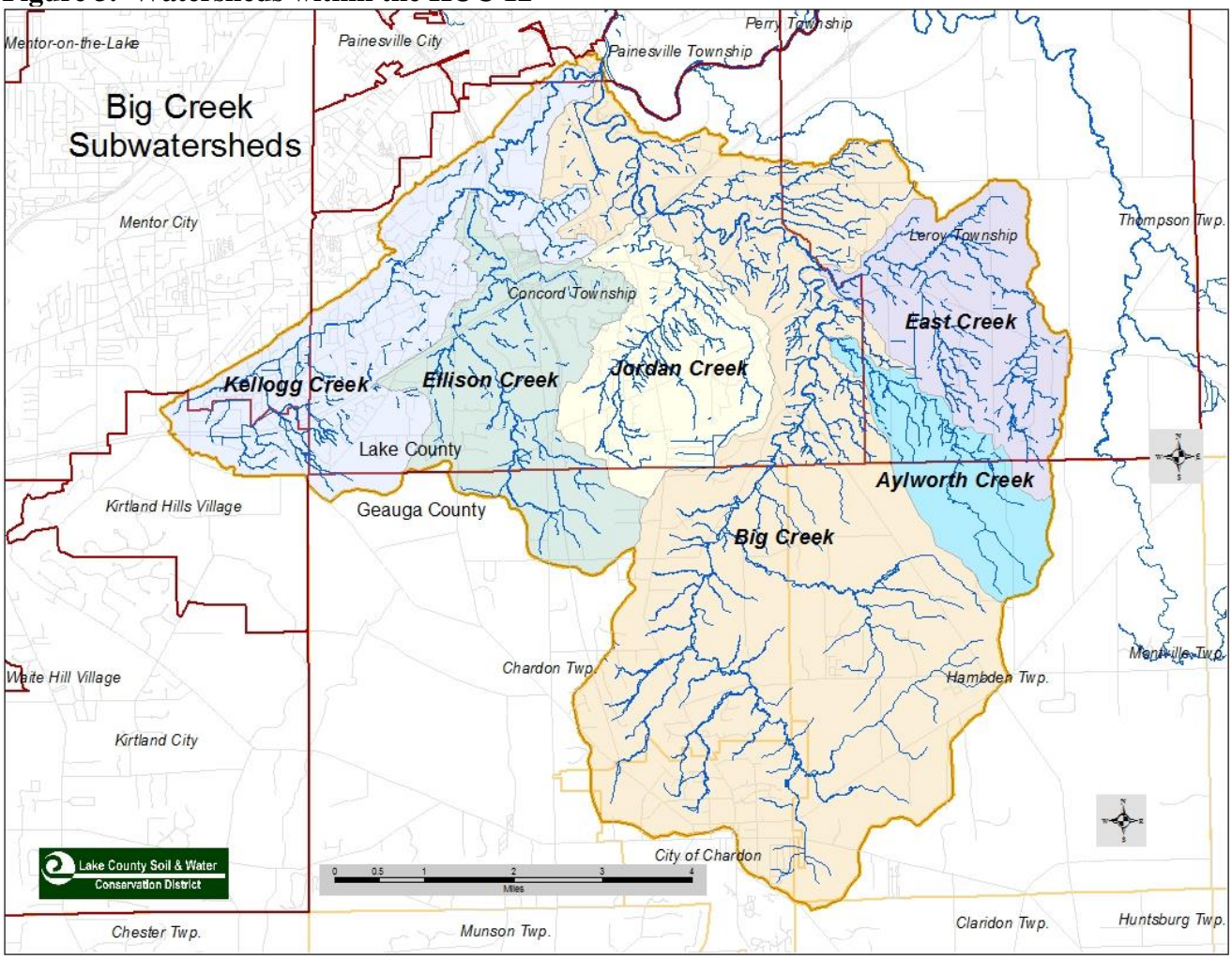


Concord Township, Painesville Township and the Village of Kirtland Hills are members of the Lake County Stormwater Management Department (SMD) and meet the National Pollution Discharge Elimination System (NPDES) requirements through the county program. All of the member communities are Level Two, enabling them to utilize the services of the Lake County SMD for all six minimum control measures, and receive funding assistance to maintain and upgrade the storm sewer infrastructure within the community. The City of Mentor takes care of NPDES requirements on its own. Leroy Township is not a Phase II mandated community.

Prior to European settlement, the watershed was mostly forested with a mixed oak forest. Following early settlement, many of the forests were cleared for agricultural production, and the areas with poorly drained soils were drained with subsurface drainage and ditches. Portions of channels were dredged and straightened to improve water flow. The agricultural industries were primarily traditional row crops and dairy. Population growth from the Cleveland Metropolitan Area to the west has caused some of the subwatersheds to be close to built-out. Kellogg, Ellison and Jordan Creek have

experienced the most growth. 53.4% of the land use in the watershed is residential; 27.9% is in agricultural use and 18.5% is in commercial, industrial or public uses.

Figure 3. Watersheds within the HUC 12



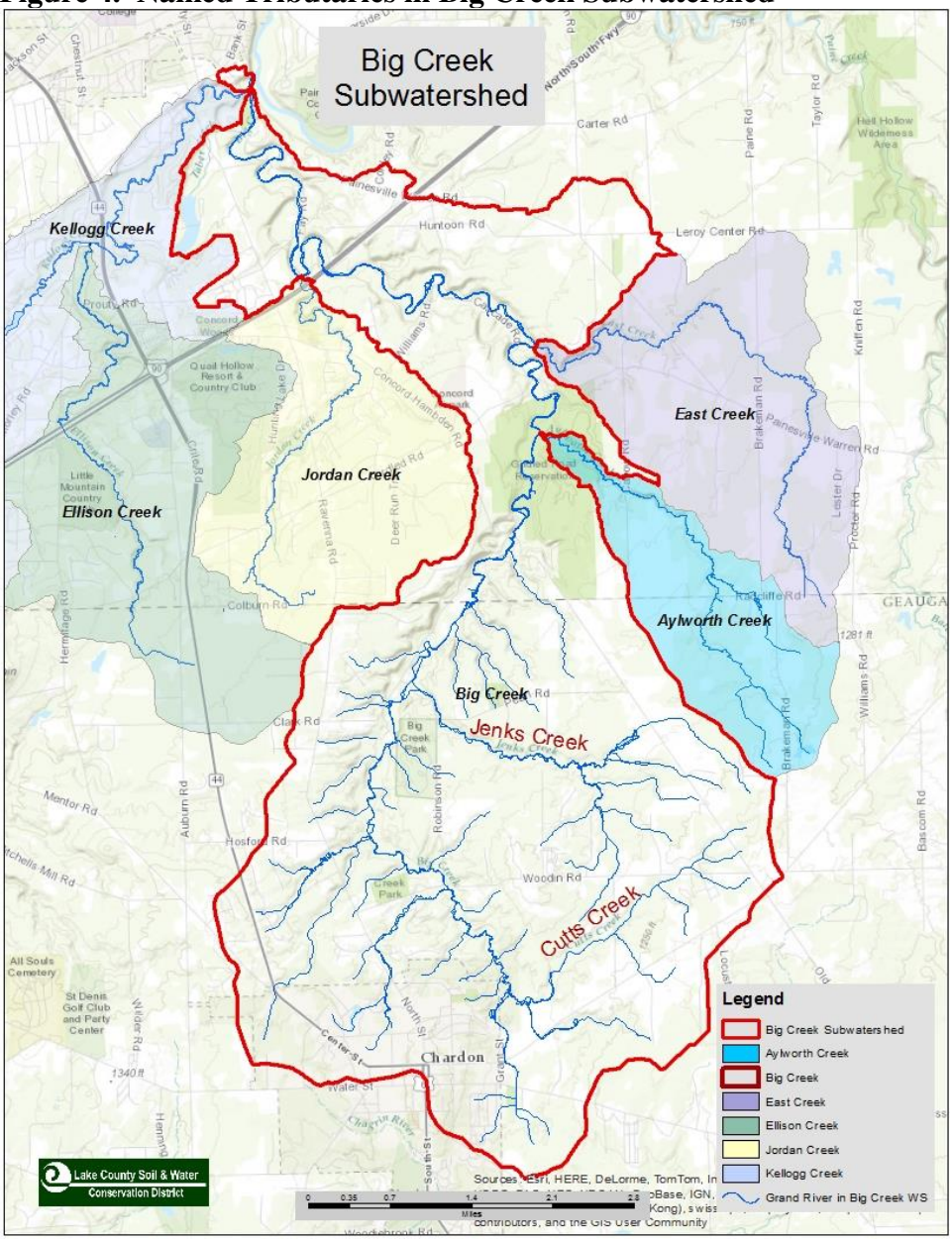
1.3 Public Participation and Involvement

This plan was created with the input of members of the community, local officials, state and local agencies, including:

- Chad Edgar, Lake County Soil & Water Conservation District
- Tim Miller, Lake County Stormwater Management Department
- David Radachy, Lake County Planning & Community Development
- Frank Kraska, Concord Township Service Director
- Dan Davis, Concord Township Service Department
- Joel Firem, Geauga Park District
- Paul Pira, Geauga Park District
- Keely Davidson-Bennett, Chagrin River Watershed Partners
- Christina Znidarsic, Chagrin River Watershed Partners

- Bob Griesmer, Geauga Soil & Water Conservation District
- John Pogocnik, Lake Metroparks
- Tom Koritansky, Lake Metroparks

Figure 4. Named Tributaries in Big Creek Subwatershed



Chapter 2: HUC-12 Watershed Characterization and Assessment Summary

2.1 Summary of HUC-12 Watershed Characterization

2.1.1 Physical and Natural Features

A brief set of descriptive data follows.

Water Resources

100 year floodplain	860.8 ac
Wetlands (2007)	1122.2 ac
Ponds & lakes	180.6 ac
Streams & rivers	122.7 ac
Approx. number of water wells	1590
Highly sensitive to groundwater contamination	32,251.4 ac
Ohio EPA permitted CSOs	0

Land Use and Environment

Conservation & recreation land	2912.0 ac
Ohio EPA NPDES industrial & municipal discharge permits	17
Ohio EPA Approved bio-solid app. fields	94.5 ac
Dams	14
Ecological region:	Erie Lake Plain, Erie Gorges, Mosquito Creek/Pymatuning Lowlands, Low Lime Drift Plain

Land Use (acres)	**1994**	**2001**	**2009**
Agriculture	7,149	5,850	4,732
Water	1,299	1,557	135
Urban	1,000	3,773	10,723
Forest	21,210	21,051	16,663
Barren	5	8	0
Shrub/scrub	1605	32	3

Ohio EPA Aquatic Life Use Designation Miles

Coldwater Habitat (CWH)	21.4
Exceptional Warmwater Habitat (EWH)	0
Warmwater Habitat (WWH)	31.6
Seasonal Salmonid Habitat (SSH)	
Big Creek (Girdled Road to mouth)	
Ellison Creek	
Kellogg Creek	

Ohio EPA Stream Classifications (Miles)

Primary Contact Recreation Class A Waters	0
Outstanding State Waters	0

Ohio EPA Source Water intakes & Protection Areas

Akron City Public Water Supply	19.3 ac

People (reported by tract)

Rural:	6,358
Urban:	15,569

Agricultural: 86
In Labor Force: 12,224

Source: 2011 ERIN Watershed Report

Topography

The elevation ranges from 1340 feet above sea level in the southern watershed boundary on the Allegheny Plateau to 610 feet at the confluence with the Grand River, a change of 730 feet.

The majority of the watershed is located in the Allegheny Plateau physiographic region, which is characterized by mid-elevation hills separated by numerous narrow stream-cut valleys, and an abundance of rivers and streams. This region of the Plateau was glaciated. The Portage Escarpment, which marks the boundary between the Lake Plain region and the Allegheny Plateau, crosses the northern section of the watershed (Figure 5).

Figure 5. Topography

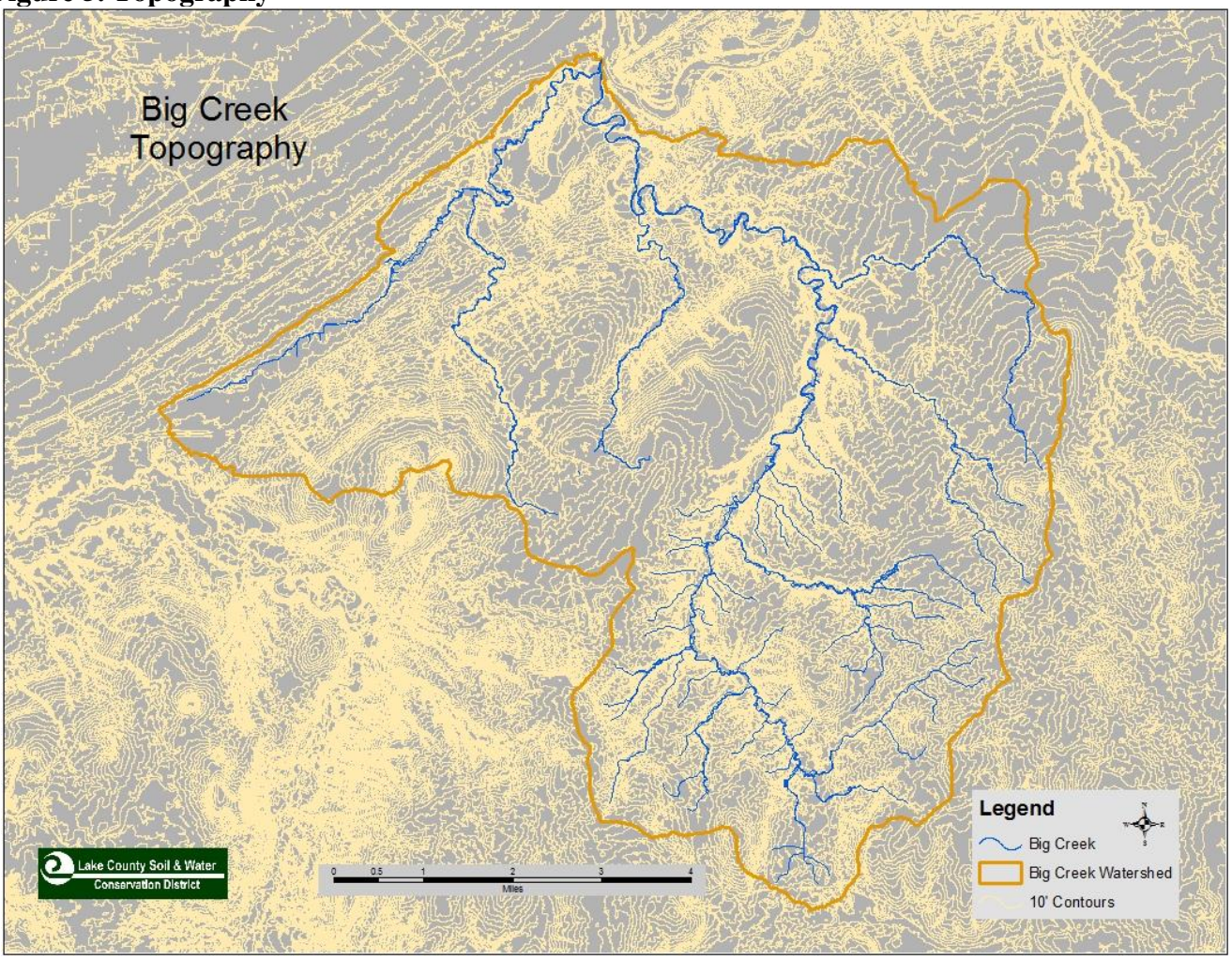
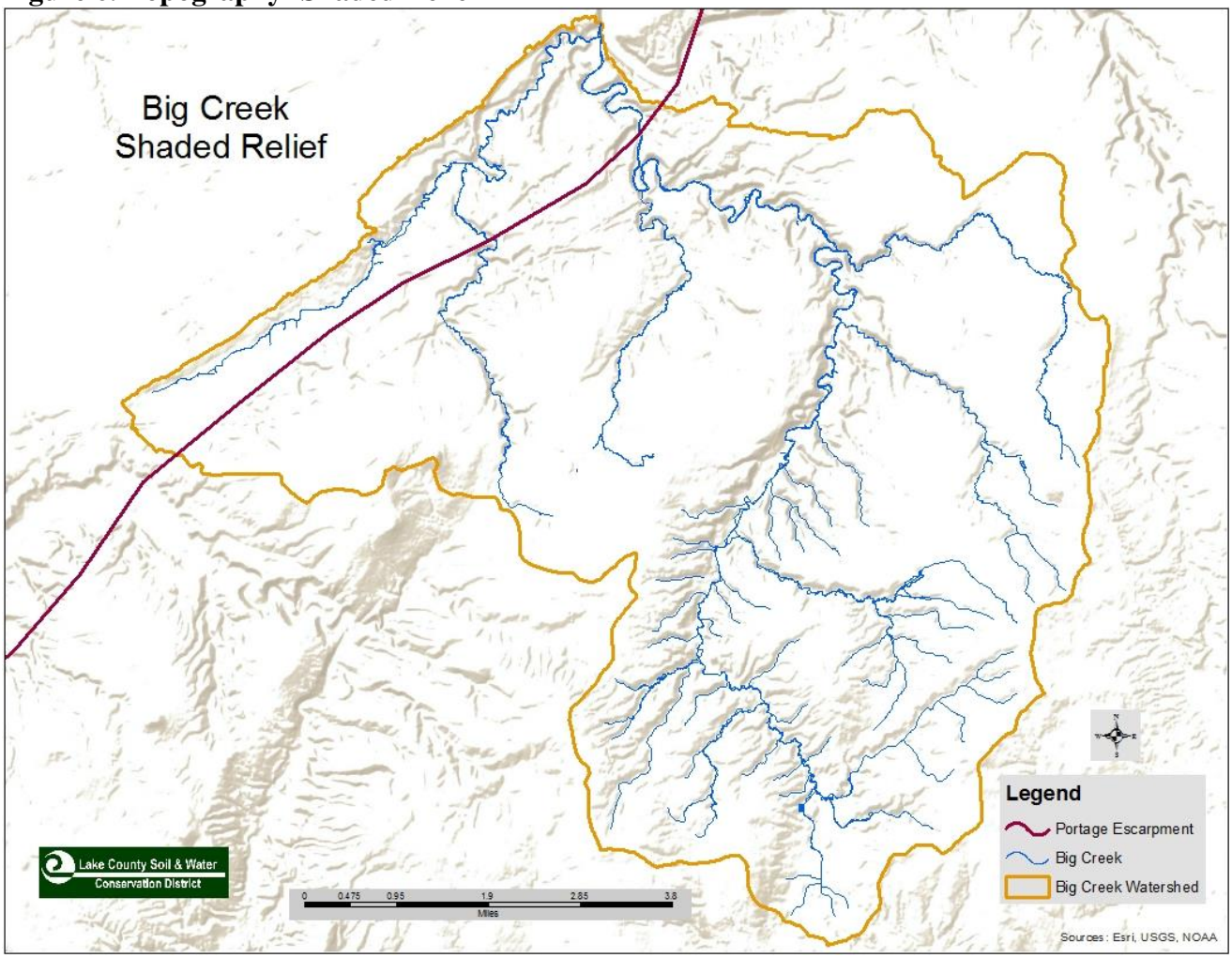


Figure 6. Topography- Shaded Relief



Geology & Glacial History

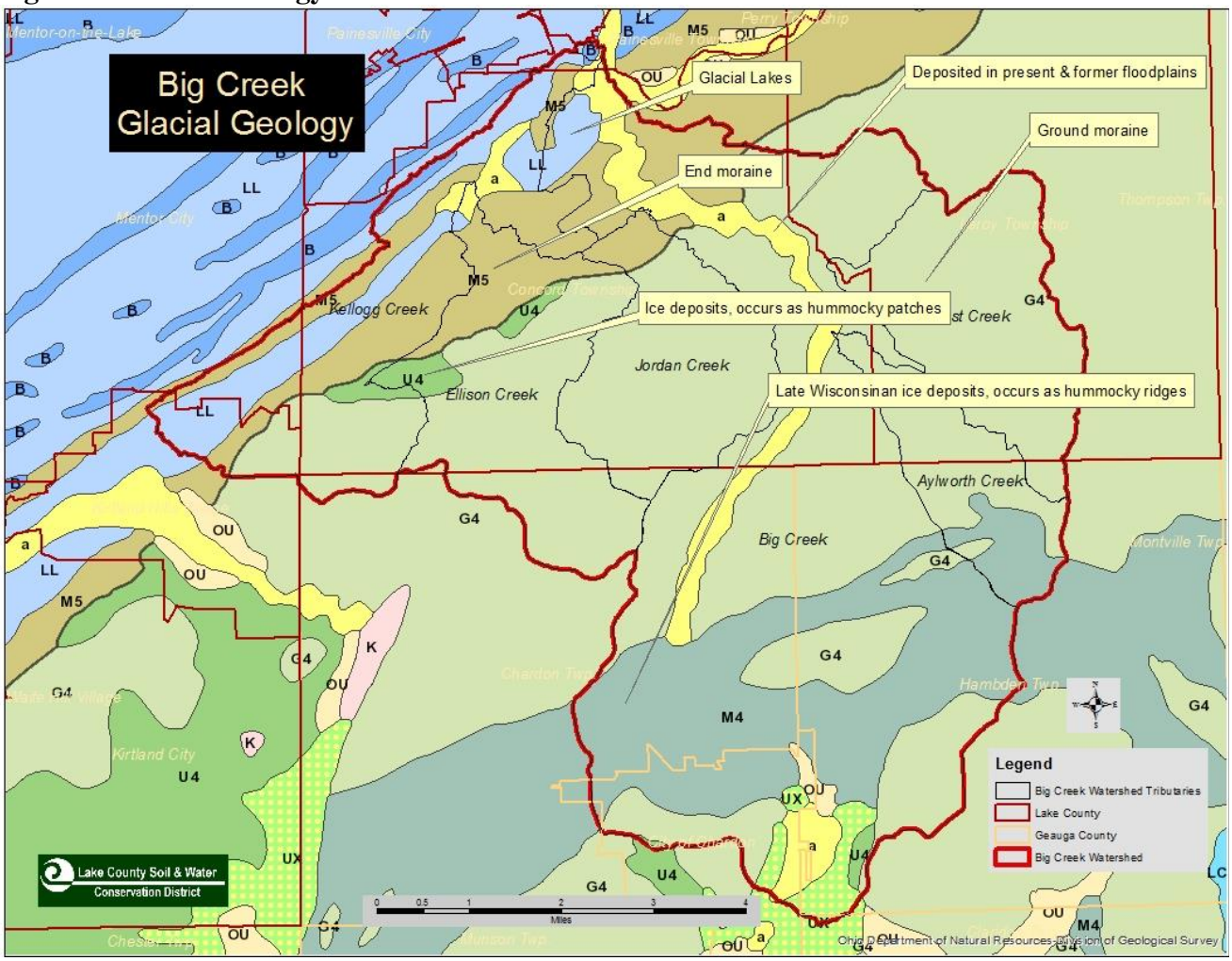
The Big Creek Watershed is in the glaciated plateau of Ohio, underlain by Chagrin Shale bedrock of Devonian age, part of the Paleozoic area which lasted about 416 to 2.8 million years ago (Figure 7). The gray shales and siltstones of the Chagrin Shale were deposited as sea-bottom muds in alternating 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.

Six glacial features are found in the watershed:

1. Glacial lakes
2. End moraine
3. Ground moraine
4. Deposits in present and former floodplains
5. Ice deposits, which occur as hummocky patches
6. Ice deposits, which occur as hummocky ridges

The hummocky ridges are found in a band in the higher elevations across the southern portion of the watershed, the central portion of the watershed is ground moraine, and the northern portion of the watershed consists of the end moraine. The watershed is bisected by the mainstem and floodplain of Big Creek.

Figure 7. Glacial Geology



Soils

The soils in the watershed (Figure 9) reflect the glacial history of the region and can be divided into several categories: soils on the lake plain, soils on terraces, soils on flood plains, soils on till plains, soils at heads of drainageways, soils on side slopes parallel to drainageways, soils in depressions, soils on floodplains and bogs. Refer to the Soil Survey of Lake County and Geauga County, Ohio for more information about the soils and their properties.

66% of the soils are somewhat poorly drained, 25% are moderately well drained and 5% are well drained (Figure 8). Soil drainage characteristics information is essential for siting Best Management Practices (BMPs) so that they will work properly. BMPs such as rain gardens and pervious pavers that are based on infiltration are best suited for well drained soils (in shades of green, Figure 11), whereas wetlands and on-site storage BMPs should be utilized in hydric soils (in shades of blue, Figure 11).

Steep slopes (12% to 70%) are found along the majority of the Big Creek subwatershed mainstem, the headwaters of Kellogg Creek, Ellison and Jordan Creek and the lower sections of Kellogg and Jordan (Figure 10). Many of these steep sided channels are protected as parks, particularly in the Big Creek subwatershed, but in Kellogg, Ellison and Jordan Creeks, they have been incorporated into residential development, which has caused difficult issues with stormwater management.

Figure 8. Soil Drainage Characteristics

Drainage Characteristic	Acreage	%
Well drained	1484.1	5
Moderately well drained	7886.7	25
Somewhat poorly drained	20576.4	66
Poorly drained	141.3	.5
Urban	877.8	3
Water	147.3	.5

Figure 9. Soils

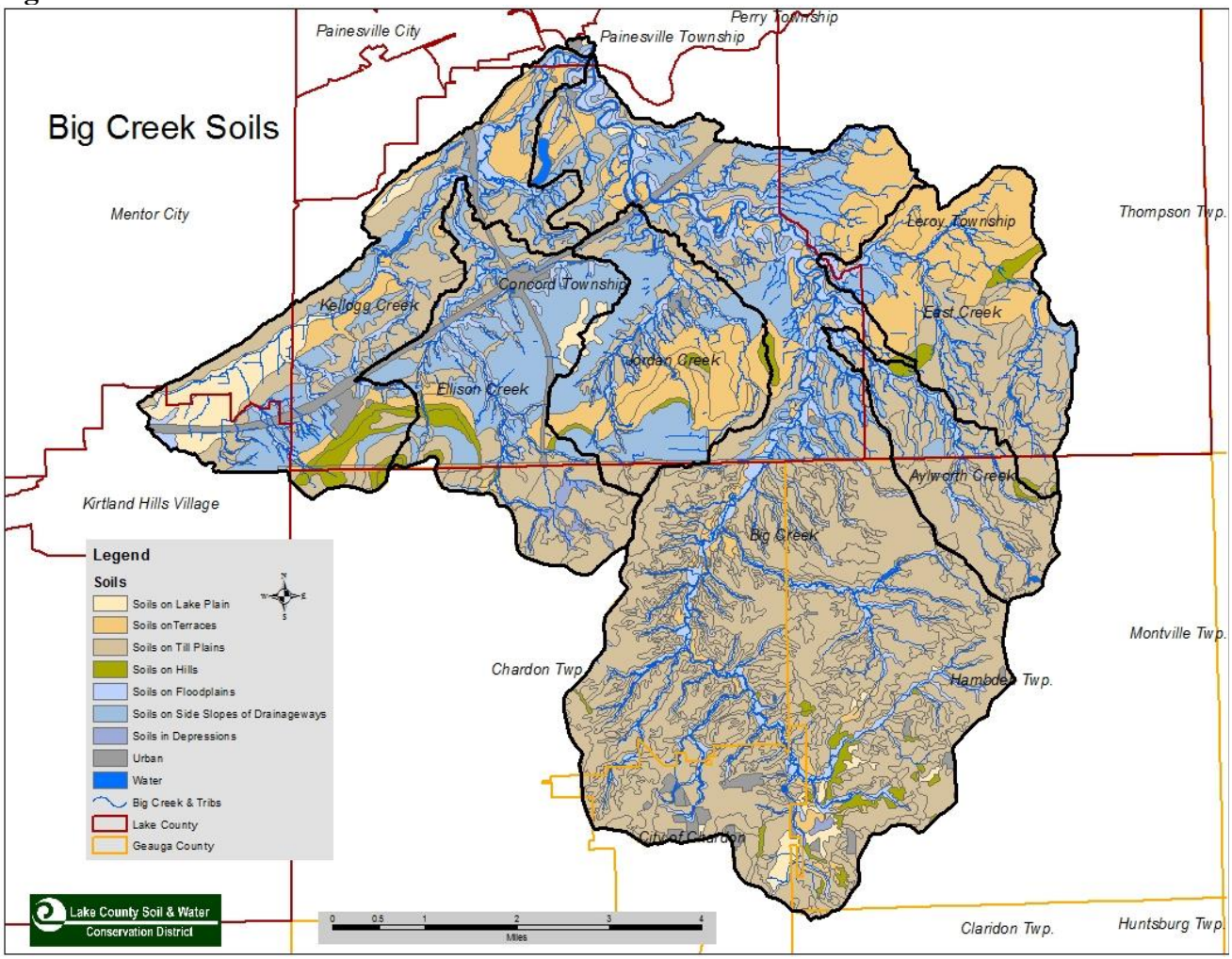


Figure 10. Soils with Steep Slopes

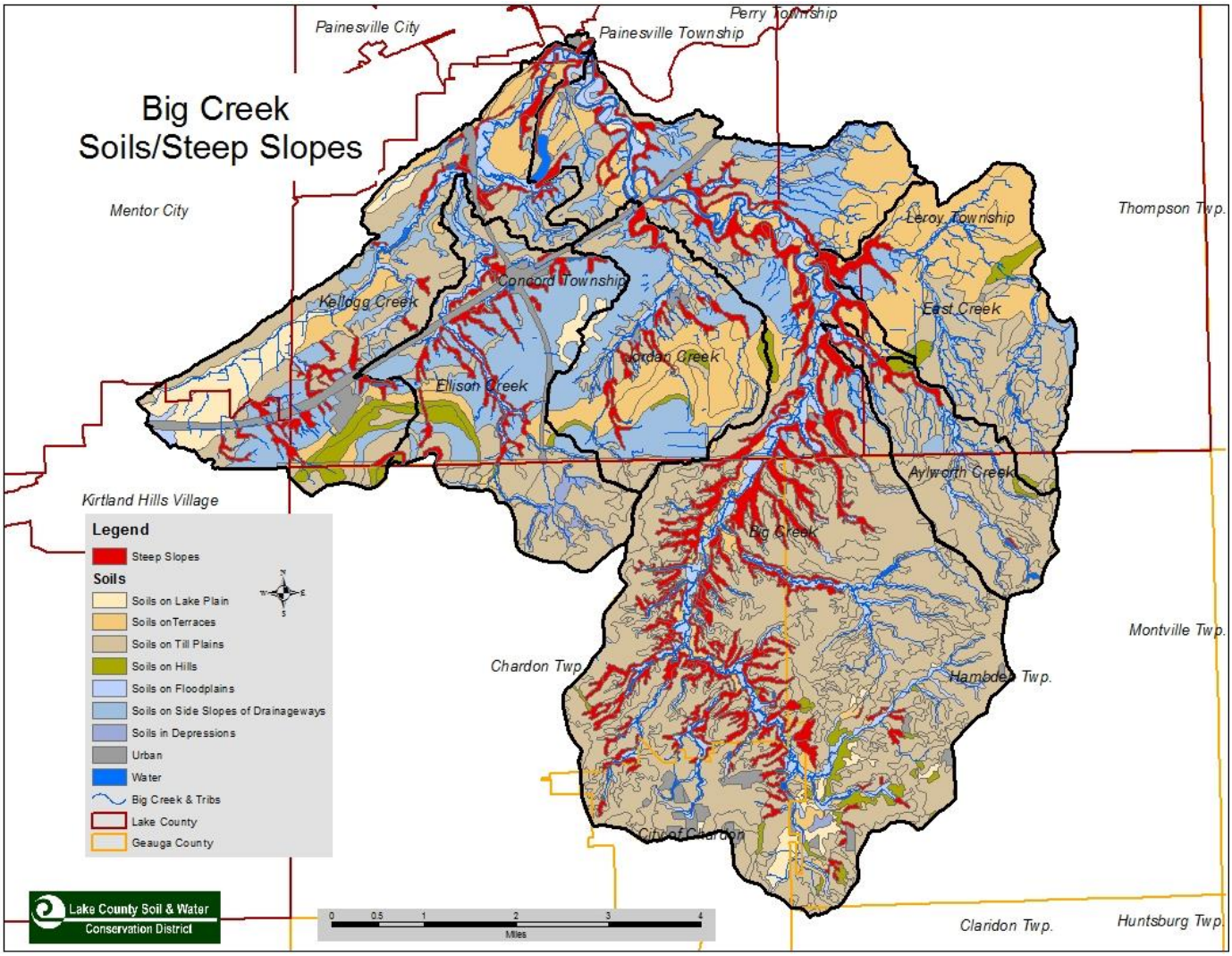
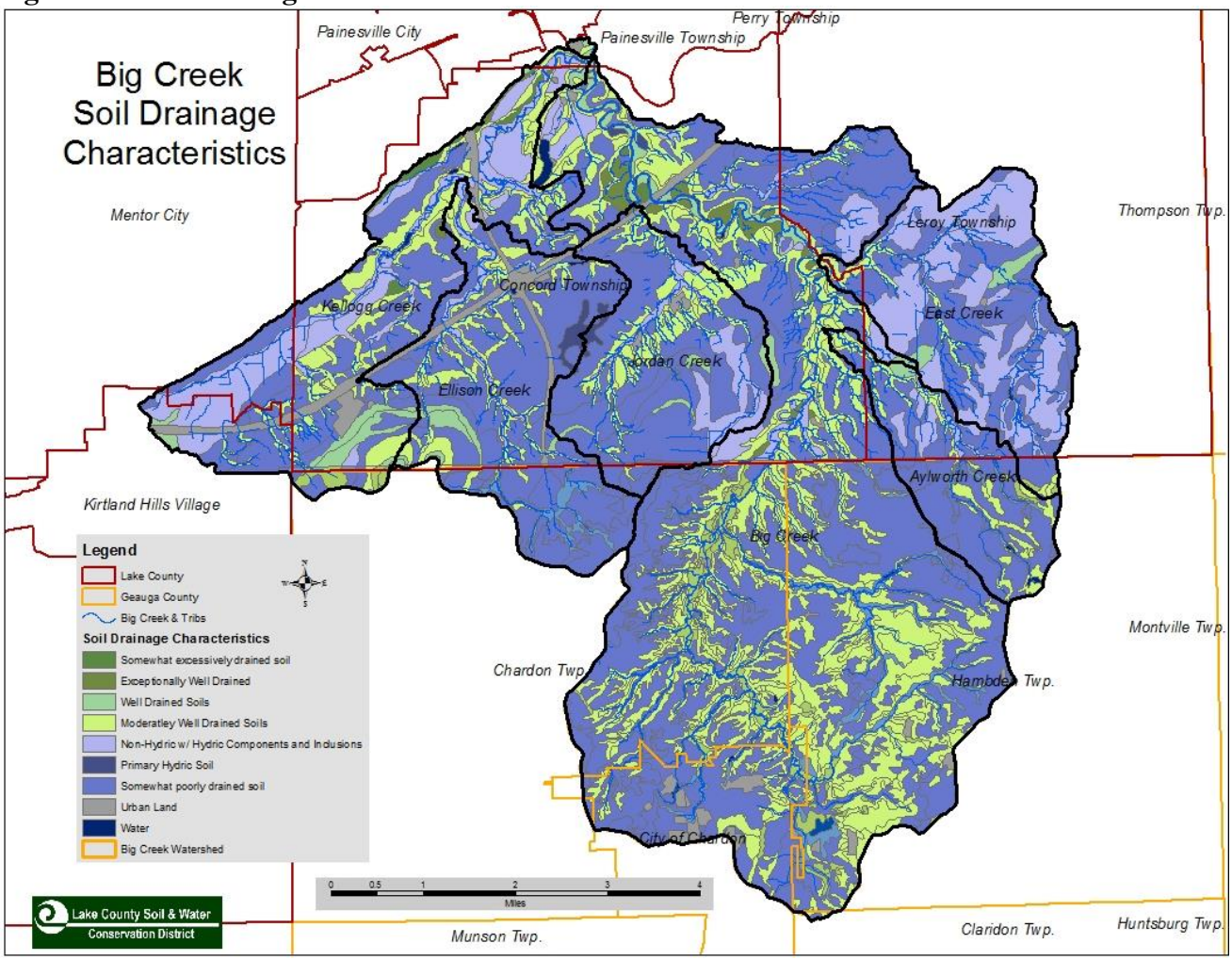


Figure 11. Soil Drainage Characteristics



2.1.2 Land Use and Protection

The ERIN Watershed Report delineated 52% of the land use as forest in 2009, and 33% of the land use as urban, and agriculture at 15% (Figure 12). U.S. Geological Survey StreamStats shows 66.6% of the Kellogg & Ellison basin as developed in 2011; 41.2% of Jordan Creek was urban land and 22.4% of the Big Creek, Aylworth and East Creek basins were urban. 2011 StreamStats data also show 78.8% of Jordan Creek was covered by forest, 67.7% of Big, Aylworth and East Creeks was forested and 57.9% of Kellogg and Ellison Creeks was forested. The high percentage of forested lands helps maintain the high water quality of the watershed.

The northwest quadrant of the watershed is bisected by Interstate 90, which runs southwest to northeast, and State Route 44. The intersection of the two roads is in the center of Concord Township, which has allowed for easy access to the region and led to high development pressures (Figure 13).

Figure 12. Land Use Percentage (ERIN Watershed Report 2009)

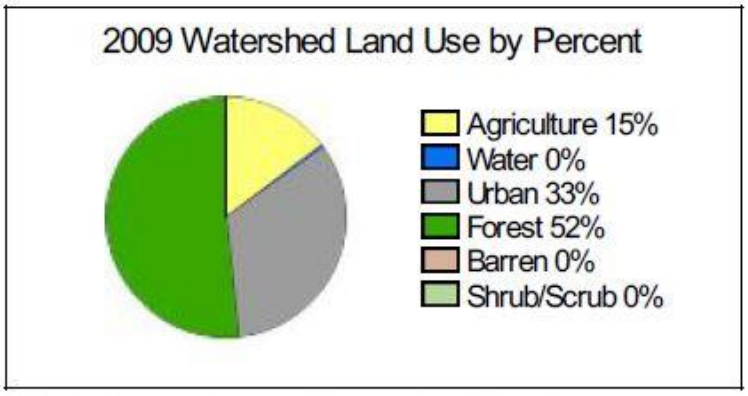
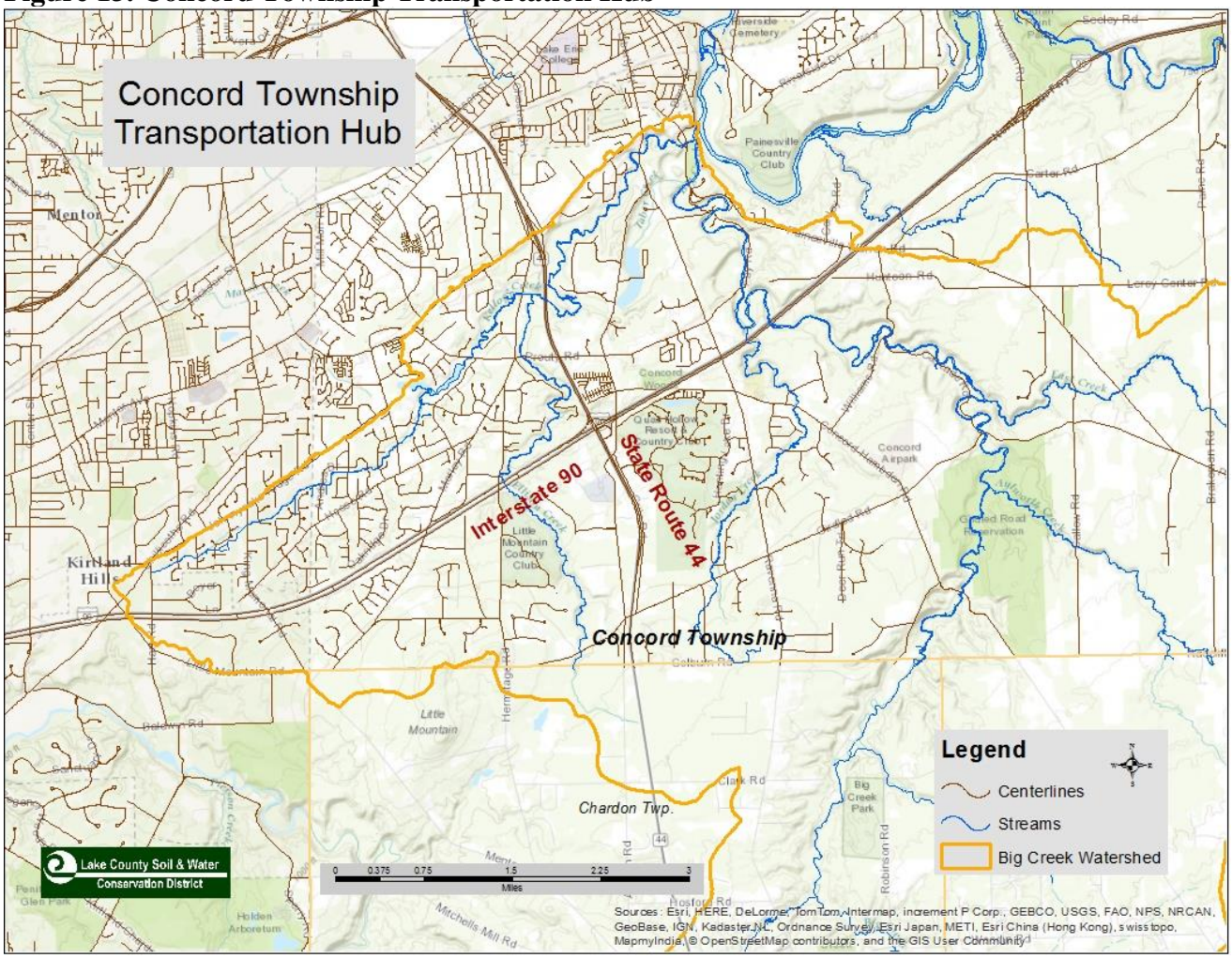


Figure 13. Concord Township Transportation Hub



In Lake County, 7.8% of the land is protected by Lake Metroparks, with parks located along the Big Creek subwatershed, and a section of walk/bike path in Painesville. 29% of the park acreage is currently undeveloped with no public access. Lake Metroparks will continue to evaluate natural areas on Big Creek and its tributaries for potential permanent protection and park development. 2% of the land is publicly owned, which includes boards of education property, County and Township-owned properties (Figure 14).

In Geauga County, 13% of the land is protected by the Geauga Park District; all of the parks are in the Big Creek subwatershed. 3.4% of the land is publicly owned.

Imperviousness of a watershed has an effect on the physical and biological characteristics of a stream. Increases in impervious cover cause decreases in conditions. Channel instability will occur when the impervious area is greater than 10%. Sharp declines in macroinvertebrate diversity occur when imperviousness is greater than 8%. (USEPA CADDIS Volume 2: Sources, Stressors & Responses)

U.S. Geological Survey StreamStats (https://water.usgs.gov/osw/streamstats/ohio.html) data show the imperviousness in selected subwatersheds as follows:

- Kellogg and Ellison Creek- 13.6%
- Jordan Creek- 7.74%
- Big, Aylworth & East Creek- 4.68%
- Big Creek by Chardon- 13.1%

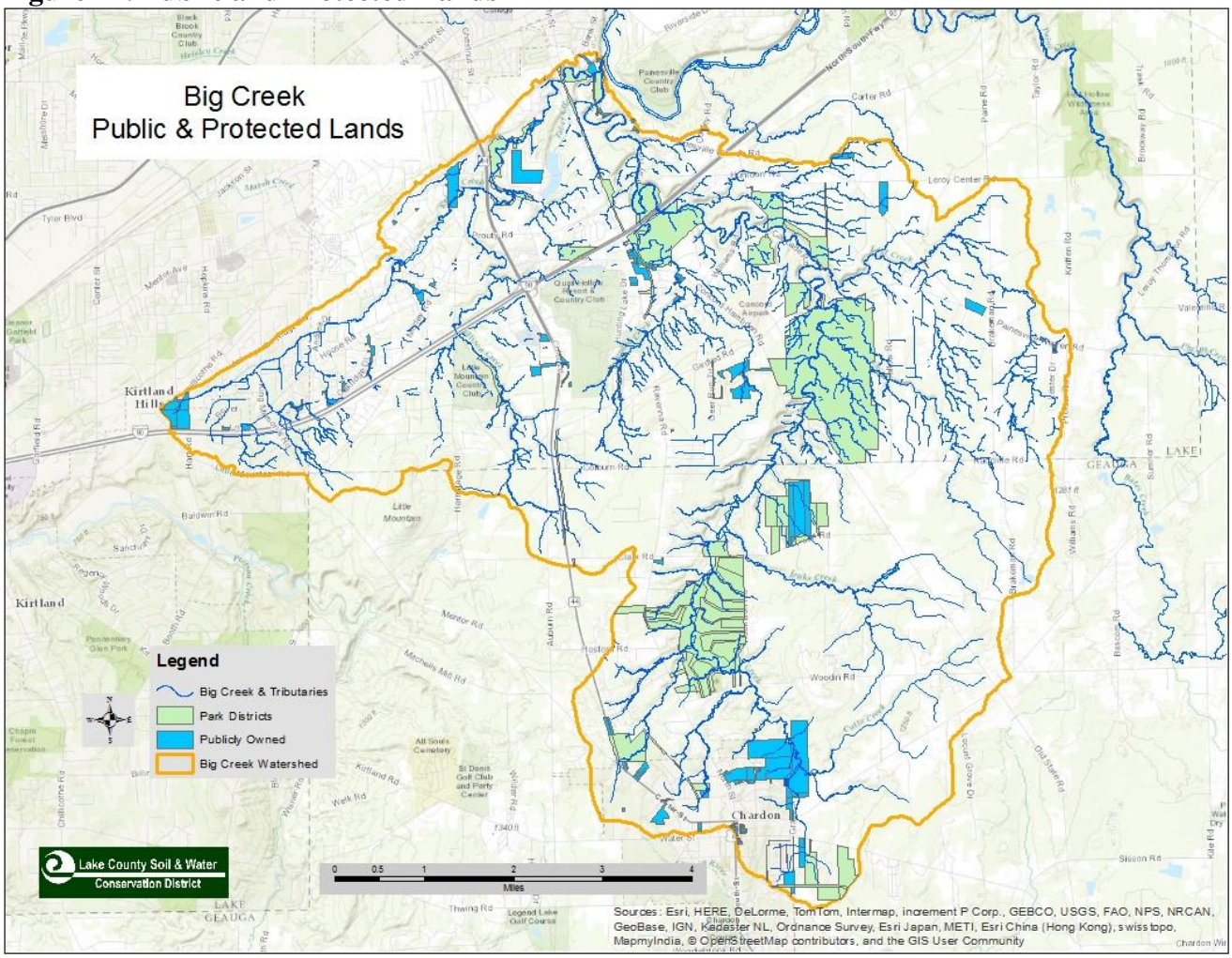
Jordan Creek is at the balance point for degradation, Kellogg and Ellison Creeks and Big Creek headwaters by Chardon have tipped over the balance point. Opportunities for retrofits with green infrastructure should be utilized wherever possible.

In Lake County, the majority of the watershed is in Concord Township. As described in the Concord Township 2004 Comprehensive Plan, "Proximity to Interstate 90, regional employment opportunities, and the historical extension of sanitary sewer and public water services have facilitated suburban type development of the northwest quadrant of the Township." The southeastern quadrant of the Township is less developed where sanitary sewer and public water services have not been extended- an important factor in determining the location and density of new development. "The lack of public water and sewer services in the eastern and southern areas of the Township is a key reason that this area of the Township has remained undeveloped and has been able to preserve its "semi-rural" character."

Although the Northeast Ohio Areawide Coordinating Agency (NOACA) indicated that the entire Township was likely to have sewer services by 2020 (NOACA Clean Water 2000 Plan, p. 36) the Lake County Planning Commission stated that the steep-sloped topography in the eastern half of the Township was not conducive to centralized sewers or water. (Concord Township 2004 Comp. Plan.) NOACA further stated that, "*…the most widespread threat to water quality in 1999 is occurring in the rapidly developing areas of the region on the periphery of the existing urban areas. This threat comes from a variety of potential sources, including new point source discharge from residential and commercial development, but most significantly from the combined effects of land disturbances to construct these new developments. This has caused a wholesale transportation of the landscape from rural, sparsely populated, vegetated open spaces to large areas of denser populations with corresponding increases in impervious surfaces (pavements, parking lots and buildings). This transformation is threatening critical water resources one thought relatively secure from water*

pollution threats (upland drinking water reservoirs, headwaters areas, and high quality streams once far removed from urbanization).”

Figure 14: Public and Protected Lands



2.2 Summary of HUC-12 Biological Trends

The Ohio EPA has designated 21.4 miles of Coldwater Habitat, 31.6 miles of Warmwater Habitat and 21.2 miles of Seasonal Salmonid Habitat in the Big Creek watershed.

“*Big Creek and its tributaries drain the heart of Ohio’s Snow Belt. A high gradient, combined with torrential, scouring flows and discontinuities in bedrock have resulted in beautiful cascades and waterfalls along the length of Big Creek and in many of its tributaries, especially the portion of the drainage in Lake County. The scouring flows, however, result in long stretches of bedrock punctuated by short aggregations of glacial till and fractured bedrock; the effect is more apparent moving downstream, and is reflected in successively decreasing QHEI scores downstream from SR 608 (RM 9.3). The upshot is that from a fish’s eye-view, the habitat becomes marginal in the lower 5 miles of the creek. Identical conditions exist in East Creek and Gordon Creek, and to a lesser extent in Ellison Creek.*

Kellogg Creek is different in that it runs parallel to the Portage Escarpment (also called the Lake Escarpment Moraine), and therefore tends to be rich (or formerly so) in glacial till. In all likelihood, Kellogg Creek was formerly a bona fide coldwater stream; however, suburban development has altered the character of the stream. The headwater reach between King Memorial Road and Johnny Cake Ridge appears to have been channelized in its past, and the downstream site (upstream SR 86) had a bedload of pulverized shale, an artifact of suburbanized land use. Despite these limitations, the habitat in Kellogg Creek is capable of supporting a WWH fish community."

The headwater portion of the Big Creek drainage in Geauga County, being smaller and therefore subject to less scouring energy, and having a thicker glacial drift than the portion in Lake County, generally has stream habitat that is more conducive to supporting fish communities in accordance with expectations derived for till-plain streams." (Biological & Water Quality Study of the Grand River Basin. Ohio EPA. November 1, 2006. P. 65 & 66.)

"*The greatest threat to the rich biological diversity of the Grand River basin is suburbanization. Regional planning, stream protection policies, comprehensive construction site management plans, construction site performance bonds, identification and preservation of sensitive areas, and above all, defined limits to growth are needed to maintain the biological integrity of the Grand River. The Grand River is an economic asset to Northeast Ohio worth maintaining in its current state. The Grand River and its tributaries are especially sensitive to pollution and disturbance because of limited summer base flows.*" (Biological & Water Quality Study of the Grand River Basin. Ohio EPA. November 1, 2006. P. 3.)

EPA Biological and Water Quality Study of the Grand River Basin 2003-2004

- Fish communities improved considerably in Big Creek subwatershed between 1995 and 2004 due to dechlorinization of the Chardon WWTP effluent in June 1995. (Ohio EPA, 1996.) The number of fish species increased, the overall relative abundance of most fish increased, and the relative composition of pollution tolerant species decreased roughly by half.
- "All sites on Big Creek met the IBI biocriterion for WWH. The Williams Road site (RM 4.9) did not meet the MIWb bio-criterion because of the natural limitation of bedrock and little cover. Like the Grand River, Big Creek is deeply incised within a steep valley. Significant portions of the valley and slope to the uplands are preserved as conservation areas through private easements, Lake Metroparks, the Cleveland Museum of Natural History, and the Geauga Park District. The challenge for Big Creek now is to prevent suburban development from saturating the uplands and eroding the gains made by improved sewage treatment and land conservation."
- Kellogg Creek, including Ellison Creek, is the second most suburbanized subcatchment in the Grand River basin, with approximately 5.8% percent of its area in impervious cover as estimated from the Anderson Level III 1994 Landsat classification (ODNR). (*Using 1994 data.*) However, because the suburban neighborhoods comprising the catchment are generally older and the landscaping well established, the satellite imagery likely underestimates the total amount of impervious cover.
- Census data from 2000 shows population densities exceeding 1000 people/sq. mi census blocks traversed by SR 84. The most upstream site sampled (Brenel Road, RM 5.7) had a poor fish community, reflecting significant degradation due to residential land use. Fish communities at the remaining downstream sites were stressed as evidenced by a higher-than-

expected proportion of tolerant fishes, and fewer than expected numbers of pollution sensitive species. However, despite the evident stress, all the remaining sites at least marginally satisfied the WWH biocriterion owning to the ameliorative influences of riparian buffers, high gradient and groundwater inputs.

- Ellison Creek is similarly stressed, though more by recent construction than total suburban landuse and though stressed, the IBI scores at the three locations sampled met the WWH biocriterion. Again, a high gradient and riparian buffers help ameliorate suburban impacts.
- The remnant coldwater character of Kellogg Creek and Ellison Creek was evident in the collection of redside dace and naturally reproduced young-of-the-year steelhead trout in both streams. Fish communities in both creeks are not likely to retain their remaining biotic integrity with further increases in suburban development.

Figure 15. Big Creek Aquatic Life Use

Tributary	River Mile	Year	QHEI	Aquatic Life Use Designation	Attainment Status
Kellogg Creek	5.7	2004	59	WWH	Non
Kellogg Creek	0.2	2004	67	WWH	Full
Ellison Creek	1.2	2004	59	WWH	Full
Big Creek	16.4	2003	62	WWH	Partial
Big Creek	15.8	2003	82	WWH	Partial
Big Creek	14.1	2003	75	WWH	Full
Big Creek	9.3	2003	85	WWH	Full
Big Creek	5.0	2003	66.5	WWH	Full
Big Creek	2.5	2003	50.5	WWH	Partial
Jordan Creek	1.1	2004	59.5	CWH	Full
East Creek	1.2	2004	58	CWH	Full
Jenks Creek	0.1	2004	80.5	CWH	Full
Cutts Creek	1.2	2004	73	CWH	Full

Headwater Habitat Evaluation Index

Lake SWCD worked with the EPA to develop and collect Headwater Habitat Evaluation Index (HHEI) data for Lake County watersheds to establish a baseline database of existing conditions. HHEI data was collected by Lake SWCD staff in the Big Creek Watershed in 2007. There is no HHEI data for Geauga County.

222 sites were assessed throughout the watershed. HHEI is used for drainage areas that are less than one-square mile. As a result, in the larger subwatersheds, the mainstem of the stream was not assessed, just the smaller tributaries. Thirty-five sites were assessed as Class III; sixty-five were Class II Modified or below. (Figures 16 and 17) See Figure 18 and the following text for an explanation of the Ohio Stream Classification system.

In the Big Creek subwatershed, the Class I streams tended to be at the headwaters of the tributaries, where the channels were very poorly developed because of the small watersheds, where there is no stream power to develop the morphology and habitat. Class III streams, conversely, were found in large part near the confluence with the larger mainstem.

Figure 16. Stream Class Percentages for the Lake County Section

Class	%
Class I	21
Class I Modified	12
Class II	29
Class II Modified	3
Class III	35
	100

Figure 17. Stream Class for the Lake County Section

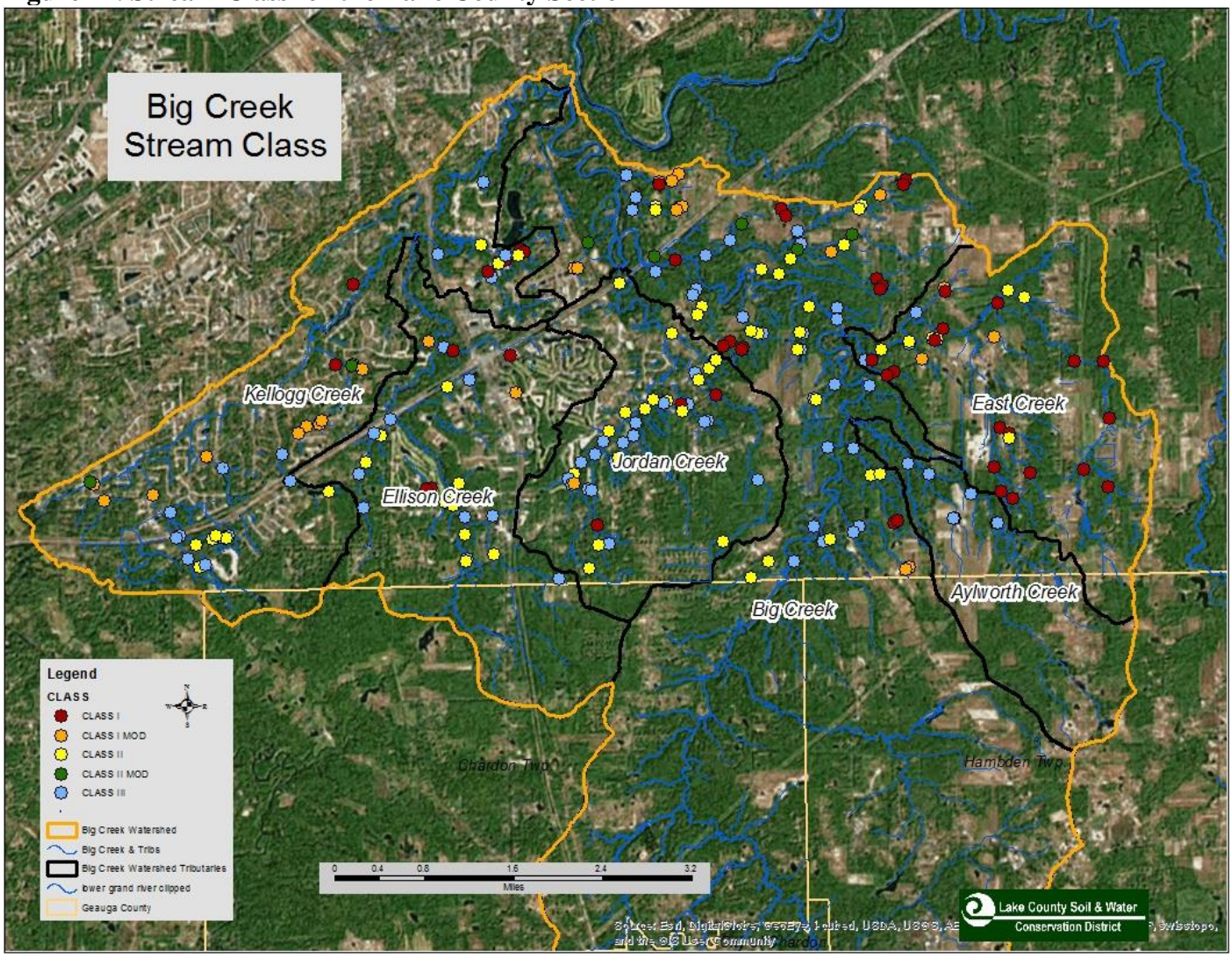
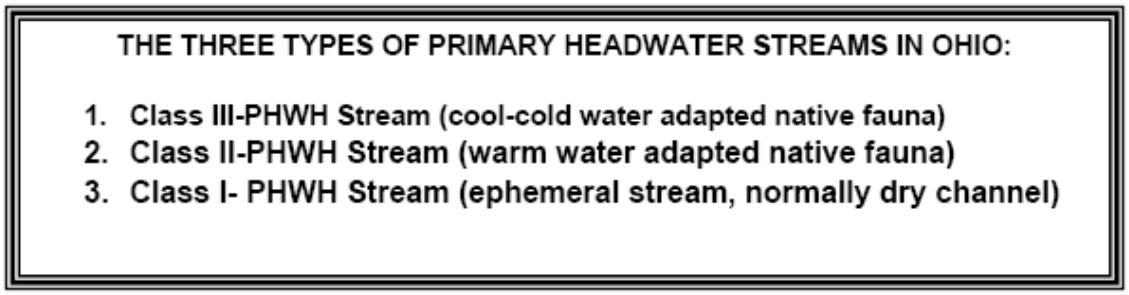


Figure 18. Three Types of Primary Headwater Streams in Ohio (OEPA. 2009.)



Class III-PHWH (Primary Headwater Habitat) streams have a diverse population of native fauna adapted to cool-cold perennial flowing water, with larval stages continuously present in the stream. They exhibit the highest quality of headwater stream habitat, with HHEI scores > 70.

Class II-PHWH streams have a moderately diverse population of warm-water adapted native fauna on a seasonal or annual basis. They are usually intermittent streams, but may have perennial flow in some instances. Class II streams will score between 30 and 70 on the HHEI.

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. They score <30 on the HHEI and do not provide good habitat for salamanders or macroinvertebrates.

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.)

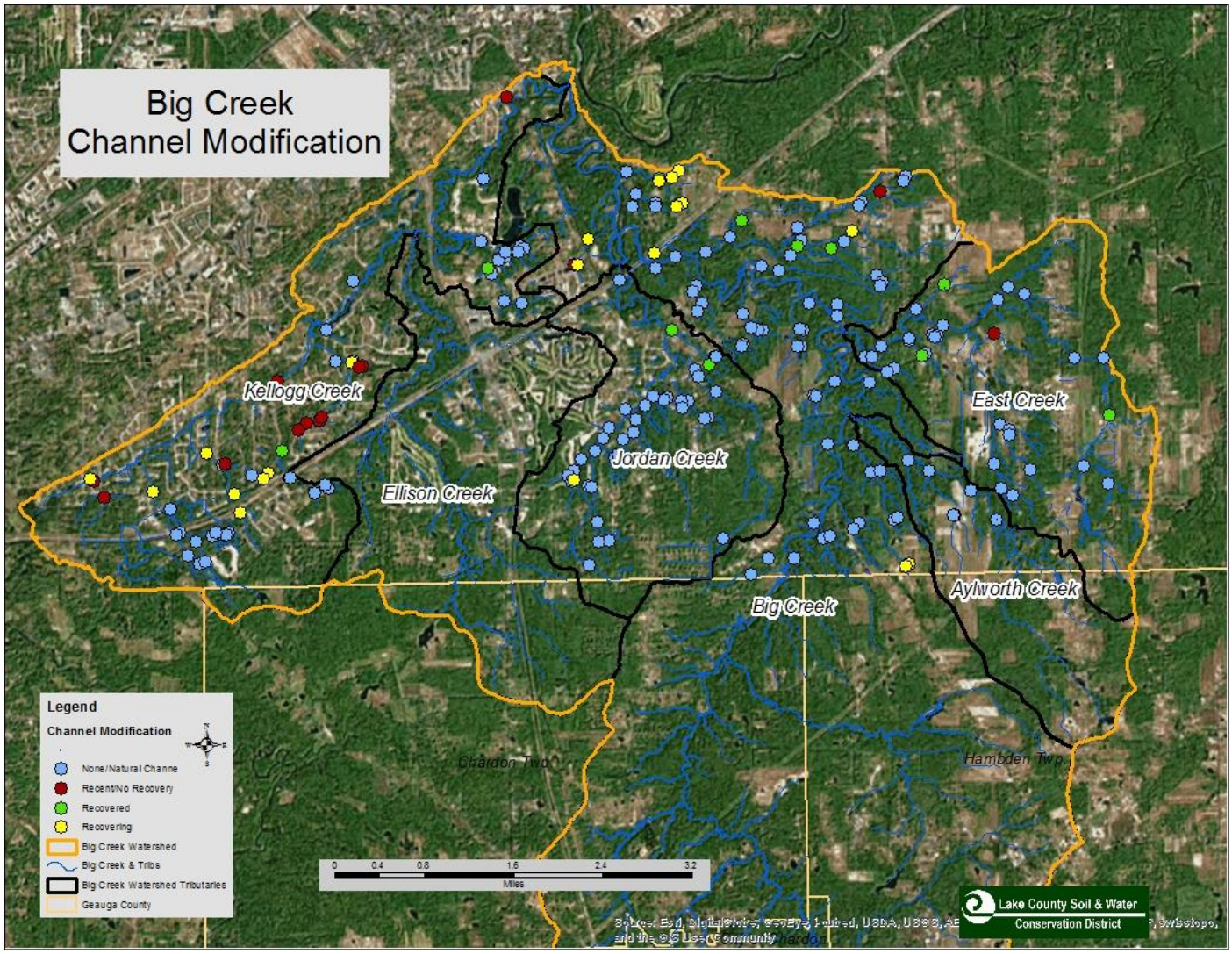
A natural "stream channel is characterized by the presence of riffles and pools, heterogeneous substrate deposition, the presence of point bars or other evidence of floodplain sediment deposition, appropriate stream channel sinuosity for the setting of the stream in the landscape, varied water depths 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 19. Channel Modification Percentages

Channel Modification	%
None/Natural Channel	77
Recent/No Recovery	8
Recovering	10
Recovered	5
	100

Figure 20. Channel Modification



When the HHEI assessment was done in 2007, 77% of the channels were identified as natural channel, with no modification (Figures 19 & 20). 15% were recovered or recovering and 8% were

recent with no recovery. Figures 21, 22, 23 and 24 illustrate different stream classifications within the watershed.

Figure 21. Class I Stream in East Creek Subwatershed

Figure 22. Class I Stream Modified in Kellogg Creek Subwatershed

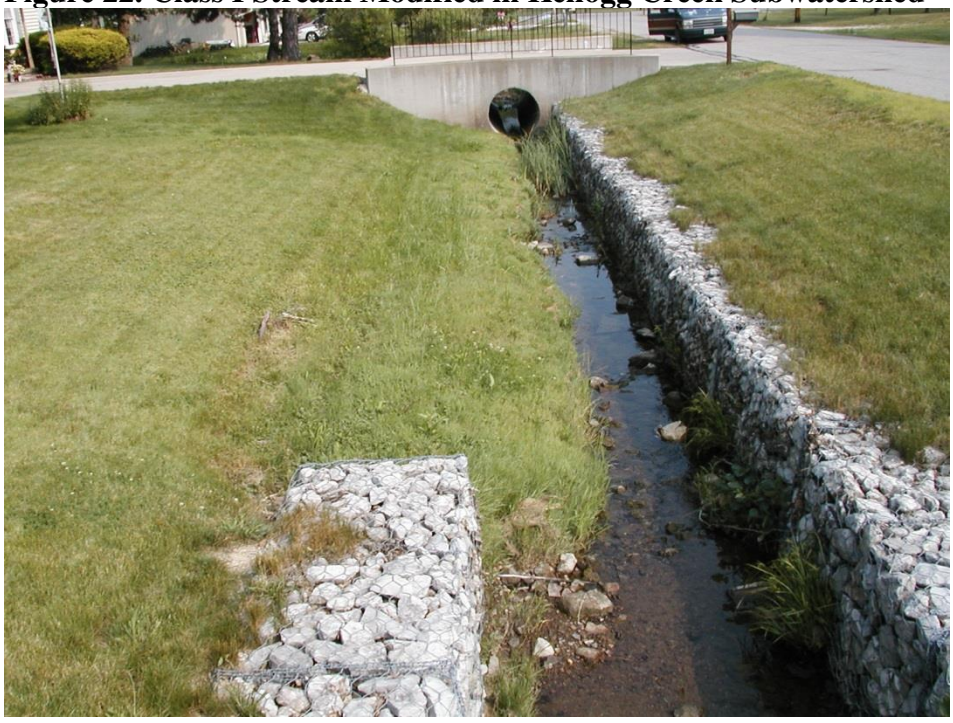
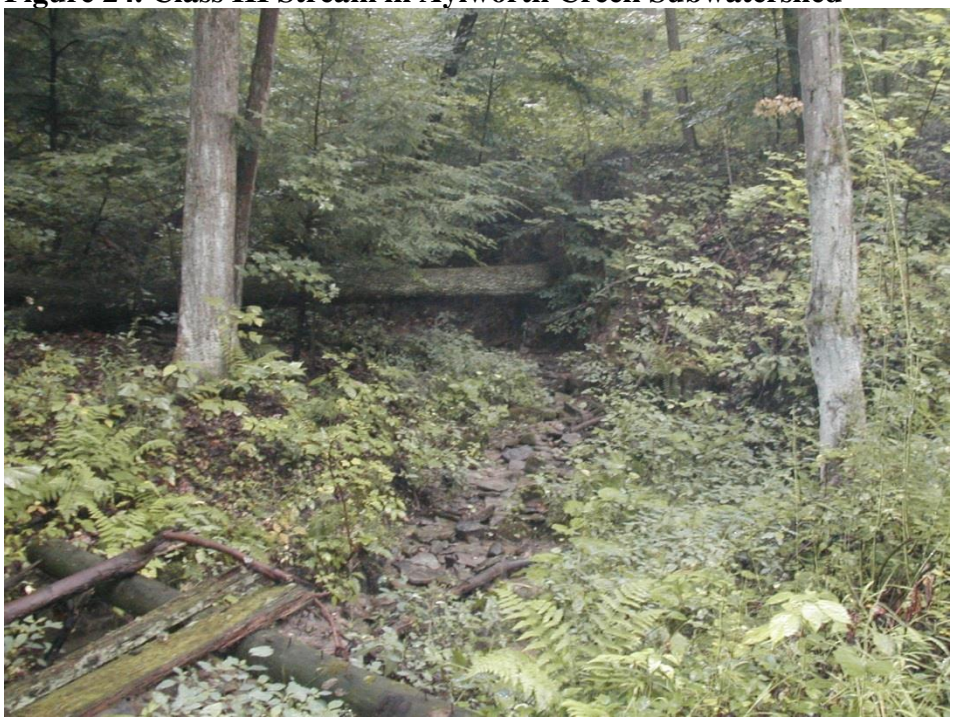


Figure 23. Class II Stream in Big Creek Subwatershed

Figure 24. Class III Stream in Aylworth Creek Subwatershed



2.3 Summary of HUC-12 Pollution Causes and Associated Sources

As listed in the 2012 Lower Grand River Watershed TMDL, Ohio EPA has determined that the causes of impairment in the watershed include direct habitat alteration, flow alteration, organic enrichment/dissolved oxygen, siltation, unknown causes and pollutants associated with urban storm water. The following parameters constitute the causes:

- Habitat alteration
- Siltation and sedimentation
- Flow alteration and imperviousness
- Metals
- Organic enrichment and low dissolved oxygen
- Temperature

Ohio EPA identified urban/suburban runoff and storm sewers as potential sources that could cause impairments. The natural hydrology of the watershed is altered by impervious surfaces, such as roads, roofs and parking lots. Biological communities are impacted by the change in flow hydrology, resulting in the following stressors:

- Degraded habitat and siltation
- High stream flow velocities
- Erosion, channel scour and bank failure
- Poor storm water quality
- Increased temperatures or rapid temperature flux
- Reduction in base flow

The impairment causes and sources reported in Ohio's 2010 303(d) Integrated Water Quality Monitoring and Assessment Report (Ohio EPA 2010a) are shown in the following table.

Figure 25. Lower Grand River watershed assessment units to be addressed by TMDLs

Name	Causes	Probable Sources
Big Creek HUC 12	Cause unknown Direct habitat alteration Pollutants associated with urban stormwater	Urban runoff, storm sewers (non-point sources) Hydromodification- development
	Natural limits	Natural
	Bacteria	

The high-priority stressors for Big Creek and Kellogg Creeks were listed as **flow alteration and imperviousness** in the Lower Grand River Watershed TMDL (January 2012. P. 73.) The TMDL further concluded that: "The water quality impairments in the lower part of the Grand River watershed can be corrected through a variety of actions. The impact of development can be lessened by retaining storm water on-site or allowing it to infiltrate the ground and by adopting better site design practices. Agricultural practices that minimize runoff from fields would reduce both sediment and nutrient impacts. Inspecting home sewage treatment systems and replacing or repairing failing

systems would reduce bacteria. Finally, future permits for some point sources should include lower effluent limits for E. coli and monitoring requirements for total phosphorus." The next field monitoring is scheduled for 2019.

2.4 Additional Information Determining Critical Areas and Developing Implementation Strategies

Concord Township is very aware that as Cuyahoga County approaches full "build-out" and communities in northern Lake County and western Geauga County fill in, Concord Township will experience an increased demand for development.

Flooding associated with urban development has been a long-standing problem in the watershed. Concord Township officials have been pro-active in assessing how to alleviate the flooding and improve water quality as the Township develops.

2.5.1
Comprehensive Planning in Concord Township

Development of Concord Township has long been a concern with the development pressures it has experienced. The Township adopted master plans to guide land development in 1969, 1975, 1986 and 1995.

1995

The 1995 Concord Township Comprehensive Plan summarized the issue of development pressure as background to the 1995 update:

> "Some common threads are evident throughout the last 25 years, during which the township population has more than doubled. Most of the growth, as predicted, has been residential. In 1969, Concord Township was seen as essentially a "residential community" and described as "semi-rural" and "uncrowded." In 1969, 85 percent of the land was undeveloped and a recommendation was made for zoning to encourage village green and cluster housing.
>
> By 1975, an increase in multi-family housing was evident and predicted to continue in the future. It was recommended that new zoning classifications be considered for residential districts of differing densities. The 1986 plan updated various data and adopted verbatim the goals outline in 1975. A continued recommendation has been to strengthen the "economic base" in the township, as well as expanding and preserving "open space."

2004

Concord Township adopted a 2004 Comprehensive Plan with "the express purpose of preserving Concord Township's rich heritage and enhancing key assets, including historic areas such as the Town Hall area, the Grand River corridor and its tributaries, the Township's riparian corridors and its steep slopes." The Plan stressed preserving the low-density residential character of the Township, conserving open space, while pursuing economic development initiatives to maintain fiscal stability. The plan recommended aggressive actions to preserve open space and natural features in the community to prevent overdevelopment and assure that residential development did not come at the expense of the natural features.

The 2004 Comprehensive Plan referenced the NOACA Clean Water 2000 Plan's strategies for water quality preservation as relevant for local governments with zoning land use authority as follows:

- Inspection and maintenance of home sewage systems
- Tightening of local government regulations relating to construction activity
- Minimizing the use of road salt
- Designing and maintaining roads to minimize runoff
- Promoting voluntary watershed stewardship programs that involve local citizens
- Educating the public about the importance of preserving water quality
- Encouraging voluntary land conservation programs
- Educating local officials about the significance of community development decisions on downstream communities
- Protecting stream and river corridors through zoning regulations
- Adopting "conservation development" subdivision regulations

2015
Concord Township adopted a Comprehensive Plan Update in 2015. With the continued development of the Township, the community has become concerned about the impacts of land clearing prior to construction and the impacts on stormwater quantity and quality. This issue came to the forefront because of flooding sustained from stormwater events in 2014. The Plan Update Committee suggested approaches that included:

- Reviewing the existing regulations and enforcement procedures relating to land clearing and stormwater protection during construction
- Limiting the area of land clearing surrounding a house foundation
- Limiting the area of land which may be "mass cleared" in a proposed subdivision
- Requiring some amount of "re-forestation" with native vegetation before construction is concluded

The Committee recommended that the issue of land clearing, including review of existing and potential regulations and their effectiveness and enforceability, be scheduled for study and action. The plan update stated that this may require information and assistance from land management and water quality professionals such as the Lake Soil and Water Conservation District.

2.5.2
Riparian Setbacks

Concord Township
Concord Township adopted riparian setbacks as a part of its Zoning Resolution, as amended through July 15, 2016. The purpose and intent of the regulations is to regulate uses and developments within riparian setbacks that would impair the ability of the riparian and wetland areas to:

1. Benefit the community by minimizing encroachment on designated watercourses
2. Reduce flood impacts
3. Assist in stabilizing the banks of designated watercourses
4. Reduce pollutants within the watercourses
5. Reduce pollutants before they enter watercourses
6. Preserve the scenic beauty of the environment

Designated watercourses include those draining an area greater than or equal to one square mile or those draining an area less than one square mile and having a defined bed and bank.

Riparian setbacks are required as follows:

1. A minimum of 120 feet on each side of designated watercourses draining an area greater than or equal to 20 square miles
2. A minimum of 75 feet on each side of designated watercourses draining an area equal to or greater than 1 square mile and up to 20 square miles
3. A minimum of 25 feet on each side of designated watercourses determined to be a Class III Primary Headwater Habitat Stream
4. A minimum of 25 feet on each side of designated watercourses draining an area less than 1 square mile and having a defined bed and bank

Thompson Township

Thompson Township has adopted riparian and wetland setbacks within its zoning code. Designated watercourses include those draining an area greater than or equal to one-half square mile or those draining less than one-half square mile and having a defined bed and bank.

Riparian setbacks are required as follows:

1. A minimum of 75 feet on each side of designated watercourses draining an area equal to or greater than one-half square mile and up to 20 square miles
2. A minimum of 25 feet on each side of designated watercourses draining an area less than one-half square mile and having a defined bed and bank

Wetland setbacks are required as follows:

1. Where a wetland is wider than the minimum riparian setback on either or both sides of a designated watercourse, the minimum riparian setback shall be extended to include the outermost boundary of the wetland, plus the following additional setback widths based upon the wetland category.
    a. An additional minimum setback of 50 feet extending beyond the outermost boundary of a category 3 wetlands
    b. An additional minimum setback of 30 feet extending beyond the outermost boundary of a category 2 wetlands
    c. No additional setback shall be required beyond the outermost boundary of a category 1 wetlands

2.5.3

Grand River Riparian Corridor Protection Plan (Davey Resource Group, March 1998)

Initiated by the Grand River Partnership, a consortium of public agencies and private organizations in Ashtabula, Geauga, Lake and Trumbull Counties, the protection plan identified three targeted "critical areas" for acquisition of conservation easements in the riparian corridor of the Grand River. Critical Area 3 includes the mainstem and eastern tributary of the Big Creek subwatershed.

The goals of the project were to:

1. Protect the water quality and aquatic habitat, wetlands and associated forest communities of the Grand River watershed
2. Provide education for landowners on the ecological and economic benefits of riparian buffers, wetlands, floodplains and steep slopes

3. Assist elected officials, public servants, decision makers and concerned citizens in making the right choices for watershed protection

Twenty benefits of riparian buffers were listed as very beneficial to the Grand River:

1. Reduces watershed imperviousness by 5 percent
2. Distances areas of impervious cover from the stream
3. Reduces small drainage problems and complaints
4. Stream "right-of-way" allows for lateral movement
5. Effective flood control
6. Protects from streambank erosion
7. Increases property values
8. Increases pollutant removal
9. Foundation for present or future greenways
10. Provides food and habitat for wildlife
11. Mitigates stream warming
12. Protects associated wetlands
13. Prevents disturbance to steep slopes
14. Preserves important terrestrial habitat
15. Corridors for conservation
16. Essential habitat for amphibians
17. Fewer barriers to fish migration
18. Discourages excessive storm drain enclosures/channel hardening
19. Provides space for stormwater ponds
20. Allows for future restoration

2.5.4
Brightwood Lake Dam

Brightwood Lake is formed by a dam on Kellogg Creek at approximately RM 4.3 just upstream of Prouty Road in Concord Township. Brightwood Lake is approximately 11.4 acres in size, and was constructed in 1967. The privately owned dam is considered a High Hazard Class I Dam, which has the potential to cause loss of life should it fail. Brightwood Lake has lost much of its volume because of sedimentation, and plans to restore the lake have been discussed since the 1990's, but no project has yet been funded.

The Lower Grand River Watershed TMDL (January 2012) stated that "removal or significant alteration of the dam to re-naturalize the stream would result in significant improvement in the integrity of the biological community in the stream." The TMDL recommended such efforts be considered as an implementation priority for the improvement of water quality in Kellogg Creek.

The Lake County Stormwater Management Department did a Brightwood Dam Removal Feasibility Study in October 2013. The Brightwood Dam study identified:

- Feasible dam removal alternatives
- Permitting constraints
- A preferred alternative

- Cost estimates
- Potential funding sources & criteria
- Stakeholder presentation

County and Township officials are working to develop a strategy that is acceptable to the private landowners.

2.5.5
Concord Township Drainage- Lake County Storm Water Proposals
The Concord Township Service Department has identified and prioritized 21 stormwater management projects to address flooding issues in the Township.

2.5.6
Chagrin River Watershed Partners (CRWP) Model Codes
CRWP has developed model ordinances/regulations and resolutions to assist its' member communities by providing tools to help maintain stream and wetland functions and minimize water quality impacts as land is developed. The codes (http://crwp.org/index.php/member-services/model-regulations) include:

- Conservation Development
- Erosion & Sediment Control
- Flood Damage Reduction
- Illicit Discharge Detection and Elimination
- Off-Street Parking
- Riparian Setbacks
- Stormwater Management
- Wetland Setbacks

The status of the communities within the Big Creek Watershed that are members of CRWP is shown below.

1. City of Chardon
    - Parking code incorporates most of CRWP's recommendations for minimizing impervious surfaces
    - No riparian setback or wetland setback ordinances
    - No Illicit Discharge Detection & Elimination code
    - Doesn't have CRWP model conservation development code. PRD code (1137) sets minimum open space requirement at 25%. CRWP recommends minimum open space requirement of 40% or greater.
    - Chardon's erosion and sediment control code was last updated in 2011. It references requirements of the Geauga Soil Sediment Pollution Control Regulations.
    - Chardon's comprehensive stormwater code was last updated in 2011. It references requirements of the Geauga Soil Sediment Pollution Control Regulations.
    - Floodplain damage reduction code was updated in 2009
2. Chardon Township
    - No riparian setback or wetland setback codes

- Use Geauga Soil Sediment Pollution Control Regulations for erosion and sediment control and comprehensive stormwater management
- Doesn't have CRWP model conservation development code
- No Illicit Discharge Detection & Elimination code
- Parking code lacks CRWP recommendations for minimizing impervious surfaces

3. City of Mentor
    - 1115.09 offers 25 ft. setbacks for streams in subdivisions with watersheds 100 acres or greater. CRWP recommends replacement with CRWP model riparian setback code.
    - No wetland setback ordinance
    - Doesn't have CRWP model conservation development code
    - Parking code incorporates most of CRWP's recommendations for minimizing impervious surfaces
    - Erosion and sediment control and comprehensive stormwater ordinances last updated in December 2016
    - Flood damage reduction code last updated in 2010
    - 1352.09 – Residential downspouts can't connect to storm sewers without City Engineer approval
    - Has Illicit Discharge Detection & Elimination code
4. Village of Kirtland Hills
    - No riparian setback or wetland setback codes
    - Has Illicit Discharge Detection & Elimination code
    - Doesn't have CRWP model erosion and sediment control and comprehensive stormwater ordinances
    - Doesn't have CRWP model conservation development code
    - Doesn't have CRWP model parking code
    - Flood damage reduction code last updated in 2009
5. Concord Township
    - Has a riparian setback resolution
    - Has conservation development codes
    - Has parking code that incorporates some practices to reduce impervious surfaces
    - Lake County erosion and sediment control regulations and comprehensive stormwater regulations apply

Chapter 3: Critical Area Conditions & Restoration Strategies

3.1 Overview of Critical Areas

The Critical Areas for the Big Creek watershed are the Big Creek Subwatershed and Kellogg Creek Subwatershed (Figure 26). The rationale for this determination is below (Figure 27). Both have been identified in several Ohio EPA documents and as part of the 303(d) listing process (Lower Grand River Watershed TMDL. January 2012. P. 66.) The Grand Biological and Water Quality Study of 2006 stated that all of the Grand River mainstem and most of its tributaries are meeting their designated aquatic life uses, with exceptions including Kellogg Creek and Big Creek in Chardon.

Figure 26. Big Creek Watershed Critical Areas

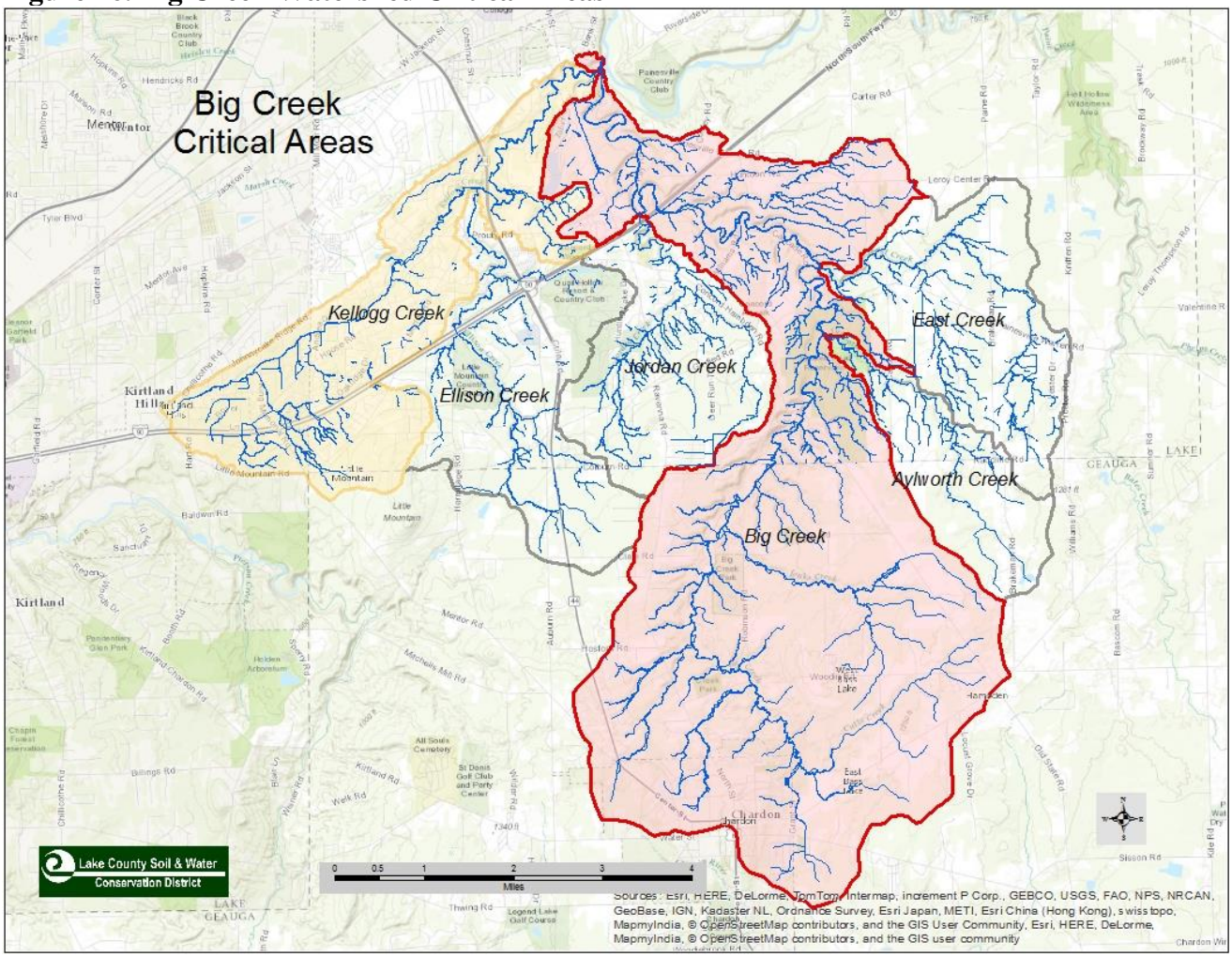


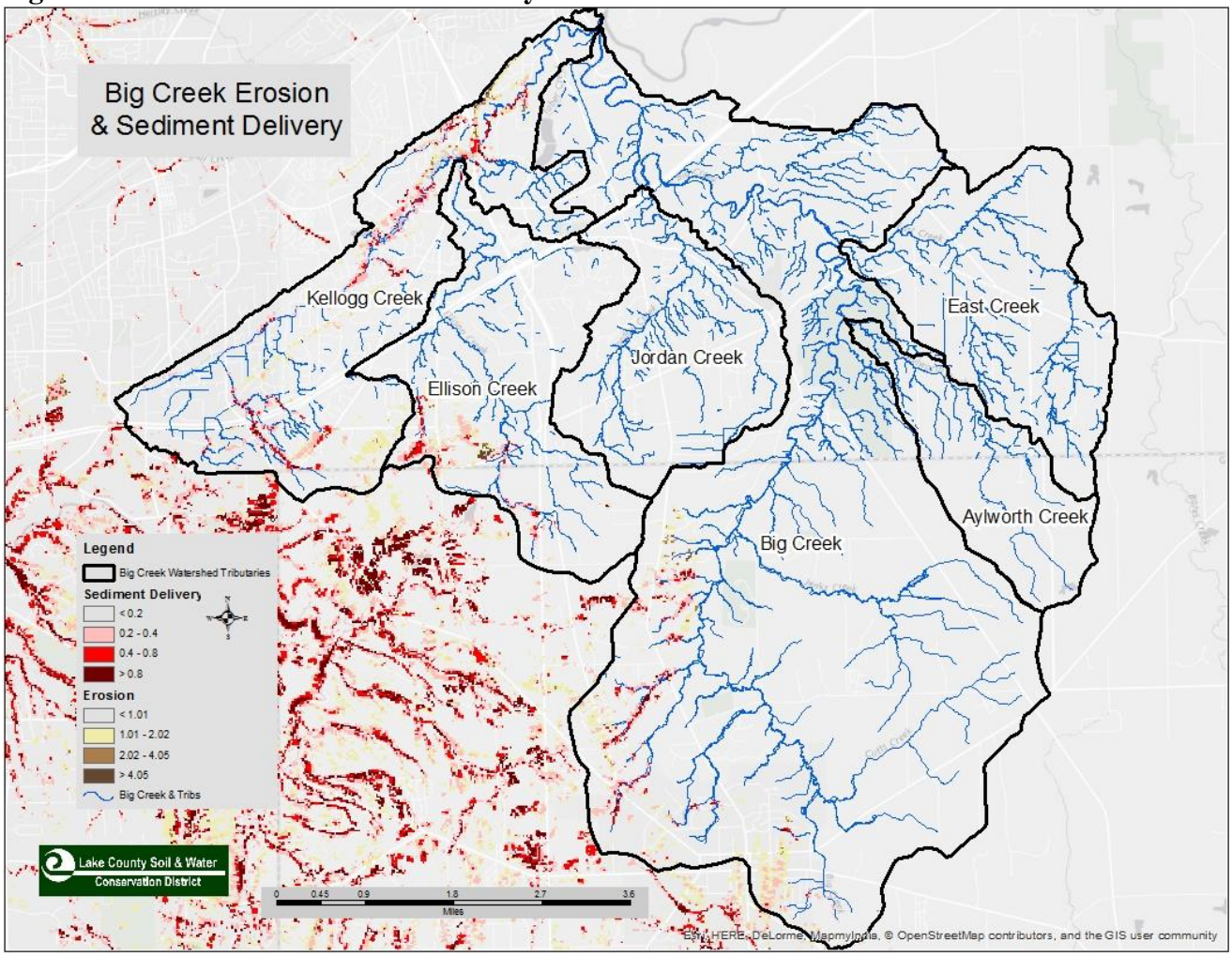
Figure 27. Potential Causes of Aquatic Life Use Impairments

Impaired Stream Name	Potential Causes of Impairment
Big Creek (Headwaters) Kellogg Creek	• Direct habitat alteration caused by urban runoff, storm sewers and hydromodification because of runoff from the City of Chardon and development in the Kellogg Creek watershed • Pollutants associated with urban storm water

HIT, the High Impact Targeting Tool (http://www.iwr.msu.edu/hit2/) a web-based model for optimizing sediment reduction efforts in the Great Lakes Basin, was used to delineate areas of higher erosion and sediment delivery (Figure 28). Although the highest levels are seen outside of the watershed, the greatest concentrations within the Big Creek HUC 12 Watershed are in the headwaters

of the Big Creek subwatershed and the headwaters and lower reaches of Kellogg Creek. Note that the Big Creek HUC 12 Watershed has a subwatershed named "Big Creek". The two will be differentiated by naming the subwatershed as "Big Creek Subwatershed".

Figure 28. Erosion and Sediment Delivery



Critical Area 1: Big Creek Subwatershed

The Big Creek Subwatershed was identified in the Biological and Water Quality Study of the Grand River Basin 2003 – 2004 as one of eight impaired creeks. See Figure 26 for the location of the Big Creek Subwatershed.

Although it has impaired sections, the Big Creek drainage area contains natural resources worthy of protection. "Big Creek (Subwatershed) and its tributaries drain the heart of Ohio's Snow Belt. A high gradient, combined with torrential, scouring flows, and discontinuities in bedrock, have resulted in beautiful cascades and waterfalls along the length of Big Creek (Subwatershed) and in many of its tributaries, especially the portion of the drainage area in Lake County." (Total Maximum Daily Loads for the Grand River (lower) Watershed. January 2012. P. 53.) The watershed contains two Coldwater Habitat (CWH) designated tributaries that are in full attainment of Aquatic Life Uses:

Jenks Creek and Cutts Creek. These coldwater habitat streams are important to the downstream Big Creek Subwatershed and Grand River in preserving base flow conditions of water quality and quantity.

The watershed has a high percentage of forested lands, and a low percentage of developed land, both of which have helped to retain the high quality waters in the watershed. The biggest threat to the water quality is the development of the City of Chardon in the headwaters, where the Aquatic Life Use was in partial attainment in 2003. The increasing levels of development and imperviousness are causing flooding, scour and sedimentation of the watercourses.

Restoring and protecting high quality in-stream habitat is an objective (4.01) of the Ohio EPA Nonpoint Source Management Update. The single greatest threat to the Big Creek Subwatershed is suburbanization of the headwaters of this high quality resource. The highest priority stressors for biological impairments in the watershed as identified in the Lower Grand River Watershed TMDL are nutrients, flow alteration and imperviousness. The imperviousness tipping point for watershed degradation has been exceeded in the Big Creek Subwatershed.

Critical Area 2: Kellogg Creek Subwatershed

The Kellogg Creek Subwatershed (Figure 26) was also identified in the Biological and Water Quality Study of the Grand River Basin 2003 – 2004 as one of eight impaired creeks. For purposes of this Strategy, the Kellogg Creek Subwatershed will be referred to as "Kellogg Creek".

Kellogg Creek is in non-attainment of its WWH designation because of urban sources. It is currently the most developed of the subwatersheds in the Big Creek HUC 12 watershed, and is considered completely developed.

"The condition of Kellogg Creek is representative of the response of ALU attainment to the gradient of impervious cover. The upper portions of Kellogg Creek, above the confluence with Ellison Creek, and upstream from I-90 are impaired for their ALU designations. Kellogg Creek runs through small-lot residential subdivisions throughout most of its length. Only in its lower segments, below Ellison Creek, does it flow through forested areas, although residential properties are usually still within a few hundred feet of the creek. The higher levels of impervious cover in the upper portion of the watershed could affect the attainment of the designated ALU. As the watershed percent impervious decreases downstream, Kellogg Creek becomes in attainment of the ALU." (Total Maximum Daily Loads for the Grand River (lower) Watershed. January 2012. P. 104.) The density of the suburban landuse within the headwaters of Kellogg Creek is likely to preclude attainment of the WWH aquatic life use given the way stormwater management was historically practiced, but the lower reaches are still marginally meeting expectations for WWH. The Ohio EPA is finding data to support the belief that higher levels of forested land and intact riparian corridors can counteract the higher levels of impervious cover in the lower portions of a subwatershed. (Total Maximum Daily Loads for the Grand River (lower) Watershed. January 2012. P. 106.)

Kellogg Creek has a seasonal salmonid aquatic life use, indicating the presence of naturally reproduced steelhead trout.

"The existing population density and inertia toward continued growth in Concord Township is likely to limit any recovery of impaired segments and in all probability will push currently attaining segments past their tipping points and into non-attainment. Therefore, the management goal for

Kellogg Creek and its tributaries should be directed at minimizing downstream impacts to the Grand River mainstem. To that end, homeowners should be educated and encouraged to naturalize their landscaping and avoid using fertilizers, herbicides and insecticides. Also, where riparian habitat can be enhanced or reforested, that should be an obvious priority." (Grand Biological and Water Quality Study of 2006. P. 5.)

3.2 Critical Area 1: Conditions, Goals & Objectives for the Big Creek Subwatershed

3.2.1 Detailed Characterization

The Big Creek Subwatershed covers 16,479.5 acres or approximately 25.7 square miles. It is the largest of the Big Creek HUC 12 subwatersheds. The headwaters are in Geauga County, draining a large portion of the City of Chardon (Figure 30). 79% of the watershed is in Geauga County and 21% is in Lake County. The mainstem of the Big Creek Subwatershed is heavily forested; urban, suburban and agricultural land uses are found on the outer edges of the watershed (Figure 31). The Big Creek Subwatershed corridor has been protected by concerted efforts on the part of the Geauga Park District, Lake Metroparks and the Cleveland Museum of Natural History (Figure 32). The land use is mixed, with the largest percentages in residential land use; agricultural land use is second and public land use is third (Figure 29). The subwatershed encompasses portions of the City of Chardon and Chardon Township in Geauga County and Concord Township, Leroy Township and a small portion of Painesville Township in Lake County (Figure 33).

Figure 29. Big Creek Subwatershed Land Use

Land Use, Lake	Acres	%	Land Use, Geauga	Acres	%
Agriculture	1199	34	Agriculture	4858	37.5
Commercial	3	.1	Commercial	221	1.5
Industrial	23.5	1	Industrial	461	3.5
Residential	1568	44.5	Residential	5907	46
Public	729.5	20.4	Public	1495	11.5
	3525.5	**100**		**12954**	**100**

Figure 30. Big Creek Subwatershed Location

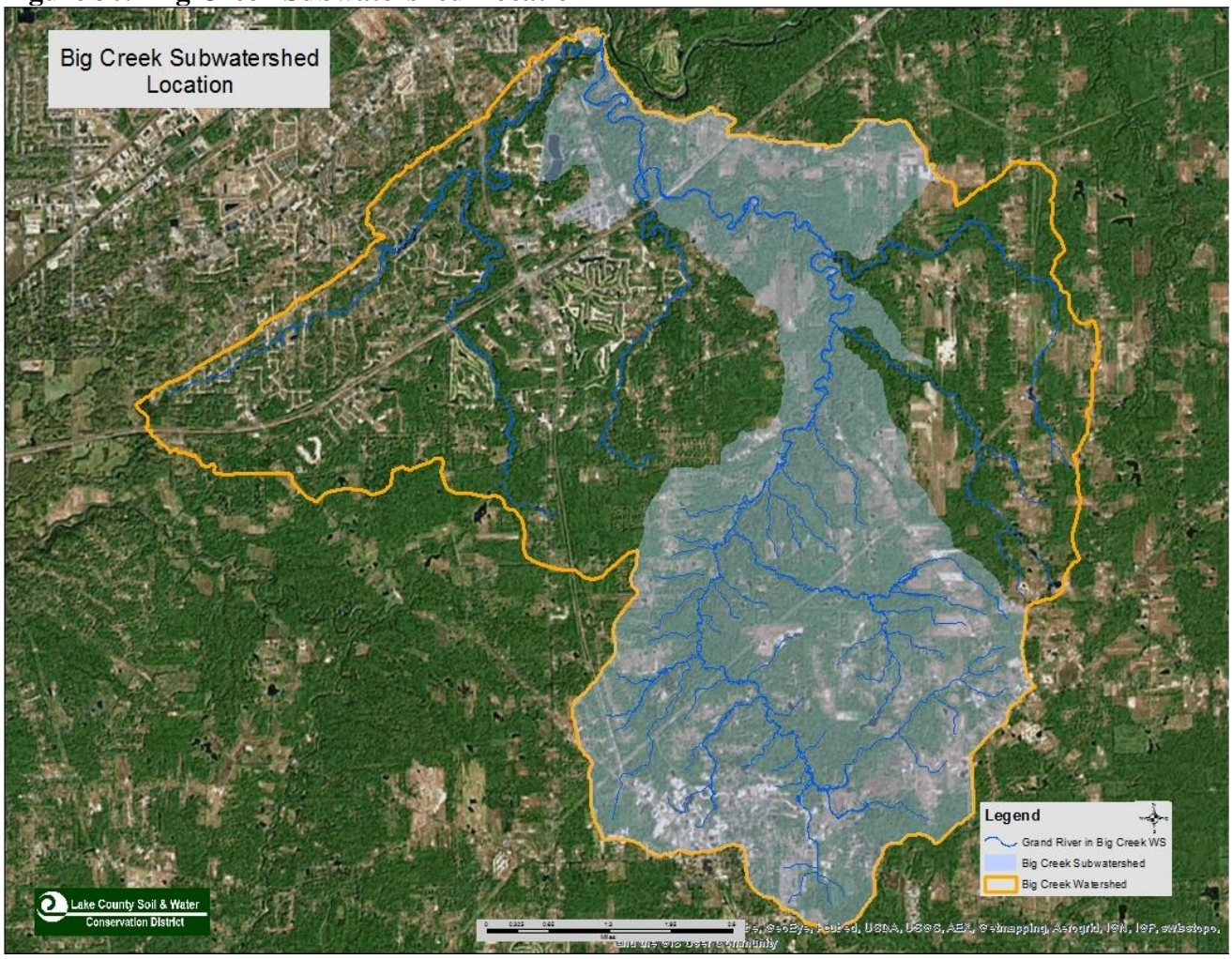


Figure 31. Big Creek Subwatershed Land Use

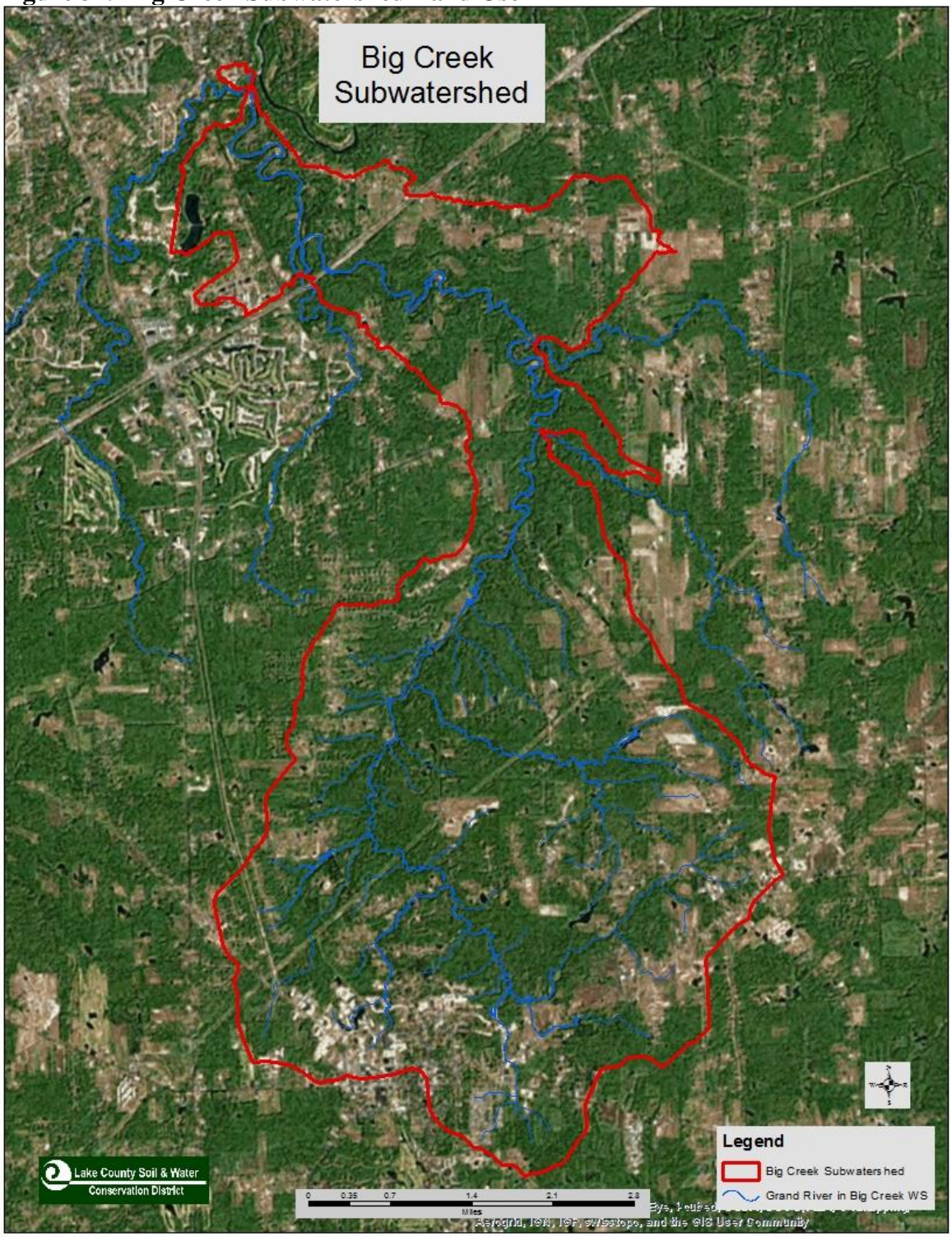


Figure 32. Big Creek Subwatershed Protected Properties

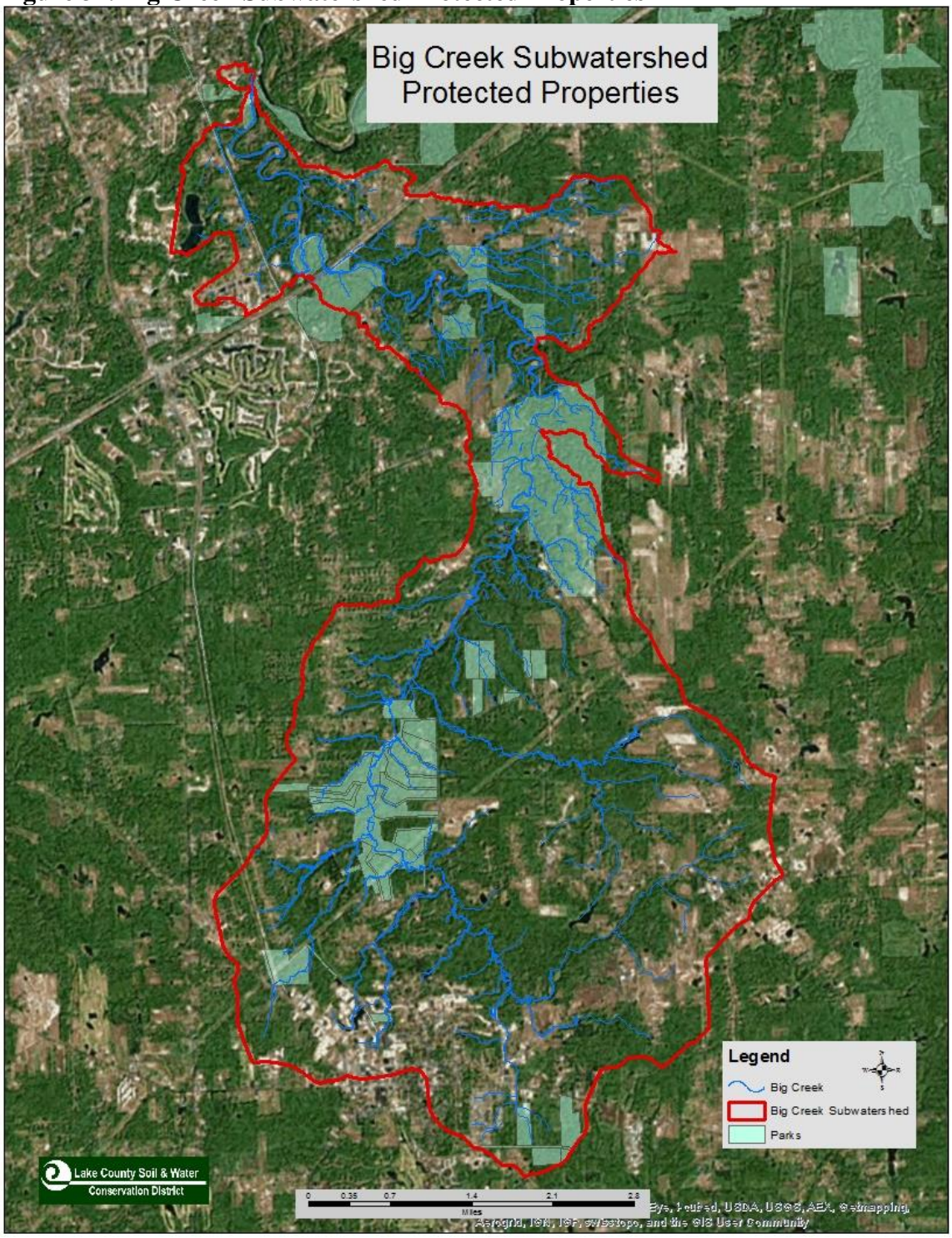


Figure 33. Big Creek Subwatershed Communities

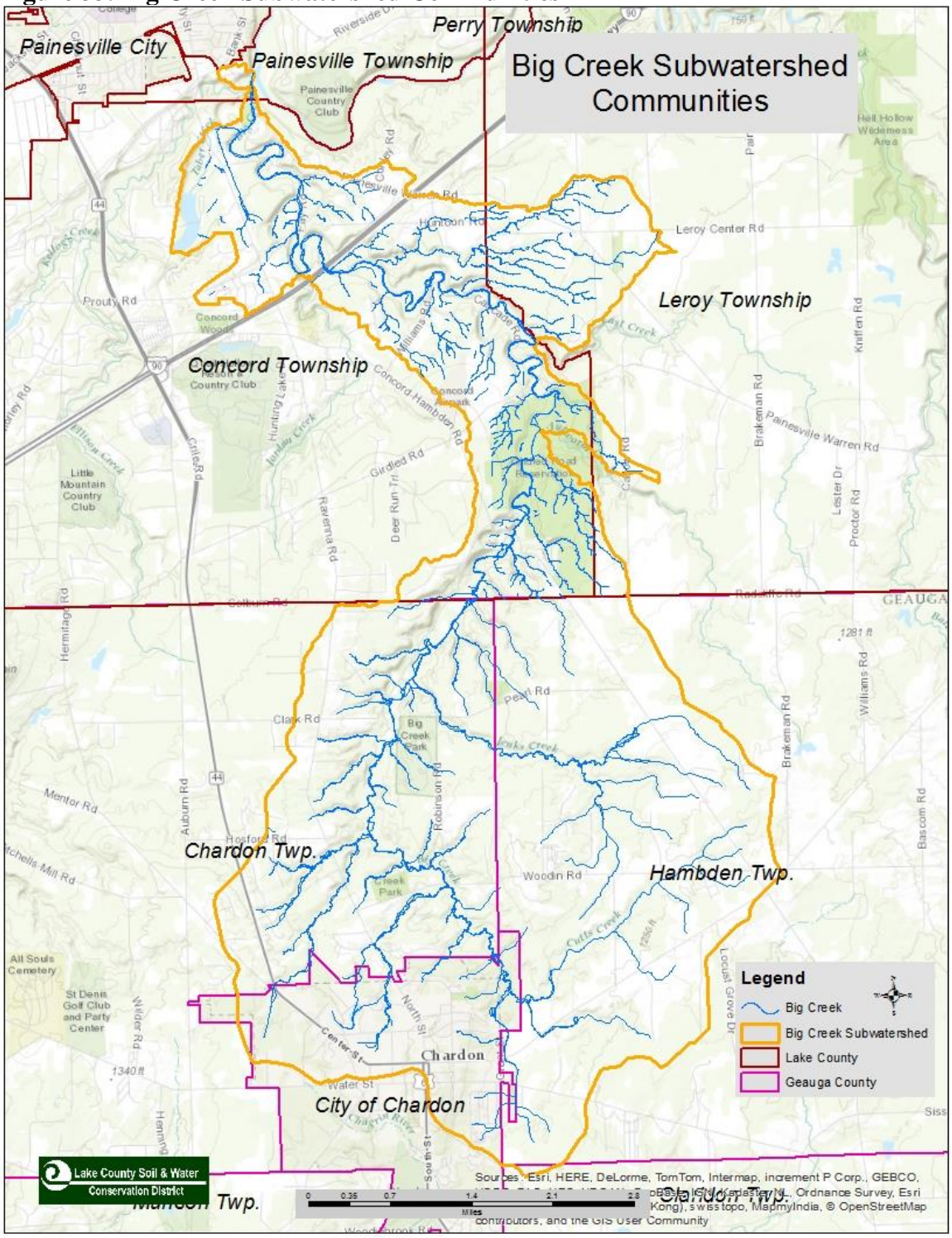
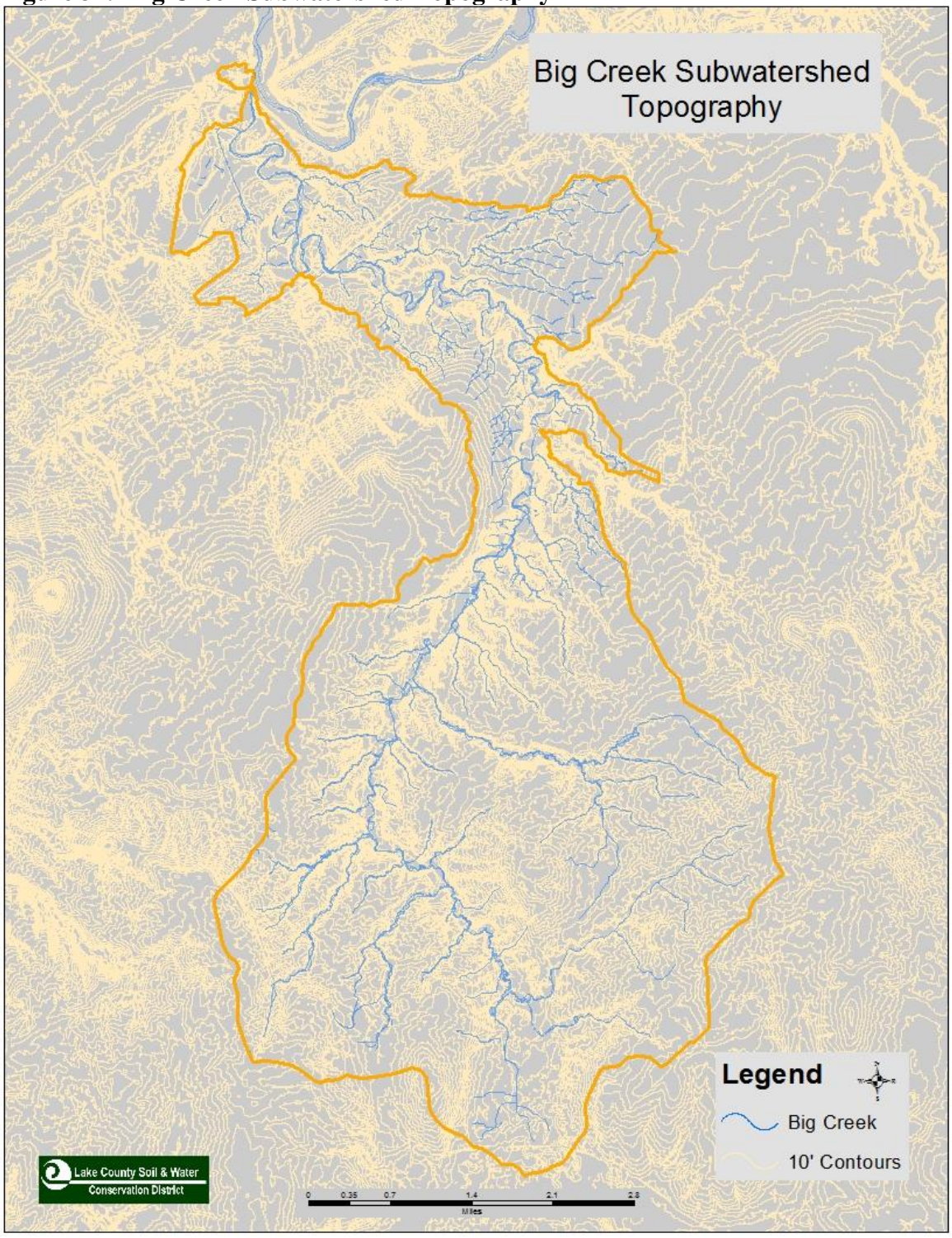


Figure 34. Big Creek Subwatershed Topography



The topography of the Big Creek Subwatershed is dominated by Big Creek and its tributaries (Figure 34). The outlet at the mainstem of the Grand River can be seen in the upper portion of Figure 34.

3.2.2 Detailed Biological Conditions

Aquatic life in Critical Area 1, the Big Creek Subwatershed is designated as a Warmwater Habitat (WWH). The QHEI scores range from 82/excellent in some sections of the headwaters to 50.5/fair in the lower reaches. The Aquatic Life Use is impaired near Chardon, where the impacts of urbanization in the headwater areas at RM 16.0 and 16.2 were identified by the Ohio EPA in 2012 (Lower Grand River Watershed TMDL. January 2012. P. 121.) The best fish communities were found in the headwaters and became slightly less healthy, though mostly in attainment, along the creek to the mouth. The macroinvertebrate data showed the reverse, where the lower reaches of Big Creek had excellent scores at RM 2.7 and 4.8 and fair scores in the headwaters at RM 16.0 and 16.2 (Figure 40).

The Big Creek Subwatershed was in *partial attainment* in the headwaters, at RM 16.4, upstream of the City of Chardon's Waste Water Treatment Plant (WWTP) at U.S. Route 6, and at RM 15.8, downstream of the WWTP in 2003. It was in Full attainment between RM 14.1 at Woodin Road through RM 5 at Williams, and in Partial attainment at RM 2.5 at Fay Road, where the cause of impairment was natural conditions and wetlands. (Total Maximum Daily Loads for the Grand River (lower) Watershed. January 2010. P. 54.)

The habitat for aquatic life use is described in the Grand Biological and Water Quality Study of the Grand River Basin. November 2006. P. 75.):
"*Big Creek and its tributaries drain the heart of Ohio's snow belt. A high gradient, combined with torrential, scouring flows and discontinuities in bedrock have resulted in beautiful cascades and waterfalls along the length of Big Creek and in many of its tributaries, especially the portion of the drainage in Lake County. The scouring flows, however, result in long stretches of bedrock punctuated by short aggregations of glacial till and fractured bedrock; the effect is more apparent moving downstream, and is reflected in successively decreasing QHEI scores downstream from SR 608 (RM 9.3). The upshot is that from a fish's eye-view, the habitat becomes marginal in the lower 5 miles of the creek. Identical conditions exist in East Creek and Gordon (Jordan) Creek, and to a lesser extent in Ellison Creek.*

The headwater portion of the Big Creek drainage in Geauga County, being smaller and therefore subject to less scouring energy, and having a thicker glacial drift than the portion in Lake County, generally has stream habitat that is more conducive to supporting fish communities in accordance with expectations derived for till-plain streams.

Considerable improvement in fish communities occurred between 1995 and 2004 in Big Creek (Figure 45), consequently to dechlorinization of the Chardon WWTP effluent in June of 1995 (Ohio EPA 1996). The improvement was most apparent in an increased number of fish species, an overall increased relative abundance of most fishes, and a decrease by roughly half in the relative composition of pollution tolerant species. All sites on Big Creek met the IBI biocriterion for WWH. The Williams Road site (RM 4.9) did not meet the MIWb bio-criterion because of the natural limitation of bedrock and little cover. Like the Grand River, Big Creek is deeply incised within a steep

valley. Significant portions of the valley and slope to the uplands are preserved as conservation areas through private easements, Lake Metroparks, the Cleveland Museum of Natural History, and the Geauga Park District. The challenge for Big Creek now is to prevent suburban development from saturating the uplands and eroding the gains made by improved sewage treatment and land conservation." (Grand Biological and Water Quality Study of the Grand River Basin. November 2006. P. 75.)

The aquatic life use attainment from 2003 is shown below (Figure 35). The EPA uses the Index of Biotic Integrity (IBI), Modified Index of Well-being (MIwb) and Invertebrate Community Index (ICI) as measures of aquatic life use. The Qualitative Habitat Evaluation Index (QHEI) is also used as a measure of the ability of the physical habitat to support a biotic community. The thresholds for attainment are shown in Figure 36.

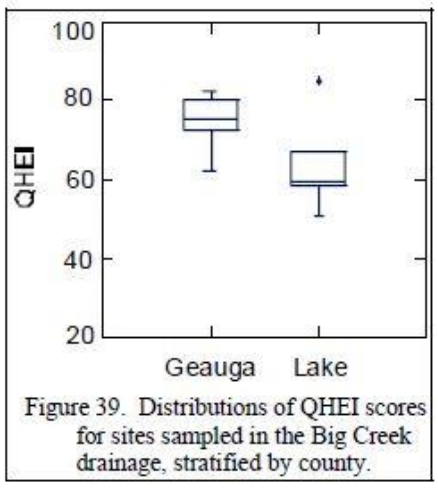


Figure 39. Distributions of QHEI scores for sites sampled in the Big Creek drainage, stratified by county.

Figure 35. Aquatic Life Use Attainment for the Big Creek Subwatershed, 2003

River Mile	IBI	MIwb	ICI	QHEI	Status	Causes	Sources
16.2/16.1	58	--	22	62.0	Partial	Habitat Alteration	Urban Runoff
16	52	--	28	82.0	Partial		Urban Runoff
14/13.8	40	--	44	75.0	Full		
9.3/9.5	48	--	--	85.0	Full		
4.9/4.8	38	7.9	50	66.5	Full		
2.5/2.7	44	7.1	54	50.5	Partial	Natural Limits	

MIwb is not applicable to drainage areas with headwater streams < 20 mi2

Figure 36. Aquatic Life Use Attainment Thresholds for Warm Water Habitat

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

The stormwater runoff volume has caused streambank erosion, channel scour and bank failure in the headwaters as channels resize (Figure 37) and sedimentation is evident (Figure 38). Channel armoring has been installed in several locations to reduce the channel degradation (Figure 39).

Figure 37. Streambank Erosion and Sedimentation on Big Creek

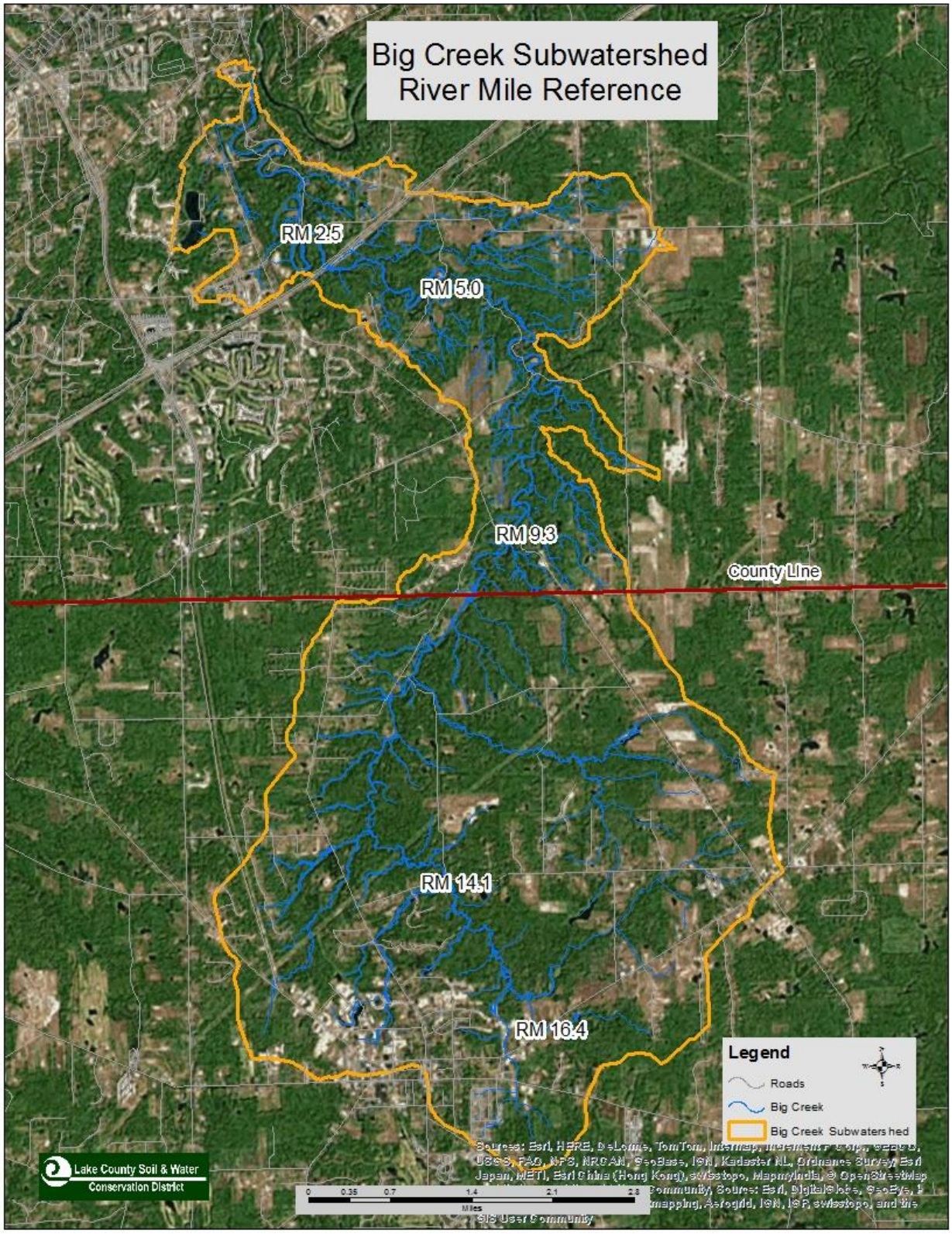
Figure 38 Sedimentation of Big Creek Main Channel at Woodin Road

Photo courtesy of Paul Pira, Geauga Park District

Figure 39. Channel Armoring

A dam is located in the northwest quadrant of the City of Chardon on industrial property near Industrial Park and Fifth Ave., known as the Loecy Dam. Removing the dam is a priority for the stakeholders and for the Ohio EPA as well. The Grand Biological & Water Quality Study of the Lower Grand River recommended preserving the hydrology of Big Creek and its tributaries as important for maintaining the long-term health of the Grand River (p. 5).

Figure 40. Big Creek Subwatershed River Mile Reference



3.2.3 Detailed Causes and Associated Sources

The causes and sources of impairment in the Big Creek Subwatershed are outlined below (Total Maximum Daily Loads for the Grand River (lower) Watershed; Ohio EPA, January 2012; stakeholder identification).

Cause	Source
Habitat alteration	Urban/Suburban runoff • Hydromodification • Storm sewers
Siltation and sedimentation	• Streambank erosion • Channel scour • Bank failure
Flow alteration and imperviousness	• Urban runoff/storm sewers
Organic enrichment/dissolved oxygen	Untreated/Undertreated Stormwater Runoff • Residential, single family development • Commercial/Institutional development
Temperature	• Urban/Suburban runoff

3.2.4 Outline Goals and Objectives for the Critical Area

Goals

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

The headwaters of the Big Creek Subwatershed in the City of Chardon are the most impacted by urban development and RM 16.0 and 16.2 are in *Partial Attainment*. Habitat alteration, flow alteration and imperviousness from hydromodification and urban/suburban runoff, as well as pollution from untreated/undertreated stormwater runoff are causes of impairment. Restoring and preserving the hydrology of Big Creek and its tributaries as important for maintaining the long-term health of the Grand River. The goals are to maintain the CWH in Cutts and Jenks Creeks and improve the QHEI scores in the headwaters so the *Partial Attainment* status can be changed to *Full Attainment*.

Goal 1. Achieve QHEI score of 70 at Woodin Road on Big Creek

- NOT ACHIEVED: Site currently has a score of 60.5

Goal 2. Maintain the CWH in Cutts and Jenks Creeks

- Achieved: CWH designation

Objectives

Objective 1. Restore natural hydrology through dam modification/removal, daylighting or similar practices

- Remove 1 dam (Loecy Dam)
- Restore 7.5 acres of wetlands

Objective 2. Reduce urban runoff from impervious surfaces in the Big Creek Subwatershed headwaters through impervious surface reduction and infiltrative green infrastructure practices.

- Install 5 acres of LID retrofits designed to treat runoff from at least 25 acres

Objective 3. Protect the Big Creek riparian corridor

- The Lake County Park District and Geauga Park Districts will preserve properties along the Big Creek corridor and in the CWH stream corridors of Cutts and Jenks Creeks

Objective 4. Protect riparian corridors to minimize water quality impacts as land develops

- Implement CRWP model ordinances and regulations in Chardon Township to protect approximately 50 stream miles
- Implement CRWP model ordinances and regulations in the City of Chardon to protect 5.4 stream miles

It is a top priority for the stakeholders to address the impairments from urban/suburban development and stormwater runoff and to preserve and restore the natural hydrology in Big Creek. The development in the headwaters of the watershed will require retrofits as well as implementing practices on new developments.

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

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

3.2.2 Critical Area 2: Conditions, Goals & Objectives for Kellogg Creek Subwatershed

3.2.1 Detailed Characterization

Critical Area 2, Kellogg Creek Subwatershed, drains 4,305.2 acres or 7.0 square miles (Figure 42). It has the highest percentage of developed land in the HUC-12 and a higher percentage of developed land than most of the rest of the Grand River Watershed. Almost 85% of the land is in residential land use (Figure 43). In the upper portions of the watershed, Kellogg Creek runs through small-lot residential subdivisions for most of its length. In its lower segments (below Ellison Creek) it flows through forested areas, although residential properties are usually still within a few hundred feet of the creek (Figure 45).

The watershed has water quality issues because of the imperviousness. Its hydrology is characterized by 14.7% imperviousness, which leads to larger runoff volumes, higher peak flows, and flashy

streams. The headwater reach between King Memorial Road and Johnny Cake Ridge appears to have been channelized in its past, as a result of suburban land use changes (Figure 44).

The watershed encompasses Concord Township, a small portion of Painesville Township, small portions of the City of Mentor and the Village of Kirtland Hills in Lake County and a small section of Chardon Township in Geauga County (Figure 46).

Interstate 90 bisects the headwaters of Kellogg Creek, which are piped beneath the highway (Figure 43).

The high point of the watershed is just below Little Mountain (Figure 47), at an elevation of 1240 feet in the southeast section. The watershed slopes steeply to the Portage Escarpment, where it levels out along the Kellogg Creek mainstem. Kellogg Creek empties into the Grand River at an elevation of 610 feet.

Brightwood Lake is formed by a dam on Kellogg Creek at approximately RM 4.3 just upstream of Prouty Road in Concord Township. Brightwood Lake is approximately 11.4 acres in size, and was constructed in 1967. The privately owned dam is considered a High Hazard Class I Dam, which has the potential to cause loss of life should it fail. Brightwood Lake has lost much of its volume because of sedimentation, and plans to restore the lake have been discussed since the 1990's, but no project has yet been funded (Figure 41). The sedimentation of the lake can be seen in the lower left-hand corner of Figure 41.

The Total Maximum Daily Loads for the Grand River (lower)Watershed (January 2012) stated that "removal or significant alteration of the dam to re-naturalize the stream would result in significant improvement in the integrity of the biological community in the stream." The TMDL recommended such efforts be considered as an implementation priority for the improvement of water quality in Kellogg Creek.

The Lake County Stormwater Management Department did a Brightwood Dam Removal Feasibility Study in October 2013. The Brightwood Dam study identified:

- Feasible dam removal alternatives
- Permitting constraints
- A preferred alternative
- Cost estimates
- Potential funding sources & criteria
- Stakeholder presentation

County and Township officials are working to develop a strategy that is acceptable to the private landowners.

Figure 41. Brightwood Lake and Dam

Figure 42. Kellogg Creek Location

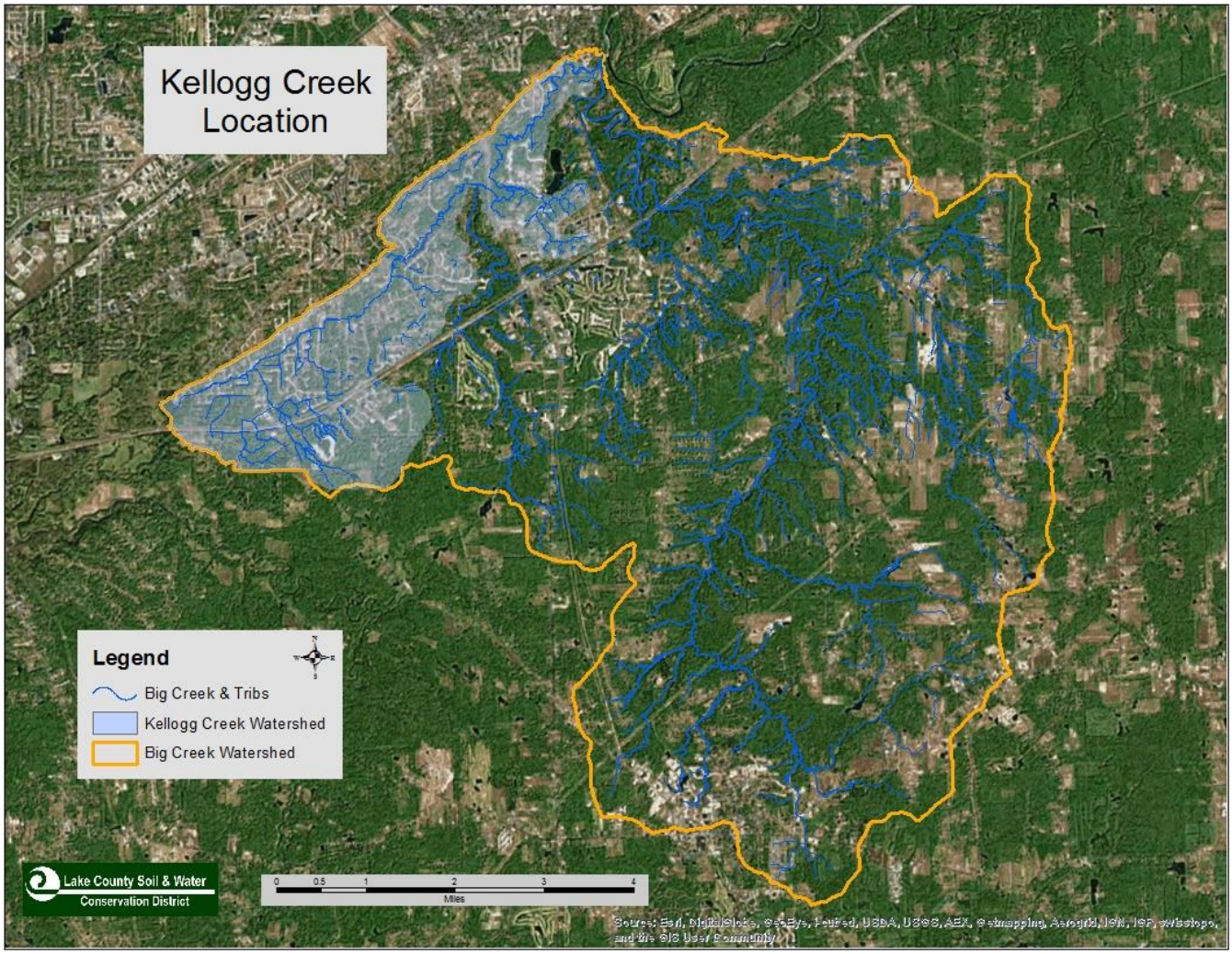


Figure 43. Kellogg Creek Land Use

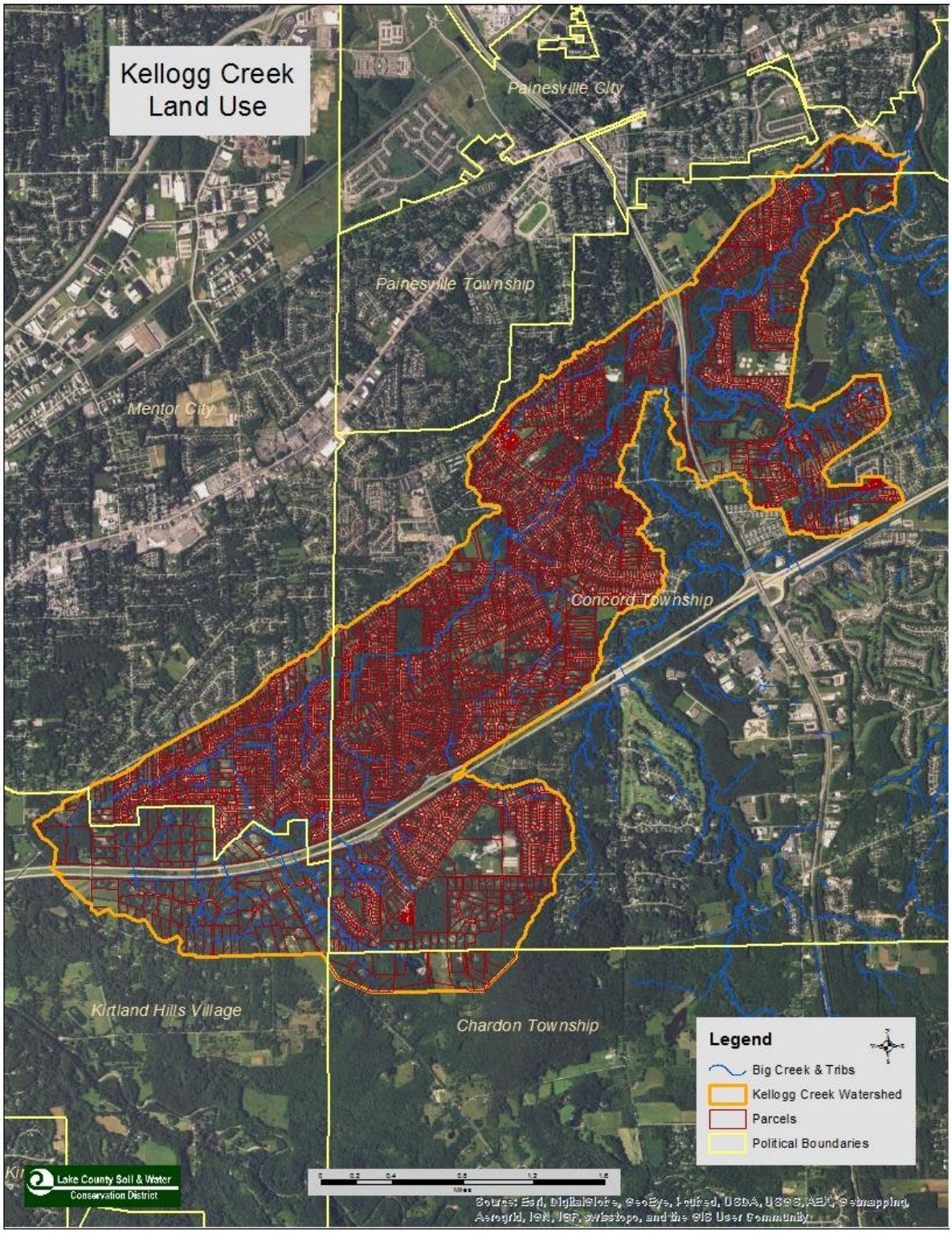


Figure 44. Kellogg Creek Channelized Section

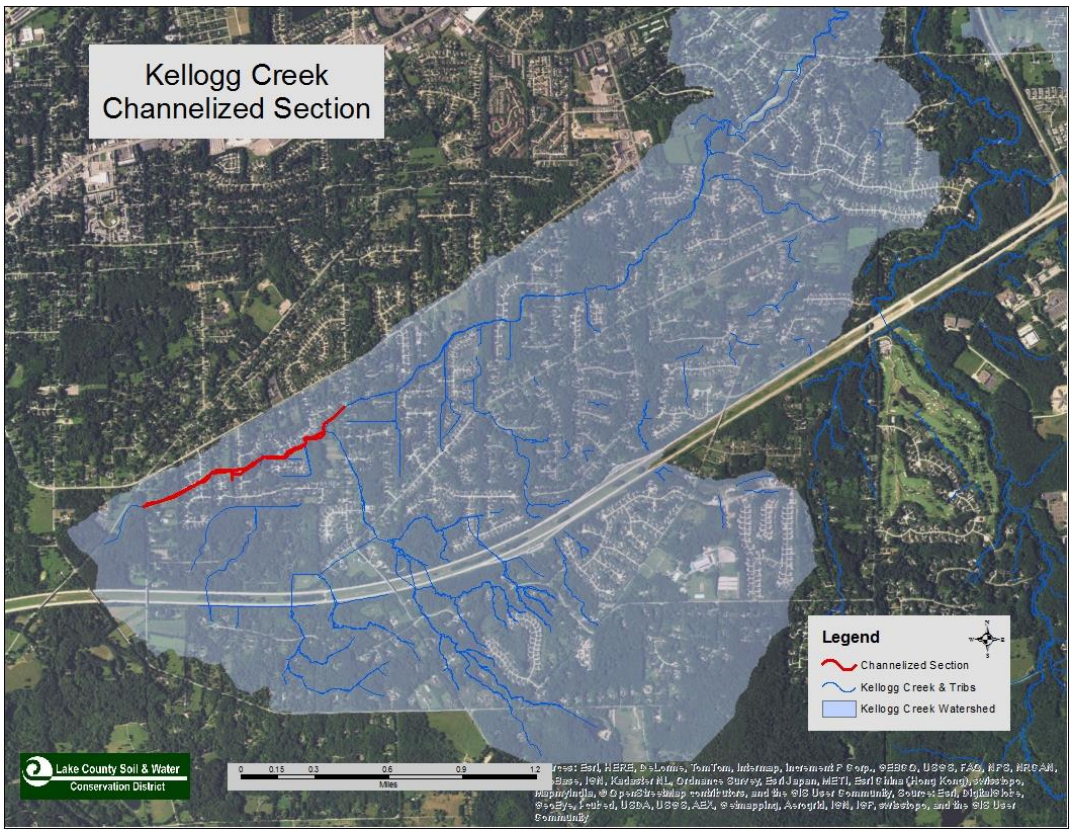


Figure 45. Lower Kellogg Creek Riparian Corridor

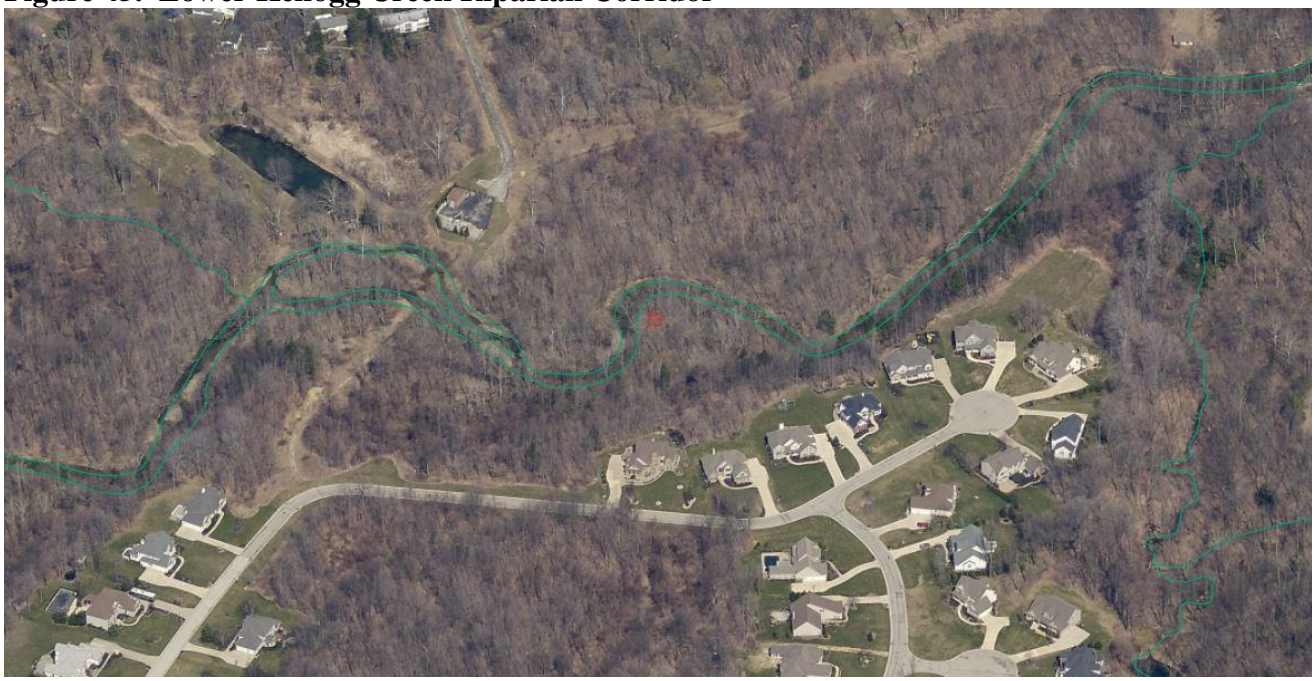


Figure 46. Kellogg Creek Communities

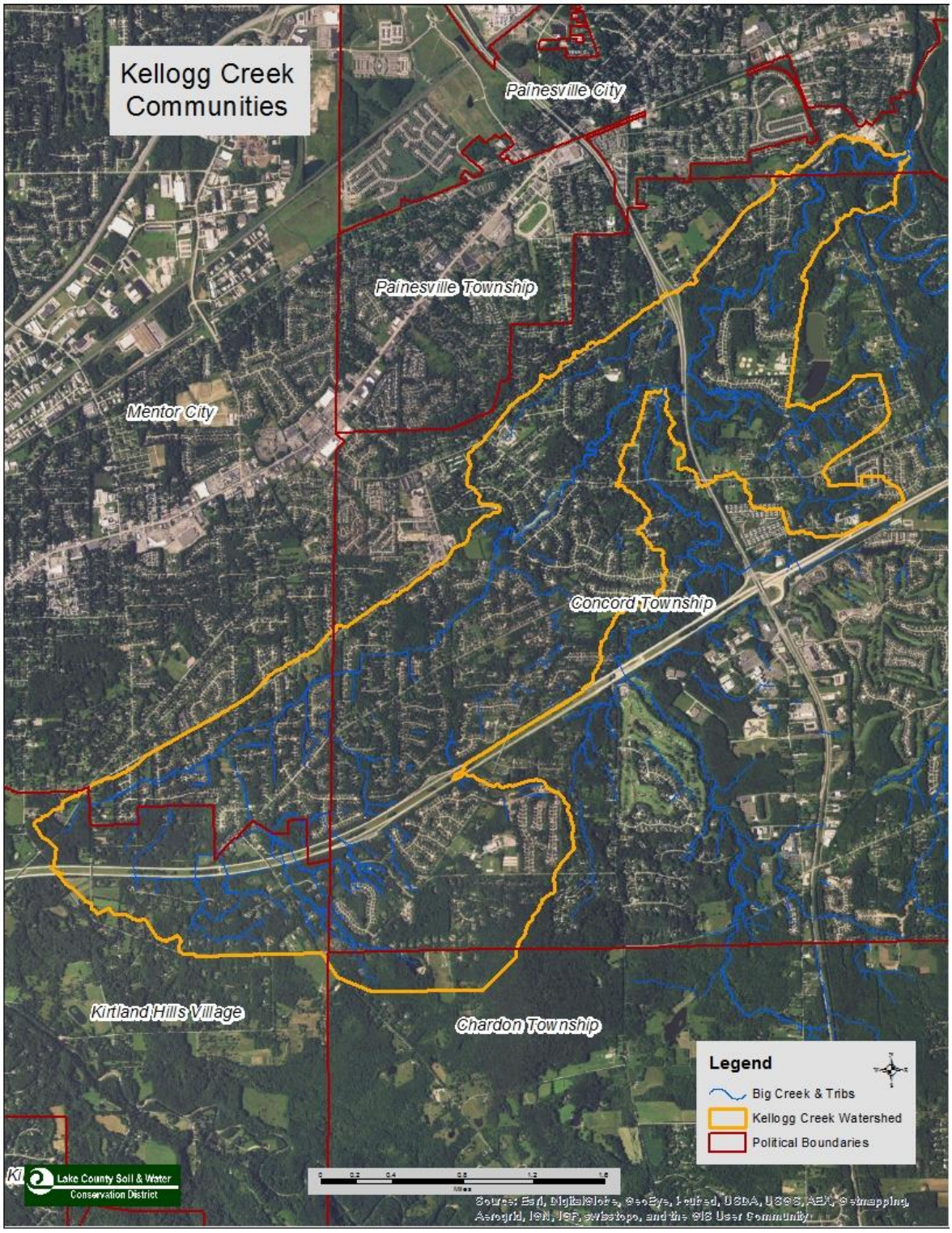


Figure 47. Kellogg Creek Topography

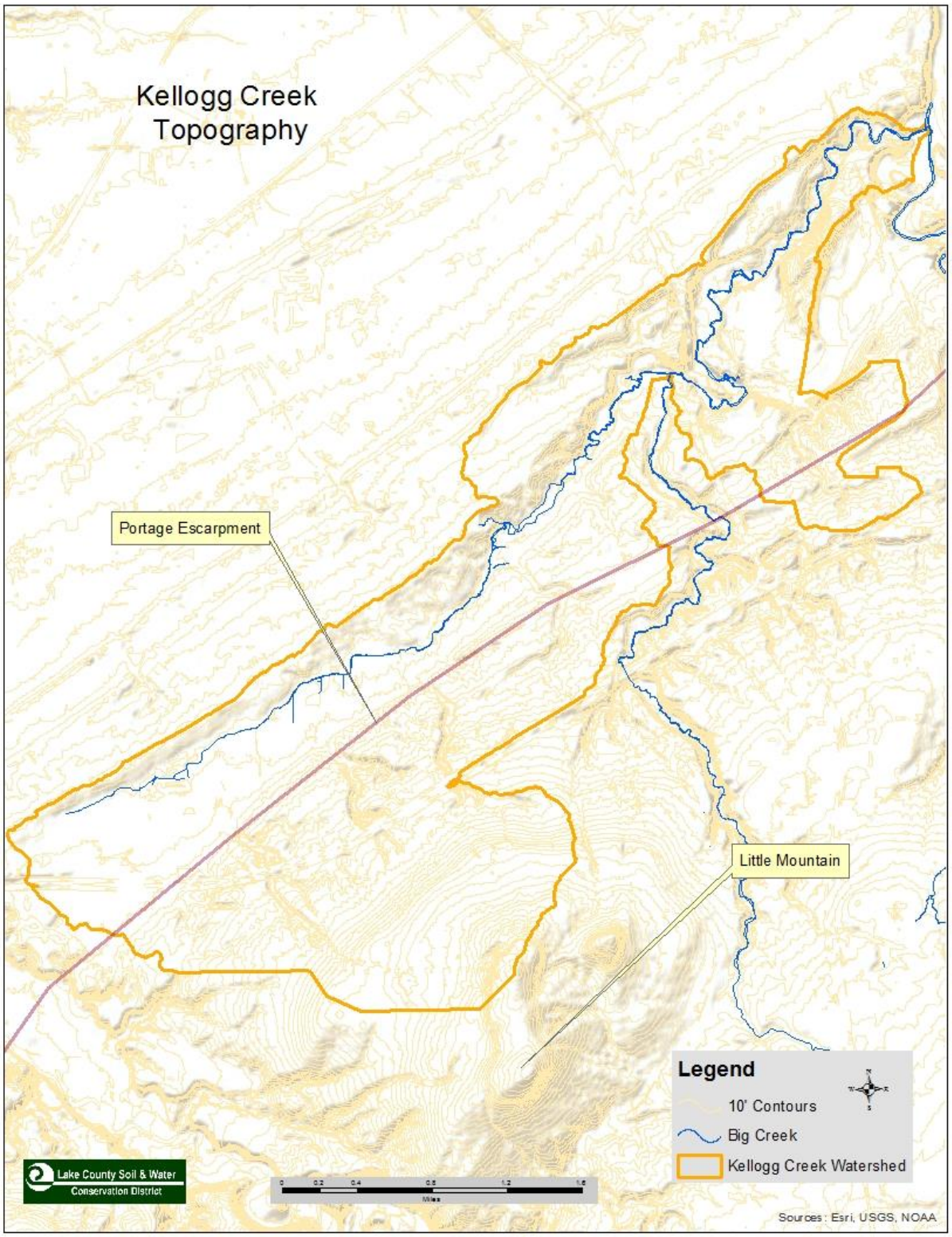
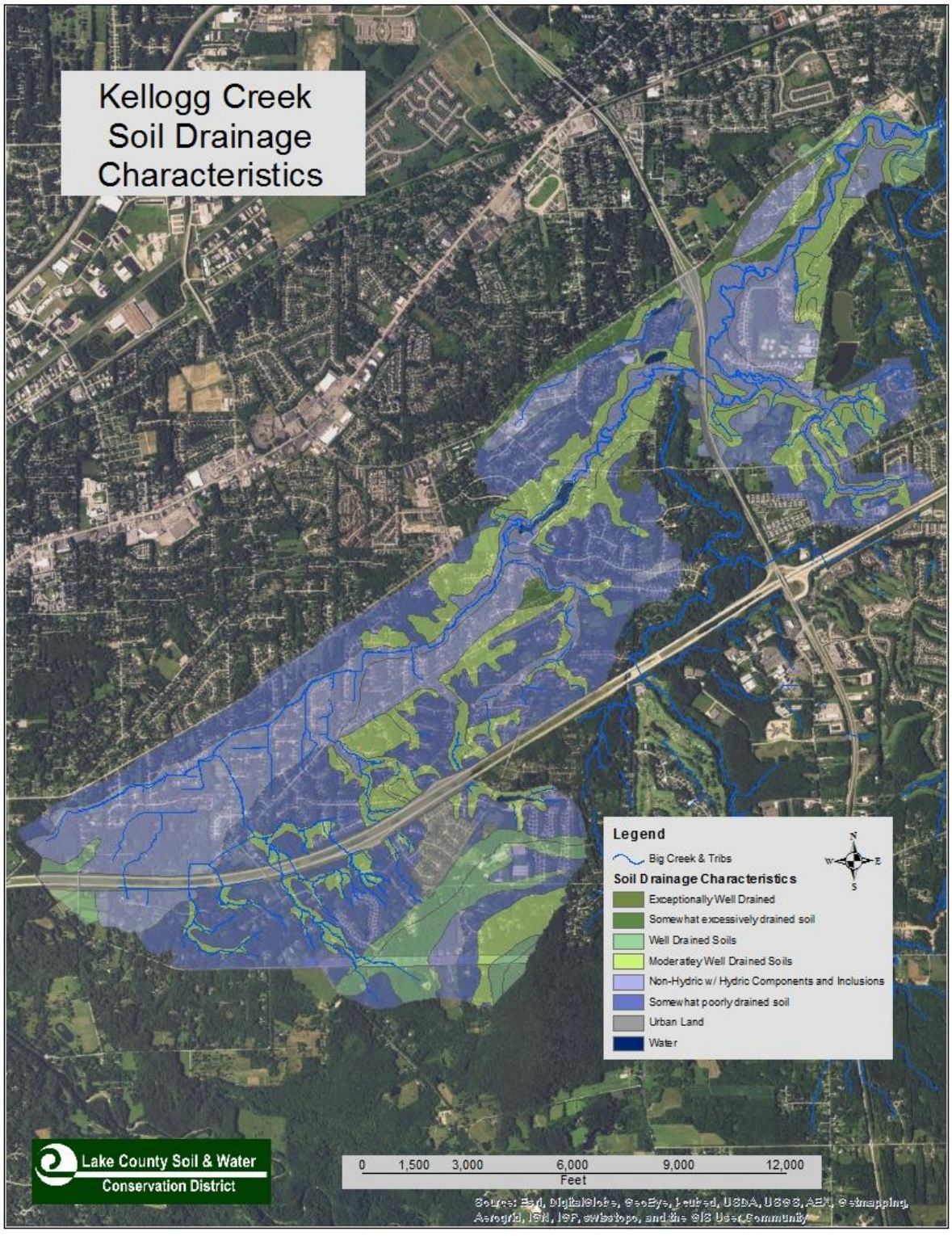


Figure 48. Kellogg Creek Soil Drainage Characteristics



The soil drainage characteristics in Kellogg Creek are 65% non-hydric with hydric inclusions and somewhat poorly drained, which limits the opportunities for infiltration practices for stormwater runoff (Figure 49). There are sections in the headwaters and along the stream channels that have good drainage (29%); slope may limit the possibilities for infiltration practices in some of these areas.

Figure 49. Kellogg Creek Soil Drainage Percentages

Soil Drainage	Percentage
Exceptionally Well, Well, Mod. Well Drained	29%
Hydric, Somewhat Poorly Drained	65%
Urban	5.6%
Water	0.4%
	100%

3.2.2 Detailed Biological Conditions

Kellogg Creek is designated Warmwater Habitat (WWH) and Seasonal Salmonid Aquatic Life Use (SSH) by the Ohio EPA. SSH waterbodies are "capable of supporting the passage of salmonids from Octoger to May and are waterbodies large enough to support recreational fishing (OAC-3745-1-07(B)(1)(e))."

Assessments in 2004 found Kellogg Creek at Button Road (River Mile 5.4) to be in **non-attainment**, and Kellogg Creek near the mouth at St. Rt. 86 (RM 0.2) to be in **full attainment**. The density of suburban landuse in the headwaters of Kellogg Creek has impacted the WWH aquatic life use because of the way that stormwater management has been addressed historically, but the lower reaches are still marginally meeting expectations for WWH. Better riparian conditions in the lower reaches of the watershed may be offsetting some of the biological degradation caused by upstream suburbanization. Sedimentation from ongoing suburbanization was identified by the Ohio EPA as a potential cause of impairment at RM 5.7. Development has likely led to larger runoff volumes, higher peak flows and flashy streams. (Total Maximum Daily Loads for the Grand River (lower) Watershed. January 2012.)

"The existing population density and inertia toward continued growth in Concord Township is likely to limit any recovery of impaired segments and in all probability will push currently attaining segments past their tipping points and into non-attainment. Therefore, the management goal for Kellogg Creek and its tributaries should be directed at minimizing downstream impacts to the Grand River mainstem. To that end, homeowners should be educated and encouraged to naturalize their landscaping and avoid using fertilizers, herbicides and insecticides. Also, where riparian habitat can be enhanced or reforested, that should be an obvious priority." (The Grand Biological & Water Quality Study of the Lower Grand River 2006. P.5.)

Kellogg Creek differs from Big Creek, with its high gradient scouring flows and exposed bedrock as it is the only waterbody that runs parallel to the Portage Escarpment which is historically rich in glacial till. Kellogg Creek also receives more groundwater than other streams in the watershed. It was likely a coldwater stream prior to suburban development, but is still capable of supporting a WWH fish community because of the influences of riparian buffers, high gradient and groundwater inputs. (The Grand Biological & Water Quality Study of the Lower Grand River 2006.)

Figure 50. Aquatic Life Use Attainment for Kellogg Creek, 2004

River Mile	IBI	MIwb	ICI	QHEI	Status	Causes	Sources
5.7/5.4	24	--	--	59	NON	Toxicity	Urban Runoff
0.2	44	--	--	67	Full	Sediment	Urban Runoff

MIwb is not applicable to drainage areas with headwater streams < 20 mi2

3.2.3 Detailed Causes and Associated Sources

The causes and sources of impairment in Kellogg Creek are outlined below (Total Maximum Daily Loads for the Grand River (lower) Watershed; January 2012; stakeholder identification).

Cause	Source
Habitat alteration	Urban/Suburban runoff • Hydromodification • Storm sewers
Siltation and sedimentation	• Streambank erosion • Channel scour • Bank failure
Flow alteration and imperviousness	• Urban runoff/storm sewers
Organic enrichment/dissolved oxygen	Untreated/Undertreated Stormwater Runoff • Residential, single family development • Commercial/Institutional development
Temperature	• Urban/Suburban runoff

3.2.4 Outline Goals and Objectives for the Critical Area

Goals

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

Kellogg Creek is in *Non-Attainment* at River Mile 5.7 (Figure 51), reflecting a significant degradation of habitat and toxicity due to residential land use. Suburban development in the watershed has altered the characteristics of the stream, which once supported coldwater habitat. Imperviousness and urban stormwater runoff from development have caused habitat alteration, flow alteration and siltation. The biological communities have been impacted by the high stream flow velocities, erosion, channel scour and bank failure. The headwaters of Kellogg Creek are highly impacted but the lower reaches are still marginally meeting the criteria for WWH. Goals 2, 3 and 4 are to improve the HHEI scores in the headwaters of Kellogg Creek above River Mile 5.7 so the *Non-Attainment* status for this sampling site can be changed to *Full Attainment* of the designated WWH aquatic life use. Brightwood Dam has affected the hydrology of the Kellogg Creek mainstem. The Ohio EPA recommended removal "or significant alteration of the dam at Brightwood Lake" to significantly improve the integrity of the biological community in Kellogg Creek. Total Maximum Daily Loads for the Grand River (lower) Watershed. January 2012.) Goal 1 is to restore the hydrological function of the Kellogg Creek mainstem.

Goal 1. Achieve QHEI score of 70 at Prouty Road on Kellogg Creek.
- NOT ACHIEVED: Site currently has a score of 48.5.

Goal 2. Achieve HHEI score of 80 upstream of Oak Ridge Drive on Kellogg Creek headwaters.
- NOT ACHIEVED: Site currently has a score of 71.

Goal 3. Achieve HHEI score of 61 upstream of Hackberry Drive on Kellogg Creek headwaters.
- NOT ACHIEVED: Site currently has a score of 51.

Goal 4. Achieve QHEI score of 70 at Painesville-Warren Road on Kellogg Creek.
- NOT ACHIEVED**:** Site currently has a score of 60.5.

Objectives

In order to achieve the overall nonpoint source restoration goal of restoring *Full Attainment* to the Big Creek HUC-12, the following objectives need to be achieved within Critical Area 2.

Objective 1. Protect and restore natural hydrology of streams and wetlands
- Remove 1 dam (Brightwood Lake)
- Restore 2,000 feet of Kellogg Creek
- Restore 6 acres of riparian corridor

Objective 2. Reduce urban runoff from impervious surfaces in Kellogg Creek through impervious surface reduction and infiltrative green infrastructure practices.
- Mitigate 35 acres of impervious surface in the headwaters above River Mile 5.7.

Objective 3. Protect riparian corridors to minimize water quality impacts as land develops
- Implement CRWP model ordinances and regulations in Concord Township to protect 37.7 stream miles

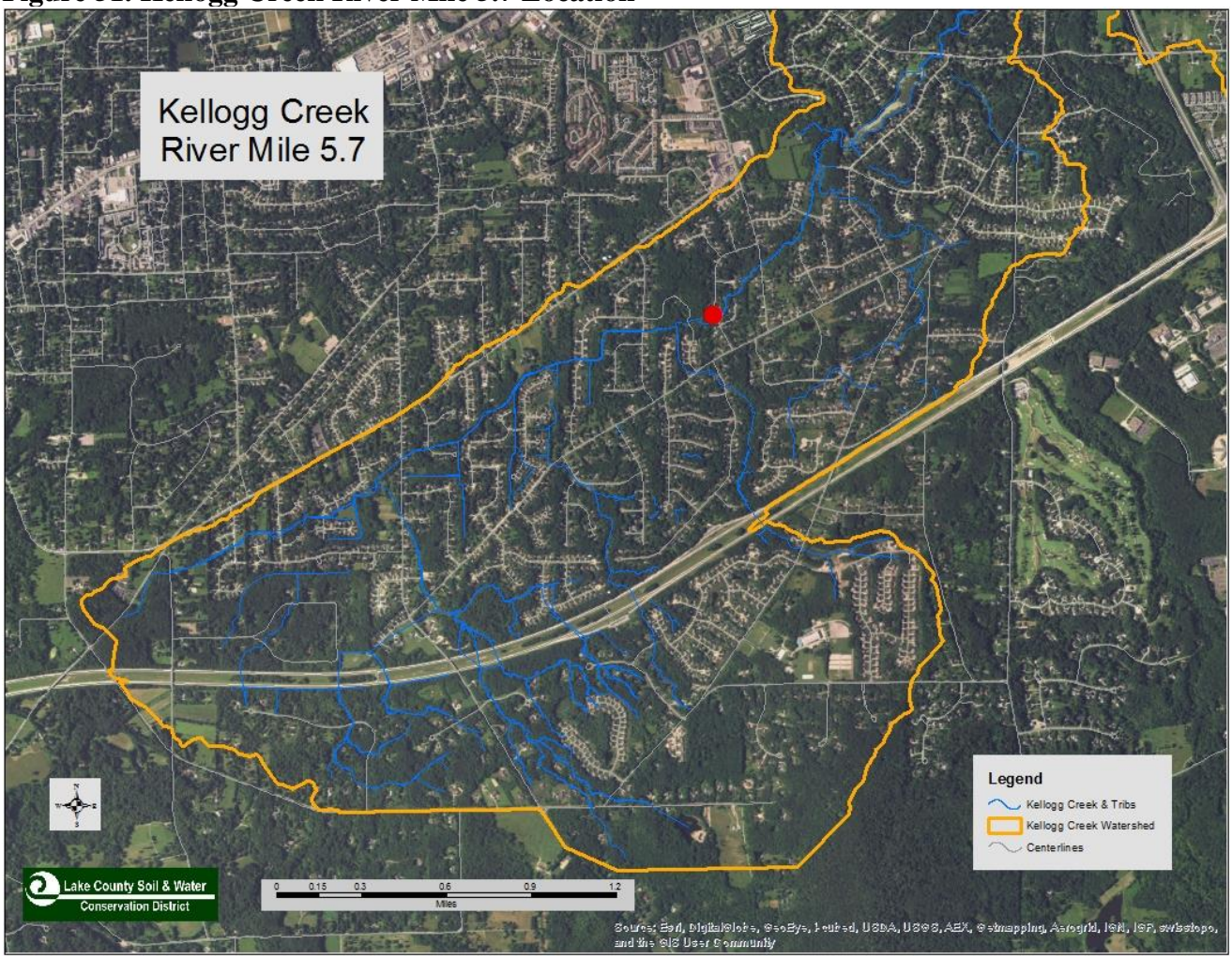
- Implement CRWP model ordinances in the City of Mentor to protect 8.8 stream miles

Hydromodification is a large source the nonpoint pollution in the watershed, so the stakeholders chose to use biological community performance measures to determine attainment levels. Using biology lets us look at trends over time and assess habitat conditions including sediment transport and water quality. If the biology is there, it is a good indicator of a healthy watershed and not just a healthy stream segment.

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

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

Figure 51. Kellogg Creek River Mile 5.7 Location



Chapter 4: Projects and Implementation Strategy

4.1 Projects and Implementation Strategy Overview Table

The projects and evaluation needs that are believed to be necessary to remove the impairments to the Big Creek HUC-12 are listed below. They were determined by evaluating the identified causes and associated sources of nonpoint source pollution. Because the attainment status is based upon biological conditions, it will be necessary to periodically re-evaluate whether or the implemented projects are sufficient to achieve restoration. The response of biological systems may take some time following project implementation. If issues other than nonpoint source pollution are causing impairments, they will need to be addressed under different initiatives, authorities or programs.

There are two Project and Implementation Strategy Overview Tables, one for each Critical Area. Critical Area 1 and Critical Area 2 Goals aim to address habitat and flow alteration and sedimentation from urban runoff through increased infiltration of stormwater runoff and restoration of natural flow conditions and habitat.

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

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

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

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

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

Section 4.1 Project and Implementation Strategy Overview Table(s)

For *Big Creek HUC-12* (*041100040606*) — Critical Area 1								
Applicable Critical Area	**Goal**	**Objective**	**Project #**	**Project Title** *(EPA Criteria g)*	**Lead Organization** *(criteria d)*	**Time Frame** *(EPA Criteria f)*	**Estimated Cost** *(EPA Criteria d)*	**Potential/Actual Funding Source** *(EPA Criteria d)*
Recommend that your critical areas be numbered or coded for reference.That number/code listed here comes from Chapter 3 section 3.1	*It is recommended that your goals and objectives be numbered or coded for easy reference. The number/code listed here comes from Chapter 3 section 3.x.4.*		*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*
Urban Sediment and Nutrient Reduction Strategies								
Altered Stream and Habitat Restoration Strategies								
1	1	1	1	City of Chardon Wetland Restoration	City of Chardon	1-3 years	$385,000	319
1	1, 2	3	2	Riparian Corridor Protection	Lake Metroparks, Geauga Park District	Medium to Long		319, NRCS
1	1	4	3	Implement Model Codes & Regulations	CRWP	Medium		Communities
Agricultural Nonpoint Source Reduction Strategies								
High Quality Waters Protection Strategies								
Other NPS Causes and Associated Sources of Impairment								

For *Kellogg Creek HUC-12* (*041100040606*) — Critical Area 2								
Applicable Critical Area	**Goal**	**Objective**	**Project #**	**Project Title** *(EPA Criteria g)*	**Lead Organization** *(criteria d)*	**Time Frame** *(EPA Criteria f)*	**Estimated Cost** *(EPA Criteria d)*	**Potential/Actual Funding Source** *(EPA Criteria d)*
Recommend that your critical areas be numbered or coded for reference.That number/code listed here comes from Chapter 3 section 3.1	*It is recommended that your goals and objectives be numbered or coded for easy reference. The number/code listed here comes from Chapter 3 section 3.x.4.*		*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*	*The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.*
Urban Sediment and Nutrient Reduction Strategies								
Altered Stream and Habitat Restoration Strategies								
2	1	1	1	Brightwood Lake Dam Removal and Stream Restoration	Lake County Stormwater Management Department	Short term (1-3 years)	$1.5 m	319, WRRSP, dam owners
2	1	3	2	Model Codes for Communities	CRWP	Medium		Communities
2	2	1	3	Kellogg Creek Restoration at Lake Erie College Equest. Ctr. Phase I	Lake SWCD	Short term	$325,000	319
Agricultural Nonpoint Source Reduction Strategies								
High Quality Waters Protection Strategies								
Other NPS Causes and Associated Sources of Impairment								

Section 4.2 Critical Area 1: Project Summary Sheet(s)

The project summary sheets provided below were developed based upon the actions needed to reach and maintain WWH attainment for Critical Area 1 and 2. These projects are considered a next step or priority/short term project because they have been thoroughly planned and are ready for implementation. Other short term, medium and longer term projects will not have a project summary sheet because they are not yet ready for implementation.

Nine Element Criteria	Information needed	Explanation
n/a	**Title**	City of Chardon Wetland Restoration
criteria d	**Project Lead Organization & Partners**	Lead: The City of Chardon. Partners: Geauga Park District, Chagrin River Watershed Partners, Inc., Dam owners
criteria c	**HUC-12 and Critical Area**	HUC 12- 041100040606; Critical Area 1
criteria c	**Location of Project**	121 Industrial Parkway, Chardon, Ohio (41.590515, -81.214226)
n/a	**Which strategy is being addressed by this project?**	Stream and Altered Habitat Restoration Strategies
criteria f	**Time Frame**	Short-Term (1-3 yr.)
criteria	**Short Description**	Remove the Loecy Dam from the small headwater stream and convert it from a pond to wetland habitat.
criteria g	**Project Narrative**	The Loecy Dam is an impoundment on a small headwater stream that eventually drains to Big Creek. It does not currently meet Ohio Department of Natural Resources dam safety standards. Because of the small drainage area of this headwater stream, it is unlikely to support perennial flow. Therefore, the primary restoration goal for this area is conversion from a pond to wetland habitat. Flashy hydrology is noted in the TMDL (p.48) as a likely problem for Big Creek in the City of Chardon. Pollutants in urban stormwater and habitat alteration are both noted as causes of impairment in Big Creek (TMDL, p. 66). Additionally, nutrient enrichment has been documented in Big Creek near Chardon (TMDL, p. 50). Wetlands have excellent pollutant removal properties and also help to protect streams from scouring flows by retaining water. Geauga Park District's Big Creek Park is less than a mile from the project site, which may assist with wetland species recruitment to the restored wetland. The City of Chardon is willing to sponsor this project. The landowners would be responsible for providing matching funds. Dam owners include: Litten Properties, NOF Metal Coatings, Fleck Controls, Geauga Park District, and Cleveland Electrical Illuminating Company. Additional pond owners include: Metal Coatings International, and Company ELLC.

criteria d	**Estimated Total cost**	Total cost: $385,000
criteria d	**Possible Funding Source**	Ohio EPA 319, dam owner contributions
criteria a	**Identified Causes and Sources**	Cause: Direct Habitat Alteration/Flow Alteration Source: Lowhead dam
criteria b & h	**Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?**	This project is aimed to protect attainment of the aquatic beneficial use at or above a QHEI score of 70.
	Part 2: How much of the needed improvement for the whole Critical Area is *estimated* to be accomplished by this project?	This project will restore hydrological function to this tributary to Big Creek by creating 7.5 acres of wetlands. It completely addresses Objective 1 in Critical Area 1. It is anticipated that both ORAM scores in the wetland and QHEI scores downstream will reflect dramatic improvement. Estimated accomplishments are for attaining a Category 2 wetland and QHEI scores of 70.
	Part 3: Load reduced?	Nitrogen: 834 lbs/yr Phosphorus: 124 lbs/yr Sediment: 90 tons/yr
criteria i	**How will the effectiveness of this project in addressing the NPS impairment be measured?**	Wetland restoration success will be evaluated using ORAM score improvement. If this project is funded through the Ohio EPA 319 program, Ohio EPA staff will conduct pre-restoration and post-restoration biological monitoring. The Big Creek-Grand River HUC-12 is scheduled for comprehensive biological monitoring by Ohio EPA staff in 2019.
criteria e	**Information and Education**	The project partners will share information about this project through their websites and presentations, including a presentation to Chagrin River Watershed Partners' Board of Trustees, which includes representatives from 34 local governments. A project fact sheet will also be developed to educate the public and interested parties about this restoration project.

Critical Area 2: Project Summary Sheet(s)

Nine Element Criteria	Information needed	Explanation
n/a	**Title**	Brightwood Lake Dam Removal & Stream Restoration
criteria d	**Project Lead Organization & Partners**	Lead: Lake County Stormwater Management; Partners: Concord Township, Lake Soil and Water Conservation District, Chagrin River Watershed Partners, Dam Owners
criteria c	**HUC-12 and Critical Area**	HUC 041100040606. Kellogg Creek Critical Area (Critical Area 2)

criteria c	**Location of Project**	10350 Prouty Rd., Concord Township, Ohio (41.678484, -81.268652)
n/a	**Which strategy is being addressed by this project?**	Stream and Altered Habitat Restoration Strategies
criteria f	**Time Frame**	Short term (1-3 years)
criteria	**Short Description**	This project would remove the Brightwood Lake Dam and restore approximately 2,000 feet of Kellogg Creek and 6 acres of riparian corridor.
criteria g	**Project Narrative**	Brightwood Lake is an 11.4-acre impoundment on Kellogg Creek at RM 4.3 just upstream of Prouty Rd. in Concord Township (TMDL, p. 48). Kellogg Creek drains 4.1 square miles at the downstream end of Brightwood Lake. Ohio EPA notes that removal or significant modification of this dam and subsequent stream restoration is an implementation priority because of algae, sedimentation, and fish passage issues associated with this structure (TMDL, p. 179). Kellogg Creek is in non-attainment of its warmwater aquatic habitat use at RM 5.7/5.4 and partial attainment at RM 3.3 due to toxicity from urban runoff (TSD, p. 10-11). Lake County will hire a design-build consultant to remove the Brightwood Lake and restore approximately 2,000 feet of Kellogg Creek within the former impoundment using natural channel design stream restoration techniques. Approximately 6 acres of riparian corridor will be revegetated with native plants with tree planting emphasized along the restored stream. Dam removal/modification and subsequent stream restoration would be expected to improve the macroinvertebrate community at RM 3.3 (currently 48.5) and the fish community IBI score at RM 5.7 (currently 24). Concord Township has a riparian setback resolution that will prohibit construction of structures within 75 feet of either side of the restored stream.
criteria d	**Estimated Total cost**	$1,500,000
criteria d	**Possible Funding Source**	Ohio EPA 319, Ohio EPA Water Resource Restoration Sponsorship Program
criteria a	**Identified Causes and Sources**	This project will address flow alterations to Kellogg Creek due to hydromodification.
criteria b & h	**Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?**	QHEI scored raised from 48.5 to 70
	Part 2: How much of the needed improvement for the whole Critical Area is *estimated* to be	This project will improve functional capacity of the riparian corridor to 2000 feet of the Kellogg Creek Mainstem and 6 acres of riparian corridor. It completely addresses Objective 1 in Critical Area 2. It is anticipated that

	accomplished by this project?	the HHEI score will reach 58 in the short term and 65 -70 in the long term through the implementation of this project.
	Part 3: Load Reduced?	Nitrogen: 136 lbs/yr Phosphorus: 136 lbs/yr Sediment: 272 tons/yr
criteria i	**How will the effectiveness of this project in addressing the NPS impairment be measured?**	If this project is funded through the Ohio EPA 319 program, Ohio EPA staff will conduct pre-restoration and post-restoration biological monitoring. The Big Creek-Grand River HUC-12 is scheduled for comprehensive biological monitoring by Ohio EPA staff in 2019.
criteria e	**Information and Education**	Project information will be made available through partner websites and presentations at events such as the Lake County Stormwater Management Department's Annual Member Meeting. Project partners will also develop a press release for the project.

Nine Element Criteria	Information needed	Explanation
n/a	**Title**	Kellogg Creek Restoration at Lake Erie College Equestrian Center Phase 1
criteria d	**Project Lead Organization & Partners**	Lead: Lake SWCD. Partners: Lake Erie College
criteria c	**HUC-12 and Critical Area**	HUC 12- 041100040606; Critical Area 2
criteria c	**Location of Project**	8031 Morley Road, Painesville OH 44077 (41.6495, -81.2778)
n/a	**Which strategy is being addressed by this project?**	Stream and Altered Habitat Restoration Strategies
criteria f	**Time Frame**	Short-Term (1-3 yr.)
criteria	**Short Description**	Restore 450 feet of an eroding gully and stream on the Lake Erie College Equestrian Center campus.
criteria g	**Project Narrative**	The Lake Erie College Equestrian Center is near the headwaters of the Kellogg Creek subwatershed, which are highly impacted by stormwater runoff. Downstream, Kellogg Creek is in non-attainment at River Mile 5.7, which reflects the degradation of habitat and toxicity due to intensively developed land uses. The biological communities have been impacted by the high stream flow velocities, erosion, channel scour and bank failure. This project will restore an eroding gully and stream in the headwaters and add increased infiltration of stormwater runoff. Lake County will hire a design-build consultant to build a stormwater detention basin above the gully and restore approximately 250 feet of a tributary to Kellogg Creek using regenerative stormwater conveyance structures and restore 200

		feet of an incised stream channel. A round culvert under a campus drive will be replaced with 3-sided box culvert, open to the stream at the bottom to allow further improvement in the habitat for aquatic organisms. Approximately 1 acre of riparian corridor will be revegetated with native plants and ground cover. This restoration project is expected to improve the macroinvertebrate community in the project area and contribute to the improvement downstream at RM 5.7. Concord Township's riparian setback resolution will require setbacks of 25 feet on each side of the restored stream. The Lake Erie College Equestrian Center is privately owned by Lake Erie College, and the restoration areas will be protected with a permanent conservation easement.
criteria d	**Estimated Total cost**	Total cost: $276,000
criteria d	**Possible Funding Source**	Ohio EPA 319, Lake SWCD match
criteria a	**Identified Causes and Sources**	Cause: Habitat Alteration/Flow Alteration Source: Urban/Suburban runoff
criteria b & h	**Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?**	This project aims to reach attainment of the aquatic beneficial use at or above a QHEI score of 61 or higher at Hackberry Drive. The project is in two reaches, divided by a campus drive. The HHEI on the upper portion is currently 54; it is currently 60 on the lower portion.
	Part 2: How much of the needed improvement for the whole Critical Area is *estimated* to be accomplished by this project?	This project will restore hydrological function to this tributary to Kellogg Creek by restoring 250 feet of eroding gully and 200 feet of an incised stream. It is part of several projects designed to meet Objective 1 in Critical Area 2. Estimated accomplishments are for attaining QHEI scores of 61. It is estimated that this project will address 25% of the needs for Goal 3.
	Part 3: Load reduced?	Nitrogen: 27.8 lbs/yr Phosphorus: 27.8 lbs/yr Sediment: 56 tons/yr
criteria i	**How will the effectiveness of this project in addressing the NPS impairment be measured?**	Restoration success will be evaluated using QHEI score improvement. If this project is funded through the Ohio EPA 319 program, Ohio EPA staff will conduct pre-restoration and post-restoration biological monitoring. The Big Creek-Grand River HUC-12 was scheduled for comprehensive biological monitoring by Ohio EPA staff in 2019. Data from that field season will be used as a comparison.
criteria e	**Information and Education**	The project partners will share information about this project through their websites, social media and with signage. A project fact sheet will also be developed to educate the public and interested parties about this restoration project. Lake Erie College professors intend to involve their students and bring lessons from this project into their classrooms.

Works Cited

Center for Watershed Protection. (2002). Watershed Vulnerability Analysis report. (http://online.sfsu.edu/jerry/geo_642/refs/Vulnerability_Analysis.pdf)

ERIN Watershed Report. Big Creek Watershed.

Ohio EPA. (2006). Biological and Water Quality Study of the Grand River Basin 2003-2004.

Ohio EPA. (2009). Three Types of Primary Headwater Habitat. Field Evaluation Manual for Ohio's Primary Headwater Habitat Streams.

Ohio EPA. (2004). Integrated Water Quality Monitoring and Assessment Report. (http://www.epa.ohio.gov/dsw/tmdl/ohiointegratedreport.aspx)

Ohio EPA. (2012). Total Maximum Daily Loads for the Grand River (lower) Watershed.

Ohio EPA. (2013). Ohio's Nonpoint Source Management Plan Update (FY 2014-2018). Columbus.

Ohio EPA. (2016). Guide to Developing Nine-Element Nonpoint Source Implementation Strategic Plans in Ohio. Columbus.

Ohio EPA. (2016). Water Quality Summary- 2016 Integrated Report. (http://www.epa.ohio.gov/dsw/tmdl/ohiointegratedreport.aspx)

The Cleveland Museum of Natural History. (2002). *A Natural History of Lake County, Ohio*. Rosemary Szubski, editor.

Thompson Township Geauga County Ohio Zoning Resolution, as amended effective to January 6, 2017. http://www.thompsonohio.org/departments/zoning/Resolution.pdf

Appendix A. Acronyms

BMP	Best Management Practice
CRWP	Chagrin River Watershed Partners
CWH	Cold Water Habitat
ERIN	Earth Resources Information Network
EWH	Exceptional Warmwater Habitat
HHEI	Headwater Habitat Evaluation Index
HIT	High Impact Targeting
HUC	Hydrologic Unit Code
IBI	Index of Biotic Integrity
ICI	Invertebrate Community Index
LID	Low Impact Development
MIwb	Modified Index of Well Being
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NPS-IS	Nonpoint Source Implementation Strategy
NRCS	Natural Resources Conservation Service
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
PHWH	Primary Headwater Habitat
QHEI	Qualitative Habitat Evaluation Index
RM	River Mile
SMD	Stormwater Management Department
SSH	Seasonal Salmonid Habitat
SWCD	Soil & Water Conservation District
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
WWH	Warmwater Habitat