

Paine Creek
HUC-12: 041100040604
Nine-Element
Nonpoint Source Implementation
Strategy (NPS-IS)



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Acknowledgements

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Chapter 1: Introduction

1.1 Report Background

The Paine Creek Nonpoint Source Implementation Strategy (NPS-IS) brings Lake and Geauga County communities together to protect the Grand River, address water quality issues in the Paine Creek watershed and manage stormwater runoff. This plan was created to restore and maintain the 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.

A stakeholder meeting was held on May 24, 2019 to solicit input for the development of the NPS-IS.

1.2 Watershed Profile & History

The Paine Creek Watershed is located in southeastern Lake County and north central Geauga County (Figures 1 and 2). The Paine Creek Watershed 12-digit Hydrologic Unit Code (HUC) is 041100040604; the watershed drains approximately 28.9 square miles. It is located in within the 10-digit HUC known as the Lower Grand River Watershed. 41.1% of the watershed is in Lake County and 58.9% is in Geauga County. 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 watershed drains to the north and empties into the Grand River mainstem just below Indian Point in Lake County. It does not contain any part of the Grand River mainstem. It collects water from parts of Hambden, Montville and Thompson Townships in Geauga County and parts of Leroy Township in Lake County (Figure 3).

“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 the 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 groundwater into the river. Those coldwater tributaries and other sources of base flow are essential to the overall health of the Grand River.” (Ohio EPA Total Maximum Daily Loads for the Grand River (Lower) Watershed. Final Report, January 31, 2012; p. 15.)

Paine Creek is influenced by coldwater tributaries of Phelps Creek, Bates Creek and an unnamed tributary at RM 7.2, which also contribute cold ground water base flow to the Grand River. EPA data show that Paine Creek contributes 2 to 5 percent of the total flow in the Lower Grand River.

In a habitat analysis of Grand River tributaries, the Ohio EPA found Bates Creek (which forms the headwaters of Paine Creek) to have habitat more conducive to supporting till-plain stream fish communities than other tributaries. It found Bates Creek to have a “virtually intact physical stream habitat; most notably the substrates are a nearly silt-free heterogeneous mix of fractured sandstone bedrock and glacial till”. (Ohio EPA Total Maximum Daily Loads for the Grand River (Lower) Watershed. Final Report, January 31, 2012; p. 45.)

“Paine Creek has very limited summer base flows, and is especially vulnerable to anthropogenic disturbance. Fortunately, the catchment is relatively undeveloped, and the lower six miles of the mainstem are protected as parkland. The tributaries originating from the east, off Thompson Ledges, are important to maintaining base flow to Paine Creek (and, axiomatically, to the Grand River) and should obviously be targeted for protection (easements, deed restrictions, etc.). (Ohio EPA Biological and Water Quality Study of the Grand River Basin 2003-2004. November 1, 2006; p. 6.)

The most significant threat to the Grand River and its tributaries is changing land use through suburbanization. Research has documented that when the impervious area exceeds 5%, streams begin to deteriorate and may fall below Clean Water Act goals. Once impervious cover exceeds 25%, irreparable damage occurs. Data from 2011 showed 6.31% of the watershed as developed and 1.17% imperviousness.

63% of the Paine Creek watershed is covered by forest, which is a very important factor for good water quality.

Figure 1. Location of the Watershed

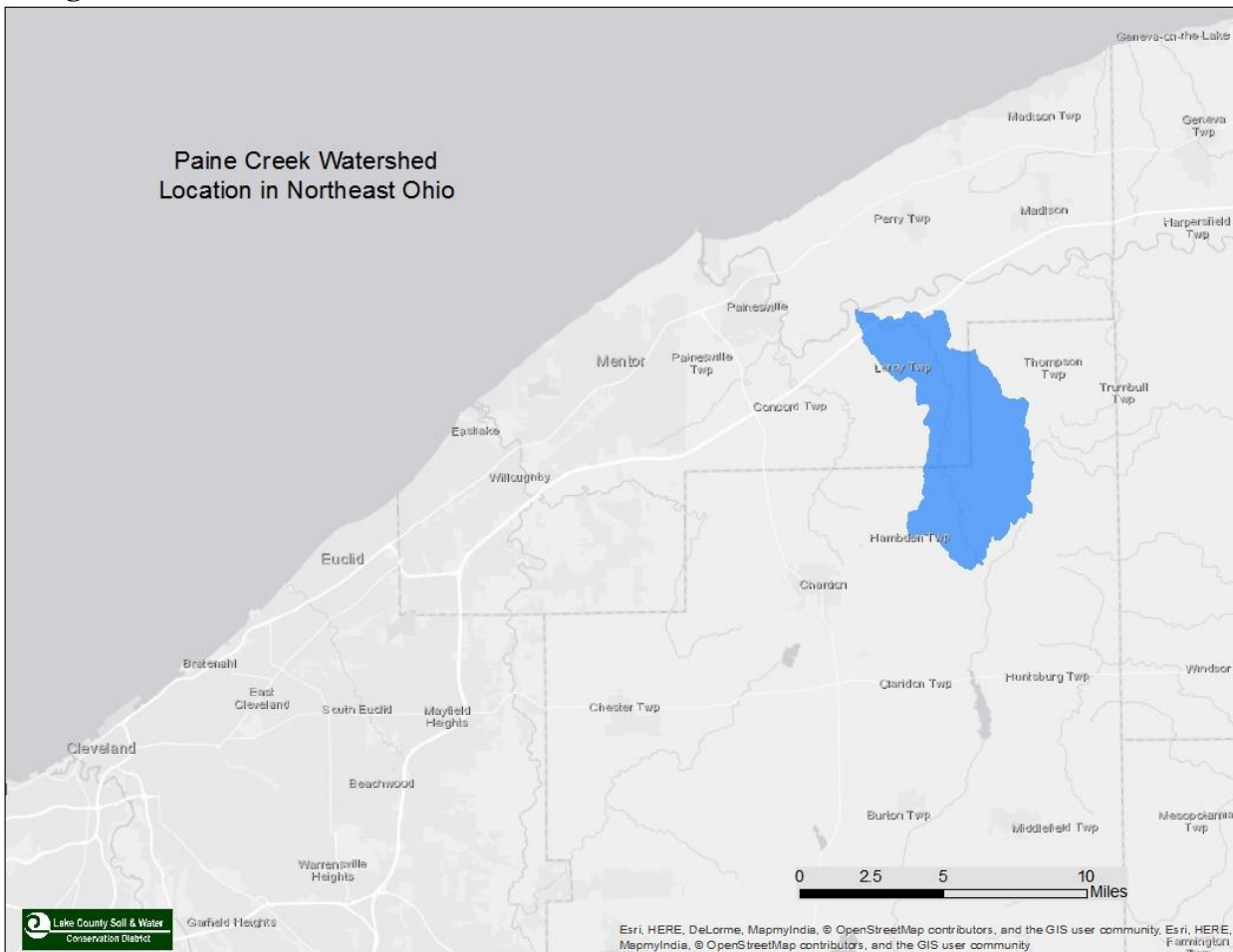


Figure 2. Location in the Lower Grand Watershed

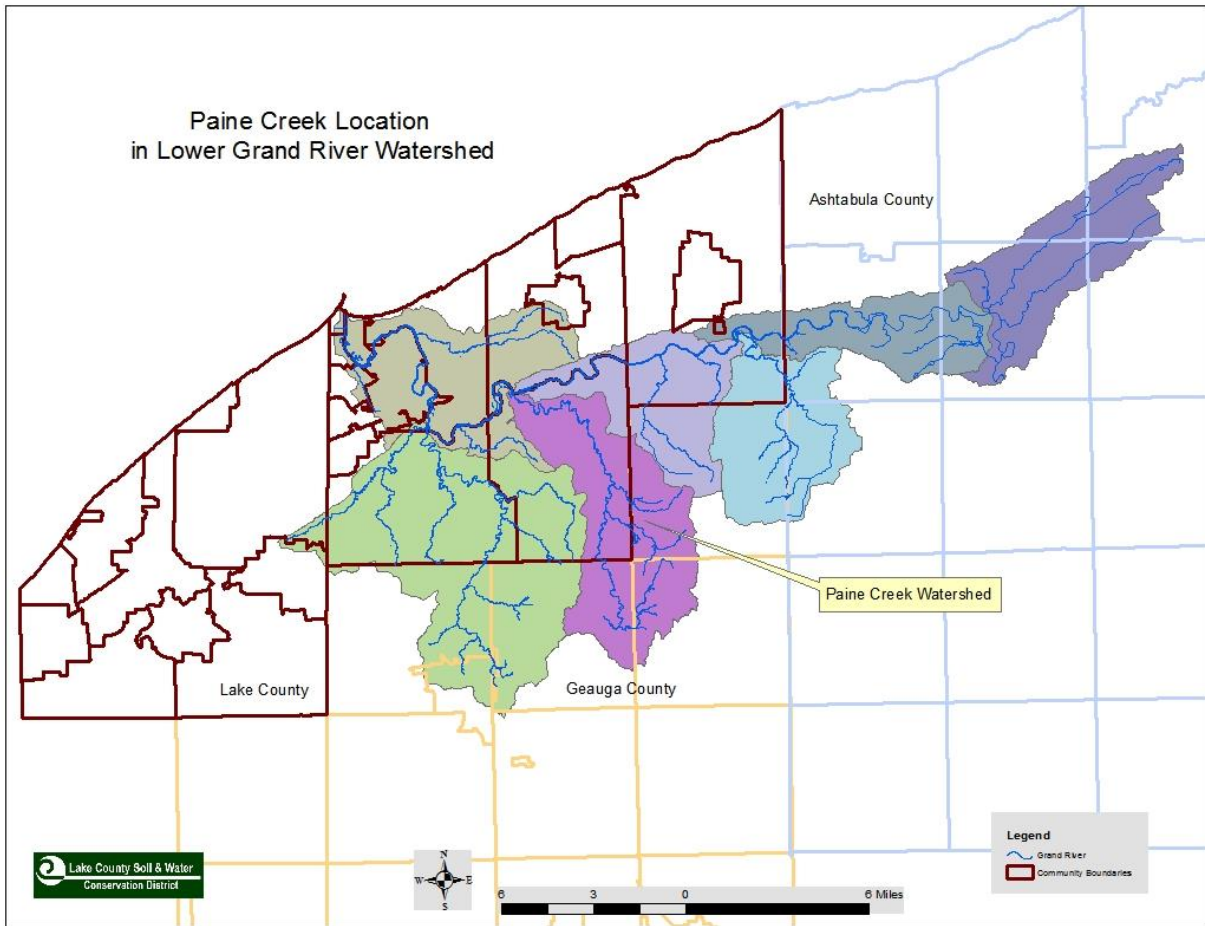
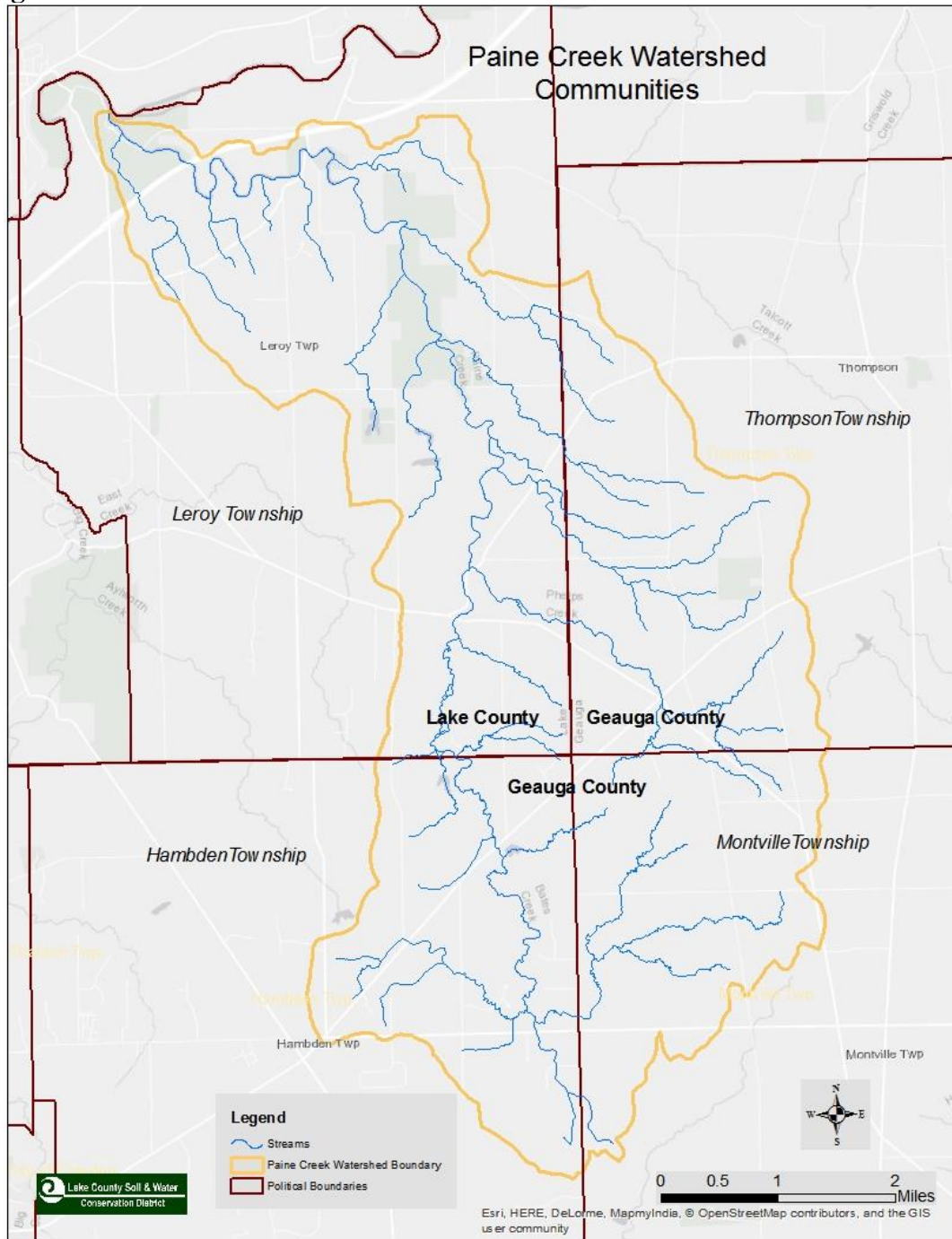


Figure 3. Watershed Communities



1.3 Public Participation and Involvement

A stakeholder meeting was held on May 24, 2019 in Thompson in Geauga County to solicit the input of members of the community, local officials and state and local agencies. Those invited to participate included Ashtabula County Park District, Harpersfield Trumbull and Austinburg Township Trustees, Ashtabula County Auditor, Ashtabula SWCD, Ashtabula Planning & Community Services, Ashtabula County Engineer, Geauga County SWCD, Geauga Park District, Geauga Planning Commission, Thompson Montville and Hambden Township Trustees, Lake County Metroparks, Madison Leroy and Perry Township Trustees, Lake County Planning and Community Development, Lake County General Health District, Cleveland Museum of Natural History, The Nature Conservancy, ODNR Division of Forestry, ODNR Division of State Parks & Watercraft- Scenic Rivers Program, Chagrin River Watershed Partners, the Natural Resources Conservation Service and Western Reserve Land Conservancy. The stakeholder meeting was a facilitated process to engage the attendees in a discussion of issues in the watershed.

Attendees included:

- The Nature Conservancy
- Ashtabula County Metroparks
- Natural Resources Conservation Service
- Chagrin River Watershed Partners
- Ashtabula County Soil & Water Conservation District
- Lake Metroparks
- Lake County Planning and Community Development
- Ashtabula County Auditor
- Thompson Township Trustee

Chapter 2: HUC-12 Watershed Characterization and Assessment Summary

2.1 Summary of HUC-12 Watershed Characterization

2.1.1 Physical and Natural Features

Topography

The Paine Creek Watershed's elevation ranges from 1310 feet in the headwaters to 640 feet where it empties into the Grand River mainstem (Figures 5 and 6). It 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. The watershed is at the northernmost extent of the Allegheny Plateau; the Lake Plain region begins at the mouth of Paine Creek. This region of the Plateau was glaciated.

Figure 5. Topography

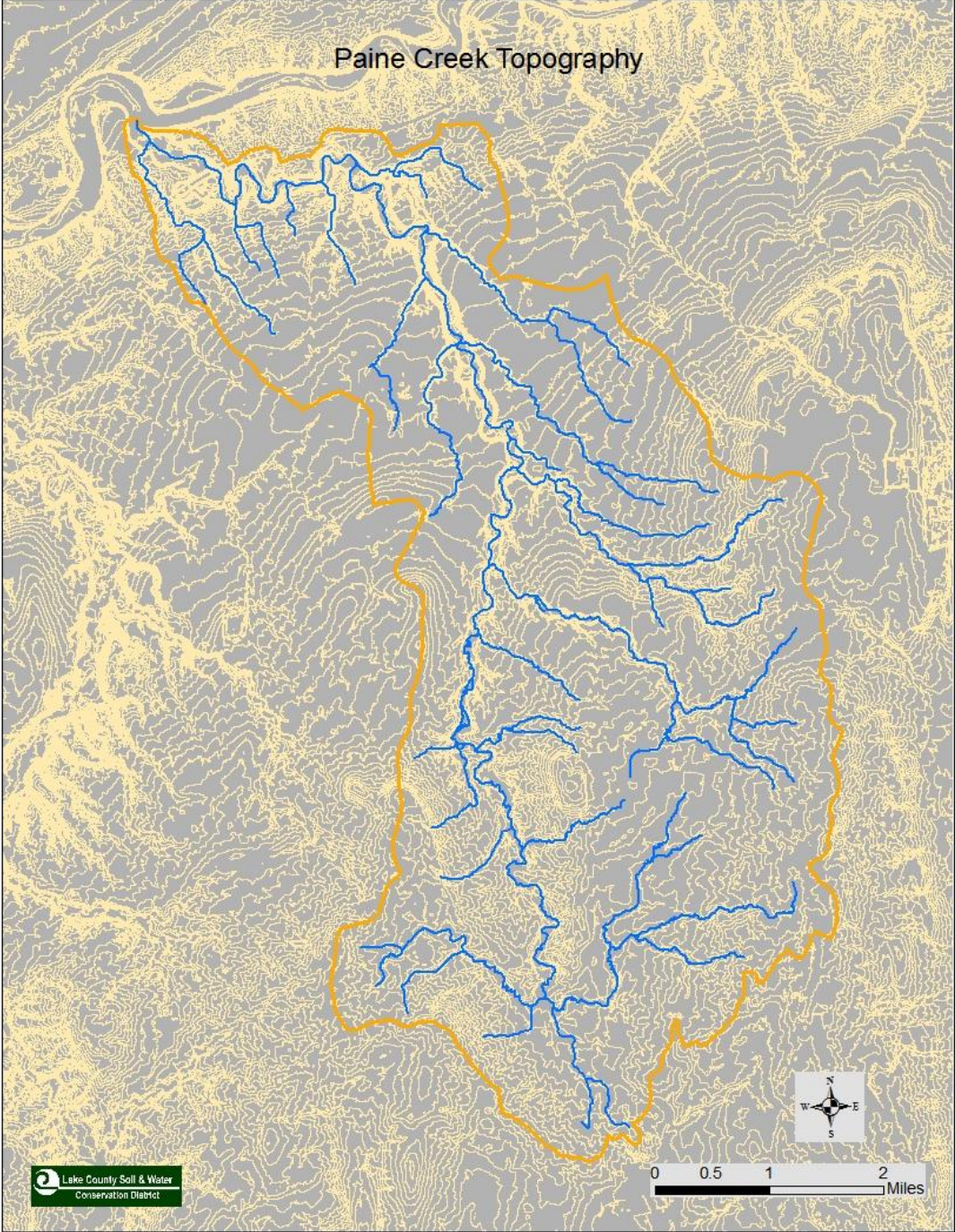
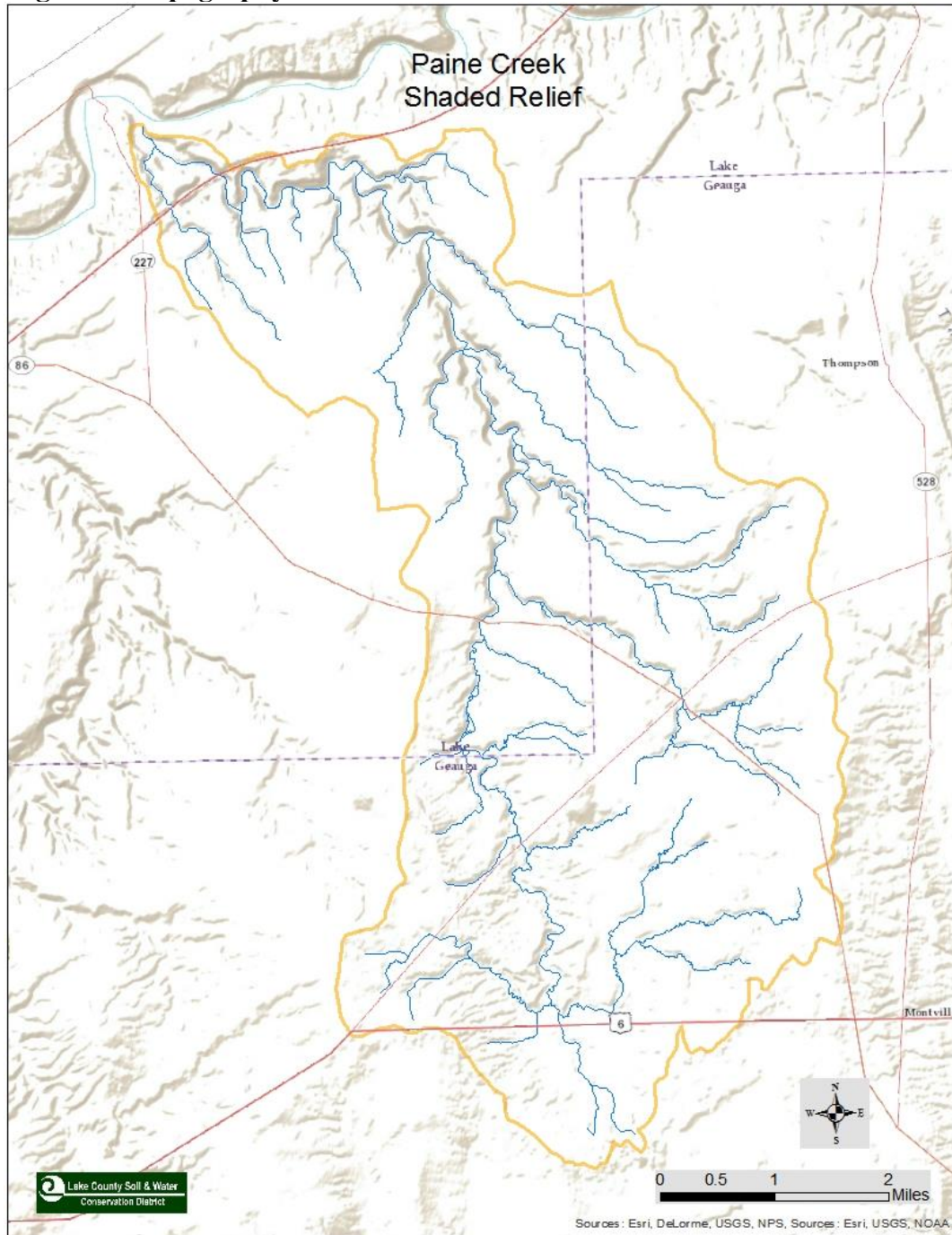


Figure 6. Topography- Shaded Relief View



Geology & Glacial History

Four glacial features are found in the watershed (Figure 7):

1. End moraine
2. Ground moraine
3. Deposits in present and former floodplains

4. Hummocky ridges

The majority of the watershed area is ground moraine, which is flat to gently undulating. There are hummocky ridges in the headwaters area in between the ground moraine features. The hummocky ridges can be clearly seen in the shaded relief map (Figure 6). The end moraine features are at the lower end of the watershed, along with deposits in present and former floodplains at the lowest stretch of Paine Creek.

Figure 7. Glacial Geology

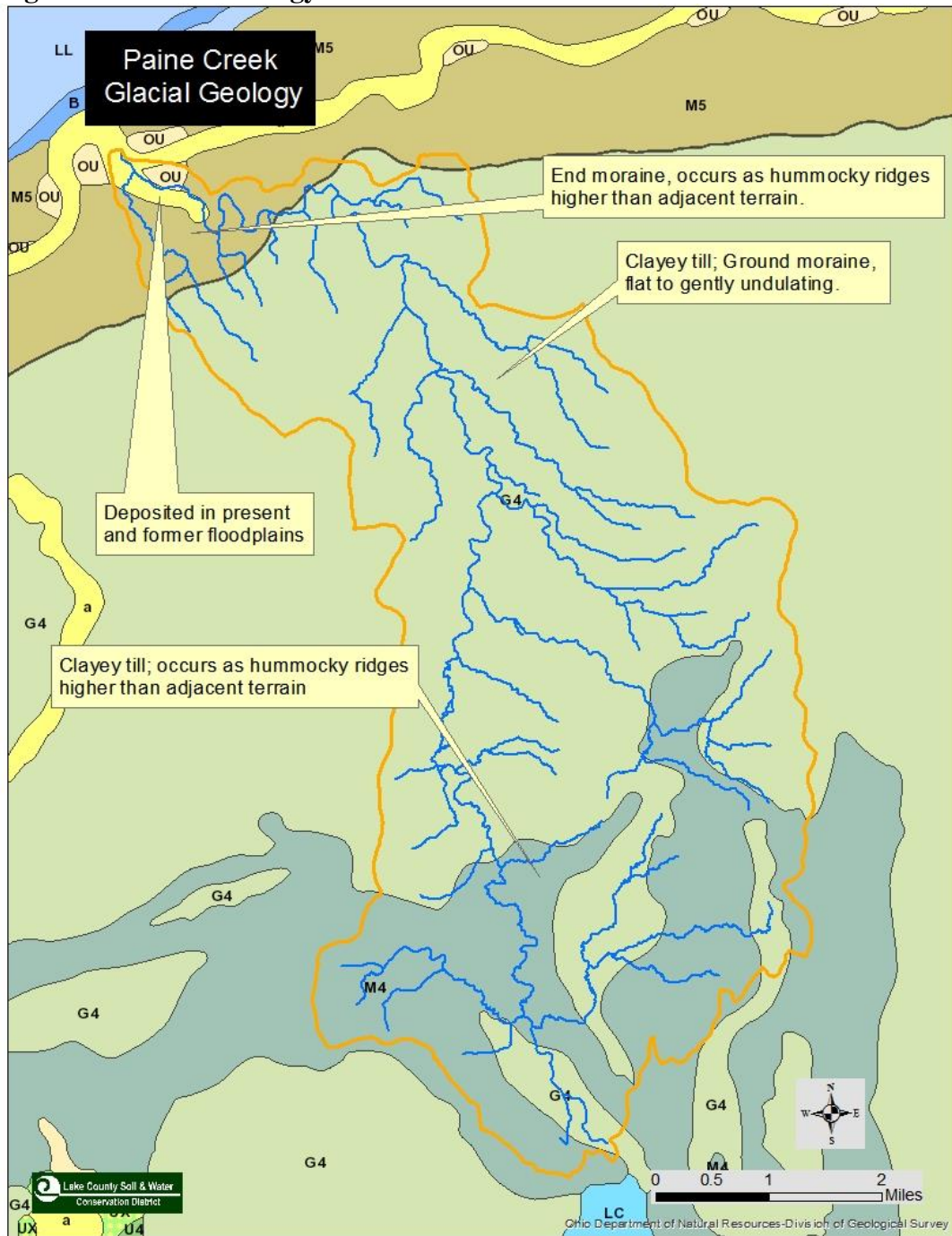
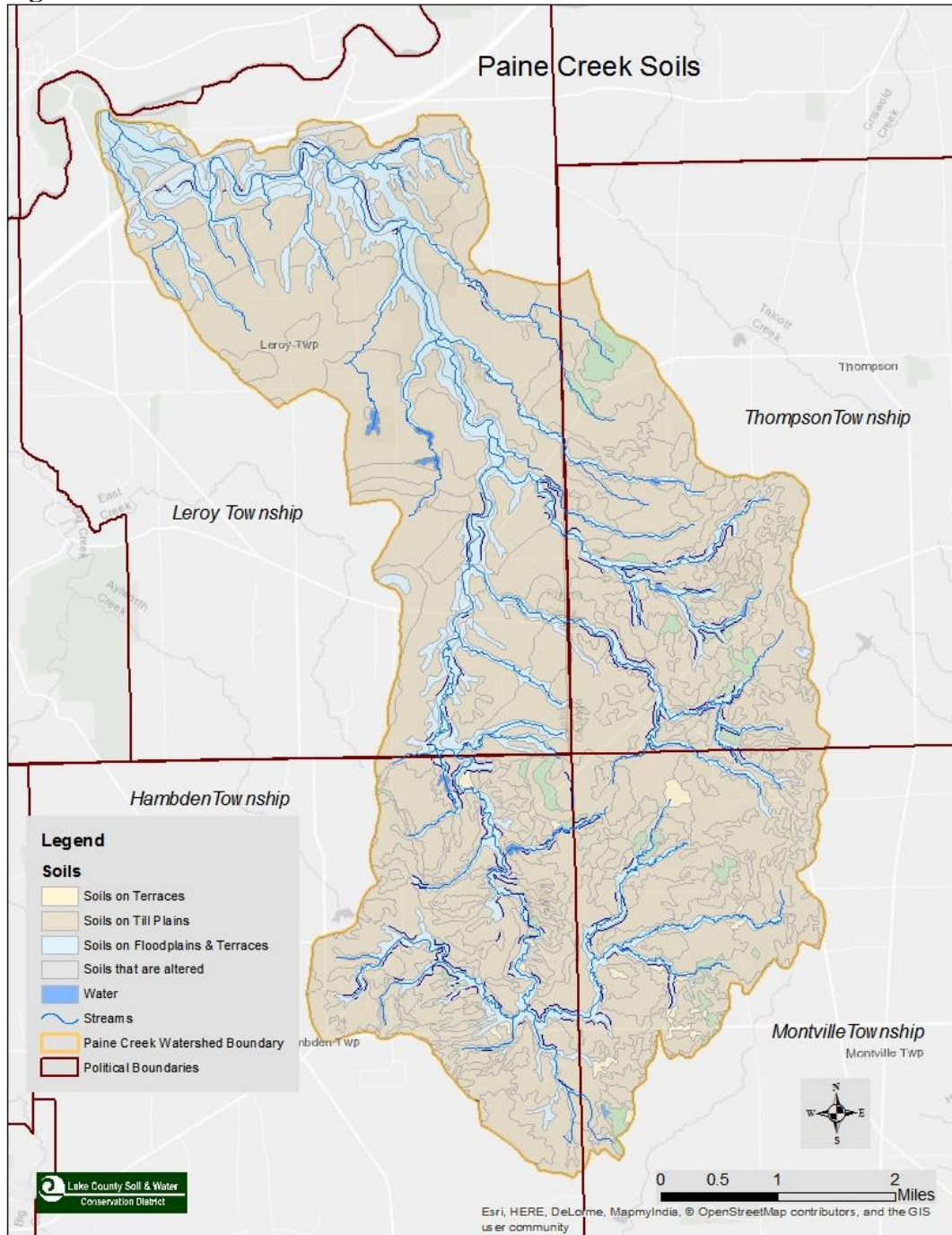


Figure 8. Soils



Soils

The soils in the watershed (Figure 8) reflect the glacial history of the region and can be divided into five categories:

1. Soils on till plains
2. Soils on floodplains
3. Soils on terraces
4. Soils on hills
5. Soils that have been altered

The largest area in the watershed is comprised of soils on till plains, followed by soils on floodplains. Soils on terraces and hills are nominal, and the small area of soils that have been altered is associated with Interstate-90 in the northwest portion of the watershed.

Refer to the Soil Survey of Lake County and Soil Survey of Geauga County, Ohio for more information about the soils and their properties.

Figure 9. Soil Drainage Characteristics

Drainage Characteristic	Acreage	%
Somewhat excessively well drained	8.3	.04
Well drained	1,331.6	7.2
Moderately well drained	3,449.8	18.7
Somewhat poorly drained	12,716.5	68.8
Urban	77.9	.4
Water	50.3	.27

68.8% of the soils are somewhat poorly drained (Figure 9). 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 10), whereas wetlands and on-site storage BMPs should be utilized in hydric soils (in shades of blue, Figure 10).

Figure 10. Soil Drainage Characteristics

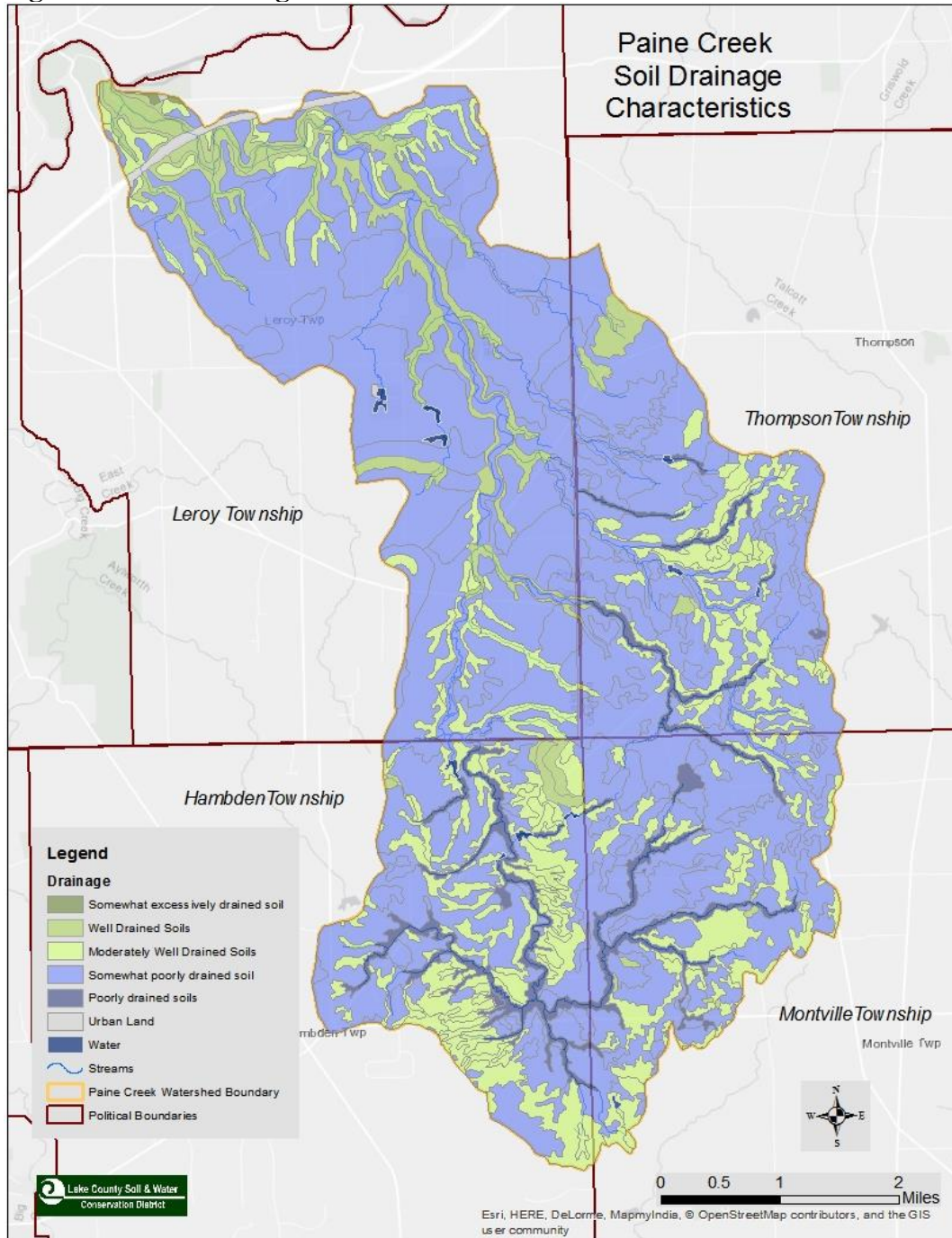
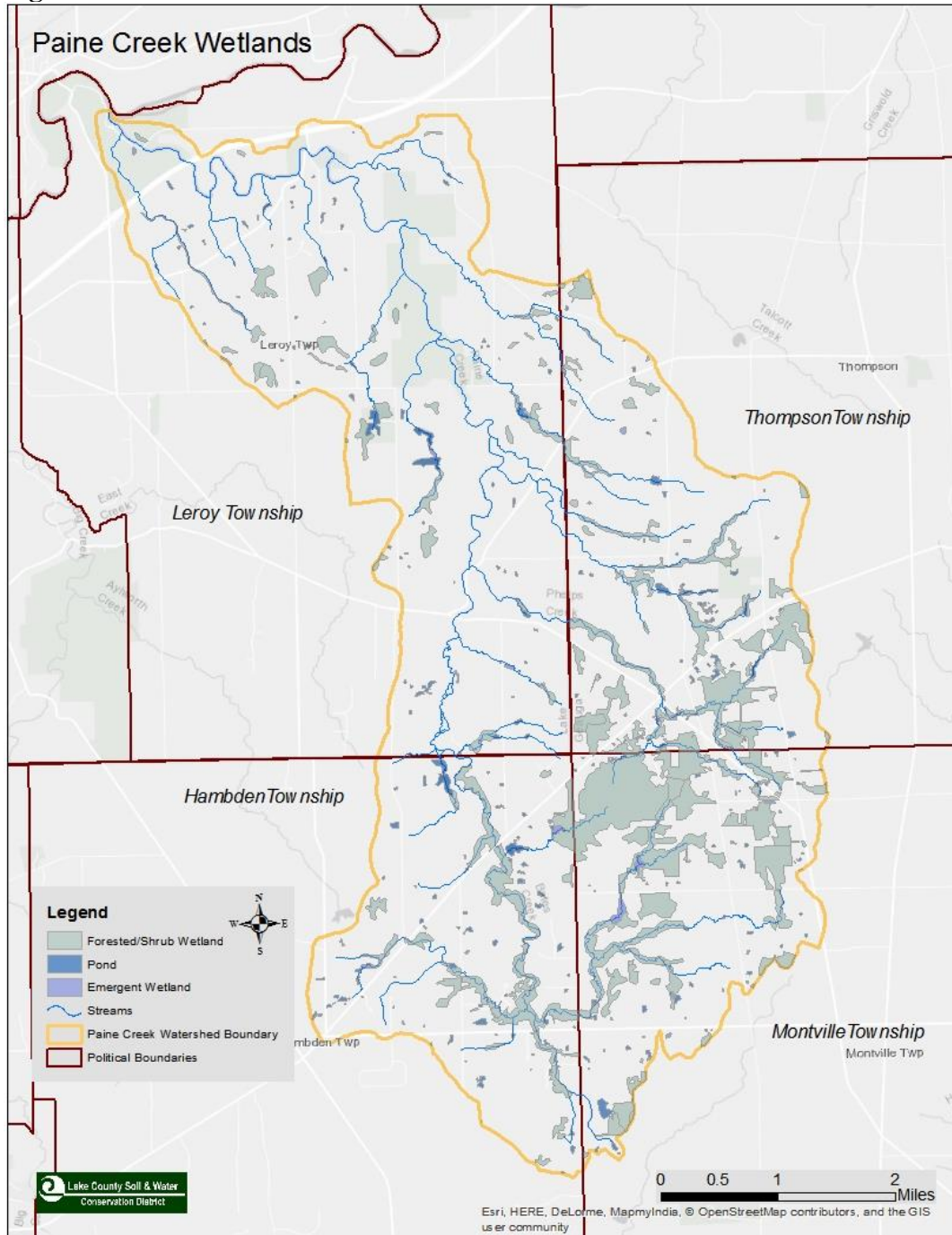


Figure 11: Wetlands



Wetlands

12% of the land in the watershed is covered by water and wetlands (Figure 11). (Federal Geographic Data Committee Wetland Mapping Standard for the conterminous United States (CONUS)). The breakdown of wetland type is as follows:

- Forested/shrub wetland 90.2%
- Pond 8.3%
- Emergent wetland 1.5%

Wetlands provide valuable ecosystem services. They are reservoirs of biodiversity; they provide flood control, replenish groundwater, purify surface waters of nutrients and sediments and act as a carbon sink. Protecting wetlands from further diminishment is an important consideration for water quality in this watershed.

2.1.2 Land Use and Protection

The National Land Cover Database (NLCD 2011) delineated 59% of the land use as forest in 2011, 19% of the land use as agriculture and 6.5% of the land use as urban (Figure 12).

Figure 12. Land Use Percentage

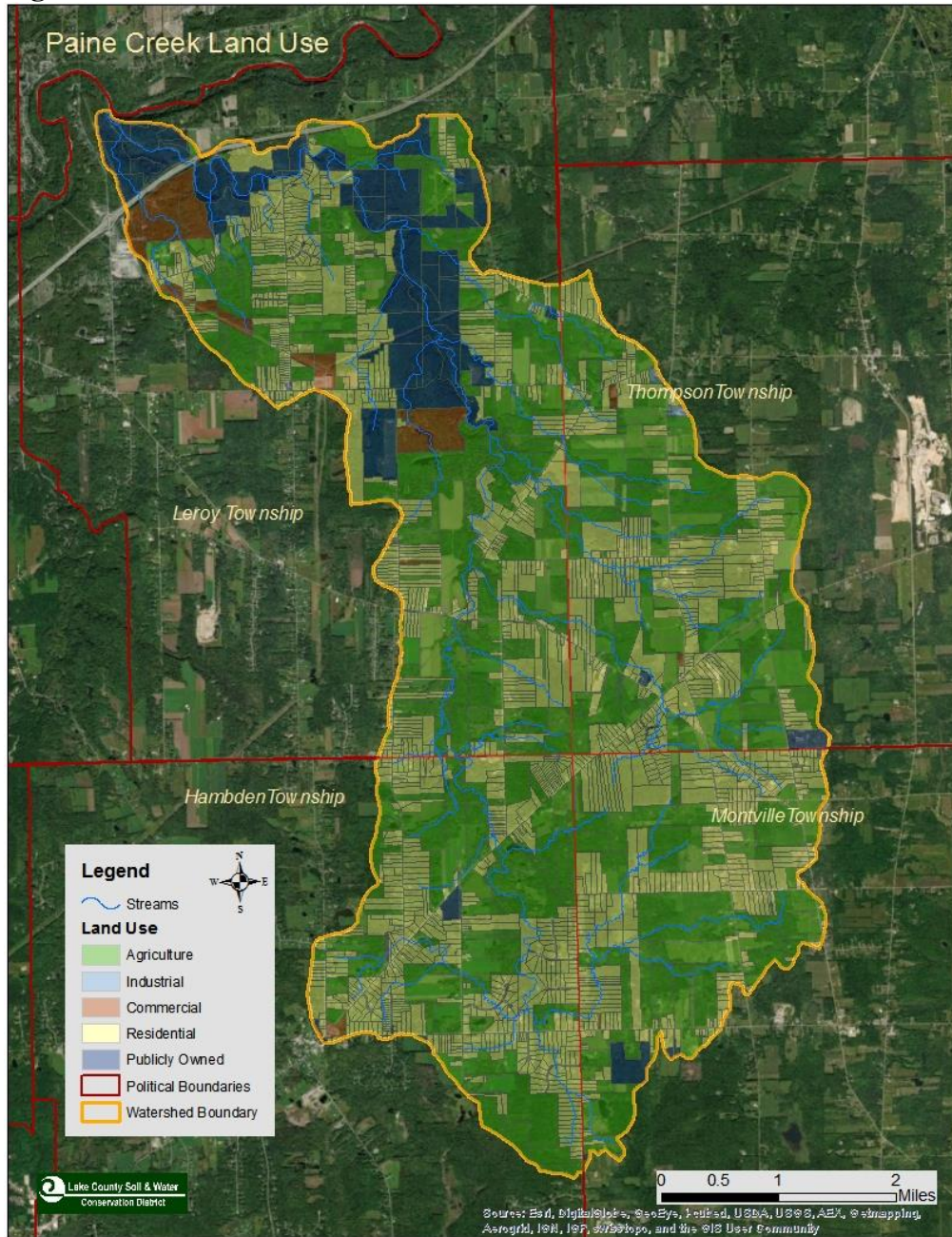
Open Water	107.3	0.58%
Developed, Open Space	681.9	3.70%
Developed, Low Intensity	481	2.61%
Developed, Medium Intensity	18.8	0.10%
Barren Land	0.9	0.01%
Deciduous Forest	10768	58.50%
Evergreen Forest	35.1	0.19%
Mixed Forest	1.3	0.01%
Shrub/Scrub	118.7	0.64%
Herbaceous	1024.9	5.57%
Hay/Pasture	1612	8.76%
Cultivated Crops	3485.4	18.93%
Woody Wetlands	74.3	0.40%

Land Use data from the 2019 Lake County parcel data and the 2018 Geauga County parcel data shows a little different picture (Figure 13). Agricultural land use includes forested lands in this dataset; urban land uses include residential, industrial and commercial. The data from each county is shown separately and as a whole because there are notable differences. Geauga has more land in agriculture and more residential land; Lake has a much higher percentage of public land due to Lake Metroparks' preservation of the mainstem of Paine Creek (Figure 14). The updated parcel data shows much higher urban land uses at 41%.

Figure 13. Land Use from Parcel Data

Land Use	Acreage in Lake	%	Acreage in Geauga	%	Totals	Total %
Agriculture	3048.5	40.6	5571	51.5	8619.7	47
Industrial			17.68	.16	17.68	.1
Commercial	445	5.9	32.3	.3	477.22	2.6
Residential	2433.5	32.5	5043	46.7	7479.5	41
Public	1568	21	145.4	1.34	1713.44	9.3

Figure 14. Land Use

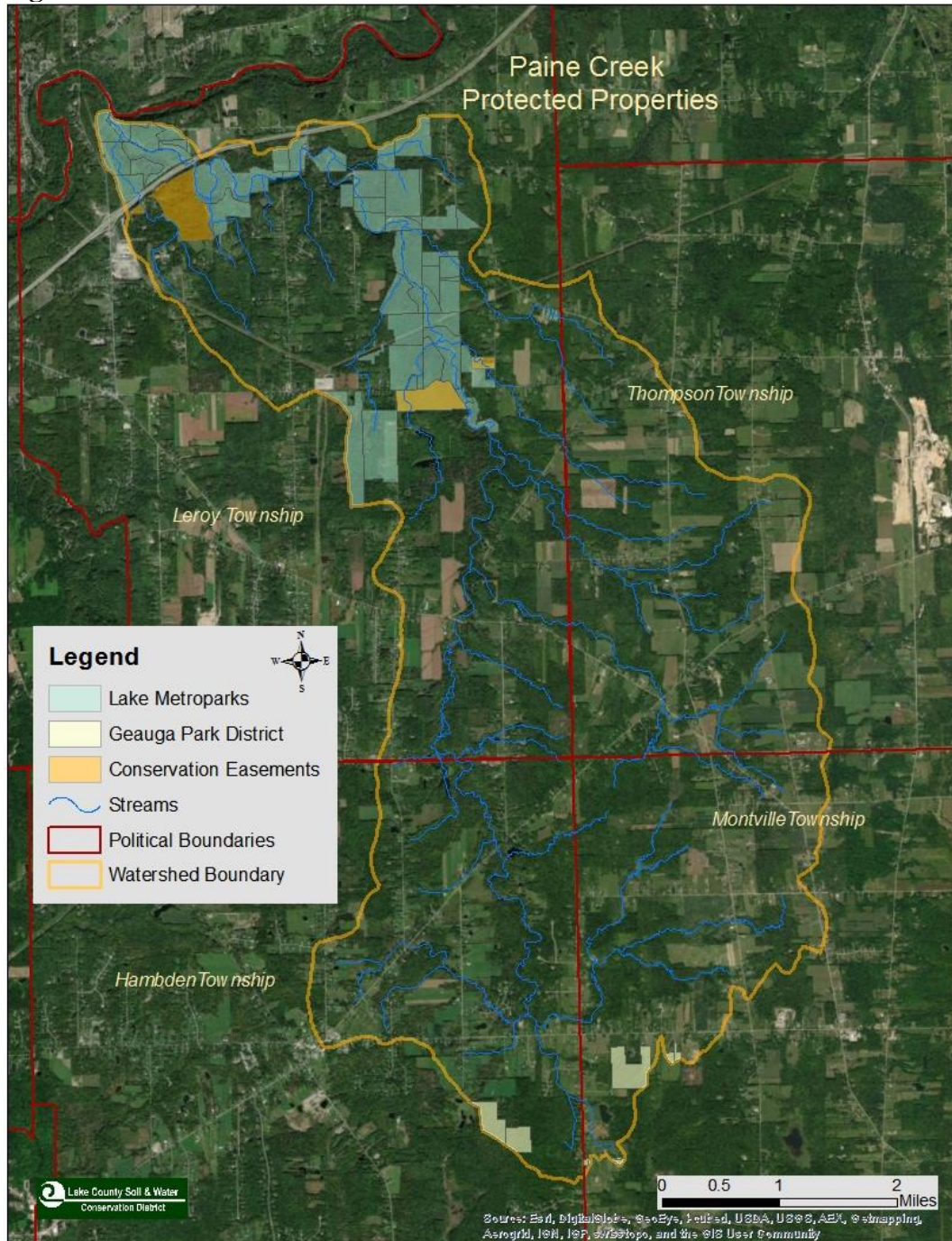


The following land use information is from David Radachy, Director of the Lake County Planning and Community Development office.

Mr. Radachy summarizes the development potential for lots in the Paine Creek Watershed as limited. The economics of building in areas with large lot sizes, large frontages, no sanitary sewer or central water make developing a parcel very difficult with thin profit margins.

- The majority of the land in the watershed is zoned 3-acre residential, with a small area of 5-acre residential land in northwest Thompson.
 - Three Acre Zoning: 93.34%
 - Five Acre Zoning: 6.19%
 - Commercial Zoning: 0.38%
 - Industrial Zoning: 0.07%
 - Park Zoning: 0.02%
- One- third of the lots that are zoned residential 3-acre minimum lot size are legal non-conforming, one-third meet minimum lot size but are not big enough to divide, and one-third are large enough to divide.
- The most common and easiest way to divide land in a township is by lot split (ORC 711.131). Many of the lots could be divided by lot split, but only two or three lots could be created because they need to be on existing roads and have minimum frontage requirements of 200 to 240 feet.
 - Hambden and Thompson Townships average 10 lot splits per year
 - Leroy and Montville Townships are averaging 5 lot splits per year
- Subdivision plats creating lots without new rights-of-way have occurred mostly in Hambden Township.
 - Four subdivision plats without rights-of-way were filed between 1997 and 2002 creating 52 lots.
 - None have been filed since 2002.
- Major subdivisions are developments that create lots and new roads. They are also limited by frontage requirements.
 - Lot size is dependent on septic areas and well water. The minimum 3- acre lot may not be big enough to for a house, septic area and water well.
 - It may only be possible for a developer to place 6 to 8 lots on a 33-acre parcel with a road that is 700 to 1,000 feet long, as an example.
 - Five subdivision plats were filed in Hambden Township creating six new rights-of-way and 66 new lots between 1997 and 2002.
 - One plat was filed in Leroy in 1999 creating one new right-of-way and 13 lots.
 - There has been no subdivision activity since 2002.
- Commercial and industrial development will be limited to areas with on-site septic treatment and well water.
 - Well water availability is the limiting factor as many uses are water dependent.
 - The lack of central water limits these land uses and may also stop development.
 - The Vrooman Road exit on Interstate 90 has central water but has never fully developed with businesses that cater to travelers.

Figure 15. Protected Lands



About 10.6% of the land is protected (Figure 15). 1,595.14 acres are owned by Lake Metroparks, 139 acres are owned by the Geauga Park District, and 218 acres are protected with deed restrictions held either by Lake Metroparks or Western Reserve Land Conservancy. A close-up view of the protected areas in Lake County shows the efforts to preserve the special resource of the steep wooded riparian corridor of Paine Creek (Figures 16 & 18). Paine Creek Falls is contained within the Lake Metroparks property (Figures 16 & 17).

Figure 16. Paine Creek Protection

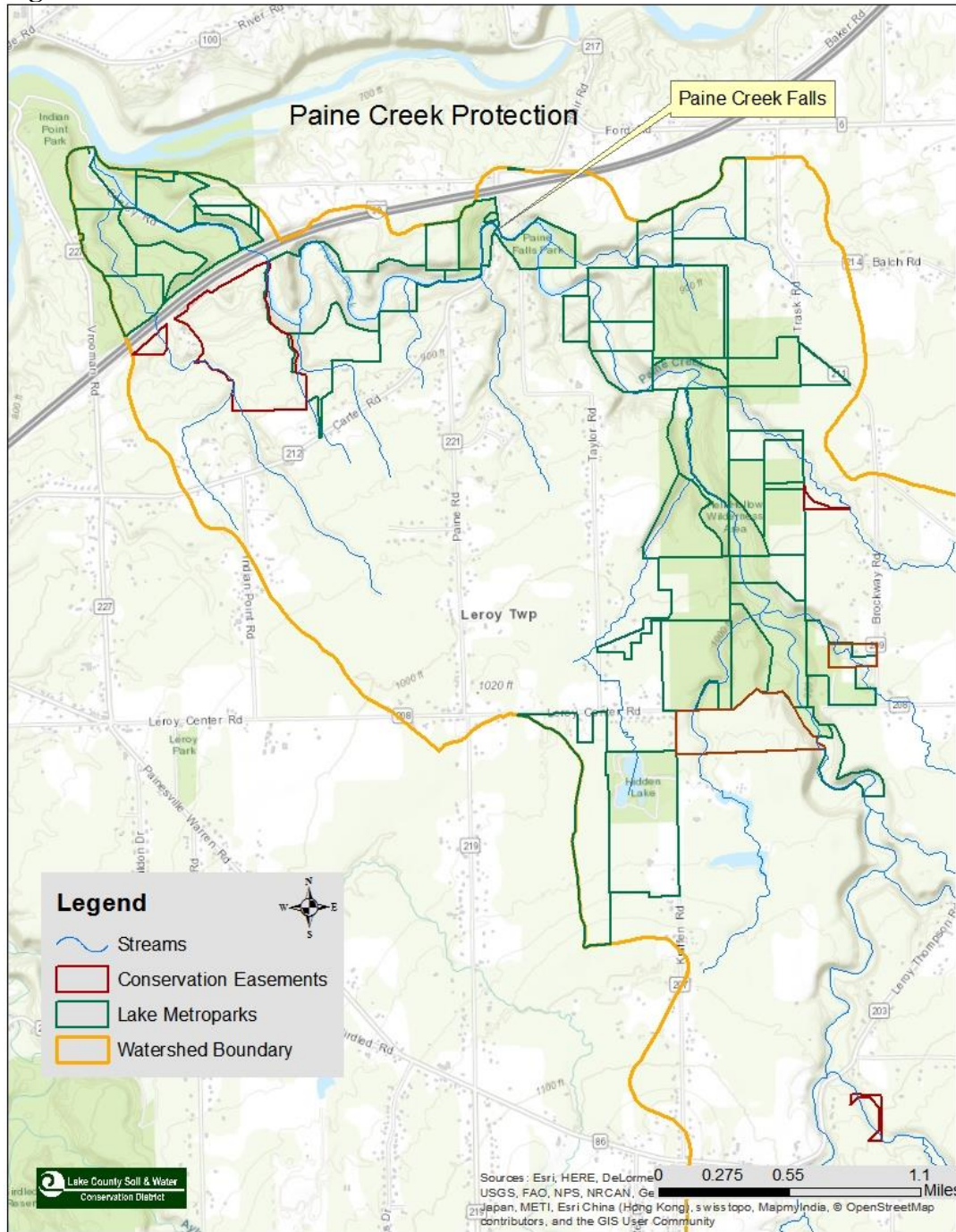


Figure 17. Paine Creek Falls



Figure 18. Paine Creek on Lake Metroparks Property



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

U.S. Geological Survey StreamStats data shows the imperviousness in selected subwatersheds (Figure 19):

Figure 19. Imperviousness

Subwatershed	Percent Forested	Percent Developed	Percent Impervious	Drainage Area-Sq Miles
Bates Creek	61.2	7.28	1.09	11.6
Phelps Creek	55.4	9.12	1.66	3.07
Paine Creek	72.9	5.71	1.40	6.95
Unnamed Creeks	63.2	4.01	0.85	6.6

As the watershed develops, the increased impervious areas will decrease the physical, chemical and biological characteristics of the creeks. “A non-structural method to counter increased impervious surfaces is riparian setbacks. As the amount and velocity of stormwater runoff increases in the watershed the stream banks will begin to erode. If setbacks are put in place then the tree roots will help to protect the streambanks. In areas where tree roots are not capable of maintaining channel stability the setback will allow room for the stream to meander without causing undue problems with nearby structures.” (Edgar. 2004.)

The high percentages of forested land and the low percentages of developed and impervious land have helped to maintain the water quality in this watershed. Figure 20 shows the mouth of the Paine Creek watershed as Paine Creek empties (on the left- clear water) into the Grand River mainstem (on the right- sediment laden) in the spring of 2019.

Figure 20. Water Quality Comparison: Paine Creek and the Grand River



2.2 Summary of HUC-12 Biological Trends

Ohio EPA uses biological assessments to support the use attainability in the state, basing the relationship between biology, habitat and the potential for water quality improvement.

OEPA has made four Aquatic Life Use designations in the watershed: Warmwater Habitat (WWH), Exceptional Warmwater Habitat (EWH), Coldwater Habitat (CWH) and Seasonal Salmonid Habitat (SSH). 13.7 miles are designated as WWH, 3.1 miles as EWH, 3.1 miles as SSH- from Paine Falls to the mouth and approximately 16 miles of CWH.

The WWH use designation defines the “typical” warmwater assemblage of aquatic organisms for Ohio rivers and streams, and represents the principal restoration target for the majority of the water resource management efforts in Ohio.

The SSH attributes are that they support lake run steelhead trout fisheries.

EWH use designation is reserved for waters which support “unusual and exceptional” assemblages of aquatic organisms which are characterized by a high diversity of species, particularly those which are highly intolerant and/or rare, threatened, endangered or special status (i.e. declining species); this designation represents a protection goal for water resource management efforts dealing with Ohio’s best water resources.

The CWH designation is intended for waters which support assemblages of cold-water organisms and/or those which are stocked with salmonids with the intent of providing a put-and-take fishery on a year-round basis which is further sanctioned by the Ohio Department of Natural Resources, Division of Wildlife; this use should not be confused with the SSH use which applies to the Lake Erie tributaries that support periodic seasonal “runs” of salmonids. (Biological and Water Quality Study of the Grand River Basin 2003-2004; Ohio EPA Division of Surface Water, November 1, 2006; p. xi-xii.)

The OEPA sampled 6 sites in 2004 (Figures 21 and 23) for aquatic life use attainment, updating the data found in the Biological and Water Quality Study of the Grand River Basin 2003-2004. Of the 6 sites, 2 were found to be in Full Attainment of Aquatic Life Use for Warmwater Habitat, 2 in Full Attainment of Coldwater Habitat, 1 in Partial Attainment of Exceptional Warmwater Habitat, and 1 in Partial Attainment of Warmwater Habitat (Figure 21). The causes and sources for the sites in Partial Attainment were listed as natural limitations due to very low summer flows and areas draining wetland and wet forested lands (which would lead to lower IBI and ICI scores). Attainment thresholds are shown in Figure 22.

In several locations, and at different sampling intervals, state threatened and species of concern macroinvertebrates were observed.

Figure 21. 2004 Sampling Data

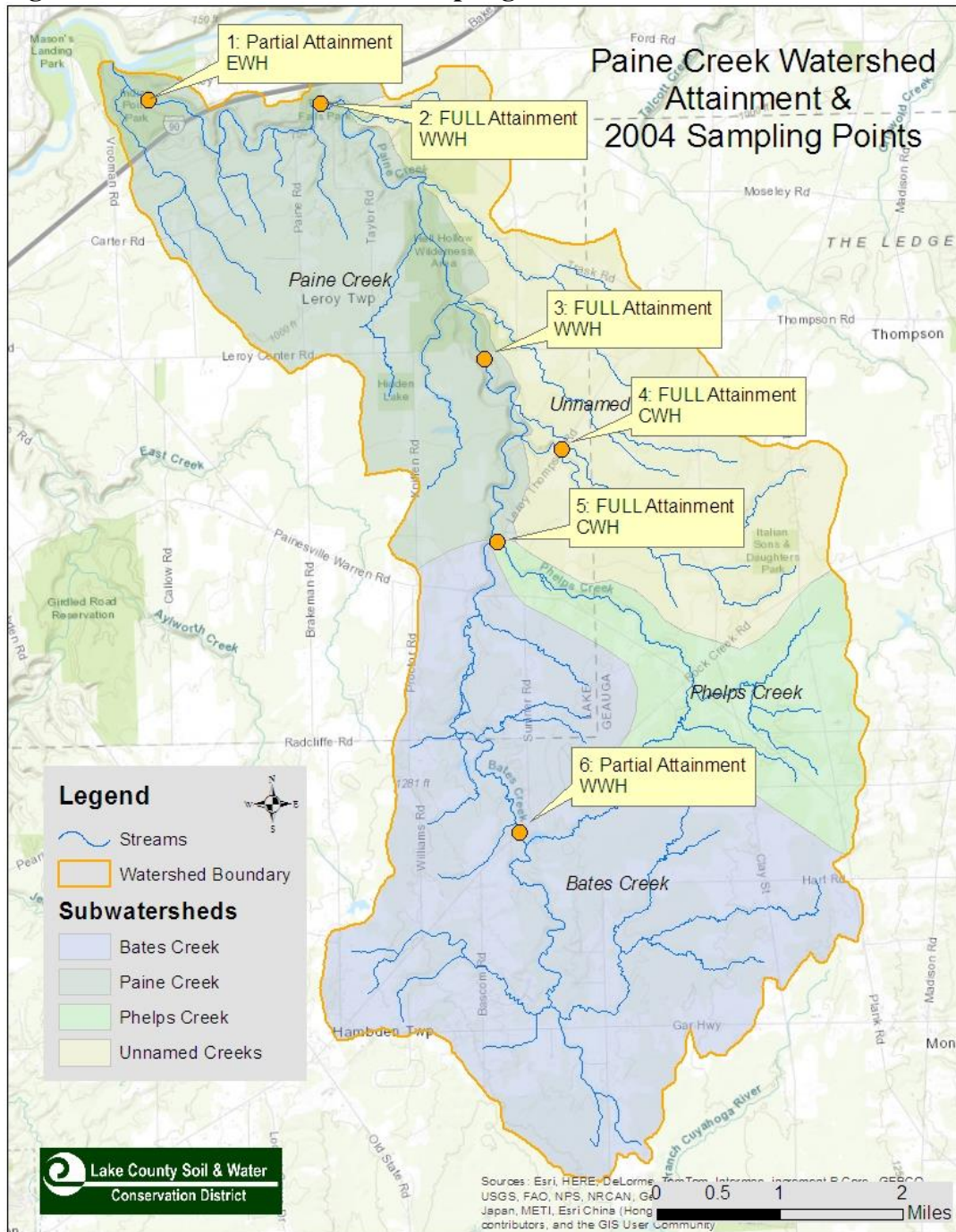
Location Number	Location	IBI/Rating	MIwb*	ICI/Rating	QHEI/Rating	Aquatic Life Use Desig.	Attainment Status
1	Paine Creek at Seeley Road	48/Very good	8.5/Good	Exceptional	60.5/Good	EWH	Partial
2	Paine Creek at Paine Road	34/Marginally good	-	-	69.5/Good	WWH	FULL
3	Paine Creek at Hells Hollow	36/Marginally good	8.2/Good	Exceptional	81.5/Excellent	WWH	FULL
4	Trib to Paine Creek at Leroy Thompson Rd	36/Marginally good	-	Exceptional	55/Fair	CWH	FULL
5	Phelps Creek at Thompson Rd	-	-	Very Good	-	CWH	FULL
6	Bates Creek at S.R. 166	32/Fair	-	Exceptional	83.5/Excellent	WWH	Partial

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

Figure 22. Aquatic Life Use Attainment Thresholds for Warmwater Habitat

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

Figure 23. Attainment and 2004 Sampling Locations



Headwater Habitat Evaluation Index

Lake SWCD worked with the EPA to develop the Headwater Habitat Evaluation Index (HHEI) protocol for use in drainage areas that are less than one square mile. Lake SWCD has used the HHEI to assess and establish a baseline database of existing conditions in many Lake County watersheds. HHEI data was collected by Lake SWCD staff in the Paine Creek Watershed between 2001 and 2003. 83 sites were assessed in Lake County. There is no HHEI data for Geauga County.

During the HHEI assessments, the Headwater Macroinvertebrate Field Evaluation Index (HMFEI) was also assessed. HHEI is an assessment of the *habitat*; HMFEI is an assessment of the *biology*. Biology trumps habitat, so a stream with a good HHEI score may still be a lower class if the biology is not there; conversely, there may be habitat but lack of biology.

The Class is determined by the assessment of the biological community and the presence or lack of indicator species. See Figure 29 and the subsequent text for a description of the three classes of Primary Headwater Habitat (PHWH) streams found in Ohio. By HHEI class, 71% of the streams in the Paine Creek Watershed are in the Class II and Class III categories (Figures 24, 25, 26 and 27). By HMFEI class, the highest percentage had no biology data- at 57.8%, followed by 21.7% as Class II.

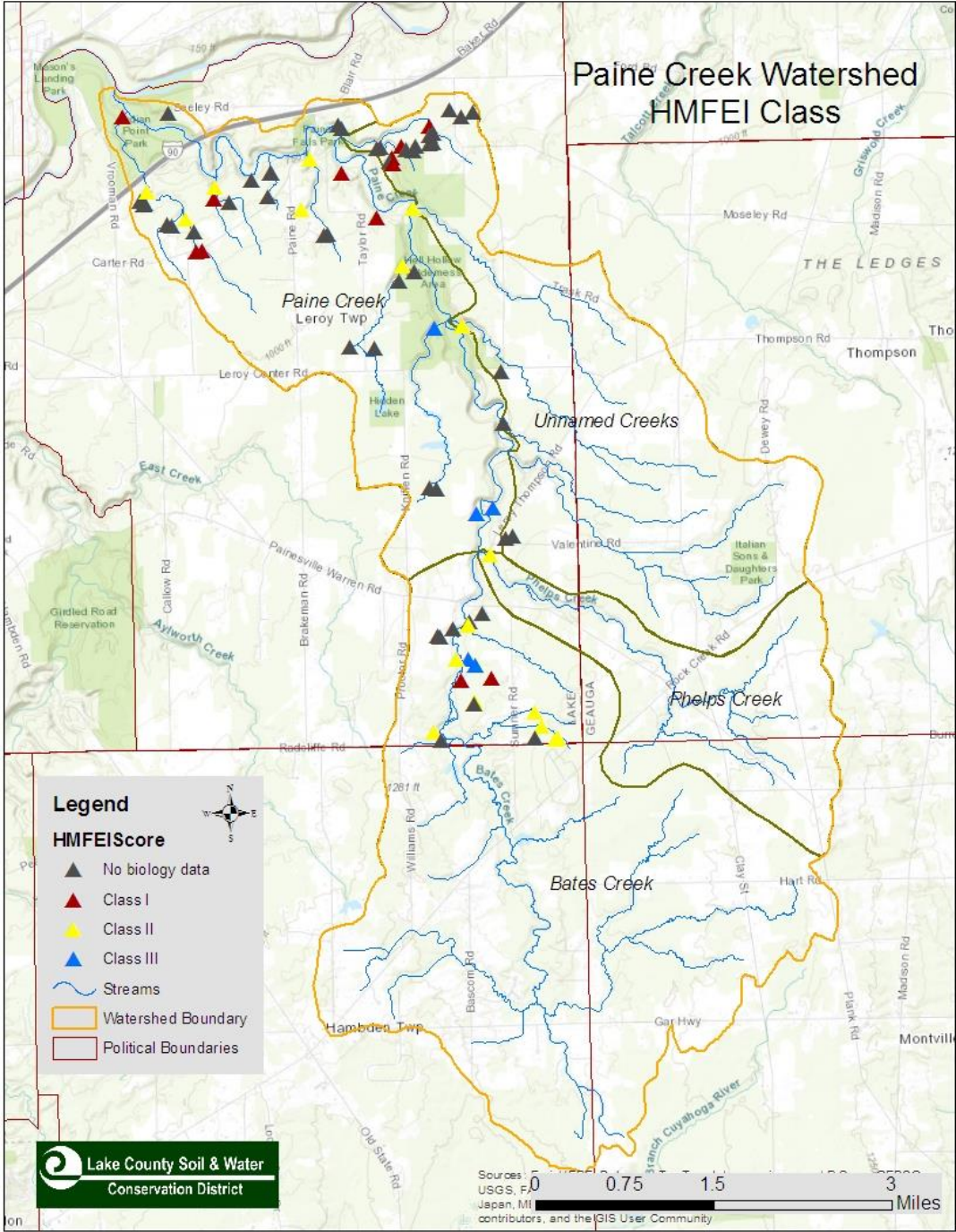
Figure 24. HHEI Stream Class

Class	Number	%
Class I	12	14.5
Class I Modified	10	12
Class II	32	38.5
Class II Modified	1	1.2
Class III	27	32.5

Figure 25. HMFEI Class

Class	Number	%
Class I	12	14.5
Class II	18	21.7
Class III	5	6
No biology	48	57.8

Figure 27. HMFEI Stream Class for the Lake County Section



The Ohio EPA Division of Surface Water's Biological and Water Quality Study of the Grand River Basin 2003-2004 addresses the causes and sources of the aquatic life use impairments in the following statements:

- Because the stream habitat in Paine Creek and its tributaries is largely dominated by bedrock and heavily influenced alternately by torrential flows from snow-melt and very low summer flows, fish communities are naturally limited such that they are hard pressed to meet the biocriteria expectations derived for till-plains-type streams.
- Most of the IBI scores marginally attained their biocriterion for respective stream sizes.
- The MIwb scores at all wadeable sites did not achieve their respective biocriterion.
- Despite the natural limitations to the fish community, Paine Creek is highly aesthetic and supports populations of bigeye chub and river chub, both pollution intolerant species with declining state-wide distributions.
- Bates Creek, which forms the headwaters of Paine Creek has limited summer flow and drains wet forests and wetlands. The fish community rated fair due to the natural limitations inherent in streams draining wetlands.

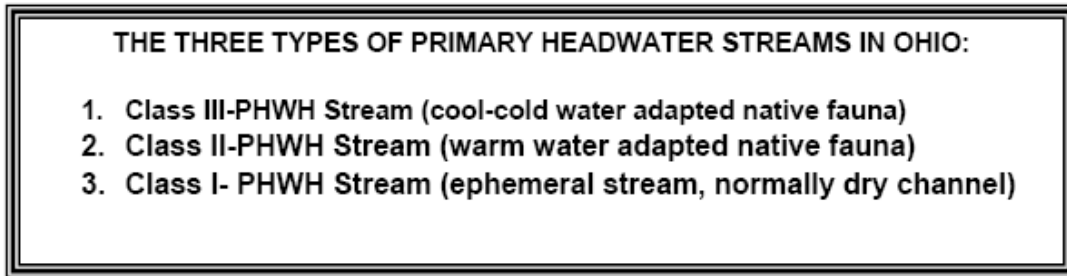
The same document discusses the coldwater habitat characteristics found in upper Paine Creek, Phelps Creek and the Tributary to Paine Creek (RM 7.17):

- The unusually high-quality macroinvertebrate communities in these streams was probably due to the streams flowing through highly wooded ravines with continuous groundwater flow and limited development.

It makes recommendations for future concerns:

- Fortunately, the Paine Creek catchment is relatively undeveloped, and the lower six miles of the mainstem are protected as parkland. The tributaries originating from the east, off Thompson Ledges, are important to maintaining base flow to Paine Creek (and axiomatically, to the Grand River), and should obviously be targeted for protection (easements, deed restrictions, etc.).
- The greatest threat to the rich biological diversity of the Grand River basin is suburbanization.
- The Grand River and its tributaries are especially sensitive to pollution and disturbance.
- The Grand River is an economic asset to Northeast Ohio worth maintaining in its current state.
- 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.

Figure 28: Three Types of Primary Headwater Streams in Ohio (OEPA. 2009.)



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

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

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

The primary physical habitat distinction between Class I and Class II- PHWH streams is that Class II-PHWH streams are watered- either with the presence of flowing water or isolated pools during the summer months, and Class I-PHWH streams 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.

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.”

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.

2.3 Summary of HUC-12 Pollution Causes and Associated Sources

On the Ohio EPA Division of Surface Water's website, the Water Quality: Assessment Unit Summaries (2014) identifies the causes and sources of impairment for all subwatersheds of the Paine Creek HUC-12.

Causes of impairment:

- Natural conditions (flow or habitat)
- Bacteria

Sources of impairment:

- Natural sources

2.4 Additional Information Determining Critical Areas and Developing Implementation Strategies

2.4.1 Lake County Soil & Water Conservation District (SWCD)

Lake SWCD was formed in 1946 to provide leadership and technical expertise to guide the protection and conservation of the unique soil and water resources of Lake County.

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

Over a ten-year period, staff collected data throughout Lake County and compiled a unique database of HHEI and QHEI (Qualitative Habitat Evaluation Index) information on local watersheds. The District utilized this data to assist communities in Lake County in establishing riparian setback ordinances and monitoring erosion and sediment control programs that would meet the goals of the USEPA Phase 2 and Lake Stormwater Management Department programs. The data was also used to evaluate and prioritize resource values for conservation easements, and to develop baseline and monitoring information for restoration assessments.

2.4.2 Lake County Stormwater Management District

Lake County's Stormwater Management District (SMD) provides treatment of stormwater and addresses the National Pollution Discharge Elimination System (NPDES) for Phase II mandated member communities. The SMD can assist with funding to improve the stormwater infrastructure and is a good source for match for grants for member communities. Leroy Township is not a Phase II mandated community and is not a member of the SMD. Geauga County does not have a stormwater utility, and funding/match for stormwater management projects can come from the local community, and private landowners.

2.4.3 Biological and Water Quality Survey of the lower Grand River Basin, 2003-2004; Ohio EPA

The main objectives of the survey (as they apply to the Paine Creek Watershed) were to:

1. Assess the overall quality of surface waters within the hydrologic units
2. Monitor for trends or changes in biological or water quality
3. Assign aquatic life uses to unassessed waters
4. Provide information for completion of a Total Maximum Daily Load Study

The results of the survey showed that the Grand River and its tributaries “continue to harbor a rich and diverse biological assemblage containing many rare and threatened species, and several state endangered species. This exceptional biological richness is the direct result of the fact that the physical habitat of the Grand River and most of its tributaries has, by dint of isolation from the surrounding uplands, been minimally altered and therefore remains largely intact. Also, land preservation through park land acquisition and conservation easements, and the numerous woodlots dotting the watershed, has maintained forest cover along much of the riparian zone, the adjacent valley slopes, and in the uplands; consequently, the water resource is, with few exceptions, very good and approaches pristine in a few cases.”

2.4.4 Total Maximum Daily Loads for the Grand River (lower) Watershed; Ohio EPA, January 31, 2012.

In 2003 and 2004, the Ohio EPA collected data related to water, sediment quality, aquatic biological communities and habitat in the lower Grand River Watershed to determine if quality criteria for designated beneficial uses were being met.

It determined that Paine Creek is influenced by coldwater tributaries including Phelps Creek, Bates Creek and an unnamed tributary at RM 7.2, which contribute cold ground water base flow to Paine Creek and the Grand River. Paine Creek contributes 2 to 5 percent of the total flow in the lower Grand River. In general, habitat conditions in the Grand River Tributary subbasin are good to excellent. The tributaries in Paine Creek have high gradients, discontinuities in bedrock and are subject to scouring flows that result in long bedrock glides, cascades and waterfalls. The headwaters of Paine Creek (Bates Creek) have habitat conducive to supporting till-plain stream fish communities, and have a virtually intact physical stream habitat, where most notably, the substrates are a nearly silt-free heterogeneous mix of fractured sandstone bedrock and glacial till. Two sites in the HUC-12 were found to be in partial attainment because of natural conditions.

The report outlined protection strategies as follows:

- Impervious cover target of 6%
- Riparian buffer targets
 - 70% forest in a 200 foot buffer
 - Targeted riparian width = $160 \times (\text{Drainage Area})$
 - Where Drainage Area is in square miles and the targeted riparian width is in feet

Stream	Target riparian width (ft)	Minimum vegetated width (ft)
Bates Creek	205	102
Phelps Creek	179	190
Unnamed Trib to Paine Creek	179	89

The report concluded that watersheds that retain relatively large areas of forest are better able to mitigate the impacts of increasing imperviousness associated with development than those with little forest cover. Procuring conservation easements and establishing parks and nature preserves can help to retain some of the forest cover. Land preservation alone is not likely to mitigate the impacts of development, but can augment other measures such as green infrastructure and on-site stormwater management.

Protecting streams from degradation due to land use changes will be critical to ensure that unimpaired streams are protected. Stormwater management, infiltration, wastewater management, using better site design practices and agricultural Best Management Practices are all applicable and recommended.

2.4.5 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.

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

2.4.6 Grand River Watershed Riparian Corridor Protection Guide (prepared by Davey Resource Group for Grand River Partners, Inc.; 1999)

This publication was financed in part by a grant through the Ohio EPA 319 program and in part by funds from the James P. Storer Foundation, with assistance from the Western Reserve Resource Conservation and Development Council and Grand River Partners, Inc. It describes the natural wealth of the Grand River, lists the many benefits of riparian corridors and states that the destruction of the riparian corridor is often the first step in the death of a river.

The benefits that riparian areas provide include:

- Absorbing and removing pollutants from runoff
- Reducing temperature extremes of waters
- Supplying organic matter to provide carbon nutrients (the most basic link in the food chain of a river ecosystem)

Preserving or restoring riparian areas along the Grand River and its tributaries was stated as key objectives for protecting the watershed. The guide enumerated ways to “save a river” as follows:

- Regulatory efforts for monitoring industrial and wastewater treatment facilities
- Community planning and tools to manage development in a sustainable manner and provide legal defenses to preserve the landscape
 - Comprehensive planning and natural resource analysis
 - Zoning and subdivision regulations
 - Growth Management
 - Easements and acquisition
 - Land trust efforts

2.4.7

Comprehensive Planning in Leroy Township

Chapter 10 of the 2018 Comprehensive Plan for Leroy Township addresses ways to protect its natural resources as the community develops through larger lot requirements than in other developing areas, stormwater management for new developments and riparian and wetland setbacks to maintain riparian area and wetland functions.

Riparian setbacks are required on all land adjacent to designated watercourses. The setback distance is determined by the size of the watershed that the watercourse drains, as follows:

1. A minimum of 120 feet on each side of all designated watercourses draining an area equal to or greater than 20 square miles.
2. A minimum of 75 feet on each side of all 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 all designated watercourses draining an area less than 1 square mile and having a defined bed and bank as determined in the regulations.
4. A minimum of 50 feet on each side of all designated watercourses determined to be a Class III primary headwater habitat stream.

Wetlands delineated by U. S. Army Corps of Engineers protocols are required to have the following setbacks as measured from the jurisdictional boundary:

1. 50 feet extending beyond the outermost boundary of a category 3 wetland.
2. 30 feet extending beyond the outermost boundary of a category 2 wetland.
3. 10 feet extending beyond the outermost boundary of a category 1 wetland.

2.4.8 Thompson Township Zoning Resolution

Thompson Township has adopted riparian and wetland setbacks within its zoning resolution. 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

2.4.9 Hambden Township Zoning Resolution

Hambden Township has adopted riparian and wetland setbacks within its zoning resolution, which are the same as Thompson Townships, above.

Hambden also has a minimum riparian setback on existing in-line ponds, but does not permit the creation of new in-line impoundments.

2.4.10 Montville Township

Montville Township has a comprehensive plan but has no zoning resolution to establish riparian or wetland setbacks.

Chapter 3: Critical Area Conditions & Restoration Strategies

3.1 Overview of Critical Area

The Critical Area for the Paine Creek watershed is the headwaters of the watershed which include Bates Creek and Phelps Creek Subwatersheds (Figure 29). The Bates Creek Subwatershed is in Partial attainment of its WWH aquatic life use; however, this is due to natural causes and sources. Phelps Creek is in Full attainment of its CWH aquatic life use. Although much of the Paine Creek mainstem has been protected by Lake Metroparks, it is not the case in these critical headwater areas. Maintaining the wooded riparian buffer in the headwaters is an integral component for the health of coldwater and warmwater habitat biology of the entire watershed.

The Ohio EPA found that Bates Creek has habitat more conducive to supporting till-plain stream fish communities than other tributaries and that it had a “virtually intact physical stream habitat; most notably the substrates are a nearly silt-free heterogeneous mix of fractured sandstone bedrock and glacial till”. (Ohio EPA Total Maximum Daily Loads for the Grand River (Lower) Watershed. Final Report, January 31, 2012; p. 45.)

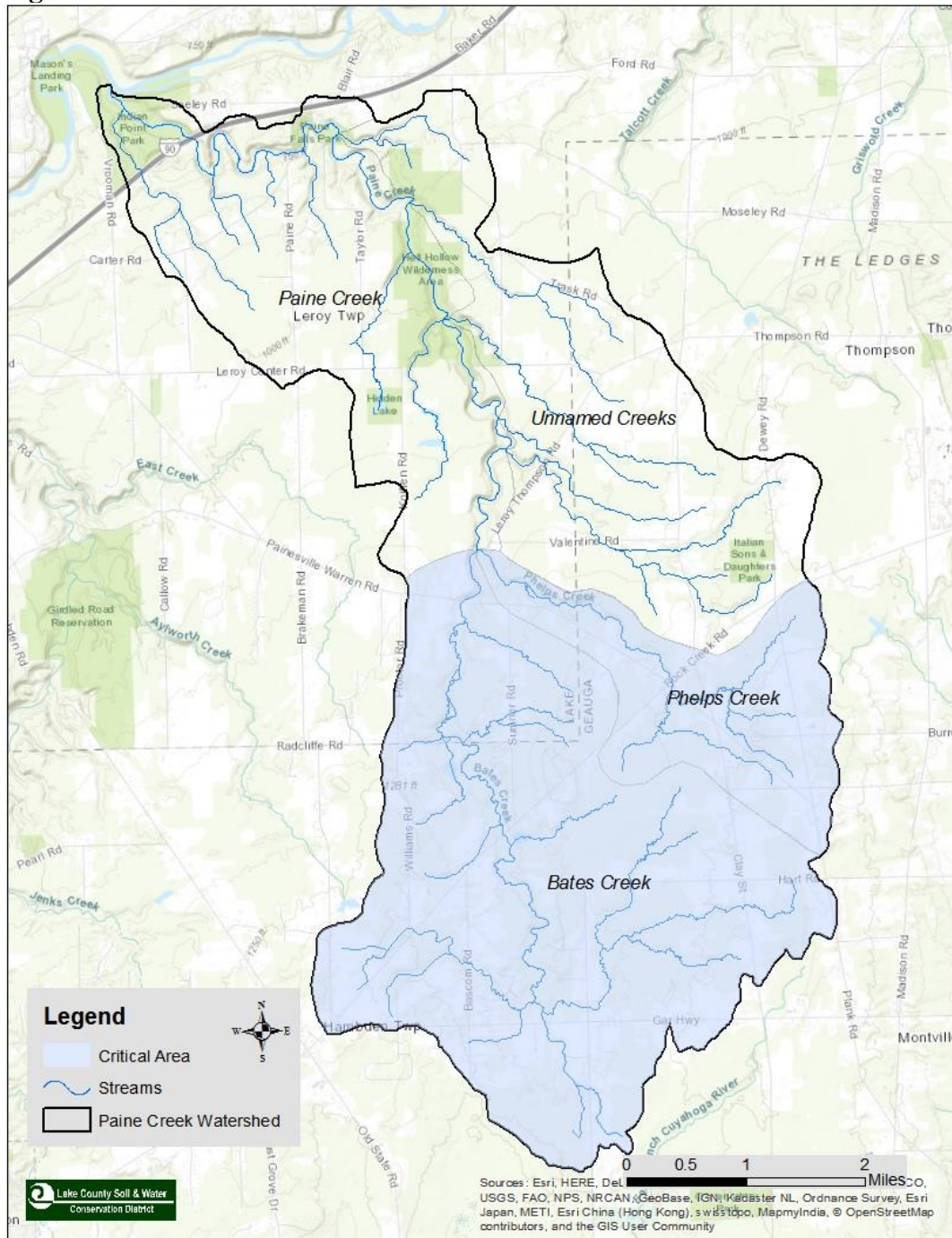
The coldwater tributary of Phelps Creek contributes cold water base flow to Paine Creek and the Grand River.

The Grand River Technical Support Document (OEPA 2006, p. 3) identifies the greatest threat to the rich biological diversity of the Grand River basin as suburbanization. It calls for the following strategies to maintain the biological integrity of the Grand River:

- Regional planning
- Stream protection policies
- Comprehensive construction site management plans
- Defined limits to growth

The strategies in this NPS-IS are focused on maintaining the aquatic life use attainment, rather than relying on restoration projects to bring the subwatersheds into attainment.

Figure 29. Critical Area



3.2.1 Critical Area: Detailed Characterization

The Critical Area (Figure 29) drains 15.1 square miles: Leroy Township in Lake County, and Hambden, Montville and a small portion Thompson Townships in Geauga County. The average percentage of impervious area is 1.21% (StreamStats from 2011 data).

Figure 30. Critical Area Land Use

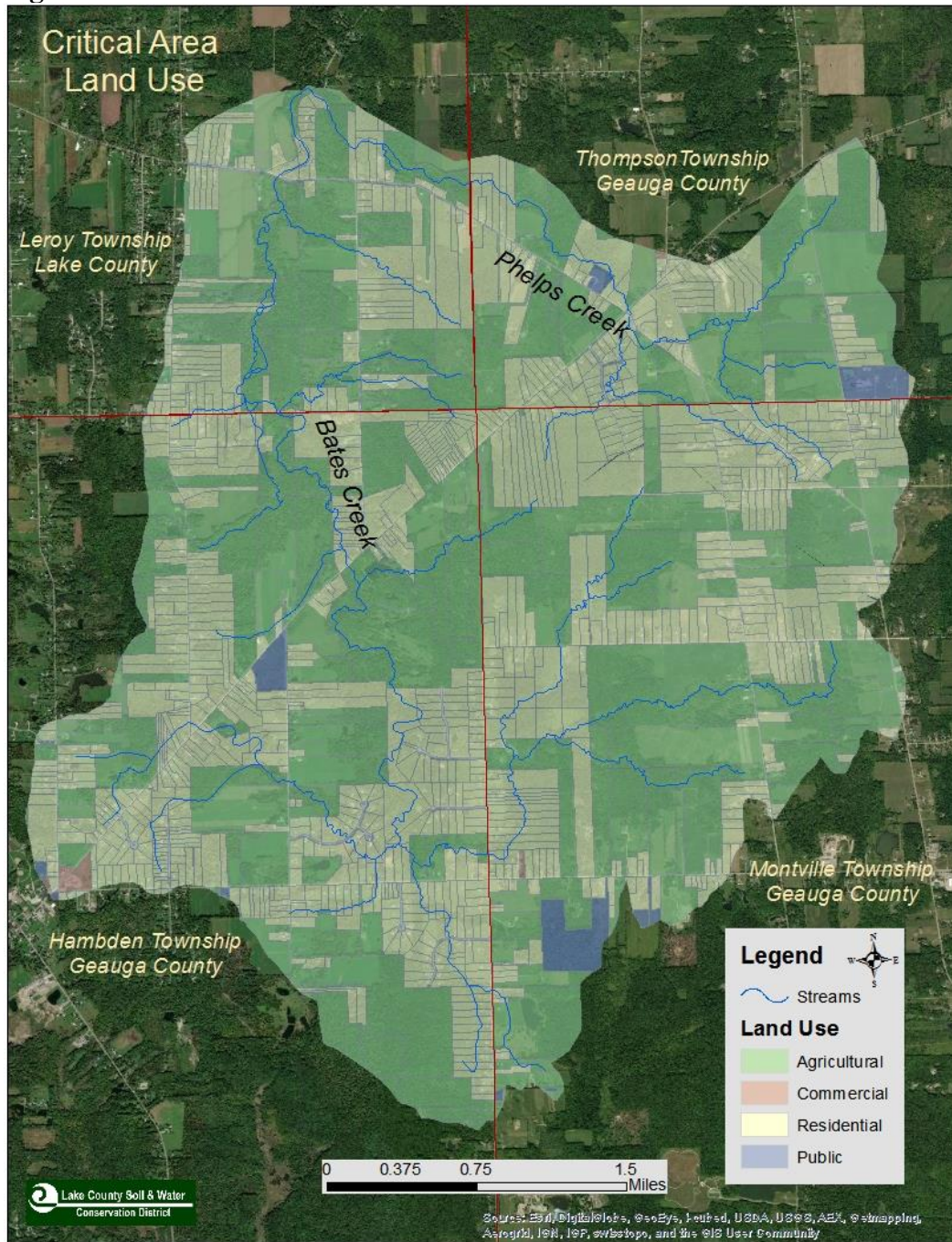


Figure 31. Critical Area Land Use Data

Land Use	Acres	%
Agricultural (green)	4300	51.1
Commercial (red)	23.5	.3
Residential (yellow)	3936	46.8
Public (black)	145.3	1.8

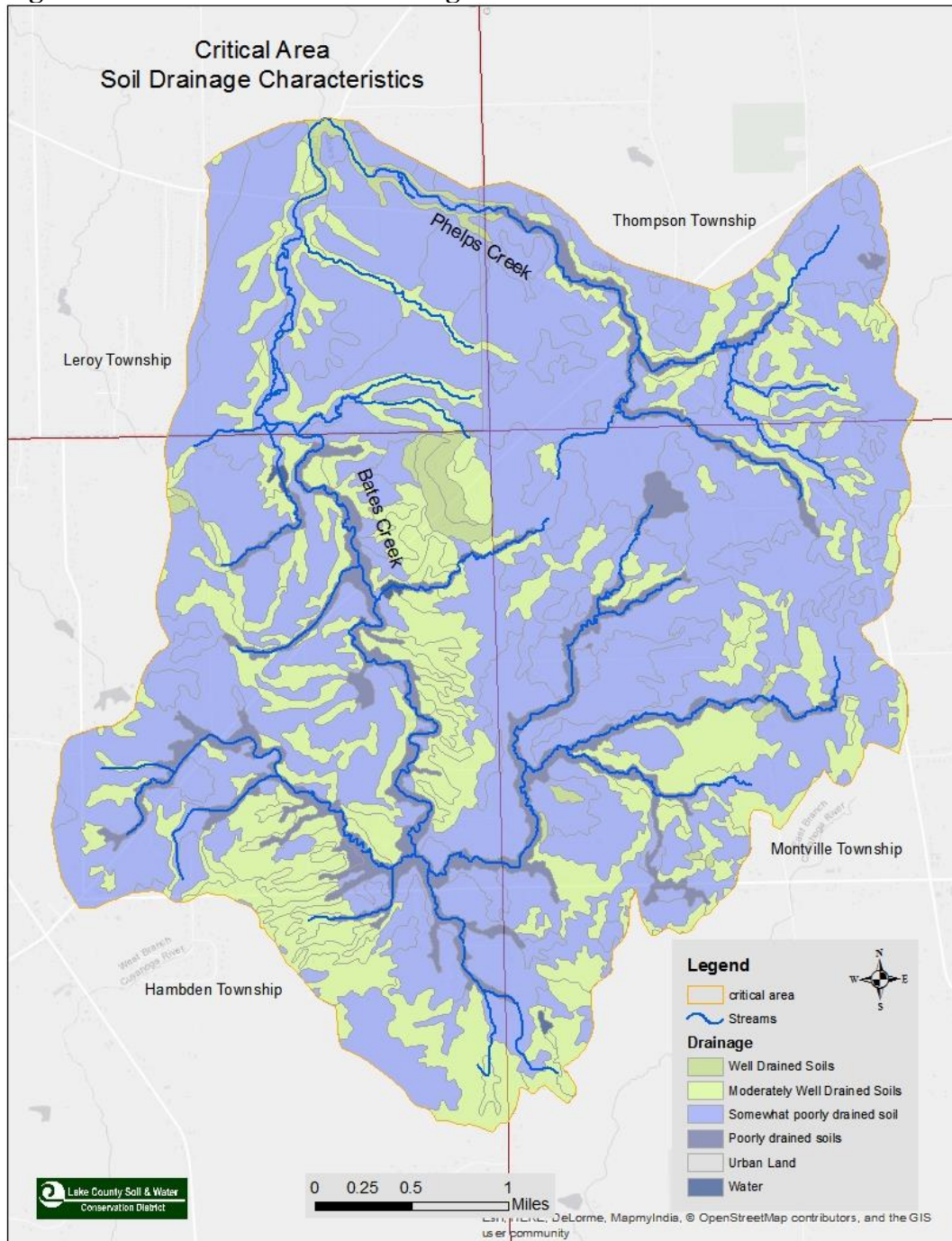
The land use is 51% agricultural (much of which is wooded) and 46.8% residential (Figures 30 and 31). There is very little industrial or commercial land use, so imperviousness in the watershed is minimal. The biggest threat to the subwatershed is development, as the watershed is approximately 3 miles from the City of Chardon, 7 miles from the City of Painesville and 4.5 miles from the U.S. Route 90 Vrooman Road interchange. Other factors that threaten the CWH and WWH attainment include a transition of land uses from agricultural to development because of aging land owners who may not have a younger generation wanting to farm, and logging of larger tracts without use of best management practices.

Conservation Development should be encouraged to help keep the WWH attainment status from declining. Conservation Developments allow developers to have smaller lots in exchange for land being preserved. This method of development usually is created through a planned unit development (PUD) and the developments are normally served by sanitary sewer and central water. Lot sizes for this type of development can be as small as ¼ of an acre. Conservation development can also work in areas where there is no sanitary sewer or central water, but lot sizes this small would not be able to contain a septic system and/or water well.

A conservation development could utilize lot sizes that are 50% or 33% of normal lot size in exchange for conservation of land so long as the lot size would have space for a septic system and/or water well. A one- or 1.5-acre lot with the right soil conditions could handle a septic system and/or well. In area of 3 acre lots, a community could approve lots that are 2 acres, 1.5 acres or 1 acre in exchange for preserved land.

Leroy Township in Lake County, Thompson and Hambden Townships in Geauga County have riparian setbacks, but Montville Township does not. The riparian corridors tend to be wooded in both agricultural and residential land uses, but some areas lack riparian buffers in residential yards, in farm fields and where logging has occurred. Planting and maintaining riparian buffers is a critical practice for the health of the watershed.

Figure 32. Critical Area Soil Drainage Characteristics

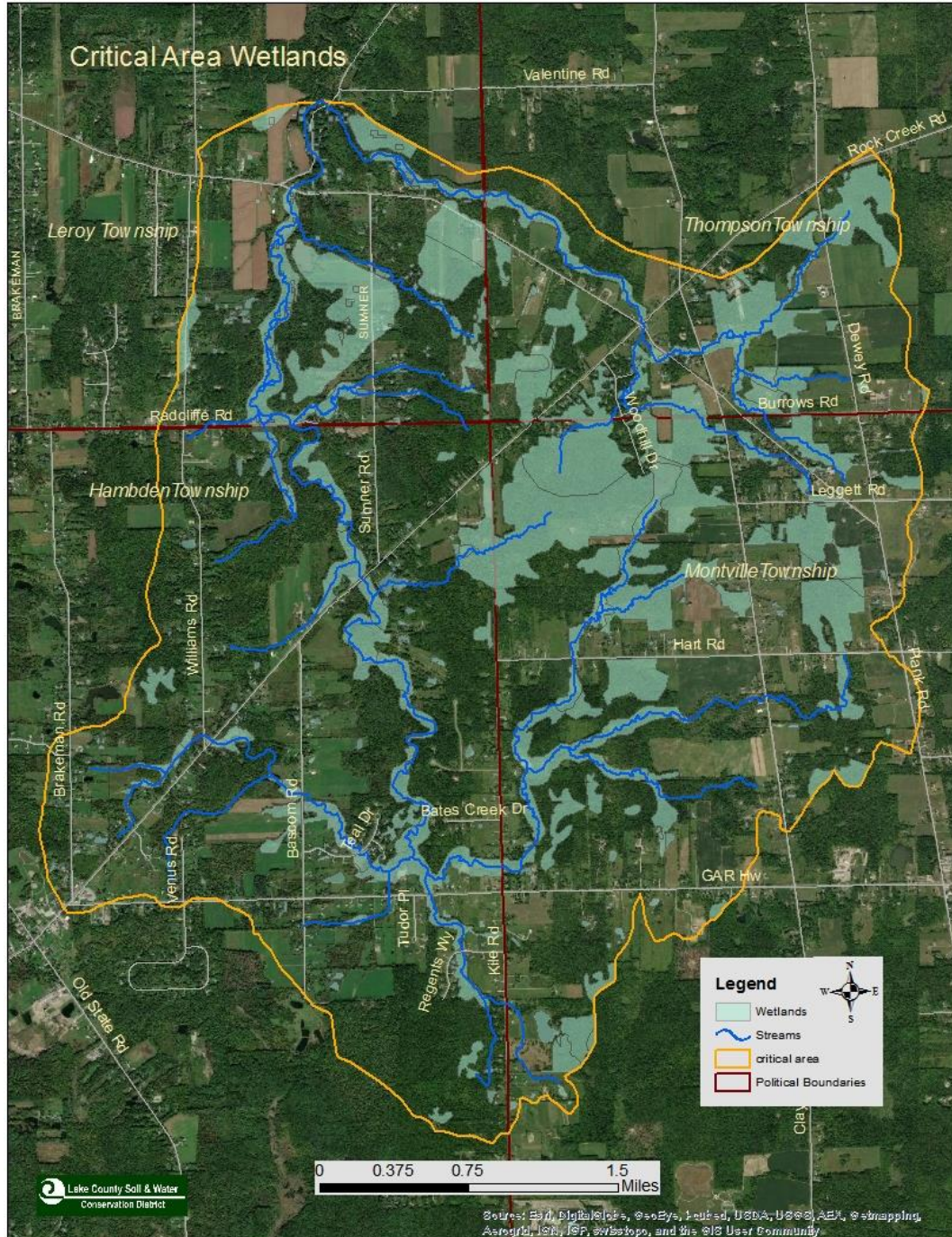


28.5% of the soils are well/moderately well drained; 63.3% are somewhat poorly drained and 8% are poorly drained, so 71.3% of the soils have somewhat poorly and poorly drainage characteristics (Figures 32 and 33). Any practices that rely on infiltration will need to be carefully sited.

Figure 33. Critical Area Soil Drainage Characteristics

Soil Drainage Characteristics	Acres	%
Well Drained	174.8	1.8
Moderately Well Drained	2592.1	26.7
Somewhat Poorly Drained	6139.9	63.3
Poorly Drained	776	8
Water	18.2	.2

Figure 34. Critical Area Wetlands



22.5% of the Critical Area is wetlands. A large portion of that is streamside wetlands, which perform vital functions for improving water quality and regulating storm flows. Streamside wetlands also contain the largest variety of plant and animal species associated with streamside wetlands. Deforestation of these wetlands can lead to increased erosion and sedimentation, warmer water temperatures and subsequent decrease in water quality and aquatic use habitat. Wetlands Best Management Practices should be used to supplement upland forestry best management practices to reduce the potential adverse impacts of forest management activities on wetlands. (Forested Wetlands; Functions, Benefits and the Use of Best Management Practices. USDA # NA-PR-01-95)

3.2.2 Detailed Biological Conditions

One point was sampled by the OEPA in 2004 in the middle of the Bates Creek subwatershed (Figure 40) was in Partial Attainment status of Warmwater Habitat Aquatic Life Use (Figure 35) because of the IBI score of 32. The water quality standard for WWH for IBI is 40 (Figure 36). The Macroinvertebrate Narrative from the 2004 sampling is “Exceptional”.

Another point was sampled at the mouth of Phelps Creek (Figure 40). It was in Full Attainment status of Coldwater Habitat Aquatic Life Use (Figure 35). It also has an Exceptional Warmwater Habitat (EWH) designation. The Macroinvertebrate Narrative from the 2004 sampling is “Exceptional”. Phelps Creek originates off the Thompson Ledges formation and is a high quality coldwater stream. It was recommended for a dual EWH/CWH aquatic life use based on the macroinvertebrate communities found there; as such, all the small streams and headwaters should be targeted for protection. “The unusually high-quality macroinvertebrate communities in these streams was probably due to the streams flowing through highly wooded ravines with continuous groundwater flow and limited development”. (Biological and Water Quality Study of the Grand River 2003-2004; Ohio EPA Division of Surface Water; November 2006).

Figure 35. EPA 2004 Sampling Data

Sampling Location	Macro-invertebrates	IBI/Narrative	ICI/Narrative	QHEI/Status	Attainment Status
Bates	Exceptional	32/Fair	-	83.5/Excellent	Partial
Phelps	Very Good	-	Very Good	-	Full

Figure 36. Index of Biotic Integrity (IBI) Criteria

Modified Warmwater habitat	Warmwater Habitat	Exceptional Warmwater Habitat
24	40	48

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

Lake SWCD assessed the HHEI in Bates Creek (Lake County only) in 2003 (Figure 37) and Phelps Creek in 2002. The majority of the streams in Bates Creek samples were Class II (48%); 81% scored Class II Modified or lower. 20% scored as Class III. At the mouth of Phelps, the sample was classified as a Class III.

Figure 37. HHEI Classification

HHEI Classification	%
Class I	14
Class I Modified	14
Class II	48
Class II Modified	5
Class III	20

Figure 38. Class III Stream in Bates Creek



Figure 39. Class III Stream in Phelps Creek



3.2.3 Detailed Causes and Associated Sources

The causes and sources of impairment in the Critical Area are listed in the Ohio EPA online Water Quality Assessment Unit Summaries (2004) for the HUC-12 watershed.

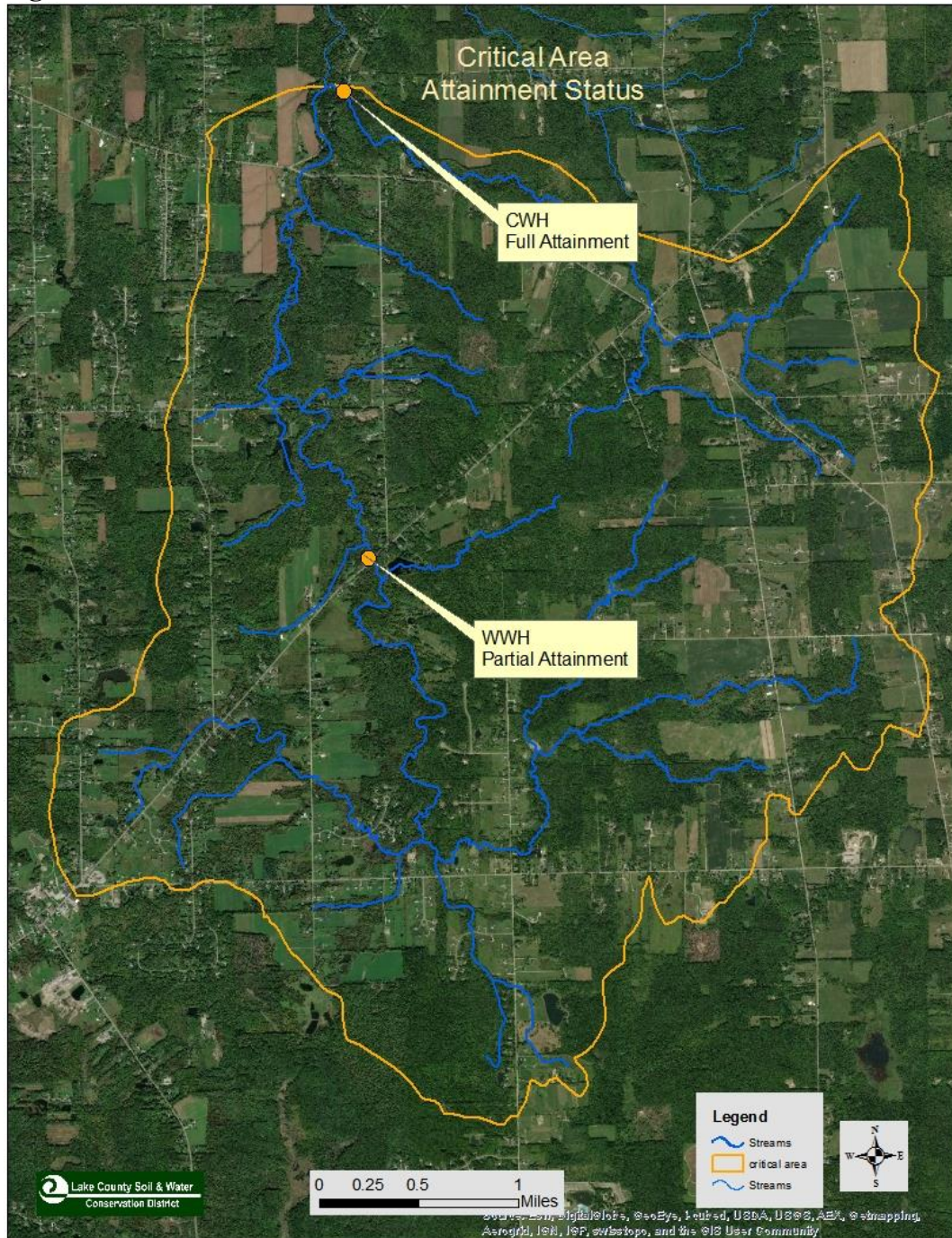
Cause	Source
Natural conditions (flow or habitat)	Natural sources

The Grand River Technical Support Document (OEPA 2006, p. 78) states that “Bates Creek at Radcliffe Road contains nearly silt-free, well-structured physical habitat (QHEI = 83.5), and is naturally limited by wetlands and low stream flow. The effect of low stream flow is apparent in the metric scores for the number of headwater, sensitive and darter/sculpin species as each departed significantly from that expected for the given stream size. New home construction and shifting landuses are ruled-out as a possible cause of impairment given that the population density in census blocks straddling the Bates Creek subcatchment has remained fairly stable between the 1990 and 2000 censuses... Furthermore, sedimentation was simply not evident.”

Phelps Creek was found to be supporting exceptionally high-quality macroinvertebrate communities including many infrequently collected sensitive taxa and three state listed taxa. Phelps Creek is characterized by coolwater/coldwater macroinvertebrate communities; the unusually high-quality macroinvertebrate communities in these streams is probably due to the streams flowing through highly wooded ravines with continuous

groundwater flow and limited development (Biological and Water Quality Study of the Grand River Basin 2003-2004, Ohio EPA Division of Surface Water; November 2006).

Figure 40. Critical Area Attainment Status



3.2.4 Outline Goals and Objectives for Critical Area

Goals

The priority nonpoint source goal identified by the stakeholder group is to maintain the Exceptional Invertebrate Narrative and Excellent QHEI scores for Bates Creek and the Full Attainment of Coldwater Habitat and Exceptional Warmwater Habitat for Phelps Creek. The goals will be accomplished by protecting and restoring the riparian, wetland and forest resources. In addition, the HHEI data will be updated.

Lake County SWCD conducted over 1200 assessments on primary headwater streams in northeast Ohio from 2000-08 in an attempt to better understand ways to protect these vital resources. As part of a small pilot study in 2018 and 2019 the Lake SWCD undertook a new effort to assess changes and trends in over 100 headwater habitats in the East Branch of the Chagrin River and the Grand River watersheds. This effort followed the same methodology and was conducted in the same locations as the original assessment effort.

The Headwater Habitat Evaluation Index (HHEI) developed by the Ohio Environmental Protection Agency described in detail in the “Field Evaluation Manual for Ohio’s Primary Headwater Habitat Streams” was used to complete an extensive baseline inventory of the biological integrity of headwater streams throughout Lake County. Primary headwater stream habitats are defined as having less than 1 mi² (2.59 km²) of drainage area and pools <40cm. HHEI assessments are ranked into five designations based on their physical, biological and chemical measurements. Important information like flooding potential, riparian corridors and chemistry is collected with reference to the amount of development, wetlands, and proximity to structures.

The original inventory unveiled the wide distribution of several obligate salamander and macroinvertebrate species which could be used to monitor long term trends in water quality impairment. The original study showed that statewide predictions for the amount of coldwater primary headwater streams within individual watersheds may be underestimated in some cases as the Grand River watershed contains twice the statewide predicted amount of coldwater streams in its watershed. Obligate salamanders of the Plethodontidae family have proven to be good predictors of habitat quality in urban, suburban and rural watersheds. Data collected from this study also provided useful information on key dragonfly larvae and salamander habitats.

Statistical analysis of the data updated in 2018 and 2019 is ongoing to determine trends and significant departures from initial data. However, early analysis suggests that stream designations (ie. Class III, Class II, Class I, etc.) have not changed significantly. Physical scoring metrics like substrate types, stream width and stream depth have predominately stayed the same. This trend stays the same for chemical parameters of temperature, conductivity, pH and salinity. Biological indicator species like salamander and dragonfly larvae ranges appear to stable. The majority of streams with previously recorded populations maintained those populations. However, abundance of individuals in each stream appears to have decreased. The most notable changes between the 2000-2008

effort and the 2018-2019 effort was the change in the flow regime in certain streams. While discharge was not physically measured in the original assessments, a notation is made during baseflow as to each individual stream's flow regime. The following regime choices are available for selection: 1. Perennial/Flowing, 2. Interstitial/Subsurface flow with isolated pools, 3. Intermittent/Moist channel with isolated pools (no flow) and 4. Ephemeral/Dry channel with no water. Approximately 22% of the streams had a reduction in the flow regime ranking. For example, a reduction in flow regime would be changing from Interstitial flow to Intermittent flow. Additional streams should be assessed to determine if this departure is significant across the entire data set. However, an early hypothesis is that the amount of groundwater infiltration feeding baseflow in these streams has been reduced. This reduction is the result of more intense, but infrequent, storm events; changes in soil texture from non-native earthworm activity; and lastly changes in evapotranspiration rates correlating to forest composition.

HHEI data supports many programs such as:

- TMDL development
- 401/404 water quality permits
- Acquisition of conservation easements
- Strengthening local planning commission and zoning board riparian setback resolutions.

Conservation of primary headwater streams and the surrounding natural areas that contain these unique habitats is essential to maintaining the function and value of downstream water quality.

Goal 1. Maintain or increase IBI score of 32 and QHEI score of 83.5 at Rock Creek Road

- **ACHIEVED:** Site currently has an IBI of 32 and QHEI score of 83.5

Goal 2. Maintain or improve ICI of Very Good at Leroy Thompson Road

- **ACHIEVED:** Site currently has an ICI of Very Good

Objectives

Objective 1. Protect and restore streams and wetlands

- Protect 100 acres of wetlands with fee-simple purchase
- Protect 12,175 feet of Bates Creek with an environmental covenant
- Enhance 50 acres of swamp forest and associated vernal pools on Geauga Park District property
- Develop 3 farm transition/succession plans

Objective 2. Protect land from development

- Purchase 100 acres wooded and riparian land on Bates Creek
- Acquire 75 acres of agricultural easements on farmland
- Connect Geauga Park District lands in Montville Township

Objective 3. Manage forest resources

- Develop 3 forest management plans
- Establish riparian buffers on 500 feet of previously clear-cut woods

Objective 4. Update HHEI data

- Re-assess 82 HHEIs in the Lake County portion of the HUC-12

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

The Phelps Creek Watershed was listed as 55.4% forested in a StreamStats Report downloaded on May 31, 2019. (The date of the data was not listed.) The 2011 NLCD Watershed Report listed forested land use at 59%. As of the writing of this NPS-IS, three large tracts of forests were identified as having been cut in 2013/2014 using Pictometry (high resolution aerial photography); none show signs of any best management practices for erosion and sediment control or stream crossing (Figures 41 and 42). Townships do not have the authority to enact legislation to address logging operations; state regulations exist for logging practices, but their enforcement is complaint-driven.

Maintaining forest cover and addressing the manner in which the larger lots are developed or managed is essential in this watershed.

Figure 41. Erosion from Logging into Phelps Creek



Figure 42. Proximity of Logging to Phelps Creek



Chapter 4. Projects and Implementation Strategy

4.1 Projects and Implementation Strategy Overview Table

The projects and evaluation needs that are believed to be appropriate to remove the impairments to the Paine 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 not the implemented projects are sufficient to achieve attainment. The response of biological systems may take some time following project implementation. If issues other than nonpoint source pollution are causing impairments, they will need to be addressed under different initiatives, authorities or programs.

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

The projects described in the Overview Table 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 Paine Creek HUC-12 Watershed.

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

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

4.1 Project and Implementation Strategy Overview Tables

For Paine Creek-Grand River Creek HUC-12 (041100040604) — 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)
<i>Recommend that your critical areas be numbered or coded for reference. That number/code listed here comes from Chapter 3 section 3.1</i>	<i>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.</i>	<i>The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.</i>	<i>The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.</i>	<i>The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.</i>	<i>The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.</i>	<i>The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.</i>	<i>The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.</i>	<i>The information listed here comes from the Project Summary Sheets Chapter 4 Table 4.2.</i>
High Quality Waters Protection Strategies								
1	1	1	1	Bates Creek Wetlands	WRLC	1-3 years	667,500	WRRSP
1	1	2	2	Wetland Enhancement	Geauga Parks	Medium		USFWS
1	1	5	3	Cianfaglione Ag Easement	Lake SWCD	1-3 years	\$228,000	ODA
	1, 2	4	4	Update HHEIs	Lake SWCD	1-3 years	\$34,000	CMAG

4.2 Critical Area: Project Summary Sheet(s)

Nine Element Criteria	Information needed	Explanation
<i>n/a</i>	Title	Bates Creek Wetlands
<i>criteria d</i>	Project Lead Organization & Partners	Western Reserve Land Conservancy (WRLC) is leading the project and will hold conservation restrictions on the property. Buckeye Retriever Club (BCR) will own and manage the property.
<i>criteria c</i>	HUC-12 and Critical Area	HUC 12: 041100040604 Paine Creek-Grand River Critical Area 1
<i>criteria c</i>	Location of Project	14849 Rock Creek Road, Chardon, OH 44024 Coordinates: -81.113603, 41.626339
<i>n/a</i>	Which strategy is being addressed by this project?	High Quality Waters Protection Strategies
<i>criteria f</i>	Time Frame	Short-Term (Priority) (1-3 yr)
<i>criteria</i>	Short Description	Protect stream, wetlands, and forested upland/buffer with an environmental covenant through WRRSP funding (pending).
<i>criteria g</i>	Project Narrative	The project will acquire 106 acres through fee-simple acquisition. 12,175 linear feet of stream and 43 acres of wetlands will be protected with an environmental covenant. Restoration will be done on 70 acres of wetland and buffer by managing invasive species for 3 years.
<i>criteria d</i>	Estimated Total cost	Estimated project cost: \$667,500
<i>criteria d</i>	Possible Funding Source	Water Resource Restoration Sponsor Program (WRRSP) (pending Program Year 2020 funding)
<i>criteria a</i>	Identified Causes and Sources	Sources of impairment: natural sources Causes of impairment: natural conditions
<i>criteria b & h</i>	Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?	The Critical Area is in attainment.
	Part 2: How much of the needed improvement for the whole Critical Area	This project will preserve 106 acres of natural area including 12,175 linear feet of riparian corridor of Bates Creek and 43 acres of

	is estimated to be accomplished by this project?	Category 3 wetlands. It will provide funding for 3 years of invasive species treatment in water resource areas of the property. It completely addresses Projects 1, 2 and 3 in Objective 1, and Project 1 in Objective 2 in the Critical Area.
	Part 3: Load Reduced?	By eliminating future land use changes, the loadings will not be increased.
<i>criteria i</i>	How will the effectiveness of this project in addressing the NPS impairment be measured?	The success of the project will be evaluated through continuing attainment of the WWH attainment.
<i>criteria e</i>	Information and Education	Successful project outreach: Buckeye Retriever Club will feature the project and reference the NPS-IS on their website and monthly newsletter. Western Reserve Land Conservancy will use press releases, their website, hard copy and e-newsletters, as well as social media outlets.
Nine Element Criteria	Information needed	Explanation
<i>n/a</i>	Title	Cianfaglione Agricultural Easement
<i>criteria d</i>	Project Lead Organization & Partners	Lake SWCD
<i>criteria c</i>	HUC-12 and Critical Area	HUC 12: 041100040604 Paine Creek-Grand River Critical Area 1: Bates Creek Subwatershed
<i>criteria c</i>	Location of Project	14354 Painesville Warren Road Painesville, Ohio 44077 Coordinates: 41.655, -81.122
<i>n/a</i>	Which strategy is being addressed by this project?	High Quality Waters Protection Strategies
<i>criteria f</i>	Time Frame	Short-Term (Priority) (1-3 yr)
<i>criteria</i>	Short Description	Establish an agricultural easement on the 114-acre Cianfaglione property near the mouth of Bates Creek.
<i>criteria g</i>	Project Narrative	The Cianfaglione farm is located on Painesville Warren Road, approximately ½ mile above the mouth of Bates Creek, where it becomes Paine Creek. The mainstem of Bates Creek flows for ¾ mile through the property, most of which is forested. The agricultural easement will protect the property and ¾ mile of Bates Creek from development in an area where development pressures are increasing.

<i>criteria d</i>	Estimated Total cost	Estimated project cost: \$228,000, through an estimated \$2,000 per acre grant from the ODA on 114 acres.
<i>criteria d</i>	Possible Funding Source	Local Agricultural Easement Purchase Program (LAEPP)
<i>criteria a</i>	Identified Causes and Sources	Sources of impairment: natural sources Causes of impairment: natural conditions
<i>criteria b & h</i>	Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?	The Critical Area is in attainment.
	Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?	This project will preserve 114 acres of farmland and ¾ mile of the riparian corridor of Bates Creek. It addresses the first item of Objective 5 in Critical Area 1.
	Part 3: Load Reduced?	By eliminating future land use changes, the loadings will not be increased.
<i>criteria i</i>	How will the effectiveness of this project in addressing the NPS impairment be measured?	The success of the project will be evaluated through continuing attainment of the WWH attainment.
<i>criteria e</i>	Information and Education	The Paine Creek NPS-IS is on the Lake SWCD website. Projects will be featured on the District website and in the District newsletter as they are completed.

Works Cited

Center for Watershed Protection, 2002. Watershed Vulnerability Analysis.

Edgar, C. 2004. *Arcola Creek Watershed Management Plan*. Lake County Soil & Water Conservation District.

Field Methods for Evaluating Primary Headwater Streams in Ohio; Ohio EPA, Division of Surface Water; Version 2.3, Ohio EPA, October 2009.

Forested Wetlands; Functions, Benefits and the Use of Best Management Practices. USDA # NA-PR-01-95.

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

Grand River Technical Support Document. OEPA 2006.

Grand River Watershed Riparian Corridor Protection Guide (prepared by Davey Resource Group for Grand River Partners, Inc.; 1999.

Ohio EPA Biological and Water Quality Study of the Grand River Basin 2003-2004. November 1, 2006. Ohio EPA Division of Surface Water.

Ohio EPA Nonpoint Source Pollution Management Plan- 2005-2010 (Ohio EPA, 2013). <http://wwwapp.epa.ohio.gov/dsw/nps/NPSMP/index.html>

Ohio Environmental Protection Agency. 2009. *Field Evaluation Manual for Ohio's Primary Headwater Habitat Streams*. OEPA Division of Surface Water, Columbus Ohio.

Ohio EPA Nonpoint Source Management Plan Update, Ohio EPA, 2013.

Ohio EPA Total Maximum Daily Loads for the Grand River (Lower) Watershed. Final Report, January 31, 2012.

Ohio Environmental Protection Agency. 2014. *Water Quality: Assessment Unit Summary*. Ohio EPA, Division of Surface Water, Columbus, Ohio. <https://oeпа.maps.arcgis.com/apps/webappviewer/index.html?id=af9b57fe031d4eea8937f474c00f97f3>

Ohio Environmental Protection Agency, 2013. *Nonpoint Source Management Plan Update*. Ohio EPA, Division of Surface Water, Columbus, Ohio.

United States Geological Survey, StreamStats in Ohio. <http://water.usgs.gov/osw/streamstats/ssinfo.html>

Appendix A. Acronyms

BMPs	Best Management Practices
CONUS	Conterminous United States
CWH	Cold Water Habitat
EPA	Environmental Protection Agency
EWH	Exceptional Warmwater Habitat
GLRI	Great Lakes Restoration Initiative
HHEI	Headwater Habitat Evaluation Index
HMFEI	Headwater Macroinvertebrate Field Evaluation Index
HUC	Hydrologic Unit Code
IBI	Index of Biotic Integrity
ICI	Invertebrate Community Index
MIwb	Modified Index of Well-Being
NPDES	National Pollution Discharge Elimination System
NPS-IS	Nonpoint Source Implementation Strategy
NRCS	Natural Resources Conservation Service
OEPA	Ohio Environmental Protection Agency
ORC	Ohio Revised Code
PHWH	Primary Headwater Habitat
PUD	Planned Unit Development
PSS	Project Summary Sheets
QHEI	Qualitative Habitat Evaluation Index
RM	River Mile
SSH	Seasonal Salmonid Habitat
SWCD	Soil and Water Conservation District
SMD	Stormwater Management Department
USDA	United States Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WWH	Warmwater Habitat