



**CHAGRIN
RIVER
WATERSHED
PARTNERS**

2019

LaDue Reservoir – Bridge Creek NPS-IS



Plan developed by:

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Nine-Element Nonpoint Source

Implementation Strategy Plan (NPS-IS)

HUC-12: 04110002 01 04

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Cover photo: Auburn Marsh Wildlife Area (4-19-2019) by Alicia Beattie, CRWP.

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Chapter 1: Introduction

1.1 Report Background

This NPS-IS is the first watershed plan for this area, with no previous Watershed Action Plan developed. This plan will continue to be updated as new needs and projects are identified. As State and Federal nonpoint source funding now relies upon the development of an NPS-IS plan, this NPS-IS plan must be accepted by Ohio EPA as meeting the 9-element minimum requirement as outlined in the USEPA's Handbook for Developing Watershed Plans to Restore and Protect our Waters. CRWP and its collaborators, including watershed members and communities, local agencies and other conservation organizations recognize the importance of strategic project implementation to address impairments within this HUC-12.

1.2 Watershed Profile and History

The Cuyahoga River drains 813 square miles within the Erie-Ontario Lake Plain in parts of Geauga, Portage, Summit, and Cuyahoga Counties. The main branch of the Cuyahoga River begins at the confluence of the West Branch Cuyahoga and East Branch Cuyahoga Rivers and flows 85 miles in a U-shaped course before flowing into Lake Erie in downtown Cleveland, Ohio (ODNR 2019). The LaDue Reservoir-Bridge Creek HUC-12 (04110002 01 04) is part of the upper Cuyahoga watershed. This HUC-12 covers 38.79 square miles (Ohio EPA Integrated Report 2018). The upper Cuyahoga River's headwaters are in Chardon, Ohio; it flows south to Lake Rockwell in Franklin township and runs about 45.52 river miles. The Upper Cuyahoga River watershed covers about 207 square miles and drains 351 miles of principal streams (OEPA 2004). In the headwater area of Hambden and Montville Townships in Geauga County, the river starts out as the East Branch and West Branch and then combines just below the Village of Burton (akronohio.gov). The Upper Cuyahoga river flows about 41 miles south to Portage County and ends at the Lake Rockwell dam near Kent. Twenty-five miles of the Upper Cuyahoga River, outside the HUC-12, was designated as State Scenic in 1974. Most of the Upper Cuyahoga watershed is rural, woodland, and agricultural uses, but development pressures are growing (Environmental Design Group 2013). The Cuyahoga River was also designated an American Heritage River in 1998, and a National Heritage Corridor in 1996. The Upper Cuyahoga River is known for its preglacial valleys, which provide a source of groundwater throughout the region and sustain the flow and quality of the River during dry weather (ohiodnr.gov).

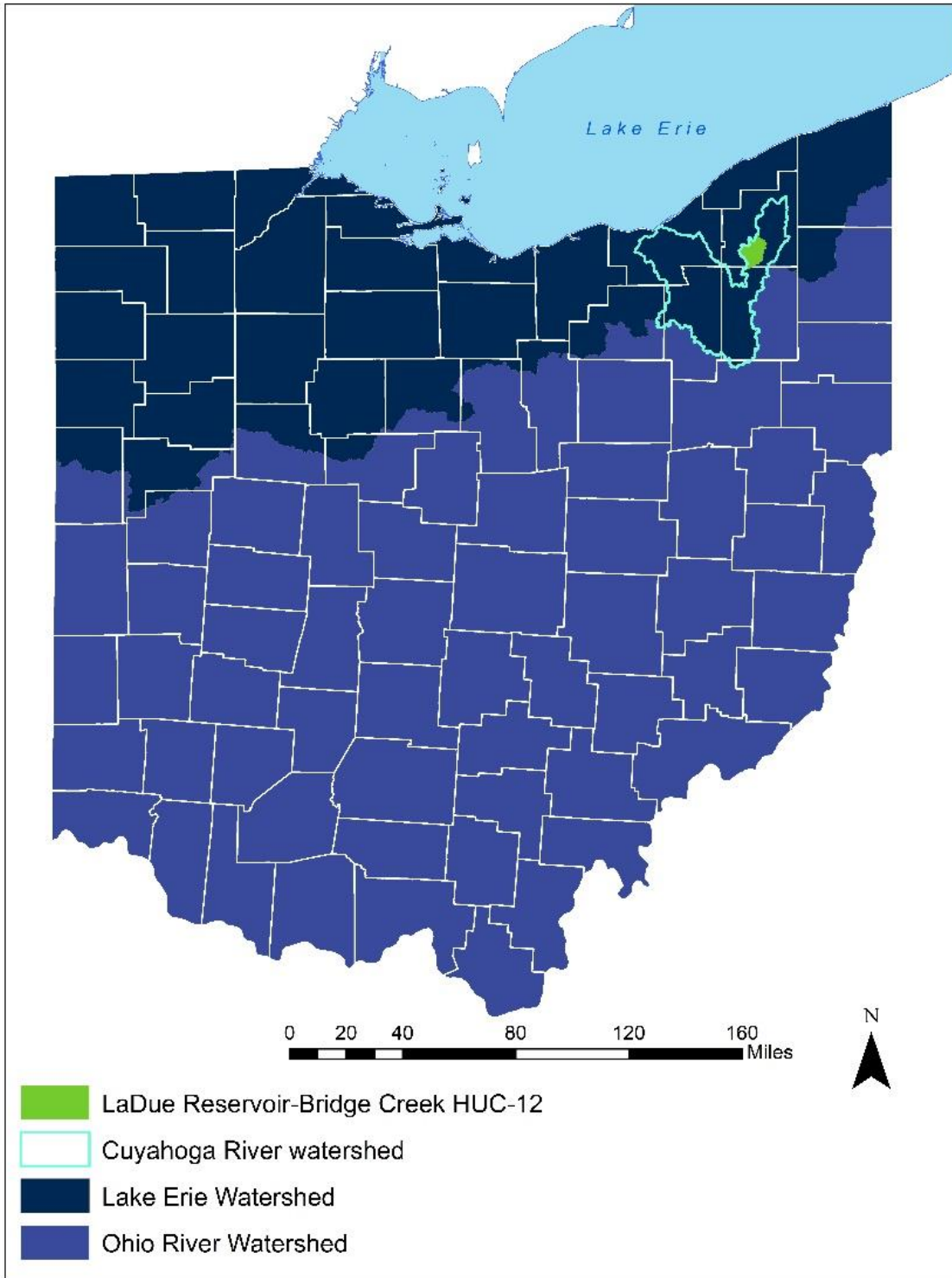
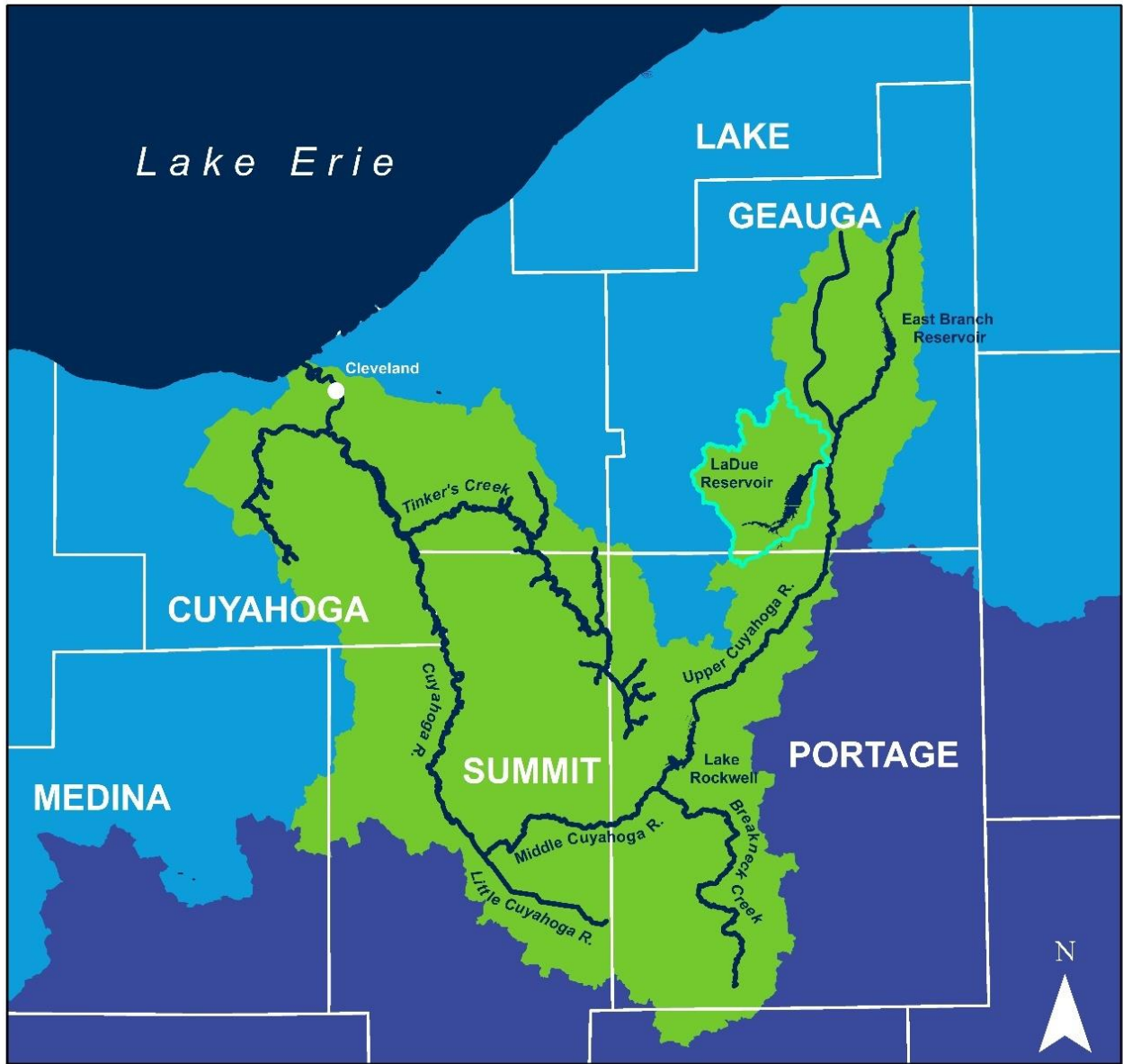


Figure 1: HUC-12 position within Lake Erie - Ohio River Basin Divide in Ohio



 LaDue Reservoir-Bridge Creek HUC-12

Figure 2: Position of LaDue Reservoir-Bridge Creek HUC-12 within Cuyahoga River watershed

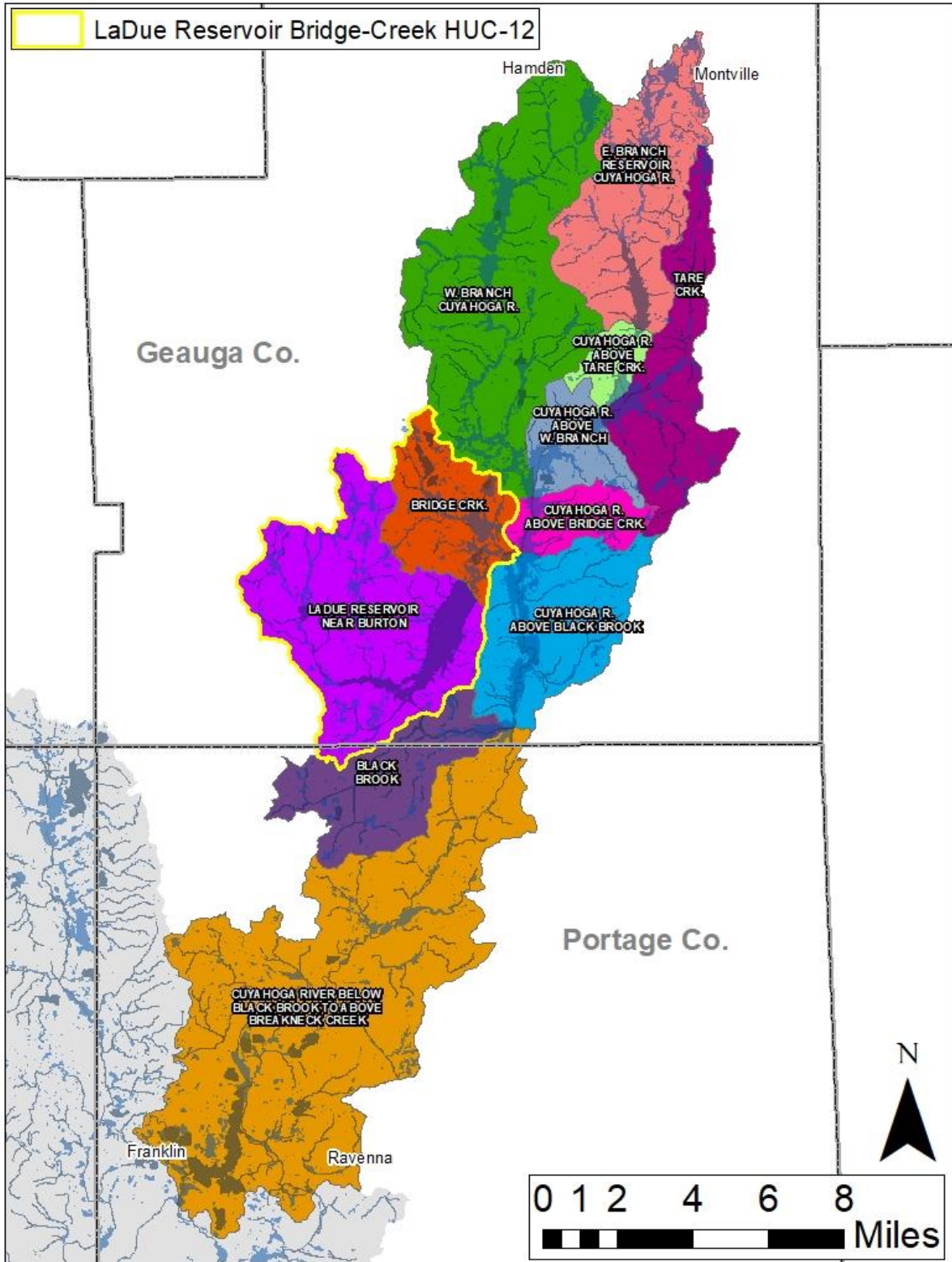


Figure 3: Upper Cuyahoga River watershed, including subwatersheds of LaDue Reservoir-Bridge Creek HUC-12

This HUC-12 includes the LaDue Reservoir, Bridge Creek, Burton Wetlands, Punderson State Park, Auburn Marsh Wildlife Area, Snow Lake, Lake Kelso, and Fern Lake.

1.3 Public Participation and Involvement

CRWP held two open houses on July 16 and July 25 to obtain public input from residents, park districts, communities, and conservation organizations for this NPS-IS. The first was held at Adam Hall in Auburn Township and the second was held at Geauga Park District's Veteran's Legacy Woods. CRWP also received input via an online survey sent to stakeholders and the public. CRWP sought input at the Upper Cuyahoga Scenic River Advisory Council meeting during the formation of the plan. This council consists of citizens representing local interests and have been selected by the Ohio Department of Natural Resources. Finally, CRWP received input via meetings with Geauga Park District, the City of Akron, Auburn Township, Geauga Soil and Water Conservation District, the Western Reserve Land Conservancy, and other organizations.

Top recommended actions identified for this subwatershed included:

- If farms / pasturelands go up for sale, restoring to natural habitat instead of converting to housing developments
- Cost share programming for BMP practices and no-till on agricultural properties
- Reforest protected properties no longer used for agriculture
- Incorporating stormwater best management practices like public rain gardens, pocket wetlands to treat stormwater prior to discharging to streams, permeable pavement, and bioretention for developed areas, particularly parking areas
- Restore wetlands that were previously drained for agriculture or development
- Invasive species control
- Purchase and permanently protect (easement or fee acquisition) land, especially in areas that would serve as a buffer to the reservoir and other water resources, including undisturbed springs, natural wetlands, and other high-quality habitats
- Address habitat loss and non-point source discharges due to residential and commercial development
- Treat or remove diseased or infested trees and replanting with a diversity of native vegetation, continue to research tree pest and disease mitigation
- Ecologically responsible timber harvesting and stream buffer areas, with timber harvest plans and best practices used to prevent degradation of water resources and loss of wildlife habitat
- More trails for hiking and biking on publicly owned land as feasible, including properties owned by the City of Akron. The large field of young successional forest located southwest of the LaDue Boathouse (41.385961, -81.208028) is an area which would benefit from the addition of trails or interpretive signage. This area attracts many rare or unusual bird species.
- Protect habitat with rare, threatened, or endangered species
- Stream restoration to address eroding streambanks, planting of native vegetation in disturbed areas
- Address pollution from fishing (e.g. trash dumping, fishing lines)
- Install pollinator gardens



Figure 4: Public Input Session at Adam Hall. Held July 16, 2019. Photo by Alicia Beattie.

Chapter 2: HUC-12 Watershed Characterization and Assessment Summary

2.1 Summary of HUC-12 Watershed Characterization

The Upper Cuyahoga River Watershed's HUC-12 watersheds include East Branch Reservoir – East Branch Cuyahoga River (04110002 01 01), West Branch Cuyahoga River (04110002 01 02), Tare Creek – Cuyahoga River (04110002 01 03), Ladue Reservoir – Bridge Creek (04110002 01 04), Black Brook (04110002 01 05), and Sawyer Brook-Cuyahoga River (04110002 01 06). This plan focuses on the LaDue Reservoir – Bridge Creek HUC-12, which is primarily in southern Geauga County within the glaciated portion of the Allegheny Plateau in northeastern Ohio, although there is a small portion within Portage County. This watershed covers parts of Newbury Township, Burton Township, Auburn Township, Mantua Township, Bainbridge Township, and Troy Township.

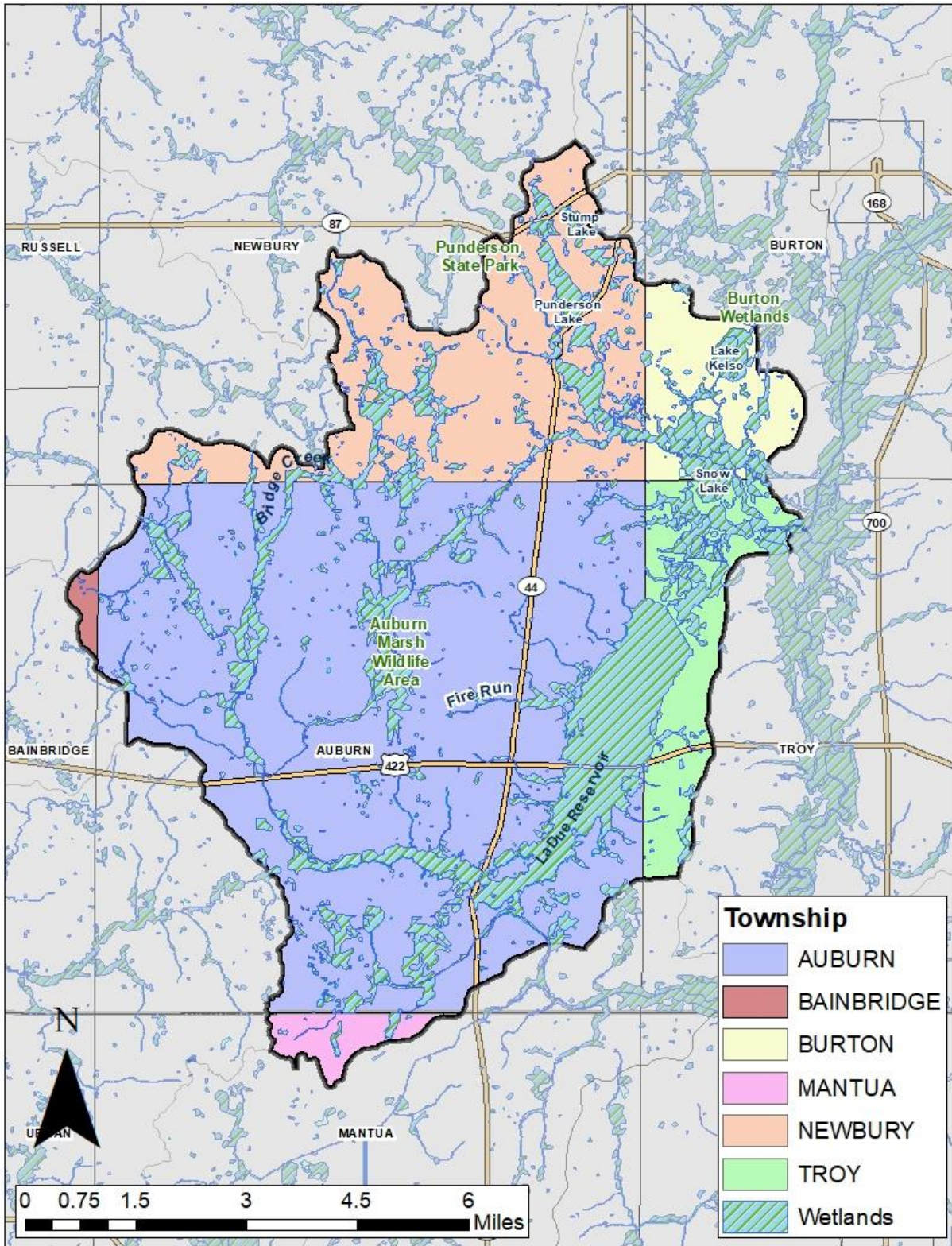


Figure 5: Townships in the LaDue Reservoir-Bridge Creek HUC-12

2.1.1 Physical and Natural Features

The Cuyahoga River watershed, located in Northeast Ohio, drains 812 square miles and flows through parts of six counties, with the eastern part of the watershed characterized by a mixture of agricultural land with cultivated crops and forest (epa.ohio.gov). The upper Cuyahoga watershed drains 208 square miles starting in northeastern Geauga County and flows southwest through kame and kettle topography. Most of the upper Cuyahoga is within the glaciated Allegheny Plateau (OEPA 2004). The upper Cuyahoga is considered a hotspot of rare and listed plant and animal species, with some of the highest quality wetland complexes in Ohio (Fennessy et al. 2007).

The LaDue Reservoir-Bridge Creek HUC-12 includes the Cuyahoga Wetlands, a 20,000-acre complex of bottomland that has not been drastically altered since the glaciers receded 10,000 years ago. A large volume of ice-contact deposits known as kames were produced with the merging of the Cuyahoga and Grand River lobes during the first Mogadore-Titusville (Altonian) ice advance. The kames, with intermixed and overlying till, produced knob-and-kettle topography in Newbury and Auburn Townships. While most of the valleys were filled with drift, the kettles mark the former position of buried ice blocks. Kames are clusters of irregular well-developed knobs or hummocks rising about ten to fifty feet above surroundings (Totten 1988).

Today, high-quality habitat in this HUC-12 includes remnants of once considerably more extensive kettle lakes and bogs, lower slope seeps, and wet flats. This HUC-12 includes the Burton Wetlands Complex, which is a buried valley/kame and kettle region in Burton, Newbury and Auburn Townships of Geauga County. Among glacial kames is a complex of kettles that includes Little Punderson Lake, Burton Lake, Kiwanis Lake, Lake Kelso, Fern Lake, and Ohio's deepest: Punderson Lake.

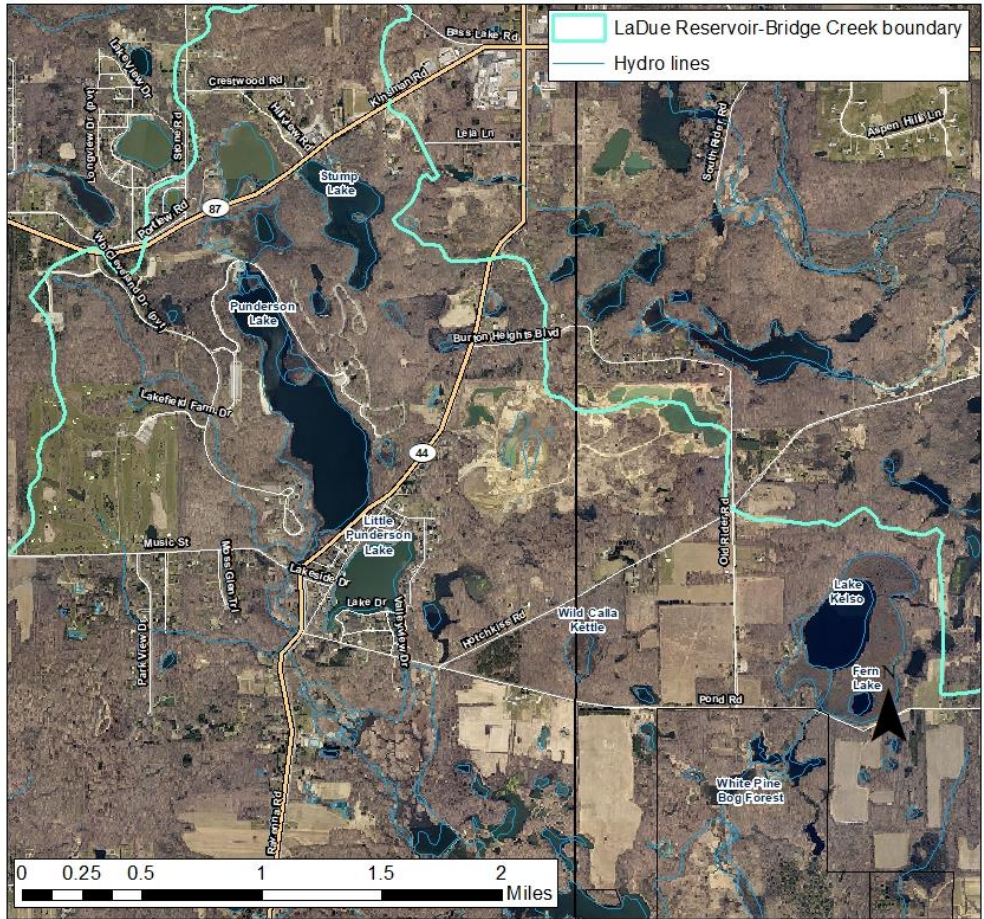


Figure 6: Lakes in northern part of HUC-12



Figure 7: Punderson Lake at Punderson State Park. September 5, 2018. Photo by Alicia Beattie.

These kettles and their associated wetlands are fed by water draining through gravelly glacial deposits from the surrounding bedrock hills. Wetland communities more typical of northern latitudes, with their distinctive associations of boreal plants, became established in the wake of glacial retreat. Kettles became bogs surrounded by wreaths of white pine and tamarack trees encompassing a middle ring of bog shrubs and ferns. On the inner edges, sphagnum mats pioneered the edges of open water providing a buoyant mat for exquisite orchids and carnivorous plants. In some places, mineral-laden water emitting from seeps at the base of kames and gravel ridges provided the environment for fens and their particular assemblage of plants. Burton Wetlands also harbors rare animals. These include Ohio Endangered dragonflies associated with glacial wetlands, Ohio Threatened fish of glacial lakes, northern nesting birds, boreal mammals, uncommon reptiles and amphibians. The lakes are vital migratory waterfowl stopovers, and breeding grounds for bald eagles and sand hill cranes (Pira 2019). Bissell (1983) reported 47 state rare plants from these and four other significant areas within the Burton Wetlands Complex.

Much of the pristine wetland complexes like Burton Wetlands and Lake Kelso in the area is owned and managed by Geauga Park District, the Nature Conservancy, the Cleveland Museum of Natural History, and the City of Akron. Glacial kettle bogs are considered one of the scarcest habitat types in Ohio, with most peatlands either filled or mined for peat. At least twenty-nine species of stat-listed flora have been documented at Fern Lake and Lake Kelso and many of the species are considered boreal relicts which would have been frequent in Ohio in the wake of the retreating Wisconsin glacier about 10,000 years ago. These habitats now seem more like northern Michigan or Canada (McCormac and Meszaros 2009).

The Cuyahoga wetlands includes Snow Lake and the surrounding hardwood forest, sedge meadows, and pristine wetlands. The Holzheimer family sold the 282-acre property to The Nature Conservancy for \$2.6 million in 2017. Snow Lake was formerly used by the Snow Lake Hunting and Fishing Club for duck hunting, fishing, and hiking. Typical plants at this property include swamp loosestrife, pickerelweed, lotus flowers, swamp milkweed, and buttonbush. This property is just south of the Lucia S. Nash Preserve, Burton Wetlands Nature Preserve, and Fern Lake, which is owned by the Cleveland Museum of Natural History. The Lucia S. Nash Preserve includes a rare tamarack-hardwood bog community with plants like the grass-pink orchid, necklace sedge, and early coral root. Birds found at the preserve include the bald eagle, hermit thrush, marsh wren, sedge wren, cerulean warbler, least bittern, Virginia rail, Canada warbler, yellow-bellied sapsucker, trumpeter swan, sandhill crane, wood duck, osprey, wild turkey, great and blue heron. Reptiles include the spotted turtle, snapping turtle, and Northern water snake. Burton Wetlands Nature Preserve includes Lake Kelso, a pristine glacier-formed kettle lake, and the Charles Dambach Preserve. Uncommon species found at Burton Wetlands Nature Preserve include the Northern Waterthrush, Veery, and Four-toed Salamander. It's also home to Bald Eagles, Osprey, Tundra Swans, Common Loons, and a variety of migrating ducks and geese. Public boating and fishing are not allowed on this property. The Burton Wetlands Nature Preserve was designated as an Ohio State Nature Preserve in 1999. The U.S. Environmental Protection Agency deemed Lake Kelso an example of a least-disturbed natural lake. The surrounding habitat is relatively undeveloped and supports tamarack trees, sundew plants, and wild cranberry.



Figure 8: Lake Kelso at Burton Wetlands Nature Preserve. April 26, 2019. Photo by Alicia Beattie.

Based on National Wetlands Inventory data, 23.3 percent of the HUC-12 is covered with wetland. The primary type of wetland in this HUC-12 is freshwater forested/shrub wetland, followed by freshwater pond, with the majority consisting of LaDue Reservoir. LaDue Reservoir is the largest lake in the HUC-12 and was formed in 1962 from the damming of Black Brook (RM 76.64) and Bridge Creek (RM 83.29). According to the City of Akron, this reservoir has a surface area of 1,450 acres, a mean depth of 10.4 ft and max depth of 28.6 ft, and a 4,800-foot-long, 40 ft high earthen dam. The Bridge Creek Dam watershed drains 35.7 square miles and was created to impound a municipal supply reservoir to supplement Lake Rockwell. When Lake Rockwell, the terminal impoundment, is drawn down during dry periods, releases are made from East Branch and LaDue Reservoirs. The water from LaDue flows to Bridge Creek, which then flows to the Cuyahoga River mainstem and eventually to Lake Rockwell (Akron 2010).

Other major lakes in this HUC-12 as characterized by the National Wetlands Inventory include Punderson Lake and Stump Lake at Punderson State Park. LaDue Reservoir is a secondary reservoir to the Akron Water Supply system and was created to help with flood control to downstream areas and replenishment of water to the Cuyahoga River during dry periods. It also serves as a supply of quality source water for drinking water treatment. It is considered a “no contact” lake and swimming is prohibited for both humans and pets. However, the City of Akron and Ohio Department of Natural Resources have a long-term agreement for fishing and hunting at the reservoir. The LaDue Reservoir subwatershed near Burton contains covers 28 square miles and has 33.6 miles of stream. The Bridge Creek subwatershed 6.1 miles of stream and covers 10.63 square miles (Environmental Design Group 2013). Part of the creek is dammed at a wide part of the valley in Troy Township to form the LaDue Reservoir. Bridge Creek drains nearly all of Auburn Township and the headwaters are in the same moraine in southern Newbury Township. The creek flows southward in Auburn Township, then eastward a short distance, and then northeastward into the Cuyahoga River in northwestern Troy Township (Totten 1988).

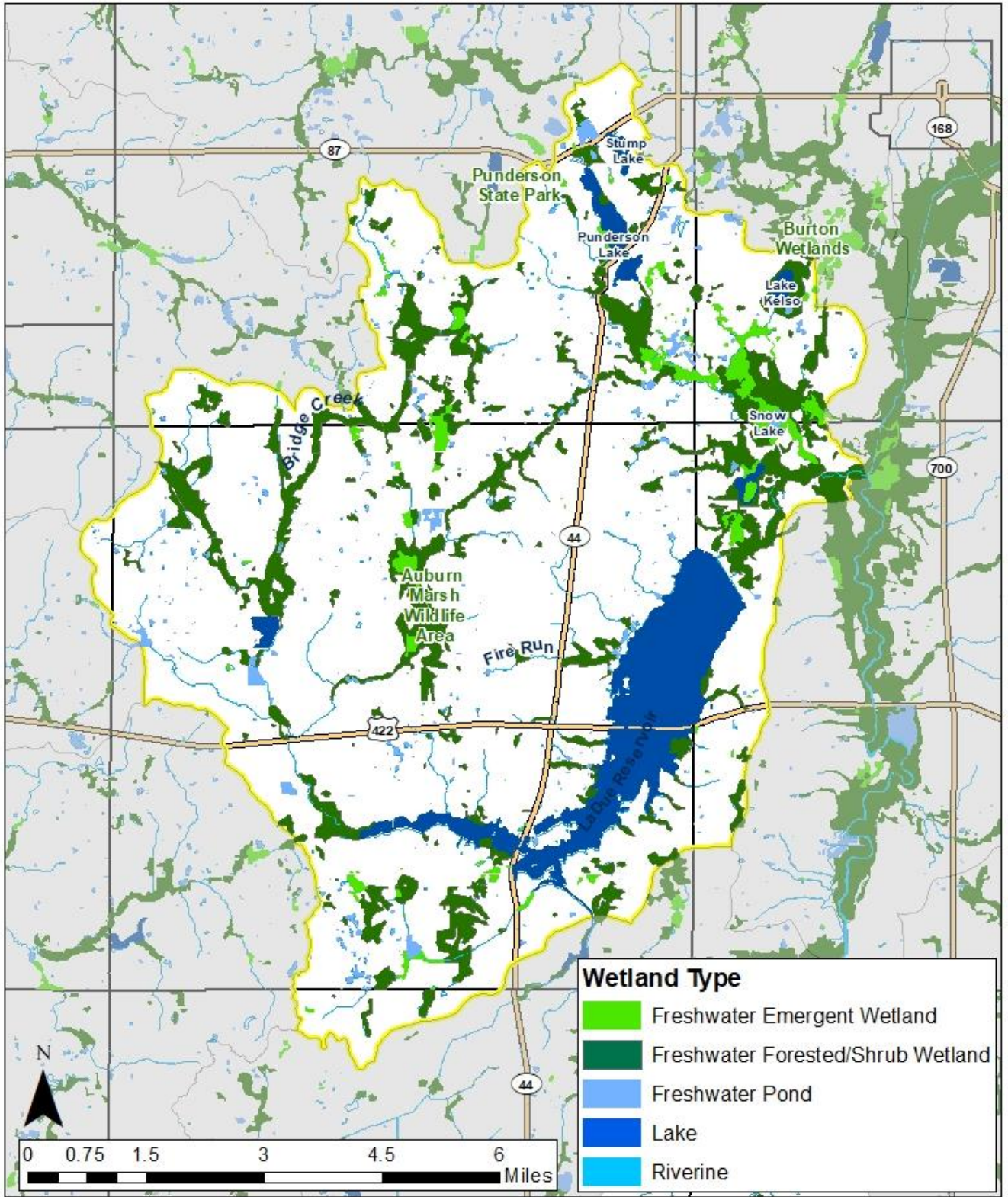


Figure 9: Wetland types in HUC-12 (Source: NWI)

Table 1: Wetland types in HUC-12 (Source: NWI)

Type	Acres	Percentage of total
Freshwater Forested/Shrub Wetland	2959.90	51.18
Riverine	214.19	3.70
Freshwater Pond	385.16	6.66
Lake	1707.75	29.53
Freshwater Emergent Wetland	516.22	8.93
	5783.22	100

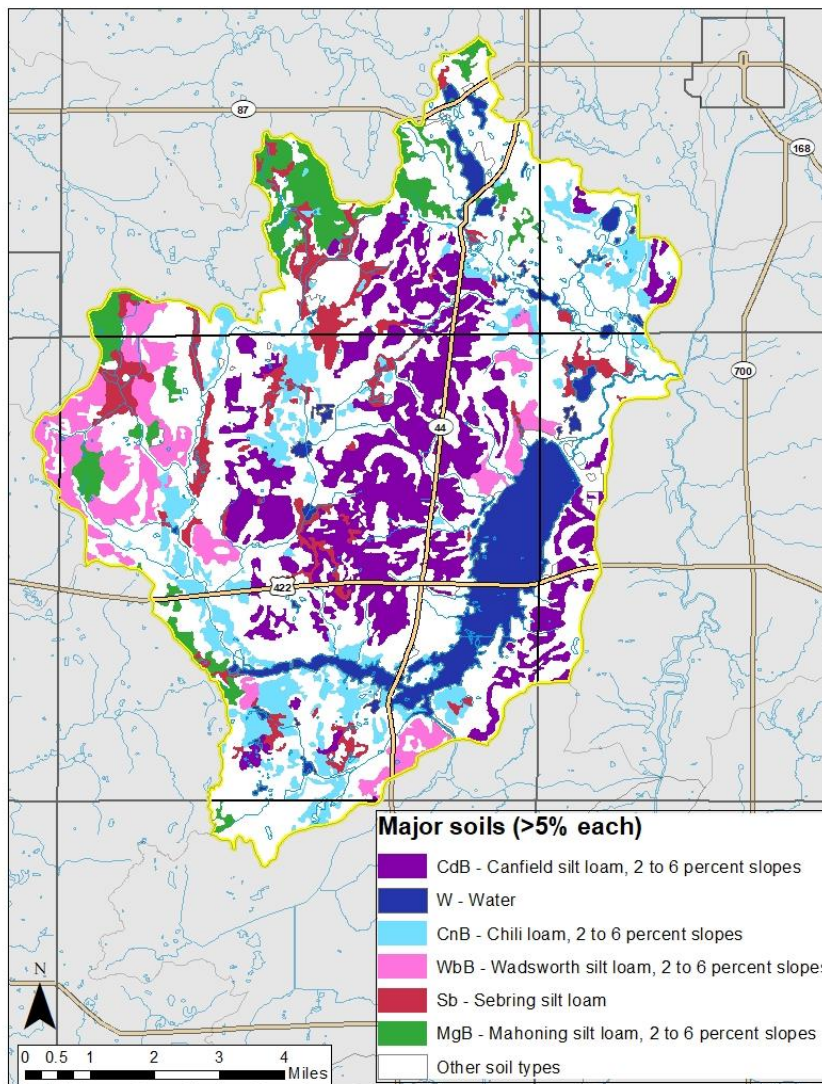


Figure 10: Major soil types in HUC-12 (Source: USDA)

Major soil types in this HUC-12 covering 5% or greater of the land area include Canfield silt loam, water at the soil surface, Chili loam, Wadsworth silt loam, Sebring silt loam, and Mahoning silt loam. The soil type with the highest percentage of land area (16% of the HUC-12), Canfield silt loam, has seasonal

wetness with a perched water table and poor suitability to septic tank absorption fields. Wadsworth silt loam, Sebring silt loam, and Mahoning silt loam also tend to have seasonal wetness. Chili loam is better suited for septic tank absorption fields, but nearby groundwater supplies can be contaminated if soils are used for sanitary facilities; sloughing and erosion is also a hazard in construction excavations.

The LaDue Reservoir-Bridge Creek HUC-12 is also within the Cuyahoga River-Upper Audubon Important Bird Area (IBA). The Upper Cuyahoga IBA includes the corridor of the Cuyahoga River including Burton Wetlands, Punderson Lake District, Eldon Russell Park, LaDue Reservoir (dammed portion of Bridge Creek), and Auburn Wildlife Area. It is known for having a high density of Prothonotary warblers and Veeries. LaDue Reservoir has a good spring and fall waterfowl site and is habitat for transient Tundra Swans (Audubon.org).

Cuyahoga River-Upper

Ohio

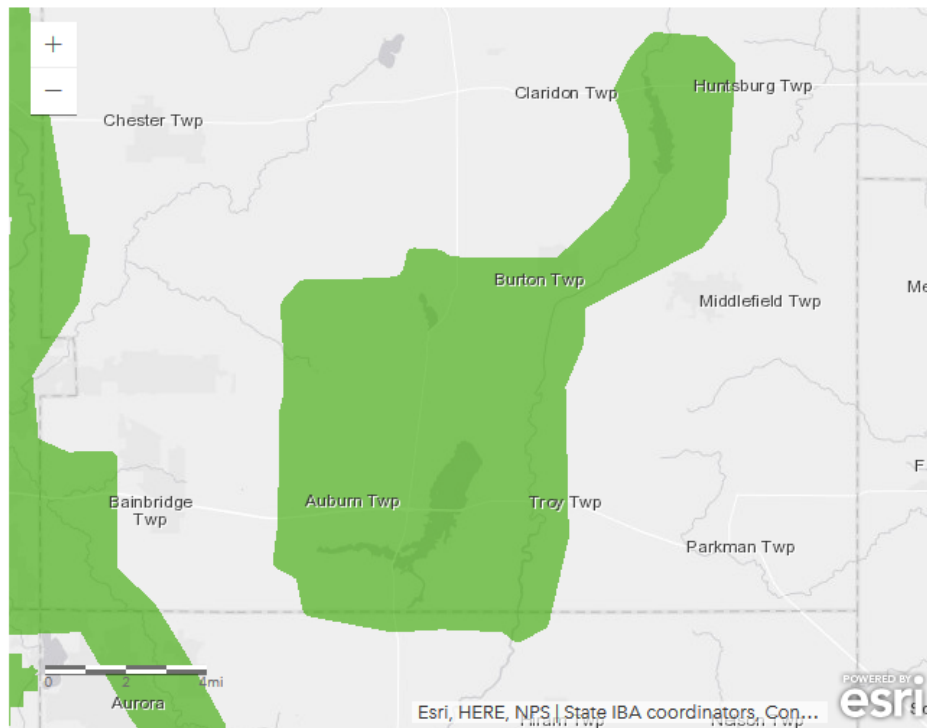


Figure 11: Cuyahoga River-Upper Important Bird Area

2.1.2 Land-Use and Protection

The upper reaches of the Cuyahoga are primarily forests, wetlands, pasture, and cropland. Land in this HUC-12 is classified by Ohio EPA as forested (50.8%), grass/pasture (14.0%), and row crops (18.5%). Much of the land is owned by the City of Akron and was purchased to protect its drinking water sources (Fennessy et al. 2007). Today, one of the largest landowners in the Upper Cuyahoga watershed is the City of Akron, with about 16,000 acres, including three reservoirs and critical riparian zones (Environmental Design Group 2013). One of the City of Akron's three large water supply reservoirs, the LaDue Reservoir (1550 ac) is in this HUC-12.

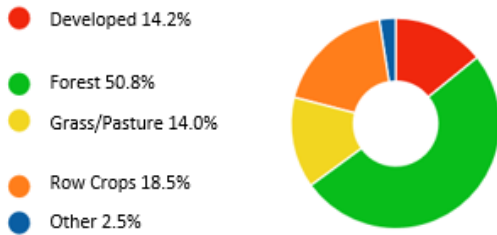


Figure 12: Land use in LaDue Reservoir-Bridge Creek HUC-12 (Source: Ohio EPA Integrated Report 2018).

Data from the National Oceanic and Atmospheric Administration (NOAA)'s Coastal Change Analysis Program (C-CAP) indicates that most of the land area in this HUC-12 is deciduous forest, palustrine forested wetland, cultivated crops, pasture/hay, and open water. Development is relatively low in this HUC-12 although pressure is increasing. There are also some sand and gravel operations in the Upper Cuyahoga, with open pit mining the most common type of operation (Environmental Design Group 2013).

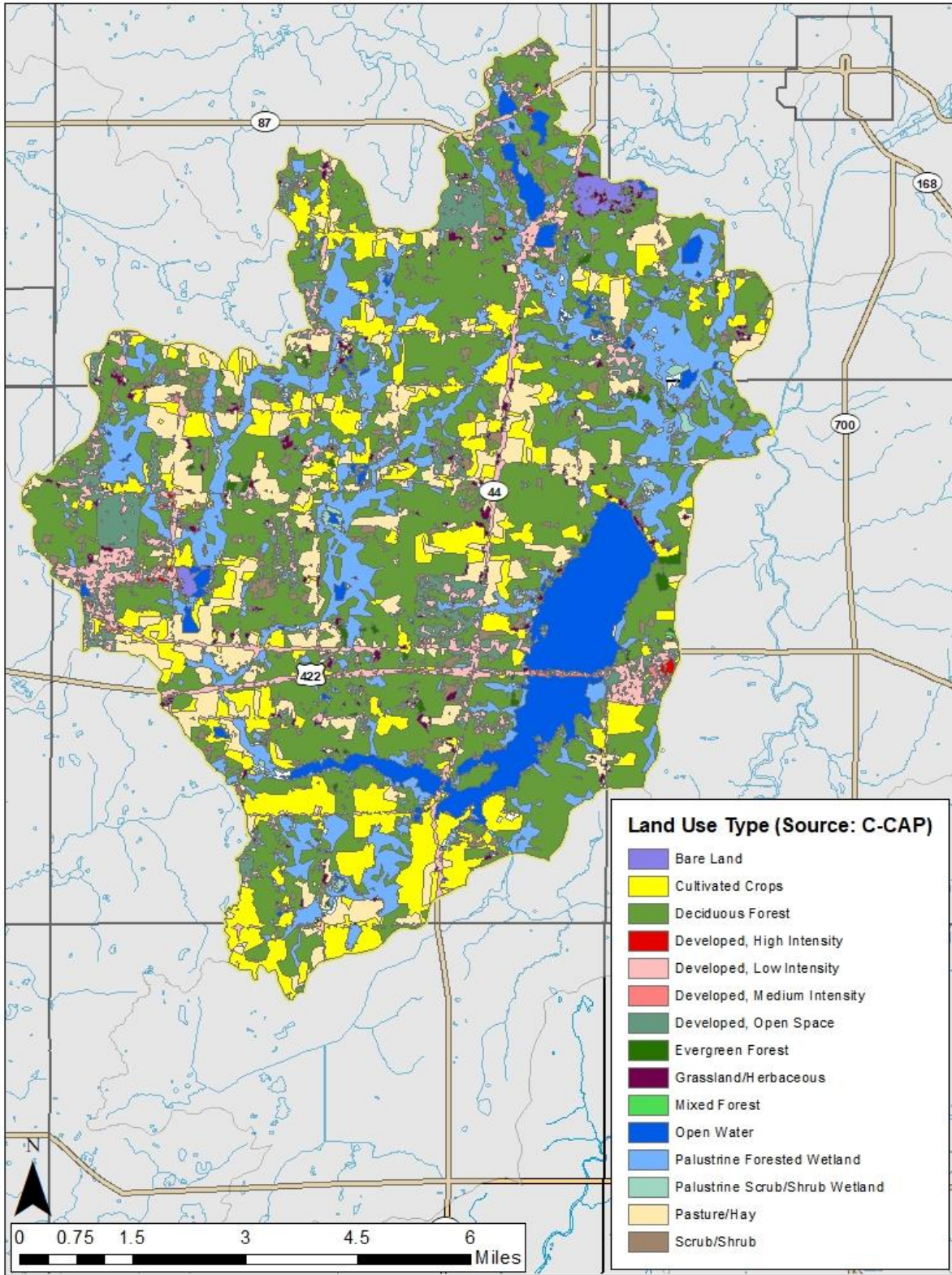


Figure 13: Land use types (Source: Coastal Change Analysis Program)

Examples of protected or publicly owned areas in this HUC-12 include the following:

- Akron
 - LaDue Reservoir was completed in 1962 to provide additional water supply to Akron. The Ohio DNR Division of Wildlife began managing the fish populations in 1983 under an agreement with the City. The reservoir is in an area of glacial deposits with numerous kames and small relict glacial lakes and ponds. The area surrounding LaDue is marshy and wooded. The City of Akron purchased much of the land surrounding LaDue Reservoir. There are also Akron owned parcels on Bridge Creek upstream of LaDue extending up to Taylor Mays Road.
- Auburn Township
 - Auburn Community Park: This 67-acre property, formerly known as the Calthan Farm, was purchased in 2005 by the Auburn Township Board of Trustees from the Western Reserve Land Conservancy. Part of the park is designated as “Natural Area” (passive park), which has walking trails through the woods, and part is “Open Field Area” (active park), which includes sports fields and playground. The natural area includes a diversity of spring wildflowers such as yellow trout lily, may apple, squirrel corn, ramps, and cutleaf toothwort.
- Cleveland Museum of Natural History:
 - Fern Lake: The Natural Areas Program at the CMNH was established in 1956 when it acquired Fern Lake Bog, a 14-acre property.
- Geauga Park District and ODNR Division of Natural Areas and Preserves:
 - Burton Wetlands Nature Preserve: The southwest part of Burton Wetlands, a 305-acre preserve, is in the northeast part of this HUC-12 in Burton Township north of Pond Road and extends into the West Branch Cuyahoga River HUC-12. The preserve includes Lake Kelso, a 22-acre glacier-formed kettle lake surrounded by 18 acres of bog habitat, and the Charles Dambach Preserve. Burton Wetlands is a designated National Natural Landmark and considered to be one of the most ecologically significant areas in Geauga County. The preserve is part of a larger 700-acre complex of kettle holes, lower slope seeps, and wet flats known as the Cuyahoga Wetlands. Several rare and endangered plants including the green woodland orchid, bunchberry, and tamarack trees can be found here. Rare animal species include the northern water thrush, veery, and four-toed salamander. The bald eagle, osprey, tundra swan, and common loon can be observed seasonally.
- ODNR Division of State Parks and Watercraft
 - Punderson State Park: This 741-acre park is at the north end of the HUC-12 and includes Punderson Lake, a 15-acre natural kettle lake (the largest and deepest in Ohio), resort manor house, family cabins, golf course, and campground.
- ODNR Division of Wildlife:
 - Auburn Marsh Wildlife Area: This 462-acre wildlife area was established in 1954 as a public hunting area for deer and waterfowl and is located on the east side of Auburn Road. Habitat includes marshland, grassland, woodland, and brushland. Drainage ditches were initially installed in the 1930s by the previous landowners to improve drainage for cultivation, but farming was eventually abandoned. Beaver colonies arrived

between 1969 and 1971 and waterfowl populations fluctuate depending on the varying size and location of the beaver marshes. The forest is primarily second-growth hardwoods although several small blocks of original mature beech-maple woods are still present.

- The Nature Conservancy
 - Lucia S. Nash Preserve: This 650-acre preserve includes Snow Lake. TNC purchased the 272 acres that includes Snow Lake, a small kettle lake surrounded by emergent marsh, sedge meadow, and shrub swamp. The upland forests include vernal pools and swamp forests. Migratory and nesting ducks, geese, trumpeter swans, and wading birds including sandhill cranes use the property. Part of the property was purchased with assistance from the WRRSP program in cooperation with NEORSD. The Preserve includes the only old growth white pine boreal fen in Ohio.

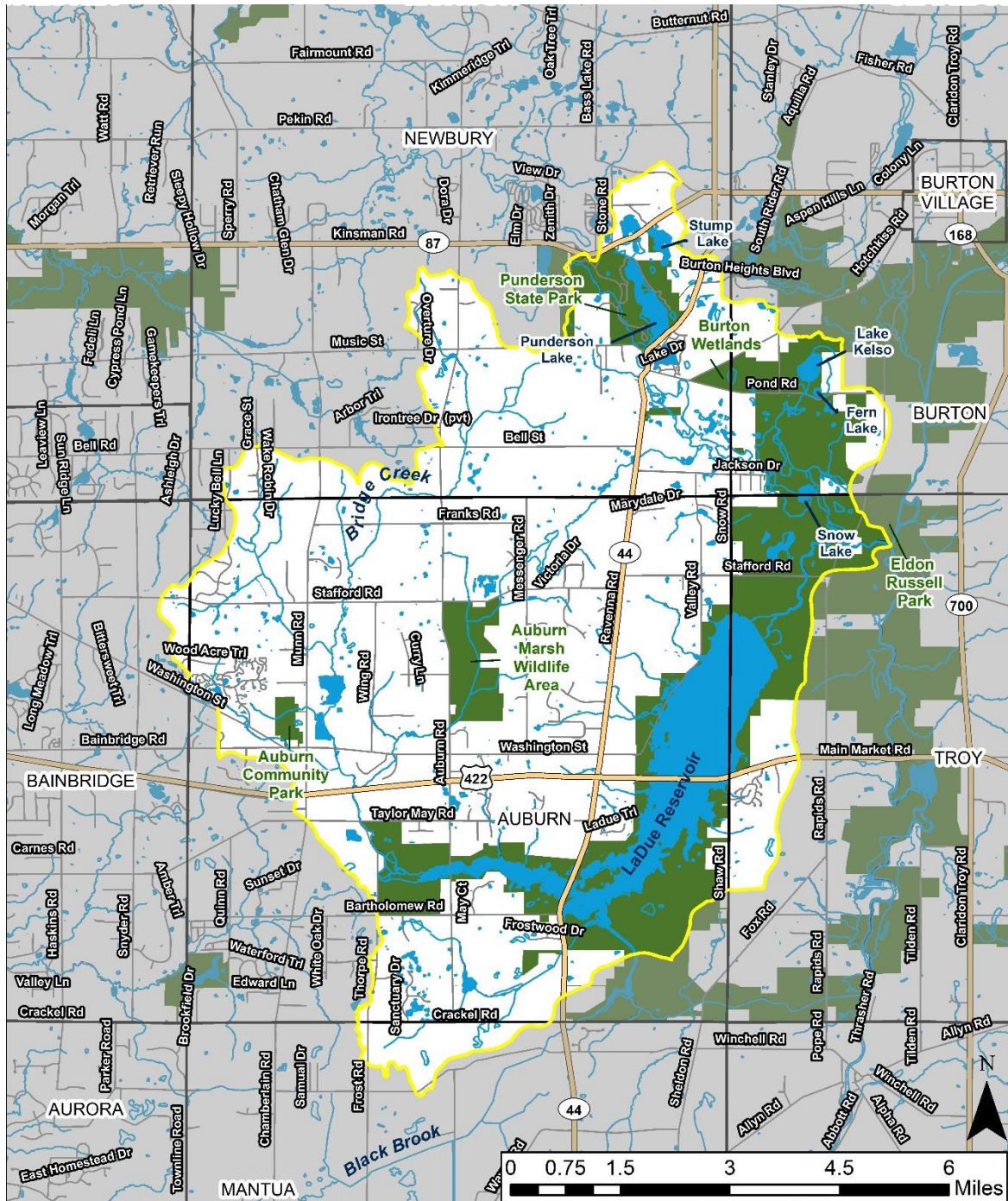


Figure 14: Protected properties and greenspace

2.2 Summary of Biological Trends

This HUC-12 is generally high-quality, with extensive wetland systems supporting a diversity of flora and fauna. It's considered by many to be the best example of a fairly intact ecosystem in Northeast Ohio, with low amounts of development and infrastructure. Bridge Creek is undesignated but recommended for warmwater habitat use designation (OEPA 2004). Snow Lake has a healthy population of lake chubsuckers (*Erimyzon sucetta*), an indicator species found in high-quality glacial lakes and likely

in decline due to agricultural practices, urban development, and exotic species. There are also records of this fish at Lake Kelso, Fern Lake, LaDue Reservoir, Punderson Lake, and the West Branch of the Cuyahoga River (Baker et al. 2015).

The Ohio EPA adopted biological criteria into the Ohio Water Quality Standards in 1990. An aquatic life use (ALU) designation is assigned to a stream or river based on the potential aquatic biological community that can realistically be sustained given the biological, physical, and chemical attributes of the waterway. Specifically, two fish and one macroinvertebrate indices are used to determine if a specific stream segment is reaching aquatic life use designation (IBI, ICI, QHEI). **Error! Reference source not found.** lists the biological criteria for applicable aquatic life use (ALU) designations in the Erie-Ontario Lake Plains ecoregion.

Biological Index	Assessment Method	Biological Criteria for the Applicable Aquatic Life Use Designations		
		WWH	EWH	MWH
IBI	Headwater	40	50	24
	Wading	38	50	24
	Boat	40	48	24 / 30
MIwb	Wading	7.9	9.4	6.2
	Boat	8.7	9.6	5.8 / 6.6
ICI*	All	34	46	22

*34-40 = good. 30-32 = marginally good. 22-28 = fair.

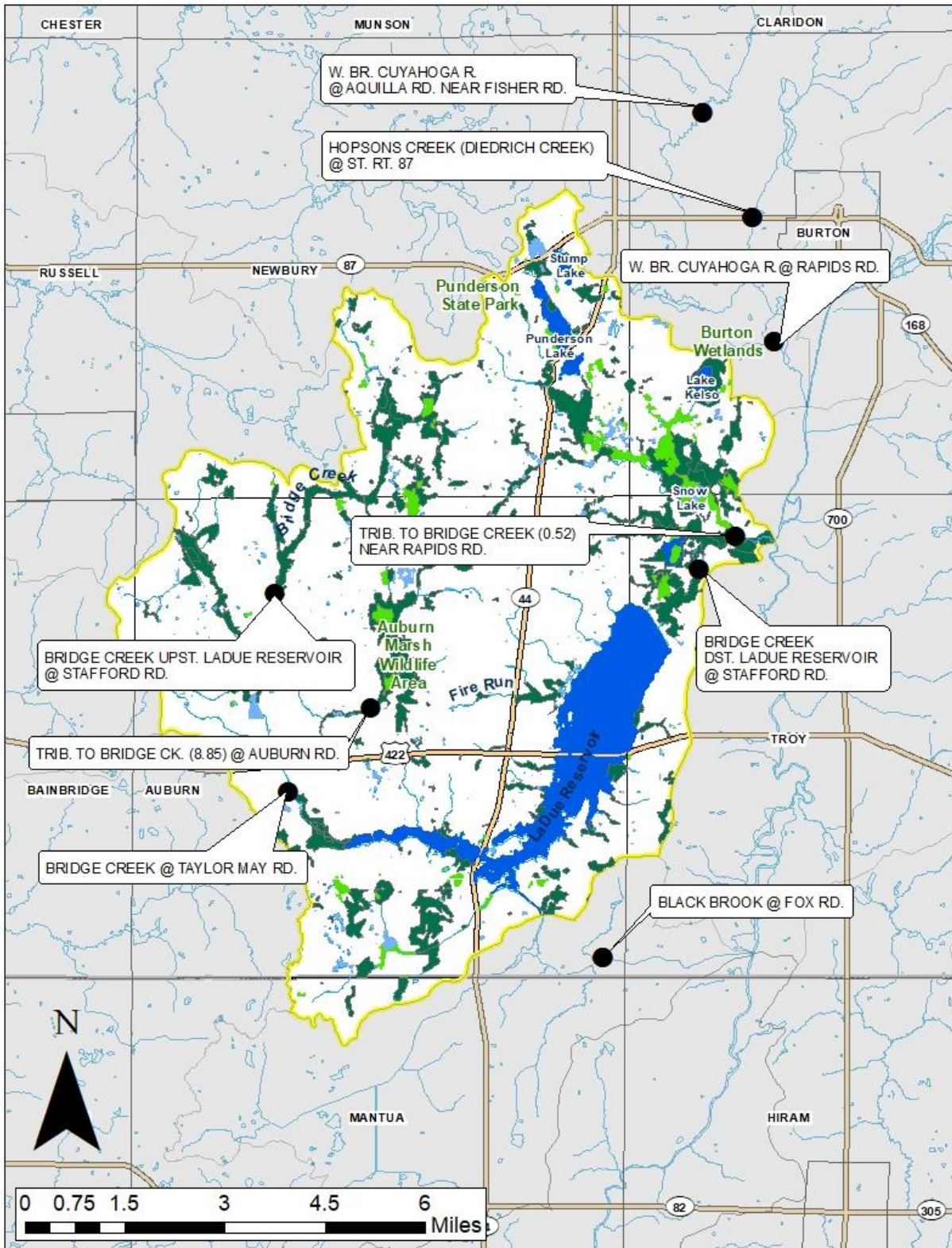


Figure 15: Biological Monitoring Sites. Source: Ohio EPA (2019).

Station Name	RM	ALU	Invertebrate Collection date	Quality Invertebrate Taxa Count	Invertebrate Score	Fish Sampling Date	Bio criteria Type	IBI Score	MIWB Score	QHEI (2018)
BRIDGE CREEK @ TAYLOR MAY RD.	8.46	WWH	7/12/2018	63	-	8/9/2018	Headwaters	44	-	
TRIB. TO BRIDGE CK. (8.85) @ AUBURN RD.	1.4	WWH	7/11/2018	52	Fair	8/8/2018	Headwaters	30	-	62
BRIDGE CREEK UPST. LADUE RESERVOIR @ STAFFORD RD.	11.22	WWH	8/19/1996	22	-	8/1/1996	Headwaters	30	-	
BRIDGE CREEK DST. LADUE RESERVOIR @ STAFFORD RD.	1.32	WWH	8/27/2018	53	34	8/7/2018	Wading	48	8.7094	62.25
TRIB. TO BRIDGE CREEK (0.52) NEAR RAPIDS RD.	0.01	WWH	7/11/2018	47	Good	8/15/2018	Headwaters	36		59

RM = river mile. ALU = aquatic life use. WWH = warmwater habitat. Blue = attainment. Red = nonattainment. MIWB was not used for headwater streams (<20 square miles drainage area).

2.3 Summary of NPS Pollution Causes and Associated Sources

Water quality in this HUC-12 is affected by agricultural runoff (including manure and fertilizer), construction runoff, and septic leaching, which may be increasingly problematic with ongoing development (Audubon.org). Due to geologic factors including permeability and depth to the water table, the disposal of sewage effluent from septic tanks is a significant problem. High percolation rates of sands, gravels, sandstones, and conglomerates can allow effluent to travel to wells and contaminate groundwater (Totten 1988). The outflow from septic systems can make its way into roadside ditches and then into streams. Another challenge is the increase in urban sprawl, as people and businesses in the western parts of Geauga and Portage counties move east near the Cuyahoga River. This may lead to more oil and road salt challenges. There may also be an increased loss in wooded riparian buffers. The Ohio Department of Natural Resources has been purchasing conservation easements along the Cuyahoga River's banks. The Western Reserve Land Conservancy has also been working to place protections on land (ideastream.org).

The last formal TMDL for the Upper Cuyahoga River (2004) lists causes of impairments including organic enrichment/dissolved oxygen, flow alteration, habitat alteration, and natural (wetlands). The upper portion of Bridge Creek, above LaDue Reservoir, was described as being in non-attainment due to natural wetland conditions as biological communities reflected the extensive wetland habitat in the headwaters at RM 11.2. Bridge Creek downstream of LaDue Reservoir occasionally runs black indicating possible hypolimnetic reservoir releases of low D.O, poor quality water. The 2004 TMDL report noted there was one Ohio EPA Emergency Response spill report of a fish kill that was attributed to a reservoir release from LaDue Reservoir into Bridge Creek. While macroinvertebrates sampled in the area were considered poor compared to warmwater habitat streams, they were described as being fairly typical of swampy/marshy habitats. The fish community did not meet the WWH bicriterion (calibrated to free-flowing streams) but the predominance of grass pickerel, a top carnivore, indicated a high level of biological integrity for the habitat. A TMDL was not completed for the upper portion of Bridge Creek

because the conditions are considered natural. Fish and macroinvertebrates reached exceptional quality upstream from LaDue Reservoir (RM 8.5), but well downstream from the marshy conditions in the headwaters. This section of the stream was described as having an area typical of good warmwater habitat conditions (i.e., hard bottom, coarse substrates, well developed riffle/pool habitats). Downstream from LaDue Reservoir, biological and water quality conditions were significantly impacted. Low dissolved oxygen levels stemming from the controlled reservoir releases and flow alterations contributed to non-attainment at RMs 1.3 and 0.5. Despite good habitat scores (QHEI = 69), and numerous parks and nature preserves in the watershed, a tributary to Bridge Creek (Snow Lake outlet) was in non-attainment due to natural wetland conditions (OEPA 2004).

Within Ohio EPA’s Integrated Report (2018), the LaDue Reservoir-Bridge Creek HUC-12 is an impaired watershed in terms of human health, recreation, and drinking water supply based on historical data. This HUC-12 is considered impaired due to PCBs and algae. According to the report, source waters for the City of Akron had microcystins levels above the drinking water threshold in 2010, 2016, and 2017. In 2010, maximum raw water microcystins concentrations were 43.0 µg/L in LaDue reservoir, 3.6 µg/L in East Branch reservoir and 3.2 µg/L in Lake Rockwell.

Table 2: LaDue Reservoir-Bridge Creek HUC-12 Prioritized Impaired Waters of Ohio (OEPA 2018 Integrated Water quality Monitoring and Assessment Report).

Section L.4. Section 303 (d) List of Impaired Waters		Sq. Mi. in Ohio	Human Health	Recreation	Aquatic Life	PDW Supply	Priority Points
Assessment Unit	Assessment Unit Name						
04110002 01 04	Ladue Reservoir-Bridge Creek	38.79	5	1h	4Ah	5	7*

* Priority point values range between 1 and 20 and are calculated if any of the use assessment categories is 5 (Impaired; TMDL Needed) or the assessment unit is not impaired but is on the nitrate and/or pesticide watch lists for public drinking water supply.

Table 3: LaDue Reservoir -Bridge Creek HUC-12 aquatic life use impairments (Ohio EPA Integrated Report 2016).

Causes of Impairment	Sources of Impairment
natural limits (wetlands)	natural
siltation	flow regulation/modification - development
direct habitat alterations	onsite wastewater systems (septic tanks)
flow alteration	pastureland
organic enrichment/DO	

There are a number of challenges in this subwatershed including nonsustainable timber harvesting, overtapping of sugar maples, and increasing development pressure. Agricultural lands can be a significant source of non-point nutrient contamination if fertilizers are not carefully applied. Tiling and soil erosion can lead to sedimentation challenges as well as deposition of herbicides and other chemicals in nearby waterbodies. Residential fertilizers, which are more likely to be misapplied without precise equipment, can also pose threats. Livestock operations can contribute nutrient loads if there is not enough land to filter and use the nutrients. Sand and gravel operations in this subwatershed can also have water quality impairment risks, with potential pollutant sources including sedimentation, groundwater contamination, and habitat modification (Environmental Design Group 2013).

2.4 Additional Information for Determining Critical Areas and Developing Implementation Strategies

CRWP completed GIS analyses using publicly available shapefiles. In addition, CRWP reviewed relevant land use plans. The Auburn Township land use plan (Geauga County Planning Commission 2016) provides recommendations for maintaining or improving water quality including:

- Working on stormwater management and sediment control
- Protecting critical natural areas (wetlands, floodplains, unique natural areas) through voluntary methods such as restrictive covenants
- Educating the public with respect to “best management practices” to protect riparian corridors, wetlands, and floodplains,
- Providing educational support with regards to protection of surface and groundwater resources from pollution through the maintenance of on-site sewage systems
- Continuing to identify and develop township recreational (active and passive) needs and resources
- Protect sensitive open space by working with landowners to preserve them through methods such as voluntary deed restrictions
- Conserve the supply of groundwater and open spaces
- Promote public stewardship of forests and wetlands
- Conserve fish and wildlife

The Newbury Township land use plan (Geauga County Planning Commission 2008) includes the following recommendations:

- Protect groundwater supplies
- Provide regulations that advance balanced and orderly growth and development as well as preserve sensitive environmental resources
- Riparian protection and water management and sediment control zoning regulations
- Protect sensitive slopes, streams, floodplains, wetlands, and wooded areas which contribute to the character of Newbury as well as enhance the protection of groundwater recharge areas and minimize stormwater runoff.

Chapter 3: Critical Area Conditions and Restoration Strategies

3.1 Overview of Critical Areas

This subwatershed includes a large amount of undeveloped, ecologically sensitive areas with forests, wetlands, and streams acting as natural filters for removing pollution and moderating the effects of stormwater runoff. Preservation and management of City of Akron lands as well as other high-quality landscapes with aquatic resources is key for preventing water quality degradation and loss of wildlife habitat. The most cost-effective method is to maintain these high-quality systems, with special attention to keeping or restoring forested buffers along streams and wetlands. Ecologically minded forest management and restoration of forest landscapes around water resources will be critical for maintaining and improving water quality. Croplands managed to keep soil healthy and minimize potential for excess soil and chemical runoff are also key to maintaining watershed health.

This NPS-IS plan has identified critical areas to maintain or improve attainment of aquatic life use, focusing on protection of water resources, targeted land management, and aquatic resource restoration.

3.2 Critical Area 1: Riparian Corridors and Wetland Buffers

Protecting and restoring riparian corridor and wetland habitats in this subwatershed will be critical for maintaining or improving water quality as well as preventing the loss of biological diversity. Areas along streams and wetlands with native vegetation protect the stream from erosion and absorb nutrients from overland and subsurface flows. The Upper Cuyahoga is well known as a hotspot of rare and listed plant and animal species, with some of the best wetland complexes in the State of Ohio. Given this sensitivity, it is a high priority to protect lands with high quality aquatic resources and restore degraded areas by planting native vegetation, restoring eroding banks, and addressing hydrological alterations. Groundwater is also a primary source of drinking water for residents living in the townships within this HUC-12; therefore, the management of groundwater resources is a paramount concern in order to maintain quality and quantity. This critical area includes areas with nonpoint source related impairments as well as areas with relatively healthy waters in need of protection from degradation by nutrients and sediment, particularly with regards to ongoing development threats.

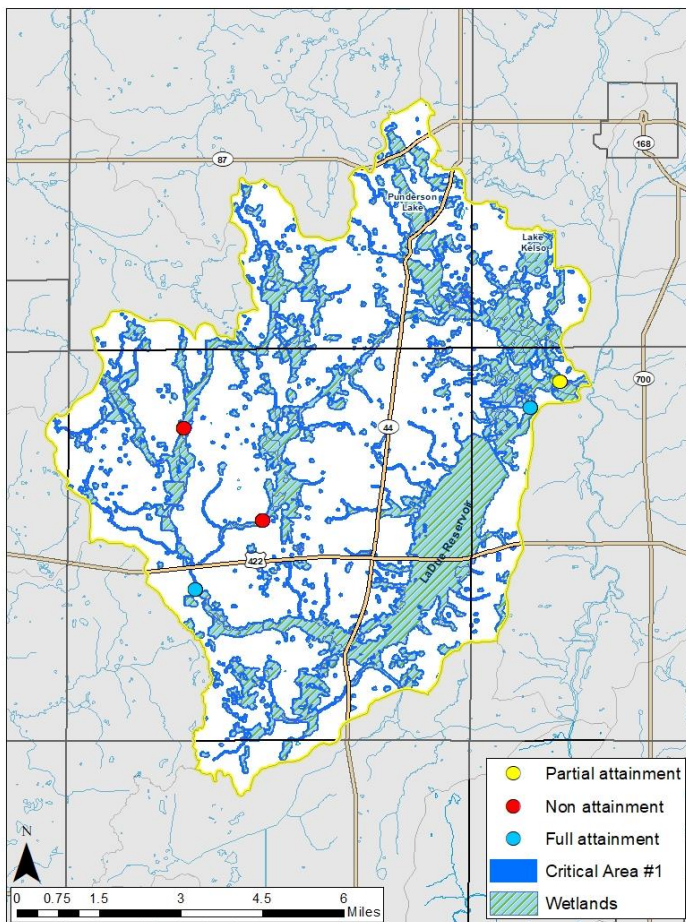


Figure 16: Critical Area 1: Riparian and Wetland Buffers

3.2.1 Detailed Characterization

This area includes the riparian areas of Bridge Creek and other small streams, LaDue Reservoir, Punderson Lake, Stump Lake, and Restful Lake, small glacial lakes such as Snow Lake, Fern Lake, and Lake Kelso, and wetland complexes scattered throughout this HUC-12. These wetlands serve critical functions in terms of filtering water and minimizing flooding during heavy rains and major weather events. These landscapes are relatively intact, provide critical habitat for wildlife, and harbor a diversity of native plant species.



Figure 17: Protected tributary to Bridge Creek at Auburn Community Park. April 19, 2019. Photo by Alicia Beattie.

3.2.2 Detailed Biological Conditions

This critical area includes many high-quality stream and relatively undisturbed wetland resources, as well as areas that could have improved biological conditions based on OEPA monitoring of Bridge Creek and its tributaries. See Section 2.2 for a complete overview. For example, Bridge Creek at Taylor May Road indicates high biological diversity and quality, with pollution sensitive species like the rainbow darter and 5 quality coldwater macroinvertebrate taxa. Bridge Creek downstream LaDue Reservoir at Stafford Road also appears to be in full attainment, although with fewer high-quality taxa. However, monitoring indicates that full attainment is not being met at Trib. To Bridge Creek (8.85) at Auburn Road, Bridge Creek Upstream LaDue Reservoir at Stafford Road, and Trib. To Bridge Creek (0.52) at Stafford Road (Ohio EPA 2019). Plant diversity is also under threat due to invasive species like Phragmites. Phragmites control along State Route 44 (wetland areas along the roadway) is needed. Invasive species also threaten high-quality natural areas with stream habitats, such as at Auburn Community Park, where garlic mustard and other invasive plant species can crowd out native plants.



Figure 18: Narrow-leaf cattail growing in wetlands on residential property on Auburn Springs Drive in Auburn Township. December 23, 2015. Photo by Keely Davidson-Bennett.

3.2.3 Detailed Causes and Associated Sources

Major causes of impairment in this subwatershed include natural limits (wetlands), siltation, direct habitat alterations, flow alteration, and organic enrichment / low dissolved oxygen. Sources include natural (wetlands), flow regulation/modification from development, septic tanks, and pastureland / farm runoff, with particular concerns about the use of liquid manure on fields during wet times of the year. In addition, efforts should be made to restore wetlands that may have been drained for previous agricultural or residential use. Stakeholders also voiced concerns about excess road salt. One of the most pressing concerns is habitat loss and non-point source discharges due to increased residential and commercial development. Bridge Creek upstream of LaDue Reservoir flows through a varied landscape of medium-density development, wetland, and agricultural land. Due to commercial/industrial use designations of lands adjacent to Bridge Creek upstream of LaDue, this area has severe development impact potential, with the potential to negatively impact LaDue's water quality. High nutrient levels such as phosphorus and ammonia have been noted by City of Akron employees during routine sampling and are indicators of influxes of agricultural runoff. When these nutrients enter LaDue Reservoir, they fuel periodic algal blooms in late summer, which are visible along the shores, especially near the LaDue south boat access on Rt. 44. The wetlands in the headwater portions of Bridge Creek are likely degraded and are at risk due to the fact that they are located in an area of rapid development with a "Severe" potential development impact (Environmental Design Group 2013). Any restoration work in this area would help improve downstream water quality for Bridge Creek and LaDue Reservoir.

The wetlands extending from below LaDue Reservoir downstream to Bridge Creek's confluence with the Cuyahoga River are extensive and extremely high-quality. Aquatic invasive species are surprisingly sparse here. The shoreline margins and lands surrounding the wetlands north of Stafford Road and west of Rapids Road (41.417718, -81.183747) have a large amount of invasive glossy buckthorn and the land shows the scars of having been intensively used as orchard land and farm fields well into the 1970s,

although natural reforestation and succession have taken place since then. These “scars” include enhanced drainage ditching and road creation which surely affect the surrounding wetlands.

The City of Akron owns and maintains significant buffer zones around its reservoirs. Because the City of Akron owns a significant forested buffer zone around LaDue Reservoir, the impacts to water quality are likely a result of the incoming water from Bridge Creek and Black Brook. Natural buffers have proven very effective in capturing nutrients and runoff. In addition, the City of Akron’s electric motor only rules mean less impact to water quality and shoreline erosion in comparison to reservoirs that allow use of gasoline motors. The Akron-owned parcels on Bridge Creek upstream of LaDue extending up to Tylor May Road area also maintained in a natural condition. Upstream from this point, the land use changes from mostly forested Akron lands to intensive agriculture. From the intersection at Taylor May Rd/ Thorpe Rd, livestock can be observed standing in the creek, and the streambanks appear to be extremely eroded. These eroding streams likely have significant impacts to water quality. Targeted stormwater management projects would help protect the water quality of LaDue. For example, just north of SR 422 on the west side of the reservoir, the Akron-owned boathouse access road and parking lot area may benefit from a large permeable-pavement installation. In addition, the access road from Valley Rd to the boathouse consists of very degraded, potholed asphalt which is part of the original SR 422 road which existed pre-reservoir. This road has a considerable slope to the east which allows any vehicle runoff, debris, and salt from the parking lot and main roads to flow directly into the reservoir.

3.2.4 Goals and Objectives for Critical Area

The overall nonpoint source restoration goals of the NPS-IS plan is to improve IBI, MIwb, ICI, and QHEI scores so that partial or non-attainment status can achieve full attainment of the designated aquatic life use and that full attaining reaches may maintain their status. Bringing impaired sites into attainment and protecting attaining sites is a priority. Specific goals referencing assessment points are outlined here:

Goal 1: Protect Bridge Creek @Taylor May Road by achieving an IBI score of 40 or higher.

ACHIEVED: Site currently has IBI of 44.

Goal 2: Achieve ICI score of 34 or higher (good) at Trib. to Bridge Creek (8.85) @ Auburn Road.

NOT ACHIEVED: Site has a narrative ranking of fair (22-28).

Goal 3: Achieve IBI score of 40 or higher at Trib. to Bridge Creek (8.85) @ Auburn Road.

NOT ACHIEVED: Site currently has an IBI score of 30.

Goal 4: Achieve IBI score of 40 or higher at Bridge Creek Upst. Ladue Reservoir @ Stafford Rd.

NOT ACHIEVED: Site currently has an IBI score of 30.

Goal 5: Protect Bridge Creek Dst. Ladue Reservoir @ Stafford Rd. by achieving an ICI score of 34 or higher (good).

ACHIEVED: Site currently has an ICI of 34.

Goal 5: Protect Bridge Creek Dst. Ladue Reservoir @ Stafford Rd. by achieving an IBI score of 40 or higher.

ACHIEVED: Site currently has an IBI score of 48.

Goal 6: Protect Trib. to Bridge Creek (0.52) Near Rapids Rd. by achieving an ICI score of 34 or higher (good).

ACHIEVED: Site currently has a narrative score of good.

Goal 7: Achieve IBI score of 40 or higher at Trib. to Bridge Creek (0.52) Near Rapids Rd.

NOT ACHIEVED: Site currently has a score of 36.

As sites are further investigated and projects are developed, goals may be adapted to reflect additional sites. To achieve these goals for Critical Area 1, the following objectives need to be achieved.

Objective 1: Restore eroding streambanks or otherwise impaired streams or wetlands by removing invasive species, increasing native plant cover (including reforestation) in riparian / wetland buffer areas, and restore streams and wetlands using bioengineered design features.

- Restore 10,000 or more linear feet of streambank within Critical Area 1.
- Native plant revegetation of at least 150 acres of riparian / wetland buffer areas.
- Restore at least 50 acres of wetlands.

Objective 2: Preserve and protect 5,000 acres or more of habitat with critical riparian corridors / wetland habitat.

- Protect habitat with ecologically valuable aquatic resources through acquisition and/or conservation easements.
- Riparian setback adoption for Newbury Township, Burton Township, and Troy Township.
- Riparian setback enforcement for Auburn Township, Bainbridge Township, Mantua Township.

Objective 3: Reduce urban runoff from impervious surfaces through impervious surface reduction and infiltrative green infrastructure practices.

- Mitigate 20 acres of impervious surface impacting riparian or wetland habitats.

Objective 4: Reduce bacterial loading to streams and wetlands

- Ensure full compliance of at least 60 HSTS.

Objectives may be modified, and additional objectives added as necessary until the streams are in full attainment of their aquatic life uses.

As these objectives are implemented, water quality monitoring (project related) will be conducted to determine progress toward meeting the identified goals (i.e. water quality standards and established metrics). These objectives will be reevaluated and modified if determined to be necessary. When reevaluating, CRWP will reference the Ohio EPA Nonpoint Source Management Plan Update (Ohio EPA, 2013), which has a complete listing of all eligible NPS management strategies to consider including:

- Urban Sediment and Nutrient Reduction Strategies
- Altered Stream and Habitat Restoration Strategies
- Nonpoint Source Reduction Strategies; and
- High Quality Waters Protection Strategies.

3.3 Critical Area 2: Agricultural and Timber Harvest Areas

3.3.1 Detailed Characterization

This critical area includes current or former cropland (row crop), animal farms / pasture (including residential horse farms) or areas used for timber harvest. The City of Akron owns a number of former farm fields and also leases farmland to Geauga County farmers who adhere to best management practices and no-till. As farmers retire, these properties may be reforested, restored to wetlands, or maintained as agricultural properties. Development of ecologically sound management plans and implementation of best management practices to reduce sediment and nutrient runoff are important to long-term health of aquatic resources.

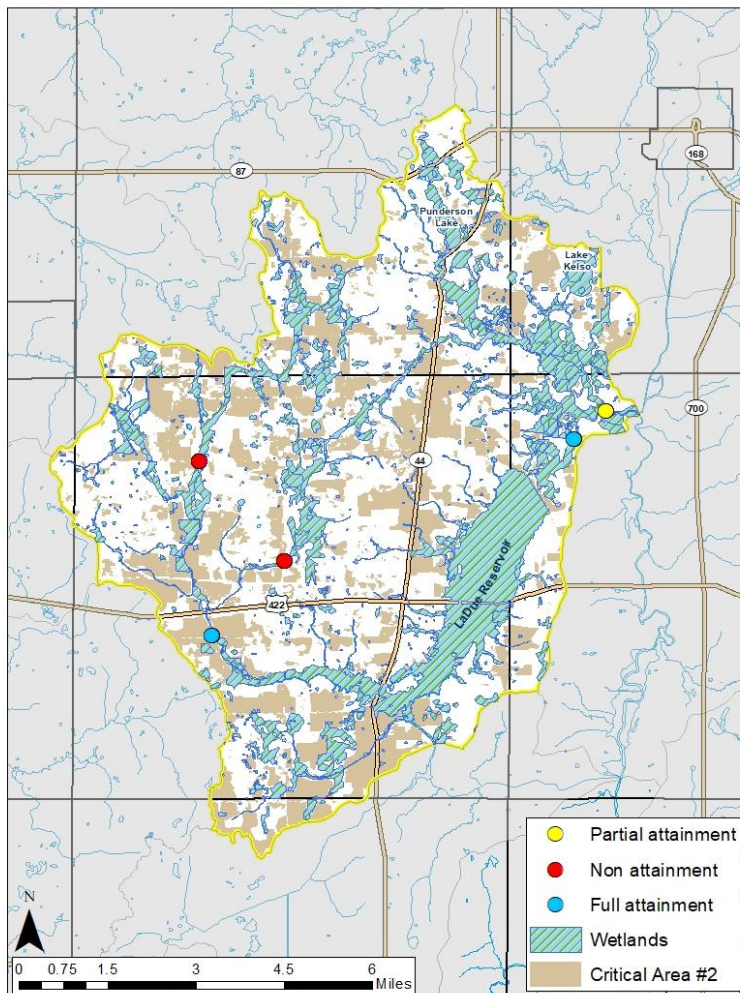


Figure 19: Critical Area 2

3.3.2 Detailed Biological Conditions

Please refer to 3.2.2 Detailed Biological Conditions.

3.3.3 Detailed Causes and Associated Sources

Fertilizing, pesticide use, and soil erosion on agricultural lands are a few of the impacts that can impair water quality (Environmental Design Group 2013). In cases where former croplands are protected,

forest edges can be very important in acting as a barrier to wind-dispersed seeds from native plants. Replanting of native vegetation, including trees and shrubs, can help ensure a more stable forest community for interior dwelling birds and other wildlife. For mature or second growth forests, ecologically sound and responsible management in conjunction with a professional forester is also key for the long-term health of this HUC-12. Practices such as selective thinning can help reduce competition for light and nutrients and enhance growth rates of remaining trees as well as improve diversity. Other practices may include controlling undesirable woody plants and invasive species and reforesting areas to create or expand woodlands. Poor harvest techniques can degrade forest land and contribute to soil erosion and stream impairments. Overtapping of maples, related to increased use of mechanical tappers and more elaborate tubing systems, is also a concern in this area. Overtapping can lead to decay and weakening of trees.

3.3.4 Goals and Objectives for Critical Area

The overall nonpoint source restoration goals of the NPS-IS plan is to improve IBI, MIwb, ICI, and QHEI scores so that partial or non-attainment status can achieve full attainment of the designated aquatic life use and that full attaining reaches may maintain their status. Bringing impaired sites into attainment and protecting attaining sites within these western tributaries is priority. Specific goals referencing assessment points are outlined here:

Goal 1: Protect Bridge Creek @Taylor May Road by achieving an IBI score of 40 or higher.

ACHIEVED: Site currently has IBI of 44.

Goal 2: Achieve ICI score of 34 or higher (good) at Trib. to Bridge Creek (8.85) @ Auburn Road.

NOT ACHIEVED: Site has a narrative ranking of fair (22-28).

Goal 3: Achieve IBI score of 40 or higher at Trib. to Bridge Creek (8.85) @ Auburn Road.

NOT ACHIEVED: Site currently has an IBI score of 30.

Goal 4: Achieve IBI score of 40 or higher at Bridge Creek Upst. Ladue Reservoir @ Stafford Rd.

NOT ACHIEVED: Site currently has an IBI score of 30.

Goal 5: Protect Bridge Creek Dst. Ladue Reservoir @ Stafford Rd. by achieving an ICI score of 34 or higher (good).

ACHIEVED: Site currently has an ICI of 34.

Goal 5: Protect Bridge Creek Dst. Ladue Reservoir @ Stafford Rd. by achieving an IBI score of 40 or higher.

ACHIEVED: Site currently has an IBI score of 48.

Goal 6: Protect Trib. to Bridge Creek (0.52) Near Rapids Rd. by achieving an ICI score of 34 or higher (good).

ACHIEVED: Site currently has a narrative score of good.

Goal 7: Achieve IBI score of 40 or higher at Trib. to Bridge Creek (0.52) Near Rapids Rd.

NOT ACHIEVED: Site currently has a score of 36.

As sites are further investigated and projects are developed, goals may be adapted to reflect additional sites. To achieve these goals for Critical Area 2, the following objectives need to be achieved.

Objective 1: Protect, restore, or create wetland habitat

- Protect, restore, or create 200 acres of wetland habitat within the critical area.
- Wetland setback adoption and implementation for Auburn, Bainbridge, Burton, Mantua, Newbury, and Troy Townships.

Objective 2: Develop nutrient management plans

- Develop at least three nutrient management plans for landowners in the critical area.

Objective 3: Implement grazing best management practices

- Implement grazing management practices on 100 acres of pasture in the critical area.

Objective 4: Protect agricultural properties or timber harvest properties. This can include agricultural conservation easements, deed restrictions landowners voluntarily place on their property to protect productive agricultural land, ground and surface waters, and wildlife habitat.

- Purchase (easement or fee acquisition) of 300 acres within the HUC-12.

Objective 5: Increase retirement of marginal and highly vulnerable lands.

- Enroll at least 30 acres of current agricultural land in the critical area into programs such as the Conservation Reserve Program (CRP), Wetlands Reserve Program (WRP), and Conservation Reserve Enhancement Program (CREP), particularly along stream corridors, wetlands, and floodplain areas.

Objective 6: Restore eroding or channelized streams

- Restore 5,000 linear feet of eroding or channelized streams within the critical area using two-stage or natural channel design features and principles.

Objective 7: Implement forest stand improvement, wildlife habitat management, or ecological restoration (such as invasive species management and native plantings) on forested or former agricultural land.

- Work with interested landowners to develop management plans and implement improvements on 300 acres of land.

Chapter 4: Projects and Implementation Strategy

4.1 Projects and Implementation Strategy Overview Table

Below are the projects and evaluation needs currently believed to be necessary to remove the impairments to the LaDue Reservoir – Bridge Creek HUC-12 as a result of the identified causes and associated sources of nonpoint source pollution. Because the attainment status is based on biological conditions, it will be necessary to periodically re-evaluate the status of the critical area to determine if the implemented projects are sufficient to achieve restoration. Time is an important factor to consider when measuring project success and overall status. Biological systems in some cases can show response fairly quickly (months); others may take longer (years) to show recovery. There may also be reasons

other than nonpoint source pollution for the impairment. Those issues will need to be addressed under different initiatives, authorities or programs which may or may not be accomplished by the same implementers addressing the nonpoint source pollution issues.

Table 4: Critical Area Overview Table: LaDue Reservoir - Bridge Creek Watershed HUC-12 (04110002 01 04)

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)
Urban Sediment and Nutrient Reduction Strategies								
Altered Stream and Habitat Restoration Strategies								
1	6,7	1	1	Burton Wetlands Complex Reforestation	Geauga Park District	Short term	\$125,125.00	USFS GLRI, private foundations
1	5,6	3	2	Boathouse Permeable Pavement Parking	City of Akron	Mid term	TBD	GLRI, Ohio EPA 319
Agricultural Nonpoint Source Reduction Strategies								
2	1-7	1-7	3	Nutrient & Sediment Reduction in Agricultural lands	Chagrin River Watershed Partners	Mid term	\$100,000	CRP, WRP, CREP, EQIP, RCPP, MRBI program funds
High Quality Waters Protection Strategies								
Other NPS Causes and Associated Sources of Impairment								
1	1-7	4	4	HSTS Repair & Replacement	Geauga County Public Health Department	Long-term	Gravityfed drainfields: \$5,000 to \$10,000 Mounds: \$10,000 to \$50,000	Ohio Water Pollution Control Loan Fund, local funds

4.2 Project Sheets for LaDue Reservoir-Bridge Creek HUC-12

Nine Element Criteria	Information needed	Explanation
n/a	Title	Burton Wetlands Complex Reforestation
criteria d	Project Lead Organization & Partners	Geauga Park District in partnership with Chagrin River Watershed Partners, Inc.
criteria c	HUC-12 and Critical Area	LaDue Reservoir-Bridge Creek HUC-12 (04110002 01 04) Critical Area 1: Riparian Corridors and Wetland Buffers
criteria c	Location of Project	Burton Wetlands Nature Preserve 15681 Old Rider Rd. Burton/Newbury Twps., Ohio Coordinates: 41.441782, -81.184236
n/a	Which strategy is being addressed by this project?	Altered Stream and Habitat Restoration

<i>criteria f</i>	Time Frame	Short Term (Priority) (1-3 years)																																																												
<i>criteria g</i>	Short Description	This project will include reforestation of approximately 13 acres west of Lake Kelso with native trees and shrubs. It will create a more natural transitional buffer between managed meadows and existing forests/wetlands, create a more stable forest community surrounding sensitive wetland habitats, control invasive plants, and improve wildlife habitat.																																																												
<i>criteria g</i>	Project Narrative	This reforestation and invasive species management site is on Geauga Park District property west of Lake Kelso and is part of the Burton Wetlands Complex within the Bridge Creek watershed of the Cuyahoga River, one of Ohio's most outstanding natural areas and a product of the Ice Age. Lake Kelso is a 28-acre glacial lake surrounded by 18 acres of bog habitat and is located northeast of the intersection of Pond and Old Rider Rd. in Burton Township. The scope of this restoration project includes native tree/shrub planting on approximately 13 acres, invasive plant control, educational engagement, and post restoration monitoring. Currently, most of the proposed/potential reforestation areas have been allowed to naturally transition from meadow to scrub/shrub/young forest. While these areas have been reverting to a natural state, they have been impacted by a variety of invasive species, particularly multiflora rose. This area could be enhanced by accelerating or jumpstarting this natural succession process through targeted reforestation plantings. Forest edges are very important structural features often influencing the integrity of interior dwelling species. These community interface areas serve as ecologically functional components and are the first point of contact for influxes of non-native species.																																																												
<i>criteria d</i>	Estimated Total cost	<table border="1"> <thead> <tr> <th></th> <th>Rate</th> <th>Units</th> <th></th> </tr> </thead> <tbody> <tr> <td>Trees/Shrubs (1 gallon) (100/acre)</td> <td>\$20.00</td> <td>1300</td> <td>\$26,000.00</td> </tr> <tr> <td>Trees (3 gallon) (25/acre)</td> <td>\$36.00</td> <td>325</td> <td>\$11,700.00</td> </tr> <tr> <td>Deer protection for 1 gallons</td> <td>\$14.00</td> <td>1300</td> <td>\$18,200.00</td> </tr> <tr> <td>Deer protection for 3 gallons</td> <td>\$25.00</td> <td>325</td> <td>\$8,125.00</td> </tr> <tr> <td>Installation</td> <td></td> <td>1</td> <td>\$15,000.00</td> </tr> <tr> <td>Site prep, invasive species removal, and monitoring</td> <td>\$20,000</td> <td>1</td> <td>\$20,000</td> </tr> <tr> <td>CRWP project management & administration</td> <td>\$7,000</td> <td>1</td> <td>\$7,000</td> </tr> <tr> <td>Project map & design</td> <td>\$1,200</td> <td>1</td> <td>\$1,200</td> </tr> <tr> <td>As-built survey</td> <td>\$2,000</td> <td>1</td> <td>\$2,000</td> </tr> <tr> <td>Interpretive sign</td> <td>\$1,500</td> <td>1</td> <td>\$1,500</td> </tr> <tr> <td>Watering</td> <td>\$5,000</td> <td>1</td> <td>\$10,000</td> </tr> <tr> <td>Mulch</td> <td>\$3,500</td> <td>1</td> <td>\$3,500</td> </tr> <tr> <td>SWPPP development</td> <td>\$900</td> <td>1</td> <td>\$900</td> </tr> <tr> <td>Estimated Project Total =</td> <td></td> <td></td> <td>\$125,125.00</td> </tr> </tbody> </table>		Rate	Units		Trees/Shrubs (1 gallon) (100/acre)	\$20.00	1300	\$26,000.00	Trees (3 gallon) (25/acre)	\$36.00	325	\$11,700.00	Deer protection for 1 gallons	\$14.00	1300	\$18,200.00	Deer protection for 3 gallons	\$25.00	325	\$8,125.00	Installation		1	\$15,000.00	Site prep, invasive species removal, and monitoring	\$20,000	1	\$20,000	CRWP project management & administration	\$7,000	1	\$7,000	Project map & design	\$1,200	1	\$1,200	As-built survey	\$2,000	1	\$2,000	Interpretive sign	\$1,500	1	\$1,500	Watering	\$5,000	1	\$10,000	Mulch	\$3,500	1	\$3,500	SWPPP development	\$900	1	\$900	Estimated Project Total =			\$125,125.00
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<i>criteria d</i>	Possible Funding Source	USFS GLRI, private foundations																																																												
<i>criteria a</i>	Identified Causes and Sources	Causes: direct habitat alterations, natural limits (wetlands) Sources : natural																																																												
<i>criteria b & h</i>	Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?	Goal 6 for this Critical Area is to protect Trib. to Bridge Creek (0.52) Near Rapids Rd. by achieving an ICI score of 34 or higher (good). This has been achieved, with a narrative score of good. Goal 7 is to achieve an IBI score of 40 or higher at Trib. to Bridge Creek (0.52) Near Rapids Rd. This has not been achieved; the site currently has a score of 36. Objective 1 includes native plant revegetation of at least 150 acres of riparian / wetland buffer areas.																																																												

	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 about 13 acres of habitat to native shrub/forest habitat and treat that area for invasive species. It is anticipated that upon completion, this project will help maintain achievement of Goal 6 and help achieve Goal 7 by meeting 8.7% of the reforestation aspect of Objective 1.
	Part 3: Load Reduced?	Based on the USFS conversions, this project will result in 1,625 x 18 gallons per tree seedling = 29,250 gallons of water treated.
<i>criteria i</i>	How will the effectiveness of this project in addressing the NPS impairment be measured?	Success of this project will be evaluated by post-planting monitoring and later downstream sampling by Ohio EPA.
<i>criteria e</i>	Information and Education	Educational efforts will include: <ul style="list-style-type: none"> • 1 fact sheet • Project updates and highlights posted on 2 websites (Geauga Park District and the Chagrin River Watershed Partners) • 1 interpretive sign at the project site • Project updates and highlights in organizational newsletters and social media • 1 project tour

Works Cited

- Bissell, J.K. 1983. Report on the Cuyahoga Wetlands. The Cleveland Museum of Natural History. Unpublished Report.56 pp.
- City of Akron. Bridge Creek Dam Flood Study. Prepared by Malcom Pirnie, Inc. March 2010. AkronOhio.gov. The Upper Cuyahoga River Watershed. https://www.akronohio.gov/cms/Water/Watershed_Cuyahoga/index.html. Accessed 10-16-2019. Copyright 2016.
- Audubon.org. Important Bird Areas – Upper Cuyahoga. <https://www.audubon.org/important-bird-areas/cuyahoga-river-upper>. Accessed 10-16-2019. Copyright 2013.
- Baker, Justin & Zimmerman, Brian & Daly, Marymegan. (2015). Current Status and Distribution of *Etheostoma exile* (Iowa Darter) and *Erimyzon sucetta* (Lake Chubsucker) in Ohio. *Northeastern Naturalist*. 22. 213-222. 10.1656/045.022.0119.
- Environmental Design Group. June 2013. Drinking Water Protection Plan for the Upper Cuyahoga River Watershed.
- Fennessy, M. S., J. J. Mack, E. Deimeke, M. T. Sullivan, J. Bishop, M. Cohen, M. Micacchion and M. Knapp. 2007. Assessment of wetlands in the Cuyahoga River watershed of northeast Ohio. Ohio EPA Technical Report WET/2007-4. Ohio Environmental Protection Agency, Division of Surface Water, Wetland Ecology Group, Columbus, Ohio.
- Geauga County Planning Commission. Revised 2016. Auburn Township, Geauga County Land Use Plan. Prepared in Cooperation with the Auburn Township Board of Trustees, The Auburn Township Zoning Commission, and the Auburn Township Zoning Inspector.
- Geauga County Planning Commission. 2008. Newbury Township, Geauga County Land Use Plan. Prepared with Assistance of the Chagrin River Watershed Partners, Inc., and Kent State University/Urban Design Center in Cooperation with The Newbury Township Board of Trustees.
- McCormac, Jim, and Gary Meszaros. *Wild Ohio*. Kent State University Press, 2009.
- Ohiodnr.gov. Upper Cuyahoga State Scenic River. <http://watercraft.ohiodnr.gov/uppercuyahogasr>. Accessed 10-16-2019. Copyright 2019.
- Ohiodnr.gov. Cuyahoga River. <http://coastal.ohiodnr.gov/cuyahogariver>. Accessed 11-5-2019. Copyright 2019.
- Ohio Environmental Protection Agency, Division of Surface Water. September 2004. Total Maximum Daily Loads for the Upper Cuyahoga River. Final Report.

Ohio Environmental Protection Agency, Division of Surface Water. 2019. Upper Cuyahoga monitoring data provided per request by CRWP.

Ohio Environmental Protection Agency, Division of Surface Water. October 2016. Ohio 2016 Integrated Water Quality Monitoring and Assessment Report.

Totten, Stanley M. Glacial Geology of Geauga County, Ohio. Report of Investigations No. 140. State of Ohio Department of Natural Resources, Division of Geological Survey. 1988.

Urycki, Mark. "The Headwaters: Fighting to Keep the Upper Cuyahoga River Pristine." Ideastream. <https://indepth.ideastream.org/cuyahoga-headwaters/index.html>. Accessed 10-16-2019.

Appendix: Acronyms and Abbreviations

The acronyms and abbreviations below are commonly used by organizations working to restore Ohio's watersheds; many of which are included in this NPS-IS plan.

AOC	Area of Concern
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
CSO	Combined Sewer Overflow
DELT	Deformities Eroded Fins, Lesions, and Tumors
EOLP	Erie-Ontario Lake Plain Ecoregion
EWH	Exceptional Warmwater Habitat
GIS	Geographical Information System
Hg	Mercury
HUC	Hydrologic Unit Code
IBI	Index of Biotic Integrity
ICI	Invertebrate Community Index
LRW	Limited Resource Water Mg/l Milligrams per Liter
MGD	Million Gallons per Day
MIwb	Modified Index of Well Being
MWH	Modified Warmwater Habitat
NPDES	National Pollutant Discharge Elimination System
ODA	Ohio Department of Agriculture
ODNR	Ohio Department of Natural Resources
ODH	Ohio Department of Health
OEPA	Ohio Environmental Protection Agency

PAH Polycyclic Aromatic Hydrocarbons
PCB Polychlorinated Biphenyls
QHEI Qualitative Habitat Evaluation Index
RAP Remedial Action Plan
SSO Sanitary Sewer Overflow
SWCD Soil and Water Conservation District
TMDL Total Maximum Daily Load Limits
TSD Technical Support Document $\mu\text{g}/\text{kg}$ Micrograms per Kilogram
USACE United States Army Corps of Engineers
USDA United States Department of Agriculture
USEPA United States Environmental Protection Agency
USFWS United States Fish and Wildlife Service
USGS United States Geological Survey
USPC United States Policy Committee
VAP Voluntary Action Program
WAP Watershed Action Plan
WBP Watershed Based Plan WQS Water Quality Standards (Ohio Administrative Code 3745-1)
WRAS Watershed Restoration Action Strategy
WWH Warmwater Habitat
WWTP Wastewater Treatment Plant