Version 1.0
February 5, 2019

Cahoon Creek-Frontal Lake Erie (HUC-12: 04110001 02 04)

Nine-Element Nonpoint Source Implementation Strategy Plan (NPS-IS)

Plan developed by:

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This report was prepared by Chagrin River Watershed Partners, Inc. using federal funds under award NA18NOS4190096 from the National Oceanic and Atmospheric Administration, U.S. Department of Commerce through the Ohio Department of Natural Resources, Office of Coastal Management. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Ohio Department of Natural Resources, or the Office of Coastal Management.

Table of Contents

Acknowledgements

Cuyahoga Soil and Water Conservation District (SWCD) would like to thank Chagrin River Watershed Partners (CRWP) and West Creek Conservancy for their assistance in developing this plan. Cuyahoga SWCD is also grateful to the Central Lake Erie Basin Collaborative (CLEB) for creating an online survey that was used to gather information from community leaders and residents in this Hydrologic Unit Code

(HUC)-12. Many stakeholders contributed to the development of this plan, including the Northeast Ohio Regional Sewer District (NEORSD), the Northeast Ohio Areawide Coordinating Agency (NOACA), the Green Ribbon coalition, Westlake Watershed Group, communities and their residents in this HUC-12, and Cleveland Metroparks.

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Chapter 1: Introduction

The Cahoon Creek-Frontal Lake Erie HUC-12 (04110001 02 04) is part of the Lake Erie watershed in Northeast Ohio. Most of the HUC-12 is in on the western side of Cuyahoga County, although there is a small area in eastern Lorain County.

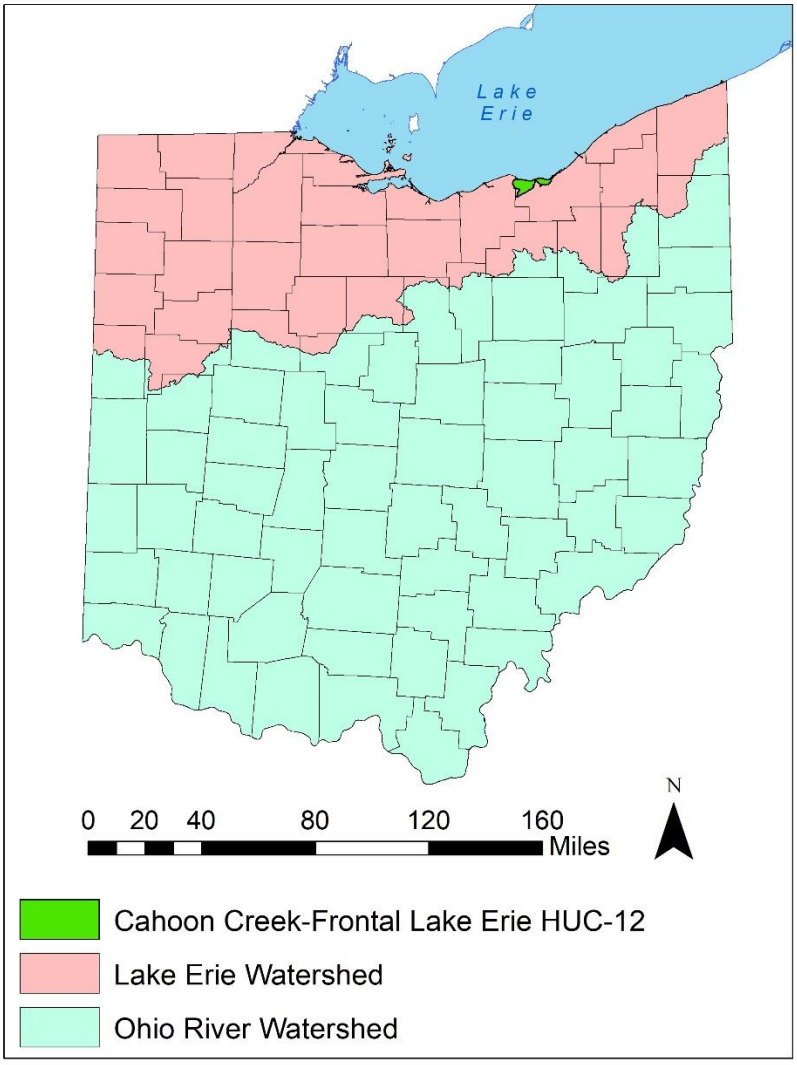
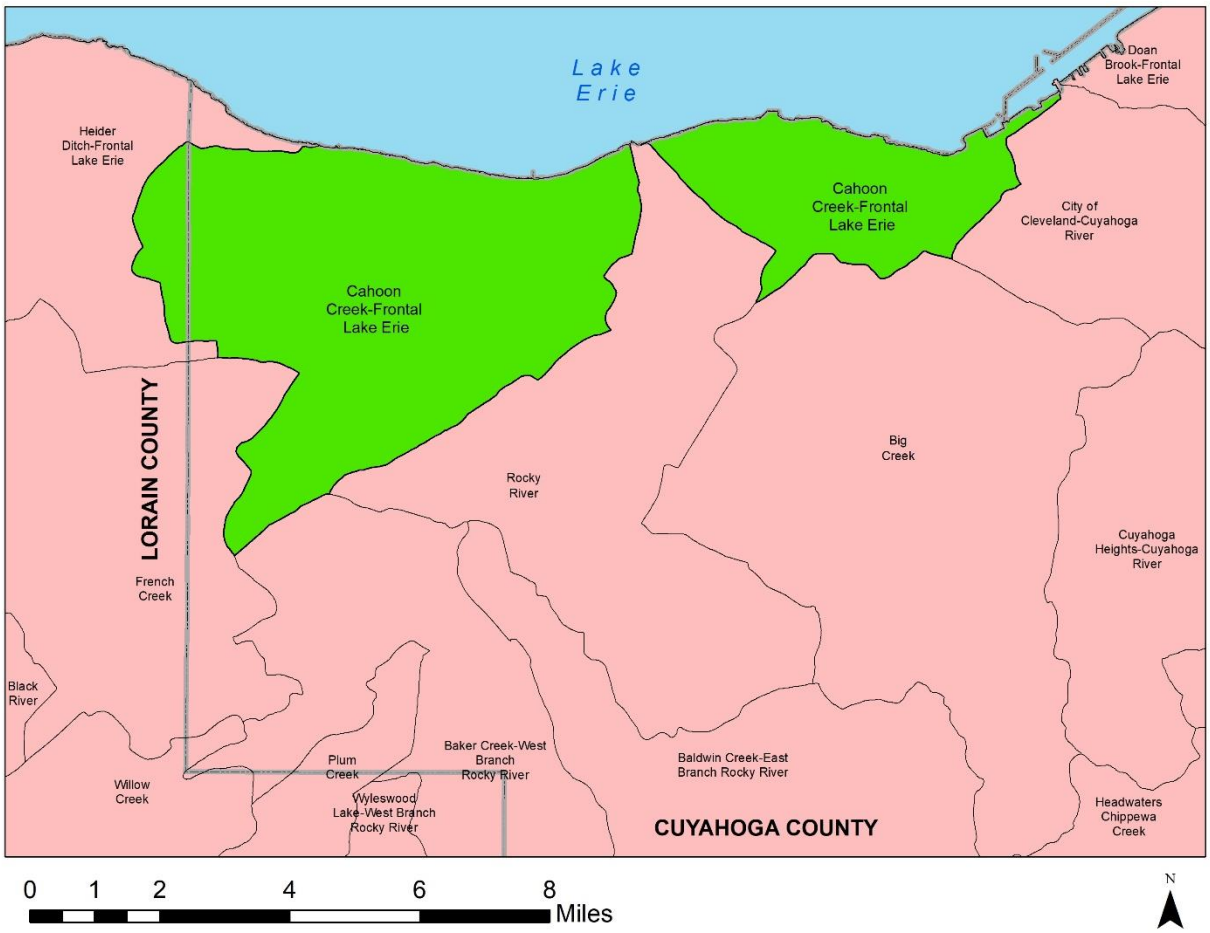


Figure 1: HUC-12 position within Lake Erie - Ohio River Basin Divide in Ohio

Table 1: Location of the Cahoon Creek-Frontal Lake Erie-HUC in Cuyahoga and Lorain Counties in relation to other HUC-12s



This HUC-12 is composted exclusively of small direct tributaries to Lake Erie including Porter Creek, Cahoon Creek, Wischmeyer Creek, Sperry Creek, and Spencer Creek. This HUC-12 covers 38.43 square miles (24,594.98 acres).

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 both the US Environmental Protection Agency (USEPA) and Ohio EPA as meeting the 9-minimum element requirement as outlined in the USEPA's *Handbook for Developing Watershed Plans to Restore and Protect our Waters.* Cuyahoga SWCD, 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.

1.1 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.

1.2 Watershed Profile and History

The Cahoon Creek-Frontal Lake Erie HUC-12 (04110001 02 04) is almost entirely within Cuyahoga County, with a small area in Lorain County that includes the eastern parts of the communities Avon Lake and Avon. This HUC-12 is split by Rocky River (not included in this HUC-12) into a west and east lobe along Lake Erie. Porter Creek, Cahoon Creek, Wischmeyer Creek, and Sperry Creek flow into Lake Erie in Bay Village. The City of Westlake has named a small reach, "Wilhelmy Creek" near Wilhelmy Road in the Porter Creek drainage area. "Wolf Creek," which is piped at Wolf Road, is also named by the City of Westlake. Spencer Creek flows through the community of Rocky River but is piped for part of its length before entering Lake Erie at Bradstreet's Landing. There are also a few other unnamed tributaries, many of which have been piped or channelized for extensive reaches. The eastern lobe is now highly developed and does not have any open streams. Communities with combined sewers are working to better manage combined sewer overflows into Lake Erie.

Figure 2: Sewer installation in City of Lakewood, 1916. Source: www.onelakewood.com

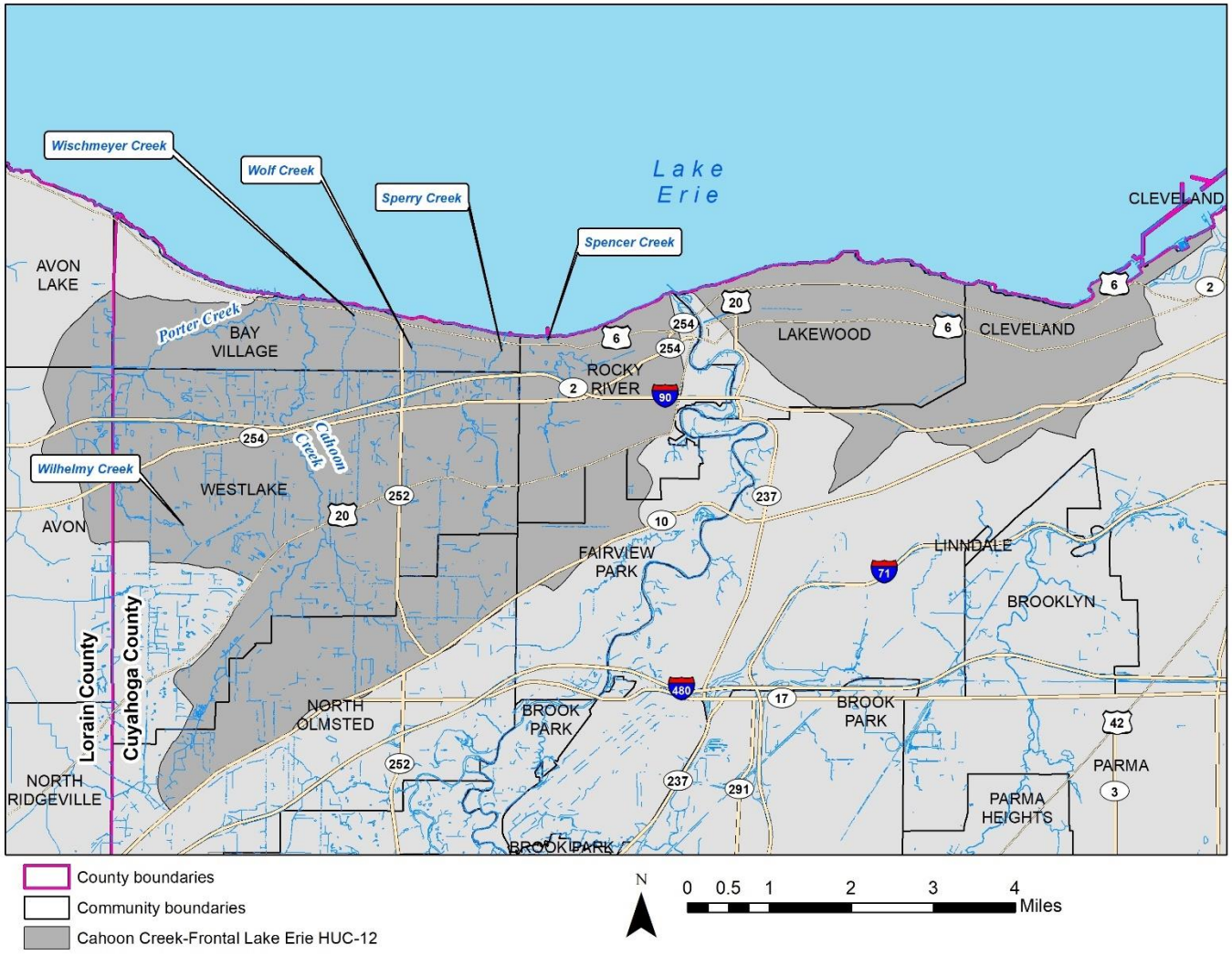


Figure 3: Cahoon Creek-Frontal Lake Erie HUC-12 Watershed Location Map

1.3 Public Participation and Involvement

Cuyahoga SWCD and CRWP held two public open houses to obtain input for this NPS-IS, one on October 30, 2018 at the North Olmstead Library, and one on November 5, 2018 at the Bay Village Library. Direct input was also obtained through conversations with key stakeholders and attending City Council meetings. A survey was also developed and shared with the public to obtain written input.

Chapter 2: HUC-12 Watershed Characterization and Assessment Summary

2.1 Summary of HUC-12 Watershed Characterization

This subwatershed includes parts of Lorain and Cuyahoga Counties. Communities with at least part of their boundary within this HUC-12 include Avon Lake, Avon, Bay Village, Westlake, Rocky River, North Olmsted, Fairview Park, Lakewood, and Cleveland.

2.1.1 Physical and Natural Features

The streams in this HUC-12 all drain relatively small areas before entering Lake Erie and impervious area is generally high. Data from the USGS StreamStats provides approximate stream drainage areas based on natural topography (does not account for any stream modifications) and impervious values.

Table 2: Natural drainage area for major streams in HUC-12 and impervious area based on NLCD 2011 dataset. Source: United States Geological Survey (USGS) StreamStats

Stream name	Natural Drainage Area (sq. miles)	Imperviousness (%)
Porter Creek	8.48	20.1
Cahoon Creek	7.52	19.2
Wischmeyer Creek	1.5	25.5
Wolf Creek	1.48	31.2
Sperry Creek	3.84	24.5
Spencer Creek	2.92	31.5

The USEPA provides guidance that watersheds exceeding 10% impervious cover will generally not be able to support high quality stream systems. Subwatersheds with 10 - 25% impervious cover are classified as degraded or impacted and subwatersheds with greater than 25% impervious cover are classified as non-supporting streams and often have characteristics such as eroding banks, poor biological diversity, and high bacteria levels (US EPA Watershed Academy Web). All major subwatersheds in this HUC-12 currently exceed 10% imperviousness and several exceed 25%.

The most common surficial geology in this HUC-12 is Wisconsinan-age till (denoted as “T”) made up of unsorted clay, silt, sand, gravel, and boulders. The near-surface clay percentage of till can be as high as 50%. Near-surface sand percentage of till is as low as 8%. In some sections of this HUC-12, surficial geology is predominantly sand and gravel (denoted as “SG”), generally Wisconsinan-age. This layer consists of interbedded sand and gravel commonly containing thin, discontinuous layers of silt and clay. It can be found in terraces and buried valleys and as beach-ridge deposits of high, proglacial predecessors of Lake Erie.

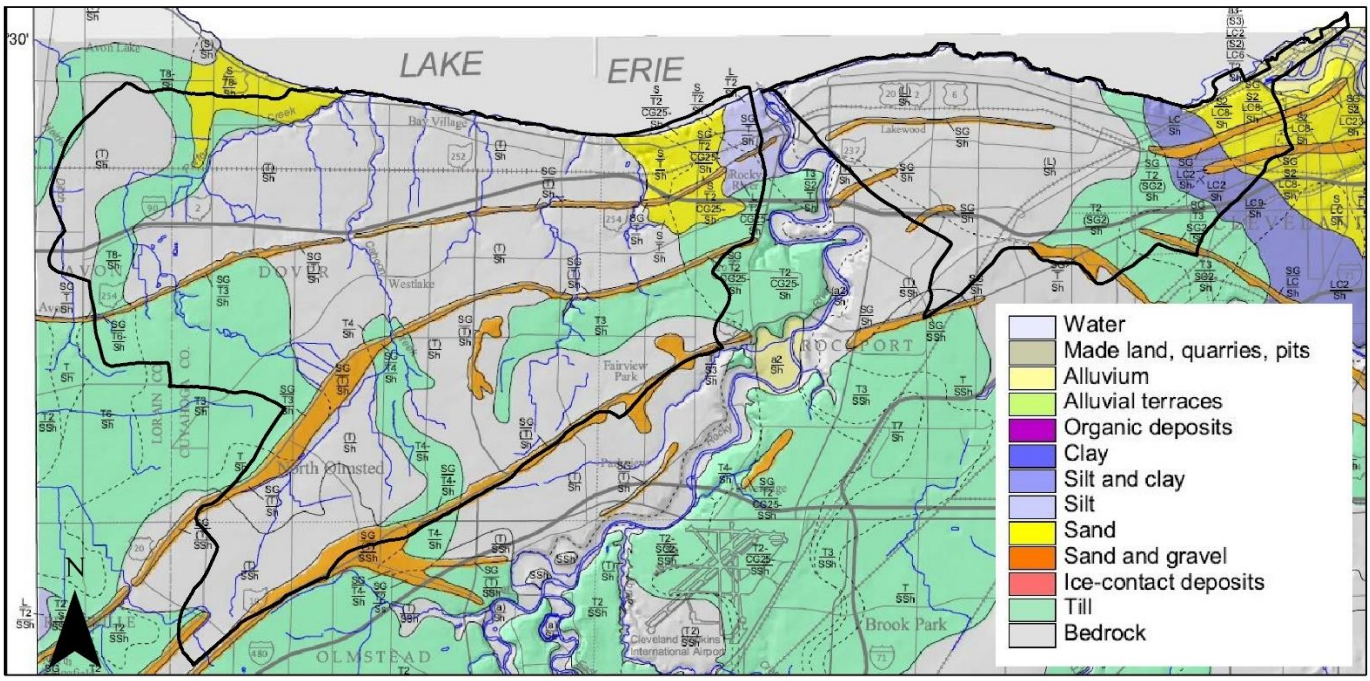


Figure 4: Surficial geology map for Cahoon Creek-Frontal Lake Erie HUC-12. The bottom symbol in each stack indicates the bedrock lithologies underlying the surficial deposits. Source: Pavey et al. (2000).

The underlying geology for this HUC-12 is primarily Ohio Shale, with a small area of Berea sandstone and Bedford shale, undivided in the southwest corner of this HUC-12, primarily in North Olmstead. The Devonian-age shale (denoted "Sh") is present in an east-west-oriented belt along the Lake Erie shoreline in Cuyahoga County. The small area of sandstone and shale (denoted "SSh") includes Mississippian-age Cuyahoga Formation, Berea Sandstone, and Bedford Shale.

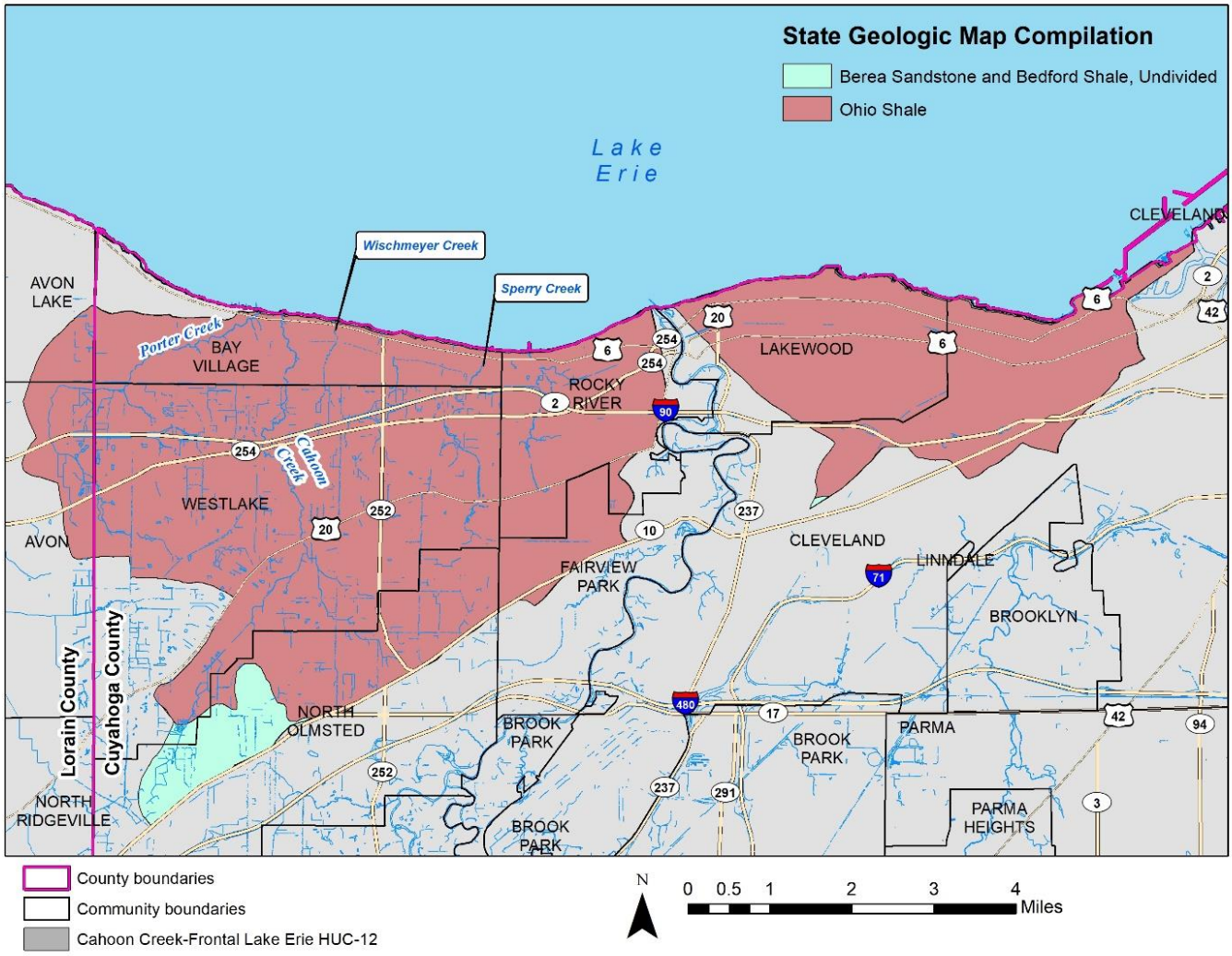


Figure 5: Underlying geology in Cahoon Creek-Frontal Lake Erie HUC-12. Source: USGS.

The primary type of wetland in this HUC-12 is freshwater forested/scrub wetland, as classified by the National Wetland Inventory. The largest wetland area of this type in this HUC-12 is at Bradley Woods. This property has high-quality wetland complexes owned by Cleveland Metroparks and is included in the list of high-quality wetland areas in the 2018 Integrated Report. This wetland complex is the largest in Cuyahoga County and portions appear nearly undisturbed, providing a reference point for wetland enhancement and restoration projects in the lake plain region. Most of the wetland complex is within Bradley Woods Reservation, but a few wetland areas and key buffers are privately owned. Upland buffer areas should be given a high priority for protection. Restoration approaches for degraded wetlands could include construction of shallow berms and plugging drainage ditches, with care taken to avoid changes to natural wetlands and flooding of adjacent residents (Davey Resource Group, 2006).

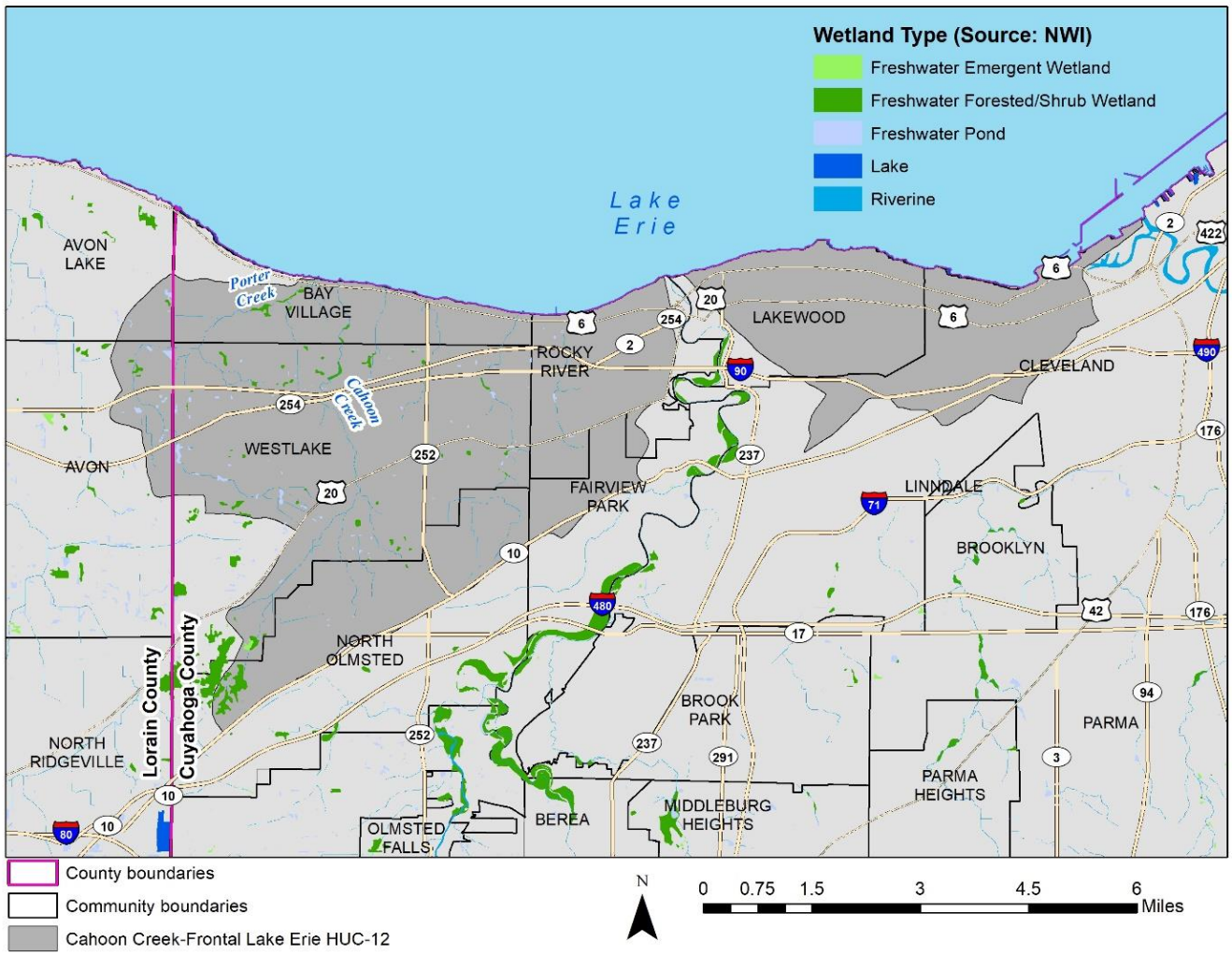


Figure 6: Wetland types in HUC-12 (Source: NWI)

Type	Acres	Percentage of total
Freshwater Forested/Shrub Wetland	183.94	44.26
Riverine	109.77	26.41
Freshwater Pond	88.49	21.29
Lake	26.61	6.40
Freshwater Emergent Wetland	6.76	1.63

Predominant soil types in the Cahoon Creek-Frontal Lake Erie subwatershed, making up at least five 5% of the land area, include Allis silt loam (9.4%), Allis-Urban land complex (9.4%), Urban land – Allis Complex (7.6%), Urban land-Oshtemo complex, undulating (7.6%), Urban land-Elnora complex, nearly level (6.1%), Mahoning silt loam, 0 to 2 percent slopes (5.69%) Urban land-Mahoning complex, 2 to 6 percent slopes (5.03%), and Miner silty clay loam, 0 to 2 percent slopes (5.0%). Most of the soils are either in Class D, soils with high clay content that infiltrate slowly, or are unclassified due to the high impervious cover in this HUC-12.

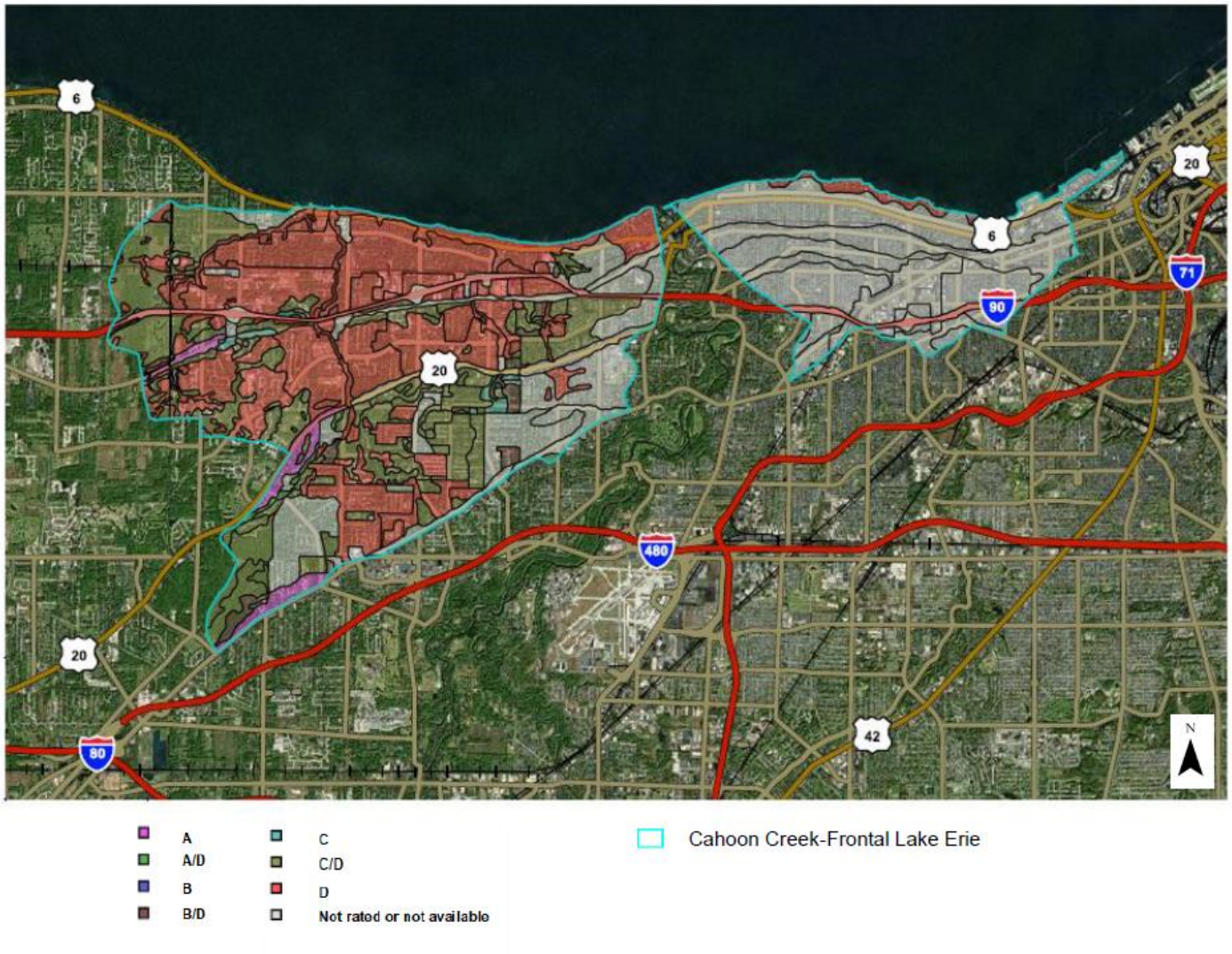


Table 3: Hydrologic Soil Groups and percent composition in HUC-12 (Source: USDA Web Soil Survey)

Rating	Description	Total %
Group A	Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.	4.81
Group B	Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.	0.0
Group C	Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.	0.62
Group D	Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high-water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.	34.36

A/D Dual Class	First letter is for drained areas and the second is for undrained areas	0.38
B/D Dual Class	First letter is for drained areas and the second is for undrained areas	1.35
C/D Dual Class	First letter is for drained areas and the second is for undrained areas	21.05
NA	Not rated or not available	37.43

With its position along the Lake Erie coast, this HUC-12 provides important habitat for many birds. At Huntington's high bluffs, bald eagles can be regularly viewed as well as a variety of hawks. In the spring, many migrating songbirds can be found along the shoreline where they feast on insects before heading to nesting grounds in Canada. In the summer, ring-billed gulls, herring gulls, great blue herons, and spotted sandpipers are often seen along the rock piers. There are also many overwintering birds like the red-breasted mergansers.

Invasive species are a significant concern in this HUC-12. For example, Cleveland Metroparks has signage posted at Huntington Reservation asking visitors not to spread Lesser Celandine. Near the mouth of Cahoon Creek, large amounts of Japanese barberry (*Berberis thunbergii*) and Japanese knotweed (*Fallopia japonica*) were identified during a survey on September 12, 2018.

Figure 7: Japanese barberry along bank of Cahoon Creek. (Source: Alicia Beattie, September 12, 2018).

Invasive aquarium snails were also noted during an aquatic invertebrate survey on September 12, 2018.

Figure 8: Invasive aquarium snail. Porter Creek at Avon Road. Source: Alicia Beattie, September 12, 2018.

2.1.2 Land-Use and Protection

Land-use in this HUC-12 is 85% developed, 12.2% forest, 0.80% grass/pasture, 0.40% row crops, and 1.60% other (Ohio EPA Integrated Report 2018).

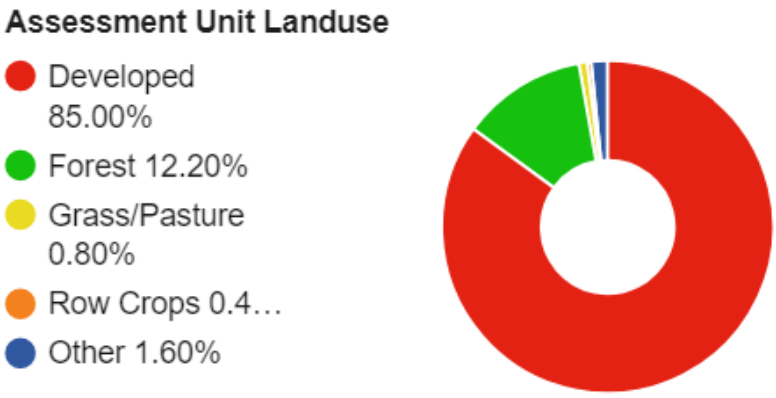


Figure 9: Cahoon Creek-Frontal Lake Erie Land use (Source: Ohio EPA Integrated Report 2018).

Data from the National Oceanic and Atmospheric Administration (NOAA)'s Coastal Change Analysis Program (C-CAP) indicates that the eastern lobe of the HUC-12 is primarily classified as medium or high intensity developed area, with little green space. The western lobe of the HUC-12 also has a high proportion of developed areas but has several areas with vegetated riparian corridors along streams as well as forested wetland areas, such as at the Bradley Woods Reservation.

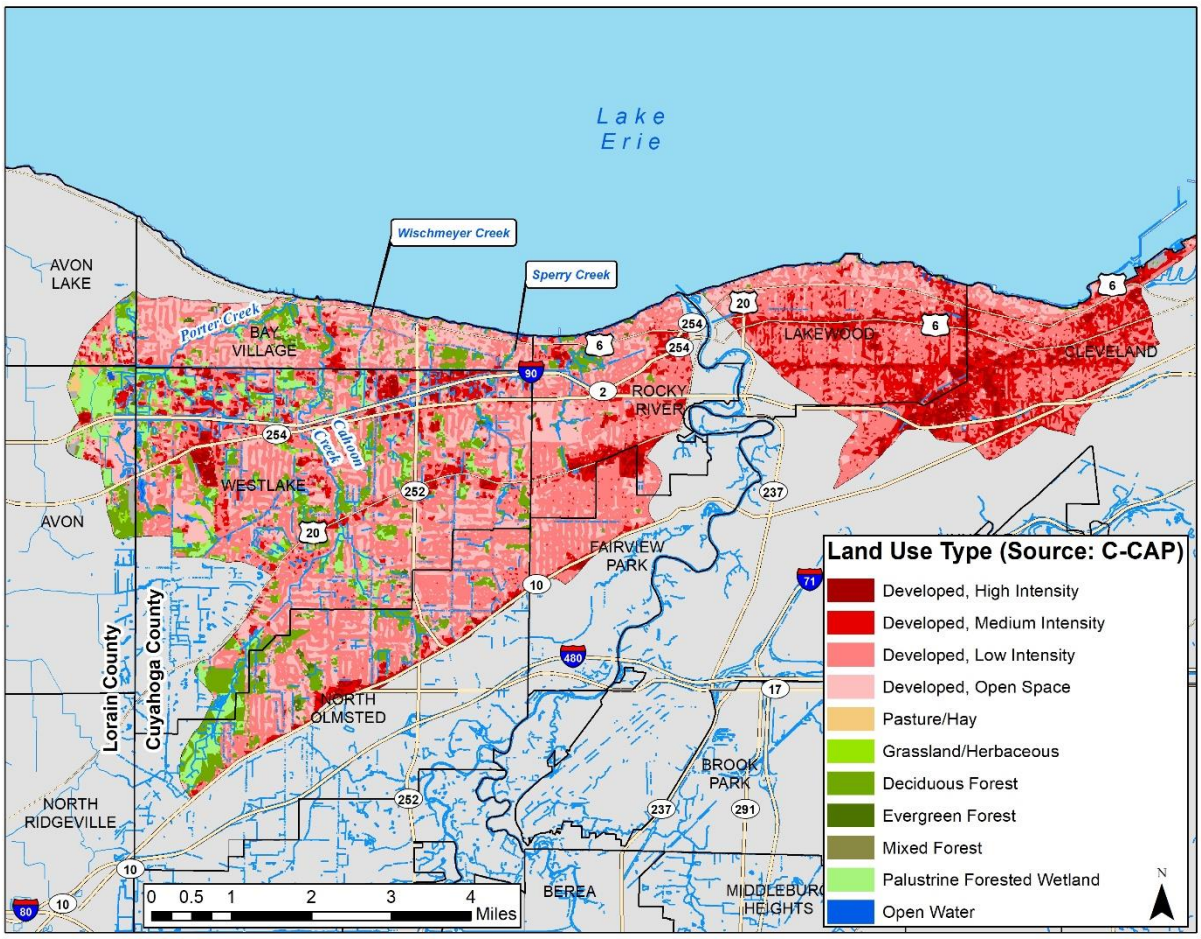


Figure 10: Land use types (Source: Coastal Change Analysis Program)

Given the large amount of developed area in this HUC-12, communities and park districts have recognized the importance of preserving open space. The City of Bay Village Master Plan (Cuyahoga Planning Commission 1999) for example, included the following goals for natural resources:

1. Improve access to Lake Erie for the residents of Bay Village.
2. Recognize the large open space provided by Cahoon and Huntington Parks as a unique resource for the community that should be preserved.

The top answer in Bay Village's 2015 survey for the question, "Why do you choose to live in the City of Bay Village" was living close to Lake Erie (56.0% of 571 respondents). Furthermore, 76.8% of respondents agreed or strongly agreed that environmentally friendly development was important.

The newest Bay Village Master Plan (2016) was adopted by the Village Council on June 26, 2017. With most of the community already developed or preserved, the Master Plan notes that the focus must be on smart redevelopment and protecting nature and natural processes. The Master Plan recognizes the importance of protecting riparian zones in development regulations via setbacks, protecting the Lake Erie shoreline, and stabilizing areas of steep slopes near developments to reduce erosion from stormwater runoff. The Master Plan also recognizes the importance of maintaining natural ecosystems and implementing green infrastructure to reduce the amount of water reaching the sewer system and

reducing the impact of peak storm flows on wastewater treatment facilities. A 2016 community survey showed that 96.7% of residents felt that the provision of City sewer service and flooding was Important or Very Important. Combined sewer overflows are an issue in Bay Village. While separate stormwater and sanitary sewer lines are noted as the ultimate long-term solution, immediate steps to improve stormwater management are outlined including reducing large impervious areas, increasing natural areas and vegetation, and implementing green infrastructure such as bioswales and rain gardens.

As noted in their Master Plan, one of Bay Village's major's goal is to protect and enhance the tree canopy with regulations that protect trees during development and by encouraging tree plantings. Benefits of trees noted include improved water quality, reduced soil erosion, increased stormwater retention, lower urban temperatures, reduced air pollution, and increased property values. Establishing a more pedestrian and bicycle friendly community are also key goals in the plan, including incorporation of bike lanes or an all-purpose trail, stormwater infrastructure, and streetscape improvements along Wolf Road. Bay Village would also like to reduce parking requirements and encourage shared parking agreements among businesses to reduce impervious area.

This HUC-12 includes the following protected areas and golf courses:

- *Golf Courses:*
    - Westwood Country Club
    - Avon Oaks Country Club: Porter Creek runs through this park.
    - Lakewood Country Club: Porter Creek runs through this park.
- *Cleveland Metroparks:*
    - **Bradley Woods Reservation:** The eastern part of this park, which includes the headwaters of Cahoon Creek, is in this HUC-12. This 785-acre park is in North Olmsted and Westlake on a massive formation of Berea sandstone. There are old quarry sites in this park. Bunns Lake, dedicated in 1986, was created to provide waterfowl habitat.
    - **Huntington Reservation***:* This park is in Bay Village along the Lake Erie coastline and was acquired by Cleveland Metroparks in 1925. This park is known for its Blue Wave Certified Beach. It has three (3) miles of nature trails. Educational programming is provided by Rocky River Nature Center staff and Lake Erie Nature and Science Center. Porter Creek flows through this park. Porter Creek flows into Lake Erie at this park.
    - **Edgewater Park***:* This 147-acre park is the westernmost park in Cleveland Metroparks Lakefront Reservation. It includes 9,000 acres of shoreline, beaches, a fishing pier, picnic areas, grills, and a rentable pavilion.
- *City of Bay Village:*
    - **Cahoon Memorial Park:** This 116-acre park at the Lake Erie coast is managed by the City of Bay Village Recreation Department and is east of the Huntington Reservation, west of Dover Center Road, and north of Wolf Road. This park has nearly 2,300 feet of coastal access. The Bay Boat Club is in operation next to the Cahoon Creek mouth.
- *City of Lakewood:*
    - **Lakewood Park**: This 40.5-acre Park is on Lake Avenue at Belle Avenue in the City of Lakewood. It is managed by the City of Lakewood Department of Public Works, Division of Parks and Public Property. This park has one-third mile of coastal access. The 14 acres that comprise most of the shore is fill material placed in Lake Erie from 1935 to

1956. A revetment helps prevent erosion along the shore. There is no beach but there is a public swimming pool (ODNR Office of Coastal Management).

- *City of Westlake:*
  - **Tri-City Park**: Tri-City Park is located on Westwood Road, and borders the cities of Westlake, Fairview Park, and Rocky River. The park features a baseball diamond, soccer field, pavilion, playground, 8 tennis courts, and public restrooms.
  - **Westlake Recreation Center**: This park includes 2 baseball/softball fields, a fishing pond, a gazebo, outdoor trail, picnic area, playground, greenspace, a recreation complex, soccer fields, and tennis courts.
  - **Clague Park:** This park is at the northeast corner of Clague Road and Hilliard Boulevard. It includes baseball diamonds, a Cabin, the Westlake Historical Society Museum, a duck pond, Peterson Pool, picnic areas, playgrounds, tennis courts, and walking trails.
  - **Roman Park:** This 13-acre park is at 28200 Ranney Parkway in Westlake. It includes three (3) softball fields, a playground, a concession stand, and restroom facilities.
  - **Bradley Nature Park:** This 20-acre park is on Bradley Road north of Center Ridge Road and the Cleveland Metroparks' Bradley Woods Reservation.

Park areas that have been preserved provide important habitat for wildlife. Many of these parks, such as at Cleveland Metroparks properties, retain forested riparian cover and include pollinator meadow rehabilitation efforts.

Figure 11: Pollinator meadow at Huntington Reservation. (Source: Alicia Beattie, September 12, 2018).

2.2 Summary of Biological Trends for Cahoon Creek-Frontal Lake Erie HUC-12

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. Ohio EPA evaluation criteria include the index of biological integrity (IBI), modified index of well-being (MIwb), invertebrate community index (ICI), and qualitative habitat evaluation index (QHEI).

Table 4: Biological criteria applicable to rivers and streams in the Erie-Ontario Lake Plains (EOLP)

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

The streams in this HUC-12 are designated as warmwater habitat. ODNR sampled on the Lake Erie shoreline, where this stretch was designated as exceptional warmwater habitat. The Cahoon Creek sampling site at U.S. Route 6 is considered in partial attainment based on the invertebrate sampling but the other two sampling locations are in nonattainment. The next field monitoring by Ohio EPA for this HUC-12 is projected for 2029.

Table 5: Biological Indices Scores for HUC-12 (Ohio EPA Integrated Report 2018)

Station ID	Sample Station Name	River Mile (Drainage Area)	ALU Type	Fish Sample Yr	IBI Score	IBI Desc.	MIwb Score	MIwb Desc.	Bug Sample Year	ICI Score	ICI Desc.	QHEI
T01P20	PORTER CREEK AT BAY VILLAGE @ U.S. RT. 6	0.10 RM (8.30 sqm)	WWH	2014	34	F	N/A	N/A	2014	N/A/	Low Fair	68.3
T01P21	CAHOON CREEK AT BAY VILLAGE @ U.S. RT. 6	0.08 RM (5.40 sqm)	WWH	2014	36	MG	N/A	N/A	2014	N/A	Fair	58.3
301760 *	LAKE ERIE SHORELINE E. OF AVON POINT (ODNR #25)	1,198.60 RM ** (0 sqm)	Exceptional warmwater habitat	2012,2011	29	Poor	6.98	N/A	N/A	N/A	N/A	N/A

P = Poor, F = Fair, MG = Marginally Good, G= Good, VG = Very Good, E = Exceptional
Full attainment status is highlighted in blue, partial in yellow, and non-attainment in red. Scores leading to partial or non-attainment at a WWH sampling point are outlined in red.
*Sample type: Boat, Night, Electrosphere. Bottom type: Rock/rubble.
** Lake Erie Shoreline data point, not a river mouth

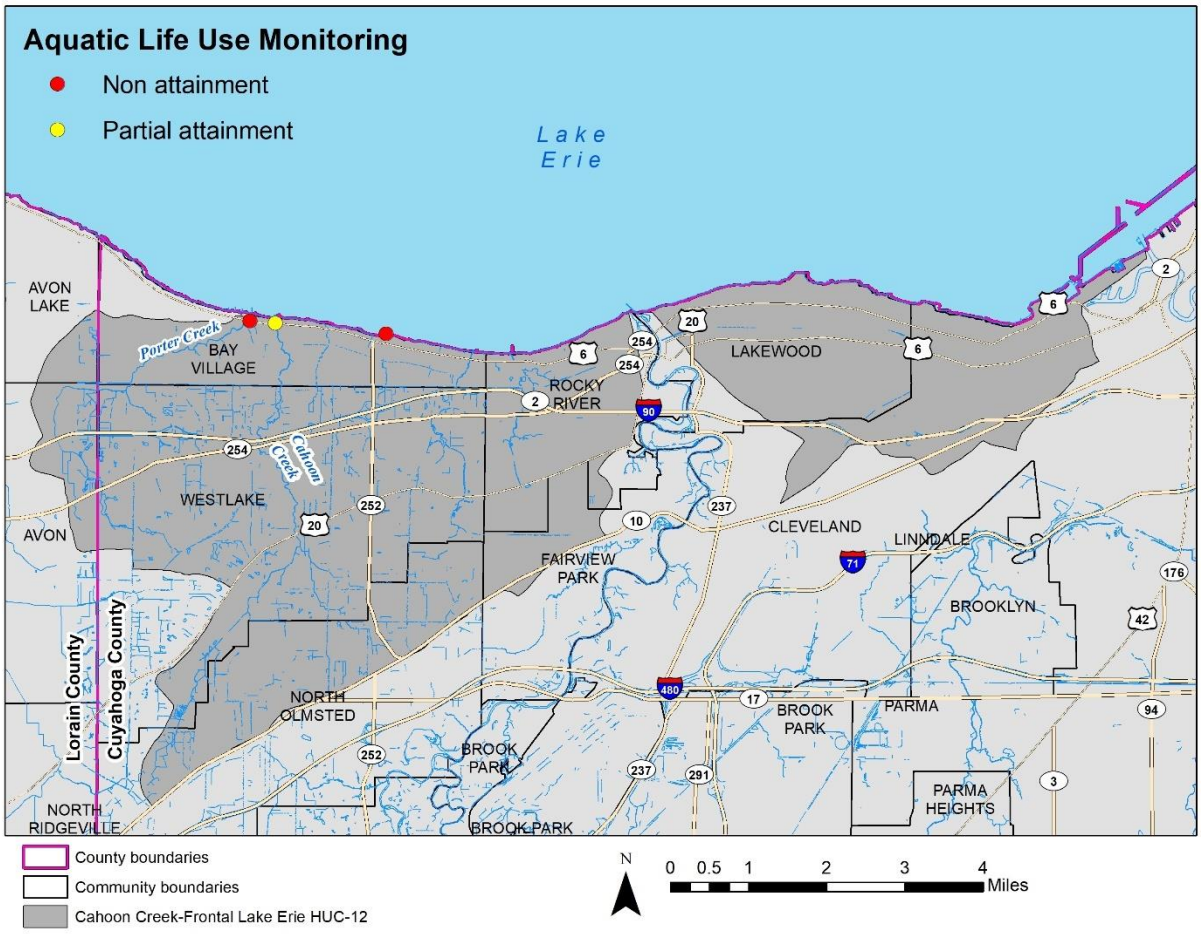


Figure 12: Aquatic Life Use (ALU) Assessment Points in HUC-12 (Ohio EPA Integrated Report 2018)

Huntington Reservation has an average Ohio Rapid Assessment Method (ORAM) score of 40 and Bradley Woods has an average score of 49. Huntington Reservation has a relatively high percentage of wetland acreage scored as Category III (Durkalec *et al.* 2009).

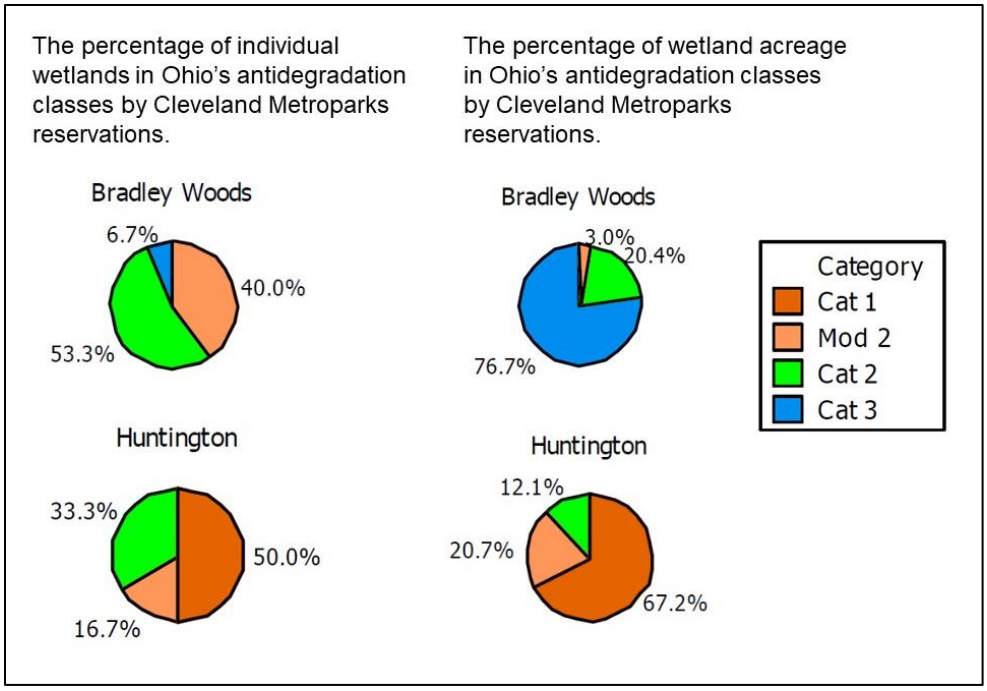


Figure 13: ORAM Scores for Huntington and Bradley Woods Reservations (Source: Durkalec et al. 2009).

Sampling conducted by Cuyahoga SWCD and CRWP in 2018 indicates a poor to fair macroinvertebrate community and QHEI narratives ranging from very poor to good. These sampling results, in combination with the elevated levels of developed land cover and impervious surface cover in this watershed lead Cuyahoga SWCD and CRWP to consider the Cahoon Creek- Frontal Lake Erie watershed impaired for the purposes of this NPS-IS, as follows:

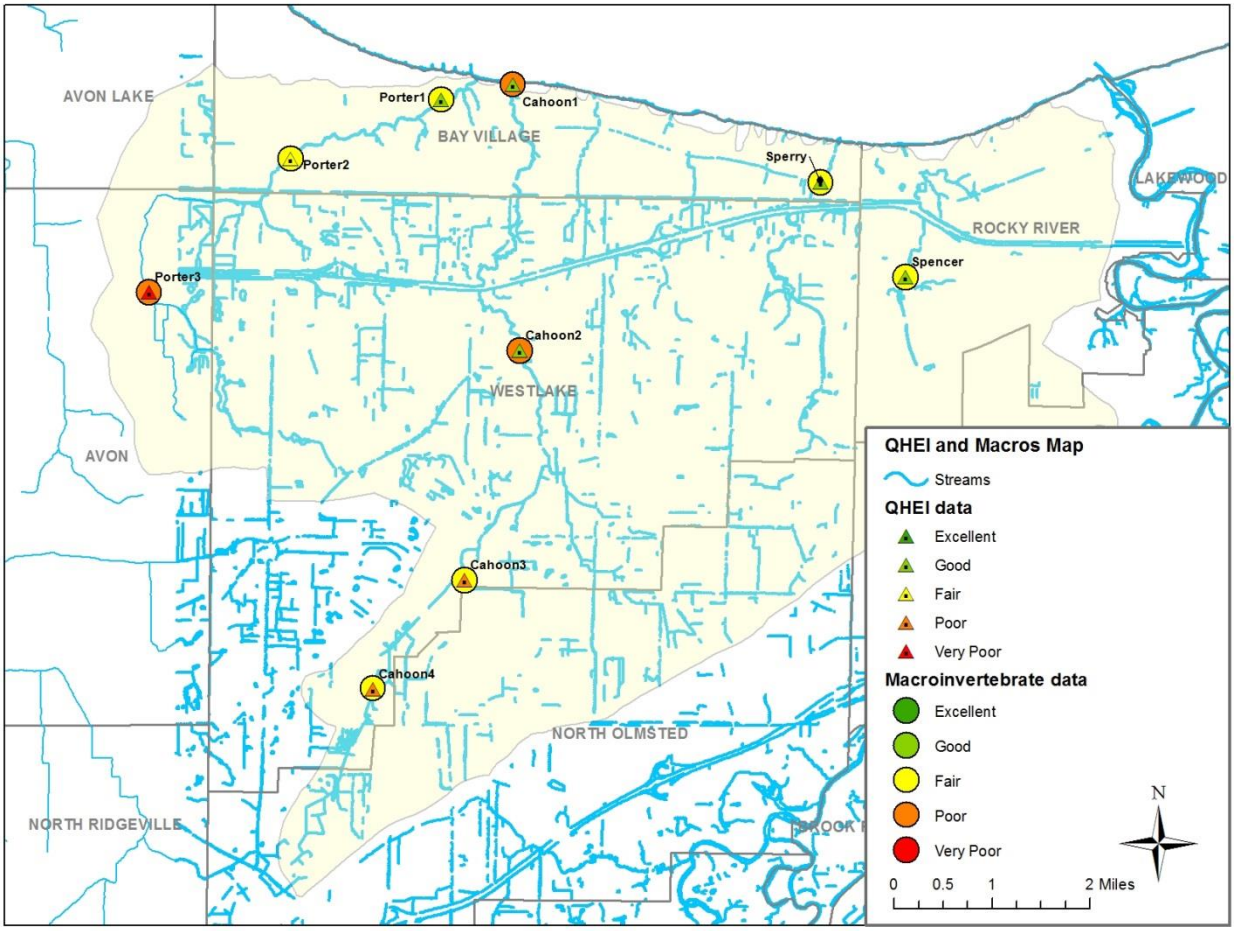


Figure 14: Map of the Cahoon-Frontal Lake Erie Western lobe sampled by Cuyahoga SWCD.

QHEI assessments were made at each site. Macroinvertebrates were sampled at each site to indicate habitat health.

Table 6: Locally Determined Aquatic Life Use Attainment for Cahoon Creek- Frontal Lake Erie Watershed

Site	River Mile (Drainage Area, mi^2)	Macroinvertebrates	QHEI	Attainment Status
Porter Creek 1 @ Porter Creek Dr.	0.4 (8.14)	Fair	Good (61)	Non
Porter Creek 2 @ Ashton Ln.	1.8 (5.82)	Fair	Fair (45)	Non
Porter Creek 3 @ Avon Rd.	3.8 (1.86)	Poor	Very Poor (27)	Non
Cahoon Creek 1 @ Lake Rd.	0.1 (7.52)	Poor	Good (64.5)	Non

Cahoon Creek 2 @ Hilliard Blvd.	2.6 (6.53)	Poor	Good (63)	Non
Cahoon Creek 3 @ Southbridge Cir.	3.6 (2.13)	Fair	Poor (36)	Non
Cahoon Creek 4 @ Crocker Rd.	5.4 (1.54)	Fair	Poor (41.5)	Non
Sperry Creek @ Reese Park	0.2 (3.77)	Fair	Good (57.5)	Non
Spencer Creek @ Lakewood Park Cemetery	0.9 (1.81)	Fair	Good (65.5)	Non

2.3 Summary of NPS Pollution Causes and Associated Sources for Cahoon Creek-Frontal Lake Erie HUC-12

The Ohio EPA Integrated Report (2018) notes other flow regime alterations as a cause of impairment and urban runoff/storm sewers as sources of impairment in this HUC-12. Bacteria is considered a cause of impairment for recreational use. This HUC-12 is considered impaired but a TMDL is needed. Causes and sources of locally determined impairments were determined by field observations by Cuyahoga SWCD and CRWP staff, as well as input from local resident stakeholders and natural resource management agencies.

Table 7: Summary of NPS Pollution Causes and Associated Sources for Cahoon Creek-Frontal Lake Erie HUC-12

Causes	Sources

Habitat Alterations	• Hydromodification
	  ○ Channel straightening/ditching
	  ○ Streambank/streambed hardening
	  ○ Riparian/floodplain development

Sedimentation/Siltation	Streambank modification/destabilization

Stormwater is a major issue in this HUC-12. Unusually heavy rains (totaling 4.44 inches, or 2.52 inches per hour) in North Olmsted damaged hundreds of homes and cars on May 12, 2014. Storm sewers could not accommodate the amount of rain fast enough and basements filled with stormwater and sewage. North Olmsted held public meetings at that time and the Mayor, Kevin Kennedy, announced plans to develop new stormwater retention projects to reduce flooding in the community. North Olmsted also worked to increase the amount of water the city's wastewater treatment plant could process. Residential issues contributing to basement flooding included gutters incorrectly tied into sanitary sewers as indicated by dye testing by the City, as well as gutters not kept clean.

A 2004 water quality study by the Cuyahoga County Board of Healthy found that "the western tributary of Cahoon Creek [Dover Ditch] has the lowest physical, biological, and bacteriological/chemical health in the creek," and it "lacks stream sinuosity, in-stream cover, and riparian zones, which are

essential contributors to stream health." The City of Westlake began a $2.2 million riparian corridor restoration project in fall 2017 that protects and enhances Dover Ditch. This project involves land jointly owned by the City of Westlake and MetroHealth, southeast of Center Ridge and Crocker Road. Dover Creek was formerly an urbanized linear channel flowing through an ill-maintained landscaping dumping ground. The existing stream was restored to include a natural riparian corridor and water settling basins. Native wetland and upland seed mixes were used to restore plant diversity. Sinuosity was also improved, with the channel increasing in length from 2,000 feet to 2,750 feet. The project included the removal of concrete weirs within the channel and creating floodplains on both sides of the new channel. The City of Westlake also enhanced public access with this project by creating a multi-purpose trail and observation deck along the north section of the project. This new trail connects Westlake Sports Park, Evergreen Cemetery (a State of Ohio Historical Landmark), the City-wide bike patch, Crocker Road (potential greenspace), a future Metro Health building, and the Westlake Community Service Center. A Conservation Easement protects the entire ~ 20-acre nature preserve from future development.

Figure 15: Dover Ditch Restoration Project. Photo taken by Jaimie Johnson, Cuyahoga SWCD. October 10, 2018.

Previous projects in the City of Westlake include Porter Creek Restoration (Crocker Basin), Ehle Lateral (Southbridge Basin) funded by the Surface Water Improvement Fund (SWIF), and Wolf Creek (Columbia Basin), also funded by SWIF.

Figure 16: Crocker Road Detention Basin retrofit, City of Westlake (Source: Dan Bogoevski, Ohio EPA)

This HUC-12 has a long history of modifications to streams. There is a historical stone bank retention wall along Porter Creek that is in disrepair at Huntington Reservation.

Figure 17: Retaining walls at Huntington Reservation (Source: Alicia Beattie, September 12, 2018).

Many sections of streams in this HUC-12 were channelized in the past and have low biological diversity.

Figure 18: Porter Creek at Avon Road (Source: Alicia Beattie, September 12, 2018).

Plastic debris is also a significant concern in this HUC-12. Plastic debris often washes up on the Lake Erie shore and along the mouths of creeks.

Figure 19: Plastic debris at mouth of Cahoon Creek at Cahoon Memorial Park. Source: Alicia Beattie, September 12, 2018.

With the large amount of impervious cover and associated stormwater, erosion and failing infrastructure are of concern in this HUC-12.

Figure 20: Failed pipe outlet near mouth of Cahoon Creek (Source: Alicia Beattie, September 12, 2018).

2.4 Additional information for Determining Critical Areas and Developing Implementation Strategies for Cahoon Creek-Frontal Lake Erie HUC-12

2.4.1 Public Input

Two (2) public open houses were held to obtain input from residents, community officials, park districts, and other stakeholders to help inform development of this plan. Open houses were held on October 30, 2018 at North Olmsted Library and November 5, 2018 at Bay Village Library from 6:30 to 7:30 pm with a short presentation at 6 pm. The open houses had a total of thirty-four (34) participants who attended and provided feedback. A survey was also developed and shared with the public to obtain written input. There were fourteen (14) participants who provided input using the survey. The survey and invitations to the open houses were advertised via websites, social media, and a press release. A news article was also published in Cleveland.com and the Westlake - Bay Village Observer to promote the survey and the open houses. Partners reached out to key stakeholders such as communities and park districts to have additional conversations and to gather further input.

Input gathered from the two public open houses:

- Residents noted that North Olmsted may need more retention areas to absorb stormwater.
- Basement flooding in Bay Village noted near Oakland and Lincoln Roads.
- Drainage ditch backing up into basin at 760 Sperry Circle in Westlake.
- Residents interested in greenspace conservation in Bay Village.
- Coastal erosion problems noted throughout Bay Village
- Porter Creek / Huntington Reservation retaining walls and water quality issues.
- Major erosion and slumping of Porter Creek's banks (15-20 feet height) on Edgewood Road in Bay Village. Residents noted that this happened in 2002.

- Wischmeyer Creek erosion at Knickerbocker Road.
- Erosion at 3029 West 231st street, North Olmsted.
- Erosion at 24298 Noreen Rd, North Olmsted.
- Country club estates basin: in-line basin downstream of Lakewood country club experiencing erosion 41°27'01.5"N 81°57'24.4"W.
- Large detention basin retrofit opportunity at 3100 Viking Parkway, Westlake.
- Streambank erosion at 2239 Dover Center Road, Westlake.

Figure 21: North Olmsted Open House October 30, 2018. Photo by Alicia Beattie.

Figure 22: Bay Village Open House November 5, 2018. Photo by Alicia Beattie.

Input gathered from the online survey uncovered the following community concerns:

- Increase in rainfall/storms in Porter Creek north of Wolf Road and east of Bay High School. It was reported that stormwater runoff, erosion, and removal of riparian vegetation are challenges surrounding this issue.
- Erosion issue located along Cahoon Creek at 41.473338, -81.925721 where the roadway is too close to the stream. They have noted streambank erosion and stormwater runoff as challenges surrounding this issue.
- Increase in stormwater volume flowing through Porter Creek from Wolf Road continuing north and throughout residential properties along Edgewood Road on the north bank of Porter Creek.
- Urbanization and stream alteration and piping were recognized as a challenge affecting the watershed.
- Dumping of landscape material, construction material, and litter.
- Flooding, and degraded habitat as challenges in Westlake, reportedly stemmingfrom a lateral ditch running along backyards of Bryandale Drive, which may not not function properly due to partial filling.
- Educating residents and landowners was the top answer for what actions need to be taken to address challenges within the watershed. Other common answers survey participants said was needed to address challenges within the watershed included educating community leaders, staff, and the business community, review and update master plans or zoning regulations, and adopt and implement local watershed conservation codes. Participants also saw the value in restoring riparian areas, streams, and natural flow while protecting streams and wetlands through conservation easements. Participants also saw the need for installing stormwater control measures such as rain gardens, bioretention, green roofs, constructed wetlands, permeable pavement, rainwater harvesting cisterns, enhanced swales or regenerative stormwater conveyance.

Chapter 3: Critical Area Conditions and Restoration Strategies

3.1 Overview of Critical Areas

The Cahoon Creek-Frontal Lake Erie watershed is heavily impacted by urban development. Major issues include larger impervious areas contributing to stormwater runoff, stream channel modification, and riparian deforestation. Critical areas were developed to reflect these issues and address causes and sources of impairment.

Critical Areas include:

Table 8: Critical Areas Nomenclature

Critical Area Name	Nomenclature
Hydromodification/Habitat Modification	HHM
Deforested Riparian Zones	DRZ

Large Impervious Areas	LIA

Hydromodification/Habitat Modification- areas experiencing erosion, channelization or disconnection from the floodplain
Deforested Riparian Zones- riparian zones lacking forest and shrub canopy
Large Impervious Areas- large parking lots and buildings (currently untreated)

Additional Critical Areas are under development and will be included in subsequent versions of the Cahoon-Frontal Lake Erie NPS-IS, which will be submitted to Ohio EPA and USEPA for approval.

3.2 Critical Area 1- Hydromodification/Habitat Modification (HHM)

3.2.1 Detailed Characterization

Critical Area 1- Hydromodification/Habitat Modification (HHM) addresses stream channel segments that have been modified either by direct alteration to the channel (hardening and/or straightening) or through changes to the watershed's hydrology, such as urbanization, that lead to insufficiently-controlled stormwater runoff that in turn alters stream channel form, pattern and profile. These modified streams generally exhibit channel incision, streambank erosion, floodplain disconnection, homogenized bedform and increased substrate embeddedness, all of which contribute to degraded aquatic habitat.

In the Cahoon Creek-Frontal Lake Erie watershed, approximately 31,579 linear feet of stream channel have been identified as modified and are included in the HHM Critical Area. These areas of modified channels were identified by Cuyahoga SWCD through Qualitative Habitat Evaluation Index (QHEI) assessments, stream walks, analysis of geospatial data, including aerial photography, and input from communities and partner organizations.

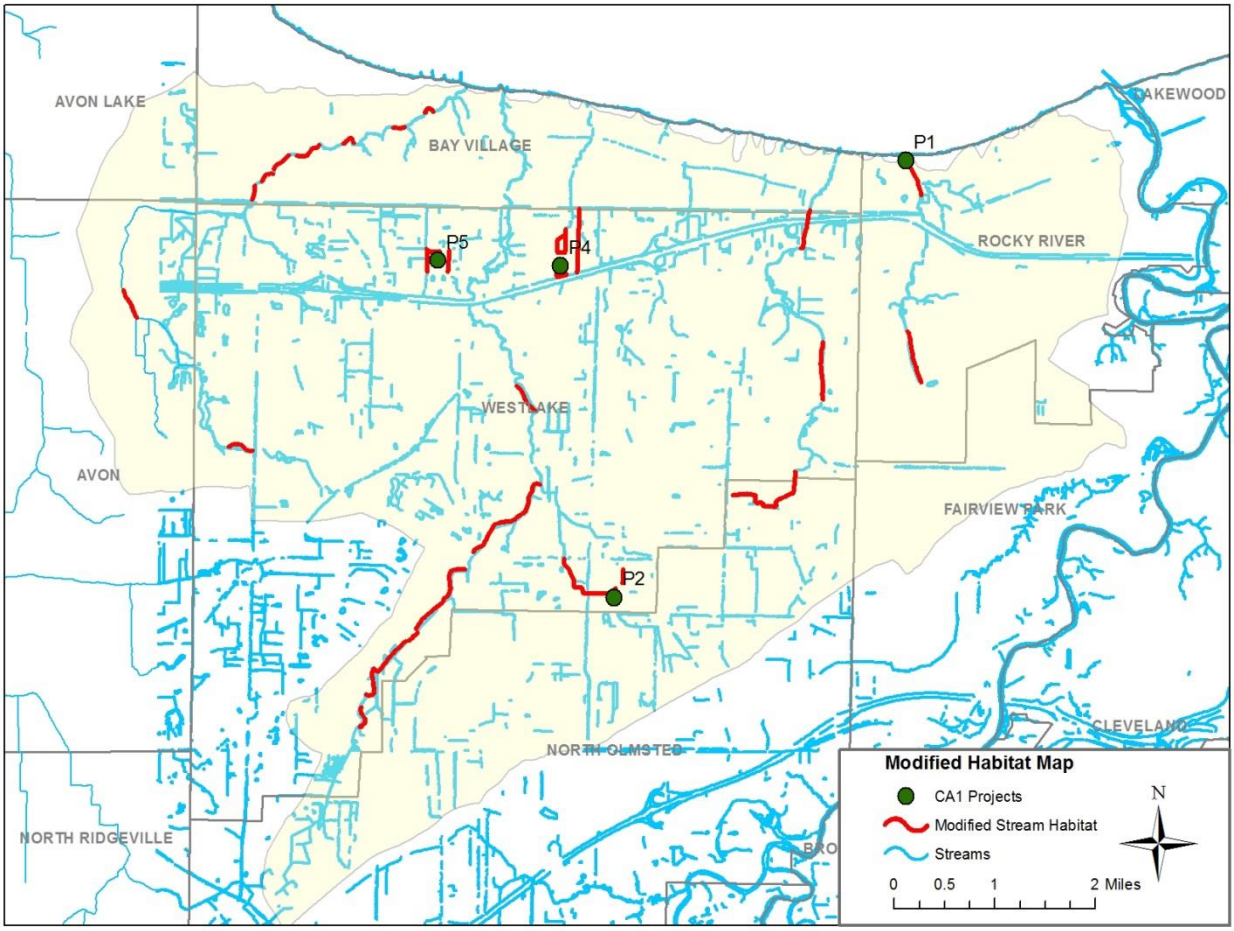


Figure 23: Map of the Cahoon Creek - Frontal Lake Erie Western lobe highlighting parts of the streams that have been modified from their natural form. The red lined tributaries are Critical Area 1 and the green points indicate projects within Critical Area 1. Refer to the project sheet in chapter 4 for project details.

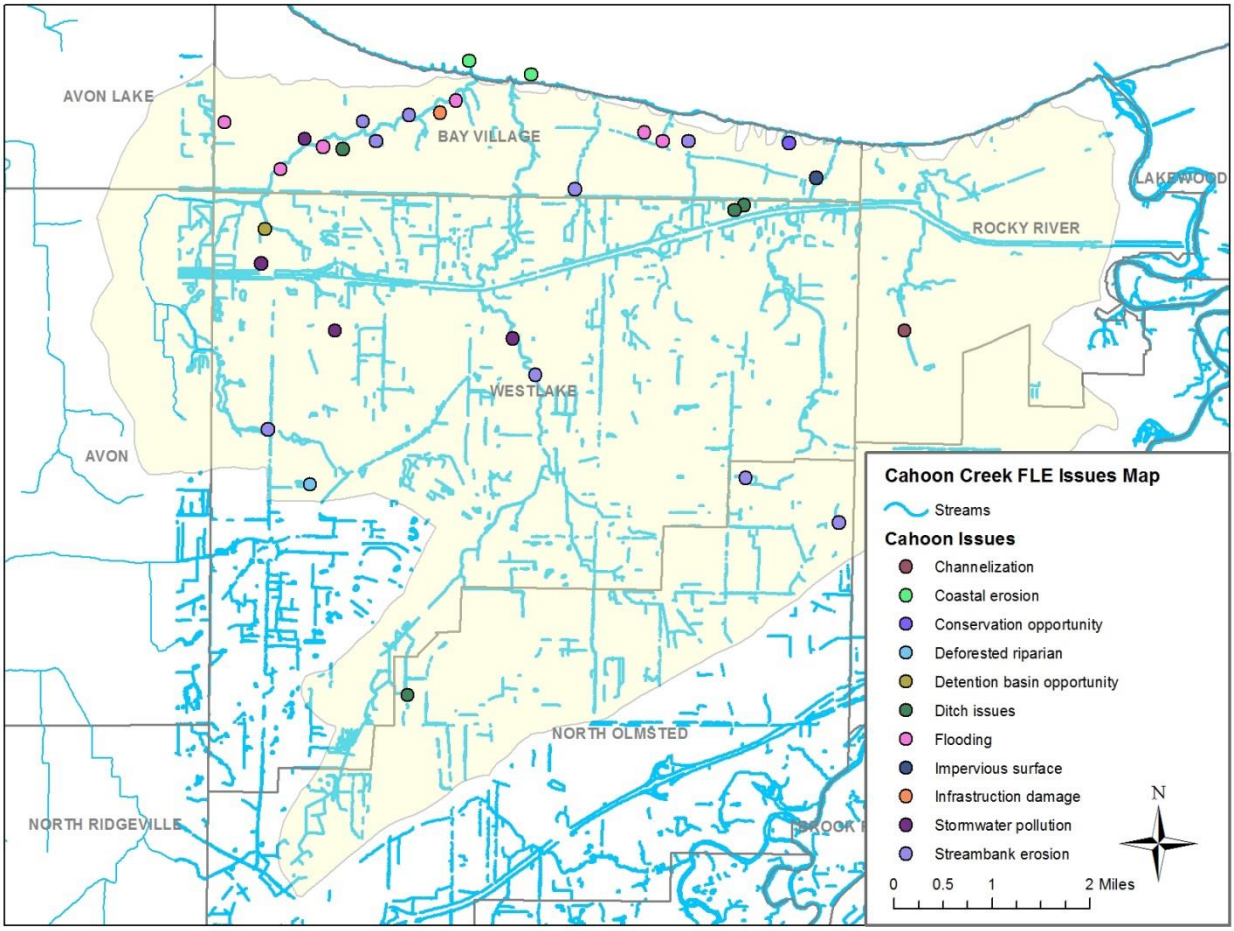


Figure 24: Map of the Cahoon Creek Frontal Lake Erie Western lobe indicating issues that have been brought to our attention by stakeholders and residents of the communities at public meetings.

3.2.2 Detailed Biological Conditions

Shown below are sites where Cuyahoga SWCD with assistance with CRWP performed QHEI assessments and sampled for aquatic macroinvertebrate communities as an indicator of aquatic habitat health. QHEI scores ranged from 27 (Very Poor) to 65.5 (Good). Macroinvertebrate communities all fell in the Poor or Fair categories.

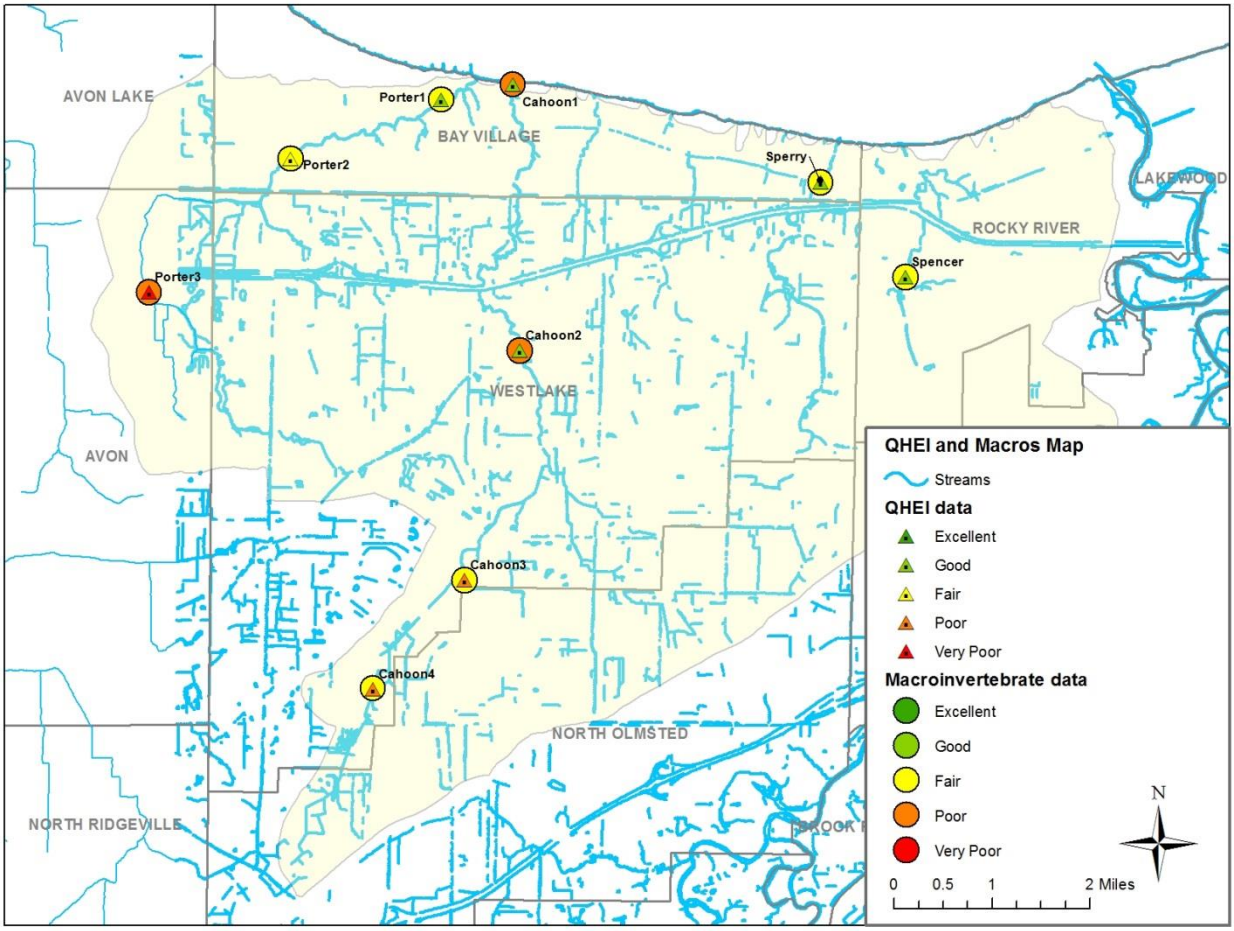


Figure 25: Map of the Cahoon-Frontal Lake Erie Western lobe sampled by Cuyahoga SWCD. QHEI assessments were made at each site. Macroinvertebrates were sampled at each site to indicate habitat health.

Table 9: Macroinvertebrates and QHEI locally determined assessment data (2018)

Site	River Mile (Drainage Area, mi^2)	Macroinvertebrates	QHEI	Attainment Status
Porter Creek 1 @ Porter Creek Dr.	0.4 (8.14)	Fair	Good (61)	Non
Porter Creek 2 @ Ashton Ln.	1.8 (5.82)	Fair	Fair (45)	Non
Porter Creek 3 @ Avon Rd.	3.8 (1.86)	Poor	Very Poor (27)	Non
Cahoon Creek 1 @ Lake Rd.	0.1 (7.52)	Poor	Good (64.5)	Non
Cahoon Creek 2 @ Hilliard Blvd.	2.6 (6.53)	Poor	Good (63)	Non
Cahoon Creek 3 @ Southbridge Cir.	3.6 (2.13)	Fair	Poor (36)	Non
Cahoon Creek 4 @ Crocker Rd.	5.4 (1.54)	Fair	Poor (41.5)	Non
Sperry Creek @ Reese Park	0.2 (3.77)	Fair	Good (57.5)	Non
Spencer Creek @ Lakewood Park Cemetery	0.9 (1.81)	Fair	Good (65.5)	Non

3.2.3 Detailed Causes and Associated Sources

Table 10: Causes and Sources of impairment in Critical Area 1 based on 2018 Integrated Report (IR) and locally determined impairments

Cause	Source

Habitat Modification	• Hydromodification
	  ○ Channel straightening/ditching
	  ○ Streambank/streambed hardening
	  ○ Riparian/floodplain development

Other Flow Regime Alterations	• Urban runoff/storm sewers

3.2.4 Goals and Objectives for Critical Area HHM

Table 11: Goals and Objectives for Critical Area HHM

Goals	Objectives
1: Raise average QHEI score from 45 to 55 for this critical area* 2: Raise average ICI narratives from Poor/Fair to Good	1: Stabilize and restore 31,579 linear feet of stream channel using bioengineering and natural stream channel design techniques

**Average QHEI has been determined based on QHEI scores that fall within Critical Area 1 where habitat has been modified*

The following sites were used to determine the average QHEI score for Critical Area 1 based on sections of streams that have been modified: Porter 1, Porter 2, Porter 3, Cahoon 2, Cahoon 3, and Cahoon 4. As this objective is implemented, water quality monitoring (both projects related and regularly scheduled monitoring) will be conducted to determine progress toward meeting the identified goals (i.e., water quality standards). This objective will be reevaluated and modified if determined to be necessary.

3.3 Critical Area 2- Deforested Riparian Zones (DRZ)

3.3.1 Detailed Characterization

Critical Area 2- Deforested Riparian Zone (DRZ) addresses stream channel segments that are lacking forest and shrub canopy. A minimum setback of 25 feet is required on each side of all designated watercourses in order to properly serve as a buffer to pollutants entering a stream from runoff, to control erosion, and to provide habitat and nutrient input into the stream.

In the Cahoon Creek-Frontal Lake Erie watershed, approximately 111,519 linear feet of stream channel are lacking a healthy riparian buffer of 25 feet on each side of the stream channel and are included in the DRZ Critical Area. These areas of deforested riparian zones were identified by Cuyahoga SWCD through Qualitative Habitat Evaluation Index (QHEI) assessments, stream walks, analysis of geospatial data, including aerial photography, and input from communities and partner organizations.

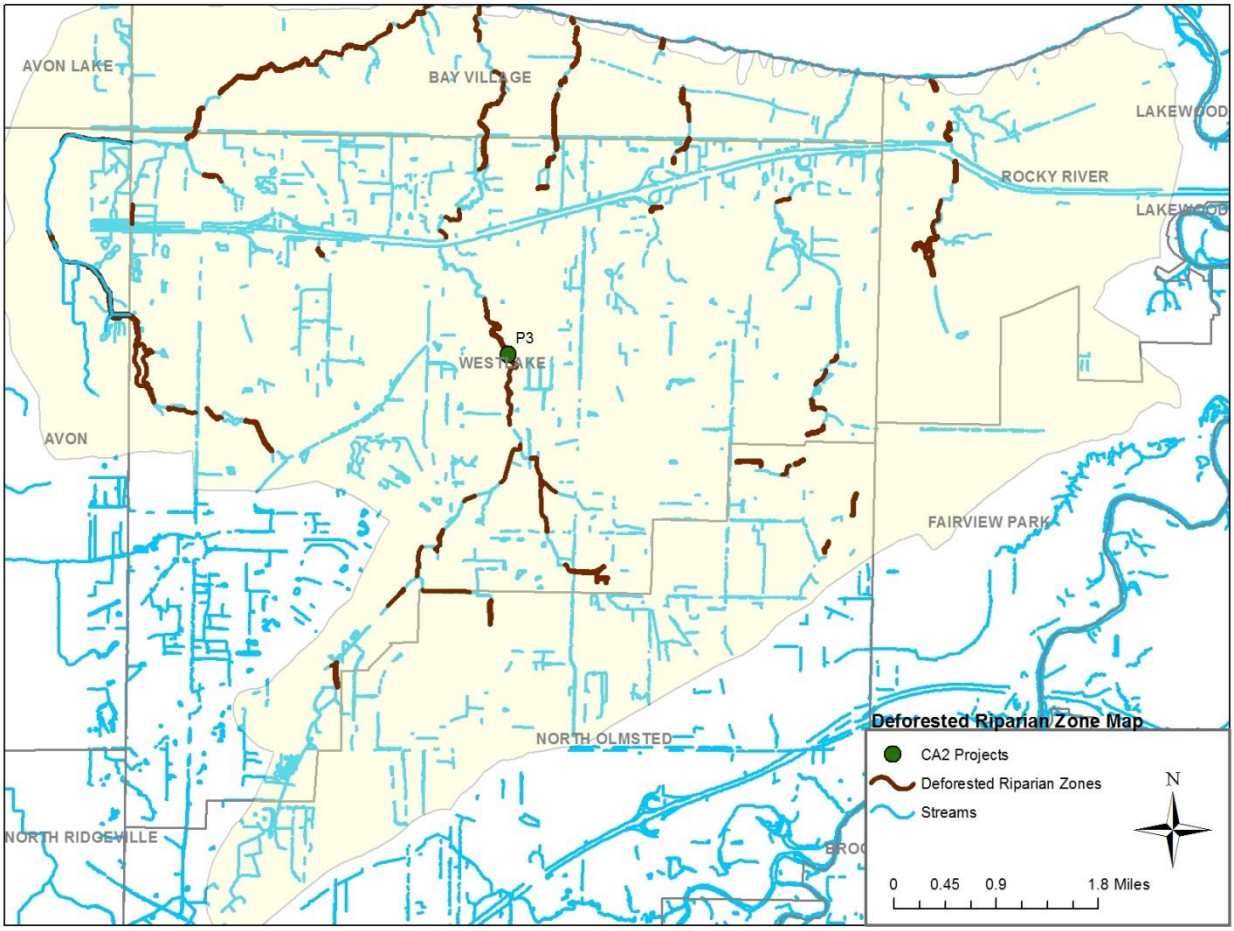


Figure 26: Map of the Cahoon Creek -Frontal Lake Erie Western lobe highlighting parts of the streams that have been identified as highly deforested and in need of restoration. The dark red lined tributaries are Critical Area 2 and the green point indicates a project within Critical Area 2. Refer to the project sheet in chapter 4 for project details.

3.3.2 Detailed Biological Conditions

Sampling by Ohio EPA during the 2014 watershed assessment showed nonattainment in Porter Creek at RM 0.10 based on an IBI score of 34, an ICI narrative of Low Fair, and a QHEI score of 68.3. Results from Cahoon Creek at RM 0.08 showed partial attainment based on an IBI score of 36, an ICI narrative of Fair, and a QHEI score of 58.3. Sampling conducted by Cuyahoga SWCD and CRWP in 2018 indicates a poor to fair macroinvertebrate community and QHEI narratives ranging from very poor to good throughout the watershed. These sampling results, in combination with the elevated levels of developed land cover and impervious surface cover in this watershed lead Cuyahoga SWCD and CRWP to consider the Cahoon Creek- Frontal Lake Erie watershed impaired for the purposes of this NPS-IS. Data is shown below.

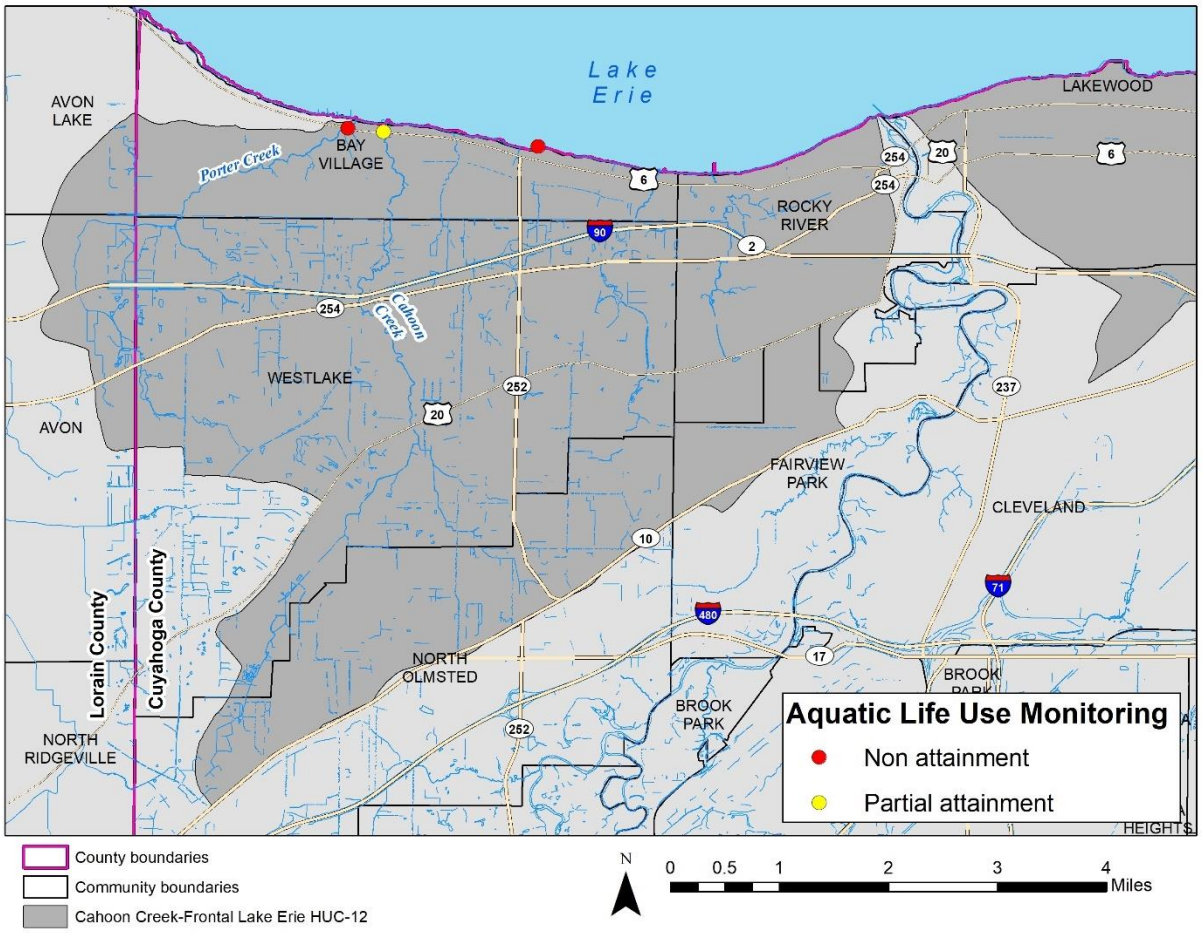


Figure 27: Assessment locations in western lobe of HUC-12 (Source: Ohio EPA Integrated Report 2018).

Table 12: Assessment locations in western lobe of HUC-12 (Source: Ohio EPA Integrated Report 2018)

Station ID	Sample Station Name	River Mile (Drainage Area)	ALU Type	Fish Sample Yr	IBI Score	IBI Desc.	MIwb Score	MIwb Desc.	Bug Sample Year	ICI Score	ICI Desc.	QHEI
T01P20	PORTER CREEK AT BAY VILLAGE @ U.S. RT. 6	0.10 RM (8.30 sqm)	WWH	2014	34	F	N/A	N/A	2014	N/A/	Low Fair	68.3
T01P21	CAHOON CREEK AT BAY VILLAGE @ U.S. RT. 6	0.08 RM (5.40 sqm)	WWH	2014	36	MG	N/A	N/A	2014	N/A	Fair	58.3
301760*	LAKE ERIE SHORELINE E. OF AVON POINT (ODNR #25)	1,198.60 RM** (0 sqm)	Exceptional warmwater habitat	2012,2011	29	Poor	6.98	N/A	N/A	N/A	N/A	N/A

P = Poor, F = Fair, MG = Marginally Good, G= Good, VG = Very Good, E = Exceptional
Full attainment status is highlighted in blue, partial in yellow, and non-attainment in red. Scores leading to partial or non-attainment at a WWH sampling point are outlined in red.
*Sample type: Boat, Night, Electrosphere. Bottom type: Rock/rubble.
** Lake Erie Shoreline data point, not a river mouth

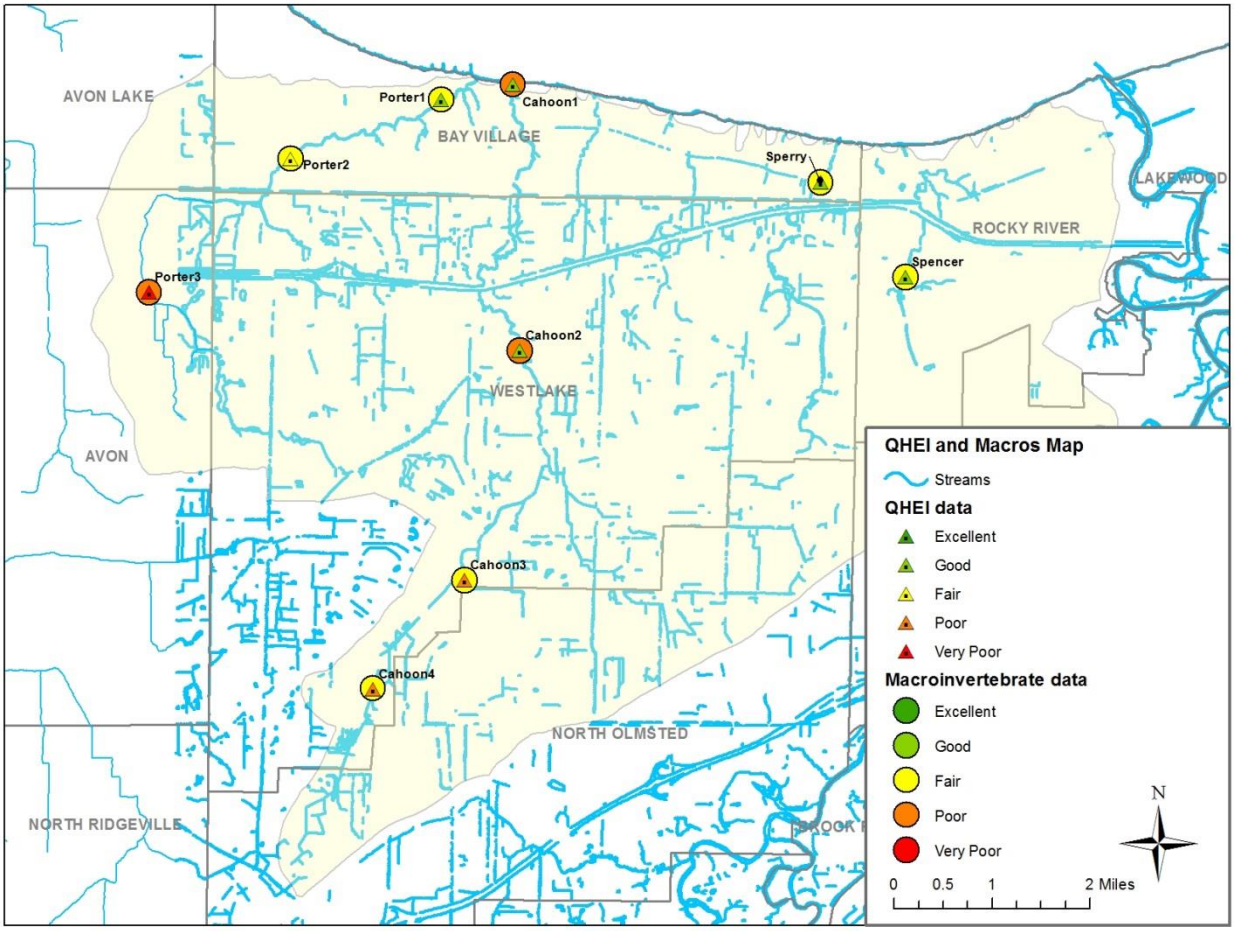


Figure 28: Map of the Cahoon-Frontal Lake Erie Western lobe sampled by Cuyahoga SWCD. QHEI assessments were made at each site. Macroinvertebrates were sampled at each site to indicate habitat health.

Table 13: Macroinvertebrates and QHEI locally determined assessment data (2018)

Site	River Mile (Drainage Area, mi^2)	Macroinvertebrates	QHEI	Attainment Status
Porter Creek 1 @ Porter Creek Dr.	0.4 (8.14)	Fair	Good (61)	Non
Porter Creek 2 @ Ashton Ln.	1.8 (5.82)	Fair	Fair (45)	Non
Porter Creek 3 @ Avon Rd.	3.8 (1.86)	Poor	Very Poor (27)	Non
Cahoon Creek 1 @ Lake Rd.	0.1 (7.52)	Poor	Good (64.5)	Non
Cahoon Creek 2 @ Hilliard Blvd.	2.6 (6.53)	Poor	Good (63)	Non
Cahoon Creek 3 @ Southbridge Cir.	3.6 (2.13)	Fair	Poor (36)	Non
Cahoon Creek 4 @ Crocker Rd.	5.4 (1.54)	Fair	Poor (41.5)	Non
Sperry Creek @ Reese Park	0.2 (3.77)	Fair	Good (57.5)	Non
Spencer Creek @ Lakewood Park Cemetery	0.9 (1.81)	Fair	Good (65.5)	Non

3.3.3 Detailed Causes and Associated Sources

Table 14: Causes and Sources of Impairment in Critical Area 2

Cause	Source
Other Flow Regime Alterations	Deforested riparian zone*

**Locally determined source*

3.3.4 Goals and Objectives for Critical Area DRZ

Table 15: Goals and Objectives for Critical Area 2

Goals	Objectives
1: Raise average QHEI score from 51 to 55 for this critical area* 2: Raise average ICI narratives from Poor/Fair to Good	1: Restore riparian buffer along 111,519 linear feet of stream channel.

**Average QHEI has been determined based on QHEI scores that fall within Critical Area 2 where streams are lacking riparian buffer*

The following sites were used to determine the average QHEI score for Critical Area 2 based on sections of streams that are heavily deforested: Porter 1, Porter 2, Porter 3, Cahoon 1, Cahoon 2, Cahoon 3, and Spencer Creek. As this objective is implemented, water quality monitoring (both projects related and regularly scheduled monitoring) will be conducted to determine progress toward meeting the identified goals (i.e., water quality standards). This objective will be reevaluated and modified if determined to be necessary.

3.4 Critical Area 3- Large Impervious Areas (LIA)

3.4.1 Detailed Characterization

Critical Area 3- Large Impervious Areas (LIA) addresses portions of the watershed that are heavily impacted by urbanization and contain a large area of impervious surfaces such as parking lots and buildings. Large impervious areas can negatively impact a watershed by increasing the quantity and rate at which urban runoff is delivered to the channel, and by increasing the pollutant load that is subsequently discharged.

Approximately 27.7% of the Western lobe of the Cahoon Creek-Frontal Lake Erie watershed consists of impervious surfaces included in the LIA Critical Area. These large areas of impervious surfaces were identified through the Cuyahoga County Tree Canopy Assessment. If the percentage of impervious area from the Eastern lobe is added to the total percentage of impervious area in the Western lobe, the total increases to 34.1% impervious area. However, considering there are no above-ground streams in the Eastern lobe, those measurements will be excluded in this version of the NPS-IS.

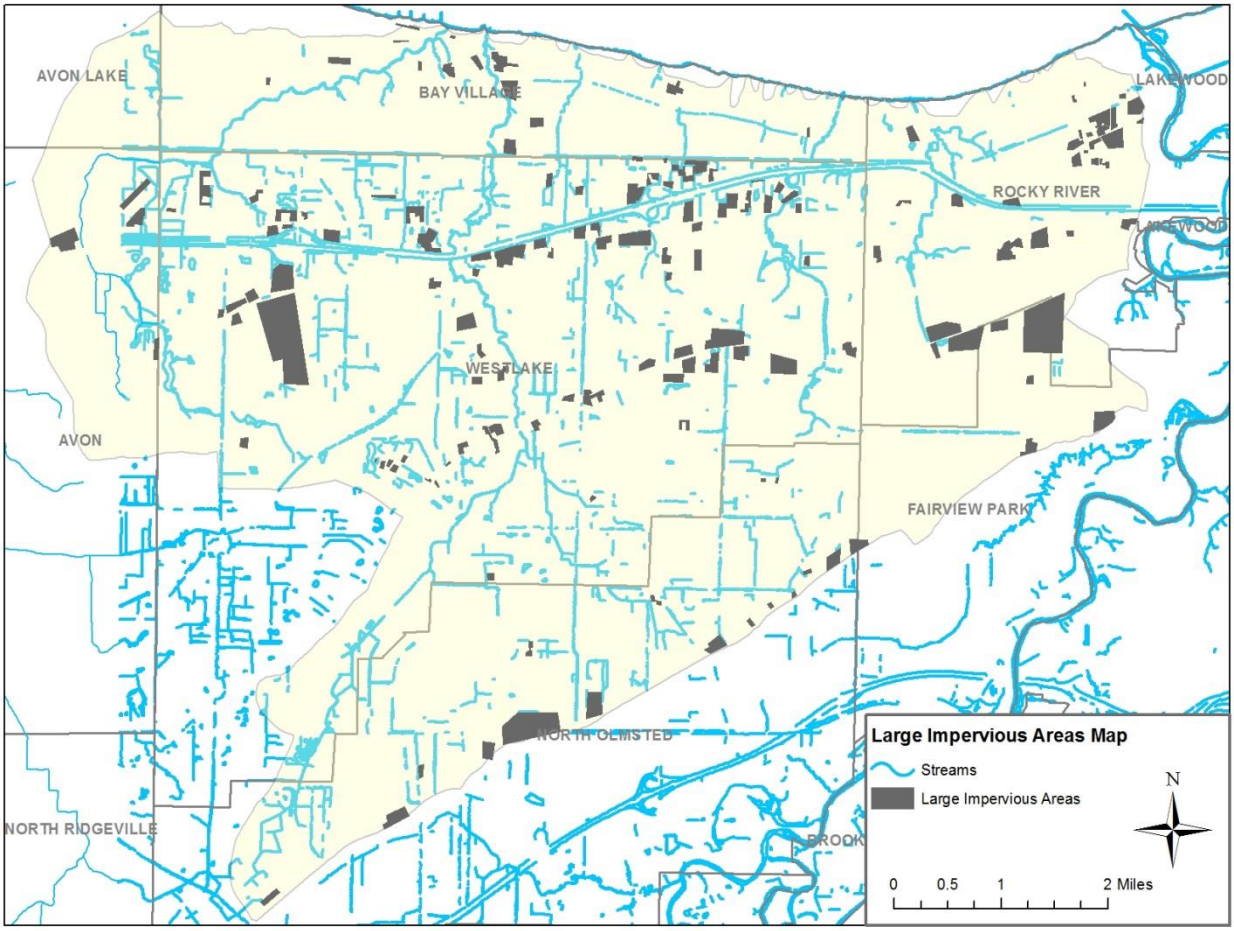


Figure 29: Map of the Cahoon Creek - Frontal Lake Erie Western lobe indicating large impervious areas. The grey polygons are Critical Area 3.

3.4.2 Detailed Biological Conditions

Sampling by Ohio EPA during the 2014 watershed assessment showed nonattainment in Porter Creek at RM 0.10 based on an IBI score of 34, an ICI narrative of Low Fair, and a QHEI score of 68.3. Results from Cahoon Creek at RM 0.08 showed partial attainment based on an IBI score of 36, an ICI narrative of Fair, and a QHEI score of 58.3 (see map and table from section 3.3.2).

3.4.3 Detailed Causes and Associated Sources

Table 16: Detailed Causes and Sources of Impairment in Critical Area 3

Cause	Source
Other Flow Regime Alterations	• Urban runoff/storm sewers ○ Large impervious areas

3.4.4 Goals and Objectives for Critical Area LIA

Table 17: Goals and Objectives for Critical Area 3

Goals	Objectives
1: Raise average QHEI score from 51 to 55 for this critical area* 2: Raise average ICI narratives from Poor/Fair to Good	1: Reduce the rate and amount of stormwater runoff by mitigating 10% of the 27.7% (1299 acres) of impervious area.

**This average QHEI pertains to the watershed as a whole*

As this objective is implemented, water quality monitoring (both project related and regularly scheduled monitoring) will be conducted to determine progress toward meeting the identified goals (i.e., water quality standards). This objective will be reevaluated and modified if determined to be necessary.

Chapter 4: Projects and Implementation Strategy

This section outlines projects and evaluations that are believed to be necessary to remove the impairments on the Cahoon Creek-Frontal Lake Erie HUC-12 as a result of the identified causes and associated sources of nonpoint source pollution. Because attainment status is based on biological conditions, it will be necessary to periodically reevaluate the status of the critical areas 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 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.

For the Cahoon Creek-Frontal Lake Erie HUC-12, there will be one Project and Implementation Strategy Overview Table that calls out relevant critical areas for each proposed project. 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 landowner willingness to engage in projects that are designed to address the causes and sources of impairment or where there is an expectation that such potential projects will improve water quality in the Cahoon Creek-Frontal Lake Erie HUC-12.

Priority 3: Input from the public on water quality issues and/or project ideas gathered from a permanent online survey and periodic stakeholder meetings will be evaluated for correlation between known causes and sources and potential for inclusion in the NPS-IS.

Projects and Project Summary Sheets are in sections 4.1 and 4.2. These summary sheets 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 summary sheets created will be submitted to the state of Ohio for funding eligibility verification (i.e., all nine elements are included).

4.1 Projects and Implementation Strategy Overview Table

The information included in the Critical Areas Overview Table is a condensed overview of all identified projects needed for nonpoint source restoration of the Cahoon Creek-Frontal Lake Erie HUC-12. Project Summary Sheets are included for short term projects or any project that is considering seeking funding soon. Only those projects with complete Project Summary Sheets will be considered for state and federal NPS program funding.

The Cahoon Creek-Frontal Lake Erie HUC-12 Critical Areas are based on nonattainment and partial attainment statuses of ALU designation at Porter Creek, Cahoon Creek, and the Lake Erie shoreline. The overview Table provides a quick summary of what needs to be done, where, and what problem (cause/source) will be addressed and includes projects at all levels of development (i.e., concept, needs funding, in progress). This Overview Table is intended to show a prioritized path toward the restoration of the Cahoon Creek-Frontal Lake Erie HUC-12.

Table 4.1: Critical Area Overview Table: Cahoon Creek-Frontal Lake Erie Watershed HUC-12 (04110001 02 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								
CA- 1	1, 2	1, 2 1, 2	P1	Bradstreet's Landing Restoration Project	Smith Group JJR, Westbrook Assoc. Engineers Inc, Cuyahoga SWCD	Short Term	$400,000	319, GLRI
CA- 1 CA- 2	1, 2 1, 2	1, 2 1, 2	P2	Woodpath Basin Stormwater Wetland Retrofit Project	City of Westlake, Cuyahoga SWCD	Short Term	$900,000	GLRI
CA- 2 CA- 3	1, 2 1, 2	1, 2 1, 2	P3	Dover Congregational Church Riparian Erosion Project	Cuyahoga SWCD	Short Term	$50,000	319
CA- 1 CA- 2	1, 2 1, 2	1, 2 1, 2	P4	Point West Stream Restoration Project	City of Westlake, Cuyahoga SWCD	Short Term	$900,000	WRRSP
CA- 1 CA- 2	1, 2 1, 2	1, 2 1, 2	P5	Clemens Stream Restoration Project	City of Westlake, Cuyahoga SWCD	Short Term	$700,000	WRRSP
CA- 3	1, 2	1, 2	P6	Cleveland Metroparks Rain Gardens Project	Cuyahoga SWCD, Cleveland Metroparks	Medium Term	TBD	GLRI, SOGL, Private Foundation
CA- 3	1, 2	1, 2	P7	Recreational Center Green Infrastructure Project	Cuyahoga SWCD	Medium Term	TBD	GLRI, SOGL
Agricultural Nonpoint Source Reduction Strategies								
High Quality Waters Protection Strategies								
Other NPS Causes and Associated Sources of Impairment								

4.2 Project Sheets for Cahoon Creek-Frontal Lake Erie HUC-12 (04110001 02 04)

Table 18: Bradstreet's Landing Restoration Project #1

Nine Element Criteria	Information needed	Explanation
n/a	**Title**	Bradstreet Landing Restoration Project
criteria d	**Project Lead Organization & Partners**	Smith Group JJR, Westbrook Associated Engineers, Inc., Cuyahoga SWCD
criteria c	**HUC-12 and Critical Area**	Cahoon Creek-Frontal Lake Erie (HUC-12: 04110001 02 04), Critical Area 1 (Hydromodification/Habitat Modification)
criteria c	**Location of Project**	22400 Lake Rd. Rocky River, OH 44116 Approximate coordinates: 41.482715, -81.867573
n/a	**Which strategy is being addressed by this project?**	Altered Stream and Habitat Restoration
criteria f	**Time Frame**	Short Term (Priority) (1-3 years)
criteria g	**Short Description**	This project will improve habitat, increase ecological diversity, and improve water quality at the mouth of Spencer Creek where it flows into Lake Erie. The eroding streambank will be restored, and invasive vegetation removed. These efforts will help expand views and fishing access to the creek as the natural floodplain is restored.
criteria g	**Project Narrative**	This project will join the City of Rocky River and Cuyahoga SWCD in order to help restore the mouth of Spencer Creek to a more natural estuarine/coastal wetland type of habitat. This project will take place at Bradstreet's landing, where Spencer Creek meets Lake Erie. This project will help address habitat modification due to development and urbanization and will help prevent further erosion and sediment loading into Lake Erie.
criteria d	**Estimated Total cost**	$400,000
criteria d	**Possible Funding Source**	319, GLRI
criteria a	**Identified Causes and Sources**	Habitat Modification: Channel straightening/ditching, streambank/streambed hardening, riparian/floodplain development. Other Flow Regime Alterations: Habitat alterations, urban runoff/storm sewers.
criteria b & h	**Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?**	A goal for this Critical Area is to raise the average QHEI score for this area from 37 to 60 (Goal 1). One objective to reach that goal is to stabilize and restore 31,579 linear feet of the stream channel using bioengineering and natural stream channel design techniques (Objective 1).
	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 800 feet of stream mouth habitat by using bioengineering and natural channel design methods as discussed in Objective 1. It is anticipated that upon completion this project will help achieve Goal 1 by restoring 2.5% of the overall critical area and increasing the average QHEI score to a minimum of 55.
	Part 3: Load Reduced?	*9.7 tons of sediment/yr., 5.1 lbs. P/yr., 13.2 lbs. N/yr.*
criteria i	**How will the effectiveness of this project in addressing the NPS impairment be measured?**	Success of this project will be evaluated by post-construction QHEI and macroinvertebrate assessments to determine improvements in stream habitat as a result of this project.
criteria e	**Information and Education**	There will be numerous educational and informational outlets throughout the Bradstreet's Landing Park. Educational efforts will include: • 1 fact sheet • Project updates and highlights posted on 2 websites (Cuyahoga SWCD and the City of Rocky River) • 1 interpretive sign at the project site • Project updates and highlights in organizational newsletters.

Table 19: Woodpath Basin Stormwater Wetland Retrofit Project #2

Nine Element Criteria	Information needed	Explanation
n/a	**Title**	Woodpath Basin Stormwater Wetland Retrofit Project.
criteria d	**Project Lead Organization & Partners**	City of Westlake, Cuyahoga SWCD, Westlake Watershed Group, Cuyahoga Board of Health
criteria c	**HUC-12 and Critical Area**	Cahoon Creek-Frontal Lake Erie (HUC-12: 04110001 02 04), Critical Area 1 (Hydromodification/ Habitat Modification), Critical Area 2 (Deforested Riparian Zone).
criteria c	**Location of Project**	This project area is located at the southern edge of Westlake near the North Olmsted border. The area contains an existing City of Westlake owned stormwater detention basin that is surrounded by residential homes in the Woodpath Trail subdivision. Approximate coordinates: 41.435641, -81.909548
n/a	**Which strategy is being addressed by this project?**	Altered Stream and Habitat Restoration
criteria f	**Time Frame**	Short-Term (Priority) (1-3 years)
criteria g	**Short Description**	This project will retrofit an existing 6-acre city owned detention basin to improve water quality, restore riparian habitat, and address the above identified impairments.
criteria g	**Project Narrative**	The project site proposes the retrofit of an existing city owned stormwater detention area to improve water quality in the Cahoon Creek watershed that has little to no aquatic habitat value and impaired water quality. This demonstration area is located at the southern edge of Westlake and North Olmsted in the Cahoon Creek watershed surrounded by residential homes. The basin will capture runoff from a 350-acre of single-family homes and some commercial properties. This site was selected as a water quality retrofit demonstration project due to impaired runoff coming from the south. The site has easy access through a dedicated easement. Project design elements include proven water quality measures. Wetland forebay pools will be constructed at the discharge of 5 storm sewer outlets to trap sediments. Existing straight stream channels will be regraded to increase sinuosity and length in order to improve pollutant filtration capabilities. The existing mowed grass basin will be revegetated with native wetland vegetation. These new floodplain wetlands would restore native vegetation, prevent erosion, improve creek water quality through the reduction of high sediment and nutrients loads, and educate surrounding residents of the benefits of water quality habitats. These improvements in the Cahoon Creek watershed should raise the existing QHEI score and improve the overall score of Cahoon Creek. The reduction of nitrogen and phosphorus is important in helping mitigate algae blooms in the lake, which are nearby to some popular swimming beaches in Bay Village. The demonstration project site is already owned and managed by the City. High boundary markers will be installed on the riparian edge to clearly delineate public vs private property. This project will restore 1,200 linear feet of stream. The utilization of City staff and a city owned website will keep consultant costs down. This water quality project is an important element of the city's water quality program. After construction, the City staff and the Westlake Watershed Group will monitor the site for success. This monitoring will include: request an as built survey to evaluate grading compliance with plans, monitor for successful vegetation establishment, and monitor for debris accumulation, blockages of channels or structures, or vandalism which could cause erosion.
criteria d	**Estimated Total cost**	$900,000
criteria d	**Possible Funding Source**	GLRI
criteria a	**Identified Causes and Sources**	Other Flow Regime Alterations: urban runoff/storm sewers, deforested riparian zones.

criteria b & h	**Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?**	A goal for this Critical Area is to raise the average QHEI score for this area from 37 to 55 (Goal 1). One objective to reach that goal is to stabilize and restore 31,579 linear feet of the stream channel using bioengineering and natural stream channel design techniques (Objective 1).
	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 1,200 linear feet of stream channel using bioengineering and natural channel design methods. This project will meet 3.8% of the in-stream habitat restoration for Objective 1 for this Critical Area. It is anticipated that upon completion this project will help achieve Goal 1.
	Part 3: Load Reduced?	Load Reduction Estimates: Nitrogen: 539 pounds/yr Phosphorus: 144 pounds/yr Sediment: 87 tons/yr Metals: 243 tons/yr
criteria i	**How will the effectiveness of this project in addressing the NPS impairment be measured?**	Success of this project will be evaluated by post-construction QHEI, macroinvertebrate and/or BEHI assessments to determine improvements in stream habitat as a result of this project.
criteria e	**Information and Education**	Permanent educational interpretive signs will be installed at the site. We will also use the existing City website with a new web page displaying construction photos and other important educational information regarding the project.

Table 20: Dover Congregational Church Riparian Erosion Project #3

Nine Element Criteria	Information needed	Explanation
n/a	**Title**	Dover Congregational Church Riparian Erosion Project
criteria d	**Project Lead Organization & Partners**	Cuyahoga SWCD
criteria c	**HUC-12 and Critical Area**	Cahoon Creek-Frontal Lake Erie (HUC-12: 04110001 02 04), Critical Area 2 (Deforested Riparian Zone), Critical Area 3 (Large Impervious Areas)
criteria c	**Location of Project**	2239 Dover Center Rd. Westlake, OH 44145 Approximate coordinates: 41.455713, -81.920673
n/a	**Which strategy is being addressed by this project?**	Altered Stream and Habitat Restoration
criteria f	**Time Frame**	Short-Term (Priority) (1-3 years)
criteria g	**Short Description**	Due to development, parts of Cahoon Creek at Dover Congregational Church have become deforested and are experiencing erosion. The plan is to stabilize 200 feet of the eroding streambank by using bioengineering and natural stream restoration techniques.
criteria g	**Project Narrative**	This project will join Cuyahoga SWCD with the City of Westlake in order to restore parts of Cahoon Creek. This site is experiencing streambank erosion and has a deforested riparian zone. Tree plantings and other bio-engineering restoration techniques would be beneficial for addressing impairments.
criteria d	**Estimated Total cost**	$50,000
criteria d	**Possible Funding Source**	Ohio EPA 319 program
criteria a	**Identified Causes and Sources**	Other Flow Regime Alterations: urban runoff/storm sewers, deforested riparian zones
criteria b & h	**Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?**	One goal for this Critical Area is to raise the average QHEI score from 51 to 55 (Goal 1). One objective to reach this goal is to restore 111,519 feet of stream channel with riparian reforestation (Objective 1).
	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 200 feet of the 111,519 feet of stream channel in need of reforesting as part of Objective 1 in this Critical Area. It is anticipated that upon completion this project will help achieve Goal 1 for this Critical Area.
	Part 3: Load Reduced?	30.4 tons sediment/yr., 18.7 lbs. P/yr., 48.6 lbs. N/yr.
criteria i	**How will the effectiveness of this project in addressing the NPS impairment be measured?**	Success of this project will be evaluated by post-construction QHEI, macroinvertebrate and/or BEHI assessments to determine improvements in stream habitat as a result of this project.
criteria e	**Information and Education**	This will be a great educational outreach project for the Boy Scouts and other local groups from the Church and City of Westlake. Educational efforts will include: • 1 fact sheet • Project updates and highlights posted on 2 websites (Cuyahoga SWCD and the City of Westlake) • 1 interpretive sign at the project site • Project updates and highlights in organizational newsletters.

Table 21: Point West Stream Restoration Project #4

Nine Element Criteria	Information needed	Explanation
n/a	**Title**	Point West Stream Restoration Project
criteria d	**Project Lead Organization & Partners**	City of Westlake, Cuyahoga SWCD, Westlake Watershed Group, Cuyahoga Board of Health
criteria c	**HUC-12 and Critical Area**	Cahoon Creek-Frontal Lake Erie (HUC-12: 04110001 02 04), Critical Area 1 (Hydromodification/ Habitat Modification), Critical Area 2 (Deforested Riparian Zone)
criteria c	**Location of Project**	The project area is located at the northern edge of Westlake near the Bay Village border. The project incorporates two areas in the Point West subdivision just north of Interstate 90 located off Dover Center Road. The north project location is just north of Kenley Court and the south project area is just south of Sentry Lane abutting Interstate 90. Approximate coordinates: 41.473080, -81.916909
n/a	**Which strategy is being addressed by this project?**	Altered Stream and Habitat Restoration
criteria f	**Time Frame**	Short Term (Priority) (1-3 years)
criteria g	**Short Description**	This project will restore Wischmeyer Creek to improve overall stormwater quality. The creek has been degraded by the development of the Point West subdivision. The project will restore the riparian buffer to protect the stream from runoff pollutants, erosion and re-establish a habitat conducive for stormwater treatment. The project will consist of two locations in the subdivision, North of Kenley Court and south of Sentry Lane.
criteria g	**Project Narrative**	The north project location will restore an existing 0.5-acre area consisting of 300 feet of an urbanized straight stream channel. The riparian habitat has been removed and the existing grass buffer is not adequate for erosion prevention and filtering runoff. The north project area will be restored by re-creating the natural stream meander, lengthening the stream to 400 feet. The riparian habitat will be restored with native wetland species to aid in the treatment process. Forebay pools will be constructed at the two discharge locations to breakdown contaminants and incoming sediment. Additional micro-pools will be installed throughout the stream channel to create aquatic wetland habitats to further improve water quality. The south project location will retrofit an existing 1-acre city owned retention basin to enhance the water quality. The basin collects a majority of the watershed's drainage area including runoff from interstate 90. This is ideally located to effectively treat the majority of the Westlake Wischmeyer watershed as the restoration will take place close to the Bay Village border. The riparian buffer will be re-established to introduce stormwater treatment in a largely residential area. The south project area will eliminate the existing retention basin and re-establish the natural creek corridor. The newly created corridor will serpentine throughout the project area to maximize the contact time with the restored riparian vegetation. A forebay will be installed at the one discharge point to trap sediment. Additional micro-pools will be installed to create various habitats to breakdown sediment and other contaminants. The project will restore 700 linear feet of stream and will effectively treat a majority of the Wischmeyer watershed.
criteria d	**Estimated Total cost**	$900,000
criteria d	**Possible Funding Source**	WRRSP
criteria a	**Identified Causes and Sources**	Other Flow Regime Alterations: urban runoff/storm sewers, deforested riparian zones
criteria b & h	**Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?**	A goal for this Critical Area is to raise the average QHEI score for this area from 37 to 55 (Goal 1). One objective to reach that goal is to stabilize and restore 31,579 linear feet of the stream channel using bioengineering and natural stream channel design techniques (Objective 1).
	Part 2: How much of the needed improvement for the whole Critical Area is *estimated* to be accomplished	This project will restore 700 linear feet of stream, effectively treating a majority of the Wischmeyer watershed, by using bioengineering and natural channel design methods. This project will meet 2.2% of the in-stream habitat restoration for Objective 1 in this Critical Area.

	by this project?	It is anticipated that upon completion this project will help achieve Goal 1.
	Part 3: Load Reduced?	17 tons sediment/yr., 12 #P/yr., 31.2 #N/yr.)
criteria i	**How will the effectiveness of this project in addressing the NPS impairment be measured?**	Success of this project will be evaluated by post-construction QHEI, macroinvertebrate and/or BEHI assessments to determine improvements in stream habitat as a result of this project.
criteria e	**Information and Education**	Permanent educational interpretive signs will be installed at the site. We will also use the existing city website with a new web page displaying construction photos and other important information regarding the project.

Table 22: Clemens Stream Restoration Project #5

Nine Element Criteria	Information needed	Explanation
n/a	**Title**	Clemens Stream Restoration Project
criteria d	**Project Lead Organization & Partners**	City of Westlake, Cuyahoga SWCD, Westlake Watershed Group, Cuyahoga Board of Health
criteria c	**HUC-12 and Critical Area**	Cahoon Creek-Frontal Lake Erie (HUC-12: 04110001 02 04), Critical Area 1 (Hydromodification/ Habitat Modification), Critical Area 2 (Deforested Riparian Zone)
criteria c	Location of Project	The project area is in the northwest corner of Westlake in a mostly commercial area on Clemens Road in Westlake. The existing site is a 2.3-acre city owned detention basin containing concrete flow channels to convey stormwater. The detention basin drains into the nearby creek to the west which is a tributary of Porter Creek. Approximate coordinates: 41.472669, -81.935228
n/a	**Which strategy is being addressed by this project?**	Altered Stream and Habitat Restoration
criteria f	**Time Frame**	Short Term (Priority) (1-3 years)
criteria g	**Short Description**	This project will establish stormwater quality treatment in this industrial area of Westlake. The existing detention basin and concrete flow channels now present do little to improve stream health as their function is primarily storm storage and conveyance. The project will restore native wetland habitat by creating a new stream corridor with proper native riparian vegetation. Stormwater quality will be greatly improved in an area where little to no habitat currently exists.
criteria g	**Project Narrative**	The existing detention basin and concrete flow channel will be removed, and 800 feet of new stream channel will be created. The 2.3-acre area will be re-established with native wetland species to create a natural riparian buffer essential for stormwater treatment. Four (4) forebays will be installed at each discharge point to catch sediment prior to entering the stream corridor. Additional micro-pools will be installed throughout the channel to decrease the flow velocity and maximize treatment time in the wetland preserve. Educational signs will be installed along Clemens Road to inform the public on the importance of the project. The project will create 800 feet of additional stream to treat stormwater runoff in an industrial area where no such habitats exist. The restoration project will benefit the Porter Creek watershed in Westlake which is a direct tributary to Lake Erie. The open location and proximity to Clemens Road will create good publicity and educational opportunities.
criteria d	**Estimated Total cost**	$700,000
criteria d	**Possible Funding Source**	WRRSP
criteria a	**Identified Causes and Sources**	Other Flow Regime Alterations: urban runoff/storm sewers, deforested riparian zones
criteria b & h	**Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?**	A goal for this Critical Area is to raise the average QHEI score for this area from 37 to 55 (Goal 1). One objective to reach that goal is to stabilize and restore 31,579 linear feet of the stream channel using bioengineering and natural stream channel design techniques (Objective 1).
	Part 2: How much of the needed improvement for the whole Critical Area is *estimated* to be accomplished by this project?	This project will create 800 feet of additional stream to treat stormwater runoff and meet 2.5% of the in-stream habitat restoration stated in Objective 1 for this Critical Area. It is anticipated that upon completion this project will help meet Goal 1 for this Critical Area.
	Part 3: Load Reduced?	1.6 tons sediment/yr., 9.3 #P/yr., 0 #N/yr.)
criteria i	**How will the effectiveness of this project in addressing the NPS impairment be measured?**	Success of this project will be evaluated by post-construction QHEI, macroinvertebrate and/or BEHI assessments to determine improvements in stream habitat as a result of this project.
criteria e	**Information and Education**	Permanent educational interpretive signs will be installed at the site. We will also use the existing city website with a new web page displaying construction photos and other important information regarding the project.

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Appendix

Appendix A: Acronyms and Abbreviations

A	
ALU	Aquatic Life Use
B	
BEHI	Bank Erosion Hazard Index
C	
C-CAP	Coastal Change Analysis Program
CRWP	Chagrin River Watershed Partners, Inc.
CZD	Coastal Zone Degradation
D	
DRZ	Deforested Riparian Zone
E	
EPA	Environmental Protection Agency
H	
HHM	Hydromodification/Habitat Modification
HUC	Hydrologic Unit Code
I	
IBI	Index of Biological Integrity
ICI	Invertebrate Community Index
L	
LIA	Large Impervious Area
M	
MIwb	Modified Index of Well-being
N	
NEORSD	Northeast Ohio Regional Sewer District
NOAA	National Oceanic and Atmospheric Administration
NOACA	Northeast Ohio Areawide Coordinating Agency
NPS	Non-point Source
NPS-IS	Nonpoint Source Implementation Strategic Plan
NWI	National Wetlands Inventory
O	

ODNR	Ohio Department of Natural Resources
ORAM	Ohio Rapid Assessment Method

Q

QHEI	Qualitative Habitat Evaluation Index

S

SWCD	Soil and Water Conservation District

U

USGS	United States Geological Survey