

Nine-Element Nonpoint Source Implementation Strategic Plan (NPS- IS) for Otter Creek-Frontal Lake Erie HUC-12 (04100010 07 06)



Version 1.0 created by the University of Toledo, City of Toledo, Partners for Clean Streams and the Toledo-Lucas County Sustainability Commission; approved May 12, 2017.

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Partners for Clean Streams (PCS) would like to acknowledge the collaboration of multiple partners in the updating of the Nonpoint Source Implementation Strategy (NPS-IS) for the **Otter Creek-Frontal Lake Erie HUC-12**. This update builds upon the work of the original Version 1.0 plan sponsors (City of Toledo - Division of Environmental Services, the University of Toledo, the Toledo-Lucas County Sustainability Commission and PCS), which occurred in 2017. These partners, and many others in the Toledo metropolitan region, contributed background information, insight into objectives and projects for inclusion in this NPS-IS. Thank you to those partners who continued the original efforts by providing information for this Version 2.0 update. Special thanks to Rick Wilson, Ohio EPA – Division of Surface Water, for guidance throughout the NPS-IS development process. Version 2.0 updates include updated text, inclusion of Maumee Area of Concern information, far-field nutrient reduction targets and re-analysis of critical areas.

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Cover photo: Otter Creek at Consaul and Yarrow Streets in 2010 (Ohio EPA, 2012)

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.

A

ALU	Aquatic Life Use
AOC	Area of Concern
AWS	Agricultural Water Supply

B

BMP	Best Management Practice
BUI	Beneficial Use Impairment
BUI #3a	Beneficial Use Impairment: Degradation of fish populations
BUI #6	Beneficial Use Impairment: Degradation of benthos
BUI #14a	Beneficial Use Impairment: Loss of fish habitat

C

CAFF	Confined Animal Feeding Facility
CAFO	Confined Animal Feeding Operation
cBOD _(5-day)	Carbonaceous Biological Oxygen Demand (5-day)
CFU	Colony Forming Units
COT	City of Toledo
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CSO	Combined Sewer Overflow

D

DAP	Domestic Action Plan
DMDS	Data Management Delisting System

E

<i>E. coli</i>	<i>Escherichia coli</i>
EPT	<i>Ephemeroptera, Plecoptera and Tricoptera</i> (sensitive species)
EQIP	Environmental Quality Incentives Program
EWB	Exceptional Warmwater Habitat

F

FOTG	Field Office Technical Guide
FSA	Farm Service Agency

G

GLC	Great Lakes Commission
GLLA	Great Lakes Legacy Act
GLRI	Great Lakes Restoration Initiative
GLWQA	Great Lakes Water Quality Agreement

H

HAB	Harmful Algal Bloom
HELP	Huron-Erie Lake Plain Ecoregion
HSTS	Home Sewage Treatment Systems
HUC	Hydrologic Unit Code

I

IBI	Index of Biotic Integrity
ICI	Invertebrate Community Index
IJC	International Joint Commission
IWS	Industrial Water Supply

L

LEPF	Lake Erie Protection Fund
LRW	Limited Resource Waterway

M

MAAC	Maumee Area of Concern Advisory Committee
MIwb	Modified Index of Well Being
MS4	Municipal Separate Storm Sewer System
MTA	Metric Tons per Annum
MWH	Modified Warmwater Habitat
MWH-C	Modified Warmwater Habitat-Channelized

N

NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NPS-IS	Nonpoint Source-Implementation Strategy

O

OAC	Ohio Administrative Code
ODA	Ohio Department of Agriculture
ODH	Ohio Department of Health
ODNR	Ohio Department of Natural Resources
ODOT	Ohio Department of Transportation
Ohio EPA	Ohio Environmental Protection Agency
OLEC	Ohio Lake Erie Commission
OpTIS	Operational Tillage Information System

P

PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PCR	Primary Contact Recreation
PCS	Partners for Clean Streams

Q

QHEI	Qualitative Habitat Evaluation Index
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R

RAP	Remedial Action Plan
RM	River Mile

S

SNC	Significant Noncompliance
SWCD	Soil and Water Conservation District

T

TLCS	Toledo -Lucas County Sustainability Commission
TMACOG	Toledo Metropolitan Area Council of Governments
TMDL	Total Maximum Daily Loads
TOC	Total Organic Carbon
TSD	Technical Support Document
TSS	Total Suspended Solids

U

USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

V

VNMP	Voluntary Nutrient Management Plan
VRT	Variable Rate Technology

W

WAP	Watershed Action Plan
WAU	Watershed Assessment Unit
WLEB	Western Lake Erie Basin
WQS	Water Quality Standards (Ohio Administrative Code 3745-1)
WRP	Wetlands Reserve Program
WTP	Water Treatment Plant
WWH	Warmwater Habitat
WWTP	Wastewater Treatment Plant

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CHAPTER 1: INTRODUCTION

The **Otter Creek-Frontal Lake Erie Hydrologic Unit Code (HUC)-12** (04100010 07 06) is located mainly in northern Lucas County, OH, with a negligible portion extending south into Wood County, and contains a watershed of 18.13 square miles (11,602.78 acres) (Figure 1). This sub-watershed includes the area located between the Maumee River eastward to Berger Ditch, and it contains two major streams, Duck Creek and Otter Creek, as well as several agricultural drainage ditches that empty into the western basin of Lake Erie (WLEB) and Maumee Bay. The HUC-12 is immediately downstream of the *Cedar Creek-Frontal Lake Erie HUC-12* (04100010 07 03), where the headwaters of Otter Creek originate (Figure 2¹). Land use within the HUC-12 is primarily developed (~68%), while a quarter of it is dedicated to row crops, mainly in the middle to eastern sections of the sub-watershed.

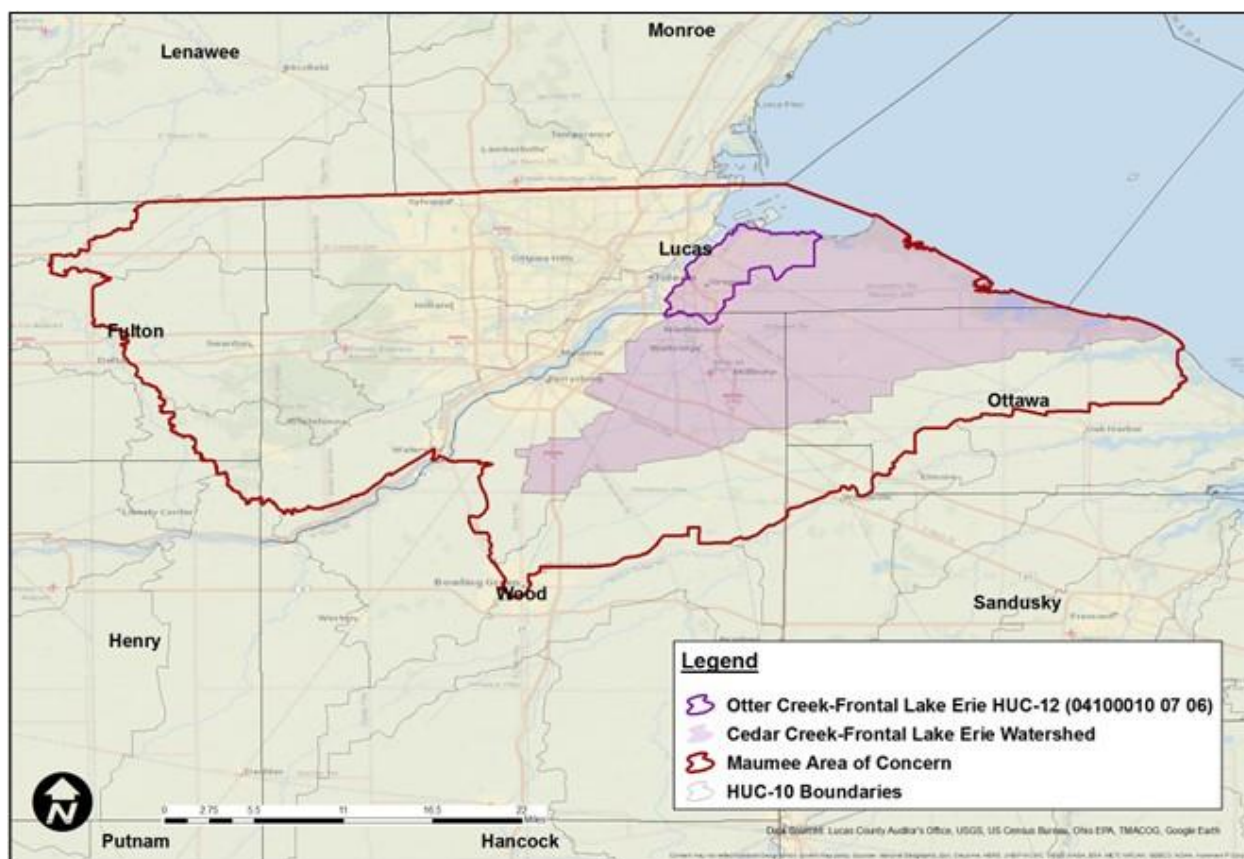


Figure 1: Location of the Otter Creek-Frontal Lake Erie HUC-12 within the Maumee AOC

¹ It should be noted that the river mile maps used in this document were created using data digitized by TMACOG (made available from the PCS DMDS online system) utilizing 2004 aerial photography and may not represent current stream lengths or correlate to other river mile data sets, notably they do not precisely align with Ohio EPA river mile delineations.

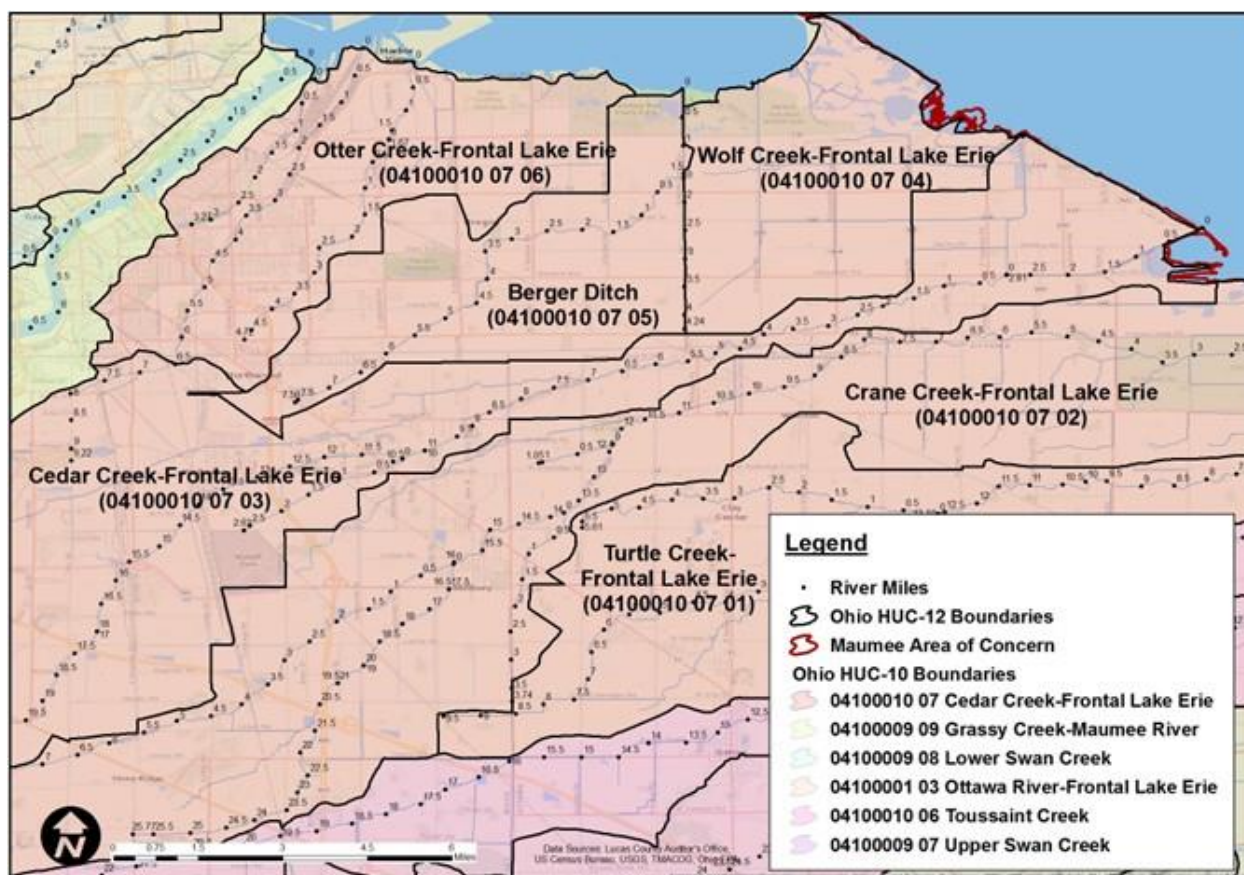


Figure 2: River Mile of Map of the Cedar Creek-Frontal Lake Erie HUC-10

1.1 Report Background

While watershed plans could be all-inclusive inventories, the US Environmental Protection Agency (USEPA) identified nine critical elements to include in strategic planning documents for impaired waters (Table 1). To ease implementation of projects addressing nonpoint source (NPS) management and habitat restoration, current federal and state NPS and habitat restoration funding opportunities require strategic watershed plans incorporate these nine key elements, concisely to HUC-12 watersheds. The Ohio Environmental Protection Agency (Ohio EPA) has historically supported watershed-based planning in many forms (Ohio EPA, 2016).

In 1997, Ohio EPA issued guidance for the development of Watershed Action Plans (WAPs), which typically covered larger watersheds (HUC-10 to HUC-8 size). The plans included an outline and checklist to ensure USEPA's nine elements were included within each plan. The USEPA issued new guidance in 2013 and concluded Ohio's interpretation for watershed plan development did not adequately address critical areas, nor did it include an approach that detailed the nine elements at the project level (Ohio EPA, 2016). In response, Ohio EPA developed a new template for watershed planning in the form of a Nonpoint Source-Implementation Strategy (NPS-IS), ensuring NPS pollution is addressed at a finer resolution and that individual projects listed within each plan include each of the nine elements. The first NPS-IS plans were approved in 2017. Over time, these plans have evolved to not only address in-

stream (near-field) water quality impairment from NPS pollution, but they also address reductions in nutrient loadings to larger bodies of water (far-field).

Table 1. Nine Elements for Watershed Plans and Implementation Projects

Element	Description
a	Identification of causes of impairment and pollutant sources or groups of similar sources that need to be controlled to achieve load reductions
b	Load reductions expected from management measures described under element (c) below
c	Description of the NPS measures that need to be implemented to achieve load reductions estimated under element (b) above and an identification of the critical areas in which those measures will be needed to implement this plan
d	An estimate of the amounts of technical and financial assistance needed, associated costs and/or sources and authorities that will be relied upon to implement this plan
e	An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing and implementing the NPS management measures that will be implemented
f	A schedule for implementing the NPS measures identified in this plans that is reasonably expeditious
g	A description of interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented
h	A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards
i	A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under element (h) above

(Source: USEPA, 2008)

Maumee Area of Concern

In 1987, the Maumee Area of Concern (AOC) was created under the Great Lakes Water Quality Agreement (GLWQA). With this, a committee formed to develop the Maumee Remedial Action Plan (RAP). In 2006, the Maumee RAP committee created the *Maumee AOC Stage 2 Watershed Restoration Plan*. This document served to be a comprehensive clearinghouse for restoration of the watersheds within the Maumee AOC to meet requirements for many programs under the International Joint Commission (IJC), USEPA and Ohio governmental agencies at the time (PCS, 2016). As one of the direct tributaries to Maumee Bay, the **Otter Creek-Frontal Lake Erie HUC-12** was included in this report.

The *Stage 2 Watershed Restoration Plan* was submitted to the Ohio Department of Natural Resources (ODNR) and Ohio EPA; however, full endorsement was pending inclusion of a Coastal Nonpoint Source Pollution Management Measures section (Ohio EPA, 2009). Since programs have more recently aligned with the USEPA's nine-element plans, the inclusion of this section was abandoned and NPS-IS for the individual HUC-12 watersheds within the greater Maumee AOC were developed. The *Otter Creek-Frontal Lake Erie HUC-12 NPS-IS, Version 1.0*, was written in 2017 to address NPS issues specifically within its drainage area, as opposed to a comprehensive watershed plan for all issues found within the region.

State of Ohio Domestic Action Plan

The State of Ohio has had a long history of identifying problems and combating Harmful Algal Blooms (HABs) within Lake Erie (OLEC, 2020). After successfully abating nutrient enrichment in the 1980s, the occurrence and severity of HABs within Lake Erie began to increase in the mid-1990s. Building on efforts initiated by the Ohio Phosphorus Task Force, Ohio participated at the federal level in the GLWQA of 2010. Along with Michigan and Ontario, Ohio committed to a goal of reducing phosphorus loadings to Lake Erie by 40% in both 2015 and in 2019 through signing the Lake Erie Collaborative Agreement, leading to the precursor of Ohio's Domestic Action Plan (DAP).

In 2018, all sub-watersheds (HUC-12s) within the Ohio portions of the Auglaize HUC-8 (including the Ottawa River (Lima), Little Auglaize River and Little Flatrock Creek), the Blanchard HUC-8 (including Eagle Creek), the St. Marys HUC-8 and the Platter Creek HUC-12 were recommended for designation as a "Watershed in Distress". This recommendation was due to relatively higher concentrations of phosphorus in surface waters contributing to HAB occurrence in Lake Erie. These waterways were found to have flow-weighted mean concentrations of phosphorus two or more times the phosphorus loading goals set forth by the GLWQA and the subsequent DAP developed by the State of Ohio (ODA, 2018). As a result, nutrient loadings were modeled and reduction targets were set for these priority areas, as well as all sub-watersheds within the WLEB, including the **Otter Creek-Frontal Lake Erie HUC-12** (OLEC, 2018).

Otter Creek-Frontal Lake Erie HUC-12 NPS-IS

The *Otter Creek-Frontal Lake Erie HUC-12 NPS-IS, Version 1.0*, was sponsored by PCS, with the City of Toledo - Division of Environmental Services, the University of Toledo, the Toledo-Lucas County Sustainability Commission (TLCSC) in 2017 as one of the first NPS-IS in the State of Ohio. In 2021, the Ohio EPA and Ohio Lake Erie Commission (OLEC) awarded a subgrant to PCS to update NPS-IS in the Maumee AOC as part of a larger, organized effort by members of the Maumee AOC Advisory Committee (MAAC) to secure grant fund eligibility for projects that would help make progress toward the removal of beneficial use impairments (BUIs) for waters located within the Maumee AOC. Fourteen BUIs are defined for the state of Ohio and identify a reduction in the chemical, physical or biological integrity of the Waters of the Great Lakes (Ohio EPA, 2017a). This update to the *Otter Creek-Frontal Lake Erie HUC-12 NPS-IS, Version 1.0* serves to include updated information regarding BUI status, AOC-specific considerations and nutrient reduction targets associated with the WLEB.

Removal of NPS impairments, reduction in overall sediment and nutrient loss, control of urban pollutants and stormwater and restoration of streambanks, floodplains and wetlands within the **Otter Creek-Frontal Lake Erie HUC-12** are crucial to the attainment of aquatic life use (ALU) standards and removal of BUIs within this sub-watershed and the greater Maumee AOC. Furthermore, removal of NPS impairments and reduction in overall nutrient loss will reduce the severity, extent and occurrence of HABs within the WLEB. Three sites in Duck Creek are in *Non-Attainment* of the Warmwater Habitat (WWH) designation for siltation/sedimentation related to urban runoff and channelization and heavy metal and polycyclic aromatic hydrocarbon (PAH)-contaminated sediments. Four sampling locations in Otter Creek are in *Non-Attainment* of the Modified Warmwater Habitat-Channelized (MWH-C) designation for siltation/sedimentation related to channelization and legacy heavy metal, PAH and

polychlorinated biphenyl (PCB)-contaminated sediments from industrial landfills and runoff and sediment resuspension. Beneficial use impairments for this watershed exist for BUI #3a: Degradation of fish populations for both riverine and lacustuary locations; BUI #6: Degradation of benthos for riverine and lacustuary locations; and BUI #14a: Loss of fish habitat for lacustuary and riverine locations. Additionally, Otter Creek and Duck Creek in the **Otter Creek-Frontal Lake Erie HUC-12** are both in *Non-Attainment* of the Primary Recreation Contact (PCR) beneficial use.

This NPS-IS will be used to strategically identify and outline projects within the **Otter Creek-Frontal Lake Erie HUC-12** to address management of NPS issues that have both near-field and far-field impacts on maintenance/attainment of State of Ohio water quality standards (WQS), as well as attainment of AOC targets for BUI removal.

Table 2. BUI Status in the Otter Creek-Frontal Lake Erie HUC-12

BUI Description	BUI Status	Metric	Target Score	HUC-12 Score (Average)	Percent Target Met
#3a: Degradation of Fish Populations	Impaired	WWH ^H - IBI	24	12.0	50.0%
		L-WWH - IBI	42	15.5	36.9%
		MWH ^H - IBI	20	24.0	120.0%
		L-MWH - IBI	27	29.0	107.41%
#6: Degradation of Benthos	Impaired	WWH - ICI	30	6.0	20.0%
		L-WWH - ICI	34	32.0	94.12%
		MWH - ICI	22	6.0	27.27%
		L-MWH - ICI	34	28.0	82.35%
#14a: Loss of Fish Habitat	Impaired	WWH ^H - QHEI	55	19.5	35.45%
		L-WWH - QHEI	55	39.0	70.91%
		MWH - QHEI	43	41.5	96.51%

(Source: PCS DMDS, 2024)

NOTES

BUI Beneficial Use Impairment

WWH Warmwater Habitat

MWH Modified Warmwater Habitat

IBI Index of Biotic Integrity

MIwb Modified Index of Well Being

ICI Invertebrate Community Index

QHEI Qualitative Habitat Evaluation Index

L Lacustuary site

H Headwater site

1.2 Watershed Profile & History

The **Otter Creek-Frontal Lake Erie HUC-12** drains an area of 21.07 square miles. The watershed contains Duck Creek² and Otter Creek, two tributaries to the Maumee River and Maumee Bay, respectively, as well as several maintained drainage ditches: Amolsch, Driftmeyer, Johlin, Heckman, Big, Tobias and McHenry in the eastern and less developed portion of the HUC-12. Otter Creek is 7.98 miles long, drains approximately 8 square miles, with headwaters that begin in the *Cedar Creek-Frontal Lake Erie HUC-12* (04100010 07 03). It flows from the city of Northwood, through the cities of Toledo and Oregon to be the first stream east of the Maumee River to empty into Maumee Bay. Duck Creek is 3.27 miles long and begins at Hecklinger Pond in east Toledo. It flows through the City of Toledo, as well as parts of Oregon, before entering the Maumee River at RM 0.25, just upstream of its mouth in Maumee Bay (Maumee RAP, 2006).

The Great Black Swamp

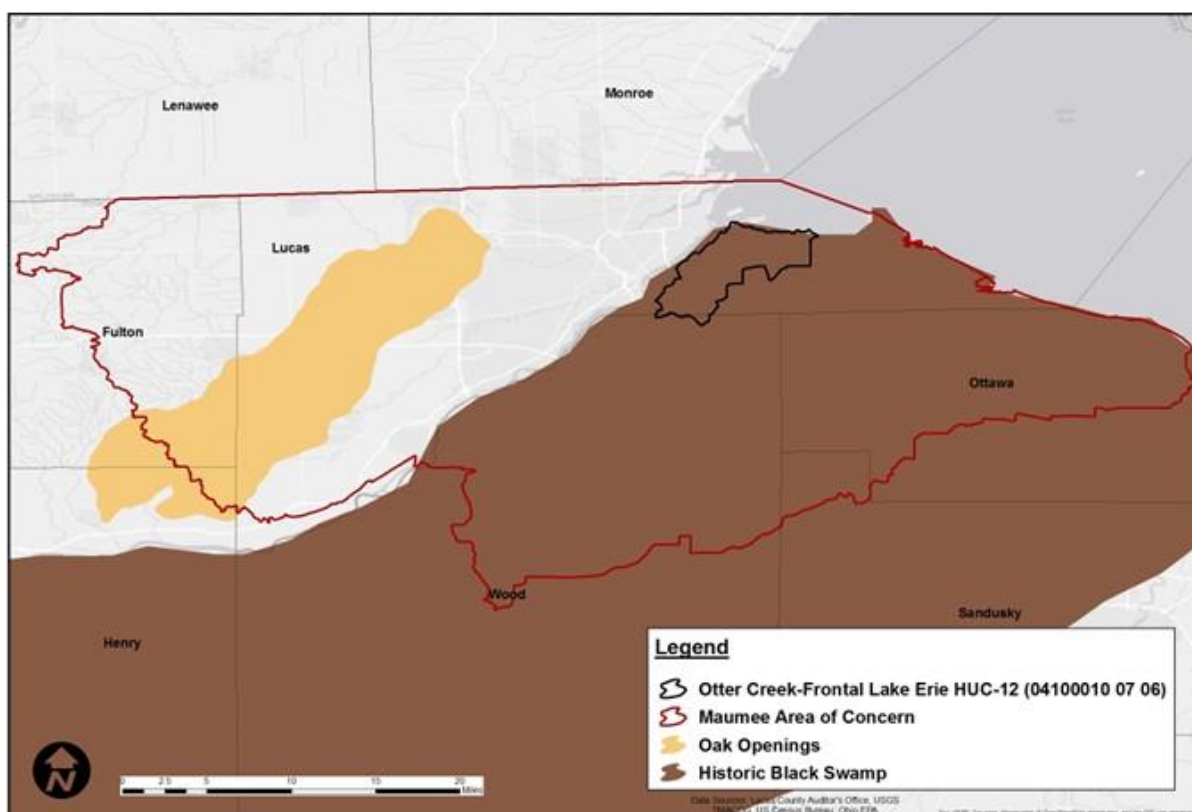


Figure 3: Otter Creek-Frontal Lake Erie HUC-12 in Relation to the Historic Great Black Swamp

The Great Black Swamp, an area approximately 120 miles long by 40 miles wide, once covered large parts of the Maumee River, Maumee Bay and Lake Erie drainage areas (Figure 3). This swamp, formed more than 20,000 years ago by retreating glaciers, was dominated by clay-rich soils with low permeability and dense vegetation (Maumee RAP, 2006). The area was covered with wet, hardwood

² Prior to 2013, Duck Creek was assigned to the Delaware Creek-Maumee River HUC-12 (04100009 09 04) in the Grassy Creek-Maumee River HUC-10 (04100009 09). In 2013, USGS re-assigned Duck Creek to the Otter Creek-Frontal Lake Erie HUC-12 (04100010 07 06) in the Cedar Creek-Frontal Lake Erie HUC-10 (04100010 07).

forests, shallow lakes and wet prairies. The difficulty associated with travel through the dense, swampy, insect-populated terrain left this one of the last areas of Ohio to be developed. In 1859, a law provided for the installation of public ditches, and by 1900, a vast system of ditches had drained the majority of the area to allow crop production on this fertile land. Remnants of the Great Black Swamp exist today, and in average rainfall events, the area still floods, making streams and ditches ideal for floodplain and wetland restoration (Maumee RAP, 2006).

1.3 Public Participation and Involvement

Watershed planning and restoration plans should include involvement from a diverse group of entities, including governmental agencies, private businesses, academia, non-profit groups, neighborhood organizations and the public at large. Many partners have been working in the greater Maumee AOC watershed toward ecological restoration and water quality goals.

Version 1.0 Partners

Several watershed groups have been involved with work within the Duck and Otter Creek watershed, including the Duck and Otter Creeks Partnership, formed in 1999. The Partnership was active during the early 2000s in coordinating efforts within the Duck and Otter Creek watershed. ClearWater and the Maumee RAP were also engaged in work throughout the greater Maumee River region. In 2007, after working under the umbrella of Toledo Metropolitan Area Council of Governments (TMACOG) for almost twenty years, the Maumee RAP merged with PCS and ClearWater was dissolved. Most restoration efforts in the Lake Erie Tributaries watershed are now led by or closely partnered with PCS. Nonprofit groups, such as the Toledo Metroparks, TMACOG, governmental agencies (City of Toledo, City of Oregon), academia, citizen action groups and watershed organizations have been interested and involved in the improvement and protection of the watershed of the Lake Erie Tributaries and greater Maumee AOC.

Due to the industrial setting of the two creeks, much focus has been placed on characterization of contaminated sediments throughout the stream segments, with potential for remediation under the Great Lakes Legacy Act. Restoration projects throughout the watershed have included wetland restoration and fish restocking at Hecklinger Pond as well as wetland restoration along Duck Creek near Wheeling Street on the Lutheran Homes property. Elsewhere in the sub-watershed, the City of Oregon implemented ditch erosion control measures by over-widening channels and planting wetland plugs along Big Ditch.

The University of Toledo, Department of Environmental Sciences, is an interdisciplinary group of ecologists and geologists dedicated to research addressing human impacts on the environment, earth system processes and ecosystem science (University of Toledo, 2017). Faculty in this department utilize research facilities at the Lake Erie Center, established in 1998, and help fulfill its mission to discern the linkages between land-use practices, water quality, habitat, economics, natural resources, sustainability, and environmental and public health. Faculty members have long been partners in local and regional task forces that investigate water quality issues in the Maumee AOC. The University of Toledo was one of the principal authors of the *Otter Creek-Frontal Lake Erie HUC-12 NPS-IS, Version 1.0*.

The City of Toledo, Department of Environmental Services was another key partner in the development of *Otter Creek-Frontal Lake Erie HUC-12 NPS-IS, Version 1.0* and is dedicated to balanced, responsible environmental protection for safe air and water for the Toledo Metropolitan Area (City of Toledo, 2017). This department governs over stormwater and pre-treatment programs, as well as collaborates with other agencies for the protection, restoration and enhancement of natural and human environments. The City of Toledo has engaged in water quality improvement in the Lake Erie Tributaries watershed through improvements made at Hecklinger Pond, as well as through programs such as the Toledo Waterways Initiative, the Combined Sewer Overflow (CSO) Long Term Control Plan and the Streamkeeper bacterial sampling program.

Additional key partners within this HUC-12 and the greater Lake Erie Tributaries watershed that worked on the *Otter Creek-Frontal Lake Erie HUC-12 NPS-IS, Version 1.0* include: PCS, TLCSC, Toledo Metroparks, Lucas County Soil and Water Conservation District (SWCD), the City of Oregon, the Lucas County Engineers Office, American Rivers, Hull and Associates, Civil & Environmental Consultants, and TMACOG.

Version 2.0 Partners

In 2021, PCS received funding from multiple sources, including the Great Lakes Restoration Initiative (GLRI) and the Lake Erie Protection Fund (LEPF), to update pre-existing NPS-IS throughout the Maumee AOC. PCS works directly with citizens, businesses, governmental agencies, and other non-profit organizations who take local ownership in their rivers, streams, and lakes. PCS strives for clean, clear and safe waters by connecting organizational and individual partners through educational opportunities, conservation programs, stream clean-ups and outreach programs for the benefit of local and regional water in Northwest Ohio. PCS also works as the facilitating organization for the MAAC. Through the MAAC, a diverse assortment of interested citizens, government agencies, businesses, and other non-profit organizations collaborate and plan together to meet the broader goals set for AOCs under the GLWQA. The AOC Program in Ohio is under direction of Ohio EPA with guidance from USEPA. Stakeholders involved in the Version 1.0 drafting were engaged for input into Version 2.0.

Chapters 1, 2 and 3 were primarily authored by the University of Toledo using the *Biological and Water Quality Study of the Portage River Basin, Select Lake Erie Tributaries, and Select Maumee River Tributaries, 2006-2008, Ohio EPA Technical Report EAS/2010-4-4* (Ohio EPA, 2010) and the *Total Maximum Daily Loads for the Maumee River (lower) Tributaries and Lake Erie Tributaries Watershed* (Ohio EPA, 2012). Updates to the *Otter Creek-Frontal Lake Erie HUC-12 NPS-IS, Version 1.0* were led by PCS and include additional AOC information, as well as nutrient reduction targets set forth by Ohio's DAP (OLEC, 2018; OLEC, 2020). These updates include data and information found in the *Biological and Water Quality Study of Swan Creek, Toussaint River, Western Lake Erie Tributaries, and Lower Maumee River Tributaries, Ohio EPA Technical Report AMS/2017-STEM-2* (Ohio EPA, 2023a) and the *2023 Water Quality and Hydrologic Units in Ohio Interactive Map* (Ohio EPA, 2024). Project information for Chapter 4 was compiled from the on-line Maumee AOC Data Management and Delisting System (DMDS) (PCS DMDS, 2024) and by collaborative meetings with stakeholders and community partners.

CHAPTER 2: HUC-12 WATERSHED CHARACTERIZATION AND ASSESSMENT SUMMARY

2.1 Summary of HUC-12 Watershed Characterization

2.1.1 Physical and Natural Features

The Lake Erie Tributaries watershed contains the entire *Cedar Creek-Frontal Lake Erie HUC-10* (04100010 07), covering an area 204 square miles south and southeast of the Maumee River. *The Cedar Creek-Frontal Lake Erie HUC-10* watershed is comprised of six HUC-12 watersheds. This document is focusing on the #06 hydrologic unit of the *Cedar Creek-Frontal Lake Erie HUC-10*—**Otter Creek-Frontal Lake Erie HUC-12** (04100010 07 06). Most of the *Cedar Creek-Frontal Lake Erie HUC-10* is predominantly rural; however, the **Otter Creek-Frontal Lake Erie HUC-12** is heavily industrialized and urbanized. The **Otter Creek-Frontal Lake Erie HUC-12** covers an area of 21.07 square miles. Its principal streams, Duck Creek and Otter Creek, empty into the Maumee River and Maumee Bay, respectively. The watershed also contains several maintained drainage ditches: Amolsch, Driftmeyer, Johlin, Heckman, Big, Tobias and McHenry, in the eastern (and less developed) portion of the HUC-12. Otter Creek is 7.98 miles long and drains approximately 8 square miles. Its headwaters begin in the *Cedar Creek-Frontal Lake Erie HUC-12* (04100010 07 03) and flow from the city of Northwood through the cities of Toledo and Oregon to be the first stream east of the Maumee River to empty into Maumee Bay. From its headwaters to RM 7.0, Otter Creek is deemed a limited resource waterway (LRW), with the remainder of the creek designated as MWH-C (Ohio EPA, 2010; Ohio EPA, 2012). Duck Creek is 3.27 miles long, beginning at Hecklinger Pond in east Toledo, and flows through the cities of Toledo and Oregon before entering the Maumee River at RM 0.25, just upstream of its mouth in Maumee Bay. Duck Creek has a WWH designation. Both Duck and Otter Creeks are affected by seiche events in Lake Erie, with backwater influence to RM 1.9 and 2.0, respectively.

The watershed of the Lake Erie Tributaries is wholly contained within the Huron/Erie Lake Plains (HELP) ecoregion. The USEPA describes this region as “Fine, poorly-drained, water-worked glacial till and lacustrine sediment; also coarser end moraine and beach ridge deposits” (Maumee RAP, 2006). These



Oily sheen brought to the surface when sediments were disturbed in Otter Creek in 2005. Photo courtesy of Deanna Bobak.

glacial sediments overlay Silurian and Devonian limestone and dolomite bedrock, which is occasionally exposed throughout areas along the Maumee River mainstem (Ohio EPA, 2012). Soils in this watershed have low infiltration rates and high runoff potential; though, 66% of the soils in this sub-watershed were not reported, likely due to the high rate of urbanization (impervious surface) within this HUC-12.

Historically, the land around Otter and Duck Creek was known for natural oil deposits. Historical accounts cite Native Americans using pitch from natural oil seepages along the creek banks to tip their

arrows (TMACOG, 2007). The most famous documentation of oil in the area occurred in the lowlands between Otter Creek and Duck Creek near RM 2.0. Here, the “Klondike Gusher” erupted in July of 1897, producing 100 barrels an hour. However, just months later in September, the Gusher was reported as being “somewhat of a frost” in the Toledo Blade (Downes, 1954). This preceded a boom in oil exploration in Lucas County. While maps from the late 1800s and early 1900s display an enormous number of oil wells (that have since been closed), the area quickly became realized for its refining activities more than its crude production abilities (Bobak, 2010).

The first industry, Diamond Oil Company, opened in the Otter Creek area in 1895 and paved the way for several oil-related industries and manufacturing facilities to also take up residence (Fassett, 1961). Over time, heavy industrialization, multiple oil spills and uncontrolled hazardous waste landfills contributed to the contamination found within the creek today.

Specific landmarks and features in this watershed include:

- City of Toledo parks: Hecklinger Pond, Ravine Park, Navarre Park;
- Oil refineries and holding facilities (Toledo Refining Company, BP Toledo Refinery, Marathon Petroleum, Citgo Petroleum);
- Toledo Water Treatment Plant (WTP) (Collins Park);
- Oregon Wastewater Treatment Plant (WWTP);
- Toledo Edison Power Plant;
- Two cemeteries;
- Two golf courses: Collins Park Golf Course and Eagle’s Landing;
- Envirosafe Services of Ohio (hazardous waste landfill);
- Buckeye Pipeline;
- Maumee Bay State Park (campground and beach facilities);
- University of Toledo Lake Erie Center;
- CSX Railway Docks; and,
- Dense residential neighborhoods in the western portion; row crops in the eastern portion.

As noted above, the **Otter Creek-Frontal Lake Erie HUC-12** is largely industrialized; little greenspace is set aside within this watershed (Figure 4). Remnant sections of the wetlands of the Great Black Swamp can be seen at the far eastern end of the watershed, but virtually none exist in the sub-watersheds of Duck and Otter Creeks.

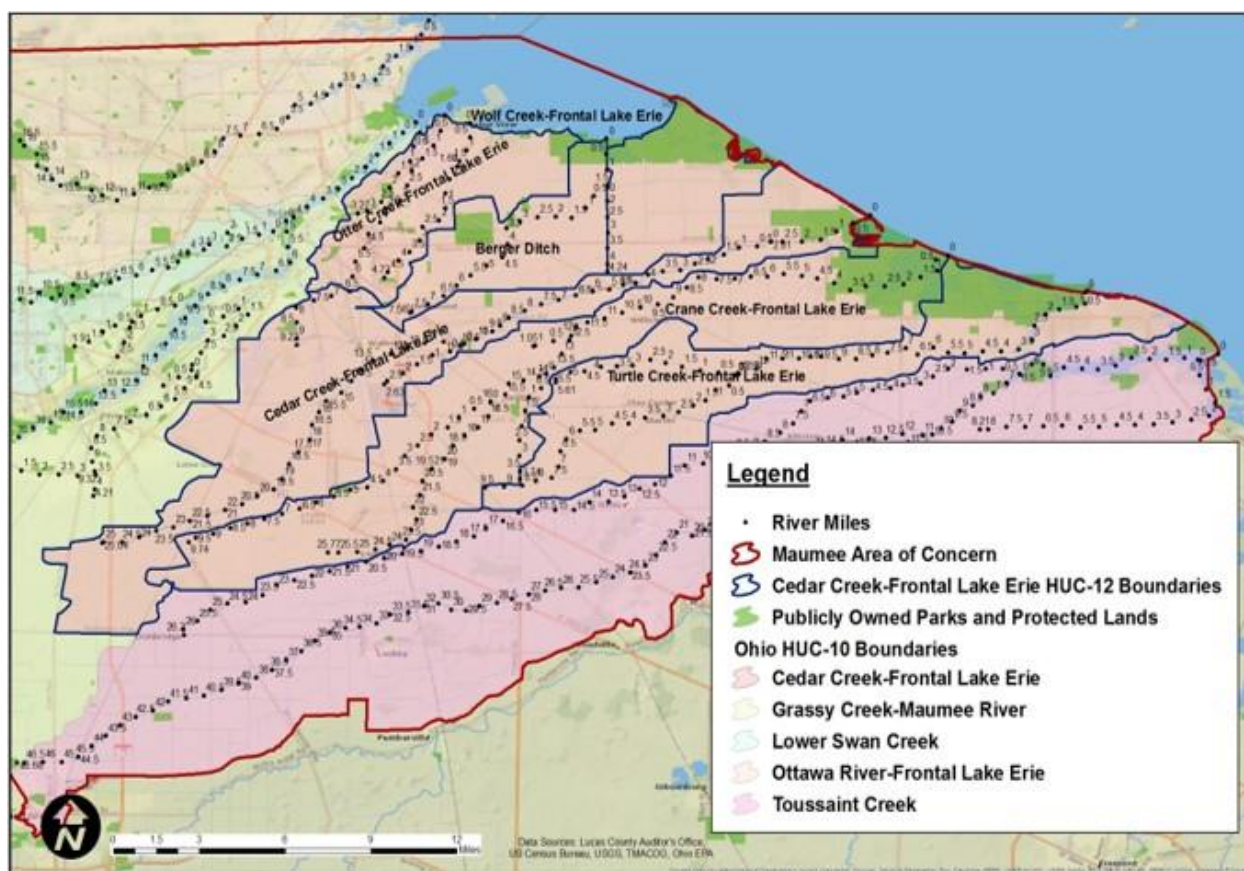


Figure 4: Publicly Owned Parks and Protected Lands in the Otter Creek-Frontal Lake Erie HUC-12

Ten facilities currently hold NPDES permits in the **Otter Creek-Frontal Lake Erie HUC-12** (Table 3). Of these, six discharge directly to Otter and Duck Creeks. Violations of the Clean Water Act regulations regularly occur throughout this watershed, particularly in the sub-watershed of Duck and Otter Creek. Persistent contamination in the sediments of Otter Creek is an issue (Table 4). Characterization of these sediments has been ongoing since 1999 in several studies (Ohio EPA, 2012). Otter Creek, from RM 2.0 to its mouth, has undergone sediment dredging under the Great Lakes Area of Concern Sediment Management Plan (USEPA, 2017).

Table 3. NPDES Permitted Facilities in Otter Creek-Frontal Lake Erie HUC-12

Otter Creek-Frontal Lake Erie HUC-12 (04100010 07 06)				
Facility Name	Industry	Permit Number	Receiving Waterbody	Reported Exceedances/ Compliance Status*
eAsphalt Materials, Inc	Miscellaneous	2IN00165*GD	Wynn Road Ditch to Lake Erie	pH
BP Husky Refining, LLC	Oil refinery	2IG00007*ND	Otter Creek, Maumee Bay	Chlorine, <i>E. coli</i> , low level mercury, pH, cBOD _{5-day} , TOC, SNC
CITGO Terminal	Oil refinery	2IG00021*ID	Driftmeyer Ditch	--
Envirosafe Services of Ohio, Inc	Miscellaneous	2IN00013*KD	Unnamed ditches and storm sewers to Otter	Low level mercury, TSS, SNC

Otter Creek-Frontal Lake Erie HUC-12 (04100010 07 06)				
Facility Name	Industry	Permit Number	Receiving Waterbody	Reported Exceedances/ Compliance Status*
			Creek, Driftmeyer Ditch, Joehlin Ditch	
FirstEnergy Generation-Bay Shore Power Station	Power plant	21B00000*TD	Maumee Bay	Low level mercury, TSS
Iron Units, LLC	Steel mill	21D00018*CD	COT storm sewer to Maumee River, Duck Creek	Oil & grease, TSS
MPLX Terminals, LLC	Oil refinery	21G00024*ID	Amolsch Ditch	--
Shelly Liquid Divisions	Miscellaneous	21N00218*DD	Otter Creek	--
Toledo Refining Company, LLC	Oil refinery	21G00003*MD	Otter Creek	--
Toledo Water Treatment Plant	Water treatment	21W00260*JD	Otter Creek, Duck Creek	SNC

(Source: Ohio EPA, 2024; USEPA, 2024)

NOTES

* Exceedances reported for the last 12-month period, July 1, 2021 – June 30, 2024 as reported in the Environmental Compliance History Online database (USEPA, 2024).

- No exceedances reported.

E. coli *Escherichia coli*

cBOD *Carbonaceous Biological Oxygen Demand (5-day test)*

TOC *Total Organic Carbon*

SNC *Significant Non-Compliance*

TSS *Total Suspended Solids*

COT *City of Toledo*

Table 4. Sediment Contaminants of Concern in Duck and Otter Creeks

Metals	Organic Compounds
Arsenic	4,4'-dichlorodiphenyldichloroethane (4,4'-DDD)
Cadmium	4,4'-dichlorodiphenyldichloroethylene (4,4'-DDE)
Chromium	Chlordane
Copper	PCBs
Lead	Total PAHs
Mercury	

(Source: Ohio EPA, 2012)

NOTES

PCB *Polychlorinated biphenyls*

PAH *Polycyclic aromatic hydrocarbons*

2.1.2 Land Use and Protection

Land use within the **Otter Creek-Frontal Lake Erie HUC-12** is primarily urban and industrial (Table 5). Developed land accounts for 68% of the entire sub-watershed, primarily in the western

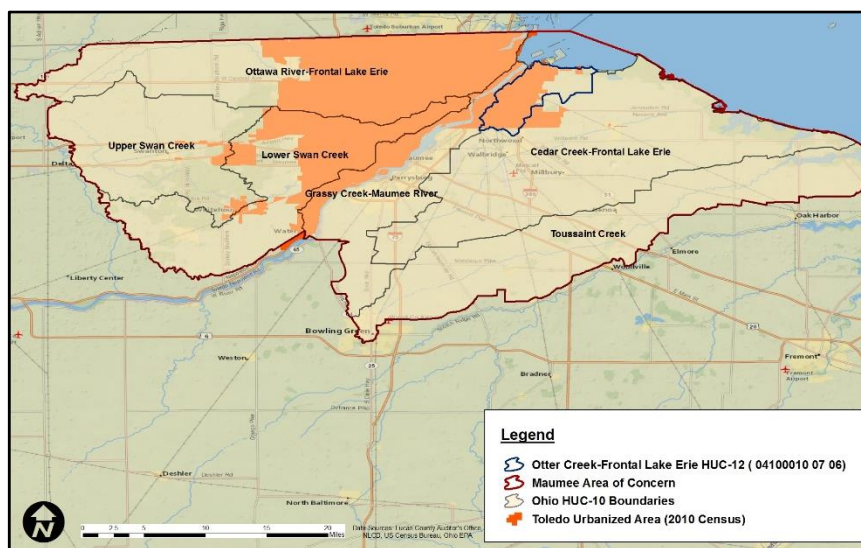
portion through which Duck and Otter Creeks flow (Figure 5). Twenty-five percent (25%) of the sub-watershed is in crop production, mainly concentrated in the eastern portion of the watershed.

Table 5. Land Use Classifications in the Otter Creek-Frontal Lake Erie HUC-12

Land Use	Otter Creek-Frontal Lake Erie HUC-12 (04100010 07 01)		
	Area (mi ²)	Area (acres)	% Watershed Area
Barren Land	0.04	28.20	0.24%
Cultivated Cropland	4.49	2,875.69	24.78%
Deciduous Forest	0.19	122.44	1.06%
Developed, High Intensity	2.78	1,781.20	15.35%
Developed, Medium Intensity	3.68	2,352.35	20.27%
Developed, Low Intensity	4.21	2,697.32	23.25%
Developed, Open Space	1.71	1,097.22	9.46%
Emergent Herbaceous Wetlands	0.56	359.51	3.10%
Hay/Pasture	0.10	65.63	0.57%
Herbaceous	0.17	111.39	0.96%
Mixed Forest	0.01	9.59	0.08%
Open Water	0.13	80.09	0.69%
Woody Wetlands	0.03	22.16	0.19%
Total	18.13	11,602.78	100.00%

(Source: Homer et al., 2020)

Approximately 80% of the **Otter Creek-Frontal Lake Erie HUC-12** is located within the NPDES regulated Municipal Separate Storm Sewer System (MS4). One Phase I MS4 permit (City of Toledo) exists throughout this watershed, along with several Phase II municipalities and agencies, including the City of Oregon, City of Northwood, Lucas County and the Ohio Department of Transportation (ODOT). The City of Toledo implemented the Toledo Waterways Initiative, a long-term, 18-year to reduce CSOs, improve storm sewer systems and reduce water pollution in the Maumee River, Ottawa River and Swan Creek waterways (Toledo Waterways Initiative, 2017). These storm water systems do not connect with water treatment systems; therefore, oil, grease, pesticides, herbicides, dirt and grit are carried directly to waterways and have a high potential to negatively impact water quality (Ohio EPA, 2009). Related to



Toledo Urbanized Area, as defined from the 2010 census. image from the Otter Creek-Frontal Lake Erie HUC-12 NPS-IS, Version 1.0.

contaminants that are directly discharged to receiving stream systems, salt pollution, often reflected by elevated chloride (Cl⁻) concentrations, is a growing concern within the **Otter Creek-Frontal Lake Erie HUC-12**.

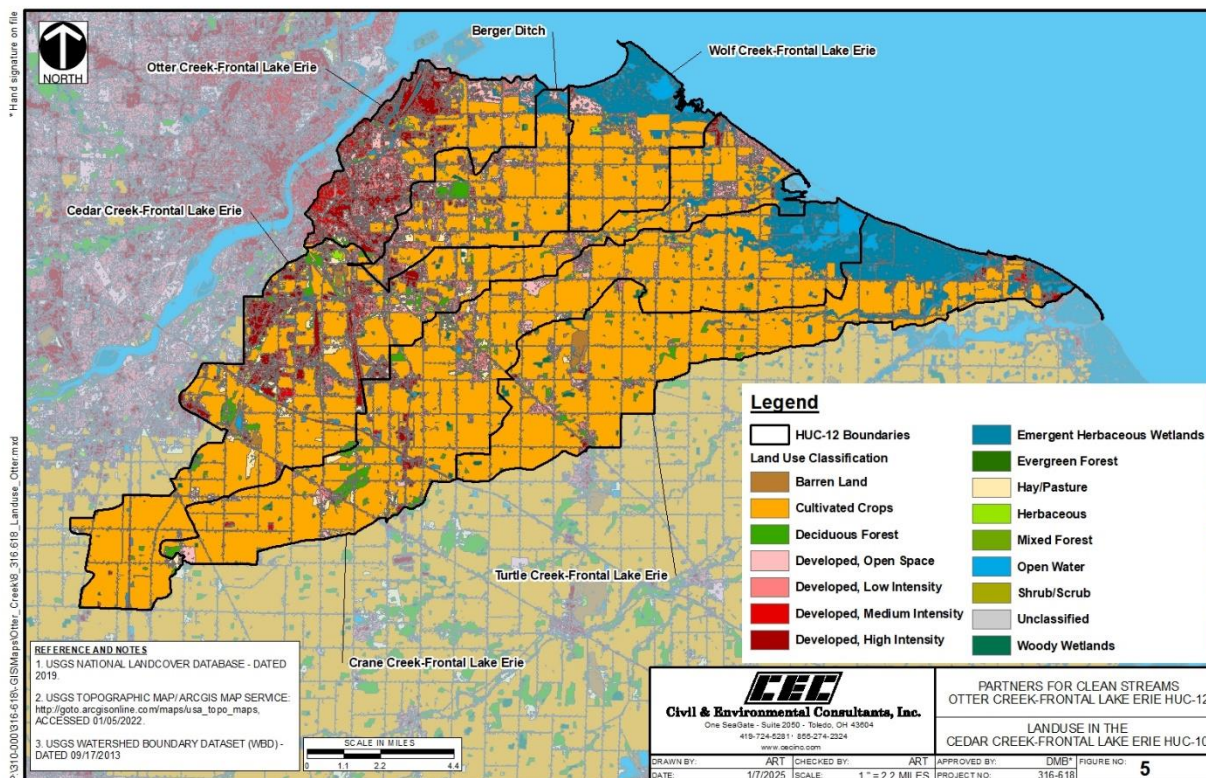


Figure 5: Land Use in the Cedar Creek-Frontal Lake Erie HUC-10

Salt pollution has occurred in northwest Ohio, and the state of Ohio has ranked as high as third among US States for total road salt use (Hintz *et al.*, 2022a). Road salts run off roadways and into ground and surface waters during precipitation events or during the spring snowmelt and are one of the largest contributors of chloride in freshwater ecosystems from anthropogenic sources (Kaushal *et al.*, 2005). Elevated chloride concentration can also occur from agricultural operations, where the application of fertilizers (e.g., potassium chloride [KCl]) can contribute salts and chloride to freshwater ecosystems (Herbert *et al.*, 2015). Irrigation practices in agricultural operation can also lead to chloride contamination when groundwater with dissolved salts is used to irrigate crops (Thorslund *et al.*, 2021). Through the process of evapotranspiration, the dissolved salts in groundwater can remain on surface soils, which are then dissolved in runoff that ends up in surface waters during precipitation events (Thorslund *et al.*, 2021). Recent evidence indicates that Ohio streams and those in the Maumee AOC are contaminated with chloride (Miltner, 2021). Additional sources of excessive chloride include mining operations, water softeners, swimming pools and dust suppressants (Herbert *et al.*, 2015; Szklarek *et al.*, 2022; Kelly *et al.*, 2018; Hintz *et al.*, 2019; Hintz *et al.*, 2022a).

There is a need to identify chloride contamination among freshwater ecosystems and implement best management practices for chloride reduction (Hintz *et al.*, 2022a). New research has indicated that

existing chloride chronic and acute thresholds of 230 mg Cl⁻/L and 860 mg Cl⁻/L, respectively, may not provide protection to many freshwater organisms (Arnott *et al.*, 2020; Hintz *et al.*, 2022b). Researchers from the University of Toledo are currently investigating chloride contamination within the Maumee AOC. Results show elevated chloride in the **Otter Creek-Frontal Lake Erie HUC-12**, with a mean chloride concentration of 215.81 mg/L in samples collected from March 2022 to July 2022³ (Hintz, unpublished data). Chloride data collected from the Ohio EPA from December 2010 to November 2019 shows that mean chloride concentrations in the **Otter Creek-Frontal Lake Erie HUC-12** were 118.18 mg/L. These chloride concentrations indicate that some of the sources discussed above might have contributed chloride to the surface waters of the **Otter Creek-Frontal Lake Erie HUC-12**.

Within the **Otter Creek-Frontal Lake Erie HUC-12**, the population is estimated to be 1,011 with 427 housing units in unsewered areas. In the rural landscape, residences and small businesses use HSTS which are a potential source of NPS pollution for bacteria and nutrients. Studies conducted by the Ohio Department of Health (ODH) across Ohio have shown an average HSTS failure rate of 39% within the WLEB (ODH, 2013). TMACOG conducted a study of locations and densities of HSTS throughout the WLEB in 2018. In Lucas and Wood counties, 45 areas were identified as Critical Sewage Areas (CSAs), in which larger-scale efforts should be initiated to address failing HSTS and/or potentially establish sewer service. A small portion of the Wolf Creek Watershed CSA (<5%) extends into the **Otter Creek-Frontal Lake Erie HUC-12**. Total phosphorus and nitrogen loads from HSTS in the **Otter Creek-Frontal Lake Erie HUC-12** are estimated to be 0.28 metric tons per annum (MTA) and 2.71 MTA, respectively, based on mass.

Animal waste is another possible source of bacteria, although there are no Concentrated Animal Feeding Operations (CAFOs) or Ohio Department of Agriculture (ODA)-permitted Concentrated Animal Feeding Facilities (CAFFs) located in the **Otter Creek-Frontal Lake Erie HUC-12** (PRR, 2023). While livestock operations do exist in the sub-watershed, estimated counts of animals are very low and smaller farms are scattered throughout the sub-watershed (Table 6).

Table 6. Estimated Animal Counts in the Otter Creek-Frontal Lake Erie HUC-12

Livestock Type	Animal Units
Beef	1
Dairy	0
Swine	505
Sheep	3
Horse	6
Chicken	36
Turkey	1
Duck	1

(Source: USDA 2012 Census of Agriculture, inputed into PLET/STEPL Data Server (USEPA, 2022))

³ Averaged from seven sites: Duck Creek at Consaul Road; Otter Creek at Cedar Point Road, Millard Avenue, Navarre Road, Consaul Road and Seaman Street; Lake Erie at the Lake Erie Center.

In the rural landscape, agriculture focuses on row crops. The 2022 United States Department of Agriculture (USDA) Census of Agriculture lists soybeans as the largest field crop harvested in Lucas County (53%) and Wood County (56%). Corn is the second largest crop, accounting for 39% in Lucas County and 33% in Wood County. Wheat accounts for a small percentage in each county, 6% in Lucas County and 7% in Wood County (USDA, 2024a). The average farm size in Lucas County is 203 acres and slightly higher in Wood County (217 acres).

Most land within the **Otter Creek-Frontal Lake Erie HUC-12** is privately owned; therefore, knowledge of conservation practices may be limited. Some conservation practices, such as the use of conservation tillage, can be estimated from remote sensing techniques used within the Operational Tillage Information System (OpTIS). From 2015-2021, OpTIS estimated an average of 30.7% of crop fields in the Cedar-Portage watershed were under no-till conditions, 33.4% were under some form of reduced tillage and 13.9% were under traditional tillage regimes (CTIC, 2024). OpTIS also estimated winter cover crop usage across the Cedar-Portage watershed at 6.9%.

Summary data provided by Ohio EPA regarding the use of the Environmental Quality Incentives Program (EQIP) within the **Otter Creek-Frontal Lake Erie HUC-12** indicated no certifications of practices occurred in the sub-watershed for data reported to be applied or certified between March 30, 2017 and 2018 (USDA-NRCS, 2018). Additional data provided by the Farm Service Agency (FSA) on current contracts within Lucas and Wood counties are found in Table 7.

Table 7. Conservation Reserve Program (CRP) Contract Acreage

Practice	Lucas County^	Wood County
	Acres*	Acres*
Establishment of Permanent Introduced Grasses and Legumes	1.42	130.39
Vegetative Cover – Grass/Trees Already Established	--	--
Wildlife Food Plot	--	3.99
Shelterbelt Establishment	--	3.95
Establishment of Permanent Native Grasses	--	164.17
Filter Strips	157.14	4,043.52
Riparian Buffer	8.38	5.33
Wetland Restoration	105.42	347.04
Wetland Restoration, Non-Floodplain	383.66	306.59
Rare and Declining Habitat	--	475.32
Marginal Pastureland and Wildlife Habitat Buffer	--	41.70
Tree Planting	--	1.98
Marginal Pastureland Wetland Buffer	--	18.56
Bottomland Timber Establishment on Wetlands	--	--
Upland Habitat Buffers		260.36
Wildlife Habitat for Pheasants	33.20	116.86
Hardwood Tree Planting	--	8.69
Pollinator Habitat	--	155.15
Prairie Strips	--	28.54

Practice	Lucas County [^]	Wood County
	Acres*	Acres*
Permanent Wildlife Habitat, Noneasement	--	405.88
Field Windbreak Establishment, Noneasement	16.98	270.34
Grass Waterways, Noneasement	--	4.13
Shallow Water Areas for Wildlife	--	2.04

(Source: USDA-NRCS, 2024b)

NOTES

* Acres reported at the county level and may not necessarily fall within the Otter Creek-Frontal Lake Erie sub-watershed boundaries.

[^] Eastern Lucas County enrollment only

Additionally, the H2Ohio Initiative, a comprehensive water quality initiative, was launched in 2019. Administered by three different departments: Ohio EPA, ODA and ODNR, the program aims to strategically address serious water issues that have been building in Ohio for decades (H2Ohio, 2024). The portion administered by ODA provides economic incentives to producers who develop Voluntary Nutrient Management Plans (VNMPs) for their fields and implement effective and cost-efficient best management practices (BMPs) that include: soil testing, variable rate fertilization, subsurface nutrient application, manure incorporation, conservation crop rotation, cover crops, drainage water management structures, two-stage ditch construction, edge of field buffers and headwaters and coastal wetlands that reduce agricultural runoff (H2Ohio, 2024). Enrollment for various practices in Lucas, Ottawa and Wood County during 2021 and 2022 is listed in Table 8.

Table 8. H2Ohio Enrollment in 2021 and 2022

Practice	Lucas County Enrollment (Acres)*		Wood County Enrollment (Acres)*	
	2021	2022	2021	2022
VNMP Development	14,768	192	65,260	3,266
VNMP Implementation	14,768	13,336	61,777	65,661
VRT Phosphorus Application	7,057	4,519	31,890	29,747
Subsurface Phosphorus Placement	5,102	5,347	12,525	12,076
Manure Incorporation	492	474	2,143	2,018
Conservation Crop Rotation – Small Grains	992	910	7,071	3,738
Conservation Crop Rotation - Forage	114	650	1,384	1,874
Overwintering Cover Crop	2,604	3,156	19,308	17,493

(Source: Data Ohio, 2024)

NOTES

*Acres reported at the county level and may not necessarily fall within the Otter Creek-Frontal Lake Erie sub-watershed boundaries.

VNMP Voluntary Nutrient Management Plan

VRT Variable Rate Technology

2.2 Summary of HUC-12 Biological Trends

The Ohio EPA sampled the **Otter Creek-Frontal Lake Erie HUC-12** in 2006, as documented in the *Biological and Water Quality Study of the Portage River Basin, Select Lake Erie Tributaries, and Select Maumee River Tributaries, 2006-2008, Technical Report EAS 2010-4-4 and the Total Maximum Daily Loads (TMDL) for the Maumee River (lower) Tributaries and Lake Erie Tributaries Watershed*. Both documents were used extensively in the preparation of the *Otter Creek-Frontal Lake Erie NPS-IS, Version 1.0*. The sub-watershed was again sampled in 2017 as part of the STEM study (Swan Creek, Toussaint River, Western Lake Erie tributaries and lower Maumee River), documented in the *Biological and Water Quality Study of Swan Creek, Toussaint River, Western Lake Erie Tributaries, and Lower Maumee River Tributaries, Technical Report AMS/2017-STEM-2*, which serves as the basis for updates to Version 2.0.

Seven Ohio EPA sampling sites are located within the **Otter Creek-Frontal Lake Erie Creek HUC-12** (Figure 6). Four locations within Otter Creek are in *Non-Attainment* of the MWH-C designation for siltation /sedimentation related to channelization and legacy heavy metal, PAH and PCB-contaminated sediments from industrial landfills and runoff and sediment resuspension. Three sites in Duck Creek are in *Non-Attainment* of the WWH designation for siltation/sedimentation related to urban runoff and channelization and heavy metal and PAH-contaminated sediments (Ohio EPA, 2023a; Ohio EPA, 2010).

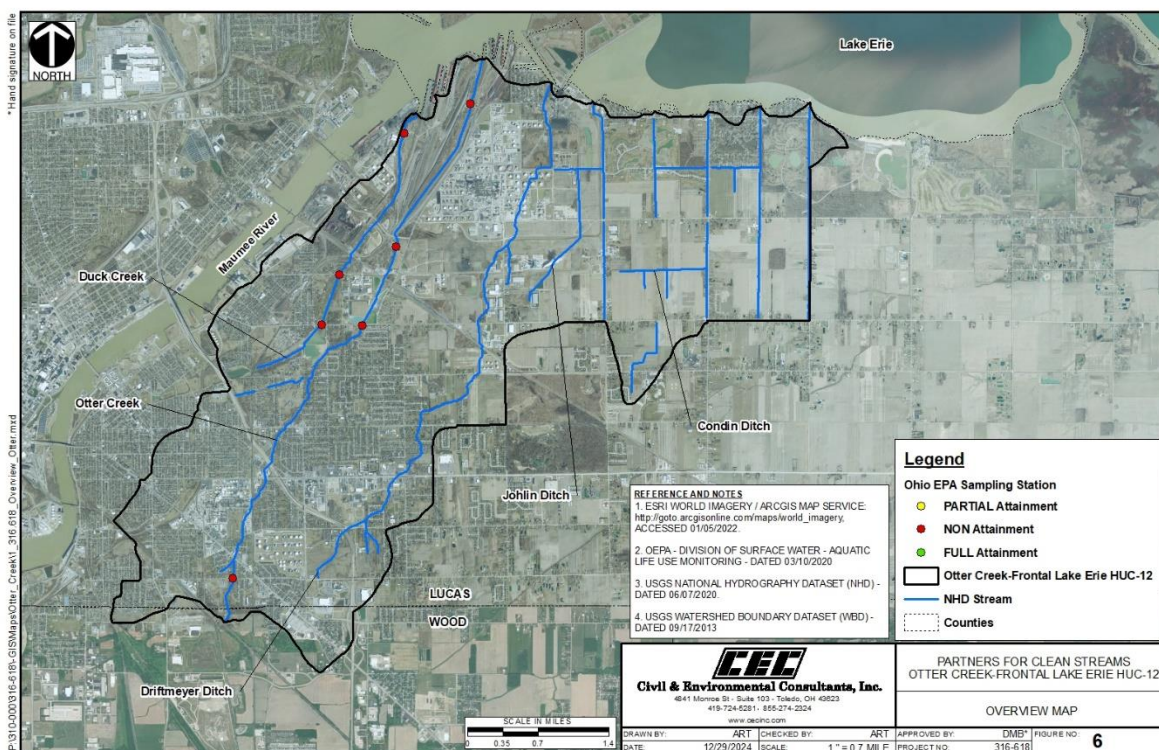


Figure 6: Otter Creek-Frontal Lake Erie HUC-12 Sampling Overview

A summary of the sample locations and their biological status in the **Otter Creek-Frontal Lake Erie HUC-12** is provided in Table 9. In addition, WQS for the HELP ecoregion are presented in Table 10 and lacustrine targets are shown in Table 11. Standards for the Maumee AOC are based upon these WQS;

although thresholds are set slightly lower, at the nonsignificant departure range for each WQS. The focus of this NPS-IS, and all of those throughout the Maumee AOC, is the attainment of state WQS, with the benefit of removing BUIs.

Table 9. Biological Indices Scores for Selected Sites in Otter Creek-Frontal Lake Erie HUC-12

Otter Creek-Frontal Lake Erie HUC-12 (04100010 07 06)							
River Mile	Drainage Area (mi ²)	IBI	MIwb ^a	ICI ^b	QHEI	Attainment Status	Location
Otter Creek (MWH-C)							
5.92 ^H	2.8	<u>16^{ns}</u>	N/A	<u>Very Poor*</u>	23.0	Non	Oakdale Avenue
2.95 ^H	5.9	24	N/A	<u>Very Poor*</u>	41.5	Non	Consaul Street
2.13 ^H	6.6	28	N/A	<u>Very Poor*</u>	30.0	Non	Millard Road
0.40 ^B	7.4	<u>28*</u>	7.66 ^{*^}	28*	38.0 [^]	Non	Near mouth adjacent to CSX Railroad
Duck Creek (WWH)							
3.10 ^H	0.6	<u>12*</u>	N/A	<u>Very Poor*</u>	19.5	Non	Consaul Street
2.52 ^H	0.8	<u>24^{ns^}</u>	N/A	<u>Very Poor*</u>	22.0	Non	York Street
0.80 ^B	1.3	<u>16*</u>	<u>3.41*</u>	32*	39.0	Non	Near mouth adjacent to Tiffin Avenue

(Source: Ohio EPA, 2010; Ohio EPA, 2023a; Ohio EPA, 2024)

NOTES

a The Modified Index of Well Being (MIwb) is not applicable to headwater sites (drainage <20 mi²).

IBI Index of Biotic Integrity

ICI Invertebrate Community Index

b Narrative evaluation used in lieu of ICI (G=Good; MG=Marginally Good; F=Fair; L Fair=Low Fair; P=Poor; VP=Very Poor).

QHEI Qualitative Habitat Evaluation Index

ns Nonsignificant departure from ecoregion biocriteria (≤4 IBI or ICI units; ≤0.5 MIwb units).

*** Significant departure from ecoregion biocriteria; poor and very poor results are underlined.

MWH-C Modified Warmwater Habitat – Channelized

WWH Warmwater Habitat

H Headwater sample

W Wading sample

B Boat sample

N/A Not applicable

^ Conflicting data between current TSD and the 2022 Ohio Integrated Report. Data reported in this NPS-IS reflect the 2022 Ohio Integrated Report.

Data highlighted in tan are from 2006-2008. All other data reported are from the 2017 sampling event.

Yellow fill indicates a lacustrine location. Attainment determined with lacustrine benchmarks.

Table 10. Water Quality Standards in the Huron-Erie Lake Plains Ecoregion

HELP Ecoregion	WWH WQS			MWH WQS		
	Headwater	Wading	Boat	Headwater	Wading	Boat
IBI	28	32	34	20	22	20
MIwb	N/A	7.3	8.6	N/A	5.6	5.7
ICI	34	34	34	22	22	22
QHEI ^a	55	60	60	43.5	43.5	43.5

(Source: OAC 3745-1)

NOTES

WWH Warmwater Habitat

MWH Modified Warmwater Habitat

WQS Water Quality Standards

a QHEI is not criteria included in Ohio WQS; however, it has been shown to be highly correlated with the health of aquatic communities. In general, sites scoring 60 or above (or above 55 for headwater sites) support healthy aquatic assemblages indicative of WWH (Ohio EPA, 1999). Sites scoring 75 or above support Exceptional Warmwater Habitat assemblages (Ohio EPA, 1999).

N/A MIwb not applicable to headwaters sampling locations with drainage areas ≤ 20 mi².

Table 11. Lacustrine Benchmarks

Index – Site Type	Exceptional	Good	Fair	Poor	Very Poor
IBI – Boat	50	42	31	17	< 17
MIwb – Boat	10	8.6	5.6	2.8	< 2.8
ICI	52	42	25	12	< 12
QHEI	> 80	60	45	30	< 30

(Source: Ohio EPA, 2014)

Fishes (Modified Index of Well-Being (MIwb) & Index of Biotic Integrity (IBI))

Fish communities are greatly impacted by the industrial and urban landscape of Otter Creek, leading to an MWH-C designation. There has been little improvement in community performance despite nearly three decades of potential natural attenuation (Ohio EPA, 2023a). An ecological risk assessment of Otter Creek determined that the ecosystem is severely stressed with the sediment concentrations exceeding all screening values for bottom-dwelling fish (Tetra Tech, 2008). The high contamination levels are likely a result of intensive industrial land use, uncontrolled waste sites and historical spills. Contaminated sediments and heavy siltation need to be addressed before further fish community improvement is likely to be observed (Ohio EPA, 2010). Despite an increase in IBI scoring to a marginally attaining threshold at RM 5.92 (Oakdale Avenue) in 2017, the score is still considered to be *Poor* (Ohio EPA, 2023a). The downstream sampling location at RM 0.4 (near the mouth) was dominated by pool-oriented species, likely a result of the hydraulic connection with Lake Erie (Ohio EPA, 2023a).

Communities in Duck Creek at RM 3.10 (Consaul Street) scored the lowest possible score that can be obtained both historically (2008) and during recent sampling (2017). These scores reflect heavy siltation (>30 cm deep), attributed to channelization and urban runoff (Ohio EPA, 2010)). Habitat in Duck Creek's lacustrine location (RM 0.8) was one of the highest in the **Otter Creek-Frontal Lake Erie HUC-12** and exhibited three WWH attributes, compared to none at the other Duck Creek locations.

Macroinvertebrates (Invertebrate Community Index [ICI])

Macroinvertebrate communities were considered *Very Poor* across all non-lacustrary Duck and Otter Creek sampling locations, mainly due to contaminated, mucky sediments and urban runoff, with the lacustrary sites being fair. Across both streams, *Ephemeroptera*, *Trichoptera* and *Plecoptera* (EPT) and sensitive taxa diversity values were almost non-existent (0-1 at each site), with macroinvertebrate communities consisting of predominantly tolerant species. These communities have been consistently degraded since 1986, particularly due to sediment contamination. In an ecological risk assessment conducted in 2008, mean percent survival of midges differed significantly in 11/12 sites over the control, showing the sediment is toxic to midges (Tetra Tech, 2008). Improvements to the macroinvertebrate communities would require prevention of further pollutants from point source (industrial) landfills, contaminated sediment dredging and restored channel design (Ohio EPA, 2010). Lacustrary locations in both streams were the only locations with quantitative results and yielded 3-4 EPT taxa per site.

Habitat (via Qualitative Habitat Evaluation Index [QHEI])

The Western Lake Erie tributaries share common traits and are influenced by similar stressors (Ohio EPA, 2023a). These streams across the shoreline, from Otter Creek to Toussaint Creek have low gradients, are long with few branches, flow over silty clay soils and have been heavily modified by drainage improvement projects. The Ohio EPA sampling crews documented various water quality and habitat attributes during the QHEI assessment in Otter Creek and Duck Creek in 2006, 2008 and 2017 (Table 12). Both Otter and Duck Creeks exhibit mainly high- and low-influence attributes of MWH streams. Both streams exhibit channelization or stream segments that are still in recovery. Silt/muck substrates, heavy siltation, poor development and embeddedness are pervasive throughout the sub-watershed. The presence of certain attributes are shown to have a larger negative impact on fish and macroinvertebrate communities. Streams designated as WWH should exhibit no more than four total MWH attributes; additionally, no more than one of those four should be of high-influence (Ohio EPA, 1999). No site within the **Otter Creek-Frontal Lake Erie HUC-12** met these criteria, with total MWH attributes ranging from 8-12 and all sampling locations exhibiting between 2-5 high-influence MWH attributes.

Table 12. QHEI Matrix with WWH Attribute Totals in the Otter Creek-Frontal Lake Erie HUC-12

Otter Creek-Frontal Lake Erie HUC-12 (04100010 07 06)																																
Key QHEI Components			WWH Attributes										MWH Attributes																			
													High Influence						Moderate Influence													
River Mile	QHEI Score	Gradient (ft/mi)	Not Channelized or Recovered	Boulder/Cobble/Gravel Substrate	Silt Free Substrates	Good/Excellent Development	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low/Normal Embeddedness	Max Depth >40 cm	Low/No Riffle/Run Embeddedness	WWH Attributes	Channelized/No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth <40 cm	High-Influence MWH Attributes	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrate (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1 or 2 Cover Types	Intermediate/Poor Pools	No Fast Current	High/Moderate Embeddedness	High/Moderate Riffle Embeddedness	No Riffle	Moderate-Influence MWH Attributes
Otter Creek (MWH-C)																																
5.92 ^H	23.0	8.06											0		•	•	•	•	4	•	•			•		•		•	•		•	7
2.95 ^H	41.5	3.70	•					•			•		3		•	•			2	•	•		•	•				•	•		•	7
2.13 ^H	30.0	0.10									•		1		•	•	•		3	•	•			•		•		•	•		•	7
0.40 ^B	38.0	0.10	•					•			•		3		•		•		2		•			•	•			•	•		•	6
Duck Creek (WWH)																																
3.10 ^H	19.5	0.74											0		•		•	•	3	•	•			•	•	•	•	•	•		•	9
2.52 ^H	22.0	0.74											0	•	•	•	•	•	5		•			•				•	•		•	5
0.80 ^B	39.0	0.74	•					•			•		3		•		•		2		•			•	•			•	•		•	6

(Source: Ohio EPA, 2010; Ohio EPA, 2023a; Ohio EPA 2024)

NOTES

WWH Warmwater Habitat

MWH Modified Warmwater Habitat

QHEI Qualitative Habitat Evaluation Index

B Boat sample

H Headwater sample

W Wading sample

-- No data available.

Data highlighted in tan are from 2006-2008.. All other data reported are from the 2017 sampling event.

Lacustrine sites are highlighted in yellow.

2.3 Summary of HUC-12 Pollution Causes and Associated Sources

As shown in the *Biological and Water Quality Study of the Portage River Basin, Select Lake Erie Tributaries, and Select Maumee River Tributaries, 2006-2008, Technical Report EAS 2010-4-4* and the *Biological and Water Quality Study of Swan Creek, Toussaint River, Western Lake Erie Tributaries, and Lower Maumee River Tributaries, Technical Report AMS/2017-STEM-2*, three sites in Duck Creek are in *Non-Attainment* of the WWH designation for siltation/sedimentation related to urban runoff and channelization and heavy metal and PAH-contaminated sediments. Four sampling locations in Otter Creek are in *Non-Attainment* of MWH-C designation for siltation/sedimentation related to channelization and legacy heavy metal, PAH and PCB-contaminated sediments from industrial landfills and runoff and sediment resuspension (Table 13).

Table 13. Causes and Sources of NPS Impairments for Otter Creek-Frontal Lake Erie HUC-12

Otter Creek-Frontal Lake Erie HUC-12 (04100010 07 06)				
River Mile	Primary Cause(s)	Primary Source(s)	Attainment Status	Location
Otter Creek (MWH-C)				
5.92 ^H	Siltation/sedimentation; Cu, Pb, Zn, As, 4,4'-DDD, 4,4'-DDE, Chlordane and total PAHs in sediments	Industrial runoff, contaminated sediments, channelization	Non	Oakdale Avenue
2.95 ^H	Cr, Cu, Pb, Zn, Hg, As, Cd 4,4'-DDD, Chlordane, total PAHs and total PCBs in sediments, sedimentation/siltation	Sediment resuspension (contaminated sediment), channelization	Non	Consaul Street
2.13 ^H	Siltation/sedimentation, Cr, Cu, Pb, Zn, Hg, As, 4,4'-DDD, Chlordane, total PCBs and total PAHs in sediments	Industrial landfills, contaminated sediments, channelization	Non	Millard Road
0.40 ^B	Siltation/sedimentation, Cr, Cu, Pb, Zn, Hg, As, 4,4'-DDD, Chlordane and total PAHs in sediments ^a	Industrial landfills/runoff, contaminated sediments, channelization ^a	Non	Near mouth adjacent to CSX Railroad
Duck Creek (WWH)				
3.10 ^H	Zn, Ca, Mg, Sr, total PAHs in sediments,	Sediment resuspension (contaminated sediment)	Non	Consaul Street
2.52 ^H	Siltation/sedimentation	Urban runoff, channelization	Non	York Street
0.80 ^B	Sedimentation/siltation ^a	Urban runoff, channelization ^a	Non	Near mouth adjacent to Tiffin Avenue

(Source: Ohio EPA, 2010; Ohio EPA, 2023a; Ohio EPA 2024)

NOTES

B Boat sample

H Headwater sample

W Wading sample

*a Assumed cause/source based upon watershed characteristics and upstream causes/sources.
Data highlighted in tan are from 2006-2008. All other data reported are from the 2017 sampling event.
Lacustrine sites are highlighted in yellow.*

Loss of sediments from the surrounding landscape may also imply loss of nutrients, as a fraction of these nutrients introduced to the landscape through fertilization techniques and other sources bind to soil particles. As soil particles are lost to local waterways, additional nutrients can become available for microorganism uptake, and in situations where nutrients concentrate and are overabundant, eutrophication occurs and drives HAB formation. This can occur both in-stream as well as in far-field, receiving waterbodies, such as Lake Erie.

The Ohio EPA has estimated spring phosphorus loadings from individual sub-watersheds throughout the greater WLEB watershed. These estimates also include a breakdown of estimated loads from contributing sources of NPS pollutants, such as agricultural lands/activities, developed/urban lands, failing HSTS and natural sources (Table 14). While urban contributions from within the MS4 area are not considered a nonpoint source, reductions on these lands will help make progress toward the 40% reduction goal outlined by Annex 4 of the GLWQA and the Ohio DAP.

Table 14. Estimated Spring Total Phosphorus Loadings from Contributing NPS Sources in the Otter Creek-Frontal Lake Erie HUC-12

	Agricultural Load (lbs)	Developed/Urban Load (lbs) [^]	MS4 Load (lbs) ^a	Natural Load (lbs)	HSTS Load (lbs)	Landscape Total (lbs)
Current Estimates*	2,400	300	2,400	< 100	110	5,300 ^b
Target Loadings*	1,400	200	1,400	< 100	70	3,200 ^b

(Source: OLEC, 2020; OLEC, 2023)

NOTES

* Estimated using two significant figures

[^] Value reported in OLEC, 2020 reduced by 89%.

^a Calculated from the difference between urban values reported in OLEC, 2020 and an assumed adjustment based on 89% of the urban/developed land in the sub-watershed now lies within the Toledo MS4 area.

^b Total differs slightly from what is reported in OLEC, 2020 due to rounding.

Both Duck Creek and Otter Creek are designated for Agricultural Water Supply (AWS) and Industrial Water Supply (IWS). Additionally, each stream has been given a PCR designation, for which it is impaired (Table 15). Geometric means and maximum values for *Escherichia coli* (*E. coli*) at all but one location exceeded WQS (Table 16). Potential sources were mainly from urban runoff or failing HSTS/package plants.

Table 15. Recreational Water Quality Data for the Otter Creek-Frontal Lake Erie HUC-12

River Mile	Location	Number of Samples	Geometric Mean (CFU/100 ml)	Maximum Value (CFU/100 ml)	Attainment Status	Potential Source
Otter Creek (PCR)						
5.92	Oakdale Avenue	8	1,343	>10,000	Non	Package plants
2.95 ^a	Consaul Street	5	343	980	Non	Urban
2.13	Millard Avenue	8	440	5,600	Non	HSTS
0.40	Adjacent CSX Road	2	212	4,100	Non	HSTS
Duck Creek (PCR)						
4.00	Burger Street	4	54	150	Full	--
3.10	Consaul Street	2	685	770	Non	HSTS
2.52	York Street	2	954	1,300	Non	HSTS; golf course

(Source: Ohio EPA, 2010; Ohio EPA, 2023a)

NOTES

PCR Primary Contact Recreation

HSTS Home Sewage Treatment System

CFU Colony Forming Units

ml Milliliters

^a Data from 2017; all other data from 2006-2008.

Table 16. Statewide Numerical Criteria for Recreational Use Protection

Recreation use	<i>E. coli</i> (CFU per 100 ml)	
	90-day geometric mean	Statistical threshold value ¹
Bathing water	126	410 ^a
Primary contact recreation	126	410
Secondary contact recreation	1030	1030

(Source: Ohio Administrative Code 3745-1-37)

NOTES

1 These criteria shall not be exceeded in more than ten percent of the samples taken during any 90-day period. A beach action value of 235 *E. coli* colony counts per 100 ml shall be used for the purpose of issuing beach and bathing water advisories.

CFU Colony Forming Units

ml Milliliters

2.4 Additional Information for Determining Critical Areas and Developing Implementation Strategies

The Otter Creek-Frontal Lake Erie HUC-12 NPS-IS, Version 1.0 was used as a template for this Version 2.0 update, and much of the original information in Chapters 1 and 2 was retained. Assessment data from the 2008 TMDL sampling event and data referenced in the *Biological and Water Quality Study of the Portage River Basin, Select Lake Erie Tributaries, and Select Maumee River Tributaries, 2006-2008*,

Technical Report EAS 2010-4-4 and the Total Maximum Daily Loads for the Maumee River (lower) Tributaries and Lake Erie Tributaries Watershed is also included in this document (Ohio EPA, 2010; Ohio EPA, 2012). Data from 2017 documented in the *Biological and Water Quality Study of Swan Creek, Toussaint River, Western Lake Erie Tributaries, and Lower Maumee River Tributaries, Technical Report AMS/2017-STEM-2* and the *2024 Water Quality and Hydrologic Map* was updated into this Version 2.0 update (Ohio EPA, 2023a; Ohio EPA, 2024).

Chloride Data

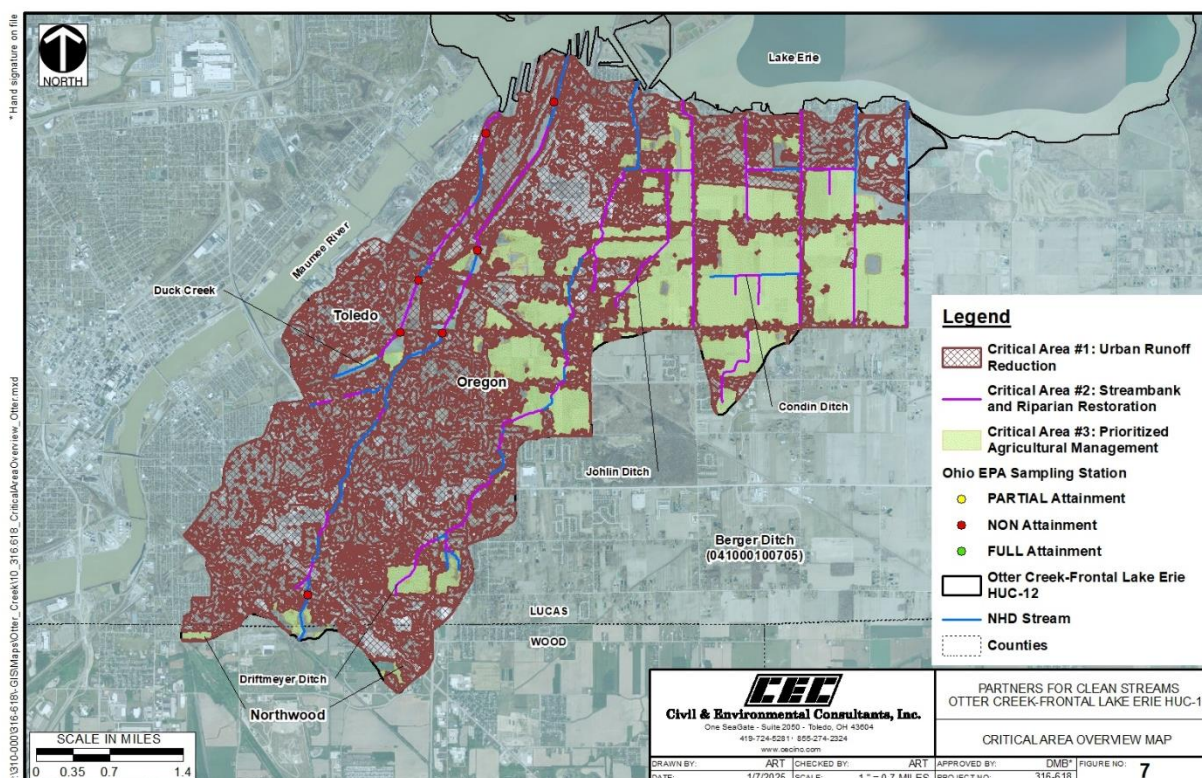
Chloride sampling conducted by the University of Toledo in 2022 documented in the *Maumee Area of Concern (AOC) Chloride Reduction Project* was used to identify HUC-12 assessment units with highly elevated chloride concentrations, which may be negatively impacting aquatic communities within the HUC-12 and perpetuating the inability of the aquatic communities to achieve performance that would remove BUIs. Critical resource needs, goals and objectives for these watersheds in relation to surface water chloride concentrations are detailed in Chapter 3.

CHAPTER 3: CRITICAL AREA CONDITIONS & RESTORATION STRATEGIES

3.1 Overview of Critical Areas

Overall, seven sampling sites are located in the **Otter Creek-Frontal Lake Erie HUC-12**. Three sites in Duck Creek are in *Non-Attainment* of the WWH designation for siltation/sedimentation related to urban runoff and channelization and heavy metal and PAH-contaminated sediments. Four sampling locations in Otter Creek are in *Non-Attainment* of MWH-C designation for siltation/sedimentation related to channelization and legacy heavy metal, PAH and PCB-contaminated sediments from industrial landfills and runoff and sediment resuspension. While many of the causes and sources for biological impairment are related to sediment contamination and are beyond the scope of traditional nonpoint source strategies, efforts made to reduce sediment (and associated nutrient) loss from the surrounding landscape may decrease additional stressors on aquatic communities.

Three critical areas have been identified for the **Otter Creek-Frontal Lake Erie HUC-12** (Figure 7⁴). Two critical areas will address far-field effects of nutrients and other pollutants, including chloride, from surrounding land use into local waterways that flow to Lake Erie, the end receiving waterbody of drainage from the **Otter Creek-Frontal Lake Erie HUC-12**. A third critical area will address habitat alterations and channelization effects that may exacerbate in-stream conditions in Otter Creek and Duck Creek (Table 17).



⁴ Critical area maps developed with the most recently available digital geographic data and may not reflect current land use or existing conditions that have changed since digital publication.

Table 17. Otter Creek-Frontal Lake Erie HUC-12 Critical Area Descriptions

Critical Area Number	Critical Area Description	Impairments Addressed
1	Urban Runoff Reduction	Far-field (Lake Erie), with near-field benefits
2	Streambank and Riparian Restoration	Near-field
3	Agricultural Runoff Reduction	Far-field (Lake Erie), with near-field benefits

Additionally, BUIs also exist for the **Otter Creek-Frontal Lake Erie HUC-12**. The attainment of WQS within this sub-watershed will also address BUI #3a, 6 and 14a within the **Otter Creek-Frontal Lake Erie HUC-12**. Actions taken to address these critical resource needs to make progress toward attainment of WQS will simultaneously make progress toward removal of BUIs.

3.2 Critical Area #1: Conditions, Goals & Objectives for Nutrient Reduction from Urban Lands

3.2.1 Detailed Characterization

In urban environments, NPS contributions to stormwater runoff can come from a variety of sources, including fertilizers, detergents, leaves and detritus, wild and domesticated animal excrement, lubricants, sediment erosion, and organic and inorganic decomposition processes (Carpenter *et. al*, 1998; Burton and Pitt, 2001). Urbanization and development often leads to increased pollutant availability, runoff, peak flows, stream “flashiness” and stream instability, along with decreased stream function, storage and retention capabilities and pollutant assimilation in soils (ODNR, 2006). Many of these effects have a direct impact on aquatic life. Degradation to stream ecosystems has been shown even in areas of low amounts of urbanization (5-10% imperviousness) (Schueler, 1994).

The **Otter Creek-Frontal Lake Erie HUC-12** is primarily developed, containing large portions of the cities of Toledo and Oregon in Lucas County and a small portion of the City of Northwood in Wood County. Urban lands cover approximately 7,928 acres. Twenty-two percent (22%) of these urban lands are high-density, reflecting the industrial nature of many of the lands adjacent to both Duck and Otter Creeks. Sixty-four percent (64%) of these urban lands are classified as low or medium density and are likely single-family homes (MRLC, 2024). *Critical Area #1* is composed of urban lands contained mainly in the western three-fourths of the sub-watershed, but encroaching eastward (Figure 8). Much of this area is also contained within the regulated Toledo MS4 area. The reduction of urban nutrients through practices that help retain, detain and filter stormwater both within and outside of the MS4 area, will help make progress toward the 40% reduction of phosphorus called for by the GLWQA and Ohio’s DAP, which offers benefits to near-field communities as well.

In addition, the **Otter Creek-Frontal Lake Erie HUC-12** is identified as an assessment unit in need of chloride reduction due to elevated concentrations observed from March 2022 to June 2022. Waterways identified as critical areas for chloride reduction both expressed elevated chloride concentrations during the aforementioned time period and are directly adjacent to or downstream from a potential chloride contributor. The **Otter Creek-Frontal Lake Erie HUC-12** is one of the most highly contaminated assessment units in the AOC (Hintz, 2022). The University of Toledo sampled the **Otter Creek-Frontal**

Lake Erie HUC-12 in five locations throughout Otter Creek, one location in Duck Creek and one location in Lake Erie over 2022-2023. Levels within the stream ranged from 24.72 mg/L to 420.37 mg/L. Potential contributors to elevated chloride levels in the **Otter Creek-Frontal Lake Erie HUC-12** include road salt from private and public applicators in heavily trafficked areas/roadways that coincide with high imperviousness, leading to concentrated runoff into streams.

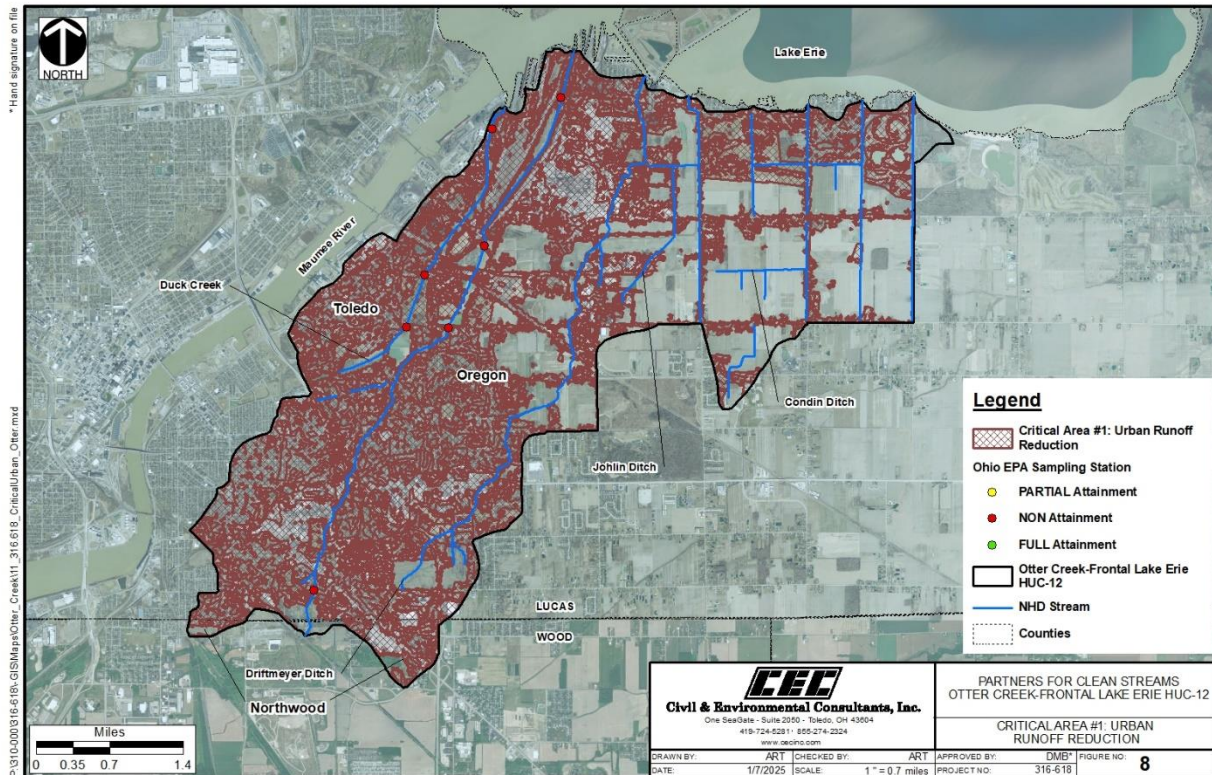


Figure 8: Otter Creek-Frontal Lake Erie HUC-12 Critical Area #1

Mean imperviousness throughout the sub-watershed is approximately 37% (Hintz, unpublished data). The sub-watershed includes portions of State Route 2 and multiple residential subdivisions, as well as several oil refineries, a metal yard, a hazardous waste landfill, a clean energy facility, a petroleum power station and a major WTP. Road salt applicators within this sub-watershed include ODOT, the City of Toledo, the City of Oregon and the City of Northwood. One of the largest applicators within this sub-watershed is the City of Toledo, which follows a Materials Application Guide for the application of brine, prewetted solids, liquid application or calcium chloride, based upon temperature, road conditions and forecasted snowfall/precipitation (*personal communication from Josh Quinlan, September 7, 2023*). Snow removal and salt application follows a tiered system, based upon severity of storm (City of Toledo, 2023). Residential streets within the City are not salted, except in extreme conditions, and are not plowed unless more than three inches of snowfall accumulates.

City of Toledo personnel identified equipment availability and training as the largest obstacles to reducing salt application. Currently, application equipment is retrofitted to trucks used for leaf collection and street cleaning. The overlap between leaf collection and salt application seasons creates issues

when trying to change out equipment in anticipation of a storm event, leaving little to no time for calibration. Consequently, the constant changing of equipment back and forth may also negatively impact the results of any calibration that was accomplished. In addition, many operators do not understand or realize the impact that calibration may have on application rates or the negative impacts that over-application has on the environment. Education and training is also needed for those maintenance employees who are responsible for application at individual buildings, including schools, parks and treatment facilities.

The City of Oregon is also a large applicator within the **Otter Creek-Frontal Lake Erie HUC-12** and operates a fleet of eight plow trucks to cover 304 lane miles. Each plow is equipped with a Storm Guard Control System to pre-wet salt with magnesium chloride and a Jomma live edge plow. City of Oregon personnel have identified proper salt storage capacity as a large need. They also recognize a general need to educate the public about tempered expectations for roadway salt application and proper salt application at residences, as well as a need to educate private applicators hired for snow removal and salt application for private parking lots and facilities.

Generally, stakeholders in the **Otter Creek-Frontal Lake Erie HUC-12** and throughout the Maumee AOC agree that statewide and regional policies and programs should be initiated and implemented to promote and support sustainable salting practices.

3.2.2 Detailed Biological Conditions

Fish community data for the sampling locations within the **Otter Creek-Frontal Lake Erie HUC-12** are summarized below (Table 18). Analysis of the abundance, diversity and pollution tolerance of existing fish species found by Ohio EPA at each sampling location, in relation to the corresponding QHEI score, aids in the identification of causes and sources of impairment. In both Duck Creek and Otter Creek, species diversity increases with increasing drainage area; however, IBI scores are relatively low. The three headwater sites in Otter Creek did reach MWH thresholds, though the most upstream sampling location was only marginally achieving thresholds. Sites in Duck Creek did not reach WWH standards, and habitat in the headwater sites were among the lowest throughout the entire Cedar-Portage study area. Fish communities in lacustrine sites in both Otter Creek and Duck Creek were mostly pool-related species, likely a factor of the interaction with Lake Erie.

Table 18. Critical Area #1 – Fish Community and Habitat Data

Otter Creek-Frontal Lake Erie HUC-12 (04100010 07 06)							
River Mile	Drainage (mi²)	Total Species	QHEI	IBI	MIwb^a	Predominant Species (Percent of Catch)	Narrative Evaluation
Otter Creek (MWH-C)							
5.92 ^H	2.8	4	23.0	16 ^{ns}	N/A	--	Poor
2.95 ^H	5.9	8	41.5	24	N/A	Creek chub (56%), green sunfish (17%), yellow perch (12%)	Poor
2.13 ^H	6.6	8	30.0	28	N/A	--	Fair
0.40 ^B	7.4	12	38.0	28 [*]	7.66 ^{*^}	Golden shiner (26%), yellow perch (24%), gizzard shad (21%)	Poor – Fair

Otter Creek-Frontal Lake Erie HUC-12 (04100010 07 06)							
River Mile	Drainage (mi ²)	Total Species	QHEI	IBI	MIwb ^a	Predominant Species (Percent of Catch)	Narrative Evaluation
Duck Creek (WWH)							
3.10 ^H	0.6	1	19.5	<u>12*</u>	N/A	Central mudminnow (100%)	Very Poor
2.52 ^H	0.8	5	22.0	<u>24^{ns^}</u>	N/A	Central mudminnow (68%), goldfish (16%), green sunfish (5%)	Poor
0.80 ^B	1.3	12	39.0	<u>16*</u>	<u>3.41*</u>	Gizzard shad (22%), bluegill sunfish (13%), common carp X goldfish hybrid (13%)	Very Poor

(Source: Ohio EPA, 2010; Ohio EPA, 2023a; Ohio EPA, 2024)

NOTES

a The Modified Index of Well Being (MIwb) is not applicable to headwater sites (drainage <20 mi²).

IBI Index of Biotic Integrity

QHEI Qualitative Habitat Evaluation Index

ns Nonsignificant departure from ecoregion biocriteria (≤4 IBI or ICI units; ≤0.5 MIwb units).

*** Significant departure from ecoregion biocriteria; poor and very poor results are underlined.

MWH-C Modified Warmwater Habitat – Channelized

WWH Warmwater Habitat

H Headwater sample

W Wading sample

B Boat sample

N/A Not applicable

^ Conflicting data between current TSD and the 2022 Ohio Integrated Report. Data reported in this NPS-IS reflect the 2022 Ohio Integrated Report.

Data highlighted in tan are from 2006-2008. All other data reported are from the 2017 sampling event.

Yellow fill indicates a lacustrine location. Attainment determined with lacustrine benchmarks.

Characteristics of the aquatic macroinvertebrate community for the **Otter Creek-Frontal Lake Erie HUC-12** are summarized below (Table 19). Analysis of the abundance, diversity, and pollution tolerance of existing aquatic macroinvertebrates found by Ohio EPA at these sampling locations, related to QHEI score, can aid in the identification of causes and sources of impairment. Macroinvertebrate community scores throughout the **Otter Creek-Frontal Lake Erie HUC-12** were generally very low, scoring in the *Very Poor* (headwater sites) to *Fair* (lacustrine sites), likely a result of poor substrate conditions—heavy silt cover, silt/muck substrates, high amounts of substrate and riffle embeddedness and contaminated sediments. Additionally, chloride impacts were also noted in Otter Creek, as chloride concentrations have increased downstream over time (Ohio EPA, 2023a). While an increase in the number of taxa in Otter Creek at Consaul Street (RM 2.95) occurred in 2017 over 2006, the new organisms had less chloride tolerance. Organisms with a low chloride tolerance have essentially been extirpated (Ohio EPA, 2023a).

Table 19. Critical Area #1 – Macroinvertebrate Community Data

Otter Creek-Frontal Lake Erie HUC-12 (04100010 07 06)			
River Mile	ICI Score—Narrative	Notes (Density of Ql./Qt.)	Predominant Species (Tolerance Categories)
Otter Creek (MWH-C)			
5.92 ^H	N/A – <u>Very Poor</u> * 0 sensitive taxa	Low-moderate qualitative density	Flatworms (F), sow bugs (MT,F)
2.95 ^H	N/A – <u>Very Poor</u> * 0 sensitive taxa	Moderate qualitative density	Flatworms (F), sow bugs (T), sponge (F)
2.13 ^H	N/A – <u>Very Poor</u> * 0 sensitive taxa	Low qualitative density	Sow bugs (MT)
0.40 ^B	28* – Fair 0 sensitive taxa	Low-moderate qualitative density/507	Snails (T), midges (F, T)
Duck Creek (WWH)			
3.10 ^H	N/A – <u>Very Poor</u> * 0 sensitive taxa	Low-moderate qualitative density	Snails (T), oligochaete worms (T), leeches (T, MT)
2.52 ^H	N/A – <u>Very Poor</u> * 1 sensitive taxa	Moderate qualitative density	Midges (F,MI), baetid mayflies (F), hydropsychid caddisflies (F)
0.80 ^B	32* – Fair 1 sensitive taxa	666 organisms per square foot	Snails (T), midges (MT)

(Source: Ohio EPA, 2010; Ohio EPA, 2023a; Ohio EPA, 2024)

NOTES

* Significant departure from ecoregion biocriteria; poor and very poor results are underlined.

ns Nonsignificant departure from ecoregion biocriteria (≤ 4 IBI or ICI units; ≤ 0.5 MIwb units).

a Narrative evaluation used in lieu of ICI

H Headwater sample

W Wading sample

B Boat sample

Ql. Qualitative sample collected from the natural substrates.

Qt. Quantitative sample collected on Hester-Dendy artificial substrates, density is expressed in organisms per square foot.

Tolerance Categories: VT=Very Tolerant, T=Tolerant, MT=Moderately Tolerant, F=Facultative, MI=Moderately Intolerant, I=Intolerant.

Data highlighted in tan are from 2006-2008. All other data reported are from the 2017 sampling event.

Yellow fill indicates a lacustrine location. Attainment determined with lacustrine benchmarks.

3.2.3 Detailed Causes and Associated Sources

Seven sampling sites are located in the **Otter Creek-Frontal Lake Erie HUC-12**. Three sites in Duck Creek are in *Non-Attainment* of the WWH designation for siltation/sedimentation related to urban runoff and channelization and heavy metal and PAH-contaminated sediments. Four sampling locations in Otter Creek are in *Non-Attainment* of MWH-C designation for siltation/sedimentation related to channelization and legacy heavy metal, PAH and PCB-contaminated sediments from industrial landfills and runoff and sediment resuspension. The data summarized previously in Table 12 (p.22) may reveal a direct link between the presence of attributes in the watershed that have influence on the aquatic communities throughout the **Otter Creek-Frontal Lake Erie HUC-12** in *Critical Area #1*. These contributing attributes in *Critical Area #1* include:

-
- Recovering Channel;
 - Silt and Muck Substrates;
 - Low to No Sinuosity;
 - Sparse/No Cover;
 - Heavy/Moderate Silt Cover;
 - Fair/Poor Development;
 - Slow Current;
 - High/Moderate Embeddedness; and,
 - Lack of Riffles.

Habitat, as scored by the QHEI, is not a WQS; however, habitat is highly correlated with the performance of aquatic communities. In general, sites that score at least 60 (or 55 for headwater streams) are successful at supporting WWH aquatic assemblages; sites scoring at least 75 are generally supporting Exceptional Warmwater Habitat (EWH) aquatic assemblages. Projects that address the above-described habitat-related attributes (e.g., siltation, embeddedness, etc.) in areas upstream and contributing to habitat impacts will have a positive effect in the QHEI scoring index. As the habitat score (QHEI) becomes better, IBI, MIwb and ICI index scores are also expected to improve.

Many of the negative habitat attributes found during the QHEI sampling event result from land use activities, including impacts from urban development within the watershed. From a far-field perspective, urban land use activities contribute to excessive nutrient loadings to Otter Creek and Duck Creek, eventually reaching the WLEB. Reduction in nutrients in urban areas and management of stormwater inputs can help decrease overall NPS pollution and improve aquatic communities. The use of green infrastructure for the retention, detention and filtration of urban pollutants can also help decrease overall NPS pollution and improve aquatic communities. Compared with natural land cover, shallow and deep infiltration and evapotranspiration decreases while surface runoff increases in urban lands (USEPA, 2003). When watersheds have as little as 10% impervious surface, studies have shown that not only does runoff increase substantially, but pollutant loads also increase (CWP, 1998).

In relation to chloride, freshwater ecosystems are being inundated from multiple sources of salt pollution such as road deicing salts, industrial operations, water softeners, and a changing climate. Specifically, in urban areas, elevated chloride concentrations are a growing concern as reductions in biodiversity and changes in ecosystem function are associated with elevated levels of chloride, and within the Maumee AOC, may impede the removal of BUIs related to aquatic community performance. The implementation of BMPs to reduce excessive chloride pollution to local waterways is needed.

3.2.4 Outline Goals and Objectives for the Critical Area

The overarching goal of any NPS-IS is to improve water quality scores or meet nutrient reduction goals in order to remove a waterbody's impairment status and reach attainment of WQS for the WAU⁵. Urban land use activities in *Critical Area #3* not only contribute to stress on aquatic communities in Otter Creek

⁵ Defined as the HUC-12.

and Duck Creek, but also far-field impairment through excessive nutrient loss to local waterways that flow to the WLEB. The Ohio EPA has estimated nutrient loadings associated with various land uses and sources within sub-basins in the WLEB and has set phosphorus reduction goals for agricultural and urban sources.

Goals

To achieve the desired springtime nutrient load reductions from urban land use in the **Otter Creek-Frontal Lake Erie HUC-12**, the following goal has been established:

Goal 1. Reduce springtime urban phosphorus loading contributions in the **Otter Creek-Frontal Lake Erie HUC-12** to a level at or below 1,600 lbs/year (40% reduction).

NOT ACHIEVED: Current estimated load contribution is 2,700 lbs/year⁶.

Projects that address chloride reduction will improve water chemistry and have a positive effect on aquatic species performance. As water chemistry improves, IBI, MIwb and ICI index scores are also expected to improve. Consequently, projects that improve habitat quality will boost the likelihood of biocriterion achievement. The goal to reduce chloride to improve the aquatic scores in the **Otter Creek-Frontal Lake Erie HUC-12** is to:

Goal 2. Reduce average chloride concentrations in the **Otter Creek-Frontal Lake Erie HUC-12** to a level at or below 108 mg/L (50% reduction).

NOT ACHIEVED: Current average chloride concentration ranges up to ~216 mg/L.

Ultimately, the stakeholders recommend that chloride concentrations not exceed 50 mg/L ever, consistent with guidance instituted for the Canadian Great Lakes and connecting waters, but recognize the difficulty in attainment of this level.

Simultaneous goals relate to the attainment or maintenance of WQS for aquatic communities within Otter Creek and Duck Creek. Implementation of BMP objectives geared toward nutrient reduction efforts will generally also help make incremental progress toward the following goals:

Goal 3. Achieve an IBI score at or above 20 at Oakdale Avenue in Otter Creek (RM 5.92).

NOT ACHIEVED: Site currently has a score of 16.

Goal 4. Achieve an ICI score at or above 22 (Fair) at Oakdale Avenue in Otter Creek (RM 5.92).

NOT ACHIEVED: Site currently has a score of Very Poor (<6).

Goal 5. Achieve a QHEI score at or above 43.5 at Oakdale Avenue in Otter Creek (RM 5.92).

NOT ACHIEVED: Site currently has a score of 23.

⁶ Estimated loading and goal based on estimated runoff in urban lands both outside and within the MS4 area.

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- Goal 6. Maintain an IBI score at or above 20 at Consaul Street in Otter Creek (RM 2.95).
✓ **ACHIEVED:** Site currently has a score of 24.
- Goal 7. Achieve an ICI score at or above 22 (Fair) at Consaul Street in Otter Creek (RM 2.95).
NOT ACHIEVED: Site currently has a score of Very Poor (<6).
- Goal 8. Achieve a QHEI score at or above 43.5 at Consaul Street in Otter Creek (RM 2.95).
NOT ACHIEVED: Site currently has a score of 41.5.
- Goal 9. Maintain an IBI score at or above 20 at Millard Road in Otter Creek (RM 2.13).
✓ **ACHIEVED:** Site currently has a score of 28.
- Goal 10. Achieve an ICI score at or above 22 (Fair) at Millard Road in Otter Creek (RM 2.13).
NOT ACHIEVED: Site currently has a score of Very Poor (<6).
- Goal 11. Achieve a QHEI score at or above 43.5 at Millard Road in Otter Creek (RM 2.13).
NOT ACHIEVED: Site currently has a score of 30.
- Goal 12. Achieve an IBI score at or above 42⁷ near the mouth of Otter Creek, adjacent to CSX railroad (RM 0.40).
NOT ACHIEVED: Site currently has a score of 28.
- Goal 13. Achieve an MIwb score at or above 8.6⁸ near the mouth of Otter Creek, adjacent to CSX railroad (RM 0.40).
NOT ACHIEVED: Site currently has a score of 7.66.
- Goal 14. Achieve an ICI score at or above 42⁹ near the mouth of Otter Creek, adjacent to CSX railroad (RM 0.40).
NOT ACHIEVED: Site currently has a score of 28.
- Goal 15. Achieve a QHEI score at or above 60¹⁰ near the mouth of Otter Creek, adjacent to CSX railroad (RM 0.40).
NOT ACHIEVED: Site currently has a score of 38.
- Goal 16. Achieve an IBI score at or above 28 at Consaul Street in Duck Creek (RM 3.10).
NOT ACHIEVED: Site currently has a score of 12.

⁷ An IBI score of 42 is a lacustrine benchmark. The WQS for WWH boat sites is 34.

⁸ An MIwb score of 8.6 is a lacustrine benchmark that is equal to the WQS for WWH boat sites.

⁹ An ICI score of 42 is a lacustrine benchmark. The WQS for WWH boat sites is 34. This site is listed as attaining WQS for IBI in Ohio EPA, 2023a; however, the goal within this NPS-IS is set for lacustrine benchmarks.

¹⁰ A QHEI score of 60 is a lacustrine benchmark, as well as an expected threshold for WWH wading sites.

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- Goal 17. Achieve an ICI score at or above 34 (Good) at Consaul Road in Duck Creek (RM 3.10).
NOT ACHIEVED: Site currently has a score of Very Poor (<6).
- Goal 18. Achieve a QHEI score at or above 55 at Consaul Road in Duck Creek (RM 3.1).
NOT ACHIEVED: Site currently has a score of 19.5.
- Goal 19. Achieve an IBI score at or above 28 at York Street in Duck Creek (RM 2.52).
NOT ACHIEVED: Site currently has a score of 24.
- Goal 20. Achieve an ICI score at or above 34 (Good) at York Street in Duck Creek (RM 2.52).
NOT ACHIEVED: Site currently has a score of Very Poor (<6).
- Goal 21. Achieve a QHEI score at or above 55 at York Street in Duck Creek (RM 2.52).
NOT ACHIEVED: Site currently has a score of 22.
- Goal 22. Achieve an IBI score at or above 42¹¹ near the mouth of Duck Creek, adjacent to Tiffin Avenue (RM 0.80).
NOT ACHIEVED: Site currently has a score of 16.
- Goal 23. Achieve an MIwb score at or above 8.6¹² near the mouth of Duck Creek, adjacent to Tiffin Avenue (RM 0.80).
NOT ACHIEVED: Site currently has a score of 3.41.
- Goal 24. Achieve an ICI score at or above 42¹³ near the mouth of Duck Creek, adjacent to Tiffin Avenue (RM 0.80).
NOT ACHIEVED: Site currently has a score of 32.
- Goal 25. Achieve a QHEI score at or above 60¹⁴ near the mouth of Duck Creek, adjacent to Tiffin Avenue (RM 0.80).
NOT ACHIEVED: Site currently has a score of 39.

Additionally, attainment of the respective recreational use in Otter Creek and Duck Creek in rural/agricultural areas in the **Otter Creek-Frontal Lake Erie HUC-12** would occur through routine repair and replacement of failing HSTS in unsewered areas. The following goals have been set to achieve this for the sub-watershed:

¹¹ An ICI score of 42 is a lacustrine benchmark. The WQS for WWH boat sites is 34. This site is listed as attaining WQS for IBI in Ohio EPA, 2023a; however, the goal within this NPS-IS is set for lacustrine benchmarks.

¹² An MIwb score of 8.6 is a lacustrine benchmark that is equal to the WQS for WWH boat sites.

¹³ An ICI score of 42 is a lacustrine benchmark. The WQS for WWH boat sites is 34. This site is listed as attaining WQS for IBI in Ohio EPA, 2023a; however, the goal within this NPS-IS is set for lacustrine benchmarks.

¹⁴ A QHEI score of 60 is a lacustrine benchmark, as well as an expected threshold for WWH wading sites.

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- Goal 32. Achieve a 90-day geometric mean value for *E. coli* below 126 colony counts per 100 ml at Oakdale Avenue in Otter Creek (RM 5.92), with a maximum value of less than 410 colony counts per 100 ml.
NOT ACHIEVED: Site currently has a 90-day geometric mean of 1,343 colony counts per 100 ml, with a maximum value of >10,000 colony counts per 100 ml.
- Goal 33. Achieve a 90-day geometric mean value for *E. coli* below 126 colony counts per 100 ml at Consaul Street in Otter Creek (RM 2.95), with a maximum value of less than 410 colony counts per 100 ml.
NOT ACHIEVED: Site currently has a 90-day geometric mean of 343 colony counts per 100 ml, with a maximum value of 980 colony counts per 100 ml.
- Goal 34. Achieve a 90-day geometric mean value for *E. coli* below 126 colony counts per 100 ml at Millard Avenue in Otter Creek (RM 2.13), with a maximum value of less than 410 colony counts per 100 ml.
NOT ACHIEVED: Site currently has a 90-day geometric mean of 440 colony counts per 100 ml, with a maximum value of 5,600 colony counts per 100 ml.
- Goal 35. Achieve a 90-day geometric mean value for *E. coli* below 126 colony counts per 100 ml at the mouth of Otter Creek adjacent to CSX Road (RM 0.40), with a maximum value of less than 410 colony counts per 100 ml.
NOT ACHIEVED: Site currently has a 90-day geometric mean of 212 colony counts per 100 ml, with a maximum value of 4,100 colony counts per 100 ml.
- Goal 36. Maintain a 90-day geometric mean value for *E. coli* below 126 colony counts per 100 ml at Burger Street in Duck Creek (RM 4.00), with a maximum value of less than 410 colony counts per 100 ml.
✓ ACHIEVED: Site currently has a 90-day geometric mean of 54 colony counts per 100 ml, with a maximum value of 150 colony counts per 100 ml.
- Goal 37. Achieve a 90-day geometric mean value for *E. coli* below 126 colony counts per 100 ml at Consaul Street in Duck Creek (RM 3.10), with a maximum value of less than 410 colony counts per 100 ml.
NOT ACHIEVED: Site currently has a 90-day geometric mean of 685 colony counts per 100 ml, with a maximum value of 770 colony counts per 100 ml.
- Goal 38. Achieve a 90-day geometric mean value for *E. coli* below 126 colony counts per 100 ml at York Street in Duck Creek (RM 2.52) with a maximum value of less than 410 colony counts per 100 ml.
NOT ACHIEVED: Site currently has a 90-day geometric mean of 954 colony counts per 100 ml, with a maximum value of 1,300 colony counts per 100 ml.

Objectives

In order to make substantive progress toward the achievement of the springtime urban phosphorus load reduction goal of 1,100 lbs for the **Otter Creek-Frontal Lake Erie HUC-12**, efforts must commence on more widespread implementation, according to the following objectives within *Critical Area #1*.

Additionally, actions taken to address nutrient reduction will also help reduce stressors on aquatic communities within Otter Creek and Duck Creek to maintain WQS.

Objective 1: Reduce stormwater inputs and impacts in the sub-watershed by implementing green infrastructure projects within *Critical Area #1* to retain, detain, and/or treat runoff from at least 3,000 acres of urbanized impermeable surfaces (i.e., parking lots, roads, etc.).

Objective 2: Reduce stormwater inputs and impacts in the sub-watershed by restoring and/or creating floodplain/riparian areas and wetland detention/storage basins to retain, detain and/or treat urban drainage from at least 1,000 acres.

Depending on the specific green infrastructure approach chosen, reduction efficiencies for these objectives may not reach the intended nutrient reduction goals for urban lands in this sub-watershed. Stakeholders in this watershed acknowledge that additional and/or altered objectives may be needed in future versions of this NPS-IS but underscore the exigence in beginning to implement projects that incrementally make progress toward achieving the aforementioned objectives as soon as possible. The objectives, as written, are reflective of what stakeholders gage as reasonable and implementable in the **Otter Creek-Frontal Lake Erie HUC-12** incrementally, over time.

Additionally, the implementation of objectives focused on chloride reduction will help make positive gains toward improving near-field impairments through a reduction in overall salt usage, leading to a reduction in localized chloride concentrations. In order to achieve the overall NPS restoration goals of maintaining *Full Attainment* at all sites within the **Otter Creek-Frontal Lake Erie HUC-12**, the following objectives need to be achieved within *Critical Area #1*.

Objective 3: Increase City of Toledo fleet size to five dedicated salt application trucks¹⁵, in order to increase calibration frequency to more than once per season¹⁶.

Objective 4: Provide training on salt application techniques to internal City applicators and crews, including those who maintain schools, parks and treatment facilities, as well as private applicators throughout the sub-watershed¹⁷.

¹⁵ This objective would offer benefit across multiple HUC-12 sub-watersheds.

¹⁶ Improving calibration frequency has been shown to decrease salt usage by 8-14% (Kimley-Horn, 2010).

¹⁷ Improved training, storage and handling practices may provide a 10-25% reduction in chloride (Weston & Sampson, 2021).

Objectives related to the improvement of HSTS and reduction of bacteria¹⁸ in the urban landscape in the **Otter Creek-Frontal Lake Erie HUC-12** will help make positive gains toward removal of the impairment for the PCR designation in both Otter Creek and Duck Creek. These objectives may include:

Objective 5: Reduce HSTS contributions through replacement efforts or connection to sanitary sewer infrastructure for at least 43 unmapped, unclustered households on an individualized, case-by-case basis.

Water quality monitoring is an integral part of the project implementation process. Both project-specific and routinely scheduled monitoring will be conducted to determine progress toward meeting the goals (i.e., water quality standards and nutrient reduction targets). Through an adaptive management process, the aforementioned objectives will be reevaluated and modified as necessary. Objectives may be added to make further progress toward attainment or reduction goals, or altered, as a systems approach of multiple BMPs can accelerate the improvement of water quality conditions. The *Nonpoint Source Management Plan Update* (Ohio EPA, 2020) will be utilized as a reevaluation tool for its 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: Conditions, Goals & Objectives for Streambank and Riparian Restoration

3.3.1 Detailed Characterization

In the absence of forested riparian corridors, streams erode downward and develop a narrow, steeply sloped bed (Montgomery County, 2006). The changing of the natural channel shape not only reduces habitat for aquatic ecosystems and causes water chemistry stress within the stream (i.e., rising temperatures within the stream due to lack of shade, dissolved oxygen (DO) regime swings, promotion of algal growth, etc.), but downcutting combined with large flow events often causes bank undercutting, exacerbating bank failure and streambank erosion. In total, there are approximately 32.5 miles (171,600 linear feet) of stream throughout the **Otter Creek-Frontal Lake Erie HUC-12**, of which 21.1 miles (111,408 linear feet) are channelized with little to no riparian corridor.

Actions that promote the restoration of banks, riparian areas, floodplains, streams and wetlands are needed throughout the **Otter Creek-Frontal Lake Erie HUC-12** in areas where land use has resulted in perennial streams that have been disconnected from their floodplains, resulting in streambank stability issues, extreme scour and denuded/unvegetated banks. Specific actions suggested in the Maumee River (lower) and Lake Erie Tributaries TMDL for the **Otter Creek-Frontal Lake Erie HUC-12** include bank and riparian restoration through bioengineering, recontouring or regrading; grass, prairie and tree plantings in riparian areas; restoring floodplains and stream channels; installing in-stream habitat and grade

¹⁸ HSTS improvements will also make progress toward nutrient reduction targets set for HSTS.

structures; constructing two-stage channels; restoring natural flow; reconstructing, restoring and reconnecting wetlands to streams; planting wetland species and acquiring conservation easements (Ohio EPA, 2012).

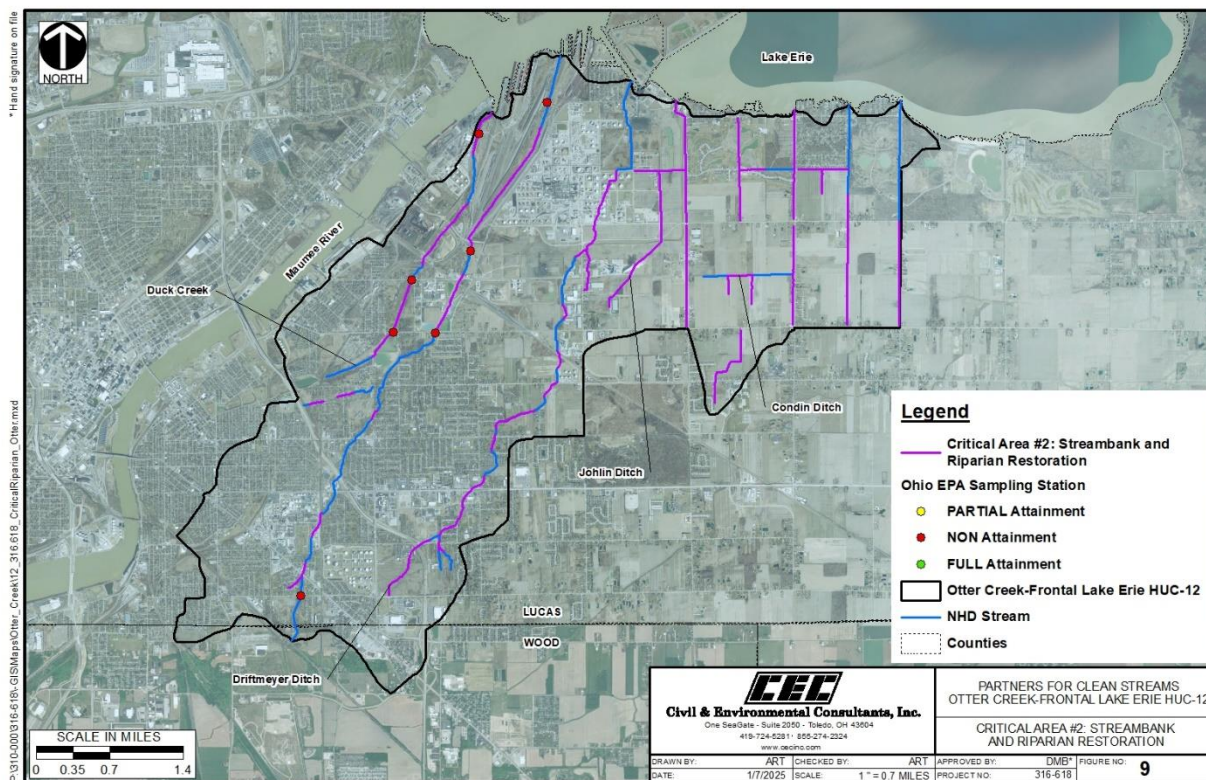


Figure 9: Otter Creek-Frontal Lake Erie HUC-12 Critical Area #2

Using the rationale described in the *Handbook for Developing Watershed Plans to Restore and Protect Our Waters* (USEPA, 2008) (Section 10.3.4): “In general, management practices are implemented immediately adjacent to the waterbody or upland to address the sources of pollutant loads”, *Critical Area #2* includes approximately 111,408 linear feet (21.1 miles) of stream length and a 50-foot buffer width on each side (Figure 9). The potential for restoration of up to approximately 255 acres of riparian corridor and floodplain exists in *Critical Area #2*.

3.3.2 Detailed Biological Conditions

Fish community data for the sampling locations within the **Otter Creek-Frontal Lake Erie HUC-12** are summarized below (Table 20). Analysis of the abundance, diversity and pollution tolerance of existing fish species found by Ohio EPA at each sampling location, in relation to the corresponding QHEI score, aids in the identification of causes and sources of impairment. In both Duck Creek and Otter Creek, species diversity increases with increasing drainage area; however, IBI scores are relatively low. The three headwater sites in Otter Creek did reach MWH thresholds, though the most upstream sampling location was only marginally achieving thresholds. Sites in Duck Creek did not reach WWH standards, and habitat in the headwater sites were among the lowest throughout the entire Cedar-Portage study

area. Fish communities in lacustrine sites in both Otter Creek and Duck Creek were mostly pool-related species, likely a factor of the interaction with Lake Erie.

Table 20. Critical Area #2 – Fish Community and Habitat Data

Otter Creek-Frontal Lake Erie HUC-12 (04100010 07 06)							
River Mile	Drainage (mi ²)	Total Species	QHEI	IBI	MIwb ^a	Predominant Species (Percent of Catch)	Narrative Evaluation
Otter Creek (MWH-C)							
5.92 ^H	2.8	4	23.0	<u>16^{ns}</u>	N/A	--	Poor
2.95 ^H	5.9	8	41.5	24	N/A	Creek chub (56%), green sunfish (17%), yellow perch (12%)	Poor
2.13 ^H	6.6	8	30.0	28	N/A	--	Fair
0.40 ^B	7.4	12	38.0	<u>28*</u>	7.66* [^]	Golden shiner (26%), yellow perch (24%), gizzard shad (21%)	Poor – Fair
Duck Creek (WWH)							
3.10 ^H	0.6	1	19.5	<u>12*</u>	N/A	Central mudminnow (100%)	Very Poor
2.52 ^H	0.8	5	22.0	<u>24^{ns^}</u>	N/A	Central mudminnow (68%), goldfish (16%), green sunfish (5%)	Poor
0.80 ^B	1.3	12	39.0	<u>16*</u>	<u>3.41*</u>	Gizzard shad (22%), bluegill sunfish (13%), common carp X goldfish hybrid (13%)	Very Poor

(Source: Ohio EPA, 2010; Ohio EPA, 2023a; Ohio EPA, 2024)

NOTES

a The Modified Index of Well Being (MIwb) is not applicable to headwater sites (drainage <20 mi²).

IBI Index of Biotic Integrity

QHEI Qualitative Habitat Evaluation Index

ns Nonsignificant departure from ecoregion biocriteria (≤4 IBI or ICI units; ≤0.5 MIwb units).

*** Significant departure from ecoregion biocriteria; poor and very poor results are underlined.

MWH-C Modified Warmwater Habitat – Channelized

WWH Warmwater Habitat

H Headwater sample

W Wading sample

B Boat sample

N/A Not applicable

^ Conflicting data between current TSD and the 2022 Ohio Integrated Report. Data reported in this NPS-IS reflect the 2022 Ohio Integrated Report.

Data highlighted in tan are from 2006-2008. All other data reported are from the 2017 sampling event.

Yellow fill indicates a lacustrine location. Attainment determined with lacustrine benchmarks.

Characteristics of the aquatic macroinvertebrate community for the **Otter Creek-Frontal Lake Erie HUC-12** are summarized below (Table 21). Analysis of the abundance, diversity, and pollution tolerance of existing aquatic macroinvertebrates found by Ohio EPA at these sampling locations, related to QHEI score, can aid in the identification of causes and sources of impairment. Macroinvertebrate community scores throughout the **Otter Creek-Frontal Lake Erie HUC-12** were generally very low, scoring in the *Very Poor* (headwater sites) to *Fair* (lacustrine sites), likely a result of poor substrate conditions—heavy silt cover, silt/muck substrates, high amounts of substrate and riffle embeddedness and contaminated sediments. Additionally, chloride impacts were also noted in Otter Creek, as chloride concentrations

have increased downstream over time (Ohio EPA, 2023a). While an increase in the number of taxa in Otter Creek at Consaul Street (RM 2.95) occurred in 2017 over 2006, the new organisms had less chloride tolerance. Organisms with a low chloride tolerance have essentially been extirpated (Ohio EPA, 2023a).

Table 21. Critical Area #2 – Macroinvertebrate Community Data

Otter Creek-Frontal Lake Erie HUC-12 (04100010 07 06)			
River Mile	ICI Score—Narrative	Notes (Density of Ql./Qt.)	Predominant Species (Tolerance Categories)
Otter Creek (MWH-C)			
5.92 ^H	N/A – <u>Very Poor*</u> 0 sensitive taxa	Low-moderate qualitative density	Flatworms (F), sow bugs (MT,F)
2.95 ^H	N/A – <u>Very Poor*</u> 0 sensitive taxa	Moderate qualitative density	Flatworms (F), sow bugs (T), sponge (F)
2.13 ^H	N/A – <u>Very Poor*</u> 0 sensitive taxa	Low qualitative density	Sow bugs (MT)
0.40 ^B	28* – Fair 0 sensitive taxa	Low-moderate qualitative density/507	Snails (T), midges (F, T)
Duck Creek (WWH)			
3.10 ^H	N/A – <u>Very Poor*</u> 0 sensitive taxa	Low-moderate qualitative density	Snails (T), oligochaete worms (T), leeches (T, MT)
2.52 ^H	N/A – <u>Very Poor*</u> 1 sensitive taxa	Moderate qualitative density	Midges (F,MI), baetid mayflies (F), hydropsychid caddisflies (F)
0.80 ^B	32* – Fair 1 sensitive taxa	666 organisms per square foot	Snails (T), midges (MT)

(Source: Ohio EPA, 2010; Ohio EPA, 2023a; Ohio EPA, 2024)

NOTES

* Significant departure from ecoregion biocriteria; poor and very poor results are underlined.

ns Nonsignificant departure from ecoregion biocriteria (≤ 4 IBI or ICI units; ≤ 0.5 MIwb units).

a Narrative evaluation used in lieu of ICI

H Headwater sample

W Wading sample

B Boat sample

Ql. Qualitative sample collected from the natural substrates.

Qt. Quantitative sample collected on Hester-Dendy artificial substrates, density is expressed in organisms per square foot.

Tolerance Categories: VT=Very Tolerant, T=Tolerant, MT=Moderately Tolerant, F=Facultative, MI=Moderately Intolerant, I=Intolerant.

Data highlighted in tan are from 2006-2008. All other data reported are from the 2017 sampling event.

Yellow fill indicates a lacustrine location. Attainment determined with lacustrine benchmarks.

3.3.3 Detailed Causes and Associated Sources

Seven sampling sites are located in the **Otter Creek-Frontal Lake Erie HUC-12**. Three sites in Duck Creek are in *Non-Attainment* of the WWH designation for siltation/sedimentation related to urban runoff and channelization and heavy metal and PAH-contaminated sediments. Four sampling locations in Otter Creek are in *Non-Attainment* of MWH-C designation for siltation/sedimentation related to

channelization and legacy heavy metal, PAH and PCB-contaminated sediments from industrial landfills and runoff and sediment resuspension. The data summarized previously in Table 12 (p.22) may reveal a direct link between the presence of attributes in the watershed that have influence on the aquatic communities throughout the **Otter Creek-Frontal Lake Erie HUC-12** in *Critical Area #2*. These contributing attributes in *Critical Area #2* include:

- Recovering Channel;
- Silt and Muck Substrates;
- Low to No Sinuosity;
- Sparse/No Cover;
- Heavy/Moderate Silt Cover;
- Fair/Poor Development;
- Slow Current;
- High/Moderate Embeddedness; and,
- Lack of Riffles.

Denuded riparian corridors not only expose streambanks but exacerbate poor stream development and riffle/substrate embeddedness. Floodplain reconnection or restoration would allow for nutrients and associated sediments to attenuate on the land, and stabilizing streambanks and replanting riparian corridors would reduce nutrients and excess sediments from entering the aquatic ecosystem. Habitat, as scored by the QHEI, is not a WQS; however, habitat is highly correlated with the performance of aquatic communities. In general, sites that score at least 60 (or 55 for headwater streams) are successful at supporting WWH aquatic assemblages; sites scoring at least 75 are generally supporting EWH aquatic assemblages. Projects that address the above described habitat-related attributes (e.g., stream cover, channelization, etc.) through in-stream, streambank and riparian restoration in areas upstream and contributing to habitat impacts will have a positive effect in the QHEI scoring index. As the habitat score (QHEI) becomes better, IBI, MIwb and ICI index scores are also expected to improve.

3.3.4 Outline Goals and Objectives for the Critical Area

The overarching goal of any NPS-IS is to improve water quality scores or meet nutrient reduction goals in order to remove a waterbody's impairment status and reach attainment of WQS for the WAU. Projects that address the above described habitat-related attributes (e.g., channelization, heavy/moderate silt cover, substrate embeddedness, etc.) through in-stream and riparian restoration will have a positive effect in the QHEI scoring index. As the habitat score (QHEI) becomes better, IBI and ICI index scores are also expected to improve.

Goals

The remaining goals for *Critical Area #2* of the **Otter Creek-Frontal Lake Erie HUC-12** are to reduce sedimentation (and associated nutrient) effects to improve the aquatic scores through stabilizing streambanks and restoring floodplains and riparian corridors. These goals are to specifically:

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- Goal 1. Achieve an IBI score at or above 20 at Oakdale Avenue in Otter Creek (RM 5.92).
NOT ACHIEVED: Site currently has a score of 16.
- Goal 2. Achieve an ICI score at or above 22 (Fair) at Oakdale Avenue in Otter Creek (RM 5.92).
NOT ACHIEVED: Site currently has a score of Very Poor (<6).
- Goal 3. Achieve a QHEI score at or above 43.5 at Oakdale Avenue in Otter Creek (RM 5.92).
NOT ACHIEVED: Site currently has a score of 23.
- Goal 4. Maintain an IBI score at or above 20 at Consaul Street in Otter Creek (RM 2.95).
✓ ACHIEVED: Site currently has a score of 24.
- Goal 5. Achieve an ICI score at or above 22 (Fair) at Consaul Street in Otter Creek (RM 2.95).
NOT ACHIEVED: Site currently has a score of Very Poor (<6).
- Goal 6. Achieve a QHEI score at or above 43.5 at Consaul Street in Otter Creek (RM 2.95).
NOT ACHIEVED: Site currently has a score of 41.5.
- Goal 7. Maintain an IBI score at or above 20 at Millard Road in Otter Creek (RM 2.13).
✓ ACHIEVED: Site currently has a score of 28.
- Goal 8. Achieve an ICI score at or above 22 (Fair) at Millard Road in Otter Creek (RM 2.13).
NOT ACHIEVED: Site currently has a score of Very Poor (<6).
- Goal 9. Achieve a QHEI score at or above 43.5 at Millard Road in Otter Creek (RM 2.13).
NOT ACHIEVED: Site currently has a score of 30.
- Goal 10. Achieve an IBI score at or above 42¹⁹ near the mouth of Otter Creek, adjacent to CSX railroad (RM 0.40).
NOT ACHIEVED: Site currently has a score of 28.
- Goal 11. Achieve an MIwb score at or above 8.6²⁰ near the mouth of Otter Creek, adjacent to CSX railroad (RM 0.40).
NOT ACHIEVED: Site currently has a score of 7.66.

¹⁹ An IBI score of 42 is a lacustrine benchmark. The WQS for WWH boat sites is 34.

²⁰ An MIwb score of 8.6 is a lacustrine benchmark that is equal to the WQS for WWH boat sites.

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- Goal 12. Achieve an ICI score at or above 42²¹ near the mouth of Otter Creek, adjacent to CSX railroad (RM 0.40).
NOT ACHIEVED: Site currently has a score of 28.
- Goal 13. Achieve a QHEI score at or above 60²² near the mouth of Otter Creek, adjacent to CSX railroad (RM 0.40).
NOT ACHIEVED: Site currently has a score of 38.
- Goal 14. Achieve an IBI score at or above 28 at Consaul Street in Duck Creek (RM 3.10).
NOT ACHIEVED: Site currently has a score of 12.
- Goal 15. Achieve an ICI score at or above 34 (Good) at Consaul Road in Duck Creek (RM 3.10).
NOT ACHIEVED: Site currently has a score of Very Poor (<6).
- Goal 16. Achieve a QHEI score at or above 55 at Consaul Road in Duck Creek (RM 3.1).
NOT ACHIEVED: Site currently has a score of 19.5.
- Goal 17. Achieve an IBI score at or above 28 at York Street in Duck Creek (RM 2.52).
NOT ACHIEVED: Site currently has a score of 24.
- Goal 18. Achieve an ICI score at or above 34 (Good) at York Street in Duck Creek (RM 2.52).
NOT ACHIEVED: Site currently has a score of Very Poor (<6).
- Goal 19. Achieve a QHEI score at or above 55 at York Street in Duck Creek (RM 2.52).
NOT ACHIEVED: Site currently has a score of 22.
- Goal 20. Achieve an IBI score at or above 42²³ near the mouth of Duck Creek, adjacent to Tiffin Avenue (RM 0.80).
NOT ACHIEVED: Site currently has a score of 16.
- Goal 21. Achieve an MIwb score at or above 8.6²⁴ near the mouth of Duck Creek, adjacent to Tiffin Avenue (RM 0.80).
NOT ACHIEVED: Site currently has a score of 3.41.

²¹ An ICI score of 42 is a lacustrine benchmark. The WQS for WWH boat sites is 34. This site is listed as attaining WQS for IBI in Ohio EPA, 2023a; however, the goal within this NPS-IS is set for lacustrine benchmarks.

²² A QHEI score of 60 is a lacustrine benchmark, as well as an expected threshold for WWH wading sites.

²³ An ICI score of 42 is a lacustrine benchmark. The WQS for WWH boat sites is 34. This site is listed as attaining WQS for IBI in Ohio EPA, 2023a; however, the goal within this NPS-IS is set for lacustrine benchmarks.

²⁴ An MIwb score of 8.6 is a lacustrine benchmark that is equal to the WQS for WWH boat sites.

Goal 22. Achieve an ICI score at or above 42²⁵ near the mouth of Duck Creek, adjacent to Tiffin Avenue (RM 0.80).

NOT ACHIEVED: Site currently has a score of 32.

Goal 23. Achieve a QHEI score at or above 60²⁶ near the mouth of Duck Creek, adjacent to Tiffin Avenue (RM 0.80).

NOT ACHIEVED: Site currently has a score of 39.

Objectives

The implementation of these objectives, partnered with implementation throughout other identified critical areas will help ameliorate negative impacts from sedimentation within the **Otter Creek-Frontal Lake Erie HUC-12**, and positive gains will be made toward maintaining near-field attainment and removing far-field impairments. In order to achieve the overall NPS restoration goals of maintaining *Full Attainment* at all sites within the **Otter Creek-Frontal Lake Erie HUC-12**, the following objectives²⁷ need to be achieved within *Critical Area #2*.

Objective 1: Stabilize and restore at least three miles (15,840 linear feet) of degraded/downcut streambanks and channel habitat through natural channel design methods and bioengineering techniques²⁸.

Objective 2: Create, enhance or restore at least 20 acres²⁹ of woody riparian corridor and/or riparian floodplain wetlands.

Water quality monitoring is an integral part of the project implementation process. Both project-specific and routinely scheduled monitoring will be conducted to determine progress toward meeting the goals (i.e., water quality standards and nutrient reduction targets). Through an adaptive management process, the aforementioned objectives will be reevaluated and modified as necessary. Objectives may be added to make further progress toward attainment or reduction goals, or altered, as a systems approach of multiple BMPs can accelerate the improvement of water quality conditions. The *Nonpoint Source Management Plan Update* (Ohio EPA, 2020) will be utilized as a reevaluation tool for its listing of all eligible NPS management strategies to consider including:

- Urban Sediment and Nutrient Reduction Strategies;
- Altered Stream and Habitat Restoration Strategies;

²⁵ An ICI score of 42 is a lacustrine benchmark. The WQS for WWH boat sites is 34. This site is listed as attaining WQS for IBI in Ohio EPA, 2023a; however, the goal within this NPS-IS is set for lacustrine benchmarks.

²⁶ A QHEI score of 60 is a lacustrine benchmark, as well as an expected threshold for WWH wading sites.

²⁷ These objectives may occur at the urban or agricultural interface and may make progress toward goals listed across multiple critical areas.

²⁸ The focus of this objective should be in improvement of channel form. While it is recognized that healthy streams are in a state of dynamic equilibrium and require adequate space for fully functioning systems, land use constraints may exist that limit the amount of improvement that can be made to channel design and form in an effort to provide stability to the system. Stabilization may be independent of in-channel work; however, bank armoring and excessive use of stone, concrete or other unnatural hardening agents is discouraged (Ohio EPA, 2020).

²⁹ With a 50-foot buffer on one river side, this equates to riparian corridor restoration along ~17,424 linear feet (~3.3 miles).

- Nonpoint Source Reduction Strategies; and,
- High Quality Waters Protection Strategies.

3.4 Critical Area #3: Conditions, Goals & Objectives for Nutrient Reduction in Prioritized Agricultural Lands

3.4.1 Detailed Characterization

Ohio's *Nutrient Mass Balance Study* (Ohio EPA, 2022) estimated 91% of the phosphorus loading to Lake Erie via streams within the Cedar-Toussaint watershed were primarily from nonpoint sources, related to land use activities, with only small contributions from failing HSTS and NPDES-permitted facilities. This estimate is consistent with several other studies and tributary data from adjacent watersheds. Approximately 25% of land use, mainly in the eastern portion of the sub-watershed, within the **Otter Creek-Frontal Lake Erie HUC-12** is dedicated to agricultural land use, namely cultivated crops with a negligible amount of pastureland (<1%).

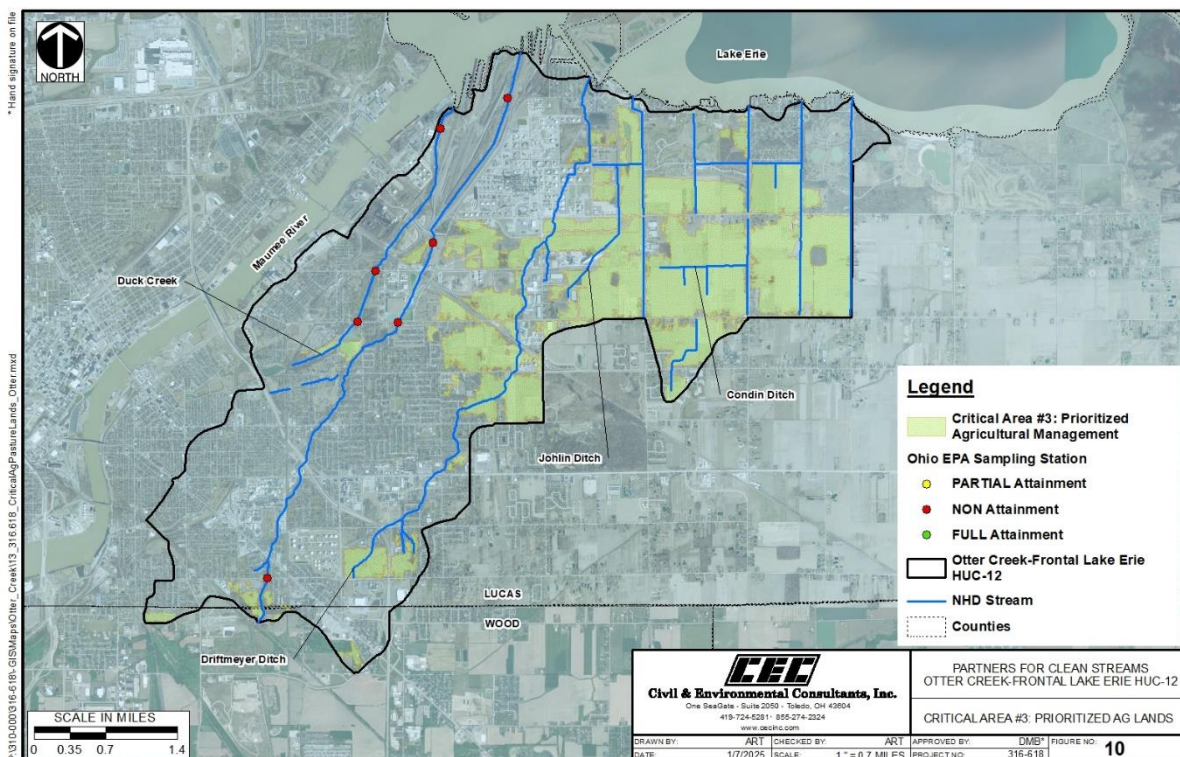


Figure 10: Otter Creek-Frontal Lake Erie HUC-12 Critical Area #3

The use of BMPs is recommended for agricultural operations to minimize nutrient and associated sediment loss to local waterways and drainage ditches through surface and tile flow. While BMPs are encouraged on all agricultural lands, certain lands are more prone to nutrient loss than others and are prioritized for BMP implementation. Lands maintained under conventional agricultural production or managed as pasture are prone to contribute excessive sediment and nutrient loadings to adjacent waterways that eventually flow to Lake Erie. Lands that are proximal to streams and ditches or do not currently implement specific BMPs are most vulnerable to excessive nutrient and sediment loss, and

these lands are also prioritized as critical within this watershed. *Critical Area #1* contains prioritized agricultural lands throughout the **Otter Creek-Frontal Lake Erie HUC-12** (Figure 10).

Of the approximate 2,941 agricultural acres in the **Otter Creek-Frontal Lake Erie HUC-12**, prioritized lands are operations that meet one or more of the following criteria:

- Lands directly adjacent to streams or drainage waterways;
- Lands with uncontrolled or unfiltered subsurface drainage water;
- Lands without a current (<3 years) nutrient management plan or soil test; or,
- Lands with high soil phosphorus levels (>50 ppm Mehlich or 50 lbs/acre Bray).

3.4.2 Detailed Biological Conditions

Most agricultural lands within the sub-watershed are located east of Duck Creek and Otter Creek. No biological sampling points exist in *Critical Area #3*.

3.4.3 Detailed Causes and Associated Sources

Seven sampling sites are located in the **Otter Creek-Frontal Lake Erie HUC-12**. Three sites in Duck Creek are in *Non-Attainment* of the WWH designation for siltation/sedimentation related to urban runoff and channelization and heavy metal and PAH-contaminated sediments. Four sampling locations in Otter Creek are in *Non-Attainment* of MWH-C designation for siltation/sedimentation related to channelization and legacy heavy metal, PAH and PCB-contaminated sediments from industrial landfills and runoff and sediment resuspension. The data summarized previously in Table 12 (p.22) may reveal a direct link between the presence of attributes in the watershed that have influence on the aquatic communities throughout the **Otter Creek-Frontal Lake Erie HUC-12** in *Critical Area #3*. These contributing attributes in *Critical Area #3* include:

- Recovering Channel;
- Silt and Muck Substrates;
- Low to No Sinuosity;
- Sparse/No Cover;
- Heavy/Moderate Silt Cover;
- Fair/Poor Development;
- Slow Current;
- High/Moderate Embeddedness; and,
- Lack of Riffles.

Many habitat attributes found during the QHEI sampling event (i.e., heavy/moderate silt cover, substrate embeddedness, etc.) are likely a result of land use activities. Agricultural operations within the headwaters of the sub-watershed are likely contributing to sediment and nutrient loads within Otter Creek and Duck Creek. From a far-field perspective, agricultural land use activities contribute to excessive nutrient loadings to Lake Erie that result in eutrophication and the formation of HABs. The use of a variety of BMPs on private agricultural lands, at both in-field and edge-of-field locations can help reduce the amount and concentration of nutrient-laden surface runoff and tile drainage. Many BMPs

can not only address reduction of nutrients in surface and drainage water, but they can also simultaneously address the loss of sediment from agricultural lands, which contributes to sediment-covered substrates in local waterways. In addition, a reduction of sediment loss to local waterways can also reduce nutrient loss to near-field and far-field waterbodies, as nutrients will also adsorb to sediment particles, potentially becoming dissolved at a later time. The implementation of BMPs on agricultural lands that are prone to sediment and nutrient loss serves as a benefit for both near-field and far-field waterbodies.

3.4.4 Outline Goals and Objectives for the Critical Area

The overarching goal of any NPS-IS is to improve water quality scores or meet nutrient reduction goals in order to remove a waterbody's impairment status and reach attainment of WQS for the WAU.

Agricultural land use activities in *Critical Area #3* contribute to far-field impairment through excessive nutrient loss (phosphorus) to local waterways that flow to Lake Erie. Through the GLWQA Annex 4 and the subsequent DAP for the State of Ohio, nutrient target loads have been set for sub-watersheds within the WLEB. These phosphorus target loads have been set at levels that are 40% lower than the current estimated loadings. Ohio's *Nutrient Mass Balance Study* has also shown that a large portion of the nutrient load to Lake Erie occurs during springtime rains (Ohio EPA, 2022; OLEC, 2023).

Many objectives within the **Otter Creek-Frontal Lake Erie HUC-12** align with the priorities of the H2Ohio Initiative, a water quality initiative with a focus on phosphorus reduction that provides economic incentive for nutrient management and associated BMP implementation. Additional funding sources that may serve to incentivize BMP implementation include the Lake Erie Conservation Reserve Enhancement Program (CREP) and CRP administered by FSA and EQIP and other Farm Bill programs administered by the USDA-NRCS.

Goals

The Ohio EPA has modeled nutrient loadings associated with various land uses and sources within each HUC-12 in the Maumee River Basin, as well as supplemental watersheds that also drain to the WLEB, and has set phosphorus reduction goals for each associated source, based upon springtime load estimates. To achieve the desired phosphorus reduction from agricultural land use in the **Otter Creek-Frontal Lake Erie HUC-12**, the following goal has been established:

Goal 1. Reduce springtime agricultural phosphorus loading contributions in the **Otter Creek-Frontal Lake Erie HUC-12** to a level at or below 1,400 lbs/year (40% reduction).

NOT ACHIEVED: Current estimated load contribution is 2,400 lbs/year.

Objectives

In order to make substantive progress toward the achievement of the springtime nutrient load reduction goal of 1,000 lbs of total phosphorus for the **Otter Creek-Frontal Lake Erie HUC-12**, efforts must commence on more widespread implementation, according to the following objectives within *Critical Area #1*.

-
- Objective 1:** Implement nutrient management (planning and implementation through soil testing and VRT) on at least 500 additional acres³⁰.
- Objective 2:** Plant cover crops on at least 300 additional acres annually.³¹
- Objective 3:** Implement conservation tillage (30-50% residue) on at least 300 additional acres³².
- Objective 4:** Reduce nutrient loss from subsurface tile drainage through the installation of drainage water management structures that drain at least 120 acres.
- Objective 5:** Reduce nutrient loss from subsurface tile drainage through the installation of blind inlets that drain at least 100 acres.
- Objective 6:** Reduce erosion and nutrient loss through the installation of filter strips/buffers (of at least a 50 ft setback), potentially with erosion control structures or designed to be saturated buffers, that receive/treat surface water from at least 200 acres.
- Objective 7:** Create, enhance and/or restore at least 10 acres of wetlands and/or water retention basins for treatment of agricultural runoff and/or nutrient reduction purposes from 250 total agricultural acres.
- Objective 8:** Increase the retirement of marginal and highly vulnerable lands by enrolling at least 10 acres into programs such as the CRP, CREP or the Wetlands Reserve Program (WRP).
- Objective 9:** Stabilize and reduce erosion from agricultural streambanks and drainage conveyances through the installation of conservation ditches (overwide or two-stage design)³³ for at least 3,100 linear feet (0.6 miles)³⁴.

³⁰ Assumes an increase in implementation of 300 acres from baseline of plan approval. No data are currently available for the number of nutrient management plans and VRT implementation in the **Otter Creek-Frontal Lake Erie HUC-12**. The H2Ohio Program initiates the development of VNMPs. Acres enrolled in the H2Ohio program in Lucas County or Wood County may be contained within the **Otter Creek-Frontal Lake Erie HUC-12**; however, this data source does not report at the sub-watershed level.

³¹ Cover crop usage is estimated to occur on approximately 190 acres, based upon OpTIS data (CTIC, 2024). To reach and maintain the desired nutrient reduction level for this objective on a year over year basis, at least 490 acres of cover crops (estimated baseline of 190 + 300 more) would need to be planted each year throughout the **Otter Creek-Frontal Lake Erie HUC-12**. Cover crop plantings may be implemented in the absence of grant funding.

³² Current estimates indicate reduced tillage occurs on approximately 880 acres, based upon OpTis data (CTIC, 2024). To reach and maintain the desired nutrient reduction level for this objective on a year over year basis, at least 1,180 acres of land would need to be maintained under conservation tillage regimes (estimated baseline of 880 + 300 more) throughout the **Otter Creek-Frontal Lake Erie HUC-12**.

³³ Conservation ditch construction should be avoided in areas where streams are naturally recovering in form and function.

³⁴ This objective is focused on stabilization through conservation ditch design within agricultural settings, but may have overlap with stabilization/restoration objectives outlined in *Critical Area #2*, within transitional zones between land use types or through incorporation of bioengineering or natural channel design methodology.

These objectives will be directed toward implementation on prioritized agricultural lands and are estimated to reach the phosphorus spring load reduction goal (Table 22). Additional conservation activities within the **Otter Creek-Frontal Lake Erie HUC-12**, both on priority and secondary lands, may also make incremental progress toward phosphorus reduction goals. The implementation of BMPs included in these objectives, as well as BMPs implemented through Federal and State programs and other voluntary efforts will be tracked to monitor progress toward phosphorus reduction goals within the watershed.

Table 22. Estimated Nutrient Loading Reductions from Each Objective

Objective Number	Best Management Practice	Total Acreage Treated	Estimated Annual Phosphorus Load Reduction (lbs)	Estimated Spring Phosphorus Load Reduction (lbs)
1	Nutrient Management (Planning and Implementation through Soil Testing and VRT) ^a	500	320	210
2	Cover Crops	300	90	60
3	Conservation Tillage (30-50% Residue)	300	200	130
4	Drainage Water Management Structures	120	60	40
5	Blind Inlets ^b	100	110	70
6	Filter Strips/Buffers (of at least 50 ft) ^c	200	160	100
7	Wetlands and/or Water Retention Basins ^d	250 ^e	160	100
8	Land Retirement	10	10	10
9	Conservation Ditches ^f	220	180	120
TOTAL		1,980*	1,290	840

(Source Model: Pollution Load Estimation Tool (PLET), Version 1.1, (USEPA, 2023b))

NOTES

- a Nutrient Management consists of “managing the amount (rate), source, placement (method of application) and timing of plant nutrients and soil amendments to budget, supply and conserve nutrients for plant production; to minimize agricultural nonpoint source pollution of surface and groundwater resources; to properly utilize manure or organic byproducts as a plant nutrient source; to protect air quality by reducing odors, nitrogen emissions (ammonia, oxides of nitrogen) and the formation of atmospheric particulates; and/or to maintain or improve the physical, chemical and biological condition of soil,” as defined by the STEPL/PLET guidance documents (USEPA, 2023a).*
- b Blind inlet phosphorus reduction efficiency estimated from values listed in Gonzalez, Smith and Livingston, 2016.*
- c Concentrated flow must be distributed so the area can slow, filter, and/or soak in runoff. Design specifications will be FOTG 393 Filter strips/area, and/or CREP CP-11 or CP2 Filter recharge areas. Conservation Cover (FOTG 327 and CREP CP-21) would not be designed to treat contributing runoff. Opportunities to enhance the edge-of-field effectiveness of filter strips includes their use combined with other practices in a “stacked practices” approach.*

-
- d Phosphorus load reduction for wetlands was calculated using data tables found in Ohio's DAP (OLEC, 2020).*
 - e If drainage water is routed through restored/created wetlands, it is assumed a 50% reduction in phosphorus from total nutrient yield for the drainage area, with a 25:1 ratio of drainage area to receiving wetland. For this objective of 10 wetland acres, total drainage area is 250 acres.*
 - f One linear foot of stream is estimated to treat 0.07 acres.*
 - * More than one BMP may be implemented within fields.*

The stakeholders of the **Otter Creek-Frontal Lake Erie HUC-12** recognize a gap between the total estimated springtime phosphorus reduction realized from these objectives and the stated phosphorus reduction goal. Stakeholders in this watershed acknowledge that additional and/or altered objectives may be needed in future versions of this NPS-IS, but underscore the exigence in beginning to implement projects that incrementally make progress toward achieving the aforementioned objectives as soon as possible. The objectives, as written, are reflective of what stakeholders gage as reasonable and implementable in the **Otter Creek-Frontal Lake Erie HUC-12** incrementally, over time.

Water quality monitoring is an integral part of the project implementation process. Both project-specific and routinely scheduled monitoring will be conducted to determine progress toward meeting the goals (i.e., water quality standards and nutrient reduction targets). Through an adaptive management process, the aforementioned objectives will be reevaluated and modified as necessary. Objectives may be added to make further progress toward attainment or reduction goals, or altered, as a systems approach of multiple BMPs can accelerate the improvement of water quality conditions. The *Nonpoint Source Management Plan Update* (Ohio EPA, 2020) will be utilized as a reevaluation tool for its 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.

CHAPTER 4: PROJECTS AND IMPLEMENTATION STRATEGY

Projects and evaluation needs identified for the **Otter Creek-Frontal Lake Erie HUC-12** are based upon identified causes and associated sources of nonpoint source pollution. Over time, these critical areas will need to be reevaluated to determine progress toward meeting restoration and attainment goals. Time is an important variable in measuring project success and overall status when using biological indices as a measurement tool. Some biological systems may show fairly quick response (i.e., one season), while others may take several seasons or years to show progress toward recovery. In addition, reasons for the impairment other than those associated with nonpoint source pollution sources may arise. Those issues will need to be addressed under different initiatives, authorities or programs that may or may not be accomplished by the same implementers addressing the nonpoint source pollution issues.

Implementation of practices described in this NPS-IS will also contribute to nutrient load reduction (specifically the 40% reduction in phosphorus load) to protect and restore use attainment in Lake Erie. Nutrient load reduction efforts are consistent with the Lake Erie Collaborative Agreement through the IJC and Ohio's DAP (IJC, 2012; OLEC, 2018).

For the **Otter Creek-Frontal Lake Erie HUC-12** there are three *Project and Implementation Strategy Overview Tables* (subsection 4.1, 4.2 and 4.3). Future versions of this NPS-IS may include subsequent sections as more critical areas are refined and more projects become developed to meet the requisite objectives within a critical area. The projects described in the *Overview Table* have been prioritized using the following three-step prioritization method:

- | | |
|------------|--|
| Priority 1 | Projects that specifically address one or more of the listed Objectives for the Critical Area. |
| Priority 2 | Projects where there is land-owner willingness to engage in projects that are designed to address the cause(s) and source(s) of impairment or where there is an expectation that such potential projects will improve water quality in the Otter Creek-Frontal Lake Erie HUC-12 . |
| Priority 3 | In an effort to generate interest in projects, an information and education campaign will be developed and delivered. Such outreach will engage citizens to spark interest by stakeholders to participate and implement projects like those mentioned in Priority 1 and 2. |

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

4.1 Project and Implementation Strategy Overview Tables – Critical Area #1

Table 23. Otter Creek-Frontal Lake Erie HUC-12 (04100010 07 06)—Critical Area #1

Applicable Critical Area	Goal	Objective	Project #	Project Title (EPA Criteria g)	Lead Organization (EPA 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								
Agricultural Nonpoint Source Reduction Strategies								
High Quality Waters Protection Strategies								
Other NPS Causes and Associated Sources of Impairment								
1	2	3	1	Dedicated Salt Application Equipment	City of Toledo	Short (1-3 years)	\$430,000	Ohio EPA §319, H2Ohio

4.1.1 Project Summary Sheets – Critical Area #1

The Project Summary Sheets provided below were developed based on the actions or activities needed to reduce nutrient and sediment loadings and maintain WQS attainment and BUI Restoration Targets throughout the **Otter Creek-Frontal Lake Erie HUC-12** in *Critical Area #1*. These projects are considered next step or priority/short term projects and are considerably ready to implement. Medium and longer-term projects will not have a Project Summary Sheet, as these projects are not ready for implementation or need more thorough planning.

Table 24. Critical Area #1 – Project #1		
Nine Element Criteria	Information needed	Explanation
<i>n/a</i>	Title	Dedicated Salt Application Equipment
<i>criteria d</i>	Project Lead Organization & Partners	City of Toledo
<i>criteria c</i>	HUC-12 and Critical Area	Otter Creek-Frontal Lake Erie HUC-12 (04100010 07 06)— <i>Critical Area #1</i>
<i>criteria c</i>	Location of Project	Throughout the Otter Creek-Frontal Lake Erie HUC-12
<i>n/a</i>	Which strategy is being addressed by this project?	Other NPS Causes and Associated Sources of Impairment: Chloride Reduction Strategy
<i>criteria f</i>	Time Frame	Short (1-3 Years)
<i>criteria g</i>	Short Description	Purchase a dedicated salt applicator truck
<i>criteria g</i>	Project Narrative	The City of Toledo currently employs a 33-truck fleet that cleans streets year-round and collects leaves and removes snow/applies salt seasonally as needed. The constant rotation of these trucks into various activities inhibits the ability for proper calibration. A dedicated snow removal/salt application fleet will allow consistent and more frequent application throughout the winter season.
<i>criteria d</i>	Estimated Total cost	\$430,000 (\$390,000 for Western Star 47X Tandem Axle with Black Belt Snow & Ice equipment + \$40,000 for dedicated application training and outreach materials)
<i>criteria d</i>	Possible Funding Source	Ohio EPA §319, H2Ohio
<i>criteria a</i>	Identified Causes and Sources	Cause: Excessive chloride Source: Urban runoff/storm sewers
<i>criteria b & h</i>	Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?	One overall goal in <i>Critical Area #1</i> is to reduce average chloride concentrations in the Otter Creek-Frontal Lake Erie HUC-12 by 50% to 108 mg/L.

Table 24. Critical Area #1 – Project #1		
Nine Element Criteria	Information needed	Explanation
	Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?	It is expected that this project will cause a decrease in average chloride reduction by 1.6-2.8% through incremental progress toward Objective #3: Increase City of Toledo fleet size to one of five dedicated salt application trucks (20%).
	Part 3: Load Reduced?	Estimated: Reduction in average riverine chloride concentrations between 3.5 and 6.0 mg/L
<i>criteria i</i>	How will the effectiveness of this project in addressing the NPS impairment be measured?	Ambient chloride monitoring may be conducted by the State of Ohio or other researchers as part of the State of Ohio's focus on rising chloride levels.
<i>criteria e</i>	Information and Education	The City of Toledo will provide dedicated training to internal salt applicators and maintenance personnel on calibration procedures and will track calibration frequency and results for long-term planning. In addition, the City of Toledo will launch an education initiative for private applicators and residents through project press releases, websites, Calibration Sessions, fact sheets and social media postings.

4.2 Project and Implementation Strategy Overview Tables – Critical Area #2

Table 25. Otter Creek-Frontal Lake Erie HUC-12 (04100010 07 06)—Critical Area #2

Applicable Critical Area	Goal	Objective	Project #	Project Title (EPA Criteria g)	Lead Organization (EPA 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								
Agricultural Nonpoint Source Reduction Strategies								
High Quality Waters Protection Strategies								
Other NPS Causes and Associated Sources of Impairment								

At this time, no short-term projects have been identified for *Critical Area #2*; therefore, no Project Summary Sheets are included.

4.3 Project and Implementation Strategy Overview Tables – Critical Area #3

Table 26. Otter Creek-Frontal Lake Erie HUC-12 (04100010 07 06)—Critical Area #3

Applicable Critical Area	Goal	Objective	Project #	Project Title (EPA Criteria g)	Lead Organization (EPA 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								
Agricultural Nonpoint Source Reduction Strategies								
High Quality Waters Protection Strategies								
Other NPS Causes and Associated Sources of Impairment								

At this time, no short-term projects have been identified for *Critical Area #3*; therefore, no Project Summary Sheets are included.

4.4 Implemented Project Record

Project Title	Lead Organization	Year Completed	Funding Source	Short Description	Reference Document
Duck Creek Wetland Restoration, Conservation and Public Access Project	City of Toledo	2007	Supplemental Environmental Project	Restoration work at Hecklinger Pond and Ravne Marsh	PCS DMDS, 2024
Oregon Flood Relief and Erosion Control Project	City of Oregon	2015	--	Restoration/creation of 12.35 acres of Category 3 wetlands and 12,583 linear feet of WWH stream in the Amolsch/ Driftmeyer Ditch/Johlin Ditch/Heckman Ditch system	PCS DMDS, 2024
Otter Creek Sediment Remediation	USEPA	2021	GLLA	Removal of 33,500 cubic yards of contaminated sediments from Otter Creek and 13,000 cubic yards of contaminated sediments from the confluence with Lake Erie	PCS DMDS, 2024
Duck and Otter Creek Wetland and Stream Restoration	Toledo Lucas County Port Authority/ Cleveland Cliffs	2021	H2Ohio	69-acre wetland and stream restoration	H2Ohio, 2024
Urban Runoff Capture and Otter Creek Restoration Project	City of Oregon	2020	GLRI	Capture of stormwater and restoration of five acres of floodplain	<i>Otter Creek-Frontal Lake Erie HUC-12 NPS-IS, Version 1.0</i>
Otter Creek Stream and Floodplain Restoration Project: 1) Berlin Avenue Floodplain and Stream Improvements and 2) Taylor Road and Yarrow Street Floodplain and Stream Improvements	City of Oregon	2024-2025	GLRI	Restoration of 2,500 linear feet of Otter Creek and 2.5 acres of floodplain	MAAC Management Action List (PCS DMDS, 2024)
Collins Park Stream Restoration Project	City of Toledo	2025	NOAA, GLRI, GLC	Restoration of 3,300 linear feet of Duck Creek, 4.2 acres of riparian and floodplain habitat, 2.3 acres of forest and 0.94 acres of pollinator habitat	MAAC Management Action List (PCS DMDS, 2024)

CHAPTER 5: WORKS CITED

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