Nonpoint Source Implementation Strategy Plan for City of Warren-Mahoning River HUC-12

(05030103-06-03)

Approved: August 14, 2019

City of Warren Riverwalk (photo courtesy Eastgate Regional Council of Governments)

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Version 1.0

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Acknowledgements

Eastgate Regional Council of Governments (Eastgate) would like to thank the many partners who helped compile the information, maps, and projects needed to create this document. This Nine-Element Nonpoint Source Implementation Strategic (NPS-IS) Plan will help direct projects to expeditiously address the nonpoint source impairments in the City of Warren-Mahoning River HUC-12 of the Mahoning River watershed.

Chapter 1: Introduction

The City of Warren-Mahoning River HUC-12 (05030103-06-03) is in southwestern Trumbull County, Ohio. This HUC-12 is immediately downstream of the Chocolate Run-Mahoning River (05030103-04-06) HUC-12 and the Duck Creek (05030103-06-01) HUC-12, and directly upstream of the Little Squaw Creek-Mahoning River (05030103-07-05) HUC-12. It is a watershed of the Duck Creek-Mahoning River (05030103-06) HUC-10 in the lower Mahoning River basin. The watershed is approximately 104.48 square miles in size, is primarily urban and suburban land use, and is an impaired watershed in non-attainment of Ohio's water quality standards.

State and Federal nonpoint source funding is now closely tied to strategic implementation-based planning that meets U.S. EPA's nine minimum elements of a watershed plan for impaired waters. Eastgate has taken the lead on authoring this NPS-IS with assistance from Environmental Design Group, Inc. Eastgate is a voluntary association of local governments in Northeast Ohio, Ashtabula County, Mahoning County, and Trumbull County; all cities, villages, and townships in the counties are members. Eastgate brings communities together to create a unified voice in areas such as transportation, water and air quality, land use planning, and local infrastructure projects.

Eastgate is directly responsible for a variety of federal, state, and local planning and project implementation programs. As a Metropolitan Planning Organization, an Area wide Water Quality Management Agency, an Economic Development District, and an Appalachian Regional Commission Local Development District, Eastgate continues to maintain required certifications and planning documents to qualify the region for federal and state funding, including the development of Nine-Element Nonpoint Source Implementation Strategic Plans.

1.1 Report Background

This NPS-IS was created as an update to the draft Mahoning River Watershed Action Plan, which was prepared in 2004 by Youngstown State University and was conditionally endorsed by OEPA and Ohio Department of Natural Resources. The planning process was supported by a Section 319 grant issued to the Trumbull Soil and Water Conservation District (SWCD) and was directed by the Mahoning River Consortium. Youngstown State University was retained to coordinate development of the plan using the approach described in *A Guide to Developing Local Watershed Action Plans in Ohio* (OEPA, 1997), and Dr. Scott C. Martin, Professor of Civil and Environmental Engineering, served as the Project Coordinator. The Mahoning River Watershed Planning Task Force, composed of Mahoning River Consortium members and stakeholders, was established to supervise the planning process, and to play an active role in converting the results of the Watershed Inventory and public input into an action plan. The plan identifies specific goals and objectives related to water quality, and actions to be implemented to achieve those goals and objectives.

The initial goal of the project was to develop a plan for the entire Mahoning River watershed, but during the course of the project, the OEPA developed a formal process for review and approval of watershed action plans, including guidelines for plan content (Appendix 8 to the *Guide to Developing Local Watershed Action Plans in Ohio*), and a decision was made to focus planning efforts on the Mosquito Creek and Lower Mahoning River subwatersheds rather than the entire Mahoning River basin. With the further change of program focus to align plans with *Ohio's Nonpoint Source Management Plan Update (FY2014 to FY2018)*, this NPS-IS is being created to guide the region in addressing nonpoint source pollution issues for the City of Warren-Mahoning River HUC-12 (05030103-06-03), rather than a watershed plan for all issues in the watershed. Other programs will be creating plans or lists to address other impairments that need attention in order to restore the area to fishable, swimmable, and drinkable waters that meet water quality standards. Eastgate with assistance from other community partners expects to create NPS-IS documents for all the impaired waters with hydrologic unit codes (HUCs) in the Eastgate regional jurisdiction.

1.2 Watershed Profile & History

The Mahoning River watershed drains approximately 1,132 square miles and extends from its confluence with the Shenango River in Pennsylvania upstream to the headwaters located in western Columbiana County, Ohio. The Mahoning River watershed is located in seven counties: Columbiana, Stark, Mahoning, Trumbull, Portage, Ashtabula, and Geauga Counties in Ohio and Lawrence County in Pennsylvania. The flow of the river originates from a wetland (Watercress Marsh) in Butler Township, Columbiana County, where it flows north between Sebring and Alliance, passes through Berlin Reservoir and Lake Milton, and joins the West Branch just north of Newton Falls. Near Warren, the Mahoning River changes direction, curving to the east and then the southeast. After passing through Warren, the river flows southeast through several cities (Niles, McDonald, Girard, Youngstown, Campbell, Struthers, and Lowellville) before reaching Pennsylvania. From its headwaters at an elevation of 1,204 feet, the Mahoning River falls an average of 3.92 ft/mi to an elevation of 761 feet at its confluence with the Shenango River near New Castle in Lawrence County, Pennsylvania, where the two rivers become the Beaver River. The Beaver River then flows into the Ohio River, which eventually flows into the Gulf of Mexico via its confluence with the Mississippi River. Main tributaries of the Mahoning River are West Branch, Eagle Creek, Mosquito Creek, Meander Creek, Mill Creek, and Yellow Creek. The watershed contains 39 HUC-12 subwatersheds which are organized into eight HUC-10 subwatersheds.

The Mahoning River watershed is located in the Erie Drift Plains Level III ecoregion (Omernik, 1988), which is characterized by hardwood vegetation with beech-maple and elm-ash forests. Common geographic features in the ecoregion include low round hills, scattered end moraines, kettles, and wetlands. As human populations increased in the Eastern United States through the 19th and 20th centuries, much of the original forest was cleared for agricultural uses. The watershed is rich in natural resources, including fertile farmland, natural gas, coal, limestone, iron ore, and salt. These resources first attracted settlers to the region in the early 1800s and led to the development of a huge steel-making industry along the lower Mahoning River, between Warren and Youngstown, in the 20th century. Mill workers and their families, including immigrants from many countries, settled in the cities along the river, increasing the population of Youngstown to 168,330 by 1950 and Warren to 61,423 by 1967. Most of the steel mills closed in the late 1970s and early 1980s. For the past 40-50 years, there has been a rapid migration of population out of Youngstown, Warren, and other cities toward the surrounding townships, and commercial districts have largely moved from the cities to the suburbs. The environmental impacts of the steel mill industry remain along the Mahoning, however, in the form of channelization and dams with their resulting impoundments, as well as legacy pollutants in the sediment along the lower Mahoning River.

Figure 1: Legacy industry in the Mahoning River Valley.

The watershed contains urban-industrial areas such as Alliance, as well as dairy, livestock, corn and soybean farming. The area from about Newton Falls northward is characterized by poor drainage, wetlands, low-gradient streams, and moisture-tolerant woodlands, underlain by clay till and fine lacustrine deposits. Between Alliance and the low-head dam in Leavittsburg, the Mahoning River changes in hydrology from a headwater stream to a small river. Two large reservoirs, Berlin Lake and Lake Milton, impound approximately 20 river miles of the mainstem between RM 84 and RM 64. The construction of these large reservoirs and low-head dams have significantly altered the natural riverine habitat and created an alternating series of free-flowing and impounded segments in the watershed (OEPA, 2008).

The bedrock geology of the Mahoning River watershed consists of layered sedimentary rocks that represent former sands, silts, and muds, deposited 280 million to 400 million years ago. Rocks exposed in the watershed are primarily from Mississippian and Pennsylvanian Age systems. Rocks of the Mississippian system, including thick shales, sandstone, and interbedded shales and sandstones, are exposed over most of Trumbull County. Rocks of the Pennsylvanian system, composed of a sequence of sandstones, shales, siltstones, coal, clay, and limestone, are exposed throughout Mahoning County. The watershed is largely covered by deposits of unconsolidated clay, sand, and gravel, left by at least two continental ice sheets. The entire watershed was at one time covered by glaciers, with the last major advance being about 20,000 years ago. The glaciers scoured and eroded the soils and bedrock as they advanced and accumulated an unsorted mixture of clay, sand, and gravel. This material was deposited in front of the ice sheet, creating glacial moraines, or left behind when the glaciers melted, forming a landscape marked by kettles, kames, and glacial erratics. Soils in the Mahoning River watershed are generally poorly drained, with moderate to steep slopes and a significant portion of the soils classified as hydric or with hydric inclusions (OEPA, 2011). The availability of underground water varies from east to west with yields ranging from 25-100 to 5-25 gallons/min. in a westerly direction. A zone of higher water yields ranging from 100-500 gallons/min. is located along the Mahoning River mainstem extending roughly from the Mahoning-Columbiana county line upstream to Berlin Reservoir (ODNR, 1961).

The Köppen-Geiger climate classification in the Mahoning River watershed is known as warm summer continental, typified by average temperatures in the warmest months below 70 degrees Fahrenheit, with summer high temperatures between 70-82 degrees Fahrenheit during the day (Kottek et. al, 2006). Average temperatures during the coldest months are typically below 27 degrees Fahrenheit. Average temperatures for the year in the Mahoning River watershed are approximately 49.5 degrees Fahrenheit, with July being the warmest month (average 71.6 degrees Fahrenheit) and January being the coldest month (average 26.6 degrees Fahrenheit). On average, there are approximately 143.5 days of precipitation in the watershed, with the most precipitation occurring in December with 13.9 days and the least in August with 9.3 days. The month with the most snowfall is January, with an average of 11.8 inches of snow.

The Mahoning River and its tributaries are all assessed by OEPA as Warmwater Habitat (WWH) streams with the exception of Dry Run, Silver Creek, Camp Creek, and the headwaters of the Mahoning River upstream of RM 97.69, which are assessed as Coldwater Habitat (CWH) for their Aquatic Life Use (ALU). The lower Mahoning has been severely impacted by point source loadings from major industrial facilities in the 1950s. Steel facilities directly discharged untreated coke plant wastes, rudimentary solids removal for blast furnace gas wash water, scale pits with and without oil skimming for hot forming wastes, untreated emulsified cold rolling oils, spent pickling acids and untreated coating wastes (Amendola et al., 1977) into the Mahoning River. Pollution control and regulation has improved loadings since then, but the majority of improvement has resulted from the near-total shutdown of many of the major steel facilities since 1978. Municipal wastewater treatment of sanitary waste post-1965 has also improved water quality significantly in the lower Mahoning; previously sewage was directly discharged into the river untreated. The cities of Girard, Warren, Niles, and Youngstown's wastewater collection systems have overflow structures that discharge to the Mahoning River and its tributaries during periods of high flow. These Combined Sewer Overflows (CSOs) have been regulated since 1990 by the U.S. EPA.

Girard, Warren, and Youngstown are currently implementing Combined Sewer Overflow (CSO) policies to separate or mitigate their CSOs. The City of Niles also implemented a CSO policy and has since completed its CSO separation. The rural areas of the lower Mahoning, notably in the Mosquito Creek, Duck Creek, Meander Creek, Mill Creek, Yellow Creek, and Hickory Run watersheds, are primarily serviced by Home Sewage Treatment Systems (HSTS). Since many of the industrial point sources have been mitigated, non-point source pollution has become a major source of water pollution to the lower Mahoning. An OEPA report identifies major non-point sources of pollution in the lower Mahoning as construction sites, agricultural farms and nurseries, failing septic systems, urban areas, sanitary landfill/industrial sites, mine drainage, timber harvesting operations, and oil and gas extraction.

There are many lakes and impoundments throughout the lower Mahoning watershed; none of which are defined as natural lakes per ODNR's Ohio Water Inventory Report (ODNR, 1991). Uses for these lakes and impoundments range from recreation to drinking water supply. Mosquito Creek Reservoir is the only waterbody in the lower watershed that is used for flow augmentation. Because of this and other flow-augmented reservoirs in the upper Mahoning, flows in the Mahoning River are typically higher in the summer and lower in the winter, while most natural Ohio streams exhibit the opposite characteristics. There are also numerous dams located along the lower Mahoning and its tributaries that are used for flood control, recreation, and public drinking water supply. Nine low-head dams are located along the lower Mahoning River mainstem and are significant impairments to water quality and aquatic habitat. They trap sediments upstream and reduce sediment transport downstream, disrupt natural flow regimes by slowing the water and creating stagnant low-oxygen environments, and restrict migration of aquatic organisms between pools.

The Mahoning River mainstem is also monitored as a Large River Assessment Unit (LRAU) from the Pennsylvania border upstream to its confluence with Eagle Creek (RM 9.8 to RM 45.09). OEPA monitors the LRAU and has determined that approximately 16.04 miles are in full attainment, while 25.57 miles are in partial or non-attainment of water quality standards. The LRAU is designated as impaired for Aquatic Life Use, Recreational Use, and Fish Tissue. It is not designated as impaired for Public Drinking Water as no waters in this stretch are currently utilized for public water supply. Causes of impairment in the LRAU are listed as organic enrichment (sewage), flow regime alteration, direct habitat alterations, sedimentation/siltation, and other non-specified causes. Sources of impairment in the LRAU are listed as combined sewer overflows, municipal point source discharges, upstream sources, and dams/impoundments.

1.3 Public Participation and Involvement

Public participation and involvement is a critical component of any planning process and should include not only the general public but diverse stakeholders such as local officials, businesses, academia, non-profit groups, and other agencies and organizations. Eastgate is well-positioned to continuously engage these diverse stakeholders through their Citizens Advisory Board (CAB), a public forum for participation in regional planning and decision-making processes as well as their Mahoning River Corridor Initiative (MRCI) a committee composed of eleven members that represent the communities along the Mahoning River, including the mayors of those communities. In addition, Eastgate engaged the Friends of the Mahoning River (FOMR), a local non-profit watershed group who has advocated for the stewardship and restoration of the Mahoning River since 2012, for their input on the nine-element planning process.

On March 7, 2019, Eastgate hosted a session of the CAB to discuss the Chocolate Run-Mahoning River and the City of Warren-Mahoning River NPS-IS plans. Environmental Design Group, Inc., presented on the status of the City of Warren HUC-12 NPS-IS and facilitated a feedback session where attendees provided input on watershed issues they felt were important to help inform critical area development and identify potential projects. Twenty

local citizens attended this meeting and identified prevalent issues they saw in the City of Warren HUC-12, including the following:

- Potential for land protection and restoration near Burbank Park
- Channelized stream on the Unnamed Tributary to the Mahoning River at RM 40.89 where it crosses Rt. 5 downstream of KSU Trumbull Campus
- Stream erosion on the Unnamed Tributary to the Mahoning River at RM 40.89 upstream of the on-line pond on KSU Trumbull Campus and downstream of the confluence with Youngs Run
- Old dam structure remnants on the Mahoning River mainstem at Gould Stewart Park upstream of ArcelorMittal Dam, unsafe for kayaking

A major point of discussion at this meeting was the improvement of the Mahoning River corridor for public recreation, especially kayak access. CAB attendees saw the river as an asset for eco-tourism and wanted restoration efforts to simultaneously enhance and improve the ability for public access and recreation. Kayaking near the ArcelorMittal dam was noted as unsafe and they were in favor of dam removal or modification there to improve safety for kayakers. Feedback from this meeting helped inform critical area development and recommendations for water quality improvement in the critical areas, as well as potential projects beyond the Summit Street and ArcelorMittal Dam removals.

On March 12, 2019, Eastgate hosted a session of the MRCI to discuss the City of Warren-Mahoning River and the Chocolate Run-Mahoning River NPS-IS plans. Environmental Design Group, Inc., presented on the status of the City of Warren HUC-12 NPS-IS and facilitated a feedback session where attendees provided input on potential critical areas and projects for the plan, as well as opportunities for funding and project implementation. Attendees at this meeting included representatives from the following:

- Friends of the Mahoning River
- Trumbull Canoe Trails
- Trumbull County MetroParks
- Trumbull County Combined Health District
- Youngstown/Warren Regional Chamber
- Western Reserve Land Conservancy
- Trumbull County Planning Commission
- Western Reserve Port Authority
- Community Foundation of the Mahoning Valley

The potential for removal of the Summit Street Dam in the City of Warren HUC-12 was discussed at this meeting as it is one of the nine dams currently targeted for removal in the Lower Mahoning River. Other opportunities for conservation and restoration were discussed too, such as potential areas for land conservation, as well as project funding sources like the OEPA 319 and the Water Resource Restoration Sponsor Program. Feedback from this meeting and further discussions with Eastgate helped inform the development of the Summit Street Dam removal project for inclusion in the City of Warren-Mahoning River NPS-IS.

On April 15, 2019, on behalf of Eastgate, Environmental Design Group, Inc. presented on the City of Warren-Mahoning River and Chocolate Run-Mahoning River NPS-IS plans at a FOMR meeting and solicited feedback on watershed issues from the fourteen attendees to help inform critical areas and potential locations for projects. Stormwater runoff from the heavily urbanized area in the watershed was identified as a primary concern, and the group was interested in the enhancement of riparian corridors and implementation of green infrastructure to help lessen the effects of impervious cover. The presence of the dams and legacy industrial pollutants were also identified as concerns, with questions raised over the potential amount of contaminated sediment in the dam areas and how best to manage the contamination during a dam removal.

Figure 2: Friends of the Mahoning River stakeholder input meeting.

In addition, Eastgate developed an online survey and sent it to decisionmakers (commissioners, mayors, trustees, etc.) of Trumbull County and the 11 communities that drain to the City of Warren-Mahoning River and/or the Chocolate Run-Mahoning River HUC-12s. The survey ran from May 7, 2019 to June 10, 2019, and had the following questions:

1. What watershed are you taking the survey for?
2. What do you feel are key issues affecting the water quality of the Mahoning River, its tributaries, and its natural resources in the watershed?
3. What do you feel causes these issues?
4. What locations do you see these issues in?
5. What actions do you feel could be taken to solve these issues?
6. Would you be interested in pursuing state or federal grant funding to accomplish the actions you've selected?

Seven of the nine survey responses received were for the City of Warren-Mahoning River HUC-12. Key water quality issues identified from the survey were riparian areas and contaminated sediment; septic system discharge from poorly functioning septic tanks and storm sewers; and sediment, downed brush and trees, and dumping. Primary causes of pollution were identified as stormwater runoff, streambank erosion, failing HSTS, flooding, dams/impoundments, poor stream habitat, stream alterations, draining/filling of wetlands, and invasive plant species. Top recommended actions identified for this watershed were:

- Install stormwater control measures (rain gardens, bioretention, green roofs, constructed wetlands, permeable pavement, rainwater harvesting, or other green infrastructure)
- Inspect, maintain, repair or replace failing septic systems
- Restore streams using natural restoration techniques
- Modify flood control basins to further improve water quality
- Improve local zoning and regulations to include conservation
- Implement best practices for timber harvesting
- Modify or remove dams/impoundments
- Implement manure management practices
- Develop nutrient management plans with farmers
- Implement other agricultural best management practices

A concern brought up by two of the City of Warren-Mahoning River survey respondents was the potential effect dam removal would have on lowering river levels and whether that would make kayaking or canoeing difficult, and further dam removal efforts should be prepared to address these concerns.

Environmental Design Group also reached out to Trumbull Soil and Water Conservation District (SWCD) for feedback on nonpoint water quality issues and watershed planning in both the City of Warren-Mahoning River HUC-12 and the upstream Chocolate Run-Mahoning River HUC-12. Email correspondence identified, in addition to the established causes and sources of water quality per Ohio EPA, local resident concerns of illegal dumping and/or spills in the watershed. Trumbull SWCD also performs chemical monitoring in the Mahoning River and its tributaries. Their most recent sampling in the City of Warren HUC-12 on the Mahoning River mainstem was 2015 below the WWTP in Weathersfield Township and noted high levels of iron, phosphorus, and nitrogen. Sampling was also conducted in the Youngs Run tributary in 2014-2018. Trends there show consistently elevated iron during all sampling years, and high levels of phosphorus in 2014 and 2017. High levels of TSS were noted in 2018 in addition to the elevated iron levels. Trumbull SWCD also provides educational materials for landowners and residents on a variety of topics, including but not limited to backyard conservation, streamside management, nonpoint source pollution, watersheds, storm water, water quality monitoring, wildlife, drainage, and pond management.

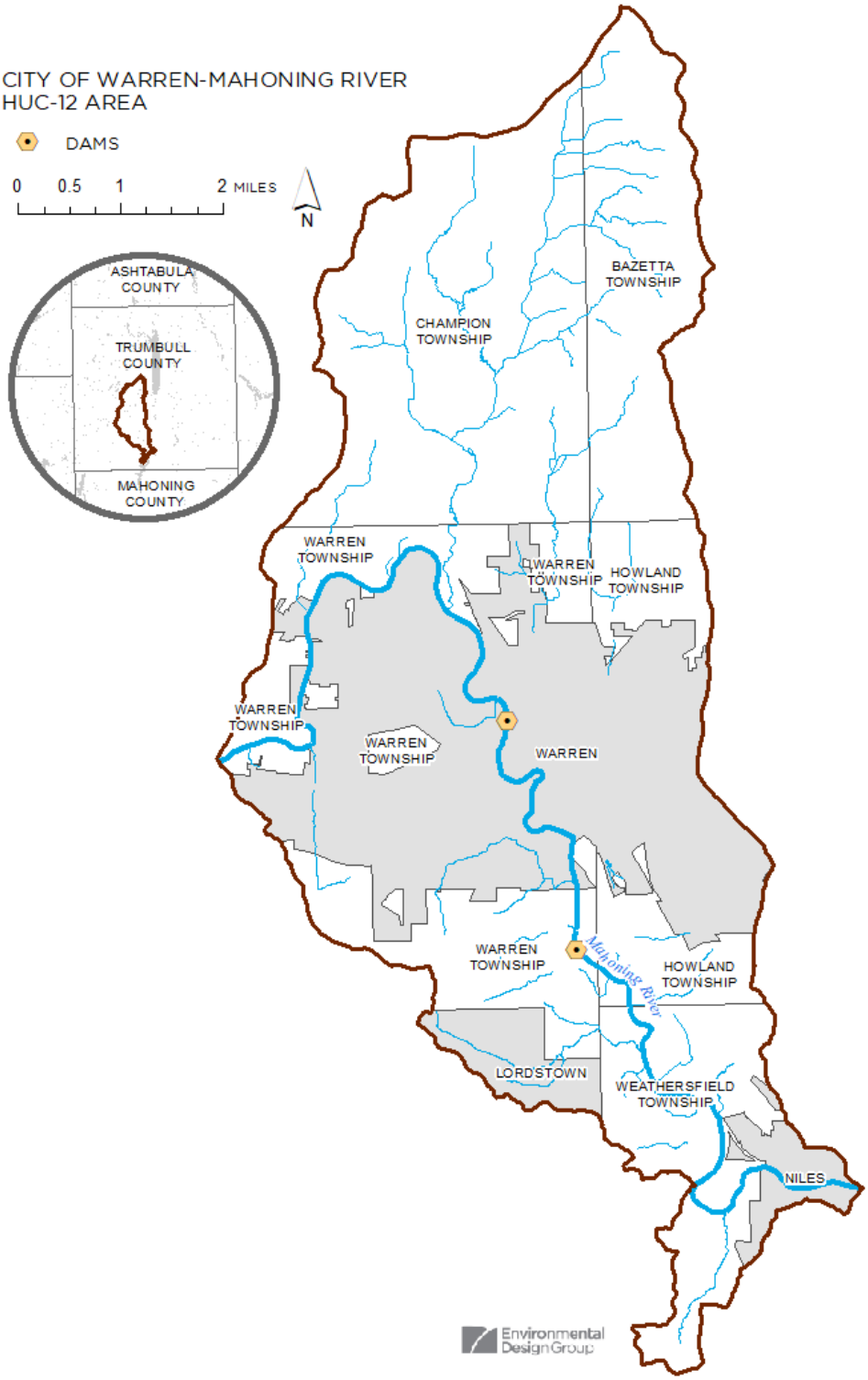
Eastgate will continue to engage stakeholders within the City of Warren-Mahoning River NPS-IS planning area through their regular CAB and MRCI meetings and other Eastgate committees like the Technical Advisory Committee (TAC) as projects in the plan are developed and implemented. The MRCI in particular serves as the guiding body for the regional watershed planning and implementation process in the Lower Mahoning River. The Friends of the Mahoning River have a presence on several of these committees and will continue to stay engaged in watershed planning and project implementation.

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 City of Warren HUC-12 is located within Ohio's Erie-Ontario Lake Plains (EOLP) Ecoregion. This HUC-12 drains 104.48 square miles (25,817.6 acres) and contains approximately 72.1 total stream miles (calculated from the National Hydrography Database), which includes approximately 45.6 miles of the mainstem of the Mahoning River from its confluence with Duck Creek at RM 43.84 to its confluence with Mosquito Creek at RM 28.91. The subwatershed is entirely located within Trumbull County and includes parts of Champion Township, the City of Warren, Warren Township, Bazetta Township, Howland Township, Weathersfield Township, the Village of Lordstown, and the City of Niles.



The City of Warren HUC-12's relationship to the other HUC-12 watersheds in the Mahoning River watershed are shown in the table below:

Subwatershed	HUC-12	Drainage Area (square miles)	Relationship to City of Warren HUC-12
Beaver Run-Mahoning River	050301030101	41.12	Upstream
Beech Creek	050301030102	31.62	Upstream
Fish Creek-Mahoning River	050301030103	56.67	Upstream
Deer Creek	050301030201	37.54	Upstream
Willow Creek	050301030202	20.01	Upstream
Mill Creek	050301030203	32.40	Upstream
Island Creek-Mahoning River	050301030204	29.03	Upstream
Kale Creek	050301030301	25.50	Upstream
Headwaters West Branch Mahoning River	050301030302	31.07	Upstream
Barrel Run	050301030303	12.42	Upstream
Michael J Kirwan Reservoir-West Branch Mahoning River	050301030304	37.28	Upstream
Marys Lake-West Branch Mahoning River	050301030305	27.50	Upstream
Charley Run Creek-Mahoning River	050301030306	33.13	Upstream
Headwaters Eagle Creek	050301030401	20.77	Upstream
South Fork Eagle Creek	050301030402	26.16	Upstream
Camp Creek-Eagle Creek	050301030403	26.27	Upstream
Tinker Creek	050301030404	16.46	Upstream
Outlet Eagle Creek	050301030405	20.68	Upstream
Chocolate Run-Mahoning River	050301030406	16.55	Adjacent-Upstream
Upper Mosquito Creek	050301030501	25.82	Not Connected
Middle Mosquito Creek	050301030502	71.46	Not Connected
Lower Mosquito Creek	050301030503	40.88	Not Connected
Duck Creek	050301030601	33.21	Adjacent-Upstream (RM 43.84)
Mud Creek	050301030602	14.18	Adjacent-Upstream (RM 31.06)
City of Warren-Mahoning River	050301030603	40.34	-
Upper Meander Creek	050301030701	23.07	Not Connected
Middle Meander Creek	050301030702	32.32	Not Connected
Lower Meander Creek	050301030703	30.65	Not Connected
Squaw Creek	050301030704	18.61	Not Connected
Little Squaw Creek-Mahoning River	050301030705	26.12	Adjacent-Downstream
Headwaters Mill Creek	050301030801	37.03	Not Connected
Indian Run	050301030802	14.27	Not Connected
Andersons Run-Mill Creek	050301030803	27.09	Not Connected
Crab Creek	050301030804	21.05	Not Connected
Headwaters Yellow Creek	050301030805	19.35	Not Connected
Burgess Run-Yellow Creek	050301030806	20.18	Not Connected
Dry Run-Mahoning River	050301030807	25.36	Downstream
Hickory Run	050301030808	27.10	Not Connected
Coffee Run-Mahoning River	050301030809	49.52	Downstream

The City of Warren HUC-12 is located entirely in the Erie Drift Plains Level III ecoregion but is divided between two Level IV ecoregions: the Low Lime Drift Plain and the Mosquito Creek/Pymatuming Lowlands. The northwestern half of the HUC-12 is located in the Mosquito Creek/Pymatuming Lowlands, and the southeastern half is located in the Low Lime Drift Plain. The Mosquito Creek/Pymatuming Lowlands region is characterized by poor soil drainage, wetlands, low-gradient streams, and moisture-tolerant woodlands. The region is nearly flat and is typically underlain by clay till and fine lacustrine deposits. The historical vegetation was beech forest, but today many areas are cleared for dairy farms or systematically cleared and managed as woodlots. The Low Lime Drift Plain is characterized by a rolling landscape composed of low rounded hills with scattered

glacial end moraines and kettles. Urban-industrial activity as well as dairy, livestock, corn, and soybean farming are common, and many ridges and lowlands are wooded.

Predominant soils in the City of Warren HUC-12 are Mahoning, urban land (where 80% of the surface is covered by asphalt, concrete, buildings, or other structures), Fitchville, Caneadea, Haskins, Ellsworth, Sebring, udorthents (areas of disturbed soils where the upper soil material has been removed, filled or graded), Wadsworth, Orrville, Canadice, Remsen, Holly, Condit, and Glenford. These soils are mainly characterized as poorly to somewhat poorly draining with slow permeability and runoff and can be challenging for traditional septic systems. They are also generally poorly suited to agricultural use unless tile, ditches or other surface/subsurface drainage systems are used. Moderately slow or very slow permeability, seasonal wetness, and the hazard of erosion are major management concerns. Many of these soils are associated with Urban land as a complex where 30% of the soil unit is Urban land, which indicates the extremely built-out nature of this HUC-12.

Symbol	Acres	Name	Percent of HUC-12
MgA	4048.5	Mahoning silt loam, 0 to 2 percent slopes	15.68%
Ur	3034.3	Urban Land	11.75%
MgB	2264.7	Mahoning silt loam, 2 to 6 percent slopes	8.77%
FdA	2156.7	Fitchville-Urban land complex, 0 to 3 percent slopes	8.35%
CeA	1854.1	Caneadea-Urban land complex, 0 to 2 percent slopes	7.18%
HaA	994.3	Haskins loam, 0 to 2 percent slopes	3.85%
FcA	821.8	Fitchville silt loam, 0 to 2 percent slopes	3.18%
EhB	680.8	Ellsworth silt loam, 2 to 6 percent slopes	2.64%
Sb	650.7	Sebring silt loam	2.52%
Ud	628.5	Udorthents, loamy	2.43%
WeB	620.8	Wadsworth-Urban land complex, 2 to 6 percent slopes	2.40%
MkB	579.9	Mahoning-Urban land complex, 2 to 6 percent slopes	2.25%
Or	563.2	Orrvile silt loam, frequently flooded	2.18%
Cb	512.3	Canadice silty clay loam	1.98%
RoB	478.4	Remsen-Urban land complex, 2 to 6 percent slopes	1.85%
CcA	477.7	Caneadea silt loam, 0 to 2 percent slopes	1.85%
Ho	396.1	Holly silt loam, frequently flooded	1.53%
Ct	376.2	Condit silt loam	1.46%
WbA	344.4	Wadsworth silt loam, 0 to 2 percent slopes	1.33%
W	340.2	Water	1.32%
GfB	335.0	Glenford silt loam, 2 to 6 percent slopes	1.30%
HaB	310.0	Haskins loam, 2 to 6 percent slopes	1.20%
RmB	298.0	Remsen silt loam, 2 to 6 percent slopes	1.15%
FcB	276.7	Fitchville silt loam, 2 to 6 percent slopes	1.07%
GnB	273.5	Glenford-Urban land complex, 2 to 6 percent slopes	1.06%

The major geologic types in this HUC-12 are Allegheny and Pottsville Groups, Berea Sandstone and Bedford Shale, and the Maxville Limestone with the Rushville, Logan, and Cuyahoga Formations. Aquifers in the HUC-12 are the Alliance Thin Upland Aquifer, the Mahoning Alluvial Aquifer, the Mahoning Buried Valley Aquifer, and the Pymatuming Thin Upland Aquifer. Locations of highest yield (25-100 gpm) in the HUC-12 are in the Mahoning Buried Valley and Mahoning Alluvial Aquifer along the mainstem of the Mahoning River and its adjacent floodplain areas in the southern portion of the watershed. The entire Mahoning River mainstem in the HUC-12

and portions of an unnamed tributary to the Mahoning at RM 39.16 are located in the Federal Emergency Management Agency (FEMA) designated Special Flood Hazard Area.

Rare, Threatened, and Endangered Species

The Ohio Department of Natural Resources (ODNR) Division of Wildlife catalogs known rare, threatened, and endangered species through its Natural Heritage Database Program. A request was made to ODNR for a list of known species identified in the City of Warren HUC-12. According to ODNR's Natural Heritage Database, the Mountain Brook Lamprey (*Ichthyomyzon greeleyi,* observed in 2013), Creek Heelsplitter (*Lasmigona compressa,* observed in 2006), and Eastern Sand Darter (*Ammocrypta pellucida,* observed in 1994) have been identified in the HUC-12. However, below is a table of known species identified in Trumbull County (which the City of Warren HUC-12 is entirely located in) that have the potential to be present in the HUC-12. The Natural Heritage Database relies on information supplied by many individuals and organizations, and a lack of records for any particular area is not a statement that rare species or unique features are absent from that area.

Status: X = Extirpated, E = Endangered, T = Threatened, PT = Potentially Threatened, SC = Species of Concern, SI = Species of Interest

State Status	Federal Status	Species	Common Name	Most Recent County Record
Fauna				
E	SC	*Cryptobranchus alleganiensis alleganiensis*	Eastern Hellbender	-
E		*Circus cyaneus*	Northern Harrier	2003
E		*Ichthyomyzon fossor*	North Brook Lamprey	2007
E		*Ichthyomyzon greeleyi*	Mountain Brook Lamprey	2013
E		*Fusconaia maculata maculata*	Long-solid	1850
E		*Pleurobema clava*	Clubshell	-
E	E	*Myotis sodalis*	Indiana Myotis	-
E		*Ursus americanus*	Black Bear	2001
E		*Sistrurus catenatus catenatus*	Eastern Massasauga	1956
T		*Psilotreta indecisa*	Caddisfly sp.	2008
T		*Ligumia recta*	Black Sandshell	1995
SC		*Hemidactylium scutatum*	Four-toed Salamander	2009
SC		*Colinus virginianus*	Northern Bobwhite	1995
SC		*Dolichonyx oryzivorus*	Bobolink	2014
SC		*Ammocrypta pellucida*	Eastern Sand Darter	2007
SC		*Esox masquinongy*	Muskellunge	2013
SC		*Orconectes (Crokerinus) obscurus*	Allegheny Crayfish	2008
SC		*Orconectes (Crokerinus) propinquus*	Great Lakes Crayfish	2007
SC		*Lasmigona compressa*	Creek Heelsplitter	2013
SC		*Pleurobema sintoxia*	Round Pigtoe	2013
SC		*Ptychobranchus fasciolaris*	Kidneyshell	1850
SC		*Condylura cristata*	Star-nosed Mole	1974
SC		*Eptesicus fuscus*	Big Brown Bat	2012
SC		*Lasiurus borealis*	Red Bat	2012

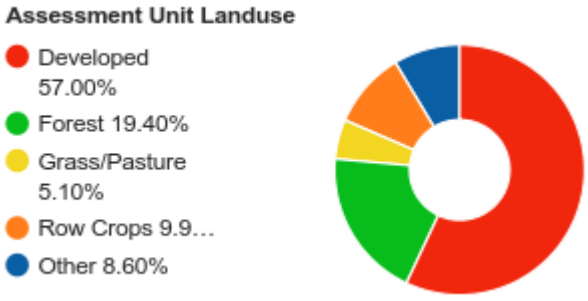
SC		*Lasiurus cinereus*	Hoary Bat	2012
SC		*Mustela erminea*	Ermine	1987
SC		*Myotis lucifugus*	Little Brown Bat	2012
SC	T	*Myotis septentrionalis*	Northern Long-eared Bat	2012
SC		*Perimyotis subflavus*	Tri-colored Bat	2012
SC		*Peromyscus maniculatus*	Deer Mouse	1982
SI		*Carpodacus purpureus*	Purple Finch	1994
SI		*Catharus guttatus*	Hermit Thrush	2002
SI		*Empidonax minimus*	Least Flycatcher	1996
X		*Actinonaias ligamentina ligamentina*	Mucket	1995
Flora				
T		*Buxbaumia aphylla*	Bug-on-a-stick	2003
P		*Calla palustris*	Wild Calla	2006
T		*Callitriche verna*	Vernal Water-starwort	1971
P		*Carex albolutescens*	Pale Straw Sedge	1990
P		*Carex cephaloidea*	Thin-leaved Sedge	2013
P		*Carex lupuliformis*	False Hop Sedge	1989
P		*Carex pallescens*	Pale Sedge	1987
T		*Carex projecta*	Necklace Sedge	1997
P		*Carex straminea*	Straw Sedge	2006
E		*Clintonia umbellulata*	Speckled Wood-lily	1987
T		*Epilobium strictum*	Simple Willow-herb	1987
P		*Equisetum sylvaticum*	Woodland Horsetail	1975
P		*Geum rivale*	Water Avens	1998
E		*Isoetes engelmannii*	Appalachian Quillwort	1987
P		*Larix laricina*	Tamarack	1955
T		*Lathyrus ochroleucus*	Yellow Vetchling	1984
P		*Luzula bulbosa*	Southern Woodrush	2010
E		*Lycopodium lagopus*	One-coned Club-moss	1995
P		*Moehringia lateriflora*	Grove Sandwort	1998
P		*Persicaria robustior*	Coarse Smartweed	2008
P		*Phegopteris connectilis*	Long Beech Fern	1960
E		*Potamogeton pulcher*	Spotted Pondweed	1992
T		*Sparganium androcladum*	Keeled Bur-reed	2011
T		*Triadenum walteri*	Walter's St. John's-wort	2009
E		*Vaccinium myrtilloides*	Velvet-leaved Blueberry	1995
T		*Viburnum alnifolium*	Hobblebush	1989
T		*Viburnum opulus var. americanum*	Highbush-cranberry	1995

Status: X = Extirpated, E = Endangered, T = Threatened, PT = Potentially Threatened, SC = Species of Concern, SI = Species of Interest

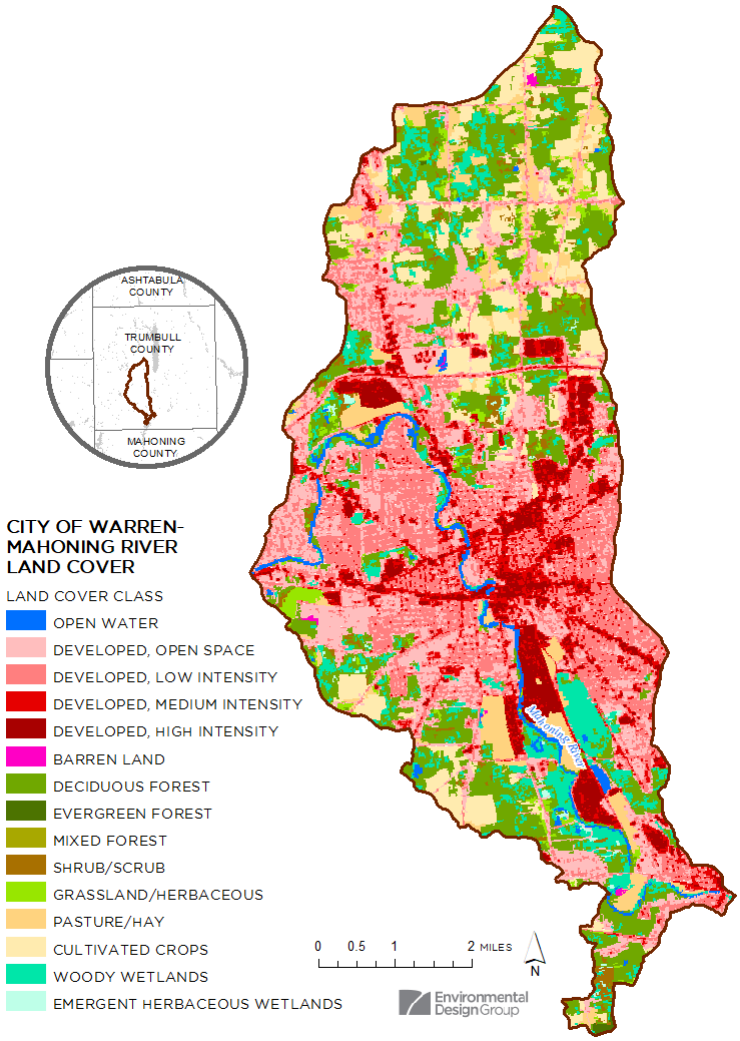
In 2014, an angler fishing just downstream of the Leavittsburg Dam caught an Eastern Hellbender (*Cryptobranchus alleganiensis alleganiensis*) which was confirmed by the Ohio State University's Amphibian and Reptile Conservation Coordinator at the Ohio Biodiversity Conservation Partnership. Hellbenders are the largest amphibian in North America and are State-Endangered and a Federal Species of Concern.

2.1.2 Land Use and Protection

Land Cover



Land cover in the City of Warren HUC-12 is characterized in the OEPA's 2018 Integrated Assessment Report as 57% Developed, 19.4% Forest, 5.1% Grass/Pasture, 9.9% Row Crops, and 8.6% Other. 2011 data from the National Land Cover Database (NLCD) estimates that developed area comprises 53.2% of the HUC-12's land cover; in addition, high and medium intensity development, typically associated with industrial/commercial uses, comprises over 25% of the total developed area. The majority of the high and medium intensity development and a significant portion of the lesser intensity development is concentrated in the center of the watershed in and around the City of Warren, and along the Mahoning River mainstem. The 2016 OEPA Integrated Assessment Report estimates historical wetland presence at 13.39% in the City of Warren HUC-12 and a current wetland presence of 3.48%, which is an over 74% loss of wetlands. Approximately 314 wetlands were inventoried in the HUC-12 through the National Wetland Inventory (NWI). The 2016 Integrated Assessment Report assigned the HUC-12 an area-weighted Level 1 score of 50.04, indicating the average quality of NWI wetlands in the HUC-12 are medium Category II or typical wetland habitat.



NLCD Land Cover	Acres	Percent of HUC-12
Developed Low Intensity	2312.3	21.8%
Deciduous Forest	1965.6	18.6%
Developed Open Space	1902.2	18.0%
Cultivated Crops	1000.2	9.4%
Developed Medium Intensity	836.9	7.9%
Woody Wetlands	752.9	7.1%
Hay/Pasture	639.3	6.0%
Developed High Intensity	577.6	5.5%
Herbaceous	207.3	2.0%
Open Water	186.7	1.8%
Shrub/Scrub	144.6	1.4%
Emergent Herbaceous Wetlands	39.8	0.4%
Evergreen Forest	13.9	0.1%
Barren Land	11.9	0.1%
Mixed Forest	3.8	0.04%

Land Use

Land use data received from Eastgate shows that while the most prevalent land use in the HUC-12 is residential, there is a significant percentage (11%) of land in use as industrial or formerly-industrialized brownfield, most of which lies alongside the Mahoning River. Agricultural use is almost a quarter of the HUC-12 and is concentrated mainly in the northern portion of the watershed in Champion and Bazetta Townships. Approximately 34.9 miles of active rail lines owned by CSX, Norfolk Southern, and the Warren & Trumbull Railroad traverse the watershed along with 63.5 miles of major roads including US Highway 422, State Route 5, State Route 82, and State Route 305. Land in the City of Warren in the center of the watershed is highly urbanized with dense residential parcels (average lot size of 0.15 acres) and larger industrial and commercial parcels. Other significant features include:

Land Use	Acres	Percent of HUC-12
Residential	7137.0	30.4%
Agriculture	5619.9	23.9%
Vacant	3454.2	14.7%
Industrial	2578.3	11.0%
Government or Public	2278.7	9.7%
Commercial	1605.5	6.8%
Rail	424.7	1.8%
Water	236.6	1.0%
NoData	176.8	0.8%

- Cranberry Hills Golf Course, a 50.5-acre golf course in Champion Township
- Kent State University's Trumbull campus, 120 acres in Champion Township
- Trumbull Career and Technical Center, 165.6 acres in Champion Township
- Warren Steel Holdings, a 360-acre abandoned steel mill in Warren Township and Champion Township along 1.3 miles of the Mahoning River mainstem
- The former Republic Steel/RG Steel mill site, a 1,100 acre demolished steel mill now owned by BDM Warren Steel Holdings along 2.28 miles of the Mahoning River mainstem in Howland Township and Warren Township

The National Land Cover Dataset (NLCD) provides a broad estimate along a percent range of impervious coverage; analysis of this layer for the City of Warren HUC-12 returns an average percent coverage of 19% or approximately 4841.1 acres of impervious surface. Distribution of impervious cover across the watershed shows that most impervious coverage is in the range of 10-30% coverage, with a small concentration of highly impervious surface in the 80-100% range, mainly along the Mahoning River mainstem. The effects of impervious cover on water quality will be discussed in more detail in Chapter 3 of this NPS-IS.

Land Protection

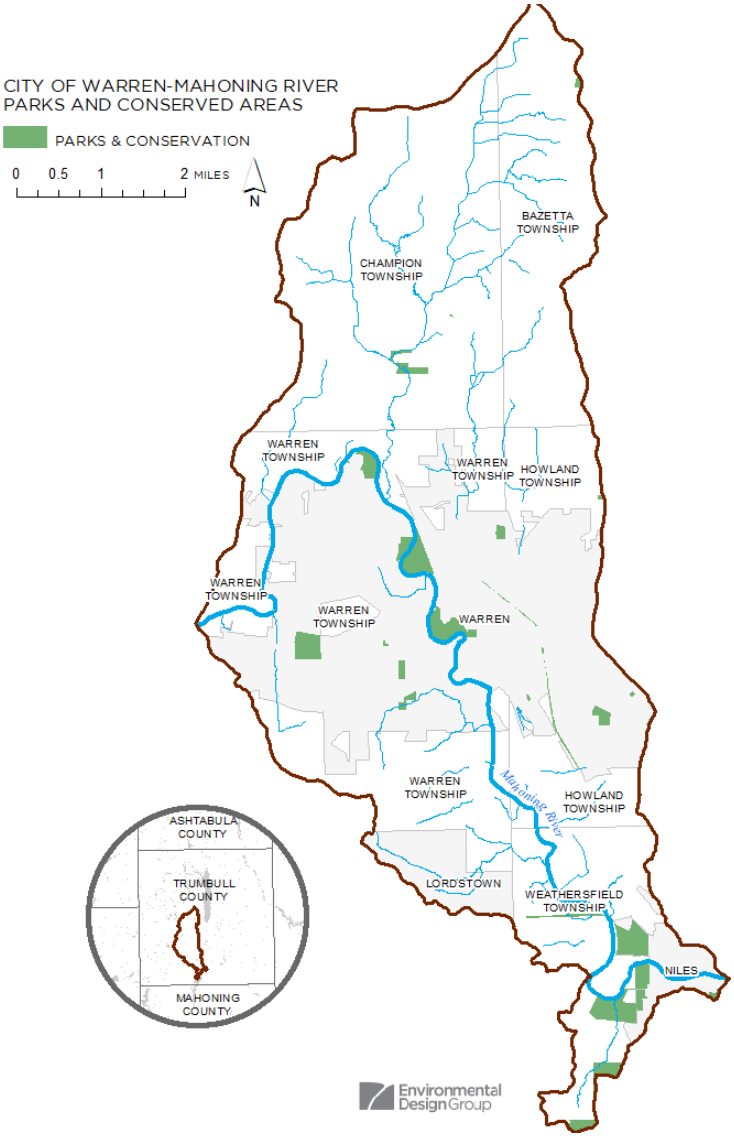
Parks GIS data received from Eastgate notes approximately 613.2 acres of parkland in the City of Warren HUC-12, represented by community parks, township parks, the Trumbull County MetroParks, County Fairgrounds, and preserved land through the Clean Ohio Fund:

- Burbank Park, Packard Park, Perkins Park, Courthouse Park, Amvets Park, Quimby Park, Southwest Park, Northend Park, Deemer Park, McBride Park, Circle Park, Wallace Lynn Park, Riverwalk, and the Warren Greenway – 325.8 acres of community park in the City of Warren
- Trumbull County Fairgrounds – 6.6 acres of County fairgrounds in Bazetta Township
- Morgandale Park – 2.6 acres of community park in Howland Township
- Brynhyfryd Park and Waddell Park – 87.3 acres of community park in the City of Niles
- Mahoning River-Bend Floodplain & Riparian Forest Preservation – 132.3 acres of preserved land in Weathersfield Township and the City of Niles
- Mahoning Valley Sanitary District – 57.6 acres of conserved land in Weathersfield Township

Of these listed parks, Burbank Park, Packard Park, Perkins Park, Waddell Park, Southwest Park, and the Mahoning River Bend Floodplain & Riparian Restoration site have 3.55 miles of stream frontage (3.16 along the Mahoning River and 0.39 of tributary stream). The Warren Greenway is part of the greater Western Reserve Greenway, a mostly-paved asphalt multi-use trail that extends 16.7 miles across Trumbull County from Bloomfield Township to the City of Warren. The Western Reserve Greenway is also a connection to the 100-mile long Great Ohio Lake-to-River Greenway, which once completed will run from the City of Ashtabula to the Ohio River at East Liverpool. The City of Warren also has the Riverwalk; a 5-mile multi use path that runs along the Mahoning River including through Perkins and Packard Parks.

Figure 3: Amphitheater at Packard Park along the banks of the Mahoning River (image courtesy Eastgate).

In addition, Ohio Department of Natural Resources conserves 40 acres of land for public hunting and fishing in Weathersfield Township as the Warren Wildlife Area, which consists of primarily bottomland hardwood forest and wetland. This wildlife area has approximately 0.27 miles of frontage along the Mahoning River mainstem.



Trumbull County has adopted riparian setbacks into its County Subdivision Regulations (701.0, Riparian Buffer Areas), which apply to unincorporated areas within the county. Riparian and wetland setbacks function similarly to front, side, and rear yard setback zoning but are placed along stream corridors rather than parcel lines. They protect the services of riparian areas by providing reasonable controls governing structures and uses in riparian setbacks. Bazetta Township, Weathersfield Township, Warren Township, and Champion Township have not adopted more comprehensive riparian setback regulations beyond the County regulations. Howland Township has adopted comprehensive riparian setbacks in its zoning resolution (Section 6, Riparian Setbacks). The Village of Lordstown and the City of Warren have not adopted riparian setbacks, and the City of Niles enforces riparian setbacks in their Chapter 922, Comprehensive Stormwater Management, as determined by the City Engineer.

STS and NPDES Discharges

Data obtained from Eastgate shows approximately 424 septic treatment systems in the City of Warren HUC-12, with the majority clustered in Warren Township at the Mahoning River's confluence with Duck Creek (32%) and in the northern headwater drainage of unnamed tributaries to the Mahoning River in Champion Township and Bazetta Township (52%). All but 8 STS are located in unincorporated areas in the HUC-12. Failing septic discharge is identified as a water quality concern in the 2004 Mahoning River TMDL and STS maintenance and repair should be prioritized in locations where connection to a sewer line is not planned or feasible.

Eight individual NPDES permit holders discharge to the City of Warren HUC-12; most are industrial permit holders with the exception of the City of Warren's wastewater treatment works (Warren WPCF) and the Kmart Warren Distribution Center. These permit holders are listed below, along with the receiving stream.

OEPA Permit #	Facility Name	Permit Type Description	Facility Type Description	Receiving Stream
3IC00026*ED	RMI Titanium Company LLC	Individual Permit - Industrial	Metal Finishing	Mahoning River
3IC00056*LD	Thomas Steel Strip Corporation - TATA Steel Plating	Individual Permit - Industrial	Metal Finishing	Mahoning River at RM 39.06
3ID00004*KD	ArcelorMittal Warren	Individual Permit - Industrial	Steel Mill	Mahoning River
3ID00071*ID	BDM Warren Steel Operations	Individual Permit - Industrial	Steel Mill	Mahoning River
3IN00336*DD	Ohio Star Forge Co	Individual Permit - Industrial	Miscellaneous	Mahoning River
3IS00102*FD	Ajax Tocco Magnethermic Corp	Individual Permit - Industrial	Metal Fabrication	Mahoning River (via a storm sewer)
3PE00008*PD	Warren WPCF	Individual Permit - Public	Municipality - 10 to 50 MGD	Mahoning River
3PS00007*HD	Kmart Warren Distribution Center	Individual Permit - Public	Semi-Public - Over 0.05 MGD	Unnamed tributary to the Mahoning River

Stormwater Management and Regulation

All of the municipalities and townships within the City of Warren HUC-12 are part of the regulated Municipal Separate Storm Sewer System (MS4), with the exception of the Village of Lordstown. Stormwater can be one of the most significant and difficult nonpoint source pollutants to address within a watershed. Stormwater is problematic because any substance such as chemicals, nutrients, sediment, and other debris is carried into the storm sewer system and discharged untreated into surrounding waterbodies. This has subsequent effects on drinking water, recreational activities, and industries that rely on clean water. The main sources of stormwater runoff come from urban, suburban, and agricultural activities; with each source effecting water quality in a variety of ways. Champion Township, Warren Township, Bazetta Township, Howland Township, Weathersfield Township, and the City of Niles are co-permittees under Trumbull County's MS4 general permit, while the City of Warren holds its own MS4 general permit with OEPA. Each regulated MS4 is required to develop and implement a stormwater management program to reduce the contamination of stormwater runoff and prohibit illicit discharges. Trumbull County has also implemented a Regional Storm Water District, which includes ten townships and six municipalities. In the City of Warren HUC-12, Champion Township, Warren Township, Bazetta Township, Weathersfield Township, and Howland Township, and the City of Niles are all part of the

Regional Storm Water District, which charges a drainage fee based on Equivalent Hydrologic Units (EHUs). The calculation assigns a value for residential properties and a proportionally higher value for commercial and industrial properties based on acreage and EPA runoff coefficients. The fees collected can be used for technical, labor, and support services or for community-specific capital improvement projects. More information on the Regional Storm Water District can be found at: http://stormwater.co.trumbull.oh.us/index.html.

Summit Street Dam (Warren Water Works Dam)

Located in the City of Warren on the Mahoning River at RM 39.9, the Summit Street Dam (or Warren Water Works Dam) is a low-head V-shape concrete structure with a sloped concrete weir owned by the City of Warren and Habosky-Davidson Enterprises. The dam is approximately 11.7 feet tall (USACE, 2006) and also consists of abutments and a spillway with two large metal gear wheels at the entrance. The original dam was constructed sometime shortly after or in 1884 to support the City of Warren's original water plant and was remodeled to support hydroelectric power. It is no longer in use.

Figure 4: Location of the Summit Street Dam (in red) in the City of Warren HUC-12 (image courtesy Eastgate).

ArcelorMittal Dam (Republic Steel Warren Works Dam)

Located in Warren Township on the Mahoning River at RM 36.7, the ArcelorMittal Dam (or Republic Steel Warren Works Dam) is a concrete weir with abutments that may be supported in some areas by submerged timber cribs. The dam is approximately 4.5 feet high (USACE, 2006) and is owned by ISG Warren, Inc. and BDM Warren Steel Holdings, Inc. It was constructed by Trumbull Steel in 1921, before Trumbull Steel was acquired by Republic Steel. The dam's original purpose was to impound water used by Republic Steel and WCI Steel. With the closure of the steel mills, the impoundment is no longer needed.

Figure 5: Location of the ArcelorMittal Dam (in red) in the City of Warren HUC-12 (image courtesy Eastgate).

2.2 Summary of HUC-12 Biological Trends

The OEPA's 2018 Integrated Water Quality Report lists the City of Warren HUC-12 as impaired for its Warmwater Habitat (WWH) aquatic life use. The WWH use applies to "typical" warmwater assemblages of aquatic organisms for Ohio rivers and streams and represents the principal restoration target for the majority of water resource management efforts in Ohio. All streams including the Mahoning River in this HUC-12 are designated WWH.

During the 2011 and 2013 field seasons, ambient biological, water column chemical and sediment sampling was conducted in the lower Mahoning River basin in order to facilitate a TMDL assessment for the lower Mahoning River and tributaries. These data were published in 2018 in a Technical Support Document (TSD) as the *Biological and Water Quality Study of the Lower Mahoning Watershed* (OEPA, 2018a). Development of TMDLs for pollutants impairing designated or recommended aquatic life uses for the lower Mahoning, including this HUC-12, is currently underway by OEPA. A TMDL for bacteria was produced for the entire Mahoning River watershed in 2004, but this TMDL does not address aquatic life use impairments. Therefore, the preparation of this NPS-IS relies primarily on the water quality information from the 2018 TSD for the Lower Mahoning. A previous TSD, *Biological and Water Quality Study of the Mahoning River Basin,* was published in 1996, and data from that monitoring will be used to show water quality trends over time in the HUC-12 where possible. In 2012, a one-mile section of the Mahoning River in the City of Warren was assessed by OEPA as part of a Targeted Brownfield Assessment (TBA) for the former Warren Gasification property, and the results of that monitoring were published in the *2012 Biological and Water Quality Study of the Mahoning River 2012: Former Warren Gasification Facility* technical report and also referenced in this NPS-IS. The below table lists the metrics for what is considered attainment of the WWH, EWH, and MWH aquatic life use designations using the Index of Biotic Integrity (IBI), Modified Index of well-being (MIwb), and Invertebrate Community Index (ICI). IBI, ICI, and MIwb monitoring were performed in the City of Warren HUC-12 for TMDL development.

Ecoregion	Biological Index	Assessment Method[2,3]	Biological Criteria for the Applicable Aquatic Life Use Designations[1]		
			WWH	EWH	MWH[4]
Erie-Ontario Lake Plains (EOLP)	IBI	Headwater	40	50	24
		Wading	38	50	24
		Boat	40	48	24/30
	MIwb	Wading	7.9	9.4	6.2
		Boat	8.7	9.6	5.8/6.6
	ICI	All[5]	34	46	22

[1] Coldwater habitats (CWH), limited warmwater habitat (LWH), resource waters (LRW) and seasonal salmonid habitat (SSH) do not have associated biological criteria

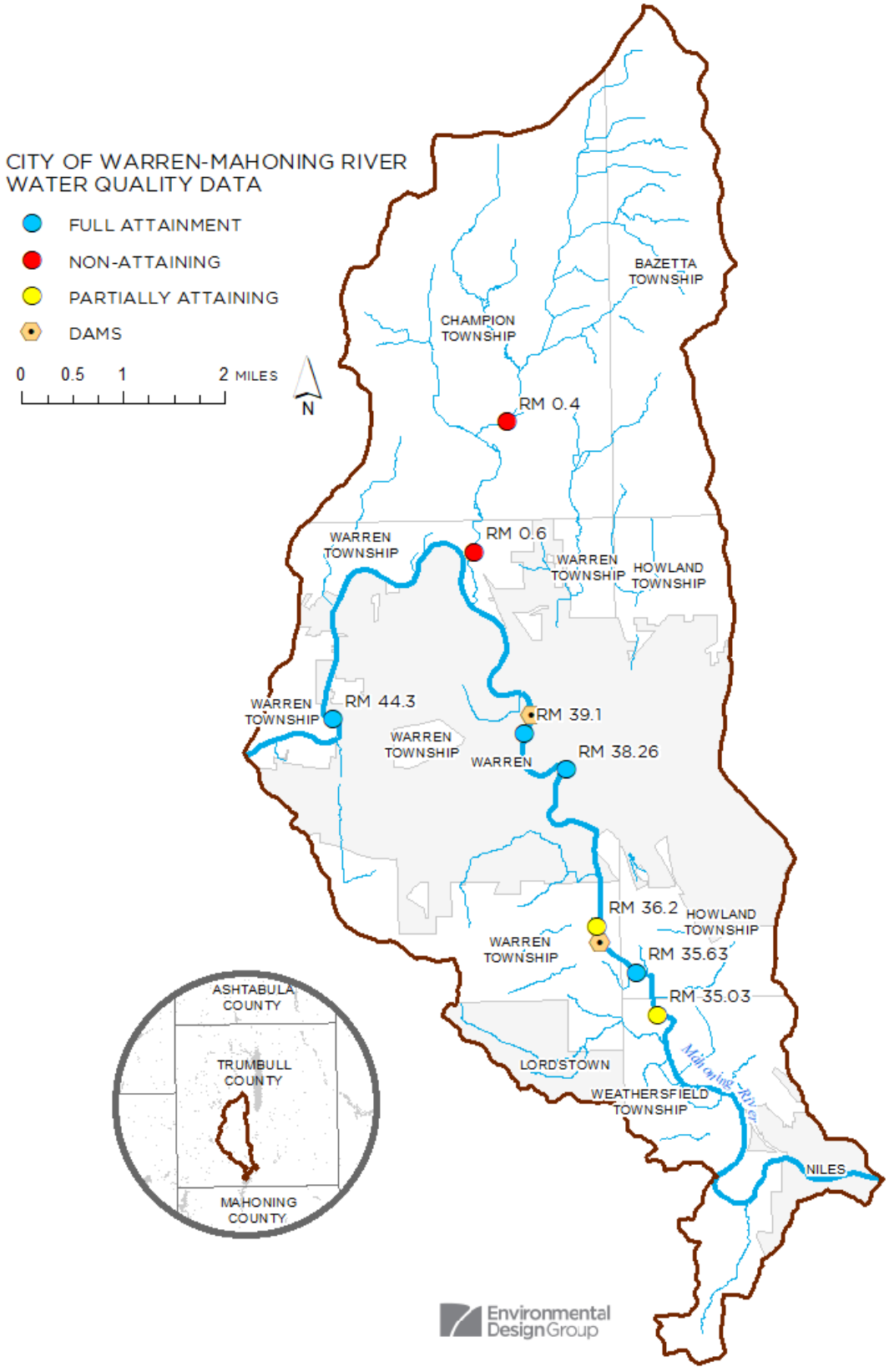
[2] The assessment method used at a site is determined by its drainage area (DA) according to the following: Headwater: DA ≤ 20mi²; wading: DA > 20mi² and ≤ 500mi²; boat: DA > 500mi²

[3] MIwb not applicable to drainage areas less than 20mi²

[4] Biocriteria depend on type of MWH. MWH-C (due to channelization) is listed first and MWH-I (due to impoundment) is listed second

[5] Limited to sites with appropriate conditions for artificial substrate placement

Monitoring was performed by OEPA at eight locations in the City of Warren HUC-12 in 2013; the below figure shows the sampling locations and attainment status of each monitoring point.



A summary of the monitoring locations and their biological status in the City of Warren HUC-12 from the 2018 Lower Mahoning TSD (sampling year 2013) and the 1996 Mahoning River TSD (sampling year 1994) are provided

in the following table. Indexes with stressed communities or below baseline scores are highlighted, and station names in green are where sampling was conducted in dam impoundments.

Station ID	Sample Station Name	River Mile	ALU Attain.	Fish Sample Year	IBI Score	IBI Narr.	MIwb Score	MIwb Narr.	Bug Sample Year	ICI Score	ICI Narr.	Bug Narr.	QHEI
N/A*	MAHONING R. NEAR LEAVITTSBURG, 1.0 MI. UPST U.S. RT. 422	44.3	Full WWH	1994	37	F	9.20	VG	N/A	N/A	N/A	N/A	65.5
200419	MAHONING R. NEAR LEAVITTSBURG, 1.0 MI. UPST U.S. RT. 422	44.3	Full WWH	2013	45	G	9.20	VG	2013	50	E	N/A	68.5
N/A*	PACKARD PARK, UST. SUMMIT DAM	39.4	Non WWH	1994	25	N/A	7.20	N/A	N/A	N/A	N/A	N/A	46.5
200405	MAHONING R. AT WARREN @ 3RD ISLAND DST. SUMMIT ST.	39.1	Full WWH	N/A	N/A	N/A	N/A	N/A	1994	34	N/A	N/A	N/A
200405	MAHONING R. AT WARREN @ 3RD ISLAND DST. SUMMIT ST.	39.1	Full WWH	N/A	N/A	N/A	N/A	N/A	2013	46	E	N/A	N/A
N/A*	PERKINS PARK, DST. THOMAS STEEL	38.8 fish, 38.2 bugs	Partial WWH	1994	34	N/A	8.30	N/A	1994	26	N/A	N/A	80.5
N03S43	MAHONING R. AT WARREN @ WEST MARKET ST.	38.26	Full WWH	2013	45	G	9.21	VG	2013	44	VG	N/A	72.5
N03K31	MAHONING R. AT LTV WARREN, NEAR SUBSTATION	36.2	Partial WWH	2013	41	G	7.70	MG	N/A	N/A	N/A	N/A	49.5
N03S60	MAHONING R. UPST. WARREN WWTP, DST W.C. INDUSTRIES	35.63	Full WWH	2013	36	MG	9.01	VG	2013	48	E	N/A	69.5
N/A*	MAHONING R. DST. WARREN WWTP	35.05	Non WWH	1994	22	N/A	6.00	N/A	1994	4	P	N/A	68.5
N03S59	MAHONING R. DST. WARREN WWTP	35.03	Partial WWH	2013	35	F	8.45	G	2013	38	G	N/A	70
302314	YOUNGS RUN (MAHONING R. 40.89/2.28) @ END OF SHAFER RD.	0.4	Non WWH	2013	30	F	N/A	N/A	2013	N/A	N/A	F	56.5
302311	TRIB. TO MAHONING R. (39.16/40.89) @ ST. RT. 45	0.6	Non WWH	2013	32	F	N/A	N/A	2013	N/A	N/A	F	74.5

P = Poor, F = Fair, MG = Marginally Good, G = Good, VG = Very Good, E = Exceptional

**1994 monitoring data uses RM and Station Name only and are not associated with Station IDs.*

2.2.1 Fish (Index of Biotic Integrity (IBI) and Modified Index of well-being (MIwb))

Generally, the 2013 IBI and MIwb scores along the Mahoning River mainstem in this HUC-12 show improvement from prior sampling in 1994. Zero out of seven IBI/MIwb scores from the 1994 sampling were in the attainment range for WWH use while two out of five IBI/MIwb scores in 2013 were fully attaining WWH. One of the lowest fish scores were found in the dam pool sampling site at RM 36.2, where good proportional community structure ranked a Good IBI score of 41, but overall low numerical abundance and disproportionately skewed biomass ranked a Fair MIwb score of 7.70. The other low fish score was at the RM 35.03 sampling site (downstream of the Warren WWTP) which was rated in partial attainment of WWH use and had a Good MIwb of 8.4 but a Fair IBI of 35. The dam pool site at RM 36.2 (upstream from the ArcelorMittal Dam) exhibited the lowest total number of species, with only 14 species found while the rest of the sites ranged from 21-27 species found. Predominant species in the samples included northern hogsucker, smallmouth bass, silver redhorse, spotfin shiner, rock bass, river chub, golden redhorse, and common carp. Bluntnose minnow was also noted at these sites, and most of these fish are considered pollution tolerant or moderately tolerant species. Species quality between 1994 and 2013 improved in the free-flowing reaches of the Mahoning River; for example, carp decreased by nearly half while northern hogsuckers increased by a third, and golden redhorse also increased significantly. However, carp populations remained unchanged in dam pool areas. 2012 IBI and MIwb sampling conducted just downstream of the RM 38.26 station at RM 38.2 and RM 37.6 for the Warren Gasification Facility TBA (OEPA, 2012) in a free-flowing reach had scores in the good to very good range, with IBI scores of 44 and 47 and MIwb scores of 8.9 and 9.2, respectively. Overall, fish population quality was correlated with presence/absence of dam pool or backwater conditions.

IBI scores in the tributary sampling locations (Youngs Run and the Unnamed Tributary to Mahoning River at RM 40.89) were both in the Fair range, indicating stressed and non-attaining fish communities. Species counts were low at both sites (14 at the Youngs Run site and 16 at the Unnamed Tributary site) and were primarily composed of creek chub, Johnny darter, central stoneroller, yellow bullhead, and white sucker. The presence of dominant creek chub populations at these sites indicate a transient fish population that lacks competition from larger, longer-lived carnivorous game fish. The Youngs Run site was also noted as having wetland-affiliated species including grass pickerel, central mudminnows and pumpkinseed sunfish, which are also pollution tolerant/moderately tolerant species.

2.2.2 Macroinvertebrates (Invertebrate Community Index (ICI))

Macroinvertebrate sampling conducted in 2013 also shows a significant improvement in population quality since the last sampling was conducted in 1994. Legacy toxicity from steel mill discharges, combined with improperly treated sanitary waste, continued to delay macroinvertebrate recovery, but almost 20 years later, a significant amount of recovery has taken place. In the Mahoning River mainstem, exceptional communities were recorded at several sampling locations in the City of Warren HUC-12 at RM 44.3, RM 39.1, RM 39.07 (not sampled for fish/QHEI) and RM 35.63. However, where impaired communities were found they were impacted primarily by dam impoundments, low-gradient stream conditions, urban runoff and municipal point-source discharges (OEPA, 2018a).

Ephemeroptera-Plecoptera-Trichoptera (EPT) are the orders of invertebrates respectively known as mayflies, stoneflies, and caddisflies. Their presence and abundance in a sample is generally considered an indicator of high-quality conditions in the benthos. The highest scoring ICI sites at RM 44.3, RM 39.1, RM 39.07, and RM 35.63 all noted EPT taxa, including net-spinning caddisflies, hydropsychid caddisflies, heptageniid mayflies, *Neureclipsis sp.* caddisflies, and *Tricorythodes sp.* mayflies in their predominant taxa. Macroinvertebrate scores in the City of Warren HUC-12 are all attaining WWH use; the lowest ICI score of 38 at RM 35.03 downstream of the Warren WWTP is still in the Good range, despite noting that the reach is entirely run habitat (no pools/riffles) with chunks of asphalt serving as larger substrates. The second-lowest score of 44 was

recorded at RM 38.26 (Mahoning River at Warren @ West Market Street), which is fully-attaining WWH but described the reach as silt-laden with a CSO just upstream of the sampling area. 2012 macroinvertebrate sampling in a one-mile free flow reach for the Warren Gasification TBA at RM 38.2, RM 38.0, and RM 37.6 were in the good to very good range, with ICI scores of 40, 36, and 42, respectively. The free-flowing conditions in these sampling locations created riffle habitat which encouraged a robust mayfly and caddisfly community (OEPA, 2012).

It is worth noting that all of the macroinvertebrate sample locations were not taken in dam pool areas, but in free-flow reaches of the HUC-12, and that ICI scores from dam pool areas both immediately upstream of the HUC-12 at Leavittsburg and downstream at Liberty Street do not meet WWH criteria. Should macroinvertebrate sampling be done at the pool areas in the City of Warren HUC-12, one may assume that the scores would be similarly low. The 2018 Lower Mahoning TSD describes low-head dams as "one of the most significant barriers preventing the Mahoning River from realizing full recovery" and that despite overall improvement to the benthos in the 2013 sampling, communities sampled in dam pools consistently underperformed in comparison to samples taken in free-flow reaches. The Exceptional community scores at several of the free-flow sampling sites in the HUC-12 do give positive assurance that removal of the dams and restoration of natural riffle-run-pool areas would result in dramatic improvements in macroinvertebrate populations throughout the Mahoning River mainstem.

The sampling locations in Youngs Run and the Unnamed Tributary to the Mahoning River at RM 40.89 did not have ICI data; however, macroinvertebrate samples which are collected only with qualitative procedures or for which a valid ICI score is not available are assigned a narrative evaluation based on the qualitative sample. The narrative evaluations align with the numeric ranges on the ICI as seen in the following figure.

Narrative	Invertebrate Community Index (ICI) Range				
	Huron/Erie Lake Plains HELP (1)	Interior Plateau IP (2)	Erie/Ontario Lake Plains EOLP (3)	Western Allegheny Plateau WAP (4)	Eastern Corn Belt Plains ECBP (5)
Exceptional	46 - 60				
Very good	42 - 44				
Good	34 - 40	30 - 40	34 - 40	36 - 40	36 - 40
Marginally Good	30 - 32	26 - 28	30 - 32	32 - 34	32 - 34
Fair	22 - 28	22 - 24	22 - 28	22 - 30	22 - 30
Low Fair	14 - 20				
Poor	8 - 12				
Very Poor	0 - 6				

The narratives can be used to rate the macroinvertebrate community condition in relation to the designated ALUs codified in the Ohio Water Quality Standards:

- Exceptional (meets Exceptional Warmwater Habitat (EWH) expectations)
- Very Good (just below EWH expectations)
- Good (meets Warmwater Habitat (WWH) or Coldwater Habitat (CWH) expectations)
- Marginally Good (just below WWH or CWH but still meets expectations)
- Fair (does not meet WWH or CWH but does meet Modified Warmwater Habitat (MWH) expectations)
- Low Fair (does not meet MWH expectations)
- Poor (meets Limited Resource Water (LRW) expectations)
- Very Poor (does not meet LRW expectations)

Both tributary sampling locations have a narrative evaluation of Fair, which is non-attaining WWH use and indicates communities with some expected taxa absent or in low abundance, low or absent sensitive taxa, a declining species richness, and an increase or domination of pollution-tolerant species in the assemblage. The Youngs Run sampling site had a moderate to low organism density with only 55 taxa collected. Of those, 3 were identified as pollution-sensitive taxa while 17 were pollution tolerant. The waters at the sampling site were noted as tannin-stained, with midges and amphipods predominating. The Unnamed Tributary to the Mahoning River at RM 40.89 sampling site had an even lower organism density with 44 taxa collected, of which 2 were identified as sensitive to pollution and 17 were identified as pollution tolerant. The water at this site was also tannin-stained, and midges were the predominant species. High conductivity (an indicator of salt contamination) has been linked with poor mayfly communities and is thought to be a factor in the Unnamed Tributary site. The Youngs Run site assemblage reflected potential nutrient/organic enrichment, due to a predominance of blackflies and midges and overall dominance of tolerant taxa (OEPA, 2018a).

2.2.3 Habitat (via Qualitative Habitat Evaluation Index (QHEI))

The below table details the QHEI scores and subcomponent attributes for each HUC-12 sampling location monitored for QHEI in 2013 in the Mahoning River mainstem and the two tributary sampling locations at an Unnamed Tributary to the Mahoning River at RM 40.89 and at Youngs Run, which flows into the Unnamed Tributary at RM 2.28.

		WWH Attributes											MWH Attributes																				
													High Influence						*Moderate Influence*																
River Mile	QHEI	No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	MaxDepth > 40 cm	Low-Normal Riffle Embeddedness	**Total WWH Attributes**	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	MaxDepth < 40 cm (WD, HW)	**Total H.I. MWH Attributes**	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod Riffle Embeddedness	No Riffle	**Total M.I. MWH Attributes**
Mahoning River																																	
44.3	68.5	□	□				□	□		□	□	6						0					●	●				●			3
38.26	72.5	□	□			□	□			□	□	6						0		●			●				●	●			4
36.2	49.5	□					□			□		3				◊		1		●	●		●	●			●	●		●	7
35.63	69.5	□	□		□	□	□	□		□		7						0		●								●	●		3
35.03	70	□	□		□	□	□	□		□		7						0		●								●	●		3
Unnamed Tributary at RM 40.89																																	
0.6	74.5	□	□		□	□	□			□		6						0		●							●	●	●		4
Youngs Run (Unnamed Tributary at RM 2.28 to Unnamed Tributary at RM 40.89)																																	
0.4	56.5		□		□	□	□			□		5				◊		1	●	●			●			●	●	●		●	7

QHEI scores in the Mahoning River mainstem in the HUC-12 are mainly affected by the presence or absence of free-flow conditions. The QHEI score of 49.5 at RM 36.2 in the dam pool of the ArcelorMittal Dam is the only score below WWH expectations for habitat. The other partially-attaining monitoring location at RM 35.03, for example, is in a free-flow area downstream of the Warren WWTP and has a QHEI of 70. With the exception of the RM 36.2 site, the QHEI scores in the HUC-12 range from 68.5 to 72.5. The low score at RM 35.03 reflects the lack of diversified current and more monotypic habitat associated with dam pools, as well as the associated sediment settling and deposition that occurs in sluggish waters, contributing to embedded substrate and poor in-stream habitat. This is reinforced in the subcomponent attributes, where the RM 36.2 site has the least total WWH attributes, the only noted high-influence MWH attribute, and the highest number of moderate-influence

MWH attributes. The modified MWH attributes (heavy/moderate silt cover, sand substrates, fair/poor development, low sinuosity, no fast current, high/moderate embeddedness, and absence of riffles) are all associated with the low-flow conditions of dam pool and backwater areas. It is also worth noting that even the high-scoring QHEI sites all exhibit at least 3 moderate-influence MWH attributes, with the most common being heavy/moderate silt cover (4/5 sites) and high/moderate overall embeddedness (all sites monitored had this attribute). 2012 QHEI sampling at the former Warren Gasification Facility at RMs 38.2 and 37.6 had Excellent scores of 77.5 and 81.5, respectively, with seven WWH attributes, zero high influence MWH attributes, and only two moderate influence MWH attributes (high/moderate overall embeddedness and high/moderate riffle embeddedness). The sampling locations were all represented by natural, free-flowing conditions, with cobble and gravel as the dominant substrate types and normal to moderate levels of silt and bottom embeddedness. These excellent scores are indicative of the potential the Mahoning River has to support high-quality biological communities in free-flowing conditions.

The 2018 Lower Mahoning TSD notes that stream habitat in small tributaries to the lower Mahoning River are nearly all degraded by channel modification, impoundment or poor construction site sediment control. Youngs Run sampling location at RM 0.4 had a QHEI score of 56.5 (Good), with one high-influence MWH attribute and seven moderate-influence MWH attributes. Lack of good in-stream cover is strongly correlated with low IBI and ICI scores in WWH streams, and direct in-stream habitat alterations in Youngs Run has increased embeddedness and left a recovering channel with only fair to poor development, heavy to moderate silt cover, and lack of good riffle/pool structure. The Unnamed Tributary to the Mahoning at RM 40.89 sampling location at RM 0.6 had an Excellent QHEI score of 74.5, but still exhibited moderate MWH attributes of high to moderate embeddedness and heavy/moderate silt cover, indicating sediment inputs from the surrounding watershed. Both tributary sites sampled had no fast current, which indicates low-gradient conditions conducive to settling out sediment. There is also a large in-line pond present upstream of the RM 0.6 location on Kent State University's Trumbull campus that may be adversely affecting flow conditions and sediment transport.

2.3 Summary of HUC-12 Pollution Causes and Associated Sources

OEPA sampled water quality in the lower Mahoning watershed, including the City of Warren HUC-12, in 2013. The reach of the Mahoning River mainstem in this HUC-12 was assessed as part of the Mahoning River Large River Assessment Unit (LRAU) and has causes and sources of impairment listed specifically for the LRAU. Tributary streams in this HUC-12 were assessed separately and have their own causes and sources of impairment. Causes of impairment in the Mahoning River mainstem are listed in the 2018 Integrated Assessment Report (under the LRAU) as flow regime alterations, sedimentation/siltation, direct habitat alterations, and organic enrichment (sewage). Sources of impairment are listed as dams or impoundments, municipal point source discharges, upstream pollution sources, and combined sewer overflows.

The major sources of bacteria loading in this HUC-12 were noted as urban runoff, WWTP bypasses and illicit sewage discharges (SSOs/CSOs) (OEPA, 2018a). No sites assessed in the HUC-12, either in the Mahoning River mainstem or its tributaries, were attaining PCR Class A Recreation Use.

The history of industrial use in the lower Mahoning River, in particular steel mills and railroads, has left a legacy of contaminated sediments behind, particularly upstream of low-head dams where they settle out and concentrate in the low-energy pools and backwaters. Sediment from the lower Mahoning River and tributaries was also analyzed in 2013 for semi-volatile organic constituents (BNAs and PAHs), polychlorinated biphenyls (PCBs) and metals, including mercury. Starting at RM 38.26 sampling station in the City of Warren HUC-12, values above the probable effect concentration (PEC), a level at which harmful effects are likely to be observed, were noted for chromium, lead, nickel and zinc, and remained elevated downstream with a spike in chromium and copper at RM 36.2. However, despite these local exceptions, the general trend for sediment quality with respect to metals contamination has improved since the last round of sampling in 1994. PAHs, however, remain

above the PEC for all sites sampled in the HUC-12 and the 2018 TSD attributes this pollution to deposition of these chemicals via stormwater runoff from surrounding urban/industrial uses. PCBs were regularly detected in the lower Mahoning River mainstem starting at RM 38.26 in the City of Warren HUC-12 and continued downstream.

As anthropogenic influences increase, fish community integrity decreases. The best MIwb fish community scores were noted in the 2018 Lower Mahoning TSD where free-flow conditions were present and a depressed MIwb score was noted in dam pool conditions at RM 36.2. Highly altered flow regimes from the presence of the Summit Street and ArcelorMittal Dams continues to impact the fish community along the Mahoning River mainstem in the City of Warren HUC-12, as well as polluted conditions from CSOs and urban runoff. Macroinvertebrate community quality is also strongly correlated to free-flow conditions, where exceptional communities are still present despite sub-optimal substrate, as at the sampling location at RM 35.63 where asphalt chunks are a dominant part of the streambed.

The Mahoning River's in-stream habitat in the City of Warren HUC-12 is degraded by the presence of two dams. The Summit Street Dam impounds approximately 2.5 miles of stream, while the ArcelorMittal Dam impounds one mile. The pools behind the Summit Street Dam and ArcelorMittal Dam are relatively short because the Mahoning River's gradient increases in this reach to 2.3 feet/mile, but the 2018 lower Mahoning TSD notes that the dam pools in the reach upstream of the Leavittsburg Dam to the ArcelorMittal Dam make it difficult to notice the river's dynamic change in size from a small creek-sized stream to a notable river. The natural gradient and flow should provide many unique habitat niches for aquatic organisms but cannot due to the presence of the dams. Instead, the dam pools collect silt and sediment and the assimilative capacity and aquatic diversity of the lower Mahoning will remain checked as long as it is dammed (Lower Mahoning TSD, 2018).

The 2006 USACE Environmental Dredging Draft Feasibility Report describes the effects low-head dams have on the water quality of the lower Mahoning River:

"The low head dams adversely impact the Mahoning River ecosystem in several ways. These dams impound over 25 miles of the 31-mile reach of river under study. Within the impounded areas, flow (river currents) is slower and river stages (elevations) are more constant than they would be in the normal or natural conditions. Due to the lower velocities behind the dams, more fine-grained sediment settles to the river bottom than in the free-flowing reaches. Since many pollutants adhere to fine-grained sediments, the greater accumulations of legacy contamination are located immediately behind the dams. Slower currents also reduce sediment transport and change the streambed grain-size distribution compared to natural conditions. Without these dams, the distribution would be expected to consist of various gradations of cobble that provide the type and quality of benthic habitat necessary for a diverse aquatic community. Natural riffles that enhance aquatic habitats are smothered by the sediment in the impounded areas reducing the diversity of aquatic substrate available for benthic organisms. The greater constancy of river elevations also "deactivate" floodplains by reducing over bank flooding that is critical to many native riparian species. Lower velocities also cause channel narrowing, reduced braiding, and associated loss of habitat complexity. Finally, these dams reduce or sever important biologic connections for aquatic species thought the entire river basin (mainstem and tributaries). All of these problems within the project area contribute to the low biologic indices, including the QHEI values, relative to both the free-flowing areas both in the project area and model reach."

Habitat improvement in the City of Warren HUC-12 has been occurring since the closure of many of the steel mills and other industries but remains limited by the redundant dam pools (OEPA, 2018a). QHEI scores did not fluctuate dramatically between 1994 and 2013, indicating that "Good" quality habitat back in 1994 remained similar nearly 20 years later. The dam pools limit assimilative capacity, trap nutrients, grow algae, consume

dissolved oxygen, and create challenging areas for fish and macroinvertebrates to thrive. The Lower Mahoning TSD states "habitat conditions in the Mahoning River watershed have appreciably improved through passive natural attenuation over the last 20 years, except in impounded locations." It recommends the removal of dams in this reach to restore assimilative capacity and improve water quality.

Causes of impairment in the tributaries to the Mahoning River in this HUC-12 are listed in the 2018 Integrated Assessment Report as specific conductance (often correlated to salinity levels) and organic enrichment (sewage). Sources of impairment are illicit connections/hook-ups to storm sewers, on-site treatment systems (septic systems and similar decentralized systems) and sewage discharges in unsewered areas. In addition, the 2018 Lower Mahoning TSD also notes that habitat conditions in small tributaries to the Mahoning River, including those in the City of Warren HUC-12, were consistently degraded by channel modification, impoundment or poor construction site sediment control. Agricultural activities (including channelization) in the headwater tributaries as well as channelization from other sources are lowering habitat quality and fish community integrity and contributing excessive sediment and nutrients to the City of Warren HUC-12 tributaries. Sediment impairs aquatic life by damaging streambed habitat. Riffles and other areas comprised of coarser material become embedded with fine sediment effectively reducing or eliminating the void spaces that provide cover to macroinvertebrates and fish as well as their eggs. Sediment itself is damaging to the aquatic ecosystem as it delivers pollutants like phosphorus and causes abrasion to organisms.

2.4 Additional Information for Determining Critical Areas and Developing Implementation Strategies

Mahoning River Reconnaissance Study

In 1999 US Army Corps of Engineers produced a reconnaissance study on the removal of contaminated sediments and dams to restore the lower Mahoning River. The report called for dredging 750,000 cubic yards of contaminated in-stream and riverbank sediment and the removal of seven small dams, including the Summit Street Dam and ArcelorMittal Dam in the City of Warren HUC-12. This study was used as the basis for a subsequent feasibility report for removal and remediation of contaminated sediments in the Mahoning River.

Mahoning River, Ohio Environmental Dredging Draft Feasibility Report and Environmental Impact Statement

In 2006 USACE produced a feasibility report that primarily dealt with the dredging and removal of contaminated sediments in the lower Mahoning River downstream of its confluence with Duck Creek to the Pennsylvania state line. The report also describes nine dams, including the Summit Street and ArcelorMittal dams, as targets for removal, and details the accumulation of sediments and channel conditions present in the stagnating dam pool areas. The report states that the presence of the nine impoundments along the lower Mahoning River impede fish migration and recreation, have negative impacts on river quality by increasing temperature and lowering dissolved oxygen, and degrade aquatic habitat through deposition of sediment and decreased habitat diversity. The dams are an important factor contributing to the non-attainment of warmwater habitat criteria, and the report concludes that without action, the overall health of the Mahoning River in the study area will not substantially change from current conditions. Slight increases in fish populations have occurred largely because of a reduction in industrial discharges from the steel industry over the past 30 years, but the non-attainment of aquatic health will continue due to the presence of excessive sediment (some contaminated) and the low-head dams.

U.S. Fish & Wildlife Service Coordination Act Report

U.S. Fish and Wildlife Service reviewed the USACE Environmental Dredging Draft Feasibility Report in 2005 and produced a Coordination Act Report that concurred with the USACE recommendations for dredging and/or dam removal, specifically noting that if dams were removed from the river subsequent to sediment cleanup, it would still provide positive results for aquatic life in the Mahoning River, and that overall aquatic benefits would be much greater if dam removal occurred rather than simply dredging. This coordination report was included in the 2006 USACE Environmental Dredging Draft Feasibility Report as Appendix N.

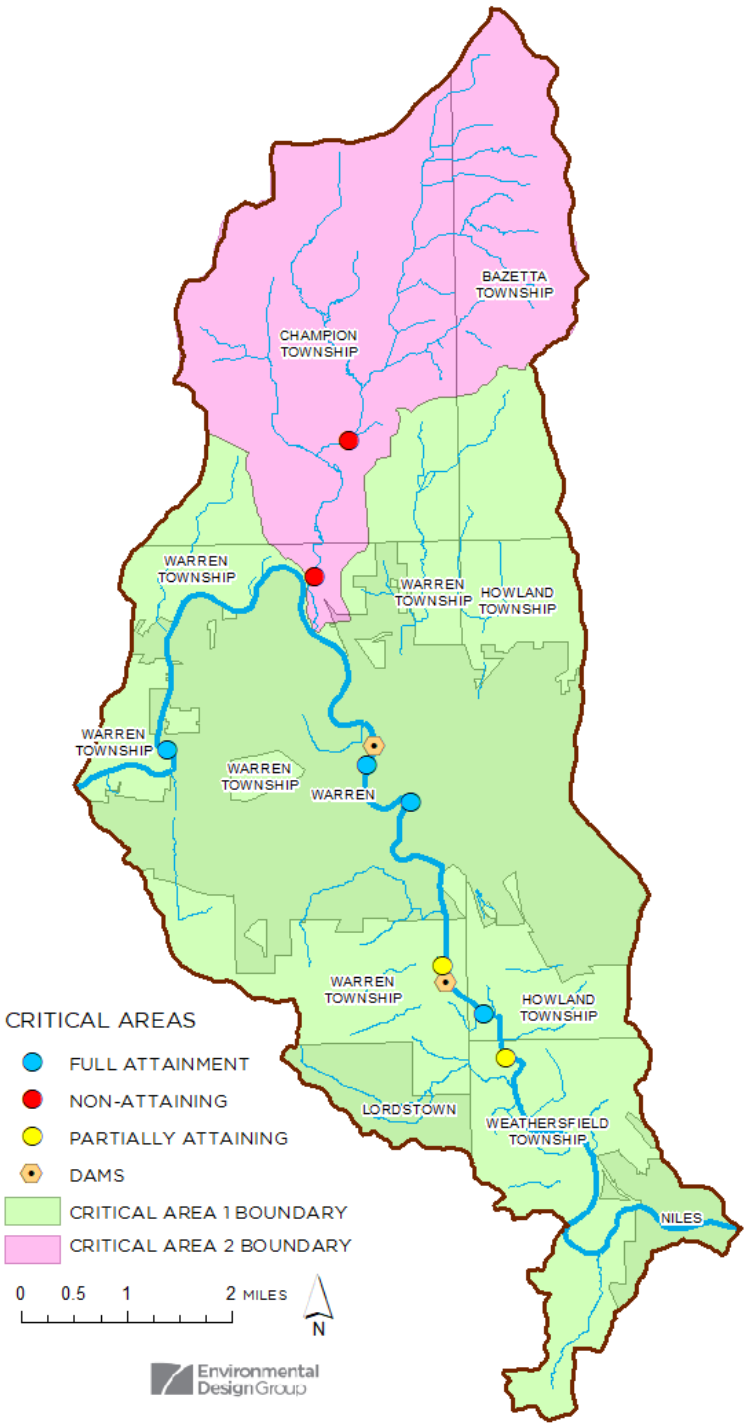
Chapter 3: Critical Area Conditions & Restoration Strategies

3.1 Overview of Critical Areas

Effective application of nonpoint source best management practices requires that these measures are properly planned, sited, and sized for implementation. An important aspect of the planning process is the identification of critical areas. Implementation of best management practices in critical areas is a key part of meeting targets set by NPS-IS plans or TMDLs, which ultimately lead to achieving water quality goals and objectives including the restoration and protection of degraded beneficial uses of waters of the US. Effective determination of critical areas supports targeted, cost-efficient implementation of practices and measures to meet water quality goals in the most efficient manner possible.

In the City of Warren HUC-12, two of the six sites sampled along the Mahoning River mainstem are in partial attainment and both of the two tributary sites sampled are in non-attainment. Two critical areas have been identified to address the primary nonpoint source pollution issues believed to be causing the impaired states of these reaches.

- Critical Area 1: Mahoning River (downstream of Leavittsburg Dam to upstream of confluence with Mosquito Creek)
- Critical Area 2: Unnamed Tributary to the Mahoning River at RM 40.89



3.2 Critical Area 1: Conditions, Goals & Objectives

3.2.1 Detailed Characterization

This critical area includes the Mahoning River mainstem and its direct tributary drainage in the HUC-12 from downstream of the Leavittsburg Dam to upstream of its confluence with Mosquito Creek, except for the drainage area of the Unnamed Tributary to the Mahoning River at RM 40.89, which includes Youngs Run.

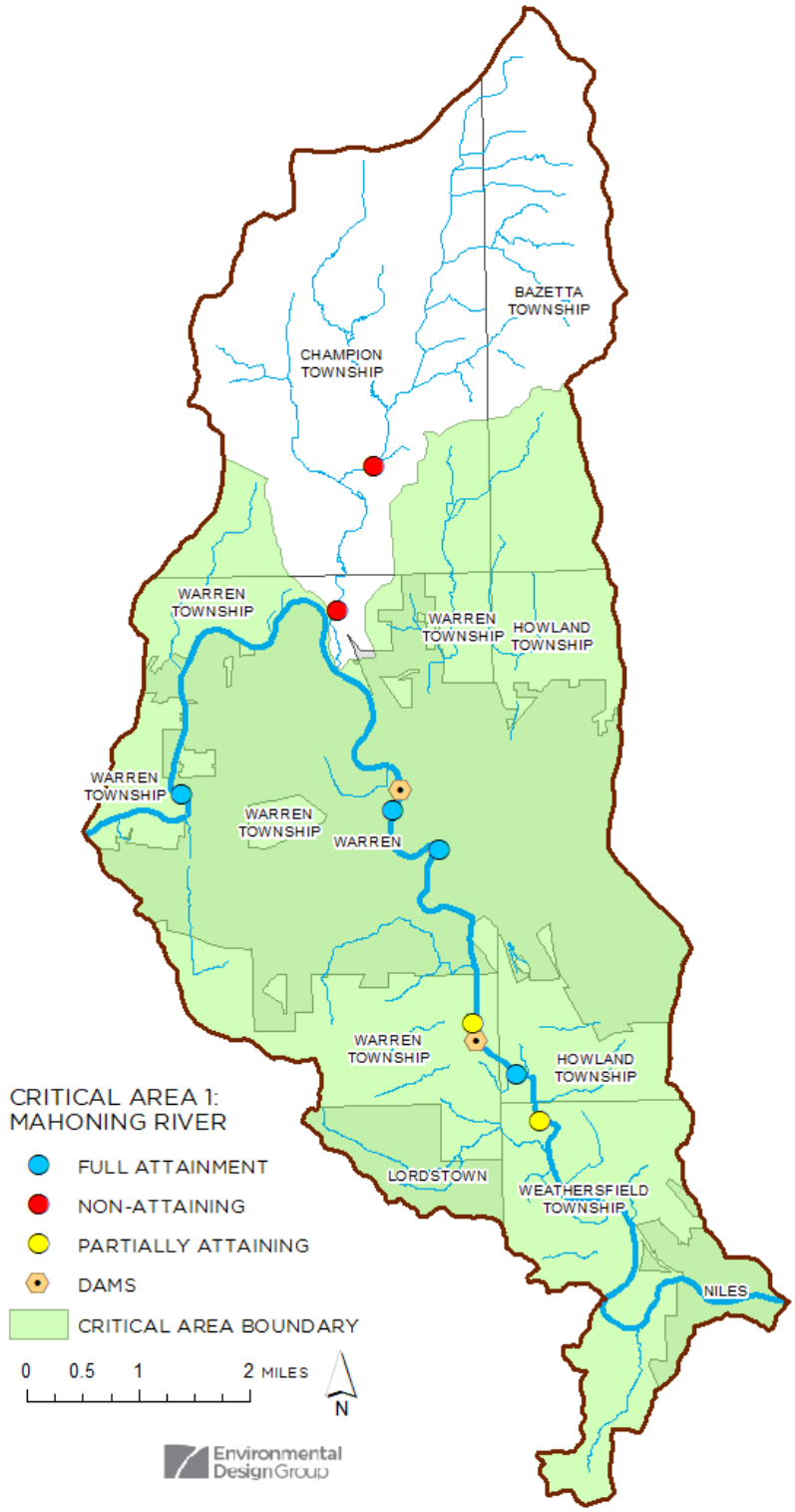
Land Use	Acres	% of Critical Area
Residential	4711.0	28.3%
Vacant	3130.8	18.8%
Industrial	2492.4	15.0%
Agriculture	2357.2	14.2%
Government or Public	1844.1	11.1%
Commercial	1285.7	7.7%
Rail	417.7	2.5%
Water	236.6	1.4%
NoData	169.3	1.0%

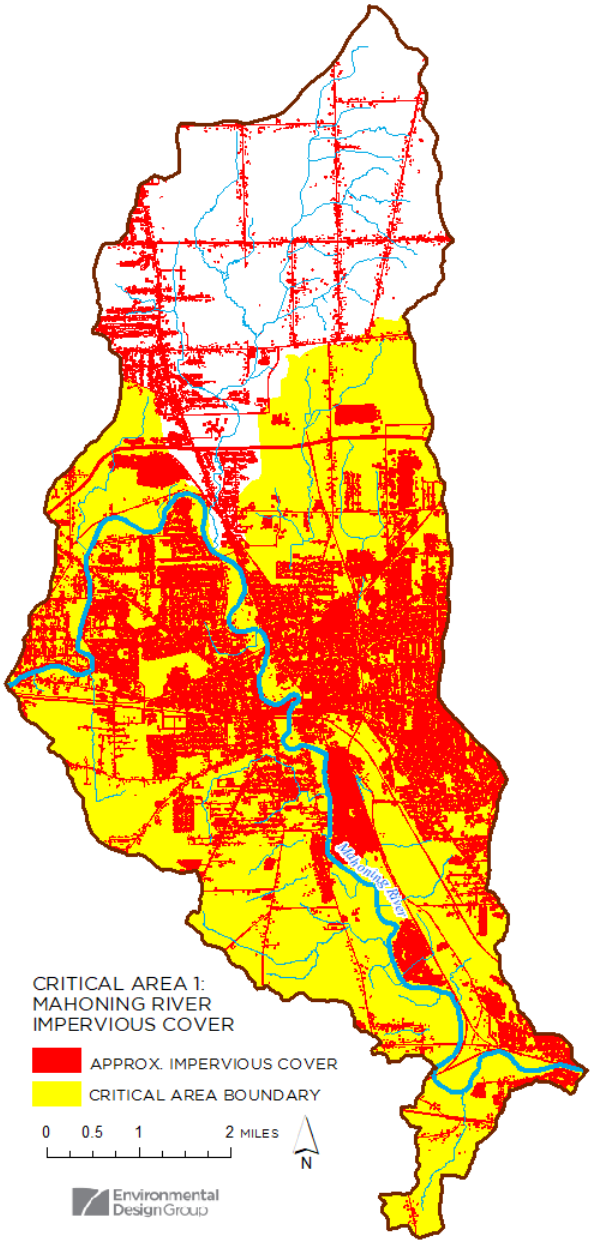
This critical area encompasses the locations in the City of Warren HUC-12 that are the most heavily degraded from legacy industrial use and urbanization in the HUC-12, such as industrial/urban runoff, impervious cover, and dams and impoundments. This critical area contains the most heavily urbanized land and the highest percentages of impervious cover in the watershed, as well as two low-head dams on the Mahoning River mainstem, the Summit Street Dam (Warren Water Works Dam) and the ArcelorMittal Dam (S. Main Street or Republic Steel Warren Works Dam). Most of the tributaries in this critical area have been culverted or ditched to accommodate urban land use.

All 15.12 miles of the Mahoning River mainstem and approximately 30.1 miles of unnamed tributaries in the HUC-12 flow through this critical area. Over half (8 miles) of the Mahoning River in this reach flows through the City of Warren, which is the most densely urbanized community and has the highest concentration of impervious cover in the HUC-12. There are also several legacy industrial or active industrial sites, totaling approximately 914 acres along 4.8 miles of the mainstem of the Mahoning River in the critical area. Fifteen percent of the critical area is classified as industrial land use, which represents 97% of the classified industrial land use in the entire HUC-12.

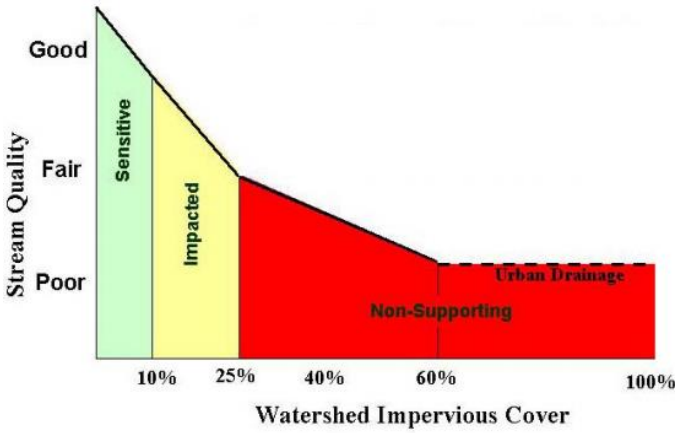
Improving water quality in Critical Area 1 must take into account both the flow alteration issues from dams as well as mitigating nonpoint source contaminants carried off the surrounding urbanized and industrialized land uses by increased stormwater runoff. Critical Area 1 priorities are dams and managing impervious runoff from urbanized non-CSO areas, with additional considerations for riparian corridor protection and restoration that may become a larger priority once these top priorities are addressed.

The critical area contains two low-head dams, the Summit Street Dam and the ArcelorMittal Dam, on the mainstem of the Mahoning River. These dams have been previously characterized in Chapter 2 of this NPS-IS plan. The Summit Street Dam impounds approximately 2.5 miles of stream, while the ArcelorMittal Dam impounds one mile of stream. Both dams have been identified as major contributors to low IBI/ICI scores in the Mahoning River mainstem and serve as literal barriers to water quality in the critical area. In the impounded pool areas, the Mahoning River widens and deepens, typically increasing in width by 10-20 percent while reaching depths of 8-12 feet (USACE, 2006). The Summit Street Dam has one of the largest slack-water pools due to its height. These dams are part of a series of low-head dams located along the Mahoning River mainstem that have been targeted for removal by Eastgate and nearby communities to restore free-flowing conditions, improve water quality, and alleviate flooding in this reach. The dams are responsible for a combined 3.6 miles of backwater flow conditions along the Mahoning River in this critical area.





Aquatic communities have been demonstrated to show water quality and habitat impairments when their drainage area exceeds 10% impervious cover (Schueler, 1994). Based upon impervious cover estimates, Critical Area 1 exceeds this threshold for stream vulnerability with an estimated impervious cover of 20.6%, well within the "impacted" range for first, second, and third order streams. Increased stormwater runoff causes increased peak flows, flow variability, and frequency of high flows. These flow alterations result in excessive sediment transport, urban/industrial runoff pollution, and low habitat diversity, which are noted impairments in this part of the HUC-12. While this critical area is under NPDES Phase II requirements, most of the impervious surface in the critical area was in place prior to post-construction stormwater regulation and retrofitting green infrastructure in non-CSO areas should be prioritized where feasible.



There are approximately 45.22 stream miles in the critical area (15.12 miles of the Mahoning River mainstem and 30.1 miles of tributary stream). While dam removal and impervious surface reduction should be prioritized in this critical area, there are also opportunities for riparian corridor protection and restoration that would provide water quality benefits. Seven communities in this critical area (Bazetta Township, Champion Township, Warren Township, Weathersfield Township, the Village of Lordstown, the City of Niles, and the City of Warren) do not have comprehensive local riparian setback legislation. The unincorporated areas generally follow the Trumbull County regulations which do provide for riparian setbacks in their subdivision code, but only Howland Township currently has comprehensive local riparian setbacks in place. If the remaining communities adopted similar riparian setback legislation, that would be an additional 40.8 stream miles protected under local comprehensive setback legislation. Restoration and revegetation of the remaining riparian corridors would also help reduce excess sediment and nutrient pollution in the critical area.

3.2.2 Detailed Biological Conditions

OEPA sampling points along the mainstem of the Mahoning River in this critical area indicate a recovering but stressed fish community, with in-stream habitat primarily affected by stagnant dam backwater conditions. The only recent sampling location taken in a dam pool (RM 36.2, upstream from the ArcelorMittal Dam) had one of the lowest comparative fish scores. While the IBI was a 41 (Good), the sampling showed low numerical abundance and disproportionately skewed biomass that scored a MIwb of 7.7 (Fair). The dam pool site at RM 36.2 also exhibited the lowest total number of species, with only 14 species found while the rest of the sites ranged from 21-27 species found. Predominant species in the samples included northern hogsucker, smallmouth bass, silver redhorse, spotfin shiner, rock bass, river chub, golden redhorse, and common carp, mainly considered pollution tolerant or moderately tolerant species. The other low fish score was at the RM 35.03 sampling site (downstream of the Warren WWTP) which was rated in partial attainment of WWH use and had a Good MIwb of 8.4 but a Fair IBI of 35. Carp populations remained unchanged in sampled dam pool locations between 1994 and 2013, indicating no major improvement in species quality in dam pools and backwaters, while fish species quality did improve overall in the free-flowing reaches.

Current macroinvertebrate scores in the critical area are all attaining WWH use. Legacy toxicity from steel mill discharges combined with improperly treated sanitary waste resulted in low macroinvertebrate scores from the previous round of sampling in 1994, but 2013 sampling shows a significant amount of recovery has taken place nearly 20 years later. Exceptional communities were recorded at several sampling locations in the critical area at RM 44.3, RM 39.1, RM 39.07 (not sampled for fish/QHEI) and RM 35.63. However, where impaired communities were found they were impacted primarily by dam impoundments, low-gradient stream conditions, urban runoff and municipal point-source discharges (OEPA, 2018a). The highest scoring ICI sites at RM 44.3, RM 39.1, RM 39.07, and RM 35.63 all noted diverse EPT taxa. The lowest ICI score of 38 at RM 35.03 downstream of the Warren WWTP is still in the Good range, despite noting that the reach is entirely run habitat (no pools/riffles) with chunks of asphalt serving as larger substrates. The second-lowest score of 44 was recorded at RM 38.26 (Mahoning River at Warren @ West Market Street), which is fully-attaining WWH but is a silt-laden reach with a CSO just upstream of the sampling area. It is important to note that all of the recent macroinvertebrate sample locations were taken in free-flow reaches of the critical area, not in dam pool areas, and that recent ICI scores from dam pool areas both immediately upstream of the critical area at Leavittsburg (in the Chocolate Run HUC-12) and downstream of the critical area at Liberty Street (in the Little Squaw Creek-Mahoning River HUC-12) do not meet WWH criteria. Should macroinvertebrate sampling be done in the pool and backwater locations in this critical area, one may assume that the scores would be similarly low.

The QHEI score of 49.5 at RM 36.2 in the dam pool of the ArcelorMittal Dam is the only score from the 2013 round of sampling below WWH expectations for habitat. All other sites sampled in 2013 in the critical area scored well for habitat, with QHEI scores ranging from 68.5 to 72.5. The RM 36.2 site has the least total amount of WWH attributes, the only noted high-influence MWH attribute, and the highest number of moderate-influence MWH attributes. The modified MWH attributes (heavy/moderate silt cover, sand substrates, fair/poor development, low sinuosity, no fast current, high/moderate embeddedness, and absence of riffles) are all associated with the low-flow conditions of dam pool and backwater areas. It is also worth noting that even the high-scoring QHEI sites all exhibit at least 3 moderate-influence MWH attributes, with the most common being heavy/moderate silt cover (4/5 sites) and high/moderate overall embeddedness (all sites monitored in the critical area had this attribute). Habitat subcomponent scores in the critical area are mainly affected by the presence or absence of free-flow conditions related to dams, and siltation/sedimentation resulting from surrounding urban and industrial runoff. Sampling conducted in 1994 at the dam pool upstream of the Summit Street Dam also shows non-attainment with a QHEI of 46.5, as opposed to the high QHEI scores found in the free-flow reaches.

No sites assessed in the critical area were attaining PCR Class A Recreation Use and all sampled reaches are listed as impaired for bacteria in the 2004 TMDL. Sediment from the critical area was also analyzed in 2013 for semi-volatile organic constituents (BNAs and PAHs), polychlorinated biphenyls (PCBs) and metals, including mercury. Starting at RM 38.26 sampling station in the critical area, values above the probable effect concentration (PEC), a level at which harmful effects are likely to be observed, were noted for chromium, lead, nickel and zinc, and remained elevated downstream with a spike in chromium and copper at RM 36.2 directly upstream of the ArcelorMittal Dam.

3.2.3 Detailed Causes and Associated Sources

Causes of impairment in the critical area along the Mahoning River mainstem (assessed as the LRAU) are flow regime alterations, sedimentation/siltation, direct habitat alterations, and organic enrichment (sewage). Sources of impairment in the critical area are listed as dams or impoundments, municipal point source discharges, upstream pollution sources, and combined sewer overflows. The major sources of E. coli loading in this critical area are listed as urban runoff, WWTP bypasses, natural sources (waterfowl) and illicit sewage discharges (SSOs/CSOs) (OEPA, 2018a).

Stream reaches within this urbanized critical area are vulnerable to contaminated runoff during precipitation events. The history of industrial use in the lower Mahoning River has left a legacy of contaminated sediments behind, particularly upstream of low-head dams where they settle out and concentrate in the low-energy pools and backwaters. The 2018 TSD attributes this pollution to deposition of these chemicals via stormwater runoff from surrounding urban/industrial uses.

Fish community health in the critical area is correlated to presence/absence of altered flow conditions. The best MIwb fish community scores in the critical area are where free-flow conditions were present and a depressed MIwb score was noted in dam pool conditions at RM 36.2 upstream of the ArcelorMittal Dam. Highly altered flow regimes from the presence of the Summit Street and ArcelorMittal Dams continues to impact the fish community in the critical area as well as polluted conditions from CSOs and urban runoff. Macroinvertebrate community quality is also strongly correlated to free-flow conditions; exceptional communities are still present in the RM 35.63 sampling location downstream of the ArcelorMittal dam in a free-flow reach despite sub-optimal substrate where asphalt chunks are a dominant part of the streambed.

In-stream habitat in the critical area is also degraded by the presence of two dams. The Summit Street Dam impounds approximately 2.5 miles of stream while the ArcelorMittal Dam impounds one mile. The dam pools collect silt and sediment and the assimilative capacity and aquatic diversity in this critical area will remain checked as long as it is dammed (OEPA, 2018a). The 2006 USACE Environmental Dredging Draft Feasibility Report also identified the presence of dams as the major barrier to improving overall water quality conditions in this critical area as well as the lower Mahoning in general. Habitat improvement in the critical area has been occurring since the closure of many of the steel mills and other industries but remains limited by the redundant dam pools (OEPA, 2018a). QHEI scores did not fluctuate dramatically between 1994 and 2013, indicating that "Good" quality habitat back in 1994 remained similar nearly 20 years later. The lowest QHEI score in the critical area is a 49.5 at the RM 36.2 sampling point in the ArcelorMittal Dam impoundment; the rest of the scores (taken in free-flow locations) ranged from 68.5 to 72.5. The Lower Mahoning TSD states "habitat conditions in the Mahoning River watershed have appreciably improved through passive natural attenuation over the last 20 years, except in impounded locations" and recommends the removal of dams in this reach to restore assimilative capacity and improve water quality.

In this critical area, impairment is primarily caused from the presence of dams and impoundments and the effects of heavily urbanized/industrialized land use. Effective restoration of this critical area will require removal of the dams, riparian and stream restoration, measures like riparian setbacks to preserve existing

corridors, and improved management of urban/industrial stormwater runoff from surrounding drainage using impervious surface reduction and green infrastructure.

3.2.4 Goals and Objectives for Critical Area 1

Goals

The overall nonpoint source restoration goals for the NPS-IS plan is to improve IBI, MIwb, ICI, and QHEI scores so that partial or non-attainment status can achieve full attainment of the designated aquatic life use. Specific goals referencing the non-attaining assessment points are outlined below. Goal criteria are based on the biological criteria found in Ohio Administrative Code 3745-1-07, *Beneficial use designations and biological criteria* (effective 2/6/2017).

Goal 1: Achieve IBI score of 40 at the Mahoning River at LTV Warren, Near Substation (RM 36.2) sampling site.
ACHIEVED: Site currently has an IBI score of 41.

Goal 2: Achieve MIwb score of 8.7 at the Mahoning River at LTV Warren, Near Substation (RM 36.2) sampling site.
NOT ACHIEVED: Site currently has a MIwb score of 7.70.

Goal 3: Achieve QHEI score of 55 at the Mahoning River at LTV Warren, Near Substation (RM 36.2) sampling site.
NOT ACHIEVED: Site currently has a QHEI score of 49.5.

Goal 4: Achieve IBI score of 40 at the Mahoning River downstream Warren WWTP (RM 35.03) sampling site.
NOT ACHIEVED: Site currently has an IBI score of 35.

Goal 5: Achieve MIwb score of 8.7 at the Mahoning River downstream Warren WWTP (RM 35.03) sampling site.
NOT ACHIEVED: Site currently has a MIwb score of 8.45.

Goal 6: Achieve ICI score of 34 at the Mahoning River downstream Warren WWTP (RM 35.03) sampling site.
ACHIEVED: Site currently has an ICI score of 38.

Goal 7: Achieve QHEI score of 40 at the Mahoning River downstream Warren WWTP (RM 35.03) sampling site.
NOT ACHIEVED: Site currently has an IBI score of 35.

Goal 8: Achieve IBI score of 40 at Packard Park upstream Summit Dam (RM 39.4) sampling site.*
NOT ACHIEVED: Site currently has an IBI score of 25.
**sampling data from 1994 dataset; 2013 sampling did not sample at this location.*

Goal 9: Achieve MIwb score of 8.7 at Packard Park upstream Summit Dam (RM 39.4) sampling site.*
NOT ACHIEVED: Site currently has a MIwb score of 7.2.
**sampling data from 1994 dataset; 2013 sampling did not sample at this location.*

Goal 10: Achieve QHEI score of 55 at Packard Park upstream Summit Dam (RM 39.4) sampling site.*
NOT ACHIEVED: Site currently has a QHEI score of 46.5.
**sampling data from 1994 dataset; 2013 sampling did not sample at this location.*

Objectives

In order to achieve the overall nonpoint source restoration goal of restoring full attainment to the City of Warren HUC-12, the following objectives need to be achieved within Critical Area 1.

Objective 1: Restore natural free-flow conditions in the Mahoning River

- Remove two (2) dams, the Summit Street Dam and ArcelorMittal Dam

Objective 2: Reduce urban runoff

- Manage 500 acres of impervious surface within the non-CSO critical area using impervious surface reduction and/or retrofitting of green infrastructure practices

Objective 3: Protect and maintain riparian corridors

- Protect and maintain 40.8 stream miles through adoption of comprehensive riparian setback regulations in seven (7) communities within the critical area: Bazetta Township, Champion Township, Warren Township, Weathersfield Township, the Village of Lordstown, the City of Niles, and the City of Warren

Objective 4: Establish forested riparian buffer along impacted or barren stretches of stream

- Reestablish 400 acres of forested riparian buffer within the critical area

Objective 5: Restore rivers and streams in the critical area using natural channel design features and principles

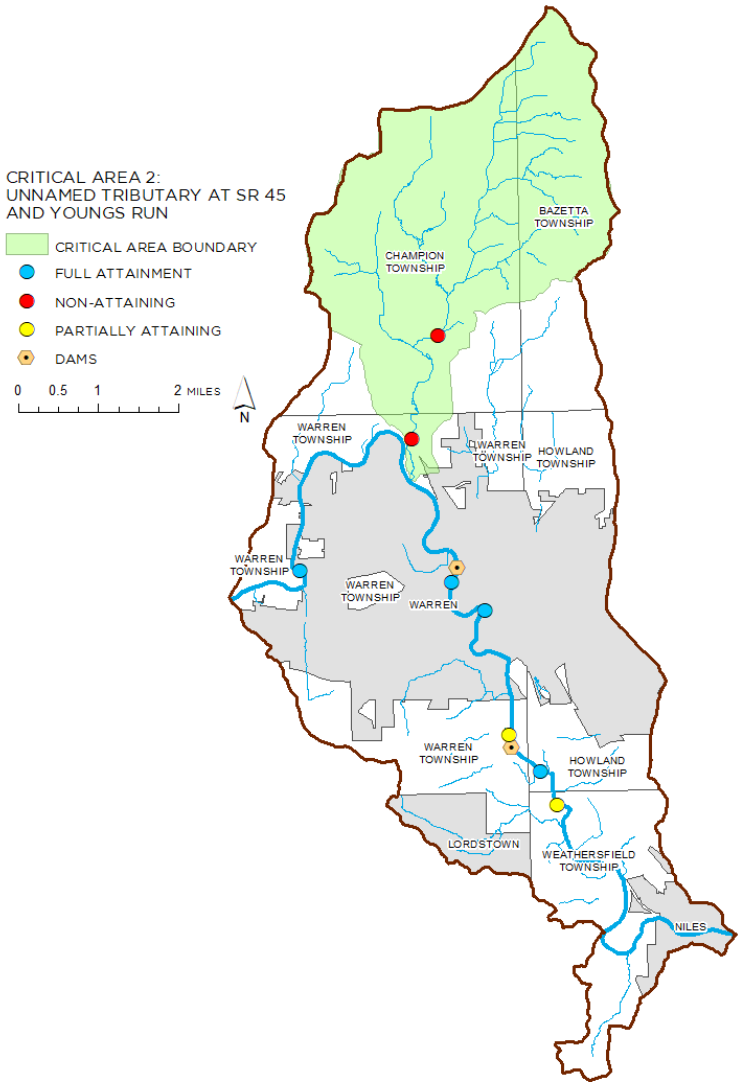
- Restore 2,000 linear feet of stream within the critical area

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 towards meeting the goals (i.e., water quality standards). Through an adaptive management process, the aforementioned objectives will be reevaluated and modified as necessary. Objectives may be added to make further progress towards attainment goals, or altered, as a systems approach of multiple best management practices (BMPs) can accelerate the improvement of water quality conditions. The OEPA Nonpoint Source Management Plan Update (OEPA, 2013) 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

3.3.1 Detailed Characterization



This critical area consists of the drainage of the Unnamed Tributary to the Mahoning River at RM 40.89, including Youngs Run which has its confluence at RM 2.28 of the unnamed tributary. It drains approximately 11.3 square miles and contains approximately 40.4 stream miles. The land use in this critical area is more suburban/rural than the rest of the HUC-12, with a land use distribution of over 47% agricultural and 35% residential based on Eastgate's land use dataset. The critical area is mainly within Champion Township and Bazetta Township; only a small portion of the critical area at the confluence with the Mahoning River is in Warren Township and the City of Warren. Priorities in this critical area are addressing stream modification and wetland loss from agricultural channelization and suburban development, and bacterial and nutrient pollution from HSTS.

Land Use	Acres	% of Critical Area
Agriculture	3255.5	47.5%
Residential	2420.9	35.3%
Government or Public	434.5	6.3%
Vacant	323.1	4.7%
Commercial	319.7	4.7%
Industrial	85.9	1.3%
NoData	7.4	0.1%
Rail	7.0	0.1%

Land cover data from the 2011 National Land Cover Dataset shows a breakdown of 30% agricultural (cultivated crops and hay/pasture) and 30% developed (low, medium, and high intensity and developed open space). Using the NLCD land cover data, it is estimated that approximately 11.8 stream miles (29%) in the critical area are lacking forested or shrub riparian cover. National Wetland Inventory Data estimates approximately 435.6 acres of emergent, forested, or shrub/scrub wetland in the critical area, mainly in the headwater streams and tributaries in Champion and Bazetta Townships. Septic data from Eastgate estimates approximately 197 HSTS in the critical area, nearly all in the rural/sub-rural northern areas of the subwatershed in Champion Township and Bazetta Township.

Notable features in this critical area include Kent State University's Trumbull campus and Trumbull County Career and Technical Center, Cranberry Hills and Northwood golf courses, and Champion High School. The densest development in the critical area is concentrated along State Route 45 in the Champion Heights area of Champion Township, and while suburban development does exist throughout the critical area, it has an estimated impervious cover of only 6.2%, a significant difference from the estimated impervious cover of Critical Area 1.

3.3.2 Detailed Biological Conditions

Monitoring was performed by OEPA at two locations in the critical area in 2013; neither of these locations were considered in attainment of their designated WWH aquatic life use. Sampling data indicates a stressed fish community, with scores of 14 at the Youngs Run site and 16 at the Unnamed Tributary site. Fish compositions at these locations were primarily composed of creek chub, which reflects a transient fish population that lacks competition from longer-lived, larger carnivorous game fish. The Youngs Run site was specifically noted to have populations of pollution tolerant species such as grass pickerel, central mudminnows, and pumpkinseed sunfish.

Macroinvertebrate data at the two sampling locations also indicates stressed populations. Both sites have a narrative evaluation of Fair, which is non-attaining of WWH use. The Youngs Run site had only a moderate to low density of organisms with only 55 taxa collected, only 3 of which are considered pollution sensitive species. The Unnamed Tributary site had an even lower organism density with only 44 taxa collected, 2 of which were considered pollution sensitive. Midges and amphipods were the predominant species at these sites, with blackflies also dominating at the Youngs Run site. The assemblages noted are often found in areas with high levels of nutrient/organic enrichment, and poor mayfly populations have been linked to the presence of high conductivity, an indicator of salt contamination.

Stream habitat quality in the sampling locations ranged from Good (Youngs Run) to Excellent (Unnamed Tributary); however, examination of the sub-metrics have one high-influence and seven moderate-influence MWH attributes at the Youngs Run site and two moderate-influence MWH attributes at the Unnamed Tributary site. These attributes included embeddedness, recovering channel, fair to poor development, heavy to moderate silt cover, and lack of good riffle/pool structure. Both critical area sites sampled also exhibited no fast current and had low-gradient conditions conducive to settling out excess sediment. A large in-line pond upstream of the RM 0.6 location at Kent State University's Trumbull campus may be adversely affecting flow conditions and sediment transport.

3.3.3 Detailed Causes and Associated Sources

Sampling locations in this critical area are noted in the 2018 Integrated Assessment Report as impaired, with causes listed as specific conductance (salinity) and organic enrichment (sewage) and sources listed as septic systems and other decentralized systems, illicit connections to storm sewers, and sewage discharges in unsewered areas. In addition, the 2018 Lower Mahoning TSD notes that habitat conditions in small tributaries to the Mahoning River, such as those in the critical area, are consistently degraded by channel modification, impoundment or poor construction site sediment control. Agricultural activities (including channelization) in the critical area as well as channelization from other sources are lowering habitat quality and fish community integrity and contributing excessive sediment and nutrients to the critical area. The QHEI sub-metrics and fish/macroinvertebrate data from the sampling sites in the critical area reinforce these observations, with populations indicative of nutrient and organic-rich, high-sediment environments, and a physical habitat reflecting embeddedness, recovering channels with fair to poor development, and heavy to moderate silt cover.

Effective restoration of this critical area will require riparian, stream, and wetland restoration, improved management of agricultural runoff, and repair or elimination of failing home septic treatment systems.

3.3.4 Goals and Objectives for Critical Area 2

Goals

The overall nonpoint source restoration goals for the NPS-IS plan is to improve IBI, MIwb, ICI, and QHEI scores so that partial or non-attainment status can achieve full attainment of the designated aquatic life use. Specific goals referencing the non-attaining assessment points are outlined here. Goal criteria are based on the biological criteria found in Ohio Administrative Code 3745-1-07, *Beneficial use designations and biological criteria (effective 2/6/2017)*.

Goal 1: Achieve IBI score of 40 at the Youngs Run (Mahoning R. 40.89/2.28) @ End of Schafer Road sampling site.
NOT ACHIEVED: Site currently has an IBI score of 30.

Goal 2: Achieve macroinvertebrate narrative of Good at Youngs Run (Mahoning R. 40.89/2.28) @ End of Schafer Road) sampling site.
NOT ACHIEVED: Site currently has a macroinvertebrate narrative of Fair.

Goal 3: Achieve QHEI score of 55 at Youngs Run (Mahoning R. 40.89/2.28) @ End of Schafer Road sampling site.
ACHIEVED: Site currently has a QHEI score of 56.5.

Goal 4: Achieve IBI score of 40 at the Unnamed Tributary to Mahoning R. (39.16/40.89) @ SR 45 sampling site.
NOT ACHIEVED: Site currently has an IBI score of 32.

Goal 5: Achieve macroinvertebrate narrative of Good at Unnamed Tributary to Mahoning R. (39.16/40.89) @ SR 45 sampling site.
NOT ACHIEVED: Site currently has a macroinvertebrate narrative of Fair.

Goal 6: Achieve QHEI score of 55 at the Unnamed Tributary to Mahoning R. (39.16/40.89) @ SR 45 sampling site.
ACHIEVED: Site currently has a QHEI score of 74.5.

Objectives

In order to achieve the overall nonpoint source restoration goal of restoring full attainment to the City of Warren HUC-12, the following objectives need to be achieved within Critical Area 2. It should also be noted that achievement of the objectives described for Critical Area 2 should also assist with improvement downstream in Critical Area 1.

Objective 1: Protect, restore or create wetland habitat

- Protect, restore or create 50 acres of wetland habitat within the critical area

Objective 2: Reduce bacterial loading to streams

- Ensure full compliance of 197 HSTS in the critical area

Objective 3: Restore channelized streams using natural channel design features and principles

- Restore 2,500 linear feet of stream within the critical area

Objective 4: Establish forested riparian buffer along impacted or barren stretches of stream

- Reestablish 100 acres of forested riparian buffer within the critical area

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 towards meeting the goals (i.e., water quality standards). Through an adaptive management process, the aforementioned objectives will be

reevaluated and modified as necessary. Objectives may be added to make further progress towards attainment goals, or altered, as a systems approach of multiple best management practices (BMPs) can accelerate the improvement of water quality conditions. The OEPA Nonpoint Source Management Plan Update (OEPA, 2013) 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

4.1 Projects and Implementation Strategy Overview Table

Below are the projects and evaluation needs currently believed to be necessary to remove the impairments to the City of Warren-Mahoning River HUC-12 as a result of the identified causes and associated sources of nonpoint source pollution. Because the attainment status is based on biological conditions, it will be necessary to periodically re-evaluate the status of the critical area to determine if the implemented projects are sufficient to achieve restoration. Time is an important factor to consider when measuring project success and overall status. Biological systems in some cases can show response fairly quickly (months); others may take longer (years) to show recovery. There may also be reasons other than nonpoint source pollution for the impairment. Those issues will need to be addressed under different initiatives, authorities or programs which may or may not be accomplished by the same implementers addressing the nonpoint source pollution issues.

For City of Warren-Mahoning River HUC-12 (05030103-06-03)								
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								
1	All	2	3	Stormwater Retrofits in City of Warren	City of Warren	Long Term	$150,000 to $200,000 per project	Ohio EPA 319, local funds
Altered Stream and Habitat Restoration Strategies								
1	8, 9, 10	1, 5	1	Summit Street Dam Removal	City of Warren	Short Term	$3 million	WRRSP, Ohio EPA 319, local funds
1	1, 2, 3	1, 5	2	ArcelorMittal Dam Removal	Warren Township	Medium Term	$3 million	WRRSP, Ohio EPA 319, local funds
2	4, 5, 6	1, 3, 4	4	Dam Modification and Stream Restoration at KSU Trumbull Campus	Kent State University	Long Term	$500,000	WRRSP, Ohio EPA 319, local funds
Agricultural Nonpoint Source Reduction Strategies								
High Quality Waters Protection Strategies								
Other NPS Causes and Associated Sources of Impairment								
2	4, 5, 6	2	5	HSTS Repair and Replacement	Trumbull County Health Department	Long Term	Gravity-fed drainfields: $5,000 to $10,000 Mounds: $10,000 to $50,000	Ohio Water Pollution Control Loan Fund, local funds

4.2 Project Summary Sheet(s)

Nine Element Criteria	Information needed	Explanation
n/a	*Title*	Project 1: Summit Street Dam Removal
criteria d	*Project Lead Organization & Partners*	City of Warren, Eastgate COG, Habosky-Davidson Enterprises
criteria c	*HUC-12 and Critical Area*	City of Warren-Mahoning River HUC-12 (05030103-06-03), Critical Area 1
criteria c	*Location of Project*	41.2439931, -80.8271622 in City of Warren, Trumbull County
n/a	*Which strategy is being addressed by this project?*	Altered Stream and Habitat Restoration Strategy
criteria f	*Time Frame*	Short Term (1-3 Years)
criteria g	*Short Description*	Sediment dredging and removal of the Summit Street Dam, a lowhead dam on the mainstem of the Mahoning River, to restore natural flow to nearly 2.5 miles of impaired dam pool and backwater in the City of Warren HUC-12.
criteria g	*Project Narrative*	The project proposes dredging of sediment and removal of the Summit Street Dam, also known as the Warren Water Works Dam. The dam is located in the City of Warren at 41.2439931, -80.8271622, downstream of Packard Park and adjacent to Mahoningside Park. The dam is primarily owned by the City of Warren with some of the eastern structure and abutment owned by Habosky-Davidson Enterprises. The dam is a V-shape concrete structure with a sloped concrete weir. The east abutment has a concrete weir wall, and the west end of the dam includes a large concrete abutment. Immediately upstream from the west abutment is an opening for a spillway, which passes by the dam and continues downstream. The spillway is constructed of concrete walls with upper and lower concrete gates. The upper gates appear to still have some remaining machinery and geared metal wheels. On top of the wall of the spillway there is a one-story brick structure, and a wall extending along the riverbank from the north end of the spillway forms the east wall of a large concrete basin that sits to the north of the brick structure. Additional small concrete basins sit to the west of the dam. The reach impaired by the Summit Street Dam backwater was sampled in 1994 by Ohio EPA at RM 39.4 and found to be in non-attainment of WWH use with IBI, MIwb, and QHEI scores were all below attainment criteria. ICI was not sampled in this location; however, based on below-attaining ICI scores from similar dam pool locations at the Leavittsburg Dam upstream and Liberty Street Dam downstream of the critical area, it can be assumed that ICI scores would be similarly low and non-attaining in this location as well. In the impounded pool areas, the Mahoning River widens and deepens, typically increasing in width by 10-20 percent while reaching depths of 8-12 feet, and the Summit Street Dam has one of the largest slack-water pools due to its height. The 2018 Lower Mahoning TSD states “habitat conditions in the Mahoning River watershed have appreciably improved through passive natural attenuation over the last 20 years, except in impounded locations” and recommends the removal of dams in this reach to restore assimilative capacity and improve water quality. The City of Warren will be the project lead, with Eastgate COG and Habosky-Davidson as project partners. Sediment behind the dam will be dredged and the dam structure will be

		removed to restore free-flowing conditions. Removal of the accumulated sediment and restoration of free-flowing conditions will encourage natural redistribution and deposition of more varied bed material which will improve benthic conditions and provide significant habitat improvement for macroinvertebrate and fish populations. Adjacent riparian corridor restoration will be completed at the City of Warren's Mahoningside Park. The restoration project area will primarily remain under City of Warren ownership as part of the adjacent Mahoningside Park and will have an environmental covenant placed on it to protect the restoration in perpetuity.
criteria d	*Estimated Total cost*	$3,000,000 estimated for property costs, title search, legal fees, permitting, planning and design, sediment and dam removal, dewatering, disposal, sediment sampling and testing, bank stabilization and restoration, construction administration and inspection.
criteria d	*Possible Funding Source*	Water Resources Restoration Sponsorship program (WRRSP), Ohio EPA Section 319, local funds
criteria a	*Identified Causes and Sources*	Causes: Habitat, Flow Regime Alteration Sources: Dam or impoundment
criteria b&h	*Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?*	This project proposes to improve the IBI from 25 to 40 or greater, the MIwb from 7.2 to 8.7 or greater, and the QHEI from 46.5 to 55 or greater at RM 39.4. ICI was not sampled in the location impaired from the dam; however, based on non-attaining ICI scores from similar dam pool locations at the Leavittsburg Dam upstream and Liberty Street Dam downstream of the critical area, it can be assumed that ICI scores are similarly low and completion of this project will also achieve an attaining ICI score of 34 or greater. This project addresses 100% of Goals 8, 9, and 10 in Critical Area 1.
	Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?	This project addresses 50% of Objective 1 in Critical Area 1 and is expected to restore the 2.5 miles of the Mahoning River mainstem impounded by the dam to full attainment of WWH use.
	Part 3: Load Reduced?	The project proposes to restore approximately 2.5 miles of in-stream habitat through elimination of a dam pool and backwater on the mainstem of the Mahoning River. Load reduction models such as STEP-L or Region 5 have difficulty estimating the water quality benefits from this type of project where impairments are from flow regime and habitat alteration. Guidance from Ohio EPA and US EPA has been requested as to how best to address these criteria.
criteria i	*How will the effectiveness of this project in addressing the NPS impairment be measured?*	If this project is funded through WRRSP or Section 319, Ohio EPA will perform IBI, MIwb, ICI, and QHEI monitoring pre- and post-implementation. Additional post-project monitoring may be performed depending on USACE permitting requirements for the dam removal and restoration.
criteria e	*Information and Education*	The project partners will share information about this project through their websites and presentations, including a presentation on the project at the Eastgate Council of Governments Annual Meeting. Eastgate will develop a project fact sheet to educate the public and interested parties about this restoration project. Eastgate will work with the City of Warren to host a tour of the completed project, and an educational sign will be posted to educate the public visiting the adjacent Mahoningside Park or using the Riverwalk Trail on the importance of dam removal to improving water quality in the Mahoning River.

Nine Element Criteria	Information needed	Explanation
n/a	*Title*	Project 2: ArcelorMittal Dam Removal
criteria d	*Project Lead Organization & Partners*	City of Warren, Eastgate COG, BDM Warren Steel Holdings, ISG Warren Inc.
criteria c	*HUC-12 and Critical Area*	City of Warren-Mahoning River HUC-12 (05030103-06-03), Critical Area 1
criteria c	*Location of Project*	41.212600, -80.8150164 in City of Warren, Trumbull County
n/a	*Which strategy is being addressed by this project?*	Altered Stream and Habitat Restoration Strategy
criteria f	*Time Frame*	Medium Term (3-7 Years)
criteria g	*Short Description*	Sediment dredging and removal of the ArcelorMittal Dam, a lowhead dam on the mainstem of the Mahoning River, to restore natural flow to 1 mile of impaired dam pool and backwater in the City of Warren HUC-12.
criteria g	*Project Narrative*	The project proposes dredging of sediment and removal of the ArcelorMittal low-head dam, also known as the South Main Street Dam or Republic Steel Warren Works Dam. The dam is located in the City of Warren on a bend in the Mahoning River at 41.212600, -80.8150164, and is an approximately 4.5 foot high straight concrete weir with some flashboards mounted on the top with metal pipes. Sections of the weir may also be composed of timber cribs. Concrete abutments are on either side of the dam, and a concrete sewer outflow pipe is located below the abutment and incorporated into the western portion of the dam. Current County auditor data indicates the dam is owned by BDM Warren Steel Holdings and ISG Warren Inc. It was constructed by Trumbull Steel in 1921, before Trumbull Steel was acquired by Republic Steel. The dam's original purpose was for water supply and it impounded water used by Republic Steel and WCI Steel. With the closure of the steel mills, the impoundment is no longer needed. It is one of a series of low-head dams that have been targeted for removal by Eastgate COG and nearby communities to restore free-flowing conditions, improve water quality, and alleviate flooding in this reach. Ohio EPA sampled upstream of the dam in 2013 and determined the reach was only in partial attainment, with the presence of the dam cited as the primary reason for impairment. The City of Warren will be the lead on the project, with Eastgate COG, BDM Warren Steel Holdings, and ISG Warren Inc. as project partners. Sediment behind the dam will be dredged and the dam structure will be removed to restore free-flowing conditions. Removal of the accumulated sediment and restoration of free-flowing conditions will encourage natural redistribution and deposition of more varied bed material which will improve benthic conditions and provide significant habitat improvement for macroinvertebrate and fish populations. The 2018 lower Mahoning TSD notes that the dam pools in the reach upstream of the Leavittsburg Dam to the ArcelorMittal Dam make it difficult to notice the river's dynamic change in size from a small creek-sized stream to a notable river. The natural gradient and flow should provide many unique habitat niches for aquatic organisms but cannot due to the presence of the dams. Instead, the dam pools collect silt and sediment and the assimilative capacity and aquatic diversity of the lower Mahoning will remain checked as long as it is dammed. The restoration project area will have an environmental covenant placed on it to protect the restoration in perpetuity.

criteria d	*Estimated Total cost*	$3,000,000 estimated for property costs, title search, legal fees, permitting, planning and design, sediment and dam removal, dewatering, disposal, sediment sampling and testing, bank stabilization and restoration, construction administration and inspection.
criteria d	*Possible Funding Source*	Water Resources Restoration Sponsorship program (WRRSP), Ohio EPA Section 319, local funds
criteria a	*Identified Causes and Sources*	Causes: Habitat, Flow Regime Alteration Sources: Dam or impoundment
criteria b&h	*Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?*	This project proposes to improve the MIwb from 7.7 to 8.7 or greater and the QHEI from 49.5 to 55 or greater at RM 36.2; and to maintain the currently attaining IBI at 41 or greater. ICI was not sampled in the location impaired from the dam; however, based on non-attaining ICI scores from similar dam pool locations at the Leavittsburg Dam upstream and Liberty Street Dam downstream of the critical area, it can be assumed that ICI scores are similarly low and completion of this project will also achieve an attaining ICI score of 34 or greater. This project addresses 100% of Goals 1, 2, and 3 in Critical Area 1.
	Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?	This project addresses 50% of Objective 1 in Critical Area 1 and is expected to restore the 1 mile of the Mahoning River mainstem impounded by the dam (represented by Goals 1, 2, and 3 at RM 36.2) to full attainment of WWH use.
	Part 3: Load Reduced?	The project proposes to restore approximately 1 mile of in-stream habitat through elimination of a dam pool and backwater on the mainstem of the Mahoning River. Load reduction models such as STEP-L or Region 5 have difficulty estimating the water quality benefits from this type of project where impairments are from flow regime and habitat alteration. Guidance from Ohio EPA and US EPA has been requested as to how best to address these criteria.
criteria i	*How will the effectiveness of this project in addressing the NPS impairment be measured?*	If this project is funded through WRRSP or Section 319, Ohio EPA will perform IBI, MIwb, ICI, and QHEI monitoring pre- and post-implementation. Additional post-project monitoring may be performed depending on USACE permitting requirements for the dam removal and restoration.
criteria e	*Information and Education*	The project partners will share information about this project through their two websites and presentations, including a presentation on the project at the Eastgate Council of Governments Annual Meeting. Eastgate will develop a project fact sheet to educate the public and interested parties about this restoration project.

Acronyms & Abbreviations

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

AOC	Area of Concern
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
CSO	Combined Sewer Overflow
DELT	Deformities, Eroded Fins, Lesions, and Tumors
EOLP	Erie-Ontario Lake Plain Ecoregion
EWH	Exceptional Warmwater Habitat
GIS	Geographical Information System
Hg	Mercury
HUC	Hydrologic Unit Code
IBI	Index of Biotic Integrity
ICI	Invertebrate Community Index
LRW	Limited Resource Water
Mg/l	Milligrams per Liter
MGD	Million Gallons per Day
MIwb	Modified Index of Well Being
MWH	Modified Warmwater Habitat
NPDES	National Pollutant Discharge Elimination System
ODA	Ohio Department of Agriculture
ODNR	Ohio Department of Natural Resources
ODH	Ohio Department of Health
OEPA	Ohio Environmental Protection Agency
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
QHEI	Qualitative Habitat Evaluation Index
RAP	Remedial Action Plan
SSO	Sanitary Sewer Overflow
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load Limits
TSD	Technical Support Document
µg/kg	Micrograms per Kilogram
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USPC	United States Policy Committee
VAP	Voluntary Action Program
WAP	Watershed Action Plan
WBP	Watershed Based Plan
WQS	Water Quality Standards (Ohio Administrative Code 3745-1)
WRAS	Watershed Restoration Action Strategy
WWH	Warmwater Habitat
WWTP	Wastewater Treatment Plant

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