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

West Fork Mill Creek – Mill Creek
HUC-12 (05090203 01 02)

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Acknowledgements

Many thanks to the invaluable contributions of time, effort, data analysis, and review by workgroup members and others including: Warren High of Christopher B. Burke Engineering, Brian Wamsley of Hamilton County Planning and Development Department, Adam Lehmann of the Hamilton County Soil and Water Conservation District, Mallory Martz of Duke Energy Corporation, Gabriela Waesch of Ohio*Kentucky*Indiana Regional Council of Governments, Chris Carr of the University of Cincinnati Department of Geology, Bruce Koehler of the Mill Creek Yacht Club, Michael Miller, UC Professor Emeritus, and Bruce Smith, Metropolitan Sewer District of Greater Cincinnati, Spencer Cox of Xavier University, and Alex Newberg of University of Cincinnati. All figures throughout this plan were produced by Mallory Martz, Madeline Mauer, Gabriela Waesch, or Spencer Cox.

Chapter 1: Introduction

The **West Fork Mill Creek – Mill Creek** HUC-12 (05090203 01 02) is located in Hamilton County to the adjacent southwest of the **East Fork Mill Creek – Mill Creek** HUC-12 (05090203 01 01) and west of **Sharon Creek – Mill Creek** HUC-12 (05090203 01 03). The West Fork Mill Creek converges with the Mill Creek mainstem at the southeastern boundary of the subwatershed as it flows into the **Congress Run – Mill Creek** HUC-12 (05090203 01 04). The **West Fork Mill Creek – Mill Creek** HUC-12 is 36.25 square miles in size and encompasses land uses including residential, commercial properties, industrial properties, and parks.

As State and Federal nonpoint source funding is now closely tied to strategic implementation-based planning that includes U.S. EPA's nine minimum elements of a watershed plan for impaired waters as they relate to each specific project or solution, the Mill Creek Alliance has collaborated with the Hamilton County Soil and Water Conservation District, Hamilton County Planning and Development, and Butler Soil and Water Conservation District to author this NPS-IS plan. Each of these organizations has a long history of collaboration and partnership with the groups and municipalities within the Mill Creek Watershed. This NPS-IS is the fourth of five such plans slated for development in the Mill Creek Watershed (05090203 01). The Sharon Creek – Mill Creek, Congress Run – Mill Creek, and East Fork Mill Creek – Mill Creek NPS-IS Plans were first approved by the implementing agency on February 24, 2017 October 27, 2017, and May 26, 2020 respectively.

1.1 Report Background

In light of the guidance from Ohio EPA regarding the development of watershed plans for single HUC-12s, this NPS-IS was created to guide the prioritization and implementation of nonpoint source pollution reduction strategies and projects in the **West Fork Mill Creek – Mill Creek** HUC-12. It complements two existing endorsed Watershed Action Plans [*Upper Mill Creek Watershed Management Plan* (December 2005), the *Lower Mill Creek Watershed Action Plan* (July 2014)], and the three NPS - IS Plans for *Sharon Creek – Mill Creek HUC-12 (05090203 01 03)* (October 31, 2023), Congress Run – Mill Creek HUC-12 (05090203 01 04) (October 27, 2017), and East Fork Mill Creek – Mill Creek HUC-12 (05090203 01 01) (May 26, 2020), which may all be found on the Mill Creek Alliance website.

According to the Ohio EPA 2016 Integrated Report, **West Fork – Mill Creek** HUC-12 is listed as an impaired watershed and demonstrates a clear need for targeted action to improve the health of streams and tributaries within the assessment unit**.** Other organizations and entities are charged with addressing additional issues that contribute to impairments in the **West Fork Mill Creek – Mill Creek** HUC-12 not addressed in this plan, such as ongoing efforts by Metropolitan Sewer District of Greater Cincinnati to reduce nutrient loads originating from combined and sanitary sewer overflows

1.2 Watershed Profile & History

The **West Fork Mill Creek – Mill Creek** HUC-12 is an assessment unit within the Mill Creek HUC-10 Watershed (05090203 01). The Mill Creek Watershed covers 166.2 square miles and encompasses thirty-seven political jurisdictions. The watershed is located in the Eastern Corn Belt Plains United States Environmental Protection Agency (USEPA)-designated Level III ecoregion. The Mill Creek mainstem flows 28.1 miles through southeastern Butler County and central Hamilton County to its confluence with the Ohio River. From its origin elevation of approximately 797' in Liberty Township, the stream falls an average of 11.8'/mile to an elevation of 466' at its confluence with the Ohio River in the City of Cincinnati. Within the **West Fork Mill Creek – Mill Creek** HUC-12**,** the elevation of the tributary falls from 981' at the top of the assessment unit to 570' at the bottom of the assessment unit at the confluence with the Mill Creek mainstem in the Village of Arlington Heights, Ohio.

The Mill Creek Basin lies in the Till Plains geological region of Ohio and flows through a broad, flat-bottomed pre-glacial valley surrounded by steep slopes (Schiefer, 2002). The major tributaries of the Mill Creek include East Fork Mill Creek, Sharon Creek, Beaver Run, Town Run, Congress Run, Cooper Creek, Amberley Creek, West Fork Mill Creek, Bloody Run, Ross Run, and West Fork Creek. These tributaries have an average gradient of 51.8 feet per mile as they flow down through the steep hillsides surrounding the Mill Creek Valley (Ellwood, 2005, p. 2).

The geology of the Mill Creek Basin includes shales and limestones of the Upper Ordovician series. The mainstem of the Mill Creek is underlain by 150 – 200 feet of buried valley deposits consisting of sand and gravel interbedded with till and clay (Schiefer, 2002). The tributaries are generally underlain by thinly inter-bedded shales and limestone bedrock, except for the lower reaches at their confluences with the Mill Creek (Ellwood, 2005). The sand and gravel deposits produce large quantities of groundwater for industrial and municipal use. The dry-weather flows of Mill Creek are low, which may be partly caused by extensive pumping of groundwater.

Soils in the Mill Creek basin mostly developed from thin Illinoian glacial till. The principal soils are the moderately deep Eden and the deep Pate, Switzerland, and Rossmoyne. These soils all have relatively low permeability. The soils of the valley are classified as Martinsville, Fox, and Genesee. They have good drainage and relatively high permeability, thus permitting recharge to groundwater bodies (Schiefer, 2002).

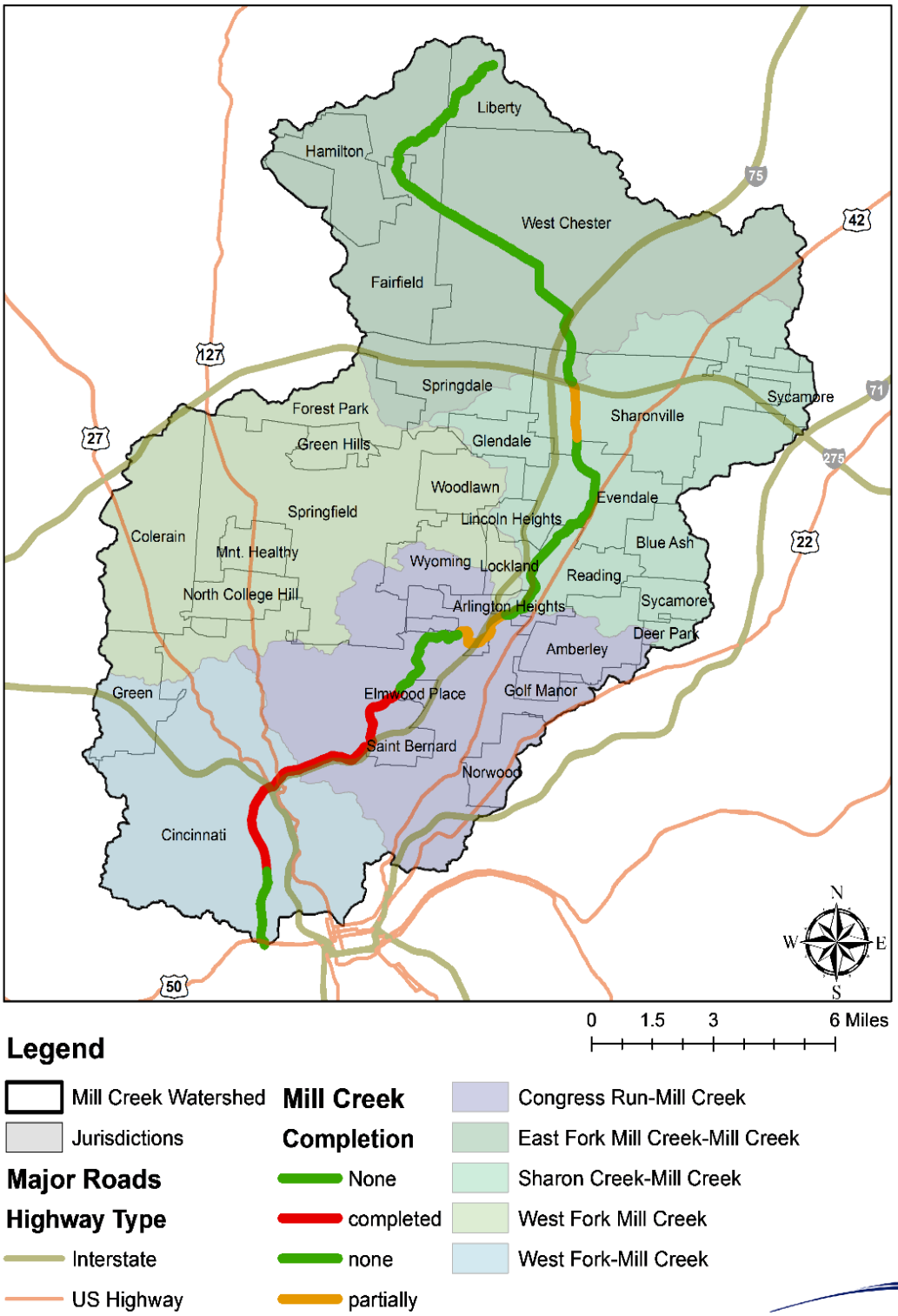
According to the Ohio EPA's page about the Mill Creek Watershed, "the watershed is predominantly comprised of urban development with pockets of forest and a small amount of agricultural land in the northern portion of the watershed. Industry dominates the mid- to lower reaches of the watershed, and commercial and suburban uses are predominant in the upper watershed. The watershed also contains several CSOs and SSOs. Old industrial landfills line the banks of Mill Creek in some areas and several old hazardous waste sites have the potential to influence the stream" (OEPA).

Aquatic life uses for the streams in the Mill Creek Watershed reflect the high degree of urban and industrial development that has occurred within the watershed. The Mill Creek is currently designated Warm Water Habitat from its headwaters in Butler County to river mile (RM) 7.9 in Hamilton County, and Modified Warm Water Habitat (MWH) for the lower eight miles of the stream, where the U.S. Army Corps of Engineers has permanently modified the channel[1].

Headwaters from the upper 29.5 square miles of the assessment area drain into West Fork of Mill Creek Lake, also known as Winton Woods Lake. The lake was from March 1949 to December 1952 by the United States Army Corps of Engineers Louisville District to fulfill a two-fold purpose for flood control: the reduction of flooding in the Mill Creek Valley and reduction of pumping requirements at the barrier dam located at River Mile 0.2 of the Mill Creek mainstem in Cincinnati. In addition to having an authorized project purpose of recreation. The lake and associated dam

[1] For more information about channelization in the lower Mill Creek, see pages 206 through 210 of the *Lower Mill Creek Watershed Action Plan* (July 2014).

FIGURE 1: MILL CREEK WATERSHED CHANNELIZATION



OKI Ohio · Kentucky · Indiana Regional Council of Governments

1.3 Public Participation and Involvement

Many organizations, jurisdictions, and communities are working to restore the Mill Creek Watershed. The Mill Creek Alliance was founded in 1995 as a multi-jurisdictional 501(c) (3) nonprofit organization with the mission to build consensus among watershed stakeholders to drive improvements to the watershed. Since being listed by American Rivers in 1997 as "the most endangered urban river in North America," the Mill Creek has experienced a remarkable comeback through the combined and sustained restoration efforts of these stakeholders; however, there is still much work to be done to restore the stream to a true regional asset.

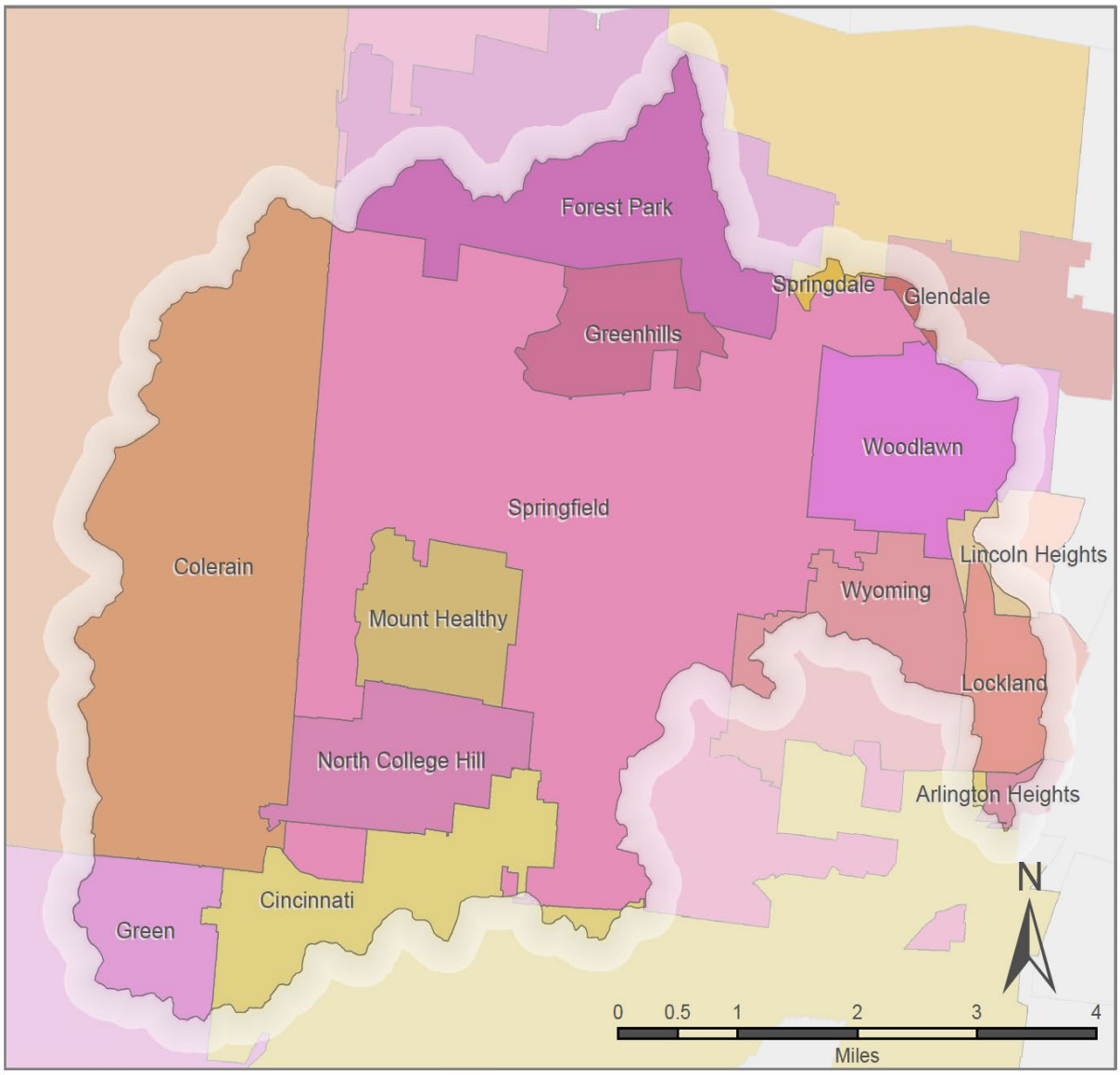
In addition to the Mill Creek Alliance, Metropolitan Sewer District of Greater Cincinnati (MSDGC), Ohio*Kentucky*Indiana Regional Council of Governments (O*K*I), Hamilton County Soil and Water Conservation District, Hamilton County Planning and Development Department, Butler County Soil and Water Conservation District (BCSWD), and a variety of consultants have supported and implemented projects to improve the Mill Creek Watershed.

An opportunity to provide input and feedback on a draft version of this plan was open to members of communities, organizations, and governments in the **West Fork Mill Creek – Mill Creek** HUC-12 in October 2019. To obtain comments and discuss potential projects to be included in the plan, a public meeting was held at 4:00 P.M. on Monday, October 19th at Groesbeck Branch Library of the Public Library of Cincinnati and Hamilton County in the Village of Colerain, Ohio. Invitations were sent to representatives of all jurisdictions within the boundaries of the **West Fork Mill Creek – Mill Creek** HUC-12. Drafts of the plan were made available to stakeholders unable to attend the meeting. In September 2020, updated drafts of the plan were made available for comment to representatives of the 15 jurisdictions found in the **West Fork Mill Creek – Mill Creek** HUC-12.

This plan was authored by the Mill Creek Alliance with assistance from O*K*I, the Hamilton County Planning and Development Department, and Hamilton County Soil and Water Conservation District. This report used the *2021 and 2016 Biological and Water Quality Assessment of Mill Creek* (Technical Reports MBI/2017-6-8), produced for the MSDGC by the Midwest Biodiversity Institute (MBI); and the more comprehensive MBI *Biological and Water Quality Study of Mill Creek and Tributaries, 2011* (Technical Report MBI/2012-6-10). Additional references included the *Ohio 2022 Integrated Water Quality Monitoring and Assessment Report* by Ohio EPA Division of Surface Water, the 2014 *Lower Mill Creek Watershed Action Plan*, 2005 *Upper Mill Creek Watershed Action Plan*, and the Congress Run –, Sharon Creek –, and East Fork – Mill Creek NPS-IS Plans. Project information from Chapter 4 was prepared by Brian Kwiatkowski of Davey Resource Group.

Chapter 2: West Fork Mill Creek – Mill HUC-12 Watershed Characterization

FIGURE 2: BOUNDARY OF WEST FORK MILL CREEK - MILL CREEK HUC-12 WITH JURISDICTION OVERLAY



According to the Ohio EPA 2018 Integrated Report, the status of the **West Fork Mill Creek – Mill Creek HUC-12** includes the below scores, which indicate that based on historical data, the assessment unit is impaired for human health but in attainment for recreation. The **West Fork Mill Creek – Mill Creek HUC-12** is impaired for aquatic life and is not used as a public drinking water supply

Assessment Unit	Assessment Unit Name	Sq. Mi. in Ohio	Human Health	Recreation	Aquatic Life	PDW Supply	Priority Points
05090203 01 02	West Fork Mill Creek – Mill Creek	36.21	5h	1h	5	0	7

2.1 Summary Watershed Characterization, West Fork Mill Creek–Mill Creek HUC-12

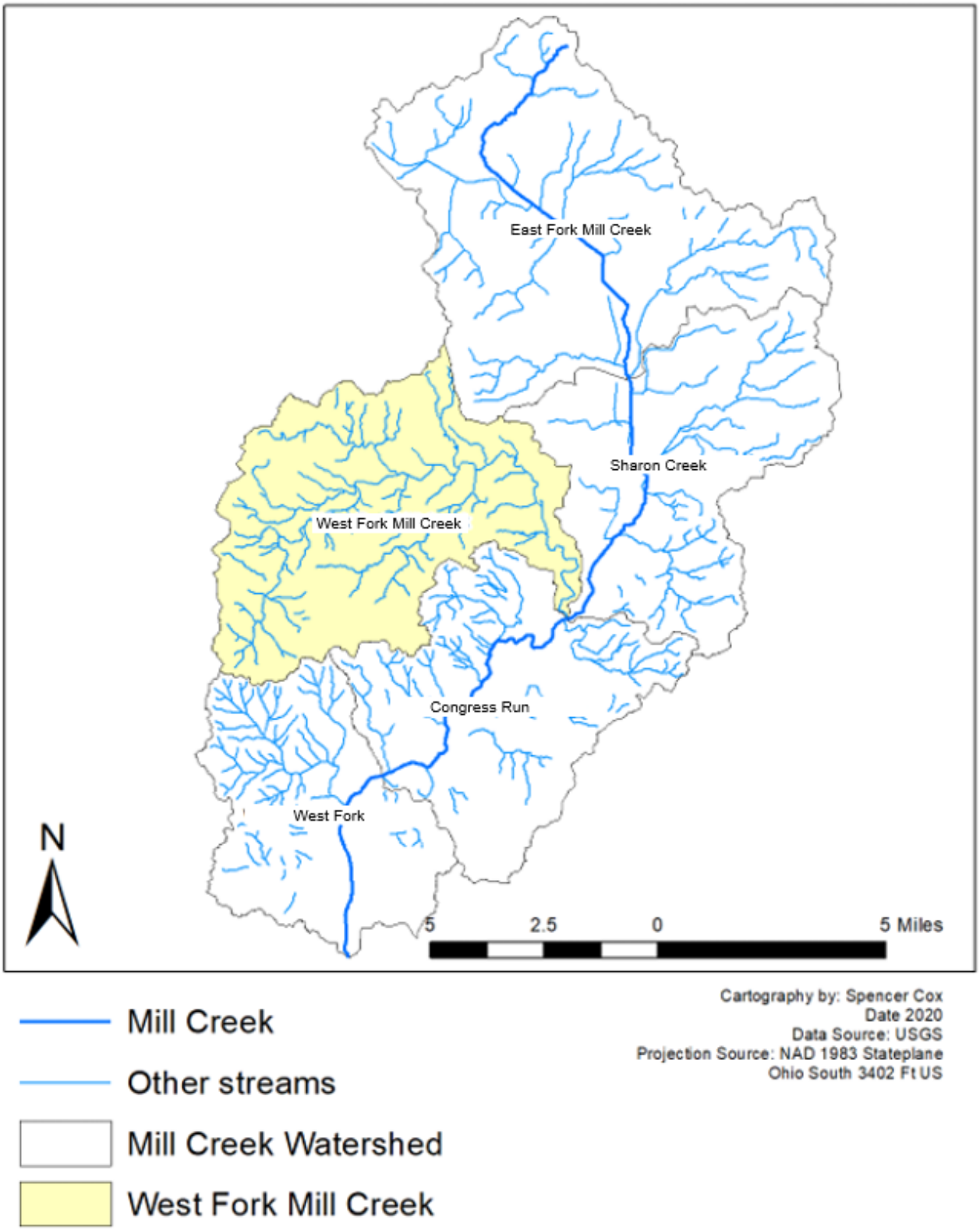
2.1.1 Physical and Natural Features

As can be seen in Figure 3, the **West Fork Mill Creek – Mill Creek** HUC-12 (05090203 01 02) is located to the adjacent southwest of the East Fork Mill Creek – Mill Creek HUC-12 (05090203 01 01) and west of Sharon Creek – Mill Creek HUC-12 (05090203 01 03). The West Fork Mill Creek converges with the Mill Creek mainstem at the southeastern boundary of the subwatershed as it flows into the Congress Run – Mill Creek HUC-12 (05090203 01 04). The **West Fork Mill Creek – Mill Creek** HUC-12 includes the named West Fork Mill Creek and numerous unnamed tributaries.

As can be seen in Figure 4, the State Geologic Map Compilation (SGMC) geodatabase indicates four types of geology are present in the **West Fork Mill Creek – Mill Creek HUC-12**. More than 90% of the assessment unit geology is comprised by the (1) Grant Lake and Fairview Formations, Miamitown Shale, Undivided and (2) Waynesville and Arnheim Formations, Undivided. The remaining geology includes the Kope and Point Pleasant Formations. Shales dominate these formations with a secondary presence of mudstone, and limestone. Point Pleasant Formation predominates the remaining 4% of the assessment unit and is dominated by limestone. Kope Formation averages 200 to 260 feet thick with Miamitown Shale thickness ranging from 5 to 35 feet. The late Ordovician formation fossil assemblages of all of the strata includes small brachiopods, thin, branching trepostome bryozoans, trilobite, crinoidal species, and minor bivalves.

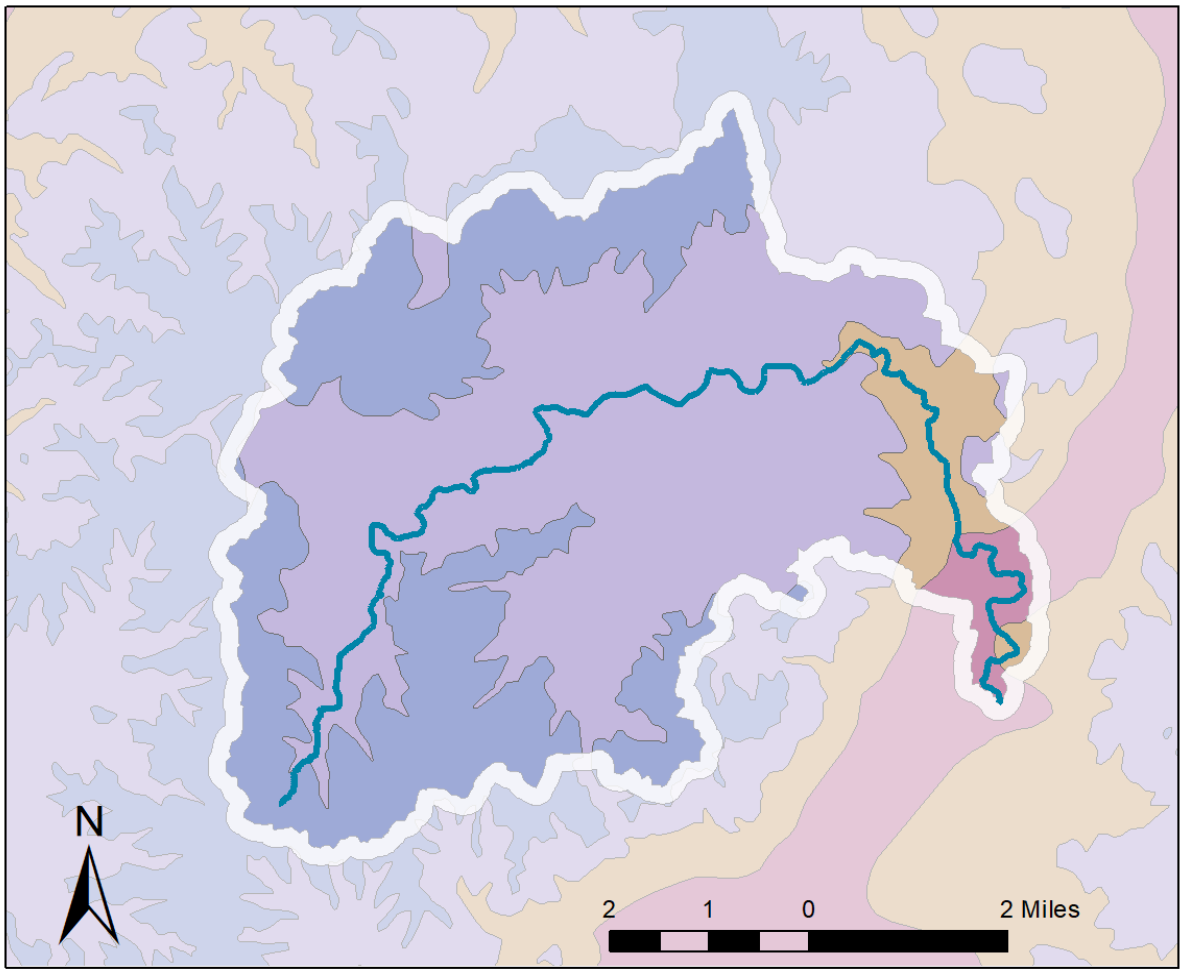
As are the other assessment units within the Mill Creek Watershed, the **West Fork Mill Creek – Mill Creek HUC-12** is predominated by till with smaller amounts of coarse-grained stratified sediment, exposed bedroom or sediment not of glacial origin, and fine-grained stratified sediment. Till is unconsolidated glacial sediment consisting of an unsorted mixture of clay, silt, sand and gravel. Till was deposited by advancing glaciers or by melting stagnant ice. Fine-grained stratified sediments consisting of alternating well-sorted silt and clay layers. They were accumulated in lake environments formed in basins or valleys dammed by glacial ice. Coarse-grained outwash stratified sediment, consisting of well-sorted sand and gravel, was deposited by glacial meltwater. When the ice sheets melted, large volumes of meltwater flowed through stream valleys carved out by previous erosional events and filled them with well-sorted sand and gravel. Such outwash deposits are found beneath most major stream valleys in Butler, Clermont, Hamilton and Warren counties. Since the Pleistocene Epoch Ice Age events, these outwash deposits have been covered by recent alluvial deposits.

FIGURE 3: LOCATION OF WEST FORK MILL CREEK - MILL CREEK HUC-12 WITHIN THE MILL CREEK WATERSHED



Geology

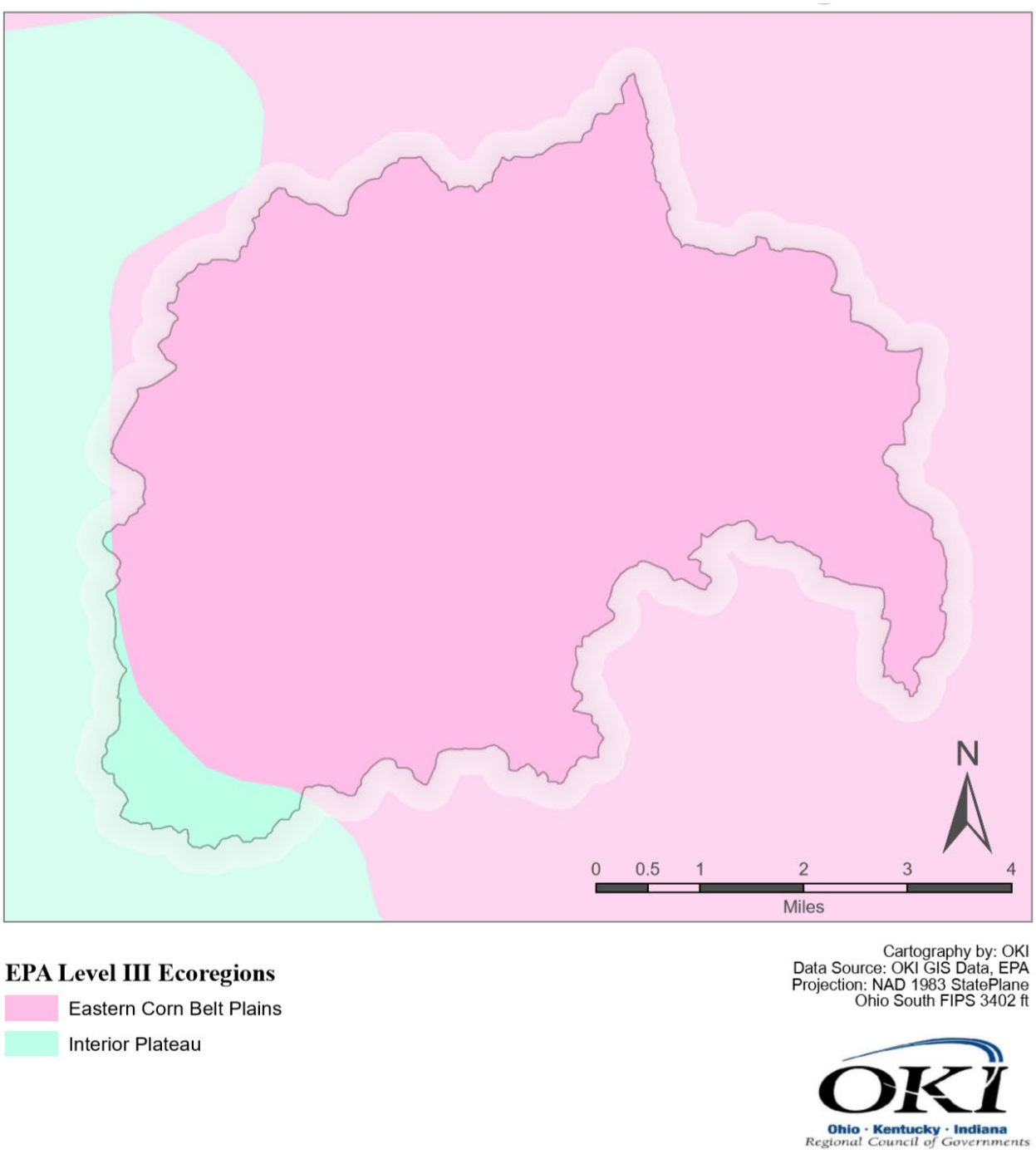
FIGURE 4: REGIONAL GEOLOGY MAP



Cartography by Spencer Cox,
Mill Creek Alliance
Date: 2020
Data Source: OKI and USGS
Projection: NAD 1983 StatePlane
Ohio South FIPS 3402 ft US

The U.S. EPA has divided the continental U.S. into 105 Level III ecoregions, which are further subdivided into 967 Level IV ecoregions. Ohio EPA's *Guide to Developing Local Watershed Action Plans* states that "ecoregions are land-surface areas that are grouped based on similarities in land use, potential natural vegetation, land surface form and soils. These underlying factors determine the character of watersheds and have a profound influence on background water quality and the type and composition of the biological communities in a stream or river and the manner in which human impacts are exhibited."

FIGURE 5: US EPA LEVEL III ECOREGION MAP



In Ohio, ecoregions are also significant to water resource assessments and regulations because the Ohio EPA partly bases its water quality standards, especially biocriteria, on the five types of ecoregions. More specifically, ecoregions influence the criteria to be applied for Warm Water Habitat, which is the predominant aquatic life use (ALU) designation for streams in Hamilton counties, including the **West Fork Mill Creek – Mill Creek HUC-12**.

When Ohio EPA assesses whether the region's streams attain their Warm Water Habitat potential, ecoregion influences the application of these biological indices:

- Index of biological integrity (IBI)
- Invertebrate health. community index (ICI)
- Modified index of well-being (MIwb).

The **West Fork Mill Creek – Mill Creek HUC-12** is located nearly entirely within the U.S. EPA Level III Eastern Corn Belt Plains ecoregion with 4.1% in the southwest portion located in U.S. EPA Level III Interior Plateau ecoregion. The Eastern Corn Belt Plains ecoregion covers all of Butler and Warren counties and the eastern half of Hamilton County, except for the Ohio River corridor. This ecoregion is typified by gently rolling glacial till plains with moraines, kames and outwash features (Omernik and Gallant 1988, as cited in Ohio EPA 1997). Before settlement, the area had plentiful natural tree cover. Many of its soils are relatively loamy, rich and well-drained. Glacial deposits of Wisconsinan age are extensive. Areas with pre-Wisconsinan till are more dissected and leached. Originally, beech forests were common on the Wisconsinan soils while beech forests and elm-ash swamp forests dominated the wetter pre-Wisconsinan soils. The Interior Plateau ecoregion is found in the southwest portion of the **West Fork Mill Creek – Mill Creek HUC-12**. The open hills, irregular plains, and tablelands of this ecoregion are comprised of Mississippian to Ordovician-age limestone, chert, sandstone, siltstone and shale. The natural vegetation is primarily oak-hickory forest, with some areas of bluestem prairie and cedar glades.

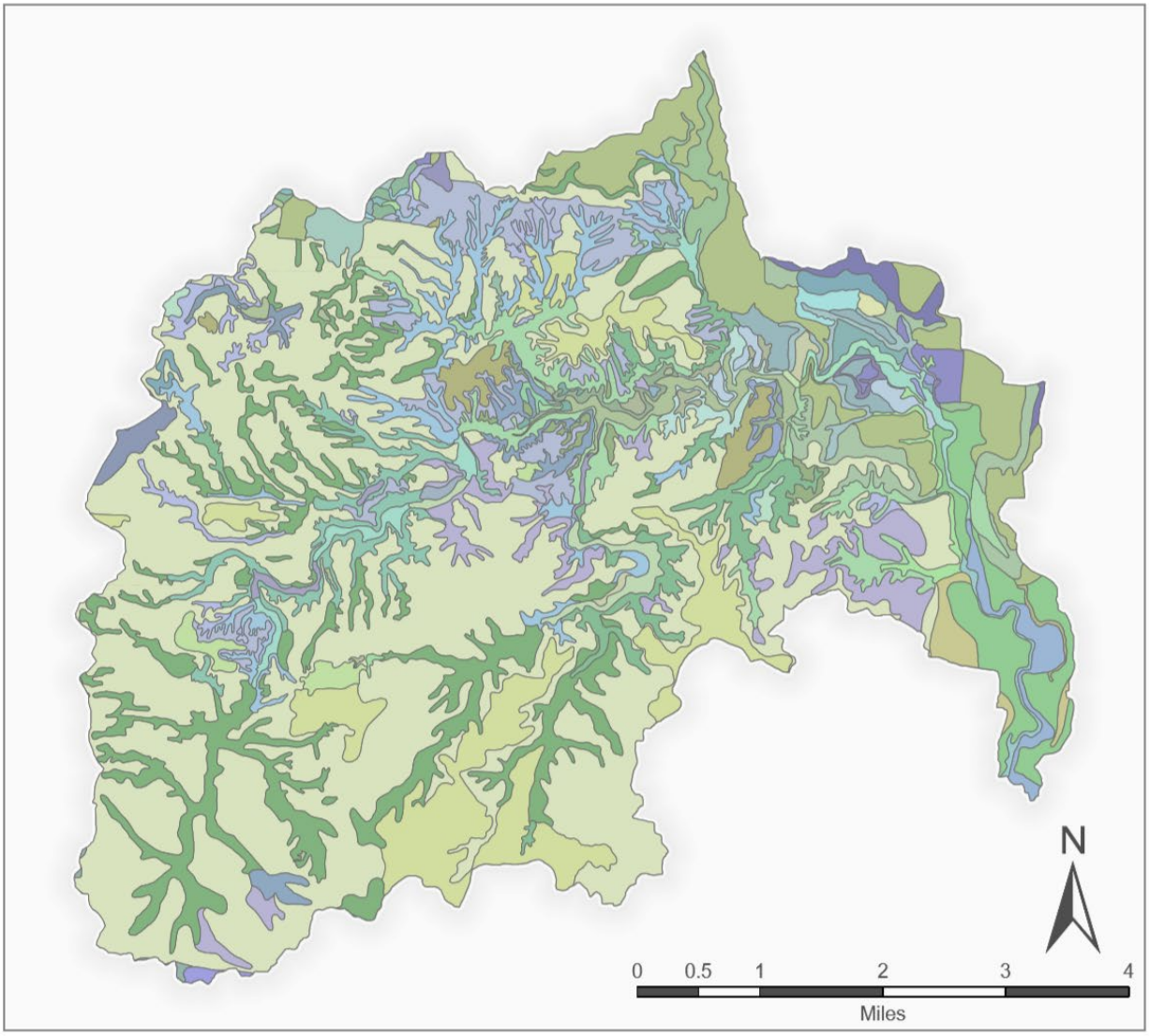
Physiography

1. **West Fork Mill Creek – Mill Creek HUC-12** is located within the Till Plains of the Central Lowland physiographic province. The province is characterized by Pleistocene glaciations. Advance and retreat of the glacial ice sheets produced a flat to gently rolling land surface that is cut by steep-walled river valleys of low to moderate relief. Towards the south, glacial deposits are thin or absent, and erosion of less-resistant shale has produced a dissected hilly terrain of higher stream density. The general topographic gradient is from north to south. The **West Fork Mill Creek – Mill Creek HUC-12** is located at the southern terminus of the Wisconsinan glacial boundary.

2. The Till Plains of the Central Lowland divide into three Ohio subunits and one Indiana subunit. Topographic variations in each Ohio subunit depend largely on the bedrock geology and glacial history of the region. The **West Fork Mill Creek – Mill Creek HUC-12** falls into the Southern Ohio Loamy Till Plan subunit. This Ohio physiographic subunit is characterized by rolling ground moraines of older till and numerous buried valleys. Its streams typically flow over exposed Ordovician shale and limestone and located within stream valleys that are filled with outwash and that alternate between broad and narrow floodplains.

Soils

FIGURE 6: SOILS MAP



According to the Soil Survey Geographic (SSERGO) database maintained by the Natural Resource Conservation Service (NRCS), there are 76 mapped soil types in the **West Fork Mill Creek – Mill Creek HUC-12**. Table 1 presents the classification distribution of several key hydrologic factors. Soils designated as unclassified are typical of urban areas, because of the common occurrence of fill material and paved surfaces in developed areas.

TABLE 1: SOIL CLASSIFICATION

Soil Classification Systems	Acres	Percent Coverage
Drainage Class* - Well drained	4,080.2	17.6%
Drainage Class* - Moderately well drained	2,097.2	9.1%
Drainage Class* - Somewhat poorly drained	87.3	0.4%
Drainage Class* - Not classified	16,911.9	72.9%
Hydrologic Soil Group** - Unclassified	17,729.3	76.5%
Hydrologic Soil Group** - A	165.9	0.7%
Hydrologic Soil Group** - B	594.1	2.6%
Hydrologic Soil Group** - C	2307	9.95%
Hydrologic Soil Group** - D	2,380.3	10.3%
Soil Erodibility*** - High	3,548.49	15.2%
Soil Erodibility*** - Moderate	1,725.36	7.4%
Soil Erodibility*** - Low	173.45	.7%
Soil Erodibility*** - Unclassified	17,729.27	76.7%

* Drainage Classifications range from "Well drained" to "Poorly drained".
** Hydrologic Soil Groups are classifications based on minimum infiltration rates: "A", relatively high infiltration rates and "D", relatively low infiltration rates.
*** Soil Erodibility was based on a classification for K-factor from the Universal Soil Loss Equation: "Low", K-factor < 0.23; "Moderate", K-factor ≥ 0.23 and < 0.4; and "High", K-factor ≥ 0.4.

Of the 23,176 acres of soils mapped within the **West Fork Mill Creek – Mill Creek HUC-12**, approximately 8% (1,875 acres) of the mapped soils types are classified as "hydric" (or wetland soil) on the NRCS 2019 Hydric Soils List. A total of 91%, or 21,129 acres, of the mapped soils were designated as "Not Prime Farmland." There are a few probable reasons for the lack of prime farmland one of which being that 33% of the land in West Fork Mill Creek is considered "Urban Land."

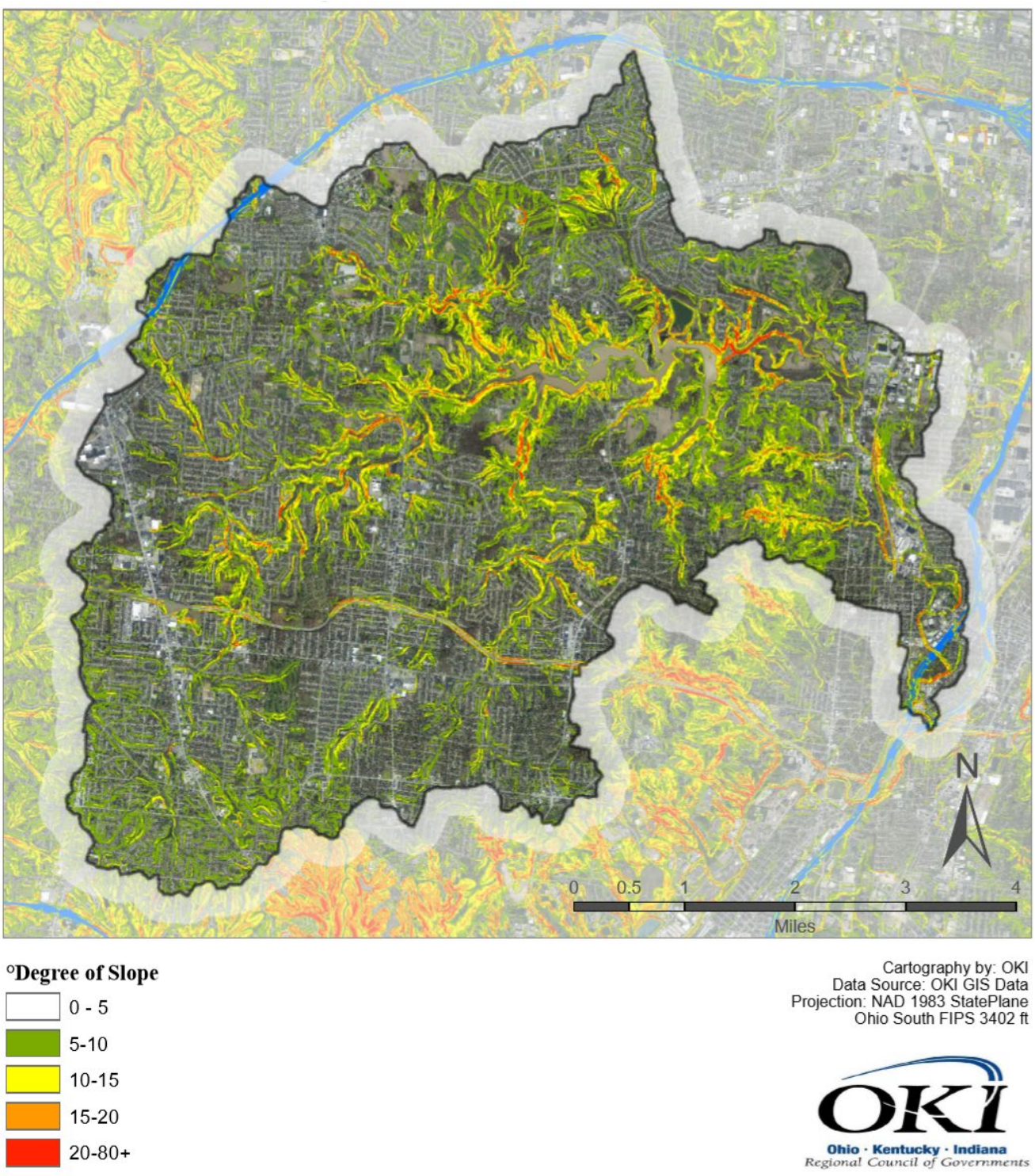
As shown in Table 1, 15.2% of the assessment unit consists of highly erodible soils and 7.4% is made up of moderately erodible soils. Although erodibility is considered low, partially due to lack of complete data, 45% of the land area has either a "High" or "Very High" rating for runoff; 35% of the land area has a "Medium" designation for frequency of runoff. As high runoff quantities often correlate to erosion issues, these numbers track with the fact that combined erosion and sedimentation within the watershed is a significant nonpoint pollutant issue that impacts both the assessment unit and the

larger Mill Creek Watershed. Actively eroding stream banks due to altered hydrology and urban runoff within the assessment unit contribute heavily to sedimentation. Restoration and preservation of natural hydrology and flow regime have been identified as needed within the entire watershed, and the **West Fork Mill Creek – Mill Creek HUC-12.**

According to the 2005 Upper Mill Creek Watershed Management Plan, typical of the Mill Creek watershed, the **West Fork Mill Creek – Mill Creek HUC-12** is dominated by soils that formed in two or three feet of loess over glacial till. They are variable in natural drainage characteristics. Soils in the uplands are generally well drained, except for the unclassified soils typical of urban areas that include fill material and paved surfaces. Russell and Miamian soils are deep to bedrock, and Wynn soils are moderately deep to bedrock. Miamian and Wynn soils formed in less than two feet of loess over glacial till. Poorly drained (Patton and Ragsdale) soils with a seasonal high water table at or near the surface are restricted to the relict valley in which the Upper Mill Creek and the lowermost portion of the East Fork run. Soils in the floodplains are generally well drained or moderately well drained. The somewhat poorly drained Fincastle soils and the moderately well drained Xenia soils are dominant in the relict valley. The well drained, moderately deep Eden soils are located on steep or very steep areas in the watershed. All of the common soils in the watershed are rated with a severe limitation for septic tank absorption fields because of slow percolation. Some are also severely limited because of a seasonal high water table, steepness, or flooding. (Soil Survey of Butler County, USDA Soil Conservation Service, January 1980). Much of the surficial materials within the watershed have been disturbed by human activity over the last two hundred years.

Slope

FIGURE 7: SLOPE CLASSIFICATION MAP



The topography of the **West Fork Mill Creek - Mill Creek HUC-12** primarily includes a floodplain with moderate to steeply sloping hillsides.

Species

According to a preliminary report run using the U.S. Fish & Wildlife Service Information for Planning and Conservation, the **West Fork Mill Creek – Mill Creek HUC-12** potentially encompasses habitat of 8 endangered species and 24 species of migratory birds; however, based on the extensive development within the assessment unit and impairments to the Mill Creek, it is unlikely that any of the listed endangered species are actually present, with the possible exception of the Indiana Bat (*Myotis sodalist*). There are no known overwintering sites for the Indiana Bat within the **West Fork Mill Creek – Mill Creek HUC-12**, or within the Mill Creek Watershed HUC-10. However, there are stands of hardwood which could provide summer roosting habitat. Although the **West Fork Mill Creek – Mill Creek HUC-12** is within the range of running buffalo clover, no documented populations exist within the watershed. There are no critical habitats located within the assessment unit.

Invasive species present in the **West Fork Mill Creek – Mill Creek HUC-12** include the Emerald Ash Borer (*Agrilus Planipennis*) and honeysuckle (*Lonicera maackii* and *Lonicera japonica*). Many of the top invasive species listed by Ohio Department of Natural Resources are also found in the Mill Creek Watershed and are likely present in the assessment unit.

Wetlands

The **West Fork Mill Creek – Mill Creek HUC-12** has a wetland area of <0.01% according to the 2011 National Land Cover Database NLCD. This value is a decline from the historical wetland area of 3.29% (Ohio EPA Division of Surface Water, 2016, Appendix, I1 Supplemental, p. 59).

2.1.2 Land Use and Protection

Stream habitat quality tracks closely with the surrounding land use. According to the 2011 NLCD, 75.9% of the **West Fork Mill Creek – Mill Creek HUC-12** is Developed, 21.3% is Forest, and 1.7% is Grass/Pasture. The assessment unit currently has an Aquatic Life Use Assessment Watershed (ALU) Score of 14.7 out of 100, which places it in the More Impaired category—the most severe level of impairment (Ohio EPA Division of Surface Water, 2016). The assessment unit currently has an Aquatic Life Use Assessment Watershed (ALU) Score of 14.7 out of 100, which places it in the More Impaired category—the most severe level of impairment (Ohio EPA Division of Surface Water, 2016).

West Fork Mill Creek – Mill Creek HUC-12 has a lower percentage of developed land than the adjacent assessment units, Sharon Creek – Mill Creek HUC-12, which is 84.50% Developed, and East Fork Mill Creek – Mill Creek HUC-12, which is 80.9% Developed. Only the West Fork – Mill Creek HUC-12 has a lower percentage of developed land (66.8%) of all the subwatersheds in the Mill Creek Watershed HUC-10.

The developed areas in the **West Fork Mill Creek – Mill Creek HUC-12** include highly developed properties: in the downgradient most communities of Arlington Heights, Lockland, Wyoming, and Woodlawn; in the southern portion of Springfield along Winton Road near the Ronald Reagan Cross County Highway (State Route 126); along Hamilton Avenue in North College Hill and Mount Health; along the entire length of Colerain Avenue from Colerain and Green Townships south to western Cincinnati. Mixed forest stands are found in much of the subwatershed, but are concentrated in the center of the subwatershed, and include the 2,555-acre Winton Woods, the headquarters of the Great Parks of Hamilton County. Interstate 75 traverses only the southeast portion of the assessment unit. State Route 126 traverses the southern portion of the assessment unit from west to east.

FIGURE 8: LAND USE MAP

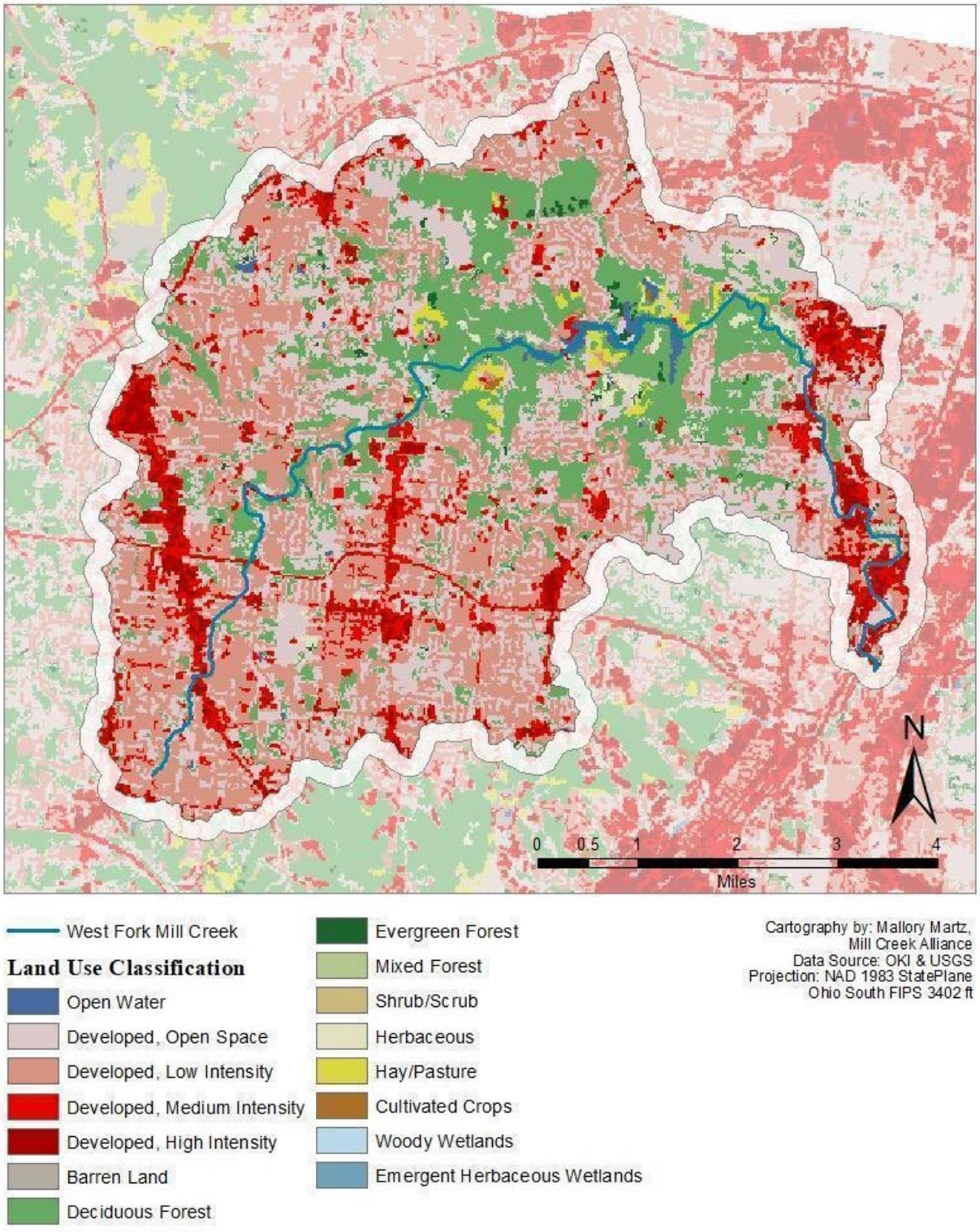


TABLE 2: LAND USE CLASSIFICATIONS FOR WEST FORK MILL CREEK – MILL CREEK HUC-12

Cover Classification	% Watershed Area	Area (mi^2)
West Fork Mill Creek – Mill Creek *(05090203 01 02)*		
Open Water	0.9%	0.33
Developed, Open Space	28.6%	10.37
Developed, Low Intensity	35.1%	12.72
Developed, Medium Intensity	9.0%	3.25
Developed, High Intensity	3.2%	1.16
Barren Land (Rock/Sand/Clay)	0.0%	<0.01
Deciduous Forest	20.8%	7.55
Evergreen Forest	0.5%	0.18
Shrub/Scrub	0.1%	<0.01
Grassland/Herbaceous	0.8%	0.28
Pasture/Hay	0.9%	0.33
Cultivated Crops	0.1%	0.03
Emergent Herbaceous Wetlands	0.0%	<0.01
Total	100.0%	36.25

TABLE 3: LAND USE CLASSIFICATIONS FOR OTHER SELECTED MILL CREEK WATERSHEDS

Cover Classification	% Watershed Area	Area (mi^2)	Cover Classification	% Watershed Area	Area (mi^2)
East Fork Mill Creek – Mill Creek *(05090203 01 01)*			***Sharon Creek – Mill Creek*** *(05090203 01 03)*		
Open Water	0.2%	0.11	**Open Water**	0.3%	0.10
Developed, Open Space	29.7%	14.08	**Developed, Open Space**	30.1%	9.59
Developed, Low Intensity	27.2%	12.87	**Developed, Low Intensity**	26.6%	8.49
Developed, Medium Intensity	11.9%	5.61	**Developed, Medium Intensity**	17.4%	5.53
Developed, High Intensity	6.2%	2.95	**Developed, High Intensity**	10.1%	3.22
Barren Land (Rock/Sand/Clay)	0.05%	0.02	**Barren Land (Rock/Sand/Clay)**	<0.01%	<0.01
Deciduous Forest	7.9%	3.72	**Deciduous Forest**	13.4%	4.27
Evergreen Forest	0.2%	0.08	**Evergreen Forest**	0.6%	0.18
Shrub/Scrub	0.1%	0.04	**Shrub/Scrub**	0.1%	0.04
Grassland/ Herbaceous	0.4%	0.18	**Grassland/ Herbaceous**	0.3%	0.10
Pasture/Hay	4.7%	2.24	**Pasture/Hay**	0.4%	0.13
Cultivated Crops	11.4%	5.42	**Cultivated Crops**	0.6%	0.19
Emergent Herbaceous Wetlands	0.01%	0.01	**Emergent Herbaceous Wetlands**	0.04%	0.01
			Mixed Forest	0.03%	0.01
Total	99.96 %	47.22	**Total**	99.97%	31.85

FIGURE 9: IMPERVIOUS SURFACE MAP

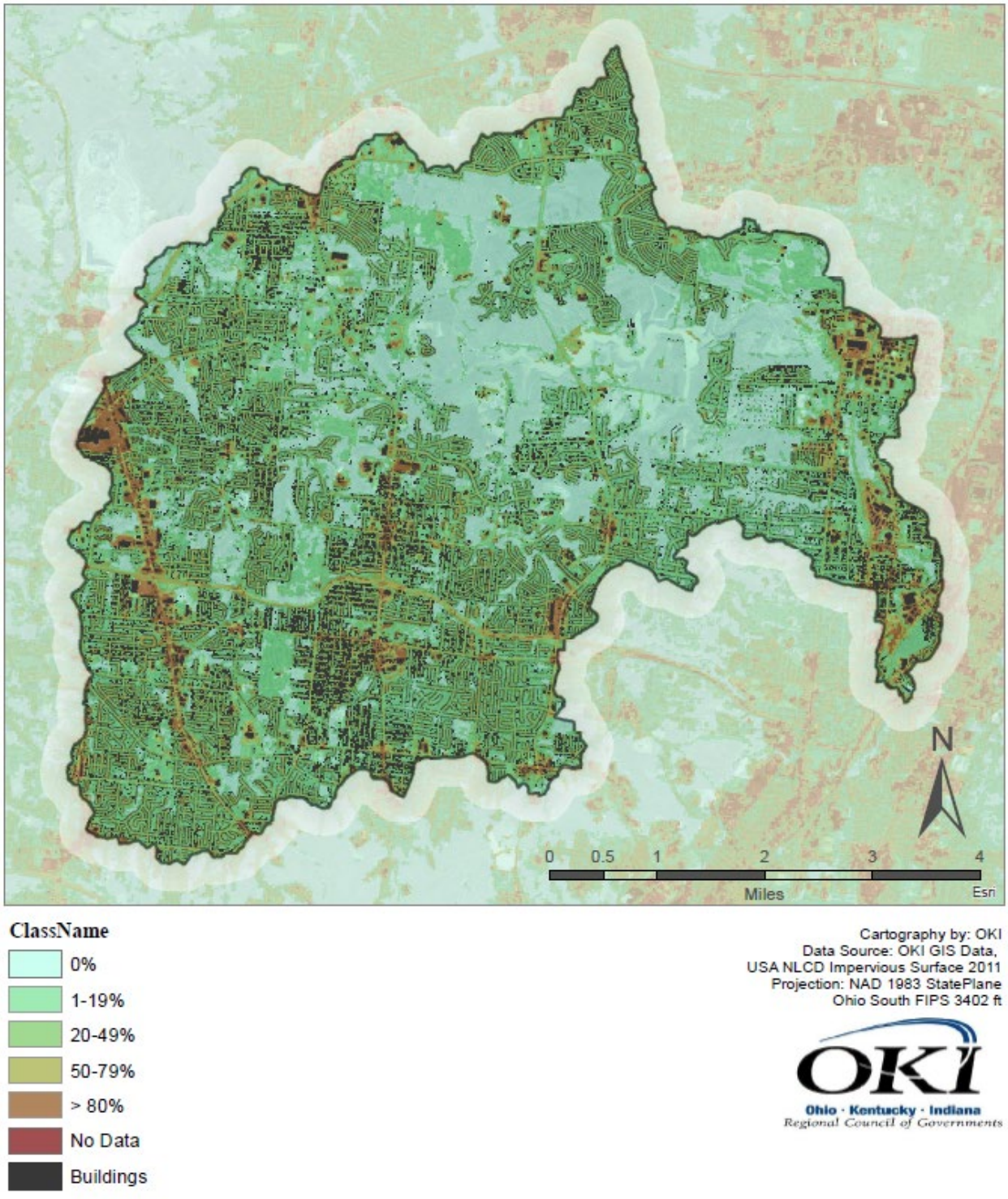


Figure 9 shows the highest percentage of impervious surface in downgradient area in the east, in the south in North College Hill and Mount Health, and along Colerain Avenue to the west. The lowest percentage of imperviousness is found in the center of the assessment unit in the forested Winton Woods. The assessment unit includes approximately 3.3 miles of interstate highways and ramps and 9.6 miles of state routes.

Protected land within the **West Fork Mill Creek – Mill Creek HUC-12** includes 5,428 acres of parks and green spaces including Winton Woods Park, Glenview Gardens, Arlington Memorial Gardens, and Oak Park. Two dam found in the assessment area include the 100-foot high Winton Woods Park dam at River Mile (RM) 6.4 and a low-head dam located at the mouth of West Fork Mill Creek (RM 0.02).

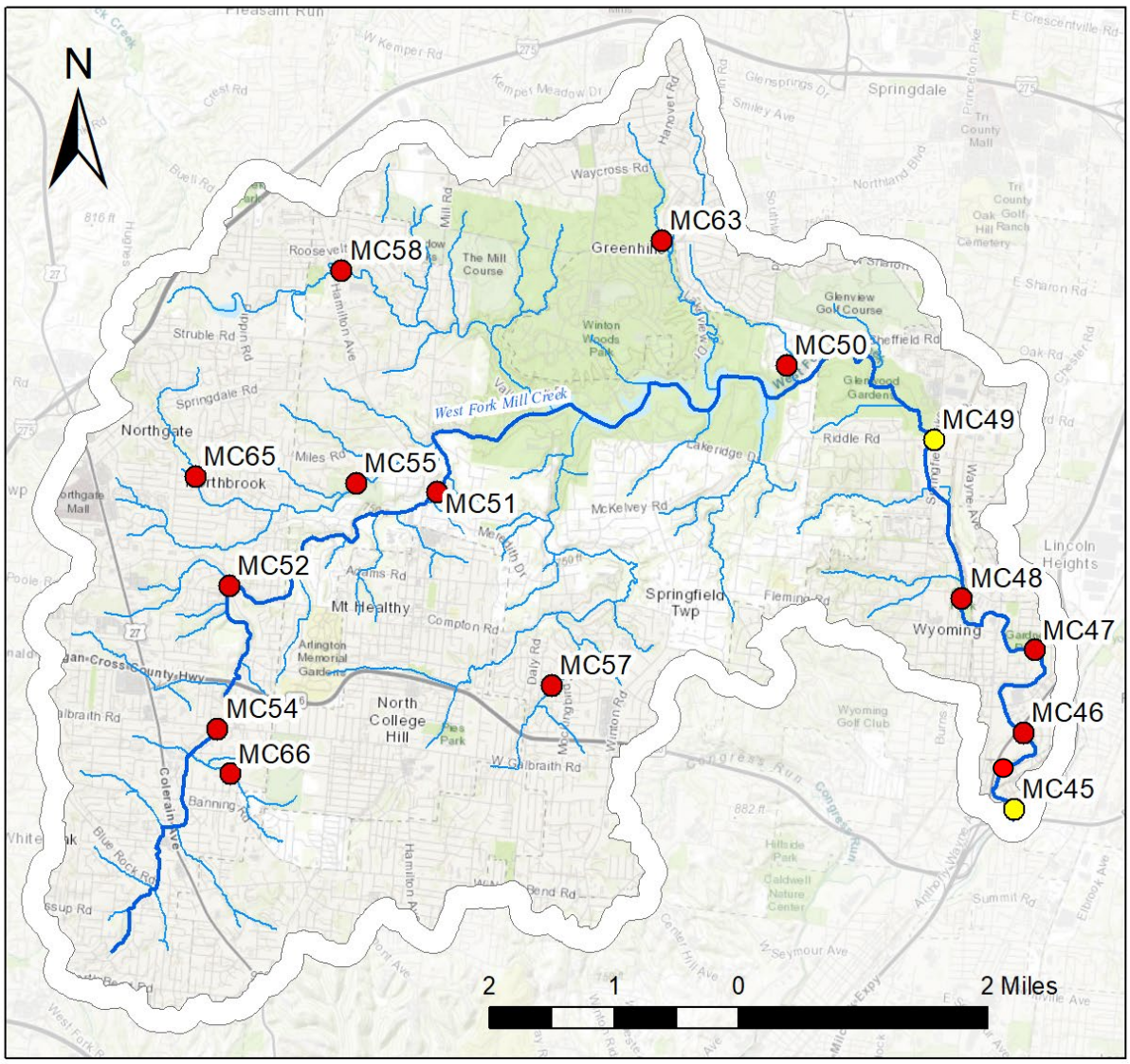
Additional specific features within the **West Fork Mill Creek – Mill Creek HUC-12** include:

Beach Grove Cemetery
Clovernook Country Club
Beech Creek Golf Course
Glenview Golf Course
Meadow Links Golf Course
Mill Golf Course
Central Park
Colerain Park
Gardener Park
Heritage Park
McEvoy Park
Northcreek Park
Joseph A Schottelkotte Park
Triple Creek Park
Winton Woods
Northgate Mall
Railroads
Two major Interstates and two major state roads
Substantial residential areas

2.2 Summary of Biological Trends for West Fork Mill Creek – Mill Creek HUC-12

Level 3 biologists from Midwest Biodiversity Institute (MBI) sampled 22 sites along West Fork Mill Creek and its tributaries in 2011 and assigned an ALU attainment status to 15 sites within the **West Fork Mill Creek – Mill Creek HUC-12** (Figure 10) in 2011. In 2016, and again 2021, MBI biologists resampled one site, MC45, the most downgradient sample site in the assessment unit. The data in this report present the most comprehensive data available (2011 *Biological and Water Quality Study of Mill Creek and Tributaries, 2011*, Technical Report MBI/2012-6-10), except for MC 45, which presents the most recent data (*2021 Biological and Water Quality Assessment of Mill Creek*, Technical Report MBI/2017-6-8). Perspectives are also included from the 2016 MBI Report (*2016 Biological and Water Quality Study of Mill Creek and Tributaries*, Technical Report MBI/2012-6-10).

FIGURE 10: MBI SAMPLING LOCATIONS AND ALU ATTAINMENT STATUS



West Fork Mill Creek Boundary

West Fork Mill Creek

Other Streams

MBI Sampling Locations

ALU Status

NON

PARTIAL

Cartography by Spencer Cox,
Mill Creek Alliance
Date: 2020
Data Sources: OKI, USGS,
and Hamilton County SWCD
Projection: NAD 1983 StatePlane
South Ohio FIPS 3402 ft US

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

TABLE 4: SUMMARY OF THE BIOLOGICAL STATUS OF STREAMS

Stream	No. of Sites	D.A. (mi^2)	Habitat Evaluation	Fish Evaluation	Macroinvertebrate Evaluation	Existing ALU
West Fork Mill Creek-Mill Creek (23-004)	9	36.4	Poor - Good	Poor - Fair	Very Poor - Marginally Good	WWH
Tributaries in West Fork Mill Creek	8	10.7	Poor - Good	Poor - Fair	Very Poor - Good	WWH, PHW II, or PHW IIIA (Recommended)

The West Fork Mill Creek within the **West Fork Mill Creek – Mill Creek HUC-12** has an existing Aquatic Life Use (ALU) designation of Warm Water Habitat (WWH). The tributaries within the assessment unit do not have existing ALU designation and are recommended for either WWH, PHII, or PHIIIA designations.

Habitat

According to the 2011 and 2021 MBI reports, QHEI scores in the streams within the assessment unit ranged from Poor to Good (37 – 68.5). Legacy modification of the West Fork Mill Creek is observed at the 2 channelized sites of the 16 sample sites within the assessment area. Positive attributes included most sites having moderate-extensive cover and maximum depths greater than 40 centimeters. Most sites had limited riffle embeddedness. Negative attributes included most sites having moderate-high silt cover and moderate-extensive embeddedness. In 2021, MBI biologists calculated a QHEI score for one site (MC45) previously evaluated in 2011, which showed a slight 14% improvement to 69.3 from the 2011 value.

Fish

The aquatic community of the **West Fork Mill Creek – Mill Creek HUC-12** was and is predominated by macroinvertebrate and fish species that tolerate high levels of pollution. IBI scores in the **West Fork Mill Creek – Mill Creek HUC-12** ranged from Poor to Fair (16 to 28). None of the sampled sites were in attainment for the fish criterion. The most downgradient sample site, MC45, did not show a statistically significant change from 2011 IBI and MIwb values when resampled in 2016 and 2021.

Macroinvertebrates

ICI scores and narrative ratings included two sites that were rating as good and met the macroinvertebrate attainment goal. One sampling site was located upgradient of the Winton Woods dam (MC55, located at River Mile 0.95 in an unnamed tributary to West Fork Mill Creek at RM 9.82), and the second sampling (MC49) site was located downgradient of the Dam at River Mile 4.4 of the West Fork Mill Creek. All remaining sites in the **West Fork Mill Creek – Mill Creek HUC-12** were not in attainment for the macroinvertebrate criterion.

2.3 Summary of NPS Pollution Causes and Associated Sources for West Fork Mill Creek – Mill Creek HUC-12

Understanding the abundance, diversity, and stressor tolerance of existing fish and macroinvertebrate species found at these sampling locations, in the context of habitat assessment information, informed MBI's determination of causes and sources of impairment. As listed in the MBI 2016 report, the biological impairments in the **West Fork Mill Creek – Mill Creek HUC-12** are from a wide range of causes, including sedimentation, nutrients, habitat alterations, chlorides, PAH (polycyclic aromatic hydrocarbons), dissolved oxygen (low concentrations and variations) and ammonia. The nonpoint sources identified by the report include hydromodification, altered hydrology, and urban runoff. Details of the causes and sources of impairments at all sampling site locations are presented in Section 3.1.3, Table 8.

The **West Fork Mill Creek – Mill Creek HUC-12** had no locations in full attainment, two in partial attainment, and 14 in non-attainment for WWH standards. According to MBI's 2021, 2016 and 2011 evaluations, the percentage of sample site impairment is caused by altered hydrology and sedimentation (93%), urban runoff (87%), nutrients (80%), toxics (27%), low

base flow and habitat alteration (13%) and dissolved oxygen (variability and low concentrations) (7%). The sources of these impairments were noted as altered hydrology, hydromodification, urban runoff, and combined sewer overflows as presented in Section 3.1.3, Table 8.

The 2016 MBI report, used the ration of Areas of Degradation (AAD) and Attainment (AAV) to represent the change between that survey result and those previously conducted of the mainstem of Mill Creek. "The ADV/AAV term is an expression of the degree to which one of the biological index values is either above or below the WWH biocriterion and the distance of the mainstem over which it occurs …normalized to a standard distance (e.g., per mile) … for the fish Index of Biotic Integrity (IBI), the Modified Index of Well-Being (MIwb), and the macroinvertebrate Invertebrate Community Index (ICI)." In 2016, the AAV was positive for all three indices and the largest for the macroinvertebrate assemblage. In terms of the miles of attainment and Non-attainment of the WWH and MWH designated uses in Mill Creek, full attainment was evident in portions of Mill Creek for the first time in 2016.

David Yoder wrote in the 2016 MBI report, "*While significant areas of degradation and non-attainment remain, these results indicate a significant incremental improvement in the Mill Creek mainstem which reflects the cumulative effects of pollution abatement efforts over the previous three decades. Realizing further improvements will require additional reductions in pollutional impacts, but will also need to include "subsidizing" the natural features of the Mill Creek Watershed such as increasing the quality of stream habitat and improving the flow regime. Restoration and abatement actions and their design will need to incorporate these important factors and understand their important role in the eventual attainment of aquatic life designated uses in Mill Creek*."

2.4 Additional Information for Determining Critical Areas and Developing Implementation Strategies

2.4.1 Midwest Biological Institute Five-Year Study on Behalf of MSDGC

The primary resource for determining critical areas and developing implementation strategies is the Midwest Biological Institute's 2011 *Biological and Water Quality Study of Mill Creek and Tributaries, 2011*, Technical Report MBI/2012-6-10). The report delineates the site-by-site causes and source identifications of impairments at 15 sampling locations in the **West Fork Mill Creek – Mill Creek HUC-12**. This report is supplement by MBI's *2021 and 2016 Biological and Water Quality Assessment of Mill Creek*, Technical Reports MBI/2017-6-8) that includes data and information regarding one site, MC45, the most downgradient sample site in the assessment unit.

Chapter 3: Critical Area Conditions & Restoration Strategies

3.1 Overview of Critical Areas

On a HUC-12 level, the overwhelming majority of MBI locations in the **West Fork Mill Creek – Mill Creek HUC-12** have a status of non-attainment for the expected aquatic life uses. No sites were in full compliance and two sites were in partial compliance. Data indicate no change in the status of the one site samples both in 2011 and 2016 in **West Fork Mill Creek – Mill Creek HUC-12**.

A variety of causes and sources of impairment negatively impact every part of the assessment unit. However, as noted in OEPA *Division of Surface Water 2016 Guide to Developing Nine-Element Nonpoint Source Implementation Strategic Plans in Ohio*, Critical Areas may be defined with a Management Zone Approach, or "*nested implementation zones where different combinations of technical, financial and outreach assistance would be made available depending upon an identified need.*" A nested Management Zone Approach coupled with land use and available sampling data, indicates two Critical Areas. In Version 1.0 of this **West Fork Mill Creek – Mill Creek HUC-12**, Conditions, Goals, & Objectives will be outlined for these two Critical Areas. The existing Critical Areas may be modified, or new Critical Areas identified in the future, as new biological monitoring data becomes available and new projects are developed.

It should be noted projects not immediately adjacent to the streams are expected to confer potentially significant water quality benefits to control the rate and amount of stormwater discharged into the streams in Critical Areas that include highly industrialized and impervious areas.

As most of the causes and sources throughout the **West Fork Mill Creek – Mill Creek HUC-12** are consistent, Critical Areas were delineated according to a nested Management Zone Approach with criteria noted in Table 5. Figures 11 and 12 presents maps of the two Critical Areas. This information is included in the plan to prevent duplication of effort on the part of organizations or individuals who submit revisions to this plan and the critical areas it contains in the future.

TABLE 5: CRITICAL AREAS IN WEST FORK MILL CREEK – MILL CREEK HUC-12

CRITICAL AREA	MANAGEMENT ZONE	CAUSES	SOURCES
1	Stream Corridor and Floodplain	Sedimentation, Nutrients	Altered Hydrology, Hydromodification
2	Uplands	Sedimentation, Nutrients	Urban Runoff

ALU attainment statuses, biological and habitat indices, as well as causes and associated sources are presented for the entire **West Fork Mill Creek – Mill Creek HUC-12** in Table 6, 7, and 8. Applicable data will be used to evaluate both Critical Areas in the subwatershed.

FIGURE 11: CRITICAL AREAS IN WEST FORK MILL CREEK – MILL CREEK HUC-12

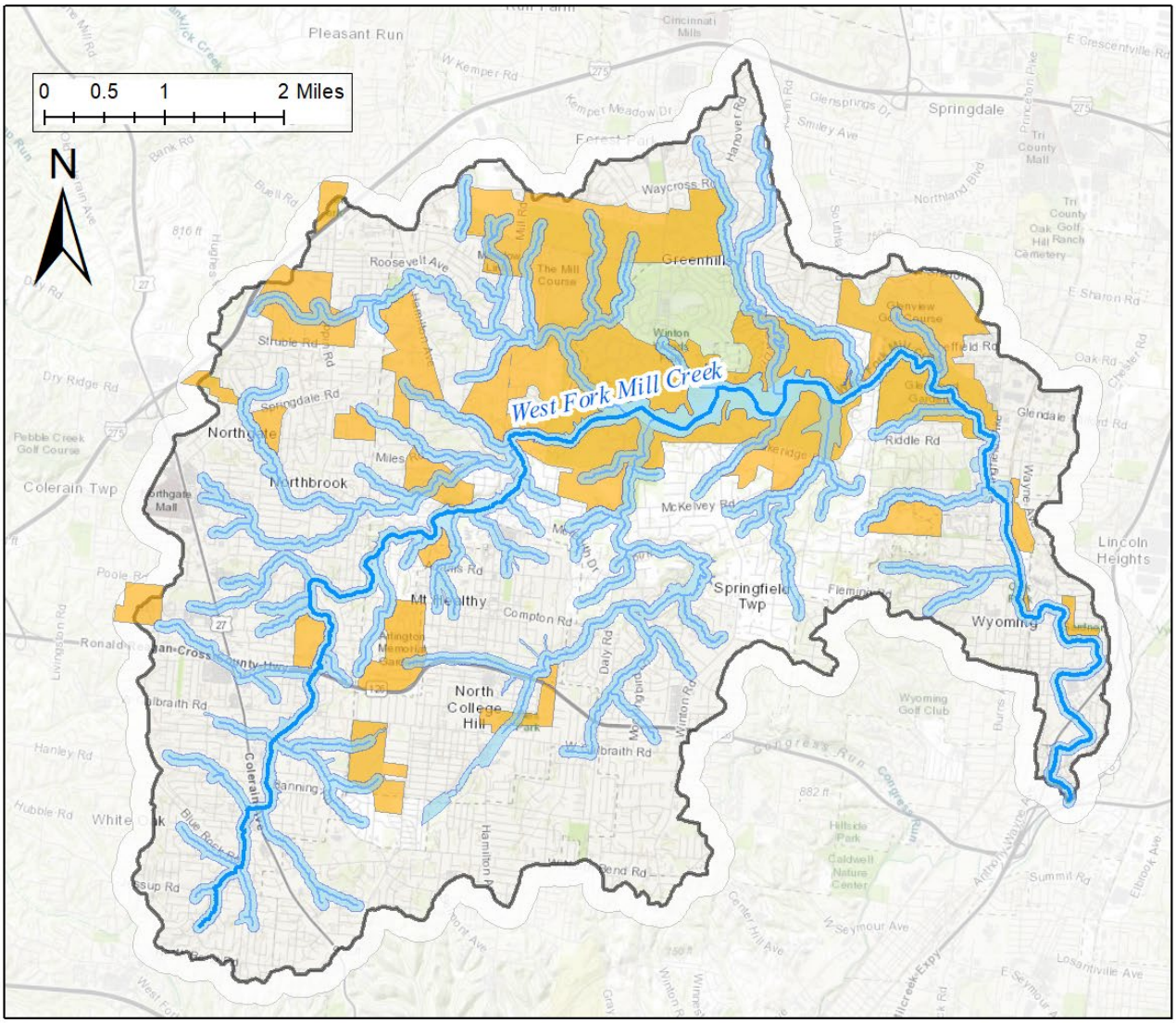
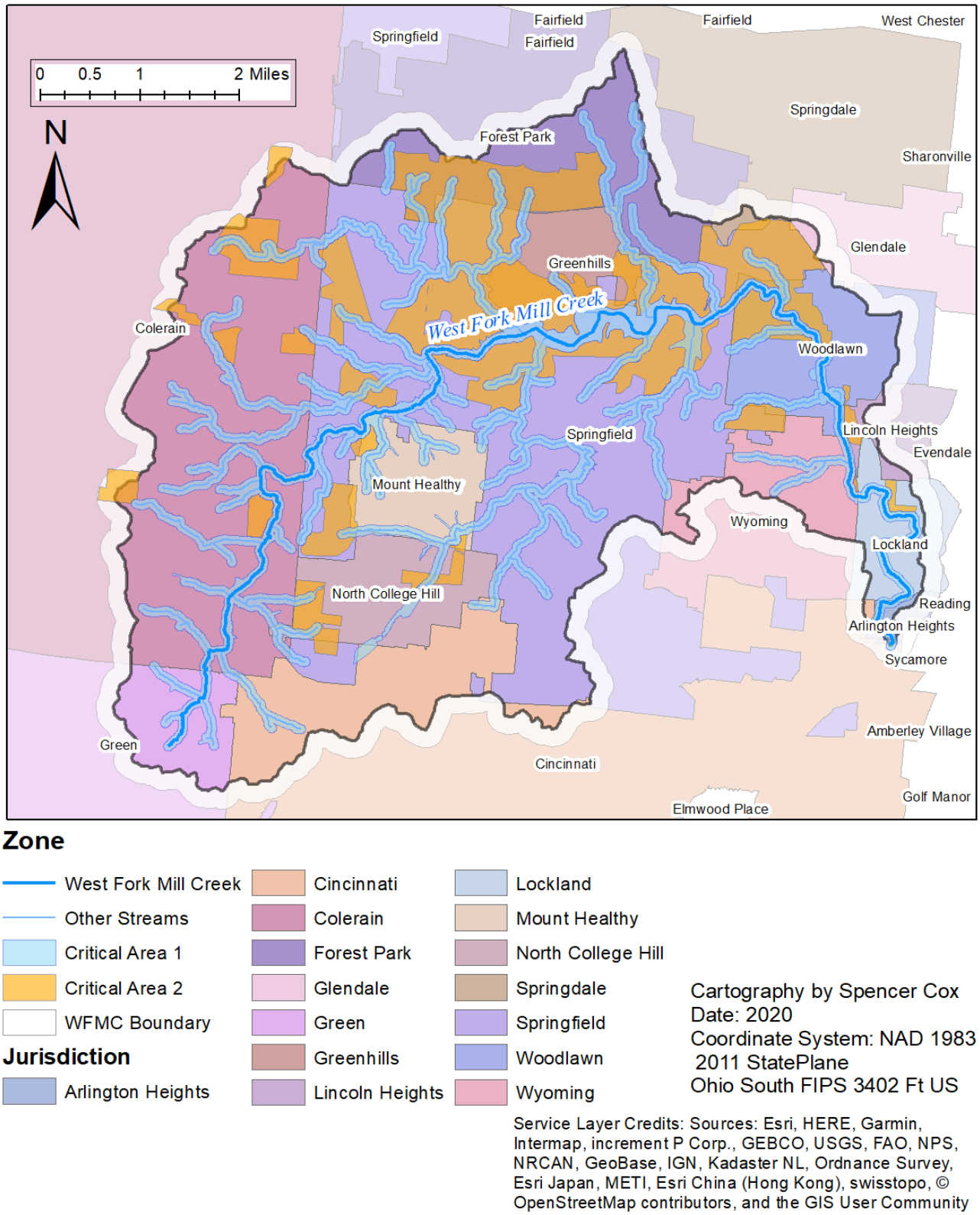


FIGURE 12: CRITICAL AREAS WITH JURISDICTION OVERLAY



3.1.1 Detailed Characterization

ALU attainment status and scores, and biological and habitat indices for **West Fork Mill Creek – Mill Creek HUC-12 s**ampling locations are presented on the next page (Table 6). ALU Status of sampling sites ranged from non-attainment to partial attainment. The one partial attainment sampling sites were found in the West Fork Mill Creek downgradient of the Winton Woods dam.

Both of the two sites sampled in the upper reach of the East Fork Mill Creek were in non-attainment. In an East Fork Mill Creek Tributary at RM 2.35, the most downgradient site was in full attainment and the upstream site (MC35) was in partial attainment and measured within the range of an excellent quality QHEI habitat score.

The most downgradient East Fork Mill Creek sampling site (MC16) both was in non-attainment and located within 1,600' feet of the sampling site that was in full attainment. The Mill Creek sampling site, MC08, is located adjacent to Twin Creeks Nature Preserve 200 meters upstream of the confluence with East Fork Mill Creek. MC17, habitat located adjacent to the Twin Creeks Nature Preserve near the East Fork Mill Creek confluence with Mill Creek was scored fair. In East Fork Mill Creek Tributary at RM 2.35, the most downgradient site was in full attainment and the upstream site (MC35) was in partial attainment. Site MC35 was measured within the range of an excellent quality QHEI habitat score. In Beaver Run and Beaver Run Tributary at RM 2.27, two non-attainment sample sites were found in addition to a site in full attainment.

TABLE 6: OVERALL BIOLOGICAL AND HABITAT SCORES

Site [H]	Fish/Invert. RM	D.A. (mi^2)	ALU Designation	Attainment	IBI/MIwb[a]	QHEI/HHEI
West Fork Mill Creek - Mill Creek HUC-12 (05090203 01 01)						
23-004 West Fork Mill Creek						
MC54	14.0/14.0	3.5	WWH	Non	26*/NA	47.50
MC52	12.65/12.65	6.1	WWH	Non	27*/NA	65.75
MC51	10.3/10.3	10.0	WWH	Non	23*/NA	52.00
MC50	6.4/6.4	30.0	WWH	Non	25*/5.4*	61.75
MC49	4.5/4.4	32.2	WWH	Partial	28*/6.3*	57.50
MC48	3.15/3.10	34.0	WWH	Non	26*/6.9*	55.00
MC47	2.1/2.1	35.6	WWH	Non	18*/5.3*	41.25
MC46	1.05/1.10	36.0	WWH	Non	23*/6.3*	62.50
MC45[b]	0.20/0.20	36.5	WWH	Non	26*/7.06*	69.3
23-029 Tributary to West Fork Mill Cr. at RM 14.26						
MC68	-/1.0	0.2	PHW II[R]	Class II	-/NA	-/40
MC66	0.4/0.4	0.6	WWH[R]	Non	26*/NA	37.0/71
23-031 Tributary (1.75) to Tributary to West Fork RM 9.82						
MC61	0.1/0.1	0.9	PHW II[R]	Class II	16*/NA	43.3/84
23-032 Tributary to West Fork Mill Creek at RM 9.82						
MC65	2.55/2.55	0.6	WWH[R]	Non	16*/NA	44.00
MC55	0.95/0.95	2.7	WWH[R]	Non	20*/NA	62.8/70
23-033 Tributary (2.92) to Tributary to West Fork at RM 8.48						
MC57	0.80/0.85	2.4	WWH[R]	Non	20*/NA	45.5/84
23-034 Tributary to West Fork Mill Creek at RM 8.72						
MC58	2.45/2.50	1.5	WWH[R]	Non	28*/NA	55.0/73
23-035 Tributary (RM 0.8) to Tributary to West Fork at RM 8.72						
MC60	0.15/0.15	1.2	PHW IIIA[R]	Class IIIA	16/NA	53.5/49
23-036 Tributary to West Fork Mill Creek at RM 7.0						
MC63	1.65/1.65	0.8	WWH[R]	Non	26*/NA	63.5/85
23-059 Tributary to West Fork Mill Creek at RM 6.4						
MC59	0.6	0.9	PHW I[R]	Class I	-/-	-/19
23-060 Tributary to West Fork Mill Creek at RM 3.23						
MC62	0.1	0.8	PHW II[R]	Class II	-/-	/53
23-061 Tributary (4.14) to Tributary to West Fork Mill Cr (RM 8.4)						
MC67	4.8	0.3	PHW II[R]	Class II	-/-	/43
MC56	3.5	2.4	PHW II[R]	Class II	-/-	/43

H - Headwater Site Type: sites draining areas <20 $mi.^2$ unless otherwise noted
W - Wadeable Site Type: sites draining areas >20 $mi.^2$ sampled with wading equipment
a - MIwb is not applicable (NA) to headwater streams with drainage areas < 20 $mi.^2$
b - 2021 data
ns - Non-significant departure from the biocriteria (<4 IBI or ICI units or <0.5 MIwb units)
* - Significant departure from the biocriteria (>4 IBI or ICI units or >0.5 MIwb units)
R - Undesignated aquatic life use; listed aquatic life use is recommended

3.1.2 Detailed Biological Condition

Fish and aquatic macroinvertebrate community data for **West Fork Mill Creek – Mill Creek HUC-12** sampling locations are presented on the next page (Table 7). Within the IP ecoregion, the WWH biocriteria for fish IBI is a score of 40 for wading/headwater sites. None of the sampled site achieved the standard. The non-attaining downgradient sites included sites both those upgradient and downgradient of the Winton Woods dam. As previously noted, two of the sampled sites attained the macroinvertebrate ICI WWH biocriterion of 30 or narrative score of Good. The attaining ICI and QHEI data coupled with the non-attaining low IBI score at the downgradient extent of the Mill Creek suggest the potential for improvement.

None of the sampling sites within the West Fork Mill Creek met the WWH fish IBI biocriterion due to hydromodification by low-head dams located at the mouth of West Fork Mill Creek (River Mile 0.02) and River Mile 1.23. Sampling found no sensitive fish species above the Winton Woods dam, which located at River Mile 6.4.

TABLE 7: FISH AND INVERTEBRATE DATA

Site [H]	Fish/Invert. RM	D.A. (mi²)	Mean Total Species	Sensitive Species	% Tolerant	MIwb[a]	IBI	ICI[b]
23-004 West Fork Mill Creek *(Non-Attainment WWH)*								
MC54	14.0/14.0	3.5	4.0 ± 1.0	0	53.5 ± 1.8	NA	26*	VP
MC52	12.65/12.65	6.1	6.0 ± 0.00	0	48.5 ± 2.8	NA	27*	F*
MC51	10.3/10.3	10.0	4.5 ± 0.5	0	53.2 ± 5.4	NA	23*	F*
MC50[W]	6.4/6.4	30.0	11.0 ± 2.0	0	50.9 ± 33.3	5.4*	25*	14*
MC49[W]	4.5/4.4	32.2	14.5 ± 2.5	1	63.2 ± 8.8	6.3*	28*	32
MC48[W]	3.15/3.10	34.0	11.5 ± 2.5	1	53.1 ± 6.7	6.9*	26*	MG[ns]
MC47[W]	2.1/2.1	35.6	9.5 ± 0.5	1	75.5 ± 4.7	5.3*	18*	28[ns]
MC46[W]	1.05/1.10	36.0	11.5 ± 0.5	1	61.7 ± 4.0	6.3*	23*	MG[ns]
MC45[Wc]	0.15/0.20	36.4	14	3	72.55	6.47*	26*	30
23-029 Tributary to West Fork Mill Creek at RM 14.26 *(PHW II Recommended)*								
MC68	-/1.0	0.2	5	0	88.8	NA	26*	VP
23-029 Tributary to West Fork Mill Creek at RM 14.26 *(Non-Attainment WWH Recommended)*								
MC66	0.4/0.4	0.6	NA	NA	NA	NA	26*	VP
23-031 Tributary (1.75) to Tributary to West Fork Mill Creek RM 9.82 *(PHW II Recommended)*								
MC61	0.1/0.1	0.9	1	0	100.0	NA	16*	-
23-032 Tributary to West Fork Mill Creek at RM 9.82 *(Non-Attainment WWH Recommended)*								
MC65	2.55/2.55	0.6	1	0	100.0	NA	16*	VP
MC55	0.95/0.95	2.7	4	0	58.3	NA	20*	G
23-033 Tributary (2.92) to Tributary to West Fork Mill Creek at RM 8.48 *(Non-Attainment WWH Recommended)*								
MC57	0.80/0.85	2.4	5	0	97.0	NA	20*	VP
23-034 Tributary to West Fork Mill Creek at RM 8.72 *(Non-Attainment WWH Recommended)*								
MC58	2.45/2.50	1.5	4	0	41.2	NA	28*	VP
23-035 Tributary (RM 0.8) to Tributary to West Fork Mill Creek at RM 8.72 *(PHW IIIA Recommended)*								
MC60	0.15/0.15	0.9	1	0	100.0	NA	20	-
23-036 Tributary to West Fork Mill Creek at RM 7.0 *(Non-Attainment WWH Recommended)*								
MC63	1.65/1.65	0.8	4	0	77.9	NA	26*	P

TABLE 7: FISH AND INVERTEBRATE DATA (CONTINUED)

Site [H]	Fish/Invert. RM	D.A. (mi²)	Mean Total Species	Sensitive Species	% Tolerant	MIwb[a]	IBI	ICI[b]
23-059 Tributary to West Fork Mill Creek at RM 6.4 *(PHW I Recommended)*								
MC59	0.6	0.9	NA	NA	NA	-	-	-
23-060 Tributary to West Fork Mill Creek at RM 3.23 *(PHW II Recommended)*								
MC62	0.1	0.8	NA	NA	NA	-	-	-
23-061 Tributary (4.14) to Tributary to West Fork Mill Creek (RM 8.4) *(PHW II Recommended)*								
MC67	4.8	0.3	NA	NA	NA	-	-	-
MC56	3.5	2.4	NA	NA	NA	-	-	-

H - Headwater Site Type: sites draining areas <20 mi.² unless otherwise noted.
W - Wadeable Site Type: sites draining areas >20 mi.² sampled with wading equipment
ns - Non-significant departure from the biocriteria (<4 IBI or ICI units or <0.5 MIwb units)
a - MIwb is not applicable (NA) to headwater streams with drainage areas < 20 mi.²
b - Qualitative evaluation used when quantitative data was not available or considered unreliable due to slow or no current velocities. Based on attributes such as EPT taxa richness, number of sensitive taxa, and community composition. VP=Very Poor, P=Poor, LF=Low Fair, F=Fair, MG=Marginally Good, G=Good, VG=Very Good, E=Exceptional
c - 2016 data
* - Significant departure from the biocriteria (>4 IBI or ICI units or >0.5 MIwb units)

3.1.3 Detailed Causes and Associated Sources

Causes and associated sources of water quality impairment for **East Fork Mill Creek – Mill Creek HUC-12** sampling locations are presented Table 8. The associated causes in **East Fork Mill Creek – Mill Creek HUC-12** include siltation/sedimentation, nutrients, chlorides, dissolved oxygen low concentrations and variability, urban runoff. Sources include altered hydrology, urban runoff, hydromodification.

TABLE 8: CAUSES AND SOURCES BY SAMPLING LOCATION

Site	Fish/Invert. RM	Causes	Sources
23-004 West Fork Mill Creek (*Non-Attainment WWH*)			
MC54[H]	14.0/14.0	Habitat Alteration, Sedimentation, Nutrients	Altered Hydrology, Hydromodification, Urban Runoff
MC52[H]	12.65/12.65	Sedimentation, Nutrients, PAH	Altered Hydrology, CSOs, Urban Runoff
MC51[H]	10.3/10.3	Sedimentation, Nutrients, PAH	Altered Hydrology, CSOs, Urban Runoff
MC50[W]	6.4/6.4	Sedimentation, Nutrients	Altered Hydrology, CSOs, Urban Runoff
MC49[W]	4.5/4.4	Sedimentation, Nutrients	Altered Hydrology, CSOs, Urban Runoff
MC48[W]	3.15/3.10	Sedimentation, Nutrients	Altered Hydrology, CSOs, Urban Runoff
MC47[W]	2.1/2.1	Sedimentation, Nutrients, PAH	Altered Hydrology, CSOs, Urban Runoff
MC46[W]	1.05/1.10	Sedimentation, Nutrients	Altered Hydrology, CSOs, Urban Runoff
MC45[W]	0.15/0.20	Sedimentation, D.O., Nutrients, Metals, PAH	Altered Hydrology, CSOs, Urban Runoff
23-029 Tributary to West Fork Mill Creek at RM 14.26 (*PHW II Recommended*)			
MC68[H]	-/1.0	-	-
23-029 Tributary to West Fork Mill Creek RM 14.26 (Non-Attainment WWH Recommended)			
MC66[H]	0.4/0.4	Sedimentation, Nutrients, Organic Enrichment	Altered Hydrology, Urban Runoff, Leaking Sewage
23-031 Tributary (1.75) to Tributary to West Fork Mill Creek RM 9.82 *(PHW II Recommended)*			
MC61	0.1/0.1	-	-
23-032 Tributary to West Fork Mill Creek at RM 9.82 *(Non-Attainment WWH Recommended)*			
MC65 [H]	2.55/2.55	Sedimentation, Nutrients, Organic Enrichment	Altered Hydrology, Urban Runoff, Leaking Sewage
MC55 [H]	0.95/0.95	Nutrients	Altered Hydrology, Urban Runoff

H - Headwater Site Type: sites draining areas <20 mi.^{2} unless otherwise noted
W - Wadeable Site Type: sites draining areas >20 mi.^{2} sampled with wading equipment

TABLE 8: CAUSES AND SOURCES BY SAMPLING LOCATION (CONTINUED)

Site	Fish/Invert. RM	Causes	Sources
23-033 Tributary (2.92) to Tributary to West Fork Mill Creek at RM 8.48 *(Non-Attainment WWH Recommended)*			
MC57 [H]	0.80/0.85	Habitat Alteration, Sedimentation, Nutrients, Ammonia, Low Flow	Hydromodification, Altered Hydrology, Urban Runoff
23-034 Tributary to West Fork Mill Creek at RM 8.72 *(Non-Attainment WWH Recommended)*			
MC58 [H]	2.45/2.50	Sedimentation, Low Flow	Altered Hydrology
23-035 Tributary (RM 0.8) to Tributary to West Fork Mill Creek at RM 8.72 (PHW IIIA Recommended)			
MC60 [H]	0.15/0.15	-	-
23-036 Tributary to West Fork Mill Creek at RM 7.0 (Non-Attainment WWH Recommended)			
MC63 [H]	1.65/1.65	Sedimentation	Altered Hydrology
23-059 Tributary to West Fork Mill Creek at RM 6.4 (PHW I Recommended)			
MC59	0.6	-	-
23-060 Tributary to West Fork Mill Creek at RM 3.23 (PHW II Recommended)			
MC62	0.1	-	-
23-061 Tributary (4.14) to Tributary to West Fork Mill Cr (RM 8.4) (PHW II Recommended)			
MC67	4.8	-	-
MC56	3.5	-	-

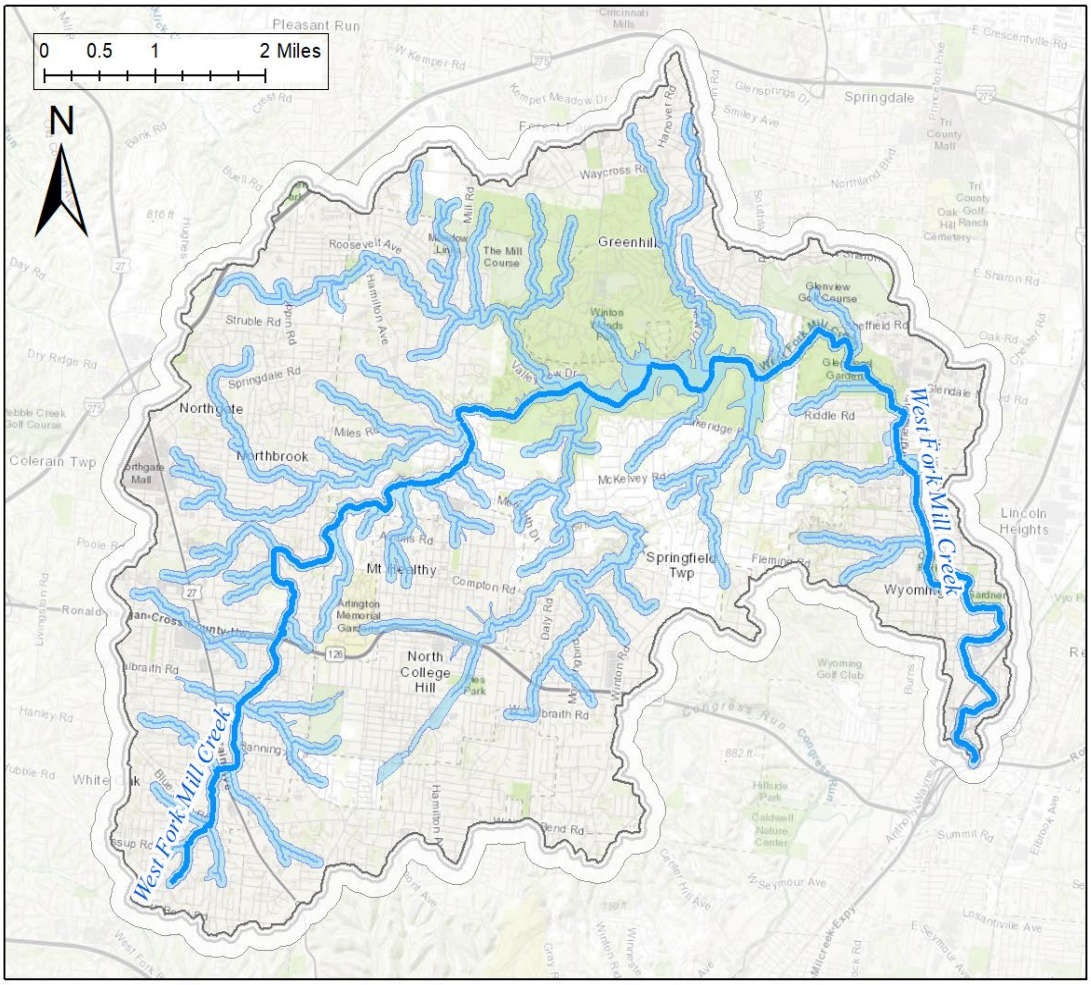
H - Headwater Site Type: sites draining areas <20 mi.^{2} unless otherwise noted
W - Wadeable Site Type: sites draining areas >20 mi.^{2} sampled with wading equipment

3.2 Critical Area 1: Goals & Objectives

3.2.1 Detailed Characterization

Critical Area 1 is the Stream Corridor and Floodplain Management Zone (Figure 13). It includes a 500-foot wide stream corridor and the 100- and 500-year floodplains.

FIGURE 13: CRITICAL AREA 1 MAP



Land use within Critical Area 1 is primarily developed, with 40% residential, 36% public/institutional, 9% vacant, and 8% each commercial. Critical Area 1 includes 22 MBI sampling locations.

Critical Area 1 includes an estimated 84.9 miles of stream length, including the West Fork Mill Creek and associated tributaries. Assuming 250' stream corridors, which contain stream channel and riparian zone, along with the connected floodplains, this equates to a combined area of approximately 5,153 acres for potential improvement projects. Projects throughout Critical Area 1, not just stream-adjacent sites, should be considered as potential pieces of the solution to altered hydrology, hydromodification, and urban runoff.

ALU Attainment statuses, biological and habitat indices, as well as causes and associated sources for Critical Area 1 were previously presented and discussed in Sections 3.1.1 to 3.1.3.

Contributing attributes of **West Fork Mill Creek – Mill Creek HUC-12** Critical Area 1 streams and tributaries include:

- Channelization
- Absence of sinuosity
- Sparse or absent canopy cover
- Absence of or shallow (<40 cm) pool depth
- Heavy or moderate silt cover
- Powerful pulse flows
- Culverting
- Embeddedness or absence of riffles
- Absence of riparian buffer

Projects that address the above described habitat-related attributes will have a positive effect in the QHEI scoring index for sampling locations within Critical Area 1. As habitat scores improve, it is expected that the IBI, MIwb, and ICI indices scoring will also improve.

3.2.4 Goals and Objectives for the Critical Area 1

As shown in detail above, Critical Area 1 is impaired based upon sedimentation/siltation and nutrients due to impacts from altered hydrology and hydromodification. The sources and causes in this Critical Area are closely interrelated, and management measures and project types will necessarily need to address multiple issues to effectively reduce impairment in Critical Area 1. For example, a lack of riparian buffer or similar filtration for stormwater runoff contributes to nutrient and transport. Habitat alterations compound the issues caused by the sedimentation and nutrients for biota in the streams within Critical Area 1. Powerful pulse flows within the Critical Area are thought to be contributing to the low QHEI, IBI and ICI scores throughout the Critical Area and are responsible for significant habitat alterations within the streams and tributaries.

Goals

The overall nonpoint source restoration goals of any NPS-IS plan include improving IBI, MIwb, ICI and QHEI scores so that streams in partial- or non-attainment status can achieve full attainment of the designated ALU for that waterbody. QHEI, IBI, MIwb, and ICI scores in Critical Area 1 are all under the standard for attainment throughout the Critical Area. Therefore, specific goals for Critical Area 1 include:

Goal 1. Achieve an IBI score of 40 at sampling locations in Critical Area 1.

- NOT ACHIEVED: 0 of 22 sampled sites have IBI scores of 40 or above. Scores varied from 18 to 27.

Goal 2. Achieve an ICI score of 30 at sampling locations in Critical Area 1.

- PARTIALLY ACHIEVED: 2 of 4 sample sites with numerical scores achieved scores of 30 or above. Scores ranged from 14 to 32.

Goal 3. Achieve an ICI narrative evaluation of "Good" or "Very Good" at the four sampling locations in Critical Area 1 where an ICI numeric assessment is not possible.

- NOT ACHIEVED: Only 3 of 12 sites rated Good. Ratings varied from Very Poor to Good.

Goal 4. Achieve a QHEI score of 60 at all sampling locations in Critical Area 1.

- NOT ACHIEVED: 6 of 17 sampled sites with QHEI data, have scores of 60 or above. Scores varied from 37 to 69.

Objectives

In order to achieve the overall nonpoint source restoration goal of full attainment in the **East Fork Mill Creek – Mill Creek HUC-12**, the following objectives that address altered hydrology and hydromodification sources need to be achieved within Critical Area 1. These objectives are the prioritized management measures and practices in Critical Area 1 and will be the primary objectives as projects are conceptualized and developed to reduce NPS impacts in this critical area. The objectives have been listed under the sub-heading indicating which category from the Ohio EPA Nonpoint Source Management Plan Update (Ohio EPA, 2013) each strategy falls. These objectives are by no means an exhaustive list of the types of approaches and projects that would contribute to the improvement of conditions in the **West Fork Mill Creek – Mill Creek HUC-12** and it is expected that the Objectives outlined in this plan could include any number of the recommended strategies in the *Nonpoint Source Management Plan Update* released by the Ohio EPA in 2013. Objective 2 is based on ability to achieve implementation. Objective 1 is based on the following technical consideration:

- A 17% increase in total phosphorous was observed from 2016 to 2021 in water samples collected at MC45, which is located at the mouth of the West Fork Mill Creek. Although confounding factors such as differential annual rainfall may have contributed, the 2021 value of 0.154 mg/L is significant higher than the value measured in 2011 value (0.030 mg/L)

Altered Stream and Habitat Restoration Strategies

Objective 1. Increase or enhance riparian wetland and other vegetated buffer areas, and floodplain-connected habitats to reduce the impact of nutrient-rich discharge water entering West Fork Mill Creek and their tributaries through the restoration of effective riparian buffers.

→ Reestablish, restore, enhance, or install streamside forest, wetland, and native vegetation restoration projects in approximately (876 acres) or 17% of the identified riparian and floodplain acreage (5,153 acres) in Critical Area 1.

Objective 2. Restore reaches of stream using natural channel design methods, including re-establishment of in-channel riffles and pools, installation of flood prone benches, and redirecting over-widened channel flow into a more natural thalweg using vanes, root wads, and similar methods.

→ Implement approximately 8.5 mile (44,880 linear feet) or 10% of natural stream restoration instream and/or along the banks of the of the waterways in Critical Area 1 (84.9 miles)

As these objectives are implemented, water quality monitoring will be conducted to determine progress toward meeting goals (i.e., water quality standards). These objectives will be reevaluated and modified if determined to be necessary.

When reevaluating, the Ohio EPA Nonpoint Source Management Plan Update (Ohio EPA, 2013) will be referenced, which has a complete listing of all eligible NPS management strategies to consider including:

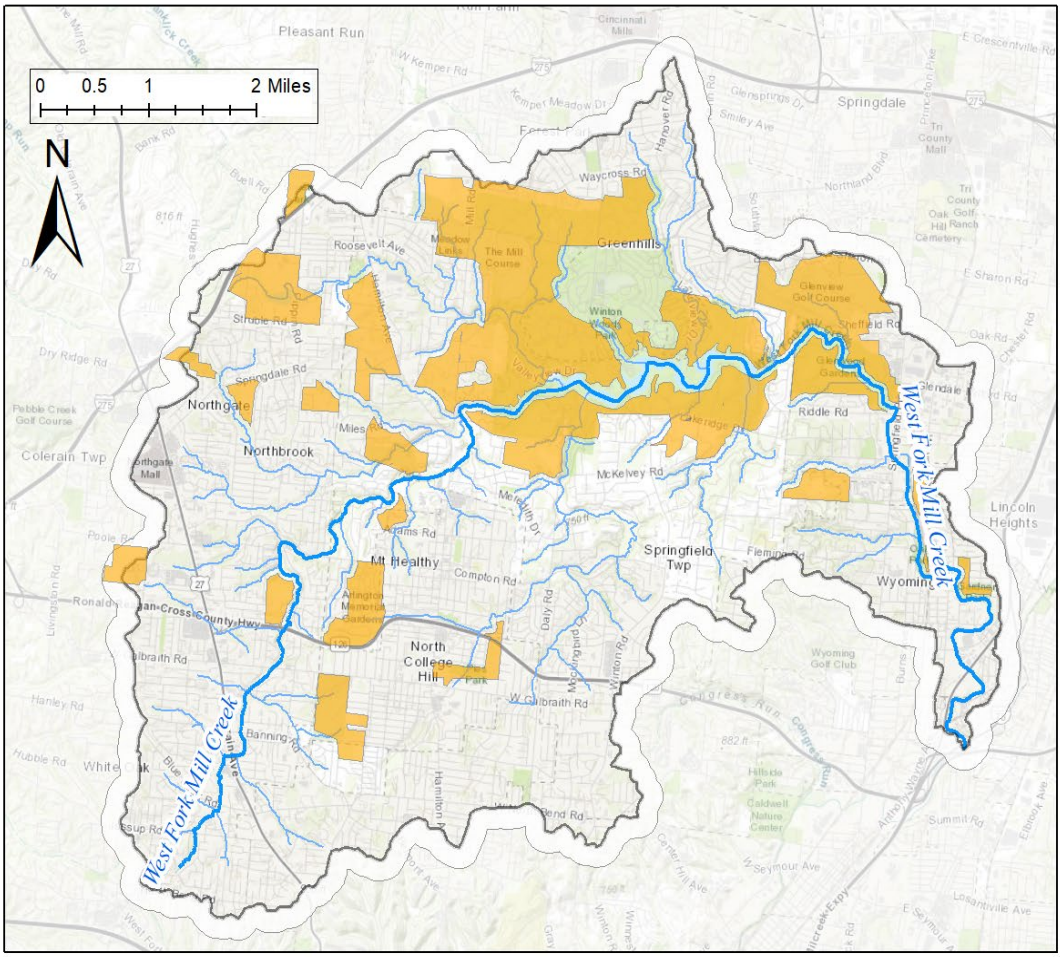
- Urban Sediment and Nutrient Reduction Strategies;
- Altered Stream and Habitat Restoration Strategies;
- Nonpoint Source Reduction Strategies; and
- High Quality Waters Protection Strategies

3.3 Critical Area 2: Conditions, Goals & Objectives

3.3.1 Detailed Characterization

Critical Area 2 is an Uplands Management Zone (Figure 14). It includes 22 upland areas, which serve as urban runoff sources.

FIGURE 14: CRITICAL AREA 2 MAP



Land use within Critical Area 2 is primarily forest and open space with 45% deciduous and mixed forest, 33% open space, 10% low-intensity development, and 9% hay/pasture. Critical Area 2 includes 22 MBI sampling locations. Critical Area 2 includes an estimated 4,427.4 acres for potential improvement projects to mitigate urban runoff sources.

ALU Attainment statuses, biological and habitat indices, as well as causes and associated sources for Critical Area 1 were previously presented and discussed in Sections 3.1.1 to 3.1.3.

Projects that address the above described habitat-related attributes will have a positive effect in the QHEI scoring index for the sampling locations within Critical Area 1. As habitat scores improve and the impacts of the UMC WRF are mitigated, it is expected that the IBI, MIwb, and ICI indices scoring will also improve.

3.2.4 Goals and Objectives for the Critical Area 2

As shown in detail above, urban runoff from Critical Area 2 causes impairment due to sedimentation/siltation and nutrients. The sources and causes in this Critical Area are closely interrelated, and management measures and project types will need to address multiple issues to effectively reduce impairment in Critical Area 2. For example, a lack of filtration for stormwater runoff contributes to nutrient transport. High rates of stormwater release from impervious surfaces results in pulse flows within the Critical Area that contribute to the low QHEI, IBI and ICI scores throughout the Critical Area and are certainly responsible for significant habitat alterations within the streams and tributaries.

Goals

The overall nonpoint source restoration goals of any NPS-IS plan include improving IBI, MIwb, ICI and QHEI scores so that streams in partial- or non-attainment status can achieve full attainment of the designated ALU for that waterbody. QHEI, IBI, MIwb, and ICI scores in Critical Area 2 are all under the standard for attainment throughout the Critical Area. Therefore, specific goals for Critical Area 2 include:

Goal 1. Achieve an IBI score of 40 at sampling locations in Critical Area 2.

- NOT ACHIEVED: 0 of 22 sampled sites have IBI scores of 40 or above. Scores varied from 18 to 27.

Goal 2. Achieve an ICI score of 30 at sampling locations in Critical Area 2.

- PARTIALLY ACHIEVED: 2 of 4 sample sites with numerical scores achieved scores of 30 or above. Scores ranged from 14 to 32.

Goal 3. Achieve an ICI narrative evaluation of “Good” or “Very Good” at the four sampling locations in Critical Area 2 where an ICI numeric assessment is not possible.

- NOT ACHIEVED: Only 3 of 12 sites rated Good. Ratings varied from Very Poor to Good.

Goal 4. Achieve a QHEI score of 60 at all sampling locations in Critical Area 2.

- NOT ACHIEVED: 6 of 17 sampled sites with QHEI data, have scores of 60 or above. Scores varied from 37 to 69.

Objectives

In order to achieve the overall nonpoint source restoration goal of full attainment in the **West Fork Mill Creek – Mill Creek HUC-12**, the following objectives need to be achieved within Critical Area 2. These objectives are the prioritized management measures and practices in Critical Area 2 and will be the primary objectives as projects are developed to reduce NPS impacts in this Critical Area. The objectives have been listed under the sub-heading which category each strategy falls in the Ohio EPA Nonpoint Source Management Plan Update (Ohio EPA, 2013). Objective 5 uses a regulatory approach. Objectives 3 and 4 are based on ability to achieve implementation. Objective 1 and 2 are based on the following technical considerations provided through personal communications with Adam Lehman, former Hamilton County Stream Conservation Program Manager, Hamilton County Soil and Water Conservation District (HCSWD):

- To restore and maintain stream quality, impervious must be reduced from the current level of 25% to 10% (Center for Watershed Protection, 2023).
- Detention basin retrofits serve to mitigate impervious surfaces.
- Some 6.6% of the impervious cover in the HUC-12 can be mitigated by retrofitting existing stormwater basins, as proposed in Objective 1. This value is based on (a) HCSWD finding that more than 80% of surveyed land owners in the Mill Creek Watershed are receptive to implementing stormwater basin retrofits and (b) HCSWD's estimate that 8.3% of the West Fork Mill Creek HUC-12 impervious cover is currently serviced by stormwater detention basins.
- The remaining 8.4% in mitigation required to meet the 10% imperviousness goal for the HUC 12, can be mitigated by installing additional stormwater basin capacity, as proposed in Objective 2.

These objectives are by no means an exhaustive list of the types of approaches and projects that would contribute to the improvement of conditions in the **West Fork Mill Creek – Mill Creek HUC-12** and it is expected that the Objectives outlined in this plan could include any number of the recommended strategies in the *Nonpoint Source Management Plan Update* released by the Ohio EPA in 2013.

Urban Sediment and Nutrient Reduction Strategies

Objective 1.	Retrofit 490 acres, approximately 6.6 % of 7,439-acre Critical Area 2, of existing retention-detention ponds to increase bio-detention and slow the rate of release of stormwater.
Objective 2.	Create 620 acres of added regional bio-detention, approximately 8.4 % of 7,439-acre Critical Area 2, to reduce stormwater inputs and impacts in the subwatershed.
Objective 3.	Reforest 270 acres of tree canopy, approximately 5% of the existing 5,428- acres of Critical Area 2 protected in parks and green spaces to increase stormwater infiltration and evapotransporation
Objective 4.	Implement 10 green infrastructure stormwater retention or infiltration projects such as rain gardens or bioswales to mitigate the harmful effects of flashy runoff flows.
Objective 5.	Encourage adoption/enforcement of post-construction stormwater regulations in 5 jurisdictions to limit surface runoff volumes and release rates, reduce water runoff pollution, maintain/improve habitat, and incentivize other low impact development practices.

As these objectives are implemented, water quality monitoring will be conducted to determine progress toward meeting the identified goals (i.e., water quality standards). These objectives will be reevaluated and modified if determined to be necessary. For instance; many agricultural BMPs can be "stacked" (a systems approach) that will also incrementally improve the quality and quantity of runoff and drainage waters and in-stream water quality.

When reevaluating, the Ohio EPA Nonpoint Source Management Plan Update (Ohio EPA, 2013) will be referenced, which has a complete listing of all eligible NPS management strategies to consider including:

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

Chapter 4: Projects and Implementation Strategy

4.1 Projects and Implementation Strategy Overview Table for Critical Areas

Below are the projects and evaluation needs believed to be necessary to remove the impairments to the **West Fork Mill Creek – Mill Creek HUC-12** as a result of the identified cause 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 (i.e., one season); others system may take longer (i.e., several seasons, years) to show recovery. There may also be reasons other than nonpoint source pollution for the impairment. Those issues will need to be addressed under different initiatives, authorities or programs which may or may not be accomplished by the same implementers addressing the nonpoint source pollution issues.

For the **West Fork Mill Creek – Mill Creek HUC-12** there is one *Project and Implementation Strategy Overview Tables* (subsection 4.2.1). Critical Areas have multiple and inter-related causes and associated sources of nonpoint source impairment. If another nonpoint source impairment is identified for one of the Critical Areas, it will be explained and added to that Critical Area table. If a new or existing impairment is determined to have a different Critical Area, a new table will be created for the new Critical Area. The projects described in the *Overview Tables* have been prioritized using the following three-step prioritization method:

Priority 1	Projects that specifically address one or more of the listed Objectives for the Critical Area.
Priority 2	Projects where there is land-owner willingness to engage in projects that are designed to address the cause(s) and source(s) of impairment, or where projects are expected to result in water quality improvements in the **West Fork Mill Creek – Mill Creek HUC-12.**
Priority 3	An information and education campaign will be developed and delivered to generate interest in projects. Such outreach will engage citizens to spark interest by stakeholders to participate and implement projects like those mentioned in Priority 1 and Priority 2.

The Project Summary Sheets (PSS) are included in section 4.2. These PSSs provide the essential nine elements for the short-term projects in the **West Fork Mill Creek – Mill Creek HUC-12** that are in development and in need of funding.

As projects are implemented and new projects developed these sheets will be updated. Any newly created PSS will be submitted to the State of Ohio for funding eligibility verification (i.e., all nine elements are included).

4.2 Critical Area 1: Overview Table and Project Sheet

The information included in the *Critical Area 1 Overview Table* is a condensed overview of the currently identified projects needed for nonpoint source restoration of the **West Fork Mill Creek – Mill Creek HUC-12** Critical Area 1. A Project Summary Sheet is included for the identified project seeking funding in the near future. It is anticipated that additional projects within Critical Area 1 will be developed.

TABLE 9: CRITICAL AREA 1 PROJECT AND IMPLEMENTATION STRATEGY OVERVIEW

Critical Area 1: Project Overview Table for *East Fork Mill Creek – Mill Creek HUC-12* (05090203 01 01)								
Applicable Critical Area	**Goal**	**Objective**	**Project #**	**Project Title** *(EPA Criteria g)*	**Lead Organization** *(criteria d)*	**Time Frame** *(EPA Criteria f)*	**Estimated Cost** *(EPA Criteria d)*	**Potential/Actual Funding Source** *(EPA Criteria d)*
Urban Sediment and Nutrient Reduction Strategies*								
Altered Stream and Habitat Restoration Strategies*								
1	1,2	1,2	1	Stream and Wetland Restoration at Struble Elementary	Colerain Township	Short	$430,380	Ohio Public Works Commission Clean Ohio Program; US EPA Section 319 grant Program
Agricultural Nonpoint Source Reduction Strategies*								
High Quality Waters Protection Strategies*								
Other NPS Causes and Associated Sources of Impairment								

TABLE 10: PROJECT 1 SUMMARY SHEET

Nine Element Criteria	Information needed	Explanation
n/a	**Title**	Stream and Wetland Restoration at Struble Elementary
criteria d	**Project Lead Organization & Partners**	Colerain Township; Mill Creek Alliance
criteria c	**HUC-12 and Critical Area**	West Fork Mill Creek – Mill Creek (50902030101) Critical Area 1
criteria c	**Location of Project**	2760 Jonrose Ave, Cincinnati, OH 45239
n/a	**Which strategy is addressed by this project?**	Altered Stream and Habitat Restoration Strategies
criteria f	**Time Frame**	2-3 Years
	Short Description	The proposed restoration plan aims to restore the lost ecological features of the West Fork of the Mill Creek and its tributaries. This will provide improved hydraulic connectivity, reduce sedimentation, enhance nutrient attenuation, and restoration of impaired habitats

criteria g	**Project Narrative**	The proposed project will include re-establishment of a more curvature of the creek, meandering flow path to a significant tributary to the West Fork Mill Creek. Also, the streambanks will be stabilized using bioengineered bank treatments along more than 1,000 linear feet of the East tributary. The banks will mainly consist of regrade, fabric and plant treatment, with composite revetment in high-stress locations, such as deeply incised channel segments and the outside of meander bends. Regrade, fabric and plant treatment consist of the construction of the bank to a stable angle of repose, seeding, installing biodegradable erosion control blanket, and replanting the native riparian vegetation. The composite revetment consists of layers of rock, coir blanket, soil, and both dead brush and live woody cuttings. Hydraulic connectivity will be enhanced by excavating the existing floodplain to an average depth of 18 inches in the south bank. Also, adding shallow soil scapes to create pocket wetlands and vernal pools throughout the corridor on the north bank, with a combination of the instream structures. The instream structures will include adding log weir cascades. Log weir cascades are constructed by two or more tiers of logs which are reinforced with a cobble bed material and riprap. In addition, a rock riffle will be constructed for grade control and energy dissipation. A portion of the excavation spoils will be used to create varied microtopography throughout the project site.
criteria d	**Estimated Total cost**	Total cost of design, permitting, program management, and construction will be approximately $430,380.
criteria d	**Possible Funding Source**	Ohio Public Works Commission Clean Ohio Program; US EPA Section 319 grant Program
criteria a	**Identified Causes and Sources**	Causes of Impairment: Sedimentation, Low-Flow, Habitats, Nutrient, Hydraulic connectivity Sources of Impairment: Altered Hydrology, Urban Runoff, Hydromodification

Nine Element Criteria	Information needed	Explanation
criteria b & h	**Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?**	With improvement needed in all indices (IBI, ICI, MIwb, and QHEI) throughout the Critical Area 1, 44,880 linear feet of stream restoration with natural channel design methods are proposed.
	Part 2: How much of the needed improvement for the whole Critical Area is *estimated* to be accomplished by this project?	The 1,000 linear feet of proposed project length, completes 2.2% of the natural channel design objective.
	Part 3: Load Reduced?	624 tons sediment/year, 747 pounds P/year, 1,622 pounds N/year
criteria i	**How will the effectiveness of this project in addressing the NPS impairment be measured?**	Pre-project scores for the IBI, ICI, MIwB and QHEI are available from Ohio EPA and MBI for Critical Area 1. Additional monitoring and scoring by Ohio EPA and MBI will be used as the post-project monitoring data to evaluate progress from Non- and Partial Attainment in the Critical Area toward Full Attainment.
criteria e	**Information and Education**	An outreach program coordinated by the MCA, with project partners including Colerain Township, will provide permanent installations of environmental signage and project information to educate area residents about the benefits this project confers in the Mill Creek Watershed. At least one community outreach post-construction tour will be led by the MCA for elected officials, watershed planning leaders, and general public audience.

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Appendix A: Acronyms, Abbreviations and Definitions

Where are US EPA's Nine Elements found in Ohio's NPS-IS?

Criteria	US EPA Definition	Location in the Ohio NPS-IS Template
a	Identify the causes and sources of pollution that need to be controlled	3.2.3, 3.3.3 ... etc. 4.2
b	Determine load reductions needed	3.2.4, 3.2.4 ... etc. 4.2
c	Describe management measures to achieve improvements in targeted critical areas	3.2.4, 3.2.4 ... etc. 4.2
d	Identify technical and financial assistance and authorities needed to implement the plan	4.1, 4.2
e	Develop an information/ education component	4.2
f	Develop implementation schedule	4.1, 4.2
g	Describe the interim, measurable milestones	4.2
h	Identify indicators to measure progress	4.2
i	Develop monitoring component.	4.2

Acronyms

IBI – Index of Biotic Integrity
ICI – Invertebrate Community Index
MIwb – Modified Index of Well Being
QHEI – Qualitative Habitat Evaluation Index
TSD – Technical Support Document
TMDL – Total Maximum Daily Load
WAP – Watershed Action Plan
WBP – Watershed Based Plan
WC – Watershed Characterization
WQS – Water Quality Standards
WRAS – Watershed Restoration Action Strategy

Critical Areas Defined

In Ohio, Critical Areas are defined as:

→ An impaired HUC 12 or an area where Ohio EPA monitoring shows a nonpoint source related cause of impairment; especially those areas with identified high magnitude causes such as habitat alteration, hydromodification, silt/sediment, or nutrient enrichment; **OR**

→ An area identified as having healthy waters that need protected from degradation by nonpoint source pollutants such as nutrients and sediment; especially those areas seriously threatened by the rapid conversion of countryside to developments.

Ranking of Projects *(used in Chapter 4)*

PRIORITY: The PRIORITY designation indicates the importance of immediate action and should be used for the most important short term projects. Immediate action may be needed due to issues such as:

- Highly threatened by development pressures or loss of full attainment status;
- Would achieve a high reduction in the loading percentage of nitrogen, phosphorus and/or fecal coliform/e. coli; and
- A publicly owned or accessible area in most need of protection.

Time Frame for Implementation *(used in Chapter 4)*

Short term: These projects should be/are expected to be implemented in Year 1-3
Medium term: These projects should be/are expected to be implemented in Years 3-7
Long term: These projects should be/are expected to be implemented in Year 7 and beyond

Definitions

Goals: A measured parameter such as sediment or nutrients (i.e. Reduce Sedimentation Rates)

Objectives: What can be done to restore the impaired measured parameter (i.e. Increase bank stabilization?)

Sources of Impairment: 1) The most prominent origins of the "agents" deemed responsible for the observed aquatic life use impairment.
(*Ohio EPA Integrated Report 2014* Glossary, Ohio EPA website: http://wwwapp.epa.ohio.gov/gis/mapportal/IR2014Glossary.html)
2) The activities, facilities or conditions that generate the pollutants including: municipal sewage treatment plants, factories, storm sewers, modifications of hydrology, agricultural runoff, etc.)
(*2002 National Assessment Database: Assessing Water Quality Q&A*, US EPA web site: http://www.epa.gov/waters/305b/assessing_quality.html)

Cause(s) of Impairment: 1) The most prominent "agents" deemed responsible for the observed aquatic life use impairment and should be the initial focus of restoration activities or TMDL development within the watershed.
(*Ohio EPA Integrated Report 2014* Glossary, Ohio EPA website: http://wwwapp.epa.ohio.gov/gis/mapportal/IR2014Glossary.html)
2) What is keeping the waters from meeting the criteria adopted to protect the designated uses including: chemical contaminants (i.e. PCBs, metals, etc.), physical conditions (i.e. temperature, excess siltation, alterations of habitat, etc.), and biological contaminants (i.e. bacteria, noxious aquatic weeds).
(*2002 National Assessment Database: Assessing Water Quality Q&A*, US EPA web site: http://www.epa.gov/waters/305b/assessing_quality.html)

Explanation of Ohio's Nonpoint Source Management Plan Update (FY2014-FY2018) Strategies

[NOTES: ALL NPS projects that are eligible for funding under Ohio EPA's §319 NPS program must be based upon the strategies outlined in the Ohio Nonpoint Source Management Plan Update (FY2014-FY2018)*. These strategies explain the types of projects that Ohio EPA can fund to restore the NPS impairments that are resulting in a Critical Area's inability to attain Ohio's WQS. This document should be used as a reference when writing a NPS-IS.]*

- **Urban Sediment and Nutrient Reduction Strategies**
  These strategies address the causes and associated sources related to Urban Sediment and Nutrient impairments (i.e. storm water runoff, LID).
- **Altered Stream and Habitat Restoration Strategies**
  These strategies address the causes and associated sources related to Altered Stream and Habitat impairments (i.e. stream restoration, riparian habitat, flow restoration).
- **Agricultural Nonpoint Source Reduction Strategies**
  These strategies address the causes and associated sources related to Agricultural Nonpoint Source impairments (i.e. upland mgmt., livestock mgmt., drainage mgmt.).
- **High Quality Waters Protection Strategies**
  These strategies address the protection of High Quality Waters (i.e. restore and protect high quality in-stream habitat, manage invasive species).

Appendix B: Index of Figures and Tables

Figures

Tables