



Version 1.0

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

Sharon Creek – Mill Creek HUC-12
(05090203 01 03)



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Chapter 1: Introduction

The **Sharon Creek – Mill Creek HUC-12** (05090203 01 03) is located at the convergence of Butler, Hamilton and Warren counties in southwestern Ohio. This HUC-12 is immediately downstream from the East Fork Mill Creek – Mill Creek HUC-12 (05090203 01 01); the confluence of the Mill Creek main stem and East Fork Mill Creek is the transition point between these two assessment units. Drainage from the **Sharon Creek – Mill Creek HUC-12** and West Fork Mill Creek – Mill Creek HUC-12 (05090203 01 02) converge at the southern end of the **Sharon Creek – Mill Creek HUC-12**, and flows downstream into the Congress Run-Mill Creek HUC-12 (05090203 01 04). The **Sharon Creek – Mill Creek HUC-12** is 31.8 square miles in size. Located on the north side of the Greater Cincinnati area, it encompasses many land uses, including high-density residential, low-density 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 Watershed Council of Communities is collaborating with the Hamilton County Soil and Water Conservation District, Hamilton County Planning + Development department, and the Ohio*Kentucky*Indiana Regional Council of Governments 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 **Sharon Creek – Mill Creek HUC-12**. This NPS-IS is the first of five such plans slated for development in the Mill Creek watershed (05090203 01).

1.1 Report Background

In light of the new guidance from Ohio EPA to 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 **Sharon Creek – Mill Creek HUC-12**. It complements two existing endorsed WAPs in the Mill Creek watershed (05090203 01). These plans, the Upper Mill Creek Watershed Management Plan (December 2005) and the Lower Mill Creek Watershed Action Plan (July 2014) [can be found on the Mill Creek Watershed Council of Communities' website](#).

According to the Ohio EPA 2016 Integrated Report, this assessment unit scores a 1.5 out of 100 in terms of watershed health. This demonstrates a clear need for targeted action to improve the health of streams and tributaries within the **Sharon Creek – Mill Creek HUC-12**. Other organizations and entities are planning and working to tackle additional issues contributing to impairments in the **Sharon Creek – Mill Creek HUC-12** not addressed in this plan, such as CSO and SSO overflows and industrial impairment contributions of an unknown nature.

1.2 Watershed Profile & History

The **Sharon 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 Interior Plateau and Eastern Corn Belt Plains US EPA Level 3 Ecoregions. The Mill Creek main stem 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 **Sharon Creek – Mill Creek HUC-12**, the elevation of the Mill Creek main stem falls from 566' at the top of the assessment unit to 519' at its confluence with the West Fork Mill Creek at the bottom of the assessment unit.

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 main stem 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, p. 2). 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 principle 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, "[t]he 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" (Ohio Environmental Protection Agency, n.d.).

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. Starting on January 2, 2017, the WWH reach [will extend to RM 7.3](#).

1.3 Public Participation and Involvement

Many organizations, jurisdictions, and communities are working to restore the Mill Creek Watershed. The Mill Creek Watershed Council of Communities 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 Watershed Council of Communities, the Metropolitan Sewer District of Greater Cincinnati, the Ohio-Kentucky-Indiana Regional Council of Governments, Hamilton County Soil and Water Conservation District, Hamilton County Planning + Development Department, Butler County Storm Water District, ORSANCO and a variety of consultants have supported and implemented projects to improve the Mill Creek Watershed.

In 2015, the Mill Creek Watershed Council of Communities held a series of charrettes to solicit feedback from a wide variety of stakeholders throughout the watershed, including a Middle Mill Creek Charrette. This event garnered participation and feedback from over 250 people and close to 30 community representatives, industrial interests, consulting firms, and regional groups and governments about the issues they found most pressing on the Mill Creek and its tributaries. Many of the problems, concerns, and potential actions to mitigate those issues identified by Middle Mill Creek stakeholders have been incorporated into this plan.

Based on the feedback from the Middle Mill Creek charrette, this watershed area is faced with major issues of riparian corridor encroachment, stormwater management, streambank erosion, and trash pollution. Suggestions for addressing these issues focused on the built urban environment and mitigating the impacts as close to source as possible. The Mill Creek could benefit from widespread adoption of policies and/or codes that encourage or mandate more comprehensive best management practices for stormwater.

Also from the charrettes, protecting and restoring the riparian corridor was considered to be a high priority. The Middle Mill Creek has limited visibility and recreational access which makes building a coalition for watershed awareness more difficult. To protect/restore the riparian corridor the best strategy is bringing more people closer to the stream thru projects that build multi-use walk and bike trails. In this way, trail building serves the dual purpose of riparian corridor expansion and protection, while bringing attention to the creek in a positive light.¹

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 **Sharon Creek – Mill Creek HUC-12** in December 2016. One public meeting was held at 1:00 P.M. on

¹ This paragraph and the preceding paragraph were authored by Brian Wamsley of the Hamilton County Planning + Development Department.

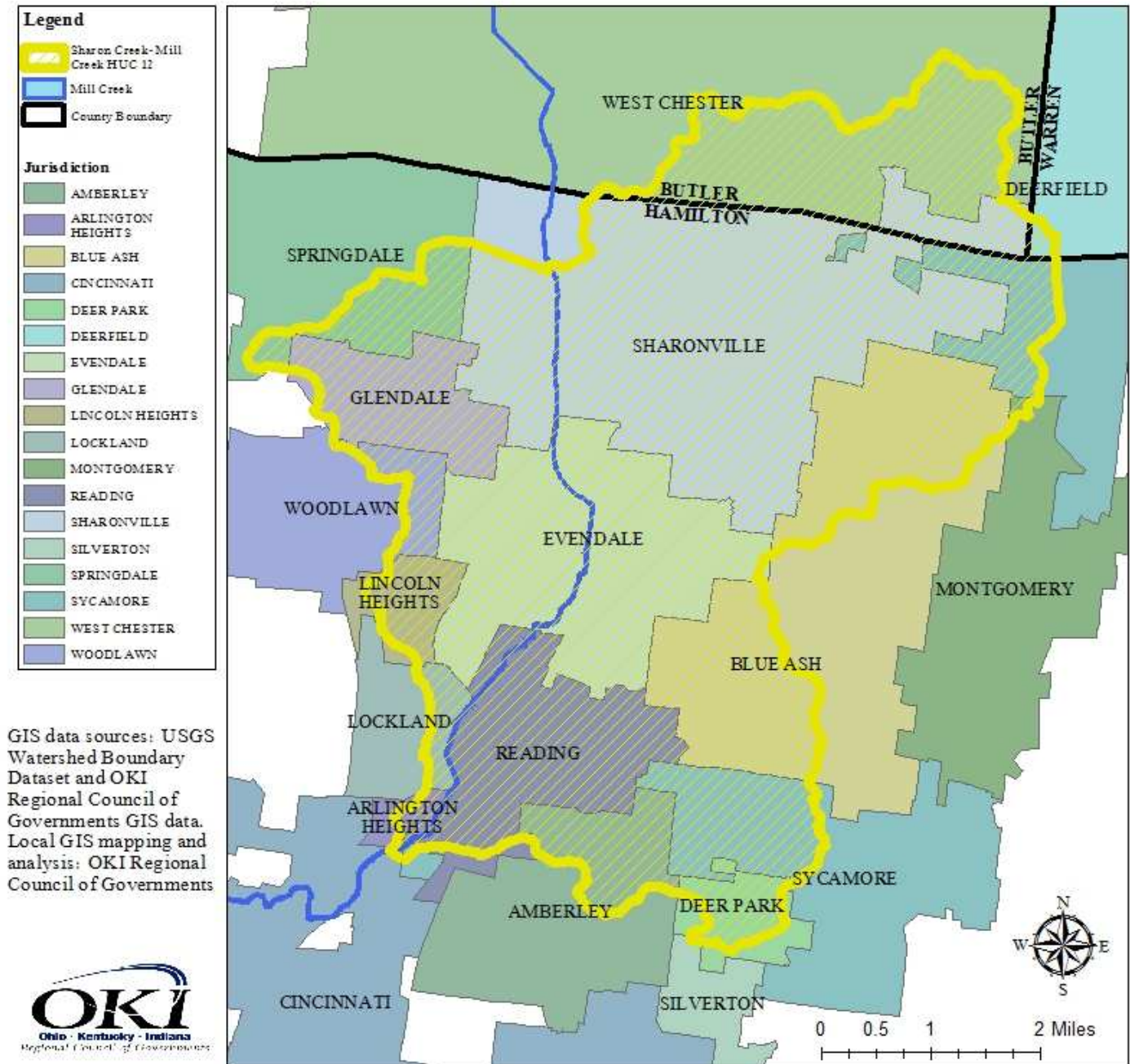
December 13th at the Blue Ash branch of the Cincinnati Public Library to obtain comments and discuss potential projects to be included in the plan. Invitations were sent to representatives of all jurisdictions within the boundaries of the **Sharon Creek – Mill Creek HUC-12**, and an announcement was posted on the Mill Creek Watershed Council of Communities' website and distributed in their bi-weekly e-newsletter. Stakeholders who were not able to attend the meeting were provided a draft of the plan to allow them the opportunity to weigh in as well.

This plan was authored by the Mill Creek Watershed Council of Communities in partnership with the Hamilton County Planning + Development Department, Hamilton County Soil & Water Conservation District, and Ohio*Kentucky*Indiana Regional Council of Governments primarily utilizing *Biological and Water Quality Study of Mill Creek and Tributaries, 2011* (Technical Report MBI/2012-6-10), produced for the Metropolitan Sewer District of Greater Cincinnati (MSDGC) by the Midwest Biodiversity Institute (MBI). In addition, the *Biological and Water Quality Study of Southwest Ohio Tributaries, 2014* (Ohio EPA Technical Report EAS/2016-06-01) (Southwest Ohio River Tributaries TSD), as well as the *Ohio 2016 Integrated Water Quality Monitoring and Assessment Report* by Ohio EPA Division of Surface Water were used as references.

The majority of the characterization information in Chapter 2 was provided by Bruce Koehler of Ohio*Kentucky*Indiana Regional Council of Governments (O*K*I) using *Water Quality Management Plan for Butler, Clermont, Hamilton and Warren Counties in Ohio* (O*K*I Regional Council of Governments, November 2015 Update). Work on the O*K*I plan was financed through grants from Ohio EPA and U.S. EPA with funds from Section 604(b) of the Clean Water Act. Project information from Chapter 4 was provided by the Mill Creek Watershed Council of Communities.

Chapter 2: Sharon Creek – Mill HUC-12 Watershed Characterization and Assessment Summary

FIGURE 1 BOUNDARY OF SHARON CREEK - MILL CREEK HUC-12 WITH JURISDICTION OVERLAY

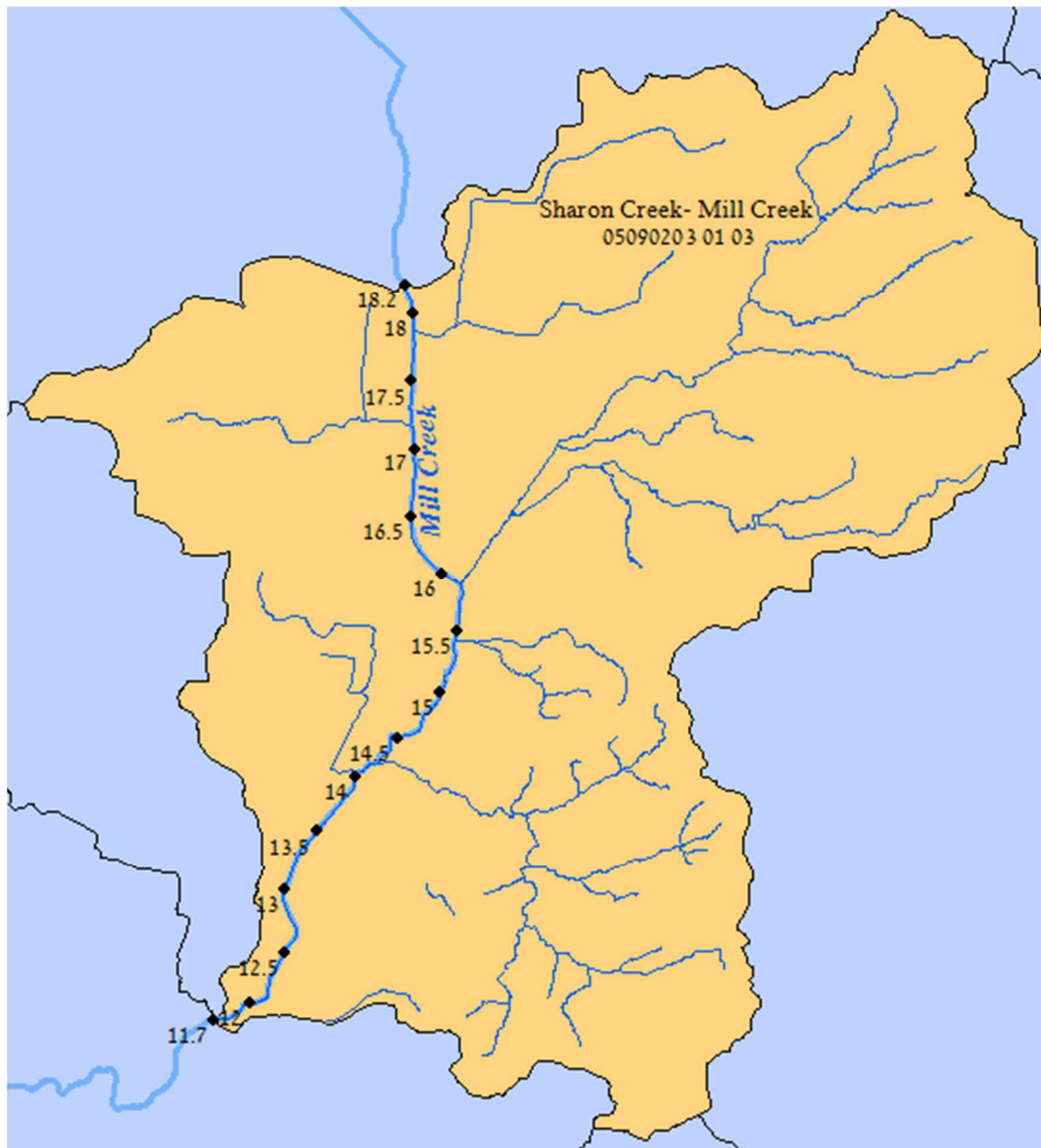


According to the Ohio EPA 2016 Integrated Report, the status of the **Sharon Creek – Mill Creek HUC-12** includes the following scores:

<i>Assessment Unit</i>	<i>Assessment Unit Name</i>	<i>Sq. Mi. in Ohio</i>	<i>Human Health</i>	<i>Recreation</i>	<i>Aquatic Life</i>	<i>PDW Supply</i>	<i>Priority Points</i>
05090203 01 03	Sharon Creek – Mill Creek	31.8	5h	5	5	0	7

A score of 5 indicates “Impaired; TMDL needed”, and the designation of “h” indicates that a score is based on historical data. For a complete overview of the Integrated Report Assessment Categories, please visit [this Ohio EPA website](#).

FIGURE 2 RIVER MILE MAP OF SHARON CREEK - MILL CREEK HUC-12



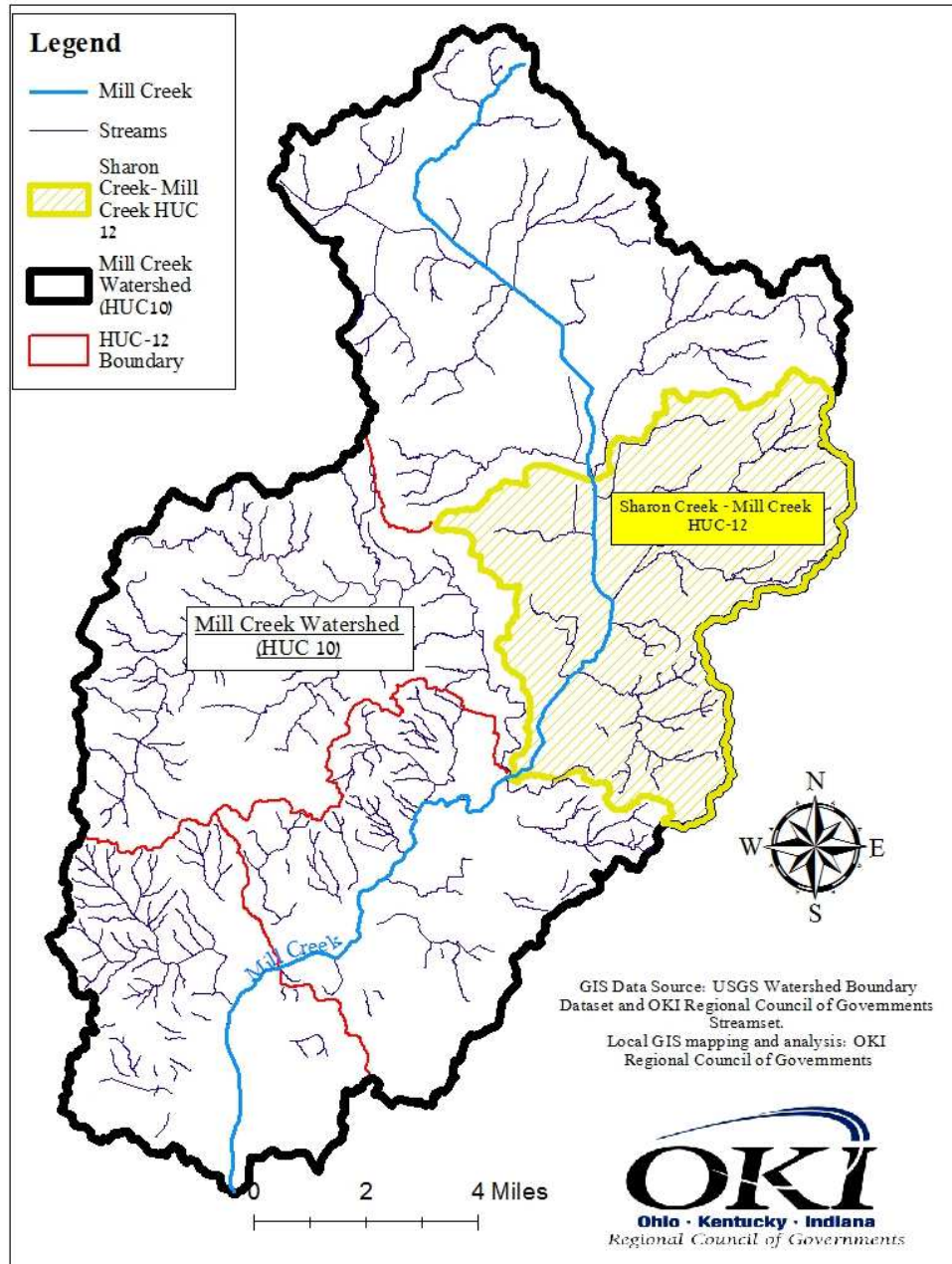
2.1 Summary Watershed Characterization for Sharon Creek – Mill Creek HUC-12

Section 2.1.1 was authored by Bruce Koehler of O*K*I using information from the [Water Quality Management Plan for Butler, Clermont, Hamilton and Warren Counties in Southwest Ohio \(November 2015 Update\)](#).

2.1.1 Physical and Natural Features

The **Sharon Creek – Mill Creek HUC-12** is the third of five HUC-12s located within the Mill Creek Watershed HUC-10, and lies in the middle of the Mill Creek Watershed north to south, and on the eastern side of the watershed.

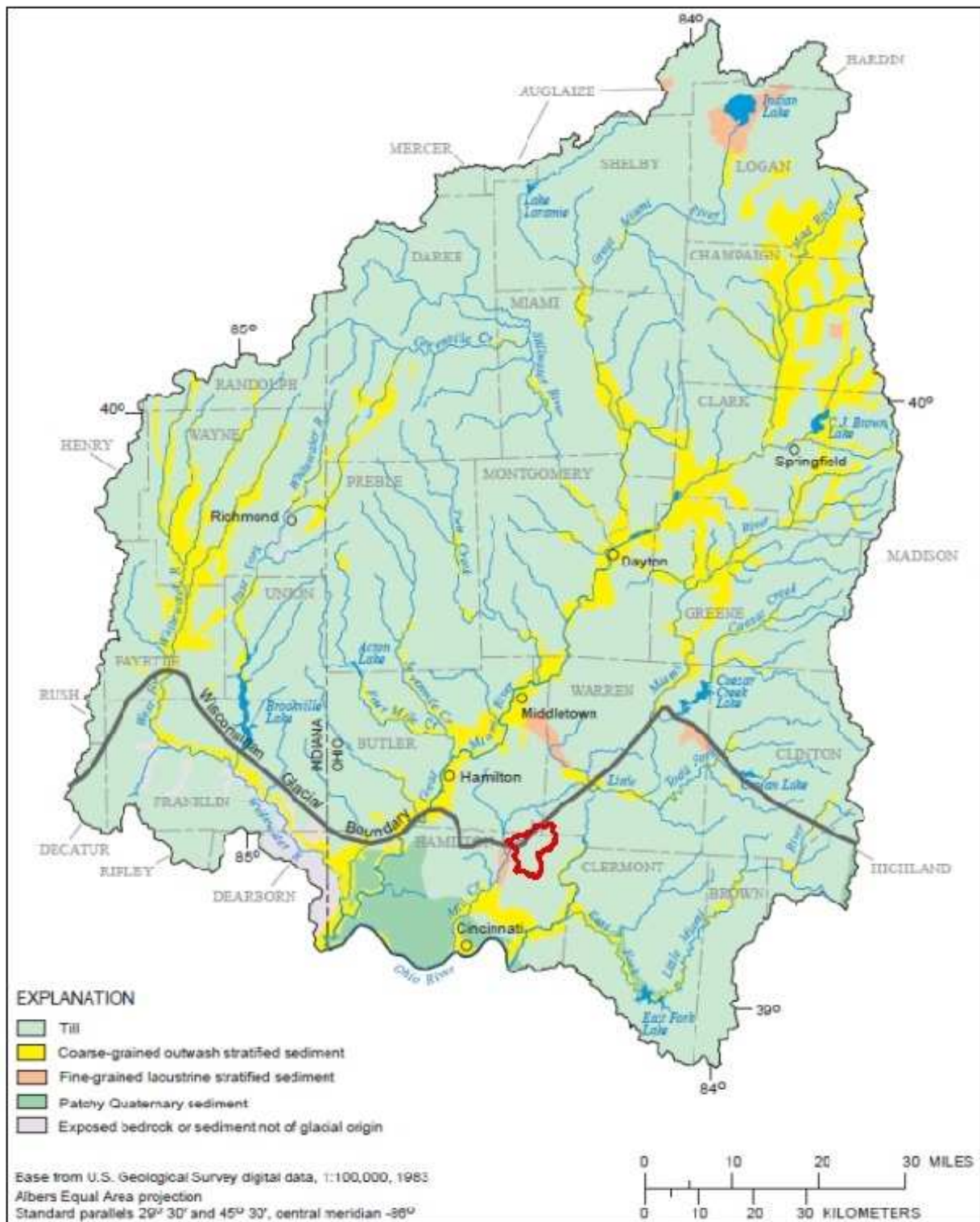
FIGURE 3 LOCATION OF SHARON CREEK - MILL CREEK HUC-12 WITHIN MILL CREEK WATERSHED



The Sharon Creek – Mill Creek assessment unit begins in the East Fork Mill Creek – Mill Creek HUC-12 to the northwest. The Mill Creek main stem and the East Fork Mill Creek converge at the boundary between the East Fork Mill Creek – Mill Creek HUC-12 and the **Sharon Creek – Mill Creek HUC-12**. Sharon Creek joins the Mill Creek in the middle of the **Sharon Creek – Mill Creek HUC-12**, and the West Fork Mill Creek converges with the Mill Creek main stem at the point where the West Fork Mill Creek HUC-12, **Sharon Creek – Mill Creek HUC-12**, and Congress Run – Mill Creek HUC-12 all meet.

Geology

FIGURE 4 MAP OF REGIONAL GEOLOGY WITH SHARON CREEK – MILL CREEK HUC-12 LOCATION

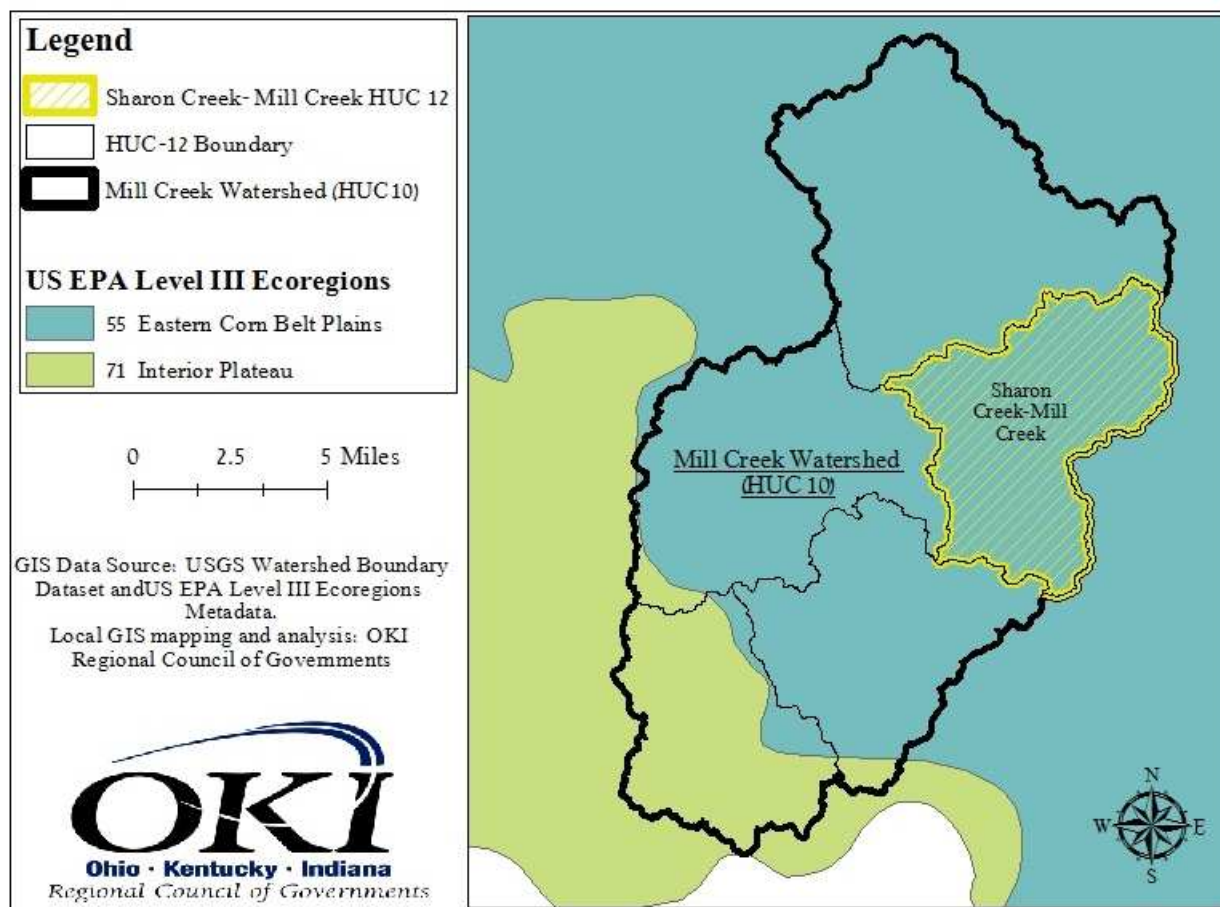


Two of the five geological map units shown in the figure above cover most of the **Sharon Creek-Mill HUC-12** (location indicated by red outline):

1. Till, which 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.
2. Lacustrine deposits, which are 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.
3. In addition, it appears that the assessment unit's southern extent fringes upon the geological map subunit titled in the figure above as "coarse-grained outwash stratified sediment." It consists of well-sorted sand and gravel. Outwash 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), these outwash deposits have been covered by recent alluvial deposits.

Ecoregions

FIGURE 5 MAP OF U.S. EPA LEVEL III ECOREGIONS WITH SHARON CREEK - MILL CREEK HUC-12 BOUNDARY



[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." In Ohio, ecoregions are also significant to

water resource assessments and regulations because 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 designation for streams in Butler, Hamilton and Warren counties, including the **Sharon 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 **Sharon Creek-Mill Creek HUC-12** is within the U.S. EPA Level III ecoregion titled Eastern Corn Belt Plains, which cover 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.

Physiography

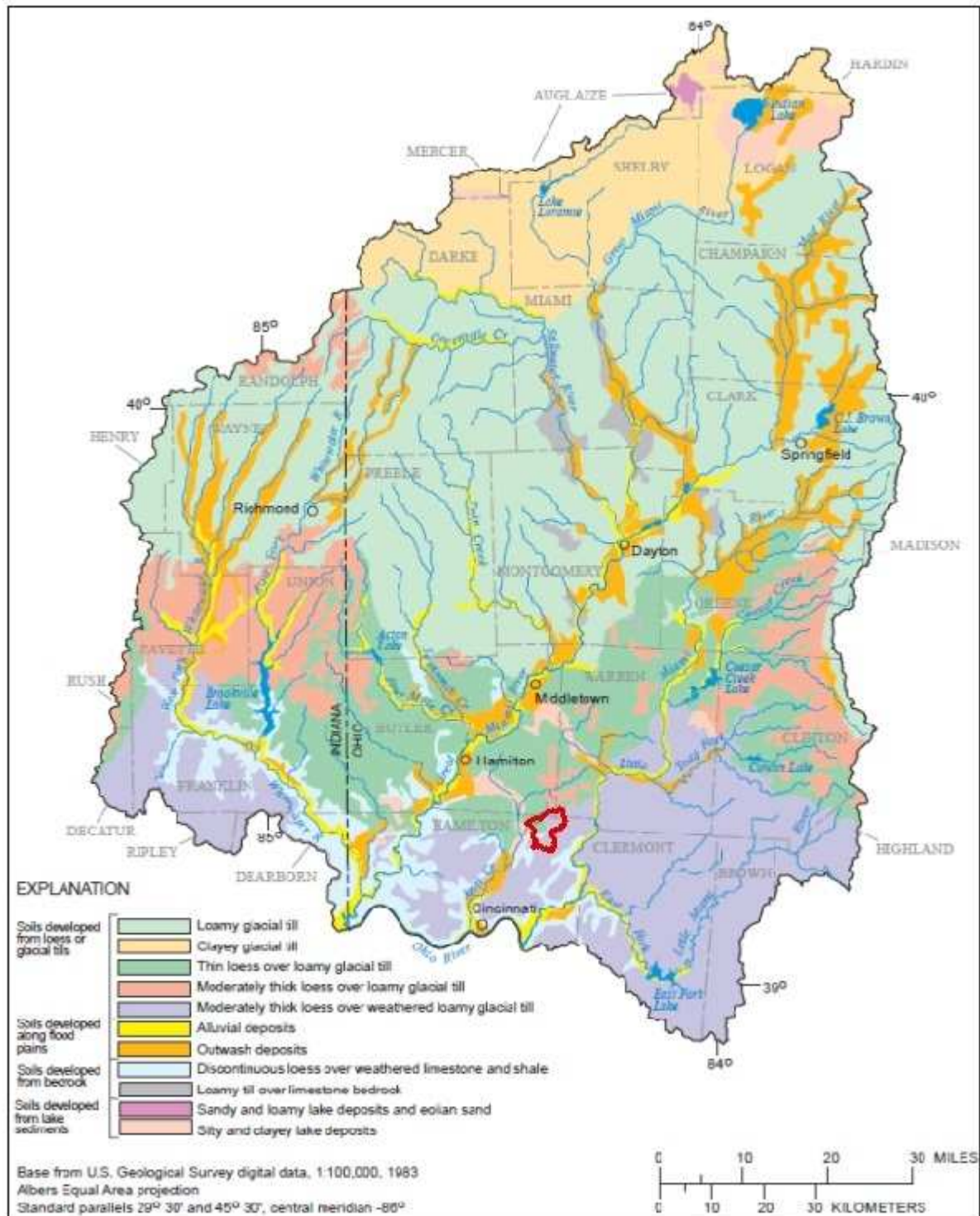
The **Sharon Creek-Mill Creek HUC-12** is within the Till Plains of the Central Lowland physiographic province. The province is characterized by Pleistocene glaciations. Advance and retreat of the glacial ice sheets produced a flat to gently rolling land surface that is cut by steep-walled river valleys 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 **Sharon Creek – Mill Creek HUC-12** is located immediately south of the southern terminus of the Wisconsinan glacial boundary.

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 **Sharon Creek-Mill Creek HUC-12** straddles two of the Ohio subunits:

1. Southern Ohio Loamy Till Plain – This Ohio physiographic subunit is characterized by end and recessional moraines between relatively flat-lying ground moraine. The morainal features are cut by steep volleyed streams, with alternating broad and narrow flood plains. Buried valleys filled with glacial-outwash deposits are common. This subunit also contains interlobate areas characterized by extensive outwash deposits, outwash terraces, and border moraines; as such they are areas of focused groundwater discharge in the form of cold, perennial, groundwater-fed springs and streams. Nearly all of the glacial deposits are underlain by Ordovician shale and limestone. In small parts of northern Butler and Warren counties, glacial deposits are underlain by Silurian carbonates.
2. Illinoian Till Plain – 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.

Soils

FIGURE 6 SOILS MAP WITH SHARON CREEK - MILL CREEK HUC-12 LOCATION



Given that a National Water Quality Assessment (NAWQA) by the U.S. Geological Survey assessed a study area that includes all of the **Sharon Creek-Mill Creek HUC-12**, the NAWQA is valid for describing the soil features of the assessment unit. U.S.G.S. describes four major types of soils found in the **Sharon Creek-Mill Creek HUC-12**:

1. *Soils developed from loess or glacial till.* These are the most common, covering large, generally continuous areas throughout the four counties. Such soils mostly comprise Wisconsin age loamy glacial till that often are overlain by thin to moderately thick loess. These soils typically have poor to moderate drainage, high base content and high fertility. This major soil type is further divided into three soil regions: (a) loamy glacial till, (b) thin loess over loamy glacial till, and (c) moderately thick loess over loamy glacial till.
2. *Soils deposited along floodplains.* These soils include alluvial and outwash deposits along the flood plains of major streams and tributaries. They are generally well-drained and fertile. They have high base contents and support intensive row crop agriculture or livestock farming. Such floodplain soils can be found along part of the Mill Creek in Hamilton County. This major soil type is further divided into two soil regions: (a) alluvial deposits and (b) outwash deposits.
3. *Soils developed from bedrock.* These soils are less common in the study area. They comprise discontinuous loess over weathered limestone and shale, mainly in Hamilton County, partly in Butler and Clermont counties, but not in Warren County. These soils are generally well-drained.
4. *Soils accumulated from lake sediments.* These soils are also less common. They are composed mainly of silty and clayey lake deposits, causing them to be poorly drained. Areas with lake sediments typically are ditched or have tile drains installed to improve drainage. Lake sediment soils are in parts of Butler, Hamilton and Warren counties.

Species

According to a preliminary report run using the U.S. Fish & Wildlife Service Information for Planning and Conservation, the **Sharon Creek – Mill Creek HUC-12** potentially encompasses habitat of 7 endangered species and 23 species of migratory birds; however, based on the extensive development within the assessment unit and impairments to the Mill Creek, Sharon Creek, and tributaries, 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 **Sharon Creek – Mill Creek HUC-12**, or, for that matter, within the Mill Creek Watershed HUC-10. However, there are stands of hardwood which could provide summer roosting habitat. Although the **Sharon 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 **Sharon 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

Historically, the **Sharon Creek – Mill Creek HUC-12** had a wetland area of 5.06%; this amount has decreased to its present 0.09% (Ohio Environmental Protection Agency, Division of Surface Water, 2016, p. (I1 Supplemental) 59).

2.1.2 Land Use and Protection

In the **Sharon Creek – Mill Creek HUC-12**, stream habitat quality tracks closely with the surrounding land use. According to the Ohio EPA 2016 Integrated Report, 84.50% of the assessment unit is Developed, 14.00% is Forest, 0.70% is Grass/Pasture, 0.60% is Row Crops, and 0.20% is Other. The assessment unit currently has an Aquatic Life Use Assessment Watershed Score of 1.5 out of 100, which places it in the More Impaired category—the most severe level of impairment (Ohio Environmental Protection Agency, 2016).

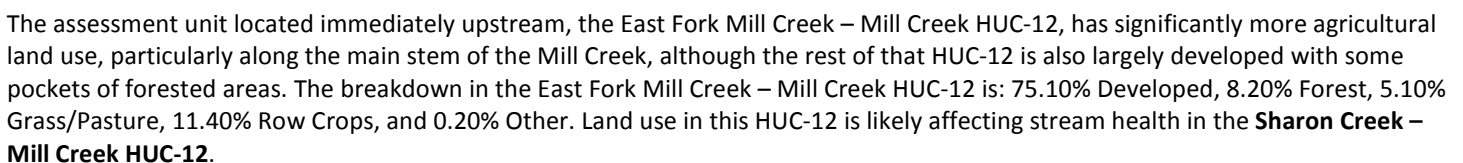


FIGURE 8 LAND COVER IN EAST FORK MILL CREEK - MILL CREEK HUC-12

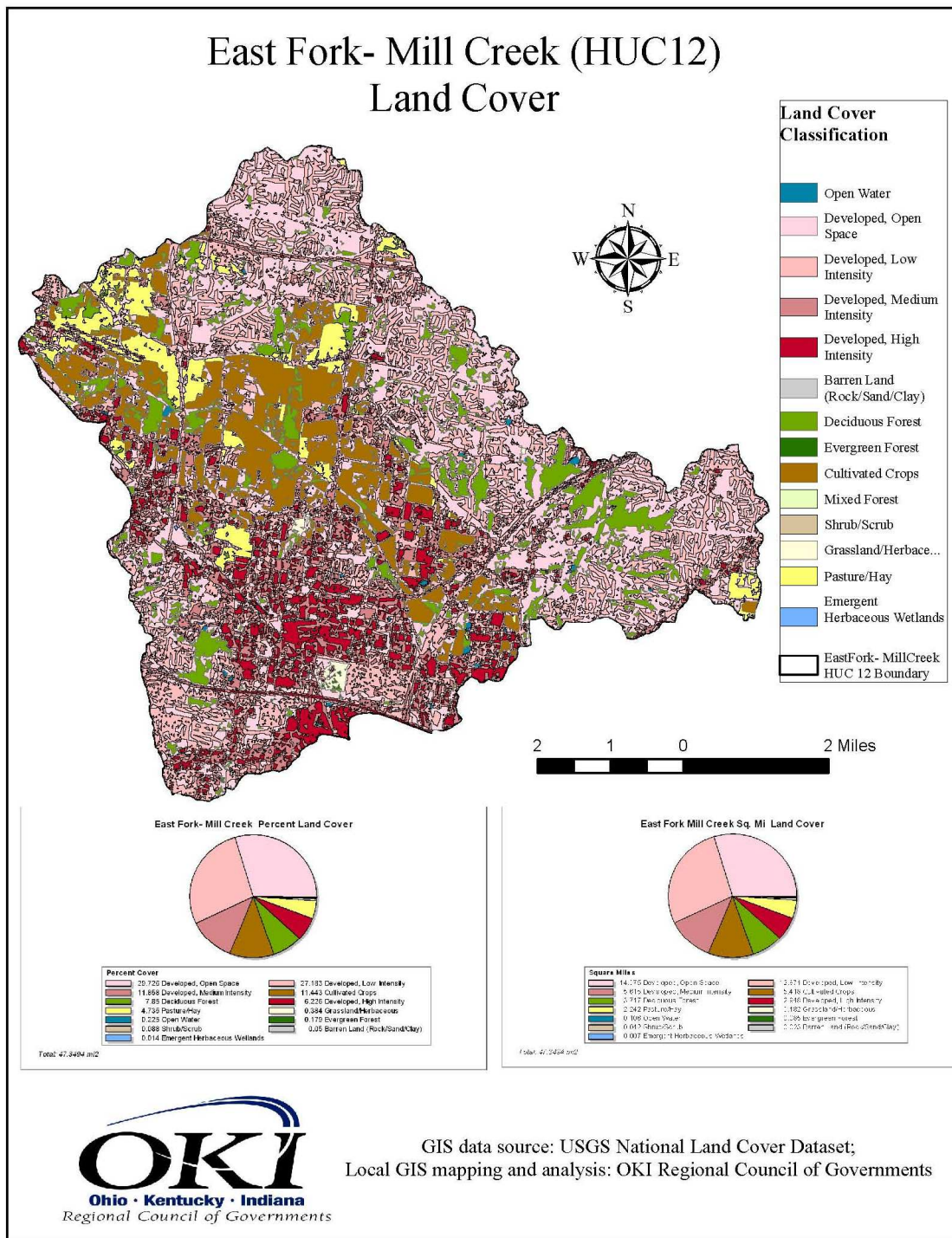


Table 1 below lists a more detailed set of Land Use Classification data for each HUC-12.

TABLE 1 LAND USE CLASSIFICATIONS FOR SELECTED MILL CREEK WATERSHEDS (O*K*I, 2016)

Cover Classification	% Watershed Area	Area (mi ²)	Cover Classification	% Watershed Area	Area (mi ²)
Sharon Creek – Mill Creek (05090203 01 03)			East Fork Mill Creek – Mill Creek (05090203 01 01)		
Open Water	0.31%	0.10	Open Water	0.22%	0.11
Developed, Open Space	30.12%	9.59	Developed, Open Space	29.73%	14.08
Developed, Low Intensity	26.65%	8.49	Developed, Low Intensity	27.18%	12.87
Developed, Medium Intensity	17.37%	5.53	Developed, Medium Intensity	11.86%	5.61
Developed, High Intensity	10.11%	3.22	Developed, High Intensity	6.23%	2.95
Barren Land (Rock/Sand/Clay)	<0.01%	<0.01	Barren Land (Rock/Sand/Clay)	0.05%	0.02
Deciduous Forest	13.40%	4.27	Deciduous Forest	7.85%	3.72
Evergreen Forest	0.56%	0.18	Evergreen Forest	0.18%	0.08
Mixed Forest	0.03%	0.01	Shrub/Scrub	0.09%	0.04
Shrub/Scrub	0.13%	0.04	Grassland/Herbaceous	0.38%	0.18
Grassland/Herbaceous	0.31%	0.10	Pasture/Hay	4.74%	2.24
Pasture/Hay	0.39%	0.13	Cultivated Crops	11.44%	5.42
Cultivated Crops	0.58%	0.19	Emergent Herbaceous Wetlands	0.01%	0.01
Emergent Herbaceous Wetlands	0.04%	0.01			
Total	100.00%	31.85	Total	99.96%	47.33

The developed areas in the **Sharon Creek – Mill Creek HUC-12** include low density residential areas in the northeast, central, western, and southeastern portions of the assessment unit. A large contiguous park space is also included in the low density residential area on the eastern side of the HUC-12. High density and medium residential land use is concentrated on the lower west side and southern end, while high and medium density commercial properties occupy the middle third of the eastern edge of the assessment unit. High and medium density industrial and commercial land lines either side of the Mill Creek main stem through the center of the **Sharon Creek – Mill Creek HUC-12**. The assessment unit includes 40.5 miles of interstate highways and ramps, 7.9 miles of U.S. highways, 9.1 miles of state routes, and 50 miles of county roads. The assessment unit is 36.9% impervious overall.

According to the Ohio*Indiana*Kentucky Regional Council of Governments, 5.26% of the assessment unit is comprised of highly erodible soils, 9.54% is made up of not highly erodible soils, and 14.28% of the assessment unit consists of potentially erodible soils. In terms of drainage, 17.63% of the soils in the assessment unit are well drained, 4.22% moderately well drained, 1.81% somewhat poorly drained, and 0.81% poorly drained (75.53% of the acreage had no drainage data available). Runoff from the **Sharon Creek – Mill Creek HUC-12** breaks down as follows:

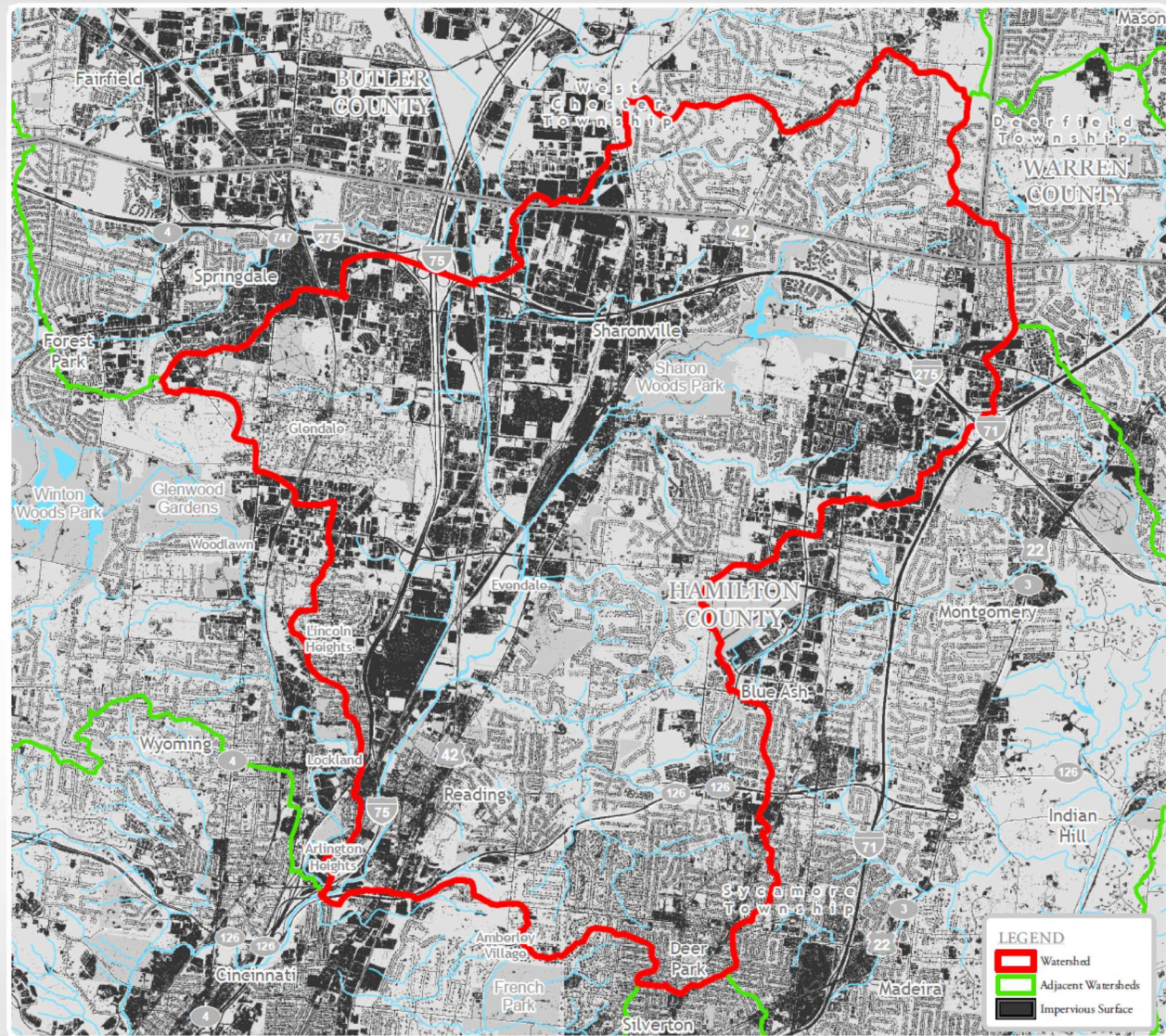
RUNOFF	PERCENT OF HUC-12
VERY HIGH	49.53%
HIGH	36.56%
MEDIUM	2.32%
LOW	3.93%
VERY LOW	0.50%
NEGLIGIBLE	0.74%
NO DATA	6.42%

FIGURE 9 IMPERVIOUS SURFACE IN SHARON CREEK - MILL CREEK HUC-12

SHARON CREEK-MILL CREEK Watershed

HUC 12: 050902030103

36.9% Impervious

ERODIBLE SOIL ACREAGES

Highly Erodible:	1070.1 acres	5.26% of Watershed
Not Highly Erodible:	1941.1 acres	9.54% of Watershed
Potentially Erodible:	2906.4 acres	14.28% of Watershed

SLOPE CLASS ACREAGES

Slight (0%-10% slope):	6514.8 acres	32.01% of Watershed
Moderate (10%-20% slope):	700.2 acres	3.44% of Watershed
Severe (more than 20% slope):	291.2 acres	1.43% of Watershed

RIPARIAN CORRIDOR ACREAGES

In Riparian Corridor:	300.9 acres	1.48% of Watershed
Outside Riparian Corridor:	7205 acres	35.4% of Watershed

AQUIFER AREA ACREAGES

Above Aquifer:	3078.5 acres	15.12% of Watershed
No Aquifer:	4427.6 acres	21.75% of Watershed

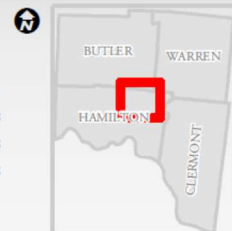
0 0.5 1 Miles

ROADWAY MILES

Interstate Highways and Ramps:	40.5 miles
U.S. Highways:	7.9 miles
State Routes:	9.1 miles
County Roads:	50 miles

POLITICAL JURISDICTIONS IN WATERSHED

Counties: Butler, Hamilton, Warren
 Townships: Deerfield, Springfield, Sycamore, West Chester
 Cities: Blue Ash, Cincinnati, Deer Park, Montgomery, Reading, Sharonville, Silverton, Springdale
 Villages: Amberly Village, Arlington Heights, Evondale, Glendale, Lincoln Heights, Lockland, Woodlawn



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 of natural hydrology and flow regime have been identified as needed restorations/improvements within the entire watershed, and especially in the highly industrialized main stem of the Mill Creek in the **Sharon Creek – Mill Creek HUC-12**.

Approximately 97% of Sharon Creek – Mill Creek HUC-12 is served by separate sanitary sewer. Approximately 2% of the area is served by combined sewer, and the remaining 1% is served by septic systems. During wet weather events, stormwater can enter the sanitary and combined sewer systems and can result in overflows from these sewer systems into streams, tributaries, or storm sewers where the sewer overflow comingles with stormwater runoff. Eight sanitary sewer overflows (SSOs) and nine combined sewer overflows (CSOs) are located throughout the portion of Hamilton County within this HUC-12. These sewer overflows are sources of such pollutants as fecal bacteria, nutrients, and total suspended solids and thereby contribute to stream impairment. Stormwater runoff throughout this highly urbanized assessment unit contributes significantly to impairment as well, both due to the quality and the quantity of runoff.²

Protected land within the **Sharon Creek – Mill Creek HUC-12** includes Sharon Woods, a Great Park of Hamilton County. According to the Great Parks website, “[m]ore than 80% of Great Parks of Hamilton County’s 17,000 acres protected are set aside as undeveloped greenspace” (Great Parks of Hamilton County, 2016).

Specific features within the **Sharon Creek – Mill Creek HUC-12** include:

- Sharon Woods: Golf course, reservoir, tributaries, waterfalls, wildlife
- Industrial corridor along the Mill Creek main stem including manufacturing, trucking, and storage
- Railroads
- Two major interstates
- Substantial residential development
- Landfills, both active and closed
- Interbasin groundwater transfer activity via pipeline and Mill Creek discharge
- SSO 700
- Numerous other SSOs and CSOs
- Two public water systems with drinking water source protection areas
- Low-head dams
- Superfund site
- Parking clusters

² This paragraph was authored by Katie Bollmer of CH2M based on data available for Hamilton County as a whole.

FIGURE 10 LOW HEAD DAM LOCATIONS ON THE MILL CREEK MAIN STEM IN SHARON CREEK - MILL CREEK HUC-12

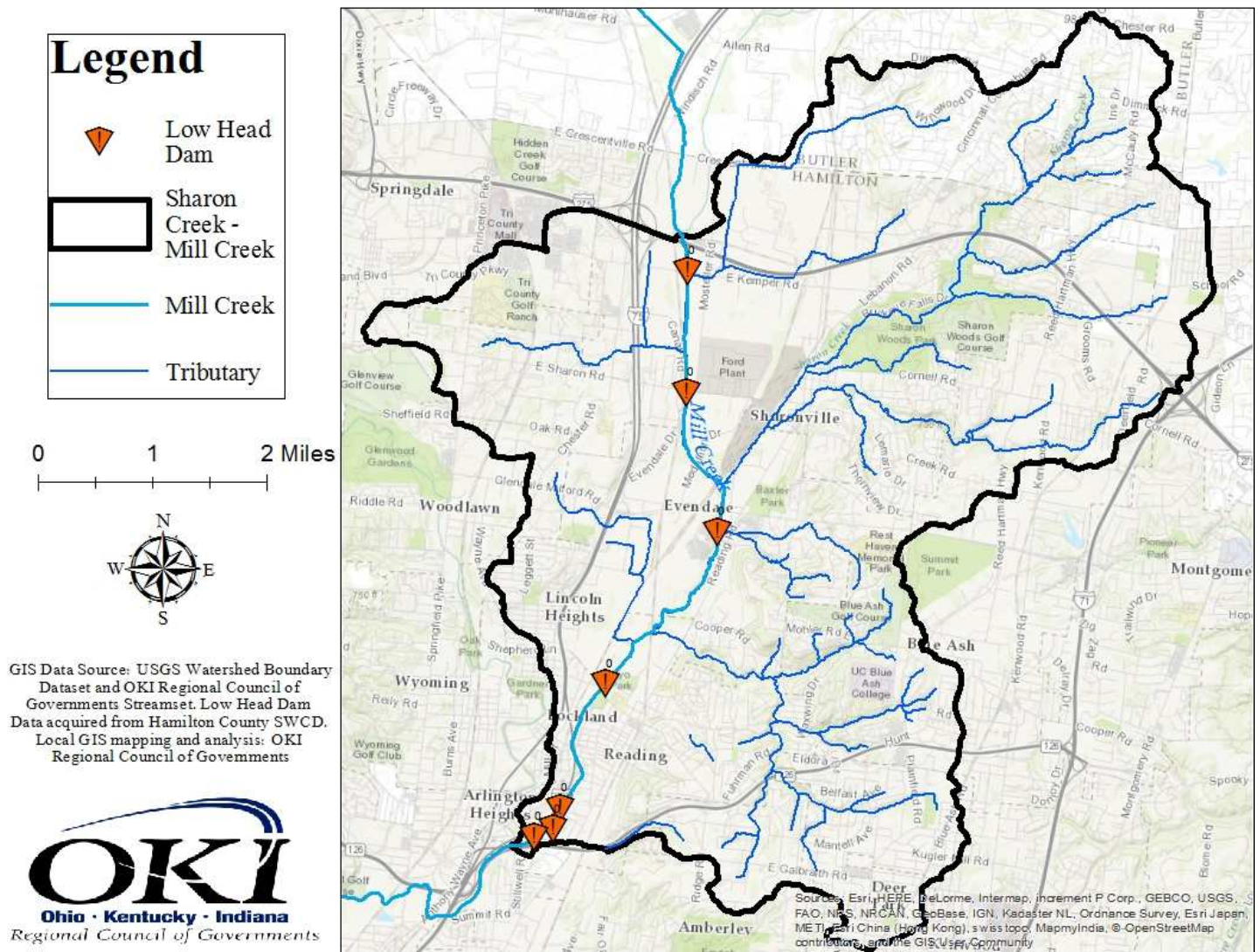


FIGURE 11 PARKING LOT CLUSTERS IN SHARON CREEK – MILL CREEK HUC-12 WITH JURISDICTION OVERLAY

Parking Lot Clusters

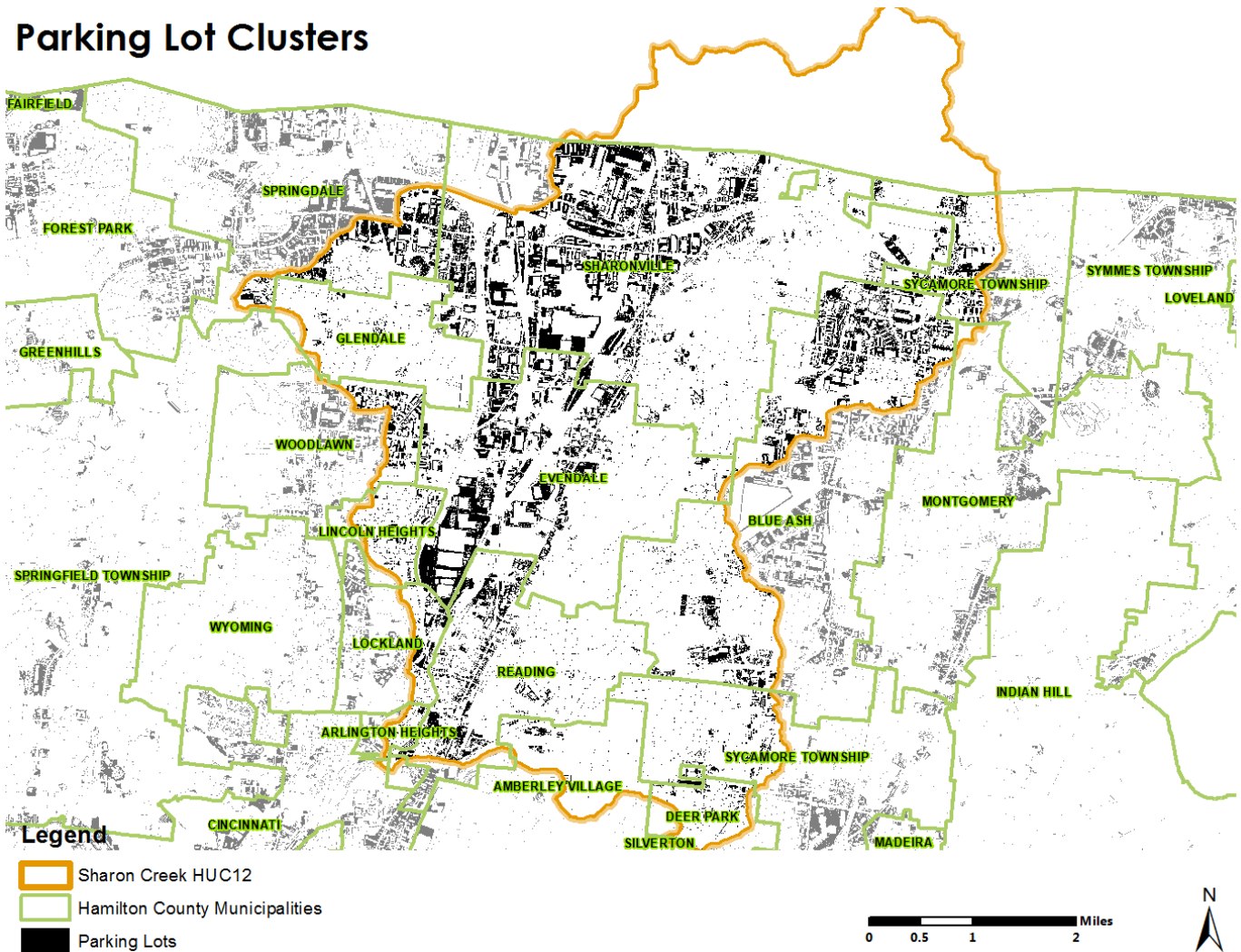
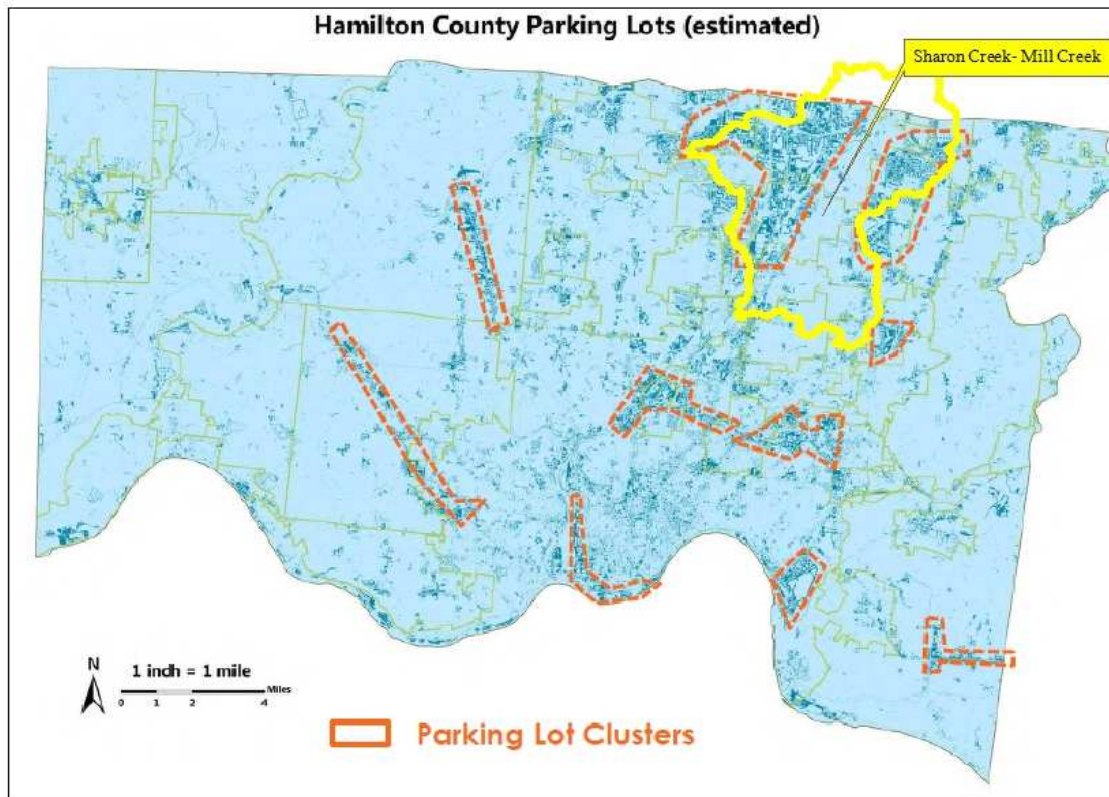


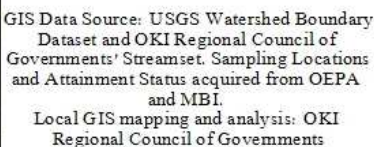
FIGURE 10 CREATED BY BRIAN WAMSLEY OF HCPD

FIGURE 12 HAMILTON COUNTY PARKING CLUSTERS WITH SHARON CREEK – MILL CREEK HUC-12 OVERLAY



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

In 2014 and 2011, Ohio EPA sampled twenty-three sites within the **Sharon Creek – Mill Creek HUC-12** (twenty-one sites in 2011 and three sites in 2014, with one overlapping site). According to the Ohio EPA, “2014 monitoring in the Mill Creek basin was supplemented by biological and habitat monitoring in 2011 conducted by Level 3 biologists from Midwest Biodiversity Institute...”, the aforementioned technical report produced by MBI for MSDGC (Ohio Environmental Protection Agency, 2016). Therefore, as there is an overlap in data sources between the various available reports, for the sake of consistency the data included in the tables in report is taken exclusively from the *Biological and Water Quality Study of Mill Creek and Tributaries, 2011* (Technical Report MBI/2012-6-10). The exception to this rule is the map of sampling locations and attainment status, which indicates the source of data for each point and status.



A summary of the biological status of streams in the **Sharon Creek – Mill Creek HUC-12** is provided in *Table 2*.

TABLE 2 SUMMARY OF THE BIOLOGICAL STATUS OF STREAMS IN SHARON CREEK - MILL CREEK HUC-12 (MBI, 2012)

Stream	No. of Sites	D.A. (mi ²)	Habitat Evaluation	Fish Evaluation	Macroinv. Evaluation	Existing ALU (2011)	Recommended ALU*
Mill Creek	4	72.2	Fair - Good	Poor - Fair		WWH	WWH
Sharon Creek	4	10.5	Poor - Good	Poor - Good	Poor - Good	WWH	WWH
Rossmoyne Creek	1	5.9	Good	Poor	Marg. Good	WWH	WWH
Town Run	3	2.1	Poor- Fair	Poor - Fair	Fair - Good	WWH	WWH
G.E. Tributary to Mill Creek @ RM 13.85	2	2.6	Poor - Good	Poor - Fair	Very Poor - Poor	None	WWH
Trib to Rossmoyne Cr @ RM 1.17	2	1.8	Fair	Very Poor - Fair	Very Poor - Fair	None	WWH
Trib (1.17) to Trib (0.43)	1	0.9	Fair	Poor	Good	None	WWH
Trib to Mill Creek @ RM 17.6	2	-	Poor	Poor - Fair	Poor - Marg. Good	None	WWH
Trib to Sharon Creek @ RM 3.0	1	1.1	Good	Poor		None	PHW III
Trib to Sharon Creek @ RM 0.60	1	1.1	Good	Poor	Good	None	WWH

*Recommendations from MBI, 2012

The Mill Creek main stem within the **Sharon Creek – Mill Creek HUC-12** has an assessment of existing aquatic life use (ALU) designation of Warm Water Habitat (WWH), as does Sharon Creek. Some of the tributaries listed in the MBI report did not, at the time of that report, have designations but MBI made recommendations based on the results of their 2011 sampling. A detailed description of these recommendations by stream is available on page 13 of the [2011 MBI Report](#).

Habitat

QHEI scores in the streams within the assessment unit ranged from Poor to Good (38.25 to 71.25). According to MBI, of the 21 sites in the **Sharon Creek – Mill Creek HUC-12**, seven had evidence of directly channel modifications. Most observed habitat impacts were determined to be “related to urban impacts related to encroachment of riparian and hydrological alterations that increase peak flows, erode banks and other habitats, and increase sedimentation and channel instability...and many sites had moderate or high embeddedness and silt cover and fair or poor riffle/pool development” (Yoder, 2012, p. 101).

Fish

The aquatic community of the **Sharon Creek – Mill Creek HUC-12** was and is predominated by macroinvertebrate and fish species that tolerate high levels of pollution. IBI scores in the **Sharon Creek – Mill Creek HUC-12** ranged from Very Poor to Good (12 to 44). During the 2011 sampling by MBI, 20% of sites attained the IBI biocriteria, while 80% were impaired. Only two of the sampling locations had scores in full attainment on both the IBI and ICI indices. All headwater sites lacked sensitive fish species; the only sensitive species in the **Sharon Creek – Mill Creek HUC-12** were sand shiners collected in the main stem of Mill Creek. According to MBI, “[t]he upstream sections of Sharon Creek had the most intact fish assemblage in this [HUC-12] and this is an Ohio EPA regional reference site. The Mill Creek main stem in this WAU had elevated levels of DELT anomalies (mean = 2.7%, range 0-4.2%) indicating some degree of chemical pollution...” (Yoder, 2012, p. 106).

Macroinvertebrates

In 2011, ICI scores were generated for four sites in the Mill Creek within the **Sharon Creek – Mill Creek HUC-12**. Each of these sites attained the ICI biocriteria for Warm Water Habitat with scores ranging from 40 to 46, although the same sites failed to meet the IBI

biocriteria, with scores ranging from 23 to 28. Causes of habitat impairment at each of these sites included sedimentation, nutrients, and chlorides. These are the only sites for which quantitative macroinvertebrate data are available. During the same sampling year, qualitative macroinvertebrate data were generated for sixteen sites in tributaries to the Mill Creek within the **Sharon Creek – Mill Creek HUC-12**. Four sites were narratively evaluated as “Good”, four sites as “Marginally Good”, three sites as “Fair”, four sites as “Poor”, and one site as “Very Poor”. All of the four sites narratively evaluated as “Poor” were located within Critical Area 1 and the site narratively evaluated as “Very Poor” was located within the tentatively identified Critical Area 3 (see Section 3.1 for discussion of Critical Areas). A more detailed breakdown of the macroinvertebrate assemblage is available on page 108 of the [2011 MBI Report](#).

2.3 Summary of NPS Pollution Causes and Associated Sources for Sharon 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 and Ohio EPA’s determination of causes and sources of impairment. As listed in the 2016 Integrated Water Quality Monitoring and Assessment Report, Ohio EPA has determined that the biological impairments in the **Sharon Creek – Mill Creek HUC-12** are from a wide range of causes. Those within the scope of this plan include sedimentation/siltation, nutrients, habitat alterations, and other/unknown impairments, likely of an industrial legacy nature. The nonpoint sources identified by this report are limited to urban runoff/storm sewers.

The MBI report includes a more granular breakdown of specific causes and sources associated with each site; these will be addressed in later chapters. However, it is important to note that the report identifies additional relevant (and critical) sources, including altered hydrology and hydromodification. Chlorides are noted by MBI as an additional cause of impairment within the assessment unit.

The **Sharon Creek – Mill Creek HUC-12’s** has only a few sampling locations from either Ohio EPA or MBI in full attainment. According to MBI’s evaluation, partial and non-attainment locations are all associated with the cause of sedimentation. Nutrients and chlorides impact the more than half of the partial and non-attainment sites, while habitat alteration is also a significant contributing factor in certain areas of the assessment unit. On the source side, altered hydrology was listed as a source at every MBI site in partial or non-attainment, urban runoff was identified as affecting all but one of these sites, and hydromodification also contributes as a source of impairment along the main stem of the 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 Midwest Biological Institute’s *Biological and Water Quality Study of Mill Creek and Tributaries, 2011* was utilized as the primary resource for determining critical areas and developing implementation strategies, as the site-by-site cause and source identifications made within the report allowed for a more precise and logical delineation of critical areas by cause and source of impairments, as well as land use.

Chapter 3: Critical Area Conditions & Restoration Strategies

3.1 Overview of Critical Areas

On a HUC-12 level, the overwhelming majority of MBI and Ohio EPA sampling locations in the **Sharon Creek – Mill Creek HUC-12** are in either Partial Attainment or Non-Attainment for the expected aquatic life uses. Three sampling locations (one Ohio EPA, two MBI) are in Full Attainment for Warm Water Habitat, and the fourth location (MBI) is designated Class IIIA Primary Headwater Habitat (Yoder, 2012, p. 13), but surrounding sampling locations are still in Partial or Non-Attainment.

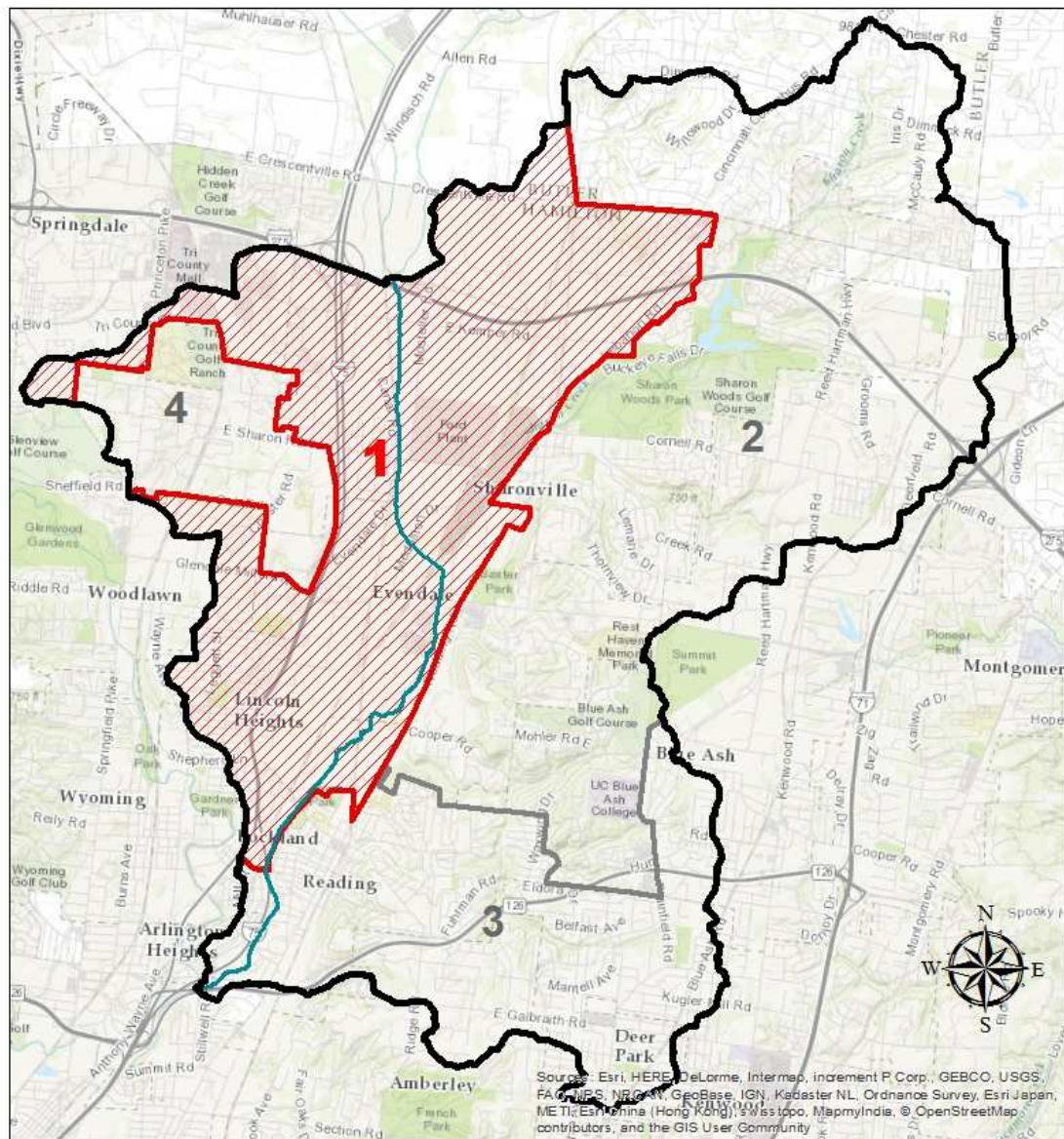
As is often the case in highly urbanized watersheds, a variety of causes and sources of impairment are negatively impacting every part of the assessment unit. As a result, there is an argument to be made that all parts of the assessment unit could be designated critical areas for various reasons.

In Version 1.0 of this **Sharon Creek – Mill Creek HUC-12 NPS-IS Plan**, Conditions, Goals & Objectives will be outlined for only Critical Area 1 (see Figure 14) as the only currently identified project within the assessment unit is contained within that Critical Area. Three potential future Critical Areas (see Figure 14) have been identified as areas in which to focus efforts to address the nonpoint source pollution issues causing the impaired state as new projects are developed. These Critical Areas were delineated by first identifying areas within the assessment unit with similar causes and sources. Then these areas were subdivided according to land use to allow a more precise delineation of sources and an assessment of the best practices for addressing impairments within each critical area. The map of critical areas and a chart indicating the logic behind their delineation is included below. This information is being 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 3 CRITICAL AREAS (CURRENT & PROPOSED FUTURE) IN SHARON CREEK – MILL CREEK HUC-12

CRITICAL AREA	LAND USE	CAUSES	SOURCES
1	Industrial/Commercial (92.56%), High Density Residential (7.44%)	Sedimentation, Nutrients, Chlorides, Habitat Alteration, Other/Unknown	Altered Hydrology, Urban Runoff, Hydromodification
<i>THE FOLLOWING CRITICAL AREAS ARE PROPOSED FUTURE CRITICAL AREAS WITH NO CURRENTLY IDENTIFIED POTENTIAL PROJECTS. THEREFORE, CHARACTERIZATION IS ONLY INCLUDED FOR CRITICAL AREA 1 IN THIS PLAN AT THIS TIME.</i>			
2	<i>Low Density Residential, Park (Sharon Woods), Commercial</i>	<i>Sedimentation, Nutrients, Chlorides, D.O.</i>	<i>Altered Hydrology, Urban Runoff</i>
3	<i>High Density Residential</i>	<i>Sedimentation, Nutrients, Chlorides, Habitat Alteration</i>	<i>Altered Hydrology, Urban Runoff, Hydromodification</i>
4	<i>Low Density Residential</i>	<i>Sedimentation, Chlorides</i>	<i>Altered Hydrology, Urban Runoff</i>

FIGURE 14 MAP OF CRITICAL AREAS (CURRENT & PROPOSED FUTURE) IN SHARON CREEK – MILL CREEK HUC-12



Legend

Sharon Creek- Mill Creek
HUC 12

Mill Creek

0 0.5 1 Miles

Critical Areas

1

2

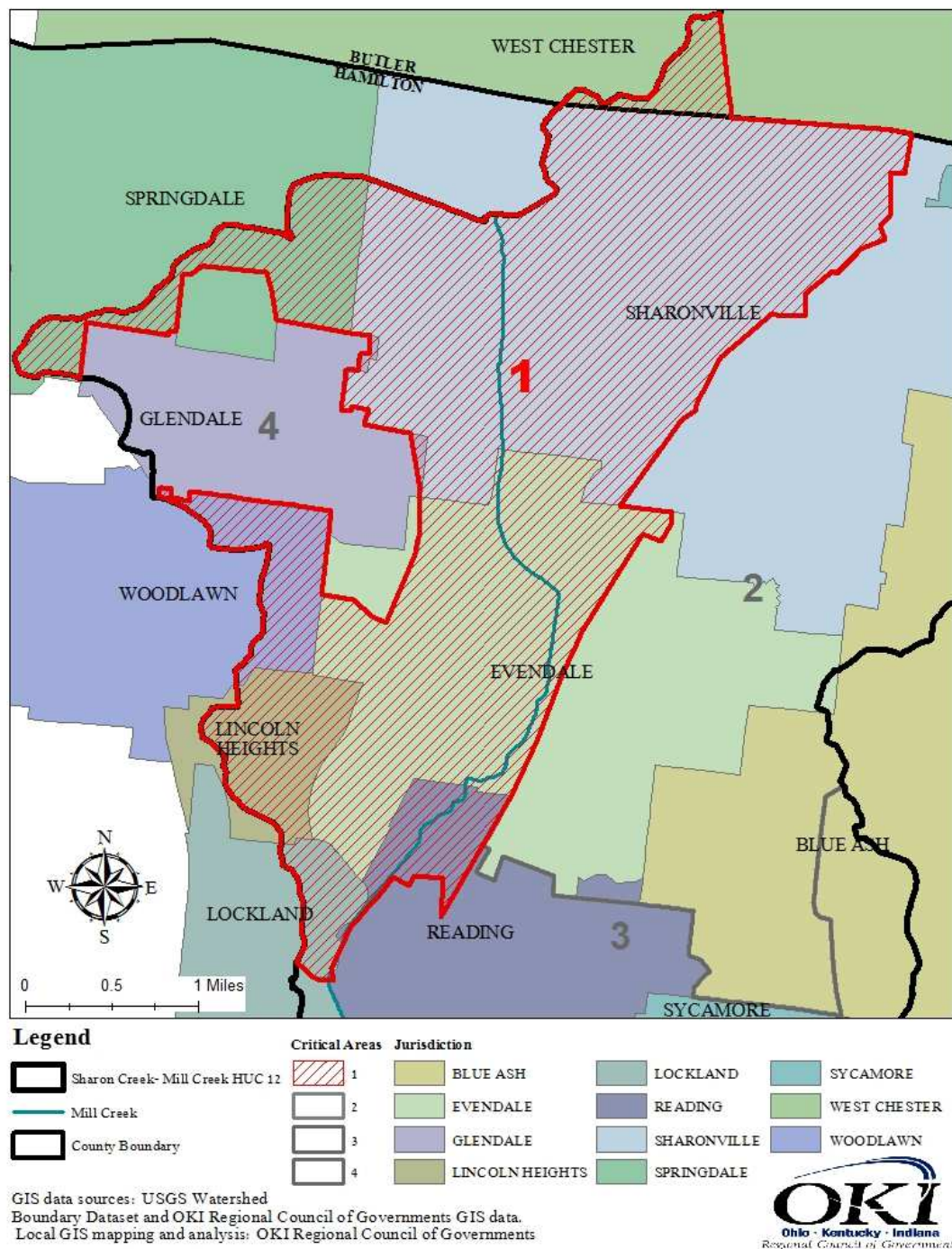
3

4

GIS data sources: USGS
Watershed Boundary
Dataset and OKI
Regional Council of
Governments GIS data.
Local GIS mapping and
analysis: OKI Regional
Council of Governments

OKI
Ohio • Kentucky • Indiana
Regional Council of Governments

FIGURE 15 MAP OF CRITICAL AREA 1 WITH JURISDICTION OVERLAY



3.2 Critical Area 1: Conditions, Goals & Objectives

3.2.1 Detailed Characterization

Critical Area 1 includes ten MBI sampling locations. In addition, two upstream sampling locations have been included in this characterization as land use and conditions in the East Fork Mill Creek – Mill Creek HUC-12 immediately upstream of Critical Area 1 is likely impacting impairment within the critical area. The land use within Critical Area 1 is primarily commercial/industrial (92.56%) with a section of high-density residential (7.44%) on the southwest side of the critical area. A 150-foot riparian zone (75 feet on

either side of the bank full mark) along the following waterways and drainage ditches in Critical Area 1 is a significant target for restoration work:

Sharon Creek – Mill Creek HUC-12
Mill Creek
Tributary to Mill Creek @ RM 13.85
Tributary to Mill Creek @ RM 17.60
Sharon Creek
Town Run (16.91)

That being said, in such a highly industrialized and impervious Critical Area, projects implemented to control the rate and amount of stormwater discharged into the streams in the Critical Area from areas not immediately adjacent to the streams would also be expected to confer potentially significant water quality benefits.

It is estimated that Critical Area 1 includes approximately 14.0 miles of stream length, including both the main stem of the Mill Creek and its tributaries. Assuming riparian zones of 75' either side of bank-full, this equates to approximately 254 acres of riparian zone targeted for improvement projects. As mentioned above, projects throughout the area of Critical Area 1, not just stream-adjacent sites, should be considered as potential pieces of the solution to altered hydrology in the Critical Area in particular.

The East Fork Mill Creek – Mill Creek HUC-12 upstream of Critical Area 1 is not included in Critical Area 1 because the impairments in that assessment unit should be remedied through the implementation of strategies outlined in an NPS-IS plan developed specifically for the East Fork Mill Creek – Mill Creek HUC-12.

Table 4 below outlines the attainment status and scores in the biological and habitat indices for the sampling locations within Critical Area 1, and two locations immediately upstream of Critical Area 1.

TABLE 4 SOURCE AREA 1 OVERALL BIOLOGICAL INDICES SCORES (MBI, 2012)

Stream	Fish/Invert. RM	D.A. (mi ²)	ALU Designation	Attainment	IBI/MIwb ^a	ICI ^b	QHEI/HHEI
Sharon Creek – Mill Creek HUC-12 (05090203 01 03)							
G.E. Trib to Mill Creek @ RM 13.85	0.10	1.50	WWH (U/R)	Non	28*/na	P*	60.25
G.E. Trib to Mill Creek @ RM 13.85	1.50	1.00	WWH (U/R)	Non	24*/na	P*	42.3/64
Mill Creek	13.2/13.1 ^w	72.00	WWH	Non	23*/3.3*	44	58.5
Mill Creek	13.9/13.9 ^w	68.80	WWH	Non	28*/5.3*	36	71.25
Mill Creek	15.0/14.85 ^w	68.80	WWH	Non	27*/6.5*	40	68.25
Mill Creek	16.6/16.6 ^w	50.50	WWH	Non	24*/4.4*	40	47.75
Sharon Creek	0.15/0.25 ^H	10.50	WWH	Non	26*/na	P*	38.5
Town Run (16.91)	0.3/0.3 ^H	2.70	WWH	Non	26*/na	MG ^{ns}	44
Trib to Mill Creek @ RM 17.60	0.35/0.35 ^H	3.10	WWH (U/R)	Non	26*/na	P*	38.25
Trib to Mill Creek @ RM 17.60	0.75/0.80 ^H	0.80	WWH (U/R)	Full	36 ^{ns} /na	MG ^{ns}	42.0/65
East Fork Mill Creek – Mill Creek HUC-12 (05090203 01 01)							
East Fork of Mill Creek	0.05/0.05 ^H	9.50	WWH	Partial	32*/na	MG ^{ns}	60.75
Mill Creek	18.15/18.15 ^w	32.40	WWH	Partial	34*/7.4	G	61.5

U/R: Undesignated/Recommended by MBI

^a - MIwb is not applicable to headwater streams with drainage areas < 20 mi.².

^b - An evaluation of the qualitative sample based on attributes such as EPT taxa richness, number of sensitive taxa, and community composition was used when quantitative data was not available or considered unreliable due to slow or no current velocities. VP=Very Poor, P=Poor, LF=Low Fair, F=Fair, MG=Marginally Good, G=Good, VG=Very Good, E=Exceptional.

H – Headwater Site Type: sites draining areas <20 mi.².

W - Wadeable Site Type: sites draining areas >20 mi.² sampled with wading equipment.

B - Boat Site Type: sampled with boat or raft mounted electrofishing.

^{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).

* - PHWH categories do not have use attainment criteria.

3.2.2 Detailed Biological Conditions

Table 5 below summarizes the fish community data at the sampling locations in Critical Area 1. Within the ECBP ecoregion, the WWH biocriteria for IBI is a score of 40 for wading/headwater sites and 42 for boat sites, and for MIwb is a score of 8.3 for wading sites and 8.5 for boat sites. None of the sampling locations within Critical Area 1 met either of these WWH standards, although one location on the Tributary to the Mill Creek @ RM 17.60 did receive a score that represents a non-significant departure from the IBI criterion of 40. IBI scores were relatively low throughout Critical Area 1, with no spatial pattern apparent at the scale of the Critical Area. With respect to physical habitat for fish, a spatial pattern is apparent with relatively low QHEI scores in the upper (northern) portion of Critical Area 1, and relatively high QHEI scores within the lower portion of the Mill Creek within this Critical Area.

TABLE 5 CRITICAL AREA 1 FISH AND HABITAT DATA (MBI, 2012)

Fish/Invert. RM	D.A. (mi ²)	Total Species	Sensitive Species	Headwater Species	% Tolerant	QHEI/HHEI	MIwb	IBI
Mill Creek (WWH) (Partial and Non-Attainment)								
13.2/13.1^w	72.00	9/8	0/0	0/0	83.3/89.3	58.5	<u>3.3*</u>	<u>23*</u>
13.9/13.9^w	68.80	11.17	1/0	0/1	53.5/54.0	71.25	<u>5.3*</u>	<u>28*</u>
15.0/14.85^w	68.80	13/18	1/1	1/1	47.8/46.6	68.25	6.5*	<u>27*</u>
16.6/16.6^w	50.50	6/10	0/0	0/0	55.7/47.7	47.75	<u>4.4*</u>	<u>24*</u>
G.E. Tributary to Mill Creek @ RM 13.85 (Recommended WWH) (Non-Attainment)								
0.10	1.50	7	0	1	66.7	60.25	N/A	<u>28*</u>
1.50	1.00	6	0	1	57.3	42.3/64	N/A	<u>24*</u>
Tributary to Mill Creek @ RM 17.60 (Recommended WWH) (Full and Non-Attainment)								
0.35/0.35^H	3.10	8	0	1	66.8	38.25	N/A	<u>26*</u>
0.75/0.80^H	0.80	7	0	1	94.4	42.0/65	N/A	36 ^{ns}
Sharon Creek (WWH) (Non-Attainment)								
0.15/0.25^H	10.50	10	0	1	85.0	38.5	N/A	<u>26*</u>
Town Run (16.91) (WWH) (Non-Attainment)								
0.3/0.3^H	2.70	9	0	0	71.7	44	N/A	<u>26*</u>

^a - MIwb is not applicable to headwater streams with drainage areas < 20 mi.².

^b - An evaluation of the qualitative sample based on attributes such as EPT taxa richness, number of sensitive taxa, and community composition was used when quantitative data was not available or considered unreliable due to slow or no current velocities. VP=Very Poor, P=Poor, LF=Low Fair, F=Fair, MG=Marginally Good, G=Good, VG=Very Good, E=Exceptional.

H – Headwater Site Type: sites draining areas <20 mi.².

W - Wadeable Site Type: sites draining areas >20 mi.² sampled with wading equipment.

B - Boat Site Type: sampled with boat or raft mounted electrofishing.

^{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).

* - PHWH categories do not have use attainment criteria.

Table 6 below summarizes the aquatic macroinvertebrate community data at the sampling locations in Critical Area 1. Within the ECBP ecoregion, the WWH biocriteria for ICI is 36. ICI scores were generated for four sites within the Mill Creek in 2011; each one of these sites met the ICI biocriteria for WWH even while not meeting the IBI biocriteria for WWH. The low IBI scores at sampling sites in lower reaches of the Mill Creek within Critical Area 1, in light of relatively high QHEI scores (58.5 – 68.25), and the relatively high ICI scores, may suggest that fish access to these reaches is being restricted by the many low-head dams located within the Mill Creek.

Narrative evaluations of macroinvertebrate communities in tributaries to the Mill Creek were generated at six sites within Critical Area 1; two sites were narratively evaluated as “Marginally Good” and four sites were narratively evaluated as “Poor”. It is noted that of the sixteen sites within the **Sharon Creek – Mill Creek HUC-12** for which narrative evaluations of macroinvertebrate communities were generated, all four of the “Poor” ratings are located in Critical Area 1. These sites are located in tributaries to the Mill Creek within a commercial/industrial landscape and three of the four sites are located within the bottom reach of their respective drainage areas, with sites above them having been evaluated as hosting healthier macroinvertebrate communities. The implication of this data is that cumulative effects of urban runoff and altered hydrology likely contribute to the noted spatial pattern.

TABLE 6 CRITICAL AREA 1 MACROINVERTEBRATE COMMUNITY DATA (MBI, 2012)

Fish/Invert. RM	D.A. (mi ²)	ICI
Mill Creek (WWH) (Partial and Non-Attainment)		
13.2/13.1^w	72.00	44
13.9/13.9^w	68.80	36
15.0/14.85^w	68.80	40
16.6/16.6^w	50.50	40
G.E. Tributary to Mill Creek @ RM 13.85 (Recommended WWH) (Non-Attainment)		
0.10	1.50	p*
1.50	1.00	p*
Tributary to Mill Creek @ RM 17.60 (Recommended WWH) (Full and Non-Attainment)		
0.35/0.35^H	3.10	p*
0.75/0.80^H	0.80	MG ^{ns}
Sharon Creek (WWH) (Non-Attainment)		
0.15/0.25^H	10.50	p*
Town Run (16.91) (WWH) (Non-Attainment)		
0.3/0.3^H	2.70	MG ^{ns}

^a - MIwb is not applicable to headwater streams with drainage areas < 20 mi.².

^b - An evaluation of the qualitative sample based on attributes such as EPT taxa richness, number of sensitive taxa, and community composition was used when quantitative data was not available or considered unreliable due to slow or no current velocities. VP=Very Poor, P=Poor, LF=Low Fair, F=Fair, MG=Marginally Good, G=Good, VG=Very Good, E=Exceptional.

H – Headwater Site Type: sites draining areas <20 mi.².

W - Wadeable Site Type: sites draining areas >20 mi.² sampled with wading equipment.

B - Boat Site Type: sampled with boat or raft mounted electrofishing.

^{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).

[‡] - PHWH categories do not have use attainment criteria.

3.2.3 Detailed Causes and Associated Sources

The sampling locations in Critical Area 1, listed below in Table 7, are in Partial Attainment or Non-Attainment for the existing or recommended WWH ALU designation. The associated causes include sedimentation, nutrients, chlorides, and habitat alteration, and sources include altered hydrology, urban runoff, and hydromodification. One of the upstream locations is also impaired by conductivity and organic enrichment.

TABLE 7 CRITICAL AREA 1 CAUSES AND SOURCES BY SAMPLING LOCATION

Fish/Invert. RM	D.A. (mi ²)	Causes	Sources
Mill Creek (WWH) (Partial and Non-Attainment)			
13.2/13.1^w	72.00	Sedimentation, Nutrients, Chlorides	Altered Hydrology, Urban Runoff
13.9/13.9^w	68.80	Sedimentation, Nutrients, Chlorides	Altered Hydrology, Urban Runoff
15.0/14.85^w	68.80	Sedimentation, Nutrients, Chlorides	Altered Hydrology, Urban Runoff
16.6/16.6^w	50.50	Sedimentation, Nutrients, Chlorides, Habitat Alteration	Altered Hydrology, Urban Runoff, Hydromodification
18.15/18.15^w Upstream	32.40	Sedimentation, Chlorides	Altered Hydrology, Urban Runoff, Hydromodification
G.E. Tributary to Mill Creek @ RM 13.85 (Recommended WWH) (Non-Attainment)			
0.10	1.50	Sedimentation, Nutrients	Altered Hydrology, Urban Runoff, Upstream Hydromodification
1.50	1.00	Sedimentation, Chlorides, Habitat Alteration	Altered Hydrology, Urban Runoff, Hydromodification
Tributary to Mill Creek @ RM 17.60 (Recommended WWH) (Full and Non-Attainment)			
0.35/0.35^H	3.10	Sedimentation, Chlorides, Habitat Alteration	Altered Hydrology, Urban Runoff, Hydromodification
Sharon Creek (WWH) (Non-Attainment)			
0.15/0.25^H	10.50	Sedimentation, Nutrients, Chlorides	Altered Hydrology, Urban Runoff-Storm Sewers
Town Run (16.91) (WWH) (Non-Attainment)			
0.3/0.3^H	2.70	Sedimentation, Chlorides	Altered Hydrology, Urban Runoff
East Fork of Mill Creek (WWH) (Partial Attainment)			
0.05/0.05^H Upstream	9.50	Sedimentation, Conductivity/Chlorides, Organic Enrichment	Altered Hydrology, Hydromodification

^a - MIwb is not applicable to headwater streams with drainage areas < 20 mi.².

^b - An evaluation of the qualitative sample based on attributes such as EPT taxa richness, number of sensitive taxa, and community composition was used when quantitative data was not available or considered unreliable due to slow or no current velocities. VP=Very Poor, P=Poor, LF=Low Fair, F=Fair, MG=Marginally Good, G=Good, VG=Very Good, E=Exceptional.

H – Headwater Site Type: sites draining areas <20 mi.².

W - Wadeable Site Type: sites draining areas >20 mi.² sampled with wading equipment.

B - Boat Site Type: sampled with boat or raft mounted electrofishing.

^{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).

[‡] - PHWH categories do not have use attainment criteria.

Contributing attributes of the streams and tributaries in Critical Area 1 of the **Sharon Creek – Mill Creek HUC-12** and areas immediately upstream in the East Fork Mill Creek – Mill Creek HUC-12 include:

- Channelization
- Silt and Muck Substrates
- Absence of Sinuosity
- Sparse or absent canopy cover

- Absence of or shallow (<40 cm) pool depth
- Heavy or moderate silt cover
- Slow current
- 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 the 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, nutrients, chlorides, and habitat alteration due to hydromodification, altered hydrology, and urban runoff. 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.

Almost all of the critical area is artificially drained. As a result, urban runoff contributes to a very flashy hydrograph, which in turn causes erosion and sedimentation issues throughout the assessment unit. A lack of riparian buffer or similar filtration for stormwater runoff also contributes to nutrient and chloride transport. Finally, habitat alterations compound the issues caused by the sedimentation, nutrients and chlorides for biota in the streams within Critical Area 1. Low-head dams and other fish barriers within the Critical Area may be contributing to the low IBI and MIWB scores throughout the Critical Area and are certainly significant habitat alterations within the stream 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, and MIWB scores in Critical Area 1 are all under the standard for attainment throughout the critical area. ICI scores are at or above attainment levels along the Mill Creek main stem, but fall short of the standard in the tributaries. Therefore, specific goals for Critical Area 1 include:

Goal 1. Achieve an IBI score of 40 at the wadeable and headwater sampling locations in Critical Area 1.

- **NOT ACHIEVED:** Seven of eight sites have scores ranging from 23 – 28. One of eight sites has a non-significant departure from the desired score of 40 but is still below 40 at 36.

Goal 2. Achieve an IBI score of 42 at boat sampling locations in Critical Area 1.

- **NOT ACHIEVED:** Two of two sites score 24 to 28.

Goal 3. Achieve a MIWB score of 8.3 at the wadeable sampling locations in Critical Area 1.

- **NOT ACHIEVED:** Four of four sites score significantly below 8.3 (range of 3.3 – 6.5).

Goal 4. Achieve an ICI score of 36 at those sampling locations in Critical Area 1 where an ICI numeric assessment is possible.

- ✓ **ACHIEVED:** Four of four sites with numeric ICI assessment score from 36 – 44.

Goal 5. Achieve an ICI narrative evaluation of “Good” or “Very Good” at those sampling locations in Critical Area 1 where an ICI numeric assessment is not possible.

- **NOT ACHIEVED:** Four of six sites have narrative evaluations of “Poor”; two of six sites have narrative evaluations of “Marginally Good”.

Goal 6. Achieve a QHEI score of 60 at all sampling locations in Critical Area 1.

- **PARTIALLY ACHIEVED:** Three of ten sites have scores above 60 (60.25 – 71.25), but the remaining seven sites are all below the goal of 60 (38.25 – 58.5).

Objectives

In order to achieve the overall nonpoint source restoration goal of Full Attainment in the **Sharon Creek – Mill Creek HUC-12**, the following objectives that address altered hydrology, hydromodification and urban runoff 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 sub-headings indicating into 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 **Sharon 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. Reduce the rate and amount of stormwater runoff entering the Mill Creek and tributaries in Critical Area 1 through retrofitting existing detention basins with multi-stage discharges.
- Implement retrofit projects in approximately 23 (50%) of the known existing detention basins in Critical Area 1.

Altered Stream and Habitat Restoration Strategies

- Objective 2. Restore several 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 2.5 miles (13,200 linear feet) of natural stream restoration in the Critical Area 1. (13,200 linear feet represents 9% of the total stream bank length in Critical Area 1.)
- Objective 3. Restore riparian habitat by removing invasive species, increasing native shrub and tree plantings in riparian areas, and stabilizing eroding stream banks.
- Remove invasive species and replant with native shrubs, trees, and forbs on approximately 25 acres of the riparian corridor along streams in Critical Area 1. This acreage represents approximately 10% of the desired minimum riparian acreage in the Critical Area (14 stream miles x 150-ft riparian zone).
- Objective 4. Restore and protect natural flow conditions through reconnection of streams to floodplains and restoring floodplain functionality.
- Implement floodplain reconnection projects and projects that install features to redirect flow into a natural regime in approximately 2.5 miles (13,200 linear feet) of stream. (13,200 linear feet represents approximately 18% of stream length in Critical Area 1).
- Objective 5. Increase aquatic connectivity through low head dam and culvert mitigation projects.
- Implement at least three (3) low head dam or culvert mitigation projects in Critical Area 1.

As these objectives are implemented, water quality monitoring (both project related and regularly scheduled monitoring) will be conducted to determine progress toward meeting the identified goals (i.e., water quality standards). 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 committee will reference the Ohio EPA Nonpoint Source Management Plan Update (Ohio EPA, 2013), which has a complete listing of all eligible NPS management strategies to consider including:

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

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 **Sharon 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 **Sharon Creek – Mill Creek HUC-12** there is one *Project and Implementation Strategy Overview Table* (subsection 4.2.1). Critical Area 1 has multiple and inter-related causes and associated sources of nonpoint source impairment. If another nonpoint source impairment is identified for Critical Area 1, it will be explained and added to that Critical Area's 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 there is an expectation that such potential projects will improve water quality in the **Sharon Creek – Mill Creek HUC-12**.
- Priority 3 In an effort to generate interest in projects, an information and education campaign will be developed and delivered. Such outreach will engage citizens to spark interest by stakeholders to participate and implement projects like those mentioned in Priority 1 and Priority 2.

The Project Summary Sheet (PSS) is included in section 4.2.2. This PSS provides the essential nine elements for the short-term project in the **Sharon Creek – Mill Creek HUC-12** that is 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 **Sharon Creek – Mill Creek HUC-12** Critical Area 1. A Project Summary Sheet is included for the one identified project seeking funding in the near future. It is anticipated that additional projects within Critical Area 1 will be developed.

4.2.1. Critical Area 1: Project and Implementation Strategy Overview Table

Critical Area 1: Project Overview Table for Sharon Creek – Mill Creek HUC-12 (05090203 01 03)								
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	1,2,3,4, 5,6	2,3,4	1	Reading Floodplain Bench – Phase I	City of Reading	Short	\$499,930	Ohio EPA \$319
Agricultural Nonpoint Source Reduction Strategies*								
High Quality Waters Protection Strategies*								
Other NPS Causes and Associated Sources of Impairment								

4.2.2. Critical Area 1: Project Summary Sheet

Nine Element Criteria	Information needed	Explanation
<i>n/a</i>	Title	Reading Floodplain Bench – Phase I
<i>criteria d</i>	Project Lead Organization & Partners	Project Lead Organization: City of Reading, Ohio Partner Organization: Mill Creek Watershed Council of Communities
<i>criteria c</i>	HUC-12 and Critical Area	Sharon Creek – Mill Creek HUC-12, Critical Area 1
<i>criteria c</i>	Location of Project	Immediately upstream of Haffey Field in the City of Reading, Hamilton County, Ohio, on the left descending bank on the main stem of the Mill Creek Located at approximately river mile (RM) 13.8, Latitude/Longitude 39.23,-84.44
<i>n/a</i>	Which strategy is being addressed by this project?	Altered Stream and Habitat Restoration Strategies
<i>criteria f</i>	Time Frame	7/2017 to 12/2018 Short-Term (Priority) (1-3 yr.)
<i>criteria g</i>	Short Description	Once constructed, the project will improve riparian habitat and decrease erosion and reduce sediment, phosphorus and nitrogen loads into the Mill Creek main stem in Critical Area 1. It will also restore more natural stream function and flow conditions by providing additional floodplain storage during periods of high flow.
<i>criteria g</i>	Project Narrative	The City of Reading, in partnership with the Mill Creek Watershed Council of Communities, is planning to reconnect 520 linear feet of the Mill Creek to floodplain and stabilize the same length of stream bank through the installation of a flood prone bench. The project will create a 50'-wide terrace near the flood elevation of the 1-year storm event. Slopes around the terrace will be cut back to a stable 3:1 slope to prevent future erosion. On the terrace and the surrounding 3:1 slopes, 400 live stakes and more than 300 containerized trees and shrubs will be installed.
<i>criteria d</i>	Estimated Total cost	\$499,930 (\$299,930 grant with \$200,000 matching) Both amounts fall into the Subcontract category. The matching funds have been committed by the City of Reading.
<i>criteria d</i>	Possible Funding Source	Ohio EPA §319

<i>criteria a</i>	Identified Causes and Sources	Causes: Habitat alteration, hydromodification, sedimentation Sources: Altered hydrology, hydromodification, urban runoff
<i>criteria b & h</i>	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, 13,200 linear feet of stream restoration with natural channel design methods, removal of 25 acres of invasive species and replanting with native vegetation, and 13,200 linear feet of floodplain reconnection are proposed in Critical Area 1.
	Part 2: How much of the needed improvement for the whole Critical Area is <i>estimated</i> to be accomplished by this project?	At 520 linear feet of proposed project length, 3.9% of the natural channel design and 3.9% of the floodplain reconnection objectives will be met. Approximately 1.1 acres will be stabilized and replanted with native vegetation, which is 4.4% of the invasives removal/natives installation objective. Goals: There is recognition that there is lag time associated with nonpoint source-related projects and measured stream response. With respect to goals in Critical Area 1, the main driver is QHEI. Current data shows that the sampling point at RM 13.2, approximately 0.6 miles downstream of the proposed project location (RM 13.8), is at 58.5, which is 1.5 points below the attainment index score of 60. It is expected that this project will cause an incremental increase in the QHEI scoring by at least 1.5 points, or 100% progress toward the QHEI goal. Since the IBI and MIWB scores are relatively lower, 100% progress is not necessarily expected toward those goals, but significant progress is expected for those index scores.
	Part 3: Load Reduced?	Estimated 281 tons sediment/year, 336 #P/year, 730 #N/year
<i>criteria i</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 already 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.

<i>criteria e</i>	Information and Education	An outreach program led by the Council, in partnership with the City, 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 two community outreach post-construction tours by canoe will be led by the Council, as well as one canoe cleanup with the Mill Creek Yacht Club. Two additional site visits will be conducted, one oriented for City of Reading elected officials, and the other for regional greenway and watershed planning leaders.
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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, measureable 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).

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