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Chapter 5

Management of Nonpoint Sources of Pollution

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Chapter 5: *Management of Nonpoint Sources of Pollution*

Introduction and Purpose

Nonpoint sources of pollution are diffuse in nature, and have more than one point of origin. Common nonpoint sources are agriculture, forestry, urban land uses, mining, construction, dams, channels, land disposal and city streets. Nonpoint source pollutants include soil particles, fertilizers, animal manure, pesticides, oil, road salt, fecal material from failing septic systems, pet wastes and debris from paved areas. These pollutants are transported over the landscape by storm runoff, snow melt and wind to eventually enter rivers, streams, wetlands, lakes, ponds or the groundwater. In some cases, the nonpoint source pollution originates at a stream or aquifer because of a disturbance.

Point sources of pollution are stationary locations or fixed facilities from which pollutants are discharged. Though often described as end-of-pipe locations, point sources include any discernible, confined or discrete conveyances from which pollutants can be discharged to surface waters of the state.

The purpose of this chapter is to analyze the significance of nonpoint source pollution to water quality management planning for Butler, Clermont, Hamilton and Warren counties in Southwest Ohio. A significant objective of nonpoint source analysis is to help distinguish areas where wastewater treatment improvements or centralized sewage service may not be effective because most of the water quality degradation in some areas is attributable to nonpoint sources rather than point sources.

Both point source and nonpoint source pollution harm aquatic habitat and life. This chapter focuses on the impact that nonpoint source pollution has on aquatic life. The means for this analysis are twofold:

1. Ohio EPA expertise available through the Watershed Assessment Unit Summaries that are part of the *Ohio 2010 Integrated Water Quality Monitoring and Assessment Report.*
2. local expertise available through the staffs of soil and water conservation districts for Butler, Clermont, Hamilton and Warren counties

This chapter's third section, titled Nonpoint Source Data and Data Sources, explains how OKI combined the expertise of Ohio EPA and the county conservation districts to analyze nonpoint source pollution.

OKI has long recognized the significance of nonpoint source pollution to water quality management planning. In the *Regional Water Quality Management Plan* (OKI, 1977) OKI noted that the Water Pollution Control Act Amendments of 1972 required that the areawide water quality management process should identify nonpoint sources of pollution and develop procedures to control it to the extent possible. OKI's 1977 plan stated "that it may be virtually impossible to economically achieve the required quality of water in the streams without identifying the nonpoint sources and exerting controls and management techniques to reduce them."

In the years since the original 1977 plan was prepared, nonpoint source pollution has taken on added prominence in the OKI Region. Regulatory programs and sewage infrastructure improvements have reduced many point source problems, while urbanization and spreading impervious surfaces have increased nonpoint source problems. Row crops still account for part of the region's nonpoint source pollution, but a growing share of the problem is attributable to developed land.

Sources and Causes of Nonpoint Source Pollution

Among the many questions surrounding nonpoint source pollution, two of the most basic questions are: *Where does the nonpoint source pollution come from?* and *How does it express itself in a river or stream?* The Ohio EPA's provides answers to these questions through Watershed Assessment Unit Summaries, which are online at:
http://wwwapp.epa.ohio.gov/dsw/ir2010/wau.php?hu= (*enter 12-digit hydrologic unit code here*).

As indicated in parentheses above, the end of the web address for each Watershed Assessment Unit Summary consists of that watershed's 12-digit hydrologic unit code. Hydrologic Unit Codes (HUCs) are a systematic method of naming watersheds in the United States. HUC watershed boundaries define areas that are drained by streams or rivers, and typically follow topographic features such as ridge lines. There are multiple levels of HUC watersheds based on size. Each large watershed is divided and subdivided into six levels: region, sub-region, basin, sub-basin, watershed, sub-watershed. Each of the six levels has a two-digit code. Watershed Assessment Units are assigned by sub-watersheds, so that each Watershed Assessment Unit Summary is signified by a 12-digit hydrologic unit code (six levels of watershed data with two-digit codes for each level).

Figure 5-1 on the next page shows the Watershed Assessment Units (i.e., sub-watersheds) of Butler, Clermont, Hamilton and Warren counties. For discussion purposes, these sub-watersheds are also referred to as HUC 12 watersheds because they correspond with 12-digit hydrological unit codes. This map shows the geological basis for further discussion on the sources and causes of nonpoint source pollution. Immediately following the map is Table 5-1, which lists the National Hydrography Dataset names for the HUC 12 watersheds shown on the map.

Figure 5-1: Watersheds in Butler, Clermont, Hamilton and Warren Counties

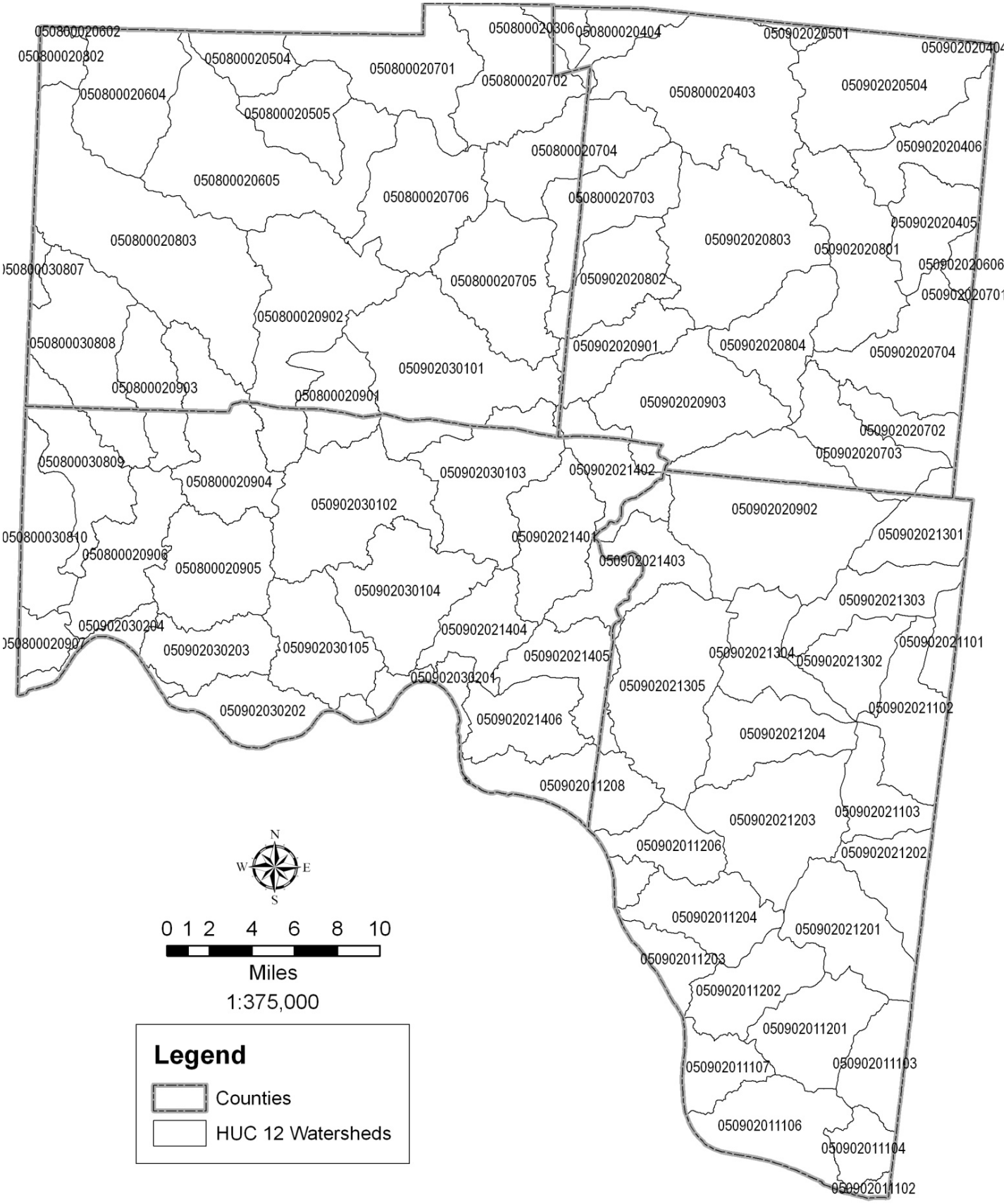


Table 5-1: Names for HUC 12 Watersheds in Butler, Clermont, Hamilton and Warren Counties

12-digit HUC	Watershed Name		12-digit HUC	Watershed Name
050800020306	Town of Germantown-Twin Creek		050902020501	Sugar Creek
050800020403	Clear Creek		050902020504	Newman Run-Little Miami River
050800020404	Dry Run-Great Miami River		050902020606	Little Creek-Todd Fork
050800020504	Rush Run-Sevenmile Creek		050902020701	East Fork Todd Fork
050800020505	Ninemile Creek-Sevenmile Creek		050902020702	Second Creek
050800020602	Little Four Mile Creek		050902020703	First Creek
050800020604	Acton Lake Dam-Four Mile Creek		050902020704	Lick Run-Todd Fork
050800020605	Cotton Run-Four Mile Creek		050902020801	Ferris Run-Little Miami River
050800020701	Elk Creek		050902020802	Little Muddy Creek
050800020702	Browns Run-Great Miami River		050902020803	Turtle Creek
050800020703	Shaker Creek		050902020804	Halls Creek-Little Miami River
050800020704	Dicks Creek		050902020901	Muddy Creek
050800020705	Gregory Creek		050902020902	O'Bannon Creek
050800020706	Town of New Miami-Great Miami River		050902020903	Salt Run-Little Miami River
050800020802	Brandywine Creek-Indian Creek		050902021101	Solomon Run-East Fork Little Miami River
050800020803	Beals Run-Indian Creek		050902021102	Fivemile Creek-East Fork Little Miami River
050800020901	Pleasant Run		050902021103	Todd Run-East Fork Little Miami River
050800020902	Banklick Creek-Great Miami River		050902021201	Poplar Creek
050800020903	Paddys Run		050902021202	Cloverlick Creek
050800020904	Dry Run-Great Miami River		050902021203	Lucy Run-East Fork Little Miami River
050800020905	Taylor Creek		050902021204	Backbone Creek-East Fork Little Miami River
050800020906	Jordan Creek-Great Miami River		050902021301	Headwaters Stonelick Creek
050800020907	Doublelick Run-Great Miami River		050902021302	Brushy Fork
050800030807	Headwaters Dry Fork Whitewater River		050902021303	Moores Fork-Stonelick Creek
050800030808	Howard Creek-Dry Fork Whitewater River		050902021304	Lick Fork-Stonelick Creek
050800030809	Lee Creek-Dry Fork Whitewater River		050902021305	Salt Run-East Fork Little Miami River
050800030810	Jameson Creek-Whitewater River		050902021401	Sycamore Creek
050902011102	Turtle Creek-Ohio River		050902021402	Polk Run-Little Miami River
050902011103	West Branch Bullskin Creek		050902021403	Horner Run-Little Miami River
050902011104	Bullskin Creek		050902021404	Duck Creek
050902011106	Bear Creek-Ohio River		050902021405	Dry Run-Little Miami River
050902011107	Little Indian Creek-Ohio River		050902021406	Clough Creek-Little Miami River
050902011201	Headwaters Big Indian Creek		050902030101	East Fork Mill Creek-Mill Creek
050902011202	North Fork Indian Creek-Big Indian Creek		050902030102	West Fork Mill Creek
050902011203	Boat Run-Ohio River		050902030103	Sharon Creek-Mill Creek
050902011204	Ferguson Run-Twelvemile Creek		050902030104	Congress Run-Mill Creek
050902011206	Tenmile Creek		050902030105	West Fork-Mill Creek
050902011208	Ninemile Creek-Ohio River		050902030201	Town of Newport-Ohio River
050902020404	Middle Caesar Creek		050902030202	Dry Creek-Ohio River
050902020405	Flat Fork		050902030203	Muddy Creek
050902020406	Lower Caesar Creek		050902030204	Garrison Creek-Ohio River

Each Watershed Assessment Unit Summary has sections indicating whether that watershed is attaining (i.e., satisfying) its designated beneficial uses for aquatic life and recreation. Beneficial use designations are goals set by the Ohio EPA for specific water bodies.

Ohio's Water Quality Standards have seven subcategories of aquatic life uses for rivers and streams. The three most commonly assigned aquatic life uses have quantitative biological criteria that express the minimum acceptable level of biological performance based on three biological indices. Those three aquatic life uses are:

- Warmwater: water bodies capable of supporting and maintaining a balanced, integrated, adaptive community of warmwater aquatic organisms
- Exceptional Warmwater: water bodies that have the potential to support and maintain an exceptional or unusual community of warmwater aquatic organisms.
- Modified Warmwater: water bodies that have been the subject of a use attainability analysis and have been found to be incapable of supporting and maintaining a balanced, integrated and adaptive community of warmwater organisms because of irretrievable modifications of the physical habitat.

Recreation use designations are in effect only during the recreation season (May 1 to October 15). They are divided into three main categories:

- Bathing Waters, which are suitable for swimming where a lifeguard or bathhouse are present
- Primary Contact, which are waters suitable for full-body contact recreation such as swimming, canoeing and scuba diving with minimal threat to public health as a result of water quality
- Secondary Contact, which are waters suitable for partial body contact recreation such as, but not limited to, wading, with minimal threat to public health as a result of water quality

Any condition that impedes a water body from attaining its designated beneficial use is an impairment. For those watersheds that are impaired, the Ohio EPA addresses both sources of impairment and causes of impairment.

In brief, a source of impairment is where the most prominent agent of impairment originates. It addresses the question: *Where does nonpoint source pollution come from?* For Butler, Clermont, Hamilton and Warren counties, the Watershed Assessment Unit Summaries listed 32 types of sources of impairment. Of those 32 types, 25 are typically considered to be indicative of nonpoint source pollution. In alphabetical order, they are:

(1) Agriculture
(2) Channelization – agriculture
(3) Channelization – development
(4) Contaminated sediments
(5) Dam construction – agriculture
(6) Dam construction – development
(7) Dredging – development
(8) Flow regulation/modification – development
(9) Land development/suburbanization
(10) Landfills
(11) Loss of riparian habitat
(12) Municipal (urbanized high density area)
(13) Natural (or Natural sources)

(14) Nonirrigated crop production
(15) Onsite wastewater systems (septic tanks)
(16) Other urban runoff
(17) Removal of riparian vegetation – agriculture
(18) Removal of riparian vegetation – development
(19) Sewer line construction
(20) Streambank modification/destabilization - agriculture
(21) Streambank modification/destabilization – development
(22) Unpermitted discharge (domestic wastes)
(23) Unrestricted cattle access
(24) Urban runoff/storm sewers (NPS)
(25) Upstream impoundment

The source of impairment types that are not typically indicative of nonpoint source pollution are:

(1) Combined sewer overflows
(2) Industrial point source (also: Minor industrial point source)
(3) Major municipal point source
(4) Minor municipal point source
(5) Municipal point source discharges
(6) Sanitary sewer overflows (collection system failures)
(7) Source unknown

For impaired watersheds, the Watershed Assessment Unit Summaries also list causes of impairment, which addresses the question: *How does the impairment express itself in a river or stream?* The Ohio EPA defines causes of impairment as the most prominent "agents" deemed responsible for the observed aquatic life use impairment in the assessment unit. Causes of impairment are important to Ohio EPA because the *Ohio 2010 Integrated Water Quality Monitoring and Assessment Report* states: "Causes will be the initial focus of restoration activities or TMDL (total maximum daily load) development within the watershed." A total maximum daily load is a calculation of the highest amount of a pollutant that a water body can receive and safely meet water quality standards set by the Ohio EPA.

For Butler, Clermont, Hamilton and Warren counties, the Watershed Assessment Unit Summaries listed 25 types of impairment causes. Of those 25 types, 14 are typically indicative of nonpoint source pollution. In alphabetical order, they are:

(1) Direct habitat alterations
(2) Flow alteration
(3) Iron
(4) Natural conditions (flow or habitat)
(5) Nutrient/eutrophication biological indicators
(6) Nutrients
(7) Oil and grease
(8) Organic enrichment/DO (which in some cases, can be indicative of point source pollution)
(9) Other flow regime alterations
(10) Phosphorus (total)
(11) Salinity/TDS/chlorides (which in some cases, can be indicative of point source pollution)
(12) Sedimentation/siltation
(13) Siltation
(14) Suspended solids

The cause of impairment types that are not typically indicative of nonpoint source pollution are:

(1) Ammonia
(2) Barium (which can indicate nonpoint source pollution in cases where it is naturally occurring)
(3) Cause unknown
(4) Chlorine
(5) Copper
(6) Organic enrichment (sewage) biological indicators
(7) Oxygen, dissolved
(8) Priority organics
(9) Taste and odor
(10) Unionized ammonia
(11) Unknown toxicity

Causes and sources of impairment for HUC-12 watershed assessment units were originally assessed by Ohio EPA for the larger 11-digit HUC areas of years past. As Ohio EPA continues converting from the 11- and 14-digit HUC system to the 10- and 12-digit HUC system, the causes and sources of impairment will become more germane to the HUC-12 watersheds.

Nonpoint Source Data and Data Sources

This section reviews data sources that help assess nonpoint source pollution. The review starts with federal data sources, then progresses to state, regional and local data sources. Useful data is printed below in custom tables for the watersheds of Butler, Clermont, Hamilton and Warren counties.

The U.S. Geological Survey performed a National Water Quality Assessment of the Great Miami River, Little Miami River and Mill Creek basins during the period of 1998-2002. This produced several technical reports that delve into nonpoint source pollution, among other issues. Those reports are described in Chapter 2: Water Resources in Southwest Ohio.

In 1997 the U.S. Environmental Protection Agency published a report entitled *The Incidence And Severity of Sediment Contamination In Surface Waters Of the United States; Volume 3: National Sediment Contaminant Point Source Inventory* (EPA-823-R-97-008) Although the report is a point source inventory and was prepared several years ago, the information on sediment contamination is still of interest because while the contaminants may originate from the ends of pipes, the contaminated sediments become nonpoint sources of pollution to rivers and streams, deposited in diffuse patterns which can persist over very long periods. Table 5-2 on the next page summarizes data from this report on contaminated sediment loadings to six watersheds in Southwest Ohio:

Table 5-2: Contaminated Sediment Loadings to Watersheds in Southwest Ohio

Hydrologic Unit Code (8-digit)	Watershed Name	Priority Group (scale of 1st to 5th)	Dominant Chemical Class	Dominant Industrial Class	Data Source
05080001	Upper Great Miami	fourth	divalent metal	sewerage systems	Permit Compliance System
05080002	Lower Great Miami	second	divalent metal	sewerage systems	Permit Compliance System
05080003	Whitewater	fourth	divalent metal	sewerage systems	Permit Compliance System
05090201	Ohio Brush-Whiteoak	fifth	divalent metal	public utilities	Permit Compliance System
05090202	Little Miami	fourth	divalent metal	sewerage systems	Permit Compliance System
05090203	Middle Ohio-Laughery	second	divalent metal	sewerage systems	Permit Compliance System

The U.S. Army Corps of Engineers maintains a database of permits required for anyone who wishes to discharge dredged or fill material into waters of the United States, under Section 404 of the Clean Water Act. The permit application requires a variety of information, including:

- project location
- waterbody to be affected
- nature of activity, such as structures that cause hydromodification, excavations, dredging or filling
- types of materials that may be discharged
- amount of each type of discharged material
- surface area of waters filled

Such information indicates activities that may produce nonpoint source pollution, at least for a measurable time period at a specific location.

Section 404 permits are required by the Clean Water Act, which also requires a Section 401 water quality certification prior to issuance of the Section 404 permit. In Ohio, Section 401 is administered by the Ohio EPA, which also can provide useful information on projects that may produce nonpoint source pollution.

The *Ohio Integrated Water Quality Monitoring and Assessment Report* is becoming increasingly useful for analyzing nonpoint source pollution. It is issued every two years by Ohio EPA's Division of Surface Water in compliance with Section 305(b) of the Clean Water Act. The report became even more useful in 2010 with Ohio EPA's conversion to smaller watershed assessment units with a corresponding increase in level of detail available. As the Ohio EPA continues to monitor on the scale of 12-digit hydrologic unit codes, the assessments and analyses in the biennial *Integrated Reports* should become more localized and specific. Prior reports were based on larger watershed assessment units.

Several sections of the *Ohio 2010 Integrated Water Quality Monitoring and Assessment Report* contain data useful to analyze nonpoint source pollution in Butler, Clermont, Hamilton and Warren counties.

Section E evaluates threats that watersheds may pose to peoples' health by noting the presence of contaminants in fish tissue. The consumption of fish is recognized in the *Ohio 2010 Integrated* Report as a beneficial use of surface water. Human health is the term used to connote this beneficial use. Ohio has adopted human health water quality standards to protect the public from adverse impacts, both carcinogenic and non-carcinogenic, due to the contaminated flesh of sport fish. The purpose of that criterion is to ensure that levels of a chemical in water do not bioaccumulate in fish to levels harmful to people who catch and eat fish.

The Ohio EPA reviewed fish tissue for six types of contaminants and found the vast majority of problems to be triggered by excessive levels of polychlorinated biphenyls (PCBs).

OKI considers PCBs to be indicative of nonpoint source pollution because their sale was banned in 1979 but they continue to persist in the environment by their presence in contaminated sediments. A table in the *Ohio 2010 Integrated Report* shows "waters impaired because levels of PCBs or mercury in fish tissue exceeded the threshold level upon which the water quality standard criterion is based." The table included eight assessment units in Butler, Clermont, Hamilton and Warren counties. All eight of the assessment units are classified with health impairments because of PCBs. The eight assessment units are shown below in Table 5-3. The first six water bodies are watershed assessment units, while the seventh and eighth water bodies (Whitewater River and Little Miami River), are large river assessment units.

Table 5-3: Ohio Water Bodies in the OKI Region Assessed with Human Health Impairments Due to PCBs

Water Body	County or Counties	Assessment Unit (HUC-12)
Dicks Creek	Butler and Warren	05080002 07 04
Beals Run-Indian Creek	Butler	05080002 08 03
Jameson Creek-Whitewater River	Hamilton	05080003 08 10
Town of New Miami-Great Miami River	Butler	05080002 07 06
Salt Run-Little Miami River	Warren	05090202 09 03
Newman Run-Little Miami River	Warren	05090202 05 04
Whitewater River	Hamilton	05080003 90 01
Little Miami River-Caesar Creek to O'Bannon Creek	Warren	05090202 90 01

Section L-1 of the *Ohio 2010 Integrated Report* shows the status of watershed assessment units in Ohio. In that section, an additional 17 watershed assessment units in Butler, Clermont, Hamilton or Warren counties are listed that have historical data indicating they are impaired for human health. Those 17 watershed assessment units are shown in Table 5-4 below:

Table 5-4: Ohio Water Bodies in the OKI Region with Historical Data of Human Health Impairments

Water Body	County or Counties	Assessment Unit (HUC-12)
Elk Creek	Butler	05080002 07 01
Browns Run-Great Miami River	Butler, Warren	05080002 07 02
Shaker Creek	Butler, Warren	05080002 07 03
Gregory Creek	Butler	05080002 07 05
Pleasant Run	Butler, Hamilton	05080002 09 01

Water Body	County or Counties	Assessment Unit
Banklick Creek	Butler, Hamilton	05080002 09 02
Paddys Run	Butler, Hamilton	05080002 09 03
Dry Run-Great Miami River	Butler, Hamilton	05080002 09 04
Taylor Creek	Hamilton	05080002 09 05
Jordan Creek	Hamilton	05080002 09 06
Doublelick Run-Great Miami River	Hamilton	05080002 09 07
Sugar Creek	Warren	05090202 05 01
East Fork Mill Creek-Mill Creek	Butler, Hamilton	05090203 01 01
West Fork Mill Creek	Hamilton	05090203 01 02
Sharon Creek-Mill Creek	Butler, Hamilton	05090203 01 03
Congress Run-Mill Creek	Hamilton	05090203 01 04
West Fork-Mill Creek	Hamilton	05090203 01 05

Section F of the *Ohio 2010 Integrated Report* addresses the designated beneficial use of recreation. Bacteria (Escherichia coli) is the criterion for assessing recreation use attainment. High bacteria levels are commonly attributed to point source pollution, such as insufficiently treated effluents discharged from wastewater treatment plants. Nevertheless, bacteria exceedances can also signify nonpoint source pollution, especially in watersheds subject to:

- poorly managed concentrations of onsite wastewater treatment systems (e.g. septic tanks)
- high densities of animal feedlots
- unrestricted cattle access

In some cases, wildlife excrement has been blamed for high bacteria levels.

Table 5-5 below shows which Watershed Assessment Units in Butler, Clermont, Hamilton or Warren counties were impaired for recreation use:

Table 5-5: Watershed Assessment Units in the OKI Region that are Impaired for Recreation Use

Watershed Assessment Unit	Assessment Unit Name	County (or Counties)
05080002 06 04	Acton Lake Dam-Four Mile Creek	Butler
05080002 08 03	Beals Run-Indian Creek	Butler
05090202 07 02	Second Creek	Warren
05090202 07 04	Lick Run-Todd Fork	Warren
05090202 09 01	Muddy Creek	Warren and Butler
05090202 13 05	Salt Run-East Fork Little Miami River	Clermont

For informational purposes, Section F of the *Ohio 2010 Integrated Report* also tabulates swimming advisory postings at Ohio's inland lake public beaches from 2004 to 2008. Swimming advisories are posted when bacteria levels are high. Table 5-6 below focuses on swimming advisory postings at the inland lake public beaches of the OKI region.

Table 5-6: Swimming Advisory Postings at Inland Lake Public Beaches in the OKI Region (2004-2008)

Park	Beach	County	2004[a]	2005[a]	2006[a]	2007[a]	2008[a]	Total
Caesar Creek	north	Warren	0/0	0/7	0/7	0/2	0/7	0
	south	Warren	0/0	1/7	2/10	0/2	0/7	3
East Fork	main	Clermont	0/0	0/15	1/14	0/13	0/12	1
	camp	Clermont	0/0	0/15	1/14	0/13	0/11	1
Stonelick		Clermont	0/0	1/13	1/14	1/11	1/11	4

[a] Indicates the number of advisories posted followed by the number of samples collected.

Section G of the *Ohio 2010 Integrated Report* addresses the designated beneficial use of aquatic life. As previously noted in this chapter, most of the causes and sources of aquatic life impairment are attributable to nonpoint source pollution. The report lists the following as the "top five causes of aquatic life impairment in HUC12 watersheds and large river assessment units based on biological water quality survey data collected from 1999 to 2008:

1. silt/sediment
2. nutrients
3. habitat modification
4. hydromodification
5. organic enrichment/dissolved oxygen

These top five causes are largely synonymous with the nonpoint source priorities stated by the four soil and water conservation districts consulted by OKI staff. The results of those consultations are tabulated later in this section.

Section H of the *Ohio 2010 Integrated Report* addresses the designated beneficial use of public drinking water supply. Only three Watershed Assessment Units of the OKI Region appear in the Section H table (H-3) on public drinking water supply assessment results for the nitrate and pesticide indicators. Nitrates and pesticides typically originate from nonpoint source pollution. These assessment units are summarized below in Table 5-7, along with another relevant unit (Lower Caesar Creek) for which data is insufficient:

Table 5-7: Summary of Public Drinking Water Supply Assessment Results in the OKI Region for the Nitrate and Pesticide Indicators

Watershed Assessment Unit	Assessment Unit Name (OKI County)	Public Drinking Water System Zone (Public Water System)	Designated Use Support	Nitrate Indicator	Pesticide Indicator
05090202 04 06	Lower Caesar Creek (Warren)	Caesar Creek Lake (Wilmington)	unknown	insufficient data	insufficient data
05090202 12 03	Lucy Run-East Fork Little Miami River (Clermont)	Harsha Lake – Impounded East Fork Little Miami River (Clermont County)	yes	full support	full support, on Ohio EPA's Watch List
05090202 07 02	Second Creek (Warren)	Whitacre Run @ RM 1.4 (Blanchester)	no	insufficient data	impaired
05090202 13 01	Headwaters Stonelick Creek (Clermont, Warren)	Stonelick Creek @ RM 23.4 (Blanchester)	no	insufficient data	impaired

Of the four watershed assessment units shown above in Table 5-7, only the Lucy Run-East Fork Little Miami River watershed has a public water system in the OKI Region. With successive *Integrated Reports*, the Ohio EPA can be expected to refine its assessment of nonpoint source pollution that impairs or threatens public drinking water supplies. The *Ohio 2010 Integrated Report* is only the second reporting cycle to assess this beneficial use. Ohio is adopting additional water quality criteria for the protection of public drinking water supply beneficial use and will expand assessments as criteria become finalized.

Section L4 of the *Ohio 2010 Integrated Report* can be an aid to ranking watersheds with nonpoint source pollution problems. Titled the *List of Prioritized Impaired Waters*, Section L4 indicates the order of

importance that Ohio EPA assigns to the various watershed assessment units for total maximum daily load work. Nonpoint source pollution is a major factor in determining a watershed's relative place on the prioritized list. Table 5-8 below selects the impaired watershed assessment units of Butler, Clermont, Hamilton and Warren counties, then lists them in the order they appeared in Section L4, based on the number of priority points assigned by Ohio EPA.

Table 5-8: List of Prioritized Impaired Waters in Butler, Clermont, Hamilton and Warren Counties, Ohio

Assessment Unit	Assessment Unit Name (OKI County or Counties)	Sq. Mi. in Ohio	Human Health	Recreation	Aquatic Life	PDW Supply	Priority Points	Next Field Monitoring	Projected TMDL
05090202 07 02	Second Creek (Warren)	20.0	3	5	5	5	10	2022	2010
05080002 06 04	Acton Lake Dam-Four Mile Cr. (Butler)	41.4	1	5	5	0	8	2020	2011
05090202 90 02	Little Miami River Mainstem, O'Bannon Creek to Ohio River (Warren, Hamilton)	1,757.0	5	5	5	0	8	2022	2010
05080002 06 02	Little Four Mile Creek (Butler)	13.7	1h	5	5	0	7	2020	2011
05080002 90 01	Great Miami River Mainstem, Mad River to Four Mile Creek (Warren, Butler)	3,298.0	5	3i	5h	0	7	2010	2013
05080002 07 04	Dicks Creek (Butler, Warren)	27.7	5	3	5x	0	6	2010	2013
05090202 13 01	Headwaters Stonelick Creek (Butler, Warren)	24.3	1h	3	5hx	5	6	2012	2015
05090202 90 01	Little Miami River Mainstem, Caesar Creek to O'Bannon Creek (Warren)	1,086.0	5	5	1	0	6	2022	2010
05080002 07 02	Browns Run-Great Miami River (Butler, Warren)	32.0	5h	3	5x	0	5	2010	2013
05080002 07 03	Shaker Creek (Warren, Butler)	21.4	5h	3	5x	0	5	2010	2013
05080002 07 05	Gregory Creek (Warren, Butler)	29.7	5h	3	5x	0	5	2010	2013
05080002 07 06	Town of New Miami-Great Miami River (Butler)	30.7	5	3	5x	0	5	2010	2013
05080002 90 02	Great Miami River Mainstem, Four Mile Creek to Ohio River (Hamilton, Butler)	5,371.0	5h	3	5h	0	5	2010	2013
05090202 09 01	Muddy Creek (Warren, Butler)	15.9	3	5	5	0	5	2022	2010
05090202 13 05	Salt Run-East Fork Little Miami River (Clermont)	42.5	1h	5	5hx	0	5	2012	2015
05080002 08 03	Beals Run-Indian Creek (Butler)	65.8	5	5	4n	0	4	2019	2011
05090201 12 01	Headwaters Big Indian Creek (Clermont)	21.5	3	3	5hx	0	4	2016	2019
05090201 12 02	North Fork Indian Creek-Big Indian Creek (Clermont)	18.4	3	3	5hx	0	4	2016	2019
05090201 12 03	Boat Run-Ohio River (Clermont)	9.0	3	3	5hx	0	4	2016	2019
05090201 12 04	Ferguson Run-Twelvemile Creek (Clermont)	19.5	3	3	5hx	0	4	2016	2019

Assessment Unit	Assessment Unit Name (OKI County or Counties)	Sq. Mi. in Ohio	Human Health	Recreation	Aquatic Life	PDW Supply	Priority Points	Next Field Monitoring	Projected TMDL
05090201 12 06	Tenmile Creek (Clermont)	13.0	3	3	5hx	0	4	2016	2019
05090201 12 08	Ninemile Creek (Clermont)	26.7	3	3	5hx	0	4	2016	2019
05080002 04 03	Clear Creek (Warren)	53.0	3	3	5hx	0	3	2010	2013
05080002 04 04	Dry Run-Great Miami River (Warren, Butler)	32.5	3	3	5hx	0	3	2010	2013
05080002 04 06	Cotton Run-Four Mile Creek (Butler)	51.3	1	1	5	0	3	2020	2011
05080002 09 01	Pleasant Run (Butler, Hamilton)	15.1	5h	3	5hx	0	3	2010	2013
05080002 09 02	Banklick Creek-Great Miami River (Butler, Hamilton)	44.1	5h	3	5hx	0	3	2010	2013
05080002 09 03	Paddys Run (Butler, Hamilton)	16.3	5h	3	5hx	0	3	2010	2013
05080002 09 04	Dry Run-Great Miami River (Butler, Hamilton)	28.8	5h	3	5hx	0	3	2010	2013
05080002 09 05	Taylor Creek (Hamilton)	26.7	5h	3	5hx	0	3	2010	2013
05080002 09 06	Jordan Creek-Great Miami River (Hamilton)	22.7	5h	3	5hx	0	3	2010	2013
05080002 09 07	Doublelick Run-Great Miami River (Hamilton)	6.7	5h	3	5hx	0	3	2010	2013
05090202 08 02	Little Muddy Creek (Warren, Butler)	20.6	3	3	5	0	3	2022	2010
05090202 14 01	Sycamore Creek (Hamilton)	23.4	3	1	5	0	3	2022	2010
05090203 01 01	East Fork Mill Creek-Mill Creek (Butler, Hamilton)	47.3	5h	3	5x	0	3	2014	2017
05090203 01 02	West Fork Mill Creek-Mill Creek (Butler, Hamilton)	36.2	5h	3	5x	0	3	2014	2017
05090203 01 03	Sharon Creek-Mill Creek (Hamilton, Butler)	31.8	5h	3	5x	0	3	2014	2017
05090203 01 04	Congress Run-Mill Creek (Hamilton)	30.0	5h	3	5x	0	3	2014	2017
05090203 01 05	West Fork-Mill Creek (Hamilton)	23.6	5h	3	5x	0	3	2014	2017
05080003 08 10	Jameson Creek-Whitewater River (Hamilton)	18.0	5	3	1hx	0	2	2010	2013
05080003 90 01	Whitewater River Mainstem, entire length (Hamilton)	1,474.0	5	3	1	0	2	2010	2013
05090202 04 04	Middle Caesar Creek (Warren)	30.1	1h	3	5x	0	2	2011	2014
05090202 04 05	Flat Fork (Warren)	16.8	1h	3	5x	0	2	2011	2014
05090202 04 06	Lower Caesar Creek (Warren)	41.2	1	3	5x	3i	2	2011	2014
05090202 05 01	Sugar Creek (Warren)	33.8	5h	3	4Ax	0	2	2011	2014
05090202 05 04	Newman Run-Little Miami River (Warren)	57.5	5	1	1	0	2	2011	2014
05090202 07 01	East Fork Todd Fork (Warren)	39.6	3	5	4n	0	2	2022	2010
05090202 07 04	Lick Run-Todd Fork (Warren)	35.7	3	5	1	0	2	2022	2010
05090202 09 03	Salt Run-Little Miami River (Warren, Hamilton)	35.3	5	3	3	0	2	2022	2010
05090202 12 03	Lucy Run-East Fork Little Miami River (Clermont)	34.7	1h	3	5hx	1	2	2012	2015
05090202 11 01	Solomon Run-East Fork Little Miami River (Clermont)	43.0	1h	3	5hx	0	1	2012	2015
05090202 11 02	Fivemile Creek-East Fork Little Miami River (Clermont)	42.6	1h	3	5hx	0	1	2012	2015

Assessment Unit	Assessment Unit Name (OKI County or Counties)	Sq. Mi. in Ohio	Human Health	Recreation	Aquatic Life	PDW Supply	Priority Points	Next Field Monitoring	Projected TMDL
05090202 11 03	Todd Run-East Fork Little Miami River (Clermont)	21.0	1	3	5hx	0	1	2012	2015
05090202 12 01	Poplar Creek (Clermont)	24.7	1h	3	5hx	0	1	2012	2015
05090202 12 02	Cloverlick Creek (Clermont)	42.3	1h	3	5hx	0	1	2012	2015
05090202 12 04	Backbone Creek-East Fork Little Miami River (Clermont)	20.8	1h	3	5hx	0	1	2012	2015
05090202 13 02	Brushy Fork (Clermont)	14.9	1h	3	5hx	0	1	2012	2015
05090202 13 03	Moores Fork-Stonelick Creek (Clermont)	19.4	1h	3	5hx	0	1	2012	2015
05090202 13 04	Lick Fork-Stonelick Creek (Clermont)	18.3	1h	3	5hx	0	1	2012	2015
05090202 14 02	Polk Run-Little Miami River (Hamilton, Warren, Clermont)	17.0	3	3	5hx	0	1	2022	2010
05090202 14 03	Horner Run-Little Miami River (Clermont, Hamilton)	21.5	3i	3	5hx	0	1	2022	2010
05090202 14 04	Duck Creek (Clermont, Hamilton)	15.5	3	3	5	0	1	2022	2010
05090202 14 05	Dry Run-Little Miami River (Hamilton, Clermont)	17.8	3i	3	5hx	0	1	2022	2010
05090202 14 06	Clough Creek-Little Miami River (Hamilton)	18.7	3i	3	5	0	1	2022	2010
05090203 02 01	Town of Newport-Ohio River (Hamilton)	7.5	3	3	5hx	0	1	2016	2019
05090203 02 02	Dry Creek-Ohio River (Hamilton)	17.3	3	3	5hx	0	1	2016	2019
05090203 02 03	Muddy Creek (Hamilton)	16.6	3	3	5hx	0	1	2016	2019
05090203 02 04	Garrison Creek-Ohio River (Hamilton)	6.6	3	3	5hx	0	1	2016	2019

From the perspective of nonpoint source pollution, the most pertinent elements of the Ohio EPA's Watershed Assessment Unit Summaries are:
(1) land use statistics; (2)causes of impairment; and (3) sources of impairment.

The land use statistics are not available for the Large River Assessment Units because they are two-dimensional, linear features; not three dimensional polygon features. For each Watershed Assessment Unit Summary, the land use statistics divide the watershed into five types of land use/land cover: (1) developed; (2) forest; (3) grass/pasture; (4) row crops; and, (5) other.

Developed land uses and row crop land uses are most likely to generate nonpoint source pollution. Developed areas send pollutants from dirty impervious surfaces to nearby rivers and streams. Row crop areas send pollutants from chemically treated farm fields that may be prone to erosion. Tables 5-9, 5-10, 5-11 and 5-12 on the next four pages rank the watersheds of Butler, Clermont, Hamilton and Warren counties by their combined percentages of land that is developed or in row crops.

Table 5-9: Combined Percentage of Land that is Developed or Farmed with Row Crops in Butler County's Watershed Assessment Units

Rank	*Hydrologic Unit Code*	*Watershed Assessment Unit Name*	*% Land Area that is Developed*	*% Land Area Farmed with Row Crops*	*Combined Percentage*
1	05080002 08 02	Brandywine Creek-Indian Creek	8.7	87.1	95.8
2	05080002 09 01	Pleasant Run	91.4	0.9	92.3
3	05090203 01 01	East Fork Mill Creek-Mill Creek	75.1	11.4	86.5
4	05080002 06 02	Little Four Mile Creek	5.5	80.8	86.3
5	05090203 01 03	Sharon Creek-Mill Creek	84.5	0.6	85.1
6	05090202 09 01	Muddy Creek	69.3	10.0	79.3
7	05080002 07 04	Dicks Creek	63.4	14.2	77.6
8	05080002 07 06	Town of New Miami-Great Miami River	39.0	31.8	70.8
9	05090202 14 02	Polk Run-Little Miami River	65.4	1.2	66.6
10	05080002 09 02	Banklick Creek-Great Miami River	56.1	6.7	62.8
11	05090202 08 02	Little Muddy Creek	29.3	33.2	62.5
12	05080002 06 04	Acton Lake Dam-Four Mile Creek	17.4	42.6	60.0
13	05080002 04 04	Dry Run-Great Miami River	40.1	18.1	58.2
14	05080002 07 03	Shaker Creek	30.5	27.3	57.8
15	05080002 07 05	Gregory Creek	51.0	16.3	57.3
16	05080002 07 02	Browns Run-Great Miami River	36.0	16.0	52.0
17	05080002 03 06	Town of Germantown-Twin Creek	12.8	30.3	43.1
18	05080002 06 05	Cotton Run-Four Mile Creek	12.1	28.9	41.0
19	05080002 07 01	Elk Creek	7.1	33.3	40.4
20	05080002 09 03	Paddys Run	13.8	25.5	39.3
21	05080003 08 09	Headwaters (of) Dry Fork Whitewater River	7.9	30.7	38.6
22	05080002 08 03	Beals Run-Indian Creek	9.9	26.5	36.4
23	05080002 05 04	Rush Run-Sevenmile Creek	6.9	27.1	34.0
24	05080003 08 08	Howard Creek-Dry Fork Whitewater River	5.8	28.1	33.9
25	05080003 08 09	Lee Creek-Dry Fork Whitewater River	14.1	16.4	30.5
26	05080002 05 05	Ninemile Creek-Sevenmile Creek	8.2	21.3	29.5

Table 5-10: Combined Percentage of Land that is Developed or Farmed with Row Crops in Clermont County's Watershed Assessment Units

Rank	*Hydrologic Unit Code*	*Watershed Assessment Unit Name*	*% Land Area that is Developed*	*% Land Area Farmed with Row Crops*	*Combined Percentage*
1	05090202 11 02	Fivemile Creek-East Fork Little Miami River	7.0	56.2	63.2
2	05090202 11 01	Solomon Run-East Fork Little Miami River	7.0	53.5	60.5
3	05090202 13 01	Headwaters Stonelick Creek	5.5	54.4	59.9
4	05090202 13 03	Moores Fork-Stonelick Creek	5.9	45.8	51.7
5	05090202 11 03	Todd Run-East Fork Little Miami River	10.0	41.1	51.1
6	05090202 07 03	First Creek	6.8	41.7	48.5
7	05090202 12 02	Cloverlick Creek	5.5	42.1	47.6
8	05090202 13 05	Salt Run-East Fork Little Miami River	42.2	4.0	46.2
9	05090202 13 02	Brushy Fork	5.3	40.4	45.7
10	05090202 14 05	Dry Run-Little Miami River	35.1	5.5	40.6
11	05090202 09 02	O'Bannon Creek	17.1	22.6	39.7
12	05090201 12 08	Ninemile Creek-Ohio River	37.2	1.5	38.7
13	05090202 14 03	Horner Run-Little Miami River	37.3	0.8	38.1
14	05090202 12 04	Backbone Creek-East Fork Little Miami River	17.4	17.1	34.5
15	05090201 11 03	West Branch Bullskin Creek	4.6	28.7	33.3
16	05090202 12 01	Poplar Creek	8.7	23.7	32.4
17	05090201 11 04	Bullskin Creek	3.6	26.7	30.3
18	05090201 12 01	Headwaters Big Indian Creek	4.4	24.8	29.2
19	05090202 13 04	Lick Fork-Stonelick Creek	11.0	14.6	25.6
20	05090202 12 03	Lucy Run-East Fork Little Miami River	16.6	7.6	24.2
21	05090201 12 04	Ferguson Run-Twelvemile Creek	7.1	13.6	20.7
22	05090201 12 06	Tenmile Creek	18.1	1.0	19.1
23	05090201 11 06	Bear Creek-Ohio River	4.1	10.6	14.7
24	05090201 12 03	Boat Run-Ohio River	10.4	4.1	14.5
25	05090201 11 07	Little Indian Creek-Ohio River	5.3	7.8	13.1
26	05090201 11 02	Turtle Creek-Ohio River	4.5	7.1	11.6

Table 5-11: Combined Percentage of Land that is Developed or Farmed with Row Crops in Hamilton County's Watershed Assessment Units

Rank	*Hydrologic Unit Code*	*Watershed Assessment Unit Name*	*% Land Area that is Developed*	*% Land Area Farmed with Row Crops*	*Combined Percentage*
1	05080002 09 01	Pleasant Run	91.4	0.9	92.3
2	05090203 01 01	East Fork Mill Creek-Mill Creek	75.1	11.4	85.5
3	05090203 01 03	Sharon Creek-Mill Creek	84.5	0.6	85.1
4	05090202 14 04	Duck Creek	79.8	0.4	80.2
5	05090203 01 04	Congress Run-Mill Creek	79.4	0.1	79.5
6	05090203 02 01	Town of Newport-Ohio River	77.1	0.1	77.2
7	05090203 01 02	West Fork Mill Creek	74.5	0.1	74.6
8	05090203 02 02	Dry Creek-Ohio River	74.4	0.0	74.4
9	05090203 02 03	Muddy Creek	68.3	0.1	68.4
10	05090203 01 05	West Fork-Mill Creek	66.8	0.3	67.1
11	05090202 14 02	Polk Run-Little Miami River	65.4	1.2	66.6
12	05090202 14 01	Sycamore Creek	65.6	0.8	66.4
13	05080002 09 02	Banklick Creek-Great Miami River	56.1	6.7	62.8
14	05090202 14 06	Clough Creek-Little Miami River	54.5	2.1	56.6
15	05090202 09 03	Salt Run-Little Miami River	40.4	13.8	54.2
16	05080002 09 05	Taylor Creek	52.0	0.4	52.4
17	05080003 08 10	Jameson Creek-Whitewater River	24.7	21.7	46.4
18	05080002 09 07	Doublelick Run-Great Miami River	8.9	32.8	41.7
19	05090202 14 05	Dry Run-Little Miami River	35.1	5.5	40.6
20	05090203 02 04	Garrison Creek-Ohio River	35.1	4.6	39.7
21	05080002 09 03	Paddys Run	13.7	25.5	39.2
22	05090201 12 08	Ninemile Creek-Ohio River	37.2	1.5	38.7
23	05080003 08 08	Howard Creek-Dry Fork Whitewater River	5.8	28.1	33.9
24	05080002 09 04	Dry Run-Great Miami River	22.1	10.2	32.3
25	05080003 08 09	Lee Creek-Dry Fork Whitewater River	14.1	16.4	30.5
26	05080002 09 06	Jordan Creek-Great Miami River	20.5	7.7	28.2

Table 5-12: Combined Percentage of Land that is Developed or Farmed with Row Crops in Warren County's Watershed Assessment Units

Rank	*Hydrologic Unit Code*	*Watershed Assessment Unit Name*	*% Land Area that is Developed*	*% Land Area Farmed with Row Crops*	*Combined Percentage*
1	05090202 09 01	Muddy Creek	69.3	10.0	79.3
2	05080002 07 04	Dicks Creek	63.4	14.2	77.6
3	05090202 05 01	Sugar Creek	62.0	12.2	74.2
4	05090202 07 01	East Fork Todd Fork	5.4	67.4	72.8
5	05090202 04 05	Flat Fork	5.7	65.9	71.6
6	05090202 04 04	Middle Caesar Creek	4.9	65.7	70.6
7	05090202 14 02	Polk Run-Little Miami River	65.4	1.2	66.6
8	05090202 08 02	Little Muddy Creek	29.3	33.2	62.5
9	05090202 07 02	Second Creek	9.4	51.3	60.7
10	05090202 13 01	Headwaters Stonelick Creek	5.5	54.4	59.9
11	05080002 04 04	Dry Run-Great Miami River	40.1	18.1	58.2
12	05080002 07 03	Shaker Creek	30.5	27.3	57.8
13	05090202 06 06	Little Creek-Todd Fork	6.3	48.9	55.2
14	05090202 09 03	Salt Run-Little Miami River	40.4	13.8	54.2
15	05080002 04 03	Clear Creek	32.0	21.5	53.5
16	05090202 04 06	Lower Caesar Creek	6.5	45.9	52.4
17	05080002 07 02	Browns Run-Great Miami River	36.0	16.0	52.0
18	05090202 07 03	First Creek	6.8	41.7	48.5
19	05090202 05 04	Newman Run-Little Miami River	9.5	36.5	46.0
20	05090202 08 03	Turtle Creek	28.9	15.1	44.0
21	05080002 03 06	Town of Germantown-Twin Creek	12.8	30.3	43.1
22	05090202 07 04	Lick Run-Todd Fork	5.8	35.4	41.2
23	05090202 09 02	O'Bannon Creek	17.1	22.6	39.7
24	05090202 08 04	Halls Creek-Little Miami River	16.9	12.9	29.8
25	05090202 08 01	Ferris Run-Little Miami River	7.6	18.9	26.6

Although the *Ohio 2008 Integrated Water Quality Monitoring and Assessment Report* has been superseded by the 2010 edition, the 2008 edition still retains value. If a watershed area of interest is more congruent with the larger 11-digit hydrologic unit code (HUC11) boundaries, then the *Ohio 2008 Integrated Report* is worth checking.

Ohio EPA has prepared statewide water quality reports on a two-year schedule for decades. This provides a wealth of information on nonpoint source patterns and trends. Previously termed the *water resources inventory*, the biennial document is now called the *integrated report*. It also is known as the *305(b) report* in reference to that section of the Clean Water Act that requires such reports. Integrated reports dating back to 2000 and water resources inventories dating back to 1994 can be found at http://www.epa.state.oh.us/dsw/document_index/305b.aspx**.**

Through the years, Ohio EPA has developed scientific reports on a variety of rivers and streams in Butler, Clermont, Hamilton and Warren counties. Commonly known as biological and water quality studies, these technical support documents provide additional regional data on nonpoint source pollution:

- Biological and Water Quality Study of the Little Miami River and Selected Tributaries (published 2009)
- Biological and Water Quality Study of the Dry Fork Whitewater River (2006)
- Biological and Water Quality Study of Sevenmile Creek and Select Tributaries (2002)
- Biological and Water Quality Study of Fourmile Creek, Indian Creek, and Select Tributaries (2005)
- Biological and Water Quality Study of Twin Creek and Selected Tributaries (2007)

The Ohio EPA and Ohio Department of Natural Resources (ODNR) are developing geographic information system (GIS) datasets that are useful for analyzing the complexities of nonpoint source pollution.

An Ohio EPA website at http://www.epa.ohio.gov/dsw/gis/index.aspx features the following interactive maps relevant to nonpoint source assessment:

- Water Chemistry & Stream Sediment Data
- Biological & Assessment Data
- Fields Approved for Biosolids Application

Among the datasets that can be downloaded from http://www.epa.ohio.gov/dsw/gis/index.aspx is a shapefile on Primary Contact Recreation Class "A" Streams. This helps planners prioritize nonpoint source problems by identifying the waterways where humans are most likely to encounter NPS pollutants.

ODNR's website at http://www.dnr.state.oh.us/soilandwater/soils/soilsandwatersheds/tabid/9076/Default.aspx is a gateway to useful maps from the ODNR's Division of Soil and Water Resources. For nonpoint source assessments, the following maps are particularly promising for the respective reasons:

- Flood Frequency – shows where floodwaters are most likely to aggravate nonpoint source pollution by coming in contact with contaminants that are normally beyond the water's reach
- Hydrologic Soil Groups – provides baseline data on the suitability of soils for septic tank-leach fields, landfills, liquid waste lagoons and other land uses that can become the origin of nonpoint source pollution
- Highly Erodible Land – shows where erosion is most likely to degrade streams with sedimentation and siltation, which are the common nonpoint source causes of impairment to watersheds in Southwest Ohio
- Slope – shows where developed land or row crops are likely to increase nonpoint source pollution.

Another center for GIS data is the ODNR's Geographic Information Management System (GIMS), which is online at: http://www.dnr.state.oh.us/tabid/10528/Default.aspx. It features 10 categories of digital themes:

- administrative, describes features related to administrative, governmental or regulatory boundaries
- biologic, describes features related to plants, animals and other living entities
- cadastral, describes features related to the land fabric, such as parcel ownership
- demographic, describes information related to human population dynamics and activities
- geologic/soils, describes features related to surface and subsurface terrain features
- hydrologic, describes features related to surface water, ground water and precipitation
- land use/land cover, describe to what extent certain features cover the earth
- recreational, shows parks, boating areas, wildlife areas, nature preserves, etc.
- topographic, shows digital elevation models and contours
- transportation/infrastructure, describes features related to transportation routes and utility systems

The hydrologic digital theme is most relevant to nonpoint source investigations, offering maps of flood hazard zones and floodways where high flows can capture pollutants normally beyond the water's reach.

A complete nonpoint source assessment requires many clues from different perspectives. These perspectives can be further informed by additional GIS datasets created by Ohio EPA and Ohio Department of Natural Resources. The *Ohio Nonpoint Source Pollution Management Plan − 2005-2010* provides the following GIS-based maps useful to nonpoint source assessment:

- Land Use and Land Cover 2000-2002 (Statewide Land Use Classification and Validation in Ohio)
- NPS Priority Ground Water Areas (based on presence of drinking water protection areas and aquifers)

- NPS Priority Drinking Water Protection Areas for Public Water Systems Using Surface Water
- Pesticide & Nitrate Impacts to Surface Water Sources of Drinking Water
- Maximum Nitrate Concentration Detected in Public Water Systems Using Ground Water
- Community PWS Using Ground Water with High Susceptibility to Contamination and Water Quality Impacts
- Drinking Water Source Protection Areas for Surface Water Systems
- Drinking Water Source Protection Areas for Groundwater Systems

The *Management Plan* is online at http://wwwapp.epa.ohio.gov/dsw/nps/NPSMP/.

More information on nonpoint source pollution can also be found in total maximum daily load (TMDL) reports and watershed management plans. The following passage from page C-10 of the *Ohio 2010 Integrated Water Quality Monitoring and Assessment Report* explains the linkage among nonpoint source management, TMDL reports and watershed management plans:

"Ohio's NPS Management Program relies heavily upon TMDL development and local watershed planning, during which the nature, extent and cause of water quality impairments caused by nonpoint source pollutants are identified. Program strategies are then designed to most effectively address identified NPS causes of impairment of Ohio's surface waters. An important revision to Ohio's Nonpoint Source Management Plan is the incorporation of identified local strategies from TMDL studies and state endorsed local watershed plans. Once such strategies are incorporated into Ohio's NPS Plan, Ohio EPA and other state funding partners mobilize programs and resources designed to result in measurable improvements to water quality throughout Ohio."

Useful information on nonpoint source pollution can be found in the following watershed management plans and TMDL reports for watersheds in Butler, Clermont, Hamilton and Warren counties:

Little Miami River Basin

- East Fork Headwaters Watershed Management Plan
- Lower East Fork Watershed Management Plan
- East Fork Lake Tributaries Watershed Management Plan
- Middle East Fork Watershed Action Plan (conditional endorsement by Ohio EPA)
- Todds Fork Watershed Management Plan (full endorsement by Ohio EPA)
- Stonelick Creek Watershed Management Plan

Great Miami River basin

- Twin Creek Watershed Action Plan

Mill Creek basin

- Upper Mill Creek Watershed Management Plan

Total Maximum Daily Load Reports

- TMDLs for the Upper Little Miami River
- TMDLs for the Mill Creek Basin
- Ohio River Bacteria TMDL

Ohio EPA and watershed groups are working on other watershed management plans or TMDL reports that can be informative about nonpoint source pollution. The next chapter, *Watershed Planning in Southwest Ohio*, summarizes the status of watershed management plans and TMDL reports for watersheds in Butler, Clermont, Hamilton and Warren counties.

Regional knowledge of nonpoint source pollution is a responsibility of the Ohio Kentucky Indiana Regional Council of Governments (OKI). As the federally designated water quality management planning agency, OKI works closely with the Ohio EPA on a variety of projects or documents that address nonpoint source pollution.

OKI's *Stream Database*, updated in 2013, is a comprehensive spreadsheet on the watersheds of Butler, Clermont, Hamilton and Warren counties. It was designed for the needs of water quality management planning and contains data useful for nonpoint source assessment. Listed with each watershed is information on its location, identity, designated beneficial uses, water quality, wastewater treatment plants, and conservation efforts. The database draws upon the *Ohio 2012 Integrated Water Quality Monitoring and Assessment Report* by the Ohio EPA, but also features regional and site specific-information compiled by OKI staff. OKI also prepared the *Stream Database Reference Guide* to facilitate public use of the *Stream Database.* Both the Stream Database and reference guide are available on OKI's website www.oki.org

To gain an idea of nonpoint source issues over time, OKI compared its 1999 report entitled *Status of Wastewater Treatment Facilities and Facility Planning Areas in Butler, Clermont, Hamilton and Warren Counties, Ohio* with the Ohio EPA's *Ohio 2008 Integrated Water Quality Monitoring and Assessment Report.* The comparison indicates that changes in watershed classification systems impose obstacles to reliable trend analyses over extended time periods.

Since the publication of OKI's original *Regional Water Quality Management Plan* in 1977, the watersheds in Butler, Clermont, Hamilton and Warren counties have been subjected to at least three classification schemes:

1. Drainage patterns, as identified by OKI's *Regional Water Quality Management Plan*, which divides watersheds into major drainage basins, and subdivides them into smaller drainage areas
2. Watershed basins, groups and segments, as identified by Ohio EPA's PEMSO (Planning and Engineering Data Management Systems for Ohio) classification scheme
3. Hydrologic units, as identified by the U.S. Geological Survey's hydrologic unit code (HUC) classification system

Comparative trend analyses are further complicated by Ohio EPA's conversion from an 11- and 14-digit HUC classification system for its *Ohio 2008 Integrated Water Quality Monitoring and Assessment Report* to a 10- and 12-digit HUC classification system for its *Ohio 2010 Integrated Water Quality Monitoring and Assessment Report.* The U.S. Geological Survey encouraged the use of 10- and 12-digit HUCs.

A comparison of OKI's 1999 report to the Ohio EPA's 2008 report can also indicate, on a case by case basis, the historical significance of nonpoint source pollution to the contemporary impairment of Southwest Ohio watersheds. This analysis was challenged by the changes in watershed classification systems.

Local expertise on nonpoint source pollution resides with the county soil and water conservation districts. OKI staff conferred closely with conservation district employees in Butler, Clermont, Hamilton and Warren to gain a better understanding of where and how nonpoint source pollution is degrading water quality in Southwest Ohio. As a departure point for local review, OKI staff shared the Watershed Assessment Unit Summaries in the *Ohio 2010 Integrated Water Quality Monitoring and Assessment Report* (Ohio EPA, Division of Surface Water).

As noted above, each Watershed Assessment Unit Summary addresses the sources (origins) and causes (agents) of impairment to the designated aquatic life use for that watershed. Sources and causes of impairment helped the local conservation districts to prioritize watersheds by nonpoint source issues. The conservation district staffs capitalized on their personal knowledge of the watersheds by adding to or subtracting from the lists of causes and sources indicative of nonpoint source pollution, based on what they have observed in the field. This is not scientific modeling, but it does serve as a basic tool for comparative analysis. The comparison indicates areas where nonpoint source pollution is more of a problem than point source pollution.

Results of the consultations with staffs of the conservation districts serving Butler, Clermont, Hamilton and Warren counties are shown in tabular summaries beginning on the next page. In many cases, the Soil and Water Conservation District staff suggested additional sources and causes of nonpoint source impairment which have been reflected in the tables.

Table 5-13 on the next page shows nonpoint source pollution indicators for the watersheds of Butler County. If a cause or source of impairment is shown in **boldface type**, it was added to the list by Butler Soil and Water Conservation District staff.

Table 5-13: Nonpoint Source Impairments to Butler County Watersheds

Hydrologic Unit Code	*Watershed Assessment Unit Name*	*Causes of Impairment*	*Sources of Impairment*	*Impaired Uses*
05080002 09 02	Banklick Creek-Great Miami River	**sediments** **nutrients** **organics** direct habitat alterations flow alteration	**gravel mining** **urban channelization** **agricultural channelization** land development/suburbanization natural removal of riparian vegetation – dev. urban runoff/storm sewers (NPS)	Aquatic Life Human Health
05080002 06 04	Acton Lake Dam-Four Mile Creek	**flow alteration** barium copper iron natural conditions (flow or habitat) and other flow regime alterations	**channelization** municipal (urbanized high density area) natural sources urban runoff/storm sewers	Aquatic Life Recreation
05080002 07 02	Browns Run-Great Miami River	**sedimentation** flow alteration nutrients	**channelization** **nonpoint source pollution** contaminated sediments landfills natural non-irrigated crop production	Aquatic Life Human Health
05080002 07 01	Elk Creek	flow alteration nutrients	**sedimentation** **channelization** contaminated sediments landfills natural **(deer feces)** non-irrigated crop production	Aquatic Life Human Health
05090203 01 03	Sharon Creek-Mill Creek	**sedimentation** direct habitat alterations flow alteration nutrients oil and grease	channelization – development streambank modification/destabilization-dev. urban runoff/storm sewers (NPS)	Aquatic Life Human Health
05080002 07 03	Shaker Creek	flow alteration nutrients	**sedimentation** **channelization** contaminated sediments landfills natural non-irrigated crop production	Aquatic Life Human Health
05080002 07 04	Dicks Creek	flow alteration nutrients	**channelization** **habitat impairment** contaminated sediments landfills natural non-irrigated crop production	Aquatic Life Human Health
05090203 01 01	East Fork Mill Creek-Mill Creek	**sedimentation** direct habitat alterations flow alteration nutrients oil and grease	channelization – development streambank modification/destabilization – dev urban runoff/storm sewers (NPS)	Aquatic Life Human Health
05080002 09 03	Paddys Run	direct habitat alterations flow alteration	**channelization – agriculture** land development/suburbanization natural removal of riparian vegetation – development urban runoff/storm sewers (NPS)	Aquatic Life Human Health

Hydrologic Unit Code	*Watershed Assessment Unit Name*	*Causes of Impairment*	*Sources of Impairment*	*Impaired Uses*
05080002 07 05	Gregory Creek	flow alteration nutrients	**channelization- urban** contaminated sediments landfills natural non-irrigated crop production	Aquatic Life Human Health
05080002 07 06	Town of New Miami-Great Miami River	flow alteration nutrients	**channelization-agriculture** contaminated sediments landfills natural non-irrigated crop production	Aquatic Life Human Health
05090202 08 02	Little Muddy Creek	**nutrients** **pesticides** **flow alteration** sedimentation/siltation	**suburban development** **agricultural practices** channelization	Aquatic Life
05090202 09 01	Muddy Creek	**flow alteration** sedimentation/siltation natural conditions (flow or habitat) nutrient eutrophication biological	**channelization – urban** **channelization – agriculture** natural sources	Aquatic Life Recreation
05090202 14 02	Polk Run-Little Miami River	siltation direct habitat alterations flow alteration	dredging – development other urban runoff sewer line construction streambank modification/destabilization – dev.	Aquatic Life
05080002 09 01	Pleasant Run	direct habitat flow alteration	land development/suburbanization natural removal of riparian vegetation – development urban runoff/storm sewers (NPS)	Aquatic Life Human Health
05080002 08 03	Beals Run-Indian Creek	**flow alteration** **habitat impairment** natural conditions	**sedimentation** **channelization** natural sources	Aquatic Life (no TMDL needed) Recreation Human Health
05080002 06 05	Cotton Run-Four Mile Creek	**Sedimentation** **flow alteration** natural conditions (flow or habitat) phosphorus	**channelization** natural sources	Aquatic Life
05080002 04 04	Dry Run-Great Miami River	direct habitat alterations flow alteration	channelization – agriculture channelization – development removal of riparian vegetation – agriculture urban runoff/storm sewers (NPS)	Aquatic Life
05080002 06 02	Little Four Mile Creek	**ammonia** (from field fertilizing) direct habitat alterations sedimentation/siltation	channelization loss or riparian habitat unrestricted cattle access	Aquatic Life Recreation
05080003 08 08	Howard Creek-Dry Fork Whitewater River	natural conditions (flow or habitat)	**channelization – agriculture** **flow alteration** natural sources	Aquatic Life (no TMDL needed)

Hydrologic Unit Code	*Watershed Assessment Unit Name*	*Causes of Impairment*	*Sources of Impairment*	*Impaired Uses*
05080002 08 02	Brandywine Creek-Indian Creek	**flow alteration** **sediment** **nutrients**	**channelization – agriculture**	(use attainments unknown)
05080003 08 09	Lee Creek-Dry Fork Whitewater River	**flow alteration** **sedimentation**	**channelization**	(Aquatic Life in attainment)
05080003 08 07	Headwaters (of) Dry Fork Whitewater River	**flow alteration** **sedimentation**	**channelization**	(Aquatic Life in attainment)
05080002 05 05	Ninemile Creek-Sevenmile Creek	**flow alteration**	**channelization – agriculture**	(Aquatic Life and Human Health in attainment)
05080002 05 04	Rush Run-Sevenmile Creek	**flow alteration**	**channelization – agriculture**	(Aquatic Life and Human Health in attainment)
05080002 03 06	Town of Germantown-Twin Creek	(No impairments in Butler County's part of the watershed.)	(No impairments in Butler County's part of the watershed.)	

The staff of the Clermont Soil and Water Conservation District collaborated with the staff of the Clermont County Office of Environmental Quality and the East Fork Watershed Collaborative to produce the information shown below in Table 5-14. If a cause or source of impairment is shown in **boldface type**, it was added by Clermont County personnel. They relied on their local knowledge to say that some of the causes or sources listed by Ohio EPA have ceased to exist.

Table 5-14: Nonpoint Source Impairments to Clermont County Watersheds

Hydrologic Unit Code	*Watershed Assessment Unit Name*	*Causes of Impairment*	*Sources of Impairment*	*Impaired Uses*
05090202 12 03	Lucy Run-East Fork Little Miami River	direct habitat alterations flow alteration nutrients siltation organic enrichment/DO	**agriculture** **dam impoundment** **riparian removal – agriculture** **streambank modification/destabilization** channelization – development flow regulation/modification – development land development/suburbanization onsite wastewater systems (septic tanks) urban runoff/storm sewers (NPS)	Aquatic Life
05090202 12 04	Backbone Creek-East Fork Little Miami River	direct habitat alterations flow alteration nutrients siltation organic enrichment/DO	**dam impoundment** **non-irrigated crop production** **streambank modification/destabilization** **mining** channelization –development flow regulation/modification – development land development/suburbanization onsite wastewater systems (septic tanks) urban runoff/storm sewers (NPS)	Aquatic Life

Hydrologic Unit Code	*Watershed Assessment Unit Name*	*Causes of Impairment*	*Sources of Impairment*	*Impaired Uses*
05090202 13 05	Salt Run-East Fork Little Miami River	**sedimentation/**siltation nutrients direct habitat alterations flow alteration organic enrichment/DO	**land development/suburbanization** **flow regulation/modification – dev.** **loss of riparian habitat** **onsite wastewater systems (septic tanks)** urban runoff/storm sewers (NPS) dredging – development sewer line construction streambank modification/destabilization – dev	Aquatic Life Recreation
05090202 12 02	Cloverlick Creek	direct habitat alterations flow alteration nutrients siltation organic enrichment/DO	**agriculture** **dam/impoundment** **streambank modification/destabilization – ag.** channelization – development flow regulation/modification – development land development/suburbanization onsite wastewater systems (septic tanks) urban runoff/storm sewers (NPS)	Aquatic Life
05090202 13 02	Brushy Fork	direct habitat alterations flow alteration nutrients siltation organic enrichment/DO	**onsite wastewater systems (septic tanks)** **golf course** dredging – development non-irrigated crop production streambank modification/destabilization – dev urban runoff/storm sewers (NPS)	Aquatic Life
05090202 12 01	Poplar Creek	direct habitat alterations flow alteration nutrients siltation organic enrichment/DO	**agriculture** channelization – development flow regulation/modification – development land development/suburbanization onsite wastewater systems (septic tanks) urban runoff/storm sewers (NPS)	Aquatic Life
05090202 13 04	Lick Fork-Stonelick Creek	**metals** flow alteration nutrients siltation organic enrichment/DO	**gun club - metals** **onsite wastewater systems (septic tanks)** **loss of riparian habitat** non-irrigated crop production streambank modification/destabilization – dev.	Aquatic Life
05090202 13 01	Headwaters Stonelick Creek	direct habitat alterations flow alteration nutrients siltation organic enrichment/DO	**onsite wastewater systems (septic tanks)** dam construction – agriculture dredging – development non-irrigated crop production streambank modification/destabilization – dev.	Aquatic Life Public Drinking Water Supply (pesticide found at upstream withdrawal site in Clinton County)
05090202 13 03	Moores Fork-Stonelick Creek	direct habitat alterations flow alteration nutrients siltation organic enrichment/DO	**onsite wastewater systems (septic tanks)** **loss of riparian habitat** dredging – development non-irrigated crop production streambank modification/destabilization – dev.	Aquatic Life

Hydrologic Unit Code	*Watershed Assessment Unit Name*	*Causes of Impairment*	*Sources of Impairment*	*Impaired Uses*
05090202 14 03	Horner Run-Little Miami River	direct habitat alterations flow alteration siltation organic enrichment/DO	**urban runoff/storm sewers (NPS)** **onsite wastewater systems (septic tanks)** dredging – development other urban runoff sewer line construction streambank modification/destabilization – dev.	Aquatic Life
05090202 11 03	Todd Run-East Fork Little Miami River	**loss of riparian habitat** **flow alteration** nutrients siltation organic enrichment/DO	**loss of riparian habitat** non-irrigated crop production onsite wastewater systems (septic tanks)	Aquatic Life
05090201 12 04	Ferguson Run-Twelvemile Creek	**nutrients** **sedimentation** **flow alteration** **organic enrichment/DO**	**agricultural runoff** **onsite wastewater systems (septic tanks)** **loss of riparian habitat** **dam construction - agriculture**	Aquatic Life
05090202 09 02	O'Bannon Creek	**nutrients** **sediments** **organic enrichment/DO** natural conditions (flow or habitat)	**agricultural runoff** **urban runoff** **onsite wastewater systems (septic tanks)** **streambank modification/destabilization**	Aquatic Life (no TMDL needed)
05090202 14 05	Dry Run-Little Miami River	direct habitat alterations flow alteration siltation	dredging – development other urban runoff sewer line construction streambank modification/destabilization – dev.	Aquatic Life
05090201 12 08	Ninemile Creek-Ohio River	**nutrients** **sediments** **flow alteration** **organic enrichment/DO**	**urban runoff** **onsite wastewater systems (septic tanks)** **dam construction - development**	Aquatic Life
05090201 12 06	Tenmile Creek	**nutrients** **sediments** **flow alteration** **organic enrichment/DO**	**urban runoff** **onsite wastewater systems (septic tanks)** **dam construction - development**	Aquatic Life
05090201 12 03	Boat Run-Ohio River	**nutrients** **flow alteration** **organic enrichment/DO**	**urban runoff** **agricultural runoff** **onsite wastewater systems (septic tanks)** **dam construction – development**	Aquatic Life
05090201 11 07	Little Indian Creek-Ohio River	**nutrients** **flow alteration** **organic enrichment/DO**	**agricultural runoff** **onsite wastewater systems (septic tanks)** **dam construction – development** **channelization – development**	(use attainment unknown)
05090201 11 04	Bullskin Creek	**nutrients** **flow alteration** **organic enrichment/DO**	**non-irrigated crop production** **onsite wastewater systems (septic tanks)** **dam construction – development** **dredging – development**	(use attainment unknown)
05090202 11 02	Fivemile Creek-East Fork Little Miami River	**direct habitat alterations** nutrients siltation organic enrichment/DO	**loss of riparian habitat** non-irrigated crop production onsite wastewater systems (septic tanks)	Aquatic Life

Hydrologic Unit Code	*Watershed Assessment Unit Name*	*Causes of Impairment*	*Sources of Impairment*	*Impaired Uses*
05090202 11 01	Solomon Run-East Fork Little Miami River	**flow alteration** nutrients siltation organic enrichment/DO	non-irrigated crop production onsite wastewater systems (septic tanks)	Aquatic Life
05090201 11 06	Bear Creek-Ohio River	**nutrients** **flow alteration** organic enrichment/DO	**agricultural runoff** **dam construction – development** **onsite wastewater systems (septic tanks)**	(use attainment unknown)
05090201 12 01	Headwaters Big Indian Creek	**nutrients** **sediments** **organic enrichment/DO**	**agricultural runoff** **onsite wastewater systems (septic tanks)**	Aquatic Life
05090202 07 03	First Creek	**nutrients** **sediments**	**agricultural runoff** **onsite wastewater systems**	Aquatic Life
05090201 11 03	West Branch Bullskin Creek	**nutrients** **organic enrichment/DO**	**agriculture – row crop, livestock** **onsite wastewater systems**	(use attainment unknown)
05090201 11 02	Turtle Creek-Ohio River	**nutrients** **organic enrichment/DO**	**removal of riparian habitat – agriculture** **onsite wastewater systems**	(use attainment unknown)

Table 5-15 below shows the nonpoint source pollution indicators in the watersheds of Hamilton County. **Boldface** causes or sources of impairment were added by the Hamilton County Soil and Water Conservation District.

Table 5-15: Nonpoint Source Impairments to Hamilton County Watersheds

Hydrologic Unit Code	*Watershed Assessment Unit Name*	*Causes of Impairment*	*Sources of Impairment*	*Impaired Uses*
05090203 01 03	Sharon Creek-Mill Creek	direct habitat alterations flow alteration nutrients oil and grease organic enrichment/DO	channelization – development streambank modification/destabilization – dev urban runoff/storm sewers (NPS)	Aquatic Life Human Health
05090203 01 04	Congress Run-Mill Creek	direct habitat alterations flow alteration oil and grease organic enrichment/DO	channelization – development streambank modification/destabilization – dev urban runoff/storm sewers (NPS)	Aquatic Life Human Health
05080002 09 05	Taylor Creek	direct habitat alterations flow alteration	land development/suburbanization removal of riparian vegetation – development urban runoff/storm sewers (NPS)	Aquatic Life Human Health
05090203 01 02	West Fork Mill Creek	direct habitat alterations flow alteration nutrients oil and grease organic enrichment/DO	channelization – development streambank modification/destabilization – dev urban runoff/storm sewers (NPS)	Aquatic Life Human Health
05090202 14 06	Clough Creek-Little Miami River	**direct habitat alterations** sedimentation/siltation	**channelization** **land development (along Clough Creek)**	Aquatic Life
05090203 01 05	West Fork-Mill Creek	direct habitat alterations flow alteration nutrients oil and grease organic enrichment/DO	channelization – development streambank modification/destabilization – dev urban runoff/storm sewers (NPS)	Aquatic Life Human Health
05090203 01 01	East Fork Mill Creek-Mill Creek	direct habitat alterations flow alteration nutrients oil and grease organic enrichment/DO	channelization – development streambank modification/destabilization – dev urban runoff/storm sewers (NPS)	Aquatic Life Human Health

Hydrologic Unit Code	*Watershed Assessment Unit Name*	*Causes of Impairment*	*Sources of Impairment*	*Impaired Uses*
05090202 14 02	Polk Run-Little Miami River	direct habitat alterations flow alteration nutrients siltation	dredging - development other urban runoff sewer line construction streambank modification/destabilization – dev	Aquatic Life
05090202 14 05	Dry Run-Little Miami River	direct habitat alterations flow alteration organic enrichment/DO siltation	dredging - development other urban runoff sewer line construction streambank modification/destabilization – dev	Aquatic Life
05080002 09 01	Pleasant Run	direct habitat alterations flow alteration	land development/suburbanization natural removal of riparian vegetation – development urban runoff/storm sewers (NPS)	Aquatic Life Human Health
05090203 02 01	Town of Newport-Ohio River	direct habitat alterations flow alteration organic enrichment/DO	dredging - development natural streambank modification/destabilization – dev	Aquatic Life
05080002 09 02	Banklick Creek-Great Miami River	direct habitat alterations flow alteration	land development/suburbanization natural removal of riparian vegetation – development urban runoff/storm sewers (NPS)	Aquatic Life Human Health
05090203 02 04	Garrison Creek-Ohio River	direct habitat alterations flow alteration organic enrichment/DO	dredging - development natural streambank destabilization – development	Aquatic Life
05090203 02 02	Dry Creek-Ohio River	direct habitat alterations flow alteration organic enrichment/DO	dredging - development natural streambank destabilization – development	Aquatic Life
05080002 09 07	Doublelick Run-Great Miami River	direct habitat alterations flow alteration	land development/suburbanization natural removal of riparian vegetation – development urban runoff/storm sewers (NPS)	Aquatic Life Human Health
05080002 09 03	Paddys Run	direct habitat alterations flow alteration	land development/suburbanization natural removal of riparian vegetation – development urban runoff/storm sewers (NPS)	Aquatic Life Human Health
05080002 09 04	Dry Run-Great Miami River	direct habitat alterations flow alteration	land development/suburbanization natural removal of riparian vegetation – development urban runoff/storm sewers (NPS)	Aquatic Life Human Health
05080002 09 06	Jordan Creek-Great Miami River	direct habitat alterations flow alteration	land development/suburbanization natural removal of riparian vegetation – development urban runoff/storm sewers (NPS)	Aquatic Life Human Health
05090202 14 04	Duck Creek	direct habitat alterations organic enrichment/DO sedimentation/siltation	Channelization urban runoff/storm sewers	Aquatic Life
05090202 14 01	Sycamore Creek	(no NPS causes listed by O EPA)	(no NPS sources listed by OEPA)	Aquatic Life
05090202 09 03	Salt Run-Little Miami River	(no NPS causes listed by O EPA)	(no NPS sources listed by OEPA)	Human Health

Hydrologic Unit Code	*Watershed Assessment Unit Name*	*Causes of Impairment*	*Sources of Impairment*	*Impaired Uses*
05080003 08 10	Jameson Creek-Whitewater River	(no NPS causes listed by O EPA)	(no NPS sources listed by OEPA)	Human Health
05090201 12 08	Ninemile Creek-Ohio River	(no NPS causes listed by O EPA)	(no NPS sources listed by OEPA)	Aquatic Life
05080003 08 08	Howard Creek-Dry Fork Whitewater River	(no NPS causes listed by O EPA)	(no NPS sources listed by OEPA)	Aquatic Life (no TMDL needed)
05080003 08 09	Lee Creek-Dry Fork Whitewater River	(no NPS causes listed by O EPA)	(no NPS sources listed by OEPA)	(use attainment unknown)

*NOTE: Although the Clough Creek-Little Miami watershed has fewer sources and causes of impairment than watersheds that follow it on the table, Hamilton SWCD staff believes it has a higher degree of impairment.

Table 5-16 below summarizes the results of consultations with Warren County Soil and Water Conservation District staff, who added the causes or sources of impairment shown in **boldface.**

Table 5-16: Nonpoint Source Impairments to Warren County Watersheds

Hydrologic Unit Code	*Watershed Assessment Unit Name*	*Causes of Impairment*	*Sources of Impairment*	*Impaired Uses*
05090202 13 01	Headwaters Stonelick Creek	direct habitat alterations flow alteration nutrients organic enrichment/DO siltation	dredging – development non-irrigated crop production sewer line construction streambank modification/destabilization – dev urban runoff/storm sewers (NPS)	Aquatic Life Public Drinking Water Supply Public Drinking Water Supply (pesticide found at upstream site in Clinton County)
05080002 04 03	Clear Creek	**suspended solids** direct habitat alterations flow alteration organic enrichment/DO	**onsite wastewater systems (septic tanks)** **urban development** channelization – agriculture channelization – development removal of riparian vegetation – ag urban runoff/storm sewers (NPS)	Aquatic Life
05090202 14 02	Polk Run-Little Miami River	direct habitat alterations flow alteration organic enrichment/DO siltation	dredging – development other urban runoff sewer line construction streambank modification/destabilization – dev	Aquatic Life
05080002 04 04	Dry Run-Great Miami River	direct habitat alterations flow alteration organic enrichment/DO	channelization – agriculture channelization – development removal of riparian vegetation – agriculture urban runoff/storm sewers (NPS)	Aquatic Life
05080002 07 02	Browns Run-Great Miami River	flow alteration nutrients salinity/TDS/chlorides	contaminated sediments landfills natural non-irrigated crop production	Aquatic Life Human Health
05090202 05 01	Sugar Creek	flow alteration nutrients organic enrichment/DO suspended solids	**non-irrigated crop production** natural	Aquatic Life (no TMDL needed) Human Health

Hydrologic Unit Code	*Watershed Assessment Unit Name*	*Causes of Impairment*	*Sources of Impairment*	*Impaired Uses*
05080002 07 03	Shaker Creek	flow alteration nutrients	**residential and commercial development** contaminated sediments natural non-irrigated crop production	Aquatic Life Human Health
05090202 04 05	Flat Fork	nutrients organic enrichment/DO siltation	land development/suburbanization non-irrigated crop production	Aquatic Life
05090202 04 04	Middle Caesar Creek	nutrients organic enrichment/DO siltation	land development/suburbanization non-irrigated crop production	Aquatic Life
05090202 04 06	Lower Caesar Creek	nutrients organic enrichment/DO siltation	land development/suburbanization non-irrigated crop production	Aquatic Life
05090202 07 02	Second Creek	nutrient/eutrophication bio indicators sedimentation/siltation	**onsite wastewater systems (septic tanks)** unpermitted discharge (domestic wastes) agriculture	Aquatic Life Recreation Public Drinking Water Supply
05080002 07 04	Dicks Creek	nutrients flow alteration	contaminated sediments natural non-irrigated crop production	Aquatic Life Human Health
05090202 07 04	Lick Run-Todd Fork	**nutrients** **sediment**	**onsite wastewater systems (septic tanks)** **non-irrigated crop production** **urban stomwater runoff**	Recreation
05090202 08 03	Turtle Creek	**sedimentation** natural conditions (flow or habitat)	**channelization** **urban development** natural sources	Aquatic Life (no TMDL needed)
05090202 07 03	First Creek	**suspended solids** **nutrient enrichment**	**non-irrigated crop production** **onsite wastewater systems (septic tanks)**	Aquatic Life
05090202 09 01	Muddy Creek	natural conditions (flow or habitat) sedimentation/siltation	natural sources	Aquatic Life Recreation
05090202 07 01	East Fork Todd Fork	natural conditions	natural sources	Aquatic Life (no TMDL needed) Recreation
05090202 09 03	Salt Run-Little Miami River	**sediment**	**urban development**	Human Health
05090202 08 02	Little Muddy Creek	sedimentation/siltation	channelization	Aquatic Life
05090202 05 04	Newman Run-Little Miami River	**sedimentation**	**non-irrigated crop production**	Human Health
05090202 09 02	O'Bannon Creek	natural conditions (flow or habitat)	natural sources	Aquatic Life (no TMDL needed)
05090202 08 01	Ferris Run-Little Miami River	(no NPS causes listed by O EPA)	(no NPS sources listed by OEPA)	(use attainment unknown)
05090202 08 04	Halls Creek-Little Miami River	(no NPS causes listed by O EPA)	(no NPS sources listed by OEPA)	(use attainment unknown)
05090202 06 06	Little Creek-Todd Fork	(no NPS causes listed by O EPA)	(no NPS sources listed by OEPA)	(no impairments)
05080002 03 06	Town of Germantown-Twin Creek	(no NPS causes listed by O EPA)	(no NPS sources listed by OEPA)	(no impairments)

University research also provides information on nonpoint source pollution. A prime example is *Report on a Reexamination of the Mussels of the Little Miami River and Its Major Tributaries: Final Report* (Hoggarth & Goodman, Otterbein College, 2007). This study confirmed the findings of a 1992 study that one-third of the mussel species in the Little Miami watershed were in danger of being extirpated and one-third were represented by non-viable populations. Mussels are sensitive to habitat quality and sedimentation, making them good biological indicators of nonpoint source pollution.

Impervious Surfaces and Nonpoint Source Pollution

Impervious surfaces correlate with many of the causes and sources of impairment in Tables 5-13 through 5-16. Because they interfere with the natural infiltration of precipitation, impervious surfaces induce many types of nonpoint source pollution.

Among the various sources of impairment listed in the four tables above, those that can be directly attributed to impervious surfaces are:

- land development/suburbanization
- removal of riparian vegetation – development
- urban runoff/storm sewers
- municipal (urbanized high density area)

In addition, impervious surfaces typically lead to the sources of impairment involving stream channelization, stream flow regulation, streambank modification and sewer line construction.

Among the causes of impairment listed in the tables above, those that can be directly attributed to impervious surfaces are:

- direct habitat alterations
- flow regime alterations
- loss of riparian habitat

Impervious surfaces also induce the causes of impairment involving sedimentation/siltation, oil and grease, and metals.

Like the Ohio EPA, OKI uses the terms *impervious surfaces* and *impervious cover* interchangeably. Under the heading of Impervious Surfaces, the Ohio EPA states, "Impervious cover can be defined as any land cover that prevents the infiltration of water into the soil. Examples are roads, parking lots, sidewalks, rooftops and other impermeable surfaces in urbanized areas." (*A Guide to Developing Local Watershed Action Plans in Ohio*, Ohio EPA, Division of Surface Water, 1997) The Ohio EPA lists five major impacts that impervious surfaces (i.e., impervious cover) have on water resources:

1. increasing the amount of runoff, peak of discharge, velocity and time of concentration
2. increasing stream cross-sectional area to accommodate higher flow, which in turn produces streambank erosion and habitat degradation
3. increasing temperature of runoff reaching streams and thereby increasing stream temperatures, which in turn reduces dissolved oxygen
4. reducing infiltration, groundwater recharge and dry weather discharge
5. reducing populations of sensitive macroinvertebrates and reducing biodiversity in general

Impacts 1 and 2 above are quintessential causes for nonpoint source pollution. Impact 3 above can also be classified as nonpoint source pollution because thermal pollution is diffuse in nature.

Ohio EPA's *Guide to Developing Local Watershed Action Plans* also notes federal findings that an acre of residential development may be only 20 percent impervious cover but an industrial or commercial development of the same size may be up to 70 percent impervious cover.

Given the deep connections between impervious surfaces and nonpoint source pollution, it is necessary to consider both in water quality management plans. An analysis of impervious surfaces can help soil and

water conservation districts, storm water managers, watershed groups, government agencies and others to focus their nonpoint source management efforts in areas where they can be most effective and to design best management practices with the most favorable cost-benefit ratios.

From the perspective of regulators, planners, property owners and other watershed stakeholders, impervious surfaces are significant because they lessen the capacity of streams to attain Ohio's water quality and habitat standards for their designated aquatic life uses. The results of OKI's impervious surface analysis are provided in context in three sections of the Water Quality Management Plan. *Chapter 3: Current and Projected Development* analyzes impervious surface percentages and associated ratings for the 82 watershed assessment units located wholly or partly in Butler, Clermont, Hamilton and Warren counties. For an impervious surface analysis of a particular watershed, see Appendix C, which maps and summarizes impervious surface data for each HUC 12 watershed in OKI's four-county study area. This chapter, *Management of Nonpoint Source Pollution*, analyzes the effects of impervious surfaces by indicating where and how they coincide with: (1) slight, moderate or severe slopes, (2) highly erodible soils and potentially highly erodible soils, (3) riparian corridors, and (4) underlying aquifer areas.

Why OKI Analyzed Impervious Surfaces

OKI analyzed the intersection of impervious surfaces with slopes, highly erodible soils, riparian corridors and aquifer areas because the resulting data helps identify areas prone to (1) increased runoff, (2) excessive erosion and sedimentation, (3) aquatic habitat degradation, and (4) reduced aquifer recharge. The first three problems often manifest themselves as sources or causes of stream impairment, as noted on the previous page. The fourth problem relates to groundwater and typically becomes an issue in protection plans for drinking water sources.

How OKI Analyzed Impervious Surfaces

For its analysis, OKI defined impervious cover as any artificial surface in the landscape that cannot effectively absorb or infiltrate precipitation. To determine impervious surfaces in Butler, Clermont, Hamilton and Warren counties, OKI performed an extensive spatial analysis using GIS (geographic information systems) data, remote sensing data from satellite imagery, and aerial orthophotos. The first step involved reviewing GIS shapefiles of building footprints, roads and airport runways to identify areas of known impervious surface. Then staff used the remote sensing tools found in ArcGIS 10 ® in conjunction with the Ohio Statewide Imagery Program's 2007 color infrared raster set. This produced a preliminary, four-county file on pervious and impervious land cover. Staff then performed an extensive quality control review of the draft file through methodical visual comparison with orthophotographs, identifying discrepancies and making clarifications or corrections as needed. Upon completion of refinements to the impervious surface layer, staff compared it with other GIS files on slope, highly erodible soils, riparian corridors, buried valley aquifer, and 12-digit hydrologic unit code (HUC-12) boundaries for 82 watershed assessment units in the four-county study area.

OKI staff relied on a variety of data sources to analyze impervious surfaces in relation to landscape characteristics. Using state elevation data, staff identified areas with slight slope (up to 10% grade), moderate slope (11% to 20% grade), or severe slope (greater than 20% grade) to analyze impervious surface in relation to slopes. Using data from the Ohio Department of Natural Resources (ODNR), staff identified areas with highly erodible soils to analyze impervious surfaces in relation to erodibility. Using stream network shapefiles from the National Hydrography Dataset, staff identified areas within 100 feet of river and stream centerlines to analyze where impervious surfaces encroach on riparian corridors. Using buried valley aquifer shapefiles from ODNR, staff identified areas of impervious surface over the aquifer that could seal off groundwater recharge. Staff also calculated acreage of impervious land cover by HUC 12 watershed to enable percentage ratings in ranges identified by the Center for Watershed Protection (less

than 10%, 10 to 25%, and more than 25%). The major findings of this work follow, with detailed analysis of each HUC-12 watershed provided in Appendix C.

Impervious Surfaces in Relation to Slope

Erosion and sedimentation are among the most prevalent types of nonpoint source pollution. The problem increases with slope because greater slope generates larger and faster stormwater flows over the short term. If a sloping area is also impervious, the acceleration and concentration of stormwater runoff is further increased, multiplying its erosive force as it nears a stream. OKI analyzed impervious surfaces in relation to slope to:

- identify watershed areas that are more likely to suffer nonpoint source pollution from erosion and sedimentation
- identify stream segments that are more likely to exhibit substandard bio-criteria because their macroinvertebrate communities and supporting habitats are being scoured out by flows from steeply sloped impervious surfaces
- characterize whether a rugged landscape is still an area that impedes development or whether it is yielding to more recent construction techniques for overcoming topography

Table 5-17 below analyzes the distribution of impervious surfaces in relation to slight, moderate and severe slopes for each of the 82 watershed assessment units in Butler, Clermont, Hamilton and Warren counties. The table lists the 82 watersheds in descending order of percentage of watershed area with impervious surface on severe slopes (greater than 20 % grade). The table also color codes the 82 watersheds into three comparably sized categories. Red rows represent the 28 watersheds having the highest percentages (0.65 percent to 5.86 percent) of watershed area having impervious surfaces on severe slopes. Yellow rows represent the 26 watersheds having mid-range percentages (0.28 percent to 0.60 percent) of watershed area having impervious surfaces on severe slopes. Green rows represent the 28 watersheds with the lowest percentages (0 percent to 0.27 percent) of watershed area having impervious surfaces on severe slopes.

Table 5-17: Impervious Surfaces in Relation to Slopes for 82 Watersheds

Watershed Name HUC 12 #	Impervious Acres with 0%-10% Slope (percent of watershed in this category)	Impervious Acres with 11%-20% Slope (percent of watershed in this category)	Impervious Acres with Greater than 20% Slope (percent of watershed in this category)
Town of Newport-Ohio River 050902030201	1,417.1 (29.6%)	361.7 (7.5%)	280.6 (5.86%)
Duck Creek 050902021404	3,106.6 (31.4%)	517.8 (5.2%)	303.0 (3.06%)
West Fork-Mill Creek 050902030105	3,832.5 (25.4%)	791.6 (5.2%)	445.3 (2.95%)
Dry Creek-Ohio River 050902030202	2,846.6 (25.7%)	611.1 (5.5%)	313.7 (2.83%)
Garrison Creek-Ohio River 050902030204	590.9 (14.2%)	148.3 (3.6%)	102.6 (2.46%)
Congress Run-Mill Creek 050902030104	5,595.2 (29.2%)	838.4 (4.4%)	399.6 (2.08%)
Muddy Creek 050902030203	2,208.4 (20.8%)	484.9 (4.6%)	192.0 (1.81%)
Taylor Creek 050800020905	1,914.5 (11.2%)	616.6 (3.6%)	282.5 (1.66%)
Clough Creek-Little Miami River 050902021406	1,892.9 (15.8%)	349.2 (2.9%)	173.8 (1.45%)
Sharon Creek-Mill Creek 050902030103	6,514.8 (32.0%)	700.2 (3.4%)	291.2 (1.43%)
Banklick Creek-Great Miami River 050800020902	5,223.1 (18.5%)	620.2 (2.2%)	380.9 (1.35%)
Jordan Creek-Great Miami River 050800020906	1,083.5 (7.4%)	230.6 (1.6%)	175.8 (1.21%)
Halls Creek-Little Miami River 050902020804	1,086.7 (8.3%)	261.2 (2.0%)	146.9 (1.12%)

Ninemile Creek-Ohio River 050902011208	2,165.4 (12.8%)	366.1 (2.2%)	186.7 (1.10%)
Sycamore Creek 050902021401	3,296.9 (22.1%)	430.2 (2.9%)	163.9 (1.10%)
Dry Run-Great Miami River 050800020904	1,332.2 (7.2%)	273.4 (1.5%)	177.7 (0.96%)
Polk Run-Little Miami River 050902021402	2,159.7 (19.9%)	268.5 (2.5%)	102.9 (0.95%)
Salt Run-Little Miami River 050902020903	3,802.8 (16.8%)	488.8 (2.2%)	193.9 (0.86%)
Dry Run-Little Miami River 050902021405	1,241.6 (10.9%)	189.0 (1.7%)	92.9 (0.82%)
Boat Run-Ohio River 050902011203	275.7 (4.9%)	67.6 (1.2%)	45.3 (0.80%)
West Fork Mill Creek 050902030102	4,986.3 (21.5%)	620.0 (2.7%)	184.6 (0.80%)
Dicks Creek 050800020704	3,709.5 (20.9%)	278.2 (1.6%)	140.8 (0.79%)
East Fork Mill Creek-Mill Creek 050902030101	7,447.1 (24.6%)	706.2 (2.3%)	235.7 (0.78%)
Pleasant Run 050800020901	2,824.9 (29.2%)	254.3 (2.6%)	70.0 (0.72%)
Lee Creek-Dry Fork Whitewater River 050800030809	892.8 (6.4%)	151.3 (1.1%)	97.4 (0.70%)
Jameson Creek-Whitewater River 050800030810	1,141.9 (10.0%)	130.3 (1.1%)	80.0 (0.70%)
Muddy Creek 050902020901	2,241.3 (22.1%)	187.8 (1.9%)	67.3 (0.66%)
Salt Run-East Fork Little Miami River 050902021305	4,193.0 (15.4%)	453.9 (1.7%)	175.7 (0.65%)
Tenmile Creek 050902011206	598.1 (7.2%)	103.8 (1.2%)	50.3 (0.60%)
Doublelick Run-Great Miami River 050800020907	142.1 (3.3%)	24.2 (0.6%)	25.6 (0.60%)
Horner Run-Little Miami River 050902021403	1,522.7 (11.1%)	197.2 (1.4%)	79.4 (0.58%)
Little Indian Creek-Ohio River 050902011107	339.3 (4.6%)	62.5 (0.9%)	41.6 (0.57%)
Gregory Creek 050800020705	2,889.7 (15.2%)	323.9 (1.7%)	98.9 (0.52%)
Watershed Name HUC 12 #	**Impervious Acres with 0%-10% Slope (percent of watershed in this category)**	**Impervious Acres with 11%-20% Slope (percent of watershed in this category)**	**Impervious Acres with Greater than 20% Slope (percent of watershed in this category)**
Dry Run-Great Miami River 050800020404	691.4 (12.3%)	57.8 (1.0%)	29.0 (0.52%)
Browns Run-Great Miami River 050800020702	2,234.3 (12.3%)	192.4 (1.1%)	83.1 (0.46%)
Little Muddy Creek 050902020802	1,215.6 (9.2%)	156.4 (1.2%)	56.8 (0.43%)
Howard Creek-Dry Fork Whitewater River 050800030808	711.3 (3.4%)	158.9 (0.8%)	89.1 (0.43%)
Ferguson Run-Twelvemile Creek 050902011204	568.4 (4.6%)	102.8 (0.8%)	51.8 (0.41%)
Ferris Run-Little Miami River 050902020801	708.3 (3.7%)	125.1 (0.6%)	78.5 (0.41%)
Rush Run-Sevenmile Creek 050800020504	263.7 (3.8%)	54.2 (0.8%)	27.9 (0.40%)
Paddys Run 050800020903	570.9 (5.5%)	104.1 (1.0%)	41.8 (0.40%)
Turtle Creek-Ohio River 050902011102	32.8 (3.9%)	3.6 (0.4%)	3.4 (0.40%)
Headwaters Dry Fork Whitewater River 050800030807	42.1 (2.9%)	9.9 (0.7%)	5.8 (0.40%)
Backbone Creek-East Fork Little Miami River 050902021204	1,025.4 (7.7%)	118.0 (0.9%)	51.3 (0.39%)
Bear Creek-Ohio River 050902011106	400.7 (2.6%)	83.2 (0.5%)	59.5 (0.38%)
Turtle Creek 050902020803	2,779.8 (9.7%)	293.0 (1.0%)	108.0 (0.38%)
Shaker Creek 050800020703	1,464.8 (10.7%)	144.2 (1.1%)	50.3 (0.37%)

Bullskin Creek 050902011104	104.1 (2.0%)	32.0 (0.6%)	17.9 (0.34%)
Acton Lake Dam-Four Mile Creek 050800020604	1,289.6 (7.3%)	150.6 (0.8%)	59.4 (0.33%)
Beals Run-Indian Creek 050800020803	1,722.6 (4.1%)	289.3 (0.7%)	134.3 (0.32%)
Town of New Miami-Great Miami River 050800020706	1,876.3 (9.6%)	174.1 (0.9%)	62.5 (0.32%)
North Fork Indian Creek-Big Indian Creek 050902011202	370.4 (3.1%)	73.3 (0.6%)	34.1 (0.29%)
Clear Creek 050800020403	3,561.7 (11.0%)	345.8 (1.1%)	92.8 (0.29%)
Ninemile Creek-Sevenmile Creek 050800020505	473.0 (4.3%)	80.2 (0.7%)	30.2 (0.28%)
Newman Run-Little Miami River 050902020504	1,115.1 (4.4%)	163.3 (0.6%)	68.1 (0.27%)
Solomon Run-East Fork Little Miami River 050902021101	163.6 (4.1%)	24.7 (0.6%)	10.7 (0.27%)
Cotton Run-Four Mile Creek 050800020605	1,429.3 (4.4%)	206.6 (0.6%)	85.2 (0.26%)
Lick Fork-Stonelick Creek 050902021304	663.1 (5.7%)	73.8 (0.6%)	29.8 (0.25%)
O'Bannon Creek 050902020902	2,604.8 (6.9%)	295.2 (0.8%)	89.5 (0.24%)
Brushy Fork 050902021302	373.9 (3.9%)	51.3 (0.5%)	22.3 (0.23%)
Lucy Run-East Fork Little Miami River 050902021203	1,464.5 (6.6%)	120.6 (0.5%)	51.8 (0.23%)
Lick Run-Todd Fork 050902020704	650.0 (3.7%)	95.1 (0.5%)	38.5 (0.22%)
First Creek 050902020703	532.4 (4.3%)	77.0 (0.6%)	25.0 (0.20%)
Elk Creek 050800020701	799.1 (4.3%)	118.1 (0.6%)	36.8 (0.20%)
Watershed Name HUC 12 #	**Impervious Acres with 0%-10% Slope (percent of watershed in this category)**	**Impervious Acres with 11%-20% Slope (percent of watershed in this category)**	**Impervious Acres with Greater than 20% Slope (percent of watershed in this category)**
Todd Run-East Fork Little Miami River 050902021103	404.5 (4.8%)	38.8 (0.5%)	16.7 (0.20%)
Second Creek 050902020702	212.4 (3.5%)	34.7 (0.6%)	11.6 (0.19%)
Fivemile Creek-East Fork Little Miami River 050902021102	588.0 (4.5%)	66.0 (0.5%)	24.0 (0.18%)
Headwaters Big Indian Creek 050902011201	413.5 (3.0%)	63.3 (0.5%)	25.0 (0.18%)
Little Creek-Todd Fork 050902020606	55.9 (2.5%)	8.9 (0.4%)	4.0 (0.18%)
Town of Germantown-Twin Creek 050800020306	189.7 (6.1%)	16.8 (0.5%)	5.4 (0.17%)
West Branch Bullskin Creek 050902011103	291.5 (3.4%)	42.1 (0.5%)	14.4 (0.17%)
Brandywine Creek-Indian Creek 050800020802	121.8 (3.4%)	14.6 (0.4%)	5.7 (0.16%)
Moores Fork-Stonelick Creek 050902021303	484.7 (4.2%)	56.2 (0.5%)	17.1 (0.15%)
Lower Caesar Creek 050902020406	339.8 (2.8%)	45.0 (0.4%)	17.1 (0.14%)
Poplar Creek 050902021201	874.1 (5.7%)	82.2 (0.5%)	21.0 (0.14%)
Flat Fork 050902020405	319.7 (3.1%)	36.5 (0.4%)	13.7 (0.13%)
Headwaters Stonelick Creek 050902021301	393.8 (3.7%)	49.5 (0.5%)	13.9 (0.13%)
Cloverlick Creek 050902021202	283.8 (3.00%)	36.1 (0.38%)	12.0 (0.13%)
East Fork Todd Fork 050902020701	2.1 (1.20%)	0.43 (0.25%)	0.16 (0.09%)
Middle Caesar Creek 050902020404	0.49 (3.60%)	0.06 (%0.44)	0.01 (0.08%)
Sugar Creek 050902020501	47.9 (3.77%)	2.95 (0.23%)	0.36 (0.03%)

Little Four Mile Creek 050800020602	5.01 (1.80%)	0.43 (0.16%)	0.01 0.00%)

Counties can also be useful building blocks for framing analyses of impervious surface in relation to a variety of natural characteristics, because counties engage in land use decisions that have impacts on water quality. Table 5-18 below analyzes the distribution of impervious surfaces in relation to slight, moderate and severe slopes for Butler, Clermont, Hamilton and Warren counties.

Table 5-18: Impervious Surfaces in Relation to Slopes for Butler, Clermont, Hamilton and Warren Counties

County	Impervious Acres with 0%-10% Slope (percent of county in this category)	Impervious Acres with 11%-20% Slope (percent of county in this category)	Impervious Acres with Greater than 20% Slope (percent of county in this category)
Butler	31,817.4 (10.6%)	3,611.4 (1.2%)	1,462.5 (0.5%)
Clermont	18,993.3 (6.5%)	2,406.3 (0.8%)	1,011.7 (0.3%)
Hamilton	48,982.0 (18.6%)	8,069.3 (3.1%)	4,124.4 (1.6%)
Warren	21,654.5 (8.3%)	2,591.0 (1.0%)	1,027.5 (0.4%)

NOTE: Where a watershed straddles more than one county, it is split along county lines for the purpose of a county-based statistical summary in Table 5-18.

The next four figures show the spatial distribution patterns of impervious surfaces in relation to slight slopes (0% - 10% grade), moderate slopes (11% - 20% grade), or severe slopes (greater than 20% grade) in Butler, Clermont, Hamilton and Warren counties. Each map also shows watershed boundaries to help identify which water resources are more likely to be affected by impervious surfaces and slopes. White areas have pervious surfaces.

Figure 5-2: Impervious Surfaces in Relation to Slopes in Butler County

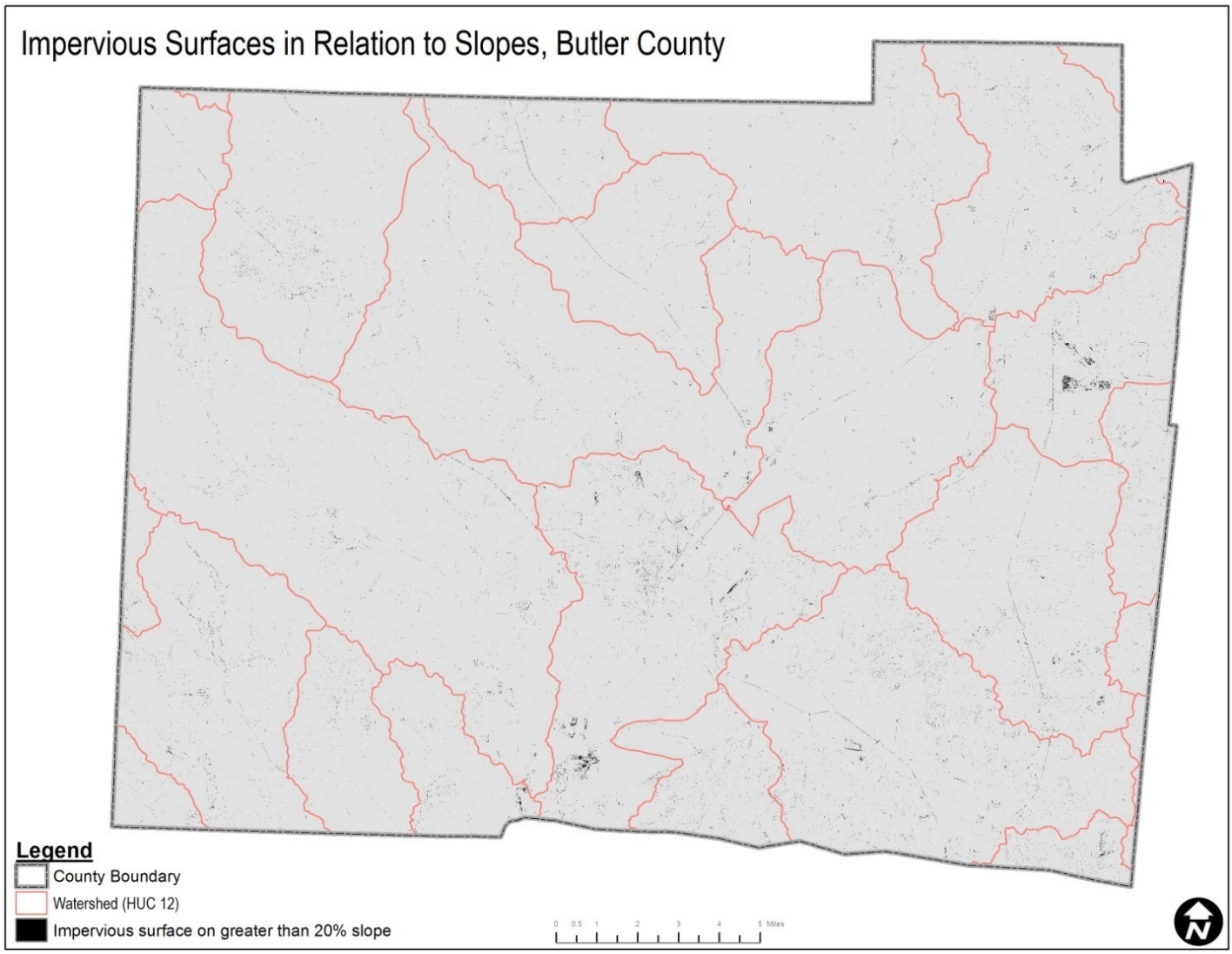


Figure 5-3: Impervious Surfaces in Relation to Slopes in Clermont County

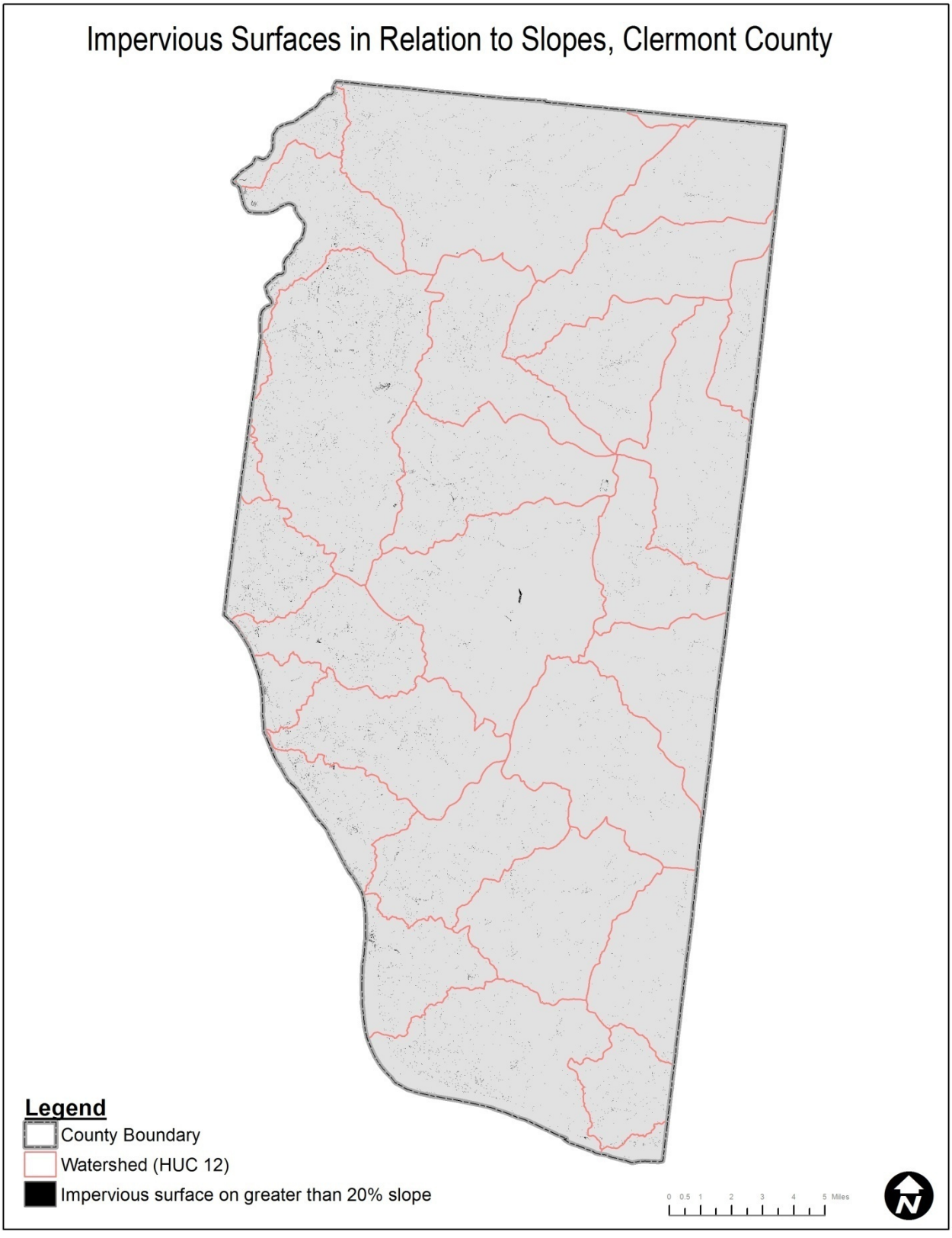


Figure 5-4: Impervious Surfaces in Relation to Slopes in Hamilton County

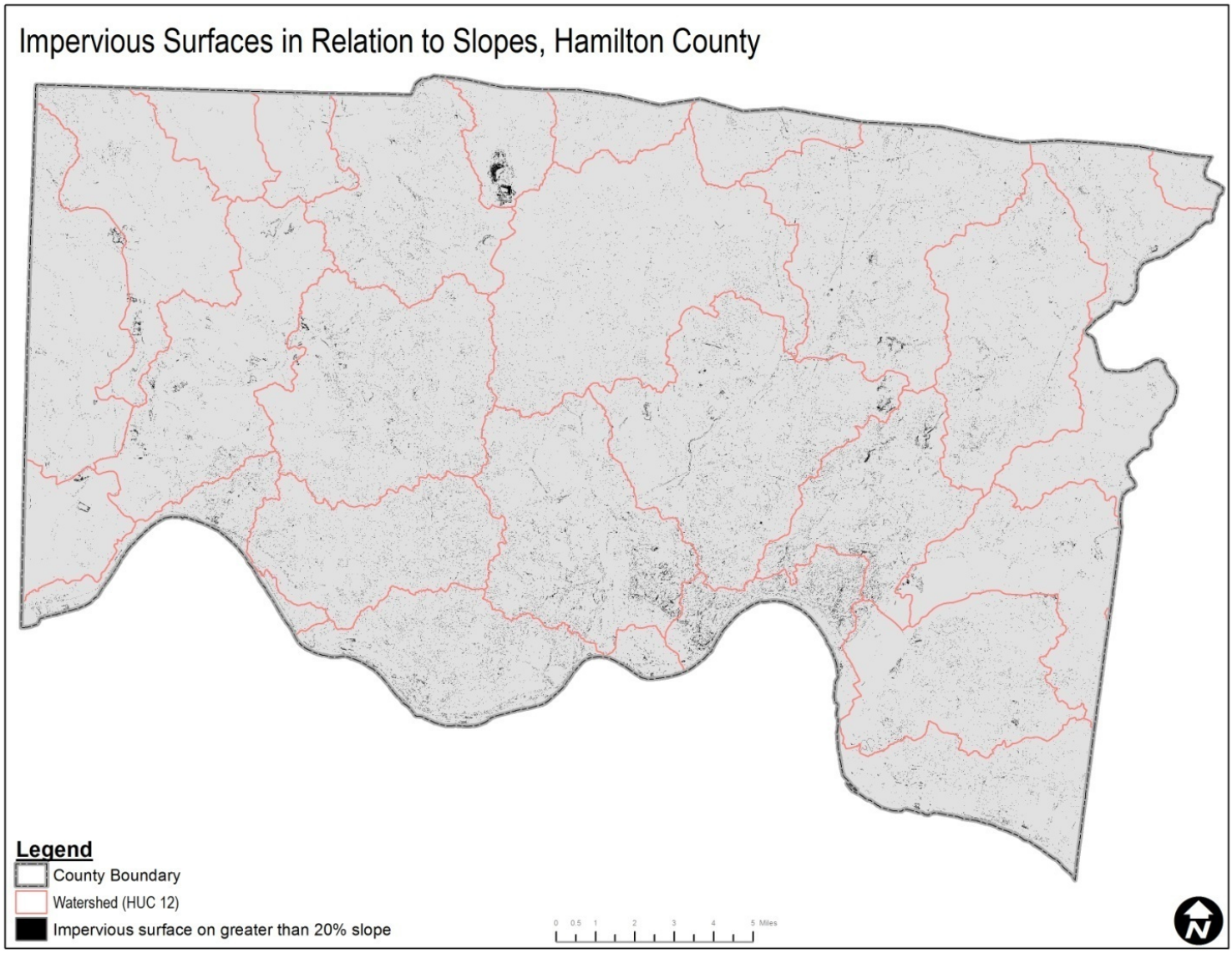
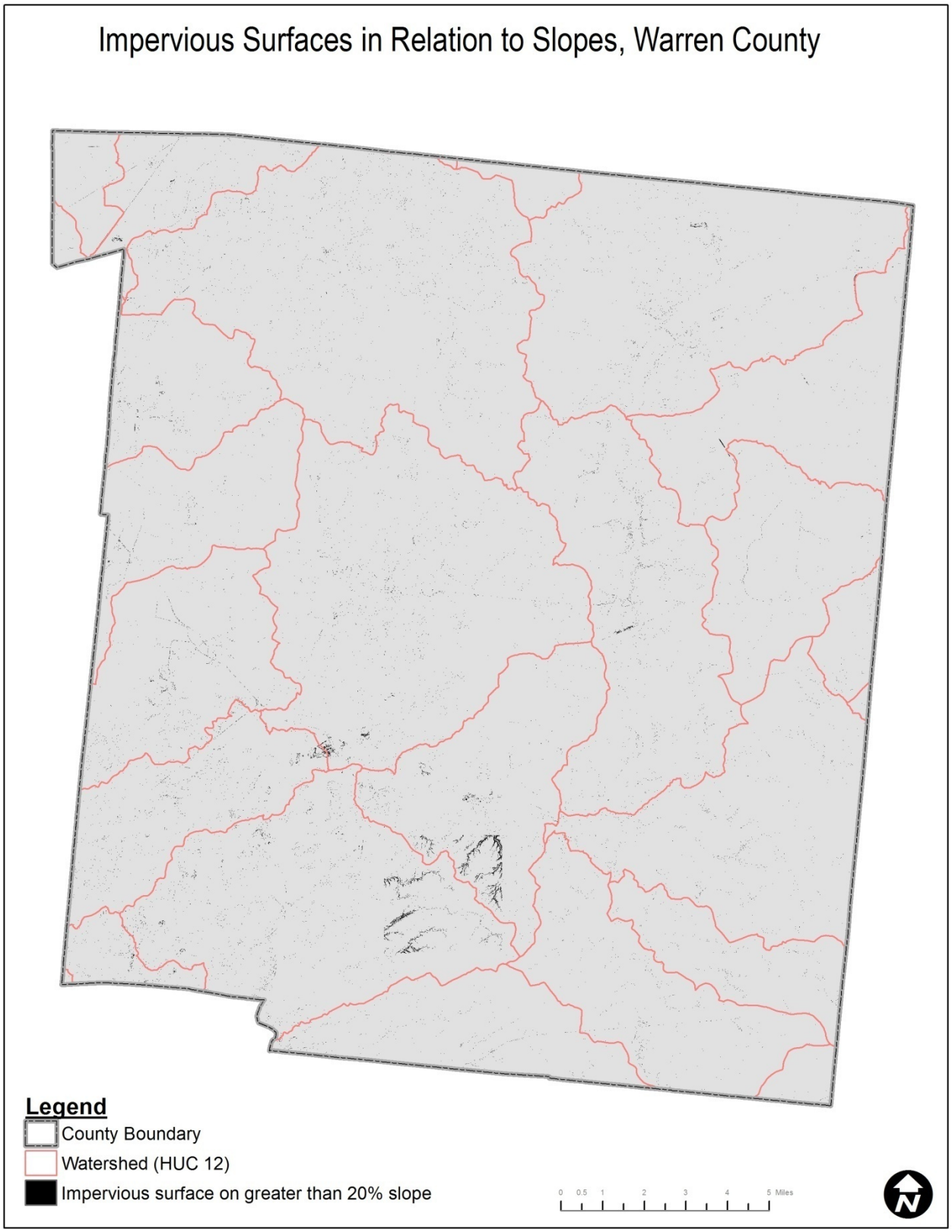


Figure 5-5: Impervious Surfaces in Relation to Slopes in Warren County



Impervious Surfaces in Relation to Erodible Soils

Various soil types differ significantly in their susceptibility to erosion, which contributes greatly to nonpoint source pollution. The problem increases where impervious surfaces are paved or built amid highly erodible soils. The acceleration and concentration of stormwater from impervious surfaces gives that runoff more erosive force when it flows over nearby highly erodible soils. OKI analyzed impervious surfaces in relation to soil erodibility to:

- identify watershed areas that are more likely to suffer nonpoint source pollution from erosion and sedimentation
- identify stream segments that are more likely to exhibit substandard bio-criteria because their macroinvertebrate communities and supporting habitats are being embedded in silts and sediments from highly erodible soils subject to the erosive forces of impervious surface runoff
- characterize whether a rugged landscape is still an area that impedes construction or whether it is yielding to more recent construction techniques for overcoming topography

For the 82 watersheds in OKI's four-county study area, Table 5-19 below analyzes the distribution of impervious surfaces in relation to soil erodibility categories. The table lists the 82 watersheds in descending order of percentage of watershed area with impervious surface on highly erodible soils. The table also color codes the 82 watersheds into three comparably sized categories. Red rows represent the 28 watersheds having the highest percentages (2.09 percent to 18.42 percent) of watershed area having impervious surfaces on highly erodible soils. Yellow rows represent the 27 watersheds having mid-range percentages (0.68 percent to 2.05 percent) of watershed area having impervious surfaces on highly erodible soils. Green rows represent the 27 watersheds with the lowest percentages (0 percent to 0.63 percent) of watershed area having impervious surfaces on highly erodible soils.

Table 5-19: Impervious Surfaces in Relation to Erodible Soils for 82 Watersheds

Watershed Name HUC 12 #	Impervious Acres on Highly Erodible Soils (percent of watershed in this category)	Impervious Acres on Not Highly Erodible Soils (percent of watershed in this category)	Impervious Acres on Potentially Highly Erodible Soils (percent of watershed in this category)
Town of Newport-Ohio River 050902030201	882.7 (18.42%)	32.3 (0.7%)	430.4 (9.0%)
West Fork-Mill Creek 050902030105	2,093.5 (13.85%)	17.2 (0.1%)	965.0 (6.4%)
Dry Creek-Ohio River 050902030202	1,220.7 (11.02%)	12.4 (0.1%)	1,098.3 (9.9%)
Muddy Creek 050902030203	1,166.4 (10.98%)	31.7 (0.3%)	1,550.0 (14.6%)
Taylor Creek 050800020905	1,792.6 (10.51%)	104.1 (0.6%)	903.7 (5.3%)
Duck Creek 050902021404	935.6 (9.46%)	874.7 (8.8%)	1,310.6 (13.3%)
Congress Run-Mill Creek 050902030104	1,530.3 (7.98%)	889.3 (4.6%)	2,020.6 (10.5%)
Salt Run-Little Miami River 050902020903	1,651.5 (7.31%)	1,906.2 (8.4%)	396.1 (1.8%)
Muddy Creek 050902020901	643.5 (6.34%)	1,224.1 (12.1%)	601.6 (5.9%)
Halls Creek-Little Miami River 050902020804	802.3 (6.12%)	622.1 (4.7%)	39.3 (0.3%)
Garrison Creek-Ohio River 050902030204	254.2 (6.10%)	10.1 (0.2%)	143.2 (3.4%)
Clough Creek-Little Miami River 050902021406	724.9 (6.06%)	306.5 (2.6%)	999.6 (8.4%)

Polk Run-Little Miami River 050902021402	624.2 (5.75%)	768.3 (7.1%)	900.9 (8.3%)
Sharon Creek-Mill Creek 050902030103	1,070.1 (5.26%)	1,941.1 (9.5%)	2,906.4 (14.3%)
Sycamore Creek 050902021401	777.6 (5.20%)	1,048.8 (7.0%)	1,879.5 (12.6%)
Clear Creek 050800020403	1,659.0 (5.14%)	1,263.1 (3.9%)	925.3 (2.9%)
West Fork Mill Creek 050902030102	1,058.5 (4.57%)	1,011.7 (4.4%)	3,615.5 (15.6%)
Turtle Creek 050902020803	1,205.2 (4.19%)	1,213.7 (4.2%)	728.5 (2.5%)
Ninemile Creek-Ohio River 050902011208	692.7 (4.09%)	359.3 (2.1%)	1,075.5 (6.3%)
Jordan Creek-Great Miami River 050800020906	519.8 (3.57%)	357.6 (2.5%)	271.3 (1.9%)
Dry Run-Great Miami River 050800020904	645.9 (3.50%)	258.7 (1.4%)	621.2 (3.4%)
Little Muddy Creek 050902020802	378.0 (2.87%)	618.3 (4.7%)	405.0 (3.1%)
Pleasant Run 050800020901	242.3 (2.51%)	592.9 (6.1%)	1,492.2 (15.4%)
Dry Run-Little Miami River 050902021405	276.6 (2.43%)	656.6 (5.8%)	322.8 (2.8%)
Ferris Run-Little Miami River 050902020801	438.7 (2.27%)	361.9 (1.9%)	40.8 (0.2%)
Horner Run-Little Miami River 050902021403	311.4 (2.27%)	530.6 (3.9%)	733.0 (5.3%)
Dry Run-Great Miami River 050800020404	123.2 (2.20%)	587.2 (10.5%)	26.4 (0.5%)
Banklick Creek-Great Miami River 050800020902	590.3 (2.09%)	1,884.3 (6.7%)	1,288.2 (4.6%)
Salt Run-East Fork Little Miami River 050902021305	557.4 (2.05%)	1,361.9 (5.0%)	2,295.8 (8.4%)
Newman Run-Little Miami River 050902020504	506.8 (2.01%)	400.9 (1.6%)	324.4 (1.3%)
Dicks Creek 050800020704	340.3 (1.92%)	1,226.0 (6.9%)	574.7 (3.2%)
Second Creek 050902020702	106.6 (1.77%)	90.7 (1.5%)	0.1 (0.0%)
Lee Creek-Dry Fork Whitewater River 050800030809	244.6 (1.77%)	519.4 (3.7%)	340.8 (2.5%)
Boat Run-Ohio River 050902011203	97.7 (1.72%)	142.1 (2.5%)	137.7 (2.4%)
Jameson Creek-Whitewater River 050800030810	191.9 (1.67%)	924.0 (8.1%)	136.4 (1.2%)
Lick Run-Todd Fork 050902020704	288.8 (1.62%)	337.1 (1.9%)	19.9 (0.1%)
First Creek 050902020703	183.3 (1.47%)	248.9 (2.0%)	6.8 (0.1%)
Watershed Name HUC 12 #	**Impervious Acres on Highly Erodible Soils (percent of watershed in this category)**	**Impervious Acres on Not Highly Erodible Soils (percent of watershed in this category)**	**Impervious Acres on Potentially Highly Erodible Soils (percent of watershed in this category)**
Shaker Creek 050800020703	198.4 (1.45%)	557.6 (4.1%)	663.9 (4.8%)
Tenmile Creek 050902011206	120.5 (1.44%)	233.5 (2.8%)	376.9 (4.5%)
East Fork Mill Creek-Mill Creek 050902030101	402.2 (1.33%)	2,421.8 (8.0%)	4,681.4 (15.5%)
Little Indian Creek-Ohio River 050902011107	77.6 (1.06%)	219.7 (3.0%)	107.8 (1.5%)
Backbone Creek-East Fork Little Miami River 050902021204	141.0 (1.06%)	462.5 (3.5%)	501.4 (3.8%)

Ferguson Run-Twelvemile Creek 050902011204	127.3 (1.02%)	257.7 (2.1%)	322.6 (2.6%)
O'Bannon Creek 050902020902	365.9 (0.96%)	1,725.5 (4.5%)	701.5 (1.8%)
Paddys Run 050800020903	98.1 (0.94%)	332.8 (3.2%)	270.7 (2.6%)
Lower Caesar Creek 050902020406	112.0 (0.92%)	130.5 (1.1%)	120.2 (1.0%)
Town of Germantown-Twin Creek 050800020306	27.5 (0.90%)	145.4 (4.8%)	36.5 (1.2%)
Bullskin Creek 050902011104	47.1 (0.89%)	24.3 (0.5%)	79.9 (1.5%)
Doublelick Run-Great Miami River 050800020907	37.8 (0.89%)	106.7 (2.5%)	31.4 (0.7%)
Gregory Creek 050800020705	161.7 (0.85%)	501.5 (2.6%)	2,550.4 (13.4%)
North Fork Indian Creek-Big Indian Creek 050902011202	98.7 (0.84%)	122.9 (1.0%)	249.9 (2.1%)
Turtle Creek-Ohio River 050902011102	6.6 (0.78%)	23.7 (2.8%)	3.9 (0.5%)
Lick Fork-Stonelick Creek 050902021304	90.8 (0.77%)	363.9 (3.1%)	250.8 (2.1%)
Bear Creek-Ohio River 050902011106	113.3 (0.73%)	158.5 (1.0%)	202.1 (1.3%)
Howard Creek-Dry Fork Whitewater River 050800030808	142.4 (0.68%)	210.1 (1.0%)	595.6 (2.9%)
Browns Run-Great Miami River 050800020702	113.4 (0.63%)	500.1 (2.8%)	413.3 (2.3%)
Little Creek-Todd Fork 050902020606	13.4 (0.60%)	17.7 (0.8%)	5.6 (0.3%)
Rush Run-Sevenmile Creek 050800020504	40.0 (0.58%)	109.8 (1.6%)	174.1 (2.5%)
Lucy Run-East Fork Little Miami River 050902021203	124.1 (0.56%)	765.2 (3.4%)	646.1 (2.9%)
Flat Fork 050902020405	53.8 (0.53%)	116.2 (1.1%)	42.7 (0.4%)
Beals Run-Indian Creek 050800020803	217.6 (0.52%)	481.0 (1.1%)	1,307.8 (3.1%)
Solomon Run-East Fork Little Miami River 050902021101	19.9 (0.50%)	101.0 (2.6%)	75.2 (1.9%)
Headwaters Big Indian Creek 050902011201	60.7 (0.44%)	173.6 (1.3%)	261.2 (1.9%)
Brushy Fork 050902021302	41.0 (0.43%)	282.7 (3.0%)	120.8 (1.3%)
Elk Creek 050800020701	74.9 (0.41%)	267.1 (1.4%)	521.8 (2.8%)
Acton Lake Dam-Four Mile Creek 050800020604	70.1 (0.40%)	711.8 (4.0%)	553.3 (3.1%)
Watershed Name HUC 12 #	**Impervious Acres on Highly Erodible Soils (percent of watershed in this category)**	**Impervious Acres on Not Highly Erodible Soils (percent of watershed in this category)**	**Impervious Acres on Potentially Highly Erodible Soils (percent of watershed in this category)**
Headwaters Dry Fork Whitewater River 050800030807	5.7 (0.39%)	13.2 (0.9%)	37.1 (2.5%)
West Branch Bullskin Creek 050902011103	33.6 (0.39%)	142.9 (1.7%)	155.7 (1.8%)
Todd Run-East Fork Little Miami River 050902021103	31.9 (0.38%)	257.4 (3.1%)	136.0 (1.6%)
Fivemile Creek-East Fork Little Miami River 050902021102	49.0 (0.37%)	398.1 (3.0%)	183.3 (1.4%)
Town of New Miami-Great Miami River 050800020706	69.9 (0.36%)	784.0 (4.0%)	766.5 (3.9%)
Cotton Run-Four Mile Creek 050800020605	114.7 (0.35%)	438.2 (1.3%)	913.1 (2.8%)
Cloverlick Creek 050902021202	29.6 (0.31%)	180.7 (1.9%)	117.9 (1.2%)

Headwaters Stonelick Creek 050902021301	32.4 (0.31%)	278.3 (2.7%)	99.7 (1.0%)
Moores Fork-Stonelick Creek 050902021303	35.2 (0.31%)	370.4 (3.2%)	145.5 (1.3%)
Ninemile Creek-Sevenmile Creek 050800020505	31.8 (0.29%)	154.5 (1.4%)	344.4 (3.2%)
East Fork Todd Fork 050902020701	0.5 (0.28%)	0.1 (0.0%)	0.4 (0.3%)
Poplar Creek 050902021201	36.9 (0.24%)	496.4 (3.2%)	335.5 (2.2%)
Brandywine Creek-Indian Creek 050800020802	1.3 (0.03%)	105.1 (2.9%)	27.8 (0.8%)
Sugar Creek 050902020501	0.4 (0.03%)	47.3 (3.7%)	3.5 (0.3%)
Middle Caesar Creek 050902020404	0.0 (0.00%)	0.2 (1.4%)	0.4 (2.7%)
Little Four Mile Creek 050800020602	0.0 (0.00%)	2.5 (0.9%)	0.0 (0.0%)

Table 5-20 below analyzes the distribution of impervious surfaces in relation to soil erodibility categories by county.

Table 5-20: Impervious Surfaces in Relation to Erodible Soils for Butler, Clermont, Hamilton and Warren Counties

County	Impervious Acres on Highly Erodible Soils (percent of county in this category)	Impervious Acres on Not Highly Erodible Soils (percent of county in this category)	Impervious Acres on Potentially Highly Erodible Soils (percent of county in this category)
Butler	2,150.5 (0.7%)	10,351.8 (3.4%)	15,467.1 (5.1%)
Clermont	2,563.1 (0.9%)	9,047.9 (3.1%)	8,930.4 (3.0%)
Hamilton	16,798.9 (6.4%)	10,138.1 (3.8%)	22,398.0 (8.5%)
Warren	8,987.3 (3.4%)	10,391.9 (4.0%)	3,867.4 (1.5%)

The next four pages have figures showing the spatial distribution of impervious surfaces in relation to erodible soils in Butler, Clermont, Hamilton and Warren counties.

Figure 5-6: Impervious Surfaces in Relation to Erodible Soils in Butler County

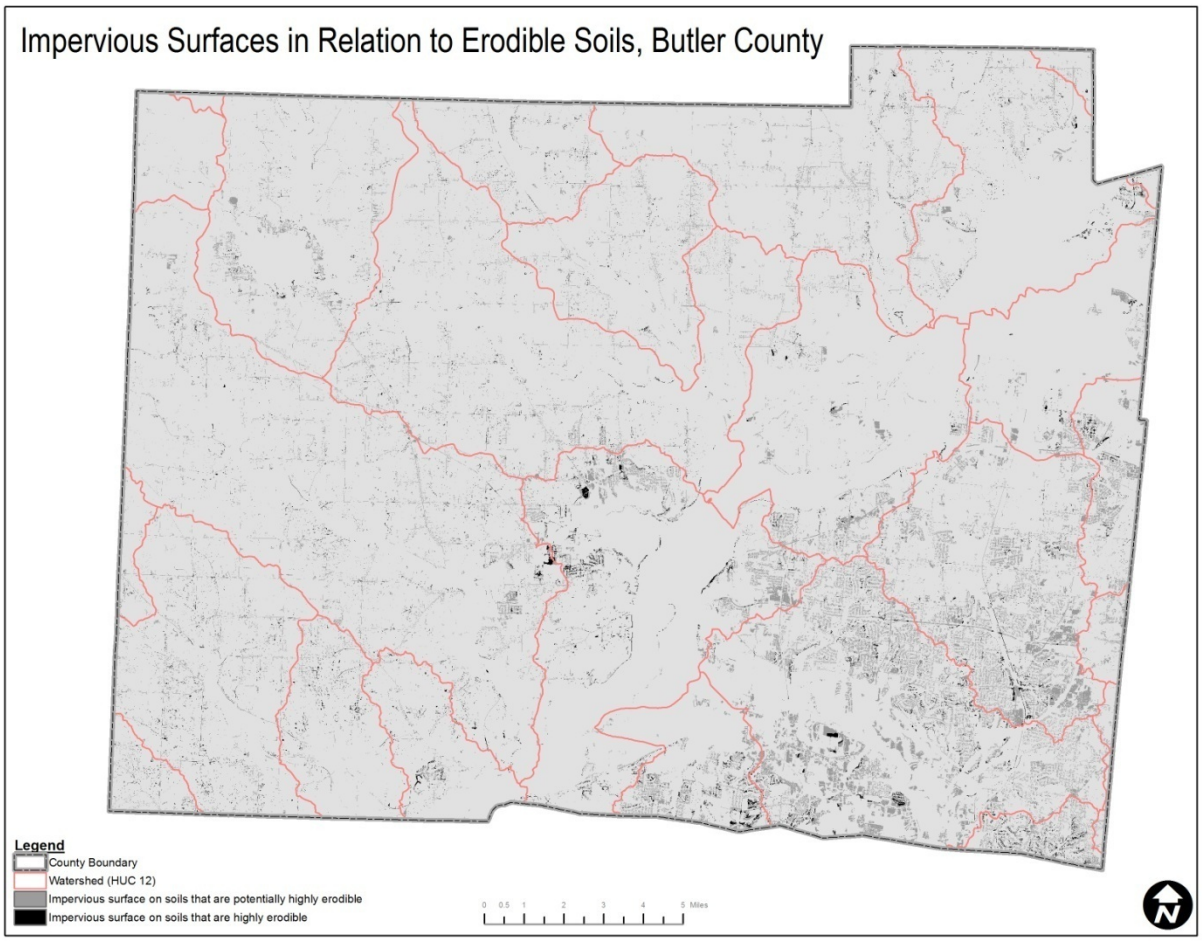


Figure 5-7: Impervious Surfaces in Relation to Erodible Soils in Clermont County

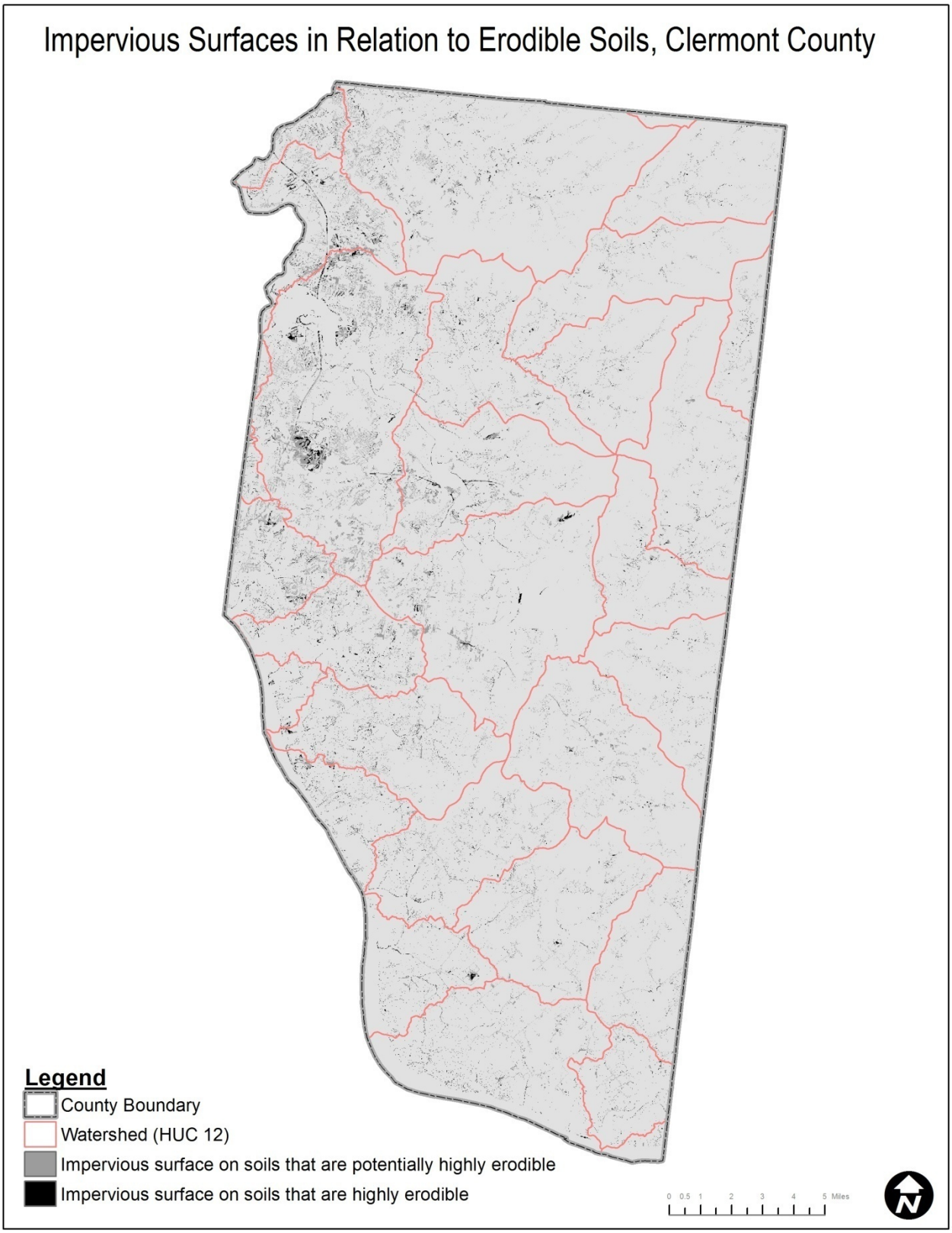


Figure 5-8: Impervious Surfaces in Relation to Erodible Soils in Hamilton County

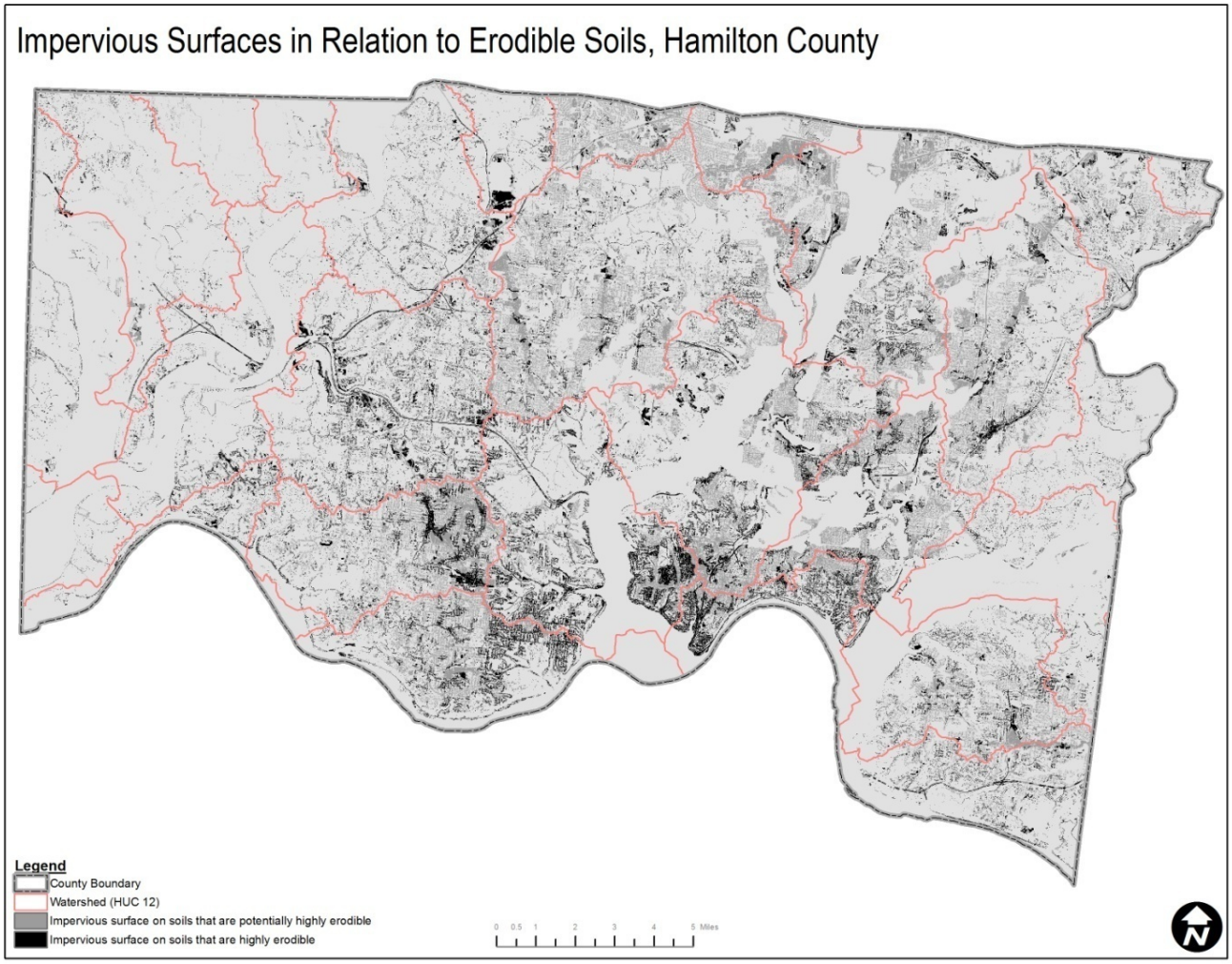
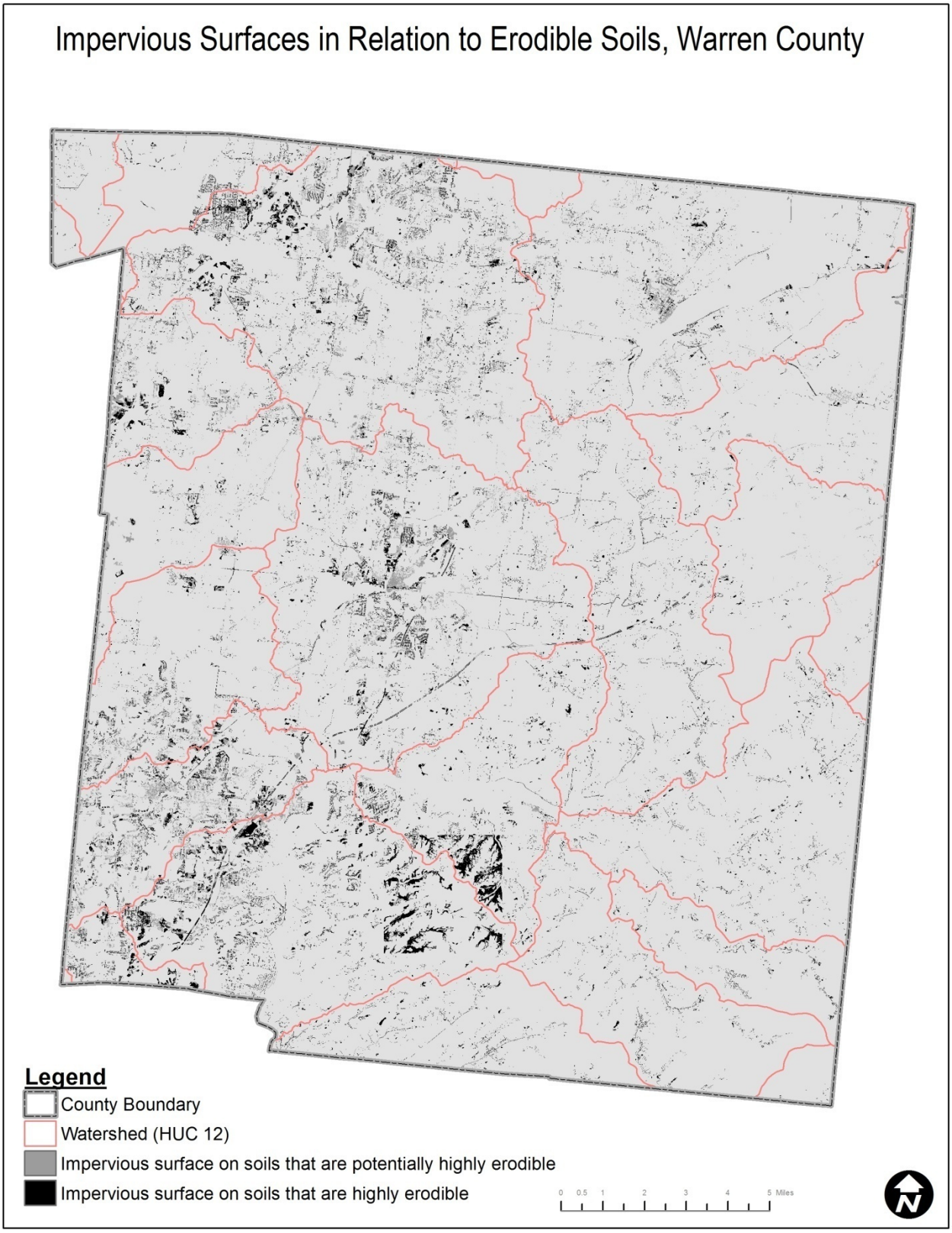


Figure 5-9: Impervious Surfaces in Relation to Erodible Soils in Warren County



Impervious Surfaces in Relation to Riparian Corridors

Where impervious surfaces are paved or built near streams, their impact on stream health can be expected to increase. This is especially true for impervious surfaces that encroach upon the riparian corridor, which OKI defined as the area located within 100 feet to each side of a river or stream centerline, resulting in a 200-foot-wide band. A vegetated riparian corridor is valuable for its capacity to function as a pollution filter. A riparian corridor can also serve as a:

- conduit, by allowing the movement of water and wildlife and supporting the distribution of seeds
- barrier, by inhibiting the movement of livestock, people and vehicles across waterways, thus protecting the streambanks
- source, by serving as a refuge for native plant and animal species, especially in a heavily developed area with high percentages of impervious surfaces
- sink, by removing pollutants and sequestering excess levels of nitrogen and phosphorus
- habitat, by shading the stream and lowering the water temperature, thus inhibiting algae blooms while increasing dissolved oxygen

Though impervious surfaces are uncommon in riparian corridors, it is useful to analyze where the two coincide because of the direct impact on stream health. For the 82 watershed assessment units in OKI's four-county study area, Table 5-21 below analyzes the distribution of impervious surfaces in relation to 200-foot-wide riparian corridors (100 feet to each side of the stream or river centerline). The table lists the 82 watersheds in descending order of percentage of watershed area with impervious surface in the riparian corridor. The table also color codes the 82 watersheds into three comparably sized categories. Red rows represent the 27 watersheds having the highest percentages (0.60 percent to 1.53 percent) of watershed area having impervious surfaces in riparian corridors. Yellow rows represent the 28 watersheds having mid-range percentages (0.38 percent to 0.59 percent) of watershed area having impervious surfaces in riparian corridors. Green rows represent the 27 watersheds with the lowest percentages (0 percent to 0.37 percent) of watershed area having impervious surfaces in riparian corridors.

Table 5-21: Impervious Surfaces in Relation to Riparian Corridors for 82 Watersheds

Watershed Name HUC 12 #	Impervious Acres Outside of Riparian Corridors (percent of watershed in this category)	Impervious Acres Inside of Riparian Corridors (percent of watershed in this category)
Congress Run-Mill Creek 050902030104	6,539.4 (34.1%)	293.6 (1.53%)
Duck Creek 050902021404	3,776.3 (38.2%)	151.0 (1.53%)
Sharon Creek-Mill Creek 050902030103	7,205.0 (35.4%)	300.9 (1.48%)
Pleasant Run 050800020901	3,008.5 (31.1%)	140.3 (1.45%)
Sycamore Creek 050902021401	3,691.4 (24.7%)	199.7 (1.34%)
Taylor Creek 050800020905	2,586.4 (15.2%)	227.2 (1.33%)
Salt Run-Little Miami River 050902020903	4,209.3 (18.6%)	276.1 (1.22%)
Clough Creek-Little Miami River 050902021406	2,275.9 (19.0%)	140.0 (1.17%)
Ninemile Creek-Ohio River 050902011208	2,534.2 (14.9%)	183.9 (1.08%)
West Fork Mill Creek 050902030102	5,540.0 (23.9%)	250.9 (1.08%)
Muddy Creek 050902030203	2,781.1 (26.2%)	104.2 (0.98%)
East Fork Mill Creek-Mill Creek 050902030101	8,106.3 (26.8%)	282.5 (0.93%)
Halls Creek-Little Miami River 050902020804	1,376.1 (10.5%)	118.7 (0.91%)

Watershed Name HUC 12 #	Impervious Acres Outside of Riparian Corridors (percent of watershed in this category)	Impervious Acres Inside of Riparian Corridors (percent of watershed in this category)
Muddy Creek 050902020901	2,411.7 (23.8%)	84.2 (0.83%)
Salt Run-East Fork Little Miami River 050902021305	4,605.7 (16.9%)	216.8 (0.80%)
West Fork-Mill Creek 050902030105	4,951.6 (32.8%)	117.7 (0.78%)
Dry Creek-Ohio River 050902030202	3,686.7 (33.3%)	84.8 (0.77%)
Tenmile Creek 050902011206	688.6 (8.3%)	63.5 (0.76%)
Banklick Creek-Great Miami River 050800020902	6,019.2 (21.3%)	204.8 (0.73%)
Little Indian Creek-Ohio River 050902011107	390.8 (5.3%)	52.6 (0.72%)
Shaker Creek 050800020703	1,561.7 (11.4%)	97.1 (0.71%)
Dicks Creek 050800020704	4,003.5 (22.6%)	124.9 (0.70%)
Dry Run-Great Miami River 050800020904	1,658.4 (9.0%)	124.8 (0.68%)
Gregory Creek 050800020705	3,185.3 (16.8%)	127.3 (0.67%)
Ferguson Run-Twelvemile Creek 050902011204	645.2 (5.2%)	77.8 (0.62%)
O'Bannon Creek 050902020902	2,754.4 (7.3%)	234.9 (0.62%)
Jordan Creek-Great Miami River 050800020906	1,403.2 (9.6%)	86.8 (0.60%)
Horner Run-Little Miami River 050902021403	1,718.4 (12.5%)	81.0 (0.59%)
Little Muddy Creek 050902020802	1,351.2 (10.3%)	77.4 (0.59%)
Rush Run-Sevenmile Creek 050800020504	305.4 (4.4%)	40.4 (0.58%)
Polk Run-Little Miami River 050902021402	2,468.0 (22.7%)	62.8 (0.58%)
Paddys Run 050800020903	657.1 (6.3%)	59.6 (0.57%)
Turtle Creek 050902020803	3,019.5 (10.5%)	161.5 (0.56%)
First Creek 050902020703	568.7 (4.6%)	65.8 (0.53%)
Solomon Run-East Fork Little Miami River 050902021101	178.5 (4.5%)	20.4 (0.51%)
Browns Run-Great Miami River 050800020702	2,416.8 (13.3%)	93.1 (0.51%)
Poplar Creek 050902021201	899.0 (5.9%)	78.3 (0.51%)
Backbone Creek-East Fork Little Miami River 050902021204	1,127.2 (8.5%)	67.5 (0.51%)
Clear Creek 050800020403	3,838.6 (11.9%)	161.7 (0.50%)
Dry Run-Little Miami River 050902021405	1,467.2 (12.9%)	56.4 (0.50%)
Dry Run-Great Miami River 050800020404	750.7 (13.4%)	27.5 (0.49%)
Elk Creek 050800020701	866.4 (4.7%)	87.3 (0.47%)
Brushy Fork 050902021302	404.9 (4.2%)	42.5 (0.45%)
Garrison Creek-Ohio River 050902030204	823.4 (19.7%)	18.4 (0.44%)
Howard Creek-Dry Fork Whitewater River 050800030808	867.1 (4.2%)	92.1 (0.44%)
Headwaters Stonelick Creek 050902021301	410.8 (3.9%)	46.3 (0.44%)
Lee Creek-Dry Fork Whitewater River 050800030809	1,083.2 (7.8%)	58.2 (0.42%)

Lick Fork-Stonelick Creek 050902021304	718.1 (6.1%)	48.5 (0.41%)
Bear Creek-Ohio River 050902011106	480.2 (3.1%)	63.3 (0.41%)
Acton Lake Dam-Four Mile Creek 050800020604	1,428.2 (8.1%)	71.3 (0.40%)
Ninemile Creek-Sevenmile Creek 050800020505	540.9 (5.0%)	42.4 (0.39%)
Little Creek-Todd Fork 050902020606	60.1 (2.7%)	8.6 (0.39%)
Headwaters Big Indian Creek 050902011201	449.5 (3.3%)	52.4 (0.38%)
Lick Run-Todd Fork 050902020704	715.9 (4.0%)	67.6 (0.38%)
Jameson Creek-Whitewater River 050800030810	1,308.6 (11.4%)	43.5 (0.38%)
Second Creek 050902020702	236.3 (3.9%)	22.3 (0.37%)
Lucy Run-East Fork Little Miami River 050902021203	1,555.4 (7.0%)	81.5 (0.37%)
Moores Fork-Stonelick Creek 050902021303	516.1 (4.5%)	41.9 (0.37%)
Boat Run-Ohio River 050902011203	367.8 (6.5%)	20.8 (0.37%)
Brandywine Creek-Indian Creek 050800020802	129.0 (3.6%)	13.0 (0.36%)
Fivemile Creek-East Fork Little Miami River 050902021102	631.2 (4.8%)	46.7 (0.36%)
North Fork Indian Creek-Big Indian Creek 050902011202	436.7 (3.7%)	41.1 (0.35%)
Ferris Run-Little Miami River 050902020801	845.1 (4.4%)	66.8 (0.35%)
Bullskin Creek 050902011104	136.8 (2.6%)	17.2 (0.33%)
Cotton Run-Four Mile Creek 050800020605	1,614.6 (4.9%)	106.7 (0.32%)
Beals Run-Indian Creek 050800020803	2,010.2 (4.8%)	135.9 (0.32%)
Headwaters Dry Fork Whitewater River 050800030807	53.1 (3.6%)	4.7 (0.32%)
Todd Run-East Fork Little Miami River 050902021103	433.4 (5.2%)	26.6 (0.32%)
Flat Fork 050902020405	338.4 (3.3%)	31.6 (0.31%)
West Branch Bullskin Creek 050902011103	321.9 (3.7%)	26.0 (0.30%)
Town of New Miami-Great Miami River 050800020706	2,062.0 (10.5%)	50.9 (0.26%)
Newman Run-Little Miami River 050902020504	1,284.9 (5.1%)	61.6 (0.24%)
Watershed Name HUC 12 #	**Impervious Acres Outside of Riparian Corridors (percent of watershed in this category)**	**Impervious Acres Inside of Riparian Corridors (percent of watershed in this category)**
Town of Newport-Ohio River 050902030201	2,048.0 (42.7%)	11.4 (0.24%)
Doublelick Run-Great Miami River 050800020907	182.8 (4.3%)	9.1 (0.21%)
Cloverlick Creek 050902021202	312.8 (3.3%)	19.1 (0.20%)
East Fork Todd Fork 050902020701	2.3 (1.4%)	0.3 (0.20%)
Turtle Creek-Ohio River 050902011102	38.3 (4.6%)	1.4 (0.17%)
Town of Germantown-Twin Creek 050800020306	207.8 (6.6%)	3.9 (0.12%)
Lower Caesar Creek 050902020406	390.0 (3.2%)	11.7 (0.10%)
Sugar Creek 050902020501	50.9 (4.0%)	0.3 (0.03%)

Little Four Mile Creek 050800020602	5.2 (1.9%)	0.1 (0.02%)
Middle Caesar Creek 050902020404	0.6 (4.1%)	0.0 (0.00%)

Table 5-22 below analyzes the distribution of impervious surfaces inside riparian corridors on a county-by-county basis. Butler, Clermont and Warren counties each have a total of 0.5 percent of their total land area as impervious riparian corridor. Hamilton County doubles that proportion, having 1 percent of its land area as impervious riparian corridor.

Table 5-22: Impervious Surfaces in Relation to Riparian Corridors for Butler, Clermont, Hamilton and Warren Counties

County	Impervious Acres Outside of Riparian Corridors (percent of county in this category)	Impervious Acres Inside of Riparian Corridors (percent of county in this category)
Butler	35,336.6 (11.7%)	1,551.7 (0.5%)
Clermont	20,944.6 (7.1%)	1,466.3 (0.5%)
Hamilton	58,574.8 (22.2%)	2,600.6 (1.0%)
Warren	23,875.7 (9.2%)	1,396.8 (0.5%)

Figures on the next four pages show the spatial distribution of impervious surfaces in relation to riparian corridors in Butler, Clermont, Hamilton and Warren counties. Given the relative narrowness of riparian corridors and the site-specific intrusions of impervious surfaces near streams, these maps show only those impervious surfaces that fall within the bounds of the 200-foot-wide riparian corridor. In order to avoid obscuring the maps' main theme, impervious surfaces *outside* the riparian corridors are not displayed.

Figure 5-10: Impervious Surfaces in Riparian Corridors, Butler County

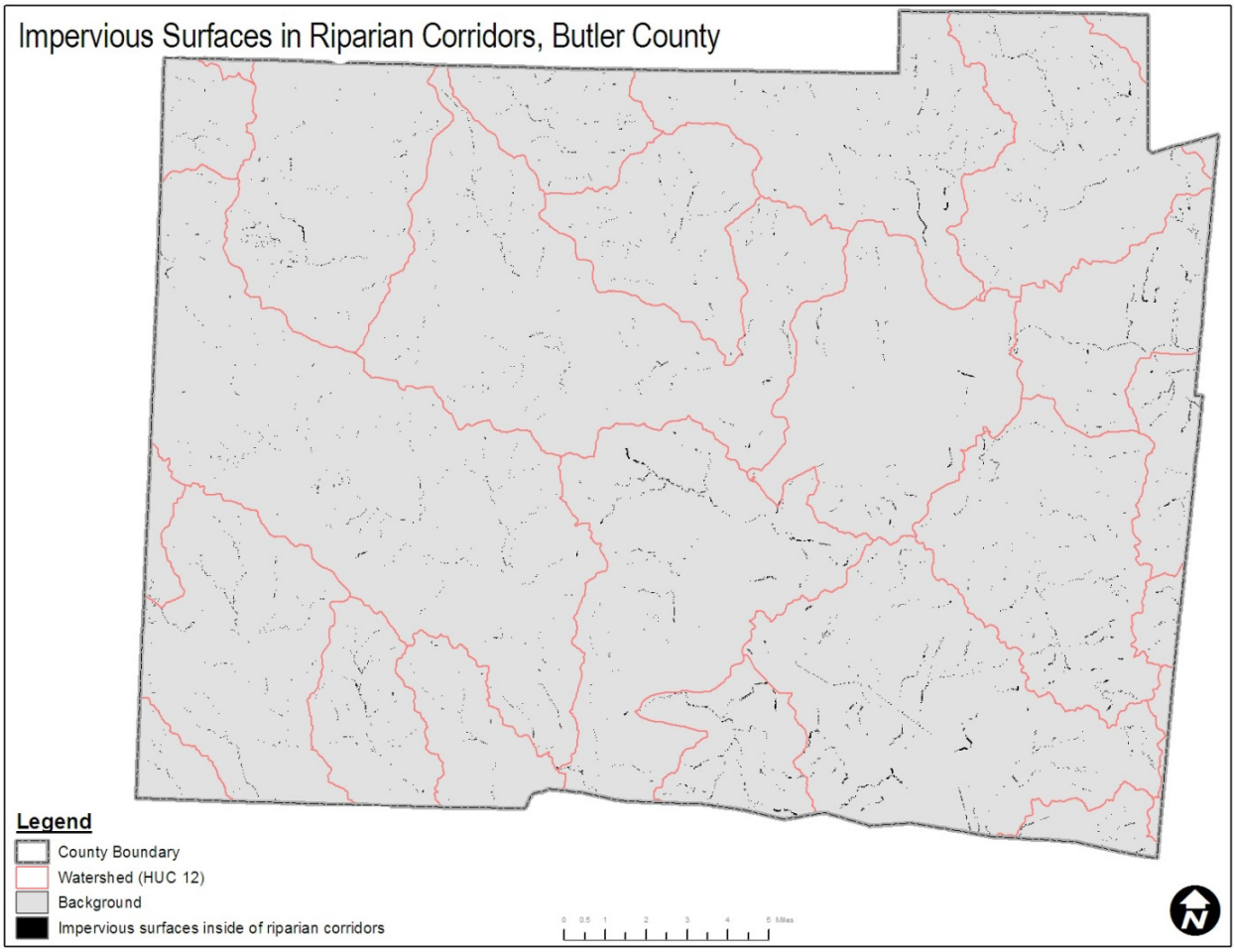


Figure 5-11: Impervious Surfaces in Riparian Corridors, Clermont County

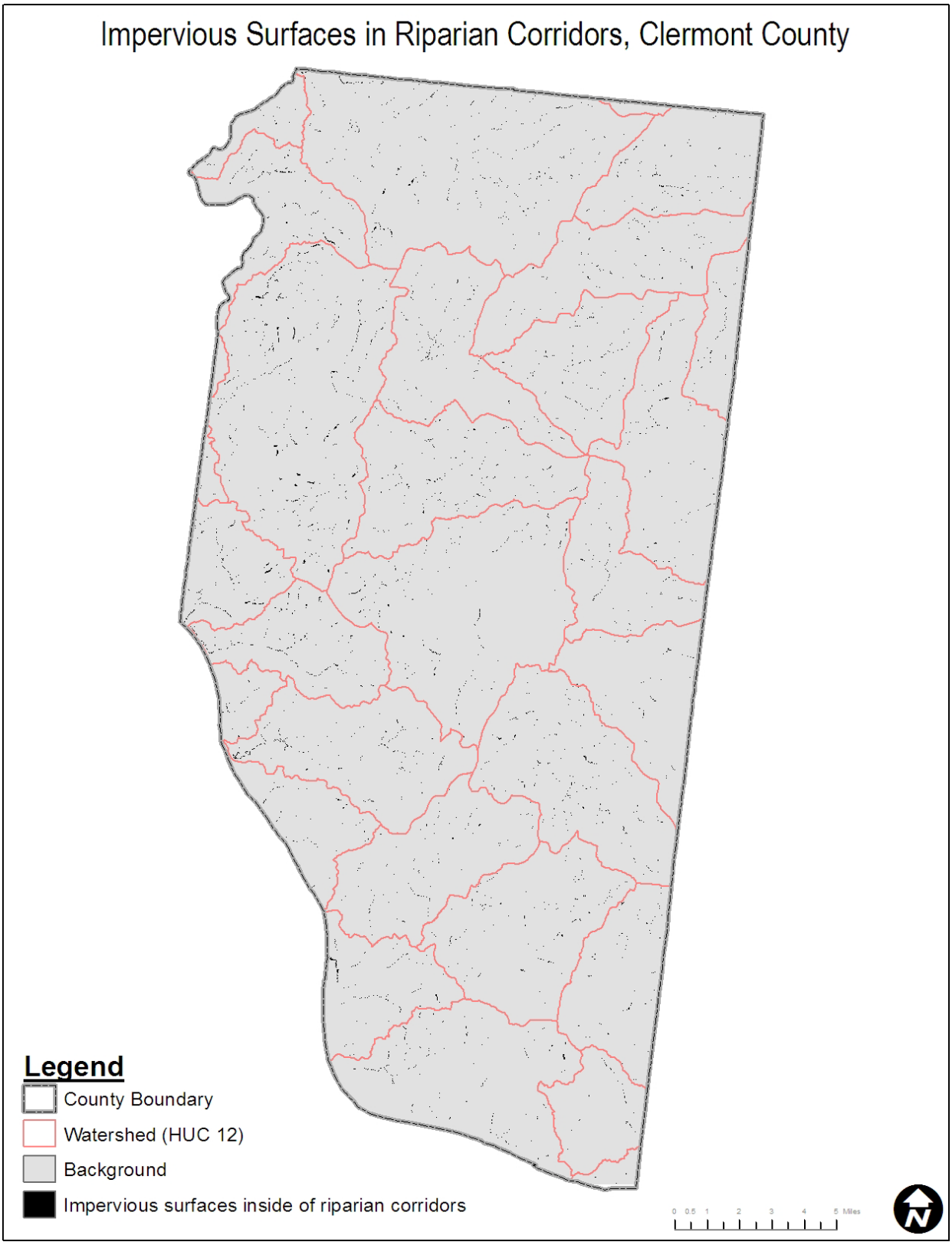


Figure 5-12: Impervious Surfaces in Riparian Corridors, Hamilton County

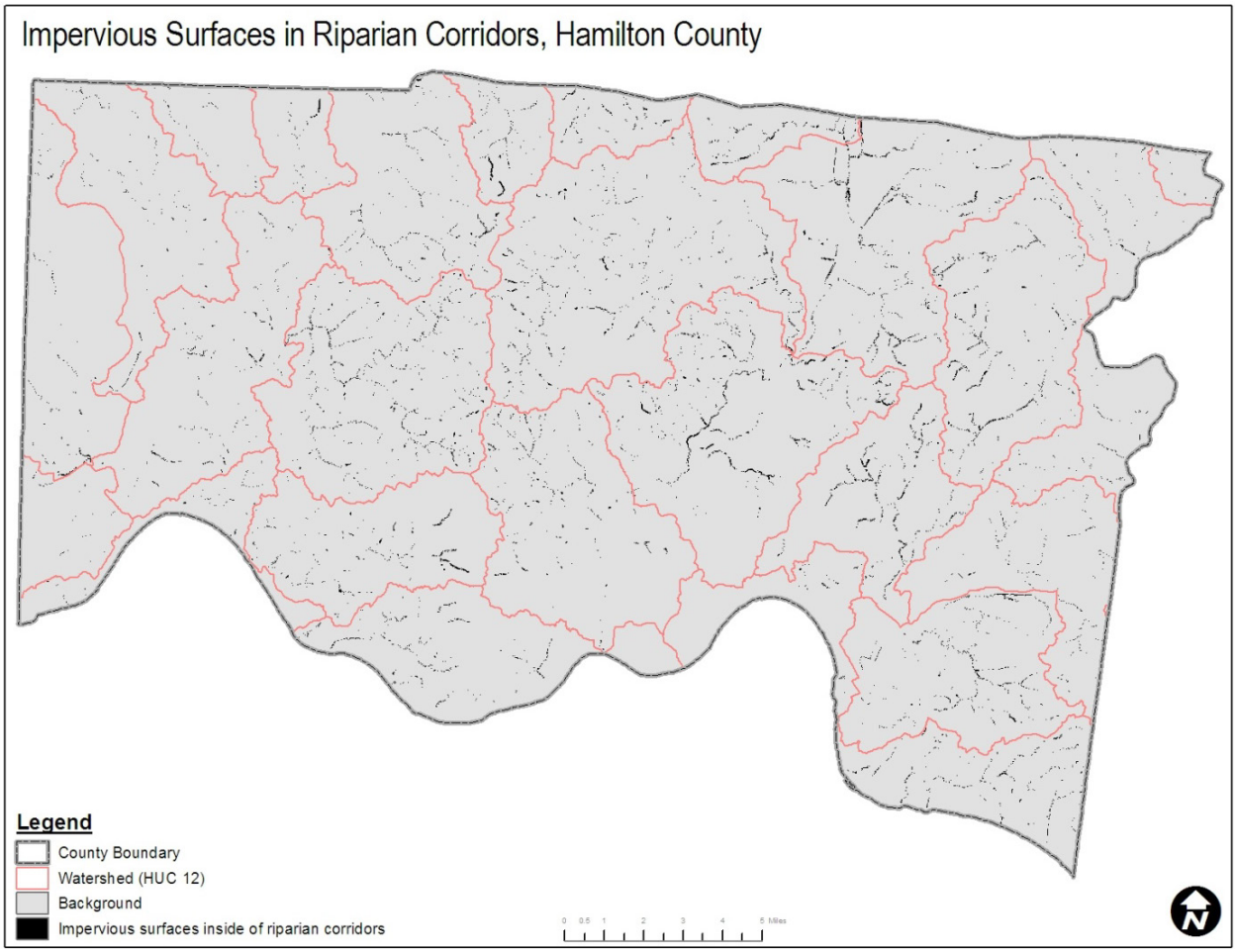
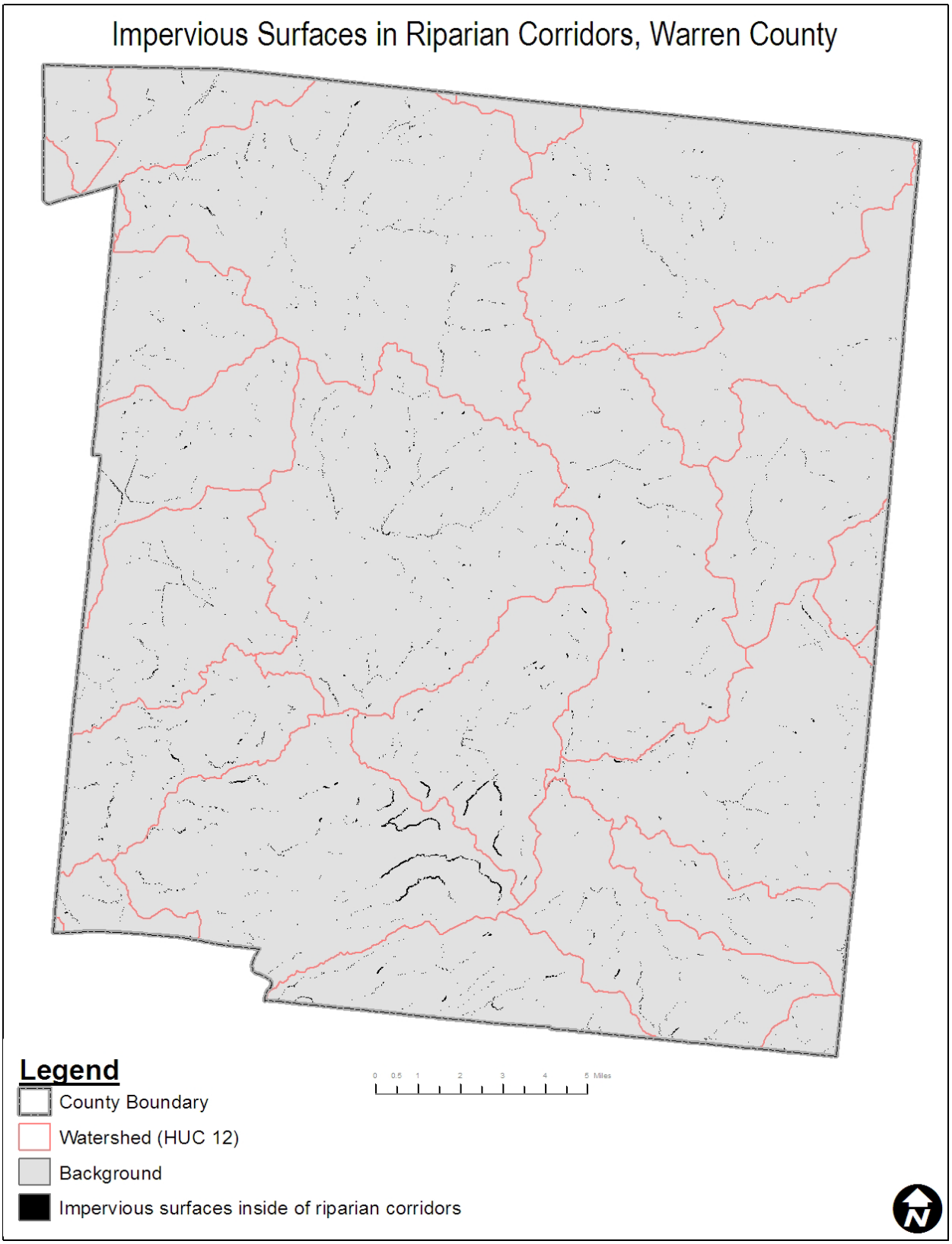


Figure 5-13: Impervious Surfaces in Riparian Corridors, Warren County



Impervious Surfaces in Relation to Aquifer Areas

The most measurable impact of impervious surfaces over aquifers is the loss of aquifer recharge areas. The process of aquifer recharge is the infiltration of precipitation, which is what impervious surfaces impede. Impervious surfaces can also increase the risk of aquifer contamination by placing potential pollution sources over the groundwater supply. Polluted stormwater, discharges or spills may be separated from the aquifer by impervious surface, but the contaminants can flow to groundwater infiltration areas nearby. Contaminants that flow to streams can also make their way to the groundwater supply through porous streambeds overlying aquifers.

For the 82 watershed assessment units in OKI's four-county study area, Table 5-23 below analyzes the distribution of impervious surfaces in relation to sand and gravel buried valley aquifer areas. The table lists the 82 watersheds in descending order of percentage of watershed area with impervious surface over the aquifer area. The table also color codes the 82 watersheds into three comparably sized categories. Red rows represent the 28 watersheds having the highest percentages (2.19 percent to 24.41 percent) of watershed area with impervious surfaces over aquifer areas. Yellow rows represent the 26 watersheds having miniscule to moderate percentages (0.01 percent to 2.03 percent) of watershed area with impervious surfaces over aquifer areas. Green rows represent the 28 watersheds with no (0 percent) watershed area having impervious surfaces over aquifers. In most cases, the watersheds with green color coding do not have sand and gravel buried valley aquifers.

Table 5-23: Impervious Surfaces in Relation to Aquifer Areas for 82 Watersheds

Watershed Name HUC 12 #	Impervious Acres Not Over and Aquifer Area (percent of watershed in this category)	Impervious Acres Over an Aquifer Area (percent of watershed in this category)
Duck Creek 050902021404	1,513.1 (15.3%)	2,414.3 (24.41%)
Congress Run-Mill Creek 050902030104	3,290.6 (17.2%)	3,542.6 (18.48%)
Sharon Creek-Mill Creek 050902030103	4,427.6 (21.8%)	3,078.5 (15.12%)
Town of Newport-Ohio River 050902030201	1,413.3 (29.5%)	645.9 (13.48%)
Banklick Creek-Great Miami River 050800020902	2,472.5 (8.8%)	3,751.7 (13.3%)
West Fork-Mill Creek 050902030105	3,134.2 (20.7%)	1,935.3 (12.80%)
Dicks Creek 050800020704	1,872.6 (10.6%)	2,256.0 (12.72%)
Dry Run-Great Miami River 050800020404	110.6 (2.0%)	667.6 (11.92%)
East Fork Mill Creek-Mill Creek 050902030101	4,829.5 (16.0%)	3,559.4 (11.76%)
Pleasant Run 050800020901	2,064.0 (21.4%)	1,085.1 (11.23%)
Jameson Creek-Whitewater River 050800030810	244.5 (2.1%)	1,107.6 (9.66%)
Browns Run-Great Miami River 050800020702	823.4 (4.5%)	1,686.5 (9.26%)
Dry Creek-Ohio River 050902030202	2,894.0 (26.1%)	876.9 (7.92%)
Dry Run-Little Miami River 050902021405	699.5 (6.1%)	824.1 (7.24%)
Town of New Miami-Great Miami River 050800020706	934.7 (4.8%)	1,178.1 (6.00%)
Jordan Creek-Great Miami River 050800020906	703.7 (4.8%)	786.4 (5.40%)

Lee Creek-Dry Fork Whitewater River 050800030809	401.2 (2.9%)	740.3 (5.34%)
Clough Creek-Little Miami River 050902021406	1,840.4 (15.4%)	575.4 (4.81%)
Town of Germantown-Twin Creek 050800020306	81.7 (2.6%)	130.1 (4.16%)
Paddys Run 050800020903	299.9 (2.9%)	416.7 (3.99%)
Doublelick Run-Great Miami River 050800020907	44.7 (1.0%)	147.2 (3.45%)
Shaker Creek 050800020703	1,186.7 (8.6%)	472.5 (3.44%)
Dry Run-Great Miami River 050800020904	1,184.9 (6.4%)	598.5 (3.24%)
Horner Run-Little Miami River 050902021403	1,414.7 (10.3%)	384.9 (2.80%)
Polk Run-Little Miami River 050902021402	2,237.9 (20.6%)	292.9 (2.70%)
Turtle Creek 050902020803	2,424.6 (8.4%)	756.2 (2.63%)
Salt Run-East Fork Little Miami River 050902021305	4,221.7 (15.5%)	600.7 (2.21%)
West Fork Mill Creek 050902030102	5,283.7 (22.8%)	507.2 (2.19%)
Clear Creek 050800020403	3,344.8 (10.4%)	655.6 (2.03%)
Halls Creek-Little Miami River 050902020804	1,236.2 (9.4%)	258.7 (1.97%)
Gregory Creek 050800020705	2,946.6 (15.5%)	365.8 (1.93%)
Backbone Creek-East Fork Little Miami River 050902021204	942.5 (7.1%)	252.1 (1.89%)
Cotton Run-Four Mile Creek 050800020605	1,120.9 (3.4%)	600.2 (1.83%)
Ninemile Creek-Sevenmile Creek 050800020505	395.6 (3.6%)	187.8 (1.73%)
Rush Run-Sevenmile Creek 050800020504	237.4 (3.4%)	108.5 (1.57%)
Ninemile Creek-Ohio River 050902011208	2,461.4 (14.5%)	256.2 (1.51%)
Muddy Creek 050902020901	2,373.3 (23.4%)	123.0 (1.21%)
Howard Creek-Dry Fork Whitewater River 050800030808	739.9 (3.5%)	219.3 (1.05%)
Watershed Name HUC 12 #	**Impervious Acres Not Over and Aquifer Area (percent of watershed in this category)**	**Impervious Acres Over an Aquifer Area (percent of watershed in this category)**
Acton Lake Dam-Four Mile Creek 050800020604	1,320.5 (7.4%)	179.1 (1.01%)
Little Muddy Creek 050902020802	1,302.8 (9.9%)	125.9 (0.96%)
Beals Run-Indian Creek 050800020803	1,759.5 (4.2%)	386.7 (0.92%)
Elk Creek 050800020701	809.6 (4.4%)	144.4 (0.78%)
Headwaters Dry Fork Whitewater River 050800030807	48.0 (3.3%)	9.8 (0.67%)

Newman Run-Little Miami River 050902020504	1,195.1 (4.7%)	151.4 (0.60%)
Ferris Run-Little Miami River 050902020801	836.1 (4.3%)	75.7 (0.39%)
Salt Run-Little Miami River 050902020903	4,429.2 (19.6%)	56.2 (0.25%)
Taylor Creek 050800020905	2,772.3 (16.2%)	41.3 (0.24%)
Lick Fork-Stonelick Creek 050902021304	746.6 (6.4%)	20.1 (0.17%)
Sycamore Creek 050902021401	3,865.6 (25.9%)	25.3 (0.17%)
Lucy Run-East Fork Little Miami River 050902021203	1,600.0 (7.2%)	36.9 (0.17%)
Lick Run-Todd Fork 050902020704	762.1 (4.3%)	21.5 (0.12%)
O'Bannon Creek 050902020902	2,965.5 (7.8%)	23.9 (0.06%)
First Creek 050902020703	632.7 (5.1%)	1.8 (0.01%)
Lower Caesar Creek 050902020406	400.3 (3.3%)	1.6 (0.01%)
Little Four Mile Creek 050800020602	5.4 (2.0%)	0.0 (0.0%)
Brandywine Creek-Indian Creek 050800020802	142.1 (3.9%)	0.0 (0.0%)
Turtle Creek-Ohio River 050902011102	39.7 (4.7%)	0.0 (0.0%)
West Branch Bullskin Creek 050902011103	347.9 (4.0%)	0.0 (0.0%)
Bullskin Creek 050902011104	153.9 (2.9%)	0.0 (0.0%)
Bear Creek-Ohio River 050902011106	543.6 (3.5%)	0.0 (0.0%)
Little Indian Creek-Ohio River 050902011107	443.5 (6.0%)	0.0 (0.0%)
Headwaters Big Indian Creek 050902011201	501.8 (3.6%)	0.0 (0.0%)
North Fork Indian Creek-Big Indian Creek 050902011202	477.8 (4.1%)	0.0 (0.0%)
Boat Run-Ohio River 050902011203	388.6 (6.8%)	0.0 (0.0%)
Watershed Name HUC 12 #	**Impervious Acres <u>Not</u> Over and Aquifer Area (percent of watershed in this category)**	**Impervious Acres Over an Aquifer Area (percent of watershed in this category)**
Ferguson Run-Twelvemile Creek 050902011204	723.0 (5.8%)	0.0 (0.0%)
Tenmile Creek 050902011206	752.2 (9.0%)	0.0 (0.0%)
Middle Caesar Creek 050902020404	0.6 (4.1%)	0.0 (0.0%)
Flat Fork 050902020405	369.9 (3.6%)	0.0 (0.0%)
Sugar Creek 050902020501	51.2 (4.0%)	0.0 (0.0%)
Little Creek-Todd Fork 050902020606	68.8 (3.1%)	0.0 (0.0%)
East Fork Todd Fork 050902020701	2.6 (1.5%)	0.0 (0.0%)

Second Creek 050902020702	258.6 (4.3%)	0.0 (0.0%)
Solomon Run-East Fork Little Miami River 050902021101	198.9 (5.0%)	0.0 (0.0%)
Fivemile Creek-East Fork Little Miami River 050902021102	677.9 (5.2%)	0.0 (0.0%)
Todd Run-East Fork Little Miami River 050902021103	460.0 (5.5%)	0.0 (0.0%)
Poplar Creek 050902021201	977.3 (6.4%)	0.0 (0.0%)
Cloverlick Creek 050902021202	331.9 (3.5%)	0.0 (0.0%)
Headwaters Stonelick Creek 050902021301	457.1 (4.3%)	0.0 (0.0%)
Brushy Fork 050902021302	447.5 (4.7%)	0.0 (0.0%)
Moores Fork-Stonelick Creek 050902021303	558.0 (4.9%)	0.0 (0.0%)
Muddy Creek 050902030203	2,885.3 (27.2%)	0.0 (0.0%)
Garrison Creek-Ohio River 050902030204	841.7 (20.2%)	0.0 (0.0%)

Table 5-24 below analyzes the distribution of impervious surfaces inside riparian corridors on a county-by-county basis.

Table 24: Impervious Surfaces in Relation to Aquifer Areas for Butler, Clermont, Hamilton and Warren Counties

County	Impervious Acres Not Over and Aquifer Area (percent of county in this category)	Impervious Acres Over an Aquifer Area (percent of county in this category)
Butler	21,242.0 (7.1%)	15,649.1 (5.2%)
Clermont	21,173.0 (7.2%)	1,237.6 (0.4%)
Hamilton	42,070.2 (15.9%)	19,104.1 (7.2%)
Warren	21,916.4 (8.4%)	3,356.2 (1.3%)

The next four figures show the spatial distribution of impervious surfaces in relation to aquifer areas in Butler, Clermont, Hamilton and Warren counties.

Figure 5:14: Impervious Surfaces in Relation to Aquifer Areas in Butler County

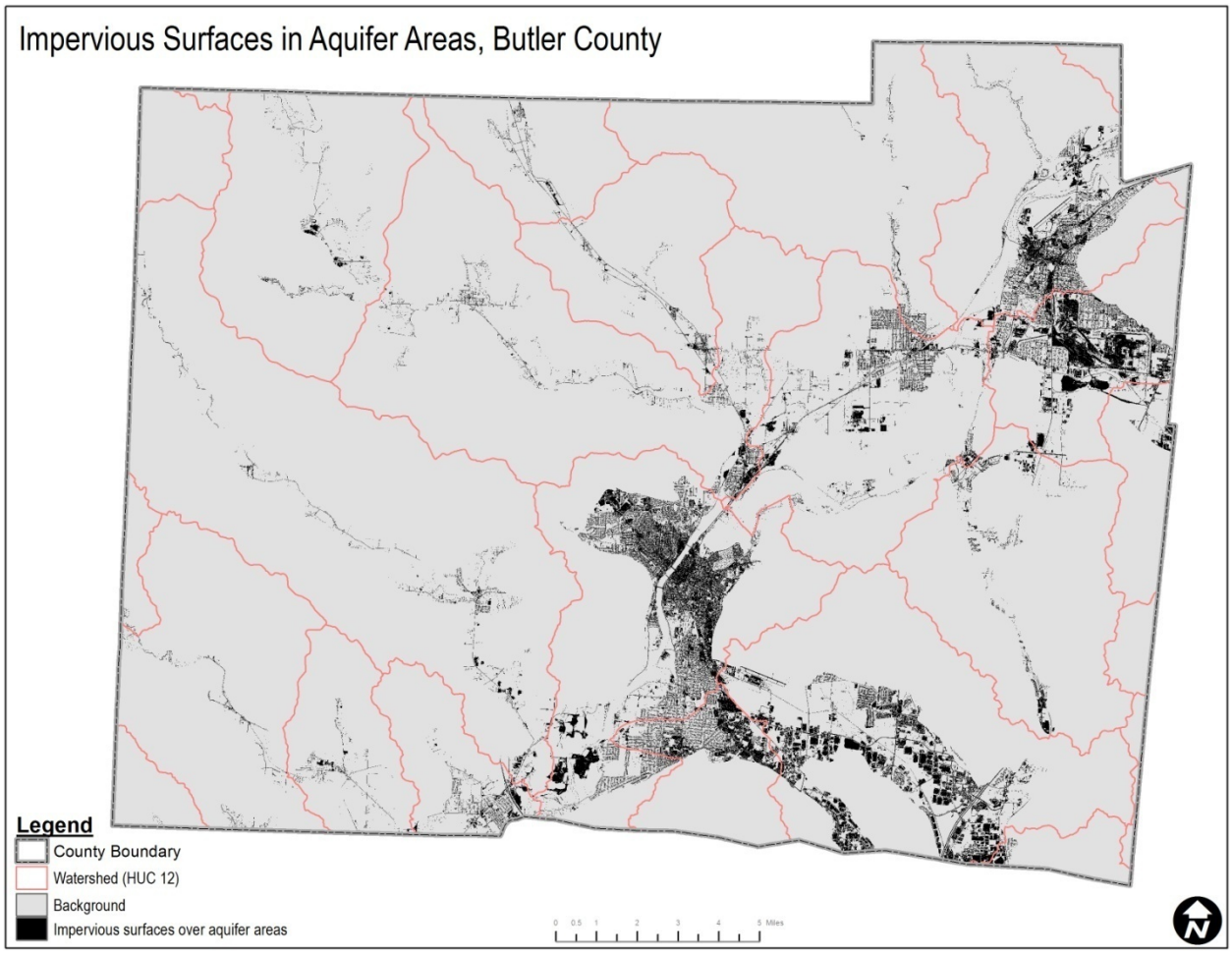


Figure 5:15: Impervious Surfaces in Relation to Aquifer Areas in Clermont County

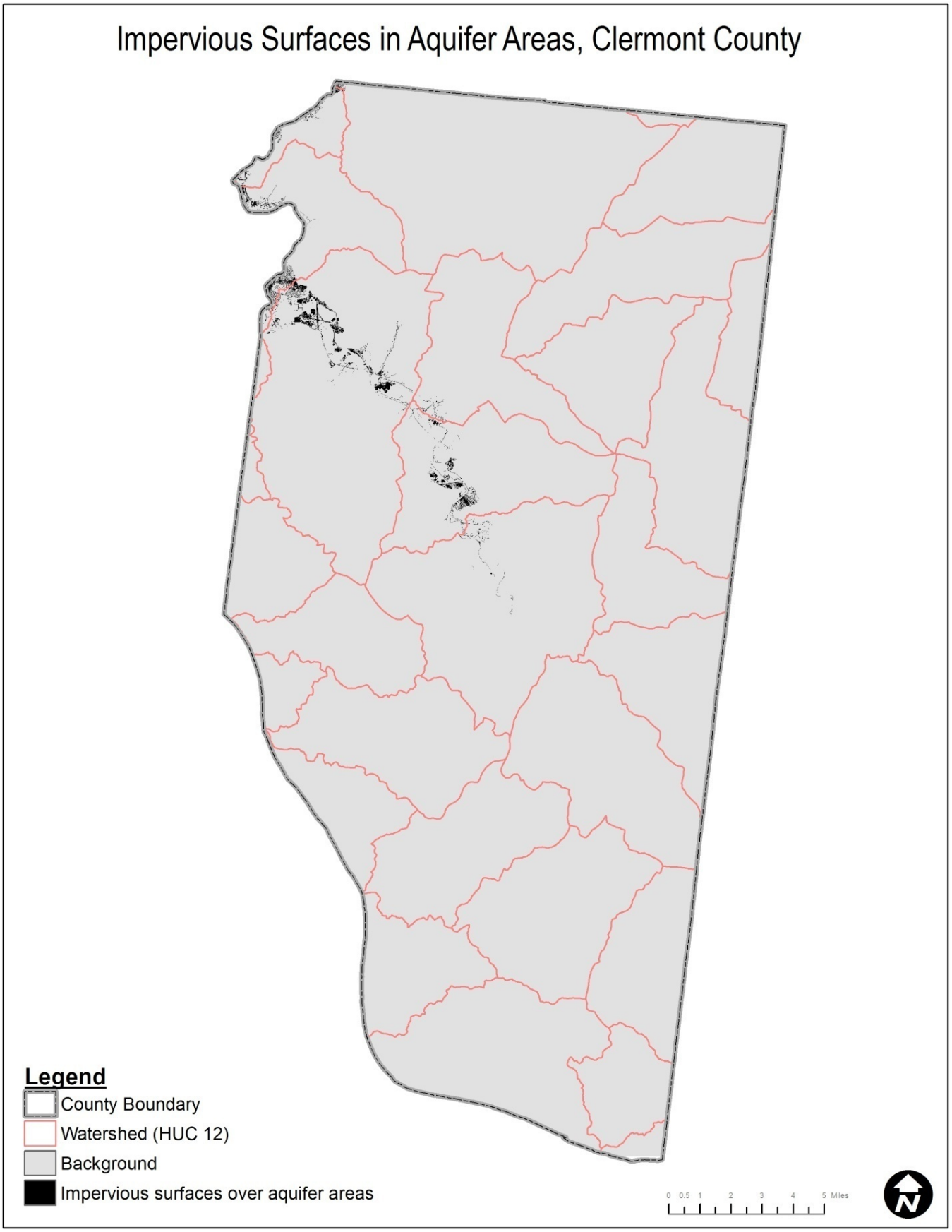


Figure 5:16: Impervious Surfaces in Relation to Aquifer Areas in Hamilton County

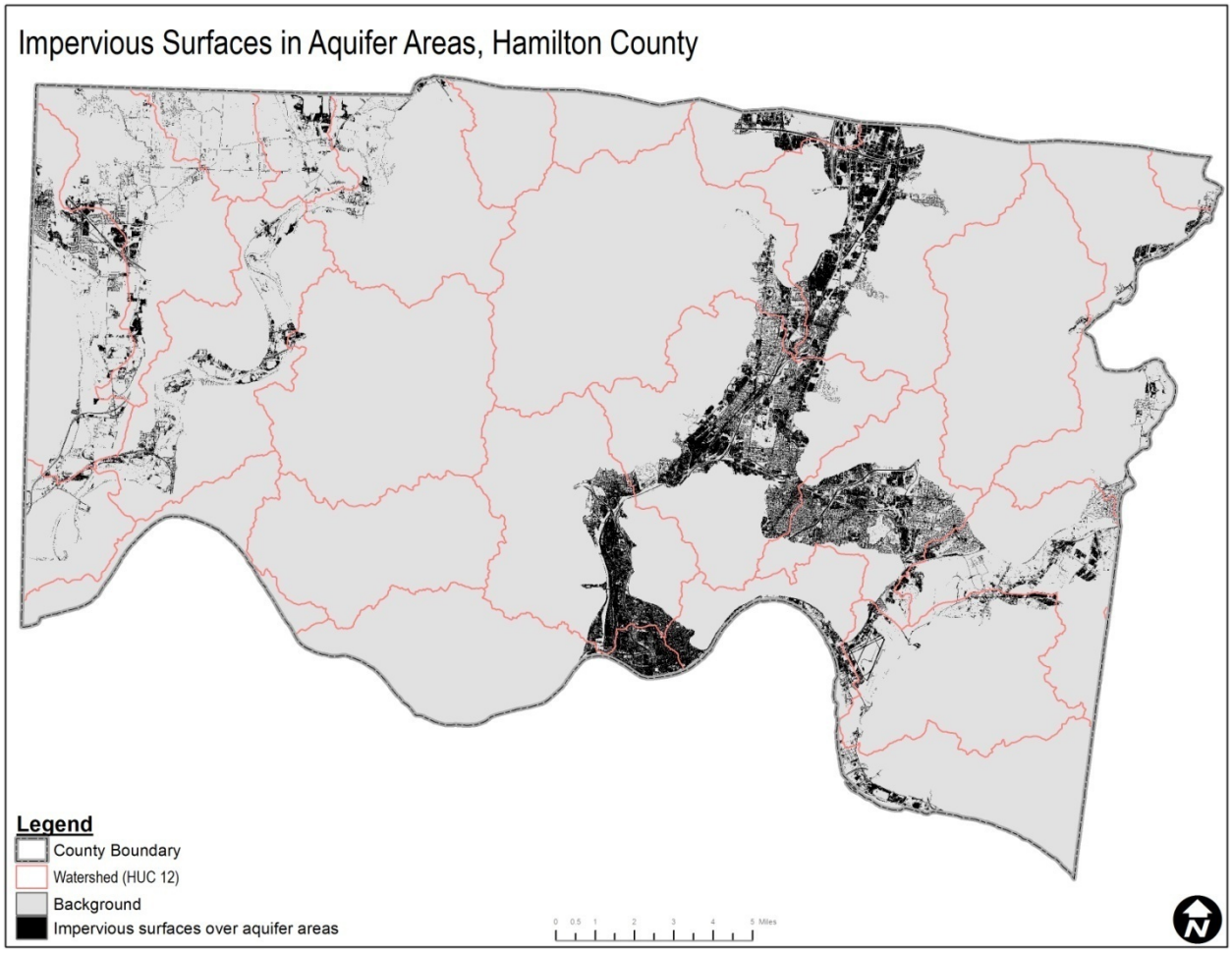
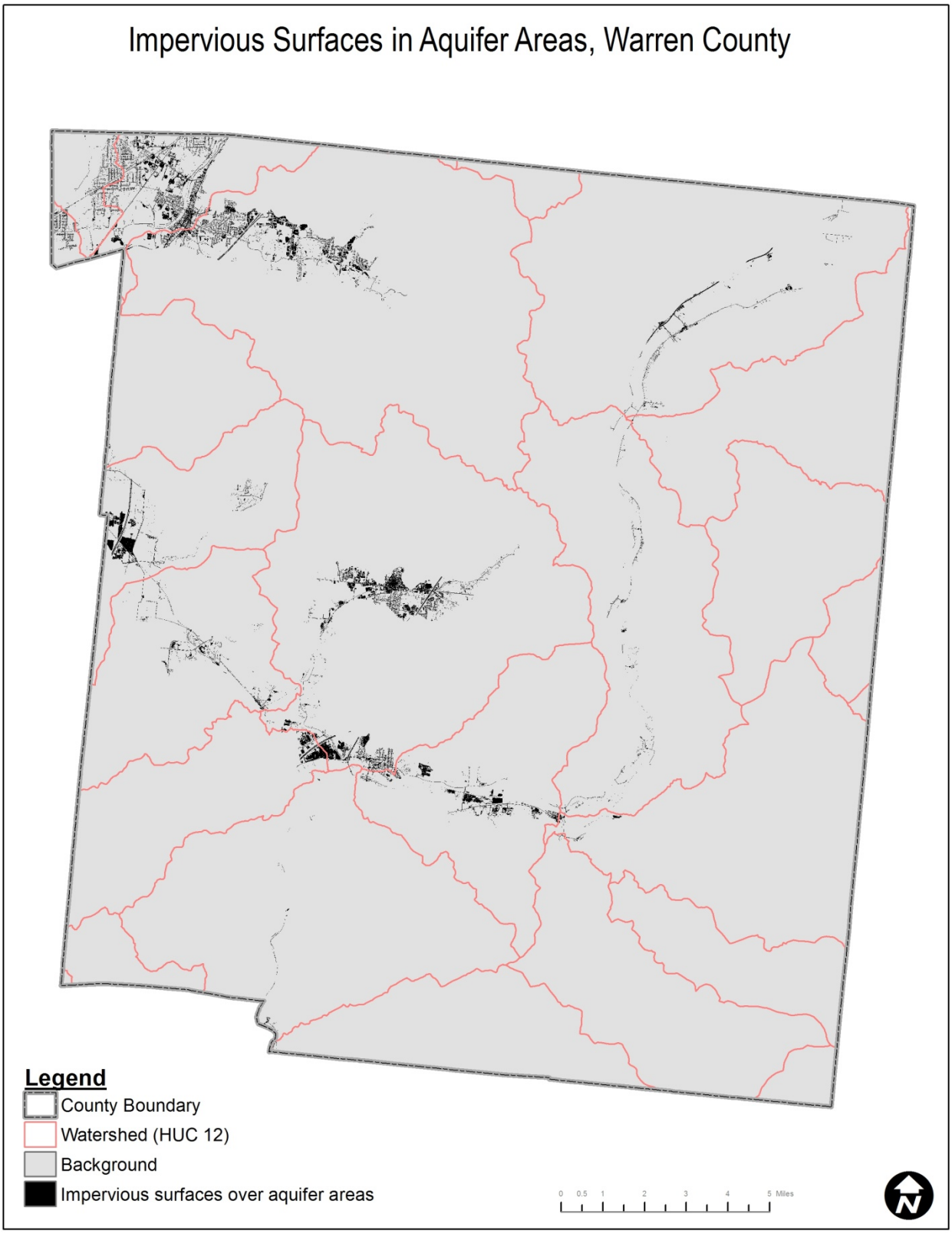


Figure 5:17: Impervious Surfaces in Relation to Aquifer Areas in Warren County



Conclusions About Impervious Surface Analysis

Impervious surface data is a practical prioritization tool. It generally indicates the level of effort needed to attain the water quality standards for a watershed's designated aquatic life uses. The consequences of increasing impervious surface percentages are well-established by the Impervious Cover Model, which is explained in *Chapter 3: Current and Projected Development*.

There is less clarity about the consequences of impervious surfaces in combination with other factors. Although showing the coincidence of impervious surfaces in combination with other factors does not necessarily portray cause and effect relationships, these coincidences do broaden perspective on watershed impairments from nonpoint source pollution. The preceding tables and figures quantify the coincidence of impervious surfaces with other factors on a relative basis, i.e. showing the relative degree of coincidence for the 82 HUC 12 watersheds in Butler, Clermont, Hamilton and Warren Counties. In trying to discern impervious surface impacts on water quality, OKI's analysis indicates that:

1. Significant levels of impervious surface in the riparian corridor merit more attention on stream habitat, especially the components measured by the Qualitative Habitat Evaluation Index (QHEI).
2. Significant levels of impervious surface on highly erodible soils merit more attention to stream embeddedness, which is "the degree that cobble, gravel and boulder substrates are surrounded, impacted in, or covered by fine materials." (*Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)*, Ohio EPA, Division of Surface Water, 2006). Substrates are embedded if more than half of their surface area is embedded in sand or silt. Where impervious surfaces are in close proximity to highly erodible soils, the stormwater runoff is likely to load the streams with silts and sediments, the byproducts of erosion. These byproducts increase stream embeddedness, which deprives macroinvertebrates of habitat, thus lowering a stream's Invertebrate Community Index (ICI). A low ICI score can cause a stream to fall short of attainment, particularly where it degrades the fish community, as measured by Index of Biotic Integrity (IBI) and the Modified Index of well-being (MIwb).
3. Significant levels of impervious surface in severely sloped areas merit more attention to a watershed's hydrology. The combined forces of impervious surfaces and steep slopes can make water *quantity* as much of an issue as water *quality* for an impaired watershed. A higher coincidence of impervious surfaces with steep slopes can also indicate areas that are more vulnerable to flash flooding because both characteristics send more stormwater runoff in less time to nearby streams.
4. Significant levels of impervious surfaces in aquifer areas merit more attention to groundwater quantity and quality. Impervious surfaces have an impact on groundwater quantity wherever they cover aquifer recharge zones. Impervious surfaces have an impact on groundwater quality wherever they place poorly managed potential pollution sources over aquifer areas. Polluted groundwater can degrade surface water, particularly when and where streams gain part of their base flow from groundwater seeping through the streambank. Incised urban streams are more likely to intersect the water table, increasing the likelihood that surface waters and groundwaters will exchange contaminants. A relatively high percentage of impervious surfaces over aquifer areas can also indicate flood damage zones, because aquifer areas in the OKI region generally coincide with 100-year floodplains, and impervious surfaces often signify the building structures that sustain damage when flooded.

The preceding tables and figures are color coded to provide a quick reference to which watersheds have higher percentages of watershed area with impervious surface in relation to the slopes, erodible soils, riparian corridors and aquifer areas. Though the color-coded groups have not been linked to cause and effect relationships in the same manner as the color-coded levels on the Impervious Cover Model (see

Chapter 3: Current and Projected Development), they do give a better idea of which watersheds face greater challenges from higher coincidences of impervious surfaces in relation to environmentally sensitive areas (i.e., severe slopes, highly erodible soils, riparian corridors or underlying aquifers). Another useful perspective is to consider the acres of watershed area in relation to the four parameters, especially for the watersheds that have larger shares of the four-county planning area.

Based on total acres of impervious surface, the top 20 watersheds for impervious cover in Butler, Clermont, Hamilton and Warren counties are:

1. East Fork Mill Creek-Mill Creek, with 8,389 acres of impervious surfaces
2. Sharon Creek-Mill Creek, with 7,506 acres of impervious surfaces
3. Congress Run-Mill Creek, with 6,833 acres of impervious surfaces
4. Banklick Creek-Great Miami River, 6,224
5. West Fork Mill Creek, with 5,791 acres of impervious surfaces
6. Muddy Creek, with 5,381 acres of impervious surfaces
7. West Fork-Mill Creek, with 5,069 acres of impervious surfaces
8. Salt Run-East Fork Little Miami River, with 4,823 acres of impervious surfaces
9. Salt Run-Little Miami River, with 4,485 acres of impervious surfaces
10. Dicks Creek, with 4,128 acres of impervious surfaces
11. Clear Creek, with 4,000 acres of impervious surfaces
12. Duck Creek, with 3,927 acres of impervious surfaces
13. Sycamore Creek, with 3,891 acres of impervious surfaces
14. Dry Creek-Ohio River, with 3,772 acres of impervious surfaces
15. Gregory Creek, with 3,313 acres of impervious surfaces
16. Turtle Creek, with 3,181 acres of impervious surfaces
17. Pleasant Run, with 3,149 acres of impervious surfaces
18. O'Bannon Creek, with 2,989 acres of impervious surfaces
19. Taylor Creek, with 2,814 acres of impervious surfaces
20. Ninemile Creek-Ohio River, with 2,718 acres of impervious surfaces

Based on acres, the top 20 watersheds for impervious surfaces in relation to severe slopes (greater than 20 percent grade) are:

1. West Fork-Mill Creek, with 445 acres of severely sloped impervious surfaces
2. Congress Run-Mill Creek, with 400 acres of severely sloped impervious surfaces
3. Banklick Creek-Great Miami River, with 381 acres of severely sloped impervious surfaces
4. Dry Creek-Ohio River, with 314 acres of severely sloped impervious surfaces
5. Duck Creek, with 303 acres of severely sloped impervious surfaces
6. Sharon Creek-Mill Creek, with 291 acres of severely sloped impervious surfaces
7. Taylor Creek, with 283 acres of severely sloped impervious surfaces
8. Town of Newport-Ohio River, with 281 acres of severely sloped impervious surfaces
9. Muddy Creek, with 259 acres of severely sloped impervious surfaces
10. East Fork Mill Creek-Mill Creek, with 236 acres of severely sloped impervious surfaces
11. Dry-Run Great Miami River, with 207 acres of severely sloped impervious surfaces
12. Salt Run-Little Miami River with 194 acres of severely sloped impervious surfaces
13. Ninemile Creek-Ohio River, with 187 acres of severely sloped impervious surfaces
14. West Fork Mill Creek, with 185 acres of severely sloped impervious surfaces
15. Jordan Creek-Great Miami River, with 176 acres of severely sloped impervious surfaces
16. Salt Run-East Fork Little Miami River, with 176 acres of severely sloped impervious surfaces
17. Clough Creek-Little Miami River, with 174 acres of impervious surfaces on severe slopes
18. Sycamore Creek, with 164 acres of impervious surfaces on severe slopes
19. Halls Creek-Little Miami River, with 147 acres of impervious surfaces on severe slopes

20. Dicks Creek, with 141 acres of impervious surfaces on severe slopes

Based on acres, the top 20 watersheds for impervious surfaces in relation to highly erodible soils are:

1. West Fork-Mill Creek, with 2,094 acres of impervious surfaces on highly erodible soils
2. Muddy Creek, with with 1,810 acres of impervious surfaces on highly erodible soils
3. Taylor Creek, with 1,793 acres of impervious surfaces on highly erodible soils
4. Clear Creek, with 1,659 acres of impervious surfaces on highly erodible soils
5. Salt Run-Little Miami River, with 1,652 acres of impervious surfaces on highly erodible soils
6. Congress Run-Mill Creek, with 1,530 acres of impervious surfaces on highly erodible soils
7. Dry Creek-Ohio River, with 1,221 acres of impervious surfaces on highly erodible soils
8. Turtle Creek, with 1,205 acres of impervious surfaces on highly erodible soils
9. Sharon Creek-Mill Creek, with 1,070 acres of impervious surfaces on highly erodible soils
10. West Fork Mill Creek, with 1,059 acres of impervious surfaces on highly erodible soils
11. Duck Creek, with 936 acres of impervious surfaces on highly erodible soils
12. Town of Newport-Ohio River, with 883 acres of impervious surfaces on highly erodible soils
13. Halls Creek-Little Miami River, with 802 acres of impervious surfaces on highly erodible soils
14. Sycamore Creek, with 778 acres of impervious surfaces on highly erodible soils
15. Dry Run-Great Miami River, with 769 acres of impervious surfaces on highly erodible soils
16. Clough Creek-Little Miami River, with 725 acres of impervious surfaces on highly erodible soils
17. Ninemile Creek-Ohio River, with 693 acres of impervious surfaces on highly erodible soils
18. Polk Run-Little Miami River, with 624 acres of impervious surfaces on highly erodible soils
19. Banklick Creek-Great Miami River, with 590 acres of impervious surfaces on highly erodible soils
20. Salt Run-East Fork Little Miami River, with 557 acres of impervious surfaces on highly erodible soils

Based on acres, the top 20 watersheds for impervious surfaces in relation to 200-foot-wide riparian corridors are:

1. Sharon Creek-Mill Creek, with 301 acres of impervious surfaces in riparian corridors
2. Congress Run-Mill Creek, with 294 acres of impervious surfaces in riparian corridors
3. East Fork Mill Creek, with 283 acres of impervious surfaces in riparian corridors
4. Salt Run-Little Miami River, with 276 acres of impervious surfaces in riparian corridors
5. West Fork Mill Creek, with 251 acres of impervious surfaces in riparian corridors
6. O'Bannon Creek, with 235 acres of impervious surfaces in riparian corridors
7. Taylor Creek, with 227 acres of impervious surfaces in riparian corridors
8. Salt Run-East Fork Little Miami River, with 217 acres of impervious surfaces in riparian corridors
9. Banklick Creek-Great Miami River, with 205 acres of impervious surfaces in riparian corridors
10. Sycamore Creek, with 200 acres of impervious surfaces in riparian corridors
11. Muddy Creek, with 188 acres of impervious surfaces in riparian corridors
12. Ninemile Creek-Ohio River, with 184 acres of impervious surfaces in riparian corridors
13. Clear Creek, with 162 acres of impervious surfaces in riparian corridors
14. Turtle Creek, with 162 acres of impervious surfaces in riparian corridors
15. Dry Run-Great Miami River, with 152 acres of impervious surfaces in riparian corridors
16. Duck Creek, with 151 acres of impervious surfaces in riparian corridors
17. Pleasant Run, with 140 acres of impervious surfaces in riparian corridors
18. Clough Creek-Little Miami River, with 140 acres of impervious surfaces in riparian corridors
19. Beals Run-Indian Creek, with 136 acres of impervious surfaces in riparian corridors
20. Gregory Creek, with 127 acres of impervious surfaces in riparian corridors

Based on acres, the top 20 watersheds for impervious surfaces in relation to aquifer areas are:

1. Banklick Creek-Great Miami River, with 3,752 acres of impervious surfaces over aquifer areas
2. East Fork Mill Creek-Mill Creek, with 3,559 acres of impervious surfaces over aquiver areas

3. Congress Run-Mill Creek, with 3,543 acres of impervious surfaces over aquifer areas
4. Sharon Creek-Mill Creek, with 3,079 acres of impervious surfaces over aquifer areas
5. Duck Creek, with 2,414 acres of impervious surfaces over aquifer areas
6. Dicks Creek, with 2,256 acres of impervious surfaces over aquifer areas
7. West Fork-Mill Creek, with 1,935 acres of impervious surfaces over aquifer areas
8. Browns Run-Great Miami River, with 1,687 acres of impervious surfaces over aquifer areas
9. Dry Run-Great Miami River, with 1,266 acres of impervious surfaces over aquifer areas
10. Town of New Miami-Great Miami River, with 1,178 acres of impervious surfaces over aquifer areas
11. Jameson Creek-Whitewater River, with 1,108 acres of impervious surfaces over aquifer areas
12. Pleasant Run, with 1,085 acres of impervious surfaces over aquifer areas
13. Dry Creek-Ohio River, with 877 acres of impervious surfaces over aquifer areas
14. Dry Run-Little Miami River, with 824 acres of impervious surfaces over aquifer areas
15. Jordan Creek-Great Miami River, with 786 acres of impervious surfaces over aquifer areas
16. Turtle Creek, with 756 acres of impervious surfaces over aquifer areas
17. Lee Creek-Dry Fork Whitewater River, with 740 acres of impervious surfaces over aquifer areas
18. Clear Creek, with 656 acres of impervious surfaces over aquifer areas
19. Town of Newport-Ohio River, with 646 acres of impervious surfaces over aquifer areas
20. Salt Run-East Fork Little Miami River, with 601 acres of impervious surfaces over aquifer areas

Conclusions and Recommendations

Nonpoint source pollution is hard to manage because it follows multiple flow paths, becomes difficult to track, occurs in many different areas, and manifests itself in many different ways. Unlike point source pollution, it can defy regulation by site-specific permits. Management of nonpoint source pollution requires voluntary actions with a variety of best management practices. Solutions lie in collaborative actions by the property owners, land managers, environmental organizations, watershed groups and government agencies confronting the issue. This generates a need to identify nonpoint source priority areas and nonpoint source priority issues.

Cumulatively, the nonpoint source priority areas cover much of Butler, Clermont, Hamilton and Warren counties. Specifically, a nonpoint priority area can be identified by the nonpoint source priority issue prevalent in the watershed. The watershed impairment maps and tables presented in this chapter illustrate where to find priority areas in connection with priority issues.

A useful classification of nonpoint source priority areas is offered by *Getting the Point about Nonpoint: Ohio Nonpoint Source Pollution Management Plan – 2005-2010,* which divides nonpoint sources into two categories: (1) polluted runoff, and (2) physical alterations. Polluted runoff is rain and snowmelt flowing across the land surface or within the groundwater that picks up contaminants and carries them to the stream or into the aquifer. Physical alterations are changes to the stream channel or its corridor, including straightening, deepening, widening or changes in flow patterns. Those seeking solutions are well advised to determine whether a nonpoint source problem results from polluted runoff, physical alterations or both.

Nonpoint source priority areas also can be classified by land use. Sources of impairment to the watersheds of Butler, Clermont, Hamilton and Warren counties fit into two broad land-use categories:

1. urban, which generally corresponds to each Watershed Assessment Unit Summary's land use statistic on developed land
2. agricultural, which generally corresponds to each Watershed Assessment Unit Summary's land use statistic for row crop land

Suburban (or mixed) could be considered a third land-use category, but does not correlate well with land-use statistics provided in the Watershed Assessment Unit Summaries.

Four nonpoint source **priority issues** are common for Butler, Clermont, Hamilton and Warren counties:

1. nutrient loading
2. sediment loading
3. habitat modification
4. organic enrichment (resulting in low dissolved oxygen)

These four issues are congruent with causes of impairment. Nutrient loading and organic enrichment indicate polluted runoff from land-use activities. Habitat modification, by definition, indicates physical alterations to stream channel, floodplain or riparian corridor. Sediment loading can indicate polluted runoff or physical alterations.

Nonpoint source pollution is a challenge to the scope of state and federal regulatory programs. It compels voluntary actions and coordinated efforts by a broad range of stakeholders. Among the many agencies and organizations dealing with the management of nonpoint source pollution in Southwest Ohio, those that have been the most clearly involved are:

- U.S. EPA
- Ohio EPA
- Ohio Department of Natural Resources
- OKI Regional Council of Governments
- county soil and water conservation districts for Butler, Clermont, Hamilton and Warren counties
- watershed groups, which are addressed in the next chapter

The OKI Regional Conservation Council is a collaborative organization of conservation districts in the tri-state formed by OKI to take the lead in nonpoint pollution management as recommended in the original 1977 Regional Water Quality Management Plan. More recently, county and municipal stormwater districts have become vital to the management of nonpoint source pollution. Butler County, Hamilton County and Warren County each have a county stormwater district under the auspices of the county engineer's office. Clermont County has a stormwater department under the auspices of county government.

Butler County Storm Water District is developing an extensive monitoring project for these objectives:
• predicting the frequency and severity of floods
• establishing quantity and quality of water for aquatic life and recreation
• managing water use
• developing watershed policies, procedures, and action plans for land use and development
The monitoring network will consist of eight rain gages throughout Butler County and a pilot water quality site in the Four Mile Creek watershed. Ultimately, the Butler County Storm Water District intends to collect information countywide. OKI agrees with the District that its monitoring network will serve as the "backbone for facilitating good decision making toward comprehensive water resource management." If the monitoring leads to better nonpoint source pollution management in Butler County, OKI recommends that other storm water districts develop similar monitoring projects.

The management of nonpoint source pollution calls not only for managerial directives and best management practices, but also for assessments and education. This adds the following to the overall list of potential entities for nonpoint source pollution management:

- U.S. Geological Survey
- The Miami Conservancy District

- Natural Resources Conservation Service
- The Ohio State University Extension Service
- universities and colleges
- public school districts
- garden clubs and others promoting rain gardens and other stormwater management practices

To the extent that nonpoint source pollution problems can trigger regulatory vigilance, these entities may also deal with nonpoint source management matters:

- U.S. Army Corps of Engineers
- county sewer districts and municipal sewer departments
- county, township or municipal departments of development, planning and zoning
- county health departments
- solid waste districts
- county and local floodplain managers
- public water systems with drinking water source protection areas
- environmental advocacy groups that assume watchdog functions

Finally, property owners and property managers should be added to the list of stakeholders who can play a role in nonpoint source pollution management. These include the land trusts and conservancy districts that help prevent nonpoint source pollution by setting aside sensitive areas through property purchases, conservation easements, flooding easements, transfer of development rights, deed restrictions and other land title instruments.

The best management practices (BMPs) to manage nonpoint source pollution are as varied as the entities involved. OKI asked the soil and water conservation districts of Butler, Clermont, Hamilton and Warren counties to identify what they consider to be the most effective BMPs for managing nonpoint source pollution in Southwest Ohio. Their responses are listed below, with obvious duplications eliminated but slight variations or subcategories of other entries included:

- Sediment basins
- Extended detention and treatment with forebays
- Water quality basin that involves a detention basin retrofit and serves as a wetland
- Streambank stabilization with bio-engineering techniques
- Riparian buffers (also known as filter strips)
- Stream setbacks, both agricultural and urban
- Grassed waterways
- Bio-swales
- Bio-retention cell with a grease separator
- Bio-retention ponds converted from traditional stormwater detention basins
- Rain gardens
- Storm drain labeling
- Watershed signage
- Public education
- Phased clearing
- Infiltration basins
- Temporary and permanent stabilization of idle ground
- Development community training
- In-line water level control structures
- Any kind of cover vegetation to hold back soil particles and encourage the uptake of nutrients
- Conservation tillage in combination with cover crops and biomass management

- No-till
- Livestock exclusion fencing
- Animal waste storage facilities
- Wetlands (construction, enhancement or preservation

Although the utilization of these BMPs needs to occur on a site-specific basis, the identification of nonpoint source priority areas contained within this chapter should serve as an aid to directing state and federal cost-sharing dollars for maximum impact.

Stormwater Management

Urban stormwater degrades our rivers, streams, lakes, ponds and aquifers. The severity of degradation depends not only on stormwater *quality* but also stormwater *quantity*. When stormwater quantity becomes excessive, the torrential flows induce erosion, siltation, wildlife habitat destruction and other impairments. It is difficult to separately address stormwater quality and quantity issues in developed areas because impervious surfaces aggravate both quality and quantity problems.

In 1990 the U.S. EPA established a set of regulations to guide the management of stormwater practices in communities with Municipal Separate Storm Sewer Systems (MS4) with populations greater than 100,000. This effort was collectively known as Phase I of the National Pollution Discharge Elimination System (NPDES) stormwater program (Fact Sheet 2.0, U.S. EPA, Jan. 2000-revised Dec. 2005). Communities with a population of 100,000-249,999 are classified as medium, and with a population greater than 250,000 are classified as large. In 1999 the U.S. EPA established an additional set of regulations that would pertain to smaller MS4 communities in Urbanized Areas (UA). The 1999 rules are collectively known as Phase II of the NPDES stormwater program (Fact Sheet 2.0, USEPA, Jan. 2000-revised Dec. 2005). Each community identified as a large, medium or small MS4 in an UA must submit an application or Notice of Intent (NOI) to their permitting authority (State or Federal EPA) to obtain NPDES stormwater permit coverage.

Smaller MS4s have three stormwater permitting options: (1) seek coverage under a general permit held by the state EPA, (2) seek an individual permit, or (3) amend a medium or large MS4 permit to include the applicant as a co-permitee. Coverage under a general permit requires submittal of a NOI. An individual permit will require an application. Coverage under a medium or large MS4 permit requires the host community to file an amendment to their permit application. On a case-by-case basis, some MS4 communities in Urbanized Areas may have their need for a permit waived by the presiding permitting authority. Conversely, the presiding permitting authority may also declare an MS4 outside of the Urbanized Area to be subject to NPDES stormwater regulations.

The general program requirements as stated by the U.S. EPA are as follows: communities subject to these regulations must, to the Maximum Extent Practicable (MEP), reduce the discharge of pollutants, and protect water quality to satisfy the requirements of the Clean Water Act. (Fact Sheet 2.0, USEPA, Jan. 2000-revised Dec. 2005) A stormwater management program/plan (SWMP) must be established and submitted which outlines the specific actions communities will take to achieve certain measurable goals through the implementation of Best Management Practices (BMPs). The plan also defines the responsible party for each measurable goal. The U.S. EPA has established six Minimum Control Measures (MCMs) for community stormwater management:

1. **Public Education/Outreach:** Distributing educational materials and performing outreach to inform citizens about the impacts polluted stormwater runoff discharges can have on water quality

2. **Public Participation/Involvement:** Providing opportunities for citizens to participate in program development and implementation, including effectively publicizing public hearings and/or encouraging citizen representatives on a stormwater management panel

3. **Illicit Discharge Detection and Elimination:** Developing and implementing a plan to detect and eliminate illicit discharges to the storm sewer system. This includes developing a system map and informing the community about hazards associated with illegal discharges and improper disposal of waste.

4. **Construction Site Runoff Control:** Developing, implementing and enforcing an erosion and sediment control program for construction activities that disturb 1 or more acres of land (e.g., controls could include silt fences and temporary stormwater detention ponds)

5. **Post-Construction Runoff Control:** Developing, implementing and enforcing a program to address discharges of post-construction stormwater runoff from new development and redevelopment areas. Applicable controls could include preventative actions, such as protecting sensitive areas (e.g., wetlands) or the use of structural BMPs such as grassed swales or porous pavement.

6. **Pollution Prevention/Good Housekeeping:** Developing and implementing a program with the goal of preventing or reducing pollutant runoff from municipal operations. The program must include municipal staff training on pollution prevention measures and techniques (e.g., regular street sweeping, reduction in the use of pesticides or street salt, or frequent catch-basin cleaning). (Fact Sheet 2.0, USEPA, Jan. 2000-revised Dec. 2005)

A review of stormwater management plans in southwest Ohio indicates a significant variance among the political jurisdictions in the scope of their measurable goals and the diversity of responsible parties. Clermont County, for example, has a detailed list of measurable goals and extensive collaborative networks to act as responsible parties for achieving them. Conversely, some of the smaller communities set fewer measurable goals and assign one department or position as the responsible party for all six minimum control measures. All four counties, however, do have similar structures for collective stormwater management, as each has organized a county department or district that most, but not all, regulated MS4 communities have chosen to join. At the same time, some communities in each of the four counties have chosen to develop and implement stormwater management programs separately and internally.

The following pages show stormwater management matrices that summarize information from each municipality or township within the four southwest Ohio counties of Butler, Clermont, Hamilton and Warren. For each local political jurisdiction in the study area, the matrices show:

- whether the municipality or township is an MS4 community
- the name of the Ohio EPA facility permit holder if applicable
- the responsible party or parties for each of the six minimum control measures
- the percentage of impervious cover
- the acreage of pervious and impervious land cover

Table 5-25: Butler County Stormwater Management Matrix Part 1 – MS4* Status and Permit Holder

*Municipal Separate Storm Sewer System

Jurisdiction	Regulated MS4 (YES/NO)	OEPA Facility Permit Holder
Butler County	YES	Butler County Storm Sewer District
City of Fairfield	YES	City of Fairfield
City of Hamilton	YES	City of Hamilton Department of Public Works
City of Middletown*	YES	City of Middletown
City of Monroe*	YES	City of Monroe
City of Oxford	YES	City of Oxford
City of Sharonville*	YES	Hamilton County and Others
City of Trenton	YES	Butler County Storm Sewer District
Village of College Corner	NO	not applicable
Village of Jacksonburg	NO	not applicable
Village of Millville	NO	not applicable
Village of New Miami	YES	Butler County Storm Sewer District
Village of Seven Mile	YES	Butler County Storm Sewer District
Village of Somerville	NO	not applicable
Fairfield Township	YES	Butler County Storm Sewer District
Hanover Township	YES	Butler County Storm Sewer District
Lemon Township	YES	Butler County Storm Sewer District
Liberty Township	YES	Butler County Storm Sewer District
Madison Township	YES	Butler County Storm Sewer District
Milford Township	NO	not applicable
Morgan Township	NO	not applicable
Oxford Township	NO	not applicable
Reily Township	NO	not applicable
Ross Township	YES	Butler County Storm Sewer District
St. Clair Township	YES	Butler County Storm Sewer District
Wayne Township	YES	Butler County Storm Sewer District
West Chester Township	YES	Butler County Storm Sewer District

*Jurisdiction lies in more than one county

Table 5-26: Butler County Stormwater Management Matrix Part 2 − Minimum Control Measures (MCMs)

MCM #1: Public Education/Outreach
MCM #2: Public Participation/Involvement
MCM #3: Illicit Discharge Detection and Elimination
MCM #4: Construction Site Runoff Control
MCM #5: Post-Construction Runoff Control
MCM #6: Pollution Prevention/Good Housekeeping

Jurisdiction	MCM #1	MCM #2	MCM #3	MCM #4	MCM #5	MCM #6
Butler County	Butler County Storm Water District	Butler County Storm Water District	Butler County Storm Water District and local	Butler County Storm Water District and local	Butler County Storm Water District, County and local	Butler County Storm Water District, County and local
City of Fairfield	City of Fairfield Storm Water Management Program	City Council of Fairfield, City Engineer, and other staff	Greater Cincinnati Hazardous Materials Unit, Fairfield Fire Department, and other staff	City of Fairfield Public Works, Planning Department, and other staff	City of Fairfield Storm Water Management Program, and Hamilton to New Baltimore Groundwater Consortium	City of Fairfield Public Works and Parks Department
City of Hamilton	Public Works Department, Butler County Department of Environmental Services, Information Technology, Gas and Water Department, Police Department, Economic Development Department, Human Relations	Public Works Department, Neighborhood Housing Services, Fire Department, Gas and Water Department	Public Works Department Street and Sewer Division, Public Works Department Wastewater Treatment Plant, Health Department, Law Department, Environmental and Engineering Department, Information Technology (GIS specialist), Butler County Solid Waste Management District, Public Works Wastewater Treatment Division	Public Works Engineering Division, Planning Department Planning and Construction Services Division, Department of Public Works	Public Works Engineering Division, Planning Department Planning and Construction Services Division	Public Works Department, Electric Department, Gas and Water Department, Parks and Recreation, Fire Department, Public Works Streets and Sewer Division, Public Works Fleet Maintenance Division
City of Middletown*	The Assistant City Engineer, and the Public Works Superintendent	The Assistant City Engineer, and the Public Works Superintendent	Public Works Superintendent	The Assistant City Engineer	The Assistant City Engineer	Public Works Superintendent
City of Monroe*	Public Works Dept.	Public Works Dept.	Public Works Dept.	Public Works Dept.	Public Works Dept.	Public Works Dept.
City of Oxford	Environmental Division-Service Department	Environmental Division-Service Department	Environmental Division-Service Department	Environmental Division-Service Department	Environmental Division-Service Department	Environmental Division-Service Department
City of Sharonville*	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
City of Trenton	Butler County Storm Water District	Butler County Storm Water District	Butler County Storm Water District and local	Butler County Storm Water District and local	Butler County Storm Water District, County and local	Butler County Storm Water District, County and local

Village of College Corner	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Village of Jacksonburg	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Village of Millville	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Village of New Miami	Butler County Storm Water District	Butler County Storm Water District	Butler County Storm Water District and local	Butler County Storm Water District and local	Butler County Storm Water District, County and local	Butler County Storm Water District, County and local
Village of Seven Mile	Butler County Storm Water District	Butler County Storm Water District	Butler County Storm Water District and local	Butler County Storm Water District and local	Butler County Storm Water Dist., County and local	Butler County Storm Water Dist., County and local
Jurisdiction	**MCM #1**	**MCM #2**	**MCM #3**	**MCM #4**	**MCM #5**	**MCM #6**
Village of Somerville	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Fairfield Township	Butler County Storm Water District	Butler County Storm Water District	Butler County Storm Water District and local	Butler County Storm Water District and local	Butler County Storm Water District, County and local	Butler County Storm Water District, County and local
Hanover Township	Butler County Storm Water District	Butler County Storm Water District	Butler County Storm Water District and local	Butler County Storm Water District and local	Butler County Storm Water District, County and local	Butler County Storm Water District, County and local
Lemon Township	Butler County Storm Water District	Butler County Storm Water District	Butler County Storm Water District and local	Butler County Storm Water District and local	Butler County Storm Water District, County and local	Butler County Storm Water District, County and local
Liberty Township	Butler County Storm Water District	Butler County Storm Water District	Butler County Storm Water District and local	Butler County Storm Water District and local	Butler County Storm Water District, County and local	Butler County Storm Water District, County and local
Madison Township	Butler County Storm Water District	Butler County Storm Water District	Butler County Storm Water District and local	Butler County Storm Water District and local	Butler County Storm Water District, County and local	Butler County Storm Water District, County and local
Milford Township	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Morgan Township	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Oxford Township	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Reily Township	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Ross Township	Butler County Storm Water District	Butler County Storm Water District	Butler County Storm Water District and local	Butler County Storm Water District and local	Butler County Storm Water District, County and local	Butler County Storm Water District, County and local
St. Clair Township	Butler County Storm Water District	Butler County Storm Water District	Butler County Storm Water District and local	Butler County Storm Water District and local	Butler County Storm Water District, County and local	Butler County Storm Water District, County and local

Wayne Township	Butler County Storm Water District	Butler County Storm Water District	Butler County Storm Water District and local	Butler County Storm Water District and local	Butler County Storm Water District, County and local	Butler County Storm Water District, County and local
West Chester Township	Butler County Storm Water District	Butler County Storm Water District	Butler County Storm Water District and local	Butler County Storm Water District and local	Butler County Storm Water District, County and local	Butler County Storm Water District, County and local

*Jurisdiction lies in more than one county

Table 5-27: Butler County Storm Water Matrix Part 3-: Percent Impervious, Acres Pervious and Acres Impervious

Jurisdiction	Percent Impervious	Acres Pervious	Acres Impervious
City of Fairfield	27%	9746	3563
City of Hamilton	31%	9634	4343
City of Middletown*	29%	12132	5015
City of Monroe*	18%	8316	1769
City of Oxford	25%	3079	1012
City of Sharonville*	41%	3735	2555
City of Trenton	20%	2265	565
Village of College Corner	6%	543	33
Village of Jacksonburg	44%	8	6
Village of Millville	13%	328	48
Village of New Miami	34%	363	185
Village of Seven Mile	15%	401	73
Village of Somerville	17%	143	29
Fairfield Township	18%	7886	1724
Hanover Township	6%	19264	1257
Lemon Township	11%	2559	326
Liberty Township	16%	15416	2975
Madison Township	6%	21712	1503
Milford Township	4%	22333	941
Morgan Township	5%	22295	1251
Oxford Township	4%	18181	709
Reily Township	4%	22589	830
Ross Township	7%	18224	1328
St. Clair Township	8%	12694	1033
Wayne Township	4%	21999	1006
West Chester Township	28%	16219	6160

*Jurisdiction lies in more than one count

Table 5-28: Clermont County Stormwater Management Matrix Part 1: MS4* Status and Permit Holder

*Municipal Separate Storm Sewer System

Jurisdiction	Regulated MS4 (YES/NO)	OEPA Facility Permit Holder
Clermont County	YES	Clermont County and others
City of Loveland*	YES	City of Loveland
City of Milford*	YES	Clermont County and others
Village of Amelia	YES	Clermont County and others
Village of Batavia	YES	Clermont County and others
Village of Bethel	NO	not applicable
Village of Blanchester	NO	not applicable
Village of Chilo	NO	not applicable
Village of Felicity	NO	not applicable
Village of Moscow	NO	not applicable
Village of Neville	NO	not applicable
Village of New Richmond	NO	not applicable
Village of Newtonsville	NO	not applicable
Village of Owensville	YES	Clermont County and others
Village of Williamsburg	NO	not applicable
Batavia Township	YES	Clermont County and others
Franklin Township	NO	not applicable
Goshen Township	YES	Clermont County and others
Jackson Township	NO	not applicable
Miami Township	YES	Clermont County and others
Monroe Township	YES	Clermont County and others
Ohio Township	YES	Clermont County and others
Pierce Township	YES	Clermont County and others
Stonelick Township	YES	Clermont County and others
Tate Township	YES	Clermont County and others
Union Township	YES	Clermont County and others
Washington Township	NO	not applicable
Wayne Township	NO	not applicable
Williamsburg Township	NO	not applicable

*Jurisdiction lies in more than one county

Table 5-29: Clermont County Stormwater Management Matrix Part 2 – Minimum Control Measures (MCMs)

MCM #1 Public Education/Outreach
MCM #2 Public Participation/Involvement
MCM #3 Illicit Discharge Detection and Elimination
MCM #4 Construction Site Runoff Control
MCM #5 Post-Construction Runoff Control
MCM #6 Pollution Prevention/Good Housekeeping

Jurisdiction	MCM #1	MCM #2	MCM #3	MCM #4	MCM #5	MCM #6
Clermont County	Storm Water Management Department, Clermont County SWCD, Clermont County Building Dept., MS4 Municipalities/Townships, Clermont County Engineer, Clermont County Health District, Clermont OEQ, Clermont Ed. Service Center, Clermont County Fleet Mgmt., Miami Township, Clermont Park District, Clermont Office of Public Info., Water Resources Dept.	Storm Water Management Department, Clermont County Commissioners, Clermont County Engineer, Clermont County Park District, MS4 Municipalities/Townships, Clermont Building Dept., Clermont SWCD, Clermont OEQ, City of Milford, Clean and Green Collaborative, Clermont Solid Waste, ORSANCO, Clermont Fleet Maintenance, Ohio EPA, Batavia Township, Village of Batavia, Miami Twp., Stonelick Twp., Owensville, Union Twp., Monroe Twp. and Pierce Twp.	Storm Water Management Department, Clermont OEQ, Clermont SWCD, Clermont County Health District and Clermont Water Resources Dept.	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Heath District, City of Milford, Storm Water Management Department, Village of Amelia	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Health District, City of Milford, Storm Water Management Department, Clermont County, Village of Batavia, Batavia Twp., Monroe Twp., Pierce Twp., Stonelick Twp. and Union Twp.	Storm Water Management Department, Clermont County Engineer's Office, Clermont County Fleet Maintenance, Miami Twp. Fleet Maintenance, Pierce Twp. Fleet Maintenance, Union Twp. Fleet Maintenance, All MS4 co-permittees
City of Loveland*	Assistant to City Manager, Building and Zoning Assistant and Service Director	City Manager, Assistant to the City Manager, Service Director, Executive Assistant to City Manager,	Service Director	Building and Zoning Division Head, Service Director, Assistant to City Manager	Building and Zoning Division Head, Building and Zoning Division, Service Director, City Manager	Service Director, Assistant to the City Manager
City of Milford*	Storm Water Management Department, Clermont County SWCD, Clermont County Building Dept., MS4 Municipalities/Townships, Clermont County Engineer, Clermont County Health District, Clermont OEQ, Clermont Ed. Service Center, Clermont County Fleet Mgmt., Miami Township, Clermont Park District, Clermont Office of Public Info., Water Resources Dept.	Storm Water Management Department, Clermont County Commissioners, Clermont County Engineer, Clermont County Park District, MS4 Municipalities/Townships, Clermont Building Dept., Clermont SWCD, Clermont OEQ, City of Milford, Clean and Green Collaborative, Clermont Solid Waste, ORSANCO, Clermont Fleet Maintenance, Ohio EPA, Batavia Township, Village of Batavia, Miami Twp., Stonelick Twp., Owensville, Union Twp., Monroe Twp. and Pierce Twp.	Storm Water Management Department, Clermont OEQ, Clermont SWCD, Clermont County Health District and Clermont Water Resources Dept.	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Heath District, City of Milford, Storm Water Management Department, Village of Amelia	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Health District, City of Milford, Storm Water Management Department, Clermont County, Village of Batavia, Batavia Twp., Monroe Twp., Pierce Twp., Stonelick Twp. and Union Twp.	Storm Water Management Department, Clermont County Engineer's Office, Clermont County Fleet Maintenance, Miami Twp. Fleet Maintenance, Pierce Twp. Fleet Maintenance, Union Twp. Fleet Maintenance, All MS4 co-permittees
Jurisdiction	**MCM #1**	**MCM #2**	**MCM #3**	**MCM #4**	**MCM #5**	**MCM #6**
Village of Amelia	Storm Water Management Department, Clermont County SWCD, Clermont	Storm Water Management Department, Clermont County Commissioners, Clermont County Engineer,	Storm Water Management Department, Clermont OEQ,	Clermont Building Dept., Clermont Planning Dept.,	Clermont Building Dept., Clermont	Storm Water Management Department, Clermont County

	County Building Dept., MS4 Municipalities/Townships, Clermont County Engineer, Clermont County Health District, Clermont OEQ, Clermont Ed. Service Center, Clermont County Fleet Mgmt., Miami Township, Clermont Park District, Clermont Office of Public Info., Water Resources Dept.	Clermont County Park District, MS4 Municipalities/Townships, Clermont Building Dept., Clermont SWCD, Clermont OEQ, City of Milford, Clean and Green Collaborative, Clermont Solid Waste, ORSANCO, Clermont Fleet Maintenance, Ohio EPA, Batavia Township, Village of Batavia, Miami Twp., Stonelick Twp., Owensville, Union Twp., Monroe Twp. and Pierce Twp.	Clermont SWCD, Clermont County Health District and Clermont Water Resources Dept.	Clermont Engineer's Office, Clermont SWCD, Clermont Heath District, City of Milford, Storm Water Management Department, Village of Amelia	Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Health District, City of Milford, Storm Water Management Department, Clermont County, Village of Batavia, Batavia Twp., Monroe Twp., Pierce Twp., Stonelick Twp. and Union Twp.	Engineer's Office, Clermont County Fleet Maintenance, Miami Twp. Fleet Maintenance, Pierce Twp. Fleet Maintenance, Union Twp. Fleet Maintenance, All MS4 co-permittees
Village of Batavia	Storm Water Management Department, Clermont County SWCD, Clermont County Building Dept., MS4 Municipalities/Townships, Clermont County Engineer, Clermont County Health District, Clermont OEQ, Clermont Ed. Service Center, Clermont County Fleet Mgmt., Miami Township, Clermont Park District, Clermont Office of Public Info., Water Resources Dept.	Storm Water Management Department, Clermont County Commissioners, Clermont County Engineer, Clermont County Park District, MS4 Municipalities/Townships, Clermont Building Dept., Clermont SWCD, Clermont OEQ, City of Milford, Clean and Green Collaborative, Clermont Solid Waste, ORSANCO, Clermont Fleet Maintenance, Ohio EPA, Batavia Township, Village of Batavia, Miami Twp., Stonelick Twp., Owensville, Union Twp., Monroe Twp. and Pierce Twp.	Storm Water Management Department, Clermont OEQ, Clermont SWCD, Clermont County Health District and Clermont Water Resources Dept.	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Heath District, City of Milford, Storm Water Management Department, Village of Amelia	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Health District, City of Milford, Storm Water Management Department, Clermont County, Village of Batavia, Batavia Twp., Monroe Twp., Pierce Twp., Stonelick Twp. and Union Twp.	Storm Water Management Department, Clermont County Engineer's Office, Clermont County Fleet Maintenance, Miami Twp. Fleet Maintenance, Pierce Twp. Fleet Maintenance, Union Twp. Fleet Maintenance, All MS4 co-permittees
Village of Bethel	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Village of Blanchester	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Village of Chilo	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Village of Felicity	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Village of Moscow	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Village of Neville	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Village of New Richmond	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Village of Newtonsville	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Jurisdiction	**MCM #1**	**MCM #2**	**MCM #3**	**MCM #4**	**MCM #5**	**MCM #6**
Village of Owensville	Storm Water Management Department, Clermont County SWCD, Clermont County Building Dept., MS4 Municipalities/Townships, Clermont County Engineer, Clermont	Storm Water Management Department, Clermont County Commissioners, Clermont County Engineer, Clermont County Park District, MS4 Municipalities/Townships, Clermont Building Dept., Clermont SWCD, Clermont	Storm Water Management Department, Clermont OEQ, Clermont SWCD, Clermont County Health District and	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Heath	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Health	Storm Water Management Department, Clermont County Engineer's Office, Clermont County Fleet Maintenance, Miami Twp. Fleet

	County Health District, Clermont OEQ, Clermont Ed. Service Center, Clermont County Fleet Mgmt., Miami Township, Clermont Park District, Clermont Office of Public Info., Water Resources Dept.	OEQ, City of Milford, Clean and Green Collaborative, Clermont Solid Waste, ORSANCO, Clermont Fleet Maintenance, Ohio EPA, Batavia Township, Village of Batavia, Miami Twp., Stonelick Twp., Owensville, Union Twp., Monroe Twp. and Pierce Twp.	Clermont Water Resources Dept.	District, City of Milford, Storm Water Management Department, Village of Amelia	District, City of Milford, Storm Water Management Dept., Clermont County, Village of Batavia, Batavia Twp., Monroe Twp., Pierce Twp., Stonelick Twp. and Union Twp.	Maintenance, Pierce Twp. Fleet Maintenance, Union Twp. Fleet Maintenance, All MS4 co-permittees
Village of Williamsburg	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Batavia Township	Storm Water Management Department, Clermont County SWCD, Clermont County Building Dept., MS4 Municipalities/Townships, Clermont County Engineer, Clermont County Health District, Clermont OEQ, Clermont Ed. Service Center, Clermont County Fleet Mgmt., Miami Township, Clermont Park District, Clermont Office of Public Info., Water Resources Dept.	Storm Water Management Department, Clermont County Commissioners, Clermont County Engineer, Clermont County Park District, MS4 Municipalities/Townships, Clermont Building Dept., Clermont SWCD, Clermont OEQ, City of Milford, Clean and Green Collaborative, Clermont Solid Waste, ORSANCO, Clermont Fleet Maintenance, Ohio EPA, Batavia Township, Village of Batavia, Miami Twp., Stonelick Twp., Owensville, Union Twp., Monroe Twp. and Pierce Twp.	Storm Water Management Department, Clermont OEQ, Clermont SWCD, Clermont County Health District and Clermont Water Resources Dept.	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Heath District, City of Milford, Storm Water Management Department, Village of Amelia	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Health District, City of Milford, Storm Water Management Department, Clermont County, Village of Batavia, Batavia Twp., Monroe Twp., Pierce Twp., Stonelick Twp. and Union Twp.	Storm Water Management Department, Clermont County Engineer's Office, Clermont County Fleet Maintenance, Miami Twp. Fleet Maintenance, Pierce Twp. Fleet Maintenance, Union Twp. Fleet Maintenance, All MS4 co-permittees
Franklin Township	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Goshen Township	Storm Water Management Department, Clermont County SWCD, Clermont County Building Dept., MS4 Municipalities/Townships, Clermont County Engineer, Clermont County Health District, Clermont OEQ, Clermont Ed. Service Center, Clermont County Fleet Mgmt., Miami Township, Clermont Park District, Clermont Office of Public Info., Water Resources Dept.	Storm Water Management Department, Clermont County Commissioners, Clermont County Engineer, Clermont County Park District, MS4 Municipalities/Townships, Clermont Building Dept., Clermont SWCD, Clermont OEQ, City of Milford, Clean and Green Collaborative, Clermont Solid Waste, ORSANCO, Clermont Fleet Maintenance, Ohio EPA, Batavia Township, Village of Batavia, Miami Twp., Stonelick Twp., Owensville, Union Twp., Monroe Twp. and Pierce Twp.	Storm Water Management Department, Clermont OEQ, Clermont SWCD, Clermont County Health District and Clermont Water Resources Dept.	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Heath District, City of Milford, Storm Water Management Department, Village of Amelia	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Health District, City of Milford, Storm Water Management Department, Clermont County, Village of Batavia, Batavia Twp., Monroe Twp., Pierce Twp., Stonelick Twp. and Union Twp.	Storm Water Management Department, Clermont County Engineer's Office, Clermont County Fleet Maintenance, Miami Twp. Fleet Maintenance, Pierce Twp. Fleet Maintenance, Union Twp. Fleet Maintenance, All MS4 co-permittees
Jurisdiction	**MCM #1**	**MCM #2**	**MCM #3**	**MCM #4**	**MCM #5**	**MCM #6**
Jackson Township	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Miami Township	Storm Water Management Department, Clermont County SWCD, Clermont County Building Dept., MS4 Municipalities/Townships, Clermont County Engineer, Clermont County Health District, Clermont OEQ, Clermont Ed. Service Center,	Storm Water Management Department, Clermont County Commissioners, Clermont County Engineer, Clermont County Park District, MS4 Municipalities/Townships, Clermont Building Dept., Clermont SWCD, Clermont OEQ, City of Milford, Clean and Green Collaborative, Clermont Solid Waste,	Storm Water Management Department, Clermont OEQ, Clermont SWCD, Clermont County Health District and Clermont Water Resources Dept.	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Heath District, City of Milford, Storm Water	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Health District, City of Milford, Storm Water	Storm Water Management Department, Clermont County Engineer's Office, Clermont County Fleet Maintenance, Miami Twp. Fleet Maintenance, Pierce Twp. Fleet

	Clermont County Fleet Mgmt., Miami Township, Clermont Park District, Clermont Office of Public Info., Water Resources Dept.	ORSANCO, Clermont Fleet Maintenance, Ohio EPA, Batavia Township, Village of Batavia, Miami Twp., Stonelick Twp., Owensville, Union Twp., Monroe Twp. and Pierce Twp.		Management Department, Village of Amelia	Management Department, Clermont County, Village of Batavia, Batavia Twp., Monroe Twp., Pierce Twp., Stonelick Twp. and Union Twp.	Maintenance, Union Twp. Fleet Maintenance, All MS4 co-permittees
Monroe Township	Storm Water Management Department, Clermont County SWCD, Clermont County Building Dept., MS4 Municipalities/Townships, Clermont County Engineer, Clermont County Health District, Clermont OEQ, Clermont Ed. Service Center, Clermont County Fleet Mgmt., Miami Township, Clermont Park District, Clermont Office of Public Info., Water Resources Dept.	Storm Water Management Department, Clermont County Commissioners, Clermont County Engineer, Clermont County Park District, MS4 Municipalities/Townships, Clermont Building Dept., Clermont SWCD, Clermont OEQ, City of Milford, Clean and Green Collaborative, Clermont Solid Waste, ORSANCO, Clermont Fleet Maintenance, Ohio EPA, Batavia Township, Village of Batavia, Miami Twp., Stonelick Twp., Owensville, Union Twp., Monroe Twp. and Pierce Twp.	Storm Water Management Department, Clermont OEQ, Clermont SWCD, Clermont County Health District and Clermont Water Resources Dept.	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Heath District, City of Milford, Storm Water Management Department, Village of Amelia	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Health District, City of Milford, Storm Water Management Department, Clermont County, Village of Batavia, Batavia Twp., Monroe Twp., Pierce Twp., Stonelick Twp. and Union Twp.	Storm Water Management Department, Clermont County Engineer's Office, Clermont County Fleet Maintenance, Miami Twp. Fleet Maintenance, Pierce Twp. Fleet Maintenance, Union Twp. Fleet Maintenance, All MS4 co-permittees
Ohio Township	Storm Water Management Department, Clermont County SWCD, Clermont County Building Dept., MS4 Municipalities/Townships, Clermont County Engineer, Clermont County Health District, Clermont OEQ, Clermont Ed. Service Center, Clermont County Fleet Mgmt., Miami Township, Clermont Park District, Clermont Office of Public Info., Water Resources Dept.	Storm Water Management Department, Clermont County Commissioners, Clermont County Engineer, Clermont County Park District, MS4 Municipalities/Townships, Clermont Building Dept., Clermont SWCD, Clermont OEQ, City of Milford, Clean and Green Collaborative, Clermont Solid Waste, ORSANCO, Clermont Fleet Maintenance, Ohio EPA, Batavia Township, Village of Batavia, Miami Twp., Stonelick Twp., Owensville, Union Twp., Monroe Twp. and Pierce Twp.	Storm Water Management Department, Clermont OEQ, Clermont SWCD, Clermont County Health District and Clermont Water Resources Dept.	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Heath District, City of Milford, Storm Water Management Department, Village of Amelia	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Health District, City of Milford, Storm Water Management Department, Clermont County, Village of Batavia, Batavia Twp., Monroe Twp., Pierce Twp., Stonelick Twp. and Union Twp.	Storm Water Management Department, Clermont County Engineer's Office, Clermont County Fleet Maintenance, Miami Twp. Fleet Maintenance, Pierce Twp. Fleet Maintenance, Union Twp. Fleet Maintenance, All MS4 co-permittees
Jurisdiction	**MCM #1**	**MCM #2**	**MCM #3**	**MCM #4**	**MCM #5**	**MCM #6**
Pierce Township	Storm Water Management Department, Clermont County SWCD, Clermont County Building Dept., MS4 Municipalities/Townships, Clermont County Engineer, Clermont County Health District, Clermont OEQ, Clermont Ed. Service Center, Clermont County Fleet Mgmt., Miami Township, Clermont Park District, Clermont Office of Public Info., Water Resources Dept.	Storm Water Management Department, Clermont County Commissioners, Clermont County Engineer, Clermont County Park District, MS4 Municipalities/Townships, Clermont Building Dept., Clermont SWCD, Clermont OEQ, City of Milford, Clean and Green Collaborative, Clermont Solid Waste, ORSANCO, Clermont Fleet Maintenance, Ohio EPA, Batavia Township, Village of Batavia, Miami Twp., Stonelick Twp., Owensville, Union Twp., Monroe Twp. and Pierce	Storm Water Management Department, Clermont OEQ, Clermont SWCD, Clermont County Health District and Clermont Water Resources Dept.	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Heath District, City of Milford, Storm Water Management Department, Village of Amelia	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Health District, City of Milford, Storm Water Management Department, Clermont County, Village of Batavia, Batavia Twp., Monroe Twp.,	Storm Water Management Department, Clermont County Engineer's Office, Clermont County Fleet Maintenance, Miami Twp. Fleet Maintenance, Pierce Twp. Fleet Maintenance, Union Twp. Fleet Maintenance, All MS4 co-permittees

		Twp.			Pierce Twp., Stonelick Twp. and Union Twp.	
Stonelick Township	Storm Water Management Department, Clermont County SWCD, Clermont County Building Dept., MS4 Municipalities/Townships, Clermont County Engineer, Clermont County Health District, Clermont OEQ, Clermont Ed. Service Center, Clermont County Fleet Mgmt., Miami Township, Clermont Park District, Clermont Office of Public Info., Water Resources Dept.	Storm Water Management Department, Clermont County Commissioners, Clermont County Engineer, Clermont County Park District, MS4 Municipalities/Townships, Clermont Building Dept., Clermont SWCD, Clermont OEQ, City of Milford, Clean and Green Collaborative, Clermont Solid Waste, ORSANCO, Clermont Fleet Maintenance, Ohio EPA, Batavia Township, Village of Batavia, Miami Twp., Stonelick Twp., Owensville, Union Twp., Monroe Twp. and Pierce Twp.	Storm Water Management Department, Clermont OEQ, Clermont SWCD, Clermont County Health District and Clermont Water Resources Dept.	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Heath District, City of Milford, Storm Water Management Department, Village of Amelia	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Health District, City of Milford, Storm Water Management Department, Clermont County, Village of Batavia, Batavia Twp., Monroe Twp., Pierce Twp., Stonelick Twp. and Union Twp.	Storm Water Management Department, Clermont County Engineer's Office, Clermont County Fleet Maintenance, Miami Twp. Fleet Maintenance, Pierce Twp. Fleet Maintenance, Union Twp. Fleet Maintenance, All MS4 co-permittees
Tate Township	Storm Water Management Department, Clermont County SWCD, Clermont County Building Dept., MS4 Municipalities/Townships, Clermont County Engineer, Clermont County Health District, Clermont OEQ, Clermont Ed. Service Center, Clermont County Fleet Mgmt., Miami Township, Clermont Park District, Clermont Office of Public Info., Water Resources Dept.	Storm Water Management Department, Clermont County Commissioners, Clermont County Engineer, Clermont County Park District, MS4 Municipalities/Townships, Clermont Building Dept., Clermont SWCD, Clermont OEQ, City of Milford, Clean and Green Collaborative, Clermont Solid Waste, ORSANCO, Clermont Fleet Maintenance, Ohio EPA, Batavia Township, Village of Batavia, Miami Twp., Stonelick Twp., Owensville, Union Twp., Monroe Twp. and Pierce Twp.	Storm Water Management Department, Clermont OEQ, Clermont SWCD, Clermont County Health District and Clermont Water Resources Dept.	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Heath District, City of Milford, Storm Water Management Department, Village of Amelia	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Health District, City of Milford, Storm Water Management Department, Clermont County, Village of Batavia, Batavia Twp., Monroe Twp., Pierce Twp., Stonelick Twp. and Union Twp.	Storm Water Management Department, Clermont County Engineer's Office, Clermont County Fleet Maintenance, Miami Twp. Fleet Maintenance, Pierce Twp. Fleet Maintenance, Union Twp. Fleet Maintenance, All MS4 co-permittees
Jurisdiction	**MCM #1**	**MCM #2**	**MCM #3**	**MCM #4**	**MCM #5**	**MCM #6**
Union Township	Storm Water Management Department, Clermont County SWCD, Clermont County Building Dept., MS4 Municipalities/Townships, Clermont County Engineer, Clermont County Health District, Clermont OEQ, Clermont Ed. Service Center, Clermont County Fleet Mgmt., Miami Township, Clermont Park District, Clermont Office of Public Info., Water Resources Dept.	Storm Water Management Department, Clermont County Commissioners, Clermont County Engineer, Clermont County Park District, MS4 Municipalities/Townships, Clermont Building Dept., Clermont SWCD, Clermont OEQ, City of Milford, Clean and Green Collaborative, Clermont Solid Waste, ORSANCO, Clermont Fleet Maintenance, Ohio EPA, Batavia Township, Village of Batavia, Miami Twp., Stonelick Twp., Owensville, Union Twp., Monroe Twp. and Pierce Twp.	Storm Water Management Department, Clermont OEQ, Clermont SWCD, Clermont County Health District and Clermont Water Resources Dept.	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Heath District, City of Milford, Storm Water Management Department, Village of Amelia	Clermont Building Dept., Clermont Planning Dept., Clermont Engineer's Office, Clermont SWCD, Clermont Health District, City of Milford, Storm Water Mgmt. Department, Clermont County, Village of Batavia, Batavia Twp., Monroe Twp., Pierce Twp., Stonelick Twp. and Union Twp.	Storm Water Management Department, Clermont County Engineer's Office, Clermont County Fleet Maintenance, Miami Twp. Fleet Maintenance, Pierce Twp. Fleet Maintenance, Union Twp. Fleet Maintenance, All MS4 co-permittees

Washington Township	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Wayne Township	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Williamsburg Township	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable

*Jurisdiction lies in more than one county

Table 5-30: Clermont County Stormwater Management Matrix Part 3 – Percent Impervious, Acres Pervious and Acres Impervious

Jurisdictions	Percent Impervious	Acres Pervious	Acres Impervious
City of Loveland* (Has its own program)	22%	2471	680
City of Milford*	24%	1849	576
Village of Amelia	25%	841	274
Village of Batavia	22%	773	215
Village of Bethel	22%	718	206
Village of Blanchester	8%	18	2
Village of Chilo	11%	135	17
Village of Felicity	39%	97	62
Village of Moscow	26%	185	66
Village of Neville	8%	257	22
Village of New Richmond	20%	1784	454
Village of Newtonsville	21%	95	26
Village of Owensville	24%	188	59
Village of Williamsburg	16%	1119	213
Batavia Township	9%	23168	2180
Franklin Township	3%	24399	847
Goshen Township	8%	20064	1640
Jackson Township	4%	19369	886
Miami Township	15%	18074	3315
Monroe Township	5%	19325	1072
Ohio Township	6%	6183	383
Pierce Township	9%	12592	1309
Stonelick Township	5%	17827	1004
Tate Township	5%	27864	1422
Union Township	18%	15307	3463
Washington Township	4%	21910	796
Wayne Township	5%	19616	926
Williamsburg Township	5%	17529	831

*Jurisdiction lies in more than one county

Table 5-31: Hamilton County Storm Water Matrix Part 1 – MS4* Status and Permit Holder

*Municipal Separate Storm Sewer System

Jurisdiction	Regulated MS4 (YES/NO)	OEPA Facility Permit Holder
Hamilton County	YES	Hamilton County and Others
City of Blue Ash	YES	Hamilton County and Others
City of Cheviot	YES	City Of Cheviot
City of Cincinnati	YES	Hamilton County and Others
City of Deer Park	YES	Hamilton County and Others
City of Forest Park	YES	City of Forest Park
City of Harrison	YES	City of Harrison
City of Village of Indian Hill	YES	Hamilton County and Others
City of Loveland*	YES	City of Loveland
City of Madeira	YES	Hamilton County and Others
City of Milford*	YES	Hamilton County and Others
City of Montgomery	YES	Hamilton County and Others
City of Mount Healthy	YES	Hamilton County and Others
City of North College Hill	YES	City of North College Hill
City of Norwood	YES	Hamilton County and Others
City of Reading	YES	City of Reading
City of St. Bernard	YES	City of St. Bernard
City of Sharonville*	YES	Hamilton County and Others
City of Silverton	YES	Hamilton County and Others
City of Springdale	YES	City of Springdale
City of Wyoming	YES	City of Wyoming
Village of Addyston	YES	Hamilton County and Others
Village of Amberley Village	YES	Hamilton County and Others
Village of Arlington Heights	YES	Hamilton County and Others
Village of Cleves	YES	Hamilton County and Others
Village of Elmwood Place	YES	Hamilton County and Others
Village of Evendale	YES	Hamilton County and Others
Village of Fairfax	YES	Hamilton County and Others
Village of Glendale	YES	Hamilton County and Others
Village of Golf Manor	YES	Hamilton County and Others
Village of Greenhills	YES	Hamilton County and Others
Village of Lincoln Heights	YES	Hamilton County and Others
Village of Lockland	YES	Hamilton County and Others
Village of Mariemont	YES	Hamilton County and Others
Village of Newtown	YES	Hamilton County and Others
Village of North Bend	YES	Hamilton County and Others
Village of Terrace Park	YES	Hamilton County and Others
Village of Woodlawn	YES	Village of Woodlawn
Anderson Township	YES	Hamilton County and Others
Colerain Township	YES	Hamilton County and Others
Columbia Township	YES	Hamilton County and Others
Crosby Township	NO	Hamilton County and Others
Delhi Township	YES	Hamilton County and Others
Green Township	YES	Hamilton County and Others
Harrison Township	YES	Hamilton County and Others
Miami Township	YES	Hamilton County and Others
Springfield Township	YES	Hamilton County and Others
Sycamore Township	YES	Hamilton County and Others
Symmes Township	YES	Hamilton County and Others
Whitewater Township	YES	Hamilton County and Others
Hamilton County Park District	YES	Hamilton County Park District

*Jurisdiction lies in more than one county

Table 5-32: Hamilton County Storm Water Matrix Part 2 – Minimum Control Measures (MCMs)

MCM #1 Public Education/Outreach
MCM #2 Public Participation/Involvement
MCM #3 Illicit Discharge Detection and Elimination
MCM #4 Construction Site Runoff Control
MCM #5 Post-Construction Runoff Control
MCM #6 Pollution Prevention/Good Housekeeping

Jurisdiction	MCM #1	MCM #2	MCM #3	MCM #4	MCM #5	MCM #6
Hamilton County	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
City of Blue Ash	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
City of Cheviot	City Safety Service Director	City Safety Service Director	City Safety Service Director	City Safety Service Director	City Safety Service Director	City Safety Service Director
City of Cincinnati	HCSWD and City of Cincinnati Stormwater Management Utility	HCSWD and City of Cincinnati Stormwater Management Utility	HCSWD and City of Cincinnati Stormwater Management Utility	HCSWD and City of Cincinnati Stormwater Management Utility	HCSWD and City of Cincinnati Stormwater Management Utility	HCSWD and City of Cincinnati Stormwater Management Utility
City of Deer Park	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
City of Forest Park	Stormwater Management Utility, Forest Park Environmental Awareness Program	Stormwater Management Utility	Stormwater Management Utility, Department of Public Works, Health Department	Stormwater Management Utility, Department of Public Works, City Engineer	Stormwater Management Utility, City Engineer	Stormwater Management Utility, Department of Public Works, Environmental Awareness Program
City of Harrison	Public Works Department	Public Works Department	Public Works Department	Public Works Department	Public Works Department	Public Works Department
City of Village of Indian Hill	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
City of Loveland*	Assistant to City Manager, Building and Zoning Assistant and Service Director	City Manager, Assistant to the City Manager, Service Director, Executive Assistant to City Manager,	Service Director	Building and Zoning Division Head, Service Director, Assistant to City Manager	Building & Zoning Division Head, Building and Zoning Division, Service Director, City Manager	Service Director, Assistant to the City Manager
City of Madeira	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
City of Milford*	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
City of Montgomery	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
City of Mount Healthy	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
City of North College Hill	City Administrator	City Administrator	City Administrator & Hamilton County Health District	City Administrator	City Administrator	City Administrator
City of Norwood	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
City of Reading	Safety Services Director	Safety Services Director	Safety Services Director	Safety Services Director	Safety Services Director	Safety Services Director
City of St. Bernard	City of St. Bernard Service Director	City of St. Bernard Service Director	City of St. Bernard Service Director	City of St. Bernard Service Director	City of St. Bernard Service Director	City of St. Bernard Service Director
City of Sharonville*	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
City of Silverton	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
City of Springdale	City of Springdale Director of Public Works and Building Official	City of Springdale Director of Public Works and Building Official	City of Springdale Director of Public Works and Health Commissioner	City of Springdale, Building Official	City of Springdale, Building Official	City of Springdale Director of Public Works

Jurisdiction	MCM #1	MCM #2	CM #3	MCM #4	MCM #5	MCM #6
City of Wyoming	City of Wyoming Assistant Public Works Director, Water Works Director, Executive Assistant, Administrative Assistant,	City of Wyoming Assistant Public Works Director, Water Works Director, Executive Assistant, Administrative Assistant,	City of Wyoming Assistant Public Works Director, Water Works Director, Fire Chief, Police Chief, Community Development Director/Building Official, Public Works Director	City of Wyoming Assistant Public Works Director, Water Works Director, Community Development Director/Building Official	City of Wyoming Assistant Public Works Director, Water Works Director, Community Development Director/Building Official	City of Wyoming Assistant Public Works Director, Water Works Director, Public Works Director, Crew Leader, Garage Mechanic
Village of Addyston	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Village of Amberley Village	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Village of Arlington Heights	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Village of Cleves	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Village of Elmwood Place	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Village of Evendale	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Village of Fairfax	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Village of Glendale	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Village of Golf Manor	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Village of Greenhills	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Village of Lincoln Heights	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Village of Lockland	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Village of Mariemont	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Village of Newtown	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Village of North Bend	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Village of Terrace Park	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Village of Woodlawn	Village of Woodlawn, Storm Water Program Coordinator	Village of Woodlawn, Storm Water Program Coordinator	Village of Woodlawn, Storm Water Program Coordinator	Village of Woodlawn, Code Enforcer	Village of Woodlawn, Code Enforcer	Village of Woodlawn, Code Enforcer
Anderson Township	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Colerain Township	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Columbia Township	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Crosby Township	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Delhi Township	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Green Township	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Harrison Township	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Miami Township	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Springfield Township	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local

Jurisdiction	MCM #1	MCM #2	MCM #3	MCM #4	MCM #5	MCM #6
Sycamore Township	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Symmes Township	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Whitewater Township	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local	HCSWD and local
Hamilton County Park District	Outdoor Education Program Supervisor, Public Affairs Manager, and Stewardship Manager	Stewardship Manager, Volunteers Coordinator, Park Services Director, Planning Director, and Public Affairs Manager	Stewardship Manager, Operations Superintendent and Facilities Management Superintendent	Planning Director and Park's Engineer	Park's Engineer	Operation Management and Facilities Management Superintendent

*Jurisdiction lies in more than one county

Table 5-33: Hamilton County Storm Water Matrix Part 3– Percent Impervious, Acres Pervious and Acres Impervious

Jurisdiction	Percent Impervious	Acres Pervious	Acres Impervious
City of Blue Ash	38%	3032	1826
City of Cheviot	54%	338	404
City of Cincinnati	36%	32613	18255
City of Deer Park	48%	283	259
City of Forest Park	31%	2840	1283
City of Harrison	30%	2164	919
City of Village of Indian Hill	8%	11037	950
City of Loveland* (Has its own program)	22%	2471	680
City of Madeira	27%	1577	583
City of Milford*	24%	1849	576
City of Montgomery	27%	2479	922
City of Mount Healthy	33%	632	314
City of North College Hill	32%	797	373
City of Norwood	55%	914	1097
City of Reading	37%	1174	700
City of St. Bernard	60%	395	587
City of Sharonville*	41%	3735	2555
City of Silverton	44%	385	306
City of Springdale	42%	1858	1352
City of Wyoming	23%	1421	418
Village of Addyston	30%	418	181
Village of Amberley Village	22%	1744	483
Village of Arlington Heights	53%	79	87
Village of Cleves	15%	871	156
Village of Elmwood Place	60%	82	124
Village of Evendale	39%	1870	1177
Village of Fairfax	50%	247	246
Village of Glendale	23%	803	242
Village of Golf Manor	42%	214	158
Village of Greenhills	18%	663	145
Village of Lincoln Heights	37%	296	175
Village of Lockland	53%	369	410
Village of Mariemont	28%	393	155
Village of Newtown	23%	1090	329
Village of North Bend	21%	573	154
Village of Terrace Park	15%	654	117
Village of Woodlawn	31%	1132	512
Anderson Township	17%	16828	3393
Colerain Township	16%	23187	4400
Columbia Township	24%	1254	396
Crosby Township	7%	11589	886
Delhi Township	25%	4810	1618
Green Township	21%	14081	3733
Harrison Township	8%	7954	678
Miami Township	9%	11689	1187
Springfield Township	19%	8588	2034
Sycamore Township	40%	2593	1750
Symmes Township	23%	4312	1265
Whitewater Township	9%	15256	1535

*Jurisdiction lies in more than one county

Table 5-34: Warren County Storm Water Matrix Part 1– MS4* Status and Permit Holder

*Municipal Separate Storm Sewer System

Jurisdiction	Regulated MS4 (YES/NO)	OEPA Facility Permit Holder
Warren County Commissioners	YES	Warren County and others
City of Franklin	YES	City of Franklin
City of Lebanon	YES	City of Lebanon
City of Loveland*	YES	City of Loveland
City of Mason	YES	City of Mason
City of Middletown*	YES	City of Middletown
City of Monroe*	YES	City of Monroe
City of Springboro	YES	City of Springboro
Village of Butlerville	NO	not applicable
Village of Carlisle*	YES	City of Carlisle
Village of Corwin	NO	not applicable
Village of Harveysburg	NO	not applicable
Village of Maineville	YES	Warren County and others
Village of Morrow	NO	not applicable
Village of Pleasant Plain	NO	not applicable
Village of South Lebanon	YES	Warren County and others
Village of Waynesville	NO	not applicable
Clearcreek Township	YES	Warren County and others
Deerfield Township	YES	Deerfield Township
Franklin Township	YES	Warren County and others
Hamilton Township	YES	Warren County and others
Harlan Township	NO	not applicable
Massie Township	NO	not applicable
Salem Township	NO	not applicable
Turtlecreek Township	YES	Warren County and others
Union Township	YES	Warren County and others
Washington Township	NO	not applicable
Wayne Township	NO	not applicable

*Jurisdiction lies in more than one county

Table 5-35: Warren County Storm Water Matrix Part 2– Minimum Control Measures (MCMs)

MCM #1 Public Education/Outreach
MCM #2 Public Participation/Involvement
MCM #3 Illicit Discharge Detection and Elimination
MCM #4 Construction Site Runoff Control
MCM #5 Post-Construction Runoff Control
MCM #6 Pollution Prevention/Good Housekeeping

Jurisdiction	MCM #1	MCM #2	MCM #3	MCM #4	MCM #5	MCM #6
Warren County Commissioners	Warren County Soil and Water Conservation District	Warren County Soil and Water Conservation District	Warren County Engineers Office and Warren County Combined Health District	Warren County Soil and Water Conservation District	Warren County Engineers Office	Warren County Engineers Office
City of Franklin	Miami Conservancy District and city staff	Miami Conservancy District and city staff	City Engineer and city staff	Warren County Combined Health District and Public Works Laboratory	City Engineer, Appeals board, and city staff	City Engineer and Public Works
City of Lebanon	City of Lebanon and WCSWCD	City of Lebanon and Warren County Soil and Water Conservation District	City of Lebanon, Warren County Soil and Water Conservation District, and Warren County Combined Health District	City of Lebanon Engineering Dept.	City of Lebanon Engineering Department	City of Lebanon Engineering, Electric, Water, Public Works, and Wastewater Departments.
City of Loveland*	Assistant to City Manager, Building and Zoning Assistant and Service Director	City Manager, Assistant to the City Manager, Service Director, Executive Assistant to City Manager,	Service Director	Building and Zoning Division Head, Service Director, Assistant to City Manager	Building and Zoning Division Head, Building and Zoning Division, Service Director, City Manager	Service Director, Assistant to the City Manager
City of Mason	Warren County Soil and Water Conservation District, Volunteers/Students, Building Dept., Storm Water Engineer, City's Web team and Engineering Dept., Parks and Recreation Dept.	Warren County Soil and Water Conservation District, Volunteers/Students, Building Department, Storm Water Engineer, City's Web team and Engineering Department, Parks and Recreation Department	Engineering Department, GIS Section, Warren County Health Department, Public Works	Engineering Department, GIS section, Public Works	Parks and Recreation Department, Engineering Department, Public Works, Utilities Department, Police Department Fire Dept., Warren County Board of Health, Public Utilities Department, Warren County Soil and Water Conservation District	Parks and Recreation Department, Engineering Department, Public Works Department, Utilities Department, Police Department, Fire Department, Warren County Board of Health, Warren County Soil and Water Conservation District
City of Middletown*	The Assistant City Engineer, and the Public Works Superintendent	The Assistant City Engineer, and the Public Works Superintendent	Public Works Superintendent	The Assistant City Engineer	The Assistant City Engineer	Public Works Superintendent
City of Monroe*	Public Works Department	Public Works Department	Public Works Department	Public Works Department	Public Works Department	Public Works Department
City of Springboro	Public Works Department	Public Works Department	Public Works Department	Public Works Department	Public Works Department	Public Works Department
Village of Butlerville	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Village of Carlisle*	unavailable	unavailable	unavailable	unavailable	unavailable	unavailable
Village of Corwin	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Village of Harveysburg	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable

Jurisdiction	MCM #1	MCM #2	MCM #3	MCM #4	MCM #5	MCM #6
Village of Maineville	Warren County Soil and Water Conservation District	Warren County Soil and Water Conservation District	Warren County Engineers Office and Warren County Combined Health District	Warren County Soil and Water Conservation District	Warren County Engineers Office	Warren County Engineers Office
Village of Morrow	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Village of Pleasant Plain	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Village of South Lebanon	Warren County Soil and Water Conservation District	Warren County Soil and Water Conservation District	Warren County Engineers Office and Warren County Combined Health District	Warren County Soil and Water Conservation District	Warren County Engineers Office	Warren County Engineers Office
Village of Waynesville	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Clearcreek Township	Warren County Soil and Water Conservation District	Warren County Soil and Water Conservation District	Warren County Engineers Office and Warren County Combined Health District	Warren County Soil and Water Conservation District	Warren County Engineers Office	Warren County Engineers Office
Deerfield Township	Deerfield Regional Storm Water District, Warren County Soil and Water Conservation District, Regional Storm Water Collaborative	Deerfield Regional Storm Water District, Warren County Soil and Water Conservation District	Deerfield Regional Storm Water District, Warren County Engineers Office, Warren County Combined Health District,	Deerfield Regional Storm Water District, Warren County Soil and Water Conservation District, Warren County Engineers Office	Deerfield Regional Storm Water District, Warren County Soil and Water Conservation District, Warren County Engineers Office	Deerfield Regional Storm Water District, Deerfield Township
Franklin Township	Warren County Soil and Water Conservation District	Warren County Soil and Water Conservation District	Warren County Engineers Office and Warren County Combined Health District	Warren County Soil and Water Conservation District	Warren County Engineers Office	Warren County Engineers Office
Hamilton Township	Warren County Soil and Water Conservation District	Warren County Soil and Water Conservation District	Warren County Engineers Office and Warren County Combined Health District	Warren County Soil and Water Conservation District	Warren County Engineers Office	Warren County Engineers Office
Harlan Township	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Massie Township	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Salem Township	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Turtlecreek Township	Warren County Soil and Water Conservation District	Warren County Soil and Water Conservation District	Warren County Engineers Office and Warren County Combined Health District	Warren County Soil and Water Conservation District	Warren County Engineers Office	Warren County Engineers Office
Union Township	Warren County Soil and Water Conservation District	Warren County Soil and Water Conservation District	Warren County Engineers Office and Warren County Combined Health District	Warren County Soil and Water Conservation District	Warren County Engineers Office	Warren County Engineers Office
Washington Township	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
Wayne Township	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable

*Jurisdiction lies in more than one county

Table 5-36: Warren County Storm Water Matrix Part 3– Percent Impervious, Acres Pervious and Acres Impervious

Jurisdiction	Percent Impervious	Acres Pervious	Acres Impervious
City of Franklin	18%	4970	1067
City of Lebanon	22%	6418	1829
City of Loveland* (Has its own program)	22%	2471	680
City of Mason	26%	8829	3054
City of Middletown*	29%	12132	5015
City of Monroe* (SWMP currently in development)	18%	8316	1769
City of Springboro (SWMP currently in development)	24%	4165	1346
Village of Butlerville	24%	43	14
Village of Carlisle*	18%	1635	364
Village of Corwin	23%	160	48
Village of Harveysburg	11%	598	74
Village of Maineville	26%	729	259
Village of Morrow	10%	1151	129
Village of Pleasant Plain	28%	37	15
Village of South Lebanon	20%	1574	384
Village of Waynesville	16%	1230	235
Clearcreek Township	8%	21846	1899
Deerfield Township	24%	7885	2506
Franklin Township	8%	10189	920
Hamilton Township	16%	17792	3292
Harlan Township	4%	27667	1275
Massie Township	3%	13015	389
Salem Township	5%	12354	612
Turtlecreek Township	5%	33847	1943
Union Township	7%	7279	541
Washington Township	4%	20756	933
Wayne Township	4%	26301	1169

*Jurisdiction lies in more than one count