NINE-ELEMENT NONPOINT SOURCE IMPLEMENTATION STRATEGIC PLAN BEALS RUN-INDIAN CREEK WATERSHED HUC 12 (50800020803)

PREPARED FOR THREE VALLEY CONSERVATION TRUST

PREPARED BY ENVIRONMENTAL SOLUTIONS AQ

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The Three Valley Conservation Trust would like to acknowledge the collaboration of multiple partners in the preparation of this Nonpoint Source Implementation Strategy (NPS-IS) for the Beals Run-Indian Creek HUC-12. Thank you to the individuals and organizations that contributed background information, insight into objectives and projects for inclusion in this NPS-IS. We would like to recognize the staff at the Butler County Soil & Water District for their outreach, contributions, and reviews ensuring a comprehensive and accurate plan. Another key partner, the Ohio-Kentucky-Indiana Regional Council of Governments (OKI) provided concise and relevant data and HST maps instrumental to the plan accuracy. Special recognition to the staff at Environmental Solutions AQ, LLC for the extensive work to source and analyze data, set up community meetings and site visits, and drafting the final plan. Finally, we wish to thank the numerous community stakeholders who attended public meetings, met with us individually to verify data in situ, and provided feedback to assist prioritizing future projects.

Chapter 1: **Introduction**

The Beals Run – Indian Creek Hydrologic Unit (BR-IC HUC 12) 50800020803 is an agricultural watershed located on the border of SW Ohio and SE Indiana, and it encompasses a drainage area of approximately 74.0 mi^2. A majority of the watershed (65.8 mi^2 or 93%) is located in Butler County, Ohio with a small portion (8.16 mi^2 or 7%) extending NW into Franklin and Union Counties in Indiana (Fig. 1).

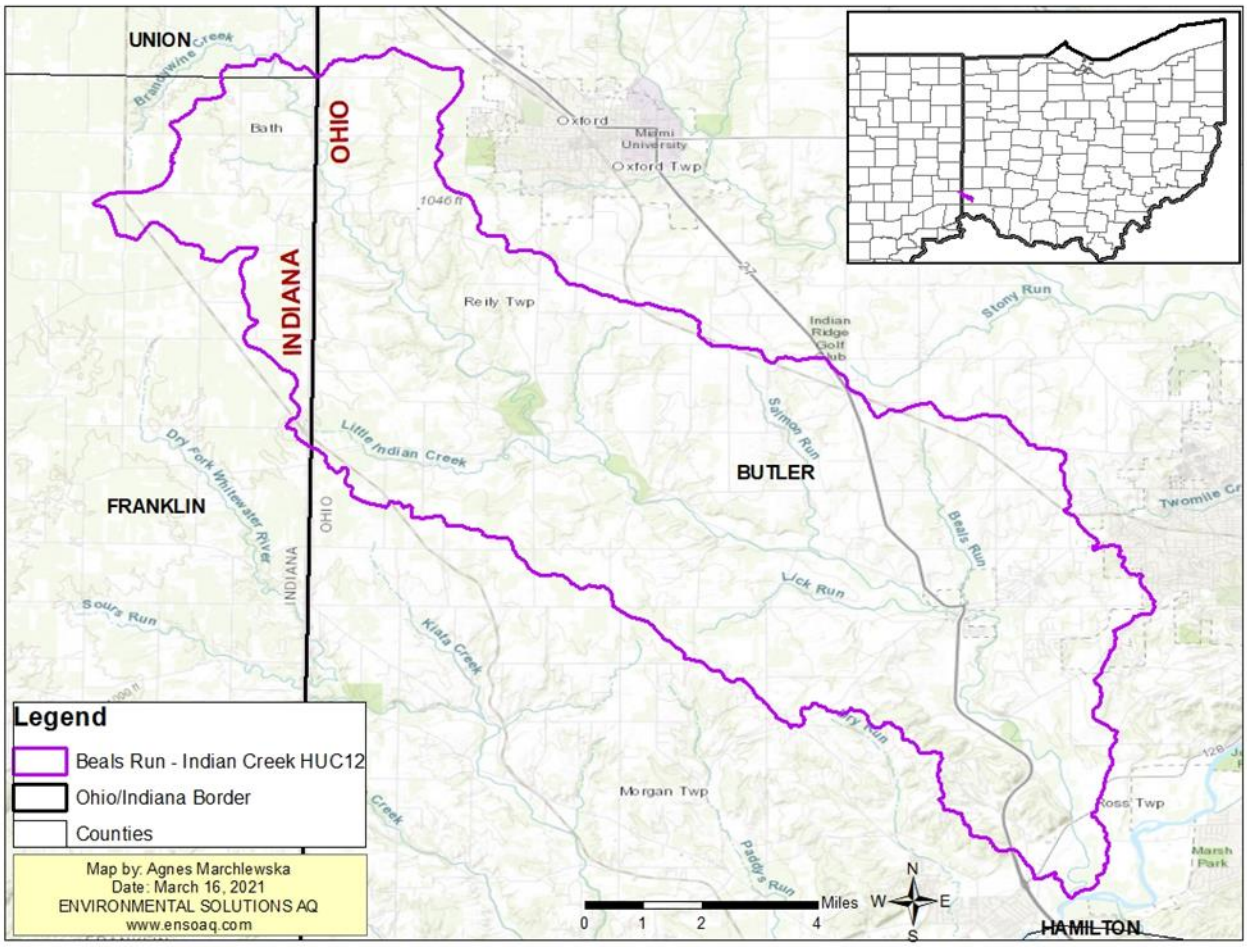


Figure 1 Beals Run-Indian Creek HUC-12 location

The BR-IC HUC 12 is located within the Great Miami River Watershed, which has recently been identified as one of the high priority watersheds in the Ohio River Basin to address water quality impairment caused by excessive nutrient loss, especially from agricultural lands. In the fall of 2020, Ohio Environmental Protection Agency (OEPA) requested proposals to develop the Nine-Element Nonpoint Source Implementation Strategic Plan (NPS-IS) for prioritized HUC 12s within the Ohio River Basin. In response to this request, the Three Valley Conservation Trust took a responsibility for creating NPS-IS for BR-IC HUC 12.

The plan will provide a road map to address the excess nutrients loads, sediments and other nonpoint sources of pollution, which impair water quality in this watershed and contribute to the downstream impairment in the Great Miami River, Ohio River and consequently the Mississippi

River and the Gulf of Mexico. Additionally, creating the plan will support the Mississippi River/ Gulf of Mexico Hypoxia Task Force (HTF) efforts to reduce nutrients in the Mississippi River Basin by 20% by the year 2025 (EPA 2017). Also, the plan will allow identified projects to meet the eligibility criteria for Clean Water Act Section 319 Grants (319 Grants) and other federal and state resources designated to address nonpoint source impairments in the watershed.

The Beals Run – Indian Creek HUC 12 NPS-IS is sponsored by Three Valley Conservation Trust and developed in partnership with Environmental Solutions AQ (ENSOAQ), a local environmental consultant. The project is funded by OEPA via a grant awarded by the United States Environmental Protection Agency (USEPA) to the Hypoxia Task Force states.

1.1. Report Background

The USEPA for many years has encouraged development of watershed plans to help protect and improve water resources in the United States. The earliest Watershed Action Plan (WAP) guidelines were released in 2001 and the first plans were endorsed in 2004. Initially the WAPs focused on larger size watersheds equivalent to HUC 8 or HUC10 hydrologic units. Over time, the planning efforts shifted to the smaller HUC 12s and focused on defining critical areas and individual projects in more details. Each plan has to include "nine essential elements" for projects to be eligible for 319 Grants. In 2013 OEPA released a new guide to address the watershed impairments caused by nonpoint source pollution and the first Nine-Element NPS-IS were approved in 2017. Over time the NPS-IS role has expanded to address not only local watershed impairments (near field) but also to help protect and improve waters downstream (far field).

Nine Elements of NPS-IS Plan
Source: OEPA, 2016a

a) An identification of the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this watershed-based plan.

b) An estimate of the load reductions expected for the management measures described under paragraph (c) below.

c) A description of the NPS management measures (solutions) that will need to be implemented to achieve the load reductions estimated under paragraph (b) above and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.

d) An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon, to implement this plan.

e) An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the NPS management measures that will be implemented.

f) A schedule for implementing the NPS management measures identified in this plan that is reasonably expeditious.

g) A description of interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented.

h) A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards and, if not, the criteria for determining whether this watershed-based plan needs to be revised or, if a NPS TMDL has been established, whether the NPS TMDL needs to be revised.

i) A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.

The BR-IC watershed is one of few in Ohio that does not have a Watershed Action Plan. In 2005, the OEPA conducted a study to assess and characterize all of the various potential sources of water quality impairment in the Indian Creek Watershed (HUC 10). At that time, the watershed condition was relatively good and it was not included on Ohio's list of impaired waters. However, it was noted that several locations might not meet water quality standards in the future unless protective measures are taken. Last year, the OEPA released Ohio 2020 Integrated Water Quality Monitoring and Assessment Report with a new list of impaired waters, which classifies the BR-IC watershed as "category 5 – impaired, TMDL needed" (OEPA, 2020a). The report indicates watershed impairment due to increased concentrations of PCBs in fish tissue that do not meet the EPA standards and might negatively affect human health. Also, high concentrations of *E. coli* were identified, making this watershed impaired for recreation.

In addition, the Great Miami River Watershed, which contains the BR-IC HUC 12, has been identified as one of high priority watersheds to address impairments caused by nutrient loss to streams and rivers in the Ohio River Basin. The Great Miami River (GMR), which drains the water from the BR-IC HUC 12 is one of the top contributors of total phosphorus (P) and dissolved P yield to the Ohio River, Mississippi River and ultimately the Gulf of Mexico (Baker et al., 2006; Goolsby, 1999). The recently published nutrient mass balance report (Ohio EPA, 2020) analyzed three major categories of nutrient sources impacting the GMR watershed; the Nonpoint Pollutant Sources (NPS) defined as nutrients associated with a general land use (developed, agricultural and natural lands), National Pollution Discharge Elimination Systems (NPDES) and Household Sewage Treatment Systems (HSTS). The NPS were identified as the largest contributor of total P and total N to the GMR (66% and 83%, respectively), whereas the HSTS produced the lowest loads of the three categories (6% of total P load and 3% of total N load) (Fig.2)

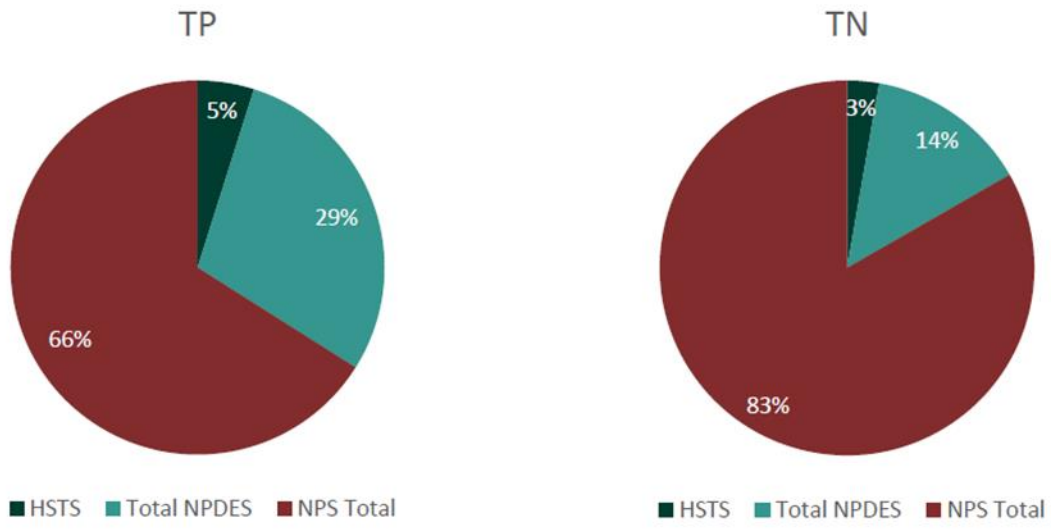


Figure 2 Proportion of total phosphorus and nitrogen load from three major sources: NPS, NPDES and HSTS in the Great Miami River Watershed Average of 5 years (wy 15 - wy 19) (Source: OEPA 2020b, Figure 65)

This NPS-IS will be one of the first developed plans in the GMR Watershed. The plan will identify causes and sources of nonpoint pollutants within the BR - IC HUC 12. It will also determine the watershed critical areas and outline strategic projects, which should be implemented to improve local water quality and help to reduce impairment in Ohio River Basin and subsequently in the Mississippi River and the Gulf of Mexico. Additionally, identified projects described in the plan will be eligible for federal and state nonpoint source (NPS) funding.

1.2. Watershed Profile & History

The BR-IC HUC 12 is located within GMR watershed on the border of SW Ohio and SE Indiana and it is the most downstream sub watershed of the Indian Creek HUC 10 (Fig. 3).

The GMR watershed extends across 15 counties and drains approximately 5,367 square miles of land, which includes 3,942 square miles in Ohio and 1,425 square miles in Indiana. The GMR flows approximately 170 miles from its headwaters in SW Hardin County to its confluence with the Ohio River in SW Hamilton County near the border with Indiana. The GMR watershed is broken into three HUC 8 sub watersheds including Upper Great Miami, Lower Great Miami and Whitewater.

The Indian Creek HUC 10 is located in the southwest part of the Lower Great Miami HUC 8 in Butler County, Ohio, and Union and Franklin counties, Indiana. Its drainage area covers approximately 106 square miles of land, including 34 square miles in Indiana. Indian Creek is 36.89 miles long and it flows from its headwaters in Center Township, Union County, Indiana to its confluence with the GMR in Ross Township, Butler County, Ohio. The main tributaries include Cottage Grove Creek, Sand Run and Brandywine Creek in Union County, Indiana; unnamed tributary and Tent Brook in Franklin County, Indiana; and Little Indian Creek, Reserve Run, Salmon Run, Lick Run and Beals Run in Butler County, Ohio. The Indian Creek HUC 10 is further divided into three smaller hydrologic units: Cottage Run-Indian Creek HUC 12, Brandywine Creek-Indian Creek HUC 12 and BR-IC HUC 12, which is the focus area for this Nine-Element NPS-IS.

There are currently four National Pollutant Discharge Elimination System (NPDES) permitted facilities within the Indian Creek HUC 10. Four of them discharge water treatment effluent into Indian Creek and its tributaries, and one, West College Corner Wastewater Treatment Plan (WWTP) discharges to Little Four Mile Creek. Three facilities are located within BR-IC HUC 12 and one is located just upstream in the Brandywine Creek – Indian Creek HUC 12 (Tab. 1). According to the USEPA Enforcement and Compliance History Online (ECHO) database, the Indian Hills Mobile Home Park (MHP) has experienced multiple permit violations over last three years, and its status is listed as the "Significant/Category I Noncompliance." All other facilities are currently in compliance with their NPDES permits (USEPA, 2021). Discharges from the wastewater treatment facilities along with agricultural runoff from fertilized lawns and cropland, runoff from animal manure storage areas and failing septic systems are significant sources of nitrogen, phosphorous and bacteria, which might cause water impairments within the BR-IC watershed.

The BR- IC HUC 12 drainage area covers approximately 74 square miles, including 8.28 square miles in Indiana. The watershed contains 26.06 miles of Indian Creek downstream from the confluence of Brandywine Creek in southeast corner of Union Township in Union County, Indiana. This section of Indian Creek flows south through the southeastern portion Union County, then it gently turns southwest flowing across the northeast corner of Franklin County, Indiana. The stream crosses the Indiana and Ohio border approximately 2.5 miles west of the Oxford city limits. In Ohio, Indian Creek continues to flow southwest through the west side of Butler County, till it reaches Millville. Then, it again turns south and flows to its confluence with GMR in the southwest portion of Ross Township.

Table 1 The NPDES permitted facilities discharging into Indian Creek and its tributaries within the Indian Creek Huc-10

Facility Name	NPDES ID	Lat/Long	Industry	HUC 12	Receiving Stream	Qtrs with NC (of 12)*
INDIAN HILLS MOBILE HOME PARK	IN0038911	39.53275 -84.82425	Mobile Home Site Operators	Brandywine Creek-Indian Creek	Unnamed tributary to Indian Creek	12
ISLAND LAKE MHP	OH0141321	39.449167 -84.687778	Mobile Home Site Operators	Beals Run-Indian Creek	Salmon Run via Island Lake	2
LAYHIGH ESTATES MHP WWTP	OH0072125	39.37428 -84.71434	Mobile Home Site Operators	Beals Run-Indian Creek	Unnamed Tributary of Lick Run	0
QUEEN ACRES WATER RECLAMATION FACILITY	OH0024261	39.39128 -84.645889	Sewerage Systems	Beals Run-Indian Creek	Indian Creek	1

**Quarters with "No Compliance" status from to 1/1/2018 to 12/31/2020*

The BR-IC watershed is located in the Eastern Corn Belt Plains (ECBP) ecoregion and has a long agricultural history. The first European settlers cleared the deciduous forests and adapted the local lands for crops and pasture beginning in the early 1800s. Currently approximately 66 % of the watershed area is in agriculture, 22 % is covered by deciduous forest, and 10% is developed (NLCD, 2011). The largest communities in this watershed are located in the villages of Reily and Millville in Butler County, Ohio with increasing development pressure caused by relatively close proximity to Cincinnati and Dayton.

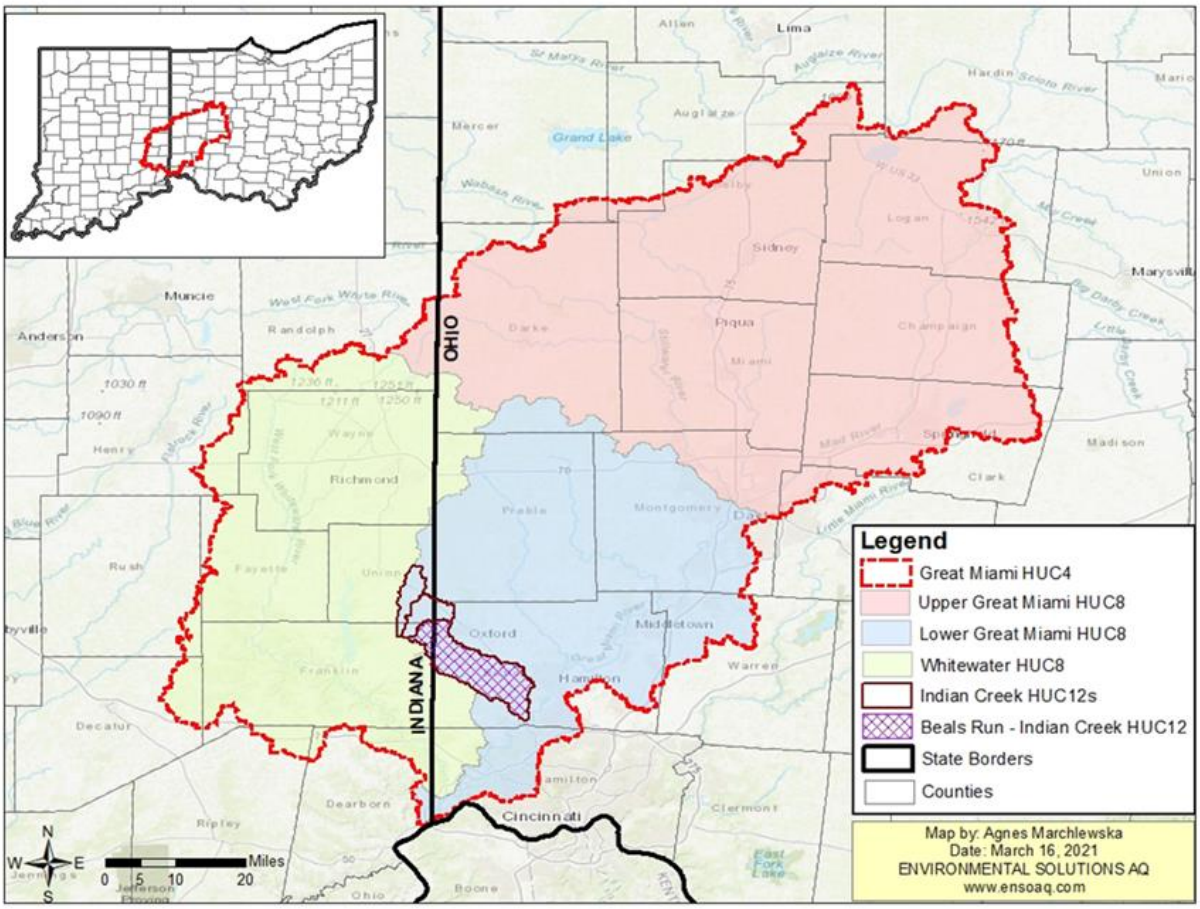


Figure 3 Great Miami River Watershed HUC

1.3. Public Participation and Involvement

To ensure the success of the NPS-IS, the Ohio EPA encourages collaboration with local stakeholders and communities who can help to develop the watershed restoration and protection strategies and later start implementing these strategies.

Three Valley Conservation Trust (TVCT) which sponsored development of the NPS-IS for BR-IC HUC 12 has been successfully leading conservation efforts in this region for more than 27 years. The organization was established in Oxford, Ohio by Edward Wallace in 1993 and incorporated as an Ohio non-profit in 1994. The land trust's mission is to conserve natural habitats, waterways and agricultural lands in Southwestern Ohio, for the benefit of present and future generations, through partnerships with people and communities. TVCT's service area covers seven regional counties with a special focus on protecting land and natural resources in Butler, Preble and Montgomery counties. The land trust's goals and objectives include:

- Setting standards for land conservation and water quality in our region.
- Protecting and enhancing waterways, woodlands, vistas and farmland in our region with conservation and agricultural easements by partnering with other nonprofit organizations, federal and state government agencies, local parks, community representatives and individual landowners.

- Initiating and promoting community conservation efforts.

Since 1994, TVCT has protected approximately 24,000 acres of important landscapes in southwest Ohio via conservation and/or agricultural easements. Currently TVCT holds easements on 211 properties with individual landowners and organization, including 26 in the BR-IC HUC 12.

To engage local stakeholders and communities in the process of developing the NPS-IS for BR-IC watershed, TVCT hosted two public meetings; first on December 7th, 2020 and the second on February 23rd, 2021. Due to COVID 19 both meetings were hosted online via Zoom.

Figure 4 First online public meeting

The purpose of the first meeting was to introduce the project, connect with local stakeholders and landowners, and discuss a scope of the NPS-IS. A total 33 people attended the meeting, including 23 residents and representatives of 2 local organizations; Butler Soil and Water Conservation District (SWCD) and MetroParks of Butler County. The local landowners and stakeholders identified agricultural runoff, stream bank and field erosion, and climate change impact as their perceived leading causes of the water quality impairments within the watershed. Some of the restoration and protection strategies to address water quality concerns were discussed, including erosion mitigation and implementation of best management practices. The summary of the meeting was posted on the TVCT website and social media as well as being shared on the Butler County SWCD website. A multiple follow up visits were conducted to meet with some of the landowners participating in the meeting and discuss potential conservation practices at their properties.

The second public meeting was advertised on TVCT's website and social media. Also, announcements were made in the local newspapers, including the Journal-News and the Oxford Press. Additionally, the Journal-News published a two-page long article about the project discussing the purpose and benefits of developing the plan and inviting landowners who live in the BR-IC watershed to participate in the next public meeting. Furthermore, 102 letters were drafted and sent directly to the farmers whose properties were identified as potentially high runoff risk areas, inviting them to the meeting.

The meeting focused on addressing watershed impairments resulting from agricultural runoff and erosion. ENSOAQ presented preliminary results of the Agricultural Conservation Planning Framework (ACPF) analyses conducted for BR-IC HUC 12. The ACPF tool spatially combines high-resolution terrain, drainage, soils, land use and cropland data to determine potential locations for best management practices (BMPs) at the field scale and helps to engage farming communities in watershed conservation efforts (ARS, 2019).

Three goals were set for the meeting: 1) review preliminary results and analyses developed using the ACPF tool, 2) discuss potential critical areas and projects in the watershed and 3) discuss next steps for the plan. The meeting was attended by 38 participants including representatives from four partnering organizations (Butler SWCD, MetroParks of Butler County,

Miami Conservancy District (MCD), Ohio-Kentucky-Indiana Regional Council of Governments OKI)), 15 local landowners and residents, TVCT staff and Board members and ENSOAQ staff. Stakeholders were asked for their input in developing criteria for prioritizing agricultural lands for conservation practices within the Agricultural Critical Area as well as for deciding on priority projects in the Riparian Corridor Critical Area. To provide more time and opportunity for reviewing presented materials and for offering their feedback, the meeting participants were emailed the slides and the ACPF output maps after the meeting. Additionally, these materials were posted together with the recorded meeting on the TVCT's website. The meeting participants were also asked to fill out a short questionnaire and submit their comments to TVCT within two weeks from the meeting. Seven completed questionnaires were returned via email and two landowners provided their feedback over the phone. In summary, the stakeholders prioritized erosion problems, loss of land, close proximity to the streams, high runoff areas and landowners' willingness to conserve the land as the main criteria for conservation projects in the critical areas. They also listed the additional potential critical areas including; areas with septic systems beyond their life expectancy, areas degraded by the pipeline or other types of utilities and areas affected by residential runoff. If funding were available landowners stated they would be interested in implementing cattle fencing, soil sampling, cover crops, stream bank erosion and wetland restoration projects.

The final version of this NPS-IS for BR-IC HUC 12 was developed using individual inputs from the local stakeholder organizations including; Butler SWCD and Natural Resource Conservation Services (NRCS), OKI, MetroParks of Butler County and MCD.

Chapter 2: **Watershed Characterization and Assessment Summary**

2.1. Summary of Watershed Characterization for Beals Run-Indian Creek HUC-12

2.1.1. Physical and Natural Features

The BR-IC HUC 12 is the most downstream sub watershed within the Indian Creek HUC 10. It contains a 26.06-mile section of Indian Creek (total length 36.86 miles) starting at Indian Creek confluence with Brandywine Creek in Union County, Indiana. The watershed's pour point or outlet is located in Butler County, Ohio where Indian Creek empties to GMR at river mile (RM) 27.7. All significant tributaries of Indian Creek within this HUC 12 are located in Butler County, Ohio and they include Little Indian Creek, Reserve Run, Salmon Run, Lick Run and Beals Run.

This watershed is located in ECBP ecoregion (Fig.5). The ECBP ecoregion is defined as a primarily rolling plain with local end moraines, extensively covered by Wisconsinan age glacier deposits. Originally, it was dominated by beech forests growing on the Wisconsinan soils. Whereas, less common wetter pre-Wisconsinan soils supported both; the beech forests and elm-ash swamp forests. Today, most of these forests have been cleared to give way to highly productive corn, soybean and livestock farms, which degraded stream habitats and water quality (USEPA, 2013).

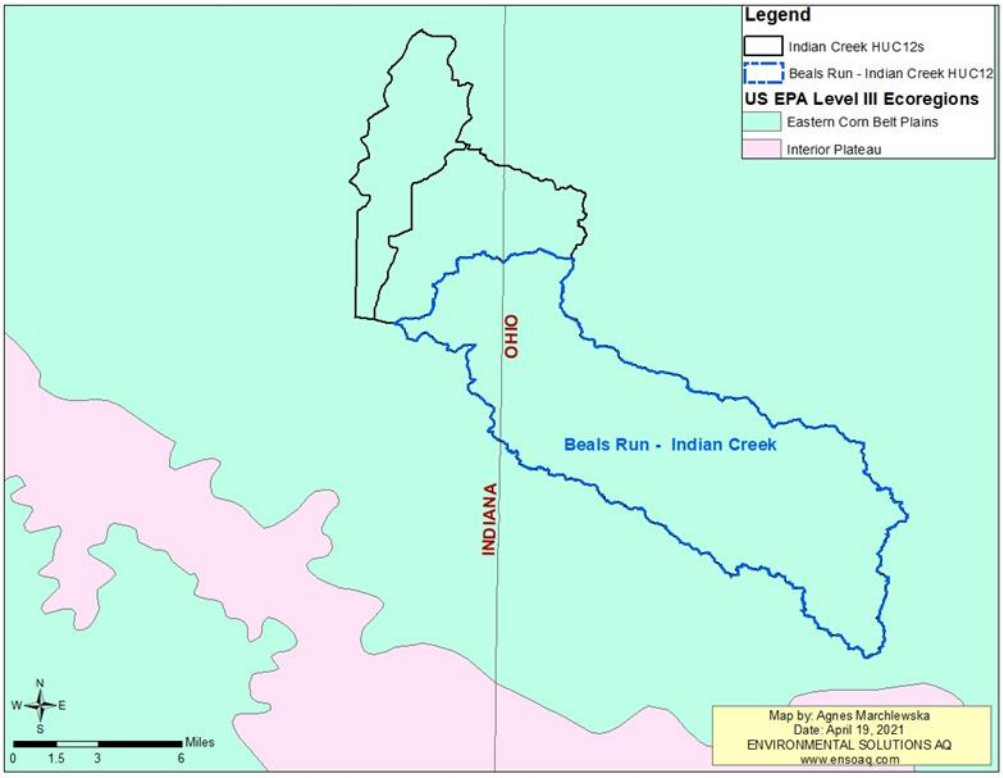


Figure 5 Ecoregion of Beals Run-Indian Creek HUC-12

The BR-IC watershed is almost completely contained within the Southern Ohio Loamy Till Plains Region of the Central Lowland physiographic province. Only the southern tip of the watershed (less than 2%) is located in the Outer Bluegrass Region of the Interior Low Plateaus province. (Ohio Geological Survey, 1998).

The topography of this area was shaped by the Pleistocene Epoch glaciations and it is characterized by flat to gently rolling hills with 0-12 degree slopes, cut by steeper stream valleys with up to 60 degree slopes. Indian Creek flows southwest through the central portion of the watershed which alternates between flat, broader floodplains and steeper narrows. The steeper narrows are a place where often active stream bank erosion sites observed in the watershed. (Fig. 6)

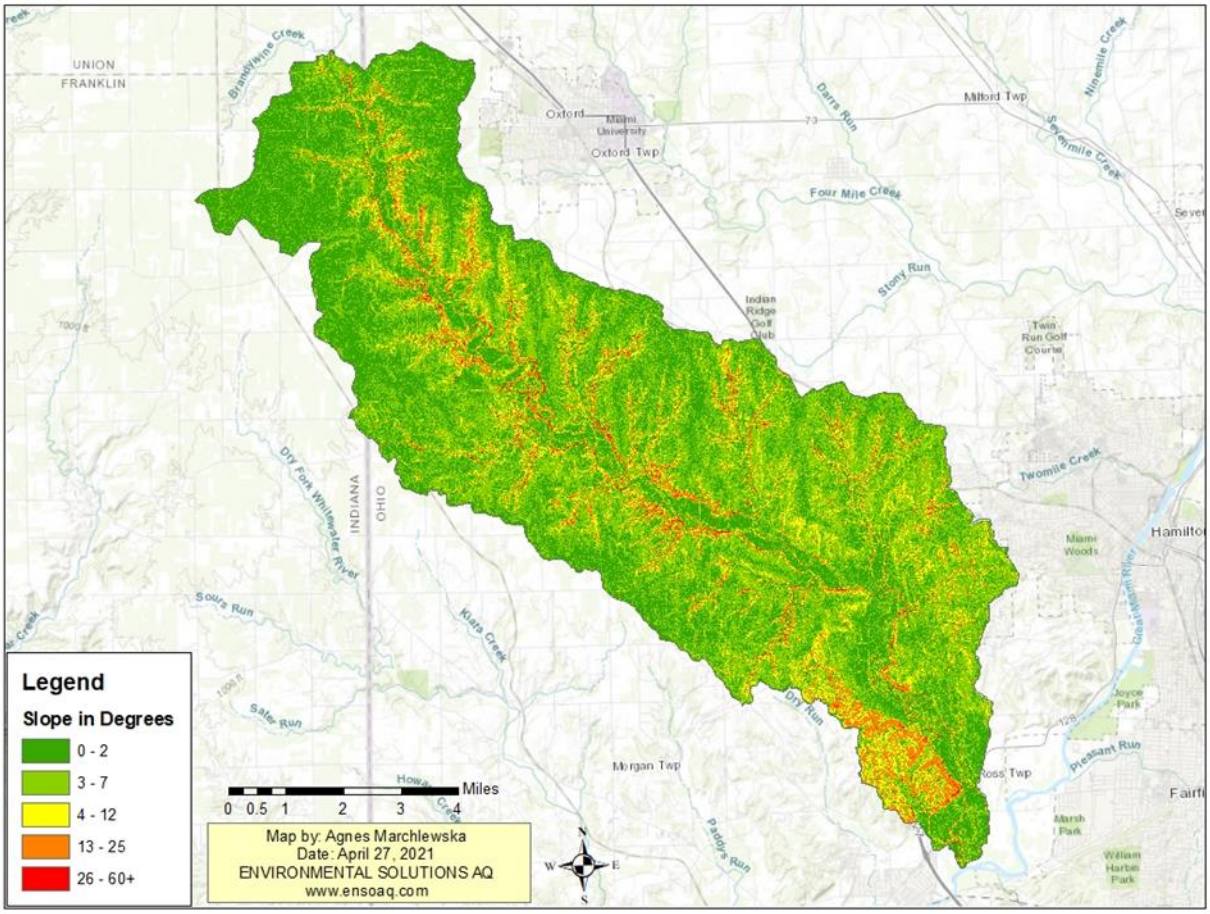


Figure 6 Slope Classification within the Beals Run-Indian Creek HUC-12

The geologic units within the BR-IC watershed are Ordovician bedrock, glacial till and outwash primarily associated with the Wisconsinan glaciation, and latest Pleistocene and Holocene alluvium (Ohio Geological Survey, 2005a and 2005 b). Bedrock is comprised of interbedded fossiliferous limestone and shale. The Drakes, Whitewater and Liberty Formations and Waynesville and the Arnheim Formations, both undivided, compromise the majority of upland portion of the watershed (USGS, 2018). Whereas, the Grant Lake and Fairview Formations,

Miamitown Shale (undivided) and the Point Pleasant Formation are exposed in the Indian Creek Valley (Fig. 6). The Wisconsinan and Illinoian Epoch ground moraines and the Wisconsinan ridge moraine comprise most of the unconsolidated sediments in the watershed (Ohio Geological Survey, 2005). Loamy, high-lime glacial till, which overlays the Ordovician age bedrock in the upland portions of the watershed is often less than 30 feet thick, and it occasionally contains lenses of gravel and sand. Outwash and alluvial materials, which filled ancient stream and river valleys in the region, are associated with a very productive Great Miami Buried Valley Aquifer (GMBVA) system. The thickness of buried valley aquifer deposits in the BR-IC watershed vary to a considerable extent (Ohio Geological Survey, 1993).

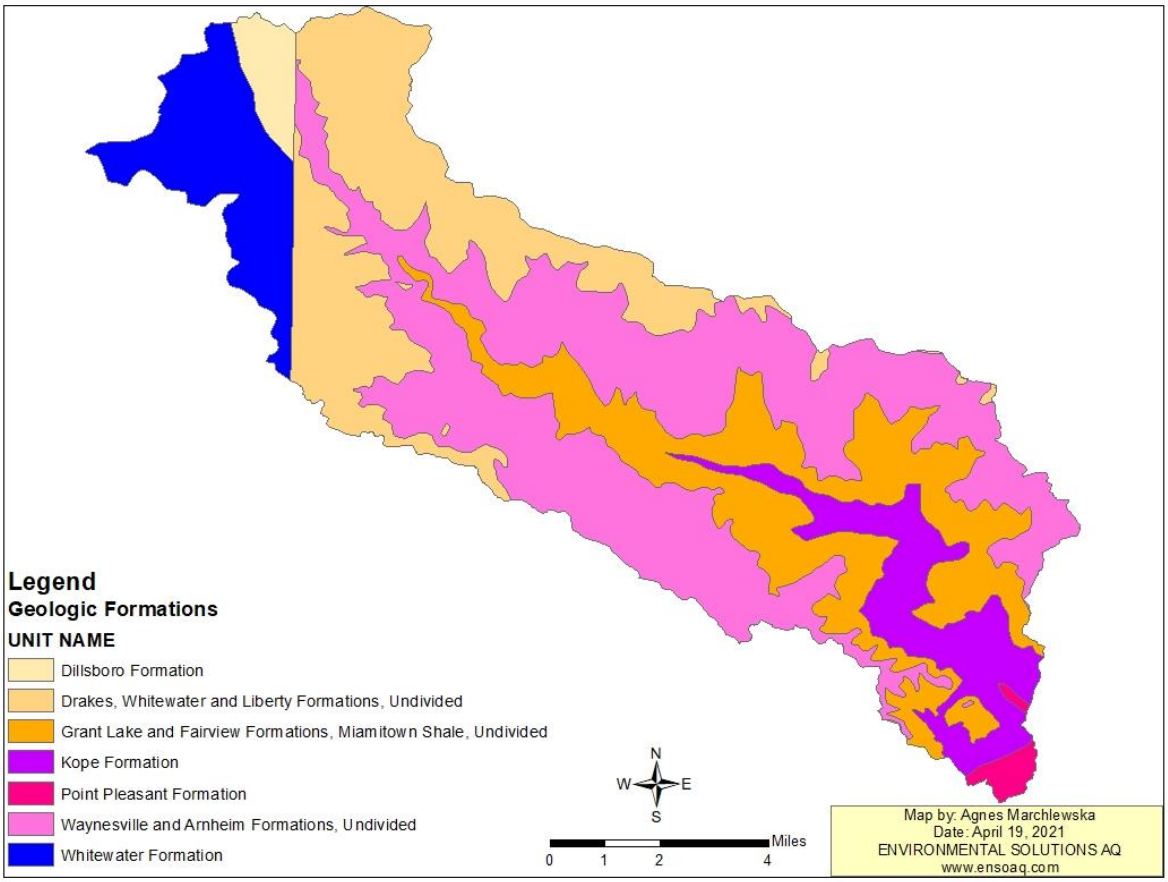


Figure 7 Geologic formations of Beals Run-Indian Creek HUC-12

According to the USDA NRCS Web Soil Survey (WSS), the BR-IC watershed is comprised of 116 different types of soil (Fig. 8). The most common soil series are: Eden, Miamian- Russell, Russell-Miamian and Xenia loams. A detailed summary of the soil types is included in Appendix A. Approximately 34,479.6 acres (72.50% of total watershed area) are classified as prime or locally important soils. An additional 5,721 acres (11.8%) are classified as prime farmland if drained or protected from flooding. A total of 18,748.1 acres (39.20%) are rated as hydric soils on the NRCS 2021 Hydric Soils List. However, according to the National Land Cover Data (NLCD 2011) less than 0.1% (38.1 acres) of the total watershed area is currently covered by

wetlands. The U.S. Fish & Wildlife Service, National Wetland Inventory database, which also includes historical wetlands data, shows a slightly higher acreage than the NLCD for areas designated as wetlands (174.2 acres or 0.36 % of total watershed area) (Fig. 9). Most of natural wetlands within the BR- IC watershed are drained by tiles commonly installed on the agricultural fields as early as at the beginning of 19th century. The presence of hydric soils shows a potential for wetland restoration opportunities within the watershed. Wetland restoration on declining agricultural land can improve habitat for native species, reduce flooding, and improve water quality.

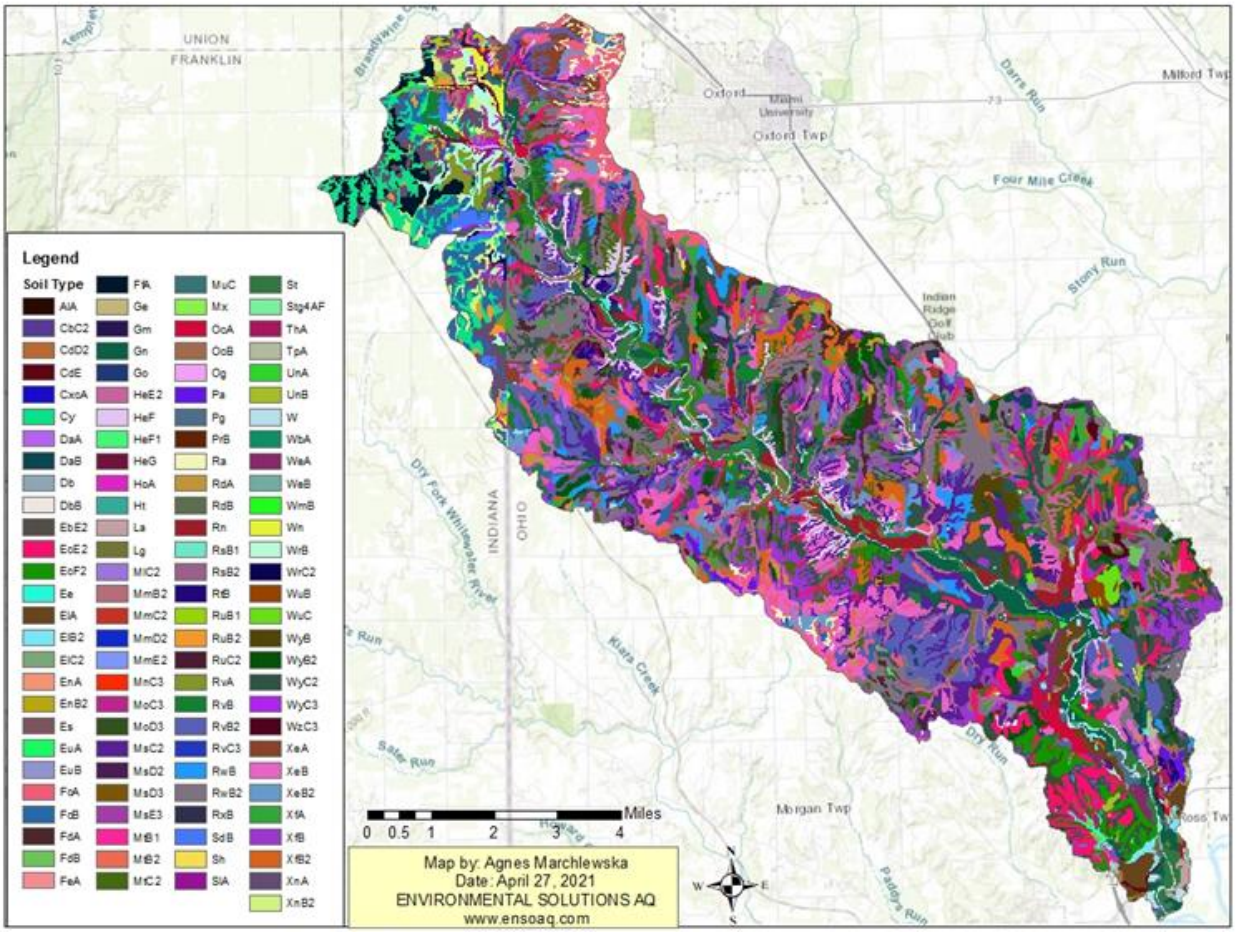


Figure 8 Soil Types within the Beals Run-Indian Creek HUC-12

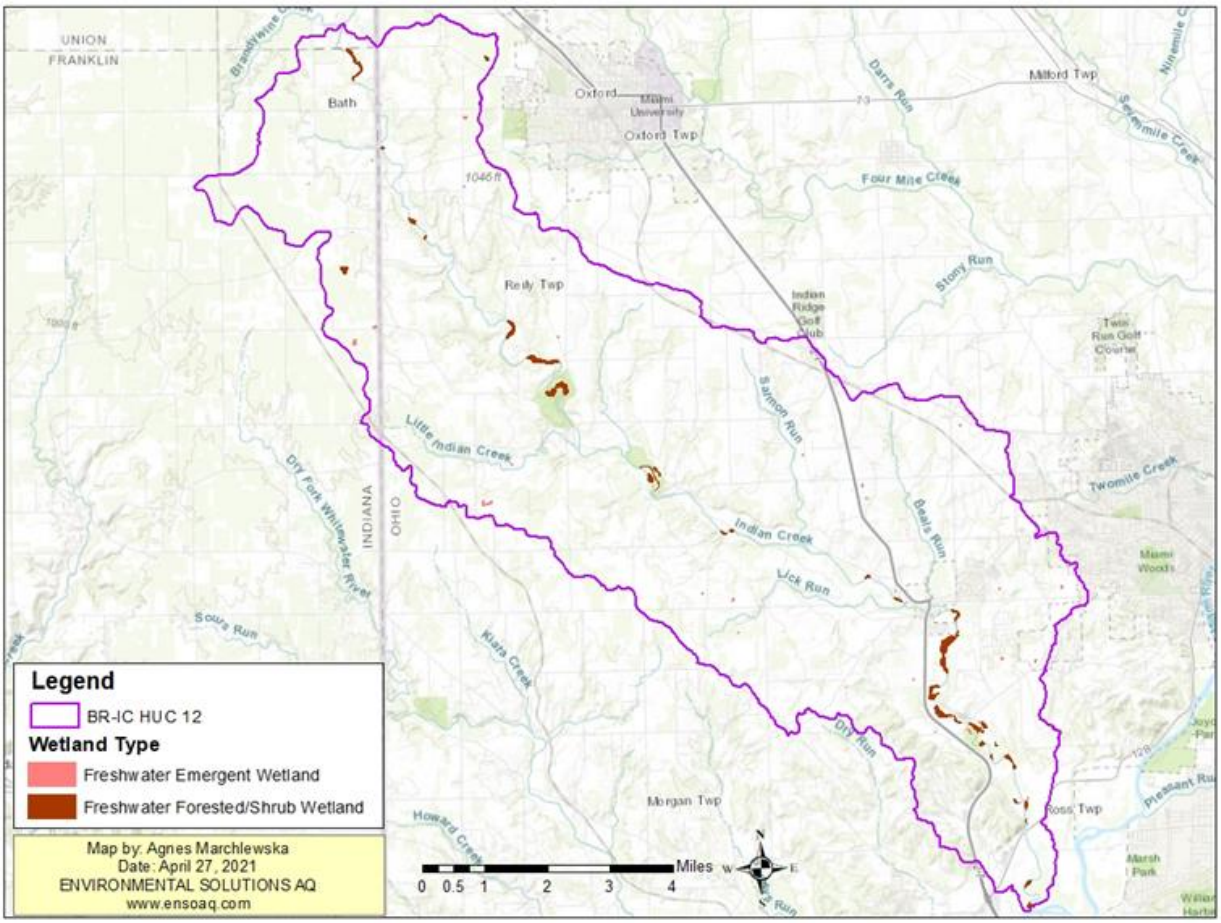


Figure 9 Wetlands within the Beals Run-Indian Creek HUC-12

Table 2 summarizes soils in the watershed based on their hydrologic characteristics. The categories listed as “unclassified” describe areas covered by water bodies or gravel pits.

The vast majority of soils within this HUC 12 are classified as well-drained (32,127.4 acres or 67.50% of the watershed area) or moderately well-drained (9,009.0 acres or 18.80% of the watershed area) (Fig. 10). The poorly drained soils (1442.6 acres or 3.00% of the watershed area) and somewhat poorly drained soils (4250.4 acres or 8.8% of the watershed) are mostly located along northeastern and northwestern watershed boundary. These soils are present in the areas which are usually very flat (0 – 2 degrees of slope) and frequently experience seasonal shallow water table.

Approximately 25,117 acres of soils (52.60% of total watershed area) and 8,506.7 acres (17.90% of total watershed area) are classified as C and D in the hydrologic group classification. These soils, when wet, have slow to very slow infiltration and water transmission rates, therefore, they have higher potential for runoff. The agricultural character of the BR-IC HUC 12, combined with a high runoff potential of the local soils, might contribute to the watershed impairment caused by the excess nutrients loads. In addition, most of the soils in this watershed have high to moderate erodibility (22,419.7 acres or 46.90% of total watershed area and

22,460.3 acres or 47.10%, respectively). The high runoff potential of the soils and increased soil erodibility makes this watershed especially susceptible to erosion problems and excessive sedimentation, which can degrade water quality of the local streams.

Table 2 Soil classifications for BR-IC Watershed

Soil Classification System	Acres	Percent Coverage
Drainage Class* - Somewhat excessively drained	0.6	0.00%
Drainage Class* - Well drained	32127.4	67.50%
Drainage Class* - Moderately well drained	9009.0	18.80%
Drainage Class* - Somewhat poorly drained	4250.4	8.80%
Drainage Class* - Poorly Drained	1442.6	3.00%
Drainage Class* - Not classified	508.20	1.00%
Hydrologic Soil Group** - A	1777.4	3.80%
Hydrologic Soil Group** - A/D	14.1	0.00%
Hydrologic Soil Group** - B	4619.2	9.70%
Hydrologic Soil Group** - B/D	3449.4	7.10%
Hydrologic Soil Group** - C	25117	52.60%
Hydrologic Soil Group** - C/D	3340.1	7.00%
Hydrologic Soil Group** - D	8506.7	17.90%
Soil Erodibility*** - High	22419.7	46.90%
Soil Erodibility*** - Moderate	22460.3	47.10%
Soil Erodibility*** - Low	1943.9	4.10%
Soil Erodibility*** - Unclassified	514.3	1.00%

**Drainage classification range from "Somewhat excessively drained" to "Poorly Drained"*

*** Hydrologic Soil Groups classification based on estimates of runoff potential. (Rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms). "A", relatively high infiltration rates; "B", relatively moderate infiltration rate; "C", relatively slow infiltration rates, "D", relatively very slow infiltration rates. "A/D", "B/D", "C/D" - the first letter is for drained areas and the second is for undrained areas.*

**** Soil Erodibility classification based on erosion factor K that indicates the susceptibility of a soil to sheet and rill erosion by water.*

"Low", K-factor < 0.23; "Moderate", K-factor ≥ 0.23 and < 0.4; "High", K-factor ≥ 0.4

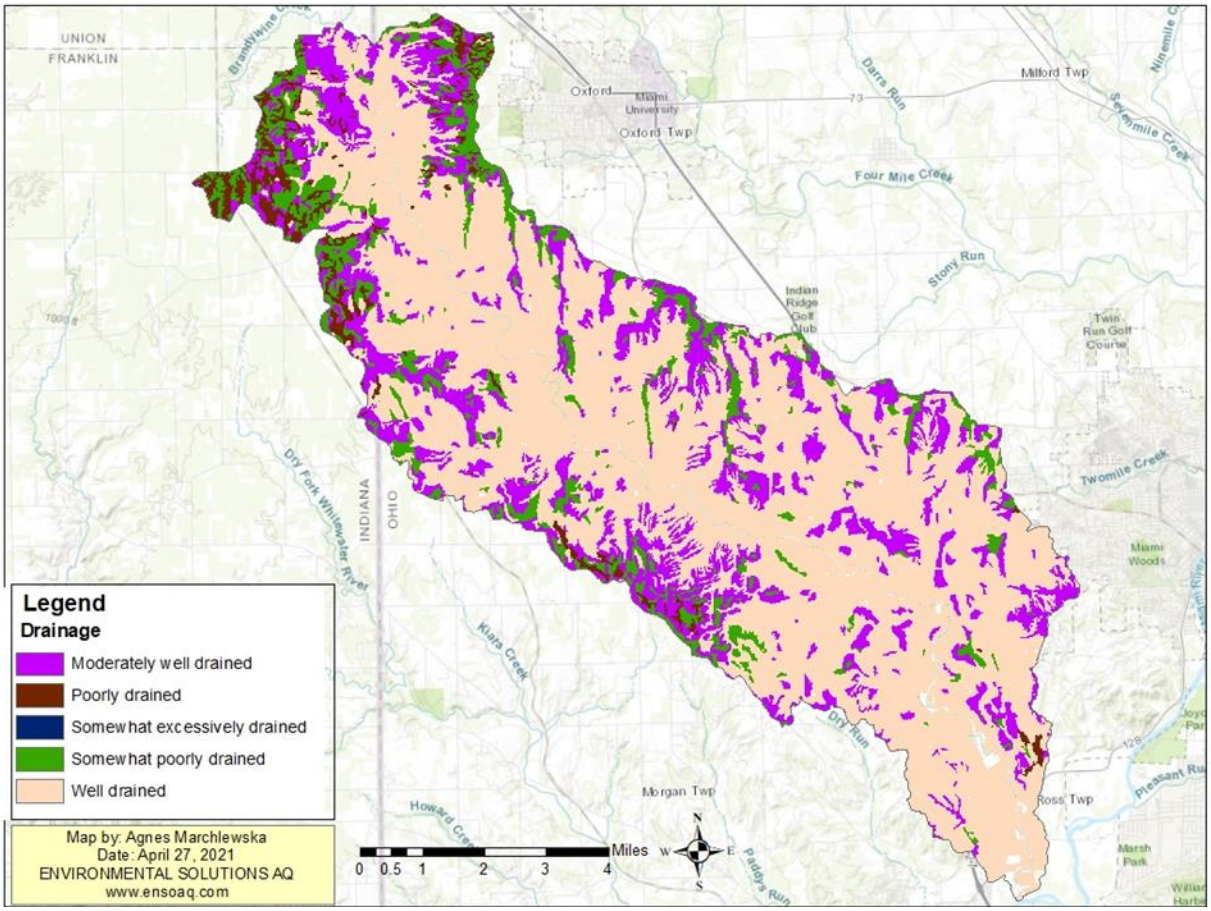


Figure 10 Drainage Classification of the soils within the Beals Run-Indian Creek HUC-12

Furthermore, the USDA NRCS Web Soil Survey (WSS) classified approximately 46,730.4 acres of soils (98.7% of the watershed area) as "very limited" for septic tank absorption fields. This rating indicates that the vast majority of soils within the watershed are not naturally inclined to properly disperse and absorb liquid sewage effluents in a conventional septic drain field, and modifications to the site or septic system itself might be expensive or impossible. According to the "Management of Onsite Wastewater Treatment Systems" document prepared by the OKI Regional Council of Governments (OKI), The Ohio Department of Health recommended "Better septic system management" within the BR-IC HUC 12 (OKI, 2020). The OEPA designated Indian Creek and its tributaries (Little Indian Creek, Lick Run, Salmon Run and Reserve Run) as impaired waters for recreation. The non-attainment status is caused by the presence of the *E. coli* bacteria in local waters exceeding water quality standards (OEPA, 2020c). The potential sources of this impairment are agricultural runoff, livestock and improperly functioning home sewage treatment systems (HSTS).

In 2018 and 2019, the OKI conducted a study to identify and prioritize areas within multiple counties in southwest Ohio, including Butler County, where the HSTS might impact water quality the most (OKI, 2020). The HSTS were evaluated using available water resource, water quality and HSTS density data. According to a heat map developed for the BR-IC watershed, there are

no high priority areas identified in this HUC 12 and only a few sites are designated as medium – high priority (Fig. 10). The OKI study did not report the number of failing home systems in this watershed. Also, the HSTS management in the BR-IC watershed is not a priority for the Butler County Health Department. The HSTS load estimates and reductions will be added in the future version of the plan, once more data is available.

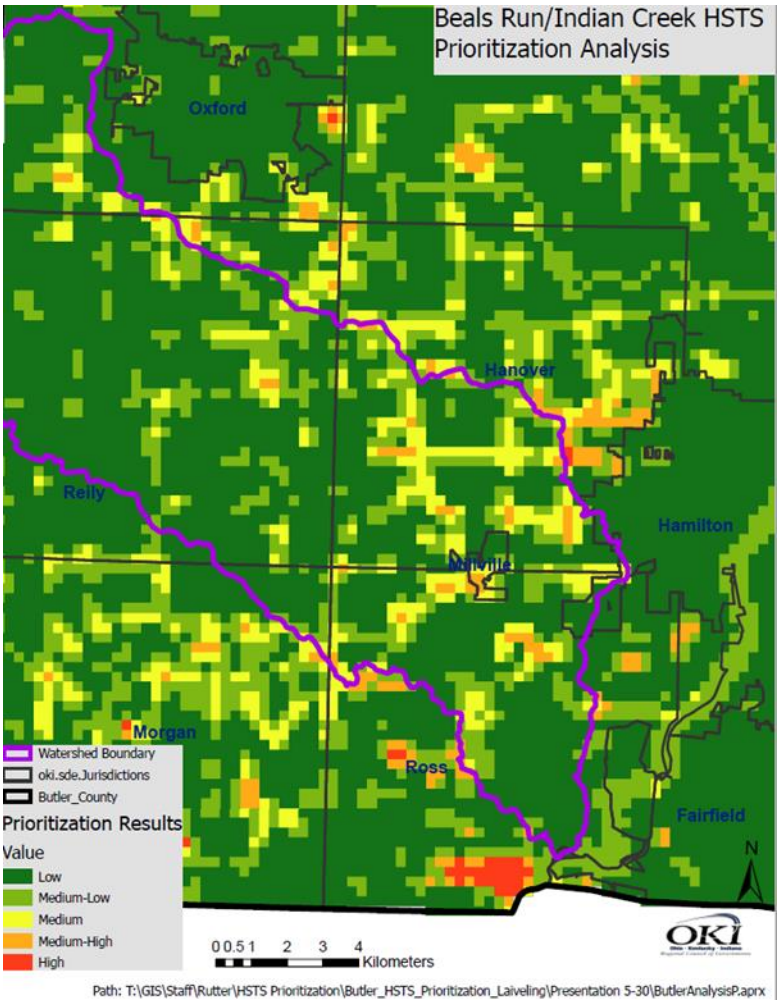


Figure 11 HSTS Priority Analysis for Beals Run-Indian Creek HUC-12 (Source OKI)

2.1.2. Land Use and Protection

The BR-IC HUC 12 is predominantly an agricultural watershed (Fig. 11). Approximately 16,523.67 acres (34.91% of watershed area) are in cultivated crops and 14,400.89 acres (30.42% of watershed area) are in hay/pasture (Tab. 3).

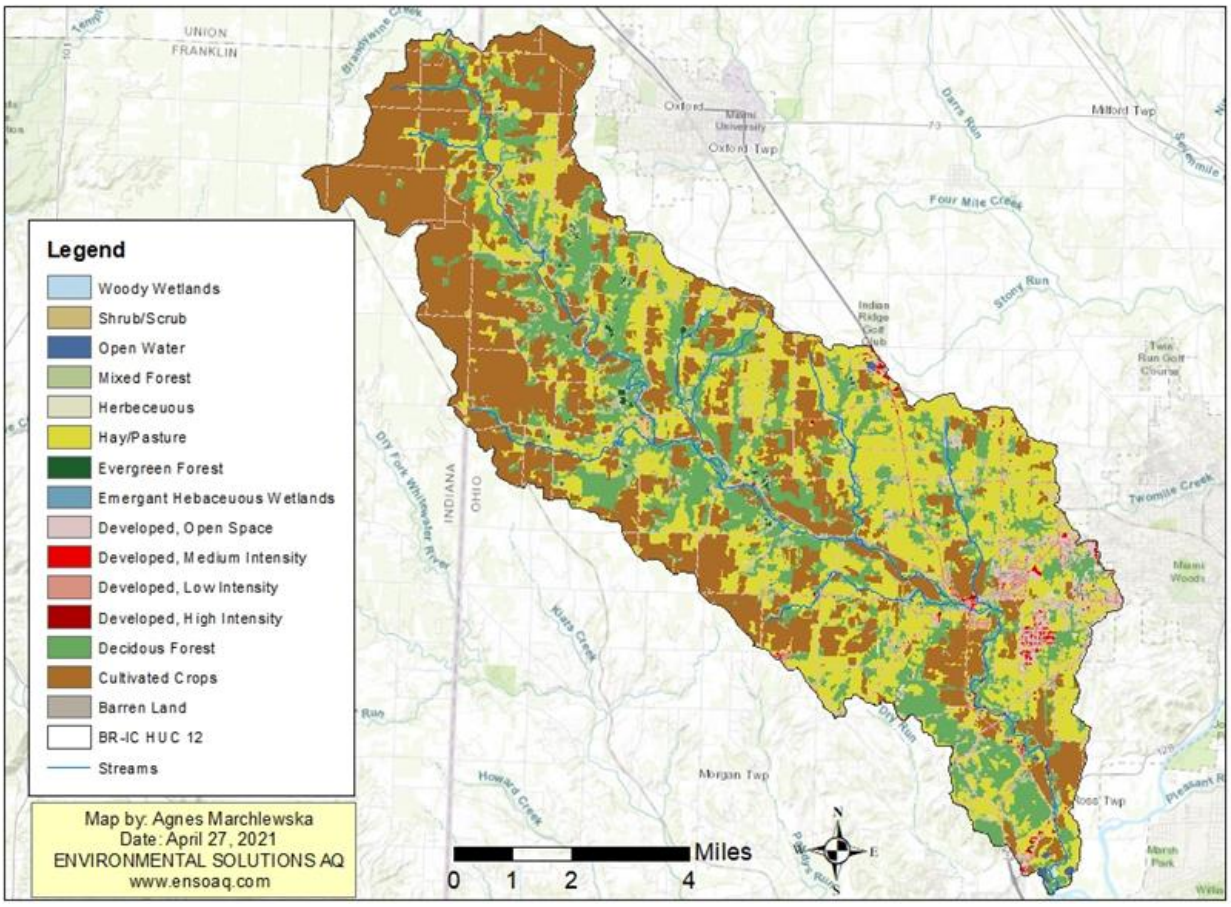


Figure 12 Land Use within the Beals Run-Indian Creek HUC-12 (Source NLCD, 2011)

*Table 3 Land Use within the **BR-IC Watershed***

Land Use	Area (Acres)	%
Cultivated Crops	16523.67	34.91%
Hay/Pasture	14400.89	30.42%
Deciduous Forest	9996.17	21.12%
Evergreen Forest	96.2	0.20%
Mixed Forest	2424.89	5.12%
Grassland/Herbaceous	130.8	0.28%
Shrub/Scrub	32.83	0.07%
Barren Land	12.85	0.03%
Developed, Open Space	2382.27	5.03%
Developed, Low Intensity	987.93	2.09%
Developed, Medium Intensity	173.28	0.37%
Developed, High Intensity	25.68	0.05%
Woody Wetlands	17.31	0.04%
Emergent Herbaceous Wetlands	20.79	0.04%
Open Water	108.44	0.23%
Total	47334	100.00%

Source: NLCD 2011

The main crops growing in this watershed are corn and soybeans (Tab. 4). On average in the last five years 7485.54 acres of land was in corn production and 9208.04 acres were in soybeans. The crop rotation practice frequently used within the watershed helps to improve and protect local soils and increase crop yields.

Table 4 Cropland Types and Acreage within Beals Run-Indian Creek HUC-12

	2020	2019	2018	2017	2016
Corn	8318.9	6918.7	7704	6510.6	7975.5
Soybeans	8891.6	9864.1	8767.7	9822.9	8693.9
Winter Wheat	341.4	163.2	252.4	257.8	259.1
Alfalfa	342.7	159	107.2	98.7	90.7
Other Hay/Non Alfalfa	658.3	622.5	487.9	399.9	296

Source: USDA NASS CropScape, 2021

No concentrated animal feeding facilities (CAFFs) and no permitted concentrated animal feeding operations (CAFOs) are in the BR-IC HUC 12. According to the Natural Resources Conservation Service in Butler County, there are many small to medium livestock operations (mostly cattle and horse farms) in the watershed. However, no detailed data is currently available. Once available, this information will be added in the next version of the plan.

Deciduous forest covers the next largest portion of the watershed (9996.17 acres or 21.12% watershed area). Its presence is mostly limited to the steeper portions of the watershed forming the riparian areas of Indian Creek and its tributaries. The forest is represented by a diverse group of moderate to high quality native trees, and it is heavily impacted by the presence of invasive species, including bush honeysuckle (Lonicera species) and Japanese honeysuckle (Lonicera japonica). Other invasives commonly found within the BR-IC HUC 12 are: multiflora rose (*Rosa multiflora*), garlic mustard (*Alliaria petiolata*) and Bradford pear (*Pyrus calleryana*).

Approximately 10% (3569.16 acres) of the watershed is developed. Two major communities in BR-IC HUC 12, include Reily with the Reily Township population of 2,728 with and Village of Millville, with a population of 667 (Reily Township, Ohio Demographics Data, 2018).

Protected lands within the BR-IC watershed include 26 conservation and agricultural easements on private and public properties held by Three Valley Conservation Trust (Fig. 13). These easements protect approximately 2,747 acres (about 5.9% of the total watershed area) of prime farmland and natural areas from development in perpetuity. In addition, multiple properties within the watershed are protected by MetroParks of Butler County, Ohio. These properties are public lands and include Forest Run MetroPark (Tmberland Ridge Area protected also by the conservation easement) and Indian Creek MetroPark. The protected areas within Indian Creek MetroPark are: Bunker Hill Cemetery, Oxford Reily Road Area, Pater Park, Pioneer Church Area and Springfield Road Area (Fig. 14).

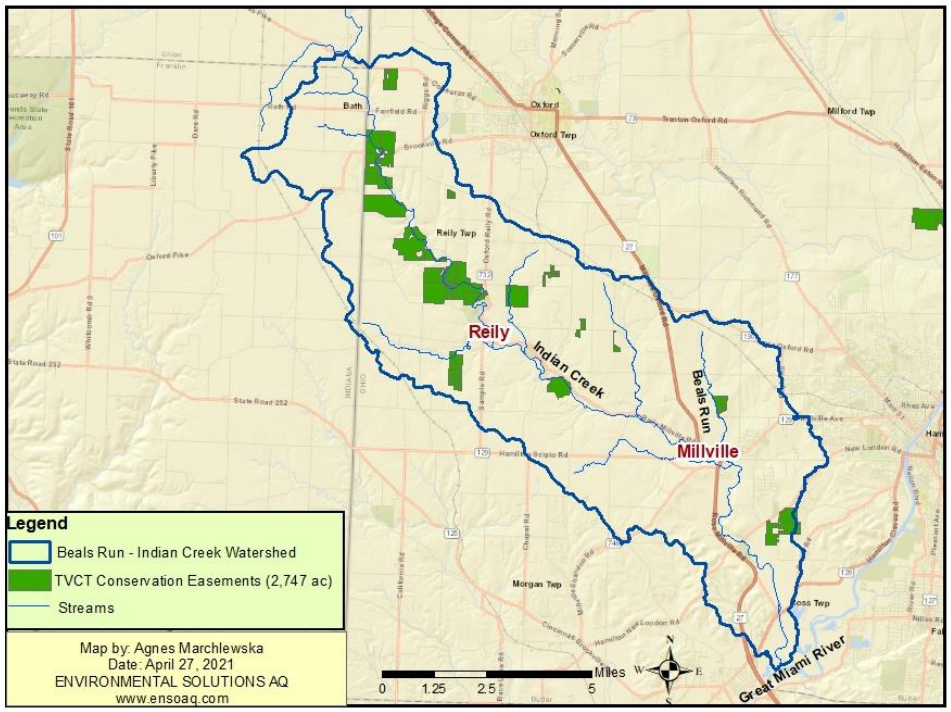


Figure 13 Conservation and Agricultural Easements within the BR-IC HUC 12 (Source TVCT, 2021)

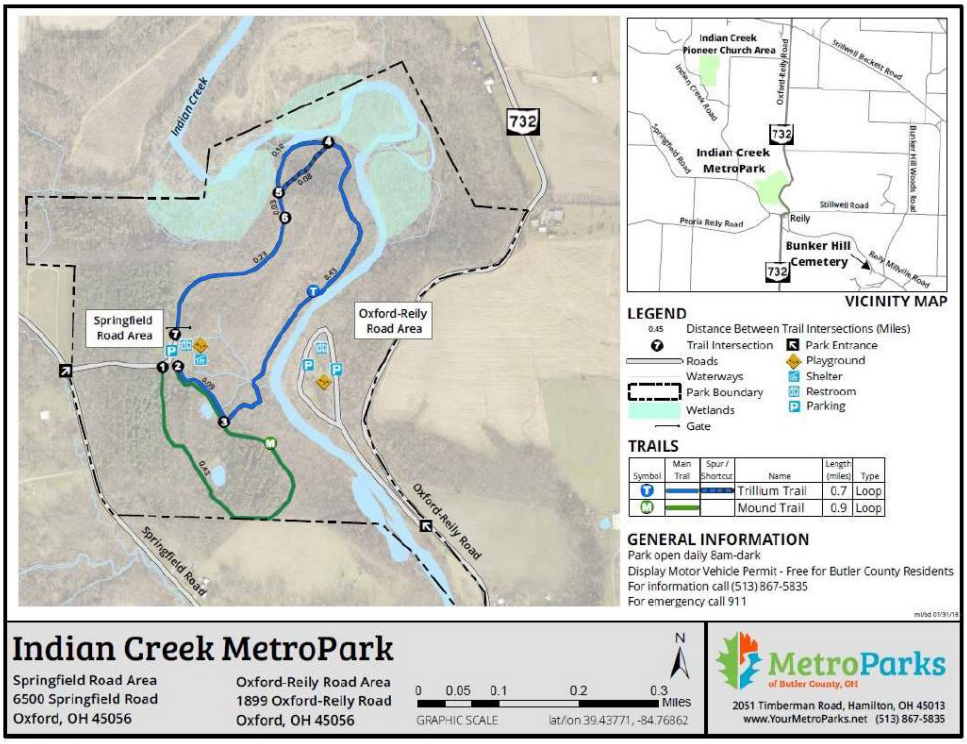


Figure 14 Indian Creek MetroPark Areas (Source: MetroParks of Butler County, Ohio website)

Five threatened or endangered species of wildlife and plants are listed for Butler County by the US Fish and Wildlife Service (USFWS) (Table 5). The deciduous forest growing in the riparian areas of Indian Creek and its tributaries might provide habitat for many of them. Therefore, it is critical to protect it from further habitat degradation caused by invasive species, and agriculture and urban development.

Table 5 Threatened and Endangered Species in Butler County

Species	Status	Habitat
Eastern massasauga (*Sistrurus catenatus*)	Threatened	Wetlands and adjacent uplands
Indiana bat (*Myotis sodalis)*	Endangered	Hibernacula = Caves and mines; Maternity and foraging habitat = small stream corridors with well-developed riparian woods; upland forests
Northern long-eared bat (*Myotis septentrionalis)*	Threatened	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. During late spring and summer roosts and forages in upland forests.
Rayed bean (*Villosa fabalis)*	Endangered	Smaller, headwater creeks, but they are sometimes found in large rivers
Running buffalo clover (*Trifolium stoloniferum)*	Endangered	Disturbed bottomland meadows; disturbed sites that have shade during part of each day

Source: US Fish and Wildlife Service, 2018

Agricultural Conservation Practices

Most of the land in the BR-IC watershed is privately owned; therefore, knowledge of conservation practices may be limited. Some conservation practices can be estimated through program enrollment initiated through the SWCD/NRCS and the Farm Service Agency. Table 6 provides a summary of the conservation practices installed within the BR-IC HUC 12 over last 10 years.

Table 6 Estimates of Conservation Practices within the BR-IC Watershed

Conservation Practice	Estimated Acreage Treated	Sponsoring Program	Estimated Nitrogen Load (lb/yr)*	Estimated Nitrogen Load Reduction (%)
Conservation Tillage** (no till, reduced till)	9914	N/A	53,407	15
Grassed Waterways[1]	33	Conservation Reserve Program (FSA/NRCS)	192	0.1
Cover Crops[1]	538	Water Quality Trading Program (SWCD)	1,489	0.4
Nutrient Management (Soil Sampling and Variable Rate)[1]	538	Water Quality Trading Program (SWCD)	1,681	0.5

**Estimates calculated using Spreadsheet Tool for Estimating Pollutant Loads (STEPL), Version 4.4 (USEPA, 2019) and further calibrated using nitrogen load estimate provided by R. Wilson in 2020.*
***Estimated by Butler SWCD office based on the field experience*
[1] The practices presented here are between current and the past 10 years. Therefore, the estimated nitrogen load maybe outdated. New load estimate will be updated in the next version of this plan when more current data are available.

Additional conservation practices in this watershed have been sponsored via Environmental Quality Incentives Program (EQIP) and they include: Heavy Use Areas, Fencing, a couple of Seasonal High Tunnels and Brush Management (Personal Communication: NRCS Butler County, Ohio).

Future nutrient reduction projects implemented through this NPS-IS and available state and federal programming will be compiled to track progress made towards nutrient reduction and conservation goals across the BR-IC HUC 12 and the Great Miami River watershed.

Watershed Development Pressure

Land development has a significant impact on quantity and quality of water resources. As the area urbanizes, it generates more sewage, and increases pollutant and pathogen loading in the watershed. Greater development might increase runoff intensity, stream fluctuation, flashiness, and frequency and severity of flooding. Also, it can increase streambank erosion and sedimentation, degrading water quality of local streams and rivers. Based on the studies conducted by the Center for Watershed Protection (CWP), most streams experience decline in their water quality and habitats when watershed impervious cover (IC) exceeds 10%, with severe degradation expected beyond 25% IC (CWP, 1993).

In 2014, the OKI conducted a study to evaluate the impact of development on the water quality of 82 watersheds in southwest Ohio, including the BR-IC HUC 12 (OKI, 2014).

The Impervious Cover Model (ICM), a widely accepted watershed management-planning tool, was used to analyze the relationship between impervious surface and slope, soil erodibility, riparian buffers and the underlying aquifer within each watershed. The analyses were conducted using imagery data from 2007 (Personal Communication, OKI). According to the ICM, in 2007 approximately 5.1% of the BR-IC HUC 12 was covered by impervious surfaces. The IC rating put this watershed in the "sensitive but should have acceptable water quality and habitat" category (OKI, 2014). The BR-IC watershed was also listed as one of the top 20 watersheds that had the most impervious cover acreage within 200-foot-wide riparian corridors.

A detailed summary of the relationships between impervious cover and environmentally sensitive areas within the BR-IC watershed are presented in Table 7.

Table 7 Impervious Cover vs. Slope, Soil Erodibility, Riparian Corridors and Aquifer Area in BR-IC HUC 12

Impervious Acres with 0-10% slopes	**Impervious Acres with 11-20% slopes**	**Impervious Areas with > 20% slopes**
1,422.6 (4.1% of the watershed area)	289.3 (0.7% of the watershed area)	34.3 (0.32% of the watershed area)
Impervious Acres on Highly Erodible Soils	**Impervious Acres on Not Highly Erodible Soils**	**Impervious Acres on Potentially Highly Erodible Soils**
217.6 (0.52% of the watershed area)	481.0 (1.1% of the watershed area)	1,307.8 (3.1% of the watershed area)
Impervious Acres Outside of Riparian Corridors*	**Impervious Acres Inside of Riparian Corridors***	
2,010.2 (4.8% of the watershed area)	135.9 (0.32% of the watershed area)	
Impervious Acres Not Over an Aquifer Area	**Impervious Acres Over an Aquifer Area**	
1,759.5 (4.2% of the watershed area)	386.7 (0.92% of the watershed area)	

Data Source: OKI
** 200 ft wide riparian corridor*

Also, OKI evaluated the residential development trends to determine anticipated growth and the wastewater facility planning areas (OKI, 2014). The portion of BR-IC watershed south of Millville was identified as one of high development pressure zones. In addition, OKI projected that the population of the BR-IC watershed will increase from 15,631 to 21,852, from 2010 to 2040 (OKI, 2014). Currently approximately 10 % of the watershed is developed. With the growing population and development pressure, the impervious cover will also increase – negatively affecting the water quality and habitats within the watershed. Therefore, protecting sensitive environments – especially riparian corridors – from further development is critical for keeping the BR-IC watershed healthy.

2.2. Summary of Biological Trends for Beals Run-Indian Creek HUC-12

The 2005 Ohio EPA Biological and Water Quality Study of Fourmile Creek, Indian Creek and selected Tributaries was the only comprehensive sampling data of the BR-IC HUC 12 watershed. This section summarizes the major findings of the 2005 OEPA sampling report (OEPA, 2008).

Eighteen sampling locations were selected in the BR-IC HUC 12 during the 2005 OEPA sampling event (Fig. 15, Tab. 8). Ten of the sampling locations are located along the Indian Creek main stem and the remaining eight were located at Little Indian Creek, Reserve Run, Salmon Run, tributary to Salmon Run, Lick Run and Beals Run. Not all the samples were analyzed for biological indicators and some of them collected only flow data.

Table 8 2005 OEPA Sampling Location Within BR-IC HUC 12

Stream Mile	Drainage Area (mi2)	Sample Type	Location	Latitude	Longitude
Indian Creek					
23.95	39	C,S,O,D,F,M	Fairfield Road near OH/IN state line	39.5085	84.8148
17.68	53	C,B,D,F,M	Indian Creek Road – southern crossing	39.4485	84.7761
15.12	NA	Flows Only	SR.732	39.4352	84.7601
12.6	N A	D	Garner Road	39.4179	84.7291
9.4	82	C,S,O,D,F,M	Adj. Reily Millville Road	39.4021	84.6828
6.8	95	C,B,S,O,D,(7.6),F,M	Upstream of Queen Acres WWTP	39.3870	84.6463
6.5	98	C,S,O,D,F,M	Downstream of Queen Acres WWTP	39.3846	84.6458
4.3	102	C,D,F,M	Hamilton New London Road	39.3631	84.6436
1.66	NA	C,B,D	SR 128	39.3374	84.6268
0.1-1	NA	C,S,O	Gravel Pit at mouth	39.3226	84.6274
Little Indian Creek					
0.09	5.6	C,D,F,M	Sawmill Road at mouth	39.4291	84.7585
Reserve Run					
0.25	4.5	C,S,O,F,M	Adjacent to Reily Millville Road	39.4296	84.6928
Salmon Run					
1.9	1.4	C,F,M	Salmon Road	39.4291	84.6950
0.1	4.8	C,B,F,M	Adj. to Reily Millville Road	39.4047	84.6934
Tributary to Salmon Run					
1.4	NA	C	Hussey Road	39.4467	84.6878
0.1	NA	C	Salmon Road	39.4286	84.6941
Lick Run					
0.9	4.7	C,F,M	Ross Road	39.3912	84.6790
Beals Run					
0.1	NA	C	Near mouth, downstream of tributary	39.3898	84.6493

M - macroinvertebrate quantitative sample, M - macroinvertebrate qualitative sample, F - fish sample (2 passes), F - fish sample (1 pass), C - conventional water chemistry parameters (5 runs), B - bacteria (5 runs), S - sediment sample (conventional and organics), D - datasonde monitor, O-organic water chemistry (2 runs).

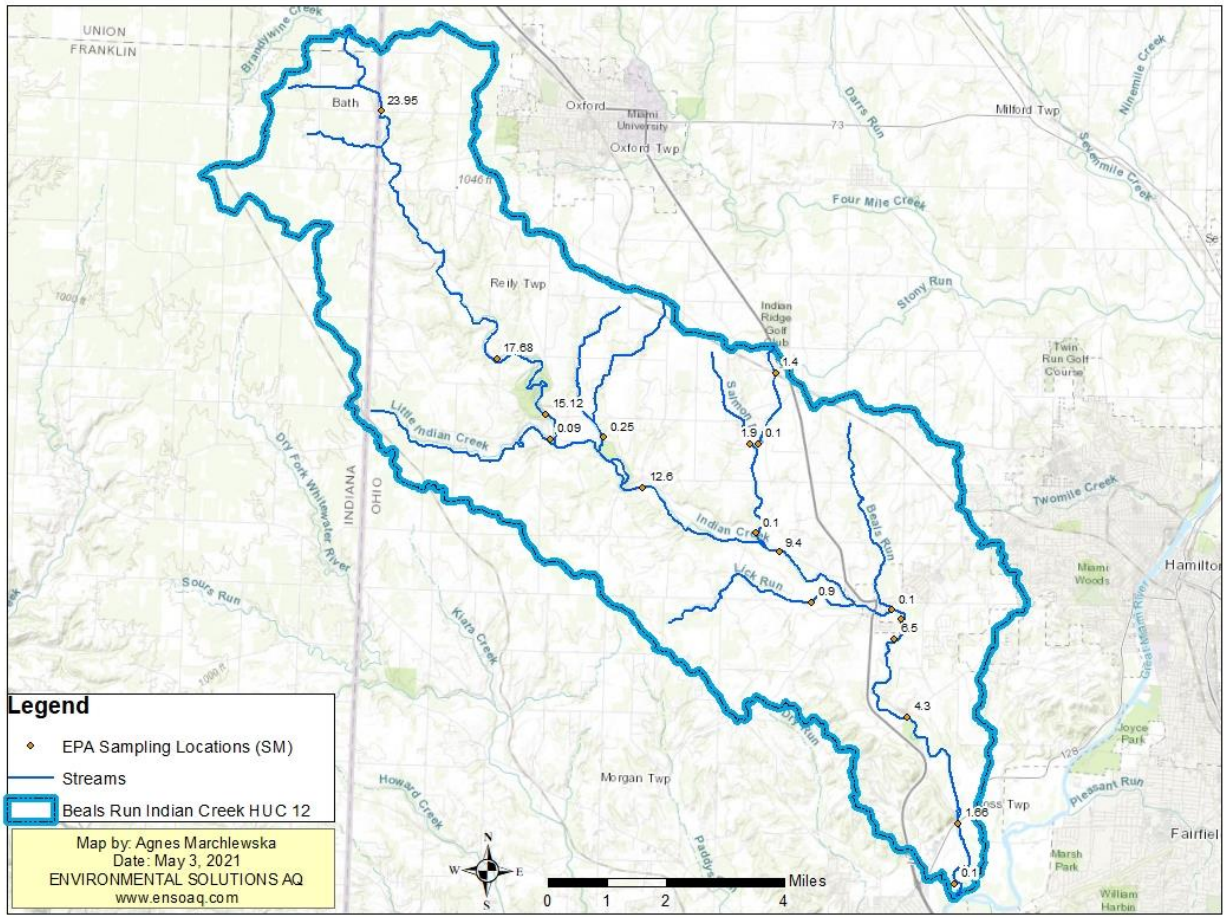


Figure 15 OEPA Sampling Locations in BR-IC HUC 12 by Stream Miles

In 2005, six sampling locations along the Indian Creek mainstem were evaluated for the biological indices indicating the quality of near and in-stream habitats (Table 9). Qualitative Habitat Evaluation Index (QHEI) values ranged between 55.5 and 74.5 with a mean of 64.58. Mean QHEI values from rivers or river segments equal to or greater than 60.0 generally indicate a level of macrohabitat quality sufficient to support an assemblage of aquatic organisms consistent with the Warmwater Habitat (WWH) aquatic life use designation (OEPA, 2008). The 2008 OEPA report concluded that the quality of near and in-stream macrohabitat throughout the entire length of Indian Creek appeared capable of supporting diverse, functionally organized, and well-structured assemblages of aquatic organisms, consistent with its recommended WWH aquatic life use. The partial and non-attainment status at the tributaries were caused by natural low flow conditions (OEPA, 2008).

Table 9 Biological Indices Scores for the Sampling Sites

River Mile	IBI	MIwb[a]	ICI[b]	QHEI	Aquatic Life Use Designation	Attainment Status[c]	Causes
Indian Creek							
23.95	38	9.7	VG	64	EWH Existing/ WWH Recommended	Full	NA
17.68	48	10.4	48	67.5		Full	NA
9.4	54	10.3	52	59		Full	NA
6.8	48	10.4	44	74.5		Full	NA
6.5	46	10.3	40	67		Full	NA
4.3	42	10.8	G	55.5		Full	NA
Little Indian Creek							
0.1	52	NA	F	65	Undesignated/ WWH Recommended	Partial	Interstitial Stream flow
Reserve Run							
0.3	NA	NA	Low F	NA	Undesignated /WWH Recommended	NA	Interstitial Stream flow
Salmon Run							
1.9	44	NA	P	63	EWH Existing/ WWH Recommended	Non	Interstitial Stream flow
0.1	52	NA	G	58		Full	
Lick Run							
0.9	50	NA	F	68	Undesignated/WWH Recommended WWH Recommended	Partial	Interstitial Stream flow

Source: OEPA, 2008

a MIwb is not applicable to headwater streams with drainage areas < 20 mi2.

b A narrative evaluation of the qualitative sample based on attributes such as EPT taxa richness, number of sensitive taxa, and community composition was used when quantitative data was not available or considered unreliable due to current velocities less than 0.3 fps flowing over the artificial substrates. VP=Very Poor, P=Poor, LF=Low Fair, F=Fair, MG=Marginally Good, G=Good, VG=Very Good, E=Exceptional

c Attainment status is given for the existing or, if a change is proposed, the recommended use designation.

ns Nonsignificant departure from biocriterion (<4 IBI or ICI units, or <0.5 MIwb units).

** Indicates significant departure from applicable biocriterion (>4 IBI or ICI units, or >0.5 MIwb units).*

Underlined scores are in the Poor or Very Poor range.

QHEI - Qualitative Habitat Evaluation Index

WWH Warmwater Habitat – ECBP Ecoregion

2.2.1. Biological Assessment: Fish Assemblages

The fish assemblages of Indian Creek and its tributaries were surveyed and assessed by OEPA in 2005. A total of 19,364 fish comprising 39 species and hybrids was collected from Indian Creek between July and September 2005. The fish sampling effort included six stations, evaluating 22 miles of the mainstem between RM 23.9 and RM 4.3 (Tab. 10). Based on aggregated catch statistics, numerically predominant species (No./0.3km) included central stoneroller (31.1%), bluntnose minnow (23.8%), sand shiner (12.2%), striped shiner (6.17%), greenside darter (3.1%), and northern hog sucker (2.3%). In terms of relative biomass (kg/0.3km), dominant species were smallmouth bass (19.4%), black redhorse (15.9%), northern hog sucker (12.0%), golden redhorse (11.5%), central stoneroller (9.6%), and common carp (6.3%). Nearly 20% percent of the numerically dominant species and over 50% of fish biomass were composed of environmentally sensitive species. No fish species classified as rare, threatened, endangered, or otherwise recognized for special conservation status by the Ohio Department of Natural Resources (ODNR) were observed. However, highly intolerant, declining or otherwise ecologically significant species included black redhorse, rosyface shiner, silver shiner, banded darter, stonecat, and southern redbelly dace. Community indices and accompanying narrative evaluations for Indian Creek ranged between exceptional (IBI=54/MIwb=10.8) and marginally good/exceptional (IBI=38/MIwb=9.7). Overall, the fish assemblage of Indian Creek was characterized as very good/exceptional. As measured by the IBI and MIwb (where applicable), community performance through the entire length of Indian Creek was consistent with the recommended WWH biocriteria.

The fish assemblages of three direct tributaries of Indian Creek were also surveyed and assessed at four sampling stations in 2005. Similar to the Indian Creek mainstem, no fish species classified as rare, threatened, endangered, or otherwise recognized for special conservation status by ODNR were observed but highly intolerant, declining or otherwise ecologically significant species included southern redbelly dace, stonecat, and banded darter. Community indices and accompanying narrative evaluations from these waters ranged between exceptional (IBI=52) and good (IBI=44). Taken together, the fish assemblages of Indian Creek tributaries can be collectively characterized as exceptional. All Indian Creek tributaries supported fish assemblages consistent with the recommended WWH biocriterion.

The only perennial Indian Creek tributary was Lick Run. Salmon Run and Little Indian Creek were ephemeral or interstitial. Despite the lack of surface flow, these streams supported fish assemblages consistent with the WWH biocriteria; and, as measured by the IBI, were comparable to Lick Run, a perennial stream.

Table 10 Fish Community and Descriptive Statistics

Stream River Mile	Mean Number Species	Cumulative Species	Mean Rel. No. (No./km)[a]	Mean Rel. Wt. (Wt./km)[a]	Mean IBI	Mean Mlwb	QHEI	Narrative Evaluation[b] (Recommended/ Existing)
Indian Creek								
23.9	29	29	5667	57.6	38[ns]	9.7	64.0	M. Good/Exceptional
17.7	27	27	4018	37.3	48	10.4	67.5	V. Good/Exceptional
9.4	26	26	3934	42.9	54	10.3	59.0	Exceptional
6.8	33	33	3585.6	123.9	48	10.4	74.5	V. Good/Exceptional
6.5	24	24	3424.5	52.5	46	10.3	67.0	V. Good/Exceptional
4.3	27	27	9055.7	78.5	42	10.8	55.5	Good/Exceptional
Little Indian Creek								
0.1	17	17	2940	52	52	NA	65.0	Exceptional
Salmon Run								
1.9[H]	10	10	694	44	44	NA	63.0	Good
0.1[H]	24	24	2156	52	52	NA	58.0	Exceptional
Lick Run								
0.9[H]	18	18	1432.1	50	50	NA	68.0	Exceptional

Source: OEPA 2008
a- Relative abundance and relative weight estimate normalized to 0.3km.
b - Narrative biological performance.
H - Headwaters: sites draining areas < 20 miles^2.
ns- Nonsignificant departure from the biocriteria (<4 IBI units or <0.5 Mlwb units).

2.2.2. Biological Assessment: Macroinvertebrate Community

Macroinvertebrate communities were evaluated at 11 stations at Indian Creek and the community performance was evaluated as exceptional at two stations, very good at two, good at three, fair at three, and poor at one station (Tab. 11). The station with the highest total mayfly (*Ephemeroptera*), stonefly (*Plecoptera*), and caddisfly (*Trichoptera*) taxa richness (EPT) was on Indian Creek at RM 17.8 with 25 taxa. The same station had the highest number of total sensitive taxa with 32. Sensitive taxa found which are noteworthy because they are not commonly collected were the mayflies *Acentrella turbida* in Indian Creek (RM 17.8), *Paracloeodes sp. 3* in Indian Creek (RM 9.7), and *Maccaffertium mediopunctatum* in Indian Creek (RMs 23.9, 17.8, 9.7, 6.9, 6.4) and the midge *Sublettea coffmani* in Indian Creek (RM 17.8). The state threatened crayfish *Orconectes sloanii* was collected from Little Indian Creek (RM 0.1), Reserve Run (RM 0.3), and Salmon Run (RMs 1.9, 0.1).

The community sampled downstream from the Queen Acres WWTP at Indian Creek RM 6.4 was exhibiting increased density (1103 orgs./ft^2 compared to 199 at RM 6.9) with increased abundance of mostly facultative taxa. The Queen Acres WWTP discharge was having a mild enrichment effect on the macroinvertebrate community. The communities at all of the Indian Creek tributary stations were limited by the lack of surface flow. The downstream station on Salmon Run (RM 0.1) had sufficient flow to maintain surface water through the riffles and was supporting a community consistent with WWH expectations.

Table 11 Macroinvertebrate Sampling Results

Stream RM	Dr. Area (Sq. mi.)	Data Codes	Qual. Taxa	EPT QI/Total	Sensitive Taxa QI./Total	Density QI.Qt.	CW Taxa	Predominant Organisms on the Natural substrates With Tolerance Category(ies) in Parentheses	ICI[a]	Narrative Evaluation
Indian Creek										
23.9	39	-	54	18	22	M	0	Caddisflies (MI,F), midges (MI,F)	-	Very Good
17.8	53	15	69	22/25	25/32	M/462	0	Rheotanytarsus midges, Helicopsyche caddisflies (MI)	48	
9.7	82	5,15	43	15/19	19/27	M/422	0	Hydropsychid caddisflies (F,MI), Rheotanytarsus midges (MI)	52	
6.9	95	15	38	13/17	14/23	H/199	0	Caddisflies (MI,F), Isonychia mayflies (MI)	44	
6.4	98	15	48	15/16	16/22	H/1103	0	Caddisflies (MI,F), mayflies (MI,F), Petrophila moth larvae (MI)	40	
4.3	102	-	48	18	18	M-H	0	Hydropsychid caddisflies (MI,F)	-	Good
Little Indian Creek										
0.1	5.6	9	25	5	7	-	0	Heptageniid mayflies (F)	-	Fair
Reserve Run										
0.3	4.5	9	22	3	2	L-M	0	Beetles (F), heptageniid mayflies (F)	-	Low Fair

Salmon Run										
1.9	1.4	9	14	2	5	L	1	Midges (F,MI)	-	Poor
0.1	4.8	-	40	14	14	M	0	Caddisflies (MI,F)	-	Good
Lick Run										
0.9	4.7	9	25	7	6	L-M	0	Heptageniid mayflies (F), aquatic sow bugs (F)	-	Fair

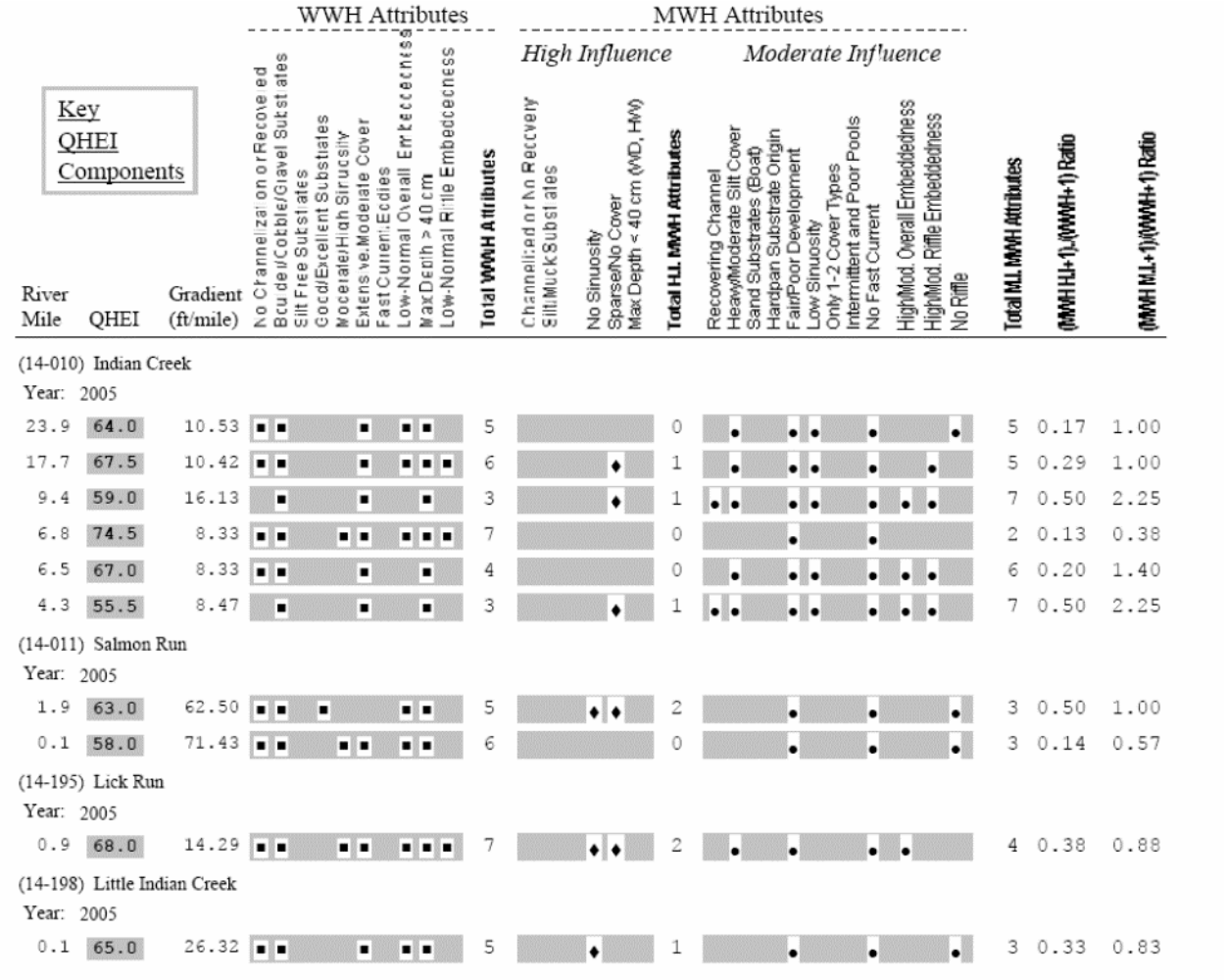
Source: OEPA. 2008
RM: River Mile.
Dr. Ar.: Drainage Area
Data Codes: 5=3 HD Only, 9=Intermittent or Near-Intermittent Conditions, 15=Current >0.0 fps but <0.3 fps.
Ql.: Qualitative sample collected from the natural substrates.
Sensitive Taxa: Taxa listed on the Ohio EPA Macroinvertebrate Taxa List as MI (moderately intolerant) or I (intolerant).
Qt.: Quantitative sample collected on Hester-Dendy artificial substrates, density is expressed in organisms per square foot.
Qualitative sample relative density: L=Low, M=Moderate, H=High.
CW: Coolwater/Coldwater.
Tolerance Categories: VT=Very Tolerant, T=Tolerant, MT=Moderately Tolerant, F=Facultative, MI=Moderately Intolerant, I=Intolerant
ICI values in parentheses are invalidated due to insufficient current speed over the artificial substrates. The station evaluation is based on the qualitative sample narrative evaluation.

2.2.3. Physical Habitat - Qualitative Habitat Evaluation Index QHEI

OEPA assessed the habitat characteristics through the Qualitative Habitat Evaluation Index (QHEI), which provides an understanding of existing habitat features important to fish communities and is based upon methodologies established by Rankin's habitat assessments (Rankin 1989, Rankin 1995, OEPA 2006). During this evaluation, several habitat characteristics were assessed on the stream reach, such as type/quality of substrate, amount/quality of in-stream vegetative cover, channel morphology, extent/quality of riparian vegetation, pool/run/riffle quality, etc. Mean QHEI values from rivers or river segments equal to or greater than 60.0 generally indicate a level of macrohabitat quality sufficient to support an assemblage of aquatic organisms fully consistent with the WWH aquatic life use designation. Average reach values at greater than 75.0 are generally considered adequate to support fully exceptional (EWH) communities (Rankin 1989 and Rankin 1995). Values between 55 and 45 indicate limiting components of physical habitat are present and may exert a negative influence upon ambient biological performance. However, due to the potential for compensatory stream features (e.g., strong ground water influence) or other watershed variables, QHEI scores within this range do not necessarily exclude WWH or even EWH assemblages. Values below 45 indicate a higher probability of habitat derived aquatic life use impairment. In the 2008 OEPA report, it was noted that substrate embeddedness and riparian encroachment were the most observed deficient habitat features on Indian Creek (Table 12). QHEI scores below 60 where were observed at RMs 9.4 and 4.3, yielding QHEI scores of 59.0 and 55.5, respectively. However, it was also noted that the magnitude and severity of these deficiencies did not appear sufficient to significantly limit biological performance. The report concluded that excluding the lower two miles, which were evidently dewatered, naturally or otherwise, aquatic life use impairment derived solely from deficient, degraded, or otherwise substandard macrohabitat was not anticipated for Indian Creek, and habitat quality appeared adequate to support and maintain WWH communities.

Surface flow of both Salmon Run and Little Indian Creek were found to be ephemeral in 2005. These two streams were reduced to residual pools, separated by substantial lengths of dry stream bed. The discontinuous surface flow observed did not appear to represent a significant impediment to the maintenance of healthy and intact headwater fish assemblages.

Table 12 QHEI Matrix and Scores



Source: OEPA, 2008

2.2.4. Water Quality

Chemistry grab samples and field measurements were collected at sixteen sites in the Indian Creek and its tributaries in 2005 (Tab. 13). Six sites were also sampled for organic compounds; bacteria samples (fecal coliform and *E. coli*) were collected at five sites; Datasonde® continuous monitors were deployed at the eight Indian Creek mainstem sites. Key results from these analyses are summarized in this section.

Water chemistry results which exceeded the Ohio Water Quality Standards (WQS) criteria were largely attributed to either low dissolved oxygen (D.O.) or bacteria. Iron exceedances of the agricultural water supply criteria were also recorded from RM 9.4 to the confluence with the Great Miami River. One ammonia-N value exceeded the WQS at the tributary to Salmon Run at RM 1.40, downstream of the Island Lake MHP wastewater facility. Fecal coliform levels were highest near the Indiana border site, suggesting Indiana as a possible contributor of pollutants to the watershed. Indiana has two wastewater facilities in the watershed: West College Corner

WWTP and Indian Hills MHP. Both facilities experienced numeric permit violations of ammonia during the 2005 survey year. Sixty-eight in-stream measurements for D.O. were taken in the mainstem and tributary sites. Twenty-six percent of readings fell below WQS minimums for their respective Aquatic Life Use and only one percent of those was recorded in the mainstem. Two mainstem sites, RM 23.95 and 6.50 (near the Indiana state line and downstream Queen Acres wastewater treatment plant respectively) had the most frequent readings below D.O. water quality standards.

Nutrient data showed that ammonia-N was most elevated in the Indian Creek mainstem near the Indiana border and downstream from the confluence of point source dischargers. Ammonia-N results did not exceed WQS standards. The highest nitrate-nitrite-N levels were recorded at all mainstem sites on the same day in 2005. Suspended solids were elevated from background conditions at RM 9.40 to downstream of Queen Acres WWTP. Phosphorus concentrations followed the same pattern as ammonia relative to stream flow. The median phosphorus level increased to above the target value downstream from the Queen Acres WWTP.

Phosphorus values remained below the target value in all the tributary sites except for elevated values in the Tributary to Salmon Run at RM 1.4 which is located immediately downstream from the Island lake MHP WWTP and Lick Run at RM 0.90, which is located about three miles downstream from the Layhigh Estates MHP WWTP. Little Indian Creek consistently had the lowest phosphorus values of all the tributaries.

The Indian Creek tributaries of Salmon Run, Beals Run, and Lick Run incurred most of the in-field dissolved oxygen WQS exceedances, with values frequently falling below WWH standards. Most of these values were connected to either interstitial or turbid flow regimes. Metals did not appear in concentrations above state water quality standards in the tributaries. Organic compounds appeared above detection limits in both tributaries - Reserve Run and Little Indian Creek, possibly either through air deposition or via unknown discharges. Reserve Run showed the greatest occurrence of organics, particularly phthalates (used in plasticizers) and the widely used herbicide atrazine.

Bacteriological data were collected from Indian Creek and tributaries in 2005. Data were collected during the recreational season (May 1 through October15) and compared to the Primary Contact Recreation use (PCR) water quality criteria in WQS to determine attainment. The results concluded that even though as the whole watershed obtained full attainment of the PCR use, 28 % of the *E. coli* samples had counts above the PCR maximum criterion. The data suggested direct access of livestock to the stream, failing onsite home sewage treatment systems, and point source human waste disposal maybe the source of this impairment.

More recent sampling of WWTP and HSTS are discussed in Chapters 1.2 and 2.1.

Table 13 2005 Water Quality Exceedances

Stream River Mile (use designation[3])	**Parameter (value)**
Indian Creek (SRW, EWH, AWS, IWS, PCR)	
23.95	Dissolved oxygen (4.89‡‡, 5.29‡‡)
17.68	Fecal coliform b (1200", 1400") *E. coli* b (200", 210", 150", 860"", 1200"")
9.4	Iron-T (88604)
6.8	*E. coli* b (180", 220, 270", 340"") Iron-T (50404, 13,8004) Lead-T (11.5*)
6.5	*E. coli* b (210", 300""370"" 440"") Dissolved oxygen (5.60‡) Iron-T (144004) Lead-T (11.6*)
4.3	Iron-T (68404, 201004) Copper-T (17*)
1.66	Iron-T (108004, 142004)
0.1	Iron-T (112004)
Little Indian Creek (undesignated[a])	
0.09	Dissolved oxygen (2.81‡‡, 3.50‡‡)
Reserve Run (undesignated[a])	
0.25	Dissolved oxygen (3.37‡‡ 4.0‡‡)
Salmon Run (SRW, EWH, AWS, IWS, PCR)	
1.9	Dissolved oxygen (1.5 ‡‡, 4.0‡‡, 4.4‡‡)
0.1	*E. coli* b (280", 420"") Dissolved oxygen (2.81‡, 5.60‡‡)
Trib to Salmon (undesignated[a])	
1.4	Ammonia-N (0.334*)
0.1	Dissolved oxygen (4.9‡‡)
Lick Run (undesignated[a])	
0.9	Dissolved oxygen (3.0‡‡, 4.9‡‡)
Beals Run (undesignated[a])	
0.1	Dissolved oxygen (1.57‡‡, 3.1‡‡, 3.3‡‡)

Source: OEPA 2008

[a] Use Designations: SRW - State Resource Water
Aquatic Life Habitat - EWH - Exceptional warmwater habitat; WWH - Warmwater habitat; (WWH criteria apply to "undesignated" surface waters)
Water Supply - IWS - industrial water supply; AWS - agricultural water supply
Recreation PCR – primary contact

[b] Bacteriological data (Fecal coliform, E. coli) is applied to estimate the potential for human health

impacts to receiving waters.
** exceedance of numerical criteria for prevention of chronic toxicity (CAC).*
4 exceedance of agricultural water supply criterion.
‡ value is below the below the EWH minimum 24-hour average D.O. criterion (6.0 mg/l) or value is below the WWH minimum 24-hour average D.O. criterion (5.0 mg/l) or value is below the MWH minimum 24-hour average D.O. criterion (4.0 mg/l) as applicable.
‡‡ value is below the EWH minimum at any time D.O. criterion (6.0 mg/l) or value is below the EWH minimum at any time D.O. criterion (5.0 mg/l) or value is below the WWH minimum at any time D.O. criterion (4.0 mg/l) or value is below the MWH minimum at any time D.O. criterion (3.0 mg/l) as applicable.
" value is above the average PCR criteria (fecal coliform 1000/100ml; E. coli 126/100ml)
"" value is above the maximum PCR criteria (fecal coliform 2000/100ml; E. coli 298/100ml) or value is above the maximum SCR criteria (fecal coliform 5000/100ml; E. coli 576/100ml) as applicable

2.3. Summary of TMDL

A Total Maximum Daily Load implementation plan (TMDL) has not been prepared for the BR-IC watershed and the TMDL was listed as not needed by the OEPA. The BR-IC aquatic life beneficial use was determined to be WWH and the watershed is listed as one of Ohio's impaired waters. The attainment status for the Indian Creek mainstem is full attainment but two partial attainment and one non-attainment for the tributaries were reported. The causes for the partial and non-attainment were determined to be natural and associated with low flow. High levels of bacteria (*E. coli*) were detected when evaluating for recreational use and the results determined the impaired recreational use status. The watershed is also identified as impaired under human health fish consumption due to PCBs in fish tissue. However, there have not been any published data or reports regarding PCBs for this watershed.

To address the recreational use impairment due to the presence of *E. coli*, a loading analysis plan (LAP) – multi-watershed bacteria TMDL is being prepared by OEPA. BR-IC watershed is included in this TMDL document. The multi-watershed bacteria TMDL LAP project will provide actions (sampling, analyses, regulatory review) to be taken to address the impairment for the selected watersheds (OEPA, 2020). Information will be updated in a future version of this NPS-IS when it becomes available.

2.4. Summary of Pollution Causes and Sources

As stated in the Biological and Water Quality Study of Fourmile Creek, Indian Creek, and Select Tributaries, 2005 (OEPA, 2008), all the stream sampling locations within the BR-IC watershed were able to support an assemblage of aquatic organisms consistent with WWH. A number of non- and partial non-attainments were determined at the tributaries. The OEPA concluded that these biological impairments were caused by natural conditions associated with the low stream flow during a dry summer season when the biological assessment was conducted. The water quality data collected in 2005 showed multiple sampling locations within the BR-IC watershed, where some parameters had elevated concentrations or exceeded the Ohio WQS (Tab. 13). These parameters included dissolved oxygen, bacteria, iron, lead and ammonia-N, which may also be the potential causes of watershed impairment. In addition, the OEPA listed PCBs as a cause of watershed impairment for human health, and bacteria (*E. coli*) as a cause of recreational impairment. The potential sources of all of these impairments may include natural sources, row crop agriculture, stream bank erosion, sedimentation, cattle access to the streams, residential runoff, failing onsite home sewage treatment systems and point discharges from wastewater treatment facilities. Furthermore, row crop agriculture has been determined to be

one of the main sources of excessive nutrient loads, and siltation/sedimentation in rural watersheds, and a major contributor to Gulf of Mexico hypoxia. The OEPA identified the BR-IC HUC 12 as one of the priority watersheds to address these pollution sources and support the Hypoxia Task Force effort to reduce nutrients entering the Gulf of Mexico by 20% by the year 2025. Additionally, increasing development pressure and impervious cover, especially in the riparian corridors may be the source of habitat impairment, nutrient enrichment from wastewater, and drainage and storage capacity impairments.

The OEPA provided nutrient load baseline estimates and reduction goals from agricultural lands/activities and urban development within the BR-IC watershed (Tab. 14). No detailed baseline estimates and reduction goals were provided for the nutrient loads from the HSTS. This version of the NPS-IS for BR-IC HUC 12 will be focusing on reducing agricultural nutrient loads. Once more information is available for the HSTS loading, the next version of the plan will updated.

Table 14 Estimated Nutrient Loadings from Contributing NPS Sources in BR-IC HUC 12

	Agricultural Load (lbs/acre)	Developed/Urban Load (lbs/acre)
Current Estimates*	350,000	17,000
Target Estimates*	70,000	3,300

Estimate provided by Rick Wilson, OEPA in November 2020.

2.5. Additional Information for Determining Critical Areas and Developing Implementation Strategies

2.5.1. Agricultural Conservation Planning Framework

The Agricultural Conservation Planning Framework (ACPF) is an agricultural watershed management tool using high-resolution spatial data and ArcGIS to identify opportunities for installing conservation practices within a watershed (Tomer et al., 2013). Developed by the US Department of Agriculture, the ACPF is being used in hundreds of watersheds to inform and engage local communities in agricultural conservation. The program spatially combines high resolution terrain, drainage, soils, land use and crop land data, and identifies and prioritizes potential areas for conservation (ARS, 2019). ACPF can engage stakeholders in the watershed planning process by proposing conservation solutions. The program is not prescriptive but provides various options and scenarios that can be evaluated at watershed and farm levels including in fields, below fields and in riparian zones (Tomer et al., 2013). The following ACPF conservation practices -- both for in fields and below fields -- and riparian buffers are found applicable in our region:

Grassed Waterway – NRCS Practice code 412
Buffer Contour Strip – NRCS Practice code 332
Nutrient Removal Wetlands – NRCS Practice code 658
Water and Sediment Control Basin (WASCOB) – NRCS Practice code 638
Riparian Buffer – NRCS Practice code 391
Streambank Stabilization – NRCS Practice code 580

The ACPF riparian assessment (riparian buffer and streambank stabilization) utilizes a matrix of two variables: the width of the riparian zone and runoff delivery. The output further provides specific riparian design types based on the cross-classification matrix which include critical zones for sensitive sites, multi-species buffer for water uptake, nutrient and sediment trapping, stiff-stemmed grasses for trapping runoff and sediment, deep-rooted vegetation tolerant of saturated soil, and sections emphasizing streambank stability because of the narrow buffer width. The purpose of this riparian management assessment is to provide the most water quality benefits by identifying segments to install permanent vegetation specifically designed to intercept surface runoff, protect shallow groundwater in low-lying areas and stabilize stream banks. This is especially applicable in this watershed since the riparian zone is steep (Figure 5) and many bare and exposed banks are the source of streambank erosion and siltation/sedimentation.

2.5.2. ACPF modeling for Beals Run-Indian Creek HUC 12

The ACPF model was performed for the BR-IC HUC 12 using a 2.5 ft LIDAR DEM from Ohio Geographically Referenced Information Program (OGRIP), 5 ft LIDAR DEM from OpenTopography High-Resolution Topography Data and Tools Datasets and a file geodatabase provided by ARS (USDA, 2020). The tool was run using cropland data layers representing the years 2010 through 2019.

The ACPF model identified a number of possible in field conservations practices, below field practices and also riparian zone designs in the BR-IC HUC 12. At the BR-IC HUC 12, 11.5% of the fields are considered high and very high runoff risks and 86% of the watershed is agricultural fields as determined by the ACPF.

Outputs from the ACPF model were presented and discussed with the stake holders at the NPS-IS public meeting on February 23, 2021 as well as during follow-up field visits and ground verification at selected locations. The output has been beneficial in engaging discussions with landowners about potential conservation practices. The ACPF maps provide a visual tool for the landowners, making field visits and discussions more effective and efficient.

Table 15 Conservation Practices at BR-IC HUC 12 Suggested by the ACPF

The ACPF Maps end estimates are only for planning purposes

	Unit	Length	Area
In fields Practices (Figure 16)			
Grassed Waterways	489 Segments	44 Miles	81 Acres*
Contoured Buffer Strips	563 Strips	61 Miles	110 Acres**
Below Fields (Figure 17)			
Nutrient Removal Wetlands	8 Wetlands	NA	15 Acres
WASCOBs	249 Basins	NA	2,343 Acres***
Riparian Zone (Figure 18)			
Streambank Stabilization	NA	199 Miles	NA
Riparian Buffers (various plants)	NA	159 Miles	NA

**Assuming 30 feet wide*
***Assuming 15 feet wide*
****Contributing area*
NA – Not applicable

Note: All measurements are rounded up to the nearest number.

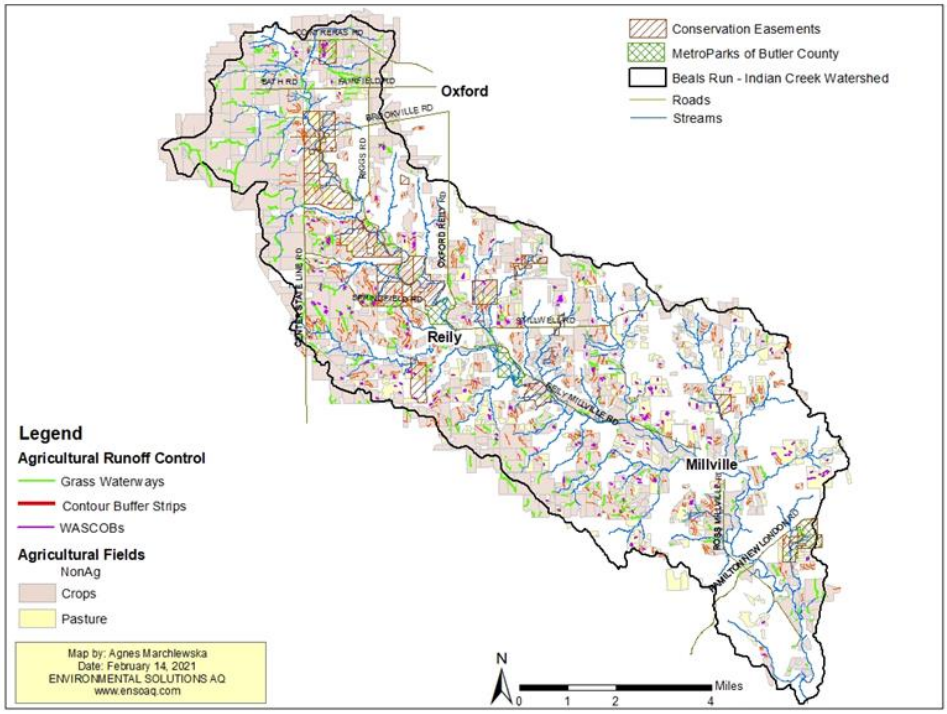


Figure 16 ACPF In-Field Agricultural Conservation Practice Opportunities in BR-IC HUC 12

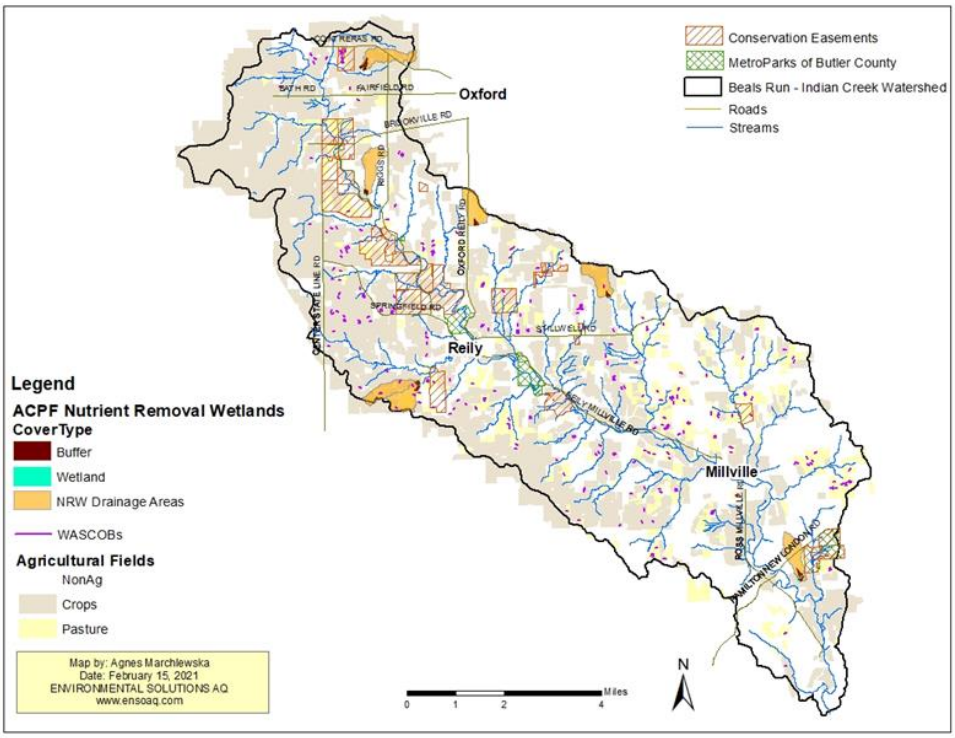


Figure 17 ACPF Below-Field Agricultural Conservation Practice Opportunities in BR-IC HUC 12

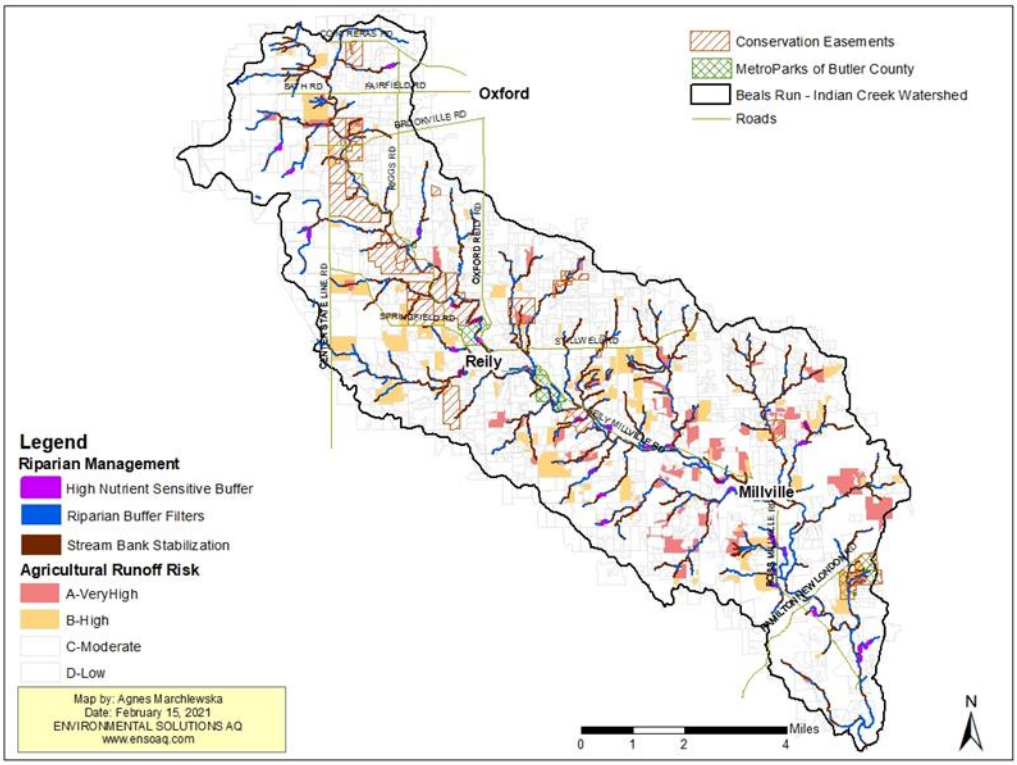


Figure 18 Riparian Function Management Suggested by ACPF IN BR-IC HUC 12

2.5.3. Citizen Science

Over the last few years, several locations within the BR-IC watershed have been sampled for water quality data by the Butler County Stream Team. The initiative is a part of a citizen science project involving a group of Butler County volunteers led by the Institute for the Environment and Sustainability at Miami University in collaboration with the Butler County Storm Water District and the Butler SWCD. The Stream Team has collected and analyzed water samples for nitrates, total phosphorous, bacteria, conductivity, total dissolved solids, pH, turbidity. However, this data has not been approved for accuracy, and therefore, it is not included in this plan. Once the data is verified, it will be added in the future version of the plan.

Chapter 3: Conditions & Restoration Strategies for Beals Run-Indian Creek HUC-12 Critical Areas

3.1 Overview of Critical Areas

In 2005, Indian Creek and its main tributaries were a part of a biological and water quality assessment completed by the Ohio EPA (OEPA, 2008). Of the 18 sampling locations located within the BR-IC HUC 12, 11 were evaluated for the biological indicators and 16 were analyzed for water quality. All sampling locations within the BR-IC watershed supported WWH aquatic communities. Every sampling location along the Indian Creek mainstream was in full attainment for Aquatic Life Use (ALU). The Indian Creek tributaries had one sampling location in full attainment (Salmon Run RM 0.1), two in partial attainment (Little Indian Creek RM 0.1 and Lick Run RM 09) and one designated as in non-attainment (Salmon Run RM 1.9). The Ohio EPA identified the natural cause of interstitial stream flow as a cause of the biological impairment of the Indian Creek tributaries. In addition, multiple sampling locations showed elevated concentrations or exceeded WQS for dissolved oxygen, bacteria, iron, lead, ammonia-N and PCBs. Currently, BR-IC HUC 12 is listed as impaired waters for recreation due to *E. Coli* and for human health due to PCBs found in the fish tissue. Sources for these impairments may include row crop agriculture, manure application/runoff, cattle access to the creeks, streambank and top soil erosion and urban runoff from unsewered communities. Furthermore, increasing development pressure and resulting impervious surface cover threaten high quality habitats within the watershed, including riparian areas and wetlands. Implementing and maximizing conservation and land management practices within this watershed are crucial in maintaining high quality and environmentally sensitive habitats and improving health of the near-field and far-field waterways.

Three critical areas have been identified within the BR-IC HUC 12 (Fig. 19). Critical Area 1 will address the far-field (Gulf of Mexico) and near-field (local waterways) effects of nutrient enrichment, siltation and sedimentation from agricultural fields and activities. Critical Area 2 will focus on improving the riparian function of Indian Creek and its main tributaries. Lastly, Critical Area 3 will concentrate on protecting environmentally sensitive areas and habitats from increasing development and impervious surface cover (Tab. 16). The critical areas may be updated or additional critical areas may be identified in subsequent versions of this NPS-IS.

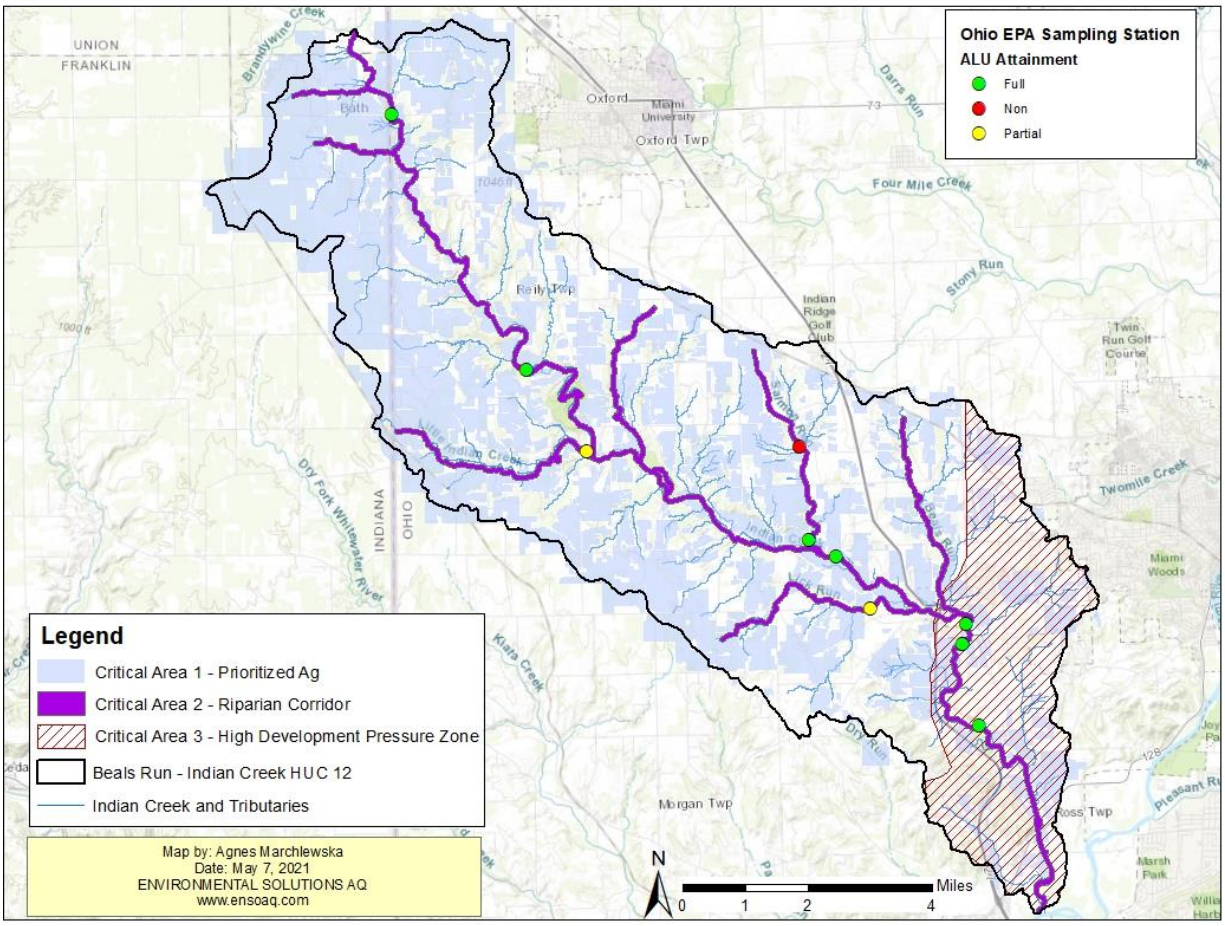


Figure 19 BR-IC HUC 12 Critical Areas Overview

Table 16 Critical Areas of BR-IC HUC 12

Critical Area	Critical Area Description	Addressed Impairments	Area (Acres)
1	Agricultural fields as determined by ACPF	Nutrient Management in Prioritized Agricultural Lands *(Near-Field and Far-Field Impairment – Gulf of Mexico hypoxia – N and P Reduction))*	26,122
2	Riparian Corridor (100 ft buffer at each stream side)	Maintain or improve high quality habitats scores in IBI, ICI, QHEI and stream health by reducing nutrients and siltation/sedimentation *(Near-Field and Far-Field Impairment – Gulf of Mexico Hypoxia*)	2,336

3	High Development Pressure Zone	Maintain high quality habitats scores (IBI, ICI, QHEI and improve stream health by limiting impervious cover *(Near Field Impairment)*	8,244

3.2. Critical Area 1: Conditions, Goals, & Objectives for Nutrient Reduction and Management in Beals Run-Indian Creek HUC-12 Agricultural Fields

3.2.1. Detailed Characterization

The Great Miami River basin in Ohio is one of the major nutrient contributors to the Gulf of Mexico according to the Ohio's Nutrient Mass Balance Study for Ohio's Major Rivers 2020 (OEPA, 2020). In the past 7 years between 2013 to 2019, there has been no reduction or change in the loadings for total phosphorus (P) or total nitrogen (N) and the data demonstrated that nonpoint source is the largest proportion of the total P and total N load in the Great Miami River at 66 and 83 percent, respectively (OEPA, 2020). As of May 2021, there has not been any Nine-Element NPS-IS approved for any HUC 12 within the Great Miami River watershed. An approved Nine-Element NPS-IS Plan is a prerequisite for implementation grant applications such as for Federal Section 319 grant.

Given the dominance of agricultural land use throughout the Great Miami River basin, including the BR-IC HUC 12, use of BMPs targeting nutrient loss from local farm fields and agricultural activities is recommended. In addition, employment of BMPs may help to reduce siltation and sedimentation in local streams. Although BMPs are encouraged on all agricultural lands, certain lands are more susceptible to nutrient loss and erosion than others are; and therefore, they need to be prioritized for BMP implementation.

Critical Area # 1 is comprised of all agricultural lands throughout the BR-IC HUC 12 as determined by the ACPF model and prioritized based on the criteria set by the local stakeholders (Fig. 20). The ACPF model was used to identify 210 high runoff fields covering 4,713 acres of the agricultural land (18%) within the BR-IC watershed. Seventy-four percent of these immediately adjoin local waterways. The modeling results aided in building objectives for this critical area and informed the prioritization of the agricultural lands and projects.

Based on stakeholders' input, the prioritized areas and potential projects should meet at least one of the following criteria:

- Lands identified as high runoff fields;
- Lands directly adjacent to Indian Creek or its tributaries;
- Lands experiencing gully erosion;
- Lands currently under conventional tillage regimes and/or underutilizing cover crops;
- Lands without current nutrient management plan or current soil test results (< 3 years).

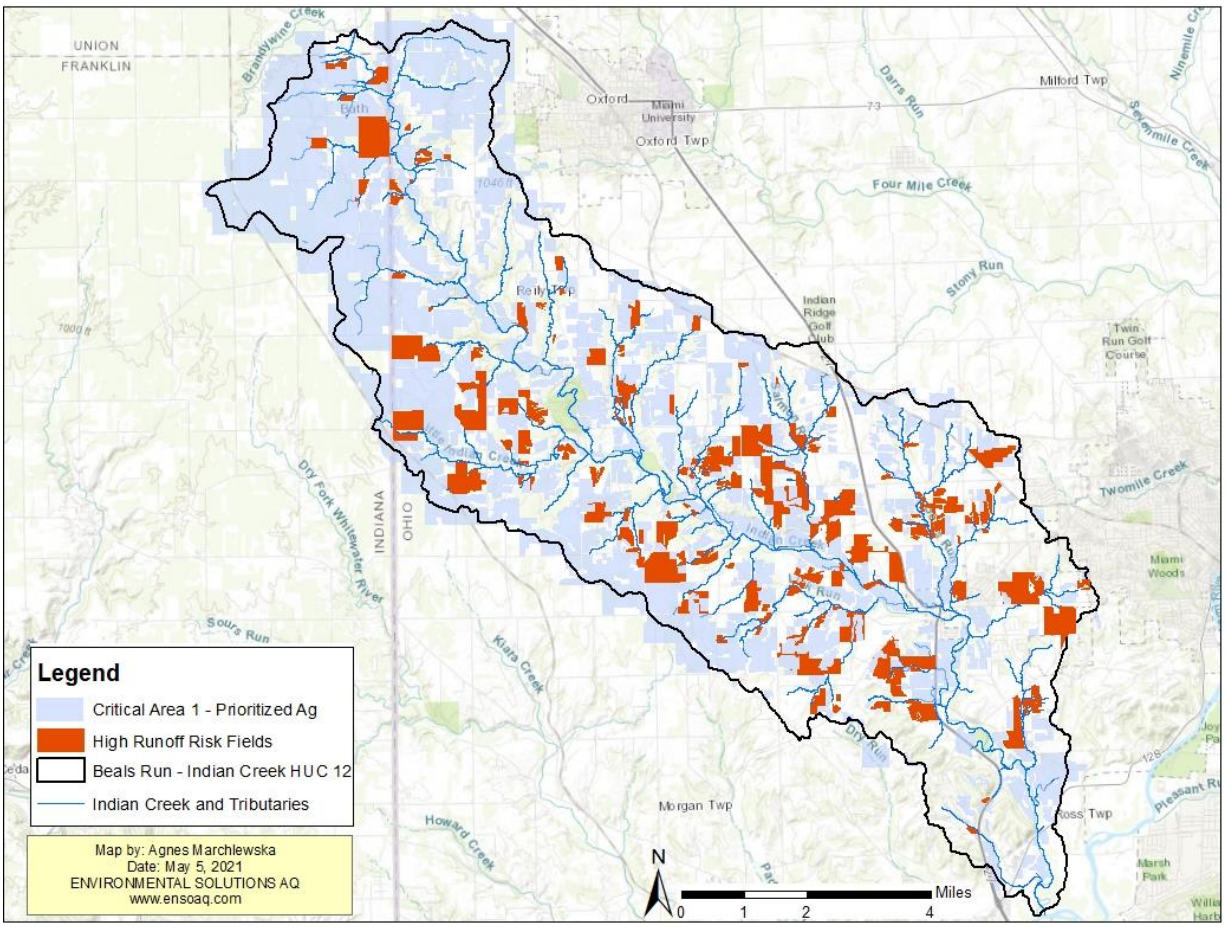


Figure 20 BR-IC HUC 12 Critical Area #1

3.2.2. Detailed Biological Conditions

Fish community assessment conducted by Ohio EPA in 2005 at ten sampling locations within the BR- IC HUC 12 is summarized in Tab. 17. Both the Indian Creek mainstem and its tributaries supported fish assemblages consistent with WWH. The biological indicators for six sampling locations along twenty-two miles of Indian Creek mainstream ranged between exceptional (IBI = 54/MIwb = 10.8) and marginally good/exceptional (IBI = 38ns/MIwb = 9.7). The fish community at each Indian Creek sampling location was in attainment and met the WWH WQS for IBI and MIwb (goal for wading sampling: IBI = 40 and MIwb = 8.3). In addition, four sampling locations were distributed among three Indian Creek tributaries to evaluate the fish communities along four linear stream miles. The biological indicators for these waters ranged from exceptional (IBI = 52) to good (IBI = 44) and collectively were characterized as exceptional. All four sampling locations met the WWH WQS for the IBI (minimum IBI = 40 for headwater sampling) and were in attainment.

In 2005, the Ohio EPA also evaluated the physical stream features and riparian conditions within the BR-IC watershed (Tab. 18). The QHEI values of Indian Creek mainstream ranged between 55.5 and 74.5 with a mean score of 64.6. The Indian Creek tributaries had QHEI values ranging between 68.0 and 58.0 with a mean score of 63.5. Seven sampling locations within the BR-IC HUC 12 had QHEI scores above 60, which generally indicates a level of macrohabitat quality sufficient to support aquatic communities consistent with WWH. Two Indian Creek stations (RM 9.4^{W} and RM 4.3^{W}) and one station on Salmon Run (RM 0.1^{H}) showed the QHEI scores slightly below 60. The most common habitat deficiencies observed within this watershed were associated with substrate embeddedness and riparian encroachment but they were not significant.

Table 17 Fish Community and Habitat Data

RM	QHEI	Drainage Area (mi²)	Mean # of Species	Predominant species (% of catch)*	Mean MIwb	IBI	Narratives
Indian Creek							
23.9[W]	64	39.0	29	Central stoneroller (31.1%), bluntnose minnow (23.8%), sand shiner (12.2%), striped shiner (6.17%), greenside darter (3.1%), and northern hog sucker (2.3%)	9.7	38[ns]	M. Good/ Exceptional
17.7[W]	67.5	53.0	27		10.4	48	V. Good/ Exceptional
9.4[W]	59	82.0	26		10.3	54	Exceptional
6.8[W]	74.5	95.0	33		10.4	48	V. Good/ Exceptional
6.5[W]	67.0	98.0	24		10.3	46	V. Good/ Exceptional
4.3[W]	55.5	102.0	27		10.8	42	Good/Exceptional
Little Indian Creek							
0.1[H]	65.0	5.6	17		NA	52	Exceptional
Salmon Run							
1.9[H]	63.0	1.4	10		NA	44	Good
0.1[H]	58.0	4.8	24		NA	52	Exceptional
Lick Run							
0.9[H]	68.0	4.7	18		NA	50	Exceptional

**Only aggregate sampling results from the Indian Creek mainstream were reported (OEPA, 2008)*
QHEI Qualitative Habitat Evaluation Index
MIwb Modified Index of Well Being
IBI Index of Biotic Integrity
H Headwater sample (Drainage Area ≤ 20 mi²)
W Wading sample (Drainage Area > 20 mi² ≤ 500 mi²)
ns not significant departure from the biocriteria (<4 IBI units)
N/A Not applicable (MIwb only applies to drainage areas > 20mile²)

Macroinvertebrate community performance within the BR-IC watershed was evaluated by Ohio EPA in 2005 (Tab.18). Of 11 sampling sites selected for the macroinvertebrate evaluation, 6 were located along Indian Creek mainstem and 5 were distributed in Indian Creek tributaries. The condition of macroinvertebrates in Indian Creek mainstem ranged from good to exceptional and met the WWH WQS (minimum ICI = 36). The dominant taxa at the Indian Creek most upstream site included caddisflies and midges, whereas the most downstream site was dominated by Hydropsychid caddisflies. The sampling site at RM 6.4 located just downstream from the Queen Acres WWTP showed a significant increase in community density compared to the sampling site at RM 6.9. The increased abundances of facultative filterers identified at this site indicated nutrient enrichment, likely from the Queen Acres WWTP discharge.

The conditions of macroinvertebrate communities in the Indian Creek tributaries ranged from poor to good, and were strongly limited by the lack of surface flow. Only a sampling station on Salmon Run (RM 0.1) had sufficient surface water flow in the riffles to support the WWH macroinvertebrate community.

Table 18 Macroinvertebrate Community

RM	Dr. Area (Sq. mi.)	Density Ql./Qt.	Predominant Organisms on the Natural Substrates with Tolerance Category(ies) in Parentheses	ICI	Narrative Evaluation
Indian Creek					
23.9[W]	39	Moderate	Caddisflies (MI, F), midges (MI, F)	-	Very Good
17.8[W]	53	Moderate	Rheotanytarsus midgets, Helicopsyche caddisflies (MI)	48	
9.7[W]	82	Moderate	Hydropsychid caddisflies (F, MI), Rhotanytarsus midges (MI)	52	
6.9[W]	95	High	Caddisflies (MI, F), Isonychia mayflies (MI)	44	
6.4[W]	98	High	Caddisflies (MI, F) mayflies (MI. F), Petrophila moth larvae (MI)	40	
4.3[W]	102	Moderate - High	Hydropsychid caddisflies (MI, F)	-	Good
Little Indian Creek					
0.1[H]	5.6	-	Heptageniid mayflies	-	Fair
Reserve Run					
0.3[H]	4.5	Low-Moderate	Beetles (F), heptageniid mayflies	-	Low Fair

Salmon Run					
1.9[H]	1.4	Low	Midges (F, MI)	-	Poor
0.1[H]	4.8	Moderate	Caddisflies (MI, F)	-	Good
Lick Run					
0.9[H]	4.7	Low - Moderate	Heptageniid mayflies (F), aquatic sow bugs (F)		Fair

Source: OEPA, 2005
RM - River Mile
W - Wading Sample (Drainage Area > 20 mi^2 ≤ 500 mi^2)
H - Headwater Sample (Drainage Area ≤ 20 mi^2)
Ql.: Qualitative sample collected from the natural substrates.
Qt.: Quantitative sample collected on Hester-Dendy artificial substrates, density is expressed in organisms per square foot.
Tolerance Categories: VT=Very Tolerant, T=Tolerant, MT=Moderately Tolerant, F=Facultative, MI=Moderately Intolerant, I=Intolerant.
ICI - Invertebrate Community Index
No data available

In 2005, Ohio EPA also collected water quality data from Indian Creek and its selected tributaries. The nutrient data showed the most elevated ammonia-N values between RM 23.9 near the Indiana boarder and RM 6.5 south of Millville. However, none of the ammonia-N values exceeded WQS. Phosphorus concentrations followed the same pattern as ammonia relative to the stream flow. The elevated phosphorous values were mostly detected downstream from the point source discharges, including Queen Acres WWTP, the Island Lake MHP WWTP and the Layhigh Estates MHP WWTP.

3.2.3. Detailed Causes and Associated Sources

The 2005 Ohio EPA survey demonstrated that the Indian Creek mainstem was in full attainment. Two partial and one non-attainment status were assigned to three sampling locations from Indian Creek tributaries (Little Indian Creek RM 0.1, Lick Run RM 0.9 and Salmon Run 1.9). The ALU impairment status of the Indian Creek tributaries was due to underperforming macroinvertebrate communities caused by lack of surface flow in the streams when the sampling was conducted. Protecting and maintaining health of the stre ams within this watershed is critical for sustaining and improving its aquatic biodiversity, therefore, nutrient management is necessary.

Agricultural land use and activities in the Great Miami River basin along with discharges from wastewater treatment facilities and failing septic systems have been found a leading cause of nutrient enrichment in local streams and rivers. Also, these excessive nutrient loads ultimately contribute to Gulf of Mexico hypoxia. Practical and property-specific BMPs can help reduce the amount and concentration of nutrient-laden surface runoff. These BMPs can also address the loss of sediment /topsoil from agricultural lands and retain and maximize the nutrients in the fields. In addition, the implementation of BMPs on agricultural lands can address the causes of sediment/topsoil and nutrient loss in the fields and reduce the sources of this excess nutrient and sediment into the waterways.

3.2.4. Outline Goals and Objectives for the Critical Area

The primary purpose of NPS-IS is to improve water quality, meet nutrient reduction goals and remove impairment status for the waterbodies. Cropland activities in Critical Area #1 contribute to far-field impairment through excessive nutrient loss to local waterways that flow to the Great Miami River and ultimately add to Gulf of Mexico hypoxia. To address this impairment, the nutrient reduction goal for the agricultural watersheds within the Great Miami River basin, including the BR-IC HUC 12 is set at levels 20% of the current estimated agricultural loadings (Rick Wilson, OEPA, personal communication). To achieve the nutrient loading goals at the BR-IC HUC 12, the following goal and objectives have been established:

Goal 1 – Reduce nitrogen loading contributions in Critical Area 1 by 20%. Current total nitrogen load for the agricultural lands is estimated to be 350,000 lb and the reduction goal is 70,000 lb.

NOT ACHIEVED: Based on the Spreadsheet Tool for Estimating Pollutant Loads (STEPL) calculation using the combined current and recent past conservation practices, the load reduction is currently 56,771 lb/yr (see page 23 for practices and estimated loads). We will need an additional 13,229 lb/yr to meet the reduction goal. Future target load reductions may also include phosphate when appropriate baselines are provided by OEPA.

OBJECTIVES

In order to reach the load reduction goal of 20% within the BR-IC HUC 12, effort will include implementing a variety of appropriate BMPs within Critical Area 1. However, the effort must also balance resources and willing landowners. With the ACPF output, a number of in-field and below-field practices are identified that are applicable in this region (Tab. 19).

Objective 1: Implement 1000 acres of conservation tillage to add to the current 9,914 acres and plant 2000 acres of cover crops in addition to the 537 acres that have already been planted.

Objective 2: Implement nutrient management planning (plan development, soil testing and variable rate fertilization) on at least 1000 additional acres.

Objective 3: Reduce erosion and nutrient loss through the installation of grassed waterways and filter strips on at least 160 acres at locations suggested by the ACPF model.

Objective 4: Reduce nutrient loss from subsurface tile drainage or below-field practices through the installation of drainage water management structures such as WASCOBs and nutrient removal wetlands on at least 90 acres at locations suggested by the ACPF model.

Objective 5: Protect at least 1300 acres of farmland; including flooded cropland, farmed wetland, riparian areas, and pastures with permanent conservation easements, in addition to 2,747 acres already protected by TVCT; and enroll at least 5% of these lands in the Conservation Reserve Program (CRP) or other suitable program to retire crop production.

Table 19 Estimated Nutrient Loading Reductions from Each Objective

Objective Number	Best Management Practice	Total Acreage Treated	Estimated Nitrogen (N)/Phosphorus (P) Load Reduction (lbs/yr)*
1	Conservation Tillage	10,914	58,748 lb/yr (N)/ 12,476 lb/yr (P)
1	Cover Crops	2,537	7,056 lb/yr(N)/357 lb/yr (P)
3	Nutrient Management (Soil Sampling and variable rate)	1537	4,812 lb/yr (N)/ 364 lb/yr (P)
3	In-field BMPs: Grassed Waterway and Filter Strips	160	904 lb/yr (N)/ 120 lb/yr (P)
4	Below-field BMPs: Nutrient removal wetlands and WASCOBs	90**	6,909 lb/yr(N)/ 208 lb/yr (P)
5	Conservation Easements and CRP	1300/65***	933 lb/yr(N)/ 92 lb/yr (P)
	TOTAL	15,313	79,362 lb/yr (N)/ 13617lb/yr (P)

**Estimates calculated using Spreadsheet Tool for Estimating Pollutant Loads (STEPL), Version 4.4 (USEPA, 2019)*
*** 1400 acres of catchment area determined by the ACPF is used for this estimate*
***65 acres of land retirement is used for this estimate*

These objectives will be directed towards implementation on prioritized agricultural lands using the stakeholder/landowner-agreed criteria. The implementation of BMPs included in these objectives, as well as BMPs implemented through federal and state programs and other voluntary efforts will be recorded to track progress towards nutrient reduction goals within BR-IC HUC 12.

Conservation easements have been successfully used in the region to protect local water resources and prime farmland from degradation caused by overdevelopment and unsuitable land management. This legal tool limits the impervious surface cover permitted on agricultural lands, encourages implementation of BMPs and permanently protects the sensitive areas including prairies, forested stream buffers and wetlands filtering the agricultural runoff. The TVCT will continue to promote conservation easements to help farmers permanently protect their land and improve overall health of BR-IC watershed.

The future project-specific monitoring efforts will be conducted by Ohio EPA, MCD or other qualified organization, and will verify progress towards meeting the goals identified in the plan. The objectives, projects and implementation strategies presented herein will be reevaluated and modified if determined necessary, as several versions of this NPS-IS are expected. This BR-IC NPS-IS presents an adaptive and living watershed planning approach and is anticipated to be dynamic as critical areas are identified and objectives are implemented, and other objectives recognized. The objectives listed above will be reevaluated, fine-tuned and modified as necessary when more information becomes available or conditions change. Additional objectives may also be included to make progress towards further reduction goals, as new and additional BMPs can improve nutrient reduction.

The Ohio EPA Nonpoint Source Management Plan Update, which includes a full list of nonpoint source management strategies, will be utilized. Strategies, as presented in the overview tables of Chapter 4, include the following:

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

3.3. Critical Area 2: Conditions, Goals, & Objectives for Nutrient Reduction and Management in Beals Run-Indian Creek and Tributaries' Riparian Zones.

3.3.1. Detailed Characterization

Critical Area # 2 contains approximately 2,336 acres of riparian corridors, including 146 acres of freshwater forested/shrub wetlands, and 96 miles of Indian Creek and its main tributaries (Fig. 22). In 2005, 11 sampling locations from Indian Creek and its tributaries were evaluated for biological indices and 16 sites were sampled for water quality (previously presented). All sampling sites along Indian Creek mainstem were in full attainment. The sampling locations from the Indian Creek tributaries achieved 1 full, 2 partial and 1 non-attainment status due to interstitial stream flow conditions. The water quality data showed nutrient levels below WQS and QHEI scores supporting WWH communities. The high quality of riparian habitats including wetlands and riparian buffers within the BR-IC watershed are critical in mitigating the negative impacts of excessive nutrients and sediments from the surrounding physical landscape. Therefore, it is important to protect, enhance and restore wetlands and riparian buffers, especially in the areas where agricultural and residential development encroach on them and on areas severely impacted by streambank erosion. In addition, landowners participating in the stakeholder public meetings voiced their concerns for riparian areas severely impacted by the installation of utility easements, especially gas and oil pipelines. Many segments of the streams have been altered and native vegetation has been removed to accommodate the new infrastructure, resulting in increasing streambank erosion and sedimentation. Streambank stabilization and replanting the riparian buffers may help to alleviate some of these negative effects.

The ACPF model identified 69 miles of eroding stream banks and of the 69 miles, 64 miles of banks suitable for enhancing or restoring riparian buffers along Indian Creek and its tributaries. Stakeholders recognize a need for restorative actions in strategic places; therefore, the following criteria have been set to prioritize areas and restoration projects in Critical Area #2:

- Riparian area of Indian Creek and its main tributaries near the high runoff fields
- Riparian area with severe encroachment by agricultural or residential activities
- Riparian area with extremely severe erosion threatening land and properties
- Riparian area severely impacted by the utility easements

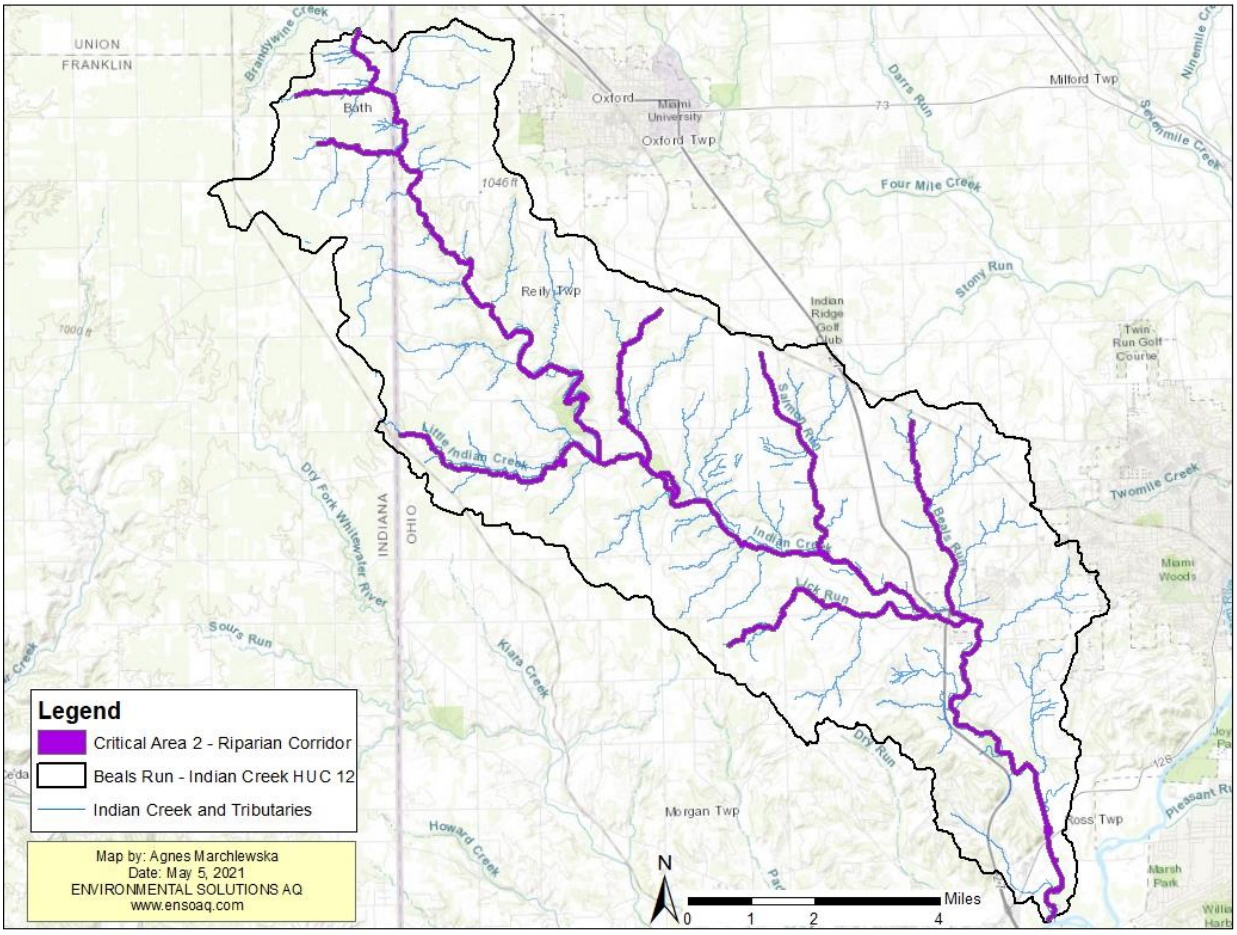


Figure 21 BR-IC HUC 12 Critical Area #2

3.3.2 Detailed Biological Conditions

As previously presented in Tab.17 and 18, the biological assessment of 11 sampling sites conducted in 2005 by the Ohio EPA supported the BR-IC HUC 12 WWH status designation. Fish community indices in this watershed ranged from exceptional (IBI = 54/MIwb = 10.8) to marginally good/exceptional (IBI =38/MIwb = 9.6). Nearly 20% of numerically dominant fish species collected in Indian Creek mainstream consisted of environmentally sensitive species. They included black redhorse, rosyface shiner, silver shiner, banded darter, stonecat, and southern redbelly dace. These species are highly sensitive to a wide range of environmental disturbances and their presence is an indicator of some of the best quality riverine habitats in Ohio (OEPA, 2008). Macroinvertebrate community performance in the Indian Creek mainstem was generally good (ICI = 40) to exceptional (ICI = 52.). However, the community performance of macroinvertebrates in the Indian Creek tributaries ranged from poor to good and it was strongly affected by the lack of surface flow in the streams. The QHEI scores within the BR-IC watershed ranged from 74.5 to 55.6 and supported WWH communities. Two sampling locations on Indian Creek mainstream (RM 9.4 and RM 4.3) and one on Salmon Run (RM 0.1) showed the QHEI yielding scores of 59.0, 55.5 and 58.0, respectively. Substrate embeddedness and

riparian encroachment were the most commonly observed habitat impairments in this watershed.

3.3.3 Detailed Causes and Associated Sources

The 2005 Ohio EPA survey demonstrated that the Indian Creek mainstream was in full attainment. Two partial and one non-attainment status were assigned to three sampling locations distributed among the Indian Creek tributaries (Little Indian Creek RM 0.1, Lick Run RM 0.9 and Salmon Run 1.9). The Aquatic Life Use impairment status of the Indian Creek tributaries was due to underperforming macroinvertebrate communities caused by lack of surface flow in the streams when the sampling was conducted. The QHEI scores ranged from 74.5 to 55.5 indicating a level of macrohabitat quality sufficient to support an assemblage of aquatic organisms consistent with the WWH aquatic life use designation. Two sampling locations on Indian Creek mainstream and one on Salmon Run showed the QHEI values slightly below 60, which was mostly attributed to riparian encroachment and substrate embeddedness.

For these high-quality riparian corridors, which also include wetlands, it is important to maintain the quality level by ensuring the riparian area is protected, wetlands are restored or enhanced, and buffers are vegetated with the appropriate plant species. For areas with severe streambank erosion, large amounts of sediments are washed down from the banks during and after intense storms. Many of the banks are bare, steeply cut and not protected. The implementation of streambank stabilization and planting of riparian buffers can reduce erosion and siltation/sedimentation in the streams.

3.3.4 Outline Goals and Objectives for the Critical Area

The goal of the NPS-IS is to improve water quality, meet nutrient reduction goals and improve impairment status. In Critical Area 2, the biological indicators evaluated at 11 sampling location within BR-IC HUC supported WWH (IBI: 38-54; MIwb (Indian Creek mainstream): 9.7-10.8; ICI (Indian Creak mainstream): 40 -52). Habitat, as scored by the QHEI, is not a WQS; however, habitat is highly correlated with the performance of aquatic communities. In general, sites that score at least 60 or at least a minimum of 55 for headwater streams are successful at supporting the WWH aquatic assemblages. Severe stream erosion and siltation/sedimentation, which are common in the BR-IC watershed, cause water quality degradation and contribute to Gulf of Mexico hypoxia. Protection and management of riparian corridors, including wetlands, can help reduce nutrients and sediments – and improve water quality and aquatic life in both near-field and far-field waterways.

Currently BMPs are underutilized in most of the BR-IC HUC 12. To maintain and improve the habitat, wetlands and riparian areas need to be protected, enhanced or restored. The stream segments severely affected by streambank erosion need to be stabilized and buffers need to be planted with specific and effective plant species. Wetland enhancement or restoration, and riparian buffer planting will provide great benefits to maintain and improve stream health and aquatic life attainment.

Goal 1 – To maintain or achieve the IBI score at or above 40 at all 2005 Ohio EPA sampling locations;

Not Achieved – The IBI at the Indian Creek RM 23.9 has a score of 38

Goal 2 – To maintain or achieve the MIwb score at or above 9.7 at all 2005 Ohio EPA sampling locations with Drainage Area > 20 mi^2

Achieved

Goal 3 – To maintain or achieve the ICI score above at or 40

Not Achieved: The ICI at the Little Indian Creek RM 0.1 has a score of Fair, at the Reserve Run RM 0.3 has a score of Low Fair, at the Salmon Run RM 1.9 has a score of Poor and at the Lick Run RM 0.9 has a score of Fair.

Goal 4 – To maintain or achieve the QHEI score at or above 60

Not Achieved: The QHEI scores yield 59 at the Indian Creek RM 9.4, 55.5 at the Indian Creek RM 4.3 and 58 at the Salmon Run RM 0.1.

Objectives

The implementation of these objectives, coupled with implementation in Critical Area #1 will help ameliorate negative impacts from excessive nutrients and sediments and improve aquatic life in the near-field and far-field waterways.

Objective 1: Stabilize at least 3 miles of the severe streambank erosion at Indian Creek and its main tributaries. [1]

Objective 2: Create, enhance and/or restore floodplain/riparian wetlands for habitat restoration and/or sediment attenuation on at least 50 acres.

Objective 3: Create, enhance and/or restore floodplain/ riparian buffer along impacted or barren stretches of Indian Creek and its main tributaries within *Critical Area #2* (at least 50 feet each side) by establishing and enhancing at least 18 acres of riparian habitats. [1]

Objective 4: Protect with conservation easements or via land acquisitions at least 6 miles of Indian Creek and its main tributaries in addition to 12 miles already protected by TVCT. Retire at least 20 acres of riparian corridor from farming.

Table 20 Nutrient Reductions from Each Objective

Objective Number	Best Management Practice	Total Length/Acreage Treated	Estimated Load Reduction using STEPL*
1	Streambank stabilization/restoration	3 miles/ 18 Acres (avg 50 feet wide)	193 lb/yr (N)/19 lb/yr (P) and sediment of 11 tons/yr
2	Floodplain/Wetland enhancement/restoration	50 acres**	3,414 lb/yr (N)/ 103 lb/yr (P)
3	Riparian Buffer as designed using ACPF modeling based on the width of the riparian	3 miles/18 Acres (avg 50 feet wide)	96 lb/yr (N)/ 13 lb/yr (P) and sediment of 8 tons/yr

[1] *Stakeholders recognize a need for restorative actions in strategic places; however, objectives are set low to realistically reflect the anticipated amount of land available for restoration.*

	zone and runoff delivery (see Section 2.5.1).		
4	Protecting riparian areas and wetland with conservation easements and retire 20 acres.	145.5 Acres/20 Acres*** (riparian corridor width: 100 feet at each side of the stream)	280 lb/yr (N)/28 lb/yr (P) and sediment of 17 tons/yr

**Estimated using Spreadsheet Tool for Estimating Pollutant Loads (STEPL), Version 4.4 (USEPA, 2019) N-Nitrogen; P-Phosphate and sediment*
***Estimated using the Controlled Drainage function in STEPL with assumed 700 acres of catchment area*
****20 acres of land retirement is used for this estimate*

In 2007, the TVCT was awarded a Section 319(h) Clean Water Act grant to acquire conservation easements on 408 acres along Indian Creek to reduce the negative impacts of new subdivision construction near the waterway. These easements provided a 600-feet wide corridor stretching 9,250 linear feet along the mainstem of Indian Creek and 200-feet wide and 3,650 linear feet along its tributaries. The TVCT will continue to promote conservation easements and work with landowners to permanently protect the riparian corridors within BR-IC watershed.

The future project-specific monitoring efforts will be conducted by Ohio EPA, MCD or other qualified organization and will verify progress towards meeting the goals identified in the plan. The objectives, projects and implementation strategies presented herein will be reevaluated and modified if determined necessary, as several versions of this NPS-IS are expected. This NPS-IS will employ an adaptive management process. As objectives and implementation projects are reevaluated, objectives listed above will be reevaluated, fine-tuned and modified as necessary when more information becomes available or conditions change. Additional objectives may also be included to make progress towards further reduction goals or water quality improvement goals, as new and additional BMPs can improve nutrient reduction and sedimentation in streams.

The Ohio EPA Nonpoint Source Management Plan Update, which includes a full list of nonpoint source management strategies, will be utilized. Strategies, as presented in the overview tables of Chapter 4, include the following:

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

3.4. Critical Area 3: Conditions, Goals, & Objectives for Protecting Environmentally Sensitive Lands in the area of Beals Run-Indian Creek Experiencing Development Pressure

3.4.1 Detailed Characterization

Critical Area # 3 covers 8,244 acres of land south of Millville, identified previously by the OKI as the area of anticipated growth and high development pressure in BR-IC watershed. This area contains approximately 8 miles of Indian Creek and 86 acres of freshwater forested/shrub wetlands.

According to the 2005 biological and water quality survey conducted by the Ohio EPA, all three sampling sites located within this critical area were in full attainment. The QHEI scores ranged from 55.5 to 74.5 and supported WWH communities.

Urbanization in Butler County has accelerated rapidly over the last century, and caused many surfaces in natural ecosystems to shift to impervious surfaces. Evaluation of the impervious surface within BR-IC HUC 12 conducted by OKI showed that in 2007 approximately 5.1% of the watershed was covered by impermeable surfaces. Based on studies conducted by the Center for Watershed Protection (CWP), most streams experience decline in their water quality and habitats when watershed impervious cover (IC) exceeds 10%, with severe degradation expected beyond 25% IC (CWP, 1993). The Impervious Surface Model categorized the BR-IC watershed as “sensitive but should have acceptable water quality and habitat” (OKI, 2014). Currently, in Critical Area #3, only 254 acres of environmentally sensitive lands and high-quality habitats are permanently protected with a conservation easement held by Three Valley Conservation Trust. The easement covers a portion of Forest Run MetroPark administrated by the MetroParks of Butler County. However, increasing development pressure and impervious surface cover identified in this Critical Area threatens these prime riparian habitats, wetlands and woodlots. Therefore, limiting development and surface cover on these environmentally sensitive lands is critical for maintaining and improving water quality and aquatic life in the BR-IC watershed.

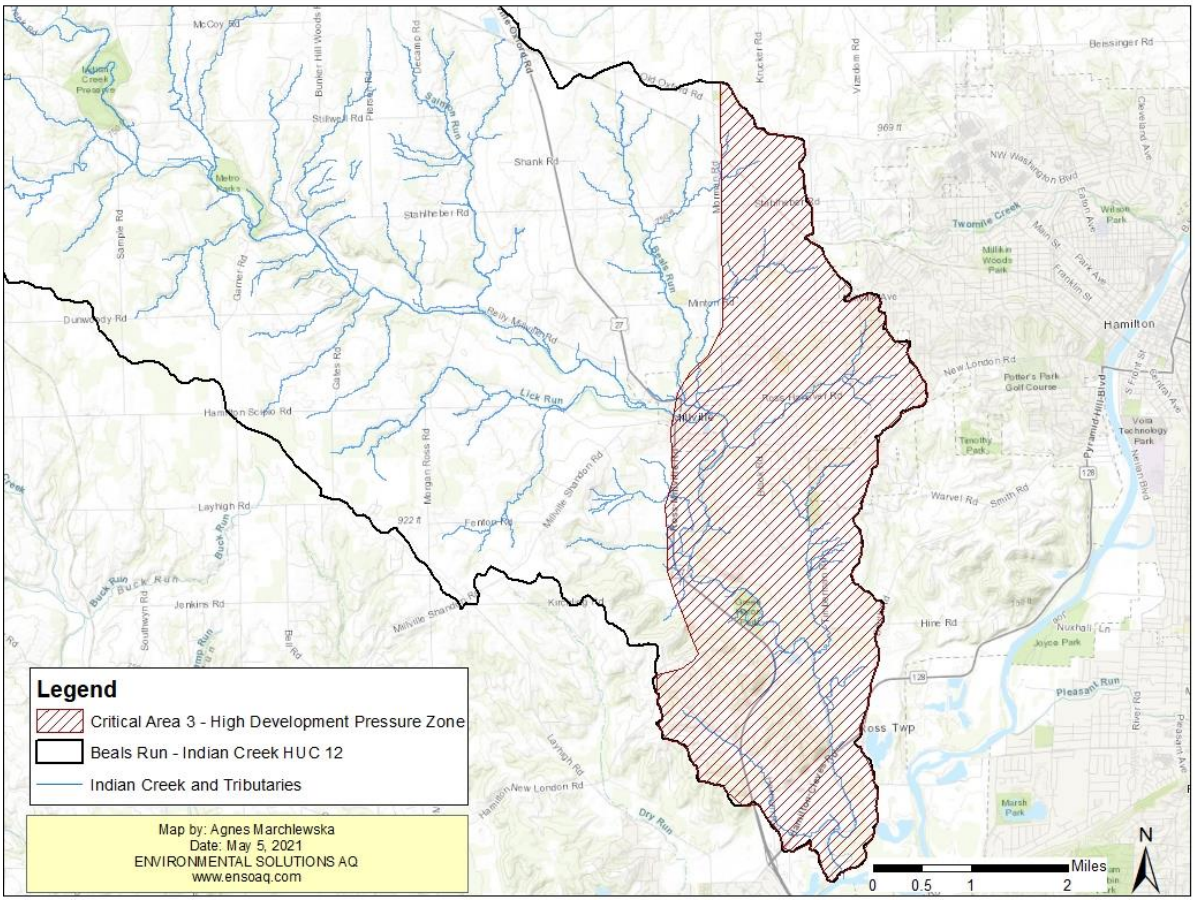


Figure 22 BR-IC HUC 12 Critical Area #3

3.4.2 Detailed Biological Conditions

The biological and water quality survey conducted by Ohio EPA in 2005 at 3 sampling locations within Critical Area #3 is summarized in Table 21. Fish community indices on Indian Creek sampling sites ranged between good/exceptional (IBI = 42/MIwb = 10.8) and very good/exceptional (IBI = 48/MIwb = 10.4). The QHEI score decreased from 74.5 at the Indian Creek upstream sampling location (RM 6.8) to the QHEI value = 55.5 at the most downstream sampling location (RM 4.3).

Table 21 Macroinvertebrate Communities in Critical Area #3

RM	QHEI	Drainage Area (mi^2)	Mean # of Species	Predominant species (% of catch)*	Mean MIwb	IBI	Narratives
6.8^W	74.5	95.0	33	Central Stoneroller (33.17%), Bluntnose Minnow (25.97%)	10.4	48	V. Good/ Exceptional
6.5^W	67.0	98.0	24	Central Stoneroller (26.11%), Bluntnose Minnow (23.65%)	10.3	46	V. Good/ Exceptional
4.3^W	55.5	102.0	27	Central Stoneroller (34.20 %), Bluntnose Minnow (23,22%	10.8	42	Good/Excepti onal

**Only aggregate sampling results from the Indian Creek mainstream were reported (OEPA, 2008)*
QHEI Qualitative Habitat Evaluation Index
MIwb Modified Index of Well Being (MIwb)
IBI Index of Biotic Integrity
W Wading sample (Drainage Area > 20 mi^2 ≤ 500 mi^2)

Macroinvertebrate community performance in this section of Indian Creek was good (ICI ≥ 40) and met WQS (Tab. 22). All sampling locations within the Critical area # 3 were in full attainment and supported the WWH aquatic life use designation.

Table 22 Macroinvertebrate Communities in Critical Area #3

RM	Dr. Area (Sq. mi.)	Density QI./Qt.	Predominant Organisms on the Natural Substrates with Tolerance Category(ies) in Parentheses	ICI	Narrative Evaluation
6.9^W	95	High	Caddisflies (MI, F), Isonychia mayflies (MI)	44	
6.4^W	98	High	Caddisflies (MI, F) mayflies (MI. F), Petrophila moth larvae (MI)	40	
4.3^W	102	Moderate - High	Hydropsychid caddisflies (MI, F)	-	Good
Little Indian Creek					

Source: OEPA, 2005
RM - River Mile
W - Wading Sample (Drainage Area > 20 mi^2 ≤ 500 mi^2)
QI.: Qualitative sample collected from the natural substrates.
Qt.: Quantitative sample collected on Hester-Dendy artificial substrates, density is expressed in organisms per square foot.
Tolerance Categories: VT=Very Tolerant, T=Tolerant, MT=Moderately Tolerant, F=Facultative, MI=Moderately Intolerant, I=Intolerant.
ICI - Invertebrate Community Index
No data available

3.4.3 Detailed Causes and Associated Sources

The 2005 Ohio EPA survey demonstrated that all three sampling sites within Critical Area #3 were in full attainment. The QHEI scores ranged from 74.5 to 55.5 indicating a level of macrohabitat quality sufficient to support an assemblage of aquatic organisms consistent with the WWH aquatic life use designation. The high quality habitats in Critical Area #3 are threatened by increasing development pressure and impervious surface cover causing decline in their water quality and habitats. Therefore, it is critical to protect sensitive environments, especially riparian corridors, wetlands and woodlots by limiting development and surface cover on these lands.

3.4.4 Outline Goals and Objectives for the Critical Area

The goal of the NPS-IS is to improve water quality, meet nutrient reduction goals and improve impairment status. In Critical Area #3, the biological indicators evaluated at three sampling locations on Indian Creek supported the WWH (IBI: 42-48; MIwb: 10.3-10.8; ICI: 40-44) and were in full attainment. Increasing development and impervious surface cover may cause habitat and water quality degradation. Permanent protection and management of riparian corridors, wetlands, woodlots and other environmentally sensitive areas can help reduce nutrients and sediments and improve water quality and aquatic life in local waterways.

Currently, BMPs are underutilized in most of the BR-IC HUC 12. Conservation easements have been successfully used in the region to protect local water resources and prime habitats from degradation caused by overdevelopment and unsuitable land management. This legal tool limits the impervious surface cover permitted on farmland and natural areas, encourages implementation of BMPs and permanently protects the sensitive areas including riparian buffers and wetlands filtering the agricultural and residential runoff. Three Valley Conservation Trust will continue to promote conservation easements to help landowners permanently protect their land and improve overall health of BR-IC watershed. Permanent protection from increasing development and impervious surfaces – especially in riparian areas, wetlands, woodlots and other environmentally sensitive areas – will provide great benefits to maintain and improve stream health and aquatic life attainment.

Goal 1 – To maintain or achieve the IBI score at or above 42 at 2005 sampling locations in this critical area;

Achieved

Goal 2 – To maintain or achieve the MIwb score at or above 10.3 at 2005 sampling locations in this critical area;

Achieved

Goal 3 – To maintain or achieve the ICI score above at or 40 at 2005 sampling locations in this critical area;

Achieved

Goal 4 – To maintain or achieve the QHEI score at or above 60 at 2005 sampling locations in this critical area;

Not Achieved: The QHEI score at Indian Creek RM 4.3 is 55.5.

Objectives

The implementation of these objectives, coupled with implementation in Critical Area #1 and Critical Area #2 will help ameliorate negative impacts from excessive nutrients and sediments, and it will improve aquatic life in local waterways.

Objective 1: Permanently protect from development and impervious surface cover at least 500 acres of high quality habitats; including riparian areas, wetlands and other environmentally sensitive areas by implementing conservation easements and/or land acquisition, and retire at least 100 acres of farmland from agricultural production.

Table 23 Estimated Nutrient Reductions from Each Objective

Objective Number	Best Management Practice	Acreage Treated	Estimated Load Reduction using STEPL*
1	Protecting the high quality habitats with conservation easements/land acquisition	500/100*	1400 lb/yr (N)/138 lb/yr (P) and sediment of 85 tons/yr

**Estimated using Spreadsheet Tool for Estimating Pollutant Loads (STEPL), Version 4.4 (USEPA, 2019) N-Nitrogen; P-Phosphate*

*** 100 acres of retired land is used for this estimate*

The future project-specific monitoring efforts will be conducted by Ohio EPA, MCD or other qualified organization and will verify progress towards meeting the goals identified in the plan. The objectives, projects and implementation strategies presented herein will be reevaluated and modified if determined necessary, as several versions of this NPS-IS are expected.

This NPS/IS will employ an adaptive management process. As objectives and implementation projects are reevaluated, objectives listed above will be reevaluated, fine-tuned and modified as necessary when more information becomes available or conditions change. Additional objectives may also be included to make progress toward further reduction goals or water quality improvement goals, as new and additional BMPs can improve nutrient reduction and sedimentation in streams.

The Ohio EPA Nonpoint Source Management Plan Update, which includes a full list of nonpoint source management strategies, will be utilized. Strategies, as presented in the overview tables of Chapter 4, include the following:

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

Chapter 4: Projects and Implementation Strategy

The Great Miami River Basin is one of the major nutrient contributors to Ohio River and Gulf hypoxia (OEPA, 2020). It is important and beneficial for the NPS-IS initiatives to be implemented in this region as soon as possible. BR-IC HUC 12 is an agricultural watershed and implementation of proposed conservation practices is targeted to reduce nutrient load reduction by 20%.

The Project and Implementation Strategy of the BR-IC HUC 12 NPS-IS includes an action plan based on the causes and sources of NPS pollution which are described in the previous chapter. Chapter 3 presented the three critical areas and their goals, objectives, and potential projects. These critical areas will be reevaluated through time to monitor progress towards meeting their NPS goals and objectives. Some of the positive impacts may be slow and take years to show progress towards recovery.

4.1 Overview Tables and Project Sheets for Critical Areas

Three Project and Implementation Strategy Overview tables and associated project summary sheets for each of the critical areas (Agricultural fields, riparian corridor of Indian Creek and tributaries and high development pressure zone) are presented in this Chapter. The presented opportunities provide a general concept and will be further evaluated as landowners provide additional feedback on the projects and each project is adequately funded. The estimated project costs and the time frame are both dependent upon funding opportunities and coordination with landowners and project partners.

In addition to the detail provided in previous chapters, the project summary sheets outline how the nine minimum elements of watershed planning are being met by each opportunity, as shown in the first column of each table. Moreover, this NPS-IS will be updated periodically to address stakeholder input and additional project opportunities may be added. If a future critical area is identified (e.g. urban loading) within the BR-IC HUC 12, supplemental information will be provided as funding allows.

The Project Overview Tables presents a summary of each strategy identified for each critical area. BMP strategies are divided into several categories, including urban storm water runoff management, altered stream and habitat restoration strategies, and other nonpoint source causes and associated sources of impairment.

Table 24 Projects and Implementation Strategy Overview - Critical Area 1

For BR-IC HUC 12 (050800020803) Critical Area 1							
Goal	**Objective**	**Project**	**Project Title (EPA Criteria g)**	**Lead Organization (EPA Criteria f)**	**Time Frame (EPA Criteria f)**	**Estimated Cost (EPA Criteria d)**	**Funding/Actual Sources (EPA Criteria d)**
Urban Sediment and Nutrient Reduction Strategies							
Altered Stream and Habitat Restoration Strategies							
Agricultural Nonpoint Source Reduction Strategies							
1	1	1	Agricultural BMPs – 500 Acres Cover Crops and 250 Acres Nutrient Management (Plan Development, Soil Testing and Variable Rate Technology (VRT) Implementation)	Butler SWCD	Short (1-3 years)	$25,250	Ohio EPA §319, H2Ohio, USDA-NRCS EQIP
High Quality Waters Protection Strategies							
Other NPS Causes and Associated Sources of Impairment							

The Project Summary Sheets provided below were developed based on the objectives set to achieve nutrient reduction targets in the BR-IC HUC 12. These projects are considered next step or priority/short term projects and are ready to be implemented. The projects, which need more outreach and thorough planning, will have the Project Summary Sheets developed and added to the plan when they are ready for the implementation.

Table 25 Critical Area #1 - Project #1

Project #1 – BR-IC HUC 12 Critical Area 1		
Nine Element Criteria	**Information needed**	**Explanation**
n/a	Title	Agricultural BMPs – Cover Crops and Nutrient Management
criteria d	Project Lead Organization & Partners	Butler Soil and Water Conservation District
criteria c	HUC-12 and Critical Area	BR-IC HUC 12 (050800020803) – Critical Area 1
criteria c	Location of Project	Private landowner – exact location not disclosed
n/a	Which strategy is being addressed by this project?	Agricultural Nonpoint Source Reduction
criteria f	Time Frame	Short (1-3 years)
criteria g	Short Description	Administer cost-share program for cover crop plantings and nutrient management Implementation (soil testing and VRT)
criteria g	Project Narrative	Butler SWCD will administer a cost-share program to local landowners in prioritized agricultural lands to plant cover crops on at least 500 acres annually. Landowners will enroll no less than 10 acres, and the maximum amount enrolled by one operation will not exceed 400 acres. Cost-share will pay out at $30 per acre. In addition, the Butler SWCD develop nutrient management plans and enroll at least 250 acres for soil testing and VRT application. Cost share nutrient management plan development will be up to $2000 per plan (estimated 100 to 150 acres). Soil testing will pay $9 per acre, VRT cost-share will be $24 per acre. Butler SWCD has a list of willing landowners prepared to implement this project if funds are available.
criteria d	Estimated Total cost	$25,250
criteria d	Possible Funding Source	Ohio EPA §319, H_2Ohio, USDA-NRCS EQIP
criteria a	Identified Causes and Sources	Cause: Nutrient loadings leading to far-field impacts Source: Agricultural land use activities
criteria b & h	Part 1: How much improvement is needed to remove the NPS impairment for the whole critical area?	Objective #1: Plant at least 2,537 acres of cover crops, resulting in plantings of 2,000 additional acres. Objective # 2: Implement nutrient management planning (develop plans, soil testing and variable rate fertilization) on at least 1000 additional acres. The overall goal in Critical Area #1 is to reduce estimated total nitrogen load for agricultural lands by 20% (70,000 lb). Current estimates indicate 56,771 lb/year reduction load based on the BMPs already implemented within this watershed. In order to meet the Gulf of Mexico hypoxia reduction goals, the total nitrogen loadings must be reduced by additional 13,229 lb/year.
	Part 2: How much of the needed improvement for the whole Critical Area is estimated to be	Goal: The goal in Critical Area #1 is to reduce nitrogen and phosphate loads by 20%. The baseline load reduction is estimated to be 70,000 lb for total nitrogen. With the current and recent conservation practices, the

	accomplished by this project?	estimated loads are 56,771 lb/yr (N) and 11,570 lb/yr (P). This project is expected to achieve 3.1% of nitrogen reduction goal.
	Part 3: Load Reduced?	**Cover crops**: estimated 1,384 lb/yr(N)/70 lb/yr (P)/45 tons sediment per year of load reduction based on STEPL 4.4. **Nutrient management**: estimate of 776 lb/yr (N)/59 lb/yr (P)/sediment reduction not applicable - load reduction based on STEPL 4.4.
criteria i	How will the effectiveness of this project in addressing the NPS impairment be measured?	It is generally not possible to determine load reduction from individual agricultural practices; Some agencies periodically conduct sampling such as MCD or Ohio EPA. Butler SWCD will conduct follow-up activities with landowners if appropriate, to document and track progress of cover crop planting.
criteria e	Information and Education	Project information will be shared at the Butler SWCD annual meeting and at applicable field days. Project highlights will also be shared on social media and/or Butler SWCD's website.

Table 26 Projects and Implementation Strategy Overview - Critical Area #2

For BR-IC HUC 12 (050800020803) Critical Area 2							
Goal	**Objective**	**Project**	**Project Title (EPA Criteria g)**	**Lead Organization (EPA Criteria f)**	**Time Frame (EPA Criteria f)**	**Estimated Cost (EPA Criteria d)**	**Funding/Actual Sources (EPA Criteria d)**
Urban Sediment and Nutrient Reduction Strategies							
Altered Stream and Habitat Restoration Strategies							
1, 2, 3, 4	1 and 2	1	600 feet of Streambank Stabilization and Wetland Enhancement	Three Valley Conservation Trust	Short (1-3 years)	$350,000	Ohio EPA, §319, H2Ohio
1, 2, 3, 4	1	2	400 feet of Streambank Stabilization	Three Valley Conservation Trust	Short to Medium (1-7) years)	$280,000	Ohio EPA, §319, H2Ohio
Agricultural Nonpoint Source Reduction Strategies							
High Quality Waters Protection Strategies							
Other NPS Causes and Associated Sources of Impairment							

Table 27 Critical Area #2 - Project #1

Project #1 – BR-IC HUC 12 Critical Area 2		
Nine Element Criteria	**Information needed**	**Explanation**
n/a	Title	Stabilize 600' of severely eroding streambank and enhance 16 acres of freshwater forested wetland
criteria d	Project Lead Organization & Partners	Three Valley Conservation Trust
criteria c	HUC-12 and Critical Area	BR-IC HUC 12 (050800020803) – Critical Area 2
criteria c	Location of Project	Private landowner – exact location not disclosed
n/a	Which strategy is being addressed by this project?	Altered Stream and Habitat Restoration Strategies
criteria f	Time Frame	Short (1-3 years)
criteria g	Short Description	**Phase 1**. Restore a severely eroding reach of Indian Creek, including 600 linear feet of streambank, currently generating large volumes of sediment/stormwater pollutants due to channel widening and meander migration. The restoration approach will employ a combination of bank grading, bioengineered bank treatments, in-stream structures, and riparian restoration. The project will stabilize eroding banks, improve water quality, restore the riparian corridor and associated habitats, and benefit adjacent landowners by protecting against loss of property. **Phase 2**. Restore a severely eroding reach of Indian Creek by providing hydraulic relief and improved floodplain connectivity with the construction of a pulsed-flow wetland complex. The restoration approach will employ a combination of bank grading, wetland construction, and riparian restoration. Restored 12 acres of floodplain wetland will capture and treat the tile drainage water from approximately 78 acres of cropland. In addition, it will help to alleviate hydraulic stresses on eroding banks, improve water quality, and restore the riparian corridor, and associated habitats.
criteria g	Project Narrative	Indian Creek and its tributaries are largely high-quality streams, in need of protection to maintain their overall health, habitat, and water quality.  **Phase 1** of this project is intended to stabilize and restore 600 feet of eroding stream channel along the main stem of Indian Creek. A BEHI/BANCS analysis has determined that the annual erosion rate for the reach is more than 1,600 ft^3/yr, generating large volumes of sediment and other stormwater pollutants that adversely impact the water quality of Indian Creek, and accelerate the process of channel widening and meander migration. Restoration at this strategic location along Indian Creek will significantly improve overall water quality and help alleviate the forces driving channel migration. Restoration components will consist of excavation and grading along 600ft of streambank, with the

		addition of vegetated rock toe, regrade, fabric and plant slopes, plus two log deflector vanes, and two rock cross vanes at either end of the project reach.  **Phase 2** is intended to provide hydraulic relief and improved floodplain connectivity with the construction of a pulsed-flow wetland complex, adjacent to an eroding reach of Indian Creek mainstem. Wetland restoration at this strategic location along Indian Creek will significantly improve overall water quality Restored 12 acres of wetland will capture and treat the tile drainage water from approximately 68 acres of cropland and will help alleviate the forces driving channel migration. Restoration components will consist of excavation and grading, installation of pulsed flow wetlands, and restoration of riparian and wetland plant communities along 800ft of stream corridor. The proposed work will follow Ohio EPA §319 project requirements
criteria d	Estimated Total cost	Phase 1: $310,000 Phase 2: $40,000 **Total cost: $350,000**
criteria d	Possible Funding Source	Ohio EPA §319, H2Ohio
criteria a	Identified Causes and Sources	Cause: Channel widening, meander migration, and subsequent erosion Source: Agricultural encroachment, unprotected and steep streambanks, loss of hydraulic connectivity with floodplain, loss of riparian and wetland vegetation, changes in watershed-scale land use, and net increase in stormwater runoff.
criteria b & h	Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?	In Critical Area 2, the biological indicates evaluated at 11 sampling location within BR-IC HUC supported the WWH (IBI: 38-54; MIwb (Indian Creek mainstream): 9.7-10.8; ICI (Indian Creak mainstream): 40 -52). The goal is to maintain or improve the IBI and ICI scores above 40, MIwb score above 9.7 and QHEI score above 60 at the 2005 sampling locations. The closest sampling site to the project area is located just upstream on Indian Creek RM 17.7. This site is in full attainment for ALU and have the QHEI score of 67.5. The closest downstream sampling site is located at Indian Creek 9.7. This site also is in full attainment for the ALU but its QHEI score is slightly below 60. The agriculture encroachments and growing intensity and frequency of storm evens have severely increased stream erosion and excess sedimentation in Indian Creek, and its tributaries. The streambank restoration and wetland enhancement should improve the riparian habitats and support aquatic communities in the watershed.
	Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?	Objective 1:. Stabilize at least 3 miles of the severe streambank erosion at Indian Creek and its main tributaries. This project will stabilize 600 feet of severe streambank erosion at Indian Creek and complete 3.8% of the streambank stabilization objective. Objective 2: Create, enhance and/or restore floodplain/riparian wetlands for habitat restoration and/or sediment attenuation on at least 50 acres. This project will enhance 12 acres of wetland habitat and complete 24% of wetland restoration objective. Goal: To maintain or improve the IBI and ICI scores above 40, MIwb score above 9.7 and QHEI score above 60 at the 2005 sampling locations. This project is expected to improve the biological indices and the QHEI score near the site and downstream to meet the WWH standard.

	Part 3: Load Reduced?	Phase 1: Estimate of 1,600 ft^3/year or 77 tons/year of sediment load reduction if the bank is stabilized based on BEHI. Using the 77 tons/year as input, an estimated of as high as 1159 lb/yr of N and 114 lb/yr of P load reductions using STEPL 4.4. Phase 2: Restored wetland will capture and treat the tile drainage water from approximately 68 acres of cropland (Drainage area delineated from the DEM using Arc GIS). Estimate of 333 lb/yr (N)/10 lb/yr (P) - load reduction based on STEPL 4.4 - Controlled Drainage function.
criteria i	How will the effectiveness of this project in addressing the NPS impairment be measured?	The project-specific monitoring efforts will be conducted by Ohio EPA, MCD or other qualified organization and will verify progress towards meeting the goals identified in the plan.
criteria e	Information and Education	The TVCT which hold a conservation easement on the impacted property, will promote this project on their website and other social media outlets and with the permission from the landowner will offer guided tours and site visits.

Table 28 Critical Area #2 - Project #2

Project #1 – BR-IC HUC 12 Critical Area 2		
Nine Element Criteria	**Information needed**	**Explanation**
n/a	Title	Stabilize 400' of severely eroding streambank
criteria d	Project Lead Organization & Partners	Three Valley Conservation Trust
criteria c	HUC-12 and Critical Area	BR-IC HUC 12 (050800020803) – Critical Area 2
criteria c	Location of Project	Private landowner – exact location not disclosed
n/a	Which strategy is being addressed by this project?	Altered Stream and Habitat Restoration Strategies
criteria f	Time Frame	Short to medium (1-7 years)
criteria g	Short Description	Stabilize an incised and severely eroding reach of Beals Run, including a 400-foot "hot spot" reach that currently generates large volumes of sediment/stormwater pollutants, using a combination of bioengineered bank treatments and in-stream structures. The project will stabilize eroding banks, improve water quality, restore the riparian corridor and associated habitats, and benefit adjacent landowners by protecting against loss of property and imminent threats to adjacent infrastructure.
criteria g	Project Narrative	 Indian Creek and its tributaries, including Beals Run, are largely high-quality streams, in need of protection to maintain their overall health, habitat, and water quality. This project is intended to stabilize 400 feet of incised and severely eroding stream channel along Beals Run. This includes an existing hot spot for sediment generation near the Old Stone Riding Center, where a BEHI/BANCS analysis has determined that the annual erosion rate for the reach is approximately 1,920 ft^3/yr, generating large volumes of sediment and other stormwater pollutants that subsequently impact the receiving watershed downstream. Erosion is driven by systemic channel incision and widening. It is critical to stabilize the eroding streambanks using robust bioengineered bank treatments, including vegetated stone toe and earth wrap bank treatments. The proposed work will follow Ohio EPA §319 project requirements.
criteria d	Estimated Total cost	$280,000
criteria d	Possible Funding Source	Ohio EPA §319, H2Ohio
criteria a	Identified Causes and Sources	Cause: Systemic incision, widening, and channel erosion Source: Unprotected and steep streambanks, loss of riparian vegetation, channel encroachment, changes in watershed-scale land use, and net increase in stormwater runoff

criteria b & h	Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?	In Critical Area 2, the biological indicates evaluated at 11 sampling location within BR-IC HUC supported the WWH (IBI: 38-54; MIwb (Indian Creek mainstream): 9.7-10.8; ICI (Indian Creak mainstream): 40 -52). The goal is to maintain or improve the IBI and ICI scores above 40, MIwb score above 9.7 and QHEI score above 60 at the 2005 sampling locations. The closest sampling site to the project area is located downstream on Indian Creek RM 6.9. This site is in full attainment for ALU and have the QHEI score of 74.5. However, stream erosion and excess sedimentation in Beals Run might impair fish and macroinvertebrates habitats not only in this tributary but also downstream in Indian Creek.
	Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project?	Objective 1:. Stabilize at least 3 miles of the severe streambank erosion at Indian Creek and its main tributaries. This project will stabilize 400 feet of severe streambank erosion at Beals Run within Critical Area 2 and complete 2.5% of the streambank stabilization objective. Goal: To maintain or improve the IBI and ICI scores above 40, MIwb score above 9.7 and QHEI score above 60 at the 2005 sampling locations. This project is expected to improve the biological indices and the QHEI score near the site and downstream to meet the WWH standard.
	Part 3: Load Reduced?	Estimate of 1,920 ft^3/year or 92.4 tons/year of sediment load reduction if the bank is stabilized based on BEHI. Using the 92 tons/year as input, an estimate of as high as 1600 lb/yr of N and 158 lb/yr of P load reductions using STEPL 4.4.
criteria i	How will the effectiveness of this project in addressing the NPS impairment be measured?	The project-specific monitoring efforts will be conducted by Ohio EPA, MCD or other qualified organization and will verify progress towards meeting the goals identified in the plan.
criteria e	Information and Education	The TVCT which hold a conservation easement on the impacted property, will promote this project on their website and other social media outlets and, with the permission from the landowner will offer guided tours and site visits.

Table 29 Projects and Implementation Strategy Overview - Critical Area #3

For BR-IC HUC 12 (050800020803) Critical Area 3							
Goal	**Objective**	**Project**	**Project Title (EPA Criteria g)**	**Lead Organization (EPA Criteria f)**	**Time Frame (EPA Criteria f)**	**Estimated Cost (EPA Criteria d)**	**Funding/Actual Sources (EPA Criteria d)**
Urban Sediment and Nutrient Reduction Strategies							
Altered Stream and Habitat Restoration Strategies							
Agricultural Nonpoint Source Reduction Strategies							
High Quality Waters Protection Strategies							
Other NPS Causes and Associated Sources of Impairment							

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

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APPENDIX

Soils Summary — Butler County, Ohio						
Map unit symbol	**Map unit name**	**Drainage Rating**	**Hydrologic Soils Groups**	**Farmland Classification Rating**	**Acres in AOI**	**Percent of AOI**
CdD2	Casco and Rodman gravelly loams, 6 to 18 percent slopes, moderately eroded	Well drained	B	Farmland of local importance	56.2	0.10%
CdE	Casco and Rodman gravelly loams, 18 to 35 percent slopes	Well drained	B	Not prime farmland	67	0.10%
DaA	Dana silt loam, 0 to 2 percent slopes	Moderately well drained	B	All areas are prime farmland	111.5	0.20%
DaB	Dana silt loam, 2 to 6 percent slopes	Moderately well drained	C	All areas are prime farmland	292.7	0.60%
DbB	Dana silt loam, bedrock substratum, 2 to 8 percent slopes	Moderately well drained	B	All areas are prime farmland	22.8	0.00%
EcE2	Eden silty clay loam, 15 to 25 percent slopes, moderately eroded	Well drained	D	Not prime farmland	2,203.80	4.70%
EcF2	Eden silty clay loam, 25 to 50 percent slopes, moderately eroded	Well drained	D	Not prime farmland	823.3	1.70%
Ee	Eel silt loam, 0 to 2 percent slopes, occasionally flooded	Moderately well drained	B	All areas are prime farmland	60.7	0.10%
ElA	Eldean loam, 0 to 2 percent slopes	Well drained	B	All areas are prime farmland	429.5	0.90%

ElB2	Eldean loam, 2 to 6 percent slopes, eroded	Well drained	B	All areas are prime farmland	164.5	0.30%
ElC2	Eldean loam, 6 to 12 percent slopes, moderately eroded	Well drained	B	Farmland of local importance	81.4	0.20%
EnA	Eldean gravelly loam, 0 to 2 percent slopes	Well drained	B	All areas are prime farmland	5.4	0.00%
EnB2	Eldean gravelly loam, 2 to 6 percent slopes, moderately eroded	Well drained	B	All areas are prime farmland	26.7	0.10%
EuA	Eldean-Urban land complex, nearly level	Well drained		Not prime farmland	6.1	0.00%
EuB	Eldean-Urban land complex, gently sloping	Well drained	B	Not prime farmland	28.4	0.10%
FcA	Fincastle silt loam, southern ohio till plain, 0 to 2 percent slopes	Somewhat poorly drained	B/D	Prime farmland if drained	1,529.60	3.20%
FcB	Fincastle silt loam, Southern Ohio Till Plain, 2 to 4 percent slopes	Somewhat poorly drained	C/D	Prime farmland if drained	269.3	0.60%
FdA	Fincastle silt loam, bedrock substratum, 0 to 2 percent slopes	Somewhat poorly drained	C	Prime farmland if drained	724.9	1.50%
FdB	Fincastle silt loam, bedrock substratum, 2 to 6 percent slopes	Somewhat poorly drained	C	Prime farmland if drained	151.6	0.30%
Gn	Genesee loam	Well drained	B	All areas are prime farmland	1,473.20	3.10%

Go	Genesee-Urban land complex	Well drained	B	Not prime farmland	74.6	0.20%
HeE2	Hennepin-Miamian silt loams, 18 to 25 percent slopes, moderately eroded	Well drained	C	Not prime farmland	1,803.90	3.80%
HeF	Hennepin-Miamian silt loams, 25 to 50 percent slopes	Well drained	C	Not prime farmland	885.9	1.90%
HoA	Henshaw silt loam, 0 to 2 percent slopes	Somewhat poorly drained	C/D	Prime farmland if drained	13.9	0.00%
La	Landes sandy loam	Well drained	A	All areas are prime farmland	83.8	0.20%
Lg	Lanier fine sandy loam	Well drained	A	All areas are prime farmland	893.6	1.90%
MlC2	Miamian silt loam, 6 to 12 percent slopes, moderately eroded	Well drained	C	Farmland of local importance	3.1	0.00%
MnC3	Miamian clay loam, shallow to dense till substratum, 6 to 12 percent slopes, severely eroded	Well drained	D	Farmland of local importance	9.4	0.00%
MsC2	Miamian-Russell silt loams, 6 to 12 percent slopes, eroded	Well drained	C	Farmland of local importance	2,702.40	5.70%
MsD2	Miamian-Russell silt loams, 12 to 18 percent slopes, moderately eroded	Well drained	C	Farmland of local importance	431.7	0.90%

MtC2	Miamian-Russell silt loams, bedrock substratum, 6 to 12 percent slopes, eroded	Well drained	C	Farmland of local importance	1,856.60	3.90%
MuC	Miamian-Urban land complex, sloping	Well drained	C	Not prime farmland	7.1	0.00%
OcA	Ockley silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes	Well drained	B	All areas are prime farmland	212.8	0.40%
OcB	Ockley silt loam, Southern Ohio Till Plain, 2 to 6 percent slopes	Well drained	B	All areas are prime farmland	233.9	0.50%
Pa	Patton silty clay loam, 0 to 2 percent slopes	Poorly drained	B/D	Prime farmland if drained	150.6	0.30%
Pg	Pits, gravel			Not prime farmland	102.4	0.20%
PrB	Princeton sandy loam, 2 to 8 percent slopes	Well drained	B	All areas are prime farmland	1.6	0.00%
Ra	Ragsdale silty clay loam, 0 to 2 percent slopes	Poorly drained	B/D	Prime farmland if drained	347.2	0.70%
RdA	Raub silt loam, 0 to 2 percent slopes	Somewhat poorly drained	D	Prime farmland if drained	310.7	0.70%
RdB	Raub silt loam, 2 to 6 percent slopes	Somewhat poorly drained	D	Prime farmland if drained	15.6	0.00%
Rn	Ross loam, 0 to 2 percent slopes, occasionally flooded	Well drained	B	All areas are prime farmland	702.8	1.50%

RtB	Russell silt loam, 2 to 6 percent slopes	Well drained	B	All areas are prime farmland	141.1	0.30%
RvB	Russell-Miamian silt loams, 2 to 6 percent slopes	Well drained	C	All areas are prime farmland	726.8	1.50%
RvB2	Russell-Miamian silt loams, 2 to 6 percent slopes, moderately eroded	Well drained	C	All areas are prime farmland	2,950.30	6.20%
RwB	Russell-Miamian silt loams, bedrock substratum, 2 to 6 percent slopes	Well drained	D	All areas are prime farmland	769	1.60%
RwB2	Russell-Miamian silt loams, bedrock substratum, 2 to 6 percent slopes, moderately eroded	Well drained	D	All areas are prime farmland	4,213.60	8.90%
RxB	Russell-Urban land complex, gently sloping	Well drained	C	Not prime farmland	53.6	0.10%
Sh	Shoals silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	Somewhat poorly drained	B/D	Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season	16.7	0.00%
SlA	Sleeth silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes	Somewhat poorly drained	B/D	Prime farmland if drained	7.5	0.00%
St	Stonelick fine sandy loam	Well drained	A	All areas are prime farmland	782.8	1.70%
Stg4AF	Stringley sandy loam, 0 to 2 percent slopes, frequently flooded	Well drained	A	Prime farmland if protected	14	0.00%

				from flooding or not frequently flooded during the growing season		
ThA	Thackery silt loam, 0 to 2 percent slopes	Moderately well drained	C	All areas are prime farmland	42.6	0.10%
TpA	Tippecanoe silt loam, 0 to 2 percent slopes	Moderately well drained	B	All areas are prime farmland	62.7	0.10%
UnA	Uniontown silt loam, 0 to 2 percent slopes	Well drained	C	All areas are prime farmland	17.6	0.00%
UnB	Uniontown silt loam, 2 to 6 percent slopes	Well drained	C	All areas are prime farmland	75.7	0.20%
W	Water			Not prime farmland	398.8	0.80%
WbA	Warsaw loam, 0 to 3 percent slopes	Well drained	B	All areas are prime farmland	71.8	0.20%
WeA	Wea silt loam, 0 to 2 percent slopes	Well drained	B	All areas are prime farmland	217.8	0.50%
WeB	Wea silt loam, 2 to 6 percent slopes	Well drained	B	All areas are prime farmland	28.3	0.10%
WuB	Wynn-Urban land complex, gently sloping	Well drained	C	Not prime farmland	68.5	0.10%
WuC	Wynn-Urban land complex, sloping	Well drained	C	Not prime farmland	109.6	0.20%

WyB	Wynn silt loam, 2 to 6 percent slopes	Well drained	C	All areas are prime farmland	354.8	0.70%
WyB2	Wynn silt loam, 2 to 6 percent slopes, eroded	Well drained	C	All areas are prime farmland	931.3	2.00%
WyC2	Wynn silt loam, 6 to 12 percent slopes, eroded	Well drained	C	Farmland of local importance	3,613.70	7.60%
WzC3	Wynn silty clay loam, 6 to 12 percent slopes, severely eroded	Well drained	C	Farmland of local importance	84.3	0.20%
XeA	Xenia silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes	Moderately well drained	C/D	All areas are prime farmland	585.1	1.20%
XeB	Xenia silt loam, Southern Ohio Till Plain, 2 to 6 percent slopes	Moderately well drained	C	All areas are prime farmland	2,088.60	4.40%
XeB2	Xenia silt loam, Southern Ohio Till Plain, 2 to 6 percent slopes, eroded	Moderately well drained	C/D	All areas are prime farmland	552.7	1.20%
XfA	Xenia silt loam, bedrock substratum, 0 to 2 percent slopes	Moderately well drained	C	All areas are prime farmland	339.9	0.70%
XfB	Xenia silt loam, bedrock substratum, 2 to 6 percent slopes	Moderately well drained	C	All areas are prime farmland	2,106.70	4.50%
XfB2	Xenia silt loam, bedrock substratum, 2 to 6 percent slopes, moderately eroded	Moderately well drained	C	All areas are prime farmland	1,292.80	2.70%
Subtotals for Soil Survey Area					**42,090.80**	**88.90%**
Soils Summary — Franklin County, Indiana						

Map unit symbol	Map unit name	Drainage Rating	Hydrologic Soils Groups	Farmland Classification Rating	Acres in AOI	Percent of AOI
AlA	Alvin sandy loam, 0 to 2 percent slopes	Well drained	A	All areas are prime farmland	2.6	0.00%
CbC2	Carmel silt loam, 6 to 12 percent slopes, eroded	Well drained	C	Not prime farmland	21.6	0.00%
Cy	Cyclone silt loam, 0 to 2 percent slopes	Poorly drained	B/D	Prime farmland if drained	938.7	2.00%
Db	Dearborn loam, frequently flooded	Well drained	B	Not prime farmland	2.1	0.00%
EbE2	Eden flaggy silty clay, 15 to 25 percent slopes, eroded	Well drained	D	Not prime farmland	21.5	0.00%
FcB	Fincastle silt loam, 1 to 3 percent slopes	Somewhat poorly drained	C/D	Prime farmland if drained	666.8	1.40%
FfA	Fincastle-Reesville silt loams, 0 to 1 percent slopes	Somewhat poorly drained	C/D	Prime farmland if drained	521.7	1.10%
Ge	Gessie loam, sandy substratum, occasionally flooded	Well drained	B	All areas are prime farmland	1.9	0.00%
HeG	Hennepin loam, 25 to 50 percent slopes	Well drained	C	Not prime farmland	81.4	0.20%
Ht	Holton silt loam, occasionally flooded	Somewhat poorly drained	B/D	Prime farmland if drained	12.4	0.00%

MmB2	Miami silt loam, 2 to 6 percent slopes, eroded	Moderately well drained	C	All areas are prime farmland	126.5	0.30%
MmC2	Miami silt loam, 6 to 12 percent slopes, eroded	Moderately well drained	C	Not prime farmland	16.4	0.00%
MmD2	Miami silt loam, well drained, 12 to 18 percent slopes, eroded	Well drained	C	Not prime farmland	5.3	0.00%
MoC3	Miami clay loam, 6 to 12 percent slopes, severely eroded	Moderately well drained	C	Not prime farmland	102.1	0.20%
MoD3	Miami clay loam, 12 to 18 percent slopes, severely eroded	Moderately well drained	C	Not prime farmland	29.6	0.10%
Mx	Moundhaven sandy loam, occasionally flooded	Somewhat excessively drained	A	Not prime farmland	0.6	0.00%
Og	Oldenburg silt loam, occasionally flooded	Moderately well drained	B/D	All areas are prime farmland	16.3	0.00%
RuB2	Russell silt loam, 2 to 6 percent slopes, eroded	Well drained	B	All areas are prime farmland	176.7	0.40%
RvA	Russell silt loam, bedrock substratum, 0 to 2 percent slopes	Well drained	C	All areas are prime farmland	237.5	0.50%
RvB	Russell silt loam, bedrock substratum, 2 to 6 percent slopes	Well drained	C	All areas are prime farmland	153.3	0.30%
SdB	Sidell silt loam, 1 to 4 percent slopes	Well drained	C	All areas are prime farmland	175.6	0.40%
W	Water			Not prime farmland	7	0.00%

WmB	Williamstown silt loam, 2 to 6 percent slopes, eroded	Moderately well drained	C/D	All areas are prime farmland	40.8	0.10%
Wn	Wirt loam, occasionally flooded	Well drained	B	All areas are prime farmland	97.3	0.20%
WrB	Wynn silt loam, 2 to 6 percent slopes	Well drained	C	All areas are prime farmland	353.7	0.70%
WrC2	Wynn silt loam, 6 to 12 percent slopes, eroded	Well drained	C	Not prime farmland	52.4	0.10%
WyC3	Wynn silty clay loam, 6 to 12 percent slopes, severely eroded	Well drained	D	Not prime farmland	122.7	0.30%
XnA	Xenia silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes	Moderately well drained	C/D	All areas are prime farmland	671.5	1.40%
XnB2	Xenia silt loam, 2 to 6 percent slopes, eroded	Moderately well drained	B/D	All areas are prime farmland	414.6	0.90%
Subtotals for Soil Survey Area					**5,070.40**	**10.70%**

Soils Summary — Union County, Indiana

Map unit symbol	Map unit name	Drainage Rating	Hydrologic Soils Groups	Farmland Classification Rating	Acres in AOI	Percent of AOI
CxcA	Cyclone silt loam, 0 to 2 percent slopes	Poorly drained	B/D	Prime farmland if drained	6.1	0.00%
Es	Eel silt loam, 0 to 2 percent slopes, frequently flooded	Moderately well drained	A/D	Prime farmland if protected from flooding or not frequently flooded during	14.1	0.00%

				the growing season		
FeA	Fincastle-Crosby silt loams, 0 to 2 percent slopes	Somewhat poorly drained	B/D	Prime farmland if drained	9.7	0.00%
Gm	Genesee loam	Well drained	B	All areas are prime farmland	11.7	0.00%
HeF1	Hennepin loam, 25 to 35 percent slopes, slightly eroded	Well drained	C	Not prime farmland	1.9	0.00%
MmE2	Miami silt loam, 18 to 25 percent slopes, moderately eroded	Well drained	C	Not prime farmland	5.4	0.00%
MsD3	Miami soils, 12 to 18 percent slopes, severely eroded	Well drained	D	Not prime farmland	5.6	0.00%
MsE3	Miami soils, 18 to 25 percent slopes, severely eroded	Well drained	D	Not prime farmland	11.5	0.00%
MtB1	Milton silt loam, 2 to 6 percent slopes, slightly eroded	Well drained	C	All areas are prime farmland	11	0.00%
MtB2	Milton silt loam, 2 to 6 percent slopes, moderately eroded	Well drained	C	All areas are prime farmland	10.4	0.00%
RsB1	Russell silt loam, 2 to 6 percent slopes	Well drained	B	All areas are prime farmland	5.8	0.00%
RsB2	Russell silt loam, 2 to 6 percent slopes, eroded	Well drained	B	All areas are prime farmland	10.8	0.00%
RuB1	Russell and Miami silt loams, 2 to 6 percent slopes, slightly eroded	Well drained	B	All areas are prime farmland	25.6	0.10%

RuB2	Russell and Miami silt loams, 2 to 6 percent slopes, moderately eroded	Well drained	B	All areas are prime farmland	11.4	0.00%
RuC2	Russell and Miami silt loams, 6 to 12 percent slopes, moderately eroded	Well drained	B	Not prime farmland	1.2	0.00%
RvC3	Russell and Miami soils, 6 to 12 percent slopes, severely eroded	Well drained	C	Not prime farmland	16.2	0.00%
XeA	Xenia silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes	Moderately well drained	C/D	All areas are prime farmland	8	0.00%
XnA	Xenia and Celina silt loams, 0 to 2 percent slopes	Moderately well drained	C/D	All areas are prime farmland	10.3	0.00%
Subtotals for Soil Survey Area					**176.8**	**0.40%**
Totals for Area of Interest					**47,338.00**	**100.00%**