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<tbody>
<tr>
<td>ALU</td>
<td>aquatic life use</td>
</tr>
<tr>
<td>AOC</td>
<td>area of concern</td>
</tr>
<tr>
<td>GLRI</td>
<td>Great Lakes Restoration Initiative</td>
</tr>
<tr>
<td>HUC</td>
<td>hydrologic unit code</td>
</tr>
<tr>
<td>IBI</td>
<td>Index of Biotic Integrity</td>
</tr>
<tr>
<td>ICI</td>
<td>Invertebrate Community Index</td>
</tr>
<tr>
<td>Mlwb</td>
<td>Modified-Index of well being</td>
</tr>
<tr>
<td>MS4</td>
<td>municipal separate storm sewer system</td>
</tr>
<tr>
<td>NPS-IS</td>
<td>Nonpoint Source Implementation Strategy</td>
</tr>
<tr>
<td>Ohio EPA</td>
<td>Ohio Environmental Protection Agency</td>
</tr>
<tr>
<td>PSS</td>
<td>project summary sheet</td>
</tr>
<tr>
<td>QHEI</td>
<td>Qualitative Habitat Evaluation Index</td>
</tr>
<tr>
<td>TBD</td>
<td>to be determined</td>
</tr>
<tr>
<td>SRP</td>
<td>soluble reactive phosphorus</td>
</tr>
<tr>
<td>TMACOG</td>
<td>Toledo Metropolitan Area Council of Governments</td>
</tr>
<tr>
<td>TP</td>
<td>total phosphorus</td>
</tr>
<tr>
<td>U.S. EPA</td>
<td>U.S. Environmental Protection Agency</td>
</tr>
<tr>
<td>WAU</td>
<td>watershed assessment unit</td>
</tr>
<tr>
<td>WWH</td>
<td>warmwater habitat</td>
</tr>
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</table>
1 INTRODUCTION

Swan Creek is a tributary of the lower Maumee River in the greater Toledo area of northwest Ohio. The Gale Run-Swan Creek watershed assessment unit (WAU), which is hydrologic unit code (HUC) 04100009 07 03, is one of seven WAUs in the 204 square mile Swan Creek watershed (HUCs 04100009 07 and 04100009 08). The Gale Run-Swan Creek WAU is in the Lower Maumee subbasin (HUC 04100009) and the Western Basin of Lake Erie. This WAU is 16.9 square miles along Swan Creek; it begins just downstream of Ai Creek and it ends just above Blue Creek. Much of Swan Creek and Gale Run in this WAU flow through Metroparks Toledo’s Oak Openings Preserve. Most of the watershed is in Lucas County (Monclova, Providence, Swanton, and Waterville townships and the village of Whitehouse), with a tiny portion in Fulton County.

The Gale Run-Swan Creek WAU is within the Maumee Area of Concern (Maumee AOC; Figure 1) that was established as part of the Great Lakes Water Quality Agreement between the United States and Canada. The Agreement seeks to restore and protect waters of the Great Lakes and provides a framework for identifying priorities and implementing actions that improve environmental quality in designated areas of concern. In 1987, the Agreement designated 43 AOCs across the Great Lakes basin, including the Maumee AOC that drains to Lake Erie in Ohio. Ten beneficial use impairments (BUIs) were identified for the Maumee AOC.

State and federal nonpoint source (NPS) funding is now closely tied to strategic implementation-based planning that meets the U.S. Environmental Protection Agency’s (U.S. EPA) nine minimum elements of a watershed plan for impaired waters. This nonpoint source implementation strategy (NPS-IS) plan was authored by Tetra Tech, Inc., under contract with the Ohio Environmental Protection Agency (Ohio EPA). The Gale Run-Swan Creek NPS-IS plan is one of 20 NPS-IS plans being developed by Tetra Tech, the Mannik & Smith Group, and several other organizations for WAUs throughout the Maumee AOC. These 20 NPS-IS plans are being developed to address the loss of fish and wildlife habitat beneficial use impairment (BUI) of the Maumee AOC.

In 2016, the Maumee AOC Advisory Committee proposed a management action to develop nine element watershed plans that will identify projects to restore and protect fish and wildlife habitat. U.S. EPA’s Great Lakes National Program Office awarded funding to Ohio EPA to develop these 20 NPS-IS plans. Ohio EPA is providing funding to several organizations to develop the NPS-IS plans.
1.1 REPORT BACKGROUND

This document is the first of its kind to address fish and wildlife habitat in the Gale Run-Swan Creek WAU and builds upon several existing plans and reports for the area. In 2001, the Toledo Metropolitan Area Metropolitan Council of Governments (TMACOG) developed the Swan Creek Plan of Action. The plan of action prioritized the loss of wetlands and floodplains, home sewage disposal, land use and zoning, and agricultural runoff for development of implementation activities in the WAU. In addition, in June 2009, TMACOG and the Lucas Soil & Water Conservation District published a Balanced Growth plan for the Swan Creek watershed (TMACOG 2009). The plan identified Priority Agricultural Areas, Priority Conservation Areas, and Priority Development Areas across the Swan Creek watershed. Lastly, a total maximum daily load (TMDL) was developed by Ohio EPA in 2009 for the Swan Creek watershed (Ohio EPA 2009b). No watershed action plan was previously developed for this watershed.

With a focus on the loss of fish and wildlife habitat BUI, this NPS-IS plan was developed to guide local partners with addressing NPS issues in the Gale Run-Swan Creek WAU. This plan does not address point source issues, including both permitted point sources and illicit discharges. Ohio EPA regulates point sources and illicit discharges. Other programs will create plans or lists to address other impairments in an effort to restore the area to fishable, swimmable and drinkable waters that meet water quality standards. Community partners expect to create NPS-IS plans for all the impaired waters in the Maumee AOC.

1.2 WATERSHED PROFILE AND HISTORY

The Gale Run-Swan Creek WAU is in northwest Ohio in Lucas County, just to the west of the city of Toledo. Swan Creek, the largest stream in the watershed, generally flows southeast toward the village of Whitehouse. Gale Run, the second largest stream in the watershed, flows southwest from the Toledo Express Airport to its confluence with Swan Creek in Metroparks Toledo’s Oak Openings Preserve.

The Swan Creek watershed was a “historically forested and wetland buffered low gradient watershed” (Ohio EPA 2009a p. 4), however the increase of agricultural land use activities (tiled fields, straightened ditches, loss of riparian habitat etc.) in the upper Swan Creek watershed have resulted in increased stream velocities, and sediment and nutrient loading in the Gale Run-Swan Creek WAU within the middle Swan Creek watershed. Much of Gale Run-Swan Creek WAU remains forested due to the presence and protections of the Oak Openings.

No combined sewer systems, municipal separate storm sewer systems (MS4s) 2, or concentrated animal feeding operations are in the watershed.

---

2 Monclova and Waterville townships are co-permitees with the Lucas County and Others Small MS4 (permit 2G000006), which is a Phase II MS4. However, the portions of Monclova and Waterville townships in the Gale Run-Swan Creek WAU are not within the 2010 Census urbanized area.
Only one facility\(^3\) in the watershed is covered by an individual permit to discharge to surface waters. The headwaters of Gale Run flow through the Toledo Express Airport; none of the permittees at the airport discharge to this WAU\(^4\).

Portions of six municipal jurisdictions are within the *Gale Run-Swan Creek* WAU (Table 1).

**Table 1. Municipal jurisdictions**

<table>
<thead>
<tr>
<th>Municipality</th>
<th>County</th>
<th>Area (acres)</th>
<th>Relative area within WAU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monclova Township</td>
<td>Lucas</td>
<td>570</td>
<td>5%</td>
</tr>
<tr>
<td>Providence Township</td>
<td>Lucas</td>
<td>338</td>
<td>3%</td>
</tr>
<tr>
<td>Swan Creek Township</td>
<td>Fulton</td>
<td>46</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Swanton Township</td>
<td>Lucas</td>
<td>7,746</td>
<td>72%</td>
</tr>
<tr>
<td>Waterville Township</td>
<td>Lucas</td>
<td>1,247</td>
<td>12%</td>
</tr>
<tr>
<td>village of Whitehouse</td>
<td>Lucas</td>
<td>859</td>
<td>8%</td>
</tr>
</tbody>
</table>

*Note: Areas are rounded to the nearest acre and percentage point.*

Several stream segments in the WAU that are not contained within Metroparks Toledo’s Oak Openings Preserve, however, have been straightened and channelized, typically to support agricultural operations. In addition, Gale Run has been altered by culverts and channels where it runs through the Toledo Express Airport (Figure 2).

\(^{3}\) Sisters of Notre Dame (U.S. EPA ID OH0146471, Ohio EPA ID 2PT00056) operates a small sanitary wastewater treatment facility in Waterville Township. The facility discharges to Swan Creek with a design flow is 17,500 gallons per day. Sewage sludge is hauled to another facility for disposal.

\(^{4}\) Three industrial permittees at the airport are permitted to discharge to surface waters. However, the permits indicate that the receiving waterbodies are Cunningham Ditch, Hill Ditch, and Zaleski Ditch, which are in the *Lower Swan WAU* (HUC 04100009 08 03) that is adjacent to the *Gale Run-Swan Creek WAU*. 

---

Figure 2. Gale Run Creek as it flows through the Toledo Express Airport runway (left) and straightened stream channels in southern portion of the watershed (right).
When developing watershed planning and restoration plans such as this NPS-IS plan, it is important to have involvement and input from a diverse group of individuals and organizations. This group should include members of the public, private businesses and organizations, academia, governmental agencies, non-profits, and community organizations. Many partners have been working in the Gale Run-Swan Creek watershed and the greater Maumee AOC to improve water quality and increase ecological restoration. These partners focus on a diverse set of interests, from access to green space to reducing nutrient loading in Lake Erie.

Some of the key partners working in the Gale Run–Swan Creek watershed include: the Green Ribbon Initiative, Oak Openings Region Conservancy, ODNR’s Division of Forestry, The Nature Conservancy, TMACOG, Metroparks Toledo, and Partners for Clean Streams.

**Green Ribbon Initiative**

The Green Ribbon Initiative is a partnership of conservation groups working together to protect the natural beauty and biological diversity of the Oak Openings Region. The GRI work to preserve, enhance, and restore critical areas in the Oak Openings region of Northwest Ohio and Southeast Michigan.

([https://www.oakopenings.org/](https://www.oakopenings.org/))

**Oak Openings Region Conservancy**

Empowering citizens to effect changes, OORC is a voice for retention of the most valuable portions of the Oak Openings in the community

([https://www.facebook.com/OakOpeningsRegionConservancy/](https://www.facebook.com/OakOpeningsRegionConservancy/))

Representatives from Tetra Tech and the Mannik & Smith Group held a public and stakeholder meeting⁵ on April 24, 2018 to discuss NPS-IS plans for seven watersheds in the Maumee AOC, including Gale Run-Swan Creek. The purpose of this meeting was to introduce the NPS-IS project and discuss critical areas and potential projects in the watershed. Then on April 25, 2018, Tetra Tech and the Mannik & Smith Group presented a brief overview of the NPS-IS project to the TMACOG Watershed Committee at their quarterly meeting⁶. The TMACOG Watershed Committee is made up of a diverse group of stakeholders from municipal and state entities, non-profits, and private firms concerned with improving water quality in the region and Lake Erie. The purpose of the presentation was to solicit feedback on critical areas and project ideas for the NPS-IS plans being authored by Tetra Tech and MSG, including the Gale Run–Swan Creek WAU.

This report was primarily authored by Tetra Tech. Chapters 1 and 2 were written using information from the TMDL report and the biological and water quality study for Swan Creek and tributaries (Ohio EPA 2009b and 2009a), the Swan Creek Watershed Plan of Action (TMACOG 2001), and reports on the Oak Openings region (GRI 2016 and Woods et al. 2014). Critical areas were delineated by Tetra Tech. Project information in Chapter 4 was obtained by Tetra Tech from identified projects leads, including Toledo Metroparks.

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⁵ The public stakeholder meeting was attended by representatives of Black Swamp Conservancy, the city of Toledo, and Wood County Soil and Water Conservation District.

⁶ The TMACOG Watershed Committee meeting was attended by representatives of state agencies (ODNR and Ohio EPA), local agencies (Lucas County, TMACOG, city of Toledo, and Toledo Metroparks), non-profit organizations (Partners for Clean Streams), private firms (Civil & Environmental Consultants, Davey Resources Group, and the Mannik & Smith Group), and members of the public.
2 WATERSHED CHARACTERIZATION AND ASSESSMENT SUMMARY

Headwaters to Swan Creek originate in Henry, Fulton and western Lucas counties. The Gale Run-Swan Creek WAU begins just downstream of Ai Creek, west of SR-64. Swan Creek flows eastward until just above Blue Creek through a rural watershed. Ultimately, the Gale Run-Swan Creek watershed drains to the Maumee River and it is part of the Western Basin of Lake Erie. This section summarizes the watershed characterization and assessment of the Gale Run-Swan Creek WAU and is primarily based upon information presented in four published reports:

- Biological and Water Quality Study of Swan Creek and Selected Tributaries 2006. Watershed Assessment Units 04100009 070 and 04100009 080. Fulton and Lucas Counties, Ohio (Ohio EPA 2009a)
- Living in the Oak Openings: A Guide to One of the World’s Last Great Places (GRI 2016)
- Swan Creek Watershed Plan of Action (TMACOG 2001)
- Total Maximum Daily Loads for the Swan Creek Watershed (Ohio EPA 2009b)

2.1 SUMMARY OF WATERSHED CHARACTERIZATION

Gale Run is a tributary to the larger Swan Creek in Lucas County that ultimately discharge to North Maumee Bay of Lake Erie. The Gale Run-Swan Creek WAU is a rural and agricultural watershed with a significant portion of forested land located within Metroparks Toledo’s Oak Openings preserve and a smaller portion within the Maumee State Forest.

The topography of the Gale Run-Swan Creek WAU is gently sloping and soils are very poor and somewhat poorly drained. U.S. EPA defines soils in the ecoregion as “fine, poorly drained, water-worked glacial till and lacustrine sediment; also coarser end moraine and beach ridge deposits” (Woods et al. 2014). Lucas County soils were formed in “clayey and loamy lake-laid sediment and water-reworked glacial till on broad flats of an old glacial lake” (Ohio EPA 2009a). More watershed characterization information is provided in the Biological and Water Quality Study of Swan Creek and Selected Tributaries and regional 208 plan prepared by TMACOG (2017): TMACOG Areawide Water Quality Management Plan.

2.1.1 Physical and Natural Features

The Maumee AOC is in the Huron/Erie Lake Plain (level III ecoregion). The Gale Run-Swan Creek WAU is specifically within the Oak Openings (level IV) ecoregion that is described as follows (Woods et al. 2014):

The Oak Openings ecoregion is a belt of low, often wooded, sand dunes and paleo-beach ridges that are situated among the broad, nearly flat, agricultural plains of [the Maumee Lake Plains]. Well-drained, sandy soils are common and originally supported mixed oak forests and oak savanna; poorly-drained depressions with wet prairies were also found. Today, general farms, residential development, oak woodland, and sand quarries occur.

Oak Openings is generally described as oak savanna ecosystems that “are characterized by low densities of trees among grassland communities” (GRI 2016, p. 10). Oak Openings is composed of six primary natural plant communities (GRI 2016, p. 12).
About 1,200 plant species have been identified in the Oak Openings region, and of the 940 native to the region, 157 plant species are on Ohio’s Rare Species List (GRI 2016). Many plants are important to maintaining habitat to rare, threatened and endangered species. For example, Blue lupine provides habitat for the federally endangered Karner blue butterfly (GRI 2016).

2.1.2 Land Use and Protection

Upper Swan Creek and its tributaries Blue Creek and Ai Creek are predominantly rural with extensive cropland, while lower Swan Creek is urban. Middle Swan Creek, which includes the Gale Run-Swan Creek WAU, is heavily forested, as compared with the rest of the Swan Creek watershed, due to Metroparks Toledo’s Oak Openings Preserve (Figure 3).

The Gale Run-Swan Creek WAU is predominantly forested (54 percent) and agricultural (25 percent; Table 2). The northwest quarter of the WAU is within the Oak Openings Preserve and is mostly forested, while the southeast quarter of the WAU includes the village of Whitehouse and much of the agricultural land in the WAU. The northernmost tip of the watershed contains portions of the Toledo Express Airport. Overall, the Gale Run-Swan Creek WAU is 3 percent impervious and 50 percent canopy cover.

The largest public land holdings in the Gale Run-Swan Creek WAU are Metroparks Toledo’s Oak Openings Preserve (3,757 acres; 35% of WAU) and the Maumee State Forest (567 acres; 5 percent of WAU).

Table 2. Land cover in the Gale Run-Swan Creek WAU

<table>
<thead>
<tr>
<th>Land cover</th>
<th>Area (acres)</th>
<th>Area (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open water</td>
<td>101</td>
<td>1%</td>
</tr>
<tr>
<td>Developed, open</td>
<td>950</td>
<td>9%</td>
</tr>
<tr>
<td>Developed, low intensity</td>
<td>389</td>
<td>4%</td>
</tr>
<tr>
<td>Developed, medium intensity</td>
<td>87</td>
<td>1%</td>
</tr>
<tr>
<td>Developed, high intensity</td>
<td>67</td>
<td>1%</td>
</tr>
<tr>
<td>Barren land</td>
<td>16</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Deciduous forest</td>
<td>4,994</td>
<td>46%</td>
</tr>
<tr>
<td>Evergreen forest</td>
<td>803</td>
<td>7%</td>
</tr>
<tr>
<td>Shrub/scrub</td>
<td>4</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Grassland / herbaceous</td>
<td>471</td>
<td>4%</td>
</tr>
<tr>
<td>Pasture/hay</td>
<td>1,660</td>
<td>15%</td>
</tr>
<tr>
<td>Cultivated crops</td>
<td>1,059</td>
<td>10%</td>
</tr>
<tr>
<td>Woody wetlands</td>
<td>190</td>
<td>2%</td>
</tr>
<tr>
<td>Emergent herbaceous wetlands</td>
<td>18</td>
<td>&lt;1%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10,807</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Source of spatial data: Jin et al. 2013.

Notes

Areas were rounded to the nearest acre or percentage point. The Totals do not sum exactly due to rounding.

Mixed forest is not present in the Gale Run-Swan Creek WAU.
Figure 4. Land cover in the Gale Run-Swan Creek WAU.
2.2 SUMMARY OF BIOLOGICAL TRENDS

During the 2006 assessment, a single site (P11K21; Figure 5) in this WAU was in partial attainment of biological criteria for its designated aquatic life use (ALU) of warmwater habitat (WWH)\(^7\) in the Huron-Erie Lake Plains ecoregion. Ohio EPA recently collected biological and habitat data in 2017 but these data have not been fully evaluated yet. Ohio EPA last collected biological and habitat data and assessed attainment in the Gale Run-Swan Creek WAU in 2012 (Table 3) as part of baseline monitoring for Section 319(h) grants awarded by Ohio EPA. The last comprehensive assessment of the entire Swan Creek watershed occurred in 2006\(^8\). The Index of Biotic Integrity (IBI) scores met their biocriteria, while the Modified Index of well-being (MIwb) and Invertebrate Community Index (ICI) scores occasionally did not meet their biological criteria. The Qualitative Habitat Evaluation Index (QHEI) scores did not meet their target\(^9\).

Table 3. Overall biological indices scores for Swan Creek in the Gale Run-Swan Creek WAU

<table>
<thead>
<tr>
<th>RM (DA)</th>
<th>ALU</th>
<th>Year</th>
<th>IBI</th>
<th>MIwb</th>
<th>ICI</th>
<th>Status</th>
<th>QHEI</th>
<th>Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>27.1 (86) W</td>
<td>WWH</td>
<td>2012</td>
<td>41</td>
<td>8.2</td>
<td>26</td>
<td>Partial</td>
<td>58.8</td>
<td>P11W12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2017</td>
<td>--</td>
<td>--</td>
<td>38</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>25.6 (88) W</td>
<td>WWH</td>
<td>2012</td>
<td>42</td>
<td>7.8</td>
<td>36</td>
<td>Full</td>
<td>39.3</td>
<td>302119</td>
</tr>
<tr>
<td>24.7 (89) W</td>
<td>WWH</td>
<td>2006</td>
<td>35</td>
<td>6.4</td>
<td>22</td>
<td>Partial</td>
<td>40.0</td>
<td>P11K21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2012</td>
<td>35</td>
<td>7.2(^\text{ns})</td>
<td>18</td>
<td>Partial</td>
<td>51.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2017</td>
<td>44</td>
<td>8.69</td>
<td>MG(^\text{ns})</td>
<td>Full(^a)</td>
<td>52.0</td>
<td></td>
</tr>
</tbody>
</table>


Notes

ALU = aquatic life use; DA = drainage area in square miles; IBI = Index of Biotic Integrity; ICI = Invertebrate Community Index; MIwb = Modified Index of well-being; ns = non-significant departure; QHEI = Qualitative Habitat Evaluation Index; RM = river mile; W = wading; WWH = warmwater habitat.

Values in red do not meet their biological criteria or targets; values in green meet their biological criteria or targets.

a. ALU attainment status is estimated by Tetra Tech. Ohio EPA has not officially determined use attainment.

\(^7\) Biological criteria for WWH wading streams in the Huron-Erie Lake Plain ecoregion are: IBI score of 32, MIwb score of 7.3, and ICI score of 34.

\(^8\) Ohio EPA also collected fish data at site P11K21 on August 25, 1989 and October 4, 1989, and Ohio EPA collected fish data at another site on August 24, 1989 and October 4, 1989. Data from both sites from 1989 are also considered historic.

\(^9\) The QHEI target is a score of 60 (wading).
Figure 6. ALU attainment in the Gale Run-Swan Creek WAU.
2.2.1 Fish Community Health

During the 2006 comprehensive survey, only site P11K21 was evaluated. At site P11K21, Swan Creek “lacked sufficient habitat to support diverse fish communities,” green sunfish were predominant, and over 30 percent of captured fish species were pollution tolerant (Ohio EPA 2009a, p. 88). No intolerant species were captured during the 2006 assessment during either pass at any site on Swan Creek upstream of site P11K21. Finally, during the 2006 assessment at site P11K21, the following metrics scored poorly (i.e., 1 point) during both passes: percent of lithophils; total species, darter species, and percent tolerant fishes.

Ohio EPA collected data in 2012 at three sites and assessed each site’s attainment; however, the agency did not determine causes and sources of impairment or further evaluate the fish data. In 2012, fish community health was marginally good to good at the three sites (Ohio EPA 2014). In 2017, Ohio EPA collected data at site P11K21 but has not published the data or made official attainment decisions. The IBI and Mlwb scores indicate that both biological criteria were met.

2.2.2 Macroinvertebrate Community Health

During the 2006 assessment, in the upper reaches of Swan Creek, predominant organisms included midges, riffle beetles, black flies, sow bugs, and hydropsychid caddisflies (Ohio EPA 2009a, p. 77), while site P11K21 (RM 24.7) in the Gale Run-Swan Creek WAU was dominated by midges\(^{10}\), riffle beetles, and sow bugs. Assessment sites upstream and downstream of the Gale Run-Swan Creek WAU typically met biocriteria in 2006, while site P11K21 in this WAU did not meet its biocriterion. In 2006, more sensitive species and more Ephemeroptera, Plecoptera, and Trichoptera were captured at the three assessment sites downstream of this WAU.

In 2012, macroinvertebrate community health at three sites in this WAU was fair to good (Ohio EPA 2014). In 2012, which was similar to 2006, the qualitative assessment scored poorly and few mayfly taxa (Ephemeroptera) were found during the quantitative assessment (Ohio EPA 2014).

In 2017, Ohio EPA collected data at sites P11K21 and P11W12 but has not published the data or made official attainment decisions. Site P11K21 is marginally good (i.e., in non-significant departure from the biological criterion. Site P11W12 meets the biological criterion with an ICI score of 38, which is significant improvement since the ICI score of 26 from monitoring in 2012.

---

\(^{10}\) The most frequently caught macroinvertebrates were all midges: Polypedilum (P.) illinoense (22 percent), Tribelos jucundum (16 percent), and Tanytarsus glabrescens group sp 7 (13 percent).
2.2.3 Fish Habitat

Swan Creek flows through some agricultural land in the Gale Run-Swan Creek WAU and “the channel substrates are unstable consisting predominantly of sand and silt” (Ohio EPA 2009a, p. 18). Much of the upper and middle reaches of Swan Creek has fair habitat quality with “moderate to heavy amounts of silt extensively embedding the substrates” (Ohio EPA 2009, p. 66). The QHEI score at site P11K21 (RM 24.7) includes several influential modified warmwater habitat attributes (Table 4) and Ohio EPA (2009a, p. 67) describes the habitat quality as follows:

Upstream of Whitehouse Spencer Road (RM 24.7) the substrate origins were tills and rip/rap with silt being the predominant substrate type. Sinuosity was low and the stream development was poor with no riffles present. The current velocity was very slow and the maximum depth was greater than a meter, despite the absence of any significant pools within the zone. Evidence of torrential flows during storm events was obvious by the eroded and incised banks throughout the length of the sampling zone.

In 2012, none of the three sites sampled had QHEI scores that met the target score of 60. Site 300119 had poor habitat (score of 39.3) while the other two sites had fair habitat (Table 4). Little improvement occurred at site P11K21 during the 2017 assessment; the QHEI was 52, a slight increase over the 51 monitored in 2012. Habitat at site P11K21 in 2018 is shown in Figure 7.

While fish habitat quality was not assessed on Gale Run, the habitat quality along larger tributaries to Swan Creek in other WAUs was assessed and the habitat quality was very poor to fair.

Figure 7. Swan Creek south of Ranger Station in Oak Openings, looking south west. Site P11K21.
### Table 4. QHEI matrix with WWH and modified warmwater habitat attributes

<table>
<thead>
<tr>
<th>Key QHEI component</th>
<th>WWH attributes</th>
<th></th>
<th>MWH attributes</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>High influence</td>
<td></td>
<td>Moderate influence</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>No. of WWH attributes</td>
<td></td>
<td>No. of high influence MWH attributes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Channelization or No recovery</td>
<td></td>
<td>Recovering channel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Silt or Muck substrates</td>
<td></td>
<td>Heavy/Moderate silt cover</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No sinuity</td>
<td></td>
<td>Sand substrate (foot)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sparse/No cover</td>
<td></td>
<td>Hardpan substrate origin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximum depth &lt; 40 centimeters</td>
<td></td>
<td>Low sinuosity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Only 1 or 2 cover types</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Intermediate/Poor pools</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No fast current</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>High/Moderate embeddedness</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>High/Moderate riffle embeddedness</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No riffle</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No. of moderate influence MWH attributes</td>
</tr>
<tr>
<td>Rm</td>
<td>Year</td>
<td>QHEI score</td>
<td>Gradient (foot/mile)</td>
<td>Not channelized or Recovered</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Boulder, Cobble, or Gravel substrates</td>
<td>Good/Excellent development</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Excellent/Moderate cover</td>
<td>Fast current/Edies</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Low/Normal embeddedness</td>
<td>Maximum depth &gt; 40 centimeters</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Maximum depth embeddedness</td>
<td>Low/Normal embeddedness</td>
</tr>
<tr>
<td>27.1</td>
<td>2012</td>
<td>58.8</td>
<td>1.86</td>
<td>●</td>
</tr>
<tr>
<td>25.6</td>
<td>2012</td>
<td>39.3</td>
<td>2.39</td>
<td>●</td>
</tr>
<tr>
<td>24.7</td>
<td>2006</td>
<td>40.0</td>
<td>4.50</td>
<td>●</td>
</tr>
<tr>
<td>24.7</td>
<td>2012</td>
<td>49.0</td>
<td>2.39</td>
<td>●</td>
</tr>
</tbody>
</table>


Notes

- **MWH** = modified warmwater habitat; **QHEI** = Qualitative Habitat Evaluation Index; **RM** = river mile; **WWH** = warmwater habitat.
- The values in red do not meet their target.

12
2.3 SUMMARY OF POLLUTION CAUSES AND ASSOCIATED SOURCES

Ohio EPA (2009a) identified the causes and sources of ALU impairment to the Swan Creek segment within the Gale Run-Swan Creek WAU as direct habitat alteration, nitrate/nitrite, and sedimentation siltation from crop production. All six water column samples collected at site P11K21 (RM 24.7) exceed the total phosphorus (TP; 0.10 mg/L) and nitrate+nitrite (1.0 mg/L) targets; the single sample collected at site P11P11 (RM 25.99) also exceeds the two nutrient targets.

2.3.1 Crop production

Cropland activities such as plowing or tilling fields can result in de-vegetated, exposed soil that is susceptible to erosion. Agricultural drainage and tile systems used on the majority of the cropland in the area are also contributing to the degradation of fish and macroinvertebrate community health. Drain tiles, by design, create a direct connection between agricultural land and surface waters by quickly removing water from agricultural fields through a conduit. This disruption of surface water flow can cause increased peak flows and velocities in the streams to which tiles discharge, both of which increase erosion and sedimentation. In addition, if left untreated, tile-water frequently contains high levels of sediment, nutrients and bacteria from cropland it flows over, which is then deposited in streams or ditches and can contribute to sedimentation, bacteria, nitrate and habitat degradation issues.

Nitrogen is a common component of agricultural fertilizers used to enhance crop health and increase yield. Over application of fertilizer, however, can result in excess nitrate/nitrite in nearby waterbodies via runoff. Both compounds are easily transported in runoff when fertilizer “is added to the soil at rates exceeding what the natural environment removes” (TMACOG 2001, p. 12). Excess levels of nutrients (such as nitrate) can encourage eutrophic conditions and reduce dissolved oxygen levels. This limits the number of aquatic species to only those that can tolerate these harsh conditions.

2.3.2 On-site treatment systems

On-site treatment systems that function properly are not a source of bacteria to surface waters. If a system fails hydraulically through surface breakouts or hydrogeologically from inadequate soil filtration, however, untreated or partially treated sewage is leaked into the environment and is a source of bacteria to surface waters. Many of the previously un-sewered areas in Lucas County have been sewered in response to the growing population in the area, however, the elimination of failing septic systems is an ongoing need and failed septic systems are believed to be major contributors to bacterial level in Swan Creek (TMACOG 2017).

2.4 ADDITIONAL INFORMATION

Load reduction goals presented in this NPS-IS plan are based upon the achievement of the Annex 4 goal of 40 percent reductions in TP and soluble reactive phosphorus (SRP) loading (Table 5). Load goals were set for the Maumee River at Waterville (6,330 square miles) based upon 40 percent reductions from the 2008 baseline year (GLWQA 2015; Ohio Lake Erie Commission 2018; U.S. EPA 2017).

<table>
<thead>
<tr>
<th>Phosphorus</th>
<th>Baseline load (MT)</th>
<th>Goal load (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual TP</td>
<td>3,812</td>
<td>2,287</td>
</tr>
<tr>
<td>Spring TP</td>
<td>1,414</td>
<td>860</td>
</tr>
<tr>
<td>Spring SRP</td>
<td>302</td>
<td>186</td>
</tr>
</tbody>
</table>


The unit area loads for the Maumee River basin are 2.07 pounds per acre (lb/ac) of annual TP, 0.769 lb/ac spring TP, and 0.164 lb/ac spring SRP.
3 CONDITIONS & RESTORATION STRATEGIES FOR THE GALE RUN-SWAN CREEK WAU CRITICAL AREAS

3.1 OVERVIEW OF CRITICAL AREAS

Sampling locations along Swan Creek are not in full attainment of the designated ALUs:

- **Full attainment**: Two sites (302119 and P11K21) are in full attainment of WWH biological criteria for the Huron-Erie Lake Plain ecoregion (wading-sized). However, both sites are ‘threatened’. Site 302119 has a QHEI score of 39.25, which is poor. Site P11K21 has a qualitative macroinvertebrate score of marginally good (i.e., nonsignificant departure from biological criteria) and a QHEI score of 52, which is fair.

- **Partial attainment**: One site (P11W12) is in partial attainment WWH of biological criteria for the Huron-Erie Lake Plain ecoregion (wading-sized). However, the partial attainment was due to an ICI score of 26 in 2012 and 2017 data yielded an ICI score of 38 that meets the biological criterion. Since the 2012 QHEI was 58.8, which is just below the target of 60 and no new data are available, this site is considered ‘threatened’.

- **Non-attainment**: No sites are in non-attainment.

Three critical areas have been identified to address the NPS issues that are believed to be causing the impairments (Figure 8). Critical areas #1 and #2 are along Swan Creek, while critical area #3 is prioritized agricultural land throughout the Gale Run-Swan Creek WAU.
Critical Areas
- Riparian Corridor downstream of the Oak Openings Preserve (CA #1)
- Riparian Corridor in the Oak Openings Preserve (CA #2)
- Agricultural Land (CA #3)

Note: Prioritized areas in CA #1 and CA #3 are not identified by unique symbology in this map.

Public Land
- Maumee State Forest
- Oak Openings Preserve

Monitoring Sites

ALU Attainment
- Full
- Partial
- NON

Figure 8. Critical areas in the Gale Run-Swan Creek WAU.
3.2 CRITICAL AREA #1: CONDITIONS, GOALS, & OBJECTIVES

3.2.1 Detailed Characterization

The Riparian Corridor downstream of the Oak Openings Preserve (Critical Area #1) is a 300-foot buffer (150-feet on each bank) along 4.2-river miles of Swan Creek from OH-295 downstream (east) to the WAU outlet near the Anthony Wayne High School (Figure 9). Swan Creek is a wading-size stream and is designated WWH. The stream is an open channel that meanders along rural residential properties, pastures, row crop fields, and a few ponds. Wockerly Road is adjacent to a few segments of Swan Creek and the stream occasionally flows beneath road bridges. Transportation infrastructure, structures, and ponds were excluded from the 300-foot buffer, which is a total of 135-acres.

The Riparian Corridor downstream of the Oak Openings Preserve is predominantly forested (42 percent), woody wetlands (23 percent), and agricultural (18 percent; Table 6); it has 1 percent impervious cover and 59 percent canopy cover. The critical area includes areas prioritized for three types of restoration projects. These areas were delineated in GIS based upon a visual review of aerial imagery and land cover.

- **Restore riparian forest**: 11.5 of acres in the 300-foot buffer appear to be vacant and without trees. These areas exclude crop land and fenced pasture. If such acreage is not used for any activity, then the riparian forest should be restored.

- **Remove crop land from production**: 10.7 of acres in the 300-foot buffer are active row crop land. The crop land within 150-feet of Swan Creek and drains directly (via tiles or overland flow) to Swan Creek. This crop land should be restored to native habitat, especially if the crop land is of marginal production quality.

- **Remove pasture land from production**: 2.3 of acres in the 300-foot buffer appear to be fenced pasture land. The pasture land within 150-feet of Swan Creek should be restored to native habitat, especially if the pasture land is of marginal production quality.

<table>
<thead>
<tr>
<th>Land cover</th>
<th>Area (acres)</th>
<th>Area (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open water</td>
<td>&lt;1</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Developed, open</td>
<td>7</td>
<td>5%</td>
</tr>
<tr>
<td>Developed, low intensity</td>
<td>4</td>
<td>3%</td>
</tr>
<tr>
<td>Developed, medium intensity</td>
<td>&lt;1</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Deciduous forest</td>
<td>56</td>
<td>42%</td>
</tr>
<tr>
<td>Evergreen forest</td>
<td>&lt;1</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Grassland / herbaceous</td>
<td>12</td>
<td>9%</td>
</tr>
<tr>
<td>Pasture/hay</td>
<td>3</td>
<td>3%</td>
</tr>
<tr>
<td>Cultivated crops</td>
<td>20</td>
<td>15%</td>
</tr>
<tr>
<td>Woody wetlands</td>
<td>31</td>
<td>23%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>135</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

**Source of spatial data:** Jin et al. 2013.

**Notes:** Areas were rounded to the nearest acre or percentage point. The *Totals* do not sum exactly due to rounding.

Developed high-intensity, barren land, mixed forest, and shrub/scrub are not present in Critical Area #1.

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11 The following were excluded from the 300-foot buffer: roads, bridges and their approaches, homes, driveways, residential pools, commercial structures, parking lots, large agricultural structures, lakes, docks, and boat storage areas. Very small structures, including sheds, were included within the 300-foot buffer.
Figure 9. **Riparian Corridor downstream of the Oak Openings Preserve** (Critical Area #1).
3.2.2 Detailed Biological Condition

Ohio EPA (2009a) evaluated fish and macroinvertebrate community health at site P11K21 (RM 24.7) using data collected in 2006. Refer to Section 2.2.1 for a summary of fish community health and to Section 2.2.2 for a summary of macroinvertebrate community health.

Following publication of the TSD (Ohio EPA 2009a), two sites in this critical area were sampled as part of baseline monitoring for Section 319(h) grants; these data are summarized in Table 7 and Table 8. Ohio EPA (2014) found fish and macroinvertebrate community health to both be good at site 302119 (RM 25.6) and to be marginally good and fair (respectively) at site P11K12 (RM 24.7). Habitat was poor at site 302119 and good at site P11K12.

In 2017, Ohio EPA sampled site P11K21 (RM 24.7). Ohio EPA has not yet evaluated fish or macroinvertebrate community health using the 2017 data. Fish community health improved from 2006 to 2012 to 2017. The IBI score increased to 44 (from 42 in 2012 and 35 in 2006) and the MIwb score increased to 8.7 (from 7.2 in 2012 and 6.4 in 2006). Total species decreased slightly to 19 (from 22 in 2012 and 16 in 2006).

### Table 7. Fish community health and habitat data – Critical Area #1

<table>
<thead>
<tr>
<th>RM</th>
<th>DA</th>
<th>QHEI</th>
<th>Total species</th>
<th>IBI</th>
<th>MIwb</th>
<th>Predominant species (percent of catch)</th>
<th>Narrative evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.6</td>
<td>88</td>
<td>39.3</td>
<td>16</td>
<td>42</td>
<td>7.8</td>
<td>Greenside darter (34%), Johnny darter (27%), Bluntnose minnow (17%), Blackside darter (7%)</td>
<td>Good</td>
</tr>
<tr>
<td>24.7</td>
<td>89</td>
<td>51.0</td>
<td>22</td>
<td>35</td>
<td>7.2ns</td>
<td>Redfin shiner (33%), Bluntnose minnow (33%), Rock bass (7%), Johnny darter (5%), Green sunfish (5%)</td>
<td>Good</td>
</tr>
</tbody>
</table>


Notes
DA = drainage area, in square miles; IBI = Index of Biotic Integrity; MIwb = Modified Index of well-being; ns = non-significant departure from biological criterion; QHEI = Qualitative Habitat Evaluation Index; RM = river mile.

Green scores meet the IBI biological criteria or QHEI target. Red scores do not meet the IBI biological criteria or QHEI target.

Macroinvertebrate community health also improved from 2006 to 2017. From 2006 through 2012 to 2017, the predominance of midges decreased, while the abundance of mayflies and damselflies increased. The improvement may be due to a recent restoration project immediately downstream of site P11K21. Macroinvertebrate community health is anticipated to continue to improve.
Table 8. Macrionvertebrate community health data – Critical Area #1

<table>
<thead>
<tr>
<th>RM</th>
<th>DA</th>
<th>Year</th>
<th>ICI</th>
<th>No. of taxa</th>
<th>Predominant species</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total</td>
<td>EPT</td>
</tr>
<tr>
<td>25.6</td>
<td>88</td>
<td>2012</td>
<td>36</td>
<td>66</td>
<td>4</td>
</tr>
<tr>
<td>24.7</td>
<td>89</td>
<td>2006</td>
<td>22</td>
<td>51</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2012</td>
<td>18</td>
<td>54</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2017</td>
<td>MG</td>
<td>67</td>
<td>8</td>
</tr>
</tbody>
</table>


Notes

Cold = coldwater taxa; DA = drainage area, in square miles; EPT = Ephemeroptera, Plecoptera, and Trichoptera; ICI = Invertebrate Community Index

MG = marginally good; ns = nonsignificant departure; RM = river mile.

Green scores meet the ICI biological criteria. Red scores do not meet the ICI biological criteria.

a. Cheumatopsyche sp. (22%; caddisflies), Polypedilum (Uresipedia) flavum (12%; midges), Stenacron sp. (35%; mayflies).

b. Crangonyx (3%; crustaceans), Microtendipes pedellus group (3%; midges), Paranytarsus sp. (4% midges), Polypedilum illinonse (22%; midges), Stenacron sp (6%; mayflies), Tribelos jucundum (16%, midges), and Tanytarsus glabescens group sp. 7 (13%; midges).

c. Dicrotendipes neomodestus (9%; midges), Glypotetendipes sp. (7%; midges), Microtendipes pedellus group (24%; midges), Parakiifferiella n.sp 1 (18%; midges) and Oligochaeta (11%; worms).

d. Argia sp. (7%; damselflies), Dicrotendipes neomodestus (14%; midges), Paranytarsus sp (3%; midges), Polypedilum illinonse (22%; midges), Polypedilum (Tripodura) scalaenum group (6%; midges), Stenacron sp (6%; mayflies), Tanytarsus glabescens group sp. 7 (10%; midges), and Tribelos jucundum (13%; midges).

3.2.3 Detailed Causes and Associated Sources

As discussed in Section 2.3, Ohio EPA (2009a) only identified the causes and sources of impairment at site P11K21 (RM 24.7) on Swan Creek. Ohio EPA (2014) did not identify causes and sources using the 2012 biological and habitat data. Ohio EPA will eventually evaluate the 2017 data and publish causes and sources in a future TSD.

In-stream habitat throughout the critical area is degraded by several symptoms of development. In agricultural areas, row crop land and grazed pasture are within the riparian corridor. Crop production also results in flow alteration (flashiness from tile drainage). In the residential and commercial areas, homes, businesses, and roads were constructed in the riparian corridor. Also, transportation infrastructure results in direct habitat alteration (from channelization and bridge culverts).

3.2.4 Goals and Objectives for Critical Area #1

As explained in detail above and by Ohio EPA (2009a), Critical Area #1 is primarily impaired by direct habitat alteration, nitrate/nitrite, and sedimentation/siltation from crop production. Riparian and in-stream habitat are also impaired by residential and commercial development and transportation infrastructure. Restoration of the riparian corridor and in-stream habitat will be needed to improve aquatic community health in Critical Area #1. Along some segments, Swan Creek is channelized and entrenched; restoration of stream channel morphology and reconnection to the floodplain will provide in-stream and riparian habitat for wildlife.

Ohio EPA (2009a) identified causes of impairment to the Gale Run-Swan Creek WAU that are derived in part from upstream sources. Installation of agricultural best management practices and restoration of stream morphology and hydrology in the upstream Ai Creek and Fewless Run-Swan Creek WAUs will likely decrease sediment- and nitrogen-loading to the Gale Run-Swan Creek WAU. The text box on the next page identifies some of the recommended objectives for NPS-IS plans being developed for these WAUs.
3.2.4.1 Goals

The overall NPS restoration goals of any NPS-IS plan are to improve IBI, Mlw, ICI, and QHEI scores such that a waterbody is brought into full attainment of the designated ALU. Both monitoring sites are in full attainment but are ‘threatened’. The sites' habitat quality is poor to fair. Additionally, qualitative macroinvertebrate community health is marginally good, which is nonsignificant departure from biological criteria. Therefore, the goals for Riparian Corridor downstream of the Oak Openings Preserve (Critical Area #1) of the Gale Run-Swan Creek watershed are to improve IBI, ICI, and QHEI scores at site P11K21 (RM 24.7) so that the site will maintain the full attainment that is just recent and barely achieved. Additionally, site 302119 (RM 25.6) is threatened by very degraded habitat and fourth goal is to improve the QHEI score at this site. These goals are specifically to:

- **Goal 1.** Achieve an IBI score of 32 at site P11K21 (RM 24.7) on Swan Creek.
  - Achieved: Site currently has a score of 44.
- **Goal 2.** Achieve an Mlw score of 7.3 at site P11K21 (RM 24.7) on Swan Creek.
  - Achieved: Site currently has a score of 8.7.
- **Goal 3.** Achieve an ICI score of 34 at site P11K21 (RM 24.7) on Swan Creek.
  - Not achieved: Site currently has a score of marginally good.
- **Goal 4.** Achieve a QHEI score of 60 at P11K21 (RM 24.7) on Swan Creek.
  - Not Achieved: Site currently has a score of 52.
- **Goal 5.** Achieve a QHEI score of 60 at 302119 (RM 25.6) on Swan Creek.
  - Not Achieved: Site currently has a score of 39.3.

3.2.4.2 Objectives

To achieve the overall NPS restoration goal of full attainment, the following objectives needs to be achieved within the Riparian Corridor downstream of the Oak Openings Preserve (Critical Area #1):

- **Objective 1** Restore riparian forest along 11.5 of acres in the 300-foot buffer along Swan Creek. Native trees should be planted in the unused vacant land.
  - Restore and protect riparian habitat (Ohio EPA 2013; Goal 2.03.01)
  - Increase native shrub and tree plantings in riparian areas (Ohio EPA 2013; Goal 2.03.04)
  - Protect and restore riparian forested acres (Ohio EPA 2013; Goal 3.04.02)

- **Objective 2** Do not farm 10.7 of acres that drain directly to Swan Creek and are within the 300-foot buffer along Swan Creek (i.e., within 150-feet of Swan Creek)
  - Encourage riparian setback and development standards and codes (Ohio EPA 2013; Goal 2.05.01)
  - Establish voluntary no-mow zones (Ohio EPA 2013; Goal 2.05.02)
  - Establish voluntary no plow zones in riparian areas (Ohio EPA 2013; Goal 3.04.03)

---

12 If Swan Creek is not suitable for placement of the in-stream modified Hester-Dendy substrate sampler, then Goal 3 is to achieve a narrative score of good.
Objective 3  Do not graze livestock along 2.3 of acres within the 300-foot buffer along Swan Creek.

- Encourage riparian setback and development standards and codes (Ohio EPA 2013; Goal 2.05.01)
- Improve grazing strategies (Ohio EPA 2013; Goal 3.02.03)

As these objectives are implemented, water quality monitoring (both project-related and regularly scheduled monitoring) will be conducted to determine progress toward meeting the identified goals (i.e., water quality standards). These objectives will be reevaluated and modified, as necessary. When reevaluating, Ohio’s Nonpoint Source Management Plan Update (Ohio EPA 2013) will be referenced, which has a complete listing of all eligible NPS management strategies.

### Upstream NPS-IS plans

Upstream WAUs (Ai Creek and Fewless Run-Swan Creek) within the larger Swan Creek watershed are also undergoing NPS-IS plan development. Example projects from upstream WAUs include:

- Cover crops
- Tile drainage control structures
- Treatment filter structures
- Ditch restoration and modification

- Buffers and filter strips
- Wetlands to treat agricultural runoff
- Restoration of historic hydrology

Projects included in NPS-IS plans for these largely agricultural WAUs are expected to have positive water quality and habitat impacts on the downstream Gale Run-Swan Creek WAU with respect to sediment and nitrate/nitrite load and with hydrology.
3.3 CRITICAL AREA #2: CONDITIONS, GOALS, & OBJECTIVES

3.3.1 Detailed Characterization

The Riparian Corridor in the Oak Openings Preserve (Critical Area #2) is a 300-foot buffer (150-feet on each bank) along 5.1-river miles of Swan Creek from east of Swanton Reservoir downstream (east) to OH-295 (Figure 10). Swan Creek is a wading-size stream and is designated WWH. The stream is an open channel that meanders along its floodplain. A few structures operated by Toledo Metroparks (e.g., the ranger station off Wilkins Road) and a few bridges (e.g., Reed Road bridge) were excluded from the 300-foot buffer.

Gale Run is excluded from this critical area because Mallard Lake is a barrier to fish migration. Upstream of the Oak Openings Preserve, Gale Run flows through several culverts under roadways. Additionally, Ohio EPA has never collected biological data from Gale Run.

The Riparian Corridor in the Oak Openings Preserve is predominantly forested (64 percent) and woody wetlands (32 percent; Table 9). This critical area is less than 1 percent impervious cover and has 77 percent canopy cover.

<table>
<thead>
<tr>
<th>Land cover</th>
<th>Area (acres)</th>
<th>Area (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed, open</td>
<td>4</td>
<td>2%</td>
</tr>
<tr>
<td>Developed, low intensity</td>
<td>&lt;1</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Deciduous forest</td>
<td>109</td>
<td>62%</td>
</tr>
<tr>
<td>Evergreen forest</td>
<td>2</td>
<td>1%</td>
</tr>
<tr>
<td>Shrub/scrub</td>
<td>1</td>
<td>1%</td>
</tr>
<tr>
<td>Grassland / herbaceous</td>
<td>&lt;1</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Woody wetlands</td>
<td>58</td>
<td>33%</td>
</tr>
<tr>
<td>Emergent herbaceous wetlands</td>
<td>2</td>
<td>1%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>176</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Source of spatial data: Jin et al. 2013.

Notes

Areas were rounded to the nearest acre or percentage point. The Totals do not sum exactly due to rounding.

Open water, developed medium intensity, developed high intensity, barren land, mixed forest, pasture/hay, and cultivated crops are not present in Critical Area #2.

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13 Mallard Lake itself may act as a barrier of lotic fish species migration from Swan Creek to Gale Run upstream of Mallard Lake. The outlet structure of Mallard lake is also a barrier to migration.
Figure 10. Riparian Corridor in of the Oak Openings Preserve (Critical Area #2).
3.3.2 Detailed Biological Condition

No intensive study or historic data are available for sites in this critical area. Ohio EPA (2009a) evaluated fish and macroinvertebrate community health at site P11K21 (RM 24.7) using data collected in 2006; however, Ohio EPA did not sample biology or habitat from within Critical Area #2 in 2006. The Gale Run-Swan Creek WAU was listed based upon evaluations of data collected at site P11K21; refer to Section 2.2.1 and Section 2.2.2 for summaries of fish and macroinvertebrate communities' health at site P11K21.

In 2012, Ohio EPA (2014) sampled three locations on Swan Creek in the Gale Run-Swan Creek WAU, including site P11W12 (RM 27.1) that is in the Riparian Corridor in the Oak Openings Preserve. Ohio EPA (2014) found fish and macroinvertebrate community health to be good and fair (respectively), and the agency found habitat to be fair.

<table>
<thead>
<tr>
<th>RM</th>
<th>DA</th>
<th>QHEI</th>
<th>Total species</th>
<th>IBI</th>
<th>Mlbw</th>
<th>Predominant species (percent of catch)</th>
<th>Narrative evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>27.1</td>
<td>86</td>
<td>58.8</td>
<td>22</td>
<td>41</td>
<td>8.2</td>
<td>Greenside darter (25%), Redfin shiner (23%), Bluntnose minnow (13%), Johnny darter (12%), Blackside darter (5%)</td>
<td>Good</td>
</tr>
</tbody>
</table>


Notes

DA = drainage area, in square miles; IBI = Index of Biotic Integrity; Mlbw = Modified Index of well-being; ns = non-significant departure from biological criterion; QHEI = Qualitative Habitat Evaluation Index; RM = river mile.

Green scores meet the IBI biological criteria or QHEI target. Red scores do not meet the IBI biological criteria or QHEI target.

Impairment at site P11W12 (RM 27.1) in 2012 was due to macroinvertebrate community health. During the 2012 sampling, only one taxa each of mayflies and caddisflies were recovered from the instream, artificial substrate sampler. Such results yielded low metric scores for number of mayfly taxa (0 points), percent mayfly composition (2 points), and number of caddisfly taxa (2 points). Mayflies are pollution sensitive and their low abundance indicates environmental disturbance and lower quality macroinvertebrate community health. About 61 percent of species recovered were other Diptera and non-insects (e.g., flatworms, hydra), which is a high percentage (2 points) indicative of poor water quality. Finally, while 47 taxa were captured during the qualitative sampling, only 8 taxa were EPT (2 points); fewer EPT taxa indicate poorer water quality and poorer habitat.

Macroinvertebrate community health improved by the 2017 sampling. More species, including EPT, were collected and the ICI attained the biological criterion (Table 11). Seven sensitive species were collected in 2017.
Table 11. Macroinvertebrate community health data – Critical Area #2

<table>
<thead>
<tr>
<th>RM</th>
<th>DA</th>
<th>Year</th>
<th>ICI</th>
<th>No. of taxa</th>
<th>Predominant species</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total</td>
</tr>
<tr>
<td>27.1</td>
<td>86</td>
<td>2012</td>
<td>26</td>
<td>66</td>
<td>8</td>
</tr>
<tr>
<td>2017</td>
<td>38</td>
<td></td>
<td></td>
<td>74</td>
<td>14</td>
</tr>
</tbody>
</table>


Notes
- DA = drainage area, in square miles; Cold = coldwater species; ICI = Invertebrate Community Index; EPT = qualitative Ephemeroptera, Plecoptera, and Trichoptera; LF = low-fair; RM = river mile.

Green scores meet the ICI biological criteria. Red scores do not meet the ICI biological criteria.

a. *Cheumatopsyche* sp (13%; caddisflies), *Microtendipes pedellus* group (10%; midges), *Macronychus glabratus* (9%; riffle beetle), *Polypedilum (Tripodura) scalaenum* group (7%; midges), *Stenacron* sp. (6%; mayflies), *Hydra* sp. (5%), and *Turbellaria* (5%; flatworms).

b. *Cheumatopsyche* sp (34%; caddisflies), *Polypedilum (Uresipedilum) flavum* (15%; midges), *Acerpenna pygmaea* (12%; mayflies), *Baetis intercalaris* (11%; mayflies), *Cricotopus bicinctus* (5%; midges), *Rheotanytarsus* sp. (4% midges), and *Tanytarsus giblarescens* group sp. 7 (2%; midges).

### 3.3.3 Detailed Causes and Associated Sources

As discussed in Section 2.3, Ohio EPA (2009a) only identified the causes and sources of impairment at site P11K21 (RM 24.7) on Swan Creek. Ohio EPA (2014) did not identify causes and sources using the 2012 biological and habitat data. Ohio EPA will eventually evaluate the 2017 data and publish causes and sources in a future TSD.

In-stream and riparian habitat in this critical area are degraded by historic land use practices (including entrenchment of Swan Creek) and upstream agricultural development. Upstream crop production results in flow alteration (flashiness from tile drainage). In a few locations, transportation infrastructure results in direct habitat alteration (from channelization and bridge culverts).

### 3.3.4 Goals and Objectives for Critical Area #2

As explained in detail above and by Ohio EPA (2009a), the WAU is primarily impaired by direct habitat alteration, nitrate/nitrite, and sedimentation/siltation from crop production. Riparian and in-stream habitat are also impaired by historic land use patterns and upstream agricultural production. Restoration of the riparian corridor, and in-stream habitat will be needed to improve aquatic community health in Critical Area #2. Along some segments, Swan Creek is entrenched and reconnection to the floodplain will provide in-stream and riparian habitat for wildlife.

#### 3.3.4.1 Goals

The overall NPS restoration goals of any NPS-IS plan are to improve IBI, MIwb, ICI, and QHEI scores such that a waterbody is brought into full attainment of the designated ALU. While the site is anticipated to achieve full attainment, historic partial-attainment in this critical area was due to *marginally good* fish and *fair* macroinvertebrate community health scores. Additionally, QHEI scores are below the target. Therefore, the goals for *Riparian Corridor downstream of the Oak Openings Preserve* (Critical Area #1) of the *Gale Run-Swan Creek* watershed are to improve IBI, ICI, and QHEI scores at site P11W12 (RM 27.1) so that the site will improve and maintain full attainment of the designated ALU.
Goal 1. Achieve an IBI score of 32 at site P11W12 (RM 27.1) on Swan Creek.
   - Achieved: Site currently has a score of 41.

Goal 2. Achieve an MIwb score of 7.3 at site P11W12 (RM 27.1) on Swan Creek.
   - Achieved: Site currently has a score of 8.2.

Goal 3. Achieve an ICI score of 34 at site P11W12 (RM 27.1) on Swan Creek.
   - Achieved: Site currently has a score of 38.

Goal 4. Achieve a QHEI score of 60 at P11W12 (RM 27.1) on Swan Creek.
   - Not Achieved: Site currently has a score of 58.8.

3.3.4.2 Objectives

To achieve the overall NPS restoration goal of full attainment, the following objectives needs to be achieved within the Riparian Corridor in the Oak Openings Preserve (Critical Area #2):

Objective 1 
Restore 2,700 lineal feet\(^{14}\) of degraded streambank and reconnect the entrenched segments to their floodplain.
   - Stabilize eroding streambanks using bio-engineering methods (Ohio EPA 2013; Goal 2.03.02)
   - Manage invasive species (Ohio EPA 2013; Goal 2.01.02)

Objective 2 
Maintain and improve riparian forest along 18 of acres\(^{15}\) in the 300-foot buffer along Swan Creek.
   - Restore and protect riparian habitat (Ohio EPA 2013; Goal 2.03.01)
   - Protect and restore riparian forested acres (Ohio EPA 2013; Goal 3.04.02)

As these objectives are implemented, water quality monitoring (both project-related and regularly scheduled monitoring) will be conducted to determine progress toward meeting the identified goals (i.e., water quality standards). These objectives will be reevaluated and modified, as necessary. When reevaluating, Ohio's Nonpoint Source Management Plan Update (Ohio EPA 2013) will be referenced, which has a complete listing of all eligible NPS management strategies.

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\(^{14}\) Ten percent of the length of Swan Creek in Critical Area #2. Field-verification may identify additional length that needs restoration.

\(^{15}\) Ten percent of the area of Critical Area #2. Field-verification may identify additional length that needs restoration.
3.4 CRITICAL AREA #3: CONDITIONS, GOALS, & OBJECTIVES

3.4.1 Detailed Characterization

The Agricultural Lands (Critical Area #3) is composed of almost 1,600 acres of row crop land, orchards, plant nurseries, and grazed pasture land in the Gale Run-Swan Creek WAU (Figure 11). Two areas of row crop land were prioritized: 137 acres along Swan Creek (Figure 12) and 146 acres along Gale Run (Figure 13). After the prioritized cropland areas are addressed, via adaptive management, it may then be necessary to re-prioritize and address other agricultural lands in this critical area.

Portions of Agricultural Lands (Critical Area #3) in the 300-foot buffer of Swan Creek overlap with Riparian Corridor downstream of the Oak Openings Preserve (Critical Areas #1). While certain portions overlap, the objectives of the two critical areas are generally different (see Sections 3.2.4.2 and 3.4.4.2 for discussions of objectives).

Swan Creek is a wading-size stream and is designated WWH. The stream is an open channel that meanders along its floodplain. Except in the Oak Openings Preserve and Maumee State Forest, series of open ditches throughout the WAU connect the Agricultural Lands to Swan Creek and Gale Run. The two prioritized areas are composed of crop land parcels that are directly connected to Swan Creek or Gale Run; tiles in these parcels and overland flow from these parcels directly discharges to either Swan Creek or Gale Run.

The Agricultural Lands is predominantly cultivated crops (46 percent) and pasture/hay (31 percent; Table 12). All of the parcels in this critical area are predominantly crop land, pasture land, orchards, or nurseries. However, many such parcels include small areas of other land covers and uses; for example, crop land parcels sometimes also contain residential structures. The Agricultural Lands critical area is about 1 percent impervious cover and has 16 percent canopy cover.

<table>
<thead>
<tr>
<th>Land cover</th>
<th>Area (acres)</th>
<th>Area (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open water</td>
<td>10</td>
<td>1%</td>
</tr>
<tr>
<td>Developed, open</td>
<td>67</td>
<td>4%</td>
</tr>
<tr>
<td>Developed, low intensity</td>
<td>24</td>
<td>1%</td>
</tr>
<tr>
<td>Developed, medium intensity</td>
<td>2</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Developed, high intensity</td>
<td>1</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Deciduous forest</td>
<td>213</td>
<td>13%</td>
</tr>
<tr>
<td>Evergreen forest</td>
<td>22</td>
<td>1%</td>
</tr>
<tr>
<td>Grassland / herbaceous</td>
<td>38</td>
<td>2%</td>
</tr>
<tr>
<td>Pasture/hay</td>
<td>489</td>
<td>31%</td>
</tr>
<tr>
<td>Cultivated crops</td>
<td>726</td>
<td>45%</td>
</tr>
<tr>
<td>Woody wetlands</td>
<td>7</td>
<td>&lt;1%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,599</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Source of spatial data: Jin et al. 2013.

Notes
Areas were rounded to the nearest acre or percentage point. The Totals do not sum exactly due to rounding.
Barren land, mixed forest, shrub/scrub, and emergent herbaceous wetlands are not present in Critical Area #3.
Figure 11. Agricultural Land (Critical Area #3).
Figure 12. Prioritized crop land along Swan Creek in the Agricultural Land (Critical Area #3).
Figure 13. Prioritized crop land along Gale Run in the *Agricultural Land* (Critical Area #3).
3.4.2 Detailed Biological Condition

Ohio EPA (2009a, 2012) evaluated fish and macroinvertebrate community health at three sites across the Gale Run-Swan Creek WAU (Section 2.2). Only one site (302119) is within a prioritized row crop area of the Agricultural Lands critical area; however, only site P11K21 is downstream of both the prioritized areas in the Agricultural Lands critical area. Refer to Section 3.2.2 for a discussion of the biological and habitat data at sites 302119 and P11K21. Note that portions of the Riparian Corridor Downstream of the Oak Openings Preserve (Critical Area #1) overlay portions of Agricultural Land (Critical Area #3).

3.4.3 Detailed Causes and Associated Sources

As discussed in Section 2.3, Ohio EPA (2009a) only identified the causes and sources of impairment at site P11K21 (RM 24.7) on Swan Creek. Ohio EPA (2014) did not identify causes and sources using the 2012 biological and habitat data. Ohio EPA will eventually evaluate the 2017 data and publish causes and sources in a future TSD.

In the Agricultural Lands critical area, the establishment of row crop land, orchards, plant nurseries, and grazed pasture has resulted in discharge of nutrients and sediment through runoff via drain tiles or overland flow to Swan Creek and Gale Run. Sediment and phosphorus loads from this critical area are eventually discharged to Lake Erie. Such loads are infinitesimal compared with the loads contributed by the Maumee River. However, all such loads do contribute to the harmful algal blooms in the Western Basin of Lake Erie and to hypoxia in the Central Basin of Lake Erie.

3.4.4 Goals and Objectives for Critical Area #3

As explained in detail above and by Ohio EPA (2009a), the WAU is primarily impaired by direct habitat alteration, nitrate/nitrite, and sedimentation/siltation from crop production. Implementation of agricultural BMPs (notably, nutrient management strategies) will be needed to improve aquatic community health in Critical Area #3 and to reduce nutrient- and sediment-loads discharged to Lake Erie.

Portions of Agricultural Lands (Critical Area #3) in the 300-foot buffer of Swan Creek overlap with Riparian Corridor downstream of the Oak Openings Preserve (Critical Area #1). The objectives of Critical Area #1 are generally to remove agricultural land from production within the 300-foot butter and return the land to a native land cover. However, the
objectives of Critical Area #3 address runoff from prioritized cropland, with a focus on land in production but upstream of the 300-foot buffer.

### 3.4.4.1 Goals

The overall NPS restoration goals for the *Agricultural Lands* critical area are twofold: (1) bring the waterbodies into full attainment of the designated ALU to meet Ohio’s WQS and (2) reduce phosphorus loads by 40 percent to meet Annex 4 recommendations (GLWQA 2015).16

The prioritized row crop areas for Swan Creek (Figure 12) and Gale Run (Figure 13) are both upstream of site P11K21 (RM 24.7) on Swan Creek. Additionally, Ohio EPA has more frequently sampled site P11K21 than sites 302119 and P11W12. In lieu of setting goals for all three monitoring sites in the *Gale Run-Swan Creek* WAU, goals are only set for site P11K21.

**Goal 1.** Achieve an IBI score of 32 at site P11K21 (RM 24.7) on Swan Creek.  
- **Achieved:** Site currently has a score of 44.

**Goal 2.** Achieve an MIwb score of 7.3 at site P11K21 (RM 24.7) on Swan Creek.  
- **Achieved:** Site currently has a score of 8.7.

**Goal 3.** Achieve an ICI17 score of 34 at site P11K21 (RM 24.7) on Swan Creek.  
- **Achieved:** Site currently has a score of *marginally good*, which is nonsignificant departure.

**Goal 4.** Achieve a QHEI score of 60 at P11K21 (RM 24.7) on Swan Creek.  
- **Not Achieved:** Site currently has a score of 52.

**Goal 5.** Achieve a 40 percent reduction in spring (March-July) and annual loads by reducing the annual TP load by 1,327 lbs., the spring TP load by 492 lbs., and the spring SRP load by 105 lbs.18  
- **Not Achieved:** The annual TP load has not been reduced (0 lbs. of 1,327 lbs.).  
- **Not Achieved:** The spring TP load has not been reduced (0 lbs. of 492 lbs.).  
- **Not Achieved:** The spring SRP load has not been reduced (0 lbs. of 105 lbs.).

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16 The objective of Annex 4 (i.e., the Nutrients Annex) of the GLWQA is to develop “load reduction strategies on Western Basin cyanobacteria blooms, Central Basin hypoxia, and Eastern Basin *Cladophora*” (GLWQA 2015, p. 1). Annex 4 used ensemble modeling and phosphorus loading data to select a phosphorus load target that would result in a mild bloom (or smaller), like the blooms that occurred in the years 2004 and 2012.

17 If Swan Creek is not suitable for placement of the in-stream modified Hester-Dendy substrate sampler, then Goal 3 is to achieve a narrative score of *good*.

18 The load reduction is calculated as 40 percent of the estimated 2008 baseline load. The baseline loads were calculated by multiplying the area of *Agricultural Lands* (1,599 ac) by the unit area loads presented in Section 2.4 to yield an annual TP baseline load of 3,316 lbs., a spring TP baseline load of 1,230 lbs, and a spring SRP baseline load of 262 lbs.
3.4.4.2 Objectives

To achieve the overall NPS restoration goal of full attainment and sediment- and nutrient-load reductions, the following objectives needs to be achieved within Agricultural Land (Critical Area #3):

**Objective 1**  Implement sediment- and nutrient-reduction strategies to treat runoff from 94 acres of tiled, row crop land in the prioritized row crop areas (46 acres along Swan Creek and 48 acres along Gale Run) such that the runoff loading is like that of the native landscape.

Sediment- and nutrient-reduction strategies include the implementing 4R fertilizer practices, planting cover crops, using minimally invasive tillage practices, and removing marginal crop land from production.

- Encourage whole farm conservation planning (Ohio EPA 2013a, Goal 3.01.01)
- Reduce erosion and nutrient- and sediment-loss to surface waters (Ohio EPA 2013a, Goal 3.01.02)

**Objective 2**  Implement drainage water management strategies to reduce runoff from 188 acres of tiled, row crop land in the prioritized row crop areas (91 acres along Swan Creek and 97 acres along Gale Run) such that the runoff volumes are like that of the native landscape.

Drainage water management strategies include the installation of retention devices and drainage tile controls and the creation of saturated buffers.

- Reduce the rate and amount of runoff (Ohio EPA 2013a, Goal 3.03.01)
- Increase treatment of field runoff (Ohio EPA 2013a, Goal 3.03.02)

As these objectives are implemented, water quality monitoring (both project-related and regularly scheduled monitoring) will be conducted to determine progress toward meeting the identified goals (i.e., water quality standards). These objectives will be reevaluated and modified, as necessary. When reevaluating, Ohio’s *Nonpoint Source Management Plan Update* (Ohio EPA 2013) will be referenced, which has a complete listing of all eligible NPS management strategies.

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**Drainage water management**

Perhaps the single most important action that can be taken to reduce nutrient loadings and impacts on Ohio streams is to reduce the rate and amount of runoff from agricultural production areas.

(Ohio EPA 2013a, p. 38, Goal 3.03.01)

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19 The Swan Creek prioritized row crop land is about 137 acres. Assuming about a third of farmers implement these BMPs yield 46 acres.

20 The Gale Run prioritized row crop is about 146 acres. Assuming about a third of farmers implement these BMPs yield 48 acres.

21 Right source, Right rate, Right time, and Right place.

22 The Swan Creek prioritized row crop land is about 137 acres. Assuming about a two-thirds of farmers implement these BMPs yield 91 acres.

23 The Gale Run prioritized row crop is about 146 acres. Assuming about a two-third of farmers implement these BMPs yield 97 acres.
4 PROJECTS AND IMPLEMENTATION STRATEGY

Projects and evaluations believed to be necessary to address the causes and sources of impairments to the Gale Run-Swan WAU are presented by critical area in this section. As Ohio assesses attainment using numeric biological criteria, periodic re-evaluation of biological condition will be necessary to determine if the implemented projects restore the critical areas.

Time is a key factor to consider when measuring project success and overall status. Biological systems in some cases can show response quickly (e.g., one season); others system may take longer (e.g., several seasons, years) to show recovery. There may also be reasons other than nonpoint source pollution for the impairment. Those issues will need to be addressed under different initiatives, authorities or programs which may or may not be accomplished by the same implementers addressing the nonpoint source pollution issues.

The Gale Run-Swan Creek WAU was delineated into three critical areas to address causes and sources of impairment. An overview table is presented for each critical area in the following subsections. Projects in each of the three critical areas were prioritized using the following process:

- **Highest priority**
  - Directly addresses one or more of the critical area’s objectives
  - Landowner support
  - Provides additional benefits to the community

- **Higher priority**
  - Directly address one or more of the critical area’s objectives

- **Lower priority**
  - Indirectly address one or more of the critical area’s objectives

If additional NPS impairments are identified for an existing critical area, the critical area’s overview table will be updated. If a new impairment is determined that is not within an existing critical area, then a new critical area will be delineated and a new summary table will be created.

Project Summary Sheets (PSS) provide the essential nine elements for short-term and/or next step projects that are in development and/or in need of funding. As projects are implemented and new projects developed these sheets will be updated. Any new PPS created will be submitted to the state of Ohio for funding eligibility verification (i.e., all nine elements are included).

TSS load reductions were calculated using estimated existing loads and TSS BMP removal efficiency. Existing loads were estimated using unit area loads calculated by the National Center for Water Quality Research (NCWQR) for the Maumee River basin and the area of the proposed BMP. NCWQR calculated unit area TSS loading for the years 2007 to 2016 to range from 285 to 833 kilograms per hectare, with a 10-year average of 537 kilograms per hectare. The 10-year average unit area loading rate was multiplied by the area of the proposed BMP to estimate existing TSS loading.
4.1 CRITICAL AREA #1: OVERVIEW TABLE AND PROJECT SHEETS

The *Riparian Corridor downstream of the Oak Openings Preserve* critical area is based upon threat of degradation to sites 302119 (RM 25.6) and P11K21 (RM 24.7). Both sites meet the appropriate biological criteria, but their habitat does not meet targets. Site 302119 is in full attainment but is threatened due to a *poor* QHEI score. Site P11K21 is in full attainment but is threatened by a *marginally good* ICI score (non-significant departure from biological criterion) and a *fair* QHEI score.

No projects were identified to address this critical area; therefore, no overview table or PSS forms are presented in this subsection.

4.2 CRITICAL AREA #2: OVERVIEW TABLE AND PROJECT SHEETS

The information included in the Table 13 is a condensed overview of all identified projects needed for nonpoint source restoration of the *Riparian Corridor in the Oak Openings Preserve* critical area. PSSs are included for short term projects or any project that is considering seeking funding in the near future. Only those projects with complete PSS will be considered for state and federal nonpoint source program funding.

4.2.1 Critical Area #2: Project Implementation Strategy Overview Table

The *Riparian Corridor in the Oak Openings Preserve* critical area is based upon partial attainment at sampling site P11W12 (RM 27.1). The overview table (Table 13) provides a quick summary of what needs to be done where and what problem (cause/source) will be addressed. The table includes projects at all levels of development (e.g., concept, in progress), and the table is intended to show a prioritized path toward restoration of the *Riparian Corridor in the Oak Openings Preserve* critical area in the *Gale Run-Swan Creek WAU*.

TSS load reductions were calculated using estimated existing loads and TSS BMP removal efficiency. Existing loads were estimated using unit area loads calculated by the National Center for Water Quality Research (NCWQR) for the Maumee River basin and the area of the proposed BMP. NCWQR calculated unit area TSS loading for the years 2007 to 2016 to range from 285 to 833 kilograms per hectare, with a 10-year average of 537 kilograms per hectare. The 10-year average unit area loading rate was multiplied by the area of the proposed BMP to estimate existing TSS loading. TSS load reductions were estimated using best professional judgement, a review of select studies, and the *Agricultural BMP Handbook of Minnesota* (Lennhart et al. 2017). Specific information on load reduction methodology is provided in PSS table notes.
Table 13. Critical Area #2: Overview table for *Riparian Corridor in the Oak Openings Preserve*

<table>
<thead>
<tr>
<th>Goal</th>
<th>Objective</th>
<th>Project</th>
<th>Project title</th>
<th>Lead organization (criteria d)</th>
<th>Timeframe (criteria f)</th>
<th>Estimated cost (criteria d)</th>
<th>Potential/actual funding sources (criteria d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban sediment and nutrient reduction strategies</td>
<td></td>
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<td>Oak Openings Preserve Historic Agricultural Ditch Disconnection</td>
<td>Toledo Metroparks</td>
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<td>GLRI AOC</td>
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4.2.2 Critical Area #2: Project Summary Sheets

The PSSs provided below were developed based on the actions or activities needed to restore sampling site P11W12 (RM 27.1) to attainment of the ALU designation. These projects are considered next step or priority/short term projects. Medium and long-term projects are not presented in PSSs since they are not yet ready for implementation.

<table>
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| criterion d               | Estimated Total Cost   | Phase 1: Feasibility Study  
Historic agricultural ditches in the Oak Openings preserve will be evaluated to determine the feasibility of disconnection from Swan Creek and restoration to natural hydrology. The impacts of such disconnection and restoration must be evaluated for upstream segments of the ditch subwatersheds that are located outside of the Oak Openings Preserve, so as not to impact the neighboring private property.  
Phase 2: Ditch Restoration  
The historic agricultural ditch will be disconnected from Swan Creek by capping the ditch at the confluence with Swan Creek. The ditch will be filled and blocked to restore a more natural hydrology in the forested wetland within the Oak Openings Preserve. Native vegetation will be planted in accordance with the restoration goals of the Oak Openings. |
| criterion d               | Possible Funding Source| GLRI AOC |
| criterion a               | Identified Causes and Sources | Ohio EPA has never evaluated these ditches; however, Ohio EPA (2009a) identified direct habitat alteration as the cause of impairment at nearby, representative streams. These anthropogenic agricultural ditches are straightened and entrenched. |
| criteria b & h            | Part 1: How much improvement is needed to remove the NPS | Minor improvement is needed to increase the QHEI score of 58.8 to 60. |
| Part 2: How much of the needed improvement for the whole Critical Area is estimated to be accomplished by this project? | The ditch restoration will improve riparian forest habitat in 0.3 acres of 18-acres of 300-foot buffer of Objective 2 (2 percent). The proposed ditch restoration will improve habitat that threatens biological communities' health. The restoration is estimated to improve QHEI target scores by 2 to 5 points. |
| Part 3: Load reduced? | Approximately 91 lbs of TSS reduced per year \(^a\) |

| **criterion i** | How will the effectiveness of this project in addressing the NPS impairment be measured? | If this project is funded through §319, Ohio EPA will perform monitoring and IBI, ICI, and QHEI will be assessed before and after project implementation. |
| **criterion e** | Information and Education | The Oak Openings has several existing outreach and education programs and signage. This project will be discussed in tours and handouts based on the history of the land and the water quality benefits of the project. |

Note: Load reduction was assumed to be 100 percent of total existing load to the agricultural ditch.
4.3 CRITICAL AREA #3: OVERVIEW TABLE AND PROJECT SHEETS

Agricultural critical area is based upon partial attainment at sampling site P11W12 (RM 27.1) and the threat of degradation to sites 302119 (RM 25.6) and P11K21 (RM 24.7).

No projects were identified to address this critical area; therefore, no overview table or PSS forms are presented in this subsection. However, Toledo Metroparks and ODNR continue to pursue property acquisitions to expand the Oak Openings Preserve and the Maumee State Forest, respectively. Acquisition, retirement, and restoration of agricultural land will achieve similar results to any project that would address Objectives 1 and 2 (i.e., nutrient and sediment reduction strategies and drainage water management).
5 REFERENCES


