DIVISION OF
NATURAL AREAS
& PRESERVES
OHIO DEPARTMENT OF NATURAL RESOURCES

Greater Central Ohio Rivers and Streams

Integrated Prioritization System (IPS) Study
Phase 1 Technical Summary

The Big and Little Darby creeks comprise one of the highest quality river systems in Ohio, providing a home to rare aquatic life and outstanding recreational opportunities. The Ohio Department of Natural Resources (ODNR) initiated an Integrated Prioritization System (IPS) study with the goal of working with communities to protect this central Ohio natural treasure for generations to come.

Why an IPS study for Darby Creek?

The Big and Little Darby creeks are recognized as one of the most important stream systems for aquatic life in the Midwest and a premiere central Ohio natural amenity. They have received Ohio's highest designations for aquatic life (Exceptional Warmwater Habitat) and antidegradation protection (Outstanding State Resource Waters).

The system faces many challenges including rapid land use change. Urban area expansion creates additional hard surfaces, known as impervious cover, that do not absorb precipitation. Urban areas shed as much as five times the amount of water, which carries increased polluted runoff, to streams after rain events. Declines in stream quality and loss of sensitive species have been shown to occur at as little as 5% impervious cover, which some portions of the Darby watershed have reached.

What is the IPS study?

In late 2024, the Division of Natural Areas and Preserves' Ohio Scenic Rivers Program initiated an IPS study which was completed in early January 2026 by the Midwest Biodiversity Institute (MBI). The IPS is a model that organizes and analyzes information to help understand patterns in stream health. It can explain current conditions and predict what to expect as conditions change.

The goal of the project is to better understand what is needed to protect the Big and Little Darby creeks in their current outstanding condition. The study will make data available to local communities to assist with land use and other conservation decisions. Phase 1 of the project is complete, and Phase 2 will be completed in late 2026.

Darby Creek: By The Numbers

100 **fish species (5 endangered)**

45 **freshwater mussel species (8 federally endangered/threatened)**

IPS Phase 1: Stressor Thresholds

The study used extensive water quality data collected at 2,600 sites over 45 years. The study area encompasses the upper Scioto River basin including Big and Little Darby creeks as well as the western Licking River, Kokosing River, and upper Paint Creek. The Ohio Environmental Protection Agency (EPA) has collected most of this data including water chemistry, biology (fish, macroinvertebrate), and stream habitat. The study also examines available freshwater mussel data.

IPS analysis examined more than 300 parameters that could potentially cause water quality impacts, referred to as **stressors**. These include metals and chemical parameters, such as nutrients and chlorides that are commonly thought of as "pollutants," as well as parameters such as physical stream habitat, land use, and dissolved oxygen that are not directly toxic but can lead to an impairment when too high or low. Land uses that were analyzed included agriculture, forest and urban, including percentage of impervious cover.

Stressor thresholds were developed for approximately 100 of these parameters that were shown to have a meaningful impact on water quality. **Stressor thresholds signify the amount of a stressor that a stream can withstand before experiencing declines in water quality and loss of biological diversity.** Thresholds were established across Ohio EPA Tiered Aquatic Life Uses (TALUs) and antidegradation tiers that correspond with narrative rankings from "outstanding" to "very poor." Thresholds were also developed for four classes of stream and river size: small headwater, headwater, wadable, and boatable rivers.

Warmwater Habitat (WWH) stressor thresholds were derived for chemical, habitat, and land use variables at the 25th percentile of parameter values (for positive attributes like QHEI) at sites that met WWH standards. This approach mimics how TALUs were originally established in the 1980s by the Ohio EPA. Thresholds were then derived for Exceptional Warmwater Habitat (EWH) and Outstanding State Resource Waters (OSRW), the highest antidegradation tier. These thresholds are more protective and set at the 25th percentile of sites meeting EWH standards that also had sensitive species. For OSRW, stressor thresholds were set at 25th percentile of existing conditions.

Additionally, Phase 1 outputs provide percentiles for stressor statistics ranging from the 2nd to 98th percentile for sites meeting WWH or better. These are useful in highlighting outlier values as well as more protective benchmarks. For instance, the 75th to 90th percentile for positive parameters, such as stream habitat (QHEI), are more representative of very high-quality sites in the Big Darby Creek watershed that perform above the EWH or OSRW baseline.

Phase 1 Study Results

The table on the next page includes a summary of stressor thresholds for key parameters. Thresholds are not regulatory; they are intended to be used as a tool to guide local decision making. The full Phase 1 report as well as a link to a data dashboard created by MBI is available at ohiodnr.gov/darbystudy.

Parameter	Taxa Group	Stressor Thresholds					Ohio WQS
		OSRW	EWH	WWH	MWH	LRW	
		Outstanding	Excellent	Good	Fair	Poor	
Land Use Parameters							
% Impervious	Fish	2.8	3.6	4.0	31.7	59.3	NA
% Agriculture	Fish	81.0	79.2	84.0	89.4	94.7	NA
% Forest	Mussels	6.2	6.2	6.1	4.6	3.8	NA
Chemical Parameters							
Chloride (mg/L)	Macros	44.1	49.3	52.0	98.0	235.9	500
Total Suspended Solids (mg/L)	Macros	28	33	33	70	179	NA
Total Phosphorus (mg/L)	Mussels	0.10	0.09	0.19	0.55	1.61	NA
Nitrate-N (mg/L)	Fish	3.4	2.6	2.8	4.1	7.8	NA
Ammonia (mg/L)	Mussels	0.06	0.05	0.07	0.23	0.74	0.3
Total Kjeldahl Nitrogen (TKN) (mg/L)	Mussels	0.52	0.50	0.60	0.92	1.76	NA
Cadmium (µg/L)	Macros	0.20	0.20	0.20	0.40	1.00	5.8
Copper (µg/L)	Mussels	10.0	3.5	10.0	11.2	14.7	24
Zinc (µg/L)	Mussels	12.2	11.6	14.2	21.2	42.4	300
Habitat Parameters							
QHEI	Fish	72.0	72.0	66.5	52.0	37.5	NA
QHEI - substrate score	Fish	14.0	14.5	13.5	8.7	3.8	NA
QHEI - riparian score	Fish	5.5	5.0	5.0	3.7	2.3	NA

Table 1: Selected thresholds for wadeable streams across the OSRW antidegredation and aquatic life use tiers.

OSRW - Outstanding State Resource Water antidegredation tier	WQS - Water Quality Standards
EWH - Exceptional Warmwater Habitat	QHEI - Qualitative Habitat Evaluation Index
WWH - Warmwater Habitat	
MWH - Modified Warmwater Habitat	
LRW - Limited Resource Habitat	

Analysis of the strength of association between stressor and aquatic life outcome were reported as a FIT ("goodness-of-fit") value. Land use variables were found to be the most strongly related to aquatic life outcomes, followed by stream habitat and chemical variables. Phase 2 of the study will include additional statistical analysis to refine which stressors are most important.

Instances in which streams perform well despite exceeding stressor thresholds may occur for a few reasons. Regarding land use, for instance, sites that have recently experienced urbanization may not yet reflect degradation that can take time to appear or may indicate conditions on the brink of decline that will be reflected in Phase 2 Threat Rankings. They might also signify natural supportive factors such as beneficial ground water flow or effective use of best management practices. Further analyses conducted in Phase 2 will examine these outliers further with a goal of determining the factors (e.g., key stressors, age of land use changes, extent of wooded stream buffers) that explain better biological performance.

Phase 2 – Threat, Susceptibility, and Restorability Rankings

In addition to Phase 2 analysis discussed above, this phase of work will utilize stressor thresholds as the basis for developing Restorability, Susceptibility, and Threat rankings:

- Susceptibility rankings will be developed for sites that are in good or excellent condition to prioritize protection.

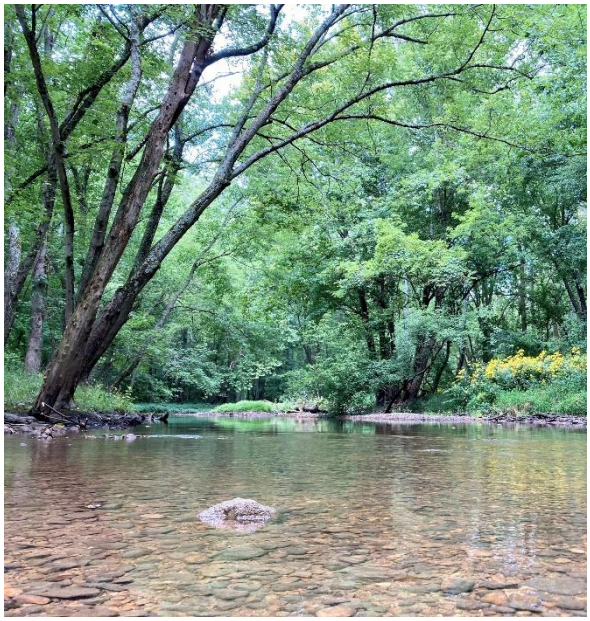
- Threat rankings will focus on sites that are in good condition but have high stress loads and are at risk of becoming impaired with additional pressure. Analysis will determine which stressors are most important and help focus action before streams become impaired.
- Restorability rankings will be developed for impaired sites based on the number and severity of stressors present to prioritize restoration where it will be most successful and cost effective.

While Phase 1 stressor thresholds apply to the entire central Ohio study area, Phase 2 rankings will apply within the Big Darby Creek watershed at the site, reach, and subwatershed (HUC 12) scale. This information will allow communities to further examine local stream sites to consider the severity of stressors present when exploring restoration or protection actions.

What's Next: Watershed Planning

To advance Phase 2 and provide additional community outreach, the division has received a grant from the National Fish and Wildlife Foundation. The grant will fund additional staff and consultant support in sharing study results and how stressors impact streams as well as learning about community needs.

Ohio Scenic Rivers Program staff will seek collaborative development of solutions related to land use and conservation, including technical tools, which align with community goals such as flood prevention and recreational value. Phase 2 will culminate in the development of a community-based watershed conservation plan which provides guidance for the long-term protection of the exceptional Big and Little Darby system.



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Funding for Phase 1 of the IPS was provided by the Ohio Department of Natural Resource's Division of Natural Areas and Preserves and H2Ohio Rivers Program with additional support from the Franklin and Madison county soil and water conservation districts, and The Nature Conservancy, Ohio Chapter.

For more information

To learn more about the division's Darby Conservation Project, visit ohiodnr.gov/darbystudy. For more information about the Ohio Scenic Rivers Program, visit ohiodnr.gov/scenicrivers.

Department of Natural Resources